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Viewpoint

Feed in or certificates, competition or complementarity? Combining a static efficiency and a dynamic innovation perspective on the greening of the energy industry☆

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Abstract

European policy on the greening of the energy industry has been characterised by a debate between proponents of two apparent polar opposites, feed in tariffs and certificate markets. Different European countries have chosen both mechanisms and, as a consequence, the European Union has maintained a fairly pluralist position, abstaining from stricter harmonisation.

Taking a dynamic innovation perspective on European energy industry, we argue that feed in tariffs and certificate markets should not be seen as competing alternatives, but rather as complementary regulatory instruments targeting subsequent steps in the product cycle, on the way from early technology-conceptualisation and development towards competitive positioning in mature energy markets. We see both policy instruments as necessary to achieve the extensive transformation towards sustainable development that is judged as important tools in the context of the global climate challenge.

Keywords: Renewable energy; Regulation; Innovation

1. Static efficiency and dynamic innovation perspectives

Our argument for complementarity rather than contradiction in the controversy between proponents of feed in tariffs and certificate markets, relies on a product cycle-based understanding of industrial development which is well known from both innovation theory (Abernathy and Utterback, 1978; Sahal, 1981; Foster, 1986), international trade theory (Vernon, 1966), and marketing theory (Kotler, 1967); and where static efficiency and dynamic innovation both have their place as illustrated in Fig. 1:

- the first phase of product development and growth is most adequately addressed within a dynamic innovation framework, with an emphasis on experimentation and learning (March, 1991; Lundvall, 2002);
- the second phase of maturation and product stabilisation is most adequately addressed within a static efficiency framework, with an emphasis on optimisation and efficiency (Samuelson and Nordhaus, 2005);
- the third phase of decline and withdrawal is most adequately addressed within dynamic efficiency terms, but this time with an added social dimension playing a major role, with an emphasis on transformation (Sapir, 2005).

Viewing greening of the energy industry from a product cycle perspective implies a focus on continuous development of technological solutions from early stage experimentation to mature competitive products to drive technological learning curves (Boston Consulting Group (BCG), 1968; Wene, 1999). Society must therefore have at its disposal a spectrum of policy instruments adequately addressing the different stages of product development.

The stages of the product cycle should, in other words, be used for policy/regulatory design, where each stage requires distinct and highly different policy interventions,

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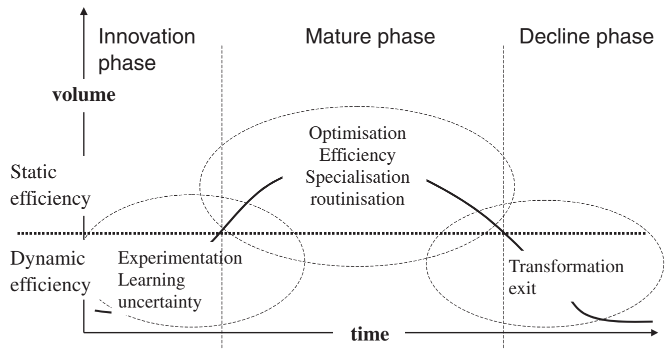

Fig. 1. Static efficiency and dynamic innovation concerns in the product cycle.

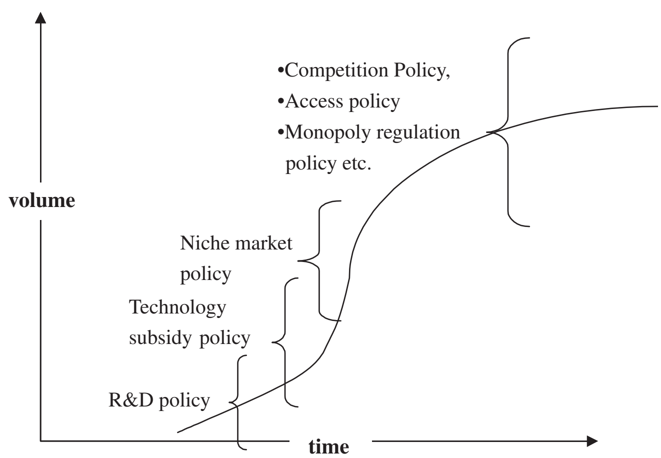

Fig. 2. Policy instruments/regulatory approaches in various sections of the policy cycle.

based on different mixes of dynamic innovation and static efficiency premises (Fig. 2). In the early innovative phase of the product cycle, the focus of government regulation should be on dynamic innovation-oriented regulation including R&D policies, technology subsidy policies and niche market policies. In the mature phase of the product cycle, relevant elements would be static efficiency-oriented regulation including competition policies, third party access policies and corporate governance policies.

Stimulus of early deployment, following the research and development phase, may probably best be supported by targeted measures such as feed in tariffs or specialised auctions. Such tariffs have the advantage of allowing differentiation and specific pricing of individual technologies, thereby permitting simultaneous development of a broad spectrum of technologies.

