INDC Implementation with Pol-MAC approaches

Designing investment-grade enabling policy framework to achieve climate/energy targets

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Lead Economist Climate Change, WBG

PMR technical workshop
Brasilia, Brazil, 2nd February, 2016
What is: “50% share of renewable sources in primary energy consumption”?
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- The right thing to do?
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- Obsession of climate lobbyists?
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- The right thing to do?
- Obsession of climate lobbyists?
- A policy?
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- Obsession of climate lobbyists?
- A policy?
- A target/abatement option?
What is: “50% share of renewable sources in primary energy consumption”?

- The right thing to do?
- Obsession of climate lobbyists?
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✓ A target/abatement option
What is: “energy performance standard for buildings (fuel efficiency standard for cars)”?

- A policy?
- A target/abatement option?
What is: “energy performance standard for buildings (fuel efficiency standard for cars)”?

- A policy?

✓ A target/abatement option
Bridging the gap between targets (abatement options) and investments

**WHAT? ➡️ HOW?**

- How to make people/firms behave consistently with government targets?
- How to attract public and private investors to abatement options?
What would you buy: Ferrari or Honda?
What if you wanted to buy Ferrari instead of Honda?

- Incremental mobility

Mobility potential (Miles/year)

Unit cost ($/mile)
What if you wanted to buy Ferrari instead of Honda?

- Incremental mobility
- Incremental capex

Mobility potential (Miles/year)
What if you wanted to buy Ferrari instead of Honda?

- Incremental mobility
- Incremental capex
- Incremental fuel cost

Mobility potential (Miles/year)
What if you wanted to buy Ferrari instead of Honda?

- Incremental mobility
- Incremental capex
- Incremental fuel cost
- Incremental maintenance cost

Unit cost ($/mile)

Mobility potential (Miles/year)
What if you wanted to buy Ferrari instead of Honda?

- Incremental mobility
- Incremental capex
- Incremental fuel cost
- Incremental maintenance cost
- Incremental taxes and fees

Mobility potential (Miles/year)

Unit cost ($/mile)
What if you wanted to buy Ferrari instead of Honda?

- Incremental mobility
- Incremental capex
- Incremental fuel cost
- Incremental maintenance cost
- Incremental taxes and fees
- Incremental risk premium (insurance)

Mobility potential (Miles/year)

Unit cost ($/mile)
What if you wanted to buy Ferrari instead of Honda?

- Incremental mobility
- Incremental capex
- Incremental fuel cost
- Incremental maintenance cost
- Incremental taxes and fees
- Incremental risk premium (insurance)
- Incremental transaction costs (waiting, inspection etc.)

Unit cost ($/mile)

Mobility potential (Miles/year)
Policy conclusion?

Honda wins!!!

Ferrari is more expensive than counterfactual!

Most people will buy Honda

Mobility potential (Miles/year)
How to make you buy Ferrari instead of Honda?

Mobility potential (Miles/year)

Unit cost ($/mile)
How to make you buy Ferrari instead of Honda?

- Non-Ferrari fuel pricing

![Graph showing mobility potential (Miles/year) vs unit cost ($/mile).]
How to make you buy Ferrari instead of Honda?

- Non-Ferrari fuel pricing
- Cash-back subsidy

Mobility potential (Miles/year)

Unit cost ($/mile)
How to make you buy Ferrari instead of Honda?

- Non-Ferrari fuel pricing
- Cash-back subsidy
- Tax/fee waivers

Unit cost ($/mile) vs. Mobility potential (Miles/year)
How to make you buy Ferrari instead of Honda?

- Non-Ferrari fuel pricing
- Cash-back subsidy
- Tax/fee waivers
- Guarantee to limit liabilities of insurance companies

Mobility potential (Miles/year)

Unit cost ($/mile)
How to make you buy Ferrari instead of Honda?

- Non-Ferrari fuel pricing
- Cash-back subsidy
- Tax/fee waivers
- Guarantee to limit liabilities of insurance companies
- More service stations with competitive services

![Graph showing mobility potential (Miles/year) vs. unit cost ($/mile)]
How to make you buy Ferrari instead of Honda?

