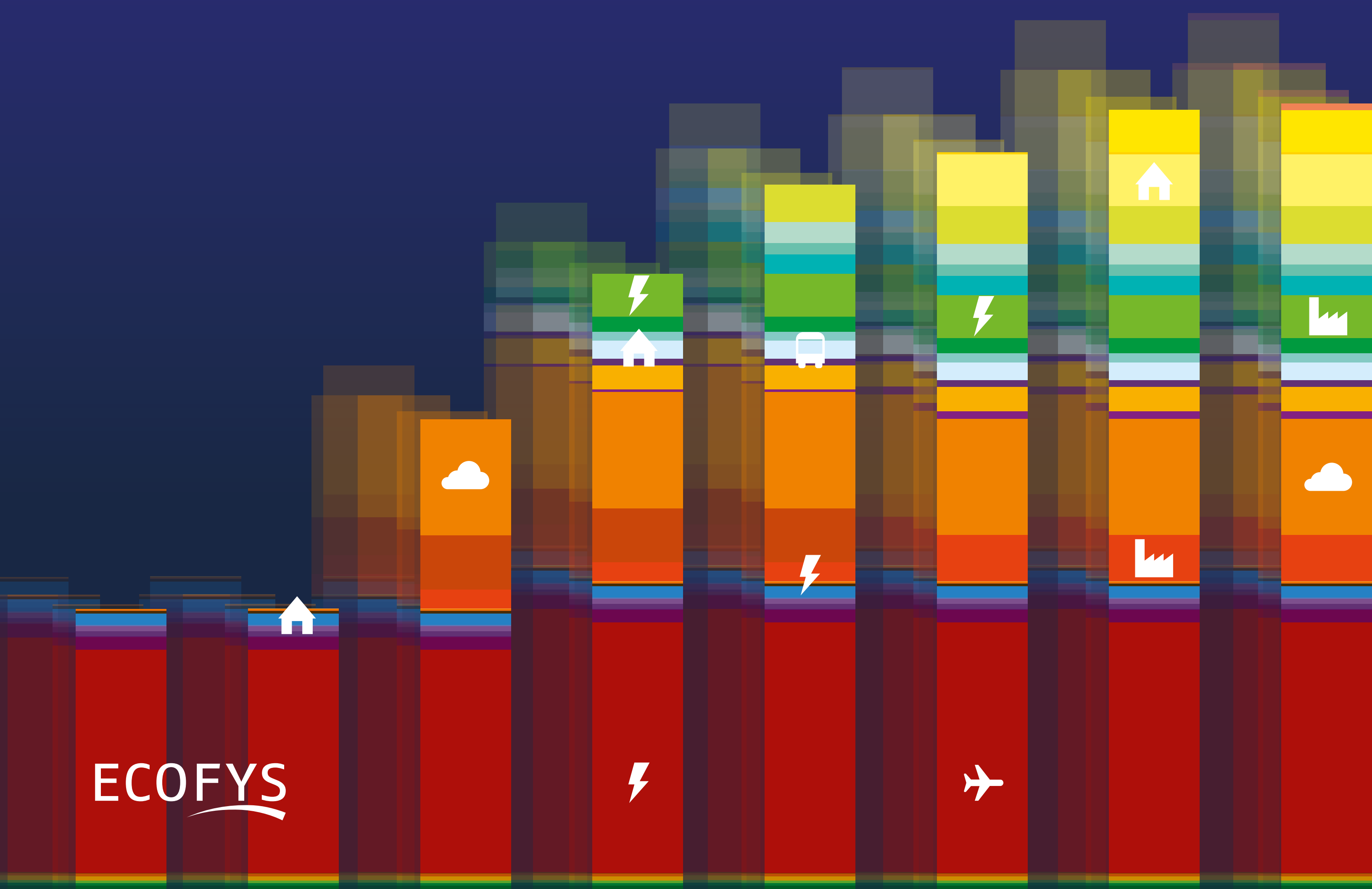
WORLD BANK GROUP
Climate Change

State and Trends of Carbon Pricing

Washington DC
September 2015

2015



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This report was prepared jointly by the World Bank and Ecofys.

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Reflecting the growing momentum for carbon pricing worldwide, the 2015 edition of the State and Trends of Carbon Pricing report targets a wider audience of public and private stakeholders who are engaged in carbon pricing design and implementation. This report also provides critical input for the negotiations leading up to the Conference of the Parties (COP) in Paris.

As in the previous editions, the report provides an up-to-date overview of existing and emerging carbon pricing instruments around the world, including national and subnational initiatives. Furthermore, it gives an overview of current corporate carbon pricing instruments.

To better reflect the plethora of topics being considered in the climate dialogue, the report also analyzes competitiveness and carbon leakage, and their impact on the development of carbon pricing instruments. The task team responsible for this report intends to select new relevant topics to be explored in future editions. These topics could include, for example, the effectiveness of existing and emerging carbon pricing instruments, and how to measure it.

Finally, this year's report gives the audience a forward-looking assessment of the advantages of international cooperation in reaching stringent global mitigation targets. A review of existing modeling work provides a qualitative and quantitative assessment of cost saving potentials and the magnitude of financial flows inherent to international cooperation aimed at reducing greenhouse gas emissions to a level consistent with the 2°C climate stabilization goal.

The report benefited greatly from the valuable written contributions and perspectives of our colleagues in the climate and carbon finance community, ensuring the quality and clarity of this report: Emilie Alberola, Carter Brandon, Marcos Castro, Alyssa Gilbert, Andries Hof, Pauline Maree Kennedy, Thomas Kerr, Grant Kirkman, Benoît Leguet, Alexios Pantelias, Jayoung Park, Ian Parry, Paul Steele, Massimo Tavoni, Adam Whitmore, and Peter Zapfel.

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We also acknowledge the support from the Partnership for Market Readiness and Vivid Economics, who produced the upcoming technical report on carbon leakage, from which Grzegorz Peszko has drawn generously to write section 3.

LIST OF ABBREVIATIONS AND ACRONYMS

	°C	Degrees Celsius
A /	**AAU**	Assigned Amount Unit
	ADB	Asian Development Bank
	ADP	Ad Hoc Working Group on the Durban Platform for Enhanced Action
	ARB	Air Resources Board
B /	**BCA**	Border Carbon Adjustment
C /	**CCER**	Chinese Certified Emission Reduction
	CCR	Cost Containment Reserve
	CCS	Carbon Capture and Storage
	CDM	Clean Development Mechanism
	CDP	Carbon Disclosure Project
	CER	Certified Emission Reduction
	Ci-Dev	Carbon Initiative for Development
	CMP	Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol
	CO_2	Carbon dioxide
	CO_2e	Carbon dioxide equivalent
	COP	Conference of the Parties
	CP1	First Commitment Period under the Kyoto Protocol
	CP2	Second Commitment Period under the Kyoto Protocol
	CPM	Carbon Pricing Mechanism
D /	**DNA**	Designated National Authority
E /	**EBRD**	European Bank of Reconstruction and Development
	ERU	Emission Reduction Unit
	ETS	Emissions Trading System
	EU	European Union
	EU ETS	European Union Emissions Trading System
F /	**FCPF**	Forest Carbon Partnership Facility
	FSB	Fixed Sector Benchmarking
	FVA	Framework for Various Approaches

G /	**GDP**	Gross Domestic Product
	GHG	Greenhouse gas
	Gt	Gigaton
	$GtCO_2e$	Gigaton of carbon dioxide equivalent
I /	**ICAO**	International Civil Aviation Organization
	ICAP	International Carbon Action Partnership
	IEA	International Energy Agency
	IET	International Emissions Trading
	INDC	Intended Nationally Determined Contribution
	IPCC	Intergovernmental Panel on Climate Change
J /	**JI**	Joint Implementation
L /	**LIMITS**	Low climate IMpact scenarios and the Implications of required Tight emission control Strategies
	LPG	Liquefied Petroleum Gas
M /	**MRV**	Monitoring, Reporting and Verification
	Mt	Megaton
	$MtCO_2e$	Megaton of carbon dioxide equivalent
	MW	Megawatt
N /	**NAMA**	Nationally Appropriate Mitigation Action
	NDRC	China's National Development and Reform Commission
	NMM	New Market-based Mechanism
	NZ-AAU	New Zealand-originated Assigned Amount Unit
	NZ ETS	New Zealand Emissions Trading System
	NZU	New Zealand Unit
O /	**OBA**	Output-Based Allocation
	OECD	Organisation for Economic Co-operation and Development
P /	**PBL**	*Planbureau voor de Leefomgeving* (Netherlands Environmental Assessment Agency)
	PMR	Partnership for Market Readiness
	PoA	Program of Activities
	ppm	Parts per million

R /	**RBF**	Results-Based Finance
	REDD	Reducing Emissions from Deforestation and Forest Degradation
	REDD+	Extends REDD by including sustainable forest management, conservation of forests, and enhancement of carbon sinks
	RGGI	Regional Greenhouse Gas Initiative
S /	**SBSTA**	Subsidiary Body for Scientific and Technological Advice
	sCER	Secondary Certified Emission Reduction
T /	**t**	Ton (unless specified otherwise, ton in this report refers to a metric ton = 1,000 kg)
	tCO_2	Ton of carbon dioxide
	tCO_2e	Ton of carbon dioxide equivalent
U /	**UK**	United Kingdom
	UN	United Nations
	UNDP	United Nations Development Programme
	UNEP	United Nations Environment Programme
	UNFCCC	United Nations Framework Convention on Climate Change
	US	United States
	US EPA	United States Environmental Protection Agency
V /	**VCS**	Verified Carbon Standard
Y /	**y**	Year

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Executive summary

With the countdown on to the Paris climate change conference, there is clear evidence of growing momentum to put a price on carbon. The growth of carbon pricing around the world has been substantial. Since January 2012, the number of carbon pricing instruments already implemented or scheduled for implementation has almost doubled, jumping from 20 to 38. Moreover, the share of emissions covered by carbon pricing has increased threefold over the last decade.

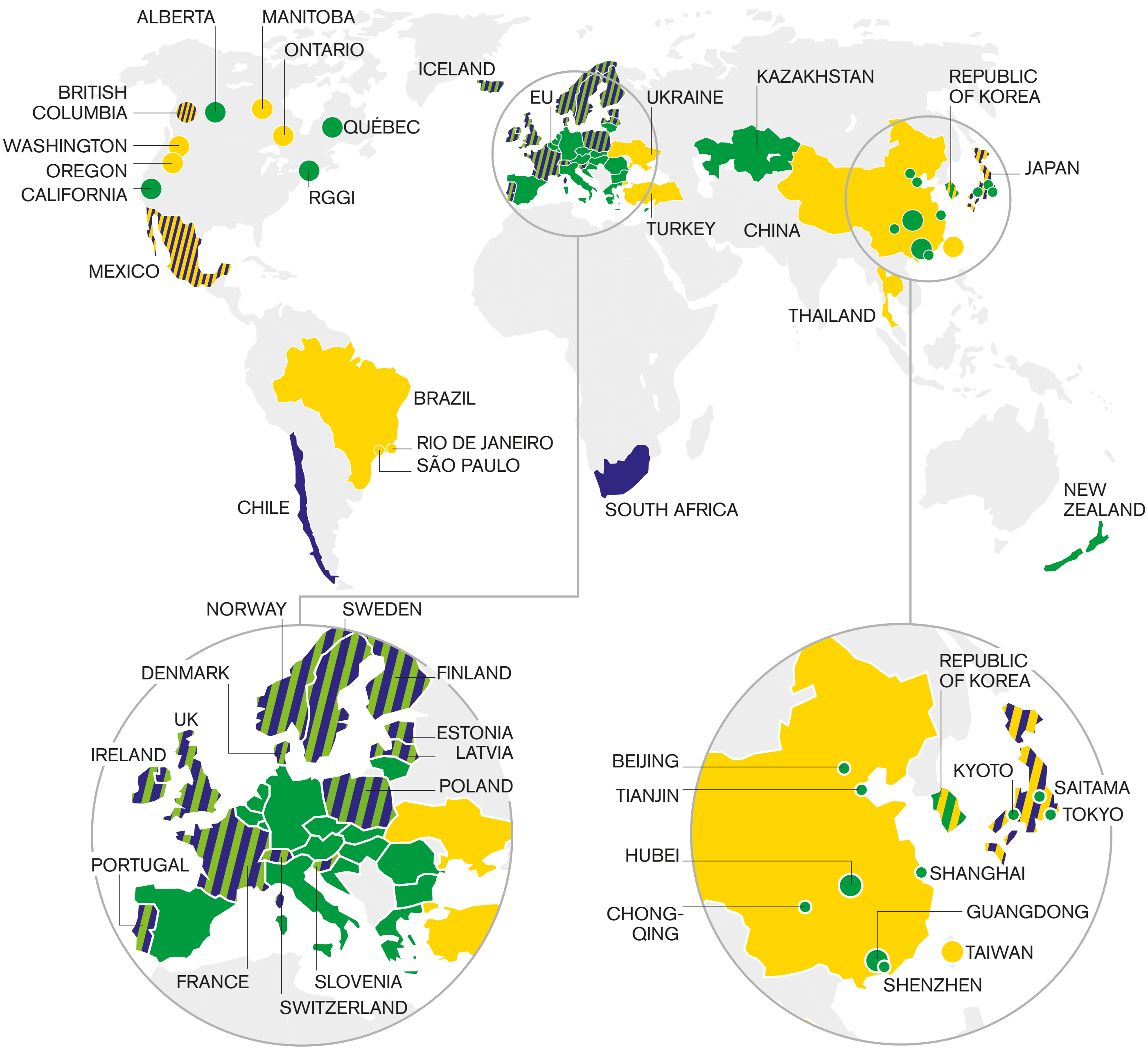
Currently, about 40 national jurisdictions and over 20 cities, states, and regions—representing almost a quarter of global greenhouse gas (GHG) emissions—are putting a price on carbon (Figure 1). Together, carbon pricing instruments cover about half of the emissions in these jurisdictions, which translates to about 7 gigatons of carbon dioxide equivalent ($GtCO_2e$) or about 12 percent of global emissions (see Figure 2).

To date, China and the United States are the two countries with the largest volume of emissions covered by carbon pricing instruments. In China carbon pricing instruments cover 1 $GtCO_2e$, while in the United States they cover 0.5 $GtCO_2e$. China has announced its intention to move to a national emissions trading system (ETS). It currently has seven pilot ETSs, which combined form the largest national carbon pricing initiative in the world in terms of volume. The European Union Emissions Trading System (EU ETS), which covers 2 $GtCO_2e$ of emissions, remains the single largest international carbon pricing instrument.

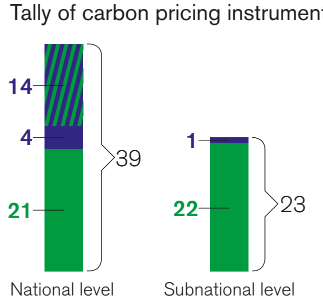
So far this year, the Republic of Korea launched an ETS, and California and Québec's cap-and-trade programs expanded their GHG emissions coverage from about 35 to 85 percent by including transport fuel. Also, Ontario announced its intention to implement an ETS linked to California and Québec's programs. A major structural reform in the EU ETS was approved for implementation starting in 2019, and a proposal to revise the EU ETS after 2020 has been put forward. These changes should make the EU ETS more resilient to sudden changes in macroeconomic conditions and help ensure that the EU ETS enables cost-effective emission reductions in the decade to come.

The advances in 2015 follow on the heels of 2014 milestones such as the implementation of two new subnational ETSs in Hubei and Chongqing (both Chinese jurisdictions), the implementation of carbon taxes in France and Mexico, and the adoption of new tax legislation in Chile. The year has also seen more companies using an internal price on carbon.

Figure 1 Overview of existing, emerging, and potential regional, national, and subnational carbon pricing instruments (ETS and tax)



Tally of carbon pricing instruments

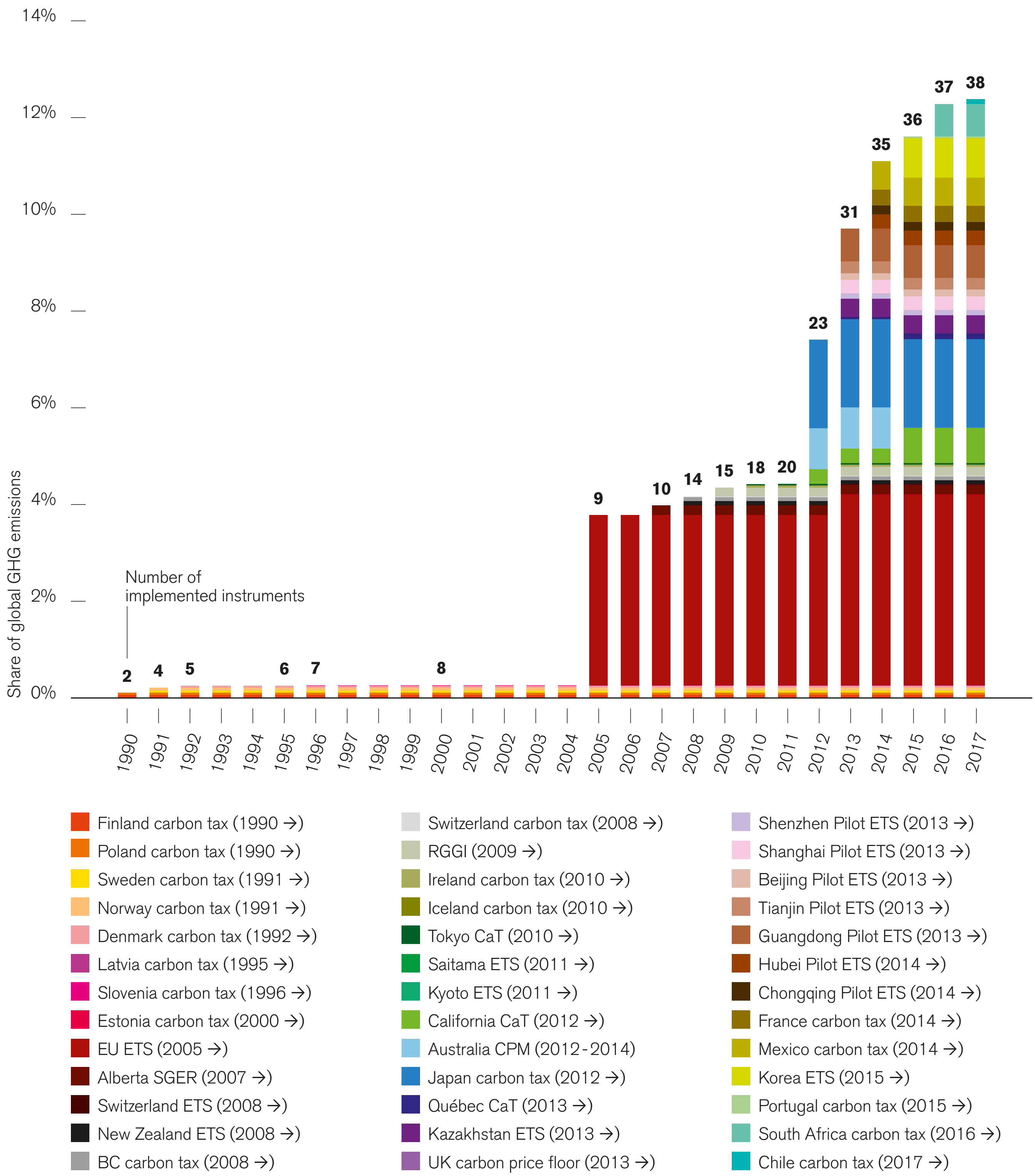


- ETS implemented or scheduled for implementation
- Carbon tax implemented or scheduled for implementation
- ETS or carbon tax under consideration
- ETS and carbon tax implemented or scheduled
- ETS implemented or scheduled, tax under consideration
- Carbon tax implemented or scheduled, ETS under consideration

The circles represent subnational jurisdictions. The circles are not representative of the size of the carbon pricing instrument, but show the subnational regions (large circles) and cities (small circles).

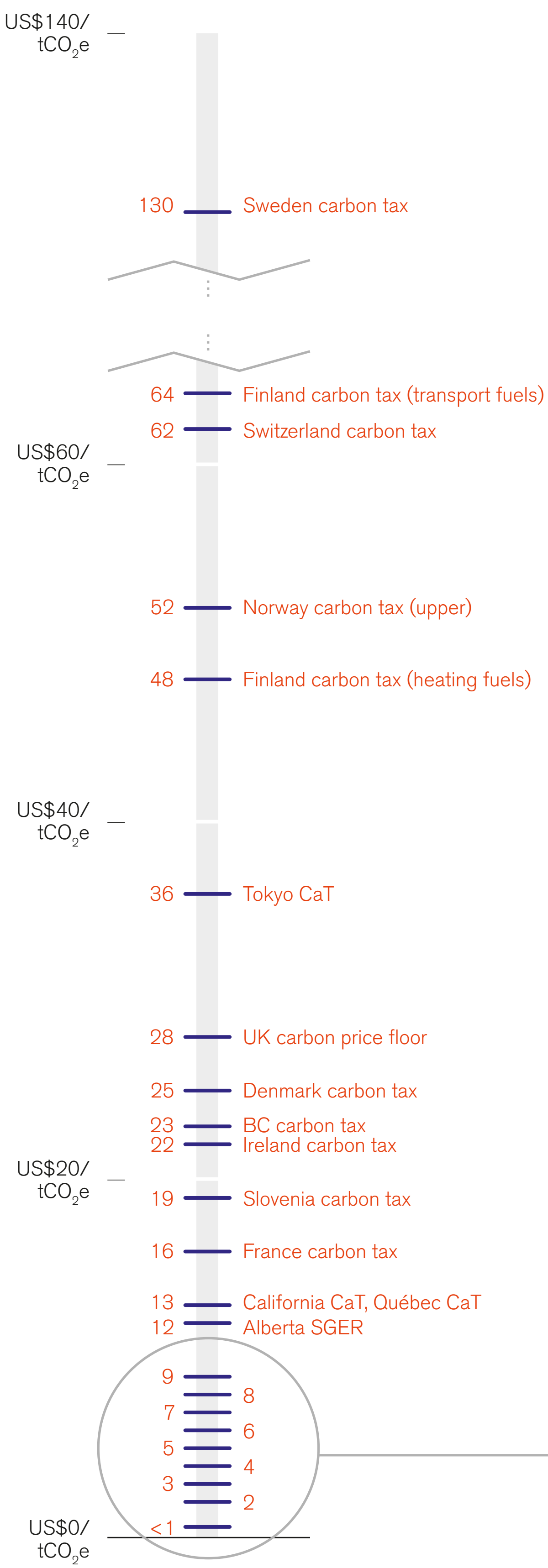
Note: Carbon pricing instruments are considered "scheduled for implementation" once they have been formally adopted through legislation and have an official, planned start date.

Figure 2 Regional, national, and subnational carbon pricing instruments already implemented or scheduled for implementation: share of global GHG emissions covered



Note: Only the introduction or removal of an ETS or carbon tax is shown. Emissions are given as a share of global GHG emissions in 2012. Annual changes in global, regional, national, and subnational GHG emissions are not shown in the graph. Data on the coverage of the city-level Kyoto ETS are not accessible; its coverage is therefore shown as zero.

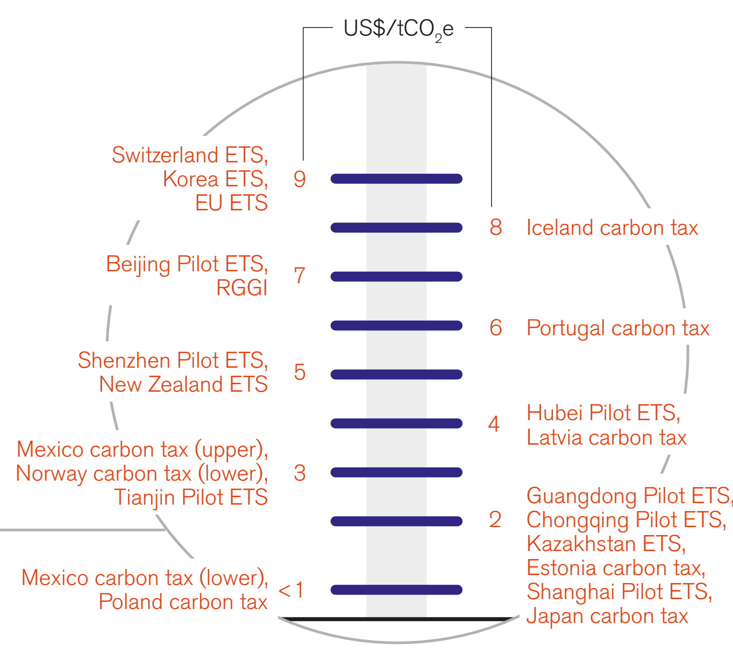
Figure 3 Prices in existing carbon pricing instruments



The combined value of the regional, national, and subnational carbon pricing instruments in 2015 is estimated at just under US$50 billion globally, of which almost 70 percent (about US$34 billion) is attributed to ETSs and the remainder (about 30 percent) to carbon taxes.

The existing carbon prices vary significantly—from less than US$1 per tCO_2e to US$130 per tCO_2e (see Figure 3). The majority of emissions (85 percent) are priced at less than US$10 per tCO_2e, which is considerably lower than the price that economic models have estimated is needed to meet the 2°C climate stabilization goal recommended by scientists.

Note: Nominal prices on August 1, 2015, shown for illustrative purpose only. The figures given in the Carbon Pricing Watch 2015[16] have been updated to August 1, 2015. The differences with the Carbon Pricing Watch are due to the daily changes in prices and exchange rates. Prices are not necessarily comparable between carbon pricing instruments because of differences in the number of sectors covered and allocation methods applied, specific exemptions, and different compensation methods.



Carbon pricing is increasingly being used internally by firms as a tool to analyze business and investment strategy. Some of these carbon prices are substantially higher than current price levels in mandatory carbon pricing instruments. Internal carbon pricing is part of a risk management strategy to evaluate the current or potential impact of a mandated carbon price on business operations. It is also used as a means to identify and value cost savings and revenue opportunities in low-carbon investments.

In a world of fragmented carbon pricing instruments, the potential impact of carbon pricing on the international competitiveness of some domestic industrial sectors has been a concern. The risk of carbon leakage is real as long as carbon price signals are strong and the stringency of climate policies differs significantly across jurisdictions.

However, the report finds, based on available research, that carbon leakage—the phenomenon of companies moving their production and/or redirecting their investments to other jurisdictions where emissions costs are lower, thereby increasing emissions there—has not materialized on a significant scale. This risk tends to only affect a limited number of exposed sectors, namely those that are both emissions- and trade intensive. This risk can be effectively managed through policy design components, such as free allocations, exemptions, rebates and border adjustment measures, as well as specific complementary measures, for example, financial assistance.

The risk of carbon leakage declines as more countries take concrete actions to prevent climate change. International cooperation through carbon pricing instruments and climate finance can help redress the existing asymmetry in carbon pricing signals, reduce concerns about their impact on competitiveness, and eliminate the need for protection of firms. Under these circumstances, carbon prices can be used to enhance the performance of economies—specifically benefiting innovative, low-carbon firms, and promoting the technical upgrade or exit of the least efficient firms in emissions-intensive industries. This would improve the overall efficiency of the economy.

In addition to reducing the risk of carbon leakage, cooperation between countries can significantly reduce the overall cost of achieving a 2°C climate stabilization goal compared to domestic actions alone, as countries have more flexibility in choosing who undertakes emission reductions, and who pays for them. Moreover, such cooperation could drive low-carbon growth in lower-income countries, some of which might lack the resources to modernize their economies, create jobs in low-carbon sectors, or reduce poverty in a sustainable manner. Through international cooperation, the global costs associated with a given emission reduction target can be lowered or a larger mitigation target can be achieved at a given cost, and development gaps can be narrowed.

According to estimates from economic models, financial transfers through cooperation could reach up to US$100–400 billion annually by 2030, possibly increasing to over $2 trillion dollars by 2050. The size of the transfers will be beyond the level of public sector spending, and will need to be channeled through a blend of instruments. These include carbon pricing instruments such as ETSs, carbon taxes, offsets and a combination thereof and linkages between them, as well as innovative hybrid instruments, such as variations of results-based climate finance. Climate finance and carbon pricing instruments will be essential in leveraging these financial transfers and enabling cooperation to mitigate climate change.

section 1

Introduction

1 / Introduction

The year 2014 proved to be the warmest year since record keeping began[1] and temperatures are now 0.8°C above pre-industrial levels.[2] From heat and precipitation to drought and cyclone activity, the frequency of extreme weather events has increased,[3] with damaging effects on settlements, crops, food, water, and energy security. The risks this poses to people's lives and well-being are expected to be even higher if the global greenhouse gas (GHG) emissions trend remains unchecked. Experts agree that the most severe climate impacts can be avoided if the mean global temperature rise is lower than 2°C.

Keeping this goal within reach requires significant cuts in emissions of all GHGs. Compared with the 2012 overall level of 54 gigatons of carbon dioxide equivalent ($GtCO_2e$), GHG emissions need to be cut by 32 $GtCO_2e$ by 2050.[4] The international community faces a huge challenge in raising the ambition expressed by countries so far to the level actually needed to avoid dangerous climate change.

Over the next 35 years, approximately US$40 trillion of additional investment will be needed to transition to a global, low-carbon energy system.[5] Beyond the official climate negotiations under the United Nations Convention on Climate Change (UNFCCC), support for the necessary changes is coming from a variety of actors,[6] public and private sector finance playing an increasingly important role. Current financial flows associated with climate change mitigation and adaptation amount to about US$343–385 billion/year globally, with most of this going to mitigation efforts.[7] However, to stabilize the climate, these resources need to be scaled up and investment patterns need to change.

1 Temperature record keeping began in 1880 (source: NOAA National Climatic Data Center, *Global Analysis - Annual 2014*, accessed April 28, 2015, https://www.ncdc.noaa.gov/sotc/global/2014/13).
2 World Bank, *Turn Down the Heat: Confronting the New Climate Normal*, 2014.
3 Ibid.
4 The UNEP says that the median emission level required for this target is 42 $GtCO_2e$ in 2030 and 22 $GtCO_2e$ in 2050. Source: UNEP, *The Emissions Gap Report 2014*. According to the IPCC, global emissions need to be reduced by 40–70% in 2050, compared to 2010 levels, in order to have a likely chance to keep the temperature change below 2°C. Source: IPCC, *Climate Change 2014: Mitigation of Climate Change – Summary for Policy Makers*, 2014.
5 The additional investment is relative to the US$318 trillion that is expected to be invested in a business-as-usual scenario. Source: International Energy Agency, *Energy Technology Perspectives 2015*, 2015.
6 UNEP, *Climate commitments of subnational actors and business: A quantitative assessment of their emission reduction impact*, 2015.
7 IPCC, *Climate Change 2014: Mitigation of Climate Change - Summary for Policy Makers*, 2014.

There is a growing consensus among both governments and businesses on the fundamental role of carbon pricing in the transition to a decarbonized economy. Placing an adequate price on GHG emissions helps mobilize the financial investments required to support diverse actions, such as fuel switching from coal to natural gas, renewable energy deployment, the adoption of energy efficiency measures and the use of low-carbon technologies in industry.

For governments, carbon pricing is an instrument to achieve emissions mitigation and also a source of revenue, which is particularly important in the current economic environment of budgetary constraints. Businesses use internal carbon pricing to evaluate the impact of mandatory carbon prices on their operations and as a tool to identify potential cost savings and revenue opportunities. Finally, long-term investors use carbon pricing to analyze the potential impact of climate change policies on their investment portfolios, allowing them to reassess investment strategies and reallocate capital toward low-carbon or climate-safe activities.

Over the past year, new carbon pricing instruments have been launched, and existing ones have been evolving in response to the lessons learned from operational experience. These existing and new instruments, as well as carbon pricing trends, are discussed in section 2. For the purpose of this report, carbon pricing refers to initiatives that put an *explicit* price[8] on GHG emissions. These initiatives include not only emissions trading systems (ETSs), carbon taxes, offset mechanisms, and results-based finance (RBF), but also internal carbon prices set by companies. Bearing in mind this scope, other policies that *implicitly* price GHG emissions—such as the removal of fossil fuel subsidies, energy taxation, support for renewable energy, and energy efficiency certificate trading – are not included.

