REGIONAL SUSTAINABLE TRANSITIONS:

On-Farm Wind Energy Production in Aberdeenshire

INTRODUCTION

Wind turbines are becoming a common sight in Aberdeenshire. Although wind energy production was experimented with in the early 1980s, with the electricity produced used on farms or rural businesses, current turbines were developed in the 2000s and the electricity produced primarily sold through the national grid. The number of planning applications for turbines has increased exponentially in the past two years: Aberdeenshire Council reported a total of 777 applications for wind turbines from 2004 - 2011; 508 of which were submitted in 2011 (see Figure 1). By January 2011, 284 turbine developments had been approved for construction in Aberdeenshire.

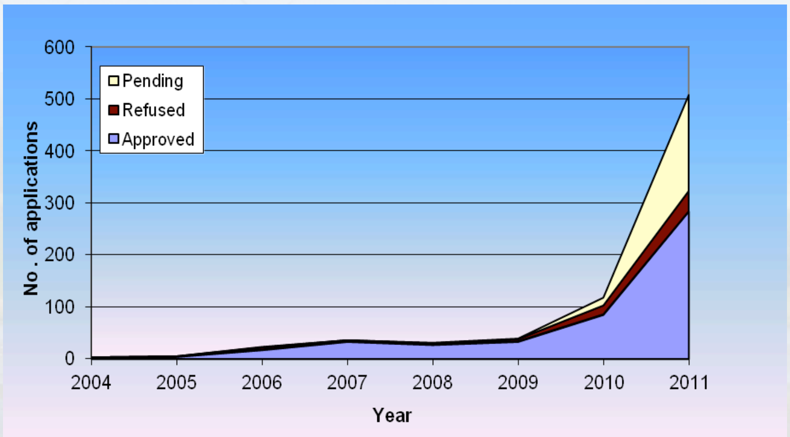

Figure 1: Number of planning applications for wind turbines received by Aberdeenshire Council 2004-2011

BACKGROUND TO THE RESEARCH

Production of wind energy on farms in Aberdeenshire was studied as part of the FarmPath (Farming Transitions: Pathways towards regional sustainability of agriculture in Europe) project, funded by the European Commission 7th Framework Programme (2011-2014). Research involved: (i) reviewing regional and national agriculture and energy policies, and (ii) interviews with representatives of Aberdeenshire Council and Scottish Government, the farming industry, landowner groups, lending institutions, regional chambers of commerce, energy consultancies, national parks and young farmer groups. Twenty-two farmers in North East Scotland who had applied for planning permission to install wind turbines were also interviewed.

The focus of the research was on understanding how and why wind turbines have become increasingly common on farms in recent years, and the implications for the agriculture industry. The research was coupled with studies of on-farm anaerobic digestion in Wendland-Elbetal in Germany and Vysocina in the Czech Republic, where these represent a major component of on-farm renewable energy production. On-farm wind energy production was chosen for study in Aberdeenshire because of the high number of farmers involved, whereas there is only one anaerobic digestor in the region (near the town of Turriff). A study of the economic benefits of wind energy by Bell and Booth of Scottish Agricultural College (2010) found that 70% of wind energy projects in Aberdeenshire were in the ownership of local farmers or landowners. However, this represented only 27% of the electricity produced, owing to the larger scale of corporate developments.

WHY DO FARMERS BECOME INVOLVED IN WIND ENERGY PRODUCTION?

The majority of the farmers spoke about their wind turbine(s) as a business investment. It was seen to complement the farm structure, requiring little labour input, staffing or management time once installed, leaving farmers to spend time on other aspects of their business that are labour intensive, such as cereal production and livestock rearing. As a diversification option, wind energy development was often referred to as a 'no brainer'.

Farmers also viewed the increased profit stream to the farm as a fund on which they could draw to make further investments (e.g. additional wind turbines, new machinery and sheds, or housing for their adult children), to enjoy a higher standard of living (particularly in retirement), or to facilitate the integration of a successor into the business. In some cases, it was seen as a form of pension fund for farmers, enabling them to work fewer hours as they aged or developed health problems. The dependability of the income stream generated was also said to act as a buffer against rising fuel prices, commodity price fluctuations and possible reductions to the Single Farm Payment.

