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The economic benefits of on-farm wind energy clusters in Aberdeenshire

Final

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EXECUTIVE SUMMARY

OUTLINE

- On farm wind power generation represents a major opportunity to support rural incomes and employment in Aberdeenshire. These benefits are greatest where projects are locally owned and managed. Expected reductions in agricultural support under CAP reform represent a serious threat to the long term viability of farms and rural businesses in Aberdeenshire. Locally developed wind power projects offer the potential to support incomes and jobs in rural Aberdeenshire for decades to come.

RENEWABLE TARGETS

- **The Scottish government has a target of 50% electricity to be generated from renewables by 2020.** This is set against latest figures of 22% electricity from renewables (2008), indicating considerable requirement for further renewable energy development. Renewable energy development is supported by various national and local policies to promote reduced carbon emissions, use of sustainable energy sources and reduction in dependence on fossil fuels.

- **Scotland has 25% of Europe's wind resource** and is well placed to continue to utilise wind as the major source of renewable energy. The combination of long coastline and undulating landscape in Aberdeenshire mean that it has a large wind resource with potential to provide considerable renewable energy.

- **IMPORTANCE OF AGRICULTURE IN ABERDEENSHIRE**
- **Agricultural output in Aberdeenshire was estimated at £223.90m in 2007** (14% of Scotland's total) plus a further £85m in subsidy payments (including £71m in Single Farm Payment).

- **Reform of the Common Agricultural Policy (CAP) is expected to see cuts in the CAP budget of 20% to 30% from 2014**. For Aberdeenshire this could represent a cut income of between £14.2m and £21.3m in SFP alone depending on exchange rates from 2014 onwards. In addition volatile agricultural markets leave farm business exposed to large swings in income, threatening financial stability, investment and jobs.

- Farm businesses in Aberdeenshire are therefore going to have to develop alternative sources of income over the next 5 years in order to maintain or increase income levels. On farm wind developments offer a key source of potential income.

WIND FARMS IN ABERDEENSHIRE

- **A total of 194.4MW of wind farm capacity was operational** or had received planning permission in Aberdeenshire by April 2010. Of this 70% of projects and 27% (52.85MW) of capacity were in the ownership of local farmers/landowners.

- **Wind farms being developed by local farmers and landowners are far smaller** (2.4MW) than those being developed by external developers (23.2MW). Per MW of capacity developed farmer owned projects are likely to have a lower visual and environmental impact but a greater local economic and employment benefits. The majority of operational farm projects have wind turbines of 0.8 or 0.85 MW. For projects with planning permission pending, half have turbines in the 0.8 – 0.85MW category with the remainder using turbines of 2.0 – 2.5 MW size. Introduction of the Feed In Tariff (FIT) scheme is likely to support a return to smaller turbine sizes on farm.

ISSUES WITH WIND POWER DEVELOPMENT

- **Significant issues for development of wind projects on farm include gaining planning permission, grid connection and finance.** Planning permission is dependent on many factors with proximity to residential property, height of turbine, and in some areas, cumulative impact being particularly current topics. Although no official policy exists on height of turbine to be permitted in Aberdeenshire, turbines exceeding a height of 80m are frequently refused planning permission. Since fewer larger turbines (e.g. 2.3MW) are required to produce a given quantity of renewable electricity, there may be grounds to consider greater acceptance and at the same time limiting cumulative impact.

Limited grid capacity can lead to very high connection costs, or delays in connection, affecting viability of some projects. Work is ongoing to reinforce the grid.

INCOME AND EMPLOYMENT BENEFITS OF ON FARM WIND TURBINES

- **Development of a single farmer owned 0.8MW turbine scheme is likely to boost farm incomes by £68,000 - £156,000 per year** depending on use of the Renewable Obligation Certificate (ROC) or FIT system respectively. These income levels reflect the high level of risk and capital investment required. As well as sustaining a farming family each turbine (where FIT funded) would also generate 1.47 additional local jobs through increased income and spending. By comparison where ownership of the turbine resides outside the area this turbine would support just 0.23 additional jobs locally.