- Non-Ferrari fuel pricing
- Cash-back subsidy
- Tax/fee waivers
- Guarantee to limit liabilities of insurance companies
- More service stations with competitive services
- Ego factor
Policy conclusion?

Ferrari wins!!!

Ferrari is cheaper for consumers than counterfactual!

Most people will buy Ferrari instead of Honda

Mobility potential (Miles/year)
The Marginal Abatement Cost models – building blocks: a primer

- Generate bottom-up, engineering marginal cost curves

- Illustrate economics of supply of individual technical/behavioral emission reduction measures. One measure = one bar;

- Height of a bar (vertical axis) = **difference** between average unit lifetime costs of an abatement measure and counterfactual carbon intensive measure;

- Width of a bar (horizontal axis) = abatement potential (**difference** between annual emissions of an abatement measure and counterfactual carbon intensive measure. Estimated as practically achievable technical/economic potential;

- Rebound effect, economy-wide feedbacks, price/demand impacts not endogenous
Techno/Economic MAC curves

Abatement Cost
$/tCO2e reduced

MtCO2e reduced (or kWh energy saved)

Abatement with net economic benefits (w/o carbon cost)

Abatement with net economic costs (w/o carbon cost)
Techno/Economic MAC curves: qualitative stories about policies

Abatement Cost $/tCO2e reduced

Implementation barriers

Insufficient returns

MtCO2e reduced (or kWh energy saved)

INDC:

Unconditional contributions

Conditional contributions

In mature technologies

Insufficient returns
Financial MAC curves: explicit quantification of hidden costs of current policies

Abatement Cost
$/tCO2e reduced

MtCO2e reduced (or kWh energy saved)

Abatement conditional upon additional policy efforts

abatement with present policies
### Different perspectives = different costs

<table>
<thead>
<tr>
<th>Techno-economic perspective</th>
<th>Pol-MAC (private/financial) perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy and input prices</strong></td>
<td></td>
</tr>
<tr>
<td>• Valued at opportunity cost</td>
<td>• Based on the observable prices</td>
</tr>
<tr>
<td>i.e., export prices</td>
<td>including subsidies and taxes</td>
</tr>
<tr>
<td><strong>Transaction costs</strong></td>
<td></td>
</tr>
<tr>
<td>• None</td>
<td>• Estimated for main groups of measures</td>
</tr>
<tr>
<td><strong>Risks (Cost of capital)</strong></td>
<td></td>
</tr>
<tr>
<td>• 3%-10% (Typical level of long-term government bonds or SDR)</td>
<td>• 10%-30% commercial hurdle rates for various measures</td>
</tr>
<tr>
<td><strong>Technological progress</strong></td>
<td></td>
</tr>
<tr>
<td>• Learning curves for different technologies (most models)</td>
<td>• The same</td>
</tr>
<tr>
<td><strong>Co-benefits, access to capital</strong></td>
<td></td>
</tr>
<tr>
<td>• Ignored (although possible to include)</td>
<td>• Partially included</td>
</tr>
<tr>
<td><strong>Sequencing, path-dependence</strong></td>
<td></td>
</tr>
<tr>
<td>• Possible</td>
<td>• Possible</td>
</tr>
</tbody>
</table>
Transaction costs are broken into 2 x 3 matrix

<table>
<thead>
<tr>
<th>Planning</th>
<th>Implementation</th>
<th>Monitoring and Verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Project’ transaction costs, covering all costs related to project execution, incremental to BAU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Search for vendors, contractors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Negotiation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Engineering feasibility studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Business plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Permits and licenses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Bribery &amp; corruption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Overheads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ Access routes and site preparation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>▪ n/a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Policy transaction costs, covering all costs associated with qualifying for ‘green’ funding etc.

