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Renewable energy in European Regions

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Abstract

Progress in renewable energy despite its costs is explained on the argument that renewable energy generates high grade outputs that compensates for the costs. The use and production of renewable energy diversify resource-wise and location-wise to enable such high grade outputs. Five cases illustrate various regional approaches. An investment program in one of the regions shows a high potential social benefit of renewable energy use. Regional policy instruments in addition to the (inter-)national instruments are presented. Action-oriented research in support of the regional initiatives in renewable energy is advocated.

Keywords:

Renewable energy, communities, regions, innovations, policy

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1. Introduction

The European Union (EU) policy aims at a shift in energy system from fossil fuel to renewable energy as a way to secure energy supplies and mitigate climate change (Directive 2001/77/EC). However, the main energy resources, which are biomass and waste, hydro-, geothermal-, solar-, and wind energy, are considered too costly for large scale implementation compared to fossil fuels (EU, 2008). Steger et al. (2005) point out that the issue how to foster the shift is a major challenge, in particular regarding controversies about EU instruments that could close the gap between the costs of fossil fuels and renewable energy, like caps, taxes, feed-in tariffs, subsidies, and so on. In the wake of this debate, regional and communal initiatives mushroom such as communal bio-fuel plants, small scale hydropower, solar energy networks, windmill co-operatives, electric transport, renewable energy competitions, solar-based products for tourism, and others. The emergence of such initiatives, which is the subject of this paper, creates opportunities for the cost-effective use of renewable energy technologies and high social response to the envisaged shift in energy systems.

The opportunities can be explained with use of mainstream economic theory. The explanation is that innovations have two effects on production function: costs reduction of production inputs and higher grade outputs for users (Helpman, 2006). The cost-reducing effect is usually observed and widely acknowledged. In the energy studies it is often presented as a learning curve of renewable energy technology. The higher grade outputs are less tangible because the benefits are generated in the life cycle of products, which is difficult to pinpoint. Life cycle costing can point out the higher grade outputs and specify the benefits throughout the history of production, consumption and disposal case by case, but such statistics are not available (Krozer, 2008). The higher grade outputs of renewable energy for energy system can be backstop of high fuel prices, coverage of peak demands, electricity co-generation, users' self-management and others entailing benefits such as lower prices, process stability, efficiency increase, stakeholders' involvement and so on. Therefore, amplifying the higher grade outputs of renewable energy could be an attractive addition to the policy debate about the shift. The question addressed in this paper is how to foster high grade outputs that contributes to the shift envisaged in the EU policy?

In this paper, we discuss the high grade outputs of renewable energy within mainstream innovation theory (section 2). Then, we show that the trends in the EU are geared towards diversification of renewable energy resources and divergence in implementation of the EU countries (in section 3), as well as variety of local and regional response (in section 4). Various regional policy instruments are pointed out (section 5). The paper concludes with advocacy for inter-regional policymaking (section 6).

2. High grade outputs of renewable energy

The high grade outputs of renewable energy can be explained within the framework of mainstream innovation theory albeit with some adaptations. In the theory it is acknowledged that innovations come about through people and organisations that develop and supply new products and services in their own way to satisfy customers' demands and gain a profit, and that the customers buy innovations due to demands for new qualities and lower costs. It is also approved that innovations do not emerge spontaneously in view of the demands because the innovation process is costly and time-consuming, whereas the rewards after the realization are

uncertain. When starting the innovation process it remains the question in how far research will result in a design, and then if the design can be demonstrated to a potential customer and ultimately manufactured and sold at a profit. In addition, it is uncertain what qualities and characteristics innovation must possess to satisfy the demands of potential customers in the future, the early adopting customers' are uncertain about the use of a new products because it can fail during life cycle and it is not clear what conditions are needed to realise the qualities desired, such as: a new infrastructure, changes in taxes, rules and legislation, behavioural adaptations and the like. In sum, the technological path and market development are uncertain and the requirements from the developers and adopters perspective can substantially differ (Stoneman, 1983; Ganguly, 2000). In result, innovation is a process of trial and error with negotiations between stakeholders about specification in which technologies are adapted to customers' demands through testing and vice versa customers' quality perceptions of new products and services change (Christensen, 2000, Farson and Keyes, 2002). Regarding the uncertainties, the developers' perspective on rewards must be highly motivating and attributes of innovations must be very attractive for early adopters. It also holds for the energy products.

