

## **WORKSHOP REPORT**

### **PMR Technical Workshop on Post-2020 Mitigation Scenarios and Carbon Pricing Modelling**

February 1<sup>st</sup>-3<sup>rd</sup>, 2016

Brasilia, Brazil

## BACKGROUND

As countries continue developing mid- and long-term emission pathways and refining their nationally determined contributions (NDCs) to achieve their mitigation ambitions, the need for them to analyze their proposed climate action plans in a broader economic development framework remains essential. Indeed, the ability to conduct underlying modeling and analytical work is critical to help them identify the scale, scope and pace of alternative emission pathways and their associated costs. Such work will also be fundamental in order to put together a suitable package of policies and measures, including carbon pricing instruments, in view of implementing their NDCs. There are various methodological approaches and tools that can support this process, as exemplified by diverse and growing practical experience on the subject around the world.

Against this backdrop, the Partnership for Market Readiness' (PMR) Policy Analysis Work Program supports countries to advance their work to assess the implications of current or envisaged mitigation objectives and to develop a package of effective and cost-efficient instruments to achieve them. As such, the Program also brings together policy makers and technical practitioners directly involved in this effort in their respective countries, to facilitate and foster the exchange of experience and knowledge and to discuss good practices on the establishment of mitigation scenarios and carbon pricing modelling.

The **PMR Technical Workshop on Post-2020 Mitigation Scenarios and Carbon Pricing Modelling**, convened on February 1<sup>st</sup>–3<sup>rd</sup> in Brasilia, Brazil, by the PMR and hosted by the Ministry of Finance of Brazil, brought together more than 50 policy makers and technical practitioners from PMR countries and international experts from research organizations and academia. It overall provided participants with an opportunity to:

- Share insights and lessons learned throughout the technical assessment work underlying countries' low emissions development strategies and, in particular, NDC decision-making process;
- Discuss common analytical challenges and gaps related to the design and operationalization of possible NDC implementation strategies, particularly with regards to the technical analysis of mitigation options and enabling policy instruments;
- Take stock of key issues and challenges facing expert modelers and policy makers when conducting carbon pricing modeling in support of an instrument design and assessment;
- Inform further work and identify key areas of support under the PMR Policy Analysis Work Program.

This note summarizes the presentations and discussions from this PMR Technical Workshop. The workshop agenda, list of participants, and all presentations are accessible at the PMR website, section 'Meetings & Events' (or follow this [direct link](#)).

