New innovative activities in renewable energy technologies and environmental policy: evidence from an EU candidate country

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Abstract

Innovative products, services, and business models can benefit the environment by reducing the pressure on natural resources and/or the emission of pollutants. At the same time, environmentally friendly innovation can foster economic development. It is likely that to solve an environmental problem like climate change, which is caused by emissions from virtually all economic sectors, we need innovations that can be of relevance to multiple sectors or the whole economy as well as systemic innovations requiring complementary changes rather than autonomous ones.

Our goal in this article is to answer the following research questions: what are the institutional factors that facilitate the diffusion of an international management standard in the area of the renewable energy? The most desirable task of all the economies perhaps is to strive for environmentally sustainable economic growth. In this context, renewable energy will be the mainstream source of the EU's energy supply by 2050.

Turkey has great potential in terms of renewable energy sources. However, public and political support is missing. The other unwanted situation is that although Turkey consumes less energy than EU countries, we have a huge population and high economic development. The management of energy demand should be strictly taken into consideration. Regarding the policy effects, the paper examines renewable energy policies of the EU and Turkey as a candidate country. Finally, the paper argues that Turkey has to make renewable energy the mainstream source of its energy system.

Keywords: The EU, Renewable Energy, Environmental Policy, Innovation, Turkey

1. Introduction

Climate change could negatively affect the quality of natural environment. Climate change frequently drives the need for increased efficiency of goods and services, particularly when resources are limited. The effectiveness of climate change management by any organization has an impact on its corporate reputation. Evolving consumer attitudes arising out of increased awareness of climate change creates a growing demand for such products. Climate
change also offers an opportunity to develop new low-carbon technologies and to consider the use of alternative fuels and energy sources in order to preserve limited resources.

Commission of the European Communities-CEC (2007) states that even with extreme efficiency measures, a significant amount of investment is required to meet the growing energy demand in the EU. Hence the CEC (2007) points out the need for EU members to invest in renewable energy as well as in energy efficiency. The commission argues that such investments are likely to lead to a knowledge based economy via encouraging innovation and also lower unemployment through job creation.

Therefore, according to World Bank, the coastal settlements of Turkey and Ukraine -the two middle-income states- are in a transition process of developing and updating their national policies towards sustainable marine resource management and environmental protection.

The question is, if oil and coal are destined to fall from their position as the world’s paramount source of energy, what will replace them? The world will rely on wind and solar power for a greater proportion of its energy within 30 years from now. According to the International Energy Agency, those energy sources will go from approximately 1% of total world energy consumption in 2008 to a projected 4% in 2035.

Therefore, in designing support frameworks for renewable energy technologies, managers of public-sector research funds seek to undertake effective ‘technology transition management’. The basic idea is to minimize the present value of the additional cost of supporting commercially immature technologies over the time needed before these technologies become cost-competitive. A currently popular approach for transition management can be captured by the idea of ‘descending the learning curve’. Experience curves (learning curves) describe how unit cost (that is, unit generating capacity cost or unit energy cost) declines with cumulative production.

The organization of the paper is as follows. In Section 2, we briefly review the literature related to environmental policy. In Section 3, EU’s innovative renewable energy policy is examined. In Section 4, we take the management side of innovation into account. In Section 5, we discuss the challenges faced by Turkey as an EU candidate country. Last section is devoted to the conclusions.

2. Theoretical Background

If we would be able to move to an economy that runs entirely on renewable energy, then energy rebound would not be a problem anymore since all extra energy use would be renewable. Apart from specific environmental problems associated with the (large scale) application of renewable energy such as noise (wind turbines at land), disturbance of marine life (wind turbines at sea), use of scarce materials (solar PV), and scarce land use and possible impacts on food production (biofuels), an important question is how efficient renewable energy technologies can become in terms of their use of labour, capital and energy itself. One composite measure that has been proposed to capture this is the energy return on (energy) investment or EROI (Murphy Hall, 2010).

