When Starting with the Most Expensive Option Makes Sense: Use and Misuse of Marginal Abatement Cost Curves

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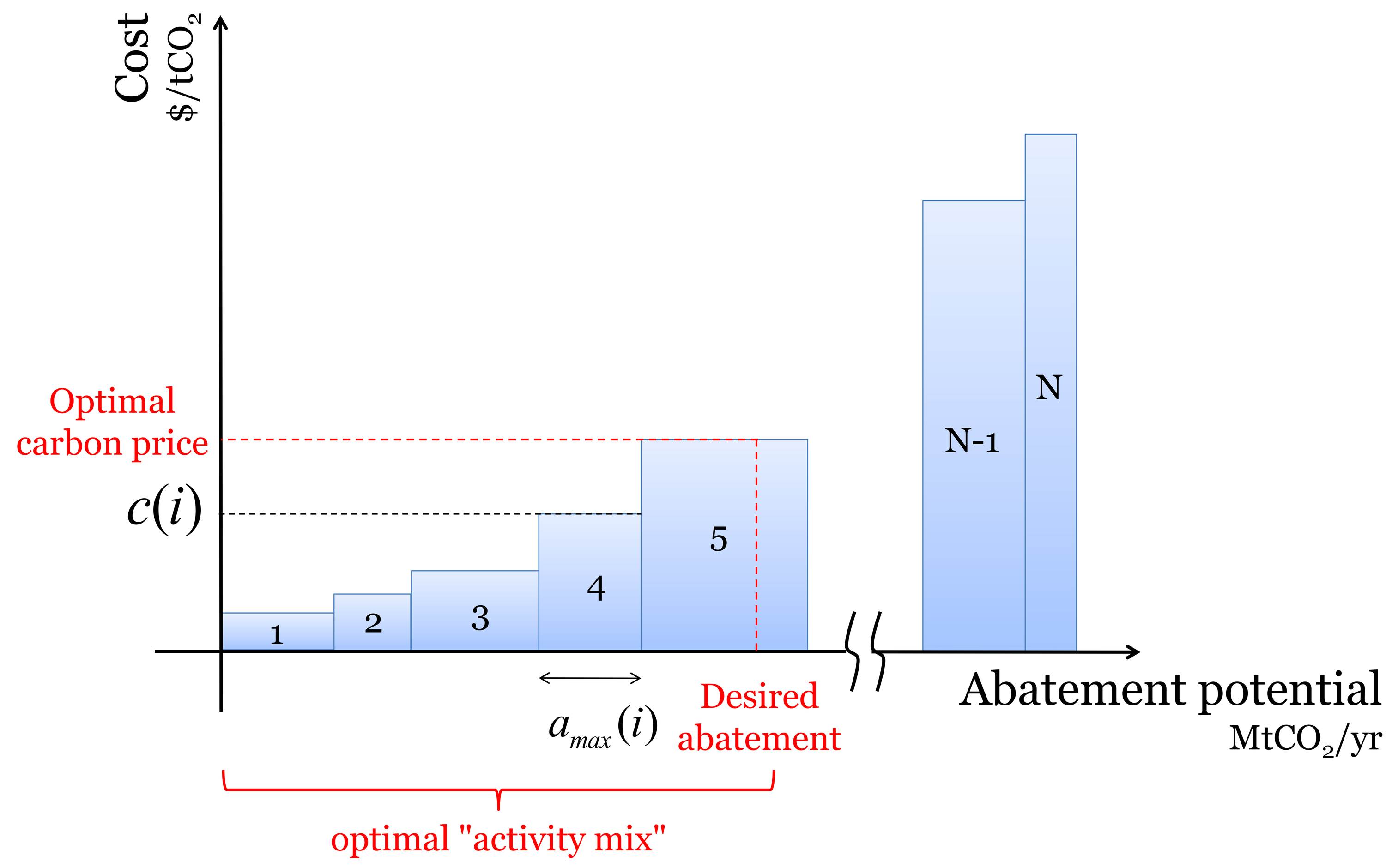
❶ This work starts from one question

Different mitigation activities are available (e.g. fuel switch, renewable power, electric vehicles, buildings retrofit…).
How can we use information on **costs** and **potentials** of each activity – for instance from a Marginal Abatement Cost (MAC) curve – to decide in which chronological order to implement them?

