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BETTER POLICIES FOR BETTER LIVES

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Preface

During its 20 years as an OECD member country, Korea has shared many good practices with its peers. It has championed green growth at the OECD, as well as establishing the Global Green Growth Institute and hosting the Green Climate Fund. This third *OECD Environmental Performance Review of Korea* assesses the country's progress in achieving its environmental policy objectives since the last review, carried out in 2006.

Korea has been one of the fastest growing OECD economies over the past decade, driven by a large export-oriented manufacturing sector. However, growth has come with high pollution and resource consumption. With increasing energy demand, greenhouse gas (GHG) emissions have risen significantly and air pollution remains a major health concern. Despite impressive improvement in wastewater treatment, diffuse pollution increasingly affects scarce water resources. Urbanisation and industrialisation are also putting considerable pressure on biodiversity. Environmental challenges are exacerbated by Korea's population density, the highest in the OECD. Access to environmental goods and services and exposure to environmental risk vary significantly by region.

To tackle these challenges, Korea has invested considerable effort in improving environmental management, for example by introducing strategic environmental assessment, reforming the environmental permitting system and strengthening air and water quality standards. Korea introduced the world's second largest emission trading scheme and remains one of the most innovative countries in climate change mitigation technology. Yet, coal is set to remain a core part of the energy mix, and road transport continues to be supported as the dominant form of mobility. Energy prices and taxes do not reflect the environmental costs of energy production and use. The *Review* emphasises that Korea needs to align its energy and climate policies to reduce GHG emissions by 37% below business-as-usual levels by 2030, as pledged at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change in Paris.

Korea's transition to a low-carbon economy is vital for its future prosperity. This is a core message of the *Review*, which provides 45 recommendations to help Korea pursue the implementation of green growth and strengthen environmental performance.

The *Review* pays special attention to waste and materials management and to environmental justice. Korea has a strong track record in waste management policies and boasts high waste recovery rates. The country was among the early adopters of extended producer responsibility, and has one of the world's most advanced food waste policies. However, total waste generation has been closely linked with economic growth. Korea will need to focus on transitioning to a circular economy approach. The Framework Act on Resource Circulation, adopted in 2016, should help drive this forward. The *Review* recommends strengthening markets for secondary raw materials and recycled products, further promoting waste prevention, and better using data on waste and materials to support decision making.

Korea has made progress in compensating victims of environmental damage, notably through new laws targeting asbestos victims and establishing strict liability to shift the burden of proof to polluters. It has a robust liability regime for soil contamination and could introduce an equivalent one to assign responsibility for past damage to water bodies and ecosystems. There is potential to improve public participation and access to information on environmental matters, as evidenced by the controversy surrounding certain high-profile development projects. The *Review* recommends introducing mechanisms for public involvement in the development of environmental permitting decisions, opening the environmental impact assessment process to the general public and non-government organisations, and broadening disclosure of records on environmental behaviour of economic entities.

This *Environmental Performance Review* is the result of a constructive policy dialogue between Korea and the countries participating in the OECD Working Party on Environmental Performance. The Korean experience provides valuable lessons for countries promoting greener and more sustainable growth. I am confident that this collaborative effort will be useful to tackle the many shared environmental challenges faced by other OECD member and partner countries.

Angel Gurría

Secretary-General of the OECD

Foreword

The principal aim of the OECD Environmental Performance Review programme is to help member and selected partner countries improve their individual and collective performance in environmental management by:

- *helping individual governments assess progress in achieving their environmental goals*
- *promoting continuous policy dialogue and peer learning*
- *stimulating greater accountability from governments towards each other and public opinion.*

This report reviews Korea's environmental performance since the previous review in 2006. Progress in achieving domestic objectives and international commitments provides the basis for assessing the country's environmental performance. Such objectives and commitments may be broad aims, qualitative goals or quantitative targets. A distinction is made between intentions, actions and results. Assessment of environmental performance is also placed within the context of Korea's historical environmental record, present state of the environment, physical endowment in natural resources, economic conditions and demographic trends.

The OECD is indebted to the government of Korea for its co-operation in providing information, for the organisation of the review mission to Sejong and Seoul (4-8 April 2016), and for facilitating contacts both inside and outside government institutions.

Thanks are also due to the representatives of the two examining countries, Reo Kawamura (Japan) and Cecilia Mattsson (Sweden), as well as Daniel E. Gogal (United States) for his comments on the chapter on environmental justice.

The authors of this report were Anna Drutschinin, Justine Garrett, Jungah Kim, Myriam Linster, Eugene Mazur, Sarah Sentier and Frédérique Zegel from the OECD Environment Directorate. Nathalie Girouard and Frédérique Zegel provided oversight and guidance. Carla Bertuzzi provided statistical support, Jackie Maher provided editorial and administrative support and Rebecca Brite copy-edited the report. Preparation of this report also benefited from comments from Nils Axel Braathen, Jane Ellis and Xavier Leflaive from the OECD Environment Directorate, Randall Jones from the OECD Economics Department, and others members of the OECD Secretariat, including the OECD Centre for Tax Policy and Administration and the Development Co-operation Directorate.

The OECD Working Party on Environmental Performance discussed the draft Environmental Performance Review of Korea at its meeting on 8 November 2016 in Paris, and approved the Assessment and Recommendations.

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Signs

The following signs are used in Figures and Tables:

. . : not available

– : nil or negligible

. : decimal point

Country aggregates

OECD Europe: This zone includes all European member countries of the OECD, i.e. Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

OECD: This zone includes all member countries of the OECD, i.e. the countries of OECD Europe plus Australia, Canada, Chile, Israel, Japan, Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.

Currency

Monetary unit: Korean won (KRW)

In 2015, USD 1 = KRW 1 131

In 2014, USD 1 = KRW 1 053

Cut-off date

This report is based on data available up to September 2016 as well as some updated information available up to November 2016.

Disclaimer

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Abbreviations and acronyms

ADF	Advance Disposal Fee
Allbaro	Korea's waste management information system
BOD	Biochemical oxygen demand
CBD	Convention on Biological Diversity
CH_4	Methane
CO_2	Carbon dioxide
CO_2 eq	Carbon dioxide equivalent
COD	Chemical oxygen demand
DAC	OECD Development Assistance Committee
DMC	Domestic material consumption
DMZ	Demilitarized Zone
EEZ	Exclusive economic zone
EGSS	Environmental goods and services sector
EIA	Environmental impact assessment
EMS	Environmental management system
ETS	Emissions Trading Scheme
GDP	Gross domestic product
GHG	Greenhouse gas
GGGI	Global Green Growth Institute
GPP	Green public procurement
HFC	Hydrofluorocarbon
IEA	International Energy Agency
IUCN	International Union for Conservation of Nature
KEI	Korea Environment Institute
KECO	Korea Environment Corporation
KEITI	Korea Environmental Industry and Technology Institute
KEPCO	Korea Electric Power Corporation
KOICA	Korea International Cooperation Agency
KEXIM	Export-Import Bank of Korea
KRW	Korean won
K-Water	Korea Water Resources Corporation
LCGG Act	Framework Act on Low Carbon, Green Growth
MAFRA	Ministry of Agriculture, Food and Rural Affairs
MOE	Ministry of Environment
MOLEG	Ministry of Government Legislation
MOLIT	Ministry of Land, Infrastructure and Transport
MOSF	Ministry of Strategy and Finance
MOTIE	Ministry of Trade, Industry and Energy
MSIP	Ministry of Science, ICT and Future Planning
Mtoe	Million tonnes of oil equivalent
N_2O	Nitrous oxide
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non-government organisation
NMOG	Non-methane organic gases
NO_x	Nitrogen oxides
NWMP	National Waste Management Plan

ODA	Official development assistance
PCGG	Presidential Committee on Green Growth
PM_{10}	Particulate matter smaller than 10 microns in diameter
$PM_{2.5}$	Particulate matter smaller than 2.5 microns in diameter
PPP	Purchasing power parity
PRO	Producer Responsibility Organisation
PRTR	Pollutant release and transfer register
R&D	Research and development
RFID	Radio frequency identification
RIA	Regulatory impact analysis
SEA	Strategic environmental assessment
SMEs	Small and medium-sized enterprises
SO_x	Sulphur oxides
SRF	Solid refuse fuel
TEE	Transportation-Energy-Environment Tax
TMS	Target Management System
TPES	Total primary energy supply
TPLMS	Total Water Pollution Load Management System
USD	United States dollar
VBWF	Volume-based waste fee
VOC	Volatile organic compound
WEEE	Waste electrical and electronic equipment

BASIC STATISTICS OF KOREA (2015 or latest available year)*

(OECD total values in parentheses)[a]

PEOPLE AND SOCIETY

Population (million)	50.6	(1 274)	Population density per km^2	504.7	(35.1)
Share of population by type of region:			Population compound annual growth rate, latest 5 years	0.5	(0.6)
Predominantly urban (%)	69.6	(48.7)	Income inequality (Gini coefficient)	0.31	(0.32)
Intermediate (%)	13.1	(26.0)	Poverty rate (% of population with less than 50% med.income)	14.6	(11.3)
Rural (%)	17.2	(25.3)	Life expectancy	82.2	(80.6)

ECONOMY AND EXTERNAL ACCOUNTS

Total GDP (billion KRW)	1 485 078		Imports of goods and services (% of GDP)	38.9	(29.2)
Total GDP (billion USD current PPPs)	1 749	(51 165)	Main exports (% of total merchandise exports)		
GDP compound annual real growth rate, latest 5 years	3.0	(1.9)	Electrical machinery and equipment and parts thereof	26.3	
GDP per capita (1 000 USD current PPPs)	34.5	(40.1)	Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	13.1	
Value added shares (%)			Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	11.8	
Agriculture	2.1	(1.7)	Main imports (% of total merchandise imports)		
Industry including construction	34.9	(23.1)	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	23.7	
Services	63.0	(75.2)	Electrical machinery and equipment and parts thereof	17.8	
Exports of goods and services (% of GDP)	45.9	(29.0)	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof	10.6	

GENERAL GOVERNMENT

as percentage of GDP

Expenditure	32.0	(44.4)	Education expenditure	5.2	(5.4)
Revenue	33.2	(42.4)	Health expenditure	3.9	(6.5)
Gross financial debt	43.7	(86.5)	Environment protection expenditure	0.8	(0.8)
Fiscal balance	1.3	-(2.0)	Environmental taxes: (% of GDP)	2.5	(1.6)
			(% of total tax revenue)	10.3	(5.1)

LABOUR MARKET, SKILLS AND INNOVATION

Unemployment rate (% of civilian labour force)	3.5	(7.9)	Patent applications in environment-related technologies (% of all technologies, average of latest 3 years)[b]	11.0	(12.0)
Tertiary educational attainment of 25- to 64-year-olds (%)	44.6	(34.5)	Environmental management	2.5	(4.5)
Gross expenditure on R&D (% of GDP)	4.3	(2.4)	Water-related adaptation technologies	0.1	(0.4)
			Climate change mitigation technologies	9.7	(9.8)

ENVIRONMENT

Energy intensity: TPES per capita (toe/cap.)	5.5	(4.1)	Road vehicle stock (veh./100 inhabitants)	39.9	(58.9)
TPES per GDP (toe/1 000 USD, 2010 PPPs)	0.16	(0.11)	Water stress (abstraction as % of available resources)		(9.7)
Renewables (% of TPES)	1.5	(9.6)	Water abstraction per capita (m^3/cap./year)		(819)
Carbon intensity (energy-related CO_2):			Municipal waste per capita (kg/capita)	361	(516)
per capita (t/cap.)	11.2	(9.4)	Material productivity (USD, 2010 PPPs/DMC, kg)	2.2	(1.7)
per GDP (t/1 000 USD, 2010 PPPs)	0.33	(0.26)	Land area (1 000 km^2)	97	(34 341)
GHG intensity[c]			% of arable land and permanent crops	17.6	(12.1)
per capita (t/cap.)	13.8	(12.4)	% of permanent meadows and pastures	0.6	(23.2)
per GDP (t/1 000 USD, 2010 PPPs)	0.42	(0.34)	% of forest area	63.6	(31.2)
Mean population exposure to air pollution ($PM_{2.5}$), µg/m^3	28.8	(14.0)	% of other land (built-up and other land)	18.2	(33.5)

* Values earlier than 2010 are not taken into consideration.

a) Where the OECD aggregate is not provided in the source database, a simple OECD average of the latest available data is calculated where data exist for a significant number of countries.

b) Higher-value inventions that have sought patent protection in at least two jurisdictions. Average of latest three years.

c) Excluding emissions/removals from land use, land-use change and forestry.

Source: Calculations based on data extracted from databases of the OECD, IEA, Eurostat.

Executive summary

Economic growth has come with high pollution and resource consumption

Korea has been one of the fastest growing OECD economies over the past decade, driven by a large export-oriented manufacturing sector. However, this growth has come with high pollution and resource consumption. Although greenhouse gas emissions (GHG) have risen less quickly than GDP since 2000, they grew faster than in most other OECD countries and Korea became the fifth largest GHG emitter in the OECD. Its energy mix is dominated by fossil fuels and the share of renewables is the lowest in the OECD. Emissions of many air pollutants have been decoupled from economic growth but exposure to fine particulate matter ($PM_{2.5}$) is severe and the number of premature deaths caused by outdoor air pollution is projected to almost triple by 2060. Infrastructure development is putting considerable pressure on ecosystems and well-being varies widely between regions. Environmental challenges are exacerbated by the population density, which is the highest in the OECD.

Korea needs to strengthen political commitment to green growth

Korea has set up an exemplary policy framework for green growth, including a national strategy in 2009 with five-year implementation plans and the Framework Act on Low Carbon, Green Growth in 2010. It has also championed green growth at the OECD and beyond, establishing the Global Green Growth Institute and by hosting the Green Climate Fund. Increased public expenditure on infrastructure has extended access to water and sanitation. High research and development budgets for energy have made Korea one of the world's most innovative countries in climate change mitigation technology. It has also made progress in using pricing instruments, introducing a tax on bituminous coal used for power generation in 2014 and launching the world's second largest emission trading scheme in 2015.

However, green growth is no longer the top political priority with the paradigm shifting to "creative economy". Korea's 2015 commitment to reduce GHG emissions by 37% below business-as-usual levels by 2030 delays emission reduction efforts vis-à-vis the 2020 target (-30%) it had previously set. Korea needs to align its energy, transport and climate policies: current energy plans do not entail a substantial change in the share of coal in the energy mix and road transport continues to be supported as the dominant form of mobility. Low, regulated electricity prices hamper efforts to reduce energy demand and act as a barrier to renewables. Furthermore, Korea provides substantial subsidies to fossil fuels, both at home and abroad. It should adjust energy prices and taxes to better reflect environmental externalities and phase out fossil fuel subsidies to achieve tangible GHG emission reduction and deploy low-carbon markets and innovations.

Progress has been made in environmental management but cross-government co-ordination should be enhanced

Korea has made significant progress related to the introduction of strategic environmental assessment (SEA), ongoing environmental permitting reform in line with international best practices, increased detection of non-compliance and strengthening of air emission and water quality and effluent standards. Room for improvement remains, however. While systems of environmental impact assessment (EIA) and SEA have been broadened, SEA does not cover sector policies or a significant share of local land use plans, raising concerns about uncontrolled development in environmentally sensitive areas. Industrial facilities are subject to EIA based on site size rather than environmental impact. Compliance monitoring could be made more efficient by focusing inspections on higher-risk facilities.

Many environmental responsibilities have been transferred to subnational governments, which do not always have adequate capacity or financial resources for these tasks. Consequently it has sometimes been necessary to reverse the devolution process, as in the case of chemical safety. Furthermore, local authorities' political emphasis on economic growth is sometimes at the expense of environmental protection, contributing to a policy implementation gap at subnational level. Inter-ministerial co-ordination could be substantially improved, in particular to adopt an integrated approach to water resource management.

A strong performer in waste management, Korea is now pursuing a circular economy approach

Korea has a very good track record in integrated waste management. It has a well-developed policy framework, was among the early adopters of extended producer responsibility and has one of the world's most advanced food waste policies. Over the past decade, material consumption and municipal waste generation have been relatively decoupled from economic growth, thanks in particular to the extension of the volume-based waste fee system for collection of mixed household waste to the whole country. More than 80% of all waste generated is recovered, and recycling rates are higher than in many other OECD countries.

However, total waste generation is still rising in line with GDP, underlining the need to further promote waste prevention. A certain amount of waste electrical and electronic equipment escapes the official recycling system through the large informal sector, which would benefit from progressive integration into the formal system. Recycling markets suffer from a general mistrust of the quality of recycled products and from low oil and raw materials prices. Material flow analysis should be encouraged to monitor progress in improving resource productivity. Additional efforts are needed to move towards a circular economy and further develop policies that consider all stages of material value chains. The Framework Act on Resource Circulation, adopted in 2016, should help drive this forward.

The liability regime has improved but progress is needed in environmental democracy and equity

Responding to a sharp increase in chemical incidents, Korea has made remarkable progress in strengthening its liability regime for compensating environmental damage to health, property and welfare. Victims' claims have been facilitated by the Asbestos Injury

Relief Act (2011) and the establishment of strict liability (since 2016), which shifts the burden of proof from victims to polluters. The government has also strengthened chemical safety regulations. Concerning damage to the environment, the liability regime for soil contamination is robust and targeted at environmental remediation. It could serve as an example for assigning responsibility for past damage to water bodies and ecosystems.

There is potential to improve public participation and access to information on environmental matters, as illustrated by controversy over some high-profile development projects. While non-government organisations are involved in strategic policy planning, there is no public participation in environmental permitting, and public engagement in EIA remains limited to local residents. Despite growing disclosure of environmental information, some remains classified to protect private economic interests. Access to justice could also be improved; the public has limited rights to challenge environment-related decisions and the alternative dispute resolution system, while successful at handing individual disputes, is not adapted to addressing major environmental conflicts.

Access to environmental goods and services varies significantly between and within regions. Water supply services in rural areas are more expensive and of poorer quality than in urban areas, although infrastructure upgrade has helped narrow the gap. However, further expanding national waterworks may not be the most cost-effective solution and small-scale alternatives could be better taken into account. While cost-recovery rates have been declining, the pricing policies for water supply and sanitation services should be assessed to ensure the financial sustainability of the sector and equitable access to these services. Exposure to environmental harm also varies. Korea has made progress in, and should further expand, analysis of environmental health issues to ensure effective follow-up of identified risks.

Assessment and recommendations*

The Assessment and Recommendations present the main findings of the Environmental Performance Review of Korea *and set forth 45 recommendations to help Korea make further progress towards its environmental policy objectives and international commitments. The OECD Working Party on Environmental Performance reviewed and approved the Assessment and Recommendations at its meeting on 8 November 2016. Actions taken to implement selected recommendations from the* 2006 OECD Environmental Performance Review *are summarised in the annex to the Assessment and Recommendations.*

*The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Environmental performance: trends and recent developments

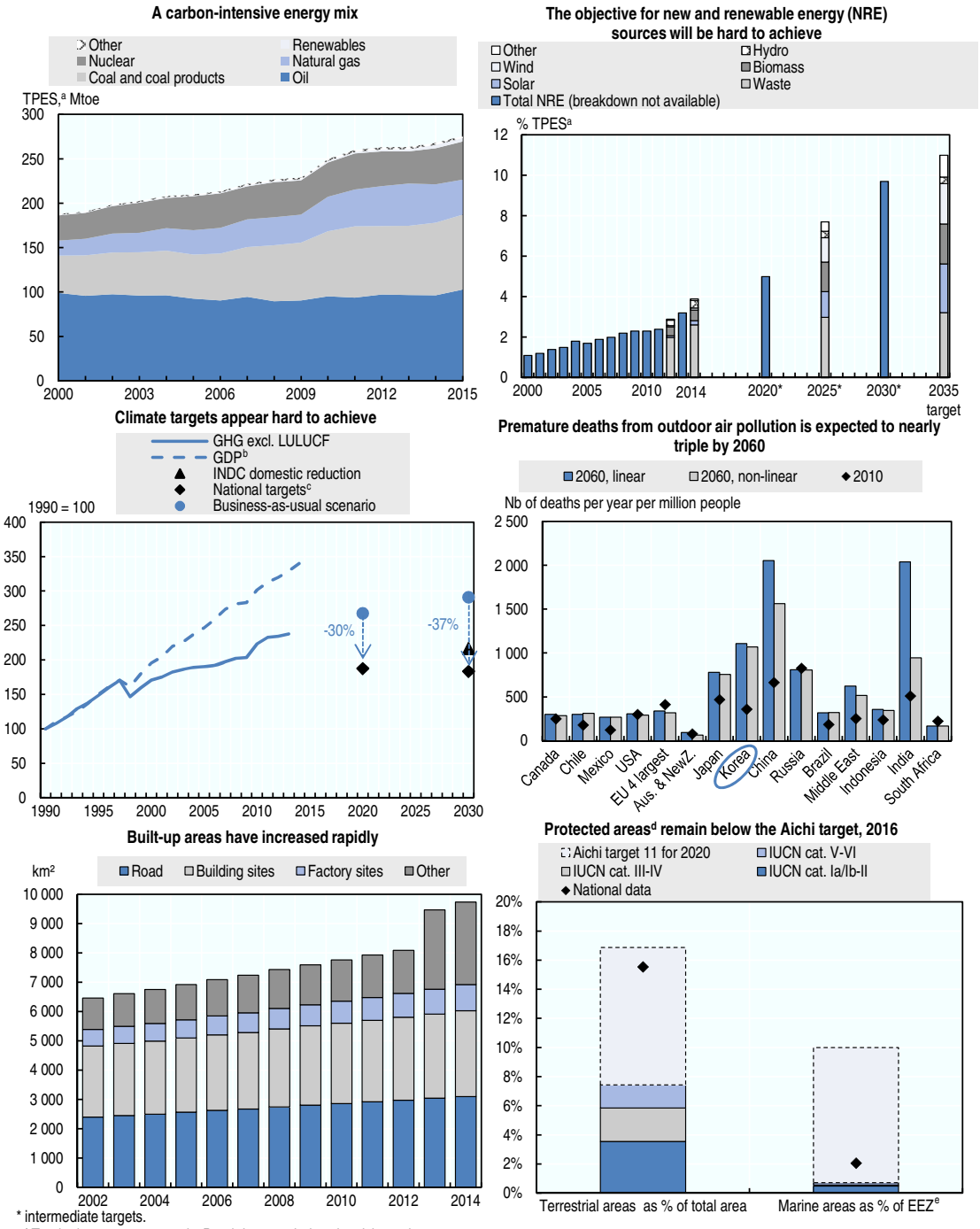
Korea, the eighth largest OECD economy, has few natural resources. It has been one of the fastest growing OECD economies over the past decade, although its traditional growth model, based on manufactured exports produced by large firms affiliated with *chaebols* (conglomerates), has become less effective (OECD, 2016a). However, growth has come with high pollution and resource consumption. Population density is the highest in the OECD, exacerbating environmental challenges. Labour productivity is low, even though Korea has excellent levels of education and skills. Moreover, it lies below the OECD average in terms of work-life balance and health.

Transition to a low-carbon and energy-efficient economy

Korea is the fifth largest greenhouse gas (GHG) emitter in the OECD. It is also one of the few member countries that is a net exporter of CO_2 emissions, due to its carbon-intensive, export-oriented economy (OECD, 2015a). While it has experienced the second highest growth in GHG emissions among OECD countries since 2000, emissions have been relatively decoupled from economic growth (Figure 1). Although Korea's target to reduce GHG emissions by 37%[1] below business-as-usual (BAU) levels by 2030 is demanding in terms of reducing emission intensity, it implies a modest decline in emissions by international comparison (Climate Action Tracker, 2015; BNEF, 2015). Moreover, it represents a postponement of the 2020 target (30% below BAU levels) Korea had previously set. Even so, Korea's current policy mix is unlikely to be sufficient to achieve its target (PBL, 2015); tightening the new Emissions Trading Scheme, reforming energy taxation and electricity pricing, developing renewable energy sources and strengthening energy demand management will be essential to change the emission trajectory to reach Korea's climate goal. Korea is more vulnerable to climate change than many OECD countries (University of Notre Dame, 2014). The country therefore needs to continue pursuing adaptation measures in parallel with GHG emission reductions to face expected challenges such as rising precipitation and sea levels, more frequent extreme weather and declining agricultural production.

Korea's energy mix is dominated by fossil fuels, which accounted for 82% of the total primary energy supply (TPES) in 2015, just above the OECD average. As the country is highly dependent on imports, energy security is a constant concern. Although oil is still the largest contributor to energy supply, there has been a shift to natural gas and coal, which have benefited from favourable prices and government subsidies. Unfortunately, current energy plans do not foresee a substantial change in the share of coal in the energy mix, and as energy demand continues to rise, so will the number of coal-fired power plants. While new plants have high efficiency and meet stringent air emission standards, and existing plants are being retrofitted, ongoing large-scale carbon capture and storage demonstration projects should be encouraged to curb GHG emissions. The share of nuclear power in TPES has remained broadly stable at around 16%, with plans to increase this share scaled back due to

Figure 1. **Selected environmental performance indicators**



* intermediate targets.

a) Total primary energy supply. Breakdown excludes electricity trade.

b) GDP at 2010 prices and purchasing power parities.

c) In 2016, the 2020 target was replaced by the 2030 target in the Framework Act on Low Carbon, Green Growth. Out of the 2030 target 25.7% of reductions would be met domestically and the remaining 11.3% through international markets.

d) International protected areas (UNESCO biosphere reserves, Ramsar wetlands and World Natural Heritage sites) are included in IUCN categories.

e) The exclusive economic zone (EEZ) stretches from the baseline out to 200 nautical miles from the coast.

Source: IEA (2016), *IEA World Energy Statistics and Balances* (database); MOTIE (2014), 4th National Basic Plan for New and Renewable Energy; OECD (2016), "Greenhouse gas emissions by source", *OECD Environment Statistics* (database); MOE (2015), "Intended Nationally Determined Contribution (INDC) of Korea" to the UNFCCC; OECD (2016), "Aggregate National Accounts: Gross Domestic Product", *OECD National Accounts Statistics* (database); Climate Action Tracker (2015); OECD (2016), *The Economic Consequences of Outdoor Air Pollution*; MOLIT (2016), *Statistical Yearbook 2015;* UNEP-WCMC (2016), World Database on Protected Areas, *ProtectPlanet* (database, accessed April 2016); Country submission.

StatLink http://dx.doi.org/10.1787/888933448886

a public confidence crisis following the Fukushima accident in Japan in 2011 and unresolved domestic storage issues (Figure 1).

Korea's share of renewables in the energy mix remains the lowest in the OECD and the country has fallen short of its intermediate renewables targets. With its mountainous topography, contested and militarised waters and high population density, it may face greater challenges to renewable energy development than other countries, yet there remain opportunities to exploit. The government is pushing for wind and solar photovoltaic power to become core pillars of Korea's new and renewable energy mix, and is also promoting strong growth in solar thermal and geothermal energy (Invest Korea, 2015). However, efforts in both support for renewables and energy demand management need to be significantly scaled up if the country is to meet its long-term target of 11% renewables in TPES by 2035, already pushed back from 2030 (Figure 1).

Korea recently shifted the focus of its energy policy from augmenting supply to curbing demand, a welcome move which will be essential to tackle rising air pollution and GHG emissions. Total final energy consumption increased by 34% over 2000-14. Nevertheless, energy intensity, which is above the OECD average per unit of GDP and per capita, is declining. Unlike in most OECD countries, industry is the largest energy consumer, followed by transport, which is dominated by roads (IEA, 2016a).

Air pollution is a major health concern, with exposure to fine particulate matter ($PM_{2.5}$) and ground level ozone being particularly severe. It is estimated that the number of premature deaths caused by air pollution rose by 29% between 2005 and 2013, and the number is projected to almost triple by 2060, due partly to an increasing and ageing population and to urbanisation (IHME, 2015; OECD, 2016b). This places Korea among the countries most affected by air pollution (Figure 1). In a welcome move, the government recently made the issue a national priority and announced a KRW 5 trillion (USD 4.4 billion) dedicated budget. Industry is the largest emitter of many pollutants and the sector's PM_{10} emissions have nearly quadrupled since 2000 due to extensive use of fossil fuels for industrial processes and combustion. Road transport is the largest source of NO_x and CO emissions (OECD, 2016c). Transboundary particles exacerbate Korea's PM concentrations, especially fine particulates from China's industrial sites and yellow dust from deserts in China and Mongolia, although the share of imported air pollution is not precisely known. Korea actively participates in regional dialogue and co-operation to monitor and mitigate these pollutants.

Korea's efforts to tackle air pollution have borne fruit: emissions of all major air pollutants but PM_{10} have been decoupled from economic growth (OECD, 2016c). PM_{10} and lead concentration levels have decreased whereas ground level ozone pollution has increased. Planning has been strengthened through the first and second Comprehensive Plans for Air Quality Improvement (2006-15 and 2016-24) at national level and the first and second Seoul Metropolitan Air Quality Improvement Plans (2005-14 and 2015-24), even though emission reduction objectives for NO_x and VOCs were not achieved. Emission standards for fuel and vehicles have been tightened, bringing them into line with US standards for petrol and EU standards for diesel. In response to studies showing the real-world NO_x emission performance of Euro 5 and 6 vehicles to be far poorer than test-cycle measurements (Carslaw et al., 2011; Franco et al., 2014), in 2016 Korea introduced real-driving emission standards on top of existing in-laboratory standards (MOE, 2016a). An innovative air pollutant emission cap management system introduced in the Seoul Metropolitan Area in 2008 has reduced NO_x and

SO_x emissions. Successful "transit mall districts" have been introduced in some major city centres, which only give access to public transport, bicycles and pedestrians, but stakeholder opposition has hindered the development of low emission zones.

Transition to efficient resource management

Korea is a resource-intensive economy due to the predominance of heavy industry (electronics, automotive, shipbuilding, chemical, iron and steel, cement) and a dynamic construction sector. Nonetheless, domestic material consumption has been relatively decoupled from economic growth, meaning that material productivity has improved. Korea is almost entirely dependent on imports for fossil fuels, metals and wood, while construction minerals are available domestically.

Total waste generation has been closely linked with economic growth, driven by the construction sector, while municipal waste generation remained relatively flat over the review period. Municipal waste management has shifted markedly away from landfill. Materials recovery rose from 41% in 2000 to 59% in 2014 (compared with the OECD average of 34%), thanks in part to Korea's volume-based waste fee system, which imposes charges that are proportional to the amount of non-recyclable waste generated (OECD, 2016c).

Korea's farming model is highly intensive, with negative ramifications for biodiversity and pollution. Despite a decrease in the surface area dedicated to agriculture, total production remained stable over the review period, with livestock production growing. The intensity of commercial fertiliser and pesticide use is among the highest in the OECD, and livestock density is the second highest after the Netherlands. Nevertheless, the nitrogen and phosphorus balances have decreased since 2000 (FAO, 2016). Organic farming represented 1.5% of agricultural land in 2012, compared with the OECD average of 2.2%.

Management of natural assets

Korea is among the few OECD countries under medium-high water stress. However, information on freshwater resources and abstractions is fragmented and infrequently updated. The concentration of the rainy season from June to September, with large variation by year and by region, poses a major challenge for water management. Steep topography and rapid urbanisation exacerbate the consequences of frequent flooding and drought caused by rainfall patterns. The country comes close to meeting its water quality target for river sections but additional efforts are needed to achieve its targets for lakes (MOE, 2016a). Many Korean lakes are artificially created by dam construction and are used as agricultural reservoirs, leaving them highly vulnerable to eutrophication as they have a lower self-purification capacity than rivers and nutrients can easily accumulate. The predominant type of water pollution has shifted from point-source to diffuse pollution, as the share of treated wastewater has improved and livestock production has increased substantially (MOE, 2015).

Korea possesses a wide variety of terrestrial, coastal, marine and island ecosystems due to its climate, with four distinct seasons, and topography characterised by mountains, forests, long coastlines and islands. However, rapid urbanisation and industrialisation are putting considerable pressure on biodiversity and ecosystems, destroying and fragmenting habitats. Built-up areas have expanded by 51% since 2002, far above the population growth rate of 6% (Figure 1), reflecting government efforts to reduce the concentration in the Seoul Metropolitan Area, home to nearly half the nation's population. The government is proposing a law to allow greater tourism infrastructure development in some mountain

conservation areas, which will increase the pressure on biodiversity. Although natural parks, wetland protected areas and ecologically sensitive areas are excluded in the proposed law, stringent impact assessment of development projects should be ensured to minimise environmental impact and prevent biodiversity loss.

Korea has invested considerable effort into strengthening and streamlining its legal and planning framework dedicated to managing biodiversity. These efforts have borne fruit: for example, by 2015 Korea had successfully restored over 60 endangered species, including the Asiatic black bear and the Sobaeskan red fox. Following a wave of laws and plans for areas such as forests, wildlife reserves, natural parks and marine ecosystems, the 2012 Act on the Conservation and Use of Biodiversity was established to streamline and better organise biodiversity management. Korea has also strengthened its institutional and information network by establishing research institutes, such as the National Institute of Biological Resources in 2007 and the National Institute of Ecology in 2013, to build a more comprehensive understanding of its biodiversity and to strengthen human capacity in this field. However, the proliferation of institutions can come with co-ordination and coherency challenges that should be borne in mind as the government chooses between creating new institutions and strengthening or integrating existing ones. Korea has expanded its terrestrial and marine protected areas, most recently through the designation of the Mudeungsan (2014) and Taebaeksan (2016) national parks, but has not yet reached international targets for protected areas as a proportion of total land and marine area (Figure 1).

Recommendations on climate change, air management and environmental information

Climate change

- Formulate a sector-by-sector roadmap with emission reduction goals and detailed measures to implement the 2030 GHG emission reduction target. Set intermediate steps to track progress towards the targeted path and adjust measures if necessary.
- Revise energy plans to ensure they are consistent with fulfilment of international climate change commitments.

Air quality management

- Consider introducing air pollutant emission cap management systems in areas with large industrial complexes outside the Seoul Metropolitan Area; continue tightening SO_x and NO_x emissions caps in the Seoul Metropolitan Area.
- Strengthen vehicle emission standards, narrowing the gap between testing conditions and on-road results.
- Pursue efforts to introduce low emission zones in areas affected by severe air pollution.
- Pursue regional co-operation to tackle transboundary air pollution.

Environmental information

- Strengthen efforts to establish a comprehensive and coherent water information system to better support national water policy; update information on freshwater resources and abstractions at national level more regularly.
- Improve knowledge of air pollution sources (domestic vs. transboundary) and of the impact of each upon health.

2. Environmental governance and management

Institutional framework

Korea has a centralised system of environmental governance, with the Ministry of Environment (MOE) playing the leading role; its budget and capacity have increased significantly over the last decade. There are national-level bodies for inter-agency co-ordination on specific issues – climate change, chemicals accident prevention, water management – as well as for cross-sector policy making on sustainable development and green growth. Their effectiveness could be substantially improved, particularly in the area of water.

Provincial and city governments play an important role in several environmental policy areas, including waste and water management. They also administer environmental permits and enforce environmental law as statutory delegates of the MOE. While many environmental responsibilities have been transferred to subnational governments over the last decade, the devolution and delegation of powers have not always been accompanied by adequate allocation of financial resources, hampering provincial and municipal governments' capacity for these tasks. In addition, the political emphasis of local authorities on economic growth, sometimes at the expense of environmental protection, contributes to a policy implementation gap at the provincial and municipal levels.

Regulatory framework

Korea has introduced rigorous requirements for *ex ante* assessment of its draft laws and regulations, including environment-related ones. However, this regulatory impact analysis applies mostly to regulatory proposals developed by the executive branch and has so far been mostly qualitative (OECD, 2015b). *Ex post* evaluation of the impact of environmental legislation is exercised through various regulatory improvement programmes.

Korea has strengthened its regulation of stationary pollution sources. Since 2006, industry-specific air emission standards have been made more stringent, and an air pollutant emission cap system has been introduced in the Seoul Metropolitan Area (Section 1). Significant progress has also been achieved in water quality management with the increased number and stringency of water quality and effluent standards and the introduction of the Total Water Pollution Load Management System for river basins. Korea has also adopted new standards for motor vehicle emissions and is implementing management programmes for diffuse water pollution.

Korea has broadened its systems of environmental impact assessment (EIA) and strategic environmental assessment (SEA), which now cover a more extensive and expanding range of projects and plans. However, both remain largely focused on infrastructure. Industrial facilities are subject to EIA based on the size of their site rather than environmental impact, and SEA does not cover sector policies or a significant share of local land use plans. Furthermore, there are concerns about the easing of land use regulations, with more development being allowed in environmentally sensitive areas in mountainous regions, as well as the fact that several development promotion laws allow certain projects to bypass regular territorial planning (Lim, 2014).

The environmental permitting system is undergoing important reforms in line with international best practices. The gradual introduction starting in 2017 of integrated permits for 19 industrial sectors will significantly streamline the permitting process. It will allow the competent authorities to consider economically viable technical solutions and local

environmental conditions in setting customised requirements for major polluters. The introduction of integrated permitting will necessitate substantial capacity building at the MOE and its regional offices, which are to assume responsibility for issuing permits. However, the reforms will not affect industrial activities with low environmental impact – chiefly small and medium-sized enterprises (SMEs) currently subject to complex medium-specific standards.

Compliance assurance

Korea has made progress in building compliance monitoring and enforcement capacity at the national and local levels. Both the central and local governments have improved detection of non-compliance, although random inspections put a strain on local governments' resources, which could be avoided by focusing site visits on higher-risk facilities. The national government promotes compliance and adoption of green business practices through voluntary agreements on the reduction of key air pollutants, environmental recognition awards and regulatory incentives for adoption of environmental management systems. While the MOE continues efforts to build enforcement capacity (e.g. by creating a central environmental crime investigation team), administrative monetary penalties are too low to deter violations, and despite the high maximum applicable criminal fines, criminal enforcement is often hampered by public prosecutors' limited willingness to pursue environmental cases.

Recommendations on environmental governance and management

- Support a whole-of-government approach to water resource management by building on the existing collaboration platforms for policy dialogue between all relevant government stakeholders and adopting a Framework Act on Water Management; strengthen co-ordination between ministries on other key environmental issues, including climate change, chemicals safety and biodiversity.
- Build provincial and local governments' capacity to carry out their statutory environmental responsibilities and tasks delegated to them by the central government; provide the necessary financial resources to ensure effective enforcement of national environmental regulations; strengthen the system of environmental performance indicators for all levels of government.
- Reinforce *ex ante* assessment of environmental policies and regulations through wider application of cost-benefit analysis, and expand *ex post* evaluation of their implementation.
- Continue to expand the coverage of the EIA and SEA systems by making hazardous industrial facilities subject to EIA independently of their size and requiring SEA for a wide range of government policies and programmes with potential impact on the environment, including all local land use plans. Ensure appropriate use of these instruments to prevent uncontrolled development in environmentally sensitive areas; pursue closer co-ordination between land use and nature conservation plans.
- Ensure coherent introduction of integrated environmental permitting reform for major industrial polluters on the basis of best available techniques, accompanied by capacity building for competent authorities and broad stakeholder involvement; consider replacing single-medium permits for low-risk installations with sector-specific general binding rules.
- Increase the efficiency of compliance monitoring through better targeting of inspections based on the level of environmental risk of individual facilities; strengthen administrative enforcement tools and build the capacity of public prosecutors and the courts in applying penalties for criminal offences.

3. Towards green growth

Korea has created a strong institutional framework for green growth and climate change with the National Green Growth Strategy, the Framework Act on Low Carbon, Green Growth, the first and second Five-year Plans for Green Growth, and detailed expenditure plans aiming to dedicate 2% of GDP to green growth activities each year. The country has also made a considerable effort to expand its international engagements on green growth, hosting the Green Climate Fund, establishing the Global Green Growth Institute and championing green growth at the OECD. Korea has applied the OECD measurement framework for developing a set of green growth indicators (Statistics Korea, 2012). This useful tool should continue to be used to track progress towards policy objectives.

However, Korea has not fully translated its green growth leadership and vision into action. Although a second plan was adopted in 2014 and relevant measures were implemented under different names (e.g. "climate change response"), green growth is no longer the top political priority, with the paradigm shifting to "creative economy". The Presidential Committee on Green Growth has been moved to the prime minister's office. The Government Performance Evaluation Committee ceased to evaluate green growth policies in 2013, though it still evaluates related policy areas. Several examples of policy inconsistency remain: GHG emissions continue to rise, coal is set to remain a core part of the energy mix (MOTIE, 2015, 2014) and road transport continues to be supported as the dominant form of mobility (MOLIT, 2016a).

Greening the system of taxes and charges

While Korea currently enjoys a fiscal surplus and low public debt, it will need to increase tax revenue to finance rising social expenditure over the long run (OECD, 2016a). Raising environmental taxes provides an opportunity to do so, while making it possible to lower other taxes that may be a brake on growth, e.g. taxes on corporate and labour income and capital gains. Korea's environment-related tax revenue as a share of GDP has fallen since 2000, yet remains above the OECD average.

Korea's energy taxes do not sufficiently consider the environmental and other external costs of energy production and use across sector activities. For instance, in terms of both energy content and carbon content, the gap between the taxation of transport fuels and that of non-transport fuels is above the OECD average (OECD, 2013a). Payment for energy also varies by user group, with tax rates highest for households, followed by industry, and agriculture enjoying exemptions, raising equity issues. As in many OECD countries, petrol is taxed more heavily than diesel. The excise tax gap between the two narrowed markedly between 2000 and 2008, but no further progress has been made since then. In fact, the real taxation level for both fuels has been declining since 2009, representing forgone revenue, reducing the incentive to save energy and frustrating efforts to shift to greener transport modes (IEA, 2016c).

Government policy to keep electricity prices low to support industrial competitiveness and affordability for households has spurred a rapid increase in electricity demand, putting supply under serious strain and contributing to GHG emission growth (OECD, 2012a). Low electricity prices also act as a barrier to renewables and energy efficiency measures. The government's steps to make electricity prices better reflect system costs include progressively raising the rate since 2010, applying seasonally/hourly tiered pricing and adopting pricing by voltage (MOTIE, 2014; KEPCO, 2013). These measures have led to an

improvement in the cost recovery rate. However, further reforms are needed to reduce peak demand, ensure prices reflect costs of power generation, transmission and distribution, and remove cross-sector subsidies (Ecofys, 2015; Pittman, 2014). Another area of improvement is the introduction of a tax on bituminous coal used for electricity generation in 2014, though its rate is modest. It is essential for the government to redouble its efforts to pursue such reforms, and to go beyond the goal of reflecting system costs so that prices also reflect the environmental and social costs of electricity production and use.

Korea launched the world's second largest emission trading scheme (ETS) in January 2015 as the centrepiece of its climate policy. The ETS covers about two-thirds of the country's GHG emissions. Concerns about industry competitiveness led to a very high share of permits being allocated for free (from 100% in the first phase [2015-17] to 90% in the third phase [2021-25], higher than in the European Union ETS), depriving the government of revenue that could be used, for example, for lowering income taxes or increasing investment in profitable areas such as green research and development (R&D). Korea could learn from the experience of the EU ETS, where free allocation of permits resulted in windfall profits to industry. OECD work has found that industry concerns about loss of competitiveness due to carbon pricing measures are often overstated (Arlinghaus, 2015).

In 2015, actual emissions slightly exceeded allocations (by 0.5%). However, all companies but one have complied with their obligations thanks to the use of flexible mechanisms such as offset credits. As with the EU ETS in the beginning, trade in allowances has been extremely low, as companies hold on to them for future use or to sell at higher prices. Most trade has been in credits and offsets obtained from abatement outside the system. Responding to the lack of liquidity, the government is raising the ceiling for borrowing allowances from the following year from 10% to 20%, providing additional allocations to reward early reduction and selling government reserves. The experience of the EU ETS offers a cautionary tale, however, where allocation above actual emissions lowered perceived investment incentives for clean technology adoption (Venmans, 2016) and increased emissions (Brouwers et al., 2016).

Changes in governance and GHG objectives have made implementation of the Korean ETS more complex; for example, ETS supervision has shifted from the MOE to the Ministry of Strategy and Finance, and the 2030 GHG emission target has postponed the 2020 one, leaving industry uncertain of emission reduction quantities and timelines. Improved transparency, stability and long-term visibility will be key factors for smooth adoption of the ETS. To make the ETS an environmentally and economically effective tool for reducing GHG emissions, the government will need to adjust the system, drawing on lessons learned in its first year of operation and experience from other such systems. Ministries will also need to work closely with the sectors concerned to help them make the transition.

The ETS was preceded by the Target Management Scheme (TMS), which caps the annual GHG emissions of individual firms and is still applied to smaller firms with emissions under a certain threshold. The TMS provides a stepping stone for some enterprises to learn monitoring, reporting and verification practices before transitioning to the ETS. However, as the firm-specific caps are set bilaterally in consultation with the government, the implicit carbon price varies between firms. A more efficient way to price carbon would be to introduce a carbon tax for all sectors and firms not covered by the ETS and then phase out the TMS (OECD, 2012a).

Korea needs to review transport-related taxes and charges in the face of rising economic, environmental and health costs in the sector. Exemptions weaken the diesel vehicle component of the environment improvement tax, and a plan to tax highly polluting vehicles has been pushed back five years. As the congestion charge on Namsan Tunnels 1 and 3 in Seoul has not been raised in several years, its impact on limiting congestion has been declining, and the use of congestion charges has not been extended as originally planned. In 2014, the traffic generation charge, which had remained unchanged for over 20 years, was raised. Following the example of Seoul, cities could differentiate the charge rate according to facility location, not just floor area.

Environmental tax and charge rates on air pollution, water pollution and use, and land development are too low to cover environmental and social externalities or to encourage pollution reduction and efficient resource use. Furthermore, despite the fact that NO_x emissions from industry are increasing, they are not subject to the air pollution tax. Although this would not be justified in the Seoul Metropolitan Area, where an emission cap management system is in place (Sections 1 and 2), it would be desirable in other areas where NO_x emissions are not priced. Korea's water supply and sanitation charges are the lowest in the OECD, and do not encourage efficient water use. Moreover there are socially motivated reductions and exemptions, which should be replaced with separate aid decoupled from water use to maintain the price signal for all. Charges related to water resource management are uniform across the country and so do not signal regional differences in water availability and risk. The low collection rates on certain taxes and charges, particularly related to water quality, suggest imperfect enforcement, which further weakens incentives for pollution reduction and efficient use.

Environmentally harmful subsidies, direct and indirect, distort incentives by encouraging increased resource use and pollution. While the government has been working to phase out some direct subsidies, such as support for coal briquette production and use, others have been extended. For example, the motor fuel subsidy, paid to buses, trucks and LPG taxis since 2000, was extended in 2015 to diesel taxis meeting Euro 6 standards. Korea also remains one of the largest providers of producer support for agriculture in the OECD (OECD, 2016d). The agriculture sector does not pay energy taxes and only partially pays water charges (OECD, 2010a), and energy-intensive industries such as cement and steel are exempt from the bituminous coal tax. In a global context of low coal and oil prices, the current environment would be favourable to phasing out these harmful subsidies and tax exemptions.

Investing in the environment to promote green growth

Following the 2008 economic and financial crisis, Korea introduced one of the world's most significant green stimulus packages, reaching 4.5% of its 2008 GDP (OECD, 2011). Korea's green new deal was then rolled into its first Five-year Plan for Green Growth (2009-13), which achieved its public spending target of 2% of GDP per year on green growth projects. Over half of expenditure went to water and green transport infrastructure (e.g. high-speed rail), providing a short-term boost to activity and employment. However, the green credentials of some expenditure under this plan, such as for the Four Rivers Restoration Project, have been questioned. *Ex post* evaluations found that while the number of large floods decreased, more water resources were secured and certain water quality indicators improved,[2] slowed river flow caused the population of some aquatic species to decline and contributed to algae blooms in some areas, and dredging and construction of

riverside eco-parks affected some habitats and species (Four River Restoration Project Investigation Evaluation Committee, 2014; Board of Audit and Inspection of Korea, 2013). Continued monitoring is needed to evaluate long-term changes in aquatic ecosystems and riverbeds.

Environmental protection[3] expenditure as a share of GDP increased steadily to reach 2.1% in 2009, driven by spending on wastewater infrastructure and, to a lesser extent, air pollution abatement and biodiversity protection. Since then, it has returned to its early 2000s level of 1.8% due to reduced public expenditure on waste management and stabilised business spending on air pollution control (OECD, 2016c). As in most OECD countries, wastewater and waste management account for the bulk of environmental protection expenditure (about 60% in 2013), which is mostly incurred by municipalities. Combatting air pollution is the next highest area of expenditure (about 20%). The stabilisation of business investment in this domain suggests some room for tightening the air pollutant emission cap management system and revising air pollution taxes to better reflect environmental and other externalities.

Public expenditure on water supply and sanitation increased steadily over 2006-14 (MOE, 2016b, 2016c), resulting in connection rates above 90% and stunning improvements in the level of wastewater treatment. However, ageing infrastructure and declining cost recovery rates for both services are threatening the financial sustainability of the sector. To bridge the financing gap, the government plans to raise water supply and sewerage charges, amalgamate multiple small water services to benefit from economies of scale, and encourage increased private sector participation. As for water quality, more attention is needed to combat the pressures posed by diffuse pollution and climate change.

Investment in renewable energy sources increased steadily over 2007-11 (MOE, 2016a; IEA, 2016b), spurred by higher oil prices and a raft of measures including a feed-in tariff (FIT) programme, R&D support, preferential loans and tax incentives for producers and installers, and subsidies for households. Investment then crashed along with the global renewables market in 2012 and government support fell (MOTIE, 2014; Invest Korea, 2015). In 2012, the FIT programme was replaced by a renewable portfolio standard (RPS) to ease the budget burden. Under the RPS, producers are given certificates based on renewables-based electricity produced, with different weightings applied depending on the technology used. Certificates can be traded between producers to allow them to meet their quota obligations. While installed capacity of renewables has accelerated, appropriately weighting certificates will require continued monitoring of technological developments.

Korea has made great strides in developing renewables technology (see below) but in global markets it faces strong price competition from China and cutting-edge technology competition from advanced economies (GGGI, 2015). One factor hindering export development is that the domestic renewables market has not yet taken off. This is due to lack of competition in the electricity market, regulated low electricity prices and the fact that the government is not prioritising renewables. Planned annual investment in coal over 2015-19 is 70% higher than the public budget for renewables[4] combined with private investment in 2014 (MOE, 2016a; MOTIE, 2015). The seventh Basic Electricity Plan (2015-29) maintains coal as the dominant energy source and increases the share of renewables in the mix by only 0.1% compared with the sixth plan (MOTIE, 2015). The domestic market is further challenged by local regulations and low public acceptance (MOTIE, 2014). The latter is a barrier shared by many OECD countries.

Korea is a leader in energy storage technology (see below), recently becoming home to the world's largest battery energy storage system for frequency regulation. The system will reduce the need for KEPCO, the country's largest power utility, to turn to power plants to provide regulation services and will therefore save fuel (Runyon, 2016). The government plans to build on this system and its industrial energy management system to create demand management markets rewarding providers of electricity capacity and energy efficiency measures (also known as white certificate markets). In designing these markets, Korea could draw upon lessons learned from similar markets in parts of Europe, Australia and the United States. While white certificate programmes have proved efficient and effective, experience in Italy and France has shown that care should be taken in minimising their administrative burden and maximising their transparency, that *ex post* evaluations are useful to determine the real energy savings achieved, and that careful analysis of their interaction with other instruments, such as the ETS and subsidies for energy efficiency measures, is desirable (OECD, 2013b; OECD, 2016e).

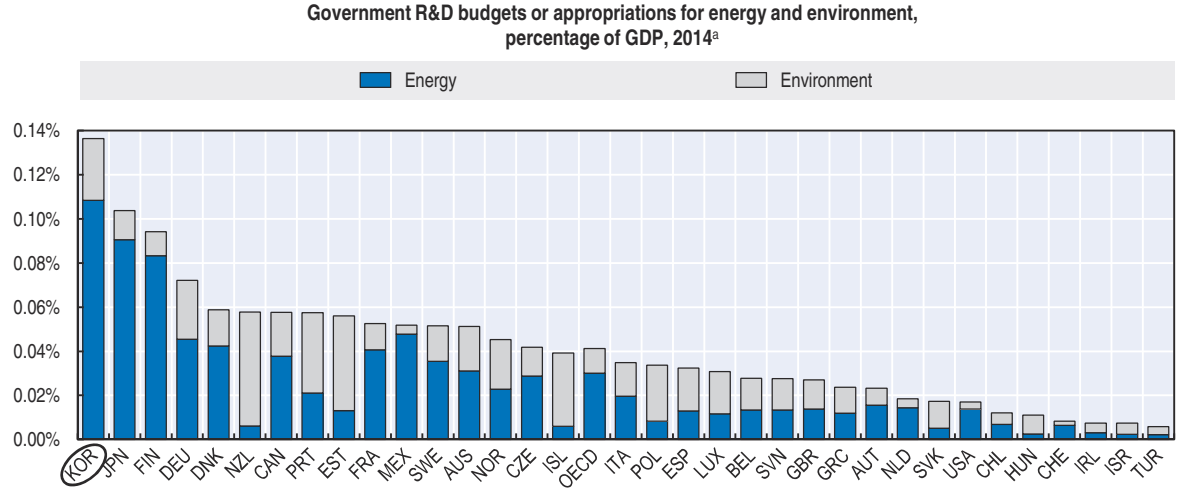
Road transport consistently accounts for over half of investment in transport infrastructure and remains the country's dominant transport mode. While the share of rail in total public investment in transport infrastructure increased from 16% in 2006 to 33% in 2015 (MOLIT, 2006, 2015), this has not led to a modal shift in freight and passenger transport from road to rail, mainly due to inaccessibility of stations and lack of integration with other transport modes (MOLIT, 2016b; OECD/ITF, 2012). Road transport is a significant factor driving air pollution and GHG emissions, and the economic cost of congestion[5] is high and rising, representing 2.2% of GDP in 2012 (Cho, 2014). Through numerous tax incentives and subsidies, the bus fleet was switched from diesel to natural gas and the number of electric and hybrid cars purchased was increased, though their uptake has been slower than targeted: their share remains marginal (1%) while the share of diesel cars is rising. Clean vehicle uptake could be further stimulated by broadening incentives to target their use, not just their purchase.

Promoting eco-innovation

Korea is the world's most R&D-intensive country and also ranks first in business R&D (OECD, 2016f). Its highly developed innovation system and increasingly stringent environmental policy have driven progress in eco-innovation. In 2014, the government of Korea was the fourth largest provider of funds for R&D on energy and the environment in the OECD, and ranked first relative to GDP (Figure 2). Since 2000, related spending has increased from 0.05% of GDP to 0.14%. This reflects both the general effort on R&D and the increased priority given to energy, which accounted for 9% of the total government R&D budget in 2014, more than twice the OECD average.

The first Five-year Plan for Green Growth clearly identified green technology as a new engine for growth and prompted increased public R&D investment in 27 key technology areas, such as intelligent transport systems, light-emitting diodes, batteries, green information and communication technology (ICT), nuclear energy, climate modelling, solar cells, green cars and CO_2 capture and storage. The government has been channelling finance to green businesses through grants, loans, credit guarantees, venture capital investment and generous generic and specific tax incentives for R&D. However, market-based financing has not taken off; adding carry-over provisions to tax breaks could further stimulate innovation in SMEs. Such a system would allow young and small firms, that typically lose money in the early years of an R&D project, to save an unused deduction for later use.

Figure 2. **Korea has the OECD's highest level of public R&D expenditure on energy as a share of GDP**



a) Canada and Chile: 2013 data; Mexico: 2011 data.
Source: OECD (2016), *OECD Science, Technology and R&D Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933448899

High levels of investment within a broad range of supply and demand instruments have made Korea one of the world's most innovative countries in climate change mitigation technology. In 2010-12, such technology accounted for 10% of overall patent applications[6] associated with inventors located in Korea, up from 4% in the early 2000s. The country developed a comparative advantage[7] in several such fields (e.g. solar photovoltaic, batteries and fuel cells, energy-efficient lighting, electric vehicles) and Korean manufacturers became key players in related global markets.

However, high R&D inputs have not delivered intended outcomes in terms of renewables development and GHG emission reduction, making the case for stronger carbon price signals. Support to energy- and climate-related innovation may have crowded out innovation in other important environmental domains, suggesting potential to better focus support on Korea's strengths and future needs. Eco-innovation and general innovation face similar barriers: public R&D investment has mainly focused on experimental development of green technology and promotion of green manufacturing industry, while basic research, the service sector and non-technological innovation have been given less attention. In addition, innovation is hampered by weak industry-university links and a low level of international collaboration (OECD, 2014). Compared with other OECD countries, Korea has one of the lowest co-invention rates with foreign partners in environment-related technologies. The second green growth plan aims at tackling these challenges by promoting fundamental research on carbon capture and storage and nuclear energy; by commercialising energy demand management technology and developing new ICT-based business models; by promoting resource-cycling industrial development; and by supporting clean production by SMEs.

Expanding environment-related markets and employment

The environmental goods and services (EGS) sector has grown far faster than the general economy; both sales and the number of employees almost tripled over 2006-14 (MOE, 2016a). Growth has been faster in resource management activities than in pollution control

activities, spurred by a strong recycling sector and the development of heat and energy saving and waste-to-energy sectors. The government has established plans and instruments to facilitate growth in green jobs and training. However, economy-wide assessments need to be performed to evaluate the overall labour market impact and skills needs associated with transitioning to a greener economy.

Korea's well-established green public procurement (GPP) system is recognised as an example of best practice among OECD countries (OECD, 2015c). GPP is strengthened by Korea's long-standing eco-labelling system, and by the 2005 Act on Promotion of Purchase of Green Products, which made GPP obligatory. While GPP has helped drive substantial growth in the number of environmentally certified products and jobs in the EGS sector, the green share of total public procurement stands at 8%, or 42% for categories that have green product options available (MOE, 2015), indicating room for further growth. To increase GPP, the scope, number and quality of green products available need to be expanded to better meet the needs of all public institutions. Harmonising GPP and other procurement regulations and designating and training GPP officials in each public institution could also facilitate growth in GPP.

While multiple environmental labels provide information on products' environmental and energy performance, recognition of them remains around 50% and a gap between label recognition and the actual purchase of certified products persists (KEITI, 2014). Consumers are discouraged by the higher prices and lack of variety of green products, insufficient product information, quality issues and perceptions of misleading labelling and advertising. To tackle the price gap, the government introduced a "carbon point" economic incentive programme that rewards electricity, water and gas savings and a "carbon cashbag" system for the purchase of energy-efficient products. These were integrated in 2011 with the flagship "green credit card" system, which is attracting a growing number of participants and international attention.

Environment, trade and development

Korea's target of increasing environment-related bilateral official development assistance (ODA) to 30% of total bilateral ODA by 2020 appears hard to achieve on current trends (OECD, 2016g). The country makes extensive use of concessional loans in its environment-related ODA, which may be appropriate for middle-income countries but is less so for low-income countries, which have less capacity to repay them. The Korea International Cooperation Agency has increased efforts to mainstream environmental considerations into its activities by developing guidelines and appointing a staff member in each department to be in charge of monitoring and evaluating environmental mainstreaming. Korea engages extensively in regional co-operation on green growth and environmental challenges, as a donor providing finance and know-how, as a partner finding solutions to common environmental challenges, and as an exporter of environmental technology.

Korea has provided substantial funding for fossil fuels overseas. Almost two-thirds of its other official flows over 2007-14 supported industry, mining and construction, including activities such as coal, gas and chemical production facilities and oil exploitation (OECD, 2016c). The value of export credits that Korea provided to coal- and oil/diesel-fired electricity generation projects substantially exceeded that of all other OECD countries over 2003-13 (OECD, 2015e). Korea will need to plan how to phase out these investments

following the OECD agreement in November 2015 restricting the circumstances under which coal-fired power plants can be financed.

In 2013, the Export-Import Bank of Korea became the first non-multilateral bank to issue green bonds and the first institution in Asia to issue green bonds in US dollars. Proceeds are used to extend loans to low carbon projects, which are independently verified.

Korea has recently signed many free trade agreements with key trading partners and, as a member of Asia-Pacific Economic Cooperation, is committed to reducing its applied import tariffs to 5% or less (on an ad valorem basis) on a standard list of goods, including many pertaining to renewable energy and energy efficiency. These developments have facilitated a decline in Korea's import tariffs on environmental goods. Korea is one of 17 economies negotiating a plurilateral Environmental Goods Agreement that would phase out import tariffs in this sector. However non-tariff barriers remain, such as high product market regulation (OECD, 2015f).

Recommendations on green growth

- Strengthen political commitment to green growth. Provide political and institutional stability in terms of roles and responsibilities in designing, monitoring and implementing the framework.
- Green the energy sector to help meet Korea's GHG gas and air pollution reduction and energy security goals:
  - Progressively raise electricity prices to reflect system costs (i.e. of production and distribution), providing targeted support decoupled from energy use to vulnerable households where needed; remove cross-sector subsidies.
  - Raise taxes on fuels used for electricity generation, particularly coal, to reflect environmental and health costs.
  - Redouble efforts in energy demand management.
  - Increase public investment in renewables development and deployment; review the outcomes and cost-effectiveness of existing instruments and adjust the measures based on the results; provide a stable and transparent policy framework; monitor changing technology costs and adjust support measures and weightings applied to different renewable energy sources under the RPS accordingly.
- Strengthen the effectiveness and efficiency of the ETS to help Korea meet its GHG emission reduction target:
  - Steadily increase the share of permits auctioned and the stringency of the total emission cap.
  - Increase the transparency, stability and long-term visibility of the ETS to allow businesses to better adapt and make the long-term investments necessary to reduce their emissions. This would include providing public information on current and future permit allocation at the sector level.
  - Phase in a carbon tax for firms and sectors not covered by the ETS; phase out the TMS.
- Adjust taxes, charges and subsidies to better reflect environmental externalities:
  - Adjust the rates of pollution- and natural resource-related taxes and charges to reflect environmental and social costs and to encourage reduced pollution and natural resource use. For example, raise water supply and sewerage charges and the water effluent tax. Strengthen the enforcement of these taxes and charges, in particular of

Recommendations on green growth *(cont.)*

those related to water quality, for which the collection rates are very low. Extend the air pollution charge to cover NO_x emissions in areas not covered by an air pollutant emission cap management system.

- Progressively phase out domestic fossil fuel subsidies, such as those for the agriculture and fishing sectors, fuel subsidies for buses, trucks and taxis, and subsidies for producers of coal briquettes used by low-income households. Progressively phase out export credits and other official flows supporting fossil fuel extraction and use.
- Reorient agriculture production subsidies away from direct producer and price support and towards support encouraging, or conditional on, provision of environmental services (e.g. water management, flood buffering, biodiversity protection) and efficient resource and input use. Remove water charge exemptions for agriculture, with the long-term objective of full cost pricing.
- Establish an institutional mechanism, such as a green tax commission, to review the environmental effects of fiscal instruments, identify environmentally harmful subsidies and prioritise which to phase out first, and improve the effectiveness and efficiency of economic instruments.

- Strengthen measures to reduce transport-related GHG emissions, air pollution and congestion:
  - Raise the excise tax on diesel to at least match that on petrol, and index the tax on both fuels to inflation to avoid erosion of its value in real terms.
  - Implement measures that encourage not only the purchase but also the use of clean vehicles, such as dedicated lanes, lower parking tariffs and tolls, and more charging stations for electric vehicles.
  - Further increase investment in rail and other public transport; better link transport modes and integrate public transport planning with land use planning.
  - Expand the use of congestion charges; update the rate of the Namsan tunnels congestion charge; continue to raise the traffic generation charge and encourage cities to differentiate its rate according to facility location.
- Secure the long-term sustainability of financing for water supply and sanitation infrastructure:
  - Gradually raise water supply and sewerage charges to improve the cost recovery ratio of providing these services.
  - Pursue the amalgamation of water supply services to enhance their efficiency.
- Pursue efforts to foster and disseminate green innovation:
  - Rebalance public spending in energy- and environment-related R&D from technology development and demonstration to fundamental and applied research; promote greater involvement from universities and strengthen links with industry and government research institutes; continue to strengthen international co-operation in energy- and environment-related R&D.
  - Regularly assess the consistency between instruments used in environmental and innovation policies and the outcomes of eco-innovation policies against Korea's strengths and future needs; scale up development and deployment of carbon capture and storage; promote innovation in a circular economy.

Recommendations on green growth *(cont.)*

- Increase green public procurement and green purchasing by consumers:
  - Improve government engagement with the private sector concerning public sector product needs and the green standards these products would need to meet to be eligible for purchase, in order to expand the range of green products available.
  - Harmonise GPP regulations with the many other procurement requirements and streamline environmental labelling and certification schemes, to reduce complexity for public procurers and consumers.
  - Tighten the application and monitoring of eco-labels to ensure that products are of high quality and that labels are not applied falsely.
- Significantly scale up green bilateral ODA to meet the 2020 target of 30% of total bilateral ODA. Ensure that the use of grants or concessional loans is adapted to recipient countries' economic context, financial position, governance, preferences and needs.

4. Waste, materials management and circular economy

Korea's fast development, dependence on external markets and high share of SMEs in the industrial base, combined with high population density, little landfill space and cheap public services, create particular challenges for waste, materials management and a circular economy.

Korea can build on a very good track record in integrated waste management since 2006. It has further consolidated and strengthened its policies. It has progressed on all recommendations of the *2006 Environmental Performance Review* (EPR) and is taking steps to move from a waste- and pollution-oriented strategy towards an integrated "circular economy" approach that contributes to raw materials and energy supply security. The related Framework Act on Resource Circulation was adopted in May 2016. The overall performance level remains high, with some of the best results among OECD countries. But progress is increasingly difficult, and in some areas improvement in recent years has been marginal.

Policy framework

Korea has a well-developed policy framework, with quantitative targets and a good mix of policy instruments. It has one of the world's most advanced food waste policies. Korea is also among the early adopters of extended producer responsibility and has considerably broadened the scope of that system since 2006. The government emphasises the economic value of waste as a resource, with the double aim of reducing amounts going to final disposal and increasing amounts of valuable materials being recovered for the economy. In recent years, the policy focus has been shifting from material recycling to energy recovery through production of solid refuse fuels and incineration (waste to energy policy) as part of a broader effort to increase the country's energy autonomy. This has been accompanied by significant investment in waste treatment and recycling facilities, whose construction benefits from government subsidies, tax credits and long-term low-interest loans. Korea exports its waste management know-how through bilateral and multilateral co-operation, including technical agreements that open up new markets for its industry.

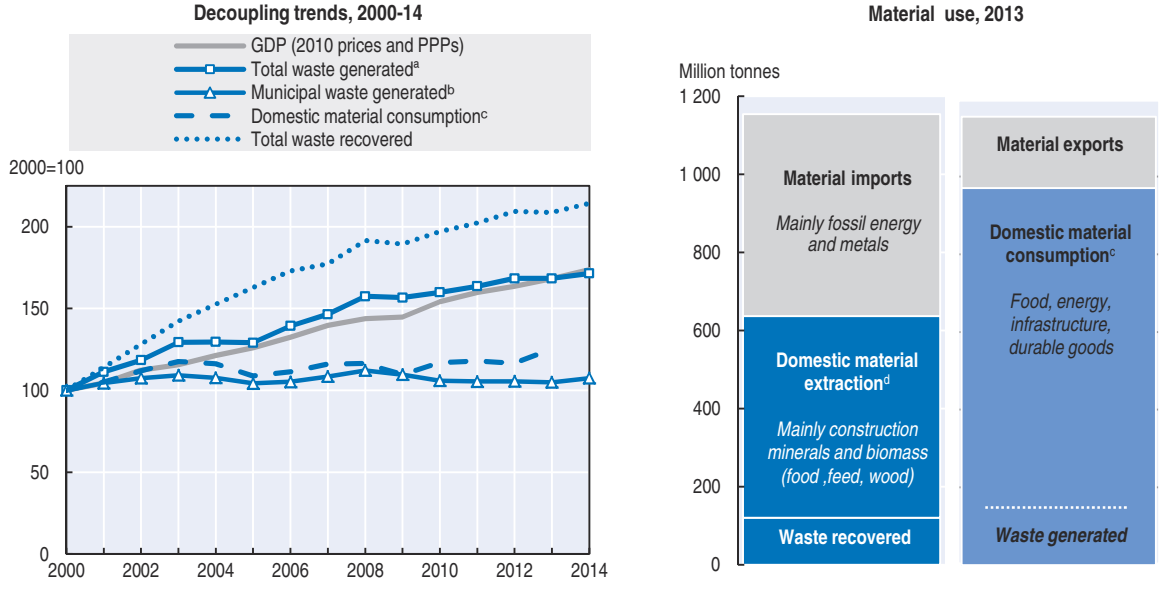
Applying the polluter-pays principle to waste and materials management

The use of economic instruments in line with the polluter-pays principle is well established and was extended over the review period. Taxes and charges are used in combination with financial support and targets to create incentives for waste reduction and recycling. Korea is one of the few countries where manufacturers and importers have to pay a waste product charge to internalise the waste management costs of products that are hard to recycle or contain hazardous substances. The volume-based waste fee (VBWF) system for collection of mixed household waste has been extended to the whole country, except small settlements and remote areas; since 2010 it has also applied to food waste. Associated with free separate collection of recyclable waste, it has been instrumental in reducing waste going to final disposal. Despite these very positive developments, the polluter-pays principle is not yet fully applied: the VBWF levels are very low, with revenue covering only one-third of the management costs. In the business sector, government support appears to be the key driver of action.

Promoting recycling and waste reduction

The amounts of waste recovered are growing and recycling rates are higher than in many other OECD countries; more than 80% of the waste generated is recovered (Figure 3). Rates are highest for construction and demolition waste, food waste and tyres, followed by packaging materials, large and medium-sized waste electrical and electronic equipment, vehicles and municipal waste. Recycling has been accompanied by an increase in the amounts of recycled products and secondary raw materials available on the market. The materials intensity of the economy has been reduced, though not as much as in other OECD countries. Municipal waste management has successfully moved away from landfilling to

Figure 3. **Waste recovery has further progressed**



a) Primary waste generated, i.e. excluding residues from treatment operations.
b) Household and similar waste collected by or for municipalities, originating mainly from households and small businesses. Includes bulky waste and separate collection.
c) Refers to domestic material extraction plus imports minus exports of raw materials and derived products.
d) Refers to raw materials that are extracted or harvested from the environment and that enter the economy for furher processing or direct consumption.
Source: Country submission; OECD (2016), "Material resources", *OECD Environment Statistics* (database); OECD (2016), "Municipal waste generation and treatment", *OECD Environment Statistics* (database); OECD (2016), *OECD National Accounts Statistics* (database).

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materials and energy recovery; the amounts generated per capita are stable and below the OECD average, and generation remains decoupled from final private consumption. Korea has recently succeeded in curbing the upward trend in food waste generation, which had been of concern for many years. Food waste is now almost entirely recycled into feed, compost, and energy via electricity production.

At the same time, waste generation remains closely linked to economic growth, and the objective in the second national waste management plan of reducing total waste generation between 2002 and 2011 was not achieved. Since 2006, the total amount of waste recovered has increased in line with total waste generation, leaving the overall recovery rate almost unchanged. Though on the rise, the recovery rates for products such as small consumer electronics remain low compared with sales and stocks in use. It is estimated that half the waste still sent to final disposal (i.e. about 8% of the amount generated) contains materials that could be recovered.

Further progress will require not only more effective collection systems for certain types of recyclable waste, but also more advanced and innovative recycling technology and measures to achieve non-toxic material cycles. Korea has a large informal recycling sector, composed of very small family-type firms that have traditionally been involved in scrap collecting and recycling. A certain amount of waste electrical and electronic equipment escapes the official system through this sector, which can pose a risk of pollution and illegal exports. Given the importance of the informal sector, Korea would benefit from its progressive integration into the formal system of extended producer responsibility, e.g. by creating local networks in which informal recyclers would register as entrepreneurs applying minimum recycling standards and receiving training and support. A useful first step would be to study the sector to better understand its functioning in terms of the number of establishments and people involved, the type of waste collected and the pathways used.

Promoting recycling markets

Markets for recycled products are encouraged by the GPP system, which has been extended to all government institutions, and by an online trading system for recycled and recyclable materials and products, which is open to businesses, waste operators and households. Recycling markets, however, remain weak. They suffer from general mistrust of the quality of recycled materials and reused products. In recent years, low oil and raw materials prices have undermined their effectiveness, making it difficult for recycled products to compete with new ones. Strengthening recycling markets to make them more resilient against commodity price volatility and stimulating demand for recycled goods beyond the public sector will be essential. To achieve this, the government will need to strengthen its action at several levels. First, restoring trust in recycled goods, e.g. through well-targeted information campaigns and expanded use of quality labels for recycled goods. Second, guaranteeing high quality of recycled goods by better informing recyclers about the materials content of recovered products, developing minimum quality standards and creating incentives to upcycle waste into high-value products. Third, continuing to develop external markets and strengthening bilateral and multilateral co-operation on resource circulation and the reduce-reuse-recycle hierarchy (the 3Rs).

Improving the environmental effectiveness of waste and materials management

Measures to minimise the environmental impact of waste and materials management show mixed results. Waste disposal methods have improved with the closure or upgrading

of substandard landfills, regular monitoring and inspection of small incinerators, a ban on direct landfilling of food waste and a ban on dumping organic waste at sea. Medical waste is tracked through a mandatory radio frequency identification system. However, not all waste is managed in an efficient and environmentally sound manner. Direct landfilling still exists, and very small incinerators, which are inspected less frequently (every three years), raise concerns. Illegal dumping and other inappropriate disposal by households and businesses, though reduced, remain an issue. Waste reduction at source and the reduction of hazardous substances in products, though encouraged through the producer responsibility system and an advance disposal fee, have not yet shown full results. Efforts need to be strengthened as regards electrical and electronic equipment and vehicles, and be expanded to other products. In this context, synergies with chemical policies and with the Korean Chemical Information Platform could be explored. It will also be important to provide businesses with incentives and improved guidance on design for environment.

Encouraging waste prevention and resource productivity in the business sector

Businesses are subject to mandatory waste reduction targets and are encouraged to voluntarily reduce waste going to final disposal. The focus is on big enterprises that generate large amounts of waste and on waste containing hazardous substances. Results have been satisfactory, though there is little control over smaller facilities. SMEs are exempt from many waste reduction measures and obligations, but receive training and support. Regulations and targets are often perceived as a burden rather than an opportunity, and many developments in the business sector are dependent on government support. All this indicates there is still room for efficiency gains in the sector and further progress can be made with resource productivity, waste reduction at source, design for environment and performance management. One area to consider in particular is further development of circular business models that achieve greater resource efficiency and fully integrate waste as a resource into the production cycle, e.g. by using the concept of industrial symbiosis and strengthening the network of eco-energy towns and eco-industrial parks.

There are important synergies between policies that encourage eco-innovation, clean production, R&D, eco-friendly businesses, remanufacturing and energy efficiency, and policies that encourage sustainable materials management and a circular economy. Although co-operation exists, these synergies could be better exploited if all ministries concerned worked together to produce a consolidated overview of support measures in place, and if there were mechanisms to co-ordinate programmes and assess their costs and benefits. Synergies also exist between policies that aim at reducing toxic chemicals, those that aim at reducing toxic product contents, and extended producer responsibility. More effective integration of these policies would be useful.

Producing reliable information on waste and materials

Korea has a well-developed monitoring and information system for waste generation and treatment, with mandatory reporting by businesses and local authorities. Movements of waste, their management and treatment processes are monitored in real time thanks to an online information system called Allbaro. The data are used to produce statistical reports and to track waste reduction efforts in the business sector. Materials flow analysis is carried out at macro level and for selected metals, but the results are not integrated with waste statistics or used for national waste and materials management policies. It is thus not easy to get a complete picture of materials flows through the economy and how they relate to

waste streams and recycling efforts. Korea could make much better use of the wealth of data produced if they were better integrated and more closely linked to policy objectives. The data could in particular be better used to elaborate policies and set targets, to evaluate policy performance and to inform the public about the results. Industry should be encouraged to use materials flow and waste information to monitor resource productivity and to combine it with accounting data to implement materials flow cost accounts. This would be a powerful tool to analyse the environmental and financial consequences of materials and energy use and identify opportunities for efficiency gains. Industry should also be encouraged to integrate such information in corporate reporting, integrated performance assessments and financial statements.

Performance outlook

Korea's overall good performance in waste management means that "low-hanging fruit" has been harvested. In the years ahead, it will be important to focus efforts on the transition to a circular economy and on areas where efficiency gains can be obtained. This will require additional efforts to encourage the 3Rs (particularly as regards industrial and hazardous waste and selected consumer products), greater attention to waste prevention measures further upstream in the value chain, and the use of circular business models. More effective alignment of policy measures and objectives across policy domains and ministries can also improve both environmental effectiveness and economic efficiency.

Recommendations on waste, materials management and circular economy

- Further improve the efficiency of recycling and recycling systems:
  - Study the informal recycling sector and consider formalising it through the creation of recyclers' networks.
  - Conduct a competition assessment of the extended producer responsibility system to identify how market forces can be further strengthened in it without compromising environmental standards.
  - Improve separate collection rates for waste electrical and electronic equipment and industrial waste.
  - Facilitate the development of new and innovative recycling technology and introduce "end of waste" criteria for recyclable materials, taking into account their environmental impact.
- Consolidate and strengthen markets for secondary raw materials and recycled goods:
  - Provide economic incentives to properly value recycled products on the markets and stimulate upcycling of waste into high-value products. Further develop the online exchange market and link it to the Allbaro system.
  - Stimulate demand for recycled goods by informing users about their quality and their economic and environmental benefits, and by further strengthening bilateral and multilateral co-operation on resource circulation and the 3Rs.
- Further promote waste prevention, along with circular business models and resource productivity in industry, by considering the whole life cycle of materials and products and their value chains:
  - Foster awareness among businesses of the economic and environmental benefits of a circular economy, design for environment and resource-efficient production.

Recommendations on waste, materials management and circular economy *(cont.)*

- ❖ Encourage industry to use waste and materials flow information in combination with accounting data to establish materials flow cost accounts to better understand the environmental and financial consequences of materials and energy use practices, and to identifying opportunities for efficiency improvements.
- ❖ Continue to support SMEs and develop specific guidance for them on waste prevention.
- ❖ Exploit the synergies between policies and support measures on clean production, eco-innovation, eco-friendly businesses, recycling businesses and waste prevention and recycling in industry by establishing effective mechanisms for co-ordinating the actions of all ministries involved and preparing a consolidated review of the measures in place.

- Further increase the economic efficiency of sustainable materials management by reducing costs and better using economic instruments in line with the producer-pays principle:
  - ❖ Ensure greater cost recovery of municipal waste management by further reducing management costs, improving the collection rate for recyclable waste in less densely populated areas and progressively increasing the VBWF.
  - ❖ Introduce a tax on landfilling and incineration by local authorities and businesses to fill the cost gap between recycling and final disposal.
  - ❖ Progressively reduce government support to industry by introducing a performance management system and by using performance targets and indicators to determine the level of support.
- Continue to improve the environmental effectiveness of waste recovery and disposal:
  - ❖ Abandon landfilling of recyclable waste, along with incineration without energy recovery. Monitor very small incinerators and shut down those that underperform.
  - ❖ Expand efforts, especially early in the value chain, to ensure that recovered materials are as free as possible of hazardous substances. Provide improved guidance to businesses on design for environment.
- Better use existing data on waste and materials to support decision making, evaluate policy effectiveness and inform the public:
  - ❖ Integrate information from Allbaro with data from materials flow analysis to monitor the circulation of waste and materials in the economy and assess the performance of resource circulation policies. Regularly produce materials flow accounts and expand their scope to cover recyclable materials and raw materials embodied in trade. Use this information to set and monitor targets for materials productivity and resource circulation, and to inform stakeholders about the results obtained.
  - ❖ Continue to work with industry to integrate data on resource productivity, and on the environmental impact and cost of materials resource use, in corporate reporting, integrated performance assessments and financial statements.

5. Environmental justice

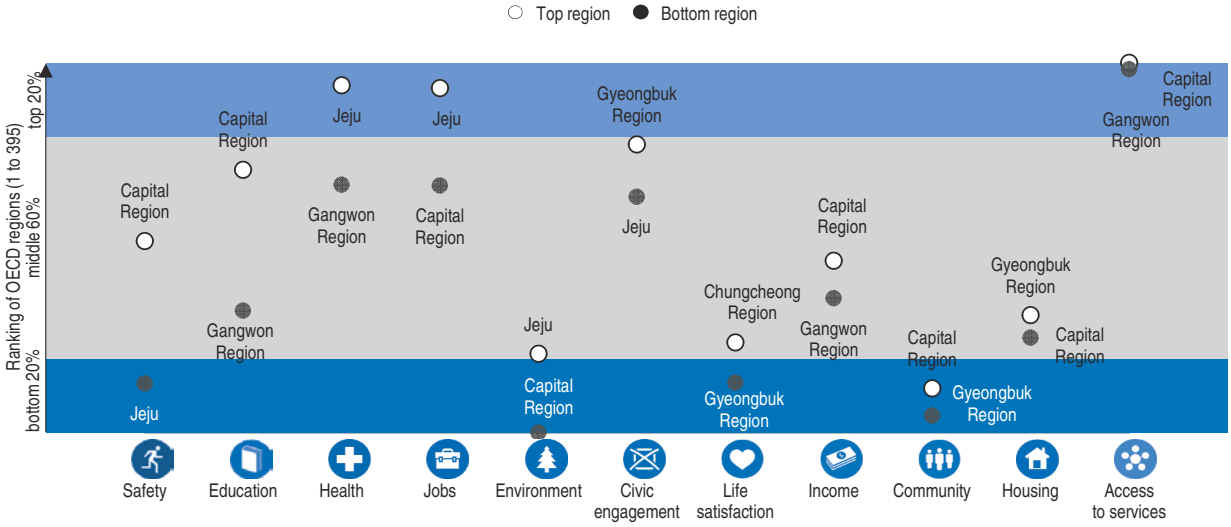
Environmental justice is a flexible concept: it can include fair treatment in terms of access to natural resources, environmental services and benefits, as well as environmental risk exposure (distributive justice); accountability and remediation for environmental harm (corrective justice); and access to environmental information, judicial and administrative proceedings and participation in environmental decision making (procedural justice).

Korea's framework environmental laws and policy documents demonstrate Korea's intent to promote environmental justice. They acknowledge distributive justice issues, and recent progress has been made in corrective justice in particular. However, as in most OECD countries, environmental justice policy remains piecemeal and at a relatively early stage. Korea does not yet have a clearly articulated definition or dedicated set of objectives for environmental justice in its laws or policies. Social aims, such as the right of all citizens – including future generations – to a healthy and pleasant environment, vary across instruments and are not underpinned by coherent or comprehensive implementing measures to achieve these objectives. The MOE intends to prioritise environmental justice matters in environmental and other relevant policies, including as part of efforts to better manage environmental health risks. This section aims to support further development and implementation of environmental justice policy in Korea.