## WORKSHOP OVERVIEW

Time	Day 1 – Context Planning for Low-Carbon Development Pathways	Day 2 – Challenges Assessing Policy Instrument Packages	Day 3 – Deep Dive Carbon Pricing Modeling & Analysis
08:30	Opening and welcome remarks		
09:00 - 10:30	<b>Session 1 - Setting the stage: NDCs – Stepping stones towards a low-carbon future</b> <ul style="list-style-type: none"> <li>• Post-Paris update on NDC implementation challenges</li> <li>• From NDCs to deep decarbonization</li> <li>• Establishing Post-2020 emissions pathways: PMR Checklist</li> <li>• Q&amp;A and plenary discussion</li> </ul>	<b>Session 4 – How can issues of policy interaction be explored?</b> <ul style="list-style-type: none"> <li>• Overview presentation on policy mapping tools and analytical approaches</li> <li>• Focus energy sector: PMR/ESMAP assessment framework on interactions between carbon pricing and energy policies</li> <li>• Q&amp;A and panel discussion</li> </ul>	<b>Session 8 – Modeling carbon pricing instruments: The state of knowledge and landscape of modelling tools</b> <ul style="list-style-type: none"> <li>• Overview: The state of knowledge and landscape of carbon pricing modeling tools</li> <li>• Insights on global carbon pricing and trading modeling</li> <li>• Q&amp;A</li> </ul>
30'	Coffee break		
11:00 - 12:30	<b>Session 2 – Analysis of mitigation options, enabling policy instruments and alternative mitigation pathways</b> <ul style="list-style-type: none"> <li>• Overview on analytical approaches and tools <ul style="list-style-type: none"> <li>- PMR country case studies: Peru &amp; Costa Rica</li> </ul> </li> <li>• Q&amp;A and plenary discussion</li> </ul>	<b>Session 5 – Bringing it all together: Building policy packages to achieve long-term mitigation pathways</b> <ul style="list-style-type: none"> <li>• Overview presentation on combined analysis of technical and policy options</li> <li>• PMR country case study: Brazil</li> <li>• Q&amp;A and plenary discussion</li> </ul>	<b>Session 9 – Panel discussions on modeling domestic carbon tax and ETS</b> <ul style="list-style-type: none"> <li>• Panel discussion A: Key modeling issues and challenges facing domestic ETS design and implementation</li> <li>• Q&amp;A</li> </ul>
90'	Lunch		
14:00 - 15:30	<b>Session 2 (Cont'd)</b> <ul style="list-style-type: none"> <li>• PMR country case studies: <ul style="list-style-type: none"> <li>- Kazakhstan &amp; Vietnam (World Bank/ESMAP study)</li> </ul> </li> <li>• NDC implementation framework</li> <li>• Q&amp;A and plenary discussion</li> </ul>	<b>Session 6 – Building policy packages</b> <ul style="list-style-type: none"> <li>• Break-out group exercise</li> <li>• Report back and plenary discussion</li> </ul>	<b>Session 9 (cont'd)</b> <ul style="list-style-type: none"> <li>• Panel discussion B: Key modeling issues and challenges facing carbon tax design and implementation</li> <li>• Plenary discussion: Views from PMR countries on carbon pricing modeling experience</li> </ul>
30'	Coffee break		
16:00 - 17:30	<b>Session 3 – NDC implementation challenges and perceived knowledge gaps</b> <ul style="list-style-type: none"> <li>• Break-out group discussion</li> <li>• Report back and plenary discussion</li> </ul>	<b>Session 7 – A closer look at carbon pricing policies</b> <ul style="list-style-type: none"> <li>• Carbon pricing policies: Overview and instrument options</li> <li>• Framework for evaluating carbon pricing policies</li> <li>• Q&amp;A</li> </ul>	<b>Session 10 – Building a modeling work program together</b> <ul style="list-style-type: none"> <li>• Break-out group exercise. Report back in plenary.</li> <li>• Proposals for PMR's modeling work program</li> <li>• Open discussion and reflection on the issues covered in the break-out session</li> </ul>
17:30	Closing session. Wrap-up and closing remarks		

## SUMMARY OF THE WORKSHOP

### Opening session

The workshop was opened with welcome remarks by Mr. Carlos Klink, Deputy Minister, Ministry of Environment, and Mr. Manoel Pires, Secretary of Economic Policy, Ministry of Finance, Brazil. For the World Bank Group, Mr. Martin Raiser, Country Director for Brazil, and Mr. Venkata Putti, Program Manager, Climate and Carbon Finance Unit, joined the host country representatives in welcoming participants on behalf of the organizers. Following these introductory remarks, Mr. Adrien de Bassompierre, Coordinator, PMR Secretariat, presented the [objectives and the agenda of the workshop](#).



### Day 1 Planning for Low-Carbon Development Pathways

The workshop sessions on day 1 overall allowed participants to share experiences and lessons gained in the articulation of their low emissions development strategies and their NDC decision-making processes. Having got past the Paris Agreement negotiations, participants discussed common challenges and gaps related to the operationalization of possible NDC implementation strategies, particularly with regards to the assessment of national emission reduction pathways and underlying analysis of prioritized mitigation options and enabling policy instruments.

#### **Session 1: Nationally Determined Contributions – stepping stones towards a low-carbon future**

The first session, moderated by Mr. Venkata Putti (World Bank), served the purpose of setting the stage for the workshop discussions. Experts delivered presentations aimed at giving a snapshot on world-wide INDC engagement and the challenges behind long-term deep decarbonization goals vis-à-vis INDC targets