<table>
<thead>
<tr>
<th>Carbon pricing</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Search for funding information etc.</td>
</tr>
<tr>
<td>▪ Registration</td>
</tr>
<tr>
<td>▪ Baseline determination</td>
</tr>
<tr>
<td>▪ Approval</td>
</tr>
<tr>
<td>▪ Validation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Government subsidies, climate finance.</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Certification</td>
</tr>
<tr>
<td>▪ Legal Fees</td>
</tr>
<tr>
<td>▪ Enforcement</td>
</tr>
<tr>
<td>▪ Review</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Baseline evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Baseline evaluation</td>
</tr>
<tr>
<td>▪ Data collection</td>
</tr>
<tr>
<td>▪ Reporting</td>
</tr>
<tr>
<td>▪ Brokerage</td>
</tr>
<tr>
<td>▪ Trading</td>
</tr>
</tbody>
</table>
Transaction costs are found to average around 7 EUR/t but can be significantly higher for some levers.

* Energy efficiency levers have been split into small, medium and large project size to show range in transaction costs.

SOURCE: EBRD/McKinsey analysis for Russia
Policy impact on costs on a level of individual measure: Retrofit building envelope, package 2, residential

Abatement cost (EUR/tonne)

- Societal cost: 13
- Energy subsidies and increased cost of capital: 113
- Transaction costs: 32
- Status quo: 158
- Price reform: 150
- Reduced transaction costs: 23
- FIT: 0
- Carbon price: 0
- Investors cost after policies: -15
Policy impact on costs on a level of individual measure: Onshore Wind

- Societal cost: 62 EUR/tonne
- Energy taxes and increased cost of capital: 111 EUR/tonne
- Transaction costs: 13 EUR/tonne
- Status quo: 186 EUR/tonne
- Price reforms: -106 EUR/tonne
- Reduced transaction costs: -10 EUR/tonne
- FIT: -75 EUR/tonne
- Carbon price: -39 EUR/tonne
- Investors cost after policies: -44 EUR/tonne

Abatement cost EUR/tonne
567 Mt of abatement viable to society
Pol-MAC in action: Russia
SQ: If 2009 policy conditions persist, fewer measures will attract investors

2030 Abatement cost per measure, EUR/t CO2

Socially viable Abatement 567Mt

426 Mt of abatement profitable to investors under SQ

SOURCE: EBRD/McKinsey analysis for Russia
Russia: policy mix 1 - Economic reforms

Abatement cost per lever, EUR/t CO2

Input parameters

Policy mix 1 = Economic reforms
- Cost of capital: 9%
- Energy prices: Liberalized
- Project transaction costs: ✓
- Trading transaction costs: ✗
- Carbon prices: ✗
- Feed in tariffs: ✗
- Reduced transaction costs: ✗

Resulting cost curve

Profitable Incremental CAPEX 254 bln €

Status Quo

Retrofit building envelope, commercial

Profitable Abatement 547 Mt

Total surplus 39,291 M€

Energy efficiency, petroleum sector

Energy efficiency, residential

Cropland afforestation

Nuclear

Large hydro

Biomass

On shore & geothermal

2030 Abatement potential, Mt CO2

SOURCE: EBRD with modelling by McKinsey
Russia: policy mix 2 - Reduction of transaction costs

Abatement cost per lever, EUR/t CO2

Input parameters

Policy mix 2 = 1 + EE support
- Cost of capital: 9%
- Energy prices: Liberalized
- Project transaction costs: ✓
- Trading transaction costs: ×
- Carbon prices: ×
- Feed in tariffs: ×
- Reduced transaction costs: ✓

Resulting cost curve

Average Abatement Cost: -12.04 €
Profitable Incremental CAPEX: 343 bln €

Retrofit building envelope, commercial

Retrofit building envelope, package 2 - residential

Profitable Abatement: 610 Mt

Energy efficiency, petroleum sector

Total surplus: 41,334 M€

Energy efficiency, buildings

Transport

Reduction of T&D loss

On shore & geothermal

CCS

Nuclear

Large hydro

2030 Abatement potential, Mt CO2

SOURCE: EBRD with modelling by McKinsey
Russia: policy mix 3 - Feed-in-tariffs
Abatement cost per lever, EUR/t CO2

