CEPS POLICY BRIEF
Thinking ahead for Europe

How should support for climate-friendly technologies be designed?

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No. 254, September 2011

Abstract

Stabilising global greenhouse gas (GHG) concentrations at levels to avoid significant climate risks will require massive 'decarbonisation' over the next few decades. Achieving the necessary scale of emissions reductions will require well-thought out strategies and a multifaceted policy effort to support a broad array of technological and behavioural changes. This paper outlines some core principles for guiding the design of clean technology policies, with a focus on energy.

The climate policy research programme Clipore, supported by the Swedish Foundation for Strategic Environmental Research (Mistra), focuses on future international policies in the area of climate change. Carried out by a consortium of universities, think tanks and non-governmental organisations in Europe, India and the US, the main aim of the programme is directed towards the use of economic incentives and instruments in the implementation of climate policies, and towards the development of new frameworks. CEPS contributes to the outreach of the Clipore research programme through the European Climate Platform (ECP), a joint initiative of CEPS and Clipore.

This Policy Brief is a shortened version of a forthcoming article to appear in a special issue of *Ambio* on Clipore research in the spring of 2012. Carolyn Fischer (fischer@rff.org) is a Senior Fellow at Resources for the Future. Asbjørn Torvanger (asbjorn.torvanger@cicero.uio.no) is a Senior Research Fellow at the Center for International Climate and Environmental Research – Oslo (CICERO). Manish Kumar Shrivastava (mshrivas@teri.res.in) is a Research Associate at the Energy and Resources Institute. Thomas Sterner (Thomas.sterner@economics.gu.se) is a professor in the Dept of Economics, University of Gothenburg, Sweden and University Fellow at Resources for the Future. Peter Stigson (peter.stigson@ivl.se) is a Senior Researcher at IVL Swedish Environmental Research Institute.

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Introduction

The first principle for guiding the design of clean technology policies is not to pick technology winners, but rather to pick winning technology *policies*. Many studies analyse the technological options for achieving deep reductions in greenhouse gas (GHG) emissions. Economists who model climate policies, on the other hand, tend to focus on cost-effective solutions, but often with less technological detail. All models have difficulties in incorporating realistic representations of technological change, uncertainties, barriers and non-market-based policies. Energy projections are difficult for proven technologies, and even trickier for emerging ones.

We are not sure what magnitude of emissions reductions will ultimately be needed or what the corresponding prices will be, and do not necessarily have a good idea of the costs of large-scale deployment of existing technologies. Breakthrough technologies might arrive, and the costs and quality of existing technologies could be improved. How to choose among technologies? On the one hand, policies should be as neutral as possible, to allow a broad range of technologies to emerge and compete, and to avoid the problem of governments attempting to pick winners. On the other hand, we cannot be fully neutral, given that we are largely aware of the major technological options that will be available over the coming decades and some technologies have specific barriers and potentials that may require targeted assistance.

A second, related principle is thus for policies to address market and regulatory barriers. In the case of *market failures*, private actors do not reap the full social benefits or costs of their actions. By correcting these market failures and 'getting the prices right', policies can better align private incentives with the public interest. In the following pages, we discuss a variety of market failures and related barriers for clean energy technologies.

Carbon pricing *is* a technology policy

The core of any cost-effective approach should be a strong price signal across the entire economy that carbon emissions are costly. This price signal should be increasing over time since a climate policy could involve a budget on allowable GHG emissions, and increasing scarcity of allowable emissions is usually characterised by rising prices. Emissions pricing can be implemented either through a carbon tax or a broad-based cap-and-trade system. The reason for a primary reliance on carbon pricing is two-fold.

First, technologies are only useful if people want to use them. Carbon pricing makes clean technologies more cost-competitive and provides 'market pull' by encouraging their adoption. It also reduces some of the need for reliance on public innovation programmes targeted specifically towards clean energy, as the market has more incentive to contribute.

Second, many options are available for reducing emissions. No command-and-control regulation could efficiently prescribe all the appropriate activities that should be undertaken. Carbon pricing, on the other hand, creates incentives to do all these things: use less carbon-intensive fuels and products, conserve energy and develop and deploy emissions-reducing technologies.