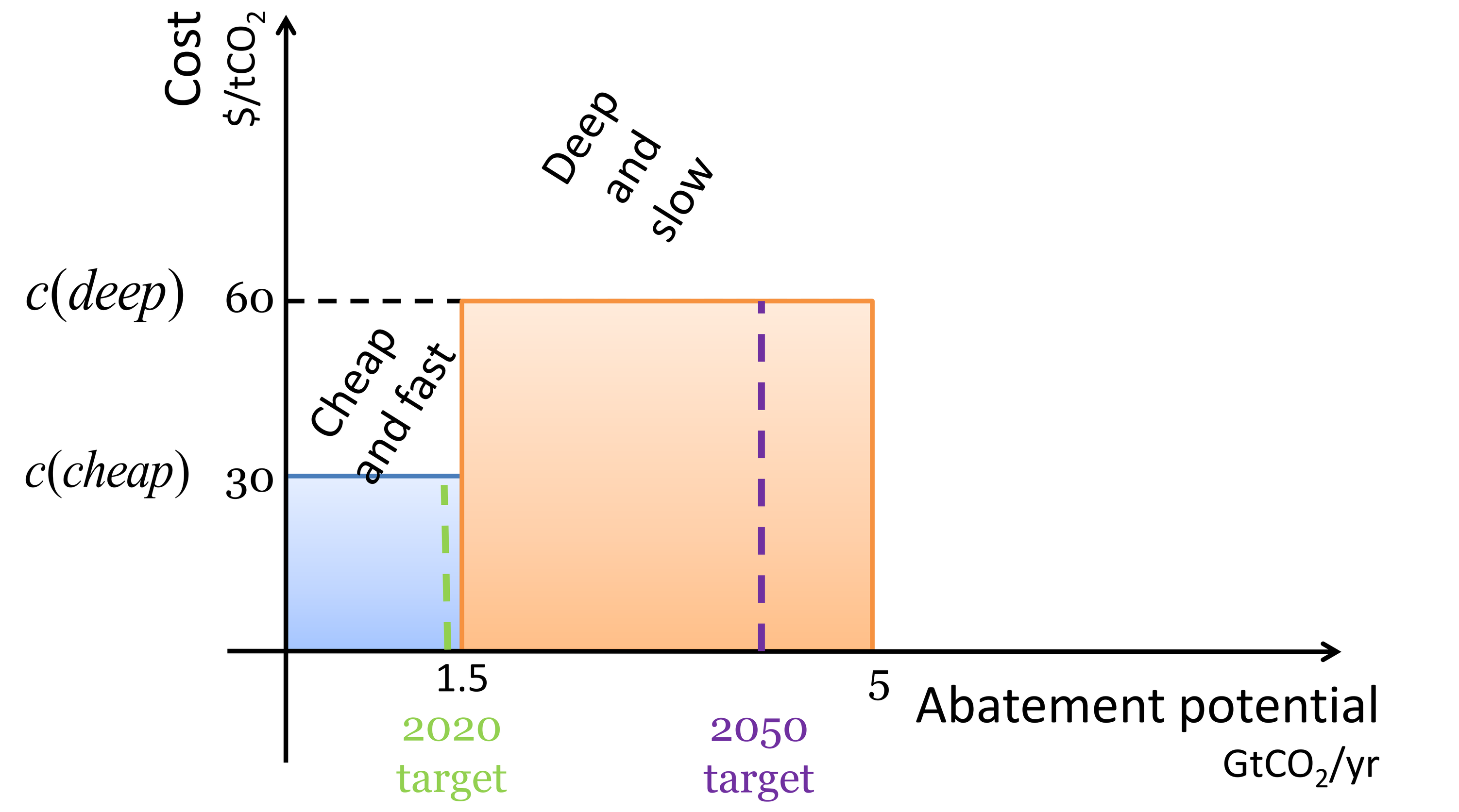
❷ A tempting answer: the merit order



At first glance, one should implement the abatement options in the **merit order**, i.e. from the least to the most expensive.
We show that this reasoning dangerously **neglects inertia** and could lead to a carbon-intensive lock-in.

❸ Our model adds inertia to a simplified MACC

We model 2 abating activities:
Cheap has low abating potential and achieves it at low cost,
Deep has a greater abating potential and is more expensive.



