Reframing Climate and Competitiveness: Is there a Need for Cooperation on National Climate Change Policies?

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EXECUTIVE SUMMARY AND ISSUES FOR DISCUSSION

In response to the threat of climate change, countries have begun putting in place national policies to curb their greenhouse gas emissions. These policies will need to be scaled up significantly if the increase in global average temperature is to be limited to 2°C.

National climate policy efforts are taking place in a global economy increasingly integrated via flows of goods, capital, ideas and people. Technologies that contribute to the reduction of greenhouse gases are also increasingly globalised. This interconnectedness means that national climate policies have international spill-overs, some of which are positive, for instance when investments in low-carbon technologies in a region deliver cost reductions from which other countries benefit. However, it is also important to underscore that spill-overs sometimes risk undermining not just the efficiency, but also indeed the effectiveness of national climate policies.

The international spill-overs of national policies point to three coordination issues, all three critical for the global transition to a low-carbon economy:

- **Incoherent market signals**. Shared policy and market expectations could be an important tool to drive strategic decision-making in globalised sectors. There are, however, examples of deployment policies for low-carbon technologies that suffered greatly from unexpected international market responses (*e.g.* photovoltaic panels), resulting in unhelpful trade frictions and less robust incentives for firms operating in this global sector.

- **Effectiveness of carbon constraints**. Fragmented policies create concerns for policymakers and firms about trade distortions and 'emissions leakage' in energy intensive, trade exposed sectors. The 'protective' measures adopted in response to these concerns hamper the effectiveness of the constraints placed on carbon emissions in these important sectors.

- **Effectiveness of public-private R&D in breakthrough technologies**. Much R&D effort is required to develop and demonstrate the breakthrough technologies needed for a deep decarbonisation of our economies in this century. International support for public-private R&D efforts could achieve progress in this area, at lower cost, with many positive externalities. There have been relatively few international policy efforts in this regard to date.

These issues make a case for the potential usefulness of international collaboration on domestic climate policy efforts, and raise the question of what kinds of collaboration would be most fruitful.

The United Nations Framework Convention on Climate Change (UNFCCC) provides the framework for state action on mitigation at an aggregate level (*i.e*. nationally-determined contributions). The Paris agreement on emissions after 2020 will be crucial in aligning broad expectations among policymakers and the private sector on the future direction of climate policy. Although the UNFCCC Parties have not been favourable to discussions of coordinated action on domestic policies, the UNFCCC could still facilitate the sharing of information on how countries progress in the implementation of their policy instruments, which may spur separate, more structured discussions on policy cooperation. Parallel supporting action in bilateral and multilateral settings, such as the recent US-China agreement, will be important in making progress.

A number of international initiatives have sprung up in recent years, maybe in part as a response to the above mentioned spill-overs. These initiatives often aim at enhancing dialogue, transparency and learning on national sectoral policies. Examples of deeper policy cooperation are rare. There is a continuum of collaborative activities that domestic policymakers and private sector stakeholders could undertake, from increased transparency on domestic actions, to coordinated adoption of different nationally-determined policies or standards, to fully coordinated policy efforts in specific areas.

Round Table participants are asked to consider the following questions:

1. How serious are the international spill-overs in the markets affected by domestic climate policies? What practical concerns do they raise among policymakers and private sector stakeholders?

2. In what policy areas or sectors could transparency and potentially cooperation be most beneficial?

3. What would be the general conditions for a fruitful public-private effort in R&D on breakthrough low-carbon technologies?

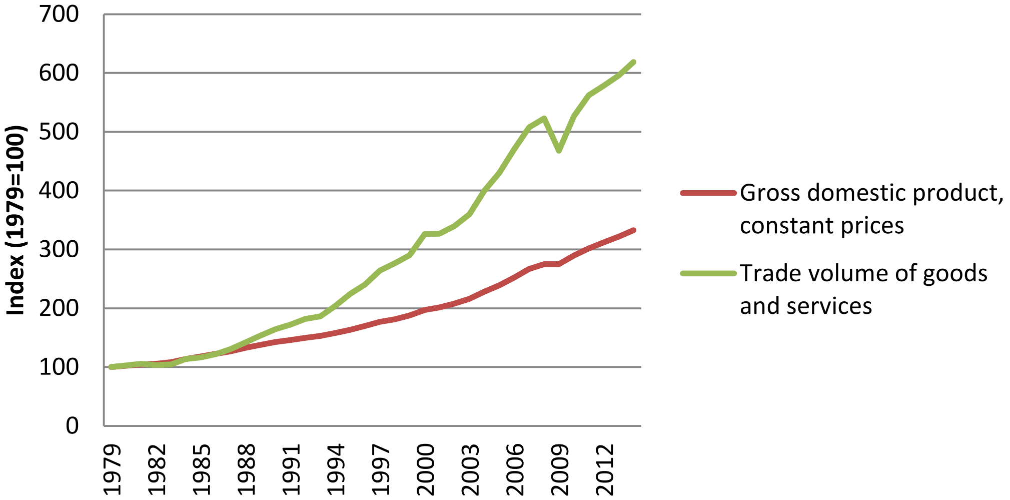
4. An effective response to climate change will come through policy-driven markets, with an essential role for the private sector. How to structure possible discussions between policymakers and the private sector internationally?

INTRODUCTION

1. Countries have agreed to negotiate a new climate agreement under the United Nations Framework Convention on Climate Change (UNFCCC) by 2015. Many countries are also putting in place ever more significant national policy frameworks to reduce greenhouse-gas (GHG) emissions, as evidenced by recent announcements by the United States, China and the European Union (Climate Action Tracker, 2014). These often aim at pricing greenhouse gas (GHG) emissions and driving the innovation and market deployment of new low-carbon technologies in both production and consumption activities.

2. These domestic policies do not exist within an international vacuum: the world's economy is more interconnected than ever before. Over the last two decades, growth in the cross-border exchange of goods, capital and ideas has been extremely rapid (Figure 1). In 1960 the trade share of GDP in an average OECD country was 12.5%; by 2010 it had doubled to 25%. This evolution has been even faster in a number of developing countries, such as China, whose trade share of GDP rose from virtually zero in 1978 to 24% in 2010 (OECD, 2012).

Figure 1. Evolution of world real GDP and the volume of trade in goods and services since 1979



Source: Authors, IMF data.

3. Low carbon technologies are also increasingly globalised, particularly in terms of manufacturing and market deployment (OECD, 2013). These technologies are often composed of thousands of sub-components[1] and draw on technologies from a range of scientific fields and economic sectors (OECD, 2013). Thus, low-carbon technologies will inevitably be built upon global value chains as much as any

[1] The average wind turbine is composed of around 8 000 separately produced components (US Congressional Research Service, 2012).

other complex manufactured product. Indeed, it is important that they are, if they are to be competitively priced for consumers and thus effectively diffused globally.

4. The globalisation of low-carbon technologies also poses a number of challenges. Markets for these technologies are shaped by national policies and support schemes which will have to increase in stringency if low-carbon technologies are to be successfully scaled-up in the coming years. At the same time, uncoordinated national support policies risk creating fragmented global markets – raising transaction costs, risking rent seeking from the most generous national support schemes, and potentially creating boom-and-bust cycles through unstable or contradictory policies in different parts of the global market.

5. A recent example is the evolution of the solar photovoltaic (PV) market. As a result of generous subsidies in Europe and support for manufacturing capacity in China, the European market was flooded with Chinese solar panels that out-competed European manufacturers. Although this competition led to important cost reductions – good news for climate mitigation – it also led to a retrenchment of European support schemes and a collapse of the international market, which threatened Chinese manufacturers (see Section 1.1.1 for more detail). In hindsight, this was an unhelpful combination of poorly designed policy instruments and unrealistic market expectations.

6. The low-carbon transition will require the emergence of many markets, created by a multitude of domestic policies that may have regional or even global dimensions, as the PV example illustrates. The absence of a shared vision of what these policies aim to achieve may create ongoing disruptive turbulences in these markets.

7. Policymakers are also concerned about the impacts of domestic climate policy on the competitiveness of certain energy-intensive, trade-exposed (EITE) industries. The risk that the policy-driven costs of energy may lead firms to offshore the most energy- or carbon-intensive parts of their value chains has been a preoccupation of policymakers since the beginning of the UNFCCC process. From a domestic policy perspective, arguments that industry will lose international competitiveness and that emissions and jobs will 'leak' overseas have proved to be a major stumbling block to implementing and reinforcing policies to reduce emissions in these sectors (Sartor *et al*., 2013). Interestingly, this line of argument, first stated in Europe, the US, Japan and Australia, is now part of the industry discourse on climate policy in emerging economies as well.

8. Driving the decarbonisation of global value chains is therefore particularly challenging in the context of a largely bottom-up, nationally-driven approach to climate policy. Among others, the following questions present themselves:

- How can a range of national technology deployment policies be coordinated to send coherent and dynamic signals to the private sector in a way that supports a smooth scaling up of manufacturing capacity and investment in innovation?

- How can countries seek to capture the benefits of new activities that contribute to low-emissions growth, while ensuring their effective global diffusion?

- What policies can create confidence in strong collective action within a bottom-up framework so that policymakers feel more confident in increasing the stringency of national policies in EITE sectors?

- How can the transparency of and cooperation on of these national policies be increased? Should the public and private sectors join forces internationally to generate the breakthrough technologies that are crucial for the low-carbon transition?

9. A new global agreement under the UNFCCC is a cornerstone of the global climate governance regime and a key enabler of domestic policy. By itself, however, the UNFCCC may not be able to facilitate greater transparency and cooperation of sector-specific policies. This is further discussed in Section 2.1.

10. This paper aims to address three questions:

1. What challenges are raised by the decarbonisation of global value chains, beyond the basic collective action challenge of climate change as a global externality?

2. Do these challenges imply a need for greater sector-specific policy transparency and cooperation?

3. Does the current international climate policy regime, broadly conceived, contain the institutions necessary to provide for this transparency and cooperation?

The purpose of developing answers to these questions would be, in turn, to provide for more effective national policies from the perspective of the public and private sectors.

11. One further point should be clarified concerning the terminology used in this paper. Conceptually, we can consider the following degrees of cooperation on national climate policies:

- **Non-cooperation**: in this framework, countries implement bottom-up, nationally-determined policies to implement their emissions objectives, without regard for the international spill-overs of national policies. In a worst-case scenario, this could amount to 'free-riding' in sectoral policies.

- **Transparency**: countries share information, lessons learned and future intentions concerning their national climate policies to enable a degree of *ad hoc* convergence of expectations, policy design and stringency.

- **Cooperation**: countries' nationally-determined policies are implemented with a degree of international cooperation, *i.e*. towards broadly defined common objectives.

