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Demonstrating climate mitigation technologies: An early assessment of the NER 300 programme

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ABSTRACT

This article takes stock of the world's largest low-carbon technology demonstration programme – the EU's NER 300. The programme has been marked by delays and many withdrawn projects since becoming operational in 2010: CCS projects have failed and not reached final investment decisions; wind and solar projects have succeeded, whereas bioenergy projects have seen successes as well as failures. These outcomes can be explained by specific design features in the program that placed large-scale projects at a disadvantage, and by the wider context of EU climate and energy policies providing inadequate market-pull incentives for CCS and biofuels. The design and policy challenges identified are related more to political feasibility than to lack of knowledge of what is needed to trigger innovation. The proposal for a follow-up Innovation Fund is assessed against the lessons from NER 300.

1. Introduction

It is widely agreed that reducing greenhouse gases (GHG) emissions on a path compatible with the recently accepted 'well below 2 degrees' target cannot be realized without a range of low-carbon technologies matured from the stage of an idea to full market deployment (IPCC, 2014). Innovation studies have shown that policy mixes (technology supply-push and demand–pull instruments) are crucial in supporting advancement of technologies through the various stages of the innovation process (IPCC, 2014).

The EU has aimed at international leadership by example in climate policy (Skjærseth, 2017) by adopting ambitious low-carbon technology demand-pull targets and policy instruments. Binding long-term targets create credible expectations that the EU is serious about transiting to low-carbon technologies. The EU target of reducing emissions by 20% by 2020 has been expanded to 40% for 2030, on the way towards a low-carbon economy by 2050 (80–95%). Pivotal policy instruments for attaining these targets have included the EU Emissions Trading System (EU ETS) that placed a price on carbon, with binding targets for the member states to increase their share of renewables in total energy consumption by 20% by 2020.

In 2009, the EU adopted a new low-carbon technology supply-push instrument, the New Entrants Reserve 300 (NER 300) programme. Aimed specifically at funding full-scale demonstration of Carbon Capture and Storage (CCS) and Innovative Renewable Technologies in the energy sector, this was one of the world's best-funded programmes for innovative low-carbon energy demonstration projects (EC, 2009). The design of the NER 300 Programme was elaborated and decided in 2009 and 2010. Decisions on what demonstration projects to fund (outcome) are taken in two rounds (EC, 2010a). NER 300 complemented the EU Strategic Energy Technology Plan, which served as a framework for spurring EU technology actors to prioritize and leverage resources for advancing the development and market introduction of especially promising low-carbon energy technologies (EC, 2007).

In this article, we take stock of the NER 300 programme and ask:

– Has NER 300 delivered outcomes as intended?
– How can we explain NER 300 performance?

We examine outcomes in terms of the demonstration projects that have reached a final investment decision, and assess these outcomes against overarching and specific intentions formulated for the programme. Performance is explained by analysing (i) the design of NER 300 and (ii) the wider EU policy context necessary to create favourable market conditions for reaching final investment decisions. Drawing on state-of-the-art innovation theory, our main contribution is a case study of how supply-push and demand-pull policies interact taking politically feasibility into account. This has only been hinted in previous studies assessing the preliminary NER 300 outcomes for CCS projects after the first fund-awarding decision (Lupion and Herzog, 2013; Scott, 2013).

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This study benefits from the fuller picture available after finalization of the 1st call with projects reaching final investment decisions, the award-decision for the 2nd call, and also taking into account the outcomes for renewables.

Further, the NER 300 literature includes studies of the political initiation phase, where early decisions shaped the ensuing design of the programme (Boasson and Wettestad, 2014; Chiavari, 2010) as well as studies assessing the implementation process against the criteria set for implementation (Fallmann et al., 2015). The Impact Assessment for the Innovation Fund (EC, 2015) includes an examination of NER 300; here the EC notes 'failure to secure financing', but does not go into detail as to why companies could not secure a final investment decision. Such studies have provided valuable empirical inputs to our study. We conclude by summarising the merits of the NER 300 in light of existing knowledge on demonstration programmes and discuss how the follow-up NER 400 programme relates to lessons drawn.

Our empirical material is based on document reviews of the calls and progress report of the projects, complemented with interviews with EU officials, starting from the launch of the NER 300 in 2010, and with companies that have withdrawn projects or have succeeded in the calls. Secondary data have been collected from the few prior studies on the NER 300 noted above.

2. Role of publicly funded demonstration programmes

The innovation process – bringing an initial idea through stages of maturation until it diffuses as a product in the market – has been thoroughly described in many innovation-chain studies. The roles played by public policy in assisting the process during the various stages through a mix of instruments are well documented (Wilson and Grubler, 2011; IPCC, 2014). Government funding of R&D is justified by positive externalities and the need to correct market failures from non-optimal levels of funding by private industry (Popp, 2010). The following step to demonstrate a promising technology at full scale involves major costs and risks if the technology should fail: government co-funding has thus been justified for leveraging necessary private money and efforts (Popp, 2010). Support for early deployment on an initial market has been motivated by the systemic barriers facing new technologies compared to established technologies (Unruh, 2002; Borrás and Edquist, 2013). Without public support, many unproven pilots would be left non-remunerated, mired down in what the innovation literature has called 'the valley of death' (Bossink, 2015; IEA, 2015). These stages of the innovation process (demonstration and early deployment) are critical for proving the market-attractiveness of the technology and for learning, and failure to support at this stage would mean a waste of resources applied earlier in the innovation cycle.