Environmental justice and broader equity challenges

As social inequality and environmental challenges can be mutually reinforcing, broader social conditions merit consideration in environmental justice policy development and implementation (Crifo and Laurent, 2013). Korea's income inequality and relative poverty have declined in recent years, but remain high. Strong segmentation in the labour market between regular and non-regular workers is a major contributor on both fronts (OECD, 2016a). The rate of relative poverty among the elderly is the highest in the OECD. Public social spending is less than half the OECD average on a GDP basis and has a weak redistributive impact. Well-being varies widely between regions, particularly regarding safety, education and health status (Figure 4) (OECD, 2016h, 2016i).

Figure 4. **Regions vary widely on well-being indicators**



Note. Relative ranking of the regions with the best and worst outcomes in the nine well-being dimensions, with respect to all 362 OECD regions. The nine dimensions are ranked according to size of regional disparity in the country.
Source: OECD (2016), *OECD Regional Well-Being* (database).

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Fair treatment of current citizens

Access to, payment for and the quality of environmental goods and services vary significantly between regions, between cities, and between urban and rural areas in Korea.

Water supply and wastewater services are a prominent example. The 2006 EPR recommended strengthening policies for balanced regional development to address disparity in access to water-related services on the basis of equity, efficiency and financing criteria, and the government has taken a number of measures to do so. Access to green space, including for vulnerable groups, also remains an area for which policy information and solutions should continue to develop.

While significant government investment has led to an impressive increase in access to water supply and wastewater services (Section 3), in particular in rural areas, a rural-urban divide remains in terms of both access and quality. The average rural water leakage rate is around six times the urban rate, and a significant proportion of samples from wells in rural areas not served by the national public supply network fails to meet certain government water quality requirements. The government is committed to expanding the national water supply network and the wastewater and sewerage network to reach 80% of the rural population by 2017 and 2025, respectively. As the cost of building pipelines to remote rural areas is high, small-scale, independent facilities may be more cost-effective beyond a certain threshold. Such facilities currently bridge the service gap in areas the national networks have not yet reached. The government is attempting to address service quality issues through infrastructure upgrades, more stringent reporting requirements and other quality assurance measures.

Similarly, water supply and sewerage charges vary significantly between regions and between rural and urban areas. The divide reflects differences in production costs but also policy choices to subsidise investment in rural areas. Tariff variation is justified when reflecting local conditions and service provision costs. Lower cost recovery targets have been set for rural areas due to regional equity concerns, for instance. Nonetheless, tariffs should also reflect similar efforts to recover costs and to deliver services of similar quality and efficiency. Cost recovery rates have been generally low and declining, threatening the financial sustainability of the sector. This benefits users who could afford to spend more, and deprives water service operators of revenue to extend and improve services to poor and remote communities (OECD, 2012b). Raising water charges to reflect the costs of service provision, combined with targeted support for vulnerable households that is decoupled from water use, would be less regressive and would encourage rational water consumption. In a welcome step, the government plans to increase cost recovery for water supply to 95%, and for sewerage services to 80%, by 2025. This is all the more justified as water prices in Korea are significantly lower than in other OECD countries (OECD, 2010b).

Korea ranks below the OECD average on the well-being indicators of environmental quality and health status (OECD, 2016h), a fact linked to its rapid growth, large manufacturing and industrial sector and dependence on fossil fuels (Section 1). The 2006 EPR recommended expanding analysis of environmental health issues (e.g. monitoring, epidemiological studies, economic analysis), especially for large cities and industrial complexes and near contaminated sites; and strengthening management of indoor air quality and occupational health. The government has taken some measures to carry out these recommendations. The Korean National Environmental Health Survey, conducted in three-year stages since 2009, monitors levels of environmental chemicals in a representative sample of residents nationwide. Results from the first two surveys show high levels of exposure to metals and pesticides, among other substances. The government has also been conducting health impact surveys for "vulnerable areas", including industrial complexes and abandoned mines, since 2011. These have revealed some instances of elevated levels of

pollutants with environmental health implications. The government is planning a project to assess causation between exposure to environmental risks and incidence of disease in infants. It is pursuing environmental monitoring of schools, nursery facilities and playgrounds to improve the environmental safety of children, and since 2015 has implemented a product labelling system to reduce child exposure to hazardous materials.

While socio-economic criteria form part of the EIA process when selecting sites for polluting facilities, there is no government information on the incidence of polluting facilities in rural vs. urban areas beyond the siting of basic waste disposal facilities, nor on where polluting facilities are situated in relation to vulnerable households. However, Korea's first environmental justice forum in 1999 noted a tendency to situate polluting facilities in rural regions, and a UN special rapporteur on human rights and hazardous substances expressed concern that some industrial and power facilities were affecting elderly and socio-economically disadvantaged residents (Bell, 2014; UN OHCHR, 2015). Energy infrastructure such as coal and nuclear plants and high voltage transmission lines also tend to be situated in rural areas, but produces electricity that primarily serves urban areas, meaning that the economic, social and environmental costs and benefits of this infrastructure are unequally distributed (Lee, 2009; CMEJ, 2016). Further corrective measures are necessary to better protect vulnerable households from unintended negative impacts of these facilities.

The government has strengthened chemical safety in response to a steep increase in significant pollution incidents in the chemical sector over the past decade. The Act on the Registration and Evaluation of Chemicals (Korea REACH, in force since 2015) imposes reporting and registration requirements on chemical manufacturers, importers or sellers, to enable risk assessment, classification and in some instances prohibition by government. A 2015 amendment to the Chemicals Control Act, due to enter into force 2017, expands the number of workplaces required to report to government on types and quantities of chemicals treated, and reduces the reporting cycle from four to two years. Hazard management requirements are also imposed on operators of certain chemical facilities.

Like many OECD countries, Korea lacks processes to systematically assess and address the potential distributive impact of environmental policy reform and decision making on households. While the government has taken some measures to try to lessen the impact of environmental policies on vulnerable households, they could be better tailored to address distributional concerns. For example, it is unclear whether the government has assessed the economic, environmental and social impact of its water tariff policy. Under EIA guidelines, project operators must visit residents and note their views and concerns, but are not required to take active measures to assess and address any potential distributional impact on socially disadvantaged groups specifically (e.g. the elderly or single-parent households).

Fair treatment of future citizens

The Framework Act on Environmental Policy declares that the right of future generations to enjoy the same environmental benefits as the current population is a fundamental policy priority. It has proved challenging, however, to translate this commitment into policy that respects critical environmental thresholds and limits on the use of natural capital to ensure that future generations' needs and interests can continue to be met. The institutional framework created for green growth demonstrated intent to reduce pollution, GHG emissions, biodiversity loss and resource use intensity, with obvious

potential benefits for inter-generational justice. Implementation efforts need to be substantially accelerated, however (Section 3).

Beyond the basic building block of sound and ambitious environmental policy, more targeted measures can help attune government decision makers and broader economic actors to the interests of future generations. Examples include taking an anticipatory and adaptive approach to environmental management, implementing policies to encourage efficient resource use and preservation of the natural asset base, and advocating for future generations' environmental interests in relation to administrative and judicial decision making. Further policy development in this area is needed. The fourth Comprehensive National Environmental Plan (2016-35) flags the need to develop policies that ensure environmental rights, including across generations, as an unresolved area of the third plan, but does not include advancing environmental equality among its strategic objectives.

Environmental liability

Korea has made remarkable progress in strengthening its liability regime for compensating environmental damage to health, property and welfare, as the 2006 EPR recommended. This was spurred by a dramatic increase in the number of chemical accidents over 2004-13. In 2014, the government adopted a law establishing strict liability[8] for compensating victims of such damage and mandating insurance coverage for environmentally hazardous facilities, with a view to facilitating victims' claims. The Asbestos Injury Relief Act, which came into effect in 2011, aims to provide fair, prompt relief to victims and their families and represents a further step forward for the effective compensation of pollution victims. The liability regime for soil contamination is also robust and targeted at environmental remediation. However, there is no strict liability regime to assign responsibility for past damage to water bodies and ecosystems. While significant efforts have been undertaken to restore abandoned mines, Korea lacks a programme supported by adequate funding for remediation of old contaminated sites.

Environmental democracy

Korea recognised the procedural rights of access to information, public participation in decision making and access to justice in Principle 10 of the 1992 Rio Declaration on Environment and Development. The 2006 EPR recommended that the country further strengthen mechanisms for preventing and resolving environmental conflicts, and that it strengthen and broaden public participation, particularly in preparing development projects and assessing their environmental impact. This remains work in progress. While non-government organisations (NGOs) are involved in strategic policy planning, there is no public participation in environmental permitting, and public engagement in most EIA cases remains limited to local residents. Controversy over a number of high-profile development projects, including the Four Rivers Restoration Project and high voltage transmission lines in Milang, demonstrates there is significant potential to better engage the public in environmental decision making (Yun, 2014; CMEJ, 2016).

Access to information is enshrined in the Constitution, and further laws require public authorities to disclose information. Websites allow the public to obtain information on the general environment, environmental and industrial technology, GHG emissions, air quality, water quality and chemical safety management. The rate of disclosure of environmental information is growing, including under the 2015 acts on Chemicals Control and on Integrated Management of Environmentally Polluting Facilities. However, some

information remains classified to protect private economic interests, and civil society groups face challenges in obtaining information about government-sponsored projects.

Korea should take a broader approach to access to justice, and implementation would need to be strengthened. The long-standing alternative dispute resolution (ADR) system has been successful at addressing individual disputes but is not well designed to address major environmental conflicts. NGOs have no independent right of access to either the courts or ADR. Considerable progress has been made in promoting compensation and relief for damage to human life, health and property, but there has not been corresponding progress on complementary remedies. The judiciary appears to play a limited role in promoting environmental justice.

Frameworks and forums are available which could help provide Korea with a structure to strengthen its procedural environmental democracy. One is the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, which is the only legally binding international instrument to implement Principle 10 of the Rio Declaration. It applies to members of the Economic Commission for Europe, but other UN countries can accede. Another instrument is the Bali Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters. While not legally binding, they are internationally recognised good practice principles intended to help governments interpret and translate Principle 10 into national law.

Recommendations on environmental justice

Policy framework

- Clarify environmental justice objectives in relevant legal or policy texts, and ensure consistency across documents, to clarify policy priorities, responsibilities across ministries and environmental justice rights of the public. Implement environmental justice objectives through appropriate laws and policies.

Environmental justice and broader equity challenges

- Reduce social inequality to improve the effectiveness of environmental policy and reduce environmental inequalities; strengthen the social safety net through increased public social spending.

Fair treatment of current citizens

- Assess the economic efficiency of further expanding wide area/municipal waterworks beyond certain threshold levels compared with measures to improve the quality of small-scale and village waterworks (e.g. supply of drinking wells, improved reporting requirements). Ensure effective measures to encourage independent water service providers to secure continued improvements in efficiency, cost reduction, cost recovery and environmental performance.
- Evaluate the economic, environmental and distributional impact of water supply and sanitation service pricing policies with a view to ensuring the financial sustainability of the sector and equitable access to these services.
- Prioritise information gathering on access of vulnerable populations to green space in metropolitan areas to promote more green space in areas identified as priorities. Encourage full consideration of green space issues in urban planning.

Recommendations on environmental justice *(cont.)*

- Continue to expand analysis of environmental health issues associated with large cities, industrial complexes and contaminated sites, including through economic analysis, and ensure effective follow-up to manage identified risk.
- Improve data collection on exposure to environmental risk in rural vs. urban areas and with respect to vulnerable households.
- Take distributive impact into account as part of site selection and policy formulation to help promote distributive justice in the face of ongoing development pressures.

Fair treatment of future citizens

- Make sure the environmental interests of future generations are considered in policy and decision making, for example by reinvigorating green growth and sustainable development policies.

Environmental liability

- Introduce a strict liability regime to assign responsibility for past damage to water bodies and ecosystems, following the example of the liability system for soil contamination. Continue to update a register of all abandoned contaminated industrial sites and develop a financing mechanism for their gradual decontamination.

Environmental democracy

- Strengthen expression of the core procedural rights of access to information, public participation in environmental decision making and access to justice in law and policy to better marshal public support in effective environmental stewardship, including of development projects, and to constructively address and resolve environmental conflicts.
- Improve public participation in environmental decision making by introducing mechanisms for public involvement in the development of environmental permitting decisions, and by opening the EIA process to input from the general public (beyond local residents) and NGOs.
- Enhance access to environmental information by broadening disclosure of records on environmental behaviour of economic entities, including permit applications, regular self-monitoring reports and inspection reports, and data on air pollutants.
- Strengthen access to justice on environmental matters:
  - Facilitate access to review procedures for information requests and decisions relating to public participation, and broadening legal standing rights in environmental proceedings, including for environmental NGOs.
  - Ensure effective access to remedies beyond compensation (e.g. those geared to prevention or remediation), including as part of the ADR system. Consider capacity-building programmes for judicial officers and other legal professionals to promote their role in facilitating access to justice.
  - Make systematic efforts to ensure that Rio Principle 10 is codified in Korean law, using the internationally agreed 2010 Bali Guidelines as a benchmark. Consider acceding to the Aarhus Convention to signal commitment to facilitating public participation in environmental decision making and provide impetus to strengthen implementation of these rights in law.

Notes

1. Of this target, 11.3% of the reductions would be met through international markets.
2. Biochemical oxygen demand and total phosphorus levels improved.
3. Investments and internal current expenditure (excluding payments for environmental protection services) less receipts from by-products (e.g. materials recovered as a result of waste treatment) by public and business sectors, including specialised producers of environmental protection services. Includes expenditure for i) pollution abatement and control covering air protection, waste and wastewater management, protection and remediation of soil and groundwater, and other activities (R&D, administration, education); and ii) biodiversity and landscape protection. Excludes expenditure on water supply.
4. For R&D and demonstration and subsidies for deployment.
5. Congestion costs have been estimated by the Korea Transport Institute (KOTI) since 1993. While the institute recognises that the traffic congestion cost should reflect environmental and social costs, the method used only reflects economic costs of congestion. KOTI estimates traffic congestion costs by taking the sum of fixed and variable vehicle operating costs and the time value of money.
6. Inventions of high potential commercial value for which protection has been sought in at least two jurisdictions.
7. As measured by the revealed technology advantage, i.e. Korea's share of world patents in such technology is higher than its share in all fields.
8. Strict liability means liability without the need for the victim to demonstrate unlawful intent or negligence on the part of the polluter, if the evidence suggests it is highly probable that the polluter's activities caused the damage.

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ANNEX

Actions taken to implement the recommendations of the 2006 Environmental Performance Review of Korea

Recommendations	Measures taken
Chapter 1. Environmental performance: Trends and recent developments	
Further reduce energy, material and pollution intensities performance indicators. Further improve energy efficiency so as to reduce energy dependency, air pollution and greenhouse gas emissions; bolster current efforts to expand the use of renewable energy sources; continue efforts to ensure that energy prices reflect environmental costs.	Energy and material intensities further declined. Emissions of all major air pollutants but PM_{10} have been decoupled from economic growth. The second Energy Master Plan (2014-35) outlines the transition to demand management and more sustainable energy policy, including the response to climate change, as two of its six major tasks. Measures taken to improve energy efficiency include compulsory energy audits for energy-intensive companies; developing energy management systems in buildings and industry; public R&D investment in energy storage systems; tightening fuel efficiency standards for vehicles; promoting energy efficient smart appliances through standards, labelling, certification and standby requirements and public procurement policies (e.g. on LED lights); and introducing energy efficiency building codes (Chapter 3). The fourth National Basic Plan for New and Renewable Energy (2014-35) aims to increase the share of new and renewable sources in TPES to 11% by 2035. Investment in renewable energy increased steadily over 2007-11, spurred by higher oil prices, a feed-in tariff (FIT) scheme, R&D support, preferential loans and tax incentives for producers and installers, and subsidies for households. In 2012 the FIT was replaced with a Renewable Portfolio Standard. Korea's share of renewables in the energy mix remains the lowest in the OECD. Energy prices do not sufficiently reflect environmental costs (Chapter 3).
Set out in the next national plan on climate change specific objectives and precise measures to be taken over the next few years to reduce the rate of growth of greenhouse gas emissions in order to participate actively in the UNFCCC process.	In 2009, Korea set itself the mid-term goal of reducing GHG emissions to 30% below business as usual (BAU) levels by 2020. The government established emission reduction targets by sector in 2011, and detailed how sector-based reductions would be achieved with the Roadmap to Achieve Greenhouse Gas Reduction Goals in 2014. In 2015, the government committed to reduce GHG emissions by 37% below BAU by 2030 which represents a postponement of the 2020 target.

Recommendations	Measures taken
Complete and firmly implement the comprehensive air management plan for the Seoul Metropolitan Area. Formulate and implement comprehensive air quality plans (including cost-benefit analyses) for the major cities and industrial complexes outside the Seoul metropolitan area. Strengthen the management of hazardous air pollutants: monitor their concentration, analyse their health effects and reduce their emissions (e.g. from existing coal-fired power plants); take further measures to reduce emissions of VOCs. Ensure that efforts to manage air quality are commensurate with the magnitude of the problem, including the damage to public health, by: further integrating air pollution and sectoral policies (e.g. energy, industry, transport and urban planning); building capacity in local government; and expanding awareness of the health effects of air pollution and their economic burden.	The first and second Comprehensive Plans for Air Quality Improvement (2006-15 and 2016-24) were adopted at national level. The second Seoul Metropolitan Air Quality Improvement Plan (2015-24), covering Seoul, Incheon and Gyeonggi province, was adopted in 2013. Measures implemented include strengthening vehicle emission and fuel efficiency standards, establishing an air pollutant cap management system in the Seoul Metropolitan Area, strengthening air quality standards and introducing standards for benzene (2010) and $PM_{2.5}$ (2015). In 2016, the government made fine particulate matter pollution a national priority and announced a KRW 5 trillion (USD 4.4 billion) dedicated budget. In 2014, the CleanSYS smokestack tele-monitoring system monitored seven air pollutants (dust, SO_2, NO_x, NH_3, HCl, HF, CO) emitted by 577 major facilities. Regulations on VOCs in paints were tightened and limits applied nationwide. Installation of petrol vapour recovery systems at petrol stations was made mandatory in air quality regulated areas and special countermeasure areas. From 2017, the obligation will be extended to cities of more than 500 000 inhabitants. The share of rail in total public investment in transport infrastructure increased from 16% in 2006 to 33% in 2015. Cycling infrastructure has been improved and extended. However, road transport remains the dominant transport mode, mainly due to inaccessibility of stations and lack of integration with other transport modes (Chapter 3). Direct and indirect subsidies are provided for buses and garbage trucks to switch from diesel to natural gas, and for individuals to purchase hybrid and electric vehicles. Some metropolitan governments (e.g. Daegu, Busan, Seoul) have introduced "transit mall districts", which are only accessible to public transport, bicycles and pedestrians.
Enable ongoing multi-national planning, modelling and monitoring programmes on critical regional problems of acid rain, dust and sandstorm pollution, and fisheries management to move into the operational problem-solving phase at an early date.	Korea contributes financially to the Acid Deposition Monitoring Network in East Asia, which examines long-range transboundary air pollution. Korea, China and Japan formed a joint response system to dust- and sandstorms (DSS) in 2007 and a yellow dust joint research team in 2008. Korea and China signed a memorandum of understanding (MOU) in 2014 to strengthen co-operation on air pollution, DSS and environmental industry and technology. The MOU established a joint research group to develop forecasting models and share air quality monitoring data. Korea and Mongolia signed an MOU in 2009 to co-operate on DSS through, for example, ecological surveys and vegetation projects.
Speed up measures to control non-point sources of water pollution, notably from agriculture, and further reduce point discharges from livestock enterprises, including through greater utilisation of manure.	The second Four Rivers Non-point Pollution Source Management Comprehensive Measure Plan (2012-20) designates and manages regions at risk of or suffering from such pollution. Manure is managed according to the 2006 Livestock Excretion Management and Use Act and public treatment facilities have been built. Dumping into the sea was banned in 2012. Diffuse pollution from livestock production continues to increase.
Increase the actual protection of designated protected areas; streamline the management of these areas by the relevant authorities; minimise the impact of recreational and tourist facilities.	Korea has increased the number of protected areas, which by national definition covered 15.5% of land and inland waters and 2.0% of the Exclusive Economic Zone in 2016. Korea introduced a management effectiveness evaluation in 60% of protected areas, and established an Ecotourism Vitalisation Promotion Plan. Damaged areas are designated as special protection zones and access is restricted to facilitate environmental recovery. A pending bill aims at allowing greater tourism infrastructure development in mountain conservation areas.
Strengthen species protection, including through habitat protection, sanctions for illegal hunting and trading, recovery programmes and measures against invasive species; ensure consistency in the actions taken by different authorities.	Korea has developed a Red List of endangered species, and promulgated the Act of Wildlife Protection and Management in 2005 and the Act on Marine Ecosystem Conservation and Management in 2007. Conservation measures include a ban on the consumption and hunting of certain wild animals; the control of overpopulated and invasive species; restrictions on trade and exploitation of wild fauna and flora; and the establishment of wildlife rescue and management centres. The 2012 Act on the Conservation and Use of Biodiversity was established to streamline and better organise biodiversity management and promote international instruments such as the Convention on Biological Diversity and Nagoya Protocol.
Further strengthen scientific knowledge of Korea's natural resources and biodiversity (e.g. through surveys in the Demilitarised Zone and other valuable areas) to support policy decisions; prepare biotope maps at the local level to support the protection of valuable areas; raise awareness of the ecological and economic value of nature, landscape and biodiversity.	The National Institute of Biological Resources was created in 2007. The National Biological Resources Integrated Management System database was launched in 2012. The National Institute of Ecology and the Marine Biology Institute (established in 2013 and 2014, respectively) as well as other regional institutions conduct research and education programmes. Studies have been conducted on the DMZ ecosystem. In 2015, 101 municipalities had completed biotope maps to be used in urban planning.
Develop and use environmental indicators to support environmental management at strategic, planning and programming levels; continue to expand the scope of and access to the pollutant release and transfer register.	30 green growth indicators were developed to monitor implementation of the first five-year green growth plan and are updated every two years. The water information system, fragmented between several ministries, is not comprehensive and coherent enough to inform policy development and evaluation. The key indicator on the intensity of use of freshwater resources dates back to 2007. National environmental master plans and basic plans for sustainable development include indicators to track progress.

Recommendations	Measures taken
Chapter 2. Environmental governance and management	
Review and revise, as needed, national, regional and local inspection and enforcement regimes. Increase inspection and enforcement capacity at the local level and strengthen the mechanisms of supervision and evaluation at the national level to ensure effective and efficient implementation.	Despite the falling frequency of site visits, the detection rate of local authorities has been increasing. The MOE encourages local authorities to conduct more frequent random inspections, but many do not have sufficient resources to do so. The MOE's regional and river basin environmental offices are staffed with special environmental police who supervise and complement local authorities' compliance monitoring activities. In 2013, the Central Environmental Controls Task Force, dedicated to compliance monitoring of the largest polluters or those provoking frequent citizen complaints, was established under the MOE.
Introduce a periodic permit renewal system, and consider introducing integrated pollution prevention and control permits for large stationary sources at the national and regional levels.	Korea is in the process of a major environmental permitting reform, moving from issue-specific to integrated permitting for large industrial installations. The Act on Integrated Management of Environmentally Polluting Facilities was adopted in November 2015 and will go into force in 2017. The new system will be applied to 19 industry sectors once the regulatory framework is complete.
Further integrate environmental concerns (i.e. pollution, natural resources, nature concerns) at all levels of land-use planning, and implement such land-use plans. Further use environmental impact assessment (EIA) for projects and expand the range of administrative plans subject to prior environmental review. Strengthen institutional mechanisms to foster integration of environmental concerns in sectoral policy planning (strategic environmental assessment) and in large projects, under the guidance of the Presidential Commission on Sustainable Development.	Korea introduced strategic environmental assessment (SEA) in 2006 and has improved its systems of EIA and SEA, which now cover a more extensive range of projects and plans. SEA targets 17 types of policy plans in 8 policy areas, but not sector development policies, and 95 types of development master plans in 17 areas, but not covering all 250 county and city spatial management plans. Korea is pursuing "national land-environment plan concurrency" which envisages closer co-operation between the two types of plans in their early stages of development.
Give higher priority to nature conservation and biodiversity protection; protect ecologically valuable areas in urban, peri-urban and coastal areas, e.g. by use of land-use planning, prior environmental review and environmental impact assessment; increase attention to landscape values.	The National Land Plan (2006-20), modified in 2011, lays out a vision of "global green national land". The Forest Master Plan (2008-17) calls for the "establishment of a balanced mountainous district management system" and the expansion of green urban spaces. SEA of a development master plan takes into account the impact on natural landscape and biodiversity. A natural landscape deliberation system was introduced in 2006, with the adoption of guidelines on evaluating landscape impact of development projects as part of SEA.
Pursue integration of transport, housing and land-use policies in the context of sustainable development.	The third Seoul Metropolitan Area Readjustment Plan (2006-20) and the Sejong Urban Master Plan (2015-30) integrate sustainable mobility considerations.
Strengthen public-private partnerships and industry-driven environmental progress, including for small and medium-sized subcontractors of large firms.	The MOE has established a number of national and regional voluntary agreements with companies to improve their environmental performance (reduce emissions of carcinogens and other air pollutants from stationary and mobile sources), and encourages good performance through environment-related business certification programmes (e.g. Green Enterprise) and awards.
Strengthen limits on industrial effluent discharges and increase rates of pollution charges.	The number of industrial effluent standards has increased significantly since 2006, and many standards have been made more stringent (e.g. for total nitrogen and total phosphorus discharges from public wastewater treatment plants). However, water effluent tax rates are too low to incentivise pollution reduction and the rate of the "excess" part of the tax has not been increased since its inception. The collection rate of the water effluent tax is extremely low (11% in 2015) (Chapter 3).
Adopt and implement biological water quality standards for surface waters.	Water quality targets are set for major rivers and lakes throughout the country. Criteria for these targets include biological water quality standards.
Consider combining the policy functions for water quantity and quality. Consider how current water supply, sewerage, stormwater and waste water treatment policies can be harmonised in urban areas to achieve an integrated urban water management.	Water quantity and quality continue to be managed separately by several ministries. In 2015, a Water Management Consultative Committee was created that brings together representatives of the Environment, the Agriculture, and the Land, Infrastructure and Transport ministries and other stakeholders to establish interagency collaboration. The fragmentation of responsibilities and lack of co-ordination and collaboration still results in a multitude of management plans whose interconnections are difficult to understand.
Further raise public awareness of environmental issues and promote sustainable consumption patterns and land use.	The Environmental Education Promotion Act (2008) laid the basis for measures to promote environmental education, many of which were envisaged in the Environmental Education Master Plan (2011-15). The Environmental Education Promotion Committee was created in 2010, and the Environmental Education Development Council in 2013. A network of national environmental education centres has been functioning since 2012. An environmental education internet portal has been operating since 2008 to share education materials and other information. The Green Credit Card system was introduced in 2011 to reward eco-friendly consumption (Chapter 3).

Recommendations	Measures taken
Chapter 3. Towards green growth	
Continue to increase the use of economic instruments (e.g. environmental charges, trading mechanisms) to further internalise environmental externalities.	Korea introduced a tax on bituminous coal used for power generation in 2014, and emission trading in 2015. The water use charge has been gradually increased, and there are plans to gradually raise the traffic congestion charge. However, the energy and transport taxes and environmental tax and charge rates on air pollution, water pollution and use, and land development are generally too low to cover environmental and social externalities or encourage behavioural change.
Develop economic analysis capacity within the Ministry of Environment.	The MOE updates Environmental Protection Expenditure Accounts annually. Statistics Korea updates National Accounting Matrices, including Environmental Accounts for air emissions, annually.
Establish an institutional mechanism, such as a green tax commission, to review the environmental effects of fiscal instruments, identify environmentally harmful subsidies, and improve the use of economic instruments.	There is no such mechanism in place.
Reduce the differential in energy prices (electricity, natural gas) between households and industry, with a view to fostering demand-driven energy planning policy.	Since 2000, electricity demand has risen rapidly, spurred by low prices. Electricity prices have been progressively raised and the price differential between households and industry has been reduced (although households still pay more). Further reforms are needed for prices to reflect system costs.
Continue efforts to strengthen emission and fuel efficiency standards for vehicles, as well as to improve fuel quality; continue efforts to review various policies to internalise externalities related to transport and the environment. Give higher priority to transport demand management, e.g. through road and road fuel pricing; streamline the current economic and fiscal incentives to enhance environmentally sustainable transport. Move towards a more environmentally sustainable modal share of freight traffic. Pursue efforts to facilitate public transportation in urban areas, e.g. through further expansion of bus-only lanes and integrated fare systems.	In 2009, Korea adopted California's Non-Methane Organic Gases Fleet Average System for petrol-fuelled vehicles. Since 2014, diesel vehicle emissions have been regulated under Euro 6 limit values. Korea introduced real-driving emission standards, on top of existing in-laboratory standards, in 2016. Since 2012, diesel fuel supplied throughout the country must have a sulphur content at or below 0.1% (Chapter 2). Fuel tax rates (the Transportation-Energy-Environment Tax) have not been adjusted for inflation, and diesel is taxed more lightly than petrol despite its heavier environmental impact. The rate of the congestion charge in the Namsan tunnels has not been raised in several years. In 2014, the traffic generation charge, which had remained unchanged for over 20 years, was raised. Korea adopted a law on sustainable development of transport logistics and a plan to ensure that transport policy considers climate change, energy and environmental protection. The government provides subsidies and tax incentives to encourage the purchase of clean vehicles. Despite increased investment in rail infrastructure, the share of total inland freight transported by rail fell from 28% in 2006 to 7% in 2013. The bus rapid transit system of the Seoul Metropolitan Area has been extended. It includes rapid transit lanes and a public transport card that can be used on all forms of public transport nationwide. Transit "malls" that only public transport, bicycles and pedestrians can use have been introduced in Daegu, Busan and Seoul.
Further strengthen water demand management policies and consistently apply the user pays principle to all categories of users. Review and improve water supply management on the basis of equity, efficiency and financing criteria.	The Comprehensive Plan on National Water Demand Management (2007-16) has led to the implementation of local plans and investment in water saving infrastructure (e.g. replacing old pipes and reusing treated wastewater). Water supply and sewerage charges do not allow full cost recovery and are low by OECD standards. Agriculture only partially pays water charges. No assessment has been reported. Investment in water supply facilities in agricultural and fishing villages and on islands totalled KRW 4.4 trillion over 1994-2014. Investment of KRW 2.2 trillion to expand the national water supply network to reach 80% of the rural population by 2017 is planned.
Strengthen funding and human resources for nature protection; increase the purchase of land by central and local government for nature protection; develop the use of economic instruments (e.g. ecosystem conservation charge); encourage stakeholder participation in policy planning. Further integrate nature and biodiversity considerations into sectoral policies and practices (e.g. agriculture, forestry and fisheries).	Public expenditure on biodiversity more than tripled over 2001-13. Several institutes were created to increase knowledge, understanding and human capacity in the field (Chapter 1). Central and local governments purchased 10.3 km^2 of private land with high protection value within national parks over 2006-14. While non-government organisations are involved in strategic policy planning, there is no public participation in environmental permitting, and public engagement in most EIA cases remains limited to local residents (Chapter 2). The introduction of Strategic Environmental Assessment helps biodiversity to be better taken into account in land use planning. Korea has introduced plans for managing and preserving marine biodiversity, forest biodiversity and agricultural biological resources (Chapter 2). However, environmentally harmful subsidies exist in the agriculture and fishing sectors: fossil fuel tax exemptions, low electricity prices, exemptions from water charges and high producer support encouraging increased natural resource and input use.
Continue to strengthen and build on Korea's recent expansion of international engagement, co-operation and leadership in regional and global environmental problems.	Korea established the Global Green Growth Institute, championed green growth at the OECD, hosts the Green Climate Fund, championed the principle of Nationally Appropriate Mitigation Actions in the context of the United Nations Framework Convention for Climate Change, and has hosted many major environment-related international events, such as the 12th conference of the parties to the Convention on Biological Diversity.

Recommendations	Measures taken
Continue to expand support to developing countries through public and private bilateral institutions and programmes as well as through financial and in-kind support for regional and multilateral banks and programmes, while seeking to increase the environmental dimension of Korea's official development assistance.	Net official development assistance (ODA) disbursements have almost quadrupled since 2006, with multilateral disbursements increasing almost twice as fast as bilateral ones. However, Korea did not meet its target of giving 0.25% of its gross national income as ODA by 2015. Green ODA as a share of total ODA declined from 18% on average in 2007-08 to 14% in 2013-14. Korea ran and funded the East Asia Climate Partnership from 2008 to 2012, investing USD 200 million in 20 bilateral and nine multilateral projects. It collaborates with the UN Economic and Social Commission for Asia and the Pacific to run the Seoul Initiative on Green Growth, which assists countries to transition to a green economy through green technology transfer and environmental co-operation projects.
Chapter 4. Waste, materials management and circular economy	
Further reduce the material intensities of the Korean economy through efficient waste reduction, reuse and recycling.	Material intensity further declined but total waste generation remained closely linked to economic growth. The volume-based waste fee system and free collection of recyclable waste have helped reduce mixed residual household waste and increase recycling and reuse of municipal waste.
Strengthen measures to reduce industrial waste generation (e.g. promoting cleaner production, broadening the scope of the extended producer responsibility system, increasing the rate of the waste treatment fee).	Financial incentives are provided to companies with good waste reduction performance, and poor performers are supported with technical assessment, guidance and information measures. The MOE supports R&D investment in waste reduction and reuse technology, and MOTIE supports environmental small and medium enterprises in developing and commercialising cleaner production technology. The scope of the extended producer responsibility system has been broadened. Since 2014, it has covered a wider range of electrical and electronic products associated with special target management systems, as well as fluorescent lamps and styrofoam float and packaging materials. Product waste charges imposed on products that are difficult to recycle or manage have increased. Waste treatment fees have slightly increased. For large businesses covered by the long-running Business Waste Reduction Program, more than 90% of waste generated is recovered for reuse and recycling.
Further reduce municipal waste generation (e.g. increased cost recovery from the volume-based waste fee).	Municipal waste generation has been decoupled from private final consumption. The volume-based waste fee system for collection of mixed household waste has been extended to the whole country, except small settlements and remote areas; since 2010 it has also applied to food waste.
Encourage the development of markets for recycled products, including by further extending green government procurement.	The recyclable resources market (web-based stock exchange and second-hand shop), introduced in 2013, has been fully operational since 2015. Mandatory green procurement has been extended to all public institutions. Eco-label certification for recycled products has been expanded.
Promote more efficient waste disposal by municipalities and industry (e.g. improved management or closure of substandard landfills and incinerators; prevention of illegal dumping of industrial waste through the waste manifest system; reducing dumping at sea of wastes such as sewage sludge and dredged spoils; close monitoring of hazardous waste management).	All landfills are controlled; substandard landfills have been upgraded or closed. Incinerators are regularly monitored and substandard installations have been closed. The Allbaro online system for waste management has been expanded. Dumping at sea of livestock manure and sewage sludge was banned in 2012; the ban was extended in 2013 to all excreta and sludge, and in 2014 to industrial wastewater and sludge. Monitoring and safety requirements for hazardous waste have been improved, in particular for medical waste. Illegal dumping has been reduced.
Foster public awareness of waste issues (e.g. reducing waste generation, preventing illegal dumping, acceptance of waste infrastructure.	There are regular awareness-raising campaigns to reduce food waste and promote recycling, including in schools. MOUs have been signed with business to reduce excessive packaging and disposable items. Training has been introduced for workers in industry.
Chapter 5. Environmental justice	
Further strengthen mechanisms for preventing and resolving environmental conflicts; strengthen and broaden public participation, especially in preparing and implementing development projects and assessing their environmental impact; strengthen the liability legislation in order to better compensate for damage to the environment in line with the polluter pays principle.	Korea has a long-standing alternative dispute resolution system, overseen by the National Environment Dispute Resolution Commission. Since 2007, a broader range of experts has been allowed to participate. The number of environmental dispute resolution fields has been expanded. The system focuses on compensation rather than damage avoidance. In 2015, Korea introduced an arbitration system based on mutual consent between the parties concerned. It is expected to swiftly resolve disputed and reduce costs of lawsuits. While non-government organisations are involved in strategic policy planning, there is no public participation in environmental permitting, and public engagement in most EIA cases remains limited to local residents. In 2014 the government adopted a law establishing strict liability for compensating victims of environmental damage and mandating insurance coverage for environmentally hazardous facilities, with a view to facilitating victims' claims. The Asbestos Injury Relief Act came into effect in 2011 and aims to provide fair, prompt relief to victims and their families. Korea has a robust liability regime for soil contamination, targeted at environmental remediation, but lacks a strict liability regime to assign responsibility for past damage to water bodies and ecosystems. Significant efforts have been undertaken to restore abandoned mines, yet Korea lacks a programme for remediation of old contaminated sites supported by adequate funding.

Recommendations	Measures taken
Expand analysis of environmental health issues (including monitoring, epidemiological studies, economic analyses), especially for large cities and industrial complexes near contaminated soils; ensure implementation of the ten-year National Environmental Health Action Plan; monitor its implementation with appropriate indicators; strengthen management of indoor air quality and occupational health.	The government conducts community health impact surveys for vulnerable areas, including industrial complexes and abandoned metal mines. It has identified 56 industrial complexes for priority assessment based on pollution emission levels and the populations affected. It has assessed three to four small and medium-sized complexes per year since 2011 (16 in total by 2015), and 108 abandoned metal mines since 2013. The National Environmental Health Survey monitors exposure levels to 21 pollutants in a representative sample of residents nationwide. The first two surveys (2009-11 and 2012-14) were limited to people over 19 while the third (2015-17) is also assessing children aged 3 and up. According to the Indoor Air Quality Control in Public-use Facilities Act, indoor air quality limits (maintenance limits for PM_{10}, CO_2, formaldehyde, total airborne bacteria, CO; recommended limits for NO_2, radon, total volatile organic compounds, asbestos, and O_3) are set in 21 groups of public facilities (e.g. subway stations, underground road shopping districts, medical institutions, steam rooms, large shops, theatres).

Source: Country submission.

PART I

Progress towards sustainable development

PART I

Chapter 1

Environmental performance: Trends and recent developments

Korea's strong economic growth has been driven by manufactured exports produced by large firms. High population density has exacerbated environmental challenges. This chapter provides a snapshot of key environmental trends in Korea since 2000. It highlights the progress made in decoupling economic activity from environmental pressures. The chapter presents the main economic and social developments, then examines Korea's progress in reducing the energy and carbon intensity of its economy, in making the transition to a resource-efficient economy and in managing the natural asset base. The chapter also summarises key policy developments in specific areas, including energy, climate change, air, water and biodiversity.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

1. Introduction

Korea has a relatively large export-oriented economy, poorly endowed with natural resources. Over the past decade it has been one of the fastest growing OECD economies, but at the expense of environmental quality.

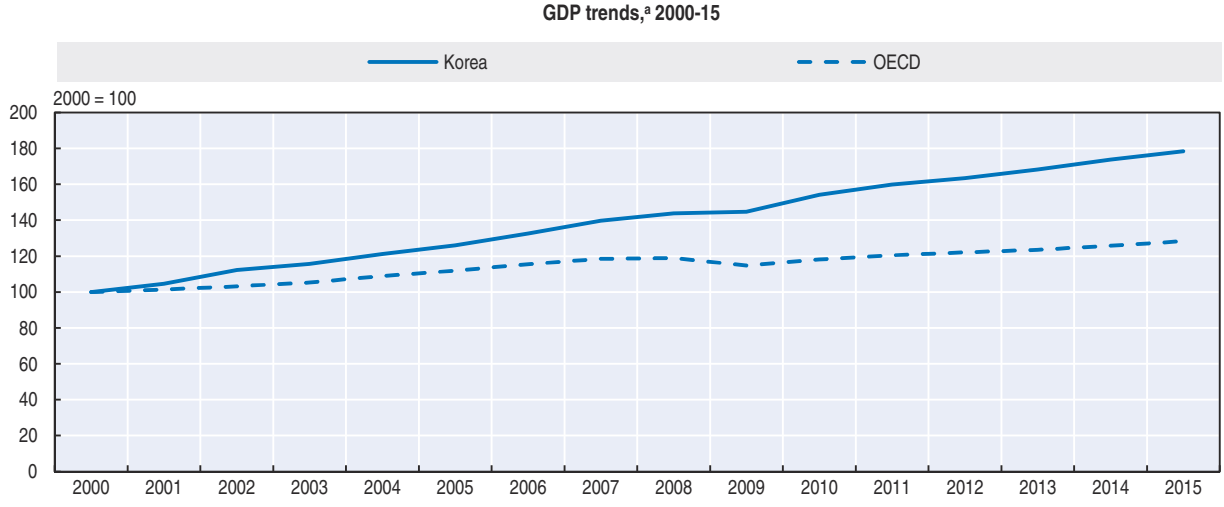
This chapter provides an overview of Korea's main environmental achievements, and its remaining challenges on the path towards green growth. Drawing on indicators from national and international sources, it reviews progress on national policy goals, and on international commitments and targets, focusing on the period since 2000. To the extent possible, it compares the state of the environment and key environmental trends with those of other OECD member countries. The chapter sketches out major policy developments in environmental sectors including air, climate, waste, water and biodiversity.

2. Key economic and social developments

2.1. Economic performance

Korea is the eighth largest OECD economy, and among the fastest growing. Real GDP increased by about 78% over 2000-15, compared with the OECD average of 28% (Figure 1.1). The GDP per capita gap narrowed from 65% of the OECD average in 2000 to 93% in 2015. Economic growth averaged 4.4% annually over 2000-11 but has since slowed to 2.8%, mainly due to weak global trade growth and sluggish domestic demand, constrained by high household debt. Projections for 2017 are for a gradual resurgence of economic growth to 3.0%, boosted by faster wage gains and stronger world trade (OECD, 2016a, 2016b).

Figure 1.1. **Korea has been one of the fastest growing OECD economies**



a) GDP expressed at 2010 prices and purchasing power parities.
Source: OECD (2016), "Aggregate National Accounts: Gross Domestic Product", *OECD National Accounts statistics* (database).

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Economic growth has increasingly relied on exports, which accounted for 56% of GDP in 2012, compared with 35% in 2000, though the share fell to 46% in 2015 due to the marked slowdown in demand from China and other Asian countries (OECD, 2016a, 2016b). A number of Korean companies are world leaders in key industries, but the country faces strong competition from emerging economies, in particular China, and advanced economies in high-end markets (OECD, 2016a). In 2015, Korea was the sixth largest world exporter, with electrical machinery and equipment the most exported products, followed by motor vehicles and nuclear reactors (Basic Statistics). The country is also dependant on imports, particularly for its energy supply which represented 24% of total imports in 2015 (OECD, 2016b; Basic Statistics).

Subdued growth since 2011 has revealed structural problems, such as high household debt (which stood at 163% of household net disposable income in 2014, well above the OECD average of 137%), a lagging service sector and weak small and medium-sized enterprises (SMEs) (OECD, 2016a, 2014a). Residential investment is robust due to low interest rates, and investment in research and development (R&D) is remarkably high: Korea is the world's most R&D-intensive country, with gross domestic expenditure on R&D at 4.3% of GDP in 2014 (OECD, 2014b; Basic Statistics).

The government has a strong fiscal position, with a budget surplus of 1.3% of GDP in 2014, against a deficit of 2.0% on average in OECD countries (OECD, 2016c; Basic Statistics). Korea is also among the least indebted OECD countries. However, the growing old age dependency ratio is expected to put pressure on public finances. While public spending was low in 2014, amounting to 32% of GDP (compared to the OECD average of 44%), it has been increasing rapidly, driven by rising expenditure on social protection, health and long-term care (Basic Statistics).

The tax-to-GDP ratio was the third lowest in the OECD in 2014 (25%, compared to the OECD average of 34%) (OECD, 2016d). The shares of revenue from taxes on income and profits and on goods and services are below the OECD averages, while the shares represented by social security and property taxes are higher. Environmentally related tax revenue slightly decreased from 2.65% of GDP in 2000 to 2.54% in 2014, but nevertheless remains above the OECD average (Basic Statistics; Chapter 3).

2.2. Structure of the economy and employment

Korea's economic structure differs from those of many OECD member countries. It has a strong industrial sector, dominated by conglomerates, accounting for 35% of value added in 2015, and the service sector represented 63%, well below the OECD average of 75% (Basic Statistics). Manufacturing and energy-intensive industries, such as electronics, transport equipment (automotive, shipbuilding), chemicals, iron and steel, are predominant: in 2012, Korea was the world's sixth largest producer of crude steel, with 4.5% of global production. In 2013, information and communication technology companies[1] accounted for about 10% of GDP and 33.5% of exports (KOSTAT, 2014).

The country is characterised by a particularly high number of hours worked per person: 2 163 in 2013, the second highest level in the OECD. Yet, labour productivity (GDP per hour worked), at USD 31 in 2014, is well below the OECD average of USD 46 (OECD, 2015a). The level of labour productivity in the service sector is about half that in manufacturing. In SMEs, which are concentrated in services, it is less than a third of that in large firms. A decline in entry and exit rates of firms has held back productivity. SME policy promotes small firm survival rather than higher productivity, and very few grow into

medium-sized firms. Product market regulation is among the most stringent in the OECD. Structural weakness in the innovation system limits gains from the high levels of R&D investment (OECD, 2016a).

The labour market is strongly segmented into regular and non-regular workers, with the latter (fixed-term, part-time and dispatched workers) accounting for about a third of employment. Women make up a disproportionate share of non-regular workers, who earn 62% as much per hour as regular workers. Consequently, wage inequality is among the highest in the OECD, particularly between men and women and between part-time and full-time jobs. The youth employment rate is among the lowest in the OECD and older workers are pushed out of firms at an early age. The shortness of the average working life contributes to an elderly poverty rate of 50%, four times the OECD average. Public social spending as a share of GDP is among the lowest in the OECD (OECD, 2016a, 2015a).

2.3. Population, regional disparities, well-being and environmental awareness

With 505 habitants per square kilometre in 2014, the highest rate in the OECD, Korea is among the world's most densely populated countries. Some 70% of the population is concentrated in urban areas, particularly in the north-east around the Seoul Metropolitan Area and along the coasts, leading to considerable regional disparity (Basic Statistics; Chapter 5). Regional disparity also results in unequal exposure to environmental and health risks: life expectancy at birth is three years longer in Jeju than in Gyeongnam, and Seoul's average level of $PM_{2.5}$ concentrations is almost twice that of Jeju. Access to the national water supply network varies from 100% in Jeju to 83% in Chungnam; the population connected to sewerage ranges from 100% in Seoul to 73% in Chungnam (MOE, 2016a; OECD, 2016e; Chapter 5).

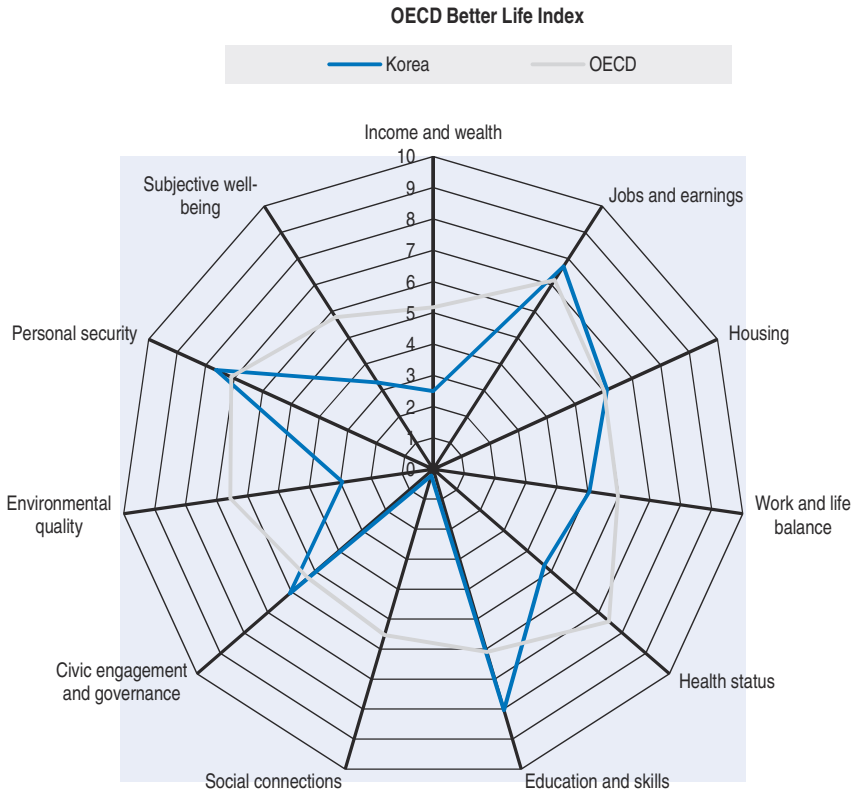
Korea has excellent performance in education and skills, civic support and governance, and personal security. It lies below the OECD average in environmental quality,[2] social connections, work-life balance and health status (Figure 1.2). Some 85% of the population aged 25 to 64 has at least upper secondary education, compared with an OECD average of 76%. Korean students score well above the OECD average in reading literacy, mathematics and science in the OECD Programme for International Student Assessment (OECD, 2016f).

Korea's population is the fourth youngest in the OECD but ageing rapidly as life expectancy rises and the fertility rate falls (to 1.2 children in 2013, the lowest in the OECD) (OECD, 2016g). This raises concerns about the future ratio of retired[3] to economically active people,[4] which is expected to increase from 17% in 2014 to 71% by 2050 (OECD, 2016h).

Health expenditure rose sharply from 4% of GDP in 2000 to 7% in 2014, yet remains below the OECD average of 9%. Despite increased public spending, households directly financed 37% of health expenditure in 2013, the second highest rate in the OECD, reflecting the need to develop Korea's social safety net. The share of the population that reports being in "good" or "very good" health is the lowest in the OECD. Although cancer and cardiovascular disease are the main causes of death, Korea also has the OECD's highest suicide rate and second highest mortality rate from road transport accidents. Since 2000, the number of suicide deaths has doubled, but road fatalities have fallen by half. About 9 million people were receiving medical treatment for environmental diseases (atopic dermatitis, asthma, and allergic rhinitis) in 2013, an increase of 17% since 2009 (OECD, 2016i; MOE, 2015).

Koreans' level of interest in environmental issues has fluctuated but is generally increasing, and people are moderately satisfied with the environment overall. Public

Figure 1.2. **Well-being indicators suggest room for improvement in Korea**



Source: OECD (2016), OECD Better Life Initiative 2016.

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perception of environmental quality is evaluated through a national conservation awareness survey regularly conducted since 1995 by the Ministry of Environment (MOE), and a national environmental awareness survey that was conducted in 2012, 2013 and 2014 by the Korea Environment Institute (KEI). Satisfaction is highest for natural landscapes and lowest for noise and for pollution and accidents caused by chemical substances (MOE, 2016c). The concern about chemical substances stem from two major accidents in recent years. The first involved hydrofluoric acid (used in the electronics industry) that leaked from a plant in Gumi, killing and injuring several workers and residents. The second concerned household humidifiers containing sterilising agents that led to death and illness in hundreds of people.

Waste and climate change are considered the most severe environmental issues among respondents to the MOE surveys, who say priority for improvement should go to the natural environment and ecosystems. In the KEI surveys, waste and natural resource depletion were the top issues, and the need to address a lack of environment information and education was also highlighted (MOE, 2016c).

3. Transition to an energy-efficient and low-carbon economy

3.1. Energy structure, intensity and use

Korea has no oil resources and very limited natural gas reserves; it produces small amounts of anthracite. Thus it is highly dependent on external energy sources: net imports account for 87% of its total primary energy supply (TPES), more than triple the OECD

average of 25% (IEA, 2016). The economy is among the most energy intensive in the OECD. Fostering energy supply autonomy is a driver of energy policies and an element of Korea's green growth strategy (Chapter 3). In recent years the government has begun to shift its focus to energy demand management (IEA, 2012).

A carbon-intensive energy mix

The energy mix is carbon intensive: fossil fuels accounted for 82% of TPES in 2015, above the OECD average of 80% (Annex 1.A1; Figure 1.3). Although oil is still the largest contributor to energy supply, since 2000 there has been a shift to natural gas and coal, which have benefited from favourable prices and government subsidies (Figure 1.3; IEA, 2012; Chapter 3). The share of nuclear power in TPES has been broadly stable around 16%, while the contribution of renewable energy sources continues to be negligible (Figure 1.3; Annex 1.A1).

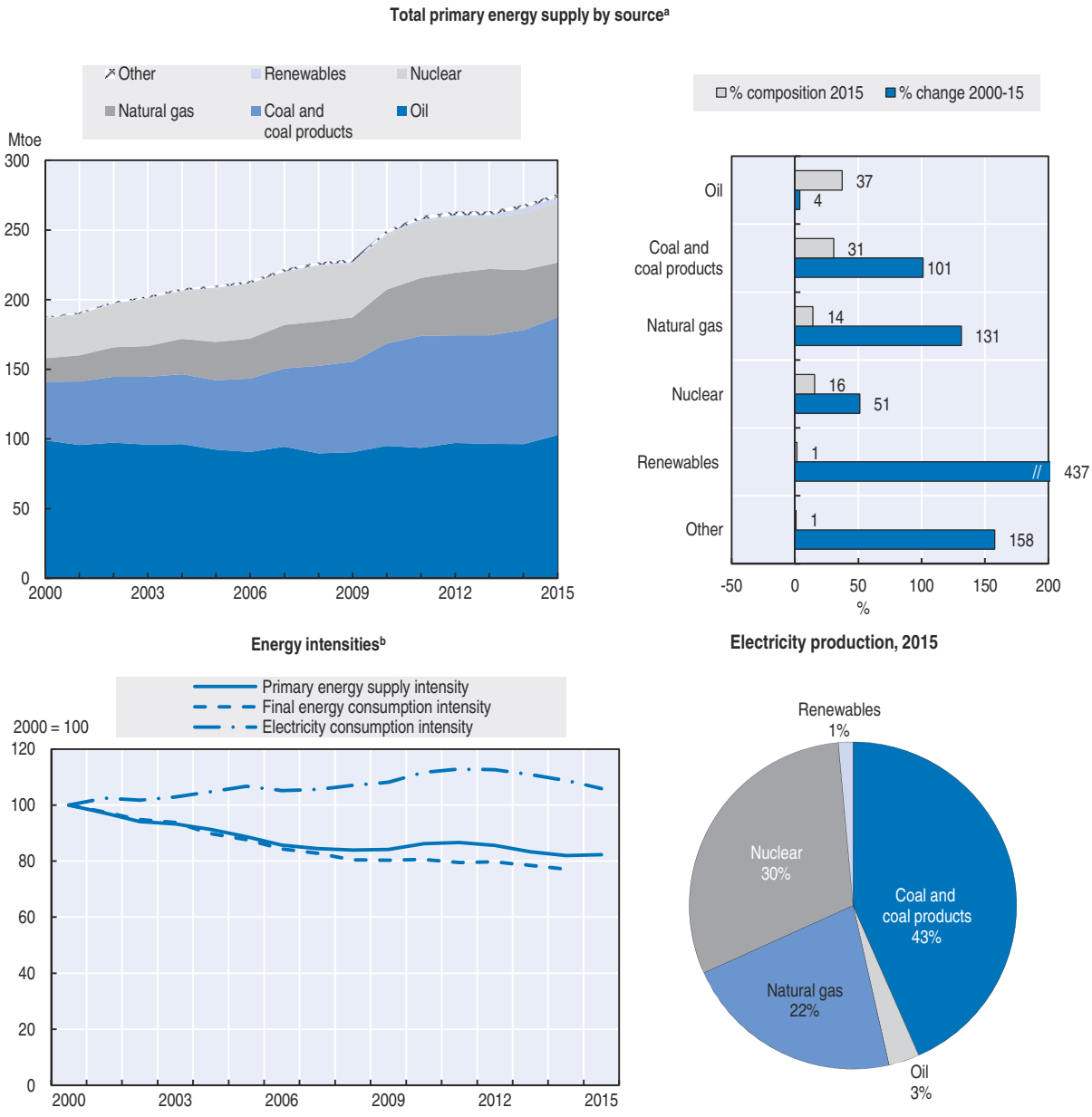
In 2015, 43% of electricity was generated from coal, 30% from nuclear energy, 22% from natural gas, 3% from oil and 1% from renewables (Annex 1.A1). Since 2000, fossil fuels have become more prominent, with electricity production from coal more than doubling and that from natural gas more than quadrupling (Figure 1.3).

Given the carbon intensity of the energy mix, aligning Korea's energy policies with emission reduction is essential for achieving the country's green growth objectives. The Energy Master Plan sets the key direction of energy policy and acts as an umbrella for sector-specific plans, such as those for electricity and renewables. The second master plan, established in 2014, outlines the transition to demand management and more sustainable energy policy, including the response to climate change, as two of its six major tasks. Expansion of nuclear power and renewables is highlighted as a way to reduce greenhouse gas (GHG) emissions in the energy sector, an aim reiterated in the seventh basic electricity plan along with demand management.

Plans to expand nuclear energy have been scaled back in recent years, however, and renewables remain a very marginal part of the energy mix (see section on renewables below). The government had strongly encouraged nuclear energy development, considering it a key instrument for reducing energy import dependency along with carbon dioxide (CO_2) emissions. By 2014, Korea was the world's fourth largest nuclear energy producer (OECD, 2015b). Nevertheless, the Fukushima accident in 2011 and domestic safety problems reduced public confidence in the safety of nuclear power (Kosch O'Donnell, 2013). The country also faces storage issues: despite efforts to enlarge capacity, spent fuel storage pools will be full by 2024 (Cho, 2014). As a consequence, while the first Energy Master Plan initially planned expansion of the nuclear energy share to 41% of electricity generation by 2030, the second one lowered the objective to 29% by 2035. This means maintaining the current nuclear level in the electricity mix for two more decades, which will involve building seven reactors by 2035 (OECD, 2012a, MOTIE, 2014).

Korea's second Energy Master Plan and seventh Basic Electricity Plan forecast that the share of coal in final energy consumption and in electricity generation capacity will remain fairly constant, putting in question the coherency of these plans with achieving Korea's GHG emissions targets. As energy and electricity demand are expected to keep rising, and the seventh Basic Electricity Plan calls for closing all anthracite coal facilities and some other old coal plants, construction has begun on 20 new coal-fired power plants. To address fine particle emissions, the new plants will have far higher efficiency levels and meet stringent air pollution standards, and existing plants are being retrofitted to reduce

Figure 1.3. **Energy supply is heavily dependent on fossil fuels**



a) Breakdown excludes electricity trade.
b) Per unit of GDP (at 2010 prices and purchasing power parities).
Source: IEA (2016), *IEA World Energy Statistics and Balances* (database); OECD (2016), "Aggregate National Accounts: Gross Domestic Product", *OECD National Accounts statistics* (database).

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pollutants and increase efficiency (MOTIE, 2016). The second Energy Master Plan also emphasises that coal plants will need to be equipped with carbon capture and storage as soon as this technology becomes available.

Energy intensity remains high

Although energy intensity is declining, in terms of TPES and total final energy consumption (TFC) per unit of GDP, it is above the OECD average (whether measured per unit

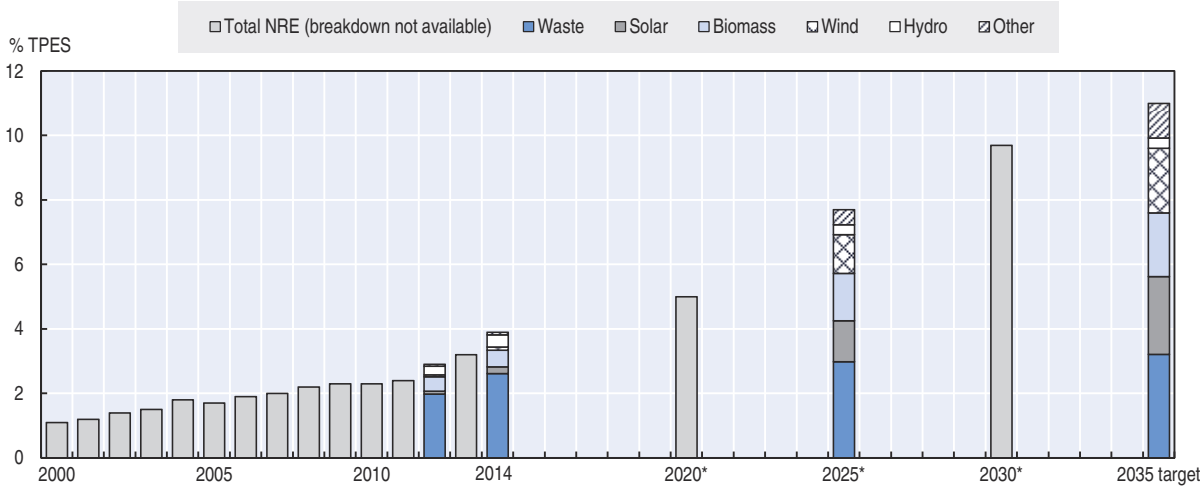
of GDP or per capita) and declining less quickly than the OECD average per unit of GDP. TPES has increased rapidly (+47%) since 2000, but more slowly than economic activity (+78%). From 2000 to 2015, TPES grew at an average annual rate of 2.4%, with a jump of 9.0% in 2010, the year after the economic crisis. Korea was not on track to meet the target set by the first Energy Master Plan of reducing energy intensity by 46% between 2007 and 2030 (Annex 1.A1; MOTIE, 2014a).

Development of renewables remains a challenge

In 2015, renewable energy sources accounted for 1.5% of TPES and 1.4% of electricity generation (Figure 1.3), the lowest shares among OECD countries. Biofuel and biogas represented 68% of renewables, followed by waste (9%), solar energy (6%), hydropower (5%) and geothermal energy (3%) (IEA, 2016).

According to the national definition,[5] new and renewable energy sources represented 4.1% of TPES in 2014, compared with 2.1% in 2004. Waste (products burnt for heat and/or power, but also biogas and biofuels produced from waste) is the primary such source (60%), followed by biomass (24%), hydro and solar (5% each), wind and ocean (3%), fuel cells (2%) and geothermal (1%). The fourth National Basic Plan for New and Renewable Energy (2014) aims to modify the mix by 2035, reducing the share of waste to 29.2% while increasing wind to 18.2%, biomass to 18.0% and solar to 14.1% (Figure 1.4; MOTIE, 2015). New and renewable sources would thus supply 13.4% of electricity.

Figure 1.4. **The objective for new and renewable energy sources will be hard to achieve**



* Intermediate targets.
Source: MOTIE (2014), 4th National Basic Plan for New and Renewable Energy.

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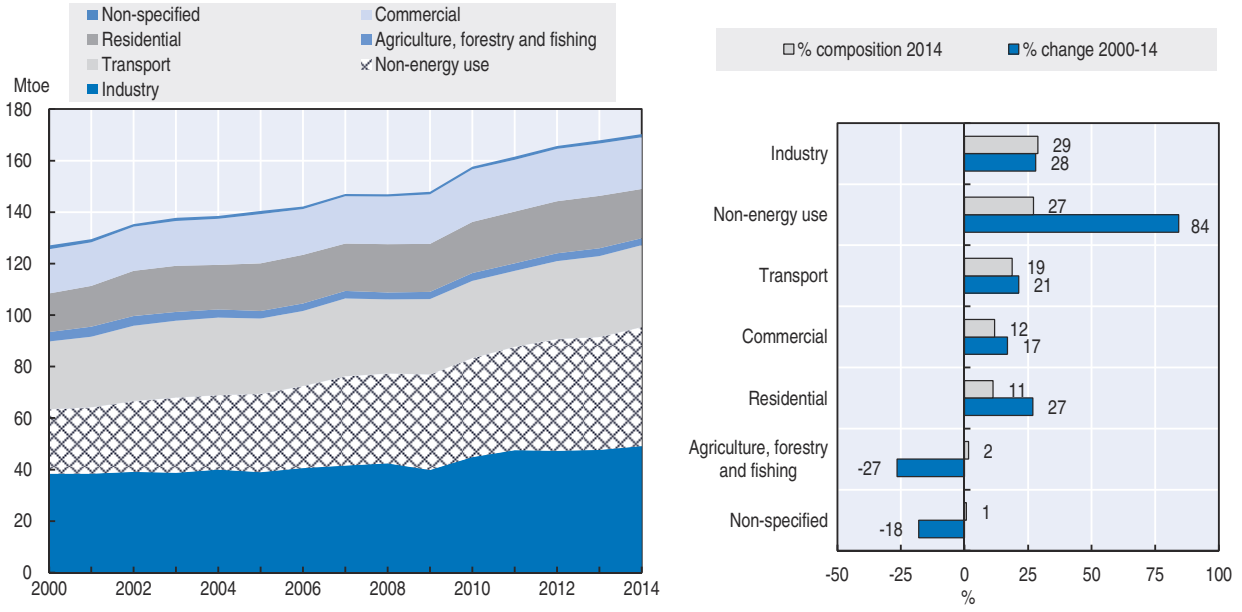
Korea has consistently missed its renewables targets, and its current targets appear difficult to achieve. The second National Basic Plan for New and Renewable Energy (2003-12) aimed to increase the share of new and renewable sources in TPES to 3% by 2006 and to 5% by 2011, yet reached only 2.2% and 2.7%, respectively. After missing the 2006 target, the government lowered and postponed the targets in the third plan (2008-30) to 2.98% in 2010 and 11% in 2030. The 2010 objective was not met either, with new and renewable sources accounting for 2.6%. The fourth plan (2014-35) pushed the 11% target back to 2035, with intermediate targets of 5.0% in 2020 and 7.7% in 2025 (Figure 1.4; KEMCO, 2014; MOTIE, 2003).

Energy consumption

TFC increased by 34% over 2000-14, far less than economic activity (74%). The industrial sector is the largest consumer, using energy resources both for energy (29%) and as raw materials in production processes (non-energy use) (27%), followed by transport (19%), the commercial sector (12%) and the residential sector (11%) (Figure 1.5). This is an unusual consumption pattern for an OECD country; on average, the transport sector is the largest energy consumer (33% in 2014), and industry consumes on levels similar to that of the residential sector (22% and 19%, respectively). Since 2000, Korean industry's non-energy consumption has almost doubled and its energy use increased by 28%, while transport use rose by 21% (Figure 1.4). Iron and steel, chemicals and petrochemicals and machinery account for 60% of industry energy consumption.

Figure 1.5. **Industries dominate Korea's energy consumption**



Source: IEA (2016), *IEA World Energy Statistics and Balances* (database).

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Electricity demand has risen rapidly, spurred by lower prices than those for other energy forms, which has encouraged switching (MOTIE, 2014). Electricity production has nearly doubled since 2000 to meet this demand, particularly from the industrial, commercial and public sectors; electricity generation intensity increased by 6% over 2000-15 (Figure 1.3).

Energy consumption grew faster than forecast by the first Energy Master Plan between 2007 and 2012, which was a factor in the government reorienting its second Energy Master Plan around demand management. The second plan sets the targets of reducing electricity demand by 15% and energy demand by 13% below the business-as-usual trajectory by 2035. It intends to achieve these targets by reforming energy taxes and electricity prices, increasing the use of technology and information systems, and reinforcing energy efficiency policies (MOTIE, 2014; Chapter 3).

3.2. Transport

The transport sector is the second highest energy consumer (19%) and GHG emitter (12%). As in many countries, road transport accounts for almost all the energy consumed by the sector (96% in 2014). The share of road in passenger transport[6] is predominant, accounting for 83% of passenger transport volume in 2013, a rapid increase from 56% in 2002; the share of rail and air transport decreased accordingly to 15% and 2%, respectively (MOLIT, 2016).

With 40 vehicles for 100 inhabitants in 2014, Korea has low motor vehicle ownership compared with the OECD average of 59 (Annex 1.A2). However, the number of vehicles has increased as the economy and incomes have grown: car registration rose by 44% over 2002-14. The share of petrol vehicles in total registrations decreased from 55% in 2002 to 47% at the beginning of 2016, while diesel vehicles increased from 33% to 41%. The remaining vehicles run on LPG (11%), whose share was stable over the period, or are hybrids (1%) (MOLIT, 2015a). The rising share of diesel vehicles, such as SUVs, can be partly attributed to an increase in leisure activities.

Traffic volume and road construction accelerated accordingly: total road length increased by 19% between 2000 and 2014 and the national expressway length almost doubled. Traffic congestion also rose: congestion costs were estimated at KRW 30.3 trillion in 2012, the highest level since measurement began in 1993, representing 2.2% of GDP. Of that, KRW 19.2 trillion is concentrated in seven major metropolitan areas, with KRW 8.4 trillion in Seoul alone (Cho, 2014). Freight transport is also dominated by road: in 2013, 75% of domestic freight[7] was transported by road, 19% by water and 7% by rail. Although the share of road has increased in the past decade, there has been a slight reduction in recent years (-1% in 2012-13) balanced by an increase in maritime transport (MOLIT, 2016).

3.3. Greenhouse gas emissions

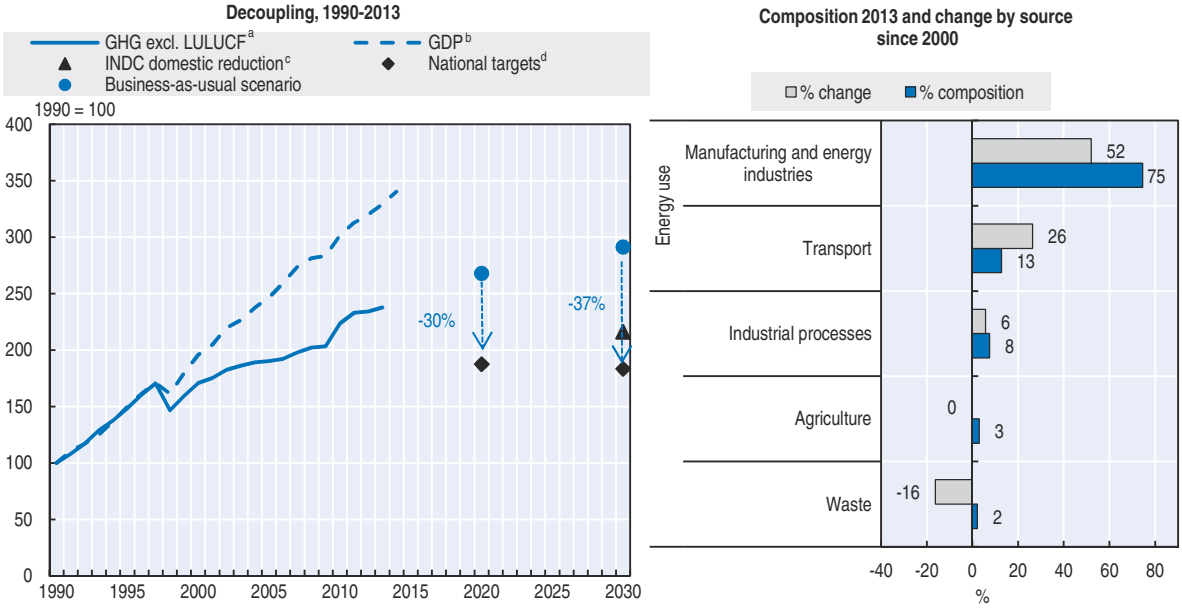
Emissions profile

Korea was the fifth largest GHG emitter in the OECD in 2013. Total GHG emissions, excluding emissions/removals from land-use, land-use change and forestry, had increased by 138% since 1990 and by 39% since 2000 – the highest increase in the OECD after Turkey – in contrast with the trend of declining GHG emissions across the OECD as a whole. Nonetheless, as GDP increased by more than 200% over 1990-2013 and by 68% since 2000, GHG emissions have been relatively decoupled from the economic growth. GHG emission intensity per capita and per unit of GDP was above the OECD average, reflecting the carbon-intensive energy mix (Annex 1.B1). Emissions per unit of GDP fell by 17%, but that was less than the OECD average decrease of 24%.

As in most OECD countries, CO_2 is the main contributor to GHG emissions, amounting to 92% of total emissions in 2013, followed by methane (4%), fluorinated gases (3%) and nitrous oxide (2%). Consumption-based CO_2 emissions (i.e. excluding emissions embodied in Korea's exports) increased less rapidly than production-based emissions and represented 10.9 tonnes per capita in 2011, slightly below the OECD average of 11.1 tonnes. Korea is among the few net exporters of CO_2 emissions in the OECD, reflecting its carbon-intensive, export-oriented economy (Annex 1.B2; OECD, 2015c). Methane emissions decreased by 14% over 1990-2013 and remained stable from 2000, due to waste reduction measures and a decline in the amount of agricultural land (MOE, 2016b).

Manufacturing and energy industries accounted for the bulk of GHG emissions in 2013, followed by transport, industrial processes, agriculture and waste management. Emissions from fuel combustion amounted to 86% of total emissions, of which 45% was emitted by energy industries and 31% by manufacturing and construction. Emissions from all major sources increased between 2000 and 2013 (Figure 1.6) due to rapid economic growth, particularly the expansion of energy-intensive industries such as steel and thermal power generation (MOE, 2016b).

Figure 1.6. **GHG emissions are decoupled from economic growth but continue to increase**



a) Excluding emissions/removals from land-use, land-use change and forestry (LULUCF).
b) GDP at 2010 prices and purchasing power parities.
c) Intended nationally determined contribution.
d) In 2016, the 2020 target was replaced by the 2030 target in the Framework Act on Low Carbon, Green Growth. Out of the 2030 target 25.7% of reductions would be met domestically and the remaining 11.3% through international markets.
Source: OECD (2016), "Greenhouse gas emissions by source", *OECD Environment Statistics* (database); MOE (2015) "Intended Nationally Determined Contribution of Korea" to the UNFCCC; OECD (2016), "Aggregate National Accounts: Gross Domestic Product", *OECD National Accounts statistics* (database); Climate Action tracker (2015) http://climateactiontracker.org/countries/southkorea.html.

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Climate change outlook

Korea is more vulnerable than many OECD countries to climate change. While the world temperature increased by 0.8°C in the past century, Korea's temperature increased by 1.2°C. The Meteorological Administration forecasts that if GHG emissions continue at their current level, temperatures will rise by 0.63°C every ten years, 1.6 times faster than over the past 30 years. The increase could be halved if GHG reduction policies were fully implemented. However, even if reduction targets are achieved, average annual precipitation is expected to increase by about 6% until 2040, and about 16% to 2100 (about four times the global average increase). Water levels are expected to rise by at least 53 cm on the south and west coasts and 74 cm on the east coast, and the subtropical climate of the south coast is expected to gradually move north. The frequency of extreme weather will increase rapidly, heat waves will last at least 1.8 times longer and tropical nights will nearly quintuple in number (MOE, 2015).

Climate change is already having a significant negative impact on biodiversity and ecosystems in Korea, with repercussions for human health, safety and food production. Rising temperatures are transforming ecosystems from temperate to subtropical, reducing pine forest cover and favouring invasive species. Natural disasters, ecosystem disturbance, disease and pests are increasing, land acidification is worsening and agricultural production is declining in both quantity and quality (MOE, 2014b). The rise in water temperature and changes in ocean currents have driven tropical marine organisms to migrate to Korean seas, leading to the disappearance of native organisms. Changes in temperature and rainfall are influencing water quality: reduced rainfall during the dry season is decreasing the dilution of point source pollutants, and increased rainfall during the wet season is raising diffuse pollution, exacerbating nutrient loads and algal blooms in lakes and rivers. The Statistical Research Institute estimated the total amount of damage resulting from extreme weather such as typhoons, heavy rainfall and heavy snow at KRW 20 trillion over 1997-2006 (MOE, 2014b). Climate change adaptation measures are thus essential to face future challenges.

Climate targets appear hard to achieve

In 2009, although it was not one of the 38 Annex I countries with a mandatory commitment under the Kyoto Protocol to reduce emissions, Korea set a mid-term goal of reducing GHG emissions by 30% below the business-as-usual level by 2020. In absolute terms, this represented an increase of 87% above 1990 emission levels (Figure 1.6). In 2015, the government committed to reduce GHG emissions by 37% below the business-as-usual level (+83% above 1990 emission levels) by 2030 in its intended nationally determined contribution, and the enforcement decree of the Framework Act on Low Carbon Green Growth was modified accordingly. Of this target, 25.7% of reductions would be met domestically and the remaining 11.3% through international markets. In practice, the 2030 target postpones the 2020 target. Although it is demanding in terms of reducing emission intensity, it implies a modest decline in emissions by international comparison (BNEF, 2015; Climate Action Tracker, 2015).

After announcing its 2020 emission reduction target, Korea took steps to institutionalise its emission reduction efforts. The Low Carbon, Green Growth Act enshrined the 2020 target in law in April 2010. A few months later, the Greenhouse Gas Inventory & Research Center of Korea was established to manage data on GHG emissions through the web-based National GHG Management System, which was key to establishment of the related Target Management Scheme and Emissions Trading Scheme (Chapter 3). The government established emission reduction targets by sector in 2011, detailing how they would be achieved with a Roadmap to Achieve National Greenhouse Gas Reduction Goals in 2014. The roadmap, resulting from collaboration between six ministries, presented over 80 sector-specific mitigation measures. It is being updated to reflect the 2030 target. Korea ratified the Paris Agreement on 3 November 2016.

The policy mix implemented thus far is unlikely to be sufficient (Climate Action Tracker, 2015; Sonnenschein and Mundaca, 2015). The main GHG reduction mechanisms are the Greenhouse Gas and Energy Target Management Scheme (2010) and Emissions Trading Scheme (2015). They are bolstered by sector-specific measures such as subsidies for clean vehicles and low-carbon fuel, automobile standards, low-carbon building standards and a renewable energy portfolio standard (Chapter 3). However, they have not yet managed to slow, let alone reverse, GHG emission growth (Figure 1.6). As Korea's annual emissions are already above the 2030 target, they must start falling soon. Modelling by the

MOE indicated that emissions would peak in 2014, then begin to decline (MOE, 2015); data are not yet available to verify whether this in fact happened.

Korea has also been devoting increased attention to climate change adaptation. Its climate change plans first integrated adaptation in 2005; in 2008, the joint efforts of 13 ministries led to the National Comprehensive Plan on Climate Change Adaptation (2009-30). As with climate change mitigation, strengthened commitment to adaptation was reflected through the creation of a dedicated institution, the Korean Adaptation Center for Climate Change, and the incorporation of adaptation efforts into national law. The Low Carbon, Green Growth Act prescribed the formulation of a short-term national adaptation plan; the 2011-15 plan comprises 87 tasks across ten sectors. Local governments must also formulate and enforce detailed plans. However, monitoring and evaluating of adaptation measures are notoriously difficult due to, among other factors, challenges in attribution of results to adaptation interventions and climate change's long time horizons and uncertain nature (OECD, 2015d). It is too early to know the results of the adaptation efforts, but it would be advisable to set a monitoring and evaluation framework to improve adaptation measures over time.

3.4. Air emissions and air quality

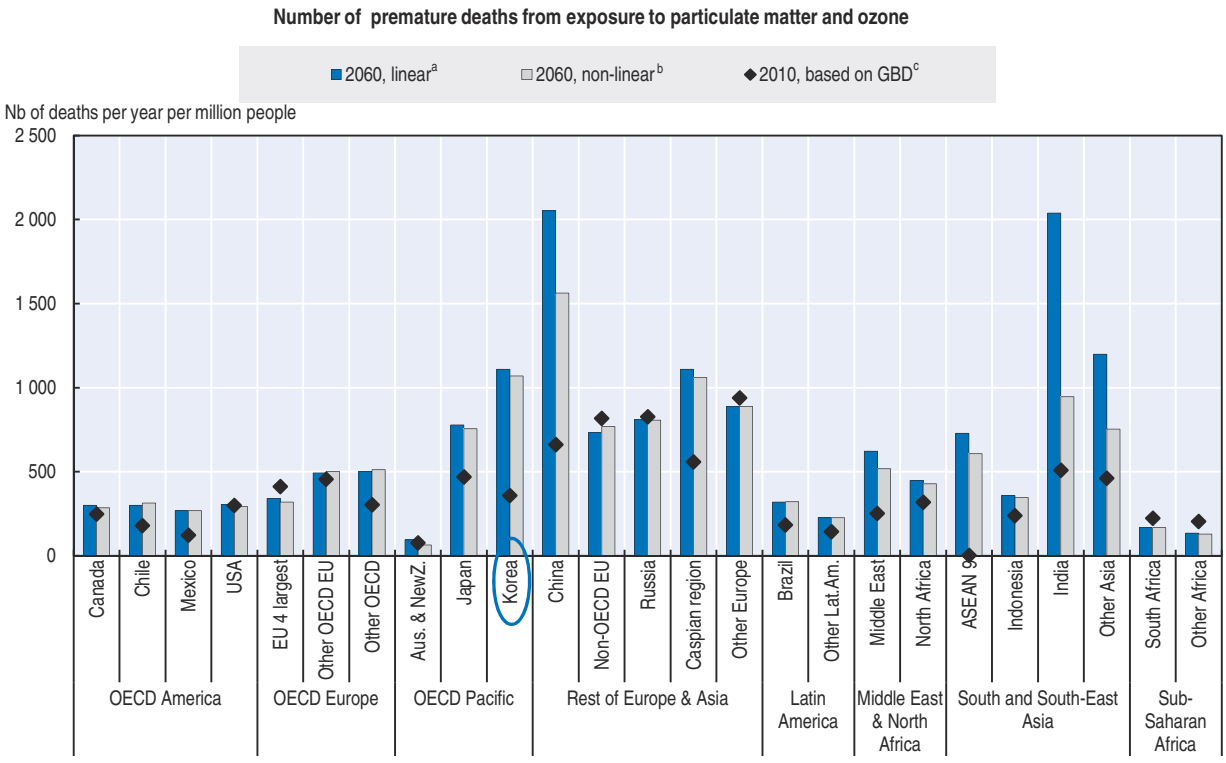
Air pollution is a major health concern in Korea. In 2013, the country had the OECD's highest share of population exposed to excessive $PM_{2.5}$ concentrations: an estimated 17% of the population was exposed to severe levels (above 35 μ/m^3), though this represented a considerable reduction from 40% in 2000; 100% of the population was exposed to levels of $PM_{2.5}$ above the recommended World Health Organization guideline value of 10 μ/m^3 (OECD, 2016j). The OECD estimated the cost of the 20 424 premature deaths due to outdoor air pollution[8] at USD 65 billion in 2013. Compared with 2005, this represented a 29% rise in premature deaths, and an 82% increase in the associated cost (IHME, 2015; OECD, 2016k). Projections indicate that the number of premature deaths could almost triple by 2060, placing Korea among the countries most affected by outdoor air pollution (Figure 1.7). In a welcome move, the government recently made the issue a national priority and announced a KRW 5 trillion (USD 4.4 billion) dedicated budget.

