

CARBON PRICING PATHWAYS

NAVIGATING THE PATH TO 2°C

PREFACE

To governments, businesses and investors working on their contributions to address dangerous climate change, the role of carbon pricing is increasingly clear.

Today, 12% of the world's annual greenhouse gas emissions are covered by a patchwork of carbon pricing policies found in 39 countries and 23 regions. A greater slice of global emissions will be captured in the coming 12 months as new schemes are expected to come online in China, South Africa and elsewhere.

More than 1,000 companies have this year reported to CDP that they are using an internal carbon price or planning to do so within two years. This represents a remarkable upward shift compared against past indicators. They see carbon pricing as a crucial financial tool to manage environmental risk and shift investment toward cleaner energy.

There is general consensus that carbon pricing can drive the economic transition needed to keep global temperatures to within 2°C of pre-industrial levels. Questions arise about what effective carbon pricing policies and pricing levels look like, and how they can best interact with the suite of complementary policies that also deal with emissions reductions. There is growing awareness that a generic call for carbon pricing, without a thoughtful examination of these questions and others, will not lead to progress.

The Carbon Pricing Pathways Project, led by CDP and the We Mean Business Coalition, seeks to accelerate the adoption of effective carbon pricing mechanisms around the world. We bring decision-makers together to have specific conversations about the price levels necessary to drive economic transformation, how carbon pricing policies interact with other policies, and the pathway to reaching a convergence of carbon pricing policies in the future. These conversations will draw on the simple concepts developed in this project, as well as the learnings of what carbon pricing can achieve gathered from current experience.

This Carbon Pricing Pathways Toolkit is a set of conceptual tools intended to stimulate productive dialogue about the future of carbon pricing. It is time that harmful CO₂ emissions carry a price, and determining that value should engage policymakers, business and investors alike.

September 2015

Front Cover Credit:

Aerial view of winding, mountain road in California.

Photo by Ron Chapple Studios

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EXECUTIVE SUMMARY

WE NEED A STRATEGIC CONVERSATION ABOUT CARBON PRICING.

Business and investors are calling for robust policies that place a price on CO₂ emissions to drive investment in low carbon solutions. A growing list of governments are taking notice and have enacted systems or plan to do so. Yet, conversation among business, investors and governments often gets stuck. A gulf exists between a general discussion about the obvious – “we agree that a price on carbon is important” – and a detailed, technical discussion about the intricacies and scale of policies.

Carbon pricing policy is complex. There are dynamic interactions between international agreements and national law, between regulation and industry-led action, between carbon taxes and cap-and-trade systems, and between explicit and implicit carbon prices. Setting future prices becomes even more difficult given ambiguity about government commitments to cutting emissions, and market uncertainties about how long policies will last.

Why do price levels matter? Policymakers need to know the prices at which technologies will shift. Many countries are currently trying to understand price levels needed to encourage the switch from coal- to gas-generated electricity. Businesses need to allocate resources and capital in line with future carbon prices. Investors need to assess portfolio risks, including the risk of stranded assets, in a fast-changing climate policy landscape. It makes sense to prepare to better navigate changing seas.

The **Carbon Pricing Pathways Toolkit** is meant to facilitate important conversations about the nature of carbon pricing and the development of price levels. We need well-designed policies and well-informed business and investment decisions to achieve a sustainable, profitable, low carbon future. The ‘right’ conversation about carbon pricing can help to ensure the global economy thrives while limiting global warming to 2°C below pre-industrial levels, by promoting:

- Widespread adoption of effective carbon pricing policies
- Carbon price levels to transform economies with large-scale decarbonization
- Converging carbon price levels over time to ensure open markets

Now is the time to engage more decision-makers in this strategic conversation.



THE TOOLKIT OFFERS A FRAMEWORK TO DISCUSS EFFECTIVE CARBON PRICING.



CARBON PRICING PATHWAYS TOOLKIT

The Carbon Pricing Pathways Toolkit offers a framework to discuss effective carbon pricing, with concepts to help the global economy navigate the complex waters and uncharted routes to decarbonization.

FINDING AN ENTRY-POINT INTO A COMPLEX PROBLEM

The Toolkit approaches the complexities of the global economy by considering two ‘dilemmas’:

- Global actions versus sovereign and sub-sovereign actions**

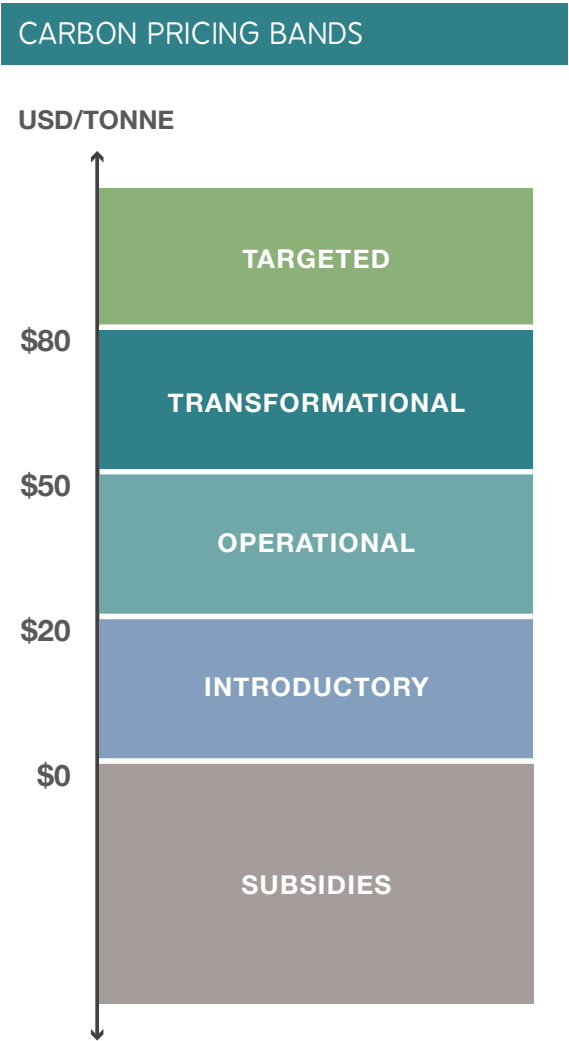
Carbon pricing policies typically reflect the actions of national and regional governments. In some instances, voluntary steps may be also taken by business, investors and the private sector. It is essential that these policies and actions interact positively with international efforts on a range of issues including trade, development and of course, climate change.
- Explicit carbon pricing versus policies that implicitly price carbon**

This Toolkit describes explicit carbon pricing instruments only, such as cap-and-trade systems and carbon taxes. However, it is important to acknowledge that carbon pricing policies alone are insufficient and need complementary policies. Some parts of the economy will not be motivated by carbon prices but may respond to energy efficiency or product performance standards. Others might require a carbon price so high that it is politically unviable, in which case strategic investments in technology research and development may be preferable.

CARBON PRICING BANDS

Carbon Pricing Bands provide a common language to talk about pricing levels, focusing on how price affects economic behavior and vice versa.

- SUBSIDIES:** Fossil fuel subsidies lower the actual cost of carbon, and make low carbon technologies relatively more expensive. This negative price on carbon is one way that governments boost fossil fuel consumption and render low carbon alternatives economically less viable.
- INTRODUCTORY:** Prices up to \$20. Most systems begin in this band, enabling businesses to adapt. Governments give clarity about future policy direction and start to collect revenue. This band is useful, but systems that languish here may not cut emissions enough over time.
- OPERATIONAL:** Price range \$20 to \$50. In this band, carbon prices start to drive economic transformation, enabling structural changes like a wholesale switch from coal- to gas-generated electricity. Carbon taxes and cap-and-trade systems start to generate significant income.
- TRANSFORMATIONAL:** Price range \$50 to \$80. Schemes in this band have secured a low carbon future beyond coal. They carry forward successes from the operational band. For example, renewables are likely to be the most attractive investment, replacing gas, and capital flows will prompt low carbon technological breakthroughs.
- TARGETED:** Prices above \$80. In limited circumstances, this band may support specific policy objectives such as eliminating certain fuel sources.



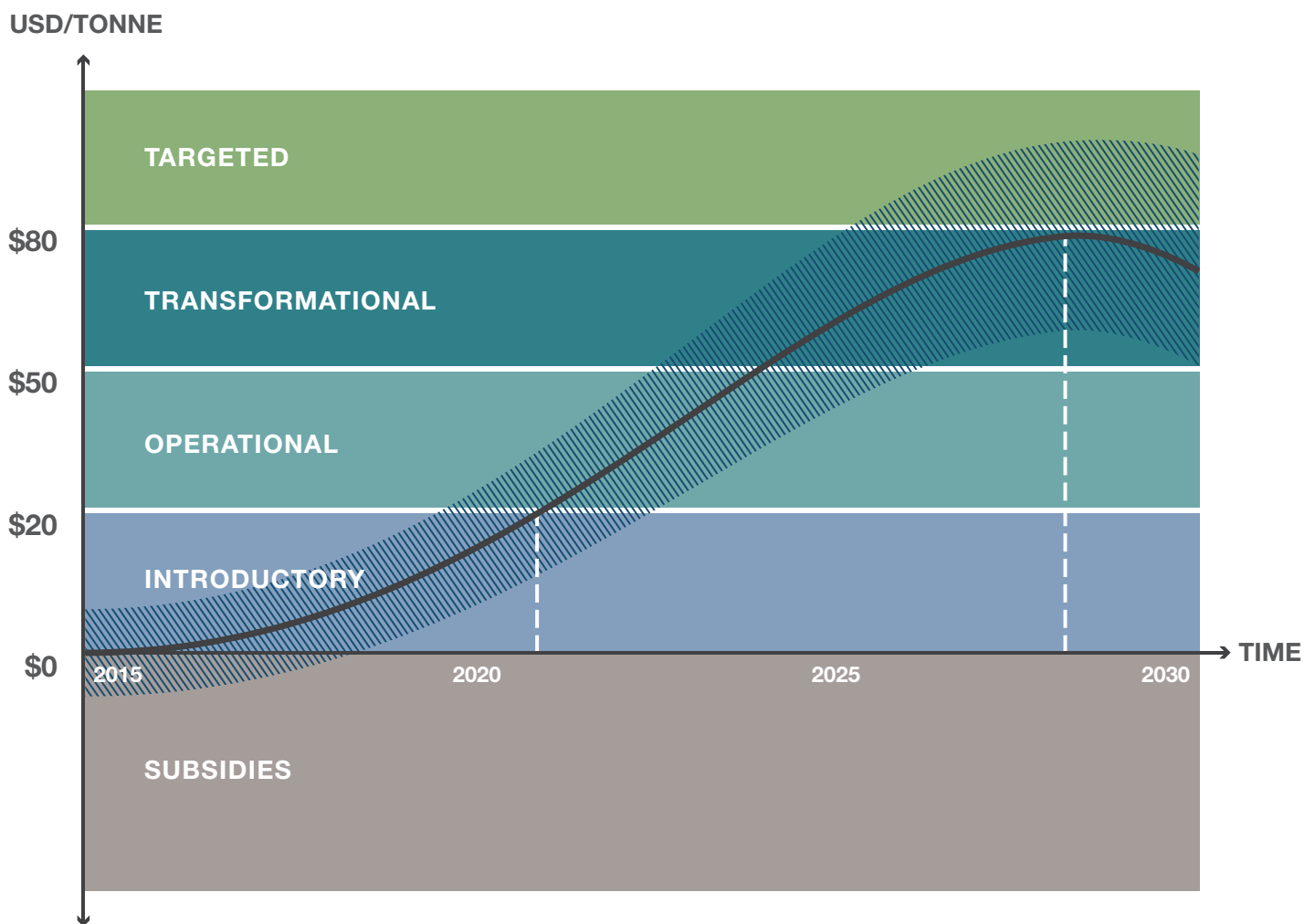
CARBON PRICING TRAJECTORIES AND NARRATIVES

Carbon Pricing Trajectories, each with a corresponding **Carbon Pricing Narrative**, are imagined futures offered to stimulate discussion about this complex question. In the Toolkit's first trajectory and narrative, the world succeeds in making the transition to a low carbon economy. The others explore alternative futures in which the global economy does not manage that transition. The future is unknowable, so clearly these trajectories and narratives are not predictive and only portray the possible impacts of today's decisions and actions. Nor are they prescriptive, as no policy recommendations are intended.

SAILING TO THE NEW LOW CARBON WORLD

Global temperatures remain within 2°C of pre-industrial levels: Business, investors and governments successfully navigate the complex waters of climate policy, guided by domestic policies and global agreements. Globally, carbon pricing is a popular policy choice; mature schemes quickly reach price levels needed to drive fuel switching, and effective mechanisms are introduced to drive price convergence. Carbon pricing sits within a package of complementary policies, which work together to deliver a low carbon economy.

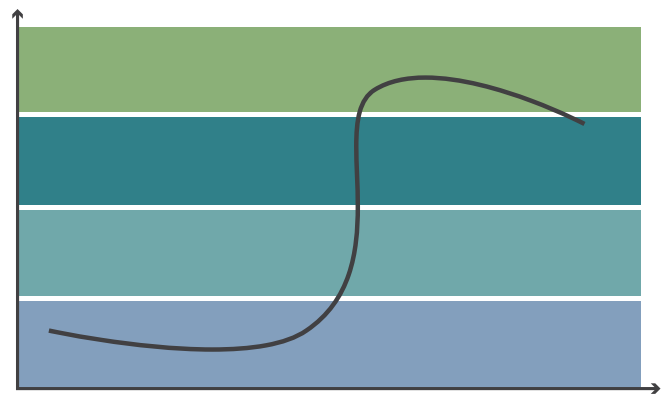
SUCCESS TRAJECTORY: SAILING TO THE NEW LOW CARBON WORLD



SAILING INTO THE CLIFF

Delayed action means global temperatures rise by 3°C or more: Global agreements are strong, but few effective national carbon pricing policies emerge. Greenhouse gas emissions diminish slowly, until catastrophic weather events trigger a radical course-correction, with carbon prices soaring worldwide. Unprepared, the world economy is crippled. Emissions do quickly drop, but the carbon budget is already breached. The accompanying trajectory shows sustained low carbon prices, which suddenly rise above the transformational level.

