The Landscape of Global Abatement Opportunities up to 2030

Methodology, assumptions and uncertainties

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Objective and approach of the study

Objective

Create a global map of greenhouse gases abatement opportunities, identifying what set of measures could be adopted if an abatement cost of maximum EUR 40/tCO_2e were accepted

Guiding principles

Abatement potential valuation

- Abatement reported for each measure is a “realistic potential”, based on the maximum technical potential and a realistic realization rate, according to assumptions on technology development and supportive energy policies
- The total potential is based only on opportunities with a cost ≤40 EUR/tCO_2e
- No assumptions have been made on existence of specific regulatory systems, e.g. taxes or other factors that could influence factors allocation
- Only currently existing (commercial or under development) technologies have been considered

Granularity of analysis

- The analysis has considered the following breakdowns :
  - **6 sectors**: power, industrial, transport, buildings, agriculture, forestry
  - **6 regions**: US + Canada, OECD Europe, Eastern Europe (including Russia), other industrial countries, China, Rest of the world
  - **3 time horizons**: 2010, 2020, 2030

Utilization of GHG abatement cost study

The CO_2 abatement cost analysis…

…**can** be used for:

- Definition/refinement of an integrated perspective on abatement potential and opportunities (e.g. setting of aspirations), given a target CO_2e concentration level
- Order of magnitude evaluation and prioritization of abatement measures
- Providing a fact base to support the assessment of possible regulatory arrangements

…**cannot** be used for:

- Forecasting GHG abatement in the future
- Analysis of specific (sub)-sectors and/or countries by direct scaling
- In depth valuation of specific abatement opportunities in terms of potential and cost
- Definition of target CO_2e concentration level to solve climate change

Source: Team analysis

Approach for each sector/industry

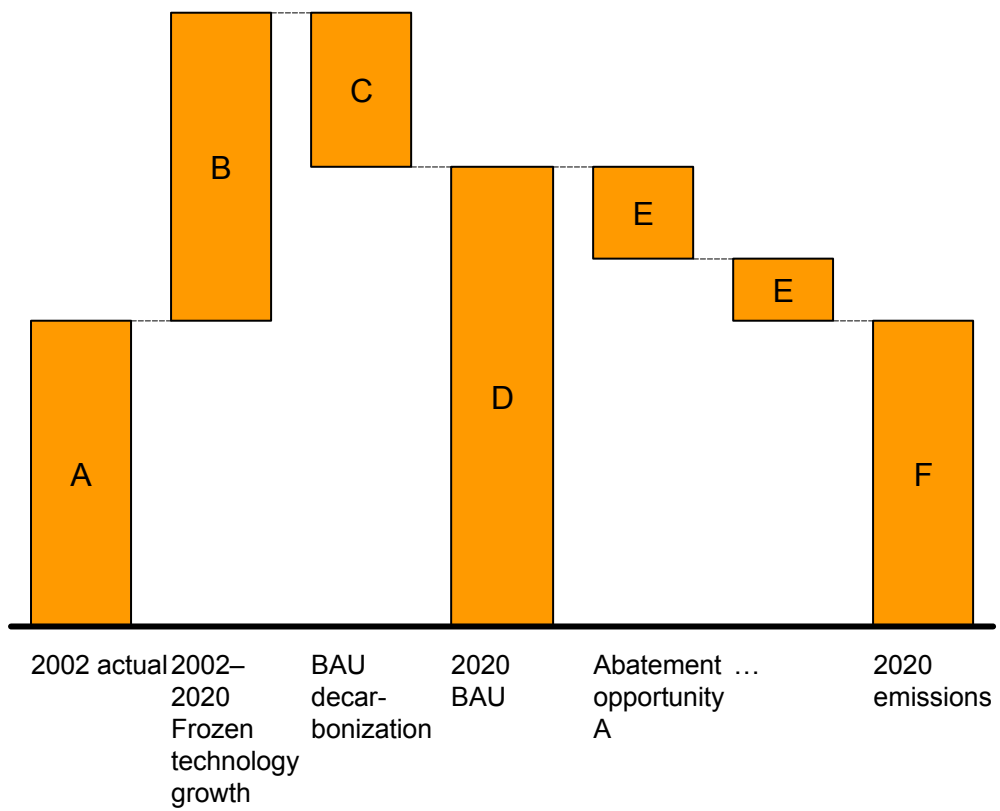
1. **Synthesize the "Business As Usual" emissions growth for the sector in each world region, and determine BAU decarbonization**