The carbon prices observed in these instruments vary significantly, from less than US\$1/tCO_2e to \$US130/tCO_2e. The majority of emissions (85 percent) are priced at less than US\$10/tCO_2e, which is considerably lower than the price that economic models have estimated is needed to meet the 2°C climate stabilization goal recommended by scientists. As carbon pricing is not implemented uniformly around the world, one of the key issues facing the affected industries is carbon leakage—the situation where production and associated emissions shift to jurisdictions that do not have equivalent policies in place. Section 3 examines this issue and suggests policy provisions that could alleviate it.

Finally, to optimize the emission reductions that carbon pricing and other policy instruments can deliver, cooperation is needed on all levels. Section 4 focuses on the rationale and potential economic gains of a joint mitigation effort. The report concludes by examining carbon pricing instruments and their crucial role in mobilizing the resources needed to achieve cost savings through international cooperation.

8 In other words, a price expressed as a value per ton of CO_2.

»Climate change poses great dangers to us all. This means that we need to limit harmful greenhouse gas emissions effectively. Economic incentives are a good way to achieve this goal. Carbon pricing makes investments in low-carbon or carbon-free technologies attractive and ensures that fossil fuels are used efficiently. This helps us to adhere to our common two-degree climate goal. […]

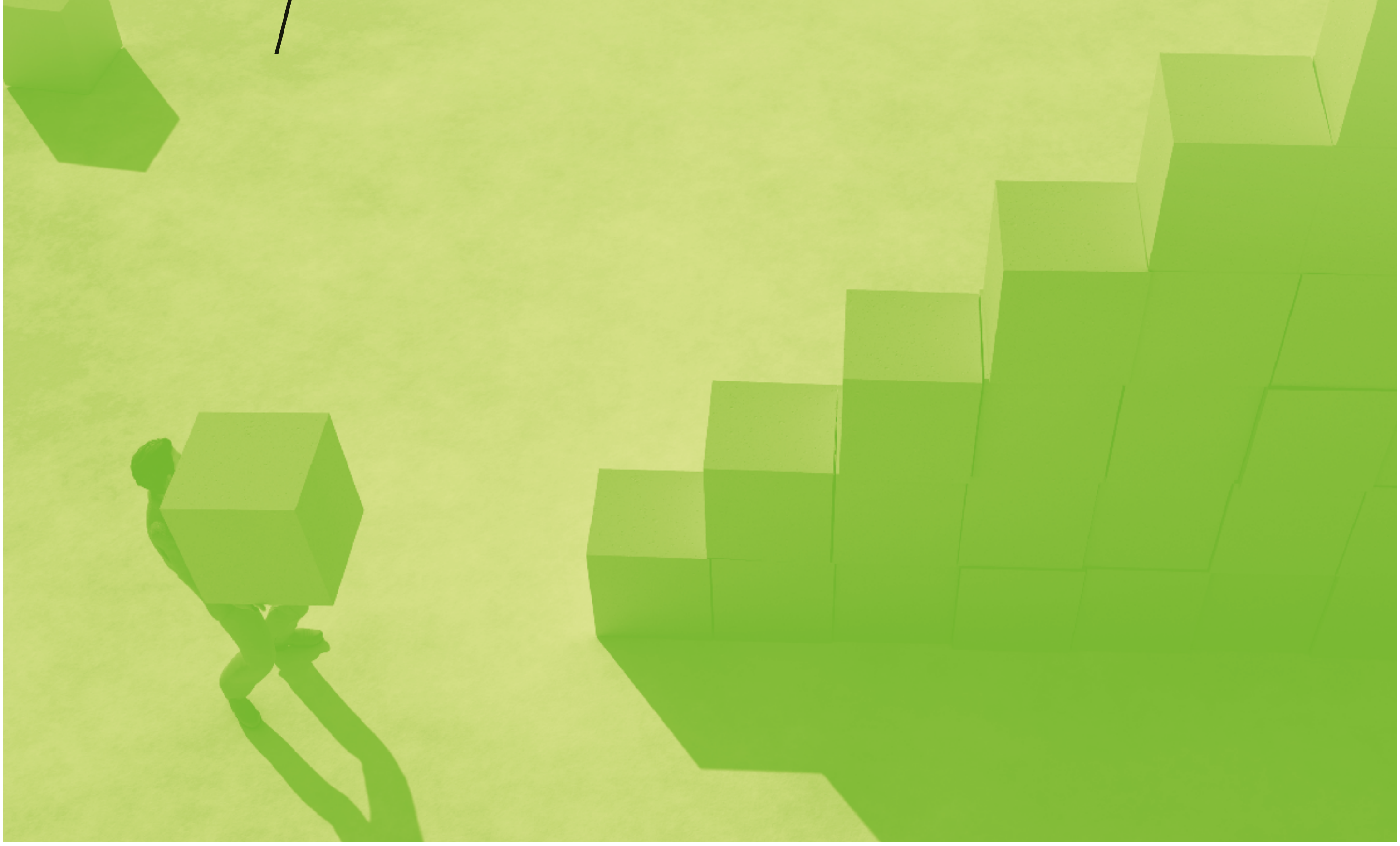
Our country's positive economic development shows that technological progress and growth can go hand in hand with climate protection. […] The emission of harmful greenhouse gases must come at a price. This is the only way that we will make any tangible progress on climate protection. And it is the only way to ensure that we will not have to pay a far higher price in the end.

Fortunately, many governments and companies are already using carbon-pricing instruments. Our hope is that all countries will perceive the opportunities that economically efficient and low-carbon development offers them.«

Angela Merkel, Chancellor of Germany

section 2

Existing and emerging carbon pricing instruments around the world



2 Existing and emerging carbon pricing instruments around the world

2.1 OVERVIEW, RECENT DEVELOPMENTS, AND EMERGING TRENDS

2.1.1 Global overview of carbon pricing instruments

As of August 31, 2015, 39 national and 23 subnational jurisdictions are putting a price on carbon through ETSs and taxes (Box 1 and Figure 4). Together, these carbon pricing instruments cover some 7 $GtCO_2e$, about 12 percent of the annual global GHG emissions.[9] This represents significant progress: the number of carbon pricing instruments has expanded by 90 percent since 2012. More specifically, since January 1, 2012, the number of carbon pricing instruments implemented and scheduled has increased from 20 to 38. In addition, the share of global emissions under a carbon pricing instrument has increased threefold over the past decade (Figure 5).[10]

Figure 5 shows three distinct periods since the introduction of carbon pricing instruments: (i) the period 1990-2005, which was dominated by early movers introducing carbon taxes; (ii) the period 2005-11, which saw the start of the Kyoto Protocol, and a rapid expansion in the coverage of GHG emissions, largely because of the implementation of the European Union Emissions Trading System (EU ETS);[11] and (iii) the period from 2012 to the present day, which is mainly defined by the decline in the mechanisms under the Kyoto Protocol and the emergence of new, national and subnational, carbon pricing instruments in both developed and developing economies.

» The number of carbon pricing instruments has expanded by 90 percent since 2012. «

9 The EU ETS operates in the 28 EU member states and the other three members of the European Economic Area (Iceland, Liechtenstein, and Norway).

10 These numbers are revised on a regular basis to reflect updated figures on GHG emissions in each jurisdiction, changes in the design and coverage of existing carbon pricing instruments, the inclusion of new instruments, and the availability of new data. Thus, these figures and the ones from previous State and trends of carbon pricing reports are not necessarily comparable.

11 In 2005, carbon pricing instruments covered 4 percent of annual global GHG emissions; in 2015, this figure stands at 12 percent.

Box 1 Carbon pricing in numbers

39
NATIONAL JURISDICTIONS

23
SUBNATIONAL JURISDICTIONS

with carbon pricing instruments

38
CARBON PRICING INSTRUMENTS

already implemented or scheduled for implementation

90% ↑
INCREASE

in number of instruments with respect to January 1, 2012

COVERING ANNUAL GLOBAL GHG EMISSIONS OF

~12% = 7 $GtCO_2e$

8%
ETSs

4%
CARBON TAXES

3x ↑
INCREASE
over 2005-2015 in share of global emissions covered

PRICES IN THE INSTRUMENTS IMPLEMENTED

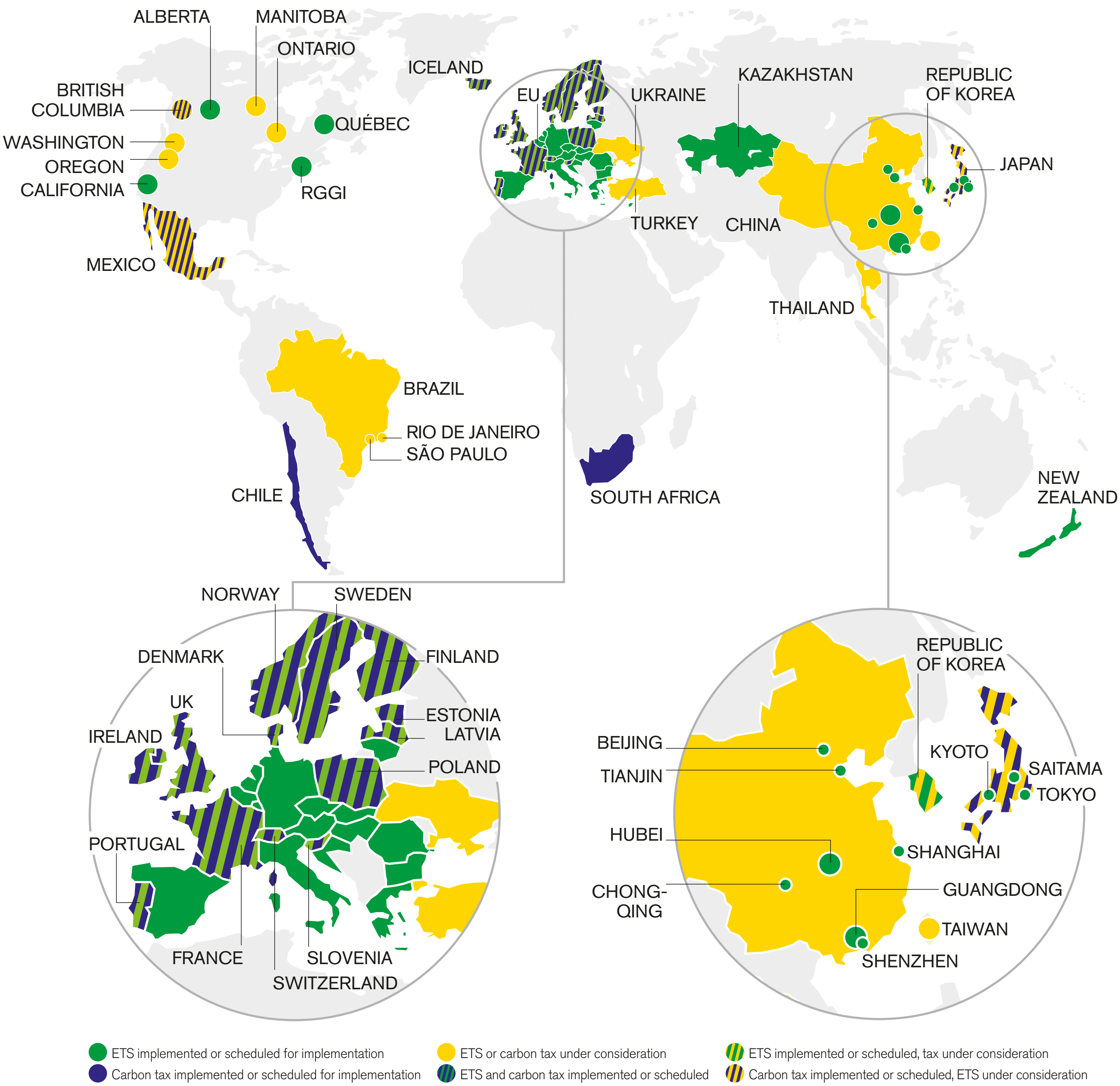
US$ 1-130/tCO_2e

85% of emissions covered are priced at <US$ 10/tCO2e

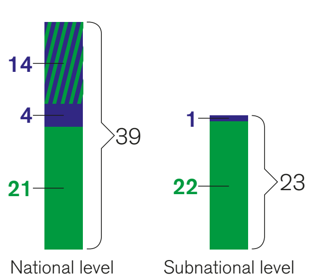
ANNUAL VALUE OF THE INSTRUMENTS IMPLEMENTED IS
just under
US$ 50 billion[12]

12 See footnote 15 for the underlying calculation related to the value of the carbon pricing instruments implemented.

Figure 4 Overview of existing, emerging, and potential regional, national, and subnational carbon pricing instruments (ETS and tax)

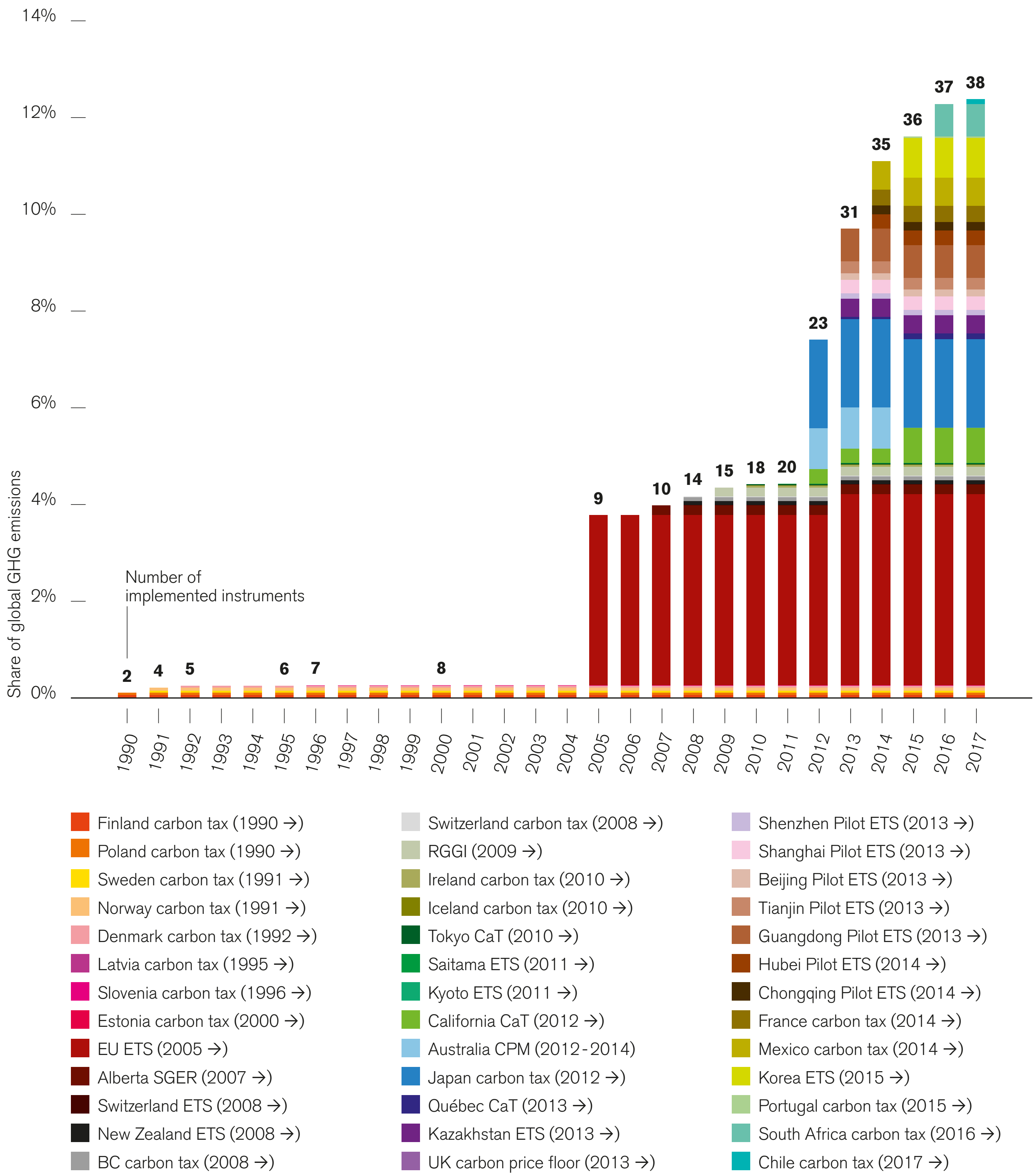


Tally of carbon pricing instruments



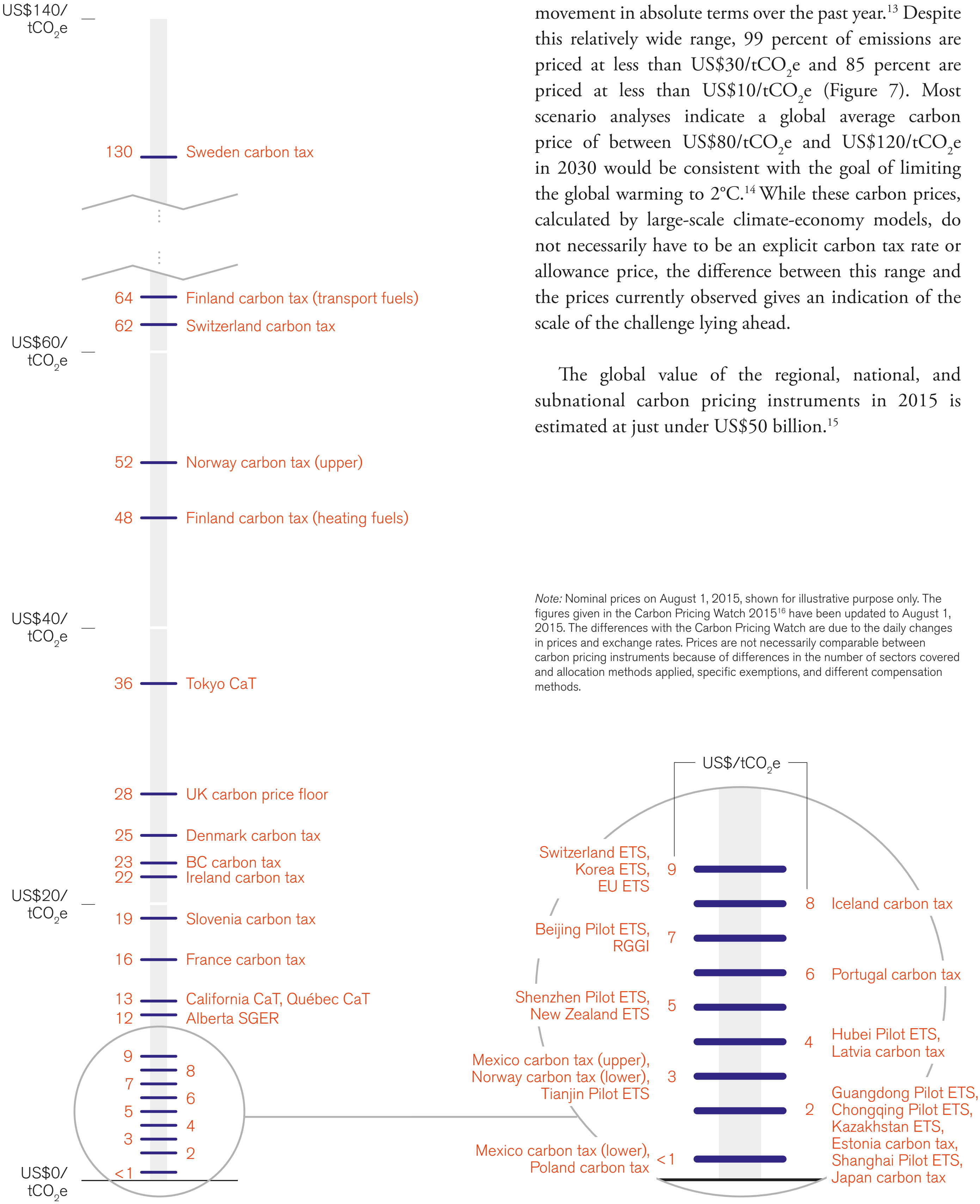
The circles represent subnational jurisdictions. The circles are not representative of the size of the carbon pricing instrument, but show the subnational regions (large circles) and cities (small circles).
Note: RGGI = Regional Greenhouse Gas Initiative. Carbon pricing instruments are considered "scheduled for implementation" once they have been formally adopted through legislation and have an official, planned start date.
Instruments implemented or scheduled for implementation: *National ETSs:* Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Germany, Greece, Hungary, Italy, Kazakhstan, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, New Zealand, the Republic of Korea, Romania, Slovakia, and Spain. *National carbon taxes:* Chile, Japan, Mexico, and South Africa. *Both ETSs and carbon taxes:* Denmark, Estonia, Finland, France, Iceland, Ireland, Latvia, Norway, Poland, Portugal, Slovenia, Sweden, Switzerland, and the United Kingdom. *Subnational ETSs:* Alberta, Beijing, California, Chongqing, Connecticut, Delaware, Guangdong, Hubei, Kyoto, Maine, Maryland, Massachusetts, New Hampshire, New York, Québec, Rhode Island, Saitama, Shanghai, Shenzhen, Tianjin, Tokyo, and Vermont. *Subnational carbon tax:* British Columbia.
Instruments under consideration: *National ETS or carbon tax:* Brazil, China, Japan (ETS), Mexico (ETS), the Republic of Korea (carbon tax), Thailand, Turkey, and Ukraine. *Subnational ETS or carbon tax:* Manitoba, Ontario, Oregon, Rio de Janeiro, São Paolo, Taiwan, and Washington State.

Figure 5 Regional, national, and subnational carbon pricing instruments already implemented or scheduled for implementation: share of global GHG emissions covered



Note: Only the introduction or removal of an ETS or carbon tax is shown. Emissions are given as a share of global GHG emissions in 2012. Annual changes in global, regional, national, and subnational GHG emissions are not shown in the graph. Data on the coverage of the city-level Kyoto ETS are not accessible; its coverage is therefore shown as zero.

Figure 6 Prices in existing carbon pricing instruments

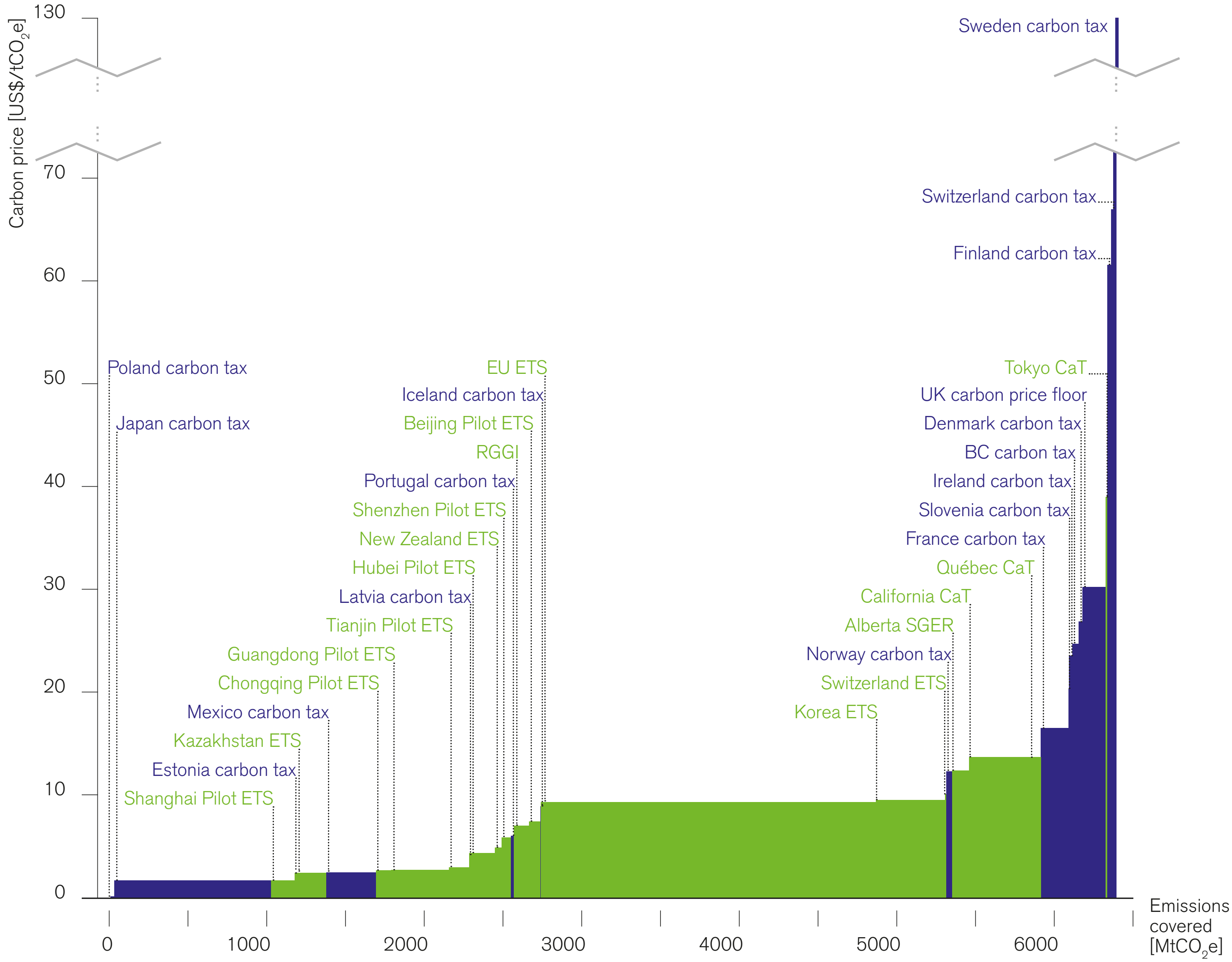


Prices currently range from about US\$1 to US\$130/tCO_2e (Figure 6) and have shown little movement in absolute terms over the past year.[13] Despite this relatively wide range, 99 percent of emissions are priced at less than US\$30/tCO_2e and 85 percent are priced at less than US\$10/tCO_2e (Figure 7). Most scenario analyses indicate a global average carbon price of between US\$80/tCO_2e and US\$120/tCO_2e in 2030 would be consistent with the goal of limiting the global warming to 2°C.[14] While these carbon prices, calculated by large-scale climate-economy models, do not necessarily have to be an explicit carbon tax rate or allowance price, the difference between this range and the prices currently observed gives an indication of the scale of the challenge lying ahead.

The global value of the regional, national, and subnational carbon pricing instruments in 2015 is estimated at just under US\$50 billion.[15]

Note: Nominal prices on August 1, 2015, shown for illustrative purpose only. The figures given in the Carbon Pricing Watch 2015[16] have been updated to August 1, 2015. The differences with the Carbon Pricing Watch are due to the daily changes in prices and exchange rates. Prices are not necessarily comparable between carbon pricing instruments because of differences in the number of sectors covered and allocation methods applied, specific exemptions, and different compensation methods.

Figure 7 Carbon price and emissions coverage of existing carbon pricing instruments



Note: The carbon tax rate applied in Mexico, Finland, and Norway varies with the fossil fuel type and use. The graph shows the average carbon tax rate weighted by the amount of emissions covered at the different tax rates in those jurisdictions.

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13 An OECD analysis calculated a total effective tax rate on CO_2 by considering explicit carbon taxes and implicit carbon tax rates from specific energy taxes, as these are economically similar. On average, the total effective tax rate in an OECD country in 2012 is €164/tCO_2 for oil products used in road transport, €24/tCO_2 for oil products used for heating and process use, and €5/tCO_2 for coal and peat used in heating and process use. Source: OECD, *Taxing Energy Use*, 2015.

14 Leon Clarke, Kejun Jiang, Keigo Akimoto, Mustafa Babiker, Geoffrey Blanford, Karen Fisher-Vanden, Jean-Charles Hourcade, Volker Krey, Elmar Kriegler, Andreas Loschel, David McCollum, Sergey Paltsev, Steven Rose, Priyadarshi R. Shukla, Massimo Tavoni, Bob van der Zwaan and Detlef P. van Vuuren, "Assessing Transformation Pathways," in *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 2014; IEA, *World Energy Outlook*, 2014.

15 The total value of the ETS markets is estimated by multiplying each ETS's annual allowance volume for 2015, or for the latest year that data are available, with the allowance price on April 1, 2015. The total value for carbon taxes is derived from official government budgets for 2015. Where the allowance volume (for an ETS) or budget information (for a carbon tax) is unavailable, the value of the carbon pricing instrument is calculated by multiplying the GHG emissions covered with the nominal carbon price on April 1, 2015. The State and Trends of Carbon Pricing 2014 report reported a total value US$32 billion for only the ETSs. The value of global ETSs as of April 1, 2015, was US$34 billion—a slight increase with respect to 2014—mainly because of the launch of the Republic of Korea's ETS and the expansion of GHG emissions coverage in the California and Québec ETSs, and despite the repeal of Australia's Carbon Pricing Mechanism in July 2014. The total value of carbon taxes around the world is about US$14 billion. There was no need to update the values presented in the Carbon Pricing Watch 2015 to August 1, 2015 because no new carbon pricing instruments have been implemented nor have any changes occurred in the existing instruments since the release of that brief in May 2015. Moreover, daily changes in prices and exchange rates over a 4-month period cannot be used as an indicator of the evolution of global carbon pricing instruments.

16 Kossoy, Alexandre; Peszko, Grzegorz; Oppermann, Klaus; Prytz, Nicolai; Gilbert, Alyssa; Klein, Noemie; Lam, Long; Wong, Lindee. 2015. *Carbon Pricing Watch 2015*. Washington, DC. World Bank.

2.1.2
Recent developments and emerging trends

This report monitors developments in carbon pricing during the period 2014–15[17] and highlights the sustained interest of governments and the growing engagement of the private sector. As further experience is gained with carbon pricing, new instruments are being designed and existing ones adjusted so as to reflect the lessons learned over the past decade. This section explores these emerging trends and policy design lessons.

New instruments continue to emerge
Six jurisdictions implemented new carbon pricing instruments in the 2014–15 period covered by this report. These instruments include:

- **In 2014:**
  - ETSs in Hubei and Chongqing (both located in China)
  - Carbon taxes in France and Mexico[18]

- **In 2015:**
  - ETS in the Republic of Korea
  - Carbon tax in Portugal.

In addition, Chile passed legislation for a carbon tax to be introduced in 2017, and Taiwan and Ontario announced that they would be adopting an ETS in the future. As planned, on January 1, 2015, California and Québec expanded the GHG coverage of their Cap-and-Trade programs to include transport fuels.

In 2014, China and the United States entered into one of the most significant bilateral agreements to date on climate change. As part of this agreement between the world's two largest emitters, both have committed to GHG emission reduction targets. China and the United States are also the two countries with the largest volume of emissions covered under carbon pricing instruments. If each country's subnational carbon pricing instruments are added up, carbon pricing covers a GHG emissions volume of about 1 $GtCO_2e$ in China and 0.5 $GtCO_2e$ in the United States.[19] The United States intends to meet its emission reduction target partly through the United States Environmental Agency's (US EPA) Clean Power Plan, which was finalized in August 2015.

» China and the United States are the two countries with the largest volume of emissions covered under carbon pricing instruments. «

Meanwhile, discussions continue on the role of carbon pricing in emission mitigation on a national or regional scale. Australia replaced its Carbon Pricing Mechanism with the Direct Action Plan, which retains offsetting, but does not impose a cap on GHG emissions. Oregon, Ontario, and Washington State are considering the implementation of an ETS, following the lead of neighboring states that have implemented carbon pricing instruments—British Columbia, California, Québec, and the Regional Greenhouse Gas Initiative (RGGI) states.[20]

17 This report covers the period from January 1, 2014 to August 1, 2015.
18 For further details on the French and Mexican carbon taxes, please refer to World Bank, *State and Trends of Carbon Pricing 2014*, May 2014.
19 The volume of GHG emissions covered is not equivalent to the ETS's allowance volume (i.e., the size of the cap). The size of the cap is used to calculate the value of an ETS.
20 The Regional Greenhouse Gas Initiative (RGGI) is the first market-based regulatory program in the United States to reduce GHG emissions. It is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector.