***Post-Paris update on NDCs and implementation challenges.*** [Ms. Ritika Tewari \(New Climate Institute, NCI\)](#) drew on findings of New Climate Institute’s INDC Catalyst Project to discuss engagement in and impacts of the INDC decision-making processes across countries in the lead up to Paris. As reported by countries themselves, INDC determination processes triggered or enhanced mainstreaming of climate change considerations into national development planning, increased national capacity for climate planning as such, significantly accelerated countries’ mitigation actions and commitments, and overall indirectly enhanced the level of pre-2020 ambition. Ms. Tewari stressed that, evidently, the “INDC momentum” has led to increased political engagement, as it begun to address what was previously a major barrier for policy planning and action at the national level. At the same time, she highlighted that countries continue to perceive limited technical capacity as a major barrier. It is detracting from the ability of countries to increase their ambition with confidence. Here, international cooperation will continue to play a critical role in closing the remaining capacity gaps.

***From NDCs to deep decarbonization.*** [Mr. Thomas Spencer \(Institute for Sustainable Development and International Relations, IDDRI\)](#) shared his insights on the importance of the Post-Paris Implementation Agenda. He discussed what it entails - for long-term policy-making and analytical work - to drive for long-term deep decarbonization. How can INDC commitments best be used as stepping stones to deep decarbonization? Where and how can we strategically overachieve INDCs? Mr. Spencer acknowledged that INDCs represent a great step forward that now must be implemented and strengthened (overall and in the right places/sectors). He stressed that the Paris Agreement has left us with a big collective action agenda, which includes – in reference to the PMR community’s core objectives – ensuring that carbon pricing is linked to the development agenda.

***Establishing post-2020 emissions pathways: PMR checklist.*** [Mr. Thomas Kansy \(Vivid Economics\)](#) supplemented the preceding presentations with a discussion on a generic methodological framework for the development of post-2020 mitigation scenarios and the assessment of corresponding effective policy packages. In particular, his presentation provided an overview of the [PMR Checklist](#) – a good practice guidance tool developed by the PMR Secretariat to assist countries in the technical/analytical process of devising, presenting and implementing their nationally determined contributions

## **Session 2: Analysis of mitigation options, enabling policy instruments and establishment of alternative mitigation pathways**

Session 9 was moderated by Mr. Marcos Castro, PMR Secretariat, and comprised two panel discussions dedicated to sharing a series of country experiences with the assessment of low carbon development pathways and how it informed their INDC decision-making process. The country case presentations were supplemented by expert presentations on a conceptual framework and methodological approaches to refine and translate a country’s alternative mitigation pathways (underlying its INDC) into an ‘INDC implementation strategy’.

- [Mr. Thomas Kansy, Vivid Economics](#) kicked off the session with a comprehensive review of analytical approaches and tools for the assessment of mitigation options and enabling policy instruments. His presentation guided participants, step-by-step, through a good practice process for the analysis of emission reduction opportunities, identification of enabling policy instruments, and aggregation of alternative mitigation scenarios. Mr. Kansy stressed the importance of ensuring iterations/feedback loops between a technology-based assessment of mitigation options (the conventional bottom-up assessment carried out in most countries) and the analysis of policy instruments aimed at enabling and achieving those mitigation options (which arguably has not been at the forefront of analytical efforts in many countries so far). On policy instrument analysis, he went through key methodological considerations for the identification of policy instruments, analysis of cost and impacts, and assessment of policy interactions
- [Ms. Veronica Villena, Ministry of Environment, Peru](#) described the analytical work underlying Peru’s INDC. The Ministry of Environment (MINAM), the agency in charge of Peru’s INDC preparation roadmap, coordinated additional analytical work building upon emissions scenario modelling work carried out under Peru’s PlanCC program. The main areas of work covered (i) broadening the bottom-up analysis of mitigation options by key sectors, including financial analysis and assessment of co-benefits and enabling environment for a prioritized subset of mitigation options; (ii) refinement of

sector MAC curves and development of alternative emissions reductions scenarios by 2030; and (iii) the CGE-based analysis of macroeconomic impacts of the proposed 2030 mitigation scenarios. The assessment results informed Peru's INDC cross-sectorial discussion process on an ongoing basis and underlie Peru's economy-wide mitigation target as expressed in their INDC.

