The First International Research Conference on Carbon Pricing

February 14-15, 2019
New Delhi, India

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FOREWORD FROM CPLC SECRETARIAT

The Carbon Pricing Leadership Coalition (CPLC) brings together governments, businesses, and civil society organizations to accelerate the uptake of carbon pricing policies that can maintain competitiveness, create jobs, encourage innovation, and deliver meaningful emissions reductions. Since launching, CPLC has been a key player in fostering leadership on carbon pricing, making a strong business, political, and social case for it, and mobilizing stakeholder support across regions and sectors. Our partners, over 250 in 2019, consistently rely on us as a trusted resource for sound knowledge and analysis on carbon pricing.

Over the last few years, as we worked closely with our CPLC partners, we recognized the need to engage the research community from around the world to strengthen the efforts of carbon pricing policy design and implementation. There was a particular need for relevant research and analysis to support developing countries that were contemplating or recently embarking on a process to price carbon, especially as it pertains to the design and application of carbon pricing instruments. The most pressing topics included getting a better understanding of the factors that determine successful and effective implementation in a developmental context; and challenges related to public acceptability, competitiveness impacts, market liquidity, and others. It was in this context that the first International Research Conference on Carbon Pricing was conceived; with the aim to bring together researchers and practitioners from around the world to share and provide insight and evidence on these, and other unanswered questions on carbon pricing.

We received an enthusiastic response to the call for abstracts, and papers were selected for presentation at the Conference based on criteria set by CPLC's Scientific Committee, a forum of carbon pricing experts from government, private sector, and civil society. Our aim was not only to present cutting-edge research at this Conference, but also to provide a platform for new and upcoming researchers to engage and form networks.

Hosted in collaboration with TERI in India, the Conference was a resounding success with over 175 participants from all over the world. It provided a platform for knowledge exchange and learning on carbon pricing and paved the way for novel ideas on how we can collectively address emerging challenges. This report highlights the key takeaways from the Conference and summarizes the presentations and research papers that were presented.

Needless to say, efforts from several people contributed to the success of the Conference. We would like to specifically extend our gratitude to CPLC's Scientific Committee for their leadership in guiding and shaping this key initiative over a year, to our host TERI, for their unwavering support at the Conference, and to the World Bank and the entire Coalition in delivering a successful Conference.

Angela Naneu Churie Kallhauge, *Head of the Carbon Pricing Leadership Coalition Secretariat and Senior Climate Change Specialist, Carbon Markets and Innovation, World Bank*

Venkata Ramana Putti, *Program Manager, Carbon Markets and Innovation, World Bank*

FOREWORD FROM THE CO-CHAIRS OF THE SCIENTIFIC COMMITTEE

When we agreed in early 2017 to chair the CPLC Research Conference, we knew from the outset that it was both an important and a timely initiative. Our own work on carbon pricing had shown us that knowledge gaps pose a central barrier to the successful introduction of carbon pricing. Wherever policy debates were dominated by sentiment rather than facts, we saw how difficult it became to muster the required political support. Where a political decision had already been secured, uncertainties about policy design and envisaged impacts often complicated or slowed down implementation.

For all its conceptual simplicity, carbon pricing is a challenging instrument to operationalize in practice. Creating a policy framework that delivers transformational change while ensuring a sustainable transition is a complex undertaking that comes with great responsibility. Early experiences—especially from the European carbon market—underscored that point. Fortunately, those same experiences have also helped to deepen our knowledge base, allowing the research community to advance its work on carbon pricing with increasingly sophisticated qualitative and quantitative research methods.

Where we have arguably made less progress is in connecting the overlapping worlds of research, decision making, and public opinion: the policymakers, whose decisions will determine the further evolution of carbon pricing; the business leaders, whose corporate strategies rely on clear policy signals; and the broader public, whose lives and livelihoods are affected by carbon pricing. Acknowledgment of this critical task prompted calls early on to explore a research conference as a potential bridge between these communities.

In our efforts to make this Conference happen, we were privileged to help establish and subsequently work with a Scientific Committee of the highest caliber, with global representation and a wide variety of professional and academic backgrounds. Being able to draw on the collective experience of this Committee was an inspirational experience: taken together, the number of years these Committee members have worked on different aspects of carbon pricing exceeds the years since which humanity has emitted greenhouse gases at industrial scale.

In shaping the main parameters of the Conference, we agreed from the start that the Conference should not only strengthen the interface between research and practice, but should also identify and empower a new generation of researchers, and—as carbon pricing itself gradually expands around the globe—help promote a more even geographic distribution of research efforts.

The high turnout of excellent abstracts was a promising indicator that the Conference would be a success. In fact, the Conference itself far exceeded our expectations. We are deeply grateful to our fellow Scientific Committee members, the CPLC Secretariat, our colleagues at TERI, and, of course, the researchers and participants themselves, for their many contributions to this success. But we are mindful that the work does not stop here. More active engagement between carbon pricing researchers and practitioners cannot be achieved through an isolated event: it calls for an ongoing commitment. We look forward with anticipation to the next chapters in this exciting process.

Andrei Marcu, *Managing Director, European Roundtable on Climate and Sustainable Transition*

Michael Mehling, *Deputy Director, Center for Energy and Environmental Policy Research (CEEPR), Massachusetts Institute of Technology (MIT)*

BACKGROUND

Over the past several years, there has been growing momentum of carbon pricing approaches around the world and an increase in the diversity of such approaches. As countries gear up to meet their Nationally Determined Contributions (NDCs), as submitted to the Paris Agreement, carbon pricing plays a critical role in helping meet these goals. Carbon pricing is a flexible and cost-efficient tool that provides a clear price signal to governments and businesses to reduce high-emitting activities and shift investment to more efficient, and lower-carbon alternatives. When designed right, carbon pricing not only reduces greenhouse gas emissions, but helps drive investments in low-carbon solutions and gives businesses the predictability and incentives they need to adopt low-carbon growth strategies.

Research has contributed to understanding how to design and deploy carbon pricing mechanisms and helped stakeholders understand carbon pricing instruments, success factors for effective implementation, ways to address market and competitive distortions, and, among other things, the role and alignment of companion policies.

In addition, a growing body of experience and data is accumulating from the operation and modeling of different carbon pricing approaches, from which much can be learned. The application of carbon pricing instruments has revealed new or persistent challenges around the following: increasing market stability and liquidity, improving climate risk management, building acceptability on carbon pricing by society, designing carbon pricing for the developing country context, managing transitions and impacts in relation to carbon-intensive sectors and communities, addressing overlapping policies, combining carbon pricing instruments, expanding the scope of carbon pricing to more heterogeneous sectors of the economy, and adjusting system designs over time to realize committed ambition levels.

To address these, and many other questions, the Carbon Pricing Leadership Coalition (CPLC) convened researchers, practitioners, and interested stakeholders for the first International CPLC Research Conference on Carbon Pricing from February 14-15, 2019 in New Delhi, India. The two-day conference was hosted by The Energy Resources Institute (TERI), following the World Sustainable Development Summit (WSDS), TERI's annual flagship event on sustainability with a specific focus on actions in the developing world.

The Conference drew participation from close to 175 delegates from all over the world, with representation from scientists, governments, the private sector, and civil society.

The key aims of the CPLC Research Conference were to:

- Bring together researchers, practitioners, and policymakers within the carbon pricing space to take stock of the knowledge base and strengthen understanding of emerging trends in carbon pricing;
- Strengthen understanding of the evolving challenges to the application of carbon pricing initiatives; and
- Identify areas of possible collaboration and issues requiring further reflection and research.

The Conference comprised several plenary sessions that focused on big-picture issues, and six parallel thematic tracks focusing on Learning from Past Experience, Carbon Pricing Design, Concepts and Methods, Political Economy, Decarbonizing the Economy, and Emerging Frontiers. CPLC's international Scientific Committee comprising of high-level representatives from government, academia, and private sector, put out a call for papers on carbon pricing. After careful selection, papers were chosen for presentation at the Conference. A particular emphasis was placed on attracting young researchers and scholars from emerging economies.

STRUCTURE OF THE REPORT

SECTION ONE

Executive Summary including key messages from the entire conference including the Opening and Closing Plenary Sessions

SECTION TWO

Summary of Keynote Address and Topical Plenary Sessions

SECTION THREE

Abstracts from Research Papers and Presentations according to the following themes:

- LEARNING FROM EXPERIENCE
- CARBON PRICING DESIGN
- CONCEPTS AND METHODS
- POLITICAL ECONOMY
- DECARBONIZING THE ECONOMY
- EMERGING FRONTIERS

"If we are emitting CO_2, its not that we are emitting CO_2 but that we are emitting money."

- Mahendra Singhi, *Managing Director and Chief Executive Officer, Dalmia Cement (Bharat) Ltd.*

SECTION ONE

EXECUTIVE SUMMARY

To achieve the large-scale emission reductions required under the Paris Agreement, the international community needs to find ways to rapidly decarbonize the economy. Putting a price on carbon pollution is one of the most effective and efficient strategies that governments, companies, and other actors can use to reduce carbon emissions and combat climate change. 96 countries mention carbon pricing in their NDCs, indicating that they are planning or considering the use of climate markets and/or domestic carbon pricing to meet their NDC commitments.[1] While developed countries have taken the lead to use carbon pricing as a way to reduce their emissions, there has recently been a growing interest from developing countries as well.

Furthermore, private sector engagement has also been robust, with nearly 1,400 companies worldwide embedding an internal price into their business strategies in 2017, up from 140 in 2014.[2] The Taskforce on Climate-Related Financial Disclosures (TCFD)[3] brought together industry to make voluntary, consistent disclosure recommendations for use by companies in providing information to investors, lenders, and insurance underwriters, about their climate-related financial risks. The TCFD has been instrumental in raising the profile of climate change among industry and encouraging private sector to assess, manage, and measure their climate risk and opportunities. TCFD highlighted the importance of transparency in pricing risk and acknowledged that while challenges exist with measuring and disclosing climate risks, mainstreaming climate into annual financial filings would ultimately assist in the appropriate pricing of risks and allocation of capital in the global economy.

In the last decade, there has been an increase in the number of carbon pricing initiatives to include jurisdictions from emerging economies. As of February 1, 2019, 57 carbon pricing initiatives have been implemented or are scheduled for

[1] World Bank; 2019. State and Trends of Carbon Pricing 2019. Washington, DC. Available at: https://openknowledge.worldbank.org/handle/10986/13334

[2] CDP, 2017. Putting a Price on Carbon, Integrating climate risk into business planning. CDP. Available at: https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/reports/documents/000/002/738/original/Putting-a-price-on-carbon-CDP-Report-2017.pdf?1507739326.%20%20%20%20CDP%202019,%20CDP%20India%20Annual%20Report%202018;%20Available%20at%20https://6fefcbb86e61af1b2fc4-

[3] Task Force on Climate-related Financial Disclosures, https://www.fsb-tcfd.org/

implementation. This consists of 28 ETSs, mostly located in subnational jurisdictions, and 29 carbon taxes primarily implemented at the national level.[4] In addition, a number of countries have policies that implicitly put a price on carbon, for example through fuel taxes and renewable energy certificates. While there has been a surge in the uptake of carbon pricing by governments and the private sector, sound research that investigates key empirical questions remains as important as ever. Several challenges exist in furthering the implementation of these policies, and robust research and insights on critical issues can help advance the uptake and robust implementation of carbon pricing initiatives.

To help address some of these empirical questions on carbon pricing, the CPLC Research Conference provided key insights and perspectives on topics such as successful carbon pricing models that can be applied in various contexts and that can address both the persistent and new barriers that limit their adoption, as well as the evolving needs of governments and the private sector as they undertake carbon pricing in various forms. The discussions will help enhance the collective understanding among researchers and practitioners and drive informed policymaking, further facilitating the adoption and durability of these policies. What follows are the main takeaways from the Conference.

KEY MESSAGES

Carbon pricing is a necessary and efficient tool that can support countries as they meet their goals under the Paris Agreement and raise their ambition on climate action. However, carbon pricing must not be considered in isolation, but as part of a broader suite of policies. Policymakers must be clear on the policy objectives they are trying to achieve—environmental, fiscal, or others—and strive for a balanced approach when considering carbon pricing and other relevant policies. Policymakers must also consider how carbon pricing can assist in the achievement of additional policy priorities, especially the Sustainable Development Goals (SDGs). When designed well, carbon pricing can generate significant economic and social benefits. These benefits include increasing ability of governments to use public financing to invest in other development priorities like health and education, stimulating growth in clean technologies and low-carbon innovation, and improving air quality.

> "The CPLC Research Conference is an initiative that can facilitate exchange of experiences from jurisdictions across the globe and make research on carbon pricing available to a broader audience. I hope the conference will serve as a gateway to better communication between academia, practitioners and policy makers - we all need to join forces to ensure an effective carbon pricing design. Solid evidence of effective carbon pricing will help give policy makers the courage to introduce such measures!"
>
> - Susanne Åkerfeldt, *Senior Adviser, Ministry of Finance, Sweden*

A complex concept such as carbon pricing is not easy to communicate. Identifying the best and most effective ways to simplify the concept and communicate its benefits will be essential moving forward. Messaging is critical. Through positive messaging—such as referring to a carbon pricing policy that returns revenues to targeted households as a carbon "cash back" program—the policy

[4] Carbon Pricing Dashboard, https://carbonpricingdashboard.worldbank.org/map_data

can be made more acceptable to stakeholders. Providing a collaborative platform for researchers and practitioners to engage and share knowledge, such as the CPLC Research Conference, is a critical step towards furthering a healthy discourse and ensuring that policymakers are informed by the latest research on this issue.

Political acceptability remains a key barrier to the wider uptake of ambitious carbon pricing policies. While economic theory clearly supports the efficiency and effectiveness of these policies, they have struggled with public acceptance. Political acceptability goes beyond economic theory to the behavioral sciences, and policymakers must take into account factors such as public perception of the costs and benefits of such policies, cultural and social perspectives, and trust in policymakers.

Climate champions, both from governments and private sector that are taking the lead in implementing carbon pricing play a vital role in inspiring others to take action and increase ambition in this context. Successful examples of how to design and implement carbon pricing policies can help get additional countries to adopt these instruments. Countries that are in the early stages of considering carbon pricing can point to these successful case studies, to get greater buy-in and acceptability from their citizens. For example, the experience with the Swedish carbon tax provides a good example on how to secure public acceptance. Clear messages on the impact that carbon pricing has had on emissions, and examples of how carbon pricing works in various national circumstances, are needed.

Building in support for the policy transition, especially for those who will be most affected, can ensure the durability and acceptability of the carbon pricing policy. Addressing concerns upfront such as on the implications for the competitiveness of energy-intensive trade exposed industries, distributional impacts of carbon pricing, and others, will be critical. Getting buy-in from sectors that are difficult to decarbonize by undertaking a rigorous stakeholder engagement process will help ensure the durability of the policy.

Developing data frameworks and processes, especially in developing countries, that ensure robust data collection and facilitate relevant analysis and research will be critical going forward. Sound research is dependent on the robustness of models and availability of data. Despite significant progress in recent years, computational and mathematical models still face shortcomings when trying to represent the complexities of the real world, and a lack of consistent, reliable data can limit the ability of researchers to undertake groundbreaking research on carbon pricing. For example, studies are often unable to quantify the impacts of carbon pricing with great accuracy due to a lack of adequate and relevant data. Similarly, most research studies currently undertaken do not fully or adequately quantify the benefits of avoided climate damages.

RESEARCH NEEDS

A clear need exists to strengthen the knowledge base on carbon pricing and provide actors from diverse backgrounds—businesses, policymakers, and civil society—with robust and objective information and data to support decision-making processes. The CPLC Research Conference identified several areas for further reflection and research. These include:

- **Design and implementation options for carbon pricing as part of a broader portfolio of policies.** Studies can help shed light on the factors that policymakers should consider when implementing carbon pricing as part of a broader suite of policies, often with multiple, overlapping or conflicting objectives. A better understanding of the role that carbon pricing plays in such a policy package, and what implications this can have under different national/sub-national circumstances as well as various policy scenarios and timeframes, will help policymakers design policies that meet the stated objectives and raise climate ambition.

