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MEASURING ENVIRONMENTAL POLICY STRINGENCY IN OECD COUNTRIES: AN UPDATE OF THE OECD COMPOSITE EPS INDICATOR

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ABSTRACT / RESUME

Measuring Environmental Policy Stringency in OECD Countries: An Update of the OECD Composite EPS Indicator

As countries implement stricter environmental policies, the need for tools to compare countries' environmental policy stringency is becoming more pressing. The OECD Environmental Policy Stringency (EPS) index has become a widely used tool for policy analysis since its creation in 2014. This paper updates the EPS index over three decades from 1990 to 2020, across 40 countries and 13 policy instruments, focussing on climate change and air pollution mitigation policies. It up-grades the index structure across all years, adding a new sub-index that measures the strength of technology support policies, which complements the existing structure of market based and non-market based sub-indices. The paper shows evolving developments – across countries and time – in the stringency of environmental policies.

Keywords: Environmental policy stringency, environmental regulation, composite indicators

JEL classification codes: Q48, Q50, Q58

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Mesurer la rigueur des politiques environnementales dans les pays de l'OCDE : Une mise à jour de l'indicateur composite de l'OCDE EPS

À mesure que les pays mettent en œuvre des politiques environnementales plus strictes, le besoin d'outils permettant de comparer la rigueur des politiques environnementales entre les pays se fait plus pressant. L'indice de rigueur des politiques environnementales (EPS) de l'OCDE est devenu un outil largement utilisé pour l'analyse des politiques depuis sa création en 2014. Ce document met à jour l'indice EPS sur trois décennies, de 1990 à 2020, à travers 40 pays et 13 instruments de politique publique, en se concentrant sur les politiques d'atténuation du changement climatique et de la pollution atmosphérique locale. Il améliore la structure de l'indice sur toutes les années, en ajoutant un nouveau sous-indice qui mesure la force des politiques de soutien au développement et à l'adoption de nouvelles technologies, qui complète la structure existante des sous-indices comprenant les politiques dites de marché et les instruments réglementaires. Le document montre l'évolution, à travers les pays et au cours du temps, de la rigueur des politiques environnementales.

Mots clés : Rigueur de la politique environnementale, réglementation environnementale, indicateurs composites

Classification JEL : Q48, Q50, Q58

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Measuring Environmental Policy Stringency in OECD countries: An update of the OECD composite EPS indicator

By Tobias Kruse, Antoine Dechezleprêtre, Rudy Saffar, and Léo Robert[1]

1. Introduction

1. The world is facing increasing environmental pressures across several domains that affect human lives and economies, including climate change and air pollution. Climate change is an existential threat, posing severe risks to individuals, society and to the economy, as exemplified by the increasing frequency and intensity of extreme weather events. Economic losses incurred from weather-related disasters amounted to an estimated USD 470 billion in 2017, and these numbers are expected to grow substantially in the near future (Giuzio et al., 2019[1]). In addition to climate change, exposure to air pollution is a major threat to human lives across the world. The World Health Organisation (WHO) (2018[2]) estimates that nine out of ten people globally live in areas that are exposed to levels of air pollution above healthy levels. High levels of air pollution are a major threat to human health, being responsible for 7 million deaths annually – one in eight deaths globally.

2. To address these challenges, countries are pledging more ambitious environmental targets and policy action. In the 2015 Paris Agreement, the international community pledged to limit global warming to well below 2°C (and to pursue efforts to limit warming to 1.5°C) (UNFCCC, 2015[3]). Countries representing 70% of the world's global carbon emissions have already announced net-zero emission targets (IEA, 2020[4]). The WHO (2021[5]) further tightened its guidelines on safe air pollution levels in light of the mounting evidence of the negative impacts of air pollution on human

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health. However, to address climate change and air pollution, further policy action is necessary. For example, with the currently implemented policies, average global temperatures are expected to rise to about 2.7°C by end of the century, increasing the likelihood of catastrophic impacts for our economies and societies (Climate Action Tracker, 2021[6]; IPCC, 2021[7]).[2]

3. As countries implement stricter environmental policies, the need for tools to measure, compare and evaluate their impacts is rising. Measuring policy stringency across countries and time is useful for three reasons. First, it is needed to monitor and track countries' progress. For example, in the context of the OECD's International Programme for Action on Climate (IPAC), the Climate Actions and Policies Index will be tracking countries' climate policy stringency to help assess whether countries are delivering on their commitments and to help countries co-ordinate and strengthen their policy action (OECD, 2021[8]).

4. Second, comparing environmental policy stringency across countries helps identifying frontrunners and laggards and benchmarking countries against each other. Benchmarking can help countries learn from each other in adopting more ambitious environmental policies. It is also useful in light of recent policy developments: for example, the European Commission has announced plans to implement a carbon border adjustment mechanism (CBAM). Its implementation requires information on the relative difference in policy stringency between countries.

5. Third, measuring environmental policy stringency makes it possible to empirically evaluate the impact of environmental policies on pollution, economic and social outcomes. The main goal of environmental policy is to reduce pollution, and it is important to understand what types of measures are most effective. Moreover, the implementation of environmental policies can generate winners and losers across households, firms, or sectors. Understanding the impacts of environmental policies on workers, firms and households is necessary to protect and compensate particularly affected and vulnerable groups and to avoid regressive policy effects (OECD, 2021[9]; Vona, 2021[10]).[3]

6. Comparing the stringency of environmental policies across countries is not trivial because the mix of policy instruments can vary widely. Some countries for example rely relatively more on pricing instruments such as carbon taxes, while others favour the use of non-market instruments such as emission limits or standards. Using a single policy instrument, e.g. energy taxes, to evaluate the policy stringency of a country can therefore only provide a partial assessment.

7. The OECD Environmental Policy Stringency Indicator (EPS), built by Botta and Koźluk (2014[11]) filled an important gap in this literature and allowed for the first time the evaluation of a comprehensive set of policies across countries and time. The OECD EPS has been used extensively in empirical studies to assess cross-country impacts of stricter environmental policies on environmental and economic outcomes and helped improve the understanding of the environmental and economic impacts of environmental policies (OECD, 2021[9]; OECD, 2021[12]; Dechezleprêtre et al., 2019[13]).[4] For example, empirical analyses on the effects of environmental policies using the EPS revealed that environmental policies have had relatively small effects on

[2] Full implementation of the pledges and targets, including those from the COP26 in Glasgow may limit global warming to around 2°C. For the emission reductions to be realised itis essential that governments turn targets and pledges into policy action.

[3] The evaluation of environmental policies across countries is needed because policy effects in one country may not be transferable to other countries. Countries differ along many dimensions including their levels of income, the sectoral composition of their economies, productivity and structural policies in place. Environmental policies can therefore have heterogeneous effects across countries.

[4] At the point of writing, the paper by Botta and Koźluk (2014[11]) had been cited nearly 300 times on Google Scholar.

aggregate economic outcomes such as employment, investment, trade and productivity but that they can generate winners and losers across firms, industries and regions. The least productive firms from high-polluting sectors are adversely affected, whereas more productive firms and low-pollution sectors benefit from tighter environmental policies (OECD, 2021[9]; Albrizio, Koźluk and Zipperer, 2017[14]; Garsous, Koźluk and Dlugosch, 2020[15]).

8. This paper revises and updates the OECD Environmental Policy Stringency index until 2020, covering 40 countries (including 34 OECD countries)[5], and 13 policy instruments, focussing predominantly on climate change and air pollution policies. The index structure and aggregation has been revised for this update and the revised structure applied to the complete time-series since 1990 to ensure consistency across time.

9. The revised EPS index (referred to as EPS21), consists of three equally-weighted sub-indices, which respectively group market based (e.g. taxes, permits and certificates), non-market based (e.g. performance standards) and technology support policies. Technology support policies are further divided into upstream (R&D support) and downstream (feed-in tariffs, auctions) technology support measures.

10. The paper shows that while the stringency of environmental policies has on average increased substantially over the past three decades across OECD countries, the rate of increase in the EPS has slowed down over the past decade. The average masks important differences across countries as in some countries the policy stringency rose faster than in others.

11. Over the past two decades and on average across the OECD, the stringency of non-market based policy instruments has increased the most in absolute terms, followed by technology support policies and market based policies. The onset of emissions trading schemes across several countries since the early 2000s has contributed to the increase in the stringency of market based policies, particularly in a small group of countries. Even so, the scope for greater pricing of emissions remains large in the majority of countries.

12. Over the past ten years, the level of technology support policies has weakened, raising concerns that incentives to innovate in clean technologies may be declining. While the declining trend may partly capture a shift towards more efficient technology support policies (including the move from feed-in tariffs to renewable auctions), the vast need for innovation and investment in green technologies requires further increase in technology support policies.

13. The main limitation of the OECD Environmental Policy Stringency index comes from the set of policies falling outside its coverage: the EPS focuses on policies aimed at curbing greenhouse gas emissions and local air pollution, and within this group of policies, it does not capture regulations across all sectors of the economy. For example, policies that regulate emissions from agricultural production are not included. In countries where agricultural production accounts for a relatively large share of total carbon emissions, the EPS may capture a relatively smaller share of the overall environmental policy mix.[6] Future work, including in the context of the OECD's International Programme for Action on Climate (IPAC), could expand the index to cover

[5] In addition to 34 OECD countries, the revised index is also available for Brazil, China, India, Indonesia, Russia, South Africa. Data for Colombia, Costa Rica, Lithuania and Latvia was not available.

[6] In particular, in countries such as New Zealand and Brazil that have a relatively large share of their emissions coming from the agriculture sector, the EPS may capture a relatively smaller share of policies.

additional policy instruments, including further non-market based instruments that regulate greenhouse gas emissions, and additional technology adoption support policies.[7]

14. The remainder of the paper is structured as follows. Section 2 describes the index structure including policy weighting and aggregation. Section 3 analyses trends in environmental policy stringency across countries and time, studying each sub-index separately. Section 4 compares the EPS index to other related indicators of environmental policy and environmental performance. Section 5 discusses the findings and concludes.

2. The revised Environmental Policy Stringency index

15. Building upon the previous version of the Environmental Policy Stringency index built in 2014 by Botta and Koźluk[1], the index is constructed by first selecting policies and scoring their stringency on a scale of zero to six, and subsequently aggregating the scores into an index.

2.1. Policy instruments and index structure

16. In selecting policy instruments to be included in the composite stringency index, trade-offs arise between the broadest possible coverage across countries, and time, and the availability and quality of data. The quality and availability of the data needs to be broadly comparable to construct a composite stringency index to avoid that differences in data quality affect the index. The quality of data across countries and time varies widely by environmental domain (climate, air pollution, biodiversity, waste, etc.) and by policy instrument.

17. In line with the previous version of the index, the revised version of the EPS covers climate change and air pollution policies, for which data is most comprehensively available. By focussing on these two domains, the index ignores other important environmental domains such as water, biodiversity, or waste management, for which data is not available in a large cross-country panel. Water and waste management policies are for example often set at the municipal level, making it difficult to include them in a national indicator. Some policies are also not measured on a continuous scale, such as the implementation of a national water management plan, which is country-specific and difficult to turn into a quantitative cross-country indicator. Similar limitations arise for the policy instruments that are included. The index is limited to include a set of air pollution and climate change policy instruments for which information is available across a wide range of countries, following the first version of the EPS indicators by Botta and Koźluk (2014[11]).[8]

2.1.1. Policy instruments included in the revised EPS index

18. The next paragraphs describe each of the policy instruments of the index and how the environmental policy stringency is measured for each policy.

[7] For future updates, policies that will be included in the forthcoming OECD Climate Action and Policies (CAP) index may help to expand the EPS series further and allow creating additional sub-indices, including separate indices measuring the stringency of greenhouse gas emissions and local pollutants.

[8] In the context of the OECD's International Programme for Action on Climate (IPAC), the forthcoming Climate Actions and Policies Index will complement the EPS index, covering further climate change mitigation policies.

Market based instruments (MBI)

19. This sub-index groups policies that put a price on pollution[9]:

- **CO_2 Trading Schemes**: CO_2 trading schemes set a cap on the total amount of CO_2 emissions that can be emitted. Regulated entities can buy and sell allowances to emit CO_2 to each other as needed. The stringency of CO_2 trading schemes is measured using the average annual permit price. Prices from regional trading schemes are aggregated to the national level. The higher the price the more stringent the policy. The raw values in national currency are converted to USD/tonne CO_2 to enable comparison.
- **Renewable Energy Trading Scheme:** Renewable Energy Trading Schemes (also known as Green Trading Schemes) are a system for trade in renewable energy certificates based on the obligation to source a mandated percentage of electricity from green sources. The higher this percentage the more stringent the policy.
- **CO_2 Taxes:** The stringency of a CO_2 tax is measured by the tax rate for CO_2 emissions. The raw values in national currency are converted to USD/tonne CO_2.
- **Nitrogen Oxides (NO_x) Tax:** The stringency of the NO_x tax is measured by the tax rate for NO_x emissions. The raw values in national currency are converted to USD/tonne NO_x.
- **Sulphur Oxides (SO_x) Tax**: The stringency of the SO_x tax is measured by the tax rate for emissions. The raw values in national currency are converted to USD/tonne SO_x.
- **Fuel Tax (Diesel):** The stringency is measured using the tax for a litre of diesel fuel used in transport for industry as a share of the pre-tax diesel price. It is calculated by dividing the tax on diesel by the national pre-tax price paid by industry for diesel. The values are converted to USD/Litre.[10]

Non-Market Based instruments (NMBI)

20. This sub-index entails policies that mandate emission limits and standards:

- **Emission Limit Value (ELV) for nitrogen oxides (NO_x):** The indicator represents the maximum concentration of nitrogen dioxide emissions permitted for a large, newly built coal-fired power plant, as a proxy for emissions standards in the energy generation sector. The lower the value the more stringent the policy. The raw values are measured in mg/m^3.
- **ELV for sulphur oxides (SO_x):** The indicator represents the maximum concentration of sulphur dioxide emissions permitted for a large, newly built coal-fired power plant, as a proxy for emissions standards in the energy generation sector. The lower the value the more stringent the policy. The raw values are measured in mg/m^3.
- **ELV for Particulate Matter (PM):** The indicator represents the maximum concentration of particulate matter (PM) emissions permitted for a large, newly built coal-fired power plant, as a proxy for emissions standards in the energy generation sector. The lower the value the more stringent the policy. The raw values are measured in mg/m^3.
- **Sulphur content limit for diesel:** The indicator represents the stringency of the diesel fuel standard with regard to the maximum concentration of sulphur permitted in diesel

[9] The Market Based Indicator does not include information on the coverage of GHG emissions regulated by an ETS or by taxation and does not include information on exemptions, which can vary across countries, industries and time.

[10] To the extent that the pre-tax diesel price (the denominator in the fuel tax indicator) fluctuates with business cycle trends, the fuel tax indicator can also be affected by fluctuations in the business cycle.

for automobiles. The lower the value the more stringent the policy. The values are expressed in parts per million (ppm).

Technology Support (TS) policies

21. This sub-index entails policies that support innovation in clean technologies and their adoption, including:

- **Public research and development expenditure (R&D):** The indicator represents the amount spent by the government for R&D on low-carbon energy technologies relative to the size of the country's nominal GDP. It includes renewable energy sources, energy efficiency, carbon capture and storage (CCS), nuclear, hydrogen and fuel cells, other power and storage technologies, as well as other cross-cutting technologies and research as defined by OECD/IEA (2022[16]). It is calculated by dividing a country's public R&D expenditure by its nominal GDP. The value is multiplied by 1000 for readability.
- **Renewable energy support for Solar and Wind:** This indicator represents the level of the price support for solar and wind energy technologies from feed-in tariffs (FIT) and renewable energy auctions, relative to the global levelized cost of electricity (LCOE). Over recent years, some countries replaced FITs by auctions. To capture this shift in policymaking the indicator represents the average awarded price from a wind or solar auction for country-year observations that replaced FITs by auction designs. The level of the price support is divided by the global LCOE to account for the decline in the costs of renewable energy production over the past decades. The value is the ratio of the price support (in USD/kWh) to the LCOE (in USD/kWh).

2.1.2. The structure of the revised EPS index

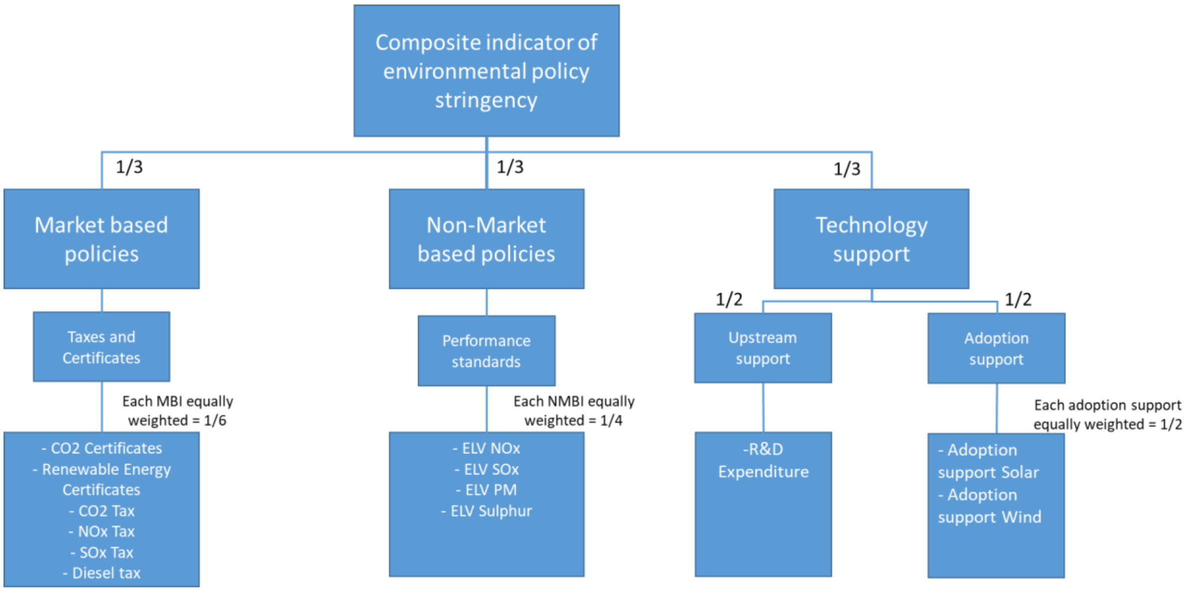
22. The previous version of the EPS ('EPS16' for the year of its latest update) contains two main sub-indices – market based and non-market based policies (See Annex A for an overview and description of EPS16). For this revised version of the EPS (which we refer to as "EPS21") an additional sub-index is added, which groups technology support policies (public R&D expenditures in low-carbon energy technologies and renewable energy price support policies for wind and solar). Figure 1 shows the structure of the revised Environmental Policy Stringency index (EPS21), consisting of three equally-weighted sub-indices, which respectively group market based, non-market based and technology support policies. Technology support policies are further divided into upstream and downstream technology support measures. Upstream technology support measures such as public R&D expenditure encourage and finance innovation in clean technologies, including in technologies that may not yet be commercially viable. Downstream technology support policies such as renewable energy support policies incentivise the adoption of specific technologies.

