STRUCTURING PUBLIC SUPPORT FOR RADICAL LOW-CARBON INNOVATION IN THE MATERIALS SECTOR: BRIDGING THE VALLEY OF DEATH

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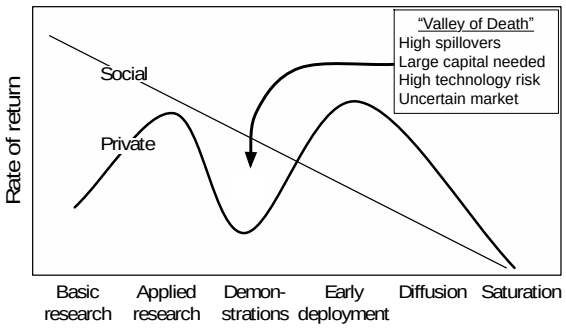
Overview

Our core research question is: ***How can public support of large scale low-carbon demonstration projects be stuctured to enhance effectiveness and avoid government failures?***

Achieving the ambitious climate change mitigation targets that 196 countries agreed upon in Paris in December 2015 will require near complete decarbonization of developed countries' economies during this century (Rogelj, Schaeffer et al. 2015). This transformation will necessarily involve not only sectors such as electricity and transportation, which are already decarboinizing, but also substantial emission reductions in the materials sector, e.g. in industries such as steel and cement (Wörtler, Schuler et al. 2013). While some opportunities remain for picking low hanging fruit, such as emission reductions through energy efficiency improvements, they are not sufficient to achieve climate goals (OECD 2015). Adoption of radical low-carbon innovations in the production process are crucial to decarbonizing the materials sector (Neuhoff, Ancygier et al. 2015).

In contrast to incremential innovations, radical low-carbon innovations face market failures and associated knowledge externalities, i.e. there is an incentive for firms to free ride by observing the experience of other firms (Jaffe, Newell et al. 2005). Moving radical innovations from the laboratory to full commercial scale thus raises questions about the need for public support. The so-called "Valley of Death" argument claims that governments need to bridge the financial gap between the early stage development phase of a technology, in which public funding of R&D is generally available, and the commercial use stage, in which incentives for private sector funding are strong (Weyant 2011, Nemet 2013). This shift in funding over the course of the innovation lifecycle, from the public to private, is in part due to declining social returns and increasing private ones (see figure on the right). At any stage at which social returns exceed private ones, there will be underinvestment without some public sector support.



Radical low-carbon innovations in the material and energy sector are especially prone to the Valley of Death problem for the four reasons noted in the figure. First, we know that radical innovations are easier to reverse engineer and imitate than incremental ones (Teece 1986, Hall, Mairesse et al. 2009). Second, funding requirements for demonstrations often exceed the financial resources of private companies in the sectors, even large ones. Third, because it has not been proven at scale, the technology is still risky and has to be demonstrated as reliable in order for commercialization to take off. Fourth, uncertainty about future markets, and particualry about future climate policies, may render risk-return ratios of these large scale projects unprofitable. However, this underinvestment has to be overcome in order to commercialise radical low-carbon innovations and thus help achieving climate goals. Transforming promising technologies from small scale to investment-heavy demonstration projects thus likely requires some form of government support to overcome the resulting underinvestment. We examine these conditions in detail in our paper.

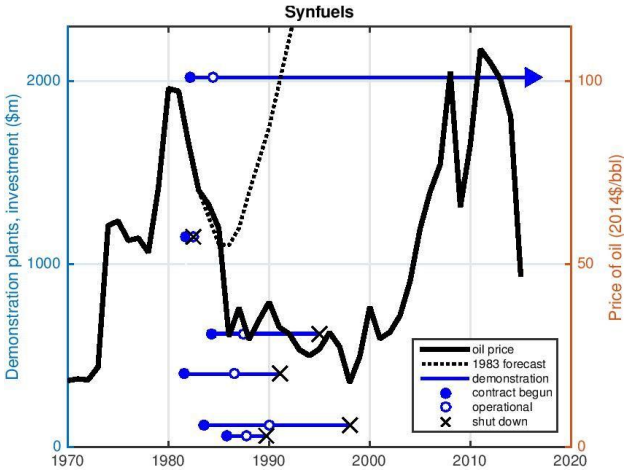
Despite strong evidence of market failures and weak private sector incentives, it is not entirely clear that governments are capable of overcoming these conditions. The track record of previous government efforts to support large scale demomnstration projects inlcudes many examples of failure (Grubler and Wilson 2014). Some analyses of previous efforts have conculded that there are structural reasons for failure (Cohen and Noll 1991). This interpretation has lead to the notion that much of these efforts consist of politicians trading favors to satisfy consituencies ("The Technology Pork Barrel") and to a widely invoked heuristic that 'governments should not pick winners.' Accepting that these government failures exceed the scale of the market failures described above has strong implications – not only for whether governments should support large-scale demonstration projects, but also about the viability of these technologies and consequently about mitigation potentials (Iyer, Hultman et al. 2015).

Methods

To investigate how public innovation support mechanisms can maximize the effectiveness of government support to overcome the Valley of Death, we analyse past cases of large scale demonstration projects. In a qualitative meta-study, we assess policy implementation considerations that can help improve incentives for firms and avoid the rather poor outcomes of past demonstration projects. Previous cases we examine include: carbon capture, synthetic fuels, solar thermal electricity, steel, advanced biofuels, wind, and nuclear power. Investigating the main characteristics of the innovation support (timeline, scale in terms of capacity, monetary scope of project, percentage of public funding, and motivation), we explore the lessons from different governance structures and instruments to provide innovation support. We investigate which role the motivation for projects and the public support play. We relate the development of projects to the relative shares of public and private financial support as well as to market conditions.

Results

The evaluation of the sample to date (n>150) shows that the main motivation for the projects was learning and proving a technology. The sole production or scaling up of plants was only a secondary motivation. The evaluation further shows that the failure of large scale demonstration projects often coincided with changing market conditions (see figure on the right). For example, many synfuel projects were started in times of high oil prices – and were cancelled with falling oil prices, despite several of these projects being completed on time and within budget. Similar pictures arise for the other technologies, e.g. with respect to CO2 prices or electricity prices.



Conclusions

Radical, low-carbon innovations in the materials sector face the Valley of Death. Many regions have public support mechanisms in place. However, a broader analysis of suitable mechanisms and incentive schemes is missing. Our meta-analysis shows that not only public support in terms of grants and loans are necessary but also the provisioin of secure investment environments such as guaranteed prices helps innovations overcome the Vallye of Death - even if the technologies proven are not necessarily commercialised.

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