Technological change and turnover will be essential for deep reductions; however, a lack of emissions pricing is not the only roadblock. There are a host of other impediments to a robust market for clean-technology research, development and demonstration (RD&D): financial, regulatory, behavioural, and network barriers; knowledge and innovation spillovers; and scale economies, among other challenges. Moreover, political realities may constrain the carbon price from being high enough to induce the necessary transformation and innovation. A carbon price should be supported by complementary policies to address barriers to technological development and deployment.

Remove distorting policies

Distorting subsidies for fossil-based energy should be removed. In non-OECD countries, subsidies are primarily used to keep consumer prices artificially low, resulting in overconsumption. In OECD countries, by contrast, most of these subsidies are for fossil-fuel production. Of course, beneficiaries of subsidies will resist reform. Therefore, removing subsidies may require a gradual phasing-out.

Another kind of indirect subsidy is inefficient regulation to reflect the cost of other environmental damages, such as conventional air and water pollutants, often related to GHG emissions through common activities or sources. Inefficient regulation of GHG-related emissions can impede technical progress. Efficient regulation will also help improve market signals and make clean-energy sources relatively more competitive compared to their fossil-fuel counterparts.

Reward the social value of innovation.

The social value of research and innovation often surpasses what the innovators themselves can appropriate. These knowledge 'spillovers' represent a kind of market failure, because by receiving only a fraction of the benefits, innovators have only a fraction of the incentive to engage in RD&D. Studies of commercial innovations suggest that, on average, less than one-half of the gains from RD&D return to the originator, although appropriation rates vary considerably over different types of innovations. Basic research, in particular, is an excellent candidate for government support, as the commercial applications are often distant and unknown. The appropriation rates for climate-friendly technologies are likely to be relatively low, at least initially, and rising over time, which means that some extra support during the transition can help clean-technology development.

Promoting learning by doing

A sizeable learning effect, by which costs fall as experience and cumulative production grow over time, is another form of innovation that the market alone may insufficiently reward. One reason may again be spillovers—if techniques can be replicated, later competitors can enjoy the benefits of the experience of the early movers without shouldering their higher costs. In promoting learning, a key question is the degree to which one should differentiate among technologies. Learning rates are, however, likely to differ among emerging technologies and are difficult to predict. Nevertheless, significant cost-saving potentials may exist.

Other barriers may require more specific attention

Information. For markets to function, they require not only good property rights and competition, but also appropriate information. Improving the availability of information can allow better consumer and firm decision-making at lower costs. Information barriers may also arise between the public and private sectors. Private actors have better information about their own costs and potentials, and may have different perceptions about policies and prices than policy-makers. These asymmetries impede the design of efficient strategies for both stakeholder groups. As such, a negotiated agreement may be considered, e.g. in a case with shared uncertainty about future abatement costs between the regulator and business.

Standards. Still, perfect information may not be enough. Consumer uncertainty about energy prices and the quality and reliability of new technologies being offered can contribute to seemingly myopic behaviour. Poor choices can also arise when those making decisions about energy-using appliances and building features are not the same people as those using or paying for the energy. Coping with short payback horizons and different incentives for investors and users can require product-specific interventions, such as building codes and standards for energy efficiency and fuel economy.

Intellectual property rights (IPRs). IPRs can provide an important vehicle for enabling innovators to gain financial returns on their investments. On the other hand, poorly designed and enforced IPRs can create obstacles to diffusion. In case of producer firms, weak protection of IPRs adds to the hesitation in transferring to or sharing technology with other firms, which may slow down the overall process not only of diffusion but also of advancement of the technological frontier.

Financing. Risk and payback horizons also influence investment decisions. If the private perceptions of these factors do not align with those of the public, then policies may be needed to assist financing and manage risks for publicly desirable projects.

Technologies for which capital costs are very large are more likely to need preferential financing or guarantees to reduce private investment risks.

Developing country challenges. In developing countries the finance sector is particularly hesitant in supporting projects with new and climate-friendly technologies on account of their lack of capability to assess financial viability and their excessive reliance on the balance-sheet as a criterion of credit worthiness of project owners.