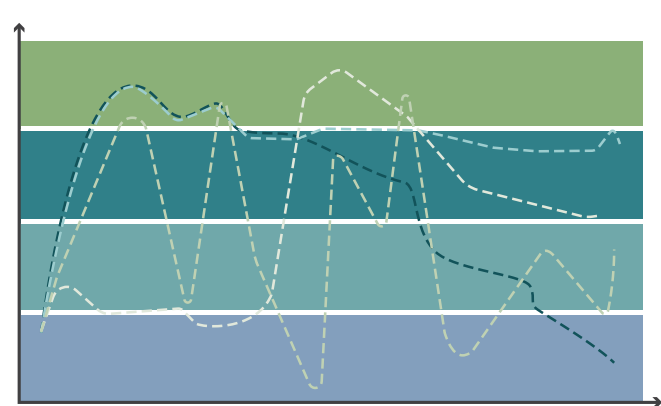
ALTERNATIVE TRAJECTORY: SAILING INTO THE CLIFF



STORMY WATERS

Confusing policy signals and fractured action means this, too, is a 3°C world: Many national carbon pricing schemes emerge, but operate haphazardly, out of sync with other domestic policies and global climate change agreements. Price convergence is unachievable. Just a handful of sectors effectively drive down CO₂ emissions. Carbon prices follow a chaotic trajectory, reflecting changing (and collapsing) political will, as well as business and investor confidence. Decarbonization of the global economy is too slow.

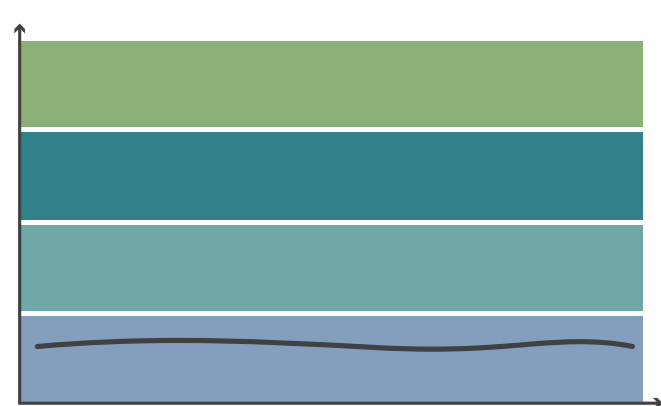
ALTERNATIVE TRAJECTORY: STORMY WATERS



RUNNING AGROUND

In the face of limited national ambition and an underwhelming global agreement on climate change, carbon prices languish in a 4°C world: As an issue, climate change promptly recedes to the background; coal consumption accelerates to support development priorities. Significant economic damage and social upheaval demonstrates what it means to remain in a carbon-intensive world.

ALTERNATIVE TRAJECTORY: RUNNING AGROUND



BUILDING THE TOOLKIT

The Toolkit is the work of CDP and the We Mean Business Coalition. It emerged through engagement with the vast body of knowledge on carbon pricing and related subjects, and after working with an expert group of policy, investment, business and civil society leaders listed in the acknowledgements. This group's input was invaluable. However, this Toolkit, and any discrepancies within it, are the responsibility of the authors alone.

Some notes on the development of the Toolkit:

- Its conceptual framework is a 'systems dynamic' for carbon pricing. This framework facilitated a thorough examination of the two dilemmas previously described.
- Futures techniques (strategic dilemmas, scenario thinking, three horizons) helped to explore the range of possible 'system futures' and to define plausible pathways that could deliver both success and failure.
- The notion of 'adaptive pathways' is central to the Toolkit's trajectories and narratives. They describe ways in which individual economies might act and react. They do not predict or prescribe the exact course of action. They should be used as navigational markers to guide exploration of the pathway to a low carbon future.

Excellent materials are available that contain expert guidance on policy design and implementation, and on related issues such as low carbon solutions and new technologies. The Toolkit draws extensively on this knowledge, a selection of which is outlined for reference.

USING THE TOOLKIT

Effective carbon pricing is a key policy instrument to ensure global temperatures do not rise more than 2°C. Successfully navigating this voyage starts by enhancing our ability to make informed decisions today. Crucially, we need to be more skillful in our discussion about the future of carbon pricing, which not only focuses on what is achievable but also on what is needed.

We encourage all to engage with the concepts or 'tools' offered the Carbon Pricing Pathways Toolkit.

Please use them. Discuss them. Critique them.

Please bring them to your stakeholders.

Please help improve them by sharing your experiences, insights and questions.

It is in this spirit that this Toolkit is offered as 'open source' materials, which will be further developed and improved, iteratively. We plan to adapt the Toolkit and issue the next version in 2016.

1. WHY HAVE A CONVERSATION ABOUT EFFECTIVE CARBON PRICING?

CARBON PRICING IS GROWING IN IMPORTANCE

Interest in carbon pricing is stronger than ever. Growing numbers of companies, investors, and governments support the use of carbon pricing as a cornerstone policy to drive the reduction of greenhouse gas emissions.

Yet, the conversation among them often gets stuck. A gulf exists between a general discussion about the obvious – “we agree that a price on carbon is important” – and a detailed, technical discussion about the intricacies and scale of policies. What is missing is a conversation that addresses the level of price needed to achieve the goal of a low carbon economy, and how tangible political and industry leadership can help bring that about.

Why does carbon pricing matter?

- **Companies** need to allocate resources and capital in line with future carbon prices. Robust policies stimulate the right economic environment for business, particularly industries that rely upon heavy emitting production processes and companies that see new opportunities in a decarbonized economy. Companies cite two main reasons for using an internal carbon: to mitigate risk from current or expected regulation imposing a carbon price; and as a financial tool in their risk management and investment processes.
- Carbon pricing is of growing interest to **investors** because it affects the valuation of assets. Investors need to assess portfolio risks, including the risk of stranded assets, in a fast-changing climate policy landscape. Investors representing over \$24 trillion in assets have called for “stable, reliable and economically meaningful carbon pricing that helps redirect investment commensurate with the scale of the climate change challenge”. With the right policy signals, investors can play a pivotal role in financing innovations in clean energy and other climate solutions.
- It is well-documented that many **governments** around the world are imposing a cost on CO₂ emissions to help cut pollution, mitigate the impacts of climate change and build resilient communities. Some, including the US and the UK, measure the ‘social cost of carbon’ when evaluating the damages of incremental increases in carbon emissions.



CARBON PRICING IS A CORNERSTONE POLICY THAT DRIVES THE REDUCTION OF GREENHOUSE GAS EMISSIONS.



CARBON PRICING DEFINED

The primary focus of the Toolkit is a discussion of the explicit carbon price levels needed to drive transformation in the global economic system.

Explicit pricing refers to mechanisms such as a tax or emissions trading scheme where carbon emissions are directly priced. Price ranges are presented in this Toolkit as an aid to illustrate the concepts of carbon pricing bands and carbon pricing trajectories; these price ranges are neither predictive nor prescriptive. Actual future prices are dependent on a mix of policies and expectations.

CO₂ emissions can also be priced implicitly by government policies that encourage emissions reductions, such as energy efficiency standards and renewable energy subsidies. The interaction of explicit and implicit pricing is key to successful climate policy, but this Toolkit does not explore what implicit price levels should be.

A social cost of carbon measures the benefit of reducing greenhouse gas emissions now and thereby avoiding future costs, and is applied to assess the impact of regulations. The social cost of carbon is an important topic that influences this conversation, but this Toolkit does not explore it at length.

Finally, there is a distinction between an external carbon price and an internal carbon price. An external carbon price is an explicit market or regulatory price. An internal carbon price is used within a company to value the cost of a unit of CO₂ emission. While this is an important contribution to the conversation, this Toolkit does not equate internal pricing with external pricing.

STARTING A CONVERSATION ABOUT A COMPLEX WORLD AND A COMPLEX PROBLEM

To open the discussion about how effective carbon pricing can help the global economy to decarbonize, the Toolkit offers two entry-points to thinking about this dynamic and complicated problem.

TWO ESSENTIAL DILEMMAS

- **Global actions versus sovereign and regional actions:** Carbon pricing policies typically reflect the actions of national and regional governments. In some instances, business, investors and private sectors may take voluntary steps. It is essential that these policies and actions interact positively with international efforts on a range of issues including trade, development, and climate change itself.
- **Explicit carbon pricing versus policies that implicitly price carbon (and other regulatory instruments):** As outlined above, this Toolkit discusses carbon price levels created by explicit carbon pricing policies only. However, it is important to acknowledge that carbon pricing policies alone are insufficient and need to be complemented by other policies. This is because some parts of the economy will not be motivated solely by carbon prices, and others might require a carbon price so high that it is politically unviable.

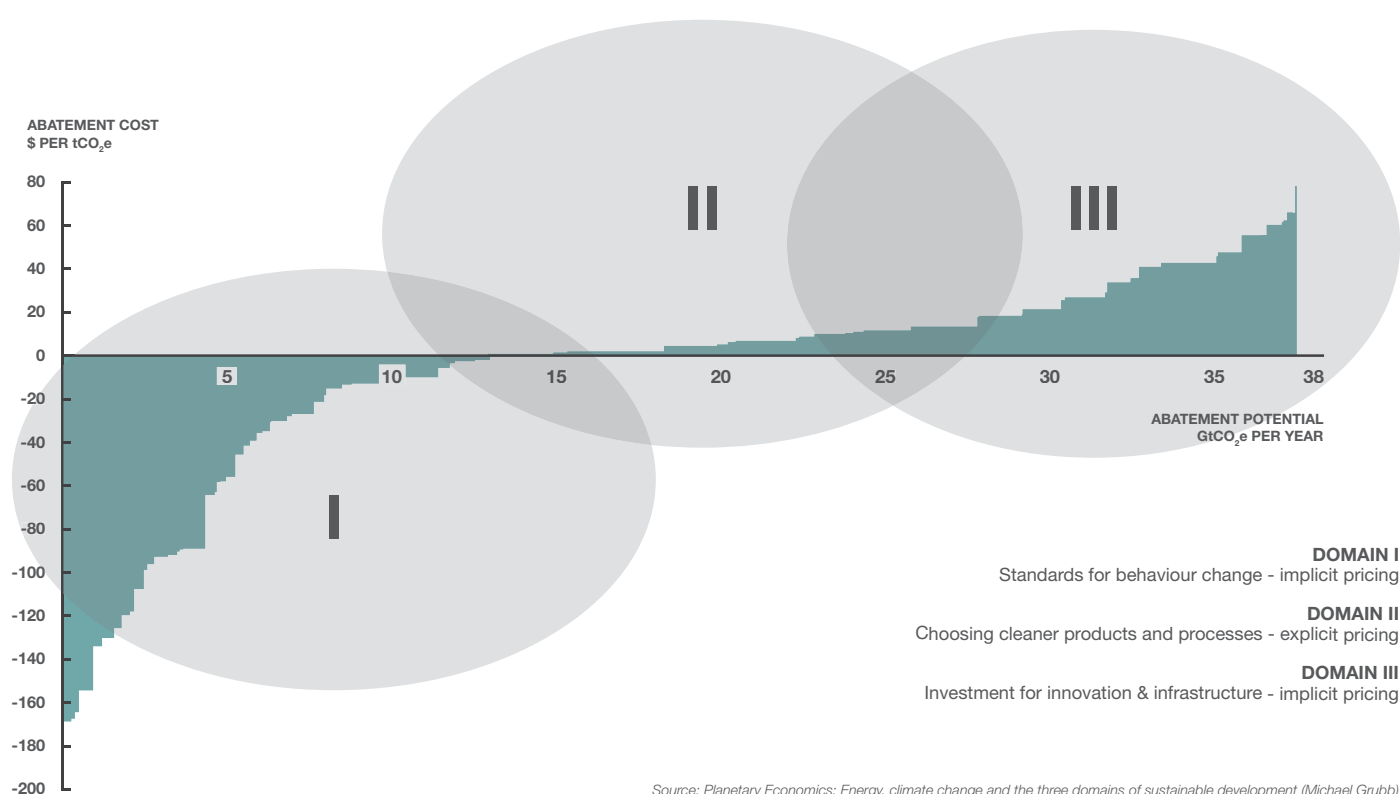
CARBON PRICING WORKING ALONGSIDE OTHER POLICIES

The Three Policy Domains framework is useful to help think about complementary policies.

It demonstrates that a package of policies, including carbon pricing, is the best approach to achieving a low carbon economy. The Three Policy Domains describe different types of policy, which operate best within a specific set of economic sectors, motivations and opportunities.

- **Domain I** policies address areas of the economy where price signals struggle to change behavior. Energy usage is an example of behavior within this domain: consumers may prefer the low-cost appliance to an energy-efficient option that is cheaper in the long run. Policies like energy efficiency and product standards, are most effective in this domain.
- **Domain II** policies address areas of the economy where price signals effectively change behavior. In this domain, market tools such as carbon pricing policies are the most effective in promoting adoption of cleaner products and processes.
- **Domain III** policies address large-scale transformational changes that cannot be achieved by market forces alone. This type of behavioral change generally requires government intervention, such as investments in research and development of new technologies, or in infrastructure to support structural shifts to clean energy.

3 POLICY DOMAINS



Source: Planetary Economics: Energy, climate change and the three domains of sustainable development (Michael Grubb)

A marginal abatement curve shows many different opportunities to cut CO₂ emissions. The inexpensive opportunities sit at the left; the high-cost opportunities at the right. Opportunities below the horizontal axis offer potential cost savings; opportunities above it are expected to come at a net cost.

Overlaying these policy domains on a marginal abatement curve – which summarizes the volume and cost of opportunities to reduce CO₂ emissions – shows that operating in a single domain of policy would be inefficient or ineffective. In this case, emissions reductions would come at too high a cost, or at an underwhelming pace. This also suggests that carbon pricing on its own, as a 'Domain II' policy, would not trigger the adoption of opportunities that sit at either end of the curve.

In order to effectively steer economies through the low carbon transition, policymakers will have to choose the right blend of policies from all three domains, depending on their economic, technological, and political circumstances.



