

Keeping it cool

Moving towards global carbon pricing

We think the world will scale up existing fragmented carbon pricing systems as efforts to reduce greenhouse gases gain momentum

This is likely to mean more carbon taxes and emissions trading schemes, as well as the removal of energy subsidies

Managing the transition will pose challenges for governments, industry and investors.

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Disclosures and Disclaimer This report must be read with the disclosures and analyst certifications in the Disclosure appendix, and with the Disclaimer, which forms part of it

Summary

- ▶ The aim behind carbon pricing is to assign a specific cost to greenhouse gas emissions as a way to reduce them
- ▶ Momentum for a global price is building with support coming from investors and companies affected by taxes and trading schemes
- ▶ Companies and investors feel frustrated by the current piecemeal approach and would like to see more policy certainty

Carbon pricing is happening now

A global carbon price - one that assigns a specific value to greenhouse gas emissions - has long been hailed as the panacea to confront global climate change. In theory, pricing CO₂ means less will be emitted, keeping temperatures down. Carbon pricing implies putting a cost on CO₂ emitted, or, in other words, putting a value on *avoiding* the addition of greenhouse gas (GHG) emissions to the atmosphere from man-made (anthropogenic) sources.

Economic tools – taxes and ‘cap and trade’ schemes – have provided a starting framework for pricing, but politics, industry lobbying, and trading scheme design faults have so far hindered widespread implementation. Now, this is changing because companies that are exposed to the existing piecemeal pricing and lack of competitiveness it can bring are looking for a more level playing field globally. Clearer policy signals would help. With the Paris talks looming, more impetus for a global carbon price is emerging from politicians, investors, climate advocacy groups, and industry. In this report, we look at how carbon is taxed, how trading works, fossil fuel subsidies and potential winners and losers.

Pricing carbon is a sensitive issue since its purpose is to change behaviour so that GHG emissions are reduced. Pricing should change the economics of high-carbon activities such that they become less competitive with low-carbon ones. The difficulty is that, on the surface, high-carbon activities are embedded into our energy and economic systems, and provide tax revenues and employment. If carbon pricing were a zero sum game, it would already have been implemented. A deeper analysis reveals that energy subsidies actually support high-carbon, which artificially makes high-carbon more profitable, in our view. Removing subsidies would provide a more even playing field and, we believe, would make lower-carbon activities more competitive.

In our view, it is in everyone’s best interests (investors, policy makers, corporates, and civil society) if the transition to a low-carbon economy is delivered as smoothly and as quickly as possible. We expect economics (such as improving profitability for clean energy) as well as policy to move in favour of a low-carbon world.

We think entities that resist change could fall by the wayside, but we also believe that existing high-carbon entities can manage an orderly transition to low-carbon by providing clear disclosure on future investment plans (to enable shareholders to make up their own minds on company alignment with a 2°C world and allocate capital accordingly). There is no escaping the point that damaging the profitability of high-carbon activity would result in some losers, but for long-term investors the aim is to ascertain which companies will be thriving in five, ten, and twenty years.

Support for a carbon price

According to the September 2014 CDP report, ‘Global corporate use of carbon pricing’, at least 150 companies use an internal price on carbon. At the June climate talks, oil and gas companies from Europe presented an open letter advocating a global carbon price, asking to be more involved in the setting up of such a scheme. Companies and investors want the policy certainty that a carbon price signal provides. We are expecting more widespread carbon pricing in the future, which builds on existing frameworks. Importantly from a climate perspective, existing carbon reduction policy efforts are not delivering the reductions required to be consistent with keeping temperatures to within agreed limits. The global consensus is to prevent temperatures from rising more than 2°C since 1880 but temperatures have risen 0.85°C since then and 2015 is increasingly looking like breaking new records according to NOAA. (National Oceanic and Atmospheric Administration).

Expectations for Paris

Whilst we expect ‘noise’ around carbon pricing in Paris, we do not expect the launch of a global carbon price because it is not central to the negotiating text, but it would be a positive surprise. Instead, discussions around market mechanisms have been an ongoing feature as a means to implement country the greenhouse gas reduction aims that are being put forward for the universal climate agreement.

Climate change is a global problem. This means that even though a country might decide not to implement GHG reducing policies at a *domestic* level (for instance because it is politically unpalatable because of job losses), this does not mean that its economy would be immune from the climate efforts that *other* countries are making. For instance, a coal rich exporting country can choose to keep producing coal, but if there are no buyers because global demand is no longer there, revenues will decline. Global economic interconnectedness also means global climate interconnectedness.

Today, a variety of carbon pricing mechanisms (taxes and trading) are already operational around the world. There are various ways to price carbon, depending on the timeframe (current vs future) and methodology. A market mechanism approach to deriving a price will give a different value from the ‘social cost of carbon’ methodology. Market prices operate as a function of **current** demand and supply (in this case of CO₂), whereas the ‘social cost of carbon’ is based on a variety of assumptions about the **future** cost of impacts. In addition a carbon tax can be applied by setting the value at an arbitrary level – e.g. USD10 per tonne. As more businesses demand carbon pricing, and as schemes begin to inter-connect, we believe it is just a matter of time before pricing carbon becomes the norm. For example, China, the world’s largest emitter, already has pilot trading schemes in place and is looking to begin a national trading scheme starting next year as well as discussing the possibility of a carbon tax in the future. Also, California is linking up its trading scheme with Quebec’s – as more schemes collaborate, we envisage a convergence on the value of carbon, towards an effective global price.

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21 *We would like to acknowledge the contribution from Abhishek Kumar to this research report. Mr. Kumar is employed by a non-US affiliate of HSBC Securities (USA) Inc., and not registered/qualified pursuant to FINRA regulations.*

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Why price CO₂?

- ▶ In an ideal world, a global CO₂ price would be set at levels that accurately reflect the future costs from climate change
- ▶ Higher CO₂ prices would make carbon-intensive activities less profitable – economics would change in favour of lower-carbon
- ▶ We expect a global carbon pricing framework in the future, but not directly from the UN climate summit this December in Paris

The externality conundrum

Greenhouse gas (GHG) emissions are a global, economy-wide factor, but they are *externalities* in the sense that the most severe consequences of higher global land-ocean temperatures caused by GHGs often do not match the source or location of the emitter. In principle, a global consensus, convened under the UN Framework Convention on Climate Change (UNFCCC), aims to stabilise man-made GHGs at levels which keep temperature rises under control, (see [Keeping it cool – Financing a 2°C world](#), September 2014). In practice, a range of realities such as economic status, domestic politics, international geo-political threats, and country endowment of high-carbon natural resources, complicate matters. Climate talks this year, known as COP 21, will take place in Paris in December to negotiate a universal climate agreement (UCA), which will set out country targets for reducing GHG emissions after 2020. The means to deliver the aims, for instance, which sectors and industries will provide the cuts, are set out in the intended nationally determined contributions (INDC) submitted by countries.

Pricing to solve the climate problem

Pricing CO₂ would be a step in the right direction for solving climate change, in our view, since it would change the economics of lower-carbon versus higher carbon activities. Currently, higher-carbon activities tend to be more profitable – on the surface at least, since in many countries, energy produced from coal and gas is cheaper than renewables. Carbon pricing is not breaking news though. Working groups have been looking at how to price carbon through market mechanisms within the UNFCCC since its inception in 1992, and the first assessment report from the ‘Intergovernmental Panel on Climate Change’ (IPCC) talked about pricing environmental externalities in 1990, in the report ‘The IPCC Response Strategies’.

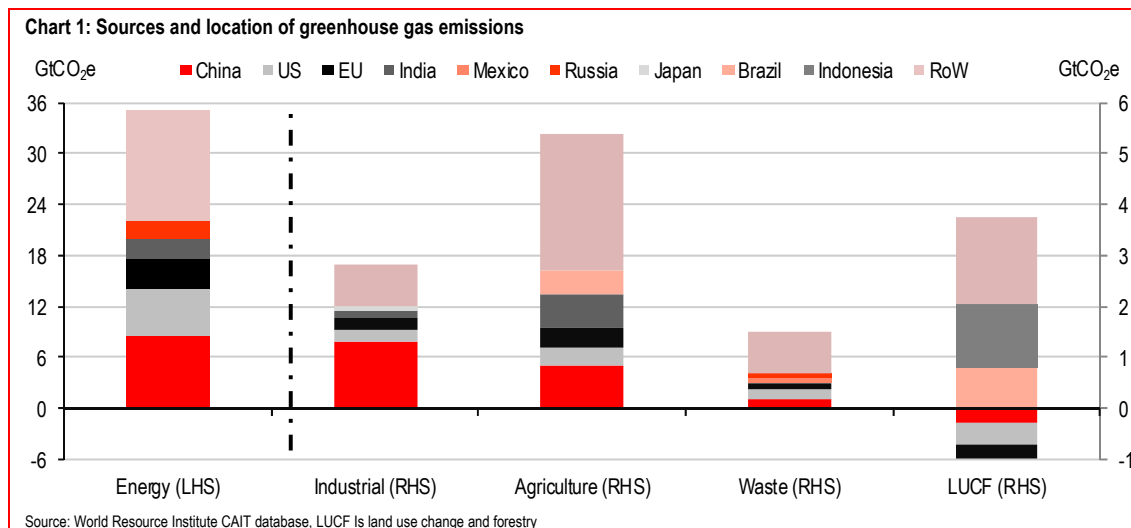
Increased urgency

Twenty five years on and the launch of a global carbon price would be a positive outcome from the Paris talks in December, but it would also be a surprise. We do not expect such a launch because of the difficulties of deriving the ‘right price’ for carbon, which we set out in this report. Nonetheless, we are expecting more widespread carbon pricing in the future, which builds on existing mechanisms because of

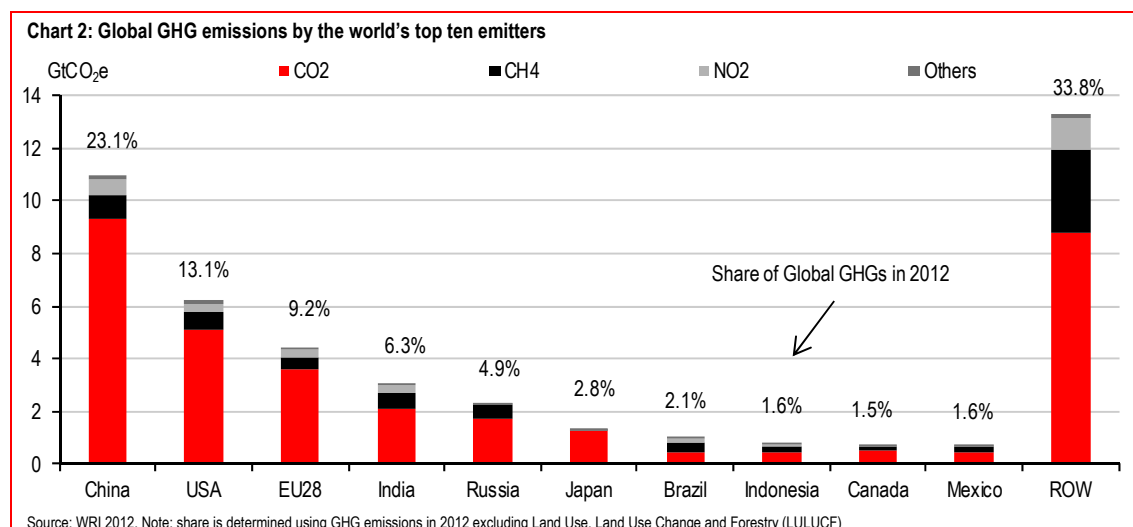
a more urgent focus on halting emissions, with countries setting out GHG reduction targets as part of the input for Paris. In addition, we think a greater focus from industry on enabling a more level playing field is positive for the take-up of carbon pricing. The urgency is driven by increased scientific evidence of the consequences of warmer temperatures as set out in the Fifth Assessment on climate change from the IPCC in 2013-14. In this chapter, we look at why carbon pricing is important and why it has been difficult to implement so far.

Emissions are generated locally....

Pinpointing the source and location of emissions is relatively easy. Over time, as shareholders and investor groups have demanded more disclosure on company-level CO₂ emissions, accounting systems for GHG reporting have been developed to help measure emissions. The 'Greenhouse Gas Protocol', set up by the World Resource Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), is the mostly widely-known accounting system, in our view. The Protocol provides granularity on how to measure different gases across sectors. In addition, wealthy countries that adopted the Kyoto Protocol in 1997 (known as Annex 1 countries, which include industrialised countries that were members of the OECD in 1992 and the economies in transition, including Russia, the Baltic States and Central and East European States) have submitted GHG inventories annually to the UNFCCC since 2003. In theory, this enables policymakers to establish the location and source (e.g. from which industry) of emissions, and potentially allocate a price accordingly. The composition of global GHG's from different sources in 2012 (the most recent data point) is set out in Chart 1 below.



Solving climate change, i.e. minimising how much the climate actually changes, involves lowering the atmospheric concentration of GHGs, which in turn means reducing the amount of GHGs emitted from man-made activities. Currently, around 46.8 GtCO₂e is emitted each year, with 35GtCO₂e from energy. The top ten largest country emitters are shown in Chart 2.



.....but the impacts reverberate globally

In many cases, the most detrimental consequences of warmer temperatures do not occur in the same countries that are the highest emitters. While all regions will feel the effects of a changing climate to some degree (Table 1), poorer countries with large and fast growing populations, which are more reliant on agriculture for livelihoods, tend to be most at risk. Evidence of this was brought to the fore in the second part of the Fifth Assessment Report (AR5) by the IPCC, Impacts and Vulnerabilities, part of the AR5 trilogy published through 2013-2014. It noted “in recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans” (see [IPCC: Impacts, Vulnerability and Adaptation](#), 31 March 2014). Among the top ten emitters, India, Brazil, and Indonesia are likely to be most impacted by warmer temperatures, since the share of agriculture in GDP is highest at 17.0%, 13.7% and 5.6% for these countries.

The location of adverse climate impacts matters because the effects have wider ramifications for the global economy, particularly when agricultural commodities are involved. For instance, if a country exports to the global wheat market, and higher-than-average temperatures during the growing season deplete the crop, then this could create a shortage that would push up prices, in turn contributing to wider inflationary pressures. A case in point is the California drought which began in 2012. According to the US Bureau of Economic Analysis, agriculture contributed USD37.3bn, or 2% to state GDP in 2013. To put this into context utilities contributed 1%, construction 3%, manufacturing 11% and finance and services 34% to regional GDP. Californian agriculture represented 17% of total US agricultural output in 2013, with export revenues falling 25% from US\$18.1bn in 2012 to US\$13.7bn in 2013. A recent scientific paper by Williams et al., published in *Geophysical Research Letters* (Contribution of anthropogenic warming to California drought during 2012–2014) found that between 8–27% of California’s drought conditions between 2012 to 2014 can be attributed to climate change. Similarly, for a country highly dependent on hydro power such as Brazil, a sustained drought can result in energy rationing, which impacts industrial activity.