It is not surprising that innovations in energy are driven towards higher grade products. Presently, one can distinguish two basic objectives for the innovations. One basic objective is higher effectiveness of energy products that is higher useful energy per resource volume. This can be reached through decarbonisation of fuel resources, which means reducing share of carbon compound per unit of energy. Hence, transition is ongoing from coal, through oil towards gas and possibly hydrogen in some future, and note that renewable energy is not per se more effective. Another direction is flexibility and convenience in use of energy, which enlarges customers' value of energy, even though effectiveness is lost. Here, the objective is valorisation that does not necessarily lead to an overall higher effectiveness. Higher grade energy products can be observed, for example electricity has about a few times higher value than the primary energy resource per energy unit. A unit energy in a battery is even thousands times dearer than unit of primary resource. Higher grade energy products pay. Similar holds to renewable energy. A small premium of a few percent is paid for the electricity based on renewable energy compared to the electricity based on fossil fuel but solar-based products for tourism, mobility, microelectronics and other uses can be very rewarding. Examples of PV products with the attributes of flexibility, freedom, spirituality and even sex appeal do pay. Valorisation of renewable energy, therefore, fosters the shift from fossil fuels to renewable energy.

3. Divergence in renewable energy

The valorisation is largely due to customizing of renewable energy use to the specific uses. Apparently, the trend towards customizing of energy production can be found. This hypothesis is based on the estimates of the average annual growth of the energy use per unit GNP and the fossil fuel productions in comparison with renewable energy production, which is done with the Eurostat data for the EU countries. It is estimated for the period 1996-2006, which is divided in the sub-periods 1996-2001 and 2002-2006 that correspond with the periods of low respectively high international oil prices. The standard deviation between the countries' average growth is used as the yardstick for the convergence, or divergence. A larger standard deviation between the countries' growth indicates divergence.

The annual energy use per unit GNP in the EU decreases by about 1% in almost all countries; standard deviation is low and nearly the same in the subsequent periods. The annual fossil fuel production in the EU also decreases by about 1% but there are differences between the

countries; standard deviation is larger compared to the energy use but nearly the same in the subsequent periods. These results indicate that the countries' energy systems evolve in the same direction and that the pace of changes does not differ much. It is different for the renewable energy production. The EU production has grown by about 5% a year. All types of the renewable energy production have grown, except hydropower, and all countries increase their annual average renewable energy production, except France. The renewable energy production differ between the countries and the increasingly diverge between the EU countries; the standard deviation of the countries' growth is large and it increases in the subsequent periods. For example, Sweden, Latvia, Finland, Estonia, Austria and Portugal are per capita the largest producers, whereas Germany, Czech Republic and Hungary are the fastest growers, but the United Kingdom, Netherlands and Poland are the smallest producers and slow growers. The divergence also holds for the specific resources; the standard deviation is large in all cases, except hydro, and it increases in the sub-periods, except for the wind energy that has the highest growth rate and the largest divergence between the countries. In sum, the renewable energy production in the EU countries increasingly diverges with respect to its volume and resource use; renewable energy is still largely based on biomass & waste energy and hydropower but solar and wind energy grow at much faster rate.

4. Divergence in policymaking

The divergence can be due to the differences in regional conditions. It is argued that socio-cultural skills and conditions enable innovations due to tacit knowledge embedded in a region. The notion of an innovation nexus that means concentration of knowledge and business networks that enable innovations is considered pivotal for regional development (Cooke and Morgan, 2000; Hospers, 2004). A renewable energy nexus can be found in several regions in Europe. Five regions are briefly described using materials of WW PR & Organization (2008) to illustrate differences in the set up of a nexus.

The Ökoregion Kaindorf (Berzik Hartberg in Austria on 6.815 hectare, 5.490 people) started in 2007. Six communities created an association for sustainable future. Its focus is on energy for mobility and households with regards to climate change. Mainly biomass and waste is used because it is an agricultural area. In 2007 the biofuel powered electricity and heating started, which reduced 540 tonnes CO₂ per year. Two energy producers started a co-operation for electricity supply from renewable energy, which reduced 8800 tonnes CO₂ per year. In mobility, the first biofuel pump is realised mid- 2007 and within half a year 180.000 liter of biofuel is sold, which reduced 375 tonne CO₂. The new issue is the electric mobility, in particular establishing charging points. Electric scooters and bikes are introduced. The bicycles routes are in progress. The main instruments is social involvement. Each topic has a working group with a chairman, targets and progress is monitored. Transparency about efforts and achievements is considered crucial; internet-based model enables to exchange information. The aim is reduction of CO₂ by 50% in four years and by 80% in eight years, eventually to compensate for CO₂ in other regions. In this regions a number of individuals have taken the lead. Network is essential for progress.

