OECD Green Growth Studies

Green Growth in Kitakyushu, Japan

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Foreword

Green growth has been a strategic pillar of the OECD's work since 2009, when OECD member countries mandated the organisation to develop a *Green Growth Strategy*. Green growth has entered a number of areas of work in the OECD, including the Directorate for Public Governance and Territorial Development. The Directorate's mission is to help governments at all levels design and implement strategic, evidence-based and innovative policies to strengthen public governance, respond effectively to diverse and disruptive economic, social and environmental challenges, and deliver on governments' commitments to citizens.

This publication is one of four metropolitan-level case studies undertaken by the OECD Green Cities Programme, which was initiated by the 2010 OECD Roundtable of Mayors and Ministers in Paris. The aim of the programme is to increase understanding of the concept of green growth in cities, to enhance the potential of urban policies to contribute to urban and national green growth, and to inform national, sub-national and municipal governments as they seek to address economic and environmental challenges by pursuing green growth. This publication is part of the *OECD Green Growth Studies* series and feeds into a synthesis report of the Green Cities Programme on *Green Growth in Cities*.

Green Growth in Kitakyushu, Japan draws on data provided by the City of Kitakyushu and the *OECD Metropolitan Database*. The analytical approach draws on the OECD Green Cities Programme's conceptual framework "Cities and Green Growth" and best practices are shared with other green city case studies (Chicago, Paris, Stockholm). This report benefited from guidance by the OECD Territorial Development Policy Committee and its Working Party on Territorial Policy in Urban Areas, and the support and co-operation of the City of Kitakyushu's local team.

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Acronyms and abbreviations

CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
ESCO	Energy service company
FAIS	Kitakyushu Foundation for the Advancement of Industry, Science and Technology
FY	Fiscal year
GDP	Gross domestic product
GFP	Green Frontier Plan
GHG	Greenhouse gas
GRP	gross regional product
HEI	Higher education institution
HERD	Higher education research and development
ICT	Information and communications technology
IT	Information technology
JICA	Japan International Co-operation Agency
K-RIP	Kyushu Recycling and Environmental Industry Plaza
KSRP	Kitakyushu Science and Research Park
LED	Light-emitting diodes
LSI	Large-scale integration
METI	Ministry of Economy, Trade and Industry
MEXT	Ministry for Education, Culture, Sports, Science and Technology
MHLW	Ministry of Health, Labour and Welfare
MLIT	Ministry of Land, Infrastructure and Transport
NEDO	New Energy and Industrial Technology Development Organisation
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development

PCT	Patent Co-operation Treaty
PV	Photovoltaic
R&D	Research and development
RIS	Regional Innovation System
SME	Small and medium enterprises
TLO	Technology Licensing Organisation
TOD	Transit-oriented development
VC	Venture capital
WHO	World Health Organisation
WTE	Waste to energy

Executive summary

This case study analyses the economic and environmental performance of the City of Kitakyushu, identifying best practices for green growth in policy and governance, and providing recommendations to further strengthen its potential for green growth. The unit of analysis is the City of Kitakyushu, the Kitakyushu metropolitan area (for the discussion of land use and density), or Fukuoka prefecture, when data is not available for the City of Kitakyushu.

Green growth aims to steer economic growth in a different direction that ensures that natural assets continue to provide the resources and environmental services on which our well-being relies. Urban green growth can be understood as fostering economic growth and development through urban activities that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services. These activities, including policies and programmes, are intended to reduce either: *i*) negative "environmental externalities" (for example, air pollution and carbon dioxide emissions that arise from urban activities); or *ii*) the consumption of natural resources and environmental services, including water, energy and undeveloped land.

Once a polluted industry zone, Kitakyushu is now a modern industrial city pursuing green growth. Since the 1960s, the city, under sustained pressure from its citizens, has made a concerted effort to reduce industrial pollution and clean up accumulated environmental degradation, massively improving water and air quality. This transformation has been achieved even as industrial output increased, through reducing the carbon intensity of production in the city's heavy manufacturing industries, and through a strong vision of sustainable development towards a low-carbon society.

In the past decade, the service sector has become a main pillar of the city's economy, but exports of manufacturing products are still driving economic growth. Important challenges remain with respect to the city's declining and ageing population and high greenhouse gas emissions. Green growth potential lies in increasingly specialised manufacturing, waste and water recycling, the port, and emerging industries, such as semiconductors, electric vehicle components, and energy systems. Kitakyushu has remarkable research and development assets for green innovation, and could play an important role in the regional innovation system of northern Kyushu.

The city's green growth initiatives include an "Eco-Town" recycling cluster and ongoing investments in green city demonstration projects, such as the "smart community" trial in the Higashida area. Kitakyushu has also implemented international city-to-city co-operation for sustainable development in Asia and has steadily built up a reputation among cities aiming for green growth. Much as for past achievements, future green growth in Kitakyushu will have to rely on strong citizen engagement.

Despite major achievements, the report's findings also point to room for improvement in Kitakyushu. Harnessing the city's local resources, such as its green innovation assets, exploiting the green growth potential of urban sectors and industries, and leveraging multi-level governance for green growth will be crucial. Focus areas should include a more collaborative approach with the central government, stronger regional co-operation and increased international collaboration.

Key findings and recommendations

- The city could more explicitly identify environmental and sustainable development initiatives as sources of growth. Horizontal collaboration between different departments in the local administration could contribute significantly to aligning environmental and economic policies towards common goals.
- Kitakyushu faces a declining and ageing population and has difficulty attracting a young, skilled workforce. City centre revitalisation is a priority, and could be enhanced through better integration of land use and transportation planning that focuses on infill and redevelopment and expanding the public transport network.
- Energy supply has been shifted to a significant extent from coal to oil and gas, but could be further diversified. The new national feed-in-tariff for renewable energies presents an opportunity to increase the share of renewable energy. A city-wide smart grid could help ensure a stable power supply, including from renewable energy sources.
- The Kitakyushu Eco-Town makes efficient use of waste-to-energy generation, notably from industrial waste. The city could further exploit waste-to-energy and heat generation, focusing on residential and commercial use. Buildings in the commercial and residential sector also offer significant potential for energy efficiency gains.
- The Eco-Town recycling cluster has been a success, but it needs to improve economic viability. Therefore, a focus on higher value added segments and measures to increase waste imports is needed.
- The city's longstanding experience in wastewater treatment could be better exploited to develop and export water technologies, as demonstrated in the Kitakyushu Water Plaza.
- There is a need to comprehensively assess and systematically co-ordinate the numerous green innovation actors and assets in the northern Kyushu region. A stronger regional innovation system should target policies to improve conditions for innovative SMEs.
- Kitakyushu could do more to exploit its local resources and strengthen its position regionally. The city could play a role in reinforcing and diversifying the northern Kyushu Recycle and Environmental Industry Plaza (K-RIP).
- Links between universities and businesses could be expanded, and the research potential of higher education institutions needs to be better attuned to the innovative potential of local companies. Kitakyushu Science and Research Park could help co-ordinate higher education institutions and commercial R&D.
- Strengthening collaboration with Asia and expanding international outreach beyond Asia could enable Kitakyushu to tap into more export markets for green goods and services. International outreach should also be strengthened in higher education institutions.
- The city's early environmental achievements were driven by citizens' initiatives and facilitated through dialogue between multiple stakeholders. Securing future citizen participation will require new incentives, such as for increasing the energy efficiency of residential buildings.

Chapter 1

Environmental and economic trends in Kitakyushu

Chapter 1 provides an overview of environmental and socio-economic trends and challenges in the City of Kitakyushu. It reviews environmental improvements achieved over the past decades in the city and assesses current socio-economic and environmental trends and challenges that underpin its economic performance and prospects for green growth. It focuses on areas with green growth potential, notably identifying an emerging green sector and its potential to contribute to growth in Kitakyushu.

Key findings

- Kitakyushu has achieved major milestones in reversing environmental degradation from its local industries. As a result of an anti-pollution movement mobilised by citizens and a transfer of authority from the prefecture to the city level, air and water pollution in the city has been reduced from health-threatening levels in the 1960s to compliance with almost all national and local standards today. The key levers for reducing the environmental externalities of its heavy manufacturing industries were the conversion of Kitakyushu's largely coal-based energy supply to oil and natural gas; cleaner production, including industrial-energy efficiency improvements; and the introduction of end-of-pipe technologies.
- From the early 20th century, Kitakyushu's economy has built upon a foundation of heavy industry, and it remains one of Japan's most important manufacturing centres today. Over the past decade, economic growth has been driven mainly by increasing exports to Asia and by growing service industries, which have replaced manufacturing as the largest economic sector. Low labour productivity, a net loss of population and an elderly dependency rate at over 30% (in Fukuoka prefecture, including the City of Kitakyushu) have weakened the city's economic performance, which is reflected in a rising gap in gross domestic product (GDP) per capita compared to national levels in the period since 1997.
- Remaining environmental challenges include high levels of greenhouse gas (GHG) emissions per capita and individual air and water quality indicators. Key drivers for high CO_2 emissions are the energy-intensive industrial base, as well as rising energy consumption in the commercial sector and in private transport, supplied to a large extent by fossil fuels. Rising levels of photochemical oxidants and exposure that is higher than Japanese cities' average for particulate matter ($PM_{2.5}$) should be further addressed. Water quality is almost fully complying with standards. Stormwater management merits more attention.
- New sources of growth can be found in the service sector, specialised manufacturing and emerging green industries. The growing service sector presents opportunities for reducing CO_2 emissions. Kitakyushu's production of water-saving appliances and its specialisation in energy efficiently produced steel and iron products are increasingly in demand, notably in Asia. Newer industries, such as semiconductors, ICT and green technologies, also offer opportunities for growth. Realising the potential of these emerging industries will depend on the provision of the necessary human capital.

Major achievements in improving environmental conditions

Industrialisation in Kitakyushu began in 1901 with the installation of a government-run steel works (Yawata Steel works) in Yahata. The company was situated near Chikuho, the site of Japan's largest coalfield, and eventually became Japan's top steel supplier. By 1913, the company was producing 80% of the country's steel consumption. This laid the foundation for the creation of the City of Kitakyushu in 1963, when five independent cities (Kokura, Moji, Tobata, Wakamatsu and Yahata) were merged into one administration. Since then, its thriving heavy industries have made Kitakyushu a strong industrial centre, and still guarantee the city's economic strength. Kitakyushu's manufacturing sector, notably in chemicals, ceramics and electronics, was boosted by its

coal reserves and its strategic port location, facing Asia. Steel manufacturing flourished during the wartime periods in the first half of the twentieth century, and drove industrial development after World War II, during the reconstruction period, the Korean War and in the context of Japan's campaign in the 1960s to double the national income. While manufacturing has declined over the last decades, Kitakyushu's economy nevertheless grew by 6.7% from 2002-07, and the city's export-oriented industries are expected to continue to provide a strong economic base.

Air and water pollution plagued Kitakyushu until the 1960s resulting in severe degradation of the environment and the health of the city's population, predominantly caused by the city's iron, steel and chemical industries. By late 1950, Kitakyushu's environmental conditions were severely threatened. Fishing rights for the Dokai Bay were abandoned in 1956, and the number of complaints about strong odours kept increasing. With concentrations of soot, dust, nitrous oxide (NO_x), particulate matter and sulphur oxides (SO_x) well over World Health Organization (WHO) standards, the city experienced an increase in pollution-related diseases. Water pollution was further aggravated by the city's limited sewer capacity, which served only a small part of the city at the time. In 1966, a scientific study confirmed high concentrations of toxic substances (e.g. cyanogens and arsenic) in Dokai Bay, dissolved oxygen levels at zero and chemical oxygen demand at a maximum of 36 parts per million. In 1969, around 4 million cubic metres of industrial waste water and 60 000m^3 of household sewage water was released daily into the bay. Factory waste water also accounted for the largest share of the chemical oxygen demand (COD) load (97.4%) (MEIP, 1996). The Dokai Bay became known as the "Sea of Death".

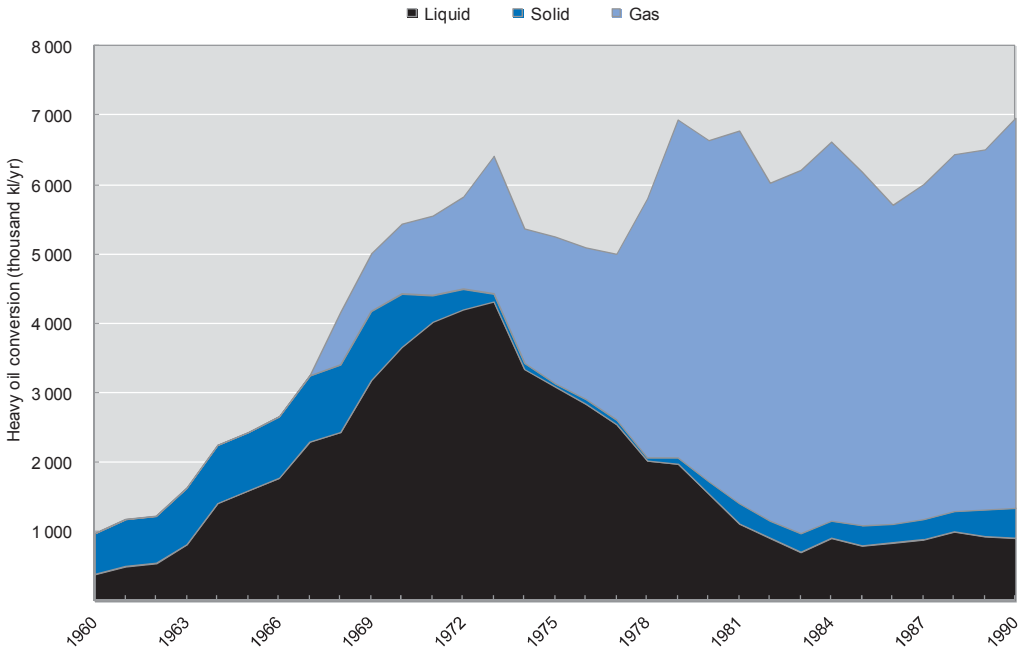
Women's associations were at the forefront of Kitakyushu's strong citizen engagement and grass-roots movements to reduce industrial pollution and improve environmental conditions in the city. Since the early 1950s, various women's associations had been formed with the mission to fight against environmental degradation and health impacts from local industrial pollution. The citizens' activism continued for over 20 years, engaging the local government and eventually local industries. The Nakabaru Women's Society was responsible for getting dust collectors installed at the Nakaburu and Kokura Daimon power plants in 1951. In the early 1960s, the Sanroku Women's Association pressured Yawata Steel Works to reduce pollution at its Tobata Iron Works plant. Women's associations started carrying out research and collaborated with scholars from Yamaguchi University to find scientific evidence to legitimise their case. At the same time, media coverage of city-released smog warnings raised public awareness of the situation, and the resulting debate increased pressure on companies to clean up their industries. In 1965, a federation of 13 women's societies launched the campaign "We Want our Skies Back", which helped mobilise the public sector to join forces with private companies to combat industrial pollution (Hayashi, 1995).

In 1970, changes in the governance structure in Kitakyushu allowed the local government to better control and reduce pollution. After the national government transferred to the city the power to issue smog alerts, which had been traditionally under the jurisdiction of the prefecture, a local smog warning system was installed, and local pollution standards were defined. That year, the city issued 17 smog warnings and 9 smog alerts, helping to raise public awareness of the city's pollution problem and putting pressure on private companies. The new warning systems and powers strengthened the monitoring stations and mobile pollution control units that the city already had in place, and the city took further steps to set up new institutions and systems to combat pollution: the Kitakyushu Air Pollution Prevention Council (1970) (which included Fukuoka

officials and 30 local corporations), the Pollution Control Bureau, a meteorological reporting system (1971) and the Regional Pollution Control Programme (1972). This institutional network created the conditions to *i*) effectively plan and implement pollution and emission mitigation strategies and measures and *ii*) institute local pollution standards more stringent than those at the national level (MEIP, 1996).

Structural changes in Kitakyushu's energy supply resulted in large reductions in the concentration of several air pollutants. The National Income Doubling Plan in the 1970s strongly boosted Kitakyushu's heavy industries and industrial energy consumption, leading to environmental and health problems. However, coal was phased out as the main energy source in the 1960s, to be replaced by oil, which was in turn replaced to a large extent by gas in the 1970s. This resulted in a significant reduction in pollution (Figure 1.1). The global oil crises in 1973 and 1979 triggered a push for energy diversification in Japan, and led to technological innovation that introduced energy saving and resource recycling in production processes. The city saw large reductions in SO_x and other pollutants during the gradual transition from oil to natural gas in electricity production and steel manufacturing. Nitrogen dioxide (NO_2) concentrations attained environmental standards in 1978; concentrations of SO_2 were brought in line with environmental standards as of 1976; and dust fall stabilised in the late 1970s (MEIP, 1996). This primary shift in the energy supply accounted for 42% of pollution reductions from 1970 to 1990. After the second oil crisis, coal was increasingly reintroduced into the energy mix.

Figure 1.1. **Fuel consumption by type, 1960-1990**

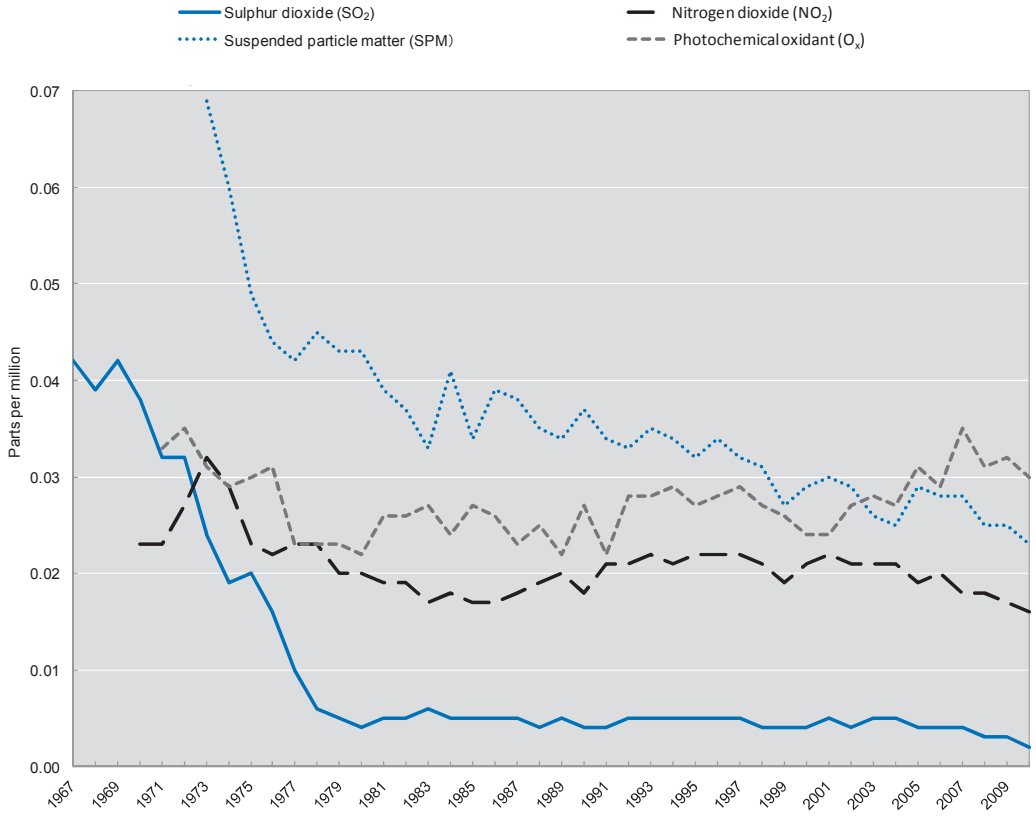


Note: Solid fuels include coal, coke and wood, while gas fuels include blast furnace gas, coke oven gas, LPG and LNG. For consumption quantities of gas fuels, values are shown beginning in 1968, when such data became obtainable.

Source: MEIP (Metropolitan Environmental Improvement Program) (1996), *Japan's Experience in Urban Environmental Management*, *Kitakyushu, A Case Study*, World Bank, Washington, DC.

Additional cuts in industrial pollution were achieved through cleaner production, including process conversion and end-of-pipe (EP) technologies. The iron and steel industry further reduced SO_x and other emissions in response to more stringent local pollution monitoring and controls and increased public pressure (Figure 1.2). The pollution reductions were significant: 42% of the pollution reduction was achieved through the energy supply shift and 33% through energy conservation. The most effective energy efficiency measures included replacement of inefficient and polluting equipment with newer and higher- performing technology, e.g. replacing small and middle-size boilers; and optimising production processes by making use of industrial process by-products, such as heat in co-generation. End-of-pipe technology contributed to another 25% of SO_x reduction, in particular desulphurisation treatment and filtering of exhaust gas and gas by-products (MEIP, 1996). Some reduction of contaminant levels was also achieved through increasing the height of chimneystacks and dispersing pollution in higher atmospheric layers. As a consequence of these measures, SO_x was reduced by almost 90% between 1970 and 1990 (City of Kitakyushu, 2012).

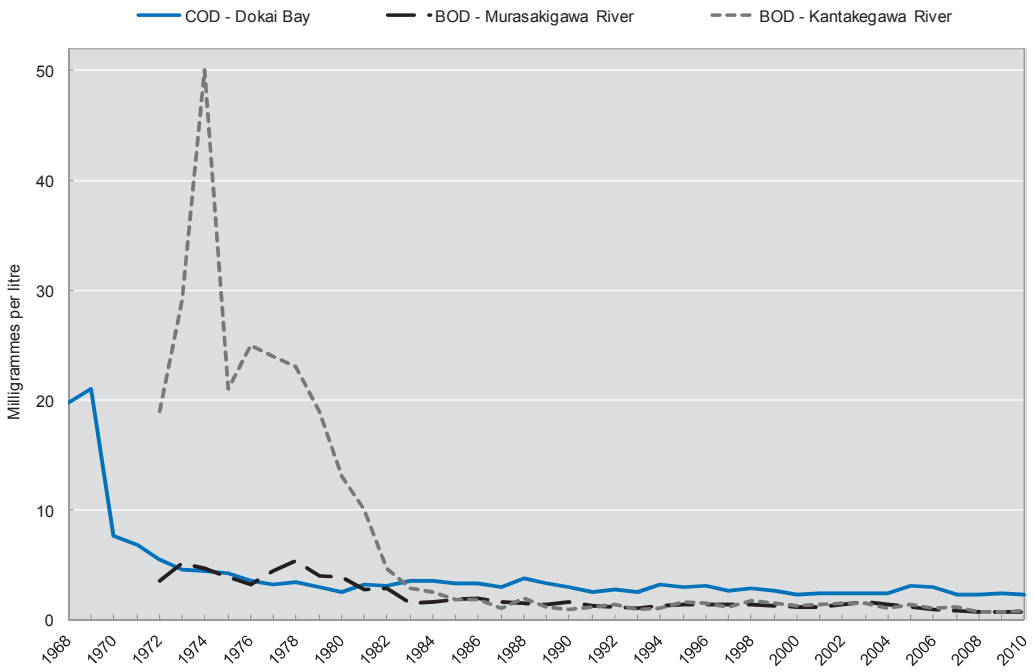
Figure 1.2. **Annual average of SO_2, NO_2, SPM and O_x from 1967-2009**



Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Major improvements in water quality were achieved as a result of decisive action to clean up industrial wastewater sediments and undertake large extensions of the public sewerage system. The city faced river and seawater pollution in the 1970s, caused by municipal and industrial waste water (MEIP, 1996). Seawater quality improved after the Dokai Bay clean-up in 1972 and implementation of industrial wastewater regulation (Figure 1.3). The city removed and treated at a special disposal zone within the bay around 350 000 m^3 of sludge, containing over 30 parts per million of mercury. This was part of the 4.8 million m^3 of sludge that are estimated to have accumulated between 1898 and 1972 in Dokai Bay (City of Kitakyushu, 2012). Private sources paid for 71% of the total cost (JPY 1.8 billion), with the remainder paid through public funds (MEIP, 1996). The city has continuously invested in pipes, pump stations, purification centres (disposal plants) and wastewater operations since the late 1970s in order to improve water quality and supply, increasing its sewerage coverage from 20% in 1970 to 99.8% in 2006 (City of Kitakyushu, 2012). The installation of septic and water-purification tanks also allowed for wastewater disposal in more remote areas. By the mid 1980s, the quality of waterways such as the Murasakigawa River and the Kantakegawa River had improved dramatically; today, they meet almost all national water standards (Figure 1.3). The city continues its efforts to keep high water quality while lowering water disposal and treatment costs.

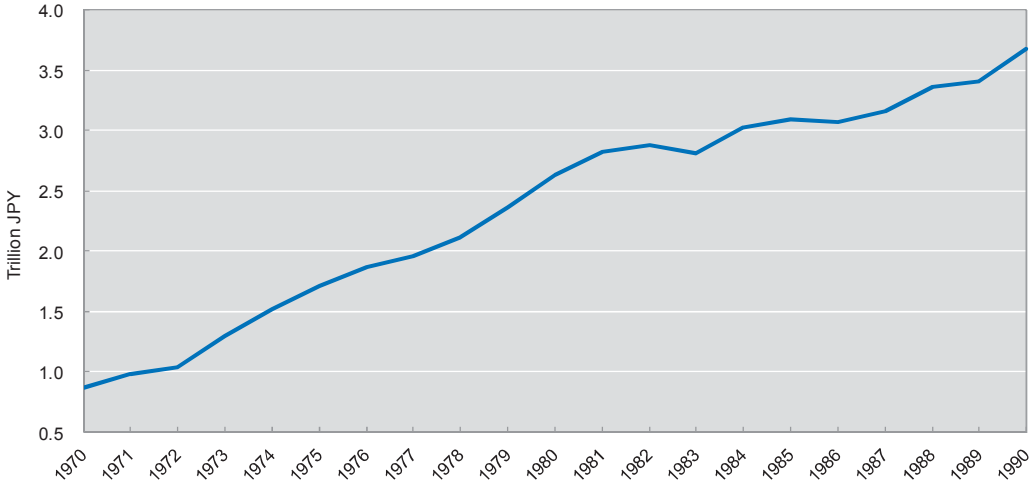
Figure 1.3. **Chemical oxygen demand (COD) and biological oxygen demand (BOD) in sea and rivers**



Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

These reductions in air and water pollution were achieved by significant investments from both the public and the private sector, over a period of solid economic growth. Between 1972 and 1991, investments in pollution abatement technologies totalled JPY 805 billion. The city contributed JPY 552 billion and the private sector JPY 253 billion (MEIP, 1996). The city invested mostly in public sewerage improvements and collaborated with major private companies to reach collective agreements on pollution prevention. Furthermore, the city set up the institutional environment for pollution and emission reduction. The city's efforts account for 98% of the resulting SO_x emission reductions. These environmental improvements were achieved during a period of solid economic growth: between 1970-1990, Kitakyushu's GDP more than quadrupled, from JPY 0.87 trillion in 1970 to JPY 3.67 trillion in 1990 (Figure 1.4).

Figure 1.4. **Kitakyushu GDP, 1970-1990**



Note: Years refer to Japanese fiscal years.

Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

The city continues to strictly monitor and control local air and water polluters to maintain satisfactory air and water quality levels. Current measures include *i*) chemical substance monitoring (SO_2, NO_2, CO, SPM, O_x, $PM_{2.5}$, dioxins, benzene and trichloroethylene) at 14 general ambient air-monitoring stations and 5 automobile exhaust gas monitoring stations and *ii*) water quality monitoring at environmental reference points (27 river sites, 7 ocean sites, 1 lake site) and general measurement points (5 river sites, 11 ocean sites). National standards limit the legal amount of air pollution and wastewater discharges from industries and businesses in Kitakyushu, and the city has the power to control the implementation of these standards. In case of non-compliance, the city can require technical improvements, provide guidance to meet regulations or request a temporary shutdown of operations. In 2010, 1 329 facilities (278 businesses) were inspected for air quality, which resulted in three instances of administrative guidance given for inadequate environmental management. In the same fiscal year, 12 cases of administrative guidance were issued after the inspection of 119 businesses that discharge

water into public water areas and 482 companies that discharge wastewater into the public sewage system.

Successful waste management has minimised municipal waste production, increased reuse and recycling rates and laid the foundation for a resource-recycling-based society. Japan has one of the lowest rates for municipal waste production among OECD countries, 1.03 kilogrammes per person per day (2008), and Kitakyushu produces less than half that amount, 506 grammes per person per day (2009) (City of Kitakyushu, 2012). Recycling rates in Kitakyushu have increased, from 0.1% in 1991 to 15% in 2003 and 30.4% in 2009 (City of Kitakyushu, 2012; MEIP, 1996). From 2001-09, the cost for waste separation went up from JPY 0.4 billion to JPY 0.6 billion, while overall waste management costs decreased from JPY 16.1 billion to JPY 13.8 billion over the same period (City of Kitakyushu, 2012). These impressive results owe much to citizen participation, incentivised by the city's policy of pricing conventional garbage bags higher (JPY 50) than recycling bags (JPY 12 and 20), which not only led to a doubling of recycling rates, but also to a reduction of waste volume by 30% (City of Kitakyushu, 2012). Waste sent to landfill has been cut almost by half, from 109 482 tonnes in 2003 to 55 181 tonnes in 2009. The city's waste strategy offers an excellent example of how to achieve environmental and economic benefits through reducing waste production and waste handling and disposal costs, while increasing material reclamation through recycling.

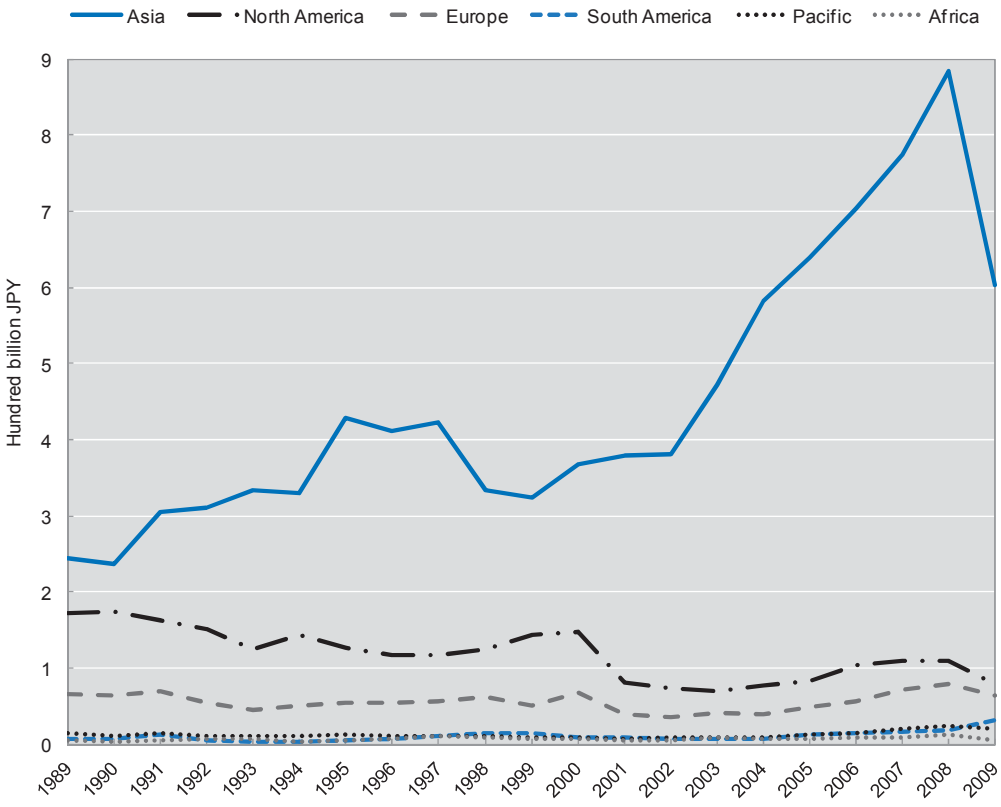
Non-recyclable waste is used for waste-to-energy (WTE) generation, without compromising ambitious goals for waste reduction and recycling. Waste reduction is the first priority (the first of the three R's – reduce, reuse, recycle) in Kitakyushu. While waste generation was reduced, recycling rates went up. Instead of curbing recycling, waste incineration was cut from 558 327 tonnes in 2003 to 367 661 tonnes in 2009 (City of Kitakyushu, 2012). Waste-to-energy directly powers all facilities located in Eco-Town, Kitakyushu's recycling complex (Box 1.1).

Remaining economic and environmental challenges

Kitakyushu's economy grows with strong exports, but is undermined by unfavourable demographics

Strong exports to Asia have driven Kitakyushu's continued economic growth over the last decade, but GDP per capita and productivity remain below the OECD metro-regions' average. Representing 0.8% of Japan's population and GDP respectively, the city's economy (GDP) grew by 8% between 1998 and 2007, from USD 30.8 billion to USD 33.2 billion. During the five-year period between 2002-07 – the "Izanami period" – export values nearly doubled, from JPY 500 billion to JPY 1 trillion, mainly driven by increases in trade shares with Asian partners (102%), notably China (142%) and Korea (81%). Exports to the United States and Europe represent a much smaller percentage of total trade, but also grew by 51% in the United States and 99% in Europe (Figure 1.5). While GDP per capita in Kitakyushu grew by 37%, from USD 23 334 to USD 31 945 from 1998 to 2007, the city's GDP per capita is still below the average for OECD metro-regions, as is labour productivity (GDP per worker) (Figures 1.6 and 1.7).

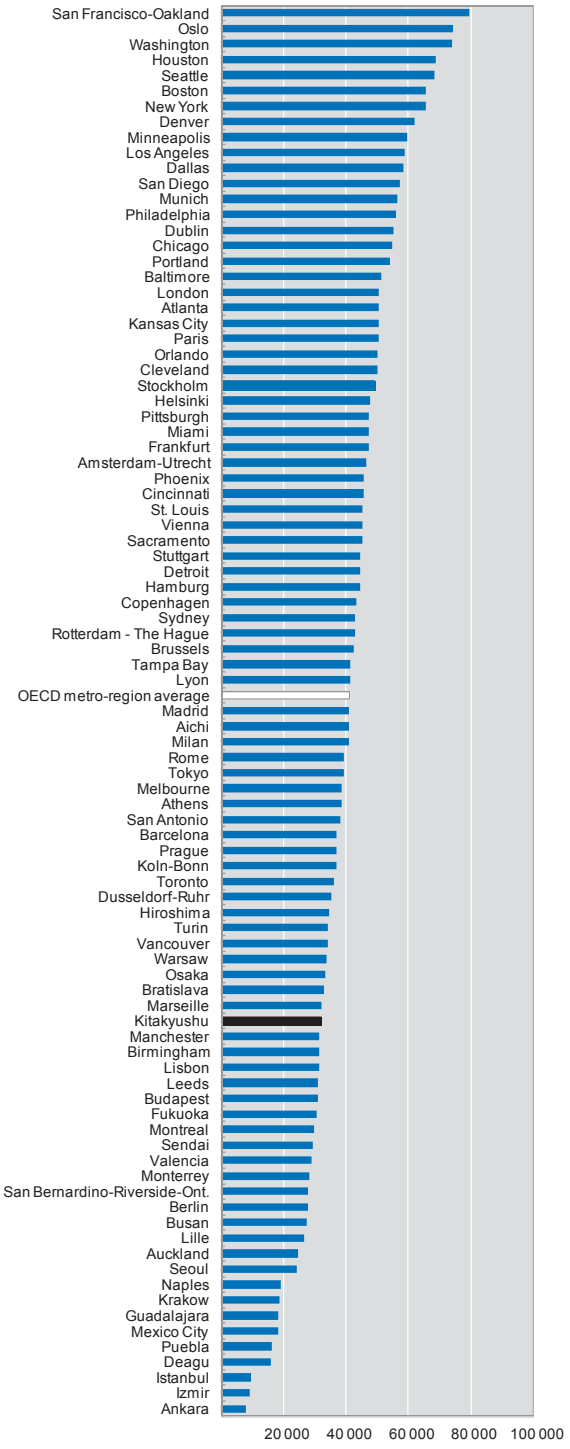
Figure 1.5. **Exports from Kitakyushu port**



Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Since the late 1990s, the gap between Kitakyushu's and the national GDP per capita has widened (Figure 1.8). This can be explained in part by the difference in the economic profiles of the city and the country at large. During the 1990s, Japan underwent a transformation towards the service sector and higher value-added activities, while Kitakyushu retained much of its manufacturing industry and basic technologies. From 2000-05, productivity (GDP per worker) in Kitakyushu fell by 0.4%, despite a declining share of the working population, while productivity in Japan rose by 9% (City of Kitakyushu, 2012; MPMHAPT 2001; MIC, 2009; OECD, 2012a). Correlating with the rising gap between the city's and the national GDP per capita over 1997-2007, elderly dependency rates[1] in Fukuoka prefecture have risen by 39%, while in Japan they increased by 13% over the same period (OECD, 2012b).

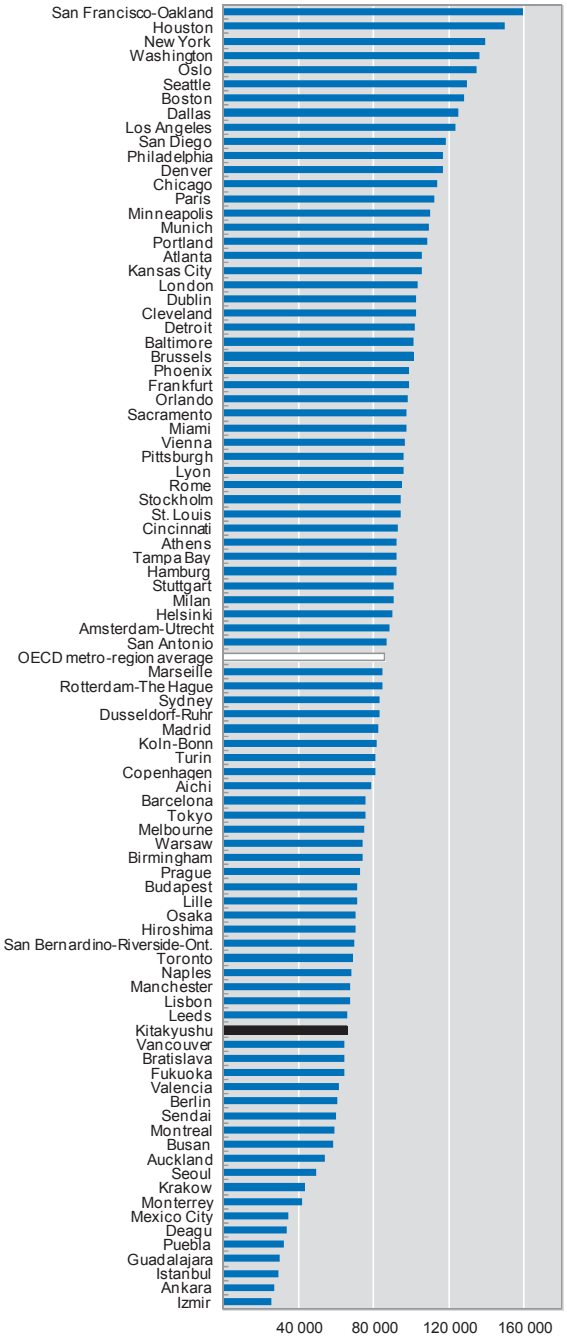
Figure 1.6. **GDP** per capita **(USD) in OECD metro-regions, 2008**



Note: Data for Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, and United Kingdom refer to 2007; data for New Zealand refer to 2003; data for Turkey refer to 2001.

