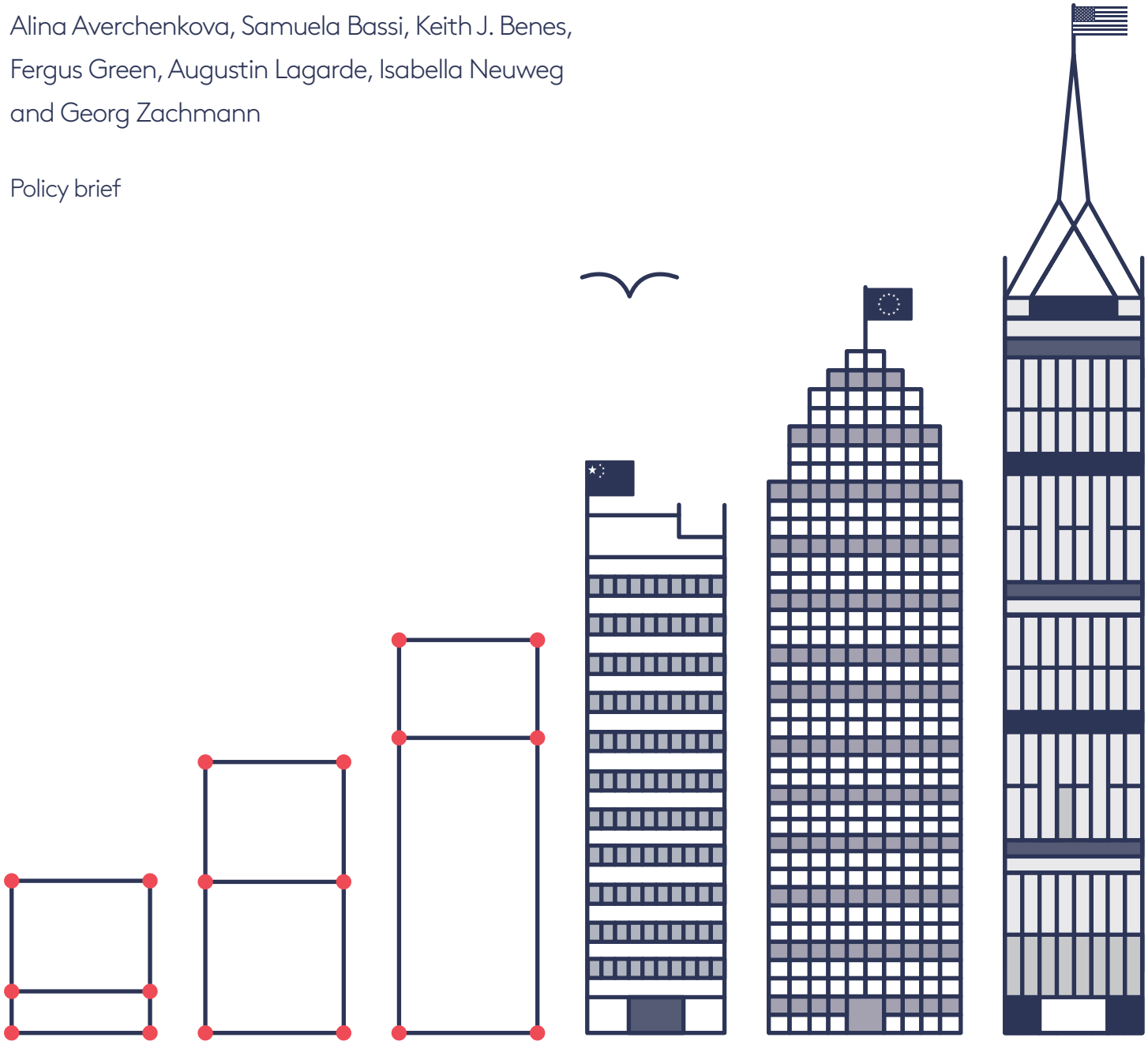
Climate policy in China, the European Union and the United States: Main drivers and prospects for the future

Alina Averchenkova, Samuela Bassi, Keith J. Benes, Fergus Green, Augustin Lagarde, Isabella Neuweg and Georg Zachmann

Policy brief



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This policy paper is the product of a multi-institutional collaboration between the Grantham Research Institute on Climate Change and the Environment at the London School of Economics and Political Science, the Bruegel Institute (Brussels), Tsinghua University School of Public Policy & Management (Beijing), and the Center on Global Energy Policy at Columbia University (New York). The initial research was carried out by each of these three last-mentioned institutes, focused on their respective jurisdictions, and using a uniform questionnaire designed by all of the institutes. Based on these research inputs, the Grantham Research Institute produced this Policy Brief, which was reviewed by all collaborating institutes and by two independent reviewers.

Executive summary

An improved understanding of current national climate policies, and the factors that drive their development and implementation, is required to aid the domestic implementation of climate policy under the Paris Agreement.

The purpose of this Policy Brief is to assess the key factors affecting both the development and the implementation of climate policies in three key jurisdictions: the People's Republic of China, the European Union (EU) and the United States (US). The aim is to assist policy-makers, climate change negotiators and analysts from outside these jurisdictions to understand the domestic constraints and opportunities facing each jurisdiction, and to identify areas of common interest or concern, facilitating both mutual understanding and cooperation.

China, the EU and the US together are responsible for the majority of global emissions of greenhouse gases, and produce about half of global GDP. Hence, their climate and energy policies not only have a strong influence on current and future global emissions of greenhouse gases, but also affect policy developments in other countries. Here we outline their key policies, describing some of the key drivers, including economic factors, institutional settings and features of the political systems, as well as the role of public opinion, interest groups and party politics.

Over the past decade, China, the EU and the US have all made progress in developing and implementing climate policies. Yet each of these three jurisdictions faces unique challenges in delivering on, and raising the ambition of, their nationally determined contributions (NDCs) to the Paris Agreement. This study highlights where levers for more ambitious climate policies lie and where structural factors as well as economic or political developments will likely help or hinder progress.

For instance, the co-benefits of fostering a growing green industry and reducing air pollution are so palpable that they have persuaded China to move strongly toward a low-carbon path for economic growth. To help this transition, China could improve incentives and mechanisms for its State-Owned Enterprises and the provinces to comply with targets set at national level. It could also allocate adequate resources to monitor compliance. The EU, on the other hand, will need to broker a deal between more and less ambitious Member States and unite them behind a common vision for the European energy market. It could also further mobilise the established and growing low-carbon industry as its ally. For the US, bottom-up action by cities or States could help to ratchet up ambition at the federal level. A few proactive States should champion more ambitious US climate policy. At the same time, a committed executive branch could make further use of provisions under the Clean Air Act to advance climate policy at the federal level. However, this seems unlikely to happen under the recently elected Donald Trump.

This analysis of the trends in the development and implementation of climate policies illustrates the importance of understanding the diversity of economic, institutional and political factors at the national level, as well as their interplay with public and private interests and the media. These will strongly affect countries' ability to implement their NDCs and to ratchet up ambition in the future. Notably, the study shows that the relative importance of the factors investigated differs across the three jurisdictions.

In China, the rise and fall of emissions is closely linked to economic development and the ongoing transition of its economy. For the EU, energy security and economic concerns have been key drivers of European leadership on climate policy and its promotion of the renewable energy industry. The EU also has an institutional system that enables the European Commission, Parliament, and some Member States to champion ambitious action on climate change. Institutional leadership matched with favourable public opinion, influential green parties and active non-governmental organisations has allowed it to agree successive packages of relatively ambitious climate and energy policies for 2020 and 2030. In the US, political institutions enable economic interests, partisanship and ideology to polarise the political debate and stymie climate action via the legislative branch. However, they also leave room for executive action from the President and the Environmental Protection Agency.

Despite these differences, there are some similarities. For instance, the political economy of climate and energy policy in the jurisdictions is driven by similar dynamics. In China, carbon-intensive industries determine to what extent climate policies are de facto implemented at the provincial levels. Similarly, the voting behaviour of Members of the European Parliament (MEPs) on climate policy tends to be strongly correlated with the carbon intensity of the Member State they represent. This is comparable to the US where legislators from States with large fossil fuel resources and/or a large share of energy intensive industries try to deter ambitious climate action. Also, despite the different governmental systems within the three jurisdictions, they all operate in a fairly decentralised way, with much of the implementation happening at the subnational level.

Key findings by jurisdiction

Key findings for China

1) Likelihood of achieving targets:

China will likely meet the targets in its nationally determined contribution (NDC) to peak carbon dioxide emissions by 2030 at the latest, and to reduce the carbon intensity of its economy by 60-65 per cent by 2030 compared with 2005.