- Extrapolated to Aberdeenshire as a whole, **local ownership** (vs. external) of 53MW of operational/approved projects is **expected to boost annual income of local landowning business by between £4m and £10m per year**. In terms of employment this additional income and expenditure is expected to lead to between **33 and 82 additional jobs** in Aberdeenshire. The higher estimates reflect FIT funding. Projects in planning and not yet submitted have the potential to increase these benefits by 2 to 3 fold.

- **Wind projects on farm also have the benefit to protect employment in existing farm businesses facing uncertainty** over market returns and support payments. Current farm wind projects in operation, approval and planning in Aberdeenshire are likely to bring additional income to the farming sector equivalent to between 5% and 10% of the counties £223m of agricultural output in 2007/08 (excluding subsidies).

- This benefit would be significantly increased if more projects were approved and if, as seems likely, the **higher value FIT scheme becomes the predominant**

funding mechanism on farm. The FIT scheme also makes it more likely that smaller farmers and landowners can benefit from wind projects.

- **Farm businesses are particularly effective at recycling income into the local economy** and thereby supporting local rural employment. As a new farm activity, what is less clear is how much of the income from wind farm development on farm will be invested in the farm or spent locally in practice. Assessing this more accurately will require a detailed survey of actual spending patterns from operational on farm wind turbines.

1 Introduction

1.1 Renewable energy and greenhouse gas emissions targets

The Scottish Government has ambitious targets for the development of renewable energy and reduction in dependence on fossil fuels, aiming for 50% of electricity consumed in Scotland to be produced from renewable sources by 2020[1]. The latest figures show that 22% of electricity consumed in Scotland in 2008 was derived from renewable sources, indicating that there is much scope for further development if targets are to be met[2].

In 2007 wind overtook hydro as the largest renewable generating source[3]. It is expected that wind will continue to contribute a substantial share of renewable electricity generation in the future, although other technologies will come on line[4].

Scotland's Climate Change bill sets out targets for each sector of the economy to reduce greenhouse gas emissions, helping to mitigate climate change and protect the environment. Renewable energy also has the benefit of being sustainable, unlike fossil fuel, and development of home-based renewables can also aid energy security. Development of renewable energy is viewed as one of the key areas in which the land based sector can contribute to tackling climate change[5] and wind energy projects are currently the most frequently developed of the renewables options. Renewable energy projects can provide a win:win outcome, by not only giving benefits for the environment, being associated with lower greenhouse gas emissions than fossil fuels, but also by providing a business opportunity for the rural economy.

There are both national and local policies supporting the development of renewable energy. Examples of these include the Scottish Planning Policy 6:

[1] www.scotland.gov.uk/About/ScotPerforms?indicators/electricity
[2] Scotland.gov.uk/About/scotPerforms/indicators/electricity
[3] www.bwea.com/onshore/index.html
[4] Scottish Planning Policy 6: Renewable Energy, Scottish Executive Development Department, 2007.
[5] www.farmingforabetterclimate.org

Renewable Energy Developments (SPP6) which notes that 'the planning system has a significant role to play in resolving conflicts so that progress towards the 2020 target continues to be made in a way that affords appropriate protection to the natural and historic environment without unreasonably restricting the potential for renewable energy development.'[4]. Renewable energy provision has been identified as an objective of the Aberdeen City and Shire Structure Plan[6]. An objective of the sustainable development and climate change section of the plan states that: 'the area will be a region which takes the lead in reducing the amount of carbon dioxide released into the air … and limits the amount of non-renewable resources it uses'.

1.2 Wind resources in the UK and Scotland

Scotland is recognised as being Europe's windiest country with 25% of Europe's wind energy resource[7], providing potential to make a substantial contribution to Scotland and the UK's renewable requirement. The combination of a long coastline in Aberdeenshire and hills mean that this county has a substantial share of the highest average wind speeds on offer and a large wind resource with potential to provide considerable renewable energy.

