FarmPath

Regional sustainability transitions:

On-farm renewable energy production

Introduction

The production of on-farm renewable energy was studied in three European study sites, focusing on two specific types of renewable technologies: biogas production through anaerobic digestion in the Vysocina Region (the Czech Republic) and Wendland-Elbetal Region (Germany), and wind energy production in Aberdeenshire (Scotland, UK). In all three sites, farmers are the most numerous producers of renewable energy using these technologies[1]. Research involved reviewing regional and national agriculture and energy policies, and interviews with representatives of regional and national governments, the farming industry, landowner groups, financial institutions, regional chambers of commerce, energy consultancies, national parks and young farmers groups. The focus of the research was to understand the process by which these technologies had become mainstream in recent years, and the implications for agriculture as an industry.

Background to research

The study compared anaerobic digestion and wind energy because in the study sites the production of these types of renewable energy is dominated by farmers. Both technologies produce electricity, although anaerobic digestion also produces heat and processed manure, which can be used as a fertiliser. Anaerobic digestion produces biogas through a process of fermenting manure, but is typically supplemented by maize, which increases the biogas yield. Although there is an anaerobic digester on a farm in Aberdeenshire, the unsuitability of local conditions for maize production make it much less viable – and therefore less common – than in Germany and the Czech Republic.

Scotland[2], Germany and the Czech Republic are all net exporters of electricity. All three have also set targets for meeting their domestic energy requirements by renewable energy by 2020: Germany 18%, Scotland 20%, Czech Republic 13.5%. Germany and Scotland have set even higher targets for 2050, but owing to the absence of a political consensus about ongoing price supports for renewable energy production the Czech Republic is considering discontinuing such mechanisms once their 2020 target is met.

In both the Czech Republic and Germany, biogas plants are primarily located on farms. By 2011 there were about 7,000 biogas plants in Germany. In Wendland Elbetal (2020km^2), the Germany case study site, there were 37 biogas plants, with the first installed in 1995. In the Czech Republic, there were 264 biogas plants by 2012, up from six in 2002. At least 24 of these were in Vysocina (6795km^2) in the Czech Republic. In Scotland, wind turbines are more likely to be found in corporate developments, but Aberdeenshire is notable for the high number of farmer-owned turbines (~70%). By 2011 there were 284 wind turbine developments approved for construction in Aberdeenshire (6,313km^2), up from just two in 2004[3]. Applications for another 185 are under review.

Biogas PS on the Sasov Farm, the Czech Republic Source: Sasov Farm (2011)

1 In 2010, 70% of wind renewable projects in Aberdeenshire were in the ownership of local farmers/landowners. However, this represented only 27% of electricity produced by wind turbines, owing to the larger scale of corporate wind farm developments in Aberdeenshire. In the Czech Republic, 95% of anaerobic digesters are located on farms.
2 Although Scotland primarily exports electricity to England; the UK as a whole is a net importer of electricity.
3 It can take some years after planning permission is received for a turbine to be constructed.

What changed?

The evolution and up-take of these technologies proceeded in clear, but overlapping, phases:

1 Pioneer Phase (1950 to 1980s) innovation and co-development by farmers, engineers, and waste management companies

- Farmers and engineers in Germany experimented with anaerobic digestion in the 1950s (50 to 70 plants in total), but these were abandoned due to improved oil and coal technologies. However, plants were revived in response to the oil price crisis in the 1970s.
- Farmers and waste management experts in the former Czechoslovakia experimented with biogas in the 1970s, primarily to deal with the slurry from large-scale feedlots. Energy produced was of secondary concern and used locally.
- Farmers in Scotland were approached by European companies to build wind turbines on their farms in the 1980s; the electricity was then used primarily on-farm.