Energy-technology innovation (ETI) is the “set of processes leading to new or improved energy technologies that can augment energy resources; enhance the quality of energy services; and reduce the economic, environmental, or political costs associated with energy supply and use” (Gallagher, Holdren and Sagar, 2006). Articles with a broader technological scope are those by Popp (2002) on energy-saving innovations and by Jaffe and Palmer (1997) and Brummermeier and Cohen (2003) on environmental innovations. More broadly, recent work by a number of innovation economists (Henderson and Newell, 2009) suggests that an effective innovation system has three key elements: (i) accelerating demand for new technology; (ii) institutions that support abundant generation and dissemination of fundamental scientific and technical knowledge; and (iii) a vibrant, competitive private sector.

But it is not only R&D in the energy sector itself that will be influenced by profit incentives arising from the increase in real energy prices. Indeed, a macro perspective regarding the consumption of energy as part of the macro-economic production process and its relation with R&D efforts that are driven by economic incentives may be a far better starting point for the analysis of the effects of incentive driven technological change in environment-economy models (Zon and Yetkiner, 2003).
There is no doubt that with enough time available, we will be able to achieve almost anything in terms of renewable energy technologies, of course within thermodynamic limits. But time is not on our side. This is illustrated by history, which shows that the full realization of energy transitions in specific countries, such as (from wood) to coal, to oil, and to electrification took some 200, 85 and 65 years, respectively (Huberty and Zysman, 2010). In addition, it is likely that to solve an environmental problem like climate change, we need innovations that can be of relevance to the whole economy.

Thus, apart from technologies, agents or “environmental innovators” can be characterized. Kemp and Pearson (2008) consider three types that are essential to understand environmental innovation and diffusion. First, strategic eco-innovators develop eco-innovations (equipment, services) for sale to other firms. Second, strategic eco-adopters intentionally implement eco-innovations, whether developed in-house or acquired from other firms. Finally, passive eco-innovators adopt process, organisational and product innovations that result in unintended environmental benefits (e.g., more energy-efficient equipment) (Bergh, 2011:12).

However, if effectiveness and efficiency gains in the sector take place at the expense of a rapid uptake of renewable-based energy supply, this is clearly a suboptimal result from a dynamic efficiency perspective. As mentioned, there is a commitment in Europe dictating that in the long run, all energy production must be sustainable as well as cost-efficient (Kaloudis, 2008:105). Furthermore, most attention has focused on a well-targeted set of climate policies, including those targeted directly at science and innovation, which could help lower the overall costs of mitigation.

It is important to stress, however, that poorly designed technology policy could raise rather than lower the societal costs of climate mitigation. To avoid this, policy could create substantial incentives in the form of a market-based price on GHG emissions, and directed government technology support could emphasize areas least likely to be undertaken by the private sector. This would tend to emphasize strategic basic research that advances science in areas critical to climate mitigation (Newell, 2010: 266).

On the other hand, countries with comprehensive climate policies comprise no more than 25 percent of the global carbon emissions today. Their policy takes the form of a binding cap on emissions valid for the period 2008-2012. This cap includes an “offset” scheme, the so-called Clean Development Mechanism (CDM), whereby abatement of carbon emissions, to comply with the overall cap, can be purchased from countries that do not have a climate policy. An objective of the CDM is to make it easier (and less costly) for emitters in the policy countries to abide with these countries’ overall emissions cap (Strand, 2011:2).

3. Renewable Energy Management Practices and Innovation

Renewable energy sources (RES) may have a proactive role in the energy needs of buildings for the energy demand management. New buildings should be designed according to green technology. They can be used efficiently in heating, cooling, lighting or ventilation. After transportation, the building sector is accepted as the biggest sector that consumes energy (Kepenek, 2009: 6).

To achieve emission reductions in an economically efficient way, the importance of technology sharing and joint investments into research and development (R&D) has been noted. Only if renewable technology is substantially improved will countries voluntarily substitute their conventional fossil technologies in a meaningful way and thus cut their greenhouse gas emissions sufficiently (Nax and Norman, 2011: 2).