Main policies and measures

Since the Clean Air Conservation Act of 1990, industrial facilities have been subject to emission standards and charges, which can vary with the severity of the air pollution where the facility is located (Chapter 2). Korea has for decades operated a smokestack tele-monitoring system, CleanSYS, to constantly monitor air pollutants emitted by major facilities. The first such system was installed in 1988, and as of July 2014 the devices had been installed on 1 477 smokestacks of 569 major emitters. However, these measures were insufficient to tackle Korea's serious air pollution challenge, so national and subnational air pollution plans were adopted: the first and second Comprehensive Plans for Air Quality Improvement (2006-15 and 2016-24) and the first and second Seoul Metropolitan[9] Air Quality Control Master Plans (2005-14 and 2015-24) to bolster efforts in the area most affected by severe air pollution. A key measure introduced in 2008 under the Seoul area plan was an air pollutant emission cap management system (Chapter 2), for which CleanSYS data provided a foundation.

Korea's air pollution plans have also introduced measures in the transport sector. Emission standards for fuel and automobiles have been strengthened (Chapter 2), as have

Figure 1.7. **The number of deaths caused by outdoor air pollution is expected to nearly triple**



a) Linear function showing a simple linear relationship between concentrations and the number of premature deaths adjusted for changes in mortality rates.
b) Non-linear function, which assumes that the incremental number of deaths decreases as concentrations become higher.
c) Based on the Global Burden of Disease work reported by Forouzanfar et al. (2015) for $PM_{2.5}$ and Lim et al.
Source: OECD (2016), *The Economic Consequences of Outdoor Air Pollution.*

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those for non-mobile sources (mainly construction and agricultural equipment). The government provides subsidies for the purchase of natural gas, hybrid and electric vehicles (Chapter 3), but the use of petrol and diesel vehicles remains cheaper in a context of low fuel prices. The government is trying to create low-emission zones, but stakeholder opposition makes this challenging.

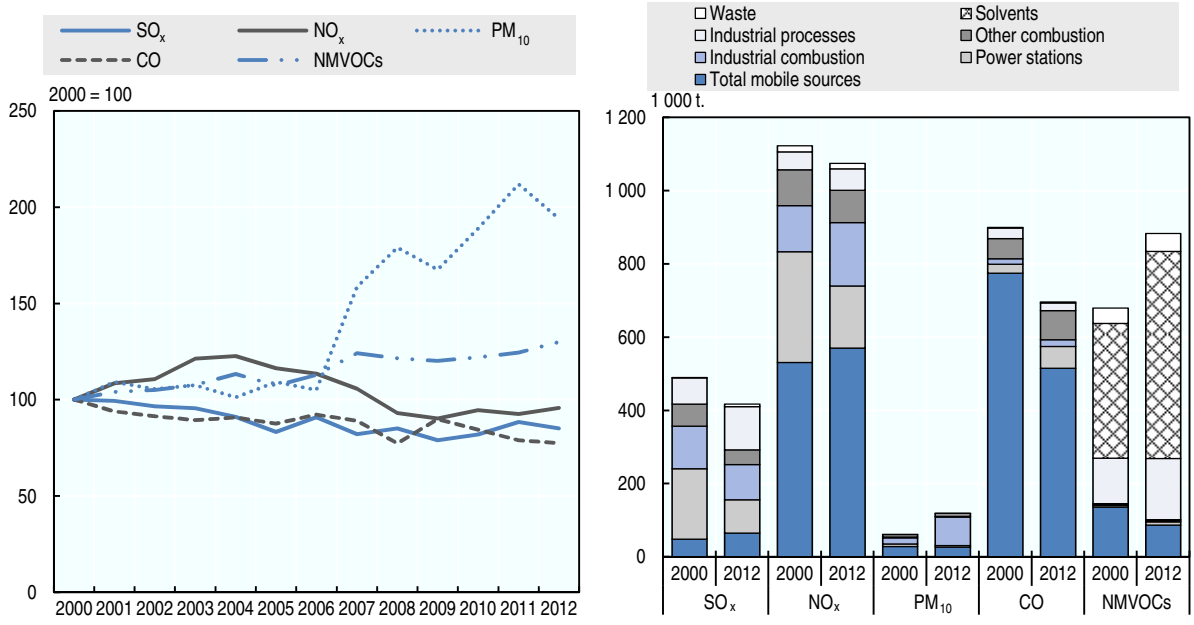
The residential sector is a source of emissions, particularly from heating, cooling and appliance use. Many household boilers produce NO_x emissions. Although the second national air quality plan contains provisions to support household purchases of low-NO_x boilers, the central government has not yet made the subsidies available (some municipalities have moved ahead unilaterally). The government is working to reduce emissions of volatile organic compounds (VOCs), e.g. by installing petrol vapour recovery at petrol stations, but the measures need reinforcement. Other measures include prohibition of solid fuel use in regions that exceed or may exceed environmental standards (currently 20); mandatory clean fuel use in 37 regions for regional heating, cooling and power generation facilities, among others; and reinforcement of air quality monitoring networks (MOE, 2016c, 2015).

Emission profile

Korea's efforts to tackle air pollution have borne fruit; since 2000, emissions of all major air pollutants but PM_{10} have been decoupled from economic growth. Emissions of sulphur oxides (SO_x), nitrogen oxides (NO_x) and carbon monoxide (CO) decreased over

2000-12, but emissions of particulate matter smaller than 10 µg (PM_{10}) almost doubled, and those of non-methane VOCs (NMVOCs) increased by 30% (Figure 1.8). Emission intensity of SO_x and NO_x per unit of GDP remains below the OECD average (Annex 1.B3, 1.B4).

Figure 1.8. **Air emissions**



Source: OECD (2016), "Air emissions by source", *OECD Environment Statistics* (database).

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Industry is the largest emitter for many pollutants, accounting for 71% of PM_{10}, 60% of $PM_{2.5}$ and 51% of SO_x emissions in 2012. Industrial PM_{10} emissions had nearly quadrupled since 2000. SO_x, NO_x, CO and NMVOCs emissions also generally increased. These rises are due to extensive use of fossil fuels for industrial processes and combustion. Power stations accounted for 22% of SO_x and 16% of NO_x emissions, but the levels have steadily declined since 2000 (Figure 1.8).

As in many countries, road transport is the most important source of NO_x emissions and CO (Figure 1.8). Levels of NO_x emissions fell by 5% and of CO emissions by 39% between 2000 and 2012, even as vehicle registrations continued to increase rapidly. This achievement can be attributed to the abovementioned policies encouraging the use of cleaner fuels and vehicles (KEI, 2008). However, ships and off-road vehicles (e.g. agricultural and construction machinery) represented 16% of SO_x and 21% of NO_x emissions in 2012, up by 51% and 36%, respectively, since 2000. They also accounted for 12% of PM_{10}, 17% of $PM_{2.5}$ and 10% of CO emissions (Figure 1.8). This suggests that policy measures covering these sources need to be tightened.

NMVOC emissions increased by 30% between 2000 and 2012. As in most OECD countries, solvents are the main source. In Seoul, NMVOC concentrations increased by about 50% over 2003-13, partly due to the small number of substances monitored and the lack of control measures. The VOC control system is under review to increase the number of substances covered and to reinforce control measures.

The government set an objective of bringing air quality in the Seoul Metropolitan Area in line with the OECD average by 2014, and set emission reduction objectives accordingly

for PM_{10}, SO_x, NO_x and VOCs; however, only the objectives for PM_{10} and SO_x were met. Estimates show that the Seoul area air pollutant emission cap management system did bear fruit, however, with NO_x decreasing by 16% and SO_x emissions by 41% for companies under the system. Nevertheless, emissions are projected to increase over 2012-25: PM_{10} by 4%, $PM_{2.5}$ by 5%, NO_x by 9% and VOCs by 18% (MOE, 2016c).

Air quality

Concentration limit values for most main air pollutants were established in 1978 and have been progressively tightened since. They are generally respected for SO_x, NO_x and lead, but more efforts are needed for fine particulates. PM_{10} concentration levels have respected the standard since 2011, but $PM_{2.5}$ concentration levels, for which standards have been applicable only since 2015, are still high. Although NO_2 and ozone concentration levels are under the limit value, they are increasing (MOE, 2016c).

Concentration targets for PM_{10} and NO_2 were also set by regional and municipal plans. In Seoul, PM_{10} concentrations significantly decreased from 59 μ/m^3 in 2004 to 41 μ/m^3 in 2012, but rebounded in 2013 so the objective of 40 μ/m^3 was not achieved. Only two of six regions met the target. Although NO_2 concentrations had decreased by 11% since 2004, Seoul did not reach that target by 2014, but four regions achieved it (MOE, 2015).

Korea's PM concentrations are exacerbated by transboundary particles, particularly from China. During pollution peaks, transboundary particles could account for up to 70% of Korea's air pollution. Fine particles not only come from Chinese's industrial sites but also include yellow dust originating mainly in the Yellow River basin and deserts in China and Mongolia. PM concentrations are higher in spring due to dust and sand storms (DSS) brought to the Korean Peninsula by winds from the west. Such storms have intensified due to desertification and soil degradation, partly caused by overgrazing and expansion of cultivated fields. Korea has been actively participating in regional co-operation to monitor and mitigate transboundary air pollution (Box 1.1).

Box 1.1. **Regional co-operation to tackle transboundary air pollution**

Korea has long been strengthening its co-operation with China and Japan on transboundary air pollution. Annual tripartite environment minister meetings have been held since 1999, with areas of co-operation including air pollutants and DSS. In addition, a policy dialogue on air pollution between technical experts was established in 2014. There are platforms for joint research and monitoring between the three countries; the Long-Range Transboundary Air Pollutants in Northeast Asia project, established in 1995, works on identifying regional air quality status and trends, and a joint research committee established in 2007 works on forecasting and ecological restoration in relation to DSS.

Korea pursues bilateral co-operation with China and Mongolia on air pollution and DSS. While Korea and China have had a Joint Committee on Environmental Co-operation since 1994 with topics including transboundary air pollution control, they signed an additional memorandum of understanding (MOU) in 2014 to strengthen co-operation on air pollution, DSS and environmental industry and technology. Through the MOU, a joint research group was established to develop forecasting models and share air quality monitoring data. Korea and Mongolia signed an MOU in 2009 to co-operate on DSS through, for example, ecological surveys and vegetation projects.

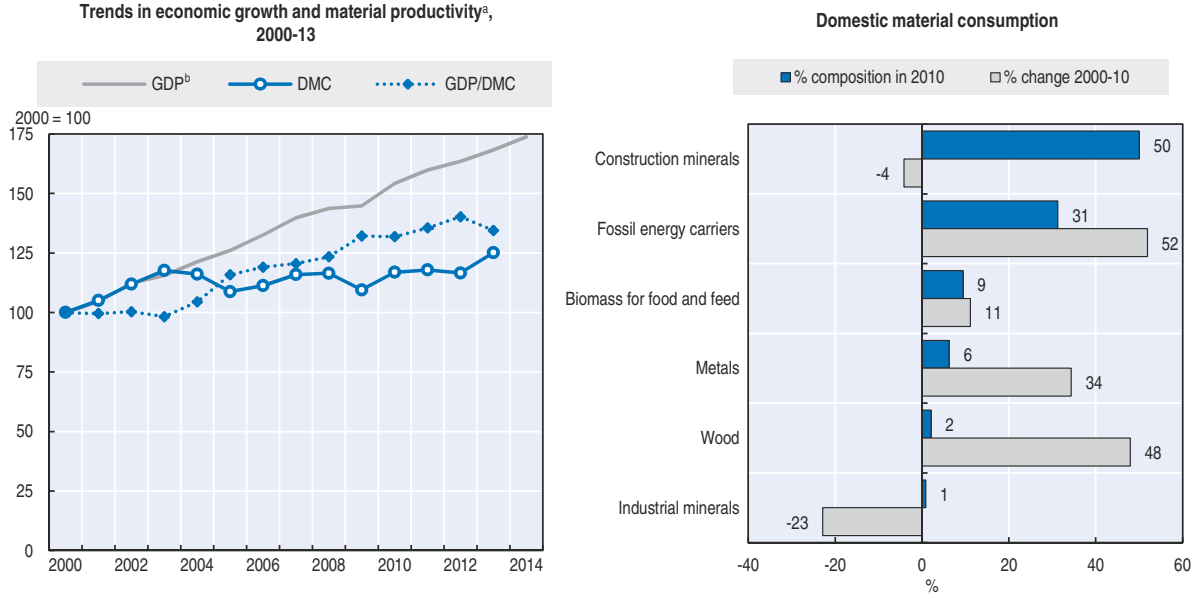
Source: MOE (2016), "Response to the questionnaire for the OECD Environmental Performance Review of Korea".

4. Transition to a resource-efficient economy

4.1. *Material consumption*

Domestic material consumption (DMC)[10] grew by 25% over 2000-13. It has fluctuated since 2004 while GDP has continued to increase rapidly, resulting in an overall 34% improvement in material productivity (the amount of economic value generated per unit of material used) (Figure 1.9). With DMC of about 852 million tonnes in 2013, Korea is a resource-intense economy due to the predominance of heavy industry and a dynamic construction sector. However, per capita DMC, although it has increased since 2000, remained below the OECD average.

Figure 1.9. **Material productivity increases**



a) Material productivity designates the amount of GDP generated per unit of materials used. It refers to the ratio of GDP to domestic material consumption (DMC), where DMC is the sum of domestic extraction of raw materials used by an economy and the physical trade balance (imports minus exports of raw materials and manufactured products). A rise in material productivity is equivalent to a decline in material intensity (i.e. DMC/GDP).
b) GDP expressed at 2010 prices and purchasing power parities.
Source: Country submission; OECD (2015), "Material resources", *OECD Environment Statistics* (database); OECD (2016), *OECD National Accounts Statistics* (database).

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Although their share had slightly declined since 2000, construction minerals still accounted for half of DMC in 2010, higher than in most OECD countries, followed by fossil fuels (31%), which registered the largest increase over the period. Biomass (9%), metals (6%), wood and industry minerals make up the remainder (Figure 1.9). Korea is almost entirely dependent on imports for fossil fuels, metals and wood, while construction minerals are more easily available domestically.

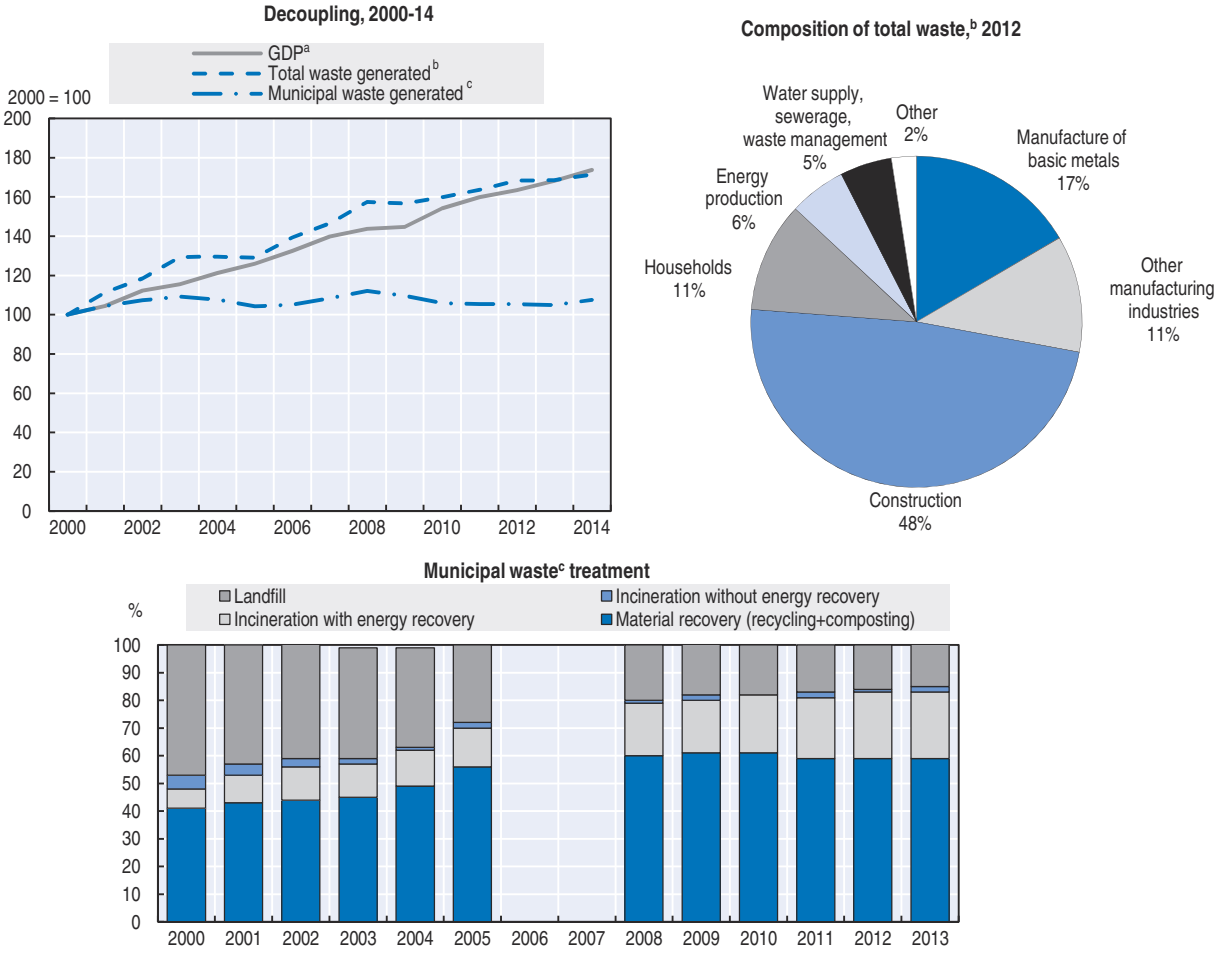
4.2. *Waste management*

Waste by sector

Rapid industrialisation and urbanisation in Korea have led to mass production and consumption, resulting in widespread material prosperity. At the same time, however, the amount of waste generated has rapidly increased and waste treatment has become more difficult (MOE, 2014a).

Korea generated more than 146 million tonnes of primary waste[11] in 2014, or 2 910 kg per capita. Primary waste generation increased by 71% between 2000 and 2014, almost keeping pace with economic activity (+74%). As in many countries, the construction sector is responsible for the largest share (48%), followed by manufacturing (28%), particularly using basic metals (17%). Households account for 11%, energy production for 6%, and water supply and waste management for 5% (Figure 1.10; MOE, 2016a).

Figure 1.10. **Waste generation has increased in line with economic activity**



a) GDP at 2010 prices and purchasing parities.
b) Primary waste generated, i.e. excluding residues from treatment operations.
c) Household and similar waste collected by or for municipalities, originating mainly from households and small businesses. Includes bulky waste and separate collection.
Source: OECD (2016), "Waste generation by sector", *OECD Environment Statistics* (database); OECD (2016), "Municipal waste generation and treatment", *OECD Environment Statistics* (database); OECD (2016), *OECD National Accounts Statistics* (database).

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While waste generation from manufacturing was stable over 2000-14, construction waste more than doubled due to major infrastructure and other projects, such as residential buildings to address the housing shortage and the country's first high-speed railway (MOE, 2016a).

In 2014, 84% of waste was recovered, 9% was sent to landfill and 6% was incinerated (MOE, 2016a). For construction waste, 97% was recovered, mainly through backfilling and

mounding; only 32% was recycled into high value added resources such as aggregates and asphalt. The government aimed to raise this to 46% by 2016 (MOE, 2015).

A Business Waste Reduction Programme introduced in 1996 imposes mandatory reduction targets on big enterprises and encourages voluntary reduction. An evaluation showed that in 2012, waste generation from businesses targeted by the programme increased less rapidly than the related production output. Extended producer responsibility was introduced in 2003 to promote reduction, reuse and recycling. Its coverage, initially mainly addressing packaging waste, has been progressively extended to other types, such as waste electrical and electronic equipment. As a result, the amounts recycled have more than doubled since 2000 (MOE, 2015, 2016a).

Municipal waste

Generation of municipal waste increased by 7% between 2000 and 2014, showing considerable decoupling from final private consumption, which rose by 52%. Per capita, municipal waste generation was 361 kg in 2014, much lower than the OECD average of 516 kg. Over 2000-14, the share of municipal waste sent to landfill decreased from 47% to 16%, while the share of material recovery[12] rose from 41% to 59%. These achievements can be attributed to the volume-based waste fee system adopted in 1995, which imposes charges proportional to the amount of non-recyclable waste generated (Figure 1.10).

Food waste generation peaked in 2008, and has since fallen every year. In 2014, it accounted for 27% of municipal waste. Korea set reduction and recovery targets through the Comprehensive Measure for Reducing Food Waste, as a result of which 96% was recycled into feed, compost and fuel for electricity production in 2014 (MOE, 2016c).

Hazardous waste

Hazardous waste generation increased by 73% over 2000-14. The largest share, 24%, is mixed waste containing hazardous substances, followed by waste from production and use of organic solvents, mainly in the petrochemical industry (23%), and waste oils, emulsions or mixtures (20%). In 2014, 57% of hazardous waste was recycled (up from 50% in 2000), while 19% was still landfilled (MOE, 2016c).

Korea operates a waste charging system in which manufacturers and importers pay for the disposal of waste containing hazardous substances. In addition, a waste management system called Allbaro, in which transboundary exchanges of hazardous waste are tracked electronically, has been extended to cover all industrial waste (MOE, 2015).

4.3. Agriculture

The Korean agriculture, forestry and fishing sector is labour intensive (accounting for 2% of GDP but 6% of employment), reflecting a predominantly small-scale farming system. The real net value of agricultural production was stable during the review period despite a decline in the surface area dedicated to agriculture and in irrigated land, by about 10% each (FAO, 2016). Output was stable because, while cereal production fell by 22% and other crops by 11%, livestock production rose by 18% and non-food output was up by 56% (FAO, 2016). Farming is dominated by rice: paddies accounted for 55% of the cultivated area in 2014, down from 61% in 2003 (MAFRA, 2014, 2015).

Intensive agriculture is a major threat to ecosystems and biodiversity and is an important source of water, air and land pollution. Korean intensity of commercial fertiliser

use[13] is among the highest in the OECD. Livestock density is the second highest after the Netherlands (Annexe 1.C3). Apparent consumption of nitrogen and phosphate fertilisers decreased more than crop production, resulting in a relative decoupling. Pesticide use per hectare of agricultural land is also among the highest in the OECD, but declined during the review period. The available information shows that overall nitrogen and phosphorus surpluses have decreased since 2000, although livestock-related surpluses rose along with livestock production (FAO, 2016; OECD, 2013; MAFRA, 2015). Organic farming is barely developed, accounting for 1.5% of agricultural land in 2012, below the OECD average of 2.2% (OECD, 2015f).

5. Managing the natural asset base

5.1. *Physical context and land use*

Korea is a relatively small, mountainous peninsula with over 3 200 islands and total land area of about 100 000 km^2. Surrounded by three seas, it has a temperate climate with wide variations in temperature and rainfall. The peninsula is largely divided into highland in the east and lowland in the west. Mountains cover about 64% of the territory, leaving limited areas for human settlement. Together with coasts and forests, they provide an important habitat for Korea's rich biodiversity (MOE, 2015).

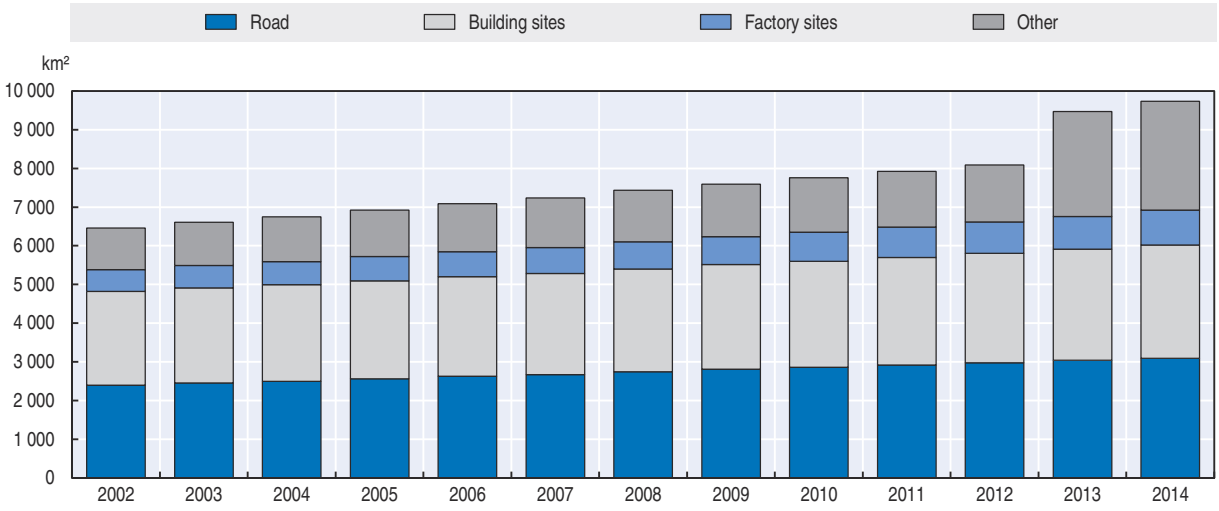
Forests accounted for 64% of the land area in 2013, a much higher share than the OECD average of 31%. Agricultural land covered 18%, a decrease of 10% from 2000 due to declines in arable land and permanent crops, along with a 27% increase in other types of land use. Lost agricultural and forest land was mainly converted to artificial surfaces, leading to habitat fragmentation and biodiversity loss, in particular in rice paddies, which host various ecosystems and about 527 species, and whose area has shrunk by 17% since 2003 (MOLIT, 2016, 2015b; MOE, 2014b; MAFRA, 2015).

Built-up areas expanded by 51% between 2002 and 2014, far surpassing the 6% population growth rate over the period and reflecting rapid industrialisation and urbanisation: 70% of the population lives in urban areas, well above the OECD average of 49% (Basic Statistics). Roads account for 32% of artificial land, followed by permanent buildings (housing, offices, shops, etc.) at 30%, other built-up areas[14] at 29% and factories at 9%. Other built-up areas almost doubled just between 2012 and 2014, driven by growth in railways and areas for leisure activities such as parks and sport facilities. Factory sites grew the second most rapidly over the past decade (by 60%), followed by roads (29%) and buildings (21%) (Figure 1.11; MOLIT, 2016). Rapid urbanisation is putting strong pressure on the environment and accelerating natural ecosystems' deterioration. Ensuring sustainable development of human and economic activities while preserving the country's great diversity of fauna and flora is a major challenge (Chapter 2).

5.2. *Biodiversity and ecosystems*

Korea has a wide variety of terrestrial ecosystems and rich biodiversity thanks to its unique topography, its geographical features and its climate with four distinct seasons. Its terrain varies from flat fields to high mountains: the Baekdudaegan Mountains form the spine of the Korean peninsula, from Baekdusan Mountain in the north to Jirisan Mountain in the south. Extensive forests host diverse vegetation ranging from warm temperate to polar. The Demilitarized Zone (DMZ) between North and South Korea provides a unique environment untouched by human activity and hosting 5 097 species, including 2% of

Figure 1.11. **Built-up areas have increased rapidly**



Source: MOLIT (2016), *Statistical Yearbook 2015.*

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threatened species. Increasing demand for agricultural and other development in the DMZ is threatening this unique habitat (MOE, 2015; Harvey, 2012).

Korea also possesses rich coastal, marine and island ecosystems, with a maritime jurisdiction 4.5 times its land area, long coastlines and an estimated 200 coastal sand dunes concentrated in the west and south. Dunes play an important role in biodiversity protection, acting as a sand repository, protecting underground water habitats for rare organisms and serving as natural barriers against wind and waves. Along with the coastal landscape, however, they are strongly influenced by marine erosion. Since most coastal dunes can be used as beaches, they also face strong pressure from urban development, particularly for accommodation and parking. Human development is increasingly damaging marine habitats as well: while 78% of coastlines are natural, 22% are artificial, consisting mainly of landfills, land reclamation, and ports for residential areas and industrial complexes (MOE, 2014b).

Forecasts of terrestrial biodiversity loss are particularly high in Japan and Korea, where a 36% decline in species abundance is expected by 2050, far above the global average of 10% (OECD, 2012b).

Rapid, widespread urbanisation is the single largest threat to Korea's rich biodiversity and ecosystems, as it has generally been accompanied by deforestation and resulted in habitat encroachment and fragmentation. It is estimated that wetlands have declined by about 20%, farmlands by 16% and forests by 2% over the last two decades. An additional threat to biodiversity linked to development is an increasing demand for recreation in natural spaces, which is damaging landscapes and putting pressure on species previously untouched by human impact. Another major threat is invasive alien species, estimated to number 2 167 in 2014, of which 18 are disturbing ecosystems (MOE, 2014b). Climate change and illegal poaching are also causing ecosystem imbalances and biodiversity losses.

Threatened species

Although the level of knowledge is incomplete for some habitats and species, the available information shows that in 2014 Korea's performance concerning the proportion of

species that are threatened was relatively good, compared to most OECD countries: 23% of amphibians, 16% of reptiles, 11% of mammals and birds and 5% of vascular plants were considered threatened (Annexe 1.D1). Some policies to protect and manage biodiversity are bearing fruit: for example, several indigenous deer species have become more common thanks to hunting controls. However, although captive breeding programmes for endangered species, such as Asiatic black bears, have been successful, large mammals such as tigers and lynx that used to be abundant have disappeared (KFS, 2016; MOE, 2016d), and the gradual reduction in wetlands threatens a diverse range of species (MOE, 2014b).

Korea's Red List estimates that 2 177 species, or 5.6% of the total, require specific management plans, either because they critically need conservation or because they pose a threat to ecosystems and human well-being. Protection systems are managed by the MOE, the Korean Forestry Service and local governments, with measures varying according to risk severity. Korea has been restoring an increasing number of endangered species, reaching 28 animal species and 36 plant species in 2015 (MOE, 2016c). In 2012 the Wildlife Protection and Management Act identified 246 endangered wild plants and animals whose population is declining, an increase of 11% since 2007. Of these species, 21% are considered to be facing risk of imminent extinction: 12 bird, 11 mammal, nine fish, nine plant, four insect, four invertebrate and two amphibian or reptile species. The remaining 195 species are considered likely to become endangered. Conservation measures include a ban on the consumption and hunting of certain wild animals, the control of overpopulated and invasive species, restrictions on trade and exploitation of wild fauna and flora, and the establishment of wildlife rescue and management centres (MOE, 2016c, 2016d, 2014b).

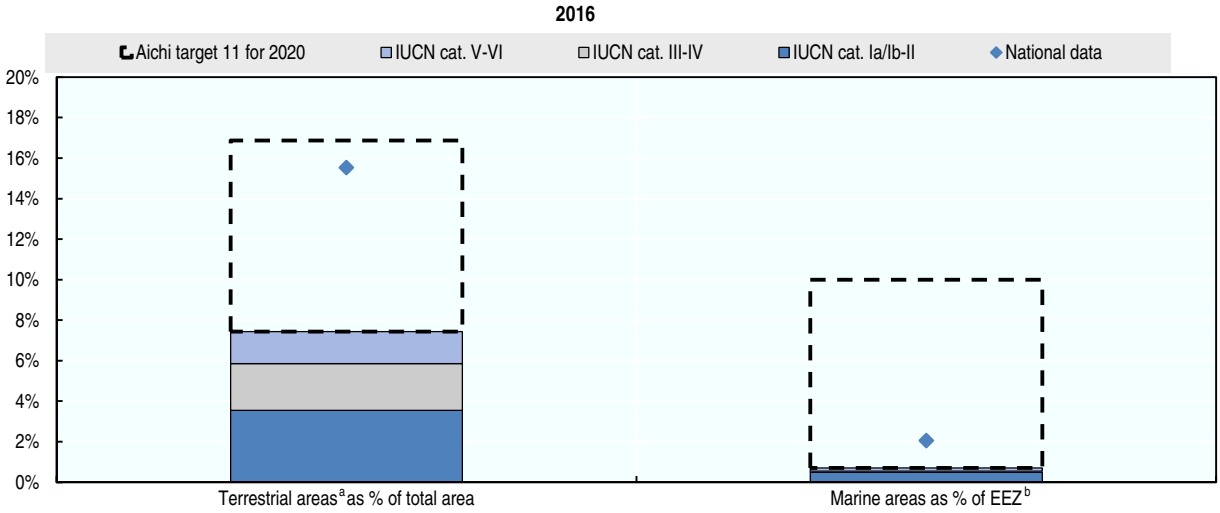
Protected areas

Korea's shares of both terrestrial and marine protected areas, as defined by the International Union for Conservation of Nature (IUCN), are low compared to most OECD countries. Under the Strategic Plan for Biodiversity 2011-20 of the Convention on Biological Diversity (CBD), Aichi target 11 is to conserve 17% of terrestrial and inland water area and 10% of coastal and marine area by 2020 through protected area systems and other area-based measures. As of early 2016, about 8% of Korea's terrestrial area and 1% of its exclusive economic zone (EEZ) were designated as protected. National parks (IUCN category II) are the most widespread designation, accounting for more than 3% of the total terrestrial area and 0.5% of the EEZ; 1.4% of the country area is also protected under international agreements (included in IUCN categories): 22 Ramsar Wetlands, five UNESCO Biosphere Reserves and one World Natural Heritage site (Figure 1.12).

Korea has increased the number of protected areas, which by national definition covered 15.5% of land and inland waters, and 2.0% of the EEZ, in 2016 (Figure 1.12). The national classification includes ten categories of protected areas, grouped in four classes: i) Natural parks[15] (5% of the territory, 1% of the EEZ), ii) Terrestrial ecosystems (mainly Baekdudaegan mountain reserve, 3%), iii) Marine ecosystems (1% of the EEZ) and iv) Wildlife protection sites (5% of the territory). Jeollabuk and Jeollanam provinces, the two main estuary areas, account for 50% of the coastline and concentrate the best-preserved islands (61% of Korea's islands), 80 of which are considered special islands with high-value habitats, where rare and unregistered species continue to be discovered (MOE, 2016c).

Trails and surroundings of national parks are under increasing pressure from leisure activities and tourism, exacerbated by the abolition of the national park entry fee in 2007. The government has accordingly designated special protection zones with restricted

Figure 1.12. **Protected areas remain below the Aichi target**



a) International protected areas (UNESCO Biosphere Reserves, Ramsar Wetlands and World Natural Heritage sites) are included in IUCN categories.
b) The exclusive economic zone (EEZ) stretches from the baseline out to 200 nautical miles from the coast.
Source: UNEP-WCMC (2016), World Database on Protected Areas, *ProtectPlanet* (database accessed in April 2016); Country submission.

StatLink http://dx.doi.org/10.1787/888933449033

access for the most vulnerable or damaged areas. At the end of 2013, 139 such zones accounted for 274 km^2 in national parks (MOE, 2015).

The Natural Environmental Conservation Act (amended 2004) added a key element to Korea's protected area policy by establishing three core ecological axes: Baekdudaegan, the DMZ and the coastal regions with islands. These axes connect the mountains, rivers and seas to enhance biodiversity and ensure continuity of ecosystem functions. The 2010 Korean Peninsula Ecological Axes Establishment Plan outlines location restrictions, damaged area restoration projects and other mid- and long-term conservation measures, as well as the restoration of connections between ecological axes. In 2013, the government also launched a project to select and restore 50 disconnected or damaged sections of the axes (MOE, 2015).

Running counter to these efforts, however, are measures prioritising investment and development at the potential expense of biodiversity conservation. They include a push for land use deregulation as part of the government's broader pursuit of deregulation, a proposal to put cable cars in national parks and a proposed law that would allow greater tourism infrastructure in mountain conservation areas (Chapter 2). Another challenge is protected area management; a recent study found that expanded capacity and expertise were needed.

Forests

Forests covered 64% of the country in 2013, a decrease of 1.4% since 2000. Coniferous forests are predominant (41%), followed by mixed (29%) and deciduous forests (27%) (MOE, 2015). Forest vegetation includes temperate deciduous broad-leaf trees in the southern coastal and island areas. Pine is the most widely distributed species, covering 23% of the total forest area, mainly in the alpine and northern regions (MOE, 2014b). Some 70% of the forest area is privately owned and 30% consists of plantations (FAO, 2015).

Forests were overexploited between 1910 and 1953, a period of occupation and war. By the end of the Korean War, almost half the forested area was destroyed. This led to serious

social and environmental problems, such as lack of fuel and severe floods and droughts. The government undertook a remarkable reforestation effort through five successive National Forest Plans spanning 1973-2017. They restored more than one million hectares of denuded forest with fast growing tree species (KFS, 2016). Consequently, the forests are young and grow rapidly; about 32% consist of trees under 30 years old, and the growing stock increased by 77% over 2000-10 (FAO, 2015). In 2015, 56% of the forest was considered primary forest, where there are no clearly visible indications of human activity and ecological processes are not significantly disturbed. Some 6% of the forest area is protected for soil, water and ecosystem services, and 14% is protected for biodiversity conservation or included in protected areas (FAO, 2015).

The fifth National Forest Plan (2008-17) aims to further apply sustainable forest management and encourage forest industry competitiveness while maximising the public benefits forests provide, such as climate change mitigation and natural disaster prevention (KFS, 2016). In 2010, the value of these and other public benefits provided by forests, such as carbon absorption, oxygen production, air purification, watershed and biodiversity conservation, recreational services and soil erosion prevention, was estimated at KRW 109 trillion, an increase of 118% from 2000 (KFS, 2013).

Main policies and measures

Korea has put considerable effort into strengthening its legal and planning framework to manage biodiversity. For example, weight was given to its first National Biodiversity Strategy and Action Plan (NBSAP) through the promulgation of the Act on Wildlife Protection and Management (2005) and the Act on Marine Ecosystem Conservation and Management (2007). Management plans have proliferated, such as two Wildlife Conservation Master Plans, the Master Plan for Marine Ecosystem Conservation and Management, two Forest Biodiversity Master Plans and two Natural Parks Master Plans, reflecting the fact that biodiversity issues are handled by multiple teams and ministries. To streamline and systematise biodiversity management, the Act on the Conservation and Use of Biodiversity was promulgated in 2012. Its purpose is to help enhance biodiversity by creating a national management system, promoting sustainable use of biological resources and co-operating in international mechanisms such as the CBD and Nagoya Protocol. Strategic environmental assessment was introduced in 2006, the scope of application of environmental impact assessment was expanded and efforts are being made to co-ordinate land use plans and Natural Environment Conservation Master Plans in the early stages (Chapter 2), thereby increasing the avenues for biodiversity to be taken into account in land use planning and development.

Korea has strengthened its institutional and information network to enable a more comprehensive understanding of its biodiversity and strengthen capacity in this field. The National Institute of Biological Resources, created in 2007, focuses on data collection and species identification, study and management. Building on its work, the National Biological Resources Integrated Management System database was launched in 2012. It was followed in 2013 by the National Institute of Ecology, which focuses on research and on educating the general public about biodiversity issues, and the Marine Biodiversity Institute in 2014, as well as other recent institutions with more specific regional focuses. More institutions are planned. However, the proliferation of institutions can come with co-ordination and coherency challenges, which should be borne in mind as the government decides whether to create new institutions or strengthen existing ones. The government recently took a step to streamline institutions in this area (Kim, 2016). The challenge of co-ordinating multiple institutions is

added to that of co-ordinating biodiversity policy among ministries. While a dedicated co-ordination committee meets three to four times a year, room for improvement remains.

In keeping with its commitments as a party to the CBD, Korea has established three consecutive NBSAPs. In light of the Nagoya Protocol, the second NBSAP (2009-13) emphasised equitable sharing of biological resources and effective conservation of major ecological regions, species and genetic diversity. It led to the establishment of the National Species List, including all endangered species, as well as to expansion of the national protected area network, the designation of wetland protected areas and regular publication of the National Biodiversity Resources and Red List Index (MOE, 2014b, 2016c). Assessment of the second NBSAP found that the implementation of 6 tasks out of 24 was "unsatisfactory". More efforts were deemed necessary for i) expanding and conserving protected areas, ii) conserving genetic diversity, iii) establishing a system to address climate change, iv) securing the use of biological resources, v) expanding education and professional training on biodiversity and vi) sharing information systematically (MOE, 2014b). The third NBSAP (2014-18) addresses some of these issues, focusing on reinforcing biodiversity conservation, promoting sustainable use of biological resources and strengthening action plans for ecosystem threats.

5.3. Management of water resources

Main plan and programmes

The fragmentation of responsibilities among ministries resulted in a multitude of management plans whose interconnections are difficult to understand (Chapter 2). The MOE has created 35 water-related plans, and is trying to streamline the four main ones into the Water Environment Management Master Plan for water quality and ecosystem health and the National Waterworks Master Plan, which includes tap water policy. MOLIT's overarching strategy is the Long-term Comprehensive Plan for Water Resources (Table 1.1).

Water resources

Korea's annual average rainfall is relatively abundant, but renewable freshwater resources per capita (1 440 m^3) are the second lowest in the OECD due to high population density. As a result, despite a moderate per capita abstraction rate, Korea is among the few OECD countries under medium-high water stress with intensity of use[16] of freshwater resources at about 35%. The concentration of the rainy season from June to September, with large variation by year and by region, poses a major challenge for water management. In addition, steep topography and rapid urbanisation exacerbate the consequences of frequent flooding and drought caused by the rainfall pattern.

Aggregated national information on freshwater resources and abstractions is reported only every five years and with considerable delay, particularly for surface water abstractions. The latest available data underlying the key environmental indicator on intensity of freshwater resource use[17] date from 2007. Such delays, which probably reflect fragmentation of the information systems set up by the various government bodies involved, make clear that further efforts are needed to integrate the water information system so as to better support water policy (Koh, 2014; Lee and Kwon, 2016). Public water supply intensity per capita (139 m^3 in 2009) is above the OECD average (116 m^3). More information is available on groundwater abstractions, which accounted for only 15% of total abstractions in 2007. In 2014, abstractions for agriculture represented half of total groundwater abstractions, most of it for irrigation. Agricultural abstractions have increased more rapidly (by 59% since 2000)

Table 1.1. **Main water plans and programmes**

Ministry in charge	Plans and programmes	Mandate	Timeline and purpose
MOE	Water Environment Management Master Plan	Water Quality and Ecosystem Conservation Act (Art. 24)	Ten-year plan to achieve water quality targets and create an ecologically healthy water environment 2006-15, 2016-25
	Comprehensive Mid-term Plan on the Ecological Stream Restoration Project	Water Environment Management Master Plan	Restoration of damaged rivers by removing artificial disturbances, maintaining integrity of ecosystem 2011-15, 2016-20
	National Sewage Master Plan	Sewerage Act (Art. 4)	Ten-year plan for development and implementation of national sewerage policy 2006-15, 2016-25
	National Waterworks Master Plan	Water Supply and Waterworks Installation Act (Art. 5)	Ten-year plan for development of national waterworks policy, effective water use and stable tap water supply 2006-15, 2016-25
	National Water Reuse Plan	Promotion of and Support for Water Reuse Act (Art.5)	Ten-year plan for promotion of water reuse and facilitation of related technology development 2011-20
	Basic Plan for Soil Conservation	Soil Environment Conversation Act (Art. 4)	Ten-year plan for prevention of soil contamination, restoration and purification of contaminated soil and provision of soil-groundwater nexus 2010-19
	Water Demand Management Plan		Tap water saving through effective water demand management 2000-06, 2007-16
MOLIT	Long-term Comprehensive Plan for Water Resources	River Act (Art.23)	Twenty-year plan for stable security and effective use, development and preservation of water resources 2001-20, 2006-20, 2011-20 (revision)
	Comprehensive Water Control Plans for River Basin	River Act (Art.24)	Ten-year plan for development and appropriate use of river basin water resources, river environment improvement, river basin flood prevention and flood damage minimisation National rivers: 2005-15 (established by the MOLIT) Local rivers: varies (established by local governments)
	Basic Plan for Waterworks Installation and Management (Multiregional and industrial)	Water Supply and Waterworks Installation Act (Art. 4)	Ten-year plan to install and manage general and industrial waterworks in a proper and reasonable manner 2012-25, 2015-25 (revision)
	Long-term Dam Construction Plans	Act on Construction of Dams and Assistance, etc. to their Environs (Art. 4)	Ten-year plan to develop water resources in an efficient and environment-friendly manner 2012-21
	Groundwater Management Master Plan	Groundwater Act (Art. 6)	Ten-Year plan for development and use and efficient preservation and management of groundwater 2012-21
	Natural River improvement programme		Restoration of river channels to near-natural state to improve aquatic habitat and amenity services
PMO, MAFRA, MOE, MOLIT, etc.	Comprehensive measures on non-point source pollution		Control of diffuse pollution sources (agricultural fields, livestock facilities, urban areas, roads, etc.) 2004-11, 2012-20
MAFRA	Rural Water Use Rationalization Plan	Rearrangement of Agricultural and Fishing Village Act (Art. 15)	Five-year plan for efficient development, use and preservation of rural water 1999
	Comprehensive measures to combat drought in the agricultural sector		Effective management of agriculture water use to minimise the impact of drought December 2015

Source: MOE (2016), Water Environment: Main Policy Framework, *http://eng.me.go.kr*; MOLIT (2016), Main Policy, Sectoral: Construction and water resources, *http://english.molit.go.kr*; MAFRA (2016), Document and Resources, *http://english.mafra.go.kr*.

than total groundwater abstractions (32%), mainly because agriculture groundwater is exempt from usage fees (Lee and Kwon, 2016).

Water use amounted to 25.5 billion m^3 in 2007. As in many countries, agriculture is the largest user, accounting for 62% of water use in 2007, a decrease from 80% in 1998. Water for domestic purposes accounted for 29% and industrial usage for 8%. In addition, 10% of

available water is designated as river maintenance water[18] and is considered part of total water use, although it is not abstracted from rivers for intentional use. The total volume of freshwater used was expected to increase by 4% in 2020 compared to 2007, with increases in domestic (4%) and industrial use (52%) and a decrease in agricultural use (3%).

The Comprehensive Plan on Water Savings (2000-06) launched measures to expand water-saving devices and wastewater systems, restructure the water billing system, replace old water pipes, etc. Estimates indicate that the plan resulted in tap water savings of 930 million m^3 between 2000 and 2012. The Comprehensive plan on National Water Demand Management (2007-16) was intended to further reduce water losses by covering all water demand stages from supply to use and reuse, with measures expected to save 1 021 million m^3 of tap water (MOE, 2015).

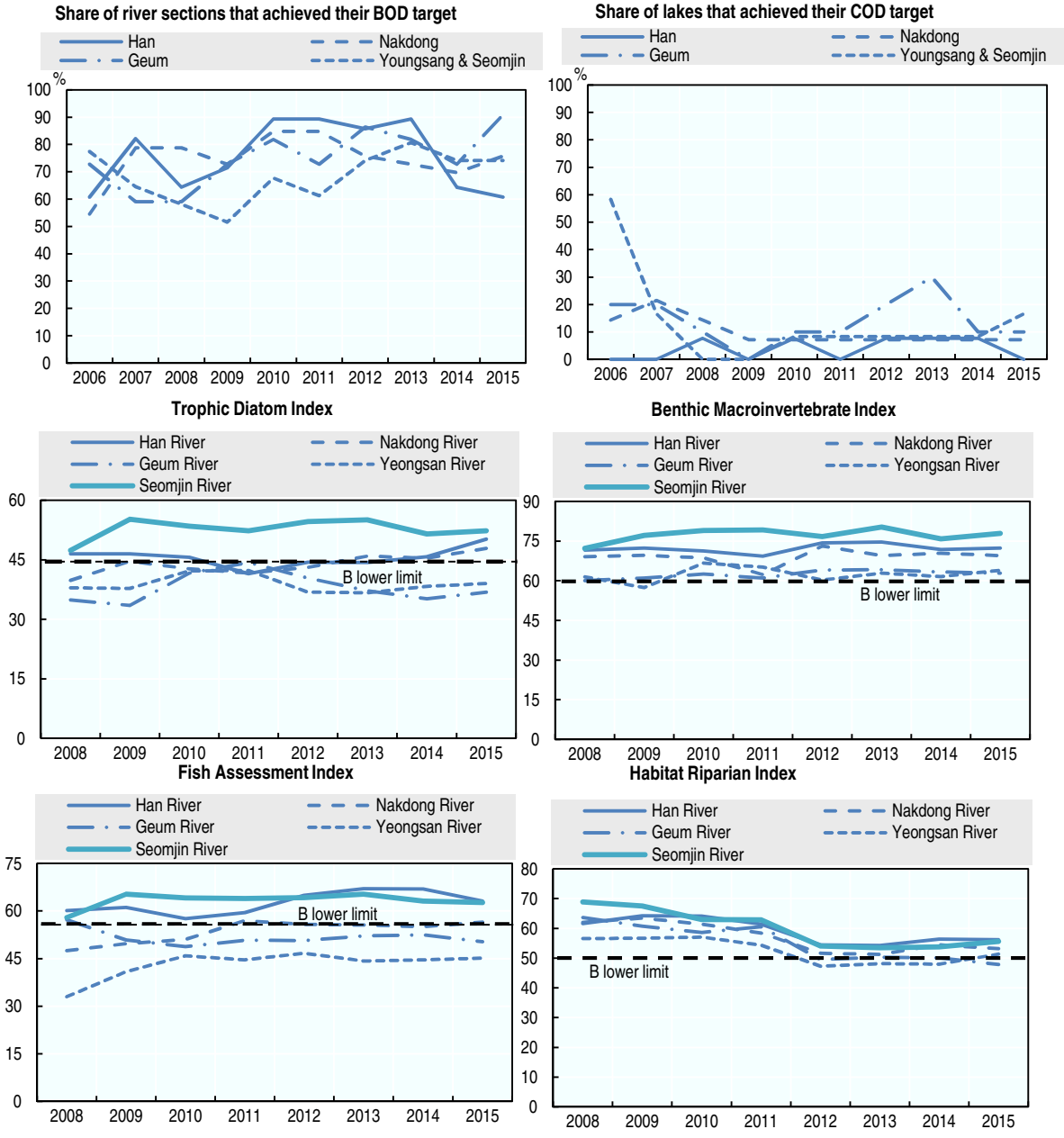
Water quality

Korea is close to achieving its water quality targets for rivers, but falls far short of those it has set for major lakes. Surface water is mainly provided by Korea's four major rivers: the Hangang, Nakdongang, Geumgang and Youngsangang. The first Water Environment Management Master Plan established water quality and aquatic ecosystem standards to protect health and the living environment: the overall objective was to achieve, by 2015, i) at least "somewhat good" water quality for 85% of river sections and 94% of major lakes, and ii) "very good" quality for 32% of river sections and 53% of major lakes. In 2015, 83.3% of river sections but only 65.3% of major lakes achieved at least "somewhat good" quality (MOE, 2016c).

Individual biochemical oxygen demand (BOD) and chemical oxygen demand (COD) targets were also established for 114 river sections and 49 lakes. In 2015, BOD targets were achieved for 75% of river sections and COD targets for only 8% of lakes (Figure 1.13) (MOE, 2015). Many Korean lakes are artificial, created by dam construction, and most serve as agricultural reservoirs. They are highly vulnerable to eutrophication as they have lower self-purification capacity than rivers and nutrients can easily accumulate. Eutrophicated waters lead to proliferation and increased frequency of algae blooms, resulting in higher costs to treat drinking water and water for industrial uses, as well as a decline in lakeside and riverside property values (MOE, 2015).

The National Aquatic Ecological Monitoring Program was introduced in 2007 to monitor and evaluate the health of freshwater ecosystems in the four major rivers as the focus of water quality management shifted from improving quality to preserving freshwater ecosystem integrity. It measures i) water quality, ii) ecological diversity and richness of aquatic organisms, and iii) habitat conditions for the reproduction, growth and adaptation of organisms. It evaluates biological parameters such as epiphytic algae, fish and benthic macro-invertebrates through the Trophic Diatom Index (TDI), the Fish Assessment Index (FAI) and the Benthic Macro-invertebrate Index (BMI). Habitat conditions are evaluated using the Habitat and Riparian Index (HRI or RAI) which looks at river flow speed, land use in riparian areas, artificial structures across rivers, stream channel conditions, etc. In 2013, 960 locations were evaluated, compared with 540 in 2007. Results were graded from 0 to 100 and assessed against a four level scale qualifying them as very good (A), good (B), average (C) or bad (D). Almost all rivers reached at least B for BMI and RAI, although habitat conditions have declined since 2008 and remained at the bottom of the B or C scales in 2014. The situation was more balanced for TDI and FAI: while the Seomjin, Han and Nakdong rivers reached B, the Geum and Yeongsan rivers have remained at C since 2012 (Figure 1.13; MOE and NIER, 2013; MOE, 2015).

Figure 1.13. **Korea is close to achieving river water quality targets, but falls short of those for major lakes**



Note: "B lower limit" refers to the lower threshold of the "good" (B) category for each index, as defined in the Aquatic Ecosystem Health indicator.
Source: MOE (forthcoming), *Second Master Plan for Water Environment Management: Appendix.*

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BOD and total phosphorus (T-P) have been falling gradually in recent years. However, COD levels increased in three of the four main rivers due to increased chemical discharges and inflows of non-degradable pollutants. There are two types of pollution affecting BOD and T-P levels: point-source and diffuse. Diffuse pollution comes from unspecified locations such as road surfaces and farmlands, mainly via storm water runoff. It represented 53% of the BOD load in the four major rivers in 2003, rising to 68% of BOD and 59% of T-P in 2010. The

predominant sources are land and livestock, which account for more than 90% of diffuse BOD and T-P pollution, and more than 65% of total water pollution. Point-source pollution is mainly from households (including wastewater), which are responsible for 74% of BOD and 61% of T-P point-source pollution and 28% of total pollution.

The main type of water pollution has shifted from point-source to diffuse over the past two decades. While the share of treated sewerage more than doubled, reducing point-source pollution, livestock production (particularly Korean native cattle, chickens and pigs) grew substantially, increasing diffuse pollution. In addition, the expansion of impervious surfaces associated with urbanisation has accelerated runoff and increased diffuse pollution from urban sources. Diffuse pollution is expected to account for 72% of BOD by 2020.

In 2004, Korea adopted the Total Water Pollution Load Control System, to manage the total pollutant quantity and meet water quality targets for watershed (Box 2.3). In 2012, the second Comprehensive Diffuse Pollution Source Control Measure (2012-20) shifted from pollutant concentration reduction to runoff volume reduction, and from post-treatment to preventive management-oriented policies. It is expected to reduce BOD pollution by 24.6% and T-P by 22.5% by 2020 from 2010 levels (MOE, 2016b, 2016c, 2015).

Water supply, sanitation and wastewater treatment

Korea achieved the 2015 target set in the National Waterworks Master Plan to extend access to public water supply to 96.5% of the population. When village waterworks[19] and small facilities[20] managed by local authorities are taken into account, the share increased from 87% in 2000 to 99%[21] in 2014 (MOE, 2016a). In 2011, 99% of controlled purification plants and 100% of tap water facilities complied with national water quality standards, but 4% of the small facilities inspected and 30% of wells in mountainous areas did not meet the standards (MOE, 2016a). The number of inspected small facilities that failed to achieve water quality standards has been steadily increasing due to unhygienic locations or inadequate management (MOE, 2015).

Access to sewerage has improved considerably. In 2014, 93% of the population was served by wastewater treatment services, compared with 71% in 2000. In addition, 83% of the population benefits from advanced (tertiary) treatment, a remarkable increase from almost nothing (1%) in 2000. In 2014, the sewage connection rate was 99% in large cities but only 66% in agricultural and fishing villages (MOE, 2016a, 2015). In the latter areas, public pipeline sewerage is often deemed too costly, and wastewater is managed more cost-effectively by small independent treatment facilities. Local governments are responsible for treatment of wastewater generated in their jurisdiction. The 2007 National Sewage Master Plan established several targets for 2015, including improvement of influent treatment quality through maintenance, repair of 93% of the sewerage infrastructure, increase of the sewerage connection rate to 92% of the population and 75% of the rural population, and increased reused rate for sludge (to 70%) and treated wastewater (to 18%).

The main government measure to reduce industrial wastewater volumes is establishing and operating terminal wastewater treatment facilities. In 2014, 100 terminals for industrial complexes and 75 for agro-industrial complexes were installed. Effluent quality standards are applied on seven pollutants, including BOD, COD, total nitrogen, and total phosphorus. Standards for BOD, COD and suspended solids are stricter for large discharge facilities. Permission or notification for the installation of wastewater discharge facilities is required.

Discharge fees are applied, and measures such as instruction, inspection and administrative dispositions are taken to ensure implementation of regulations (MOE, 2015).

The installation of livestock excreta treatment facilities with effluent standards is mandatory for livestock farms whose operations require authorisation or registration. In 2013, 87 large facilities were operating and 34 smaller facilities were being installed or expanded. As a result, 89% of livestock waste was composted in 2012. In addition, eight biogas plants producing energy from livestock waste were operating in 2014, with seven more planned (MOE, 2015).

Recommendations on climate change, air management and environmental information

Climate change

- Formulate a sector-by-sector roadmap with emission reduction goals and detailed measures to implement the 2030 GHG emission reduction target. Set intermediate steps to track progress towards the targeted path and adjust measures if necessary.
- Revise energy plans to ensure they are consistent with fulfilment of international climate change commitments.

Air quality management

- Consider introducing air pollutant emission cap management systems in areas with large industrial complexes outside the Seoul Metropolitan Area; continue tightening SO_x and NO_x emissions caps in the Seoul Metropolitan Area.
- Strengthen vehicle emission standards, narrowing the gap between testing conditions and on-road results.
- Pursue efforts to introduce low emission zones in areas affected by severe air pollution.
- Pursue regional co-operation to tackle transboundary air pollution.

Environmental information

- Strengthen efforts to establish a comprehensive and coherent water information system to better support national water policy; update information on freshwater resources and abstractions at national level more regularly.
- Improve knowledge of air pollution sources (domestic vs. transboundary) and of the impact of each upon health.

Notes

1. Including ISIC rev.4. Division 26 (Manufacture of computer, electronic and optical products) and Section J (Information and communication services).
2. Measured as urban population weighted average of annual concentrations of PM_{10} and subjective appreciation of water quality.
3. Population aged 65 and over.
4. Population aged 15-64.
5. It is based on a different estimation methodology and includes some non-renewable waste (such as industrial waste and waste gas) and “new” sources such as fuel cells.
6. Measures based on value expressed in passenger-kilometres.
7. Measures based on value expressed in tonne-kilometres.

8. Measured as the number of deaths from ambient air pollution multiplied by the value of a statistical life, which is calculated as an aggregation of individuals' willingness to pay to secure a marginal reduction in the risk of premature death (OECD, 2016d).
9. The Seoul Metropolitan Area comprises Seoul, Incheon and 24 cities in Gyeonggi-do.
10. DMC is the sum of domestic raw material extraction used by an economy and its physical trade balance (imports minus exports of domestic raw materials and manufactured products).
11. Primary waste excludes residues from treatment operations (secondary waste).
12. Including material recycling, composting and incineration with energy recovery.
13. Expressed as apparent consumption of nitrogen and phosphate fertilisers (in active ingredients) per hectare of agricultural land.
14. Schools, parking lots, gas stations, warehouses, railways, consolidated river/stream banks, fish farms, water supply sites, parks, sport and recreation sites/areas, religious sites, historic sites, cemeteries and miscellaneous areas.
15. Natural parks are designated to protect natural ecosystems, breathtaking natural scenery or cultural heritage.
16. Gross freshwater abstractions in total renewable resources.
17. Intensity of freshwater resource use is one of the ten key environmental indicators endorsed in 2001 by OECD Environment Ministers for public information and communication.
18. Based on "the minimum flow rate" needed for normal ecosystem functioning and river state, considering water use for households, industry, agriculture, environment, hydropower generation, water transport, etc. (River Act, Article 51).
19. Water supply system serving 100 to 2 500 customers and supplying 20 m^3 to 500 m^3/day.
20. Constructed and operated by residents, each one serves fewer than 100 customers or less than 20 m^3 a day.
21. This share drops to 97% when considering village waterworks meeting national standards, or to 96% when including national (multiregional) waterworks only.

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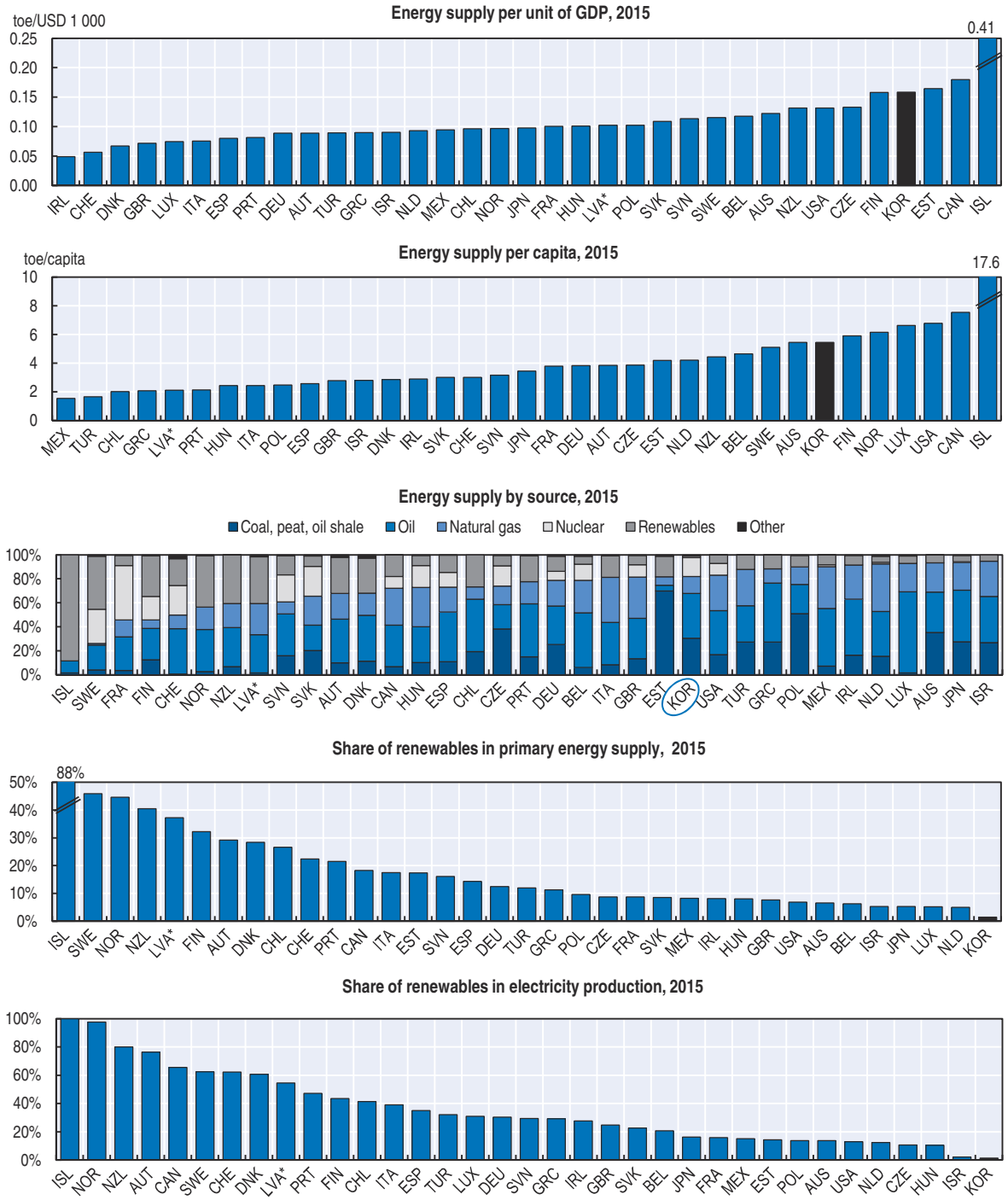
ANNEX 1.A

Energy and transport data

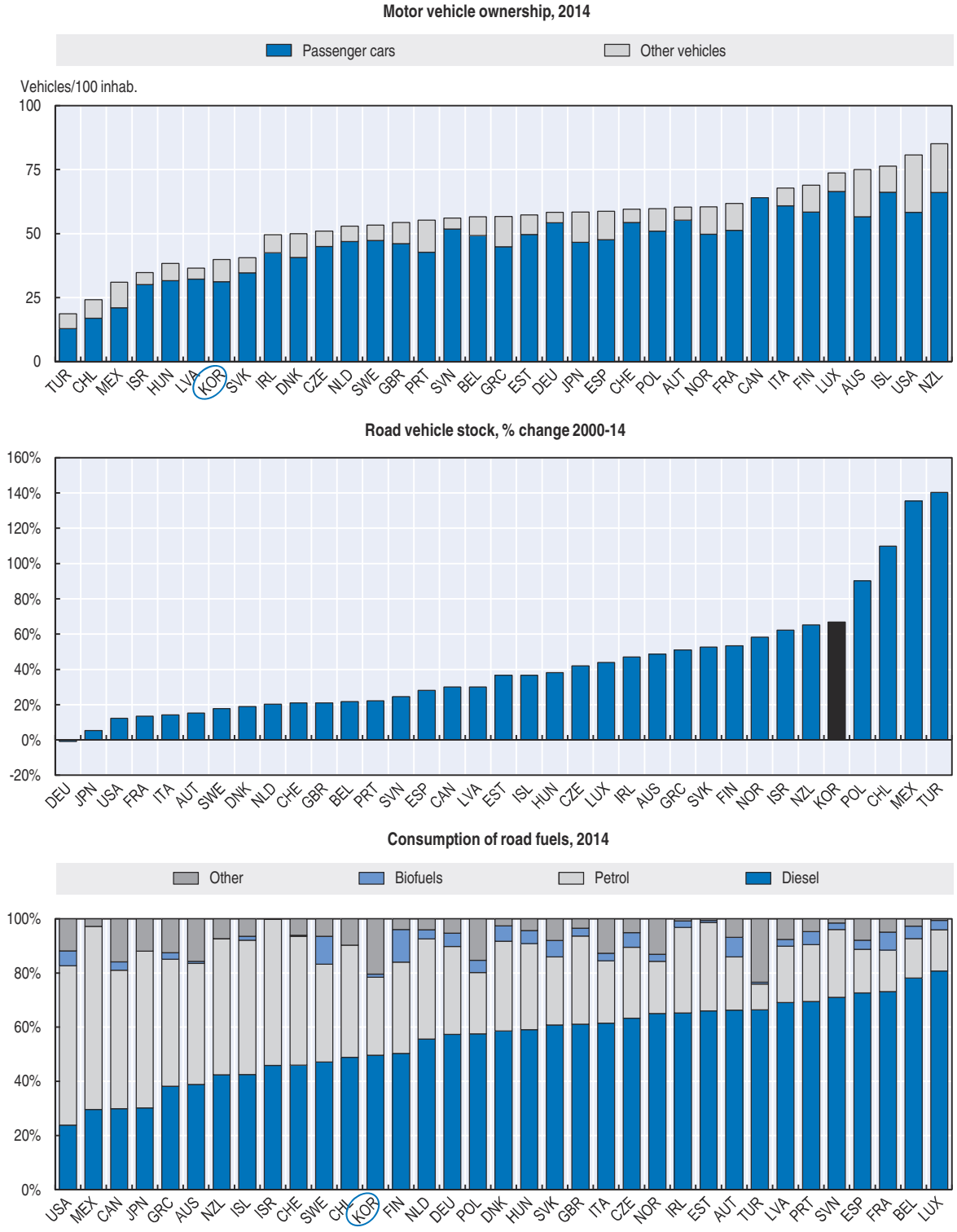
Figure 1.A1. **Energy structure and intensity**



Notes: Data may include provisional figures and estimates. Total primary energy supply: the breakdown excludes electricity trade. GDP at 2010 prices and purchasing power parities.
* 2014 data.
Source: IEA (2016), IEA *World Energy Balances* (database); OECD (2016), "Labour Force Statistics: Population projections", *OECD Employment and Labour Market Statistics* (database); OECD (2016), *OECD National Accounts* (database).

StatLink http://dx.doi.org/10.1787/888933449286

Figure 1.A2. **Road transport**



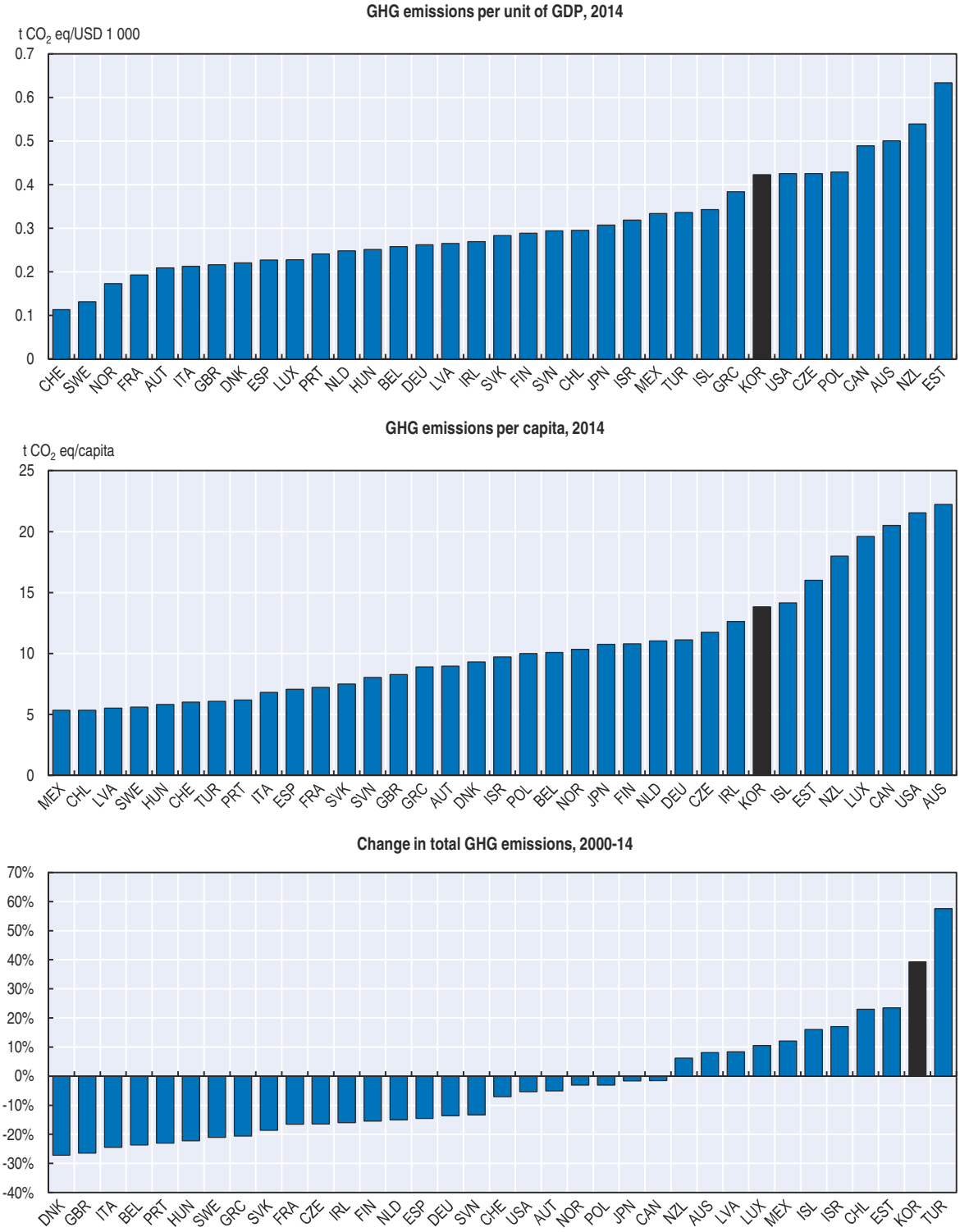
Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Motor vehicles with four or more wheels. Motor vehicle totals may not include exactly the same vehicle categories in different countries. CAN: data refer to total vehicles.
Source: Eurostat (2016) "Road Transport Equipment", *Transport* (database); IEA (2016), *IEA World Energy Statistics and Balances* (database); IRF (2016); *World Road Statistics*; North American Transportation Statistics (2016), *NATS* (database); UNECE (2016), *UNECE Transport Division Database;* national sources.

StatLink http://dx.doi.org/10.1787/888933449290

ANNEX 1.B

Climate change and air pollution data

Figure 1.B1. **GHG emissions and intensity**

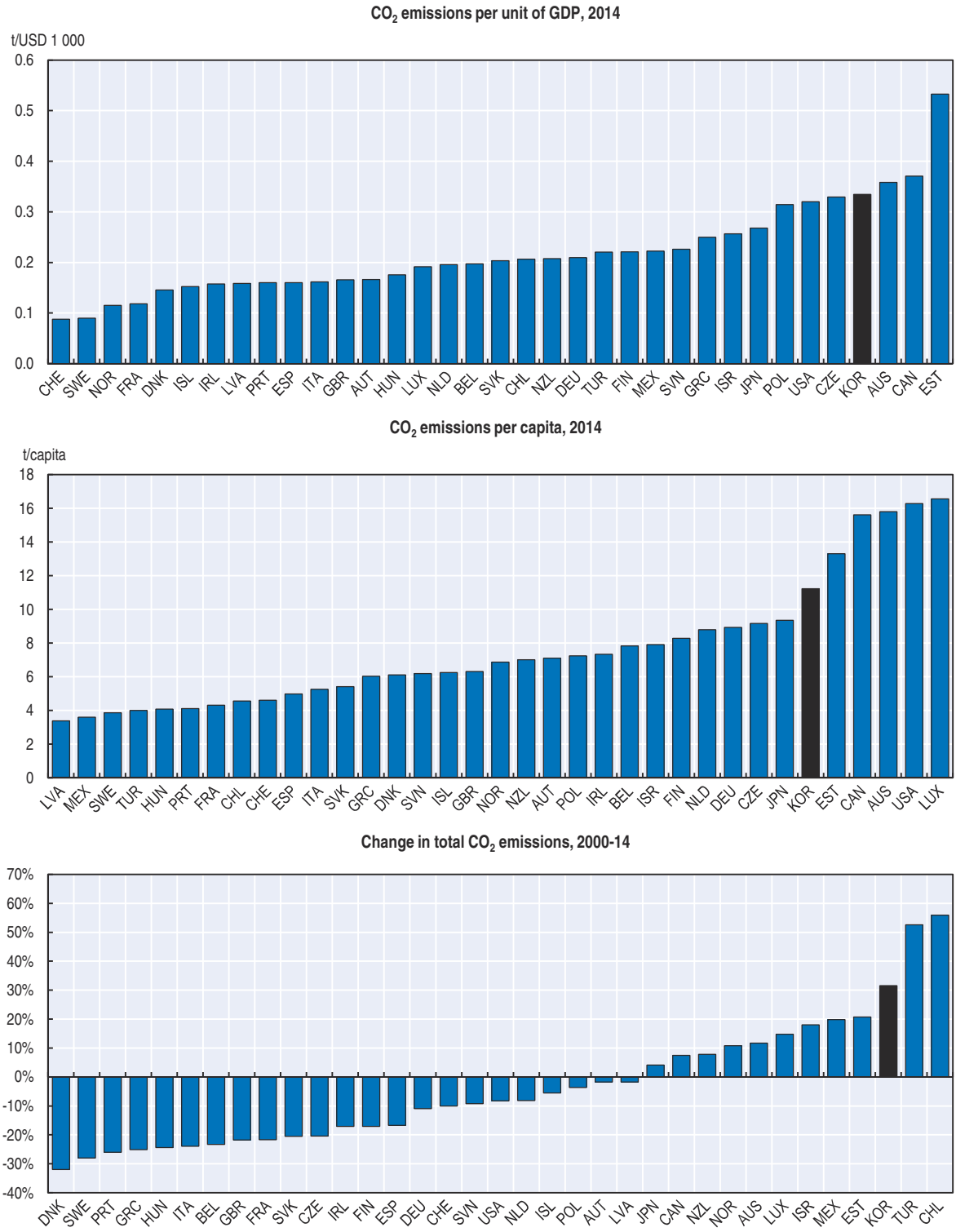


Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. GHG emissions excluding emissions/removals from land use, land-use change and forestry (LULUCF). KOR: 2013 data. MEX: data include emissions or removals from land-use change and forestry (LUCF). GDP at 2010 prices and purchasing power parities.

Source: OECD (2016), "Greenhouse gas emissions by source", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449305

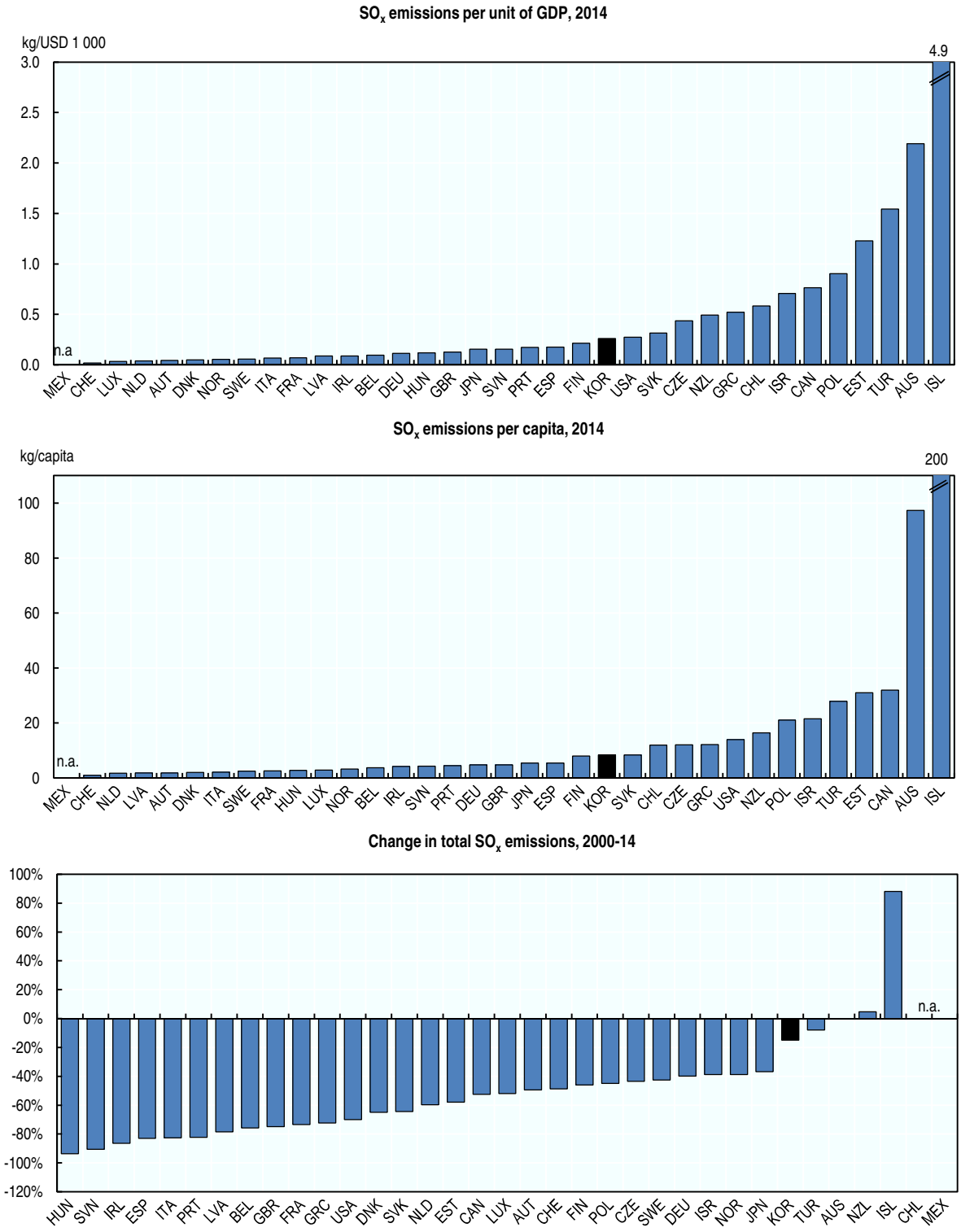
Figure 1.B2. CO_2 emissions and intensity



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. CO_2 emissions from energy use only; excluding international marine and aviation bunkers; sectoral approach. GDP at 2010 prices and purchasing power parities.
Source: IEA (2016), *IEA CO_2 Emissions from Fuel Combustion Statistics* (database).OECD (2016), "Labour Force Statistics: Population projections", *OECD Employment and Labour Market Statistics* (database); OECD (2016), *OECD National Accounts* (database).