2. **Build a full marginal abatement cost curve, for each time period and world region**
   - Identify major abatement measures
   - Assess cost and volume per measure, for 2010, 2020, 2030, and for each region

3. **Synthesize and validate the results including sensitivity analysis and expert review**

Illustration of calculations performed for each sector/geography/timeframe

YEAR 2020 EXAMPLE



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Definition of abatement cost

$$\text{Abatement cost} = \frac{[\text{Full cost of } CO_2\text{e efficient alternative}] - [\text{Full cost of reference solution}]}{[CO_2\text{e emissions from reference solution}] - [CO_2\text{e emissions from alternative}]}$$

Full cost includes…

- Operating costs
- CAPEX

Full cost does not include…

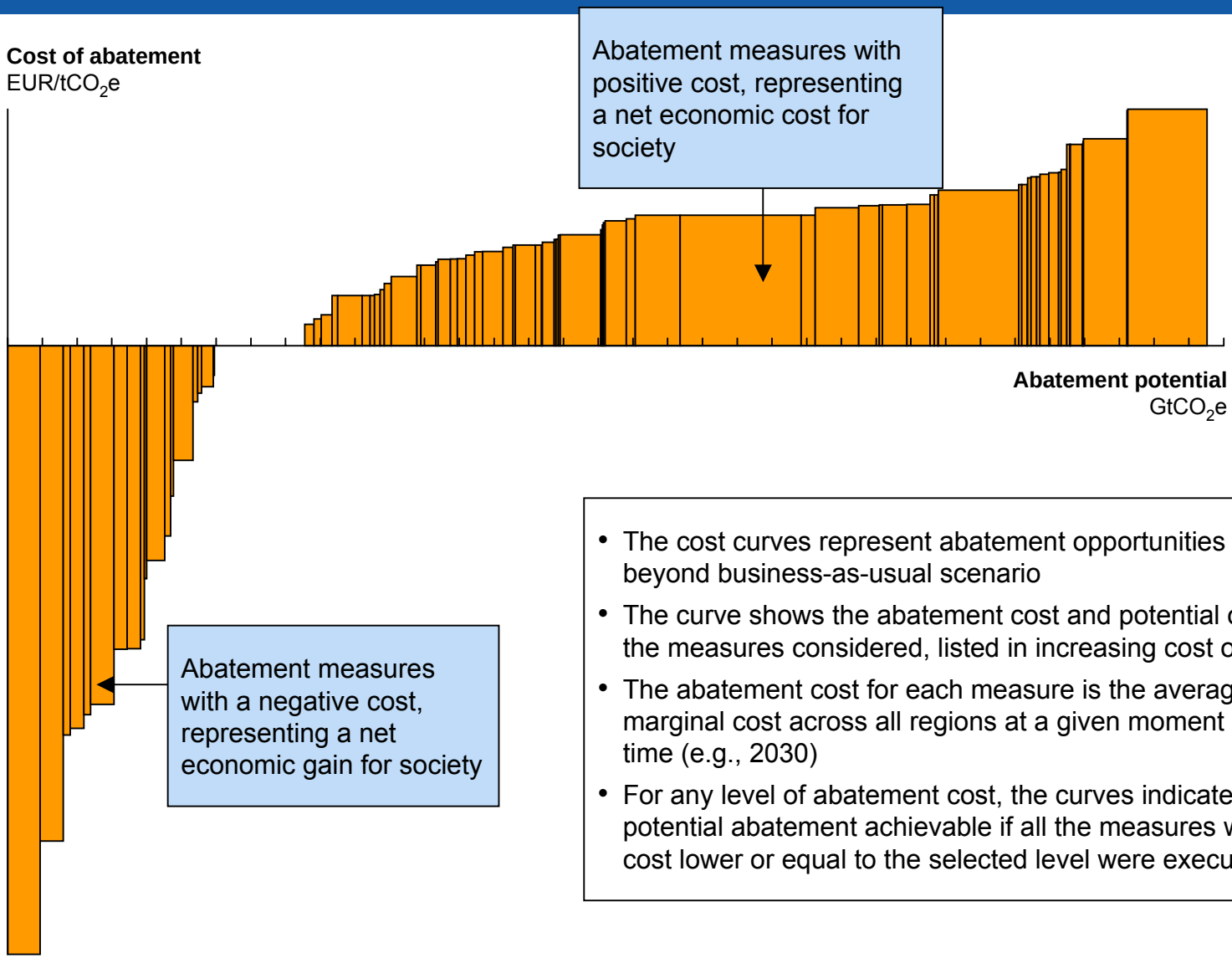
- Transaction costs
- Communications/information costs
- Subsidies or CO_2 costs (i.e., tax, CO_2 price)

