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Climate policy strength compared: China, the US, the EU, India, Russia, and Japan

Compston, H

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1. INTRODUCTION

International climate negotiations are largely about who should do what in terms of reducing emissions. Knowing who does what now, and how it compares with others, is therefore essential. Experts may have impressions about where climate policies are strongest but things change rapidly and there are no precise measures. Trends in emissions are not always reliable measures of climate policy strength because they are also affected by factors such as economic performance. Emissions targets are also untrustworthy because it is hard to identify how far they represent deviations from business as usual emissions and, moreover, they do not guarantee that substantive policies will be introduced, much less whether targets will be achieved. Comparing complete sets of climate policies is problematic because the policies that can be classified as climate policies are so numerous and varied.

Comparing across countries and regions therefore requires identification of a subset of climate policies that can be used as an indicator of the strength of each polity's climate policy as a whole. According to the OECD, an indicator isdefined as:

> A quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions (e.g. of a country) in a given area. When evaluated at regular intervals, an indicator can point out the direction of change across different units and through time (OECD, 2008, p. 13).

Comparisons of climate policies are numerous but few focus specifically on comparing their stringency (see, for example, Dubash et al, 2013). Those that do start with a carefully chosen set of individual climate policy types, assign precise numbers to each of these on the basis of a quantitative scale of stringency based either on direct measures (e.g. taxes on energy as a percentage of energy prices) or expert assessments of stringency, and obtain a summary score for climate policy strength by transforming scores into a common metric where necessary, weighting individual scores according to an assessment of their importance to climate policy, then averaging or aggregating them (Kuenkel, Jacob and Busch, 2006; Germanwatch, 2011, 2012; Steves and Teytelboym, 2013). The result is misleading precision and questionable validity as a measure of climate policy strength due to the largely arbitrary way in which scores and weights are assigned. Local experts may use different criteria when ranking stringency, for example, while weighting of individual climate policies is almost entirely arbitrary. Other criticisms can also be made (see, for example, Surminski and Williamson, 2014).

The aim of this article is to improve on these studies by devising a more meaningful and realistic index of climate policy strength. It opens by explaining the criteria used to identify six keynote climate policies for inclusion in an index of climate policy strength. The following sections then use this index to compare the strength of climate policies in the six biggest emitters of CO_2: China, the US, the EU, India, Russia, and Japan. Conclusions are then drawn.

2. METHOD

The first step in constructing any climate policy index is to clarify its purpose. The aim here is to compare the strength of climate policies across polities and time. The strength dimension is defined in terms of the extent to which the statutory provisions of policies are likely to restrict greenhouse gas emissions if implemented as intended, as distinct from their actual effects on emissions. This is because good information on the effects of these policies net of other factors (such as economic conditions, demography, quality of implementation, other policies, and investment climate) is not available.

This approach requires a strong positive correlation between the strength of policies included in the index and the strength of the entire range of climate policies the index seeks to represent. This is the issue of validity and is a central problem because there is no means of determining with certainty whether the strength of any subset of climate policies correlates highly with the full suite of climate policies in a single geographical unit, let alone several. Instead, like the authors of previous indices, a number of rationally defensible assumptions are needed about the relationship between the whole set and the subset.

The first assumption is that the index should include policies which most experts believe can have a substantial standalone effect on emissions, such as emissions trading. This is because (a) such policies by themselves account for a significant portion of the emissions reductions caused by climate policies as a whole, and (b) it is reasonable to believe that governments which implement such policies are likely also to implement other climate policies in the same policy sector as well as similar types of climate policy in other sectors. One would expect, for example, stringent vehicle emissions standards to be correlated with both high motor-fuel taxes and stringent industry emissions standards.

The second assumption is that the extent to which the index reflects the wider range of climate policies increases with (a) the number of policy sectors covered, and (b) the number of policy types covered (taxes, standards etc.). For this reason it is desirable to include policies from most if not all relevant sectors as well as all major types of relevant policy instruments.

The next step is to avoid aggregation. Scores for individual policies cannot be combined into a summary score without giving each a weighting. However, such weightings are essentially arbitrary because we do not know how important each policy type is relative to all the others.

The consequence of avoiding aggregation is that the index produces a profile of policies rather than a single summary score. To compare profiles as a whole requires keeping all the constituents in mind simultaneously. For this reason, the number of items in the index should be limited to ten at most.

A further consideration is that policies in the index should be applicable to all the countries for which comparisons are sought.

Finally, for a policy to contribute usefully to the index it must be possible not only to specify the policy type (e.g. emissions standards) but also to measure its scope (e.g. carbon emissions for passenger road vehicles), settings (e.g. specific limits set), and geographical coverage. These considerations mean that the indicators need to be measures on which high quality information is available.