23. The motivation for creating a separate technology support sub-index is that subsidies for R&D and feed-in tariffs operate differently from market and non-market based policies. Also, the renewed policy interest for clean innovation requires metrics to track progress on innovation policies. The IEA (2021[17]) estimates that by 2050 half of the reductions in carbon emissions necessary to reach net zero emissions come from technologies that are currently in prototype phase. Major efforts to innovate are needed over the next decades to bring these technologies into the market. R&D subsidies lower the costs of clean technologies by subsidizing innovation. FITs and renewable energy auctions incentivize the adoption of specific energy sources, meaning that governments 'select' winning technologies (e.g. wind and solar), that receive price support. While the market- and non-market based components target primarily the negative externalities of emissions, the technology support component also targets positive externalities from Research, Development and Demonstration (RD&D), which – in the absence of public policy – may lead to sub-optimally low investment. In particular when assessing the effect of environmental policies on

innovation outcomes, the revised structure can be useful and allow for a more granular analysis of the effects of environmental policies.

24. The EPS21 index excludes two policy instruments, compared to the previous version of the index, which are Deposit & Refund Schemes and White Certificates[11] (also known as energy efficiency certificates)) because of limited data availability and concerns about the data quality.[12]

Figure 1. The 2021 Environmental Policy Stringency Index



Note: The figure shows the aggregation structure of the revised EPS index (referred to as "EPS21").
Source: OECD.

2.2. Methodology

2.2.1. Defining index scores

25. The stringency of environmental policies is measured in different units. A carbon price is for example measured in US dollar per tonne of CO_2 emissions, while an emissions limit for NO_x is measured in milligrams of pollutants per cubic metre. To aggregate several policy types into a composite index of policy stringency, their stringency needs to be measured on a common scale. To this end, a data-driven approach is taken so that threshold levels are determined by the distribution of observations, as explained in more detail in the next paragraphs. In line with the previous version of the index, the EPS ranges from zero (no policy) to six (most stringent).

[11] White certificates are designed to encourage companies to invest in energy efficiency measures. The investments are rewarded through certificates certifying a reduction in energy consumption, which can often be traded among firms.

[12] Deposit & Refund Schemes are excluded because of the binary nature of the variable and concerns about the quality of the underlying data. White certificates (also known as energy efficiency certificates) are excluded because they exist only in few countries. Most countries would therefore be assigned a value of zero on this policy component, which could bias the index.

26. For each policy instrument, the raw data is ordered from the least to the most stringent observation across the 1990-2020 period. The lowest score of zero is assigned to observations with no policy in place. The remaining scores are assigned using the distribution of observations that have the policy in place. The highest score of six is assigned to observations with values above the 90th percentile of observations that have the respective policy implemented. To assign the remaining scores, the difference between the 90th and the 10th percentile is divided into five equal bins that define the thresholds.[13] For example, in the case of renewable energy certificates, the 90th percentile is at 17%, the 10th percentile is at 2%. The difference between the 90th and the 10th percentile (equal to 15) is divided by five. The resulting value (equal to 3 in this case) is the increment from one threshold to the next, defining the remaining five thresholds (Table 1; column 3).

27. For variables that are highly skewed, for which the standard deviation is larger than 1.5 times the mean of the variable, the score of six is assigned to observations with values above the 75th percentile, to avoid that extreme values drive the thresholds. This applies to four instruments (NO_x taxes, SO_x taxes, ELV sulphur, ELV PM), which have a skewed distribution.[14] For these four variables, the remaining thresholds are assigned using the difference between the 75th and the 25th percentile. The difference between the 75th and the 25th percentile is divided into five equal bins to assign the remaining thresholds. For example, in the case of NO_x taxes, the 75th percentile is at 278 USD/tonne, and the 25th percentile is at 41 USD/tonne.[15] The difference between the 75th and the 25th percentile (equal to 237) divided by five (equal to 47 in this case) is the increment from one threshold to the next (Table 1; column 5).

28. The method is applied across all policy instruments. Annex B reports the full threshold structure across all policies. Annex C shows the distribution of the raw policy values and the distribution of EPS scores by policy for observations with the policy in place.

Table 1. Threshold distribution for market based policies

Market based policy scores						
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Score	CO_2 certificate	Renewable energy certificates	CO_2 taxes	NO_x taxes	SO_x taxes	Fuel taxes (diesel)
0	0	0	0	0	0	0
1	0<x<=10	0<x<=0.05	0<x<=10	0<x<=90	0<x<=116	0<x<=0.2
2	10<x<=20	0.05<x<=0.08	10<x<=20	90<x<=137	116<x<=180	0.2<x<=0.3
3	20<x<=30	0.08<x<=0.11	20<x<=30	137<x<=184	180<x<=244	0.3<x<=0.4
4	30<x<=40	0.11<x<=0.14	30<x<=40	184<x<=231	244<x<=308	0.4<x<=0.5
5	40<x<=50	0.14<x<=0.17	40<x<=50	231<x<=278	308<x<=372	0.5<x<=0.6
6	x>50	x>0.17	x>50	x>278	x>372	x>0.6

Note: The table shows the threshold structure for market based policies. See Annex B for the full threshold structure.
Source: OECD.

[13] To define the thresholds, we subtract the 10th from the 90th percentile to avoid that thresholds are driven by outliers.

[14] The ratio of standard deviation to the mean for the variables are 1.94 (NO_x tax), 2.5 (SO_x tax), 1.58 (ELV sulphur), and 4.14 (ELV PM).

[15] For NOx taxes the 90th percentile is at 4755 USD/tonne, and the 10th percentile is at 14 USD/tonne.

2.2.2. Policy weighting and index aggregation

29. After converting the raw policy stringency values into scores from zero to six, the scores are aggregated into the composite EPS index. Figure 1 above shows the aggregation structure. Three main considerations guide the index structure and aggregation. The variable scores will be made publicly available so that practitioners can also choose alternative weights.

30. First, each sub-index (market based, non-market based, technology support) receives an equal weighting. Countries use different combinations of policy instruments to regulate emissions. Some countries rely more on pricing instruments such as carbon taxes, while others prefer to use non-market based policies such as emission limits or standards.

31. Second, each sub-index must be self-contained so that it functions as a stand-alone indicator, meaning that the policy weights within each sub-index add to one. Analysing the effects of the sub-indices separately can be particularly useful. For example, market-based and non-market based policies may have heterogeneous effects on firms' innovation behaviour.

32. Third, the policies within each sub-index are weighted equally. For example, the market based sub-index includes six policies, which are each equally weighted by one-sixth (Table 2, column 7). When the number of policies within each sub-index varies (and weights within the sub-indices sum to one), a consequence is that the weighting of individual policies in the overall EPS index can vary. For example, the index contains four non-market based instruments, which each receive a weight of one-fourth within the non-market based sub-index. This implies that non-market based policies receive a weight of 8.25% each within the overall index, which is slightly higher than the weight received by each market based instrument (5.5% each) (Table 2 column 8).[16] Table 2 shows the aggregation and weighting of the revised EPS index. Column 7 shows the weights each policy receives within the sub-indices. Column 8 shows the weight of each policy in the overall Environmental Policy Stringency index.

[16] The TS component is divided into two sub-components, one upstream policy support as measured by R&D subsidies, the second being downstream policies support as measured by FITs for wind and solar. FITs are counted as a single policy consisting of wind and solar FITs.

Table 2. EPS aggregation and weights

Updated EPS aggregation structure							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Level 0		**Level 1**		**Level 2**	**Level 3**	**Weight within Level 2**	**Weight in the overall index**
EPS index	0.33	Non-Market based indicator	1.00		ELV NO_x	25%	8.25%
					ELV SO_x	25%	8.25%
					ELV PM	25%	8.25%
					Sulphur content limit for diesel	25%	8.25%
	0.33	Market based indicator	1.00		CO2 certificate	16.7%	5.5%
					Renewable energy certificates	16.7%	5.5%
					CO_2 taxes	16.7%	5.5%
					NO_x taxes	16.7%	5.5%
					SO_x taxes	16.7%	5.5%
					Fuel taxes (diesel)	16.7%	5.5%
	0.33	Technology Support	0.50	Upstream support	R&D expenditure	100%	16.5%
			0.50	Adoption Support	Adoption support solar	50%	8.25%
					Adoption support wind	50%	8.25%

Note: The table shows the weighting structure of the updated EPS index.
Source: OECD.

2.2.3. Missing data treatments

33. The collection of data across the 13 policy variables and 40 countries is an important contribution of this paper. A combination of data sources was used to reduce the occurrence of missing values as much as possible. Data is collected from cross-country datasets (such as OECD and IEA statistics), and country-specific datasets (e.g. official government statistics). To complete data points unavailable in public datasets, Ministries and government agencies across OECD and non-OECD member countries were contacted with requests to help complete the missing information. The direct correspondence with Ministries enabled the completion of data points not available otherwise.[17] Overall, 85 percent of values of the complete panel of country-policy-year observations were filled using any of the three sources.

34. Once all available data had been collected, missing values (concerning the remaining 15% of observations) were interpolated, following a set of rules, which take into account the type of missing data (in the beginning of the series, mid-series, at the end of the series), the variable type (discrete or continuous) and are harmonized as much as possible across policy instruments

[17] The correspondence with ministries helped us complete up to 10 percent of values that were not available from publicly available sources.

(market based, non-market based, technology support instruments).[18] Box 1 explains the missing data treatment rules in detail, Table D.1. in Annex D summarizes the rules by policy instrument.

Box 1. Missing data treatments

This Box describes the motivation for the set of rules that determine how missing data is filled. The rules are applied to missing data at the country-policy-year level. Table D.1. in Annex D summarizes the rules by policy instrument.

Treatment of missing data at the beginning of a series

- For non-market based instruments with missing data at the beginning of a series, the assumption is that no emission limit is in place prior to the first observed value. The introduction of an emission limit is a discrete policy decision for which information is likely available in national statistics. Thus, for non-market based policies, missing data is equal to a non-existence of the policy.
- For market based policies such as taxes and trading schemes a tax level of zero is assumed for missing data points at the beginning of a series.[19]
- For technology support policies, one of two approaches is used depending on the type of data. For FITs and auctions, missing data at the beginning of the series is replaced by zero, assuming that the announcement of such discrete policies is reported and would be observed. For R&D subsidies, missing data is replaced by linearly extrapolating backwards using the closest ten years of data, assuming gradual change in public R&D expenditures.

Missing data in the middle of a series

- For non-market based instruments, mid-series missing data are filled using the previous year value, assuming no change in policy stringency in the year compared to the previous one. This replacement of values concerns largely single-year observation gaps.
- For market based indicators one of three possible approaches is used to replace missing data in the middle of a series depending on the type of variable and length of the missing data gap. For CO_2 trading schemes and renewable energy certificates a linear extrapolation, based on the previous 10 years of data is used, assuming that the prices and electricity shares in these policies develop linearly over the missing data horizon. For taxes on CO_2, NO_x, SO_x, and Diesel missing data for single-year gaps is filled by the average of the previous and the following year value. For larger gaps of missing data across several years, the last available year is used, assuming that discrete changes in tax rates are likely published by national statistics.
- For technology support policies, missing data in the middle of the series are replaced using a linear extrapolation of R&D subsidies based on the previous 10 years, assuming linear changes in countries' R&D subsidies. Missing data for single-year gaps is filled by the average of the previous and the following year value. For FITs and auctions, previous year values are used to replace mid-series missing values assuming that discrete changes in the renewable energy adoption support rates are likely to be published in national statistics.

[18] An alternative to the proposed missing data treatment would be to treat any missing data as an absence of policies replacing all missing values by zero. This would however result in a downward bias of the indicator.

[19] An exception is the price for diesel, which is used to calculate the policy stringency of diesel taxes. For missing data on the diesel price variable that is extrapolated backward based on the closest ten years for which data is available.

Missing data at the end of a series.

- For non-market based instruments missing data at the end of the series are filled using the previous year value, assuming no change in policy stringency in the year compared to the previous one. This predominantly concerned single-year observation gaps.
- For market based indicators, missing data at the end of a series is filled using a linear extrapolation based on the previous 10 years assuming linear changes in these policies over time.
- For the technology support indicator, missing data at the end of the R&D subsidies series is filled using a linear extrapolation based on the previous 10 years, assuming linear changes in countries' R&D subsidies. For FITs and auctions, the previous year value is used to replace missing data at the end of a series, assuming that discrete changes in the renewable energy adoption support rates are likely to be published in national statistics.

3. Results and analysis

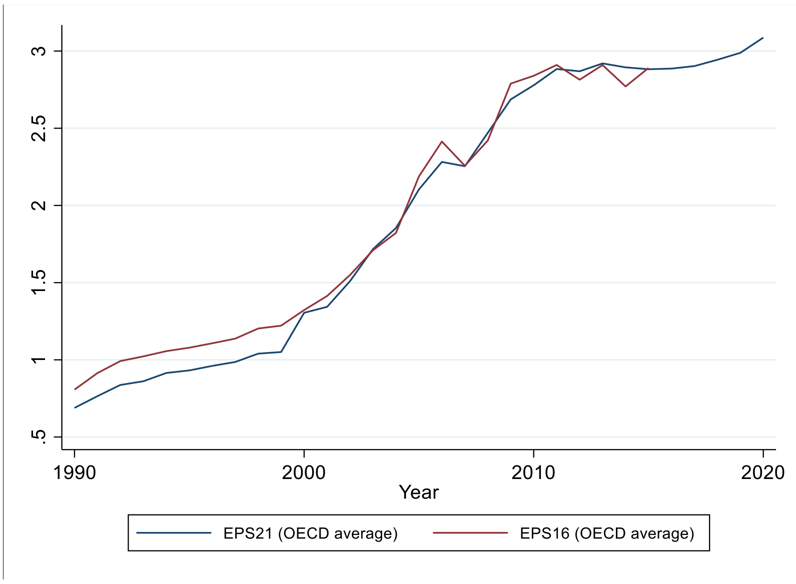
3.1. Changes in Environmental Policy Stringency across time

35. This section presents the revised Environmental Policy Stringency index and its division into sub-indices. Figure 2 shows the OECD average Environmental Policy Stringency over time and compares the EPS21 version with the previous version of the index ("EPS16" for the year of the latest update). The two series follow each other closely over time.

36. On average, Environmental Policy Stringency significantly increased since 1990 across OECD countries. Over the past two decades since 2000 it more than doubled (+138%) from 1.3 to 3.1.[20] The average annual growth rate of the EPS between 1990 and 2000 is 6.8%, and 8% between 2000 and 2010. While the increase in policy stringency has been substantial over the past decades, the trend has flattened in the most recent decade with an average annual growth rate of 1.1% between 2010 and 2020. The EPS levelled-off between 2010 and 2015. It increased since 2015 to reach a score of 3.1 in 2020 (see Figure 2, Table 3 and Table 4 below).

[20] Over the entire series between 1990 and 2020 environmental policy stringency increased on average by 348% (from 0.69 to 3.09) in OECD countries.

Figure 2. Comparing the revised EPS ('EPS21') to the previous version of the EPS ('EPS16')



Note: The figure shows the OECD average of the revised Environmental Policy Stringency index (blue line) and of the previous version of the EPS (red line). The average of the EPS21 index covers 34 countries. The EPS16 covers 26 countries. Data for Colombia, Costa Rica, Latvia and Lithuania was not available.
Source: OECD.