- [Mr. Felipe de León, Ministry of Environment and Energy \(MINAE\), Costa Rica](#) explained the combined forecasting and backcasting exercises underpinning Costa Rica's ambitious INDC, namely an absolute target of emissions reduction (-25%) compared to a base year (2012), equivalent to a targeted 2030 annual GHG emissions (9.374 MtCO<sub>2</sub>e). As for the 'forecasting' element, it focused on bottom-up modelling and analysis comprising (i) development of plausible reference scenarios for sector activity and associated GHG emissions, in five priority sectors (energy, transport, forestry, agriculture, waste management); (ii) prioritization and assessment of emissions mitigation options by sectors, and subsequent development of marginal abatement cost curves (MAC curves); and (iii) exploration of alternative emissions reduction scenarios to reach different levels of mitigation ambition in the mid- and long-term, including assessing the mitigation gap to reach Costa Rica's carbon neutrality goal.
- [Mr. Yerbol Akhmetbekov, Nazarbayev University, Kazakhstan](#) presented on the PMR-supported modelling work aimed at combining and linking top-down and bottom-up economic models with a dual objective, namely (i) to understand the economy-wide impacts of the ETS and other complementary policies in Kazakhstan's development plans, while (ii) informing Kazakhstan's INDC determination process. Mr. Akhmetbekov underscored that this work has enhanced national understanding of opportunities and challenges behind different types of economy wide mitigation objectives in the Kazakh context, and has strengthened the modeling capacity in Kazakhstan for analyzing mitigation pathways, enabling policy options and macro-economic impacts.
- [Mr. Suphachol Suphachalasai, PMR Secretariat](#) shared the key results, findings and recommendations of a recently finalized assessment of low-carbon development pathways for Vietnam, carried out by the World Bank/ESMAP for the Vietnamese government. This project, built upon two years of consultations in Vietnam with Government counterparts, research organizations, state-owned enterprises, the private sector, and Vietnam's international development partners, and ultimately formulated two concerted scenarios - a business-as-usual and a low-carbon development scenario - to explore and analyze Vietnam's options up to the year 2030. Importantly, within the context of Vietnam's Green Growth Strategy, the analytical work carried out unveils a basket of cost-effective mitigation options in key sectors, and lays the foundation to assess corresponding market, economic and fiscal policy instruments that may create the enabling environment for actual implementation of those mitigation options.
- [Ms. Emelia Holdaway, Ricardo AEA](#) capped the series of country case presentations with the discussion of a simple but comprehensive 'NDC implementation framework' that could assist countries in organizing the process of translating INDC objectives and pledges into implementation strategies. The proposed framework comprises five distinct but intrinsically linked pillars: (i) governance and political will, (ii) Long-term mitigation strategies, (iii) Integrated adaptation planning, (iv) climate finance frameworks, and (v) Measurement, reporting and verification (MRV) systems. Ms. Holdaway highlighted that together, these five pillars, when appropriately tailored to national circumstances, can transform the momentum built up in a country's INDC process into action towards achievement of the INDC ambition.

### Session 3: Breakout group exercise 1 - NDC implementation challenges and perceived knowledge gaps

During the last session of the first day, workshop participants engaged in small-breakout group discussions amongst peers on (I)NDC implementation challenges and perceived knowledge gaps. The group discussions, facilitated by a designated expert and PMR Secretariat team members, aimed at identifying common implementation challenges and knowledge gaps, exchanging experience in overcoming certain challenges/knowledge gaps, and clarifying where external support might be needed and/or deemed most helpful in overcoming implementation challenges. The short background note for this discussion can be accessed [here](#).

#### Five potential areas of implementation challenges and knowledge gaps

Technical	Regulatory	Institutional	Planning	Political and social
<ul style="list-style-type: none"> <li>•availability of analytical tools and models</li> <li>•data availability and reliability</li> <li>•skills and people</li> </ul>	<ul style="list-style-type: none"> <li>•mandates and responsibility for implementation</li> <li>•legal framework to support implementation</li> </ul>	<ul style="list-style-type: none"> <li>•specialised institutions</li> <li>•institutional capacity</li> <li>•funds</li> <li>•collaboration across sectors and ministries</li> </ul>	<ul style="list-style-type: none"> <li>•national economic and development plans</li> <li>•sectoral plans</li> <li>•tools for policy instrument analysis</li> </ul>	<ul style="list-style-type: none"> <li>•stakeholder incorporation</li> <li>•sector and industry cooperation</li> <li>•impact on different regions and vulnerable communities</li> <li>•demonstration of co-benefits</li> </ul>