In later phases, where some technologies develop performance characteristics closer to established incumbent technology, niche markets, such as the certificate markets will probably provide a more adequate stimulus to further commercialisation before full competitiveness in the mainstream market is achieved. The new green technologies will then be exposed to general inter-technology competition and will have to win in this arena before being exposed to regular energy market competition in the next round.

The feed in tariffs and the certificate markets, thus, represent regulatory mechanisms adequately targeting different stages in the product cycle between early R&D and later full market deployment. The feed in tariffs only exposes the technology to a benchmark cost model for the relevant technology, sometimes even favouring suboptimal conditions by, e.g. giving extra support for windmills in locations with poor wind. The certificate-market, on the other hand exposes to cross-technology competition and gives no handicap-privilege.

2. German feed in tariffs and Swedish certificate prices

A comparison of German feed in tariffs and Swedish certificate prices (STEM, 2004; Midttun et al., 2005) may serve as an illustration (Fig. 3). The figure presents various technologies along the vertical axis, and price/cost in Eurocent per kW h along the horizontal. The horizontal bars represent the German feed in tariffs for various technologies, while the stapled vertical lines represent the Swedish elcert price at its lowest and highest level. The dotted lines represent the sum of the elcert price and an average electricity price in the Nordic market, for respectively, the low and high elcert price level. Since the feed in tariffs include the total subsidy per kW h the relevant comparison for the elcert price is the dotted line.

A striking feature when comparing the two approaches is the high degree of differentiation between technologies of the German tariffs. Tariffs above 50 Eurocents for photovoltaics and below 10 Eurocents for wind illustrate the difference in commercial maturity between the two technologies, and the need to differentiate tariffs to achieve successful development of both. A second observation is that the Swedish certificate prices, based mainly on bio-fuels, are far lower than the German wind tariffs, and much lower than special German tariffs for bio-fuel. Presumably, competitive pressure in the Swedish market stimulates a selection of more cost-efficient solutions than in the German feed in system.

However, the certificate system with free competition between all renewable technologies (except large hydro-power) is clearly not capable of supporting the broader development necessary to further subsequent generations of renewable technology. It could, therefore, plausibly lead to a technological lock-in to mature renewable technology without stimulating future next generation technologies. This is an argument for also having supplementary feed in regulation at early stages of technological development.

Nevertheless, keeping technologies within a feed in mechanism for too long would probably slow down technology development as well as entail foregoing an efficiency potential. When technology development takes place under stronger competitive pressure, as in the certificate model, it would probably stimulate the

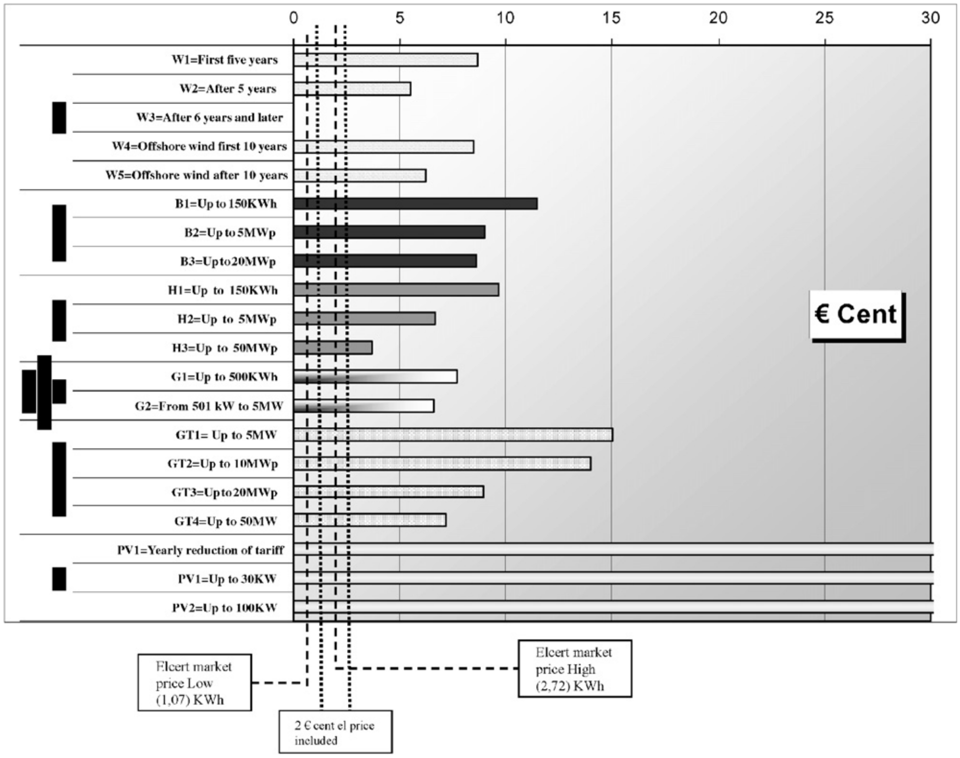

Fig. 3. German feed in tariffs and Swedish elcert prices. (*Source*: Senternovem (2005), STEM (2004), Midttun et al. (2005)).

