ESTIMATING THE COST OF CLIMATE CHANGE USING THE OPTIMAL COST OF CONTROL METHODOLOGY

Jan Horst Keppler

NEA Nuclear Development Division

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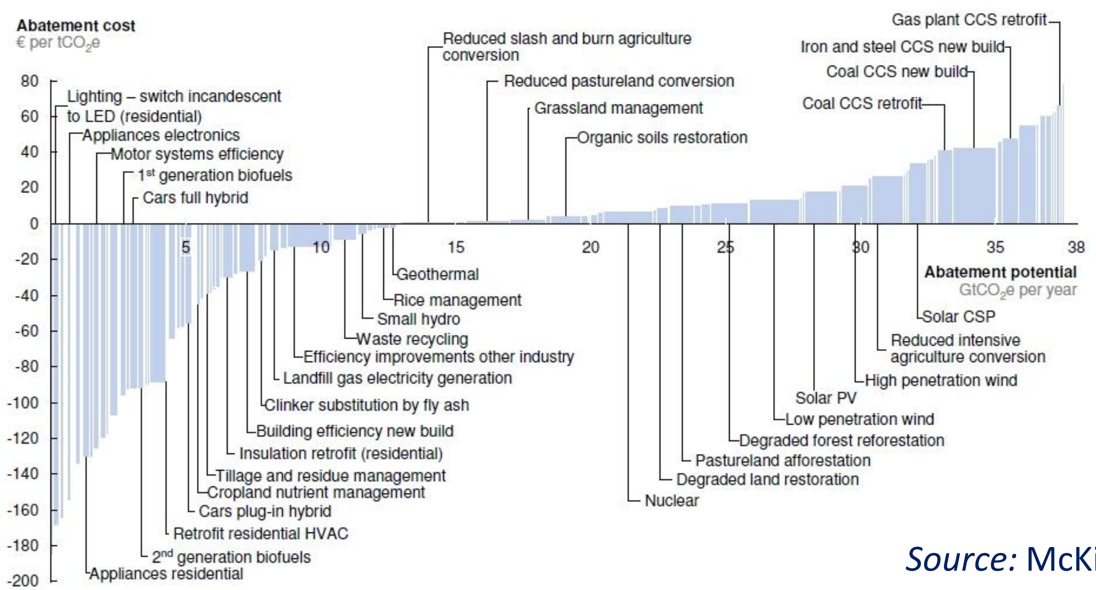
Challenges in Estimating Abatement Costs

- Determining the costs of climate change as well as of abatement costs to reduce GHGs is intrinsically difficult.
  - Kuik, Brander and Tol (Energy Policy, 2008) indicate on basis of 26 studies for a stabilisation target of 450 ppm in 2050 a range of €/t 128-396.
  - Many MACs are econometrically based top-down models (e.g., MIT EPPA model, formerly OECD GREEN).
  - Existing bottom-up estimates are frequently "eye-balled" and approximate.
- All have their merits in a necessarily challenging data environment.



Source: McKinsey (2010)