- **Coordination**: countries' policies are defined with a high degree of coordination, *e.g*. with common standards etc.

12. This paper concentrates mainly on the potential for transparency and cooperation, *i.e.* the second and third bullet points above.

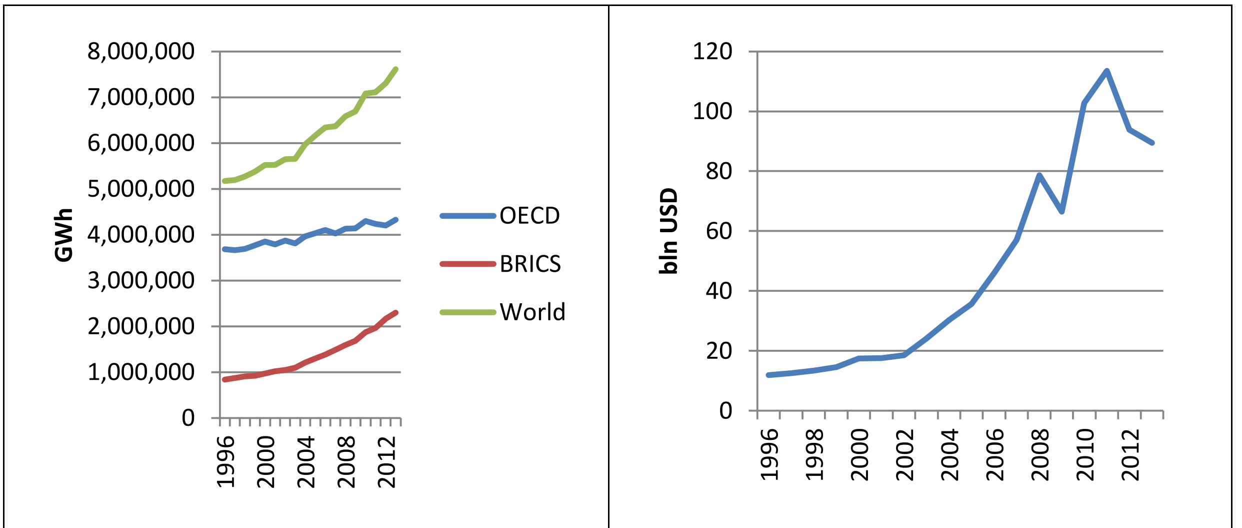
1. CLIMATE POLICY IN THE CONTEXT OF GLOBALISATION

13. Domestic climate policy, to be effective, will have to re-direct investment, technology choices and behaviours towards low-GHG options. The resulting domestic policy-driven markets will have international spill-overs. In turn, these spill-overs may point to benefits from various forms of cooperation on national policies. It is important to underscore that such spill-overs risk undermining not just the efficiency (*i.e.* cost), but also indeed the effectiveness (*i.e*. ambition) of national policies.

1.1 Market Deployment of Low Carbon Technologies: are more transparent market signals needed?

14. The manufacturing and deployment of low-carbon technologies has grown dramatically over the past decade. To give one indication, between 1996 and 2013 the global production of CO_2-free electricity[2] grew by 47% (Table 2). The production of renewable electricity grew by 86% in the same timeframe. The growth in the deployment of low carbon technologies has been driven by national policies and resulting improvements in their competitiveness. These policies have multiple objectives including health benefits, energy security, and reducing GHGs. One additional objective revolves around promoting technology learning and reducing costs, another around developing national innovation and manufacturing capabilities in emerging low-carbon activities. A corollary of these policies has been a dramatic growth in the trade of climate-related manufactured goods. Between 1996 and 2013, global exports of selected climate-related goods grew more than six-fold (Figure 2).

Figure 2. Global deployment of renewable electricity (left) and trade in climate-related manufactured goods, 1996-2013 (right)



Source: authors based on Enerdata.

Source: authors based on COMTRADE.

2 Nuclear and renewable electricity.

15. The importance of global flows of low-carbon technologies, knowledge and investment is also illustrated by Table 1, which highlights three important channels for the transfer of low-carbon technologies to large emerging economies in 2011:

- *Patent inward flows*: this indicator represents the import of low-carbon technologies via patenting. It measures a country's 'imports' of foreign low-carbon patents as a share of global low-carbon patent 'imports'. For example, foreign low-carbon patents registered in China as a share of global low-carbon patents registered outside their country of origin was 15.5.%. The figure in parentheses represents a country's foreign patents for all technologies as a share of global patents registered outside their country of origin.

- *Import of low-carbon equipment*: the indicator represents the physical import of low-carbon goods. It measures a country's imported low-carbon goods as a share of global imports of low-carbon goods. The figure in parenthesis represents a country's imports of all goods as a share of global imports of all goods.

- *Inward FDI links*: this indicator represents the import of low-carbon technologies via foreign direct investment (FDI). It measures the number of transactions of FDI flowing into a country from companies with at least one low-carbon patent as a share of total global FDI inflows from companies owning at least one low-carbon patent. Due to data constraints it represents thus the number of FDI links rather than the investment volume in monetary terms.

16. In general, these figures show that low-carbon technology transfers are occurring more or less in line with the share of a country in the world economy, with the exception of India and Brazil. Thus, while the figures appear low in absolute terms, they are actually quite large and important to global efforts to decarbonise large emerging economies.

Table 1. Low carbon patent inflows, imports of capital goods, and foreign direct investments, in selected emerging economies as a share of the world total

Country	Patent inward flows [a]	Import of low-carbon equipment [b]	Inward FDI links [c]	Economy size (2009 GDP)
China	15.5% (12.2%)	8.3% (15.3%)	7.1%	11.1%
Mexico	2.2% (1.6%)	1.7% (3.0%)	2.5%	2.2%
Russia	1.3% (0.9%)	1.4% (1.8%)	2.2%	3.3%
South Africa	1.2% (0.8%)	0.4% (0.6%)	0.9%	0.7%
India	n.a. (n.a.)	1.5% (1.5%)	1.6%	4.9%
Brazil	0.7% (0.5%)	0.7% (1.1%)	2.5%	2.9%

Source: Glachant *et al.* (2013), based on PATSTAT, COMTRADE and ORBIS data.

Notes: Results for all technologies and equipment good appears in parentheses. [a] Average of patent flows covering 23 technology classes except agriculture and forestry (2007-2009). [b] Average of low-carbon equipment from 18 products/sectors: hydro, wind, solar photovoltaic and thermal, nuclear, energy storage, electric and hybrid vehicles, rail locomotives, cement, insulation, lighting, economizers, super-heaters, soot removers, gas recoverers (2007-2009). [c] Count of capital links between a source company owning at least one low-carbon patent and a foreign company in 2011.

17. Table 1 illustrates the emergence of significant policy-driven markets for low-carbon technologies. If climate change is to be adequately mitigated, these markets will have to scale up dramatically and broaden to encompass a large group of different technologies.

1.1.1 Fragmented policies and markets

18. Firms whose products are exported internationally face different national policies. For them, strategic incentives to innovate and deploy new technologies depend importantly on the direction of the sector as a whole at the global level. Gallagher (2014), in her recent comprehensive study of the globalisation of low-carbon technologies in China, notes:

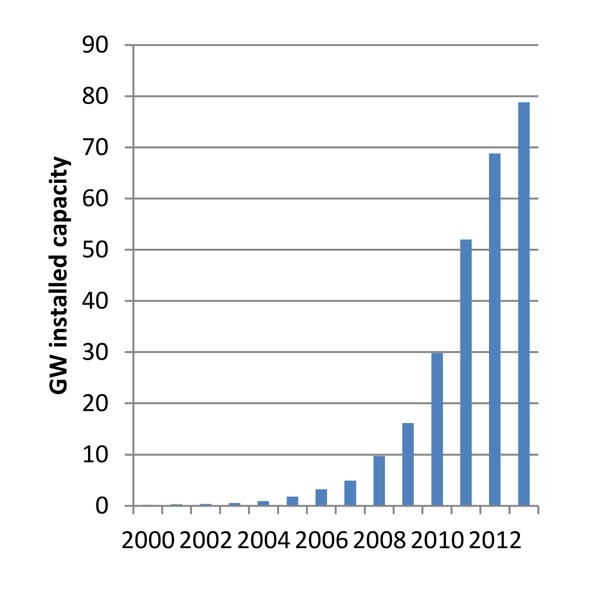
> "…*there is little coordination among countries on these [low-emissions] policies and few attempts at formal harmonization. The global policy landscape is thus a mosaic of many different types of policies that cumulatively affect the global marketplace for clean energy. The heterogeneity in the policies has created a somewhat haphazard global market for producers, but it has also allowed for considerable policy experimentation as well."* (Gallagher, 2014)

19. While this "haphazard global market" may allow for experimentation, it risks creating unnecessary, costly barriers to standardisation, trade and economies of scale. Perhaps more importantly, it could lead to market fragmentation and instability. At its worst, it may lead to a boom-and-bust cycle of unstable or conflicting policy signals in different markets.

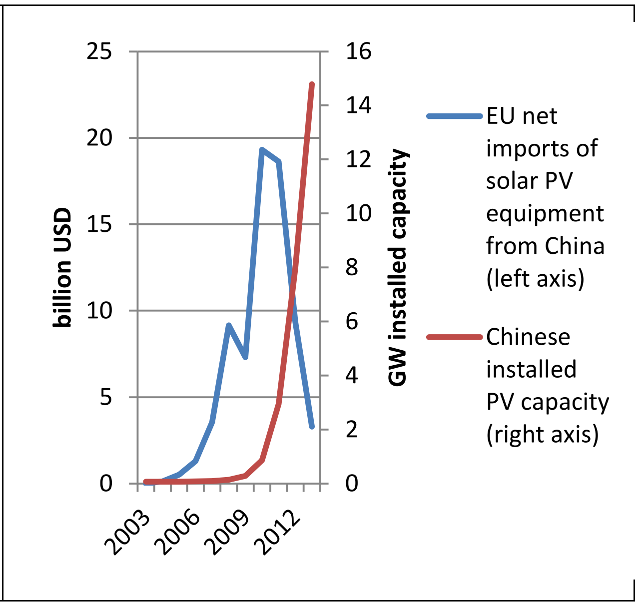
20. The case of solar PV is an interesting example. Since the mid-2000s Europe has implemented significant market-pull policies for solar PV such as feed-in tariffs or quota systems for low-carbon electricity. These are shown in Annex 1. Meanwhile, China started to put in place significant policies to support solar PV manufacturing capacity. These are shown in Annex 2.