- **Contextualizing carbon pricing for developing country implementation.** While significant research has been conducted on the design, implementation, and impact of emissions trading schemes (ETSs) and carbon taxes in the developed world, very little research exists on its application in a developing country context. Research is needed to better understand the role carbon pricing policies can play in developing country economies where other pressing sustainable development challenges exist and climate mitigation may not be of primary importance. For example, different designs may be needed for countries with low emissions per capita, countries where a significant proportion of emissions originates from the agricultural sector (e.g. Ethiopia), or countries that are facing immediate impacts of climate change (e.g. Bangladesh). Developing countries vary widely in terms of institutional capacities, stages of implementation or consideration of carbon/climate policies, as well as national priorities and circumstances. China and India are top emitters and recognized as major economies, and the responsibilities that arise from this ranking in terms of addressing climate mitigation are vastly different when compared to the development priorities of small island developing states and least-developed countries. It will be important to have a robust understanding of how carbon pricing policies and measures may be crafted and the impacts such instruments may have on developing economies; and how to build capacity, educate and sensitize policymakers, the private sector, and the public on carbon pricing in such economies. Also critical is country-specific and targeted research that recognizes the differing development priorities and economic stages of countries, and provides insights into the design and application of carbon pricing in these varying contexts.

- **Understanding synergies and co-benefits, and potential unintended negative impacts, of undertaking both climate change and air pollution policies.** Further research is needed that provides insight into policy packages that achieve the dual goals of climate change and other social or environmental benefits in varying scenarios. This could include benefits such as air pollution mitigation achieved under scenarios that reflect economy-wide or sector-specific deployment, a developing country context in which climate change mitigation is not a development priority, or transitional solutions vs. final solutions as countries implement their NDCs.

- **Innovative ways to use revenues generated from carbon pricing to drive a low-carbon transition, increase political acceptability, and balance efficiency and equity concerns.** Importantly, the political acceptability of revenue use is dynamic. For example, modest carbon prices and the limited amounts of revenue they raise may still allow earmarking the latter for green expenditures, whereas allocation of larger revenue streams from a more robust carbon price to a particular industry or use may meet with public resistance. Related to revenue use is the question of how carbon pricing may support the low-carbon transition, including a just transition of the affected workforce, and investments in areas that are traditionally considered difficult to fund by the private sector, such as infrastructure and early-stage innovation.

- **Use of carbon pricing to further incentivize the adoption of innovative, low-carbon technologies by country and by sector, including successful examples.** A key issue for policymakers will be to consider the evolutionary nature of technological shifts and how a price on carbon can help accelerate this technological transformation. For example, the Indian steel sector is forecast to triple in capacity by 2030, but using current carbon-intensive manufacturing technologies will likely result in considerable carbon lock-in. Policymakers urgently need to design policies that incentivize companies now to avoid this lock-in and adopt lower-carbon technologies, even if those are currently still more expensive. Understanding how a carbon price can serve as a tool to incentivize this transformation will be critical.

- **Benefits and cost savings from linking carbon markets at the regional or international levels,** for instance through use of cooperative approaches under Article 6 of the Paris Agreement, and best practices related to the design and operation of such linkages. Exploring linking options for raised ambition and accelerated achievement of a net-zero carbon world will be increasingly important going forward. Examples such as the carbon market links between California and Quebec or between the European Union (EU) and Switzerland, and lessons learned from their implementation, can help inform policymakers as they explore this promising option.

- Modeling studies indicate that well-designed carbon pricing policies can deliver significant cost benefits by designing them such that they include certain elements, such as broad or economy-wide coverage, promote international cooperation, and allow use of offsets. Even though policymakers are aware that carbon pricing is a more cost-effective tool, the political will to enact it is still lacking, suggesting that the research is not persuasive enough to convince policymakers. **A better understanding of the factors that contribute to this situation, including ways to address it, will help accelerate the adoption of this cost-efficient policy option.**

- **Strategies that countries may adopt for implementation of their NDCs through the use of market mechanisms.** It is important to develop an understanding of the market position a country might take—long or short—and the impact these may have on achieving targets, on global ambition, and on ensuring the robustness, liquidity, and growth of the carbon market itself.

- **The need for governance frameworks and processes** that promote policy integrity and help secure a sustained consensus on carbon pricing policy, including ways to build such frameworks.

- **Research on understanding the benefits of carbon pricing—such as the technological innovation it can initiate—not only in the industries that pay the carbon price, but across supply chains,** and the ripple effects it may have.

"There is widespread agreement among a diverse set of policy analysts that in many countries economy-wide carbon-pricing systems will be essential elements of any policies that can achieve meaningful reductions of CO_2 emissions cost-effectively. For that reason, this global conference is timely and of great importance."

- Robert Stavins, *A.J. Meyer Professor of Energy & Economic Development, John F. Kennedy School of Government, Harvard University*

SECTION TWO

This section presents the summaries of the keynotes address and the topical plenary sessions of the Conference.

CARBON TAX DESIGN, THE USE OF REVENUES AND PUBLIC ACCEPTABILITY

If a carbon tax is considered from a pure public finance perspective, the design of the instrument can have significant repercussions on the volume of revenue generated, which can impact its use and ultimately, distributional impacts. Several possible uses of carbon tax revenue exist. These include:

- General government budget: raising additional revenue for government policy priorities (education, health etc.);
- Revenue neutral households: reducing burdens for households/consumers through reducing income taxes, sales taxes or direct returns of revenue (including lump-sum transfers);
- Revenue neutral firms: reducing costs for firms exposed to price effects, for example support for emission-intensive sectors or trade exposed firms (e.g. grandfathering, free tax allowances) or providing support for firm activities (e.g. energy efficiency, new technology, process improvements);
- Allocations for green purposes such as supporting research and development, or investing in green infrastructure; and
- Support for developing countries to help finance the transition to a low-carbon economy.

A mix of revenue use options can be used to achieve various policy goals and objectives. Equity, efficiency, administrative burdens, environmental impact and political acceptability considerations must be taken into account, especially when considering the use of revenues. Several pros and cons exist for the options listed below (Table 1).

Table 1: Carbon Tax Revenue Use: Pros and Cons		
All uses can be assessed relative to efficiency, equity, administrative burdens and environmental impact		
OPTION	PROS	CONS
General government budget	• Relatively simple to implement and manage. • Provide potential allocation to "best-use".	• Lack of transparency in allocation. • Potentially limits acceptability if low trust in politicians.
Revenue neutral-households	• Can be used to reduce distortions in other tax systems. • Ability to support lower-income/ vulnerable households.	• Potentially limited public awareness and understanding, unless direct "carbon transfers". • May divert revenue from better uses.
Revenue neutral-firms	• Simple and easy to manage. • Support can be offered to emission-intensive sectors and trade exposed firms. May overcome oppositions from industry.	• Less equitable than other revenue-recycling options. Might slow adjustment.
Allocation for 'green' purposes	• Demonstrates commitment to 'green' initiatives. • Additional support for investment in infrastructure/R&D programs with broad benefits.	• Limited flexibility due to need for long term allocation. • Possible mistrust of government 'schemes'.
Support for developing countries	• Demonstrate commitment to support objectives of Paris Agreement and SDGs. • Well established system for allocation and management.	• Potential public acceptability of use of revenues outside of the country.
All options should be coupled with clear communication and transparency of revenue-use. Important that uses are relevant for a broad range of constituencies. Must observe country specific regulations/laws e.g. ear-marking.		

Source: Stern, Nicholas. "Carbon tax design, the use of revenues and public acceptability;" LSE. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

To ensure acceptability of any of the above options, it should be coupled with clear communication and transparency of revenue use. Political acceptability of revenue uses plays a crucial role for the rapid uptake of carbon pricing implementation. Along the political acceptability continuum, revenue use for households would rank high in terms of political acceptability, while revenue use for general public budget or support for developing countries might be a harder sell politically.

When designing a carbon tax, policymakers must be clear about its policy objective, and consider both the tax rate and the tax base to ensure acceptability and efficiency of the tax. For the tax rate, the High-Level Commission on Carbon Pricing found that a carbon price of at least US$40–80/t$CO_2$ by 2020 and US$50–100/t$CO_2$ by 2030 should be applied to achieve the targets established in the Paris Agreement, assuming a supportive policy environment is in place. The proposed carbon price must be long-term, credible, and predictable to send clear signals to the market. On tax base, policymakers should be clear on where to levy tax, whom to include, and on coverage of greenhouse gas (GHG) emissions. The decision on whether a carbon tax is applied upstream or downstream can determine whether it will be administratively easy or difficult to capture the benefits, or if a clear signal is provided to consumers. Efficiency is particularly important in the structure of pricing, incentives, and revenue-raising.

Policymakers can facilitate a "Zero Carbon Transition" by providing support such as learning, local skills/innovations and investments, relocation

of public sector services, and social protection measures. Carbon pricing revenues should play a key role in supporting the transition. Additionally, policymakers must recognize that managing "just transition" is different from managing zero-carbon transition. For a "just transition" one needs to consider a shift to services, labor-saving technologies, and other factors.

The urgency of climate action needed is unquestioned. The next two decades will be critical in determining whether the global community is able to garner the political will needed to address climate change. Urgent and swift action is required, especially to ensure that the levels and coverage of carbon pricing are expanded. Public acceptability and initial success stories will be key to getting higher uptake of these instruments. International agreements play a key role in providing political direction to countries for effective carbon price practices. The twenty-sixth Conference of the Parties (COP) in 2020 will be a major platform for all countries to demonstrate climate ambition if the "well-below 2°C" target of the Paris Agreement is to be achieved.

CONVERSATION ON ARTICLE 6: LESSONS FROM KATOWICE

Article 6 of the Paris Agreement provides the legal framework that allows the international use of market-based mechanisms to address climate change. It lays the groundwork for countries to be able to cooperate with each other to meet their NDCs, as well as to facilitate raising the ambition of their NDCs.

At the most recent COP in Katowice, Parties agreed to the Katowice Rulebook, essentially a package which operationalizes the Paris Agreement. However, Article 6 remained the one area where Parties were unable to come to agreement, and the issue remains unresolved.

As negotiators prepare for COP 25 in 2019, Article 6 will be of prominent importance as Parties will need to iron out their differences and reach consensus to ensure that international markets under the Paris Agreement become a reality.

Coming out of Katowice, while there are several technical issues that negotiators need to tackle, a key issue that parties will need to address is the level of centralization in governance, and the role of Parties and that of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (CMA).

This may be interpreted as a debate between the primacy of the NDC as a building block of the Paris Agreement, versus the real or perceived needs of Article 6 in providing comfort to Parties to the Paris Agreement with respect to the integrity of the market—i.e.—should Article 6 accommodate the implementation of all NDCs, independent of their form (i.e. primacy of the NDC) or should negotiators construct Article 6 in a manner that ensures robust market and environmental integrity and then parties adapt their NDCs so that they are able to participate in it. This is a political question that will need to be addressed.

Even though negotiators were unable to come to a consensus on Article 6, the Katowice Rulebook agreed to a specific provision in Article 13, para 77d, which lays down elements of basic accounting. Independent of the Katowice results, rather than wait, countries and the private sector can begin engaging by demonstrating through pilots what a carbon transaction could look like, especially under Article 6.2, and, thus, they can provide some real-life experiences.

The Asian Development Bank's Article 6 Support Facility is one such initiative through which capacity building and technical support are provided to its member countries with the aim to identify, develop,

and test mitigation actions under the framework of Article 6. Drawing on lessons learned from the pilot activities, the Facility aims to inform the international negotiations, and at the same time boosts the readiness of its member countries for participation in post-2020 markets. Countries will need to begin strategizing on: how they plan to implement their NDCs, the impact on their positions in terms of length, and what areas can be open to international cooperation under Article 6.

There are other examples of jurisdictions that are moving ahead where independent standards are being used to generate investments. In California, for instance, three different offset standards are used: American Carbon Registry, Voluntary Carbon Standard, and Climate Action Reserve.

In South America, Colombia is an interesting example as a country which has adopted a carbon tax, but allows offsetting of tax payments by using emission reduction units through Verra or Colombian Clean Development Mechanism (CDM) credits. It provides an example of blending between an offset and a tax in a developing country. The Joint Crediting Mechanism (JCM) is also another example of how Article 6.2 could be operationalized for mobilizing finances to fund low-carbon technologies.

Several countries are showing an increasing interest in piloting some of these transactions and not necessarily waiting for the negotiators to agree to an outcome. However, one must be clear that while countries can begin to move ahead on piloting some approaches, agreement on Article 6 is essential for many smaller countries to get access to international carbon markets. Research on modeling scenarios on various options on the outcomes of Article 6 would also be extremely helpful for carbon market practitioners and policymakers.

To advance international cooperation, a coalition of governments may be formed in which parties set a high bar on environmental integrity and ambition, and spearhead the use of carbon markets under the Paris Agreement.

Another key issue is participation by private sector in carbon markets and the importance of ensuring environmental integrity. Environmental integrity will translate not only to ensuring long-term public confidence in the system for robust investment but will also assist in ratcheting up ambition. “Branding” of the units will be extremely important for sellers to ensure that there is enough demand for a quality product.

A key challenge that inhibits agreement is the interconnected nature of issues in Article 6. Unraveling of one can have repercussions across all other related issues and result in a “no consensus” scenario. Several other technical issues will need to be addressed. These include ways to ensure environmental integrity and avoidance of double counting, accounting for single-year targets, corresponding adjustments for emission reductions achieved inside and outside an NDC, ability for Article 6 to be crafted in a manner that allow it to engage with other international systems like Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), metrics to be used for internationally transferred mitigation outcomes (ITMOs), and the transition of CDM.

An international carbon market and a carbon price are key tools in reducing emissions in a cost-effective and efficient manner and in helping countries achieve their long-term goals under the Paris Agreement.

CARBON PRICING IN PRACTICE

Canada’s Pan-Canadian Framework lays the foundation to address climate change, grow the economy, and build climate resilience. Adopted on December 9, 2016, it consists of four main pillars, of which pricing carbon pollution is one. The other three are mobilizing complementary mitigation action across all sectors, addressing adaptation and

climate resilience, and focusing on clean technology, innovation, and jobs. The Framework calls for the establishment of a price on carbon, as part of a larger policy to achieve emission reductions across all economic sectors.

Canada has also established a Pan-Canadian Approach to Carbon Pollution, which gave provinces and territories the flexibility to implement their own carbon pollution pricing system that meets certain criteria as set by the federal government (the 'benchmark'). It also allows the federal government to implement a carbon pollution pricing system in those provinces or territories that do not meet the benchmark, or those that request it do so. Provinces and territories must have carbon pollution pricing in place that meet the benchmark elements as outlined by the government. Under this, jurisdictions can implement either an explicit pricing system or a cap-and-trade system.

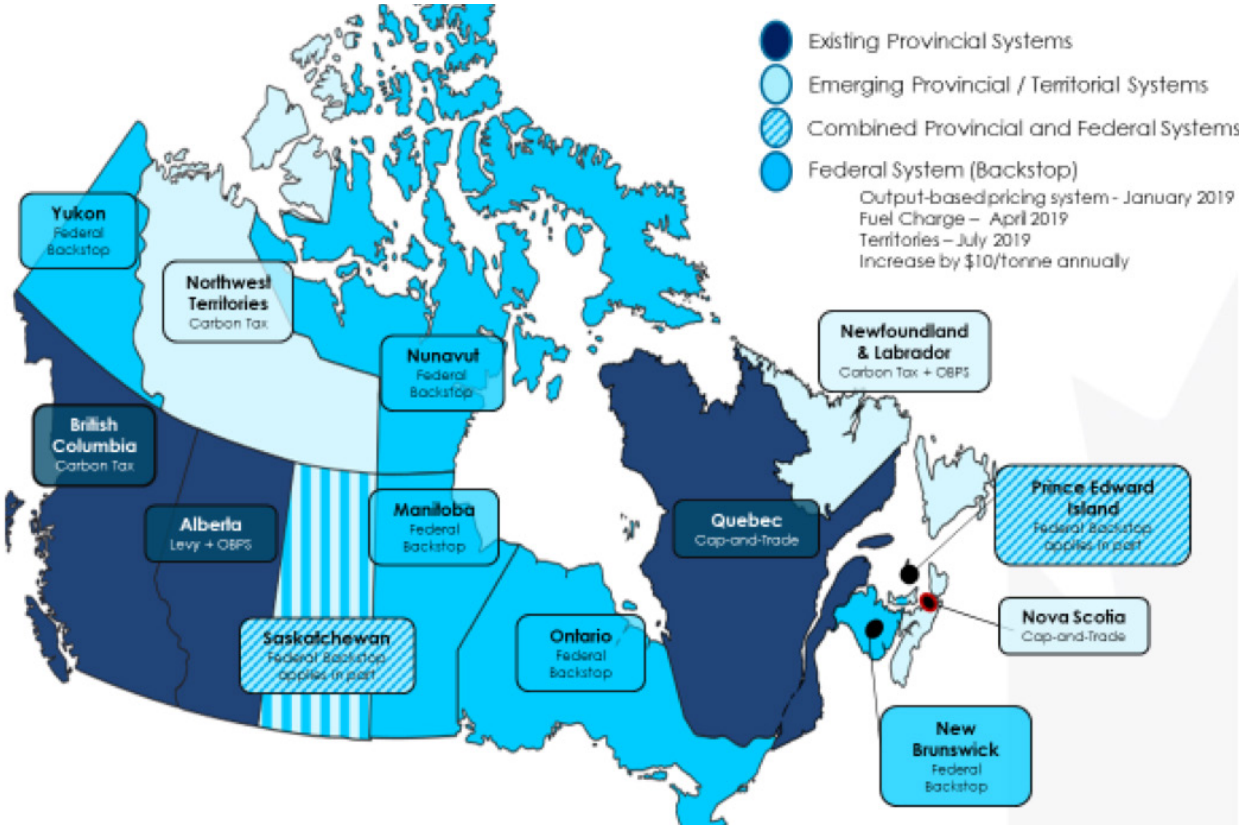
For those jurisdictions that do not meet the benchmark, a federal backstop system will be applied which has two components: a regulatory charge on fossil fuels, and a regulatory trading system called the Output-Based Pricing System (OBPS) that applies to power generation and certain industrial facilities. In the provinces in which the backstop applies, the OBPS took effect on January 1, 2019, and the fuel charge took effect in April 2019. After an evaluation of the carbon pricing systems that have been submitted by provinces and territories, the current map of carbon pricing in Canada is fairly diverse (Figure 1).