Support for carbon pricing growing in public and private sectors A number of government leaders and policy makers in both developed and developing economies continue to advocate the use of carbon pricing to achieve a global decarbonized economy.[21] Business leaders are also increasingly engaging with this topic and several have stated their support for carbon pricing. For example, over 1,000 investors and companies signed the "Put a Price on Carbon Statement".[22] Moreover, several initiatives have been launched by alliances such as the Carbon Pricing Leadership Coalition, to jointly make a business case for carbon pricing and formulate key principles for successful policy design and implementation.[23]

The choice of carbon pricing instrument is based on national circumstances and political realities After more than a decade of experience with carbon pricing, the long-running debate over the superiority of an ETS or tax has been replaced by a pragmatic dialogue. In fact, what is the most suitable instrument depends on the specific circumstances and context of a given jurisdiction, and the instrument's policy objectives should be aligned with the broader national economic priorities and institutional capacities. An ETS and a carbon tax are increasingly being used in complementary ways, features of both instruments often being combined to form hybrid approaches.[24] The differences and commonalities of ETSs and carbon taxes are discussed further in Box 2.

Carbon pricing is only one instrument in a range of approaches that need to be mobilized for emissions mitigation. Other policy instruments, such as the removal of fossil fuel subsidies, infrastructure investments in transport and energy, renewable energy portfolio standards, and energy efficiency standards, also have an important role to play in achieving emission reductions. Carbon pricing and these complementary policy instruments need to operate in tandem to address the urgency and scale of the climate change mitigation challenge.

Box 2 Emissions trading systems and carbon taxes

While both an ETS and a carbon tax can achieve cost-effective and efficient emission reductions, these two instruments differ significantly. One of their key differences is the level of uncertainty associated with the carbon price and emission reductions that will be achieved. On the one hand, a carbon tax provides more certainty as to the price level, as the latter is set by the government, although this is subject to regulatory risk. On the other hand, the price signal given by an ETS arises from a restriction on the quantity of emission allowances and economic cycles. Price certainty is desirable because investment in low-carbon technology requires confidence in the existence of a sufficiently high, long-term carbon price. On the other hand, it is almost certain that an ETS will deliver emission reductions, as this is achieved by controlling the volume of allowances through the cap, while a tax is not directly related to an emission reduction target. Taxes are generally set by modeling the cost of reducing emissions up to a certain target. Any inaccuracies in the model used will result in actual emission reductions that are different from the emission reductions target. →

21 The World Bank Group is supporting these developments with catalytic initiatives, among others, the Carbon Pricing Leadership Coalition (CPLC) and the Partnership for Market Readiness (PMR).
22 World Bank, *We Support Putting a Price on Carbon*, 2014.
23 Carbon Pricing Leadership Coalition, accessed June 11, 2015, http://www.carbonpricingleadership.org/.
24 Generally ETSs and carbon taxes cover different sectors; in the EU, for example, carbon taxes mostly apply to sectors not covered by the EU ETS.

However, the degree of certainty in meeting environmental targets or strengthening the price signal can be increased through dynamic adjustments to changing circumstances. For example, tax rates can be altered to reflect the level of progress in emission reductions, while the supply of emission allowances can be modified to influence prices.

An ETS and a carbon tax also differ in administrative complexity. A carbon tax is generally easier to implement, as it can build on existing taxation infrastructure, for example, through the expansion of an energy taxation policy. The operation of a carbon tax is also relatively simple, as it only requires emissions monitoring and reporting. However, an administrative burden arises from the iterative approach often used to set tax rates. These revisions may also involve changes in the scope of the carbon tax or its integration into a broader energy tax, thereby creating uncertainty for low-carbon investments. The implementation of an ETS is more complicated because it requires the creation of a new commodity (emission allowances), the allocation of these emission allowances, and the establishment of a market for trading. New institutions may also have to be set up, further adding to complexity and costs. However, the administrative costs are generally low in relation to the value of the carbon pricing instrument.

Often, the choice of instrument is not only motivated by the above characteristics, but also by specific national circumstances. For example, the EU chose an ETS rather than a carbon tax partly because the EU legislative remit simply does not cover fiscal policies such as carbon taxation.[25] South Africa opted for a carbon tax because of the concentrated nature of its energy sector-marked by a small number of market participants and small trading volumes. This would have resulted in an illiquid and potentially skewed market, making it hard to operate an efficient ETS and thereby defeating one of the main purposes for establishing an ETS.[26] Another reason South Africa chose a carbon tax over an ETS is that this instrument could be built on the existing infrastructure used for other taxes.[27]

While jurisdictions commonly start to price carbon by introducing an ETS or carbon tax, these two instruments are increasingly being deployed together. A carbon tax may also be used as a transitional instrument toward an ETS. Moreover, an ETS and a carbon tax can be used to target emission reductions in different sectors of one jurisdiction. The carbon taxes in France, Ireland, Portugal and Sweden, for instance, are applicable to selected, non-EU ETS sectors. In some cases, compatibility of future instruments is considered. For example, the implementation of Chile's tax and MRV system will be ETS compatible to facilitate the possible implementation of an ETS in the future.

Finally, hybrid instruments and tax instruments that also permit the use of offsets actually combine some of the features of ETSs and taxes. For example, the California Cap-and-Trade Program applies an auction reserve price and a soft price ceiling to provide both liable entities and investors with a degree of price certainty. Similarly, the use of offsets in Mexico's carbon tax and, potentially, in South Africa's proposed carbon tax provides liable entities with flexible mechanisms for compliance.

25 Maria Lee, *EU Environmental Law, Governance and Decision Making* (Bloomsbury Publishing, 2014).
26 National Treasury, Republic of South Africa, *Carbon Tax Policy Paper: Reducing Greenhouse Gas Emissions and Facilitating the Transition to a Green Economy*, May 2013.
27 Ibid.

Carbon pricing instruments are fine-tuned, incorporating lessons learned One key feature of the latest instruments is a well-designed price stabilization measure, such as the floor price and soft ceiling price in the California Cap-and-Trade Program and the reserve of allowances in the Republic of Korea's ETS. These price stabilization measures are designed to facilitate emission reductions in a cost-effective manner. Predictability of carbon prices is essential to reducing the investment risk of low-carbon technologies. Another way to strengthen the carbon price signal is by reducing market volatility through market stabilization measures. In the EU ETS, the large surplus of emission allowances has undermined the carbon price signal, and the EU addressed this by the implementation of backloading in 2014 and the market stability reserve (MSR), which is expected to come into force in 2019.

Industry protection provisions evolve to avoid carbon leakage Policymakers continue to reduce the risk of carbon leakage and assist emissions-intensive, trade-exposed industry sectors in remaining internationally competitive through the free allocation of emission allowances and other methods. In 2014, the EU finalized the list of industries that will receive additional free allowances for the EU ETS in the period 2015–19. Under the Republic of Korea's ETS, all allowances will be given out free of charge during the first phase, reflecting concerns about carbon leakage and international competitiveness. China's national ETS will also distribute allocations for free. Another method to reduce the risk of carbon leakage is through border carbon adjustments, a measure bearing resemblance to the equal treatment of emissions associated with electricity importers and generators in the California Cap-and-Trade Program. A more thorough analysis of the impacts of carbon pricing on carbon leakage and industrial competitiveness is presented in section 3.

The environment and social welfare are among beneficiaries of carbon pricing revenue Total government revenue derived from ETS allowance auctions and carbon taxes in 2014 is estimated at over US$15 billion (Box 3). This revenue is used in diverse ways, for example, to lower taxes, provide additional payments to citizens, or finance emission reduction activities or other projects. For instance, some ETS revenue in Guangdong will be channeled to a low-carbon development fund that will support energy savings and emission reductions,[28] while a portion of the post-2020 revenue from the EU ETS will finance an energy system modernization fund and a low carbon innovation fund.[29] Revenue from Switzerland's carbon tax is returned to the country's citizens through lower health insurance payments and to business via the social security contributions.[30] The proposed Oregon ETS, which is currently under debate in the State's legislature, intends to return the revenue collected to Oregon's citizens in the form of a "dividend" payment.

28 Sun Yat-sen University, Research Center of Low Carbon Technology and Economy and ICIS China, *Guangdong Pilot Emissions Trading Scheme Report (2013-2014)*, March 2015.

29 European Council, *Cover Note from General Secretariat of the Council of Delegations to Delegations: European Council (23 and 24 October 2014) % Conclusions*, October 24, 2014.

30 Switzerland Federal Office of the Environment, *Redistribution of CO_2 tax*, accessed August 12, 2015, http://www.bafu.admin.ch/klima/13877/14510/14749/index.html?lang=fr.

Box 3 Carbon taxes and ETSs as tools to support public budget

It is estimated that in 2014 over US$15 billion[31] in government revenue was raised through carbon taxes and ETS sales. About US$5 billion, or a third of total government revenue, was derived from the sale of emission allowances under ETSs, mostly through auctions, the EU ETS accounting for almost US$4 billion. The total revenue in 2014 raised through carbon taxes implemented around the world is estimated at over US$10 billion, the United Kingdom accounting for about a fifth of the total amount, followed by Japan, Finland, Norway, and British Columbia. These figures highlight the potential to generate significant revenue streams through these means. The rise in carbon prices that is necessary to limit the global temperature increase to 2°C would, in turn, further increase revenues.

Carbon pricing revenues are used in various ways, for example:

- RGGI has already invested over US$1 billion, or more than 70 percent of its 2008–13 ETS revenue, in projects on energy efficiency, renewable energy and GHG abatement, and support for household energy bills.[32] Almost all remaining revenue has been reserved for future projects in those same areas.
- Total payments of GHG emitters into Alberta's Climate Change and Emissions Management Fund have grown to CAN$578 million (US$443 million) in the 2007–14 compliance periods. They must be dedicated to reducing emissions of specified gases or improving the province's ability to adapt to climate change. The Climate Change and Emissions Management Corporation, using competitive processes, has funded 109 projects for a total of CAN$350 million (US$268 million). These projects represent a total value of over CAN$2.2 billion (US$1.7 billion), if private sector investments are also taken into account.
- The EU ETS member states have indicated that they will use around €3 billion (US$3.3 billion) of their 2013 auction revenues, or 80 percent, for energy- and climate-related projects.[33] Additionally, the EU has used the revenue derived from the sale of 300 million allowances to set up a dedicated fund of €2.1 billion (US$2.3 billion) to support demonstration projects on innovative low-carbon technologies.
- British Columbia is required by law to recycle all carbon tax revenues through tax reductions. The revenue is returned through tax cuts in personal and corporate income tax and tax credits. In the tax year 2013/14, the total revenue recycling measures amounted to CAN$1,232 million (US$944 million) while total carbon tax revenue amounted to CAN$1,222 million (US$937 million), meaning the carbon tax was revenue-negative.[34] In fact, it has been revenue-negative since its introduction in 2008 and is expected to remain so.
- Switzerland redistributes about two thirds of its annual carbon tax revenue of about CHF800 million (US$831 million) to businesses and the public.[35] In 2014, about CHF180 million (US$187 million) was redistributed to the employers by reducing their social security contribution, and CHF297 million (US$309 million) went to the public by lowering the health insurance premium. A third of the revenue (maximum of CHF300 million (US$312 million) goes into an energy refurbishment fund for buildings. Finally, another CHF25 million (US$26 million) goes into a low-carbon technology fund. The revenues do not feed into the federal budget.

Beyond raising revenues, carbon taxes offer other fiscal advantages. Placing a carbon tax on the carbon content of fuels may be administratively easy relative to some other taxes, in particular where the tax administration can be built on existing excise taxes. Furthermore, carbon emissions are a good tax base, as carbon sources are concentrated and difficult to evade. For example, in Sweden, which has had a carbon tax since 1992, tax evasion is less than 1 percent for carbon, much less than it is for the value added tax.[36]

31 Authors' calculations, based on auction revenue reports of the different ETSs, sales of allowances from the EU ETS' fund for demonstration projects in innovative low-carbon technologies (NER300), payments into Alberta's Climate Change and Management Fund, and the annual budget of governments with carbon taxes in place. The total government revenue in 2014 is calculated at US$16 billion.

INDCs give some insights into countries' plans and actions on carbon pricing At the international level, the role of carbon pricing post-2020 is being discussed ahead of the December 2015 Paris climate change conference (21st session of the Conference of the Parties to the UNFCCC—COP 21—and 11th session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol—CMP 11). The Intended Nationally Determined Contributions (INDCs) indicate national climate policy objectives. Some INDCs also shed light on the envisaged use of domestic and international carbon pricing instruments toward meeting post-2020 emission reduction targets (see section 2.2.1). As discussed in section 4, cooperation between countries through carbon pricing instruments and climate finance is the key to ensuring that mitigation is optimized and achieved cost-effectively.

2.2 INTERNATIONAL CARBON PRICING INSTRUMENTS

2.2.1 International carbon pricing under the UNFCCC

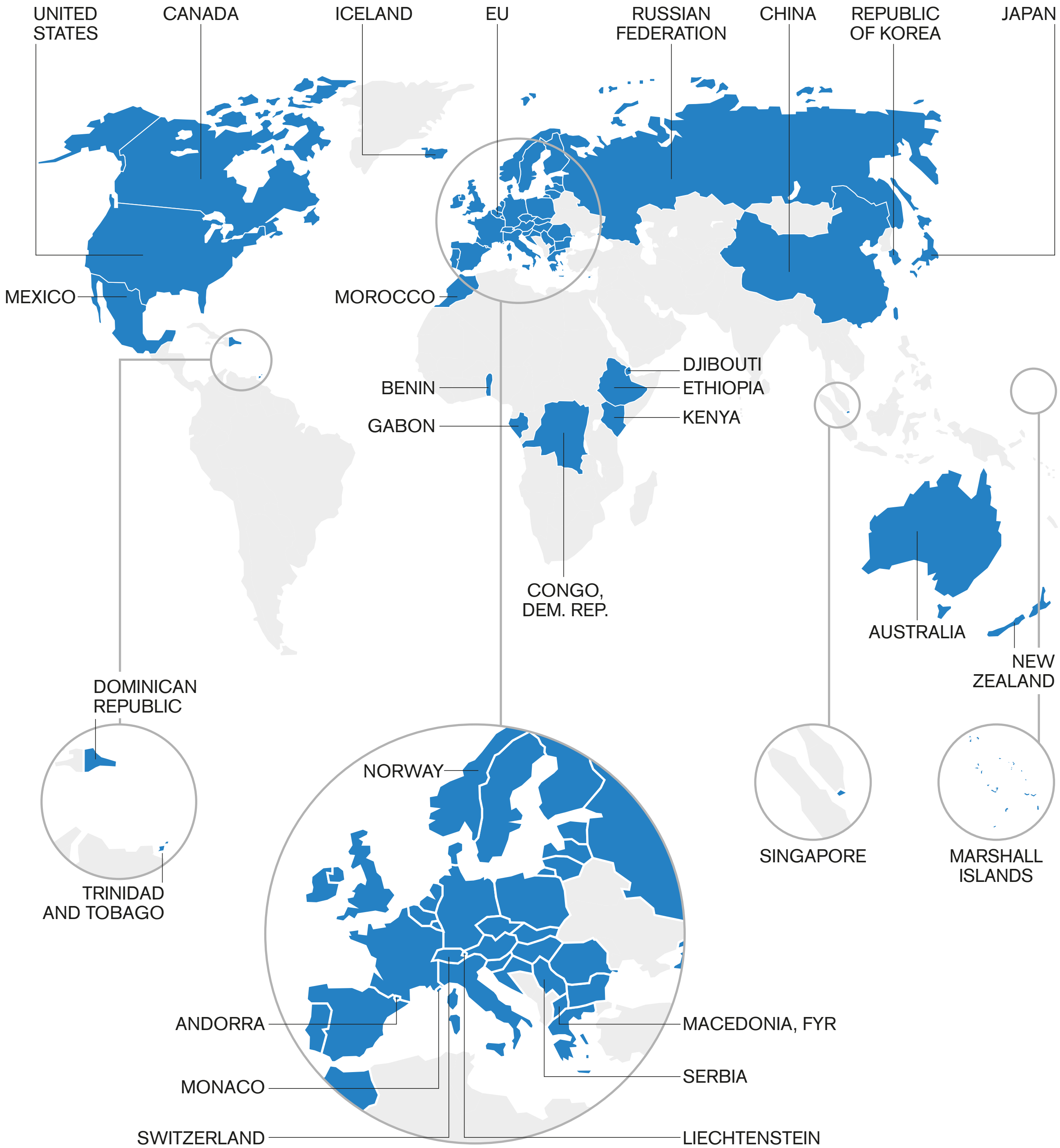
Status of the international post-2020 climate negotiations A new post-2020 agreement is expected to be reached at the Paris climate change conference to be held in December 2015. The details of this agreement are under negotiation, and, as of July 2015, two options were being considered for the role of carbon markets.[37] The first option includes provisions in the proposed text for market mechanisms, such as descriptions of the purpose of such a mechanism, while the second option does not. Prior to COP 21, further discussions on the negotiating text will take place.

Countries were invited to communicate to the UNFCCC their INDCs in advance of COP 21. As of August 31, 2015, 57 Parties—representing approximately 61 percent of global GHG emissions—had submitted their INDCs (Figure 8). According to some analysts, further discussions will be needed to make the INDCs consistent with the 2°C pathway.[38]

Several INDCs explicitly indicate that carbon pricing will be an element of their mitigation strategy. For example, China, Norway, and Iceland highlighted that an ETS will play a role in their post-2020 emission reductions. Other countries, such as the Republic of Korea and Switzerland, stated their intention to use international credits to meet their targets. By contrast, some INDCs—including those of Andorra, the EU, Gabon, the Marshall Islands, and the United States—explicitly rule out the use of international credits. However, INDCs do not provide a comprehensive overview of how carbon pricing will be used. For instance, the EU's INDC does not discuss the role of its ETS but, in another official communication, the EU ETS is identified as the main instrument to deliver emission reductions.[39]

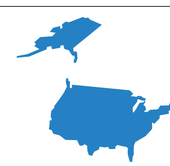
32 RGGI, *Investment of RGGI Proceeds Through 2013*, April 2015.
33 European Commission, *Press Release, EU gears up for 2030 with more emissions reductions*, October 28, 2014, http://europa.eu/rapid/press-release_IP-14-1202_en.htm.
34 British Columbia Ministry of Finance, *Budget and Fiscal Plan – 2015/16 to 2017/18 Carbon Tax Report and Plan*, February 2015.
35 Switzerland Federal Office of the Environment, *Redistribution of CO_2 tax*, accessed August 12, 2015, http://www.bafu.admin.ch/klima/13877/14510/14749/index.html?lang=fr.
36 Marianne Fay, Stephane Hallegatte, Adrien Vogt-Schilb, Julie Rozenberg, Ulf Narloch, Tom Kerr, *Decarbonizing Development: Three Steps to a Zero-Carbon Future*. Washington, DC: World Bank. 2015.
37 UNFCCC, Informal Note ADP.2015.4., *Scenario note on the tenth part of the second session of the Ad Hoc Working Group on the Durban Platform for Enhanced Action*, July 24, 2015.
38 Based on an analysis of the INDCs submitted as of May 14, 2015 and related policy statements on future energy trends. Source: IEA, *Energy and Climate Change – World Energy Outlook Special Report*, 2015.
39 European Council, *European Council (October 23–24, 2014) Conclusions*, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf.

Figure 8 INDCs submitted



Note: INDCs can take the form of unconditional or conditional pledges, or a combination of both. This map shows the unconditional pledges, where available. The conditional pledge is shown only if an unconditional pledge has not been made.

Figure 8 INDCs submitted

ANDORRA	37% below BAU levels by 2030	
AUSTRALIA	26-28% below 2005 levels by 2030	
BENIN	Cumulative emission reductions of 163 $MtCO_2e$ over 2020 - 2030 through forestry sinks	
CANADA	30% below 2005 levels by 2030	
CHINA	Achieve the peaking of CO_2 emissions at around 2030 and making best efforts to peak early Lower CO_2 emissions per unit of GDP by 60-65% from the 2005 level by 2030	
CONGO, DEM. REP.	17% below BAU levels by 2030	
DJIBOUTI	40% below BAU levels by 2030	
DOMINICAN REPUBLIC	25% below 2010 levels by 2030	
ETHIOPIA	64% below BAU levels by 2030	
EU	At least 40% below 1990 levels by 2030	
GABON	At least 50% below BAU levels by 2025	
ICELAND	40% below 1990 levels by 2030	
JAPAN	26% below 2013 levels by 2030	
KENYA	30% below BAU levels by 2030	
REPUBLIC OF KOREA	37% below BAU levels by 2030	
LIECHTENSTEIN	40% below 1990 levels by 2030	
MACEDONIA, FYR	Reduce CO_2 emissions from fossil fuels combustion for 30%, that is, for 36% at a higher level of ambition, by 2030 compared to BAU levels	
MARSHALL ISLANDS	32% below 2010 levels by 2025	
MEXICO	22% below BAU levels by 2030	
MONACO	50% below 1990 levels by 2030	
MOROCCO	13% below BAU levels by 2030	
NEW ZEALAND	30% below 2005 levels by 2030	
NORWAY	At least 40% below 1990 levels by 2030	
RUSSIAN FEDERATION	25–30% below1990 levels by 2030	
SERBIA	9.8% below 1990 levels by 2030	
SINGAPORE	36% reduction in emissions intensity from 2005 levels by 2030	
SWITZERLAND	50% below 1990 levels by 2030	
TRINIDAD AND TOBAGO	30% reduction in public transportation emissions below BAU levels by 2030	
UNITED STATES	26–28% below 2005 levels by 2025	

Supply and demand outlook for Kyoto credits pre-2020 Lack of pre-2020 ambition under the UNFCCC remains an issue. The need for more ambitious targets—for example, through mitigation of GHG other than carbon dioxide and further technical examination of opportunities with high mitigation potential and co-benefits—was reiterated at COP 20 in Lima.[40] However, no specific action was agreed upon. With no sign of an increase in countries' pre-2020 ambition, the declining market trend for Kyoto credits—Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs)—continued in 2014 and 2015 (Figure 10).

To date, EU ETS installations have used 1.45 $GtCO_2e$ of CERs and ERUs[41] to help them meet their compliance obligations, or 90 percent of the total 1.6 $GtCO_2e$ allowed under that system between 2008 and 2020. The latter figure represents about 60 percent of total Kyoto credits issued so far.[42] If this trend persists, EU ETS installations are likely to exhaust their Kyoto credit quota in the next few years, leaving sellers of Kyoto credits without their historically largest buyer.

Outside the Kyoto Protocol, various instruments create demand sources for CERs, such as domestic instruments accepting CERs, purchase programs, and voluntary cancellations of CERs. Mexico's carbon tax and the Republic of Korea's ETS allow the use of CERs issued by Clean Development Mechanism (CDM) projects located in the country,[43] and so may South Africa's carbon tax, which is scheduled to be launched in 2016. CERs are currently priced significantly lower than the carbon tax or allowances under these domestic instruments and they may therefore be attractive to compliance entities. CERs are also targeted by purchase programs, such as the RBF-based Carbon Initiative for Development (Ci-Dev), the Pilot Auction Facility for Methane and Climate Change Mitigation (PAF), and the Swedish Energy Agency purchase program.[44] However, these demand sources are limited.[45, 46] The total residual demand for Kyoto credits between 2015 and 2020 is therefore expected to be minimal, resulting in a surplus of these credits.

Credits yet to be issued will add to this surplus. The CDM pipeline is estimated to have the potential to issue about 6,600 $MtCO_2e$ between now and 2020, should the demand exist (Figure 9). This potential is based on the registered portfolio, without considering the effect of actual demand on the issuance levels. However, given the lack of demand, supply continues to head downwards (Figure 10), and a more realistic maximum potential issuance till 2020 is about 750 $MtCO_2e$ (Figure 9).[47] Yet even this figure remains significantly higher than potential demand. The supply-demand imbalance is therefore not expected to tip, thereby preventing any significant price recovery from the historically low prices.

40 UNFCCC, Decision 1/CP.20, *Lima Call for Climate Action*, February 2, 2015.

41 European Commission, *Updated information on exchange and international credit use in the EU ETS*, May 4, 2015, http://ec.europa.eu/clima/news/articles/news_2015050402_en.htm.

42 As of August 10, 2015, 2.48 billion CERs and ERUs had been issued. Source: UNFCCC, *CDM Insights - Project Activities*, accessed August 10, 2015, https://cdm.unfccc.int/Statistics/Public/CDMinsights/index.html#iss; UNFCCC, *CDM Insights: Programme of Activities*, accessed August 10, 2015, https://cdm.unfccc.int/Statistics/Public/PoA/index.html; UNFCCC, *Emission Reduction Units (ERUs) Issued*, June 30, 2015, http://ji.unfccc.int/statistics/2015/ERU_Issuance_2015_06_30_1200.pdf.

43 CERs need to be voluntarily canceled before they can be swapped for Korean domestic credits that can be used for compliance under the Republic of Korea's ETS.

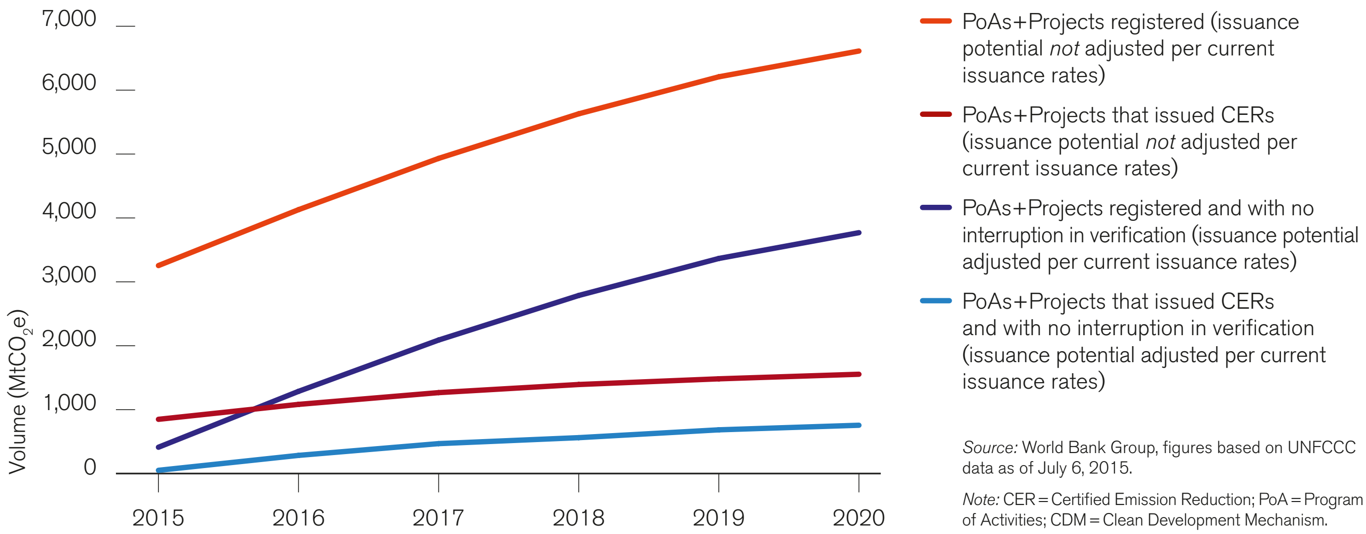
44 Carbon Initiative for Development, http://www.ci-dev.org/; Pilot Auction Facility for Methane and Climate Change Mitigation, http://www.pilotauctionfacility.org/; Swedish Energy Agency, *The Swedish Energy Agency Is Supporting New Climate Change Mitigation Activities in Developing Countries*, May 21, 2015, http://www.energimyndigheten.se/en/About-us/Press-/Press-releases/The-Swedish-Energy-Agency-is-supporting-new-climate-change-mitigation-activities-in-developing-countries/.

45 The theoretical demand for offsets under the Republic of Korea's ETS, based on the ceiling on offset use, is estimated at 187 million for 2015–17. However, only 1.9 million had been issued as of April 2015, converted from canceled CERs, and it is estimated that only 20 million, coming from CDM projects in Korea, will become available by the end of 2017. Source: Thomson Reuters, *Fragmentation of the Credit Markets*, Carbon Market Monitor, June 10, 2015. There is no estimate of the potential demand under the Mexican and South African carbon taxes, but it is unlikely to be high enough to bridge the demand gap. As of August 31, 2015, about 4 $MtCO_2$ had been voluntarily canceled, including a significant share for conversion to offsets for use under Korea's ETS. Source: UNFCCC, *CERs Cancelled to Date in the CDM Registry*, accessed August 10, 2015, http://cdm.unfccc.int/Registry/vc_attest/index.html. PAF: the PAF has a capitalization target of US$100 million. The clearing price for the first auction was US$2.40/$tCO_2e$. Assuming a similar price for future auctions, the PAF could purchase about 40 $MtCO_2e$. Source: Pilot Auction Facility, http://www.pilotauctionfacility.org. Ci-Dev: Ci-dev has a budget of US$95 million. Assuming a price of US$4–5/$tCO_2e$, this would cover a purchase of 20–35 $MtCO_2e$.

46 Currently, most Chinese Certified Emission Reductions (CCERs) issued under the Chinese scheme are pre-CDM, that is, credits from registered CDM projects that were issued for emission reductions that happened before the projects were registered by the CDM Executive Board. The majority of the projects waiting to be registered are new projects that have not previously been registered as CDM projects. CDM projects can deregister and be registered as CCER projects, which represents an additional source of demand for the emission reductions generated by these projects. However, significant deregistration is only expected if the national ETS creates demand. Therefore, the impact of the CCER program on the CDM is not quantified at this stage and is expected to be limited. Source: Thomson Reuters, *Fragmentation of the Credit Markets*, Carbon Market Monitor, June 10, 2015.

47 Projects incur operational and regulatory costs to generate credits. Without a strong demand signal for these credits, project developers are expected to reduce or discontinue their mitigation activity in some of these projects.

Figure 9 Potential supply of CERs until 2020



Source: World Bank Group, figures based on UNFCCC data as of July 6, 2015.

Note: CER = Certified Emission Reduction; PoA = Program of Activities; CDM = Clean Development Mechanism.

In parallel, market participants continue to exit the market.[48] Some of the experience gained and the infrastructure developed through the CDM have nevertheless benefited or been adapted by several new instruments. For example, the CDM framework is being used as the basis for the domestic Chinese CER (CCER) scheme, CDM standardized baselines are being used in Nationally Appropriate Mitigation Actions (NAMAs),[49] and multilateral development banks are starting to issue green bonds on the basis of CDM projects.[50]

Market and policy update (mechanisms under the Kyoto Protocol and new mechanisms under the UNFCCC) The role of the CDM post-2020 remains uncertain. By the end of 2014, the CDM supported investments worth approximately US$90 billion[51] in GHG emission reduction projects in developing countries, or approximately 13 percent of the total renewable energy investment in these countries.[52] There is interest in ensuring the continuation of the CDM as an instrument to incentivize investments in mitigation, especially shortly after 2020, and facilitate cooperation on climate action.[53] Market participants are investigating alternative uses of the CDM infrastructure beyond an offset mechanism, and potential integration of the CDM with new market mechanisms. However, discussions on the future of market mechanisms under the UNFCCC are likely to remain stalled while the 2015 Paris agreement, including the role of carbon markets, is being negotiated. Table 1 summarizes the state of the market, policy updates of the mechanisms under the Kyoto Protocol (CDM, Joint Implementation or JI, and International Emissions Trading or IET), and new mechanisms under the UNFCCC (New Market-based Mechanism or NMM, and the Framework for Various Approaches or FVA).

48 For example, SGS withdrew from the validation and verification business in June 2014, Standard Bank closed its carbon desk in April 2015, and Bunge has announced it would close Climate Change Capital.

