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**Research Report**

## Climate-related innovations, crowding out, and their impact on competitiveness

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# ZEW policy brief

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## Climate-Related Innovations, Crowding Out, and Their Impact on Competitiveness



### Essential Issues

Within the last few decades, rising environmental concerns, particularly about global climate change, have forced policy-makers to act in an effort to mitigate further harm. Yet though greenhouse gas emissions and the wasteful use of natural resources are detrimental to the environment, policy-makers are reluctant to enact any green legislation that might undermine national competitiveness. This is the main reason why governments often fail to agree on legally binding emissions targets on the international level. Many now see the solution to lie in the development of new environmental technologies, which promise to address environmental problems while maintaining a strong economy and competitiveness.

This ZEW project examines the effects of environmental technology on competitiveness, especially as it relates to the governmental regulation of pollutants. A key determinant for the proliferation of green technology – and for tackling the environmental problems they are meant to solve – is whether they produce positive returns.

### Research Question and Relevance

Positive returns were found for integrated process technologies in areas that save resources and materials and that enhance energy efficiency. The introduction of such technologies by firms also provides positive returns when they have been introduced to cope with regulatory constraints. For other environmental technologies, such as scrubbers to reduce air or water pollution, positive effects on profitability were not found, regardless whether the measures were introduced voluntarily or if imposed by governmental legislation. Another important finding is that technologies that save materials or resources or that reduce CO<sub>2</sub> emissions can be used more efficiently when incorporated into a company's organisational infrastructure, thus attenuating possible negative effects on productivity. Finally, firms that had to introduce environmental technology due to regulation were observed to shift financial resources away from research and development (R&D) activities. Thus, regulation-induced green innovations can come at the expense of other innovation activities and may therefore impede competitiveness-enhancing investments, at least in the short run.

### Key Messages

## Green Innovation and Competitiveness

### Key Messages

The adoption of environmental innovations is often seen as unprofitable, especially if introduced only to comply with environmental regulations. Yet the profitability of environmental technology is key to their proliferation and for achieving environmental targets while maintaining national competitiveness. What policy-makers can learn from our studies is how the introduction of environmental innovations by firms, especially when required by government regulations, affects competitiveness. In particular:

- The introduction of environmental innovations by firms is not necessarily associated with lower financial performance when they are introduced to fulfil regulatory requirements. Put simply, positive returns depend on the character of the adopted technology and on regulatory design.
- Environmental technology can be used more efficiently if firms adapt their organisational infrastructure (organisation procedures, responsibilities and decision-making) to better fit to the new technology, thus mitigating possible negative effects of environmental technology adoption on productivity. This does not mean that public authorities can impose more regulations with no cost on competitiveness. The point is that firms could have spent their resources for more productive or innovative investments.
- The adoption of environmental technology due to regulation may “crowd out” competitiveness-enhancing investments such as R&D in the short run. An adequate policy design offering subsidies for environmental technology can alleviate this problem.

Given these insights from three studies in the SEEK project, we arrive at two central conclusions. There is no reason to believe that the use of environmental innovations is per se a barrier to competitiveness. To make positive returns possible, an adequate policy design and technology-appropriate restructuring of company organisational infrastructure are needed. This includes environmental policy that stimulates the development and use of technologies that save energy or materials, as well as a policy mix that includes subsidies that compensate for possible crowding-out effects.

### Research Questions and Relevance

## Climate Change and Climate Policy

The phenomenon of climate change has become a hotly debated topic in economic research, all the more so after Nicholas Stern’s bleak projection in 2006 of the future costs of climate change. Such projections motivated policy-makers to put climate change on their agenda to prevent a climate disaster. In light of other recent serious problems such as recession in the eurozone, however, climate change seems to have lost some of its horror in the eyes of the public and policy-makers. This is also the case because the regulation of emissions such as greenhouse gases can lower competitiveness, especially when imposed unilaterally. This may be one reason why the Conferences of the Parties (COP) in the United Nations Framework Convention on Climate Change (UNFCCC) frequently fail to agree on legally binding international reduction targets.