In choosing to invest in wind energy production, farmers were also often choosing (in the intermediate term) not to invest in other aspects of the farm, so the turbine development had to be weighed against other options. The feed-in tariffs (FiTs) in particular were seen as important in tipping the balance of the financial equation towards investments in wind turbines. The FiTs were particularly important for reducing investment risk.

Few of the farmers were using the electricity produced on their own farms, owing to the cost of the converter required to achieve this. However, farmers saw their own rising energy bills on-farm as evidence that there would be a long-term market for the renewable energy they could produce. Some farmers rationalised their wind turbine purchases with arguments about depleting energy resources (e.g. oil and gas), "doing their bit for renewables" or the perceived oncoming energy crisis.

Farmers with wind turbines generally believed that, at present, they were accepted by other farmers, who recognised the importance – and difficulty - of maintaining a financially viable farm. Respondents also believed that farmers have become increasingly accepting of wind turbines over time. They related this to an accumulative effect (i.e. that turbines are now more visible throughout Aberdeenshire, so are considered as a normal farming activity).

This same accumulation effect was also perceived to have led to society in general becoming more 'anti-turbine'. This was viewed as slowing down the planning process and increasing the risk associated with installing a wind turbine as it meant that decision makers could be under pressure to refuse applications. Objections were seen to come primarily from rural non-farm residents, exemplified by CAWT (Concerned About Wind Turbines) (www.cawt.co.uk). Farmers did not see concerns raised by this type of group as valid for a number of reasons, such as the distance of the home of the objector to the location of the wind turbine, or the importance of agriculture to rural life.

The farm household's decision on whether to invest in the turbine themselves or to rent out the land to a wind energy developer is to a degree based on farm size – larger farms find it easier to leverage the capital required. A sense of independence was also important, as those investing themselves had more freedom to decide on the size and manufacturer of the wind turbine, although they also faced greater risk if something went wrong.

Logistical problems such as having to deal with 'legal people' were seen as an extra layer of complication. Developers were often seen as taking advantage of farmers and, due to their resources and experience in the topic, developers were often perceived as able to pressurise farmers into certain aspects of contracts, which disproportionately benefitted the company rather than the farmer. Many farmers reported visits by agencies to scope options for renting land for wind turbine installation. Such agencies were not trusted by some farmers who thought that they could be selling untested wind turbines. One company in particular had gone bankrupt after supplying a number of low quality (which then became unsafe) wind turbines. Information about the experiences of others made farmers more cautious about investing. They were also concerned that some agencies may go through the motions of putting up a wind turbine: apply for permission, decide turbine specifications etc., but then pull out at last minute.

Planning permission was seen to be very dependent on key individuals (i.e. local authority planning officers), with a degree of variability and subjectivity in approach and decisions. Several farmers expressed their opinion that the personal views of the planner who assessed their application impacted on the outcome, and that there was considerable variation between local authorities in their approach towards wind turbines (some were viewed as being more difficult to obtain planning permission than others). Obtaining planning permission was viewed as a time consuming, complicated and expensive process (respondents reported costs of up to £50,000). These issues were as seen to be a deterrent to wind turbine installation, particularly for smaller farm holdings

The banking sector was seen to be supportive of on-farm renewables, and it was thought to be relatively easy to get funding. In relation to collateral requests, farmers noted that the increasing price of land and the currently profitable state of farming increased their leverage with lenders. Many famers accessed funding through the

Cooperative Bank Renewable Energy Fund. However, some farmers opted against this fund due to higher interest rates with the Cooperative Bank, seeking loans from other banks instead.

Some of the farmers interviewed had considered collaborating with neighbouring farmers to produce on-farm wind energy. This was often an appropriate route due to the poor financial situation of some farms, probably smaller ones, and the high cost of installing wind turbines. Success of these agreements was seen to be dependent on personalities of neighbours, and the extent that some farmers may wish to remain 'independent'. Collaboration, in such instances, was seen to detract from farm independence.