Table 1: Impacts of climate change

Risk	Confidence level	Climate drivers
Africa		
Water: Drought stress exacerbated in drought-prone regions	High	Warming trend, drying trend, extreme temperature, sea level
Food: Reduced crop productivity associated with heat and drought stress; increased pest and disease damage and flood impacts on food system infrastructure	High	Warming trend, drying trend, extreme temperature, extreme precipitation
Health: Changes in the incidence and geographic range of vector- and water-borne diseases	Medium	Warming trend, precipitation, extreme precipitation
Europe		
Water: Economic losses by flooding in river basins and coasts, driven by increasing urbanization, coastal erosion, and peak river discharges	High	Extreme precipitation, sea level
Water: Significant reduction in water availability from river abstraction and from groundwater resources	High	Warming trend, extreme temperature, drying trend
Food: crop production and increasing risk of wildfires in southern Europe and in Russian boreal region	Medium	Extreme temperature
Health: Increased economic losses and people affected by extreme heat events: impacts on health and well-being, labour productivity, crop production, air quality, and increasing risk of wildfires in southern Europe and in Russian boreal region	Medium	Extreme temperature
Asia		
Water: Increased riverine, coastal, and urban flooding leading to widespread damage to infrastructure, livelihoods, and settlements in Asia	Medium	Extreme precipitation, damaging cyclone, sea level
Food / Health: Increased risk of drought-related water and food shortage causing malnutrition	High	Warming trend, extreme temperature, drying trend
Health: Increased risk of heat-related mortality	High	Warming trend, extreme temperature
Australasia		
Water: Increased frequency and intensity of flood damage to infrastructure and settlements in Australia and New Zealand	High	Extreme precipitation
Water: Increasing risks to coastal infrastructure and low-lying ecosystems in Australia and New Zealand, with widespread damage towards the upper end of projected sea-level-rise ranges	High	Damaging cyclone, sea level
North America		
Water: Urban floods in riverine and coastal areas, inducing property and infrastructure damage; supply chain, ecosystem, and social system disruption	High	Extreme precipitation, damaging cyclone, sea level
Heat: Wildfire-induced loss of ecosystem integrity, property loss	High	Warming trend, drying trend
Health: Heat-related human mortality	High	Extreme temperature
Central and South America		
Water: water availability in semi-arid and glacier-melt-dependent regions and Central America; flooding and landslides in urban and rural areas	High	Warming trend, drying trend, snow cover, extreme precipitation
Food: Decreased food production and food quality	Medium	Extreme temperature, extreme precipitation, ocean acidification, precipitation
Health: Spread of vector-borne diseases in altitude and latitude	High	Warming trend, extreme temperature, extreme precipitation, precipitation
Small Islands		
Economic: Loss of livelihoods, coastal settlements, infrastructure, ecosystem services, and economic stability	High	Drying trend, damaging cyclone, ocean acidification, sea level, extreme precipitation
Water: The interaction of rising global mean sea level in the 21st century with high-water-level events will threaten low-lying coastal areas	High	Damaging cyclone, sea level

Source: Intergovernmental Panel on Climate Change Fifth Assessment report

The value of avoiding carbon emissions

From a climate perspective, there is value in avoiding putting man-made (anthropogenic) GHG emissions into the atmosphere. Carbon pricing involves attributing a cost to these emissions. The roots of determining a global carbon price lie in estimating the long term environmental, societal and economic costs that arise from climate change. There is now more of a consensus within the economic and scientific community that the damage from climate change could impose a huge cost over a longer timeframe. However, current economic decision making does not fully factor in this climate risk, mainly because it is very difficult to assess. We set out some of these difficulties in [Keeping it cool – Financing a 2°C world](#), September 2014. A global carbon price would overcome this market failure by penalising GHG emissions.

Table 2: Estimates of damage costs from climate change impacts

Author/ publisher	Losses	Time Frame	Region	Notes	Report
DARA (2010)	USD 273bn	in 2030	World	Assesses the economic stress, sea level rise and weather disasters in 2030 which, it finds, will cost USD157bn, USD96bn and USD20bn respectively.	Climate Vulnerability Monitor 2010
Economist Intelligence Unit (2014)	USD4.2trn	PV of losses up to 2100	World	Considers cumulative loss to private portfolio managers	The cost of inaction: Recognising the value at risk from climate change
European Commission (2009)	USD24-78bn	in 2020	Europe	Considers five impact categories, namely, agriculture, river floods, coastal systems, tourism and human health and provides multi-sectorial estimates of impacts to the economy	Climate change impacts in Europe: Final report of the PESETA research project
Nicholas Stern (2006)	USD4-37bn per yr.	2006-2100	Developed countries	Estimates the cost of transition to low-carbon economy	The Economics of Climate Change
OECD (2014)	0.7 – 2.5% of GDP	2060	World	Derived from OECD models focusing on various regions at macro and sectoral levels	Consequences of climate change for economic growth
OECD (2014)	1.5 – 4.8% of GDP	2100	World	Derived from OECD models focusing on various regions at macro and sectoral levels	Consequences of climate change for economic growth
World Bank (2010)	USD70-100bn per yr.	2010-2050	Developing countries	Analyses the impact on developing countries of 2°C increase in temperature by 2050	Economics of Adaptation to Climate Change

Source: HSBC, Note DARA is Development Assistant Research Associates

What is the right price?

Answer: One that changes behaviour but is not too economically disruptive

In our view, the right carbon price needs to be high enough to provoke behavioural change, but not so high that the economy is subjected to a severe shock. This is because the possible negative economic consequences from a severe shock (e.g. job loss, decrease in public service provision because of lower tax revenues) would likely fall disproportionately on lower income families, potentially exacerbating income inequality. Finding the ‘right’ price is therefore incredibly difficult. The central idea is that a carbon price steers the economy away from high-carbon activities without killing growth. The economic consequences can be both *positive* (such as the development of new products and markets) and *negative* (such as job loss).

A price that addresses climate change **at speed and at scale** is unpalatable to deliver because it would need to be high (to deliver behavioural change) and would likely have negative economic consequences, such as changing the competitiveness of export markets, higher energy costs for domestic industry (versus overseas industry not subject to a carbon price), and the potential for job losses. This explains why carbon pricing has been introduced very differently across different countries over the last twenty five years.

Pricing to reflect future costs

Whilst new markets will spring up, the worry for governments is whether the *new* market opportunity (e.g. new jobs, new industries and innovation) fully absorbs the *old* ‘market consequences’ (e.g. job loss, revenue to the exchequer). In theory, the right price would reflect the *future damage costs* arising from warmer temperatures. In practice, setting this price requires a lot of assumptions, which are difficult to agree on – even before attempting to allocate a value to them – see Box 1.

Box 1: Using a 'social cost of carbon' (SCC) methodology to derive a global carbon price

The term '*social cost of carbon*' refers to the monetary value of future climate change damages associated with an incremental tonne of CO₂ emissions, discounted back to current prices. The size and scale of how future climate impacts play out depends on many factors including: the existing cumulative stock of GHGs, the lifetime of additional GHGs, values applied to future uncertain impacts and at what rate these are discounted back to current prices.

If the SCC is higher than the cost of avoiding an extra tonne of CO₂ (known as the marginal abatement cost) then it makes sense *not* to emit that extra tonne. In other words, it would be more profitable to prevent extra emissions *now* than it would be to pay for the resulting damages *later*. Conversely, if the SCC is less than the mitigation cost now, then it is cheaper to do nothing.

Uncertainty: The problem with this approach lies in the uncertainty on what the future impacts, and therefore damage costs, will be. Calculating the right global price level using the social cost of carbon methodology would involve deriving accurate values for *all* future impacts (e.g. health, economic disruption, lost income, etc.) resulting from incremental GHGs. The resulting price would thus be dependent on assumptions such as: the level of existing GHGs in the atmosphere, the trajectory of future GHGs, the interplay between existing and future GHGs and the resulting physical impacts.

Assumptions: Modelling for these factors would also be dependent on other variables (which themselves have many assumptions) such as: economic growth forecasts, energy consumption forecasts, primary energy mix forecasts (e.g. low carbon versus high-carbon sources)

Discount rates: Lastly, the applied *discount rate* is also a significant determinant of the resulting social cost of carbon.

So far, in much of the literature, estimates of the social cost of carbon along business-as-usual assumptions are much *higher* than the marginal abatement cost today – meaning that it is *beneficial* to act now, although estimates tend to have a wide range. For instance, the Stern review (2006) estimates ranged between \$0/tCO₂ in 2000 prices to over \$400/tCO₂, which, as Stern noted, makes policy based on a social cost of carbon difficult to apply. The US has used this type of social cost analysis to assess the cost-benefit of acting on climate change. In May 2013, it calculated the social cost of carbon for 2015 at either USD11, USD37 or USD57 depending on the discount rate applied (5%, 3% and 2.5% respectively). *Quoted in 2007 dollars per metric ton of CO₂.*

While Box 1 shows that a social cost of carbon can be calculated in theory, it also demonstrates the difficulty in doing so because of the number of assumptions which have to be made. Disagreement over the assumptions leaves more room for arguments in favour of a lower social cost of carbon figure, which would suggest – incorrectly in our view, that it is better to wait rather than to act now. We think the root of global carbon pricing inertia so far is because of the uncertainty on just how big future damage costs will be, and since it requires time and effort to calculate these costs, a more straightforward approach is to use taxes and trading. We look at these in Chapters 2 and 3 respectively. In our opinion, the difference now is that the observed climate impacts, which scientists have set out in the periodic assessment reports, are coming through. This provides an increased driver for change.

Support for carbon pricing is intact

Despite the difficulty of calculation and the fact that it could be economically detrimental to some, there is widespread support for carbon pricing even from companies that are exposed to high-carbon business activity, as shown in Table 3. The demand from business, investors, and NGOs for a stronger CO₂ price signal has become more vocal of late. We believe this is because corporates and investors believe that carbon pricing will eventually become universal, and therefore want more transparency on how different regions will implement pricing legislation i.e. through taxes or trading. In addition, we think that because pricing efforts so far have been piecemeal and have different rules from region to region, (particularly for carbon trading), this means that compliance costs to companies are higher than they would be under a universal pricing scheme. For instance, Rio Tinto notes that in 2013, more than two-thirds of its total GHG emissions across different regions were covered by a carbon price. We also think that global corporates, particularly in high energy use industries such as cement and steel, would like to see a more level playing field in terms of pricing per tonne of carbon.

In many cases, business is already factoring a carbon price in. According to the September 2014 CDP report 'Global corporate use of carbon pricing', at least 150 companies use an internal price on carbon. In addition, at the UNFCCC June talks in Bonn, oil and gas companies from Europe presented an open letter advocating a global carbon price and asking to be more involved in the setting up of such a scheme. Secondly, and more importantly from a climate perspective, existing carbon reduction policy efforts are not delivering the reductions required to be consistent with keeping temperatures to within agreed limits.

Pricing and Paris

Every year, the UNFCCC convenes a conference in December, known as the conference of the parties or COP. It is designed to further the aim of the convention which is to "stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". The target of limiting temperature rises to within 2°C versus pre-industrial times was set and formally accepted by the UNFCCC at COP16 (2010), in Cancun, Mexico.

Negotiating a climate agreement – but not specifically carbon pricing

The Paris conference this year, COP 21, is aiming for a universal climate agreement, which is being developed by a working group set up in Durban in 2011 (at COP 17) – the AD Hoc Working Group on the Durban Platform for Enhanced Action (ADP). There is no specific mandate for this working group to include pricing as part of the agreement negotiating text. Instead, another working group, the Subsidiary Body for Scientific and Technological Advice (SBSTA) is working on market-based mechanisms. The discussions of this group are on-going and the idea is that there will be recommendations on new markets for adoption in Paris, but we don't expect a lot of coverage on this area in Paris because it is not integral to the main negotiating text for an agreement. See [Building Bridges in Bonn](#), 8 September 2015.

Current market mechanisms

The Kyoto framework tried to reduce emissions and minimise disruption by giving freedom to signatories to decide how they would reduce GHGs, which was more manageable than attempting to derive a global carbon price. Existing market mechanisms that were set out under the Kyoto Protocol are: 1) emissions trading; 2) the clean development mechanism (CDM), which is a form of carbon credits for developing countries; and 3) joint implementation (JI) – another form of carbon credits for slightly wealthier