21. As a result, EU installed capacity of solar PV grew quickly from 0.19 GW in 2000 to 79 GW in 2013 (Figure 3). At the same time, EU imports of solar panels from China exploded from USD 1.77 million in 1996 to a peak of USD 19.3 billion in 2010 before a significant drop off in 2012 and 2013 (Figure 4). As EU policymakers scaled back support and the EU market shrank, China progressively implemented more attractive incentive policies for domestic installation of PV capacity. For example, in 2013 the Chinese State Council increased the 12th Five-Year Plan target for solar PV from 5 to 35 GW by 2015. This resulted in rapid growth of Chinese installed capacity (Figure 4). China's Energy Development Strategy Action Plan (2014-2020), released in November 2014, sets a target of 100 GW of solar PV by 2020 (State Council, 2014). This did not prevent, however, significant and still ongoing turmoil and consolidation amongst Chinese solar PV manufacturers, including the bond default and eventual delisting of Suntech – once the world's largest solar PV manufacturer – from the NY Stock Exchange in 2012.

Figure 3. Solar PV installed capacity in EU	**Figure 4. Net imports of PV in EU and PV installed capacity in China**



Source: authors based on Enerdata.



Source: authors based on Enerdata and COMTRADE.

22. The EU-China PV story is certainly an extreme example of the potential risks posed to consumers and producers of low-carbon goods by uncoordinated national policies. The extent to which this could be repeated in other technologies is a matter for debate. Solar PV is a highly tradable, commoditised product, in comparison with other less tradable renewable energy technologies, for example (Huberty and Zachmann, 2011). Nonetheless, there may be some lessons that can be learned from the experience with PV.

1.1.2 The fine balance between domestic-oriented policies and gains from international trade

23. The kind of “Schumpeterian” cycle experienced by PV may eventually promote competition, consolidation and innovation. Likewise, technology cost reductions arising from broader markets through trade can be important for improving the cost competitiveness of clean energy technologies. Between 2008 and 2012, solar PV module costs fell by 80% (JRC, 2013). However, boom-and-bust cycles may also create a number of difficulties. First, such cycles put significant pressure on manufacturing industry. Second, unexpected or undesired outcomes (such as market flooding by foreign imports or the collapse of foreign export markets) can also undermine the support and stability of domestic policies. Third, this can and has led to trade frictions around dumping or asymmetrical policy incentives in different markets (Sugathan, 2013, Annex 1). Generally speaking, policymakers are accustomed to facing boom-and-bust cycles that result from market forces, but are unlikely to accept those that result from misaligned policies.

24. An important motivation for market deployment policies is to capture the private benefits of the creation of low-carbon activities, including innovation and the development of new industries. This motivation can be undermined if the expected private benefits evaporate as a result of international trade competition. It is important to note, however, that international trade in low-carbon technologies is the outcome of both ‘natural’ competitive advantage and the balance of push-pull policies between different

markets. Moreover, international trade can be an important contributor to reducing the cost to consumers of low-carbon technologies. There is a fine balance between maintaining incentives for national policymakers to implement deployment policies and reaping the benefits of international trade.

1.1.3 The risk of multiple standards

25. Apart from the highly visible example provided by solar PV, there are other potential negative consequences to the predominantly bottom-up development of market deployment policies for low-emissions technologies. As noted by Grübler *et al.* (2012), "shared or collective expectations are an important means of reducing uncertainty and stimulating entrepreneurial activity", thus stimulating innovation. Fragmented global markets could thus potentially act as a brake on innovation efforts in low-emissions technologies. In addition, divergent standards or policies may raise transaction costs, restrict the benefits of economies of scale and raise the costs of compliance to industry and of policy-making to national authorities.

26. Perhaps the clearest example of this risk relates to the emergence of multiple standards for fast-charging infrastructure for electric vehicles. Three standards are currently in operation: 1) the SEA-Combo standard developed by a coalition of US and German manufacturers; 2) the CHAdeMO developed by Japanese manufacturers; and 3) Tesla Motors' Supercharger. A more prosaic example relates to refrigerators, highly traded products subject to energy efficiency standards in 60 different countries using at least ten different test methodologies to assess performance against them (Ellis and Rozite, 2013). As noted by the International Standards Organisation, "International Standards can also be the vehicle for the dissemination of innovative technologies, particularly for alternative and renewable sources, by reducing time to market, creating global interest and developing a critical mass of support to ensure the economic success of such technologies." (ISO, 2008) International standard-setting bodies such as the ISO and the International Electrical Commission (IEC) have begun to be more active in the area of climate-related performance of energy-using equipment. This policy challenge is further discussed in Box 1, taking the G20 Energy Efficiency Action Plan as an example.

Box 1. The G20 Energy Efficiency Action Plan

In 2014, the G20 developed and adopted a voluntary collaboration on energy efficiency: the Energy Efficiency Action Plan. In a number of respects, this could be an interesting case study of approaches to the challenge of coordination of national policies, particularly with regard to internationally-traded products. This being said, having just been adopted in November 2014, it remains to be seen how this initiative will be implemented. Importantly, the Action Plan was given high-level political endorsement by heads of state in their communiqué (G20, 2014, §18).

The central deliverable for the Action Plan is the promotion of more stringent domestic vehicle efficiency standards, particularly for heavy duty vehicles hitherto unregulated in the majority of G20 countries. Heavy duty vehicles could provide significant fuel and emissions savings: according to the IEA, trucks are responsible for 40% of incremental demand for oil (in a business-as-usual scenario) but fuel efficiency in trucks could be improved by 30 to 50% (IEA, 2012, p. 91). The Action Plan notes that such standards will be applied domestically, but underscores that "… international work can accelerate technical development of standards and testing regimes and facilitate voluntary harmonisation. Harmonisation of national standards helps reduce development costs for new vehicles and lessens the regulatory burden. *This work will include collaboration and exchange of experiences and best practices on relevant national standards*". (G20, 2014b, §2.3, emphasis added) The work will provide recommendations to the G20 in terms of "strengthened domestic standards in G20 countries in as many areas as possible related to clean fuels, vehicle emissions and vehicle fuel efficiency". (G20, 2014b, §2.1) Other areas of work include exploring standards and goals for networked devices which are "widely traded internationally". (G20, 2014b, §2.1)

The Energy Efficiency Action Plan will be coordinated by the International Partnership for Energy Efficiency Cooperation (IPEEC), in collaboration with other international organisations such as the IEA. It will report results to the Energy Sustainability Working Group of the G20.

27. A number of factors point to the need for some level of international transparency and cooperation as a means of facilitating market deployment of low-carbon technologies. There are a number of barriers to such cooperation as well, including transaction costs, international distributional consequences of regulation and divergent national circumstances. Nonetheless, policy spill-overs already appear to be pushing an *ad hoc* emergence of cooperation efforts (Box 1.). Efforts in this area could improve the alignment and robustness of market expectations in key globalised low-carbon sectors through a common understanding of policy-driven market developments of low-carbon and related technologies. The establishment of cooperative frameworks for the adoption of national policies affecting highly-traded products could also be explored.

1.2 Transformation and Competitiveness in Energy-Intensive, Trade-Exposed Industries

28. A few industrial sectors are energy-intensive and trade-exposed (EITE). Policymakers are often concerned that divergent policy-related costs of energy could lead to the offshoring of economic activity in EITE sectors to jurisdictions with more favourable energy input costs (IEA, 2013). Most studies find that EITE sectors can effectively be reduced to a handful of very energy- or carbon-intensive basic manufacturing sectors: aluminium, cement, clinker and lime, steel, refining, certain chemicals, and nitrogenous fertilisers; glass, pulp and paper, and ceramics are sometimes added to the list (Droege *et al.*, 2009). Sustained input cost disparities are not uncommon in these sectors: locational, production and investment decisions in EITE sectors are made on numerous criteria, of which the policy-related cost of energy is just one, albeit an important one.

29. However, energy-intensive industries are major emitters of CO_2 and other greenhouse gases, and account for two-thirds of industrial energy use globally. In 2011, emissions from five broad energy intensive sectors made up 10% of global CO_2 emissions from fuel combustion; 15% in BRICS countries and 7% in OECD countries.[3] In the long-term, therefore, these industries will need to decarbonise dramatically as part of a trajectory to keep warming below 2°C. According to the IEA's *Energy Technology Perspectives 2014* (IEA, 2014a), the following emissions reductions will be needed by 2050 in

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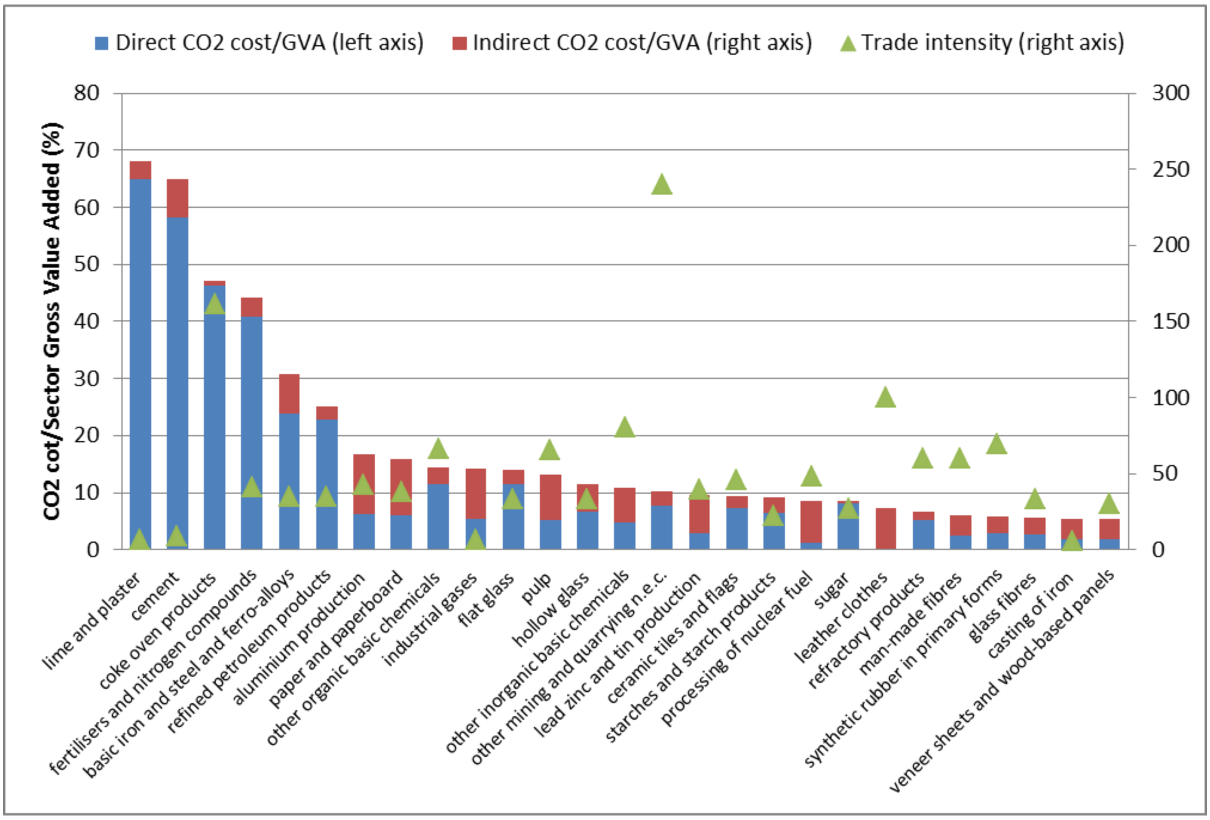
3 These sectors are steel production, non-ferrous metals production, non-metalic minerals production, chemicals production, and paper production.

a 2°C-compatible scenario, compared to a business-as usual scenario: steel (44%); chemicals (46%); cement (35%); pulp and paper (52%); and aluminium (11%).