Source: *OECD Metropolitan Database, http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES*; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

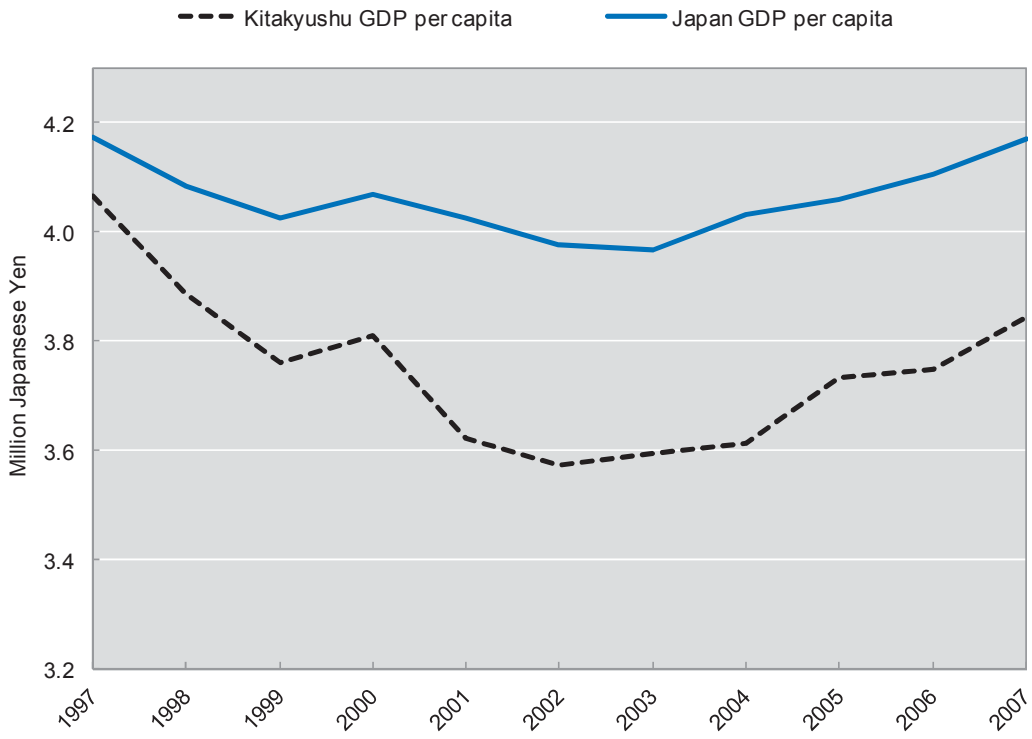
Figure 1.7. **Labour productivity (GDP per worker) in OECD metro-regions (PPP, USD), 2008**



Note: Data for Austria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan (except Kitakyushu) for 2005, Korea, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, and United Kingdom refer to 2007; data for Belgium and Ireland refer to 2006; data for New Zealand refer to 2003; data for Mexico and Turkey refer to 2000; no data for Switzerland available.

Source: *OECD Metropolitan Database, http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES*; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Figure 1.8. **GDP** per capita **in Kitakyushu and Japan, 1997-2007**



Note: Years refer to Japanese fiscal years.

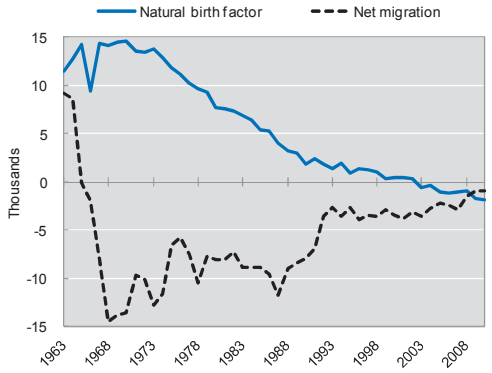
Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan; OECD (2012), *OECD Stat*, *country statistical profiles,* OECD statistics website, doi **:** *10.1787/20752288* accessed 22 October 2012.

The city confronts a declining and ageing population

A major challenge for Kitakyushu is population decline, mainly driven by net out-migration. Kitakyushu's population peaked in 1979 at 1 086 415, and has declined by 10.5% since then, to 972 719 in October 2011 (City of Kitakyushu, 2012). Although migration patterns have improved in the last decades, the city has experienced net out-migration since the mid-1960s. In 2010, net out-migration had improved, but was still slightly negative (-951) (Figure 1.9). Of particular importance is the tendency for young people to leave the city, including a significant number of students who leave the city after graduation to seek opportunities elsewhere. Only 193 out of 888 graduates from Kitakyushu University stayed in the city in FY 2010, and 239 stayed within the Fukuoka prefecture. Some people return after having gained work experience, but it is still difficult for Kitakyushu to attract students from other cities or to retain educated workers. Improvements in migration patterns, even though net out-migration is still negative, correlate with the environmental improvements made starting in the late 1960s and could indicate that the city is increasing in attractiveness.

A negative and decreasing natural birth factor (births minus deaths) also affects population decline, while driving up elderly dependency rates. Since the late 1990s, Japanese annual population growth rates have slowed and became negative in 2008 (OECD, 2012a). Today, Japan is the most rapidly ageing country in the world. By 2010, almost all Japanese cities were on the brink of population decline (OECD, 2012c). In Kitakyushu, the population decreased by 5% from FY 1990 to FY 2011, while elderly dependency rate (in Fukuoka prefecture) increased by 77% (Figure 1.10). The steady decline of the natural birth factor since the late 1960s is the primary reason for the shrinking population. It dropped below zero in 2003 and stood at -1 832 in FY 2010 (Figure 1.9).

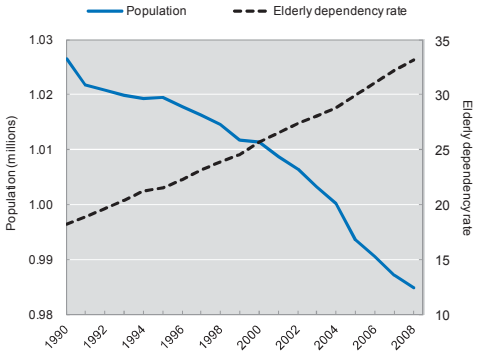
Figure 1.9. **Natural birth factor and net migration in Kitakyushu**



Note: Years refer to Japanese fiscal years.

Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Figure 1.10. **Population change in Kitakyushu and elderly dependency rate in Fukuoka prefecture**



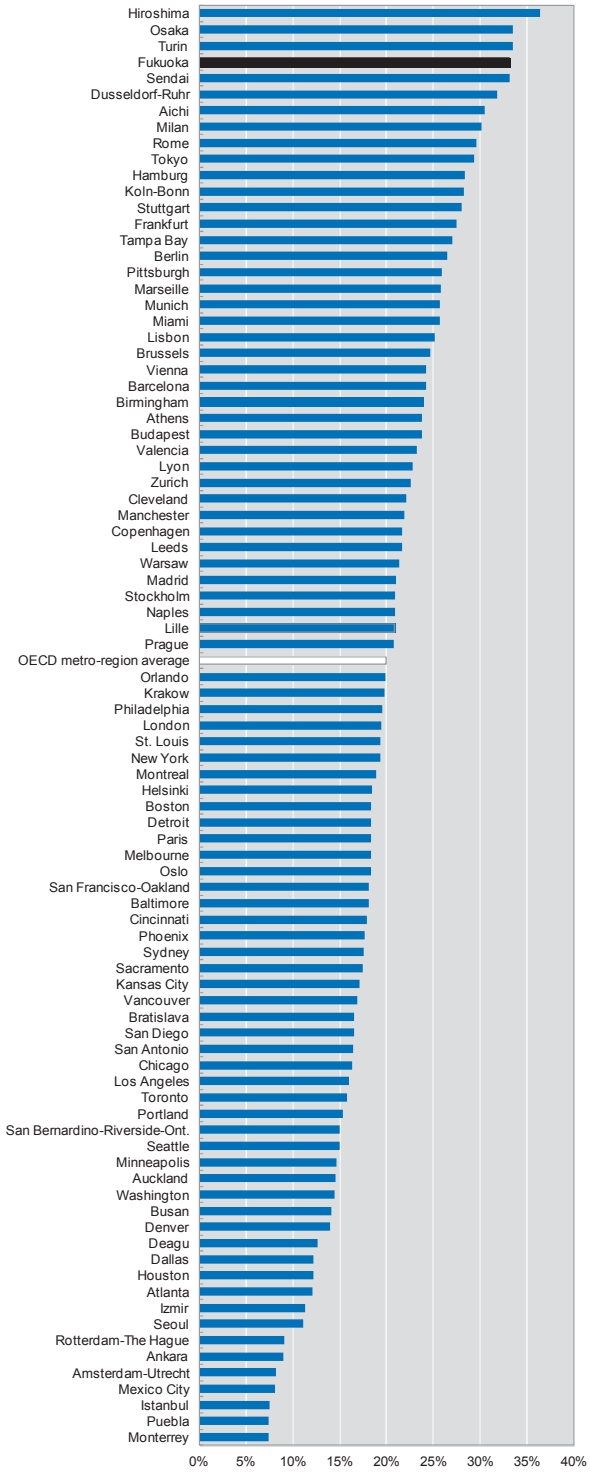
Note: Years refer to Japanese fiscal years.

Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan;. *OECD Regional Database: http://stats.oecd.org/Index.aspx?datasetcode=REG_DEMO_TL3.*

Kitakyushu has the highest percentage of 65+ year olds among all Japanese "designated cities" selected by the central government for special national programmes. In FY 1980, 8.7% of Kitakyushu's household members were 65 years or older, and by FY 2010, this share had grown to 25.1%. The population under 15 years declined from 23.1% in FY 1980 to 12.9% in FY 2010. The working population (15-64 year olds) represented 68% in FY 1980 and 61.3% in FY 2010. These tendencies are reflected in one of the highest elderly dependency rates[2] among OECD metro-regions (Figure 1.11).

Kitakyushu's unemployment is above the national average and rising, despite a shrinking working-age population. Kitakyushu's unemployment rate rose from 6.15% in FY 2000 to 7.73% in FY 2005, while over the same period, national rates rose from 4.7% to 5.95% (City of Kitakyushu 2012; OECD, 2012a). In Kitakyushu, unemployment rose despite a decline in the total number of employees from 452 085 in FY 2000 to 436 842 in FY 2005. The goal for 2007-2012 of Kitakyushu's Industrial Employment Strategy was to create 10 000 new jobs from 2007 to 2012 and had led to the creation of 7 321 new jobs by 2011.

Figure 1.11. **Elderly dependency rate in OECD metro-regions, 2008**



Note: Data for Canada refer to 2005; data for Germany refer to 2007.

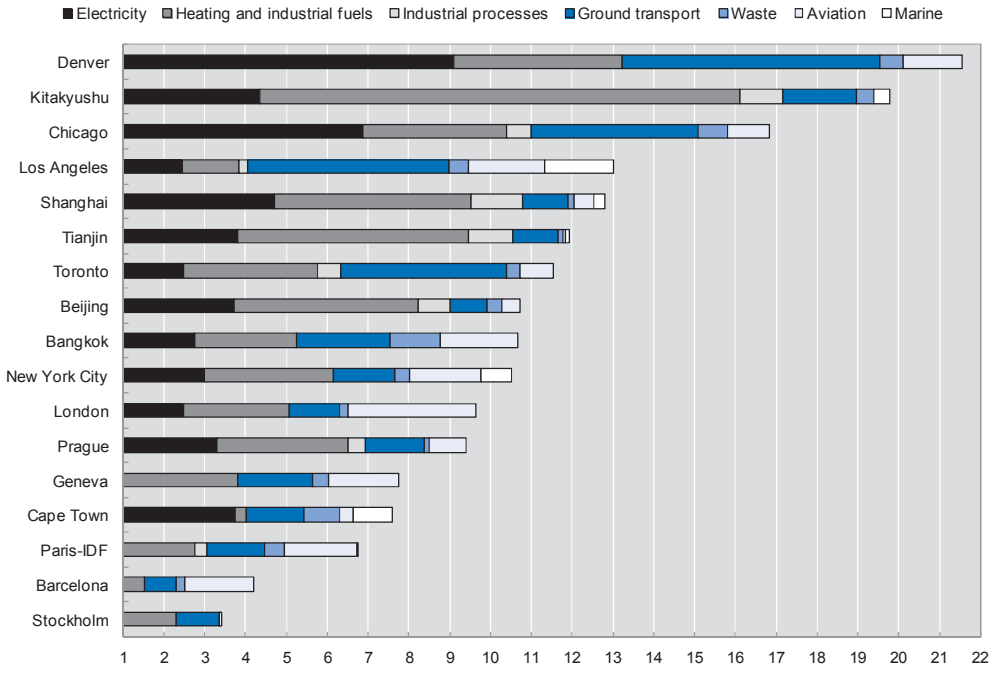
Source: OECD Metropolitan Database, http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.

High greenhouse gas emissions and pollution remain

The city has achieved important milestones in improving environmental conditions and performance, but some challenges remain, one of which is a high level of greenhouse gas emissions. Kitakyushu's economic foundation was built on emission-intensive industries, and its industrial profile predetermines much of what Kitakyushu can do about greenhouse gas emissions. Japan's manufacturing sector is one of the most efficient worldwide, but additional measures are necessary to further reduce emissions, which could include a cleaner power supply. The transport and commercial sectors are also drivers of greenhouse gas emissions, with an increasing number of private vehicles in the city's modal share and increased energy consumption in the commercial sector. As regards air quality, almost all standards are satisfied, with the exception of photochemical oxidants. Water quality complies with all standards. However, some parameters, such as boron and fluoride, need further attention and monitoring.

Kitakyushu's CO_2 emissions per capita are high today and have increased over the last decade. With 0.76% of Japan's population (2011), Kitakyushu accounts for around 1.2% (15.6 million tonnes in FY 2005) of Japan's greenhouse gas emissions (City of Kitakyushu, 2012; OECD, 2012a). CO_2 emissions per capita in Kitakyushu amount to 19.8 tonnes (2007), which is more than double the national average of 9.7 tonnes per capita, and higher than in many other cities (Figure 1.12) (OECD, 2010). The highest-emitting sectors are industry (66.6%), transportation (10.2%) and commercial and other sectors (7.9%), all of which have increased their CO_2 emissions in recent years. CO_2 emissions decreased in some sectors between 1990 and 2007, markedly in industrial process (-42%) and energy conversion (-29%). However, the increases in the majority of sectors, notably in industries (17%), transportation (13%), commercial and other sectors (103%), residential (3%) and waste (65%), led to an overall increase of 13% in CO_2 emissions (Figure 1.13).

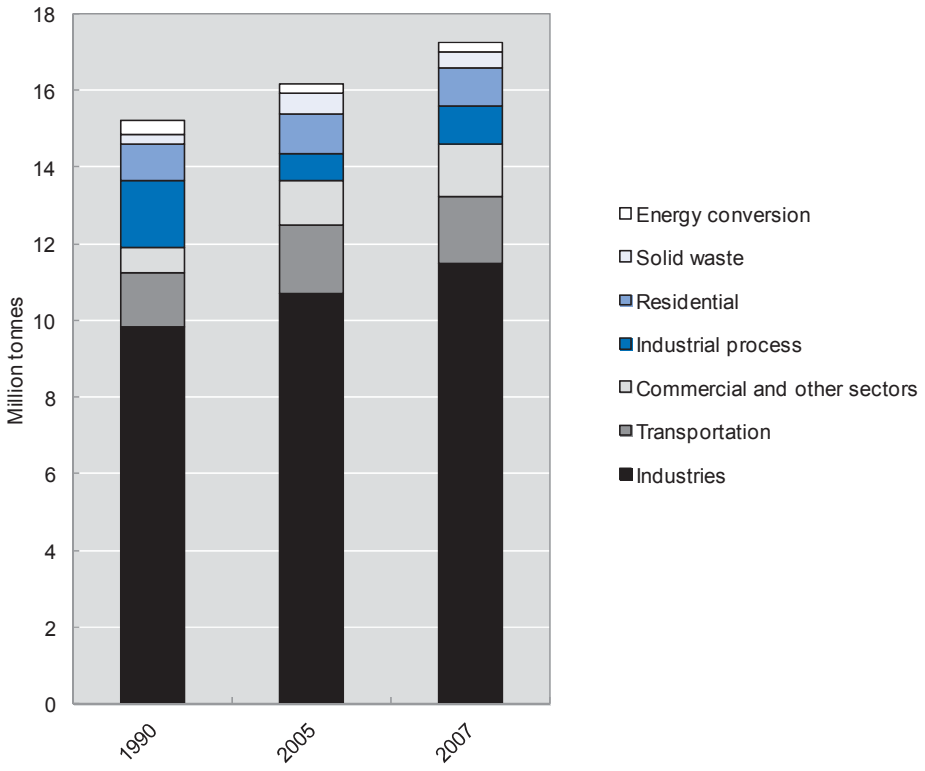
Figure 1.12. **CO_2 emissions** per capita **(tonnes) in selected cities**



Note: Kitakyushu figures do not contain aviation emissions.

Source: Kennedy, C. (2012), calculations (personal communication) adapted by Christopher Kennedy, March 2012, using methodology from Kennedy C., et al. (2009), "Greenhouse Gas Emissions from Global Cities", *Environmental Science and Technology*, Vol. 43, No. 19, American Chemical Society, Washington, DC; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

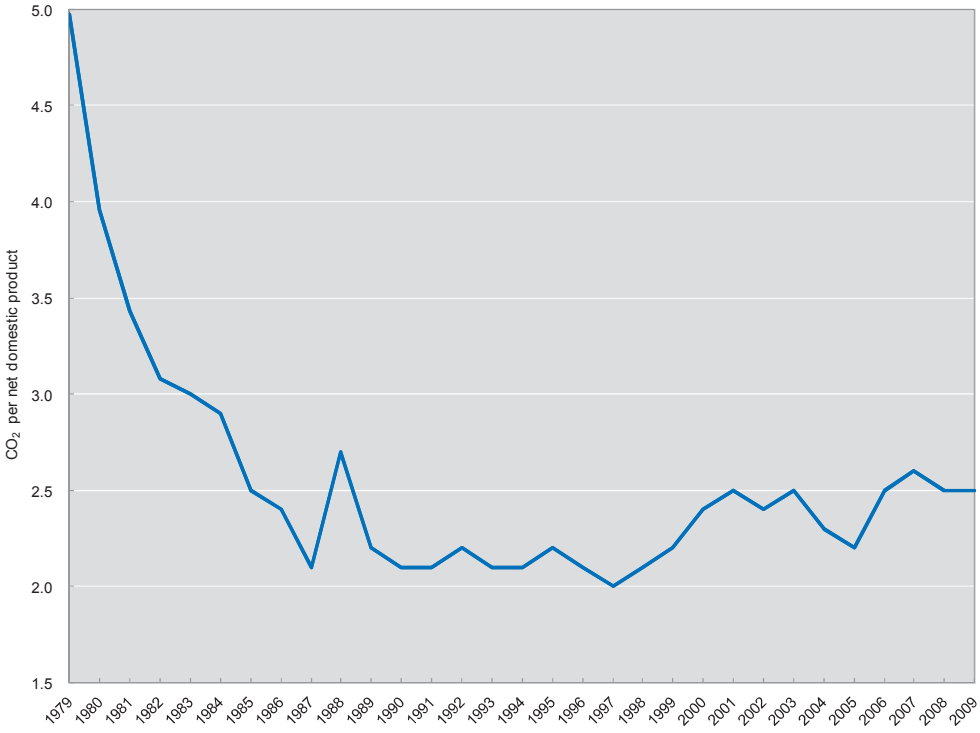
Figure 1.13. **CO_2 emissions in Kitakyushu by sector**



Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Industrial energy efficiency is high in Japan compared to other OECD countries, but further emission reductions are achievable. Strong efficiency gains in heavy industries were achieved between 1960 and 1990, which led to reductions in CO_2 emissions. The CO_2 intensity of Kitakyushu's net domestic product (NDP) was reduced from 100 in 1963 (1963=100) to 4 in 1980, and to 2.1 in 1990. However, this value slightly increased again after 1990 to 2.5 in 2009 (Figure 1.14). While growth of CO_2 emissions over growth in gross regional product (GRP) in Kitakyushu also showed a slight decoupling from 1990 to 2005, this tendency turned around in 2005, when emissions started increasing faster than GRP. The recent recoupling of GRP with faster rising emissions could be related to the ongoing financial and economic crisis, during which industries might revert to cheaper and dirtier energy sources. However, the effects of earlier industrial efficiency improvements that had led to a decoupling of local CO_2 emissions from GRP seem to have reached their limits. Further reducing CO_2 intensity of industrial production would therefore probably need to include a cleaner energy supply mix.

Figure 1.14. **CO_2 intensity of Kitakyushu's net domestic product**



Note: The Y-axis scale is calibrated on the value (CO_2 per net domestic product) for 1963 = 100.

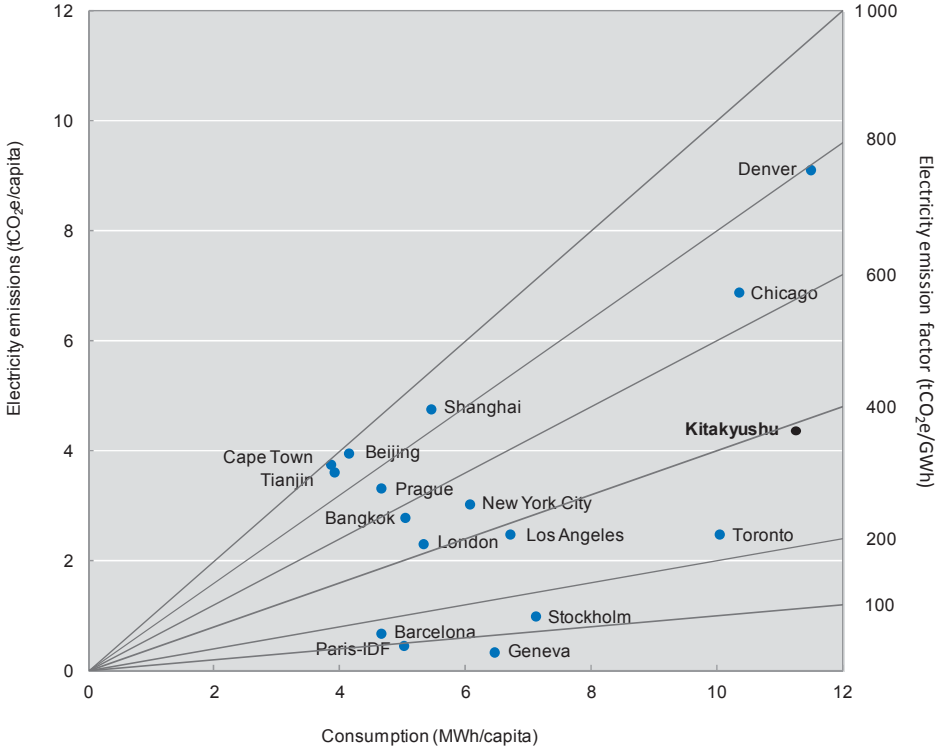
Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Fossil fuels remain an important part of the regional energy mix

High industrial emissions are driven by the large amounts of fossil fuels consumed in Kitakyushu's industries. Energy-related industrial emissions represent over two-thirds (66.6%) of its CO_2 emissions. In comparison, this sector represents only 28% of all CO_2 emissions in Japan (City of Kitakyushu, 2012; OECD, 2010). This is due to the large share of heavy industries in Kitakyushu and the mix of industrial energy supply. Carbon dioxide emissions from its industrial fuel consumption come mainly from oil and coal combustion (65%), electricity (32%) and town gas (2%). Of the oil and coal used in industries, 99% is consumed in manufacturing (City of Kitakyushu, 2012). Carbon dioxide emissions from industrial fuel use rose by 17% between 1990 and 2007, and emissions from oil and coal rose by 21%; non-energy-related industrial emissions (from industrial processes) declined by 42% over the same period. This decrease can mainly be attributed to a reduction in cement production, but also indicates a lag in the transition towards cleaner energy supply. This picture is confirmed at the national level, where CO_2 emissions per unit of total primary energy supply (TPES) rose by 5.5% over seven years (2000-07), while in many other OECD countries, CO_2 emissions per unit of TPES declined over the past decade. The increasing share of fossil fuels in the national energy mix, especially coal, is an important driver for this trend in Japan (OECD, 2010).

High electricity consumption contributes to elevated CO_2 emissions from electricity production. Per capita consumption of electricity in Kitakyushu compares to levels of North American or Canadian cities such as Chicago, Denver and Toronto, while CO_2 emissions per capita from electricity are at levels similar to those of Shanghai and Beijing (Figure 1.15). Kitakyushu has a better electricity emission factor than Beijing and Shanghai, comparable to less industrialised cities such as Los Angeles and London. However, per capita CO_2 emissions are still high in Kitakyushu, due to high electricity consumption. Industries consume 63% (67 863 TJ) of total electricity, accounting for 3.7 million tonnes of CO_2 emissions in 2007. This represents over one-third of total industrial emissions, and is equivalent to more than all CO_2 emissions from residential, commercial and other sectors combined (2.3 million tonnes in 2007). Much of this is related to the fact that almost half (48%) of electricity produced in Kitakyushu comes from thermal (coal and gas) power production. Electricity production is therefore an important lever for reducing overall CO_2 emissions in Kitakyushu. While there might be limits to integrating large amounts of fluctuating renewable electricity into the industrial electricity supply, storage solutions, such as existing or new hydro storages, could be used to add more wind and solar energy to the local grid. Carbon intensity of the electricity supply in Kitakyushu is likely to increase if the potential phasing out of nuclear energy (in the aftermath of the Tohoku Great Earthquake) does not include a strong commitment to replace nuclear with renewable and low-carbon energy.

Figure 1.15. **Greenhouse gas emissions from electricity in selected cities**



Note: The data (2009) for Chicago correspond to the Chicago Metropolitan Agency for Planning region (seven counties); the data for Kitakyushu (2007) and Stockholm (2009) correspond to the cities.

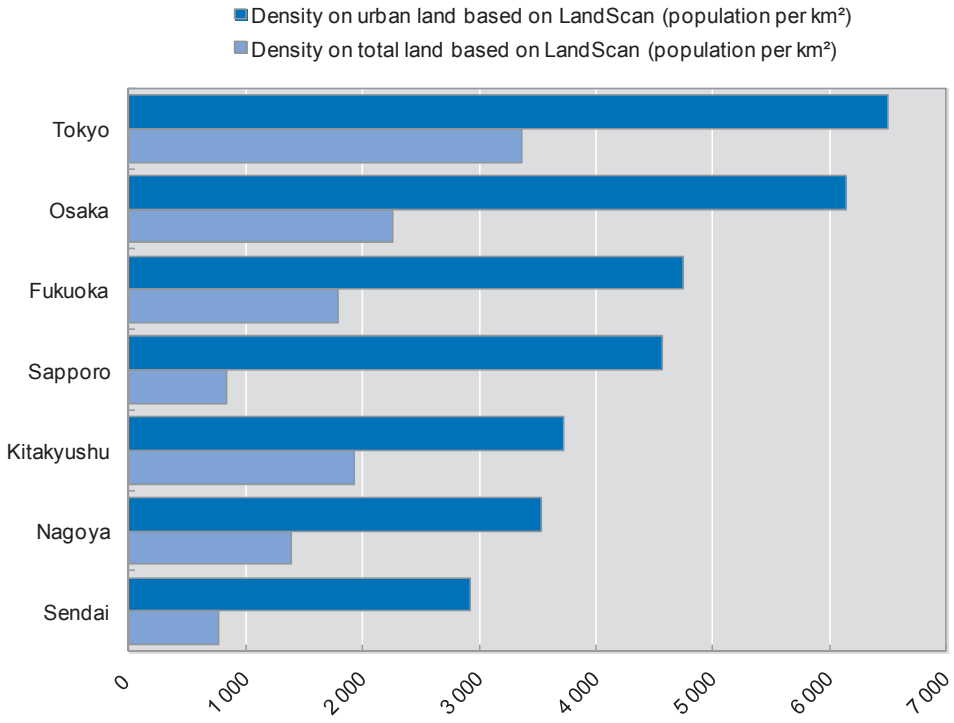
Source: Kennedy, C. (2011), Personal communication, calculations adapted by C Kennedy, October 2011, using methodology from Kennedy, C. et al. (2009), "Greenhouse Gas Emissions from Global Cities", *Environmental Science and Technology*, Vol. 43, No. 19, American Chemical Society, Washington, DC; data for Chicago comes from the Center for Neighborhood Technology (2009), "Creating a Chicago Regional Building Energy Efficiency System", Center for Neighborhood Technology, Chicago; data for Stockholm and Kitakyushu were provided by the city administrations.

Kitakyushu's considerable renewable energy resources, particularly in solar and wind energy, could be exploited with stronger policies to boost the presently marginal share of renewable energy in the city's energy mix. Solar irradiation in Kitakyushu is 4 kWh/m^2, which is more than in any German city and more than in large parts of France (MOE, 2011; IET, 2012). Average wind speed is 5 m/s, which is equivalent to the wind speeds in large parts of Germany (Windfinder, 2012; Wind Atlas, 2011). While both wind and solar energy production was introduced in Kitakyushu, current installed capacity only represents a marginal fraction (1.6%) of total energy supply. Within the current renewable energy mix, solid waste incineration contributes the most (84%), followed by wind (8.9%), solar (5.3%) and hydro (1.8%). Wind, solar and hydro combined serve only 0.2% of the city's total energy demand (BR final, slide 68). Solar was the only source of renewable energy whose contribution to the energy mix increased, with 126% growth from 10 179 MWh in 2007 to 23 048 MWh in 2010. In addition to energy from solid waste, solar and wind (as well as marine power) still have substantial potential to contribute to greater energy independence and emission reductions in Kitakyushu. An important condition for integrating more renewable energy is to introduce demand side management through smart grids and related systems, which would help to balance peak load demand, matching electricity demand and supply and reducing electricity prices (IEA, 2011).

Urban sprawl correlates with increasing car dependency

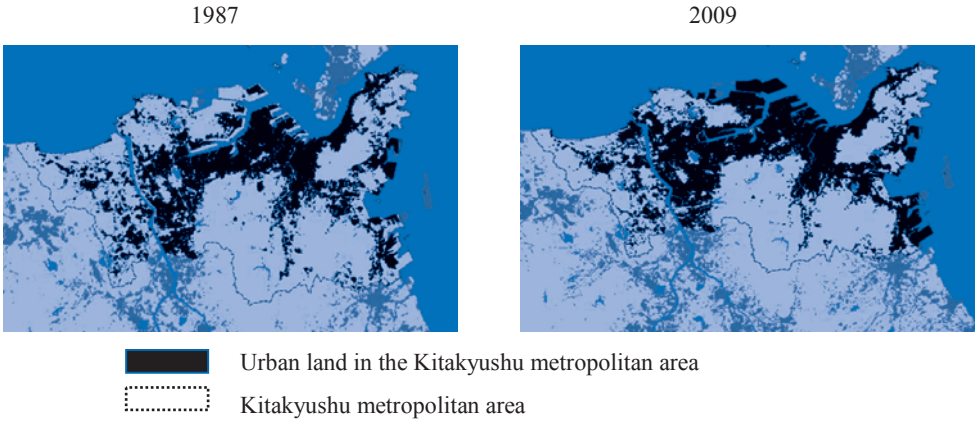
Kitakyushu is characterised by relatively high population density, but has experienced urban sprawl over the past few decades. Developable land in Kitakyushu is limited due to its mountainous landscape on one side and adjacent ocean on the other. The habitable land surface accounts for only 20% of total land surface of the city (99.79 km^2 out of 487.89 km^2) (City of Kitakyushu, 2012). Traditionally, urban areas in Kitakyushu have been relatively compact due to its geographical characteristics, and population density on urban land in the Kitakyushu metropolitan area is still high, with 3 728 pop/km^2, which is lower than Tokyo (6 501), Osaka (6 149) and Fukuoka (4 750) but higher than Nagoya (3 527) or Sendai (2 919) (Figure 1.16). However, like many other cities worldwide, Kitakyushu has experienced continued urban sprawl over the past decades. From 1987 to 2009, urban land in the Kitakyushu metropolitan area has increased by 123%, from 117 square kilometres to 261 km^2 out of 565 km^2 total land surface, while the population in the Kitakyushu metropolitan areas has decreased by 4.1% over the same period, from 1 221 892 in 1990 to 1 171 258 in 2010 (National Land Numerical Information, 2009; Census Japan, n.d.). Land cover data illustrates that the use of urban land and greenfield development expanded mainly westward (Figure 1.17). Many of these new developments are low-density residential neighbourhoods, while traditional urban centres in the Kitakyushu metropolitan area are losing population. This trend might be related to land use regulations under Japan's City Planning Act that do not sufficiently discourage suburban development, as well as to the possibility that people may consider finding a better quality of life outside the city centre.

Figure 1.16. **Population density in selected Japanese OECD metropolitan areas**



Source: *LandScan Global Population Database* (2009); National Land Numerical Information (2009), National Numerical Land information download service, *http://nlftp.mlit.go.jp/ksj-e/index.html*, accessed 31 August 2012 (for Kitakyushu); National Land Numerical Information (2006), National Numerical Land information download service, *http://nlftp.mlit.go.jp/ksj-e/index.html*, accessed 31 August 2012 (for the other metropolitan areas).

Figure 1.17. **Urban land cover change in the Kitakyushu metropolitan area**

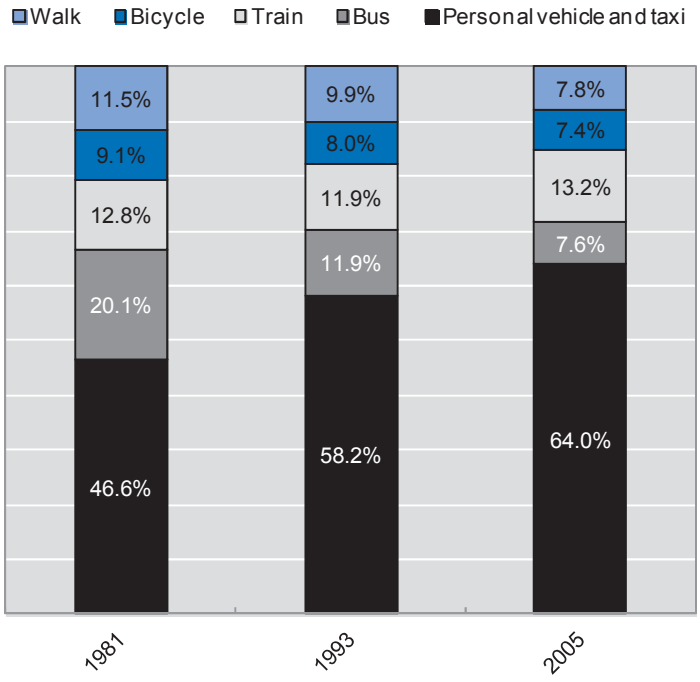


Note: Kitakyushu metropolitan area consists of the City of Kitakyushu, City of Nakama, Town of Ashiya, Town of Mizumaki, Town of Okagaki, Town of Onga, Town of Kurate and Town of Kanda. These maps are for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by these maps.

Source: National Land Numerical Information (1987) and (2009), *http://nlftp.mlit.go.jp/ksj-e/index.html*, accessed 31 August 2012.

CO_2 emissions from ground transportation in Kitakyushu are still moderate, but the growing use of private cars raises emission and air pollution levels. In 2007, transportation was the second biggest source of CO_2 emissions in the city, representing 10.2% of overall emissions, which was almost twice the amount of emissions stemming from the residential sector. Commuters who work or live in Kitakyushu increasingly take their car to work, while the number of people who commute by public transport, bike or walk is decreasing (Figure 1.18). The biggest changes occurred in the increasing number of people using personal vehicles to commute, from 45.7% in 1981 to 63.7% in 2005, and the decreasing number of people using the bus, from 20.1% in 1981 to 7.6% in 2005. In 2005, 30 417 fewer commutes were on public or non-motorised transport (walking, biking, bus and train) as compared to 1993 (-17%), while also in 2005, 15 386 more commuters used personal vehicles than in 1993 (+6%). Between 1990 and 2005, transportation-related emissions in Kitakyushu increased by 23%, while over the same period, on the national level, they increased by 17% (City of Kitakyushu, 2012; MOE, 2012).

Figure 1.18. **Changes in modal share for commuting in Kitakyushu**



Note: Data shows total commuting trips (including in-in city and in-out/out-in trips).

Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

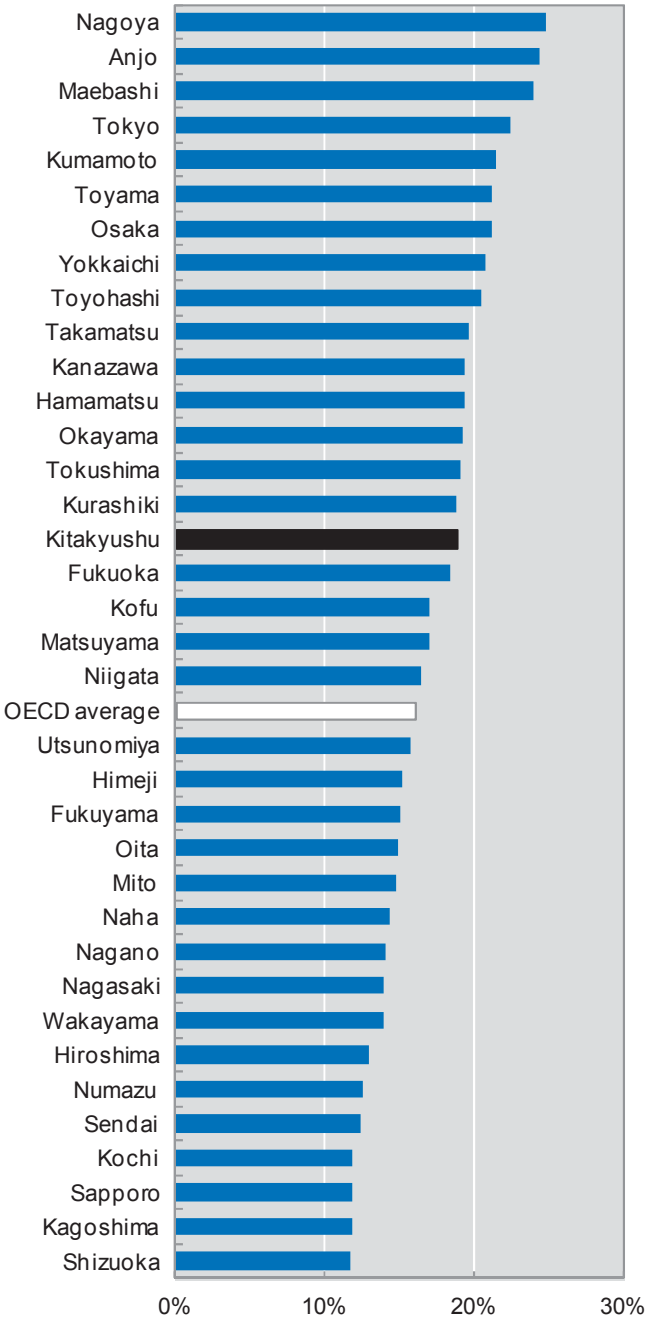
Some air and water quality indicators and stormwater management could still be improved

Overall, air quality is satisfactory in Kitakyushu, and pollution levels conform to Japanese and local air quality standards. However, the city still has problems with photochemical oxidants (O_x) and particulate matter (PM). The annual average level of nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) in Kitakyushu complies with Japanese and WHO standards. Despite significant decreases in PM levels detected by roadside monitoring over the past 15 years, $PM_{2.5}$ (fine particles) exposure is still higher than the OECD average and than in many other Japanese cities (Figure 1.19). Photochemical oxidants (O_x) still present a challenge, not only in Kitakyushu, but in many parts of Japan. In FY 2009, only one out of 1 152 ambient air-monitoring stations in Japan measured levels conforming to Japanese environmental standards (City of Kitakyushu, 2012). In part, the high O_x levels might be caused by transboundary pollution from the Asian continent, through advection currents blowing to Japan, including to the Kyushu region (NIES, 2010). In Kitakyushu, O_x levels have risen, in particular, over the last decade (Figure 1.2). As a reaction to high O_x levels, Kitakyushu asked local industries four times in 2007 to curtail production, and in 2009, the daily mean (12 hours) of O_x exceeded local standards of 0.06ppm (120 $\mu g/m^3$) and WHO guidelines of 100 $\mu g/m^3$ (8-hour mean) on 37 days (WHO, 2005; City of Kitakyushu, 2012).

Water quality in Kitakyushu is good, but further attention could be paid to some items and monitoring. Most water quality indicators have been improved or maintained their level since the 1980s. Biological oxygen demand (BOD), as measured in six rivers, and chemical oxygen demand (COD), as measured in the Dokai Bay, are low and almost unchanged since the 1980s (City of Kitakyushu, 2012). In recent years, measurements of 62 items in 5 rivers and 11 ocean sites have met all environmental standards related to human health and most monitoring-required water quality parameters. In FY 2010, however, high measures of boron and fluorine were detected at sites near the ocean, which was possibly due to boron and fluorine derived from sea water (City of Kitakyushu, 2012). Also, wastewater discharged by some companies into public waters – rivers or sea – still exceeds local standards. Unannounced inspections by the city in FY 2010 of 601 businesses led to 12 administrative guidance procedures for inadequate wastewater management (City of Kitakyushu, 2012).

Stormwater management has become increasingly important over the past decade, due to heavier rainfalls, and needs further improvement. Repeated stormwater runoffs during heavy rains (e.g. 1999, 2003, and July 2009 and 2010) increased attention to stormwater management in Kitakyushu. Based on a 10-year rainfall projection, Kitakyushu expects an increase of rainfall by 53.1mm/h and has selected 13 858 hectares as a target area for a Stormwater Management Improvement Zone (City of Kitakyushu, 2012). Key measures for improvement within this zone include better flood control, increased capacity of pumping stations, and stormwater reservoirs that improve storm sewer tributaries and safeguard facilities against water immersion. Today, about 70% of the designated zone is equipped for heavier stormwater events, and this coverage is expected to rise to 73% in 2021 (City of Kitakyushu, 2012).

Figure 1.19. **Population exposure to $PM_{2.5}$ levels in Japanese cities and OECD average, 2008**

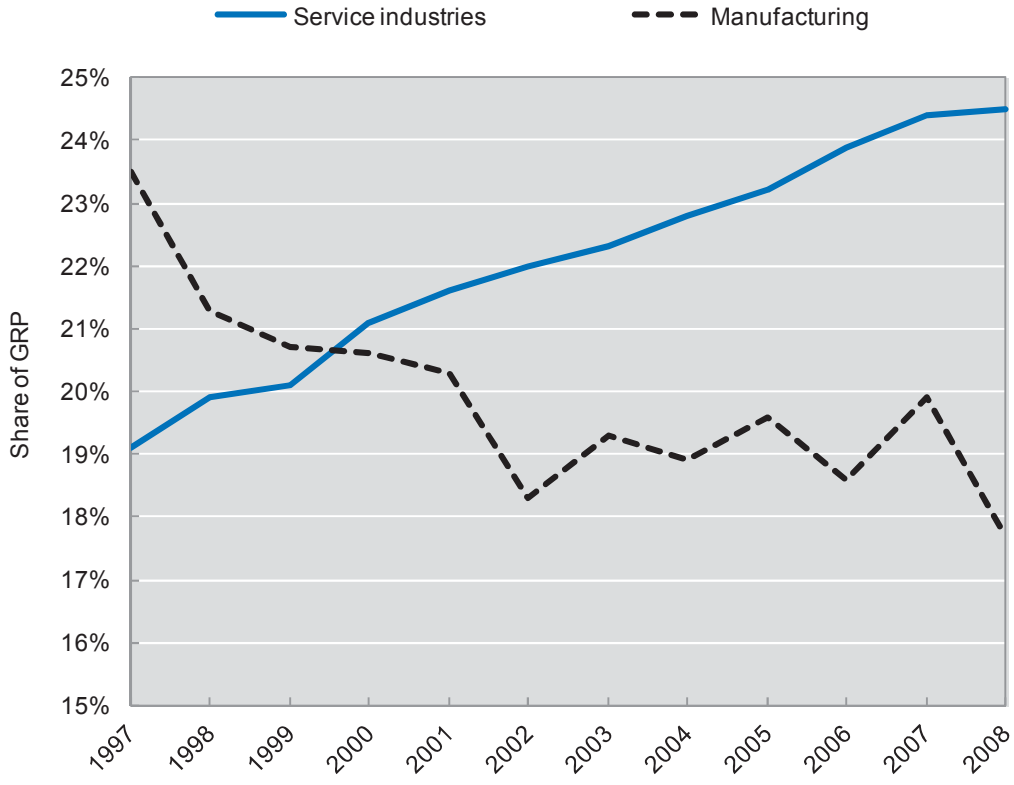


Source: OECD Metropolitan Database, http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.

New sources of growth in services, specialised manufacturing and green industries

Kitakyushu is going through a slow but continuous transformation away from manufacturing towards more services. Manufacturing was its key industry over the last century, but the service industry has gained importance in the last decade (Figure 1.20). In 1997, manufacturing represented 23.5% of the local economy (GDP), whereas services (excluding finance and real estate) accounted for only 19.1%; in 2007, services already represented 24.4%, while manufacturing had declined to 19.9% of economic output (Table 1.1). While Japan was going through massive de-industrialisation in the 1980-1990s, Kitakyushu was still a stronghold of manufacturing. The current shrinking of the manufacturing sector has occurred more gradually in Kitakyushu than elsewhere in Japan, but the move from manufacturing towards services is now evident. From a green growth perspective, services can offer higher value-added activities and can improve productivity, while often being less energy intensive and thus helping to reduce greenhouse gas emissions.

Figure 1.20. **Share of services and manufacturing in Kitakyushu's economy**



Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Table 1.1. **Change in economic output (GDP) by sector, 1997-2007**

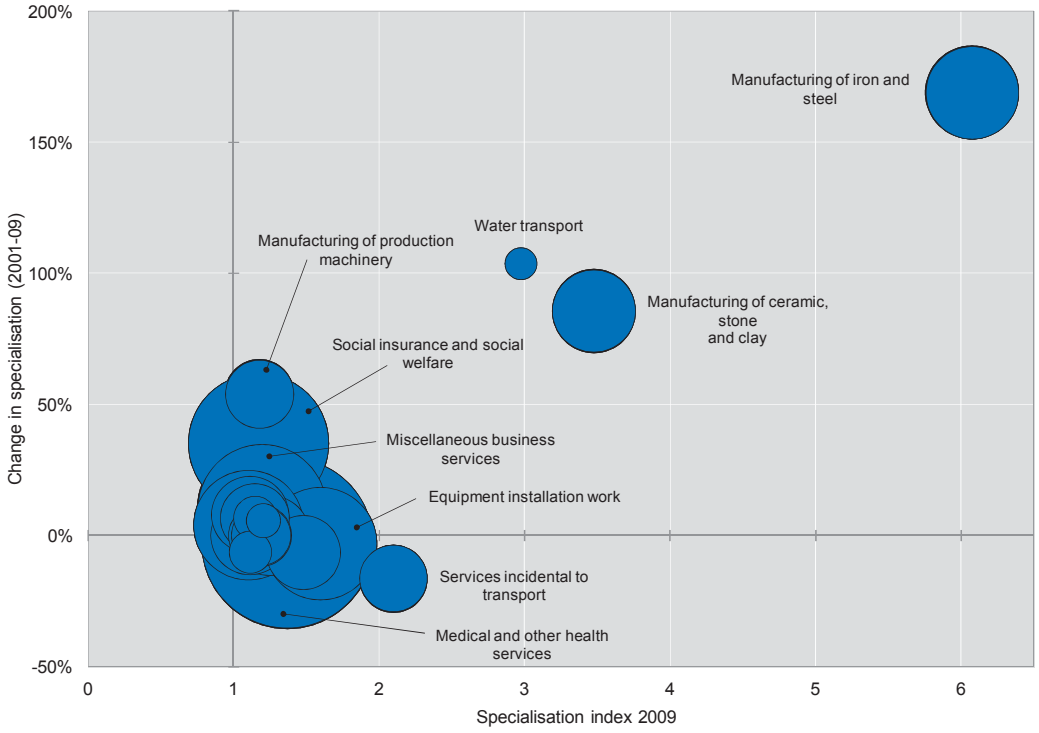
Sector	% of total 1997	% of total 2007	% change 1997-2007
Service industry	19.1	24.4	21.72
Manufacturing	23.5	19.9	-18.09
Transportation and information	11.6	12.7	8.66
Wholesale and retail trade	11.3	9.7	-16.49
Real estate, rental and leasing	7.8	9.7	19.59
Public administration	6.9	7.3	5.48
Finance and insurance	6.5	5.1	-27.45
Construction	7.1	4.9	-44.90
Utilities	3.5	3.5	0.00
Other	3.0	2.8	-7.14

Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

As manufacturing shrinks, certain segments in manufacturing as well as social insurances and welfare become increasingly specialised. A location quotient specialisation index shows that between 2001 and 2009, iron and steel manufacturing grew in terms of total employees (23%) and became significantly more specialised (Figure 1.21). This means that contrary to the overall shrinking of the manufacturing sector, the employment share in iron and steel manufacturing in Kitakyushu (out of total employees) grew by 169% relative to the employment share in the same sector in Japan (out of total employees). A remarkable increase in specialisation can also be observed in ceramic, clay and stone product manufacturing (86%), as well as in production machinery manufacturing (54%). This shows that Kitakyushu specialises in areas of traditional strength – iron, steel and ceramics – as well as in some higher value-added manufacturing, such as production machinery. While the largest services sector, medical and other health services, has become slightly less specialised over the past decade (-3%) despite overall employment growth in the sector (10%), social insurance and social welfare has strongly expanded (222%) and increased in specialisation (35%). This expansion and specialisation of social insurance and social welfare is likely to reflect job losses in declining industries, as well as the rapidly ageing population.

Fukuoka has a more service-based economy and shows different specialisations from Kitakyushu, but overlaps in some sectors between the cities point to direct competition. Kitakyushu and Fukuoka are part of the Fukuoka prefecture, situated at only an hour's train distance from one another, sharing parts of their respective labour markets. Fukuoka has a different industry profile from Kitakyushu and relies more on service industries (Figure 1.22). Recent increases in Fukuoka's specialisation include equipment and installation work, public health and hygiene, production and distribution of gas, communications and financial auxiliaries. Comparing both cities, two specialization trends stand out: in Fukuoka, the

Figure 1.21. **Dynamics in Kitakyushu's sectoral specialisations, 2001-2009**



Source: City of Kitakyushu (2002), "2001 Establishment and Enterprise Census", City of Kitakyushu website, *www.city.kitakyushu.lg.jp/files/000019936.xls*; MPMHAPT (Ministry of Public Management, Home Affairs, Posts and Telecommunications) (2001), "2001 Establishment and Enterprise Census", Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/Xlsdl.do?sinfid=000000292646*; MIC (Ministry of Internal Affairs and Communications) (2009), "Economic Census for Business Frame", data for Kitakyushu and Fukuoka, Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000004967194&releaseCount=1*; MIC (2009), "Economic Census for Business Frame", data for Japan, Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000005007518&releaseCount=1*, accessed 31 August 2012.

increasing specialization in equipment installation work (89%) and the decreasing specialisation in miscellaneous business services (-15%); and in contrast, in Kitakyushu, the decreasing specialisation (-3%) in equipment installation work and an increasing specialisation in miscellaneous business services (10%). This inverse dynamic strengthens the observation that Kitakyushu is reinforcing its service sector, but also points to potentially counterproductive intra-regional competition. Instead of moving activities from one city to the other, both cities would profit from identifying the synergies from which they can benefit in exploiting their common strengths in several sectors.

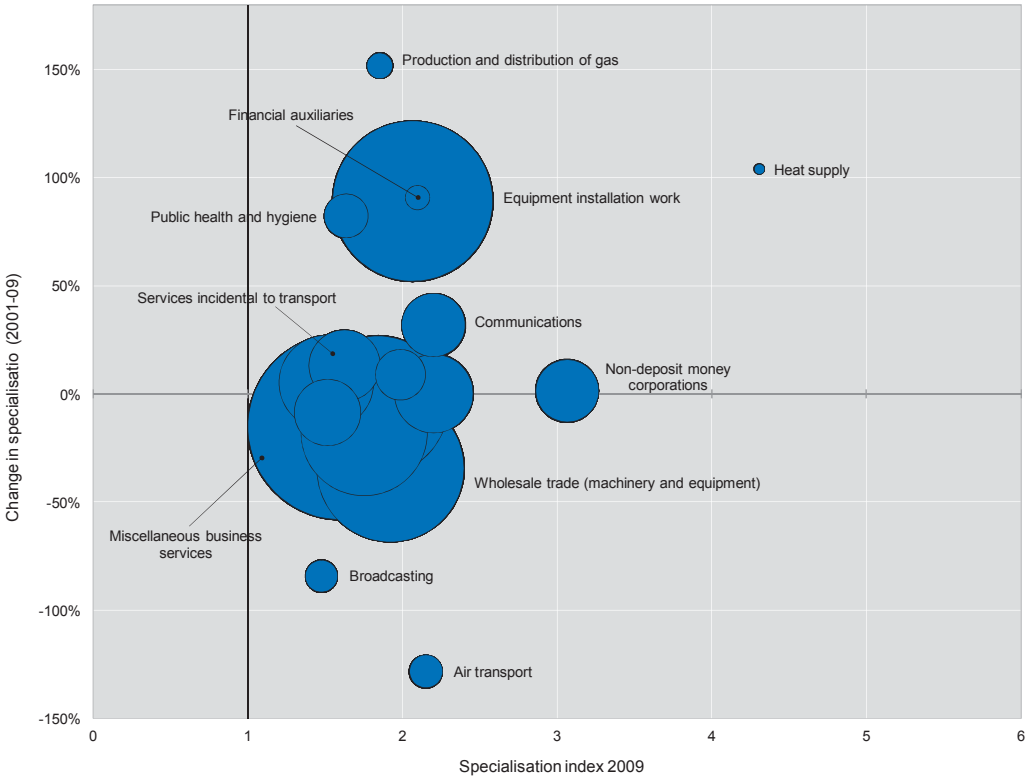
Table 1.2. **Specialisation index Kitakyushu, 2009**

Sector	Employees 2009	% change in employees 2001-09	Specialisation index 2009	% change in specialisation 2001-09
Manufacture of iron and steel	11 074	23	6.08	169
Manufacture of ceramics, stone and clay	8 809	5	3.48	86
Water transport	1 285	50	2.97	104
Services incidental to transport	5 754	-28	2.10	-16
Equipment installation work	16 302	-1	1.60	-3
Road passenger transport	7 174	-2	1.48	-6
Medical and other health services	37 513	10	1.37	-3
Technical services not classified elsewhere	8 293	n.d.	1.25	n.d.
Manufacture of non-ferrous metals and products	1 469	-9	1.21	6
Miscellaneous business services	21 225	21	1.20	10
Manufacture of chemical and allied products	4 490	-2	1.19	0
Food and delivery services	5 023	87	1.18	n.d.
Manufacture of production machinery	6 013	4	1.18	54
Social insurance and social welfare	25 169	222	1.17	35
Automobile maintenance	2 439	-9	1.15	7
Insurance institutions, including agents, brokers and services	6 043	11	1.15	7
Machine etc., repair services, except otherwise classified	2 352	2	1.11	-6
Employment and worker dispatching services	7 953	n.d.	1.11	n.d.
Real estate lessors and managers	7 705	-50	1.11	8
Road freight transport	6 043	-53	1.11	4

Note: The table presents a selection of sectors in which Kitakyushu is more specialised than Japan.

Source: City of Kitakyushu (2002), "2001 Establishment and Enterprise Census", City of Kitakyushu website, *www.city.kitakyushu.lg.jp/files/000019936.xls*; MPMHAPT (Ministry of Public Management, Home Affairs, Posts and Telecommunications) (2001), "2001 Establishment and Enterprise Census", Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/Xlsdl.do?sinfid=000000292646*; MIC (Ministry of Internal Affairs and Communications) (2009), "Economic Census for Business Frame", data for Kitakyushu and Fukuoka, Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000004967194&releaseCount=1*; MIC (2009), "Economic Census for Business Frame", data for Japan, Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000005007518&releaseCount=1*, accessed 31 August 2012.

Figure 1.22. **Dynamics in Fukuoka's sectoral specialisations, 2001-2009**



Source: City of Fukuoka (2002), "2001 Establishment and Enterprise Census", City of Fukuoka website, *www.city.fukuoka.lg.jp/data/open/cnt/3/7347/1/159105355517.xls*; MPMHAPT (Ministry of Public Management, Home Affairs, Posts and Telecommunications) (2001), "2001 Establishment and Enterprise Census", Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/Xlsdl.do?sinfid=000000292646*; MIC (Ministry of Internal Affairs and Communications) (2009), "Economic Census for Business Frame", data for Kitakyushu and Fukuoka, Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000004967194&releaseCount=1*; MIC (2009), "Economic Census for Business Frame", data for Japan, Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000005007518&releaseCount=1*, accessed 31 August 2012.

Table 1.3. **Specialisation index Fukuoka, 2009**

Sector	Employees 2009	Change in employees 2001-09	Specialisation index 2009	Change in specialisation 2001-09
Heat supply	164	98	4.31	104
Non store retailers	5 452	n.d	3.16	n.d.
Non-deposit money corporations, including lending and credit card business	6 020	-18	3.06	1
Wholesale trade (textile and apparel)	9 569	49	2.20	0
Communications	6 184	205	2.20	32
Air transport	1 662	-92	2.15	-128
Financial auxiliaries	931	196	2.10	91
Equipment installation work	39 418	10	2.07	89
Advertising	3 881	193	1.99	9
Wholesale trade (machinery and equipment)	33 343	49	1.92	-34
Production and distribution of gas	1 016	20	1.85	152
Information services	29 787	12	1.84	-5
Miscellaneous wholesale trade	24 578	-10	1.75	-18
Employment and worker dispatching services	23 274	n.d.	1.75	n.d.
Public health and hygiene	2 956	-94	1.64	82
Services incidental to transport	7 833	-15	1.63	13
Miscellaneous business services	53 083	8	1.60	-15
Real estate agencies	6 781	0	1.52	-9
Road passenger transport	13 670	14	1.51	5
Broadcasting	1 553	-27	1.48	-84

Note: The table presents a selection of sectors in which Fukuoka is more specialised than Japan.

Source: City of Fukuoka (2002), "2001 Establishment and Enterprise Census", City of Fukuoka website, *www.city.fukuoka.lg.jp/data/open/cnt/3/7347/1/159105355517.xls*; MPMHAPT (Ministry of Public Management, Home Affairs, Posts and Telecommunications) (2001), "2001 Establishment and Enterprise Census", Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/Xlsdl.do?sinfid=000000292646*; MIC (Ministry of Internal Affairs and Communications) (2009), "Economic Census for Business Frame", data for Kitakyushu and Fukuoka, Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000004967194&releaseCount=1*; MIC (2009), "Economic Census for Business Frame", data for Japan, Portal Site of Official Statistics of Japan, *www.e-stat.go.jp/SG1/estat/GL08020103.do?_xlsDownload_&fileId=000005007518&releaseCount=1*, accessed 31 August 2012.

Green industrial assets are emerging and growing

Green economic activities and growth can be identified primarily within three areas: recycling of residential and industrial waste, industrial energy efficiency and resource-efficient products, and emerging green technologies.

- Kitakyushu strategically invested in the recycling industry at the first signs of de-industrialisation during the early 1990s. Major advances in the recycling sector qualified the city for the "Eco-Town" pilot project (a national designation) in 1997, and Eco-Town has become the cornerstone for growing green industries in Kitakyushu.
- Kitakyushu made increased energy efficiency of its major polluting industries a central element in reducing environmental externalities from heavy industry. This

has become a key asset today for producing energy-efficient and resource-saving products, which Kitakyushu exports worldwide.

- Increasing investments in semiconductor R&D and green technologies offer a key asset to Kitakyushu as a way of engaging with emerging technologies, including clean energy technologies and ICT.

Developing an exemplary recycling sector was a starting point for Kitakyushu to develop green industry assets. "Eco-Town" (the title of the pilot project given to Kitakyushu by the national government in 1997) was built in response to early signs of de-industrialisation, with the aim of developing a "resource, recycling-based" society. It is located in a 38.8-hectare industrial park and consists of 29 recycling-related companies that form a recycling cluster for treating both industrial and residential waste (City of Kitakyushu, 2012). The cluster extracts rare metals and other recyclable materials from a diverse range of products, such as cars, PET bottles, electronic household appliances and more. Non-recyclable waste is incinerated in an on-site waste-to-energy (WTE) facility that supplies adjacent recycling firms with electricity. Slag, Kitakyushu's largest industrial waste product, is processed for reuse as cement material. Sludge from wastewater treatment, another waste product, is used as input for local WTE production or recycled as feedstock for cement production. One hundred tonnes of the 200 tonnes of sewage treated sludge generated every day is used as a raw material for cement. The remaining 100 tonnes are mixed for combustion with general waste and converted to steam and electric power. Currently, Kitakyushu is studying the viability of new recycling activities, in particular the recycling of solar panels and systems, an area that is likely to gain importance in the near future.

High energy efficiency is a key asset for Kitakyushu's heavy industry, which has increasingly focused on resource-efficient production of a number of products. Japan's iron and steel manufacturing reached high energy efficiency levels early on and is among the most energy-efficient worldwide (IEA, 2007). A 2008 report from the Research Institute of Innovative Technology for the Earth (RITE) measures the energy efficiency of Japan's steel manufacturing at 0.59 tonnes-oil/tonnes-crude steel, which, by comparison with Germany (0.69), France (0.71) and the United Kingdom (0.72), ranks as the world's most energy-efficient steel industry (JISF, 2008). However, manufacturing of iron and steel is still the largest driver for CO_2 emissions worldwide, representing 27% of all direct industrial CO_2 emissions.

In Kitakyushu, absolute emissions from the iron, steel and other manufacturing are largely responsible for the high CO_2 emissions per capita, but the energy efficiency of its iron and steel manufacturing also makes this sector an asset for the city's green growth agenda. Moving the iron and steel production from Kitakyushu or Japan to another country would be likely to create more CO_2 emissions for the same output. Kitakyushu's iron and steel industry offers a range of products with advanced energy performance, such as flat rolls, magnetic steel sheets, thin sheets or surface-treated steel sheets. These products represent over 80% of iron and steel exported from Kitakyushu to China and about 75% of all products shipped (City of Kitakyushu, 2012). The growing exports of these products assure economic growth for the city. Kitakyushu can thus offer environmentally advanced products to other countries that would in all likelihood emit more CO_2 if they were to produce such products locally. Kitakyushu's manufacturing can thus contribute to minimising CO_2 emissions globally, if it maintains its leading position in energy efficiency and further reduces the CO_2 intensity of its production; such reductions have to be achieved locally.

Box 1.1. **Kitakyushu "Eco-Town"**

The Kitakyushu Eco-Town is an environmental industrial park that facilitates resource circulation and eco-industries. In 1997, the Japanese government recognised it as the first of its kind in Japan. Eco-Town is situated on 38.8 hectares in the Hibikinada area of the Wakamatsu ward and comprises 29 industrial plants, 16 research facilities and a waste-to-energy (WTE) plant. Recycling ranges from plastic PET bottles, automobiles and electronic home appliances, to mixed construction waste, fluorescent tubes and office equipment, etc. All non-recyclable residuals are processed in the Kitakyushu Eco-Energy Co. Ltd.'s direct melting furnace situated in Eco-Town. This WTE plant recycles melted materials into slag and metals and provides 99 870 MWh of electricity to the adjacent recycling facilities, meeting all of Eco-Town's electricity demand. Eco-Town reduces 380 000 tonnes of CO_2 per year (FY 2010) through recycling and WTE.

Total investments (private and public) into the Eco-Town amount to JPY 66.8 billion: as of March 2012, 72% from private sources, 15% from the national government, 10% from the City of Kitakyushu and the rest from other sources, including Fukuoka prefecture. Since its launch in 1991, Eco-Town has created 1 418 jobs and aims to attract more companies and jobs to the area. In co-operation with businesses, government, academia and government, enclosed research facilities in Kitakyushu focus on practical research areas, in particular on higher value-added recycling activities. In 2001, a presentation platform was created – the Kitakyushu Eco-Town centre – to present Eco-Town activities to the public and to inform and educate the public about the concept of a resource-recycling-based society. Over 1 million people have visited the Eco-Town centre to date.

In addition to attracting further recycling-related businesses into the designated area, the basic concept of Eco-Town is now being expanded to the whole City of Kitakyushu. Certain aspects of the Eco-Town offer an opportunity for expansion to a larger scale, including its physical size (i.e. considering the city as an Eco-Industrial complex), recycling local industrial waste and reuse of industry by-products such as heat for residential and commercial use.

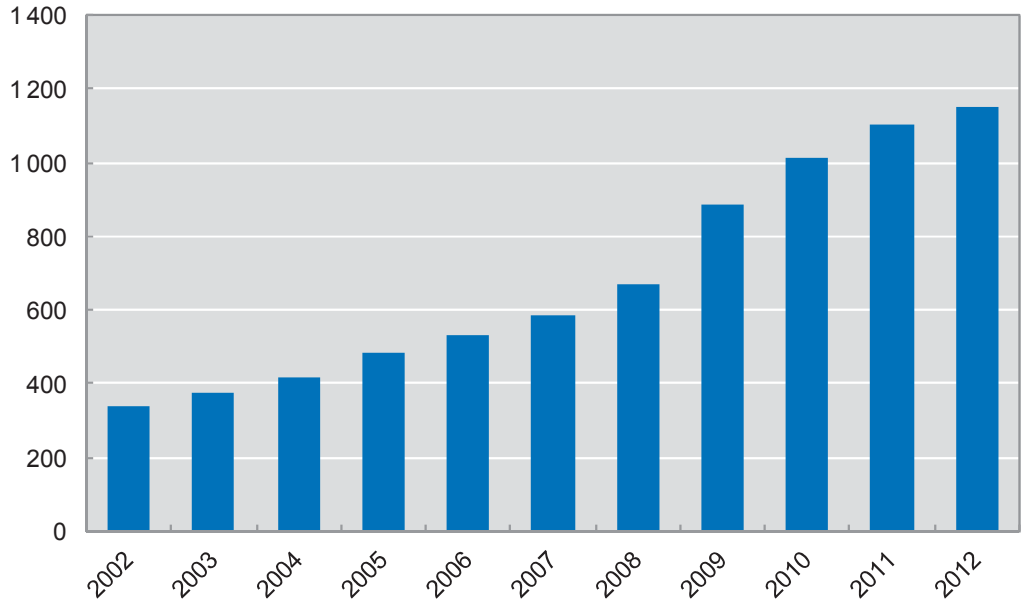
Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan; City of Kitakyushu Office for the Environmental Future City Promotion (2011), "City of Kitakyushu Eco-Town Project", information brochure, Environment Bureau, City of Kitakyushu, Japan.

Successful energy-efficient and resource-saving products from a number of traditional local industries are contributing strongly to Kitakyushu's growth. The local ceramic, chemical and electric manufacturing industries are successfully selling resource-saving products to national and international markets. While most of these industries are resource intensive, they can contribute to emission reductions through resource-efficient product manufacturing and reducing their production process emissions. TOTO, a large ceramic and water appliances manufacturer in Kitakyushu, has focused primarily on eco-efficient products in recent years, and its revenues from new products amounted to 68% of total sales in 2009. Mitsubishi Chemical Corporation works on light-emitting diode (LED) technology, batteries for electric vehicles and light-weight automobile components, all of which can contribute to CO_2 emission savings. It addition, it announced ambitious CO_2 emission reduction targets for its own production: 20% by 2015 and 50% by 2050. Yaskawa Electric Corporation is another example. It commercialises inverter controls for electric motors, which can significantly improve motor-drive efficiency and thus lead to energy savings. The city labels all types of technology, products and services that lead to the reduction of environmental impacts as

"Eco-Premium", products to help raise product awareness and stimulate product growth. To date, 124 companies have been labelled as "Eco-Premium".

A survey undertaken by the City of Kitakyushu found that a growing number of companies reported practicing green management or producing green products or services. In spring 2012, the city sent a survey to more than 15 000 companies, asking whether their products *i*) have low environmental impacts, including the effects from secondary products, *ii*) save energy or preserve the environment; *iii*) are easy to maintain; *iv*) are made by using recycled and reused materials; *v*) are rented and leased; or *vi*) provide services and information related to the above; or if companies practice "green management", defined as having obtained ISO 14001, engaging in Eco Action 21 (the Japanese environmental management system) or having a unique environmental management system of their own. The response rate to the survey was 12% and of these replies, 1 824 companies reported that they increasingly can respond positively to at least one of the above-mentioned criteria (Figure 1.23). Since companies are more likely to answer if they can respond positively to one of the criteria, the survey results within the number of replies cannot be taken as representative for the city. And for the companies that replied, the criteria allow many small activities to count as "greening" the company's products or services, even if they might not represent the overall activity of the company. The survey thus merely represents a trend of perception and shows that private companies in Kitakyushu increasingly value "green" management, products and services.

Figure 1.23. **Number of firms in Kitakyushu reporting greening activities**



Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

With respect to growing and emerging technologies, Kitakyushu is strongly investing in semiconductor, ICT and green technology R&D. Kitakyushu's R&D expenditures in green technologies rose 4.6% per year (on average; and far higher, 10.8%, from 2010 to 2011) from 2006-2011 to JPY 1.9 billion in 2011, representing 0.05% of the city's

GDP. This is still modest compared to national expenses in environment-related fields, which amount to 0.3% of national GDP (JPY 1.1 trillion in 2008), but the growing budget clearly indicates the city's ambition to move faster into the growing field of green technologies and smart infrastructure (City of Kitakyushu, 2012). Green technology R&D in Kitakyushu focuses on car electronics and electric vehicle components (e.g. batteries), as well as on semiconductors and their applications in green technologies (e.g. renewable energy technologies). Smart energy systems have recently become a new focus and a first smart-grid experiment is soon going to be operational in the near future (Box 2.6). Research in solar cell production, solar cell and installation structures recycling and marine energy are promising activities in the renewable energy technology field. These areas are currently gaining in importance in Japan through the recent introduction of national feed-in tariffs for renewable energy exploitation. Some of the assets in the semiconductor industry and ICT could be applied to the growing fields of sustainable products, resource-efficient industrial production and energy systems, such as smart grids, that help to reduce energy consumption.

Many of these emerging industries require new skills, which points to the need to renew training programmes and attract an educated workforce to Kitakyushu. Skilled labour, for example workers with a background in material sciences or engineering, who are needed for higher value-added recycling and manufacturing activities, are in short supply. Immediate labour shortages are being met by importing the necessary workforce, but this is unsustainable. The emerging green technology sector will soon demand skilled labour, which is not available, owing to a lack of local training and education in this field. Many companies rely on personal on-the-job training, which has recently been professionalised through a formal "Meister" system (with 39 people qualified so far) that certifies skilled and experienced workers to teach young people on the job. Meisters also provide technical instructions outside their own companies and thus offer training in skills in a range of companies in the city. In addition to existing science and technology studies, the city has also introduced training programmes in environmental engineering. However, an emerging green sector is likely to require specialised skilled human capital that the current education infrastructure may not be equipped to supply. This applies in particular to skills in engineering, science and technology.

Notes

1. The elderly dependency rate is defined as the ratio between the elderly population and the working-age (15-64 years) population.
2. Data for elderly dependency rates refers to the whole Fukuoka prefecture.

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Chapter 2

Policies and sectoral opportunities for green growth in Kitakyushu

Chapter 2 reviews Kitakyushu's plans, strategies and sectoral policies and their potential for further strengthening green growth. It assesses urban sectors and activities that foster economic growth and reduce pressure on the environment, focusing on land use and transportation, waste recycling, energy, energy efficiency in buildings as well as potentially undervalued industrial assets that could foster green growth and exports.

Key findings

- Kitakyushu has a comprehensive plan (the Green Frontier Plan) for sustainable development that defines a vision of a low-carbon city and spells out concrete strategies for a path towards these goals. Since 1997, the city was designated several times by the national government for its efforts towards sustainable development, in particular for the Eco-Town recycling cluster. As an important strategy for sustainable development, green growth in Kitakyushu needs a clearer alignment of economic and environmental policy goals, which have hitherto been developed separately.
- One of the important drivers for the rising greenhouse gas emissions in Kitakyushu is its sprawling development pattern and corresponding increases in private car use. Integrated land use and transportation planning towards more compactness and transport-oriented development could increase the efficiency of the transportation system and facilitate investment in public transport. Infill development as well as brownfield and waterfront redevelopment could help achieve this, and this would also help reviving the currently declining city centres.
- Low waste production, high recycling rates and a unique recycling cluster (Eco-Town) are a testament to Kitakyushu's successful waste policies and management. While the Eco-Town is a successful pilot project, its economic viability is fragile today, and higher value-added recycling activities are needed to increase the scale and profitability of recycling activities. Energy recovery from incineration of non-recyclable waste and the use of excess energy (heat, gas and electricity) from industries for commercial and residential use present a key area in which to expand principles of the Eco-Town to larger parts of Kitakyushu.
- The centralised energy supply in Kitakyushu is highly dependent on fossil fuel imports. Japan's recent ambitions to increase the share of its renewable energy supply and to build more production capacity for green energy technologies present an opportunity for Kitakyushu to exploit more of its own renewable energy sources and to identify potential for energy technology R&D and production. Kitakyushu's smart-grid experiment (one of four in Japan) is an important step towards creating the conditions to reduce energy consumption through demand management and to integrate larger shares of renewable and decentralised energy into the grid.
- Rising energy consumption could also be reduced through efficiency gains in buildings, notably in the commercial sector. Kitakyushu's commercial sector is the second-largest energy consumer after industries, and its consumption is rising. Energy efficiency in buildings could be achieved through retrofits or through new energy-efficient building practices. Current efficiency measures are mainly applied to public sector buildings. Expanding retrofits to commercial and residential buildings would allow significant energy and cost savings and stimulate local job creation and economic activity in energy-related services and in the production of energy-saving products.

Green growth in Kitakyushu

The concept of green growth has given rise to much debate. Green growth aims to steer economic growth in a different direction, addressing externalities and other factors poorly served by current measures of economic activity. It also recognizes that environmental policies that do not support economic growth and wealth creation are

not sustainable in the long term. For the purposes of this case study, we define green growth in cities as:

> *Fostering economic growth and development through urban activities that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services* (OECD, 2013a).

This definition draws from the OECD Green Growth Strategy, which applies to national-level policies and which emphasises fostering economic growth and development while ensuring the continual provision of resource and ecosystem services (OECD, 2011). The definition for green growth in cities differs in that it explicitly takes into account negative environmental externalities. This is crucial, because economic growth and development on the urban level can be undermined by the negative externalities of urban agglomeration, including traffic congestion, air pollution and development on land that provides ecosystem resources.

It is valuable to examine opportunities for green growth in cities because it is at the urban level that complementarities between environmental and economic policies can be most easily identified. Such complementarities can yield benefits in the returns generated when one policy is enacted alongside another (Macedo and Oliveira Martins, 2006). Cities' activities to deliver the public services and conditions that will foster growth can enhance, and be enhanced by, cities' activities to improve environmental quality and reduce pressures on the environment. In this way, cities may more effectively deliver on national-level environmental and economic objectives – whether or not they are identified as "green growth" – than national-level policies.

To assess the potential benefits of pursuing green growth in cities, the report focuses on the impact of policies on:

i. Urban attractiveness, defined here as the conditions that will attract firms and high-skilled workers to a metropolitan region.

ii. Job creation, which includes job opportunities at low, medium and high skill levels. We do not attempt to calculate net employment growth, but rather look at which activities might foster job creation in a particular green growth sector.

iii. Increasing the supply and demand of regionally produced green goods and services, which we define as those that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services.