In this context, there are several very simple ways to account for risk and uncertainty in environmental economics and policy development. These include:
(i) Clearly defining the problem to ensure that the researcher thinks through any possible risks or issues of uncertainty and considers how they may affect the research or policy in question;
(ii) Utilising existing frameworks such as Adaptive Management and the Precautionary Principle which have been created for problems such as those in environmental economics and their resulting policy options;
(iii) Being aware of, and accounting for, the different perceptions and attitudes towards risks of different actors within the system, especially the general public (Lobb, 2011:9).
According to the Figure 1 above, the Adaptive Management focuses on four main aims:

1. To bound management problems in terms of explicit and hidden objectives, practical constraints and factors in policy analysis;
2. To represent all known systems in terms of dynamic behaviour with clear assumptions and predictions to allow learning from error;
3. To represent uncertainty through time in relation to management actions using models consistent with experience to lead to improved productivity;
4. To design balanced policies that provide for continuing resource production whilst increasing understanding - e.g. use of decision tables or matrices.

In summary, there does not appear to be a clear or a single ‘solution’ to the problem of uncertainty in a policy framework. Essentially a holistic ‘adaptive management’ approach is needed and this should be taken ex-ante and ex-post in the policy process where possible (Lobb, 2011:41).

3.1. Applying Learning Curves for Transition Management

In designing support frameworks for renewable energy technologies, managers of public-sector research funds seek to undertake effective ‘technology transition management’. The basic idea is to minimize the present value of the additional cost of supporting commercially immature technologies over the time needed before these technologies become cost-competitive. Support can take on various forms, notably RD&D subsidies, investment support and direct market support (volume support, price support) by public funding and strategic cross-subsidisation by private firms. A currently popular approach for transition management can be captured by the idea of ‘descending the learning curve’. Experience curves (learning curves) describe how unit cost (that is, unit generating capacity cost or unit energy cost) declines with cumulative production (Jensen, 2003: 62).

The findings about climate friendliness show that firms with better management practices are, on average, more productive (Bloom and van Reenen, 2007) and more energy efficient (Bloom et al., 2009). It is also suggested that EU
should support research on technologies with an indirect but considerable environmental impact, most notably ICT. Technologies for monitoring energy management in households could be another area for further inquiry with a potential for innovative solutions for reducing energy waste (Kaloudis, 2008: 98).

In the energy industry, it is recognized that the countries that had environmental management policies and renewable energy resource management programs have been gaining competitive power within the industry and the world (Ekmekçi, 2011: 55). In particular, firms have more climate friendly management practices ceteris paribus if climate change issues are managed by the environmental or energy manager. This fact concerns the adoption of targets for both energy consumption and GHG emissions as well as the participation in voluntary policies aimed at improving energy efficiency. Moreover, the hierarchical proximity of the climate change manager to the CEO is associated with firms adopting more strategic practices such as product and process innovation related to climate change, as opposed to operational practices such as energy monitoring (Martin, 2010: 42).

The rationale for sustainable entrepreneurship, therefore, involves more than the coincidence of business interests and environmentally related innovations. It concerns the coordination of, and negotiation between, multi-contextual and inter-generational interests involving economic, social and environmental discourse. From this perspective, environmental entrepreneurship concerns connections between the futures of multiple stakeholders in business, organizational, governmental, social and environmental contexts (Fletcher, 2010: 86).

3.2. Renewable Energy Investments

According to Fairbank and Barley (2008), the countries and companies should act for the creation and development of renewable energy resources and work for the sustainable energy resource management. For this aim, it is suggested that the countries and the companies should enact legislation supporting investment in renewable green energy developments, more specifically for the renewable energy and job creation Act of 2008.

The pace of economic growth may have different impacts on environmental efficiency and productivity. A higher rate of growth might encourage investments in technological innovations and lead to more sophisticated and more efficient plants, or it might stimulate more efficient employment of resources in order to meet the increasing energy demand (Jaraitė, 2011: 12).

Meanwhile, investment in environmental innovation and related R&D may have crowding-out effects. This has received attention in recent studies on innovation and climate change. Crowding-out is a term that has been used in different contexts. It can be generally defined as an unintended effect of a policy that frustrates the intended beneficial outcomes of it. A much mentioned example in the context of environmental policy is that price regulation may crowd out intrinsic motivations and associated voluntary action, which can result in a smaller ultimate or net effect on behaviour than a-priori expected or planned. Other crowding-out effects of climate policy involve environmental R&D reducing investments aimed at improving the productivity of labour (education) and capital (general R&D) (Bergh, 2011: 8).