2 Technological Anchoring Phase (mid 1980s to 1996) ongoing experimentation and the beginning of state recognition and support

- In the 1980s, agricultural science institutions and faculties started to become involved in biogas in Germany. This enabled the 'professionalisation' of experiments which were previously conducted by farmers, on farms.
- In 1989, the Non-Fossil Fuel Obligation and Scottish Renewables Obligation were imposed by Electricity Act of 1989 in the UK. This required the (then) public electricity suppliers to purchase electricity from renewable generators and provided for this electricity to be purchased at fixed prices for long term contract periods (typically 15 years). Subsequent orders for electricity followed in 1994, 1997, 1999 and 2002 (Ofgem, 2012).
- Transformation and liberalization in the Czech agrarian sector resulted in collapse of the communist model of agriculture.
- The first biogas plant by a pioneering farmer in the Wendland-Elbetal region was installed in 1995, in response to increased energy costs and the desire to be more ecologically responsible.

3 European Directive Phase (1997 to 2007) establishment of European directives In 1997, the European Commission published a White Paper on renewable energy: gross in-land primary renewable energy was to increase from 5.4% in 1997 to 12% in 2010 (European Commission, 1997). This led to the Renewable Electricity Directive 2001/77/EC and Biofuels Directive 2003/30/EC. This led to specific regional and national responses:

- In 1997, the regional government in Wendland-Elbetal established the goal of meeting 100% of primary regional energy demand through regionally produced renewable energy and savings through increased energy efficiency. The district won the Sustainable Energy Europe Award for rural areas in 2000.
- During pre-accession to the EU (2000 to 2004), the Czech Republic established an 8% target for renewable energy production by 2010. In 2002, the Czech government started supporting renewable energy production through price supports. Amendments to the Renewable Energy Law in 2004 led to an increase in biogas plants.
- In 2002, Renewable Obligation Certificates (ROCs) were introduced in Scotland, England and Wales, which obligated energy suppliers to supply a set percentage of their electricity from renewable sources.
- Significant increases in public protests against wind turbines and digesters began in all three countries.
- Farming and land owning organisations in all three countries started holding information events for their members on renewable energy.
- New companies were formed to sell renewable technologies and manage processes of installation and approvals.

Wind turbine on a farm in Aberdeenshire Source: Lee-Ann Sutherland (June 2012)

- In 2007, the German national government establishes an 'Integrated Energy and Climate Programme'.
- The second Czech Rural Development programme included a measure to support the construction of biogas stations on farms; this type of support had been in place in Western Europe since the 1990s.

4.Mainstreaming – Refinement and Saturation Phase (2008 to present)
Digesters and wind turbines become common at a landscape level

- Commodity prices for wheat and maize rose rapidly, leading to a decline in up-take of anaerobic digesters in 2008/2009.
- New renewable energy targets for 2020 were set in response to EC regulation 2009/28/EC. These are 20% for Scotland, 13.5% for the Czech Republic, and 18% for Germany. The Czech Republic developed a national action plan to reach these targets.
- In Wendland-Elbetal in 2009, biogas plants accounted for 45% of the total electricity from renewable energy sources; the equivalent of 113% of regional electricity used was generated from renewable sources.
- In 2010, Feed in Tariffs (FiTs) were introduced by the UK government, which guaranteed purchase prices for renewable energies produced at different scales and through different sources for up to 20 years. FiTs were limited to developments of up to 5 MW. Applications for wind turbines in Aberdeenshire increased exponentially.
- In Germany, the 'energy turnaround' initiated by the state established a goal of achieving an energy supply primarily from renewable sources by 2050; the Fukushima nuclear disaster in 2011 led to a resolution to accelerate the timing of reaching this goal.
- In 2012, a new Act for the support of renewable energy production was passed in the Czech Republic, making a minimal use of the waste heat from biogas stations obligatory, and setting a new framework for development of the sector.
- In all three study regions, there has been an increase in local opposition to additional digesters/wind turbines (respectively). 'Community'-based options are being pursued to address this issue in all three regions.
- There is local opposition in the Czech population lobby to support for renewable energy once the 13.5% target is reached (expected in 2013).

