The Networked Carbon Markets initiative Partners & Strategy Workshop

Combined presentation slides:

The Mitigation Action Assessment Protocol (Miguel Rescalvo, World Bank Group)
Potential application for the NCM Framework in China (Xi Liang, University of Edinburgh)
Domestic Carbon Markets Linking ‘PAT’ & ‘REC’ in the Indian Context (Karan Mangotra, TERI)
Using Mitigation Values to Guide the Design of Trading Rules (Cyril Cassisa and Sylvain Cail, ENERDATA)
International Carbon Asset Reserve (Luca Taschini, Grantham Research Institute, LSE and Jurg Fuessler, INFRAS)
COP21, Carbon Pricing and “Climate Clubs” (Michael Grubb, UCL)
Mitigation Value to Enable International Linkage of Domestic Programs (Johannes Heister, World Bank Group)
MITIGATION ACTION ASSESSMENT PROTOCOL (MAAP)

World Bank Networked Carbon Markets Initiative

Miguel Rescalvo
Cologne. May 28 2016
Mitigation Value Assessment

PROGRAM LEVEL: Risk relating to the characteristics of a specific program

POLICY LEVEL: Risk relating to the characteristics of a jurisdiction’s collective low-carbon policies

CONTRIBUTION TO A GLOBAL TARGET
Risk relating to the characteristics of a jurisdiction’s contribution to addressing global climate change

Mitigation Action Assessment Protocol
• Developed by DNV GL
• Expert Reviewed by IISD and New Climate Institute.
Development Process

Stakeholders engagement
- Carbon Expo May 2013
- Latin America Carbon Forum (Rio de Janeiro), FICCI (New Delhi), Asian Carbon Forum (Bangkok) – Fall 2013
- GHG verifiers. Thailand Feb 2016

Working group - Globally Networked Carbon Markets
- WB Internal Meeting – June 2013
- Paris Working Group meeting 1 – Sept. 2013
- Webinar Update – Dec. 2013
- Paris Working Group meeting 2-February 2014

Peer review
- Comments invited from the Working Group, selected individuals and organizations
  2015- IISD, New Climate Institute

Testing and Pilots
- NAMAs- Ecuador, Peru
  Low Carbon City Programs
  Phitsanulok and Pakkret, Thailand.
Goals and MAAP Structure

Key Indicators score

- Score range for each level of development
  - Default
  - Override score

- Level of confidence

Module area weighting
relative importance of each risk area within a module

Higher weight will assign a larger impact

Module’s assessment result
1. Definition and scope of the MA
2. Objectives and targets
3. Planning
4. Roles, Responsibilities And Authorities
5. Documents and records control.
6. Emissions reductions from interventions
7. Monitoring and reporting

LCC Program Design

Rating
Max Rating
## LCC Program- Phitsanulok Feb 2016

<table>
<thead>
<tr>
<th>Module</th>
<th>Impact Area</th>
<th>Weighted rating</th>
<th>Weighted Rating</th>
<th>Max Rating</th>
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<td>PM1 1. Definition and scope of the MA</td>
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<td>20%</td>
<td>68</td>
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<td>PM2 2. Objectives and targets</td>
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<td>20%</td>
<td>47</td>
<td>9.4</td>
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<tr>
<td>PM3 3. Planning</td>
<td></td>
<td>20%</td>
<td>48.5</td>
<td>9.7</td>
<td>20</td>
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<tr>
<td>PM4 4. Roles, Responsibilities And Authorities</td>
<td></td>
<td>10%</td>
<td>20</td>
<td>2</td>
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<td>PM5 5. Documents and records control.</td>
<td></td>
<td>10%</td>
<td>20</td>
<td>2</td>
<td>10</td>
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<td>PM6 6. Emissions reductions from interventions</td>
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<td>10%</td>
<td>20</td>
<td>2</td>
<td>10</td>
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<tr>
<td>PM7 7. monitoring and reporting</td>
<td></td>
<td>10%</td>
<td>20</td>
<td>2</td>
<td>10</td>
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<td><strong>LCC Program Management Entity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>EG1 1. Management Framework</td>
<td></td>
<td>50%</td>
<td>47</td>
<td>23.5</td>
<td>50</td>
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<tr>
<td>EG2 2. Finance and investment</td>
<td></td>
<td>20%</td>
<td>35</td>
<td>7</td>
<td>20</td>
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<tr>
<td>EG3 3. Climate change programs management</td>
<td></td>
<td>30%</td>
<td>32</td>
<td>9.6</td>
<td>30</td>
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<td><strong>Sustainable Development Contribution</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BD1 1. Development</td>
<td></td>
<td>40%</td>
<td>47</td>
<td>18.8</td>
<td>40</td>
</tr>
<tr>
<td>BD2 2. Planning and participation</td>
<td></td>
<td>30%</td>
<td>59</td>
<td>17.7</td>
<td>30</td>
</tr>
<tr>
<td>BD3 3. Monitoring of development benefits.</td>
<td></td>
<td>30%</td>
<td>21</td>
<td>6.3</td>
<td>30</td>
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</table>
Evolution and Benefits of the MAAP

- Self-evaluation,
- Prioritization,
- Design...

... of mitigation actions
Pilots
Application of program-level assessment

• Peru MRP elaboration: selection of 3 NAMAs for development of crediting instrument:
  • Shortlisting of mitigation actions for ex ante assessment.
  • Customization of Mitigation Action Assessment Framework.
  • Assessment of 10 prioritized mitigation actions.

• Thailand LCC programs Assessment
  • Thailand PMR proposal – LCC Fund
  • Assessment of LCC Phitsanulok and Pakkret
MAAP Pilots and Development

- Lessons learned
  - Crediting readiness
  - Availability of data for quantitative assessments
  - Jurisdiction level - it needs to assess policy level
  - MAAP implementation / databases / benchmarking

- Ongoing Pilots: Chile, Jordan, (Thailand)

- Capacity building:
  - Assessor Guidelines
  - Practical Guidance Document

- Support
  - Design level MAAP Tool
  - Deployment strategy
MAAP Deployment Strategy Proposed Activities

• Online MAAP Tool
  • Self assessment / benchmarking

• MAAP Tool – Assessments Database
  • Goal- position MAAP Tool as a reference for MA
  • Partner with recognized institution/s to build a database of assessed MA
  • Three tier approach:
    • Unsolicited assessment – self assessment - external
Conclusions

• MAAP serves at this stage two purposes
  • Self evaluation
  • MAAPs as the basis for programs development- eg. LCC
  • Assessment tool for governments, development banks

• Benchmarking
  • Need for databases, online tools, etc.

• The beauty of Assessments is in the numbers
  • MAAPs use needs to be expanded
Potential Applications for the Networked Carbon Market (NCM) Framework in China

Xi LIANG, Maosheng DUAN, Tim YEO, Xiaohu XU, Jiuhong QI

28/May/2016

Presentation at the Cologne
Content

Overview of China’s Carbon Markets
Apply NCM Framework for Domestic Linkage
Apply NCM Framework to Improve Linkage Compatibility
Progress in NCM (China) Scoping Study
• Timeline of ETS developing in China

Pilot ETS in 7 regions: 2011
National ETS: 2017 - 2020
National ETS Phase II: Post-2020
2016 Work Plan for National ETS Development

Released by NDRC in Jan 2016

• Provincial DRC submit the list of companies involved in the national ETS (the threshold is 10,000 tonne metric coal energy consumption or equivalent per year)

• Corporate audit, third party verify, government report to NDRC (year 2013, 2014, 2015 data)

• Train and select third party verification institutes and staff

• Strengthen capacity building
Findings from an early study from EU-Guangdong ETS Linkage Research Project

The study found the current linkage readiness index between the EU ETS and the GD ETS scored **6.3 out of 10**.
Planned Scoping Study on ‘Networking’ in China

BACKGROUND OF CARBON MARKETS IN CHINA

7 Pilot ETSs (2013-2015/6)
- Varying levels of economic development in participating regions
- Local governments given significant flexibility in designing pilot ETSs
- Resulted in ETSs with fairly heterogeneous structures

National ETS Phase 1 (2017-2020)
The first phase will focus on refining the national carbon market framework and convince Chinese stakeholders consider apply NCM framework for ETS linking in the national ETS design.