CHANGING TECHNOLOGY

The technology for renewable energy production has increased in quality and accessibility, particularly in the past decade. The capacity of wind turbines has increased from 200 to 350 kilowatts in the 1980s, to the largest of between 5 and 7 megawatts at present. The majority of wind turbines originally came from Germany and Denmark, but are now also being produced in Spain and China. Technological development for wind energy in Scotland is primarily being focused on off-shore wind.

Since 2010 (and the introduction of feed-in tariffs), the market for small and medium wind turbines (6 to 500 kilowatts) has grown with a corresponding increase in the range of wind turbines available in this size. Respondents indicated that wind turbines have also become more reliable (i.e. less likely to break down). Considerable advances have been made in technology over the last 15 years, overcoming problems with the reliability of gear boxes and hydraulics. In 2000, almost all transformers at the base of turbines were outside, whereas at present new turbines typically have these within the tower. There has also been a move towards computerised monitoring of the condition of wind turbines in order to schedule maintenance and avoid mechanical failures.

Wind turbine efficiency has also been improved, and noise reduced, as a result of computing advances, enabling the regulation of the speed of rotation of turbine blades in response to local wind conditions, and proximity to housing (e.g. slowing the turbine so it doesn't become too noisy in high winds if the site is near houses). Wind turbine providers typically offer service contracts and guarantees (warranties) for a period of time after purchase (e.g. that the company will service it for 10 to 15 years, and guarantee it will be operating 97% of the time). However, the respondents made references to one company which went out of business after selling deficient wind turbines, because it was not able to afford all the promised repairs. This left farmers with faulty turbines and large repair bills.

Unlike solar technology, the cost of wind turbines does not appear to have reduced in real terms. Some key informants believed they had become more expensive, particularly for smaller wind turbines after the introduction of Feed-in-Tariffs. This reflects the increasing costs of installing wind turbines, in particular the cost of concrete and labour. There have been a number of new manufacturers entering the market, setting lower prices in order to gain entry, but that was not viewed as a real decline in prices. One key informant described a period in the late 1990s where the number of manufacturers reduced significantly, owing to consolidation, but the number has since increased again. The cost of purchase, fulfilling planning requirements, grid access and installation can cost up to £3 million for a development of 3 1.5 kW turbines.

Access to the electricity grid for the wind turbines was a key issue identified – this is often difficult and expensive. One key informant likened it to a tree – it is much better developed in the central areas (in terms of delivering electricity), with decreasing capacity as the 'branches' get farther away from the trunk. The issue with renewable energy is that much of the electricity is generated at the small branches at the tips of the tree (i.e. remotely from the central areas of the grid), which were not designed to carry large electricity loads. The energy regulator in the UK will not allow the grid to be up-graded proactively (i.e. in advance of requirements), so the cost is paid by the business requiring access. Respondents have reported this as costing up to £800,000 (€993,000).

There has been a rapid increase in the number of wind turbine suppliers, although respondents also described consolidation of renewable equipment suppliers in the late 1990s. There has also been a growth in companies which administer the turbine installation process, from initial assessments through to construction.

Wind turbine near Whiterashes, Aberdeenshire
Source: Lee-Ann Sutherland

SKELMONAE WIND FARM UNDER CONSTRUCTION IN 2009, NEAR AUCHNAGATT, ABERDEENSHIRE

Source: David C. Smith

WIND TURBINES IN ABERDEENSHIRE

Aberdeenshire Council classifies applications for wind turbine developments into three categories, based on hub height: small (up to 30 metres), medium (31 – 54 metres) and large (55 metres and over). A general rule of thumb is for the tower to be the height of the diameter of the turbine, adjusted downwards for high wind speed sites . A turbine with a 55 metre hub would therefore have blades reaching 80 metres, whereas an 80 metre turbine would have a tip height of up to 125m. Taller turbines typically have longer blades, which generate more electricity. Larger turbines are also generally more efficient at producing electricity.