Table 1. Objectives

The policies included in the index are selected by applying the above criteria to the inventory of policy instruments recommended by the Intergovernmental Panel on Climate Change (IPCC, 2007, p. 750), as this is arguably the most authoritative list available. This results in the following portfolio.

2.1 Carbon tax or emissions trading for the energy and manufacturing sectors

There is general agreement among economists that putting a price on carbon is essential if progress is to be made in curbing carbon emissions. One approach is to set a fixed carbon price by imposing a carbon tax on fossil fuels, or on electricity produced from fossil fuels, that is higher than the cost of reducing emissions. Another is to introduce a cap-and-trade emissions trading scheme that establishes limits on emissions from targeted sources and requires each source to hold permits equal to its actual emissions or be fined, while allowing permits to be traded among emitters so that emissions reductions can be achieved where they are cheapest. Here the carbon price – the price of emissions permits – varies according to the pattern of supply and demand created by the size of the emissions cap relative to expected emissions. The strength of the incentive to reduce emissions depends on expected future permit prices being high relative to the cost of reducing emissions.

What distinguishes carbon taxes as such is that they are assessed solely on the basis of carbon emissions. Taxes that are at least in part assessed on other criteria, such as taxes on motor fuel and the British Climate Change Levy, are not included. While taxes on fossil fuel-based energy are also taxes on carbon emissions, the number and complexity of these means that aggregating and comparing them would be difficult if not impossible.

Once established, carbon taxes can be made more effective by broadening the emissions sources covered, raising tax rates, and removing exemptions. Emissions trading can be strengthened by lowering emissions caps and expanding the emissions sources and greenhouse gases covered. Both can be strengthened by widening their geographical coverage.

Carbon taxes and emissions trading can be regarded as good indicators of climate policy because (1) they can potentially account for a substantial proportion of possible policy-induced emissions reductions, and (2) it is reasonable to expect that places with carbon taxes or emissions trading are relatively likely to have implemented other policies to reduce emissions in energy and manufacturing, as well as climate-related taxes and/or market-based instruments in other sectors.

2.2 Feed-in tariffs and quotas for low carbon energy

Although there are numerous ways of encouraging investment in low-carbon energy generation, most commentators favour feed-in tariffs and quota systems. Feed-in tariff schemes oblige electricity suppliers to purchase electricity produced by low-carbon generators at prices designed to be high enough to encourage investment in low-carbon energy. Quota schemes oblige suppliers to source a specified minimum percentage of their electricity from low-carbon generators or face penalties. Some schemes allow suppliers who have sourced more low carbon electricity than required to sell permits for this excess to suppliers who fail to meet their quotas. The general agreement in the literature is that feed-in tariffs are the more effective of the two instruments (Bürer, 2009; European Commission, 2008, p. 8).

Feed-in tariffs and quotas can be applied to renewable energy, nuclear energy, and/or electricity produced by fossil-fuel power stations equipped with carbon capture and storage (CCS). In general the wider the coverage of energy sources, the stronger the policies will be. High feed-in tariff rates relative to the cost of generating low carbon energy are more effective than low rates, as are high quotas that rise steeply over time and stringent fines for non-compliance. The strength of both policies is affected by their geographical coverage.

Feed-in tariffs and quotas can be regarded as good indicators of climate policy more generally because they are effective if well-designed (IPCC 2011, pp.25, 896-905), and imply the existence of other climate policies in the energy sector, and of market-based instruments in other sectors.

2.3 Bans on fossil-fuel power stations without CCS, or emissions standards with equivalent effect

Although phasing out fossil-fuel power stations without CCS might be accomplished solely through carbon pricing and incentives for low-carbon energy generation, the prospects of this happening are poor at present. An alternative is to ban conventional non-CCS fossil-fuel power stations or impose emissions standards that they cannot meet. This could start with an explicit or implicit ban on new coal power stations and progressively broaden in scope to other fossil fuels and to existing power plants until no conventional fossil fuel power stations are operating. Their actual impact on emissions would depend on the nature of existing plans for new fossil fuel power stations and, ultimately, on the size of the existing fossil fuel power sector. One might expect that authorities that use bans or emissions standards in this way are more likely also to have taken other steps to reduce emissions in the energy sector and to have imposed bans and/or emissions standards in other sectors.