<table>
<thead>
<tr>
<th>Input parameters</th>
<th>Resulting cost curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy mix 3 = 2 + FIT</td>
<td>Profitable Incremental CAPEX 369 bln €</td>
</tr>
<tr>
<td>Cost of capital</td>
<td>On shore wind</td>
</tr>
<tr>
<td>Energy prices</td>
<td>Large hydro</td>
</tr>
<tr>
<td>Project transaction costs ✓</td>
<td></td>
</tr>
<tr>
<td>Trading transaction costs ✗</td>
<td></td>
</tr>
<tr>
<td>Carbon prices ✗</td>
<td></td>
</tr>
<tr>
<td>Feed in tariffs ✓</td>
<td></td>
</tr>
<tr>
<td>Reduced transaction costs ✓</td>
<td></td>
</tr>
</tbody>
</table>

Retrofit building envelope, commercial

Total surplus 41,750 M€

Profitable Abatement 652 Mt

2030 Abatement potential, Mt CO2

SOURCE: EBRD with modelling by McKinsey
Russia: policy mix 4 - Carbon trading or tax

Abatement cost per lever, EUR/t CO2

Input parameters

- Cost of capital: 9%
- Energy prices: Liberalized
- Project transaction costs: ✓
- Trading transaction costs: ✓
- Carbon prices: ✓
- Feed in tariffs: ✓
- Reduced transaction costs: ✓

Resulting cost curve

- Large hydro
- On shore & geothermal
- Distribution maintenance, petroleum sector
- Cropland afforestation
- Protective afforestation
- Pasture land afforestation

Policy mix 4 = 3 + carbon trading

- Profitable Incremental CAPEX  546 bln €
- Total surplus 59,949 M€
- 2030 Abatement potential, Mt CO2
- Reduced T&D loss
- More CHP
- Improved insulation of heating grids

Retrofit building envelope, commercial
- Cropland afforestation

SOURCE: EBRD with modelling by McKinsey
Pathways to deliver profitable abatement by policy mixes

Mt of CO2e per year

Emissions w/r to 1990

Technology progress (SQ)

-10%

-23%

Status quo
Pathways to deliver profitable abatement by policy mixes

Mt of CO2e per year

Emissions w/r to 1990

-10%

Technology progress (SQ)

-23%

Economic reform, transaction costs

-29%

FIT

2010
2020
2030

Status quo
Policy Mix 2
Policy Mix 1
Policy Mix 3

Pathways to deliver profitable abatement by policy mixes

Emissions w/r to 1990

-10%

Technology progress (SQ)

-23%

Economic reform, transaction costs

-29%

FIT

2010
2020
2030

Status quo
Policy Mix 2
Policy Mix 1
Policy Mix 3
Pathways to deliver profitable abatement by policy mixes

Emissions w/r to 1990

-10%
-23%
-29%
-45%

Technology progress (SQ)

Economic reform, transaction costs
FIT

Carbon prices

Mt of CO2e per year

2010  2020  2030

Status quo  Policy Mix 2  Policy Mix 4
Policy Mix 1  Policy Mix3
Pathways to deliver profitable abatement by policy mixes

Mt of CO2e per year

Emissions w/r to 1990

-10%

Technology progress

-15%

-23%

Economic reforms

-25%

-29%

transaction costs

FIT

-45%

Carbon prices

-52%

Additional incentives needed (e.g. for CCS)

Status quo

Policy Mix 2

Policy Mix 4

Cancun pledges

Policy Mix 3

Policy Mix 1

Policy Mix 3

Full potential

Cumulative abatement (Mt/year)

Pathways to deliver profitable abatement by policy mixes

<table>
<thead>
<tr>
<th>path</th>
<th>Mt/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status quo</td>
<td>426</td>
</tr>
<tr>
<td>Policy Mix 2</td>
<td>652</td>
</tr>
<tr>
<td>Policy Mix 3</td>
<td>1159</td>
</tr>
<tr>
<td>Policy Mix 4</td>
<td>~1400</td>
</tr>
</tbody>
</table>

Cancun pledges:

- 45%
- 29%
- 23%
- 10%

Cumulative abatement (Mt/year):

- 52%
- 45%
- 25%
Emissions pathways under different policy scenarios in Turkey

- **Reference**: +358% to 852 Mt
- **Status quo**: +298% to 741 Mt
- **Planned policies**: +275% to 697 Mt
- **Enhanced policies**: +163% to 489 Mt