2) Enhanced monitoring, reporting and verification:

A significant challenge for the successful implementation of climate policies is that regions and industries (including state-owned enterprises) that suffer economic losses as a result may seek to evade them. Monitoring, reporting and verification (MRV) and enforcement capacity will therefore need to be improved if targets and standards are to be fully implemented. A more rigorous and better resourced system would help to improve access to information and help more effective implementation of climate policies. Key for this is to have independent MRV enforcement capacity at the local level i.e. funded by the national level and not by the local level, where leaders are more likely to be conflicted.

3) Energy market reform to increase renewable energy penetration:

Further state measures to support the accelerated scale-up of renewable and other non-coal energy sources — such as feed-in tariffs and green finance initiatives — offer strong potential for climate change mitigation in China, as they lead to industrial modernisation and innovation, job creation, lower air pollution and improved energy security. Such measures are likely also to enjoy widespread public backing. However, as renewable sources compete for grid access with fossil fuel incumbents in a flat energy market, the former may continue to be under-utilised relative to their potential, as local governments and market operators favour coal-fired utilities. Reforming the electricity market to avoid these problems will be a considerable challenge over the coming years. The challenge of connecting major hydro and wind resources to distant populations continues to be a major driver of China's growing grid investments.

4) Developing transition strategies for steel and coal mining:

The biggest challenges for China's climate policies relate to phasing out high-carbon and energy-intensive industries, such as coal-mining, coal-fired power generation, and steelmaking — industries in which the state and party are deeply entangled. Nevertheless, China has committed up to 100 billion yuan (US$15.27 billion) to cover the significant lay-offs they expect in the steel and coal industries as a result.

5) Addressing rising non-CO_2 gases:

China's overall greenhouse gas emissions are likely to continue to grow until and beyond 2030 due to expected higher production and application of fertilisers, expansion in the electric power sector, coal-mining and because current policies are likely to be insufficient to address non-

CO_2 greenhouse gas emissions. China will need to implement additional policies to reduce emissions of non-CO_2 gases especially from the chemical, electrical, coal mining and agricultural industries.

Key findings for the European Union

1) Likelihood of achieving targets:

The European Union (EU) will need to increase its current ambition and ensure effective policy implementation in order to meet its 2030 targets. Current policy assessments indicate that the EU's emissions are likely to exceed its 2030 target by about 5-10 percentage points. The EU will need to at least double the annual rate of emissions reductions from 2015 onward to meet the 2030 target, focussing on power generation, industry, transport and buildings.

2) Stable climate policies and leadership from the European Commission:

The climate policies already in place commit the EU to a continued reduction in emissions until 2030. A constant annual reduction factor under the EU emissions trading system (EU ETS) directive will bring the issuance of new allowances to zero by 2067. This target can only be changed by a qualified majority. The EU's integrity is being threatened by a number of current crises (e.g. the economic malaise that has persisted since the global financial crisis and challenges particularly from southern Member States; the refugee and migrant crisis; and the growing sense of dissatisfaction within some Member States about the concept of a federal Europe). Yet the European Commission - a permanent bureaucracy with a long record of climate leadership – so far has shown itself capable of driving the climate policy agenda among EU institutions and Member States, even amidst significant shocks, such as the global financial crisis and its regional aftermath. Hence, unless the institutional set-up of the EU itself is undermined, the European Commission will continue to play a significant role in shaping the climate policies of Member States.

3) Reform despite resistance:

The EU must deal effectively with resistance to European climate change policies from Member States with large fossil fuel resources and/ or large pollution-intensive sectors as it proceeds with the implementation of the Energy Union and the reform of other key policy instruments (i.e. the EU ETS) geared to achieving its existing climate targets for 2020 and 2030. The Market Stability Reserve agreed as a reform of the EU ETS will be insufficient to remove the oversupply of permits. Since renegotiations have started over the EU ETS, the divide over how ambitious the EU should be in its climate policies after 2020 has re-emerged among the Member States, creating a risk that the EU will focus on its current commitments to 2020, and delay decisions on increasing its post-2020 ambition. Instruments such as the Modernisation Fund, which sets aside allowances from the EU ETS to support lower income Member States to modernise their energy systems, will need to be further developed and transparently implemented.

4) Energy Union as a give-and-take:

The European Commission needs to come up with a package of energy and climate policies that makes Member States better off by reaching high-level compromises on issues that they consider to be secondary. For example, Germany might increase efforts to help central and eastern European partners to modernise their energy infrastructure, who in return might accept a continuation of the EU's decarbonisation ambition. Or France may cease its insistence on strong government intervention into energy markets and prices if the price of allowances for the EU ETS is sufficiently high to make its nuclear power generators more competitive. However, such compromises between Member States might unbalance delicate compromises between domestic stakeholders. Hence, the European Commission must seek for this agenda to be discussed by heads of states and by ministers of energy and environment, as they are often more aware of sectoral preferences and sensitivities.

5) Focus on low-carbon innovation:

European research and development spending on innovation has been decreasing since 2009 and is now at a record low level (although large disparities exist between the Member States on innovation spending, and some have been investing more). There is also little cooperation between Member States on low-carbon innovation. However, the EU is working to improve this. The EU has set a target to increase overall innovation spending from the equivalent of 2 per cent of GDP at present to 3 per cent (1 per cent public funding, 2 per cent private-sector investment) by 2020. In addition to plans to double its funding for clean energy research under the Horizon 2020 programme, the EU is preparing an integrated research, innovation and competitiveness strategy for the Energy Union, to be launched in November 2016. It has also joined Mission Innovation, a global initiative on clean energy launched at COP21.

Key findings United States

1) Likelihood of achieving targets:

In order to meet the target in its nationally determined contribution (NDC) (decreasing annual emissions by 26 to 28 per cent below 2005 levels by 2025) the United States (US) will not only have to increase its ambition for emissions reductions from its power sector, but will also need to introduce more ambitious policies for emissions reductions from its industry and transport sectors, amongst others.

2) Executive branch action can drive climate policy:

The institutional system in the US has a high separation of powers between the legislative (Congress) and executive (President) branches that makes aligning different priorities between the two difficult. On the other hand, it also vests the executive with considerable powers to develop policies independently of Congress. For instance, President Obama released the Climate Action Plan in June 2013, which directed federal agencies to take concrete steps to reduce emissions, and proposed the Clean Power Plan, which aims to cut carbon dioxide emissions from the power sector by 32 per cent compared with 2005 levels by 2030.

3) Subnational action as driver:

The 50 States have considerable authority. In some areas, their authority extends beyond that of the federal government, and in other areas authority is shared between the Federal and State governments. This means that many policy ideas are first generated locally, with much climate policy leadership coming from the States. For example, 19 States have indicated that they will continue to submit plans to comply with the Clean Power Plan, and thus reduce emissions from their power sectors, despite the stay by the Supreme Court. Together they represent 36 per cent of the emissions reductions that would be delivered by the Clean Power Plan in the interim period (2022-2029), and 30 per cent of the cuts expected by 2030 and beyond. Nevertheless, the election of Donald Trump as President creates significant uncertainty.

4) Risk of roll-back of climate policies post-election:

Donald Trump announced during the presidential campaign and in his America First Energy Plan that he would cut all federal climate spending by eliminating domestic and international climate programs, withdraw from the UNFCCC Paris Agreement, repeal the Clean Power Plan, encourage use of fossil fuel resources and dismantle climate policy in general through executive action. This is unlikely to be a straightforward, quick or easy process. Firstly, under existing law the US Environmental Protection Agency, the climate policy administrator, has not only the authority to regulate greenhouse gas emissions, but also an obligation to do so. Secondly, any change to regulations (including repeal) must go through the same type of rigorous public notice and comment process that the original regulations went through to become law. So changing them would take significant political commitment over several years. Thirdly,

the subsequent rule-making must take account of the administrative record compiled to support the original rule. In the case of the Clean Power Plan, this record includes hundreds of pages of technical documents and responses to 4.5 million public comments that were produced to support the final rule. A repeal or change to the regulations that does not adequately address the record that supported the regulations in the first place is more susceptible to being invalidated as 'arbitrary and capricious' by a reviewing court.

Nevertheless, given that Donald Trump will appoint at least one Supreme Court justice, likely tilting the court towards conservatism, he could seek to repeal previous amendments to the Clean Air Act that bought greenhouse gases under the EPA's remit, and override or weaken the authority of the EPA. It has already been reported that Trump will appoint a climate skeptic, Myron Ebell, to run the EPA. It is difficult to predict how quickly changes to climate policy will happen, but the Climate Action Plan and the Clean Power Plan will likely stall. Action on climate change would then depend largely on the States.