**THE TOOLKIT GIVES A COMMON BASE
OF KNOWLEDGE, LANGUAGE AND
LONG-TERM OBJECTIVE TO HELP BRING
ABOUT A SHARED DIALOGUE.**



2. CARBON PRICING PATHWAYS TOOLKIT

WHAT IS THE TOOLKIT?

A set of conceptual tools intended to stimulate a productive and progressive dialogue about the future of carbon pricing, and the specific values that need to be assigned to the cost of CO₂ emissions, which will engage with policymakers, business and investors alike.

The topic of carbon pricing is often defined by a myriad set of technical, economic, and socio-political intricacies that hinder efforts to deploy carbon pricing policies at scale.

The following set of concepts – ‘tools’ – contained within this Toolkit are intended to facilitate a strategic conversation that approaches these complex considerations within a simple framework. The common base of knowledge, language and long term objectives will bring investors, business, and government leaders into a shared dialogue about how effective carbon pricing policies can help chart the course to a future low carbon economy.

THE POTENTIAL

of carbon pricing to help to keep global temperature rises below 2°C is dependent on:



Adoption by a greater number of the world's governments of policies that embed a value on CO₂ emissions in recognition of its effectiveness in driving down emissions



Setting prices on CO₂ emissions that will transform the growth of low carbon technologies and the transition away from carbon intensive energy sources



The eventual convergence of carbon prices on a global scale over time

The Toolkit is intended to be used by all who operate in the global economy – business, investors, governments, and civil society.

The Toolkit provides a set of core concepts that can be applied by decision-makers that plan to reap the benefits of effective carbon pricing. They are designed to provide actors, from a variety of economic and political contexts, the agency to ‘chart their own course’, using carbon pricing policies, toward a future low carbon economy. The Toolkit is intentionally non-prescriptive and non-predictive. Because it seeks to look into the future, it must be dynamic and changeable.

This Toolkit does not cover the rich body of knowledge on the technical considerations of carbon pricing, including choice of instruments, MRV (monitoring, reporting and verification), and modelling. Similarly, it does not explore in depth the full range of topics that often arise in a conversation about carbon pricing, including revenues, offsets, competitiveness and carbon leakage. Acknowledging that these are all important, and are dealt with in other publications, the Toolkit is a timely complement to bridge the growing political and industry appetite for carbon pricing with the tools for its effective implementation.

WHAT IS COVERED IN THIS SECTION?

Navigational tools: Carbon pricing bands and illustrative prices; carbon pricing trajectory and narrative of success; alternative trajectories and narratives.

Introduction to other topics: Overview of current carbon pricing policies and private sector actions; range of other tools that can help in the development of effective carbon pricing policies; range of other tools that can help business and investors to approach carbon pricing.

CARBON PRICING BANDS

WHAT IS A CARBON PRICING BAND?

A band represents a range of prices that produce specific techno-economic and political effects. Bands allow the user to identify transformational price thresholds necessary for triggering investment and the adoption of alternative, clean technologies.

The deployment of carbon pricing to achieve 2°C will require the linking up of carbon markets. However, given the variety of political and economic circumstances and the unique emissions reduction journeys that each country or region is on, adoption and linkage of carbon pricing in all economies is a longer term goal.

To this end, carbon pricing bands demonstrate to all actors, regardless of their political and economic reality, how they can devise their own adaptive pathway forwards. Carbon Pricing Pathways recognize that there is not one 'true' course of action that fits all circumstances. Pathways are adaptive or dynamic recognizing that any decisions made or action taken today will have subsequent impacts upon tomorrow. So, a successful carbon pricing pathway will be sufficiently flexible to respond to changes happening within an economy, and outside of it.

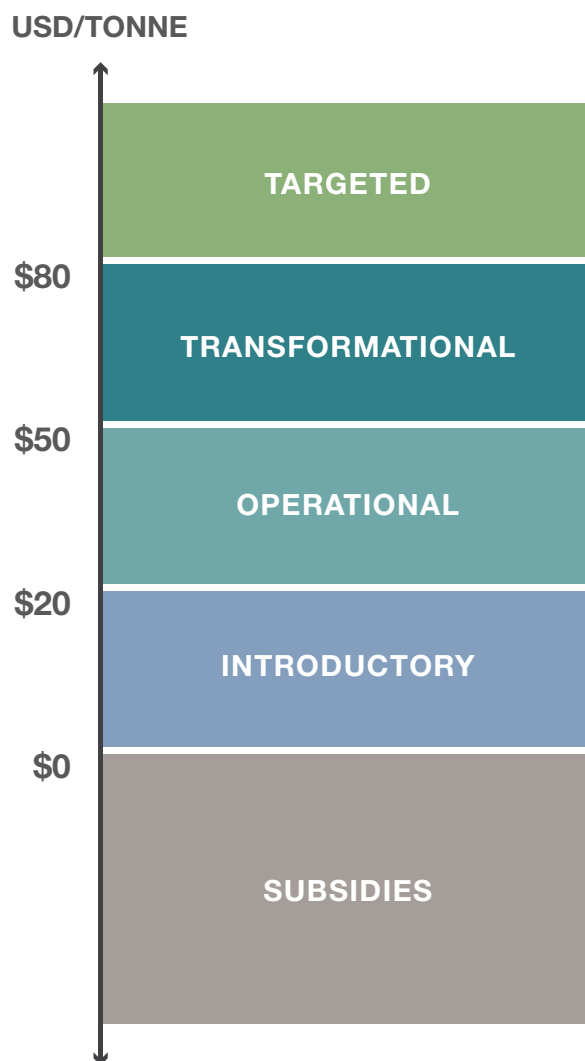
A band represents a range of prices that produce specific techno-economic and political effects. These bands allow the user to identify transformational price thresholds necessary for triggering investment and the adoption of alternative, clean technologies. Each band presents core concepts, such as conditions of entry and exit, and expected changes in policies, business behaviors, and importantly, greenhouse gas emissions activity. The ranges of (USD per tonne of CO₂) are illustrative in nature, and are presented to help decision-makers to apply the concept of price bands within their own economies. It is worth noting that these prices, too, are dynamic because they are sensitive to the decisions and actions that are undertaken over time.

Carbon pricing bands:

- Acknowledge that each actor in the global economy will begin the 'low carbon' journey in a different and unique politico-economic environment
- Encourage users to establish a price on carbon, no matter how low, that should be expected to increase over time
- Provide users with the flexibility and adaptive agency necessary to create a unique pathway toward a converging global price

If enough economies adopt effective carbon pricing policies, global convergence of carbon pricing may be achieved in the future. As a first step, an informed conversation about effective carbon pricing and the specific levels of price, is needed.

CHART 1: BANDS DIAGRAM

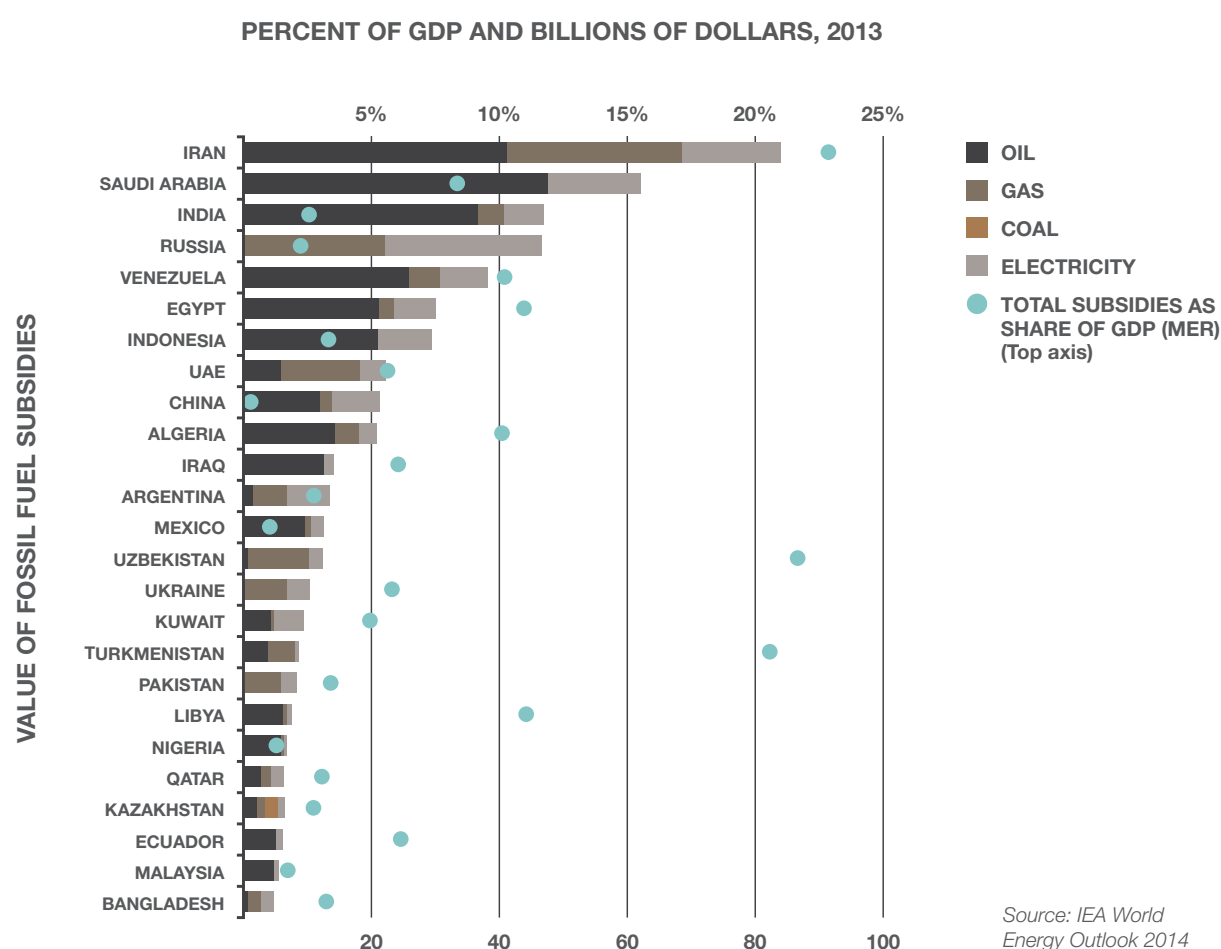


FOSSIL FUEL SUBSIDIES: A NEGATIVE CARBON PRICE

This band represents a, negative price on carbon in the form of fossil fuel subsidies. In this band, relevant policies and action are underpinned by governmental support of the consumption of fossil fuels. This has a correlative effect of delaying the economic viability of low carbon technologies. Fossil fuel subsidy reform is an imperative first step for any country to effectively price carbon.

Governments often justify the use of fossil fuel subsidies as a tool to increase energy accessibility to poor communities. Some evidence suggests that the benefits of subsidies are disproportionately accrued by the wealthier populations and fail to serve their socio-economic objectives. For example, in Indonesia, 77% of the domestic fossil fuel subsidy is accrued by the wealthiest 40%, while the poorest 10% receive a mere 1%.

CHART 2: FOSSIL FUEL SUBSIDIES BY COUNTRY



WHERE ARE WE NOW?

Countries at a variety of stages of economic development use fossil fuel subsidies. In 2014, total value of fossil fuel subsidies surpassed \$500 billion globally. This value is over four times the size of global renewable energy subsidies.

OECD countries are responsible for two-thirds of global subsidies. Some countries with existing carbon pricing schemes, continue also to subsidize fossil fuels, like the US, Germany, Japan, the UK, and Canada. Each of these countries have some form of national or sub-national policy that places a value on CO₂ emissions.

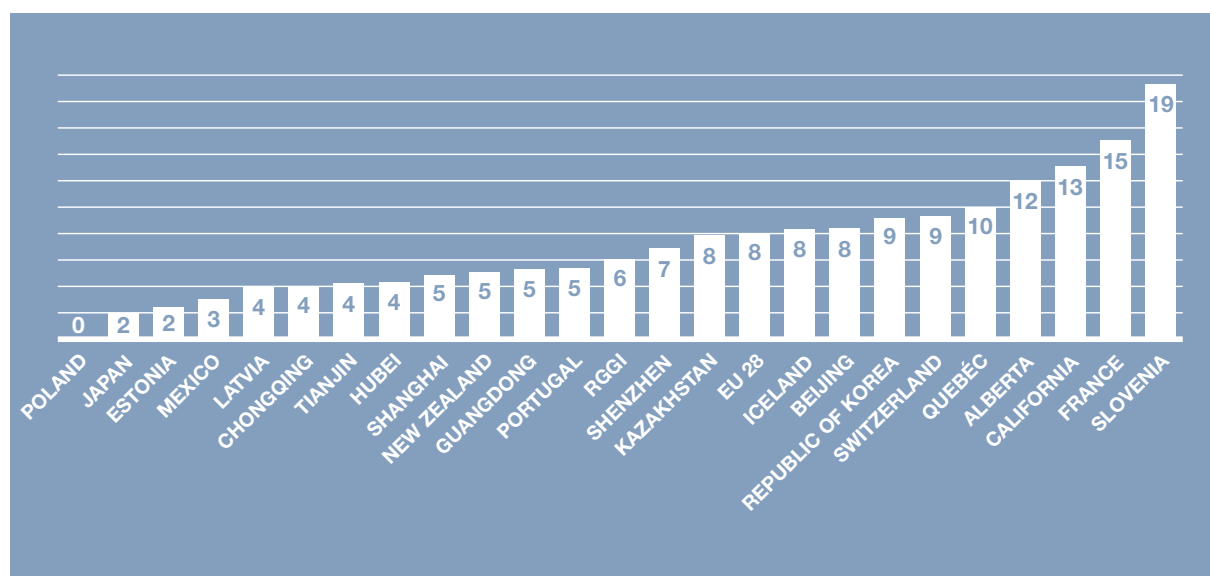
INTRODUCTORY PRICE BAND

ILLUSTRATIVE RANGE: UP TO \$20

The lowest band of carbon prices introduces governments and business to the concept of pricing greenhouse gas emissions in an effort to significantly reduce them in the long-run.