49 For example, the Climate Change Adaptation-Oriented NAMA Option for the Rice Sector in the Philippines, Mitsubishi UFJ Morgan Stanley.

50 African Development Bank Group, *The AfDB's Annual Green Bond Newsletter*, Issue 02, July 2015; Korea Eximbank, *Green Bond Newsletter*, January 2014.

51 This figure was calculated assuming an investment leverage factor of five, an average nominal CER price of US$11.77 over 2002–11 (weighted by the traded volume), and a total of 1.523 billion CERs issued between January 1, 2006 and December 31, 2014. The actual value of the investment is likely to be higher as the figure above does not take into account the under-delivery of CERs that has been observed nor the projects that were executed considering the prospect of the CDM but that ended up not issuing CERs because of adverse market conditions.

52 Total new renewable energy investments (excluding hydropower projects of >50 MW) in developing countries amounted to US$671 billion over the period 2006–14. Source: REN21, *Renewables 2015 Global Status Report*, July 2015.

53 UNFCCC, "What the CDM Can Offer the Emerging Market Mechanisms?" (presented at the Global CDM DNA Forum, Bonn, November 13, 2014); UNFCCC, *CDM Has Wide Role to Play Before and After 2020*, June 1, 2015, http://newsroom.unfccc.int/financial-flows/cdm-has-role-to-play-in-pre-and-post-2020-world/.

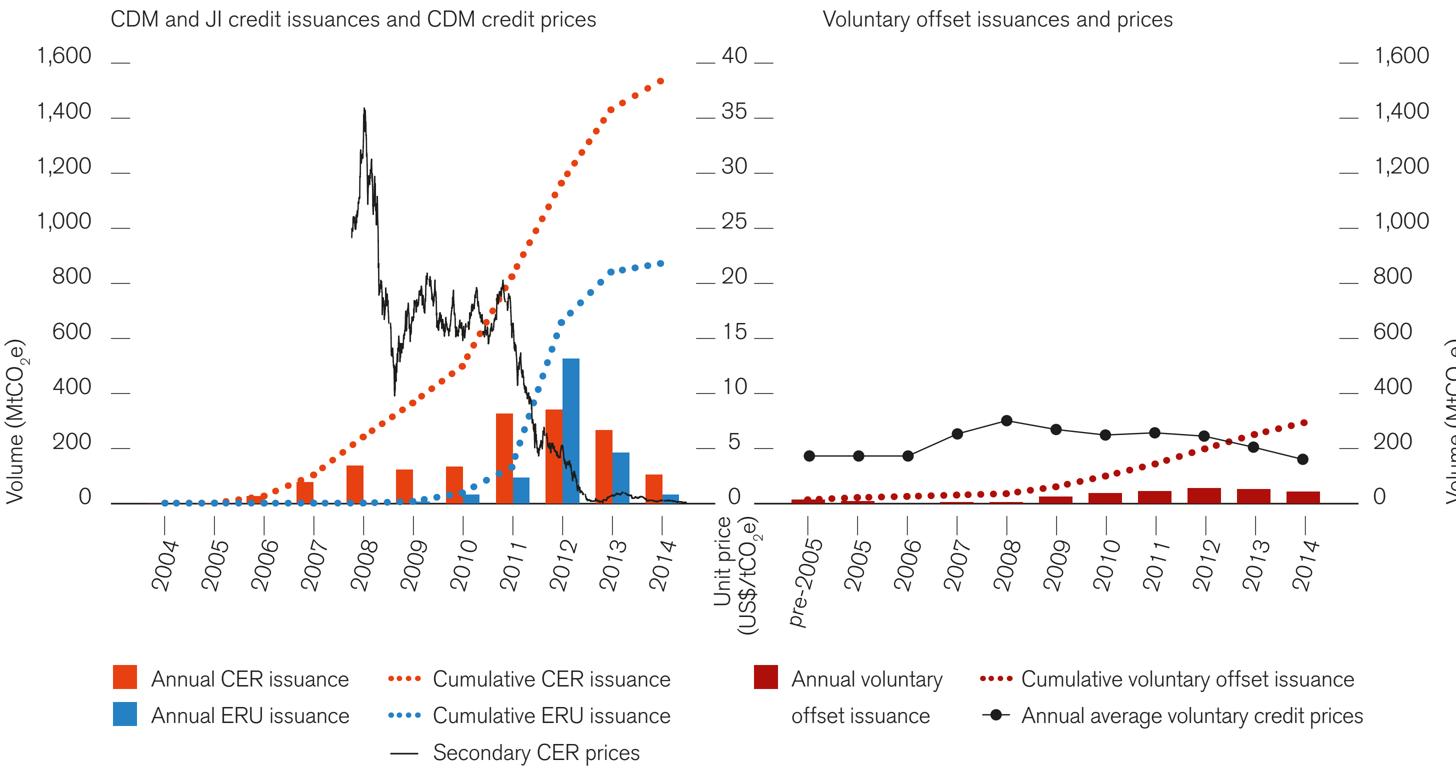
Table 1 Market and policy update of mechanisms under the Kyoto Protocol and new mechanisms under the UNFCCC

	Market update	Policy update
Existing mechanisms	**CDM**	
	– The number of projects and PoAs registered in 2014 was 160, 53% lower than in 2013. – The number of CERs issued in 2014 was 104 $MtCO_2e$, 61% lower than in 2013. This continues the declining trend of the CDM market, as shown in Figure 10. – In the primary CER market, a total of 60 million CERs were traded, a 70% drop with respect to 2013.[a] Over half of these transactions were made by the governments of Norway and Sweden through their CER purchase programs.[b] – 25 million primary CERs are expected to be traded in 2015.[c] – The average CER price on the secondary market was €0.17/ tCO_2e (US$0.19) in 2014, more than 50% lower than in 2013.[d]	– Procedures for voluntary deregistration of projects were adopted in 2015.[e] – An online platform for voluntary cancellation of CERs will be launched on September 22, 2015.[f] – Efforts continue to streamline CDM procedures through digitalization of forms, simplification of methodologies, and simplified registration for projects that automatically qualify as additional.[g] – The CDM Executive Board and the UNFCCC Secretariat are actively investigating alternative uses of the CDM infrastructure beyond an offset mechanism under the Kyoto Protocol, to increase the demand for the CDM and strengthen its ability to enhance mitigation activities.[h]
	JI	
	– No project was registered in 2014.[i] – The number of ERUs issued in 2014 was 31 $MtCO_2e$, 83% less than in 2013. This continues the declining trend of the JI market, as shown in Figure 10. – In 2014, no primary ERU contracts were closed and only 17.8 $MtCO_2e$ of trading took place on the secondary market.[j] – The ERU price fell to €0.03 (US$0.03) in December 2014.[k]	– The UNFCCC Secretariat produced a technical paper on how the JI can achieve cost savings and efficiencies, based on lessons learned from the CDM. The findings of this paper may be taken into account in future deliberations.[l]
	IET	
	– The true-up period for the first Kyoto Commitment Period (CP1) ends on November 18, 2015. Before the end of this period, countries need to retire sufficient eligible units to cover their CP1 emissions.[m]	– Little progress has been made, as the Doha agreement has not been ratified. – No further decisions have been made since Doha, 2012, on the carry-over of Assigned Amount Units (AAUs) from CP1 to CP2.
New Approaches	**NMM and FVA**	
	– Not operational	– Progress has been limited. The role of the mechanisms in the post-2020 agreement and their technical design remain open. – No conclusion has been reached and the issues were placed on the preliminary agenda for SBSTA 43, to be held in Paris, in December 2015.[n]

Note: The true-up period refers to the additional period given for fulfilling commitments.

a Thomson Reuters, 2014 Year in Review and Outlook: Asia on the Rise, Carbon Market Analyst, January 2015.
b Ibid.
c Ibid.
d Intercontinental Exchange ICE, Daily Future sCERs.
e UNFCCC, *CDM Executive Board Eighty-Second Meeting Report*, February 20, 2015.
f UNFCCC, *Online Platform for Voluntary Cancellation*, accessed September 4, 2015, http://customers.meta-fusion.com/wcm/150720_5051_UNFCCC_CDM-EB_85_Bonn/download/2.2_4%20EB85_VC_tool.pdf.
g UNFCCC, Decision 4/CMP.10, *Guidance Relating to the Clean Development Mechanism.*
h UNFCCC, *CDM Executive Board Eighty-Fourth Meeting Report*, May 28, 2015.
i UNEP DTU Centre on Energy, Climate and Sustainable Development, *UNEP DTU CDM/JI Pipeline Analysis and Database*, August 1, 2015, http://www.cdmpipeline.org/; UNEP DTU Centre on Energy, Climate and Sustainable Development, *JI Pipeline*, August 1, 2015, http://www.cdmpipeline.org/publications/JiPipeline.xlsx.
j Thomson Reuters, *2014 Year in Review and Outlook: Asia on the Rise.*
k Ibid.
l UNFCCC, *Opportunities for Cost Savings and Efficiencies in Joint Implementation, Learning from Experience with the Clean Development Mechanism While Recognizing the Respective Mandates of the Two Mechanisms*, April 21, 2015.
m UNFCCC, *SIAR - True-up Period Report Procedure*, October 8, 2014.
n IISD, *Summary of the Bonn Climate Change Conference 1-11 June 2015, Earth Negotiations Bulletin* Vol 12, Issue 638 (2015).

Figure 10 Annual and cumulative CER and ERU issuance, secondary CER prices (left), and voluntary offset issuance and prices (right)



Source: UNFCCC for CDM and JI data on issuances, Intercontinental Exchange ICE for CDM data on prices, Forest Trends' Ecosystem Marketplace for data on voluntary offsets.

2.2.2 International carbon pricing outside of the UNFCCC

Voluntary carbon market In 2014, carbon offsets worth US$395 million were purchased, representing a volume of 87 $MtCO_2e$, up 13.6 percent with respect to 2013. However, the annual issuance volumes and prices of carbon offsets continue to fall, as shown in Figure 10. This trend can be attributed to the policy uncertainty and the diminishing number of new corporate offsetting programs.[54] Yet the issuance and price decreases seen in the voluntary market are less substantial than in the CDM market.

Reducing Emissions from Deforestation, Forest Degradation, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks (REDD+) On June 9, 2015, an agreement was reached on the outstanding items on the agenda for the UNFCCC's REDD+ mechanism: safeguards, non-market-based approaches, and non-carbon benefits.[55] Draft decisions on these issues have been forwarded for consideration and adoption at COP 21. If these decisions are adopted in Paris, there will be adequate guidance for implementation of REDD+, complementing the Warsaw Framework on REDD+ adopted at COP 19.[56] Countries are making progress on establishing

54 Forest Trends' Ecosystem Marketplace, *Ahead of the Curve: State of the Voluntary Carbon Markets 2015*, June 2015.
55 UNFCCC, *Methodological Guidance for Activities Relating to Reducing Emissions from Deforestation and Forest Degradation and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries*, June 9, 2015.
56 Gustavo A. Silva-Chávez, *Surprising Development at UN Climate Meetings: REDD+ Is Finished, Forest Trends*, June 9, 2015.

the national REDD+ infrastructure and REDD+ projects have already been launched, primarily through financing from donor countries rather than carbon markets.[57] For example, the Forest Carbon Partnership Facility's (FCPF) Readiness Fund provides technical guidance[58] and the BioCarbon Fund's Initiative for Sustainable Forest Landscapes will purchase significant portions of verified emission reductions from successful programs. These large forest carbon operations are essential ingredients for low-carbon development in many countries.

The New York Declaration on Forests estimates emissions could potentially be reduced by 4.5–8.8 $GtCO_2e$ per year by 2030.[59] These numbers assume country-specific policy reforms to be successfully adopted and certain strategies aimed at reducing forest emissions to be implemented, for example, land use planning, increased transparency, and law enforcement. Many of the technical concerns about REDD+ can be addressed today, for instance, by managing risks through buffers.

Results-Based Finance The RBF approach provides a mitigation activity with financial support once its emission reductions have been duly verified. Some RBF programs purchase compliance emission reduction units, including CERs and ERUs,[60] helping bridge the current lack of demand for these units. Other programs not specifically designed for compliance markets use RBF as a direct funding mechanism.[61] Elements of the existing carbon market infrastructure, such as the CDM monitoring, reporting and verification (MRV) requirements, have been incorporated into some programs, including the Carbon Initiative for Development (Ci-Dev) and the Pilot Auction Facility for Methane and Climate Change Mitigation (PAF), which purchase CERs. Other current programs, such as the Performance Based Climate Finance Facility (PBC) in Latin America, were built from the ground up.

The PAF provides project developers with a guaranteed minimum price for reducing methane emissions through the auctioning of tradable put options. The first auction for the PAF was held on July 15, 2015, and was attended by 28 bidders from 17 countries. There were 12 winners from developing countries. The clearing price in this auction was US\$2.40/tCO_2e and 8.7 $MtCO_2e$ of put options were sold. The PAF currently has capitalization of over US\$50 million through contributions from Germany, Sweden, Switzerland, and the United States, and aims to reach US\$100 million.[62] Another two or three auctions are planned over the next year and a half.

International Aviation The international aviation industry's commitment to limit its emissions was affirmed by the 2013 Assembly of the International Civil Aviation Organization (ICAO), which resolved to cap net carbon emissions at 2020 levels.[63] The ICAO has identified four pillars of climate action, which it intends to use to meet its emission reduction target: technology, operations, infrastructure, and a global market-based measure (MBM). The 2013 Assembly decided to finalize the MBM by 2016, and set into motion several actions to accomplish this task:

- Finalize work on the technical aspects, environmental and economic impacts and modalities of the possible options for a global MBM scheme, including its feasibility and practicability;
- Organize seminars and workshops on a global scale for international aviation officials and experts of member states as well as relevant organizations; and
- Identify the major issues and problems, including those expected to affect its member states, and make recommendations for a global MBM scheme to be implemented by 2020.

Further details on the development of the MBM are provided in Box 4.

57 Gustavo A. Silva-Chávez, *On the Road to Paris. Next Stop: Bonn, June 2015, Forest Trends*, June 10, 2015.
58 Key outcomes include national REDD+ strategies, effective stakeholder participation, safeguard instruments, reference levels and national forest monitoring systems. 14 countries are developing large-scale emission reductions programs to implement their national strategies combining high climate impact potentials and development benefits. These programs range from supporting communities in establishing new agricultural production schemes to encouraging the supply of deforestation-free agricultural commodities and managing protected areas.
59 Climate Summit 2014, *FORESTS: Action Statements and Action Plans*, September 23, 2014.
60 Examples include the Carbon Initiative for Development (Ci-Dev) and the Pilot Auction Facility for Methane and Climate Change Mitigation (PAF).
61 Examples include the Energy+ Partnership, the Nordic Climate Facility and the Facility for Performance Based Climate Finance in Latin America from the Development Bank of Latin America (CAF).
62 World Bank, *First Pilot Auction to Capture Methane a Success*, July 17, 2015, http://www.worldbank.org/en/news/press-release/2015/07/17/first-pilot-auction-to-capture-methane-a-success.
63 ICAO, *Consolidated statement of continuing ICAO policies and practice related to environmental protection – Climate change*, 2013.

Box 4 A global market-based measure for a global industry

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International Air Transport Association (IATA)

The global air transport sector links economies and societies. It provides connectivity to over three billion passengers a year, supports US$2.4 trillion in global GDP, almost 60 million jobs, a third of world trade by value and half of all international tourists. It is also growing fast, particularly in emerging economies. Recognizing the need for the sector to both foster this growth and also play its part in meeting the climate change challenge, the aviation industry has set comprehensive short-, medium-, and long-term climate goals.

Coordinated by the industry-wide Air Transport Action Group, the goals are to:

1. Improve the fuel efficiency of the world fleet by an average 1.5% per annum, a goal it is already exceeding;
2. Stabilize net aviation CO_2 emissions at 2020 levels through carbon-neutral growth;
3. Halve aviation's net CO_2 emissions by 2050, compared with a 2005 baseline.

Significant work is underway to meet the first and third goal through new technology, alternative fuels, better operational methods and improved infrastructure such as air traffic management reforms. However, the mid-term goal of capping CO_2 at 2020 levels will be achieved through a global market-based measure (MBM), currently being developed through the sector's specialized UN agency, the International Civil Aviation Organization (ICAO).

The industry itself has taken the unusual position of calling for such a measure and is actively involved in its design, arguing that a global standard scheme is favourable to a patchwork of disjointed regional or national measures that would increase compliance complexity, reduce environmental integrity and lead to market distortion. Airlines are fiercely competitive businesses, operating in an international environment. Whilst the implementation of such a measure will place a financial burden on airlines, it is fairly modest compared with the costs of fuel (around a third of airline operating costs) and the competitive impact that unaligned schemes will bring.

In order to have a global MBM in place in time for the 2020 start date (which neatly now coincides with the start of the next UNFCCC commitment period to hopefully be agreed upon at COP 21), the industry has called for a simple offsetting scheme as the best option to fulfil its criteria.

The ICAO Assembly (a meeting of 191 government representatives) in 2013 supported the development of such a global MBM, to be presented at the next ICAO Assembly in September 2016. In the three intervening years, both political and technical design elements are being debated, analyzed and discussed by representatives of governments, industry and civil society. Political questions include how to take account of the need to reflect maturity of developed and developing markets, whilst maintaining a level playing field for airlines. Technical discussions have centered on the eligibility criteria of offsets (does the scheme use CDM, VCS, REDD+, etc?); and the MRV requirements for such a scheme.

Progress is extremely encouraging and the industry is putting all of its efforts into achieving a final agreement in September next year. This is not a process without challenges, but it is also the first time such a global mechanism for an individual sector has ever been attempted.

For further information about aviation's climate action, see www.enviro.aero.

2.3 REGIONAL, NATIONAL, AND SUBNATIONAL CARBON PRICING INSTRUMENTS

Carbon pricing has been implemented or is scheduled for implementation in 39 national and 23 subnational jurisdictions. Together, these carbon pricing instruments cover some 7 $GtCO_2e$, or about 12 percent of annual global GHG emissions.[64, 65] ETSs cover 8 percent of annual global GHG emissions, while a further 4 percent are covered by carbon taxes. As highlighted in Figure 11, the sectoral coverage of carbon pricing instruments varies per jurisdiction, but typically includes the power and industry sectors.

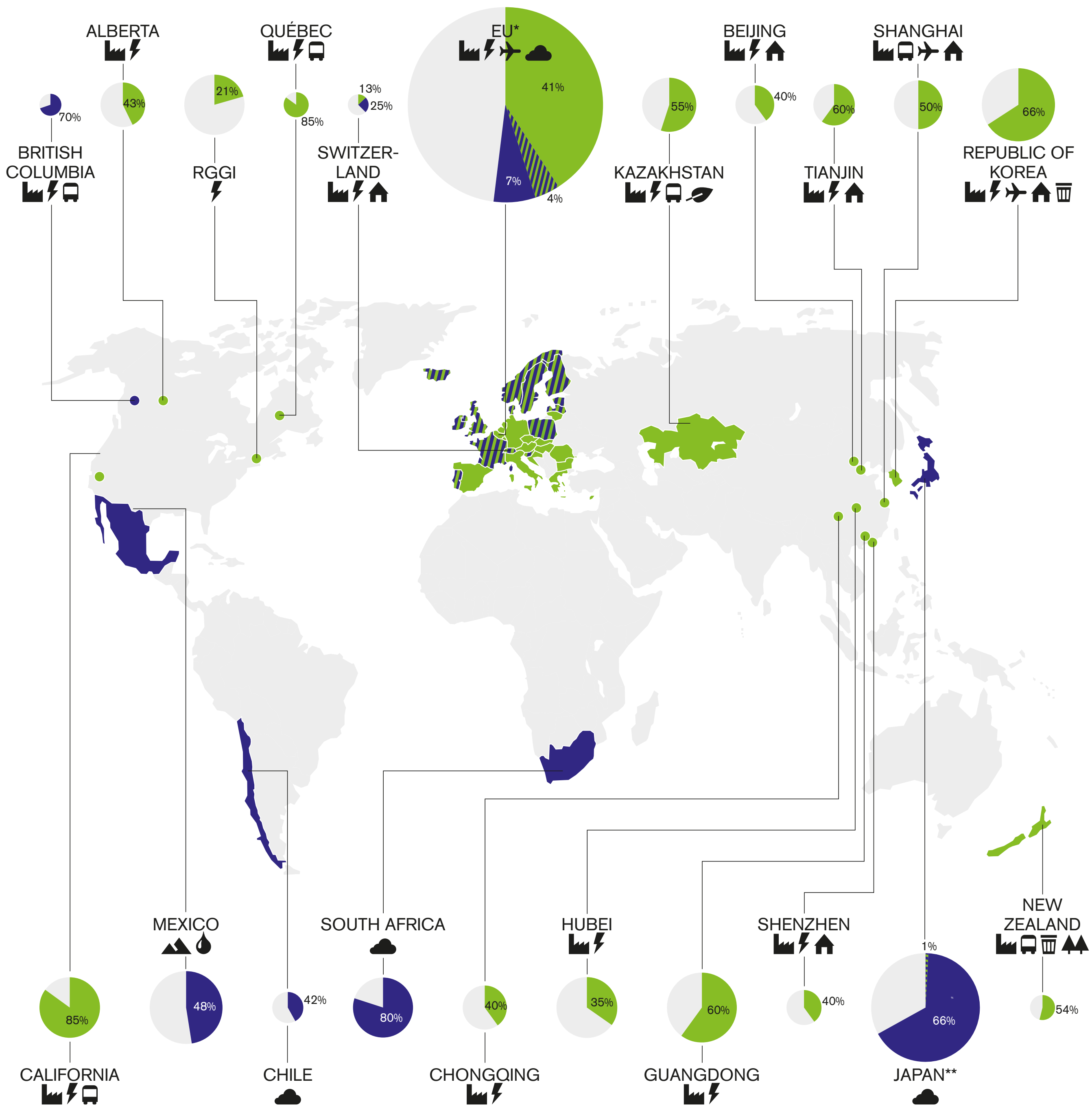
Further details on the key developments in carbon pricing over 2014–15[66] are presented by jurisdiction below, in alphabetical order. This convention will be used throughout this section. It should be noted that this section is not intended to be exhaustive, but rather a summary of the most recent developments in the instruments implemented and currently being designed or proposed.

Canada and the United States In the absence of national carbon pricing instruments in Canada and the United States, ETSs are continuing to develop and mature in California, Québec, the RGGI states, and other states and provinces. The California and Québec Cap-and-Trade programs officially linked up in January 2014, and the first shared auction took place in November 2014. The scope of both programs was enlarged in 2015 to include transport fuels. This extended the coverage to 85 percent of California and Québec's total GHG emissions. Continuation of the California Cap-and-Trade Program post-2020 is currently in the legislative process.[67] This follows California's announcement of a 2030 target to reduce GHG emissions by 40 percent with respect to the 1990 emission level, a target that has been incorporated into a bill for consideration in the legislature.[68]

Since reaching the 2014 US$4/short ton of CO_2 (US$4.4/tCO_2) trigger price for RGGI's cost containment reserve (CCR)[69] at the first auction held in 2014, the auction clearing price has steadily increased. At the most recent auction, held in March 2015, the auction clearing price reached US$5.5/short ton of CO_2 (US$6.1/$tCO_2$),[70] below the 2015 CCR trigger price of US$6/short ton of CO_2 (US$6.6/tCO_2). A comprehensive review of RGGI is expected no later than 2016; it will consider potential additional reductions to the cap post-2020 and other program design elements.[71]

64 These numbers are revised on a regular basis to reflect updated figures on GHG emissions in each jurisdiction, changes in the design and coverage of existing carbon pricing instruments, the inclusion of new instruments, and the availability of new data. Thus, these figures and the ones from previous reports are not necessarily comparable.
65 It should be noted that 100 percent coverage of GHG emissions by carbon pricing instruments is neither desirable nor realistic.
66 This report covers the period from January 1, 2014 to August 31, 2015.
67 Environmental Defense Fund, *Carbon Market California*, 2015.
68 Office of Governor Edmund G. Brown Jr., *Governor Brown Establishes Most Ambitious Greenhouse Gas Reduction Target in North America*, April 29, 2015, http://gov.ca.gov/news.php?id=18938; State of California, *California Global Warming Solutions Act of 2006: Emissions Limit, SB-32*, 2015.
69 RGGI, *Summary of RGGI Model Rule Changes: February 2013*, n.d.
70 RGGI, *Auction Results*, accessed May 19, 2015, http://www.rggi.org/market/co2_auctions/results.
71 RGGI, *RGGI 2012 Program Review: Summary of Recommendations to Accompany Model Rule Amendments*, 2013.

Figure 11 Carbon pricing instruments implemented or scheduled for implementation, with sectoral coverage and GHG emissions covered



Note: The size of the circles reflects the volume of GHG emissions in each jurisdiction. Symbols show the sectors and/or fuels covered under the respective carbon pricing instruments. The largest circle (EU) is equivalent to 4.8 $GtCO_2e$ and the smallest circle (Switzerland) to 0.05 $GtCO_2e$.

* Also includes Norway, Iceland and Liechtenstein. Carbon tax emissions are the emissions covered under various national carbon taxes; the scope varies per tax.

** ETS emissions are the emissions covered under the Tokyo CaT and Saitama ETS. No coverage information was available for the Kyoto ETS. The scope shown is for the Japan carbon tax and the ETS scope is more limited.

- ETS implemented or scheduled for implementation
- Carbon tax implemented or scheduled for implementation
- ETS and carbon tax implemented or scheduled
- 40% Estimated coverage

- Industry
- Power
- Transport
- Aviation
- Buildings
- Waste
- Forestry
- Agriculture
- All fossil fuels (tax only)
- Solid fossil fuels
- Liquid fossil fuels

In addition, another two U.S. states are actively considering the implementation of an ETS: Washington and Oregon. After the Washington State legislature failed to pass the ETS bill on June 28, 2015,[72] Governor Inslee announced on July 28, 2015 that his government would implement a regulatory cap on GHG emissions, which may allow emitters to trade among themselves.[73] Oregon is currently debating bills in both the House and Senate. One pair of bills (SB965 and HB3250) would introduce a cap-and-dividend program to reduce GHG emissions.[74] This program would essentially operate like an ETS, except that the auction revenue would be distributed to tax payers in the form of a "dividend." Another bill (HB3470) sets a cap on Oregon's GHG emissions and mandates the implementation of an ETS.[75]

On April 13, 2015, the Canadian province of Ontario announced its intention to implement an ETS linked to California and Québec's Cap-and-Trade programs.[76] Ontario also signed a Memorandum of Understanding with Québec to collaborate on market mechanisms and harmonize GHG emission reporting. Alberta amended the Specified Gas Emitters Regulation, in June 2015, to extend the scheme through 2017.[77] Under the previous rules, facilities with annual emissions of 0.1 $MtCO_2e$ or more were required to reduce their emissions intensity by 12 percent with respect to the average emissions intensity in 2003–05. Under the amended rules, the required emissions intensity reduction will be raised to 15 percent on January 1, 2016, and to 20 percent on January 1, 2017.[78] Also, facilities that choose to meet their compliance by contributing to the Climate Change and Emissions Management Fund will face higher costs. The current carbon price of CAN\$15/tCO_2e (US\$11/tCO_2e) will increase to CAN\$20/tCO_2e (US\$15/tCO_2e) on January 1, 2016, and to CAN\$30/tCO_2e (US\$23/tCO_2e) on January 1, 2017. British Columbia's carbon tax remains at the 2012 level of CAN\$30/tCO_2e (US\$23/tCO_2e).

The United States Environmental Protection Agency's (US EPA)—through its Clean Power Plan, finalized on August 3, 2015—has set an emission reduction target of 32 percent of 2005 levels by 2030 for the country's power sector.[79] This represents a 7 percent increase in the targeted emission reductions with respect to the draft regulation released in 2014. The Clean Power Plan reduces power sector emissions through a range of measures. States have the flexibility to choose their own compliance mechanisms, including emissions trading, efficiency measures, and increased deployment of renewable energy. This will enable California and the RGGI states to use their existing ETSs to meet their emissions target. The Clean Power Plan has received overall support from officials representing the California Cap-and-Trade Program and RGGI.[80]

The United States has also been active internationally, signing a bilateral agreement with China on emission reduction targets on November 12, 2014.[81] In this agreement, the US and China announced their respective post-2020 emission reduction targets, which are reiterated in their INDCs (see section 2.2.1 for more details).

Chile In September 2014, the Chilean Parliament approved the implementation of a national carbon tax. The tax will put a price on emissions from 2017 onward.[82] The tax applies to all stationary sources with

72 Washington State Legislature, *HB1314 – 2015-2016 Implementing a carbon pollution market program to reduce greenhouse gas emissions*, August 12, 2015, http://app.leg.wa.gov/billinfo/summary.aspx?bill=1314&year=2015.
73 Governor Jay Inslee, *Inslee Directing Ecology to Develop Regulatory Cap on Carbon Emissions*, July 28, 2015, http://www.governor.wa.gov/news-media/inslee-directing-ecology-develop-regulatory-cap-carbon-emissions.
74 State of Oregon, *Relating to Climate Protection; Prescribing an Effective Date, SB 965*, 2015; State of Oregon, *Relating to Climate Protection; Prescribing an Effective Date, HB 3250*, 2015.
75 State of Oregon, *Relating to Greenhouse Gas Emissions; Declaring an Emergency, HB 3470 B*, 2015.
76 Ministry of the Environment and Climate Change, Ontario Government, *How Cap and Trade Works*, April 13, 2015, http://news.ontario.ca/ene/en/2015/04/how-cap-and-trade-works.html.
77 Province of Alberta, *Alberta Regulation 139/2007, Climate Change and Emissions Management Act: Specified Gas Emitters Regulation*, 2015.
78 Alberta Environment and Parks, *Greenhouse Gas Reduction Program*, accessed August 10, 2015, http://esrd.alberta.ca/focus/alberta-and-climate-change/regulating-greenhouse-gas-emissions/greenhouse-gas-reduction-program/default.aspx.
79 EPA, *Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units*, 2015.
80 RGGI, *RGGI States Comments Support EPA Proposed Clean Power Plan*, November 7, 2014; California Environmental Protection Agency Air Resources Board, "Letter to Ms. Janet McCabe RE: Docket Number EPA-HQ-OAR-2013-0602," November 24, 2014, http://www.arb.ca.gov/cc/powerplants/ca-comments-2014-clean-power-plan.pdf.
81 The White House, Office of the Press Secretary, *U.S.-China Joint Announcement on Climate Change*, November 12, 2014, https://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change.
82 Tax payments for the 2017 calendar year will be due in April 2018.

a thermal input capacity greater than 50 megawatts (MW).[83] The value of this tax is denominated in U.S. dollars. The level of this tax is the local currency equivalent of US$5/t$CO_2$e, which means that tax liabilities in the local currency will depend on the prevailing exchange rate on the day of payment.[84]

China The seven pilot ETSs combined form the largest national carbon pricing initiative in the world in terms of volume, putting a cap on 1.3 GtCO_2e.[85] Since the start of the pilot ETSs in Beijing, Guangdong, Shanghai, Shenzhen, and Tianjin in 2013, and in Chongqing and Hubei in 2014, the designs of some of these systems have been rapidly evolving – their scope has been expanding and their stringency has been increasing. For example, Shenzhen is planning to expand its ETS to include transport;[86] Guangdong is considering including more industrial sectors, buildings, and transport; and Hubei is adding 49 new companies to its pilot ETS.[87] In addition, Chongqing has reduced its cap at a greater rate than anticipated, lowering the number of allowances freely allocated by 7 percent with respect to the 2013 level.[88]

For the compliance year 2014, which ended in June or July 2015 (depending on the jurisdiction), 24.7 million allowances were traded in all systems combined.[89] In Beijing, Guangdong, Shanghai, Shenzhen, and Tianjin, between 99 and 100 percent of the companies met their compliance obligations, while 70 percent of the participants in Chongqing, and 80 percent of the participants in Hubei[90] met the first compliance in June 2015. The amount of Chinese offsets has also been growing, bringing the total number of offsets issued to about 25 million by the end of July 2015.[91] Most Chinese offsets are location-specific and restricted to the compliance market of the region in which the offset project is located.