StatLink http://dx.doi.org/10.1787/888933449317

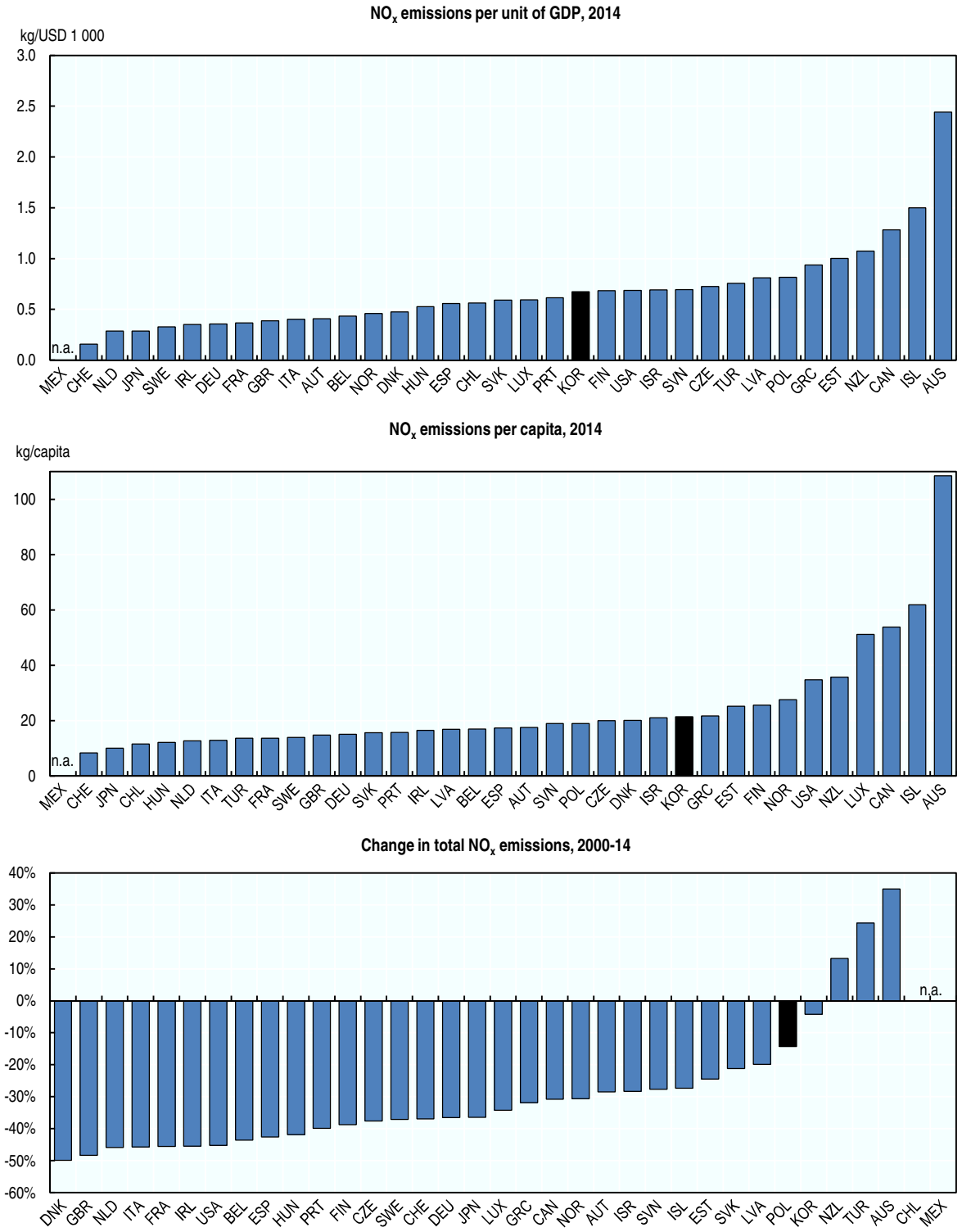
Figure 1.B3. SO_x emissions and intensity



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. GDP at 2010 prices and purchasing power parities. KOR: 2012 data.
Source: OECD (2016), "Air emissions by source", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449328

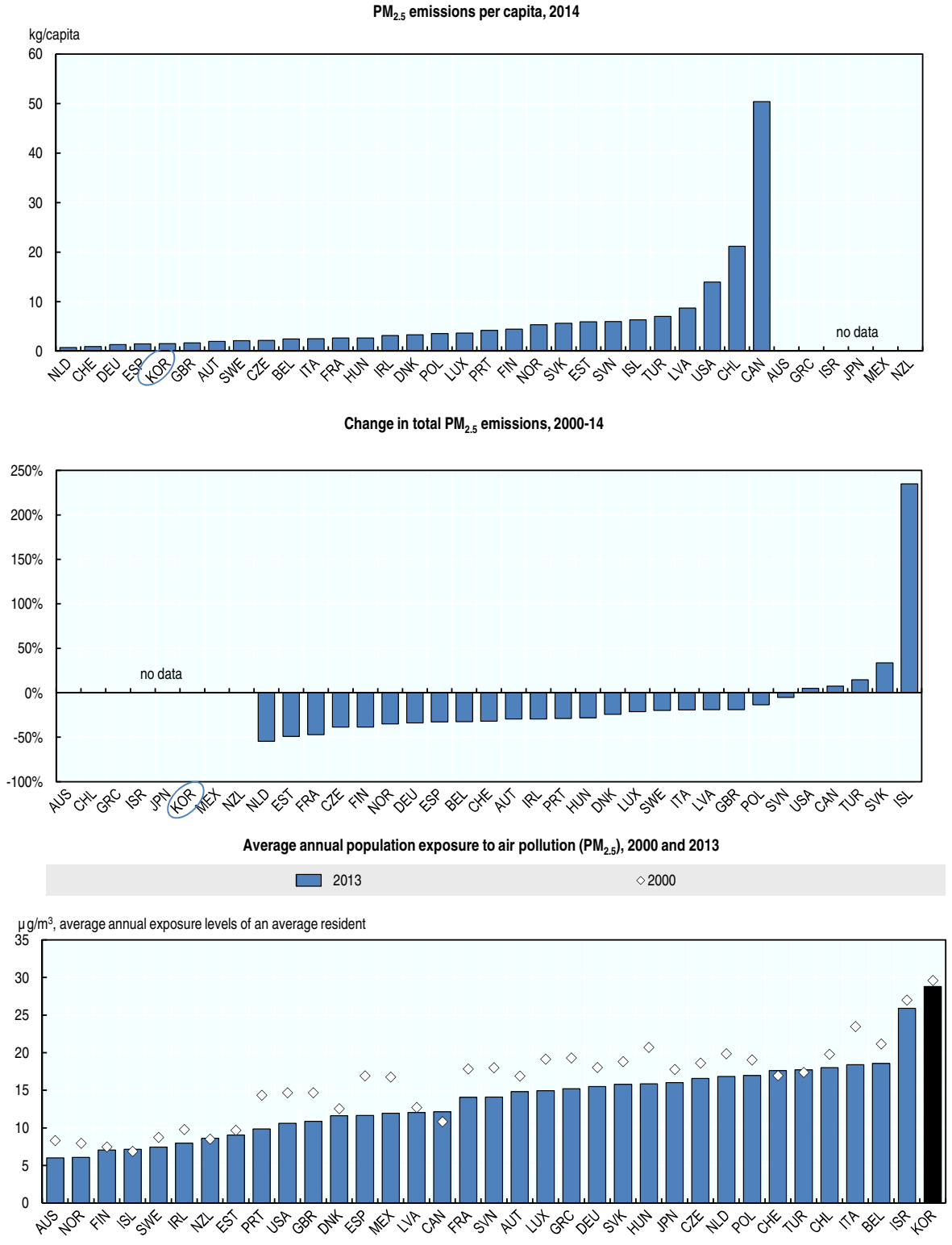
Figure 1.B4. NO_x emissions and intensity



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. GDP at 2010 prices and purchasing power parities. KOR: 2012 data.
Source: OECD (2016), "Air emissions by source", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449337

Figure 1.B5. $PM_{2.5}$ emissions and intensity



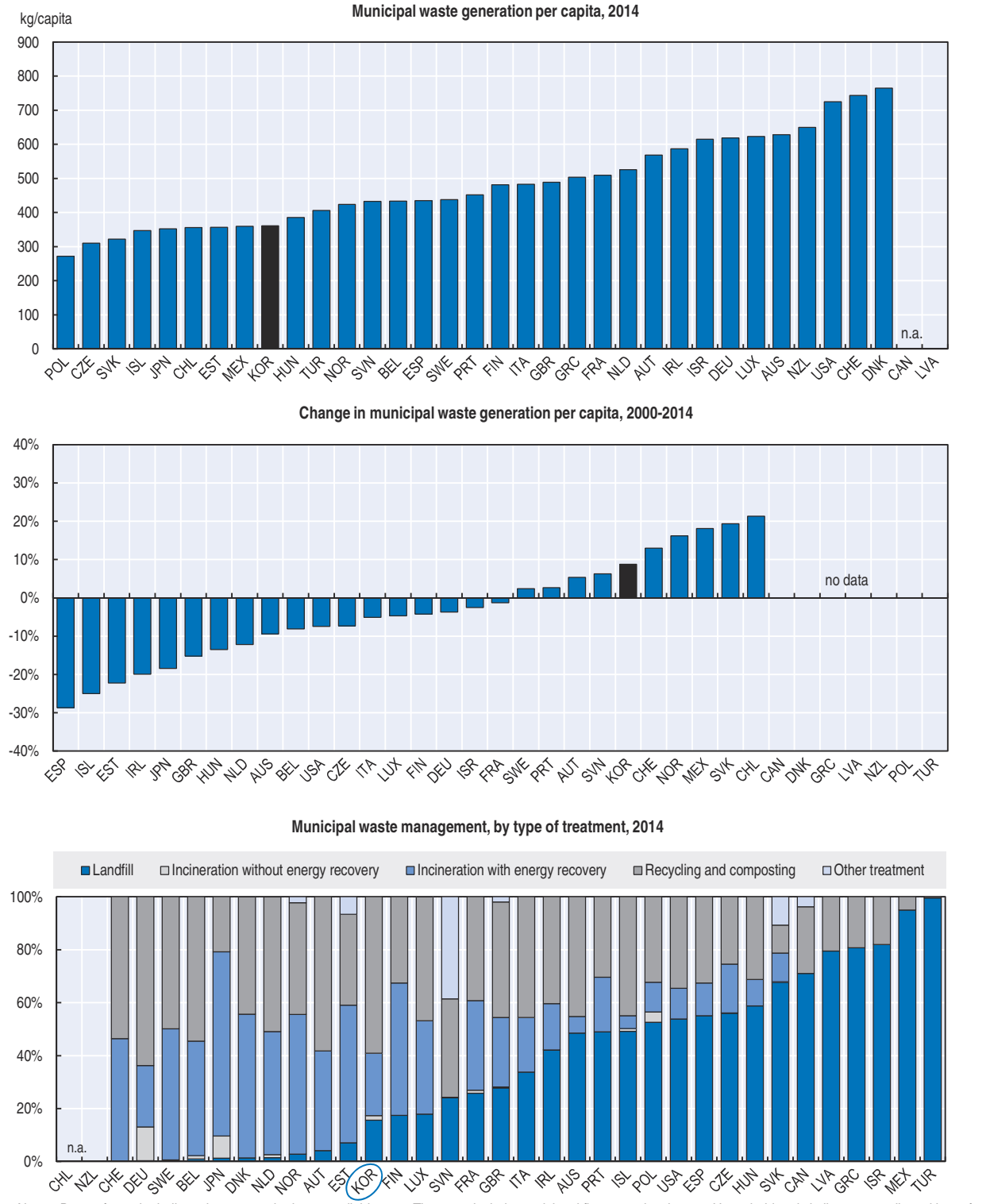
Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Population exposure to air pollution: estimates based on satellite observations and chemical transport models, calibrated against ground-based measurements. KOR emissions: 2012 data.
Source: OECD (2016), "Air emissions by source", *OECD Environment Statistics* (database); OECD (2016), "Exposure to air pollution", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449347

ANNEX 1.C

Waste and resource management data

Figure 1.C1. **Waste generation and management**

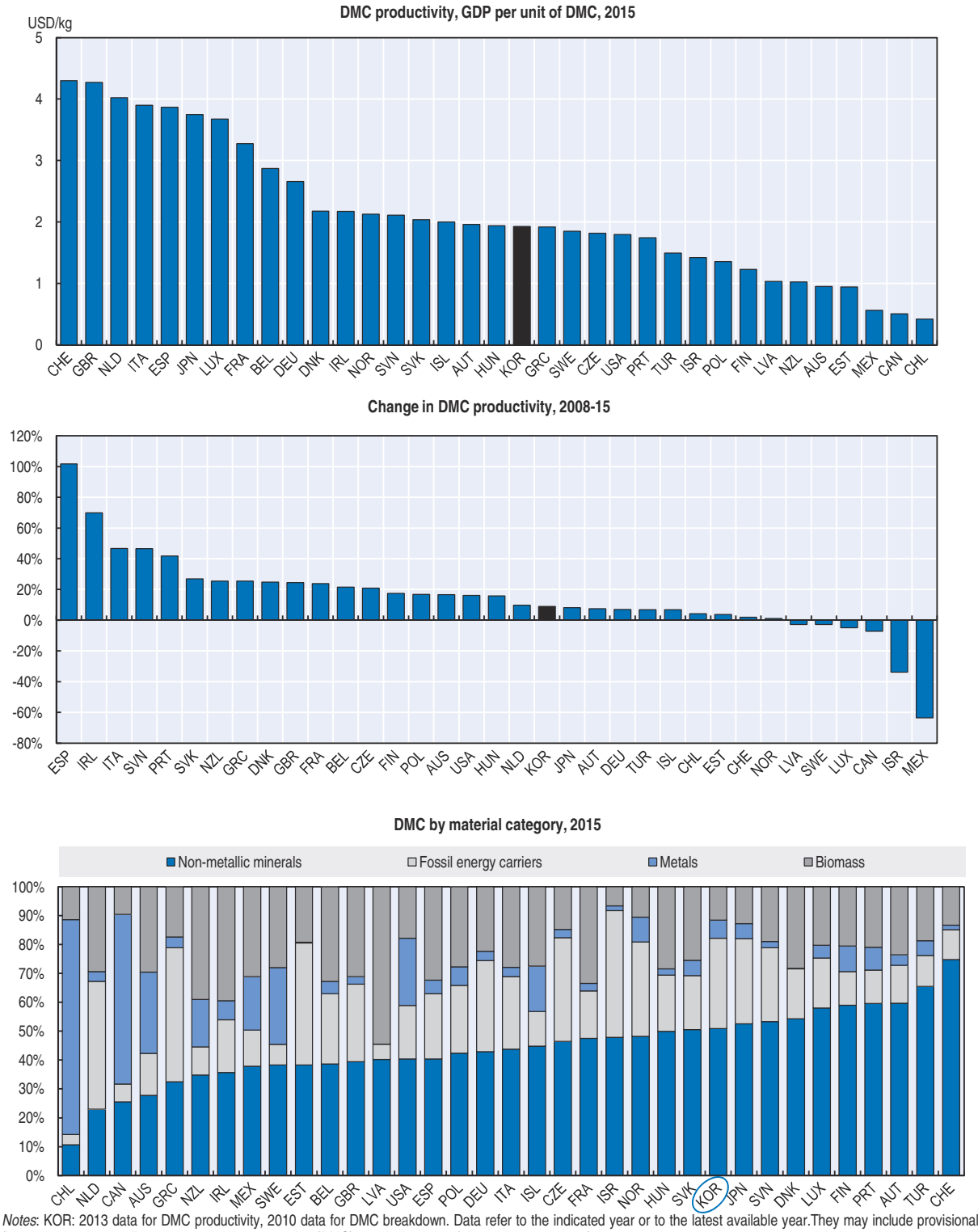


Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Household and similar waste collected by or for municipalities, originating mainly from households and small businesses. Includes bulky waste and separate collection. CAN: data include construction and demolition waste.

Source: OECD (2016), "Municipal waste", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449358

Figure 1.C2. **Material consumption and productivity**

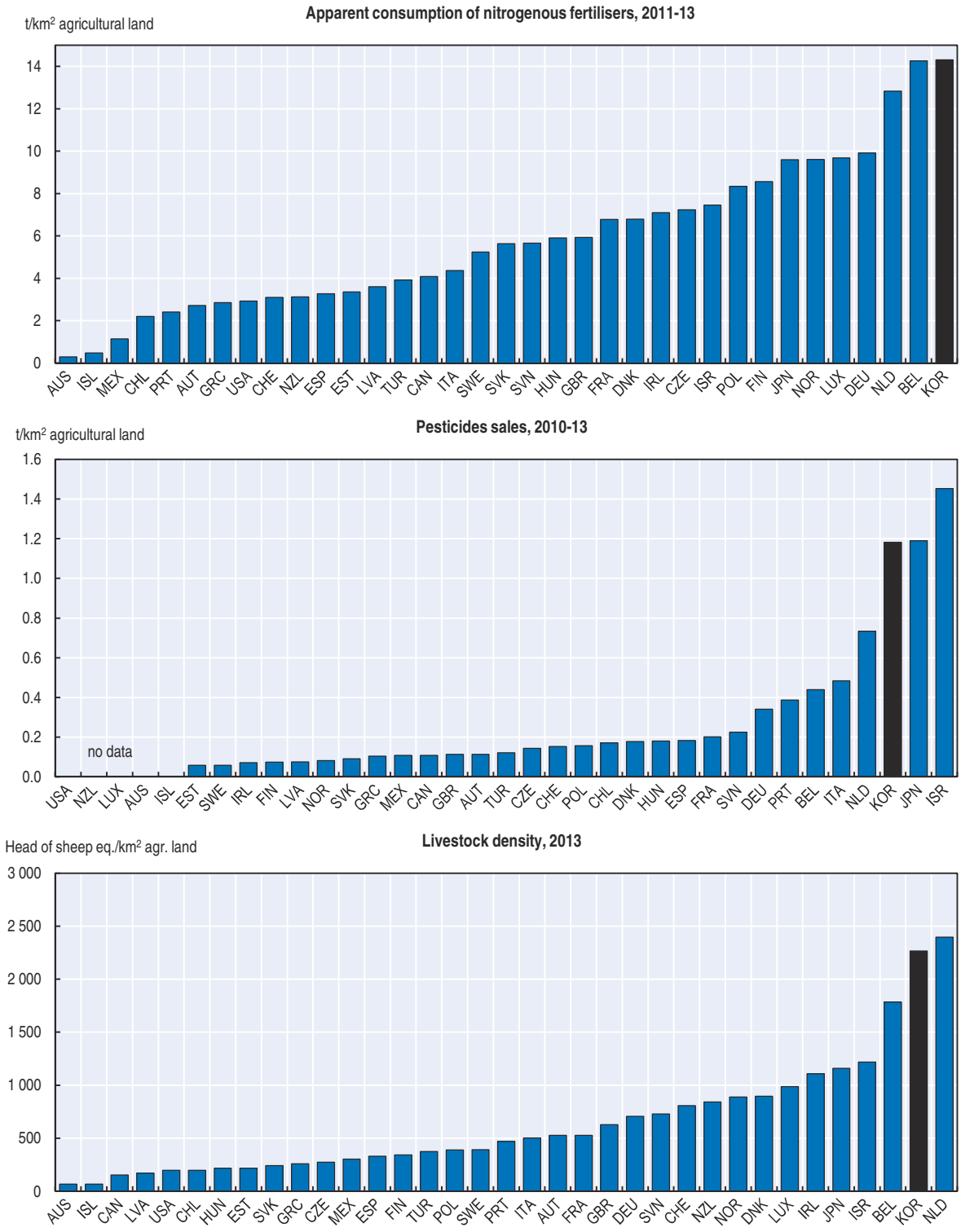


Notes: KOR: 2013 data for DMC productivity, 2010 data for DMC breakdown. Data refer to the indicated year or to the latest available year.They may include provisional figures and estimates. Domestic material consumption (DMC) equals the sum of domestic extraction of raw materials used by an economy and their physical trade balance (imports minus exports of raw materials and manufactured products). DMC productivity designates the amount of GDP generated per unit of materials used. GDP at 2010 prices and purchasing power parities. It should be born in mind that the data should be interpreted with caution and that the time series presented here may change in future as work on methodologies for Material Flow accounting progresses.

Source: Eurostat (2016), *Material flows and resource productivity* (database); OECD (2016), "Material resources", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449368

Figure 1.C3. **Agricultural inputs and livestock density**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. Conversion coefficients used to convert livestock heads in sheep equivalent: 1 for sheep and goats, 6 for cattle and buffaloes, 4.8 for equines,1 for pigs, and 0.06 for poultry birds.
Source: FAO (2016), *FAOSTAT* (database); OECD (2016), *Environmental Performance of Agriculture* (database).

StatLink http://dx.doi.org/10.1787/888933449378

ANNEX 1.D

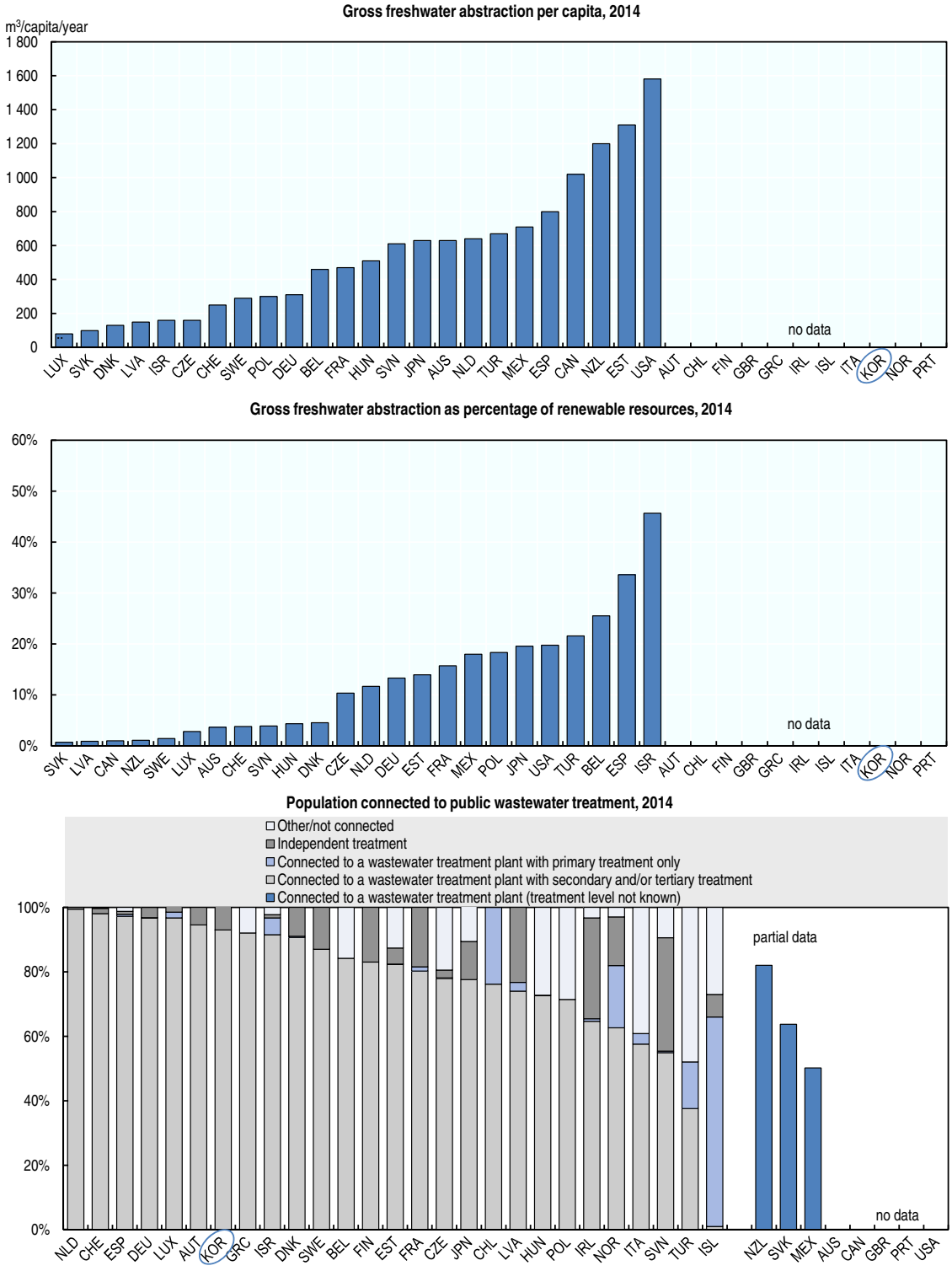
Biodiversity and water data

Figure 1.D1. **Fish catches and threatened species**

Notes: Fish data excludes aquaculture and whales, seals and other aquatic mammals, aquatic plants and other miscellaneous aquatic animal products. IUCN: categories critically endangered, endangered and vulnerable in percentage of known species. Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
Source: FAO (2016), *FAOSTAT* (database); OECD (2016), "Threatened species", OECD *Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449387

Figure 1.D2. **Water abstraction and wastewater treatment**



Notes: Data refer to the indicated year or to the latest available year. They include provisional figures and estimates. Freshwater abstraction: for some countries, data refer to water permits and not to actual abstractions. Wastewater treatment: "other" includes connected without treatment, not connected or independent treatment (where there is no data for independent treatment). KOR: 2013 data.

Source: OECD (2016), "Water: Freshwater Abstractions", *OECD Environment Statistics* (database); OECD (2016), "Water: Wastewater treatment", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449397

PART I

Chapter 2

Environmental governance and management

Korea has made significant progress in environmental governance over the past decade, including introducing strategic environmental assessment, reforming environmental permitting and strengthening environmental standards. This chapter examines Korea's environmental governance framework for environmental management, including mechanisms for horizontal and vertical co-ordination. It reviews the regulatory framework for environmental management, including for environmental impact assessment, land use planning and permitting, as well as enforcement and compliance assurance. It also briefly addresses the promotion of environmental democracy through public participation, access to information and environmental education.

1. Introduction

Korea has made substantial progress in implementing the *2006 OECD Environmental Performance Review* (EPR) recommendations in the area of environmental governance. The most important achievements are related to the introduction of strategic environmental assessment (SEA), the ongoing environmental permitting reform, and the strengthening of air and water quality and emission/effluent standards. These policy areas, along with achieving more effective and efficient compliance monitoring, represent key priorities of the Ministry of Environment (MOE), as challenges in these areas still persist.

At the same time, further environmental management improvements are held back by insufficient collaboration among key government ministries, lack of environmental policy implementation capacity and political will at the provincial and local levels, and limited engagement of civil society in environmental decision making.

2. Institutional framework for environmental governance

Korea has a centralised system of environmental governance, albeit with significant devolution and delegation of policy implementation responsibilities to provincial and local governments. Local authorities' political emphasis on economic growth, sometimes at the expense of environmental protection, and their capacity to adequately enforce environmental regulations remain key multilevel governance concerns, provoking a slow-down and in some cases reversal of the devolution process. At the national level, many environmental responsibilities (e.g. for water resource management) are fragmented across multiple ministries, and permanent rather than ad hoc co-ordination mechanisms have been put in place only recently.

2.1. National institutions and horizontal co-ordination

The MOE is responsible for environmental policy and legislative development, formulation and implementation of comprehensive plans for environmental conservation, and support for environmental management activities of local governments. Its annual budget grew by an average of 5.3% per year in real terms from KRW 3.6 trillion in 2006 to KRW 5.7 trillion in 2015. During this period the MOE lost some of its functions to other ministries: for example, management of the Emissions Trading Scheme was moved to the Ministry of Strategy and Finance (MOSF).

The MOE has four River Basin Environmental Offices, for the Han, Nakdong, Geum and Yeongsan river basins, and three Regional Environmental Offices, in Wonju, Daegu and Saemangeum, as well as the Metropolitan Air Quality Management Office in charge of improving air quality in the Seoul Metropolitan Area. The Regional Environmental Offices' tasks include developing and implementing environmental management plans in their areas of jurisdiction, providing formal MOE opinions on environmental impact assessment (EIA) and SEA reports, and supervising compliance assurance by local governments. After a major acid leak in Gumi in September 2012, the National Institute of Chemical Safety was

established as an affiliated agency of the MOE in September 2013 and made responsible for preventing and responding to chemical accidents and terrorism.

Other ministries with environment-related responsibilities include the Ministry of Agriculture, Food and Rural Affairs (MAFRA), Ministry of Trade, Industry and Energy (MOTIE), Ministry of Land, Infrastructure and Transport (MOLIT) and Ministry of Oceans and Fisheries (MOF). These ministries, along with the MOSF and the Ministry of the Interior (MOI), are part of the Commission on Sustainable Development, which since 2010 has been chaired by the environment minister. The commission, consisting of high-ranking public officials and experts, reviews the National Sustainable Development Master Plan as well as legislation and key administrative plans with sustainable development implications. Initially, the commission was convened under the president's office, but was relegated to the MOE to make way for the Presidential Committee on Green Growth (PCGG) at the ministerial level (Box 2.1). That committee, established in 2009, became the prime minister's responsibility in 2013 under a new administration that prioritises a "creative economy". Such institutional instability may hinder effective environmental policy implementation.

Box 2.1. **Korea's green growth institutional arrangements**

The Presidential Committee on Green Growth was established in January 2009 to formulate, co-ordinate, monitor and evaluate Korea's green growth strategy and policy. Its functions were further concretised in the 2010 Framework Act on Low Carbon, Green Growth, and in 2013 it came under the aegis of the prime minister's office. The committee has formulated the National Green Growth Strategy and master plans on climate change response and energy, among other initiatives. In terms of co-ordination, ministries and subnational governments must report their green growth action plans to the PCGG annually. The PCGG took 267 green growth-related projects submitted by 20 ministries and offices, and streamlined them into nine core projects. It has also undertaken evaluations of green growth policy implementation and suggested direction for improvement. Green growth policy is implemented by individual ministries, other public institutions and local green growth committees.

The PCGG has been held up as an example of multi-stakeholder collaboration for green growth policy development. It is co-chaired by the prime minister, with members including representatives from ministries, national research institutes, universities, the private sector and civil society. Despite its multi-stakeholder structure, however, non-government members have voiced concern that their participation is limited and that it is difficult to make their voices heard. Members meet regularly: 21 standard meetings and 11 policy implementation review meetings were held between January 2009 and October 2012. Since 2013 the work of the PCGG has been divided into four subcommittees: on green growth strategy, climate change countermeasures, energy, and green technology and industry. Furthermore, five multi-stakeholder green growth consultative groups – in the fields of industry, finance, science and technology, green lifestyle, and green IT – have been established to provide feedback to the PCGG on the feasibility and practicality of implementation of the policies it proposes.

Source: GGGI (2015), *Korea's Green Growth Experience: Process, Outcomes and Lessons Learned*; Choi (2014), "The green growth movement in the Republic of Korea: option or necessity?"; UNEP (2010), *Overview of the Republic of Korea's National Strategy for Green Growth*.

Collaboration between key government players in the environmental field, such as the MOSF, the MOE, MOLIT, MOTIE and MAFRA, needs to be reinforced significantly to overcome a historical "silo culture" of adversity and competition. As part of Government 3.0, a concept unveiled in 2012, efforts are under way to make inter-agency collaboration more effective. For example, six regional Chemical Accident Prevention Centres were established in 2013 with staff from the MOE, MOTIE, Ministry of Employment and Labour, Ministry of Public Safety and Security, local governments and associated institutions. Regarding climate change, there is some co-operation between the MOE, MOTIE and MOLIT.

The main institutional challenges are in the area of water management. After extensive droughts in 2015, a Water Management Committee was established under the Office for Government Policy Coordination, bringing together representatives of MOLIT (responsible for water quantity management, hydropower generation and inter-regional water supply), the MOE (water quality management, aquatic ecosystem conservation, water supply and sewerage infrastructure), MAFRA (agricultural water use) and other stakeholders depending on the committee's agenda, including representatives of subnational governments and state-owned corporations.[1] Such collaboration on water resource management goes in the direction of the 2006 EPR recommendation to consider combining policy functions for water quantity and quality. Inter-agency consultations on water management highlighted the need for an overarching legal framework, leading to elaboration of the latest draft Framework Act on Water Management, being considered by the National Assembly. Eight drafts of such an act have been considered since 1997 to provide a legal foundation for integration of water management functions and systems. The lack of success so far has been attributed to political disagreement between stakeholder ministries.

2.2. Subnational institutions and vertical co-ordination

Korea is divided into eight provinces (*do*), one special autonomous province (Jeju), six metropolitan cities, one metropolitan autonomous city (Sejong) and one special city (Seoul). Other administrative divisions include cities of at least 150 000 people (*si*), counties (*gun*), townships and villages.

Provincial and city governments play an important role, administering environmental permits and enforcing environmental laws as statutory delegates of the MOE. They also develop and implement environmental conservation policies within their jurisdiction and are in charge of municipal waste management, local water supply and sewage treatment, as well as regulation of vehicle emissions and noise.

Since 2002, 328 environmental responsibilities have been devolved to local governments, and 128 further tasks have been delegated to them by the MOE (KEI, 2013). In 2008, decentralisation was reconsidered in the Special Act on Local Decentralisation and the Reform of the Local Administrative System, which stipulated more gradual devolution with priority on delegating rather than transferring responsibilities, and the return of certain responsibilities (e.g. chemical management) to the central level.

Most local authorities lack fiscal autonomy and rely on financial transfers from the central government. The degree of fiscal autonomy is defined as the ratio between local tax revenue and the local budget, with the gap covered by central government subsidies. The degree of fiscal autonomy ranges from 80% in Seoul to an average of 11.6% for *gun* governments; the overall average is 45%. While over 60% of the MOE budget is spent on support to local governments, responsibilities were often devolved to the provincial and local

levels without sufficient funding. Financial transfers tend to address immediate priorities rather than long-term local capacity needs. As a result, subnational governments, especially outside the Seoul Metropolitan Area, lack human, technical and financial resources to carry out these responsibilities, notably in compliance monitoring and enforcement (KEI, 2012b). The MOE carries out a capacity building programme, including training, for local authorities to address this challenge.

While administrative capacity of local governments has substantially improved in recent years, the lack of competent local environmental staff remains a major constraint. Moreover, environmental tasks are often assigned low priority and fragmented across several divisions (e.g. in charge of health or forest management) within a local government (MOE, 2013). Local authorities seem to have particular difficulty handling air quality and industrial and commercial waste management issues, where powerful private sector interests are involved. More generally, local economic development considerations tend to take precedence over environmental ones.

General policy co-ordination between the central and local governments is carried out by the Local Government Policy Council, created in July 2015. The Central Government Policy Delivery Council also assists in communication between government levels. A joint annual evaluation assesses the performance of local governments in executing delegated responsibilities and state-funded projects (mostly using output indicators such as number of inspections conducted). Regional councils formed by the MOE and several local governments address specific environmental issues in some regions. Environmental co-operative conferences on various environmental topics are held to promote vertical policy co-ordination. Still, the level of vertical collaboration is insufficient in some policy areas, including water resource management (Ahn et al., 2015).

3. Setting of regulatory requirements

Korea's Constitution (Article 35) states that all people have the right to live in a healthy and pleasant environment. The country's environmental regulatory framework is made up of laws, enforcement decrees, ministerial decrees and regulations. Since 2006, many issue-specific environmental laws have been amended, notably those governing air, water and soil pollution, as well as EIA; and several important new laws have been adopted, including the Framework Act on Low Carbon, Green Growth (2010) and the Environmental Education Promotion Act (2008).

3.1. Regulatory impact analysis

The quality of draft versions of new and amended regulations is considered by a "regulation self-evaluation committee" in each ministry. They deliver their opinion to an independent Regulatory Reform Committee, which deliberates further on the appropriateness and feasibility of the proposed regulatory change and may return the assessment to the ministry if it deems the analysis to be inadequate. In 2015, Korea's score on the OECD Regulatory Impact Analysis (RIA) Index was slightly above the OECD average for both primary laws and secondary regulations (OECD, 2016). However, RIA applies mostly to regulatory proposals developed by the executive branch (OECD, 2015a).

RIA is a key part of the Korean government's "cost-in cost-out" initiative. Following a court decision imposing rigorous ("scientific") cost-benefit analysis of draft policies and regulations, the MOE developed a manual for such analysis of environmental measures and

works with other agencies to conduct quantitative analysis of costs and benefits of draft regulations. As of early 2016, only eight draft regulations had undergone cost-benefit analysis. In cases where such quantitative analysis is complicated, regulations are assessed using indices based on qualitative evaluation of their potential economic, social and financial impact.

Two independent RIA centres have been established, under the Korea Development Institute and the Korea Institute of Public Administration, to ensure that all the RIA requirements are fully met and that government does not view RIA as a formality. In September 2015, the government introduced an e-RIA system enabling officials to prepare, submit and review RIA reports online (OECD, 2016). All RIA reports are published on the relevant ministry websites. The public can comment on drafts of major laws, but not on proposed implementing regulations (Chapter 5). *Ex post* evaluation of the impact of environmental legislation is part of several legislative review and improvement programmes.

3.2. Key regulatory requirements for economic activities

This section provides a brief overview of instruments used to regulate air and water quality and respective pollution releases. Waste management regulations are addressed in Chapter 4.

Air quality and emission standards

Korea sets ambient air quality standards for seven major pollutants: SO_2, NO_2, CO, fine particulate matter (PM_{10} and $PM_{2.5}$), ozone, lead and benzene. Industry-specific emission standards are set for 26 substances. They have been progressively tightened every five years; the most recent ones went into effect in 2015. Even stricter emission standards can be applied to industrial complexes (as is the case for the Ulsan-Onsan and Yeosu industrial complexes) and other areas of severe air pollution designated as "air conservation special countermeasure areas".

Emission standards can be made more stringent by a municipal ordinance in designated "air quality control areas" and other areas where it is difficult to meet national or regional air quality standards. For example, industrial installations emitting air pollutants in the Seoul Metropolitan Area are regulated by the Special Act on the Improvement of Air Quality in Seoul Metropolitan Area (2003), which established an emission control regime as part of an air pollutant emission cap management system for the entire metropolitan area (Box 2.2). In addition, the Clean Air Conservation Act (2007) requires facilities that produce fugitive dust (over 80% are construction businesses) to report to the local government and adopt preventive practices promoted by the government through continuous guidance, inspections and education.

Korea has made considerable progress with respect to the 2006 EPR recommendation to strengthen vehicle emission and fuel efficiency standards. In 2009, it adopted California's "fleet average" system for non-methane organic gases (NMOG) from petrol-fuelled vehicles, in which a carmaker can offer a range of models with different emission levels as long as its fleet meets a prescribed level of average NMOG emissions, which is lowered over time. Diesel vehicle emission standards follow the European example and were last updated in 2013. Since 2014, diesel emissions have been regulated under Euro 6 limit values. As studies have shown the real-world NO_x emission performance of Euro 5 and 6 vehicles to be far poorer than test-cycle measurements in laboratories (Carslaw et al., 2011; Franco et al., 2014), Korea introduced real-driving emission standards on top of

Box 2.2. **Managing air pollution in the Seoul Metropolitan Area**

The Seoul Metropolitan Area air pollutant emission cap management system has been implemented since 2008 as part of measures to control metropolitan air quality. It allocates yearly emission allowances for nitrogen oxides (NO_x) and sulphur oxides (SO_x) to large facilities, requiring them to keep their emissions within the allowances and allowing them to trade any surplus allocations. Fines are imposed on facilities that exceed their total allocated emission amount and have not purchased adequate allowances to cover the excess emissions. The system initially covered 117 of the largest-emitting installations and has gradually been expanded to lower emitters; 295 facilities were participating by the end of 2013.

Allocations in the first year, 2008, were 2.3 times higher than emissions for NO_x and 2.1 times higher for SO_x, casting doubt on the system's effectiveness. However, allocations have since been continuously reduced, and in 2013 NO_x and SO_x allocations exceeded emissions by only 20%. Emission trading affected only 1.4% of NO_x emissions and 0.5% of SO_x emissions in 2008, but by 2013 the respective shares were 6% and 23%, at unit prices of KRW 285 000 per tonne of NO_x and KRW 180 000 per tonne of SO_x. Future allocations are expected to be assigned at the levels of actual emissions, further increasing demand for emission trading. Now that the system has been tested and shown to work, it could be expanded to other parts of the country with large industrial complexes.

The Seoul Metropolitan Air Quality Control Master Plan (2005-14), aimed at improving PM_{10} and NO_2 concentrations to the levels of Tokyo, Paris and other major cities by reducing air pollutant emissions by half from 2001 levels by 2014. While air quality improved significantly over the period, the concentration targets were not achieved. In 2013, a second master plan (2015-24) was formulated, adding targets for $PM_{2.5}$ and ozone. Measures to achieve these goals consist of motor transport management – including a project to reduce exhaust gas from vehicles in operation – and total emission load management for large installations.

Source: MOE (2015), *Ministry of Environment*, brochure, *http://eng.me.go.kr/eng/file/readDownloadFile.do?fileId=115224&fileSeq=1&openYn=Y*.

existing in-laboratory standards in 2016 (MOE, 2016a). Fuel regulations also apply; for example, the sulphur content of diesel and heavy fuel has been regulated since 1981, and standards have been continuously tightened. Since 2012, diesel fuel supplied throughout the country must have a sulphur content at or below 0.1% (MOE, 2015).

Water quality and effluent standards

Since the early 2000s, water management policies have focused on river basins to address conflicts between upstream and downstream reaches and between urban and agricultural regions. The key instruments of river basin management include the Total Water Pollution Load Management System (TPLMS) (Box 2.3), riparian zone designation, land purchase and establishment of a river management fund from water use charges.

Water quality targets are set for major rivers and lakes throughout the country. The water quality classification system consists of seven grades across seven pollution parameters for rivers and eight for lakes with respect to aquatic ecosystem protection ("living environment standards"), with a grade assigned to each river reach and lake as the water quality target. The criteria include biological water quality standards, as recommended by the 2006 EPR. In addition, ambient water quality standards for human health protection are set for 20 chemical substances, consistent with good international

Box 2.3. **Total Water Pollution Load Management System**

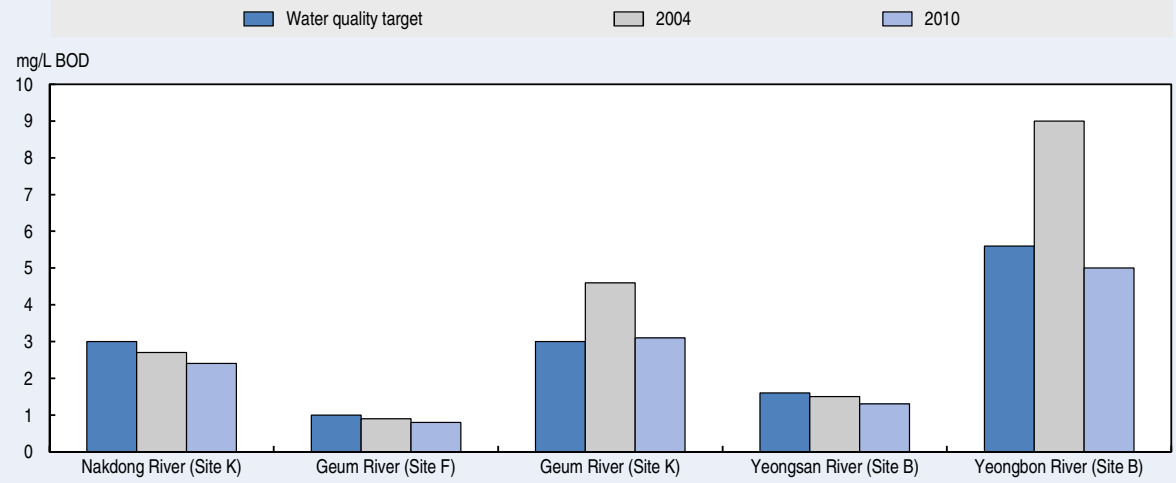
The TPLMS sets water quality goals for each river basin based on scientific evidence, limiting the total amount of pollutant load for each water body. It also calculates total pollutant discharges to reach these goals, and allocates discharges to each local government in the river basin to keep the total volume of emissions from each section under the permissible level. If the total pollution load for certain parameters is exceeded, specific measures to reduce it are prescribed, with the MOE monitoring their implementation. Only biochemical oxygen demand (BOD) was targeted by load management until 2010 (leading to a more than 60% reduction in BOD discharges compared to 2002); in stage 2 (2011-15), total phosphorus was added as a target pollutant, and there are plans to expand the coverage to other substances.

Initially, three river basins (Nakdong, Geum and Yeongsan-Seomjin) had to carry out load management if they did not reach the water quality goals. Since June 2013, the TPLMS has been extended to the Han River basin and areas that are not part of the four major river basins but are affected by severe water pollution. As of June 2015, the TPLMS had been implemented by 122 local governments. Pollution load is allocated from top to bottom: from the watershed to each local government, then to a group of pollution sources, then to individual facilities. Feasibility, equity, cost of pollution reduction and local policies are all factors in load allocation.

Local governments applying the TPLMS must formulate a pollution load management master plan that includes pollution load allocation and reduction plans to meet the targets. "Basic plans" at the watershed level are developed under the jurisdiction of metropolitan mayors or provincial governors and are approved by the MOE, while more detailed "action plans" are submitted by local mayors for approval at the metropolitan or provincial level. The allocation of pollution load permits to individual facilities to attain and maintain the overarching target for the watershed is done in accordance with technical guidelines issued by the National Institute of Environmental Research.

The TPLMS has contributed to improving water quality in many previously polluted areas: in 2015, water quality targets were achieved in 75% of rivers, but in only 8% of lakes. The figure below demonstrates BOD reductions in the Nakdong, Geum, Yeongsan and Yeongbon rivers.

Figure 2.1. **Water quality improves in several river basins**



Source: OECD (forthcoming), *Diffuse water pollution in OECD countries: Policies and principles for action.*

StatLink http://dx.doi.org/10.1787/888933449050

Source: MOE (2015), *Ministry of Environment*, brochure, *http://eng.me.go.kr/eng/file/readDownloadFile.do?fileId=115224&fileSeq=1&openYn=Y*.

practice. While the water quality targets and standards are regarded as policy goals, the TPLMS pollution load limits are directly enforceable.

Effluent standards (discharge limits) have been set for 49 parameters, including organic substances, suspended solids and phenols. Their number has increased significantly since the 2006 EPR, and many standards (e.g. for total nitrogen and total phosphorus discharges) have been made more stringent, representing important progress. Receiving water body characteristics such as water quality grade are considered in the application of the effluent standards. To comprehensively manage the ecosystem impact of hazardous water pollutants, an effluent standard measured in "toxic units" (a composite measure of concentration reflecting the toxicity of individual substances) has been applied to industrial facilities and wastewater treatment plants since 2011.

With regard to diffuse water pollution, environment-friendly land use has been promoted from the early stages of development and land use projects by continuously applying non-point source (NPS) management provisions to 27 regulations and guidelines associated with EIA, city master plans and forestry legislation. Eight regions where diffuse pollution may significantly harm aquatic ecosystems were designated as NPS Control Areas, and pollution reduction projects involving land use improvement have been implemented.

3.3. Environmental impact assessment

EIA, in use since the early 1980s, is the cornerstone of Korea's environmental regulation. The Environmental Impact Assessment Act (1993, last amended 2012) requires EIA as a precondition for a construction permit in 17 activity sectors (80 types of projects), mostly covering infrastructure development. The government plans to extend EIA requirements to several other types of projects. However, for industrial sites, only those with a surface area greater than 150 000 m^2 are subject to EIA, but these accounted for less than a quarter of EIAs conducted in 2011 (KEI, 2012a). This size criterion does not take account of the potential environmental impact of an industrial facility and may leave many hazardous facilities outside the EIA coverage.

EIA scoping, including description of alternatives (but not concerning site selection, already determined in a master plan), is set out in a preliminary assessment report reviewed by the EIA Council. The council is made up of representatives of the approving authority (a local government or a ministry), other relevant public officials, experts and residents' representatives. The 2012 amendment of the EIA Act gave residents near the work site – but not the public at large or non-government organisations (NGOs) – an opportunity to comment as early as the EIA scoping phase, and again while a draft EIA report is prepared. However, there is no obligation for authorities to consider the public's comments (Chapter 5). The EIA report is submitted to the approving authority, which must consult the MOE before deciding whether to grant the permit. After the report's approval, the operator is responsible for monitoring the project's impact and reporting to the MOE and the approving authority.

A project that does not fall under EIA Act requirements may undergo an EIA by a local government (in metropolitan cities, provinces and cities with a population of at least 500 000) based on a local ordinance if the project raises local environmental concerns. As of 2014, eight local governments, including the cities of Seoul, Busan, Incheon and Daejeon, had applied this provision.

A simplified, small-scale EIA can be used when a development project is planned in one of the 19 environmental conservation areas designated under the National Land Planning

and Utilization Act (2002), Mountainous Districts Management Act (2002), Natural Parks Act (1980, amended 2001) and Wetlands Conservation Act (1999). The developer must prepare a small-scale EIA report and request approval from the MOE. No public participation takes place as part of this procedure (MOE, 2015).

An extensive information and services network supports the EIA procedure. The online EIA Support System provides EIA-related information to the project proponent, the local authority and the public to ensure transparency. The MOE has developed about 50 guidelines and regulations on EIA in specific activity sectors. The Korea Environment Institute (KEI) has been a professional reviewing agency for EIA matters since 1997. The KEI reviews assessment reports and delivers formal opinions upon request from the MOE. An EIA Agent System aids the MOE in licensing professional engineers and EIA consulting firms. There were more than 330 EIA consulting firms in 2012 (KEI, 2012a).

By late 2014, over 5 100 EIAs had been conducted, with nearly 90% of EIA reports approved, almost always with additional environmental conditions. The effectiveness of the EIA system is illustrated by the fact that, between 2012 and 2015, EIA conditions imposed on industrial complex projects led to emission reductions of 56% for cadmium and 27% for PM_{10}, as well as 46% more green space conservation, compared to projections of preliminary assessment reports (MOE, 2016).

3.4. Land use planning and strategic environmental assessment

Korea faces rapid urbanisation and deterioration of natural ecosystems. The surface area of urbanised and dry areas doubled between 1989 and 2009; over the same period, the area of grasslands decreased by 24% and of wetlands by 61% (MOE, 2016). To address this challenge, the comprehensive national land plan (2006-20, modified 2011), lays out a vision of "global green national land" for Korea, while the fifth National Forest Plan (2008-17) calls for "establishment of a balanced mountainous district management system" and expansion of green urban spaces.

The provisions of the comprehensive national land plan, comprehensive provincial plans and regional and sector plans are used to develop larger city (*si*) and county (*gun*) master plans, which guide local authorities' more specific management plans. For example, the third Seoul Metropolitan Area Readjustment Plan (2006-20) and Sejong Urban Master Plan (2015-30) integrate sustainable mobility considerations pursuant to the 2006 EPR recommendation on better integration of transport, housing and land use policies in the context of sustainable development.

In addition, the concept of concurrence between national plans for land and for environment entails close co-ordination between land use plans and Basic Plan for Natural Environment Conservation (the current one, the third, covers 2016-25) at an early stage. This concept was inscribed in amendments to the Framework Act on Environmental Policy in December 2015, and the MOE has prepared general guidelines for its implementation, but implementing it requires increased collaboration between the MOE and MOLIT. Such concurrence allows environmental considerations to be better taken into account in land use planning and should be pursued further.

Various development acts, such as the Industrial Sites and Development Act (2009), have complicated land use planning. Industrial complexes, power sector facilities, even urban residential areas are routinely developed either bypassing regular territorial planning or having the latter validate predetermined development projects. As a result, in

many instances planning is led by development rather than guiding it (Lim, 2014). Various development acts have complicated the planning system that controls territorial development.

By 2016, the MOE had reviewed 75% of environmental regulations and revised "unrealistic and unreasonable" ones to facilitate business investment and economic revitalisation (CMEJ, 2016). For example, green belt restrictions could be lifted in the Seoul region, enabling development in areas of high conservation value. There is evidence that economic development and investment increasingly take precedence over biodiversity conservation. Two high-profile cases are proposals to build a ski run for the 2018 Winter Olympics in a native forest and to install cable cars in some national parks (e.g. Seoraksan Mountain National Park). Currently pending in the National Assembly is an act to promote tourism in mountain areas, which would allow tourism infrastructure development in protected and other ecologically sensitive areas. Local governments, which have recently assumed the management of many protected areas, largely support such initiatives, which pose concerns for biodiversity that is already under high pressure from urbanisation (Chapter 1). In addition, there is a proposal to lift a ban on siting new polluting facilities in areas that do not meet environmental quality standards.

SEA was introduced in 2006, in line with that year's EPR recommendation to enhance environmental review of land use planning. In reviewing the environmental appropriateness of a plan, it focuses primarily on location. SEA targets 17 types of policy plans in eight policy areas (including urban development and road construction), but not sector development policies, and 95 types of development master plans in 17 areas, but not covering all 250 county and city spatial management plans. Land use plans are developed under the supervision of MOLIT, which has its own assessment system. Co-ordination between the MOE and MOLIT on SEA coverage and implementation is often challenging.

SEA of a policy plan evaluates conformity with national environmental policy and the target area's environmental capacity. SEA of a development master plan takes into account the impact on natural landscape and biodiversity, existence of adequate environmental infrastructure, compliance with environmental standards, and resource and energy efficiency considerations. A "natural landscape deliberation system" was introduced in 2006, also in response to a 2006 EPR recommendation, with the adoption of guidelines on evaluating landscape impact of development projects as part of SEA.

A preliminary assessment report defining the SEA scope (target area, proposed land use and alternatives) is reviewed by the EIA Council. The authority responsible for the plan must request the MOE consent prior to approval of the SEA report (the MOE may ask the KEI or other experts for technical advice or a field survey). Residents' opinions on the draft SEA report are solicited through public notice, presentation or hearing, but only in the case of a development master plan, which limits the extent of public participation. Areas with high ecological value are an exception (section 5.1).

3.5. Environmental permitting

Korea is undertaking a major environmental permitting reform, moving from issue-specific to integrated permitting for large industrial installations. The existing system has 10 environmental permits prescribing uniform emission limit values (ELVs) for each activity sector, with permitting procedures involving multiple authorities and 73 types of documents. Any facility with a potentially significant air emission or wastewater discharge, for instance,

must obtain a permit from, or file a report with, the local government. The regulatory regime depends on whether the facility would release any specified hazardous air or water pollutants, or is located in an environmentally sensitive area. Self-monitoring requirements are more stringent for permitted facilities.

The new integrated permitting system, inspired by the EU system of integrated pollution prevention and control (IPPC) and following best international practices, is being introduced following adoption in November 2015 of the Act on Integrated Management of Environmentally Polluting Facilities. It is expected to go into force in 2017, starting with power and heat generation and incineration facilities. The government was expected to adopt implementing regulations in the second half of 2016. This reform directly responds to the 2006 EPR recommendation to introduce IPPC permits for large stationary sources at the national and regional levels.

The new system will be applied to 19 industry sectors once the regulatory framework is complete. Best available techniques (BAT) will be identified for each sector by technical working groups and specified in BAT reference documents (K-BREFs, an analogue of EU BREFs, which are also prepared and revised through a robust technical expert process), taking into account potential compliance costs and economic feasibility. Industries participate directly in technical working groups to select and periodically review K-BREFs. A K-BREF with ELVs for the power generation sector was completed in 2014; the ones for the steel, non-ferrous metals and organic chemicals industries are under development. Seven K-BREFs are expected to be developed by 2021. Existing industrial facilities will be given a four-year grace period (until 2021) to obtain integrated permits and comply with new ELVs, customised for each installation by considering BAT and local environmental conditions. Mechanisms to link site-specific evaluation for permitting purposes with EIA for new facilities, to avoid duplication of assessment, are being considered.

The reform is expected to reduce the administrative burden by combining medium-specific permits into one through a single procedure involving online applications. The MOE is expected to become the sole competent authority for issuing integrated permits and controlling compliance with them, thus taking back much of environmental permitting responsibility from local governments. An Environmentally Polluting Facility Permit System Advancement Division is expected to be established within the ministry, supported by a technical expert panel. The role of the MOE's regional offices and degree of co-ordination with local governments have not yet been defined, but it is clear that implementing the reform will require substantial capacity building at the MOE in issuing and enforcing integrated permits.

An online integrated environmental permitting system will be established to provide technical information and application support. Permits will be reviewed and revised every five to eight years. Unlike in the existing system, integrated permits will require facility operators to disclose information on their environmental impact. However, public participation is not envisaged as part of integrated permitting.

This reform will not affect industrial activities with low environmental impact – mostly small and medium-sized enterprises (SMEs). The administrative burden of current issue-specific permitting is particularly heavy for SMEs, which have little in the way of human resources and technical capacity. To simplify the regulatory regime for low-risk installations, Korea may consider replacing multiple permits with sector-specific general binding rules (GBRs), as other OECD countries have done (e.g. the Netherlands, Box 2.4).

Box 2.4. **General binding rules in the Netherlands**

The Netherlands has different requirements for three categories of installations, as defined in a 2008 decree:

- Type A facilities, characterised by minimal environmental impact, are regulated by general, not activity-specific provisions; they do not need to notify the competent authority of their operations.
- Type B installations have a moderate environmental impact, are covered by activity-specific GBRs and must notify the competent local or provincial authority of the nature and size of their activities four weeks before starting operations.
- Type C installations have a potentially important impact and require an environmental licence, which they have to comply with along with activity-specific GBRs. This category includes large installations which are subject to the EU Industrial Emissions Directive and need an integrated permit/licence.

GBRs establish "quantitative target-based provisions" (i.e. ELVs) that can be achieved by any "recognised" measure without prior consent from the competent authority, as well as "qualitative" provisions that require certain techniques or management practices that can be modified only with the authority's consent.

GBRs have been developed for activities related to hazardous substances, plastics, metals, paper and textiles, food products, vehicles and other motorised equipment, etc.

Source: Mazur (2012), "Green Transformation of Small Businesses: Achieving and Going Beyond Environmental Requirements".

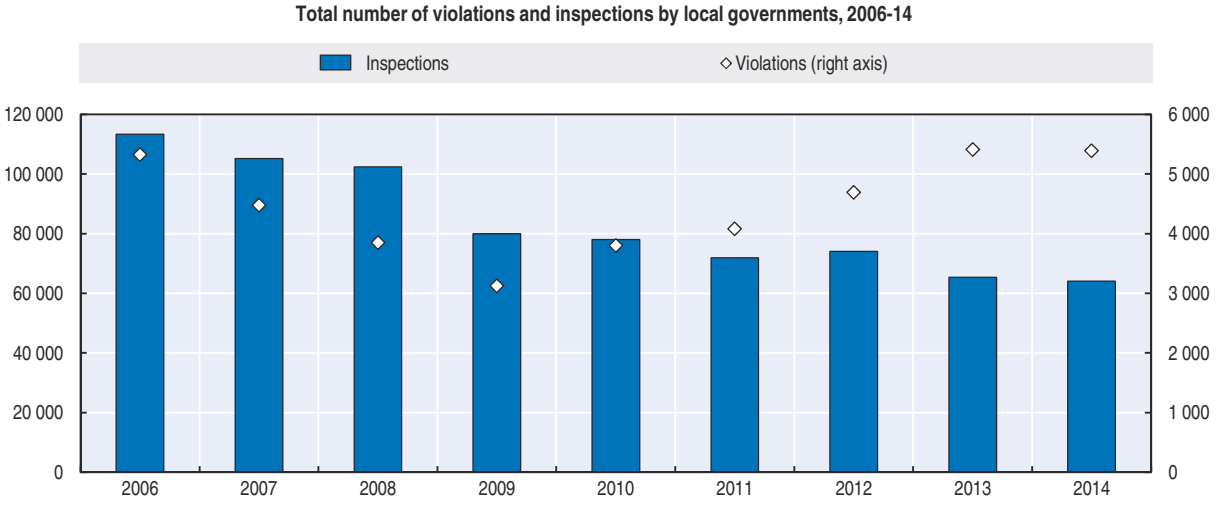
4. Compliance assurance

Korea has made significant progress since the 2006 EPR, which recommended increasing local inspection and enforcement capacity and strengthening related national supervision and evaluation mechanisms. The central and local governments have been reinforcing their compliance assurance programmes to better detect and deter non-compliance (environmental liability regimes are discussed in Chapter 5). The national government is also actively promoting voluntary compliance and adoption of green business practices.

4.1. Environmental inspections

Compliance monitoring responsibilities for stationary sources (in all areas except management of designated hazardous waste) was transferred in 2002 from the MOE to local governments (the authority that issues a permit also monitors compliance with it), but in 2015 toxic chemicals control reverted to the MOE because local management of major chemical accidents had been insufficient. Figure 2.2 presents the number of local authority inspections and identified violations in 2006-14. Although the frequency of site visits fell – after a tele-monitoring system for air and water pollution from large facilities was introduced and inspections were focused on recidivist violators, but also due to resource constraints – the detection rate (the ratio between the number of detected offences and the number of inspections) grew steadily from 4.7% in 2006 to 8.4% in 2014. To further increase detection rates, the MOE is encouraging local authorities to conduct more frequent random inspections. However, many municipalities do not have sufficient resources to do so. Local governments also rely on civil environmental monitoring groups to signal visible offences.

Figure 2.2. **Inspections decreased but detection of violations by local governments rose**



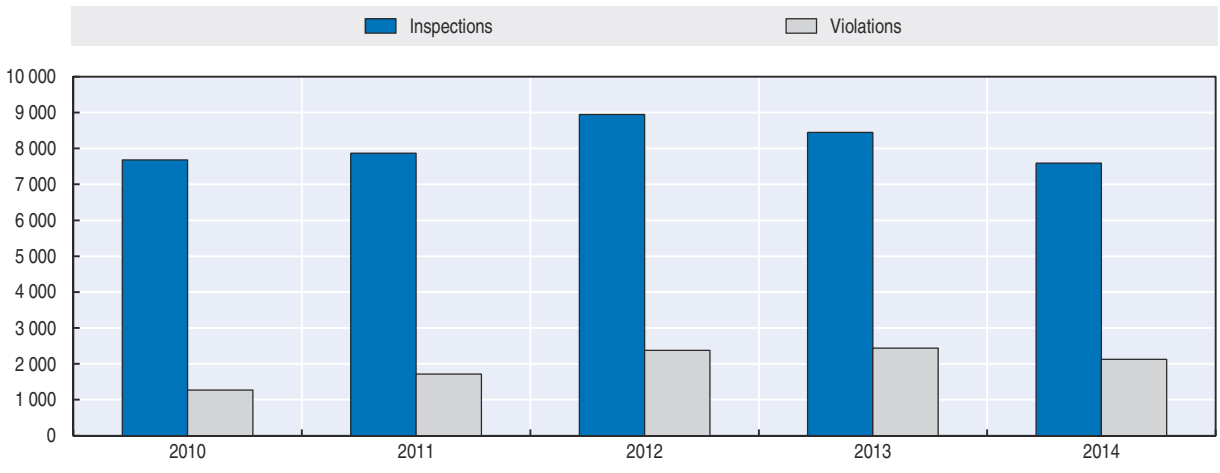
Source: Country submission.

StatLink http://dx.doi.org/10.1787/888933449069

Better targeting of inspections, based on the level of environmental risk of individual facilities, would help make compliance monitoring more efficient.

The staff of the MOE's regional and river basin offices include environmental police who supervise and complement local authorities' compliance monitoring activities. They focus on highly polluted areas and recalcitrant offenders. Detection rates of MOE inspections grew from 16.6% in 2010 to 28% in 2014 (Figure 2.3). In addition, since 2013 the MOE's head office has had a Central Environmental Controls Task Force dedicated to compliance monitoring of the largest polluters or those provoking frequent citizen complaints. Thus far the task force has targeted over 630 polluting installations with an offence detection rate of 43.1%. Its recent focus was discharges from public sewage treatment plants and illegal wastewater

Figure 2.3. **Targeted inspections by the central government are becoming more effective**



Source: Country submission.

StatLink http://dx.doi.org/10.1787/888933449074

dumping. MOE compliance monitoring capacity was further reinforced in 2016 by the creation of an Environmental Offence Investigation Planning Division.

The transition to integrated environmental permitting also entails reform of the compliance monitoring regime, from largely reactive inspections triggered by incidents or complaints to planned periodic controls with a frequency based on the installation's level of risk.

4.2. *Enforcement tools*

Very significant criminal sanctions for non-compliance are set in issue-specific environmental laws. Criminal fines for operating without a permit are up to KRW 50 million under the Water Quality and Ecosystem Conservation Act (2005) and up to KRW 100 million (KRW 200 million in the Seoul Metropolitan Area) under the Clean Air Conservation Act (2007). In addition, if there are aggravating circumstances in terms of damage to public health or the environment, heavier criminal penalties (three or more years of imprisonment) can be applied under the Act on Special Measures for the Control of Environmental Offences and Aggravated Punishment. There are plans to amend this act in the near future to make the sanctions even more severe.

In practice, however, sanctions of this degree are rarely applied. For criminal proceedings to take place, the MOE or the local authority that identifies a violation must refer the case for investigation to the special environmental police and then to the public prosecutor, who decides whether to pursue it in court. In 2013, such referrals occurred in only 1.8% of local authorities' enforcement cases related to air pollution and 1.5% of water pollution cases (MOE, 2014). Public prosecutors assign relatively low priority to environmental offences and rarely pursue such cases. Judges generally lack expertise to consider the merits of environmental cases. The MOE would be well advised to work more closely with prosecutors' offices and the courts to build capacity in this area.

At the same time, administrative sanctions are relatively weak: authorities can impose light monetary penalties for minor offences and issue orders to stop the polluting activity, but violators can avoid this by paying a higher "excess" pollution charge. Polluters often get away with a simple warning: in 2013, for air pollution cases, warnings accounted for 57% of local authorities' administrative enforcement actions, cessation orders for 30% and corrective action for only 13%. With respect to wastewater discharges, the administrative response tends to be more robust, with 35% of actions ordering corrective measures (MOE, 2014).

4.3. *Promotion of compliance and green practices*

The MOE promotes good environmental behaviour in the regulated community through voluntary agreements, information-based instruments and regulatory incentives.

Voluntary agreements and corporate social responsibility

The ministry makes extensive use of various kinds of voluntary agreements to address key environmental issues in a non-regulatory manner. Voluntary agreements help industry to either avoid additional regulation or better prepare for it, and to improve relations with affected communities. Examples of such agreements include the following:

- Since 2013, four-year voluntary agreements have been concluded with 31 companies in the Ulsan, Yeosu, Daesan and Ochang regions to reduce emissions of carcinogens (benzene,

butadiene, etc.). In total, these agreements are expected to reduce Korea's emissions of carcinogenic substances by 14% compared to the 2012 levels.

- Two four-year regional agreements in the Kwangyang Bay and Ulsan areas have engaged 40 companies in voluntarily designing and implementing their own reduction plans for particulate matter, SO_x, NO_x and volatile organic compounds (VOCs). A 2012 sector-wide agreement with the shipbuilding industry (six companies) targeted VOCs and a 2014 agreement with 26 cement, power generation, and steel and iron manufacturing firms focused on voluntary cuts in SO_x, NO_x and particulates. Overall, the pledged reductions would amount to about 1% of the country's emissions of these pollutants.
- In 2015, the MOE signed an agreement with three online trade companies that pledged to strengthen their internal controls to prevent illegal online sales of toxic chemicals.
- The MOE, the automobile industry and the fuel industry agreed in 2011 to contribute a total of KRW 1 billion, in equal shares, to the Auto-Oil Program, a public-private research project aimed at reducing emissions of greenhouse gases and other air pollutants from motor vehicles.

To promote corporate social responsibility, the government issues the Grand Award for Excellence in Sustainability Management to large enterprises and public institutes; 124 awards were conferred in 2014. They are based on annual sustainable management reports as well as business and consumer surveys. The number of enterprises publishing such reports went from four in 2003 to 224 in 2014, including 64 of the top 100 Korean companies (MOE, 2016). The award criteria cover such areas as corporate environmental management, sustainable use of resources, green management of the supply chain, enhanced management of hazardous substances and actions related to climate change.

Advice and guidance

The MOE provides information on environmental regulations and green business practices through its website and printed materials, and operates a web-based helpline where regulatory questions must be answered within five working days. The Korea Environmental Industry and Technology Institute (KEITI) operates the Green-Up programme, a customised consulting service for environmental improvement of SMEs. It also offers financial support for environmental performance audits.

Environmental management system certification and awards

The Green Enterprise certification programme was established in 1995 and converted in 2010 into a statutory programme under the Environmental Technology and Industry Support Act. The MOE, through its regional offices, designates as Green Enterprises businesses that undertake substantial voluntary reductions of pollutant releases, carry out resource and energy saving measures, improve their products' environmental characteristics, adopt environmental management systems (EMS), etc.

Green Enterprises can submit a declaration instead of applying for a permit, are exempted from periodic inspections and are subject to more lenient penalty rules, which are important regulatory incentives for going beyond environmental compliance. The MOE periodically reviews a company's Green Enterprise designation and can cancel it if the company's environmental performance deteriorates. As of September 2014, there were 197 Green Enterprises, including 52 in the chemicals sector and 39 in electronics (MOE, 2016).

To facilitate access to finance, a support system for green businesses called enVinance has been established to give the financial sector information on eco-friendly companies. The government created a database of information from ministries on green businesses (including environmental performance) and makes it available to financial institutions to help them better evaluate businesses when deciding which ones to provide loans to or invest in.

ISO 14001 EMS certification has been very popular among Korean companies, primarily due to international market demand. Between 2002 and 2012, the number of certified firms increased tenfold, though it has declined somewhat in recent years. The government promotes EMS certification through reduced frequency of environmental inspections. Korea's SME agency also has a programme to encourage EMS certification among small businesses.

Green public procurement

Korea has a well-developed system of green public procurement (GPP). Although GPP has been encouraged since the 1994 Development and Support of Environmental Technology Act, the 2005 Act on Promotion of Purchase of Green Products made it obligatory for all government agencies (including local authorities) and other public institutions. Public institutions must buy products that are certified by Korea Eco-Label or the Good Recycled Mark, or that meet other environmental criteria set by the MOE, assuming such products are available, can be supplied in a stable manner and are of sufficient quality. However, neither producers' environmental compliance records nor EMS certification are among the selection criteria. Incorporating these into the GPP system would help promote better environmental performance of government suppliers. More details on Korea's GPP system can be found in Chapter 3.

5. Promoting environmental democracy

Since 2006, Korea has established a firm legal and policy framework for environmental education and a multitude of programmes to raise environmental awareness of students and the general public. At the same time, it has a fairly restricted system of public participation and access to information on environmental matters. While NGOs are involved in strategic policy planning, there is no public participation in law making, and public engagement in environmental assessment remains limited to local residents. Despite growing disclosure of environmental information, much of it remains classified to protect private economic interests. Public participation and access to justice and information are addressed in detail in Chapter 5.

5.1. *Public participation in environmental decision making*

The main national stakeholder consultation body on environment is the Central Environmental Policy Committee, which is involved in developing the Comprehensive National Environmental Plan, conservation master plans and other policy documents. It has almost 200 members from academia, research institutions, private companies, etc. There are also issue-specific stakeholder committees, such as the river basin management committees in each river basin, the Environmental Health Committee and the Chemicals Evaluation and Management Committee.

Large NGOs, such as the Korean Foundation for Environmental Movements and Green Korea United, actively seek to influence national environmental policy making. NGO representatives can participate as technical experts in consultative bodies but not promote

their organisations' policy agendas. A significant reduction in the number of stakeholder co-ordination bodies in recent years has contributed to distrust between the government and civil society groups. Unlike in most OECD countries, NGOs in Korea generally do not receive government financial support.

In accordance with the Administrative Procedure Act (1996) and the Operational Regulation of Legislative Affairs (1998), the main provisions of every draft law and most executive regulations are announced through the media and the government's public relations portal (*www.epeople.go.kr*). The public then has 40 days to submit comments and opinions.

Public participation in EIA and SEA is restricted to residents of the area affected by the proposed project or plan (as defined by government authorities) and does not include the wider public. Citizens living outside the designated "impact area" who feel affected by the project or plan can appeal to the MOE or their local government, but do not have judicial recourse. Non-residents can express opinions only on plans related to areas with "high ecological value". EIAs do not have to be announced in the mainstream media, public hearings serve mostly to inform rather than seek comments, and there is no obligation for authorities to accept citizens' proposals. Nor does the integrated permitting reform (Section 3.5) envisage public participation in permitting decisions.

This lack of transparency has led to strong, sometimes unconstructive, citizen opposition to major government-promoted projects, such as the Four Rivers Restoration Project (Chapter 3), nuclear power plant construction and siting of hazardous facilities (Bell, 2014). An effective conflict resolution mechanism is needed to address this issue and ensure that government works in partnership with NGOs.

5.2. Access to environmental information

The public is entitled to access to environmental information under the Official Information Disclosure Act, except in cases where disclosure "may interfere with government business" or damage the company or organisation in question. Any applicant denied access to information is entitled to an administrative hearing or administrative court action under the Administrative Procedures Act.

Korea has had a pollutant release and transfer register (PRTR) since 1999. Pollution release data by industry sector and by pollutant are publicly available on the PRTR website. The 2015 Act on Integrated Management of Environmentally Polluting Facilities requires facilities with environmental impact above defined thresholds to disclose their integrated permit applications and annual reports containing data on pollution releases, except when this information is judged commercially sensitive. Although businesses must provide formal justification for non-disclosure of information for commercial confidentiality reasons to a special government commission for approval, many civil society groups feel it is difficult to obtain timely information from private enterprises.

The MOE provides a wide range of environmental information to the public, including the annual Environmental Statistics Yearbook and the biennial Ecorea white paper. Environmental authorities maintain records on all regulated entities, including permit applications, regular self-monitoring reports and inspection reports. The Government 3.0 initiative, launched in 2013, aims to open up public data and foster its reuse by business as well as the administration (OECD, 2015b). As a result, the disclosure rate of environmental information produced or managed by government rose from 24% in 2012 to

55% in 2013 (MOE, 2016). The MOE intends to disclose 80% of government-held environmental information by 2017 through Korea's main information portal (*www.data.go.kr*) or on the MOE website.

5.3. *Environmental education*

In line with the 2006 EPR recommendation on raising public awareness of environmental issues, the Environmental Education Promotion Act (2008) provided the basis for measures to promote environmental education, many of which were envisaged in the Environmental Education Master Plan (2011-15). An Environmental Education Promotion Committee was formed in 2010 and an Environmental Education Development Council in 2013. A network of national environmental education centres has been functioning since 2012. An environmental education internet portal created in 2008 shares education materials and other relevant information.

Korea has made substantial progress in expanding environmental education in schools. This is particularly important in the context of its heavily test-driven education system, which leaves little space for behavioural learning. To provide assistance for school environmental education, the National Environmental Education Centre has been operating since 2012, and an environmental education teaching tool has been available since 2007. Over 350 000 students from more than 3 000 elementary schools were reached between 2004 and 2014 by Pureumi mobile environmental classrooms – trucks or buses remodelled and equipped with educational tools. After-school environmental classes have been given in over 340 schools since 2013. Environmental experience education programmes receive state support of almost KRW 1 billion per year (MOE, 2016).

In the area of social environmental education, an environmental education promotion team numbering 400 people in 2015 conducted about 2 000 awareness-raising sessions for businesses, local governments, military troops, etc. Over 300 environmental education programmes have received official certification since 2010, further illustrating Korea's achievements in this area.

Recommendations on environmental governance and management

- Support a whole-of-government approach to water resource management by building on the existing collaboration platforms for policy dialogue between all relevant government stakeholders and adopting a Framework Act on Water Management; strengthen co-ordination between ministries on other key environmental issues, including climate change, chemicals safety and biodiversity.
- Build provincial and local governments' capacity to carry out their statutory environmental responsibilities and tasks delegated to them by the central government; provide the necessary financial resources to ensure effective enforcement of national environmental regulations; strengthen the system of environmental performance indicators for all levels of government.
- Reinforce *ex ante* assessment of environmental policies and regulations through wider application of cost-benefit analysis, and expand *ex post* evaluation of their implementation.
- Continue to expand the coverage of the EIA and SEA systems by making hazardous industrial facilities subject to EIA independently of their size and requiring SEA for a wide range of government policies and programmes with potential impact on the environment,

Recommendations on environmental governance and management *(cont.)*

including all local land use plans. Ensure appropriate use of these instruments to prevent uncontrolled development in environmentally sensitive areas; pursue closer co-ordination between land use and nature conservation plans.

- Ensure coherent introduction of integrated environmental permitting reform for major industrial polluters on the basis of best available techniques, accompanied by capacity building for competent authorities and broad stakeholder involvement; consider replacing single-medium permits for low-risk installations with sector-specific general binding rules.
- Increase the efficiency of compliance monitoring through better targeting of inspections based on the level of environmental risk of individual facilities; strengthen administrative enforcement tools and build the capacity of public prosecutors and the courts in applying penalties for criminal offences.

Note

1. Other co-ordination committees on specific water-related issues include the Committee for Deliberation of Police on Water Quality and Aquatic Ecosystems and the Water Reuse Policy Committee.

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PART I

Chapter 3

Towards green growth

Korea has created a strong institutional framework for green growth but faces challenges in making the transition to a more environmentally sustainable economic model. This chapter reviews efforts to mainstream environmental considerations into economic policy and to promote green growth. It analyses the use of taxation and other economic instruments to pursue environmental objectives and discusses environmentally harmful subsidies. The chapter examines efforts to scale up environment-related and low-carbon infrastructure, expand related markets and support eco-innovation as a source of economic and employment growth. It also reviews progress in mainstreaming environment in development co-operation programmes, promoting corporate social responsibility of Korean multinational enterprises and greening export credit systems.

1. Introduction

Korea has the eighth largest economy among OECD members, which was, until recently, one of the fastest growing. Real gross domestic product (GDP) increased 78% over 2000-15, almost three times the OECD average (28%). Since recovering from the 2008-09 global financial crisis, it has posted average annual growth of about double the OECD average. Korea's rapid recovery was spurred by its fiscal stimulus, which was the largest among OECD countries (OECD, 2010a). Growth has slowed, however, dampened by high household debt, low productivity (particularly in services and small and medium-sized firms) and sluggish exports (OECD, 2016a). GDP per capita is increasing but remains below the OECD average. While the relative poverty rate and income inequality have fallen recently, both remain high.

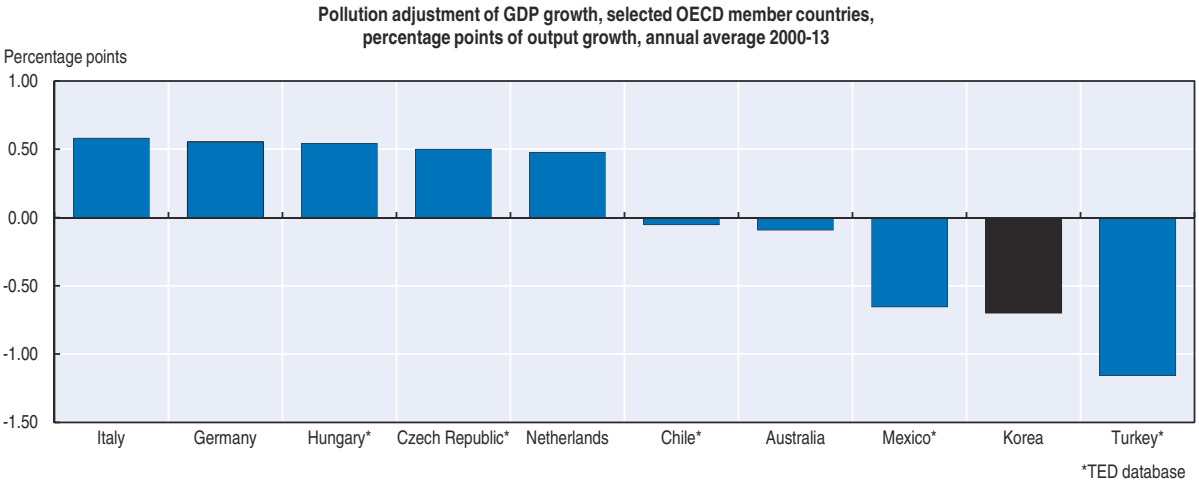
Despite expressing a strong commitment to green growth, Korea faces challenges in transitioning to a more environmentally sustainable economic model. Large energy-intensive industries drive GDP growth, supported by low electricity prices, and the energy mix is dominated by fossil fuels. As a result, Korea has one of the most carbon-intensive OECD economies, and greenhouse gas (GHG) emissions increased by 39% over 2000-13. Air pollution is a serious concern, caused by emissions from energy-intensive industries, the preponderance of roads in Korea's transport system and transboundary air pollutants and dust from China and Mongolia (Chapter 1). It is estimated that decreased labour productivity and increased health expenditure caused by air pollution will reduce GDP by 0.62% by 2060 – more than any other OECD country – compared to a baseline excluding the economic consequences of air pollution (OECD, 2016b).

A recent OECD study estimates that incorporating the total cost of pollution abatement in Korea's GDP would reduce growth over 2000-13 by 0.7% per year, on average, more than any OECD country except Turkey (Figure 3.1). This reflects the fact that much of Korea's spectacular growth has been at the expense of environmental quality (Cárdenas Rodríguez et al., 2016). Environmental challenges are exacerbated by the population density, which is the highest in the OECD (Chapter 1).

2. Green growth policy framework

Green growth was instilled in Korea's development framework in response to Korea's high dependence on energy imports, high vulnerability to the effects of climate change and need to transition to a less resource-intensive economic growth model (Han, 2015; Choi, 2014;). After then-President Lee proclaimed "Low carbon, green growth" as the national long-term vision in 2008, the National Strategy for Green Growth (2009-50) structured this vision around three objectives (climate change mitigation and adaptation and energy independence; creating new engines for economic growth; and improvement in quality of life and enhanced international standing) and ten policy agendas. The 2010 Framework Act on Low Carbon, Green Growth (LCGG Act) provided the legal foundation for its implementation. A first Five-year Plan for Green Growth (2009-13) was launched to provide a

Figure 3.1. **Economic growth in Korea is largely based on pollution-intensive activities**



Note: The indicator shows to what extent a country's GDP growth should be corrected for pollution abatement efforts - adding what has been undervalued due to resources being diverted to pollution abatement, or deducing the "excess" growth which is generated at the expense of environmental quality.
The chart compares the five countries at the top and at the bottom of the range.
Source: Cárdenas Rodríguez, M., I. Haščič and M. Souchier (2016), "Environmentally adjusted multifactor productivity: methodology and empirical results for OECD and G20 countries", *OECD Green Growth Papers*, No. 2016/04; Conference Board (2014), "The Conference Board – Total Economy Database" (TED database), extracted in September 2014. www.conference-board.org/data/economydatabase/.

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comprehensive roadmap and expenditure plan for implementation (Section 4.1). Korea also became a promoter of green growth and climate change action on the international stage (Box 3.1). The LCGG Act established additional core plans for energy, climate change and sustainable development[1] to facilitate implementation.

The LCGG Act established a comprehensive institutional framework for implementing the National Green Growth Strategy and evaluating progress. It obliges all central administrative agencies and local governments to develop annual green growth action plans. Their implementation is reviewed and evaluated by the prime minister or local governors. Results are reported to the Committee on Green Growth, which is charged with steering the implementation of the low carbon, green growth vision. In addition, individual green growth projects were evaluated over 2009-12, either directly by the Government Performance Evaluation Committee or under its supervision. Thirty green growth indicators were developed to monitor implementation of the first Five-year Plan for Green Growth and draw lessons for development of the second plan; Statistics Korea publishes results in a biennial report. From October 2013 to March 2014, some projects and measures under the first plan, chosen based on their size, policy significance and impact, were evaluated by the government and 21 experts from the public and private sectors to identify the achievements and limits of the first plan and prepare the second plan.

Korea's green growth framework stimulated green investment, but tangible environmental progress has been hindered by pricing and fiscal policies that insufficiently integrate environmental externalities (Section 3) (Sonnenschein and Mundaca, 2015). Evaluations of the first five-year plan, while applauding the establishment of policies and projects, the increase in green expenditure and progress made in developing green industry and accelerating eco-innovation, noted that development of renewable energy sources remained marginal and below target, GHG emissions continued to rise and the general public remained largely disengaged from the green growth revolution.

Box 3.1. **International engagement for green growth**

Korea has made considerable effort to expand its international engagement in the area of green growth. In 2009, it was a strong promoter of green growth at the OECD when it chaired the Ministerial Council Meeting, initiating the OECD Declaration on Green Growth and contributing to the launch of the OECD Green Growth Strategy. In 2010, Korea became the host of the Green Climate Fund, established under the UN Framework Convention on Climate Change to collect and disburse finance to help developing countries mitigate GHG emissions and adapt to the effects of climate change. The same year, Korea established the Global Green Growth Institute. Originally a local think tank aiming to provide technical and policy advice on green growth to developing countries, it became an international organisation in 2012. President Lee was vocal in climate negotiations, championing the principle of Nationally Appropriate Mitigation Actions (NAMA) and the establishment of a NAMA Registry, both which were adopted by the international community (Han, 2015; MOE, 2015a). In 2014, Korea hosted the 12th conference of the parties to the Convention on Biological Diversity.