- **Status quo**
- **Planned policies**
- **Enhanced policies**

- Emissions trends from 1990 to 2030.
Kazakhstan emission pathways under policy scenarios

MtCO$_2$e per year

- 52% 490 Mt Frozen Technology
- 40% 451 Mt Status Quo
- 35% 434 Mt Planned Policies
+ 9% 350 Mt Enhanced Policies
- 14% 277 Mt Full MACC, Enhanced Policies
- 22% 250 Mt Gas Fuel Switch
- 41% 190 Mt CCS

Kazakhstan emissions commitments
Financial impacts

- Investment costs required by sector/technology
- Public expenditure requirements (whether funded by domestic resources or – e.g. budget for energy efficiency or afforestation projects)
- Impact on consumers (e.g. total feed-in tariff budget to be passed through)
- Impact on firms (e.g. policy induced cash transfers, impact on projects’ IFRRs)
- Fiscal revenues (e.g. savings from energy subsidy reforms, carbon tax revenues)
- Others (tbd)
Policy marginal energy saving curves
Thermal retrofit of buildings in Bulgaria and Croatia

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Renovation packages (thermal insulation thickness &amp; windows)</th>
<th>Building Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 Baseline; no grants</td>
<td>B No insulation Double glazing (baseline)</td>
<td>Single Family Houses, detached (SFHdh)</td>
</tr>
<tr>
<td>S2 Baseline + 25% grants</td>
<td>R1 5cm roof Double glazing</td>
<td>Single Family Houses, semi-detached (SFHsdy)</td>
</tr>
<tr>
<td>S3 Baseline + 50% grants</td>
<td>R2 15cm roof &amp; walls, 10cm floor Double glazing</td>
<td>Multi Family Houses (MFH)</td>
</tr>
<tr>
<td>S4 Baseline + 75% grants</td>
<td>R3 15cm roof, walls &amp; floor Double glazing</td>
<td>Offices (Public &amp; Private)</td>
</tr>
<tr>
<td>S5 Soft policy measures only</td>
<td>R3 30cm roof, 20cm walls &amp; 15cm floor Triple glazing</td>
<td>Education</td>
</tr>
<tr>
<td>S6 Energy price reform only</td>
<td>Th Substitution of the heating system Installation of a heat recovery unit</td>
<td>Health</td>
</tr>
<tr>
<td>S7 Combined market reforms (soft policies and energy price reform); no grants</td>
<td></td>
<td>Hotels &amp; Restaurants</td>
</tr>
<tr>
<td>S8 Combined market reforms; no grants; EEO/CP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S9 Combined market reforms + EEO/CP + 25% grant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S10 Combined market reforms; no grants; 2xEEO/CP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S11 Combined market reforms; EEO/CP; 50% grant</td>
<td></td>
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</tr>
</tbody>
</table>
Operational/practical uses

- Designing realistic implementation programs for INDC and other targets (bridging the gap between technologies and targets)
- Unlocking finance flows on demand side - precursor for investment/financing plans
- Negotiating access to climate/carbon finance and technology transfers to support implementation of the conditional INDC contributions
- Framing and monitoring of policy matrix and result indicators of the CC or energy DPLs (e.g. Vietnam)

Deliverables

- Report describing current policies with their mitigation potential, alternative policy options and presenting their aggregate impact on national emission trajectories and financial flows.
- Trained national experts in using (POL-MAC) model and capable of conducting additional policy simulations independently of international experts.
Applications so far

National, economy-wide pol-MAC analysis
• Russia (EBRD/McKinsey)
• Turkey (EBRD/NERA/Bloomberg-NEF)
• Kazakhstan (EBRD/NERA/Bloomberg-NEF)
• Ukraine (EBRD/NERA/Bloomberg-NEF)

Sector specific EE retrofit of existing buildings
• Bulgaria (WBG/BPIE)
• Croatia (WBG/BPIE)

In the pipeline
• Vietnam (GCCPT/PMR)
• Pakistan (GCCPT/CFAssist)
• Chile (PMR)
• Morocco (GCCPT/PMR)

Under discussion
• Saudi Arabia
• Kazakhstan