Sweden is one of the first countries to put a price on carbon, implementing a price of CPLC €24 per ton of CO_2 emitted in 1991. Today, the carbon price is close to €114 per ton of CO_2 . The carbon tax remains a cornerstone of Swedish climate policy and provides incentives to reduce energy consumption, improve energy efficiency, and increase the use of renewable energy alternatives. The successful implementation of the carbon tax in Sweden was in part due to buy-in from the public and making the case that the revenues will be utilized for a cleaner economy, for example to implement better technologies, cleaner fuels, and better public transportation systems. The tax level was raised gradually and in a stepwise manner, giving households and businesses time to adapt, resulting in improved acceptability of tax increases. A key impact of the carbon tax has been the reduced use of heating oil in buildings, as households have replaced it with increased use of biomass. This has been a key success factor of the policy, where feasible options existed that enabled households to make the switch from high-carbon heating oil to lower carbon biomass fuels.

Colombia has been an early mover in mainstreaming climate change impacts in their decision-making process. In Colombia, about 70% of their electricity is from clean hydroelectric power. Due to the impact climate change might have on the hydrological resources, Colombia has made climate change a central issue in its forecasting for the electricity sector, not only in terms of impact that climate change may have (i.e. in terms of reduced supply of electricity due to lower hydro resources) but also in terms of how to ensure that Colombia is able to meet its NDC due to the shift away from clean hydro that may result due to climate change.

The World Bank Group has been a frontrunner in facilitating and advocating for the uptake for carbon pricing among its client countries. Through its various programs, its focus has been on capacity building, communication, and conducting country specific research. Several initiatives exist within the World Bank Group that facilitate meeting these goals. For example, CPLC brings together governments, private sector, and civil society to advocate for carbon pricing; and the Carbon Partnership Facility and the Transformative Carbon Asset Facility are facilities to pilot carbon markets under the Paris Agreement. Partnership for Market Readiness (PMR) is a flagship initiative of the World Bank that provides market-readiness programs at country level, undertakes upstream policy analysis, provides technical/analytical support, provides training and capacity

Figure 1: Carbon Pollution Pricing in Canada



Source: Mercer, Jackie. "Carbon Pollution Pricing in Canada;" Environment and Climate Change Canada. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

building, and hosts convening and knowledge-sharing sessions. Initiatives like PMR have been instrumental in addressing challenges specific to country circumstances, and are helping countries adopt carbon pricing measures and policies. Going forward, one of the key focus areas for the PMR will be to provide technical and advisory support for developing countries, specifically in relation to carbon markets and how such support might be applied in their national context.

In the Americas (North America and Latin America), more than 20 countries have considered the use of carbon pricing in their NDC and a comparative analysis of the carbon tax in Latin American countries shows a variety of approaches are being used (Table 2).

Table 2: Carbon Tax in Latin American Countries				
Key Features	**Argentina**	**Colombia**	**Chile**	**Mexico**
Total Emissions (mm ton CO_2)	368	169	109	665
Paris/NDC Commitments 2030	Unconditional: 15% Conditional: 30% BAU	Unconditional: 20% Conditional: 30% Forcasted emissions	Unconditional: 30% Conditional: 45% GDP Intensity	Unconditional: 22% Conditional: 36% BAU
Type of Tax	Fuel Tax, Carbon content Law 23.966 en su Part III	Fuel Tax, Carbon content Art. 221 Law 1819, December 2016	Emission Tax Art. 8 Law 20.780 Amendment 20.899	Fuel Tax, Carbon content Special Tax Law 2013, Article 2, Part I
Coverage (% GHG)	40%	16%	42%	30%
Year of Implementation	2018	2017	2017	2014
Tax Base	Purchase/sale of fossil fuels: All sectors except biofuels	Purchase/sale of fossil fuels; All fuels except carbon	Emissions from boilers/ turbines (>50MW); all sectors and fuels, except biomass	Purchase/sale of fossil fuels; All fuels except gas
Tax Rate (US$/Ton CO_2e)	1-10 (2019-2028)	5	5	1-4
Destiny of Tax Collected	General Budget	Environmental Fund and tax rebates	General Budget	General Budget and offset
Compliance & Surveillance	Finance Ministry	MRV of emissions: Environment and social Development Ministry and Internal Revenue Service	MRV: Environment Ministry Tax collection, audits and sanctions: Internal Revenue Service	MRV of fuels, collection, audit and sanctions: Internal Revenue Service
Other Price Carbon Instruments	Under consideration	Tax and offset	Under consideration	ETS internal and Linking with WCI

Source: Lendo, Enrique. "Carbon Tax in Latin America;" EDGE LAC. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

An unprecedented regional effort was made by the governments of Canada, Chile, Colombia, Costa Rica, Mexico, and Sonora (subnational government from Mexico), as well as United States (US) states of California and Washington, and Canadian provinces including Alberta, British Columbia, Nova Scotia, and Quebec, when they announced the creation of the Declaration on Carbon Pricing in the Americas. The Declaration created a cooperation platform in the region exclusively on carbon pricing, and members demonstrated a joint recognition that climate change is a global threat and reaffirmed their support for the Paris Agreement as a necessary step toward fighting it. They also recognized their commitment to implement carbon pollution pricing as a central economic and environmental policy instrument for ambitious climate action.

Several challenges exist as countries in the Latin America region have adopted carbon pricing—political transitions and lack of policy certainty being a key one. Policy uncertainty increases the risk to invest in low-carbon technologies from the private sector perspective. Lack of capacity and fear of losing competitiveness by industries, are other challenges that the countries have had to face.

While India has no explicit price on carbon, it has adopted other measures that incentivize the transition toward a greener economy: Perform, Achieve, and Trade (PAT) Scheme, market-based instruments, and Renewable Purchase Obligations. Currently, India is considering piloting a market-based mechanism for the micro, small and medium enterprise (MSME) sector which includes 180 clusters within 18 energy-intensive industries.

Table 3: Examples of Internal Carbon Pricing adopted by the Indian Private Sector					
Internal Carbon Pricing Examples					
	Mahindra	Infosys	Arvind	Dalmia Bharat	Essar
Approach	Shadow-Explicit Price Hybrid to help decision making and boost investments	Inbuilt cost of initiatives to be understaken for carbon abatement	Shadow price to better inform decision making	Explicit price involving cash flows to create a dedicated fund	Shadow price to better inform decision making & drive innovation.
Motivation	Accelerate investment in low-carbon alternatives and reduce exposure to environmental taxes and other regulations.	Take leadership position on climate action and become carbon neutral.	Reduce energy consummption as hedge against future energy cost/ instability.	Reduce emissions to lessen exposure to clean environment tax or levy & create revenue stream to fund further efficiency and abatement measures	Manage climate-related risks and drive technological innovation.
Internal Carbon Price (in US$)	10	10.5	Mark-up of 5-25% on its electricity tariff across operations	11	15
Emission Sources	Scope 1 and 2: Fuel & Electricity consumption for assembly	Scope 2: Electricity consumption at offices & data centers	Scope 1 and 2: Electricity consumption at facilities	Scope 1: Fuel consumption for operations	Scope 1 & 2: Fuel consumption for operations
Goal served by Carbon Pricing	Reducing Emissions Intensity by 25% by 2019.	Being Carbon Neutral across key operations.	Achieving sector leading benchmarks on energy intensity globally by 2020	Building a 4-fold increase in the renewable energy component across the overall fuel mix by 2030.	Reducing the risks of future regulations by driving business innovation.

Source: Adhia, Vivek. "Carbon Pricing in Action: Learnings from India;" WRI-India. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

These sectors, currently not covered under the PAT Scheme, have significant potential to reduce emissions as well as overall energy consumption. The Government of India is also setting up a national meta-registry, that PMR is assisting with, which will serve the dual purposes of data management as well as transaction registry. Such a registry will establish systems and processes to collect, organize, report and analyze data from markets, facilitate linking among existing markets and an international market-based mechanism, and inform policymaking.

Indian businesses have been proactive in engaging on climate, especially adopting internal carbon prices. WRI India conducted a survey which found that a key driver for adopting carbon pricing is to manage long-term risk exposure to climate change, and there are clear linkages between carbon pricing and eventually taking-up ambitious emission reduction targets, thus enhancing business competitiveness and resilience. A range of carbon pricing approaches are being adopted by the Indian private sector, with coverage of mostly Scope 1 and 2 emissions (Table 3).

CARBON PRICING AND AIR QUALITY

Climate policies, such as carbon pricing, can deliver substantial air quality co-benefits in addition to climate benefits as fossil fuel combustion is a common source for both problems.

Well-designed policies that take into account both the synergies and the tradeoffs between climate and air quality policy, can deliver substantial benefits. This is especially true as climate targets become more stringent over time, and in some scenarios health benefits alone can exceed the cost of meeting the Paris Agreement goals. Some recent positive examples of policies that are taking both climate and air quality into account include Chile's green tax on electricity generation, California's 2017 legislative packages to address climate change and air pollution, and the EU's green mobility package. The latter highlights interdependencies not only between climate and air pollution, but also, safety.

At the governance level climate change policies require international cooperation, and the impact of the policy tends to be measurable over a longer-term and felt globally. On the other hand, policies tackling air pollution have a more short-term and visible impact at the local level. These short-term attributes can help contribute to social acceptability of carbon pricing.

Scientists and policymakers must work together to understand the full range of impacts—both positive and negative—that these policies might have. Designing policies that take the full picture into consideration can be fairly complex. For instance, a modeling study[5] found that by undertaking global decarbonization of about 80% reduction in CO_2 in 2050, the surface ozone pollution reduces significantly, and in this case could potentially save about 1500 lives every year in Mexico City in addition to lives saved from reducing other air pollutants. In a different study,[6] researchers found different results: if China were to reduce its SO_x, NO_x and CO_2 emissions as per its 12th Five-Year Plan, the study found that, in addition to having mostly positive impacts, this could have resulted in up to 10% increase in the monthly mean concentrations in surface ozone in some highly polluted regions in 2015. This is largely due to the background emissions in the ambient environment, where high levels of NO_x emissions occur and where VOC and CO emissions from transport and industry are not addressed. Other research looking at health and air pollution co-benefits of climate action, found that health co-benefits associated with achieving the Paris Agreement targets would outweigh mitigation costs with a ratio ranging between 1.4 and 2.45.[7]

Better policy coordination and consistency in the short-, medium-, and long-term across all levels of governance based on the best available science, are needed. Doing so will enable businesses to explore opportunities in a stable and predictable regulatory environment, manage risk with a long-term perspective, and avoid lock-in of investments and high cost.

[5] Barker, T., A. Anger, O. Dessens, H. Pollitt, H. Rogers, S. Scrieciu, R. Jones, J. Pyle (2010) Integrated modelling of climate control and air pollution: Methodology and results from one-way coupling of an energy–environment-economy (E3MG) and atmospheric chemistry model (p-TOMCAT) in decarbonising scenarios for Mexico to 2050. *Environ.Sci.Policy*, vol. 13, no 8, pp. 661-670.

[6] Anger, A., O. Dessens, F. Xi, T. Barker, R. Wu (2016) China's air pollution reductions efforts increase ozone levels, *AMBIO*, March 2016, Volume 45, Issue 2, pp 254-265.

[7] Markandya A., Sampedro J., Smith SJ., Van Dingenen R., Pizarro-Irizar C., Arto I., González-Eguino M. 2018. Health co-benefits from air pollution and mitigation costs of the Paris Agreement: a modelling study. The Lancet Planetary Health. DOI (10.1016/S2542-5196(18)30029-9).

There is an increasing trend to address both policy areas simultaneously, with different and new actors taking action on both priorities. This has been seen especially in cities where officials are deeply engaged in design and implementation of policies that address both climate and air quality. To be able to respond to the urgent call for climate action, greater cooperation and coordination is needed in several areas:

- Communication and social acceptance: develop narratives that acknowledge the linkages between climate and air quality policies. The Guide to Communicating Carbon Pricing[8] is a valuable resource in this context.
- Vertical alignment: align air quality and climate issues across all (such as national, local, regional, and global) governance levels to leverage synergies in policymaking.
- Economic and regulatory measures—define and design tools that simultaneously address climate and air quality.
- Sectorial coordination: have a broad, economy-wide perspective and an understanding of how a single policy may impact another policy, and the impacts it may have across various sectors, and, therefore, promote coordination across different policy areas.
- Dialogue and cooperation: encourage a learning mindset by enabling conversations and engagement across sectors, countries, stakeholders, and experiences.
- Research and analysis: spearhead research in the synergies and linkages between climate and air quality policies to maximize their joint benefits.

While there is a need for a coordinated analysis of the co-impacts of climate and air quality policies, it is essential that transition solutions and final solutions are taken into consideration to ensure that policies in place do not lock in investments and hinder long-term solutions. Similarly, tailored messaging of these policies for a targeted audience is essential. For example, low-income countries have no perceived or immediate benefit from climate policies contrary to related air pollution reductions where benefits are visible and immediately captured. An inclusive approach to climate and air quality actions can deliver substantial monetary and health benefits, can help drive social acceptance of carbon pricing and consumption decisions, and can promote a more stable regulatory environment.

[8] "Partnership for Market Readiness; Carbon Pricing Leadership Coalition. 2018. Guide to Communicating Carbon Pricing. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/30921

"...To broaden and deepen carbon pricing instruments around the world, it is essential to make sure that sciences supports policy decisions. The CPLC Research Conference on Carbon Pricing, first in its kind, will bring innovative solutions to address the challenges faced by policy makers in the transition to a low carbon economy."

- Enrique Lendo, *Former Co-Chair, CPLC Steering Committee*

SECTION THREE

This section is a compilation of the abstracts of the research papers and the presentations made at the conference.

THEME 1: LEARNING FROM EXPERIENCE

RESEARCH PAPERS: ABSTRACTS

Has Pricing Carbon Reduced Aggregate Emissions?: Evidence from 25 OECD Countries

Ryan Rafaty[9]* and Geoffroy Dolphin*[10]

Assessments of the effects of carbon prices on aggregate CO_2 emissions have been scarce. This is attributable to challenges presented by the lack of standardized carbon price data accounting for heterogeneous coverage cross-nationally, as well as econometric difficulties in isolating the (causal) effect of said prices on emissions. Using a novel dataset of emissions weighted, economy-wide carbon prices in 25 OECD countries from 1990 to 2012, we employ a dynamic macro-panel model to estimate the cross-nationally heterogeneous relationships between carbon prices and per capita CO_2 emissions. We take a conservative perspective, approaching the problem from a correlational rather than causal lens. Controlling for average energy prices, non-pricing drivers of energy and carbon intensity, and various fixed effects, we find that the relationship between changes in carbon prices and changes in per capita CO_2 emissions has been negligible in approximately 84% of the countries analyzed. Among the four countries—all in Europe—wherein carbon price increases have been linearly related to emission reductions, the ostensible short-term effects of a US$10/t$CO_2$ price increase have varied within an order of magnitude. When assuming non-linear relations, however, carbon pricing has been effective in only two countries: a 10% carbon price increase has been robustly associated with reductions of per capita CO_2 emissions of 1.35% in Sweden and 0.067% in Finland. While our findings should be cautiously interpreted as correlational and not necessarily causal, they nevertheless strongly suggest that the "carbon pricing performance gap" is even larger than typically assumed.