Table 3: Support for a carbon price

Name	Country	Stance
Business coalitions		
UN Global Compact's Business Leadership Criteria on Carbon Pricing: Caring for Climate	Global	Supports putting a price on carbon as it encourages low-carbon growth and lower GHG emissions
The Prince of Wales's Corporate Leaders Group - Carbon Global Price Communiqué - 173 Members		Advocates carbon prices as a building block while creating climate change policy
Carbon Pricing Leadership Coalition - 73 national and 11 regional governments and c1,000 companies	Global	Expressed support for putting a price on carbon ahead of the NY Climate Summit- 2014
Europe's largest oil and gas companies - Statoil, Total, BP, Shell, ENI and BG	EU	Have sought a global carbon pricing system to be formed at the COP 21 discussions
Prince of Wales's Corporate Leaders Group - Philips, Shell, Unilever, Eurelectric, IETA	UK	Urges the EU to bolder action on carbon pricing
We Mean Business Coalition (74 Countries, 23 provinces and 1,000 Business)	Global	Sees putting a price on carbon as an essential part of any strategy to combat climate change
Investor Coalitions		
Australia's largest investment managers and superannuation funds - Colonial First State, AMP Capital Investors, BT Investment Management, Cbus, Australian Super, Hesta and others	Australia	Lobbied the Government to provide clarity on carbon pricing; uncertainty was causing loss in investments
Ceres' Investor Network on Climate Risk (INCR)	US	A smart climate policy can create a mechanism to put the right price on carbon, and rapid economic change will follow that firm price signal, along with reduced climate risks.
Political / Academia / Other		
Barak Obama - President	US	When a New York Times journalist asked: what would you still like to do to address climate change? Obama said: "Put a price on it."
Angela Merkel – Chancellor	Germany	"We support a price on carbon – growth and climate protection can go hand in hand"
Francois Hollande - President	France	"For us to send the proper information to the markets, carbon pricing is essential, this is the most tangible signal we can send to all the economic sectors."
Al Gore - Former Vice President	US	"We've got to put a price on carbon in the marketplace and put a price on denial in politics."
Lord Nicholas Stern - Economist	UK	Called for governments to put a strong price on carbon
Jean Tirole - Nobel Laureate Economics	France	People will not curb polluting (fuel emissions) till a price is put on carbon
Joseph Stiglitz - Nobel laureate Economics	US	The current ambition for curbing emissions is not high enough and a carbon price may provide the impetus needed
World Resource Institute	US	A price on carbon can provide a clear and consistent economic signal that can help shift market growth towards a low-carbon economy
Pope Francis	Global	2015 Encyclical Letter demands that a "fully borne" carbon price be emplaced on greenhouse gas (GHG) pollution in order to prevent "millions of premature deaths"
Corporates		
American Electric Power Company	US	AEP utilizes an internal price of carbon in all generation planning decisions, which encourages investment in low-carbon generation and divestment of high-carbon generation
Apache Corporation	US	"We evaluate various GHG reduction scenarios for anticipated carbon price costs in Australia, UK and Canada to justify investments that are otherwise of marginal value."
BG	UK	BG's shadow carbon price allows them to test the resilience of their investments against costs associated with future climate change policies and regulations."
BP	UK	"We factor a carbon cost into our investment appraisals and engineering designs for some new projects, this standard cost assumption is currently USD40/tCO _{2e} ."
BHP Billiton	UK	"We have been incorporating a carbon price into all our investment decision-making for over a decade through the mandated use of our Carbon Pricing Protocol."
Chevron Corporation	US	Chevron's Carbon Markets Team developed tools to assess the market exposure of CO ₂ emission and provide carbon price forecasts to estimate potential financial risks
Devon Energy Corporation	US	Devon's oil sands operation prices carbon at USD15/tCO _{2e} to account for the cost or benefit associated with any change in GHG emissions resulting from each project
ENI	Italy	ENI considers carbon price as a fundamental factor for assessing its investments
Entergy Corporation	US	Entergy maintains a projection on CO ₂ pricing which is used to evaluate business decisions, such as, power uprates, acquisitions, deactivations, power purchases and divestitures
Exxon Mobil Corporation	US	ExxonMobil addresses the potential for future climate-related controls, through the use of a proxy cost of carbon, which may approach USD80/tonne
National Grid	UK	"A strong carbon price signal in the economy is essential to drive the right behaviours. To this end we have used the value of GBP55/tonne of Carbon as the shadow price of carbon for 2013/14."
Royal Dutch Shell	Netherlands	"We believe that a real carbon price in the global energy system will be the most effective approach to managing GHG emissions and consider a potential screening value of CO ₂ emissions at USD40/tonne."
Statoil	Norway	"We consider the potential cost of a project's CO ₂ emissions in all investments decisions."
Total	France	Total uses an internal price of carbon of EUR25/tonne
Xcel Energy Inc.	US	Xcel includes a carbon proxy cost (approx. USD20/tCO ₂) to project the expected future costs of CO ₂ emissions on various planning scenarios

Source: HSBC, Company Reports, CDP

‘economies in transition’. The CDM is an example of a carbon credit system. We focus mainly on taxes and trading in this report, but carbon credits from individual projects, such as those set up under the CDM could be used for compliance in regional schemes in the future, in our view. We briefly describe carbon credits in Box 2. The Kyoto Protocol is currently in its second commitment period, which runs from 2012 – 2020. The agreement to be discussed in Paris will cover emission reduction goals for the post-2020 period, most likely from 2020 to 2030 initially, but with regular reviews on timeframe.

This market mechanism approach to deriving a price will give a different value to the one that would be implemented under the ‘social cost of carbon’ methodology (Box 1), since market prices operate as a function of *current* demand and supply, whereas SCC is based on a variety of assumptions about the *future* cost of impacts.

Box 2: Carbon credit systems

How does it work? A project (such as a wind farm) generates carbon credits which are then purchased by third parties.

How does it reduce emissions? Credits can be bought for compliance reasons (e.g. as part of an allowance in a trading scheme) or for voluntary reasons (e.g. a facility wants to be carbon neutral). If both the price and demand for credits is high, this creates demand for more projects. *Examples:* The Clean Development Mechanism (CDM); China’s Certified Emissions Reduction (CCER) scheme.

Problems: These schemes are mainly voluntary resulting in no guarantee of demand for the credits. There are also wide variations in the certification process and debates as to whether credits are ‘additional’ or not. (‘Additionality’ describes whether a project delivers GHG reductions “in addition to” the status quo or a baseline scenario that either already exists or would have been implemented anyway.)

Accurate pricing requires accurate accounting

The ADP is also looking at issues related to Monitoring, Reporting, and Verification (MRV), and this is an area for inclusion in the universal climate agreement text. We think this is important for the future of carbon pricing because it lays the groundwork for more accurate GHG accounting. That is, for countries to be able to price CO₂ *accurately*, the first step is to be able to account for it *accurately*.

Pricing is sensitive but necessary

Pricing carbon is a sensitive issue, because the whole point is to change behaviour by reducing the profitability of carbon-intensive activity e.g. power generation from fossil fuels. The key drivers for policy makers to act now include the risk of run-away climate change which will be more expensive to fix later, and increased analysis and estimates of the investment required for adaptation and mitigation. The ‘want’ of a carbon price is in place in many regions but the ‘need’ for it to be higher to act as a proper signalling mechanism for capital flows to move in a cleaner direction is not currently in place.

If CO₂ is priced accurately, our view is that the economics of project evaluation should be more favourable towards lower-carbon decisions, which will play out through energy, industry and transportation, enabling a cleaner energy mix.

Conclusions

In theory, a global carbon price would reflect future damage costs from warmer temperatures and act as a signal to drive capital from high-carbon to low-carbon activities. In reality, the right price for this is very difficult to calculate and piecemeal efforts have been implemented using the well-known available policy tools of taxing and trading. We look at these in the next chapters.

A global carbon price that reflects the social cost of climate change is not the same as the settlement price paid to emit a tonne of CO₂ as regulated by a trading scheme, or the level levied as a tax, because the social cost takes *future* expectations into account whereas the settlement price is a function of *current* supply and demand. For us, the direction of travel is clear – we expect wider implementation of policies aimed at pricing carbon through market mechanisms – carbon taxes and emissions trading.

Taxing Carbon

- ▶ We think taxing is the most straightforward means of pricing CO₂ because it is all-encompassing and relatively easy to implement
- ▶ Raising taxes can be a political challenge but we believe ensuring revenue neutrality is a good way to overcome this
- ▶ The winners are low-carbon consumers and producers; the losers are high-carbon energy producers and high-carbon energy users

Taxing CO₂: a straight forward option

In Chapter 1, we discussed that (in theory) pricing CO₂ would change behaviour so that less would be pumped out. If the future damage costs of a higher temperature world (as a result of CO₂ emissions) are high, then a high price for CO₂ would make lower-carbon alternatives more profitable. In turn, this would speed up the transition to a low-carbon economy. However, in reality, early attempts at pricing mechanisms were hit and miss, erring on the side of leniency of emission reduction in favour of protecting industry incumbents. Nevertheless, the carbon pricing mantra soldiered on and what has gone up a gear now is the volume and variety of entities supporting the idea of a carbon price. The two economic tools to deliver that at a regional level are taxes and trading.

The economics of tax regimes

In principle prosperous countries give rise to thriving societies. Well-functioning (and well-governed) affluent economies provide higher employment, in turn providing consumers with spare cash and governments with more income from taxation. Receipts from the fiscal system are used to provide funding for public goods and services such as health and education. The trick for governments is to set tax rates high enough to maximise their own revenue generation, but low enough so as not too cut-off investment. In most cases, consumers and industry are tax takers, in the sense that the government sets the rates for personal income or corporation tax and the cash is collected at source.

With a carbon tax, the burden of higher costs for higher carbon is initially spread across everyone, but the fiscal system can be used to recycle the revenues back into the broad economy, by reducing personal income tax rates for example. Conceptually, this is rational because by taxing the CO₂ externality now, there is less need for higher taxes to pay for increased health care, resilience to climate change factors in the future. In our view, the way to achieve success, i.e. reducing GHG's at a rate that is quick enough to meet climate goals while maintaining economic and energy prosperity, is down to the design of the system. We think transparency on future carbon tax rises and the methodology of recycling revenues are crucial.

Taxing to limit carbon emissions – tiered pricing

The disadvantage with carbon taxes is that there is usually no attempt to curb GHGs by restricting volumes. Unlike emissions trading schemes, tax regimes do not put a cap on overall carbon emissions, but we think tiered-pricing of carbon taxes could help with this issue. For instance, in some regions such as Hong Kong and various counties in the US, especially California, water is priced using a tiered system so that using a basic amount of water for daily needs incurs a low price per m³, but above a certain threshold, a higher price is set.

We think this concept could be applied to carbon taxes too. For instance, a jurisdiction sets a cap of 100tCO₂ which covers most of its carbon needs and is allocated between all emitters. Most emissions would be priced at a standard carbon price, but emissions over a certain threshold would be priced higher. In theory, this should further encourage carbon efficiency since a price jump would deter non critical use. If the price jumped significantly at a 90% or 95% threshold it would encourage everyone to stay within the cap of 100tCO₂.

How is a carbon tax implemented?

Some 10 countries have already implemented a form of carbon tax as shown in the Table 4 on the next page. Carbon taxes are different from income or corporation taxes in the sense that they can give individuals, and to a lesser extent industry, a degree of choice over how much tax they pay. For instance, buying a more efficient car means less fuel purchased per kilometre travelled, therefore less carbon tax. This is supposed to change behaviour over time as consumers and businesses move to lower-carbon alternatives to be economically efficient – and it results in the desired effect of reducing emissions. The most straightforward way to implement a carbon tax in our view is to adopt an economy-wide approach and tax all fossil fuel combustion emissions, and then expand this to other GHG emissions at a later stage.

Covering a wide range of carbon emissions

For most governments, we believe a sensible intention would be to tax all fossil fuels used within national boundaries. This would include fossil fuels used in transportation and in industry, by individuals and by corporations. It would also cover fuels used to heat households, and in industrial processes such as producing cement and drying coal. This blanket approach would be relatively simple to administer, making the implementation costs low, in our view. We also think it would capture the widest range of CO₂ sources. For instance by adopting this approach, the province of British Columbia in Canada captured 70% of provincial emissions.

Table 4: Carbon tax in key counties

		Launch date	Tax rate (latest)	USD/ tCO ₂ *	Entities/ Facilities taxed	Use of tax proceeds
North America						
Canada	British Colombia- Carbon tax	2008	Carbon tax: CAD30/ tCO ₂ which translates to Gasoline: CAD66.7/kL; Diesel: CAD76.7/kL; Natural Gas: CAD1.4898/GJ (eff. since 1 Jul 2012)	24.60	Consumption of all fossil fuels in the state covering 70% of the province's emissions including transport and industry	Tax is revenue neutral- revenue collected is returned back through reduction in other taxes
	Quebec- Carbon tax	2007	CAD3.50/tCO ₂	2.62	Energy producers, distributors and retailers	Climate mitigation programs
US	Bay Area Air Quality Management District, California	2008	USD0.07/tCO ₂ e	0.07	Applied to c2,500 companies across all the sectors	Climate mitigation programs
	Boulder (Colorado)-Climate Action Plan (CAP) Tax	2007	Tax rate of USD4.9/MWh for residential, USD0.9/MWh for commercial and 0.3/MWh for industrial consumers; translates to USD0.41-6.68/CO ₂ e	0.41-6.68	Residential, industrial and commercial electricity use	The revenue collected is distributed to energy-efficiency and renewable-energy programs
Mexico	Carbon Tax on Fossil Fuel	2014	MXN10-50/tCO ₂ depending on the type of fuel; the price capped at 3% of sales price of the fuel; offset from CDM projects allowed	1-4	Fossil fuel except natural gas; tax on first fuel producers/ importers; covers 40% of the total GHG emissions	
EU						
Denmark	Carbon dioxide tax	1992	DKK90/tCO ₂	13.50	All consumption of fossil fuel; companies participating in EU ETS are exempted	Environmental subsidies and also returned back to the industry
Finland	Carbon tax (national)	1990	EUR35/tCO ₂ e (2013)	39.20	Heat, electricity production, transportation	
France	Tax on energy products	2014	EUR14.5/tCO ₂ for 2015 and EUR22 for 2016	16.24(2015), 24.64 (2016)	Imposes energy-saving obligations on all the suppliers of final energy	
Sweden	Carbon dioxide tax	1991	SEK1080/tCO ₂	129.60	Fossil fuel use in industry, transport, except for that in electricity generation	Offset labour taxes
UK	Climate Change Levy (CCL); Carbon Price Floor (CPF)	2001	Electricity- 0.554p/kWh; Gas- 0.193p/ kWh; LPG- 1.24 p/kg; Others (solid fuel, etc.)- 1.512p/kg (effective from 1 Apr 2015). Carbon floor for FY2015-16 is set at GBP18.08/tCO ₂	28.39	Non-domestic use of energy	Other taxes are reduced
South Africa	Proposed carbon tax	2016	R120/tCO ₂ e for 2016 and 10% increase thereafter to 2019	10.20	Carbon tax to cover all direct GHG emissions from both fuel combustion as well as non-energy industrial process emissions	Sale of electricity and new vehicles.
Asia						
Australia	None		Tax Repealed in July 2014			
Japan	Fossil fuel Tax	2012	Tax from April 2014- Petroleum: JPY 760/KL, Gas JPY 780/t and Coal JPY 670/t with an implicit cost of carbon at JPY289/tCO ₂	2.40		Revenue allotted to energy-oriented CO ₂ emissions restraint measures
China	Proposed carbon tax	Future	Proposed: A carbon tax was discussed for the 12th Five-year plan at CNY10/tonne of CO ₂ , this could be implemented during the 13FYP	1.60	Intended to cover all GHG emissions from the consumption of coal, crude oil and natural gas	
India	Clean energy CESS	2010	Tax on coal, lignite and peat of Rs300 per tonne	4.80/ tonne of coal		Clean energy investment
South Korea	Proposed carbon tax	2020			Tax on carbon emissions from vehicles	

Source: Government of British Columbia, California Air Resource Board, Danish Energy Agency, Regional Greenhouse Gas Initiative (rggi.org), State and Trends of carbon pricing, World Bank, May 2014, International Emissions Trading Association (IETA), International Carbon Action Partnership (ICAP); Note: *at current conversion rate

Taxing based on carbon intensity

This tax would be imposed on fossil fuels according to their carbon intensity so that a lower carbon-intensive source attracts a lower carbon tax rate. Table 5 below shows the different carbon intensities of fuel sources and what a given tax per tonne of CO₂ would mean for the individual fuel types, demonstrating that among these fuel sources, natural gas is the most carbon efficient. The effect of a carbon tax on fuel use can range from a few cents at the everyday domestic level to more than USD20 per tonne at the power generating level. How this will play out depends on the substitutability of the fuel source. For instance, carbon efficient gas might not be able to replace coal in all cases because of infrastructure, transportation and availability constraints. Table 5 provides investors and governments with an illustration of the degree to which a carbon tax can have a ripple effect on the power sector, industry and transport, and consumers if the effect of the carbon tax is passed on.