National ETS Phase 2 (post-2020)
The second phase would start to explore pilot regional or sectoral international linkage and implement concepts networked carbon market opportunities

NCM ACTIVITIES

- A scoping study in China will be led by Tsinghua University, University of Edinburgh, and the China Beijing Environment Exchange (CBEEEX) to explore opportunities for the NCM Initiative to support China’s international linkage efforts
- The study will conduct stakeholder outreach to explore opportunities for the NCM Initiative to support China’s international linking efforts and identify potential for conducting regional pilots

Image source: SEI (2012)
Work Plan about the Scoping Study on ‘Networking’ in China (to be completed by 30 Sep 2016)

- **Stakeholder Consultation**
- **Research Paper**
  - Section 1: Conceptual review - risks and opportunities of ETS linkages in China and options for applying the NCM initiative to support linking efforts
  - Section 2: Recommendations for developing international linkage opportunities in China
- **Apply NCM Framework to Improve Linkage Compatibility**
- **The 2nd China’s market international linkage workshop**
Plan to host the 2\textsuperscript{nd} China’s Carbon Market International Linkage Workshop in Beijing on 1 or 2 Sep 2016

The 1\textsuperscript{st} China’s Carbon Market International Linkage Workshop held in Beijing on 8/Jul/2015 (Right)
Draft Questionnaire Finalized by 30 May 2016

- **Stakeholder Consultation**
- **Research Paper**
  
  Section 1: Conceptual review - risks and opportunities of ETS linkages in China and options for applying the NCM initiative to support linking efforts (incl. stakeholder perception, an impact assessment, develop a CGE model analysis for EU-China linkage simulation)

  Section 2: Recommendations for developing international linkage opportunities in China (a staged approach to apply linkage, motivate industry interest, apply NCM Mitigation Value in domestic market linkage, other innovative approach)

- **Apply NCM Framework to Improve Linkage Compatibility**
- **The 2\textsuperscript{nd} China’s market international linkage workshop**
What is your perceived most effective approach for merging the existing allowance in the seven pilot carbon markets into the national carbon market?

A. Adopt a fixed percentage conversion rate to convert existing allowance to national allowance
B. Adopt a mitigation value methodology to calculate a conversion rate (i.e. estimate hot air effect) for each pilot market
C. Adopt a mitigation value methodology to calculate a conversion rate (i.e. estimate hot air effect) for each compliance company
D. Only allow companies to convert a part of their allowance, if these allowances were generated from qualified low-carbon abatement investment or adopt innovative low carbon technologies.
E. Unsure about the conversion rate
F. Instead of conversion of existing allowance to national allowance, the pilot carbon markets would exist and continue to use the existing allowance
How do you perceive the impact of an ETS linkage pilot on China’s domestic energy and climate policy in terms of certainty and flexibility?

A. It provides more certainty and enhance flexibility
B. It provides less certainty but enhance flexibility
C. It provides less certainty and reduce flexibility
D. It provides more certainty but reduce flexibility
E. Unsure
Whether it is necessary for China to carry out international carbon market linkage, and when it is possible?
A. Not necessary at the moment and future
B. Necessary, at the pilot stage
C. Necessary, at Phase I of national market (2017-2020)
D. Necessary, at Phase II of national market (after 2020)
How do you perceive the impact of an ETS linkage pilot on China’s domestic energy and climate policy in terms of certainty and flexibility?

A. It provides more certainty and enhance flexibility
B. It provides less certainty but enhance flexibility
C. It provides less certainty and reduce flexibility
D. It provides more certainty but reduce flexibility
E. Unsure
What is your perception about changing Market Design in the future of China’s National ETS to Improve the Compatibility of ETS and achieve Linkage Readiness status?

8A. Improve allocation method compatibility

1  2  3  4  5

[ ] [ ] [ ] [ ] [ ] strongly disagree

[ ] [ ] [ ] [ ] [ ] strongly agree

8B. Avoid double accounting

8C. Regulation and financial support related to MRV

8D. Improve market transparency

8E. Classify emission allowance as financial products

8F. Enhance legal and regulatory framework and provide flexible provision
To what extend do you agree with the following statement:
(Tick from 1 to 5 scale, where 1 means ‘strongly disagree’ while 5 means ‘strongly agree’.)

9A. Integrating the Chinese carbon trading market into the international trading system could help reduce the adverse impact on carbon price from the interactions of other national carbon reduction incentive mechanisms.

9B. If an unexpected national carbon tax is suddenly announced for immediate implementation across all major industry sectors (power, cement, refinery, etc.), what do you think will be the most likely immediate impact on the carbon price in these pilot carbon markets?
(Tick from 1 to 5 scale, where 1 means ‘large decrease’ while 5 means ‘large increase’.)

9C. If a higher than expected short-term renewable energy target is enacted in the pilot cities (e.g. increase from 10% to 15%), what would be the most likely impact on carbon price in the pilot carbon market?
(Tick from 1 to 5 scale, where 1 means ‘large decrease’ while 5 means ‘large increase’.)
9D. If a higher than expected offset proportion of forest carbon sinks in the pilot cities (e.g. increase from 5% to 10%), what would be the most likely impact on carbon price in the pilot carbon market?

9E. Whether carbon sink credits (e.g. agricultural and forestry) could be accepted as an international general carbon offsets mechanism?
What is your perception of ‘Mitigation Value’ and its applications for China’s domestic and international linkage?
A. Likely being applied in the short-term for domestic linkage but the long-term perspective for international linkage was uncertain
B. Only likely be applied in the long-term for international linkage
C. Not likely to be applied in either short-term or long-term
D. Likely being applied in both short-term and long-term
E. Not sure
What is your perception about pilot international linkage of carbon market between 2020 and 2025?
A. Start with one sector at the national level
B. All sectors at either provincial or municipal Level
C. Pilot emission trading linkage within entities that adopt advanced abatement technologies
D. Should not pilot international linkage at all
What is your perception about the feasibility of an international ‘Carbon Asset Reserve’ for stabiles price in China’s domestic and international carbon markets?
A. Positive
B. Neutral
C. Negative
D. Unsure
If a carbon club was established to pave the pathway towards a global carbon pricing system, do you think China should be a pioneer in the proposed international carbon club between 2020 to 2025?

A. China should only focus on its domestic market in this period
B. China should participate in the club but not take a pioneer role
C. China should be a pioneer in the carbon club
D. Unsure
Open Questions: Stakeholders’ awareness of and recommendations to the World Bank NCM programme and opportunities and risks in making China’s carbon market linkage readiness
Acknowledgements
感谢支持
Domestic Carbon Markets
Linking ‘PAT’ & ‘REC’ in the Indian Context

Karan Mangotra
Fellow
The Energy & Resources Institute
Addressing climate change concerns involves choosing higher-cost lower-CO2 emission technologies over lower-cost, higher emission technologies

- For some applications, especially for energy efficiency, initial cost is higher, but running (energy) costs are lower
- For some applications, especially for renewables, the long-term cost of electricity is higher
- Technology evolution is bringing down costs and enhancing performance

Addressing climate change is about meeting higher costs (at least in the medium term) and enabling rapid technology evolution.
Paris Agreement is a Step Ahead

- Focuses on a long term goal of limiting global temperature rise to much less than 2 Deg C
- All countries take action, with developed countries taking lead
- Countries pledge action and report in a transparent manner
- Mechanism to enable “ratcheting up” of ambition in subsequent pledges
- Global technological cooperation – International Solar Alliance and Mission Innovation
India’s INDC contains two main targets:

- **Intensity**: INDC targets a 33%-35% decrease in emissions intensity of GDP by 2030 (compared to 2005). This will be overachieved under current policies.

- **Non-fossil**: INDC targets 40% non-fossil power generation capacity target by 2030. This target is in line with current policies.

**Total emissions** (excl. LULUCF) under current policies will more than double from 2010 reaching ~5.4 GtCO\(_2\)e in 2030

- ~80% of this growth is through energy-related emissions

- Electricity generation will grow at 6% per year.
India: 8 levers are identified in the INDC, of which 6 are also quantified

<table>
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<tr>
<th>Reduction levers</th>
<th>Included in INDC?</th>
<th>Specification</th>
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<tr>
<td><strong>Non-fossil</strong></td>
<td></td>
<td></td>
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<tr>
<td>Energy efficiency</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Wind</td>
<td>✓</td>
<td>Wind: 60 GW by 2022</td>
</tr>
<tr>
<td>• Solar</td>
<td>✓</td>
<td>100 GW by 2022</td>
</tr>
<tr>
<td>• Other</td>
<td>✓</td>
<td>Biomass: 10 GW by 2022</td>
</tr>
<tr>
<td>Fuel shifts</td>
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<td></td>
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<tr>
<td>• Coal to gas</td>
<td>✗</td>
<td>Not mentioned in the INDC</td>
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<tr>
<td>• Transport (NG/ biofuels)</td>
<td>✓</td>
<td>20% blending of biofuels</td>
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<tr>
<td>Non energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-core energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Methane</td>
<td>✗</td>
<td>Non-CO2 emissions are not mentioned specifically in the INDC.</td>
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<tr>
<td>• Nitrogen oxide</td>
<td>✗</td>
<td>However, various measures related to reducing emissions from waste are included.</td>
</tr>
<tr>
<td>• Other</td>
<td>✗</td>
<td></td>
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<td>LULUCF(^1)</td>
<td></td>
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<tr>
<td>• Aforestation</td>
<td>✓</td>
<td>Additional (cumulative) carbon sink of 2.5 to 3 billion tonnes of CO(_2) equivalent through additional forest and tree cover by 2030.</td>
</tr>
<tr>
<td>• Reforestation</td>
<td>✗</td>
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</table>

\(^1\) LULUCF: Land Use, Land Use Change and Forestry
Sectoral Emissions Scenario

Emission by sector INDC-L scenario

Emission in energy sector
India’s Growth Imperatives

• In the 2000-2013 period
  • GDP of the Indian economy grew at 7.3% p.a.,
  • the total primary energy supply grew at 5.8% p.a.; &
  • electricity supply alone grew at 5.6% p.a.