Challenges in Estimating Damage Costs

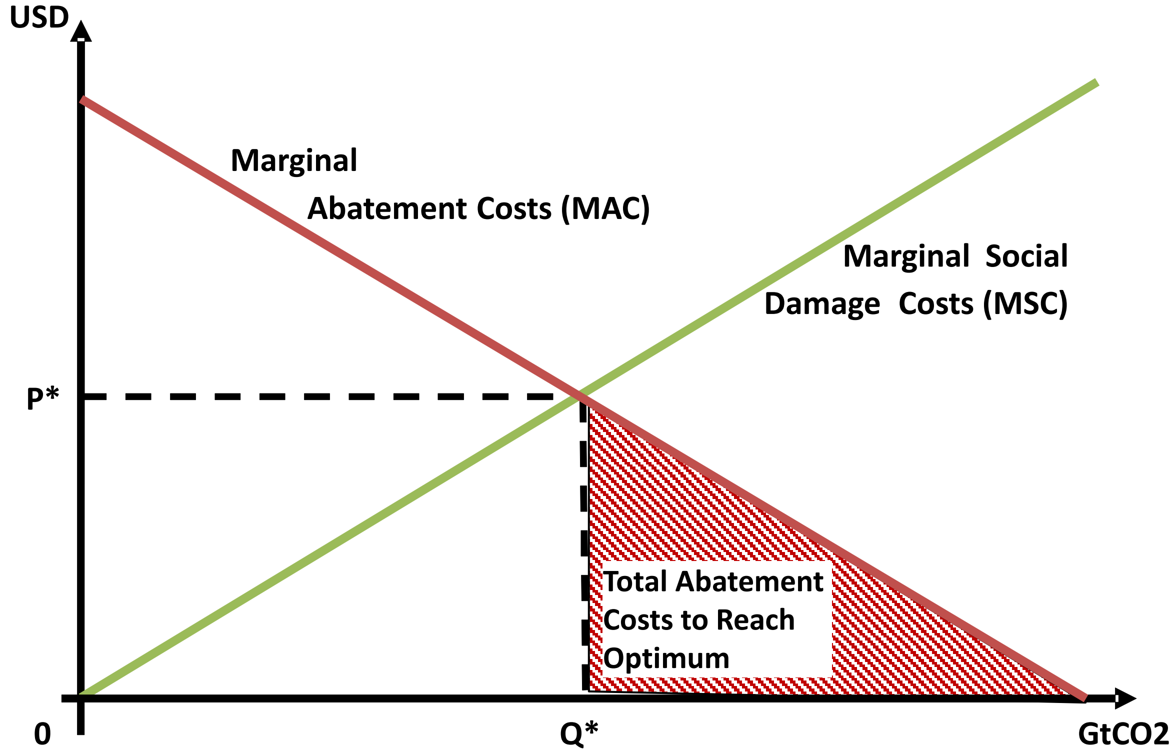
- Damage cost estimates display even wider ranges. Only a small fraction of total climate change risks are insurable. Climate change impacts are part of "uncertainty", **uninsurable, residual risk with collective responsibility**.
- Governments thus have a decisive role in determining societal abatement objectives *even in the absence of explicit damage costs measurements.* In GHG abatement, optimality, in the sense of aligning marginal cost and effort, is **implicitly determined** through social, political choices.
- This holds for both damage costs and abatement costs:
  - Damage costs are implicitly determined through the abatement objective that governments have signed up to, i.e., to hold global mean temperatures below 2°C.
  - Abatement costs are implicitly determined through the energy sector choices countries have made or are likely to make as reflected in major international scenarios (IPCC, WEP, ETP…).

The Cost of Control Approach I

- Attempts to answer question "how much is climate protection really worth to the global community or individual countries?" based on empirical data and widely accepted projections .
- Based ultimately on Pigouvian approach, equalising marginal abatement costs with marginal damage costs, the Cost of Control (CoC) approach is based on abatement costs and *politically decided* optimal abatement (2°C objective) rather than damage costs.
- In principle, abatement cost estimates can be explicit or implicit:
  - Explicit approaches (e.g., McKinsey) model costs of individual technologies or econometric approximations.
  - Implicit approaches (e.g., NEA) derive total incremental costs of abatement effort from energy scenarios that model 2°C objective (WEO 2015).
- Key advantages: policy relevance, based on official objectives and widely accepted scenarios; positive rather than normative approach.
- Key drawbacks:
  - Working with average rather than (economically relevant) marginal abatement costs,
  - Relying on implicit modelling assumptions rather than on explicit abatement costs.