Table 5: Effective of a carbon tax on various fuel types

Fuel type	Main uses	Everyday unit	Avg. heat content MMBTU / everyday unit	Emission factor		Carbon tax set at:		
				kg CO ₂ / MMBTU	kg CO ₂ / everyday unit	USD10 Translates to USD / everyday unit	USD25	USD50
Propane	Domestic	gallon	0.091	63.1	5.8	0.058	0.1440	0.2880
Butane	Domestic	gallon	0.103	65.0	6.7	0.067	0.1678	0.3357
Butane/Propane Mix	Domestic	gallon	0.098	64.0	6.2	0.062	0.1554	0.3107
Home Heating and Diesel Fuel	Domestic	gallon	0.138	73.2	10.2	0.102	0.2540	0.5080
Kerosene	Domestic	gallon	0.135	72.3	9.8	0.098	0.2438	0.4876
Anthracite	Domestic	short ton	25	103.7	2,579	25.787	64.5	128.9
Natural Gas	Domestic, power gen, transport	tcf	1.03	53.1	54.4	0.544	1.4	2.7
Coal (All types)	Power gen / industry	short ton	22	95.3	2,101	21.008	52.5	105.0
Bituminous	Power gen / industry	short ton	25	93.3	2,237	22.368	55.9	111.8
Subbituminous	Power generation	short ton	17	97.2	1,686	16.855	42.1	84.3
Lignite	Power generation	short ton	13	97.7	1,266	12.662	31.7	63.3
Gasoline	Transportation	gallon	0.124	71.3	8.9	0.089	0.2223	0.4445
Jet Fuel	Transportation	gallon	0.135	70.9	9.6	0.096	0.2393	0.4785
Aviation Gas	Transportation	gallon	0.120	69.2	8.3	0.083	0.2087	0.4173

Source: HSBC (based on EIA, IEA). Note: BTU = British thermal unit; tcf = thousand cubic feet

The importance of GHG inventories

Many countries take stock of national GHG inventories on a regular basis. Some countries are required to submit these inventories to the UNFCCC as part of their ongoing participation to the convention. For instance, the USA last submitted a GHG inventory in April 2014, detailing the 2013 GHG volumes. A summarised version of the inventory is in Table 6 overleaf.

Table 6: Sectors/Industries Covered in US GHG Emissions and Sinks (MtCO₂e)

Chapter/IPCC Sector	1990	2005	2010	2013	% GHG	Chapter/IPCC Sector	1990	2005	2010	2013	% GHG
Total Emissions	6,301.10	7,350.20	6,898.80	6,673.00	100	Total Sinks	-775.8	-911.9	-871.6	-881.7	-13.2
% change		16.6	-6.1	-3.3		% change		17.5	-4.4	1.2	
Net Emissions (Sources + Sinks)	5,525.20	6,438.30	6,027.20	5,791.20	86.8						
% change		16.5	-6.4	-3.9							
Energy	5,290.50	6,273.60	5,854.60	5,636.60	84.5	Industrial Processes & Product use	342.1	367.4	353.6	359.1	5.4
% change		18.6	-6.7	-3.7		% change		7.4	-3.8	1.6	
Fossil Fuel Combustion	4,740.70	5,747.70	5,367.10	5,157.70	77.3	Iron and Steel & Met. Coke	100.9	67.5	56.4	53	0.8
% change		21.2	-6.6	-3.9	-0.1	% change		-33.1	-16.4	-6	
Natural Gas Systems	216.8	206.3	191.9	195.2	2.9	Cement Production	33.3	45.9	31.3	36.1	0.5
% change		-4.8	-7	1.7	0	% change		37.8	-31.8	15.3	
Non-Energy Use of Fuels	117.7	138.9	114.6	119.8	1.8	Petrochemical Production	21.9	28.3	27.4	26.6	0.4
% change		18	-17.5	4.5		% change		29.2	-3.2	-2.9	
Coal Mining	96.5	64.1	82.3	64.6	1	Lime Production	11.7	14.6	13.4	14.1	0.2
% change		-33.6	28.4	-21.5		% change		24.8	-8.2	5.2	
Petroleum Systems	36	28.4	25.5	31.2	0.5	Nitric Acid Production	12.1	11.3	11.5	10.7	0.2
% change		-21.1	-10.2	22.4		% change		-6.6	1.8	-7	
Stationary Combustion	20.4	27.6	29.3	30.8	0.5	Ammonia Production	13	9.2	9.2	10.2	0.2
% change		35.3	6.2	5.1		% change		-29.2	0	10.9	
Mobile Combustion	46.9	41.1	26	20.6	0.3	Aluminium Production	28.3	7.6	4.6	6.2	0.1
% change		-12.4	-36.7	-20.8		% change		-73.1	-39.5	34.8	
Incineration of Waste	8.4	12.8	11.4	10.4	0.2	Electrical T&D	25.4	10.6	7	5.1	0.1
% change		52.4	-10.9	-8.8		% change		-58.3	-34	-27.1	
Abandoned Coal Mines	7.2	6.6	6.6	6.2	0.1	Semiconductor Manufacture	3.6	4.7	3.8	4.2	0.1
% change		-8.3	0	-6.1		% change		30.6	-19.1	10.5	
Agriculture	448.7	494.5	524.8	515.7	7.7	LULUCF	13.8	25.5	20.3	23.3	0.3
% change		10.2	6.1	-1.7		% change		84.8	-20.4	14.8	
Waste	206	189.2	145.5	138.3	2.1						
% change		-8.2	-23.1	-4.9							

Source: UNFCCC; Note: LULUCF = Land Use, Land-Use Change, and Forestry

These inventories can be used as a starting point to assess:

- 1 how much of the country GHG's would be captured by a carbon tax;
- 2 how much revenue would be raised;
- 3 industry sensitivity to the impact of the tax.

We think industry sensitivity is a particularly important aspect to consider because it enables an assessment of the competitiveness of various sectors post the implementation of a carbon tax. This is particularly pertinent when close proximity countries don't implement a carbon pricing system, such that industry may be exposed to carbon leakage – that is where the emissions that are regulated in one region are simply transferred to another by changing the location of production. For example, the steel and cement sectors are high-carbon, high-energy sectors, and would likely have a higher cost base resulting from a carbon tax. Alternatively, for some countries which have a higher proportion of services in the mix, a carbon tax could impact consumers more significantly than industry through higher heating and transport bills.

Gaining political support

Additional taxes are generally disliked because they reduce profitability for corporates and disposable income for individuals. But transparency on how the proceeds of a carbon tax will be used can help to mitigate potential opposition. We consider ensuring the revenue neutrality of carbon taxes as a good way to implement carbon tax regimes. Revenue neutrality involves reducing other taxes or giving tax credits so that the proceeds compensate those adversely affected by increased costs. This was the approach adopted by British Columbia (Box 3).

Box 3: A successful carbon tax example: British Columbia

In its 2008 budget, British Columbia set out a three year plan of carbon taxation, to be implemented from 1 July 2008. The tax started at CAD10 per tonne of greenhouse gas (GHG) emissions, but steadily increased each year to reach USD30 per tonne by 2012.

The tax was made revenue neutral in several ways. The province introduced a low income refundable climate action tax credit of CAD100 per adult and CAD20 per child for low income families to be paid quarterly, it also reduced personal income taxes by 5% on the first CAD70,000 of income by 2009, and lowered the general corporate income tax rate to 11% from 12%, and the small business rate to 3.5% from 4.5%. The goal was to lower the general corporate income tax rate even further to 10% and the small business rate to 2.5% by 2011. A 10% corporate tax rate was effective from 1 January 2011 to 31 March 2013, when it was increased to 11%. The small business tax has remained at 2.5% since 1 December 2008. At the time of launch, the government estimated that in total CAD1.85bn would be returned to tax payers over three years through tax cuts and tax credits.

The tax was applied to all the fossil fuels purchased for use in the province or used by those importing or producing the fuel, which accounted for about 70% of BC's total current GHG emissions. Other emissions, including those resulting from industrial processes such as production of oil, gas, aluminum and cement, as well as emissions from landfills and other sources were not subject to the tax initially.

During 2008-2013, over which the carbon tax has been effective, the transport fuel consumption in BC has fallen c10% while that in the country as a whole has remained largely the same. In 2013, the per capita GHG emission in British Columbia was around 30% lower than the country average.

Besides revenue neutrality, another option to gain political support is to ensure that the revenue raised from a carbon tax is put back towards solving the climate change problem. This can be done through further building out the low-carbon economy (e.g. more renewables) or preparing for the impacts of climate change. Some countries, such as Japan, have used this approach. The problem however is that it is difficult to demonstrate that the revenue raised is put towards the *best* and most *effective* use related to climate change.

Winners and losers from carbon taxes

The magnitude of impact on consumers from a carbon tax mainly depends on their transport and heating patterns, and how high/low carbon these activities are. For instance, low-carbon lifestyles, such as using public transport or low-emission vehicles, buying energy efficient appliances and where possible opting to use low-carbon sources for power generation, would be better placed for carbon tax implementation. Conversely, consumers who choose high-carbon options would be negatively impacted from rising bills. The impact on consumer spending in the overall economy would depend on whether or not there is an income tax drop (i.e. the degree to which the tax implements revenue neutrality principles).

Industry would be impacted by the changing costs of fuel for transportation, heating, and industrial processes. The consequences across industry would vary depending on the industry, the configuration of each facility, the ability to use alternative fuel sources and the ability to make new investments that reduce the use of fossil fuels. We think efficiencies can always improve as technologies and processes advance. For instance, the World Steel Organisation estimates that emissions from steel production have

reduced by 60% over the last 50 years – but that the industry could still reduce the average energy intensity of steel production by a further 15-20%.

The most energy and carbon intensive sectors are utilities, cement and construction, steel, chemicals and oil and gas. These industries would either have to become even more efficient, absorb the carbon tax (which would reduce profitability), or pass on the charge to customers (which would create wider inflationary pressures).

Conclusions

In our view, taxing carbon is a good strategy for governments since it tackles the climate problem, raises revenues for them to spend how they choose, and can spark innovation in new industries that ‘solve’ climate change, therefore creating new markets including potential for new export revenues. The advantage of carbon taxation is that it does not favour one form of emission reduction over another, so that business and individuals can choose whether to pay the tax or avoid it by using lower carbon, more energy efficient alternatives, adopting new technology, or changing fuels. Low income families can be protected by revenue neutrality principles. The problem with carbon taxation is the fear that setting it too high would hurt competitiveness and for this to feed back through the economy via inflationary pressures and disruption to trade flows.

Another problem is also whether a carbon tax regime is successful at reducing CO₂ (the key aim) without disrupting the wider economy. In our view, this depends on the transparency of the regime. For example, the timing of future tax hikes and the fairness of income distribution from the proceeds of the tax. We think revenue neutrality is a key feature of successful carbon tax regimes and suggest the option of tiered-pricing in order to limit absolute levels of emissions.

Trading Carbon

- ▶ Emissions trading schemes set constraints on GHG volumes but leave the market to decide how best to achieve these reductions
- ▶ Setting long run caps requires estimating future economic activity, a notoriously difficult task since it depends on many variables
- ▶ Building in a price stabilisation mechanism can be effective in ensuring that emissions are actually reduced, in our view

Trading CO₂: harder to get right

In Chapter 2, we showed that taxes are relatively simple to administer since they can be implemented across all industries centrally, starting with a fixed carbon price. On the negative side for solving climate change, a taxation system does not usually impose a cap on emissions. Conversely, trading systems start with capping CO₂ emissions at a given level (usually a percentage reduction below a fixed baseline year), and then allow the carbon price to float as a function of supply and demand.

How does carbon trading work?

A country (or an industry) sets a cap on future emissions over a time period (e.g. a year) versus a baseline (e.g. three year historical average emissions, or an estimate of future emissions). It then distributes the volume of the emissions cap amongst participants (e.g. controlled entities such as companies or facilities). Participants that emit more than their quota of allowances need to buy from participants who have emitted less (i.e. trade). To deliver the aim of GHG reduction, the emissions cap should be reduced (either on an absolute basis or relative to projected business growth) each year so that it becomes harder to comply with. This drives up the carbon price and encourages participants to become more carbon efficient. The key benefit of trading is that it allows the regulated entities to decide for themselves the least cost option to reduce emissions. Table 7 shows carbon trading schemes.

Table 7: Cap and trade scheme in key countries

	Year	Launch carbon price Local currency	USD/ tCO ₂ e*	Emissions goal	Base year	Industries regulated	Linked to another scheme	Last (av.) price 2014 (local)
Americas								
Canada								
Alberta-Specified Gas Emitters Regulation	2007	Price ceiling of CAD15/ tCO ₂ e	12.50	Emission intensity of 88% in any compliance period compare with base year	Average over 2003-05	Facilities with GHG emissions >100ktCO ₂ e; covers c50% of Alberta's emissions	-	
Québec Cap and Trade System	2013	CAD10.75/tCO ₂ (Auction price in 2013)	8.94	Annual cap reduction of c4% over 2016-2020 to achieve an overall 20% reduction in GHG	2009	Threshold emission of at least 25ktCO ₂ emissions in 2009, 2010, or 2011; second phase (2015-17) covers electricity generation, industry and distributors of fuel; represents 85% of Quebec's emissions	Linked to California cap-and-trade since 1 Jan 2014 as a part of Western Climate Initiative	11.96
Western Climate Initiative	2007			15% reduction in GHG by 2020	2005	Electricity generation, large industrial, commercial sources, transportation and other fuel use within member states of British Columbia, California and Quebec	WCI provided administrative and technical assistance for linking of California and Quebec cap-and-trade systems in 2014	
US								
The Regional Greenhouse Gas Initiative (RGGI)	2009	USD3.07/tCO ₂ (Auction price in Sept 2008)	3.07	15% of the covered emissions. (2.5% annual reduction in cap from 2014 to 2020)	2014	Fossil fuel electricity generation within covered regions (9 US states) with nameplate generation capacity of 25MW or more	Nine US states, namely Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont are participants to RGGI. Each state's CO ₂ Budget Trading Program is based upon its own statutory and/or regulatory authority, however, they are guided by the Model Rule established under RGGI to established state participation in regional CO ₂ allowance auctions	4.78
California Cap and Trade	2013	USD10.09/tCO ₂ (Auction price in Nov 2012 of the 2013 vintage certificates)	10.09	c17% reduction in emissions by 2020. The emissions cap reduced at 2% in 2013 and 2014. Over 2015-2020 the emissions cap of the expanded coverage will reduce at 3% p.a.	2013	Electricity generations and large industrial facilities with GHG emissions greater than or equal to 25ktCO ₂ e in 2013 and 2014; beginning 2015 distributors of transportation, natural gas and other fuels with emissions greater than 25ktCO ₂ e threshold are also covered under the cap-and-trade regulating 450 facilities and representing 85% of the total emissions in California region.	Linked to Quebec cap-and-trade since 1 Jan 2014 as a part of Western Climate Initiative.	11.65
Brazil								
Brazil ETS	ETS under consideration as per Brazil's National Climate Change Policy (PNMC).							
Rio de Janeiro ETS	The scheme, covering major polluting industries, was announced during the Rio+20 conferences in 2012 and was expected to start early 2013, but was later delayed until further notice.							
Sao Paulo ETS	The Brazilian state of Sao Paulo announced plans for the introduction of an ETS in 2012. The plan was, however, put on hold for an undetermined time horizon in 2014.							
Mexico- Cap-and-trade	The cap and trade scheme announced in early 2014 is still in pipeline.							
EU								
EU Emissions Trading Scheme	2005	EUR16.85/tCO ₂ e as on 22 Apr 2005	18.90	Emission reduction of 21% in 2020 and 43% in 2030 (under 2030 framework). The emission cap is set to reduce at 2.2% annually in the phase 4 starting in 2021 compared to 1.74% in phase 3	2005	Energy intensive installations in power, manufacturing and commercial aviation sectors; the scheme regulates c45% of the GHG emissions in the EU 28 region and the three EEA-EFTA states covering 11, 000.		6.00