Developments during this final phase suggest that the transition to a changed base level of the contribution of renewable energy to energy demand may be nearing completion, without renewable energy production becoming ubiquitous on all farm enterprises. This 'saturation' reflects the political and environmental constraints on the technologies being used. However, wind turbines and digesters are now common in the three research regions. In Aberdeenshire, planning approval for large (tall) turbines has dropped, owing to lack of suitable locations, but approval for small turbines continues. In Vysocina and Wendland-Elbetal, regulations and restrictions are tightening and farmers are being required to consider local impact and by-products of digestion. For example, in some cases this has led to creative ways of using heat produced as a by-product, including as a means of diversification.

Biogas plant located in the 'circular village' of Püggen, Germany Source: Sarah Peter (April 2012)

Key lessons learned:

- Macro-level issues, particularly climate change, but also rising energy prices and low commodity prices, opened a 'window of opportunity' for on-farm renewable energy production in the late 1990s/early 2000s, which had been in development for decades previously.
- The rapid up-take of renewable energy production reflects the business opportunity it represented for farm businesses, technology suppliers, consultancies and national governments.
- The up-take of renewable energy production on farms clearly followed the implementation of long-term price supports. It is notable that these supports have been primarily energy (as opposed to agriculture) oriented; the longevity of price guarantees (typically 10 to 20 years), is much longer than historical agri-environmental subsidies.
- The physical resources farmers can most easily access (land, field crops and manure) are key to farmers' involvement in renewable energy production. Farmers now face increased competition for these resources from other commercial actors.
- On-farm renewable energy production contributes to decentralisation of energy production in general, but also encourages intensification of agriculture, because it tends to be located on large or intensive farms, because these farms can most easily afford (i.e. get loans) to install renewable technologies. Returns from diversification into renewable energy can thus act as a form of large farm subsidy.
- Young farmers and new entrants, despite being enthusiastic about the technology, are largely excluded from renewable energy production owing to the high investment costs. The economic opportunities of renewable production may facilitate farm succession on those farms able to invest in it.
- Farmers with digesters or wind turbines identify their motivations as primarily towards securing a source of income for the farm (as opposed to the more environmental motivations of pioneers). Electricity produced is primarily sold into the electricity grid for public use, rather than being used on farm.
- Access to the electricity grid to sell electricity is a key constraint in the Czech Republic and Scotland. Germany has addressed this issue by requiring grid managers to give priority to renewable energy producers.
- Technological developments for anaerobic digestion and wind energy production have been minimal in the past 10 years, focusing primarily on increasing efficiency and scale of production (i.e. wind turbines have got larger, a wider range of substrates for digesters), reducing impact (e.g. noise, odour) and increasing accuracy of monitoring (preventing breakdowns).
- The renewable technologies studied (anaerobic digestion and wind) have not become cheaper over time; instead, technology prices have remained stable, and costs of installation (labour, equipment, construction materials) have become more expensive. This is in contrast to photovoltaics (solar panels) which have become considerably cheaper, potentially because of the larger market for them and cheaper purchase and installation costs.
- Changes to price supports for solar panels have led to uncertainty over the longevity of price supports for other technologies. The rapid up-take of solar panels (which was perceived as being primarily oriented towards receiving subsidies and associated with high electricity prices) has led to public concern over the utility of renewable energy price supports in all three regions, but particularly in Vycosina (the Czech Republic).
- Both wind turbines and digesters are objects of social protest owing to public concerns about amenity (visual and odour) and environmental impact (for wind turbines, on wildlife; for digesters, the impact of monoculture maize).
- Saturation in relation to on-farm anaerobic digestion and wind energy production appears to be occurring before it has been implemented on the majority of farms, owing to physical limitations and public acceptance. There is a move toward 'community' renewable energy generation in all three countries, which may increase public tolerance, but progress has been slow.

For further information

See the FarmPath project web-site:
www.farmpath.eu

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