Source: Vivid Economics

A plenary session to report back on the group discussions succeeded this exercise. Across the four groups, there was close to consensus on the following priority challenges and key areas for (analytical) support:

#### **Priority challenges**

- Regulatory framework
- Demonstration of co-benefits
- Integration of policies across sectors and the economy
- Financing for policies that require government expenditure

#### **Areas for analytical support**

- Policy mapping and analysis of interactions between policies (across sectors/within a given sector)
- Economy-wide impact assessment of policies/policy instruments (macro-economic and social impacts)
- Assessment of 'co-benefits'

## **Day 2      Assessing Policy Instrument Packages**

The workshop session on day 2 comprised presentations and panel discussions dedicated to discussing issues, options and tools related the analysis of policy interactions between carbon pricing instruments and existing and/or forthcoming sectoral policies. Participants were also invited to apply the concepts and insights shared through practical case studies discussed in break-out groups.

### **Session 4: How can issues of policy interaction be explored?**

***Policy mapping tools and analytical approaches.*** [Mr. Felix Matthes \(Oeko-Institut\)](#) provided an overview of the tools and analytical approaches to explore policy interactions and coordination. He first underlined the importance of performing an initial policy strategy assessments, such as through the “four A’s” the framework, i.e. Are the potentials for GHG mitigation available? Can these potentials be implemented in a way that certain (long-term) targets are achievable? Can pathways be designed that are affordable? And, will such pathways be acceptable? In addition, he highlighted that policy coordination requires sound policy mapping supported by an analysis of the dynamic of the market environment and the variety of policy interactions, focusing on most significant sectors. Taking into account uncertainties and providing solutions to deal with them are also critical to such efforts.

***Focus on the energy sector: interactions between carbon pricing and energy policies.*** [Mr. Christophe de Gouvello \(World Bank Group\)](#) illustrated the challenges and options related to policy coordination focusing on the energy sector in the context of developing economies. While in theory customers respond to the carbon price signal and reduce their emissions accordingly, in practice a series of issues – such as oil price volatility and undesired rent transfer – may lead to an inefficient carbon price signal. In addition, he highlighted that beyond the interactions between the instruments themselves, the policy objectives these instruments support may also converge or diverge. Finally, he made recommendations and proposed options to deal with these interactions, in order to reconcile carbon pricing and energy policies.

### **Session 5: Bringing it all together - Building policy packages to achieve long-term mitigation pathways**

***Combined analysis of technical and policy options.*** [Mr. Felix Matthes \(Oeko-Institut\)](#) reminded participants of the complex and coordination-intensive policy framework for climate and carbon pricing policies, and highlighted the strong interrelations existing with other policies – such as in energy policies, economic/industrial policies, and other social and economics polices with key distributional objectives – not forgetting the risk for regulated entities to game the different mechanisms underpinning policies. He explained that policy coordination and integration requires managing the complexities and interrelations towards a common policy objective. To do so, options include policy coordination by the design of the policy mix (i.e. comprehensive policy planning reflecting all dimensions, and low-carbon investments and carbon-minimizing operations); careful ex ante planning(i.e. reflecting interactions in the design of policy mechanisms, and remaining uncertainties), the design of responsive carbon pricing tools (i.e. price control, quantity control with both explicit price elements and quantity/scarcity-based price elements), and integrating the longer-term horizon (i.e. explicitly such as through long-term caps, and/or through complementary measure such as through other framing options (e.g. long-term contracts etc.)). He finally underlined the key role of revenue recycling in enabling the double or triple dividend (i.e. labor cost, removal of structural barriers, triggering innovation, addressing targeted structural change), managing



distributional challenges (affordability, competitiveness), fostering political buy-in, and allowing international integration. Key challenges related to revenue recycling include maintaining incentives from pricing instruments and enabling appropriate compensation strategies (e.g. lock-in effects from compensation provisions which can distort or erode the price signals (free allocation, tax deductions etc.)). One preferential but much more difficult approach to revenue recycling involves a more targeted use for compensation purposes.