[9] Institute for New Economic Thinking at the Oxford Martin School, University of Oxford
[10] Judge Business School, University of Cambridge

**In the Research Papers section, the names of the presenters have been highlighted to indicate that they presented at the Conference. In some cases, these were not the author(s) of the paper, and it has been indicated accordingly.*

The Use of Revenues from Carbon Pricing[11]

Melanie Marten and Kurt Van Dender[12]
Luisa Dressler

The paper collects comprehensive and detailed data on what 40 OECD and G20 economies do with revenues from carbon taxes, emissions trading systems, and excise taxes on energy use. It notes that constraints on revenue use differ between carbon taxes, emissions trading systems, and excise taxes. Constraints can take the form of political commitments or legal earmarks. Constraints are less common for excise taxes, which also raise the most revenue. Carbon tax revenues are relatively often associated with environmental tax reforms, involving reductions in personal or corporate income taxes. Revenues from emissions trading systems are frequently directed towards green spending. The discussion of these results suggests that these observations are relevant to the political economy of ambitious carbon pricing schemes (which are estimated to generate revenue worth 2% to 5% or more of country's GDP), in the sense that it casts doubt on the view—held among some stakeholders—that carbon pricing will meet with stronger public support if revenues are used for green spending.

Carbon Tax in the Building Sector: A Comparison of European Countries

Eoin Ó Broin,[13] ***Jens Ewald,***[14] ***Franck Nadaud,***[15] ***Érika Mata,***[16] ***Magnus Hennlock,***[17] ***Louis-Gaëtan Giraudet,***[18] ***Thomas Sterner***[19]

Across the EU, substantial carbon taxes outside of sectors covered by the EU Emissions Trading Scheme (ETS) have been applied in Sweden. This raises the question as to where the EU might currently be with respect to greenhouse gas emissions had other EU countries followed the Swedish example. We simulate how a high carbon tax would have affected demand in the residential sectors in France, Germany, Italy, Spain, and the United Kingdom. We utilize the residential sectors' price elasticity of demand for energy and use it to estimate the fall in energy demand that would have accrued had carbon taxes at the Swedish level been in place in these five countries. Our conservative estimates indicate reductions in demand for fossil fuels of a minimum of 10–20%. This means that at least 60 $MtCO_{2eq}$ yearly greenhouse gas reductions could have been achieved only in the five countries of focus if such carbon taxes would have been implemented at the time of the signing of the Kyoto Protocol in 1997.

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[11] Marten, M. and K. Van Dender (forthcoming 2019), "The use of revenues from carbon pricing", *OECD Taxation Working Papers*, OECD Publishing, Paris.

[12] OECD's Centre for Tax Policy and Administration, 2, rue André Pascal, 75775 PARIS CEDEX 16, France. Email: Kurt.VanDender@oecd.org. Views and opinions expressed in this paper are the authors' and not necessarily those of the OECD.
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[19] Environmental Economics Unit, Department of Economics, University of Gothenburg, Sweden

PRESENTATIONS

Emissions Trading around the World: A Status Update

William Acworth, International Carbon Action Partnership (ICAP)

There has been significant momentum building around emissions trading systems (ETSs) worldwide, with 20 ETSs operating across 27 jurisdictions currently (regulating emissions from more than 7 billion tons CO_2). Another six jurisdictions are putting in place their systems that could be operating in the next few years, including China and Mexico. 12 jurisdictions are considering the role that ETS can play in their policy mix.

The European Union's ETS (EU-ETS), one of the oldest trading systems, plans to link their ETS with Switzerland from 2021 onwards providing learning opportunities on how linking systems may work. Since 2010, governments in Asia have been increasingly interested in carbon pricing with 12 ETSs being implemented in the region; 8 of these are pilot schemes in China's provinces and two are from the Japanese provinces of Tokyo and Saitama. Several interesting examples exist in the region. South Korea's ETS had issues with liquidity concerns and Kazakhstan recently strengthened their trading procedures and allocations for participants and recommenced operations in 2018. In Thailand, development of a domestic carbon market is part of the 12th National Economic and Development Plan (2017–2021) and the Indonesian government issued a Regulation on Environmental Economic Instruments, which provide the policy basis for a market-based instrument and mandate to establish an ETS before 2024. Turkey, as it considers an ETS, has developed reporting software that is considered state-of-the-art which may provide learning opportunities for other jurisdictions globally. China's national ETS, once it begins trading, will be the largest in the world.

In North America, California and Quebec represent mature systems linked since 2013, and developed under the Western Climate Initiative (WCI). The Regional Greenhouse Gas Initiative (RGGI), the first mandatory market-based program in the US, has been highly effective in reducing emissions and aims to reduce emissions by a further 30% between 2021 and 2030. RGGI states are also exploring options to introduce a market-based mechanism in the transportation sector, which may result in a future expansion of RGGI's coverage. Oregon intends to pass an ETS bill with future linking possible. Mexico is gearing up for a pilot ETS in 2020 that will provide hands-on experience which is critical for policymakers and private sector to better understand the impact of such a policy. Mexico aims to launch a mandatory ETS in 2022. Chile and Colombia's growing experience with carbon pricing is helping them establish the necessary measurement, reporting, and verification infrastructure for an ETS. Similarly, Brazil has run a voluntary simulation for businesses since 2013 and a national system is under consideration. There have been challenges as well; Ontario recently withdrew from the WCI, which is representative of a broader trend wherein climate policy is becoming somewhat polarized in political debates.

Establishment and uptake of ETSs worldwide demonstrates the trends that established systems have witnessed key reforms in preparation for post-2020 period, and a significant increase in the regional and global cooperation such as Carbon Pricing in the Americas initiative. Article 6 will also provide ways in which countries can work together through market approaches.

To accelerate the uptake of carbon pricing, research plays a critical role. Several areas can benefit, and these include:

- Empirical investigation: assessing the impact of carbon pricing (mitigation, pass through to product prices, interaction with companion policies);
- Decarbonizing the materials sectors: sending a strong carbon signal to the carbon intensive materials sector;
- Third generation ETS: ETS & regulated power sector; cap-setting in a dynamically growing economy;
- Linking: from proof of example to broader trend;
- Overcoming politics: what processes or governance frameworks have resulted in bipartisan (multi-party) support for climate policy; and
- Delivering on the Paris Agreement: quantifying ambition and maintaining (or adopting) two degree-compatible cap trajectories in the face of rising carbon prices.

Lessons Learned from 30 Years of Research on Carbon Tax

Govinda R. Timlisina, World Bank

World Bank's Development Research Group has conducted a comprehensive review covering almost all peer-reviewed journal articles on carbon taxes published over the last 30 years. There exist some common problems of carbon tax in practice: carbon tax rates can be fairly low to make a significant impact, with tax being less than US$5/t$CO_2$ in some jurisdictions; carbon taxes in practice are heavily distorted due to fuel and sectoral exemptions (for example: exemptions for energy intensive sectors, natural gas exemptions, etc.); and the selection of revenue recycling schemes is on an ad-hoc basis rather than on economic efficiency or equity considerations.

Not taking into consideration the benefits generated from climate change mitigation, most studies show carbon pricing causes net economic costs (loss in GDP, welfare), even with revenue recycling. There have been some recent studies that demonstrate that net economic benefits (GDP or welfare gain) do exist when tax revenue is recycled to cut capital taxes, or when pre-existing distortions like incomplete and distorted tax collection is recognized (realities of developing countries). Analyzing several studies highlights that from a cost effectiveness perspective, the best way to recycle carbon tax revenue would be in the following order: cutting corporate tax or capital tax, cutting income or labor tax, instituting a lump-sum rebate, cutting government debt, and, finally, for public consumption. However, this complicates matters since those revenue recycling schemes that perform better from an efficiency perspective tend to be worse from an equity perspective. The regressivity of a carbon tax can be reduced by transferring some of the carbon tax revenue to lower-income households. Equity remains a critical issue for policymakers in this context, and governments (developed and developing countries) want to be fully aware of the impacts of carbon tax on income distribution and poverty incidence before considering carbon pricing as a climate change policy.

Another key issue is competitiveness concerns, specifically for emissions-intensive trade exposed (EITE) sectors. Several measures have been discussed in this context. One such measure is a border tax adjustment and studies have shown widely varying impacts with large to small damages to developing countries. Other measures include reducing taxes for EITE industries, and providing corporate income tax credits tied to carbon tax payments of EITE industries. Implementation of these measures depends on multiple factors such as level of tax rate, structure of international trade, and levels and types of existing taxes.

Environmental co-benefits of carbon tax can also be significant. A recent study by Li et al. (2018) found that in China, at US$72/t$CO_2$ (2007 price), the reduction of particulate matter (PM) concentration would avoid 94,000 premature mortalities and the value of health co-benefits are 3.7 times larger than cost of the carbon tax. Estimating health co-benefits of a carbon tax in the largest 20 emitting countries, Parry et al. (2015) report that countries such as Saudi Arabia, Iran, Russia, China and Poland would receive most health benefits of a carbon tax.

Theoretically, even though a carbon tax and an ETS should be equivalent in terms of reducing CO_2 emissions and associated economic impacts; they differ significantly due to their design architectures, such as quota allocation rules in the emission trading scheme and revenue recycling options in the carbon tax. ETS requires monitoring and verification processes which can increase administrative and legal compliance costs. However, a "tax" can be perceived as a burden and the ETS can be perceived by some players as new market opportunity.

Additional research on the following areas will help facilitate in the uptake of carbon pricing policies: impacts of carbon tax on poverty and shared prosperity, impacts of carbon tax given several pre-existing distortions in developing-country economies, efficiency versus equity of revenue recycling schemes, political economy of various sector and fuel exemptions, and analysis of carbon tax on full social cost basis.

An Update on Work on Carbon Taxation within the UN Committee

Susanne Åkerfeldt, Government of Sweden

The United Nations Committee of Experts on International Cooperation in Tax Matters, established in 1990s, consists of 25 members and tax experts from around the world. The Committee provides a framework for dialogue with a view to enhancing and promoting international tax cooperation among national tax authorities and assesses how new and emerging issues could affect this cooperation. The Committee is also responsible for making recommendations on capacity-building and the provision of technical assistance to developing countries and countries with economies in transition. A proposal by Sweden for the Committee to examine carbon taxation to the Committee led to the establishment of a Sub-Committee on Environmental Tax Matters in 2017. Comprising of government officials, and tax experts from government and private sector, the mandate of this committee is to consider, report on and propose guidance on environmental tax issues and opportunities for developing countries in particular. The Committee places a specific emphasis on the application of carbon taxes, including reporting on current country practices, policy considerations, and administrative issues. Currently, the Sub-Committee is developing a Handbook due to be released in 2021. The Handbook will draw on practical applications of carbon tax and investigate the policy options on the scope and design of carbon tax by analyzing different existing carbon tax approaches. For example, the Handbook will delve into Sweden's tax, which is applied at the end product—diesel, petrol, coal, etc. and the tax rate is based on the average fossil fuel carbon co-efficient and compare that with Chile's taxation approach, which targets emissions from stationary boilers or turbines above 50MW. The Handbook will specifically draw on lessons learned from these practical examples and provide guidance for developing countries in particular.

THEME 2: CARBON PRICING DESIGN– INTERNATIONAL AND CONCEPTUAL PERSPECTIVES

RESEARCH PAPERS: ABSTRACTS

Business responses to climate policy uncertainty: Theoretical analysis of a twin deferral strategy and the risk-adjusted price of carbon

Alexander A. Golub,[20] *Ruben Lubowski,*[21] *Pedro Piris-Cabezas*[22]

There is currently a mismatch between politically declared climate goals and the current level of action in progress worldwide to cut greenhouse gas emissions. Adjustments of climate policy will inevitably result in carbon markets corrections. We use a theoretical analysis of the relative riskiness of different abatement strategies to explain business behavior with respect of abatement. By delaying investment into low-carbon technologies, corporations are building up a net short position on abatement that is subject to risk, as reductions in policy uncertainty could drive carbon prices upward. Given the potential for a number of sequential adjustments to climate policy, we estimate a stepwise rising function to describe the shape of the future price pathway across emerging global carbon markets. We develop a feasible hedging strategy for corporations potentially exposed to future carbon liabilities. In particular, options on low-cost abatement options, such as from reducing emissions from deforestation (REDD+), could play an essential role in helping firms to engineer the future payoffs from their abatement strategies. Policies to facilitate the use of REDD+ will help make it part of solutions for business and environment in the face of continued uncertainty and policy delays. Research and development into new low carbon technologies is a complementary hedging approach that corporations may use to mitigate risks of future carbon liabilities.

Global carbon pricing: When and What flexibilities revisited in a second-best framework

Meriem Hamdi-Cherif[23]

This article analyzes the gap between the recommendations of public economics in favor of a unique carbon price throughout the world and the results of empirical nonstandard modeling exercises in a second-best world. It uses the IMACLIM-R model, a computable hybrid general equilibrium model. It investigates the time profile of carbon emission reductions and the use of complementary instruments to carbon pricing in the design of policy packages that go further than a global and unique carbon price. The article highlights the asymmetry between developed and developing countries when implementing a unique carbon price. It shows

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that the recycling of carbon tax revenues towards lower labor taxes and an early action on long-lived infrastructure offers important reductions of macroeconomic costs of low-carbon scenarios. It is found that such complementary measures to carbon pricing are important determinants of social and economic implications of the transition to a low-carbon society as the time profile of emissions.

Creating a Climate for Change? Carbon Pricing and Long-Term Policy Reform in Mexico

***Arjuna Dibley*[24] *and Rolando Garcia-Miron*[25]**

Since 2013, Mexico has been celebrated as an international leader in carbon pricing policy, having introduced both a carbon tax and an ETS. These carbon pricing policies present an interesting puzzle: democratic governments often struggle to make long-term policy "investments," in which they seek to impose short-term costs on specific groups for long-term gains. Indeed, this dynamic has beleaguered carbon pricing policies in democracies around the world. How is it that the Mexican government has overcome these problems to impose two carbon pricing laws? In this paper, we argue that the Mexican government introduced its carbon pricing policies without making a long-term policy "investment" in either the carbon tax or the ETS. Both policies are designed structurally to impose only minimal costs upon the industrial sectors they purport to regulate. Nonetheless, the policies allow the Mexican government to obtain meaningful short-term "returns;" both from the revenue raised from them, and from the international status, aid, and technical assistance they attract. These short-term returns mean that the government has limited incentives to impose the costly reforms needed to achieve the benefits of carbon pricing over the long-term. We conclude offering some policy reform suggestions to change the interests among cost-burdened groups and the government. Deploying international and domestic policy efforts that better orient the private and public sector towards the long-term, may better enable the Mexican government to truly "invest" in carbon pricing reform.

A Proposal for a Carbon Fee and Dividend in New Jersey

William Atkinson, Stav Bejerano, Victor Hua, Jonathan Lu, Samuel Moore, Jivahn Moradian,*[26] *Hamza Nishtar, Aileen Wu

We describe a comprehensive, politically feasible proposal for a Carbon Fee and Dividend (CF&D) policy in the state of New Jersey, USA. This proposal is informed by conversations with over 80 state stakeholders, including legislators, academics, and representatives from environmental, labor, and business groups. We propose a rising fee beginning at US$30/t$CO_2$, with 70% to a household dividend and 30% to energy-intensive/trade-exposed businesses, vulnerable communities, climate change adaptation, and low-carbon technology investments. We analyze the potential economic effects of this policy, including the positive effect on New Jersey renewables, changes in energy prices, impacts on households by size and income level, impacts on vulnerable economic sectors, and overall macroeconomic effects. We suggest avenues for sustainable investment, and address potential legal barriers including the Motor Fuels Tax Act. Finally, we discuss the political feasibility of the policy, including public opinion and the results of our stakeholder conversations. We conclude that a statewide CF&D policy is a politically feasible way to reduce emissions without significantly harming New Jersey's economy.