Green growth in cities must be understood within the place-specific context of each city, and Kitakyushu is a distinguished instance of what are commonly known as "green cities". Kitakyushu offers an instructive example of an industrialised city that has transformed itself and turned toward green growth. Its salient characteristics include its history as an industrial centre of Japan; its fight against environmental degradation from negative externalities of local heavy industries; major improvements in the environmental performance of its industries and in the city's environmental conditions; and a unique combination of greening heavy industries while building an emerging green sector. This section focuses on green growth policies and on sectoral opportunities that can reduce environmental pressures while fostering economic growth.

Kitakyushu's plans and strategies for sustainable development

Since early 2000, Kitakyushu has developed comprehensive plans and strategies to improve the city's environmental conditions and to green its economic growth. Launched in 2004, *the Grand Design for a World Capital of Sustainable Development* envisions Kitakyushu as a "World Capital of Sustainable Development". The "Kitakyushu Council for a World Capital of Sustainable Development" brought together a large number of stakeholders and local institutions and integrated their ideas and proposals into the Grand Design. The Grand Design's major objective is the "development of a city with true wealth and prosperity inherited by future generations", and is built on three pillars (each of which spells out ten principles) of environmental action: *i*) live together, create together, *ii*) develop economically in a healthy environment, *iii*) enhance the sustainability of the city. Two "master concepts" were formulated to guide current implementation, the "Energetic Start! Kitakyushu Plan" and the "Environmental Basic Plan". Each plan sets out a strategy and respective policy measures with a focus on human resource development, industries, city life, recycling and environmental conservation.

In 2009, following Kitakyushu's designation as an "Eco-Model City", the *Green Frontier Plan* (GFP) was designed to present concrete measures for a low-carbon society (City of Kitakyushu, 2012). The plan was developed in collaboration with residents, firms and universities, and its main objectives are to decrease greenhouse gas emissions in the city by 30% by 2030, and by at least 50% by 2050 (compared to 2005), while reaching 40% economic growth by 2050. In addition, inter-city environmental diplomacy with Asian countries aims to reduce 23.4 million tonnes of greenhouse gas emissions (representing 150% of Kitakyushu's emissions in FY 2005) by 2050 (City of Kitakyushu, 2012). The plan provides five strategic measures to guide implementation: *i*) convert Kitakyushu into a stock-based city, *ii*) establish industrial clusters, *iii*) develop a pro low-carbon learning system, *iv*) create a fulfilling life for a low-carbon society, and *v*) transfer low-carbon technology to other Asian cities. The first four measures are expected to bring the 50% emission reduction (8 million tonnes) in Kitakyushu by 2050, while the transfer of low-carbon technology to Asia should lead to additional emission reductions in Asia.

National designations for model and demonstration projects

In addition to the city's ambitious plans and strategies, national government designations and local demonstration projects showcase the commitment of both the national government and the City of Kitakyushu to green growth. National designations include the *Eco-Model-City* project, the *Future Cities* programme and the *Special Deregulation Zone for International Strategy* – run by the Regional Revitalisation Bureau of the Cabinet Secretariat in co-ordination with respective ministries – as well as the *Eco-Town* and the *Smart Community Demonstration Area,* designated by the Ministry of Economy, Trade and Industry (METI) (Table 2.1). All projects resulting from national designations are implemented by the City of Kitakyushu in co-operation with private companies.

Table 2.1. **National designations for Kitakyushu**

1997	2008	2010	2011	2011
Eco-Town	Eco-Model-City	Smart Community Project	Future City initiative	"Green Asia" Comprehensive Special Zone
Develop the Kitakyushu recycling cluster	Build exemplary approaches for a low-carbon society.	Test and demonstrate a smart community approach, including a smart grid and smart mobility.	Formulate best practices in technologies, services and city development.	Develop industries, technology and environmental infrastructure in Asian cities; promote green innovation worldwide.
Total investments in the recycling complex amount to almost JPY 67 billion (as of March 2012). The project was expanded in 2004 to encompass the entire city.	Requires the city to lay out a five-year action plan with detailed steps towards a low-carbon society (The Green Frontier Plan in Kitakyushu).	In co-operation with Nippon Steel. One of four smart community projects in Japan. The only project with a smart grid that includes a demand-side management system.	Broader scope than the Eco-Model City, including resource and water recycling, and ageing-related measures. Has JPY 1 billion (cabinet office) budget for pioneering projects.	Measures and reforms are defined in collaboration between local representatives and the national government: deregulation, tax incentives and financial assistance are an integral part of the plan.

Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Toward a better integration of environmental and economic policies

The different green development plans and designations reflect a determination to move towards a low-carbon society. Although the existing projects are excellent examples for urban green growth approaches, several are demonstration projects that do not easily lend themselves to implementation citywide. The most comprehensive vision of sustainable development is the *Grand Design for a World Capital of Sustainable Development*, whose sustainability goal includes environmental, economic and social elements. However, the concrete policy measures for reaching such a goal, as spelled out in the subsequent *Green Frontier Plan*, only marginally address two of Kitakyushu's central issues: *i*) greenhouse gas emission reductions from the major pollution sources, notably power production and industrial combustion, and *ii*) the co-ordination and integration of environmental and industrial policies (City of Kitakyushu, 2012).

Harnessing green growth opportunities in Kitakyushu depends notably on better aligning environmental and economic development policy goals. As in many OECD cities, current planning documents and strategies do not yet explicitly link environmental and economic targets, which, other than in the Green Frontier Plan, have been pursued largely along parallel tracks. The major policies in the current Kitakyushu Industrial Strategy, for instance, do not specifically target the green sector (City of Kitakyushu, 2012). The gradual depletion of traditional industries in Kitakyushu, in particular of labour-intensive and low value-adding manufacturing segments, demands investment in higher value-added activities and future industries, including green technologies. Increasing activities and investment in such sectors can

be confirmed e.g. through growing numbers of patent applications, but this potential can only be translated into new industrial activities and economic growth if conditions are favourable for new industries. The city's structural transformation from a manufacturing to a serviced-based economy could be more fully acknowledged in the city's plans and strategies. More attention could be paid, for instance, to green services, which have significant potential for increasing industry's energy efficiency and competitiveness, and for increasing exports. Green exports are currently thought of primarily in terms of products, rather than as both products and services.

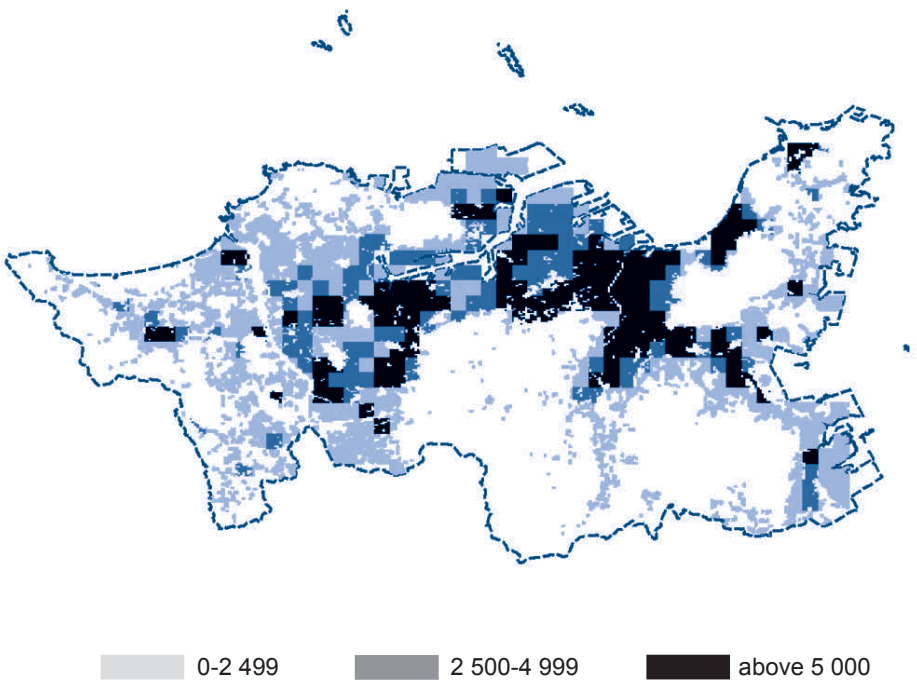
Integrate city-wide land use and transport planning to increase compactness

Land use planning

Revitalisation and densification of existing urban centres have been two priority areas for urban planning in Kitakyushu. The city was created by merging five cities, and it has attempted to revitalise the traditional urban centres and to maintain the public transportation network between them. The current *Kitakyushu Urban Planning Master Plan* (and its *Individual Area Plans* by administrative ward) sets out a clear vision to create a compact city with minimal environmental impacts and stresses the importance of a "downtown" concept (City of Kitakyushu, 2012). In 2008, two urban centres – Kokura and Kurosaki – were chosen in a central government scheme (the *Act for Revitalising Urban Centres*) to profit from national financial incentives for revitalisation. As of March 2011, 103 and 56 projects respectively have been planned and/or implemented in the designated Kokura and Kurosaki areas (City of Kitakyushu, 2012). Thus far, the projects are reporting positive outcomes: the population of the Kurosaki area has increased by 7.5% between 2007-2010 (from 5 689 to 6 117), despite the overall population decline in Kitakyushu; and the number of visitors in both areas has increased, by 13% in Kokura and by 18% in Kurosaki. Regarding the densification strategy, the city has been investing in infill development and brownfield redevelopment, as industrial activities are hollowing out and brownfields become available for urban development. Such projects include JR Jinnoharu Station, Higashida district, JR Moji Station, Yahata district, Yahata-Takami district and Wakamatsu Kukinohama district, many of which were developed around existing railway stations. In addition, the Kitakyushu Monorail, opened in 1985, is an example of successful Transit Oriented Development (TOD) that resulted in urban development along the line from Kokura station to the southern part of the city.

However, as in many other Japanese cities, Kitakyushu has experienced urban expansion in the last couple of decades mainly towards the western part of the city (Figure 2.1). While current city policies aim to focus investments to foster development in existing urban centres, new urban development in the past few decades has been dominated by low-density residential development in suburban areas. Some unplanned suburban development also occurred, because current land-use regulations using urbanisation promotion areas (where urban development is allowed under Japan's City Planning Act) are not very aggressive.

Figure 2.1. **Population density in Kitakyushu metropolitan area (land scan)**



Note: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: LandScan (2009), *Global Population Database 2009*, LandScan website, *www.ornl.gov/sci/landscan/*, accessed 31 August 2012.

The city has put considerable efforts into promoting infill and brownfield redevelopment, but this should be accelerated. Improving conditions that attract private investment is vital to support the reuse of former industrial sites and to optimise the exploitation of existing services. One option would be to introduce a target on brownfield development. The "refill rates" used in Portland, Oregon, can be useful indicators (Box 2.1). An inventory of developable urban land including brownfield sites, as introduced in Portland and Melbourne, could be drawn up to estimate the total for potential urban development. Fiscal incentives can also be used more effectively to guide housing development in urban centres, particularly in the two designated areas.

Widespread integration of transport and land-use planning can help optimise the existing transport network and underutilised urban land. The Jono zero-carbon zone is a good example of Kitakyushu's commitment to redevelop unused state-owned land adjacent to a railway station and to attract private investment. The Jono area is being developed as a new district, with the aim of reducing the net CO_2 emissions from residential buildings to zero. Located 3 kilometres outside the City of Kitakyushu's Kokura centre and close to the JR Jono station, the 19-hectare area is connected to the public transportation network and promotes car sharing, walking and public transportation inside the Jono district. Housing is developed along green guidelines, with

Box 2.1. **Portland's "refill rate" as a target for brownfield development**

Portland's Buildable Lands Inventory ensures periodic revisions of urban growth boundaries in which the necessity of enlargement is reassessed. While a state law requires Portland Metro to review the capacity of the Urban Growth Boundary every five years to ensure a 20-year land supply, Metro has developed a detailed and sophisticated land-monitoring process to inventory vacant land and track the "refill rate". The refill rate is defined as the rate at which new development occurs through "infill" (when more units are constructed on an already developed lot) or "redevelopment" (when a structure is removed and another is built in its place).

In 2009, Metro found that the refill rate for new industrial development was 20%. For non-industrial use, 52% of new capacity was built on developed land (Metro, 2010a). The residential refill rate has climbed steadily, from 30.4% in the period 1997-2001 to 33% during 2001-06 (Metro, 2010b). Metro predicts the rate will rise to 38% from 2010-30 (Metro, 2010). If it does, the urban growth boundary will be able to accommodate 11 300 additional dwellings without expanding.

Refill rates are highest in the central city and lowest in suburban residential neighbourhoods. Most residential refill is multi-family housing, often as part of transit-oriented development (TOD). Portland prioritises transport projects that support refill and investment in TODs to achieve higher density and a greater mix of uses than prevailing market conditions would support in terms of developers' construction costs and income from rent or sale (CTOD, 2011).

Source: OECD (2012), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264167865-en*.

the goal of producing energy on site and increasing energy efficiency in buildings. The district is scheduled to be finished by 2016, and will include private residences in the Jono Zero Carbon Block that are planned to be (net) carbon neutral. In order to better integrate land use and transport planning, the city could strategically target under-utilised urban areas with public transport connection for redevelopment and low-carbon development projects.

Opportunities to redevelop Kitakyushu's coastline and waterfront development could be better exploited, which would help increase the city's attractiveness. Kitakyushu has 226 kilometres of coastline, 49% of which is publicly owned and 42% private. About 80% of this coastline is used by ports, and 20 kilometres are still natural coast (City of Kitakyushu, 2012). Successful urban waterway revival projects such as the "My Town, My River: Murasaki River Improvement Project" and the "Mojiko Retro District Revitalisation Programme" increased the attractiveness of inner-urban areas and helped attract private investment (City of Kitakyushu, 2012). While the natural coast and some public coastal zones can be used for recreation and tourism, more coastal areas could be considered for waterfront redevelopment. Other OECD cities with direct water exposure, such as Hamburg, Chicago or Stockholm, offer examples of how waterfront redevelopment, driven by private investment, can improve a city's attractiveness (Box 2.2).

Box 2.2. **Hamburg's HafenCity waterfront development**

Hamburg HafenCity is a new urban district in Hamburg, Germany, developed on an area of 157 hectares of former brownfields as a mixed-use waterfront area. Expanding the city centre by 40% and offering 10.5 kilometres of quayside promenade and 3.1 kilometres of riverfront, the HafenCity will add 6 000 homes and over 45 000 new jobs in service businesses, culture, leisure, tourism and commerce, as well as higher education institutions.

Most of HafenCity is developed through private investment: EUR 8 billion in private and EUR 2.4 billion in public investments. About EUR 1.5 billion of the public investments are financed by land sales within the area, which also cover the construction of infrastructure and public spaces, as well as soil decontamination.

The new district is connected to public transport through a new subway station and a bus network and features a dense network of bicycle and walking paths. A district heating system integrating bio-methane fuel cells, wood combustion and heat pumps, as well as solar energy, provide renewable and low-carbon energy to residential and commercial buildings.

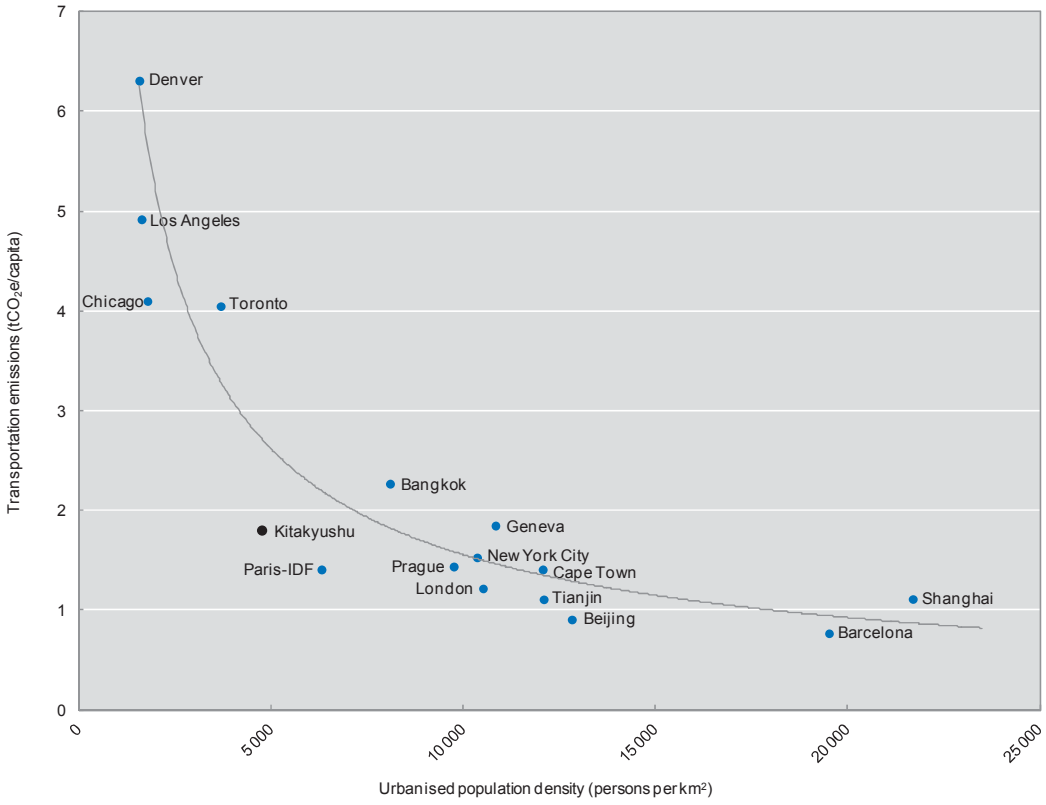
Source: HafenCity Hamburg (2012), "HafenCity – Facts and Figures", HafenCity Hamburg website, *www.hafencity.com/en/overview/hafencity-facts-and-figures.html*, accessed 31 August 2012.

Transport

Kitakyushu's decreasing density correlates with increasing shares of car use for commuting and rising emissions from transport. Research has shown a clear correlation between lower density levels and higher greenhouse gas emissions from transportation (Kennedy, 2009). The data from Kitakyushu seems to confirm this finding. From 1987 to 2009, urban land in the Kitakyushu metropolitan area (which is larger than Kitakyushu city) increased by 123%, from 117 km^2 to 261 km^2 out of 565 km^2 total land surface (National Land Numerical Information, 2009). Over almost the same period (1990-2007), transport emissions in Kitakyushu rose by 23% (City of Kitakyushu, 2012) (Figure 2.2).

Reliance on private cars has increased significantly in Kitakyushu, while the use of public transport is declining. Between 1981 and 2005, the modal share of commuting among modes of transport changed significantly: walking decreased from 11.5% to 7.8%, bicycle use from 9.1% to 7.4%, bus and tram use from 20.1% to 7.6% and personal vehicle trips increased from 45.7% to 63.7% (City of Kitakyushu, 2012). In the past decade, public transport services shrank considerably. Between 2001-06, 11 bus lines (accounting for 40 kilometres of service) were discontinued; as were two private train lines in 1992 and 2000 (City of Kitakyushu, 2008). Compared to other OECD metropolitan regions, Kitakyushu is situated in the mid-range both for its share of private vehicles and its share of public and non-motorised transport used for commuting (Figure 2.3). However, it is more dependent on cars than many other major Japanese cities: in 2000, 45% of commuting to work and school) in Kitakyushu was done by car, compared to 28% in Fukuoka, 32% in Hiroshima, 35% in Sapporo and 40% in Sendai (City of Kitakyushu, 2008).

Figure 2.2. **Emissions (CO_2e) from ground transportation**

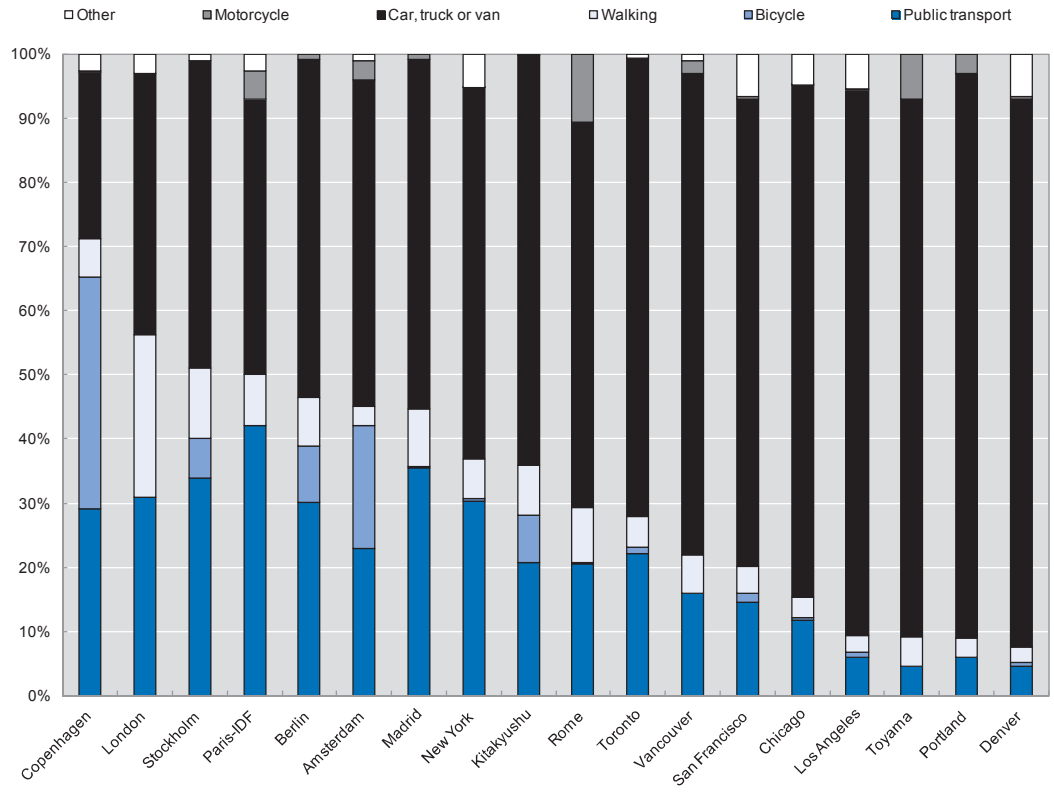


Note: Density of urbanised area is calculated excluding green space. For Kitakyushu, density is calculated based on "area designated for urbanisation". The Chicago region corresponds to the CMAP region (seven counties).

Source: Kennedy, C. (2011), calculations (personal communication) adapted by C. Kennedy, October 2011, using methodology from Kennedy, C. et al. (2009), "Greenhouse Gas Emissions from Global Cities", *Environmental Science and Technology*, Vol. 43, No. 19, American Chemical Society, Washington, DC; data for Chicago comes from the Center for Neighborhood Technology (2009), Creating a Chicago Regional Building Energy Efficiency System, Center for Neighborhood Technology, Chicago; data for Kitakyushu was provided by the city administration.

The city is implementing a number of measures to improve the quality of public transport services while maintaining residents' accessibility to the system. In 2008, Kitakyushu published the *Comprehensive Transport Strategy for the Environmental Capital City of Kitakyushu,* to prevent excessive car use. Currently, the city is implementing 28 concrete policy measures based on the 2010 *implementation plan*, mainly to improve the functionality of transportation hubs and main bus lines through "mobility management", shared community cycles and enhanced options for people with physical limitations. The aim is to maintain the share of trips on public transport and accessibility to public transport at the current levels. For public transport, that means about 15% of total trips, and for public transport accessibility, it means 80% of residents living within close proximity of public transport (within 500 metres of train stations and 300 metres of bus stops). The main measures are:

Figure 2.3. **Modal share for commuting in selected OECD urban areas**



Note: For London, the category "Other" comprises motorcycle and bicycle.

Source: (Unit of analysis, source, year): Paris-Ile-de-France (Paris-IDF region, Insee, Enquête Nationale Transport, 2008) ; Vancouver (Census Metropolitan Area, Census Statistics Canada, 2006); Toyama (Toyama-Takaoka Wider Urban Zone, 3rd Person Trip Survey, 2001) ; Portland (Metropolitan Statistical Area, American Community Survey, 2009); Chicago (Chicago Tri-State metro-region (MSA), American Community Survey, 2005-2009); New York, Los Angeles, San Francisco (OECD metro-regions definition, American Community Survey, 2005-2009); London (London Boroughs, Department of Transport, 2008-2009); Berlin, Copenhagen, Stockholm (Eurostat metropolitan regions definition (larger urban zone), Eurostat, 2003-2006); Toronto (Census Metropolitan Area, Statistics Canada, 2006); Denver (OECD metro-regions definition, American Community Survey, 2005-09); Madrid, Rome, Amsterdam (Eurostat metropolitan regions definition (larger urban zone), Eurostat, 2003-06); Kitakyushu (City of Kitakyushu, Person Trip Census, 2005).

- The city continues to improve train and monorail stations in order to increase the transfer of passengers. Past achievements include Kokura Station (consolidation of the monorail and JR stations, north-south access way and north entrance pedestrian deck) and the renovation of the Bus Centre at Kurosaki Station. To increase accessibility to public transport for children and the elderly, JR will install elevators by 2020 in all stations that serve over 3 000 passengers per day.
- The "100-Yen Monorail" fare system promotes monorail use by setting fares for rides between adjoining stations at the relatively low price of JPY 100. The "Station Next Door" fare system implemented by Chikuho Railways promotes the

use of its train network by allowing travel to an adjoining station for JPY 100 per trip (a 40% discount).

- "Bus-only" and "bus-priority" lanes preserve the public transportation system's uninterrupted and timely operation, and are being established in strategic areas. From 7 to 9 a.m. and 5 to 7 p.m., passenger cars are prohibited from entering bus-only lanes. Along with coloured paving in priority lanes, the adoption of the Public Transportation Priority System (PTPS) plans to ensure on-time arrival and departures and increase smooth operation, by easing traffic congestion through the adjustment of traffic signal. At present, the city has 23 bus-only lanes (40.17 km) and 14 bus-priority lanes (20.08 km).
- By 2020, the city will retrofit 565 Nishitetsu buses and 129 municipal buses (approximately 70% of all city buses) with low-floor equipment. In 2009 and 2010, the city supported the introduction of five low-emission hybrid buses.
- The city encourages the use of park-and-ride facilities, which involves parking private passenger vehicles in parking lots near stations and travelling by train or other forms of public transit (City of Kitakyushu, 2012). All the major public transport operators have been involved and responsible for the administrative cost, including JR Kyushu (17 parking lots accommodating 1 496 vehicles), Kitakyushu Monorail (2 parking lots, 233 vehicles), Expressway bus (1 parking lot at Sendai New Town, 160 vehicles), and Chikuho Electric Railroad (1 parking lot at Einomaru station, 23 vehicles).
- The city encourages the use of bicycles despite the city's hilly terrain, which is not conducive to bicycle traffic. In January 2008, the central part of Kokura and the Tahara area were designated as environmental model areas featuring bicycle lanes. The construction of bicycle lanes is partly funded by the central government. In March 2010, a rental bicycle system (Community Cycle Project) was introduced. A non-profit organisation (Town Mobile Network Kitakyushu) initiated the scheme at the downtown Kokura area (92 electrically assisted bicycles at 7 locations) as well as the Higashida area (3 stations, 24 electrically assisted bicycles).
- Since 2006, the city has promoted a modal shift in freight transport from truck to ferries and RO-RO vessels and container ships, which led to a reduction of CO_2 emissions of approximately 11 300 tonnes in 2010-2011.

Despite numerous measures to optimise the existing public transport system, the lack of densification measures that would maximise the impact of the infrastructure investments has contributed to a long-term lock-in into environmentally less sustainable and equitable modes of transportation. More effective measures are needed to guide urban development into urban centres and to focus transport investments on public transport into high-density, strategic development areas. At the same time, the city could consider limiting development that is not supported by existing or newly developed public transport. Hammarby Sjöstad in Stockholm, another successful brownfield redevelopment project, offers a good example of transport-oriented development (TOD). Providing good public transport connections to Stockholm's inner city contributed to higher redeveloped land values, and this made it easier to integrate decontamination costs into developers' business plans.

Improve the economic viability of recycling and exploit synergies with other sectors

Policies that improve waste reduction, reuse and recycling as well as material and energy recovery from waste can improve the efficiency of municipal waste systems and foster economic growth. A central cost factor for municipalities is waste collection and disposal, which tends to exceed the cost of recycling (Bohm, 2010). Reducing waste production and thus the amount to be collected and disposed of can reduce the overall costs of waste management. Recycling, composting and waste incineration-to-energy present opportunities for using waste as a resource for raw materials and energy. A range of materials can be recovered through recycling processes, including rare metals from electronic waste. Biogas can be obtained through anaerobic digestion, and electricity and heat from waste incineration. Policies that favour these activities over waste disposal on landfills also lead to savings in energy consumption and greenhouse gas emissions within the waste cycle (Morris, 2005). This can in turn boost economic growth, through increased demand for local service providers and activities.

Kitakyushu can be proud of its achievements in reducing household waste and landfill rates and increasing waste recycling, as well as its commitment to making further improvements. Despite having reached one of the lowest municipal waste production rates among developed cities around the world, 506g per person per day (2009), the city still continues to improve its waste performance (City of Kitakyushu, 2012). These efforts are guided by the *Kitakyushu Fundamental Plan for Establishing a Resource-Circulation Society*, a general waste disposal plan based on the Waste Disposal and Public Cleansing Law and the City of Kitakyushu Environmental Basic Plan. The basic concept of the plan draws on the main components of local society – residents, businesses, NGOs and government – that collectively aim at developing a "model sustainable city" by pro-actively and co-operatively working on 3R (reduce, reuse, recycle) and "proper disposal" (City of Kitakyushu, 2012). The plan covers a 10-year period, from FY 2011 to FY 2020, and targets further domestic waste reduction to 470g/person/day; an increase in the recycling rate to 35% or higher; and 22 000 tonnes of CO_2 reductions from general waste disposal (compared to 2009 figures) in 2020. The City of Kitakyushu's waste disposal system separates general domestic waste into 15 types and 21 categories to maximise the circulation and recycling of resources.

Successful waste reduction and recycling owes much to citizen participation, incentivised by city policies and enhanced through effective communication. The city introduced higher pricing of conventional garbage bags (JPY 50) as compared to recycling bags (JPY 12 and JPY 20, depending on the recycling items), which not only led to a doubling of recycling rates, but also to a reduction of waste volume by 30% (City of Kitakyushu, 2012). Landfill waste has almost been halved, from 109 482 tonnes annually in 2003 to 55 181 tonnes in 2009. The city also organises yearly waste-related events to raise awareness of the projects. The Eco-Life Stage Executive Committee (comprised of 18 members from local civic groups, businesses and the City of Kitakyushu) organises events providing opportunities to communicate practical information about sustainable development, including waste reduction and other waste-related matters. The first event in 2002 sparked interest among the local population, increasing attendance at the 2010 event to 665 000 participants. Eco Life events are financed by the city and co-sponsored through private enterprises (City of Kitakyushu, 2012). The Eco-Town Centre – situated in Eco-Town – also serves as an information and presentation platform for the local population, informing and educating citizens about the concept of a resource-recycling-based society. The centre has had over 1 million visitors since its opening in 2001.

The Eco-Town waste recycling complex has become the flagship for Kitakyushu's strategic orientation towards an industrially based green growth, but it needs to be updated to

stay economically viable. Eco-Town has a large range of material recycling and waste-to-energy capabilities, and the recycling complex has won national recognition and international praise (Box 1.1). With the current objective to extend key features and principles of the Eco-Town to the entire city, resource recycling and circulation has become an underlying model for Kitakyushu's larger ambitions for green growth. However, Eco-Town is not yet fully economically viable. As of March 2012, total investments in Eco-Town amounted to JPY 66.8 billion: 72% private, 15% national, 10% city and some other sources, including Fukuoka prefecture.

The Eco-Town could further improve and learn from international best practice. Areas of improvements include: enlarging the scale of the most profitable activities, developing higher value-added recycling processes and upgrading waste-to-energy (WTE) technologies. State-of-the-art WTE technology that allows very high recycling rates in waste-to-energy incineration processes has been introduced in Amsterdam (Box 2.3). To ramp up quantities, Kitakyushu would have to increase its waste imports, which would entail significant increases in logistical and transport costs. For higher value-added activities, more R&D in recycling is needed. Any policy to improve the economic viability of Eco-Town should thus focus on logistics, to enlarge the catchment area for waste imports. Innovation should also be supported to introduce higher value-added recycling activities. One important step in this direction is the city-financed Eco-industrial Complex Promotion Project. This focuses on solar panel and installation structure recycling, and improves regional co-operation on the recycling of industrial waste from larger areas around the City of Kitakyushu.

Box 2.3. **Amsterdam's waste-to-energy company**

The City of Amsterdam's Waste and Energy Company (*Afval Energie Bedrijf*, or AEB) is a world leader in the sustainable conversion of waste into energy and valuable, reusable raw materials. AEB's mission is to extract the maximum possible benefit from waste. AEB uses innovative techniques to produce sustainable energy and reusable materials from waste. It generates electricity that is fed to the grid to supply households and industries, and it produces heat used in the local district heating system. Over the next few years, AEB and the Dutch energy company Nuon (now part of Vattenfall) will jointly implement the City of Amsterdam's energy and climate policy by connecting 100 000 households to the district heating system. In the longer term, the connection of 200 000 households is planned.

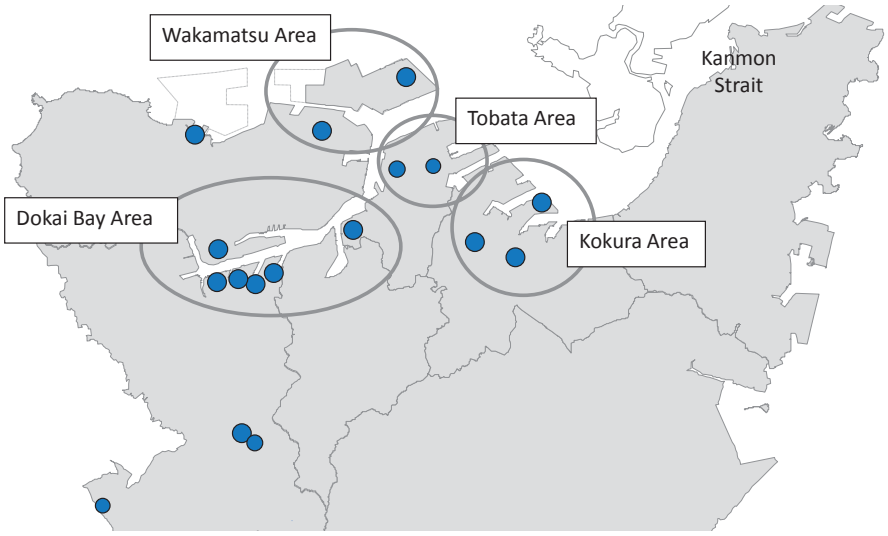
Nearly 99% of over 1.4 million tonnes of processed waste is recycled at AEB every year. This makes AEB the largest single-location waste processor in the world. The innovative plant has set a new global standard for electrical efficiency and maximising products from waste. New technology has achieved an energy efficiency that is 30% higher than the average. The Dutch Ministry of Infrastructure and the Environment therefore awarded AEB "Recovery" (R1) status. This means that the government regards the method applied by AEB for converting waste into energy and construction materials as recycling, and therefore good for the environment. This also enables AEB to import waste for processing.

Source: City of Amsterdam (2011), "Waste and Energy Company", City of Amsterdam, *www.afvalenergiebedrijf.nl*, accessed 7 February 2013.

Kitakyushu could tap the potential in waste-to-energy (WTE) for its commercial and residential sectors. The proximity of industrial areas, such as the Eco-Town, to commercial facilities and residential areas in the city offers an opportunity to exploit recycling activities to benefit a greater area of the city. Other cities, such as Stockholm or Amsterdam, transfer heat from waste incineration to buildings via district heating systems. Stockholm powers 31% of its heating system with WTE incineration, and Amsterdam provides 100 000 households with

heat from its WTE plant, which also produces electricity and is able to recycle up to 99% of incinerated materials (OECD, 2013c; City of Amsterdam, 2011). Kitakyushu has started to identify areas in which it plans to expand the use of industrial by-products, such as excess heat, to create synergies with residential and commercial areas. The Eco-Industrial Complex Promotion Project is exploring four areas, including 17 factories, where hydrogen, heat and other industrial waste or by-products could be used as resources for heating or fuel for hydrogen cars (Figure 2.4).

Figure 2.4. **Eco-Industrial Complex Promotion Project**



Note: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Extensive experience in water treatment technology and systems gives Kitakyushu an advantage for establishing a cluster of water treatment and water recycling technologies. The improvements in Kitakyushu's water quality were achieved to a great extent through advanced wastewater treatment of industrial wastewater. The City of Kitakyushu, New Energy and Industrial Technology Development Organisation (NEDO), and a number of private actors, such as Hitachi Plant Technology, Inc. and Toray, Inc., have established the Kitakyushu "Water Plaza" to develop and promote advanced Japanese water technology, with a focus on water recycling and desalination. The world's freshwater supply is limited, and water shortages are growing in many places, but desalination is still an expensive and energy-intensive process. The Kitakyushu Water Plaza has built pilot plants with a new low-cost, low-energy desalination system based on Kitakyushu's experience in wastewater treatment. In these plants, sewage and seawater are processed to obtain high-quality water. In addition, Water Plaza collaborates with the Global Water Recycling and Reuse Solution Technology Research Association (GWSTA) to further develop water treatment technologies. This public-private partnership is funded by NEDO. The City of Kitakyushu is responsible for acquiring land-use consent and supplying treated sewage. Building on Water Plaza, the city could take a more pro-active role in building a cluster for water treatment and recycling technologies in Kitakyushu and the region, in addition to exporting the technology to cities and areas with water shortages. The Milwaukee Water Council in the Chicago Tri-State metro-region offers a good example of a strong and growing cluster built around water technologies (Box 2.4).

Box 2.4. **Milwaukee Water Council**

The Milwaukee Water Council advances the interests of more than 150 companies and research institutions located in the greater Milwaukee region, all of which produce goods, services or research that relate to water in some way. Formally established in 2009, the Council grew out of an analysis launched by officials from the Milwaukee 7, a non-profit economic development organisation focused on the seven-county region around Milwaukee, Wisconsin.