**Analytical approaches and tools.** [Mr. Grzegorz Peszko \(World Bank Group\)](#) provided an overview of the application of Pol-MAC approaches based on the work of the World Bank and other institutions to date with a number of countries such as Russia, Turkey, Kazakhstan, Ukraine, Bulgaria, Croatia – with other to come (e.g. Vietnam, Pakistan, Chile, Morocco etc.). The Marginal Abatement Cost models generate bottom-up, engineering marginal cost curves to illustrate the economics of supply of individual technical/behavioral emission reduction measures. These can be used to in the context of INDC implementation in particular to determine the mitigation potential of current policy and alternative policy options, as well as their aggregate impact on national emission trajectories and financial flows. The main objective is to design investment-grade enabling policy framework to achieve climate/energy targets, bridging the gap between targets (abatement options) and investments.

**Brazil Case Study.** [Dr. Roberto Schaeffer \(Federal University of Rio de Janeiro\)](#) and [Mr. Régis Rathmann, \(GEF/Brazilian Federal Ministry of Science, Technology and Innovation\)](#) presented a case study on the project “Mitigation Options of GHG emissions in key sectors in Brazil”. The goal of the project is to assist the Government of Brazil to strengthen its technical capacity in supporting the implementation of its mitigation actions of GHG in key economic sectors (industry, energy, transport, household and services, AFOLU, waste management and other cross-sector alternatives). The different models used (e.g. MESSAGE–Brasil 8000) and process to integrate them in order to deliver an integrated analysis of scenarios were presented. Critical challenges facing such analysis the need for high quality, detailed sectoral information and experts capable of interpreting results; time requirement to establish a soft link between models to reflect interactions between the different sectors involved in the modeling exercise.

## **Session 6: Group exercise 2 - Building policy packages**

Participants took part in break-out group exercises inviting them to identify and discuss potential interactions existing between carbon pricing policy and sectoral policies – considering both synergies as well as potential tensions. [Case studies](#) included transport policy and the EU, industry policy in India, and agricultural policy in Kenya. In addition, each group was asked to discuss how the modelling of carbon pricing policies should take into account the potential interactions identified, in particular baseline emissions and available emission abatement measures, emissions growth and fuel mix over the short, medium and long term, uptake of low carbon measures over the short, medium and long term, and the use of offsets. The [case studies background notes](#) are available at the workshop website, too.

## **Session 7: A closer look at carbon pricing policies**

Following up on the earlier sessions during which a number of issues around policy interactions and policy packages that can help countries achieve long-term mitigation targets were discussed, this session provided a deep dive into the role of carbon pricing instruments in this regard.

**Carbon pricing policies: Overview and instrument options.** [Mr. Thomas Kansy \(Vivid Economics\)](#) presented the overview of carbon pricing policy and instrument options, including different forms of explicit and implicit carbon pricing (from feed in tariffs and vehicle efficiency standards to emissions trading and carbon taxes). The presentation also reflected on the economic rationale for introducing carbon pricing policies, including cost-effectiveness of proposed measures, revenue recycling options, and technological innovation. The presentation also outlined some of the key issues that typically arise when countries design and implement carbon pricing policies, as well as ways of overcoming them. Among others, they included issues around competitiveness and leakage, potentially disproportionate impacts on low-income households and policy interactions. Finally, the presentation also provided an overview of the ongoing and planned carbon pricing initiatives globally, as well as the early lessons learned.

**A framework for evaluating carbon pricing policies.** Based on the growing experience in designing and implementing carbon pricing initiatives, [Mr. Grzegorz Peszko \(Climate Policy Unit, World Bank Group\)](#) presented examples of various frameworks for evaluating carbon pricing policies, including the OECD framework for evaluating ETSs and the joint WBG-OECD “FASTER” principles for successful carbon pricing. Outlining key issues around fairness, alignment of policies, stability and predictability, transparency, efficiency and cost-effectiveness, and reliability and environmental integrity, the key messages included that carbon pricing instruments, if properly designed and implemented, can play in fostering innovation and making the transition to a low carbon economy smoother.