1.3 Wind energy generation in Aberdeenshire

There are relatively few large scale wind farms in Aberdeenshire with large scale developers targeting other areas of Scotland. There are a number of drawbacks for the large scale developer:

- many of the highland areas have highly valued landscapes which are protected from development,
- the lowland areas are extensively covered by civil and military radar,
- there are environmentally sensitive areas such as SSSIs, special areas of conservation and special protection areas, or areas which are

[6] Aberdeen City and Shire Structure Plan, 2009.
[7] www.scottishrenewables.com

constrained due to being on the flight path of certain bird species, such as geese.

By contrast with some other areas of the UK, in Aberdeenshire, wind project development has centred on a 'second tier' of smaller scale wind projects consisting of single turbines or clusters of, frequently, 2 – 4 turbines. Focussing on smaller scale projects gives more flexibility to avoid the issues making development at a larger wind farm scale difficult. A number of these smaller scale options have been developed in recent years. The structure of land ownership in Aberdeenshire, with many farmer owner occupiers, rather than few, larger, land ownerships has perhaps encouraged this development. Added to this is an entrepreneurial spirit of farmers in the North East. Distance from markets and climatic challenges have also encouraged farmers to consider a range of diversification options.

In the majority of the wind projects in Aberdeenshire the farmer/landowner retains control of the project, and therefore financial returns remain within the local economy. This is in contrast to large wind farm projects which frequently require to be financed by large companies based out-with the local area and which therefore make a relatively small contribution to the local economy.

1.4 Concerns over increasing numbers of wind project development in Aberdeenshire

With the increasing numbers of wind projects being developed in Aberdeenshire, a number of concerns are now being voiced over the impact of turbines. A particular issue seems to be the distance permitted from a residential property. Current guidance in Aberdeenshire is a minimum separation distance of 400m to residential property, but there are some requests for this to be increased, whereas others argue that the distance should be site specific and related to turbine size.

A further issue relates to the height of turbines permitted for development. Although Aberdeenshire Council has no formal policy on this aspect, applications for planning permission for turbines over 80m to blade tip have been refused due to landscape concerns, although some have now received permission on appeal. A ceiling of 80m restricts maximum turbine capacity to 0.8MW, although there is a global trend towards larger turbines (e.g. 2.3MW with height to blade tip of 99m)) which are able to produce greater amounts of renewable energy, at lower capital and operational cost, relative to their size. Permitting larger turbines would mean that fewer turbines were required to produce a given quantity of electricity, so delivering targets for renewable energy. This could also address cumulative impact cited by planners as an issue in particular areas.

The structure of wind turbine development in Aberdeenshire with clusters of several wind turbines which are locally owned contrasts with the wind farms containing many turbines owned by companies based out-with the area. This different in structure is not well known and it is of note that the economic benefits of these types of wind projects for the local economy are not presently recognised. There is a need to determine likely returns from typical wind projects in Aberdeenshire and indicate their effect on the wider economy.

1.5 Aims of study

The aims of this study are to produce a briefing paper for local planners and decision makers which will highlight the local economic benefits of developing on-farm wind clusters in northern Aberdeenshire.

2 Wind energy capacity in Aberdeenshire

The current picture for wind energy developments at a commercial scale in Aberdeenshire was investigated with reference to available databases. 'Commercial' wind developments were defined as those where the electricity is sold solely to the national grid, or where the electricity is to be used by an associated high power requiring business e.g. ice cream manufacture or vegetable processing. These developments are distinct from smaller scale options, of less than 100kW, where the electricity produced is mainly used by the farm business itself.

2.1 Outline of wind generation capacity

There is approximately 84 MW of capacity from wind turbines currently in operation (Table 2.1 and Appendix 1). When capacity from projects which have been granted planning permission, or have planning permission subject to conditions is added total capacity increases to close to 200 MW. There is planning permission pending for over 30 projects and these have a combined capacity of a further 190 MW (Table 2.1 and Appendix 1).