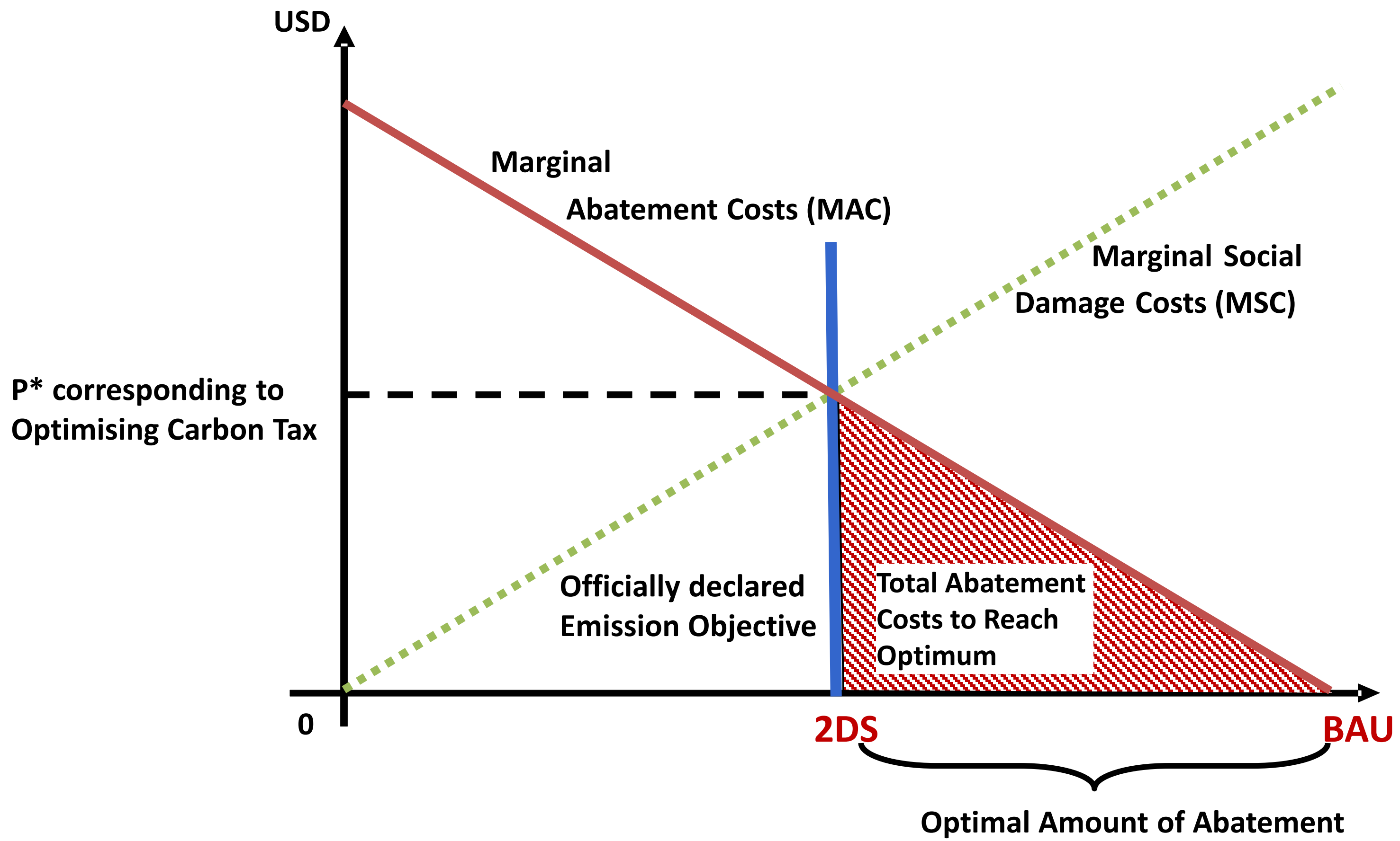
The Cost of Control Approach II

- The well-known starting point…