Over the past year, China has focused on extending emissions trading beyond the seven pilot regions. Guangdong and Shenzhen are exploring a more coordinated approach to their respective ETS pilots,[92] while Beijing is exploring an inter-regional ETS with Chengde city in Hebei province.[93] Furthermore, Shanghai is considering regional cooperation with Zhejiang, Jiangsu, Anhui, Jiangxi, Shandong, and the Fujian provinces to exchange information and discuss ETS design and operation.[94] In addition, Gansu, Qingdao,[95] Hangzhou, and Anhui[96] are investigating the implementation of their own ETSs. Finally, Beijing, Tianjin, and the Hubei provinces have signed an agreement to cooperate on GHG mitigation activities.[97]

On June 15, 2015, Taiwan adopted the Greenhouse Gas Reduction and Management Act.[98] This law sets an emission reduction target of 50 percent below 2005 levels by 2050 and indicates that one of the major means to achieve this target will be an ETS. However, the schedule for launching the ETS is unclear.

83 Ministry of Finance, Chile, *Ley Nº 20780*, accessed August 12, 2015, http://www.leychile.cl/Navegar?idNorma=1067194.
84 Ministry of Finance, Chile, 2014, *Tax reform to amend the system of income taxation and introduce various adjustments in the tax system*, http://www.leychile.cl/Navegar?idNorma=1067194.
85 Authors' calculation, based on cap for 2015 or the latest year for which information is available.
86 Carbon Pulse, *Shenzhen Set to Broaden out Emissions Scheme*, March 16, 2015, http://carbon-pulse.com/shenzhen-set-to-broaden-out-emissions-scheme/.
87 Carbon Pulse, *Hubei to Expand Emissions Trading Scheme*, December 3, 2015, http://carbon-pulse.com/hubei-to-expand-emissions-trading-scheme-state-media/.
88 Chongqing Municipal Development and Reform Commission, *Chongqing Municipal Development and Reform Commission issued a notice of 2014 annual Chongqing carbon emissions quotas*, March 19, 2015, http://www.cqdpc.gov.cn/article-1-21088.aspx; Carbon Pulse, *Chongqing Cuts Allocation by 9 Million Permits in 2014*, March 10, 2015, http://carbon-pulse.com/chongqing-allocates-115-7-million-permits-for-2014/.
89 Carbon Pulse, *China Sees Six-Fold Increase in Carbon Trading Volumes despite Teething Issues*, July 21, 2015, http://carbon-pulse.com/china-sees-six-fold-increase-in-carbon-trading-volumes-despite-teething-issues/.
90 ICAP, *Second Compliance Period Ends in Chinese ETS Pilots*, July 28, 2015, https://icapcarbonaction.com/news/news-archive/294-second-compliance-period-ends-in-chinese-ets-pilots.
91 Carbon Pulse, *China Issues Fresh Batch of 5.1 Mln Mostly Ineligible Carbon Offsets*, August 3, 2015, http://carbon-pulse.com/china-issues-fresh-batch-of-5-1-mln-mostly-ineligible-carbon-offsets/.
92 Carbon Pulse, *Guangdong close to Launch 600 Million Yuan Carbon Fund*, March 17, 2015, http://carbon-pulse.com/guangdong-close-to-launch-600-million-yuan-carbon-fund/.
93 Beijing Municipal Commission of Development and Reform, *Regional Committee Held in Beijing and Hebei on Emissions Trading*, December 19, 2014, http://www.bjpc.gov.cn/gzdt/201412/t8594655.htm.
94 Shanghai Municipal Development and Reform Commission, *Regional Cooperation Seminar Held on Emissions Trading*, accessed April 28, 2015, http://www.shdrc.gov.cn/second.jsp?colid=551&top_id=316&artid=24800.
95 Qingdao Municipal People's Government, *Notice on the Organization and Implementation of Low-Carbon City Qingdao Pilot Carbon Emissions Trading Market Embodiments*, September 24, 2014, http://www.qingdao.gov.cn/n172/n68422/n68424/n30259215/n30259219/140924163750977834.html.
96 Anhui People's Government, *Anhui Provincial People's Government Office on the Issuance of Anhui 2014-2015 Annual Energy Saving and Emission Reduction Carbon Development Action Programs*, September 24, 2014, http://www.ah.gov.cn/UserData/DocHtml/1/2014/12/9/6417463050796.html.
97 The White House, Office of the Press Secretary, *U.S.-China Joint Announcement on Climate Change*, November 11, 2014, https://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change.
98 Government of Taiwan, *Greenhouse Gas Reduction and Management Act*, 2015.

At the national level, China has committed to reach its peak in GHG emissions around 2030,[99] with best efforts to peak earlier. In addition, details are gradually being revealed on a nationwide ETS, which may be launched by the end of 2016 and fully implemented in 2019.[100] The general rules of the national ETS were published by the National Development and Reform Commission (NDRC) in December 2014.[101] The national ETS should cover power generation, metallurgy and non-ferrous metals, building materials, chemicals, and aviation.[102] The importance of the national ETS for China to achieve its GHG emission objective is highlighted by the ETS's inclusion in China's INDC.[103] The latter also includes its post-2020 emission reduction target, announced on November 12, 2014[104] after a bilateral agreement with the United States had been reached on emission reduction targets. China also continues to seek cooperation with the EU on carbon markets, as specified in the EU-China Joint Statement on Climate Change, through, among others, its capacity-building activities in preparation for the national ETS.[105]

EU In the course of 2014, the price of allowances in the EU ETS has increased from less than €5/tCO_2 (US$5/$tCO_2$) to just below €7/$tCO_2$ (US$8/$tCO_2$). The average price in 2014 was €6/tCO_2 (US$7/$tCO_2$), with a total trading volume of 6.1 billion allowances.[106] As of August 1, 2015, the EU allowance price stands slightly below €8/tCO_2 (US$9/$tCO_2$).

In February 2014, the European Union decided to temporarily postpone the auctioning of 900 million EU allowances from the period 2014–16 to the period 2019–20, a process known as backloading. Following this change, the focus of the EU ETS structural reform shifted to the need for greater price stability and predictability through flexibility of allowance supply in the EU ETS. The proposed MSR is designed to achieve this goal by removing allowances from the market if supply is much higher than demand, and injecting allowances into the market if the market is undersupplied. At the May 5, 2015 "trilogue" meeting of the European Parliament, European Council, and European Commission, consensus was reached on a 2019 start date for the MSR. The agreement further specifies that the 900 million back-loaded EU allowances will be placed in the MSR, instead of returned to the market in 2019–20. The MSR proposal also includes provisions for the fate of the so-called "unallocated" allowances – leftover allowances available at the end of EU ETS Phase III in 2020 that were intended for new and expanding installations, and allowances that were returned by installations after (partially) shutting down. Barring special measures, these allowances would come onto the market in 2020, thereby undermining the operation of the MSR.[107] The European Parliament approved the MSR on July 8, 2015.[108] Formal adoption of the MSR is expected in September 2015, following approval by the European Council. The other significant change to the EU ETS was the approval of a new carbon leakage list for the period 2015–19 on October 27, 2014.

The EU has committed to reducing emissions by at least 40 percent with respect to the 1990 baseline level by 2030 through domestic actions.[109] The EU ETS will be the main instrument to achieve this mitigation target, corresponding to a 43 percent emission reductions by 2030 compared with 2005 emissions in the sectors covered by the EU ETS.[110] The above target will help ensure that the EU is on a cost-effective track toward meeting its objective of cutting emissions by at least

99 Department of Climate Change, National Development and Reform Commission of China, *Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions*, 2015.
100 ICAP, *China to Cap Emissions from Six Sectors, ETS to Launch 2016*, February 9, 2015, https://icapcarbonaction.com/news/news-archive/268-china-to-cap-emissions-from-six-sectors-ets-to-launch-2016.
101 National Development and Reform Commission, *People's Republic of China Order: No. 17*, October 12, 2014, http://qhs.ndrc.gov.cn/gzdt/201412/t20141212_652035.html.
102 ICAP, *China to Cap Emissions from Six Sectors, ETS to Launch 2016*, February 9, 2015, https://icapcarbonaction.com/news/news-archive/268-china-to-cap-emissions-from-six-sectors-ets-to-launch-2016.
103 China, *Intended Nationally Determined Contribution*, 2015.
104 The White House, Office of the Press Secretary, U.S.-China Joint Announcement on Climate Change, November 11, 2014, https://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change.
105 European Union-China, "EU-China Joint Statement on Climate Change," June 29, 2015, http://ec.europa.eu/clima/news/docs/2015062901_statement_en.pdf.
106 Thomson Reuters, *Big Emitters Promise Cuts, but Pledges Are Hard to Compare*, Carbon Market Monitor, January 15, 2015.
107 European Union, *Decision of the European Parliament and of the Council Concerning the Establishment and Operation of a Market Stability Reserve for the Union Greenhouse Gas Emission Trading Scheme and Amending Directive 2003/87/EC*, 2015.
108 European Parliament, *Parliament Adopts CO_2 Market Stability Reserve*, July 8, 2015, http://www.europarl.europa.eu/news/en/news-room/content/20150703IPR73913.
109 European Union, *Intended Nationally Determined Contribution of the EU and Its Member States*, March 6, 2015.
110 European Council, *European Council (23 and 24 October 2014) Conclusions*, http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/145397.pdf.

80 percent by 2050. On July 15, 2015, the European Commission put forward a proposal for a revised EU ETS for the period after 2020.[111] The key proposed changes are increasing the annual cap reduction from 1.74 to 2.2 percent, adopting better targeted rules for the free allocation of allowances (to guard against carbon leakage risks), and establishing funds using allowances to finance low-carbon innovation in industry and modernization of the energy sector in the lower-income member states. The proposal does not include any provisions for the use of international offsets after 2020.

France France's carbon tax came into effect on April 1, 2014, putting a carbon tax of €7/tCO_2e (US$8/t$CO_2$e) on the use of fossil fuels not covered by the EU ETS. The carbon tax rate increased to €14.5/tCO_2e (US$16/t$CO_2$e) in 2015 and will rise to €22/tCO_2e (US$24/t$CO_2$e) in 2016. On July 22, 2015, France formally adopted its Law on the Energy Transition to Green Growth. This law sets a trajectory for the country's carbon tax level to rise to €56/tCO_2e (US$61/t$CO_2$e) in 2020, and €100/t$CO_2$e (US$110/tCO_2e) in 2030.[112] This augmentation in the carbon tax rate will be revenue-neutral, as other taxes will be lowered.[113] The aforementioned law also sets the objective to reduce GHG emissions by 40 percent with respect to 1990 levels by 2030, consistent with the EU target.

Kazakhstan Full enforcement (of regulations) and trading in the Kazakhstan ETS started in 2014. Total trade volume over 2014 was low, with only 35 transactions, totaling 1.3 MtCO_2e. The average price of allowances in 2014 was KZT406 (US$2).[114] Although the pilot phase was completed in 2013, the Kazakhstan ETS is still facing challenges with the MRV of GHG emissions, in particular regarding the verification process. The Kazakh government is looking to develop clearer guidance, formats, and templates for monitoring.[115] Other elements of work on the ETS are efforts to improve electronic reporting, develop and support the ETS registry, implement benchmarking rather than grandfathering as the free allocation methodology, and explore the potential to link with other existing carbon markets.

Mexico In February 2014, the Mexican Ministry of Energy announced the possible development of an ETS in the energy sector. This would complement Mexico's tax on fossil fuel sales, excluding natural gas, which went into effect on January 1, 2014.

New Zealand As of June 1, 2015, Kyoto credits, with the exception of New Zealand-originated Assigned Amount Units (NZ-AAUs), are no longer allowed for compliance under the NZ ETS. As of that date, only domestic units, New Zealand Units (NZUs), and NZ-AAUs can be used to meet compliance obligations.[116] This decision was motivated by changes in international rules and the oversupply of Kyoto markets. New Zealand will reassess this decision once international market conditions are better suited to its domestic circumstances. A comprehensive review of the NZ ETS is scheduled in the second half of 2015. The exact scope, objective, process, and timing of the review are yet to be decided. However, the review will look to set a long-term direction for the NZ ETS so that it is fit for purpose and can evolve to assist in meeting New Zealand's post-2020 commitments.

Norway In May 2015, the Norwegian government proposed several changes to the carbon tax rates, which entered into force on July 1, 2015.[117] These changes include an increase in the tax rate for natural gas and liquefied petroleum gas (LPG)—from NOK337/tCO_2 (US$41/t$CO_2$) to NOK412/t$CO_2$ (US$50/t$CO_2$) and NOK410/t$CO_2$ (US$50/t$CO_2$) respectively—bringing it in line with the tax rate for petrol. The higher carbon

111 European Commission - Climate Action, *Revised Emissions Trading System Will Help EU Deliver on Climate Goals*, July 15, 2015, http://ec.europa.eu/clima/news/articles/news_2015071501_en.htm.

112 French Senate, *Bill on the Energy Transition to Green Growth*, July 24, 2015, http://www.senat.fr/espace_presse/actualites/201406/engager_la_france_dans_la_transition_energetique.html.

113 French National Assembly, *Bill on the Energy Transition to Green Growth*, July 22, 2015, http://www.assemblee-nationale.fr/14/ta/ta0575.asp.

114 Caspy Commodity Exchange, *Stock Trading in Quotas Are on the Increase*, September 8, 2014, http://comex.kz/ru/press/news/42-%D0%B1%D0%B8%D1%80%D0%B6%D0%B5%D0%B2%D1%8B%D0%B5-%D1%82%D0%BE%D1%80%D0%B3%D0%B8-%D0%BF%D0%BE-%D0%BA%D0%B2%D0%BE%D1%82%D0%B0%D0%BC-%D0%B8%D0%B4%D1%83%D1%82-%D0%BD%D0%B0-%D1%83%D0%B2%D0%B5%D0%BB%D0%B8%D1%87%D0%B5%D0%BD%D0%B8%D0%B5.

115 Aigerim Yergabulova, *Kazakhstan Emission Trading Scheme (KAZ ETS): Status and Challenges of MRV*, http://www.thepmr.org/system/files/documents/18.0-%20KAZAKHSTAN%20presentation-kaz.pdf.

116 New Zealand Environmental Protection Authority, "The New Zealand Emissions Trading Scheme: NZEUR Account Holders Access to Kyoto Units," accessed August 10, 2015, http://www.eur.govt.nz/how-to/guides-hmtl/guides-pdf/NZEUR%20account%20holders%20access%20to%20Kyoto%20units.pdf.

117 Ministry of Finance, Norway, *Changes in Tax, Royalty and Interest, Prop. 120 LS*, 2015, http://www.statsbudsjettet.no/upload/Revidert_2015/dokumenter/pdf/prp120.pdf.

tax has been linked to the delay in implementing a road tax on natural gas and LPG, which was intended to stimulate the use of biogas. The government has also exempted the share of hydrogen gas in natural gas and LPG from the carbon tax.

Portugal A carbon tax of €5/tCO_2e (US$5/t$CO_2$e) was approved in November 2014, as part of a wider package on green tax reform. The carbon tax entered into force on January 1, 2015. It applies to all energy products used in non-EU ETS sectors and covers approximately a quarter of the country's GHG emissions. The tax rate will be determined annually, based on the average EU allowance auction clearing price in the preceding years. The 2015 tax rate of €5/tCO_2e (US$5/t$CO_2$e) is expected to yield approximately €95 million (US$104 million) in revenue. The full green tax reform package aims to be fiscally neutral and the revenues from the carbon tax and other taxes will be redistributed in the form of income tax relief to lower-income families.

Republic of Korea The Republic of Korea's ETS entered into force on January 1, 2015, and covers 23 subsectors, including steel, cement, petro-chemicals, refinery, power, buildings, waste, and aviation. In the first phase (2015–17), the affected installations will receive a free allocation of 100 percent based on their average 2011–13 GHG emissions and the national GHG reduction target. No auctioning is foreseen in the first phase. There is a perception that the Korean market is undersupplied, resulting in Korean companies being reluctant to sell their allowances. The latest trading was reported on January 16, 2015.[118] Companies can also use Korean offsets, including Korean CERs,[119] for up to 10 percent of their compliance obligation. Given that the price of CERs is much lower than that of Korean Allowance Units (KRW10,300 or about US$9), some demand for CERs issued for projects in the Republic of Korea is to be expected.[120] As of early July 2015, around 780,000 Korean offsets had been traded on the Korean exchange.[121]

Sweden The Swedish government is considering changes to the Swedish carbon tax. Under current rules, the carbon tax covers all fossil fuels used for heating that are not covered by the EU ETS and motor fuels. However, non-EU ETS installations, as well as the agriculture and forestry sectors receive tax rebates for their use of fossil heating fuels.[122] Under the new rules considered for introduction in the 2016 Budget Bill, to be presented on September 21, 2015, the aforementioned tax rebates would be abolished as of January 1, 2016. The Swedish government argues that the removal of these tax rebates would better align its policy with the polluter pays principle, lead to a more cost-effective instrument, and improve the transparency of the taxation system.[123]

Switzerland In Switzerland, the first auction of allowances under its ETS was held in May 2014. As of August 1, 2015, four auctions had taken place, showing a wide price range for emission allowances—ranging from CHF40/tCO_2e (US$42/t$CO_2$e) at the first auction of May 2014 to CHF12/tCO_2e (US$12/t$CO_2$e) at the auction held in February 2015. Switzerland and the EU continued negotiations on linking through a seventh round of talks, which took place in March 2015.[124]

Switzerland's carbon tax on thermal fuels (that is, excluding fossil motor fuels) will be raised from the current rate of CHF60/tCO_2e (US$62/t$CO_2$e) to CHF84/t$CO_2$e (US$87/tCO_2e) on January 1, 2016.[125] This increase follows a 2015 review of Switzerland's GHG emissions trajectory, which found that the current emission level lies above the targeted level. The next review of the tax rate will be based on emissions from 2016, and tax rates may have to be adjusted again as of 2018, depending on the evolution of Switzerland's GHG emissions trajectory. The maximum level of the tax rate is 120 CHF/tCO_2e (US$125/t$CO_2$e).

Selected changes in the instruments are summarized in Box 5.

118 Carbon Pulse, *South Korea's Hanwha Corp. to convert 286,000 CERs to Korean offsets*, August 18, 2015, http://carbon-pulse.com/south-koreas-hanwha-corp-to-convert-286000-cers-to-korean-offsets/.
119 CERs need to be canceled first before they can be converted to Korean offsets.
120 Carbon Pulse, *UN Cancels First CERs Bound for Korean ETS*, March 14, 2015, http://carbon-pulse.com/un-cancels-first-cers-bound-for-korean-ets/.
121 Carbon Pulse, *Korean Market to Get Offset Infusion, Simpler Rules*, July 6, 2015, http://carbon-pulse.com/korean-market-to-get-offset-infusion-simpler-rules/.
122 Ministry of Finance, Sweden, *Certain Point Tax Issues Before the Budget Bill for 2016*, June 25, 2015, http://www.regeringen.se/contentassets/50c71588b22043e6ac47acbad136919f/vissa-punktskattefragor-infor-budgetpropositionen-for-2016.pdf.
123 Ibid.
124 Swiss Federal Office for the Environment, 7th *Round of Negotiations for Switzerland-EU Linking of Emissions Trading Systems*, March 26, 2015, http://www.bafu.admin.ch/klima/13877/14510/14882/15415/index.html?lang=de.
125 Swiss Federal Office for the Environment, *Imposition of the CO_2 Levy on Thermal Fuels*, July 3, 2015, http://www.bafu.admin.ch/klima/13877/14510/14748/index.html?lang=en.

Box 5 Summary of selected changes in regional, national, and subnational carbon pricing instruments

Instruments implemented in 2014: Hubei and Chongqing (ETS), Mexico and France (tax)
Instruments implemented in 2015: Korea (ETS), Portugal (tax)
New instrument scheduled for implementation: Chile (tax), as of 2017
ETS under consideration or development: Washington and Oregon (US); Ontario (Canada); Mexico; Taiwan and nationally (China)

Scope expansion:
2014/2015: California and Québec included transport fuels, Hubei added new companies
Future developments: Shenzhen plans to include transport, Guangdong is considering the inclusion of additional sectors

Price rate changes (tax only):
2014/2015: Norway's carbon tax rate for natural gas and LPG increased in 2015, from NOK337/tCO_2 (US$41/t$CO_2$) to NOK412/t$CO_2$ (US$50/t$CO_2$) and NOK410/t$CO_2$ (US$50/t$CO_2$), respectively; France's carbon tax rate increased from €7/tCO_2e (US$8/t$CO_2$e) in 2014 to €14.5/t$CO_2$e (US$16/tCO_2e) in 2015
Future developments: France's carbon tax rate to be raised to €56/tCO_2 (US$61/t$CO_2$) as of 2020 and to €100/tCO_2 (US$110/t$CO_2$) by 2030; Sweden's carbon tax rebates to be removed for non-ETS, agriculture, and forestry as of 2016; Switzerland's carbon tax to increase to CHF84/tCO_2e (US$87/t$CO_2$e) from 2016

Price/market stabilization mechanisms (ETS only):
2014/2015: RGGI's cost containment reserve triggered in 2014
Future developments: EU ETS to implement a market stability reserve as of 2019

Offsets:
2014/2015: New Zealand's ETS restricted use of offsets to domestically generated offsets only; growth in offsets for use in Chinese ETS pilots and the Republic of Korea's ETS
Future developments: The European Commission's proposal of July 15, 2015 foresees no use of international offsets in the EU ETS for the revised EU ETS after 2020

Linking:
2014/2015: California and Québec Cap-and-Trade Programs linked up in 2014
Future developments: Ontario intends to join the California and Québec Cap-and-Trade Programs, Beijing is exploring linking with Chengde city, Shanghai is seeking regional cooperation on ETS

Instruments under review:
2014/2015: EU ETS started review for post-2020
Future developments: Review of the New Zealand's ETS to start in second half of 2015, RGGI in 2016 for post-2020, and Switzerland's carbon tax in 2017.

2.4 CORPORATE CARBON PRICING

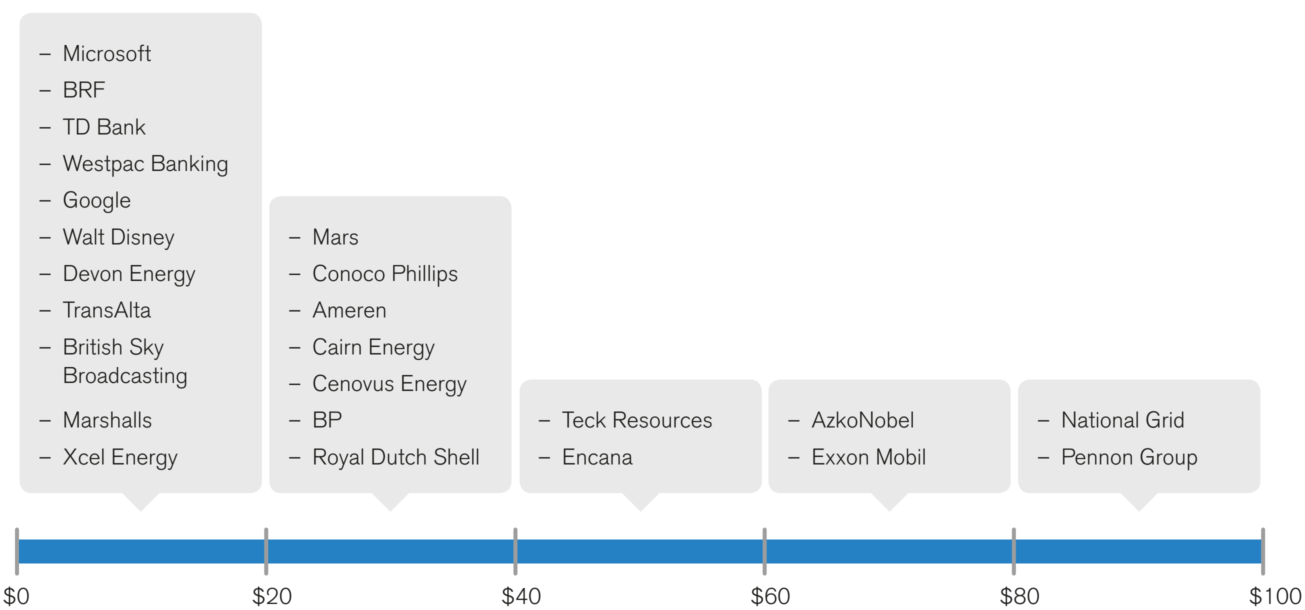
Carbon pricing is spreading beyond the domain of government policy and becoming an increasingly common tool in business decision making. Private sector firms are adopting internal carbon prices, even in jurisdictions without legislated carbon pricing. Internal carbon pricing can be implemented in various forms: some companies incorporate it into the business case for investment, while other companies use it to transfer the costs of emissions offsetting to individual business units.

Globally, at least 150 companies use an internal carbon price, as reported by the Carbon Disclosure Project (CDP), with disclosed prices ranging from US$6 to US$89/tCO_2e[126] (Figure 12). These companies represent diverse sectors of the economy, including the consumer goods, energy, finance, industry, manufacturing, and utilities sectors.

» Globally, at least 150 companies use an internal carbon price, with disclosed prices ranging from US$6 to US$89/tCO_2e. «

For many businesses, using an internal carbon price is part of a risk management strategy to evaluate the current or potential impact of a carbon price obligation on their operations. Furthermore, it is used as a means to identify and value cost savings and revenue opportunities in low-carbon investments. Corporate carbon pricing can also help companies demonstrate their support for effective carbon pricing policies. Governments designing a carbon pricing instrument can benefit from the lessons learned through corporate carbon pricing initiatives such

Figure 12 Price range of the average internal carbon price, as disclosed by companies to CDP



Note: Some companies report that a price *range* is applied as part of a sensitivity analysis, or to take into account projected price increases and regional differences in carbon prices.

Source: Authors, based on CDP data.

126 CDP, *Global Corporate Use of Carbon Pricing: Disclosures to Investors*, 2014.

as the Business for Climate Platform (EPC-ETS), which operated an ETS simulation with the engagement of 20 of the largest Brazilian companies. Further details on corporate carbon pricing in practice are provided in Box 6.

In the lead-up to COP 21, seven oil and gas companies[127] have called on governments and the UNFCCC to introduce carbon pricing instruments in jurisdictions where they do not yet exist and to create an international framework that could eventually link domestic instruments.[128] This initiative adds weight to the growing number of private sector representatives who have signaled their support for carbon pricing. At the 2014 New York Climate Summit, over 1,000 companies and investors voiced their support for carbon pricing policies in a public statement.[129]

Long-term investors are also beginning to realize that climate change can undermine the financial returns of their portfolio and have started rethinking their investment strategies and practices. A recent study confirms that climate change will inevitably affect returns and that prudent investors could realize net gains by positioning across and within sectors and asset classes.[130] Leading financial institutions are responding to climate risk by allocating capital and steering financial flows toward low-carbon and "climate-safe" activities. For example, the Swedish pension fund AP4 is decarbonizing its equity portfolio by tilting it toward more carbon-efficient companies.[131] Also, the Norwegian Government Pension Fund Global will cease investing in coal companies as of January 1, 2016.[132]

Box 6 Highlights from Caring for Climate survey on carbon pricing

By United Nations Global Compact

As far as many leading companies are concerned, internal carbon pricing does not need to be complicated. While thorough analysis is needed to identify a meaningful price for carbon, complex modeling or projections internally often creates confusion and delay in implementation. This is a key insight shared by the respondents of a global survey of nearly 100 companies that are creating internal carbon pricing systems and engaging governments to advance effective market-based climate policies.

Companies at the forefront are aligning with the UN Caring for Climate Business Leadership Criteria on Carbon Pricing.[133] They are working to: (1) value carbon internally; (2) advocate for carbon pricing policies externally; and (3) report publicly on these activities.[134]

UN Caring for Climate initiative (C4C) together with the World Resources Institute (WRI) took a closer look at companies' approaches in 2015. The objective was to gather perspectives and experiences of individual companies confronting the challenges and maximizing the opportunities related to carbon pricing. To do this, C4C and WRI interviewed senior staff from nearly 20 companies and received further input through a global survey from approximately 100 companies across multiple sectors and geographies.[135] →

127 BP, BG Group, Eni, Repsol, Royal Dutch Shell, Statoil and Total. Source: Bloomberg, *Repsol Signs Up to European Oil Group's Stance on Climate Change*, June 9, 2015, http://www.bloomberg.com/news/articles/2015-06-09/repsol-signs-up-to-european-oil-group-s-stance-on-climate-change.
128 BG Group plc et al., May 29, 2015, http://www.statoil.com/en/NewsAndMedia/News/2015/Downloads/Paying%20for%20Carbon%20letter.pdf.
129 World Bank, *We Support Putting a Price on Carbon*, 2014.
130 Mercer, *Investing in a Time of Climate Change*, 2015.
131 Global Investor Coalition, with support from UNEP-FI and the World Bank Group, *Financial Institutions Taking Action on Climate Change*, 2014.
132 The Storting, *The Storting Has Made the Unanimous Decision to Pull the Government Pension Fund Global (GPFG) out of Coal*, May 28, 2015, https://www.stortinget.no/en/In-English/About-the-Storting/News-archive/Front-page-news/2014-2015/hj9/.
133 Caring for Climate is a joint initiative of the UN Global Compact, UN Environment Programme, and UN Framework Convention on Climate Change. The Business Leadership Criteria form one of the workstreams of the Carbon Pricing Leadership Coalition, led by the World Bank Group. Partners on the Leadership Criteria include: WRI, CDP, The Climate Group, Principles for Responsible Investment, and UN Foundation.
134 For the full criteria, see: www.caringforclimate.org/carbonpricing.
135 The input received is informing the *Executive Guide to Carbon Pricing Leadership*, to be released in draft form in September 2015 and launched at COP 21 in December 2015. For more information, visit www.caringforclimate.org/carbonpricing.

The effort yielded results that are consistent with general expectations. Companies from sectors or regions that are already subject to carbon pricing policies were largely ahead of others in terms of internal awareness and support at senior levels. Building internal capacity and engagement ranked among the most common benefits cited by companies that are pricing carbon internally (see the table below).

	Most common benefits of carbon pricing	Most common challenges of carbon pricing
1	Helps translate carbon into business- relevant terms and engage internally	Lack of common method or guidance to set a carbon price
2	Increases support and investment for energy efficiency projects	Lack of clarity and long-term certainty in countries' climate policies
3	Helps company achieve ambitious GHG reduction targets	Prices (internally or externally) too low to shift investment decisions

Interestingly, some 40 percent of the companies that responded to the survey noted they had no plans and no interest in creating internal carbon pricing programmes. Most of these companies expressed one of two reasons for not pursuing carbon pricing: (1) they did not see carbon pricing as material or practical for their company/industry (i.e., not from regulated or energy-intensive sectors); or (2) they could not identify a clear methodology to create an internal carbon pricing programme. Nonetheless, more than half of these companies still noted a desire to see an external carbon price and are actively engaging governments to advance such policies.

Those companies that have successfully established internal carbon pricing programmes tend to take a simple, straightforward approach. They adapt carbon pricing to fit their own internal investment needs, market interests, and outlooks (rather than trying to create complex formulas for predicting market prices and policy changes). Most companies do one or more of the following:

- Treat carbon pricing like any other effort to evaluate and account for financial risks, costs, and market opportunities.
- Establish a modest carbon price as a means of creating internal awareness, funds, and incentives to support GHG reduction goals.
- Build internal expertise on the topic and find influential channels (e.g., trade groups, leadership coalitions) to share their views and experiences.

In each case reviewed by C4C and WRI, champion companies are not waiting or trying to make guesses about the future. Instead they are accepting that eventually carbon costs will be reflected in market prices and taking prudent steps to ensure their business is “market-ready”.