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Figure 2: Carbon pricing approaches being applied by companies in the construction value chain to support decarbonization and risk management

RAW MATERIALS & MANUFACTURED PRODUCTS

CEMEX
MEXICO

- $30/tCO$_2$ in planning exercises for risk management to understand exposure to carbon risk, applied to Scope 1
- Reducing Scope 2 through multiple initiatives as use of renewable energy; asking suppliers to follow a Sustainability Code for Scope 3

Dalmia Bharat Cement
INDIA

- $11/tCO$_2$ shadow price applied on low-return projects with long payback periods; target: carbon negative by 2040
- Piloted on a 9.2 MW waste-heat-recovery plant

LafargeHolcim
FRANCE/SWITZERLAND

- $31.19/tCO$_2$ applied to operations in jurisdictions with existing or upcoming carbon tax
- This price generates an internal P/L statement to simulate LH's impact on triple bottom-line; people, profit, planet

RUSAL
RUSSIA

- $20/CO$_2$ applied to new project's financial models to assess carbon risk exposure & influence investment decision-making
- Price levels higher than EU ETS, used to evaluate strategic decisions like expansion, acquisitions, new buildings, and divestments

SAINT-GOBAIN
FRANCE

- 2 parallel carbon prices
  - €30/tCO$_2$ applicable to Scope 1, 2 emissions for capital expenditure projects & energy-related investments;
  - €100/tCO$_2$ applicable to Scope 1, 2, 3 emissions for R&D projects
- Projects structured so that their payback accounts for the carbon price

SIEMENS
GERMANY

- Developed a framework and initiated activities towards applying an internal carbon price across operations
- Identified 4 pillars to halve carbon footprint by 2020 & become climate neutral by 2030, including activities that have a price premium as an implicit cost for carbon reduction

CONSTRUCTION SERVICES

EllisDon
CANADA

- Developing a Carbon Accounting Tool to track new building & retrofit lifecycle emissions from design to operation
- Working with governments, companies, and coalitions to advance carbon pricing & carbon neutrality agendas

MOTT MACDONALD
UNITED KINGDOM

- Coauthored world's 1st carbon management standard for infrastructure
- Clients are looking for clarity on how to measure Scope 3 emissions and implement TCFD recommendations for scenario analysis
- Working with FSB on TCFD to create greater transparency for investors, insurers, and other actors on carbon exposure and risk

PROJECT DEVELOPERS & CONSTRUCTION EQUIPMENT

acciona
SPAIN

- Carbon neutral in Scope 1 and 2 since 2016, intending to continue reductions as per SBTs
- Carbon pricing since 2008; additional shadow price since 2015 for new & future investments to assess & mitigate climate risk; internal offset price in 2016 to ensure compliance with carbon neutrality objective

GROUPE ADP
FRANCE

- \$23/tCO_2 shadow price since 2017 applied on operation of 3 Paris airports to encourage low-carbon decisions & operational efficiency
- Applicable to projects with energy impact, currently for energy efficiency but discussing application to construction of projects

Mahindra
INDIA

- Hybrid shadow and explicit pricing in automobile activities under consideration for replication in construction activities
- Current price determined as abatement cost for emissions that will have a material impact on decision making

TATA
INDIA

- Tata Steel: \$15/tCO_2 calculated by estimating investment required to meet emissions targets
- Projects evaluated on 2 IRRs, judged on a per-case basis at board level
- Tata Group-wide guidance for carbon pricing with price levels and structure to be reevaluated after 2020

Source: Maheshwari, Aditi. "Carbon Pricing in the Construction Value Chain;" IFC. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

PRESENTATIONS

Construction Value Chain: Carbon Pricing in Practice

Aditi Maheshwari, IFC

The global construction industry accounts for between 25-40% of total carbon emissions in the world with projections showing a 4.2% growth annually between 2018 and 2023 in terms of market value. By 2050, more than 70% of the global population will live in urban areas, 60% of which still remains to be built. A recent IFC study estimated an investment potential of almost US$25 trillion in green buildings in emerging market cities to 2030 alone. This expected growth and the need for decarbonization signaled by the Paris Agreement creates a massive opportunity for new cities in emerging economies and elsewhere to leapfrog traditional construction patterns and adopt sustainable construction solutions. A recent IFC and CPLC report, *Construction Industry Value Chain: How Companies Are Using Carbon Pricing to Address Climate Risk and Find New Opportunities*, highlights how the construction sector is using carbon pricing to move towards sustainable construction, and it identifies common concerns and experiences.

As there is no industry-accepted definition of the construction value chain, the report considers the value chain in its entirety which is composed of specific variations within a fixed framework of distinct stages—design, production and conversion of raw materials into manufactured products, and construction itself. Each of these comprises its own internal stages, processes, stakeholders, and aspects, that interact to bring a project to fruition. The distinctness of these processes, as well as the fixed-term, project-based nature of relationships along the supply chain, results in a highly fragmented industry structure. This structure makes it particularly difficult for an individual company to have an impact, and coordination across the value chain is needed to maximize impact of sustainability initiatives.

The report includes interviews from twelve companies from sectors across the construction value chain, including aluminum, cement, glass, steel, infrastructure, construction services, and equipment manufacturing to get better insight on their existing sustainability initiatives especially in relation to carbon pricing, their companies' culture and attitude, and their forward-looking plans. Companies are applying a range of carbon pricing approaches including shadow prices; implicit pricing; and internal taxes or carbon fees (Figure 2).

Learning more about these companies revealed common concerns and themes surrounding carbon pricing in the value chain. The main takeaways include:

- Using carbon pricing to reduce the industry's carbon footprint will work only if companies can remain competitive. To address this, CPLC has formed the High-Level Commission on Competitiveness and Carbon Pricing that brings together private leaders to explore the concerns of businesses on competitiveness impacts.

- Companies would prefer to operate on a level playing field and seek the universal application of an external regulatory carbon price across their industries, applicable to all firms operating in the sector or jurisdiction.
- The challenges faced by companies in the construction value chain differ by geography and jurisdiction. No one solution is applicable across all business units or stages of the value chain.
- Companies need support with managing Scope 3 emissions and engaging with their supply chains. They also need standardized and comparable frameworks for scenario analysis as well as for rating suppliers by their low-carbon credentials.
- The challenge of internal "socialization" of the carbon pricing concept faced by early movers has eased because of a change in culture brought about by recent advances such as the Paris Agreement and the Financial Stability Board's Task Force on Climate-related Financial Disclosures recommendations.
- Companies lack clarity on how to operationalize and standardize the implementation of an internal carbon price. Businesses are interested in learning from the experiences of other companies.
- All the companies surveyed advocated for the development of an integrated carbon pricing mechanism that could be applied along the construction value chain to cover lifecycle emissions from construction projects.

IFC released another follow-up report with CPLC on *Greening Construction—The Role of Carbon Pricing*. This explores adjustments to existing carbon pricing mechanisms applicable across the construction value chain for different types of construction and contracts, aimed at developing an integrated approach to carbon pricing along the value chain and identifying optimal design and impact on emissions reductions across the sector.

THEME 3: CONCEPTS AND METHODS

RESEARCH PAPERS: ABSTRACTS

Internal Corporate Carbon Pricing: An Analysis of Carbon Emission Reductions for US Companies

John W. Byrd[27] *and Elizabeth S. Cooperman*[28]

A growing trend among corporations is to utilize an internal carbon price to make energy-related investment decisions, with a rise from 100 in 2014 to about 1,400 companies at the end of 2017 reporting to the CDP that they do use, or plan to use, internal carbon pricing in the next two years (CDP 2018). Utilizing an internal carbon price tilts investments away from high-carbon emissions projects toward low-carbon emission alternatives. In this study we investigate whether early internal pricing adopters in the US show any future carbon emission reductions, and whether reductions, if they occur, are related to the use of an internal carbon price. Our analysis uses CDP emissions data for 2011–2016 for 201 US companies, with 52 currently reporting that they use an internal carbon price and another 30 planning to use a carbon price within the next two years. Examining changes in industry-adjusted carbon emissions intensity, we find strong evidence in support of an internal carbon price being associated with emissions reductions with one measure, but only weak evidence with the second metric. These mixed results may reflect the short period of time for US companies in applying internal carbon pricing and the range of ways it is being applied.

Estimating Effective Carbon Prices: Accounting for Fossil Fuel Subsidies

Vivid Economics and Overseas Development Institute

Naina Khandelwal[29]

This paper develops an improved approach to the estimation of effective carbon prices. Effective carbon prices provide an internationally comparable measure of the incentives to reduce emissions in different parts of the economy. However, to date, effective carbon price calculations have not accounted for negative carbon prices created by fossil fuel subsidies, which lead them to overstate incentives for decarbonization. This paper presents two complementary approaches for measuring and comparing decarbonization incentives across the economy. The "revenue approach" identifies the relative fiscal stance of governments to high and low carbon technologies and the "price approach" develops an updated measure of effective carbon prices. Both approaches account for fossil fuel subsidies. These approaches are applied to the United Kingdom as a proof of concept, to test how this analysis might be replicated for the G7 countries. If taken up by key governments and international institutions, these metrics would significantly increase transparency around fossil fuel subsidies and support fiscal policy coherence through more robust carbon pricing combined with wider fiscal tools to implement climate policy.

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The Environmental Effectiveness of Carbon Taxes: A Comparative Case Study of the Nordic Experience

Sachintha Fernando[30]

This paper evaluates the reductions in carbon (CO_2) emissions as a result of introducing CO_2 taxes for the period 1990–2004 in four Nordic countries: Denmark, Finland, Norway, and Sweden. These countries were among the first to introduce CO_2 taxes, and hence, present a quasi-experimental setting to evaluate their experience. Synthetic controls methodology is used to construct synthetic counterfactuals, which emulate the CO_2 emission trajectories for each country in the absence of a CO_2 tax. This allows the comparison of synthetic and actual emission trends. Norway and Sweden, which had much higher CO_2 tax rates than Finland and Denmark, reported statistically significant emission reductions. Since ex-post evaluations of the effects of CO_2 taxes are sparse, this study advances our insights into the potential environmental effectiveness of such measures. Further, it provides a comparative case study by applying a uniform method to all countries, allowing opportunities to learn from their experiences.

Pricing Carbon to Contain Violence

Shiran Victoria Shen[31]

Violence is destructive to social order, economic growth, and the human condition. The annual total cost of violence is estimated to be 11% of the world's GDP. However, violence has rarely made its way into economic models. In the meantime, increasing scientific evidence points to an active link between climate change and the incidence of interpersonal and inter-group violence. This study connects the climate-economy and the climate-violence systems by putting forth a new method to internalize the costs of climate-induced violence in the established MERGE integrated assessment model. It finds that such internalization can double the optimal carbon price, a relationship that holds across different specifications regarding climate sensitivity, GDP growth rate, and the willingness to pay (WTP) to avoid nonmarket climate damages. Normatively, under the realistic assumption that the WTP is at 1% of regional income, the avoided costs from climate-induced violence in sub-Saharan Africa is modeled to reach 3.7% of the region's GDP in 2200, a very significant figure for an area that is already riddled with underdevelopment and violence. The approach of this paper is a first for the modeling community, indicating directions for future research. For the policy community, this paper takes recent econometric findings to the next step toward understanding required for decisions.

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PRESENTATIONS

The Corporate Carbon Pricing Tool: Getting Ahead of Climate Risk

Gautham Prabhu, Trucost

A corporate carbon pricing tool helps a company understand their environmental, social, and corporate governance exposure, including financial exposure to regional carbon taxes. Companies need to communicate to their stakeholders on corporate sustainability, specifically the environmental and social benefits of a company and its products. The "Carbon Price Risk Premium" is the gap between current carbon prices and future carbon price targets and varies by sector and geography. It reflects the additional financial exposure of a company, sector, or facility to carbon pricing regulations in the future and can be a useful benchmark for setting internal carbon prices. Companies tend to use GHG intensity as an indicator for carbon pricing risk exposure which can be an imperfect tool, as it creates blind spots to carbon pricing risk. Estimates indicate that carbon pricing risk exposure is high in 2030 for many sectors.[32] Robust tools that are built on strong methodologies can provide insights on the potential range of estimated internal carbon prices, help benchmark carbon regulation risk exposure against key competitors, conduct scenario analysis, and better understand current and future financial implications of carbon regulation risk on operating costs and margins, and prioritize low-carbon innovation in a business.

Internal Carbon Price (ICP): Lessons learned from carbon pricing disclosure

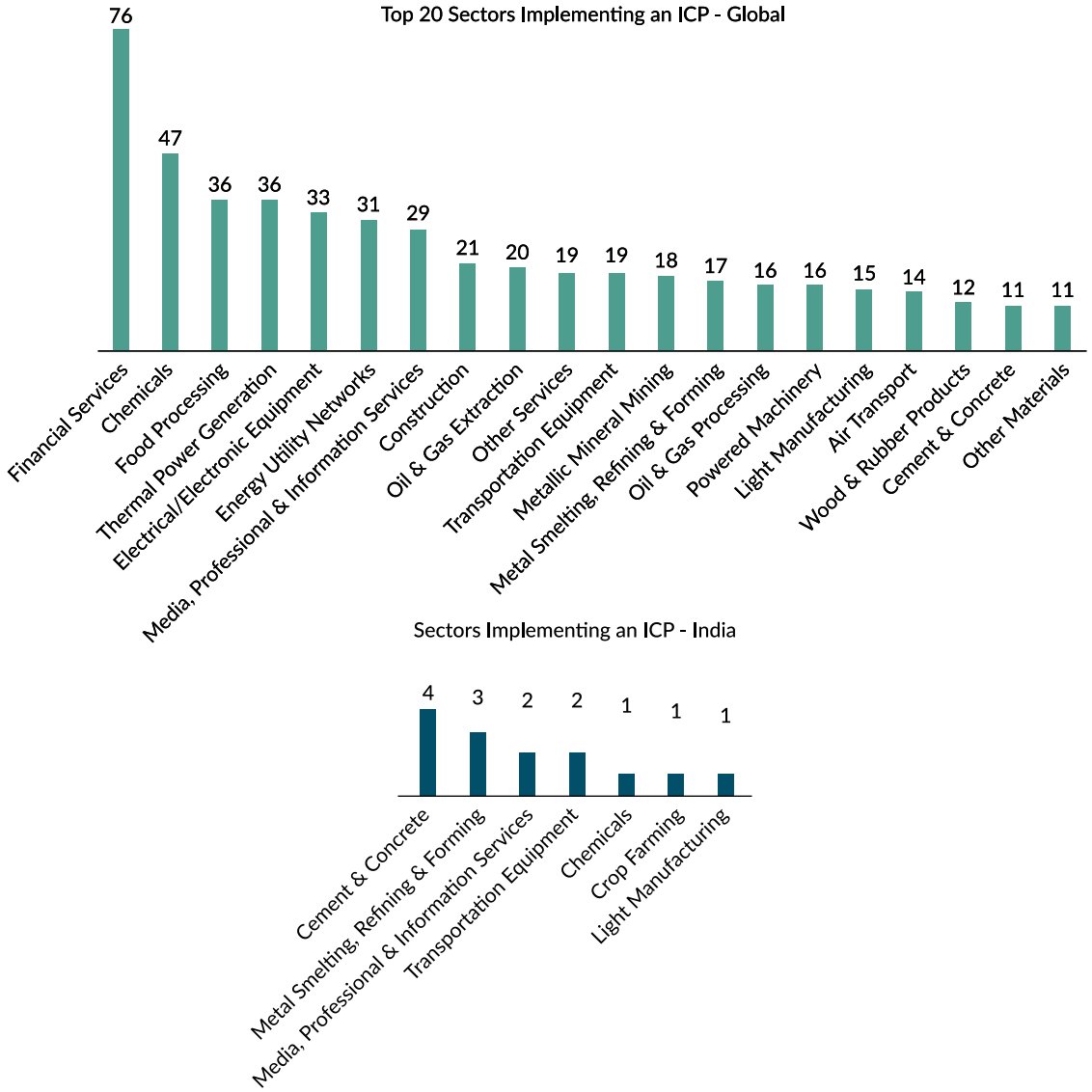
Gargi Sharma, CDP

The latest CDP Report found that in 2018, globally, 594 companies are implementing an internal carbon price, and 711 companies are considering implementing an internal carbon price in the next two years. In 2015, only 435 companies were implementing an internal carbon price. In India, latest numbers reveal that 14 companies are implementing an internal carbon price, and 32 companies are planning to implement a price in the next two years. In 2015, only two Indian companies were implementing a carbon price. Figure 3 below shows the sectoral representation of these companies adopting a price on carbon. Carbon prices in Indian companies ranges from US$2 per ton of CO_2 (Shree Cement) to about US$47 (ACC Limited). There are different variations of carbon prices being adopted:

- Shadow price: attaching a hypothetical cost of carbon to each ton of CO_2e to assess hidden risk and opportunities and for decision making of future investments;
- implicit price: some companies with emissions reduction or renewable energy targets calculate their "implicit carbon price" by dividing the cost of abatement/procurement by the ton of CO_2e;
- internal fee: charging responsible business units for their carbon emissions and reinvesting the collected revenue into clean technology;

[32] Trucost Analysis, 2018, based on an analysis of automotive companies' 2016 publicly disclosed GHG data on Scope 1 and 2 for a two degree scenario. https://us.spindices.com/documents/research/research-carbon-pricing-discover-your-blind-spots-on-risk-and-opportunity.pdf

Figure 3: Sectoral Representation of Companies Adopting a Carbon Price



Source: Sharma, Gargi. "Internal Carbon Price: Lessons Learned from Carbon Pricing Disclosure;" CDP. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

- use of offsets: utilizing the voluntary carbon markets to offset their emissions, internalizing this cost per ton of CO_2e;
- internal trading: allowing the business units to trade allocated carbon credits.