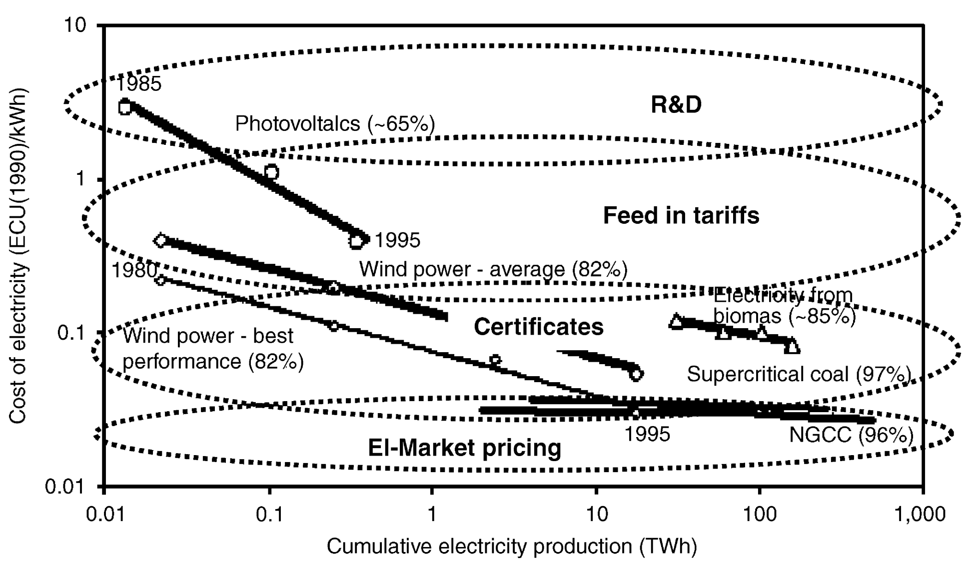

Fig. 4. Complementary support systems imposed on IEA's learning curve estimates. (*Source*: From IEA (2000)).

development of new business models and increase the fit between technology and market needs, thus pressing technology development further down the learning curve.

Market-based support, like the certificate markets, also lends itself more easily to internationalisation, with technology mobilisation on a regional or global scale. Internationalisation of renewable energy technology development would deliver advantages of scale and scope as well as traditional Ricardian advantages from international trade specialisation.

An IEA study of conversion of energy technology illustrates the extensive potential for innovation as part of the transformation towards a green energy system of the future. The complementary manner in which various policy measures may further introduce new renewable technologies can be illustrated by superimposing the policies we have proposed for technologies at various stages of the product cycle on the IEA (2000) study (see Fig. 4).

The lines descending from the right towards the left represent learning curves for various energy technologies, as presented by the IEA (2000). The dotted ovals represent the domain for various policy instruments, ranging from R&D support in the early high cost technology development phase, through differentiated feed in systems for proven technologies in a phase of early deployment, followed by certificates in a more mature phase and finally by the regular electricity market as renewable technologies can compete against dominant incumbent technologies.

If the necessary technologies are to be developed, it is not sufficient merely to develop the most competitive renewable technology currently available, as would be the case with an undifferentiated certificate market. Instead, it would be necessary to put in place a number of support schemes to create sufficient momentum in a whole range of technology developments. In this process, both R&D and feed in tariffs may be allotted a legitimate position alongside certificate markets (Fig. 4) at various stages of product development. Photovoltaics, being at an early stage would need R&D and specialised feed in, while biomass and wind would be ready for competition in a certificate market and on their way towards survival against traditional coal- and gas technologies.

3. Conclusions

We maintain that the European debate on feed in versus certificates does not sufficiently reflect the dynamic character of product development. When the product cycle is taken into consideration, there is a clear need for both elements. Rather than continuing a debate for or against given policy instruments, a more useful focus would be on how technologies may be phased through either of these support instruments on their way to the mainstream energy market.

Appropriate timing in the use of policy instruments is of great importance to further green innovation. Failure to differentiate at early stages might lead to technological lock-ins, while failure to promote competition and pressure for efficiency at later stages, when volumes are greater, might entail excessive costs and severe loss of industrial momentum.

To achieve the extensive transformation towards sustainable development that is judged necessary in the context of the global climate challenge, a broad and systematic policy mix is called for. In this perspective nationally based feed in systems should be supplemented by softer market deployment on an international scale that allows industrial specialisation to exploit diverse national resources and that allows mainstreaming of green industrial actors to provide sufficient scale and scope to achieve the transformation to sustainable energy development.

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