The Milwaukee 7 identified a wide range of firms in the area that had at the core of their business an interest in water quality, water supply and distribution, water recreation or water engineering. Some of these firms have been in the area for hundreds of years, but until the Council was created, few knew that these firms were located nearby or recognised that they shared a common interest. The region also had a huge asset in the Great Lakes Water Institute at the University of Wisconsin at Milwaukee, which uses land secured by the Council to test and showcase cutting-edge water treatment technologies.

Milwaukee 7 water companies

Category	Within 7 counties	Outside 7 counties
Water/wastewater treatment systems	15	5
Industrial water-processing systems	6	11
Water system products: Non-mechanical	7	4
Water system products: Mechanical	31	2
Water system components	36	17
Chemical/biological treatment producer	7	6
Engineering/planning/software services	19	13
Maintenance equipment and services	4	2
Distributor	9	3
Well equipment and services	5	0
General consumer products	10	2
Miscellaneous product manufacturers	3	2
Total	152	67

An early census of the water-related firms in the area found that their core business operations are quite diverse, with half of the firms involved in the manufacture or distribution of various water components (meters, pumps, valves, filters, monitors, heaters) used by government, businesses or homeowners. Twelve percent of firms are solution providers working all over the world to satisfy water supply or treatment needs of cities and regions (White & Lenze, 2009). The economic activity driven by these firms is sizeable, as collectively, they employ roughly 20 000 people in the immediate area. Five of the eleven largest water firms in the world have operations in the Milwaukee region, with their local operations doing USD 10.5 billion in business annually, the equivalent of 4% of the total global water market.

The Water Council has launched a venture fund to provide capital to water start-ups and has begun work on a business incubator. The Council worked with the University of Wisconsin at Milwaukee and the City of Milwaukee to procure land adjacent to the School of Fresh Water Sciences for testing and showcasing cutting-edge water treatment technologies.

The world has also taken note. Milwaukee was selected as one of 14 Global Compact Cities, deliberately chosen for the region's focus on water-quality issues. Universities around the world are now in conversation with the University of Wisconsin at Milwaukee about research partnerships, while the National Science Foundation has awarded the University of Wisconsin at Milwaukee and Marquette USD 675 000 for research on seven different projects over the next five years. The Council helped arrange another USD 1.5 million in private sector donations to supplement that amount.

Source: OECD (2012), *OECD Territorial Reviews: The Chicago Tri-State Metropolitan Area, United States 2012*, OECD Publishing, Paris, doi: *10.1787/9789264170315-en*.

Diversify and stabilise energy supply and engage with energy technology production

Energy policies that diversify energy supply and maximise the use of local and renewable energy sources decrease the dependency on energy imports and can stimulate the local economy. The development, production, installation and maintenance of solar, wind, marine and other renewable energy technologies have attracted large investments and created a fast-growing market worldwide. Only a fraction of the exploitable renewable energy capacity is installed to date, and in several areas, such as solar, offshore wind and marine power, the technology is still in the R&D phase (IEA, 2012a). Many countries are increasing their share of renewable energy exploitation and are building production capacities for renewable energy technologies, including the United States, China, a number of European countries and Japan. This will contribute to reduce the dependence on imported fossil fuels and to have a stake in an emerging industry (IEA, 2012b). Some regions, such as northern Germany, are already becoming energy self-sufficient, or net even energy producers, by exploiting their local renewable energy sources. Policies supporting the installation and exploitation of renewable energy technologies, notably in Europe and more recently in Japan, are fuelling the demand that is driving this growing market. With increasingly fluctuating renewable energy capacity, smart grids have grown in importance and have also emerged as a fast-growing area of R&D. Initial pilot projects have contributed to growing certainty about the efficiency gains of demand-side management and the potential of integrating decentralised and unstable energy sources (IEA, 2011).

Energy supply is a key to unlocking Kitakyushu's remaining potential to green its economy, increase energy independence and realise a "low-carbon society" (City of Kitakyushu, 2012). Large industrial energy consumption (66%) dominates the city's energy needs. Energy supply in Kyushu is composed of nuclear power (46%), thermal power (42%), natural gas (13%) and heat supply (0.2%). Installed capacity of renewable power generation from wind, solar, hydro and waste is marginal thus far, with much potential untapped. Kitakyushu's current electricity emission factor is in the range of those of Los Angeles and London, while the city's CO_2 emissions from electricity are close to those of Shanghai, mainly due to high electricity consumption in industries (Figure 1.15). Shifting parts of the current fossil- fuelled electricity production to renewable electricity would reduce the electricity emission factor and thus overall CO_2 emissions from electricity. In addition, power production would become more independent from fuel imports and from fluctuating fossil fuel prices.

The city is undertaking several initiatives to reduce energy consumption and increase renewable energy exploitation:

- The city conducts a direct dialogue with the private sector to promote energy efficiency improvements. For SMEs, the city subsidises one-third of installation cost for energy-saving equipment or power-generation infrastructures.
- Incentives for solar power. The city provides financial assistance of JPY 30 000 per kilowatt (the maximum is JPY 70 000) to encourage the installation of solar power systems on individual houses. For FY 2012, 1 400 new applications were expected. The programme is implemented in collaboration with a grant programme operated by the central government (City of Kitakyushu, 2012).
- The city promotes the *Kitakyushu Next-Generation Energy Park*, which consists of a collection of various energy-related facilities, especially wind and solar

power, as a showcase of the city's low-carbon efforts. Private companies have established 11 wind power generation facilities to provide electricity (with the total power generation capacity of 17 100 kW).

Kitakyushu has transitioned from coal to oil and then oil to gas, and new national feed-in tariffs for clean energies offer an opportunity for the city to complement and reduce remaining fossil fuel in its energy mix. Solar, wind and marine power have substantial potential for further exploitation. Seasonal northwesterly winds on the northern coastline of Kitakyushu provide great wind power potential (City of Kitakyushu, 2012); annual daylight hours are comparable to most European cities (1 811 hours per year in Fukuoka) and solar radiation is higher than in any German city (MOE, 2011). Furthermore, important energy potential and technical feasibility for marine power exploitations in the Kanmon Straits were identified in a scientific study, as well as through pretesting carried out by the City of Kitakyushu, local universities and private enterprises in 2010 (Fujiwara, 2003; City of Kitakyushu, 2012). As of March 2012, the city has an ongoing test of marine power just off its coast. The national feed-in-tariff for renewable energies, introduced in July 2012, applies to all these renewable sources and presents a new opportunity for the city to exploit its unused resources. In addition to the national feed-in-tariff, the city could help by lowering the barrier for residents and businesses to invest in renewable energy through providing relevant information or securities for low-interest loans, as it was successfully done in other OECD cities (Box 2.5).

Box 2.5. **Lowering barriers for renewable energy exploitation**

Information campaigns on solar potential

Cities can play a key role in disseminating information on the potential of renewable energy exploitation, in particular of solar power. In German cities like Osnabrück and Freiburg, local authorities deployed an aerial laser scanning system to map building rooftops in the city. The city used the information to build a database including information on the orientation and slope of each roof as well as potential shade from trees, chimneys and adjacent buildings. This allows building owners to calculate the exact solar heating or PV potential of their rooftops. A similar approach was taken in San Francisco, where the local government provides data on solar potential of the city's buildings on a public web page. In the first two years after the solar map went online, solar PV deployment in and around San Francisco nearly doubled.

Low-interest loans for renewable energy investments

Property-Assessed Clean Energy (PACE) programmes allow property owners to borrow funds from their municipality to pay for efficiency improvements and renewable energy installation. The cost of the loan is added to the property tax bill, and repayment occurs on a quarterly basis as part of the regular tax payment. This strategy eliminates the problem that property owners who intend to sell their property have little incentive to invest in efficiency upgrades, because PACE passes the repayment obligation on to the new property owner. Under PACE, municipalities establish a funding pool to pay for the upfront installation costs, and the pool is repaid over time, allowing funds to be reused to support additional loans. PACE attracted considerable attention nationally when it was first employed in California.

Source: Hammer, S., et al. (2011), "Cities and Green Growth: A Conceptual Framework", *OECD Regional Development Working Papers 2011/08*, OECD Publishing, Paris, doi: *10.1787/5kg0tflmzx34-en*; OECD (2012), *OECD Territorial Reviews: The Chicago Tri-State Metropolitan Area, United States 2012*, OECD Publishing, Paris. doi: *10.1787/9789264170315-en*.

Industries require a consistent energy supply, so increasing the share of renewable energy calls for new storage solutions. These solutions, such as existing or new hydro storage systems and batteries, will help to facilitate integration of renewable energy and stabilise base load supply to industries. Other methods exist to balance fluctuating renewable energy sources, including adding traditional sources, such as gas power plants that adapt well to different output levels, to the energy mix. The Tobata Co-operative Thermal Power Company's power plant, which currently generates half of Kitakyushu's electricity production, is equipped with a flexible gas generator that can adapt power output from 100% to 30% (Mitsubishi, 2004). Kitakyushu is testing the grid infrastructure to see what is needed to manage different levels of energy supply and demand throughout the day. This is being done through the Kitakyushu Smart Community project's comprehensive smart grid, which includes sophisticated demand-side management, supported smart meters, home energy management systems (HEMS) and building energy management systems (BEMS). The HEMS and BEMS allow businesses and residents to adapt their energy consumption in real time to current electricity demand levels and corresponding price levels (Box 2.6). While this experiment is strong on demand-side management, more emphasis could be paid to integrating fluctuating renewable energy sources.

Box 2.6. **Kitakyushu Smart Community**

The Higashida district was chosen in 2005 as a deregulation zone (within a national government special district scheme) and designated to become a demonstration area for a Smart Community project. The heart of the Higashida Smart Community is a smart grid, which was set up in 2010 with direct support from the Ministry of Economy, Trade and Industry (METI) as part of METI's Next Generation Energy and Social System Demonstration Project. Three other smart-grid projects are currently running under this programme in Japan: Yokohoma City, Toyota City and Kyoto's Keihanna district. The investments mobilised for these projects amount to USD 800 million. All four projects entail different smart-grid approaches, and the one in Kitakyushu is the only smart grid that entails a power demand management system, supporting HEMS (home energy management system) and BEMS (building energy management system) technologies.

Kitakyushu City, Fuji Electric Systems, IBM, Nippon Steel and more than 40 organisations and companies, run the Kitakyushu Smart Community project. Nippon Steel operates the Yahata Higashida natural gas power plant with 33 000 kW power generation capacity, which supplies 70 companies and 200 private residences with electricity and adjacent industrial facilities with heat from co-generation. In total, 210 companies and organisations and 900 residents are based within the Higashida district, supplied by different power sources, including co-generation, hydrogen, solar, wind and other sources. Wind and solar energy is planned to provide up to 10% of the community's electricity needs by 2015; so far, renewable sources represent only 2% of energy supply. A Community Energy Management System (CEMS) helps to stabilise volatile power inputs from solar photovoltaic (PV) or wind. All end users are provided with smart meters that communicate price levels and warnings at peak load times in order to shave peak demand and balance power demand and supply. Electricity pricing will be dynamic, with price levels from JPY 7 to JPY 30 per KWh, which is slightly more competitive than electricity prices from the local utility Kyushu Electric Company (JPY 8-35). To discourage consumption during peak load times, demand prices can go up to JPY 150.

The experiment runs until 2015 and there are plans to extend it to a larger urban district, the Jono zero-carbon zone, and eventually to the entire city.

Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

The production of renewable energy technologies has not been a priority for Kitakyushu in the past, but the conditions for solar technology are becoming more favourable in Japan. Japan was the world's leading solar technology producer at the beginning of the 2000s. The country lost big shares in production to Europe and more recently to China, which accounted for 46.4% of the world's PV cell production in 2010 (IEA, 2010). However, Japan is still the world's largest investor in solar R&D and yielded the largest share of patents in clean energy after the United States from 2005 to 2008 (IEA, 2012b). The national government currently aims to reinstate Japan among the world's leading solar producers. Large increases in solar installation have already been seen following the recent introduction of a new feed-in-tariff for renewable energy in Japan, which is also likely to boost the demand of local producers.

In this context, Kitakyushu could make better use of its industrial assets and R&D capacities to engage with solar technology production. Other cities in the region are pro-actively moving to attract solar energy-related activities. In March 2012, the Kitakyushu-based Shibaura-Group Holdings set up Japan's first "Megasolar Training School" 70 kilometres south of Kitakyushu in Fukuoka Prefecture's mid-sized City of Omuta (population 127 000 in 2010), a former coal-mining centre. The city is also the headquarters for the regional utility, Kyushu Electric, and has a 3MW solar facility at the firm's Megasolar Omuta Generating Station. Kitakyushu's chemical industries and its research capacities in solar-related technology fields such as semiconductors could be exploited for advanced second- and third-generation solar technology R&D.

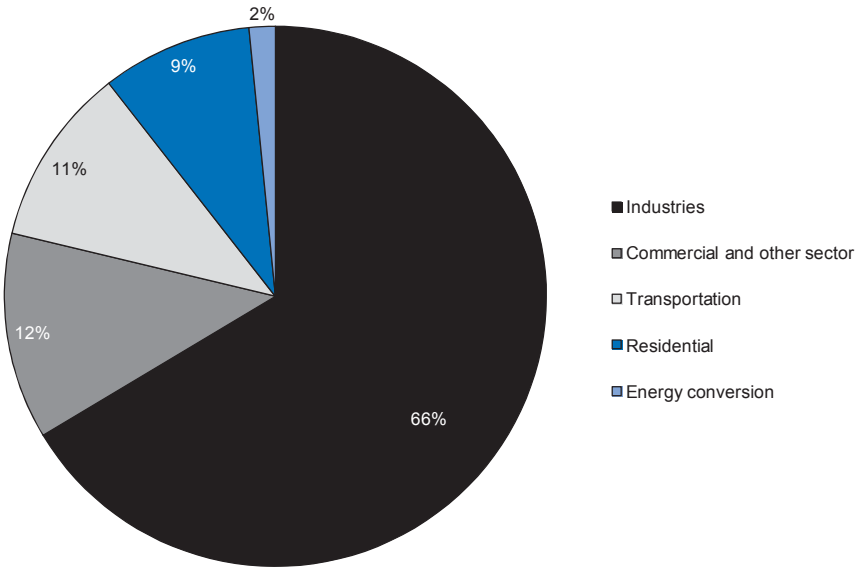
Offshore wind power might also hold significant potential for development in Kitakyushu. Offshore wind technology is still in a testing and R&D phase, and Kitakyushu has favourable conditions to test such technology. Good coastal wind, the city's harbour and logistics network, as well as expertise in producing, handling and shipping heavy goods (iron and steel) are important assets for offshore wind power testing and exploitation. Recently, NEDO has set up a research and demonstration project for off-shore wind power in Kitakyushu that consists of a collaboration of J-Power, the Port and Airport Research Institute, the Itochu-Techno Solutions Corporation, Japan Steel Works Ltd., Penta Ocean Construction Co., Ltd., Nippon Steel and Sumikin Engineering, Co. Ltd. The first offshore wind turbines are scheduled to be operational in 2013 (City of Kitakyushu, 2012). If this project delivers promising results, Kitakyushu's iron and steel industry, as well as other industrial assets, offer a good manufacturing base to set up wind turbine manufacturing. Proximity of production and exploitation of wind energy technology is an important factor, due to the large and heavy elements of wind turbines. The Chicago Tri-State metropolitan area provides a good example of using its strategic location close to the Midwest wind belt, which offers favourable conditions for wind power exploitation. Targeted incentives helped the Chicago region retool former car manufacturing industries for wind-turbine manufacturing and component suppliers. In the meantime, Chicago has attracted a significant number of the headquarters of global wind energy companies (OECD, 2012a).

Exploit untapped potential in building energy efficiency

Policies to improve energy efficiency in buildings and to construct new energy-efficient buildings can lead to economic growth through increased activities in energy services and the production of energy-saving products, insulation materials and renewable energy technology. Large energy savings could be exploited in Kitakyushu's commercial and residential sectors through increasing energy efficiency in buildings. After industries,

the commercial/other sector is the second-largest energy consumer in Kitakyushu, but with the residential sector, still only represents one-third of industrial energy consumption (Figure 2.5). While these sectors are smaller energy consumers, industrial energy efficiency is already high. For example, the Japanese steel industry has the most energy-efficient steel production worldwide. In contrast, building energy efficiency in the commercial and residential sector still offers potential for energy savings; in Japan, about half of all energy is consumed for heating and cooling in the tertiary sector (OECD, 2010). In Kitakyushu, the largest increases in energy consumption between 2005 and 2007 occurred in the commercial sector (13%), while energy consumption in the residential sector declined (by 6%) over the same period (City of Kitakyushu, 2012). Retrofitting and new energy-efficient buildings would not only contribute to energy savings, but also to job creation and to increased economic activity in local energy services and construction firms (Schrock and Sundquist, 2009).

Figure 2.5. **Energy consumption by sector**



Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

The City of Kitakyushu has started to implement energy-efficiency measures in public buildings. In FY 2010, Kitakyushu began implementing electricity and energy conservation measures in all its public facilities. Measures include energy assessments of public facilities, road lighting and public vehicles; manuals to diagnose energy conservation measures; and the introduction of devices to visualise electricity consumption, as well as LED lighting and other energy-saving equipment. The efforts resulted in a 24% reduction of energy consumption in the month of July, as compared to the previous year, after the first year of implementation. The measures were financed partly through national government contributions targeted to stimulate employment, as well as through city funds allocated to energy-saving equipment and devices.

Other city initiatives that aim at decoupling growing energy consumption and related emissions from economic growth are:

- The *CASBEE Kitakyushu* (Kitakyushu's Comprehensive Assessment System for Building Environmental Efficiency) is a system used for new buildings as well as additions or structural alterations to existing buildings. CASBEE helps building owners to assess the environmental performance of their buildings and to provide the results to the city. CASBEE Kitakyushu targets buildings of over 2 000 square metres. As of 2010, a total of 50 new buildings had been assessed, which resulted in an average reduction of greenhouse gas emissions of about 16% per case (City of Kitakyushu, 2012).
- The *green roof programme*. The city provides stipends of JPY 20 000 for each square metre of planted rooftop, or financial assistance covering half of the allowed construction costs.
- The city has a master plan to introduce LED lighting for city road lights, which will convert all road lights to LED by FY 2025.
- The Jono district pilots high building energy-efficiency measures. However, these standards are not applied for development elsewhere in Kitakyushu.

Appropriate financial incentives and mechanisms are needed to extend the successful reduction of energy consumption in public buildings to the commercial and residential sector. Building retrofits have been used in a number of OECD cities to reduce energy consumption and carbon footprints. In many European cases, energy performance contracting (EPC) and energy service companies (ESCOs) have offered viable models to implement energy-efficiency measures, including building retrofits. A crucial condition for EPC and ESCOs to become attractive models for implementation are national or local saving targets and an appropriate framework for investment (Energieagentur Berlin et al., 2008). The Kitakyushu Electricity Conservation Promotion Headquarters, created in 2011, could play an important role in defining respective targets and identifying suitable investment models. A successful approach for financing and implementing energy efficiency in buildings can be found, for example, in Berlin (Box 2.7). A number of cities, such as Los Angeles, Chicago or Toronto, have also identified building retrofits as a key area for green and local job creation, with a particular focus on integrating low-skilled and unemployed workforce (CGCI, 2009).

Green building codes and labelling can also contribute significantly to better energy performance and to higher real estate values. In Kitakyushu, most new buildings comply with the national minimum standards for energy efficiency, as defined in the Energy Conservation Act and guided by the CASBEE approach. These standards are not very ambitious yet, except for large buildings (of 5 000m^2 and larger), and the CASBEE assessments and respective energy efficiency measures are still voluntary. Kitakyushu has extended the CASBEE approach to buildings with floor areas above 1 000 m^2, but implementation is still voluntary. Japanese residential buildings have a relatively short average lifespan (30 to 40 years for typical wooden houses). Within this context, stricter building codes for new development and redevelopment could significantly contribute to better energy performance in buildings. Stricter codes could reduce energy and resource consumption and increase the lifespan of Japanese residential buildings. Further measures, such as a sustainable building performance labelling programme, could increase the real estate value of labelled buildings (Popescu et al., 2011).

Box 2.7. **Financing and implementing energy efficiency in buildings**

The City of Berlin has worked with the German public investment bank Kreditanstalt für Wiederaufbau (KfW) and the Investitionsbank Berlin, which provide private buildings' owners, tenants and housing corporations with low-interest loans. Since 1991, over EUR 4 billion has been invested in building retrofits in Berlin, resulting in roughly 631 000 tonnes of CO_2 reduction every year. The loans are refinanced through energy bill savings, or in the case of rental units, through rent increases of up to 11%, which the tenant can recover through lower energy bills. As a result of various KfW programmes since the early 1990s, around one-third of the residential buildings in Berlin have been retrofitted, including 273 000 high-rise apartments, for which energy consumption was reduced by 50%.

Implementation of building retrofits in the commercial and public sector is organised by the Berlin Energy Agency (BEA), which sets up energy performance contracts (EPC) between building owners and Energy Service Companies (ESCOs). Participating ESCOs must guarantee minimum energy cost savings of 26% and define appropriate measures to be implemented in the respective project, such as automatic control engineering systems, heating control systems, lighting systems, ventilation and air conditioning systems. The BEA also assists individual building owners and ESCOs to determine terms of repayment, which range on average from 8 to 12 years.

Source: City of Berlin (2011), "Climate Protection in Berlin", presentation brochure, Senatsverwaltung für Gesundheit, Umwelt und Verbraucherschutz, Berlin, *www.stadtentwicklung.berlin.de/umwelt/klimaschutz/download/Klimaschutzbroschuere_V07.pdf*;
New York City Global Partners (2011), "Best Practice: Public-Private Partnership for Building Retrofits", New York City Global Partners, *www.nyc.gov/html/unccp/gprb/downloads/pdf/Berlin_Buildings_ESP.pdf*.

District heating and cooling systems present an attractive option for Kitakyushu to reduce energy consumption on a larger scale. Currently, individual heating and electronic air conditioning consume a large part of the energy used in Kitakyushu's buildings. Cities like Stockholm, Copenhagen or Paris have implemented district heating and cooling systems that reduce building energy consumption and can integrate renewable energy and waste incineration. Stockholm covers over 70% of the city's building stock with district heating, and 68% of the heat is generated with biofuels and waste incineration. Kitakyushu is working on a more systematic approach to heating by using thermal fluctuation in the Murasaki River to heat parts of the Muromachi area (City of Kitakyushu, 2012). This is a good start, but Kitakyushu has much larger potential to exploit, in particular due to the unique proximity of industrial, commercial and residential areas in the city, which allows for direct exploitation of industrial excess products, such as heat, for residential and commercial use. Also, district cooling systems could be installed in parts of the city close to the coast.

Identify and support undervalued industrial assets for green growth and exports

The manufacturing sector: A central pillar for green growth in Kitakyushu

The manufacturing sector will continue to be a central pillar of Kitakyushu's economy, despite an ongoing gradual shift to services, as is discussed in Chapter 1. Therefore, it is important to identify green growth opportunities in the manufacturing sector. Increasing the greening and growth potential of the manufacturing sector can be understood in three ways: *i*) promote manufacturing products that help reduce environmental impacts in the locations they are used (greener products), *ii*) decrease the impact of manufacturing on the local environment (greener production), and *iii*) identify and foster emerging green segments within the manufacturing sector.

Kitakyushu's main policy tool to promote greener products is a labelling programme, which could be strengthened. The current eco-labelling programme, Eco Premium, certifies products, technologies and services that reduce environmental impact or have specific value-added characteristics, such as long product life or easy maintenance. This programme can motivate manufacturing companies to innovate and green their products, as it helps the market to recognise and value certified products and services. Some manufacturing companies, including Hohkohsha and Nippon Kanryu Industry, reported increased sales of Eco-Premium products after the labelling. Nonetheless, such products only account for a limited share of the market, and there is still a relatively low number of the labelled products (168 items as of 2010). This is partly due to the fact that shifting product line-ups often require significant investment in R&D and equipment. Incentives for firms to implement such actions are still limited. New incentive structures, such as prioritising R&D funds for firms that produce green labelled products, could be an option to increase companies' interest in green products and greener production. Supporting green producer networks around the labelling programme could also be helpful. The Kitakyushu Committee to Promote Environmental Industry, which now has 450 members, is a good start, and firms, and SMEs in particular, would profit from more exchange and networking opportunities. The French "poles of competitiveness" present a good example for effective private-sector networking platforms, supported by the public sector (Box 2.8). Such measures could be an important step in forming stronger networks and clusters around green products.

The city has promoted cleaner manufacturing process in steel, chemical and other industries by setting high environmental standards and supporting R&D for greener production. Notwithstanding these efforts, and the most energy-efficient steel production worldwide, technological and process innovation and improvements could permit further achievements. The US "Save Energy Now" programme offers a good example of how the US Department of Energy helps the manufacturing sector to access information, technical support and financial resources, to improve its facilities' energy efficiency (Box 2.9). The city could also co-operate with firms to develop an indicator that would allow to regular measuring and monitoring of the green production.

Box 2.8. **French poles of competitiveness: An increasing focus on green technologies**

"Poles of competitiveness" in France integrate a diverse range of actors and agents: business, research and testing centres; basic and further training organisations, which help to ensure a satisfactory range of products and services available on the market, and implement joint projects. To identify these poles, a project tender was put out that closed in February 2005. For 2005-2007, the state earmarked EUR 1.5 billion to launch and support poles of competitiveness. Partners associated with the designated poles benefited from different types of non-exclusive incentive measures: public subsidies, tax exemptions and lower social contributions, financing schemes and specific guarantees.

In the 2007-2008 period, assessments showed that 39 clusters or poles had fully reached the objectives of the policy, 19 clusters had partially reached them but needed to devote more effort toward strategy definition and governance, and 13 clusters were identified for in-depth restructuring. Between 2005 and 2008, the number of new entries into competitiveness clusters increased, in particular the number of large firms and SMEs. The evaluation stressed that the competitiveness cluster policy had triggered or accelerated a co-operation process on innovative projects in all industrial sectors. It also concluded that the competitiveness clusters could be an important factor in improving the links between public and private research, and eventually strengthen France's strategic position in the fields of research, development and innovation, particularly abroad. On the basis of these results, the French government decided to launch a second phase of the competitiveness cluster policy (Cluster 2.0) for a further three- year period (2009-2011), with a total budget of EUR 1.5 billion.

According to the data published by the Ministry for the Economy, Industry and Employment, at the end of the first round of the programme, 71 competitiveness clusters were supported and divided into three types: 7 global world-class competitiveness clusters, 10 globally oriented competitiveness clusters and 54 competitiveness clusters. The original version of the policy allowed for the selection of only 15 competitiveness clusters. Despite the fear that public funding would be spread amongst the 71 clusters, data show that funding was focused on the top clusters. Eighty percent of the cluster's grant (EUR 36 million) was channelled to the world-class clusters. The various clusters cover thematic areas such as aeronautics, ICTs, life sciences and other traditional sectors such as wood, construction and finance. Five thousand companies were cluster members in 2007, of which 80% were SMEs. Since 2005, 738 R&D projects with EUR 3.9 billion budgets and roughly 14 000 researchers received a total of EUR 946 million in public funding. Within the framework of the French Interministerial Fund and Oséo (not including support for laboratories), SME clusters received 54% of the funding. A total of 2 097 R&D projects received agency support (ANR and Oséo) in 2006, 2007 and 2008.

Among the 52 selected poles that took part in the tenth call for tender for French poles of competitiveness projects (July 2010), 30 poles are involved in sustainable development projects. These green projects now attract 30% of the state's support, compared to lower shares (10% and15%) in the first years of the poles of competitiveness programme. In 2010, five eco-poles were labelled as poles of competitiveness. In the Paris/Ile de France region, only two poles, ADVANCITY (clean technologies, housing and mobility) and to a lesser extent MOVEO (Automobiles), focused on green technologies. Poles are now endowed with a strategic document: the performance contract. The ADVANCITY performance contract emphasises *i*) instrumentation and city management and engineering; *ii*) environmental efficiency of the city: ground, underground, infrastructure and sustainable building, and *iii*) the quality of city services.

Source: OECD (2006), *OECD Territorial Reviews: France 2006*, OECD Publishing, Paris, doi: *10.1787/9789264022669-en*, updated.

Box 2.9. **Save Energy Now**

Save Energy Now was set up to realise the goals of the Energy Policy Act of 2005 (EPAct) for reducing industrial energy intensity by 2.5% annually over 10 years (USDEO, 2010). As a part of the Industrial Technologies Programme (ITP) of the US Department of Energy, Save Energy Now is implemented through regional partnerships in various US states. In the Midwest states, for example, a partnership programme of the ITP with the Illinois Department of Commerce and Economic Opportunity's State Energy Office, the University of Illinois at Chicago's Energy Resource Center, a team of industrial manufacturers, state energy offices, utilities and academia implements Save Energy Now in the region.

US companies can sign up for Save Energy Now to receive access to a number of resources, technical information and webinars that help to achieve energy reduction in industrial production. As a part of the initiative, the LEADER programme has since 2010 offered additional resources and free assessment of the energy-saving potential to companies that sign a voluntary pledge to reduce their facilities' energy intensity by 25% or more over 10 years.

The growing list of companies that participate in Save Energy Now and the LEADER programme includes major companies like Chrysler, Goodyear, Dow Chemicals, US Steel, Saint-Gobain or Volvo, which not only save energy, money and reduce CO_2, but also increase their leverage to keep existing jobs and to invest in new ones (USDEO, 2011). The savings between 2006 and 2009 of over 2 000 plants assessed throughout the United States, are 119 trillion Btu, USD 1.3 billion and 11.2 million metric tonnes of CO_2.

Source: USDEO (2010), "Midwest States Save Energy Now Partnership Program", Energy Efficiency & Renewable Energy, USDEO, *www1.eere.energy.gov/industry/states/pdfs/illinois_midwest_save_energy_now.pdf*; USDEO (2011), "Save Energy Now update", Energy Efficiency & Renewable Energy, USDEO, *www.naseo.org/events/energyoutlook/2011/presentations/Scheihing.pdf*.

Identifying and encouraging emerging and growing segments within the manufacturing sector is crucial for the city's future competitiveness in a greener economy. A location quotient specialisation index indicates that, despite the overall shrinking of the manufacturing sector, a remarkable increase in specialisation can be observed in iron and steel manufacturing, ceramic, clay and stone product manufacturing, as well as in production machinery manufacturing (Figure 1.21, Table 1.2). Along with this specialisation, exports of steel products with high environmental performance grew strongly over the last decade. This observation is highly relevant for an industrial city pursuing green growth. Instead of concentrating only on the growing service sector, Kitakyushu should support the specialisation in the manufacturing sector, and identify other segments with potential for growth. Other former industrial cities, such as Chicago and other Great Lake states in the United States, have responded to the shrinkage of the manufacturing sector by successfully retooling parts of their industries for new uses (Box 2.10).

Box 2.10. **Retooling of the manufacturing sector in the Midwest United States**

The Midwest United States has traditionally had a strong manufacturing sector. In response to a decline of manufacturing in the region over the past decades, effective retooling initiatives help manufacturing facilities to convert to new demand and products. A major obstacle for companies is to understand new market opportunities and what is needed to build up stakes in emerging segments and product groups.

The states of Michigan and Ohio provide advice and assistance to companies to retool their operations. A key emerging manufacturing segment in the Midwest is wind turbine manufacturing. The assistance for firms focuses on understanding market opportunities in this sector and the needs of the wind industry, and on technical assistance for companies to retool their operations in order to enter the wind energy technology supply chain. The Ohio Energy Office is financing a collaborative project, led by the Great Lakes Wind Network (GLWN) and Ohio's Edison Technology Center, to identify suitable companies for retrofitting of their facilities to produce wind energy technology components (AWEA, 2010). A study of the Chicago Tri-State region has identified particularly strong opportunities for local gear and drive-train manufacturers to penetrate the wind turbine component parts market (CMC/JARC, 2009).

Regional co-operation can significantly enhance this process of identifying and reanimating existing potential for new opportunities in manufacturing. The Midwest Governors Association provides a platform for attracting investment to renewable energy producers and their supply chain, across the states of Illinois, Indiana, Wisconsin, Iowa, Kansas, Ohio, Michigan, Minnesota, Missouri and South Dakota. Given the need to manufacture wind turbines relatively close to where they will be installed, working with other states in the "wind belt" benefits wind-related suppliers and manufacturers in this region.

Source: OECD (2013), "Cities and Green Growth: The Case of Chicago", *OECD Regional Development Working Papers 2013/06*, OECD Publishing, doi: *10.1787/5k49dv6c5xmv-en*.

A recent survey done by the City of Kitakyushu confirmed the ongoing trend of the greening of local companies across a large range of sectors (Figure 1.23). This survey could be used to help identify greening dynamics within Kitakyushu's industrial base. Expanding and using the survey to monitor greening development in all sectors could help to inform targeted policies for fast-growing greening segments and sectors. Kitakyushu currently has a strong focus on solar cell system recycling, and the city may identify other niches with strong potential, such as offshore wind or marine power. Furthermore, the city's important R&D assets in green growth-related sectors, such as semiconductors and chemicals, could become a focus of new green industry and innovation policies. The Lahti Cleantech Cluster in Finland gives a good example of targeted cluster-building around green R&D and technology companies, with a strong focus on international partnerships and exports (Box 2.11).

Box 2.11. **The Lahti Cleantech Cluster in Finland**

The Lahti Cleantech Cluster in Finland is a real development success story, both at home and abroad. The cluster now embraces 250 firms, representing 60% of Finnish companies working in the eco-technology sector and accounting for 80% of eco-technology research in the country. The Lahti Science and Business Park (LSBP) coordinates the activities of the cluster. The key objective of this grouping of firms is to create 40 new high-tech firms a year, a goal that has already been achieved. Another goal is to increase venture capital for clean technologies by 15% of total investment. Lahti has already created 500 green jobs and expects to create 900 more.

Its performance in terms of "deal flow" has been excellent. Development abroad is a priority, and in 2010, Lahti expanded into Russia, with a programme to create three mini-clusters, involving 38 companies. In China, more than 100 companies are engaged in the Finnish Environmental Cluster for China (FECC). Business contracts have been concluded over the last two years amounting to EUR 120 million. Activities have also been launched with India in the context of a strategic collaboration agreement with the YES Bank.

The LSBP hosts numerous events for investors every year, such as clean technology workshops and "Cleantech Venture Day". Firms such as Eagle Windpower, EcoCat, Numcore and Green Stream Network got their start at Lahti.

Source: OSKE Center of Expertise (2010), Finnish Cleantech Cluster, Kuopio.

In addition to green products, green services are becoming increasingly important, notably in the context of the potential contribution of smart and soft infrastructure to urban green growth. There is growing recognition in the Japanese domestic debate that smart cities are as much about services as hardware. Analysts are concerned that Japanese smart city initiatives have not devoted enough attention to the service options that will benefit residents and enhance the competitiveness of domestic industry. A major part of the rethinking deemed necessary is in finding the applications that engage residents, making them comfortable with the new urban design and such features as the smart grid and visualisation of such items as energy consumption and production. Additional features include energy services as well as services related to health care. These latter seem especially suited to Kitakyushu, given its high rate of ageing. Home security and automation functions are also part of an overall smart city service market that has been predicted to represent JPY 1 000 trillion in cumulative value by 2030 (Mochizuki, 2012).

Untapped potential of the port of Kitakyushu in stimulating regional exports

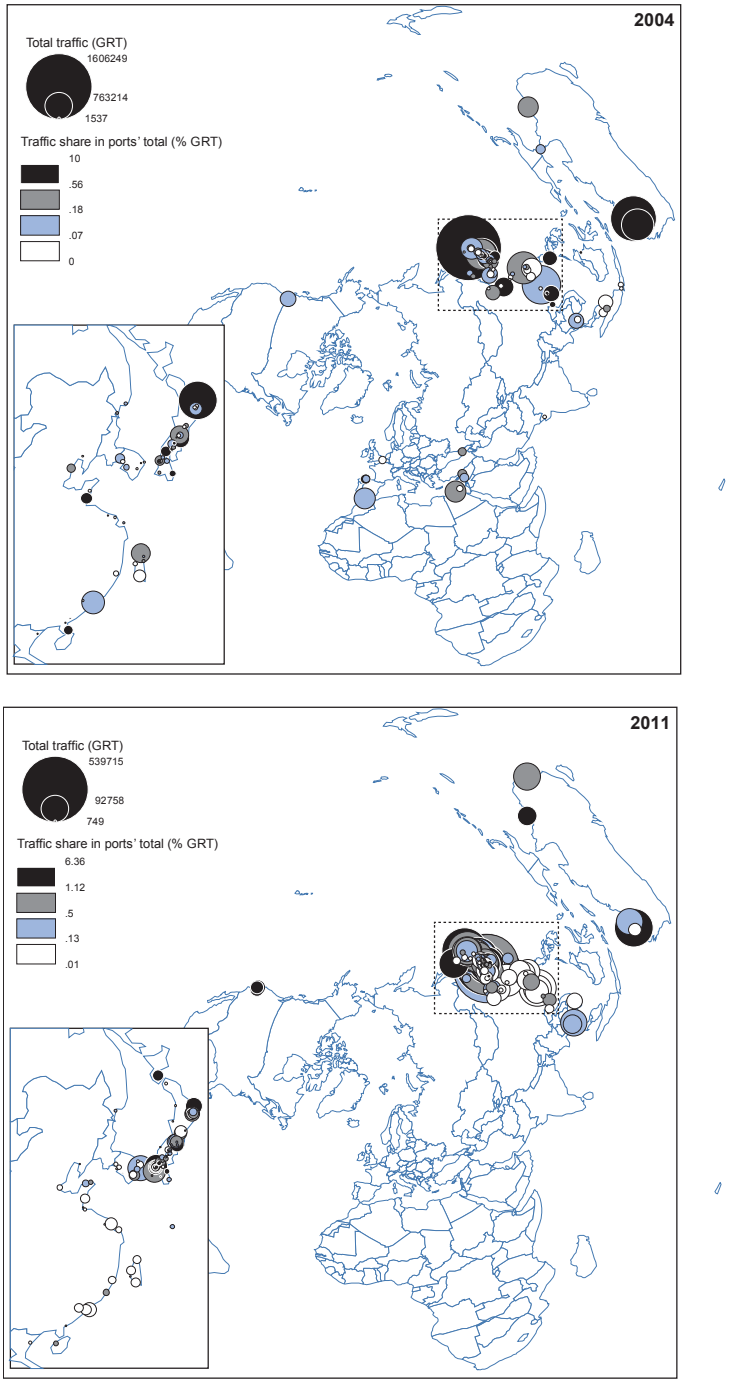
Ports reduce transport costs and have thus facilitated trade in many parts of the world. Well-functioning ports provide a competitive advantage for exporting and importing regions: they reduce the cost of trade, making trade relations with other countries more profitable. Clark et al. (2004) found that improving port efficiency from the 25th to the 75th percentile reduces shipping costs by 12%. Ports that under-perform are equivalent to being 60% farther away from markets for the average country. In addition, they found that reductions in country inefficiencies associated with transport costs, from the 25th to the 75th percentiles, result in an increase in bilateral trade of around 25%. Port efficiency is also important in explaining trade

flows between countries. Blonigen and Wilson (2008) found a statistically significant elasticity of 0.32 after controlling for unobserved country-level heterogeneity, implying that a 10% increase in port efficiency leads to a 3.2% increase in real trade between two countries. This is logical if one realises that maritime transport costs make up a substantial part of the value of exported or imported goods, generally in the range of 5% to 10%. Port costs, consisting of charges for port facilities and services, form a non-marginal share of maritime transport cost, approximately 10%, according to industry observers.