However, Korea needs to consolidate its green growth results at home to maintain credibility on the international stage and with the Korean population. A gap remains between the country's international ambition and its domestic performance (Chapter 1). A public opinion survey on green growth policy, conducted by the Presidential Committee on Green Growth in 2013, shows a strong preference for a focus on concrete domestic actions, with only 2.8% of respondents prioritising global leadership (Han, 2015).

Source: Han, H. (2015), "Korea's pursuit of low-carbon green growth: A middle-power state's dream of becoming a green pioneer", *http://dx.doi.org/10.1080/09512748.2015.1013491*; MOE (2015), *Ecorea: Environmental Review 2015, Korea*.

The second five-year plan (2014-18) aims to address these shortcomings and integrate the current government's flagship concept of "creative economy". It pushes for reform of energy taxation and electricity pricing; one of its three pillars is to achieve a creative economy through the convergence of green technology and information and communications technology (ICT); and it envisages green reforms being made more tangible at local level through "eco-friendly energy towns".

Although the second plan was adopted in 2014 and certain relevant measures were implemented, green growth is no longer the top political priority. In 2013, the Committee on Green Growth was moved from the president's to the prime minister's office and the Government Performance Evaluation Committee stopped evaluating green growth policies, though it still evaluates related policy areas. The environment is one of many subtopics in the government's current blueprint for the economy, the Creative Economy Action Plan, and green growth policies were repackaged as "climate change response policies" after the Paris Agreement in December 2015. To consolidate the progress made over 2009-12, it will be essential to ensure that core and sector plans related to green growth continue to be implemented and evaluated.

3. Greening the system of taxes and charges

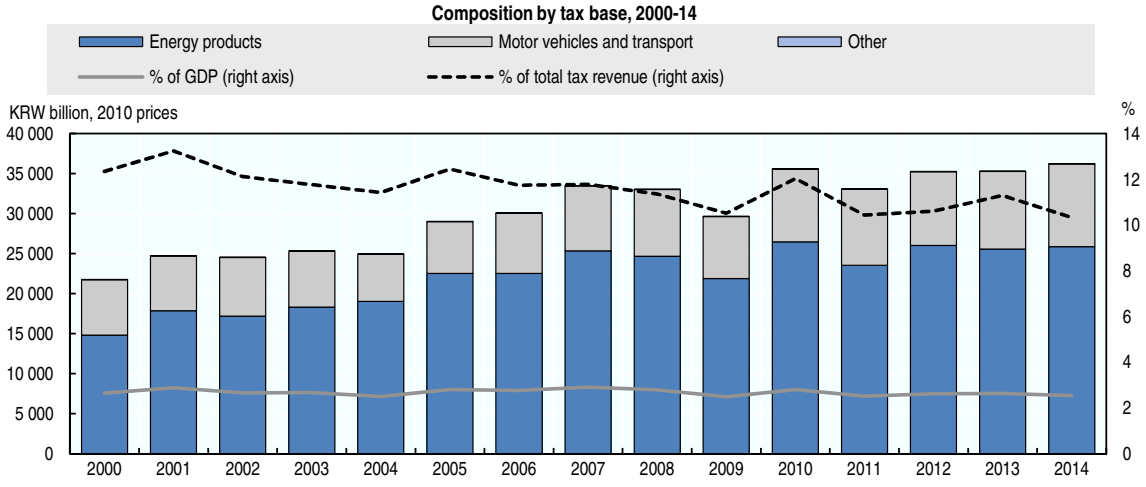
3.1. Introduction

While Korea currently enjoys a fiscal surplus and low public debt, it will need to increase tax revenue to finance rising social expenditure over the long run (OECD, 2016a). Although public social spending as a share of GDP was less than half the OECD average in 2014 (10.4%

vs. 21.6%), it is forecast to balloon to 29% of GDP by 2060 to fund the National Pension Scheme, meaning that tax revenue will also need to rise to maintain Korea's fiscal soundness. Environmentally related taxes provide one opportunity to do so. Furthermore, raising environmentally related taxes could give the government leeway to lower other taxes that may be putting a brake on growth, namely those on corporate income and capital gains, which, at 14% of fiscal receipts, are the fourth highest in the OECD (OECD, 2015a).

Korea's environmentally related tax revenue rose in real terms over 2000-14. Although it dipped in 2009, due in part to the global financial crisis lowering consumption and spending and in part to the government lowering certain tax rates (e.g. the individual consumption tax on vehicles was reduced by 30% to boost the car industry), it rebounded in 2010 along with the general economy. Environmentally related tax revenue as a share of GDP and as a share of total tax revenue has declined since 2000 (Figure 3.2) but was above the OECD average in 2014 (2.5% vs. 1.6% and 10.3% vs. 5.1%, respectively), in the latter case mainly because Korea's total tax revenue is relatively low. Environmentally related tax revenue comes almost exclusively from energy-related taxes (71%) and transport-related taxes (29%), in line with the OECD averages. Taxes are also imposed on pollution and resource use but raise very little revenue. The government is streamlining the number of environmental taxes and charges.

Figure 3.2. **Environment-related tax revenue as a share of GDP has declined**



Source: OECD (2016), "Environmental policy instruments", *OECD Environment Statistics* (database).

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3.2. Taxes on energy consumption

As in most OECD countries, Korea taxes transport fuels more heavily than heating and process fuels and electricity. The difference between taxation of transport and non-transport fuels is, however, more marked than the OECD average in terms of both energy and carbon content (OECD, 2013a). Overall, taxes levied on transport fuels raise at least 70% of the revenue from energy taxation owing to the much higher rates at which they are taxed compared to other energy products.

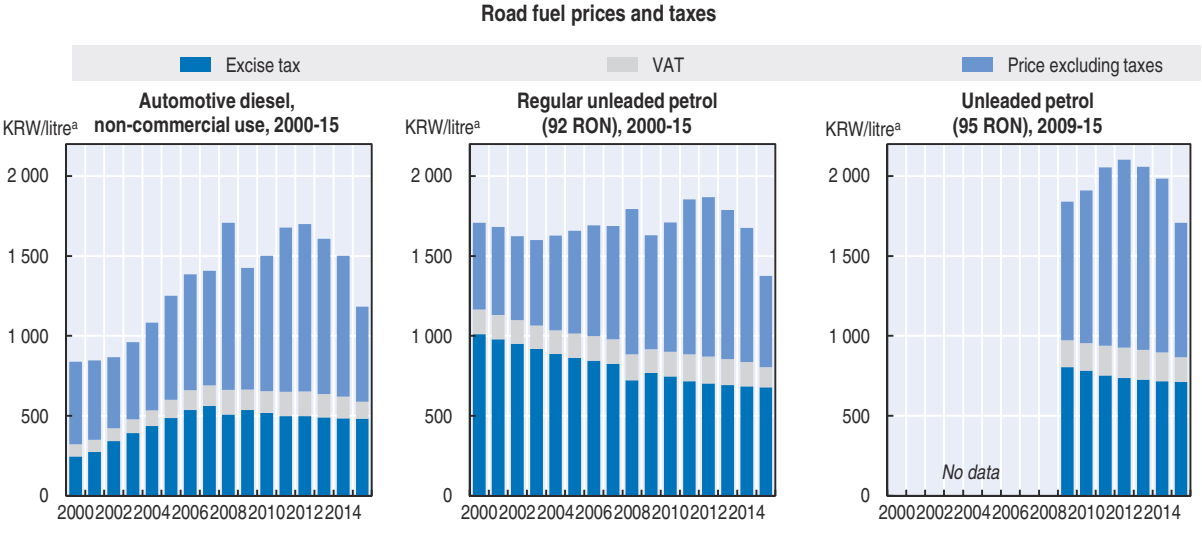
The bulk of the transport fuel tax revenue comes from the Transportation-Energy-Environment tax (TEE, equivalent to an excise tax) on unleaded petrol and diesel; the rest comes from two taxes applied on top of the TEE tax, one for education (15%, applied to several taxes to fund the public education system) and the other a local motor fuel tax (36%).

Energy used for heating and processes is predominantly taxed through the Individual Consumption Tax, which is also imposed on purchases of vehicles and of energy-intensive household appliances (e.g. white goods, televisions). In addition, Korea imposes import and sales duties on petroleum products, which may be used in both transport and heating and in processes. Electricity consumption is taxed through the Electricity Industry Foundation Fund Charge at a low rate: 3.7% of the retail price, before VAT (10%). The charge is intended to finance electricity market policies such as energy-saving measures and the former feed-in tariff (Ecofys, 2015). The government sets electricity prices for different users. Fuels used to produce electricity, including coal since 2014, are also subject to the individual consumption tax, again at low rates.

Transport fuel tax revenue increased in real terms between 2000 and 2007, driven by rising tax rates and growing diesel consumption. Revenue slumped during the economic crisis, when fuel consumption declined and tax rates were temporarily reduced. Since then, revenue has remained broadly constant due to increased road fuel consumption, while tax rates have steadily decreased in real terms (Figure 3.3). Failure to adjust the rates for inflation is costly in terms of forgone fiscal revenue, and reduces incentives to save energy and shift to greener modes of transport. The current context of low international fuel prices presents an opportunity to increase these taxes without overburdening consumers.

As in most OECD countries, petrol is taxed more heavily than diesel. This is regrettable from an environmental perspective, as diesel emits more CO_2 and local air pollutants than an equivalent volume of petrol, and a litre of diesel normally allows more kilometres to be driven than petrol, meaning that its tax per litre should be higher to internalise driving-related externalities (Harding, 2014). As part of energy price reforms in 2001 and 2007, the government adjusted the taxes on diesel and petrol so that the tax gap narrowed markedly (Figure 3.3). While this was a positive development, it occurred more through reduced petrol taxation than higher diesel taxation, and progress has stalled since the economic crisis.

Figure 3.3. **Motor fuel taxation is declining in real terms**



a) At 2010 prices.
Source: IEA (2016), *IEA Energy Prices and Taxes Statistics* (database).

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The government has long maintained a policy of low, stable energy taxes and electricity prices to keep energy affordable for households. This has supported the development and competitiveness of energy-intensive industry, which has been the backbone of the country's growth. However, low prices have helped encourage demand, which increased faster than forecast under the first Energy Master Plan (2008-12). Large fuel price differentials have also distorted consumption, adding to the rapid rise in electricity demand (MOTIE, 2014). Recognising that continued low energy prices are unsustainable from an economic, energy supply and environmental perspective,[2] the government has recently undertaken reforms. After the electricity price for industry only increased by 1% in real terms between 2000 and 2010, and fell in real terms for households, the government has progressively raised electricity prices since. Overall, the price gap between households and industry has been reduced. In 2014, the individual consumption tax was adjusted to incorporate bituminous coal and to lower the rates on "alternatives to electricity" (kerosene, LNG and propane) by 30%.

3.3. Carbon pricing through the Emissions Trading Scheme

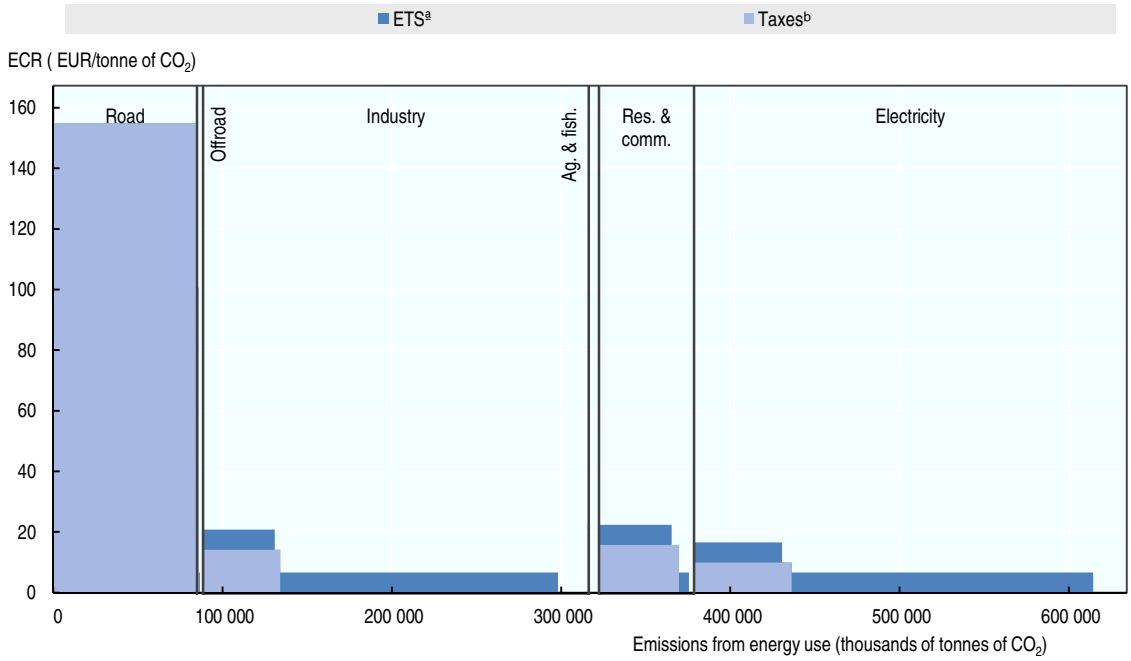
Korea's Emissions Trading Scheme (ETS), legally established by the Act on the Allocation and Trading of Greenhouse Gas Emission Permits in 2012, came into effect in January 2015. The world's second largest carbon market (after that of the European Union), it applies to all entities with annual emissions of at least 125 000 tonnes of carbon dioxide equivalent (CO_2 eq) at company level, and of at least 25 000 tonnes of CO_2 eq at facility level. The scheme covers 525 companies in 23 subsectors from the steel, cement, petrochemical, refining, power, buildings, waste and aviation sectors, accounting for about two thirds of total national emissions (ICAP, 2015). All Kyoto protocol GHGs are covered: CO_2, CH_4, N_2O, HFC, PFC and SF_6.The Korean ETS is thus broader than the European Union (EU) ETS in both the number of sectors and gases covered. However, the effective carbon rate arising from Korea's ETS is low, far below the price resulting from taxes on road transport fuels (Figure 3.4).

The ETS has a high share of allowances allocated for free (rather than auctioned), which will decline gradually from 100% in the first phase (2015-17) to 90% in the third phase (2021-25). Energy-intensive, trade-exposed industries will receive 100% of their allocation for free in all three phases, which means the most efficient allocation of permits will not be achieved. Korea may learn from the experience of the EU ETS, where free allocation resulted in windfall profits for some industries (Box 3.2). Participants in the Korean ETS can bank permits during the first phase for use in subsequent phases, and the government manages an allowance reserve enabling it to stabilise the market when price-climb, demand-climb and price-crash thresholds are crossed (Afriat et al., 2015). A third-party monitoring system verifies the emission reports companies submit to the government. While many companies make this information public, for example through annual reports, information on permit allocation is not public.

Trade in permits in Korea has been low. The government attributes this to companies still determining what is the best option for them: abatement, permit trading or holding on to excess permits to use if their emissions increase or to sell if the permit price increases. The lack of liquidity in the market has made it difficult for certain energy-intensive industries with high emissions (e.g. cement, petrochemicals) to adapt to the ETS, as there have been no permits available for them to purchase, and they are already highly energy efficient by international standards (OECD, 2012a). In response, the government is raising the ceiling for borrowing allowances from the following year from 10% to 20%, providing additional allocations to reward early reduction and selling government reserves. The

Figure 3.4. **A large share of carbon emissions are priced but at low rates outside the transport sector**

Average effective carbon rates (ECR) by sector and component, 2012



a) The tax on bituminous coal used in coal generation, introduced in 2014, is not reflected in the graph.
b) ETS: average permit price as traded at the Korea Emissions Exchange in the first half of 2015, adjusted for inflation.
Source: OECD (2016), *Effective Carbon Rates: Pricing CO_2 through Taxes and Emissions Trading Systems.*

StatLink http://dx.doi.org/10.1787/888933449116

Box 3.2. **Lessons from the EU ETS**

The European Union was an emission trading scheme pioneer. Launched in 2005, the EU ETS is now in its third phase. It covers 31 countries, over 11 000 power generation and manufacturing installations, commercial aviation, and 45% of the EU's GHG emissions. As the world's largest, oldest ETS, the scheme has been extensively studied and evaluated, and provides valuable lessons for other countries considering or beginning such systems.

Evaluations have found the EU ETS to have been successful in reducing GHG emissions in the sectors covered. The system has also motivated companies to adopt low-carbon technology. Despite industry fears, carbon leakage has not been found to have occurred. However, over-allocation in the first two phases combined with the economic crisis led allowance prices to fall too low to provide incentives for long-term low-carbon investment and innovation. Free allocation of permits led to sizeable windfall profits, particularly in the power sector, which lacks exposure to competition outside the EU. Companies passed costs through to consumers and thus left them to bear most of the burden, raising equity issues. Studies have found this pass-through of carbon prices in sales prices to be very income-regressive, as low-income households spend a larger share of their income on carbon-intensive products (e.g. electricity) than high-income households. Evaluations have also shown that policy and regulatory stability, long-term clarity of emissions reduction goals, and open, transparent information and communication about emissions, auctions and allowance allocations are essential for the development of a stable, efficient market.

Box 3.2. **Lessons from the EU ETS** *(cont.)*

In response to such observations, the EU increased trading period lengths as well as the number of permits auctioned rather than freely allocated. Countries also took individual action; for example, in the second trading phase, Germany and a few other countries allocated far fewer allowances than warranted by the country's verified emissions in the previous three years, thus correcting for over-allocation in the first phase. In the third phase, the EU has addressed the surplus of allowances by backloading permits (i.e. postponing their release into the market) and placing others in a market stability reserve.

Source: European Commission (2016), *The EU Emissions Trading System (EU ETS)*, *http://ec.europa.eu/clima/policies/ets/index_en.htm*; Laing, T. et al. (2013), "Assessing the effectiveness of the EU Emissions Trading System", *www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/02/WP106-effectiveness-eu-emissions-trading-system.pdf*; Wrake, M. et al. (2012), "What have we learnt from the European Union's Emissions Trading System?", *http://dx.doi.org/10.1007/s13280-011-0237-2*; OECD (2012), *OECD Environmental Performance Review: Germany 2012*, *http://dx.doi.org/10.1787/9789264169302-en*; Ellerman, D. and Joskow, P.L. (2008), "The European Union's Emissions Trading System in perspective", *www.c2es.org/docUploads/EU-ETS-In-Perspective-Report.pdf*.

experience of the EU ETS offers a cautionary tale, however, as allocation above actual emissions lowered perceived investment incentives for clean technology adoption (Venmans, 2016) and increased emissions (Brouwers et al., 2016).

Industry has opposed the ETS, citing concern about its impact on international competitiveness, particularly vis-à-vis China, Japan and Taiwan (Kim, 2015; FKI, 2014). This has been influential in increasing the share of permits allocated for free[3] and banning participation of private finance until 2021. Even so, the sector criticises the estimated business-as-usual GHG trajectory as being too low (Park and Hong, 2014), and over 40 companies have filed lawsuits against the government to demand higher allocations (Afriat et al., 2015).

The actual impact may be less substantial than industry has feared. Arlinghaus (2015) found that carbon prices worldwide have not hurt competitiveness, and that free permit allocation may not be necessary to protect firms' competitiveness. As Korea's strictly regulated electricity market limits the ability of firms in the sector to pass through compliance costs to consumers, they will bear the cost of the ETS more than, for example, their European counterparts (Park and Hong, 2014). Still, international competition is of less concern for the power sector, as it sells only to local markets. Initial feedback from the first year of the ETS has been that, overall, allocations are not so low as to harm industrial competitiveness; indeed, while actual emissions slightly exceeded allocations in 2015, all companies but one have complied with their obligations through the use of flexibility mechanisms such as offsets. Finally, Korea's key competitors are also pricing carbon. An ETS was introduced in Tokyo in 2010, and Japan imposed a carbon tax in 2012. China has been operating seven pilot ETS since 2013, with a view to creating a national scheme in 2017. Korea has started to explore carbon market co-operation with China and Japan (Reklev, 2016), and these efforts should be pursued.

Industry cites increased transparency, stability and long-term visibility as key factors necessary for a smooth adoption of the ETS. In the past, mixed messages from the Ministry of Environment (MOE) and the Ministry of Trade, Industry and Energy (MOTIE) on the number of permits to be allocated in the first phase made it more difficult for companies to prepare for the introduction of the scheme. In 2016, the management of the ETS was transferred from the MOE to the Ministry of Strategy and Finance. The adoption of a 2030

target replacing the 2020 target leaves industry uncertain of emission reduction quantities and timelines. More transparency and long-term visibility concerning permit allocation are necessary. The government has identified a need to work more closely with companies and sectors to build trust and to better accompany industry in ETS adoption. To this end, it plans more information and awareness-raising activities, as well as increased support for research and development (R&D).

The ETS was preceded by the Target Management System (TMS), a regulatory instrument implemented in 2010 that caps the annual GHG emissions of individual firms. Firms negotiate their targets with the government, and pay fines based on the number of failures to meet the target, no matter how much the target is exceeded by.[4] The scope of application has gradually expanded, and now applies to facilities with annual emissions of 15 000 to 25 000 tonnes of CO_2 eq; those emitting more are subject to the ETS (GIR, 2015; KEI, 2012). Abatement achieved by the TMS increased from 21.3 million tonnes (Mt) of CO_2 eq in 2012 to 39.8 Mt CO_2 eq in 2014 (MOE, 2016a). This represented 5.3% of actual GHG emissions in 2013. The petrochemical, semiconductor/display/electrical and electronic industries contributed most significantly to this result (Republic of Korea, 2014a). However, environmental NGOs argue that the TMS gives industry too much influence over target setting, and that the fines are too low to act as incentives for firms to meet their targets (Kim, 2015).

The government supports continuing the TMS in parallel with the ETS, maintaining that the TMS provides a mechanism through which smaller companies can learn and build capacity, for example concerning monitoring, reporting and verification practices, before joining the ETS. It also ensures that firms that are too small to ever join the ETS have to reduce emissions. In addition, as Korean firms are more familiar with regulation than with taxation, regulation is a relatively more accepted way of pricing carbon in the Korean context. However, to maximise efficiency and level the playing field, the TMS should be phased out and a carbon tax adopted for all sectors not covered by the ETS (OECD, 2012a; OECD, 2014a). Indeed, a 2009 study estimated that achieving Korea's former 2020 emission reduction target through an ETS would cost only 40% as much as relying on direct regulations (Lee, 2009), indicating that the TMS is not a cost-efficient way to reduce emissions.

3.4. Transport taxes and charges

Taxes on vehicles

Korea taxes diesel vehicles more heavily than petrol ones, reflecting the higher contribution of diesel vehicles to local air pollution. At national level, vehicles purchases are subject to the individual consumption tax; the education tax is applied on top of it as a surtax. The use of diesel vehicles is taxed further as a component of the environment improvement tax. Together these three taxes made up 25% of transport tax revenue, on average, over 2006-14, with the rest coming from local vehicle taxes. The environment improvement tax is applied twice a year to the use of diesel vehicles based on their age and estimated pollution emitted, while the individual consumption tax is based on engine capacity. An initial plan to impose the environment improvement tax on diesel fuel consumption – more efficient from an environmental perspective, as it is vehicle use that generates CO_2 emissions – met stiff opposition (Kang, 2012).

Exemptions to the diesel vehicle component of the environment improvement tax may limit its effectiveness in reducing local air pollution. A permanent exemption of vehicles meeting the Euro 5 emission standards was introduced in 2010, and extended to vehicles

meeting the Euro 6 standards in 2015. The permanent exemption means the tax cannot keep up with technological improvements. Furthermore, studies have shown the real-world NO_x emission performance of Euro 5 and 6 vehicles to be far poorer than test-cycle measurements (Carslaw et al., 2011; Franco et al., 2014), suggesting there is no environmental justification for exempting them from the tax. In the context of a rationalisation of Korea's environmental taxes and charges, the environment improvement tax is scheduled to be phased out by 2020.

The government planned to introduce a bonus-malus programme in 2015, modelled on the French system, to provide incentives for the purchase and technological innovation of vehicles with low CO_2 emissions. It would have added a tax on purchases of highly polluting vehicles and used the revenue to subsidise purchases of less polluting ones. However, implementation was postponed to 2020 due to concern that introducing this programme at the same time as the ETS would overburden industries. The government could learn from stumbling blocks encountered in the French experience, such as a prolonged deficit due to criteria which led the bonus to far outweigh the malus component, and an adverse effect on air pollution because the programme favoured diesel vehicles (OECD, 2016e). Broadening the vehicle purchase tax base to local pollutants, as in Israel, would allow average GHG emissions per car to be reduced without increasing health-damaging local air pollution (OECD, 2016f).

The government has introduced exemptions and reductions to the individual consumption tax to encourage fleet renewal and purchases of less polluting vehicles (Section 4.5). The government also encourages the retirement of old, more polluting vehicles by offering owners of cars registered before 31 December 1999 a 70% tax reduction (up to KRW 1 million) if they scrap their old diesel vehicle and register a new one within two months of scrapping. An evaluation of French, German and US vehicle scrapping programmes reveals that environmental benefits (in terms of reduced CO_2 and NO_x emissions) and cost-effectiveness are highest if the new car must comply with stricter fuel efficiency standards and emission limits than the scrapped car, which in addition has to have been in active use (ITF, 2011).

Road congestion

Road congestion in Korea is heavy and has been rising over time, and instruments to tackle the problem have not kept up. The economic cost of congestion was estimated at KRW 30.3 trillion in 2012 by the Korea Transport Institute,[5] the highest value since measurement began in 1993, representing 2.2% of GDP (Cho, 2014). While Korea has economic, regulatory and voluntary instruments in place to tackle congestion (e.g. a congestion charge and a traffic generation charge), there has been little progress in their application since the last *OECD Environmental Performance Review*. However, the introduction of "transit mall districts" in Daegu, Busan and Seoul, to which only public transport, bicycles and pedestrians have access, is a positive development (OECD, 2012b; Lim et al., 2015).

Although a congestion charge on Namsan tunnels 1 and 3 in Seoul initially reduced vehicle volume and increased average speed through the tunnels, the rate has not been raised since its introduction in 1996. Its impact on congestion has therefore declined over time as the general price level and the costs of other transport modes have increased. Raising the rate, particularly at peak hours, could help increase the instrument's impact (Seoul Solution, 2015). There is also a need to expand the use of congestion charges to other

parts of Seoul and major roads in other cities (OECD, 2006; OECD, 2012b). While the Urban Traffic Readjustment Promotion Act provides the legal foundation to do so, the charges have not been expanded due to public opposition, a common challenge across OECD countries (ITF, 2010). Complementary measures to improve public transport and make it affordable for low-income households would be required (OECD, 2012b; Mo, 2009). Research by the Korea Transport Institute also recommends rebranding the instrument (e.g. as a "green pass") to focus on its positive impact, closely involving citizens in the design and implementation as well as in conflict resolution related to congestion charges, increasing strategic promotion and bolstering the legal reinforcement of the charge (Mo, 2009).

The impact of the traffic generation charge has been limited by its low rate and its failure to accurately reflect regional characteristics and facility location. The charge has therefore been criticised in the past as being imposed unnecessarily in areas where congestion is not a problem, and conversely as being too low in areas where congestion is severe (Seoul Solution, 2015). Based on the principle that urban expansion generates more traffic, the charge is levied on buildings larger than 1 000 m^2 in cities with more than 100 000 inhabitants. Revenue, which is used to improve transport infrastructure, has increased steadily as the number of participating facilities rises. While the unit cost component (imposed per square metre) was not raised in over 20 years, in 2014 the government introduced plans to increase it to almost three times its current level by 2020, a welcome move. Seoul has already begun to increase its rates. Furthermore, a congestion coefficient is available to calibrate the charge for regional differences and facility location. Seoul applies this coefficient, and it is essential for other cities to do the same.

3.5. *Taxes and charges on environmental pollution and resource use*

Korea has many other environmentally related taxes and charges, whose features and revenue use are determined by individual laws. Their levels are generally too low to bring about behavioural change, yet the government is reluctant to raise rates due to concern about burdening industry and hindering investment in an economic downturn. The collection rate of many taxes and charges is also fairly low (Kang, 2012), representing substantial forgone revenue.

The MOE collects the bulk of taxes and charges on pollution and resource use, namely those pertaining to air and water pollution, waste (including recycling) and ecosystem preservation. These are explained below, with the exception of waste charges covered in Chapter 4. Other agencies collecting environmentally related taxes and charges include the Korea Forest Service, with a reforestation tax on land developers to finance reforestation in mountainous districts; the Ministry of Oceans and Fisheries, which collects four taxes and charges to discourage pollution and other damage to the marine environment and to fund marine ecosystem conservation; the Ministry of Land, Infrastructure and Transport (MOLIT), which imposes taxes on congestion, noise and land development; and the Ministry of Trade, Industry and Energy (MOTIE), with taxes to help improve nuclear safety.

Air pollution

Air emission standards (Chapter 2) are complemented by an air pollution tax, introduced in 1983. It has two components. The "basic" rate, imposed on SO_2 and total suspended particles, is applied to emissions within permitted levels, while the "excess" rate, imposed on nine pollutants including SO_2 and NH_3, applies to emissions exceeding permitted levels (MOE, 2015a). The government uses data from the well-established

smokestack tele-monitoring system (Chapter 1) to apply the taxes. However, their level would need to be raised to have an environmental impact. Furthermore, while increasing, NO_x emissions from industry are not yet subject to either component of the tax. Finally, small companies are exempt from the basic charge, and facilities using low-sulphur fuels are exempt from the SO_x charge.

Water resource management

Korea's charges related to water resource management do not encourage efficient water management and use. MOLIT manages the river water use fee to finance water management expenditure, the dam water tariff to recover the cost of building and operating dams, and the multiregional water tariff to cover the cost of supplying water through multiregional systems. The tariffs do not signal water-related risk (e.g. flooding, scarcity) as they reflect neither local water conditions nor shifts in water availability (OECD, forthcoming). Instead, MOLIT sets a nationwide unitary rate for each tariff and fee, and their revisions are infrequent and minor. As the rates of these tariffs do not cover all infrastructure costs, long-term construction and maintenance of physical assets depend on the ability of local water authorities to secure funding from the central budget, which is difficult in the current economic context.

Water and wastewater infrastructure and services

A water supply charge and sewerage charge are intended to cover costs associated with providing water supply and sanitation services. While these charges are under the remit of the MOE, their rates are set at local level and thus vary across 162 local governments. Both comprise a fixed minimum charge plus block charges that increase with the volume of water used and wastewater produced. Rates also vary by user type, with households generally paying the least. "Polluter charges" apply to those requiring the extension or creation of a new water supply and sanitation network in order to cover the costs involved.

The rates of these charges are insufficient to guarantee the continued operation, maintenance and extension of water and sewerage infrastructure. Although the revenue from both charges has been gradually increasing, it has not kept pace with the rising cost of providing these services and, consequently, the cost recovery rate has been declining. The growing gap between the charge paid by consumers and the cost of service provision is particularly marked for wastewater treatment, as costs have risen due to strengthened effluent quality standards and increased tertiary treatment (MOE, 2016a; MOE, forthcoming).

The water supply and sewerage charge rates are the lowest in the OECD, and do not encourage efficient water use. They are kept low to address social concerns, but their share of household disposable income is far below the OECD and global averages, suggesting there is room to increase them (OECD, 2011a; Ahn et al., 2015). There are also considerable cross-subsidies between user groups and regions; for example, in 2014, the average rate of the water supply charge paid by large bath and sauna businesses was 61% higher than that paid by households, and 41% higher than that paid by industry (MOE, 2016b).

In addition, socially motivated reductions and exemptions to the water supply charge dilute the incentive to rationalise water use and reduce the budget available for water infrastructure. Reductions apply to those over 65, those with a disability, and low-income households. The amount of reduction is decided by ordinance by each local government. Schools, social welfare facilities, facilities with rainwater storage and wastewater

reclamation and reuse systems, public restrooms, and disaster shelters also pay reduced rates (MOE, 2016a). From a financing perspective, the reduction for those over 65 is particularly critical, given the rate at which the population is ageing. Alternative solutions could restore the incentive to rationalise water use while supporting vulnerable households, such as removing reductions and exemptions but providing separate aid decoupled from water use.

Water quality

The MOE manages four economic instruments related to water quality. Two are intended to raise revenue for water quality projects and the other two to encourage pollution reduction. The one that raises the most revenue is the water use charge, which is applied to end (downstream) users of water from the four major rivers as a function of the volume used. Revenue from the charge, which has risen gradually over time, is used to finance water quality improvement projects and compensate landowners for constraints on their property rights (certain activities are restricted upstream in order to maintain good water quality). The rate is adjusted every two years by each River Basin Management Committee, taking into account the water quality target and the budget required to meet this target.

To encourage pollution reduction, the tax for total pollution load management applies to discharges in excess of an actor's allocated load of biochemical oxygen demand (BOD) and total phosphorus (T-P), and the water effluent tax penalises actors that exceed effluent standards for 19 types of pollutants (Chapter 2). The latter has two components: the basic effluent tax for discharges of organic substances and suspended solids above effluent water quality standards but below permissible discharge limits set in the Water Quality and Aquatic Ecosystem Conservation Act, and the excess water effluent tax for discharges of all 19 types of pollutants above the act's permissible limits. Once again, the rates are too low to encourage pollution reduction. The collection rate of the water effluent tax is very low – 5.4% in 2011, 11% in 2015 (MOE, 2016a). This lack of enforcement further weakens the power of the tax to encourage pollution reduction. One reason for the low collection rate is that the tax applies predominantly to smaller businesses, of which an increasing number and share are non-viable (with negative operating profit over three years) (OECD, 2016a) and are hence unable to pay.

Finally, there is the water quality improvement charge, imposed on manufacturers and importers of spring water. Of the total revenue, 60-70% goes to local governments to subsidise public drinking water quality management; the rest goes to the Special Account for Environmental Improvement. As with other water quality taxes and charges, the collection rate is fairly poor – below 60% (MOE, 2016a).

Biodiversity protection

Korea applies an ecosystem conservation tax to developers of projects whose environmental impact assessment indicates that they could negatively affect biodiversity. The amount corresponds to the size of the land area lost or damaged; there is no component linked to the type of damage done. The revenue is used to fund conservation efforts, including ecosystem restoration. A developer that carries out a conservation project or pays a third-party professional to do so can be refunded up to 50% of the tax (MOE, 2015a). However, developers rarely take this option; between 2006 and 2014, there were 7 350 cases of the tax being paid and only 93 reimbursement projects (MOE, 2016a), suggesting it is cheaper to pay the tax and cause environmental damage than to engage in conservation efforts and obtain partial reimbursement.

Environmental improvement

Despite being a large and rising revenue raiser for the MOE, the environmental improvement tax is being phased out following criticisms of being out of date, imperfect in its application and collection, and overlapping with other taxes and charges (GSC, 2012a). Introduced specifically to reduce pollution and create a stable revenue stream to finance investment in environmental improvement, it was imposed on facilities over 60 m^2 causing air and water contamination, and still applies to the use of diesel vehicles (GSC, 2012a) (Section 3.4). The tax on facilities was discontinued in 2015, with the water pollution component incorporated into the sewerage charge. The tax was not efficient in encouraging pollution abatement, as it was imposed on facility owners rather than occupants, the standard quantities used to calculate it differed substantially from actual quantities, and the air pollution element was restricted to SO_x (GSC, 2012a). The tax was unpopular with the public and subject to many petitions demanding modifications (Kang, 2012). The diesel car component is to be phased out by 2020.

3.6. Environmentally harmful subsidies

Support to fossil fuel production and consumption

The government has been phasing out long-standing support for domestic coal production. The abolition of the coal production stabilisation subsidy, involving price support subsidies for capital equipment acquisition and exploration, was completed in 2010. However, support for the coal briquette production subsidy fund has been increasing since 2012 and represented KRW 166 billion (USD 158 million) in 2014 (OECD, 2015b), the equivalent of about 3% of the MOE's budget that year (MOE, 2016a). The subsidy aims to combat fuel poverty by setting the price of briquettes below production costs and paying the difference to producers (OECD, 2015b). It was scheduled for abolition by 2020, but the process was put on hold after an increase in price levels raised concern that low-income households would not be able to cope without the subsidy. However, since 2014, the minimum wage has increased much faster than the economy in real terms, and very low inflation in 2015 meant that real overall wage growth was higher than economic growth for the first time in years. This context, plus the recent introduction of the energy voucher system (see below), presents an opportunity for the government to resume phasing out the coal briquette subsidy.

As part of the transition away from coal briquette subsidy, the government introduced an energy voucher system in December 2015. Available in the winter months only, it targets low-income households with elderly people, young children and people with disabilities. The system may require some changes to improve its impact. The amount was based on the cost of heating in 2009, leading to criticism that it was insufficient, so the government plans to raise the voucher value to reflect current heating prices (Seo, 2016). Furthermore, a survey by the Korea NGOs Energy Network indicates that many energy-poor households suffer heat-related illnesses in summer, suggesting that energy support may also be needed for cooling, and that more communication is necessary to raise awareness among energy-poor households about the government's energy welfare policies (Ahn, 2016). Finally, as the voucher can only be used for energy, it effectively reduces the price of energy and therefore works against more frugal, efficient energy consumption. To avoid diluting the incentive to save energy, the voucher could be untied from energy use and used by low-income families to meet needs of their choice.

Korea also provides substantial consumer support through tax exemptions on a number of fossil fuels, particularly for agriculture and fishing. Although support to these two sectors fell almost by half between 2007 and 2014, it still stood at KRW 1.8 trillion (USD 1.7 billion) in 2014, over ten times the level of support for coal briquettes (OECD, 2015b). Energy-intensive industries (e.g. cement and steel) are exempt from the tax on bituminous coal, which is only applied to power generation. Agriculture and fishing are also major beneficiaries of electricity cross-sector subsidies. Electricity prices are below production cost for all sectors, representing an environmentally harmful indirect subsidy (Section 4.4), and the cost recovery rate is lowest for agriculture (33% in 2012) (MOTIE, 2014).

The government has provided a fuel subsidy to buses, trucks and LPG taxis since 2000. It is funded by the motor fuel tax, introduced for this purpose, meaning that private vehicle users are cross-subsidising buses, trucks and taxis. The subsidy was to initially run for three years to help these vehicles' operators cope with rising LPG and diesel prices resulting from the government's first energy tax reform to recalibrate fuel prices. However, extended multiple times, it still operates today and was expanded in 2015 to diesel taxis meeting the Euro 6 standard so as to promote fuel diversification in the taxi industry. This is despite the fact that diesel vehicles emit more local air pollutants than LPG vehicles (which the majority of taxis are) and studies show that Euro 6 vehicles emit more air pollution than test-cycle measurements indicate (Franco et al., 2014). Other OECD countries are moving in the opposite direction, with Paris committing to ban diesel vehicles by 2020 and London and Madrid considering similar measures.

The above exemptions and subsidies are regrettable, as they encourage increased fossil fuel use, generate more pollution and represent substantial forgone and spent budget resources that could be used to support other policies. They also contravene the polluter-pays principle and can lead to additional future expenditure to remediate the potential environmental and health damage caused.

Support for agricultural production

Although Korea has gradually reduced its farm support over the past decade, it is still one of the largest providers of producer support for agriculture in the OECD: the producer support estimate (PSE) as a share of gross farm receipts is almost three times the OECD average (OECD, 2016g). However, the role of agriculture in the economy is moderate and declining; between 2006 and 2014, the share of agriculture, forestry and fishing in GDP declined from 2.4% to 2.0%, and from 7.7% to 5.7% of employment (OECD, 2015c). The predominant method of producer support is market price support. High import tariffs are also applied; indeed, in 2009-11, Korea had the OECD's highest share of production and trade-distorting support in its PSE (OECD, 2013b). Recent free trade agreements with Canada, Australia and New Zealand have helped reduce barriers to agricultural imports (OECD, 2015d), but some high tariffs remain; for example, the tariff rate on rice imports is 513% (OECD, 2016g).

Direct producer support distorts the market in an environmentally harmful way by encouraging farmers to increase production and use more inputs than they otherwise would, thereby increasing pressures on the natural resource base (OECD, 2013b). Some OECD countries are moving to green direct payment programmes by restricting the amount of output allowed, decoupling support from production (e.g. through "area payments") and integrating environmental conditionality into the granting of support. There is great potential for Korea to make progress on this front, given that the share of its PSE based on

commodity output and non-constrained variable input use is the highest in the OECD, providing an incentive for agricultural intensification (OECD, 2013b).

In addition, agriculture has been largely exempt from water charges since 2000, which contravenes the user-pays and polluter-pays principles (OECD, 2010b; OECD, 2006). In 2013, 12% of water use expenditure went to agricultural water management (MOLIT and K-Water, 2016). The sector is the economy's largest water user, and groundwater abstraction for agriculture has increased rapidly (Chapter 1). Land and livestock account for over 90% of diffuse pollution and over 65% of BOD and T-P water pollution, owing to intensive pesticide use and rising livestock numbers. Subjecting the sector to water charges would be highly desirable, from an ecological perspective, to encourage efforts to reduce consumption and pollution.

The government provides support for environment-friendly agricultural practices, though it has not been sufficient to offset harmful subsidies. To cover the start-up costs and initial loss of income associated with transitioning to eco-friendly farming, the government has provided subsidies to registered farmers with eco-friendly product certification since 1999. Support is available for five years for organic farmers and three years for farmers using either no or low amounts of pesticides, on farms of up to 5 hectares. However, participation has been declining since 2011, the intensity of commercial fertiliser use remains among the highest in the OECD, and the share of agricultural land dedicated to organic farming is about half the OECD average (Chapter 1). Farmers can be paid to carry out ecosystem conservation activities on their land through biodiversity management contracts with local governments. Use of this instrument rose from 3 local governments in 2002 to 25 in 2015 (MOE, 2016a).

4. Investing in the environment to promote green growth

4.1. *The Green New Deal and the first Five-year Green Growth Plan*

Following the 2008 economic crisis, Korea's green stimulus package was one of the world's most significant, representing 4.5% of its 2008 GDP (OECD, 2011b). The KRW 50 trillion (USD 39 billion) package was allocated to 9 key projects and 27 supporting projects in water and waste management, green transportation, energy efficient buildings, and clean energy (OECD, 2011b). The Four Rivers Restoration project (Box 3.3) and rail investment accounted for over half of spending, underscoring the government's emphasis on large-scale public infrastructure to stimulate growth and job creation.

Box 3.3. **The Four Rivers Restoration Project**

The Four Rivers Restoration Project was a flagship green growth expenditure project under the former Lee government. Its stated objectives were to secure water resources, control floods, improve water quality, restore river ecosystems, develop waterfront leisure spaces and promote regional development (KEI, 2009). A 2012 evaluation by MOLIT found the project achieved some of these objectives: the number of large floods decreased, more water resources have been secured and water quality, as measured by average BOD and T-P, improved (Kang et al., 2014). Completed in about two years (2009-11), the project was of an unprecedented scale and budget, costing around KRW 22.2 trillion (USD 19.3 billion), restoring over 1 000 km of major streams and involving the building of 16 weirs (dams that allow water to flow over the top).

However, independent reviews by the Board of Audit and Inspection of Korea in 2013 and the Four Rivers Restoration Project Investigation Evaluation Committee in 2014 identified

Box 3.3. **The Four Rivers Restoration Project** *(cont.)*

environmental, procedural and structural problems. They found, for example, that some weirs were insufficiently durable and that high maintenance costs are expected. The reviews also found that the dredging plan was implemented inefficiently and without accurate prior review, and that there is a mismatch between where water resources have been secured by weirs and locations of previous serious droughts. From an environmental perspective, the reviews found that while BOD and T-P levels improved, other measures of water quality deteriorated, with algae blooms in some areas caused by the weirs slowing flows almost to a standstill. The slowed flow has caused the population of some aquatic species to decrease and the dams block ecological corridors. The river dredging and construction of the riverside eco-parks affected some habitats and species, and much of the planted flora is inappropriate for marshes. As the eco-parks were designed without overarching land use planning, the necessary mix of conservation areas, buffer zones and leisure spaces is lacking. Continued monitoring is needed to evaluate long-term changes in aquatic ecosystems and riverbeds.

The project met heated opposition from civil society organisations, academics and some local politicians. They contended that it was rolled out too fast, raising concern about the quality of the planning and construction, and flagged negative environmental effects. As with other large infrastructure projects, the groups also maintained that the government failed to take into account the views of a range of stakeholders (e.g. local residents, NGOs) when designing and implementing the project (Chapters 2 and 5).

Source: Four River Restoration Project Investigation Evaluation Committee (2014), *Four River Restoration Project Evaluation Report, www.molit.go.kr/USR/policyData/m_34681/dtl.jsp?id=3860*; KEI (2009), "Four Major River Restoration Project of the Republic of Korea"; BAI (2013a), *Environmental Audit on Four Major Rivers Restoration Program, http://english.bai.go.kr/bai_eng/cop/bbs/detailBoardArticle.do?bbsId=BBSMSTR_200000000004&nttId=14087&searchCnd=7&searchWrd=&searchBgnDe=&searchEndDe=&searchYear=&searchCate=&mdex=*; BAI (2013b), "Quality of main facilities and water quality management status of the Four Rivers Restoration Project"; Kang et al. (2014), "Experiences and Lessons of Korea's Green Growth"; Kang et al. (2012), *Water and Green Growth*.

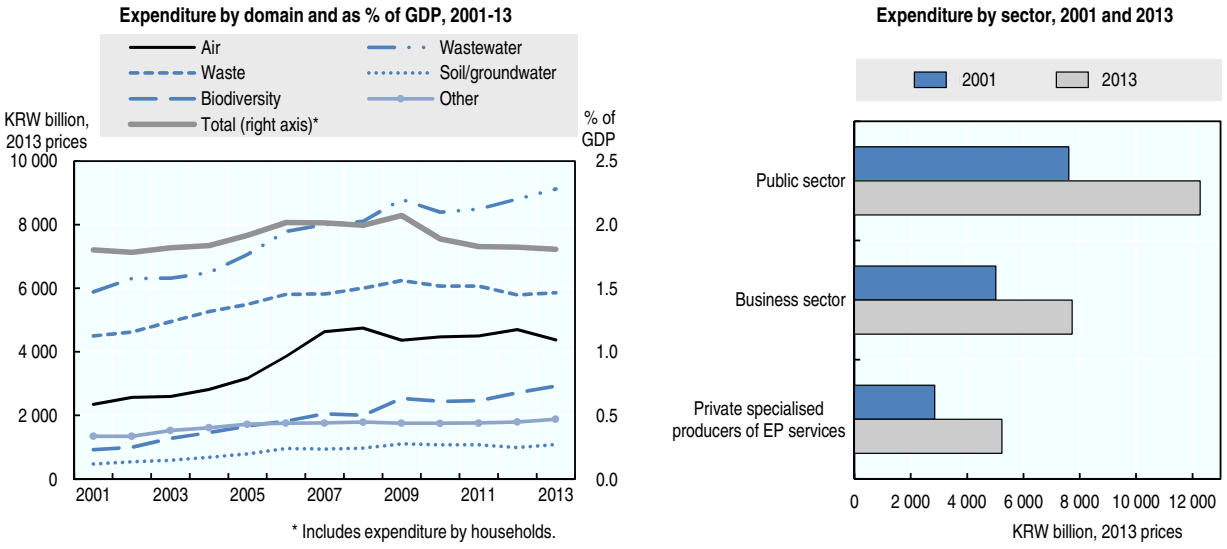
Korea's Green New Deal was integrated into the budget for the first Five-year Green Growth Plan (2009-13), which aimed to spend 2% of GDP per year (KRW 107 trillion in total) on green growth projects. Actual expenditure over this period exceeded what was planned (KRW 111 trillion) (Choi, 2014), allowing the 2% target to be met. The government expected the plan to induce production worth 20% of 2009 GDP and boost employment by as much as 10% by 2013. Expenditure was divided under the plan's ten policy agendas, with the bulk going to water, waste and transport infrastructure. While the high spending on green growth is laudable, the green credentials of some areas of expenditure, such as "development of foreign oil fields" and "nuclear energy development", are questionable.

4.2. Expenditure for environmental protection

Environmental protection[6] expenditure as a share of GDP increased steadily from 2001 to 2009 before falling annually from 2010 to 2014. As in most OECD countries, the bulk goes to wastewater and waste management (about 60%). The public sector accounts for over half of wastewater expenditure, and private specialised producers account for over half of waste expenditure (Figure 3.5).

Combating air pollution is the next highest area of expenditure (around 20% per year), reflecting Korea's challenges in this area. Air pollution is particularly severe in the Seoul Metropolitan Area due to its high population density (and accompanying road traffic) and high concentration of industry, engendering substantial health impacts (MOE, 2015d;

Figure 3.5. **Wastewater and waste management account for the bulk of environmental protection expenditure**



Note: Expenditure by abater principle by public (including public specialised producers of environmental protection (EP) services) and business sectors, and private specialised producers of EP services.
Data refer to investments and internal current expenditure (excluding payments for EP services) less receipts from by-products (e.g. materials recovered as a result of waste treatment). Data include expenditure for i) pollution abatement and control covering air protection, waste and wastewater management, protection and remediation of soil and groundwater, and other EP activities (R&D, administration, education); and ii) biodiversity and landscape protection. Excludes expenditure on water supply.
Source: Country submission; OECD (2016), "Environmental protection expenditure and revenues", *OECD Environment Statistics* (database).

StatLink http://dx.doi.org/10.1787/888933449127

OECD, 2010a) (Chapter 1). Business sector expenditure on combatting air pollution reflects obligations arising from measures the government has taken over the past decade (Chapters 1 and 2).

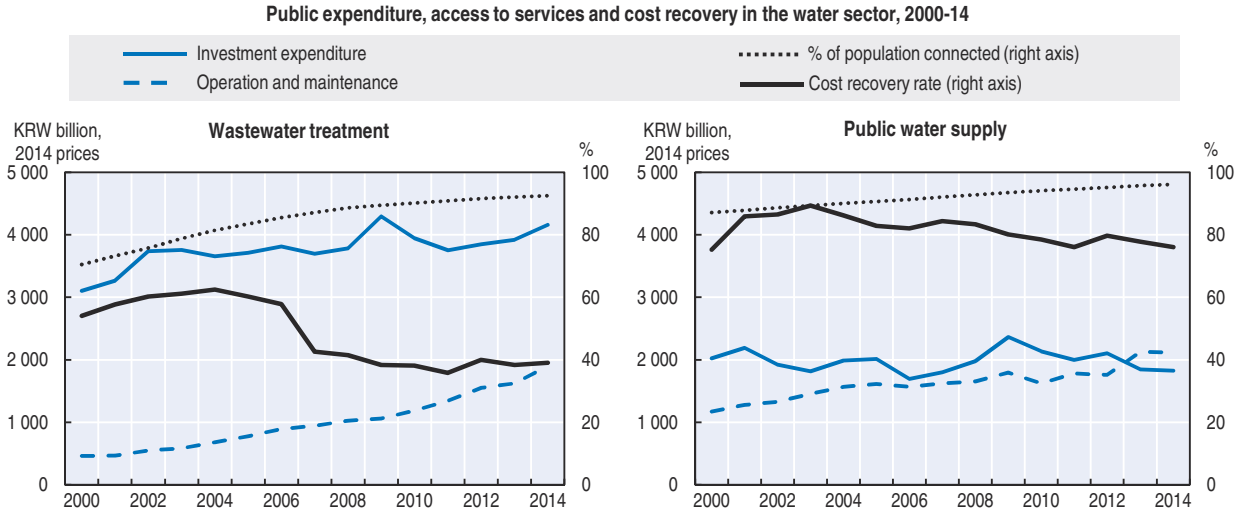
4.3. *Investment in water supply and sanitation*

The financing of water infrastructure and services is fragmented and heavily reliant on the central budget. MOLIT, the MOE and the Ministry of Agriculture, Food and Rural Affairs are the key ministries involved, in addition to spending by local governments and K-Water.[7] Expenditure data are not readily available to those outside each ministry. Nor do the ministries appear to co-ordinate data collection time frames, making it difficult to get an overview of how much the public sector spends on water as a whole. Nonetheless, water management expenditure was estimated at KRW 17.9 trillion (USD 16.3 billion) in 2013, of which only about 50% was covered by revenue in the sector (MOLIT and K-water, 2016).

Public expenditure on water supply and sanitation increased steadily over 2006-14, resulting in excellent connection rates; in 2014, 96%[8] of the population was connected to public water supply and 93% to wastewater treatment plants (Figure 3.6). Since 2000, expenditure on operation and maintenance (current expenditure) has increased faster than investment. Current expenditure for water supply has surpassed investment; with the majority of the population now connected, the focus is shifting from building new infrastructure to maintaining the existing network.

Declining cost recovery rates for water supply and sanitation services, increasing costs from ageing infrastructure and a persistent gap between urban and rural services threaten the sustainability of Korea's water sector financing model. Cost recovery rates declined

Figure 3.6. **Declining cost recovery rates threaten the financial sustainability of the water sector**



Note: Percentage of population connected to public water supply: excluding village waterworks and small facilities.
Source: MOE (2016), *Sewage statistics and Waterworks statistics* (raw data); MOE (2008-15), *Environment Statistics Yearbook* (several issues).

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between 2006 and 2014, from 82% to 76% for water supply and from 58% to 39% for sewerage services (Figure 3.6). This puts increasing strain on central and local budgets; indeed, sewerage infrastructure and wastewater management systematically received the highest share of the MOE's budget over 2006-15 (MOE, 2016a). The share of multiregional and local infrastructure which is over 20 years old is projected to reach 80% and 46%, respectively, by 2025 (MOLIT and K-Water, 2016). To replace ageing sewerage, annual expenditure will need to increase by about a third from the 2009-14 level. Finally, the water supply charge in rural areas is higher than that in cities, as the former do not benefit from economies of scale and the infrastructure quality is worse (the leakage rate is six times higher in rural than in urban areas) (MOE, 2016c). There is also a substantial gap in service coverage between urban and rural areas (Chapter 5).

Korea is taking a multipronged approach to address its financing challenge for water supply and sanitation. One element is a commitment to gradually raise the water supply and sewerage charges over time (MOE, 2016a). The National Sewerage Service Master Plan (2016-25) sets the objective of achieving a cost recovery rate of over 80% by 2025 by making central government subsidies conditional on local governments' plans and performance in increasing the cost recovery rate (MOE, 2016a), and the National Waterworks Master Plan (2016-25) sets a 95% waterworks cost recovery rate objective. The government is also pursuing improved management efficiency, for example by introducing an asset management system for water supply and sanitation, rationalising operations by amalgamating multiple water supply services to benefit from economies of scale, and devolving water services from local governments to specialised agencies. The amalgamation of water supply services and their devolution to K-Water achieved positive results in Gyeongnam Province; consignment charges (operating cost, investment repayment and commissions to K-Water) have fallen in every participating municipality, and the project is expected to cut costs by KRW 24 billion (USD 21 million in 2015) over the 20- to 30- year contract period (OECD, 2015e), compared with business as usual. The government is also encouraging private sector participation by introducing a Rehabilitate-Transfer-Operate

system (MOE, 2016f), and has committed to directly using the public budget to replace ageing rural water supply and sanitation infrastructure (MOE and MOSF, 2016).

Rising investment in water quality over 2006-15 led to a marked reduction in point source pollution, but with water systems under increasing pressure from diffuse pollution and climate change, more investment will be needed in those areas. Point source pollution has fallen, largely thanks to heavy investment in sewerage treatment, which accounted for 76% of water quality expenditure over 2006-15. Although investment in reducing diffuse pollution has risen far faster than any other area of water quality expenditure, only 43% of the original investment planned in this area in 2006 was actually made, and it remained the area of lowest investment overall over 2006-15, at 1% (MOE, forthcoming). The remainder of water quality investment went to restoring freshwater ecosystems (12%), managing hazardous substances (9%) and building livestock waste treatment facilities (2%). As livestock wastes alone account for 37% of the total water pollution (MOE, 2013), efforts could be bolstered in treatment facilities.

4.4. *Investment in energy efficiency and renewable energy*

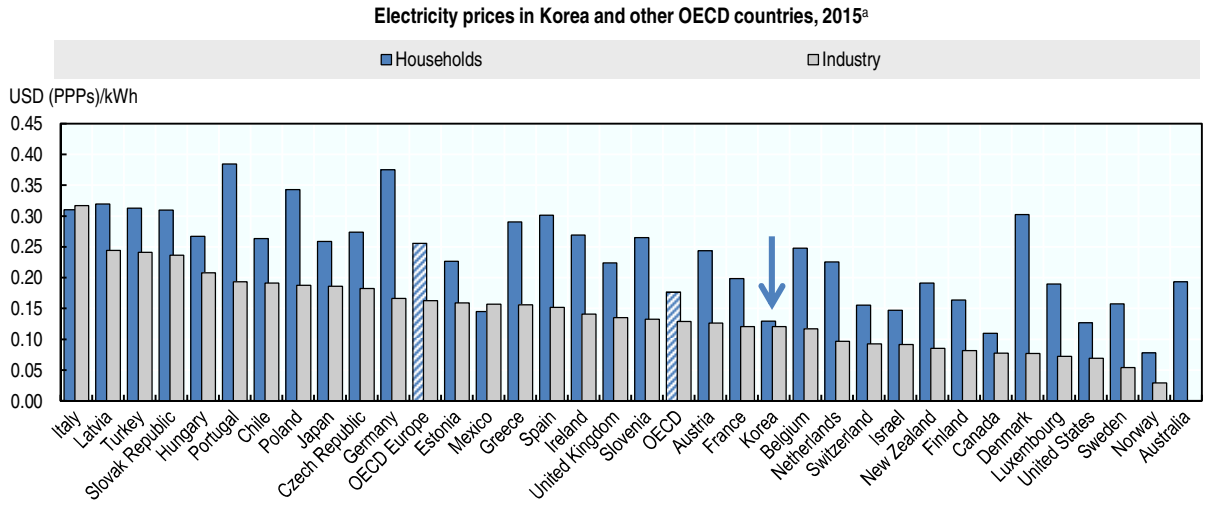
Developing renewable energy sources and curbing increasing energy demand are essential to improve energy security and reduce GHG emissions. One study estimates that if Korea invested 1% of GDP in renewables and 0.5% of GDP in energy efficiency measures every year over the next 20 years, it could halve its total energy consumption and CO_2 emissions per capita compared to a business-as-usual scenario (UNIDO and GGGI, 2015). The Korean share of renewables in the energy mix is the lowest in the OECD, and energy intensity has been declining more slowly than the OECD average. The second Energy Master Plan (2014-35) sets ambitious targets for energy demand and renewables (Chapter 1). A transition to demand management policies and improvement of energy policy sustainability are two of plan's six major tasks. Korea has made progress on both, but needs to scale up efforts to meet its targets. Price reform, subsidies and technology development will all have roles to play.

Managing energy demand

Demand has increased faster for electricity than for any other energy source (Chapter 1), leading the government to make electricity rate revision one of the pillars of the transition to demand management policies (MOTIE, 2014). Korea's electricity prices have long been maintained below production cost to support industrial competitiveness, keep electricity affordable for households and provide price stability. The government regulates electricity prices on the grounds that the network structure is monopolistic, and prices are differentiated by sector and user. There are considerable cross-subsidies between and within sectors, of which industry and agriculture have been the primary beneficiaries (Section 3.6) (MOTIE, 2014; Pittman, 2014).

Korea's electricity prices are low by OECD standards, with negative economic, environmental and social outcomes. Demand has outstripped supply, resulting in rolling blackouts in Seoul in 2011 and 2014. The cost recovery rate hit a trough in 2008 (77.7%) and another in 2011, the year of the first blackouts (87.4%), but has been improving since (KEPCO, 2016). The prices for industry and households are below the OECD average (Figure 3.7), much lower than the OECD Europe average at purchasing power parity (PPP) exchange rates and among the lowest in the OECD at market exchange rates (IEA, 2016a). Korea's electricity prices are also lower than those of oil and fall far short of reflecting the social and environmental costs of power generation (MOTIE, 2014, 2015).

Figure 3.7. **Korea's electricity prices are below OECD averages**



a) 2015 or latest available year, data prior to 2010 have not been taken into account.
Source: Country submission; IEA (2016), *IEA Energy Prices and Taxes Statistics* (database).

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The government has announced reforms to make electricity costs better reflect system costs (i.e. of production, transmission, distribution, peak load management, etc.). However, it has struggled to translate these into action. The first and second Energy Master Plans called for abolishing cross-sector subsidies, but they remain. In June 2009, the government announced plans to introduce a pricing system that would move in line with global energy commodity prices and allow the Korean Electric Power Corporation (KEPCO) to pass fuel costs on to consumers, but they have not been implemented (IEA, 2012; Ecofys, 2015).

The government has, however, raised electricity prices since 2010, which has led to improvements in the cost recovery rate. Research by the Korea Energy Economics Institute found that the long-term benefits of raising electricity prices, in terms of energy efficiency and energy import cost savings, would far outweigh the short-term economic shock (Choi and Lee, 2015). In line with IEA recommendations (IEA, 2012), the government has introduced pricing by voltage to more accurately reflect system costs, in addition to load management measures such as seasonally/hourly tiered pricing. Time-of-use pricing, whereby prices reflect generation costs hour by hour, has been compulsory for all high-voltage general and industrial users since 2013, and may be expanded to households following the roll-out of smart meters (MOTIE, 2014). However, further reforms are needed to reduce peak demand and to ensure prices reflect costs of power generation, transmission and distribution (Pittman, 2014).

Korea has made progress in sector-specific demand management policies. In industry, Korea introduced a pilot energy management system in 2008, and established a legal basis for it in 2011. The system works via ISO 50001 certification and is applied to industrial facilities and large buildings. In addition, soft loans and tax incentives are available for investment in energy-saving facilities; the total value of the tax expenditure (in terms of forgone revenue for the government) peaked in 2011 before falling year on year (MOE, 2016a). Energy audits are compulsory for companies using more than 2 000 tonnes of oil equivalent (TOE) annually but audit fees for small and medium-sized enterprises with energy

consumption below 10 000 TOE are subsidised. In the transport sector, fuel efficiency standards led to efficiency gains of 32% over 2006-12, but vehicles remain less efficient than those in the EU and Japan, suggesting there is room to tighten the standards. They could also be extended from passenger cars to small commercial vehicles (MOTIE, 2014). In the area of buildings, while the scope of standards applicable to new buildings has been expanded to cover all buildings over 500 m^2, there is an urgent need to improve policies for existing buildings, which often have low energy performance. The inclusion of existing buildings in energy efficiency certification is a step in the right direction. As for household appliances, Korea operates four programmes: the Energy Efficiency Labelling and Standard programme, the High-efficiency Appliance Certification programme, the e-Standby programme and a subsidy for high-efficiency electrical products. These programmes could be further strengthened, for example by expanding the range of products subject to energy efficiency standards or to production and sales bans (MOTIE, 2014).

Korea is a leader in energy storage technologies (Section 6), recently becoming home to the world's largest battery energy storage system for frequency regulation. The system will reduce the need for KEPCO, the country's largest power utility, to turn to power plants to provide regulation services and will therefore save fuel (Runyon, 2016). The government plans to build on this system and its industrial energy management system to create demand management markets rewarding providers of electricity capacity and the energy efficiency measures (also known as a white certificate market). In designing these markets, Korea could draw upon lessons learned from such programmes in parts of Europe, Australia and the United States. While white certificate systems have proven efficient and effective, experience in Italy and France has shown that: care should be taken in minimising their administrative burden and maximising their transparency; *ex post* evaluations are useful to determine the real energy savings achieved by the certificates; and careful analysis of the interaction of the system with other instruments, such as the ETS and subsidies for energy efficiency measures, is desirable (OECD, 2013c; OECD, 2016e).

Support for renewables

While its mountainous topography, contested and militarised waters and high population density pose challenges to renewables development, Korea has further opportunities to exploit, both in domestic production and in development of technology for export. The government is pushing for wind and solar photovoltaic power to become core pillars of Korea's new and renewable energy mix, and is also promoting strong growth in solar thermal and geothermal energy (Invest Korea, 2015). Korea also has a robust manufacturing industry and advanced technology to draw on in pursuing, for example, development of solar cells and tidal power turbine technology (Chen et al., 2014; Kim, 2015).

Renewables investment and generation capacity increased steadily over 2008-11 (MOE, 2016a), made more competitive by high oil prices and further spurred by a raft of government support measures detailed below. Investment then crashed along with the global renewables market in 2012, caused by sluggish demand, oversupply and a reduction in government support (MOTIE, 2014; Invest Korea, 2015). Solar PV and wind were hit hardest. The government budget for renewables has also declined since 2011, and it consistently amounted to less than 0.1% of GDP over 2011-14 (MOE, 2016a).

The government introduced a feed-in tariff (FIT) system in 2002 as its key renewables support measure. It was replaced by a renewable portfolio standard (RPS) in 2012 to accelerate renewables diffusion and ease the budget burden, though FITs continue to be paid

to existing participants and amounted to 60% of the budget for renewables deployment and infrastructure in 2015. The burden will continue to decrease over time as the FIT contracts end. Under the RPS, power producers with generation capacity exceeding 500 MW must produce or buy a share of their electricity from renewables, set at 2% in 2012 and rising to 10% by 2022. In parallel, producers have to include a rising share of solar PV in their supply. Under the RPS, producers get certificates based on kilowatt hours of renewables-based electricity produced, with weightings applied to different renewable sources based on generation costs, the expected impact on renewable technologies, and the environmental effect. Certificates can be traded between producers to allow them to meet quota obligations (OECD, 2012a).

The RPS appears to have accelerated the installed capacity of renewables: while the FIT system led to the installation of 1.03 GW over nine years, the RPS led to the installation of 1.75 GW in just two years. However, the renewables industry is also much more developed now than it was when FITs were introduced, making it difficult to attribute the rapid growth in capacity solely to the transition to the RPS.

While empirical analysis shows that an RPS has a larger impact on renewables innovation than FITs (Johnstone et al., 2010), it also comes with a risk of excessive use of low-quality renewables. Weighting certificates by technology can address this problem, but the government will need to continue to monitor technological developments in the renewables market and adjust weightings accordingly (OECD, 2012a).

In addition to the RPS, the government operates a Renewable Fuel Standard (RFS) programme, and studies are underway to introduce a Renewable Heat Obligation (RHO) for new buildings over a certain size. The aim is to combine the RPS, RFS and RHO in an integrated market that allows the transaction of certificates between them. The current RFS was introduced into law in 2013 and applied from 31 July 2015. However, the blending of a small share of biodiesel into transport fuel has been obligatory since 2012, following a history of pilot programmes and voluntary blending. The raw materials to produce biodiesel must be imported, therefore not improving energy security, and some (e.g. palm oil) come with their own environmental and social controversies. This challenge needs to be addressed before increasing the mandatory share of biodiesel to be incorporated into transport fuel.

Korea also provides subsidies, loans and tax incentives to develop renewables. These include the home subsidy programme, formerly known as 1 Million Green Homes, which aimed to install renewables-based systems (solar thermal, solar PV, geothermal, biomass and/or small scale wind) on one million houses by 2020. In 2013, the programme was renamed and the target was changed to the installation of renewables-based systems for 10% of all households by 2020. Most installations so far have been solar PV, in part because 1 Million Green Homes absorbed an existing programme to install 100 000 solar roofs. Subsidies are also available for renewables installations on existing local government and other buildings, and long-term, low-interest loans and tax incentives are available to both customers and manufacturers of completely commercialised renewables systems (KEMCO, 2014).

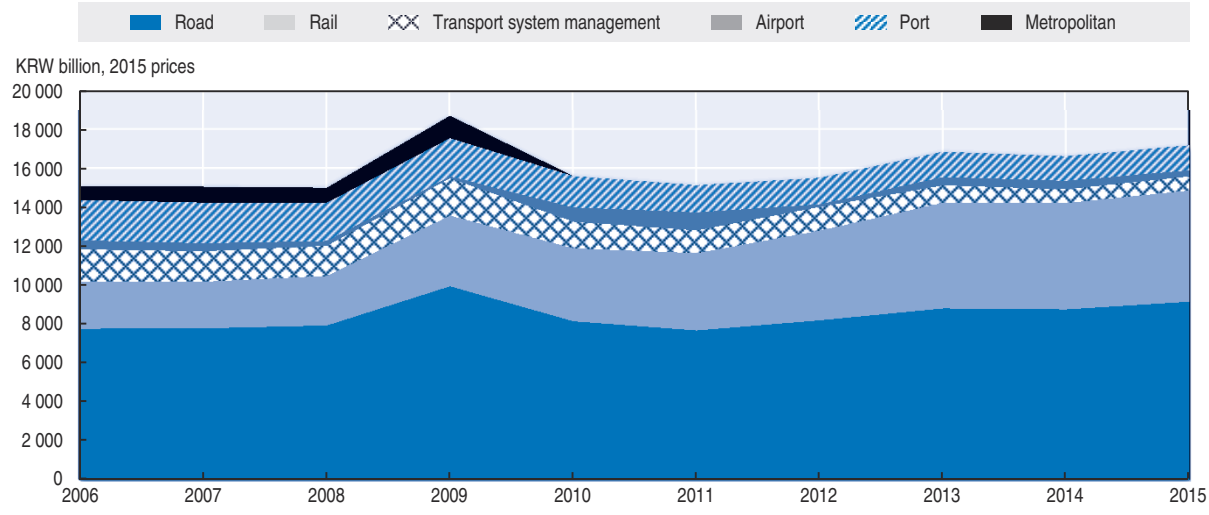
The second Energy Master Plan proposes reforming subsidies to focus on communities instead of individual homes and buildings, and calculating incentives as a function of renewable energy rather than up-front installation investment. Loans could also be redirected, decreasing the focus on renewables that are already economically feasible and instead supporting commercialisation of emerging technology.

Despite this raft of support measures, renewables deployment remains hindered by low electricity prices, the failure of government to prioritise renewables, low public acceptance (e.g. for dams and wind farms) and local regulations (e.g. for wind installations in mountainous areas) (MOTIE, 2014). Public and private funding for fossil fuels continues to outweigh that for renewables; promoting renewables represented only 3.4% of the budget for the first Five-year Green Growth Plan, less than that dedicated to the development of foreign oil fields, and planned annual investment in coal over 2015-19 is 70% higher than the public budget and private investment in renewables in 2014 (MOE, 2016a; MOTIE, 2015). The seventh Basic Plan for Electricity (2015-29) maintains coal as the dominant power source and only increases the share of renewables in the mix by 0.1% compared to the sixth plan (MOTIE, 2015).

4.5. *Investment in transport*

Road transport consistently accounts for over half of transport investment expenditure (MOLIT, 2016a, 2008-14). Over 2000-14, the total length of roads grew by 19%, the third highest increase in the OECD and double the averages for the OECD as a whole (9%) and for OECD Asia-Oceania (10%) (MOE, 2016d; OECD, 2015f). The share of investment in rail infrastructure increased from 16% in 2006 to 33% in 2015 (Figure 3.8), thanks to a boost to high-speed rail by the first Five-year Plan for Green Growth. However this has not translated into a modal shift to rail. Between 2006 and 2013, the share of total inland freight transported by rail fell from 28% to 7%. As for passenger transport, although the volume of passengers using subway and rail transport[9] increased markedly over 2006-13, the share of total passengers transported by these means fell from 35% to 15%. The large majority of freight and passengers are transported by road (74% and 83%, respectively, in 2013) (MOLIT, 2016b).

Figure 3.8. **Roads dominate investment in transport infrastructure, but rail is growing**



Source: Country submission.

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Rail transport is used less frequently for inter-city transport due to the inaccessibility of the stations, such as for pedestrians and cyclists, and the lack of linkage with other transport modes, such as buses. This makes rail transport both slower and more expensive than private vehicle use (IFT, 2012). Korea is aiming to build a single nation-wide public transport

system which would allow all forms of transport to be planned and operated together, instead of independently as at present. It will also be essential to integrate public transport planning with land use planning, to ensure that the network meets the population's needs efficiently and effectively (ITF, 2012; Kwon and Ahn, 2013; OECD, 2014b).

The government has introduced some measures to make urban public transport more convenient, such as bus rapid transit lanes and a public transport card that can be used on all forms of public transport nationwide. These appear to have borne fruit. For example, comprehensive reform of the bus infrastructure, routes, and fare and information systems in the Seoul Metropolitan Area in 2004 led to a substantial increase in ridership and satisfaction within a year of operation (Allen 2011; Lee, 2013). The government has also increased its focus on supporting bike transport: the Master Plan for National Bike Roads, implemented in 2010 with a budget of KRW 2.35 billion (USD 2.03 million), developed 4 835 km of bike paths. Public bike share systems have been growing and existed in 14 cities in 2012, and newly planned cities integrate bike infrastructure (Shin et al., 2013).

As with environmental protection, Korea has a special budget account for transport infrastructure, managed by MOLIT. Roughly 65% of its funds come from the TEE tax (the share fluctuated between 53% and 85% over 2006-15). Indeed, 80% of TEE tax revenue is earmarked for this account, down from 86% in 2006 (Park, 2012). Plans call for the TEE tax to be merged with the individual consumption tax in 2019, which may have implications for the funding of transport infrastructure; however, the TEE tax has been extended multiple times since its initial planned expiry in 2003.

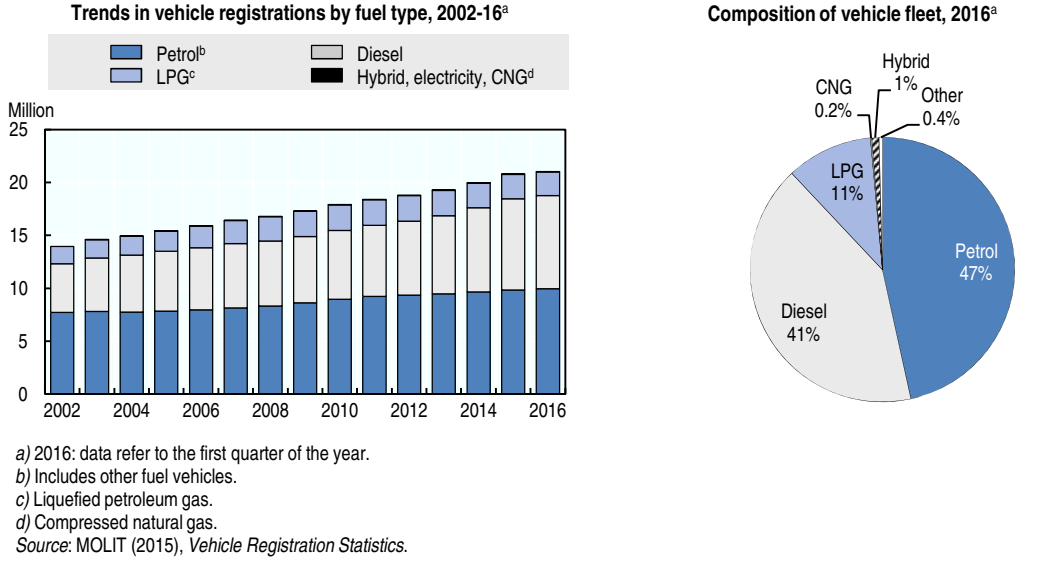
As road transport is a significant source of air pollution and GHG emissions, the government has introduced subsidies and tax incentives for less polluting vehicles. This effort began in 2000 with a programme to replace diesel buses and garbage trucks with natural gas in urban areas. Between 2000 and 2014, 36 162 buses and 1 212 garbage trucks were replaced, and 189 natural gas stations were constructed at a cumulative cost of KRW 795 billion (USD 755 million[10]). Support was provided through grants (65%) and loans (34%) for vehicle and fuel purchases, and through tax and charge reductions and exemptions (e.g. exemption from value-added tax) (GSC, 2012b; KEI, 2008). As of 2014, 82% of intra-city buses ran on natural gas. The investment in natural gas vehicles is seen as an important factor in reducing PM_{10} concentrations in urban areas (MOE, 2016a; KEI, 2008). The next step could be to progressively convert inter-city buses from diesel to natural gas.

More recently, Korea introduced tax incentives and subsidies to promote the use of hybrid, plug-in hybrid, electric and hydrogen vehicles. The exemption of hybrid vehicles from the individual consumption tax, up to KRW 1 million (KRW 1.3 million including the education tax exemption), was introduced in 2008 and extended until the end of 2015. Electric vehicles are exempt from the individual consumption tax, up to KRW 2 million, from 2012 to 2017. Parallel subsidies for electric vehicle purchase, introduced in 2010, have totalled more than KRW 104 billion (USD 92 million[11]) to date. Subsidies for hybrid vehicles were introduced in 2014. The government plans to accelerate electric vehicle uptake through further subsidies and tax incentives, expanding support to electric taxis, buses and trucks, mandating 25% of vehicle purchases by public institutions to be electric, and encouraging private sector engagement (MOE and MOTIE, 2014).

These incentives appear to be encouraging people to buy clean vehicles, but such vehicles still account for an extremely marginal share of the fleet. The share of hybrid cars in total vehicle registrations increased from 0.02% in 2008 to 0.87% in the first quarter of

2016. Over the same period, the share of diesel cars rose from 37% (up from 33% in 2002) to 41%, at the expense of cleaner petrol and LPG vehicles (Figure 3.9). As for electric vehicles, annual purchases more than tripled between 2011 and 2014, with uptake particularly strong on the island of Jeju (MOE, 2016g). Nonetheless, with just 5 838 electric vehicles on the road in early 2016, uptake must increase dramatically for the target of 200 000 by 2020 to be met, a goal revised down from 1 million (MOE and MOTIE, 2014). One approach may be to increase incentives associated with green vehicle use, such as creating dedicated lanes, and lowering parking tariffs that they pay (OECD, 2012b). Another would be to invest in more charging stations, to increase the convenience of using the vehicles.

Figure 3.9. **The share of diesel in the vehicle fleet is rising**



a) 2016: data refer to the first quarter of the year.
b) Includes other fuel vehicles.
c) Liquefied petroleum gas.
d) Compressed natural gas.
Source: MOLIT (2015), *Vehicle Registration Statistics*.

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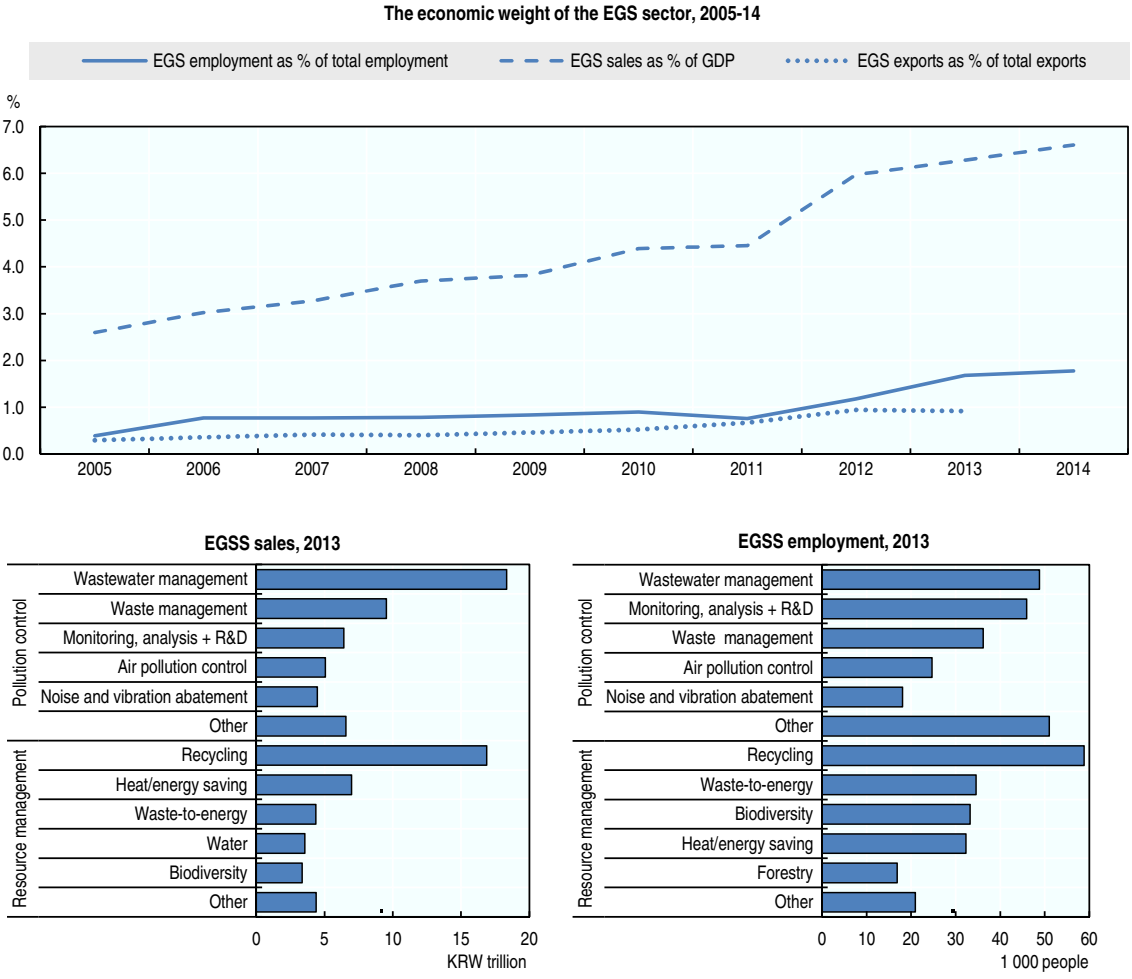
The private sector has an important role to play in facilitating the transition towards a greener vehicle fleet. The government estimates that over 2008-10, private investment in green cars by 30 Korean corporations totalled KRW 2.4 trillion (USD 2.1 billion[12]), with a focus on increasing battery and engine efficiency (MOE, 2016a). As for the car industry, the government aims to increase production of environment-friendly vehicles from 78 000 in 2015 to 920 000 in 2020, and expects their domestic market share to rise from 2% to 20% of new vehicles sold over the period (Lee, 2015).

5. Expanding environment-related markets and employment

5.1. *Trends in the environmental goods and services sector*

The environmental goods and services sector (EGSS) accounted for 6.6% of GDP and 1.8% of total employment in 2014, an impressive increase from 2.6% and 0.5%, respectively, in 2005 (Figure 3.10). The growth rate has been far higher than that of the general economy; both sales and the number of employees in the EGSS almost tripled over 2006-14. Wastewater management and the recycling sector have consistently been the strongest performers in EGSS sales over time and also employ the most people (Figure 3.10), which may reflect the high government focus on these areas (Section 4.3; Chapter 4). Growth has been faster in resource management activities than in pollution control activities, spurred

Figure 3.10. **The environmental goods and services sector is growing**



Note: The environmental goods and services (EGS) sector includes activities aimed at pollution control and resource management carried out by the main economic sectors. The definition includes "cleaner technologies" and "cleaner goods and services". There are breaks in the series as measurement of new categories began at various stages over the review period. Measurement of sales related to the distribution of recycled products began in 2006, and of related exports in 2011. Measurement of sales and exports related to resource management services begain in 2012, and measurement of sales and exports related to clean technology production and resource management-related construction begain in 2013.
"Recycling" includes the treatment of recyclable materials, the production of recycled goods, and their distribution.
"Biodiversity" includes manufacturing, construction and services in biological resources management and conservation, biodiversity and landscape protection, and other biodiversity and bio-related activities.
Source: Country submission; MOE (2012-15), *Environmental Statistics Yearbook* (several issues).