Other assumptions

- Abatement cost for new technologies are consistently compared to the specific cost and emission intensity of displaced alternatives
- Full costs could be negative, i.e., indicating a net benefit deriving from the use of the solution

How to read the cost curve

2030



- The cost curves represent abatement opportunities beyond business-as-usual scenario
- The curve shows the abatement cost and potential of all the measures considered, listed in increasing cost order
- The abatement cost for each measure is the average marginal cost across all regions at a given moment in time (e.g., 2030)
- For any level of abatement cost, the curves indicates the potential abatement achievable if all the measures with a cost lower or equal to the selected level were executed

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Key sources of uncertainty

	Description	Examples
1. Baseline uncertainty	• Future CO_2e intensity • Macroeconomic factors	• Energy intensity and fuel mix • GDP developments populations growth
2. Assessment of abatement potential	• Valuation of emission level • Estimate of abatement potential • Realization rate (i.e. development over time) • Introduction of (local) policies supporting specific solutions • Political/social barriers to implementation of specific abatement ideas at local level (beyond the assumed realization rate)	• Deforestation • Smart transit, re/afforestation • Hybrids • Biofuels, waste • Nuclear energy, CO_2 storage
3. Development of abatement cost	• Technology progress: development rate of new technologies • Learning rates • Fuels price	• Hybrids, Biofuels • Solar PV • Biomass, fossil fuels, uranium, etc.
4. Overall rate of innovation	• Introduction of unforeseen new technologies • Development of unforeseen “entrepreneurial solutions” driven by market opportunities	• Transportation, Power sectors • Compare with NO_x reduction

Key sources

Sector	Main sources
Power	• IEA (International Energy Agency) • IPCC (Intergovernmental Panel on Climate Change) • NREL (National Renewal Energy Laboratory)
Industrial	• IEA (International Energy Agency) • EPA (Environmental Protection Agency) • International Iron and Steel Institute • World Business Council for Sustainable Development
Buildings	• IEA (International Energy Agency) • EIA (Energy Information Agency) • EcoFys
Transport	• IEA (International Energy Agency) • EIA (Energy Information Agency)
Agriculture	• EPA (Environmental Protection Agency)
Forestry	• IPCC (Intergovernmental Panel on Climate Change) • FAO (Food and Agriculture Organization)

Academic reviewers

Name	Institution
Prof. Dennis Anderson	• Imperial college
Prof. Lars Bergman	• Stockholm School of Economics
Prof. Steve Pacala	• Princeton University
Prof. Robert Socolow	• Princeton University
Prof. Robert Williams	• Princeton University