30. These levels of GHG reduction will result from a range of measures, from the use of new breakthrough technologies such as carbon capture and storage (CCS), to product substitution, materials recycling and reductions in the throughput of these products through dematerialisation. Incentivising this degree of change throughout the value chain will require significant policy stringency (CEFIC, 2013; Neuhoff *et al.*, 2014a and 2014b).

31. CCS provides a useful example of challenges ahead for industry when it comes to the decarbonisation agenda. CCS costs for industry remain uncertain, but are likely to be on the order of USD 50/tCO_2 or more (IEA, 2014). Carbon pricing on this level would have a significant impact on the production cost of the primary product in EITE sectors. Figure 5 shows the impact of a USD 50 carbon price on the most carbon-intensive industries in Europe, expressed in terms of CO_2 cost as a share of sectoral gross value added. This indicator reaches a level of roughly 70-15% for the most impacted sectors. Carbon costs of this level would have significant impacts on product price, downstream markets and international competitiveness. However, in the absence of cheaper low-carbon technologies, this is the level of policy stringency required in order to transform some of these sectors.

Figure 5. Comparison of a USD 50/CO_2 with sectoral gross value added in the most affected industries



Source: Authors' calculations based on EC, 2014 To date, there is very little empirical evidence of trade distortions in EITE sectors due to divergent stringency of climate policies, although this may change as these policies are tightened (Bolscher *et* *al*., 2013). However, so far climate policies have not reached the level of stringency that would be required to incentivize significant transformation in EITE sectors. Moreover, where GHG mitigation policies have been introduced in industry, they have almost universally been accompanied with measures to mitigate the signal of the carbon constrain in EITE sectors, such as free allocation to these sectors under emissions trading schemes (cf. Hood, 2010).[4] These policies aim at removing or mitigating the carbon price pass-through into primary products in EITE sectors, so that producers in these sectors do not risk losing market share to international competitors who are not under carbon constraints. In turn, this effectively removes or reduces the cost of the carbon constraint throughout the value chain for EITE sectors. Incentives for a less intensive use of these products and innovation into low-carbon substitutes are also hindered by these protective measures.

32. The carbon leakage threat is not uniquely the concern of industrialised countries. The Chinese State Information Centre, an internal economic think tank at the Chinese National Development and Reform Commission (NDRC), is now exploring the potential impacts of Chinese carbon pricing policies for the electricity sector on its industries (Ji *et al.*, 2014). The Chinese government has pledged to introduce a national carbon trading scheme by 2020, which will most probably include heavy industry. As the scope and level of carbon pricing rises in China over the coming decade, the same issues of carbon leakage and competitiveness are beginning to arise in the Chinese climate policy debate.

33. Protecting EITE industries from carbon constraints may be a justifiable objective in the short-term, in the context of fragmented global policies. However, as noted above, these are major sectors that will need to be decarbonised everywhere if the 2˚C objective is to be met. Theoretically, firms should integrate the price of carbon into their investment and operational decisions, thereby reducing emissions where doing so is profitable given the opportunity cost of free allowances. However, on exactly the same logic, firms may substitute domestic production for imports in order to sell allowances (operational leakage), if allocation is based on historical production levels.

34. Firms may also not act as fully rational cost-optimal agents. There is empirical evidence from behavioural economics that real costs, such as buying allowances at auction or paying a carbon tax, may be more salient for management than the opportunity costs of, for example, free allowances (Abrell *et al*., 2011). Real costs may thus create a stronger incentive for firms to implement carbon abatement policies. Perhaps even more importantly, future levels and values of free allocation may be too uncertain for firms to justify large scale investments such as in CCS, the profitability of which depends on the ability to sell surplus allowances at an appropriate price (Neuhoff *et al.*, 2014a and 2014b).

35. There are different ways to protect EITE sectors from carbon leakage in the transition, all of which have drawbacks. Table 2 summarises three anti-leakage measures against four different policy objectives. As can be seen, free allocation, either *ex-ante* or *ex-post*, does not score well on its capacity to incentivise mitigation, innovation and substitution in the EITE value chain. Border adjustments do score well here, but they are currently likely to be seen as a non-cooperative move by implementing countries' trading partners.

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[4] Examples include: the EU ETS (2005); the US Waxman Markey Bill of 2009; the Californian Emissions Trading Scheme (2013); the Australian CPRS Proposal (2008); The New Zealand Emissions Trading Scheme (2009); the Tokyo Emissions Trading Scheme (2007); the Norwegian Emissions Trading Scheme (now linked to the EU ETS); the Kazakhstan Emissions Trading Scheme (2013); and the Republic of Korea's Emissions Trading Scheme (2015).

Table 2. Summary of pros and cons of different anti-leakage measures

	Prevents carbon leakage?	Creates incentives for mitigation and breakthrough technologies upstream?	Incentives for mitigation downstream?	Does not require international cooperation?
Ex-ante free allocation based on historical production	+	- -	+	+++
Ex-post free allocation based on annual production	+++	- - -	- -	+++
Border Adjustment	+++	+++	+++	- - -

Source: authors.

36. There is therefore a fundamental trade-off between protection and the low-carbon transformation in EITE sectors in the context of solely national policies. This raises the question of how governments can create sufficiently strong incentives to significantly transform these sectors, given fragmented national policies and concerns arising from asymmetrical policy and distortions of competition. Of course, concerns of fragmented global policy could be mitigated by a global agreement; however, this paper argues that even under a global agreement, countries will continue to implement diverse policies reflecting their national circumstances. So even if a global agreement is struck, concerns about carbon leakage are unlikely to disappear completely.

37. Unilateral policy efforts lead to less efficient approaches and ultimately to policies that are inadequate to transform EITE sectors in the long term. As more countries embark on the low-carbon transition, they will inevitably face similar resistance to ambitious emissions reduction goals in sectors with high carbon intensity. The question is whether an enhanced dialogue between policymakers from global trading partners could facilitate domestic policy efforts while ensuring free trade in the context of industrial decarbonisation.

38. An appropriate forum for the discussion on the free trade-climate policy nexus would need to bring together expertise on both climate and trade aspects. It would also need to include, at a minimum, representatives of major trading countries in energy-intensive goods, countries that either have developed, or are in the process of developing, carbon emissions regulations for industrial sectors, and the private sector. A possible model for such a forum could be the World Bank's Partnership for Market Readiness (PMR) (Box 2). As noted below, the PMR creates a neutral platform for technical discussion between both developed and developing countries on the implementation of carbon pricing and related policies.

Box 2. The Partnership for Market Readiness (PMR)

The Partnership for Market Readiness (PMR) is a World Bank-led initiative that brings together 31 countries and two regional (so-called 'technical') partners (California and Quebec). The initiative includes Contributing Participants who provide financial support to the PMR trust fund, and Implementing Country Partners who receive PMR funding for implementation activities. Contributing Partners include the United States, European Commission, Japan, and Norway, among others. Implementing Country Partners include Brazil, China, India, Indonesia, South Africa, Vietnam, Colombia, Peru, Costa Rica, Morocco, Tunisia, as well as Chile, Mexico and Turkey.

The goal of the PMR is to help countries pursue more effective greenhouse gas mitigation efforts through the use of innovative policy instruments to increase financial flows for mitigation, including through the use of carbon market-based policy instruments. It therefore provides grant-based funds as well as technical assistance to Implementing Country Partners. However, it also provides a platform for discussion and knowledge sharing and engages in technical discussions related to market-based instruments. These can include North-South or South-South exchanges on policy challenges encountered and experiences gained in other countries.

The PMR is country-led and focuses on building up Implementing Countries' capacities to design, test, and implement mitigation policies. It could be seen as an interesting template for a forum in which domestic policymakers could exchange policy experience on how to address competitiveness issues arising from countries progressively strengthening their carbon pricing or equivalent policy efforts. It would contribute to improved transparency – *e.g.* answer the questions: what are partner countries doing in the following sectors? How does this compare with other countries' efforts? – and possibly cooperation (countries pushing in the same direction and seeking to learn from each other what is the best way forward).

1.3 Research and Development

39. Investment in research and development (R&D) will need to increase to ensure the necessary technological innovation to meet the 2°C. The IPCC cites estimates for the required increase in energy-related R&D ranging from USD 4.5-78 billion per year between 2010-2029, for example (IPCC, 2014).

40. Numerical assessments of current R&D expenditure on energy technologies are fraught with uncertainty. Nonetheless, they can be used to garner broad trends and implications. Currently, about USD 50 billion is spent globally on energy-related R&D (Grübler *et al.,* 2012). Of this, about USD 35 billion is invested by the private sector. This strong role for the private sector is also reflected in studies focused on the European Union: Weisenthal *et al.* (2009) estimated that EUR 2.38 billion were allocated to R&D in low-carbon technologies in the EU in 2007, of which EUR 1.66 billion came from the private sector.

41. At the same time, it is important to highlight that R&D spending is not the only driver of improved performance of low-carbon technologies. As well as 'learning-by-researching', 'learning-by-doing' through deployment is an important driver of cost reductions in low-carbon technologies. Indeed, it is important to carefully articulate push policies such as R&D and pull policies such as deployment of low-

carbon technologies. Estimates of market deployment[5] investments for pre-commercial low-carbon technologies place these at around USD 150 billion per year. Investments in the diffusion of commercial technologies place them at more than USD 1 000 billion per year. These figures give a sense of the scale of the deployment and diffusion incentives on which technology researchers and producers base their strategic decisions. Policymakers need to effectively combine incentives across the innovation chain, from R&D to market formation and diffusion, in order to promote innovation and improved performance of low-carbon technologies.

42. There is evidence that energy-related R&D efforts are increasingly globalised, as suggested by the significant share of emerging countries in the above estimate of global energy-related R&D spending. Grübler *et al*. (2014) estimate energy-related R&D in BRIMCS countries (Brazil, Russia, India, Mexico, China, South Africa) at USD 15 billion, which is roughly equivalent to the entire public expenditure on energy R&D of IEA countries (USD 13 billion). Whether such R&D is predominantly going into fossil fuel technologies or into low-carbon is another question.