## Green Innovation Needed

In addition to the adoption and proliferation of existing pollution control technologies, R&D in cleaner production is considered a central strategy for addressing climate change and other environmental problems. Because a global unilateral agreement on restricting greenhouse gas emissions is unlikely, hope now rests on technological change in the future. But the cleaner technolo-

gies of tomorrow are based on today's efforts to find them. Since private incentives to invest in R&D alone are considered to be too low, public measures such as regulation of pollutant emissions or public subsidies may encourage R&D expenditures in cleaner technologies. The European Union has imposed unilateral goals to restrict greenhouse gas emissions by 2020 and to push forward economically efficient technologies for cleaner production that maintain competitiveness. Our central research question is whether and how the use of environmental innovations affects the competitiveness of German companies. We have given special attention to environmental innovations introduced to cope with constraints imposed by regulations. In particular, we considered financial performance, productivity (production process efficiency), and innovation activities.

## Research Results in Detail

The impact of environmental technology adoption on financial performance largely depends on which technology is introduced. Environmental technology that reduces material consumption and increases resource and energy efficiency helps to increase financial performance (measured as return on sales). This finding holds true for both voluntarily introduced technology and technology introduced to fulfil regulatory requirements. Using financial performance as a measure of competitiveness has the advantage that it accounts for the two channels of environmental technology that may affect competitiveness. On the one hand, environmental innovations introduced by firms that lower material and energy use can improve the efficiency of the production process, though introducing such technology may be associated with substantial costs. On the other hand, introducing such resource-saving technologies in the production process may allow firms to separate themselves from competitors as producers of environmentally friendly goods for customers willing to pay for such products. In this sense, offering environmentally friendly goods may allow firms to charge higher prices if they are able to separate themselves from their rivals. For other environmental technologies such as scrubbers, which reduce air, water, or soil pollution, we did not find positive effects on financial performance, but we did find some weak evidence for negative effects. This was true for both regulation-driven and non-regulation-driven innovation adoption.

Another indicator of competitiveness is productivity – the amount of efficiency when transforming input into output. We found that firms can use environmental technology for reducing CO<sub>2</sub> emissions or for reducing material consumption more efficiently when they adapt their organisational infrastructure to these technologies. Organisational change – a change in business practices for organising procedures and/or new methods of organising tasks and decision-making – mitigates the possible negative effects of environmental technology and allows it to be used more productively. Note that this result only holds true for environmental technology integrated into a firm's production process, not for additive environmental technology such as scrubbers.

Innovation is central for firm competitiveness in the long run, especially in highly industrialised countries such as Germany. If firms are financially constrained, the need to introduce environmental technology to fulfil regulatory requirements can force such firms to draw the needed financial resources for regulatory compliance from R&D or innovation budgets. Indeed, we found some evidence for such a crowding-out effect in our study. Firms that introduce environmental innovations were found to have (significantly) lower R&D expenditures (net costs for environmental innovation) in the period in which they invested in abatement technology. For environmental technology supported by public subsidies, such a crowding out was not observed. These results provide some support for the idea that a policy mix of regulation and subsidies can stimulate en-

**Profitability of  
Regulation-Driven  
Green Technology**

**Using Environmental  
Technology More  
Productively**

**Is There a Crowding  
Out of Other Innovation  
Activities?**

## Data from the Mannheim Innovation Panel

environmentally friendly technological change that does not jeopardize competitiveness. These results are based on data from the Mannheim Innovation Panel (MIP) conducted in 2009. The advantage of this representative firm survey is that it includes information on both environmental innovations introduced by firms and whether these technologies were introduced to cope with regulatory constraints.

## Project Profile

### Research Team

- **Junior-Professor Dr. Hanna Hottenrott**, Düsseldorf Institute for Competition Economics (DICE), Heinrich Heine Universität Düsseldorf and ZEW
- **Sascha Rexhäuser**, ZEW and Katholieke Universiteit Leuven (KU Leuven), BE
- **Professor Dr. Reinhilde Veugelers**, Katholieke Universiteit Leuven (KU Leuven), Bruegel, and Centre for Economic Policy Research (CEPR), BE

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### Publications

**Rexhäuser, Sascha and Christian Rammer** (2014), Environmental Innovations and Firm Profitability: Unmasking the Porter Hypothesis, in: Environmental and Resource Economics, Vol. 57, No. 1, pp. 145–167.

**Hottenrott, Hanna, Sascha Rexhäuser and Reinhilde Veugelers** (2012), Green Innovations and Organisational Change: Making Better Use of Environmental Technology, ZEW Discussion Paper No. 12-043, Mannheim, and CEPR Discussion Paper No. 9055, London.

**Hottenrott, Hanna and Sascha Rexhäuser** (2013), Policy-Induced Environmental Technology and Inventive Efforts: Is There a Crowding Out?, ZEW Discussion Paper No. 13-115, Mannheim.