Because of **limited turnover rates**, abatement in activity i cannot be implemented faster than an exogenous speed α(i) :

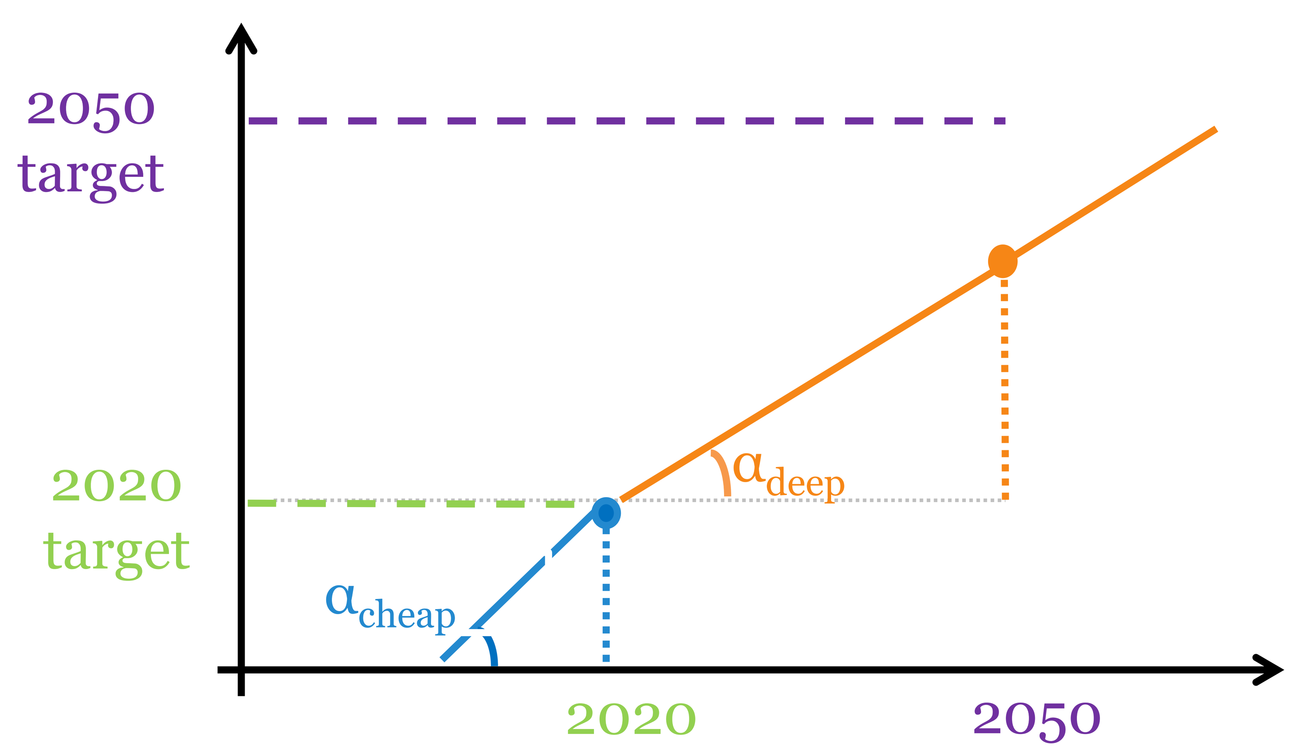
$$a(i,t+1) \leq a(i,t) + \alpha(i)$$

Cheap is fast, it can be implemented in 25 years,
Deep is more inert, it requires 70 years to be fully implemented.

A social planner minimizes the total discounted cost while achieving an emission target:

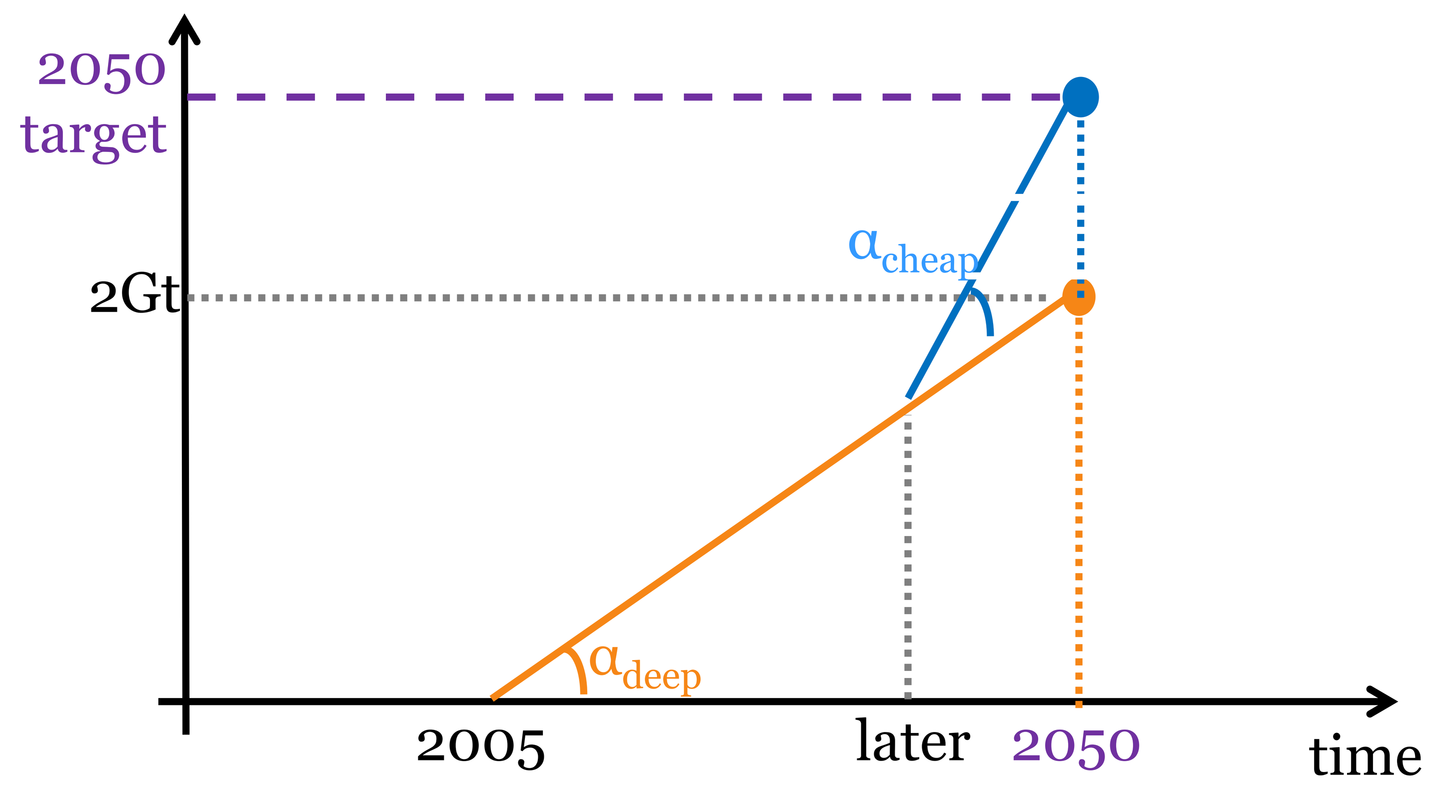
$$min \sum_{t=0}^{T} \sum_{i=1}^{N} \frac{a(i,t) \cdot c(i)}{(1+r)^t} \quad s.t \quad E_{ref}(T) - \sum_{i=1}^{N} a(i,T) = E_{obj}$$

❹ Reaching short-term targets with the cheapest options may lock the economy in a carbon intensive pathway



1. The 2020 target is reachable by implementing only the cheap option (as switching from coal to gas).
2. In 2020, attention goes to the 2050 target. Economic agents implement deep (e.g. renewable electricity) at the maximum speed, but the 2050 target is not reachable at time.