Source: California Air Resource Board, Danish Energy Agency, Regional Greenhouse Gas Initiative (rggi.org), State and Trends of carbon pricing, World Bank, May 2014, International Emissions Trading Association (IETA), International Carbon Action Partnership (ICAP); Note: *at current conversion rate

Table 7 continued: Cap and trade scheme in key countries

	Year	Launch carbon price Local currency	Emissions goal USD/ tCO ₂ e*	Base year	Industries regulated	Linked to another scheme	Last (av.) price 2014 (local)
Asia Pacific							
Australia- Emissions Reduction Fund	2014	Emission Reduction Fund of AUD2.55bn under the Carbon Farming Initiative Amendment Bill 2014 has provision of auction and purchase of emissions reduction from eligible projects. In July 2014, the Australian government repealed the carbon tax and the emissions trading scheme (set to start in 2015).					
Japan							
Voluntary Emissions Trading Scheme (JVETS)	2005 (ended in 2012)			Absolute GHG target for each participant which are unilaterally decided	80 firms, representing 1% of Japan's industrial emissions, adopted a voluntary target for the fifth phase (from 2011); sectors covered: nonferrous metal industry, machine and other manufacturing, ceramic, steel, chemical, paper and pulp, textile, food and drink and some non-industrial sectors.		
J-Credit Scheme	2013				102 registered projects and 51 certified projects as of March 2015 in solar power, electric vehicle, co-generation and fuel switch segments	Integrates Japan Domestic Credit Scheme (JCDM) and Offset Credit Scheme (JVER)	
Tokyo Emissions Trading Scheme (cap-and-trade)	2010	cJPY15,000/tCO ₂ (Aug 2010)	142	6-8% CO ₂ emissions reduction during the first compliance period (2010-2014) and 17%emissions over second compliance period (2015-2019)	Prior 3 yr. av. Large facilities (buildings, factories) with energy usages of 1,500 kL in crude oil equivalent or more. Covers c1400 facilities accounting for 20% of Tokyo's CO ₂ emissions and 40% of the industrial and commercial CO ₂ emissions in the city	Linked to Saitama Trading System	JPY8,000-10,000/tCO ₂ e (Nov 2013)
Saitama Prefecture Trading System (cap-and-trade)	2011			6-8% CO ₂ emissions reduction during the first compliance period (2010-2014) and 17%emissions over second compliance period (2015-2019)	Prior 3 yr. av. Facilities (buildings, factories) with energy usages of 1,500 kL in crude oil equivalent or more; covers c600 facilities	Linked to Tokyo Emissions Trading Scheme	
China- Pilot ETS program in Shenzhen, Shanghai, Beijing, Guangdong, Tianjin, Hubei and Chongqing	2013-2014	Shenzhen- 75.2, Shanghai- 31.4, Beijing- 52.6, Guangdong- 61.8, Tianjin- 34.7, Hubei- 24.7 (Average price in CNY/ tCO ₂ up to 18 Apr 2014)	3.95-12.03	Emission intensity of GDP target by 2015: 2010 Guangdong- 19.5%; Shanghai- 19%; Shenzhen- 21%; Beijing- 18%; Tianjin- 19%; Hubei- 17%; Chongqing- 17%	1GtCO ₂ (c10%) of China's CO ₂ emissions; Sectors: Power, cement, iron and steel and petrochem, ceramic, textile, non-ferrous metals, plastics, paper- Guangdong; all industry- Hubei; iron and steel, petrochem, non-ferrous metals, power, materials, textile, paper, rubber, aviation, railways, commerce, finance- Shanghai; iron and steel, chemicals, power, petrochem- Tianjin; companies with an emission threshold of >10,000 tCO ₂ or energy consumption of >5,000 tonnes of coal equivalent between 2009 and 2012- Beijing; industry and public buildings- Shenzhen; companies with a threshold of >20,000 tCO ₂ - Chongqing		
India- Perform Achieve and Trade (PAT) scheme	2012			Facilities are required to improve energy efficiency by 1-2%/ year. Overall aims to reduce emissions by 26MtCO ₂ e and fuel consumption by 6.6Mtoe during the first commitment period	2012-2015	478 industrial facilities in power sector and other energy intensive sectors together comprising of 60% of India's GHG emissions in 2007	
South Korean ETS	2015	Opening trade at USD7-8/CO ₂ e	7-8	Gases covered are CO ₂ , CH ₄ , N ₂ O, HFC, PFC, SF ₆ ; cap of 1.69GtCO ₂ e over Phase 1 (2015-2017)	2011	Threshold for- company >125,000tCO ₂ /year, installation >25,000tCO ₂ /year; Phase 1 covers 525 entities from 23 sectors including steel, cement, petrochem, refinery, power, buildings, waste and aviation and representing c65% of the total GHG emissions	Threshold for 2015 and 2016 : KRW10000/tCO ₂ e (USD9)
Kazakhstan ETS	2014			Reduce GHG emissions by 15% by 2020	1992	Covers GHG emission from energy, transport, industrial process, agriculture and waste; Phase I (2013): 178 companies and Phase II (2014-2015): 166 companies	
New Zealand ETS	2012			Stabilise GHG levels to 1990 levels by 2012; Reduce emission by 5% by 2020; reduce emissions by 50% by 2050	1990	Covers GHG emission from energy, transport, industrial process solvent and other products, agriculture and waste; as at 30 June 2014, 2424 entities were registered: 264 entities with mandatory reporting and surrender obligation, and 2159 with voluntary reporting and surrender obligation	

Source: California Air Resource Board, Danish Energy Agency, Regional Greenhouse Gas Initiative (rggi.org), State and Trends of carbon pricing, World Bank, May 2014, International Emissions Trading Association (IETA), International Carbon Action Partnership (ICAP); Note: *at current conversion rate, **new ETS under consideration as mandated by the Basic Act on Climate Change Countermeasures

The success of a trading scheme is down to the design and implementation, which is much more difficult than designing a tax system in our view because it involves estimating the future demand for CO₂ and determining an appropriate emissions cap based on the forecasts. There are two key steps for setting up a successful trading scheme:

- 1 determining the participants i.e. which entities such as companies or facilities to include;
- 2 determining how many permits or allowances to allocate to these regulated entities

The threshold for participation ought to ensure it covers a decent proportion (say, 60% or more) of the emissions of the country (or industry). Too few participants results in a scheme that does not reduce emissions; too many and a tax could be easier to implement.

Setting the number of allowances is critical for success in reducing emissions

The main problems associated with a trading scheme are the result of the allocation of permits. This allocation depends on the level that the emissions cap is set at, and what proportion of those permits should be allocated for free versus paid for. (In most cases, making entities pay for 100% of permits from day one is not really viable, in our view). If the overall emissions cap is set too high then it is easily met and results in a low carbon price (as there is an oversupply of permits). This results in a disincentive to be more carbon efficient as it is cheaper to trade than to improve.

Accurate accounting and accurate forecasting

In Chapter 1, we discussed the importance of accuracy in accounting for GHGs – the concept of MRV, measuring, reporting and verification. On top of this, trading adds in the need for *forecasting*. In our view, trading should not stymie development or economic growth. Scheme participants should therefore be allowed some “room for growth”, for example, if an entity builds a new factory, it should be allocated additional permits, albeit in a more carbon-efficient manner. This involves the concept of decarbonisation on top of energy efficiency – in short the new facility should be more carbon-efficient than the old one.

The trouble is that the initial free allocation, more often than not is set too high, as projections of future emissions are exaggerated or participants complain that too few permits could hurt competitiveness. The result is an oversupply of permits and a low carbon price. This *misallocation* of permits can arise because actual growth is lower than forecast and because participants lobbied for more permits than they really needed to give themselves a safety net.

Lower-than-expected growth: Most trading systems do not have a method to “claw back” allocations in the event that business is not as good as expected. The trading scheme regulators can only *estimate* how much carbon is emitted by entities based on the reporting volumes of participants. However, since reported volumes are based on *historical* emissions, *future* emissions still need to be forecast or estimated. This was the case of the EU in general during the financial crisis of 2008. The volume of allowances available remained high but no entities required them because of the economic slowdown, as shown in Chart 3 below.

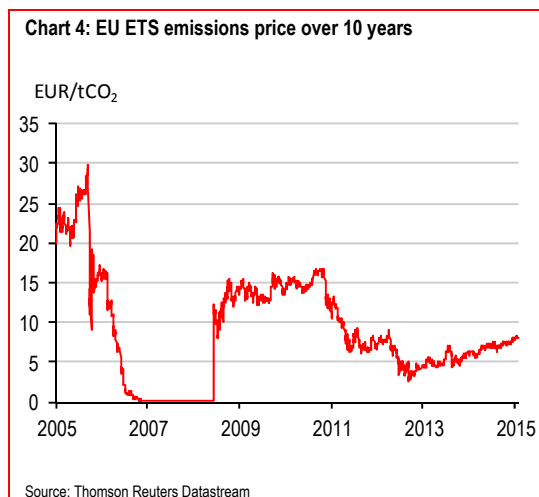
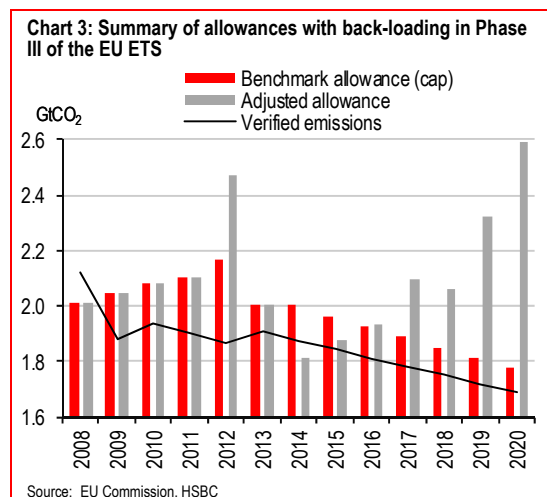
Industry lobbying: Understandably, industries prefer to transition towards lower-carbon activities at their own pace rather than being forced to at a potential cost. Hence, participants may exaggerate or overstate their forecasts of growth for the purposes of garnering more future allowances. Besides

reducing absolute costs, another reason is the fear or perception of being less competitive against companies operating in countries without trading schemes because trading may increase the cost base. This perception becomes less true as more countries adopt carbon pricing. Indeed, we argue that companies operating in countries *without* carbon pricing schemes may be disadvantaged in the future as climate policies render their products less acceptable to more carbon-efficient economies.

The proportion of free permits

Most schemes try to “ease-in” the resulting costs for participants by gradually reducing the portion of free permits. Some start with 100% free allowances in the first year/phase before reducing this to, say, 90% – which means that participants have to pay for the other 10% (and then reducing the free portion even further in subsequent years/phases). This encourages carbon-efficiency as companies gradually pay for an *increasing* portion of their emissions i.e. it should cost them more over time. However, striking the right balance is difficult. Some schemes have scaled back on the portion of non-free allowances because of industry lobbying. Despite the pitfalls, assortments of schemes are up and running.

The European Emissions Trading Scheme (EU ETS) is the front runner for carbon trading. Launched in 2005, it was designed to respond to European commitment under the Kyoto Protocol, which aimed for a 5% reduction of Greenhouse gases from 1990 levels by 2012. The first phase of the scheme, from 2005-2007, was a ‘learning by doing’ approach before the first commitment period of the protocol, when GHG reduction aims were from 2008 to 2012.



Somewhat unkindly in our view, the EU ETS is sometimes referred to as a case study on what not to do in relation to emissions trading. The main problem was the timing of derivation of who should get what in terms of free credits. The bargaining process meant that individual countries lobbied the EU for how many credits they thought they should receive, and then those were divvied up between the emitting “installations”, (entities regulated by the scheme). In this way, governments often pitched for more than they needed to protect industry, and since this process took place in 2007 shortly before the financial crisis and resulting recession, an overhang of surplus credits was left as economic activity slowed and energy use dropped. In phase 3 from 2013 to 2020, the scheme moved to a centralised EU wide scheme of setting emissions. Table 8 compares the differences between the European and Californian schemes.

Improving the efficiency of trading schemes

Following the pricing problems of the EU ETS, it has tried to adjust for the over-supply by “back-loading”, which removes some of the glut of allowances for a certain time period – in theory, causing the price to rise – before reintroducing these allowances at a later stage. However, this was a very complicated process, which had to go through many political and legal hoops because the system was never designed to accommodate such actions. Other schemes have pre-designed price stabilisation mechanisms.

Price stabilisation by auctioning: The California trading scheme holds an auction for allowances every quarter. The number of allowances it auctions is set according to a formula that broadly depends on whether the state is on track to meet its emissions target, and also the prevailing trading price. There is also a maximum limit as to how many allowances an entity may hold in a calendar year. We think this is an effective method for maintaining price levels because it is built into the design of the system and effectively “checks in” on the price every quarter.

Price stabilisation by controlling the volume of allowances: In China, some of its pilot trading schemes have an option to increase or withdraw allowances depending on the price. This mechanism is effectively the same as the EU’s back-loading, but without the political hoops to endure since it is pre-designed into the system. It may not work in jurisdictions outside of China, however, because it is open to legal challenges by companies that may feel they have little or no control over the handling of their allowances (whether they will be able to use them or not). As such, we prefer the auctioning method for price stabilisation.

We think new schemes in the future should have some in-built mechanism, like auctioning, to ensure that the carbon price is not too low, and that the scheme is doing what it was designed for i.e. reducing emissions.