Table 3. Average annual growth rate of Environmental Policy Stringency

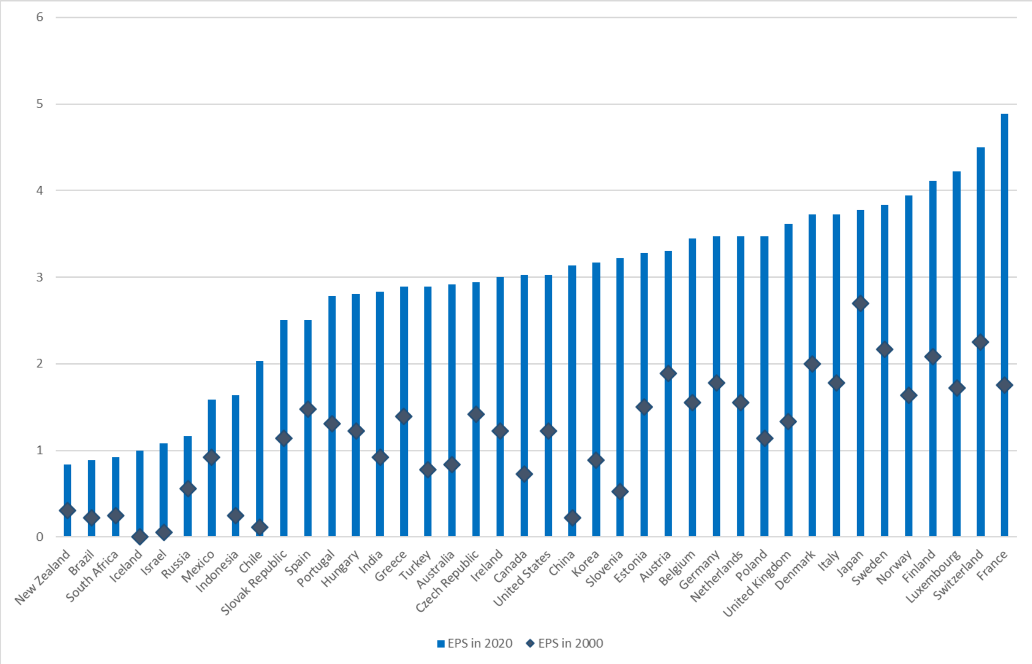
Decades	Average annual growth rate
1990 – 2000	6.8%
2000 – 2010	8.0%
2010 – 2020	1.1%

Note: The table shows the OECD-average annual growth rates of the EPS for each decade.
Source: OECD.

3.2. Country-specific changes in Environmental Policy Stringency

37. The substantial increase in the Environmental Policy Stringency on average across the OECD over the past decades masks wide heterogeneity across countries. Figure 3 shows countries according to their EPS in 2020 (blue bars), together with their scores in 2000 (blue diamonds). All countries increased their environmental policy stringency between 2000 and 2020. In 2020, the countries with the most stringent environmental policies are France, Switzerland, Luxembourg and Finland.

Figure 3. Environmental Policy Stringency in 2020 and 2000

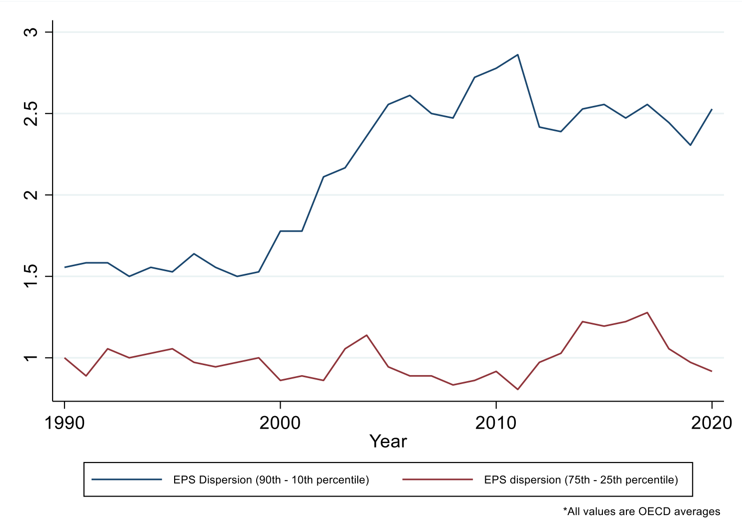


Note: The blue bars show the EPS in 2020. The diamonds show the EPS in 2000. Data for Colombia, Costa Rica, Latvia and Lithuania was not available.
Source: OECD.

38. Likewise, some countries strengthened their environmental policies more than others. Looking at the changes in absolute values of the EPS score, France (+3.2), China (+2.9), Slovenia (+ 2.8) increased their policy stringency the most (between 2000 and 2020) (Figure F.1. in Annex F). While the environmental policy stringency in some countries increased vastly, several countries also started from a low basis, so that their policy stringency remains at a relatively low level as seen towards the left of Figure 3.

39. Figure 4 shows the dispersion of environmental policy stringency over time. The red line shows the interquartile range (the difference between the 75th and 25th percentile), which stays relatively constant over time, showing that a large group of countries (the median 50%) strengthen their policies together at similar speed. The blue line shows the difference between the 90th and 10th percentile. The value increases since 2000, showing that a group of frontrunners increase their environmental policy stringency faster than others, while a group of laggards progresses more slowly. The increasing dispersion between the group of frontrunners and laggards is driven by increasing dispersion in market-based and technology support policies (Annex G).

Figure 4. Dispersion of Environmental Policy Stringency over time



Note: The figure shows the dispersion of the EPS over time. The blue line shows the difference between the 90th and the 10th percentile. The red line shows the difference between the 75th and the 25th percentile. All values are OECD averages.
Source: OECD.

40. Table 4 shows the average changes (across the OECD) in the EPS and its sub-indices between 2000 and 2020 in intervals of ten years. Across the OECD, the stringency of non-market based policy instruments has on average increased the most in absolute values (+2.8), followed by technology support policies (+1.47) and market based policies (+1.08) over the past two decades (Table 4; column 6). Looking at the changes over the past decade (Table 4; column 5), non-market and market based policies increased by less than 0.7 points. The level of technology support policies declined by 0.25 points.

Table 4. The EPS and its components over the past two decades

	(1)	(2)	(3)	(4)	(5)	(6)
	EPS 1990	**EPS 2000**	**EPS 2010**	**EPS 2020**	**Change from 2010 to 2020**	**Change from 2000 to 2020**
Non-Market based Policies (*Performance Standards*)	0.85	2.27	4.40	5.07	+0.67 (+15%)	+2.8 (+123%)
Market based Policies (*Taxes & Certificates*)	0.43	0.79	1.36	1.87	+0.51 (+38%)	+1.08 (+137%)
Technology Support	0.79	0.85	2.57	2.32	-0.25 (-10%)	+1.47 (+173%)
EPS (Total indicator)	**0.69**	**1.30**	**2.78**	**3.09**	**0.31 (+11%)**	**1.79 (+138%)**

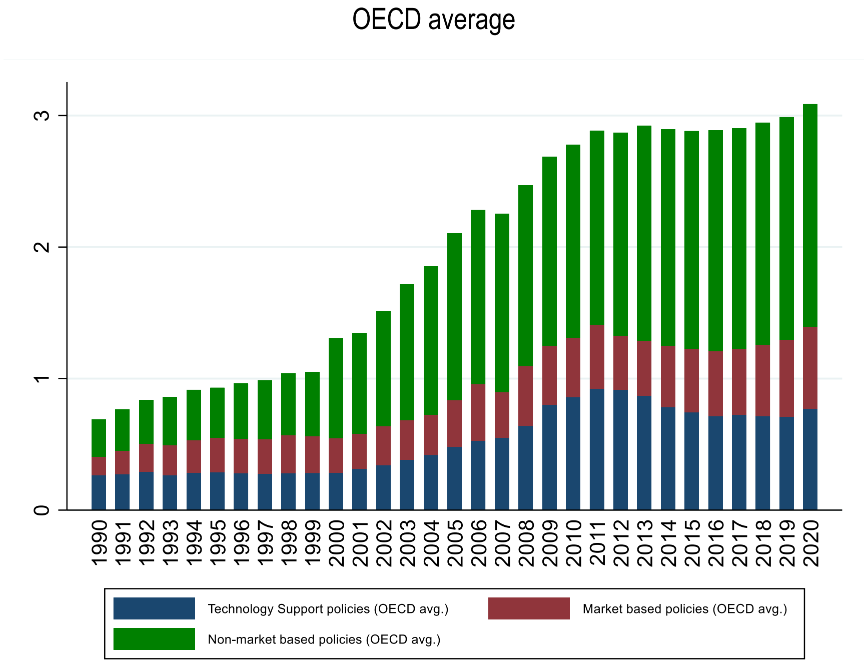
Note: The table shows the values of the EPS and its main components over time and the change between 2010 and 2020, as well as between 2000 and 2020, both in absolute and percentage values. All values are OECD averages for 34 member countries. Data for Colombia, Costa Rica, Latvia and Lithuania was not available.
Source: OECD.

41. Separating the EPS into its sub-indices, Figure 5 shows that non-market based EPS scores have been higher compared to the other sub-indices, consistently since the 1990s. Figure 6

plots the decomposition for the year 2020 across countries, showing that in most countries – and not only on average – the EPS score of non-market based environmental policies is highest, followed by technology support policies and market based policies.

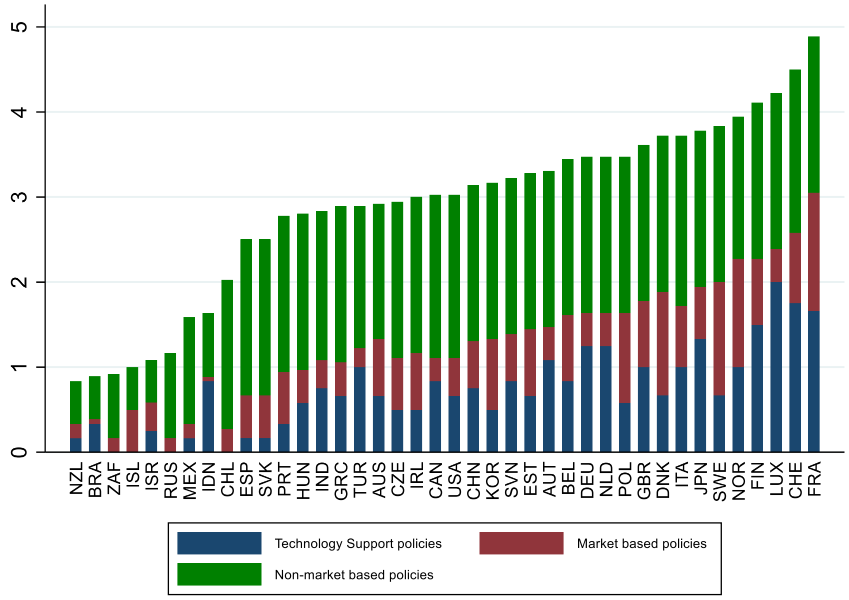
42. On average in the OECD, the stringency of market based policies increased notably since the early 2000s, largely due to the onset of emissions trading schemes as discussed below. Between 2000 and 2011, the level of technology support policies increased markedly. While declining in the first half of the 2010s, the level of technology support policies increased again in the second half of the decade (2016-2020), yet staying below its peak of 2011.

Figure 5 Environmental Policy Stringency by sub-indices



Note: The figure shows the composition of the EPS over time for the OECD average. Blue bars show the contribution of technology support policies in the overall EPS. Red bars show the contribution of market based policies. Green bars show contribution of in non-market based policies. The OECD average is computed for 34 member countries. Data for Colombia, Costa Rica, Latvia and Lithuania was not available.
Source: OECD.

Figure 6. Environmental Policy Stringency by sub-indicator across countries in 2020



Note: The graph shows the contribution of the policy components to the EPS across countries for the year 2020. The blue bars show the contribution of non-market based policies to the EPS. The red bars show the contribution of market based policies. The green bars show the contribution of technology support policies. Data for Colombia, Costa Rica, Latvia and Lithuania was not available.
Source: OECD.

3.3. Changes in policy stringency by sub-indices

43. Looking in further detail at each of the three sub-indices permits a granular analysis of policy trends. Figure 7 shows the contributions for each policy by sub-index. For non-market based policies (panel A), each of the four policies (regulating NO_x, SO_x, PM, sulphur) has increased in a similar fashion.

44. Within market based policies, the stringency of the diesel tax has been relatively constant over time. Until the mid-2000s, it was the dominant market based instrument, because other instruments were weak. The onset of the emissions trading scheme in the European Union and in other jurisdictions have led to increase the prominence and stringency of this policy tool since the mid-2000s. As the price of EU ETS – the largest trading scheme in the world – has fluctuated substantially in the early trading phases, we also see a relatively high volatility in the stringency of this component. For example, the dark red bars in panel B of Figure 7 show the drop in prices in 2007, which was the last year of the EU ETS pilot phase. In the pilot phase the amount of emission allowances exceeded actual emissions and emission allowances from the pilot phase could not be re-used in the next year so that excess certificates lost their value at the end of the pilot phase and their price dropped to zero. Figure 7 also shows the low-price periods between 2012 and 2017 in the EU ETS when prices remained largely below EUR 10 per tonne of CO_2. In the following years 2018 to 2020 the stringency significantly increased as prices rose to between EUR 20-30 per tonne of CO_2.[21]

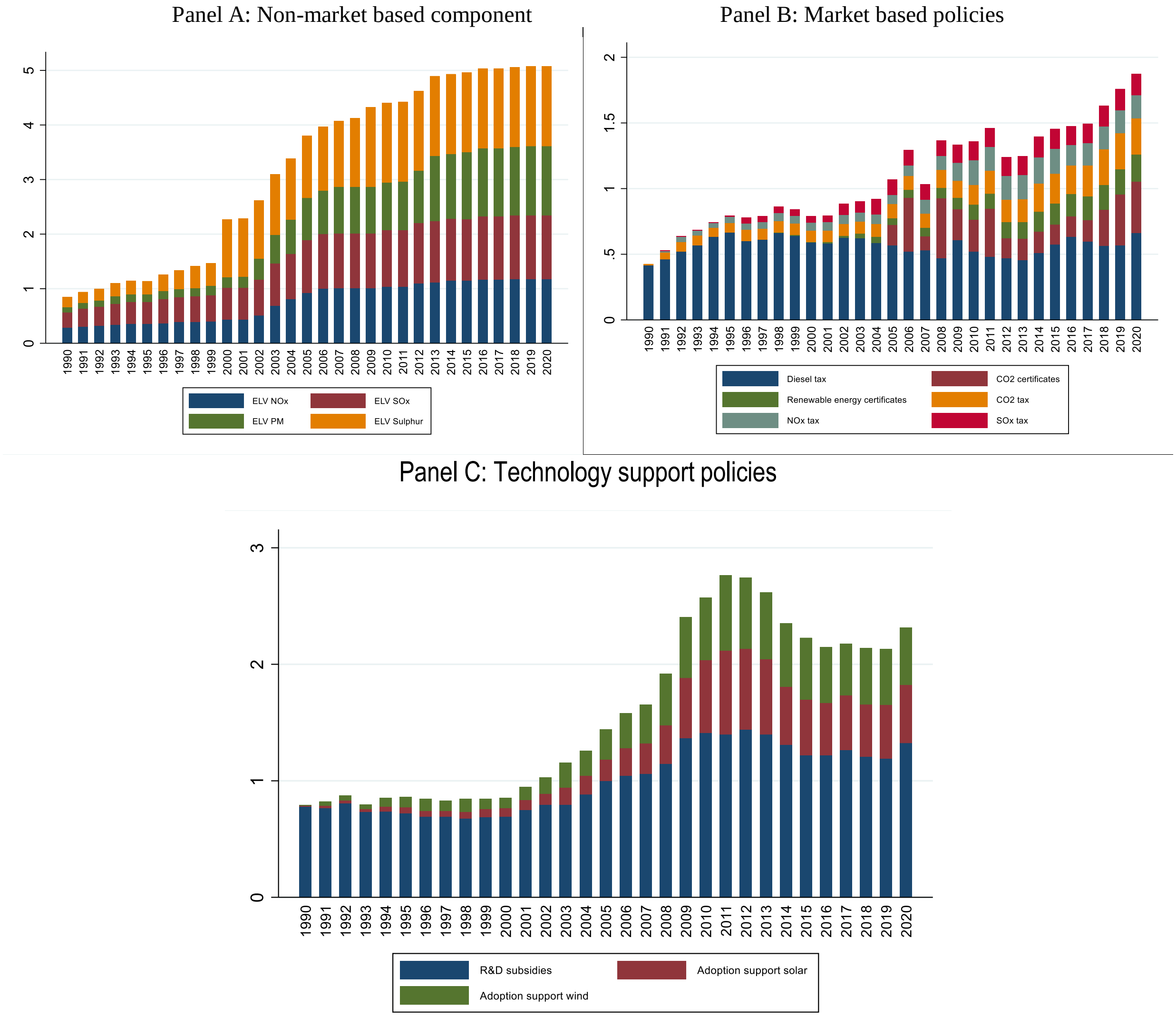
[21] The price of emission permits can also be implemented by business cycles, for example the price of permits may decline during a recession as businesses produce and pollute less.

45. The stringency of renewable energy certificates, NO_x, SO_x and CO_2 taxes gradually increased over the past decade, particularly in a small group of countries. Even so, the scope for the pricing of emissions remains large in the majority of countries (Annex H, Figure H.1.).[22]

46. Technology support policies (Panel C in Figure 7) increased from the 1990s until 2011. In the first part of the 2010s, the level of technology support policies declined – both for R&D expenditures and for FITs. The level of technology support policies increased again in the second half of the past decade (For the distribution of EPS stringency scores across the three sub-indices see Annex H).

[22] The combination of the policy weight in the index and the observed policy stringency determines the contribution to the overall policy stringency. For example, in the case of non-market based instruments, each policy instrument has been roughly equally stringent over the past years. Hence, each instrument contributes equally to the policy stringency of the non-market based sub-index (as seen by the roughly equal lengths of the bars in Panel A of Figure 7). For market based policies, diesel taxes have been on average more stringent than renewable energy certificates, so that on average diesel taxes account for a larger share of the overall market based policy stringency (while all market based policies are weighted equally).