Some early benefits of carbon pricing are achieved in this band. Governments receive new revenue by taxing carbon pollution, and communicate to the economy that a 'business as usual' approach to greenhouse gas emissions will soon be unfeasible. Companies can move ahead of governments to set an internal price to help offset the risks of carbon emissions and finance their shift to cleaner energy sources. An introductory price level can catalyze some behavioral change in pockets of the economy, but will not be sufficiently stringent to drive the broader economy-wide transformations.

CHART 3: INTRODUCTORY



WHERE ARE WE NOW?

Thirty-nine countries and 23 regions have placed a price on carbon, according to the World Bank's 2015 State and Trends of Carbon Pricing. Currently, 85% of global prices are below \$10 and are too low to generate techno-economic shifts.

Companies have moved ahead to assign their own values to CO₂ emissions. In 2015, 437 companies disclosed to CDP that they use an internal carbon price. Of these, 162 are based in Europe, where prices are set to rise under the European Union's Emissions Trading Scheme and under the United Kingdom's CRC. For example, Swiss-based Nestlé disclosed using an internal carbon price of \$15.47 and Centrica of the UK a price of \$19.98.



**THE LOWEST BAND INTRODUCES
GOVERNMENTS AND BUSINESSES TO
THE CONCEPT OF PRICING GREENHOUSE
GAS EMISSIONS.**



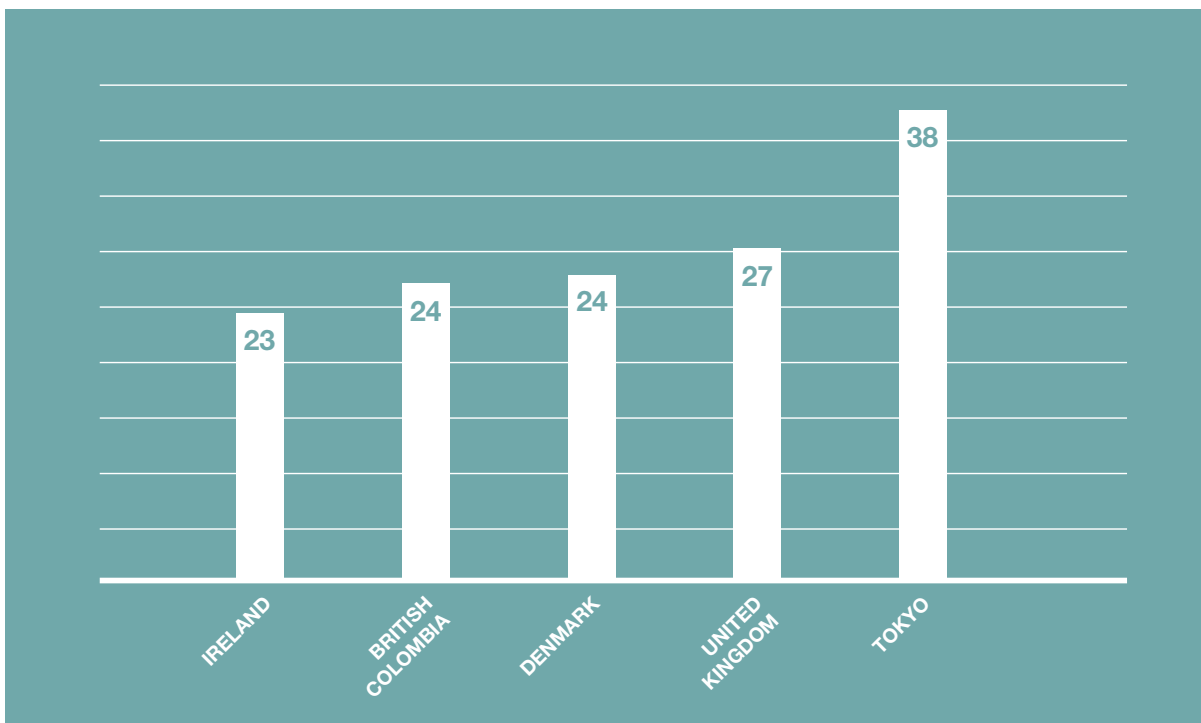
OPERATIONAL PRICE BAND

ILLUSTRATIVE RANGE: \$20 – \$50

Prices in the operational band effectively engage market forces to cut emissions.

A shift from reliance upon coal to natural gas is a key characteristic of this price band. Carbon prices within this price band start to break traditional assumptions about the relationship among economic growth, resource usage, technological boundaries and carbon emissions. This level encourages companies to change their operations and to become more efficient, by turning to lower-carbon fuels.

CHART 4: OPERATIONAL

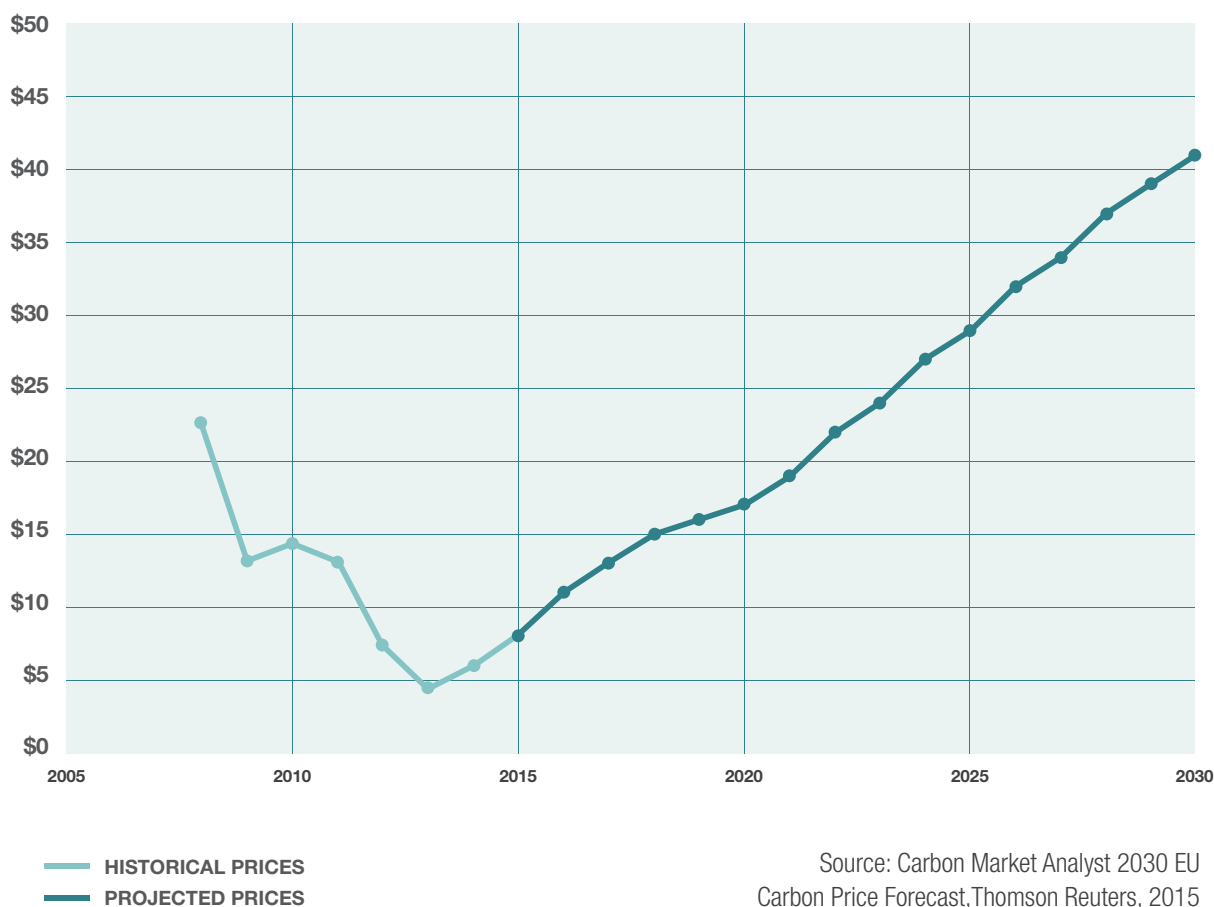


WHERE ARE WE NOW?

British Columbia, Denmark, Ireland, Tokyo, and the UK are five economies situated within the operational band.

The carbon tax in the UK increased from a minimum of £9.54 (\$15) to £18.08 (\$28) per tonne of CO₂ on April 1, 2015, raising it into the operational price level. It has been estimated that this price increase will cause generators to use gas to replace up to 20 terawatt hours of coal generation in the coming year. It is estimated that the price hike will result in a halving of the profitability of coal-fired power plants.

The price in Europe currently hovers around €7.15 (\$8) per tonne, but the price is expected to return to 'operational' levels by 2022. From 2007-2008 during Phase II of the EU ETS, the average carbon price was \$20. This price level motivated a switch from coal to gas and saw the initiation of numerous carbon capture and storage (CCS) projects at an industrial scale.

CHART 5: EU ETS PRICES

**SUCCESSFULLY NAVIGATING THIS VOYAGE
STARTS BY ENHANCING OUR ABILITY TO
MAKE INFORMED DECISIONS TODAY.**



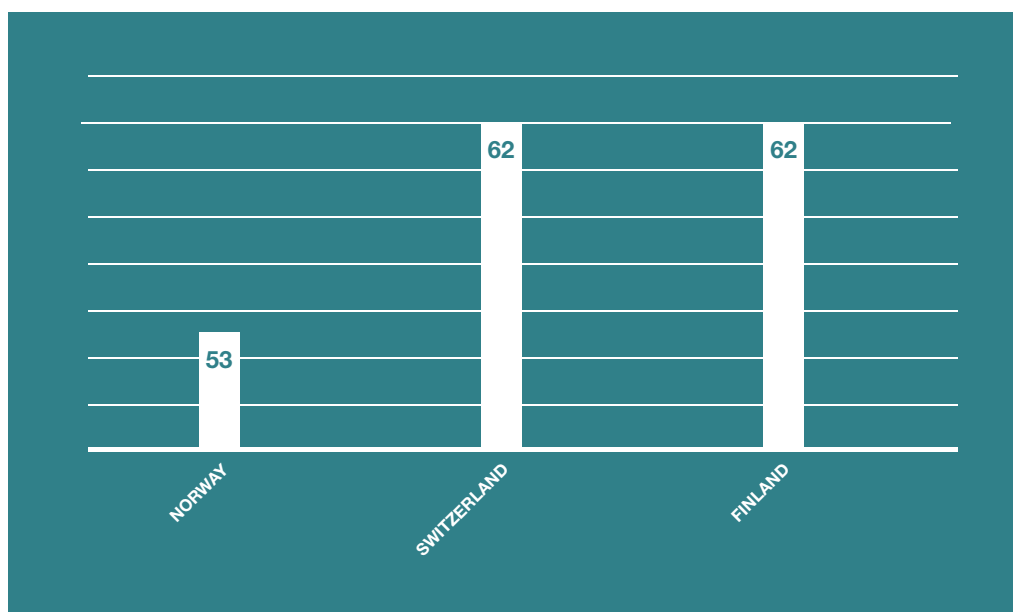
TRANSFORMATIONAL PRICE BAND

ILLUSTRATIVE RANGE: \$50 – \$80

The transformational band of carbon prices triggers a switch away from heavy emitting to renewable energy sources, and promotes investment in the development of alternative and clean technologies including carbon capture and storage and fuel cell storage. As pricing schemes mature, they are expected to converge in this band.

There are powerful incentives – both from the carbon price and from complementary policies such as subsidies for solar power – for companies to significantly reduce greenhouse gas emissions over time, without causing significant operational disruptions.

CHART 6: TRANSFORMATIONAL



WHERE ARE WE NOW?

Based on our illustrative range of prices for this band, Norway, Switzerland, and Finland represent the few countries currently sitting within this band.

Companies are actively using internal carbon prices within the \$50-\$80 range. The Brazilian mining company Vale disclosed to CDP a 'flat threshold' price of \$50 per tonne "over time as a proxy to carbon price in order to achieve Vale's carbon goal." Vale launched ITV – Instituto Tecnológico Vale (Vale Institute of Technology) – to develop low carbon and clean/renewable energy research and development, and new products.

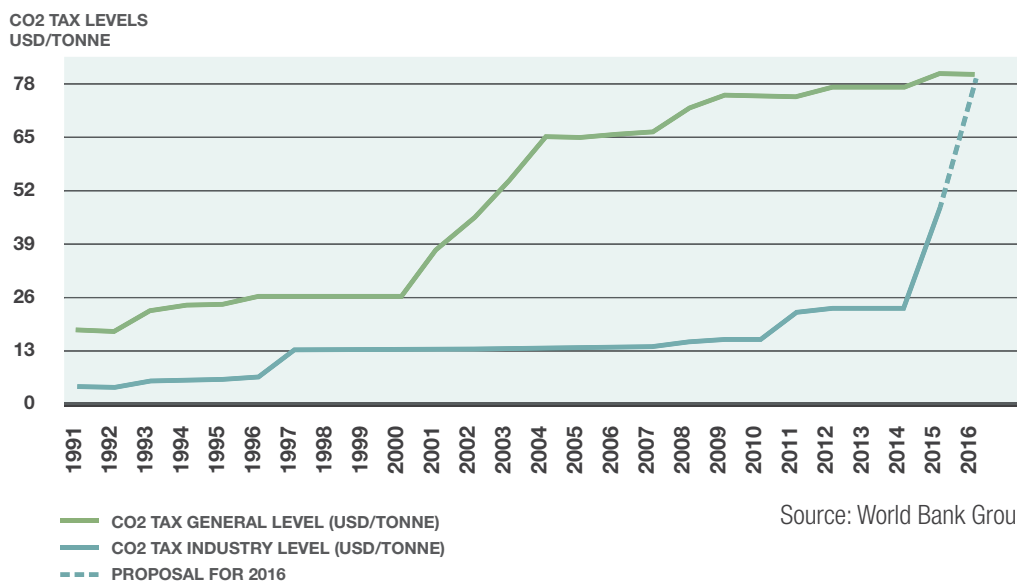
A Spanish utility, Gas Natural SDG, uses an internal carbon price to determine whether alternative technologies can displace cheaper conventional fossil fuels. They identify a carbon price threshold of \$49.52 as effectively displacing coal with gas and almost makes the price of solar PV level with that of gas-fired electricity.