5) Importance of energy-intensive industries:

The relative importance of the energy-intensive industries to the US economy affects government willingness to implement ambitious policies to reduce emissions and also gives industrial interests a strong voice in US climate policy-making. However, the economic importance of the energy-intensive industries varies greatly between States, which means that there are leaders and laggards in climate policy at the State and local level. It remains true, nevertheless, that legislators from States with high concentrations of energy-intensive industries have actively tried to hinder more ambitious climate action in Congress and through judicial rulings (the stay of the Clean Power Plan by the highest federal US court was one outcome of several groups suing the Environmental Protection Agency).

1. Introduction

The signing ceremony of the Paris Agreement at the United Nations in New York on 22 April 2016 marked the beginning of a new chapter in international climate action. As governments have now reasserted their commitment to the Agreement, attention will turn from the international stage to the domestic arena. Questions have emerged about whether and how countries will implement the pledged targets and policies contained in their 'nationally determined contributions' (NDCs) and about the potential to increase their ambition in the future. A key need is for policy-makers to gain an understanding of the current trends in national policy-making, and their implications for the achievement of targets, as well as of the key institutions and actors that shape the design and implementation of climate policy at the national level.

The purpose of this Policy Brief is to assess the key factors affecting both the development and the implementation of climate policies[1] in three key jurisdictions: the People's Republic of China, the European Union (EU) and the United States (US). The aim is to assist policy-makers, climate change negotiators and analysts from outside these jurisdictions to understand the domestic constraints and opportunities facing each jurisdiction, and to identify areas of common interest or concern, facilitating both mutual understanding and cooperation. The framework used in this work and its main insights may serve as a useful tool for undertaking similar analyses in other jurisdictions.

This Brief provides a comparative summary of a more extensive assessment undertaken for each of the three jurisdictions in an accompanying Policy Paper 'Climate policy in the United States, China and the European Union: main drivers and prospects for the future - country analyses' (Averchenkova et al., 2016).

1.1 The study approach

China, the EU and the US were chosen as the focus of the study for three reasons. First, they are the three largest emitters, collectively emitting around 55 per cent of global greenhouse gas emissions, measured by domestic production (Boden et al., 2015; Germanwatch, n.d.), as shown in Figure 1. Furthermore, as they together import more emissions embodied in tradable goods than they export, they are responsible for up to two-third of global emissions (Boitier, 2012). Understanding the

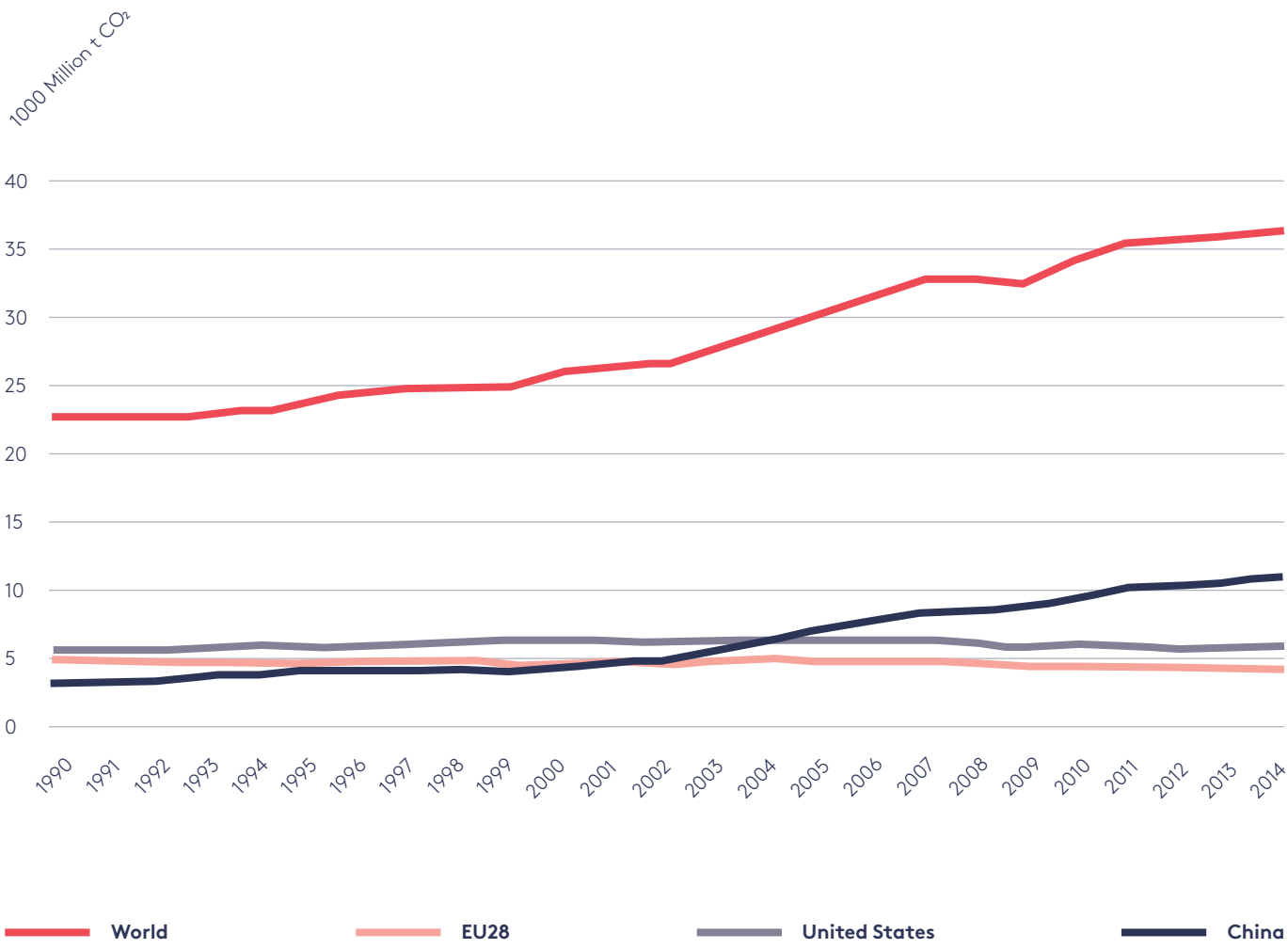
[1] 'Climate policies' in this Policy Brief refers to policies having the explicit aim and/or significant effect of reducing greenhouse gas emissions below what they would otherwise be. This definition is intended to capture policies that may have other primary objectives (e.g. energy security or air pollution reduction) if they also have a significant mitigation effect on greenhouse gas emissions. It also covers laws and regulations as well as plans and other non-legal instruments.

factors affecting domestic climate policy in these geographies is therefore key for assessing the overall dynamics of global emissions.
Second, the economies of these three jurisdictions are the three largest in the world, together accounting for 50 per cent of global GDP in 2015 (IMF, 2015). Therefore, they have an important influence on global production, consumption, trade, investment, policy and technological innovation. Hence, for the task of decarbonising the global economy, they will have significance for reasons extending well beyond the size of their emissions per se.

The following sections explore current climate change policies (chapter 2), the economic factors affecting climate change policy (chapter 3), institutions for policy development and implementation (chapter 4); public opinion, interest groups and political consensus on climate change (chapter 5), and the outlook for policy development (chapter 6) in each jurisdiction.

Figure 1. Carbon dioxide emissions in the US, China, EU (EU-28) and the world (total)[2]

Source: European Commission, Joint Research Centre, PBL Netherlands Environmental Assessment Agency (2015); Olivier et al (2015).



[2] Carbon dioxide emissions totals from fossil fuel use and industrial processes (cement production, carbonate use of limestone and dolomite, non-energy use of fuels and other combustion). Excluded are: short-cycle biomass burning (such as agricultural waste burning) and large-scale biomass burning (such as forest fires).

2. Current climate change policies

In this first part, an overview is presented of the status quo of climate policies in the three jurisdictions. The constellations of climate policies, as well as their drivers and level of ambition, differ greatly across the three jurisdictions (see Table 2).

China

China has moved from a relatively reactive approach to a much more active stance toward climate policies, integrating them closely with other policy priorities. This change has occurred in stages over the last decade, mostly driven by energy security, air pollution, and economic development objectives, as well as growing awareness of the potential negative impacts of climate change on its development. Since 2005, climate change targets have been included in the Chinese Five-Year Plans. A number of climate change laws, policies and measures have also been introduced, including: energy conservation targets and associated accountability mechanisms for officials and state-owned enterprise (SOE) managers; frameworks for monitoring, reporting and verifying progress on energy conservation/efficiency; targets and support measures (e.g. feed-in tariffs; subsidised finance, etc) for low-carbon energy; and, more recently, air pollution-related restrictions on coal production and consumption in key regions. Additionally, pilot emissions trading schemes have recently been introduced in seven cities and provinces, and a national scheme is planned for rollout in 2017.