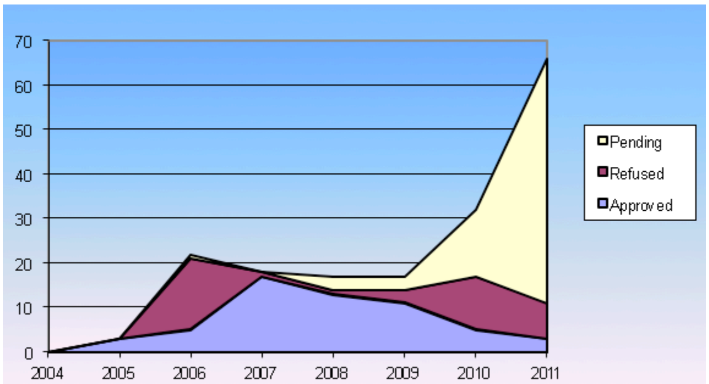

Figure 2: Number of applications for large turbines in Aberdeenshire

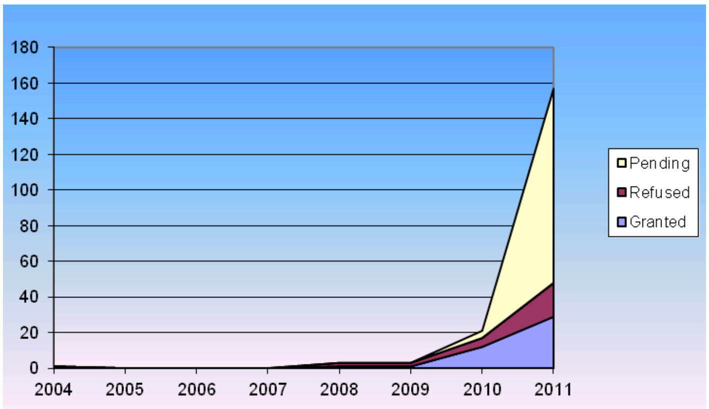

Figure 3: Number of applications for medium turbines in Aberdeenshire

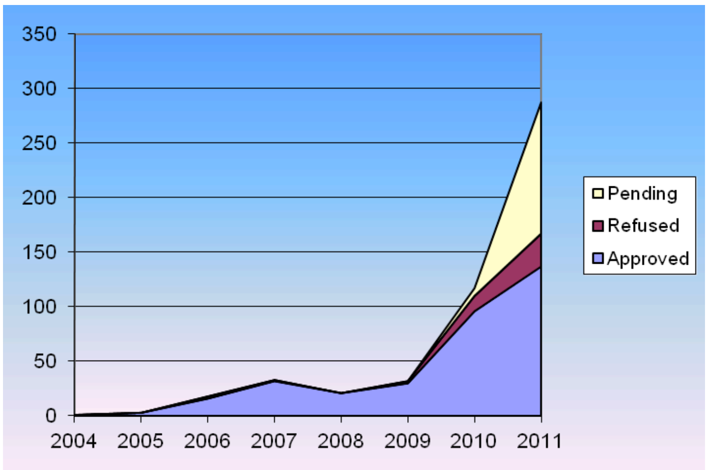

Figure 4: Number of applications for small turbines in Aberdeenshire

Wind turbines can be singular, but are more commonly part of developments with two or even three turbines that are similar in size; wind 'farms' of multiple turbines are relatively uncommon. In recent years there has been a considerable increase in developments with three turbines, led by farmer or community groups. As a consequence of such development pressure Scottish Natural Heritage produced guidelines to inform developers, an updated version of which is currently being finalised.

Successful applications for developments with large turbines appear to have peaked in 2007, and are since in decline (see Figure 2). This reflects the scale of impact of tall turbines, and the relative saturation (i.e. number of existing turbines and lack of further appropriate sites) within Aberdeenshire. In contrast, small and medium turbines (Figures 3 and 4) have continued to increase in terms of numbers of successful (and unsuccessful) applications, with applications increasing exponentially following the introduction of the Feed in Tarriffs in 2010. Aberdeenshire Council reported seeing trends towards applications for wind turbines around the 15 metre and 55 metre hub-height levels, and has consistently advised that 80m hub-height turbines were likely to be considerably more acceptable in landscape terms than larger facilities.

