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Long-term payoffs of near-term low-carbon deployment policies

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HIGHLIGHTS

- We study long-term payoffs of promoting near-term low-carbon technology deployment.
- Conditions exist under which global and domestic cost-effective outcomes diverge.
- The globally cost-effective, near-term strategy is a diversified portfolio of investments.
- But the domestically cost-effective outcome is to invest in mature technologies.
- There are also conditions in which domestic outcomes align with the global outcome.

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ABSTRACT

Recent climate change negotiations indicate that near-term policies to address climate change are likely to vary across countries with countries employing a range of different policy options. One option frequently mooted at the national level is to promote, via policy, the deployment of low-carbon technologies. Promoting the deployment of low-carbon technologies can involve a near-term cost, if such technologies are more expensive overall, or require more upfront capital, than emitting alternatives. However, it lowers future costs of emissions abatement by reducing emissions in the near-term and potentially accelerating rates of improvement in targeted low-carbon technologies. We derive a globally cost-effective, near-term international technology investment strategy to achieve a long-term climate goal and show that it employs a diversified international technology investment portfolio across countries. We also explore the degree to which independent national technology deployment policies align with collaboratively determined regimes. We show that conditions exist under which there are substantial gains to international cooperation in the deployment of diverse low-carbon technologies and also circumstances in which domestic outcomes align with the global outcome.

1. Introduction

Recent climate change negotiations indicate that near-term actions to address climate change are likely to occur on the basis of national priorities and preferences. Leading up to the 21st Conference of Parties under the United Nations Framework Convention on Climate Change (UNFCCC) in December 2015 at Paris, countries are submitting their Intended Nationally Determined Contributions (INDCs), which detail their plans for climate change mitigation in the period to 2025 or 2030. As key emitters have looked at their own options for reducing emissions domestically, increased deployment of low-carbon technologies is an important component of the mitigation opportunities for many of them.

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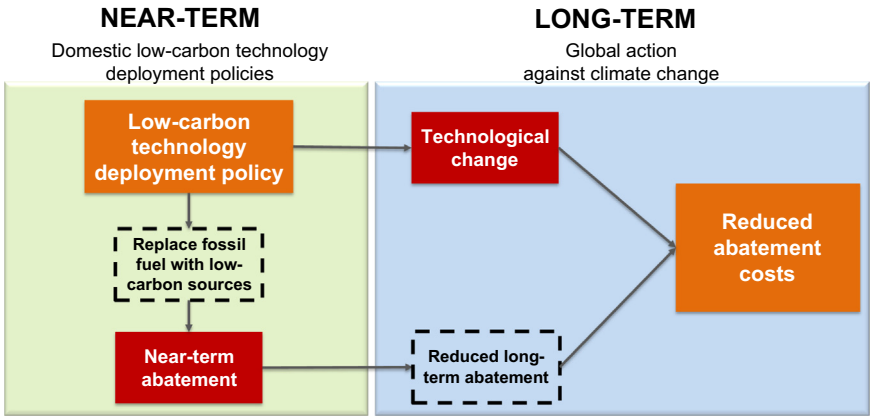

Fig. 1. An example of long-term payoffs of near-term low-carbon technology deployment policies in the context of long-term climate change mitigation. Promoting the deployment of low-carbon technologies by means of a deployment policy (such as subsidy or portfolio standard) would lead to reduced abatement costs in the long-term through two effects: the near-term abatement effect and technological change effect.

Countries are therefore at an important stage of setting near to medium-term goals for mitigation that they will then need to implement domestically via policy. For example, in the recent US–China joint announcement on climate change, China's commitments focused on increasing the share of non-fossil energy sources in the near-term (The White House, 2014). Likewise, in the recent US–Brazil joint statement on climate change, the countries expressed an intention to increase the share of renewables in electricity generation to 20% by 2030 (The White House, 2015).