2.4 Emissions standards and/or fuel-economy standards for motor vehicles

Global CO_2 emissions from transport grew by 49% between 1990 and 2011, led by emissions from the road sector, and now account for 22% of global CO_2 emissions (IEA, 2013, pp. 11, 16). One approach to halting this trend is to impose or strengthen emissions standards and/or fuel-economy standards for new motor vehicles (placing limits on fuel usage per kilometre also places limits on CO_2 emissions) in order to encourage manufacturers to build more efficient and therefore less polluting cars. The impact on emissions of such standards will depend on how many new cars are sold as well as on the extent to which they are enforced. It is reasonable to believe that authorities which have introduced such standards are relatively likely to implement other policies to reduce transport emissions and to apply emissions standards in other sectors.

2.5 Is that all?

A number of climate policies fail to meet the criteria for inclusion in the Index. Targets and plans of action are excluded because they describe aims rather than constituting policy instruments that act on the world. Voluntary agreements, and information policies such as product labelling, are omitted because experts are divided about their effect on emissions (IPCC, 2014, ch15, pp. 42-44). Public spending on low carbon energy research, development and deployment is excluded because we cannot be sure that such spending will result in emissions reductions. Emissions in some sectors are insignificant compared to other sectors; consequently, policies to reduce emissions from waste are omitted (IPCC, 2014, ch5, p. 34). The provision of financial and technical assistance to developing countries is excluded because by their nature these are policies pursued by donor countries only.

Some policies are omitted because good comparable data are not available. Official documents such as National Communications to the UNFCCC often omit details on policy mechanisms and settings in favour of outlining the aims of policies. They are also often outdated. Information gathered by organisations such as the International Energy Agency (IEA), Climatico and the GLOBE study of climate legislation is often incomplete or lacks relevant details (IEA, 2014; Climatico, 2010; Nachmany et al, 2014). Where information is available, the policies described often vary over so many dimensions that meaningful comparison is impossible. As a result the Index does not include policies relating to emissions reductions in the building, forestry, agriculture or waste sectors.

Table 2 summarises the policies chosen to constitute an index of climate policy strength , along with their potential coverage and settings. Geographical coverage within a polity is a variable that applies to all the policies.

Table 2. A representative index of climate policy strength

The composition of this Index meets almost all the criteria summarised in Table 1. The policies included are widely regarded as effective in reducing emissions and could in principle be applied anywhere. Accurate and up-to-date information is usually available on their existence, coverage and settings. And restricting the index to six policy types means, as we shall see, that the results of measuring their stringency can be understood as a whole without aggregating them into a summary score.

3. RESULTS

In this section the Index is applied to China, the US, the EU, India, Russia and Japan. Together these account for over 70% of global CO_2 emissions: China emits 29%, the US 16%, the EU 11%, India 6%, Russia 5%, and Japan 4% (Olivier et al, 2013, pp. 10-14, 17). The EU is analysed as a single unit because (a) many key elements of climate policy in Europe are adopted as common EU policies and (b) European countries are represented at climate negotiations by the EU. Information is taken mainly from official sources, data-oriented NGOs, and the academic literature.

3.1 Carbon tax

Table 3 shows that so far carbon taxes are limited to Europe and Japan.

Table 3. Carbon taxes

In Europe carbon taxes were pioneered by Finland (1990), Norway (1991), Sweden (1991), and Denmark (1992). There was a setback when one introduced in Italy was abolished in 2002, but progress resumed when carbon taxes were introduced in Ireland (2010) and France (2013). The Carbon Price Floor introduced by the UK in 2013 counts as a carbon tax because it sets a minimum price for carbon. All these taxes cover a range of fossil fuels but often include significant exemptions and discounts. Rates vary markedly between countries and over time, and between fossil fuels within countries (Nachmany et al, 2014, p. 288; World Bank & Ecofys, 2014, pp. 77-83).

The Japanese carbon tax introduced in 2012 covers the use of all fossil fuels apart from certain parts of the agriculture, transport, industry and electricity sectors. Its rate is currently about US$2 per tonne of CO_2 (tCO_2) (Japan Ministry of Environment, 2012, 2012a; World Bank & Ecofys, 2014, pp. 80-81).

The stringency of carbon taxes can be compared by comparing tax rates weighted by the percentage of total emissions covered. These can be calculated for each geographical unit by multiplying the rates listed in Table 3 by the percentage of emissions covered. This reveals a very wide variety of average carbon prices, with Sweden way out in front and Japan bringing up the rear. Once the national rates for EU member states are weighted by each country’s emissions as a percentage of EU emissions, however (EEA, 2014, p. 13), it becomes clear that the effective rates for the EU and Japan are very similar:

1. EU $1.8

   1. Sweden $42
   2. Denmark $14
   3. Ireland $11
   4. Finland $7
   5. UK $4
   6. France $3.5

7. Japan $1.4

The ranking is therefore:

Carbon taxes: EU/Japan

3.2 Emissions trading

In addition to the European Emissions Trading Scheme (EU ETS) there are schemes at subnational level in China, the US and Japan (Table 4).