Based on insights in the draft Executive Guide to Carbon Pricing Leadership. For more information, visit www.caringforclimate.org/carbonpricing.

section **3**

Competitiveness and carbon leakage

3 Competitiveness and carbon leakage

Carbon prices are intended to have an efficient and fair impact on the relative competitiveness of firms. They are expected to favor innovative, clean firms, and facilitate the exit or upgrade of the least efficient firms in emissions-intensive industries, thereby improving the overall efficiency of the economy. Carbon prices are particularly effective at achieving such an intended and efficient outcome if they are broadly similar across jurisdictions.

However, as demonstrated in this report, current efforts to put a price on GHG emissions around the world remain fragmented. Both the coverage and carbon price vary significantly between jurisdictions. In such an asymmetric world, countries are legitimately concerned that their ambitious climate action may undermine the international competitiveness of some domestic sectors, which may lose market share and profit margins to competitors who do not face similar emission costs abroad. A phenomenon known as carbon leakage occurs if such differences in emission costs lead to the relocation of carbon-intensive activities and related emissions from jurisdictions with stringent climate policies (including a high price on carbon) to jurisdictions with less stringent climate policies (low or no price on carbon), resulting in higher emissions at the latter jurisdictions.[136] In this way, climate policy in one country would favor inefficient, carbon-intensive firms abroad.

So far, carbon or a broader emissions leakage has not materialized on any significant scale, at least not in the more advanced industrialized countries. However, as long as climate policies and carbon prices significantly differ between jurisdictions, the risk of carbon leakage seems real. This risk is nevertheless localized in a few exposed economic activities (not the whole economy) and can be effectively managed through policy design, as discussed in this section.

The risk of carbon leakage declines as more countries take concrete action on climate change. International cooperation and coordination of climate policies is an ultimate remedy for the risk of leakage. It would help redress asymmetry in carbon pricing signals, thereby eliminating the need for protection of firms, although more research may be needed to understand the impact of similar carbon prices on firms in countries with very different income levels.

This section unpacks the concerns over carbon leakage and reviews how they can best be addressed, drawing on experience and literature.

136 The Intergovernmental Panel on Climate Change defines emissions leakage as "the increase in CO_2 emissions outside the countries taking domestic mitigation action divided by the reduction in the emissions of these countries." Source: IPCC, 2007, *Fourth Assessment Report: Climate Change 2007, Climate Change 2007: Working Group III: Mitigation of Climate Change*, section 11.7.2.

3.1 ANALYZING CARBON PRICING'S IMPACT ON COMPETITIVENESS

Legitimate concerns over carbon pricing's potential impact on competitiveness arise when a different price is charged (or expectations about future prices differ) for firms' or sectors' GHG emissions in different jurisdictions, possibly causing emissions leakage. Holding all other things constant, if firms in one jurisdiction face a new cost that their competitors in another jurisdiction do not face, they will fear either a loss of market share or a reduction in profit margin, or both. If it leads to relocation of emissions-intensive production and associated emissions to a jurisdiction where emissions costs are lower, emissions leakage occurs.

In reality, things are not that simple. Making firms pay for emissions does increase their costs, but this does not necessarily affect their competitiveness. In many sectors, companies do not compete mainly on costs, but rather on overall efficiency in converting complex input costs (energy, material, labor, land, knowledge) into high-value products and services.[137] This is especially true in the more advanced markets where the product and consumer preferences are of a highly dynamic nature and very sophisticated. An increase in energy or labor costs often goes hand in hand with increased profits and productivity.[138, 139]

However, for sectors producing relatively homogenous products—such as commodities, steel, cement, and electricity—cost competition is crucial. Such firms find it difficult to gain market share by differentiating their end products from those of their competitors. They must increase market share and profit margins mainly through production-side innovation and cost reduction. Often, production of these relatively homogenous goods is also emissions-intensive and carbon pricing could have a significant impact on companies' production costs, leading to loss of their international competitiveness and, as a consequence, emissions leakage. In lower-income countries, an increase in production costs may have challenging social and distributional consequences also for domestic consumers, which would need to be managed with a range of policies and institutions. The social and income distribution impacts are not the main focus of this section but may deserve special attention in future editions of the State and Trends of Carbon Pricing report.

The cost impact of carbon pricing must be seen in the context of other business costs and risks, even in the case of homogenous products. Production and investment decisions are influenced by a wide range of factors, such as proximity to product markets and low-cost inputs, construction costs of new facilities, transport costs of reaching key markets, exchange rate fluctuations, labor costs, and overall business risks, as might be captured in a firm's cost of capital.[140] Factors, such as other taxes, the quality of institutions and infrastructure, are often far more significant in a company's decisions than a carbon price.[141] Besides, explicit carbon prices (carbon taxes and ETSs) are not the only instruments that make emissions-intensive firms internalize their emission costs. Firms are also affected by implicit and indirect carbon prices embedded in other policy instruments, such as energy taxes, emission standards, or support systems for renewable energy and energy efficiency.[142] These implicit and indirect carbon prices should also be considered when comparing carbon prices across firms and jurisdictions.[143]

The traditional notion of cost competitiveness is of little relevance at the national level.[144] Countries do not compete with one another like firms do.[145] Most

137 Porter, M. E. "How Competitive Forces Shape Strategy." *Harvard Business Review* 57, no. 2 (March–April 1979): 137–145.
138 Ibrizio, S., T. Koźluk and V. Zipperer, "Empirical Evidence on the Effects of Environmental Policy Stringency on Productivity Growth", *OECD Economics Department Working Papers*, No. 1179, OECD Publishing, 2014.
139 Productivity is understood to be the value of output per unit of production inputs.
140 Oliver Sartor and Thomas Spencer, *An Empirical Assessment of the Risk of Carbon Leakage in Poland*, Working Paper (IDDRI, 2013).
141 Julia Reinaud, *Issues Behind Competitiveness and Carbon Leakage: Focus on Heavy Industry* (IEA, 2008).
142 Vivid Economics (2010), *The implicit price of carbon in the electricity sector of six major economies*, London.
143 OECD (2013a), *Effective Carbon Prices*, OECD Publishing, Paris.
144 Michael E. Porter, "The Competitive Advantage of Nations," *Harvard Business Review* Vol 68, Issue 2 (1990): 73–93; Josef T. Yap, "A Note on the Competitiveness Debate," *Philippine Journal of Development* Vol XXXI, Issue 1 (2004).
145 Paul Krugman, "Competitiveness: A Dangerous Obsession," *Foreign Affairs*, 1994.

economists argue that "the only meaningful concept of competitiveness at the national level is productivity."[146] In a similar vein, the World Economic Forum's Global Competitiveness Report defines national competitiveness as "the set of institutions, policies, and factors that determine the level of productivity of a country."[147] The competitive economies worldwide are usually not the economies that have the lowest labor or energy costs, but those that are able to generate the highest value from the total portfolio of its resources, skills, and other assets, and increase the sustainable prosperity of its population, as demonstrated by high-income countries.

3.2 POSITIVE CARBON PRICING IMPACTS ON COMPETITIVENESS

It needs to be stressed at the outset that putting a price on GHG emissions is meant to change the relative competitive position of firms. Carbon pricing is supposed to increase the financial costs of emissions-intensive activities, as they inflict climate change damages on society, and promote low-emission activities that do not contribute to climate change.[148] This result is an economically efficient and socially fair impact on the relative competitiveness of firms, which makes them face the truer economic cost of production. It levels the playing field between the emissions-intensive and relatively "clean" firms. The expected macroeconomic result is a shift in the structure of the economy toward low-carbon activities.

Even fragmented carbon pricing may sometimes support the competitiveness of certain firms and productivity of the economy. The so-called Porter hypothesis suggests that properly designed environmental policies may—under certain conditions—enhance the competitiveness of firms by inducing technology innovation and increasing productivity, thereby partly or fully offsetting the additional cost of compliance.[149] This hypothesis has been widely tested since it was first formulated 20 years ago, at least for high-income OECD countries. Generally, there is clear and well-established empirical evidence for the "weak" version of the Porter hypothesis, that is, that environmental regulations indeed stimulated innovations and had no significant adverse impact on competitiveness.[150] The evidence seems to be less conclusive for the "strong" version of the hypothesis, namely, that this innovation led to cost savings, which more than compensated for the additional costs of compliance, and enhanced business performance.[151] Environmental policies were found costless only under rare conditions of significant prior market barriers and where policy was designed as very efficient and market friendly.[152] Certain studies even found some negative impact of stringent environmental policy on productivity and exports.[153] However, this impact was small, and only affected a few sectors when the policy targeted production-related emissions. Tightening environmental standards did not seem to reduce international competitiveness when pollution was generated by consumption. And where depletion of natural capital was at stake, effective environmental policy was found to contribute to developing long-run international competitiveness.[154] Interestingly, the more recent studies tend to provide clearer empirical support for the "strong" hypothesis that environmental regulations improve business performance, although the impact may differ by sector.[155]

146 Michael E. Porter, "The Competitive Advantage of Nations," *Harvard Business Review* Vol 68, Issue 2 (1990): 73–93; Robert D. Atkinson, *Competitiveness, Innovation and Productivity: Clearing up the Confusion* (ITIF, 2013).

147 Klaus Schwab, *Global Competitiveness Report* 2012–2013. (World Economic Forum, September 2012).

148 Alex Bowen, *The Case for Carbon Pricing* (Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, December 2011).

149 Porter, Michael E. (1991), "America's Green Strategy," Scientific American (Apr. 1991), 168; Michael E Porter and Claas van der Linde, "Toward a New Conception of the Environment-Competitiveness Relationship," *Journal of Economic Perspectives* Vol 9, Issue 4 (November 1995): 97–118.

150 Lanoie. P., J Laurent-Lucchetti, N Johnstone, S Ambec. "Environmental policy, innovation and performance: new insights on the Porter hypothesis". *Journal of Economics & Management Strategy* 20 (3): 803-842.

151 Jaffe, A., and K. Palmer (1997), *Environmental Regulation and Innovation: A Panel Data Study, The Review of Economics and Statistics*, Vol. 79, No. 4 (Nov., 1997), pp. 610-619, MIT Press 1997.

152 Brannlund, R., and T. Lundgren. 2009. "Environmental policy without costs? A review of the Porter Hypothesis". *International Review of Environmental and Resource Economics* 3 (2): 75–117.

153 Jug, Jerneja, Mirza, Daniel (2015), Environmental Regulations in Gravity Equations: Evidence from Europe, in: World Economy, Vol. 28, Blackwell Publishing Ltd

154 Copeland, Brian R., *International Trade and Green Growth.* World Bank, Washington, DC, (2012).

155 Ambec, Stefan, et al., "The Porter Hypothesis at 20: Can Environmental Regulation Enhance Innovation and Competitiveness?," *Review of Environmental Economics and Policy* Vol 7, Issue 1 (2013): 2–22.

However, it is important to note that the empirical evidence is based mainly on studies in the advanced industrialized countries, which have relatively few barriers to information and innovation. A recent OECD review also found that the tightening of environmental policies led to improvements in production efficiency, but mainly in already technologically advanced industries and firms, while less productive firms saw their productivity fall even further.[156] This finding may have an important implication for extending carbon pricing to less developed countries where firms, particularly domestic firms in energy and labor-intensive sectors, are often less technologically advanced and not as productive as their foreign competitors; moreover, it is precisely these firms that account for a major share of the jobs and incomes of low-income households. Symmetric carbon pricing may have asymmetric impact across countries at different income levels. Some emerging research indicates that the longer-term effects on productivity and export can be positive, even in developing countries.[157] However, more research is needed to better understand the impact of climate policies on the performance of firms in developing countries, especially of those traditionally dependent on fossil fuels.

Another consistent finding is that market-based mechanisms (such as carbon pricing) tend to have a more robust positive effect on productivity than their less flexible alternatives.[158] Firms also tend to prefer flexible economic instruments of environmental policy over command-and-control alternatives because the former offer companies greater flexibility regarding the means and timing of reducing emissions. They also provide firms with dynamic incentives for innovation and efficiency improvements, although some environmental performance standards can also be designed to foster such dynamic efficiency, for example, the EU's Industrial Emissions Directive or the United States' Corporate Average Fuel Economy (CAFE) vehicle standards.

There is growing evidence that environmental regulations do promote innovation in green technologies.[159] Even more important, green innovation appears to entail stronger growth benefits than traditional innovation in fossil fuel sectors. Clean technology research and development has economic benefits that spill over to the rest of the economy through diffusion of new knowledge, in a way that is comparable to the spinoff of "frontier" technologies such as robotics, IT, and nanotechnologies. Fossil-based technologies tend to find narrower, more traditional applications in mature, slower growing sectors.[160]

As the aforementioned OECD review of existing evidence demonstrated, a large part of the economy-wide productivity gains from environmental policies stem from the exit of the least productive firms from the market. This is akin to other market transformations, which cause both losses and gains in different industries, even without climate policies, releasing workforce, land, and physical assets for a more productive use in other sectors.[161]

For sectors and regions that have been affected by firms' exits, the government may assist in shutting down the least efficient facilities and in retraining and reemploying workers in other, growing, sustainable sectors. Social protection provides additional safety nets

156 Albrizio, S., T. Koźluk and V. Zipperer (2014), "Empirical Evidence on the Effects of Environmental Policy Stringency on Productivity Growth", OECD Economics Department Working Papers, No. 1179, OECD Publishing.

157 Zhu, J., and M. Ruth (2015), "Relocation or reallocation: Impacts of differentiated energy saving regulation on manufacturing industries in China," *Ecological Economics*, 110, 119–133. doi:10.1016/j.ecolecon.2014.12.020.

158 Silvia Albrizio, *et. al, ibidem.*

159 Raphael Calel and Antoine Dechezleprêtre, "Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market," *Review of Economics and Statistics* (2012).

160 Antoine Dechezleprêtre, Ralf Martin, and Myra Mohnen, *Policy Brief: Clean Innovation and Growth* (Imperial College London Business School, n.d.).

161 Samuel Fankhauser, Friedel Sehlleier, and Nicholas Stern, "Climate Change, Innovation and Jobs," *Climate Policy* Vol 8, Issue 4 (2008): 421–429.

for those who find it difficult to transition to a new job. Public assistance can also facilitate skills development through national education systems. For example, Chile introduced its carbon tax with the explicit aim of providing additional resources to improve its education system.[162] Countries and regions where many people rely on emissions-intensive industries for jobs and where incomes are lower and institutions weaker will be more vulnerable to an increase in carbon prices. This vulnerability can be reduced, for instance, by supporting innovation and energy efficiency improvements in the industrial sector (for example by providing access to information about new technologies and access to finance for SMEs). This enhances workforce capability to pursue new, "cleaner" business opportunities.[163] Technology and resource transfers and institutional strengthening will be crucial to manage structural transformations in less advanced low-income countries.

3.3 ADVERSE IMPACT OF CARBON PRICES ON COMPETITIVENESS; CARBON LEAKAGE

The likelihood of a positive impact of carbon pricing on firms' productivity and their competitiveness is seriously challenged when asymmetric climate policies significantly differentiate price signals between jurisdictions. Industry and policy makers are often concerned that rather than enhancing the productivity of domestic firms, such asymmetric carbon pricing will benefit emissions-intensive firms abroad. The price signals may force specific sectors to shift their output and eventually also their investments to other countries, so-called "pollution havens,"where firms face lower GHG emission costs.[164] Policy makers and environmentalists are worried that this relocation could be followed by an increase in emissions at the new jurisdiction—the carbon leakage discussed above. These concerns over the adverse impact on competitiveness and the possibility of carbon leakage are probably the single most common concern challenging the introduction of carbon prices around the world.

If carbon leakage occurred, it would have two main knock-on effects on environmental policy objectives: it would reduce the environmental effect of emission reduction efforts and increase the cost of meeting specific climate targets. An increase in emissions in jurisdictions with low or no carbon prices would require additional efforts in the jurisdictions with carbon pricing policies in place to achieve the same net global emission reduction.

Carbon leakage can occur through three main channels (Box 7); the short-term output channel, the long-term investment channel, and thirdly, global fossil fuel prices channel. While global economic models show the third channel may actually be very important, this subject is not discussed in this report because it does not originate from the distorted international competitiveness of firms due to asymmetric carbon prices.

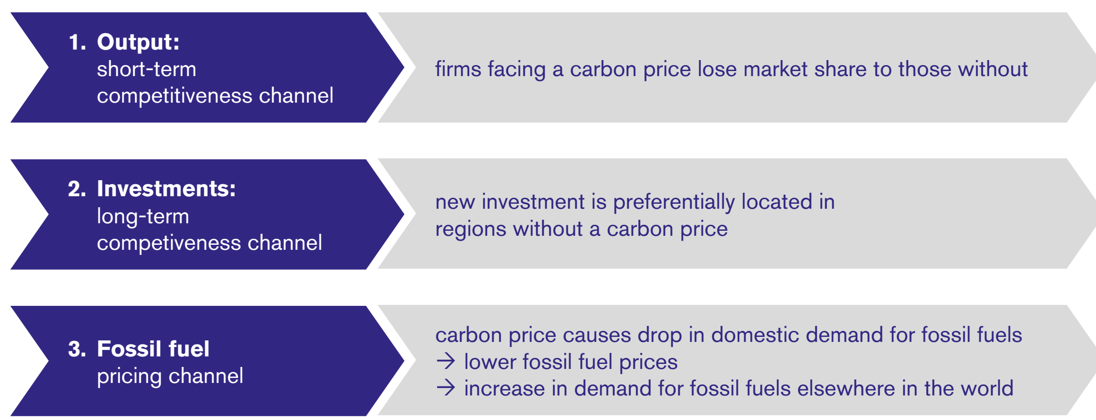
162 PMR, *Chile*, accessed August 10, 2015, http://www.thepmr.org/country/chile-0.
163 World Bank, *Decarbonizing Development: Three Steps Toward a Zero Carbon*, 2015.
164 Arik Levinson, "Offshoring Pollution: Is the United States Increasingly Importing Polluting Goods?," *Review of Environmental Economics and Policy* Vol 4, Issue 1 (2010): 63–83; Josh Ederington & Arik Levinson & Jenny Minier, 2005. "Footloose and Pollution-Free," The Review of Economics and Statistics, MIT Press, vol. 87(1), pages 92-99.; Levinson, A., and Taylor, M.S. (2008), Unmasking the Pollution Haven Effect. International Economic Review 49: 223-54.

Box 7 Different channels of carbon leakage

The *output*, or *short*-term competitiveness, channel operates when higher carbon emission costs force firms to reduce the utilization of their production facilities in jurisdictions covered by carbon pricing, to the benefit of plants located elsewhere that are not covered by carbon pricing.[165]

The *investment*, or *long*-term competitiveness, channel operates if different carbon prices in different jurisdictions affect investment decisions relating to choice of location (country). Existing plants in jurisdictions with a carbon price may first reduce investment in maintenance to sustain output levels, and eventually close. Companies may prefer to relocate to jurisdictions without a carbon price.

Figure 13 Three channels of transferring emissions leakage



The third channel of carbon leakage, the *fossil fuel pricing* channel, operates if climate policies in some countries were to reduce global demand for fossil fuels, which would in turn depress their global prices, thereby leading to a rebound in demand elsewhere and a subsequent increase in emissions.[166]

165 Julia Reinaud (2008), *Issues Behind Competitiveness and Carbon Leakage: Focus on Heavy Industry*. International Energy Agency.

166 Burniaux, J.-M.; Martins, J. Oliveira (2000). "Carbon Emission Leakages: A General Equilibrium View". OECD Working Paper No. 242.; Sinn, H. W. (2008). "Public policies against global warming" (PDF). International Tax and Public Finance 15 (4): 360–394; Elliott, J., I. Foster, S. Kortum, T. Munson, F. Pérez Cervantes, and D. Weisbach (2010), "Trade and Carbon Taxes," *American Economic Review* 100 (May): 465–469.

3.4 HOW TO ASSESS THE RISK OF CARBON LEAKAGE?

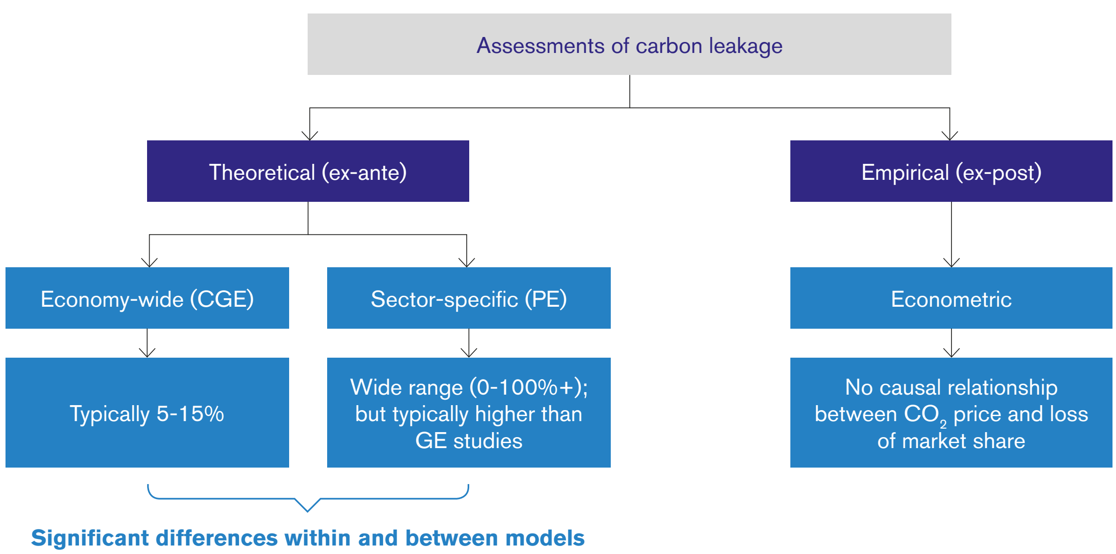
Carbon leakage only exists if the decision to relocate output and/or investment can be directly attributed to differences in carbon prices and, in turn, leads to an increase in emissions somewhere abroad where carbon prices are lower. In other words, causality needs to be established. Carbon leakage therefore needs to be assessed against what would have happened if carbon prices had been similar.

In reality, firms change location of production and investments every day, motivated by a variety of idiosyncratic factors discussed above. It is difficult to attribute such decisions to a single factor—like the increase of a carbon price. Furthermore, the real reasons for shifting production or investments are a firm's private knowledge. Firms always strategically select the information they share with governments and the public.

The risk of carbon leakage is often debated even before the implementation of carbon pricing instruments. The risk of carbon leakage can be assessed before a certain policy is introduced ("ex ante") or a few years after its implementation, allowing empirical evidence to be collected ("ex post"). These two complementary approaches to assessing leakage are illustrated in Figure 14.

Ex-ante modeling suggests a wide range of potential leakage rates.[167] Economy-wide models tend to find leakage rates in the region of 5–20 percent (meaning that for every 1,000 kg of reduced emissions in jurisdictions with a carbon price, emissions are expected to increase by 50–200 kg in other jurisdictions)— still yielding a net reduction. The results were found for a blend of sectors, more and less heavily exposed to carbon leakage. However, in the economy, when some sectors lose market share and employment, others gain. Leakage rates for individual sectors therefore differ. The range of leakage rates estimated by single-sector, partial equilibrium models is much wider: rates vary from just a few percentage points to rates even exceeding 100 percent (meaning that emissions in other jurisdictions are expected to increase by more than the emission reduction achieved in a jurisdiction with a

Figure 14 Ex-ante and ex-post assessments of carbon leakage



Source: Authors, based on Vivid Economics
Note: CGE = Computable General Equilibrium (model); PE = Partial Equilibrium (model).

167 See the comprehensive review of the ex-ante and ex-post studies on carbon leakage in the forthcoming: Partnership for Market Readiness, *Carbon leakage: theory, evidence and policy design*, World Bank.

carbon price). However, such models tend to focus on the sectors that are particularly vulnerable to carbon leakage. The different findings of the various modeling approaches are also explained by the diversity of the underlying assumptions and data, meaning that the results can only be duly compared if they are presented in a transparent way.

Ex-post studies are based on empirical assessments of existing schemes (mainly carbon taxes in individual EU countries and the EU ETS), using econometric approaches to try and establish a causal relationship between carbon pricing and leakage. The results of ex-post assessments consistently indicate that so far there is very little evidence that carbon prices have caused any significant carbon leakage and, least in Europe.[168] However, it is important to recognize that the absence of evidence to the contrary does not necessarily indicate that carbon leakage has not occurred and will not occur in the future. Several factors could explain the above results:

- The risk of leakage is negligible because emission costs represent only a small fraction of production costs and/or other factors are more important determinants of a firm's production and location decisions;
- Carbon prices in the existing schemes have been too low to have an impact;
- Mitigation measures worked—free allowances, for example, have successfully neutralized the leakage risk;
- Methodological challenges have distorted the results because of the relatively short period that carbon pricing has been in existence and the limited geographical coverage of the schemes that could be studied for a longer period of time (almost all empirical studies focus on the EU countries).

The next section discusses when it may be justified to provide assistance to firms to mitigate the risk of leakage.

3.5 WHICH FIRMS NEED ASSISTANCE TO PREVENT LEAKAGE AND WHEN?

In the presence of fragmented policies and different carbon costs, the risk of carbon leakage justifies giving assistance to the exposed firms and sectors. Policy makers usually face strong pressures from affected vested interest groups to shield them from the impact of carbon prices, and need to ascertain whose claims are legitimate and who is just seeking windfall gains.

Three criteria are typically used to identify the sectors that are exposed to the risk of carbon leakage:

1. Level of carbon price (capturing the impact of carbon prices), which determines the magnitude of costs associated with emissions;
2. Emission intensity (another measure of the impact of carbon prices), which determines the cost increase that can be attributed to carbon pricing, including direct on-site emission costs and indirect emission costs passed on through electricity price increases;
3. Trade intensity (capturing the exposure to carbon prices), which is a proxy for the ability of a firm or sector to pass on a cost increase to consumers without losing significant market share. Absent trade, or the potential to trade, firms covered by carbon pricing are insulated from uncovered competitors and the risk of carbon leakage should be small.

168 Johanna Arlinghaus, *Impacts of Carbon Prices on Indicators of Competitiveness: A Review of Empirical Findings*, OECD Environment Working Papers, 2015; Abrell, J., G. Zachmann andA. Ndoye (2011), "Assessing the impact of the EU ETS using firm level data," Bruegel Working Paper, 2011/08; Silvia Albrizio et al., *Do Environmental Policies Matter for Productivity Growth? Insights from New Cross-Country Measures of Environmental Policies*; Ralf Martin et al., "On the Empirical Content of Carbon Leakage Criteria in the EU Emissions Trading Scheme," *Ecological Economics* Vol 105 (September 2014): 78–88; *The New Climate Economy*, 2014; Florens Flues and Benjamin Johannes Lutz, *Competitiveness Impacts of the German Electricity Tax*, OECD Environment Working Papers (May 2015); Sartor, O. (2012), *Carbon leakage in the primary aluminium sector: what evidence after 6 ½ years of the EU ETS?* CDC Climate Research Working Paper 2012-12; Sartor, O. and T. Spencer (2013), *An Empirical Assessment of the Risk of Carbon Leakage in Poland*; Barker, T., S. Junankar, H. Pollitt and P. Summerton (2007), "Carbon leakage from unilateral Environmental Tax Reforms in Europe, 1995–2005," *Energy Policy*, 35(12), 6281–6292, Chan, H. , S. Li, and F. Zhang (2012), "Firm competitiveness and the European Union Emissions Trading Scheme," *World Bank Working Paper*; Cummins, M. (2012), *EU ETS market interactions: a multiple hypothesis testing approach*, Mimeo, Dublin City University Business School; Ellerman, A., F. Convery, and C. De Perthuis (2010), *Pricing Carbon: The European Union Emissions Trading Scheme*, Cambridge University Press; Graichen, V., K. Schumacher, F. Matthes, L. Mohr, V. Duscha, J. Schleich, and J. Diekmann (2008), *Impacts of the EU Emissions Trading Scheme on the industrial competitiveness in Germany: final draft report prepared under the UFOPLAN*, Berlin; Lacombe, R. (2008), "Economic Impact of the European Union Emission Trading Scheme : Evidence from the Refining Sector," Thesis for the Degree of MTech, Massachussetts Institute of Technology.

The full picture can be obtained when these three criteria are considered together rather than in isolation. In the California Cap-and-Trade Program, leakage assistance is determined by a combination of emission intensity and trade intensity, and, in the period 2018–20, sectors will receive different levels of leakage assistance according to their level of exposure to leakage. However, some instruments, such as the EU ETS (in its current phase) and the proposed carbon tax in South Africa, offer support to entities that are deemed trade exposed, even if they are not carbon-intensive.

It is best to assess the carbon leakage risk exposure of entities at the sector rather than the firm level. This approach avoids rewarding firms that are more emissions-intensive than their competitors and prevents firms from changing sales patterns in order to satisfy trade exposure tests.

The impact of carbon and trade intensity can be further fine-tuned by considering: (i) the price sensitivity of consumers; (ii) the degree of competition within the industrial sector in question; (iii) the availability and cost of abatement options; (iv) carbon pricing (implicit and explicit) in other jurisdictions (the main trading partners), and (v) the carbon intensity of production in other jurisdictions. In sum, exposed sectors are those that are carbon-intensive, burdened with costly abatement options, and exposed to international trade with jurisdictions that do not charge their firms for emissions. However, the lack of data and the accompanying administrative burden often prevent the use of these criteria for more targeted assistance.

Assistance should be narrowed over time, as it can otherwise have undesirable fiscal and economic consequences and possibly undermine the core objective of a policy by maintaining support for carbon-intensive firms. However, when carbon pricing is introduced for the first time, providing broad support to all sectors is sometimes necessary to gain public and political acceptance. It can be gradually limited and better targeted over time as acceptance increases and more relevant data become available.

3.6 HOW TO ASSIST EXPOSED AND VULNERABLE SECTORS?

Once the risk of leakage has been determined to be significant for certain sectors, governments can assist the affected firms in several ways. They can assist in mitigating the social and economic impact of the sector's decline, for instance, by retraining workers. Alternatively, governments can lower the risk of leakage through special measures— including integrated assistance measures that are included in the design of a carbon pricing instrument and complementary measures, which are not part of the carbon pricing instrument's design.

3.6.1 Integrated assistance measures

Integrated measures have been the generally preferred approach to date. Directly incorporating measures that protect against leakage in the carbon pricing legislative package transparently addresses leakage concerns and can help secure the necessary political support for the policy. Broadly speaking, six distinct types of integrated measures can be observed, three of which involve free allowance allocations:

- Free allowance allocations, based on:
  - Grandfathering: firms receive free allowances directly related to their historical emissions (e.g., EU ETS Phases I and II, the Republic of Korea's ETS in all but three sectors, Kazakhstan ETS Phases I and II, and most sectors in the pilot ETSs of Beijing, Chongqing, Guangdong, Hubei, Shanghai and Tianjin);
  - Fixed sector benchmarking (FSB): firms receive free allowances related to their historical production and a product-specific benchmark of emission intensity of the whole sector (EU ETS Phase III)
  - Output-based allocation (OBA): firms receive free allowances related to their actual production and a product-specific benchmark of emission intensity of the whole sector (e.g., California, New Zealand, the Republic of Korea in three sectors, and Shenzhen);

– Administrative exemptions: exempting some emissions or sectors/firms from the carbon pricing instrument, or setting reduced rates for them (e.g., a number of carbon taxes in EU countries and South Africa's proposed carbon tax);
– Rebates: providing subsidies to industry (direct rebates) or reducing other taxes paid by the exposed industry (indirect), often by an equivalent amount (e.g., the U.K. climate change levy and the Swedish Nitrogen Oxide charge);
– Border carbon adjustments (BCAs): imposing emission costs at the border on importers of carbon-intensive goods and/or providing a rebate to firms exporting to third countries, unless those countries have an equivalent carbon pricing regime.

The various assistance measures each have their own relative merits and weaknesses in terms of administrative feasibility and costs, effectiveness in leakage prevention, and usability as an incentive to reduce emissions. They are sometimes combined in one legislative package, where different forms of assistance are given to different sectors.