Table 8: Comparison of California and EU emissions trading schemes

	California Cap and Trade program	EU Emissions Trading System (EU ETS)
Jurisdiction	California state	28 EU member states, Iceland, Liechtenstein and Norway (EEA-EFTA members)
Year of commencement	2013	2005
Targets		
-ETS	c17% reduction in emissions over 2013-2020	21% reduction in emissions over 2005-2020
-Overall	a) 1990 levels by 2020 b) 40% below 1990 by 2030 c) 80% below 1990 by 2050	a) 20% below 1990 by 2020 b) at least 40% below 1990 by 2030 c) 80-95% below 1990 by 2050 (aspirational)
Gases covered	Carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), sulfur hexafluoride (SF ₆), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), nitrogen trifluoride (NF ₃), and other fluorinated greenhouse gases	Carbon dioxide (CO ₂), nitrous oxide (N ₂ O) and perfluorocarbons (PFCs)
Linkage	Linked to Quebec cap-and-trade since 1 Jan 2014 as a part of Western Climate Initiative; In 2015, Ontario announced its plan to join this program	Planned linkage with Swiss ETS
Sectors/ entities covered	Electricity generations and large industrial facilities with GHG emissions greater than or equal to 25ktCO ₂ e in 2013 and 2014; beginning 2015 distributors of transportation, natural gas and other fuels with emissions greater than 25ktCO ₂ e threshold are also covered under the cap-and-trade, in all regulating 450 facilities and representing 85% of the total emissions in California region.	Energy intensive installations in power, manufacturing and commercial aviation sectors; the scheme regulates c45% of the GHG emissions in the EU 28 region and the three EEA-EFTA states covering 11, 000.
Point of regulation	Electricity producers/ importers/ industrial facilities/ fuel distributors	Downstream, i.e. end-users of energy
Compliance and trading periods	Compliance period 1: 2013-2014; compliance period 2: 2015-2017; compliance period 3: 2018-2020; the entire allowances of the 3(2)-year compliance period is submitted in the following year. Calendar year vintage and future vintage allowances are auctioned or allocated free each year, however the future vintage allowance can be traded only in the compliance period.	One year compliance period from May to April; trading period- Phase 1: 2005-2007, Phase 2: 2008-2012, Phase 3: 2013-2020, Phase 4: 2021-2028
Allocation of allowances	Allocations based on sector average emissions, (normally set at 90%); free allowances given to industry for transition assistance, which decreases gradually, and also for prevention of leakage.	Phase 1 & 2: c100% free allocation through grandfathering; phase 3: about 40% allowance auctioned in 2013, 100% auctioning in power sector with few exception for member states, free allocation to manufacturing based on benchmarks and risk of carbon leakage, c85% free allocation to aviation in phase 3.
Banking and borrowing (across compliance period)	Banking allowed; borrowing not allowed	Unlimited banking, no borrowing
Offsets	Offset allowed up to 8% of the compliance obligations from the following US schemes- U.S. forest projects, Urban forest projects, Livestock projects (methane management), Ozone depleting substances projects, Mine methane capture (MMC) projects	Phase 3 only allows CDM credits generated post 2012 from LCD, no credits from LULUCF allowed; phase 1 allowed unlimited CDM and JI credits; proposal to exclude international credits in phase 4
Provision for price stability	Allowance Price Containment Reserves set at 1% for 2013-2014, 4% for 2015-17, 7% for 2018-2020; Auction Reserve Floor Price of USD12.10/tCO ₂ e in 2015 which increases annually by 5% plus inflation; accumulated allowances can be sold in three tiers in 2015 at price of USD 45.20/ allowance, 50.86, and 56.51, tier price increases annually by 5% plus inflation	Backloading of 900million allowances in phase 3; proposal for Market Stability Reserve (MSR)
Penalties for non-compliance	Four allowances are required to be submitted for every ton of emissions that was not covered in time	EUR 100/t CO ₂ e for each excess ton emitted

Source: California Air Resource Board, European Commission

Winners and losers from carbon trading

The winners and losers from a carbon trading scheme are less straightforward to identify than for carbon taxes because participation is usually based on a specific threshold of emissions, which might not be directly related to how carbon-efficient a company is. Table 7 shows that the regulated entities can be varied. For instance, companies within the same sector may be either positively or negatively impacted depending on their efficiency of energy use (e.g. companies improving efficiency may end up with surplus credits to sell versus others that don't from the same sector).

We expect companies that have a long track record of reporting on CO₂ through initiatives such as CDP (formally known as the Carbon Disclosure Project) to be better positioned for new trading schemes. This is because they are experienced at disclosing and managing carbon risks and so have deployed responses to the data they have gathered – and therefore should be better at minimising the associated costs. These are mainly developed market corporates in the high carbon industries of oil and gas, utilities, metals and mining, construction, and engineering. For instance, Shell first started reporting to CDP in 2003, and by 2014, it was using a price of USD40/tonne of CO₂ for project screening. The CDP initiative also puts pressure on companies to improve emissions performance through better management, in our view.

Box 4: Carbon trading: The CO₂ price and utilities

Carbon pricing impacts the profitability, and therefore valuation, of utility companies, by changing the economics for power prices. In this simplified example, we use German power prices to show how the CO₂ price influences the competitiveness of coal versus gas.

In Germany, the power price is made up of three elements: the cost of coal, the cost of CO₂, and the dark spread (the profit margin on a medium efficiency coal-fired plant of 10-15 years old). In July 2015, the cost of coal averaged EUR54/t, which translated into about EUR22/MWh for the cost of power generation from coal. The cost of CO₂ averaged EUR7.5/tCO₂. Since coal emits 0.85tCO₂/MWh on average, the CO₂ cost for coal represents EUR6.38/MWh. Hence the total cost of coal-fired power generation is EUR22 + EUR6.38 = EUR28.38/MWh. (This excludes the dark spread which was around EUR3.0-3.5/MWh in July.)

The average cost of gas in July was GBP44/therm, representing around EUR37/MWh, clearly uneconomic compared to providing electricity from coal. To change the economics of power production in favour of gas over coal, the CO₂ price needs to rise to a level that makes the coal price per MW at least as high as gas. Gas emits c0.35 tCO₂/MWh (which is 0.5tCO₂/MWh less than coal). To make up the EUR15/MWh gap, the CO₂ price needs to be EUR30/tCO₂. (The calculation for this is $1/0.5=2.0$; $15 \times 2.0 = 30$). In reality, the dark spread and spark spread (for gas) complicate the pricing of power.

This CO₂ price rise would also push up the cost of electricity from gas as well as coal, although to a far lesser extent. So all other things being equal, in this example, if the price of CO₂ rose to EUR38/tCO₂ this would make gas competitive versus coal for power generation at roughly EUR51/MWh, despite the initial feedstock cost differential of EUR15/MWh. For comparison, the average cost of onshore wind power (in which Germany is the world's largest market) is around EUR75/MWh.

Conclusions

If designed well, carbon trading schemes can give more flexibility to industry and facilities on how they manage energy and become more carbon efficient than taxes which are a blanket based approach. However, design flaws that lead to the over-allocation of supply can reduce the effectiveness of the pricing notion, as prices fall to zero. In some cases, it can even result in surplus allowances for energy industries to sell, losing the incentive to reduce emissions, which is ultimately the aim of the scheme. Hence we believe schemes should be designed with built-in mechanisms which allow for prices stabilisation such as periodic auctioning.

Removing Fuel Subsidies

- ▶ Fossil fuel subsidies artificially cheapen high carbon energy and hence act as a deterrent to lower-carbon activities
- ▶ Increased calls to remove subsidies would make low-carbon more attractive, but could also create inflationary impacts for society
- ▶ From a societal perspective low oil prices provide a good backdrop to remove subsidies as the impact is cushioned

Subsidies distort the “right price” for carbon and energy

Energy subsidies distort the energy market by creating an uneven playing field. A subsidy is a mechanism, usually implemented by government that change the economics for a certain activity by making the subsidised activity more profitable. Subsidies can be direct (cash payment, tax rebate) or indirect (under-pricing the externalities caused by that activity).

Similarly to carbon pricing more broadly, removing fossil fuel subsidies as a means to mitigate emissions is not breaking news. In February 2004, the World Bank noted “World subsidies of fossil fuels are estimated at more than USD210bn. Removing such subsidies would reduce global carbon emissions by 7 percent”. In recent years the World Bank and IMF have been vocal about advocating the removal of fossil fuel subsidies as a means to speed up the transition to a low-carbon economy. In April 2015, the President of the World Bank, Jim Yong Kim, said, "Fossil fuel subsidies send out a terrible signal: burn more carbon", as he urged the world to scrap subsidies and bring in a carbon tax. In July 2015, the UAE announced it would end fuel subsidies from 1 August 2015, estimated at USD29bn, or 6.6% of GDP by the IMF. The UAE’s Minister of Energy said that the decision was taken "based on in-depth studies that fully demonstrate its long term economic, social, and environmental impact".

One of the reasons why subsidy removal is not straightforward is because subsidies are perceived to be providing energy access to lower-income populations in poorer countries. However, the IMF in a May 2015 working paper entitled “How large are global energy subsidies?” found that energy subsidies:

- ▶ Damage the environment (air pollution, premature deaths, more congestion, more GHGs)
- ▶ Impose large fiscal costs (higher public debt, higher tax; crowd out productive public spending)
- ▶ Discourage other investments (in energy efficiency, renewables, energy infrastructure)
- ▶ Are highly inefficient (most benefits are typically captured by rich households – not low-income)

There are various methods to calculate energy subsidies

The global value of energy subsidies is relatively difficult to calculate because of the stage in the process that the subsidy is applied, but the IMF analysed energy subsidies across 176 countries in its January 2013 paper, 'Energy subsidy reform'. It found that on a *pre-tax basis* (where the price paid by consumers is less than the benchmark or cost-recovery price), global subsidies for fossil fuels amounted to USD492bn in 2011. However, on a *post-tax basis* (where negative externalities such as health and pollution are also taken into account), the global subsidy was USD2trn. The more recent May 2015 IMF working paper found post-tax subsidies to be higher than previously estimated, at USD4.9trn (6.5% of global GDP) in 2013 and projected to reach USD5.3trn (again, 6.5% of global GDP) in 2015. Table 9 provides a summary of the range of subsidy estimates based on different methodologies.

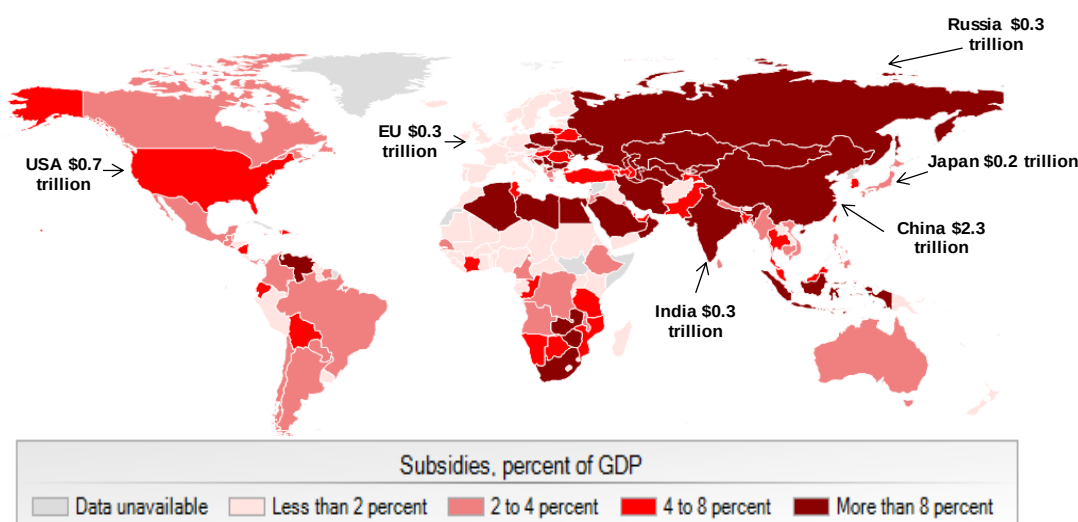
Table 9: Estimates of energy subsidies

Agency	Subsidy (USD)	Year/s	Region	Approach/ constituents
IEA	543bn	2014	World	<i>Price-gap approach</i> : compares end-user prices with reference prices
ODI	775bn	2012	World	Includes exploration (USD88bn) and consumption (USD687bn) subsidies
OECD	50-90bn	annually (2005-11)	34 OECD countries	<i>Inventory approach</i> : direct budgetary support, tax expenses that provide a benefit for fossil-fuel production or consumption
IMF	492	2011	World	<i>Pre-tax</i> : compares consumer prices with supply costs
IMF	2trn	2011	World	<i>Post-tax</i> : compares consumer prices with supply costs, also includes a 'corrective' tax to reflect externalities and a consumption tax

Source: How large are global energy subsidies?, IMF working paper, May 2015, The fossil fuel bailout: G20 subsidies for oil, gas and coal exploration, E. Bast et. al., ODI, Oil Change International, Nov 2014

Subsidies eat into government budgets, which might be better spent on other areas such as improving infrastructure, healthcare, and education, as shown in Chart 5.

Chart 5: Energy subsidy is high in developing compared to developed countries (2015e)



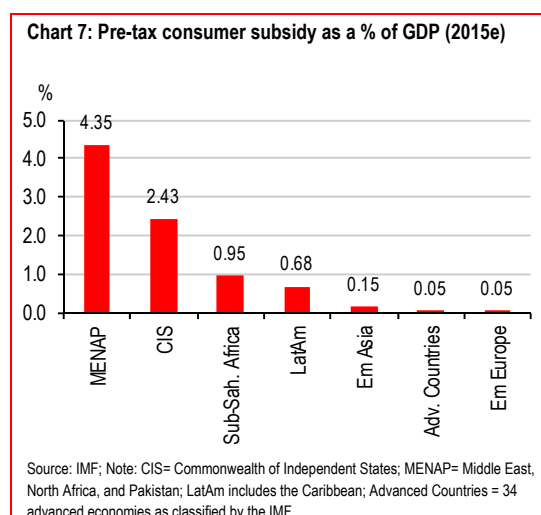
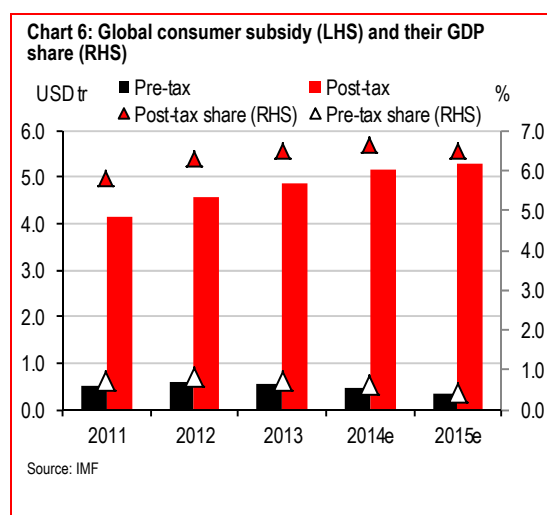
Source: IMF

How do energy subsidies work?

Energy systems are subsidised in different ways, with energy subsidies applied to benefit producers or consumers.