StatLink http://dx.doi.org/10.1787/888933449178

by the strong recycling sector and the development of heat and energy saving and waste-to-energy sectors. Nonetheless, the share of renewables and energy savings in total sales and employment is well below many other OECD countries. Employment in biodiversity is surprisingly high, likely due to Korea's broad definition of "bio-related services" (e.g. spraying pesticides and fertiliser on crops).

Growth in EGSS employment has been strong; however, there has been some criticism about the quality of the jobs (i.e. their duration, skill level and wages), particularly those associated with large construction projects launched under the green stimulus package and first Five-year Green Growth Plan (Kim, Han and Park, 2012; Yun, 2014). While the government established a plan for green job creation and training in 2009 and 70 000 green job traineeships were created between 2009 and 2011 (Republic of Korea, 2014b), a government performance

evaluation of green growth policies in 2012 found that more specific and targeted measures were needed to create green jobs (Prime Minister's Office, 2012).

More recent efforts have been made to boost green jobs and skills. Under the creative economy strategy, a plan to foster human capacity in the green technology industry has been given a legal grounding, and is to be reviewed every five years. It focuses on seven environment-related areas[13] identified by analysing skills demanded by industry. In addition, a job matching system, established in 2013, serves as an interface between universities training individuals and environmental industries demanding people with particular skills (MOE, 2016a). However, to manage the transition to a green economy, Korea will need to conduct a whole-of-economy, quantitative assessment to identify where and how many jobs in "brown" industries may be lost, where there is concrete potential to create green jobs, the skills needed to do them and the training and investment needed to develop them, and how to assist workers in the transition between contracting and expanding sectors (OECD, 2015g; OECD, 2012a).

In the renewables industry, government measures (section 4.4) have stimulated firm and job creation, investment and exports. Solar PV dominates the industry, accounting for 70-90% of employment, investment and exports in any given year (KEMCO, 2014; KNREC, 2015). Between 2008 and 2011, sales tripled, employment doubled, the number of renewables companies almost doubled and export revenue increased by a factor of 2.6 (MOTIE, 2014). However, domestic and global demand did not keep pace with the rapid growth of the renewables industry, leading to an overabundance of solar PV and wind manufacturers (KEMCO, 2014; MOTIE, 2014). The industry contracted sharply in 2012, with investment amounting to less than a third of its value in 2011, exports almost halving, employment dropping and firms closing (KNREC, 2015). In the mid- to long term, however, the government expects increased competition fostered by the RPS and related policies to lead to considerable further growth (MOTIE, 2014).

It remains a challenge for Korea to position itself in the renewables export market, given that its technical capacity remains below that of the United States, Japan and the EU yet its products are more expensive and produced in lower volume than in China, its key rival (GGGI, 2015; Invest Korea, 2015).

5.2. Green public procurement

Korea's well-established green public procurement (GPP) system is recognised as an example of best practice among OECD countries (OECD, 2015h). It is part of a broader world-class public procurement system praised for its efficiency, comprehensiveness and flexibility (OECD, 2016h). GPP in Korea, which relies on a strong eco-label foundation (see below), received a boost in 2005 when the Act on Promotion of Purchase of Green Products (Chapter 2) made it obligatory. Each year, institutions must submit a voluntary GPP target and implementation plan to the MOE, though there is no overarching, binding government target. Institutions must also submit a record of green purchasing receipts from the previous year, and over 96% comply (OECD, 2015h). Reporting data are centralised online at the Green Products Information Platform (*www.greenproduct.go.kr*), which streamlines the monitoring and reporting process and renders institutions' performance transparent to the public (OECD, 2015h).

The GPP system has stimulated Korea's EGSS. The Korea Environmental Industry and Technology Institute (KEITI) estimates that the number of certified products grew from

2 721 to 14 026 and total green purchase value by public institutions increased from KRW 787 billion (USD 768 million) to KRW 2.4 trillion (USD 2.1 billion) over 2005-15, and that 18 264 jobs were created over 2005-14 (MOE, 2016a). Despite this progress, green products only account for 8% of total public procurement and 42% for categories with green options available, indicating room for growth (OECD, 2015h; KEITI, 2014).

To further strengthen the impact of Korea's GPP, the scope, number and quality of green products could be expanded to better meet public institutions' product needs. To this end, the government should improve engagement with the private sector concerning these needs and the green standards that products should meet to be eligible for purchase. Maintaining open channels for dialogue between government, procurers and businesses has been crucial to the success of GPP in Canada, Belgium and Austria, for example (OECD, 2015h). GPP officials should be designated in each public institution, to help combat the problem of frequent turnover, and they should receive more specialised training (KEITI, 2014). Increased support for professionalisation has been identified as a need in the broader public procurement system (OECD, 2016h). Finally, GPP regulations should be harmonised with Korea's numerous other procurement regulations to minimise procurers' confusion and regulatory burden (OECD, 2015h).

5.3. *Supporting sustainable consumption*

The government manages many environmental labels to inform consumers about the environmental and energy performance of products, shops and buildings so as to stimulate green consumption and production. The Korea Eco-Label (1992) and Good Recycled Mark (1997) are the best-established labels, and provided the basis for smooth implementation of GPP and rapid growth in the green goods market. A carbon footprint label was introduced in 2009. These represent just a fraction of Korea's numerous labelling and certification programmes, which create complexity and burden for producers, consumers and public procurement officials (OECD, 2016h). It may be beneficial to review environmental labelling and certification programmes to look for opportunities to streamline and simplify them.

The number of Eco-Label certified products has grown steadily since 2001, yet recognition of the label remains around 50% and a gap persists between its recognition and actual purchase of certified products (KEITI, 2014). Reasons include higher prices and a lack of variety of green products, insufficient product information, problems with quality and what are perceived as misleading labelling and advertising (GSC, 2014). Indeed, in 2012, 46.4% of eco-labels were found to be false, leading the government to revise the Environmental Technology and Industry Support Act in 2014 to provide a legal basis to punish false eco-labels (MOE, 2015b). Greater collaboration with the private sector and tighter monitoring of eco-labels is essential to tackle low quality and false labelling. Experience from other countries, such as India, shows that full life-cycle analysis of green products and communication of their costs and benefits to consumers are essential to convince people of the economic (as well as environmental and social) advantages of purchasing them (OECD, 2015h). High-level support from a trusted public figure could help overcome misgivings about the system; for example, support by Vienna's city councillor for environment for the "ÖkoKauf GPP project" helped overcome a belief that ecologically sound goods and services were more expensive than conventional ones (OECD, 2015h).

The government has introduced incentives that reward consumers who buy environmental goods and services and save resources. Since 2009 the "carbon point" system has rewarded electricity, water and gas savings and the "carbon cashbag" system has

rewarded purchases of energy-efficient products. Both were integrated with the flagship Green Credit Card system in 2011 (Box 3.4). However, KEITI has found that one barrier to greater uptake of the card is a lack of consumer awareness of eco-friendly lifestyles (KEITI, 2014). This is despite the Greenstart Movement, launched in 2008 to promote green behaviour in non-industry sectors (households, transport, businesses) by developing green leaders, running seasonal events and campaigns, and supporting climate change education (KEI, 2013a).

Box 3.4. **The Green Credit Card system**

The Green Credit Card system was introduced in 2011 to reward eco-friendly consumption. It provides a normal credit card service, but also allows users to accumulate "eco-money points" (equivalent to 3-24% of the product price) when they use the card to purchase low-carbon and eco-friendly products. They can also earn points by saving electricity, water and gas (through linkage with the "carbon point" system) and using public transport (points equivalent to up to 20% of the fare). The points can be converted into cash rebates, used to buy other products (not only green) or to pay public transport fares and phone bills, or donated to environmental associations. Cardholders can also get into certain public facilities such as national parks and museums free of charge.

There are more than 10 million users of the system. The Green Credit Card is used more often than other credit cards to pay for public transport. The number of participating public facilities increased from 381 in 2012 to 746 in 2014. KEITI estimates that reduced household use of electricity, water and gas through the system saved USD 6 million between July 2011 and December 2014. The system is estimated to have mitigated 531 000 tonnes of CO_2 over 2011-14; however, on an annual basis this represents less than 0.02% of total GHG emissions. The system is attracting international attention as a low-cost, convenient way to encourage green consumer behaviour (KEITI, 2016). The government plans to expand its partnerships with retailers and manufacturers (e.g. adding large supermarkets and department stores) as well as the number and type of eligible products and services (e.g. car sharing). The government is also looking to extend use of the card to online shopping and, eventually, to international purchases by establishing a global green credit card partnership (KEITI, 2014).

Source: KEITI (2014), *Policy Handbook for Sustainable Consumption and Production of Korea*; KEI (2012), "Green card system", Korea *Environmental Policy Bulletin*, Issue 1, Vol. X, Korea Environment Institute, Sejong.

6. Promoting eco-innovation

6.1. General innovation performance

Korea is the world's most research and development (R&D)-intensive country. Gross domestic expenditure on R&D grew from 2.2% of GDP in 2000 to 4.3% in 2014, well above the OECD average (2.4%), but below the ambitious target of 5% set for 2012 in the first Five-year Plan for Green Growth (OECD, 2016i). Korea also ranks first in business R&D, which accounted for 3.4% of GDP in 2014. Large manufacturing conglomerates are the main performers of business R&D, with the service sector and SMEs playing much smaller roles (OECD, 2014c). The government has implemented a vast array of initiatives to raise public support to SMEs. However, streamlining could be beneficial, and some incentives – such as the R&D tax credit, which lacks carry-over provisions or cash refunds – could better stimulate innovation in small service sector firms (OECD, 2014d).

While public R&D expenditure is high, Korea has few world-class universities and produces few high-impact publications by OECD standards (OECD, 2014c). This partly results from Government Research Institutes (GRIs) focusing on applied and development-oriented research. While the Basic Plan for Science and Technology (S&T) aims to expand public R&D to KRW 92.4 trillion (6.2% of 2014 GDP) over 2013-17, public R&D investment could be made more efficient by strengthening fundamental research and evaluating the performance of national R&D programmes (OECD, 2015i). Industry-university links have traditionally been underdeveloped. Current initiatives, such as the plan to establish new joint industry-university-GRI R&D centres, should be strengthened to improve technology transfer and commercialisation.

Better integration with global science and innovation networks is a priority, as Korea's levels of international co-authorship and co-patenting are among the lowest in the OECD. The low level of patent applications with foreign co-inventors is partly due to Korea's conglomerate industrial structure, which tends to keep technology development within the group. The government has developed a Comprehensive Plan for Global Co-operation, emphasising the formation of a global network of overseas Science, Technology and Industry (STI) outposts, expansion of S&T-related official development assistance, reinforcement of science diplomacy, promotion of international joint R&D and sharing of large R&D facilities. These measures could be usefully complemented by further improvement of the regulatory environment for trade and investment (OECD, 2016a).

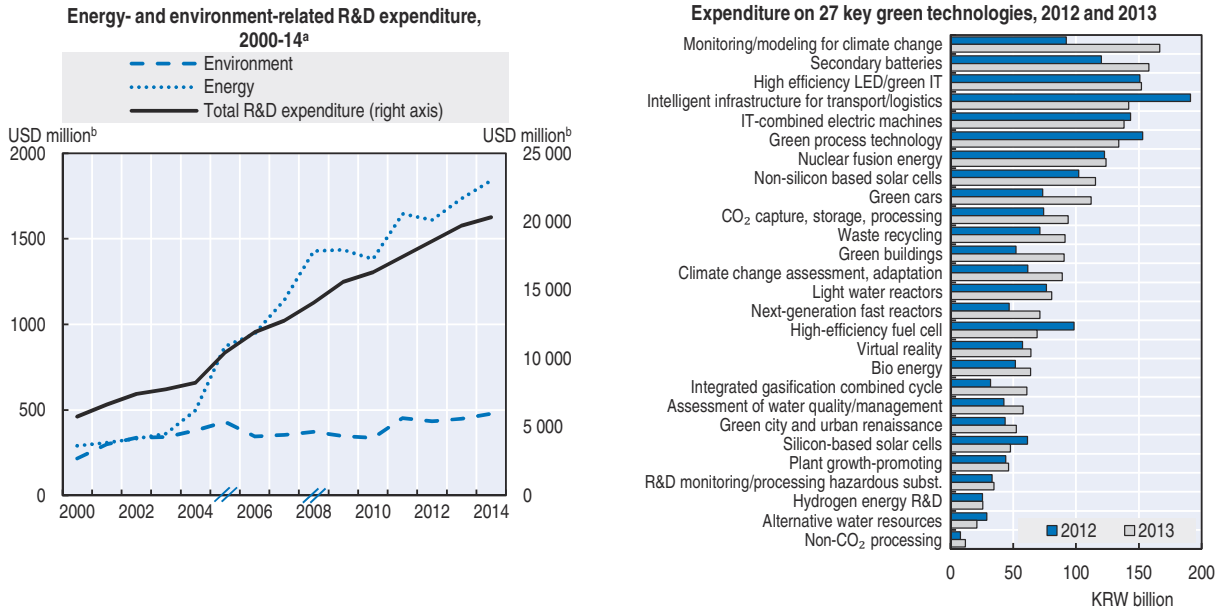
6.2. Performance on eco-innovation

In 2014, the government of Korea was the fourth largest provider of funds for R&D on energy and the environment in the OECD. Since 2000, spending on energy and environment-related programmes has increased from 0.05% to 0.14% of GDP (compared to the OECD average of 0.04%), reflecting both the government's overall effort to promote R&D and the increased priority given to energy. In 2014, 9% of the total government R&D budget was allocated to energy, more than twice the OECD average (Figure 3.11). Over the past decade, projects have increasingly focused on renewables (solar and wind), energy efficiency and fossil fuels (carbon capture and storage), while nuclear power has received less support (IEA, 2016b).

The first Five-year Green Growth Plan clearly identified green technologies as new engines for economic growth and prompted increased public R&D investment on these, which cover a broader scope than energy and environment (Figure 3.11). The Green Technology R&D Master Plan provided for a doubling of related funding over 2008-12 with a focus on 27 key technologies selected for their growth potential. In 2013, about half of public investment in green technologies was allocated to experimental development and one-fifth to applied research. Although the share of fundamental research increased from 15% in 2008 to 26% in 2013, the 35% target set for 2012 was not met (MSIP-GTC-K, 2014). Raising this proportion to 40% of total R&D expenditure, as planned in the Basic Plan for Science and Technology (2013-17), could maximise social returns and spillover effects (OECD, 2014d).

The government has been supporting green businesses through grants, loans, credit guarantees and venture capital investment. The LCGG Act (Articles 28 and 31) provided for specific provisions to channel finance to green technologies and the enVinance system was established to give the financial sector information on companies involved (Chapter 2). However, public financing mostly relies on state-owned banks and public funds (OECD, 2012a). While support to green technologies is justified by higher risk, such intervention

Figure 3.11. **Public R&D budgets on energy and key green technologies increased**



a) Government budget appropriations or outlays for R&D; breakdown according to the NABS 2007 classification. Breaks in time series in 2005 and 2008 (up to 2005 data exclude R&D in the social sciences and humanities; since 2008, estimates have been done in the breakdown categories to fit NABS 2007).
b) At 2010 prices and purchasing power parities.
Source: MOSIP (2016), *Statistics Yearbook 2013 of Green Technology;* OECD (2016), *OECD Science, Technology and R&D Statistics* (database).

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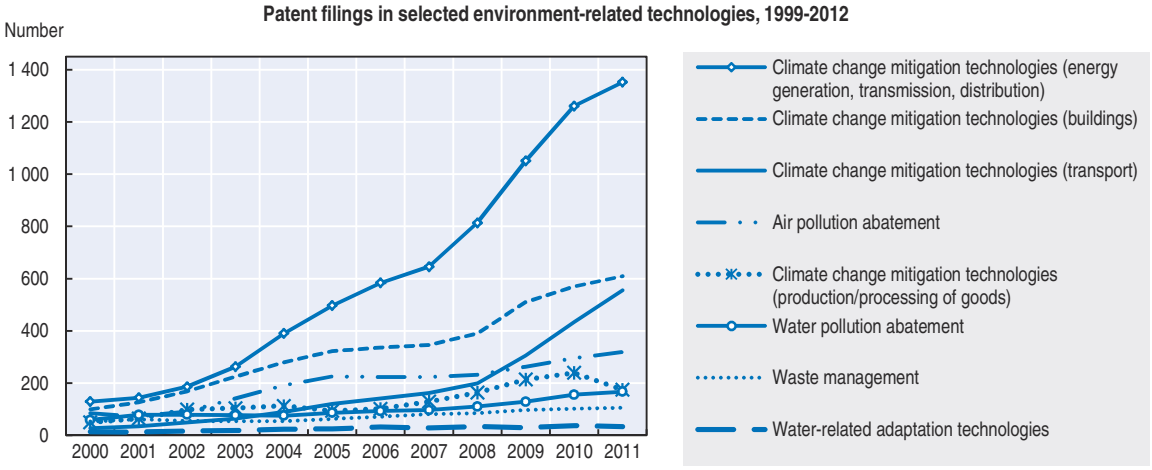
can cause distortions by limiting the development of market-based financing. Companies involved in green technologies have also been granted generous tax incentives, including an income and corporate tax deduction of up to 30% for SMEs and 20% for non-SMEs for research and human development costs (OECD, 2014d). Although such tax incentives ensure a more market-based selection of research projects, they often involve windfall profits and tend to benefit incumbent firms more than young SMEs which lack taxable income. For example, tax deductions for energy savings were found to have mostly benefitted large enterprises (GGGI, 2015).

A high level of investment has made Korea one of the world's most innovative countries in climate change mitigation technology. Over the past decade, high-value inventions in such technology increased more than sixfold (Figure 3.12). In 2010-12, climate change mitigation technology accounted for 10% of overall patent applications[14] associated with inventors located in Korea, up from 4% in the early 2000s. In particular, Korea has developed a comparative advantage[15] in technology related to renewable energy sources (solar photovoltaic), energy sector enabling technology (batteries and fuel cells), buildings (energy-efficient lighting, ICT for the reduction of energy use) and transport (electric vehicles).

Technological advancement has been most prominent in secondary batteries and light-emitting diodes (LEDs), which also benefitted from a strong public procurement policy. In 2013, Korea held the greatest share (36%) of the global lithium-ion battery market and Korean manufacturers are now key players in the market. The LED industry's exports increased from KRW 1.4 trillion (USD 1.1 billion) in 2009 to KRW 5.6 trillion (USD 5.0 billion) in 2012, raising related SME revenue. The total number of employees manufacturing LED lights increased from 4 750 to 19 900 over 2007-12 (GGGI, 2015).

Figure 3.12. **Korea has become one of the world's most innovative countries in climate change mitigation technologies**



Note: Patent statistics are taken from the Worldwide Patent Statistical Database (PATSTAT) of the European Patent Office (EPO), with algorithms developed by the OECD. Data refer to patent applications filed in the inventor's country of residence according to the priority date and apply solely to inventions of high potential commercial value for which protection has been sought in at least two jurisdictions. Data refer to three-year moving averages.
Source: OECD (2016), "Patents", *OECD Environment Statistics* (database).

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High R&D inputs have not yielded the expected outcomes for renewable development and GHG emission reductions, highlighting the need to strengthen Korea's climate policy. A survey of petrochemical companies showed that, besides high up-front costs and investment uncertainty, low energy prices are a major impediment to low-carbon technology uptake (Suk, Lee, and Jeong, 2016).

Although an increasing number of patents have been applied for technology related to air and water pollution abatement, there has been a shift in focus from general environmental management to climate-and energy-related technology, as in other OECD countries. This shift may partly reflect the greater maturity of environmental management technologies, but could also suggest some missed opportunities. For example, while Korea is recognised as a growing market[16] for technology related to water pollution abatement and waste management, it has lost its competitive advantage in such technology over the past decade. While climate-related innovation is crucial for Korea, it should not crowd out innovation in other important environmental domains. When selecting technologies to target, Korea should carefully assess the extent to which they reflect current strengths and future needs. The Basic plan for Science and Technology (2013-17) updated the roadmap for green technology development. It renewed the focus on many of the 27 key technologies (solar energy, eco-friendly automobile, smart grid, carbon capture and storage [CCS], high-efficiency buildings), although waste recycling is excluded (Han, 2013). The second Five-year Green Growth Plan aims at promoting fundamental research on CCS and nuclear energy; commercialising energy demand management technology and developing new IT-based business models; and promoting resource-cycling industrial development and supporting clean SME production.

Compared with other OECD countries, Korea has one of the lowest co-invention rates with foreign partners in environment-related technology, mirroring the general weak links with international knowledge networks. However, the country is increasingly collaborating in international technology programmes and recorded one of the highest levels of

participation in IEA programmes on energy and climate in 2015 (IEA, 2016c). The 2013 Basic Plan for Science and Technology aims at expanding international joint research on global challenges such as climate change and energy; establishing Korea as a hub of global science and technology; increasing overseas development assistance in science and technology; and building infrastructure for international co-operation (OECD, 2014d).

6.3. The eco-innovation policy framework

Korea has a rich organisational landscape of ministries, public agencies and co-ordination bodies engaged in formulating, implementing and evaluating technology and innovation policy (OECD, 2014d). In 2013, the Ministry of Science, ICT and Future Planning (MSIP) was established to implement the creative economy initiative introduced to foster cutting-edge innovation and consolidate a knowledge-based economy increasingly driven by high-value services. A new National Science and Technology Council (NSTC) was established under the Prime Minister's Office (previously under the president) as the highest decision-making body on cross-agency STI policy issues (OECD, 2014c). It established the Basic Plan for Science and Technology (2013-17) with the aims of strengthening R&D's ties to economic growth, technology commercialisation and job creation.

Eco-innovation policy is organised around a range of actors. The Green Technology Council, established under the previous NSTC, was the overarching body in charge of the green technology agenda. It provided R&D support for the Green Growth Committee (Chapter 2) and played a key role in the formulation of the 2009 Green Technology R&D Master Plan and prioritisation of key green technology areas together with 11 government ministries and agencies (GGGI, 2015). Line ministries have also contributed with their own plans to the promotion of green technology, in particular the second and third plans for Fostering Environmental Technology and Industry (2008-12, 2013-17, MOE) and the third and fourth plans for New and Renewable Energy (2009-30, 2014-35, MOTIE). Since 2009, the Korea Environmental Industry and Technology Institute, affiliated with the MOE, has promoted the sector's expansion by granting green certifications and managing the support system for certified businesses. In 2013, the Green Technology Center was established as an affiliate of the Korea Institute of Science and Technology[17] for managing government budget and co-ordinating policies on green technology.

MOTIE and MSIP play a key role in supporting green technology. In 2013, they accounted for 35% and 33%, respectively, of related public R&D expenditure. Other ministries with significant responsibilities include MOLIT (7%), the Small and Medium Business Agency (6%), the MOE and the Ministry of Oceans and Fisheries (5% each) (MSIP-GTC-K, 2014). Enterprises and GRIs are the main recipients, receiving 37% and 35%, respectively, of public R&D on green technology, while universities received 17%.[18] Since 2012, SMEs have benefited slightly more than large conglomerates from this support, reflecting renewed efforts to encourage SME innovation.

7. Environment, trade and development

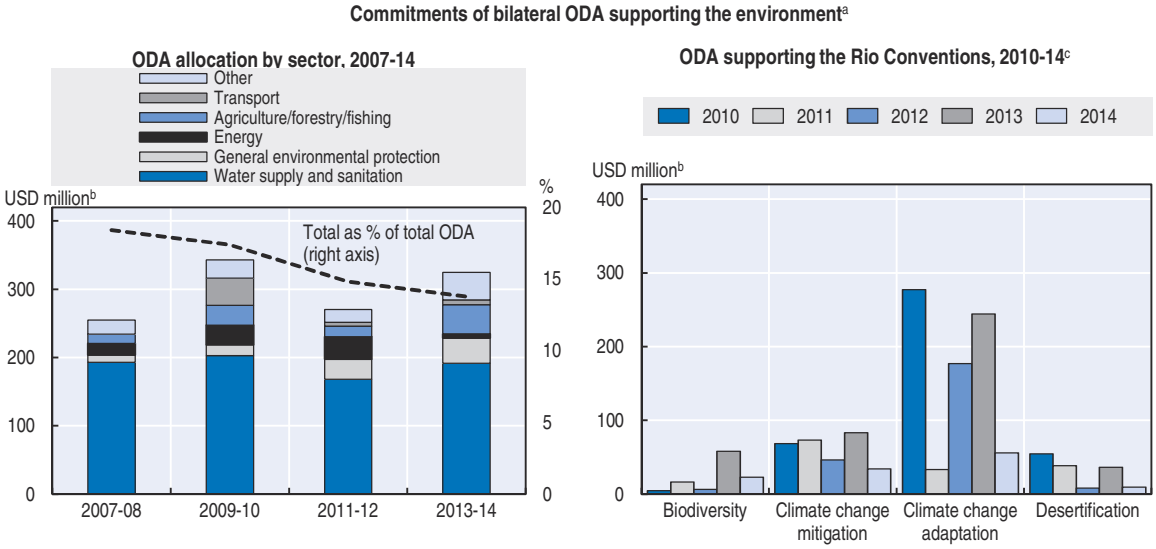
7.1. Development co-operation

Korea was the first former aid recipient to join the OECD Development Assistance Committee (DAC), gaining membership in 2010. This transformation from recipient to provider allows it to play a bridging role between the two communities, and experience as a developing country heightens its credibility as a provider of finance and know-how (OECD,

2013d). Korea's net official development assistance (ODA) disbursements have almost quadrupled since 2006, with multilateral disbursements increasing almost twice as fast as bilateral ones. However, Korea did not meet its target of giving 0.25% of gross national income (GNI) as ODA by 2015 due to the global economic downturn, tighter fiscal policy and a change in the GNI calculation (OECD, 2016j). Korea has set itself the new target of giving 0.30% of GNI by 2030.

Korea aims to increase its green ODA to 30% of total ODA by 2020, which appears difficult to achieve (OECD, 2016j). Its green ODA, as measured in the DAC Creditor Reporting System using the environment and Rio markers, declined from 18%, on average, in 2007-08 to 14% in 2013-14 (Figure 3.13), while the OECD DAC average increased from 15% to 25%. Korea's environment-related bilateral ODA is heavily concentrated in water supply and sanitation (particularly large systems and waste management and disposal) (Figure 3.13), in which it has extensive domestic experience (Section 4.3), and in the Asia Pacific region, in which it has a geographic and cultural advantage. Korea's environment-related ODA is more focused on adaptation and desertification than the OECD DAC average, reflecting the importance of these issues in Asia Pacific. For example, 68% of Korea's bilateral environment-related ODA in Oceania and 46% of that in Far East Asia over 2010-14 targeted adaptation.[19] Korea also provides multilateral environment-related ODA, including USD 27.5 million to the Global Environment Facility over 2010-14, USD 20 million to the Asian Development Bank's Future Carbon Fund over 2010-13 and USD 100 million to the Green Climate Fund for the initial period of resource mobilisation through to 2018. Korea engages in regional co-operation on green growth and environmental challenges, as a donor providing finance and know-how and a partner finding shared solutions (Box 3.5).

Figure 3.13. **Environment-related ODA is concentrated in water supply and sanitation**



Note: Korea joined the OECD Development Assistance Committee in 2010.

a) Data refer to activities that have been marked with at least one of the environment and/or Rio policy markers. They include activities where the environment, climate change mitigation, climate change adaptation, biodiversity and/or desertification is an explicit objective of the activity and fundamental in its design, and activities where one or more of these is an important, but secondary, objective of the activity.The marker data do not allow exact quantification of amounts allocated or spent in support of the environment. They give an indication of such aid flows and describe the extent to which donors address these objectives in their aid programmes.

b) At 2014 prices.

c) An activity can target the objective of more than one of the conventions; thus respective ODA flows should not be added.

Source: OECD (2016), *OECD International Development Statistics* (database); OECD calculations.

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Box 3.5. **Regional co-operation on green growth and environmental challenges**

As a donor, Korea actively promotes green growth in the Asia Pacific region. Its flagship programme was the East Asia Climate Partnership (EACP), which provided USD 200 million to 20 bilateral and nine multilateral projects over 2008-12 supporting water management, low-carbon energy, low-carbon cities, waste treatment, forestation and biomass. Projects implemented through the EACP were independently evaluated in 2013, and the Korea International Cooperation Agency (KOICA) has since provided follow-up assistance. Korea also collaborates with the United Nations Economic and Social Commission for Asia and the Pacific to run the Seoul Initiative on Green Growth, which has helped countries transition to a green economy through green technology transfer and environmental co-operation projects since its founding in 2005.

Korea also co-operates closely with countries in the region on shared environmental challenges. Korea, China and Japan hold an annual Tripartite Environment Ministers Meeting to develop and implement joint five-year action plans on environmental co-operation, and have more specific co-ordination and co-operation structures to tackle dust and sand storms, air pollution (Chapter 1) and marine waste. The three have also held an annual environmental industry round table meeting since 2001. Korea co-operates with China, Russia and Mongolia on transboundary environmental impact assessment, though this initiative has not yet led to the creation and adoption of a mechanism (Lee and Moon, 2014). Korea has bilateral environmental co-operation agreements with China, Japan and Russia, and has signed memoranda of understanding on environmental co-operation with Viet Nam (2000), Indonesia (2007), Mongolia and Cambodia (2009).

Source: MOE (2016), "Response to the questionnaire for the OECD Environmental Performance Review of Korea"; MOE (2015), *Ecorea: Environmental Review 2015, Korea*; Lee, Y-J. and N. Moon (2014), "Strategy for Introducing Transboundary Environmental Impact Assessment in Northeast Asia", *http://dx.doi.org/10.14249/eia.2014.23.6.505*.

Korea has taken steps to mainstream environment- and climate-related considerations into its ODA activities. Although its mid-term ODA Policy for 2011-15 identifies environment as one of five cross-cutting issues to be considered in all development co-operation activities, a review in 2012 found that mainstreaming guidance for environment and climate change needed to be strengthened (OECD, 2013d). In response, KOICA developed a Guideline and Implementation Strategy on Environment Mainstreaming 2013-15, including an Environment Manager System that appoints a staff member in each department to be in charge of monitoring and evaluating environmental mainstreaming, and introduced a screening and evaluation mechanism to review the environmental impact of all projects. KOICA later published a Guide to Environmental Mainstreaming for Practitioners, and has added environmental mainstreaming as a key performance indicator. The Economic Development Co-operation Fund (EDCF) applies environmental safeguards based on those of the Asian Development Bank, and is conducting two pilot projects upon which an updated safeguards strategy in 2016 was based.

Korea makes extensive use of concessional loans in its environment-related ODA, as in its total ODA. Over 2007-14, 64% of Korea's environment-related ODA was delivered as loans, a share greater than that of all but three other DAC donors (OECD, 2016j). The remainder was delivered as grants. Reflecting the importance of loans in Korea's aid system, they are managed separately by the EDCF within the Ministry of Strategy and Finance, while grants are managed by KOICA within the Ministry of Foreign Affairs and Trade. Korea's emphasis on

loans stems from its positive experience as a recipient of loans in the past, and a belief that they impose fiscal discipline on recipient countries (OECD, 2013d). However, Korea's use of loans is fairly uniform across all income groups, while loans are generally considered more appropriate for middle-income countries than for least developed and other low-income countries, given that the former have more capacity to repay them.

Korea's policies for international co-operation and for environmental technology export promotion are closely intertwined. It has programmes to identify opportunities for environmental technology transfer and technical knowledge-sharing, and to adapt its environmental technology to best suit the context of partner developing countries. These programmes are run by KEITI, established in 2009 to provide systematic support to the environmental technology industry. Technology transfer and other environmental co-operation opportunities are identified through environment management master plans that Korea establishes with partner countries, and through feasibility studies on overseas environmental projects funded by Korea. The master plans count as part of Korea's ODA activities, while the rest of KEITI's global partnership activities do not. While KEITI's technology expertise is strong, it could be better complemented with financial expertise to accompany project implementation. Knowledge-sharing takes place through seminars and exhibitions, exchanges of specialists, and joint research. Korea has established Environmental Cooperation Centres in China, Viet Nam, Indonesia, Colombia and Algeria, thereby institutionalising its environmental co-operation with these five partner countries in particular. The centres serve as channels to promote the exchange of environmental information, technology and experts between Korea and partner countries, and facilitate the development and implementation of joint co-operation projects (KEI, 2013b; MOE, 2015a).

While Korea is committed to greening its ODA, its other official flows (OOF[20]) to developing countries have provided considerable support to polluting activities, raising questions about Korea's policy coherence. For example, over 2007-14, almost two-thirds of Korea's OOF supported the industry, mining and construction sector, including activities such as drilling and mining for oil, coal and gas, and chemicals production. In other sectors, support for more polluting activities outweighed that for greener alternatives; for example, in the energy sector, OOF for coal- and gas-fired power plants was more than triple that for geothermal and hydroelectric plants.

7.2. Corporate social responsibility

Korea's National Contact Point (NCP), established in 2000, promotes the OECD Guidelines for Multinational Enterprises, but could improve the transparency of its activities. Korea is one of the four OECD countries to include independent experts, who work with delegated officials from MOTIE, the Ministry of Employment and Labour, and the MOE. The NCP is well resourced, benefiting from a dedicated budget and staff (OECD, 2014e). It has an arbitration committee to handle specific cases, of which there have been seven since 2000. None was related to the environment; rather, they primarily pertained to employment, industrial relations and human rights (OECD, 2016l). Only two cases are published on the NCP website (*www.ncp.or.kr*), and the NCP does not adhere to the best practice of publishing its annual reports online (OECD, 2014e).

7.3. Export credits

The Export-Import Bank of Korea (Kexim) has developed internal policies to implement the Common Approaches for Officially Supported Export Credits and Environmental and

Social Due Diligence. All projects above SDR 10 million, with a repayment term of two years or longer, related to the nuclear sector or in environmentally sensitive areas, are screened for potential environmental and social risks. Projects classed as category A (potential for serious adverse impact) or category B (potential for adverse impact) undergo full environmental and social impact assessments (ESIA) for the preparation of environmental and social management plans, and details of the projects are published on the KEXIM website. KEXIM publishes ESIA and review checklists on its website to help clients prepare for environmental and social due diligence procedures. The bank recognises the Guidelines for Multinational Enterprises vis-à-vis The Common Approaches in its procedures for social and environmental due diligence (OECD, 2014e).

The value of export credits that Korea provided to coal-, oil- and diesel-fired power generation projects substantially exceeded that of all other OECD members over 2003-13. The value of its export credits supporting coal-fired power plants is USD 1 billion higher than that of the second highest supporter, Japan (USD 4.3 billion vs. USD 3.3 billion), and the value of its export credits supporting oil- and diesel-fired power plants is more than twice that of the second highest supporter, France (USD 2.6 billion vs. USD 1.2 billion) (OECD, 2015j). Korea's exports credits for coal-fired power plants will be greatly restricted by an OECD agreement, reached in November 2015, to significantly limit the circumstances under which these can be financed; the OECD estimates that two-thirds of all coal-fired power plants financed by export credits over 2003-13 would not have been eligible under the new rules (OECD, 2015k). Korea and Australia weakened the ambition of the agreement by securing an exception allowing construction of less efficient small coal-fired power plants in developing countries.

7.4. Green bonds

In 2013, KEXIM became the first non-international bank to issue green bonds and the first institution in Asia to issue green bonds in US dollars, showing itself to be a pioneer in this field. The bank issued USD 500 million in five-year bonds at 1.75%, which attracted USD 1.8 billion of demand from more than 100 investors, 47% of them from the US, 32% from Europe and 21% from Asia. After this successful issuance, the bank followed up with a second five-year green bond in 2016 (USD 400 million, 2.125%). Interest in green bonds in Asia is growing, with investors in the region taking 48% of Kexim's 2016 issuance. Proceeds are used to extend loans to projects that promote "low carbon, climate resilient growth", including renewables and water treatment projects (Horne, 2016; Wee, 2013). The green expertise of Kexim and the green credentials of the financed projects are independently verified by the Norwegian research centre Cicero, a leading provider of second opinions on green bond frameworks for over 30 institutions. However, Kexim is one of only four institutions that does not permit Cicero to publish their second opinion of its green bond projects online.

7.5. Plurilateral agreements on environmental goods

Korea has aggressively pursued trade liberalisation by signing many free trade agreements with key trading partners such as the European Union (2011), the United States (2012) and China (2015). These agreements have facilitated a decline in Korea's import tariffs on environmental goods; for example, 95% of tariffs on US exports to Korea, including environmental goods, will be eliminated by 2017 (US Department of Commerce, 2016). Nonetheless, in 2013 Korea's barriers to trade and investment were ranked second highest in

the OECD (OECD, 2016a). In the environment sector, a number of non-tariff barriers exist, such as testing requirements for products already meeting international standards, and a culture of demanding high quality at low cost (US Department of Commerce, 2016; Canadian Trade Commissioner Service, 2012).

Korea is one of 17 economies participating in negotiations to forge a plurilateral Environmental Goods Agreement. The negotiations, if successful, will phase out import tariffs on a range of goods used to control pollution, monitor the environment or improve environmental performance. Many of the goods under consideration for tariff elimination are used to generate electricity from renewables or to improve energy efficiency. Korea has completed legislative preparations to allow for domestic implementation of the agreement once it is concluded. As a member of Asia-Pacific Economic Cooperation, Korea has committed to reduce its applied import tariffs to 5% or less (on an *ad valorem* basis) on a list of goods covered by 54 tariff subheadings, many of which pertain to renewables or energy efficiency.

Recommendations on green growth

- Strengthen political commitment to green growth. Provide political and institutional stability in terms of roles and responsibilities in designing, monitoring and implementing the framework.
- Green the energy sector to help meet Korea's GHG gas and air pollution reduction and energy security goals:
  - Progressively raise electricity prices to reflect system costs (i.e. of production and distribution), providing targeted support decoupled from energy use to vulnerable households where needed; remove cross-sector subsidies.
  - Raise taxes on fuels used for electricity generation, particularly coal, to reflect environmental and health costs.
  - Redouble efforts in energy demand management.
  - Increase public investment in renewables development and deployment; review the outcomes and cost-effectiveness of existing instruments and adjust the measures based on the results; provide a stable and transparent policy framework; monitor changing technology costs and adjust support measures and weightings applied to different renewable energy sources under the RPS accordingly.
- Strengthen the effectiveness and efficiency of the ETS to help Korea meet its GHG emission reduction target:
  - Steadily increase the share of permits auctioned and the stringency of the total emission cap.
  - Increase the transparency, stability and long-term visibility of the ETS to allow businesses to better adapt and make the long-term investments necessary to reduce their emissions. This would include providing public information on current and future permit allocation at the sector level.
  - Phase in a carbon tax for firms and sectors not covered by the ETS; phase out the TMS.
- Adjust taxes, charges and subsidies to better reflect environmental externalities:
  - Adjust the rates of pollution- and natural resource-related taxes and charges to reflect environmental and social costs and to encourage reduced pollution and natural resource use. For example, raise water supply and sewerage charges and the water

Recommendations on green growth *(cont.)*

effluent tax. Strengthen the enforcement of these taxes and charges, in particular of those related to water quality, for which the collection rates are very low. Extend the air pollution charge to cover NO_x emissions in areas not covered by an air pollutant emission cap management system.

- Progressively phase out domestic fossil fuel subsidies, such as those for the agriculture and fishing sectors, fuel subsidies for buses, trucks and taxis, and subsidies for producers of coal briquettes used by low-income households. Progressively phase out export credits and other official flows supporting fossil fuel extraction and use.
- Reorient agriculture production subsidies away from direct producer and price support and towards support encouraging, or conditional on, provision of environmental services (e.g. water management, flood buffering, biodiversity protection) and efficient resource and input use. Remove water charge exemptions for agriculture, with the long-term objective of full cost pricing.
- Establish an institutional mechanism, such as a green tax commission, to review the environmental effects of fiscal instruments, identify environmentally harmful subsidies and prioritise which to phase out first, and improve the effectiveness and efficiency of economic instruments.

- Strengthen measures to reduce transport-related GHG emissions, air pollution and congestion:
  - Raise the excise tax on diesel to at least match that on petrol, and index the tax on both fuels to inflation to avoid erosion of its value in real terms.
  - Implement measures that encourage not only the purchase but also the use of clean vehicles, such as dedicated lanes, lower parking tariffs and tolls, and more charging stations for electric vehicles.
  - Further increase investment in rail and other public transport; better link transport modes and integrate public transport planning with land use planning.
  - Expand the use of congestion charges; update the rate of the Namsan tunnels congestion charge; continue to raise the traffic generation charge and encourage cities to differentiate its rate according to facility location.
- Secure the long-term sustainability of financing for water supply and sanitation infrastructure:
  - Gradually raise water supply and sewerage charges to improve the cost recovery ratio of providing these services.
  - Pursue the amalgamation of water supply services to enhance their efficiency.
- Pursue efforts to foster and disseminate green innovation:
  - Rebalance public spending in energy- and environment-related R&D from technology development and demonstration to fundamental and applied research; promote greater involvement from universities and strengthen links with industry and government research institutes; continue to strengthen international co-operation in energy- and environment-related R&D.
  - Regularly assess the consistency between instruments used in environmental and innovation policies and the outcomes of eco-innovation policies against Korea's strengths and future needs; scale up development and deployment of carbon capture and storage; promote innovation in a circular economy.

Recommendations on green growth *(cont.)*

- Increase green public procurement and green purchasing by consumers:
  - Improve government engagement with the private sector concerning public sector product needs and the green standards these products would need to meet to be eligible for purchase, in order to expand the range of green products available.
  - Harmonise GPP regulations with the many other procurement requirements and streamline environmental labelling and certification schemes, to reduce complexity for public procurers and consumers.
  - Tighten the application and monitoring of eco-labels to ensure that products are of high quality and that labels are not applied falsely.
- Significantly scale up green bilateral ODA to meet the 2020 target of 30% of total bilateral ODA. Ensure that the use of grants or concessional loans is adapted to recipient countries' economic context, financial position, governance, preferences and needs.

Notes

1. The notion of sustainable development in Korea pre-dates that of green growth, with the first sustainable development plan spanning 2006-10. The LCGG Act incorporated the second and future sustainable development plans, providing the legal basis for their renewal every five years. Implementation is tracked by way of indicators and the Commission on Sustainable Development, which sits under the MOE. The third sustainable development plan (2016-20) aims to increase emphasis on the social pillar of sustainable development. This is particularly important given that Korea's green growth policy focuses solely on integrating economic and environmental considerations, leaving the social dimension to be addressed by the sustainable development plan.
2. For example, the LCGG Act of 2010 states that "the Government shall [reorganise] taxation and financial systems so that economic expenses incurred by environmental pollution or greenhouse gases can be reflected reasonably in market prices of goods and services", and the second Energy Master Plan of 2014 states that the future direction must be one in which energy taxes and electricity prices are adjusted to encourage more rational energy and electricity consumption, and to better reflect social costs such as GHG emission reduction.
3. In the first draft of the bill (2010), 90% of the permits in the first phase would be allocated, the share in the second phase would be determined according to presidential decree and 0% would be allocated in the third phase. After three iterations, the enforcement decree (2014) provides for 100% of permits to be allocated in the first phase, 97% in the second, and 90% in the third (Kim, 2015).
4. According to Kim (2015), the fine is KRW 3 million for the first violation, KRW 6 million for the second, and KRW 10 million (USD 8 840) for the third.
5. Congestion costs have been estimated by the Korea Transport Institute (KOTI) since 1993. While the institute recognises that the traffic congestion cost should reflect environmental and social costs, their method only reflects economic costs of congestion. KOTI estimates traffic congestion costs by taking the sum of fixed and variable vehicle operating costs and of the time value of money.
6. Investment and internal current expenditure (excluding payments for environmental protection services) less receipts from by-products (e.g. materials recovered as a result of waste treatment) by public and business sectors, including specialised producers of environmental protection services. Includes expenditure for i) pollution abatement and control covering air protection, waste and wastewater management, protection and remediation of soil and groundwater, and other activities (R&D, administration, education); and ii) biodiversity and landscape protection. Excludes expenditure on water supply.
7. Public corporation acting under the authority of MOLIT and responsible for the operation and management of water resources facilities. K-Water supplies bulk water to municipalities and industries through dams and multi-regional water supply systems. In some cases, it acts as service provider through a consignment contract with local authorities to manage water services.
8. Excluding village waterworks and small facilities.

9. As measured in million passenger-kilometres.
10. Calculated using 2014 average exchange rate.
11. Calculated using 2015 average exchange rate.
12. Calculated using 2010 average exchange rate.
13. The seven environment-related industries on which the Korean government is focusing its human capacity development efforts are: climate and air; water; environmental restoration and recovery; environmental health and safety; resource recirculation; sustainable environment and resources; and environmental knowledge and services.
14. Inventions of high potential commercial value for which protection has been sought in at least two jurisdictions.
15. As measured by the revealed technology advantage, i.e. Korea's share of world patents in these technologies is higher than its share in all fields.
16. As measured by the share of patent applications filed in Korea by domestic or foreign applicants in total patents filed in these technologies.
17. A GRI created to carry out R&D in key technological fields.
18. The remaining part goes to ministries and public research bodies other than the GRIs.
19. The adaptation "Rio" marker in the OECD Creditor Reporting System was introduced in 2010. The environment marker was introduced in 1992, and the mitigation, biodiversity and desertification markers were introduced in 1998. Application of the markers has been mandatory since 2007.
20. Other official flows are defined as official sector transactions that do not meet ODA criteria. OOF include grants to developing countries for representational or essentially commercial purposes; official bilateral transactions intended to promote development, but having a grant element of less than 25%; and official bilateral transactions, whatever their grant element, that are primarily export-facilitating in purpose.

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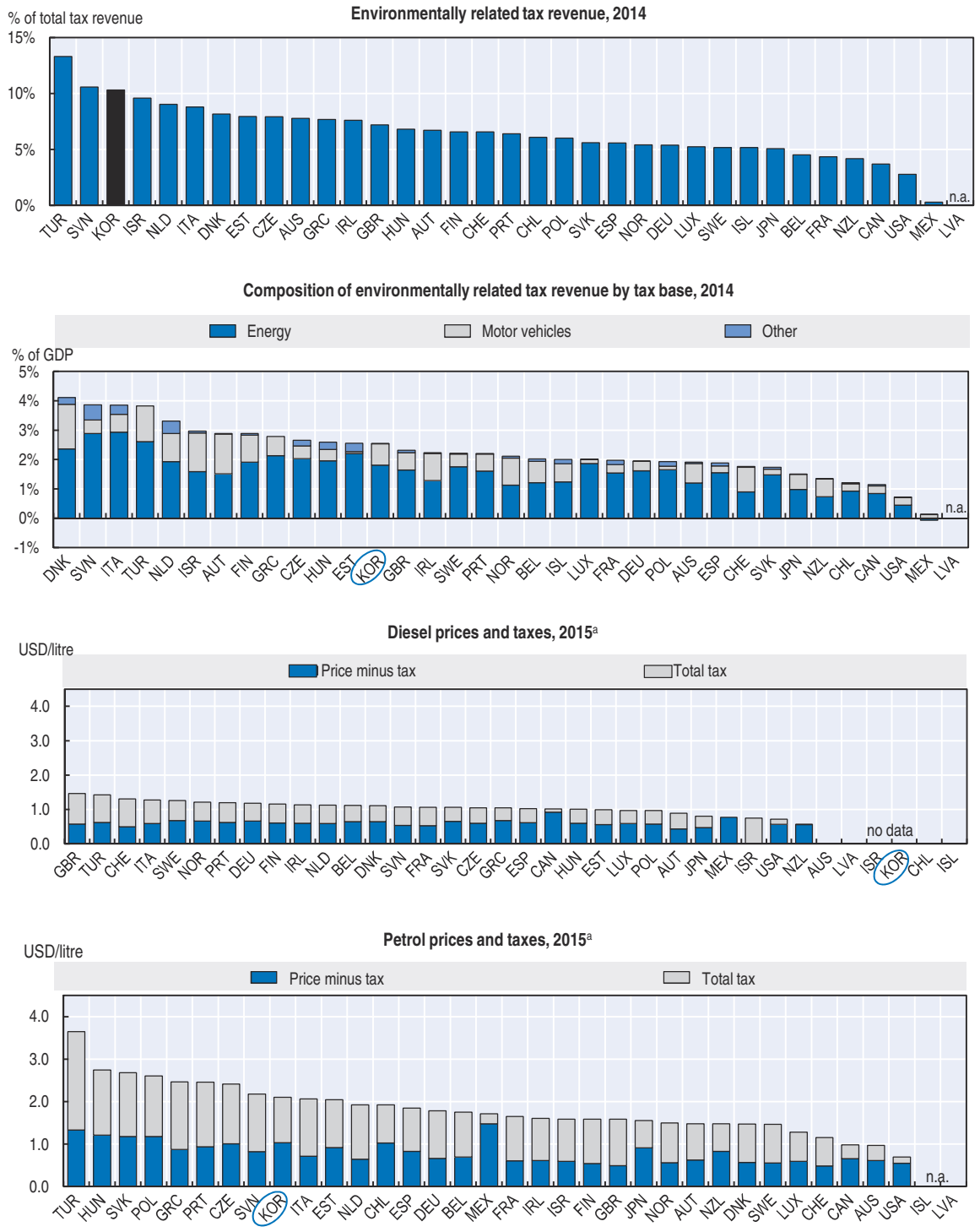
ANNEX 3.A

Data on green growth performance

Figure 3.A1. **Environmentally related tax revenue**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
a) Diesel: automotive diesel for commercial use, current USD; petrol: unleaded premium (RON 95), except Japan (unleaded regular), USD at current prices and purchasing power parities.
Source: IEA (2016), *IEA Energy Prices and Taxes Statistics* (database); OECD (2016), "Environmental policy instruments", *OECD Environment Statistics* (database).

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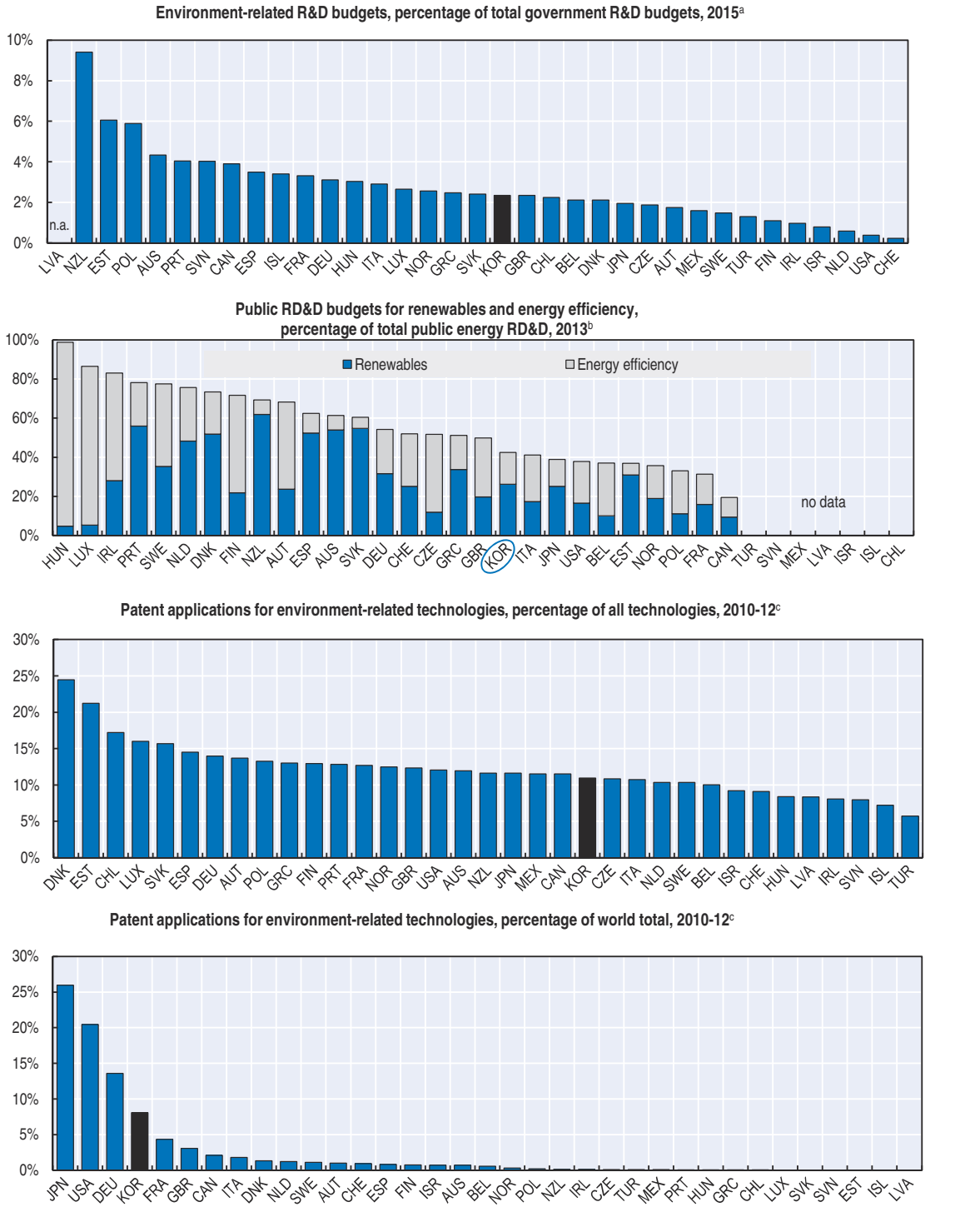
Figure 3.A2. **Green innovation**



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates.
a) Government budget appropriations or outlays for research and development (R&D); breakdown according to the NABS 2007 classification.
b) Public energy technology budgets for research, development and demonstration (RD&D).
c) Patents: higher value inventions that have sought patent protection in at least two jurisdictions (family size: two or more). Data are based on patent applications and refer to fractional counts of patents by inventor's country of residence and priority date.
Source: IEA (2016), *IEA Energy Technology RD&D Statistics* (database); OECD (2016), *Government budget appropriations or outlays for R&D* (database); OECD (2016), "Patents: Technology development", *OECD Environment Statistics* (database).

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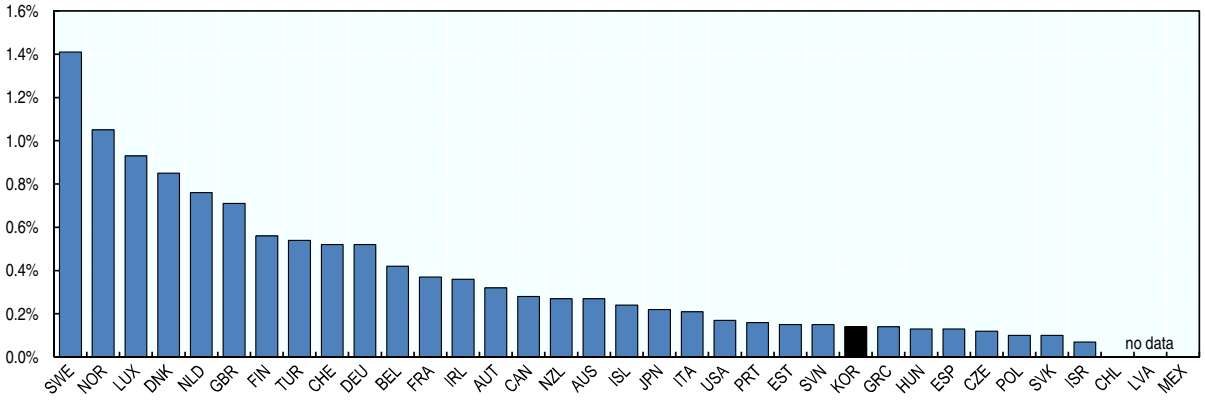
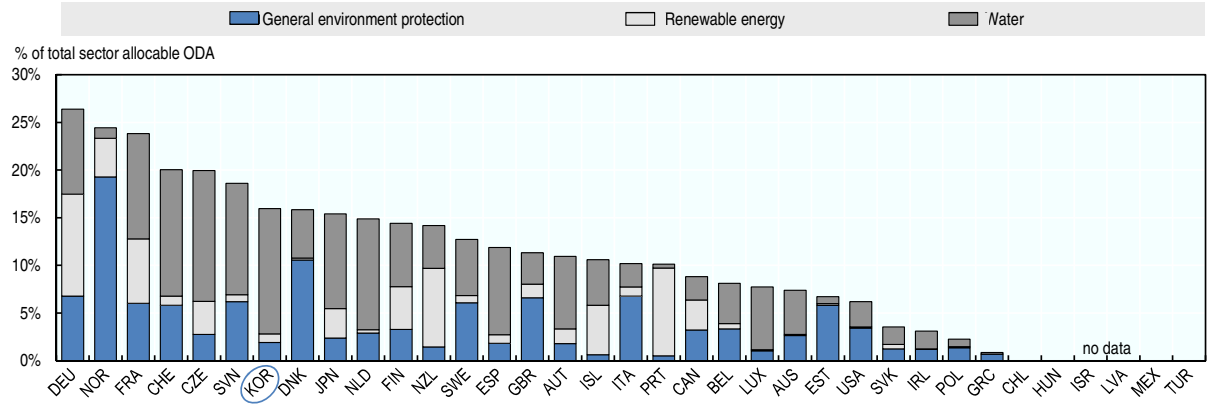
Figure 3.A3. **International development co-operation**

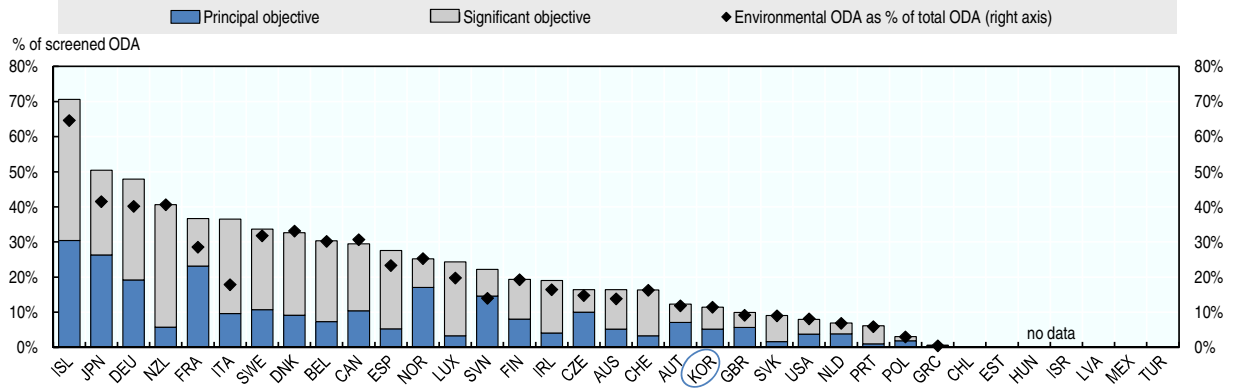
Net ODA disbursements as percentage of gross national income, 2015



Bilateral ODA commitments to the environment, renewable energy and water sectors, average 2012-14[a]



Bilateral ODA commitments targeting the environment, average 2012-14[b]



Notes: Data refer to the indicated year or to the latest available year. They may include provisional figures and estimates. CHL, EST, HUN, ISR, LVA, MEX, and TUR are not members of the OECD Development Assistance Committee and report on a voluntary basis, thus data maybe not always be available, or may be partial.

a) Renewable energy includes power generation/renewable sources; hydroelectric power plants; geothermal, solar, wind and ocean energy; biofuel-fired power plants.

b) Activities are classified as "principal" when environment protection is a primary objective and "significant" when it is an important but secondary objective. In comparing data across countries it should be noted that the coverage ratio of the environmental policy objective (i.e. the proportion of aid which is screened against the environment policy marker) varies considerably among countries; low coverage rates can significantly increase the shares of environment-focused aid.

Source: OECD (2016), *OECD International Development Statistics* (database).

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PART II

Progress towards selected environmental objectives

PART II

Chapter 4

Waste, materials management and circular economy

Korea is a good performer in waste management and is now seeking to move further towards a circular economy approach. This chapter examines trends in materials use and waste generation, as well as related policies, objectives, and legal and institutional frameworks. It looks at the instruments Korea uses to encourage waste prevention and reduction and to promote recycling and related markets. It studies the environmental effectiveness of Korea's waste disposal and management before focusing on food waste, waste electrical and electronic equipment, and construction waste. The chapter also discusses engagement in international co-operation and outreach.

1. Introduction

Korea is among the fastest growing countries in the OECD. Resource- and energy-intensive industries are predominant, and small and medium-sized enterprises (SMEs) play an important role, especially in the environmental industry and technology development sectors, where they represent 90% of firms. Economic growth relies heavily on imports of energy and mineral resources and on exports by Korean industries, driven by the information and communication technology (ICT) and electronics sectors. This is accompanied by growing domestic consumption of natural resources and materials, and growing amounts of waste generated. Korea is the most densely populated country in the OECD, and GDP per capita and average disposable income of households remain below the OECD averages[1] (Basic Statistics, Chapters 1 and 5).

These characteristics create particular economic and environmental challenges for the management of waste and materials, and have shaped Korean waste polices over the past 25 years. Efforts have focused first on reducing the amount of waste going to final disposal to cope with rapidly growing volumes, little space for landfilling and local opposition to waste disposal facilities; and second on increasing the amount of valuable waste materials that are recovered for recycling and reuse so as to become less dependent on imports for the supply of strategic raw materials. Public authorities have also been keen on keeping prices of public services, including waste management, at an affordable level for all.

Korea has a well-developed and fully fledged policy framework in place, using a variety of instruments and associated with quantitative targets and efficient monitoring of compliance and enforcement. It can build on a very good record in integrated waste management and has in the past achieved top results among OECD countries. This laid the groundwork for a good overall performance in waste and materials management over the review period, with important progress since the *2006 OECD Environmental Performance Review* (EPR).

The current aim is to move further towards a life cycle-based "circular economy" approach that keeps valuable materials in the economy. This will require even greater economic efficiency and improved policy alignment, additional efforts to apply the 3Rs (reduce, reuse, recycle) and more systematic consideration of all stages in the life cycle of materials and the value chain of products. It will need to be accompanied with strengthened international co-operation in these areas, particularly in Asia, along with expanded outreach activities and further development of external markets, areas in which Korea is well placed for action.

Korea's overall good performance in waste management does not leave much room for manoeuvre. In the years ahead, it will be important to focus efforts on the transition to a truly circular economy and on those areas where efficiency gains can be obtained.

2. Trends in waste management and material consumption

2.1. *The information basis*

Korea has a well-developed monitoring system for waste generation and treatment, with mandatory reporting by businesses and local authorities and a web-based online information system through which waste transfers, treatment processes and process results are reported and managed in real time (Box 4.1).

Data and statistics on waste generation and management have been produced since 1996 and are updated regularly. Definitions, however, differ from those used in international work. A breakdown of waste generation by industry as requested in the OECD questionnaire has been available since 2010. Data on municipal waste are collected from regional governments through surveys carried out by the Korea Environment Corporation (KECO), which also manages the Allbaro online waste management system. Other waste-related data come from surveys, such as an agricultural waste survey and a recycling market survey.

Most data produced are freely available on public websites (in Korean only). Korea is an OECD leader in Open Government Data, with high overall levels of availability and accessibility of government data on the national web portal and of government support for their use (OECD, 2015).

Monitoring and analysis of material flows are less developed. Efforts focus on analysis of flows of particular metals, including strategic metals; these data are regularly updated (annually for some metals, every three years for others). Macro-level material flow accounts (MFAs) in line with OECD guidance were set up on a pilot basis for 1991-2009 and updated recently. But they are not maintained as part of the official statistical system,[2] and the results are not linked to waste statistics. It is thus not easy to get a full picture of the material flows through and within the economy, how they relate to waste streams and recycling efforts, and where further opportunities for efficiency gains exist. Hence little use is made of these data in national waste and materials management policies.

Regular production of MFAs at macro and industry level, and further integration with waste data as part of the Korean Resource Cycle Information System, would be all the more important since Korea is moving towards greater resource circulation and life-cycle-based management. Synergies could also be explored with the Korean Chemical Information Platform (*https://kreachportal.me.go.kr*), which since 2014 has enabled electronic processing of the reporting, registration and evaluation of chemical materials.

More generally, the wealth of data produced by Korea could be better used to inform decision making, set targets, monitor the effectiveness of policy measures and support public information. Information from Allbaro could be combined with material flow data to monitor the circulation of materials and waste in the economy and assess the performance of resource circulation policies. Industries could be encouraged to produce material flow and waste information to monitor their resource productivity, and to use this information in combination with accounting data to implement material flow cost accounts. This would be a powerful tool to help analyse the environmental and financial consequences of material and energy use practices and identify opportunities for efficiency gains. Industries could also be encouraged to more systematically include such information in corporate reporting, integrated performance assessments and financial statements. Guidance on reporting criteria could be provided by the government to ensure harmonised data and reports.

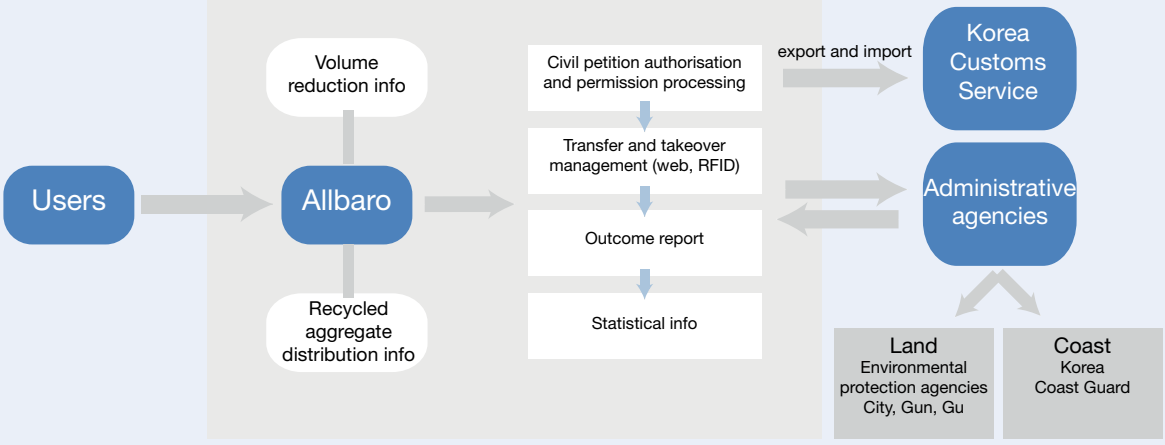
Box 4.1. **Allbaro – Korea's online waste management information system**

Allbaro is a comprehensive online waste information and management system (*www.allbaro.or.kr*). It was initially developed to track the transport of hazardous waste. Following a trial in 2001, the system was implemented in September 2002 to serve businesses that discharge large amounts of designated waste (more than 200 tonnes per year) and their subcontractors associated with waste collection, transport and treatment. The system has been gradually expanded to cover other waste streams.

The Allbaro system enables online preparation and tracking of official transfer documents. It digitises and processes the waste transfer certificates that circulate between waste producers, transport agents, processing agents and administrations, and allows users to compare and analyse license information and actual waste transfer data. Government administrators oversee the entire process of waste management in real time, and can check whether waste is transferred in a legal and transparent manner to prevent illegal disposal.

The system is used by over 340 000 businesses, representing about 128 million tonnes of waste, i.e. most of the waste generated by business operations in Korea. Waste flows are monitored in real time through radio-frequency identification (RFID). A user can thus trace waste transfers and the various waste processing stages, and see the processing results at any time. The data from Allbaro are used for the generation of annual statistical reports on waste management and for statistical analysis. The system is also used to monitor developments in waste reduction, the reduction methods used and model cases in the business sector, and to encourage co-operation and sharing of best practices among enterprises. Businesses with outstanding performance get a reward or benefit from a presentation programme for model businesses. The information on processing results – secondary raw materials and recycled products – is used in combination with an online platform for the exchange of reusable and recyclable products to stimulate recycling markets.

The Allbaro system involves the participation of the Ministry of Environment (MOE), KECO, local governments and local environmental agencies, and users. A partnership has been established with the Korea Coast Guard that controls waste at sea. The system is managed by KECO, which maintains and further develops the system, takes care of the data processing and provides education and training.

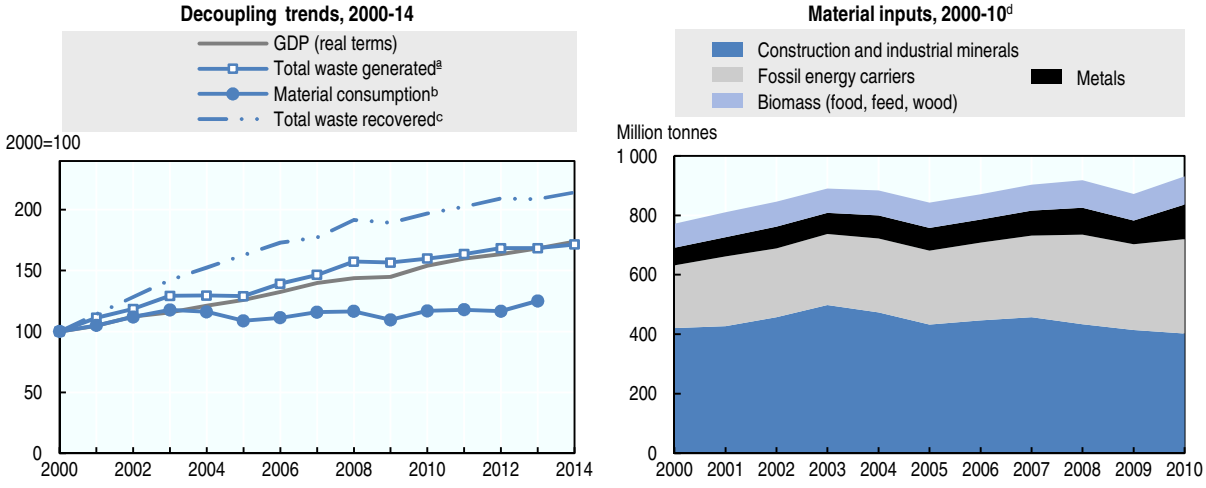


Source: KEI (2013), "Recyclable Resources Market in Korea", *Korea Environmental Policy Bulletin*, Vol. 11, No. 1, Korea Environment Institute, Sejong.

2.2. The material basis of the Korean economy

Korea is among the OECD's most resource-intense economies, due to its resource-intensive industries and a dynamic construction sector. The amounts of material resources used as inputs for domestic production and consumption increased by more than 30% between 2000 and 2013, reaching about 1 billion tonnes in 2013. The amounts of waste generated over the same period increased by 68%, reaching 144 million tonnes in 2013 (Figure 4.1).

Figure 4.1. **Material resource use is growing, but at a lower rate than the economy and waste**



a) Primary waste generated, i.e. excluding residues from treatment operations.
b) Refers to domestic material consumption, i.e. domestic material extraction plus imports minus exports of materials and derived products.
c) Recovery mainly refers to recycling, composting, and re-use as fuel.
d) Refers to domestic material extraction plus imports of materials and derived products.
Source: Country submission; OECD (2016), "Material resources", *OECD Environment Statistics* (database); OECD (2016), "Waste generation by sector", *OECD Environment Statistics* (database).

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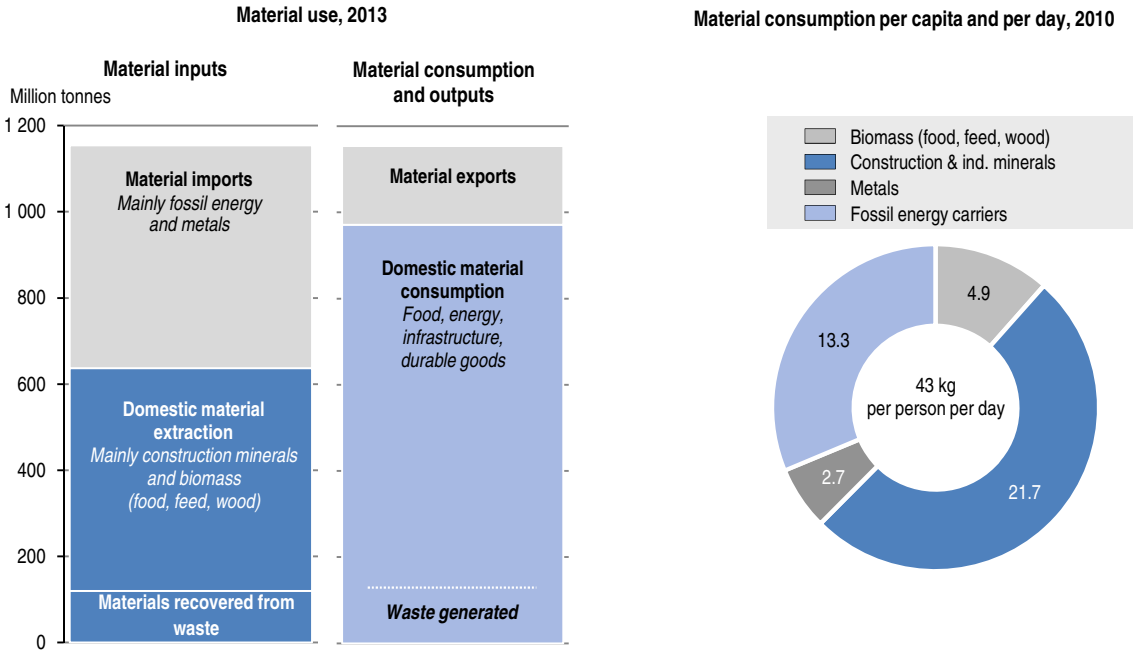
More than half (53%) of the material resources used as inputs for domestic production and consumption are imported. The country's import dependence is particularly high for fossil fuels and metals (close to 100%) and wood (more than 75%), while most construction minerals are available in the country. An estimated 20% of the material inputs are used for products that are exported, and about 80% are consumed in the country (in the form of energy and food consumption, durable goods, infrastructure).

Domestic material consumption (DMC)[3] grew by 25% over 2000-13. From 2004, it grew at a lower rate than GDP, resulting in an overall 34% improvement in material productivity (defined as the amount of economic value generated per unit of materials used, expressed in terms of GDP per unit of DMC). In 2013, Korea generated almost USD 2 000 of economic value per tonne of materials used in the country. This is slightly more than the OECD average. Though reliable data on the raw material equivalents embodied in international trade are not yet available, estimates suggest that, had these raw materials been accounted for, productivity gains would have been lower. About 17% of Korea's material consumption ends up as waste that is subsequently recovered to a great extent (Figures 4.1, 4.2).

About half the materials consumed are construction minerals, a share higher than in most OECD countries. This is mainly due to the replacement or renovation of apartment buildings built in the 1960s and 1970s and to big infrastructure projects such as the

Figure 4.2. **Material consumption is driven by construction minerals and fossil fuels**



Note: Domestic material extraction refers to the raw materials that are extracted or harvested from the environment and that enter an economy for further processing or direct consumption.
Domestic material consumption refers to domestic material extraction minus imports plus exports of raw materials and derived products.
Source: Country submission; OECD (2016), "Material resources", *OECD Environment Statistics* (database); OECD (2016), " Municipal waste", *OECD Environment Statistics* (database).

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construction of a high speed railway. It is followed by fossil energy carriers (31%), which registered the largest increase over the period due to the expansion of industrial activity and increasing living standards. Per capita DMC remains below the OECD average (as does GDP per capita), but is higher than the world average. The level is comparable to those in Belgium and the Czech Republic.

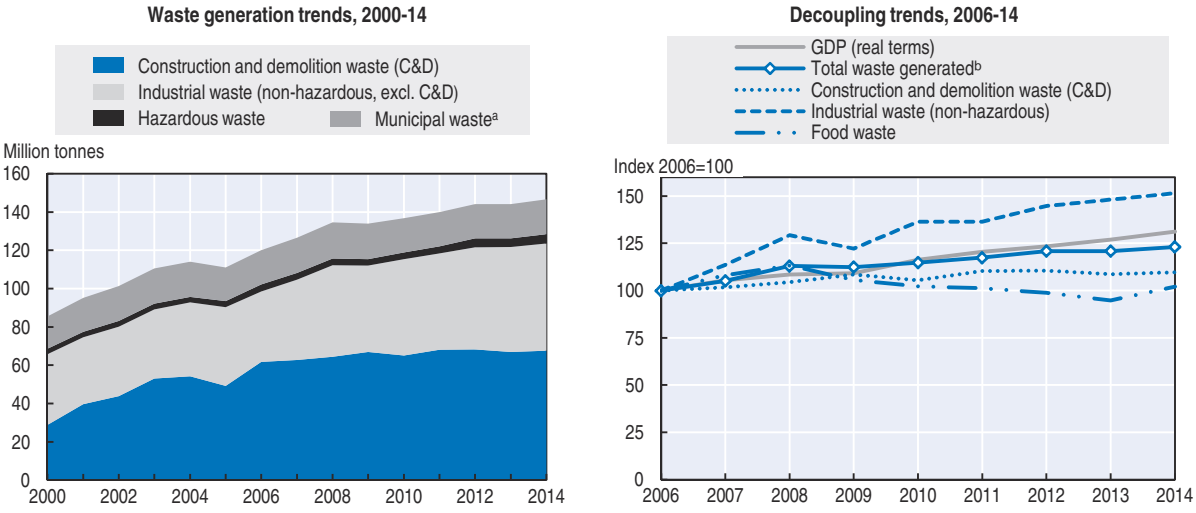
2.3. Trends in waste generation and management

Korea generated 146.6 million tonnes of waste in 2014. This represents 2.9 tonnes per capita and 8.6 tonnes per USD 1 000 of GDP, which is lower than in many other OECD countries. Waste generation remains closely linked to economic growth; it increased by 71% since 2000, at a rate close to economic activity (74%). While in the first half of the 2000s, the amounts of waste grew at a faster rate than GDP, recent data indicate a flattening of the growth rate and first signs of a weak decoupling from economic growth. Whether this indicates a new trend remains to be seen in the years to come (Figure 4.3, Table 4.1).

As in many countries, construction and demolition activities are responsible for the largest share of the waste generated (48%), followed by manufacturing (28%) with manufacturing of basic metals and metal products representing 18% (2012 data). Waste from households account for 11% (Figure 4.4).

Between 2000 and 2014 general business waste (industrial waste) grew by 51% and hazardous waste by 73%, while construction and demolition waste more than doubled (+135%). In 2014, 57% of designated waste was recycled, compared with 50% in 2000 and 61% in 2005, while 19% was landfilled, compared with 3% in 2000 and 18% in 2005.

Figure 4.3. **Waste generation continues to grow**



a) Household and similar waste collected by or for municipalities, originating mainly from households and small businesses. Includes bulky waste and separate collection.
b) Primary waste generated, i.e. excluding residues from treatment operations.
Source: Country submission; MOE (2016), *Environmental Statistics Yearbook 2015;* OECD (2016), *OECD National Accounts Statistics* (database).

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Table 4.1. **Trends in waste management, 2005-14**

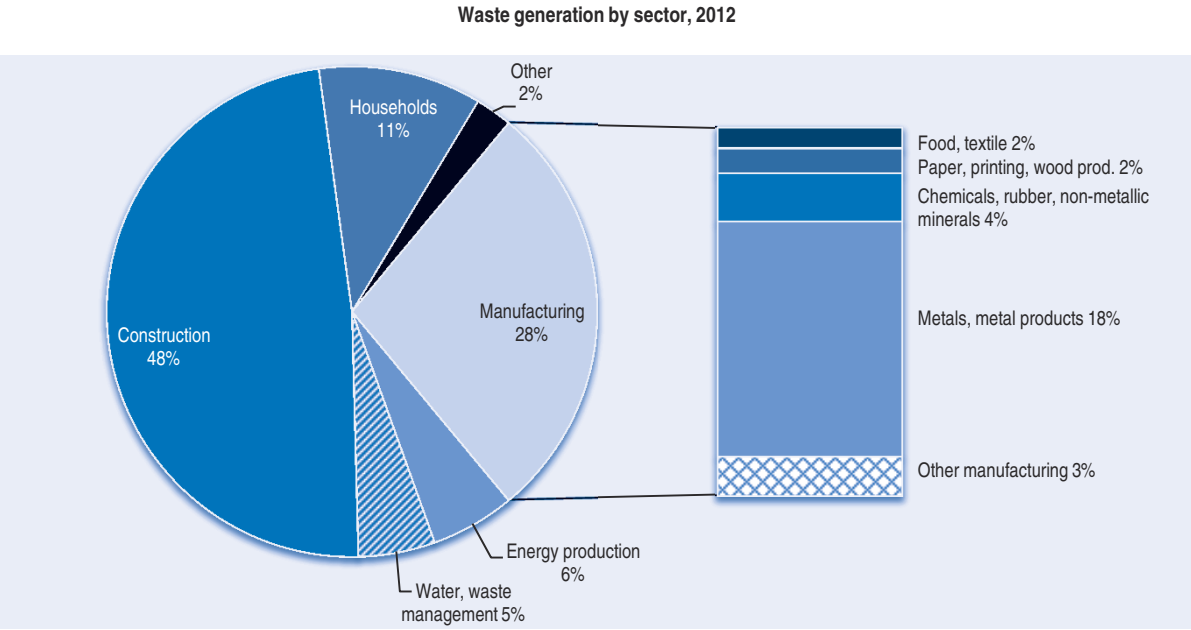
	2005	2006	2010	2013	2014
Total waste generated (1 000 tonnes)	111 090	120 068	136 744	143 992	146 607
of which					
Landfilled *(%)*	*11*	*8*	*10*	*10*	*9*
Incinerated *(%)*	*6*	*6*	*6*	*6*	*6*
Recycled *(%)*	*79*	*83*	*83*	*83*	*84*
Other (dumping at sea, permanent storage, etc.) *(%)*	*4*	*3*	*2*	*1*	*1*

Source: Country submission; MOE (2016), *Environmental Statistics Yearbook 2015*.

Over the review period, there was a marked shift from landfilling to recycling and incineration with energy recovery. Most of the waste generated is recovered for reuse in the economy. Only 9% is landfilled, 6% incinerated and 1% kept in permanent storage or dumped into the sea. Sea dumping of sewage sludge, food waste leachates, and livestock wastewater was banned in 2012-13 when the 1996 Protocol to the London Convention took effect; such waste is now incinerated or recycled (Table 4.1).

The amounts of waste recovered and recycled have more than doubled since 2000. Since 2006, they have grown on par with waste generation, leaving the overall recycling rate almost unchanged at 84%. Recycling rates are higher than in many other OECD countries. They are highest for construction and demolition waste (97%), food waste (96%) and tyres, followed by packaging materials, large and medium-sized waste electrical and electronic equipment (WEEE), vehicles and municipal waste. This is accompanied with an increase in the amounts of recycled products and secondary raw materials available on the market. The high recycling rate is mainly driven by construction waste that weighs a lot and is almost entirely recycled, mainly through backfilling and mounding (Section 8.3). But recycling rates for other industrial waste and for designated hazardous waste are also growing.