China's 13th Five-Year Plan (2016–2020), released in March 2016, includes an updated target to reduce the carbon intensity of GDP by 18 per cent over the course of the plan period. This equates to a 50 per cent reduction in carbon intensity of GDP relative to a 2005 baseline, a more ambitious 2020 target for carbon intensity than China pledged in the 2009 Copenhagen Accord (King, 2016). The 13th Plan also includes a target to keep energy consumption within 5 billion tonnes of standard coal equivalent by 2020, which is more ambitious than the forecast target for 2020 contained in the 12th Plan (Chen & Stanway, 2016). In continued efforts to diversify their energy mix and limit coal use, the Chinese Government has also set a target to increase the share of natural gas to 10 per cent by 2020 and to have 150 GW of solar capacity, 200-300 GW of wind capacity (Roselund, 2015, The Climate Group, 2015) and 58 GW of new nuclear capacity (Xinhua, 2016) installed by 2020. Furthermore, through its NDC to the Paris Agreement in December 2015, China has committed to peak its carbon dioxide emissions by

around 2030 and to make its best efforts to peak earlier; to reduce the carbon intensity of GDP 60-65 per cent below 2005 levels by 2030; and to meet 20 per cent of total primary energy consumption from sources other than fossil fuels by 2030 (China, 2015).

European Union

The European Union (EU) has so far shown the most ambitious and consistent approach to climate change. A range of targets for emissions reductions, energy efficiency and renewable energy have been set for 2020 and 2030, as well as aspirational long-term objectives for 2050. Some of these have been translated into mandatory national targets for Member States. The targets have been accompanied by a large number of policies and regulations to curb emissions, improve energy efficiency and stimulate the uptake of low-carbon energy sources, including the world's first carbon emissions trading scheme. A new goal of establishing an Energy Union was also set in 2014 and its related strategy aims to foster affordable, secure and sustainable energy across the Member States. This represents one of ten priority areas which the Junker Commission has set for its term between 2014 and 2019.

The EU's '2030 framework for climate change and energy policies', approved in 2014, sets the objectives to be met by 2030, namely: a binding EU target of reducing annual emissions of greenhouse gases by 40 per cent below 1990 levels; a binding target of generating at least 27 per cent of energy from renewable sources; a non-binding target of improving energy efficiency by at least 27 per cent, to be reviewed by 2020 (with the potential of raising the target to 30 per cent); and an electricity interconnection target of 10 per cent between Member States by 2030 (European Commission, 2016c).

United States

In the United States (US), on the other hand, developing climate change policy at the federal level has been increasingly challenging, due to strongly divided political views on the issue along partisan lines. As a result, the US lacks comprehensive climate change legislation, but has been regulating greenhouse gases using existing laws. Furthermore, federal legislation has been shaped by judicial rulings, rather than the 'standard' legislative route (e.g. through the President and the bicameral system). Most notably, court rulings required greenhouse gases to be covered by the 1970 Clean Air Act and its subsequent amendments, so that, as from 2009, the regulation of these emissions fell within the responsibility of the Environmental Protection Agency (EPA). A number of climate-change-related regulations have since been introduced, including transport emissions standards, tax breaks for renewable electricity and several energy efficiency programmes. Given the difficulty of passing legislation at the federal level, several initiatives have also flourished at sub-national level, including renewable energy portfolios in several States and a cap-and-trade system in California (AB 32).

A key recent set of federal regulations is the Clean Power Plan (CPP), which for the first time sets a target to cut carbon dioxide emissions from the power sector by 32 per cent compared with 2005 levels by 2030 (EPA, 2015a)[3]. The Plan will be key for the US to achieve the target of reducing total greenhouse gas emissions by 26-28 per cent below 2005 levels by 2025, as per its NDC to the Paris Agreement (The White House, 2015). The legislation, however, is currently been challenged in court and it is not yet clear whether part, or even the whole, of the Plan may be invalidated. The future direction of US climate policy will also be highly affected by the outcome of the 2016 Presidential election (see Chapter 6).

[3] And emissions from sulphur dioxide would be reduced by 90 per cent and nitrogen oxides cut by 72 per cent by 2030 compared with 2005 levels.

Table 2. Status quo of climate policy in the three jurisdictions

Sources: China (2015); Chen & Stanway (2016); The White House (2015).

	China	EU	US
Key climate policies and legislation	No dedicated climate change law (but in progress). Climate-relevant policies and measures: • Air Pollution Prevention and Control Plan (2013) • Several targets set in Five-Year-Plans (esp. 2011-15; 2016–20) • Pilot carbon emissions trading schemes • Moratorium on new coal mine and possibly coal-fired power station approvals (2016); plan to eliminate 500 million tonnes of coal capacity	• 2020 Climate and Energy Package (2009); • 2030 framework for climate and energy policies (2014) • EU Emissions Trading System (2005)	No dedicated climate change law. Relevant legislation: • Clean Air Act (1963, interpreted in 2009 to apply to greenhouse gases) • Climate Action Plan (2013) • Clean Power Plan (proposed 2015, awaiting legal ruling)
GHG targets			
Short term	• 2020: Carbon dioxide emissions intensity of GDP 50% lower than in 2005 (13th Five Year Plan)	• 2020: 20% reduction in annual greenhouse gas emissions compared with 1990	• 2020: 17% reduction in annual greenhouse gas emissions compared with 2005 • 2025: 26 -28% reduction in annual greenhouse gas emissions compared with 2005 (NDC)
Medium term	• 2030: Peak carbon dioxide emissions by 2030 or earlier; CO2 intensity of GDP of 60-65% below 2005 (NDC)	• 2030: 40% reduction in annual greenhouse gas emissions compared with 1990 (NDC)	• 2030: proposed 32% reduction in annual greenhouse gas emissions compared with 2005 for power sector
Long term	N/A	• 2050: 80–95% reduction in annual greenhouse gas emissions compared with 1990	N/A
Renewables targets	• 15% of primary energy from low-carbon sources by 2020 and • 20% of primary energy from low-carbon sources by 2030.	• 20% of primary energy from Renewables by 2020 (with individual Member States' targets) • 27% of primary energy from renewables by 2030 (no individual targets)	• 20% of electricity from non-hydro renewables by 2030 (President announcement 2015)
Energy efficiency targets	• Energy conservation targets in the Five Year Plans • Energy efficiency standards for vehicles, buildings, appliances and industrial equipment	• 20% improvement in energy efficiency vs 'business as usual' by 2020; • 27% improvement in energy efficiency vs 'business as usual' by 2030 • Emission standards for light duty vehicles • Energy efficiency standards for buildings	• 20% of electricity from non-hydro renewables by 2030 (Presidential announcement, 2015)

3. Economic factors affecting climate policy

Different economic circumstances, including resource endowments (Figure 2) and the carbon intensity of manufacturing sectors, within the three jurisdictions affect the preferences of businesses and other stakeholders, which in turn can influence the design, implementation and outcomes of climate change policies.

China

China is a middle-income developing country. While its formerly centralised economy has been gradually opened-up and marketised since the late 1970s, a high proportion of its economy remains under state control. State-owned enterprises (SOEs) dominate in the energy sector — particularly fossil fuel businesses — and in numerous other high-carbon sectors, such as steel and cement manufacturing. Its industrial development has heavily relied on fossil fuels, especially large domestic coal resources. In 2013, roughly half of the world's coal, steel and cement production took place in China (Green & Stern, 2015). As a result of this heavy-industry-focused growth model, overall energy consumption, fuelled by coal in particular, soared during this period (see Green & Stern, 2015; Green & Stern, 2016). This has led to a large increase in emissions of greenhouse gases — especially in the period between 2001 and 2013 — as well as significant local pollution effects (particularly from coal power plants), triggering public demand for climate policies and stimulating Government action.

The way in which China manages its rapid urbanisation will also influence the trajectory of its emissions pathway in the future. China's urban population is expected to increase from around 700 million in 2013 to around 850 million in 2020, and to approach 1 billion in the late 2020s (World Bank & Development Research Center of the State Council, 2014). World Bank (2015a; 2015b) data show China's urban population was 53 per cent of China's total population of 1.36 billion in 2013. China's urbanisation plan has a target urban population of 60 per cent by 2020 (Xinhua, 2014b), implying a total of about 850 million urban residents on the assumption that China's total population at that time will be around 1.4 billion. China can manage this extraordinary urbanisation in a way that reduces traffic congestion and inefficient public transport, as well as air pollution, and builds adequate infrastructure for energy, water and waste; this would also limit greenhouse gas emissions (Floater, Rode, Friedel & Robert, 2014).