• In the period up to 2030, the economy is expected grow to 8% to 10% due to the growth in manufacturing which would result in a greater demand for energy

• Economic growth results will double per capita income every 10 years; & per capita electricity supply will be more than 2,500 kWh per year, compared to 1010 kWh per year (2014).

• GHG emissions from industry are expected to grow to 448 mtCO2 in 2020 and to 806 mtCO2 in 2030 which translates to energy savings of 9% & 16% respectively over 2005 levels
India proposed the following Market Readiness Components

The objective is to create an effective centralized data management and registry system to capture GHG emissions data and enable implementation of MBMs which support issuance, transfer, and cancellation of credits.

- **Component 1**: Creation of a national registry to which various Market Based Mechanisms (MBMs) and a national GHG inventory management system (NIMS) can be linked.

- **Component 2**: Design framework for new MBMs activities and exploring the linkages of new and existing MBMs with registry.

- **Component 3**: Possible linkages of the registry to a national GHG inventory management system (NIMS).
Perform Achieve and Trade

- **Specific Energy Consumption (SEC) targets mandated for 478 units in 8 energy intensive sectors**
- Energy Savings Certificates will be issued for excess savings; can be traded and used for compliance by other units
- Financial penalties for non compliance
- Baseline conditions have changed; normalization factors developed
- Widening of PAT: Inclusion of more units from new sectors
  - New sectors: Refinery, Railways and Electricity DISCOMS
  - About 175 new DCs

<table>
<thead>
<tr>
<th>PAT Cycles</th>
<th>No. of Units</th>
<th>Share of total energy consumption (2009-10 Level)</th>
<th>Sectors covered</th>
<th>Energy Reduction</th>
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<tbody>
<tr>
<td>Cycle I (2012-13 to 2014-15)</td>
<td>478 DCs</td>
<td>36%</td>
<td>8</td>
<td>Target: 6.6 MToE</td>
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<td></td>
<td></td>
<td>Achieved: 8.4 MToE</td>
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<tr>
<td>Cycle II (2016-17 to 2018-19)</td>
<td>900-950 DCs</td>
<td>50%</td>
<td>11</td>
<td>Target: 8.86 MToE</td>
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</table>
Concept of Target, Compliance, ESCerts & Penalty

Scenario 1

Baseline SEC

Target SEC

Target

Issued ESCerts

Achieved SEC

Compliance

Scenario 2

Purchase ESCerts

Penalty
Renewable Energy Certificates
Schematic of Operational Framework for REC Mechanism
Way Forward – A common ‘Green Credit Value’

Unbundling Environmental Services: EE measures under PAT (2)

- Value to the carbon market: Mitigation value to be determined. Financial value to be determined by carbon market.
- Value to the Indian market: Energy Saving Certificates (ESCs) for PAT scheme. Value determined by national market.

Unbundling Environmental Services: Clean energy under REC (3)

- Value to the carbon market: Mitigation value to be determined. Financial value to be determined by carbon market.
- Value to the Indian market: Renewable Energy Certificates (RECs) for REC scheme.
Challenges to ‘linking’ the PAT & REC

• MRV
• Modalities for banking
• Stringency of targets and enforcement
• What would the mega-registry look like?
• Avoiding market failures – compliance period, prices?
• What will be the allocation methods?
• Interaction of the Green Credit Value with other global carbon pricing initiatives
Thank You

For more details contact
Karan Mangotra
karan.mangotra@teri.res.in
Enerdata/NCMI: Project methodology

Using Mitigation Values to Guide the Design of Trading Rules

Enerdata

NCMI’s Partners and Strategy Workshop, Cologne, 28 May 2016
Agenda

- Brief Background Information: Enerdata, POLES, MACCs
- Enerdata’s contribution to NCMI: objective and framework
- Proposed methodology
  - Focus on marginal abatement cost curves
- Preliminary results
  - On 2 jurisdictions
Background Information

- Enerdata
- The POLES model
- Marginal Abatement Cost Curves
Enerdata: global energy intelligence company

• **Independent** energy research & consulting company since 1991
• Spin-off of CNRS research center
• **Expert** in analysis and forecasting of global energy & climate issues
• **In-house** and globally recognized databases and forecasting models
• Headquartered in the Grenoble (French Alps) research cluster
• Offices in Paris, London and Singapore + network of partners worldwide
• **Global reach**: clients in Europe, Asia, Americas, Africa
Enerdata: fields of expertise

• Market Study
  • Market Assessment in developed and developing countries
  • Due diligence, feasibility studies

• Energy Efficiency & Demand
  • Analysis & Forecasting of energy demand by end use and energy efficiency
  • Policy evaluation & simulation

• Global Energy Forecasting
  • Analysis & Forecasting (drivers, supply/demand, prices)
  • Energy & Climate policy shaping
  • Power generation
The POLES model: origins and objectives

- The objective of POLES (Prospective Outlook on Long-term Energy Systems) is to analyze and forecast the supply & demand of energy commodities, energy prices, as well as the impact of climate change and energy policies on energy markets.

- Initially developed in the early 1990s by the Institute of Energy Policies and Economics IEPE (now EDDEN-CNRS) in Grenoble, France.

- Since then, POLES has been further developed by Enerdata, EDDEN, and JRC-IPTS of the European Commission.

- POLES draws on practical and theoretical developments in many fields such as mathematics, economics, engineering, energy analysis, international trade, and technological change.
POLES: a multi-issue energy model

**International markets**

<table>
<thead>
<tr>
<th></th>
<th>Oil (1 market)</th>
<th>Gas (3 markets)</th>
<th>Coal (15 markets)</th>
<th>Biomass (1 market)</th>
</tr>
</thead>
</table>

**National energy balances (66)**

**SUPPLY**
- Domestic production
- Import/Export
- Trade routes

**PRIMARY DEMAND**
- Fossil fuels
- Nuclear
- Hydro
- Biomass & wastes
- Oth. RES

**TRANSFORMATION**
- Power sector
  - Investments/capacity planning
  - Electricity generation
- Refineries (incl. synfuels)

**FINAL DEMAND**
- Industry
- Transport
- Buildings
- Agriculture

**Resources**

**Macroeconomic assumptions**

**Climate and Energy policies**

**Technologies**

**Consumption**

**Production**

**GHG emissions**

**International prices**
POLES geographical coverage: 66 countries & regions

<table>
<thead>
<tr>
<th>Regions</th>
<th>Sub-regions</th>
<th>Countries</th>
<th>Country aggregates</th>
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<tr>
<td>North America</td>
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<td>USA, Canada</td>
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<tr>
<td>Europe</td>
<td>EU15</td>
<td>France, United Kingdom, Italy, Germany, Austria, Belgium, Luxembourg, Denmark, Finland, Ireland, Netherlands, Sweden,</td>
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<tr>
<td></td>
<td>EU25</td>
<td>Spain, Greece, Portugal, Hungary, Poland, Czech Republic, Slovak Republic,</td>
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<td>Estonia, Latvia, Lithuania, Slovenia, Malta, Hungary, Poland, Czech Republic,</td>
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<td>EU28</td>
<td>Cyprus, Croatia</td>
<td>Rest of Europe</td>
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<td>Bulgaria, Romania</td>
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<td>Iceland, Norway, Switzerland, Turkey</td>
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<td></td>
<td>Japan, Australia, New Zealand</td>
<td>Rest of South Pacific</td>
</tr>
<tr>
<td>CIS</td>
<td></td>
<td>Russia, Ukraine</td>
<td>Rest of CIS</td>
</tr>
<tr>
<td>Latin America</td>
<td>Central America</td>
<td>Mexico</td>
<td>Rest of Central America</td>
</tr>
<tr>
<td></td>
<td>South America</td>
<td>Brazil, Argentina, Chile</td>
<td>Rest of South America</td>
</tr>
<tr>
<td>Asia</td>
<td>South Asia</td>
<td>India</td>
<td>Rest of South Asia</td>
</tr>
<tr>
<td></td>
<td>South East Asia</td>
<td>China, South Korea, Indonesia, Malaysia, Thailand, Viet Nam</td>
<td>Rest South East Asia</td>
</tr>
<tr>
<td>Africa / Middle East</td>
<td>North Africa</td>
<td>Egypt, South Africa</td>
<td>Rest of North Africa x2;</td>
</tr>
<tr>
<td></td>
<td>Sub-Saharan Africa</td>
<td>South Africa</td>
<td>Rest of Sub-Saharan Africa;</td>
</tr>
<tr>
<td></td>
<td>Middle-East</td>
<td>Saudi Arabia, Iran</td>
<td>Gulf countries; Rest of Middle East</td>
</tr>
</tbody>
</table>
Marginal Abatement Cost Curves (MACCs)

• Top-down MACCs produced by the POLES model as the result of sensitivities on carbon value

• Curves are produced by POLES for:
  • 66 countries/regions
  • 20 emitting sectors
  • 6 GHGs (from energy and industrial activities)
  • All years from 2020 to 2050

• The MACCs from POLES are based on:
  • Power sector: full technological description and load curve simulation
  • Final demand sectors: econometric demand functions (including short-term price and long-term price elasticities), incorporating explicit description of technologies in road transport and buildings
How MACCs from POLES are built

• At a given year, we simulate the impact of a given carbon taxation on the level of CO$_2$ (or GHG) emissions
How MACCs from POLES are built

• At a given year, we simulate the impact of a given carbon taxation on the level of CO₂ (or GHG) emissions
How MACCs from POLES are built

- At a given year, we simulate the impact of a given carbon taxation on the level of CO$_2$ (or GHG) emissions
- Using a recursive process, a complete curve is built
Use of MACCs: from a reduction target to a marginal cost and to an abatement cost

Enerdata/NCMI Project, 28 May 2016
MACCs are the major input for the present work

• A set of coherent and interdependent MACCs for all sectors and countries considered

• Covers all GHG and emitting sectors, with the exception of LULUCF and non-CO₂ agriculture

• MACCs for the year 2030 constitute the main input data to EVALUATE
Enerdata’s Contribution to NCMI: Objective and Framework
Project Objective

- Analyze impacts of various design options for Emissions Trading Schemes (ETS):
  - Domestic and International
  - Mitigation Values between jurisdictions
  - Trading limitations between jurisdictions
Project Framework

1. **Case study on 3 jurisdictions**: China, Mexico and South-Korea
   → Covered by EVALUATE: robust historical data and forecast

2. **Target year**: 2030

3. **ETS sectoral coverage**: Only energy-related Emissions - which sectors have targets and are allowed to trade?