Table 4. Emissions trading schemes

The EU ETS, which started operations in 2005, applies to installations in power and heat generation, energy-intensive industrial sectors, nitrous oxide production, and aviation. It covers about 45% of the EU's greenhouse gas emissions. Widely fluctuating allowance prices indicate that so far most installations have been able to cover their emissions using only their initial stocks of allowances: in 2013 allowance prices averaged around EUR 4/tCO2 emitted (about $5.60). The scheme was strengthened in 2013 when it was agreed to tackle the problem of too many allowances by holding back from auction 400 million allowances in 2014, 300 million in 2015, and 200 million in 2016 (Europa, 2014; World Bank and Ecofys, 2014, pp. 54-56, 110).

China plans to introduce a national emissions trading scheme later this decade, and launched pilot emissions trading schemes in six key industrial regions in 2013. These apply mainly to energy, industry and buildings (World Bank and Ecofys, 2014, pp. 64-67).

Although in the US Republican opposition has so far thwarted attempts to introduce emissions trading at federal level, by 2013 two subnational schemes had been set up. The Regional Greenhouse Gas Initiative (RGGI) began operation in 2009 and covers emissions in nine states from fossil-fuel fired power plants of 25MW or above. The cap was cut by 45 per cent cut in 2014 in response to the discovery that emissions from RGGI power plants were 27% lower than the cap. California established its own scheme in 2013 (Environment North East, 2011; RGGI, 2014; California EPA, 2012; World Bank and Ecofys, 2014, pp. 57-58).

Although a planned national emissions trading scheme in Japan lapsed in the legislature, mandatory schemes are in place in Tokyo and Saitama (World Bank and Ecofys, 2014, pp. 63-64).

The average carbon prices across all emissions of relevant geographical units (mainly subnational) that are created by emissions trading schemes can be obtained by multiplying the carbon prices given in Table 4 by the percentages of emissions covered. Again this results in a wide range of figures:

1. Tokyo $19
2. California $4.6
3. Beijing $4.5
4. Guangdong $4.2
5. Shenzhen $4.2
6. Tianjin $3.6
7. EU $2.7
8. Shanghai $2.5
9. Hubei $1.4
10. RGGI $0.6

Average carbon prices across total CO_2 emissions in China, the US, the EU, and Japan can be estimated by weighting the above carbon prices by the percentage of total emissions accounted for by the relevant geographical units in the US (2011), the EU and Japan (2010) and, in the absence of relevant emissions data, by the percentages of Chinese GDP accounted for by the relevant provinces (2012) (National Bureau of Statistics of China, 2014; EPA, 2014a; Tokyo Metropolitan Government, 2013; Olivier et al, 2013, p. 16). This reveals that the carbon price attributable to emissions trading is highest in the EU, at $2.70/tCO2, compared with $0.90 for Japan, $0.83 for China, and just $0.34 in the US:

Emissions trading: EU, Japan/China, US.

These figures are very low. The International Energy Agency argues that stabilising greenhouse gas emissions at 450 parts per million would require allowance prices of $50/tCO2 in 2020 and $110/tCO2 in 2030 (Hood 2010, pp. 17-18).

3.3 Feed-in tariffs

Feed-in tariffs are more widely used than either carbon taxes or emissions trading (Table 5).

Table 5. Feed-in tariffs

After a pilot phase from 2003, in 2009 the Chinese government required electricity grid companies to buy all electricity generated by renewable sources and set national feed-in tariff rates for onshore wind with four regional categories varying from EUR 0.052 per kilowatt hour (kWh) to EUR 0.062/kWh ($0.07-0.08/kWh). In 2010 a tariff rate for biomass was set at $0.11/kWh, and in 2011 a rate for solar energy was set at $0.08/kWh (IEA, 2014).

Although there is no federal feed-in tariff scheme in the US, by 2013 mandatory feed-in tariffs had been introduced in six states. The scope of these is generally restricted to certain technologies (mainly solar), payment levels are generally low ($0.10-0.39/kWh for Hawaii, Maine, Oregon and Rhode Island), and coverage is often restricted to power plants below a certain size (REN21, 2014, p. 129; US Department of Energy, 2014; US EIA, 2013a).

In Europe the lack of an EU-level system is compensated for by the extension of national feed-in tariff schemes (including feed-in premiums) from nine member states in 2000 to 22 in 2013. Most cover most if not all renewable technologies, although eligibility for some is restricted to power plants below a certain size or by a cap on the total amount of electricity covered. Tariff rates vary widely by country, technology, plant capacity and other factors but for Eurozone countries generally fall in the range EUR 0.05-0.30/kWh ($0.07-0.41/kWh) (REN21 2014, p. 129; RES Legal, 2014).