Kitakyushu is one of the most time-efficient ports in the world, although its role of stimulating export growth is largely geared towards Asian trade. Kitakyushu is currently the fourth-largest Japanese port, with a throughput of 100 million tonnes in 2011, but its total growth rates over the last decades have been modest. One reason for this is that ferry cargo represents 40% of the total cargo at Kitakyushu port, and ferry cargo has not evolved much among Japanese ports. At the same time, other Japanese ports, such as Nagoya and Osaka, have managed to show comfortable total growth rates in these decades. While container throughput at Kitakyushu port has increased by 80% over the last 20 years, growth in international cargo was limited, with a large share of domestic cargo (70%). The limited international exposure is confirmed by calculations of hub functions and foreland diversification, where Kitakyushu trails behind most Japanese and many world ports.[1] Moreover, the international connections of the port of Kitakyushu have become more focused on main Chinese and Japanese ports and less on other international ports (Figure 2.6). An explanation for the limited international share of cargo can be found in the port specialisation pattern in Kitakyushu, which has only limited traffic in containers, which have become the main transport units for international trade (City of Kitakyushu, 2012).

The port could better be exploited as an asset for export-driven growth and in its potential for becoming a green port. Current and potential initiatives might stimulate its performance. Kitakyushu promotes itself as an obvious node in a system of combined sea and rail traffic from China to Tokyo, which could not only attract more port traffic, but also extend the number of its connections with other ports and strengthen its hub position. The national government could help Kitakyushu by easing restrictions on foreign-made chassis, in order to stimulate truck flows between Japan, China and South Korea. An advantage for increasing the port's role in export-driven growth might be that the port of Kitakyushu is relatively green, which could increase its acceptance among the local population and might provide business opportunities in itself, such as renewable energy production. Kitakyushu port uses shore power electricity, and the city is actively engaged in changing the modal split figures of the hinterland traffic towards a more sustainable mode (more rail, less trucks). The Kitakyushu Seaport and Airport Bureau administering the port has developed the concept of the "Green Energy Port Hibiki", clustering environmental and energy industries in the waterfront area and promoting the location of renewable energy facilities, such as wind energy, solar and biomass energy. In all these areas, including tidal energy, different actors in the city have conducted research and feasibility studies, which could now be concretised and put into action.

Figure 2.6. **Maritime forelands of the port of Kitakyushu in 2011 and 2004**



Note: These maps are for illustrative purposes and are without prejudice to the status of or sovereignty over any territory covered by these maps.

Source: OECD calculations based on vessel movement data from Lloyd's Marine Intelligence Unit.

Notes

1. Port hub functions here are measured by three criteria: degree centrality, betweenness, centrality and clustering coefficients. All indicators confirm the modest hub function of Kitakyushu, ranked 334th, 888th and 1 082nd respectively on the three indicators. Similarly for the index of the diversification of the maritime foreland, on which the port of Kitakyushu ranks 116th. (Own calculations based on vessel movement data from Lloyd's Marine Intelligence Unit).

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Chapter 3

Unleashing Kitakyushu's green innovation potential

Chapter 3 reviews the green technologies innovation ecosystem in Kitakyushu and in the northern Kyushu region. It identifies assets and key players for a regional innovation system, focusing on links between research and business, conditions for entrepreneurship and small and medium enterprises, higher education, and regional collaboration on innovation, as well as international co-operation.

Key findings

- Kitakyushu has important green technology innovation assets, which need to be fully assessed and co-ordinated within a systematic approach. Significant investments in R&D by major private companies, key institutions and actors, such as the Kitakyushu Science and Research Park, and a growing numbers of international patent applications in green technologies indicate strong potential that needs systematic co-ordination within a regional green innovation system.
- Kitakyushu needs an articulated innovation strategy with measurable objectives. Various plans and strategies address the issue of innovation, and national cluster programmes have been implemented in the city. However, in order to fully exploit existing innovation assets and the potential for green innovation in the city and the region, a coherent innovation strategy for green growth is needed.
- Fragmented higher education institutions and weak links with businesses have held back commercialisation. Creating a stronger network of higher education institutions and establishing more links between higher education and commercial R&D will be important for reaping the fruits of the high-quality research in the region. The Kitakyushu Science and Research Park could play an important role in enforcing this nexus.
- The city's major companies and international corporations are responsible for large parts of R&D investments. The Kitakyushu Foundation for the Advancement of Industry Science and Technology (FAIS) facilitates R&D conditions for SMEs, but stronger support is needed for SMEs to unleash their potential for a regional innovation system for green growth.
- The (northern Kyushu) K-RIP cluster presents an important network that Kitakyushu could engage further. Strong research and innovation assets in Fukuoka and the northern Kyushu region present important partners for collaboration with research institutions and companies in Kitakyushu.
- Successful international co-operation has focused on technology transfer and capacity-building so far, but could be extended to international research collaboration.

Assess local and regional green technology innovation assets

Kitakyushu has made strong efforts towards a greener and more innovative economy. The city's mature industries, such as chemical, iron and steel, are facing a multitude of challenges, many of which are linked to strong competition from low-wage economies. A central part of the response to these challenges is Kitakyushu's emphasis on green growth and environmental protection. Local and national governments have made concerted efforts to revivify and rebrand the city in order to make it more attractive to a high skilled workforce and for new and innovative green businesses. Kitakyushu has important assets for an innovative green economy, both in its traditional sector as well as in new and emerging industries. Identifying the strongest potential and helping respective innovative sectors to grow is crucial for making green growth a sustainable perspective for the city.

Kitakyushu has important innovation assets that could be more fully utilised

- R&D investments. TOTO, Yaskawa Electric and Nippon Steel spent almost USD 600 million on research and development in green technologies in 2010. Environmental R&D in Japan in 2008 totalled USD 7.3 billion.

- Companies. The city has about 800 green companies in the field of green technologies, 450 of which are members of the city-established Kitakyushu Committee to promote Environmental Industry, 124 offer Eco-Premium products, and 67 are part of the Directory of Environmentally-Friendly Technologies and Business Opportunities.
- Patents. OECD REGPAT statistics show that Fukuoka Prefecture has strong growth in green technology, ICT, nanotech and biotech patent applications. In Kitakyushu, 492 environment and energy related patents held by 30 companies were submitted in 2011, reflecting the R&D concentration in big companies.
- Institutions. The Kitakyushu Science and Research Park is the key institution bundling innovation activities in Kitakyushu (Box 3.1), where 70 universities, research organisations and private companies conduct R&D activities. Northern Kitakyushu has a concentration of research institutions and facilities in Fukuoka, Omuta and Nagasaki, including the National Institute of Advanced Industrial Science and Technology of Kyushu and Kinki, Oita, Saga and Kyushu universities. All these institutions present opportunities for co-operation for the main innovation actors in Kitakyushu.

Box 3.1. **The Kitakyushu Science and Research Park (KSRP)**

Construction of the science city began in 1996, and the Kitakyushu Science and Research Park (KSRP) opened in 2001, as an academic and research centre. Initially created by the City of Kitakyushu, the Kitakyushu Foundation for the Advancement of Industry, Science and Technology (FAIS) manages the district of the research park with the mandate to attract researchers, professors and extend university research to the park. Several institutions of higher education have established graduate schools in the research park: the Engineering School of Fukuoka University, the Graduate School of Information Production and systems of Waseda University, the Environmental Engineering School of the University of Kitakyushu, the Graduate School of Life Science and Systems of Kyushu Institute of Technology, and a university affiliated with the University of Cranfield (UK). KSRP offers 153 research labs, of which 101 are currently occupied. There are about 300 researchers in the park, primarily focused on environmental sciences, life sciences, engineering and ICT. With its geographical advantages and experience in technological co-operation in environmental fields with other Asian countries, the facility aims to be a core academic research centre in Asia.

An academic hub, advancing science and technology and serving as Kitakyushu's central pillar of the competitiveness and high-tech industries, KSRP educates 2 300 students, including 500 overseas students. It employs 152 teaching staff members, 141 researchers, and is also host to 60 firms. One of its most important members is FAIS, which acts as liaison and co-ordinator between companies and the universities and research institutes. FAIS has 88 staff members and provides support for national and international R&D institutes and universities, enabling them to make full use of KSRP facilities. FAIS benefitted from EUR 2 million in research grants during FY 2009. Its operating costs the same year were EUR 21 million. The Kitakyushu Technology Licensing Organisation (TLO) within FAIS oversees patent activities in the city. In 2007, 105 patents were obtained, 18 in health, medicine and medical care; 1 in food and agriculture; 44 in ICT; 21 in production technologies; 16 in energy, environment and transport and 5 in construction.

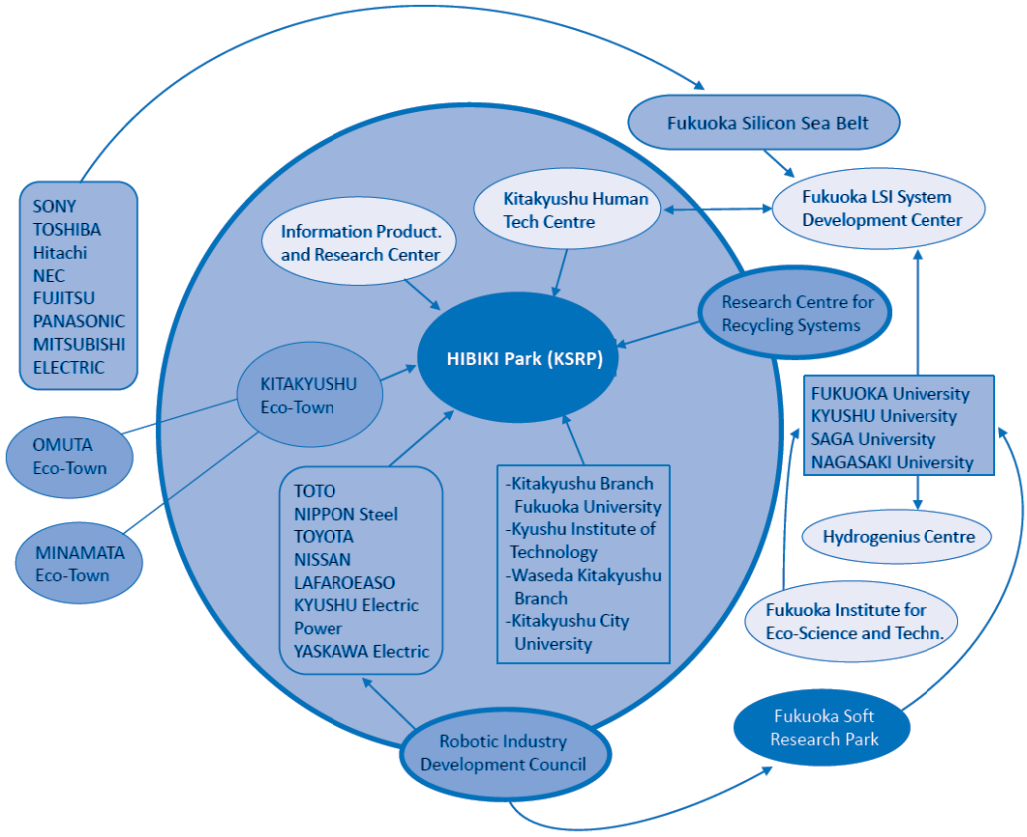
Source: City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

The R&D activities of large local firms are crucial assets for the city's innovation potential. Large firms such as Nippon Steel, TOTO and Yaskawa Electric, Mitsui High Tech Inc., Asahi Glass, Lafarge Aso and Zenrin are based in the city, while other Kyushu cities (apart from Fukuoka) mainly host branch plants and subsidiaries of big business. These large firms concentrate R&D investments and activities, and important product innovations have been developed in Kitakyushu, including electromagnetic steel plates, galvanised steel plates for fuel tanks, steel sheets for containers, steel pipe piles for civil engineering (Nippon Steel), household water equipment (TOTO), inverter control (Yaskawa Electric Corp.), white LED, lithium secondary batteries and chemical automobile material (Mitsubishi Chemical Corp.). The accumulation of leading industrial technologies in metal processing, chemical products, robots and electronic systems, mechanical systems and optics, lasers and semiconductors is reflected in the compilation of patents acquired in the United States (1998-2006) by Kitakyushu companies (Feldman, 2008).

A multitude of innovation actors present promising potential for a region-wide innovation eco-system (Figure 2.6). Kitakyushu is part of a large industrial and research network in semiconductors, which is concentrated in the northern Kyushu area, with the main production centres located in Fukuoka, close to the Institute of System and Information Technologies and to Kyushu University, as well as in Lizuka and Kitakyushu. A particular strength lies in LSI (large-scale integration) systems that provide basic hardware, embedded software and information technologies. LSIs find numerous applications in automobile, biotech, robotics and materials industries in the Kitakyushu area. The Kitakyushu Research and Science Park is home to a semiconductor R&D facility that is connected to Waseda University's Graduate School of Information, Production and Systems. An important application-specific System on Chip (SoC) design project between Kyushu University (Fukuoka) and the Waseda Information Production and System research Center (Kitakyushu) is currently under way. Kitakyushu is also part of the Silicon Sea Belt Fukuoka Project, which aims to establish northern Kyushu as a Centre of Excellence and as an international semiconductor hub in East Asia.

Strong growth in Patent Co-operation Treaty (PCT) patent applications reflects a dynamic, innovative region with a particular strength in information and communications technology (ICT). Total numbers of ICT patent applications in Fukuoka are still much lower than in OECD and Japanese metro-regions (population weighted), but growth rates have been significantly higher in Fukuoka. Over the last decade, the largest share of PCT patent applications in the Fukuoka prefecture – which includes the city of Kitakyushu and Fukuoka – were issued in ICT (216 per year on average, 2000-09). The area with the second-highest number of PCT patent applications in Fukuoka was biotech, with 58 applications per year on average (2000-09), ahead of green technologies and nanotech, with 50 and 12 applications per year on average respectively (2000-09). In terms of growth in patent applications, this order is almost reversed. The highest growth in patent applications from the periods of 2000-04 to 2005-09 are in nanotech and green technologies, with 59% and 50% respectively, while ICT has grown by 34% and biotech 24%. All these growth rates are higher than in OECD metro-regions (average) for all patent categories. Compared with the average of other Japanese metro-regions, Fukuoka also outperforms in all patent categories except ICT. While in the Japanese context Tokyo stands out as the largest and best-performing metro-region in terms of PCT patent applications, Fukuoka is clearly emerging as a strong player both in Japan and among OECD metro-regions.

Figure 3.1. **Kitakyushu's regional green innovation system**



Create a coherent innovation strategy

The city has launched a number of territorial or sectoral plans that recognise the importance of innovation, but it lacks an articulated innovation strategy. The Kitakyushu *Green Frontier Plan*, the *Kitakyushu Fundamental Plan* for establishing "resource circulation", the Kitakyushu *Environment Basic Plan*, *Hydrogen Town Plan*, *Energy Start! Kitakyushu* and *Murasaki Eco River Plan* all offer policy initiatives for innovation, but no common strategy exists that would link different priorities and potentials. In addition to this fragmentation, innovation support at the local level is limited.

The national government supports innovation mainly through a cluster policy, which is carried out through the Ministry of Economic Trade and Industry (METI) and Ministry for Education, Culture, Sports, Science and Technology (MEXT) programmes (Box 3.2). After the recent conclusion of the second MEXT programme, a new approach focuses on a regional innovation system (RIS). The Kyushu Recycle and Environmental Industry Plaza (K-RIP) received about EUR 7 million, while the support from METI amounted to about EUR 16 million. Although these amounts are relatively modest, they provide impetus for green innovation in the region. The Cluster Project has created 177 collaborations between companies, 531 projects or commercial products, and 29 new or secondary businesses. Examples of new green products include dry powder moulding technology for making ceramics (e.g. ceramic tiles) by a non-thermal process, with the option of utilising waste ash from coal power stations; a new soil/irrigation system for reducing the cost and improving the effectiveness of rooftop gardens; and a solar-powered water aeration system.

Box 3.2. **Japanese cluster programmes**

The Japanese approach. A first programme, managed by the Ministry for Education (MEXT) targets universities to encourage them to work with local industries and financing bodies to bring new technologies to the market. The programme sets up networks and grants start-up subsidies for joint activities to reform R&D centres and improve knowledge. Each knowledge cluster's activities are managed by a lead organisation (usually a R&D centre), and a team of science and technology co-ordinators and experts drive the cluster, mainly by organising forums and seminars. This group advises participants to identify priorities, obtaining patents and marketing. MEXT invested USD 410 million over five years, spread over 18 designated clusters and 5 exploratory clusters.

The second programme, run by the METI, is designed to capitalise on the existing endogenous capabilities of 19 major regions and, in particular, their R&D structures and characteristic industrial features. Its object is to provide support for *i*) exchanges and co-operation between the university, industry and the government; *ii*) development of technologies for local application; and *iii*) the establishment of structures to provide training to entrepreneurs. Under this programme, civil servants from the METI regional offices (about 500 people) co-operate with 5 800 SMEs and researchers from more than 220 universities. Local authorities and their staff are also involved, as well as local incubators. METI is devoting USD 350 million to this over a period of four years.

One main objective of the METI programme is to support dialogue between industry, academia and government. While a relatively large number of local governments participate in the projects and operate incubators, and provide office space, development sites and incentives to locate, their capacity to facilitate networking is quite limited, especially within academia.

While METI's approach seems to concentrate on existing industry strength, the knowledge cluster (the second programme) developed by MEXT focuses on universities. Its aim is to make them co-operate with industries and commercialise new technologies. The emphasis is on creating human resource-based or proximity-based networks that encourage face-to-face interactions. The implementation is decentralised and run by an organisation nominated by the local governments. While this programme has an impact, it is not clear whether its potential has been reached, in particular in terms of higher education institution (HEI) participation.

Within the framework of the projects implemented, many universities that would like to increase project size and extend their co-operation to other HEI abroad do not have the funds to do so. On average, the knowledge clusters receive an annual subsidy of USD 5 million. Given the size of the Japanese economy, the central government financing is relatively small. There is some discussion about targeting fewer clusters across programmes to increase the grant size for selected groups, and channel funds to the most dynamic clusters.

One important issue is the co-ordination between the two programmes, in particular to better use HEI resources. If MEXT focuses on universities and public institutes developing new technologies and METI supports commercialisation, they share a common network approach that could lead to overlapping and duplication of tasks. Thus far, the programmes have mostly developed in parallel, due in part to information exchange and interactions during conferences. A number of regional cluster promotion committees have been set up, however.

Source: OECD (2007), *Higher Education and Regions: Globally Competitive, Locally Engaged*, OECD Publishing, Paris, doi: *10.1787/9789264034150-en*.

The disparate initiatives and innovation incentives could yield more results if they were linked to a more coherent strategy. Kitakyushu provides a one-stop service for green technology enterprises and supports a wide range of research activities, including support for research into hydrogen-propelled vehicles, rare metals projects, the creation of technical

centres at the University of Kitakyushu, promotion of ESCO projects and solar power generation systems. By making use of the Comprehensive Assessment System for Building Environment Efficiency (CASBEE) approach, Kitakyushu also tries to encourage self-directed initiatives by building owners and facilitates the maintenance of environmentally friendly infrastructure, in particular in the public sector. While these initiatives stimulate innovation in different fields, they are not conceived of as particular elements of a larger innovation strategy. If they were to feed into the development of the regional innovation system, and vice versa, they could profit from a larger network, which would strengthen the potential for innovative outcomes.

In order to realise Kitakyushu's innovation potential for green technologies, future development needs direction through a coherent innovation strategy for green growth. Green technologies develop at the technology frontier and often combine different disciplines and innovation assets from different areas. In Kitakyushu, several green growth-related programmes are focused on green innovation, such as the Eco-Town Programme, the Smart Community Project and the Low-Carbon Society, but the links and complementarities between the different initiatives are underexploited. Current fragmentation of programmes also leads to overlaps and a clear definition of green companies and products is still lacking, which makes it difficult to design effective green innovation policies. A coherent innovation plan is needed, with clear goals, interlinked strategies and a stronger focus on public-private collaboration to consolidate the still fragmented clustering process at work. Kitakyushu is not exceptional in this lack of coherent plans, which is a common characteristic of Asian industry clusters (Feldman, 2008). In addition, quantified milestones, such as those defined for San Jose in the Silicon Valley (Box 3.3), might help to rationalise development and adjust to opportunities through continuous assessment and benchmarking.

Box 3.3. **San Jose and the Silicon Valley**

There are about 25 000 technological firms in the Silicon Valley and about 1 million jobs in the information and communication technology industries. Silicon Valley accounts for one-third of all capital risk investment in the United States. The area is made up of interconnected networks of entrepreneurs, developers and top leaders of large firms, laboratories and universities.

Silicon Valley has benefited from different innovation cycles: from the defence industry and semiconductors in the 1950s, PCs in the 1970s and 1980s, and the Internet at the end of the 1990s. The cleantech revolution has emerged in the last decade and local companies are now at the forefront of sustainable development practices. Hewlett Packard (HP) is the first large enterprise to systematise emission measurement at each step of its supply chain, Adobe built headquarters using environmental practices, and Intel is the most important consumer of renewable energy among US companies.

In 2007, San Jose launched the San Jose Green City Programme. This programme is pursuing 10 main goals over a 15-year period: *i*) to create 25 000 green jobs, *ii*) reduce energy consumption per capita by 50%, *iii*) meet 100% of electricity demand with renewable sources, *iv*) build 5 million square metres of buildings according to environmental standards, *v*) recycle and covert into energy 100% of urban waste, *vi*) clean 100% of wastewater, *vii*) use only clean vehicles, *viii*) plant 100 000 trees (net number), *ix*) replace 100% public lighting network by a zero-emission connected system, and *x*) build a 150 kilometre-long railway network system.

Source: Ktitareff, M. (2010), "Développement Durable: L'Amérique passe au Vert", WDHB Consulting Group presentation, *www.lamelee.com/les-ressources/forum-sur-le-marche-des-green-tech-dans-la-silicon/developpement-durable-lamerique-passe-au-vert/view.html*, accessed 30 August 2012.

Strengthen and formalise links between research and business

High-quality research is taking place in Kitakyushu, but the knowledge generated at local institutions is not sufficiently transferred to and commercialised by local businesses. International university rankings confirm the quality of research conducted in Kyushu and notably northern Kyushu HEIs. According to the international SCImago classification, Kyushu University is ranked 94th in the world and 5th in Japan for the size of its research output. Kyushu University and Kurume University (both universities in Fukuoka prefecture), are also top performers for the quality of their publications (see Table 3.1, Column 6). The rank of universities with a campus in the Kitakyushu KSRP – Waseda, Kyushu Institute of Technology, Kitakyushu and Fukuoka University – is more modest. Vast fields of research are nevertheless covered by these different universities, including IT, LSI systems, energy, advanced materials, artificial intelligence and biotech, including a total of more than 1 000 master's and PhD students per year. Waseda University has the highest international profile, mainly due to its strong links with the Tokyo region. The Kyushu Institute of Technology is also strongly engaged in a number of international co-operation with HEIs worldwide, such as Malaysian universities. This does not mean that northern Kyushu HEIs and in particular Kitakyushu-based HEIs are more active internationally than their southern Kyushu counterparts (Table 3.1, Column 5).

Table 3.1. **Kyushu universities in the 2012 SCImago classification**

Institution (U)	World ranking	Japan ranking	Output	Intern-ational collabor-ation (%)	Q1 (quality) (%)	NI (impact)	Special-isation	Excellence	Leader-ship
Tokyo U	6	1	49 529	26.7	57.5	1.3	0.5	14.2	27 308
Kyushu U	94	5	19 935	20.2	50.2	1.0	0.5	9.7	12 367
Waseda	367	14	8 728	22.5	37.9	1.1	0.6	11.1	5 339
Kumamoto	606	19	5 590	19.9	49.6	1.0	0.6	9.9	3 364
Nagasaki	682	24	4 826	21.2	47.0	0.8	0.7	7.6	2 954
Kinki	745	30	4 456	16.9	47.0	1.0	0.6	8.0	2 576
Kagoshima	841	37	3 867	22.6	46.5	0.8	0.6	6.4	2 251
Kyushu IT	890	39	3 630	17.6	25.0	0.7	0.8	6.1	2 381
Saga	988	46	3 216	25.6	42.6	0.9	0.6	9.3	1 909
Fukuoka	1 224	59	2 457	17.3	43.5	0.8	0.7	7.4	1 459
Kurume	1 335	66	2 187	14.2	49.1	0.9	0.8	10.5	1 336
Miyazaki	1 336	67	2 156	20.5	45.2	0.8	0.7	7.3	1 245
Oita	1 440	73	1 988	14.7	41.8	0.7	0.7	6.0	1 351
Fukuoka IT	2 866	109	665	38.5	19.6	0.7	0.9	7.2	386
Kitakyushu U	2 983	114	594	14.8	30.8	0.8	0.8	5.7	414

Note: Universities are ranked according to their publication output (O) i.e. the total number of documents published in scholarly journals indexed in Scopus (see Column 4). IC (international collaboration) in Column 5 is the institution's output ratio produced in collaboration with foreign institutions. Q1 (Column 6) stands for high-quality publication. It is the ratio of publication that an institution published in the most influential scholarly journals of the world. For NI, i.e. normalised impact, the value shows the relationship between an institution's average scientific impact and the world average (Column 7). A NI score of 0.8 means that the institution is cited 20% below world average. Spec (Column 8) is a specialisation index. This index indicates the extent of thematic concentration/dispersion of an institution's scientific output (1 for the most concentrated, 0 for the most dispersed). Exc (Column 9) index measures the amount in % of an institution's scientific output that is included in the set of the 10% of the most cited papers in their respective scientific field. This is a measure of the high-quality output of a research institution. The last column indicates an institution's output as the main contributor, that is the number of papers in which corresponding authors belong to the institution.

Source: SCImago Institutions Rankings (2012).

Important potential could be released through more R&D collaboration between academia and businesses. Higher Education Research and Development (HERD) amounts to 0.4% of GDP in Japan, which is very close to the OECD average. However, the intensity of the relationship between business and HEIs remains low, despite renewed efforts and incentives from the central government to increase collaboration and to generalise a triple-helix approach (Box 3.4). HERD financed by industry is about 2%, which is far below the German and Korean share of 14%. This reflects the Japanese industries' R&D strategy, which does not make enough use of HEI research capacities. This percentage share remained the same between 1995 and 2008, and during this period, Japan ranked lowest among OECD countries for HERD financed by industry (OECD, 2009).

Box 3.4. **Japan university-industry collaboration policy**

In Japan, university-industry collaboration (UIC) policy is jointly organised by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Ministry of Economy, Trade and Industry (METI). The Act on the Promotion of Technology Transfer from Universities to Private Industry (the "TLO Act") was enacted in 1998. The policy of promoting technology licensing organisations (TLOs) to activate technology transfers was spelled out on the basis of this Act, and 47 TLOs approved by MEXT and METI were established by 2009. The Act on Special Measures for Industrial Revitalisation, which was enacted in 1999 and modelled on the US Bayh-Dole Act, allowed universities to retain rights to inventions resulting from state-funded research. In Japan, however, since many research universities were national universities, restrictions on retaining rights to invention were applied. As state organisations, national universities had to comply with rigorous restrictions on the assertion of their rights with regard to patent filing. Universities rarely filed patent applications, and in cases where inventing was part of a university research scientist's academic duties, the rights to inventions were generally vested in the individual, i.e. the professor and not the organisation.

To address these problems, national universities were incorporated in 2004, and restrictions on technology transfers were relaxed. A mechanism was introduced to create competition among universities. The university budget was paid in a lump sum as an institutional discretionary fund for operating expenses. The total amount of the institutional fund was steadily reduced, while competitive funds were expanded. Because the funds for joint research undertaken with the private sector constituted an important source of income for universities, there was a shift in their identity as corporations increased the incentive for universities to engage in UICs. In addition, incorporation made it possible for a university to own intellectual property as an organisation.

The 2002 Outline of Intellectual Property Strategy spelled out a principle according to which the title to inventions devised by university employees was vested in the university as a corporation, rather than in the individual inventor. From the FY 2003, MEXT promoted the establishment of "Programmes for the Establishment of University Intellectual Property Offices" to support intellectual property activities in universities, and the operational framework for and management of intellectual property in universities were put in place; principally at 34 universities whose programmes were accepted in MEXT's solicitation of bids. As described above, the series of UIC promotion policies devised a method of establishing university ownership of university research results and transferring the resulting technologies to the private sector through licensing agreements with corporations. It has become common practice for companies and universities to co-own the results of joint research, as specified by contractual agreements. This arrangement transformed the nature of UICs from informal relationships between companies and individual researchers (where the results of joint research would be owned by the company as intellectual property, while the academic researcher would be compensated through scholarship donations and other means) to formal collaborations on a contractual basis, with the university patent office serving as the intermediary.

Box 3.4. **Japan university-industry collaboration policy** (*cont.*)

After 2004, the number of university patent applications surged. Motohashi (2011) shows that the new policies increased the number of UIC patents in the late 1990s and that the quality of patents did not decrease. However, it is also found that strong intellectual property (IP) policies pursued by universities may reduce the incentive for firms to commercialise inventions resulting from UIC collaborations. It follows that IP policies at national universities, which now have a uniform system guided by MEXT, should be flexible, depending on a company's needs.

Finally, an R&D partnership system was introduced in 2009, based on legislative action by METI to enable the creation of a new legal entity. When multiple firms engage in a joint R&D project, they can create a new entity such as a Limited Liability Corporation (LLC) or Limited Liability Partnership (LLP). An LLC has a legal personality, which enables its asset and patent ownership and its economic transactions with other firms.

However, the amount invested in an LLC cannot be treated as R&D expenditure, so parent companies cannot benefit from an R&D tax credit. On the other hand, fees to LLP can be treated as R&D expenses, but an LLP cannot claim its own juridical personality, so economic activities such as asset management have to be dealt with by each of the participating companies individually.

Source: Extracted from Motohashi, K. (2011), *Innovation Policy Challenges for Japan*, IFRI Center for Asian Studies, Paris.

The Hibiki Park, which consists of the Hibikino Science and Research Park and Hibikinada Area, plays a crucial role for creating links between higher education, businesses and research institutions, and could become the focal point for strengthening connections between R&D and business. The Hibiki Park is home to the Kitakyushu Science and Research Park (KSRP) and the Kitakyushu Eco-Town. KRSP is promoting R&D, and its outcomes are integrated in the Eco-Town. The Eco-Town is divided into three parts: *i*) the Comprehensive Environmental Industrial Complex, which hosts several large company research labs (Aso Mining, West Japan Auto Recycling), *ii*) the Hibiki recycling area, dedicated to SMEs and *iii*) the Practical Research area occupied by the KRSP and R&D institutes. The KSRP includes a Technology Licence Organisation, which applied for the registration of 306 patents in 2010 and has 10 years of experience in the application of the semiconductor industry to green technology. Chemical and mechanical environment engineering R&D is also being conducted in the park within the framework of the City University. Energy, environment systems and recycling activities are important fields of research for the Fukuoka University branch located in KSRP. On the whole, activities are nevertheless limited, with 21 000 students in the city (2 300 in the park – see above), 6 500 in the University of Kitakyushu (Kitakyushu Daigaku), and 4 graduate schools. Many of the companies located in KSRP are involved in the design of semiconductors.

Box 3.5. **Øresund Environment: Driving the development of green technologies, mobility and cities**

Denmark and Sweden each have a long history of environmental awareness and action to protect their natural heritage. They also share a region, Øresund, uniting Copenhagen in eastern Denmark with Malmö in southern Sweden. Together, the two countries have created Øresund University, a co-operation between 14 universities on both sides of the border that aims to be a world leader in scientific research.

Øresund University has been the driving force behind Øresund Environment, one of seven thematic clusters set up in the region to drive eco-innovation by bringing together stakeholders from the academic, private and public sectors. All three sectors help finance this venture, which also benefits from EU funds.

The environmental cluster started out specialising in water and waste management, driven by a focus on the marine environment – Copenhagen and Malmö are separated by a strait. More recently, it has launched projects on eco-building and eco-cities – an "Urban Transition" project is in the pipeline – as well as on renewable energies such as wind, solar and biomass and biofuels for green mobility.

The choice of topics is reinforced by the types of companies involved in the project. These include: the DHI Group, which specialises in water, environment and health; Novozymes, which has an interest in biofuels; and Vestas Wind Systems, Denmark's leading wind-turbine manufacturer.

To get involved, companies must pay a fee, have a base in the region and commit to intensive R&D. So far, the forum boasts 70 corporate members, out of a total of 500 eco-technology companies in the region. Apart from the 14 academic members of Øresund University, involving some 900 researchers, another 13 research institutes and several local authorities are members.

Øresund Environment is more concerned with getting innovations to the market than deciding on basic R&D, but its academic members clearly provide a solid foundation for its work. Around 500 students graduate from these institutions each year with an MSc in environmental technology.

Partnerships with some of the other six thematic clusters have been invaluable, notably those on materials, logistics and information technology, particularly smart grids. The cluster is working hard to maintain these links today, since it left the Øresund umbrella at the start of 2011 to begin operation as an independent unit administered by Lund University and Roskilde University.

Ultimately, the goal of Øresund Environment is to promote innovation and the dissemination and commercialisation of research on eco-technologies. But it also aims to offer stakeholders a platform where they can exchange information and find inspiration. It works with regional incubators to bring innovations to market. Through synergies, Øresund seeks to secure its place as a world leader for innovation in environment, climate and energy.

Source: OECD (2003), *OECD Territorial Reviews: Oresund, Denmark/Sweden 2003*, OECD Publishing, Paris, doi: *10.1787/9789264100800-en*.

The different green technology-related R&D centres need to reach a critical size and embark more on collaborative projects, notably with other regions.[1] Certain actions could accelerate R&D:

i. Review all research projects implemented, identify new opportunities for expansion and organise events for actors in the private sector. The communication policies of HEI-based research centres in Kitakyushu should be improved to increase the visibility of research projects in the business sector.

ii. Set up a forum with neighbouring universities in northern Kyushu to further collaborate on research projects related to sustainable development, waste management and eco-products (see the Øresund trans-border case in Box 3.5).

iii. Strengthen the links between the higher education sector and local SMEs. Several countries have set up voucher systems to give incentives to companies to commission research from university or purchase knowledge services from consulting services. The Japanese government could consider launching a green voucher pilot programme for Kitakyushu.

iv. Strengthen the higher education sector. Kitakyushu would profit from a strong research university of its own. The highest-performing clusters in the world are all supported by a strong university sector (Box 3.6). Kitakyushu needs to better train its engineers and technicians and expand its course selection to attract students. These elements should be part of a Kitakyushu plan to strengthen its higher education sector to meet the anticipated demand for green jobs. It is crucial to develop a green workforce, as local green industries need skilled workers. Better-educated personnel can also be a source of innovation in organisations. Strengthening the higher education sector will require significant new investment.

Provide greater assistance to small and medium enterprises

While small and medium enterprises (SMEs) are well represented in all greentech activities, they need special support for three reasons *i*) because it is increasingly acknowledged that they are more innovative than the big business, *ii*) because of the degree of (technological) risks they encounter in their innovative projects and *iii*) because their financial standing is often not sufficiently robust (in terms of size, profitability, cost of accession to the banking system) to engage in these projects.

The increasing number of SMEs has made the industry network more complex. In the last decade, the structure of the manufacturing industry in Kitakyushu has been modified not only because of the establishment of new enterprises and the construction of new plants but also because of the internal restructuring of existing industries. In particular, there has been a growing tendency among large companies e.g. in the iron steel, chemical and automobile sector, to shift a number of activities to local SMEs (support work, components, various supplies and downstream activities) or to spinout companies. New challenges have emerged with the multiplication of actors and the fragmentation of activities. Greening of production has become more complex and the need to design a policy targeted at these new actors (cluster, very small SMEs, spinoffs, etc.) more urgent.

Box 3.6. **Teaching and research potential in several advanced OECD green clusters**

Lahti cluster (Finland). In Lahti, R&D support is ensured by a consortium of five universities. The Lahti region spent USD 43 million on eco-tech research (2006 figures). Main higher education institute (HEI) players comprise the Lahti center of the University of Helsinki (8 000 students in all disciplines and 14 university chairs), the Tampere University of Technology (laboratory of plastics and elastomer technology), Lahti Science Library, Lahti University of Applied Sciences and Lahti Polytechnic. A master's degree in green technologies was recently created at the University of Helsinki. On the Lahti campus in the Lahti Science and Business Park (LSBP), 325 students are being trained in environmental technologies. The Business Park is also host to 130 eco enterprises employing 1 800 people, accounting for about 10% of all green business in Finland.

Envirolink Northwest (UK). The HEI infrastructure is also very strong in the case of Envirolink Northwest (EN), a major UK green cluster located in the northwest of the country. The 1 500 eco-enterprises in the region generated a turnover of EUR 6 billion in 2008 (10% of the UK market). The North West University Association (NWUA), representing 14 regional HEI, is part of the cluster and represents the third-largest HE capacity in the country. These HEI propose numerous courses linked with environmental sciences. In collaboration with the NWUA, EN offers a main educational instrument called Discover HE, which consists of 7 500 courses delivered in 15 establishments, 700 of which are supplied by further education institutions in the northwest and 500 directly linked with energy and environmental matters.

The region also has 50 research centres. Companies have particularly strong links with the Lancaster Environment Center, the Center for Waste Management, the Liverpool Center of Environment Technologies and the University of Manchester's Joule Center of Energy Research and Development. EN was involved in 28 collaborative projects with these centres and others during the four-year period between 2006-09.