TARGETED PRICE BAND

ILLUSTRATIVE RANGE: ABOVE \$80

The targeted band represents a price level that is so high that it is normally politically unfeasible and hard to implement, but can be useful in special circumstances to target a specific activity. Such high carbon prices can be used to phase out a particular technology, to raise revenues for early-stage technology investment, or during crises to kick-start much faster decarbonisation.

CHART 7: TARGETED: EVOLUTION OF SWEDEN'S CARBON TAX



WHERE ARE WE NOW?

Sweden established a carbon tax in 1991 to complement existing energy taxes, which were then cut in half. This dramatically shifted the tax burden onto coal-intensive sources, and lowered it on natural gas as part of a targeted plan to reduce carbon emissions. As a result, the energy sector quickly invested in developing biomass extraction technology and removing systemic energy efficiencies, resulting in a considerable expansion of biomass use in district heating systems.

Today, Sweden uses a carbon tax and an emissions trading scheme (part of the EU ETS). From 2000-2012, Swedish GDP grew 30% but emissions decreased by 16%, suggesting some success in decoupling economic and CO₂ emissions growth. Sweden has a unique economic and political position that enables a carbon price to operate at a targeted level of \$130 per tonne. To address concerns with industry competitiveness, consumers are taxed at a higher rate, as illustrated by the graph above.

CARBON PRICING TRAJECTORIES

WHAT IS A CARBON PRICING TRAJECTORY?

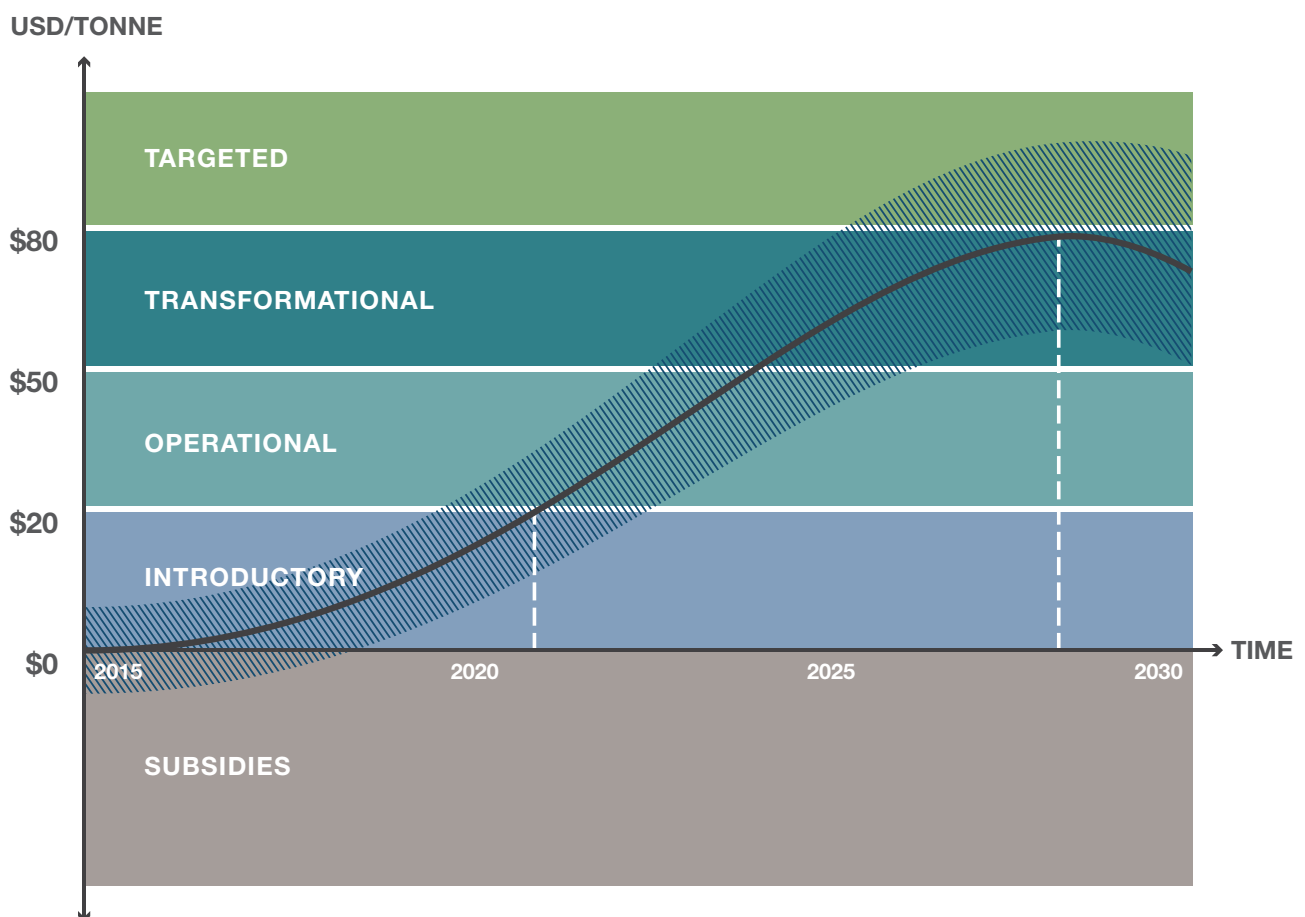
A carbon pricing trajectory shows the variation of price over time within a particular economy, assuming the existence of a suite of complementary policies. There are as many trajectories as there are economies around the world.

With the common framework of pricing bands in place, we can now discuss pathways for how carbon pricing policies could influence our ability to arrive at a future low carbon economy.

SUCCESS TRAJECTORY: SAILING INTO THE NEW LOW CARBON WORLD

The following carbon price trajectory generalizes a global adaptive pathway toward reaching prices in the transformational band, at which we achieve the objective of peaking and reducing greenhouse gas emissions, and by so doing restrict global temperature rises to 2°C above pre-industrial levels.

CHART 8: SUCCESS TRAJECTORY: SAILING TO THE NEW LOW CARBON WORLD





IN THE SUCCESS TRAJECTORY, THERE IS STRONG MOMENTUM FOR CARBON PRICING AT INTERNATIONAL, NATIONAL AND REGIONAL LEVELS.



The trajectory starts at today, with 39 countries and 23 regional jurisdictions using cap-and-trade systems and levying carbon taxes. Already, this covers about 12% of annual global greenhouse gas emissions and has a market value of \$50 billion. Within this pathway, there is strong momentum for carbon pricing at international, national and regional levels.

2015–2020: The next five years will be a period of heightened ambition, in which policymakers and business reduce emissions by moving from the introductory band of prices to the operational band. The most carbon-intensive countries introduce carbon pricing to cover significant levels of their emissions, but keep prices within the introductory band for the first two to five years. Governments use revenues from carbon pricing policies to subsidize research and development of clean technologies, to encourage energy efficiency, and to combat the ill effects of global warming on community wellbeing and public health.

2020 – 2030: Higher carbon prices drive the systemic transformation to low carbon technologies and accelerate the use of alternative and renewable energy. As carbon pricing systems mature, carbon prices rise and emissions caps decline. Newer carbon pricing systems move toward the transformational price band. The global carbon market itself matures, with greater liquidity and efficiency. As costs of alternative energy falls and most carbon pricing policies (markets or otherwise) become linked, carbon prices peak and decline as efforts succeed in stabilizing greenhouse gas emissions at levels that can keep global warming within 2°C.

It is difficult to forecast beyond 2030. We may need high carbon prices to complete emissions reductions and keep the remaining fossil fuels in the ground. Or, the widespread adoption of technology and infrastructure may have eliminated the demand for fossil fuels altogether, making a carbon price redundant in the new global economy.

SAILING TO THE ‘NEW LOW CARBON WORLD’

In this vision of the future, global temperatures remain within 2°C of pre-industrial levels. Business, investors and governments successfully navigate the complex waters of climate policy, guided by a combination of domestic policies and global agreements. Carbon pricing truly emerges as a bedrock mechanism to secure emissions reductions and to stimulate investment in the infrastructure for a sustainable low carbon economy. Carbon pricing policies, though central, are not the sole drivers of this change; they are complemented by other policy measures and private sector efforts around industry standards and strategic investments in research and development.

2005 – 2015

○ In 2005, the European Union introduces its Emissions Trading Scheme (EU ETS), focusing on fossil fuel power generation and heavy industries that represent around 45% of total EU greenhouse gas emissions. At first, prices quickly ascend to €30 (\$34) per tonne, bringing with it technological innovation and a shift to natural gas as the market responds favourably to a long term price signal. During the 2008 financial crisis, however, prices plummet and the number of unallocated permits causes concern. Critics believe that these low carbon prices mean that the EU ETS has failed, but others herald its success since emissions are down by 200 million tonnes in 10 years. On its 10th anniversary, Europe announces reform of the EU ETS, placing in reserve a large number of surplus permits. With this, confidence grows that prices will again top €20 (\$22) per tonne by the early 2020s.

Learning from the European experience, in 2006 California implements a cap-and-trade system under legislation known as AB32, which goes beyond the power sector to cover 85% of emissions in the state, among the world's largest economies. Like Europe, the California system ensures steadily rising prices by introducing a floor price which increases by 5% plus inflation each year. By 2015, revenue from the auctions exceeds \$2 billion, all of which is placed in the Greenhouse Gas Reduction Fund that supports a variety of community priorities, including affordable housing, water conservation, renewable energy and low carbon solutions for the car-intensive state, like a high-speed rail line. Meanwhile, in 2008 nine Northeastern US states that have joined forces through the Regional Greenhouse Gas Initiative (RGGI), conduct their first auction. By 2014, RGGI raises over \$2.2 billion in auction proceeds and more than \$1 billion of it is invested in energy efficiency and strategic energy innovation.

As the number of carbon-tax and cap-and-trade initiatives grows, a global patchwork of national, state and provincial policies emerges. The World Bank reports that 12% of global greenhouse gas emissions are now covered by some form of carbon price.

Of note is the first cross-border program, a regional carbon market created by Quebec and California in 2014 as part of the Western Climate Initiative (WCI). Before long, Ontario announces that it, too, will link under the WCI. The Obama administration's Clean Power Act encourages many other US states to explore cap-and-trade systems, and raises the likelihood of even more linkages.

Perhaps most significant, China pilots seven cap-and-trade programs and publicly commits to a nationwide carbon market by 2020. Other fast-growing economies explore carbon pricing in 2015:

- India raises the tax on coal production to 200 rupees (\$3), and commits all revenues to investments in renewable energy to meet its goal of doubling the share of renewable power in the country's power mix to 175 gigawatts by 2022, 100 gigawatts of that coming from solar power.
- While waiting for the national carbon tax to take effect from 2016, South African businesses like Exxaro Resources Ltd, Sibanye Gold, and MTN Group move ahead to set internal carbon prices based on the expected tax rate range of R48-200 (\$4-\$15).
- A group of major Brazilian companies, including Braskem, Vale and Itaú Unibanco input live corporate data in a pilot cap-and-trade simulation known as the Empresas Pelo Clima Emissions Trading Scheme, using auctions, bond markets and fines for non-compliance to demonstrate how a national system could work.

Finally, in December 2015, global political leaders converge at the UN Paris Climate Change Conference, COP21, intent on forging a global agreement that fulfils the promise of a long term, ambitious climate change framework. The resultant global agreement falls short of this goal, but the credible contributions from countries with developed and emerging economies alike, boost confidence that international cooperation will eventually secure the hoped-for outcome. Alongside these sovereign efforts, business, regional governments and other entities declare their climate commitments, demonstrating the economic and moral leadership that will help bridge the emissions reduction gap.

The Global Commission on Carbon Pricing is widely acknowledged as a key outcome of the conference. The Commission represents new political and industry leadership on this subject, and the Commissioners call for 80% of the world's economy to come under a carbon pricing scheme by 2025, working with the Carbon Pricing Leadership Coalition on this ambitious goal.

2015 – 2020

In 2016, China introduces a national carbon pricing scheme. By the time it is fully functioning, in 2020, this mega-market covers nearly four billion tonnes of CO₂ emissions from heavy emitters in the power generation, chemicals, and aviation sectors among others. Together, this accounts for 30% of China's annual emissions. Building on the Californian experience, China sets a floor price, creating the expectation that, emitting CO₂ in China will cost over 130 RMB (\$20) per tonne by 2020, in line with California and the EU. The early success of China's ETS puts the world's fastest growing economy on track to peak emissions whilst decoupling economic growth from pollution, well ahead of its 2030 target year. With this renewed confidence, China encourages its BIC partners – Brazil and India – to follow a similar pathway. China emerges as a leading advocate of greater ambition in tackling climate change at the first five-yearly review of the Paris Climate Change Agreement.

Alongside the growth in popularity of trading systems, taxation becomes the preferred approach of emerging economies seeking to efficiently impose a price on carbon. After the first full year in operation, the South African carbon tax is raised by 10%. The revenue funds a major public-private partnership supporting local power grids. Morocco announces at the close of the 2015 Paris Climate Change Conference that it is preparing for a carbon tax within two years. Then in quick succession, four other major oil-producing African economies – Nigeria, Egypt, Angola and Algeria – all enact carbon taxes by 2018. Chile implements a \$5 per tonne carbon tax and Mexico, which already has a carbon tax, commits to a cap and trade scheme before the end of the decade. Investments in renewable power and low power grids are a high priority, seen by these governments as key to solving systemic energy insecurity. These countries next set their sights on creating a converged system that links their respective carbon tax regimes. Seizing upon its presidency of the 2016 UN Climate Change Conference, Morocco works with the African Union to convene a symposium to sketch Africa's plan for a continent-wide carbon pricing system and renewable energy access for all by 2035. This is a momentous achievement since more than half of these countries hold or are believed to hold substantial oil or gas reserves. The investment community represented by the Portfolio Decarbonization Coalition welcomes this announcement, which diminishes calls for fossil fuel divestment in Africa, but does not dispel the fear of stranded assets.