National feed-in tariffs for solar, wind, geothermal, small-scale hydro, biomass and biogas were introduced in Japan in 2012. Rates varied between 13.65 and 57.75 yen/kWh ($0.13-0.57/kWh) depending on technology (Japan METI, 2014).

In India feed-in tariffs were introduced first at state level. A national system was introduced in 2006 when the central government required State Electricity Regulatory Commissions to establish preferential tariffs for electricity generated by renewable sources (IEA, 2014). In 2009 the government issued binding guidelines on how feed-in tariff rates should be calculated (CERC, 2009). All renewable technologies are covered. The number of schemes operating in the 28 states rose from zero in 2000 to 18 in 2013. Their scope differs from state to state but generally covers wind, solar, biomass, biogas and small hydro. State rates in 2014 were in the range 1.71-17.96 rupees (approximately $0.03-0.36) depending on factors such as state, technology, and plant size (REN21, 2014, p. 129; IREED, 2014). In 2010 national Power Purchase Tariffs were set at about $0.36/kWh for solar photovoltaic and $0.31 for solar thermal energy for a maximum of 10MW per state and 5MW per developer. Central rates for solar, wind, bagasse, biomass and hydro in 2014 were in the range 2.72-11.88 rupees ($0.05-0.24), depending on technology and plant size (IEA, 2014; Arora et al, 2010, p. 40; ICF, 2012, p. 70, IREED, 2014).

There is no easy way of comparing feed-in tariff rates due to the complexity of many systems and the fact that it isn't nominal rates that matter but rates relative to production costs, for which good comparable data is not available.

The comparison is therefore restricted to coverage of renewable energy technologies, geographical coverage, and nominal tariff rates, so has to be regarded as tentative rather than conclusive. Judging by these critera Japan's scheme is the strongest, as it is Japan-wide, covers a broad range of technologies, and has the highest maximum and minimum tariff rates. Schemes in the EU and India also cover a broad range of technologies but have lower rates and are narrower in geographical scope. For this reason they must be considered roughly equivalent. Feed-in tariffs in China are weaker still because although they cover the entire country, rates are consistently low and only cover a limited range of technologies. American feed-in tariffs are the weakest because although rates tend to be higher than in China, and coverage of renewables is similar, they only exist in six of the 50 states. There is no feed-in tariff in Russia.

Feed-in tariffs: Japan, EU/India, China/US

3.4 Quota schemes

Schemes setting quotas for renewable energy for electricity suppliers exist in the US, Europe, and India (Table 6).

Table 6. Quota systems

Despite the absence of a national-level quota system in the US, state-level schemes have spread from 12 states in 2000 to 29 in 2013. Most cover a fairly broad range of technologies, but quota sizes vary widely (REN21, 2014, p. 82; US Department of Energy, 2014).

Quota schemes are less popular in Europe: by 2013 just six countries were involved (REN21, 2014, p. 130; RES Legal, 2014).

In India, quotas were pioneered by Maharashtra in 2003. A national-level quota system was introduced in 2006 when State Electricity Regulatory Commissions were required to establish quotas for wind, solar and biomass. In 2011 national minimum quotas for solar energy were established and are set to increase gradually from 0.25% in 2012 to 3% by 2022. A further development in 2011 was the introduction of tradable certificates to strengthen incentives and help states meet their quotas (REN, 2014, p. 130; MNRE, 2014; Arora, 2010, p. 25). By 2013 the federal target for Indian states for renewables in general was 8%. Information for 2014 shows that state solar RPOs were in the range 0.1-1.5%, while non-solar RPOs were in the range 0.6-10% (IEA, 2014; IREEED, 2014).

Quotas for wind, solar, hydro, geothermal and biomass were introduced in Japan in 2003 but replaced by feed-in tariffs in 2012 (Japan METI, 2014; IEA, 2014).

The strength of quota policies is difficult to compare due to their complexity and their diversity within polities, but it is possible to make a distinction between the US and India, on the one hand, and the EU on the other. The US and India are considered to be roughly equivalent in that US quota levels are relatively high but apply to only 29 of the 50 states, while coverage in India is national but quota levels are lowrange of renewables covered is similarThe much narrower geographical coverage of quota systems in Europe means that the EU is behind on this policy.

Quotas: US/India, EU

3.5 Effective bans on fossil fuel power stations

The only effective bans on fossil fuel-fired power stations in 2013 related almost exclusively to new coal-fired power stations (Table 7).