Navarra, (north of Spain on 10,421 km², about 600.000 people) started in the eighties with building small hydropower plants. In the late eighties a renewable energy company EHN is established with 48% public capital. The regional political party Green Peace was initiator of this process and it is still a driving force. Studies into wind and sun energy started in 1992, the first wind turbine of 500 kW is installed in 1995. EHN is crucial in implementation. It provides turn-key services including installing and payments for electricity. To inform people,

EHN has build windfarm close to the city as a showcase. In 2007 the renewable energy production was about 195 MWe from small scale hydropower, 935 MW windpower, solar electric 5 MWe and thermal 14.5 MWth, biofuel 1.8 MW. Feed-in tariffs is the main policy instrument. Solar energy is also promoted through tax deduction up to 20% of its costs. The renewable energy covers about 60% of all electricity demand in the region. About 40 businesses started and some established companies provide renewable energy. About 5000 employees at different levels are involved, which attracts young people. In his region regional politicians have taken the lead. Public-private company is essential for implementation.

Emden (northwest Germany 51,700 inhabitants) is industrial town (e.g. Volkswagen plant). Stadtwerke Emden that supplies energy and water delivers 6 MWe windenergy to 5500 inhabitants and the aims is to cover all households in five years. In 1991 the company started the renewable energy program despite uncertainty about the costs and fees associated with renewable energy because it wasn't government priority by that time. Stadtwerke Emden took the lead and it gradually received citizens and political support. Meanwhile, Emden attracted the largest windmill production plant in Germany. The limitation of windpower is discontinuity of supply because of the changing weather and the company works on electricity storage. An area for the future is geothermal energy for heating from 3000-4000 meter deep. In this area, there is co-operation on national level. In this region the municipal company has taken the lead. It is still essential for progress.

City of Freiburg (southwest Germany 205,000 people) has the reputation of Germany's "ecological capital" due to network of stakeholders that has emerged after anti-nuclear power campaigns in the seventies. Its renewable energy policy is focused on: conservation, new technologies and new uses. Energy conservation covers housing insulation, renovation, and for new houses stricter than national energy demands. Examples are an ecologically designed district Vauban and "Solar Village" Schlierberg with 50 energy producing houses, using solar and biomass. Technologies are developed in the institutes like Fraunhofer Institute for Solar Energy Systems and Solar Training Centre. Solar-Fabrik produces solar modules (130 people) and it is 'zero emissions', powered by 570 m² PV and biomass co-generator. The Solar policy address PV installations, solar thermal, sunrooms or "wintergardens", passive solar design, solar cooling, solar insulation that converts the solar heat from walls into useable thermal energy and others. Key instrument is feed-in tariff that obliges electricity distributors to accept electricity from renewable sources at 0.457 euro per kWh compared to average 0.15-0.20 euro per kWh. In addition, the regional energy supplier Badenova, owned by a number of municipalities in the region, offers an investment subsidy for PV based on small voluntary surcharge on electricity bill (about 10% of its customers participate in this "Regiostrom"). Renewable energy covers only 2% of all energy demand; the aim is to cover 10% in 2010 from biomass and wind. Geothermal energy is investigated. In this region initiatives are taken by the stakeholders and progress is largely due to local initiatives.

Fryslân (province of the Netherlands 643,000 inhabitants) started with renewable energy program in the eighties. The region has launched energy saving lamps, it hosted one of the first wind energy companies and the municipality of Terschelling was one of the first worldwide with solar energy. Thereafter, several others by international standards trailblazing actions can be pointed out. By the end of the nineties several low-energy housing projects and even a CO₂ neutral housing are developed and awarded in Europe. It is aimed to scale up to 2000 houses. In mobility, tourists' solar boats operate; gas and bio-fuel stations are constructed. The international race with solar boats is developed and awarded in Europe. There are many initiatives but little progress in scaling up of these activities. Individual

policymakers and businesses are usually the initiators. Social and political support is essential for progress.

The activities in the regions Kaindorf and Fryslan are initiated by change agents that create a successful network or a business. The change-agents can be a local group but also a politician, or a business. In Emden, it is a public business –an innovator in the Schumpeterian term- that has taken the initiative and it still leads renewable energy transition. The policymakers have been decisive in Freiburg and Navarra, but the initiatives in Freiburg evolve largely due to market initiatives, whereas in Navarra the regional energy company is pivotal for progress. In Emden, Freiburg and Navarra, the use of renewable energy grows largely due to national policy instruments that enable to deliver renewable energy to the grid at a premium prices compared to the electricity prices produced from fossil fuels. In these regions, the local energy company uses these national instruments and it adds a premium to the use of the regional renewable energy resource. In result, renewable energy becomes a high grade output due to the national and local authorities and businesses. In Kaindorf and Fryslan, such national instruments are weaker or non-existing and the progress in renewable energy is largely due to the regional networks and policies.