Figure 7. The contribution of policies by sub-indices



Note: The figure shows the composition of the three main components of the EPS and the relative stringency of each policy within. Panel A shows the contribution of each of the non-market based policies to the non-market EPS. Panel B shows the contribution of each of the market based policies to the market based EPS. Panel C shows the contribution of each of the technology support policies to the technology support part of the EPS. All values are OECD averages for 34 member countries. Data for Colombia, Costa Rica, Latvia and Lithuania was not available.
Source: OECD.

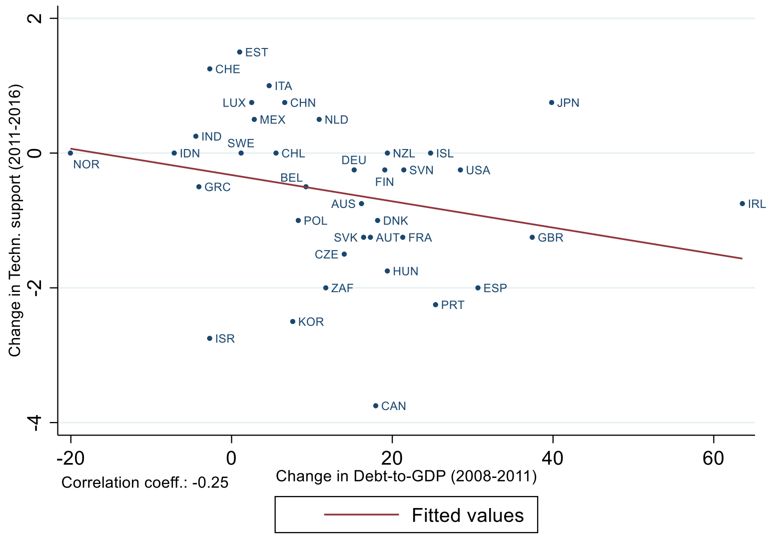
3.4. Separating technology support policies

47. Two factors drive the decline in technology support policy stringency since 2011. First, R&D subsidies (in low-carbon energy technologies) – the largest sub-component – have declined as a proportion of GDP. To reduce emissions towards net zero by mid-century and to lower costs of the transition, the development and deployment of new clean technologies is crucial (Acemoglu et al., 2012[18]; Dechezleprêtre, 2016[19]). This declining trend in R&D subsidies (which is analysed in more detail below in Section 4.6.) raises concerns that government support for clean technologies weakens at a time when it is needed the most to encourage innovation in clean technologies. The declining trend in technology support policies may also be related to fiscal consolidation in the aftermath of the Global Financial Crisis (GFC) when governments reduced

fiscal expenditures. While governments implemented stimulus and recovery packages as an immediate response to the GFC, support for public low-carbon R&D continued to increase (2009-2012). Due to the phasing out of emergency measures and political requirements for fiscal consolidation government budgets came under increased budgetary pressures since 2010/11 (OECD, 2021[20]). This may reflect in the downward trend in low-carbon public R&D expenditure. The correlation between countries' change in their debt-to-GDP ratio (between 2008-11) and the decline in technology support expenditure (between 2011 and 2016) is modestly negative (-0.25) (Figure 8). Detailed analysis is necessary to identify the potential effects of the GFC and fiscal consolidation on the downward trend in technology support policies across countries.

48. The second factor is that governments started replacing feed-in tariffs with alternative policy tools including renewable energy auctions. As wind- and solar energy technologies have matured and the price for renewable energy has declined over the past decades, FITs became costly and potentially inefficient policies for governments, largely because they guarantee a fixed rate per unit of clean electricity to providers and do not elicit competition between bidders. Fiscal pressures in the aftermath of the GFC may also have accelerated this shift from FIT towards policies that can be designed more flexibly and efficiently (OECD, 2021[20]). Instead of offering a fixed rate via a FIT, some governments gradually shifted to auction designs, whereby they issue a call for tender to install a certain capacity of renewable electricity, which allows for a more flexible policy design. Project developers can submit a bid with a price per unit of electricity at which they can realise the project. The government can choose a bidder based on the lowest price. The competition between bidders reduces the problems of asymmetric information between firms and the government because bidders reveal information about their costs of operating a renewable energy facility (IEA, 2020[4]; IRENA, 2019[21]). The updated EPS accounts for the declining costs of renewables by dividing FITs by the global levelized cost of electricity. Moreover, it combines information on FITs with the average awarded price from renewable energy auctions for countries where this information is available. Future version of the index may consider including auctions as a stand-alone component of the index.

Figure 8. Change in Technology support and debt-to-GDP levels

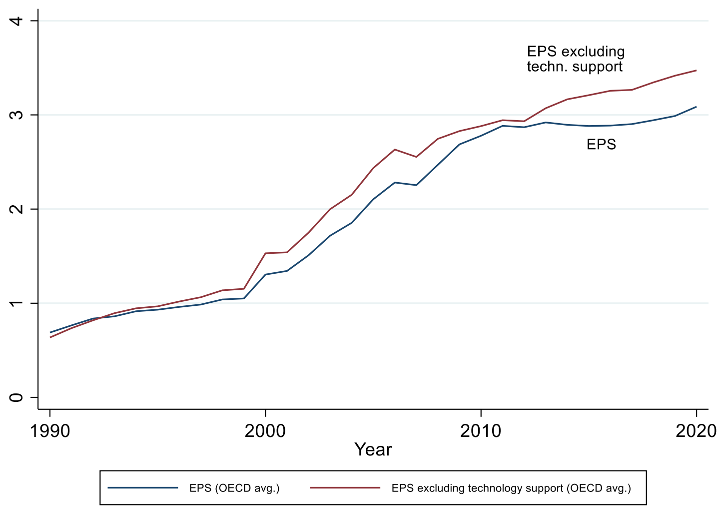


Note: The figure shows the debt-to-GDP levels of countries in 2010 on the horizontal axis, where a higher value represents a higher share of debt to a country's level of GDP. On the vertical axis it shows the change in the EPS Technology Support Score between 2011 and 2016, where negative values represent a decline in the EPS Technology Support component between 2011 and 2016.
Source: EPS: OECD; Debt-to-GDP (General Government Debt) from OECD.Stat.

49. Because of the differing trend in technology support policies, a restricted version of the EPS index – excluding technology support policies – may be helpful for specific research purposes, for example when analysing the effect of environmental policies on firms in non-energy sectors.[23] For instance, some non-energy firms may be less exposed to FITs or R&D subsidies for low-carbon energy technologies.

50. Figure 9 plots the EPS and the restricted version of the EPS, which excludes technology support policies. It shows that both indices follow each other closely until 2011 after which the EPS (blue line) declines first and subsequently increases again, whereas the restricted version of the EPS – which excludes technology support policies (red line) – continues to rise. This underlines that technology support policies largely account for the recent flattening of the overall EPS. Figure 10 graphs the change in the Technology Support score between 2011 and 2016 by country, showing that some countries lowered the stringency of their Technology Support policies more than others. Annex I shows the distribution for the components of the technology support indicator (low-carbon R&D, technology adoption support for wind and solar).

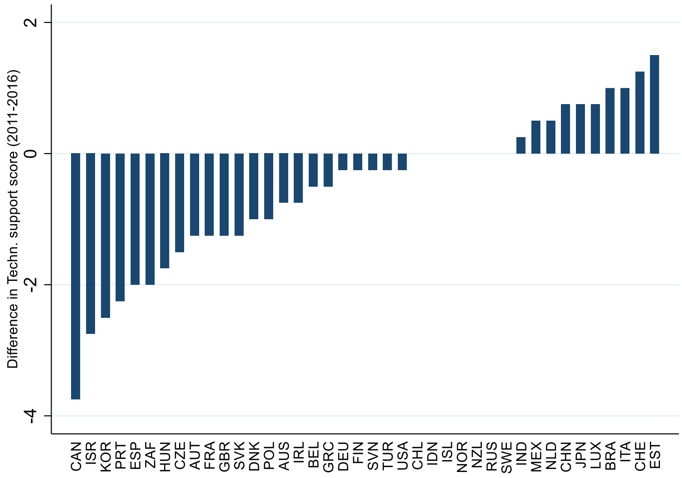
Figure 9. Environmental Policy Stringency excluding technology support measures



Note: The figure plots the EPS index (blue line) and a restricted version of the EPS that excludes technology support (red line) for the OECD average. The OECD average is computed for 34 member countries. Data for Colombia, Costa Rica, Latvia and Lithuania was not available.
Source: OECD.

[23] Because the coverage of environmental policies varies across sectors, sub-sets of the EPS may be relevant for specific research purposes that focus on individual sectors.

Figure 10. Change in technology support score between 2011 and 2016 across countries



Note: The figure shows the change in the Technology Support score between 2011 and 2016 by country. Countries to the left of the figure lowered the stringency of their Technology Support policies between 2011 and 2016. Countries to the right of the figure increased the stringency of their Technology Support policies between 2011 and 2016
Source: OECD.

4. Comparing the EPS index to related indicators

51. This section compares the EPS to related indicators of environmental policy, and analyses the direction and degree to which the EPS covaries with them.

4.1. Other measures of environmental policy stringency

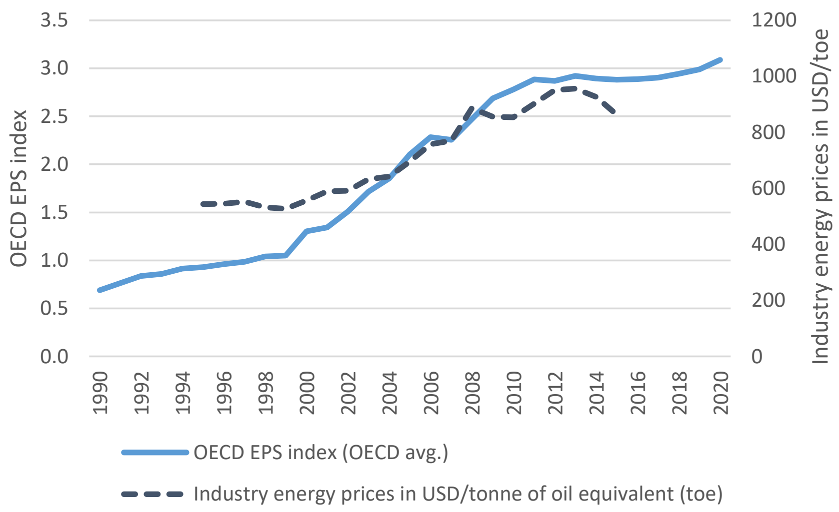
4.1.1. Energy prices

52. Industry energy prices – which are affected by energy taxes, carbon pricing and other environmental policy instruments – have become a commonly used metric to track progress in environmental policymaking and evaluate the effect of environmental pricing policies on economic outcomes of industrial sectors and firms (OECD, 2021[9]; Dechezleprêtre, Nachtigall and Stadler, 2020[22]). Sato et al., (2019[23]) construct an industrial energy price index covering 48 countries and 12 sectors for the period 1995 to 2015. The energy price index is constructed as a weighted average of fuel-specific prices by fuel consumption. Figure 11 shows the average industry energy prices and the OECD Environmental Policy Stringency index. Both indicators increase since the mid-1990s and follow similar trends. They deviate slightly over the recent time period between 2008 and 2015. Energy prices fluctuated and declined between 2012 and 2015, which may also be related to the aftermath of the financial crisis.

53. While energy prices can be an important lever of stringent environmental policies, they only provide a partial picture by measuring market based policies and are also influenced by other factors not related to environmental policies, including business cycles and past investment

decisions.[24] The main benefit of the OECD EPS index is that it measures environmental policy stringency covering a comprehensive set of environmental policies.

Figure 11. Environmental Policy Stringency and energy prices



Note: The figure shows the OECD Environmental Policy Stringency (EPS) indicator for the OECD average across 34 OECD countries (solid line, left axis) and industrial energy prices (dashed line, right axis) (Data for Columbia, Costa Rica, Latvia and Lithuania is not available).The industry energy price data are taken from Sato et al., (2019[23]). The values are computed from their VEPL_MER variable (Variable weights Energy Price Level at Market Exchange Rate). It is based on a weighted average of fuel consumption by fuel mix. The graph is based on their industry-level prices which covers 12 industrial sectors across 25 OECD countries.
Source: OECD; Sato et al., (2019[23]).

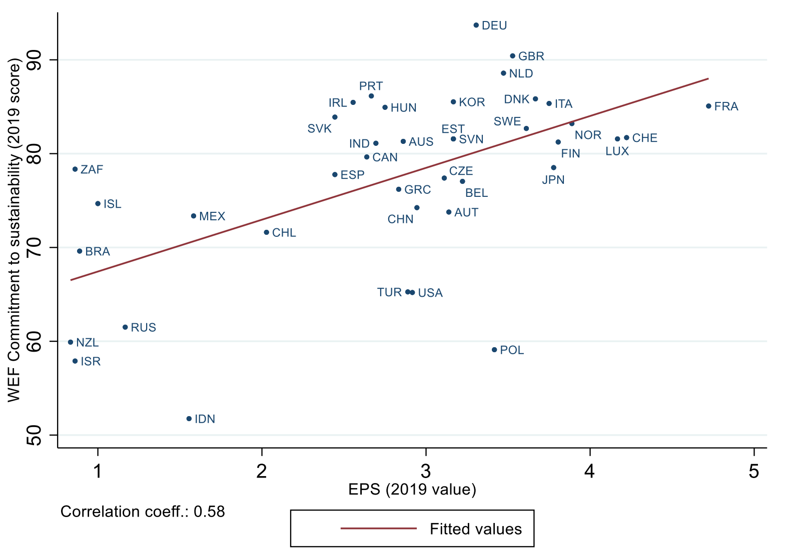
4.1.2. The WEF Commitment to Sustainability index

54. As part of its Global Competitiveness Index (GCI 4.0), the World Economic Forum (WEF) computes a score of countries "Commitment to Sustainability" ranging from zero to one hundred, with higher values indicating stronger commitment to sustainability. It is a composite indicator entailing three sub-indices, which assess countries' energy efficiency regulation, renewable energy regulation, and the number of ratified environmental treaties. Each of the three indicators is computed from secondary data (collected from international organisations) for the year 2019 (WEF, 2019[24]). The WEF is a cross-sectional indicator providing insight into environmental regulation in a specific year. The OECD EPS correlates positively (0.58) with the WEF Commitment to Sustainability indicator in the 2019 cross-section (Figure 12). A higher environmental policy stringency is associated with a stronger commitment to sustainability as measured by the WEF indicator. Similarly, the EPS correlates positively and in similar magnitude with each of the three WEF sub-indicators that assess energy efficiency and renewable energy regulation, as well as the number of environmental treaties that are ratified by a country (Annex J, Figures J1-J3). While both indicators correlate positively, the different scope of the policies included in the indices help explain why some countries perform relatively higher on the WEF compared to the EPS. For example, Germany is the highest-performing country in the WEF index, and is in the upper third of countries

[24] While energy prices reflect primarily energy pricing instruments, they can also be influenced by non-market instruments. Emission limits can for example increase the operational costs for power generators that may recover the higher operational costs by increasing energy prices.

on the EPS scale, where however several countries like France, Switzerland and Luxembourg score higher.[25]

Figure 12. Environmental Policy Stringency and WEF Commitment to Sustainability Index



Note: The figure shows the relationship between the EPS and the WEF Commitment to Sustainability score in 2019.
Source: EPS from OECD; WEF (2019[24]).

4.2. *Other dimensions of environmental policies*

4.2.1. The OECD DEEP indicator

55. The OECD DEEP (Design and Evaluation of Environmental Policies) indicator[26] measures the extent to which the introduction of environmental policies imposes burdens on economic activities across OECD countries (Berestycki and Dechezleprêtre, 2020[25]). It is constructed using a survey instrument that is completed by OECD member countries and rescaled into a composite index from zero (lowest burdens) to six (highest burdens). Data on the DEEP indicator has been collected in two waves in 2013 and 2018. It is a composite index constructed from four components. First, the administrative costs associated with permitting and licensing procedures for managers operating a plant or firm. Second, direct impediments to competition, which captures the aspects of environmental policies that can directly discriminate against new entrants. These include vintage differentiated regulations where new entrants face stricter environmental regulations than incumbent firms. Taxes and subsidies can for example benefit incumbent firms if the receipt of subsidies is based on past performance. The DEEP index also measures evaluation procedures of environmental policies. Its third (fourth) component assesses if new (existing) environmental policies are evaluated with respect to their economic impacts. Laxer and less transparent practices

[25] Poland and Indonesia are outliers in this relationship. The positive correlation persists when excluding the two countries from the graph.

[26] The DEEP indicator was previously known as BEEP (Burdens on the Economy from Environmental Policies) (Berestycki and Dechezleprêtre, 2020[25]).

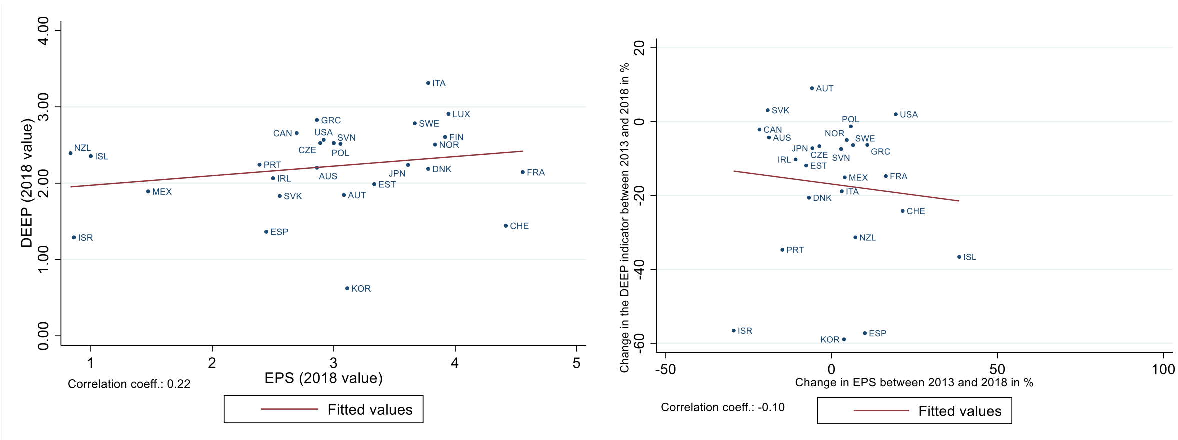
in the evaluation of economic effects of environmental policies can lead to higher burdens on economic activity and result in a higher score.