Table 7. Bans on fossil fuel-fired power stations or emissions standards with equivalent effect

By 2013 emissions performance standards (EPCs) for coal-fired power stations stringent enough to preclude the operation of new coal power plants without CCS were in place in five American states. The standards for California, Oregon and Washington were set at 1,100 pounds of CO2 per megawatt hour (lb/MWh), and 925 lb/MWh for New York. Montana requires that new plants capture and store at least 50% of their emissions (C2ES, 2014; Rubin, 2009, p. 8). Similar standards were planned at federal level but were not yet in operation (EPA, 2014).

An EPC for new coal-fired power stations of 450g/kWh (992 lb/MWh) was introduced in the UK in 2013 (DECC, 2014).

Also in 2013 China banned the approval of new coal-fired power stations in three major industrial regions, having begun to close down small inefficient thermal power stations in 2008 (State Council, 2013; Yang and Cui 2013; ICF, 2012, pp. 48-49).

All these measures focus exclusively on new coal-fired power stations apart from the Chinese programme of closing down small thermal power stations. However the shares of GDP covered are rather different: 15% for the EU, 25% for the US, and 43% for China (Eurostat, 2014; US Department of Commerce, 2014; National Bureau of Statistics of China, 2014). These are big differences even though the Chinese figure is inflated by the fact that the relevant regions do not cover all of the provinces in which they are located and for which GDP figures have been collected.

Effective bans on fossil fuel-fired power plants: China, US, EU

3.6 Emissions standards for road passenger vehicles

Fuel economy standards were introduced in the US in the wake of the 1973 oil crisis (Table 8). In 2010 it was announced that they would be merged with new carbon emissions standards. Japan's fuel efficiency standards also have a long history. The EU started with voluntary standards agreed with vehicle manufacturers before moving to a mandatory system in 2009 when manufacturers failed to achieve these targets. In China fuel economy standards were introduced in 2005 (An Feng, 2011, pp. 5-10; Dieselnet, 2009; ICCT, 2012, 2014a).

Table 8. Passenger vehicle emissions standards (gCO2/km)

As small differences between emissions standards are unlikely to be significant in terms of emissions, the most meaningful distinction is between the relatively stringent standards of the EU and Japan and the less stringent standards of China and the US:

Passenger vehicle emissions standards: EU/Japan; China/US

4. CONCLUSIONS

The 2013 rankings on the six policies that comprise the Strong Climate Policy Index are summarised below:

Carbon taxes:	EU/Japan
Emissions trading:	EU; Japan/China; US.
Feed-in tariffs:	Japan; EU/India; China; US
Quotas:	US/India; EU
Fossil fuel power plant bans:	China; US; EU
Vehicle emissions standards:	EU/Japan; China/US

An idea of the pressure exerted by carbon pricing on firms to reduce their emissions can be obtained by combining the carbon prices created by carbon taxes and emissions trading. This reveals that the EU has the highest carbon price followed by Japan, the US and China. (Table 9).

Table 9. Carbon price signal strength

Indirect support for the feed-in tariff and quota rankings comes from the fact that the places with the longest records of these policies, the EU and US, have the highest proportions of renewable energy technologies that rely especially heavily on state support to expand (Table 10).

Table 10. Renewable energy

The main finding is that, contrary to expectations, Europe is not the clear frontrunner on climate policy stringency: the EU does lead on a number of policies but so does Japan. China, the US, and India each lead on one area. Russia doesn't do anything.

What then is the overall ranking on climate policy? The temptation to produce one is almost overwhelming but has to be resisted because there is no way of combining the six rankings without making arbitrary judgments on the relative importance of each type of climate policy. It is this set of six rankings itself – the Strong Climate Policy Index - that is the most meaningful summary indicator of the relative strength of climate policies. While in common with previous indices there are question marks over how representative the policies chosen for the Index are of climate policy in general, unlike these other indices the Strong Climate Policy Index does not import further sources of error in the form of largely arbitrary numerical scorings and weightings. And the result of applying the Index is a mixed picture: we must abandon any idea of clear European or Western leadership. Only Russia lags.

We also find that although there is a marked trend towards stronger policies in all areas as time goes on, climate policies everywhere remain weak compared to the potential settings listed in Table 2. Emissions trading caps are high, for instance, and the reach of feed-in tariffs and quotas is often restricted.

One important caveat is that the rankings do not take account of the extent to which the policies concerned are implemented as intended, as the information needed to assess this is too patchy. It is also important to stress the need for frequent updating of the Index. If the planned national emissions trading scheme is implemented in China, for example, the rankings will change.

The few systematic international comparisons of climate policy strength made so far have serious weaknesses. The Strong Climate Policy Index is designed to avoid these by producing a set of rankings of emitters on key policy types. The policy significance of this is that it enables climate policy strength to be assessed and compared more realistically across space and time. As such its availability should facilitate international negotiations (1) by giving participants a better idea of where each emitter stands relative to the others as far as climate policy stringency is concerned and (2) by clearly identifying policy types on which each emitter is relatively weak.