43. Estimates reveal a discrepancy between relatively lower R&D investment in demand-side technologies and their importance in achieving environmental and economic objectives. Table 3 summarises historical data of public R&D in IEA countries in demand and supply technologies, compared to their relative importance in reducing GHG emissions in long-term mitigation scenarios. This leads the authors to argue that there is a "significant bias in past and current R&D portfolios … [to] the detriment of energy efficiency and conservation". (Grübler *et al.*, 2014)

Table 3. Cumulative public R&D expenditure in IEA countries in supply and demand-side technologies compared to their role in GHG emissions reductions

	% share in emissions reductions 2000-2100, mean all scenarios	Cumulative R&D expenditures, 1974-2008, billion USD_{2008}	% share in total 2008 R&D
Energy efficiency	59.2	38	9.1
Fossil fuels	6.2	54	12.8
Renewables	18.2	36	8.7
Nuclear	8.5	225	53.8
Others	8.0	65	15.5
Total	100.0	417	100.0

Source: Grübler and Riahi (2010)

5 *i.e*. deployment of new energy technologies in specific 'niche markets' before full commercial diffusion.

44. Analysts place increasing importance on the entire ecosystem for energy-related innovation, leading to the development of the Energy Technology Innovation System (ETIS). The components of this system can be analysed individually. They include knowledge, resources, actors and institutions, and conditions for the adoption and use of new technologies (see in particular Grübler and Wilson, 2014, for more details). There is not room here for a detailed exposition of these concepts and their interactions, though two points should be highlighted:

- The emphasis on multi-component systems for energy innovation stresses the need for comprehensive and coherent incentives and policies across the innovation system and the energy value chain.

- Energy innovation is inherently a long-term endeavour, with large inertias, sunk costs and barriers to entry. Change in the energy sector is measured in decades, not years. Actors can be durably discouraged by innovation failures. This reinforces the importance of structural, sustained and long-term incentives and policies.

45. The above discussion has underscored a few salient aspects of the current state of the art of energy innovation, in particular as it is relevant to the national policy debate. However, the focus of this paper is on international policy cooperation. As noted earlier, innovation, manufacturing and deployment of low-emissions technologies are increasingly globalised into an international energy technology innovation system comprising a patchwork of national policies, international policy collaboration, the activities of multinational firms, global networks of research institutions, and international trade. The operation of this international energy technology innovation system is relatively understudied.

46. From the perspective of a national policymaker**,** cooperation on R&D within a 'club' of countries with similar sectoral interest may be attractive for a number of reasons:

- Firms and researchers have strategic perceptions about the future direction of the technologies and sectors in which they work. These anticipations are important drivers of R&D efforts and can be influenced by credible policy. As noted in the *Global Energy Assessment*: "shared or collective expectations are an important means of reducing uncertainty and stimulating entrepreneurial activity". (Grübler *et al.*, 2012) In the context of globalised clean energy innovation, such anticipations are in part influenced by expectations on policies in other countries – another argument in favour of reliable, transparent information sharing on policy efforts.

- International R&D cooperation may improve the efficiency of R&D activities by reducing duplications of efforts.

- Knowledge is cumulative and combinatorial and is therefore subject to high spill-overs. These features can generate high rates of social return from knowledge access. Increased scientific exchange and collaboration can therefore accelerate the growth rate of the overall stock of knowledge from which national policymakers can benefit. Ultimately, participants must also organise in order to allow capture of the benefits, without which joined efforts and pooling resources would be pointless.

- Technology diffusion is largely dependent on the absorptive capacity of the country in question. Participation in global knowledge networks can help to improve domestic capacities to adopt, adapt and generate new technologies. There is evidence, for example, that participation in international knowledge networks by Chinese scientists, engineers and entrepreneurs was a crucial factor in the rapid growth of the Chinese solar PV industry (Gallagher, 2014).

47. Evidently, there are multiple factors which get in the way of international R&D cooperation. These include transaction costs, commercial sensitivities, divergent preferences and research capacities. In the case of pre-commercial R&D, commercial sensitivities may be reduced; there is indeed evidence that R&D collaboration is more significant in pre-commercial technologies (De Coninck *et al*., 2008). There is too little research on the scale, modalities and results of international energy-related R&D collaboration. The survey of international initiatives provided in Section 2.3 does suggest that there is relatively little concrete cooperation on energy-related R&D, although such cooperation may be more prevalent at the regional (*e.g.* EU) or bilateral (*e.g*. US and China) level. Nonetheless, a recent comprehensive assessment of energy-related innovation at the global level argued that the global potential for cooperation on R&D was not being sufficiently tapped: "International knowledge spill-overs through government-sponsored collaboration efforts seem weak compared to what is needed to foster a significant global energy transition." (Grübler *et al*., 2012)

1.4 Summary

48. The previous sub-sections illustrated three issues related to negative and positive potential spill-overs of national policies on climate change.

- **Incoherent market signals**. There are examples of deployment policies for low-carbon technologies that suffered greatly from unexpected international market responses (*e.g.* solar photovoltaic panels), resulting in unhelpful trade frictions and less robust incentives for firms operating in this global sector. It seems worth asking whether the large-scale, policy-driven deployment of many low-GHG technologies globally could benefit from international sharing of information on market expectations and enhanced transparency on domestic policy.

- **Effectiveness of carbon constraints**. Fragmented policies create concerns for policymakers and firms about trade distortions and 'emissions leakage' in energy-intensive and trade-exposed industries. The 'protective' measures adopted in response to these concerns hamper the effectiveness and ambition of the emission constraints placed on these important sectors. They also slow down the innovative capacity of value chains towards low-greenhouse gas practices. As other countries seek to set those activities on a low-carbon path, an exchange among like-minded domestic policymakers could prove useful.

- **Public-private R&D**. Related to the previous point is the inadequate level of expenditures allocated to researching and developing breakthrough low-carbon technologies: additional effort is required. Here again, the question is whether policymakers and the productive sector could benefit from joining forces, as it seems that international support for public-private

R&D efforts could achieve progress in this area, at lower cost, with many positive externalities.

49. The following section surveys the emerging policy response to these challenges, beginning with the UNFCCC.

2. THE GLOBAL POLICY LANDSCAPE FOR COOPERATION ON CLIMATE CHANGE

2.1 Role of the UNFCCC

50. The previous section highlighted some of the challenges to national policy-making on climate change, given the globalised context in which such policies are developed. It is worth inquiring what the UNFCCC, as the main forum for cooperation on the global response to climate change, may offer as an avenue for international cooperation on domestic policy efforts.

51. The UNFCCC, as an international treaty with 195 Parties consisting of sovereign nation states, is centrally focused on the negotiation of state-to-state agreements such as the Kyoto Protocol (1997), the Copenhagen Accord (2009) and the Cancun Agreements (2010). Negotiations are currently focused on developing a new global agreement by 2015 under the auspices of the Durban Mandate (UNFCCC, 2011). This negotiation aims to achieve "a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties". (UNFCCC, 2011, §2) This universal legal agreement should address mitigation, adaptation, finance, technology development and transfer, transparency of action and support, and capacity-building.

52. The cornerstone of this new agreement will be state action. All Parties have agreed to submit so-called 'nationally-determined contributions' (NDCs) during 2015 to be included in the new agreement. The centrepiece of these contributions will be greenhouse gas mitigation, although it is expected that Parties will continue to strengthen action on the other pillars of the agreement. The 2014 Lima Conference of the Parties (COP20) negotiated loose, voluntary rules concerning the content of these NDCs in order to ensure their *ex-ante* transparency and credibility. The Lima decision merely stated:

> "*Agrees that the information to be provided by Parties communicating their intended nationally determined contributions, in order to facilitate clarity, transparency and understanding, may include, as appropriate,* inter alia, *quantifiable information on the reference point (including, as appropriate, a base year), time frames and/or periods for implementation, scope and coverage, planning processes, assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals …*" (UNFCCC, 2014, §14)

53. In addition to the above paragraph, the Lima decision also concluded the discussion on the *ex-ante* examination of proposed NDCs. Many Parties had hoped for a robust process in order to ensure the their transparency and clarity, but in the final outcome this was watered down to a synthesis report by the Secretariat on the aggregate effect of the contributions (UNFCCC, 2014, §16b).

54. The above-quoted decision has several implications for this discussion. First, mitigation contributions will probably remain complex and diverse documents, albeit an improvement on the Copenhagen pledges in terms of *ex-ante* transparency (Maljean-Dubois *et al.*, 2014). NDCs will contain multiple elements, from aggregate, economy-wide absolute targets to relative targets to sectoral policies and measures. Countries have a wide degree of latitude to choose which of these elements they place in their NDC (Spencer *et al.*, 2014). Second, the inability to agree to a robust mechanism for the *ex-ante*

examination of NDCs suggests the difficulty of developing a stronger element of policy transparency, let alone coordination, under the UNFCCC.

55. There are a number of reasons why this may be the case:

- Parties may be reluctant to develop stronger mechanisms toward policy transparency under a formal legal regime such as the UNFCCC. The connotations of legal obligation may be a deterrent in this regard.

- Action under the UNFCCC has been characterised since the mid-1990s by a lack of interest in policies and instruments as such. Indeed countries have actively rejected the idea of discussions on national policies and instruments, largely out of concern that this would impinge on national sovereignty. The focus has been on negotiating new rounds of international pledges, leaving it up to countries to achieve their pledges as they wish.

- The large number and diversity of countries under the UNFCCC may preclude the kind of detailed, technical exchanges that would be needed within a mechanism to increase the transparency of and cooperation on national policies. The necessary sectoral technical expertise may also be missing in the context of the UNFCCC.

56. Another aspect of the UNFCCC regime merits attention. The UNFCCC Conference of the Parties established a further work stream in 2011 focused on increasing the ambition of state action before 2020. Workstream 2 has begun to focus on sectoral policy opportunities or 'international cooperative initiatives' (ICIs), and has tried to involve expertise from the private sector as well as actors from civil society, research and domestic policy-making in its workshops. It consists largely of in-session workshops, an online portal summarising existing ICIs[6] and a series of UNFCCC secretariat papers summarising opportunities to enhance mitigation and develop ICIs (UNFCCC, 2014b). Additionally, the UNFCCC has established the Climate Technology Centre and Network (CTCN), with the aim of facilitating the diffusion of technology to developing countries.