Exemptions perform most poorly in terms of abatement incentives, but are easy to implement. They may be appropriate to ensure political support so that carbon pricing survives the infancy stage.

Grandfathering may be appropriate when a scheme is in its early stages, where the need to tackle other administrative challenges may make benchmarking approaches complex, or where there is a desire to provide one-off compensation to firms, even if they are not at risk of leakage. Grandfathering entails perverse incentives to increase emissions, unless firms expect that it will be soon replaced with benchmark-based assistance.

Of the free allocation approaches, those that use benchmarking (either OBA or FSB) generally perform better by most criteria than those that provide free allowances on a grandfathered basis. By breaking the link between a firm's own historical emission levels and its free allowance allocation, the risk of rent-seeking is reduced. The additional administrative costs incurred to calculate the benchmarks, and in the case of OBA also to update output data, are higher for the benchmarking approaches, but are manageable.

There is a trade-off between the two benchmarking approaches. OBA may be more effective at preventing leakage but may also compromise the environmental integrity of the carbon pricing instrument, unless it is designed with additional environmental safeguards. This is particularly true if OBA is applied to sectors that are not exposed to leakage.

BCAs arguably perform best in terms of environmental integrity, but face political, administrative,[169] and possibly also legal challenges. BCAs effectively extend the carbon pricing regime to entities outside the implementing jurisdiction. Legal considerations will influence any design[170] but many commentators suggest that these considerations will not represent an insurmountable barrier.[171, 172] World Trade Organization requirements might possibly be met if BCAs demonstrate their effectiveness at reducing emissions, rather than at addressing carbon leakage.[173] The political challenges may be as great, or greater, than any legal constraints, as demonstrated by the experience of the EU in seeking to establish a regime that would have extended its ETS to cover emissions from all international flights from and to Europe. Application of trade measures to climate change

169 Davie, Bruce F. (1995), *Border tax adjustments for environmental excise taxes: the US experience*, Mimeo Washington DC, US Treasury Department.
170 Laborde, D. and S. Msangi (2011), "Biofuels, Environment, and Food: The Story Gets More Complicated," International Food Policy and Research Institute, Washington, DC, www.ifpri.org/node/8439.
171 Condon, M. and A. Ignaciuk (2013), "Border Carbon Adjustment and International Trade: A Literature Review", *OECD Trade and Environment Working Papers*, No. 2013/06, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/5k3xn25b386c-en.
172 Cosbey, A., S. Droege, C. Fischer, J. Reinaud, J. Stephenson, L. Weischer and P. Wooders (2012), "A Guide for the Concerned: Guidance on the elaboration and implementation of border carbon adjustment," ENTWINED/International Institute of Sustainable Development, Stockholm.
173 Stéphanie Monjon and Philippe Quirion, "A Border Adjustment for the EU ETS: Reconciling WTO Rules and Capacity to Tackle Carbon Leakage," *Climate Policy* Vol 11, Issue 5 (September 2011): 1212–1225.

regulation remains largely untested and risky. Trade disputes can spill over to many areas of international relations, making BCA a very expensive policy for all parties concerned. Border adjustment measures appear more feasible when introduced by a coalition of partners who account for a significant share of world trade.[174] Moreover, considerable administrative challenges arise from the fact that the legislator introducing BCA has no jurisdictional access to third-party companies to ensure accurate measurements of emissions. Adequate monitoring, reporting, and third-party verification of emissions has proved essential for the proper functioning of carbon markets.

A more technical discussion of the integrated assistance measures is presented in Annex II.

3.6.2 Complementary leakage mitigation measures

Complementary measures tend to have a less immediate impact on leakage and are more challenging to design in a way that flexes in value with the carbon price. They can reduce the carbon cost burden faced by sectors exposed to leakage through grants; tax incentives; and financial assistance for emission reduction projects for firms in leakage-exposed sectors or for R&D of low-emissions technologies applicable in leakage-exposed sectors. For example, under Phase III of the EU ETS, member states can compensate firms for indirect emission costs using national resources via state aid schemes. Both the EU and New Zealand provide research and development funding to affected sectors. However, the link between these measures and leakage prevention may not be strong.

3.6.3 Ensuring targeted and effective leakage assistance measures

Experience suggests that to successfully address competitiveness and leakage concerns requires that assistance be targeted at those sectors where the risk of leakage is significant. The assistance measures implemented should be chosen after considering multiple criteria, such as effectiveness in leakage prevention and administrative feasibility, as indicated in Table 4 in Annex II. If this is a politically difficult process, assistance measures should be reviewed periodically and adjusted as more jurisdictions apply similar policies, and additional knowledge is gained on this subject.

Studies suggest that leakage prevention assistance has not always been necessary to maintain the competitiveness of firms affected by these policies.[175] A number of analyses found no difference in output or employment between firms that faced the full carbon price and those that were fully or partially exempt.[176] However, this finding may not necessarily apply to higher carbon prices.

The ultimate solution to carbon leakage is international cooperation, which would harmonize carbon price signals across all jurisdictions. It would remove the underlying cause of leakage and therefore reduce the need for assistance measures. Nonetheless, as pointed out above, more empirical evidence is needed on the impact of internationally harmonized but high carbon prices in less developed, low-income countries. The benefits of international cooperation and the fundamental role of carbon pricing instruments are discussed in the next section.

174 Nordhaus, B. (2015), "Climate Clubs : Overcoming Free-riding in International Climate Policy," *American Economic Review*, 105(4), 1339–1370.
175 Johanna Arlinghaus, *Impacts of Carbon Prices on Indicators of Competitiveness: A Review of Empirical Findings*, OECD Environment Working Papers, 2015.
176 Niels Anger and Ulrich Oberndorfer, "Firm Performance and Employment in the EU Emissions Trading Scheme: An Empirical Assessment for Germany," *Energy Policy* Vol 36, Issue 1 (2008): 12–22; Ralf Martin, Ulrich J. Wagner, and Laure B. de Preux, *The Impacts of Climate Change Levy on Business: Evidence from Microdata*, CEP Discussion Paper, 2009; Ralf Martin et al., "Industry Compensation under Relocation Risk: A Firm-Level Analysis of the EU Emissions Trading Scheme," *American Economic Review* Vol 104, Issue 8 (2014): 2482–2508; Flues and Lutz, *Competitiveness Impacts of the German Electricity Tax*, OECD Environment Working Papers (May 2015).

section **4**

International cooperation on mitigation

4 International cooperation on mitigation

As outlined in section 2, new national and subnational carbon pricing instruments have emerged since 2012 in a bottom-up process. Countries are defining their mitigation efforts in INDCs. These INDCs will inform future action on carbon pricing. Section 3 has shown that competiveness and carbon leakage are serious concerns in a world of uncoordinated, fragmented action on carbon pricing. Policy tools are available to manage these risks but ultimately international cooperation will be essential to realizing the full potential of carbon pricing.

This section explores the broader role of international cooperation in achieving the 2°C mitigation target in a cost-efficient manner. Because of the unequal distribution of wealth and abatement potential around the world, all countries would benefit from cooperation. Some countries can afford to reduce GHG emissions but have already exploited most of their low-cost abatement options, while others have many low cost low-carbon development opportunities, but lack the resources to harness them. Carbon pricing and climate finance instruments are important facilitators of cooperation, as these are the primary mechanisms through which international finance can be transferred between countries. Through carbon pricing instruments, a portion of the resulting cost savings in countries that avoid the most expensive abatement measures can be converted to financial transfers and drive low-carbon growth in the lower-income countries, which might otherwise lack the resources to modernize their economies, create jobs in low-carbon sectors, and reduce poverty in a sustainable manner. Rewards such as these financial transfers between countries and penalties, for example, border carbon adjustments, are necessary instruments to overcome incentives to “free-ride” on the efforts of others, something that prevents a cooperative solution. They align incentives between countries, avoid fragmentation, and enable harnessing of the common benefits from cooperation.[177]

177 Nordhaus, W., “Climate Clubs: Overcoming Free-riding in International Climate Policy”, *American Economic Review*, 105(4): 1339–1370, 2015.

The natural starting point to estimate the potential cost savings through cooperation and associated financial transfers would be the INDCs. However, as some INDCs have not yet been submitted, it is too soon to model the cost savings that could be achieved on the basis of INDCs. Therefore, this section follows an alternative approach that illustrates a possible range of INDCs using so-called effort-sharing scenarios. Based on the modeling of these scenarios from various leading literature sources, ranges of cost savings and associated resource transfers are presented. While these ranges are broad, reflecting different impacts from the various effort sharing scenarios and models used, the possible savings and resource transfers are nonetheless large in all cases, across a diverse range of assumptions. This demonstrates the robustness of the conclusions of this section and highlights the indispensable role of international cooperation, through carbon pricing and climate finance instruments, in mobilizing resources at the scale needed to stabilize the climate.

4.1 INCENTIVES FOR COOPERATION ON CLIMATE MITIGATION

The magnitude of cost savings that can be achieved through cooperation depends mainly on the initial distribution of mitigation efforts among countries, the stringency of the emission reduction targets, the differential of mitigation costs between countries, and the size of the coalition of countries pursuing climate action. Although all countries ultimately benefit from cooperation, each country will benefit to a different extent—some will be recipients of resource transfers, while others will transfer resources to other countries.

» The main reward for global cooperation on climate change lies in the savings that can be gained on the costs of limiting the global temperature increase to 2°C. «

The distribution of mitigation efforts among countries reflects national circumstances, political realities, economic possibilities, and strategic interests. International climate negotiations recognize that countries should participate in climate mitigation in accordance with their common but differentiated responsibilities and respective capabilities, taking into account their specific social and economic circumstances.[178] Once all INDCs have been submitted, they will reveal the *de facto* initial distribution of mitigation efforts.

The INDC effort-sharing outcome can be compared with the outcome of a process purely based on the principle of efficiency: a least-cost approach, which calls for emission reductions to be achieved wherever it is cheapest to do so, without regard for political or other constraints. As the INDC process is still underway, it is too early to make such a comparison. However, regardless of the distribution of mitigation efforts that will emerge from the INDCs, it is likely that the cost burden of climate change mitigation can be reduced. This is because the actual emission reductions can be achieved either through domestic actions alone or through a combination of domestic and cooperative actions undertaken jointly by several countries.

178 *United Nations Framework Convention on Climate Change*, 1992.

Academic literature can give an insight into the extent to which cooperation can help reduce the cost burden. It compares effort-sharing outcomes based on the least-cost approach with effort-sharing approaches based on normative principles, reflecting different stakeholders' preferences on how the effort should be distributed according to principles such as fairness and equity. Some examples of these normative effort-sharing approaches are equal costs per GDP, per GDP convergence, and per capita convergence.[179] By definition, these effort-sharing approaches are more expensive than (or at least as expensive as) the least-cost approach.

The cost savings that can be achieved by moving from various initial effort-sharing approaches to a least-cost scenario through cooperation are presented in Table 2. Although these estimates are based on effort-sharing approaches that may be different from the outcome of the INDC process, they can be considered as a proxy of the cost savings that can be achieved through cooperation. This is justified because the normative principles used in the academic research presented in Table 2 are also, implicitly or explicitly, adopted in the INDC process.

According to this academic research, cooperation can reduce the global costs of meeting a long-term climate target by about 6–67 percent.[180] The magnitude of these cost savings depends on the assumed distribution of the mitigation effort among countries compared to a least-cost scenario, as discussed above. In general, the largest global cost savings are expected if the distribution of effort is not based on low-cost mitigation options. This is highlighted in Table 2, which shows that cooperation is more valuable if the initial effort-sharing approach is based on the per capita convergence principle rather than on effort-sharing approaches that take global mitigation opportunities into account (that is, the equal costs per GDP and per GDP convergence approaches). Moreover, a study by Clarke et al. (2009), which is quoted by the IPCC, estimates that the potential cost savings are larger under a scenario where only a few countries take mitigation action, as delayed mitigation by the other countries results in higher global mitigation costs (see Table 2).[181] Furthermore, research has found that lower relative cost savings are obtained for more ambitious global emission reduction targets, such as the 450 ppm CO_2e scenario,[182] compared with less ambitious targets, such as the 550 ppm CO_2e scenario (Table 2). The main explanation for this finding is that in order to achieve substantial global emission reductions, both developed and developing countries have to use relatively expensive abatement measures. As the costs of achieving emission reductions in industrialized and developing countries converge, the benefits of shifting the mitigation effort from one country to another are lower.

179 Equal costs per GDP – this approach assumes that the mitigation effort is divided among countries so that all countries have equal mitigation costs as a share of GDP. This burden differentiation model takes into account countries' mitigation opportunities and their ability to pay for mitigation. Per GDP convergence – this approach is based on the convergence of emissions per unit of GDP, which is an indicator of the carbon efficiency of a country. Under this burden differentiation model, countries with lower carbon efficiencies (that is, higher emissions per unit of GDP) are required to make deeper emission reductions than countries with higher carbon efficiencies (that is, lower emissions per unit of GDP). Typically, these deep emission reductions can be achieved at a relatively low abatement cost, as countries with low carbon efficiency generally have numerous low-cost mitigation opportunities. Per capita convergence – this approach distributes the mitigation effort among countries so that the emissions per capita of countries converge over time to a common level. This model is based on the egalitarian principle, where all citizens have equal rights to "use" the atmosphere.

180 Savings are reported on a net basis, i.e. are calculated as a sum of avoided mitigation costs in some countries after transfers plus a sum of surplus of other countries resulting from transfers after additional mitigation costs have been incurred.

181 Leon Clarke, Kejun Jiang, Keigo Akimoto, Mustafa Babiker, Geoffrey Blanford, Karen Fisher, J. Vanden, Jean-Charles Hourcade, Volker Krey, Elmar Kriegler, Andreas Loschel, David McCollum, Sergey Paltsev, Steven Rose, Priyadarshi R. Shukla, Massimo Tavoni, Bob van der Zwaan and Detlef P. van Vuuren, "Assessing Transformation Pathways," *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Chapter 6 (2014): 413–510, quoting Leon Clarke, Jae Edmonds, Volker Krey, Richard Richels, Steven Rose, and Massimo Tavoni, "International climate policy architectures: Overview of the EMF 22 International Scenarios," *Energy Economics*, Vol 31 (2009): 64–81.

182 A long-term 450 ppm CO_2e target is "likely" (>66%) to limit the global temperature rise to 2°C.

Table 2 Literature overview of global cost savings from international cooperation

Source	Regional scope	Target year	Distribution of mitigation efforts across countries	Long-term climate target	Global cost savings from international cooperation (in %)
Hof et al. (2012)[a]	Global, 26 regions	2030	Equal costs per GDP	450 ppm CO_2e	16%[b]
			Per capita convergence	450 ppm CO_2e	32%
Fujimori et al. (2015)[c]	Global, 17 regions	2050	Per capita convergence	450 ppm CO_2e	16%[d]
				550 ppm CO_2e	35%
			Per GDP convergence	450 ppm CO_2e	6%
				550 ppm CO_2e	19%
Clarke et al. (2009)[e]	Global, 10 regions	2100	Fragmented action[f]	450 ppm CO_2e and 550 ppm CO_2e	33–67%
Böhringer and Welsch (2004)[g]	Global, 12 regions	2050	Per capita convergence	25% below 1990 levels	59%[h]
EBRD and Grantham Research Institute on Climate Change and the Environment (2011)[i]	Economies in transition[j]	2050	Uniform: 80% below 2005 levels by all countries	500 ppm CO_2e	47%[k]
OECD (2010)[l]	Annex I only[m]	2020	Uniform: 20% below 1990 levels by all Annex I countries	n/a	13%[n]
		2050	Uniform: 50% below 1990 levels by all Annex I countries	n/a	7%

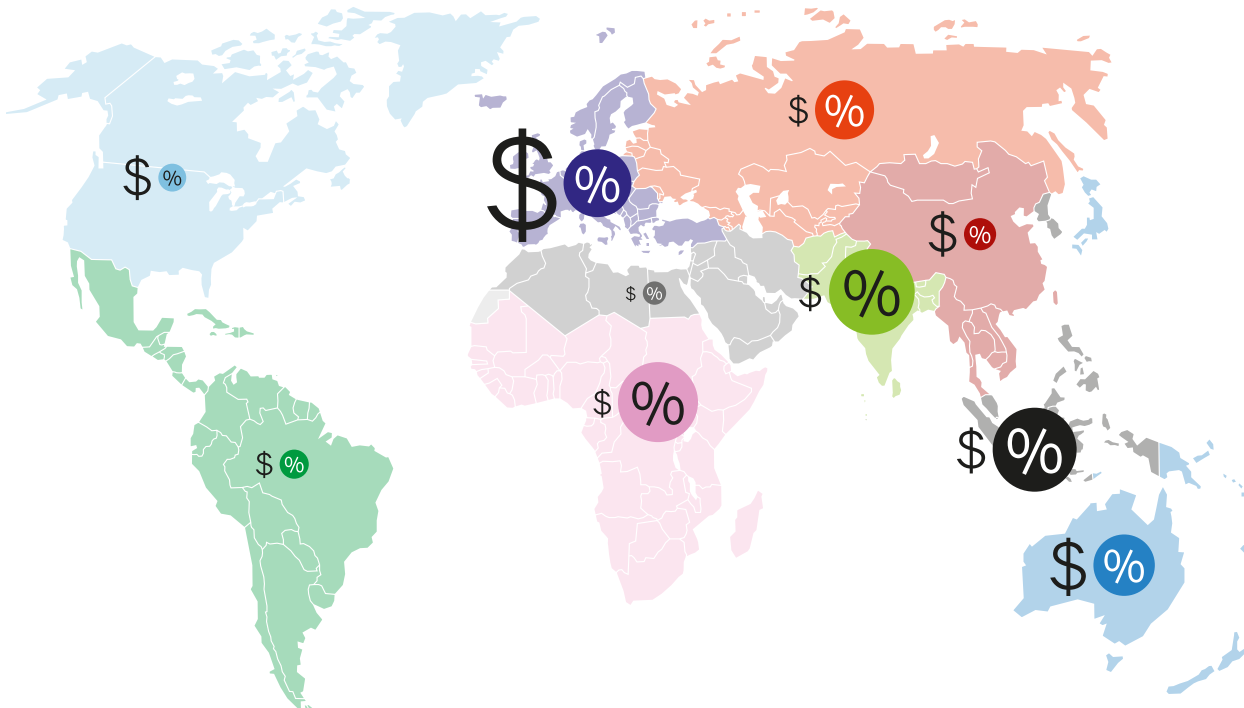
Note:

a Costs are expressed as share of GDP in the target year.
b Source: Andries Hof, Corjan Brink, Angelica Mendoza Beltran, Michel den Elzen, *Greenhouse Gas Emission Reduction Targets for 2030. Conditions for an EU Target of 40%*, PBL Netherlands Environmental Assessment Agency, 2012.
c Source: Shinichiro Fujimori, Toshihiko Masui, and Yuzuru Matsuoka, "Gains from Emission Trading under Multiple Stabilization Targets and Technological Constraints," *Energy Economics*, Vol 48 (2015): 306–315.
d Costs are expressed as welfare changes.
e Leon Clarke, Jae Edmonds, Volker Krey, Richard Richels, Steven Rose, and Massimo Tavoni, "International climate policy architectures: Overview of the EMF 22 International Scenarios," *Energy Economics*, Vol 31 (2009): 64–81.
f This scenario assumes that Annex I countries (without Russia) take immediate mitigation actions, Brazil, Russia, India and China participate in 2030 and the rest of the world participates in 2050.
g Source: Heinz Welsch and Christoph Böhringer, "Contraction and Convergence of Carbon Emissions: An Intertemporal Multi-Region CGE Analysis," *Journal of Policy Modeling Vol 26*, Issue 1 (2004): 21–39.
h Costs are expressed as welfare changes.
i Source: EBRD and Grantham Research Institute on Climate Change and the Environment, *The Low Carbon Transition*, 2011.
j Eastern and South-eastern Europe, Baltic countries, Russia, former Soviet Union, Central Asia (excluding China) and Turkey.
k The mitigation cost without cooperation was calculated in this study using a "limited trade" scenario, in which 20% of the emission reductions can be imported from other regions and 80% needs to be achieved through domestic actions. Costs are expressed as share of business-as-usual GDP in net present value for period 2010–50.
l Source: OECD, *Towards Global Carbon Pricing*, 2010.
m As the scope of this study is limited to Annex I countries only, the cost increase relates to linking Annex I countries. If the scope would be extended to also include non-Annex I countries, the cost increase would most likely be much higher.
n Costs are expressed as welfare changes measured by income equivalent variation in target year.

Cost savings from cooperation on a regional level vary significantly, as demonstrated in Figure 15, which shows the absolute and relative cost savings for an approach where the effort-sharing uses equal costs per GDP (chosen for illustration only). In this figure, the largest circle represents a 45 percent reduction of mitigation costs in South Asia.[183] The largest $ sign represents US$39 billion in absolute cost savings in Europe. While the size of the cost savings varies widely, all regions nonetheless benefit from cooperation. It is important to highlight that Figure 15 presents the regional cost savings calculated on the basis of a single model study by Hof et al. (2012) and on only one effort-sharing approach. The cost savings calculated by other studies may not be identical, as these other studies may use different models, based on different underlying assumptions and different effort-sharing approaches. However, in general, studies show that all countries benefit from international cooperation as it leads to a more efficient use of global resources.

183 The exact definition of this region depends on the calculation model used. South Asia includes India, and may include, among other countries, Afghanistan, Bangladesh, Nepal and Pakistan. Source: Tavoni, M., Kriegler, E., Aboumahboub, T., Calvin, K., De Maere, G., Jewell, J., Kober, T., Lucas, P., Luderer, G., McCollum, D., Marangoni, G., Riahi, K., and van Vuuren, D., *Limits Special Issue on Durban Platform scenarios: The distribution of the major economies' effort in the Durban platform scenarios*, 2013.

Figure 15 Illustration of cost savings from international cooperation relative to mitigation costs without cooperation for ten regions by 2030



Note: Circles represent the relative cost savings, while $ symbols represent the size of the absolute cost savings. Absolute cost savings are expressed in US dollars and represent the difference between the global mitigation cost in a scenario without international cooperation and the global mitigation cost in a scenario with international cooperation based on an equal costs per GDP effort-sharing approach. Relative cost savings are the absolute cost savings expressed as a percentage of global mitigation costs without cooperation. For example, the mitigation costs in South Asia without cooperation amount to US$9.3 billion, but drop to US$5.1 billion with cooperation. This represents absolute cost savings of US$4.2 billion, or 45 percent in relative cost savings. The regions were based on the model and do not imply any judgement concerning the legal status of any territory or the endorsement or acceptance of such boundaries. Values are in 2005 US$ per year.

Source: Authors, based on Andries Hof, Corjan Brink, Angelica Mendoza Beltran, Michel den Elzen, *Greenhouse Gas Emission Reduction Targets for 2030. Conditions for an EU Target of 40%*, PBL Netherlands Environmental Assessment Agency, 2012.

It is important to note that these studies only take into account the direct costs of GHG emission mitigation and the resource transfers that enable cost savings. The global benefits of avoided climate change damages are not considered. Furthermore, co-benefits[184] of mitigation that are not quantified in these studies include improvement in human health, energy access, and energy security. Cooperation can also strengthen trust between countries, reduce the potential for conflicts, and facilitate knowledge sharing.

184 Parry, I., Veung, C., and Heine, D., *How much carbon pricing is in countries' own interests? The critical role of co-benefits*, 2014.

4.2 REALIZING THE BENEFITS OF COOPERATION

Carbon pricing instruments can mobilize the resources needed to achieve cost savings from cooperation in the form of financial transfers between countries. Such instruments include carbon taxes, ETSs, carbon offset instruments as well as different forms of climate finance that can be funded by the revenues derived from carbon pricing or regular taxes.

Climate finance involves financial transfers between, for example, countries or international investors. It can take the form of direct investment in low-carbon technologies through grants or concessional loans and tax rebates, among other instruments. It can also fund readiness activities such as capacity building, institutional development, and policy design.[185] Climate finance can help economies prepare for the introduction of a carbon price signal by providing the upfront funds needed to set up the infrastructure for a carbon pricing instrument or by phasing in carbon pricing in the form of carbon RBF.

Furthermore, carbon pricing instruments (carbon taxes, ETSs, and carbon offset instruments) have features that complement climate finance instruments:

– *Cost discovery:* Carbon pricing instruments can engage private sector actors to actively search for and discover the lowest-cost mitigation options. While models can be used to estimate emission mitigation costs and identify optimal mitigation strategies, these models are based on assumptions made with limited information available to modelers at the time the model was built. By contrast, the cost discovery function of carbon pricing facilitates innovation that uncovers mitigation options and costs.

– *Flexibility:* This is needed to provide policy makers with the ability to deal with uncertainties in future economic development and emission trajectories. In particular, permitting the use of mitigation outcomes achieved abroad can provide comfort to policy makers who set an ambitious emission reduction target.

– *Resource mobilization and private finance leveraging:* Achieving ambitious and cost-efficient mitigation globally requires significant international financial transfers that cannot be mobilized through public budgets only. The leveraging of private sector financial flows is therefore important, especially for developing countries, where low-carbon, capital-intensive technologies often struggle to compete with cheaper, traditional, carbon-intensive technologies. Developing countries also have higher sovereign risks, which reduce the attractiveness of investments in low-carbon technologies. Carbon pricing helps overcome these issues by providing an economic incentive for investors to assume the additional investment risk and shift resources from carbon-intensive to low-carbon technologies.

Combining and linking up different carbon pricing instruments can facilitate financial transfers even further (see Box 8).

185 While climate finance is often considered to be a resource flow from developed to developing countries, climate finance can also flow between developing countries or between developed countries. Moreover, climate finance includes financial resources from both the public and private sectors.

Box 8 Linking of carbon pricing instruments

There are various ways to combine and link different carbon pricing instruments. For instance, offsets have commonly been used under ETSs. A well-known example is the use of CERs and ERUs in the EU ETS. The import of offsets up to about 6% of the cumulative cap is allowed under the EU ETS in the period 2008–20. Offsets can also be used in carbon taxes. For example, offsets are expected to be permitted for use in the scheduled South African carbon tax and CERs can be used in the Mexican carbon tax.

Several countries mention the use of international credits in their INDCs. The use of a common offset standard by various ETSs and carbon taxes indirectly links the instruments and helps carbon prices converge. Common offset standards such as the CDM, recognized by a wide range of countries, can help facilitate this indirect link of instruments and cooperation between countries. Another example of an indirect link is the international emissions trading under the Kyoto Protocol, where the trading of AAUs between countries creates implicit links between the countries' domestic mitigation policies.[186]

Directly linking carbon tax instruments may involve different jurisdictions agreeing on (minimum) tax rates. Furthermore, it would require a consensus on the rules for transferring tax revenues across borders. ETSs and carbon taxes can also be linked directly. An example of a direct link between ETSs is found in the California and Québec Cap-and-Trade programs. Another linking variant is where ETS allowances are accepted under a carbon tax. Similarly, ETSs can also accept tax credits, which entities liable under a carbon tax would receive when paying taxes beyond their obligations. These types of links can be two-way, where units from one instrument are accepted in the other instrument and vice versa, or one-way, where only one instrument accepts units from the other.[187] While harmonization of key design elements can help facilitate direct linking, this can be a challenge. Jurisdictions are currently designing and implementing carbon pricing instruments that reflect their national circumstances and that are, therefore, not harmonized. The concept of "networking" carbon pricing instruments is an alternative to direct linking which reflects this political reality. Networking accepts differences in the design and ambition of instruments, and seeks to facilitate cross-border trade by assigning a value to these differences.[188] Another alternative to direct linking is to establish quantitative limits on the flows of units between instruments. While this option may restrict overall efficiency gains, it is recognized as an important mechanism to ensure that linking supplements domestic action.

186 Daniel Bodansky, Seth Hoedl, Gilbert Metcalf, Robert Stavins, *Facilitating Linkage of Heterogeneous Regional, National, and Sub-National Climate Policies Through a Future International Agreement*, Harvard Project on Climate Agreements, 2014.

187 Adelphi (on behalf of the BMUB), *Towards a Global Price on Carbon: Pathways for Linking Carbon Pricing Instruments*, 2015.

188 The World Bank Networked Carbon Markets (NCM) initiative supports international cooperation. It has a long term vision that is focused on how a future international carbon market could accommodate a 'patchwork' of different, domestic climate actions. It is collaborating with a wide range of stakeholders to explore the post-2020 services and institutions that might be needed to achieve this, including: an independent assessment framework to establish a shared understanding of the climate change mitigation value of a wide range different climate actions; an International Carbon Asset Reserve to support and facilitate carbon market related functions; and an International Settlement Platform to track cross-border trades and provide a possible clearing house function. Further information is available at: http://www.worldbank.org/en/topic/climatechange/brief/globally-networked-carbon-markets.

The magnitude and direction of financial transfers through economic instruments depend on the initial distribution of mitigation efforts. The LIMITS project[189] found that under a scenario compatible with a 2°C target,[190] the net annual flow of financial resources will be US$100–400 billion/year by 2030. By 2050, this net flow is estimated to increase to approximately US$400–2,200 billion/year.

An illustrative example of the magnitude and direction of the financial transfers in 2030 for two different effort-sharing approaches (equal costs per GDP and per capita convergence) are presented in Figure 16. Similar to the analysis of cost savings from cooperation, the size and direction of financial transfers depend on the effort-sharing approach adopted, the specific model used, and the underlying assumptions. It is important to note that these financial transfers are *net* flows, which take into account the difference between inflows and outflows. The value of these flows is directly related to the size of the cost savings: a large flow (in either direction) is associated with a high level of cost savings to a particular region.

The analysis shows that, in general, developing regions are recipients of net financial inflows. However, for some regions or countries—such as East Asia[191], the Middle East and North Africa (MENA), and the former Soviet Union—the direction of financial transfers depends on the effort-sharing approach selected:

– Under the convergence per capita approach, East Asia would be transferring finance to other regions, as its per capita emissions are relatively high (currently larger than the EU), while under the equal costs per GDP scenario, East Asia would be a recipient of finance.
– Energy-exporting regions such as the MENA and the former Soviet Union would be transferring finance to other jurisdictions under the convergence per capita approach, as this approach involves high reduction targets for these countries. However, under the equal costs per GDP approach, these regions would be receiving international finance, as the relatively large impact of climate mitigation on fossil fuel trade reduces their GDP. As a consequence, this lowers their emission reduction targets.

Financial transfers need to take place even in a future where net global GHG emissions will be nil. It is expected that some countries will reach zero GHG emissions through the achievement of net negative emissions (or emission removal) by, for example, reforestation, or biomass with CO_2 Capture and Storage (bio-CCS), which balances other countries' positive emissions. Financial flows are therefore needed to facilitate cooperation between these two groups of countries to achieve the net zero emissions target.

In summary, the long-term, global costs of reaching the 2°C target can be reduced by cooperation between countries. The corollary of this result is that, for a given cost figure, countries can achieve larger emission reductions through cooperation than through domestic actions alone.