Massachusetts Clean Energy Centre (United States). The Massachusetts Clean Energy Center (Mass CEC) located in Boston, is an additional example of a strong concentration of HE capacities. It is host to 550 eco-business enterprises (14 400 jobs in 2006), as well as to several well-ranked universities. Mass CEC acts as a quasi-autonomous non-governmental organisation and is particularly active in promoting training offers to match the needs of the energy efficiency and renewable energy sector through its Workforce Development Programme. Main players include MIT (through its Energy Education Programme), selected in 2010 as the US Eco-tech University of the year, the University of Massachusetts (Wind Energy Center) and Harvard (Center for Environment). The Commonwealth of Massachusetts has created the Massachusetts Technology Park Corporation (MTPC), which assists firms to access federal programmes and to set up collaborative R&D projects. Each year, Mass CEC invests USD 40 million to USD 50 million in grant and subsidies to finance R&D endeavours. Additional resources – risk capital – are available from private sources for eco-technology startups. The investments in eco-technology startups are significantly lower than the USD 2 billion in venture capital that is spent each year in California.

Source: OSKE (2012), "Cleantech", OSKE Centre of Expertise Programme, *www.oske.net/en/competence_clusters/cleantech/*, accessed 30 August, 2012; MEEDDM (Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer) (2010), *Les Clusters Mondiaux dans le Domaine des Éco-Technologies: Enseignements, Perspectives et Opportunités,* MEEDDM, *http://competitivite.gouv.fr/documents/commun/Documentation_poles/Comparaisons_internationales/rapport.pdf*.

The city supports SMEs, but stronger support and a broader approach are needed, in addition to the subsidies allocated for innovative demonstration studies. FAIS (heavily

nurtured by city funds) provides some support for R&D and studies involving academia and business collaboration for low-carbon technology projects. International experience – as in San Diego (Box 3.7), the Dutch approach or the French poles of competitiveness – show how broader approaches can be effective (Box 2.8). A key finding in these examples is increasing local and central governments' intervention to compensate for the disadvantages of small businesses through renewed support and coaching programmes.

Box 3.7. **Cleantech San Diego Cluster (CSDC)**

Since 2006, more than 100 new cleantech companies have been established in San Diego, many of them affiliated with the city's world-class universities and biotechnology industry. With early support and commitment to this sector, San Diego stands to become a hub for the development and commercialisation of cleantech products and technology.

About 50 research centres, higher education institutions and related institutes are based in San Diego, and several are members of the CleanTech San Diego Cluster. One is the University of California, San Diego (UCSD), which is involved in several renewable energy pilot projects.* Scripps Institute of Oceanography, also a cleantech cluster member, develops algae-based biofuel. Other relevant centres include San Diego State University, the Salk Institute for Biological Studies and the San Diego Centre for Molecular Agriculture.

San Diego's cleantech cluster is distinctly different from the biotechnology and wireless telecommunication sectors. While those sectors tend to be geographically concentrated in the Torrey Pine Mesa and Sorrento Valley area, in close proximity to UCSD, the local cleantech industry is scattered throughout the region, dictated by proximity to natural resources, specific land use requirements and access to affordable land.

A number of San Diego's cleantech companies have roots in other technological disciplines. The region is seeing the convergence of technologies from biotech and wireless/telecommunication with cleantech innovations in areas such as alternative fuel, smart wireless sensor technologies and biomimetic solutions.

San Diego has already built a track record in cleantech. While its population is less than a third of the size of the population of Los Angeles, the city has installed 60% more solar roofs. In July 2009, San Diego was recognised as the leading solar city in the state, with the most solar installations (over 2 200 rooftop installations) and the greatest solar capacity in the state. Cluster successes include Siliken Renewable Energy, ClearEdge Power, Synthetic Genomics and Sapphire Energy.

Note: * In the field of solar energy, the CleanTech San Diego Cluster also assists local governments in securing funds from the clean Renewable Energy Bonds Fund, a federal programme with a USD 800 million budget to finance solar panel installation projects.

Source: MEEDDM (2010), Les Clusters Mondiaux dans le Domaine des Éco-Technologies: Enseignements, Perspectives et Opportunites, MEEDDM, *http://competitivite.gouv.fr/documents/commun/Documentation_poles/Comparaisons_internationales/rapport.pdf,* translated by the author.

Supplementary incentives could help small business in Kitakyushu to consolidate their operations and to strengthen their innovation trajectory. Given the number of good practices developed in foreign countries, there are several measures that Kitakyushu could implement:

i. Launch a special SME programme within the K-RIP cluster. SME plans deployed in some of the green poles of competitiveness in the Paris metro-region, notably ADVANCITY, MOVEO and SYSTEMATIC, could be a source of inspiration. Such plans target the specific needs of SME in areas such as coaching, financing, technological watch, training activities and partnerships with large companies.

ii. Give more attention to the internationalisation of research on eco-products and environment industries and to linking SMEs with the new network of knowledge. Knowledge Transfer Networks (KTNs) have been set up in eco-innovation in the UK to foster the growth of green industries.[2] Seventy-five percent of business respondents have rated KTN services as effective, 50% developed new R&D and commercial relationships with people met through these networks and 25% made a change to their innovative activities as a result of their involvement within KTN. Promoting this type of network in Kitakyushu and encouraging SME participation would be particularly welcome.

iii. Reinforce support for instruction in entrepreneurship in Kitakyushu universities. Setting up a green "team academy" on the basis of the Finnish model would be one option (Box 3.8). This could attract students from Kyushu, the rest of Japan and even from abroad, and lay the foundation for a substantial increase in the number of entrepreneurs in the city.

Box 3.8. **Team Academy in Finland**

Established in 1993, Team Academy is a special unit for entrepreneurship and leadership at the Jyväskylä University of Applied Sciences in Central Finland. It aims to *i*) increase student and graduate enterprise formation; *ii*) encourage an entrepreneurial attitude and *iii*) help small and medium-sized enterprises (SMEs) and other companies access university expertise in marketing, management and entrepreneurship. At the same time, it acts as a "learning laboratory", where new learning methods and models for business life are developed (e.g. effective teams, learning organisations and modern marketing).

Team Academy offers a special three and a half year educational stream. Each student takes intensive training in leadership and marketing as a member of a team through real-life project work. Team Academy is open to business students, but based on its experiences, a series of courses in entrepreneurship – "The Path for Prospective Entrepreneurs" – has been developed and is available to all students.

In the past ten years, Team Academy has taken on 1 750 projects. It has provided entrepreneurial education for more than 500 Bachelor of Business Administration (BBA) graduates and helped start 17 companies. About 25% of Team Academy graduates are active entrepreneurs, especially in the service sector and consulting. Team Academy has received a number of national awards for its innovative learning methods and its proven track record in promoting entrepreneurship.

Source: OECD (2011), *Higher Education in Regional and City Development: The Galilee, Israel 2011*, OECD Publishing, Paris, doi: *10.1787/9789264088986-en*.

Increase regional research co-operation: The Kyushu network

Kitakyushu is part of a green Regional Innovation System (RIS) within northern Kyushu and the Fukuoka prefecture, and should make better use of this system. Cross-jurisdictional collaboration has already proved useful and efficient in the large-scale innovation (LSI) system field, and 110 new LSI-related firms have been created in the Fukuoka/Kitakyushu/Iizuka region since the inception of the Silicon Sea Belt Project (SSBP) ten years ago.[3] However, significantly more benefits would result if this co-operation could be extended to the whole set of green technologies.

There are two reasons why Kitakyushu would benefit from adopting this geographical and larger perspective: the city would be able to *i*) exploit size and inter-sectoral effects and *ii*) compensate for some of its weaknesses in R&D and university research.

i. Northern Kyushu provides strong industrial support for Kitakyushu activities. Fukuoka Prefecture, whose industries include strong concentrations in automobiles, semiconductors (Institute of Industrial System for LSI Design), ICT (Software Research Park in Fukuoka City), biotech (Fukuoka Biovalley), nanotechnology, robotics and hydrogen and fuel cells, now boasts a GDP of over USD 155 billion (on the level of the GDPs of Hong Kong and Malaysia). Meanwhile, the GDP of Kyushu as a whole is in the vicinity of USD 430 billion, which would place the island in 17th place in a global ranking by country.

ii. Fukuoka Prefecture is home to 39 universities (12 of them offering science and technology departments), which, in combination with other HEIs, provide outstanding programmes that attract top-level students, mainly from within Japan. About 130 000 students are being educated at the university and junior college level, with some 28 000 capable graduates entering the workforce every year, making the prefecture a reservoir of talent. In addition, Fukuoka hosts around 6 000 overseas students from over 90 countries, and the prefecture is active in matching up foreign students with interested domestic and foreign companies. Fukuoka is home to the high-ranked Kyushu University and other academic research institutes, as well as to public research institutes that advance R&D in a wide range of fields and other cutting-edge sectors.

The main elements of a Regional Innovation System already exist (Figure 3.1). Companies based in Fukuoka prefecture, higher education institutions and research organisations are increasingly partners of their counterparts in Kitakyushu. Already in 1999, METI had identified the Kyushu Recycle and Environmental Industry Plaza (K-RIP) cluster, with a focus on recycling activities and environmental industries, as a target for the national cluster policy (Box 3.9). K-RIP's mission can be summed up in the "3Rs" motto: Reduce, reuse and recycle. The cluster comprises not only Kitakyushu's eco cities but also two other cities: Omuta and Minamata (Figure 3.2).

Box 3.9. **Overview of K-RIP cluster**

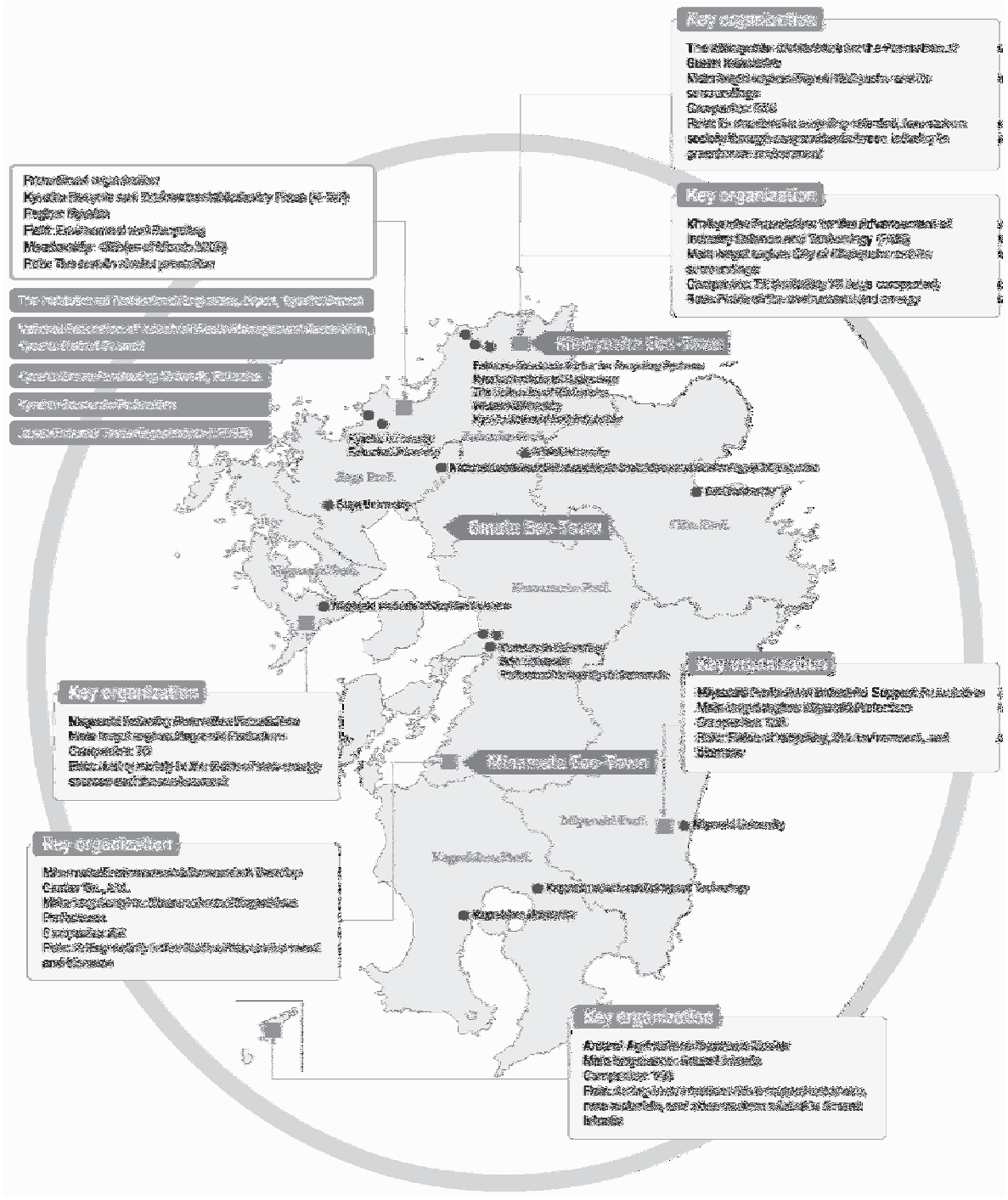
The Kyushu Recycle and Environmental Industry Plaza (K-RIP) is composed of 493 members (2008) including 293 enterprises (90% SMEs), 86 individuals related to higher education institutions, 65 representatives of other organisations, 40 local communities and 9 organisations. In 2008, the member firms and organisations were involved in 121 collaborative projects, and several goals were assigned to the cluster: the launching of 1 500 projects from 2006 to 2010, the establishment of 20 enterprises in foreign markets and the provision of significant assistance to 10 highly innovative firms.

The K-RIP RIS is governed by a steering council of 28 members from industry, public administration and the academic world. Three working groups take care of information exchanges, business generation and international activities. The cluster's operational budget is EUR 400 000 per year, two-thirds of which is supplied by METI and one-third by membership fees. Support is also given by the Japan External Trade Organisation (JETRO), as well as by the Professional Association (including the Professional Engineers Association, Green Purchasing Network and the National Federation of Industrial Waste Management). Main cluster actors can benefit from regional "fellowships" for their R&D projects and from the support of the Fukuoka Venture Market Association, an association of 38 venture capital funds and 26 banks. METI ranked the K-RIP cluster in sixth place among 25 designated clusters (METI cluster Programme). METI's initial assessment clearly showed that K-RIP is a leader in green technologies in Japan, performing better than the Kansaï energy and environmental cluster. It was also described as being more open to international co-operation than the Chugoku cluster project for a recycling-oriented society. The review also showed that K-RIP enterprises were growing faster than those of the Chubu cluster on fuel cells and energy-based new industries. This configuration has not changed in recent years.

Source: MEEDDM (2010), Les Clusters Mondiaux dans le Domaine des Éco-Technologies: Enseignements, Perspectives et Opportunités, MEEDDM, *http://competitivite.gouv.fr/documents/commun/Documentation_poles/Comparaisons_internationales/rapport.pdf.*

The performance of K-RIP in generating innovation and fostering technology transfers has been less than optimal. Despite the support from MEXT and METI to nurture cluster development, K-RIP has shown some results but is still underachieving. Since K-RIP was established, cluster member companies have patented applications through the Kyushu TLO (established in 2000) and the Kitakyushu TLO (established in 2002) but there is room for improvement. Incubator activities within the cluster framework are still weak and need to be strengthened.

Figure 3.2. **Kyushu cluster**



Note: This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: MEEDDM (Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer) (2010), Les Clusters Mondiaux dans le Domaine des Éco-Technologies: Enseignements, Perspectives et Opportunités, MEEDDM, *http://competitivite.gouv.fr/documents/commun/Documentation_poles/Comparaisons_internationales/rapport.pdf*; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Kitakyushu's benefits from K-RIP could be strengthened by:

i. Creating the conditions for enhanced cluster governance. While a large majority of its business members are small firms, their interests do not seem to be properly represented at the level of the governing board.[4] A reorganisation of K-RIP governance more in line with the distribution of memberships would help to take into consideration the needs of innovative SMEs, and in particular, those from Kitakyushu. At the same time, it is imperative that the cluster be granted more autonomy. The (Council) budget should therefore be fully covered by the members, which means phasing out the METI subsidy.

ii. Promoting the creation of green incubators and accelerate spinoffs from sustainable development public research and eco-activities. The K-RIP cluster has no incubator of its own. In Kitakyushu, there are several incubators, but they are specialised in media or ICT and not technology-specific. Given the strong priority the city accords to green technologies, KRSP needs to more actively carry out this ambition to strengthen its capacity to deliver services to incipient green companies. Co-operation could also be developed with the other two Kyushu eco-cities: Omuta and Minimata.

iii. Improving K-RIP cluster output, enhance its innovation capacities and improve its interaction between business and higher education institutions. One way to achieve this goal is to set up performance contracting procedures in main research institutions and for the cluster as a whole, e.g. fix medium-term objectives to continuously monitor the results and readjust the strategy when necessary.

Expand international co-operation beyond Asia

The City of Kitakyushu has transferred experiences and technologies in pollution abatement, resources recycling, and development of a low-carbon society, in addition to many other areas, to the Asian community through environmental international co-operation, using environmental networks developed with a number of cities overseas. For example, the Kitakyushu Initiative for a Clean Environment ran from 2000 to 2010, involving 170 cities supported among entities including the United National Economic and Social Commission for Asia and the Pacific (UNESCAP), the City of Kitakyushu and the Institute for Global Environmental Strategies (IGES), an international research institute.

An infrastructure for international co-operation is in place. The City of Kitakyushu has developed an inter-city network through co-operation with the relevant institutions and worked on joint sustainable development projects. Several organisations have been set up by the city, the private sector and the central government to manage these collaborative projects. Kyushu Japan International Co-operation Agency (JICA), located in the city, receives trainees from developing countries and dispatches experts to those countries. The Kitakyushu International Techno-cooperative Association (KITA) was established by the Chamber of Commerce and other partners to hold international training courses. Furthermore, the Asian Centre for Low-Carbon Society sets up environmental business projects, facilitates environmental international business activities and provides support for applying for grants from national and international organisations. Finally, the City of Kitakyushu supports activities by dispatching staff and granting subsidies to IGES.

Thus far, the main outcomes include the environmental improvement master plan jointly formulated with Chinese partners, resulting in a substantial reduction of pollution in the city of Dalian (China). A project was conducted with success in Surabaya (Indonesia) using Kitakyushu's expertise in waste disposal to reduce organic waste and build up compost supply. Kitakyushu also signed a Memorandum of Understanding to improve the water leakage ratio in the Phnom Penh water supply system and organise personnel exchanges between the two cities.[5]

These achievements should be built on to strengthen existing co-operation. This can be envisioned in two ways, by diversifying:

i. Targets: There is significant potential for more international collaborations beyond Asia. Large firms in Kitakyushu, including Yaskawa Electric Corp., TOTO Ltd, Nippon Steel Corp, Nippon Magnetic Dressing Ltd. and Eco Material Corp., are involved in projects in Cambodia, China, India, Indonesia, and Vietnam. These globalised firms could serve as brokers for establishing green technology collaborations between Kitakyushu and non-Asian cities worldwide.

ii. Collaboration: Research co-operation with foreign universities and research centres is not as well developed as it could be (Table 3.1). Policies should foster collaboration and co-operation with partners that can offer complementary assets and comparative advantages.

Notes

1. In Japan, the share of patent applications within at least two co-inventors from two different regions (as a percentage of total patent applications) has significantly decreased since the early 1990s, in contrast to the United States and the major European countries.
2. Among UK KTNs, the environmental sustainability, energy generation and supply, materials, ICT and biosciences KTNs are, not surprisingly, those with the highest number of participants.
3. SSBP has been able to promote LSI systems R&D all over the supply chain at different strategic levels: basic technology (embedded software, ICT), application technology (automobile, biotechnology, robot) and system packaging (design, advanced materials) levels.
4. The governing board has a president and 6 vice presidents. None of them belongs to SMEs.
5. In Dalian city, air pollution was significantly improved. In Surabaya city, the volume of landfilled waste was reduced by 30%. In Phnom Penh, the leakage ratio of the water supply system was reduced from 72% to 8%. The water supply has been purified and residents can drink water directly from the tap.

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Chapter 4

Fostering green growth in Kitakyushu through multilevel governance

Chapter 4 examines the local, regional and national institutions and governance mechanisms for strengthening green growth in Kitakyushu. It reviews multilevel governance mechanisms, notably with respect to the city's relations with the central government, the opportunities and limitations of decentralisation, the role of citizens in shaping and implementing green growth in Kitakyushu, and opportunities for leveraging international networks and green exports.

Key findings

- The local administration has started to increase horizontal co-operation between different city departments, but could do more to reduce their tendency to operate in administrative silos. This could help align environmental and economic policy goals and enhance collaboration with the private sector.
- The central government has a longstanding tradition of leading regional development, and has also been influential in shaping green city policies in Kitakyushu, notably through national designations. A more collaborative approach with the central government could allow Kitakyushu to reduce its dependency on national designations and to embrace more of its local green growth potential. Stronger regional co-operation might enhance Kitakyushu's capacity to move on from the institutional legacy of central government programmes.
- Kitakyushu could better exploit opportunities from decentralisation to foster green growth, as has increasingly been the case in other designated cities and regions in Japan. Deregulation still needs to address key green sectors, like energy, which remains dominated by a few players that tend to block progress towards green growth.
- Overcoming the persistent barriers to greater regional co-operation within the Fukuoka prefecture would strengthen Kitakyushu's position in key green growth sectors as well as within international green city networks. Kitakyushu could also aim for greater leadership within the Japanese green cities movement, notably among designated cities.
- Kitakyushu's tradition of strong citizen engagement in environmental clean-up since the 1960s should be called upon to fully realise Kitakyushu's green growth potential. Decentralised renewable energy exploitation, energy savings through the use of smart grids, and unconventional financing mechanisms offer win-win situations.
- International collaboration for sustainable development in Asia is well established with a number of selected partners, but could be reinforced with a focus on exports of green goods and services. International relations offer untapped potential through which Kitakyushu can promote its progress as a green city and enlarge its sales prospects internationally.

In the past decades, the City of Kitakyushu has built an impressive and internationally recognised green city project. Its efforts began in the 1960s, and were initially aimed at reducing and then rolling back extensive environmental damage from its fossil fuel-fired and steel-centred manufacturing economy. But its initiatives now include advanced applications in recycling, power and water management, renewable energy and several other key areas of urban green growth. The city has worked productively with private and public sector partners, building the institutional capacity to draw on its developmental past as the basis for a new trajectory of economic growth.

Even as Kitakyushu reaps gains from the legacy of previous efforts, new opportunities are rapidly opening up to accelerate and deepen green growth and increase the returns from investing in this area. Driven by multiple crises, the Japanese central government is emphasising a comprehensive "green model" role for its own city-regions, within the Asian countries' rapid and environmentally unsustainable economic growth. Official policy at present aims for a green economy that contributes JPY 50 trillion and 1.4 million jobs by 2020 (National Policy Unit, 2012). Japan is revising its national

energy and environmental policies, giving greater weight to renewable energy, conservation and efficiency (Box 4.1). It is also further decentralising decision-making on green growth, increasing the incentives for subnational actors to co-operate in regional blocs and press for yet more decentralisation. At the same time, the central government has shown itself, in most respects, institutionally unwieldy in responding adroitly to the various challenges in the wake of the devastating earthquake and tsunami in the Northeast region on 11 March 2011 (Wagner, 2012). In this context, Kitakyushu could take on more of a leadership role. Based on its own experience and awareness of market opportunities, the city could help to refine the large number of policies and programmes that seek to foster green growth within its own confines, its region, and more broadly, the Japanese archipelago as a whole.

Box 4.1. **Rethinking growth and energy policy at the national level**

As a result of the 11 March 2011 Great Northeast Japan earthquake and tsunami, Japan's "Basic Energy Plan" and "New Growth Strategy," both enacted in June of 2010, are being reshaped. The Basic Energy Plan planned for nuclear plants to provide 53% of electric-power generation by 2030, up from roughly 30% in early 2011. This target has been replaced by the three scenarios of zero nuclear, 15% nuclear and 25%-30% nuclear (by the 2030s) in the ongoing effort to rethink energy policy. In addition to the ambitious goals for nuclear power, the 2010 energy plan also sought to make LEDs 100% of Japan's lighting market by 2020 (and 100% of all lights by 2030), increase renewable energy to 21% by 2030, increase numbers of electric and other second-generation cars to 50% of new car sales by 2020 (and 70% by 2030), as well as make all new homes net-zero energy by 2030. While the nuclear goals might be scaled back, the other goals may be accelerated. In addition, Japan's growth strategy aimed at JPY 50 trillion of green growth and 1.4 million new green jobs by 2020. The growth strategy content is becoming increasingly detailed. The country seeks to build up its strong manufacturing skills by making hitherto individuated product categories elements of overall green-city packages. Since the disasters, smart cities, smart grids and other infrastructure have emerged as the key not only for rebuilding the devastated areas but for the new growth strategy itself. The central government's Energy and Environmental Committee announced in May 2012 that it would inaugurate a new "Green Growth Strategy Commission," which aims to expand renewable power, efficiency, conservation and power storage solutions.

For a variety of institutional and political reasons, in 2012 Japan had difficulty restarting more than two of the 50 viable nuclear reactors that, on paper, represent roughly 30% of the country's electrical power generation. The Kyushu region was thus compelled to cut its power consumption by at least 10% between 2 July and 7 September. The uncertainty about power supplies has greatly accelerated public and private sector plans for investments in energy efficiency, conservation, in-house power generation (renewable as well as gas-fired) and other means to bolster local resilience and self-sufficiency. The Roland Berger strategy consultancy argues that for Japan as a whole, emphasising conservation and renewables as its reliance on nuclear power declines can build robust domestic green markets and help Japan gain the lead over competitors in Europe and North America (Hirai and Toyama, 2012).

Source: Hirai T. and Toyama K. (2012), "A Green-Business Strategy for Winning in a 350 Trillion Yen Economy", ToyoKeizaishinposha, Tokyo, *www.rolandberger.co.jp/press/publications/green_business/2012-01-31-green_business.html*, accessed 16 November 2012.

Kitakyushu is in a favourable position for advancing and developing its green-city objectives. As of December 2011, it was designated one of the spearhead "environmental future cities" of Japan's redoubled emphasis on green growth. Because of the central government's overall policy commitment, it can also reasonably anticipate that there will be an increasingly favourable fiscal and regulatory regime for green growth. It has significant opportunity to benefit, especially if it leverages this support as the basis for a much broader base of collaboration and innovation.

The city occupies a niche of multilevel green governance that is structured, as well as constrained, by three key factors.

- First, the city collaborates intensively with its rather concentrated local manufacturing base. The major firms include Nippon Steel (as of October 2012, Nippon Steel and Sumitomo Metal), Yaskawa Electric, TOTO and others that are in the front ranks of Japan's biggest manufacturing firms.
- Second, the city works closely with the central government's agencies to maximise its receipt of fiscal and other support within the still highly centralised inter-governmental system.
- Third, Kitakyushu deploys these local and inter-governmental resources in its project to expand its international green business network, especially in the larger and rapidly growing Asian region.

Several reforms could contribute to realising Kitakyushu's potential:

i. Reduce the tendency to operate in administrative silos and enhance institutional capacity. Kitakyushu needs to systematise its own green planning and decision-making in order to take more of a leadership role in Japan's greening. From a multilevel governance perspective, the city is advised to start at the local level by increasing efforts to overcome sectionalism in its local administration. Hitherto, the city has been quite adept at leveraging its limited resources and options to build a credible model of green growth, while relying to a large extent on its industrial base and the auspices of the central government in crafting industrial and green growth policy. These organisational assets remain valuable. But the city should enhance its own institutional capacity in order to increase its autonomy and thereby maximise its flexibility and inventiveness to act in a rapidly evolving, and global, green growth arena.

ii. Increase inter-regional co-ordination. Kitakyushu should build on its recent successes in pursuing co-operation with its regional partners, including the City of Fukuoka, the prefecture of Fukuoka, and the newly (as of April, 2012) "designated city" of Kumamoto. These urban and prefectural governments afford a significant force in seeking to shape and make coherent the numerous national and regional policies directed at green development. Kitakyushu is well placed to reach out further beyond its own borders. The broader network can do much to encourage greater innovation in new materials, advanced energy conservation, efficiency and renewable energies.

Regional co-ordination is particularly important because of the uncertainty in Japanese energy and environmental policy after the 11 March 2011 natural disasters. The earthquake and tsunami were followed by supply shortages and

other problems in the country's power economy, the world's third largest at JPY 16 trillion. The central government has had difficulty in co-ordinating a coherent and effective response to these multiple crises, and many policy areas remain under contentious study. But the general trend of policy change is towards distributed and smart power generation coupled with a greater decentralisation of administrative and planning functions. This background suggests an opportunity for Kitakyushu to reduce its dependence on the central government in favour of a more effective and nimble regional governance.

A more regional focus is already encouraged by a range of policy-making tools, such as METI's policies to foster clusters. It is also favoured by Japan's ongoing devolution of fiscal and administrative powers to prefectural blocs, representing large geographic regions as well as city-regions. Kitakyushu's regional bloc is the island of Kyushu, which is being positioned for a gateway role within rapidly growing Asia. The geography of Kyushu and its proximity to Asia makes it, in the Japanese context, the natural site for the doorway to an expanded interaction.

iii. Maximise the use of local resources. Local citizens were a catalysing force in fighting against pollution in the 1950s and 1960s. But the green growth initiative and opportunity in the present does not have the immediacy that very visible and destructive pollution did in the past. Green growth can involve lifestyle changes, and at times short-run cost increases, whose overall benefits might not be immediately apparent to many residents. Yet the citizens' role is crucial not only as a local source of demand for green goods but also for the continued reinforcement of the green-city model. Their support for smart grids and energy conservation appears robust at present, especially because of Japan's ongoing power crisis. Yet this should not be taken for granted. Expanding the incentives to encourage a thickening of civil society generally requires many years. A number of goals, such as reducing energy consumption, waste production or increasing decentralised energy production, rely on citizens' active participation in shaping this process. Communication and information campaigns as well as clear incentives to engage with urban green growth in Kitakyushu are essential to generate the necessary level of citizen participation.

iv. Help leading the legacy interests in the local industrial base. The industries' role in Kitakyushu's green-city design centres on exports of products and services that reflect *status quo* levels of efficiency. But as a result of the continuing disruption in Japan's energy policy and power supply, efficiency and conservation efforts may have to be increased significantly. While this will demand strenuous efforts, the pressure could also encourage smart deregulation, accelerate the deployment of alternative energy and energy-management systems and revitalise the national economy through rapid growth in LED lighting, energy-management systems, storage technologies and related markets. As is evident in the growing support for green-city initiatives, the business community increasingly recognises the productive role of public policy that targets sustainability.

Reduce the tendency to operate in administrative silos

Deeply embedded "vertical administration" (*tatewari gyousei)* in Japanese intra- and inter-governmental affairs appears ill suited for tackling cross-cutting policy challenges of urban green growth. Over the past two decades, Japan has seen considerable fiscal decentralisation and changes to administrative law. These changes have reformed Japan's agency delegation and other mechanisms through which central agencies reproduced themselves at the local level, maintaining bureaucratic control. However, this progress on decentralisation was not matched with the direct transfer of authority over regional bureaus of central state agencies. The imprint of these institutions continues to structure the norms and expectations of local policy makers as well as path-dependent flows of personnel and other resources. Japan's larger local governments are seeking ways to overcome this lingering sectionalism in order to grapple with greening, the ageing society and other policy challenges that cut across established bureaucratic categories.

Kitakyushu city authorities have reacted to difficulties in policy co-ordination by introducing measures to minimise silo effects in the local administration. In the past, a number of local development initiatives have not met with success, due, at least in part, to the fact that regional development policy was being centrally led in a context of strong vested interests. For example, the city government's 1980s-era forays into fostering new directions in local development tended to be "subsidiary to large and powerful interests" in the local economy, including the firm Nippon Steel (Shapiro, 1993). In seeking to expand green growth, Kitakyushu has been transferring administrative staff between the bureaus focused on economic development and those centred on environmental affairs. This policy is still at an early stage and its concrete outcomes have yet to be proven. But it is an explicit effort to foster "green growth personnel" who understand inter-sectoral linkages and trade-offs between short-run economic imperatives and long-run sustainability goals. Rotation of staff throughout the various bureaus of urban administration is not unique in Japan, where administrative staff routinely moves every two years. But Kitakyushu may offer a practice worth emulating in structuring the rotation so as to diffuse a common understanding of green growth.

The Overseas Water Infrastructure Public-Private Partnership Council offers an example for the contribution of public-private-partnerships to overcome administrative silos. The City of Kitakyushu was included as a member of the central government's Overseas Water Infrastructure Public-Private Partnership Council (Box 4.2). This national council was in fact preceded by Kitakyushu's own initiative at the local level. In 2010, the city set up the Kitakyushu Oversees Water Business Promotion Council, whose members include the heads of the Environment Bureau, the General Affairs and Planning Bureau, the Industry and Economy Bureau and the Water and Sewer Bureau. The Kitakyushu Waterworks Association, consisting of 125 companies, 7 related organisations including JICA and the Japan Bank for International Co-operation (JBIC), academic experts, several Bureaus of the Kitakyushu City government as well as national observers,[1] also sits as a member on the Council. Through its central role in the Kitakyushu Overseas Water Business Promotion Council and its membership in the national Overseas Water Infrastructure Public-Private Partnership Council, the city acts as a window for public-private partnerships, giving local firms access to international networks.

Box 4.2. **Overseas Water Infrastructure Public-Private Partnership Council**

Established in 2010, the Overseas Water Infrastructure Council consists of three Ministries: the Ministry of Land, Infrastructure and Transport (MLIT), the Ministry of Health, Labour and Welfare (MHLW), and METI. It was formed to investigate Japan's opportunities to increase its presence in the global water business, with a focus on water infrastructure and management. The water business is expected to expand from JPY 36 trillion in 2007 to JPY 87 trillion in 2025 (City of Kitakyushu, 2012a). Japanese local governments' waterworks departments and their private-sector partners have developed very good water-management technology. But policy makers and analysts believe them to be too balkanised, with insufficient incentives and institutional support for entering this expanding international market.

As for Kitakyushu's own local council, the original corporate membership of 57 firms (27 local, 30 from outside Kitakyushu) expanded to 131 firms by the end of 2012. Three universities in the area are also represented on the council, whose operations are managed by the Kitakyushu Waterworks Association. The Kitakyushu Council is focused on promoting the water business in Cambodia, China, Saudi Arabia, Vietnam, and other overseas venues. Kitakyushu has already secured contracts with Haiphong in Vietnam, the Kingdom of Cambodia and other markets.

Kitakyushu's initiatives caught the attention of the specialist community across Japan. In April 2012, the Ministry of Land Infrastructure, Transport and Tourism presented the city with a certificate of merit as a "Water Environmental Solution Hub" for its organisational approach as well as its skillful deployment of water technologies.

Source: Roland Berger (2011), (in Japanese) "Building Strategic Organization for the Global Water Business", Business Perspectives from Roland Berger, Vol. 77, December, *www.rolandberger.co.jp/media/pdf/Roland_Berger_Shiten77_20111219.pdf*; Kitakyushu Bureau of Economy, Trade and Industry (2012), (in Japanese) "Mid-Term Report on Fostering Development of Asia Business", from the proposal of the Board of Strategic Studies for Asia Business, Kyushu Bureau of Economy, Trade and Industry, *www.kyushu.meti.go.jp/seisaku/kokusai/oshirase120326_1.pdf*; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan.

Kitakyushu seeks to institutionalise green growth goals by including an International Office in its Environmental Bureau. This institutional innovation was implemented in 2000 and then followed up, in 2005, with an "Office for a World Capital of Sustainable Development." Kitakyushu has also sought to alleviate the problem of silos at the city's top administrative level by instituting its "Office for Eco-Model City Promotion." Through this agency, the mayor and ranking officials from all city bureaus meet regularly and seek to arrive at planning and programme decisions to further the overall goal of achieving the eco-model city programme. The city administration's various bureaus also hold joint seminars and related events to further mutual understanding of their efforts in encouraging new industries to hold stakes in the city's green growth ambitions. Kitakyushu's innovation of putting an International Office in its Environment Bureau also reflects the city's longstanding endeavour to help overseas partners learn from its developmental know-how as well as build a business model based on these experiences.

However, it is still unclear whether these innovations and initiatives have built enough organisational capacity to overcome the problem of sectionalism and ensure a steady flow of new ideas. It seems doubtful that the closed circle of co-ordination will suffice to innovate, or at least revise strategies to stay abreast of the rapidly evolving

domestic and international contexts. This goes beyond managing the implementation of the green model to its very design and continuing evolution, as Yokohama's innovative effort to continually draw on local civil society demonstrates (Box 4.3). While it is inevitable that the framing of Kitakyushu's green model bears the imprint of legacy interests, the city needs institutional mechanisms to alert it to unduly circumscribed perceptions of what is feasible and desirable. Kitakyushu confronts the challenge of growing green services, and has clustered some of the human and other resources essential to that end. Yet if the city staff are generally socialised in a constrained model of green growth, and tend to interact with those of like mind, that can limit the potential benefits from the rotation of personnel and better co-ordination of policies.

Box 4.3. **Yokohama's co-governance approach**

On design and implementation of a greener city, Japan's much larger city of Yokohama (population 3.6 million) has recently evolved a more overarching approach. Like Kitakyushu, it seeks to foster inter-bureau linkages. For example, it includes an Office of International Policy within its generalist Policy Bureau. The purview of this office is cultural exchange and other conventional forms of international co-operation. The city's Climate Change Policy Headquarters, an independent and high-priority bureau, is also involved in the city's main initiative, Y-PORT, which is a window project for international technical co-operation. But the Yokohama Policy Bureau's newly established (from May of 2011) "Centre of Co-Governance and Creation" co-ordinates these programmes. Co-governance has institutionalised consultative channels with the various bureau heads in the city wards as well as local civil society. Co-governance runs regular "co-governance forums" on specific themes to generate new ideas on business and other opportunities. These events include city staff, businesses from within and outside the city, academics and consultants, and entrepreneurs and representatives of non-profit organisations. It also holds regular "open forums," to get feedback from the broader public. In short, Yokohama has created an innovative coordinating institution that links its greening initiatives together as well as seeks to innovate within them.

Source: Co-Governance and Creation Task Force (2011), (in Japanese) "Co-Creation in Yokohama", City of Yokohama, *www.city.yokohama.lg.jp/*seisaku*/kyoso/sales-sheet2011-8.pdf*.

