

# Science for Environment Policy

## Drivers of renewable energy innovation in the EU

**The effects of market regulation and environmental policy on eight types of renewable energy in the EU are identified in a study which examines nearly three decades' worth of data.** The researchers found that reducing entry barriers is a major driver of renewable energy innovation and that the ability of environmental policy to promote renewable energy innovation depends on the technology; for example, quota systems appear to work better with older technologies.

**Policy plays a key role in promoting renewable energy, and much research has been conducted to assess its effects on renewable energy innovation.** For example, previous [work](#) has shown that guaranteed price schemes (which guarantee a minimum price for energy producers for a specified period) and investment incentives (such as grants and other measures to reduce the capital costs of adopting renewable energy technologies) benefit the development of emerging technology, while obligations (requiring suppliers to provide a share of their energy supply from renewables) can be more effective for established technologies, such as wind power.

Other [research](#) has shown that market liberalisation (removing government control and opening up energy markets to private companies, as occurred in the 1990s in the EU<sup>1</sup>) also has a significant effect on renewable energy innovation.

Despite extensive research, little attention has been paid to the effects of these factors on individual technology types. This study, therefore, explored the effect of market regulation and environmental policies on eight individual renewable energy technologies, using data from 19 European countries. It looked at eight types of renewable energy — geothermal, hydroelectric, marine, wind, solar thermal, solar photovoltaic, biofuel and waste — over the period 1980–2007.

The data analysed included information on the number of renewable energy patents in each country (a measure of innovation) and the value of different environmental policies for innovation.

The researchers considered the effect of seven different policy instruments:

- 1) Government spending on research and development (R&D).**
- 2) Incentive (feed-in) tariffs** i.e. guaranteed price schemes, through which the energy authority obliges energy distributors to feed in the production of renewable energy for a certain number of years at fixed prices, which vary according to the various sources.
- 3) Investment incentives** i.e. capital grants and all other measures aimed at reducing the capital cost of adopting renewable energy technologies.
- 4) Tax measures**, such as tax credits or property tax exemptions.
- 5) Voluntary programmes** adopted nationally by stakeholders (such as government and public utilities) to buy energy generated from renewable sources.
- 6) Obligations**, which place a requirement on producers to provide a share of their energy supply from renewable energy.
- 7) Renewable energy certificates** — tradeable certificates used to document compliance with a quota system.

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1. In the 1990s, the EU began to open up the national electricity and gas markets to competition. The first liberalisation directives were adopted in 1996 (electricity) and 1998 (gas).

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2. A variable accounting for the accumulated stock of past innovation in renewable energy technologies; the results suggest that the creation and adoption of innovation has a dynamic effect through time, making future investment less expensive and more secure, through a learning process which diminishes overall innovation costs.

To assess the effect of market competition, the researchers used the OECD [Indicators of Product Market Regulation](#), which includes information on three different aspects of the liberalisation process: ownership (from 'private' to 'public'); third-party access to the grid (from 'regulated' to 'no access'); vertical integration (from 'unbundling' to 'full integration').

Overall, policy support, total historical renewable-energy innovation<sup>2</sup> and the level of entry barriers came out as the major drivers of innovation in renewable energy technologies. These were more influential than the size of the energy market and consumer preferences for green goods.

This study also showed that market liberalisation had a greater impact on renewable technologies which have lower 'developer intensity' (i.e. where patents are spread among firms, and there are no major market leaders) and more independent power producers, such as is the case for wind and solar thermal energy. In relation to the other components of market regulation, public ownership and unbundling has a low impact on renewable energy innovation.

The effect of individual policies also varied depending on the maturity of the technology. For example, more established technologies seem to be better regulated with quota systems, which reduce compliance costs for producers, while more emerging technologies benefit from demand subsidies and support for R&D.

Specifically, the effect of feed-in tariff was largest for solar PV, while R&D support had the most significant effect on wind and marine energy. Policy had no significant effects on hydropower, likely because it is a mature technology which is close to capacity in several Member States. Finally, market stimulus due to an increase in electricity prices had a significant effect on innovation in solar thermal, solar photovoltaic and marine energy.

Overall, the study shows that the magnitude of the benefits of environmental policies on renewable energy innovation depend on technological potential and are, therefore, strongest for wind and solar power. The researchers recommend specific policy support for these technologies in countries with the right environmental conditions, such as Denmark and Spain, respectively.

To close, the researchers warn that market integration in the EU (which can lead to few large energy companies dominating the market) could be a major concern for the future, as it may undermine market entry for new, innovative companies and the development of [distributed energy](#), which is highly efficient and benefits the environment by reducing emissions.