Figure 4.4. **Waste generation is dominated by the construction sector and metal industries**



Source: OECD (2016), "Waste generation by sector", *OECD Environment Statistics* (database).

Generation of municipal waste has increased by 7% since 2000, showing considerable decoupling from final private consumption, which increased by 52%. The amounts generated per capita remained stable (361 kg per person) and below the OECD average (525 kg per person). This can be attributed to the volume-based waste fee (VBWF) system that has been in place since 1995 and to the free collection of recyclable waste.

The upward trend in food waste generation has been curbed in recent years, with a decrease of 9.6% between 2008 and 2014. In 2014, food waste accounted for 27% of municipal waste; about 96% of it is recycled into feed and compost, and fuel for electricity production. This is attributable to Korea's active food reduction policy (Section 8.1).

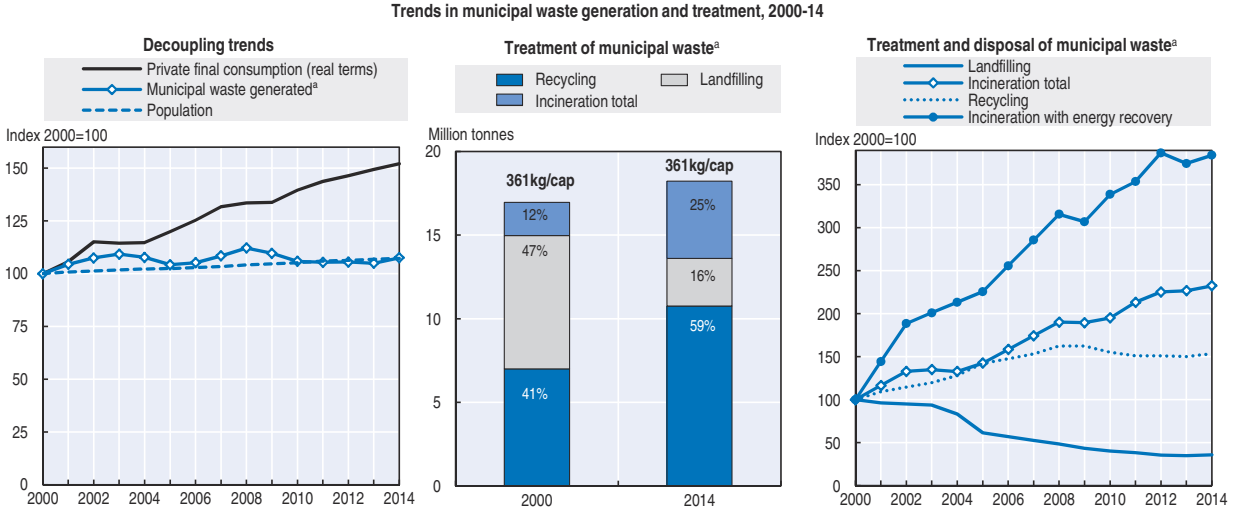
The management of municipal waste has continued to shift from landfill dominated treatment towards more recovery. The performance of separate collection of municipal waste has improved over time for major waste streams. Some 77% of municipal waste (recyclable and non-recyclable) is collected from door-to-door, 23% from dedicated collection points. As a result, landfilling has decreased from 47% to 16%; and the overall recovery[4] rate has grown steadily since 2000 (from 48% to 82%). Material recycling increased from 41% to 59%. The highest growth rates can be observed for waste incinerated with energy recovery, which has almost tripled since 2000 (+275%). This can be attributed to the government's active waste-to-energy policy, implemented since 2008. As a result, some waste that was previously recycled is now being converted into energy (Figure 4.5).

3. Objectives and policies for waste and materials management

3.1. Policy framework and objectives

Korea has a well-developed policy framework using a mix of instruments associated with quantitative targets for waste reduction and recycling. It promotes an integrated approach to waste and material management, building on the principle of the 3Rs. The aim

Figure 4.5. **Municipal waste remains decoupled from private consumption and is increasingly recycled and used as an energy source**



a) Household and similar waste collected by or for municipalities, originating mainly from households and small businesses. Includes bulky waste and separate collection.
Source: Country submission; OECD (2016), "Municipal waste generation and treatment", *OECD Environment Statistics* (database); OECD (2014), "Labour Force Statistics: Population projections", *OECD Employment and Labour Market Statistics* (database); OECD (2016), *OECD National Accounts statistics* (database).

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is to minimise landfilling of untreated waste, maximise cyclical use of materials in the economy and encourage recycling of waste materials into high value products. The stated goal is to move away from a waste and materials-oriented approach towards a life-cycle-based "circular economy" approach, and to establish an efficient resource circulation society. This move is driven by concerns about climate change and the supply security of raw materials and solid fuels. Priority is given to the economic value of waste as a resource.

In recent years, the policy focus has been shifting from material recycling to energy recovery through the production of solid refuse fuels and incineration as part of a broader effort to increase the country's energy autonomy via a waste-to-energy policy.

The main policy documents are the Comprehensive National Waste Management Plans (NWMP) and the Fundamental Plan for Resource Circulation (FPRC), complemented with more specific plans and legislation to deal with selected waste streams: construction waste, food waste, hazardous waste, WEEE and waste vehicles. The plans are supported by measures to promote extended producer responsibility and green public procurement (GPP), to foster recycling markets and to support technology development, clean production and innovation.

The second NWMP (2002-11), covering part of the review period, promoted an integrated approach to waste management along with quantitative targets for waste reduction and recovery. It was revised in 2008 to further strengthen the management system for hazardous waste, among other elements. A third NWMP is in preparation, having been delayed by discussions about the elaboration of a new law on resource circulation (see below). The plan will include targets for resource circulation, and will regulate the performance of resource circulation in industries and in the provinces.

The first FPRC (2011-15) was established with the stated goal of establishing a zero-waste society that goes beyond purely quantity-based resource circulation and shifts towards qualitative resource circulation by encouraging upcycling (i.e. recycling that upgrades the value of the materials recycled).

3.2. Legal framework

The legal framework for waste and material management is comprehensive. Reflecting the country's policy objectives, it shifted progressively from a pure waste management approach in the mid-1980s to a 3Rs approach in the 1990s and more recently to a circular economy approach that considers waste to be a domestic resource.

The main laws are the Waste Control Act (1986), which regulates the recycling of commercial waste (industrial, hazardous, construction), and the Act on Promoting the Saving and Recycling of Resources (1992), which restricts the use of disposable goods in the service sector (restaurants, food stores, hotels), among other provisions. They are supplemented by laws that address specific types of waste and specific management challenges, such as the recovery and recycling of construction and demolition waste, WEEE and waste vehicles. Transboundary movements of hazardous waste and their disposal are regulated under a 1992 act that transposes the provisions of the Basel Convention into national law. Other relevant laws include the Environmental Technology Promotion Act (1994) and the Act on Promoting a Transition towards Environment-Friendly Industry (1995).

The Waste Control Act specified the types of waste whose recycling was permitted and the treatment types that could be used. Its provisions were very restrictive and rigid, strictly limiting the number of authorised recycling methods and uses of recycled products. With the increased focus on recycling and resource circulation, these provisions proved to be counterproductive, as they represented barriers to the development and use of new recycling technology, and hence to the recycling of valuable materials. The act was revised in July 2015 to overcome these obstacles. The revised act, taking a more positive approach, specifies only the types of waste materials and recycling methods that are forbidden by law, and gives waste generators and recycling businesses greater flexibility concerning the recycling of all other waste and the development of related technology.

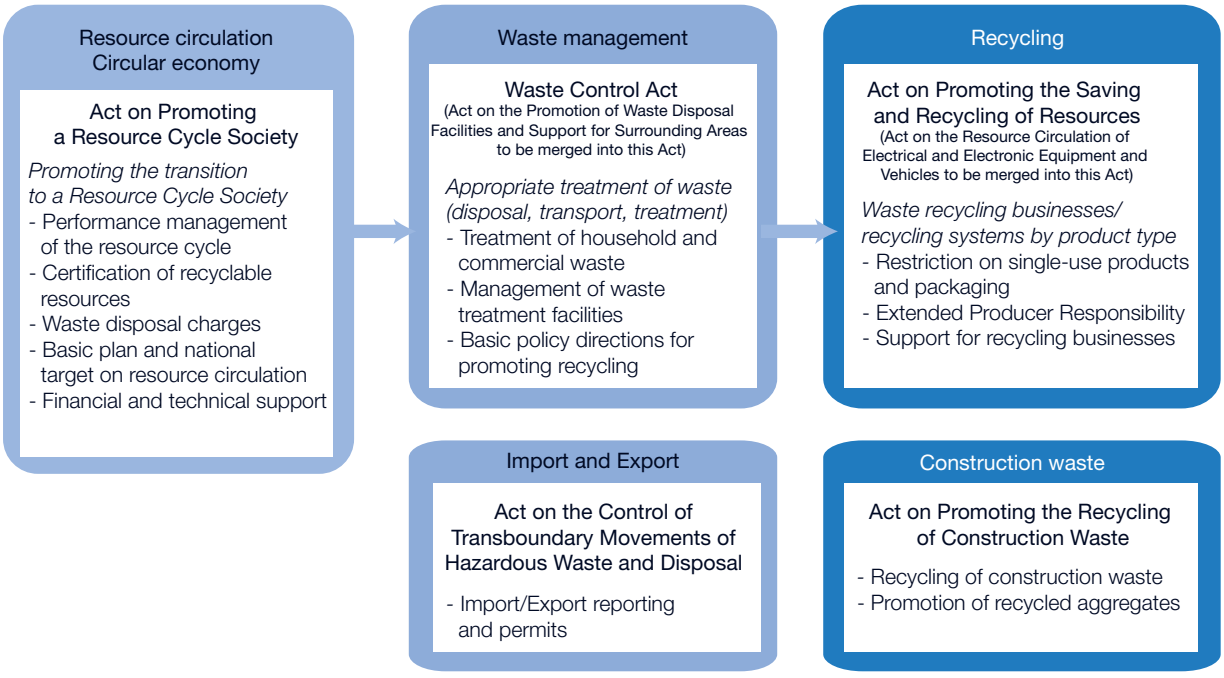
To support the new policy approach to waste and materials, the legal framework is being streamlined and restructured. All legal acts on waste disposal, recycling and transboundary movement of waste are being brought together in a coherent framework under the umbrella of a new law, the Framework Act on Resource Circulation, adopted in late May 2016 and entering into force in 2018; application decrees are pending (Figure 4.6). It will be accompanied by a new NWMP.

Implementation of the framework act is expected to further encourage the use of recycled and remanufactured products, and help businesses find a market for their recycled materials. One goal will be to achieve a 3% landfill rate and 87% recovery rate. Implementation will also further consolidate extended producer responsibility by assessing the resource circulation potential of consumer products, and issuing certificates for recyclable and recycled resources. It will strengthen the waste-to-energy policy by charging a disposal tax for waste that is landfilled or incinerated without energy recovery. And it will create a framework to ensure that businesses committed to resource recovery get the financial and technical support they need.

3.3. Institutional arrangements and governance

The MOE is responsible for the policy and legal framework for waste management at the central level. It implements and revises waste-related legislation; develops, co-ordinates, enforces and monitors the NWMPs; and conducts waste-related statistical surveys that inform the development and implementation of national waste policies. It

Figure 4.6. **New legal framework for waste and materials management**



Source: Country submission.

manages the disposal and treatment of controlled waste carried out by the private sector (the government having devolved these functions to the private sector in the early 2000s) and issues permits and authorisations for transboundary movements of hazardous waste. The MOE works closely with other ministries, including the Ministry of Science, ICT and Future Planning (MSIP) on nuclear waste; the Ministry of Health and Welfare on medical waste; the Ministry of Trade, Industry and Energy (MOTIE) on control of transboundary movements of hazardous waste; the Ministry of Land, Infrastructure and Transport on construction waste; and the Ministries of Agriculture, Food, and Rural Affairs and of Health and Welfare on food waste.

Local authorities (16 regional autonomous governments: nine provinces and seven metropolitan areas) are responsible for establishing basic plans on waste treatment within their jurisdiction, including current and planned developments and related financing. They manage the disposal and treatment of non-hazardous municipal and business waste, and take care of the installation and operation of waste treatment facilities and the long-term closure and aftercare of landfills. To carry out these functions, they can impose a charge on landfilled waste; the revenue feeds into a fund to cover post-closure landfill costs. Since 2002, local authorities have also been responsible for the permitting and enforcement systems concerning waste management in their jurisdictions, and for compliance and enforcement inspections, which can be delegated to private sector inspectors. The MOE provides assistance and guidance on inspections and monitoring, which has led to improved consistency in inspection and enforcement, though room for further progress exists.

Municipalities (cities and counties) are responsible for the collection, transport and management of municipal waste, including the separate collection of recyclable waste and the establishment of drop-off recycling centres within easy reach. Collection frequency

and treatment methods are specified in the local basic plans, which take into account local circumstances, including storage and recycling capacity. A total of 3 488 administrative districts are in charge of waste collection and separation. Waste collection is carried out directly or outsourced to a private company. Municipalities set tariffs for waste collection and collect recycling and waste disposal charges.

Most incineration plants and landfills for municipal waste are managed by local authorities. Some disposal sites are run by private operators. The Sudokwon Landfill in Incheon, near Seoul, has been run since 2000 by a public-private partnership, the Sudokwon Landfill Site Management Corporation, affiliated with the MOE, which replaced the municipal operator. Most hazardous waste landfills are owned and managed by the private sector.

Businesses are responsible for managing their non-hazardous waste, including construction waste. They can do so directly in their own facilities or outsource the treatment to certified specialised operators. All waste transfers and disposal methods have to be registered in the Allbaro system.

3.4. Policy instruments

Korea employs a range of complementary policy instruments to encourage waste reduction, reuse and recycling. These include separate collection requirements, mandatory recycling targets for packaging materials and products, voluntary agreements for waste reduction and recycling in businesses, economic instruments such as volume-based municipal charging schemes and deposit/refund systems for beverage containers, extended producer responsibility and take-back systems for waste that is easy to recycle, a landfill ban on food waste, and charging schemes for business waste and for products that are difficult to recycle or contain harmful substances.

These instruments are complemented by mandatory GPP; information instruments such as eco-labelling, awareness-raising campaigns and training; and measures that support the development, commercialisation and export of new technology (e.g. clean production, recycling technology, use of biogas). Korea exports its know-how in waste management through bilateral and multilateral co-operation, including technical agreements that open up new markets for Korean industries.

Many of the measures taken and the targets in place apply to the amount of waste generated or collected, i.e. to the end of life of materials and products. New measures increasingly apply to the design and production phases or include provisions that stimulate actions during these phases (remanufacturing, design for environment, reduction of toxic contents in products).

Targets

Objectives and quantitative targets have played an important role in Korean waste and material management policies. Targets are set for waste reduction, for waste treatment and disposal rates, and for recycling rates. They are closely monitored, and regularly reviewed and updated. Mandatory targets are imposed on product recycling, such as consumer electronics under the extended producer responsibility system; on recycling of end-of-life vehicles; and on waste reduction by businesses. Other targets are set to serve as a guide for government policies and public action, such as those set for food waste reduction and for the recovery and upcycling of construction waste.

Korea reached most of its quantitative targets during the review period and set new ones. However, it did not meet the overall objective set in the second NWMP to reduce total waste generation by 8.5% between 2002 and 2011, to 374 314 tonnes per day. Indeed, in 2011, 383 333 tonnes of waste was generated per day, and waste generation continues to grow, though at a lower rate than in the 1990s.

Economic instruments

The use of economic instruments in line with the polluter-pays principle is well established and was extended over the review period. Taxes and charges are used in combination with financial support and targets to create incentives for waste reduction and recycling. Korea is one of the few countries where manufacturers and importers have to pay a waste product charge to internalise the waste management costs of products that are hard to recycle or contain hazardous substances. The VBWF system for collection of mixed household waste has been extended to the whole country, except small settlements and remote areas; since 2010 it has also applied to food waste. Together with free separate collection services for recyclable waste, it has been instrumental in reducing waste going to final disposal.

Investment in waste treatment and recycling facilities, in recycling technology and in research and development (R&D) for clean production and eco-innovation benefits from government subsidies, tax credits and long-term low interest rate loans.

Information tools

The government uses various channels and tools to inform the public about waste management issues and raise awareness about the importance of waste reduction and recycling and environmentally sound management. Among them are advertisements, public discussions and conferences, and voluntary agreements with businesses. To reduce food waste, special TV advertisements are broadcast during national holidays such as Lunar New Year and Chuseok, the Korean Thanksgiving Day, and are included in TV entertainment programmes. The government also organises public contests on practical examples of effective waste reduction that are compiled in promotional booklets, and on ideas for food waste reduction and user-created contents.

Information campaigns are also carried out to stimulate the collection and recycling of WEEE. A campaign to collect used cell phones in elementary and middle schools, through large retailers and railway corporations, resulted in the collection of 350 000 phones. A campaign called Recycle 2008 targeted the collection of used home appliances on islands, providing free "after sale" services and promoting recycling.

3.5. International co-operation and outreach

Korea is a party to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, and to the Basel Convention on the Control of the Transboundary Movements of Hazardous Wastes and their Disposal. It participates actively in multilateral and regional organisations and hosts major international meetings related to waste and material management. In 2012, it launched the Korea Basel Forum, a public-private co-operation platform for implementation of the Basel Convention. Korea plays an important role in regional initiatives to promote the 3Rs (e.g. in the Asia-Pacific 3R Forum) and green growth. Outreach has a twofold objective: a) exchanging experience with other countries; and b) exporting Korea's know-how and opening up new markets for Korean

industries (in waste management and recycling, technology development, etc.). It includes MOUs and technical co-operation agreements with developing countries, as well as waste-related aid projects, transferring Korea's waste management experience and technology. Bilateral policy dialogues on waste and material management have also been established with Germany and Japan.

Since 1999, the environment ministers of Korea, China and Japan have met every year to tackle environmental issues in north-east Asia. This Tripartite Environment Ministers Meeting is the highest-level co-ordination mechanism on environmental co-operation among the three nations. *Waste* is one of ten priority areas, and a collaboration mechanism on waste trade in north-east Asia has been set up. Since 2005, a waste seminar has been held every year with the participation of experts and government officials to discuss waste policies and issues, including hazardous waste management, transboundary movement of e-wastes, the 3Rs and a sound resource-recycle society.

As part its international co-operation programme for environmental technology, Korea supports joint research with institutes in countries importing Korean technology. It also provides technology support concerning research and analyses on waste management, recycling and harmful substance management. The countries involved have been expanding to include China, Viet Nam, Russia, the United States and countries in the Middle East and Europe. Sharing some of Korea's environmental technology and policies with developing countries in the form of pilot projects is seen as an important way to promote exports of environmental technology by Korean firms. Examples include the installation of a hazardous waste incinerator in the city of Linyi in Shandong, China (2012), projects in Indonesia and in African countries, a grant project for construction of a landfill in Cambodia (2009) and a project on managing urban waste and abandoned mines in Mongolia.

Korea also supports developing countries in establishing national waste management master plans and in building capacity on waste and material management. Over 2007-15, 11 countries benefitted from its support in this area, including Algeria, Costa Rica, Indonesia and Viet Nam.

4. Encouraging waste prevention and reduction

The target groups for waste reduction efforts are households and consumers, along with retail and manufacturing businesses. Target product categories include food, packaging materials, single-use disposable goods, and goods that contain toxic components or are hard to recycle. Many efforts aim at reducing the amounts going to final disposal. Other measures address reduction at source and prevention, through remanufacturing (e.g. machinery, medical devices) and eco-design (e.g. electric and electronic equipment) and through information and awareness raising campaigns (food waste, WEEE) and restrictions on the use of disposable goods and excessive packaging.

4.1. The volume-based waste fee system for municipal waste and food waste

The VBWF system, initiated in 1994, applies the polluter-pays principle to reduce amounts that going to final disposal and to maximise separate collection of recyclable materials. The fee is calculated based on the amount of mixed residual waste collected. It applies to municipal waste originating from households and businesses, and was expanded to food waste in 2010. Recyclable waste collected separately remains free of charge regardless the amount. This helps ensure a stable collection performance, which is

important for the downstream recycling channels, and for negotiating good prices for selling the recyclable materials.

The VBWF is collected by local administrative districts; the system covers 142 out of 145 local authorities (3 478 out of 3 488 administrative districts; the districts not covered are those that are very small – fewer than 50 households – or located in remote areas that are difficult to reach, such as mountains (two-thirds of the territory is mountainous) and islands (the country has more than 3 000).

The collection methods, billing systems and fee level vary according to local circumstances. The methods in use include:

- Radio frequency identification-based billing. The RFID system uses electronic tags to record which container is picked up and where, and to calculate the fee according to the weight of waste collected. This method is recommended by the MOE.
- Payment chip or sticker. The waste generator buys a payment chip or a sticker that is attached to the waste container. This method is commonly used for the collection of bulky waste for which the price varies according to the type and size of the items collected.
- Designated standard garbage bag system, in which the waste generator buys standard 20 litre plastic disposal bag. The fee is built into the bag purchase price. The bag system is the most common. It is used for mixed household waste and food waste. The government sets an affordable price for the bags. Local governments can adjust it, after consideration of their fiscal situation and consumer prices. Hence the prices vary across the country. Low income household can receive the bags for free. Each administrative district has its own bags that until recently could only be used in the district where they were bought. This has generated complaints from citizens moving from one district to another.

The VBWF system has been instrumental in limiting and reducing the amounts of municipal waste generated and going to final disposal. Landfill rates have steadily decreased, down to 15.6%, accompanied by a significant increase in recovery rates to 59.1%. It has been estimated that between 1995 and 2013 the system generated cumulated gross economic value of KRW 21 353 billion.

The VBWF has increased over time. But, as with other public services, its level remains very low and the system seems to be starting to lose its incentive role. An attempt to harmonise and raise the price of garbage bags at the national level in 2008 failed; in a context of recession and increasing consumer prices, local authorities were reluctant to impose an extra financial burden on citizens.

Remaining and new challenges include illegal dumping, which, although reduced, remains of concern; incineration without energy recovery; and inappropriate waste sorting practices by households and small businesses. The share of recyclable materials put in official bags for residual waste remains high (70%) and has been growing. This signals decreasing public motivation and challenges the effectiveness of the VBWF system. Recent years have also seen a sharp increase in the number of small households, whose consumer behaviour differs and which generate much more waste per capita than bigger households.[5]

Korea needs to find new and better ways to address changing behaviours and further improve the efficiency of the VBWF system. The government recently took measures to oblige businesses in several districts that dispose of large amounts of household-like waste to write their name and contact information on the garbage bags they dispose of. The

waste bag system has become more flexible: in case of a move, the bags bought in one district can be used in another in combination with a special permission sticker, and smaller and cheaper 3 and 5 litre bags have been introduced to satisfy the needs of smaller households. Beyond these measures, it will also be important to take better advantage of the synergies with other measures, such as reduction at source of single-use disposable products and packaging waste.

There is a potential conflict between, on the one hand, the objective of increasing the cost-effectiveness of waste management through the use of economic instruments and the application of the polluter-pays principle to achieve full cost recovery, and, on the other, the social objective of keeping fees for public services at an affordable level for everyone. While the government favours a reduction in the management costs, this may not be sufficient; ultimately, an increase in the fees imposed on households and other generators of municipal waste may be required. This could be supported with the development of a long-term plan for cost recovery by the MOE in collaboration with local governments.

4.2. Product charges and waste reduction plans in the business sector

Businesses are subject to several complementary measures and economic instruments to encourage them to reduce the amounts of waste they generate and dispose of. These include waste product charges for products that are difficult to recycle or to manage, mandatory waste reduction plans for large companies, recycling duties under extended producer responsibility, and the planned waste disposal charges for landfilling and incineration.

To reduce waste in industry through clean production, the MOE supports R&D investment in waste reduction and reuse technology, and MOTIE supports environmental SMEs in developing and commercialising cleaner production technology (around 140 core types, including zero-pollution technology).

MOTIE has further supported reuse of goods by giving a legal basis to nurturing remanufacturing industries through an amendment of the Act on Promoting a Transition towards Environment-Friendly Industry in 2005. The revised act established a detailed implementation system, including quality certification of remanufactured products and financial support. The scope of items subject to remanufacturing, formerly limited to automobile parts and WEEE components, has been expanded progressively to include industrial machinery, electronic products, military equipment and medical devices.

Waste charging system for manufacturers and importers

Korea is one of the few countries where manufacturers and importers have to pay a waste product charge, the Advance Disposal Fee (ADF), on products that contain hazardous substances, are difficult to recycle or are likely to cause management problems. Such a fee creates incentives to design products that are easier to dismantle and recycle, and that contain less harmful substances. It also helps internalise the management costs for small waste streams for which take-back programmes would be too costly. The ADF applies to containers for pesticides and hazardous chemicals, and to anti-freeze solutions, chewing gum, disposable diapers, cigarettes, and non-packaging plastics that are not included under extended producer responsibility, such as PVC pipes, toys and kitchenware. The system is designed to prevent and control waste generation by applying the polluter-pays principle. As separate collection and recycling technology evolves, products subject to the ADF are progressively integrated into the producer responsibility system.

The ADF, collected by KECO for the MOE, feeds into the Special Account for Environmental Improvement. The revenue is used to fund studies on waste reduction and reuse, to develop related technology and facilities, to fund waste recovery and reuse operations by local governments, and to buy and store reusable materials. The rate rose from 20% of the disposal cost in 2008/09 to 60% in 2010/11 and 100% in 2012.

Businesses that sign voluntary agreements on the collection and recycling of plastic waste and that perform well can be exempted from the ADF. For economic reasons, exemptions are also given to SMEs with annual revenue below KRW 20 billion, and to small and medium-sized start-ups.

Business Waste Reduction Programme

The Business Waste Reduction Programme, introduced in 1996, imposes mandatory waste reduction targets for big enterprises. The aim is to reduce negative environmental impact by minimising the amount of harmful waste going to final disposal, controlling waste generation and expanding recycling. The programme targets businesses and operations that generate large amounts of waste (i.e. a three-year average of more than 1 000 tonnes of non-hazardous waste per year, and more than 100 tonnes of hazardous waste). The programme covers 2 312 businesses, including 1 538 target businesses that are subject to mandatory waste reduction, and 18 types of business operations.

Target businesses have to prepare a waste reduction and recycling plan every three years, and to report on the results obtained. The Allbaro system is used to monitor developments in waste reduction, the reduction methods used and model cases. This information is used to encourage co-operation and sharing of best practices among enterprises. Businesses with outstanding performance are rewarded with either priority access to government funding and technical support for waste reduction technology and facilities, or a presentation programme for model businesses (e.g. at fairs and through publications showcasing good practices). Companies that underperform are given a technical diagnosis and receive information and guidance on how to reduce waste.

The amount of waste generated by the businesses targeted by this programme tend to increase at a slower pace than production output. More than 90% of the waste generated is recovered for reuse and recycling. These positive results are insufficient, however, to curb the upward trend in industrial waste generation. SMEs, which represent an important share of Korea's industrial base, are exempted from many waste reduction measures and obligations, but receive training and support. Further progress will require additional measures, including a greater focus on the needs of SMEs.

The government also needs to provide greater impetus to industries to fully engage them in such projects. Regulations and targets are still often perceived as a burden rather than an opportunity, and many developments in the business sector remain dependent on government support. This indicates that there is room for efficiency gains and that further progress can be made with resource productivity, waste reduction at source, design for environment and integrated performance management. Implementation of the 2016 Framework Act on Resource Circulation will be instrumental in this respect.

Circular business models

One area to be considered in particular is further development of circular business models that achieve greater resource efficiency and fully integrate waste as a resource in the

production cycle via the concept of industrial symbiosis. Korea has ample opportunities for industrial symbiosis and closed-loop processes in industry. Further steps could be taken to establish eco-industry town projects that bring together firms or clusters of industries that are complementary and in which the by-products or residuals of one enterprise are used as a resource by another enterprise, with mutual economic and environmental benefits. This could build on experience with existing projects such as the eco-energy town projects managed by the MOE, MOTIE and MSIP, and the network of eco-industrial parks established under the eco-industry master plan (MOTIE) and supported by regional centres. Waste treatment firms could be integrated into such complexes to improve opportunities to match material inputs and outputs.

There are also important synergies between policies that encourage eco-innovation, clean production, R&D, eco-friendly businesses, remanufacturing and energy efficiency, and policies that encourage integrated waste and material management and a circular economy. Although co-operation exists, such synergies could be better exploited if all ministries involved worked together to establish a consolidated overview of the existing support measures, and if mechanisms were in place to co-ordinate the relevant programmes and to assess their costs and benefits.

4.3. *Disposable and overpackaged products*

To reduce the amount of disposable goods and use of excessive packaging, priority is given to legal instruments combined with voluntary agreements. Measures to reduce waste at source include the Packaging and Labelling Recommendation System (2003) and the Packaging Inspection System, which identifies excessive packaging. The use of disposable single-use products (e.g. cups, vinyl bags, plastic shopping bags) and overpackaged products has been regulated since 1994.

- Businesses that use a lot of disposable products have to restrict their use and cannot give them out for free. Regulations and targets are differentiated according to the business type (Table 4.2).
- To reduce unnecessary packaging, restrictions are imposed on product packaging methods (e.g. double or triple layers and empty space inside containers), and on packaging materials by prohibiting the use of materials that are difficult to recycle, including PVC.

Table 4.2. **Regulations for disposable products**

Business type	Requirement	Subject items
Restaurants, food services	Restriction of use	• Disposable cups (synthetic resin, aluminium foil) • Disposable plates (paper, synthetic resin, aluminium foil) • Disposable bowls (paper, synthetic resin, aluminium foil) • Disposable chopsticks, toothpicks, forks, spoons, knives, tablecloths
Bathhouses	Prohibition of giving away	Disposable razors; tooth brushes; toothpaste; shampoo, conditioner
Large retail stores, wholesale and retail	Prohibition of giving away	Disposable plastic bags and shopping bags (except paper bags)
Food production (manufacturing, processing), industry and large scale stores	Restriction of use	Disposable synthetic resin containers
Banking, insurance & securities	Restriction of use (Restriction of production and distribution)	Disposable promotional material

Source: MOE (2015), *Disposable Products and Over-packaged Products*, *http://eng.me.go.kr/eng/web/index.do?menuId=384*.

To assist local authorities in monitoring and inspecting target businesses, the MOE developed guidelines on restrictions of use of disposable products. Special attention is

given to limiting overpackaged products during such traditional holidays as the Lunar New Year and Chuseok, and during the school admission and graduation periods. The targets and measures are regularly updated to reflect behavioural changes and technical developments concerning recycling and packaging methods. In 2008, biodegradable resin products were thus exempted from the regulation on disposable products, the disposable cup deposit programme was abolished, and the use of disposable paper cups and free paper bags was permitted, a move that non-governmental organisations have criticised.

Voluntary agreements have been signed by the MOE with businesses that typically use disposable products, including:

- Major coffee shops and fast-food restaurants, which agreed to reduce the use of disposable products, enhance the collection and recycling of used disposable cups and provide incentives to people using reusable cups, including instant cash discounts. The agreement, signed in 2002, was renewed in 2013. It includes the setting of quantitative reduction targets and the dissemination of inspection results via press releases.
- Five megastores and two bakery franchises (agreements signed in 2010 and 2012, respectively), which agreed to reduce the use of disposable plastic bags and promote the use of shopping baskets, volume-based garbage bags and packing containers instead.
- Large-scale distributors of farm products and civic groups, which agreed to reduce the use of accessory product packaging for agricultural and fishery products (e.g. paper bands and ribbons on fruit gift baskets for Chuseok), and to increase the use of reusable packaging materials (agreement signed in 2011, expanded in 2013).
- The cosmetics industry, which signed an agreement on a pilot project to reduce the packaging of cosmetics containers and increase the use of refillable containers.

5. Promoting recycling

Recycling is promoted through various channels and instruments. The target groups are consumers, manufacturers, construction firms and importers. Target waste types and products for which recycling is mandatory include food waste, product packaging materials (paper, glass, aluminium, synthetic resin), batteries, lubricants, tyres, fluorescent light bulbs, WEEE and vehicles. Many measures that address recycling at the end of products' life also encourage changes in their design and processing, including reduction of toxic contents.

Recycling is further supported through investment in recycling and clean production technology, and through government support for the construction of recycling facilities. The development of markets for recyclable products and materials is encouraged by the GPP system, which has been extended to all government institutions (Chapter 3), and by green purchasing by consumers and an online trading system for recycled and recyclable materials and products open to businesses, waste operators and households.

5.1. *Separate collection and recycling of municipal waste*

Waste recycling and separate collection by households and small businesses is encouraged by volume-based fees on the collection of non-recyclable waste and food waste, associated with free separate collection services; and by the extended producer responsibility system. Recyclable waste is collected separately through door-to-door collection, local recycling centres and take-back systems. Free pickup services are provided for large waste home appliances covered by the producer responsibility system.

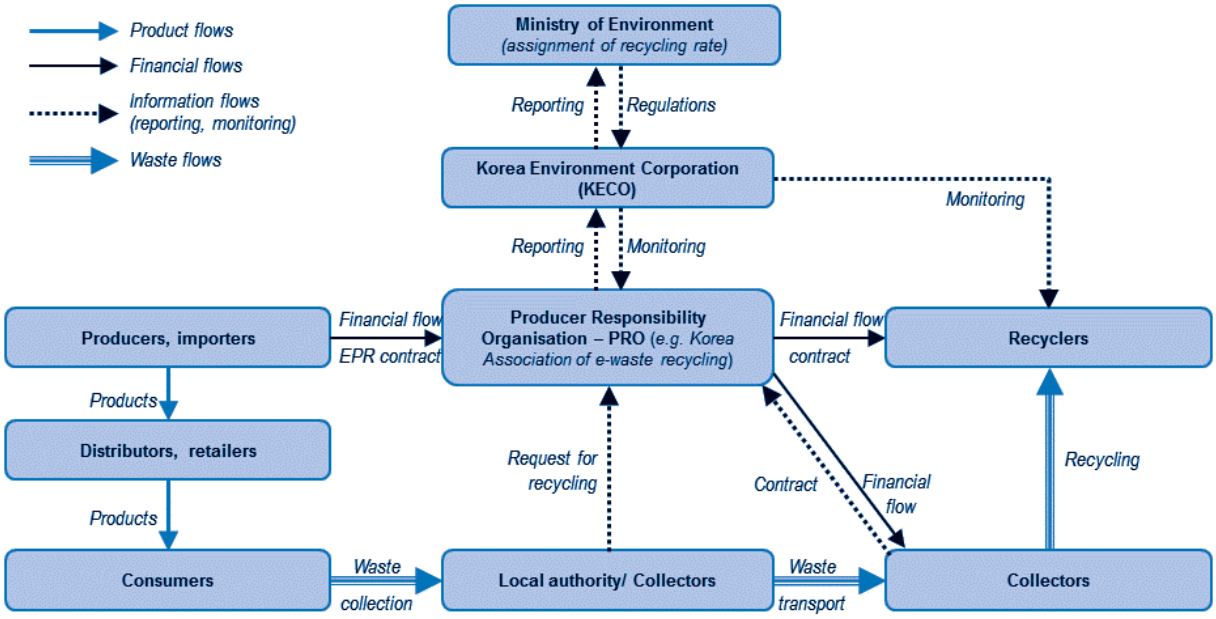
Real estate developers have to install proper on-site waste collection equipment or pay the local government for such equipment and its operation. Since 2010, local governments have been obliged to install and operate recycling centres to promote trading in second-hand goods and recycling of large reusable waste items; 136 such centres are currently in operation. Private collectors often establish separate waste collection contracts directly with multistorey buildings or apartment blocks, which enables them to sell the recyclable material collected to recycling businesses at reduced operating costs.

The performance of the separate collection of municipal waste has improved over time for major waste streams. Recovery rates are close to 60% and have grown steadily over the past decade. This led to the provision of more and higher quality material to recycling businesses, and an increase in the amount of recycled products and secondary raw materials available on the market.

5.2. *Extended producer responsibility*

Korea was among the early adopters of extended producer responsibility. Its system is well established and legally based, and is supported by solid monitoring and enforcement. The legal obligations for waste recycling lie with producers, but the system requires shared duties between all stakeholders (e.g. consumers, local governments and the central government) (Figure 4.7).

Figure 4.7. **Korea's extended producer responsibility system**



Source: Based on Yong-Chul Jang, Chungnam National University, presentation on 10 March 2016 at 3R Conference, Hanoi.

The extended producer responsibility system was introduced in 2003 and its scope broadened progressively. Initially, it was limited to selected products (batteries, tires, lubricants), packaging containers (e.g. paper packs, glass bottles, metal cans, synthetic resin packaging) and selected electric and electronic equipment. Since 2004, products such as fluorescent lamps, styrofoam floats and additional types of packaging materials have been added. In 2014, the range of electric and electronic products covered was further

expanded and associated with a special target management system. In 2016, the system covered 43 different types of packaging container and product categories. Products subject to the ADF are integrated into the producer responsibility system as their recyclability and associated recycling processes evolve.

Recycling methods and standards are specified in the enforcement regulation of the recycling act and in the Eco-Assurance Act, which applies to WEEE and to vehicles. The Eco-Assurance Act also controls the use of hazardous substances and encourages design for environment (DfE); it is the Korean equivalent of the European Union directives on Restriction of Hazardous Substances and WEEE.

End-of-life vehicles are managed under a partial extended producer responsibility system that encourages carmakers to use environment-friendly materials in vehicles' production and facilitate their recycling at the end of their life. A specific Vehicle Eco-Assurance System (EcoAS), using the principle of producer responsibility, was introduced in 2008 for cars, vans and small trucks. It imposes recycling obligations, covering the vehicles' life cycle, on vehicle manufacturers, importers, dismantlers and scrap recyclers, and provides standards and guidelines on how to meet the obligations. The recycling target was set at 85% in 2008-14, and increased to 95% in 2015. The system produces good results; more than 85% of targeted vehicles are recycled. However, the obligation only concerns cars, vans and small trucks; it could be usefully expanded to other vehicles, such as buses and larger trucks (above 3.5 tonnes), now exempted.

Mandatory recycling rates, fees and take-back systems

The MOE sets a mandatory recycling rate for each product category annually; it is associated with sanctions in case of non-compliance. The rates are designed to increase over time and are defined through consultation with stakeholders and experts. For each category the rate is calculated on the basis of quantity produced, quantity previously recycled and national recycling capacity. It is adjusted to take into account developments in recycling technology, product life cycle, etc. To give manufacturers a longer-term perspective and help them plan their recycling activities, since 2008 the annual targets have been accompanied by longer-term (five year) recycling targets (Table 4.3).

Under extended producer responsibility, producers and importers with recycling obligations pay a recycling fee to a Producer Responsibility Organisation (PRO)[6] that collects and recycles the used products or packaging materials and manages the fees. Allotments are distributed among the members of the PRO according to the mandatory recycling quantity assigned to each producer. Until 2013, seven PROs were operating; then the MOE merged the six packaging PROs into one, the Korea Packaging Recycling Association, to reduce administrative costs.

The fees paid by producers fully cover the PROs' costs for collection, treatment and administration. A large share of the fees comes from food manufacturers, retailers and producers of cosmetics, and the plastic packaging industry. The revenue generated and the way funds are used differ among the PROs. Each PRO decides how and to whom to distribute the funds. A majority (70-90%) of the fees are used to remunerate recyclers, and about 1-5% are used for information and awareness-raising campaigns.

Table 4.3. **Extended producer responsibility: recycling targets, fees and financial sanctions**

Product category	Long-term target rate	Annual target rate						Standard fees (KRW) 2015	Financial sanctions imposed (1 000 KRW) 2015 (July)
		2005	2010	2013	2014	2015	2016		
Carton pack	**0.360**	0.278	0.327	0.341	0.346	0.348	0.350	185/kg	1 902 701
Glass bottle	**0.793**	0.672	0.751	0.760	0.760	0.763	0.763	34/kg	1 197 540
Iron can	**0.831**	0.700	0.756	0.786	0.797	0.808	0.808	87/kg	0
Aluminum can	**0.816**	0.700	0.756	0.786	0.791	0.797	0.797	151/kg	0
PET bottle	**0.830**	0.695	0.764	0.806	0.812	0.818	0.818	178/kg	1 142 559
Colored PET bottle				0.806		0.818	0.829	235/kg	2 374 347
Mixed material PET bottle				0.806		0.818	0.818	360/kg	0
EPS	**0.805**	0.613	0.760	0.781	0.790	0.795	0.807	317/kg	0
PSP	**0.423**	0.249	0.367	0.423	0.423	0.423	0.423	327/kg	0
PVC	**0.733**	0.480	0.600	0.644	0.690	0.765	0.735	981/kg	0
Plastic container tray	**0.845**	0.502	0.702	0.800	0.806	0.821	0.833	327/kg	0
Plastic film and sheet	**0.675**	0.368	0.517	0.600	0.603	0.628	0.652	467/kg	0
Lubricant container	**0.790**			0.795	0.794	0.796	0.793	327/kg	0
Lubricant	**0.730**	0.687	0.692	0.725	0.726	0.727	0.728	20/liter	0
Tire	**0.770**	0.718	0.754	0.762	0.765	0.766	0.767	30/kg	0
Fluorescent lamp	**0.394**	0.189	0.261	0.328	0.355	0.356	0.356	143/product	8 968 094
Styrofoam float	**0.277**			0.285	0.280	0.281	0.281	627/kg	105 555
Mercury battery	**0.600**	0.250	0.600	0.600	0.600	0.600	0.600	39.6/g	2 639
Silver oxide battery	**0.560**	0.250	0.424	0.560	0.560	0.588	0.670	35.5/g	44 572
Lithium battery	**0.650**	0.249	0.577	0.650	0.650	0.651	0.726	0.80/g	117 611
Nickel-cadmium battery	**0.400**	0.246	0.333	0.400	0.400	0.403	0.403	0.78/g	0
Manganese battery	**0.213**		0.236	0.216	0.216	0.216	0.216	0.35/g	87 485
Nickel-hydrogen battery	**0.153**		0.289	0.203	0.203	0.203	0.207	0.16/g	2 413
Television	**0.431**	0.118	0.190	0.564	*In 2014, the scope of WEEE was expanded from 10 to 27 product categories and the target rates set by group and no longer by product (section 8.2.)*			196/kg	192 063 (2013)
Refrigerator	**0.389**	0.165	0.221	0.343				197/kg	190 401 (2013)
Washing machine	**0.392**	0.228	0.274	0.330				137/kg	100 837 (2013)
Air conditioner	**0.080**	0.015	0.024	0.028				98/kg	1 840 (2013)
Computer	**0.260**	0.085	0.123	0.158				188/kg	158 562 (2013)
Audio	**0.278**	0.102	0.170	0.268				225/kg	43 983 (2013)
Mobile phone	**0.400**	0.119	0.220	0.257				2 649/kg	269 401 (2013)
Copier	**0.280**		0.134	0.234				273/kg	22 900 (2013)
Fax	**0.250**		0.130	0.223				403/kg	0
Printer	**0.243**		0.142	0.218				400/kg	27 921 (2013)

Source: Heo, H. and M.-H. Jung (2014), *Case study for the OECD project on extended producer responsibility*, *www.oecd.org/environment/waste/OECD_EPR_case_study_Korea_revised_140522.pdf*, country submission.

Compliance and enforcement

KECO, a public entity under the MOE, monitors producer compliance. Producers, importers and recycling firms are obliged to record the recycling process online in Allbaro, including amount of waste collected, amount recycled and recycling methods used. KECO checks the records through on-site inspection. Waste that is treated and recycled in an unauthorised facility does not count towards fulfilment of the producer's responsibility.

When a producer with a recycling obligation fails to comply or when a PRO fails to fulfil members' obligation, the MOE imposes payment of the recycling cost of the unmet portion, plus a surcharge of up to 30%. When a producer exceeds its targets, the amounts that surpassed the targets can be used for the following two years.

Producers of items covered by extended producer responsibility, other than electrical and electronic equipment, with yearly output of less than KRW 1 billion, along with importers with imports of less than KRW 300 million, are exempt from the fees.

Results

Overall, the system performs well. The number of producers with recycling obligations and recycling businesses has been growing. The ratio of producers per recyclers rose from 6.6 in 2003 to 7.3 in 2012. Recycling rates for products such as packaging and tyres increased significantly (to 74% and 62%, respectively, in 2012). The total amount of recycled waste products and packaging materials grew by more than 60% (from 938 000 tonnes in 2002 to 1.52 million tonnes in 2012), and the total amount of products recycled under the producer responsibility system increased by 70% (from 928 000 tonnes to 1.16 million tonnes). This represents cumulative savings in landfill costs of KRW 2.89 trillion, and cumulated revenue of KRW 3.05 billion from selling the recycled materials, as well as the estimated creation of up to 9 769 jobs over ten years. Positive effects are also seen with respect to DfE improvements for consumer electronics (Table 4.4).

Table 4.4. **Overview and performance of the Korean extended producer responsibility system**

Cost coverage	PROs' costs are fully covered by the recycling fees
Role of government	• Creates and implements extended producer responsibility regulation • KECO accredits PROs and monitors compliance, including by verifying annual reports and carrying out on-site inspection • The MOE imposes fines with up to 30% surcharge in case of non-compliance
Environmental performance	• Recycled products and packaging materials totalled 1.52 million tonnes in 2012, up 62% from 2002 • The overall recycling rate increased by almost 103%, while landfill use decreased by 31%
DfE incentive	Producers are obliged to develop recycling technology, resource efficiency design, and restrict the use of hazardous substances and produce (or import) easier-to-recycle products
Cost efficiency	• KRW 2.89 trillion of cumulative landfill savings over ten years (2003-12 included) • KRW 3 055 billion in cumulated revenues from selling recycled goods and materials over ten years (2003-12 included).
Employment effects	Estimated creation of up to 9 769 jobs over ten years (2003-12 included)

Source: OECD (2016), *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management*.

Progress is slower for products such as household fluorescent light bulbs and batteries, cardboard, packaging materials – particularly styropore and plastics used in farming and fishing – and small consumer electronics, whose recycling rates, though increasing, remain low compared to the sales and the stocks in use. This leaves room for further progress. The capacity of Korea's recycling facilities is large enough to process 100% of all extended producer responsibility target products plus other products that could be integrated in the system.

At the same time, Korea has a large informal recycling sector composed of very small family-type firms that have traditionally been involved in scrap collecting and recycling. Given the importance of this sector, Korea would benefit from gaining better knowledge of the sector and integrating it into the formal recycling system – and possibly into the producer responsibility system. This could be done, for example, by creating a network or association in which informal recyclers would register as entrepreneurs who benefit from training and support, and who apply minimum recycling and safety standards to their activities. A useful first step would be to study the sector to better understand its functioning in terms of number of establishments and people involved, types of waste collected and pathways used.

5.3. *Waste-to-energy policy*

With a net import dependence of 87% for the primary energy supply (Chapter 1), further development and use of new and renewable energy sources is crucial for Korea's

economic development. The government plans to increase the share of renewables in total primary energy supply from 3.2% in 2012 to 20% by 2050. An important part of the planned increase is expected to come from the use of waste as fuel (residual heat from waste incineration, landfill gas, biogas, solid refuse, etc.).

A set of Measures for Energy from Waste Resources and Biomass was released in October 2008, followed by an implementation plan in July 2009. Their objective is to increase by 2020 the shares of combustible and organic waste that are recycled as an energy source to 90% and 36% respectively (compared to 1.5% and 2% in 2012). The government particularly encourages the production of solid refuse fuel (SRF) from combustible waste, the establishment of SRF power plants and the upgrading of power plants to generate electricity using biogas from organic waste. This is supported by an SRF Product Information Management System that was set up in late 2010 to promote exchange of information between manufacturers and users (*www.SRF-info.or.kr*, in Korean).

To facilitate implementation of waste-to-energy measures, legal provisions were or are being amended. One example concerns sewage sludge, whose dumping at sea was banned in 2012. An amendment now enables its use as fuel in coal-fired power plants and combined heat and power plants. Other examples concern the supply of biogas through city gas lines and the development of production standards for biogas used as a vehicle fuel. Other amendments concern the raw materials, manufacturing processes and quality standards for producing SRF, which allow the use of combustible waste to produce SRF (originally forbidden under the Waste Control Act). Since 2014, SRF imports have been legal.

Government financial support for waste-to-energy facilities has been gradually increasing since 2007 (in 2014, about KRW 105.3 billion of financial aid was allocated to such facilities). Twelve SRF manufacturing facilities and boilers are in operation (including in Wonju and Busan), and eight are under construction. Ten plants converting organic waste, including food waste, to biogas are in operation (among them one at the Sudokwon Landfill site in Incheon and one in Seoul), and eight such plants are under construction (in Busan and Daejon).

The policies and support measures put in place by the government are showing initial results. The ban on direct landfilling of food waste (2005) and the development of new measures and technology for the use of biogas have contributed to these results. In the first half of 2015, domestic production of SRF totalled about 770 000 tonnes, imports 130 000 tonnes and consumption 880 tonnes. This represents increases of 36-63% from the previous year.

The further success of the waste-to-energy policy will depend on factors including the evolution of oil prices (currently very low), the level of economic activity (now slowing), the solidity of the SRF market and public acceptance of SRF facilities. Despite the government's awareness-raising efforts and compensation, local opposition to construction of such facilities remains high in some areas. Further success will also depend on developments concerning waste-to-energy technology and improvement in the quality of recovered combustible waste. So far, the production costs of converting waste to energy have been much lower than that of solar power (by 10%) and wind power (by 66%), but the waste-to-energy processes currently in use have been criticised for low energy efficiency because combustible waste is less efficient than other energy sources.

There are also potential conflicts between the objective of maximising use of waste as a resource for energy production (waste-to-energy policy) and that of maximising material

recovery through improved recycling and reduction of waste. Many waste materials can be used for both purposes. Little information is available to assess and compare the life cycle-wide costs and benefits of the two approaches and identify optimal uses for the various waste streams.

6. Promoting recycling markets

Markets for recycled products are encouraged by a recycling market support programme targeted at SMEs, the GPP system, which has been extended to all government institutions, and an online trading system for recycled and recyclable materials and products that is open to businesses, waste operators and households. They are further supported by measures that encourage green purchasing by consumers.

6.1. Recycling market support for SMEs

A recycling market support programme provides long term low interest loans to recycling businesses to support facility installation, management stability and technology development. The programme targets SMEs whose annual average sales in the two previous years did not exceed KRW 30 billion. Between 1994 and 2015, 2 996 companies benefitted from the programme and a total of KRW 1 241 billion was lent (Table 4.5).

Table 4.5. **Recycling market support programme, 2015**
(*Indirect loan: MOE takes out loan from financial institutions and grants it to enterprises.)

Purpose of support	Interest rate	Loan period	Maximum amount (KRW)	Repayment
Facility installation	(Quarterly) variable rate (announced by MOE, 1.77% 4Q 2015)	3 year deferment 7 year repayment (not exceeding 10 years)	2.5 billion	Quarterly amortisation after deferment
Commercialisation of new technology			1 billion	
Technology development			400 million	
Business stability		2 year deferment 3 year repayment (not exceeding 5 years)	500 million	
Distribution and sales			200 million	

Source: Country submission.

The programme has increased the recycling efficiency of the targeted SMEs. Efforts are also being made to prevent potential environmental harm from recycling. Progress in the past few years has slowed, however; further improvement in recycling performance was hampered by the number of legal restrictions concerning the materials whose recycling is allowed. The recent revision of related provisions in the Waste Control Act and implementation of the Framework Act on Resource Circulation are expected to give new impetus to the programme.

6.2. The recyclable resources marketplace

To further encourage recycling, curb waste generation and divert valuable resources from landfill and incineration, in 2013 Korea introduced an online market for recyclable resources, a customised and web-based trading system (or marketplace) for users and suppliers of recyclable materials and reusable products. The system is open to businesses, public waste operators and households (private persons). It focused first on waste material (e.g. waste synthetic resins[7]), used furniture, home electronics and baby products. Since 2015 it has covered used machines and equipment, semi-processed goods and any other recyclable or reusable material or good. The system is being connected to information from

the Allbaro system to avoid duplicating registration of items, but more could be done to fully exploit the synergies between the two systems.

Suppliers register information about the type of waste material or used product available, its composition and its properties (quality, quantity); users use this information to find and purchase optimal products. Four types of trading operations are in service: i) matching system, ii) auction, iii) group purchase and iv) ordinary trading, in which a consumer can personally search for and buy products. In 2014, a help desk providing liaison between waste collectors and waste treatment firms, a GIS-based search function and an electronic bidding tool were added to the system. In 2015, regional distribution centres were established to reduce the costs of logistics.

Users include the 800 000 business operators that generate, transport and treat waste, as well as local government recycling centres and citizens (mainly for used home electronics and furniture). In 2013, the market had 53 635 registered users, 44% being individuals and 56% businesses. By the end of 2014, the system had registered around 690 000 trades. The most traded resources were waste synthetic polymer compounds, recyclable raw materials, recycled aggregates and abandoned metal; the resources with the highest transaction values were oil, synthetic polymer compounds, metal and board.

The government plans to make greater use of this system to stimulate demand and create new markets for reused goods and recycled materials, in line with the introduction of landfill and incineration charges in the framework of the new law on resource circulation. It also plans to initiate trading of purchased but unused goods owned by the government, including the Public Procurement Service (PPS).

Despite these very positive measures, recycling markets remain weak. They suffer from a general mistrust in the quality of recycled materials and reused products. And in recent years, low oil and raw material prices have undermined their effectiveness, making it difficult for recycled products to compete with new products. Strengthening the recycling markets to make them more resilient against the volatility of commodity prices and stimulating demand for recycled goods beyond the public sector are essential. To achieve this, the government needs to strengthen action at the following levels.

- Restore trust in recycled goods, for example through well-targeted information campaigns and expanded use of quality labels for recycled goods.
- Guarantee high quality in recycled goods by informing recyclers about the material content of recovered products, developing minimum quality standards and creating incentives for upcycling waste into high-value products. A first step has been taken with the creation of a quality certification system for materials recovered after intermediate treatment or from recycling processes (e.g. used organic solvent, used moulding sand, animal residues, sludge, waste acid).
- Continue developing external markets and strengthening bilateral and multilateral co-operation on resource circulation and the 3Rs.

6.3. Green purchasing by the public sector

Measures to improve recycling markets and move towards a circular economy are further supported by the government's green public procurement system. The Act to Promote the Purchase of Environment-friendly Products (2004) makes it mandatory for public institutions to buy such products. It is complemented with a basic plan on promoting

the purchase of green products (2005). Since 2006, the scope of the GPP system has expanded considerably and today it covers all government institutions.

Environment-friendly or green products are those that have received environmental certification, such as the Eco-Label in existence since 1992, or the Good Recycling (GR) mark launched in 1997. These products are given preferential treatment. For example, they are exempt from the eligibility evaluation when the PPS issues calls for tender for Multiple Award Schedule (MAS) contracts,[8] they are selected as procurement excellence products, and they receive bonus points in other eligibility assessments. By the end of 2015, 15 060 products had been granted Eco-Label certification and 229 products GR-mark certification.

In addition to products certified as "green", PPS has identified 100 products that meet a "minimum green standard" and whose purchase is mandatory. They were selected based on life-cycle costing, taking into account factors linked to energy efficiency, standby power or recycling.

As a result, the volume of GPP rose from KRW 255 billion in 2004 to KRW 862 billion in 2006 and KRW 2 402 billion in 2015, representing 8% of total public procurement.

6.4. Green purchasing by consumers

The government also encourages and supports efforts in the private sector to expand the availability of green products to consumers, mainly through voluntary agreements between the MOE and private firms. Examples include the establishment of green product corners at large retailers (373 retailers, or 97%, participated in the project, launched in late 2007). Other examples include guidelines for green purchasing and training for green purchasing target management. Green purchasing is further supported by civic groups, such as the Green Purchasing Network.

To encourage environment-friendly behaviour, a Green Credit Card programme was created by the Korean Environmental Industry & Technology Institute and the MOE with private sector backing in July 2011 (Chapter 3). It rewards environment-friendly behaviour by consumers and users of public services such as water and energy, the use of public transport and the purchase of environment-friendly goods. The rewards come in the form of points that can be used to buy products or services, be exchanged for cash or be given as donations to environmental funds. Uptake of the card exceeded expectations; there are more than 10 million users where 3 million were originally expected – equivalent to about a fifth of the population. At the same time, eco-related sales increased significantly, by 160% from 2013-14.

7. Improving the environmental effectiveness of waste disposal and management

Waste disposal

Waste disposal by municipalities and industry has improved considerably since 2006. All substandard landfills have been upgraded thanks to a programme comprising application of leak prevention materials, construction of advanced leachate treatment facilities and thorough soil covering. Soil quality in and around landfills is controlled through regular monitoring and inspection, along with through impact assessments in neighbouring areas. Additional regular inspections are carried out to detect and prevent soil contamination in controlled landfills of capacity of over 10 000 m^3 and commercial landfills of capacity of over 150 000 m^3. After closure, monitoring of leachate, gas emissions, and ground and surface water quality continues for 30 years, during which use of the site is restricted.

Korea has been particularly successful in managing its large landfill sites and converting them gradually into eco-industrial leisure complexes. A prominent example and model case is the Sudokwon Landfill in Incheon, whose management model and know-how have been exported to other countries. Today, the Sudokwon site features, beside its remaining landfills, a range of activities, including an eco-energy town, natural areas, sports fields, a golf course and flower gardens, and is a venue for cultural and sporting events (Box 4.2).

Box 4.2. **Sudokwon – from landfill to waste-to-energy town and Dreampark**

The Sudokwon Landfill Site is the world's largest landfill, covering 20 square kilometres. Established in 1990 on land reclaimed from the sea, the site uses advanced, high-tech waste management technologies to treat every day about 20 000 tonnes of waste from households, construction sites and businesses from the Seoul Metropolitan Area where about 40% of the national population lives.

The "Dreampark" is a project initiated in 2000 by Sudokwon Landfill Site Management Corporation (SLC) to convert its used landfill sites into an ecological leisure and education space that can be enjoyed by local residents and international tourists alike. A sports park for local residents encompassing a soccer field, basketball court, tennis court, athletics track and more is already available, as are a flower garden, a botanical garden and a greenhouse for tree seedlings. In partnership with local residents, 5.3 million trees have been planted at the site; the goal is to reach 10 million. The Dreampark cultural classes programme, established in 2012, offers classes in fashion, traditional music, yoga, etc. A horse riding centre, swimming pool and golf course, constructed for the 2014 Asian Games, are now open to residents. A trekking course, campsite, nature observation zones, theme park and more are under construction or planned for the near future. The Dreampark is a place where visitors can learn both about nature and about waste management and recycling, for example during the annual Dreampark Festival. Beyond providing leisure and educational amenities, the Dreampark is expected to stimulate the local economy by creating jobs, increasing land prices and attracting investment. About 400 000 local jobs have been created to date.

SLC actively pursues waste-to-energy projects. The complex houses a "Waste-to-Energy Town" bringing together facilities to treat and recycle household food waste, construction waste, sewage sludge and more while simultaneously using some of the energy by-products and selling others. To date, 2.96 billion kWh of electricity has been generated by the landfill gas power plant, equivalent to about USD 33 million in electricity revenues per year. SLC also recycles sludge to create solid fuel, which is then sold to thermal power generation plants. Projects to produce biogas from food waste and SRF from construction waste are in the pipeline.

Source: SLC (2015), "Waste to Energy, Landfill to DreamPark".

Small- and medium-sized incinerators are controlled twice a year through joint visits by local authorities and inspectors, during which the existence and performance of pollution prevention equipment is checked. Small incinerators with improper pollution prevention systems are being progressively shut down. Very small incinerators, however, are inspected less frequently (every three years) and continue to raise concerns about their environmental impact. And the use of best available technology is not mandatory for waste incinerators that are subject to the new integrated permitting system for polluting facilities.

Direct landfilling of untreated waste and incineration without energy recovery still exist. It is estimated that half the waste going to final disposal (about 8% of the amount generated) contains materials that could be recovered.

Illegal dumping

The mandatory implementation of Allbaro since 2008, using RFID to monitor waste flows in real time, has helped to reduce illegal dumping of waste from businesses. This, however, does not prevent illegal dumping of residue from WEEE collected and dismantled in the informal sector. Illegal waste practices persist as regards the use of non-standard, unpaid bags for the collection of mixed household waste and food waste and illegal waste incineration. Residents who report illegal waste practices to local authorities can be rewarded. About 10% of the cases of illegal dumping are reported by local residents; 90% are detected during inspections by local authorities (Table 4.6).

Table 4.6. **Illegal dumping of waste has been reduced, but still raises concern**

	2010	2011	2012	2013	2014
Number of cases of illegal dumping detected[a]	371 584	351 691	258 193	267 212	287 404
of which:					
cases reported by residents (%)	*7*	*7*	*9*	*9*	*11*
cases detected through local government inspections (%)	*93*	*93*	*91*	*91*	*89*
Share of cases in which a fine was imposed (%)	*67*	*66*	*58*	*46*	*51*
Total amount of fines imposed (million KRW)	10 755	12 160	7 219	7 942	9 087
Share of cases whose reporting by residents was rewarded (%)	*29*	*23*	*15*	*19*	*16*
Total amount of rewards paid to residents (million KRW)	130	92	75	231	115

a) Illegal dumping of waste and of waste cigarettes (79.5%), illegal use of non-VBWF bags (18.8%), illegal incineration (1.4%); plus dumping of waste at tourist or leasure sites, dumping of waste from cars and illegal dumping of waste from businesses.

Source: MOE (2016), *Environmental Statistics Yearbook 2015*.

Dumping at sea of organic waste was banned as of 2012,[9] much later than in other OECD countries. In 2014 the ban was expanded to industrial wastewater and sludge. Water quality, living organisms and sediments in sea areas where waste used to be discharged are monitored regularly. Sewage sludge is now entirely treated on land, and increasingly used to manufacture SRF. The government invested KRW 590 billion to build sludge treatment facilities between 2008 and 2011, and the efficiency of decomposers that degrade sludge has been increased, resulting in a cut in the weight of the sludge, in operating costs (by KRW 1.18 billion per year) and in related CO_2 emissions (by 2 451 tonnes per year).

As in many countries, the installation of waste treatment facilities often faces local opposition. But the high population density in Korea can make such reactions stronger than elsewhere. Waste legislation enables public participation in decision making on waste management installations, and since 1995 residents living close to waste facilities have been able to receive compensation from local governments.[10] The money comes from a resident support fund set up by the local government and fed with revenue from the waste facility. Combined with proactive information campaigns, this has helped alleviate public opposition around sites such as the Sudokwon Landfill, where representatives of local residents are involved in the site management committee and can take part in site inspections and monitoring. Local opposition remains strong around other sites, however, and increasingly targets waste recycling facilities, especially those treating food and other

organic waste, whose growing number raises concern. Additional efforts will be required to tackle the negative public perception of such facilities, for example by further developing successful models such as eco-energy towns.

Hazardous waste

The management of hazardous waste has been improved since 2006 and safety requirements are being strengthened to minimise associated risk. In January 2016, new provisions on safety entered into force.[11] Designated hazardous waste that entails a risk of fire, explosion or gas leak must now be physically separated from other waste (e.g. acidic and alkaline waste, spent oil and organic solvents, synthesised high molecular compounds, dust and sludge). And businesses generating more than 100 tonnes of hazardous waste per year, along with the companies that treat it, have to install and maintain proper safeguards (fire alarms, gas detectors, ventilators, decontamination supplies) to prevent leakage and explosion risk.

Korea is working to establish a mandatory information system on the hazards of controlled waste to prevent waste-related accidents and guarantee safe handling and treatment, in line with a 2015 revision of the Waste Control Act stipulating that anyone disposing of controlled waste must provide hazard information, including on risks and precautions for handling and treatment, to waste disposal businesses.

Special attention is given to medical waste, of which 148 000 tonnes is generated yearly (as of 2012), with the amount expected to continue to grow as the population ages. A RFID system for tracking transfers of medical waste became mandatory in August 2008. It enables real-time computerised monitoring of the discharge, collection, transport, storage and disposal of medical waste. Medical waste must be disposed of in special containers with RFID tags. Legal action is taken against anyone who produces, distributes or uses such containers illegally.

The MOE is developing a take-back programme for mercury-containing devices and products, to ensure safer and more environment-friendly treatment of mercury-containing waste such as fluorescent lamps and medical instruments. According to a survey the MOE carried out at 169 workplaces with heavy volumes of mercury waste (in the framework of the global convention on mercury), an annual average of 33.5 tonnes of mercury was found in their waste between 2012 and 2014.

Transboundary movements

Korea signed the Basel Convention in 1994, and implements it through the Act on the Control of the Transboundary Movements of Hazardous Wastes and their Disposal, which was adopted in 1992 in anticipation of the Basel Convention and came into force in 1994. The list of hazardous waste types whose movement is subject to official approval and notification is specified in the Waste Control Act and is in line with the OECD Red and Amber lists and Basel Convention annexes. It is revised periodically. Guidebooks and information material are available on imports and exports of waste and on waste regulations and control.

Since 2008, the system has also been mandatory for non-hazardous waste whose domestic and international flows require control. Movement is monitored through Allbaro (Table 4.7).

Illegal export of e-waste has long been a difficult issue. Such waste now must be disposed of domestically or sold abroad as used products after repair and performance testing.

Table 4.7. **Transboundary movements of waste**

(1 000 tonnes)

	Waste exports							Waste imports						
	2008	2009	2010	2011	2012	2013	2014	2008	2009	2010	2011	2012	2013	2014
Total amounts	21	62	203	213	287	299	268	540	970	1 705	1 892	2 177	2 528	2 163
Permit[a]	0.3	0.6	0.6	0.6	0.3	0.4	0.5	139	149	325	276	256	407	416
Declaration[b]	21	61	203	212	287	299	267	401	821	1 381	1 616	1 921	2 122	1 747

a) Import/export permits (since May 1994) apply to hazardous waste controlled under the Basel Convention Annex VIII (List A, 61 types), Annex II (wastes requiring special consideration, two types), and to 23 waste types from the OECD Amber List.

b) Import/export declarations (since August 2008) apply to 25 categories of non-hazardous waste that are not subject to import permits (e.g. synthetic high molecular compounds, sludge, sillage) but controlled under national legislation (Waste Control Act).

Source: Country submission; MOE (2016), *Environmental Statistics Yearbook, 2015*.

Bilateral and tripartite co-operation has been established with China and Japan to prevent illegal trade of e-waste in the region. Korea is also engaged in international debates to establish a clear distinction between e-waste and second-hand goods, and to keep e-waste from being exported illegally as second-hand equipment without proper repair and testing.

8. Focus on selected waste streams

8.1. Food waste

Food waste management has long been of particular concern in Korea. Nearly one-third of the waste generated by households is food waste (27% in 2014, i.e. 13 697 tonnes/day). The custom is to prepare meals including many small dishes, and to prepare more than can be eaten. Hence, leftovers are abundant. Much Korean food is fermented, and most Korean meals include some kind of soup. This often results in semi-liquid, pungent food waste that is not easy to manage; the high water content generates a lot of leachate in landfills and decreases incinerator efficiency, resulting in high treatment and disposal costs.

Korea's food waste reduction policies are among the world's most advanced. Korea applies a successful mix of instruments to reduce food waste amounts at source and promote recycling of food waste. This includes waste reduction and recycling targets (since 1996), a ban on direct landfilling of untreated food waste (since 2005), a ban on ocean dumping (since 2012), the application of the VBWF and mandatory separate collection (initiated in 2010), and the signature of voluntary agreements with food waste generating sectors. Efforts to reduce food waste are encouraged through awareness-raising campaigns and public-private projects targeted at improving the national food culture. Funding and loans are available to support the development of recycling technology and separate collection for food waste.

National waste reduction targets and measures to reduce and recycle food waste were introduced in 1996, and updated in 2004 and 2010 under the Comprehensive Plan for Food Waste Reduction, established through interministerial collaboration involving the MOE, and that were then the Ministry for Food, Agriculture, Forestry and Fisheries and the Ministry for Health, Welfare and Family Affairs. The plan and associated targets serve as a guide to local governments, which are in charge of food waste management. The plan applies the polluter-pays principle by extending application of the VBWF to food waste, and introduces measures to reduce food waste from households and from large food waste producers such as restaurants and wholesale markets through voluntary agreements. The VBWF system for food waste was introduced in August 2010 and expanded in 2013, with a

mandatory separate collection, mainly using designated standard bags, but also special food waste bins on which official stickers have to be affixed. Households that mix food waste with other waste in the official food waste bags can be fined.

To improve the effectiveness of food waste collection, the current collection method, commonly using waste bags, is being replaced with methods including special bins for food waste and high-tech collection systems being piloted in large cities. These systems rest on the use of personalised magnetic cards with embedded RFID chips that need to be scanned to open the waste bin. Information on the chip owner and the weight of waste deposited is sent automatically to KECO, which calculates the fees to be paid every month. In areas where this system is in use, the amounts of food waste generated have decreased on average by an additional 20% and the quality of the waste recovered has improved.

Large food producers have to deal with the food waste directly or outsource collection and treatment to specialised operators. Most of the waste is recovered to produce compost and animal feed. Agreements have been signed with various sectors, including restaurants, hotels, schools and highway rest areas. Restaurants were encouraged to use fewer small side-dish plates and consider environmental aspects when developing their menus. Canteens in public institutions launched "no leftovers day" once a week.

Public funds are available to support construction of public food recycling facilities and separate collection (by 2013, KRW 185 billion had been spent). The government also provides loans to the business sector through the Recycling Industry Promotion Fund targeting development of recycling technology and construction or upgrading of recycling facilities (by 2013, a total of KRW 926 billion had been lent to 2 227 businesses). Between 1996 and 2014, the government invested KRW 163 billion in building 131 food waste recycling plants.

Following the establishment of reduction and recovery targets, food waste has been progressively diverted from landfill and is now almost entirely recycled (96%) into feed, compost and fuel for electricity production. Korea also succeeded in curbing the upward trend in food waste generation that has been of concern for many years. Until 2008, food waste grew in line with increasing living standards and changing consumer behaviour. It then started to decrease, reaching 5 million tonnes in 2014, down by 9.6% between 2008 and 2014 (Table 4.8).

Table 4.8. **Food waste generation and treatment, 2000-14**

	2000	2005	2008	2010	2011	2012	2013	2014	% change 2000-08	% change 2008-14
Generation (1 000 tonnes)	4 173	4 737	5 527	4 990	4 941	4 821	4 622	4 999	32.4	-9.6
Recovery/recycling (%)	45	93	90	96	95	96	96	94		
Incineration (%)	10	4	6	3	4	3	3	4		
Landfilling (%)	45	3	4	1	1	1	1	1		

Source: Country submission.

Recent data reveal a halt in this decrease, partly reflecting structural changes in average household size fuelled by the ageing of the population, among other factors, and partly the insufficient financial incentive of the VBWF. Further progress will depend on a gradual increase of the VBWF to reflect actual costs. Wider implementation of high-tech collection would also help, but would require significant funding and a thorough analysis of its economic and environmental costs and benefits.

8.2. Waste electrical and electronic equipment

Since 2003, manufacturers and importers of electric and electronic equipment have had an obligation under the producer responsibility system to collect, transfer and recycle WEEE (recycling duty). They must also provide recycling businesses with information to facilitate recycling, including about product composition, presence of harmful substances and dismantling methods to be used. Retailers have an obligation to collect and transfer the waste (collecting duty). Take-back programmes for WEEE such as TVs, refrigerators, washing machines, computers and mobile phones, have been mandatory since 2003.

The recycling duty is imposed on manufacturers with sales of electric and electronic products of more than KRW 1 billion in the previous year and importers with import volumes of more than KRW 300 million in the previous year. The collection duty is imposed on enterprises with sales of more than KRW 5 billion in the previous year.

From 2003 to 2013, ten products were subject to mandatory recycling; the recycling rates were set for individual product classes (e.g. refrigerator, computer, mobile phone) and expressed as a percentage of the total quantity on the market. In 2014, Korea introduced a new WEEE Recycling Target Management System, as the previous system that did not produce the expected results. The new system sets a target for amounts to be recycled per capita (expressed in kilograms per person) and requires individual manufacturers to recycle a given amount of material that is defined by taking into account the market share of each manufacturer. The concept is similar to that used for other products under extended producer responsibility, but instead of setting a mandatory recycling rate per product, it sets a per capita target.[12] Achievement of the targets is monitored and penalties are imposed on companies not fulfilling their duty.

The number of target products for which recycling is mandatory has been expanded; since 2014, it has included 27 types of equipment, classified into five groups: large equipment, communication devices (ICT), including mobile phones, medium-sized equipment and small equipment. The per capita targets have also been progressively increased. In 2014 an annual recycling target of 3.9 kg per capita applied.

E-waste is collected by three major players:

- Local governments, through collection at designated areas or kerbside with municipal waste near residential buildings, which accounts for 5% of the total amounts collected (requires buying a sticker and putting it on the equipment, which costs between KRW 3 000 and KRW 15 000); through free collection boxes for small items in residential areas; and through a free pickup service for large appliances (TVs, refrigerators, washing machines, air conditioners, etc.), which accounts for 25% of the total collected.
- Producers and retailers through take-back programmes, which account for 70% of the total collected.
- Private collectors and recyclers.

The free pickup service is handled by Korea Electronics Recycling Cooperative (KERC), the PRO for WEEE, which also bears the costs. It can be booked on the internet or through a call centre hotline, and can be used for medium-sized appliances (computers, stereos, microwave ovens) and several types of small electronics in groups of at least five. The service was polited in 2012 in Seoul, then extended to a few other cities and Gyeonggi province. Positive results[13] led to it being expanded to the whole country in 2014. KERC also

works with local governments to improve collection of e-waste and organises meetings of e-waste producers, importers and recyclers.

Seven big producer-owned recycling centres across the country serve all regions and provide annual recycling capacity of 120 000 tonnes. They mainly process refrigerators, TVs, washing machines and air conditioners. Some local governments also have their own e-waste recycling programmes and recycling centres. This includes Seoul, which generates about 10 tonnes of e-waste a year. About 20% of this waste is directed to the Seoul Resource Centre, where the devices are dismantled and valuable metals such as gold and copper extracted for reuse as secondary raw materials.

Official data show significant increases in the amounts of e-waste collected and recycled in recent years, with 214 446 tonnes collected and recycled in 2015 (up from 200 259 tonnes in 2014 and 58 000 tonnes in 2003). This corresponds to 4.2 kg per person (Table 4.9).

Table 4.9. **Targets and actual recycling rates, 2015 and 2016**

Recycling collection targets	Large appliances	Medium-sized equipment	Small equipment	ICT, including mobile phones	Total
2015 targets (tonnes)					
Mandatory recycling target	166 975	16 569	23 795	19 714	227 053
Actual recycling	162 206	22 408	17 767	12 065	214 446
% of mandatory target	*97%*	*135%*	*75%*	*61%*	*94%*
2016 targets (provisional)					
Mandatory recycling target	180 283	18 476	24 789	20 296	243 844

Source: Country submission.

These figures, however, do not account for e-waste collected and processed in the informal sector. The collection and recycling rates and the pathways of these streams are largely unknown. It has been estimated that the total amounts are important, but decreasing since the establishment of the free pickup service for large appliances. Most of this waste is sorted, reused, processed, exported, or recycled in private facilities not linked to the official producer responsibility system. This entails a risk of pollution and of illegal exports.

Recyclers still encounter difficulties in dismantling products and understanding their composition. Evidence suggests that implementation of related provisions in the Act on Promoting the Recycling of WEEE and Vehicles could be strengthened, notably through provision of better and more harmonised information to recyclers and continued training.

Further progress will require more effective collection systems for certain types of WEEE, in particular small and medium-sized devices from households, for which the collection rates, though growing, remain low compared to sales and the stocks in use. It will also require more effective recovery of valuable resources (Al, Cu, Fe, plastic, glass, rare metals and earth elements Pt, V, W, Ty) from e-waste using advanced recycling technology. More could also be done to better understand the role of the informal sector and to progressively integrate it into the formal recycling system (Section 5.2).

8.3. Construction waste

Construction waste increased from 28.8 million tonnes in 2000 to 67.7 million tonnes in 2014 (+135%); it makes up more than half of all commercial waste. The government's aim is to treat it in an environmentally sound manner and maximise its recycling into high-value products.

Municipal construction and demolition waste must be disposed of in containers rented from the local government. Large generators are responsible for treating their own waste. The use of recycled aggregates (asphalt and concrete) in construction of roads, industrial complexes and environmental infrastructure has been mandatory since 2013. Asphalt-concrete waste used for simple mounding and backfilling has to be collected and stored separately from other construction waste, and its use is restricted to road construction. Since 2007 the quality of recycled aggregates has been guaranteed through a quality certification system, and quality standards for the use of recycled aggregate products have been in use since 2012.

Information on the transfer and management of construction waste has to be entered into the Allbaro system to ensure transparency. A construction waste information management system further provides information on the production, quality, demand and supply of recycled aggregates for manufacturers and users. The government plans to introduce a separate demolition system for buildings and to estimate the volume of construction waste by building type.

The recovery rate of construction waste has steadily increased, reaching 97.3% in 2012, along with a gradual decrease of the landfill rate. But most construction waste is only recovered through mounding and backfilling. The recycling rate into high-value materials such as aggregates and asphalt remains around 35%, which is below the government's objective of 45% in 2016. This may be due to a certain reluctance to use recycled materials, among other factors.

Further progress would require a more complete management system for construction and demolition materials, considering the whole material chain, associated with life cycle-based construction policies and performance-based building codes. Experience in other OECD countries, such as France, Switzerland, the United Kingdom and the United States, could be useful in this respect.

Recommendations on waste, materials management and circular economy

- Further improve the efficiency of recycling and recycling systems:
  - Study the informal recycling sector and consider formalising it through the creation of recyclers' networks.
  - Conduct a competition assessment of the extended producer responsibility system to identify how market forces can be further strengthened in it without compromising environmental standards.
  - Improve separate collection rates for waste electrical and electronic equipment and industrial waste.
  - Facilitate the development of new and innovative recycling technology and introduce "end of waste" criteria for recyclable materials, taking into account their environmental impact.
- Consolidate and strengthen markets for secondary raw materials and recycled goods:
  - Provide economic incentives to properly value recycled products on the markets and stimulate upcycling of waste into high-value products. Further develop the online exchange market and link it to the Allbaro system.

Recommendations on waste, materials management and circular economy *(cont.)*

- Stimulate demand for recycled goods by informing users about their quality and their economic and environmental benefits, and by further strengthening bilateral and multilateral co-operation on resource circulation and the 3Rs.

- Further promote waste prevention, along with circular business models and resource productivity in industry, by considering the whole life cycle of materials and products and their value chains:
  - Foster awareness among businesses of the economic and environmental benefits of a circular economy, design for environment and resource-efficient production.
  - Encourage industry to use waste and materials flow information in combination with accounting data to establish materials flow cost accounts to better understand the environmental and financial consequences of materials and energy use practices, and to identifying opportunities for efficiency improvements.
  - Continue to support SMEs and develop specific guidance for them on waste prevention.
  - Exploit the synergies between policies and support measures on clean production, eco-innovation, eco-friendly businesses, recycling businesses and waste prevention and recycling in industry by establishing effective mechanisms for co-ordinating the actions of all ministries involved and preparing a consolidated review of the measures in place.
- Further increase the economic efficiency of sustainable materials management by reducing costs and better using economic instruments in line with the producer-pays principle:
  - Ensure greater cost recovery of municipal waste management by further reducing management costs, improving the collection rate for recyclable waste in less densely populated areas and progressively increasing the VBWF.
  - Introduce a tax on landfilling and incineration by local authorities and businesses to fill the cost gap between recycling and final disposal.
  - Progressively reduce government support to industry by introducing a performance management system and by using performance targets and indicators to determine the level of support.
- Continue to improve the environmental effectiveness of waste recovery and disposal:
  - Abandon landfilling of recyclable waste, along with incineration without energy recovery. Monitor very small incinerators and shut down those that underperform.
  - Expand efforts, especially early in the value chain, to ensure that recovered materials are as free as possible of hazardous substances. Provide improved guidance to businesses on design for environment.
- Better use existing data on waste and materials to support decision making, evaluate policy effectiveness and inform the public:
  - Integrate information from Allbaro with data from materials flow analysis to monitor the circulation of waste and materials in the economy and assess the performance of resource circulation policies. Regularly produce materials flow accounts and expand their scope to cover recyclable materials and raw materials embodied in trade. Use this information to set and monitor targets for materials productivity and resource circulation, and to inform stakeholders about the results obtained.
  - Continue to work with industry to integrate data on resource productivity, and on the environmental impact and cost of materials resource use, in corporate reporting, integrated performance assessments and financial statements.

Notes

1. The average net adjusted disposable income of households (money available to a household for spending on goods or services), and average net financial wealth (such as money or shares held in bank accounts) remain below the OECD averages. The average net adjusted disposable income of the bottom 20% of the population is estimated at USD 7 000 per year.
2. In 2013, Statistics Korea developed a Medium and Long Term Development Plan on Environmental Economic Accounting (2014-22), aimed at using integrated environmental and economic accounting in collaboration with relevant institutions. The plan includes regular updating of economy-wide material flow accounts and air emission accounts by Statistics Korea.
3. DMC is the sum of the domestic extraction of raw materials used by the economy and the physical trade balance of materials and products that embody them (imports minus exports of raw materials, semi-processed and processed goods).
4. Including material recycling, composting and energy recovery.
5. About half the households in Korea are one- or two-person households; a one-person household generates, on average, more than twice as much waste per capita as a five-person household.
6. Even though PROs are private non-profit organisations, they are considered public because their role and their work are for the public good.
7. Waste synthetic resins used to be incinerated, crushed and ground up. The amounts incinerated or landfilled accounted for more than a third (32%) of the total amount of waste generated.
8. MAS is a system in which contracts are made with multiple suppliers that offer products with identical or similar quality/performance/efficiency. Goods or services targeted for MAS must meet four general criteria. They must have a commercialised specification, allow for contracting via unit price, be supported by a competitive market and have sufficient demand among end users. For goods or services that satisfy these criteria, the PPS prepares an announcement for purchasing and a call for tender.
9. See the 2006 revision of the enforcement rule for the Prevention of Marine Pollution Act and the Comprehensive Measures to Manage Ocean Dumping of In-Land Waste. Korea is a party to the 1972 London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. The London Convention has been in force since 1975. Its objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.
10. In line with the Act on the Promotion of Waste Disposal facilities and Support for Surrounding areas.
11. Under a recent enforcement decree (July 2015) of the Waste Control Act (revised in December 2015).
12. Under the extended producer responsibility system for other products, mandatory recycling rates for individual manufacturers are calculated by applying the market share rates to the mandatory recycling rates by product. Under the Recycling Target Management System, the per capita recycling target is converted to the total amount to be recycled by using the total population; the mandatory recycling targets for individual manufacturers are calculated taking into account the market share of each manufacturer.
13. Some 162 000 units were collected in 2013; the collection performance improved by a factor of 1.5 to 6; the recovery rate improved from below 5% to over 95%.