Political attention has recently moved from a near-exclusive focus on generating high rates of economic growth, to a greater emphasis on the quality of growth, often referred to as the 'new normal', creating greater political space for policies that reduce greenhouse gas emissions. This has entailed state support for low and zero -carbon energy

[3] And emissions from sulphur dioxide would be reduced by 90 per cent and nitrogen oxides cut by 72 per cent by 2030 compared with 2005 levels.

industries, for example China matched Europe's investment in research and development for renewable energy for the first time in 2015, spending US$2.8 billion (Frankfurt School-UNEP Centre/BNEF, 2016). This has entailed measures to reduce over-capacity in the coal and steel sectors through targets for capacity reduction, and funds to restructure poorly-performing companies and resettle millions of displaced workers from these industries.

These new economic dynamics have made it both easier and more justifiable for the Government to develop further climate change policies, as these are now seen as net-beneficial and complementary to the 'new normal' growth model and the wide-ranging reforms needed to fully achieve it. However, fully implementing the new growth model requires considerable reform of institutions, including SOEs and the financial sector, as well as fiscal arrangements (IMF, 2015). Implementation is being affected by the political economy that has evolved under the old model of growth. High-carbon producers and energy-intensive manufacturers, which tend to be concentrated in particular regions, will likely suffer financial and job losses, leading to resistance from the affected sectors (disproportionately SOEs) and the sub-national governments in the regions where these firms operate (Hornby, 2016).

European Union

In the past three decades, the European Union (EU) has seen a rapid increase in its dependence on imported fossil fuels, especially from volatile suppliers such as Russia, which has led to growing concerns over security of supply. Net imports increased from less than 40 per cent of gross energy consumption in the 1980s to reach 53 per cent by 2013 (Eurostat, 2015a). This has provided a common motivation for Member States to seek climate policies that also reduce energy use or create substitutions for imported fossil fuels. Yet large disparities in economic performance and fossil fuel endowments between Member States have affected their willingness to commit to ambitious climate objectives.

While the EU's GDP almost doubled between 1990 and 2012[4], the growth slowed down and declined in 2008 and 2009, and then again in 2012, due to the global financial crisis. Yet the EU still retains the largest share of the world GDP among the three jurisdictions, at about 17.3 per cent in 2014 (World Bank, 2016b). However, there are large differences among the Member States in per capita income – ranging from US$17,200 in Bulgaria to US$98,500 in Luxembourg (World Bank, 2016a) - and in their capability to recover after the crisis.[5] Since 1990, the EU has experienced a general decoupling of economic growth from greenhouse gas emissions. Overall, energy industries are by far the largest source of emissions, accounting for about 33 per cent of the total in 2011[6], followed by the transport sector (21 per cent) and manufacturing and construction (20 per cent) (European Commission, 2014).

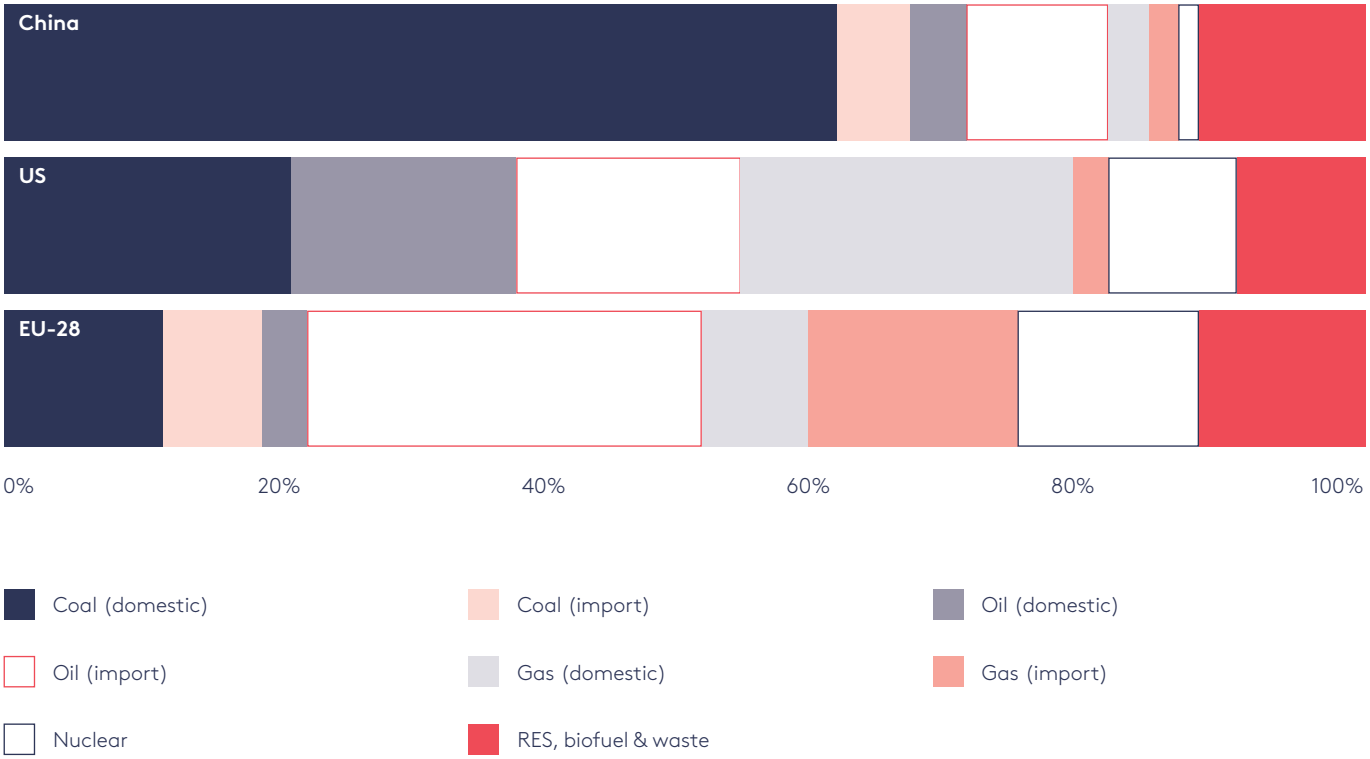
Structural and public budget reforms have been the main priorities in the aftermath of the financial crisis in the EU. However, short-term boosts, in the form of 'green' investment (see e.g. Spencer, Bernoth, Chancel, Guerin, & Neuhoff, 2012) that could increase productivity and employment, improve economic resilience against fossil fuel prices, and facilitate the low-carbon transition, are needed to meet EU climate change objectives. Although innovation is a stated policy priority for the EU to enhance competitiveness (European Commission, 2014), public and private financial support for low-carbon research and development is relatively low. Private investment in research and development in the energy sector is four to five times lower now than it was 20 years ago (International Energy Agency, 2015).

[4] EU GDP increased by 44 % (in volume terms)

[5] In 2014 growth rates ranged from negative 0.4 per cent in Croatia, Finland and Italy, to positive 5.2 per cent in Ireland (The World Bank, 2016a).

[6] 2011 is the last year for which official UNFCCC data is available.

Figure 2. Primary energy supply (2012)



United States

The United States (US) can count on large domestic resources of coal, oil and gas, especially thanks to the recent development of shale reserves. Furthermore, it is still reliant on significant energy imports, especially of oil. This has contributed to relatively high emissions per capita in the US[7], which in 2014 were the world's third largest, after Saudi Arabia and Australia. Overall, the key sectors responsible for the highest shares of greenhouse gas emissions, and therefore the ones where mitigation policies are most needed, are electricity generation (about 31 per cent in 2013), transportation (27 per cent) and industry (21 per cent).

The economic importance of the energy-intensive industries varies greatly between States. For example, the mining sector (crude oil, natural gas, coal and ore extraction) contributed only 2 per cent to total US GDP in 2013, but its share of GDP in some States, such as in Texas, Wyoming, Alaska and West Virginia, accounts for more than 10 per cent (EIA, 2014). Elected representatives in these States tend to strongly oppose federal climate change regulations.

Reliance on imported fossil fuels (particularly oil) in the past has led to strategic concerns about energy security[8], motivating legislation that has mandated larger use of renewable fuels in the transport sector (Leiby, 2007), notably the Renewable Fuel Standard programme from the Environmental Protection Agency (Earley, 2009).[9] However, the energy security argument has not proved sufficiently powerful to generate broader support for climate change action in other areas. Energy security has become less of a policy driver because of the large-scale development of hydraulic fracturing and horizontal drilling in the US. Significant emissions reductions have been achieved in the past decade due to non-policy drivers, in particular the substitution of coal in power stations as the price of natural gas has dropped to the abundance of supply from shale reserves and

[7] About 16.5 tonnes in 2014 (Oliver, J., Janssens-Maenhout, G., Muntean, M., Peters, J., 2015)
[8] In 2007, oil imports made up over 60 per cent of annual petroleum consumption, a quarter of it coming from the Middle East.
[9] The increased use of bioethanol, however, has generated concerns over biodiversity impacts and raising food prices

the reduction in demand for electricity during the financial crisis and economic downturn (OECD, 2014). Yet overall the low-carbon sectors in the US economy remain relatively slow-growing. Furthermore, evidence suggests that the scale-up of new technologies has not been maximised due in part to policies that have left domestic demand weaker than it might be, financing harder to obtain, and the innovation pipeline unsecured for the future (Brookings, 2011). The future of clean technology investment will remain strongly dependent on policy choice in the absence of strong economic signals, such as carbon pricing. The US therefore appears particularly vulnerable to possible sudden changes in Presidential and Congressional priorities following the US elections in November (see section 5).