One of the main investment barriers to new renewable energy capacity is the lack of certainty which private investors have in the end-market for clean technologies (the adoption hurdle). Without a clear expectation of demand for their product or service and therefore future revenue streams, private investors will typically under-invest in R&D or not take on the financing risks of commercial scale demonstration (Knight, 2011: 14).

Management practices explain a great deal of the dispersion in energy intensity across firms within a sector, even after controlling for size, age, and other exogenous firm characteristics. Perhaps more important from a climate policy perspective, however, is our finding that several such factors are also associated with the firm’s innovation of cleaner processes and products. While causal inference is beyond the scope of this study, we cautiously interpret our findings as evidence that management practices and organizational structure of a firm are crucial for its ability to use energy more efficiently both today and in the future, and to respond to public policy in this area (Martin, 2010: 43).
Thus, the response of technology to policy leads to a more optimistic scenario than that emerges from models with exogenous technology; in particular, environmental problems can be solved with only temporary intervention and without causing major long-run distortions. However, directed technical change also calls for immediate and decisive action in contrast to the implications of several exogenous technology models used in previous economic analyses (Acemoğlu et al., 2009: 40).

In this context, the Porter hypothesis has been suggested. This hypothesis states that stringent environmental regulation can create a win-win situation in the sense that next to the environment, economic competition is improved through better management, innovation and first-mover advantages (Porter and van der Linde, 1995).

4. Environmental Policy Implications in the Light of EU’s Energy Policy

The application of the EU framework in environmental economics is similar to other areas of economics, with popular methods such as Pareto Optimality and Contingent Valuation based on EU theory. However, there is evidence that conventional EU theory (linear probabilities) does not apply in the context of less clearly identifiable risks or true uncertainty; these are important for the development of environmental policy because it shows that there are reasons why alternative theories should be considered over standard EU theory (Lobb, 2011: 19).

In 2006, the ‘Mobilising public and private finance towards global access to climate-friendly, affordable and secure energy services: The Global Energy Efficiency and Renewable Energy Fund’ [COM(2006) 583] has been communicated by the European commission to the Council and the European Parliament. It is a proposal to 'set up a global fund of risk capital with a budget of 100 million to mobilize private investment in projects promoting energy efficiency and renewable energy in developing countries and emerging economies’ (EU, 2007).

Moreover, the EU can be considered as the pioneer institution in the promotion process of renewable energy sources, in environmental and energy policy issues. But, successful implementation of energy policies is the main problem for the EU. The relationship between energy, environmental, economic and social policies and also the policies of member states should be prepared in a coherent way (Kepenek, 2009: 17).

Additionally, the EU developed different sustainable development instruments to ensure a union-wide sustainable development management, which are shown in Table 1 below.

Table 1. Sustainable Development Instruments

| Instrument | 
| --- | 
| Environmental indicators | 
| Strategy on the sustainable use of natural resources | 
| Strategy on the prevention and recycling of waste | 
| Action plan in favour of environmental technologies | 
| Competitiveness and Innovation Framework Programme (CIP) 2007-2013 | 
| Program for clean and competitive SMEs | 
| Promoting corporal social responsibility | 
| The Global Energy Efficiency and Renewable Energy Fund | 

Source: Oberer and Erkollar, 2011.

Renewable energy policies should be assessed in an integrative way with respect to their potential contribution to the three main pillars of energy policy, that is (1) the competitiveness of the EU economy, (2) the security of energy supply and (3) environmental protection at local and global levels. Current renewable energy policies put the emphasis on facilitation of fast market penetration through ambitious target setting (Jensen, 2003: 12).