Not until 2020 do countries establish clear principles for adjusting policies between jurisdictions with and without effective carbon pricing. In the meantime, private industry provides a fertile space for collaboration to mitigate concerns about carbon leakage. The airline industry leads the way in conceptualizing a sectoral carbon pricing scheme, led by the International Civil Aviation Organization (ICAO). In 2016, ICAO approves a design that would support a low carbon price covering international flights. Then, in preparation for a sector-wide price, several industry leaders scale-up internal carbon pricing policies; most change their procurement metrics by applying a 2025 value of \$40-60 per tonne. In 2019, as the sector-wide agreement matures, ICAO announces a price signal of \$25 per tonne by 2020, and confirms this price a year later when the agreement comes into effect.



IN THIS VISION OF THE FUTURE, CARBON PRICING EMERGES AS A BEDROCK POLICY COMPLEMENTED BY OTHER POLICIES AND PRIVATE SECTOR EFFORTS.



Market analysts and think tanks continue to track the yearly performance of existing carbon pricing schemes and detect little if any evidence of carbon leakage. This confirms the early work of the World Bank, among the first to suggest the EU ETS had not hindered competitiveness or spurred carbon leakage.

Surpassing all expectations, a swelling number of big businesses voluntarily set emissions reduction targets that align with climate science. Some take the added step of pushing their global supply chains to follow suit. Clear correlation emerges from CDP's corporate data: Companies with substantial operations in countries that have a carbon price above \$20 achieve their emissions reduction targets ahead of time. These same companies report that they are ready for long term, science-based targets over a 30-year horizon but need a coherent global approach to pricing carbon. A coalition of business CEOs from global 'household' brands partner with citizen and civil society groups to launch a corporate awareness campaign. The message is simple – a healthy climate change 'report card' is the new norm, and companies that aim for profit-at-all-cost risk losing their license to operate. By 2018, the Ten Principles of the UN Global Compact formally mandate that business use carbon pricing and set science-based emissions reduction targets.

Work to develop clean coal capabilities picks up momentum thanks to an industry partnership on carbon capture and storage (CCS) through the Low Carbon Technology Partnership Initiative (LCTPi). The group's focus is on accelerated research and development to bring this technology to scale, but in the near-term, CCS remains 'a technology of the future.' As costs tumble for solar PV across the world, solar panel installation skyrockets. A climate-conscious Australian government reinstates a popular rebate for residential solar power, and directs the Productivity Commission to assess the viability of a nationwide solar power grid. Wind-powered electricity enjoys similar success, with leaders India and Germany accelerating rates of turbine installation.

By comparison, investors remain subdued pending a breakthrough in CCS. Companies assuming widespread CCS deployment face risks of downgrades by market analysts who see alternatives like renewable energy and electricity storage continue to be cheaper and more popular politically. But some investors remain optimistic, as the latest Intergovernmental Panel on Climate Change (IPCC) report finds that the cost to achieve a net-zero emissions society will be higher without CCS.

By 2020, the majority of the carbon pricing schemes have matured over the past five years and are delivering greenhouse gas emission reductions at prices in the operational band. One of the clearest examples is the EU, which meets its 2020 climate change and energy goals ahead of time. At the same time all OECD countries have at least started pilot schemes so they can learn and develop prices that reach the operational level by 2025.

2020 – 2030

Global greenhouse gas emissions peak in 2021 at 32 gigatonnes.

The start of the new decade is marked by the milestone that over 70% of global GDP is now covered by carbon pricing schemes, representing a six-fold increase since the 2015 Paris Climate Change Agreement. The Global Commission on Carbon Pricing claims an important victory as every continent now hosts a thriving carbon price club alongside typical collaborations on trade and development. These clubs become incubators for knowledge and learning, and by the middle of the decade, the myriad of carbon pricing systems converge. Carbon prices plateau by 2028, then decline even with lower caps on greenhouse gas emissions as national climate commitments are strengthened in subsequent meetings on the Paris Climate Change Agreement.

Many countries raise their 2030 ambition after achieving their 2025 targets early, leading to growing confidence that the world will be on track to stay within 2°C.

In 2028, China reaches peak CO₂ emissions. China's own Silicon Valley is renowned for the development and commercialization of the first 500-hour fuel cell. Clear blue skies are reported in Beijing and beyond, reducing incidents of asthma and ending China's record for the world's worst asthma mortality rate.

In the US, the Clean Power Act's rule for existing power plants delivers on the promise of reducing 32% of emissions. Federal and state leadership enables the US to meet this goal on time, spurring special interest groups to bring legal challenges before the US Supreme Court, and sparking a robust public debate around transparency in corporate lobbying. The Environmental Protection Agency (EPA) resets its calculations of the Social Cost of Carbon on the back of this achievement. Joining California, Washington, the RGGI states and all the Canadian provinces are 47 of the 50 US states, making a North American carbon market a reality. Talks begin with Mexico, with the hope that the carbon market will cover this economy by 2023.

Mexico's state-owned oil company retools its plants and promotes investment in solar power and clean energy for cooking fuels. It signals that regulatory certainty on carbon pricing would be welcome. Mexican multinational giants in cement fund a boom in green-housing construction, and wireless and media all use their vast resources to promote climate awareness.

India's new carbon tax, set at 730 rupees per tonne (\$11), ends the government's longstanding subsidization of fossil fuel power. In 2021, domestic solar and wind markets generate 110 gigawatts and 65 gigawatts respectively, helping India to reach its Renewable Energy Target. This beats estimates that the Indian solar PV market would produce only 34 gigawatts by 2020. Alongside a new carbon tax, India commits to trebling its Renewable Energy Target by 2025. It partners with Australia to pilot a state-wide solar power grid in Madhya Pradesh, one of India's fastest growing economies and a long-time leader in renewable energy. Consequently, hundreds of companies with significant operations in India announce confidence in their ability to source 100% of energy demands from renewable sources by 2025.

In 2021, a major global automotive company reveals a plan to completely electrify its fleet by 2035, breaking with the industry norm. This company announces plans to produce and sell 100 million affordable electric vehicles in the first three years of full electrification, bringing low-cost electric mobility to India and Africa. Their share price gains 7% on the news and Forbes ranks them No. 1 among innovative companies in the world. Soon after, successive domestic policy directives create an effective deadline for the global automotive industry to build its last internal combustion engine by 2045.

By 2030, accelerated deployment of new, clean technologies at scale drives down generation costs below the level of 'old technology'. Low cost energy storage is widely deployed, eliminating a key barrier to the widespread adoption of renewables: intermittent supply. This helps to transform the aviation, shipping and long-haul trucking industries.

At the 2030 UN Climate Change Conference, the OECD unveils its estimate that global carbon prices peaked in 2028 at an average of \$71. Global CO₂ emissions continue to fall – with no impact on global GDP – leading the IPCC to conclude that the world is finally on track to limit warming to less than 2°C.

ALTERNATIVE TRAJECTORIES AND NARRATIVES

Of course, there is no guarantee that the global economy will collectively skilfully navigate our way towards a 2°C future.

The 'voyage' is uncharted and hazardous, and needs to be guided by secure global climate change agreements on the one hand, and on the other, by matched national policies. In addition, carbon pricing mechanisms, whether an emissions trading system or a tax, will need to stand next to other policies that deal with a host of complementary issues, from energy efficiency to health to infrastructure.

In the passages that follow, we present three illustrative carbon pricing trajectories, paired with short narratives describing how partial success, or complete failure to skilfully navigate the balance of policy choices, might arise. Understanding these alternative versions of the future can help us to correct the course of travel before we find ourselves off-track, far from the pathway to a low carbon economy.



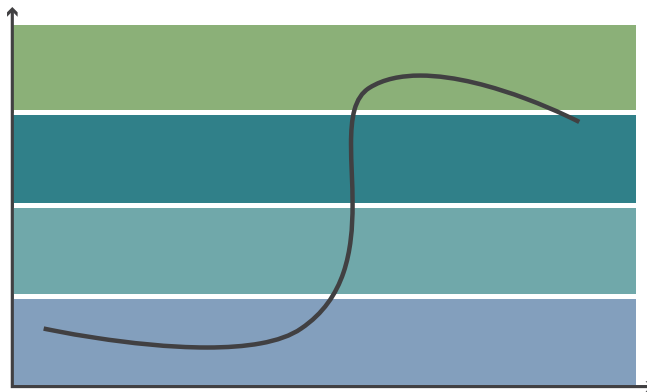
**THE 'VOYAGE' IS UNCHARTED AND HAZARDOUS,
AND NEEDS TO BE GUIDED BY SECURE GLOBAL
CLIMATE CHANGE AGREEMENTS AND MATCHED
NATIONAL POLICIES.**



SAILING INTO THE CLIFF

This trajectory shows carbon prices that remain depressed, before rising sharply and suddenly above the transformational level. The accompanying narrative describes a world where global agreements are strong but are not matched by new effective carbon pricing policies at the national level. In this ‘two-track’ world, emissions reduction efforts stagnate, before a chain of catastrophic weather events triggers a crisis and a radical course-correction. With no time to prepare, the world economy is sharply jolted and high-carbon assets are left stranded. Delayed action on climate change means global temperatures rise by more than 3°C above pre-industrial levels.

CHART 9: ALTERNATIVE TRAJECTORY: SAILING INTO THE CLIFF



2015

- The Paris Climate Change Conference, COP 21, delivers a strong agreement that shows that countries are committed to working together. The OECD recommends member countries employ carbon pricing to achieve national commitments to cut emissions. Consensus emerges that carbon prices need to rise above \$50 to drive fuel switching at the rate needed.

2015-2020

- Early adopters of carbon pricing policies push to link existing pricing schemes. The EU and the ‘Western Alliance’ of California, Quebec and Ontario are first to seal the deal, even as critics question the pact’s very existence now that the Paris Agreement has been struck. The partners also hope that a successful, linked market will attract other US states to join. But few, if any, do. States instead begin to lobby, refusing to follow the US EPA’s directive to cut greenhouse gas emissions from existing power plants by 32% by 2030. A group of Midwestern states go one step further and appeal to the US Supreme Court. The Court strikes down the EPA rules, concluding that Congress’ failure to ratify the Paris Agreement means that the rules are now an example of unlawful federal executive overreach.

With existing pricing schemes covering less than 40% of global greenhouse gas emissions, carbon prices remain stuck in the introductory band, reaching an operational level in only a handful of economies. Carbon pricing does not pick up traction in Asia, due mainly to concerns about carbon leakage from heavy emitting sectors in developed economies. In 2019, China’s national emissions trading system, now the largest in the world, becomes fully operational nonetheless and with plans to raise the price floor to \$40 by 2025.

When few countries honour their promised contributions to the international Climate Development Fund, emerging economies react with disappointment that a global solution has once again failed. These countries struggle with continued population and in the absence of energy security; without development finance to support climate change mitigation, they forcefully argue that poverty eradication must come before the environment. Carbon pricing is demonized as a barrier to addressing these social challenges.

Despite early cooperation on border adjustment measures between countries with wildly different carbon prices and policies, continued business and political pressure in the US, India and Russia stymies further progress. The US and China bring a dispute over agricultural produce before the World Trade Organization (WTO), sparked by a Chinese import tariff on US soy in an attempt to mitigate carbon leakage from an unregulated US. This protracted dispute undermines the commitment to cooperative climate leadership announced by President Xi and President Obama on the eve of the Paris Climate Change Conference.

2020-2030

The climate crisis makes this decade a singularly challenging period in world history. Super storms and other extreme weather events cause \$800 billion in damage in 2022 alone, quadruple estimates for the 10-year average released by the insurance industry in 2015. In Florida, which once enjoyed rapid economic growth and had attracted many new residents, a state of emergency now governs the lower third of its area. Its formerly populous cities are empty of its residents, creating a crisis in the national housing market. Much of the US Eastern seaboard bans permanent structures in low-lying coastal areas, including bridges, which cripples commuter railways.

Meanwhile, soaring temperatures test the limits of India's power grid, causing costly and persistent disruptions to the steel and cement industries and other energy-intensive sectors. It also heralds widespread drought, forcing subsistence farming communities off their traditional lands. India's major cities struggle to handle this influx of people. Civil society groups dispute the government's estimates that internal displacement due to climate change affects only 5% of its population; they fear that the true number is closer to 20%.

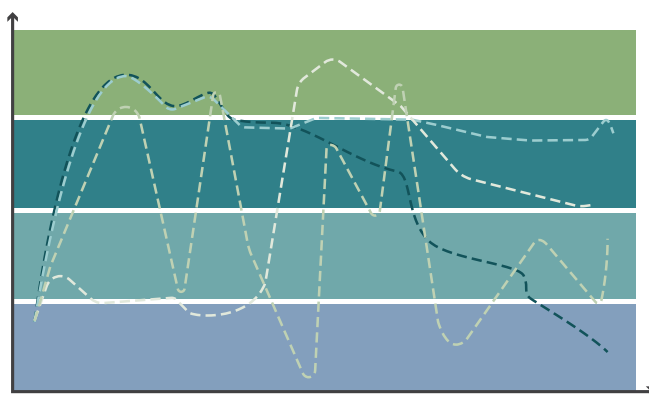
In 2028, the UN's climate change authority, the UNFCCC, convenes its first emergency international summit. Nations come to the talks demanding robust action. Reversing recent trends, the private sector and civil society are excluded from this convening. A campaign organized under the hashtag #toolittletoolate gives voice to global citizens, who 'terrorize' political leaders by crashing multiple governments' social media sites with an overload of tweets, posts and (dis)likes. Seizing this momentum, the citizen movement's leader demands a global carbon price of \$150 per tonne. Governments quickly capitulate to this demand under unprecedented pressure from an angry global citizenry demanding drastic action. The resultant deal stuns even the most fervent advocates of carbon pricing. This price quickly drives down emissions. The global stock market crashes in 2029, driven by the plummeting value of companies in every carbon-intensive sector as fears of stranded high-carbon assets become a reality. The global economy stagnates.