   All energy-related sectors
   (13 in EVALUATE)
Project Framework

1. **Case study on 3 jurisdictions**: China, Mexico and South-Korea
   → Covered by EVALUATE: robust historical data and forecast

2. **Target year**: 2030

3. **ETS sectoral coverage**: Only energy-related Emissions - which sectors have targets and are allowed to trade? All EVALUATE’s 13 sectors

4. **What reference scenario**: Country’s “BaU” or “Baselines”?
   - Baseline: Enerdata POLES forecast included in EVALUATE (i.e. where the jurisdiction will get without additional efforts – inline with WEO2013 current policy forecast):
     + quantified forecast for all energy-related variables available
     - may differ from country’s own 2030 forecast (BaU)
   - BaU: Country’s own 2030 forecast:
     + fit to their iNDC
     - No information about it (only sometime 2030 BaU emissions provided)
Reference scenario = POLES “Baselines”

- **EVALUATE** covers only energy-related emissions
  - POLES baseline forecast considered to be BaU energy-related country’s forecast
  - Reduction efforts equally distributed between energy-related emissions and others (LULUCF and non-CO₂ agriculture)

- **Baseline GDP and Population**
Data illustrations for selected jurisdictions

- Baseline emissions by sector in 2030

Enerdata/NCMI Project, 28 May 2016
Project Framework

1. **Case study on 3 jurisdictions**: China, Mexico and South-Korea
   → Covered by EVALUATE: robust historical data and forecast

2. **Target year**: 2030

3. **ETS sectoral coverage**: Only energy-related Emissions - which sectors have targets and are allowed to trade? **All EVALUATE’s 13 sectors**

4. **Country’s “BaU”, “Baselines” and “Reduction target”**:  
   - Baseline: Enerdata POLES forecast included in EVALUATE (i.e. where the jurisdiction will get without additional efforts – inline with WEO2013 current policy forecast):
     + quantified forecast for all energy-related variables available  
     - may differ from country’s own 2030 forecast (BaU)

5. **“Reduction target”**: iNDC target *(What is the 2030 cap?)*
## What the INDCs provide us

<table>
<thead>
<tr>
<th>Jurisdiction iNDCCs</th>
<th>China</th>
<th>Mexico</th>
<th>South Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of target</strong></td>
<td>% CO2/GDP</td>
<td>% GHG</td>
<td>% GHG</td>
</tr>
<tr>
<td><strong>Base year</strong></td>
<td>2005</td>
<td>BaU 2030 (973 MtCO2eq.)</td>
<td>BaU 2030 (850.6 MtCO2eq.)</td>
</tr>
<tr>
<td><strong>Mitigation effort</strong></td>
<td>60-65%</td>
<td>22%</td>
<td>37%</td>
</tr>
<tr>
<td><strong>GHGs</strong></td>
<td>CO₂</td>
<td>All GHGs</td>
<td>All GHGs</td>
</tr>
<tr>
<td><strong>Sectors</strong></td>
<td>Economy wide</td>
<td>Economy wide</td>
<td>Economy wide</td>
</tr>
<tr>
<td><strong>Market-based mechanism</strong></td>
<td>ETS (Power &amp; Industry to be covered in national ETS)</td>
<td>ETS (not yet in place)</td>
<td>ETS (23 sub-sectors from steel, cement, petro-chemistry, refinery, power, buildings, waste and aviation sectors)</td>
</tr>
</tbody>
</table>
## Project framework conditions: proposal

<table>
<thead>
<tr>
<th>Framework</th>
<th>China</th>
<th>Mexico</th>
<th>South Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030 baseline energy-related emissions</td>
<td>13,547 MtCO₂</td>
<td>723 MtCO₂ eq</td>
<td>744 MtCO₂ eq</td>
</tr>
<tr>
<td>Type of target</td>
<td>% CO₂/GDP</td>
<td>% GHG</td>
<td>% GHG</td>
</tr>
<tr>
<td>Base year</td>
<td>2005</td>
<td>Baseline 2030</td>
<td>Baseline 2030</td>
</tr>
<tr>
<td>Emissions: 5,831 MtCO₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP: 5,942 $2010Bn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitigation effort</td>
<td>60-65%</td>
<td>22%</td>
<td>37%</td>
</tr>
<tr>
<td>2030 baseline GDP ($2010Bn)</td>
<td>34,291</td>
<td>2,698</td>
<td>2,451</td>
</tr>
<tr>
<td>Resulting absolute cap</td>
<td>13,460 MtCO₂ (60%)</td>
<td>564 MtCO₂ eq</td>
<td>469 MtCO₂ eq</td>
</tr>
<tr>
<td></td>
<td>11,778 MtCO₂ (65%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute reduction effort</td>
<td>87 MtCO₂</td>
<td>159 MtCO₂ eq</td>
<td>275 MtCO₂ eq</td>
</tr>
<tr>
<td></td>
<td>1,769 MtCO₂</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Enerdata/NCMI Project, 28 May 2016
Data illustrations for selected jurisdictions

- Baseline emissions by sector with national cap in 2030

![Bar charts showing baseline emissions by sector for China, Mexico, and South Korea.](Enerdata/NCMI Project, 28 May 2016)
Key ETS design features in POLES

Market price:
- Linearly evolving from 2015 to 2030

Total allowances:
- Auctioned (at the market price)

Allocation:
- Effort: Equally distributed between sectors

Effort: 37% reduction compared to baseline
Proposed Methodology
Focus on Marginal Abatement Cost Curves
EVALUATE MACCs

- Baseline to 2030 → No effort, no carbon value

- MACCs are generated from POLES by simulating a series of scenarios introducing different carbon values (MACCs available for each sector in each jurisdiction)

- For an emission reduction – the corresponding effort is represented by a marginal cost

Introduction of a 10$ carbon price
Scenario 1: Domestic ETS

Example for jurisdictions A and B

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Emissions reduction</th>
<th>Total abatement cost</th>
<th>Carbon price</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>55 tCO2</td>
<td>3781 $</td>
<td>137.5 $/tCO2</td>
</tr>
<tr>
<td>B</td>
<td>20 tCO2</td>
<td>200 $</td>
<td>20 $/tCO2</td>
</tr>
</tbody>
</table>

Total emissions reduction: 75 tCO2
Carbon prices: 20 and 137.5 $/tCO2
Total costs (2015-2030): **3981 $**
Scenario 2: Direct linking

MACCs for jurisdictions A and B

Emissions reductions (tCO2)

Marginal Cost ($/tCO2)

Domestic ETS A

International ETS

Domestic ETS B

Country A

Country B

Enerdata/NCMI Project, 28 May 2016
Scenario 2: Direct linking

<table>
<thead>
<tr>
<th>MV</th>
<th>A:1</th>
<th>B:1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traded permits</td>
<td>33.6</td>
<td>-33.6</td>
</tr>
<tr>
<td>Resulting emissions</td>
<td>33.6 tCO₂</td>
<td>-33.6 tCO₂</td>
</tr>
<tr>
<td>Equilibrium prices</td>
<td>53.6 $/tCO₂</td>
<td>53.6 $/tCO₂</td>
</tr>
</tbody>
</table>

Total emissions reduction: 75 tCO₂
Carbon prices: 53.6 $/tCO₂
Total costs (2015-2030): 2010 $ ( < 3981 $)

Jurisdiction A
- Emissions reduction: 55 tCO₂
- Abatement cost: 3781 $
- Carbon price: 137.5 $/tCO₂

With direct linking
- Emissions reduction: 21.4 tCO₂
- Abatement cost: 573.5 $
- Trade cost: 1800.96 $

Jurisdiction B
- Emissions reduction: 20 tCO₂
- Abatement cost: 200 $
- Carbon price: 20 $/tCO₂

With direct linking
- Emissions reduction: 53.6 tCO₂
- Abatement cost: 1436.5 $
- Trade cost: -1800.96 $