Based on information supplied by Aberdeenshire council and SAC, wind farm capacities as of April 2010 were estimated as follows;

- 83.95MW operational
- 110.45MW planning permission granted
- 194.4MW TOTAL (operational or planning granted)

- 192.03 MW planning permission pending
- **386.43MW TOTAL (all proposals)**

2.2 Pattern of wind project development

There are currently 15 ‘commercial scale’ wind enterprises operational in Aberdeenshire (Appendix 1). Significant activity with wind energy in Aberdeenshire started in 2005 – 07 with the development of wind farms at Glens of Foudland, Boyndie Airfield and Dummuie. These consist of 7 – 20 turbines, and were developed by large companies, without significant landowner involvement in company operation.

Farmer led wind projects at Hill of Easterton, Hill of Balquindachy and North Redbog followed with small clusters of 2 – 3 turbines of 0.8 – 0.85 MW each. In 2009 a further 8 sites became operational with 2 more so far in 2010. All of these projects, bar one, were developed by farmers/landowners. It is of note that the majority of turbines are ‘medium’ commercial scale of either the 0.8 MW Enercon machine or the 0.85 MW Vestas turbine.

Some 14 projects in Aberdeenshire are noted as having been granted planning permission or have been awarded planning permission subject to conditions (Appendix 1). With the exception of Mid Hill and Tullo, all of the sites consist of single turbines or small clusters of turbines, usually of 3 turbines. These are mainly being developed by locally based farmers/landowners. Again the 0.8 or 0.85 MW turbine size is most popular amongst the current group of projects that have been granted planning permission, but there is a greater proportion of 2.3 MW turbines than for projects which are already operational. This may reflect the growing confidence in wind projects amongst farmer developers.

A growing interest in wind energy projects in Aberdeenshire is demonstrated by the large number of planning applications pending. Thirty four projects are noted as pending on the Aberdeenshire planning website, discounting several which have been refused and no appeal lodged. Approximately two thirds of these are being developed by farmers/landowners as the main partners.

Discussions with consultants indicates that development of on-farm wind projects in Aberdeenshire is set to continue beyond the current range of projects going through planning[8]. It is estimated that at least as many projects which have so far been granted planning permission or at planning pending are being developed. Not all of these will reach the planning application stage and with increasing numbers of operational turbines numbers of new projects achieving planning permission may be limited by cumulative effects. Grid connection capacity may also limit numbers of projects in some areas. However, it is clear that the sector is set to remain extremely active in the foreseeable future.

At the present time around half of the projects in the planning pending category are based on the 0.8 or 0.85 MW turbine, with most of the remaining projects intending to use 2.0 – 2.5 MW machines. Projects centred on the larger 2.3 MW machines, with associated higher capital costs, are more frequently developed by large renewable companies based out-with Aberdeenshire than projects based on the 0.8/0.85MW machines. Analysis of the numbers and sizes of turbines coming through the planning system provides a snapshot of the situation and appears to indicate that turbine sizes are increasing. However, it is considered that this trend in turbine size is unlikely to continue, due to a limited number of sites suitable for the larger turbines and mainly due to developments with the Feed In Tariff as described below.

The Feed In Tariff (FIT) was introduced in April 2010, and offers progressively greater levels of support for smaller wind turbines. Under the FIT system, the 100 - 500 kW size gives a return which is competitive with the 800 kW scale on the Renewable Obligation Certificate (ROC) system, and there is much interest amongst farmers in developing projects based on this scale. There has not yet been sufficient time for wind project applications to move through the planning system since the FIT was introduced, but it is expected that the introduction of the FIT will lead to a trend towards the

[8] Gavin Catto, Green Cat Renewables and Rod McGovern, SAC

development of sub-500kW turbines. Overall it is anticipated that there will be a greater range of scales of turbines in operation in the future.

A number of planning permission applications have been submitted for turbines of up to 50kW rating. In the current report the focus is on larger scale wind turbines which have potential to generate greater revenues so data relating to this small scale are not considered here.