Three main drivers exist for implementing a carbon price: 1) policy risk; 2) transition risk; and 3) stakeholder expectations. The objectives for implementing a price are to assess and manage climate-related risks and opportunities, and for use as a transition tool.

Most companies start by internalizing the existing, expected, or potential price of carbon—from an ETS, carbon tax, or implicit carbon pricing policy—to assess its risk exposure. Some have also discovered that internal carbon price reveals potential business opportunities that may emerge as policy and legal, market, technological and reputational factors shift. When used as a proxy in this way, an internal carbon price can help guide strategic decisions, such as low-carbon research and development to create the products and services of the future.

A best practice approach has been developed for companies that consider implementing an internal carbon price. This consists of four steps:

1. Engaging the business by establishing a diverse governance board representing various key departments across the business, setting clear objectives, and building a strong business case to get buy-in for the internal carbon price approach, from decision makers to operational employees;
2. Designing the approach, using the 4-dimensional framework developed by CDP;
3. Testing, planning, and rolling-out of the approach through clear communication and messaging; and
4. Monitoring and evaluation of the approach.

In 2017, CDP and We Mean Business Coalition launched the Carbon Pricing Corridors initiative with the aim of enabling large market players to define the carbon prices needed for industry to meet the Paris Agreement. It aims to provide a valuable benchmark for business and investors who are seeking to make strategic decisions consistent with a low-carbon economy, but who struggle with a lack of information about the risks and opportunities involved in the transition. The initiative can also inform governments who are turning to carbon pricing as a mechanism to achieve their climate goals as well as those seeking to reform existing carbon pricing policies to strengthen market signals.

THEME 4: POLITICAL ECONOMY–DISTRIBUTIONAL EFFECTS, POLITICAL ACCEPTANCE, REVENUE USE

RESEARCH PAPERS: ABSTRACTS

Making Carbon Pricing Work for Citizens[33]

David Klenert,[34] Linus Mattauch,[35] Emmanuel Combet,[36] Ottmar Edenhofer,[37] Cameron Hepburn,[38] Ryan Rafaty,[39] Nicholas Stern[40]

The gap between actual carbon prices and those required to achieve ambitious climate change mitigation could be closed by enhancing the public acceptability of carbon pricing through the appropriate use of the revenues raised. In this Perspective, we synthesize findings regarding the optimal use of carbon revenues from traditional economic analyses, and studies in behavioral and political science focused on public acceptability. We then compare real-world carbon pricing regimes with theoretical insights on distributional fairness, revenue salience, political trust, and policy stability. We argue that traditional economic lessons on efficiency and equity are subsidiary to the primary challenge of garnering greater political acceptability and make recommendations for enhancing political support through appropriate revenue uses under different economic and political circumstances.

Lobbying, relocation risk and allocation of free allowances in the EU ETS

Kerstin Burghaus,[41] Nicolas Koch,[42] Julian Bauer,[43] Ottmar Edenhofer[44]

We study the nexus between permit allocation, lobbying and relocation risk. Using new data from the EU Transparency Register and the European Union Transaction Log, we start with an empirical analysis of how the number of free emission

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allowances under the EU Emissions Trading System (EU ETS) is linked to lobbying activity. Although registration is voluntary and data limitations remain, the register constitutes a considerable improvement over previous data on lobbying in terms of reliability and coverage. With the data, we establish a robust positive link between lobbying and the number of free allowances. To offer an explanation for our empirical findings, we then develop an analytical model of a signaling game with asymmetric information about relocation cost. We examine under which conditions sectors have an incentive to systematically understate their cost of relocating to a country without emissions regulations, thus exaggerating relocation risk. Further, we analyze when this strategy indeed leads to an overallocation of free emissions allowances compared to a benchmark allocation without lobbying.

Carbon pricing of international transport fuels: Impacts on carbon emissions and trade activity

B. Gabriela Mundaca, Jon Strand, Heinrich Bofinger[45]

We study impacts of carbon pricing for international transport fuels on fuel consumption and carbon emissions, trade activity, and welfare, focusing on sea freight, which constitutes the most important international trade-related activity. We use the WITS global dataset for international trade for the years 2009–2017 to estimate the impacts of changes in the global average bunker fuel price on two aspects of international trade transported by sea: the weight of goods transported and the number of products that are traded between country pair trading partners. We find strong negative effects of fuel cost increases on weight, for products at the 2- and 4-digit HS level of aggregation with the greatest overall weight in global trade, and products with the longest distance travel between trading country pairs. Elasticities are in the range -0.4 to -0.5. Since changes in fuel price can serve as a proxy of a fuel tax, these results indicate that there could be substantial impacts of fuel taxes on the weight of exported products. An estimate is that a global US$40 per ton CO_2 tax on carbon emissions from ships reduces bunker oil consumption, and carbon emissions from the shipping fleet, by up to 12%.

Global Carbon Pricing System as a Mechanism to Strengthen Competitiveness and Reduce GHG in Energy-Intensive Trade Exposed Sectors, such as Primary Aluminum Production

Sergey Chestnoy[46] ***and Dinara Gershinkova***[47]

The absence of global carbon pricing distorts the competitive environment. Countries that have carbon-pricing point out the additional competitive advantages the producers have in countries without carbon pricing. Universal charge for CO_2 emissions would create an unbiased competitive environment for all producers. The sectoral approach in basic sectors may be the first step in creation of a global framework for carbon regulation, although it is a long-term objective. Using the example of emissions-intensive, trade-exposed industries such as aluminum production, which accounts for 3.5% of global electricity consumption, the authors considered low carbon initiatives that already have been implemented by aluminum producers (mostly promotion of clean energy use and aluminum recycling) and analyzed how carbon pricing may foster those.

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The obvious advantages of sectoral approach are a small group of countries' negotiators and a relatively uniform production processes and technologies in the industry around the globe. That makes the negotiations easier, compared with the UNFCCC process. There are a number of options for intergovernmental decision-making on this, including regional and intergovernmental platforms such as APEC and G20. Negotiators should address such questions as the size of carbon price itself, who will pay, who will collect money, how to use them and how to ensure transparency of the entire process.

A decision on the method of carbon pricing (cap and trade or carbon tax) could be taken at the final stage of negotiations, considering the financial and economic impact of introducing regulation as well as the preparedness of countries in adopting the method. Article 6 of the Paris Agreement might be another incentive mechanism for low carbon development of the global aluminum sector.

Making carbon taxes pro-poor using cash transfers in Latin America and the Caribbean

Adrien Vogt-Schilb,[48] Brian Walsh,[49] Kuishuang Feng,[50] Laura Di Capua,[51] Yu Liu,[52] Daniela Zuluaga,[53] Marcos Robles,[54] Klaus Hubaceck[55]

Carbon taxes are advocated as efficient environmental policies, but they have proven difficult to implement in both developed and developing countries. Indeed, carbon taxes can be perceived as working against other political priorities. They can aggravate poverty by increasing prices of basic goods and services such as food, heating, and commuting. Meanwhile, direct cash transfer programs have been established as some of the most efficient poverty-reducing policies used in developing countries. Here, we show how governments can mitigate the negative social consequences of carbon taxes by recycling revenues leveraging existing cash transfer programs. We focus on Latin American and the Caribbean, a region that has pioneered cash transfer programs, that increasingly aspires to contribute to the climate stabilization agenda, and that faces inequality and limited fiscal space. Our study demonstrates concrete quantified options to correct distributional impacts of carbon taxes in developing countries while reducing fiscal deficits.

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PRESENTATIONS

Carbon pricing and Competitiveness at the Global Level

Nathaniel Keohane, EDF

One of the main barriers to the adoption of carbon pricing policies and measures is the competitiveness concerns of businesses. These concerns arise in two ways: 1.) from lower carbon competitors with products easily substituted, and 2.) from foreign competitors with comparable products without similar environmental constraints. At a macro-level, while competitive risks for firms, sectors, and countries are real, these risks should not be overstated. These risks tend to be limited to emission intensive trade exposed (EITE) sectors. There exists a general concern that reduced competitiveness due to carbon pricing can result in relocation of the production of goods and services. Currently, the evidence of the materialization of these risks remains limited. This could be due to the low carbon prices in most jurisdictions, as well as the fact that decisions related to relocation of production are driven by several other factors beyond the carbon price. Furthermore, as more countries adopt climate policies in line with the Paris Agreement, competitiveness concerns should be less of an issue. Competitiveness concerns can be addressed through policy design, and, in fact, all existing programs have protections for EITE sectors. These include output-based allocations (e.g. California), benchmarking (e.g. EU ETS), and border tax adjustment (not implemented in practice). A carbon price creates a cost differential within countries and sectors; some of this is inevitable and desirable. From an economic point of view the increased cost of production is passed through to consumers that creates the positive driver for a low-carbon transition. Winners and losers will be created within a country, and even within an EITE sector, with those innovating and transitioning to low-carbon products having a competitive advantage over those that are unable to do so. While policies can dampen the impacts of competitiveness and assist with the transition of EITE sectors, completely eliminating the cost differential is self-defeating, as this will eliminate the price signal for low-carbon transition.

It was with the intention to clarify and address the competitiveness concerns relating to carbon pricing that the CPLC established the High-Level Commission on Carbon Pricing and Competitiveness. This Commission is scheduled to present its findings in fall 2019.

THEME 5: DECARBONIZING THE ECONOMY: CARBON PRICING AND DEVELOPMENT

RESEARCH PAPERS: ABSTRACTS

Designing a US Carbon Pricing Policy to Ensure Greater, and More Equitably Distributed, Public Health Benefits from Co-Pollutant Reductions

Rachel Cleetus* and *Julie McNamara

Carbon pricing programs to date have been designed with the primary objective of lowering energy-related CO_2 emissions. However, it has been well documented that a carbon price can also drive significant simultaneous reductions of co-pollutants alongside cuts in carbon emissions. Here, we explore policy design options to help enhance these co-pollutant reduction benefits, especially for communities that face a disproportionate burden from conventional and toxic pollution related to fossil fuel use. Because co-pollutant hotspots in some communities are a problem presently unresolved by existing policies, and because a rare window of opportunity is emerging for a federal carbon pricing program in the US, we argue that carbon pricing policy design should be intentionally considerate of its distributional impacts on co-pollutant reductions. Our research shows that flexible, innovative design options can be incorporated into or alongside carbon pricing programs to help ensure that multiple pollution externalities are addressed in a way that delivers near-term public health benefits alongside climate benefits, and helps ensure those benefits are shared in a more equitable way with a broader segment of the population.

Financing Low-Carbon Transitions through Carbon Pricing and Green Bonds

***Arkady Gevorkyan,*[56] *Dirk Heine,*[57] *Mariana Mazzucato,*[58] *Michael Flaherty,*[59] *Siavash Radpour,*[60] *Willi Semmler*[61]**

To finance the transition to low-carbon economies required to mitigate climate change, countries are increasingly using a combination of carbon pricing and green bonds. This paper studies the reasoning behind such policy mixes and the economic interaction effects that result from these different policy instruments. We model these interactions using an intertemporal model, related to Sachs (2015),[62] which suggests a burden sharing between current and future generations. The issuance of green bonds helps to enable immediate investment in climate change mitigation and adaptation, and the bonds would be repaid by future generations in such a way that those who benefit from reduced future environmental damage share in the burden of financing mitigation efforts undertaken today. We examine the effects of combining green bonds

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[62] Sachs, J. 2015. Climate Change and Intergenerational Well-Being, The Oxford Handbook of the Macroeconomics of Global Warming, Lucas Bernard & Willi Semmler (Ed.). Oxford: Oxford University Press, 248-259.

and carbon pricing in a three-phase model using nonlinear model predictive control (NMPC), which allows for finite-horizon solutions and phase changes. We show that the bonds issued can be repaid and that the debt is sustainable within a finite time horizon. Moreover, we show that green bonds perform better when they are combined with carbon pricing. Our proposed policy option appears to be politically more feasible, speeds up the transition, and offers a fair intergenerational burden sharing.

Leveraging Private Sector Investment in Energy Efficiency: Pilot Case Studies of Selected Sub-Saharan African Countries

Martin Burian, Joachim Schnurr, Grant A. Kirkman and Janak Shrestha

Current climate change policy negotiations consider private sector involvement for structuring the significant investments needed for implementing the Paris Agreement and its objectives. Private sector involvement may be effectively stimulated through appropriate policies which allow reducing emissions/reducing costs of the private sector over the lifetime of interventions, and reduce public sector costs.

The Article 6.2 of the Paris Agreement allows for the establishment of international cooperative exchange of GHG emissions towards nationally determined contributions, applying robust GHG accounting and, among others, ensuring environmental integrity. This article discusses the example of a carbon finance instrument for reducing technical losses in electricity grid and how it could potentially support 4 pilot countries (Mozambique, Uganda, Zambia, and Zimbabwe) in realizing economically viable interventions at demand side. Crediting sectoral baselines is also developed as a test case example under Article 6.2 for the purpose of quantifying transferable mitigation units. The analysis indicates an energy saving potential of 458.3 GWh/yr, private sector investment costs of 80.6 million US$ as well as reduction of electricity costs of 19.8 million US$/yr.

However, the realization of such potentials is hindered by high prime lending rates ranging from 15.5-19.3% and the other barriers such as technology, regulatory and foreign currency risks. To enable more favorable commercial sector lending terms, an efficient performance-based carbon pricing instrument blended together with appropriate risk guarantee instrument is proposed, which significantly reduces cost of financing to incentivize uptake within a short payback period, while ensuring that only the marginal abatement costs of individual interventions are credited.

Interaction between the carbon tax and renewable energy support schemes in Colombia: Complementary or overlapping?

Daniela Gutiérrez Torres[63]

Colombia is advancing its climate change mitigation and renewable energy policy instruments. Specifically, the country has introduced support schemes for electricity generation from renewable energy sources (RES-E) and a national carbon tax. Therefore, these two instruments interact within the climate-energy policy mix. However, the interaction between them could be complementary or overlapping depending on the policy design of each instrument. The main objective of this paper is to analyze if the policy design elements of the carbon tax and the RES-E support schemes make them complementary or overlapping instruments. The methodology is mainly qualitative and encompasses descriptive, as well as interpretative, stages. Additionally, it comprises a comprehensive literature review and a content analysis based on interviews with related stakeholders. The analysis is made primarily through the comparison of the instruments' policy objectives. Results show that the policy objective design element from the instruments was crucial to classify them as complementary and to conclude that their coexistence is justified. That is, the mitigation objective of the carbon tax and the energy security aim of the RES-E support schemes suggest the two instruments are complementary.

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PRESENTATIONS

Emissions Trading and Electricity Sector regulation: A Conceptual Framework for Understanding Interaction between Carbon Prices and Electricity Prices

William Acworth, ICAP

An ETS is a market-based mechanism that places a quantity constraint on emissions aiming to achieve emissions targets at least cost. ETS has static efficiency—marginal abatement costs are equivalent across covered entities—and dynamic efficiency—marginal abatement costs are equivalent through time. In theory, ETS establishes a clear reduction pathway and sends a signal to investors that high emission investments will not be profitable over the long term.

In a competitive wholesale electricity sector, relevant actors act as follows: Generators offer electricity at a price that reflects their marginal costs of production. Those generators offering the lowest cost electricity are dispatched to the market first, with increasingly expensive options utilized until demand is met. In this way, electricity is supplied at least cost. The order in which electricity is supplied to the grid is called the "merit order curve." The final bid required to meet demand or the willingness to pay from the consumer side if no additional supply is available determines the wholesale market price, which all generators are paid. Under these (ideal) conditions, operations and investment decisions are based on the market and the expected profits. A carbon price impacts this in a number of ways. It increases the cost of fossil-based generators making them less competitive. This results in a shift in the merit order curve, resulting initially in a coal to gas shift, wherein gas becomes more competitive than coal and moves up the merit order curve. Renewables are also impacted and become more competitive driving low-carbon investments. Prices are passed through to consumers in this scenario in which consumers transition to more energy efficient appliances. There is both static efficiency and dynamic efficiency in such a market, and in such a scenario regulators favor the decommissioning of a fossil-based asset to retrofitting it.