What B earned
What A saved
### Scenario 3: MV linking

<table>
<thead>
<tr>
<th>MV</th>
<th>A:1</th>
<th>B:2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traded permits</td>
<td>30</td>
<td>-30</td>
</tr>
<tr>
<td>Resulting emissions</td>
<td>15 tCO₂</td>
<td>-30 tCO₂</td>
</tr>
<tr>
<td>Equilibrium prices</td>
<td>100 $/tCO₂</td>
<td>50 $/tCO₂</td>
</tr>
</tbody>
</table>

#### Total emissions reduction:
- 90 tCO₂ (75 tCO₂)

#### Carbon prices:
- 50 – 100 (53.6 $/tCO₂)

#### Total costs (2015-2030):
- 2010 $ < 3250 $ < 3981 $

---

**A (With direct linking)**

- **Emissions reduction**: 21.4 tCO₂
- **Abatement cost**: 573.5 $
- **Trade cost**: 1800.96 $

**With MV 1**

- **Emissions reduction**: 40 tCO₂
- **Abatement cost**: 2000 $
- **Trade cost**: 1500 $

**B (With direct linking)**

- **Emissions reduction**: 53.6 tCO₂
- **Abatement cost**: 1436.5 $
- **Trade cost**: -1800.96 $

**With MV 2**

- **Emissions reduction**: 50 tCO₂
- **Abatement cost**: 1250 $
- **Trade cost**: -1500 $
Scenario 4: Trade cap linking (15 tCO$_2$)

<table>
<thead>
<tr>
<th>MV</th>
<th>A:1</th>
<th>B:1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traded permits</td>
<td>15</td>
<td>- 15</td>
</tr>
<tr>
<td>Resulting emissions</td>
<td>15 tCO$_2$</td>
<td>- 15 tCO$_2$</td>
</tr>
<tr>
<td>Equilibrium prices</td>
<td>100 $/tCO$_2$</td>
<td>35 $/tCO$_2$</td>
</tr>
</tbody>
</table>

Total emissions reduction: 75 tCO$_2$
Carbon prices: 35 – 100 $/tCO$_2$
Total costs (2015-2030):
2010 $ < 2612$ < 3250$ < 3981$

A (With direct linking)
- Emissions reduction: 21,4 tCO$_2$
- Abatement cost: 573,5 $
- Trade cost: 1800.96 $

With MV 1 trade cap 15
- Emissions reduction: 40 tCO$_2$
- Abatement cost: 2000 $
- Trade cost: 525 ~ 1500 $

B (With direct linking)
- Emissions reduction: 53,6 tCO$_2$
- Abatement cost: 1436,5 $
- Trade cost: -1800.96 $

With MV1 trade cap 15
- Emissions reduction: 35 tCO$_2$
- Abatement cost: 612,5 $
- Trade cost: -525~ -1500 $
Preliminary results

On 2 Jurisdictions
### Key indicators

#### Scenario 1: No link
#### Scenario 2: Direct link
#### Scenario 3: MV link
#### Scenario 4: Trade Cap

<table>
<thead>
<tr>
<th>Global indicators</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global emissions reductions (MtCO₂)</td>
<td>2045</td>
<td>2045</td>
<td>2172</td>
<td>2045</td>
</tr>
<tr>
<td>Global total cost ($Bn)</td>
<td>497</td>
<td>337.5</td>
<td>393.6</td>
<td>348.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>MV 1 - No cap</th>
<th>MV 2 - No cap</th>
<th>cap: 127.7</th>
</tr>
</thead>
</table>

**CHINA**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>MV 1 - No cap</th>
<th>MV 2 - No cap</th>
<th>cap: 127.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions reduction (MtCO₂)</td>
<td>1769</td>
<td>1955.6</td>
<td>2024.7</td>
</tr>
<tr>
<td>Traded emissions (MtCO₂)</td>
<td>-186.3</td>
<td>-255.4</td>
<td>-127.7</td>
</tr>
<tr>
<td>Marginal Abatement Cost ($/tCO₂)</td>
<td>42</td>
<td>47</td>
<td>49</td>
</tr>
<tr>
<td>Net trade Balance ($Bn)</td>
<td>-65.6</td>
<td>-93.6</td>
<td>(-43.4~93.6)</td>
</tr>
<tr>
<td>Abatement Cost ($Bn)</td>
<td>262.5</td>
<td>324.4</td>
<td>349.2</td>
</tr>
<tr>
<td>Total Cost (abat + Trade) ($Bn)</td>
<td>262.5</td>
<td>258.8</td>
<td>255.7</td>
</tr>
</tbody>
</table>

**SOUTH KOREA**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>MV 1 - No cap</th>
<th>MV 2 - No cap</th>
<th>cap: 127.7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions reduction (MtCO₂)</td>
<td>275</td>
<td>89.1</td>
<td>147.7</td>
</tr>
<tr>
<td>Traded emissions (MtCO₂)</td>
<td>186.3</td>
<td>127.7</td>
<td>127.7</td>
</tr>
<tr>
<td>Marginal Abatement Cost ($/tCO₂)</td>
<td>327</td>
<td>47</td>
<td>98</td>
</tr>
<tr>
<td>Net trade Balance ($Bn)</td>
<td>65.6</td>
<td>93.6</td>
<td>(43.4~93.6)</td>
</tr>
<tr>
<td>Abatement Cost ($Bn)</td>
<td>234.8</td>
<td>13.1</td>
<td>44.3</td>
</tr>
<tr>
<td>Total Cost (abat + Trade) ($Bn)</td>
<td>234.8</td>
<td>78.7</td>
<td>137.9</td>
</tr>
</tbody>
</table>

**Additional reductions (MtCO₂)**

127.7
Summary and further works

**Summary:**

- Defined the approach methodology for:
  - Mitigation values
  - Trade offset limitation
- Test impacts on 2 jurisdictions

**Further works:**

- Simulate scenarios for 3 jurisdictions
- Analyse results of Mitigation Values for different rule options
Thank you for your attention!

About Enerdata:

Enerdata is an energy intelligence and consulting company established in 1991. Our experts will help you tackle key energy and climate issues and make sound strategic and business decisions. We provide research, solutions, consulting and training to key energy players worldwide.

Contact:

Global Energy Forecasting
Cyril CASSISA
cyril.cassisa@enerdata.net

www.enerdata.net
Annex

Preliminary results

on 3 jurisdictions for scenarios 1 and 2
### Scenario 1: Domestic ETS

<table>
<thead>
<tr>
<th>Country</th>
<th>Emissions reduction</th>
<th>Total abatement cost</th>
<th>Carbon price</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Korea</td>
<td>275 MtCO₂</td>
<td>234.8 $Bn</td>
<td>327 $/tCO₂</td>
</tr>
<tr>
<td>Mexico</td>
<td>159 MtCO₂</td>
<td>89 $Bn</td>
<td>185 $/tCO₂</td>
</tr>
<tr>
<td>China</td>
<td>1769 MtCO₂</td>
<td>262.5 $Bn</td>
<td>42 $/tCO₂</td>
</tr>
</tbody>
</table>

Total emissions reduction: 2204 MtCO₂  
Carbon prices: From 42 to 327 $/tCO₂  
Total costs (2015-2030): 586 $Bn

Emissions reduction are in MtCO₂ compared to 2030 baseline
Total abatement costs are cumulative between 2015-2030
Scenario 2: Direct linking ETS

**South Korea**

- Emissions reduction: 92.5 MtCO₂
- Net trade Balance: 67.8 $Bn
- Abatement Cost: 14.3 $Bn
- Total Cost: 82.1 $Bn

**Mexico**

- Emissions reduction: 66.8 MtCO₂
- Net trade Balance: 34.2 $Bn
- Abatement Cost: 9 $Bn
- Total Cost: 43.2 $Bn

**China**

- Emissions reduction: 2044 MtCO₂
- Net trade Balance: -102 $Bn
- Abatement Cost: 356.5 $Bn
- Total Cost: 254.5 $Bn

**Total emissions reduction:**
2204 MtCO₂

**Carbon prices:**
From 49 $/tCO₂

**Total costs (2015-2030):**
380 $Bn

Emissions reduction are in MtCO₂ compared to 2030 baseline
Total abatement costs are cumulative between 2015-2030
Direct linking effect

**Scenario 1:** The three countries respect exactly their cap.

**Scenario 2:** China reduces more; Mexico and South Korea reduce less.

<table>
<thead>
<tr>
<th>Additional effort to Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
</tr>
<tr>
<td>Mexico</td>
</tr>
<tr>
<td>South Korea</td>
</tr>
</tbody>
</table>
Focus on Emissions
Domestic ETS

Jurisdictions’ trajectories

Today

2030 Baseline

Emission reduction achieved through domestic ETS

2030 Baseline: Enerdata view of jurisdiction’s path to 2030 for energy-related emissions

Baseline

Emission

reduction

CAP = reduction target
Direct linking methodology: International ETS (1:1)

Jurisdiction A  \( MV=1 \)

2030 Baseline  Emission reduction achieved through domestic ETS

Reduction with trade

CAP = reduction target

Jurisdiction B  \( MV=1 \)

Reduction with trade  Emission reduction achieved through domestic ETS

2030 Baseline

CAP = reduction target
Role of mitigation values: focus on environmental integrity

Jurisdiction A

CAP = reduction target

2030 Baseline

Emission reduction achieved through domestic ETS

Reduction with trade

MV=1

Jurisdiction B

CAP = reduction target

2030 Baseline

Emission reduction achieved through domestic ETS

Reduction with trade

MV=1

These credits might not be traded on 1:1 ratio

MV=1
With mitigation value

Jurisdiction A

MV=1

CAP = reduction target

2030 Baseline

Emission reduction achieved through domestic ETS

Reduction with trade

Jurisdiction B

MV=2

CAP = reduction target

2030 Baseline

New Reduction with trade

Permit value on the trade platform from A to B = ½
But B will have to purchase 2 permits to A

Emission reduction achieved through domestic ETS
Juerg Fuessler (INFRAS), Luca Taschini (LSE)

International Carbon Asset Reserve (ICAR)

The NCM initiative Partners & Strategy Workshop, Cologne, 28 May 2016
Linking and the role of ICAR

- The form of a link between two jurisdictions will lie along a spectrum that ranges from full link to restricted link.