2.3 Details of wind farm ownership and scale

Ownership

Ownership amongst wind projects that are **operational or with planning permission** granted is currently as follows;

- 52.85MW (27%) owned by the landowner
- 194.4MW (72%) owned by external investor
- 2.4MW (1%) unknown
- **194.4MW total**

Ownership amongst **all operational or planned wind projects** including those still awaiting planning permission is currently as follows;

- 126.9MW (33%) owned by the landowner
- 12.5MW (3%) under joint ownership (landowner/external investor),
- 241.6 MW (62%) owned by external investor
- **386.4MW total**

Table 2.1 Wind farm capacity (MW)

STATUS	Total	Landowner	Joint	External	Unknown
			OWNERSHIP		
Operational	83.95	24.8		59.15	
Planning granted	110.45	28.05		80.0	2.4
Sub total	*194.4*	*52.85*	*0*	*139.15*	*2.4*
Planning pending	192.03	74.03	12.5	105.5	-
TOTAL	386.43	126.88	12.5	241.65	2.4

Source; adapted by SAC from data supplied by Aberdeenshire Council (April 2010)

Table 2.2 Number of wind farms

The number of wind farm projects by status and ownership is detailed below. Over 70% of projects are owned by farmers or other landowners.

Numbers of wind farm projects

STATUS	Total	Landowner	Joint	External	Unknown
			OWNERSHIP		
Operational	15	11		4	
Planning granted	14	11		2	1
Sub total	*29*	*22*	*0*	*6*	*1*
Planning pending	34	23	1	10	0
TOTAL	63	45	1	16	1

Source; adapted by SAC from data supplied by Aberdeenshire Council (April 2010)

Average size of wind farms

The average size of all approved and operational wind projects by ownership category;

- 2.4 MW owned by landowners
- 23.2MW owned externally
- 2.4MW ownership unknown
- 6.7MW overall average

Table 2.3: Average size of wind farms

Locally owned projects are considerable smaller than those owned by external investors. The average size of projects in planning is significantly lower than those already approved or operating.

			OWNERSHIP		
STATUS	**Total**	**Landowner**	**Joint**	**External**	**Unknown**
Operational	5.60	2.25		14.79	
Planning granted	7.89	2.55		40.00	2.4
Sub total	*6.70*	*2.40*		*23.19*	*2.4*
Planning pending	5.65	3.22	12.50	10.55	-
TOTAL	6.13	2.82	12.50	15.10	2.4

Source; adapted by SAC from data supplied by Aberdeenshire Council (April 2010)

3 Financial appraisal of on-farm wind energy

3.1 Scope of financial appraisal

Most wind turbines currently installed in Aberdeenshire are 0.8MW, many as single turbines, or in small clusters of typically 3 turbines. Of the projects in planning at the present time, many are of the 2.3MW scale. Financial analysis is given for single 0.8MW, cluster of 3 x 0.8MW and single 2.3MW wind projects.

On-farm projects currently operational will have started generation under the Renewable Obligation Certificate (ROC) scheme. The Feed In Tariff (FIT) system, introduced in April 2010, provides an alternative means of reward for renewable electricity produced and it is anticipated that this will be attractive for many on-farm wind projects. Returns for the ROC and FIT systems are compared here.

3.2 Income – FIT and ROC systems

The Feed In Tariff system provides a fixed payment for electricity generated, the generation tariff, and also a payment for electricity exported to the grid, the grid export tariff. FITs for wind projects are shown in table 3.1.