However, the reality is different where varying levels of regulation exist in electricity markets and can serve as a barrier to the promise of ETS. In a recent study, conceptual frameworks were designed to better understand the varying levels of regulation in electricity markets, and the functioning of an ETS in such markets and the impact it can have on emissions. Four frameworks were considered, ranging from most regulated to low levels of regulation:

- Retail price regulation is where the price pass through to consumers does not occur. This results in no immediate incentive for consumers to shift their consumption patterns. However, consumers may shift their patterns based on how the electricity rates and tariffs are set. Wholesale markets send the required investment signals. Complementary policies can be implemented to address this lack of consumer shift.
- Wholesale market regulation is a scenario where the merit order curve gets distorted in different ways depending on the type of regulation. Price caps may exist, in which case the true cost of carbon is not reflected. In cases wherein a power purchasing agreement may exist, these generators are not subject to a price and, thus, the carbon price is distorted, and its impact is limited. The coal-gas shift and cost-effectiveness for renewables might not occur.
- Regulation of investment occurs when governments request coal-based generators to remain online due to current or anticipated

capacity constraints, and may pay fees to do so, or have a regular tendering contract. In such a scenario, the carbon price signal can become detached and not play a role in low carbon investment. The criteria of the government procurement process will determine the impact to some extent.

- Regulation of production is when a government plans the production, sometimes through a quota system. This is based on factors such as capacity, but not driven by market condition and results in a scenario where there is no channel for the carbon price to impact the electricity markets. There is little role carbon can play in the dispatch channel and there is no pass-through to consumers. If an ETS were to be introduced in such a market, there would be declining emissions due to the existence of a cap. There might be weaker long-term signals that could encourage low-carbon shifts.

Several options exist to restore abatement levers under different forms of power sector regulation, namely: consignment auctions, coverage of indirect emissions, establishment of pricing and investment committees, and establishment of a consumption charge. For example, Korean ETS and Chinese pilot schemes have broadened the coverage of their ETS to include indirect emissions. This helps to strengthen the downstream price signal in their markets where wholesale prices are regulated. Korea requires both electricity generators to surrender allowances for their direct emissions, and large electricity consumers to surrender allowances for the indirect emissions associated with electricity consumption.

Emissions trading is most effective in liberalized markets where market actors are free to reflect allowance costs in product price and able to make (dis)investment decisions based on market principles. In the real world, where electricity markets tend to be regulated, ETS can still be effective, but need to be carefully designed. Understanding the barriers that exist, the mitigation potential that is lost due to regulated markets, and ways in which complementary polices can address these barriers, will be important going forward. Strong case studies of success with ETSs in regulated markets where policy design has enabled the strengthening of the allowance price signal, are also important.

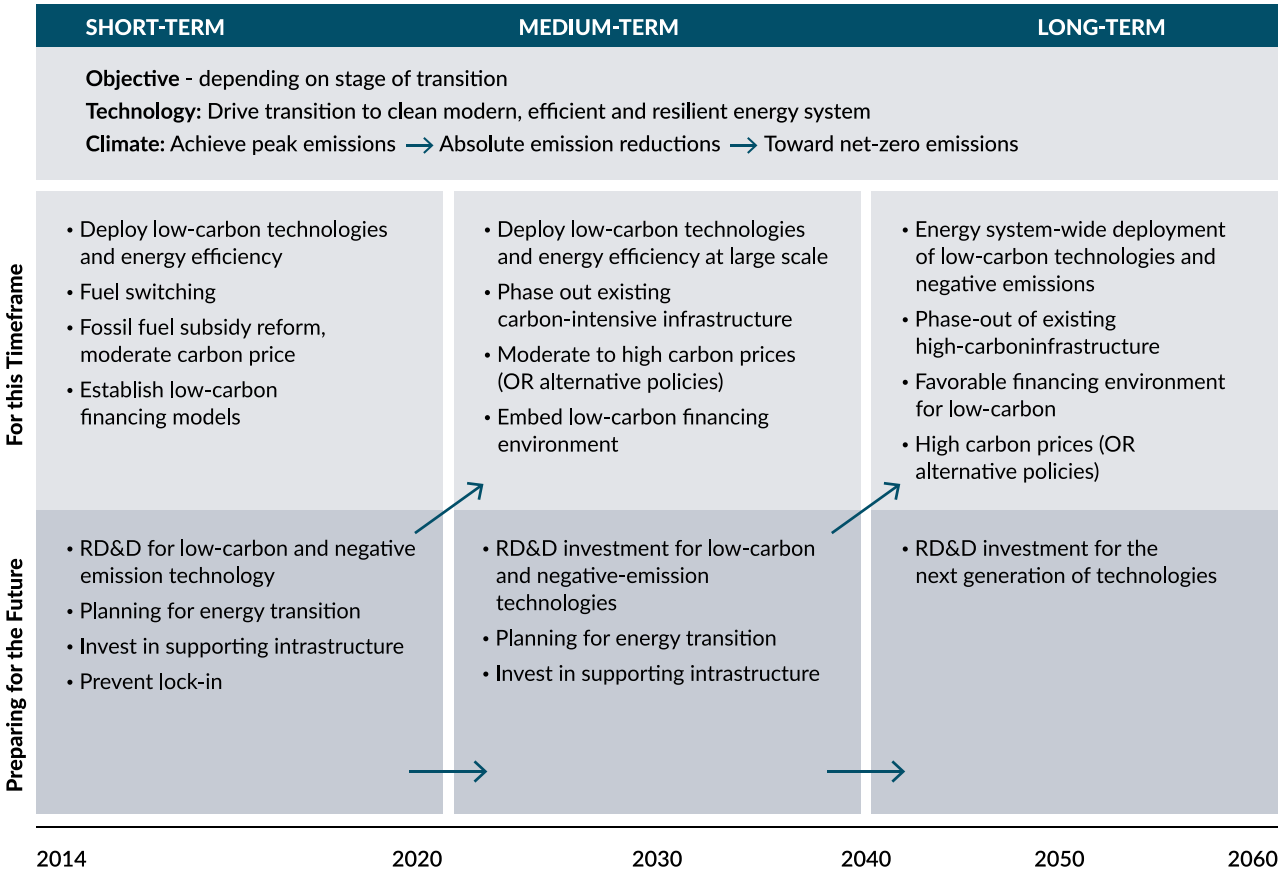
Carbon Pricing and the Energy Sector: Optimizing Policy Packages

Peter Janoska, IEA

To transition to sustainable clean energy systems, an integrated policy strategy is necessary. In this context, policies that drive change in all energy sub-sectors, act in both the short- and long-term, are cost-effective, and support innovation and diffusion of clean technologies will be essential (Figure 4). However, different country contexts and national circumstances will lead to different policies that play different roles. Design of these policies will vary depending on the national context and they will evolve over time. Policy packages that are designed for long-term transition will inevitably contain different elements than one for a shorter timeframe given that current policies need to unlock technologies and infrastructure that will be needed in the future.

To effectively implement this complex mixture of policies, the interactions and overlaps between multiple policy goals need to be taken into account. Objectives of the three SDGs that are most closely related to energy—addressing climate change, achieving universal energy access, and improving air quality along with water scarcity (SDG Goals 13, 3, 7, 6)—can be effectively addressed in an integrated manner with considerable synergies across the three areas. As IEA's Sustainable Development Scenario, which integrates the three objectives, shows, low-carbon measures play a critical role in reducing air pollution at no extra cost (Figure 5).

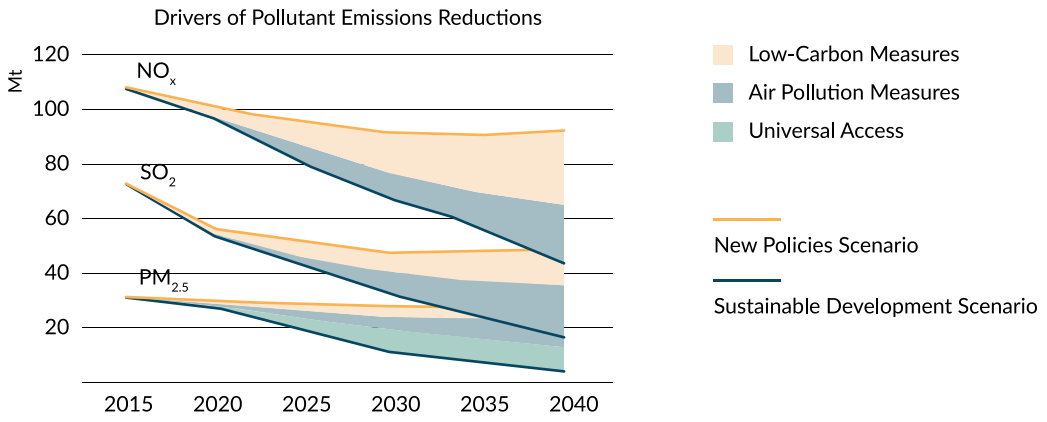
Figure 4: Indicative Policy Packages Pathways



Source: Janoska, Peter. "Policy Packages for Energy Transitions;" IEA. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

Carbon pricing plays a critical role in driving change under this integrated policy approach (Figure 6). However, real-world policymaking is challenging and complementary policies are needed to achieve the objectives of the clean energy transition. No single policy can deliver the changes needed given the complexity of energy sector transitions. Policy packages that drive a whole-scale shift in energy systems in all sub-sectors cover three domains: negative cost opportunities (in energy end-use sectors such as transport and buildings, where there is potential to reduce emissions through incentives that drive improved energy use, such as targeted energy efficiency policies); optimization based on pricing (primarily when increased investor confidence in rising future carbon prices can drive investment in low-carbon alternatives in power and industry and phase-out of current high-carbon or polluting assets, or the use of policies such as standards, regulations, etc. when prices are lower); and based on short-term investment for long-term returns (ability to shift the boundary of achievable emissions reductions by supporting the underpinning infrastructure and markets such

Figure 5: Impact of Low-Carbon Measures on Air Pollution



Low-carbon measures rather than measures of specific to air pollution account for 57% of NO_x and 40% of SO_2 emissions reductions.

Source: Janoska, Peter. "Policy Packages for Energy Transitions;" IEA. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

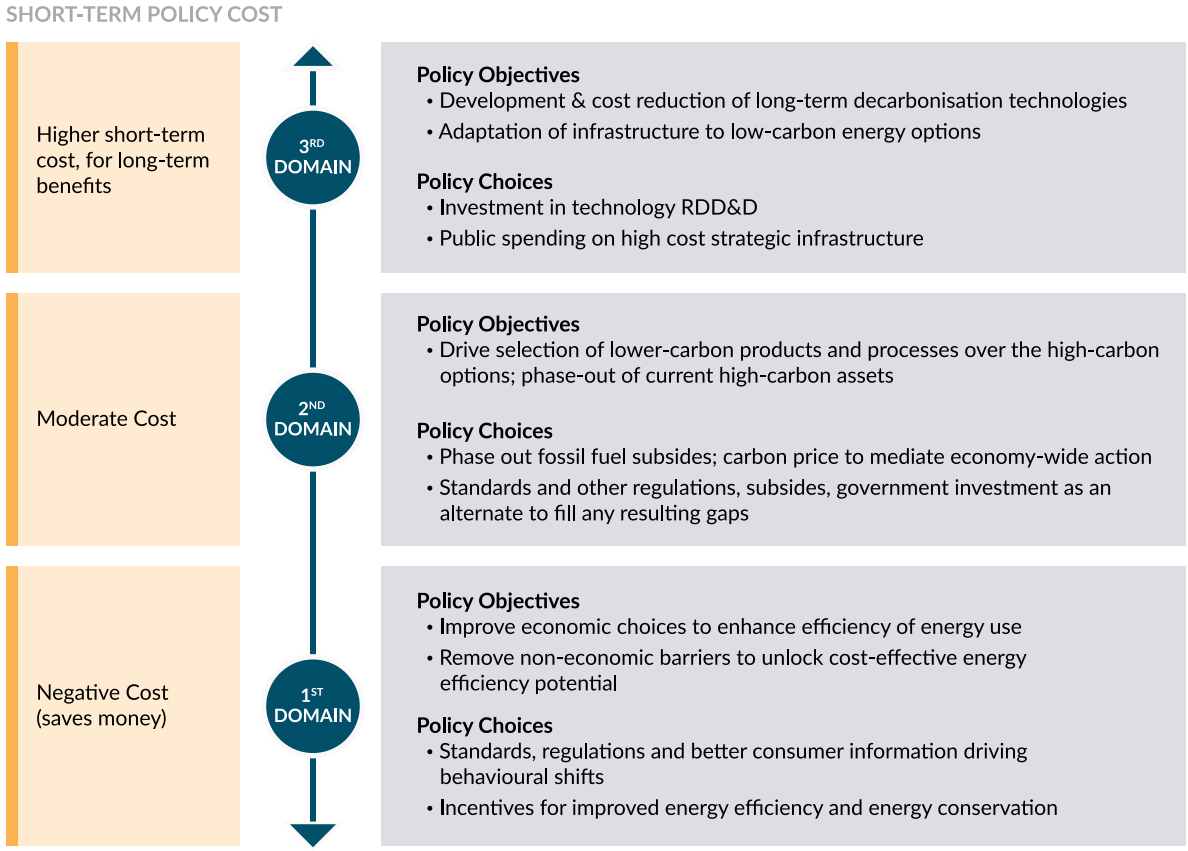
as electric vehicle (EV) charging networks); and investing in technology research development demonstration and deployment to unlock deeper mitigation potential on a larger scale.

IEA analysis shows that while targeted policies can peak emissions, high carbon prices and advanced technologies are required to generate deeper decarbonization consistent with climate goals. For example, in power generation and industry, high carbon prices are needed to drive early retirement of coal plant and retrofit for carbon capture and storage. In the transportation sector, carbon pricing helps offset the effects of lower oil prices in a decarbonized world. But it alone cannot unlock substantial technology shifts such as electrification or advanced biofuels development. For these shifts to occur, standards, mandates and subsidies are needed as part of a comprehensive policy package.

As comprehensive policy packages are designed at the national level, governments must consider policy interactions, both positive and negative, of these policies. For example, China has several climate and energy policies that address climate, air pollution, energy supply and demand, and industrial restructure, and all these policies will interact directly or indirectly with China's ETS and carbon price. In China's case, the design of its ETS needs to take into account how it will interact with the power market reform, and if the ETS is designed in an integrated manner, the development of carbon pricing and power sector reform can be mutually supportive.

For the international community to transition to a low-carbon pathway, governments must be clear about the role of carbon pricing within a country's policy mix, better understand the interactions within its suite of policies, and ensure that a comprehensive policy package is coherent and aligned towards the achievement of its objectives.

Figure 6: Role of Carbon Pricing in Policy Choices and Objectives



Source: Janoska, Peter. "Policy Packages for Energy Transitions;" IEA. Presented at CPLC Carbon Pricing Research Conference, New Delhi, India, February 2019.

THEME 6: EMERGING FRONTIERS

RESEARCH PAPERS: ABSTRACTS

Preparing India for Future Carbon Markets: Building on India's PAT and REC Schemes for the Post 2020 Markets

Tamiksha Singh and Karan Mangotra[64]

Over the last decade, an extensive and complex climate change regime has emerged, comprising a wide range of initiatives and institutions. There is now a need to develop methods for building fungibility for heterogeneous climate actions, with the aim of creating an efficient and effective international carbon market.

As we get closer to 2020, it is important for countries to plan on how best they can participate in the new market mechanisms for financing their climate actions, being mindful of the learnings from the failure of some of the past systems, and prepare their existing mechanisms or markets to be effective under the post 2020 regime. While India has not yet established a carbon market or carbon pricing policy, it has two proxy carbon market schemes in place: the Perform, Achieve and Trade (PAT), and the tradable Renewable Energy Certificates (REC). Through this paper, we intend to analyze the steps required to prepare these two Indian market-based mechanisms for the post 2020 period, by potentially linking these two carbon pricing methodologies.

Comparative Analysis of the Stringency of Heterogeneous Carbon Pricing Instruments: An exploration of an applied approach

Johannes Ackva

Diverse carbon pricing instruments are spreading across heterogeneous economies. Policy crediting (e.g. in the context of Article 6 of the Paris Agreement), harmonization of sub-national carbon pricing efforts (e.g. in the Canadian context), and a policy landscape of moving towards newly implementing and reforming existing carbon pricing instruments all raise the question of how to assess "stringency," the ability of a carbon pricing system to set incentives for abatement. This paper seeks to make progress on this question by combining conceptual analysis with illustrative application across a number of carbon pricing instruments. In particular, given the importance of investment for deep decarbonization, this paper develops and evaluates a set of increasingly refined metrics of average carbon prices that express the investment incentives of carbon pricing policies. While results and metrics are preliminary, the paper seeks to advance the development of an integrated stringency metric.