- Full linking requires a high degree of consistency between programs:
  - alignment of technical requirements (e.g. monitoring, reporting and verification (MRV) and tracking systems)
  - alignment of design features (e.g. level of ambition, mode of allocation, inter-temporal flexibility, price management rules)
- Rather than seeking to align systems, ‘networking’ is about recognizing differences in the programs and placing a value on these differences.
Three ICAR prototypes for discussion

<table>
<thead>
<tr>
<th>Element</th>
<th>1 «Platform»</th>
<th>2 «Central hub»</th>
<th>3 «Gateway»</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach</td>
<td>De-centralized</td>
<td>Centralized</td>
<td>«Facilitator»</td>
</tr>
<tr>
<td>ICAR Service</td>
<td>Platform for trading</td>
<td>Marketmaker and risk mitigator</td>
<td>Gateway for transfer of offsets Insurance services</td>
</tr>
<tr>
<td>Units</td>
<td>Local Units</td>
<td>International Units</td>
<td>International Units</td>
</tr>
<tr>
<td>Reserve</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
ICAR «Platform»: Description

• Decentralised trading platform (a marketplace) where to buy and sell allowances originating from multiple ETSs.
• Control timing, type and volume of export/import.
• Quality restrictions by independently deciding on CV.

![Diagram of ICAR Platform](image-url)
ICAR «Platform»: How it operates

- Each jurisdiction individually determine the CV they’d like to attribute to a non-domestic allowance.
- ICAR aggregates information to aid with the matching process (pool of compliance compatible allowances).
- A non-domestic allowance can have different CVs (allowance price spreads within ICAR Platform).
- Units in the system:
  - local units are directly transferred from one ETS to another
  - Independent jurisdictions’ assessment will be reflected in price spreads
ICAR «Central hub»: Description

- Provide a platform for centralized trading of International Units among member jurisdictions.
- Tool for mitigating carbon risk via a centralized intermediation service (import risk) and via the provision of allowance buy and sell services (price risk).
ICAR «Central hub»: International units

- Creation of a pool of internationally-fungible allowances (IU)
- Allowances are chosen on the basis of their relative MVs.
- Allowances are attributed weights which need to add up to 1 to create an IU.
- Restricted trading: IUs are issued directly to a jurisdiction and are only used to meet domestic compliance obligations
- Unrestricted trading: IUs can also be openly traded within the domestic market, this will create a secondary IU market so that IUs are traded alongside domestic allowances.
ICAR «Central hub»: How it operates

• Recourse to the Central Hub’s services is rule-based (i.e. driven by triggers) – thus predictable.

• The trigger for what constitutes a contingency is pre-agreed with each jurisdiction and requires the approval of all participating jurisdictions.
Example ICAR Central Hub
ETS China – ETS South Korea

Assumptions:

• National domestic ETSs in both China and S. Korea and members
• S. Korea ETS has local price ceiling in place with limited buffer

• Functioning of ICAR Central Hub in the S. Korea ETS:
  • Risk of import of non-domestic units (ICAR pool takes the hit)
  • Domestic price risk

- upward pressure on prices
- domestic buffer is depleted

trigger

ICAR Central Hub replenishes local S. Korean buffer
ICAR «Gateway and insurance»

- «Facilitator» for one-way transfer of International Units (IU)
- Pool of units/fund for risk mitigation
- Insurance services for key mitigation action risks (issuance, reversal, technology, regulation,...)
Example ICAR Gateway
EU ETS – FiT wind and solar in Tunisia

Assumptions:
- EU ETS agrees with Tunisia on ICAR Gateway for transfer of mitigation outcomes from new renewable power plants
- Demand in EU ETS

- Functioning of ICAR Gateway to facilitate transfer:
  - Buy side: Gateway pays guaranteed feed-in-tariff (FiT) for wind and solar power
  - Gateway converts kWh generated into tonnes of non-emitted CO2
  - Sell side: Gateway sells guaranteed volumes of IU to EU installations
  - Gateway’s pool absorbs some of the risks; the rest is distributed among e.g. governments, private sector
The evolution of networking

- We anticipate that a future international carbon market, whether through linking in the traditional sense or networking, would develop gradually (stages).
- The scope of ICAR should be seen along a continuum:
  1. facilitate the exchange of different carbon units;
  2. Intermediate services.

Germination
This stage is characterised by the emergence of carbon market networks that are easiest to establish.
Trading between jurisdictions is of allowances that are compliance compatible or transfer of non-ETS carbon instruments within similar jurisdictions.
ICAR Gateway provides insurance services both for buyers and sellers.
ICAR Platform and ICAR Gateway could co-exist.

Growth
A necessary factor for this stage is the emergence of an universal mitigation value system, that can be used to issue international units.
To mitigate the risks associated with imported non-domestic allowances ICAR Central Hub provides mitigation tools.
All ICAR prototypes could co-exist.

Consolidation
A defining element of this stage is the mass of existing networks and linking agreements.
Foregoing benefits will induce non-member jurisdictions to engage in network activities or linking agreements.
All ICAR prototypes could co-exist.
Concluding findings

• Linking is beneficial but (full linking) arrangements can be costly and may lead to some loss of control over domestic priorities
• ICAR can facilitate trade of carbon assets among heterogeneous jurisdictions
• Acting as an intermediary, ICAR can mitigate associated risks and preserve national sovereignty
• Scope of ICAR could evolve with the evolution of carbon markets
Thank you!

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Linking and ambition
- On Ends, Means
and Multilateral Cooperative Arrangements

Michael Grubb
Prof. International Energy and Climate Change Policy, UCL
Editor-in-Chief, Climate Policy journal
Board member, Climate Strategies

• What has Paris Changed?
• Carbon pricing and ‘cooperative arrangements’
• Some implications for EU ETS
The wider significance of Paris COP21 resides in four fundamental changes

• Twenty-three years after the UNFCCC, we have a specific interpretation of ‘avoiding dangerous interference’ in formal UN Agreement
  – And it is a highly ambitious one, on mitigation, adaptation and finance
• We are all in this together, but with extensive and nuanced recognitions of differentiation
  – a new global balance with higher relevance of diverse developing country concerns
• An evolutionary solution
  – In time, \textit{and space} – and potentially, in legal form
• A global social endeavour (COP Decision, sections IV and V)
  – not a UN-driven solution relying purely on nation-state implementation
  – a revolution in international governance and indeed the assumptions underpinning it
  – rooted in transparency, multi-level solutions, private sector and social pressures

A fundamental updating of the UNFCCC framework for the \textit{21st} Century

\textit{And}

The 2018-2020 review in itself could provide pressure – or pretext – for strengthening NDCs, \textit{unlikely to be universal}
Development of carbon pricing will involve co-evolution of systems along with coalition building & rules to support
- like any process of political evolution
- noting that international flexibility and pricing overlap but not synonymous

Goals and review: task for UNFCCC/NDCs

Implementation: a task for national, regional, plurilateral

‘Clubs’ terminology quite loaded: the core is *multilateral cooperative arrangements*
Roadmap for carbon pricing

• Deepening

• Broadening

• Converging
‘All politics is local’

Facing the realities of international carbon pricing

- Some 5000? years after inventing money, we still do not have a single global currency ..
- Some 25 years after UNFCCC and Scandinavian implementation of carbon pricing, 20 years after the US Administration advocated for global carbon markets, 10 years after the EC set explicit objective to achieve that by 2020 …
  - … c 10% of global carbon emissions covered by any carbon price
  - … almost all the systems differ in design, coverage, price, etc.
- Fully harmonized carbon pricing is precluded for economic (development stage), political (sovereignty), and institutional (coordination of cycles) reasons

The purpose of carbon pricing MCAs (Multilateral Cooperative Arrangements) must be to help national decision-makers, not to replace them!
(International) Roadmap for carbon pricing

- Deepening
- Broadening
- Converging

- International or inter-sectoral linkages
  - Offsets
  - Exchange rates
Linking is potentially disruptive for both jurisdictions and entails a loss of national control
- The political issue is not efficiency, but acceptability
- Unitary linking is potential culmination of convergence, not the driver