On the producer side, the subsidy can be applied to inputs to production, e.g. oil (making them cheaper), to the capital required to finance projects (e.g. cheaper funding for loans), tax rebates, or a straight forward budgetary transfers from government to producer. Essentially a producer subsidy exists if profitability is greater than it otherwise would be, through either direct or indirect support. The IMF and OECD find producer subsidies to be relatively smaller than consumer subsidies.

On the consumer side, there are pre-tax and post-tax subsidies. A *pre-tax consumer subsidy* reduces the price paid by consumers when compared against a simple benchmark price – the cost to producers to supply the energy. If the gap is negative (i.e. the consumer pays less than the cost of production), then the consumer is receiving a pre-tax subsidy. Charts 6 and 7 shows the IMF estimates of *pre-tax subsidy*.



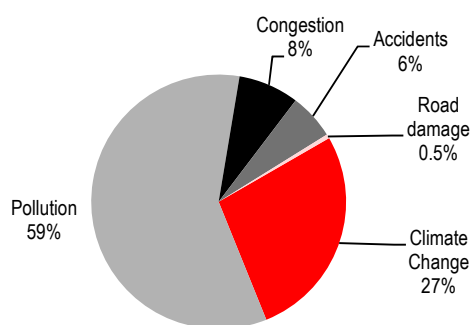
A *post-tax consumer subsidy* however, is the effective price paid by consumers against a more complicated benchmark price – the cost to producers to supply the energy plus the *negative externalities* associated with high fossil energy such as local air pollution, the associated detrimental health impacts as well as the CO₂ contribution to climate change. In effect, the consumer is under-charged for energy consumption because he or she does not provide funding for health treatment for instance. Post-tax consumer subsidies are much larger than pre-tax estimates, as shown in Table 9. Some estimates of the post-tax consumer subsidy also take consumption taxes into account that are charged to raise revenue for health for instance.

Energy subsidies and the climate change externality

The IMF includes local pollution, climate change, congestion, accidents and road damage as *negative externalities*. Climate change accounts for over a quarter of the externalities (Chart 8). Post-tax consumer subsidies pass on the cost of these externalities to *society*. Since governments do not price externalities efficiently, we all bear the consequences and have relatively little control over minimising them. From a climate perspective, we think it would be better if these *negative externalities* were borne by either the *producer* or the *consumer* – rather than society-at-large.

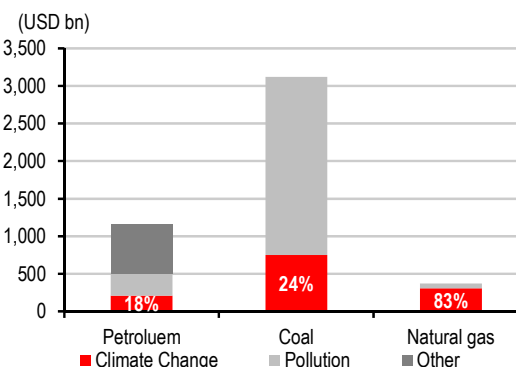
If the **producer pays** for these externalities then cleaner or lower-carbon technologies would emerge as a much more attractive proposition against fossil fuels since the producer would choose to invest in more profitable energy options. This would result in a lower supply of carbon-intensive fuels and, possibly, a more rapid rate of advancement in lower-carbon technologies.

Chart 8: Components of externalities (2015e)



Source: IMF

Chart 9: Externality by fossil fuel (2015e)



Source: IMF. Note: other includes congestion, accidents and road damage

The IMF finds that coal is the most subsidised fossil fuel due to the high environmental damage (mainly air pollution) caused from its use and also, unlike the road fuels, governments normally do not impose excise duty on its consumption (Chart 9). Its contribution to climate change is also the highest in absolute terms at USD750bn in 2015. However, in percentage terms, over four-fifths of the negative externalities of natural gas can be attributed to climate change.

If the **consumer pays** for these externalities directly (i.e. it is included in the price of the fuel) then, again, there would likely be a movement towards lower-carbon or cleaner alternatives as demand for carbon-intensive fuels declines. There are thus two stages to subsidy removal. Firstly, accurate pricing of the externality (i.e. associated costs from air pollution or climate change), followed by ensuring that either the producer or the consumer pays for the externality (i.e. not just society-at-large).

Renewable energy subsidies

It is not just fossil fuels that receive subsidies. Electricity produced from renewable energy sources such as wind and solar is often supported in the form of tax incentives, feed-in-tariffs or other investment subsidies. However, these subsidies are usually much lower than those of fossil fuel energy. For example, in 2008, the IEA estimated that subsidy support for non-hydro renewables globally was around USD27bn or US\$4.7/kWh. This estimate was revised in 2013's World Energy Outlook which found that "the global cost of fossil-fuel subsidies expanded to USD544bn in 2012." whereas "financial support to renewable sources of energy totalled USD101bn." This means that the direct cost of renewables subsidies is around one-fifth to one-sixth that of subsidies for fossil fuels – either on the producer or the consumer side – and before externalities are included into the calculation (post-tax consumer subsidy).

According to BP's 2015 Statistical Review of World Energy, renewables accounted for just 2.5% of global primary energy consumption in 2014 vs 86% for fossil fuels. Six percent of electricity generated globally comes from renewables (excluding hydro) and the remaining 67% from fossil fuels. There may be a case for arguing that removing all energy subsidies – for renewable energy as well as fossil fuels – because the

money could be spent on other areas of development such as poverty eradication. We believe that removing all direct (producer and consumer) subsidies would even out competitiveness for renewable energy, especially since efficiencies are improving as the technology improves and costs decline. That said, in our view, there is far more to be gained from removing fossil fuel subsidies alone because the current dollar amount is higher, and the future cost of damages is higher, given the contribution of fossil fuels to anthropogenic climate change. The consequences of fossil fuel subsidy removal would again be to encourage more investment into lower-carbon activities – even before a price on carbon is added on top. We think this would go some way to solving the climate problem, which we look at in the next chapter.

Winners and losers from subsidy removal

The winner from subsidy removal is *society* since it is not bearing the (spread out) costs and consequences of artificially high use of fossil fuels. The losers from subsidy removal depend on who the subsidy was designed to benefit in the first place i.e. consumers or producers. If a subsidy makes a certain activity more profitable, then removing it would reduce the profitability, which naturally has economic consequences. However, there could be a point where the removal of subsidy has an economic value benefit that can offset the profitability loss. We look at the case of Indonesia in Box 5 overleaf. Indonesia's example of energy subsidy reform shows that implementing reform during a period of low oil prices can actually be beneficial because it cushions the impact on consumers and business as well as saves public spending.

Box 5: Indonesia's subsidy reforms saved USD15.4bn

In December 2014, Indonesia announced it would reform its policy on energy subsidies. According to the 'Global Subsidy Initiative' and the IMF, the energy subsidies given to household and industry were the single largest budgeted central expense in 2013, comprising 25% of total expenditure and amounting to around c3-3.5% of GDP.

Floating rate: The Indonesian government significantly increased petrol and diesel prices in November 2014 to reduce the subsidy bill. However, post the announcement of subsidy reform and also aided by falling world crude oil prices, the government reduced the prices of petrol and diesel on 1 January 2015, aligning them with market prices. It also adopted a 'managed floating rate' semi-automatic system to determine the prices of the fuel in future. Under this new system, petrol was made subsidy-free while the subsidy on diesel was fixed at IDR1,000/litre (USD0.08). Kerosene, was still sold at a fixed price of IDR2,500/litre (USD0.20).

Fiscal impacts of subsidy reform: Indonesia is also looking to reduce the electricity subsidy in 2016 with a targeted reach to poor and vulnerable households. As a result, the electricity subsidy in the state budget 2016 is cut to IDR50trillion (USD4bn) compared IDR104trillion (USD8.3bn) in 2014 representing a 50% reduction (Table 10).

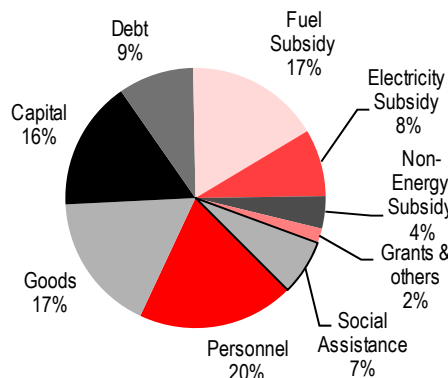
Table 10: Energy subsidy reform in Indonesia

USDbn	SB 2013	RSB 2013	SB 2013 (audited)	SB 2014	RSB 2014	SB 2015	RSB 2015
Fuel subsidy	18.5	19	20.1	16.9	19.7	22.1	6.5
Electricity subsidy	7.8	9.6	9.6	5.7	8.3	5.5	6.1
Subsidy to GDP ratio	3.0%	3.2%	3.4%	2.7%	3.5%	3.1%	1.3%
State revenue	146.4	143.7	138	133.4	130.8	143.5	141.5
State expenditure	161	165.2	157.9	147.4	150.2	163.2	159.6
Budget deficit	14.7	21.6	20.3	14	19.3	19.7	18.1
GDP	891	908	871	828	804	891	953
Deficit to GDP ratio	1.65%	2.38%	2.33%	1.69%	2.40%	2.21%	1.90%

Source: Indonesia energy subsidy review, GSI, IISD, March 2015; Note: SB = State budget, RSB = Revised state budget, fuel subsidy includes premium, solar, kerosene and LPG 3-kg combined, State expenditure includes transfer to regions, exchange conversions for 2013 IDR10,451 per USD (official figure), for 2014 and 2015 are assumed at IDR12,500 per USD.

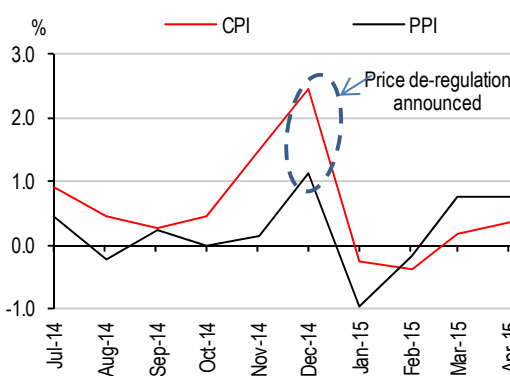
After the subsidy reform, the budgeted subsidy expense in Indonesia for 2015 declined c55% to 1.3% of GDP as per the revised state budget. A key impact of the reform is the expected reduction of the fiscal deficit to 1.9% of GDP in 2015 against 2.4% in 2014. Consumer and producer price inflation peaked in December 2014 post the fuel price hike in the previous month but has been within the normal band through the first quarter of 2015 (Chart B).

Chart A: Central expense budgeted in 2013



Source: Indonesia energy subsidy review, GSI, IISD, March 2015

Chart B: inflation peaked in Dec 2014



Source: Statistics Indonesia

Conclusions

Fuel subsidies artificially increase the use of carbon-intensive fuels by spreading out the cost of associated negative externalities across society-at-large. In doing so, this absorbs a lot of cash that could be used for other public services such as education, healthcare or infrastructure. Removing subsidies i.e. making either producers or consumers pay for these externalities directly would likely shift demand away from carbon-intensive fuels to cleaner, lower-carbon alternatives. The ‘co-benefits’ of subsidy removal would be improved health through lower air pollution. The effect of subsidy removal on a post-tax consumer basis is similar to partly putting a value on carbon. Separating out the externalities (climate change vs local pollution) could be difficult, however.

Wider pricing issues

- ▶ It is just a matter of time before pricing carbon becomes the norm as industry and business seek more policy certainty
- ▶ The economics for cleaner energy systems are already improving as technology advances – carbon pricing further enhances this
- ▶ Capital allocation consistent with a low-carbon economy will become more prevalent with carbon pricing – green bonds to lead

Carbon pricing is here to stay

The global interconnectedness of climate change – and carbon pricing

In Chapters 2 and 3, we showed that some carbon pricing mechanisms are already in place through taxes and trading. While not perfect, we think that the risk of complete reversal of the existing schemes in operation is unlikely, since climate is an all-inclusive concept. Just as the effects of increased warming from GHGs affect the whole world, so the climate actions of other countries will still likely have implications because of global economic interconnectedness, even if one country decides not to introduce greenhouse gas mitigating actions. For example, countries which are more dependent on exporting energy resources could feel the effects of climate policy that is implemented in other regions.

Take energy systems for instance. Economic activity is the primary driver of energy demand. While there is a base level of energy use that households need for heat and light, innovation in energy efficiency, and new infrastructure systems mean that future energy demand is unlikely to have the same relationship with economic activity as it has in the past. In other words, the precedents for forecasting energy demand are not as robust as before in our view. In addition, we expect the growth of lower-carbon technologies. This means that in the future governments and corporates may over-estimate high-carbon energy demand requirements for future growth, and underestimate the scale up of renewables, which will impact domestic and international trade.

Better climate knowledge will lead to carbon pricing

We believe carbon pricing (taxes or trading) will become more prevalent in the future. As knowledge of the (negative) consequences of climate change improves with more scientific research and better modelling, the urgency of mitigating emissions will become more acute in our view. As discussed above, carbon pricing is an effective means to temper down emissions. In addition, more industries are calling for policy-certainty when it comes to climate change, including carbon pricing. Policy-certainty helps businesses make better decisions for the long term. For example, if carbon pricing was *never* going to happen (i.e. zero probability), then businesses would not have to even consider it when deciding which

projects to pursue and which technologies to invest in advance. However if carbon pricing *might happen*, then it must be considered in business decisions. In our view, policy-certainty would lend itself to more assessments around carbon pricing.

Regional scale-up and linking of pricing schemes

Some nine jurisdictions are looking to introduce more carbon pricing. For example, although China already has seven pilot carbon trading schemes up and running, it has allowed other regions to explore setting up more schemes as well preparing for national trading from (possibly) 2016. In our view, carbon taxes are likely to remain a domestic focus, whereas trading has the opportunity to be interlinked, as in the case of California and Quebec.

Linking trading schemes: California and Quebec

In October 2013, California and Quebec signed an agreement concerning “The harmonization and integration of cap-and-trade programs for reducing greenhouse gas emissions.” Various articles were agreed including the: mutual recognition of compliance instruments; trade of compliance instruments; joint auctions; and common program registry and auction platforms. This was done after a comprehensive review of each other’s schemes and working towards a compatible set of regulations (which were broadly similar given that both schemes were part of the Western Climate Initiative).

Besides regulations, the most important step was the development of a system which allowed the linking of the two schemes. California and Quebec jointly developed their Compliance Instrument Tracking System Service (CITSS). This system allows instruments from either scheme to be used in compliance in by emitters covered by either jurisdiction. The two schemes officially began linkage on 1 January 2014, and held their first joint auction on 19 November 2014.