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Blockchain, Double Counting, and the Paris Agreement

Henrique Schneider

This essay explores possibilities and limitations of applying blockchain distributed ledger technology to select aspects of the Paris Agreement, especially to issues under Article 6 (and, where relevant, Articles 4, and 13). Through the application of blockchain, double counting (and similar concerns) can be mitigated while making reporting, tracking and managing corresponding adjustments efficient. Blockchain enables accounting for nationally determined contributions (NDCs) and increases the transparency in the implementation of the Paris Agreement. This, on the other hand, depends on a careful institutional set-up. This essay lays out the requirements for a blockchain system (or a set of blockchain) under Article 6. At the same time, it considers the limitations of applying blockchain. These limitations arise not only due to the distributed ledger technology itself, but also due to the nature of international negotiations in connection with the Paris Agreement.

Carbon taxes that even fuel exporters would like

Grzegorz Peszko,[65] Alexander Golub,[66] Dominique van der Mensbrugghe[67]

Economists often argue that the Paris Agreement will deliver on its two degree goal when the self-interests between a "club" of primary movers on climate action and more reluctant parties are aligned. A joint and reciprocal commitment to minimum domestic carbon prices and international transfers is often identified as an efficient instrument of this alignment. The climate policy leaders have not mobilized the political will to form such a club yet, let alone mobilized adequate transfers to induce comprehensive cooperation. Even if they do, they will face several fossil fuel producers and exporters who are particularly reluctant to cooperate through traditional carbon prices, which extract their resource rents and transfer them to fuel importers. This paper argues that one way to align incentives for increased climate policy ambition is to shift the base of carbon taxes upstream to where fossil fuels are first extracted from the ground. This could be implemented through cooperative wellhead carbon tax treaties between fuel exporters and importers with revenue sharing agreements. Producers' carbon tax would cover domestic emissions in fossil-fuel dependent countries but allow them to retain (a portion of) revenues otherwise collected abroad. This proposition is first illustrated in a partial equilibrium welfare economic framework and then quantified with a global, dynamic, recursive general equilibrium model integrated with global partial equilibrium fuel extraction models. Design, implementation and political economy issues are discussed.

Estimating the Power of International Carbon Markets to Increase Global Climate Ambition

Pedro Piris-Cabezas, Ruben Lubowski, and Gabriela Leslie[68]

By helping achieve emissions targets more inexpensively than expected, emissions trading systems can lower political resistance to more ambitious targets, enabling deeper and faster cuts in climate pollution over time. Using a dynamic global partial-equilibrium carbon market model, we quantify cost savings under scenarios for emissions trading both within and across countries, as well as the corresponding potential to escalate reductions if those cost savings were translated into greater mitigation. We examine the potential for emissions trading to allocate reductions cost-

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[66] American University
[67] Purdue University
[68] Environmental Defense Fund (EDF)

effectively over time, and also assess the possible impact of including emissions reductions from avoided deforestation within international carbon markets. Finally, given that substantial political and implementation hurdles remain to full international trading, we evaluate scenarios in which future policy developments are uncertain as well as scenarios in which only partial subsets of the nations participate in international market cooperation. We find the global use of carbon markets could allow the world to nearly double climate ambition relative to current Paris pledges (NDCs) over 2020–2035, without increasing total global costs compared to a base case without international markets. Since avoided deforestation is such a large source of low-cost mitigation, linking reduced deforestation to an international carbon market is a key driver of the potential ambition gains. Significant ambition gains remain under partial coverage scenarios with less than half of global emissions linked via markets, based on a "heat map" analysis of countries' market readiness, and scenarios with policy uncertainty that causes market actors to delay mitigation.

Australia-EU ETS linking – lessons for the post-Paris world

***Stuart Evans* and Aaron Wu**

The Australia-EU ETS linking negotiations were the first attempt to link emissions trading systems (ETS) with substantively different designs. While negotiations were cut short by the subsequent repeal of Australia's carbon price, the progress made toward developing the link brings lessons for bottom-up cooperation, as envisioned under the Paris Agreement. This paper draws on the authors' first-hand experience negotiating the link, and interviews with key players in the negotiations to draw lessons regarding the drivers of, and barriers to, cooperation. Moreover, it considers several unanswered questions regarding the practical design of international linking agreements. In doing so, the paper addresses the broader implications of linking for the political economy of carbon markets and climate clubs, to assess how linking policy design interacts with domestic and international political processes.

ANNEX ONE

PROGRAM AGENDA*

DAY 1: FEBRUARY 14, 2019			
TIME	**SESSION**		**SPEAKERS**
8:00am	**Registration**		
INAUGURAL SESSION: STEIN AUDITORIUM			
9:00am	**Welcome Remarks**		***John Roome,*** World Bank ***Gérard Mestrallet,*** CPLC High-Level Assembly Co-Chair
9:20am	**Keynote Address**		***Lord Nicholas Stern,*** London School of Economics
9:40am	**Opening Panel:** Panel discussion on the importance of research and evidence for effective carbon pricing design and implementation Chair: ***Susanne Åkerfeldt,*** Ministry of Finance, Sweden		***Mahendra Singhi,*** Dalmia Cement ***VK Duggal,*** Asian Development Bank ***Sergey Paltsev,*** Massachusetts Institute of Technology ***Tomasz Chruszczow,*** Ministry of Environment, Poland
10:40am	**CPLC Secretariat Messages** **Conference Co-Chair Messages and Context-Setting**		***Angela Naneu Churie Kallhauge,*** CPLC Secretariat ***Andrei Marcu,*** European Roundtable on Climate and Sustainable Transition ***Michael Mehling,*** Massachusetts Institute of Technology
11:00am	Break		
MORNING SESSIONS: Concurrent Sessions for Themes 1–3			
11:30am-1:00pm	**Theme 1: Learning from Experience** (Silver Oak 1) Chair: ***Malin Ahlberg***	**Theme 2: Carbon Pricing Design—International and Conceptual Perspectives** (Gulmohar Hall) Chair: ***Sergey Paltsev***	**Theme 3: Concepts and Methods—Theory, Assessment, and Performance Review** (Amaltas) Chair: ***Grzegorz Peszko***
	William Acworth Emissions Trading around the World: A Status Update	***Alexander Golub*** Theoretical Analysis of a Twin Deferral Strategy and the Risk-Adjusted Price of Carbon	***Gautham Prabhu*** Carbon Pricing Risk Premium: Theory and Concepts, with Live Demonstration
	Ryan Rafaty Has Pricing Carbon Reduced Aggregate Emissions? Evidence from 25 OECD Countries	***Meriem Hamdi-Cherif*** Global Carbon Pricing: When and What Flexibilities Revisited in a Second-best Framework	***Gargi Sharma*** Lessons Learned from Carbon Pricing Disclosure in CDP Data
	Govinda R. Timilsina Carbon Pricing: What have we learned from Empirical Studies	***Arjuna Dibley and Rolando Garcia Miron*** Creating a Climate for Change? Carbon Pricing and Long-Term Policy Reform in México	***John Byrd*** Internal Carbon Pricing and Carbon Emission Reductions: An Analysis of Early and Second Round Adopters versus Non-Adopters
1:00pm	Lunch		
AFTERNOON SESSIONS: Concurrent Sessions for Themes 2–3 (continued)			
2:00-3:00pm	**Theme 1: Learning from Experience** (Silver Oak 1) Chair: ***William Acworth***	**Theme 2: Carbon Pricing Design—Subnational and Corporate Perspectives** (Gulmohar Hall) Chair: ***Neha Mukhi***	**Theme 3: Concepts and Methods—Theory, Assessment, and Performance Review** (Amaltas) Chair: ***Rachael Jonassen***

**For the thematic tracks, some titles of the research papers were modified to accommodate the agenda.*

2:00-3:00pm	***Susanne Åkerfeldt*** An Update on Work on Carbon Taxation within the UN Committee	***Martin Rabbia*** Patterns of Electricity Consumption and Carbon Pricing in Subnational Jurisdictions in Argentina	***Naina Khandelwal*** Estimating Effective Carbon Prices at the Sector and National Level: Taking into National Level: Taking into Account Fossil Fuel Subsidies
	Luisa Dressler The Use of Revenue from Carbon Pricing	***Aditi Maheshwari*** Construction Value Chain: A Practical Application Perspective	***Sachintha Fernando*** The Environmental Effectiveness of Carbon Taxes: A Comparative Case Study of the Nordic Experience
	Jens Ewald Carbon Tax in the Building Sector: A Comparison of European Countries	***Jivahn Moradian*** A Proposal for a Carbon Fee and Dividend Policy in the State of New Jersey	***Shiran Victoria Shen*** Pricing Carbon to Contain Violence
PLENARY: STEIN AUDITORIUM			
3:00-4:00pm	**Conversation on Article 6: Lessons from Katowice** • ***Abdelrahman M. Al-Gwaiz,*** Ministry of Energy, Industry and Mineral Res., Saudi Arabia VK Duggal, Asian Development Bank (ADB) • ***Dirk Forrister,*** International Emissions Trading Association (IETA) • ***Nathaniel Keohane,*** Environmental Defense Fund (EDF) • Chair: ***Andrei Marcu,*** European Roundtable on Climate and Sustainable Transition		
4:00pm	Break		
PLENARY: STEIN AUDITORIUM			
4:30-5:30pm	**Roundup Session** Reporting back and reflecting on the day's discussions and their relevance for decision making in policy and practice		Designated **Rapporteurs,** facilitated by the **Conference Co-Chairs**
5:30pm	Adjourn		
6:30pm	Reception		
DAY 2: FEBRUARY 15, 2019			
TIME	**SESSION**		**SPEAKERS**
8:00am	Registration		
PLENARY: STEIN AUDITORIUM			
9:00am-10:00am	**Carbon Pricing in Practice - Experiences from Around the World** with updates on: • World Bank efforts to build market readiness • Acceptance of the Swedish carbon tax • Canada's experience with carbon pricing • Latin American experiences with carbon taxation • Carbon pricing and the private sector in India • Chair: ***Michael Mehling,*** MIT		***Vivek Adhia,*** WRI India ***Susanne Åkerfeldt,*** Ministry of Finance, Sweden ***Enrique Lendo Fuentes,*** CPLC Steering Committee, Mexico ***Jackie Mercer,*** Government of Canada ***Venkata Putti,*** World Bank
10:00am	**Setting the Context for Themes 4–6**		Conference Co-Chairs
10:30am	Break		
MORNING SESSIONS: Concurrent Sessions for Themes 4-6			
11:00am-12:30pm	**Theme 4: Political Economy: Distributional Effects, Political Acceptance, Revenue Use** (Silver Oak 1) Chair: ***Andrei Marcu***	**Theme 5: Decarbonizing the Economy: Carbon Pricing and Development** (Gulmohar Hall) Chair: ***Emilio Lèbre La Rovere***	**Theme 6: Emerging Frontiers** (Amaltas) Chair: ***Michael Mehling***
	Ryan Rafaty Making Carbon Pricing Work for Citizens	***Rachel Cleetus*** Carbon Pricing Design Options to Address CoPollutant Hotspots	***Tamiksha Singh*** Preparing India for Future Carbon Markets Building on India's PAT and REC Schemes for the Post2020 Markets
	Kerstin Burghaus Lobbying, Relocation Risk and Allocation of Free Allowances in the EU ETS	***Michael Flaherty*** Financing Low-Carbon Transitions through Carbon Pricing and Green Bonds	***Johannes Ackva*** Comparative Analysis of the Stringency of Heterogenous Carbon Pricing Instruments: An Applied Approach

11:00am-12:30pm	***Gabriela Mundaca*** Carbon Pricing to Reduce Carbon Emissions from International Goods Transport	***Martin Burian*** Leveraging Private Sector Investment in Energy Efficiency: Pilot Case Studies of Selected African Countries	***Henrique Schneider*** Blockchain and Double Counting
12:30pm	Lunch		
PLENARY: STEIN AUDITORIUM			
1:30pm	**Carbon Pricing and Air Quality** ***Marta Martinez Sanchez,*** Iberdrola ***Annela Anger-Kraavi,*** University of Cambridge and Climate Strategies Chair: ***Neha Mukhi,*** World Bank Group		
AFTERNOON SESSIONS: Concurrent Sessions for Themes 4-6 (continued)			
2:30-4:00pm	**Theme 4: Political Economy—Distributional Effects, Political Acceptance, Revenue Use** (Silver Oak 1) Chair: ***Susanne Åkerfeldt***	**Theme 5: Decarbonizing the Economy—Policy Choice and Interactions** (Gulmohar Hall) Chair: ***Rachael Jonassen***	**Theme 6: Emerging Frontiers** (Amaltas) Chair: ***Malin Ahlberg***
	Sergey Chestnoy Global Carbon Pricing as a Mechanism to Strengthen Competitiveness and Reduce GHG in Energy-intensive Trade-exposed Sectors	***Daniela Gutiérrez Torres*** Interaction between the Carbon Tax and Renewable Energy Support Schemes in Colombia: Complementary or Overlapping	***Grzegorz Peszko*** Carbon Taxes that even Fuel Exporters Could Like
	Brian Walsh Making carbon taxes propoor using cash transfers in Latin America	***William Acworth*** Emissions Trading and Electricity Sector Regulation: A Conceptual Framework for Understanding Interaction between Carbon Prices and Electricity Prices	***Ruben Lubowski*** Estimating the Power of International Carbon Markets to Increase Ambition
	Nathaniel Keohane Competitiveness of Emissionsintensive Trade-exposed Sectors in Canada	***Peter Janosk***a Carbon pricing and the energy sector: optimizing policy packages	***Stuart Evans*** Australia–EU ETS Linking Negotiations: Lessons for the Post-Paris World
4:00pm	Break		
PLENARY: STEIN AUDITORIUM			
4:30-5:00pm	**Roundup Session** Reporting back and reflecting on the day's discussions and their relevance for decision making in policy and practice		Designated **Rapporteurs,** facilitated by the **Conference Co-Chairs**
5:00-6:00pm	**Closing Plenary** • Panel discussion on the key takeaways from the conference, their relevance for decision making, issues requiring further reflection, and possible directions for future research • Facilitated by ***Andrei Marcu,*** European Roundtable on Climate and Sustainable Transition, and ***Michael Mehling,*** Massachusetts Institute of Technology • **Message from Chile on the Road to COP25**		***Ajay Mathur,*** The Energy and Resources Institute (TERI) ***Anirban Ghosh,*** Mahindra Group ***David Hone,*** Shell International ***Juan Angulo,*** Embassy of Chile
CONFERENCE CLOSE			
6:00pm	Closing Remarks		***John Roome,*** World Bank

ANNEX TWO

LIST OF ACRONYMS

APEC	Asia-Pacific Economic Cooperation
CDM	Clean Development Mechanism
CEEPR	Center for Energy and Environmental Policy Research
CF&D	Carbon Fee and Dividend
CMA	Conference of the Parties serving as the meeting of the Parties to the Paris Agreement
COP	Conference of the Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CO	carbon monoxide
CO_2	carbon dioxide
CPLC	Carbon Pricing Leadership Coalition
EITE	emissions-intensive trade exposed
ETS	emissions trading scheme
EU	European Union
EV	electric vehicle
GDP	Gross Domestic Product
GHG	greenhouse gas
GWh/yr	gigawatt hours per year
G7	Group of Seven
G20	Group of Twenty
ICP	internal carbon price
IEA	International Energy Agency
ITMOs	internationally transferred mitigation outcomes
JCM	Joint Crediting Mechanism
MIT	Massachusetts Institute of Technology
MSMEs	micro, small, and medium enterprises
NDCs	Nationally Determined Contributions

NMPC	nonlinear model predictive control
NO_x	nitrous oxide
OBPS	Output-based Pricing System
OECD	Organization for Economic Co-operation and Development
PAT	Perform, Achieve, and Trade
PM	Particulate Matter
PMR	Partnership for Market Readiness
REC	Renewable Energy Certificates
REDD+	Reducing Emissions from Deforestation and Degradation
RES-E	renewable energy sources
RGGI	Regional Greenhouse Gas Initiative
SDGs	Sustainable Development Goals
SO_x	sulfur oxide
TCFD	Taskforce on Climate-Related Financial Disclosures
tCO_2	metric ton carbon dioxide
tCO_2e	metric ton carbon dioxide equivalent
TERI	The Energy Resources Institute
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
US$	US dollar
VOC	Volatile Organic Compounds
WCI	Western Climate Initiative
WTP	willingness to pay
€	euro

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