56. The Environmental Policy Stringency index is not strongly correlated with the DEEP indicator – neither in the cross-section (+0.22) nor in the 2013-18 trend (-0.1) (Figure 13). Stricter environmental policies do not need to imply higher burdens on the economy, which confirms the earlier findings by Berestycki and Dechezleprêtre (2020[25]) that used the EPS16 index version. In addition, correlating the EPS against the sub-components of the DEEP indicator is helpful to assess if a specific type of economic burden is associated with environmental policies (or certain types of policies). For example if one component of the DEEP index were positively correlated while the other three are negatively correlated with the EPS, this heterogeneity could be masked in the overall correlation. Table 5 shows that the EPS (and its sub-indices) is largely uncorrelated with the individual components of the DEEP indicator. The findings suggest that stricter environmental policies do not need to imply higher burdens on businesses and the economy or, conversely, that some of the barriers to entry and burdens on businesses from environmental policies can be eased without undermining environmental objectives.

Figure 13. Environmental Policy Stringency and the OECD DEEP indicators

Panel A: Cross-section (2018)

Panel B: Change between 2013-18



Note: The left figure shows the cross-sectional relationship between the EPS and the DEEP indicator (both in 2018). The right figure shows the relationship in the change of the EPS and DEEP from 2013 to 2018.
Source: OECD.

Table 5. Correlations of the EPS and DEEP indicators

	DEEP (2018)				
	Administrative Burdens	Impediments to Competition	Evaluation of policies (new)	Evaluation of policies (existing)	Total DEEP
Non-Market based	0.14	0.08	0.17	-0.03	0.18
Market based	-0.12	0.15	-0.03	0.21	0.11
Technology Support	0.25	0.12	0.17	-0.13	0.20
EPS Final	0.15	0.15	0.15	-0.01	0.22

Note: The table shows the correlation coefficients comparing the EPS and its components with the DEEP indicator and its components. All values are for 2018.
Source: OECD.

4.3. Environmental outcomes

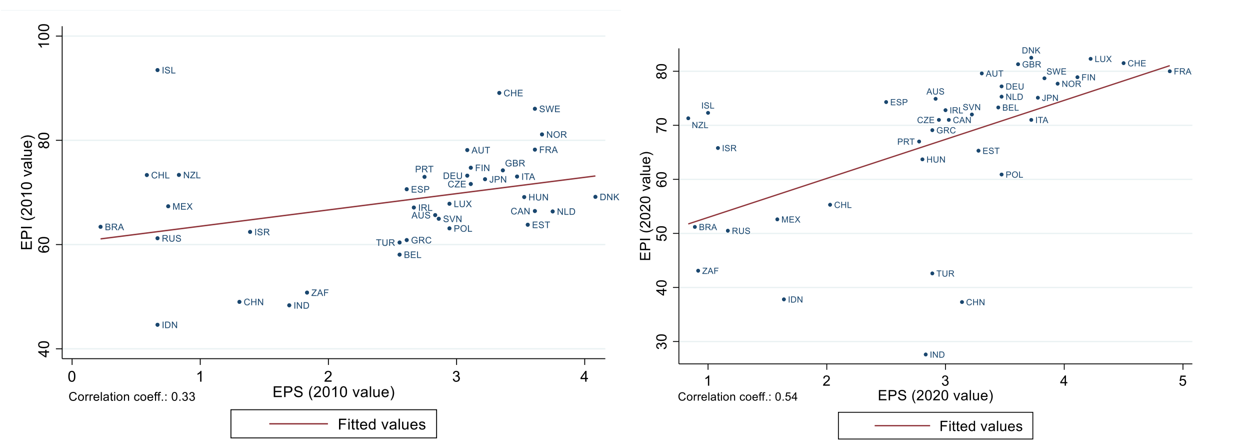
4.3.1. The Yale Environmental Performance Index (EPI)

57. The Yale Environmental Performance Index (EPI) is a measure of countries' environmental performance across 32 indicators covering 11 environmental domains, including climate change and air pollution, which are also covered in the EPS, but also sanitation and drinking water, biodiversity and ecosystem services, which are not covered in the EPS. The Yale EPI ranks countries according to environmental health and ecosystem vitality on a score from zero to one hundred with higher values indicating a better performance. The indicator differs from the EPS because it measures countries' observed performance in environmental outcomes – a potential outcome of environmental policies. The OECD EPS measures the policy stringency of countries that may subsequently impact countries' environmental performance. The Yale EPI provides a snapshot that allows comparing the environmental performance of countries in a specific year. The methodology and the underlying data change between versions of the index so that it cannot be used for time series or panel analyses (Wendling et al., 2020[26]).

58. Figure 14 shows the cross-sectional relationship between the Yale EPI and the OECD EPS indicator for the years 2010 and 2020. The correlation coefficients between the two indicators are 0.33 (in 2010) and 0.54 (in 2020). A higher environmental policy stringency correlates with better environmental performance, which is in line with existing evidence that stricter environmental policies reduce emissions and improve environmental outcomes (OECD, 2021[9]; Dechezleprêtre et al., 2019[13]; Dechezleprêtre, Nachtigall and Venmans, 2018[27]).

Figure 14. Environmental Policy Stringency and the Yale EPI

Panel A: EPS versus EPI in 2010 | Panel B: EPS versus EPI in 2020



Note: The left figure shows the correlation between the EPS and the EPI in 2010. The right figure shows the correlation between the EPS and the EPI in 2020.
Source: EPS from OECD; EPI from Wendling et al., (2020[26]).

4.3.2. CO_2 intensity and PM2.5 exposure

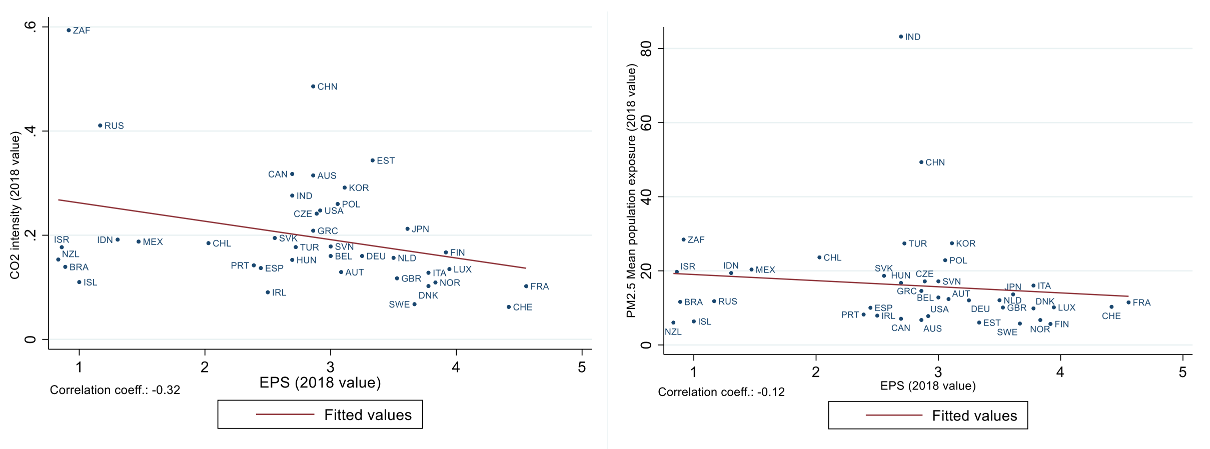
59. The Environmental Policy Stringency index measures predominantly the stringency of policies to regulate carbon emissions and air pollution. Figure 15 (Panel A) shows the cross-sectional relationship between the EPS index and CO_2-emissions intensity measured in kg of CO_2 per GDP (in 2017 PPP USD). The two indicators are negatively correlated (-0.32). Countries like

France, Switzerland and Denmark that have the strictest environmental policies also have among the lowest CO_2 intensity. Panel B of Figure 15 plots the relationship between the EPS index and the mean population exposure to PM2.5 pollution in a country. Both indicators are negatively correlated (-0.12). People in countries with stricter environmental policies are less exposed to PM2.5 pollution than people in countries with less stringent environmental policies. India and China are outliers in this relationship, and excluding them, the correlation coefficient is higher at -0.27. Both countries have intermediate levels of environmental policy stringency but have the highest population exposure to air pollution, which is partly explained by their large populations that live in relatively polluted cities in both countries. Further strengthening of policies – beyond intermediate levels of policy stringency – is needed to improve air quality and reduce emissions. The relationships in Figure 15 are based on simple correlations and do not imply a causal relationship. They are in line with the existing evidence showing that stricter environmental policies can significantly reduce carbon emissions and air pollution (OECD, 2021[9]; Dechezleprêtre, Nachtigall and Venmans, 2018[27]; Dechezleprêtre, Rivers and Stadler, 2019[28]).

Figure 15. Environmental Policy Stringency, CO_2 emissions intensity and PM2.5 exposure

Panel A: EPS vs CO_2 emissions intensity

Panel B: EPS vs. PM2.5 exposure



Note: Panel A shows the relationship between the EPS and CO_2 emissions intensity (measured in kg of CO_2 per 2017 PPP USD of GDP). The right figure shows the relationship between the EPS and PM2.5 mean population exposures (measured in micrograms per cubic metre)
Source: CO_2-intensity from WDI (2021[29]); PM2.5 exposure from OECD (2021[30]); EPS data from OECD.

4.3.3. The Ecological Footprint indicator

60. The Ecological Footprint (EF) indicator measures the ecological resource use (land and sea area, waste absorption etc.) of a country relative to the natural capacity of the planet.[27] It is developed by the York University Ecological Footprint Initiative & Global Footprint Network (2021[31]), which publishes several ecological footprint indicators. The Ecological Footprint of consumption indicates the consumption of biocapacity by a country's inhabitants. It includes the domestic demand for resources and ecosystem services, the export of national resources for use

[27] It is defined as measuring "the biologically productive land and water area an individual, population or activity requires to produce all the resources it consumes, to accommodate its occupied urban infrastructure, and to absorb the waste it generates, using prevailing technology and resource management practices." (York University Ecological Footprint Initiative & Global Footprint Network, 2021[31])

in other countries and the import of resources for domestic consumption. To facilitate interpretation, the EF can be measured in 'Planet Equivalents' (or number of Earths), which would be necessary to support humanity's Footprint if everyone on the planet had the same Ecological Footprint as the inhabitants of a specific county. The 'Planet Equivalents' measure differs from other indicators discussed above because it measures the current consumption behaviour in proportion to the planetary capacity to produce goods and services and to absorb waste. It is measured as the ratio of an individual's footprint to the per capita biological capacity on Earth. A higher value indicates a higher demand of resources and less sustainable consumption behaviour. The EF and its sub-indicators are available for the year 2017. A sub-indicator of the EF is the Carbon Footprint indicator, which measures the amount of forestland needed (in hectares per person) to absorb the carbon dioxide emissions a country emits.

61. Panel A shows the EPS in 2017 against the carbon footprint of consumption indicator. The two indices correlate positively (+0.34). The EPS targets production-based emissions, while the carbon footprint measures the consumption-based carbon footprint. For example, the off-shoring of emissions-intensive production processes may lead to higher imports of carbon-intensive goods in countries with stricter environmental policies. Production and consumption-based emissions may follow different trends. As seen above in Figure 15 (Panel A), the EPS correlates negatively with production-based CO_2 emissions intensity. The difference between production-based and consumption-based emissions is even larger when taking all environmental impacts (beyond carbon emissions) into account. Panel B of Figure 16 shows the EPS in 2017 against the Planet Equivalents of consumption by country. The two indicators correlate positively (+0.41). Countries with stricter environmental policies have higher environmental footprints.[28]

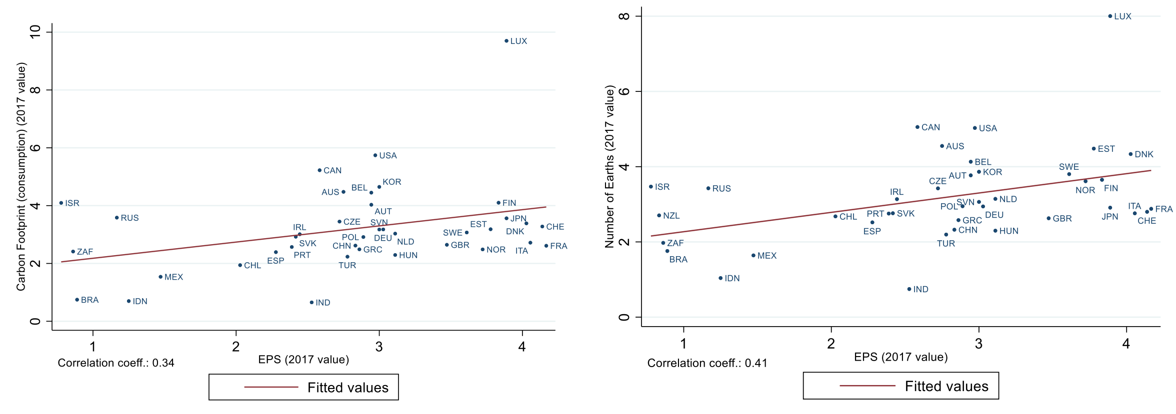
62. While it is difficult to draw strong conclusions from cross-sectional correlations, the findings indicate that while stricter environmental policies can lower the domestic production-based carbon emissions (Figure 15, panel A), countries may import carbon-intensive goods, which increases the consumption-based footprint. Figure 16 indicates that currently implemented environmental policies are insufficient to limit consumption behaviour to natural boundaries of the planet. In most countries the Ecological Footprint is three to four times above the natural capacity, adding to the existing evidence that further policies are necessary to reduce the ecological footprint of countries to sustainable levels (York University Ecological Footprint Initiative & Global Footprint Network, 2021[31]).

[28] It is relevant to note that the EPS does not directly capture policies aimed at reducing pressures on biodiversity and resource utilisation, which can also help to explain the lower correlation.

Figure 16. Environmental Policy Stringency and the Ecological Footprint indicator

Panel A: EPS and Carbon Footprint indicator

Panel B: EPS and 'Number of Earths' indicator



Note: The left figure shows the cross-sectional relationship between the EPS and the Carbon Footprint indicator based on consumption-based carbon emissions (both values in 2017). The right figure shows the cross-sectional relationship between the EPS and the Number of Earths indicator (both in 2017)

Source: OECD; York University Ecological Footprint Initiative & Global Footprint Network (2021[31]).

4.3.4. Technology support and low-carbon innovation

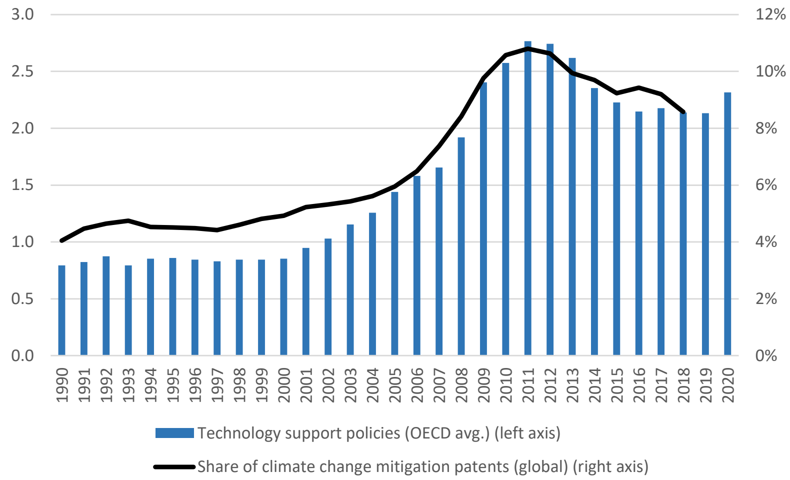
63. Innovation in clean technologies is necessary to transition our economies to net zero by mid-century and to lower the costs of the transition (Acemoglu et al., 2012[18]; OECD, 2018[32]). Vast investments into low-carbon research and development – including improvements in existing technologies as well as the development of radically new technologies – are required.

64. As illustrated above, the level of technology support policies has declined between 2011 and 2015. A similar trend is observed for patents in climate change mitigation technologies – one indicator of innovation in low-carbon technologies that cover patentable technologies.[29] Figure 17 plots patents in climate change mitigation technologies as a share of overall patents (black line) together with the EPS Technology Support sub-index over time. The share of climate change mitigation patents and R&D support policies follow similar trends. Both indicators increased until 2011 and declined until 2015. While the share of low-carbon patents continues to decline, the level of technology support policies started increasing again in the second half of the 2010s, remaining however below the peak in 2011.

65. The decline in the share of low-carbon patents raises concerns that innovation in cleaner technologies is slowing down at the time when they are needed the most (Dechezleprêtre, 2016[19]; Dechezleprêtre and Kruse, 2022[33]; OECD, 2020[34]). This may suggest that innovators see low-carbon technologies as not sufficiently profitable within the current policy environment. Similar trends in patent filings are also observed for broader groups of environmental technologies, beyond low-carbon, while the number of patent filings across all technologies continues to increase. Empirical evidence shows that well-designed environmental policies provide incentives that increase innovation in clean technologies (Acemoglu et al., 2012[18]; Calel and Dechezleprêtre, 2016[35]; Aghion et al., 2016[36]). Accelerating innovation in low-carbon technologies may require further technology support policies incentivising innovation in and adoption of low-carbon technologies. Further work is necessary to understand the relationship between environmental policies – including technology support measures – and innovation in low-carbon technologies.