Exchange rates are therefore crucial for managing the process

Note: * The prices reflected are illustrative only
Source: Climate Strategies, as developed in Carbon Trust (2009)
A remark on EU ETS (Part 1)

• Carbon pricing debate in Europe become dominated by means (EU ETS) not ends (eg. role of carbon pricing in decarbonising electricity, in transformative strategies for energy intensive industries, etc – ie. meeting Paris goals)

• Ideology of the EU ETS became rooted in rapid convergence (OECD-wide full unitary linked by 2015, All Major Economies by 2020) set in global breadth (through Kyoto CDM)
  • Which would then enable deepening
  • ie. back-to-front

• The abject failure of this strategy on both counts has led to retreat
  • A weak system, riven by the politics i.a. of ‘carbon leakage’
  • A lack of any coherent international vision

• ... and a dangerous intellectual inconsistency
A remark on EU ETS (Part 2)

• The Allowance Surplus in the EU ETS is now on a scale directly comparable to the ‘Hot Air’ surplus in Russia under Kyoto CP1
  • And projections under current proposals are that this surplus could continue or even expand through the 2020s

• Linking the EU ETS to *anything* under these circumstances would be either
  • irrelevant (if others refused to buy surplus, as most refused to do under Kyoto CP1) or
  • fundamentally destructive (if they did buy – except perhaps at extremely low exchange rate to reflect the minimal mitigation value)

• Yet there remains vacuum of policy for facilitating industrial transformation in a world of unequal carbon prices (eg. through ETS Article 10b), on the grounds that .... ?
Conclusions

• Deepening
  A national endeavour, with reference to ..
  *Offsets (domestic, and international), wider context Paris finance & development (w.r.t. Paris Arts. 6.1, 6.4?)*

• Broadening
  Development of MCAs with rules for
  *Exchange rates, system management, treatment of carbon-intensive goods trade (with ref to Paris Art 6.2?)*

• Converging
  International or inter-sectoral linkages
Linking and ambition
- On Ends, Means
and Multilateral Cooperative Arrangements

Michael Grubb
Prof. International Energy and Climate Change Policy, UCL
Editor-in-Chief, Climate Policy journal
Board member, Climate Strategies

• What has Paris Changed?
• Carbon pricing and ‘cooperative arrangements’
• Some implications for EU ETS

• ANNEX
Need to map contours of carbon pricing

which will vary between applications and economies, and evolve, eg

(a) Market / equivalent carbon prices

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>Expectation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industrialised</strong></td>
<td>P2 ~ D2</td>
<td>P3 ~ D3 Innovation &amp; Transformation</td>
</tr>
<tr>
<td><strong>Emerging economies</strong></td>
<td>P1 ~ D1? Behaviour and learning</td>
<td>P2 ~ D2</td>
</tr>
</tbody>
</table>

(b) Institutional / ‘shadow’ / anchor carbon prices

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>Expectation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industrialised</strong></td>
<td>P2</td>
<td>P3</td>
</tr>
<tr>
<td>Country public &amp; MDBs</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Emerging econ</strong></td>
<td>P1</td>
<td>P2</td>
</tr>
<tr>
<td>public &amp; SOEs (state-owned enterprises)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Damage/risk perspectives:**

- D1. Global damage as evaluated by a national decision-maker in emerging economy
- D2. Global damage as evaluated at developed economy social discount rate
- D3. Global damage + risk-aversion or 2 deg.C threshold implied cost or inclusion of learning/pathways benefits

**Carbon price equivalents:**

- P1. ‘Entry price’ to establish legal basis, attention & institutional credibility
- P2. Price to drive substantial operational substitution and deter higher carbon lock-in
- P3. Price to support investment, innovation and strategic decision-making including risk management
Purpose of carbon pricing clubs – to help jurisdictions navigate a difficult journey

- In a world of unequal carbon prices
  - Governments can take interim action
    - While working towards multilateral solutions for leakage concerns
      - That feed into fuller global action

- If carbon pricing increases production costs
  - For most sectors: Accept and adapt, sector abates and passes through remaining costs, innovates low carbon systems
  - For significantly exposed sectors: Action to avoid or adjust for cost difference
    - Subsidies or free emissions allowances to avoid or reduce carbon cost impacts
    - Align with other ETS regions to enable declining free allocations without distortions
      - Compatible allocation to facilitate mutual recognition
      - Link systems to establish similar carbon prices

- If carbon pricing increases production costs
  - For most sectors: Accept and adapt, sector abates and passes through remaining costs, innovates low carbon systems
  - For significantly exposed sectors: Action to avoid or adjust for cost difference
    - Subsidies or free emissions allowances to avoid or reduce carbon cost impacts
    - Align with other ETS regions to enable declining free allocations without distortions
      - Compatible allocation to facilitate mutual recognition
      - Link systems to establish similar carbon prices

- Persuade other trading partners to accept or take action on exports to ETS regions
  - Provide data for emission-based inclusion
  - Accept ETS regions’ benchmarked inclusion/rebates
  - Persuade other trading partners to accept or take action on exports to ETS regions
  - Other countries could:
    - Align with other ETS regions to enable declining free allocations without distortions
      - Compatible allocation to facilitate mutual recognition
      - Link systems to establish similar carbon prices

- Measures with increasing impact on emissions
  - Wider action on domestic emissions
  - Key sector agreements to ‘level up’ globally
  - ETS without a country cap
  - National caps with linked/aligned carbon costs

Breadth and Depth of national systems
Planetary Economics: Energy, Climate Change and the Three Domains of Sustainable Development

1. Introduction: Trapped?
2. The Three Domains

Pillar I

- Standards and engagement *for* smarter choice
- 3: Energy and Emissions – Technologies and Systems
- 4: Why so wasteful?
- 5: Tried and Tested – Four Decades of Energy Efficiency Policy

Pillar II

- Markets and pricing *for* cleaner products and processes
- 6: Pricing Pollution – of Truth and Taxes
- 7: Cap-and-trade & offsets: from idea to practice
- 8: Who’s hit? Handling the distributional impacts of carbon pricing

Pillar III

- Investment and incentives *for* innovation and infrastructure
- 9: Pushing further, pulling deeper
- 10: Transforming systems
- 11: The dark matter of economic growth

12. Conclusions: Changing Course

Kindle: http://www.amazon.co.uk/Planetary-Economics-Sustainable-Development-sustainable-ebook/dp/B00JQFBWDO/ref=tmm_kin_swatch_0?_encoding=UTF8&sr=8-1&qid=1415625933

http://climatestrategies.org/projects/planetary-economics/
for information, Highlights summary and register of related work.
Mitigation Value to Enable International Linkage of Domestic Programs

Networked Carbon Markets Initiative

Partners & Strategy Workshop
Cologne, 28 May 2016

Johannes Heister, World Bank Group
Starting points

• In the Paris Agreement, UNFCCC Parties laid down two important cornerstones:
  1. They capped global temperature increases at 1.5°C. This translates into a global carbon budget of still available GHG emissions.
  2. They directed all Parties to contribute to this goal through nationally determined contributions (NDCs).

• These decisions allow to measure the level of ambition and can server as an anchor for defining “mitigation value” (MV) :
  1. Are the aggregated NDCs consistent with the global budget? (collective objective)
  2. Is each Party’s proposed NDC a “fair” contribution relative to other Parties NDCs. (burden sharing)
  3. Will each Party’s emissions stay within its NDCs? (compliance)

• This presentation explores MVs only at the global level.
Anchors

• MVs may be anchored in the global temperature target.

International carbon markets may operate under assumption of compliance with the global temperature target.

→ Exported units must be made compatible with the global budget (“budget compliant”).

Anchoring MV in this way produces a system of \textit{ex ante} “fixed” exchange rates between countries.
Operationalizing MV

Definitions:

i = countries

\( t = \text{time periods} \)

\( B = \text{global emissions budget (derived from temperature goal)} \)

\( (\text{Pit}) = \text{NDCs, planned emissions of countries i in periods t} \)

\( (\text{pit}) = (\text{Pit})/B = \text{claimed shares of global emissions budget} \)

\( (\text{bit}) = (\text{Bit})/B = \text{goal compliant shares of emission budget} \)

\( = \text{“fair” distribution matrix, sum of (bit) = 1} \)
Discount Factors and Exchange Rates

• Discount factor: \( (dit) = (bit)/(pit) = (Bit/Pit) \)

  Determines the mitigation value of each emitted unit in relation to the global temperature goal. E.g. a country emitting twice its budget share has a discount factor of 0.5.