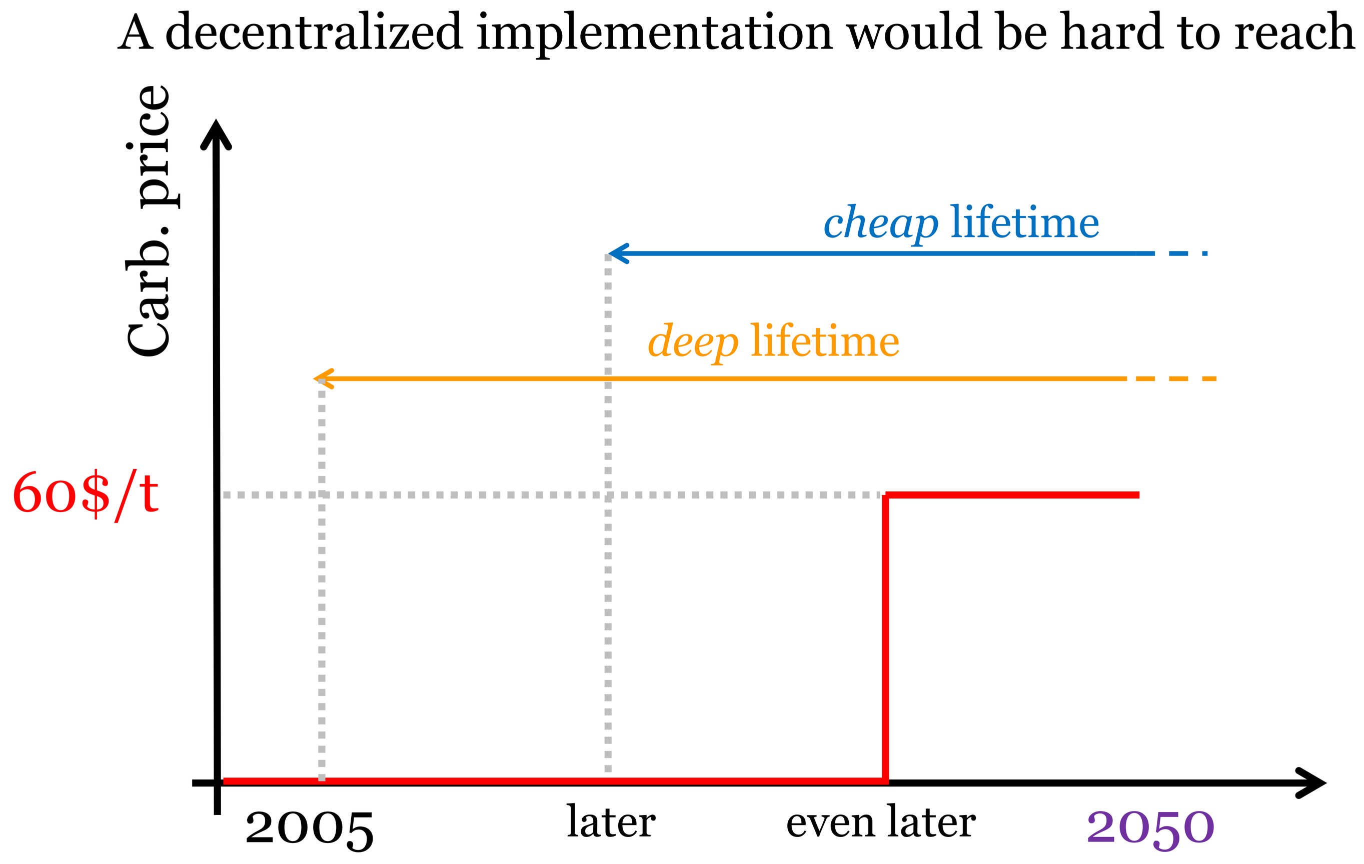
❺ Optimal strategies may actually use expensive options before cheap ones



1. Assume that one knows that the optimal abatement from expensive solar power in 2050 should be 2Gt.
2. Installing that much solar power takes time, we should therefore start to implement solar plants from 2005.
3. Cheaper but faster-to-implement options (e.g. gas power) required in 2050 may enter later.

❻ Sectoral policies may complement efficiently the carbon price

A decentralized implementation would be hard to reach



- Achieving the optimal strategy by imposing a carbon price would require **perfect foresight** from private firms and **credible commitment** of public policies announced decades in advance. In this case, agents would anticipate the carbon price when investing on long-lived capital (cars, power plants, urban structures).
- In a more realistic framework, with myopic agents and limited commitment, **sectoral policies** (e.g. efficiency standards, green quotas, urban planning…) may enforce the implementation of expensive but high potential activities (e.g renewable power, efficient cars…).
- **MAC curves extended with information on inertia** can help to design such sectoral policies.

C.I.R.E.D.

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