[29] Low-carbon patents are one possible measure of clean innovation that cover patentable technologies. One advantage of patent data is that globally comprehensive data – including all patents filed in any of the major patent offices – is maintained and regularly updated by the European Patent Office. Not all innovations are patentable or patented by firms – a limitation of patent data.

Figure 17. Technology support and patents in low-carbon technologies



Note: The blue bars show the OECD average technology support score of the EPS. The black line shows the share of climate change mitigation patents (out of all patents) that are filed globally. Patent data is published with a two-year delay.
Source: OECD.Stat.

5. Discussion

66. As countries implement stricter environmental policies, the need for tools to compare countries' environmental policy stringency is rising. This is especially the case as the mix of policy instruments to regulate environmental pressures varies widely across countries. Some countries rely relatively more on pricing instruments, while others use non-market or technology support instruments. Built in 2014 by Botta and Koźluk, the OECD Environmental Policy Stringency index was the first cross-country index that enabled a comprehensive evaluation of environmental policy stringency in a panel setting covering more than 20 countries and more than a dozen policy measures, making an important contribution to the field.

67. This paper updates and upgrades the OECD Environmental Policy Stringency (EPS) index. The updated version of the index measures environmental policy stringency over three decades from 1990 to 2020, across 40 countries (34 of which are OECD member countries), and 13 policy instruments, focussing on climate change and air pollution mitigation policies. This paper also updates the index and its structure across all years and adds a new sub-index, measuring the level of technology support policies, which complements the existing structure of market based and non-market based sub-indices.

68. Over the past three decades, the stringency of environmental policies increased substantially across OECD countries – but the increase in policy stringency has slowed over the past ten years. The average increase in policy stringency masks important heterogeneity across countries, as some countries increased their stringency more than others. The separation of the EPS into stand-alone sub-indices allows for a detailed observation of trends in environmental policy and opens up possibilities for empirical evaluations. The stringency of market based policies increased since the early 2000s with the onset of emissions trading schemes across several countries. Over the past ten years the level of technology support policies has weakened raising concerns that incentives to innovate in clean technologies may be declining. While the declining trend may partly capture a shift towards more efficient technology support policies (including the move from FITs to renewable auctions), the vast need for innovation and investment in green

technologies requires further increase in technology support policies. This is because half of the reductions in carbon emissions necessary to reach net zero emissions will need to come from technologies that are currently in prototype phase. Major efforts to innovate and public support for clean innovation are needed over the next decades to bring these technologies into the market (IEA, 2021[17]). While the level of technology support policies gradually started increasing again in the second half of the 2010s, it remains to be seen if this change can help reverting the downward trend in clean technology innovation (as measured by patents). Empirical policy evaluations that distinguish between these types of policy instruments can provide information on the strengths and weaknesses of policy instruments and their effects on environmental and economic outcomes.

69. The OECD Environmental Policy Stringency index is limited by the policies it includes. Future work could expand the index to include additional policy instruments, including non-market based instruments that regulate greenhouse gas emissions, and additional technology adoption policy designs. As countries approach net-zero emissions with varying means and speed, comparing the level of ambition across countries becomes increasingly important to support international cooperation on mitigation policies. The OECD EPS could provide input into the development of an inclusive framework to allow the comprehensive evaluation and benchmarking of environmental policies across countries using explicit and implicit carbon pricing.

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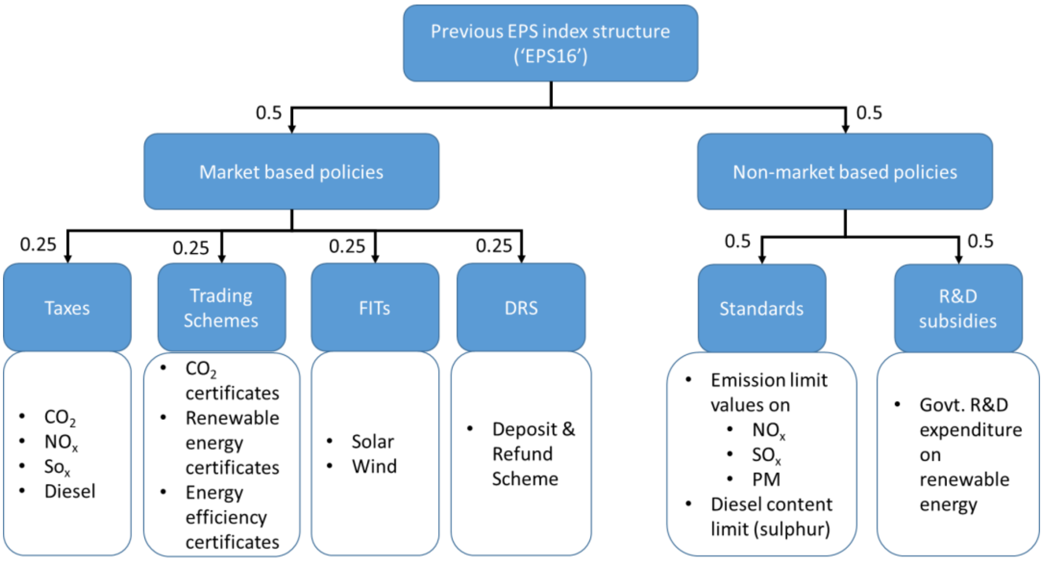
Annex A. The structure of the previous EPS index ('EPS16')

The previous version of the OECD Environmental Policy Stringency Index (referred to as "EPS16" for the year of its latest update) developed by Botta and Koźluk (2014[11]) consists of two main sub-indices: market based and non-market based policies. The market-based group of instruments entails policies, which assign an explicit price to environmental externalities (taxes on CO_2, SO_X, NO_X and diesel fuel; trading schemes for CO_2, renewable energy certificates, and energy efficiency certificates; feed-in-tariffs; and deposit-refund schemes). The non-market component groups command-and-control instruments, such as standards (emission limit values for NO_X, SO_X and PM, limits on sulphur content in diesel), and technology-support policies, such as government R&D subsidies. The score assigns values from 0 (lowest) to 6 (highest). Figure A.1. shows the weighting scheme of the EPS16.

Figure A A.1. The previous EPS index structure



Note: The figure shows the structure of the previous version of the EPS index ("EPS16").
Source: Botta and Koźluk (2014[11])

Annex B. Threshold structure

Table A B.1. Thresholds by EPS component

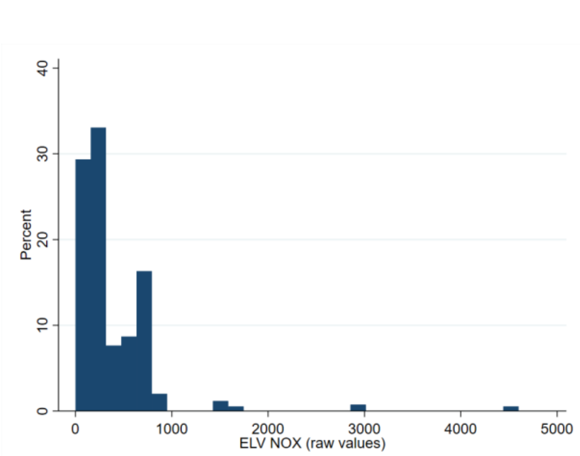
EPS components	Non-market based policies				Market based policies						Technology support policies		
Scores	Emission Limit NO_x	Emission Limit SO_x	Emission Limit PM	Emission Limit Sulphur (diesel)	CO2 certificate	Renewable energy certificates	CO2 taxes	NOx taxes	SOx taxes	Fuel taxes (diesel)	R&D expenditure	FIT solar	FIT wind
0	No limit	No limit	No limit	No limit	0	0	0	0	0	0	0	0	0
1	>563	>643	>44	x>1602	0<x<=10	0<x<=0.05	0<x<=10	0<x<=90	0<x<=116	0<x<=0.2	0<x<=0.14	0<x<=0.41	0<x<=0.95
2	458<x<=563	518<x<=643	38<x<=44	1204<x<=1602	10<x<=20	0.05<x<=0.08	10<x<=20	90<x<=137	116<x<=180	0.2<x<=0.3	0.14<x<=0.27	0.41<x<=0.81	0.95<x<=1.27
3	353<x<=458	393<x<=518	32<x<=38	806<x<=1204	20<x<=30	0.08<x<=0.11	20<x<=30	137<x<=184	180<x<=244	0.3<x<=0.4	0.27<x<=0.4	0.81<x<=1.21	1.27<x<=1.59
4	248<x<=353	268<x<=393	26<x<=32	408<x<=806	30<x<=40	0.11<x<=0.14	30<x<=40	184<x<=231	244<x<=308	0.4<x<=0.5	0.4<x<=0.53	1.21<x<=1.61	1.59<x<=1.91
5	143<x<=248	143<x<=268	20<x<=26	10<x<=408	40<x<=50	0.14<x<=0.17	40<x<=50	231<x<=278	308<x<=372	0.5<x<=0.6	0.53<x<=0.66	1.61<x<=2.01	1.91<x<=2.23
6	0=<x<=143	0=<x<=143	0=<x<=20	0=<x<=10	x>50	x>0.17	x>50	x>278	x>372	x>0.6	x>0.66	x>2.01	x>2.23

Note: This table shows the conversion of raw policy variables into EPS scores.
Source: OECD.

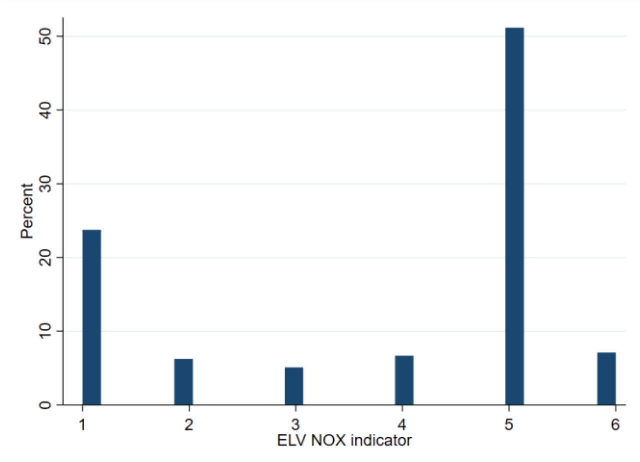
Annex C. Distribution of raw values and indicator scores

Figure A C.1. Distributions of raw policy indicators and EPS scores

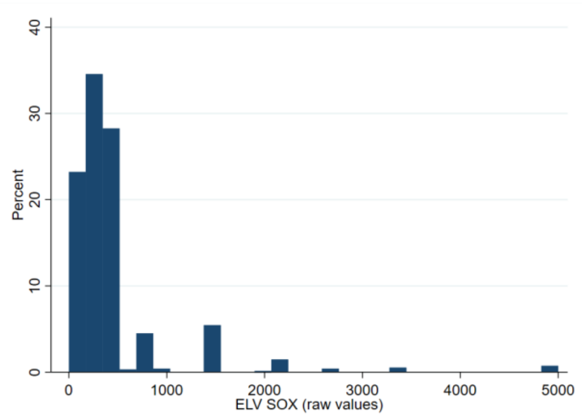
Panel A: ELV NO_x raw policy values



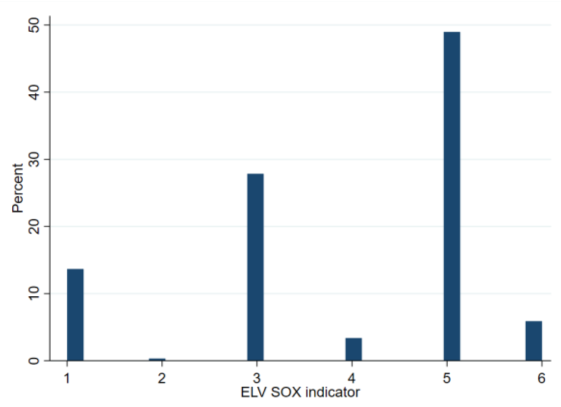
Panel B: ELV NO_x indicator scores



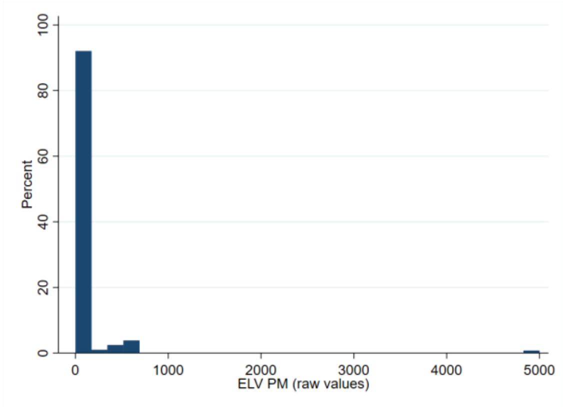
Panel C: ELV SO_x raw policy values



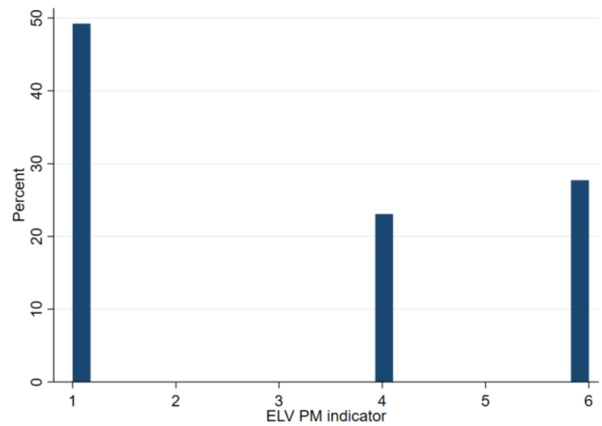
Panel D: ELV SO_x indicator scores



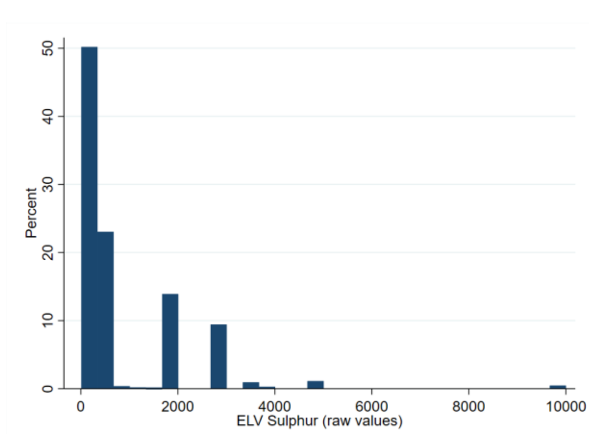
Panel E: ELV PM raw policy values



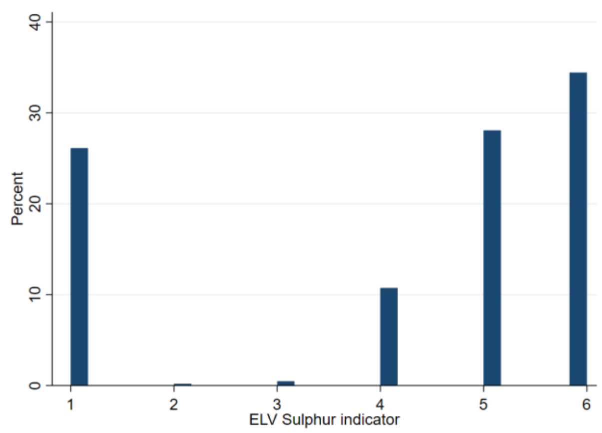
Panel F: ELV PM indicator scores



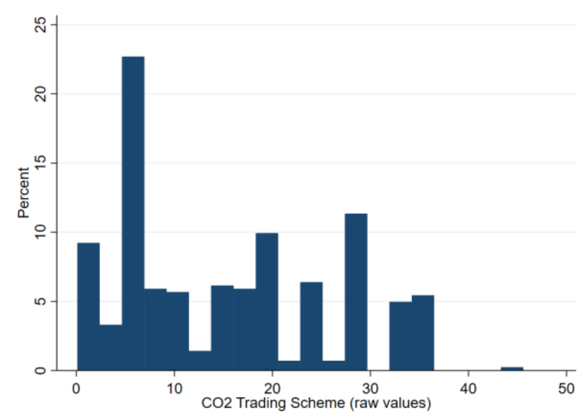
Panel G: ELV Sulphur raw policy values



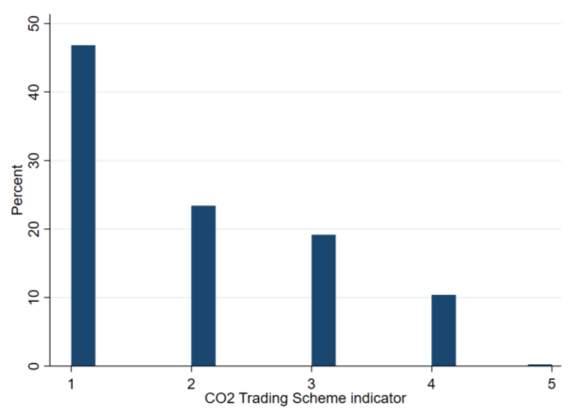
Panel H: ELV Sulphur indicator scores



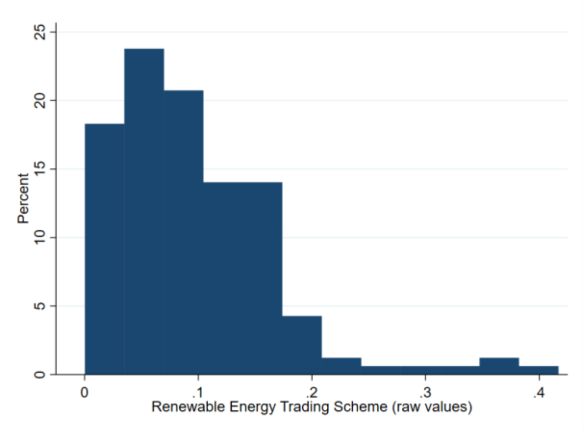
Panel I: CO_2 certificates raw policy values