Table 2 summarises the key economic factors and their influence on climate change policies in the three jurisdictions.

Table 2. Summary of economic factors affecting policy

	China	EU	US
Energy resources	• Domestic access to cheap coal • Imports most of its oil and natural gas, and some coal	• Large fossil fuel import dependency • Wide differences in domestic resources between Member States (e.g. coal in Poland; natural gas in the Netherlands) • Nuclear phase-out is being discussed in several Member States	• High endowments of oil and natural gas (including from shale) • Domestic access to cheap coal • Switch to natural gas has reduced coal in electricity generation mix
Importance of energy-intensive industries	• Structural change toward higher value-added manufacturing and service sectors • High-carbon producers and energy-intensive manufacturers play large role in some regions; require financial support for phase-down	• Coal- and natural gas-powered energy utilities and large energy users can be strong economic players. Their influence tends to be offset by lower-carbon sectors in western Member States but not eastern Member States)	• Their influence varies greatly across States, but in some they are very powerful • Leader in innovation on energy efficiency technologies
Energy security	• Energy security concerns have been strong motivator for energy conservation and alternative energy policies since ~2006	• Strong concerns over increasing oil and natural gas import dependency, especially from Russia	• Historical energy security concerns concerning crude oil, but recently mitigated by domestic shale oil exploitation
Implications of economic factors for climate policy	• Delicate balance between economic development concerns and climate change mitigation • Increasing importance of low carbon industry to economy • Recent strong investments in renewables • State-owned enterprises can exert high influence	• Some Western Member States push for renewables as economic and energy security opportunity • Eastern coal-rich Member States driven towards less ambitious climate action • Lobbying from both carbon-intensive and low-carbon industries	• Strong lobbying from coal, oil and natural gas industries • Increasing counterweight from growing renewables sector (solar and wind)as a result of decreasing costs of low-carbon technologies • Energy producing and industrial States can delay climate legislation

4. Institutions for climate policy development and implementation

Institutions make and shape climate policies. Institutional systems define how power is distributed among decision-making bodies (i.e. legislative, jurisdictional and executive branches) and across levels of administration (i.e. federal or central systems of governance). The way power is distributed across different institutional bodies also affects the extent to which political leaders can exert influence. Overall, the concentration of authority can facilitate leadership if key policy-makers are personally committed to climate action, in the same way that this can lead to stagnation in climate policy if they are not (Harrison & Sundstrom, 2007).

On the other hand, institutions affect climate policies because implementation depends, to a large extent, on the capacities institutions have to ensure enforcement and oversight of their policies. Institutions generate a mix of sanctions and incentives which steers political, social and economic actors towards certain types of behaviour (Ostrom, 2015; Purdon, 2015). Whether these go in the direction intended by policy-makers is often difficult to predict at the stage of policy development. Successful implementation thus depends on the institutional capacity possessed by policy-makers to correct for unintended policy outcomes (Jänicke, 1992). The monitoring, reporting and verification (MRV) mechanisms in place can help detect when policies 'go off-course' and provide necessary tools to measure and improve their performance. In addition, they enable comparability of climate action between nations. In the context of international climate negotiations, MRV is of particular importance for guaranteeing transparency and generating trust between parties. Based on the United Nations Framework Convention on Climate Change, we define monitoring as the measurement of efforts to address climate change and to the impacts of these efforts, including the level of emissions of greenhouse gases by sources and removals by sinks, overall emissions reductions and other co-benefits. Reporting refers to the presentation and transmission of data, measurements, and associated analysis. Verification refers to the evaluation of emissions reductions and other information that is measured and reported.

Institutions vary greatly across the three jurisdictions. However, there are some similarities in the way that these institutions affect the development and

implementation of climate policies. With regard to policy-making, the nature of institutions in the US and China results in a centralised concentration of authority in key decision-makers, while the EU's policy development is more fragmented.

Congressional gridlock in the US has meant that federal policy development has been largely left to the President (within the limits of existing authority), with the result that climate policies are highly dependent on the personal commitment of the President at a given point in time.

For very different reasons, climate policy-making in China is also highly concentrated in the national party and state organs. Whilst this renders China's climate policies vulnerable to subordination to other higher priority issues, the fact that the objectives of climate change mitigation are overwhelmingly convergent with the direction of economic development strategy, economic reform, and domestic environmental and energy policy means that in practice the direction of climate policy development is highly stable.

In the EU, on the other hand, many organs and actors are involved in policy development, meaning policy agreement can be harder to build, yet policy is relatively stable once consensus is achieved, with the European Council and European Commission being the main sources of initiatives.

The three jurisdictions under consideration all involve federal or quasi-federal arrangements. However, institutional power differs significantly between the jurisdictions. If sub-national systems of government hold significant authority, as in China for example, it becomes crucial for decision-making bodies at the top to ensure their buy-in. Otherwise strategies formulated at the top might not trickle down to the extent intended. Similarly, if multiple layers are involved in decision-making, as in the EU, actors and interests have more scope to influence the making of climate policies than, for instance, in a top-down decision-making process, as in China. This can either advance or hinder the development of climate policies depending on how the interests of actors with access to decision-making processes are aligned.

In terms of implementation, the US, China and the EU give a lot of discretion to the sub-national levels of government and private actors on the specificities of achieving targets. MRV and enforcement mechanisms are most highly developed in the EU, meaning implementation is arguably most effective there (if far from perfect). While the US federal government can also sanction States if they do not adhere to their targets, the resulting legal disputes under regulations, such as the Clean Power Plan can delay implementation by years. In China, MRV mechanisms for greenhouse gases are still being developed (although MRV systems for energy production and consumption do exist). This makes it more difficult to assess whether differences in performance at local or enterprise levels are due to lack of effort or other factors beyond the control of the relevant agents. Similarly, while China's enforcement mechanisms entail incentives for lower-level government officials to comply, they are often subject to corruption, clientelism and lack of oversight from Beijing.

Table 3 summarises the key factors related to the institutional frameworks across the three jurisdictions and their influence on the development and implementation of climate change policy.

Table 3. Key institutions for development and implementation of climate policies

Sources: China (2015); Chen & Stanway (2016); The White House (2015).

	China	EU	US
Executive	• Communist Party of China and central government sets direction • Provinces have discretion in interpretation of mandates set centrally	• European Council (Member State heads of state) • European Commission • National governments • Can allow leadership by Commission	• President has the power to issue executive orders without legislative (congress) approval • Executive agencies e.g. EPA • States can set their own directions to some extent
Legislative	• National People's Congress with limited influence on climate policies • 'Mandate', not law-based system	• European Parliament • Council of EU (MS ministries) • National Parliaments • Complex procedure ensures longevity once laws are passed	• House of Representatives • Senate • Grid-lock within Legislative or between Legislative and Executive branches can hinder passing of laws
Judiciary (highest level)	• Supreme People's Court	• European Court of Justice	• Supreme Court
MRV	• Energy consumption data gathered (submitted by companies); monitored and verified by higher level Statistical Bureaus • Target responsibility system makes energy reduction achievements part of performance evaluation for local officials	• Rigorous MRV system for both installation-level and aggregate data implemented by Member States	• EPA assembles inventory, based on data collected at State level • Some firm-level data must be provided by large emitters
Implications for policy-making	• Policy development involves many differing voices and bureaucratic rivalries • High-level Party and state (executive) decision-making is centralised, with few veto players • Central administrative planning is the most important governance mechanism - laws and law-centred processes play a subsidiary role	• Complex institutional arrangements: multi-level (EU, Member State and local level) and multipolar (several agencies involved) • Large number of access/veto points: they can both hamper the introduction of new policy, but also allow progressive actors to drive policy and ensure policies are relatively stable over time	• Progress on climate policy strongly dependent on leadership from US President • Division of authority has been an obstacle to adoption of comprehensive climate legislation, but allowed President to make progress with Climate Action Plan
Energy efficiency targets	• China's five-year plans implemented through sub-national plans - successful policy implementation depends on cooperation of sub-national governments and SOEs • Willingness to cooperate in policy implementation varies between regions and sectors - such variations are considerable for energy and climate policies	• Implementation subject to 'principal-agent' problems: difficult for top-level government to ensure that lower-level agents act with integrity when chains of command are long and outcomes (e.g. energy consumption, greenhouse gas emissions) are not easily observable • The powers to commit Member States to implement policies they do not like is limited, but complex compromises typically ensure buy-in from the Member States	• Uncertainty on time-consistency of executive action deters efficient implementation • Great scope for bottom-up action at State and local level ('race-to-the-top') but also danger of delaying action

5. Public opinion, interest groups and political consensus on climate change

An important consideration for understanding the development and implementation of climate change policies is the status of the domestic political debate, including public perceptions and opinions, positions and lobbying powers of key interest groups, individuals and political parties with respect to climate change, as well as whether there is overall political consensus on the issue. Interest groups can have a strong influence on government decisions, either in favour or against ambitious climate change policies. In countries where environmental civil society groups are more involved in policy-making, public support for domestic and international climate policies has been shown to be stronger (Bernauer & Gampfer, 2013). Powerful lobbying from carbon-intensive and/or fossil fuel industries, on the other hand, can constrain climate action (Ward & Cao, 2012). Yet, low-carbon energy manufacturers and energy producers tend to view climate change policies as a business opportunity and may counteract the anti-regulatory stance of the fossil fuel industry (Falkner, 2008). Public opinion and climate change risk perceptions also affect the levels of political support between countries for climate action (Leiserowitz, 2007; Lee et al., 2015).