Looking specifically at the demonstration phase in the innovation chain, several studies have assessed 'success factors' in the design of demonstration programmes (Baer et al., 1976; Lefevre, 1984; Nemet et al., 2016; Hart, 2017). An important conclusion is that identifying the long term contribution to technological development from demonstration programmes is inherently uncertain and dependent on external developments of both technologies and markets (Lefevre, 1984; Nemet et al., 2016; Hart, 2017). Premature assessment of programme achievements in spurring technology breakthroughs may fail to account for lagged effects stemming from market conditions for the technology changing at a later point (Hart, 2017). ´Learning´ is crucial for demonstration programmes (Reiner, 2016) but *what* to learn and *who* should learn differs depending on the scale, scope and technical maturity of the demonstrated technologies (Bossink, 2017; Frishammar et al., 2015). In our case, the NER 300, the aim was to demonstrate new technical systems ´on a commercial scale´ with the aim of spurring a rapid uptake on the market. Attracting private actors to shoulder part of the risk and committing commercially is thus crucial to advance learning across the full value chain from technology providers to customers and policy makers. It is against this backdrop that we conclude that 'reaching final investment decision' is a valid criterion for this phase in the innovation chain.

To sum up, the literature has identified a range of factors, both internal concerning programme design but also external market factors that affect the willingness of private investors to invest in demonstrations. As to programme design, governments must accept failure (i.e. have modest risk aversion) and be patient, not expecting immediate commercial breakthrough; further, that stable funding over time should be ensured; learning as main outcome should be encouraged, and considerable attention be paid to identifying and selecting projects so as to reduce risks and support technologies with a strong potential from a societal point of view (Bossink, 2017; Frishammar et al., 2015). However, assessing demonstration programmes need also to look beyond the specific programme design and to assess the conditions for market access. Both short- and long term conditions for market access will be a crucial factor in spurring private investors to risk their money and engage in co-funding of the demonstration project, especially when the scale of the project is large and the technology is close to market readiness. Demonstration projects will be regarded as increasingly risky for private investors, and demonstration programme will become less attractive, if broader market-creating climate policies (demand-pull) are weak or unstable, and likely to remain so.

3. Initiation and design of NER 300

NER 300 was formally established in 2009 (Art 10a (8) of the revised ETS Directive), becoming operational in 2010, when the criteria and rules shaping the design were adopted (Decision 2010/670/EU). The programme was developed in a unique 'window of opportunity' for EU energy and climate policy. Strong political momentum was built up for the EU to expand its ambitions in climate policy in order to demonstrate leadership at the upcoming COP15 in Copenhagen. At the same time, new energy security concerns brought momentum for stronger EU policies aimed at promoting indigenous renewable energy sources (Skjærseth et al., 2016).

EU climate policy had since 2003 been built around the EU ETS as the core policy instrument, aimed at pricing carbon emissions to incentivize demand for low-carbon energy sources. The system, in operation from 2005, was contested by fossil fuel-based interests, notably so by member states and industries profiting from European coal resources. In this context, carbon capture and storage (CCS) emerged as a strategic future option that could secure reduction of carbon emissions without a need to halt the combustion of fossil fuels and abandon European coal resources (Skjærseth et al., 2016, interviews). Climate policy makers and NGOs had viewed CCS with some suspicion, but perceptions shifted after the release of an IPCC special report in 2005 (Chiavari, 2010; IPCC, 2005). In 2006, the EU turned CCS into a legitimate and promising mitigation option in its green paper on a new energy strategy for Europe and proposal for a Strategic Energy Technology Plan (SET-Plan) aimed at accelerating innovation in low-carbon technologies (EC, 2006).

In March 2007, the European Council endorsed new ambitious and binding climate and renewable energy targets towards 2020, to be based on reforms of existing policies and new policy instruments. This included strong endorsement of the Commission´s ambition to have up to 12 demonstration projects for CCS operational by 2015 to verify for the market that large-scale CCS was feasible, economically motivated and could deliver quick and major emission reductions.

In January 2008, the Commission launched a package of policy proposals to accomplish the new climate and energy policy targets, with important pillars including: reform of the EU ETS, new renewable energy policies, and a new CCS Directive. The latter mandated the member states to develop the necessary legal, technical and regulatory frameworks for CCS to be realized (Skjærseth et al., 2016).

The EU ETS Directive needed to be adapted to the new, more ambitious climate targets set for 2020 and reformed to correct weaknesses