The following list shows the most important technologies to be developed in European energy production in the years to come:

- [ ] Hydrogen economy
- [ ] Wave power
- [ ] Wind power
- [ ] Solar power/photovoltaics
- [ ] Hydroelectricity
Tidal power □ Ocean energy □ Ocean thermal energy conversion □ Geothermal power □ Biofuels
□ Marine current power □ Biomass (Kaloudis, 2008: 85).

On the other hand, research on climate change has intensified on a global scale as evidence concerning the costs of global warming that continue to accumulate. Confronted with such evidence, the EU set in late 2006 an ambitious target to reduce its greenhouse gas emissions by 2020 to 20%, below the level of 1990; and invited the rest of the developed economies and the developing world to take part with the Kyoto Protocol (Telli, 2008: 1).

Thus, technological change is a key driving force behind a sustainable energy future, ensuring a secure energy supply that is far less carbon-intensive than is now the case. With increasing awareness about the likely impacts and costs of climate change, much attention is being given to power generation from renewable sources. Several types of such technologies are available, but they are usually not competitive with the use of fossil fuels. Their larger-scale adoption is still dependent on technological innovations and further improvements to reduce costs. Innovation is no panacea for climate change, but it is a crucial factor in reducing greenhouse gas emissions and limiting the costs associated with that task (Braun, 2009: 1).

The EU further announced plans to go further and declared that it would raise its targets to 30% below the 1990 levels by 2020 to encourage the rest of the developed economies and the developing world to take part with the Kyoto Protocol. With the EU, Turkey has some joint programmes, SAVE, ALTENER I-II for the structuring of legislative and executive bodies in the energy sector. Turkey does really need a proper energy vision with definite targets and models. The future projections should be logical and coherent with other social and economic ideals. Moreover, R&D activities and scientific research are very weak and the efforts for RE cannot be strengthened due to the said deficiencies. The EU membership process will be very beneficial especially in terms of establishing an energy vision. Turkey has to increase its international co-operation with the EU and neighbouring countries in terms of energy (Kepenek, 2009: 12).

Last but not least, since the level of the required environmental investment, even with strong political will, was a tremendous challenge for all the candidate countries, significant financial support provided by both the EU and international financial institutions has played a great role in their compliance with the EU environmental acquis (Tisma, 2010: 263). In the accession negotiations, the EU granted the candidate countries several long transitional periods for the particularly heavy investment provisions of the EU environmental legislation, in particular in the area of waste water treatment (Kraemer, 2002: 46).

5. Challenges Faced by Turkey as an EU Candidate Country

As in many countries, decision-makers in Turkey are facing a dilemma between the use of relatively rich and cheap domestic fossil resources to get rid of the energy bottleneck and external dependency and the use of domestic renewable resources to be environmentally friendly and climate conscious (Bali et al., 2011: 2). Turkey is a dependent country in terms of energy with around 70% imported sources. However, instead of promoting new domestic energy sources, Turkey has decided to focus on securing the energy supply. For the last 10 years, a liberalization process has been chosen as a policy tool in terms of restructuring the energy market. On the other hand, due to her geographical position, Turkey has great potential in terms of RE sources. But public and political support is missing. The other unwanted situation is that although Turkey consumes less energy than EU countries, she has a huge population and high economic development, but she cannot use it efficiently. The management of energy demand should be strictly taken into consideration immediately. But, firstly, a definite energy policy vision is required (Kepenek, 2009: 3-17).

We have chosen Turkey as a case study firstly because it is an emerging economy and a candidate country for full membership to the EU. Turkey needs to adjust her infrastructure, economy, and government policies (including environmental, energy, and growth policies) to make them in line with the EU requirements. Secondly, with a 72.6%
rise in GHG emissions in 2000-2004, Turkey has the fastest growing emissions in the world (UNFCCC, 2006), although her per capita emissions and per capita GDP are among the lowest ones of the countries in Annex 1 of the Kyoto Protocol (Soytaş, 2007: 3).