Party politics and the extent to which consensus exists on climate change issues, between leading and opposition parties (or even within the same party), are strongly polarised. Notably, a difference of views between the main parties may jeopardise the ability to put forward ambitious policies, as well as to maintain political commitment, in particular when a country faces elections that may result in a change of the ruling party or of the leader in charge (Averchenkova & Bassi, 2016).

China

The dynamics of public opinion, party politics and interest group influence interact very differently in China compared with liberal-democratic states. The ideology and strategic priorities of the Communist Party of China are the most important political factors affecting climate policy development. Despite being relatively highly centralised, policy development is nonetheless subject to a wide variety of influences from interest groups, economic elites and experts (Williams, 2014). One challenge for climate policy is that fossil fuel producers, fossil-fuel-based utilities and energy-intensive manufacturers tend to be dominated by state-owned enterprises (SOEs),

whereas private companies predominate in the renewable energy sector. Consequently, polluting industries enjoy greater operational privileges and access to the political process than key low-carbon industries and elites.

Despite low awareness and concern about climate change, public opinion plays a significant indirect role in China as a driver of climate policies because of public concerns about local environmental pollution that have intensified in recent years (in some polls, it has been the highest priority concern; Pew Research Centre, 2013; Wike & Parker, 2015). This has provoked strong rhetoric and significant responses from Chinese policy-makers in order to tackle the underlying problems, such as excessive steel production and coal-fired power generation, both of which, in addition to being a major source of air pollution, also contribute greatly to China's greenhouse gas emissions (Sheehan, Cheng, English, & Sun, 2014).

European Union

The development and implementation of climate policies in the EU is influenced by the motivations, interests, behaviours and relative power of the actors that fill this multi-level and multi-polar political space: specifically, Member States, EU political parties, interest groups, elites, and the general public. Member States' greatest influence on the EU's climate policy is via the European Council, where the most populous Member States (ie Germany, UK, France and Poland) are most influential. For instance, Poland, a country with large coal reserves, has been the most influential blocker of climate policies due to concerns about their economic consequences.

The two largest European political parties tend to be relatively supportive of climate action, making the European Parliament generally a positive driver of climate policy. Yet the strengthening of nationalist and Eurosceptic parties since the 2014 elections, as well as greater dominance of domestic concerns in the voting behaviour of Members of the European Parliament (MEPs), suggest that this may change in the future. Yet the overall support of the public, as well as sizeable and growing low-carbon industries which are very effective at lobbying the European institutions, may prove to be strong levers for the future development of EU climate policies.

United States

Party politics, namely the interplay between the positions of the two main parties (Republican and Democratic), and their relative power at a given point in time (e.g. which holds the Presidency, controls the House and the Senate, etc.)[10], are the key factors in the development and implementation of climate change policies in the United States (US). This is particularly important given the high degree of separation of powers. US electoral institutions enable various economic interests, including corporations, special interest groups (e.g. trade associations and think tanks) and wealthy individuals to exercise considerable influence over the political process. Climate scepticism is the defining feature of the campaign by some economic elites against climate change policies in the US, and one that has affected the overall stance of the country on climate policies (Dunlap, 2013).

While the overall awareness of climate change among the general public in the US seems to be quite high, action is not regarded as a priority. Elite cues and structural economic factors, which, to a large extent, are reflected in media coverage of the issue, have been shown to have the largest effect on the level of public concern about climate change in the US (Brulle, Carmichael, & Jenkins, 2012).

Table 4 summarises the main factors related to public opinion, key political and economic interests and their influence on the development and implementation of climate change policies in the three jurisdictions.

[10] While these two parties dominate the political landscape, there are also various smaller parties, which advocate for specific issues. Occasionally, their candidates may play a critical role in elections by diverting potential voters from the main parties. For example, the Green Party and its candidate for President, Ralph Nader, took away many votes from Democrat Al Gore in 2000. The Libertarian Party is a recent example of a right-wing small party.

Table 4. Public opinion, interest groups and political parties

Sources: China (2015); Chen & Stanway (2016); The White House (2015).

	China	EU	US
Public awareness	• Concern over air quality, environmental pollution and health • Little, but increasing awareness of impacts of climate change	• Strongly in favour of climate action, but since financial crisis economic concerns have taken priority	• Relatively low priority compared to other issues, but acknowledgement that future risks are growing • The majority approves of federal climate action
Survey (2007-2008) **Proportion of the population that is:**			
Aware of climate change:	62%	98%	90%
Believe climate change is man-made:	58%	49%	59%
Rank climate change as a serious threat :	36%	64%	69%
Climate change 'sceptics'	• Not a significant force	• Limited influence, confined to particular Member States	• Contributed significantly to political polarisation since 1990s, but influence is waning
Major interest groups affecting climate policies	• Corporations, wealthy individuals, entrepreneurs, economic elites, private companies (e.g. renewable energy companies), state-owned enterprises (e.g. fossil fuel industries, electric utilities and grid operators), top Chinese universities and think tanks and NGOs (especially international NGOs)	• Industry associations (both low-carbon and fossil fuel industries), large multinational corporations (especially oil majors), NGOs and think tanks	• Wealthy individuals/economic elites, faith-based communities, NGOs, think tanks, corporations, special interest groups
Political parties	• The Communist Party of China has an effective monopoly on state organs and state decision-making • Contemporary ideology and doctrine favour ecologically sustainable development and green growth — a crucial change from earlier 'growth at all costs' approach	• Two largest parties in the European Parliament are relatively pro-climate action • Nationalist and Eurosceptic ideologies are on the rise • National interests and pressures play a strong role in voting on climate policies by MEPs	• Increased polarisation on climate change between left and right: Democratic party tends to favour more government intervention on climate change; Republican party tends to be more sceptical of climate change action
Political parties Implications for policy-making	• Early stages of policy-making (debate, development of policy ideas) quite open to multiple voices, though more so from 'inside-system' groups, but limited scope for such voices to influence formal decision-making processes, which is controlled by the Communist Party of China • Public opinion can be indirectly influential where Government perceives bottom-up threats to social stability e.g. in case of air quality concerns	• Given the multi-level governance system, public opinion influences policy-making at various levels. This can both result in more ambitious climate policy-making or delay action	• Lobby groups can exert strong influence on policy-making due to the structure of political campaign finance and electoral system • Responding to public comments on developing rules and procedures under existing legislation can absorb large amounts of resources and delay the process of finalising regulations

6. Outlook for development of climate policies

An analysis of the main features of the current policy framework, key economic interests, functioning of institutional systems, and public opinion in the European Union (EU), China and United States (US) offers important insights about future risks and opportunities for climate change policy-making. These three jurisdictions are also facing a period of transition, for instance due to upcoming or recent elections (notably in the US), economic and social tensions (such as the faltering economic recovery in the EU and the migration crisis), and structural change of the economy (in China). These elements combined are likely to influence the development of climate change policies in the coming years. This, in turn, can affect the extent to which these jurisdictions will be able to implement the commitments made in their nationally determined contributions (NDCs) and will be willing to ratchet up their ambitions.