Table 3.1 Generation tariffs for wind energy under the Feed In Tariff

Wind scale	Tariff level for new installations in period (p/kWh)		
	Year 1 (1 Apr 10 – 31 Mar 11)	Year 2 (1 Apr 11 – 31 Mar 12)	Year 3 (1 Apr 12 – 31 Mar 13)
<1.5 kW	34.5	34.5	32.6
>1.5 – 15 kW	26.7	26.7	25.5
>15 – 100 kW	24.1	24.1	23.0
>100 – 500 kW	18.8	18.8	18.8
>500 – 1.5 MW	9.4	9.4	9.4
>1.5 – 5 MW	4.5	4.5	4.5

For wind projects, FITs will be paid for 20 years and will be index linked so that payments will increase according to Retail Price Index (RPI). Projects becoming operational between 1 April 2010 and 31 March 2011, year 1 of the scheme, will be eligible for the tariff level as shown, with projects becoming operational in later years receiving the appropriate tariff level for each year. Tariff levels decline year on year for future entrants for scales of up to 100kW, as shown in Table 3.1 for years 1 - 3. This reflects the expected improvements in technology, therefore reduced need for enhanced support for this scale of wind turbines. For scales larger than 100 kW, the feed in tariff payable for new entrants remains the same throughout the 20 year period, the only change being an inflationary increase.

In addition to the generation tariff, an export tariff is payable for each kWh of electricity produced under the FIT system. A minimum guaranteed payment of 3p/kWh has been set, however higher figures, in the region of 5p/kWh have been achieved for many wind turbine projects which are currently operational.

Under the ROC system a payment is made for the electricity produced and also for a number of different elements relating to the generation of renewable energy. Values attached to each will vary from contract to contract but will include Renewable Obligation Certificates (ROCs), which comprise the largest proportion of renewables payment, Levy Exemption Certificates (LECs), embedded benefits and Renewable Energy Guarantees of Origin (REGOs).

3.3 Costs and returns for 0.8 MW turbine projects

Costs and returns will vary from project to project. The following are given as typical examples of costs and returns for 0.8MW turbines (Tables 3.2 and 3.3).

Table 3.2 Typical costs for a single 800 kW turbine, and for a cluster of three 800 kW turbines

Capital costs		Single 800 kW turbine	Cluster of 3 x 800 kW turbines
	Turbine	870,000	2,540,000
	Civils/electrical engineering	125,000	400,000
	Grid connection	150,000	350,000
	Financing	50,000	140,000
	Professional	80,000	150,000
	Interest During Construction	20,000	50,000
	Insurance	10,000	20,000
	Contingency	95,000	250,000
	Total capital cost	1,400,000	3,900,000
Operating costs (annual)	Maintenance	20,000	60,000
	Meter operator	500	500
	Rates	7,000 or 0	21,200 or 0
	Community benefit	2,000	6,000
	Insurance	5,000	11,000
	Telecom lines	600	1,800
	Contingency	10,000	24,000
	Total	45,100	124,500
Capital and interest cost (annual) on 20 year loan for total capital costs @ 6% interest		121,800	339,300
Total annual cost		166,900	463,800

Assumptions:

- Assumes borrowing of 100% of capital requirement, paying back capital and interest over 20 year life of turbine.
- Exchange rate for turbine purchase £1:€1.15
- Professional costs include consultancy to planning, project management in construction, legal and accountancy fees

Output and incomes for both the ROC and FIT systems for the different turbine options are considered in this report:

Calculations of incomes for 0.8 MW turbine options:

- On the FIT system, the income for a single 0.8MW turbine (within the 500 – 1500kW band, qualifying for a 9.4p/kWh generation tariff plus an export tariff of 5p/kWh to give a total of 14.4p/kWh) would be 2,242,560kWh x £0.144 = £322,929.

- For 3 x 800 kW machines on the FIT system, the project would fall into the 1.5 – 5MW band (qualifying for 4.5 p/kWh generation tariff + 5p/kWh export tariff to give a total of 9.5p/kWh) and the income would be 6,727,680kWh x £0.095 = £639,130.

- By comparison, on the ROC system, a typical value for projects in operation is £0.105/kW ('brown electricity' price plus ROCs, LECs, embedded benefits and REGOs). The income for a single 0.8MW turbine on the ROC system would be 2,242,560kWh x £0.105 = £235,469.

- For a cluster of 3 x 800kW machines on the ROC system the income would be £706,406.