In spite of the rush of corrective activities, the prolonged delay in sustained action means that the global carbon budget is already bust, ensuring that a '3°C world' is inescapable.

STORMY WATERS

'Stormy waters' describes a world rapidly deploying national carbon pricing schemes, but they are disjointed and divorced from other domestic policies. This patchwork is also mismatched with overall emissions reduction goals embedded in global climate change agreements. No mechanism to promote price convergence emerges out of this fractured landscape. Admittedly, some sectors do enjoy rapid progress in elimination of CO₂ emissions but they stand in the minority. Carbon prices rise initially, but increasing concern about negative impacts on competitiveness eventually precipitates a collapse in political will. Chaotic price trajectories result, matched by equally confusing signals to the market, undermining investor confidence. Decarbonisation of the global economy soon slows.

CHART 10: ALTERNATIVE TRAJECTORY: STORMY WATERS



2015

Despite the disappointing conclusion to the Paris Climate Change Conference, COP 21, business and investors are cautiously upbeat that enough momentum and political will remains to spark a transition to a low carbon economy.

Encouraged by progress in California and China, a global investor coalition urges adoption of carbon pricing regimes in all OECD countries, believing that this will provide clear economic signals to drive growth in clean-tech industries and help reduce portfolio climate risk.

2015-2020

In 2016, the US Supreme Court upholds Obama's Clean Power Plan, leading to a roll-out of carbon pricing systems in many US states, most of which commit to link to existing carbon markets in North America, the WCI or RGGI, by 2020. Elsewhere, investors serious about carbon pricing play an active role to influence governments. In Europe, they urge faster emissions caps reductions, and in India they press for another coal tax increase. Unsurprisingly, the various emissions trading schemes and taxes around the world quickly surpass the introductory band of carbon pricing.

By 2020, many countries have deployed trading schemes but Russia is a notable exception. Market analysts fear that these new ones will suffer from instability and ineffectiveness if they do not incorporate thoughtful learning from the earlier schemes. Before long, carbon prices of over \$30 a tonne become the norm, and some schemes are forecast to reach prices above \$100 by 2025.

2020-2030

Investors respond to rising carbon prices in predictable ways. In the early 2020s, market sensitivity to stranded assets precipitates a record rate of capital transfer from 'black' to 'green' investments. Global fossil fuel stocks slump. Countries sign a moratorium on drilling in the Arctic and curtail activity on Canadian tar sands. The renewable energy boom – most evident in Germany, Scandinavia and India – beats all estimates and finally puts the brakes on rising carbon prices. Prices return to operational levels, averaging around \$30. The lower carbon price bursts the bubble in clean energy stock valuations; several of the world's largest pension funds struggle to rebalance their portfolios, and the ripple effect ultimately slows the global economy.

Around the world, several regulators, alarmed by the carbon asset bubble, intervene to adjust carbon pricing schemes, raising price floors in some cases, tightening caps on others. In their rush to respond, countries forsake the chance to forge common policies, on the sentiment that there is little to be gained from coordinating a myriad of unlinked trading schemes. But swings in carbon price levels generate a new set of confusing market signals, further dampening investor confidence.

As in all bubbles, there is a silver lining. The global direct current 'electricity Internet' is now almost complete, finally making energy access for all a reality. Across the world, leading advocates promoting access to education and healthcare hail this as the most important advancement in the battle to combat systemic disadvantage in poor communities and raise living standards within a single generation. With redundant capacity, the electricity Internet ensures the continued viability of renewable energy production in remote yet windy or sunny regions of the world.

The rocky experience of the past five years reminds the world that carbon pricing mechanisms can be incredibly effective when matched with complementary policies and implemented appropriately, but are not a panacea. In 2025, belated global discussions on the need for fuel efficiency standards at last drive the electrification of passenger cars at scale. Commentators bemoan a 'lost decade of innovation.'

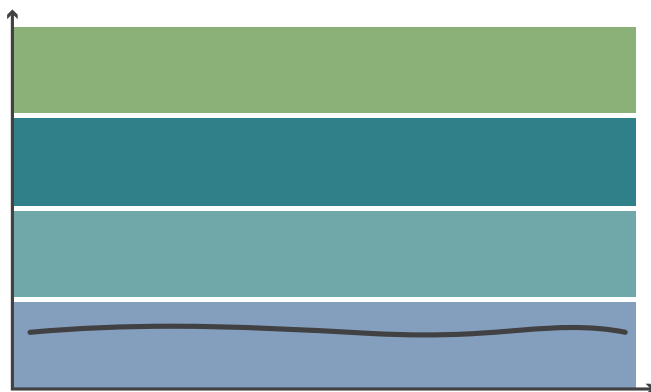
Without agreed mechanisms for linking schemes or converging prices, pockets of political intervention in existing schemes are unwelcome. Wild price fluctuations, low investor confidence, and rising capital costs ensue. For example, the UK's elimination of the carbon floor price in 2026 precipitates the suspension of construction of three major offshore wind projects. Increasing trade pressures finally drive Russia to action. Hit by the new EU import duty, which adds \$50 per tonne of embedded CO₂, Russia introduces of a 3,000 RUB (\$45) carbon tax across its economy and plans for a cap-and-trade system by 2027. The EU adopts border targets for imports from countries with no or much lower carbon pricing. However, they are not implemented as no one can agree a set of rules and regulations for their operation.

An incoherent approach to carbon pricing plagues efforts to innovate. The resultant '3°C world' must contend with reduced economic growth and inefficient investment in clean technologies.

RUNNING AGROUND

In this version of the future, carbon prices languish due to a lack of ambition on climate action and without a strong global agreement. Starting in the 2020s, the world appreciates what it means to be on the pathway to a 4°C temperature rise, which causes significant economic damage and social upheaval.

CHART 11: ALTERNATIVE TRAJECTORY: RUNNING AGROUND



2015

Nations converge in Paris in December for the UN Climate Change Conference, COP 21, to forge a global agreement that holds the promise of a long-term, ambitious framework to tackle climate change. However, as widely predicted, the limited agreement cannot keep future temperature increases to 2°C. The press brands the Paris Climate Change Agreement, and indeed the entire international effort to combat dangerous climate change, a failure. Civil society is equally disappointed, and signal that they will adopt tougher positions against governments and business that erect barriers to a sensible climate solution. Some countries concede that the world has missed the last opportunity at a crucial juncture. The majority of countries at least agree to review their national plans for climate action every five years. This does little to satisfy civil society and the 'progressive' business block, since world political leaders largely ignore this review process in subsequent years. Measured against the impressive commitment of 'non-state actors'— cities, states, business, investors and civil society – to climate action, international observers suggest that the era of nation-states dominating climate negotiations is over.

As capital markets respond to gloomy climate predictions, the flow of capital into clean technology slows significantly. A period of bitter recrimination follows, with developing countries focussing on the lack of real new finance for clean technology transfer and inadequate progress on adaptation or payments for loss and damage.

Yet the picture is far from uniform. Some countries, states and regions seize the opportunity to forge ahead in driving competitive green economies. With few exceptions, existing carbon pricing schemes remain but hope of widespread global adoption of carbon pricing fades and work on market linking is resoundingly dismissed as a futile exercise. With such great potential trade hurdles between countries with and without carbon prices, hope of an eventual high carbon price above \$50 soon becomes a nostalgic memory of academic interest only.

2015-2020

In heavy emitting sectors, a 'twin-track' world emerges.

Electric vehicle adoption accelerates in California, Scandinavia and several Asian mega-cities like Hong Kong, driven by both regulation and the marketing of electric vehicles as the aspirational choice. However, continued low oil prices drive the growth in car ownership globally, outpacing the ability and ambition of the automotive industry to grow the market share of electric vehicles. Unsurprisingly, overall greenhouse gas vehicle emissions continue to rise. Consumers and industry groups resist attempts to introduce stringent fuel efficiency standards.

Decarbonisation of electricity generation in the EU, the US and China continues, driven by low gas prices and effective carbon pricing regimes, but industry concerns about competitiveness grows. With low carbon prices and investor disinterest, CCS technology becomes viable for only select industries, like cement and steel, who successfully lobby for government intervention. It is recognized that, due to the very nature of their core industrial processes, no degree of innovation will help them cut emissions without CCS. Elsewhere, the continued availability of very cheap coal, and the urgent development needs to achieve mass energy access, lead to a spurt of coal-fired electricity generation in Africa and India. With robust economic growth comes rising emissions.

The effects of climate change hits food production. The 2017 'Super Heatwave' leads to a decline of 20% in Brazilian soybean production. The price of pork doubles, and the oldest wine regions of France and Italy predict their own demise within a few years. Carbon prices remain at low levels, with pressure mounting to freeze the carbon floor price in California, and to eliminate the market stability reserve in the EU ETS.

2020-2030

Investment in coal-fired power continues unabated in Africa and India, driven by a shared view that this is a viable way to drive economic growth.

Carbon pricing levels in jurisdictions with carbon trading or tax regimes remain subdued, due to the lack of linkage as multilateral institutions fail to implement clear border adjustment arrangements.

The repercussions of the 2023 wheat crop failure across North Africa dominate discussions at the 2024 World Economic Forum meeting in Davos. Civil conflict in multiple countries drives levels of immigration to Europe to unprecedented levels, with over 5 million risking the journey to Europe by increasingly precarious means in 2025 alone. Right-wing movements are on the rise in Greece, France, Germany, Italy and Hungary. Violent attacks on transportation, entertainment and education hubs in Paris and London put security forces around the world in high alert. This only serves to exacerbate tensions in the international arena, further hampering the chances that a global climate deal will be resurrected.

Carbon prices under the EU ETS languish below €10, inspiring several states to revoke their carbon tax schemes as American industry undermines the Clean Power Plan to unleash itself from the scourge of high electricity prices. US economic growth stalls.

A ray of sunlight emerges in select sectors of the economy. The airline industry surprisingly continues ICAO's plans to introduce a carbon price. In the electric vehicle sector, adoption rates pick up pace, the infrastructure to support it slowly improves, and battery prices fall even as their range increases beyond 400km. In 2028, a leading producer announces a project to produce 100 million low-cost electric vehicles for Indian and African markets by 2040. Alarming rates of asthma-related disease lead to the Asia-Africa Clean Air Better Lives conference at which China commits \$100 billion to support clean power generation, storage and electric vehicle charging infrastructure.

Climate returns to the front pages of the news as capital markets respond accordingly, with a new wave of clean-tech investment helping to maintain the impressive growth rates in these sectors. But this economic growth is coupled with rising greenhouse gas emissions, locking in the world's pathway to a 4°C temperature rise.

RESOURCES FOR EFFECTIVE CARBON PRICING

WHAT IS COVERED IN THIS SECTION?

- Selection of current carbon pricing policies and private sector actions
- Range of resources that inform the development of effective carbon pricing policies
- Range of resources that inform business and investor approaches to carbon pricing

This section of the Toolkit collects together some key resources that give expert guidance on policy design and implementation, and on related issues such as low-carbon solutions and new technologies. Other issues that are relevant to a discussion about carbon pricing, including competitiveness, carbon leakage, offsets and revenue among others, are not covered in this Toolkit but are important to a successful conversation about effective carbon pricing.

This section is intended represent the range of readily available resources.

OVERVIEW: CURRENT CARBON PRICING POLICIES AND PRIVATE SECTOR ACTIONS

CARBON PRICING POLICIES AROUND THE WORLD: WORLD BANK 2015 STATE AND TRENDS OF CARBON PRICING REPORT

<http://www.worldbank.org/content/dam/Worldbank/document/Climate/State-and-Trend-Report-2015.pdf>

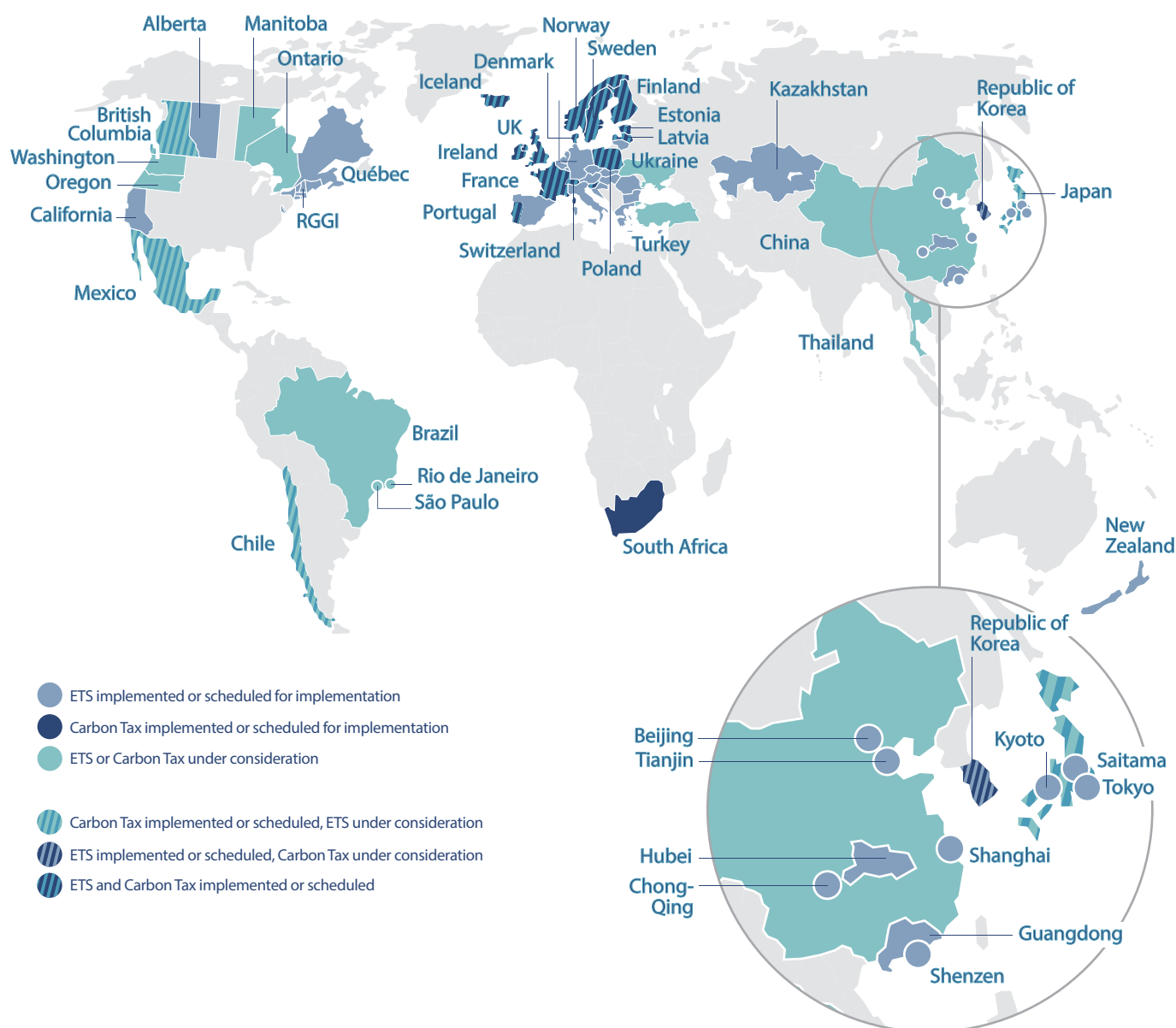
The current patchwork of carbon pricing policies regulates seven metric gigatonnes or 12% of annual global greenhouse gas emissions. These policies, which reflect carbon taxes and cap-and-trade systems, are spread among 39 countries and 23 regions, with a total value of about \$50 billion, according to the World Bank's 2015 State and Trends of Carbon Pricing report.