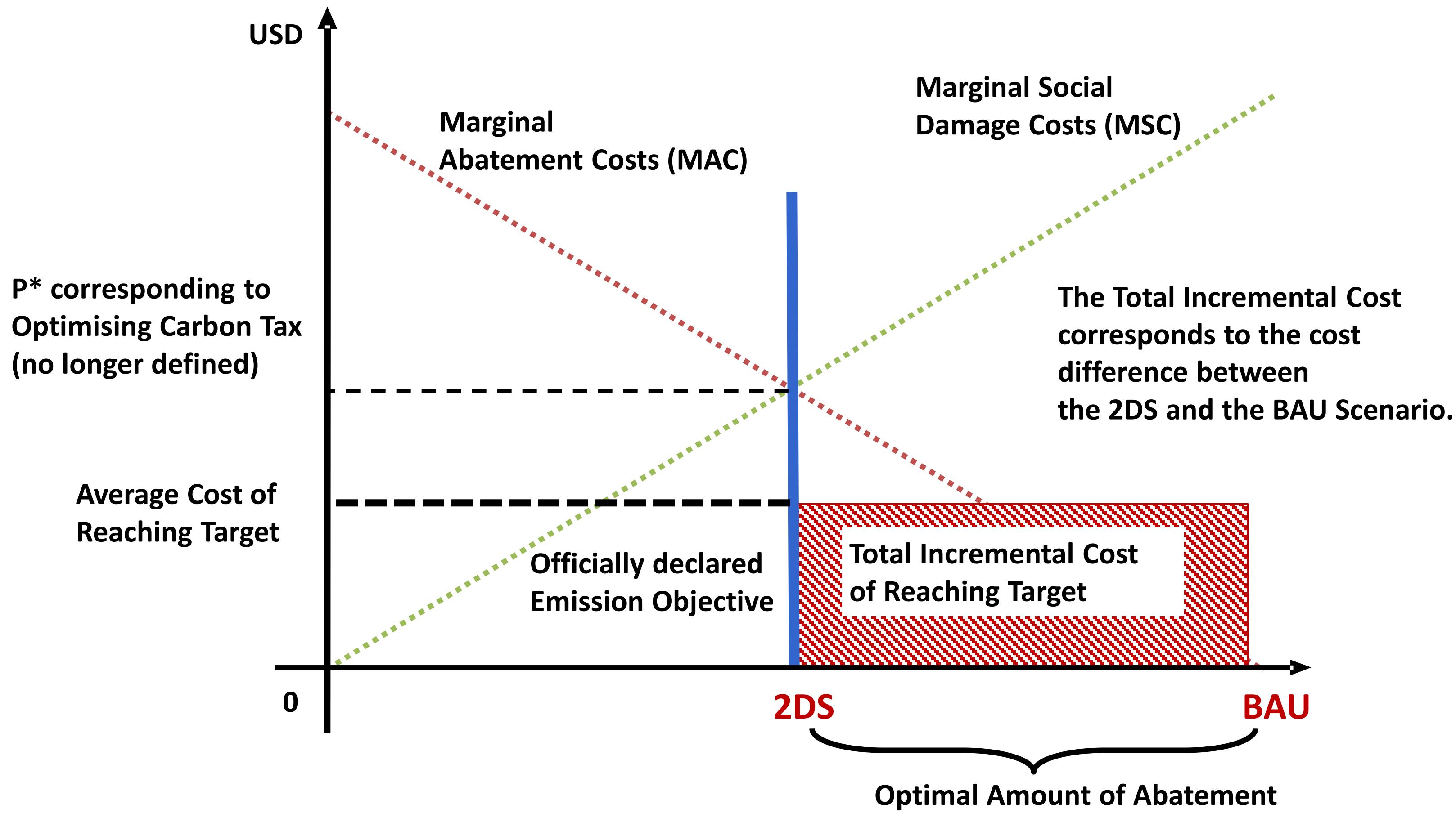
The Cost of Control Approach III

➢ With unknown damage cost function but known abatement cost function:



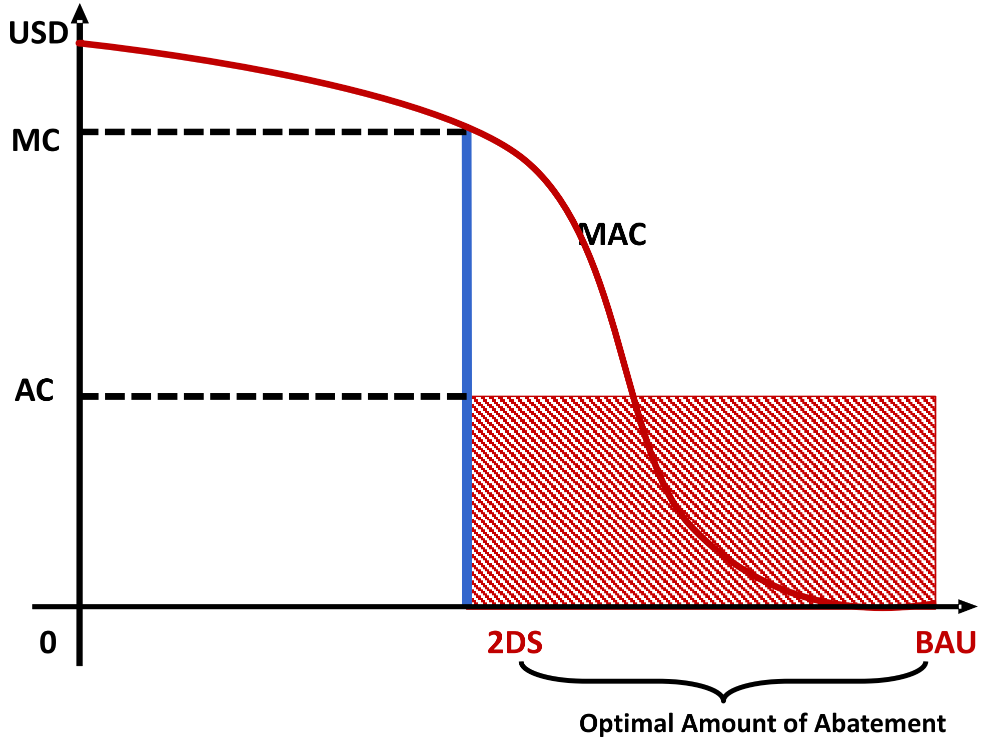
The Cost of Control Approach III

- With unknown damage cost function and unknown abatement cost function but known **total incremental cost of reaching the declared target**:



The Cost of Control Approach IV

- NB1: with continuously rising MAC (standard assumption), marginal costs at the optimum (and hence an optimising carbon tax will be higher than average costs.
- NB2: only with very unusual MACs would marginal costs be radically different from average cost (e.g., MC >> 2*AC).



Modelling the CoC of the 2DS in the Electricity Sector

- Data Sources:
  - Quantity data for electricity and CO_2 emissions from *IEA World Energy Outlook 2015* for 2DS and BAU Scenario for 2040,
  - Cost data (LCOE) from *IEA/NEA Projected Costs of Generating Electricity: 2015 Edition.*
- The modest modelling effort we performed requested a number of "heroic" assumptions:
  - 50/50 split for OECD and non-OECD energy-consumption for cost calculations,
  - Cost figures from EGC 2015 (netted for CO_2) do not introduce major distortions by not using cost figures underlying WEO 2015,
  - Generation cost figures for 2015 same as in 2040,
  - Data for 2040 covers genuine 2°C scenario (usually calibrated on 2050 or 2100 timeframe).

Results for Global Electricity

WORLD 2040	Total Energy (MTOE/TWh)	Total Cost (USD, net of CO2)	Total CO2 (MtCO2)	CO2 per TOE/MWh (CO2)	Unit Cost to go from BAU to 2DS 450
BAU	43120	3.51E+12	19992	0.46	**15**
2DS 450	33910	3.76E+12	3968	0.12	
2DS 450 w/o EEI	43120	3.91E+12	5046	0.12	**27**

- Two different methodologies were pursued in order to account for the cost of energy efficiency improvements between 2015 and 2040 that would compensate for the reduction in energy use:
  1. WEIO 2014 and WEO 2015 provide rough summary estimates for investments in energy end-use efficiency that were added to total system costs.
  2. No EEI was added but total output was left identical with BAU scenario in order to simulate identical level .

Questions

1. Is the methodology considered sufficiently robust and relevant to merit further investment (e.g., use of WEO cost data) and extension to individual regions and countries?

2. Which modifications in methodology and presentation are most relevant?

3. Are results for *average abatement costs* to reach the 2DS in the 15-25 USD/tCO2 range realistic?

   - Consider this: for a *marginal abatement cost* of USD 20/tCO2, the McKinsey results suggest an abatement potential of roughly 30 GtCO2 per year. Going from BAU to 2DS 450 scenario requires 26 GtCO2.

   - Results indicate qualitatively that carbon prices even at levels that should be politically feasible have a serious chance at making a real difference on the ground.

Thank You