Turkish environmental policy is at a crossroad. As part of its bid for full membership to the European Union, Turkey is under significant pressure to comply with the Kyoto Protocol and to constrain its CO2 emissions and other gaseous pollutants over the next six years. Yet, as a newly emerging, developing market economy, Turkey has not yet achieved stability in its energy utilization and gaseous emissions either as a ratio to its GDP or in per capita terms. Turkey is among the 25 countries with the fastest rate of growth in industrial use of energy sources (OECD, 2004). Thus, as part of its accession negotiations with the EU, Turkey will likely to face significant pressure to introduce its national plan on climate change along with specific emission targets and the associated abatement policies (Telli, 2008: 2).

Another much debated option for Turkey is nuclear power. Nuclear power is the cheapest carbon free energy source and is not subject to fuel price changes (CEC, 2007). High standards of safety, security, and nuclear waste management may push the costs up, not to mention the dependence on imported technology in the case of Turkey. Furthermore, at current consumption levels the proven reserves of uranium will last about 85 years (CEC, 2007). Turkey may have a big potential in improving her energy efficiency as an emerging market and a big responsibility as a future member of the EU. The EU target is to reduce energy use by 20% by 2020 (CEC, 2007). Hence the CEC (2007) points out the need for EU members to invest in renewable energy as well as in energy efficiency.

One of the crucial missing points of developing countries like Turkey is the lack of a green tradition. That is to say, environmental and energy ideals/way of life have/not been so well developed. The old generations did not grow up with the importance of health and a green world. For example, the first wind turbines were installed in the 1920s in Denmark. In Turkey, energy was considered first after the 1960s in the First Five Year Development Plan and its first wind turbine was established in 1998. For that reason, due to this historical absence, the awareness related to these subjects has remained always weak either publicly or politically. Education can make a great contribution in that sense. (Kepenek, 2009: 14). Therefore, Turkey has become more crucial for the attainment of the EU external energy policy objectives. However, Turkey may have reached the limits of its willingness to cooperate on energy security without more decisive EU reciprocation of Turkey’s own EU membership efforts. In the short run, Turkey is not essential to the EU, but in the longer run, as European energy needs become more pressing, the EU may have to give more serious consideration to Turkey’s accession (Tekin, 2009: 1).

Specifically, in the reference abatement-investment scenario, we follow the State Planning Organization (SPO) estimates and implement energy-saving (CO2 emission-reducing) abatement-investments of 1.5% of the GDP in 2006-2020. The SPO’s estimate is that such investments will help reducing the energy-input related emission coefficients by 5% (Telli, 2008: 18). In this regard, Turkey is facing an investment problem. Regardless of which alternative energy sources she wants to develop or utilize, a large portion of this investment would be through accumulating capital based on imported technology. In order to reduce dependence on imports, Turkey needs to adopt a strategic long term plan in technology development (Soytaş, 2007: 16).

6. Conclusions

The most desirable task of all the economies perhaps is to strive for environmentally sustainable economic growth. According to the United Nations Human Development report and to water specialists like Professor A.K. Biswas, the problem is not one of scarcity, but mismanagement. Leaking taps in the developed world waste more water than is available to the billions of people in the developing world who need it.

The shortage of energy supply and global warming represent daunting challenges for the EU. It is time to invest more in renewables such as wind, hydrogen energy and solar power. In this context, renewable energy will be the mainstream source of the EU’s energy supply by 2050s. Renewable energy is the competitive advantage of the EU and the key to a sustainable 21st century economy.

As a candidate country for the membership to the EU, Turkey should seriously pay attention to the issues of renewable energy and environment. Unfortunately, the idea of renewable energy is not discussed adequately in
academic and political circles in Turkey. In this respect, the EU membership process will be very beneficial especially in terms of establishing an energy vision for Turkey.

To recapitulate, this study has presented evidence that a number of climate friendly management practices are positively associated with climate friendly innovation. An important policy implication of this result is that some of the managerial factors that facilitate energy efficiency investments could also promote clean innovation, thus leveraging their beneficial effect. The empirical link between existing climate policies and innovation is weaker, which suggests that the design of these policies could be improved to align them with long-term mitigation objectives (Martin et al., 2010). Finally, we have to make renewable energy the mainstream source of our energy system. At the same time, we should not wait for environmental innovations to arise spontaneously through business and market incentives in the absence of stringent environmental regulation and specific technological policies in the EU and Turkey.

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