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Table 1. Objectives

Criterion	Details
Aim	To construct an index of climate policy strength that has high validity and is easy to use to assess and compare climate policy strength around the world, defined as the logical potential of the statutory provisions of climate policies to restrict greenhouse gas emissions, other things being equal.
Validity	Index should be representative of the strength in any given geographical unit of climate policies as a whole. Component indicators to consist of policies that: Are relevant to all countries examined; Experts agree are effective in reducing emissions significantly when implemented with strong settings; Taken together cover most if not all major emitting sectors; Taken together include most if not all effective policy instruments.
Ease of use	Fewer than ten policies in order for the resulting profiles to be easily comprehensible, thereby avoiding the need to aggregate numerical scores; not too time-consuming to apply; Composed of policies on which accurate up-to-date information is available for the geographical units covered.

Table 2. A representative index of climate policy strength

Policy instrument	Potential coverage of emissions sources	Strong settings
Emissions trading	All or almost all energy generation and industry, plus air and sea transport	Large annual reductions in emissions cap
Carbon tax	All or almost all energy generation, industry, transport	High rate, no exemptions
Feed-in tariffs	Renewables, nuclear, CCS; few if any restrictions	High tariff level relative to costs
Low carbon energy quota schemes	Renewables, nuclear, CCS; few if any restrictions	High quotas/large annual increases in quota size
Ban on fossil fuel-fired power plants without CCS, or standards with equivalent effect	Coal, gas, oil	Ban or emissions standards that fossil fuel power plants without CCS cannot meet
Emissions and/or fuel economy standards for motor vehicles	All motor vehicles	Low grammes of CO2 per kilometre

Table 3. Carbon taxes

	2000	2005	2010	2013
China	-	-	-	-
US	-	-	-	-
EU	Denmark , Finland, Italy, Sweden	Denmark , Finland, Sweden	Denmark , Finland, Ireland, Sweden	Denmark ($31/tCO2, 45% of emissions), Finland ($48, 15%), France ($10, 35%), Ireland ($28, 40%), Sweden ($168, 25%), UK ($16, 25%)
India	-	-	-	-
Russia	-	-	-	-
Japan	-	-	-	National ($2/tCO2, 70% of emissions)

tCO2 = tonne of CO2 emitted. US dollars. Some rates relate to early 2014.

Source: World Bank and Ecofys, 2014, pp. 32, 51-52.

Table 4. Emissions trading schemes

	2000	2005	2010	2013
China	-	-	-	Beijing ($9/tCO2, 50% of emissions), Shanghai ($5, 50%), Tianjin ($6, 60%), Guangdong ($10, 42%), Hubei ($4, 35%), Shenzhen ($11, 38%).
US	-	-	RGGI: 10 states: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont; energy only, undemanding caps	RGGI 9 states (New Jersey left in 2011); energy only ($3/tCO2, covers 20% of emissions) California ($13/tCO2, 35%)
EU	-	EU ETS: energy and industry, undemanding caps	EU ETS: energy and industry, undemanding caps	EU ETS ($6/tCO2, 45% of emissions); energy, industry, aviation
India	-	-	-	-
Russia	-	-	-	-
Japan	-	-	Tokyo	Tokyo, buildings ($76-95/tCO2, 20% of emissions), Saitama, buildings (price not available, 16% of emissions)

tCO2 = tonne of CO2 emitted. US dollars. Some prices relate to early 2014.

Source: World Bank and Ecofys, 2014, pp. 32, 51-52.

Table 5. Feed-in tariffs

	2000	2005	2010	2013
China	-	Pilot schemes, some provinces	National feed-in tariffs for wind and biomass	National feed-in tariffs for wind, biomass and solar
US	-	-	California, Hawaii, Maine, Oregon, Vermont; limited scope	California, Hawaii, Maine, Oregon, Vermont, Rhode Island; some renewables, caps on coverage
EU	9 member states, most renewables	18 member states, most renewables	20 member states, most renewables	22 member states, national coverage: wind (22 member states, 4 caps), solar (18, 11), hydro including wave and tidal (20, 8, patchy coverage), geothermal (14, 3), biomass (21, 7), biogas (22, 7)
India	-	6 states, most renewables	Mandatory for states, in place 14 states, most renewables; national solar feed-in tariff	Mandatory for states, in place 18 states, all renewables; national solar feed-in tariff
Russia	-	-	-	-
Japan	-	-	-	National feed-in tariffs covering wind, solar, small hydro, geothermal, biomass and biogas

Sources: see text. 2013: REN21, 2014, p. 82; RES Legal, 2014; US Department of Energy, 2013; Japan METI, 2014; IEA, 2014 (India); IREEED, 2014.