Collaborate more with, rather than depend on, central government

A major challenge for Kitakyushu is the extent to which it can graduate from the institutional legacy of an older model of regional development that shapes the city's green growth. Kitakyushu has been at the head of Japan's green city movement since 1980, being a pioneer in this kind of urban development. At the same time, its institutional context suggests potential problems of path dependence. They stem from the city's historical role as a target of national industrial and regional development policies. In 1913, Kitakyushu's steel mills were producing 80% of the steel that the country was consuming. In the post-World War II years, Kitakyushu was a focus of the central government's efforts to initiate a productivity-driven revival and rebuild of the economy, one that fostered a virtuous loop between coal and steel production, with each supporting and then expanding the other. The city was one of Japan's four primary industrial-development zones. Close inter-governmental ties are a natural outcome of this economic history, given the large role of the central government in planning its infrastructure. But more room to manoeuvre would enable Kitakyushu to better take advantage of

institutional innovation that is essential for building a competitive green growing city, particularly one with a more robust service sector.

Among the designated cities, Kitakyushu has a comparatively difficult position within the nexus of Japanese inter-governmental fiscal and administrative relations. Kitakyushu does not possess the size advantage of such megacities as Tokyo, Yokohama or even Osaka, and is not even capital of its home prefecture of Kyushu. It is one of Japan's 20 designated cities, which hold administrative powers roughly equivalent to the prefectural governments, but considerably less fiscal capacity. Kitakyushu's ranking of 974 000 residents placed it at 12th among Japan's 19 designated cities (prior to Kumamoto City becoming the 20th designated city in April 2012). But its population represents only 19.2% of the immediate prefectural population, lowering the city's rank in this respect a little further to 13th among the designated cities. The Kyushu prefectural capital of Fukuoka, meanwhile, has a population of 1.46 million. Adding to the city's constraints, Kitakyushu is now the most aged and rapidly ageing of Japan's designated cities. In 2010, 25.1% of its residents were over the age of 65, compared to 17.5% in nearby Fukuoka City and a national average of 22.8% (City of Kitakyushu, 2012b).

To a significant extent, Kitakyushu remains an example of centrally guided regional development policy, albeit with a green agenda. Among other indicators of this aspect, the city is more dependent on the central government than most of the other designated cities. The city's relatively low fiscal capacity – with only 71% of its expenditures being funded out of taxation, versus an average of 87% for the other designated cities – make it more dependent on fiscal transfers than the average. It funds 33.5% of its expenditures through local taxes, compared to a 44% average for the other designated cities. Also, it receives 24.7% of its revenues from the central government as block transfers and specific grants. The average for designated cities is 18.7%. Moreover, 11.9% of the city's revenues are from the central government's local allocation tax, which is a no-strings block grant that redistributes according to fiscal need. The other designated cities' average dependence on this subsidy is 5%. Though this is a block grant, its prominence as a revenue source is one more indicator of how much Kitakyushu relies on the central government. Working in tandem with Kitakyushu's fiscal dependence is guidance by the centre's initiatives. A striking feature of its green city efforts, such as its recycling and water initiatives, is that most of the component projects are clearly associated with one central agency or another. Most major green city projects are supported or implemented through regional offices of national agencies or set up in the context of national designation programmes (Table 2.1).

Yet there are times when the city appears able to move flexibly in this context. For example, the city used the partial decentralisation of fiscal rules to implement an "Environmental Tax" (Box 4.4). It was also very pro-active in fostering local efforts in the water business, as discussed earlier. Another example of taking action is seen in its development of a smart grid without the involvement of the regional utility. Japan's monopolised utilities have long been averse to the development of smart grids, viewing them as inconsistent with their maintenance of the status quo in market structures and the power mix. Moreover, METI was itself somewhat dismissive of the potential for smart grids within the Japanese political community. In February of 2009, the Vice Minister of the METI suggested that in fact Japan did not need a smart grid because its grid was already robust, with very high reliability. The hesitance about the smart grid within the Japanese context appears to have centred on the concern by the utilities that it would lead to a potential erosion of their monopoly position in the power market by encouraging competitors, as well as renewable energy (Fujii, 2011). Kitakyushu, however, was able to

devise a test of the smart grid within its jurisdiction without the co-operation of the local utility, Kyushu Electric Power. The administrative ruling was a *de facto* relaxation of the electrical monopoly law (Impress R&D, 2011). Kitakyushu's good relations with the central government as well as Nippon Steel's interest in the deregulation of the power market (Nikkei Business, 2012) seem to have facilitated Kitakyushu's more flexible implementation of a smart-grid project. In the continuing political and policy-making instability at the central government level, Kitakyushu can further exploit these assets for its current crop of green technology, as well as in expanding its opportunities for innovation.

Box 4.4. **The Kitakyushu Environmental Tax**

Kitakyushu's "Environmental Tax" is an earmarked local tax, whose revenues are dedicated to uses specified in the enabling law. The tax is not one of the regular local taxes as specified in the local tax law and is therefore deemed "extra-legal". The tax measure was approved by the City Council in March 2002, and received approval from the Ministry of General Affairs, which oversees local fiscal affairs, in September of the same year. The tax was then implemented from October of 2003.

In the first year of its implementation and continuing to 2007, the tax was levied at JPY 500 per tonne of waste. The rate was then doubled from 2008 to JPY 1000 per ton, where it remains. The tax revenue amounted to JPY 1.2 billion in 2010. The tax is levied on the final stage of waste treatment, disposal, leaving mid-stage processes untaxed. The tax therefore acts to increase the incentives for recycling as well as reduction of final waste volumes.

Revenues collected from the tax are used to fund a range of activities. One of these efforts is the various forums in which citizens, NGOs, firms and specialists interact to exchange ideas on enhancing the city's environmental profile. Other activities include seminars on energy efficiency, venues for the citizens' direct participation in environmentally oriented activities, as well as the promotion of environmentally oriented international linkages.

A recent European Union study of the use of economic instruments to improve waste management determined that landfill taxes applied to municipal waste tended to reduce the percentages of waste being sent to landfill. The study found a positive correlation between higher landfill charges and higher rates of recycling, especially with tax levels approaching EUR 100 per tonne.

Source: Ministry of Internal Affairs and Communications (2012), (in Japanese) "Current Conditions of Extra-Legal Taxes", www.soumu.go.jp/main_content/000165240.pdf; European Commission (2012), "Use of Economic Instruments and Waste Management Performances, Final Report," European Commission, DG ENV, *http://ec.europa.eu/environment/waste/pdf/final_report_10042012.pdf.*

Building stronger regional capacity would help Kitakyushu to become more autonomous from Japan's centre-local institutional context. It would also help bolster its visibility and influence among Japanese green cities and internationally. Kitakyushu finds itself in a national and global context in which green development is no longer an unusual niche but rather an increasingly strategic approach. Central-government-led regional development has been a key driver behind Kitakyushu's green city model. "Graduating" from this model may be a condition for playing a larger role in the international green-city movement. There is plenty of competition. For example, a 2011 survey from the University of Westminster's authoritative International Eco Cities Initiative found "an unprecedented mushrooming of various kinds of eco-city initiatives and projects across the world," with a total of 174 eco-city projects catalogued. Strengthening its regional

capacity would help the City of Kitakyushu to gain yet more authority vis-à-vis central agencies and its own legacy economic base. Important steps in this process would include such institutional changes on the local and regional level as an office for policy co-ordination to overcome sectionalism. In addition, the city should stress more collaboration with regional partners to expand economic opportunities that are more broadly based and thus less dominated by local and central legacy interests.

Potential areas for collaboration are seen in deregulation. Japan's green cities call for deregulation, in particular in the power sector, to foster local power businesses and related opportunities. Local governments are keen on deploying new energy technology in order to further their projects of building resilient sustainable cities. But they often encounter regulatory barriers in the current power company law, for instance when setting up test structures of smart communities and other technologies. Hence they press for deregulation of the power law in order to allow them to turn those tests into "mini-power firm" businesses. Their smart community businesses include solar power generation as well as power management systems that are increasingly core elements of their model communities, aimed at raising levels of efficiency and resilience. One example is Yokohama city's Minato Mirai 21 Area. This project faced difficulties in satisfying the regulatory conditions for building a grid network, and thus requested rule changes. From 2013, an independent power company will be operating in this area. The city of Kyoto is also interested in building a mini-power company from within its Keihan research city initiative, and would like to pursue the option of being a power producer and supplier. However, the power producer and supplier market is limited to large-lot customers, and the mini-power company's overhead and other costs are too great at present to replicate such models at scale. Kitakyushu's experience has been instructive for these smart-city examples, and an exchange of experience has started to be organised over the Japan Smart City Portal. However, the increasing diffusion of smart approaches throughout Japan suggests the need for a broader mechanism for collaboration and exchange.

Japan's power-supply crisis may be protracted, and the need to continue innovating in the face of the crisis will entail further need for rule changes and may imply new opportunities for Kitakyushu. The larger question of what kind of deregulation of the current power monopolies best suits Japan's emerging needs as well as evolving technologies cannot be answered in the abstract. But as Japan moves towards increasing adoption of renewables and smart grids, good governance of the market is likely to be strongly shaped by actors, such as Kitakyushu, with experience in deploying new energy systems. The central government appears responsive on this front. On 26 March 2012, the national political leadership brought out a wide-ranging set of 103 deregulation proposals. The proposals were released through the National Policy Unit, which is headed by the prime minister and explicitly designed to amplify the elected politicians' voice in policy making. Many of the proposals include items being discussed in the central agencies. Of the total, 39 are directed at renewable energy, 38 deal with power systems such as smart grids, and 26 are devoted to facilitating energy conservation. Reports indicate that most of them are fairly simple changes to rules or ordinances. In the context of a power crisis, it would appear that Japanese central government policy making is accelerating. The more pro-active Kitakyushu is in this rapidly evolving context of deregulation and restructuring Japan's JPY 17 trillion per year power economy, the more it enhances its potential benefits from stimulating innovation and attracting innovators.

The context of continuing uncertainty in central government policy making can provide Kitakyushu opportunities to build on its green city leadership. As one avenue in

pressing for deregulation and related green initiatives to enhance the scope for local and regional green growth, Kitakyushu can make use of its chairmanship of the Promotion Council for the "FutureCity" initiative (Box 4.5). The Council is a large organisation, with 204 members, and could help co-ordinate green-city programmes overall with the National Policy Unit, even if only in an advisory capacity. The Promotion Council is not at present a very active central organisation outside policy-making circles. It meets once or twice a year in a full conference. But it is also composed of working groups that study best practices among the eco-model cities, the green economy and other themes related to building low-carbon cities and greenhouse gas reduction mechanisms. Moreover, with its experience and extensive network, Kitakyushu would seem to be ideally situated to help lead the Council towards a more central role in interest aggregation and articulation into the policy process. Against the larger backdrop of rapidly increasing salience of the green city policy in Japan's strategic growth plans, Kitakyushu could help shape policy coherence.

Box 4.5. **The Promotion Council for the Low-Carbon Cities**

The Promotion Council for the Low-Carbon Cities was given its official launch on 14 December 2008, at the Kitakyushu International Convention Centre, and became the Promotion Council for the "Future City" initiative in 2012. The organisation is aimed at accelerating innovation and learning within the eco-model cities. The administrative backup is provided by the Cabinet Office's Local Revitalisation Section. The initial membership of the Council totalled 130 organisations. Of these organisations, 70 were "highly motivated municipalities" along with 39 prefectures, 12 related government ministries and 19 quasi-governmental organisations. The Initiative has a working group for "best practices", which was established at the general meeting on May 28, 2010. It is designed to diffuse best practices that can be applied in other cities.

As of 9 November 2011, the Council's membership had increased to 89 cities, 46 prefectures, 12 governmental offices, 29 public organisations, and 28 organisations from the private sector, a total of 204 organisations. The private sector members include some of Japan's major business firms, such as Osaka Gas, Japan IBM, Mitsubishi Automobiles, Pacific Consulting and Nikkei BP. The quasi-governmental organisations include the Urban Energy Association, the Urban Environmental Energy Association, the Heat Pump and Battery and Storage Center and other organisations.

Source: Eco-Model City Project (2011), (in Japanese) "An Introduction to the Low-Carbon City Promotion Council", Eco-Model City Project website, *http://ecomodelproject.go.jp/pclcc/*, accessed 16 November 2012.

Make decentralisation work for green growth

Japanese regions are increasingly pressing for decentralisation in the still highly centralised Japanese state. While only 40% of general-budget public sector revenues are collected locally, 60% of Japan's programme spending is done at the subnational level. This fiscal gap affords numerous avenues of central interference in local affairs. Japanese regional initiatives on decentralisation are aimed at forging a new dynamism in Japan's political economy, which could also give regions the institutional and political tools for more autonomous green development (Box 4.6). The influence of particularly active cities on Japan's regional governance as well as its energy and environmental policy, gives an important signal to Kitakyushu and its regional partners towards more co-operation.

Box 4.6. **Japan's "designated cities" and decentralisation**

Regional reform has long been an item in Japan's debate over inter-governmental reform. The high rate of ageing, hollowing out of manufacturing, efforts to grow green and other challenges are placing a premium on co-ordinating action at the local level. Problems include the reliance of smaller communities on the fiscal and administrative arms of the central government, even as the big cities and regions need more autonomy to shape their green-economy models. There are issues within the regions as well. One of these is the overlap of responsibilities between the "designated cities" and their respective prefectural governments. An October 2012 survey of designated cities conducted by Nikkei Shimbun found that 12 among the 20 designated cities want administrative powers and resources from their respective prefectures in order to enhance their autonomy through the construction of "special autonomous cities". These cities include Kitakyushu as well as Kyoto and Yokohama. The cities seek the decentralisation of fiscal and administrative resources in order to bolster their capacity to deal with the challenge of natural disasters, as well as economic policy making and other functions that require swift responses. Yokohama city published a proposal for the special autonomous city in June of 2012. Gaining momentum on these initiatives will require further co-ordination and collaboration among the cities and prefectures.

Source: Nikkei Shimbun (2012), (in Japanese) "The Special Autonomous City: Survey Finds Support of 12 Designated Cities for Expansion of Fiscal and Administrative Powers", October 7.

One of the major avenues in decentralisation initiatives is focused on the regional bureaus of the METI and other agencies. The regional bureaus of central agencies dominate regional planning and infrastructure and are therefore key agencies in forging a regional green project.[2] Pro-active initiatives towards decentralisation in the Kansai region have encouraged the Kyushu region to do likewise (as is also true of the region of Shikoku). Parliamentarians in the Fukuoka Prefectural legislature grouped in September 2011 to formally inaugurate the "Consider Autonomy for Kyushu." This organisation is an expanding movement of lawmakers that also draws on representatives of regional businesses, business associations and non-profit organisations. Together with the Kyushu Governors' Association, the autonomy movement is preparing the Kyushu region for regional devolution. The two regions of Kansai and Kyushu have been co-operating in the effort to secure decentralisation of these central agency functions (Keidanren Times, 2012). In order to exploit synergies and avoid overlap, they and the other regions will need to develop vehicles and mechanisms for negotiation and collaboration.

Kitakyushu could also play a role in fostering a more equitable green devolution by highlighting the road to opportunities for smaller local communities. Japan's current movements towards decentralisation are historic. They are proceeding rapidly and on a scale that has elicited a backlash from smaller local communities. Thus on 3 March 2012, over one-quarter of Japan's 1 719 cities (as of 1 April 2012), towns and villages formally met to protest the pressure for devolution. Their concern is that the negotiations on decentralisation are taking place between the central government and powerful players at the regional level, including prefectures and designated cities. They evidently worry that decentralisation would leave them even harder-pressed to amalgamate[3] and otherwise surrender their local autonomy in addition to fiscal redistribution and other benefits.

Kitakyushu could be helpful in promoting equity and assuaging these concerns. One of Japan's policy streams seeks a "green decentralisation" to balance the role of urban and rural areas and to provide increased opportunities for the latter. This green decentralisation initiative was inaugurated in December 2009, under the stewardship of the Ministry of Internal Affairs and Communications, whose jurisdiction encompasses local finance. In tandem with the increasing importance of the bio-economy, which is largely rural, the ministry's vision of an equitable green decentralisation could be made part of the regional bloc initiative. That effort could help make rural areas more cognisant of the connection between decentralisation and the opportunities afforded by the shift to more distributed energy and greater local reliance. The more they see a profitable role for themselves and their communities inside the regional bloc, the more likely they are to be persuaded of the initiative's merits. The Mayor of Kitakyushu sits on the "Local Sovereignty Strategy Council" that is working up the legislative agenda for decentralisation, and the city itself has multiple channels into regional policy. These institutional channels afford the potential to advocate its own green-growth initiatives in recycling and other readily adopted businesses as examples for diffusing local growth. The increasing green-growth orientation of the region *per se* also affords rural areas opportunities to provide bio-material inputs, giving them a stakeholder rather than largely bystander role.

Enhance inter-regional co-ordination

Historical inter-regional rivalry between Kitakyushu and Fukuoka and jurisdictional overlaps can explain some of the barriers to inter-regional co-ordination. Into the 1960s, Kitakyushu was the Fukuoka Prefecture's largest centre of employment and population, a legacy of its role as Japan's premier steel-making centre. Both cities have promoted many of their own green initiatives independently. They do not appear to duplicate one another's developmental efforts, however, due to the divergent evolution in their industrial bases as well as the overall financing and co-ordinating role of the central government. A limiting factor for co-operation among the cities and the prefecture is the overlapping of jurisdictions in tax collection. In a number of administrative areas, all three actors – Fukuoka Prefecture and City and Kitakyushu City – are roughly equivalent, even though they are differentiated overall as prefectures and designated cities. This overlap may have led to frictions among the cities and prefecture.

Kitakyushu and Fukuoka also have a history of co-operation, which has become more focused and deliberate since the natural and nuclear disasters of 11 March 2011. Regional-scale initiatives in tourism promotion, research on common environmental problems, deploying charging stations for electric cars, and other initiatives have proven to be effective projects of co-operation. There is also a considerable history of business and other actors seeking to build on transportation and energy (e.g. gas pipelines) infrastructures for the so-called "Fukuhoku" region, a term that combines initial Japanese characters of Fukuoka and Kitakyushu. Co-operation between the two cities is also fostered to some extent by initiatives from Fukuoka prefecture as well as the central government agencies, especially the Kyushu Bureau of Economy, Trade and Industry, a regional agency of the METI. In mid-2011, the prefecture of Fukuoka as well as the City of Fukuoka and the City of Kitakyushu co-operated by jointly applying for the national government's special comprehensive deregulation zone (Box 4.7). The comprehensive zones stress tax breaks and deregulation and are limited to seven nationwide. That means the hurdles to acceptance are quite high.

Box 4.7. **Japan's flagship comprehensive special zone law**

Japan's flagship comprehensive special zone law was passed on 22 June 2011. The zone initiative was billed as a means to "concentrate resources of central and local government in areas of high pioneering potential." It is not simply a relaxation of rules but also an overall package of support that includes regulatory exemptions, tax breaks, financial aid and loans and other mechanisms aimed at innovation.

The major types of comprehensive special zones are the international strategic zones and the regional revitalisation zones. The strategic zones are aimed at clustering industry and related intellectual and other resources so as to increase growth opportunities in the environment, next-generation energy, bio-life science and other areas. These zones include the "Green Asia International Strategy Comprehensive Special Zone" that groups Fukuoka City and Prefecture with Kitakyushu City in an initiative to position their region in western Japan as the gateway to Asia.

There were seven special zones as of February 2012. In total, they comprise budgetary requests of JPY 153.9 billion, which are expected to lead to JPY 6.97 trillion in new economic activity and 298 000 new jobs.

At present there are 26 regional revitalisation zones. The ambit of this zone programme includes disaster prevention and mitigation, environment and next-generation industry, tourism and culture, agriculture, biomass, finance and social business, health care and nursing. The total fiscal scale of the zones is JPY 63 billion, which is expected to lead to JPY 2.15 trillion in new business activity and 67 000 new jobs.

The tax exemptions in the international strategy zones are focused on lowering the corporate tax in order to foster competitiveness in international markets, while those in the regional revitalisation zones centre on deductions for individual investment in enterprises that are part of the strategy.

Source: Fukuda, A. (2012), (in Japanese), "Promotion of Japan's Revival and Recovery via use of Comprehensive Zones and Related Measures", presentation by General Affairs Vice-Minister, Cabinet Office, Government of Japan, 27 February, *www5.cao.go.jp/keizai1/keizaitaisaku/2012/0227_2-3_soumu.pdf*.

Competition between international city regions can be another important driver for more inter-regional co-operation. Reflecting their previous "go it alone" tendencies, the Fukuoka prefecture and cities had designed their own individual comprehensive special zone approaches in 2010. Kitakyushu's plan stressed the fostering and clustering of environmental businesses; the City of Fukuoka focused on attracting more tourists from Asia, while Fukuoka Prefecture emphasised the development of the electronics industry. But anxiety concerning the prospect of failing in their individual bids pushed them towards co-operation. The prefecture and the two designated cities openly express their concern about being left behind in the competition of increasingly competitive global city regions. In September 2011, the mayors and prefectural governor met to discuss how to bolster environmental industries, and they announced that they would jointly appeal for a "Green Asian International Strategy Comprehensive Special Zone." They asked for special tax measures as well as deregulation to accelerate co-operation among themselves on developing water and sewage technology exports as well as next-generation fuel cells and other products. Hence, Kitakyushu's environmental approach went on to frame the co-operative application for the special zone, which was granted in December of 2011 (Nikkei Net, 2012).

Achieving a comprehensive packaging of green technologies and related services into green city models requires co-ordination from the regional governments acting together. This is not only because of the efficiencies gained from clustering and collaboration. It is also because the Japanese national government is marked by sectionalism as well as impeded by political instability and limited capacity to achieve co-ordination of the very ambitious and wide-ranging new growth strategy. The national government is also being forced to rethink much of its energy and growth policy regime, along with its regulatory and fiscal policies relevant to these areas, even as powerful beneficiaries of the status quo fight to preserve it (Wagner: 2012). Regional government are the politico-administrative actors whose fortunes depend most directly on success of the green-growth policy measures. They therefore have potentially the most powerful incentives to act. But at present they possess inadequate tools, such as co-ordinating the demand for and supply of green jobs,[4] to act successfully on their own. Working in concert, they can iron out their differences and avoid impeding their initiatives through overlap and other potential detractions from co-ordinated political action.

Private sector co-operation offers an opportunity for the city administration to overcome sectionalism. The public-private-partnership council promotes business initiatives in the overseas water business and at the same time encourages co-operation among divisions of the city administration to promote the local water business. But this is neither a context nor an outcome where there is an unambiguous standard of performance. The contracts won appear largely to be aid projects financed by such agencies as the Japan-ASEAN Integration Fund and the Japan International Co-operation Agency (Japan FS, 2012). The use of aid funds is perhaps unavoidable given the novelty of the water-business market to Japanese firms and the income level of many of the recipient countries. But it may not be fostering an economically sustainable route into the business. This is because Japanese firms' costs are relatively high, and there is no mechanism evident for encouraging cost reductions. In this case, the institutions designed to overcome the problems of silos and various barriers to entry may encourage an environment in which there is insufficient incentive to reduce costs because the sale is subsidised. METI is planning on introducing qualification assessments for projects in order to strengthen their cost competitiveness (METI, n.d.), but it is not clear when and in what fashion. It will therefore be crucial to ensure, for the time being, that the institutions do not themselves turn into a silo through becoming selective, opaque and dependent on subsidisation.

Enable local citizens to take a greater part in the green economy

Environmental governance in Kitakyushu has a strong tradition of citizen participation. Citizen movements, notably women's associations, were at the forefront of pushing for environmental improvements in the 1960s to 1980s. Also more recently, citizens played an important role in conceiving sustainability plans and documents such as the Grand Design and the Green Frontier plan, via participation in a large number of town-hall style meetings (City of Kitakyushu, 2012a). An important recent initiative is the Kitakyushu Clean-up Union, organised by a community-based "sanitation and environment association" with over 70% over Kitakyushu's households participating. This association includes a large number of elderly people who aim to pass on their experience and know-how to younger generations (City of Kitakyushu, 2012a).

Yet green growth governance would gain from more consistently drawing on local residents and broaden the scope of participation to focus on environmental activities that contribute to growth. Descriptions of citizens' involvement in the environmental model city programme tend to centre on relatively passive roles, such as their purchases of energy-efficient appliances as well as participation in reforestation. Residents earned eco-points through the Kitakyushu citizens "environmental passport" and the Kitakyushu green fund. Through these involvements, the citizens are deemed to directly experience environmental activities, making them visible and tangible. The city also seeks to raise their environmental consciousness through environmental learning activities. The emphasis on raising awareness has been a constant theme in Kitakyushu's green-city approaches. Its Eco-Town project came with the stipulation that the recycling businesses would have to be open to public view. To be sure, these are important elements of the green city, and offer some tendrils of green service growth. However, a broader role for urban residents as stakeholders appears possible and necessary.

The ongoing effort to increase the level of power supplied by renewable energy may offer an important means of more deeply involving and organising the public. Kyushu has Japan's best level of solar insulation, and is thus a primary focus of investment activity, especially because the 1 July 2012 expansion of Japan's feed-in tariff will see large-scale solar subsidised at JPY 42 Kilowatt/hour for a period of 20 years. The city already works with local small business to facilitate the deployment of solar panels on the roofs of warehouses along its shoreline. To this end, in January 2012 Kitakyushu set up an agency called the "Kitakyushu Solar Power Deployment Promotion Committee." The committee groups Kyushu Institute of Technology with 22 other firms and organisations. The Kyushu Electric Power Corporation and the Kyushu Bureau of Economy, Trade and Industry (the regional office of the Ministry of Economy Trade and Industry) are participating as observers. The Council is aimed at maximising opportunity from the new feed-in tariff. Estimates indicate that the roofs of factories and warehouses along Kitakyushu's shoreline could generate as much as 323 million KWh of electric power, which is roughly the consumption of 90 000 to 100 000 households.

Unconventional financing could help the city to better leverage its investment opportunities in green technologies. Fostering solar power opportunities for SMEs and households still represents a large potential. Other Japanese cities, such as Iida City in Nagano Prefecture (population 104 575) have worked with credit unions and local civil society to foster a wider distribution of pecuniary benefits and local organisation through the feed-in tariff (Box 4.8). Innovative credit unions within Japan, especially Jonan Shinkin Bank in Tokyo, the country's largest, have shown great enthusiasm for lending into the rapidly expanding energy efficiency and renewable energy-oriented consumer and business markets. While transaction costs involved in getting smaller projects under way increase with a growing number of organisations and individuals, a significant market share of distributed power supply is linked to a growing number of energy consumers who become producers. Expanding the scale of this market and its equity opportunities require new financing models, which credit unions, regional banks and larger banks have begun to address.

Box 4.8. **Iida City**

Working with local financial institutions, Iida City – another of Japan's eco-model cities – has formulated a more diverse and equitable approach, in an effort to maximise local residents' opportunity to invest in renewable energy. Iida city is a mid-sized city in Nagano Prefecture, and has gained a strong reputation in Japan for its renewable energy and energy-efficiency initiatives. The city developed a "new energy vision" in 1996, and set about encouraging a variety of renewable and energy-efficiency businesses through the use of subsidies and other measures. As a result, it was selected in 2009 as one of the 12 eco-model cities. In its action plan for becoming a model city, it committed itself to reducing greenhouse gases from the household sector by 40% to 50% by 2030 relative to 2005 emission levels. To achieve these objectives, the city institutionalised itself as a co-ordinator between the citizens and the local businesses. The city leadership views the public sector role as being one of aggregating information and expertise concerning renewable energy and disseminating it to citizens and businesses. They also see the city as a key agency for encouraging citizens and businesses to deploy and use renewable energy.

One of the important elements in achieving these objectives was to get finance flowing into projects. To this end, the city implemented a variety of programmes between 1997 and 2010, raising the diffusion of solar in the household sector from the 1997 level of 0.17% to 3.61% as of 2010. Among the city's policy supports were assistance in financing and low interest loans. It also subsidised deployment at JPY 30 000 per kilowatt with an upper limit of JPY 100 000 on the subsidy between 2004 and 2007. It then increased this level of subsidy to JPY 70 000 per kilowatt, with an upper limit of JPY 200 000, and applied it between 2008 in 2010. From 2009, the city has made the installation of solar effectively cost free with its so-called "zero yen system".

The Environment Ministry is also helping the city to set up its own local power company. The ministry provides two-thirds of the financing for system installations via subsidies, and the rest is financed by investments from citizens and businesses in increments of JPY 100 000 per investment. The generating capacity comprises 5 to 10 kilowatt solar panel systems installed at 38 locations, for a total of 208 kilowatts. The sites include parks, day care centres and other facilities that are owned by the city. The power produced, in excess of the facility's own consumption, is sold to the regional utility. The utility in turn pays a premium price for the renewable power. This payment is returned to the community power producer and becomes finance for the dividend that investors receive on their investments.

Source: Watanabe, S. (2011), (in Japanese) "Nagano Prefecture's Iida City and the Cooperative Approach to Diffusing Renewable Energy", Norinchukin Research Institute Report, October, *www.nochuri.co.jp/genba/pdf/otr11102601.pdf.*

Kitakyushu's smart-grid project focuses on reducing end-user energy consumption, but undermines the opportunities of distributed energy supply. The Higashida smart-grid project aims for a comparatively low percentage of renewable energy supply (10%). A higher ratio of renewable energy would appear to be possible, in particular in the new investment climate shaped by the national feed-in tariffs. Current renewable energy policy and market movements indicate that the level of renewable energy reliance is likely to increase dramatically. Thus it would seem a lost opportunity for the city not to re-orient some of its planning and programmes towards increased distributed energy supply. It should also link these objectives with its smart-grid project in order to make it a comprehensive demand and supply focused system, and to optimise related equity opportunities of smart grids and distributed energy supply. Other Japanese cities,

including Hiroshima Prefecture and Tokyo's Setagaya-Ku (Box 4.9), have in fact maximised the degree of equity in the diffusion of renewable energy technology and the use of the feed-in tariff to supplement local incomes.

Box 4.9. **Renewable energy exploitation in Hiroshima and Setagaya-Ku**

Hiroshima Prefecture announced that it would set up a special fund to encourage area residents to invest in solar. The fund is one of the "Ohisama" project funds that have been a feature of Japanese local governments' renewable-energy programmes for some years. In Hiroshima's case, the fund is to be JPY 10 billion and to run for four years through 2015. The prefecture itself is putting up JPY 1 billion, JPY 3 billion is to be collected from area residents, and the balance from businesses and financial firms. The fund will cover the installation of solar arrays on approximately 6 700 homes. It will help residents put up solar panels, as they will rent them from the fund and get paid for their power via the feed-in tariff. It will also give residents an opportunity to invest in renewable power and receive dividends from the fund (Hiroshima, 2012).

As for Setagaya-Ku, one of the 24 wards of Tokyo, it is innovating through bulk purchases of solar to reduce the costs for ward residents. The measure will not cost the ward in fiscal terms, as its public agency will act as the purchaser for residents. The ward expects that it will be able to get solar panels onto 1 000 homes per year through this mechanism. Since 2009, the ward has had a subsidy system for defraying the roughly JPY 2 million cost of solar installations by JPY 100 000, but because of budget restrictions, this allows for only about 200 projects per year. The ward has roughly 1 800 residents with installed solar as of April 2012, and expects to increase that figure by 50% in the year. The ward's initiative was the result of a February 2012 public forum, where ideas were sought for promoting solar. Setagaya's measure is being closely watched by other Japanese local governments as a means for enhancing the access to home solar.

Source: Hiroshima (2012), (in Japanese) "Policies for Increasing the Diffusion of Solar Power," *www.pref.hiroshima.lg.jp/uploaded/life/122142_175962_misc.pdf*.

Use international networks to increase opportunities for green exports

Kitakyushu's international network is extensive, but centred on the east and southeast Asian countries. While this focus is to be expected, due to geography, Kitakyushu's particular focus on less-developed urban partners as sources for green growth may imply missing opportunities elsewhere. In particular, the city may risk finding itself with inadequate incentives to stay ahead of rapidly developing competitors in the swiftly evolving green city economy. Broadening its contacts and seeking export opportunities in more challenging markets is important to keep local industries in the green sector innovating at the cutting edge.

Kitakyushu's focus on international assistance has extended in the recent past to partnership and co-operation, with increasing stress on related economic opportunities. Kitakyushu has been involved in international environmental co-operation for over 30 years. Its initial forays into this field focused on assistance (Kikusawa, 2011). One notable example is the 1980 construction of KITA, the Kitakyushu International Techno-Co-operative Association (Box 4.10). From about 2000 however, Kitakyushu began to stress partnership and co-operation and in recent years has also focused on the economic benefits of overseas environmental co-operation. In June 2010, the city set up

the Kitakyushu Asian Centre for a Low-Carbon Society. The centre emphasises the connections between business and environmental and social infrastructures as export opportunities. The city is currently preparing a manual on its experiences for distribution, both as an instructional aid as well as to foster more sales.

Box 4.10. **Kitakyushu International Techno-cooperative Association**

Kitakyushu International Techno-cooperative Association (KITA) works with the Japan International Co-operation Agency (JICA) in fostering education in developing countries. The association was renamed the Kitakyushu International Techno Co-operative Association in August of 1992. In 1994, the KITA worked with Kitakyushu to develop an association inside KITA called the KITA Environmental Co-operation Centre. This centre receives staff from the city's management personnel. The KITA receives technical students from overseas and also sends experts overseas. It has received 6 200 trainees from 138 countries.

Source: Kikusawa, I. (2011*),* "Development of Japan-China Environmental Co-operation and Business Potential – Case of Kitakyushu City", *A Perspective on East Asia*, 23-26 September, International Centre for the Study of East Asian Development Foundation, Kitakyushu, Japan, *http://enviroscope.iges.or.jp/modules/envirolib/view.php?docid=3345*, accessed 16 November 2012.

While Kitakyushu is aware of its high-carbon footprint, it argues that it should be afforded special consideration because it exports energy-efficient products that reduce emissions indirectly. Kitakyushu counts its exports of energy-intensive products – mostly steel – which are produced more energy efficiently in Kitakyushu than in the recipient countries as a reduction factor for local carbon emissions. The city considers that if these relative emission savings are not taken into account, "the city's successes in green growth are underestimated" (City of Kitakyushu, 2012a). This would indeed be a relevant claim if there were a regime for consumption-based carbon accounting for cities with a generally recognised accounting standard. In that case, upstream impacts of cities would be taken into account along with downstream impacts. International data availability, however, does not as yet allow for such accounting. More generally, given the scope of policies and influence of local governments, focusing on local challenges that can be solved locally is likely to be more effective.

Kitakyushu's current structure of international collaboration might distort its incentives to advance its own green profile and to stay competitive among green growing industries and cities. While transitioning to a more service-based and knowledge-intensive industry structure, Kitakyushu also has to become more attractive to highly educated and mobile workforce. For this purpose, local environmental performance is an important factor. While a comparison with post-industrial cities, such as Stockholm or Sydney would be inappropriate, Kitakyushu would profit from stronger reflecting international and long-term trends in its current strategies. Indirectly offsetting local carbon emissions overseas might give a temporary benefit for local carbon accounting. But at the same time, the approach risks creating misleading incentives concerning the needs of local development, both with regards to increasing the competitiveness of local industries and in terms of increasing the city's attractiveness to highly skilled workforce. These points are also matter for staying competitive within the growing arena of international green cities.

International city networks, such as the International Council for Local Environmental Initiatives (ICLEI), could be better used to enhance Kitakyushu's position on the green cities map and to find new export opportunities for local products. Kitakyushu's focus so far has been on developing links and partnerships with less developed Asian countries and cities. Good potential also lies in developed countries' and cities' markets, in particular for resource-efficient and energy-saving products. Enhancing Kitakyushu's exposure to the network of cities that are pursuing green growth internationally affords opportunities not only for the city to share its own experience and ambition, but also for local industries to promote their products. Increasing export shares of green products will help the city both in growing green industries in Kitakyushu and in supporting the city's ambitions to contribute to urban sustainability worldwide.

The city now confronts the challenge of deepening the hue of its green city model by opening it up to a broader network of actors, ideas and institutions. Kitakyushu has achieved impressive results on the basis of its core strategy, garnering worldwide recognition for rapidly alleviating its own dire environmental challenges between the mid-1960s and early 1990s. From the 1990s, it went on to work hard in helping decrease the environmental impact of its urban partners in Cambodia, Vietnam, China and elsewhere. Its green development and branding have started to position it smartly on the international stage. But the Kitakyushu green growth strategy could become too strongly defined by the city's extant business network and their priorities as well as the various agendas of central agencies. The city confronts the risk of a "Galapagos effect", referring to the recent failure of popular Japanese products to sell well outside the home market because of costly overspecialisation, inadequate responsiveness with shifting market conditions, and insufficient engagement with actual and potential clients.

This challenge could be addressed by better identifying local assets, broadening the city's orientation to international markets and intensifying international exposure to keep abreast of fast-moving technologies. The City of Kitakyushu is involved in the development of a Water Plaza, based on its experience in industrial wastewater treatment. While the water technology market is developing worldwide, the city's sales target is a rather constrained category of developing country markets, including Vietnam, Cambodia and Saudi Arabia. Kitakyushu's smart-grid experiment is expected to deliver valuable experience that could be commercialised internationally. The fact that Kitakyushu's smart grid is developed and operated in an industrial city differentiates it from many other smart grids in high-tech, service-centred and upper-income cities and might make it particularly valuable for future smart-grid markets in mixed residential and commercial areas in industrial cities. Maintaining a competitive edge on an international stage will need further external engagement. Certainly, Kitakyushu is a member of the Japan Smart City Portal and related organisations within Japan. It is also a member of the Overseas Water Development Platform that links Japan's central and big local governments. However, Kitakyushu needs more global exposure to assure continuous learning and to maximise opportunities in international markets.

Notes

1. Moreover, the Kitakyushu Overseas Water Business Association includes a broad array of national and local actors. The former include, among others, the Japan Waterworks Association, the Development Bank of Japan, and the Japan Bank for International Co-operation.
2. One example is the Kyushu Bureau of Economy, Trade and Industry, the Kyushu regional agency of the METI.
3. Japan's amalgamation policies have seen the number of its cities, towns and villages fall from 3 232 on 1 April 1999 to 1 719 as of 4 January 2012 (MIC, 2012).
4. Japan's Ministry of Health, Labour and Welfare's jurisdiction includes the "Hello Work" centres for co-ordinating employment markets and dealing with the unemployed. The decentralisation of its functions is to be tested from the fall of 2012 in special regional zones in Saitama and Shiga Prefectures

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