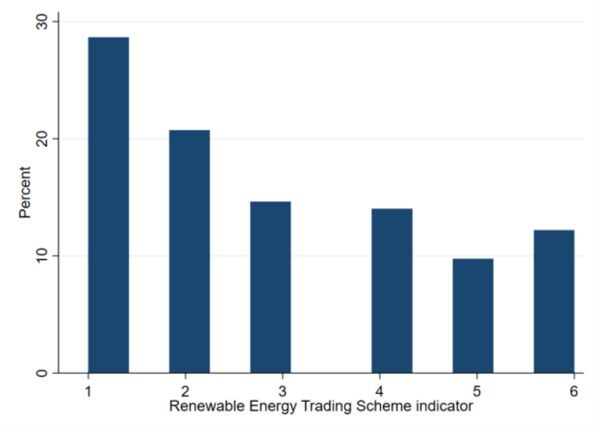
Panel J: CO_2 certificates indicator scores



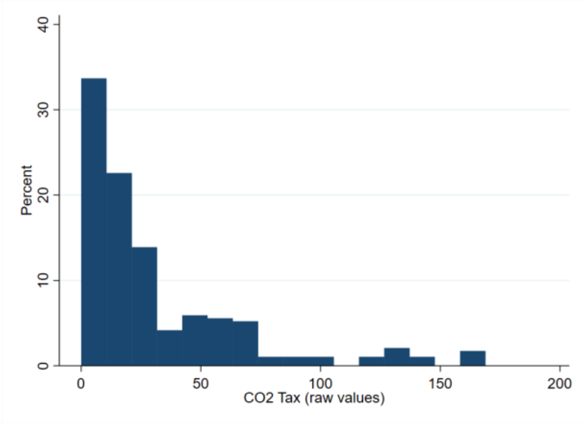
Panel K: Ren. energy certificates raw policy values



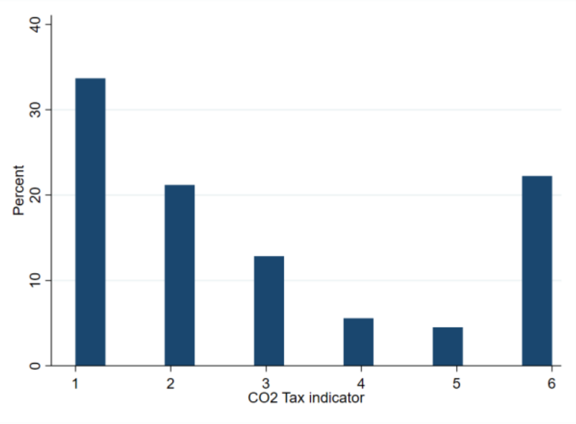
Panel L: Ren. energy certificates indicator scores



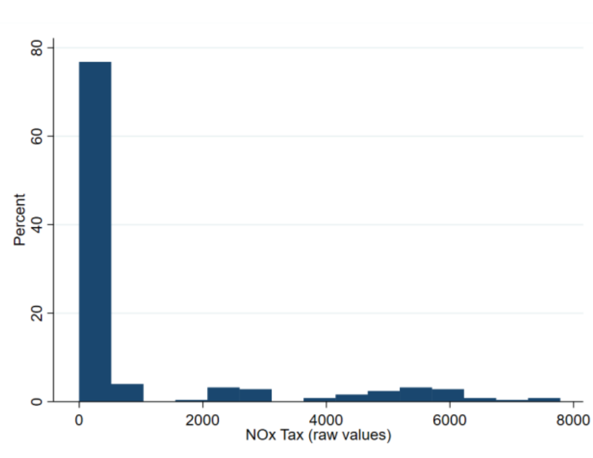
Panel M: CO_2 Tax raw policy values



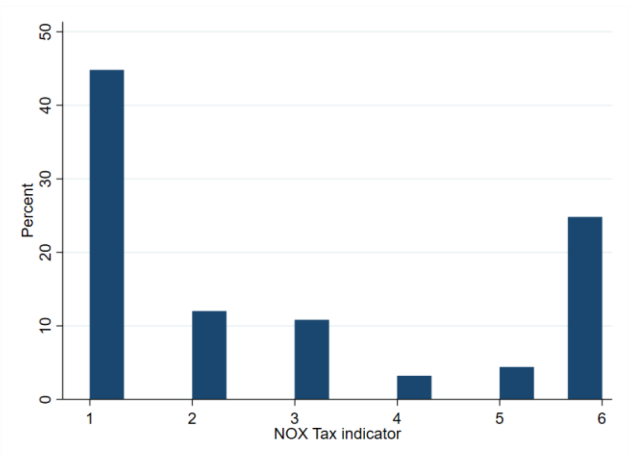
Panel N: CO_2 Tax indicator scores



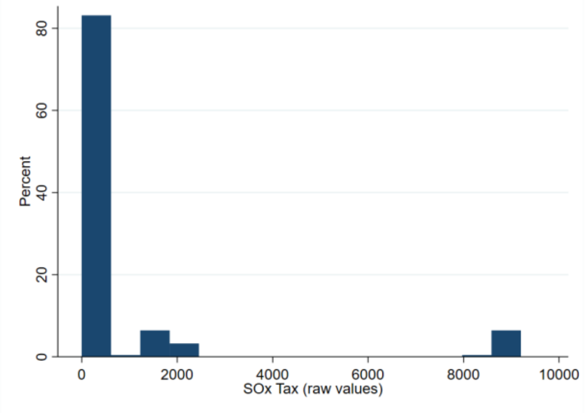
Panel O: NO_x tax raw policy values



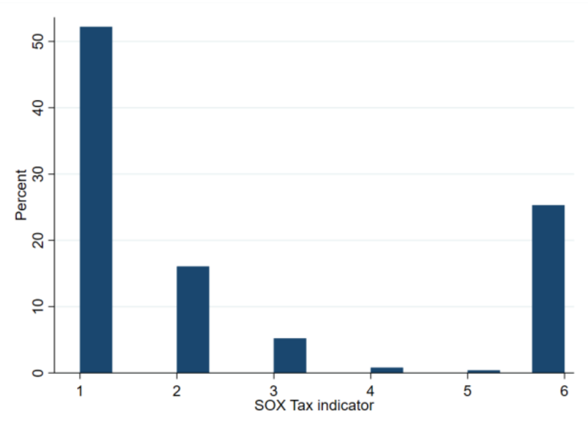
Panel P: NO_x tax indicator scores



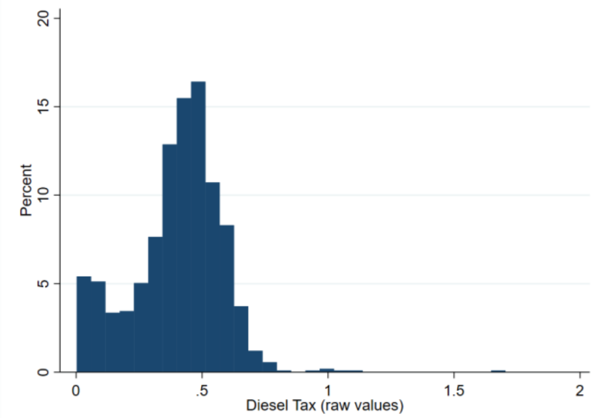
Panel Q: SO_x tax raw policy values



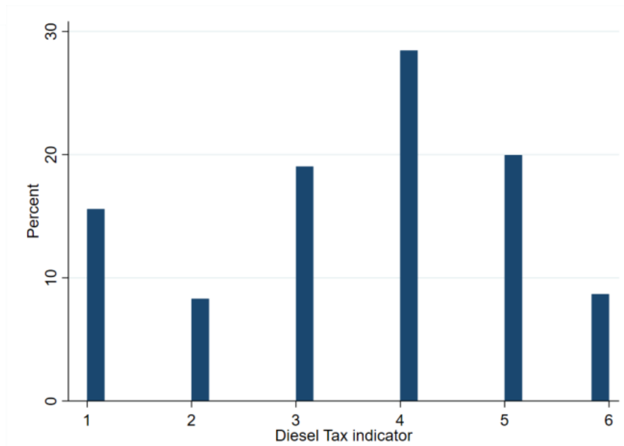
Panel R: SO_x tax indicator scores



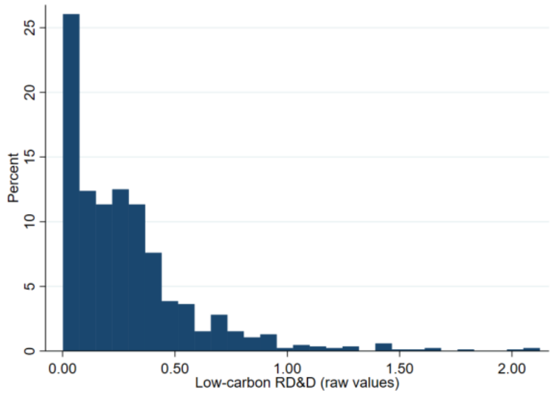
Panel S: Diesel tax raw policy values



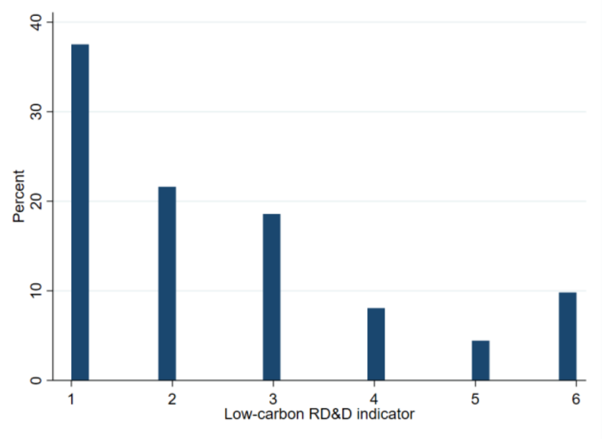
Panel T: Diesel tax indicator scores



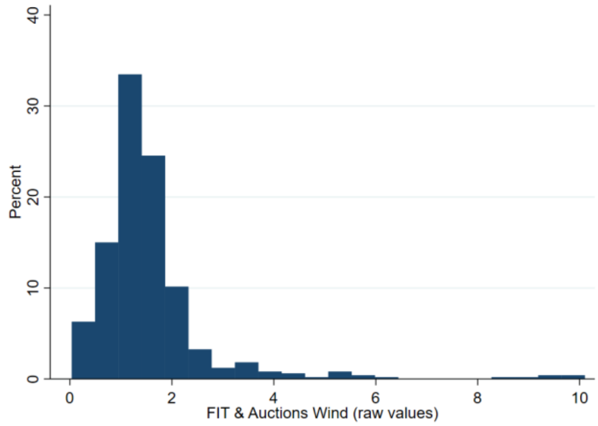
Panel U: Low-carbon R&D raw policy values



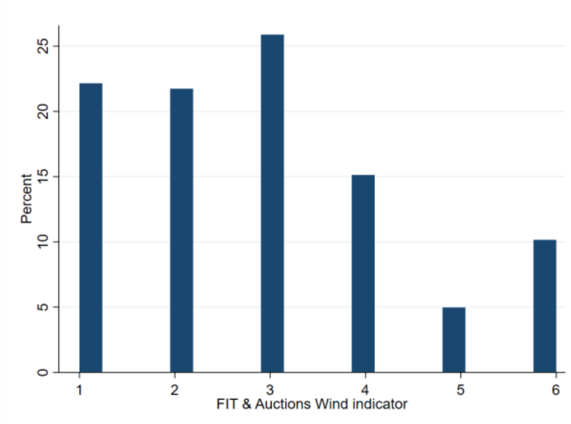
Panel V: Low-carbon R&D indicator scores



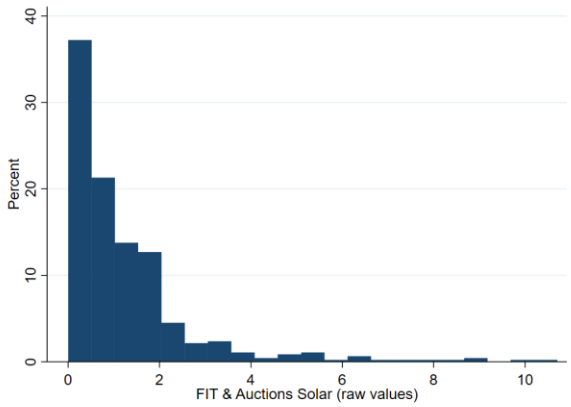
Panel W: Adoption Support Wind raw policy values



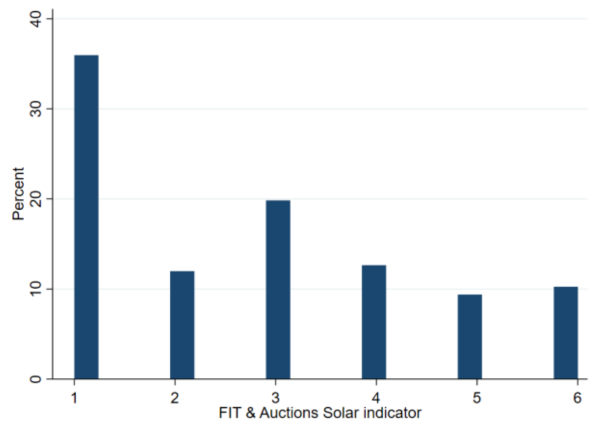
Panel X: Adoption Support Wind indicator scores



Panel Y: Adoption Support Solar raw policy values



Panel Z: Adoption Support Solar indicator scores



Note: The Figure shows the distribution of the raw policy values and the corresponding EPS scores for the policy indicator. All distributions are for observations with the respective policy in place (strictly positive values).
Source: OECD.

Annex D. Treatment of missing values (table)

Table A D.1. Missing data treatments across policy instruments

Policy Instrument	Variable	Missing data at beginning of a series	Missing data in the middle of a series	Missing data at the end of a series
Non-market based instruments	Emission Limit NO_x	No limit	Previous year value	Previous year value
	Emission Limit SO_x	No limit	Previous year value	Previous year value
	Emission Limit PM	No limit	Previous year value	Previous year value
	Emission Limit Sulphur (diesel)	No limit	Previous year value	Previous year value
Market based instruments	CO_2 Certificates	No case	Linear extrapolation (last 10 years or less if not complete)	Linear extrapolation (last 10 years or less if not complete)
	Renewable energy certificates	No case	Linear extrapolation (last 10 years or less if not complete)	Linear extrapolation (last 10 years or less if not complete)
	CO_2 Tax	0	Previous year value OR Mean of N-1 and N+1 (for 1 year gaps)	Linear extrapolation (last 10 years or less if not complete)
	NO_x Tax	0	Previous year value OR Mean of N-1 and N+1 (for 1 year gaps)	Linear extrapolation (last 10 years or less if not complete)
	SO_x Tax	0	Previous year value OR Mean of N-1 and N+1 (for 1 year gaps)	Linear extrapolation (last 10 years or less if not complete)
	Diesel Tax	0	Previous year value OR Mean of N-1 and N+1 (for 1 year gaps)	Linear extrapolation (last 10 years or less if not complete)
Technology support instruments	R&D in low carbon energy technologies	Linear extrapolation (last 10 years or less if not coherent)	Linear extrapolation (last 10 years or less if not complete) OR Mean of N-1 and N+1 (for 1 year gaps)	Linear extrapolation (last 10 years or less if not complete)
	FIT & Auctions solar & wind	0	Previous year value	Previous year value

Note: This table describes the ways missing data was treated in revising the EPS. The cells in the table show the values that are assumed in case of a missing value by the respective policy type and location in the data series. For detailed description of the treatment of missing values see Box 1.
Source: OECD.

Annex E. Descriptive statistics

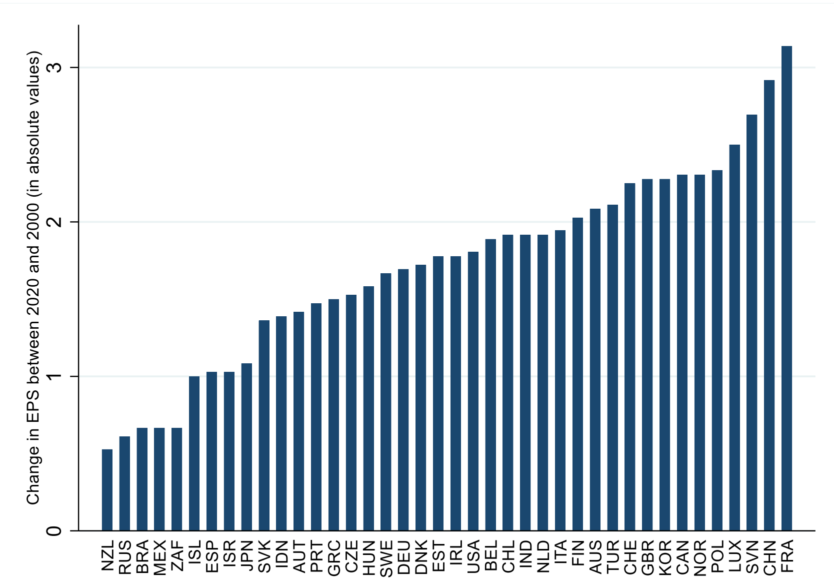
Table A E.1. Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)
	Count	Mean	Standard deviation	Minimum	Maximum
Non-market based policies	1240	2.96	2.01	0	6
Market based policies	1240	0.98	0.81	0	4.33
Technology support policies	1240	1.40	1.32	0	6
FINAL EPS	1240	1.78	1.19	0	4.94
ELV NO_x	1240	2.87	2.23	0	6
ELV SO_x	1240	3.00	2.11	0	6
ELV PM	1240	2.35	2.30	0	6
ELV Sulphur (diesel)	1240	3.61	2.34	0	6
CO_2 certificates	1240	0.66	1.16	0	5
Renewable energy certificates	1240	.39	1.17	0	6
CO_2 tax	1240	.68	1.55	0	6
NO_x tax	1240	.57	1.48	0	6
SO_x tax	1240	.52	1.39	0	6
Diesel tax (industry)	1240	3.07	1.85	0	6
R&D subsidies (low-carbon energy tech.)	1240	1.72	1.77	0	6
FIT & Auctions wind	1240	1.13	1.71	0	6
FIT & Auctions solar	1240	1.03	1.70	0	6

Note: The table reports the summary statistics of the EPS scores and its components.
Source: OECD.