See also REN21, 2014, p. 129.

Table 6. Quota systems

	2000	2005	2010	2013
China	-	-	-	-
US	12 states, most renewables	20 states, most renewables	31 states, most renewables	29 states + Washington DC; most renewables; quotas by target year: 2015: Montana 15%, Wisconsin 10%, Michigan 10%, New York 29%, Texas 5,880MW; 2017: Maine 40% 2020: Washington 15%, California 33%, Colorado 30%, Kansas 20%, New Mexico 20%, Massachusetts 22.1%, Rhode Island 16%, Connecticut 27%, Washington DC 20% 2021: Missouri 15%, North Carolina 12.5%, Pennsylvania 18%, New Jersey 20.38% 2022: Maryland 20% 2024: Ohio 12.5% 2025: Minnesota 25%, Illinois 25%, New Hampshire 24.8%, Oregon 25%, Nevada 25%, Arizona 15% 2026: Delaware 25% 2030: Hawaii 40% No date: Iowa 105MW
EU	Italy only, most renewables	5 countries, most renewables	6 countries, most renewables	6 countries, all renewables: Belgium (various quota sizes), Italy (7.55%), Poland (12%), Romania (14%), Sweden (0.135/MWh), UK (0.206 certificates/MWh)
India	-	6 states, most renewables	National, most renewables, implemented by 18 states; actual quotas vary by state	National (8%), most renewables; actual quotas vary by state
Russia	-	-	-	-
Japan	-	National, most renewables	National, most renewables	(replaced by feed-in tariff 2012)

Sources: see text. 2013: US Department of Energy, 2014; RES Legal, 2014; IEA, 2014 (India); IREEED, 2014.

Table 7. Bans on fossil fuel-fired power stations or emissions standards with equivalent effect

	2000	2005	2010	2013
China	-	-	-	Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta
US	Oregon	Oregon	California, Montana, Oregon, Washington	California, Montana, New York, Oregon, Washington
EU	-	-	-	UK
India	-	-	-	-
Russia	-	-	-	-
Japan	-	-	-	-

Sources: State Council, 2013; C2ES, 2014; DECC, 2014

Table 8. Passenger vehicle emissions standards (gCO2/km)

	2000	2005	2010	2013
China	-	213	180	161 (2015)
US	226	215	190	171 (2016)
EU	(172, voluntary)	(161, voluntary)	(140, voluntary)	130 (2015)
India	-	-	-	-
Russia	-	-	-	-
Japan	169	153	128	125 (2015)

Sources: see text. 2013: ICCT, 2014a, 2014b; Transport.net, 2014.

Table 9. Carbon price signal strength

Emitter	Carbon price ($US)	Emissions ($MtCO_2e$) 2011	Percent coverage of national emissions	Emissions covered ($MtCO_2$)	Strength index (price times percent coverage)
China	3.26	9,700	7.2	700.0	0.23
US	10.15	5,420	10.8	588.1	1.10
California	*14.00*			*450.9*	
RGGI	*3.40*			*137.2*	
EU	5.94	3,790	50.0	1895.0	2.97
Japan	2.89	1,240	90.0	1,116.0	2.60
India	-	1,970	-	-	-
Russia	-	1,830	-	-	-

CO2 emissions: EDGAR 2014.

Carbon price: China: estimated rate of 20 yuan for combined emissions trading and carbon tax 2016 (Jotzo *et al.*, 2013, p. 17). US: aggregate of California and RGGI. US rate is weighted price by emissions price and coverage for the two schemes (Point Carbon, 2013, p. 2). EU: European Carbon Exchange in Tindale, 2012, p. 2. Japan: Japan Ministry of Environment, 2012, 2012a; ACC, 2012.

Coverage: IETA 2013; California EPA ARB, 2014, p.2; Environment North East, 2011, p.1; IETA, 2014, p. 2; Lee et al, 2012, p.2.

EU strength index relates to emissions trading only.

Table 10. Renewable energy

Emitter	Wind + biomass/waste + solar		All renewable technologies	
	Terawatt hours	% total energy	Terawatt hours	% total energy
China	110	2.47	797	17.88
US	178	3.15	520	9.20
EU	296	5.37	699	12.70
Japan	31	2.53	116	9.41
India	31	2.79	162	14.58
Russia	3	0.30	166	17.83

Sources: European Commission, 2012 for EU, otherwise US EIA, 2013. Figures are for 2011 apart from EU and Russia, for which they are for 2010.