Global carbon price

The linking of regional trading schemes would be the beginning of a *global carbon price*, in our view. As we demonstrated in Chapter 1, there is already a call for this from a cross section of politicians, corporates and investors. From a corporate perspective it would make internal accounting, comparison between projects, and ultimately business decisions easier. We expect various stages to be necessary en-route to a global carbon price. Firstly, enough jurisdictions need to have some form of carbon price. Secondly, two or more of these schemes would need to link up to some degree such that carbon allowances in one scheme could be used in another scheme. At this stage, there may need to be limits on the proportion of allowances transferrable between schemes – this is to ensure the emissions reductions are primarily achieved domestically and economy-wide, rather than just through the trading of allowances. As more schemes collaborate in this manner, we envisage a *convergence* on the price, although not necessarily a single price globally. Since carbon is a global “commodity” without storage or transportation costs, it has the potential to become an efficient market with slight differences in pricing. For example, different trading and transaction costs, as well as country-specific policies would still allow for differential pricing although we think movements in prices would be broadly linked.

Economic drivers will overtake political ones

We expect economic drivers for a low carbon transition to start overtaking political drivers. As the realities of climate change become more apparent, more certain, with the impacts felt more at local levels, we think the urgency for climate action (policy and pricing) will start to bite. Historically, policy, while

implemented and working in some regions such as Europe, has been challenged in others (US, Australia) because of domestic politics. Although we do not underestimate the influence of domestic political challenges on the road to Paris, we think these will gradually be overwhelmed by the reality of climate change impacts and scientific evidence and the associated estimates of the cost of consequences. Pricing should help to mitigate some of the challenges which arise from climate change.

The rise of renewables – technological drivers

We think that technology will also help to improve economics drivers. In a global context renewable energy is still small. It provides just 2.5% of the world's primary energy needs. But, as we demonstrated in [The rise of renewables](#) (26 April 2015), USD1m invested in clean energy today buys on average 30% more capacity than it did in 2010. The unit costs of power from wind and solar have fallen by 23% and 55%, respectively over the same period. Regardless of politics, the falling price of power generation from renewable sources will help to improve its competitiveness against fossil-fuel based sources of power generation. We are already seeing onshore wind and solar become increasingly competitive with coal and gas in a number of countries.

Besides advances in renewables (more efficient solar, wind), newer technologies and innovation should also contribute to shifting economics in favour of lower-carbon. For example, energy storage capabilities could change how renewables contribute to the power mix, with smarter transmission systems providing a leg up for efficiency.

Green investment flows will be more transparent

Going forward, we believe it is important for financial flows to demonstrate that the economic system is moving in the right direction to reduce GHG emissions and increase resilience to the consequences of warmer temperatures – in other words, financing for a 2°C world. In any case, capital will be deployed to cope with a growing population, provide better networks and systems and enhance economic growth prospects, but the important point in our view is for capital to be allocated in a way that leads to sustainable growth by avoiding locking-in CO₂ trends to a high-carbon future.

We expect the marriage of climate policy and investment flows to become more transparent. In our view, a key factor for the success of the talks in Paris comes from the amount of trust between countries. The parties of the UNFCCC have been talking about how to confront the climate problem for a long time, with the deal breaker generally how the transition to a low-carbon economy will be paid for. In Paris, the collective will need trust that countries are committed to doing what they say they will in terms of reducing CO₂, and trust that there will be a financial safety net for the poorest countries that are the most vulnerable to the consequences of warmer temperatures (extreme droughts and floods), but least able to pay for them. The demonstration that capital is allocated in a means consistent with a low-carbon economy will become more prevalent in our view, with the green bond market leading the way.

Financial decisions have long incorporated discount rates, interest rates and the cost of capital. We think the price of carbon could also play an important role in financial decisions of the future.

Conclusions

Carbon prices have long been advocated as a means to tackle GHGs and have already been implemented in some regions. Attaching a price to carbon, and ensuring that global emissions are kept within certain caps, would drive investment towards lower-carbon technologies because there would be a natural “limit” to how much GHGs can be emitted. As with any finite resource, investment would flow towards finding alternatives – either substitutes or different ways of doing things to achieve the same outcome.

The removal of subsidies, such that either the producer or the consumer pays for the externalities, levels the playing field for energy. Carbon-intense activities are no longer (artificially) favoured; investment naturally flows towards lower-carbon technologies, which is positive for confronting climate change. Subsidy removal is already underway in some countries.

The challenge for both these approaches is implementing accurate pricing of the CO₂ externality such that it becomes cheaper to invest in lower-carbon now, rather than do nothing and face the consequences of unpalatable climate change later. However, confronting the CO₂ externality also comes with co-benefits such as a lower health cost burden and an improved natural environment (cleaner air and, to some extent, cleaner water). Nonetheless we expect further pricing implementation on a regional basis.

References

External Research Papers

- Alberta Government, Environment and Sustainable Resource Development Annual Report 2013-14
- Alberta Government, Annual Summary of Specified Gas Emitters Regulation: 2009
- Bureau of the Environment - Tokyo Metropolitan Government, Tokyo Cap-and-Trade Program, March, May 2010
- California Air Resources Board Quarterly Auction Summary Results Report 2012, 2013, 2014
- California Cap-and-Trade Program and Québec Cap-and-Trade System Joint Auction Summary Results Report 2013, 2014, 2015
- Carbon Market Watch Report, Towards a Global Carbon Market Prospects for Linking the EU ETS to other Carbon Markets, May 2015
- CCEP - GRI, Assessing the effectiveness of the EU Emissions Trading System, Tim Laing, Misato Sato, Michael Grubb and Claudia Comberti, January 2013
- CCEP - GRI, Burden or opportunity? How UK emissions reductions policies affect the competitiveness of businesses, Samuela Bassi and Dimitri Zenghelis, July 2014
- CDP, Global Corporate Use of Carbon Pricing, September 2014
- C2ES, Comparison of Carbon Pricing Proposals in the 113th Congress, Jason Ye, December 2014
- DARA, Climate Vulnerability Monitor 2010: The State of the Climate Crisis, 2010
- EPA, Factsheet: Social Cost of Carbon, November 2013
- EDF - IETA, The World's Carbon Markets: A Case Study Guide to Emissions Trading (Alberta, Brazil, China, India, Japan, Mexico. Quebec, RGGI), May 2013 - March 2014
- European Commission, Factsheet: The EU Emissions Trading System (EU ETS), 2013
- European Environment Agency, Country profile – (Denmark, Finland, France, Sweden), 2014
- GSI - IISD, Indonesia Energy Subsidy Briefing, June 2014, 2015
- ICAP, Korea Emissions Trading Scheme, February 2015
- ICAP, Emissions Trading Worldwide Status Report 2014
- IEA, Managing interactions between carbon pricing and existing energy policies, Christina Hood, 2013
- International Chamber of Commerce, Carbon Pricing Principles, June 2015
- IETA, Allowance Reserves across Emission Trading Systems, April 2014
- IMF, Fiscal Policy to Mitigate Climate Change: A Guide for Policymakers, 2012

IMF, Working Paper - How Large Are Global Energy Subsidies?, David Coady, Ian Parry, Louis Sears, and Baoping Shang, May 2015

Institute for Public Policy Research, Growing Pains - British Industry and the Low-Carbon Transition, 2012

IPCC, 2014: Africa. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Niang, I., O.C. Ruppel, M.A. Abdrabo, A. Essel, C. Lennard, J. Padgham, and P. Urquhart, 2014

IPCCC, National Inventory Submissions 2014 – United States: Main Text and Annex, April 2014

Japanese Ministry of Environment, Details on the Carbon Tax, 2012

Ministry of Finance, British Columbia, Budget and Fiscal 2008, 2009, 2012

Ministry of Finance Government of India, Budget 2015-16, February 2015

Ministry of Finance Tax Bulletin, British Columbia, Tax Rates on Fuels Motor – Fuel Tax Act and Carbon Tax Act, December 2014

National Roundtable on the Environment and Economy Canada, Getting to 2050: Canada's Transition to a Low-emission Future, 2007

National Treasury, Republic of South Africa, Carbon Tax Policy Paper – Policy Paper for Public Comment, May 2013

Navius Research Inc., Is British Columbia's Carbon Tax Good for Household Income? Working Paper, Noel Melton, Jotham Peters, July 2013

NREL: U.S. Department of Energy, Carbon Taxes: A Review of Experience and Policy Design Considerations, Jenny Sumner, Lori Bird, and Hillary Smith, December 2009

OECD, Pricing Carbon – Policy Perspectives, 2013

OECD, The Social Cost of Carbon, Paul Watkiss, 2007

Pew Center on Global Climate Change, The European Union's Emissions Trading System in perspective, A. Denny Ellerman, Paul L. Joskow, May 2008

PMR, Preparing for Carbon Pricing, Technical Note 9, January 2015

SSRN, Salience of Carbon Taxes in the Gasoline Market, Nicholas Rivers, Brandon Schaufele, October 2014

Stern Review: The Economics of Climate Change, Nicholas Stern, Jan 2007

Stockholm Environment Institute, Did the Stern Review underestimate U.S. and global climate damages, Frank Ackerman, Elizabeth A. Stanton, Chris Hope, and Stephane Alberth, October 2008

Sustainable Prosperity, The Political Economy of California and Québec's Cap-and-Trade Systems, Mark Purdon, David Houle, Erick Lachapelle, 2014

The Economist – Intelligence Unit, The cost of inaction: Recognising the value at risk from climate change, 2015

Upstream versus Downstream Implementation of Climate Policy, Erin T. Mansur, June 2010

Whitehouse, Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis, November 2013

Whitehouse, The Cost of Delaying Action to Stem Climate Change, 2014

World Bank, Cities and Climate Change Mitigation: Case Study on Tokyo's Emissions Trading System, May 2010

World Bank, Decarbonizing Development, Three Steps to a Zero-Carbon Future, May 2015

World Bank, Green Subsidies and the WTO, Steve Charnovitz, October 2014

World Bank, State and Trends of Carbon Pricing, May 2014

Datasets

British Petroleum, BP Statistical Review 2014

California Air Resource Board Carbon Pricing Auction Reports 2012, 2013, 2014

Danish Energy Agency Database

Intergovernmental Panel on Climate Change Fifth Assessment Report

International Carbon Action Partnership (ICAP)

International Energy Agency, Policy and Measure Databases

International Energy Agency, World Energy Outlook, 2014, 2013, 2012 and 2011

International Monetary Fund

Regional Greenhouse Gas Initiative

The World Bank, The World Bank Database

World Bank, State and Trends of Carbon Pricing May 2014

World Resource Institute, Climate Analysis Indicators Tool

Websites

International Monetary Fund

European Commission

International Capital Market Association

International Emissions Trading Association (IETA)

United Nations Framework Convention on Climate Change

Selected HSBC climate change reports:

[No water, more trade-offs, 24 August 2015](#)

[US: Methane next in line, 20 August 2015](#)

[Taking stock of progress to Paris, 12 August 2015](#)

[Obama targets coal-fired power, 05 August 2015](#)

[Negotiation tool to expedite talks, 28 July 2015](#)

[UK: mixed messages on climate, 27 July 2015](#)

[Japan's nuclear-reliant pledge, 21 July 2015](#)

[Green buildings and climate, 21 July 2015](#)

[Adapting to the worst case scenario, 14 July 2014](#)

[UK: no help for tackling CO₂, 10 July 2015](#)

[New Zealand's provisional pledge, 08 July 2015](#)

[Singapore signs up to Paris, 06 July 2015](#)

[Green Bonds in China, 06 July 2015](#)

[China's ambitious climate pledge, 01 July 2015](#)

[Korea pledges for Paris, 01 July 2015](#)

[Improving health with climate, 25 June 2015](#)

[Decoupling CO₂, energy & GDP, 18 June 2015](#)

[Bonn: slowly but surely, 12 June 2015](#)

[Ethiopia first LDC to pledge, 11 June 2015](#)

[G7 climate change declarations, 09 June 2015](#)

[Morocco pledges for Paris, 08 June 2015](#)

[Bonn: more vocal, less text, 05 June 2015](#)

[Paris shifts up a gear, 29 May 2015](#)

[Canada sets out pledge for Paris, 20 May 2015](#)

[Green bonds: More to come, 08 May 2015](#)

[Minnows maintain momentum: Gabon,](#)

[Lichtenstein and Andorra latest to submit INDCs,](#)
[08 May 2015](#)

[Climate Impacts: Getting hotter, 23 April 2015](#)

[China releases Water Plan, 16 April 2015](#)

[Stranded assets: what next?, 16 April 2015](#)

[US and Russia set climate aims, 1 April 2015](#)

[Norway and Mexico set out aims, 31 March 2015](#)

[UK: favoured oil is climate foe, 26 Mar 2015](#)

[Winning China's war on pollution, 20 March 2015](#)

[EU: No surprise en route to Paris, 12 March 2015](#)

[Switzerland: a good opener, 04 March 2015](#)

[Keeping it cool: Oil, CO₂ and the carbon budget,](#)
[02 March 2015](#)

[EU: climate strategy on track, 27 February 2015](#)

[Geneva climate talks deliver, 18 February 2015](#)

[EU: Saving energy, 13 February 2015](#)

[India & US: Courting consensus, 03 February 2015](#)

[Pollution control in shipping, 29 January 2015](#)

[US to regulate methane emissions, 15 January 2015](#)

[Korea's emissions trading begins, 13 January 2015](#)

[2015: Dissect, debate, deliver, 07 January 2015](#)

[Keeping it cool: Oil, Financing a 2°C World,](#)
[10 September 2015](#)

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Zoe Knight is Head of the Climate Change Centre of Excellence at HSBC. She joined HSBC in 2010 and has been an investment analyst at global financial institutions since 1997, initially focusing on pan-European small-cap equity strategy before moving into socially responsible investing, covering climate change issues. She contributed to the FTSE's 2009 book 'Investment opportunities for a low-carbon world'. Since joining HSBC Zoe has co-authored reports on low-carbon opportunities in bond and equity markets, as well as long-term carbon and water risks. The Climate Change Centre of Excellence produces reports on 2°C finance, climate policy and climate impacts which are aimed at institutional investors. Throughout her career Zoe has been ranked in Extel and Institutional Investor surveys. She holds a BSc (Hons) Economics from the University of Bath.



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Wai-Shin joined HSBC in 2011 as the Director for Climate Change Strategy in Asia Pacific. The role involves helping HSBC's clients to prepare their portfolios for the effects of climate change, as well as internal consulting for different business functions within the bank. Before HSBC, Wai-Shin worked as a fund manager where he was centrally involved in the integration of Environmental Social Governance (ESG) issues into the investment decision-making process. He is a former Executive Director of ASrIA (Association for Sustainable and Responsible Investment in Asia) and was previously the ESG equity analyst for Asia at an investment bank. Wai-Shin holds a degree in Mathematics and Physics from Durham University (first class honours) and is a CFA charterholder.



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Issuer of report: HSBC Bank plc