Annex F. Change in EPS between 2000 and 2020

Figure A F.1. Change in Environmental Policy Stringency between 2000 and 2020 in absolute values

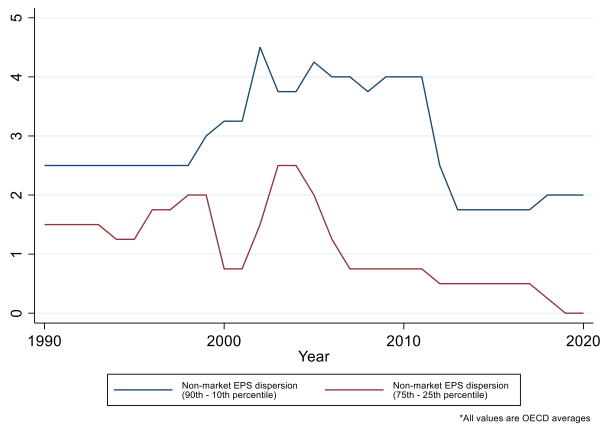


Note: The bars show the absolute increase in the EPS between 2000 and 2020.
Source: OECD.

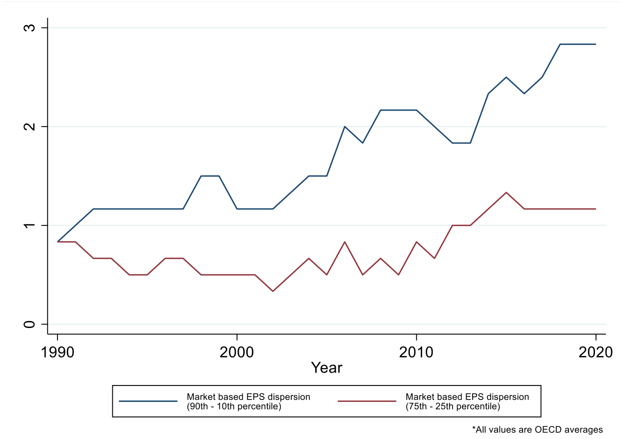
Annex G. Dispersion of EPS components

Figure A G.1. Dispersion of the EPS components

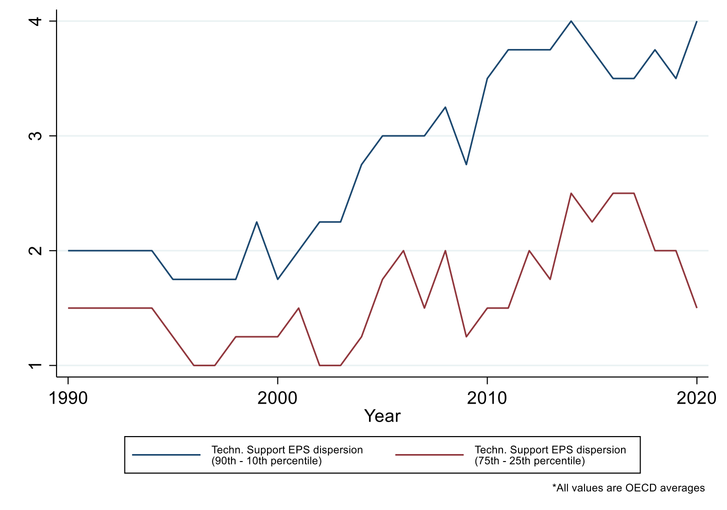
Panel A: Dispersion in non-market based EPS



Panel B: Dispersion in market based EPS



Panel C: Dispersion in technology support EPS

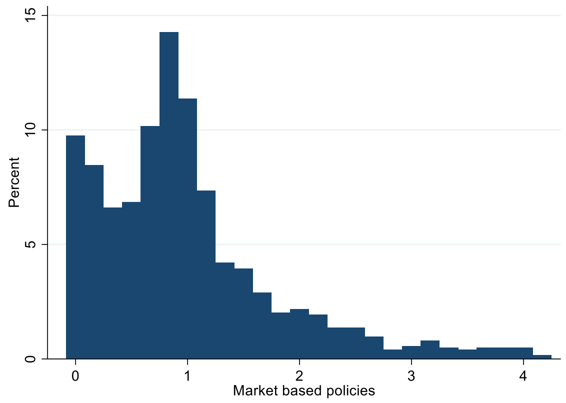


Note: The figures show the dispersion in the EPS components over time. Panel A shows the dispersion in environmental policy stringency for non-market based policies. Panel B shows the dispersion in environmental policy stringency for market based policies. Panel C shows the dispersion in environmental policy stringency for technology support policies. The blue lines show the difference between the 90th and the 10th percentile of the respective indicator. The red lines show the difference between the 75th and the 25th percentile. All values are OECD averages.
Source: OECD.

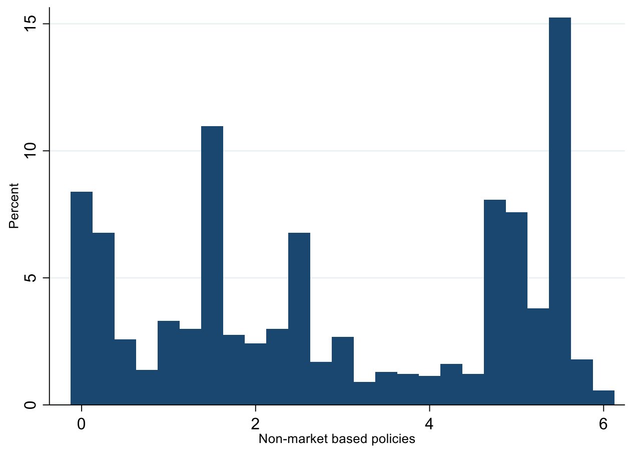
Annex H. Distribution of the EPS sub-indices

Figure A H.1. Distributions of the EPS sub-indices

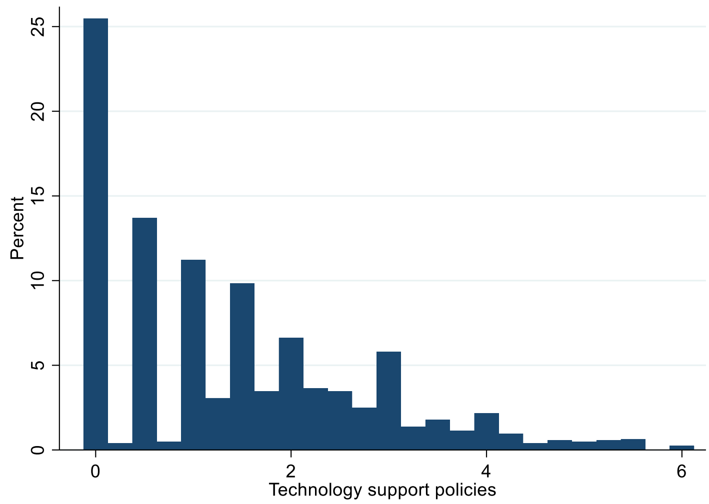
Panel A: Market based policies



Panel B: Non-market policies



Panel C: Technology support policies

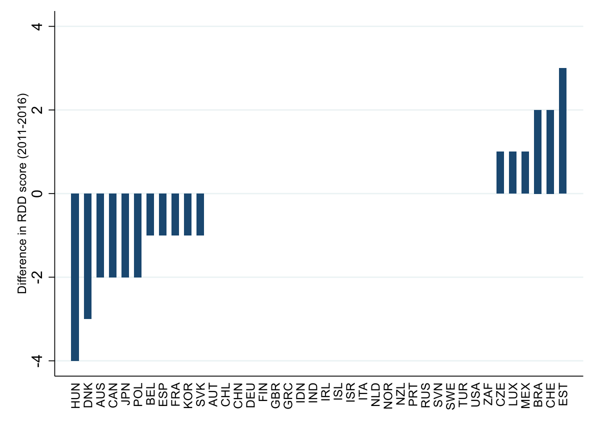


Note: The figure shows the distribution of the three EPS sub-indices. Panel A shows the distribution of values of the market based EPS. Panel B shows the distribution of values of the non-market EPS. Panel C shows the distribution of values of the technology support EPS sub-index.
Source: OECD.

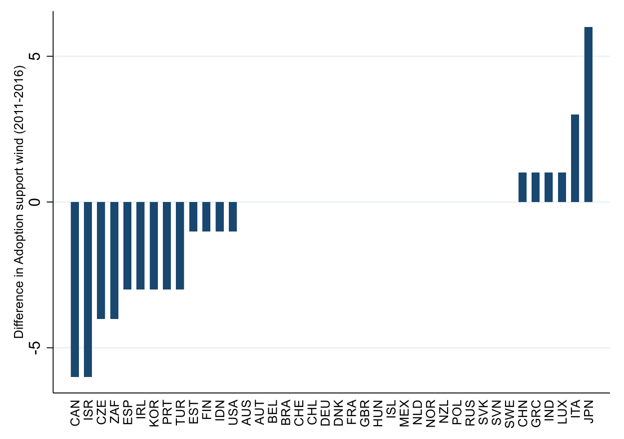
Annex I. Changes in technology support scores

Figure A I.1. Change in technology support components (2011-2016)

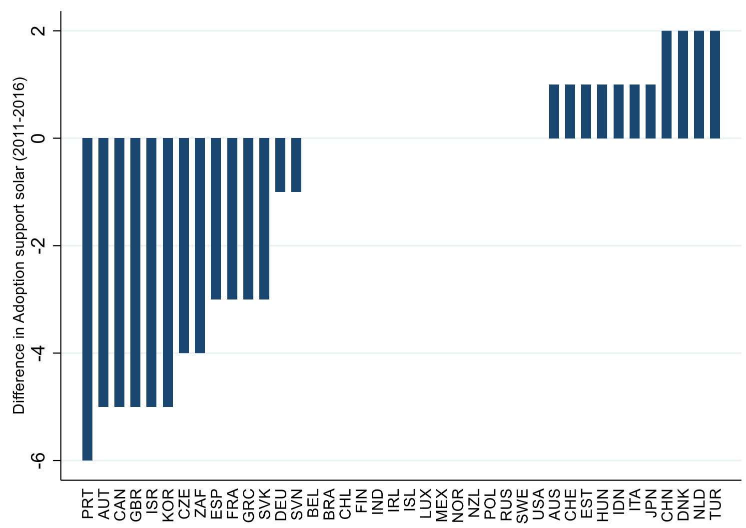
Panel A: Change in the low-carbon R&D score (2011-16)



Panel B: Change in the adoption support policy for wind (2011-16)



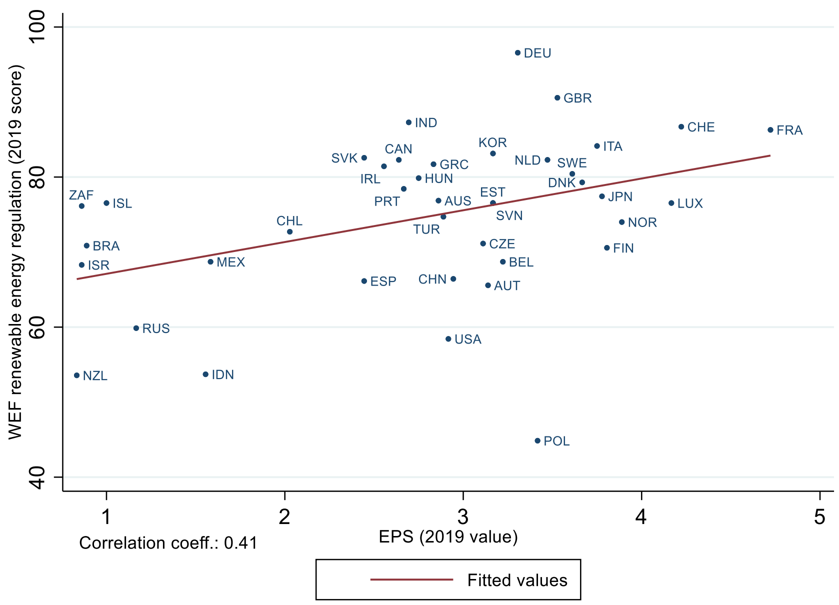
Panel C: Change in the adoption support policy for solar (2011-16)



Note: The Figure shows the change in the technology support policy components between 2011 and 2016 by country. Panel A shows the change (2011-16) for low-carbon research and development. Panel B shows the change (2011-16) for technology adoption support wind. Panel C shows the change (2011-16) for technology adoption support solar.
Source: OECD.

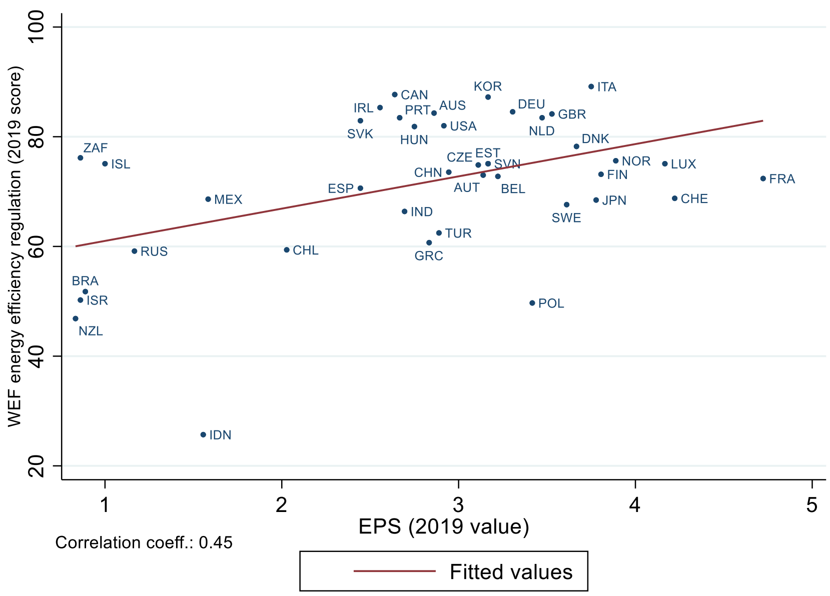
Annex J. The EPS and related indicators

Figure A J.1. Environmental Policy Stringency and the WEF renewable energy regulation score



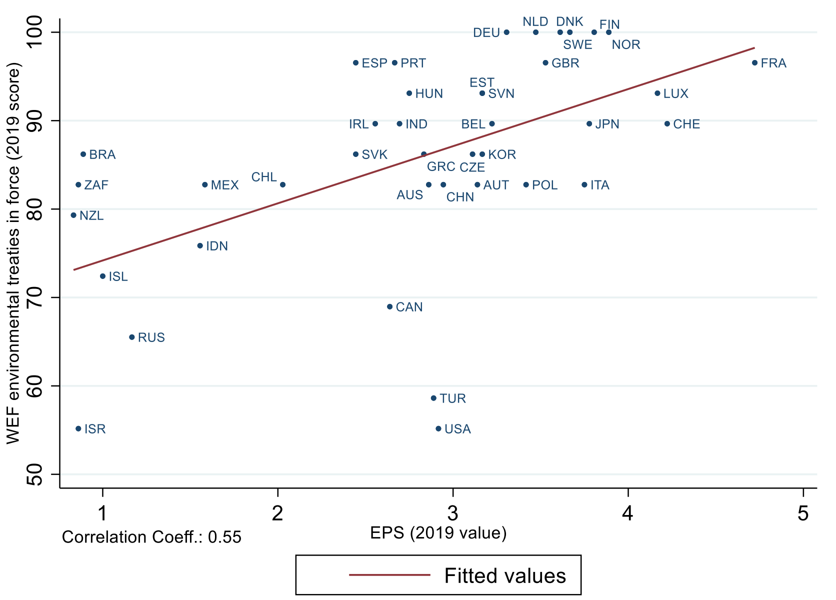
Note: The graph shows the relationship between the EPS and the WEF renewable energy regulation score (both in 2019 values).
Source: OECD; WEF, (2019[24]).

Figure A J.2. Environmental policy stringency and the WEF energy efficiency regulation score



Note: The graph shows the relationship between the EPS and the WEF energy efficiency regulation index (both in 2019 values).
Source: OECD; WEF, (2019[24]).

Figure A J.3. Environmental policy stringency and the WEF environmental treaties in force score



Note: The graph shows the relationship between the EPS and the WEF environmental treaties in force score (both in 2019 values).
Source: OECD; WEF, (2019[24]).