5. Role of regional policymaking

The pivotal role of the community's energy company and the state guaranteed feed-in tariffs in renewable energy should be considered with regard to capital intensive production of renewable energy. Large capital needs imply that the interest rate paid on capital is a major factor in the total production costs. For example, the Frisian renewable energy investment program of 2,609 million euro is assessed under 5% and 15% interest on capital. The low interest rate enables net savings of 26 million euro due lower energy cost but it would need a non-commercial approach, whereas the commercial interest of 15% would need 178 million euro to balance the annual costs and savings. The low interest is about 205 million euro cheaper than the subsidies. The interest on capital investments usually covers two main components: earning on credit and risk coverage. The earning on credit can better be acceptable for the state or communal companies than for private investors. The risk can be reduced by the regional policy instruments. A number of financial instruments are regulations are pinpointed in discussions with authorities, businesses and experts.

5.1 Financial instruments

The possibilities to cover the investments through public means are limited because the energy sector has largely been privatized. Massive direct public investments in commercial companies are restricted but the regulations do allow support of investments in renewable technologies under the tendering and procurement standards that maintain an international level playing field. Several financial instruments can reduce the risks of investments in energy saving and renewable energy, apart from national instruments, which is particularly important for the innovative projects such as PV use, gasification and so on. A few possible financial policy instruments are mentioned but the list is not exhaustive.

- Regional and local authorities can attract investments through an infrastructure that encourages energy saving for example through local grid and biogas networks.
- Support of private investment can be provided via utilities in order to provide infrastructure such as sludge processing of water boards.

- The local taxation system can be adapted for example by differentiating taxation for house owners on the basis of energy saving standards.
- The barriers posed by EU regulations can be avoided through clustering of businesses and experts for technology development.
- Regional co-financing may consist of participation in projects through the regional development corporations.
- The regional development corporations may also provide co-financing for the development of innovative projects such as renewable technologies.
- Regional authorities can generate EU funds for regional development and for research, development and demonstration of new solutions.
- Grants from national and EU funds can be used to generate and disseminate know how and to build up capacity of human resources.
- Schooling funds can be used to upgrade the skills of workers and experts in the relevant sectors and expertise of the authorities.

5.2 Regulations

The local and regional authorities are the main buyers of products and services and they are the regulators of procurement in the private sector.

- The procurement of the regional and local authorities can be guided by the strict criteria on energy saving and use of renewable energy in public utilities, housing, lighting, electric and household appliances and so on.
- The regional regulations can address private sectors through energy saving and renewable energy specifications for constructions, rewarding tenders with renewable energy in public transport, procurement and lease of vehicles that are energy saving and use renewable energy, contests with rewards for outstanding performance.
- Regional and local authorities can differentiate local fees, taxes and rules with regard to people's behavior such as lower parking fees for "clean cars" or lower taxes for "clean establishments" like gasoline stations with renewable energy
- There are various promotional possibilities, like contests with rewards for cleaner actions, labels and quality scans, education and marketing of renewable energy.
- Environmental legislation gives regional and local authorities also flexibility in licensing innovative solutions and spatial planning that enables renewable energy.

The financial instruments, although insufficient to cover the investment costs, attract the private sector to make risky investments. The financial instruments can be focused on the most risky parts of the investments. The regulatory instruments enable to negotiate best solutions in the region. A "first mover facility" for renewable energy in Fryslân is in negotiation. Such a facility combines national funds with regional funding to provide guarantees and soft loans for risky projects. It is estimated that the regional "first mover facility" of 15 –20 million euro a year during a few years for risk coverage can generate substantial investments in the region to attain the targets in the program if regional authorities enforce regulations that encourage energy saving and use of renewable energy.

6. Conclusions

The paper shows that renewable energy creates high grade products that contribute regional development. Actually, the European trend in renewable energy production is towards diversification of energy resources and the EU countries apparently tune the renewable energy production and use to the regional skills and conditions. The way regions develop renewable

energy differs. In some regions makers take the initiatives for the shift from fossil fuels to renewable energy, in a few regions it is a communal company and in some regions the initiatives are due to the change agents in private enterprises and social organizations. There are various options, but no golden bullet. A key factor in the implementation of renewable energy is risk reduction of the investments. The risk reduction can be achieved through the regional and local policy instruments that can be both, the financial instruments and direct regulations. Such regional risk-reducing instruments are sporadically implemented. So far, there is not much knowledge about the regional and community participations in renewable energy, neither experience with various options in this policy making. This is an important omission because every innovation is rooted in a setting that uses local skills and natural endowments. Therefore, a process of inter-regional co-operation on renewable energy in Europe should be adhered. A few regions have already expressed their interest for such a co-operation within the framework of Interreg projects Energizing Regional Economies and Facilitating Sustainable Innovations. The inter-regional co-operation should create a platform for know-how exchange about localized shift from fossil fuels to renewable energy and regional policy instruments to foster this shift; the academician should support these efforts with knowledge.

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