China

With 'green' being a crucial theme of China's 13th Five-Year Plan, released in March 2016, climate change mitigation and local environmental improvement will be a whole-of-Government priority. Significant expansion and strengthening of China's domestic climate policies is expected over the plan period (2016 to 2020), as well as a greater focus on green foreign investment through China's role in the G20, the Asian Infrastructure Investment Bank, New Development Bank, and the One Belt One Road initiative. China will likely meet its NDC targets to i) peak carbon dioxide emissions by 2030 at the latest, and ii) reduce the carbon intensity of its economy by 60-65 per cent by 2030 compared with 2005. carbon emissions from China are likely to peak before 2030, based on reduced emissions growth from the energy, steel and cement industries, and some have argued that the peak is likely to come much earlier (Green & Stern, 2016; Spencer et al., 2016). Non-CO_2 greenhouse gases, however, will most likely increase beyond 2030 (CAT, 2015; Jiang et al., 2013; Zhang et al., 2015). The focus in China therefore needs to turn toward policies to achieve rapid absolute reductions in carbon emissions as soon as possible (Spencer et al., 2016) as well as policies aimed at peaking and reducing emissions from non-CO_2 greenhouse gases, especially from the chemicals, electrical, coal mining and agricultural industry.

[3] And emissions from sulphur dioxide would be reduced by 90 per cent and nitrogen oxides cut by 72 per cent by 2030 compared with 2005 levels.

One of the greatest risks to climate policy development in China in the future is continued fiscal stimulus into the construction and heavy industrial sectors. A significant challenge for successful implementation of climate policies is that regions and industries (including state-owned enterprises) that suffer economic losses as a result may seek to evade them, and the risk of social instability in areas of high lay-offs of labour may also delay progress. In addition, climate policies that depend on complex governance arrangements, sophisticated and well-resourced regulatory capacity, and comprehensive, micro-level monitoring, reporting and verification (MRV) systems (such as the proposed national emissions trading system) are likely to prove challenging to implement and may be vulnerable to manipulation. A more rigorous and better resourced MRV system would help improve access to information and help more effective implementation of climate policies. Additionally, expanded use of policy levers that work relatively well in China, for example reallocating resources using fiscal policy (such as imposing a coal tax) and strengthening regulation of coal-related sectors, would be valuable policy initiatives.

European Union

The future of leadership by the EU in international climate change politics and its ability to meet domestic decarbonisation goals will depend on how it holds together in the face of recent crises. These include the economic malaise that has persisted since the global financial crisis and challenges particularly in the southern Member States, the refugee and migrant crisis, and the growing sense of dissatisfaction within some Member States about the concept of a federal Europe. This latter factor was manifest in the recent UK referendum on its membership of the EU, when there was a narrow vote to leave. Greece also came close to leaving the EU amid deep financial crisis after 2010. The EU must also deal effectively with resistance to climate change policies from Member States with large fossil fuel resources and/or large pollution-intensive sectors (e.g. Poland) as it moves ahead with the implementation of the Energy Union and the reform of other key policy instruments geared to achieving its existing climate targets (both 2020 and 2030).

The EU will need to increase its current internal ambition in order to meet its 2030 targets. Studies have highlighted that current policy assessments indicate the EU's emissions are likely to miss the 2030 target by about 5-10 percentage points. The EU will need to double at least the annual rate of emission reductions from 2015 onwards to meet the 2030 target. The EU will likely meet its renewable energy targets, but implementing its 2020 and 2030 energy efficiency targets will be more challenging. For example, 20 Member States are on track to reach their 2020 energy efficiency targets, while eight (Belgium, Estonia, France, Germany, Malta, the Netherlands, Poland and Sweden) are not. Member States are divided over the level of stringency of new policies required to achieve the 2030 targets. This dynamic could result in the EU focusing on its current commitments until 2020 while delaying decisions on increasing post-2020 ambition in order to appease Member States that are opposed to the increase in ambition.

United States

In order to meet the target in its NDC (decreasing emissions by 26 to 28 per cent below 2005 levels by 2025), the US will not only need to ensure that all the policies announced in 2015, including the Clean Power Plan and the targets set in the Executive Orders of the President's Climate Action Plan, are implemented within their proposed timeline, it will also need to introduce more ambitious policies for emissions reductions, particularly from its industrial and transport sectors (CAT, 2015; Belenky, 2016; and Larsen et al., 2016). The final Supreme Court decision about the Clean Power Plan is likely to be made some time in 2017 or 2018 – close to the deadline when States are meant to submit their plans to meet the Plan's targets. Therefore, the ability of the US to meet its NDC in 2025 is dependent on these States being ready to start

implementation in 2022. The future direction of US climate policy, particularly at the federal level, will be shaped by the outcome of the 2016 Presidential election, at least for the coming years. Under Republican President Donald Trump it seems likely, based on his comments during the election campaign and his campaign manifestos (Trump, 2016a,b), that US climate policy will become significantly less ambitious. For example, Donald Trump has announced that he would repeal the Clean Power Plan through executive action, cut all federal climate spending by eliminating domestic and international climate programs, withdraw from the UNFCCC Paris Agreement, encourage the use of fossil fuel resources and dismantle climate policy in general through executive action. This could be difficult for several reasons, one being that under the Clean Air Act the Environmental Protection Agency (EPA) has responsibility to regulate greenhouse gas emissions, the other being that any change to this law would require significant political commitment and take several years.

However, given that Donald Trump will appoint at least one Supreme Court justice, likely tilting the court towards conservatism, he could seek to repeal previous amendments to the Clean Air Act that bought greenhouse gases under the EPA's remit, and override or weaken the authority of the EPA. It has already been reported that Trump will appoint a climate skeptic, Myron Ebell, to run the EPA (Bravender, 2016). It is difficult to predict how quickly changes to climate policy will happen, but the Climate Action Plan and the Clean Power Plan will likely stall. Action on climate change would then depend largely on the States. According to E&E Publishing (2016) 19 States have announced (prior to the election) that they will submit plans to comply with the Clean Power Plan, and thus reduce emissions from their power sectors, despite the stay by the Supreme Court. Together these States would represent 36 per cent of the emissions reductions due to be achieved by the Clean Power Plan in the interim period (2022-2029), and 30 per cent of reductions due by 2030 and beyond. This means that emissions cuts could take place at State and local levels, even if efforts on the federal level were lagging, although they would have less impact than concerted efforts on a national scale. The accompanying policy paper (Averchenkova et al., 2016) outlines the legislative and regulatory procedures, as well as the allocations of power in place, that could slow down or hinder President Trump in scaling back major climate policies.

[3] And emissions from sulphur dioxide would be reduced by 90 per cent and nitrogen oxides cut by 72 per cent by 2030 compared with 2005 levels.

Conclusion

This analysis of the trends in the development and implementation of climate policies in China, the European Union (EU) and the United States (US) confirms the importance of understanding the relevant economic, institutional, political and ideational factors at the national level, and their unique interplay, as these strongly affect countries' abilities to implement their nationally determined contributions (NDC) and to ratchet up ambition in the future. Notably, the study shows that the relative importance of these factors differs across the three jurisdictions.

For China, the key driver of climate policies is the strategic importance the Chinese leadership places on building a low-carbon economy. The rise and fall of emissions in China is closely linked to its economic development and will depend on its future economic transition.

For the EU, energy security and economic concerns have also played their part in fuelling European leadership on climate policy and the promotion of its renewable energy industry. The institutional system has further allowed leadership from the European Commission, the European Parliament and proactive Member States, as well as support from public opinion, 'green' parties and non-governmental organisations, to translate into a package of ambitious climate and energy policies. In the US, the institutional system allows for electoral rules and economic interests to polarise the political debate. This strongly influences the direction of climate change policy, but allows executive action from the President and the Environmental Protection Agency.

More importantly, this study demonstrates where the levers for change towards more ambitious climate policies lie, and where structural factors will likely help or hinder progress. The co-benefits of a growing green industry and reduced air pollution are so palpable that they could put China onto a low-carbon path for economic growth. To help this transition, China can create incentives for its state-owned enterprises and provinces to comply with targets set at the national level. It will also need to allocate adequate resources to monitor compliance and find different mechanisms to continue doing this. The EU, on the other hand, will need to broker a deal between its more ambitious and less ambitious Member States, and to align them behind a common vision for the European energy market. It could further mobilise the established and growing low-carbon industries as allies. Federal climate action in the US has relied largely on executive action during the Obama administration which makes it susceptible to stalemate and even roll-back

from a president who is not committed to climate change action. Although changing and repealing existing rules and legislation is a lengthy process and requires considerable political commitment, it is very likely that climate policy will be scaled back under a President Trump, with a conservative majority in the Supreme Court and a Republican majority in Congress.

This means that progress on climate change policy during the Trump presidency will need to be championed by US States. Over the long-term, however, there is the potential for State action to ratchet up ambition at the federal level and for a committed executive to make use of provisions under the Clean Air Act to advance polices at the federal level.

This study thus highlights where and how constraints can be addressed and efforts should be focussed. In addition, it provides an in-depth overview of developments relating to the three largest emitters, which have implications for international climate change negotiators and other forms of international collaboration (e.g. US-China bilateral cooperation). Successful negotiation depends strongly on gaining a sense of the interests and institutions that drive countries' bargaining positions.

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