### **Day 3      Carbon Pricing Modeling and Analysis**

Building on the discussion on the previous days of the workshop, day 3 took a closer look at the modeling and analysis of carbon pricing instruments, particularly ETS and carbon tax. The day began with a presentation on an overview of available modeling tools and techniques that are relevant to carbon pricing modeling. Three global models were then presented to illustrate how they are deployed to answer carbon pricing policy questions in different international settings. This was followed by two panel discussions: one on ETS and the other on carbon tax, with the aim to gain better understanding of how countries/jurisdictions use modeling work at the national and sub-national levels in support of the design and implementation of their respective carbon pricing instruments. Day 3 also ran an interactive exercise involving all participants which culminated in a discussion on shaping up the PMR’s modeling work stream under the Policy Analysis work program.

### **Session 8: Modeling carbon pricing instruments**

**The state of knowledge and landscape of carbon pricing modeling tools.** [Mr. Francesco Bosello \(Euro-Mediterranean Center on Climate Change, CMCC\)](#) presented on the state of knowledge and landscape of carbon pricing modeling tools. The presentation described different modeling tools (such as dynamic optimization, computable general equilibrium (CGE), macro-econometrics, bottom-up, and hybrid), the mechanics and theories behind the tools in modeling carbon pricing instruments, their respective strengths and weaknesses, and provided examples of a range of carbon pricing modeling results from IPCC’s 5<sup>th</sup> Assessment Report.

**Insights on global carbon pricing and trading modeling.** To illustrate how global models can be utilized for carbon pricing modeling, [Mr. Duncan Gray \(UK Department of Energy & Climate Change, UK DECC\)](#)

made a presentation on the framework and outputs from the *Global Carbon Finance (GLOCAF) model*, while [Mr. Francesco Bosello \(CMCC\)](#) presented the *Intertemporal Computable Equilibrium System (ICES) model* and the *World Induced Technical Change Hybrid (WITCH) model*. The GLOCAF model is a top-down global model with 24 regions, building on country-/region-specific MAC curves. The GLOCAF model is typically used to develop scenarios for international carbon price and carbon and financial flows, based on pre-determined mitigation targets and carbon market design. The ICES model is a top-down multi-sectoral, multi-region, CGE model that is oriented towards climate change mitigation and adaptation policy analysis. The model can be used to assess national carbon taxes as well as international carbon pricing policies. The WITCH model is a long-term hybrid dynamic optimization model, with the capability to analyze international emission trading scenarios and associated carbon prices and carbon/financial flows.

### **Session 9: Panel discussion on modeling domestic carbon tax and emissions trading systems (ETS)**

Session 9 comprised two panel discussions dedicated to carbon tax and ETS, drawing on country experiences with the design and implementation of the policies, and the modeling work undertaken to support them. Both panels were moderated by Michael Toman (World Bank).

The panel discussion on ETS – ***“Key modeling issues and challenges facing domestic ETS design and implementation”*** - involved experiences from the European Commission, Republic of Korea, Kazakhstan, and the US state-level Regional Greenhouse Gas Initiative (RGGI):

- [Mr. Miles Perry \(DG Climate Action, European Commission\)](#) discussed the role of modeling exercise in support of EU’s climate policy and target setting in the ETS and non-ETS sectors. He also compared auctioning and free-allowance for ETS design options, and emphasized the importance of analyzing ETS in conjunction with other/complementary measures in the broader climate policy context.
- [Ms. Hyungna Oh \(Kyung Hee University, Republic of Korea\)](#) outlined key challenges associated with the preparation and implementation of the Korea ETS, and discussed technical underpinnings of the cap setting exercise. She highlighted a CGE model used to support the modification of Korea ETS.
- [Mr. Aidyn Bakdolotov \(Nazarbayev University, Kazakhstan\)](#) gave an overview of the modeling work undertaken for Kazakhstan ETS, focusing on the use of TIMES model in assessing the economic and emission implications of the ETS with different set-ups. Future work will develop a hybrid model soft-linking a CGE with TIMES to provide more insights into the potential impacts of INDC and the role of ETS in the economy and energy system.
- The panel discussion ended with the intervention from [Mr. William Space \(Department of Environment, State of Massachusetts; on RGGI experience\)](#) who discussed the use of complementary modeling and analysis tools, including IPM electric sector model, REMI macroeconomic model, and household-level analysis of bill impacts to consider the different aspects of RGGI.