SEVEN GIGATONNES OR 12% OF ANNUAL GREENHOUSE GAS EMISSIONS ARE CURRENTLY REGULATED BY A PATCHWORK OF CARBON PRICING POLICIES.



STATE AND TRENDS REPORT MAP



EMISSIONS CAP AND TRADING SYSTEM

While each emissions trading system (ETS) is unique, they have common features. They cap the amount of CO₂ emissions that certain industries, or the whole economy, can release. They issue allowances to participating companies, representing their share of emissions. They require companies to measure, report and verify their CO₂ emissions. And they have a trading or auction mechanism.

Examples of mature systems include those in the European Union, California, and the group of Northeastern US states operating under the Regional Greenhouse Gas Initiative (RGGI), which started in 2005, 2006 and 2008 respectively. Since 2013, new systems have emerged in Kazakhstan, South Korea, Switzerland, as well as in seven economic regions of China -- Beijing, Chongqing, Shanghai, Shenzhen, Tianjin, Hubei and Guangdong.

Some systems have broadened their reach, for example when California and Quebec linked their systems in 2014 and then began covering transport fuel. Ontario has announced it soon intends to link to this system. Both China (at the national level) and Washington State expect to announce ETS systems soon.

CARBON TAX

Another policy to limit carbon is to tax CO₂ emissions, levying fees on emissions from fossil fuels production, distribution, or use. Examples of carbon taxes may be found in Mexico, Japan, British Columbia and across Europe (including in Denmark, Finland, France, Norway, Portugal and Sweden). Australia briefly had a carbon tax, before it was repealed in 2014 after the election of a conservative government. South Africa is expected to enact a carbon tax in 2016 and Chile in 2018.

COMPANIES PRICING CO₂ EMISSIONS: CDP 2015 GLOBAL PRICE ON CARBON REPORT

<https://www.cdp.net/en-US/News/CDP%20News%20Article%20Pages/surge-in-companies-disclosing-carbon-price.aspx>

Over 1,000 major companies around the world already use an internal price on carbon or plan to do so within two years. Based on data reported in 2015 to CDP by companies in every major economy, and across all industries and sectors:

150 → 437 companies use carbon prices	The number of companies placing a value on CO ₂ emissions has tripled – 437 companies in 2015 compared with 150 in 2014.
NEW: 583 plan to set carbon Prices	A further 583 companies plan to set an internal price within two years, indicating carbon pricing's growing influence in corporate decision-making.

This dramatic increase demonstrates the ongoing mainstreaming of carbon pricing as a priority for business and an essential component of the corporate strategic toolkit.

Companies outlined to CDP how and why they place a value on carbon pollution.

- Many companies used this approach to mitigate risk from current or potential regulation. Some stated they anticipate a future in which their carbon emissions will carry a price.
- Other companies reported using a price on carbon to drive investments in energy efficiency, switching to clean energy, cleaner purchasing or other GHG reduction activities.

This research builds on 2013 and 2014 reports, all available on the CDP website (www.cdp.net).

GROWING SUPPORT FOR CARBON PRICING CARBON PRICING LEADERSHIP COALITION AND 'PUT A PRICE ON CARBON' STATEMENT

www.carbonpricingleadership.org

<http://www.worldbank.org/en/news/feature/2014/09/22/governments-businesses-support-carbon-pricing>

After the 2014 UN Climate Summit in New York, where more than 1,000 businesses and 100 governments supported a price on carbon. The Carbon Pricing Leadership Coalition was created to turn this support into meaningful action.

Given the potential for carbon pricing to bring down greenhouse gas emissions and lower climate risks, a number of organizations, including the World Bank Group, have adopted a multi-faceted approach to promote carbon pricing across all stages of development from planning, design and implementation to connectivity, scale-up and cross-border trade.

The aim of the Coalition is to accelerate the adoption of carbon pricing programs around the world, by bringing together political and business leaders to share their experience and insights on carbon pricing. The Coalition will increase ambition of, political support behind, and demand for policies that maintain competitiveness, encourage innovation, and deliver emissions reductions by:

- Building and sharing the evidence base for action
- Mobilizing business support for increased action
- Convening leadership dialogues

The list of coalition members is growing steadily, representing government, business, investor and civil society interests.

GLOBAL INVESTOR COALITION STATEMENT ON CLIMATE CHANGE

<http://investorsonclimatechange.org/>

Nearly 350 global institutional investors representing over \$24 trillion in assets issued the Global Investor Coalition Statement on Climate Change. In it, they asked government leaders to develop plans to phase out fossil fuel subsidies and to “provide stable, reliable and economically meaningful carbon pricing that will help redirect investment commensurate with the scale of the climate change challenge”.

In addition to the statement, issued on the eve of the 2014 UN Climate Summit, these investors recognize their pivotal role in financing clean energy and climate solutions, and have outlined their own commitments.

In 2015, these investor groups continue to work with investors to gather strong commitments to climate action, before COP21. The groups are: AIGCC, Asia Investor Group on Climate Change; IGCC, Investors Group on Climate Change (Australia and New Zealand); IIGCC, European Institutional Investors Group on Climate Change; INCR, Ceres’ Investor Network on Climate Risk (United States); UNEP FI, United Nations Environment Programme Finance Initiative; PRI, Principles for Responsible Investment; and CDP.

This effort is supported by the We Mean Business Coalition: www.wemeanbusinesscoalition.org/take-action

THE CARBON PRICING COMMUNIQUÉ

<http://www.climatecommuniques.com/Carbon-Price.aspx>

The Carbon Price Communiqué was issued in 2012 in the run up to the Doha UN Climate Change Conference, COP 18, and so far has the support of more than 155 companies. It remains open for sign up.

The Communiqué describes carbon pricing as a building block of an effective and ambitious climate change policy framework. The Communiqué states that a strong, well-designed carbon price along with complementary policies can deliver carbon emissions reductions on the scale of the climate challenge.

The Communiqué was created by The Prince of Wales’s Corporate Leaders Group (CLG), and is managed by the University of Cambridge Institute for Sustainability Leadership (CISL).

OVERVIEW: RANGE OF RESOURCES THAT INFORM THE DEVELOPMENT OF EFFECTIVE CARBON PRICING POLICIES

LEARNING FROM EXPERIENCE: EXISTING CARBON PRICING SYSTEMS AND COMMON ISSUES

A number of organizations have examined current and past carbon pricing policies. Their findings may help those seeking to better understand various carbon pricing mechanisms, their successes and challenges.

- The Environmental Defense Fund, CDC Climat and the International Emissions Trading Association's series on the world's carbon markets is an in-depth source of information <https://www.edf.org/climate/worlds-carbon-markets>.
- As the EU ETS marks its 10th anniversary, a number of publications explore this carbon market's past performance and outlook. In July 2015, the Prince of Wales's Corporate Leaders Group released a study, '10 years of Carbon Pricing in Europe – a business perspective' <http://www.cisl.cam.ac.uk/publications/low-carbon-transformation-publications/10-years-of-carbon-pricing-in-europe>), which focuses on the experience of the ETS user.
- This Toolkit has referred to the price outlook from the Thomson Reuters Carbon Market Analyst, which released the '2030 EU Carbon Price Forecast: What's Next for the EU ETS' https://forms.thomsonreuters.com/260515_CarbonReport/.

LEARNING PLATFORM FOR POLICYMAKERS: INTERNATIONAL CARBON ACTION PARTNERSHIP (ICAP)

<https://icapcarbonaction.com/>

The International Carbon Action Partnership (ICAP) is an international forum for governments and public authorities that have implemented or are planning to implement emissions trading systems (ETS). ICAP facilitates cooperation between countries, sub-national jurisdictions and supranational institutions. Members share best practices and discuss ETS design elements with a view to creating a well-functioning global carbon market through linking ETS.

POLICY BEST PRACTICE: FASTER PRINCIPLES FOR SUCCESSFUL CARBON PRICING

<https://openknowledge.worldbank.org/bitstream/handle/10986/22641/TheOFASTEROpriOn0initial0experience.pdf?sequence=1>

The FASTER Principles for Successful Carbon Pricing combine economic analysis and historical perspective in a set of principles to aid the design and implementation of successful carbon pricing policies. These principles, outlined in a report by the World Bank Group and the OECD in September 2015, can guide and inspire countries, regions, states and businesses considering carbon pricing systems.

FASTER PRINCIPLES	
FAIRNESS	Successful carbon pricing policies reflect the ‘polluter pays’ principle and distribute costs and benefits equitably, avoiding disproportionate burdens on vulnerable groups.
ALIGNMENT OF POLICIES AND OBJECTIVES	Successful carbon pricing policies are part of a suite of measures that facilitate competition and openness, and ensure equal opportunities for low-carbon alternatives, and interact with a broader set of non-climate policies.
STABILITY AND PREDICTABILITY	Successful carbon prices are part of a stable policy framework that gives a consistent, credible and strong investment signal, the intensity of which should increase over time.
TRANSPARENCY	Successful carbon pricing policies are clear in design and implementation.
EFFICIENCY AND COST-EFFECTIVENESS	Successful carbon pricing improves economic efficiency and minimizes the costs of emission reduction.
RELIABILITY AND ENVIRONMENTAL INTEGRITY	Successful carbon pricing schemes result in a measurable reduction in environmentally harmful behavior.

OVERVIEW: RANGE OF RESOURCES ON BUSINESS AND INVESTOR APPROACH TO CARBON PRICING

Business and investors frequently ask where they can turn for insight and guidance on why carbon pricing is relevant to them, and what they can do about it. In recent years, carbon pricing has raised its profile, as seen by CDP's data and the global business and investor movements discussed earlier in this section.

The following resources can provide guidance, assistance or a platform for shared action.

BUSINESS LEADERSHIP CRITERIA ON CARBON PRICING

<http://caringforclimate.org/workstreams/carbon-pricing/>

Ahead of COP21 in December 2015 in Paris, The UN Global Compact together with UNEP, UNFCCC secretariat and Caring for Climate partners – WRI, CDP, The Climate Group, UN Foundation and Principles for Responsible Investment – are urging companies to become Carbon Pricing Champions by aligning with the Business Leadership Criteria on Carbon Pricing.

The Leadership Criteria has three elements:

- Set an internal carbon price high enough to materially affect investment decisions to drive down greenhouse gas emissions
- Publicly advocate the importance of carbon pricing through policy mechanisms that take into account country specific economies and policy contexts
- Communicate on progress over time on the two criteria above in public corporate reports

This effort is supported by the We Mean Business Coalition: www.wemeanbusinesscoalition.org/take-action.

EXECUTIVE GUIDE ON CARBON PRICING LEADERSHIP

<http://caringforclimate.org/workstreams/carbon-pricing/>

The Executive Guide on Carbon Pricing Leadership will be published in December 2015. A consultation version will be available from September 24 - October 30, 2015 through the UN Global Compact and World Resources Institute, as the lead authors of the guide.

The guide is being developed by and for companies. It is designed as a resource about why and how a company might use carbon pricing to reduce greenhouse gas emissions. Specifically, the objective is to help an individual or team explore opportunities for their company to align with the Business Leadership Criteria on Carbon Pricing and gain formal recognition from the UN's Caring for Climate initiative, CDP, and We Mean Business.

LEARNING PLATFORM FOR BUSINESS: INTERNATIONAL EMISSIONS TRADING ASSOCIATION (IETA)

<http://caringforclimate.org/>

The International Emissions Trading Association (IETA) is a non-profit business organization created in June 1999 to serve businesses engaged in the new field of carbon markets.

IETA's objective is to build international policy and market frameworks for reducing greenhouse gases at low cost, and works with its members to capture opportunities, mitigate risks and manage uncertainties of global emissions markets. IETA members seek to develop an emissions trading regime that results in real and verifiable greenhouse gas emission reductions, while balancing economic efficiency with environmental integrity and social equity.

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In this Toolkit, carbon dioxide emissions and carbon dioxide equivalent emissions are referred to as 'CO₂ emissions', 'carbon emissions' and 'greenhouse gas emissions'.

CURRENCY RATES USED IN CONVERSION OF PRICES PER TONNE OF CO₂

CURRENCY	CONVERSION RATE	CURRENCY	CONVERSION RATE
Australian Dollar	1.42	Indian Rupees	65.69
Brazilian Real	3.76	Japanese Yen	120.32
British Pound	0.65	Russian Ruble	66.07
Canadian Dollar	1.33	South African Rand	13.44
Chinese Yuan	6.37	South Korean Won	1183.74
Euro	0.89	Swiss Franc	0.97
Hong Kong Dollar	7.75		

*All prices converted to US dollars using a conversion rate from September 2, 2015

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