• Exchange rate: \( (dit)/djt) \)

  Determines the ambition of two countries relative to each other as expressed in their NDCs. The global budget is used to measure ambition. The exchange rate is not budget compliant, it only preserves the recipient country’s ambition level.
Example: Discount Factor

Blue-shaded values are assumed, red-shaded values are calculated:

<table>
<thead>
<tr>
<th></th>
<th>t=1</th>
<th>t=2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$B = 100$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Pit)=</td>
<td>i=1</td>
<td>74</td>
</tr>
<tr>
<td></td>
<td>i=2</td>
<td>150</td>
</tr>
</tbody>
</table>

$(bit) = \begin{align*} t=1 & \quad 0.25 \\ t=2 & \quad 0.25 \end{align*}$

Discount factors for two countries and two periods

<table>
<thead>
<tr>
<th>(dit) =</th>
<th>t=1</th>
<th>t=2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$i$</td>
<td>0.3333</td>
</tr>
<tr>
<td></td>
<td>$j$</td>
<td>0.1667</td>
</tr>
</tbody>
</table>

For every 3 units emitted by country $i$ in period 1, two units are not “goal compliant”. In the first period:

→ Units exported by country $i$ must be discounted down to $\frac{1}{3}$.
→ Country $i$ is twice as ambitious as country $j$. 
Example: Exchange Rate

Exchange rates for two countries and two periods:

<table>
<thead>
<tr>
<th></th>
<th>t=1</th>
<th>t=2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(dit/djt)</td>
<td>2.0000</td>
<td>4.0000</td>
</tr>
<tr>
<td>(djt/dit)</td>
<td>0.5000</td>
<td>0.2500</td>
</tr>
</tbody>
</table>

→ For each unit imported from country i, country j can issue 2 of its own units.
→ To preserve its level of ambition, country i can only issue 0.5 of its own units for each unit imported from country j.

These trades can be implemented through an international registry, which adjusts incoming and outgoing units by applying the respective discount factors.
Ex ante vs. ex post

Discount factors and exchange rates based on NDCs can be calculated ex ante.

But actual emissions at the end of each period \((A_{it})^p\) can exceed planned (NDC) emissions.

<table>
<thead>
<tr>
<th></th>
<th>(t=1)</th>
<th>(t=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>((P_{it}))</td>
<td>74</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>150</td>
<td>200</td>
</tr>
</tbody>
</table>

\[(P_{it}) = \frac{(A_{it})^p}{(B \times b_{it}) / (A_{it})^p}\]

\[0.3125 \quad 0.2778\]

\[(d_{it}/d_{jt})^a = 2.0000 \quad 4.0000\]

\[0.5000 \quad 0.2500\]

\[(d_{jt}/d_{it})^a = 0.5000 \quad 0.563\]
Criteria to determine fair shares

• General consensus on criteria to determine fair share:
  • Emissions responsibility (e.g. historical, current, or projected future emissions per capita or total emissions)
  • Economic capacity and development indicators (e.g. GDP per capita, indicators related to health, energy access, etc.)
  • Relative costs of action and mitigation potential
    • Vulnerability and capacity to adapt to physical and social impacts of climate change
  • Benefits of action

• Criteria weights determines fair share:
  • E.g. Civil Society Review: 50/50 weights for
    (1) historical responsibility (cumulative emissions) and
    (2) capacity to take on the climate challenge.
Constructing the distribution matrix (bit)

The distribution matrix (bit) above was assumed for 2 countries. Using a set of fairness criteria, a distribution matrix can be constructed. Example for period \( t=1 \):

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Formula ((t=1))</th>
<th>Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand fathering: actual emissions ( A )</td>
<td>( (A_i)/A )</td>
<td>0.4</td>
</tr>
<tr>
<td>Per capita sharing: population ( N )</td>
<td>( [(B/N)*N_i]/B = (N_i)/N )</td>
<td>0.4</td>
</tr>
<tr>
<td>Responsibility: historic emissions ( H )</td>
<td>( (H-H_i)/H = 1 - (H_i)/H ) (normalized)</td>
<td>0.1</td>
</tr>
<tr>
<td>Ability to pay: (GDP/capita) ( G )</td>
<td>( (G-G_i)/G = 1 - G_i/G ) (normalized)</td>
<td>0.1</td>
</tr>
<tr>
<td>Mitigation cost (per unit, first 50%): ( M )</td>
<td>( M_{50}/M_{50} )</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Calculating elements of (bit)

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Annual CO2 (ex LUCF)</th>
<th>Historic CO2 (ex LUCF)</th>
<th>Population</th>
<th>GDP per capita at PPP</th>
<th>1-Gi1/G1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>2012</td>
<td>338</td>
<td>6844</td>
<td>0.0663</td>
<td>42980026</td>
<td>0.0092</td>
</tr>
<tr>
<td>Australia</td>
<td></td>
<td>648</td>
<td>14880</td>
<td>0.0658</td>
<td>23470118</td>
<td>0.0050</td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
<td>1013</td>
<td>11775</td>
<td>0.0660</td>
<td>206077898</td>
<td>0.0443</td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td>714</td>
<td>28317</td>
<td>0.0651</td>
<td>35543658</td>
<td>0.0076</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td>10975</td>
<td>150109</td>
<td>0.0581</td>
<td>136427000</td>
<td>0.2930</td>
</tr>
<tr>
<td>European Union</td>
<td></td>
<td>4399</td>
<td>329072</td>
<td>0.0479</td>
<td>507962837</td>
<td>0.1091</td>
</tr>
<tr>
<td>India</td>
<td></td>
<td>3014</td>
<td>37976</td>
<td>0.0645</td>
<td>1295291543</td>
<td>0.2782</td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td>761</td>
<td>9554</td>
<td>0.0661</td>
<td>254454778</td>
<td>0.0546</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td>1345</td>
<td>51005</td>
<td>0.0638</td>
<td>127131800</td>
<td>0.0273</td>
</tr>
<tr>
<td>Korea, Rep. (S.</td>
<td></td>
<td>693</td>
<td>13226</td>
<td>0.0659</td>
<td>50423955</td>
<td>0.0108</td>
</tr>
<tr>
<td>Mexico</td>
<td></td>
<td>724</td>
<td>14983</td>
<td>0.0658</td>
<td>125385833</td>
<td>0.0269</td>
</tr>
<tr>
<td>Russian Federat</td>
<td></td>
<td>2322</td>
<td>102709</td>
<td>0.0608</td>
<td>143819569</td>
<td>0.0309</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td></td>
<td>527</td>
<td>8698</td>
<td>0.0662</td>
<td>30886545</td>
<td>0.0066</td>
</tr>
<tr>
<td>South Africa</td>
<td></td>
<td>463</td>
<td>14865</td>
<td>0.0658</td>
<td>54001953</td>
<td>0.0116</td>
</tr>
<tr>
<td>Turkey</td>
<td></td>
<td>420</td>
<td>7289</td>
<td>0.0663</td>
<td>75932348</td>
<td>0.0163</td>
</tr>
<tr>
<td>United States</td>
<td></td>
<td>6235</td>
<td>366421</td>
<td>0.0457</td>
<td>318857056</td>
<td>0.0685</td>
</tr>
<tr>
<td>Sum</td>
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<td>1167723</td>
<td>1</td>
<td>4656489917</td>
<td>1</td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Country</td>
<td>Distribution</td>
<td>Allocated emissions from carbon budget</td>
<td>Planned emissions under NDC</td>
<td>Ex ante discount factors</td>
<td>Observed emissions in the future</td>
<td>Ex post discount factors</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------</td>
<td>----------------------------------------</td>
<td>-----------------------------</td>
<td>-------------------------</td>
<td>----------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td></td>
<td>bit</td>
<td>bit*B</td>
<td>Pit</td>
<td>dit</td>
<td>Ait</td>
<td>dit (ex post)</td>
</tr>
<tr>
<td>Argentina</td>
<td>0.0206</td>
<td>2057</td>
<td>5550</td>
<td>0.3707</td>
<td>6000</td>
<td>0.3429</td>
</tr>
<tr>
<td>Australia</td>
<td>0.0221</td>
<td>2206</td>
<td>7500</td>
<td>0.2942</td>
<td>7600</td>
<td>0.2903</td>
</tr>
<tr>
<td>Brazil</td>
<td>0.0425</td>
<td>4246</td>
<td>17400</td>
<td>0.2440</td>
<td>17500</td>
<td>0.2426</td>
</tr>
<tr>
<td>Canada</td>
<td>0.0238</td>
<td>2382</td>
<td>10275</td>
<td>0.2318</td>
<td>11000</td>
<td>0.2166</td>
</tr>
<tr>
<td>China</td>
<td>0.2564</td>
<td>25640</td>
<td>145500</td>
<td>0.1762</td>
<td>150000</td>
<td>0.1709</td>
</tr>
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Allocated and Planned Emissions

- Allocated emissions from carbon budget
- Planned emissions under NDC
## Exchange rates (ex ante)

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Operating the system

• The calculation system and ex ante discount factors are made known.
• Ex post discount factors are calculated and applied when units are accepted for compliance.
• Market participants will anticipate in their trading decisions later corrections to discount factors.
• With better information and projections, ex ante and ex post discount factors (and exchange rates) will converge.
Conclusions

• A relatively simple system to determine mitigation values seems possible.

• Normative issues (fairness of distribution matrix) and data challenges (MRV system) must be resolved.

• A matrix of discount factors can be calculated. It describes mitigation values of the units by country and time period.

• Applying the discount matrix to traded volumes makes internationally traded emission quantities consistent with the global target.

• A matrix of bilateral exchange rates can be calculated. It describes relative ambition for pairs of countries.

• These exchange rates can be used to raise or lower imported units to the ambition level of the importing country.

• If discount factors and mitigation values are calculated ex post for compliance, market participants will factor this information into their operations.