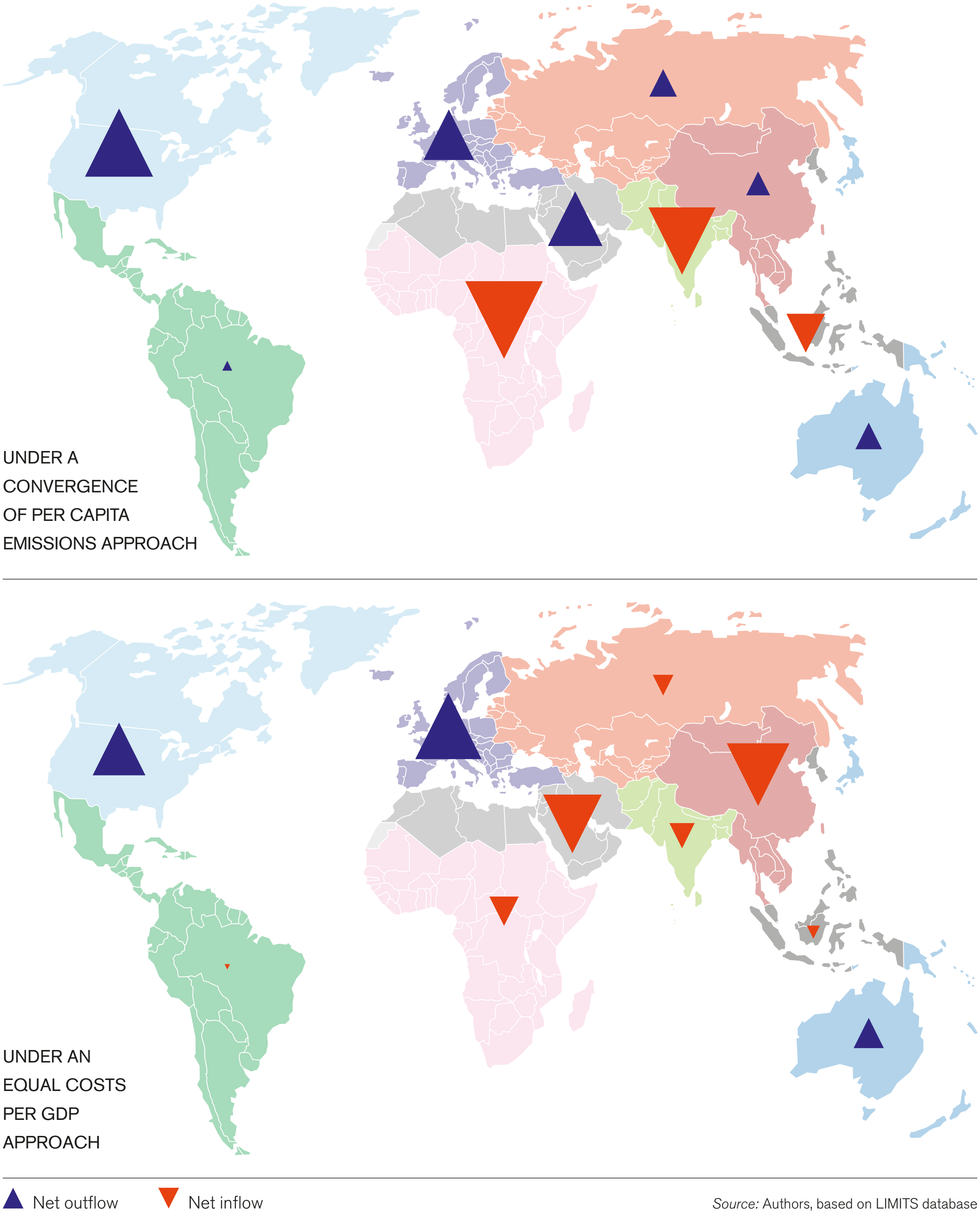
The large-scale international resource transfers will be beyond the level of public sector spending, and will need to be channeled through a blend of instruments. These include carbon pricing instruments such as ETSs, carbon taxes, offsets and a combination thereof and linkages between them, as well as innovative hybrid instruments, such as variations of results-based climate finance. Climate finance and carbon pricing instruments will be essential in leveraging these financial transfers and enabling cooperation to mitigate climate change.

189 The LIMITS project is one of the most complete studies to date of regional resource transfers. LIMITS compares six different models that, among other outcomes, evaluate financial transfers under various scenarios. Financial transfers are calculated as the volume of emission reductions transferred multiplied by a carbon price. For further details, see Massimo Tavoni, Elmar Kriegler, Keywan Riahi, Detlef P. van Vuuren, Tino Aboumahboub, Alex Bowen, Katherine Calvin, Emanuele Campiglio, Tom Kober, Jessica Jewell, Gunnar Luderer, Giacomo Marangoni, David McCollum, Mariësse van Sluisveld, Anne Zimmer, Bob van der Zwaan. (2015) "Post-2020 climate agreements in the major economies assessed in the light of global models". Nature Climate Change 119–126 (2015) and http://www.feem-project.net/limits/.

190 This scenario assumes a GHG concentration of 450 ppm CO_2e by 2100.

191 The exact definition of this region depends on the calculation model used. East Asia includes China, and may include, among other countries, Cambodia, Mongolia, North Korea and Vietnam. Source: Tavoni, M., Kriegler, E., Aboumahboub, T., Calvin, K., De Maere, G., Jewell, J., Kober, T., Lucas, P., Luderer, G., McCollum, D., Marangoni, G., Riahi, K., and van Vuuren, D., *Limits Special Issue on Durban Platform scenarios: The distribution of the major economies' effort in the Durban platform scenarios*, 2013.

Figure 16 Illustration of approximate regional financial flows required to achieve GHG mitigation in line with a 2°C target at global least costs by 2030



Source: Authors, based on LIMITS database

Note: Regional mitigation contributions are determined by either convergence of per capita emissions (top map) or equal costs per GDP (bottom map). The area of the triangles scales with absolute resource flows. The largest triangle (Sub-Saharan Africa in top map) depicts a value of US$95 billion and the smallest triangle (Latin America in bottom map) corresponds to a value of US$0.4 billion. Values are in 2005 US$ per year.

ANNEX I
CONVERSION RATES

Table 3 Currency conversion rates as of August 1, 2015

Currency	Symbol	US$ equivalent
British Pound	£	1.5574
Danish Krone	DKK	0.1470
Canadian Dollar	CAN$	0.7664
Chilean Peso	CLP	0.0015
Chinese Yuan	CNY	0.1635
Euro	€	1.0967
Icelandic Krona	ISK	0.0074
Japanese Yen	¥	0.0081
Kazakhstan Tenge	KZT	0.0053
Korean Won	KRW	0.0009
Mexican Peso	MXN	0.0622
New Zealand Dollar	NZD	0.6577
Norwegian Krone	NOK	0.1218
Polish Zloty	PLN	0.2637
South African Rand	R	0.0790
Swedish Krona	SEK	0.1159
Swiss Franc	CHF	1.0392

Source: International Monetary Fund, accessed August 6, 2015, https://www.imf.org/external/np/fin/data/param_rms_mth.aspx.

ANNEX II
INTEGRATED ASSISTANCE MEASURES TO MITIGATE THE RISK OF LEAKAGE

Table 4 Pros and cons of various leakage assistance measures

Leakage prevention measure	Administrative feasibility/cost	Leakage prevention	Incentives to reduce emissions	Demand-side efficiency incentives	Other issues
Free allocation: Grandfathering	Relatively easy to implement if historical emissions data are available	Relatively weak, relying on periodic updates of free allowances	Diluted by strategic gaming by firms	May be preserved	Risk of windfall profits and rent-seeking by firms
Free allocation: Fixed sector benchmarking	Relatively complex and risks being subject to lobbying, but this can be overcome	Relatively weak, relying on periodic updates of free allowances	Preserved by using firm-independent benchmarks	May be preserved	Low risk of rent-seeking by firms
Free allocation: Output-based allocations	Relatively complex and risks being subject to lobbying, but this can be overcome	Strong, due to the clear and explicit link between output and allocations, depending on which benchmarks have been set	Preserved by benchmarks, but lower predictability of overall environmental impact	None if applied too broadly	Low risk of rent-seeking by firms
Administrative exemptions	Easy to implement	Strong, but inefficient firms will be artificially shielded from competition from efficient ones	None	None	No risk of windfall profits
Rebates	Depends on the choice	Strong if rebates are linked to output (like output-based allocations), but weaker if rebates are in the form of lump-sum transfers	Strong if rebates are not linked to emission intensity	Stronger for lump-sum rebates than for those linked to output	
Border carbon adjustments (BCAs)	Very complex and administratively costly	Strong	Preserved and may also be extended to firms outside the direct scope of the policy	Yes	Significant political and possibly legal challenges; lower risk when introduced by a coalition with market power

Source: Vivid Economics: Technical note for the World Bank Partnership for Market Readiness 2015.

Free allowance allocations

The most common policy mechanism that policy makers have used to address leakage to date is the provision of free allowances under ETSs.[192] This reduces the financial cost of emissions for firms and is thus expected to reduce the risk of leakage. Free allowances can be allocated in many different ways, but the following two questions best characterize design efforts so far:

– Does the amount of free allowances vary with the output of the individual firm?
– Is the amount of free allowances linked to the emissions of the individual firm?

Combining the two questions offers four conceptually distinct approaches to assistance (Table 5).

Table 5 Free allocation approaches and their relationship to a firm's output and emission intensity

		Does allocation vary in proportion to a firm's output?	
		Yes: Output-Based Allocation	**No: Fixed allocation based on a firm's historical output with periodic updating**
Is allocation linked to the emissions of individual firms?	**Yes, allocation is directly proportional to a firm's emission intensity**	This would effectively eliminate carbon price.[193] To date, this approach has not been adopted.	*Grandfathering:* Allocations are directly linked to a firm's historical emissions. Examples include the EU ETS Phases I and II, the Republic of Korea's ETS (for all but three sectors), Kazakhstan's ETS Phases I and II, and most sectors in the pilot ETSs of Beijing, Chongqing, Guangdong, Hubei, Shanghai and Tianjin.
	No, allocation is benchmarked to the emission intensity of the sector in question	*Output-Based Allocation:* Allocations are proportional to sector-wide product benchmarks and a firm's current output levels. Examples of its implementation include the California Cap-and-Trade Program, New Zealand's ETS, Australia's former carbon pricing mechanism (CPM), the Republic of Korea's ETS (in three sectors), and the Shenzhen ETS.	*Fixed sector benchmarks:* Allocations are proportional to sector-wide product benchmarks and firm-specific, historical activity levels. Output adjustments take place between phases. An example of its implementation is Phase III of the EU ETS.

Source: Authors, based on Vivid Economics: Technical note for the World Bank Partnership for Market Readiness 2015.

Note: Some schemes use grandfathering for the majority of their allocations but adopt benchmarking approaches for new entrants or capacity expansions. These schemes are categorized as grandfathering for simplicity. The Shanghai ETS pilot involves a hybrid approach that combining combines some elements of grandfathering and benchmarking, and so thus is not included in this typology.

192 Economic impacts similar to those of free allowances under a cap-and-trade scheme can be achieved by transferable tax exemptions under a carbon tax. For example, carbon tax equivalents of free allowance allocations have been described in Pezzey (1992) and Pezzey & Jotzo (2012). Source: John C. V. Pezzey, "The Symmetry between Controlling Pollution by Price and Controlling It by Quantity," *The Canadian Journal of Economics* Vol 24, Issue 4 (1992): 983-991; John C. V. Pezzey and Frank Jotzo, "Tax-versus-trading and efficient revenue recycling as issues for greenhouse gas abatement," *Journal of Environmental Economics and Management* Vol 64, Issue 2 (2012): 230–236.

193 If a firm were allocated allowances on the basis of both its actual output and actual emission intensity, the volume of allowances granted would move in direct proportion to its carbon cost, and therefore the firm would effectively be exempted from some or all of the carbon cost.

Some countries provide different types of free allowance allocation for different sectors. Under the Republic of Korea's ETS, the majority of sectors receive free allowances through a grandfathering approach in the first phase. However, the clinker, refineries, and aviation sectors have obtained assistance through output-based allocation. This reflects the perceived relative ease of creating benchmarks in these three sectors. Policy makers have expressed a desire to shift increasingly toward the use of benchmarks in future phases. These different leakage risk mitigation measures are discussed in turn below, skipping free allocations that vary both with output and emission intensity, as this would effectively cancel the impact of carbon pricing.

Grandfathering

Under a grandfathering approach, firms receive free allowances directly related to their historical emissions, and the amount does not automatically change with their future output. This ensures that incentives to reduce emissions are retained because even allowances received free of charge have a market value that can be cashed out through abatement investments. This feature, combined with administrative simplicity, has made grandfathering a popular method of providing assistance in the initial stages of many carbon pricing schemes. Prominent examples include the first two phases of the EU ETS, the first phase of the Republic of Korea's ETS (for most sectors), Kazakhstan's ETS, and various Chinese ETS pilots.

Existing grandfathering schemes periodically adjust free allocations to the changes in production levels. Free allowances are usually also canceled if firms do not maintain a minimum level of production. This normally takes place every three to seven years, as under the EU ETS and the Republic of Korea's ETS, as well as under the various Chinese pilot ETSs. These adjustments weaken some of the incentives that grandfathering can provide to reduce output and can even shut down emissions-intensive facilities if the sale of unused allowances generates a higher profit than maintaining production. Another reason for reducing allowances with output is to prevent windfall profits. In particular, in Phase II of the EU ETS, unexposed firms, especially energy utilities, passed on the cost of their allowances to their customers, even though they did had not even had to pay for them. Furthermore, such adjustments, if not managed properly, create a temptation for "rent-seeking" by firms. When firms expect that updates to the volumes of allowances will be linked to the level of their emissions-intensive activities, they tend to increase their current emissions-intensive output to receive more free allowances for the next period.[194] These rent-seeking incentives disappear when firms expect that grandfathering will be replaced by an allocation scheme in which the volume of free allowances cannot be "gamed" so easily by individual firms.

194 Frédéric Branger et al., *EU ETS, Free Allocations and Activity Level Thresholds, the Devil Lies in the Details* (Centre for Clima te Change Economics and Policy Working Paper No. 190, Grantham Research Institute on Climate Change and the Environment Working Paper No. 169, October 2014).

Fixed Sector Benchmarking (FSB)

Like grandfathering, this approach breaks the link between the emission intensity of an individual firm and the allowances this firm receives. However, in contrast to grandfathering, the level of assistance is determined not by reference to the current or historical emissions (intensity) of each individual firm, but by reference to a product-specific benchmark of emission intensity of the whole sector.

This is the approach adopted in Phase III of the EU ETS. The benchmark for free allowances is based on industry emissions performance, so that only the top 10 percent performers receive free allowances to, in principle, cover 100 percent of their emissions. Other firms receive the same volume of free allowances as the best performers, but have to purchase additional allowances at the market price to cover their actual emissions.[195] It provides an ongoing incentive for firms to outperform others in their sector in terms of emission efficiency. Benchmarks are also periodically updated, but opportunities for strategic gaming that increases emissions and windfall gains by individual firms are much weaker because the benchmark is derived from the performance of several firms.

Output-Based Allocation (OBA)

OBA is similar to the benchmarking scheme, except that the changes in a firm's output (upwards or downwards) lead to rapid, almost automatic, changes in allowance allocations. Variants on this basic model are used for providing assistance to firms in California, New Zealand, some sectors in Korea, and in Shenzhen.

OBAs preserve the incentives to reduce emission intensity, as do the other free allocation approaches, and give a competitive edge to emissions-efficient firms. More importantly, OBA offers stronger leakage protection than FSB and grandfathering. Under OBA, an increase of production by an extra unit will directly result in additional free emission allowances. The level at which a benchmark is set affects the level of protection against leakage. A stringent benchmark will offer weaker leakage protection, as most firms will have an emission intensity that is worse than the benchmark and, hence, will have to purchase many extra allowances to produce an extra unit of output. Conversely, a higher benchmark will better protect against leakage but could have a negative effect on the environmental outcome. The benchmarks are also often tightened over time.

The key downside of OBA is that it could make the total environmental outcome of a carbon pricing scheme less certain, because the overall emissions cap can increase with the output of the industry. Without careful design, the environmental integrity of an emissions pricing scheme with OBA may be compromised.

195 European Commission - Climate Action, *Free Allocation Based on Benchmarks*, accessed August 10, 2015, http://ec.europa.eu/clima/policies/ets/cap/allocation/index_en.htm.

Exemptions

The design of carbon pricing schemes may include exempting some emissions (for example, by implementing carbon tax–free thresholds), exempting some sectors/firms from the scheme (for example, the Swedish carbon tax[196]), or setting reduced rates for them. Sometimes these exemptions are driven by practical difficulties, political sensitivities, or the high transaction costs of covering certain sectors. For example, small and dispersed emitters in transport, agriculture, forestry, and municipal waste are often exempt from an ETS. However, sometimes these exemptions are also motivated by concerns about leakage.

While exemptions are effective in addressing leakage and administratively easy to implement, they fundamentally undermine the abatement incentives of carbon pricing. Reducing the effective carbon price means that abatement incentives are reduced as well. Exemptions, like grandfathering, may be useful when establishing a carbon pricing regime for the first time but should be accompanied by a credible plan for their eventual replacement with more targeted assistance. This thinking underpins the proposed South African carbon tax.

Rebates

Sometimes policymakers aim to reduce the leakage risks associated with carbon prices by reducing other taxes paid by the exposed industry, or providing other subsidies to industry, often of an equivalent amount. This is an approach most commonly adopted in countries pursuing a carbon tax. Often, rebates are funded by recycling a portion of the emissions tax revenue. Tax rebates preserve an incentive for firms to reduce their emission intensity, provided the rebates are not in proportion to emissions. They favor less emissions-intensive firms, without reducing the overall tax liability faced by the industry, although they may slow down the structural transformation marked by shifts in the shares of emissions-intensive and cleaner firms in the industry in question. Output-based rebates, such as in the case of the Swedish Nitrogen Oxide charge, have very similar properties to OBA and provide strong leakage protection, without compromising environmental integrity (OECD, 2013c).[197] Alternatively, lump-sum rebates resemble grandfathering and FSB approaches.

Border Carbon Adjustments (BCAs)

BCAs involve imposing an emission cost at the border on importers of carbon-intensive goods and/or providing a rebate to firms exporting to third countries, unless those countries have an equivalent carbon pricing regime. BCAs can be introduced either as a border tax or, under an ETS, by requiring importers to surrender allowances for the GHG emissions associated with producing the imported goods or resources. The fundamental difference between BCAs and standard free allowance approaches is the effective extension of the carbon pricing regime to entities outside the implementing jurisdiction. This, in turn, dramatically changes the economic, environmental, and political effects of such a policy.

196 Over the years, carbon tax exemptions have increased for installations under the EU ETS, with the most recent increase in exemption starting from 2014 for district heating plants participating in the EU ETS.
197 The coverage has subsequently been expanded to all plants producing more than 25MWh of useful energy. Source: OECD, 2013.

BCAs have been widely modeled and discussed, but not often implemented. Article 10B.1 of the EU ETS Directive opens the possibility of applying BCA in the EU. Bearing some resemblance to a BCA, the emissions associated with imported electricity have to comply with the California Cap-and-Trade Program in the same way as emissions from electricity generated in California. In another example more broadly on border tax adjustments, the United States imposed a tax on imports whose production relied on ozone-depleting chemicals but also provided a tax rebate to manufacturers or exporters of those very same products.[198]

The modeling of BCAs generally suggests that BCAs would be effective in reducing leakage. However, the administrative difficulties associated with border adjustments may be substantial.[199] Accounting for emissions embodied in the products and services imported from different places can be complex,[200] although some say it is "administrable."[201] Considerable administrative challenges can arise from the fact that the legislator introducing BCAs has no jurisdictional reach to assure accurate measurement of emissions in third party companies, while practical experience has shown that accurate monitoring, reporting and third party verification of emissions is absolutely crucial for a well-functioning carbon market. BCAs may be easier to introduce in sectors with relatively homogenous products, such as cement.[202] An alternative, simpler approach has been proposed: to impose a blanket tariff on all goods imported from non-participating countries without linking these tariffs to embedded emissions, to encourage third countries to join the "climate policy club."[203]

Legal considerations will influence any design but many commentators suggest these considerations will not represent an insuperable barrier. World Trade Organization requirements might possibly be met if BCAs demonstrate their effectiveness at reducing emissions rather than at addressing carbon leakage.[204]

Yet the political challenges may be as great, or greater, than any legal constraints, as demonstrated by the experience of the EU in seeking to establish a regime that bore some resemblance to a BCA in the civil aviation sector. Trade disputes can spill over to many areas of international relations, making BCA a very expensive policy for the affected parties. Some experts suggest that the larger the market power of a coalition of countries applying border adjustments, the more feasible the BCA will be.

198 J. Andrew Hoerner, *The Role of Border Tax Adjustments in Environmental Taxation: Theory and U.S. Experience*, Working Paper, March 19, 1988.
199 IFPRI, "Biofuels, Environment, and Food: The Story Gets More Complicated," in *2011 Global Food Policy Report*, 2012; Madison Condon and Ada Ignaciuk, *Border Carbon Adjustment and International Trade: A Literature Review*, OECD Trade and Environment Working Papers, October 31, 2013; WTO, *European Union and Certain Member States – Certain Measures on the Importation and Marketing of Biodiesel and Measures Supporting the Biodiesel Industry: Request for Consultations by Argentina, WT/DS459/1, G/L/1027, G/SCM/D97/1,G/TRIMS/D/36, and G/TBT/D/44*, 2013; Persson, 2010.
200 IISD, *A Guide for the Concerned: Guidance on the Elaboration and Implementation of Border Carbon Adjustment*, November 21, 2012.
201 Bruce F. Davie, *Border Adjustments for Environmental Excise Taxes: The U.S. Experience*, January 8, 1995; J. Andrew Hoerner, *The Role of Border Tax Adjustments in Environmental Taxation: Theory and U.S. Experience*.
202 Dieter Helm, Cameron Hepburn, and Giovanni Ruta, "Trade, Climate Change, and the Political Game Theory of Border Carbon Adjustments," *Oxford Review of Economic Policy* Vol 28, Issue 2 (2012): 368–394.
203 Nordhaus, W., "Climate Clubs: Overcoming Free-riding in International Climate Policy", American Economic Review, 105(4): 1339–1370, 2015.
204 Stéphanie Monjon and Philippe Quirion, "A Border Adjustment for the EU ETS: Reconciling WTO Rules and Capacity to Tackle Carbon Leakage," *Climate Policy* Vol 11, Issue 5 (September 2011): 1212–1225.

GLOSSARY

Annex I (Parties)
The industrialized countries listed in Annex I to the UNFCCC were committed to return their GHG emissions to 1990 levels by 2000. They currently include Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Monaco, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, the Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, the United Kingdom, and the United States, as well as the European Union.

Assigned Amount Unit (AAU)
Annex I Parties are issued AAUs up to the level of their assigned amount, corresponding to the quantity of GHG they can release in accordance with the Kyoto Protocol (Article 3), during the first commitment period of that protocol (2008–12). One AAU represents the right to emit one metric ton of carbon dioxide equivalent.

Backloading
The European Commission's temporary postponement of the auctioning of 900 million allowances from 2014–16 to 2019–20 by changing the auctioning timeline to rebalance supply and demand of emission allowances in the EU ETS in the short term.

Banking or Carry over
Compliance units under the various schemes to manage GHG emissions in existence may or may not be carried over from one commitment period to the next. Banking may encourage early action by mandated entities, depending on their current situation and their anticipation of future carbon constraints. In addition, banking brings market continuity. Banking between Phase I and Phase II of the EU ETS is not allowed; it is allowed between Phase II and further phases. Some restrictions on the amount of units that can be carried over may apply; for instance, EUAs may be banked with no restriction, while the amount of CERs that can be carried over by a Kyoto Party is limited to 2.5% of the assigned amount of each Party.

Baseline
The emission of GHG that would occur without the policy intervention or project activity under consideration.

Benchmarking
Benchmarking is used to compare the operations of one company with those of others, with the industry average, or with best practice, to determine whether they have opportunities to improve energy efficiency or reduce GHG emissions. In the EU ETS, for example, free allocation is carried out on the basis of ambitious benchmarks of GHG emissions performance. These benchmarks reward best practice in low-emission production.

Cap-and-Trade
Cap-and-trade schemes set a desired maximum ceiling for emissions (or cap) and let the market determine the price for keeping emissions within that cap. To comply with their emission targets at least cost, regulated entities can either opt for internal abatement measures or acquire allowances or emission reductions in the carbon market, depending on the relative costs of these options.

Carbon Dioxide Equivalent (CO_2e)
The universal unit of measurement used to indicate the global warming potential of each of the six GHGs regulated under the Kyoto Protocol. Carbon dioxide—a naturally occurring gas that is a by-product of burning fossil fuels and biomass, land use changes, and other industrial processes—is the reference gas against which the other GHG are measured, using their global warming potential.

Carbon Finance
Resources provided to activities generating (or expected to generate) GHG emission reductions through the transaction of such emission reductions.

Carbon Leakage
Shift in CO_2 emissions from countries taking stringent actions to countries taking less stringent mitigation actions.

Carbon tax
A tax that explicitly states a price on carbon or that uses a metric directly based on carbon (that is, price per tCO_2e).

Cost Containment Reserve (CCR)
A pool of CO_2 allowances, established by the RGGI states and replenished at the start of each calendar year, which creates a fixed, additional supply of CO_2 allowances that are only available for sale if CO_2 allowance prices exceed certain prices levels.

Certified Emission Reduction (CER)
A unit of GHG emission reductions issued pursuant to the Clean Development Mechanism of the Kyoto Protocol and measured in metric tons of carbon dioxide equivalent. One CER represents a reduction in GHG emissions of one metric ton of carbon dioxide equivalent.

Chinese Certified Emission Reduction (CCER)
The NDRC issued rules to regulate the voluntary emission reduction credits market in China, in the form of CCERs, in June 2012. These will be issued in units of tCO_2e, and will include CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6.

Clean Development Mechanism (CDM)	The mechanism provided by Article 12 of the Kyoto Protocol, designed to assist developing countries in achieving sustainable development by allowing entities from Annex I Parties to participate in low-carbon projects and obtain CERs in return.
Conference of the Parties (COP)	The supreme body of the UNFCCC. It currently meets once a year to review the UNFCCC's progress. The word „conference" is not used here in the sense of „meeting" but rather of „association," which explains the seemingly redundant expression „fourth session of the Conference of the Parties."
Conference of the Parties Serving as the Meeting of the Parties (CMP)	The UNFCCC's supreme body is the COP, which serves as the meeting of the Parties to the Kyoto Protocol. The sessions of the COP and the CMP are held during the same period to reduce costs and improve coordination between the UNFCCC and the Kyoto Protocol.
Emission Reduction	The measurable reduction of release of GHG into the atmosphere from a specified activity, and a specified period.
Emission Reduction Unit (ERU)	A unit of emission reductions issued pursuant to Joint Implementation. One ERU represents the right to emit one metric ton of carbon dioxide equivalent.
Emissions Trading Scheme (ETS)	Emissions Trading Scheme (ETS): See cap-and-trade.
European Union Allowance (EUA)	The allowances in use under the EU ETS. An EUA unit is equal to one metric ton of carbon dioxide equivalent.
First Commitment Period under the Kyoto Protocol (CP1)	The 5-year period, from 2008 to 2012, during which industrialized countries committed to collectively reduce their GHG emissions by an average of 5.2% compared with 1990 emissions under the Kyoto Protocol.
Framework for Various Approaches (FVA)	Defined at COP 17 in Durban, general framework at the UNFCCC level that allows various approaches—including opportunities for using markets to enhance the cost effectiveness of mitigation actions and promote their use, bearing in mind the different circumstances of developed and developing countries—which must meet standards that deliver real, permanent, additional and verified mitigation outcomes, avoid double counting of effort, and achieve a net decrease and/or avoidance of GHG emissions.
Greenhouse Gas (GHG)	Both natural and anthropogenic, GHGs trap heat in the Earth's atmosphere, causing the greenhouse effect. Water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary GHGs. The emission of GHGs through human activities (such as fossil fuel combustion and deforestation) and their accumulation in the atmosphere are responsible for an additional forcing, contributing to climate change.

Intended Nationally Determined Contribution (INDC)	Sets the climate actions (mitigation and adaptation) that a country intends to take under the new international agreement to be negotiated under the UNFCCC in Paris in December 2015.
Internal carbon price	A price on GHG emissions that a company uses internally to guide its business decisions.
Joint Implementation (JI)	Mechanism provided by Article 6 of the Kyoto Protocol whereby entities from Annex I Parties may participate in low-carbon projects hosted in Annex I countries and obtain Emission Reduction Units (ERUs) in return.
Kyoto GHGs	The Kyoto Protocol regulates six GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).
Kyoto Mechanisms	The three so-called flexibility mechanisms that may be used by Annex I Parties to the Kyoto Protocol to fulfill their commitments. These are Joint Implementation (JI, Article 6), the Clean Development Mechanism (CDM, Article 12), and International Emissions Trading (Article 17).
Kyoto Protocol	Protocol that commits industrialized country signatories to collectively reduce their GHG emissions by at least 5.2% below 1990 levels on average over 2008–12 while developing countries can take no-regret actions and participate voluntarily in emission reductions and removal activities through the CDM. It was adopted at the third Conference of the Parties to the UNFCCC held in Kyoto, Japan, in December 1997, and entered into force in February 2005.
Nationally Appropriate Mitigation Action (NAMA)	Refers to a set of mitigation policies and/or actions a developing country undertakes aimed at reducing its GHG emissions and on which countries report to UNFCCC on a voluntary basis. NAMAs were defined in 2007 under the UNFCCC Bali Action Plan as "Nationally Appropriate Mitigation Actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity building, in a measurable, reportable and verifiable manner."
New Market-based Mechanism (NMM)	New market-based mechanism to promote mitigation actions and enhance their cost effectiveness, bearing in mind different circumstances of developed and developing countries (as guided by decision 1/CP.18, paragraph 51); operating under the guidance and authority of the COP; defined at COP 17 in Durban. It may help developed countries meet part of their mitigation targets under the UNFCCC but should consider the principle of supplementarity.
Offset	Designates the emission reductions from project-based activities that can be used to meet compliance or corporate citizenship objectives vis-à-vis GHG mitigation.

Primary Transaction A transaction between the original owner (or issuer) of the carbon asset and a buyer.

REDD Plus (REDD+) All activities that reduce emissions from deforestation and forest degradation and contribute to conservation, sustainable management of forests, and enhancement of forest carbon stocks.

Registration The formal acceptance by the CDM Executive Board of a validated project as a CDM project activity.

Results-Based Finance (RBF) Funding approach where payments are made only after predefined outputs or outcomes, such as emission reductions, have been delivered and verified.

Second Commitment Period under the Kyoto Protocol (CP2) The 8-year period, from 2013 through 2020, in which Annex I Parties to the Kyoto Protocol committed to reduce GHG emissions by at least 18% below 1990 levels. The composition of Parties in the second commitment period is different from that in the first.

Secondary Transaction A transaction where the seller is not the original owner (or issuer) of the carbon asset.

Supplementarity Following the Marrakesh Accords, the use of the Kyoto mechanisms shall be supplemental to domestic action, which shall thus constitute a significant element of the effort made by each Party to meet its commitment under the Kyoto Protocol. There is no quantitative limit, however, to the use of such mechanisms. Supplementarity also needs to be considered in the development of modalities and procedures for the UNFCCC NMM (Draft decision -/CP.18, para 51, February 28, 2013).

Union Registry An online database that holds accounts for stationary installations that have been transferred from national registries, as well as accounts for aircraft operators, which have been included in the EU ETS since January 2012. The Union registry replaces EU member states' national registries.

United Nations Framework Convention on Climate Change (UNFCCC) The international legal framework adopted in June 1992 at the Rio Earth Summit to address climate change. It commits the Parties to the UNFCCC to stabilize human-induced GHG emissions at levels that would prevent dangerous, man-made interference with the climate system, following "common but differentiated responsibilities" based on "respective capabilities."

Validation The process of independent evaluation of a project activity by a Designated Operational Entity (DOE) against the requirements of the CDM. The CDM requirements include the CDM modalities and procedures, subsequent decisions by the CMP, and documents released by the CDM Executive Board.

Verification — The review and *ex-post* determination by an independent third party of the monitored reductions in emissions generated by a registered CDM project or a determined JI project (or a project approved under another standard) during the verification period.

Verified Emission Reduction (VER) — A unit of GHG emission reductions that has been verified by an independent auditor. Most often, this designates emission reduction units that are traded on the voluntary market.

Voluntary Carbon Market — The market that caters to the needs of those entities that voluntarily decide to reduce their carbon footprint using offsets. The regulatory vacuum in some countries and the anticipation of imminent legislation on GHG emissions also motivates some pre-compliance activity.

Notes

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