Owing to the number of wind turbines already approved for construction by Aberdeenshire council, the number of other locations suitable for wind turbines is decreasing. There are some geographic areas in which further development would lead to an unacceptable level of cumulative impacts, or exceed some quantitative or qualitative estimate of 'capacity'. The result is that it will be increasingly difficult to get planning permission for developments with large turbines.

Aberdeenshire is unusual for the high percentage of farmer-owned wind turbine developments. Respondents credited this to the historic entrepreneurship of Aberdeenshire farmers (i.e. a culture of being at the forefront of technology and innovation), and the relative profitability of farming and high number of owner-operators (i.e. a higher number of farmers who can leverage the capital to invest in wind turbines). There is also a perception that Aberdeenshire authorities are more open to renewable energy developments than other Scottish Councils, owing to the importance and experience of the energy industry in the region. Earlier experimentation, pioneering and advocacy of locals like Maitland Mackie have also set an example, which other farmers have been able to follow.

STATE SUPPORTS FOR ON-FARM RENEWABLE ENERGY PRODUCTION

Scottish Government actively supports renewable energy production in Scotland, setting a target of meeting 20% of Scotland's renewable energy needs through renewable energy production by 2020, including the equivalent of 100% of annual electricity demand. Energy consumption in Scotland has remained fairly static between 1991 and 2008, with increased energy efficiency and improvements in housing stock off-set by increased demand for electrical appliances and single-person households.

Although price subsidies have the most impact, on-farm renewable energy production (including wind turbines) has been included in the Scotland Rural Development Programme (SRDP) and its predecessors since the mid-1980s. At present:

- the Farm Modernisation Measure (121 in Axis 1 of the SRDP) includes Rural Priorities such as 'Restructuring agricultural businesses', which aims at supporting capital costs in a wide range of renewable energy technologies and equipment including wind, solar, hydro, biomass and biogas renewable energy systems. The focus is on small-scale renewable energy capacity (up to 250 kW) and on-farm consumption; which are supported through the reimbursement of up to 50% of the eligible cost of renewable energy development in Less Favoured Areas (LFA) and 40% in non-LFAs. Young farmers receive an additional 10% of the eligible cost (Scottish Government, 2010).

- In Axis 3, support for 'Diversification outwith agriculture' (Rural Priority under Measure 311) provides capital grants for the supply and sale of renewable energy. The capital grants cover up to 50% of the eligible cost for the installation or infrastructure for renewable energy using biomass and other renewable energy sources. In contrast to support provided through Rural Priorities under measure 121, the Rural Priority 'Diversification outwith agriculture' also targets the commercial use of the renewable energy produced. Projects designed mainly for energy consumption by the agricultural business should apply for support through Axis 1 Rural Priorities (Scottish Government, 2010).

- The Rural Priority 'Support for renewable energy – non land-based' under the Measures 312 and 321 encourages a wide range of renewable energy technologies and equipment (e.g. small scale wind turbines, hydro-electric turbine, solar panels and supply chain equipment). This Rural Priority is open to rural communities and micro-enterprises. However, at least 51% of the generated energy must be consumed by the rural community or business which applies for the capital grant. The capital grant covers up to 50% of the eligible cost for installations and equipment. In addition, this Rural Priority also supports direct set up costs related to the creation of producer groups producing and using renewable energy (Scottish Government, 2010).

The introduction of Renewables Obligation Certificates (ROC) in 2002 was seen as a key driver of on-farm renewable energy production. Prior to that there was a 'Scottish Renewables Obligation', but it does not appear that many farmers were involved. Under the ROC, energy companies were required to ensure a set percentage of their energy was produced through renewable sources; if they were not producing sufficient energy through renewable resources themselves, they could purchase certificates from others who were. Access to the ROC was significant to the construction of the wind turbines approved in Aberdeenshire from 2004 (See graph on page 1).