57. Nonetheless, the UNFCCC remains largely focused on negotiating new rounds of state contributions on climate change, with also a crucial role on the transparency of aggregate country-level actions. This is arguably its core added value, as a treaty-based, structured, universal platform for intergovernmental climate cooperation. A state-to-state agreement is, however, also of the utmost interest to the private sector, in the sense that it makes national policies more credible and robust. Thus the UNFCCC has an important role in aligning the expectations of the private sector behind the low-carbon transition, even if policy details are elaborated at the national level.

58. In addition, the UNFCCC has an important role in gathering data and ensuring the transparency of the achievement of contributions through the transparency regime developed since Cancun. This regime does not operate at a high level of policy granularity, however. Further developed, these arrangements under the UNFCCC could also facilitate the sharing of information on Parties' actual policy efforts (*e.g.*,

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6 http://unfccc.int/focus/mitigation/items/7907.php.

implementation, policy goals), which would improve the private sector's visibility on actual markets internationally and, perhaps, the coherence of national-level policies. This could also open the possibility of more detailed and structured discussion elsewhere on the issues of market signals, the effectiveness of carbon constraints and joint R&D efforts.

59. This paper has argued that there are international spill-overs from national climate policy which could, if appropriately addressed, enhance countries' ability to adopt lower-GHG economic paths. However, in the foreseeable future it seems unlikely that the UNFCCC will develop significant further capacities to create greater transparency, convergent expectations and cooperation *at the level of specific national policies* in order to manage these spill-overs. The core value-added of the UNFCCC appears to be its role as a locus for state-to-state agreements, which can nonetheless send important signals to the private sector. The agreement can help to generalise long-term expectations about the broad direction of markets and innovation (low- versus high-carbon) thus helping to support the broad strategic orientations of the private sector (Haščič *et al.*, 2011). However, a global agreement on climate change will need to be subsequently implemented with ever-more stringent, yet still diverse, national policies. In consequence, the policy cooperation challenges posed in this paper may not be significantly allayed solely by the negotiation of a new global agreement on climate change.

2.2 'Sectoral Approaches' Before Copenhagen

60. Before Copenhagen, much interest and ink were expended in developing the concept of 'sectoral approaches' (Baron, 2007). This was motivated by similar considerations highlighted in this paper, namely concerns about the distortion of trade and mitigation efforts in largely globalised sectors. The policy discussion was focused in particular on three large GHG-emitting industrial sectors: cement, aluminium, and steel. Each of these sectors was and still is organised under the auspices of an industry association which played a role in the policy discussion: the Cement Sustainability Initiative; the International Iron and Steel Institute (now Worldsteel); and the International Aluminium Institute. Much of the work was on sharing best practice targeted to lowering GHGs, but industry, mostly in developed countries, also called for a more universal approach, at a time where ambitious climate policy was implemented in some regions (*e.g.* the EU ETS), but not in others.

61. At the same time, the UNFCCC expert community focused particularly on the development of so-called sectoral market mechanisms. Developed countries were interested to see the Clean Development Mechanism evolve into a more efficient mechanism which would cover entire sectors with a carbon price – albeit with a view that developing countries might initially receive credits for their GHG reduction efforts in these sectors. Moreover, policymakers in developed countries were likewise concerned about the competitiveness impacts of divergent policy incentives in major EITE sectors. Sectoral approaches were thus seen as a way towards a more level playing field, with similar incentives applied via the carbon market. A more pragmatic route was followed by the Asia Pacific Partnership on Clean Development and Climate (APP), who brought together government and private sector actors from Australia, Canada, China, India, Japan, Korea and the United States. The APP sectoral task forces, which included cement, steel and aluminium, focused on technical exchanges of policy experience and technological best practices, as well as specific project implementation. APP stopped in 2011 after the change in the US administration.

62. The experience of sectoral approaches brings a number of lessons. First, although the pre-Copenhagen discussion of sectoral approaches has largely disappeared, the motivations that drove the discussion have not. Policymakers and global sectors continue to be concerned with international spill-overs from national climate policies. Second, many developing countries saw sectoral approaches as contradicting the principle of common but differentiated responsibilities, as some proposed that international sectors be treated equally regardless of their country location. Third, analysts have highlighted the lack of an institutional or legal basis for major cooperative initiatives in many sectors and the lack of an anchor point for these initiatives in the legal apparatus of the UNFCCC (Baron *et al*., 2007). Fourth, the objective of establishing global carbon markets in certain sectors was overly ambitious in the face of countries' different national circumstances, resources, policy capacities and preferences, even in major globalised sectors.[7] Common policy (such as cap setting) requires a degree of institutional cooperation that is beyond the scope of the relationship between many jurisdictions. Some believe that regional approaches are more promising, given the high degree of regional trade in many major sectors (for example at the level of NAFTA, or the EU). At a global level or between very different jurisdictions, more pragmatic approaches aiming at the exchange of best practice, implementation of pilot projects and 'softer' policy cooperation may be more promising.

63. We now turn to recent efforts that resemble this kind of policy dialogue and cooperation.

2.3 Recent International Cooperative Policy Initiatives

64. There is today a plethora of intergovernmental policy initiatives and dialogues taking place outside the UNFCCC. Numerous examples can be cited from the last five or so years: the Clean Energy Ministerial (CEM), Sustainable Energy For All (SE4ALL), the International Renewable Energy Agency (IRENA), the International Partnership for Energy Efficiency Cooperation (IPEEC), the Technology Action Plans of the Major Economies Forum in 2009, the G20, the Global CCS Institute, the Climate and Clean Air Coalition, the World Bank Partnership for Market Readiness, etc. Figure 6 presents a non-comprehensive overview of the growth of multilateral climate and energy related initiatives. This trend of new initiatives is matched by existing structures working increasingly on energy, too. This growth has led to concerns of 'overcrowding' of international initiatives. There seems, however, to be a significant degree of organic cooperation between initiatives to benefit from synergies and avoid duplication (Barnsley and Ahn, 2014). Against this, however, some observers have also complained of a lack of political direction and political follow-up (see Box 3 for how co-operation has been organised in the area of financial sector regulation).

65. Many of these initiatives, in particular those created recently, tend to be informal cooperation platforms, as opposed to formal international organisations. In this regard, there seems to be a preference for the flexibility and expediency given by less formal modes of cooperation. A downside is the potential lack of resources and political buy-in from which some informal structures may suffer. A further characteristic that can be noted is the high degree of participation of emerging countries, including in the creation of recent initiatives. This indicates their high degree of interest and importance in international

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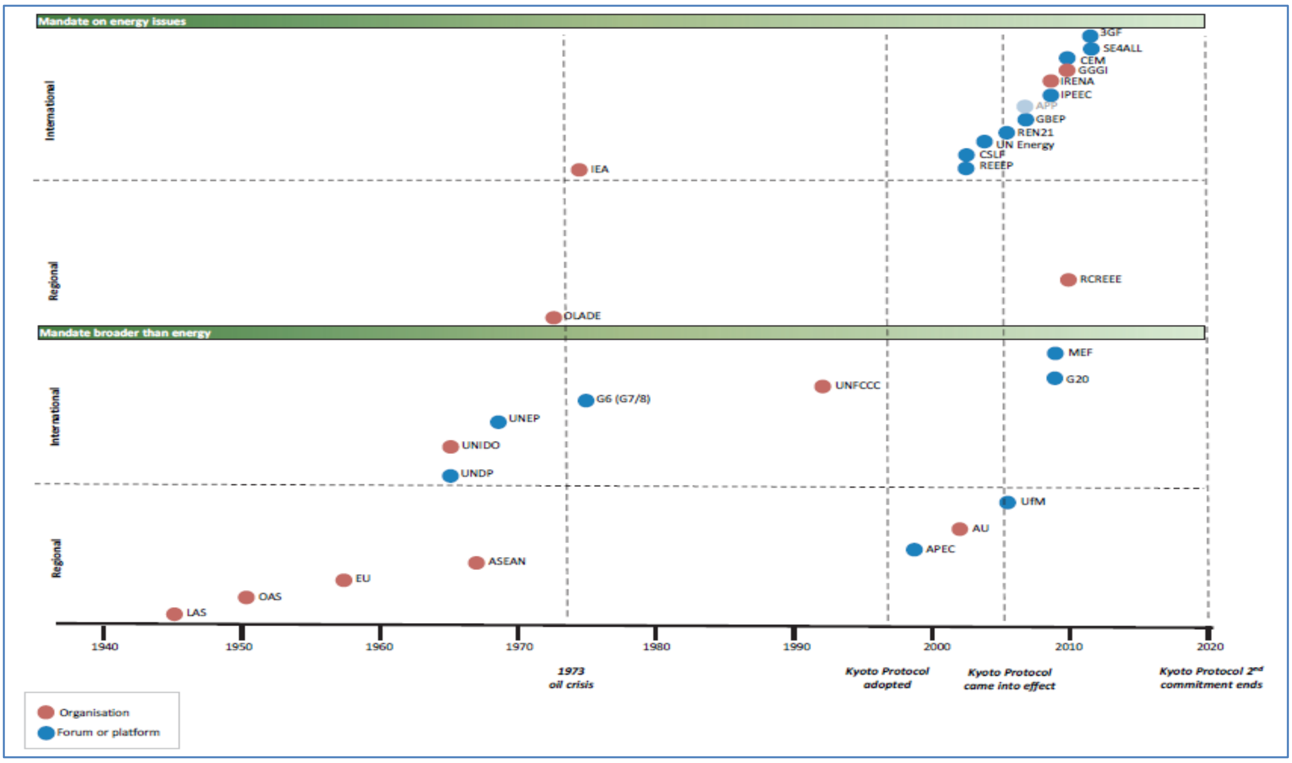
[7] The development of a more global carbon market than exists today remains worth pursuing. The announcement that China may have a national emissions trading system in place by 2020, based on its current pilot experiments, is a good sign in this direction, together with the launch of the Korea ETS this year.

energy and climate issues. In comparison, smaller developing countries tend to be much less well-represented. This is a gap which the CTCN under UNFCCC is trying to fill, as are many regional UN bodies, and SE4ALL through their increasing work on energy and climate issues.

Figure 6. Growth of energy and climate related multilateral policy initiatives



Source: Barnsley and Ahn (2014). ASEAN: Association of Southeast Asian Nations, APEC: Asia-Pacific Economic Cooperation, APP: Asia-Pacific Partnership on Clean Development and Climate, AU: African Union, CEM: Clean Energy Ministerial, CSLF: Carbon Sequestration Leadership Forum, EU: European Union, G6/7/8 : Group of 6/7/8, G20: Group of 20, GBEP: Global Bioenergy Partnership, GGGI: Global Green Growth Institute, IEA: International Energy Agency, IPEEC: International Partnership for Energy Efficiency Cooperation, IRENA International Renewable Energy Agency, LAS: League of Arab States, OAS: Organization of American States, OLADE: Organización Latinoamericana de Energía (Latin American Energy Organization), UNDP: United Nations Development Programme, UN-Energy: United Nations-Energy, UNEP: United Nations Environment Program, UNIDO: United Nations Industrial Development Organisation, UNFCCC: United Nations Framework Convention on Climate Change, SE4All: Sustainable Energy for All, UfM: Union for the Mediterranean, MEF: Major Economies Forum, RCREEE Regional Center for Renewable Energy and Energy Efficiency, REEEP: Renewable Energy and Energy Efficiency Partnership, REN21: Renewable Energy Policy Network for the 21st Century, 3GF: Global Green Growth Forum.