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PART II

Chapter 5

Environmental justice

Environmental justice can include fair treatment in terms of access to natural resources, environmental services and benefits, and environmental risk exposure (distributive justice), accountability and remediation for environmental harm (corrective justice) and access to environmental information, judicial and administrative proceedings and participation in environmental decision making (procedural justice). This chapter looks at the current generation's access to water supply and sanitation services and to green space and exposure to air pollution, chemicals and other environmental risks. It then considers measures to ensure future generations' access to a clean environment and natural resources. The chapter examines progress in the environmental liability framework. It also addresses procedural rights and proposes international frameworks that Korea could use to advance in this area.

1. Introduction

Environmental justice is a flexible, plural concept; its meaning can differ depending on the country or context (OECD, 2000). Fair treatment of current and future citizens in terms of access to natural resources, environmental services and benefits, and in managing potential exposure to environmental risk, is one aspect (distributive justice). Ensuring accountability for environmental harm and effective, adequate and prompt remedies in environmental cases, including compensation for victims and restitution and restoration of the environment, is another (corrective justice). Procedural justice is also relevant: the right of access to environmental information held by public authorities, including on environmental problems; the right to meaningful participation in environmental decision-making processes; and the right of access to judicial and administrative proceedings in environmental matters.

Korea does not yet have a clearly articulated definition or dedicated set of objectives for environmental justice in its laws or policies, and its policy development in the area remains – as in most OECD countries – piecemeal and still at a relatively early stage. Some social aims are set out in framework laws and policy documents relevant to the environment (Table 5.1), but they vary across instruments and in many instances are not underpinned by coherent or comprehensive implementing measures. The main policy objectives on environmental

Table 5.1. **Social aims set out in select framework instruments**

Instrument	Specified social aims
Constitution (No.10, 1987), Article 35(1)	All citizens to have the right to a healthy and pleasant environment
Framework Act on Environmental Policy (2012), Article 2	The act's "fundamental idea" is to have current citizens enjoy environmental benefits while enabling future generations to inherit such benefits National and local governments are to pay due regard to the balanced use of environment-related goods and services among regions, people of every class and other groups
Framework Act on Low Carbon, Green Growth (2010), Article 1 (Purpose)	Purposes include contributing to improvement of every citizen's quality of life
Second Five-year Plan for Green Growth (2014-18)	"Creating green spaces in the national territory" and "expanding the foundation for green welfare" are goals under one of five strategic directions, "Realising a sustainable green society"
Sustainable Development Act (2007, amended 2010), Article 1 (Purpose)	The purpose is to ensure that present and future generations enjoy a better quality of life via sustainable development, including international efforts
Second Basic Plan for Sustainable Development (2011-30)	Enhancing social equity is one of four strategies; related "tasks" are promoting economic activity and improving quality of life of the socially vulnerable, improving income and living quality for rural areas and protecting citizens against environmental change
Third Basic Plan for Sustainable Development (2016-35)	"Integrated and secure society" and "Inclusive and innovative economy" are among four goals; strategies include fostering integration of social segments and gender equality, solving the regional gap and promoting inclusive growth
Fourth National Environmental Master Plan (2016-35)	"Systematic innovation to ensure environmental rights" is included as a goal
Environmental Health Act (2008), Article 4	The act provides for preferential protection and care for groups sensitive to exposure to environmentally hazardous facilities and people in regions with serious pollution
Comprehensive Plan for Environmental Health (2011-20)	The vision is to create a healthy and safe society by preventing damage from environmental hazards; a related task is protecting the health of sensitive groups and vulnerable regions

Source: MOLEG (2016), *Korean Laws in English*; Country submission.

justice appear to be distributive. For example, Article 35(1) of the Constitution provides that all citizens have the right to a healthy and pleasant environment (MOLEG, 2016). The Framework Act on Environmental Policy states (Article 2) that the "fundamental idea" behind the act "is to have current citizens… enjoy environmental benefits and simultaneously to allow future generations [to] inherit similar benefits" (MOLEG, 2016).

Controversy over high-profile development projects, such as the Four Rivers Restoration Project and high-voltage transmission lines in Milang, demonstrates challenges in engaging the Korean public in environmental decision making (Yun, 2014; Chapter 3). Rapid industrialisation, scarce land resources, strong implication of the state in industrial activity, and environmental and land-use deregulation compound pressures. Meaningful public involvement in handling environmental matters can play a major role in preventing or constructively resolving environmental conflicts. Finding ways to build public confidence in the government's commitment to procedural justice and address tensions over development projects is likely to remain a pressing priority, not least given plans to build 20 coal-fired power plants and seven nuclear reactors (Chapter 1).

A sharp increase in significant pollution incidents over the past decade, particularly in the chemicals sector (KEI, 2014), has highlighted difficulties victims face in holding polluters accountable under traditional liability provisions. A positive measure is the Act on Liability for Environmental Damage and Relief Thereof (Liability and Relief Act), in effect since January 2016. It clarifies polluters' liability for damage to human life, health and property arising from pollution and requires compensation.

The Ministry of Environment (MOE) intends to prioritise environmental justice matters in environmental and other relevant policies, including as part of efforts to better manage environmental health risks. This chapter aims to support that process, including through experience in other countries.

2. Environmental justice in context: broader equity challenges

Social conditions are relevant from an environmental justice perspective because they can influence environmental policy effectiveness, as well as environmental outcomes in communities and regions, with implications for distributive justice. Environmental conditions and policies, in turn, can compound social inequality if not effectively managed or implemented (Crifo and Laurent, 2013). As social inequality and environmental challenges can be mutually reinforcing, social conditions merit consideration in environmental justice policy development and implementation.

Korean society is essentially homogenous ethnically, with 2% of the population foreign in 2013, up from 0.4% in 2000. Thus the concern for ethnic communities that has driven and largely characterised environmental justice movements in other countries does not resonate in Korea (Box 5.1; OECD, 2000). Still, the country faces challenges in promoting equity among its population (OECD, 2014a).

Korea has had one of the fastest growing economies in the OECD in the past decade (Chapter 1). The benefits of this growth have not been evenly distributed across Korean society (Figure 5.1). Income inequality and relative poverty have declined in recent years, but remain high. In 2014, Korea ranked within the top 15 OECD countries both in the ratio of the 90th income percentile to the 10th and in the rate of relative poverty.[1]

Labour market dualism is a major contributor to income inequality and relative poverty levels in Korea (OECD, 2016a). Non-regular (e.g. fixed-term or part-time) workers,

Box 5.1. **Linking social justice and the environment: the US experience**

The notion of environmental justice originated in the United States in the 1980s, triggered by protest in ethnic minority communities and indigenous communities over disproportionate exposure to hazardous and polluting facilities. Studies confirmed that racial minorities faced "some of the worst environmental devastation in the nation", whether by "conscious design or institutional neglect" (Robert D. Bullard, quoted in EPA, 2016a).

An executive order clarified the government's position in 1994, two years after an office focused on the issue was established at the Environmental Protection Agency (EPA) (Bell, 2014). Each federal agency was directed to make achieving environmental justice part of its mission by "identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (NARA, 1994).

While the initial focus was on unequal distribution of pollution, over time EPA has also encompassed procedural elements. Environmental justice is "the fair treatment and meaningful involvement of all people regardless of race, colour, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies". All communities and people should enjoy "the same degree of protection from environmental and health hazards, and equal access to the decision-making process to have a healthy environment in which to live, learn, and work". Meaningful involvement is understood as the opportunity to participate in decisions about activities that might affect an individual's health or environment, with that participation having the potential to influence decision making. It also means that community concerns are considered in the decision-making process and that decision makers seek out and facilitate involvement of potentially affected stakeholders (EPA, 2016a).

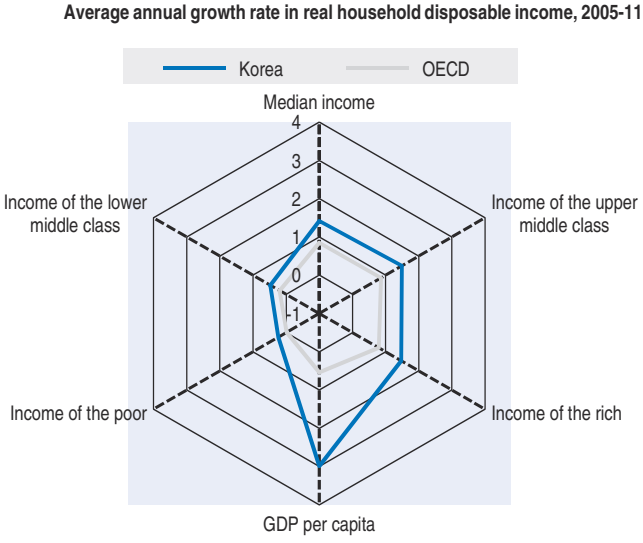
Led by its Office of Environmental Justice, the EPA pursues environmental justice in all of its work, including setting standards, licensing facilities, awarding grants, issuing licences and regulations, and enforcing legislation. A Federal Interagency Working Group on Environmental Justice chaired by the EPA administrator, brings together the heads of 17 agencies monthly to advance environmental justice through collaborative, cross-government action.

The EPA also created a federal advisory committee, the National Environmental Justice Advisory Council, to provide advice and recommendations from stakeholders about cross-cutting issues related to environmental justice. In addition, the council provides a forum for discussions about integrating environmental justice with other EPA priorities and initiatives, as well as with other federal agencies (EPA, 2016a).

Source: Bell (2014), *Achieving Environmental Justice: A Cross-national Analysis*; EPA (2016a), "Environmental Justice"; NARA (1994), 1994 Executive Orders Disposition Tables.

who are disproportionally female, represent around a third of dependent employment. Those with a lower level of education are particularly hard hit, with an incidence of non-standard work of over 60% (OECD, 2015a). In 2014, non-regular workers earned almost 40% less per hour than regular workers, despite possessing comparable skills (OECD, 2013a). In 2014, the share of workers earning less than two-thirds the median wage stood at 23.7%, placing Korea fourth in the OECD (OECD, 2016b). Wage dispersion is the fourth highest in the OECD (after the United States, Israel and Turkey), with wages of workers at the 9th decile 4.8 times higher than those in the first, compared to 3.5 times on average in the OECD (OECD, 2016b). The government is pursuing labour market reform to help address exclusion and marginalisation with the aim of increasing the employment rate, which

Figure 5.1. **Rich and upper middle income households have benefited disproportionally from per capita GDP growth**



Source: OECD (2015), *Economic Policy Reforms 2015: Going for Growth*.

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stood at 66% in 2015 (OECD, 2016b). Its 2013 "creative economy" growth strategy aims to support job creation through innovation (Chapter 3).

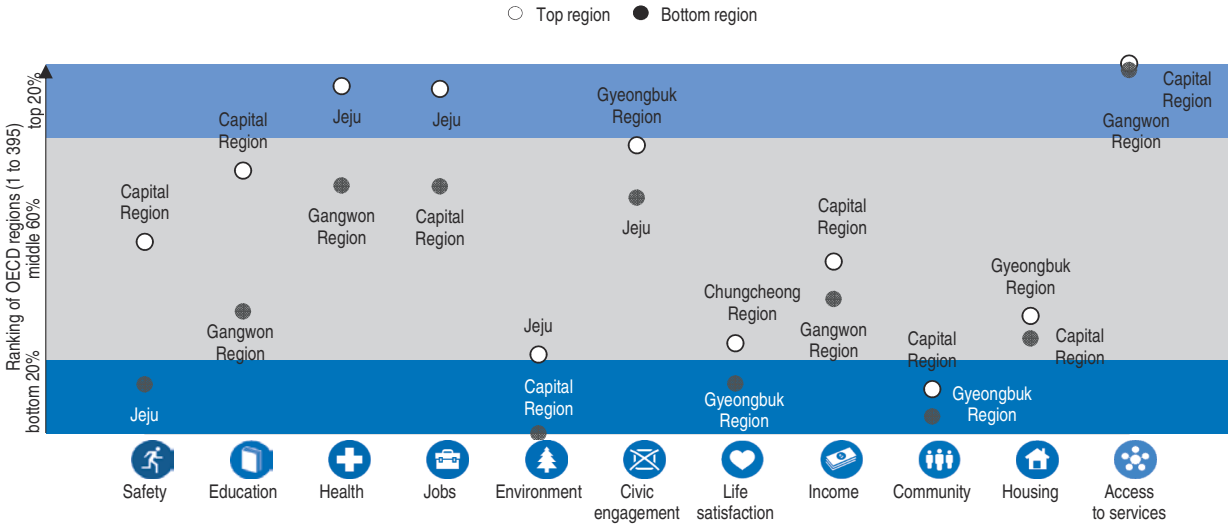
Korea is facing challenges in gearing its social welfare system to better tackle income inequality and relative poverty, particularly among the elderly (OECD 2014a). Public social spending is under half the OECD average on a GDP basis, at 10.4% in 2014 (OECD, 2016a), and has a weak redistributive impact. Half of Koreans over 65 live in relative poverty, while the OECD average is 12.6%. One-third live in absolute poverty (i.e. on income below the minimum cost of living). This is the highest rate in the OECD and three times the poverty rate for the population as a whole. The figure is of concern, not least because the rate of population ageing is projected to top those of other OECD countries. It also disproportionally affects rural regions, where 17.8% of the population is over 65, compared with 10.9% in predominantly urban regions. The National Pension Scheme reaches only around a third of Koreans over 65 and pays not even a quarter of the average wage. The Basic Pension, introduced in 2014, reaches around 70% of the elderly, but the high rate of coverage means payments are low, at 6.2% of the average wage. The company pension system – still at an early stage – cannot compensate. The government is prioritising increased government spending to support social cohesion, but targeting the lowest-income citizens remains a challenge (OECD 2016a).

Regional disparity also looms large, with Korean regions varying widely on well-being indicators such as access to services, education and health (Figure 5.2).

3. Fair treatment of current citizens

Ensuring that all receive equitable treatment in access to environmental resources, goods and services, and that no segments of society are disproportionally exposed to environmental risk or the potential impact of environmental policy reform, are relevant to ensuring fair treatment of current citizens from an environmental justice perspective (intra-

Figure 5.2. **Regions vary widely on well-being indicators**



Note. Relative ranking of the regions with the best and worst outcomes in the nine well-being dimensions, with respect to all 362 OECD regions. The nine dimensions are ranked according to size of regional disparity in the country.
Source: OECD (2016), *OECD Regional Well-Being* (database).

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generational justice). Access to, payment for and quality of environmental goods and services vary significantly between regions, between cities and between urban and rural areas in Korea (Table 5.2). Against this background, Korea's Framework Act on Environmental Policy was amended in 2012 to require the national and local governments to pay due regard to the balanced use of environment-related goods and services among regions, classes and other groups.

3.1. Access to environmental services

Korea's first environmental justice forum, organised in 1999 by the non-government organisation (NGO) Citizens' Movement for Environmental Justice, reported unequal access to safe drinking water and sanitation as a major environmental justice issue (Bell, 2014). The *2006 Environmental Performance Review* (EPR) of Korea recommended strengthening policies for balanced regional development to address disparity in access to water-related services on the basis of equity, efficiency and financing criteria. Significant government investment has led to an impressive increase in access to water supply and wastewater services, in particular to rural areas, but a rural-urban divide persists (KEI, 2015) (Table 5.2). In 2014, nearly 100% of the population in large cities had access to the national water supply network and 99% had access to the wastewater network, while in rural areas the figures were 71% and 66%, respectively (MOE, 2016a). Nonetheless, rural access has improved considerably in recent years: water service access stood at 47% in 2008 and wastewater service access at 55% in 2010. The government is committed to expanding the national water supply network and the wastewater and sewerage network to reach 80% of the rural population by 2017 and 2025, respectively, with priority to areas that do not meet groundwater quality standards and have poor access to capital (MOE, 2016b; MOE, 2016c).

Small, independent facilities currently bridge the waterworks service gap in rural areas, expanding access but raising quality concerns. When these facilities are taken into account, rural water supply access rises to 92%, and in 2012, 416 075 wastewater facilities were

Table 5.2. **Selected environmental indicators by administrative district, 2014**

	Administrative district	Population density (inh./km^2)	Mean exposure to $PM_{2.5}$[a] (µg/m^3)	Population connected to national water supply network[b] (%)	Drinking water average unit price (KRW/m^3)	Waterworks cost recovery ratio (%)	Population connected to sewerage (%)	Sewerage average unit price (KRW/m^3)	Sewerage cost recovery ratio (%)
1	Gyeonggi-do	1 207	33.0	97.6	642.3	83.9	93.7	320.2	32.0
2	Seoul	16 343	34.2	100.0	571.0	89.3	100.0	516.4	67.9
3	Busan	4 432	18.9	100.0	713.1	75.8	99.2	514.8	61.3
4	Gyeongsangnam-do	311	19.4	92.4	822.7	76.5	88.1	325.0	26.0
5	Incheon	2 728	34.9	98.5	669.1	100.0	97.6	479.2	82.1
6	Gyeongsangbuk-do	139	21.6	89.4	707.0	58.5	78.7	283.9	19.7
7	Daegu	2 784	24.3	99.9	578.6	88.0	98.3	373.7	62.1
8	Chungcheongnam-do	253	29.9	82.7	737.1	62.7	72.7	350.7	26.0
9	Jeollabuk-do	223	25.8	95.0	917.4	77.5	85.1	330.2	26.7
10	Jeollanam-do	143	21.8	84.7	819.1	62.8	75.1	212.9	15.8
11	Chungcheongbuk-do	210	28.3	90.2	696.7	73.2	85.5	320.5	19.7
12	Daejeon	2 866	30.1	99.9	513.6	87.5	97.4	389.9	69.1
13	Gwangju	3 025	29.9	99.6	555.0	87.2	98.6	370.9	59.0
14	Gangwon-do	89	22.0	88.8	802.2	52.0	85.6	243.1	15.0
15	Ulsan	1 073	19.9	98.0	868.6	96.4	98.1	401.8	59.6
16	Jeju-do	314	18.7	100.0	715.7	75.7	91.1	313.9	13.1
17	Sejong	288	30.4	82.3	766.5	66.4	81.4	213.0	11.5
	Korea	**503**	**28.8**	**96.1**	**666.9**	**76.1**	**92.5**	**386.2**	**39.1**

a) 2013 data.
b) Excluding village waterworks and small facilities managed by local authorities.
Source: MOE (2016), *Environmental Statistical Yearbook 2015*; OECD (2016), "Exposure to air pollution", *OECD Environment Statistics* (database).

operating outside the public system service zone (MOE, 2015a). However, 4% of small facilities failed water quality tests conducted by the Korean Environment Corporation (KECO) in 2014, and a significant proportion of samples from wells in rural areas not serviced by national service networks fail to meet certain government water quality requirements (e.g. limits on total coliforms and nitrate-nitrogen) (MOE, 2016d). The government considers that most small-scale and village systems need improvement, particularly as 40% were constructed before the 1980s (MOE, 2015a). To tackle the quality gap, the government undertook groundwater quality tests in about 68 000 locations over 2012-15, with local governments overseeing follow-up. It is currently testing around 20 000 additional locations and plans to provide subsidies to rural areas to help improve water supply infrastructure from 2017; details are still being determined (MOE, 2016d). The government has taken quality assurance measures related to sewage treatment by independent facilities as well: for example, since 2007, those over a certain size have had to be built by professional service companies (MOE, 2015a).

As the cost of building pipelines to remote rural areas is high, small, independent facilities may be more cost-effective in some circumstances. According to the Korea Environment Institute, the highest technically feasible level of coverage of wide area/municipal waterworks in rural areas based on conversion of small-scale and village waterworks is around 90% (KEI, 2015), but the cost-effectiveness of attaining this level has not been assessed. To ensure that regional development goals on access to safe drinking water are met as cost-effectively as possible, it would be prudent to assess the costs and benefits of expanding national waterworks beyond certain thresholds and determine when it might be more cost-effective to prioritise alternative measures, such as upgrading the infrastructure of existing independent facilities or making reporting requirements more stringent.

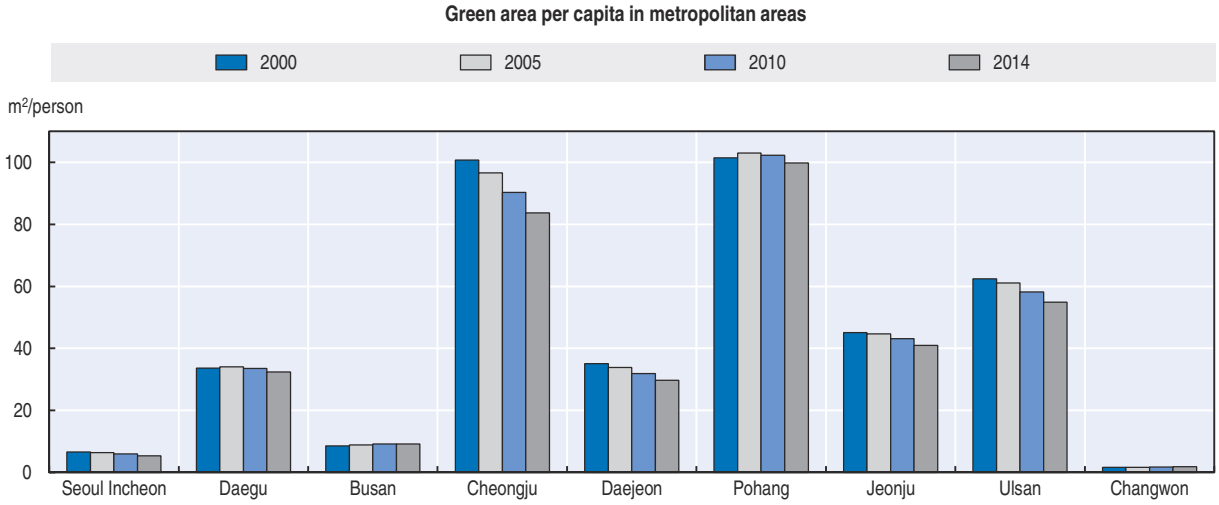
Differences in water supply and sewerage charges and cost recovery rates between regions also play into equity considerations regarding water supply. While there is large variation between regions, rural areas tend to pay higher water supply charges and have lower cost recovery rates (Table 5.2). Although tariff variation is justified when reflecting local conditions and service provision costs, tariffs should also reflect similar efforts to recover costs and to deliver services of similar quality and efficiency. The government keeps water charges low, in part to ensure that water services are accessible to all. However, this benefits users who could afford to spend more, and deprives water service operators of revenue which could be used to extend and improve services to poor and remote communities (OECD, 2012a). Raising water charges to reflect the costs of service provision, combined with targeted support for vulnerable households that is decoupled from water use, would be less regressive and would encourage rational water consumption (Chapter 3).

Across the country, low cost recovery rates threaten the financial sustainability of the water supply and wastewater sectors (Chapter 3). To address this, the government aims to increase the national average cost recovery level for water supply services to 95% (97% in large cities, 95% in other cities and 70% elsewhere) and that of wastewater services to 80% (over 90% in large cities and over 70% elsewhere) by 2025. The government should bear regional equity considerations in mind as it advances efforts in this area. A first step would be to comprehensively assess the distributional implications of actual and proposed cost recovery systems across places and user categories, and the factors driving any pricing discrepancies (e.g. affordability concerns, difficult access to the resource, poor equipment or infrastructure). This would help identify equity concerns and inform measures to address them. Should the government consider cross-subsidisation of water charges appropriate for regional development and equality reasons, similar to its practice of setting abstraction charges at a uniform national rate (MOLIT and K-Water, 2016), it should ensure that financial flows are measured and transparent to enable clear policy discussion.

Access to nature and green space in urban areas is relevant in assessing equity in access to environmental services. Half of all regions in Korea contain less than 9 m^2 of green space per person, the World Health Organization (WHO) international standard, and these urban green areas are shrinking by 3.5%, on average, every year (OECD, 2014b), although the fourth Land Master Plan targets 12.5 m^2 per person by 2020. Access to green space varies considerably across metropolitan areas (Figure 5.3). In 2014, residents of three metropolitan areas with a population between 500 000 and 1.5 million had access to 9 m^2 or less per capita of vegetation, croplands, forest, shrub lands or grasslands, while at the other end of the spectrum, each resident of Pohang (pop. 520 300) had access, on average, to almost 100 m^2 of green cover. Interpreting this indicator depends somewhat on whether peri-urban areas are included and how accessible and attractive the green spaces are, but the discrepancy is nevertheless pertinent for urban planning. Measures to ensure that this issue is fully considered can include incorporating green spaces in zoning ordinances for future development or redevelopment areas, classifying green spaces as protected, providing incentives for developers to include green space in projects, increasing the attractiveness of underused green space, and adopting transport options to enhance the accessibility of green spaces outside city limits.

Disadvantaged segments of the population may have less access to green spaces (KEI, 2009). Seoul's 2015 Basic Plan for Parks and Green Spaces does not appear to consider the issue, for example (Seoul Metropolitan Government, 2015). Urban liveability and revitalisation policies can have a positive impact on both social cohesion and access to green

Figure 5.3. **Green cover varies considerably between metropolitan areas**



Source: OECD (2015), "Metropolitan areas", *OECD Regional Statistics* (database).

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spaces. The Ministry of Land, Infrastructure and Transport has carried out some projects to improve urban environments in designated revitalisation and regeneration areas, including with the aim of increasing accessibility to green spaces.

The national government could provide direction on improving access to green spaces by prioritising information gathering on relevant indicators (e.g. share of population living within a specified distance of urban open spaces, or attractiveness and accessibility of green space, including for vulnerable groups). It could consider initiating programmes to develop more green space, including by providing incentives to municipalities, such as financial assistance programmes that require partnerships with disadvantaged communities in planning, designing and implementing green space projects.

3.2. Managing environmental health risks

Korea ranks below the OECD average on environmental quality and health status well-being indicators, a fact linked to its rapid growth, large manufacturing and industrial sector and dependence on fossil fuels (Chapter 1). The 2006 EPR recommended expanding analysis of environmental health issues (including monitoring, epidemiological studies and economic analysis), especially for industrial complexes and large cities and near contaminated sites; and strengthening management of indoor air quality and occupational health.

The government has undertaken some measures in line with these recommendations. The Korean National Environmental Health Survey, conducted in three year cycles under the Environmental Health Act since 2009, monitors levels of environmental chemicals in a representative sample of residents nationwide. The first two surveys (2009-11 and 2012-14) were limited to people over age 19 while the third (2015-17) is also assessing children aged 3 and up. The survey screens for exposure levels to 21 pollutants. Results of the first and second surveys show high levels of exposure to metals and pesticides, among other substances. Average blood levels of mercury were more than triple the average US and Canadian levels (MOE, 2016a).

The government also conducts community health impact surveys for "vulnerable areas", including industrial complexes and abandoned metal mines. It has identified 56 industrial complexes for priority assessment based on pollution emission levels and populations affected. It has assessed 3 to 4 small and medium-sized complexes per year since 2011 (16 in all by 2015), and 108 abandoned metal mines since 2013, revealing some instances of elevated levels of pollutants with environmental health implications. The government plans to assess causation between environmental exposure and incidence of disease in infants. It is also pursuing environmental monitoring of schools, nursery facilities and playgrounds to improve the environmental safety of children, and since 2015 has implemented a product labelling system to reduce child exposure to hazardous materials.

Korea's first environmental justice forum in 1999 noted a tendency to situate polluting facilities in rural regions, highlighting this as an important environmental justice concern (Bell, 2014). An October 2015 "End of Visit Statement" by a United Nations special rapporteur on human rights and hazardous substances and waste reported significant health risks in communities facing encroachment by industrial and power facilities as a result of government deregulation policies; it expressed concern that many affected residents were elderly or disadvantaged socio-economically (UNOHCHR, 2015). The government has not provided anything beyond information on the siting of basic waste disposal facilities in rural areas. There is also a lack of information on the siting of polluting facilities as regards vulnerable households. The potential for disproportionate impact on vulnerable households is not taken into account in site selection. Improved data collection will be important in promoting fair treatment of all residents as development pressures continue. The US EPA's EJ SCREEN, an environmental justice mapping tool, which brings together environmental and demographic indicators, provides an example of the types of data that may be relevant (EPA, 2016b).

The siting of coal and nuclear power plants and of high voltage power transmission lines has long been a sensitive issue in Korea. As with industrial facilities, these tend to be situated in rural areas, but produce electricity that primarily serves urban areas, meaning that the economic, social and environmental costs and benefits of this infrastructure are unequally distributed (Lee, 2009; Lee and Park, 2015; CMEJ, 2016). The public has not been meaningfully involved in decisions concerning these projects, generating strong opposition (EJA, 2014a, 2014b, 2014c) (Section 6.2). Financial compensation has been used in the past for communities hosting coal plants, and rural communities can now apply to host nuclear waste disposal sites in return for financial support provided to the local government. This approach detracts attention from the associated environmental and health risks of these facilities.

Air pollution poses significant environmental health risk and economic costs in Korea. The estimated cost of the health impact of outdoor air pollution was USD 65 billion in 2013, up 82% from 2005 (OECD, 2016c). The entire population is exposed to annual average outdoor $PM_{2.5}$ concentrations exceeding the WHO air quality guideline of 10 $\mu g/m^3$, and regions with high population density are affected more severely (Table 5.2). Despite important progress since 2000, it is estimated that 17% of the population is exposed to levels exceeding 35 μ/m^3, which is associated with a 15% higher long-term mortality risk relative to levels at or below 10 μ/m^3. Mean $PM_{2.5}$ exposure in 9 of 17 regions falls into the 25-35 μ/m^3 bracket, a level which lowers the risk of premature mortality by around 6% compared to > 35 μ/m^3. Mean exposure in the eight other regions are in the bracket below (15-25 μ/m^3), which reduces the mortality risk by a further 6% (Table 5.2; Mackie et al., 2016).

Korea did not adopt standards for $PM_{2.5}$ levels until 2015 (WHO Interim Target 2 level). Local governments can apply tighter standards to account for regional environmental characteristics. The government sees reducing $PM_{2.5}$ levels as a mid- to long-term policy goal. Over time, the new standards should help manage exposure levels across regions. Effective enforcement across regions will be important to ensure progress is made to the benefit of people in all parts of the country, as will ongoing discussions with neighbouring countries on minimising transboundary air pollution.

The government has strengthened chemical safety in response to a steep increase in significant pollution incidents in the chemical sector over the past decade. The Act on the Registration and Evaluation of Chemicals (Korea REACH, in force since 2015) imposes reporting and registration requirements on chemical manufacturers, importers or sellers, to enable risk assessment, classification and in some instances prohibition by government. A 2015 amendment to the Chemicals Control Act, due to enter into force 2017, expands the number of workplaces required to report to government on types and quantities of chemicals treated, and reduces the reporting cycle from four to two years. Hazard management requirements are also imposed on operators of certain chemical facilities.

3.3. Managing potential distributional effects of environmental policies

A major intra-generational justice concern is ensuring that lower-income households do not bear a disproportionate financial burden from environmental policy implementation, particularly given the levels of income inequality and relative poverty in Korea. The potential labour market impact is also relevant due to the strong link between labour market challenges and inequality in the country.

Korea has taken some measures to try to lessen the impact of environmental charges on households, such as reductions to and exemptions from water charges for low-income households and users aged over 65, distribution of free volume-based waste disposal bags under local ordinance, and targeted energy efficiency initiatives under broader welfare services. Certain measures could be better tailored to address distributional concerns. For example, it is unclear whether the government has assessed the economic, environmental and social impact of its water tariff policy (Section 3.1). Similarly, maintaining electricity prices below production cost, in part to ensure affordability for low-income households (Chapter 3), may in fact hurt the poor by depriving service operators of revenue to improve service quality. Providing a direct support mechanism decoupled from electricity use, as the government has through its introduction of an energy voucher in 2015, is more efficient at achieving both efficiency and equity (Chapter 3; Jung, 2013; Im, 2013).

Like most OECD countries (OECD, 2015b), Korea lacks processes to systematically assess and address the potential distributive impact of environmental policy reform and decision making on households and labour markets. Important issues such as energy welfare and possible effects on the sectoral composition of employment do not appear to have been taken into account when formulating recent major environmental acts such as the Framework Act on Low Carbon, Green Growth. The act "neglects questions of social and intergenerational justice" such as who benefits from and pays for environmental protection (Kim, 2015), which can also represent significant obstacles to reform if not well handled. While the MOE's 2013 environmental impact assessment (EIA) guidelines require project operators to visit residents and note their views and concerns, operators are not required to take active measures to assess and address any potential distributional impact on socially disadvantaged groups specifically or adjust or cancel plans that are likely to

disproportionally affect disadvantaged households. The important role of the EIA process in addressing environment-related distributive impacts in the United States, including for low-income and foreign-born groups, was explicitly identified in Executive Order 12898 (Box 5.1). The government has paid more attention to managing any potential competitiveness impact on industry, offering, for instance, free allocation of Emissions Trading Scheme (ETS) allowances in all three initial ETS stages for energy-intensive, trade-exposed industry.

A 2015 OECD report assessing progress regarding green growth identifies greater emphasis on the social impact of environmental reform as a major future priority across countries (OECD, 2015b). Transitional, targeted compensation programmes that go beyond compensation offered by well-functioning tax and welfare systems may be necessary to address disproportionate effects of reform on vulnerable households. To ensure policy responses are effective, governments first need to understand i) how environmental policy reform can affect households, e.g. the likely impact of energy taxes on energy affordability at household level – a point relevant to Korea given recent discussions on electricity price reform (Chapter 3); ii) under what circumstances reform can have regressive effects; and iii) policy responses, such as social transfers, that could alleviate any negative impact on the poorest households. Understanding barriers to environmental tax reform and how to address them is also important because of the role revenue recycling can play in supporting low-income households. Any aid for vulnerable households should reflect rigorous, evidence-based assessment of disproportionate consequences.

Policies can also help address negative short-term labour market effects of environmental policy by helping to minimise skill bottlenecks, to prevent increases in structural unemployment and to assist workers in moving between contracting and expanding sectors. The transition to a low-carbon, resource-efficient economy is unlikely to provoke significant job reallocations overall, but there can be large shifts in labour demand in certain industries, such as those in the energy sector (OECD, 2012b). It is important to ensure accurate projections of likely structural changes and labour market reactions at country level, along with the potential impact of reform on skill patterns and demand, and on workers with different occupations, skills and income sources. Labour market mobility, skill development policies and training programmes should be responsive to demand. Labour and social policy systems also need to respond flexibly as environmental reform leads to demand for more green skills (OECD, 2015b).

3.4. Judicial precedents taking account of intra-generational equity

Korea's judiciary appears to play a very limited a role in promoting intra-generational equity on environmental matters. The government was unable to provide examples of authoritative judicial precedent taking into account intra-generational equity considerations.

4. Fair treatment of future citizens

The responsibility to protect and improve the environment for future as well as present generations (inter-generational justice) was recognised at the international level in the 1972 Stockholm Conference and the so-called Brundtland Report in 1987 by the World Commission on Environment and Development (UNWCED, 1987). Korea's Framework Act on Environmental Policy reflects this responsibility in declaring that the right of future generations to enjoy the same environmental benefits as current ones is a fundamental policy priority (MOLEG, 2016). The third Comprehensive National Environment Plan (2007-15)

set out to establish a framework to ensure equity across and within generations, including environmental equity as one of seven strategic priorities.

Inter-generational justice implies an obligation on current generations to limit natural resource use and avoid irreversible environmental harm so the needs and interests of future generations can be met: in short, to pursue sustainable development (Dinah, 2008; Brown Weiss, 2008). The obligation is threefold. First, current generations should take care to "conserve the options" available to future generations by maintaining the diversity of the natural resource base, as an environment characterised by "a robust and flexible heritage" is more likely to promote health and well-being. Second, they should "conserve the quality" of the environment to ensure it remains broadly comparable across generations, taking into account factors like natural resource depletion and pollution, but also those that present the possibility of substitutes and solutions, like knowledge and capital. Third, inter-generational justice implies "conservation of access" – i.e. conservation of natural heritage to ensure equitable access for future generations (Brown Weiss, 1992).

Translating the theory on inter-generational justice into effective policy and integrating longer-term perspectives into public decision making has proved challenging in practice (Schneeberger, 2011), including in Korea.

4.1. Pursuing inter-generational justice through green growth

Since 2009, Korea has framed its efforts to pursue sustainable development through the conceptual lens of green growth, which focuses on fostering innovation, investment and competition to create sources of growth that are consistent with sustainable and resilient ecosystems (OECD, 2011). The country's strong institutional framework and international engagement on green growth (Chapter 3) demonstrated intent to shift from its resource-intensive industrial growth path to a more sustainable trajectory, with obvious potential benefits for inter-generational justice. However, Korea has not fully translated its green growth leadership and vision into action, and green growth is no longer the top political priority, with the paradigm shifting to "creative economy" (Chapter 3).

Respecting critical environmental thresholds and limits on the use of natural capital to ensure support for human well-being and growth is the essence of both inter-generational justice and green growth. It follows that reinvigorating and extending Korea's efforts to realise green growth would help protect future generations' environmental interests. Chapter 3 provides extensive advice on how Korea might enhance the ambition of its green growth policies. Because the implications of environmental harm for future generations vary by pollutant or action, policy action may be more pressing in some areas than others from an inter-generational justice perspective. For example, climate change-inducing greenhouse gas (GHG) emissions are likely to be more detrimental for future generations than more localised, transient air pollutants. The high carbon-intensity of Korea's economy is relevant in this regard, as is the precedence afforded to development and investment over biodiversity conservation (Chapter 2).

4.2. Targeted policy measures for inter-generational justice

Beyond the basic building block of sound and ambitious environmental policy, more targeted measures can help attune government decision makers and broader economic actors to future generations' interests. Korea's fourth Comprehensive National Environment Plan (2016-35) flags the need to develop policies that ensure environmental rights, including across generations, as an unresolved area coming out of the third plan

(although the fourth plan does not list advancing environmental equality among its strategic objectives). Further policy development is needed in this area, but some relevant measures are in place. For example, KRW 619 billion (USD 588 million[2]) was collected from the ecosystem conservation tax over 2006-14 and used to fund ecosystem restoration or other conservation projects (Chapter 3). However, there is opportunity for using EIA information to link the tax to the type of damage and define priority restoration projects (Lee, 2015). In addition, since 1 July 2016 the Liability and Relief Act has obliged businesses posing "significant environmental risk" to purchase adequate environmental liability insurance (Section 5).

Priority measures that form the backbone of green growth policy and should be pursued are: taking an anticipatory approach to national and regional planning to help conserve future generations' access to a diverse, high quality resource base; pricing pollution to better integrate environmental and social externalities; and pursuing efficient resource use. Other potential measures include (Young, 1999):

- *Applying adaptive environmental management:* taking a cautious, flexible approach to long-term conditions and risk when assessing or implementing policies or projects, to help conserve the diversity and quality of the resource base in case of uncertainty or error. Examples are determining initial constraints, using monitoring and remediation mechanisms, and providing for periodic reviews and mechanisms to incorporate changes.
- *Better reflecting future generations' environmental rights in policy and project assessment:* for example, making better use of EIA and cost-benefit analysis to assess and address environmental risks for future as well as present generations (Box 5.2).

Box 5.2. **Taking future generations into account in cost-benefit analysis**

Cost-benefit analysis of policies and projects ought to be used to support public decisions with a potentially significant impact, including in sectors like energy and transport. There is much scope to improve *ex ante* and *ex post* assessment of policy proposals and investment projects through more and better use of such analysis (Atkinson and Mourato, 2015). There is also scope to improve the way future generations' interests are reflected.

Long-term environmental challenges are difficult to assess in cost-benefit analysis because of uncertainty over future economic and environmental developments and because markets "express consumer rather than community values" and do not fully take into account uncertainty (Young, 1999). Appropriate discount rates to take into account future costs and benefits are also perpetually under debate.

Challenges associated with integrating estimates of the marginal value of changes in CO_2 emissions in policy appraisals demonstrate potential difficulties in trying to account for costs and benefits in an inter-generational context. Assessing changes in the "social cost of carbon" is one method to estimate the change in worldwide damage caused per additional tonne of CO_2 emitted. Discounting – valuing future costs and benefits in relation to current terms – is common in cost-benefit analysis, but is challenging when it comes to climate change because the consequences of current policy stretch far into the future. Debate over whether and how far existing discounting conventions are relevant has been rigorous and there is no widespread agreement on rates. Furthermore, because of the long timescale, the discount rate applied has a dramatic effect on the estimated social cost of carbon (Smith and Braathen, 2015).

Box 5.2. **Taking future generations into account in cost-benefit analysis** *(cont.)*

Consequently, estimates of the social cost of carbon span a wide range; judgements about treatment of equity and weight to be given to high-damage scenarios of unknown but probably low probability also come into play. The US Interagency Working Group on Social Cost of Carbon recently recommended assessing policy based on four possible values, acknowledging this uncertainty. The estimates could in principle be adopted by other countries to assist in policy appraisal and evaluation. The United Kingdom assesses the value of changes in carbon emissions with reference to legally binding targets for future emissions.

Source: Atkinson and Mourato (2015), "Cost-Benefit Analysis and the Environment"; Smith and Braathen (2015), "Monetary Carbon Values in Policy Appraisal: An Overview of Current Practice and Key Issues"; Young (1999), "The Precautionary Principles as a Key Element of Ecologically Sustainable Development".

- *Hedging against future harm*: using offsetting projects and "countervailing policies" if a policy or project is to proceed despite likely or potential environmental impact. For example, if an endangered species' habitat is to be cleared, developers might have to reclaim an equivalent or greater habitat. If long-term costs are uncertain, requiring project operators to obtain financial instruments such as environmental assurance bonds can help future generations meet any damage and provide incentives to firms to minimise risk.
- *Appointing a guardian to represent future generations' interests:* as future generations cannot participate in present-day administrative and judicial decision making with potential impact on their welfare, appointing a representative such as an ombudsman (Box 5.3) to advocate for their interests can help ensure that their voice is considered (Brown Weiss, 2008; Schneeberger, 2011).
- *Setting standards:* ensuring that environmental risk is kept within acceptable limits.
- *Linking markets with sustainability constraints for conditionally renewable resources*: ensuring that rights to use resources respect ecologically sustainable limits.

Box 5.3. **Hungary's ombudsman for future generations**

In Hungary, an "ombudsman for future generations" has the task of protecting the constitutional right to a healthy environment, including for future generations. The ombudsman, elected by the parliament, can fulfil that task by:

- challenging national or local legislation in the Constitutional Court, where there is a "strong belief" of violation of the right to a health environment
- intervening in public administrative court cases relevant to environmental protection
- initiating and participating in the investigation of complaints or *ex officio* investigations conducted under the auspices of the Commissioner for Fundamental Rights, under whom the ombudsman sits
- monitoring legislative and policy proposals to ensure they do not "pose a severe or irreversible threat to the environment or harm the interests of future generations"
- issuing non-binding statements to public authorities.

Source: AJBH (2016), "The role of the Ombudsman".

4.3. The role of the judiciary

The judiciary can play a role by taking into account inter-generational equity in enforcing and giving effect to environmental law. Korea has no authoritative judicial precedent explicitly taking into account inter-generational equity, but instructive jurisprudence exists in other countries. The landmark Urgenda Foundation case in the Netherlands, which for the first time required a state to take steps against climate change, demonstrates the potentially instrumental role of the judicial system in advancing inter-generational environmental equity (Box 5.4).

Box 5.4. **Judicial decisions on inter-generational equity**

On 24 June 2015 the District Court of The Hague handed down its decision in the case brought by the Urgenda Foundation against the Dutch government seeking an order that the government should drastically reduce CO_2 emissions to the level determined by scientists to be in line with the international 2 degree goal. The court invoked inter-generational equity considerations in ruling in Urgenda's favour and ordering the government to take enhanced action to reduce the country's GHG emissions.

The court took into account the objectives and principles of the UN climate change convention, including the principle that parties are obliged to protect the climate system for the benefit of current and future generations on the basis of equity (Article 3). It held that the principle of equity as set out in the convention meant policy "should not only start from what is most beneficial to the current generation at this moment, but also what this means for future generations, so that future generations are not exclusively and disproportionately burdened with the consequences of climate change". If current insights demonstrate that on balance it is cheaper to act on climate now, the state "has a serious obligation, arising from due care, towards future generations to act accordingly". The court held that the possibility of damage for current and future generations of Dutch nationals was "so great and concrete that given its duty of care, the State must make an adequate contribution, greater than its current contribution, to prevent hazardous climate change". The government has appealed the decision.

A potential obstacle in intergenerational equity cases is that they seek to uphold rights for plaintiffs that by definition are not immediately identifiable. In a case seeking an order for the government to discontinue existing and future timber licence agreements to reduce environmental damage from deforestation, the 1993 Philippine Supreme Court decision in Minors Oposa v. Secretary of the Department of Environment and Natural Resources affirmed standing for the plaintiffs to represent present and future generations. Every generation, the court found, has a "responsibility to the next to preserve … the full enjoyment of a balanced and healthful ecology". The plaintiffs' "assertion of their right to a sound environment" was simultaneously the "performance of their obligation to ensure the protection of that right for the generations to come", and the plaintiffs were therefore able to act on behalf of future generations (Dinah, 2008).

Source: de Rechtspraak (2015), Case number C/09/456689/HA ZA 13-1396 (English translation), Rechtbank Den Haag; Dinah (2008), "Equity".

5. Environmental liability

Korea's environmental liability regime has been the focus of recent government measures on environmental justice, as a dramatic increase in the number of chemical accidents (from 13 in 2004 to 70 in 2013)[3] created momentum for a comprehensive overhaul of the traditional tort regime.

5.1. Liability for damage to human life, health and property

The Liability and Relief Act, which the National Assembly adopted in December 2014, came into force in January 2016. The act represents a significant step forward for Korea's environmental remedies framework in clarifying the liability of polluters to compensate for damage to human life, human health and property arising from pollution, and facilitating claims by victims. Under the previous system of fault-based liability, victims of damage from environmental pollution had to pursue compensation claims under general liability provisions in the Civil Act;[4] there was no dedicated liability and compensation programme. As in all civil proceedings, the victim had to prove the polluter's unlawful intent or negligence, the damage, and causation between the two, which entailed substantial time and cost (KEI, 2014).[5] Moreover, challenges in getting access to the necessary information made it difficult for victims to prove liability. In cases of large accidents causing extensive damage, the liable parties often lacked the means to compensate victims and pay for environmental remediation, and so declared bankruptcy, leaving victims in the lurch unless government intervened with taxpayers' money.

The Liability and Relief Act stipulates the legal principle of liability without fault (strict liability) for damage to human life, health and property arising from pollution cases related to defined facilities, and it shifts to business the burden of disproving the causal relationship between its activities and the damage. Strict liability applies to facilities rather than actions; i.e. the facility is regarded as responsible for pollution if the evidence suggests it is highly probable (based on features of its production process, time and place of damage, etc.) that its activity caused it. Liability for environmental damage caused by consumer products (e.g. those containing toxic chemicals) is regulated by the Product Liability Act (2000, last amended in 2013). Victims have the right to obtain access to information on the incident from implicated businesses or from public institutions, aiming to facilitate proof of damage and probability of cause. The act provides that the MOE may assist socially disadvantaged victims bringing claims under the act, in particular by operating a group of lawyers to support litigation. It is too early to assess how well the act has been operating in practice.

If two or more companies are implicated and the principal party at fault cannot be determined, the law stipulates that all businesses involved are jointly and severally responsible[6] for compensation even if the exact cause of the damage cannot be specified. The act sets limits on liability depending on what is deemed to be the facility's level of environmental risk: KRW 200 billion (about USD 177 million) for high risk, KRW 100 billion (about USD 88 million) for medium risk and KRW 50 billion (about USD 44 million[7]) for low risk. The risk levels are based on multiple criteria of environmental impact (which, however, are not used for targeting inspections or for any other regulatory instrument). The limits do not apply in cases of intention or gross negligence, which provides a strong incentive for businesses to take accident prevention measures.

In addition to the new act, several legal regimes impose tort liability for environmental damage, including oil pollution and environment-related disease. The Compensation for Oil Pollution Damage Guarantee Act (2009) establishes ship owner responsibility for compensating oil pollution victims. Another prominent instrument for compensating pollution victims is the Asbestos Injury Relief System (Box 5.5).

Box 5.5. **Asbestos Injury Relief System**

The Korean government and industries that earned profit from the use of asbestos assumed joint responsibility for this environmental health issue with the creation of a programme to compensate ordinary people (as opposed to workplace victims) made ill by asbestos. The Asbestos Injury Relief Act, which came into effect on 1 January 2011, aims to provide fair, prompt relief to victims of asbestos-related disease and their families. Previously, such victims found it hard to obtain compensation due to difficulty in establishing causation.

To be eligible for relief payment, victims or their families must apply to the local government, which requests the MOE agency KECO to verify that the disease was induced by asbestos. Decisions on whether to grant relief, and how much, are made within 90 days, and applicants can review them. Compensation comes primarily from the Asbestos Injury Relief Fund, with local governments providing the remainder.

The money required for the fund is around KRW 15 billion (about USD 13 million)[8] per year. At first, local governments and industry contributed to it in equal shares, with industry's contribution to rise to 70%. Businesses that used or manufactured more than a cumulative total of 10 000 tonnes of asbestos must pay an additional sum. The fund can be used for out-of-pocket medical expenses, a monthly medical treatment allowance and funeral expenses, among other payments. It also covers operating costs for the programme, asbestos damage prevention projects and studies on the health impact of asbestos. Between 2011 and end-March 2016, 2 966 cases were handled and KRW 37.5 billion disbursed.

Source: KEI (2011), "Asbestos Damage Relief System".

5.2. Liability for damage to the environment

Korea does not have an overarching liability system for remediation of damage to the environment similar to the one for health and property damage relief. There is administrative liability in cases of environmental violations, whereby local or national government inspectors can order offenders to take corrective actions, where possible, to clean up their pollution releases. However, soil contamination is the only area where the liability regime covering past pollution is well developed (Box 5.6); there is no similar regime for damage to water bodies or ecosystems.

The Soil Environment Conservation Act was inspired by the US Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 1980). At the time of its adoption in 1995 it was a very progressive piece of legislation, envisaging the creation of a remediation fund (similar to the US Superfund) based on revenue from fees on hazardous industrial facilities. However, in 2012 the Constitutional Court exempted landowners who acquired the land prior to the act's entry into force from liability for clean-up. The remediation fund was also discontinued. The amended act established a Soil Decontamination Advisory Committee which determines the allocation of clean-up responsibilities among multiple parties that are held responsible for the contamination.

The government has put priority on contaminated sites for which no responsible party can be identified, mostly abandoned metal, asbestos and coal mines. By 2015, Korea had identified 2 428 abandoned metal mines, 423 abandoned coal mines and 36 abandoned asbestos mines, most of them developed before the 1940s (MOE, 2015b). By 2015, soil contamination surveys had been completed for 1 489 of the abandoned metal mines; the rest are to be surveyed by 2023 in a joint effort by the MOE and the Ministry of Trade, Industry and Energy.

Box 5.6. **Strict liability for soil contamination**

The Soil Environment Conservation Act (1995, last amended in 2015) specifies that if the MOE discovers soil contamination, the local government can investigate and order the responsible party to decontaminate the site; non-compliance entails criminal penalties. This is a strict liability regime: a physical or legal person that owned, occupied or operated a soil-contaminating facility when pollution occurred is deemed responsible unless it can prove it did not cause the contamination. For cases where two or more parties may have been responsible, the law provides for joint and several liability. An entity that acquires a facility that had caused soil contamination can be regarded as a responsible party unless it can prove due diligence, including a soil quality assessment at the time of the acquisition.

Korea has specified 21 substances, including cadmium, copper, arsenic, mercury, oils and organic solvents, as controlled soil contaminants in the Soil Environment Conservation Act. For these substances, Korea also prescribes "soil contamination warning limits" describing the degree of contamination that may undermine human health, property, animal and plant growth, and development; and "soil contamination counterplan limits", in which contamination exceeds the warning limits, undermining human health and requiring measures to address the contamination.

Source: Park et al. (2012), "Environmental law and practice in South Korea: overview".

5.3. Financial instruments to address future environmental risk

Insurance is the main instrument used in Korea to address financial risk from environmental accidents. Two kinds of insurance are available for environmental damage or liability: commercial general liability insurance, under which environmental accidents can be covered as an option; or special insurance for damage to third parties or clean-up costs due to environmental accidents.

Since 1 July 2016, the Liability and Relief Act has required businesses posing significant environmental risk (waste processing facilities, companies handling hazardous chemicals or discharging hazardous air or water pollutants, etc.) to buy adequate Environmental Impairment Liability insurance. The requirement is expected to apply to 17 000 industrial facilities. The law sets mandatory minimum insurance values depending on the general level of risk: KRW 30 billion (about USD 27 million) for high-risk facilities, KRW 10 billion (about USD 9 million) for medium-risk facilities and KRW 5 billion (about USD 4 million[9]) for low-risk ones. Proof of insurance is a condition for receiving or renewing an environmental permit. This requirement serves as an incentive for businesses to reduce their environmental risk by taking preventive measures and thus lower their insurance premiums.

Insurance companies providing environmental liability insurance should be approved by the MOE. Insurance companies cannot refuse to cover industrial facilities regardless of their level of environmental risk. Facilities whose level of risk is deemed very high are covered by a guarantee programme run by the government-owned Korea Environmental Industry and Technology Institute rather than by insurance companies. These provisions dampen companies' incentive to reduce their environmental risk, unlike in a system that exists in many OECD member countries where insurers may refuse to cover excessive risky companies (Box 5.7).

A national reinsurance programme provides for insurance companies to pay a portion of their premium income to the government as a reinsurance premium in order to share

Box 5.7. **Financial responsibility for environmental obligations: International practice**

Financial responsibility (assurance) rules require potential polluters to demonstrate – before the fact – that they have the financial resources to correct and compensate for any future environmental damage. Financial responsibility instruments provide timely, relatively low-cost public access to compensation. They also ensure that the expected cost of environmental risk appears on a firm's balance sheet and in its business calculations. As a result, firms and their underwriters have a strong incentive to monitor environmental safety and fulfil their restoration obligations.

Firms can purchase financial security in the form of insurance, bank letters of credit and deposit certificates. Alternatively they can establish trust funds or escrow accounts dedicated to future obligations. Most industrial operators are not proactive in managing their environmental liabilities and leave themselves exposed to environmental risk. Therefore, a system of mandatory financial security – at least for activities that are particularly dangerous for the environment – may be an appropriate solution.

Financial assurance is widely practised in the US: it is required for a variety of commercial operations, including municipal landfills, ships carrying oil or hazardous cargo, hazardous waste treatment facilities, offshore oil and gas installations, underground gas tanks, nuclear power stations and mines. Several EU countries, including the Czech Republic, Spain and Portugal, have followed suit and introduced mandatory financial security for such industrial activities. Lower-risk activities may be exempted on the basis of certain criteria: for example, Spain and the Czech Republic exempt operators with a certified environmental management system.

Importantly, the mandatory environmental insurance regimes in OECD countries are unilateral; that is, rather than require insurance companies to insure individual operators, each operator must buy coverage to be allowed to operate, and insurers may refuse to cover anyone at their own discretion. Environmental insurance policies are tailor-made and site-specific, and not every facility has the characteristics to be insurable.

Most European countries rely on voluntary financial security. For instance, France and Germany decided that compulsory insurance would not make sense in an emerging insurance market with a limited number of insurers, which could result in high premiums. In voluntary systems, insurers and operators negotiate limits on the kinds and size of damage to be covered. The maximum insured amount should be based on an economic assessment reflecting the risk involved and the insurance companies' financial capacity. Too high an amount would lead to excessive insurance costs for firms. Too low, and the insured enterprises would have to cover the remainder of the damage or, if they cannot, the government would have to pay.

A strict environmental liability regime without any requirement of financial security can lead to increased litigation and transaction costs. However, it is ultimately the enforcement of liability by administrative and judicial means, not a regulatory mandate, that drives demand for environmental liability insurance.

Source: OECD (2012c), *Liability for Environmental Damage in Eastern Europe, Caucasus and Central Asia (EECCA): Implementation of Good International Practices*; Boyd (2001), *Financial Responsibility for Environmental Obligations: Are Bonding and Assurance Rules Fulfilling Their Promise?*.

the risk between the government and insurance companies for large environmental damage amounts that would exceed compensation liability limits.

Under the Liability and Relief Act, the government manages a pollution indemnification account intended for cases where damage is caused by unknown, non-existent or

incompetent offenders or where its size exceeds polluters' liability limits. Funded primarily by reinsurance premiums and government contributions, this account can be used to make compensation payments to victims[10] and reinsurance pay-outs to insurance companies, as well as to cover the cost of investigation into the accident and damage assessment.

Another financial instrument, performance guarantee bonds, is used to ensure post-closure landfill management under the Waste Control Act (2007). Money deposited by landfill operators in a special account is refunded upon verification by the MOE of completion of environmentally safe close-down measures; failing that, the government uses the money to carry out measures instead of the operator. An insurance policy may substitute for the guarantee bond.

6. Environmental democracy: progress on core procedural rights

Korea recognised the procedural rights of access to information, public participation in decision making and access to justice at the international level in Principle 10 of the 1992 Rio Declaration on Environment and Development (UN, 1992). Principle 10 affirms that "environmental issues are best handled with the participation of all concerned citizens". States agree to provide appropriate access to environmental information held by public authorities, including on hazardous materials and activities in communities; the opportunity to participate in decision-making processes, facilitated and encouraged by information provision; and effective access to judicial and administrative proceedings, including redress and remedy. Principle 10 was reaffirmed at the 2012 UN Conference on Sustainable Development (Rio+20). In addition to promoting social justice aims and helping ensure that community needs are taken into account, public involvement enhances the effectiveness of environmental decision making and implementation, thereby promoting environmental interests for the public good. Involvement of non-state actors can help give legitimacy to laws and policies. Involving the public also promotes "exchanging 'second thoughts'" and "thinking in terms of alternatives", both important for sound environmental policy (Ebbesson, 2009).

No global legal instrument has been developed to implement the Principle 10 rights, but they have been given legal force for ratifying parties to the 1998 Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (UNECE, 1998), and other regional initiatives have moved forward (Box 5.8). The Aarhus Convention is an instrument of the UN Economic Commission for Europe (ECE), but non-ECE countries that are UN members can accede if parties agree.[11] Country evidence gathered for the online Environmental Democracy Index, developed by The Access Initiative and World Resources Institute to track country progress on Principle 10 rights, suggests that these rights enjoy better legal protection in countries that are party to the Aarhus Convention (AI-WRI, 2016).

Governments adopted voluntary guidelines to accelerate implementation of Principle 10 at a session of the United Nations Environment Programme (UNEP) Governing Council in 2010 (Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters, or Bali Guidelines) (UNEP, 2010). While not legally binding, the 26 Bali Guidelines are internationally recognised good practice principles intended to help governments interpret and translate Principle 10 into effective and complete national law.

Box 5.8. **Implementing Principle 10 in the LAC region**

Latin American and Caribbean countries adopted the Declaration on the Application of Principle 10 in Latin America and the Caribbean at the Rio+20 Conference, agreeing to work towards implementing a regional instrument to ensure full exercise of the rights of access and more concerted, proactive and effective regional action. Countries committed to drafting and implementing a plan of action over 2012-14, supported by the Economic Commission for Latin America and the Caribbean (ECLAC). Following adoption of founding documents (roadmap, plan of action, vision statement, priority action for capacity building and co-operation, content guide), formal negotiations on the regional instrument were launched in November 2014 with the Santiago Decision and establishment of a negotiating committee to have significant participation from the public. The committee is due to complete its functions by December 2016, which may lead to adoption of a binding regional instrument on the rights of access to information, public participation and access to justice in environmental matters. Draft texts of the regional instrument, issued in late 2015, are available on the ECLAC website. As of September 2016, there were 21 signatory countries.

Source: ECLAC (2016), "Principle 10".

The 2006 EPR recommended that Korea "further strengthen mechanisms for preventing and resolving environmental conflicts", including "conflicts over new infrastructure and other development projects and over competition for the use of scarce land". Giving full expression to environmental democracy is a major element. This section uses the Bali Guidelines, supplemented by indicators used in the Environmental Democracy Index, as a benchmark to assess Korea's progress. As in many other countries (WRI, 2015; UNEP, 2015), Korean measures remain a work in progress. The gaps between them and the guidelines are important, as they point to ways the government might strengthen national measures to better engage the public in environmental decision making, constructively address and resolve conflicts and strengthen environmental outcomes.

6.1. Access to environmental information

Beyond its inherent value as a right, access to information is essential in enabling meaningful public participation in environmental decision making. Bali Guidelines 1-7 (Table 5.3) relate to this right. Guideline 1 sets out the basic right: any natural or legal person should have affordable, effective and timely access to environmental information held by public authorities upon request, without having to prove a legal or other interest. Guideline 2 defines the basic scope of information to be made available and Guideline 3 provides guidance on grounds for refusing information requests. At a minimum, the public should have access to information about environmental quality, environmental impact on health and related factors, information about legislation and policy, and advice about how to obtain information. Grounds on which a request for information can be refused should be clearly defined in law and interpreted narrowly, weighed against the public interest served by disclosure. Guidelines 4-6 set out additional requirements relating to collection, maintenance and dissemination of public information, reflecting the idea that states' possession of certain information is fundamental to sound environmental management, and that the information must be made accessible in a structured way to enable the public to make effective use of it (UNEP, 2015). Guideline 7 relates to capacity building to facilitate access to information.

Table 5.3. **The Bali Guidelines on access to information**

Guideline	Subject	Requirements
1	Access to environmental information from public authorities	Affordable, effective and timely access to information held by public authorities Access on request, without having to prove legal/other interest Access by any natural or legal person
2	Scope of information to be made available	Information about environmental quality, environmental impacts on health and factors that influence them Information about relevant legislation and policy Advice on how to obtain information Other information as appropriate
3	Ground for refusing an information request	Specific grounds for refusal to be clearly defined in law Grounds for refusal to be interpreted narrowly, taking into account public interest served by disclosure
4	Information collection and maintenance by States	Regular collection and updating of environmental information, including on operator performance and compliance Establish systems to ensure adequate flow of information on proposed and existing activities that may significantly affect the environment
5	Provision of information on state of environment	States to prepare and disseminate up-to-date information on the state of the environment Include information on quality and pressures Prepare and disseminate at reasonable intervals
6	Information dissemination in case of imminent threat of harm	In case of imminent threat of harm to human health or the environment, provision of all information enabling the public to take preventive measures Immediate dissemination
7	Capacity-building	Provide means for and encourage effective capacity-building to facilitate effective information access Capacity building among public authorities and the public

Source: UNEP (2010), *Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters*.

In Korea, the public is entitled to access to environmental information under the Official Information Disclosure Act, except in cases where the disclosure "may interfere with government business" or damage the company or organisation in question. Any applicant denied access to information is entitled under the Administrative Procedures Act to an administrative hearing or administrative court action.

Public availably of information on the state of the environment minimises the need for individual requests, so the extent to which the government collects and makes environmental information freely available is a threshold consideration. The MOE provides a range of environmental information to the public, including the annual Environmental Statistics Yearbook and the biennial White Paper. Websites give the public access to information on the general environment, environmental and industrial technology, GHG emissions, air quality and water quality. Korea has operated a pollutant release and transfer register (PRTR) since 1999. Pollution release data by industry sector and by pollutant are publicly available on the PRTR website.

Environmental authorities maintain records on all regulated entities, including permit applications, regular self-monitoring reports and inspection reports. The Government 3.0 initiative, launched in 2013, aims to open up public data and foster its reuse by businesses as well as inside the public administration. As a result, the disclosure rate of environmental information produced or managed by government rose from 24% in 2012 to 55% in 2013 (MOE, 2016a). The MOE intends to disclose 80% of government-held environmental information by 2017 through Korea's main information portal (*www.data.go.kr*) or on the MOE website. However, other environmental records concerning private enterprises are not generally open to, or easily accessible by, the public. Although businesses must provide

formal justification for non-disclosure of information for commercial confidentiality reasons to a special government commission for approval, many civil society groups feel it is difficult to obtain timely information from private enterprises.

6.2. Public participation

Beyond direct benefit to the public in terms of facilitating its right of engagement and helping ensure that community needs are taken into account, enabling meaningful public participation in environmental decision making brings governments benefits as well. Public participation brings additional resources to bear on environmental management and can help strengthen government policy and decision making through better information and more effective assessment of challenges and needs, helping avoid actions that result in unnecessary impacts to the environment, public health, cultural resources and other socio-economic and quality of life interests of individuals and communities. It "brings the public along", building trust and enhancing the likelihood of public support for government decisions. Meaningful public participation mechanisms also help avoid and diffuse conflict by providing a clear and constructive avenue for public input.

Bali Guidelines 8-14 (Table 5.4) relate to this point. Guidelines 8-10 deal with the nature and quality of participation. States should seek early and effective public participation in a proactive, transparent and consultative manner, providing adequate information and opportunity for public views to be expressed. The relevant public constitutes those people affected or likely to be affected by or having an interest in a given decision. Environmental NGOs meeting any requirements under national law are deemed to have an interest. Guidelines 12 and 13 extend the scope of decisions to include preparation of laws and policies, and cases where a review process is carried out and previously unconsidered environmentally significant issues or circumstances arise. The state is to ensure that public comments are taken into account and make decisions publicly available (Guideline 11). Guideline 14 deals with capacity building to promote public participation.

Table 5.4. **The Bali Guidelines on public participation**

Guideline	Subject	Requirements
8	Public participation	Ensure opportunities for early and effective participation Inform of opportunities to participate at early stage Includes public affected, likely to be affected, or having an interest in the relevant decision and environmental NGOs that meet any requirements under law
9	Positive and proactive obligation on States	States to seek public participation in proactive, transparent and consultative manner Ensure adequate opportunity to express views
10	Provision of information	Make all relevant information available in an objective, understandable, timely and effective manner Provide information to members of public concerned
11	Taking account of public comments	Ensure public comments taken into due account Decisions to be made public
12	Participation in review processes	Ensure public participation in review processes resulting from previously unconsidered environmentally significant issues or circumstances Participation to the extent circumstances permit
13	Participation in preparation of laws and policy	Ensure public input into laws with potentially significant environmental effects and policies, plans and programmes relating to the environment Ensure input at appropriate stage
14	Capacity building	Provide means for capacity-building to promote public participation Includes environmental education and awareness raising

Source: UNEP (2010), *Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters*.

The main national-level stakeholder consultation body on environment is the Central Environmental Policy Committee, which is involved in developing the National Environmental Plan, environmental conservation master plans and other policy documents. It has almost 200 members from academia, research institutions, private companies, etc. There are also several issue-specific stakeholder committees: river basin management committees in each of the four major river basins, the Environmental Health Committee, the Chemicals Evaluation and Management Committee, etc.

Large NGOs, such as the Korean Foundation for Environmental Movements and Green Korea United, actively seek to influence national environmental policy making. NGO representatives can participate as technical experts in consultative bodies but not promote their organisation's policy agenda. The number of stakeholder co-ordination bodies has been significantly reduced in recent years, which has contributed to distrust between the government and civil society groups. Unlike in most OECD countries, NGOs in Korea generally do not receive government financial support.

In accordance with the Administrative Procedures Act (1996) and the Operational Regulation of Legislative Affairs (1998), the main provisions of every draft law and most executive regulations are announced in the media and on the government public relations portal (*www.epeople.go.kr*). The public then has 40 days to submit comments and opinions.

Public participation in EIA and strategic environmental assessment (SEA) is restricted to residents living in the area affected by a proposed project or plan (defined by government authorities) and does not include the wider public. Processes that pertain to areas with "high ecological value" are the sole exception: non-residents (but not environmental NGOs) may also participate. If citizens live outside a designated "impact area" but feel affected by a project or plan, they can appeal to the MOE or their local government, but do not have judicial recourse. EIAs do not have to be announced in the mainstream media, public hearings come late in the process – in the implementation phase – so serve mostly to inform the public of decisions already made rather than seek its input, and there is no obligation for authorities to accept citizens' proposals. The integrated permitting reform (Chapter 2) does not envisage public participation in permitting decisions.

These shortcomings in the environmental decision-making process has led to strong, sometimes unconstructive, public opposition to government-promoted projects such as the Four Rivers Restoration Project (Chapter 3), construction of nuclear power plants and high voltage transmission lines, and siting of nuclear waste storage and other hazardous facilities (Bell, 2014). This in turn has heightened tension over specific projects and government-citizen relations on environmental matters more broadly. An effective conflict resolution mechanism is needed to address this issue and ensure that government works in partnership with NGOs.

6.3. Access to justice in environmental matters

The right of access to judicial and administrative proceedings in environmental matters underpins the procedural rights set out in Principle 10, as it enables enforcement of the right to have access to information, participate in environmental decision making and challenge decisions affecting the environment or violating environmental norms in a fair and impartial manner. It serves to operationalise the role of the public in enforcing environmental law and promoting good governance in environmental matters, as recognised in Principle 10 (UNEP, 2015). Table 5.5 sets out the detailed requirements of the Bali Guidelines on access to justice

Table 5.5. **The Bali Guidelines on access to justice**

Guideline	Subject	Requirements
15	Access to review procedures, information requests	Access to review for information requests not handled in accordance with applicable law (e.g. unreasonable refusal, inadequate answer or lack or response) Review before law court or other independent and impartial body Standing for natural and legal persons
16	Access to review procedures, public participation	Access to challenge legality of any decision, act or omission relating to public participation on substantive or procedural grounds Review before law court or other independent body Standing for any member of public concerned
17	Access to review procedures, decisions affecting environment or violating environmental norms	Access to review for decision, act or omission affecting the environment or allegedly violating legal norms on substantive or procedural grounds Decision of public or private decision-maker Review before law court or other independent body or administrative procedure Standing for any member of public concerned
18	Legal standing	Broad interpretation of standing in environmental proceedings
19	Effective, timely review	Effective procedures for timely review of implementation and enforcement of environmental law/decisions Fair, open, transparent, equitable proceedings Review before law court or other independent body or administrative procedure
20	Affordability	Review procedures not prohibitively expensive Consider establishment of assistance mechanisms to remove or reduce financial or other barriers
21	Access to remedies	Framework for prompt, adequate and effective remedies (e.g. injunctive relief) Consider potential use of compensation, restitution, other appropriate measures
22	Enforcement	Timely and effective enforcement of decisions Decisions by law courts, administrative or other relevant bodies
23	Procedural information	Adequate information provision to the public on court procedures, procedures of other relevant bodies
24	Public access to decisions	Public availability of decisions in accordance with national law Decisions by law courts, administrative or other independent/impartial bodies
25	Capacity-building	Regular capacity building programmes in environmental law Targeted at judicial officers, other legal professionals, other relevant stakeholders
26	Alternative dispute resolution	Encourage development and use of alternative dispute resolution mechanisms

Source: UNEP (2010), *Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters*.

(Guidelines 15-26). Guidelines 15, 16 and 17 are the core provisions dealing with the three access rights (access to review for information requests not handled in accordance with the law, requests on the legality of decisions relating to public participation in environmental decision making, and those on decisions affecting the environment or allegedly violating environmental legal norms). Guidelines 18-26 provide guidance to governments on complementary measures that support full enjoyment of the access rights: on legal standing, quality and affordability of review mechanisms, access to remedies, enforcement of decisions, alternative dispute resolution, etc.

As in most countries, Korea's access to justice framework is the least advanced of the three access rights (OECD, 2012d), with progress confined to access to compensation, and tentative in other areas. In terms of access to judicial or other independent and impartial review mechanisms for information requests, use of the legal entitlement to an administrative hearing or court action when an applicant is denied information appears to be limited in practice: for example, there were no administrative appeals or administrative litigation proceedings filed against MOE decisions under the Official Information Disclosure Act in 2015 (Section 6.1). Similarly, the government was able to provide only a limited number of examples of cases involving review procedures related to public participation, the

potential of which is already limited by the narrow scope of public participation rights (Section 6.2). The United States has issued guidance clarifying how existing legal tools confer opportunities to pursue environmental justice aims (EPA, 2014); Korea could consider a similar initiative to enhance use of existing instruments.

Korea takes a narrow approach to standing, with direct implications for access to review procedures for decisions affecting the environment or allegedly violating environmental legal norms (Box 5.9). Natural or legal entities must have a specific and direct proprietary interest to bring environmental proceedings, which effectively restricts standing to local residents, or those with actual or probable damage to environmental interests. Environmental NGOs do not have standing without a "substantial or direct" legal interest of their own at stake (i.e. a direct infringement of a right of an organisation as a result of the infraction in question), consistent with a historic tendency to limit their role in government decision making (Kim, 2015).[12] The public has certain consultation rights tied to draft EIA processes, but again these only apply to local residents and do not amount to a formal right of review. The requirements for consultation vary but include notice, inspection, presentation of the assessment to the public, public hearing and information provision, with final EIA reports to state whether public opinions are reflected. EIA processes, moreover, represent only one aspect of the wide range of decisions, acts or omissions that affect the environment or have the potential to violate legal norms (e.g. laws, broader government policy, environmental permitting decisions, actions by private actors outside EIA processes). The Administrative Litigation Act provides a mechanism for residents to appeal administrative decisions granting approval to development projects that may cause environmental pollution or damage, and request temporary suspension of approval while the appeal is under way. The Constitutional Court Act also provides for appeal to the court if the fundamental right to a healthy and pleasant environment is infringed due to the exercise or non-exercise of public authority. Again, only limited examples of cases involving the exercise of these provisions were provided, suggesting their use remains limited in practice.

Box 5.9. **Expanding legal review rights: examples from other countries**

In 2012, Chile passed a law to create environmental courts, following the example of the US EPA's Environmental Appeals Board. In doing so it substantially enhanced access to review procedures with respect to environmental law and decisions, including standards, EIA decisions and enforcement actions of the environmental superintendent. It has also enabled claimants to seek environmental remediation measures. The Santiago court handled 133 cases over 2013-15, the majority of which dealt with EIA. Each environmental court is staffed by three judges: two lawyers and one environmental scientist, increasing the technical level of environmental rulings. Hearings are open to the public and streamed live on the internet. The courts are independent, but their decisions can be overturned by the Supreme Court or a Court of Appeals.

Mexico recently expanded the interpretation of standing in environmental proceedings. In 2011 it passed a law to enable collective action by certain groups affected by environmental decisions, with a right to seek resolution of disputes affecting environmental rights and seek compensation for environmental harm and the restoration of damage.

Source: OECD/ECLAC (2016), *OECD Environmental Performance Reviews: Chile 2016*; UNEP (2015), Putting RIO Principle 10 into Action: An Implementation Guide.

Korea's Liability Relief Act and Asbestos Injury Relief System represent important progress in facilitating access to justice (Section 5.1). The reforms are in line with an initial focus of Korea's environmental justice movement on the impact of localised air pollution from rapid industrialisation on human health and ensuring appropriate compensation for victims in specific cases rather than ecosystem preservation or the social implications of environmental damage more broadly (Lee, 2009). Remedies beyond compensation are also important to environmental justice, a point forcefully underscored in 2015 by the UN special rapporteur on human rights and hazardous substances and waste, in view of the well-known "humidifier disinfectant" case that killed 140 people and injured over 500, and vulnerability of workers to hazardous substances (UNOHCHR, 2015). From a victim's perspective, prevention is better than a cure; also, compensation will not necessarily result in "full restoration of ecological services given the irreversible impacts of many environmentally hazardous acts and activities" (UNEP, 2015). The remedies set out in the Framework Act on Environmental Policy are broader than those provided for in the Liability and Relief and Asbestos Injury Relief acts: it imposes liability without fault for damage caused by pollution by any person and an obligation to compensate victims, prevent relevant pollution or damage, and recover and restore polluted or damaged environments. However, the scope of responsibility is so broad as to be "no more than a declaratory regulation" with no force in practice (KEI, 2014). Because a framework for remedies relies on the underlying liability framework to provide the right of action, based on a transgression of law, the relatively narrow scope of Korea's liability regime also acts as a limitation.

Korea's long-standing alternative dispute resolution (ADR) system similarly focuses on compensation. The Environmental Dispute Conciliation Act was approved in 1990 to provide "rapid, fair and efficient" relief for damage to health and property through adjudication, mediation and recommendation procedures in environmental disputes. The system is overseen by the National Environment Dispute Resolution Commission under the MOE, together with equivalent regional entities. Collectively, the commissions had handled 3 853 cases by the end of 2014; 260 applications were made in 2014 alone, of which 236 were resolved, with an average turn-around time of 5.5 months from filing. The figures demonstrate the utility of the quasi-judicial commissions in facilitating compensation for damage in environmental disputes. Yet, as with the broader relief system, the compensation focus of Korea's ADR system is to the expense of a focus on avoiding damage to the environment through the ability to challenge decisions, acts or omissions that affect the environment or breach environmental laws; or indeed resolving disputes associated with the rights of access to environmental information and public participation. In addition, the system focuses on individual disputes, which means it is basically ineffective when it comes to major environmental conflicts. Environmental NGOs do not have independent standing rights and their involvement in the ADR system is limited.

As Bali Guideline 25 underlines, capacity-building programmes in environmental law targeted at judicial officers, other legal professionals and other relevant stakeholders are one avenue to promote access to justice, as well as the other Principle 10 rights and broader environmental justice issues. This may be particularly relevant in Korea, given the apparently very limited role of the legal profession in promoting environmental justice (Box 5.10). Capacity issues have also been flagged in the context of the ADR system (KEI, 2012a). Enhancing commission members' expert knowledge would help reduce financial and time burdens on disputing parties, given the members' role in fact-finding and establishing causation.

Box 5.10. **Enhancing legal officers' capacity on environmental justice**

UNEP (2015) sets out numerous examples of initiatives aimed at enhancing the capacity of judges and other legal officers on application of laws relevant to the effective implementation of Principle 10. UNEP itself has a programme for judges that includes training modules, manuals, judgement summaries and other materials on environmental law. The Asian Development Bank initiated the Asian Judges Network, which enables senior judges from countries of the Association of Southeast Asian Nations and the South Asian Association for Regional Cooperation to share information and experience to help build capacity on environmental adjudication through forums such as a symposium on environmental issues in 2010. The Regional Environmental Center for Central and Eastern Europe and the Organization for Security and Cooperation in Europe have conducted activities to enhance capacity on access to justice in Central and Eastern Europe, including round-table meetings and training initiatives for judicial officers.

Source: UNEP (2015), *Putting RIO Principle 10 into Action: An Implementation Guide*.

Recommendations on environmental justice

Policy framework

- Clarify environmental justice objectives in relevant legal or policy texts, and ensure consistency across documents, to clarify policy priorities, responsibilities across ministries and environmental justice rights of the public. Implement environmental justice objectives through appropriate laws and policies.

Environmental justice and broader equity challenges

- Reduce social inequality to improve the effectiveness of environmental policy and reduce environmental inequalities; strengthen the social safety net through increased public social spending.

Fair treatment of current citizens

- Assess the economic efficiency of further expanding wide area/municipal waterworks beyond certain threshold levels compared with measures to improve the quality of small-scale and village waterworks (e.g. supply of drinking wells, improved reporting requirements). Ensure effective measures to encourage independent water service providers to secure continued improvements in efficiency, cost reduction, cost recovery and environmental performance.
- Evaluate the economic, environmental and distributional impact of water supply and sanitation service pricing policies with a view to ensuring the financial sustainability of the sector and equitable access to these services.
- Prioritise information gathering on access of vulnerable populations to green space in metropolitan areas to promote more green space in areas identified as priorities. Encourage full consideration of green space issues in urban planning.
- Continue to expand analysis of environmental health issues associated with large cities, industrial complexes and contaminated sites, including through economic analysis, and ensure effective follow-up to manage identified risk.
- Improve data collection on exposure to environmental risk in rural vs. urban areas and with respect to vulnerable households.

Recommendations on environmental justice *(cont.)*

- Take distributive impact into account as part of site selection and policy formulation to help promote distributive justice in the face of ongoing development pressures.

Fair treatment of future citizens

- Make sure the environmental interests of future generations are considered in policy and decision making, for example by reinvigorating green growth and sustainable development policies.

Environmental liability

- Introduce a strict liability regime to assign responsibility for past damage to water bodies and ecosystems, following the example of the liability system for soil contamination. Continue to update a register of all abandoned contaminated industrial sites and develop a financing mechanism for their gradual decontamination.

Environmental democracy

- Strengthen expression of the core procedural rights of access to information, public participation in environmental decision making and access to justice in law and policy to better marshal public support in effective environmental stewardship, including of development projects, and to constructively address and resolve environmental conflicts.
- Improve public participation in environmental decision making by introducing mechanisms for public involvement in the development of environmental permitting decisions, and by opening the EIA process to input from the general public (beyond local residents) and NGOs.
- Enhance access to environmental information by broadening disclosure of records on environmental behaviour of economic entities, including permit applications, regular self-monitoring reports and inspection reports, and data on air pollutants.
- Strengthen access to justice on environmental matters:
  - Facilitate access to review procedures for information requests and decisions relating to public participation, and broadening legal standing rights in environmental proceedings, including for environmental NGOs.
  - Ensure effective access to remedies beyond compensation (e.g. those geared to prevention or remediation), including as part of the ADR system. Consider capacity-building programmes for judicial officers and other legal professionals to promote their role in facilitating access to justice.
  - Make systematic efforts to ensure that Rio Principle 10 is codified in Korean law, using the internationally agreed 2010 Bali Guidelines as a benchmark. Consider acceding to the Aarhus Convention to signal commitment to facilitating public participation in environmental decision making and provide impetus to strengthen implementation of these rights in law.

Notes

1. Percentage of persons living with less than 50% of median equivalised disposable income.
2. Calculated using the 2014 average exchange rate.
3. In particular, the hydrofluoric acid gas accident at a chemical factory in the Gumi National Industrial Complex in September 2012, causing KRW 55 billion worth of human health and property damage.
4. Article 750, liability for damage caused by an unlawful act; Article 758, liability for damage caused by defect in the construction or maintenance of a structure.

5. The very real difficulties experienced by claimants were underscored by a United Nation special rapporteur on human rights and hazardous substances and waste following a country visit in October 2015; *see www.ohchr.org/EN/NewsEvents/Pages/DisplayNews.aspx?NewsID=16639&LangID=E*.
6. Joint and several liability means a claimant may pursue an obligation against any potentially responsible party as if all were jointly liable and it becomes the responsibility of the defendants to sort out the respective proportions of liability and payment.
7. Calculated using the 2015 average exchange rate.
8. Calculated using the 2015 average exchange rate.
9. Calculated using the 2015 average exchange rate.
10. The amount of compensation for health damage is based on the degree of damage (class 1-10); for property losses it is based on expert assessment, with a cap of KRW 50 million.
11. To date, no non-ECE countries have done so.
12. Supreme Court Decision 97Nu19571 of 22 September 1998. While the decision does not have formal precedential value under Korean law, in practice it is highly persuasive and has been applied in subsequent cases as binding.

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