The most important policy development for on-farm renewables was the introduction of Feed-in Tariffs (FiTs) in April 2010, which have provided a financial incentive to farmers to invest in renewable energy generation. The FiTs are available for renewable energy generation from wind, solar, hydro, anaerobic digestion and domestic scale micro combined heat and power. The FiT specifically targets small-scale production, with a production limit of 5 megawatts.

Cluster of three small turbines on the Aberdeenshire coast near Foveran

View of turbines across the Ythan estuary, near Newburgh, Aberdeenshire
Source: Lee-Ann Sutherland

- FiTs consist of two components: the Generation Tariff and the Export Tariff. The Generation Tariff is paid for every unit (kWh) of electricity generated regardless of whether the electricity is used onsite or exported to the grid. The payment rate depends upon the technology used and the scale of the installation. In 2011/2012, the tariff for wind ranged from 36.2 p/kwh (for installations of less than 1.5 kW) to 4.7 p/kwh (for installations between 1.5 and 5 mW). Rates also differ according to the source of renewable energy production (i.e. for solar, hydro etc.). In order to promote early uptake of FiTs, a degression in rates was built into the scheme (i.e. the Generation Tariff for new installations will be reduced each year). However, once the scheme has been taken up by a farm business (or other), the Tariff remains constant at the rate of the year of installation. The Export Tariff is a fixed sales price payable for electricity exported to the national grid. The purpose of the Export Tariff is to remove the uncertainty of fluctuating wholesale power prices. The Export Tariff is initially set relatively low (3p/kWh), but generators may opt out of the Export Tariff and sell power on the open market.

Since the Amendment Order of the FiTs in May 2011, businesses and communities receiving grants for the generation of renewable energies through the SRDP will not qualify for FiTs or the Renewable Heat Incentive (RHI). The phasing-out of the compatibility of SRDP grants and FiTs reflects the intention associated with FiTs to replace other public grant schemes as the principal instrument to promote small scale, low carbon electricity generations.

The Scottish Government Community and Renewable Energy Scheme (CARES) was introduced in 2011 to provide loans to support the pre-planning consent stages of renewable energy projects (up to 5 MW) which have local community engagement and benefits. Loans are then repaid if planning permission is successful.

KEY LESSONS LEARNED

- The rapid up-take of renewable energy production reflects the business opportunity it represents; enabling farm businesses, technology suppliers and consultancies to engage in and pursue this type of development; and Scottish government to view it both as an environmental and an economic development opportunity.

- The up-take of renewable energy production on farms clearly follows the implementation of long-term price supports; it is notable that these supports are 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.

- On-farm renewable energy production contributes to decentralisation of energy production in general, but can contribute to increased intensification of agriculture, because it tends to be located on large or intensive farms. This is because these farms can most easily afford (i.e. get loans) to make the investment required for medium to large wind-turbines. Returns from diversification into renewable energy can thus act as a form of 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 energy production may facilitate farm succession on those farms able to invest in it.

- Farmers with wind turbines identify their motivations as primarily about securing a reliable income source for the farm, as opposed to more environmental motivations. Electricity produced is primarily sold into the grid for public use, rather than being used on-farm.

- The potential for on-farm wind energy generation through collaboration with neighbouring farmers is an area which is deserving of further study. Collaboration is seen as a way through which farmers can overcome high costs associated with the planning process and wind turbine erection. However, farmers also tend to have a strong sense of independence, preferring to work alone.

- Technological development for wind energy is perceived as minimal in the past 10 years, focused primarily on increasing efficiency and scale of production (i.e. the capacity and height of wind turbines have increased), reducing impact (e.g. noise) and increasing accuracy of monitoring (preventing breakdowns).

- Wind turbines 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 (i.e.solar panels) which have become considerably cheaper, potentially because of the larger market and ease of access.

- Regional saturation of on-farm wind production appears to be occurring before it has been implemented on the majority of farms, owing to physical limitations and public resistance.

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www.farmpath.eu

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