66. An important aspect to highlight is the continuum that exists in terms of the modes of cooperation undertaken by these initiatives. It has already been noted that international sectoral initiatives pre-Copenhagen may have been too ambitious, often aiming at full regulatory harmonisation (*e.g.* an international cap and trade scheme for entire industrial sectors). While not pretending to comprehensiveness, Annex 3 tries to construct a first classification of the different modes of cooperation and provide examples thereof.

67. The growth of new initiatives in this domain has been spectacular, and they certainly bring interesting ideas to the table with the modalities of cooperation that they pursue. Several points for discussion can be highlighted.

- Analysts underscore the importance of the alignment of domestic policies and international initiatives in order to create the right enabling environment for the uptake of low-emissions technologies. Many initiatives pursue a soft approach, focusing more on policy dialogue, knowledge generation and capacity-building or interventions at the project rather than policy level. There may be scope to improve the link between domestic policy efforts and multilateral initiatives to promote what could be termed 'internationally-coordinated adoption' of domestic policies.

- The proliferation of initiatives has led to concerns of overcrowding. While studies suggest that there is a degree of coordination taking place between initiatives (Barnsley and Ahn, 2014), some also point to a lack of high-level political engagement that would give initiatives stronger mandates, direction and follow-up (Box 3).

- Many initiatives focus on 'soft cooperation'. Undoubtedly, there is a value added from this. Nonetheless, it is an open question whether more action-oriented cooperation modalities could be developed, focusing on joint R&D, practical discussions on domestic policy implementation and possibly greater international cooperation on domestic policies.

Box 3. The Policy Coordination Challenge in Financial Governance

Subsequent to the financial crisis, policymakers enacted swift and far reaching reforms (although more remains to be done). This was achieved through the high-level coordination of a diverse range of policy fora, followed by national implementation of agreed regulations. In this, the G20 Leaders' Forum played an important role providing political guidance and direction to the reforms which were delivered in other, often sectoral, fora (for example the Basel Committee for Banking Stability). Some commentators presented the G20 as a global "Executive Committee", coordinating post-crisis reforms. Accordingly, some commentators have argued that there has been a falling off of the activism of the G20 as the crisis abated.

The crisis also led to the creation of the Financial Stability Board (FSB), which grew out of the Financial Stability Forum (FSF). Compared to the FSF, the FSB enlarged participation to include all G20 countries, and a number of smaller financial markets such as Singapore and Switzerland. Each member is represented by Treasury, Central Bank, and securities regulator. The key international institutions are also members: the IMF, OECD, Bank of International Settlements, World Bank, International Accounting Standards Board, International Organisation of Securities Commissions, International Association of Insurance Supervisors, etc. A noteworthy innovation is the formality of the FSB, which is incorporated under Swiss civil code; members subscribe to a charter and broad articles of agreement. The FSB cannot issue binding regulation: its articles of association state that the FSB's activities "shall not be binding or give rise to any legal rights or obligations". Its main function is to ensure the coordination and monitoring of the implementation of international standards, to keep the stability of the financial sector under strategic review, and to liaise directly with the leaders' level under the auspices of the G20.

While the climate change issue benefits from a dedicated intergovernmental process, the UNFCCC, which was not the case for finance regulation, there are couple of interesting lessons to draw from this example, including on potential gaps in today's international climate governance. The first relates to the importance of creating a structural link to political leadership at the highest level. The FSB reports directly to the G20.

Secondly, the combination of national governments and policy organisations from multiple domains allows the FSB to play the role of agenda setter and watchdog, and to understand the spill-overs from one regulatory area to another. In a similar way, coordinating multiple sectoral organisations and fora presents a challenge for climate governance, as do the spill-overs between regulatory areas (such as climate and trade, or climate and investment). Thirdly, the FSB is endowed with a strong institutional and technical capacity. While many climate initiatives are informal, the existence of institutional and analytical capacity is a plus. Fourthly, the FSB includes major emerging countries as equal partners. This is not the case in some energy or climate related fora or organisations, and indeed the G20 principles on energy set the objective of increasing participation of emerging countries in global energy governance (cf. G20, 2014c).

Source : Spencer and Hipwell, (2013).

SUMMARY

68. This paper has surveyed the global policy landscape for climate change cooperation in the light of the challenges outlined in Section 1. Section 2 argued that the UNFCCC has a crucial role to play in formulating state-to-state agreements that can make national policies more robust and credible, thus helping to align the expectations of the private sector behind the low-carbon transition. Beyond, the UNFCCC could also generate transparency on domestic policy implementation and design, although there may be questions about the level of granularity with which it could do this. If done well, it could improve the private sector's visibility on low-carbon technologies and markets internationally and ideally improve the coherence of national-level policies.

69. Section 2.3 highlighted other cooperation initiatives on climate change. We can reflect on these in terms of the three policy challenges laid out in Section 1. In the area of market deployment (Section 1.1.1), a number of initiatives do focus on increasing the transparency and learning of different national policies. Few efforts have been made to move into deeper cooperation, such as the adoption of internationally coordinated standards or targets in global markets for low-carbon technologies. The G20's recent initiative on performance standards for trucks is an interesting innovation in this regard.

70. In the area of transformation and competitiveness of EITE sectors, there are a number of examples that can be discussed. These include efforts at regional harmonisation under the EU ETS and the carbon market link between California and Quebec. These are interesting examples, particularly given the strong regionalisation of EITE sectors (IEA, 2014b). However, on the one hand, the example of the EU ETS shows that even very tight regional cooperation has not completely removed concerns about carbon leakage; indeed, the global picture is that the majority of GHG-intensive facilities are not yet subject to a direct constraint on their emissions. On the other hand, as more countries take on GHG mitigation objectives, the question of how to best address these large emitters will quickly arise. Will countries seize the opportunity to exchange information, or even policy approaches? The World Bank Partnership for Market Readiness provides the precedent of a forum in which domestic policymakers could exchange experience on how to address competitiveness issues arising from countries progressively strengthening their GHG constraints, for instance.

71. There are few examples of concrete international collaboration on R&D in low carbon technologies that would have delivered significant breakthroughs. Structures for such collaboration exist, of course (*e.g*. the IEA Implementing Agreements; IEA, 2011). The R&D effort for the transition to a low-carbon economy needs to occur in a range of technologies, and should be driven significantly by broad incentives (carbon pricing, standards, etc.).

72. However, 'breakthrough' technologies (*e.g*. carbon capture and storage for electricity and industry, electricity storage, to name just a few) may warrant special attention from the international community, as they are in need of a significant technology push to demonstrate commercial viability and to improve their competitiveness.

73. The urgency of addressing climate change is at odds with an incremental approach to making the transition to a low carbon economy. As a result, more stringent national policies can be expected to be

imposed over the next ten years if the 2°C target is to remain achievable. Such policies will necessarily reflect the circumstances and preferences of individual countries, including their contribution to global mitigation. However, they are not implemented in a vacuum. Climate change is obviously a collective action challenge, so each country has good reason to be concerned about the action of its partners, all the more so as international spill-overs of domestic action will be ubiquitous if and when countries take serious climate action at home.

74. While this is nothing new, the required technical and infrastructure transformation required by a global response to climate change implies the very rapid transmission of such spill-overs. The issue raised here is how to ensure that this development will be harmonious rather than disruptive – notwithstanding the fact that some activities and technologies will win and others will lose in the transition.

75. From the perspective of a national policymaker, the speed and scale of the necessary transformation are likely to raise concerns which may not be addressed solely via UNFCCC negotiations. These include issues of competitive distortion caused by different regulations, the effectiveness of solely national R&D programmes and the coherence, effectiveness and stability of different national policies to deploy clean energy technologies.

76. A global agreement under the UNFCCC would play a crucial role in this regard, sending a strong signal to align long-term expectations towards a low-carbon global economy, and giving confidence to national policymakers and the private sector. In order to do so, it is important that it contains credible long-term collective and individual goals to guide action. However, by itself it seems unlikely that the UNFCCC will have the capacity to initiate sector-specific activities involving domestic policymakers.

77. This may explain why in recent years a number of initiatives in the area of climate and energy have developed outside the UNFCCC. These cover a wide variety of sectors, institutional settings, geometries of participation, and modalities of cooperation. Generally speaking, they appear to be more focused on soft cooperation and dialogue than on concrete R&D efforts, let alone regulatory harmonisation.

78. There may be reasons why countries may be reluctant to engage more internationally on their domestic actions to fight climate change. However, to be effective in a globalised economy, policymakers will have to take into account the international dimensions of domestic actions. The central interrogation of this paper is on the value of international discussions on domestic climate policy actions as a means to enhance their efficiency, effectiveness, and bring about a harmonious, if not fully harmonised, transition to a low-carbon economy. The recently agreed G20 Energy Efficiency Action Plan indicates that countries are ready to collaborate, and even to coordinate some elements of their domestic policies in order to drive global market transformations. If successful, this type of initiative should also facilitate the private sector response. It would also set an important precedent for broader international collaboration on domestic climate policies.

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ANNEX 1: SOLAR PHOTOVOLTAIC SUPPORT POLICIES IN THE EU

Current national support schemes, PV, EU27			
Country	**Type**	**Start year**	***Comments***
GR	Feed-in tariffs	before 1997	
ES	Premium tariffs/ Feed-in tariffs	1998	*(currently suspended). Plant operators may choose between a feed-in tariff and a bonus on the top of the market price.*
DK	Premium tariffs	before 1997	
AT	Feed-in tariffs	1998	
PL	Green certificates	2000	
FR	Feed-in tariffs	2001	*A Premium tariff scheme is currently under discussion.*
LV	Feed-in tariffs	2001	
BE	Green certificates	2002	
LT	Feed-in tariffs awarded by tenders	2002	
CZ	Feed-in tariffs	2002	
SE	Green certificates	2002	
BG	Feed-in tariffs	2003	
EE	Feed-in tariffs	2003	
MT	Feed-in tariffs	2003	
RO	Green certificates	2004	
SI	Feed-in tariffs	2004	
IT	Feed-in tariffs	2005	
SK	Feed-in tariffs	2005	
CY	Feed-in tariffs	2006	
IE	Feed-in tariffs	2006	
NL	Premium tariffs/ Investment grants	2009	

FI	Feed-in tariffs	2011	
GB	Premium tariffs *(with Contract for Difference)* Green certificates	2014 2004 - 2014	*The Contract for Difference works by stabilising revenues for generators at a fixed price level known as the 'strike price'. Generators will receive revenue from selling their electricity into the market as usual. However, when the market reference price is below the strike price they will also receive a top-up payment from suppliers for the additional amount. Conversely if the reference price is above the strike price, the generator must pay back the difference.*
DE	Premium tariffs	2014	*Market premium. Plant operators of RES plants exceeding an installed capacity of 500 kW are supported by a market premium for electricity they sell directly. The amount of the market premium shall be calculated each month.*

Source: www.res-legal.eu/compare-support-schemes/.