The panel discussion on carbon tax – ***“Key modeling issues and challenges facing carbon tax design and implementation”*** involved experiences from British Columbia, Chile and the United Kingdom:

- [Ms. Anne Foy \(Ministry of Finance, British Columbia\)](#) described main technical characteristics of the BC’s carbon tax, including its coverage, tax base, revenue recycling, determination of fuel-specific tax rates, and policy administration.
- [Mr. Francisco Pinto \(Ministry of Environment, Chile\)](#) outlined Chile’s green tax and carbon tax, and discussed PMR-supported modeling work to examine the potential effects of different levels of

carbon tax and different application approaches on the trajectories of power generation mix and emissions. He shared lessons learned from this modeling work and stressed the need to align modeling scenarios and assumptions with political reality.

- [Ms. Emelia Holdaway \(Ricardo AEA\)](#) provided an overview of the UK climate change levy, highlighting the determination of the main rate (energy tax) and the carbon price support rate (carbon tax). Economic modeling was done to assess the price impact; however, non-price factors emerge as a significant influence on consumers’ behavior too. She also discussed the UK Climate Change Agreement (voluntary targets whose achievement trigger reduction in the main rate applied to energy-intensive industry). ENUSIM, a MAC-based bottom-up model, was used to support target setting for the UK CCA in industry sub-sectors.

### Session 10: Building a modeling work program together

The [objective of this session](#) was to bring together the discussions throughout the three-day workshop and to identify a long-list of analytical questions/issues that could be potentially included in the PMR’s Policy Analysis Work Program both at country- and program-levels. All participants were invited to provide (i) two suggestions on specific analytical questions or issues that are still outstanding or for which further work or support would be helpful for their countries, and (ii) two suggestions on topics that could benefit from cross-country cooperation or require deep dive via the PMR platform.

Based on these inputs, the PMR Secretariat organized the suggestions into four clusters, namely: (1) Analytical support for modeling tools and approaches, (2) Support for the analysis of policy impact, (3) support for the analysis of design features, and (4) Training, capacity building, and events (capacity building modalities). The participants then voted on the specific activities (three deemed most critical) under the four clusters to help prioritize them.

The activities that received significant number of votes were:

Analytical support for modeling tools and approaches	Support for the analysis of policy impact	Support for the analysis of design features	Cross-cutting: Capacity building modalities
<ul style="list-style-type: none"> <li>• Develop sector-specific models for carbon pricing instruments</li> <li>• Modeling/ analytical approaches to assess barriers to low carbon options</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis of co-benefits associated with carbon pricing policies</li> <li>• Analysis of policy interaction between key sectors and relevant guidelines</li> </ul>	<ul style="list-style-type: none"> <li>• Assessment of design options for ETS, carbon tax, and implicit carbon pricing</li> <li>• Analysis on new market mechanism and transfer of mitigation units</li> </ul>	<ul style="list-style-type: none"> <li>• Training on modeling techniques with deep dive into specific topic/s</li> </ul>

Other relevant activities discussed in the session included:

- MAC-based simulation tool for carbon pricing policies
- Modeling tools and analysis of mitigation pathways including INDCs
- Assessment of linking national markets to create regional markets
- Assessment of cost and price impact of carbon pricing policies
- Strategies and approaches for national stakeholder engagement and consensus building

### **Next steps and closing**

The PMR Secretariat explained that all presentations from the workshop would be posted on PMR website, that a summary note of the workshop would be prepared and circulated and that a Policy Analysis Work Program proposal would be submitted to the participants for (virtual) feedback.

The meeting was closed with remarks and words of appreciation from the World Bank Group, through Mr. Venkata Ramana Putti, Program Manager, Carbon and Climate Finance, and Mr. Adrien de Bassompierre, Coordinator, PMR Secretariat.