A fundamentally important question for these countries is the appropriate balance between proven and new technological approaches, and to what extent they can or should pursue policies that help drive cost reductions either via global markets or via domestic policies. A complication is that promoting the deployment of low-carbon technologies through policies can involve a cost in the near-term, even as such policies can pay off in the long-term, through reduced costs of long-term emissions abatement, improved competitiveness of domestic industries leading to expanded exports and improved energy security.

This paper focuses on reduced costs of long-term emissions abatement due to near-term low-carbon deployment policies. There are two avenues for reducing long-term abatement costs (Fig. 1). First, there is a *near-term abatement* effect. Promoting the deployment of low-carbon technologies may avoid lock-in into carbon-intensive technologies – by replacing carbon-intensive fossil fuel with low-carbon sources, leading to emissions abatement in the near-term. Climate change is a long-term cumulative emissions problem. Thus, for any long-term limit on climate forcing, emissions abatement in the near-term reduces the need for abatement in the long term, resulting in reduced long-term abatement costs. Second, there is a *technological change* effect-promoting the deployment of low-carbon technologies could lead to improvements in technology costs, reducing long-term abatement costs (Goulder and Mathai, 2000; Schneider and Goulder, 1997). An important question in this context is, how do these effects interact and what does this mean for the most effective mix of near country-level deployment policies? Should all countries pursue the same technologies? Is a diversified approach more effective?

The potential answer to these questions is complicated by the fact that the above effects have public goods characteristics. Emissions abatement is a public good because most greenhouse gases are well-mixed (that is, they have lifetimes long enough to be relatively homogeneously mixed in the troposphere). Likewise, technological change that occurs domestically due to a domestic deployment policy may spill over to firms globally, also representing a public good. Hence, what is cost-effective globally may not be so from the domestic perspective.

In this study, we examine the divergence between long-term domestic and global outcomes in the context of an international approach to emissions abatement, in which countries promote low-carbon technologies in the near-term by means of deployment policies. To illustrate this divergence, we investigate an example in which China and the U.S.A. have the option to promote wind or solar technologies in the near-term. Assuming that the countries make near-term technology investment choices in a non-cooperative game, we show that the nature of the divergence between the domestic outcome (derived as the Nash equilibrium) and the global outcome (derived as the globally cost-effective strategy) depends on a range of factors, including the nature of technological change, technology spillovers, and domestic mitigation potentials. It is important to note that the aim of this analysis is not to represent any particular real-world policy, but rather to illustrate, by means of an example, the various forces at work, how they interact, and the implications for international collaborations on climate change mitigation and technology.

The paradox that individually rational strategies lead to collectively irrational outcomes has been discussed at length (Olson, 1965) and illustrated for a broad range of issues such as supply chain management (Cachon, 2001; Cachon and Netessine, 2004) and even international climate change negotiations (Barrett, 2003). The principal contribution of this paper is to illustrate these effects in the context of low-carbon technology deployment policies and international climate change mitigation, and in doing so, to highlight opportunities for international and domestic policies.

In addition, our study extends existing analyses based on energy-economic models that have explored the economics of "suboptimal" near-term policies in the context of long-term climate change mitigation. Such studies have represented near-term action as a price on carbon (Bosetti et al., 2009a; Bosetti et al., 2009b; Jakob et al., 2012), assessed the effectiveness of different policy options (Fischer and Newell, 2008) or focused on the interaction effects of carbon-price based and technology policies (Böhringer and Rosendahl, 2010; Fankhauser et al., 2010; Pethig and Wittlich, 2009). In contrast to the above studies, Clarke et al. (2010) explored the role of advanced technologies being available only in the U.S.A. versus globally and found that domestic and global benefits of achieving a stringent climate goal in these cases are vastly different. For example, if advanced technologies are made available everywhere but the U.S.A., global abatement costs are lower than if advanced technologies are available only in the U.S.A. On the other hand, if advanced technologies are made available in the U.S.A. alone, abatement costs to the U.S.A. are higher. This paper builds off the Clarke et al. (2010) study by introducing