ANNEX 2: SOLAR PHOTOVOLTAIC SUPPORT POLICIES IN CHINA

Date of implementation	Policy name	Policy description
Jan. 2006	Notice of income tax deduction for enterprises engaged in R&D activities (Cai Shui (2006) No.88)	– R&D costs can be deduced at the rate of 150% from income tax. – Costs related to the training of own employees for R&D activities will be deduced from income tax as long as the sum is less than 2.5% of total base taxable. – Accelerated discounting rate for R&D equipment.
Jan 2008	State Council Order No.512 on the Implementation Regulations of Corporate Income Tax Law	0% income tax for first three years, and 50% reduction of income tax rates for years 4 to 6 for PV production firms. (standard corporate income tax rate in China: 25%).
Mar. 2009	Provisional Regulations on subsidies for building-integrated photovoltaics (Cai Jian (2009) No.129)	Benchmark subsidy level: 20 Yuan/Wp to building-integrated PV projects.
Jul. 2009	Notice of the Implementation of the Golden Sun Project (Cai Jian (2009)	Grants of 50% of the funding needed for PV power projects (with grid connection); and grants of 70% for PV power investment in remote regions (no grid connection).
Jul. 2011	NDRC Notice of PV electricity grid price (Fa Gai Jia Ge (2011) No.1594)	PV electricity grid price is fixed at 1 Yuan/Kwh (and 1.15 Yuan/kwh for Tibet).
Sept. 2011	Notice for Strengthening the Management of the Golden Sun and building-integrated PV projects (Cai Jian (2010) No. 662)	Subsidies for project installation and other costs (excluding purchasing costs): 4, 6 or 10 Yuan/W. 50% subsidies for the cost of panels (silicon), inverters and electricity storage facilities, paid directly to production firms.
Feb. 2012	PV Industry 12th FYP (2011-2015), MIIT	By 2015: – Polysilicon capacity of leading firms to reach 50kt; PV cells at 5GW. – Efficiency of mono-silicon cells to reach 21%, poly-silicon cells to reach 19% and thin-films 12%. – To increase the industrial scale of new general thin-film production. – Costs of PV cells to reach 7k Yuan/Kw, PV systems to reach 13k Yuan/Kw and PV electricity generation costs to reach 0.8 Yuan/Kwh.
Mar. 2012	PV electricity technology 12th FYP (2011-2015), MOST	– Ensure the economy of scale of PV technology. – Continue R&D into new and emerging PV technologies.

Mar. 2012	Provisional Regulation of the Renewable Energy Electricity Price Added Subsidy Fund (Cai Jian (2012) No. 102)	Subsidies for PV power grid connection, construction and maintenance, to project developers, based on the distance of the connection: 0.01, 0.02 and 0.03 Yuan/kwh for <50km, 50km-100km and >100km respectively.
Sept 2012	China Development Bank, NDRC	– Guidelines to ensure that the necessary loans are provided to 12 PV firms in China.
Sept 2012	PV Electricity 12th FYP (2011-2015)	– By 2015, PV electricity installation to reach 21 GW and annual electricity generation to reach 25 billion Kwh. – Total Distributed PV electricity capacity in Eastern regions to reach 10 GW. – To establish 100 renewable energy pilot cities and 1,000 parks/districts.
Sept 2012	Notice of applications for large scale Distributed PV Electricity Power pilot projects (National Energy Administration)	To support 3 pilot projects for each province with a unit capacity of less than 500 MW.
Oct 2012	Guidance for Distributed PV Electricity Power Pilots Implementation Plan (National Energy Administration)	Provision of formalised procedures to implement such projects.
Oct 2012	State Grid's Notice on strengthening PV electricity grid connection	– Grid connection work will be started within 20 days of a request from PV firms. – Free connection for PV installations with less than 6MW and below 10kV. – Grid will purchase PV electricity surplus. [zero cost for project implementers]
15 July 2013	Suggestions on promoting the healthy development of PV industry (关于促进光伏产业健康发展的若干意见)	– PV sector is strategic and emerging sector that will grand China continuous competitiveness at global level. – 35GW of installed PV power by 2015, with an annual growth rate of 10GW for 2013-2015. – Priority is distributed PV power. – General guidance on PV sector restructuring and policies areas is given.
18 July 2013	Provisional Regulations of distributed power generation (分布式发电管理暂行办法)	– Grid should provide facility and takes the charge of the connection of distributed power (including PV power). – Major electricity generated from distributed power is for own use. The rest can be sold to the grid. – Subsidies are given whether to the construction or the unit electricity price
24 July 2013	Notice on subsidies of distributed PV power generation (关于分布式光伏发电实行按照电量	– Subsidies based on unit of electricity generated. – Subsidies will be given by MOF through the grid to PV power installers.

	补贴政策等有关问题的通知)	– Other RENs, such as PV power station, wind power station, etc. continue to receive subsidies previously defined by other policies.
	Notice on the development of pilot distributed PV power projects (关于开展分布式光伏发电应用示范区建设的通知)	– Identify 18 pilot projects to be conducted at different regions in China. – Major use of electricity from distributed PV power is own use. – The rest of electricity is purchased by the grid.
22 August 2014	Notice of supporting financial services of distributed PV power generation (关于支持分布式光伏发电金融服务的意见)	– CDB provides loan facilities to distributed PV power projects. – In particular, in association with national and local pilot projects of low-carbon cities and distributed PV power generation. – CDB provides facilities and flexibilities on third-party insurance and guarantee systems for distributed PV power projects.
26 August 2014	Notice on the use of pricing policies to stimulate the development of PV sector (关于发挥价格杠杆作用促进光伏产业健康发展的通知)	– FIT at 1, 0.95 and 0.90Yuan/kwh based on regions for PV power generation station. Difference with conventional electricity grid price is covered by REN Development Fund. – Unit subsidies of 0.42Yuan/kwh for distributed PV power. This is paid by REN Development Fund via the grid.
27 August 2014	Notice on the adjustment of additive fees of renewable energy and environmental protection electricity price. (关于调整可再生能源电价附加标准与环保电价的有关事项的通知)	– Increase the REN additive fee from 0.008Yuan/kwh to 0.015Yuan/kwh for electricity use except for agricultural and households.
16 September 2013	Standards of PV manufacturing sectors (光伏制造行业规范条件)	– Strictly limit pure expansion of PV production capacity, own capital rate of total investment of new expansion/installation of PV production capacity should be higher than 20%. – PV production firms must possess R&D activities: for each year, at least 3% (and more less than 10Mn Yuan) of total sale revenue of the firm should be used to conduct R&D and production process improvement activities. – Minimal annual production capacity is set: 3000ton for polycilicon, 1000ton for silicon ingot and rod, 50Mn pieces for silicon wafers (pellet), 200MWp for PV cells and panels, 50MWp for thin film PV panels. – Minimum technical standard of products, energy intensity, water consumption standards for existing PV production firms. – More stringent minimum technical standard for new installations of PV production capacity.

24 September 2013	Provisional regulation of PV power station	– Requirement of good planning of PV power station installation. – Detailed administrative plan of PV power station installation.
29 September 2013	Notice on the VAT of PV power generation (关于光伏发电增值税政策的通知)	– From 1 Oct. 2013 to 31 Dec. 2015, 50% reduction of VAT of PV power electricity sold from generator.
11 October 2013	Provisional regulation of Standards of PV manufacturing sectors (光伏制造行业规范公告管理暂行办法)	– Implementation plan of assessing the compliance of PV production firms to standards published in "Standards of PV manufacturing sectors".
29 October 2013	Letter for consultation of distributed PV power generation activities and scales in 2013 and 2014 (关于征求2013、2014年光伏发电建设规模的函)	– NEA requires local governments to provide 2013 distributed PV power generation development report and provide suggestions for 2014 targets.
18 November 2013	Notice of the publication of Provisional regulation of distributed PV power generation projects (关于印发分布式光伏发电项目管理暂行办法的通知).	– Provide regulations for distributed PV power projects.
19 November 2013	Notice of the exemption of governmental funds added fees of own use redistributd PV power (关于对分布式光伏发电自发自用电量免征政府性基金有关问题的通知).	– REN electricity price added fees, National key hydro power fund added fees, Supportive Fund for migration due to key hydro power installation added fees, Agricultural loans Fund added fees are usually collected from electricity price in China. This notice exempts these four fees from own use electricity generated by distributed PV power.

Source: IDDRI, based on online documentation.

ANNEX 3: A TYPOLOGY OF COOPERATION MODES IN INTERNATIONAL INITIATIVES ON CLIMATE CHANGE

Mode of cooperation	Example
Regulatory harmonisation	Regulations for the energy efficiency of ships adopted by the International Maritime Organisation (IMO) in 2011 under the MARPOL treaty, and entering into force on January 1 2013.
Voluntary regulatory standards or international voluntary benchmarks	The development by the US, EU, Australia and China of energy efficiency standards for external power supplies using a standardised testing methodologies, and a flexible 'tiered' system of energy performance standards. The US, Australia, Europe, China, Korea and Canada have introduced domestic policy measures based on the performance standards developed (cf Ellis and Rozite, 2013)
'Soft' cooperation through capacity building, knowledge and best practice exchange, creation of new knowledge networks	Many initiatives focus on policy dialogue and capacity building activities. Indeed, this kind of activity seems to predominate in multilateral initiatives on energy and climate. While often seen as less 'action-oriented', such capacity building initiatives can have important, albeit perhaps less visible, benefits (Baker and McKenzie, 2009).
Knowledge production and dissemination	Some initiatives focus on the production and dissemination of new knowledge, as a policy support to government authorities and other stakeholders such as the private sector. Examples include the technology roadmaps produced by the IEA, or the Global Atlas for Renewable Energy undertaken by the Multilateral Solar and Wind Working Group of the Clean Energy Ministerial.
Tracking progress on implementation	Some initiatives also include a component of tracking progress on policy adoption, and the implementation and achievement of policy pledges.

Source: authors.