WHEN STARTING WITH THE MOST EXPENSIVE OPTIONS MAKES SENSE: USE AND MISUSE OF MARGINAL ABATEMENT COSTS CURVES

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Overview

To design the best policies to mitigate climate change, decision makers need information about the different options for reducing greenhouse gas emissions. Such information has been provided in many different ways, including through activity-explicit, marginal abatement cost (MAC) curves. These curves represent information on abatement costs and potentials for a set of mitigation activities. Where MAC curves have been developed, they have proved useful in communicating about abatement options and potentials.

MAC curves rank potential mitigation options from the least to the most expensive and therefore look like "merit-order curves." (McKinsey and Company 2007; Sweeney & Weyant 2008). This suggests that they are meant to be used as conventional supply curves. If they were, an abatement activity should be implemented when the price of carbon is higher than or equal to the reported cost of its abatement. In other words, a cost-minimizing strategy would exhaust the cheapest available options before turning to progressively more expensive options as the carbon price rises and until the targeted abatement level is reached (figure 1).

But MAC curves are not merit-order curves: they report on activities that could take decades to implement, such as retrofitting buildings or switching to electric mobility. Because of this inertia, the choice of mitigation options and the implementation schedule suggested by a naive interpretation of MAC curves is suboptimal.

Method

In this paper, we investigate the optimal timing for abatement of greenhouse gas emissions (choice across time) along with the optimal dispatch of the reduction burden (choice across abatement sectors or technologies). To do so, they extend a MAC curve with information on inertia in the form of a *cost in time* for each option. Achieving a given amount of abatement through a given option requires spending both money and time on implementation. These extended MAC curves make it possible to distinguish available abatement activities not only by their costs and potentials but also by the time it takes to implement them. We then look for the least-cost strategy for achieving different climate objectives.

Results

With an objective expressed in terms of cumulative emissions over a long period—a good proxy for climate change—it is preferable to start by implementing the cheapest options. But it makes sense to implement the more expensive ones at the same time, particularly before exhausting all the potential of the cheapest options. Reaching ambitious objectives requires implementing abatement options that are slow to act. Time is not only money; the start date for implementation is defined by time constraints as well as by the cost of options.

With objectives expressed in terms of aggregate abatement at one point in time, such as the −20 percent in 2020 of the European Union, the order can even be reversed: it can be preferable to start with the most expensive options if their potential is higher and their inertia is great. This optimal schedule cannot be enforced with a unique carbon price across sectors unless economic actors exhibit perfect foresight and the long-term carbon price signal is perfectly credible.

Moreover, short-term emission targets can dangerously mask longer-term targets. In the European Union, for instance, the best way to reduce emissions by 20 percent by 2020 depends on whether this is the ultimate objective or only one milestone in a trajectory toward a 75 percent reduction in 2050. With an ambitious long-term objective, the short-term target needs to be achieved by implementing the options with the largest potential and the greatest inertia. A mitigation strategy based on a naive interpretation of a MAC curve would start with the cheapest options, possibly locking the economy into a carbon-intensive pathway and making the longer-term target unreachable.

Conclusions

We provide some insights into carbon pricing as well as a framework for analyzing overlapping mitigation policies (Braathen 2007; Fischer & Preonas 2010). A uniform carbon price across sectors cannot trigger the optimal dispatch of activities unless its long-term evolution is perfectly credible and predictable and economic actors have perfect foresight. In a realistic setting—with inertia, credibility issues for public policy over the long term, and imperfect foresight—it makes sense to use complementary sector-specific policies. The cost-effectiveness of such overlapping policies—such as Europe's 20 percent renewable energy target or fuel economy standards for newly sold cars—should be assessed in a dynamic framework that takes inertia into account.

References

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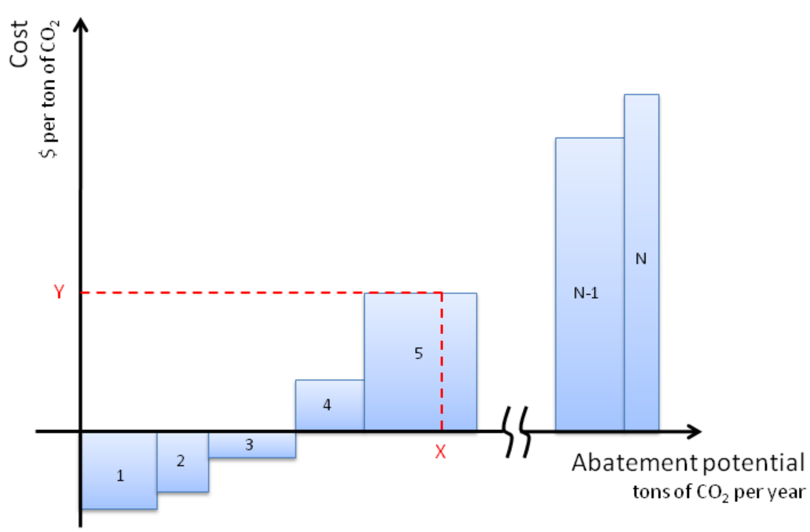
Figure 1. A Bottom-Up, activity-explicit Marginal Abatement Cost Curve



Note: The classic interpretation, challenged in this paper, is that the optimal strategy for achieving abatement *X* is to implement activities 1–5: the level Y would be the marginal abatement cost, and imposing this carbon price to the whole economy would lead to the optimal dispatch of the reduction burden (negative-cost activities 1-3 are options such as building retrofiting that have a positive value (or negative cost) based on energy savings). The paper explains why starting with more expensive options is sometimes to be preferred.