Some barriers are more closely linked to certain technologies

Scale economies. Economies of scale are an issue for many new technologies, causing high production costs for the first units. Policies to address this barrier can legitimately help some new technologies gain acceptance and get off the ground, but they should be careful to avoid extended support for uneconomic technologies. An example of a policy to address this barrier is the hybrid vehicle tax credit in the United States, which phases out after a certain number of models are sold.

Networks and infrastructure. Some technological options require new infrastructure and support networks in order to function. However, private actors are reluctant to take on activities that supply public goods, and most would prefer to wait for someone else to do it. The resulting network externalities are an important cause of 'technological lock-in', and public intervention may be required to change paths.

Tradeoffs. Many technologies that reduce GHGs may instead cause other environmental damages and risks, such as nuclear generation, which creates radioactive waste and security concerns. Public assessment of the tradeoffs is needed before allowing broad deployment.

Certain technologies may deserve preferential treatment

In addition to addressing important market failures and barriers, policy-makers may want to direct extra attention and support to certain kinds of technologies that have special potential. Some examples of especially desirable technologies are those that expand options and reduce costs of reaching deep GHG emissions reductions ('backstop technologies'), i.e. those that may have additional spillover benefits at home, and those that may have spillover benefits abroad, further reducing global emissions and improving the likelihood of more globally stringent GHG agreements.

Countries may have national RD&D deployment policies, but the development of new technologies is a global effort. Consequently, there may be opportunities for coordination (or free-riding, for that matter) and for specialisation. Technology-oriented agreements can be aimed at knowledge-sharing and coordination, research, development or demonstration, and even deployment. Due to differences in national skills and opportunities (comparative advantages), the large investments needed with uncertain payback, and positive spillover effects, international coordination and even collaboration makes sense.

Policy interactions

Policy-makers have enacted a variety of measures both to reduce emissions and to promote alternative energy sources. However, more policies do not always mean better outcomes, or more clean-energy technologies. In particular, when additional policies to promote renewable energy overlap with tradable quota mechanisms, the clean-energy policies can instead benefit the dirty sources.

Summary and options

Not all barriers to adoption of emerging technologies are market failures. Cost, reliability and quality issues, and risk are all legitimate aspects that the market should be allowed to weigh in. As a result, the main tools for encouraging climate-friendly technologies should be those that encourage the market to make good choices more generally: pricing carbon emissions and other environmental damages, removing distorting subsidies and barriers to competition and supporting RD&D broadly. Broad-based policies include RD&D tax credits, funding universities and research institutions, and other public support for research through competitive grant processes.

Some technologies face particular barriers, requiring society to make a decision of whether to support them, committing to major infrastructure investments or environmental risks. Other technologies may merit extra support, because they offer insurance against the possible need for deeper reductions, or because they have greater potential for being adopted in other parts of the world.

More specific policies are required to address particular market failures and barriers, including information requirements, energy-efficiency standards, building codes, and the like. In these cases, policies will generally be more effective, the more closely they target the specific market failure, as opposed to a specific technology.

International engagement is another component of technology policy. Recognising that climate mitigation and technological advances are a global effort, countries can leverage their own RD&D resources with international partnerships and agreements to encourage knowledge-sharing and broaden the markets for new technologies.

Ultimately, the biggest driver of technological adoption and change will be the mitigation policy, which determines the demand for those technologies. An additional advantage of emissions-pricing policies is their ability to generate revenue, which can help fund the complementary technology programmes.

ABOUT CEPS

Founded in Brussels in 1983, the Centre for European Policy Studies (CEPS) is widely recognised as the most experienced and authoritative think tank operating in the European Union today. CEPS acts as a leading forum for debate on EU affairs, distinguished by its strong in-house research capacity, complemented by an extensive network of partner institutes throughout the world.

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- Maintain the highest standards of academic excellence and unqualified independence
- Act as a forum for discussion among all stakeholders in the European policy process, and
- Provide a regular flow of authoritative publications offering policy analysis and recommendations,

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Energy and Climate Change
EU Foreign, Security and Neighbourhood Policy
Justice and Home Affairs
Politics and Institutions
Regulatory Affairs
Agricultural and Rural Policy

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