Table 3.3 Typical output and returns for a SINGLE 0.8MW turbine and for a CLUSTER of 3 0.8 MW turbines, comparing ROC and FIT systems

	SINGLE 0.8 MW turbine		**CLUSTER of 3 x 0.8 MW turbines**	
	ROC	***FIT***	***ROC***	***FIT***
Income	£235,469	£322,929	£706,406	£639,130
Annual Cost	£166,900	£166,900	£463,800	£463,800
Annual Return	**£68,569**	**£156,029**	**£242,606**	**£175,330**

Assumptions:

- Capacity factor of 32%. This is a relatively high capacity factor and has been selected in recognition of the high average wind speeds at many Aberdeenshire sites.
- Theoretical power production:
    - 800 kW machine = 800 x 24 hours x 365 days = 7,008,000 kWh
    - Cluster of 3 x 800 kW machine = 21,024,000 kWh
- Actual power production = theoretical power production x capacity factor
    - For single 800 kW= 7,008,000 x 32% = 2,242,560 kWh
    - Cluster of 3 x 800 kW machines = 6,727,680
- Total annual costs taken from Table 3.2

Once annual costs are taken into account it can be seen that the FIT system clearly favours the smaller scale project considered here; the single 0.8 MW turbine, as the 9.4p/kWh generation tariff can be obtained. Returns for the same size of project were less than half under the ROC system in this example.

Installing three 0.8 MW turbines brings the total size of the project to 2.4 MW, and into the 1.5 – 5 MW FIT banding with the less favourable generation tariff of 4.5p/kWh. In the comparison shown here where a 10.5p/kWh figure is achieved under the ROC system, the ROC system gives a 40% higher return than the FIT system. Market conditions are slightly poorer for those signing up for ROC contracts at the time of writing (May 2010) reducing the differential between the systems. It should also be borne in mind that the FIT contracts offer a guaranteed level of income for 20 years whereas contracts for ROC are not available for this long. Farmer developers may be willing to forgo a portion of the additional income which ROC may offer in order to reduce risk.

3.4 Costs and returns for a single 2.3 MW turbine

Costs typical for a single 2.3 MW turbine wind project are shown in Table 3.4.

Table 3.4 Typical costs for a single 2.3 MW turbine

Capital costs		
	Turbine	2,000,000
	Civils/electrical engineering	300,000
	Grid connection	350,000
	Financing	130,000
	Professional	150,000
	Interest During Construction	50,000
	Insurance	20,000
	Contingency	200,000
	Total capital cost	3,200,000
Operating costs (annual)	Maintenance	55,000
	Meter operator	500
	Rates	20,300 or 0
	Community benefit	6,000
	Insurance	10,000
	Telecom lines	600
	Contingency	25,000
	Total	117,400
Capital and interest cost (annual) on 20 year loan for total capital costs @ 6% interest		278,400
Total annual cost		£395,800

Assumptions:

- Assumes borrowing of 100% of capital requirement, paying back capital and interest over 20 year life of turbine.
- Exchange rate for turbine purchase £1:€1.15
- Professional costs include consultancy to planning, project management in construction, legal and accountancy fees

Table 3.5 Typical output and returns for a single 2.3 MW turbine, comparing ROC and FIT systems

	FIT System	ROC System
Income	£574,218	£634,662
Annual Cost	£395,800	£395,800
Annual Return	£178,418	£238,862

Assumptions

- Capacity factor of 30%
- Typical value per kW for projects in operation for ROC system - £0.105/kW (this is the 'brown' electricity price plus ROCs, LECs, embedded benefits and REGOs)
- Income under the FIT system for 2.3 MW turbine in 1.5 – 5 MW band – 4.5p/kWh generation tariff plus 5p/kWh export tariff to give a total of 9.5p/kWh
- Theoretical power production of a 2.3 MW machine is 2300 x 24 hours x 365 days = 20,148,000 kWh.
- Actual power production = theoretical power production x capacity factor = 20,148,000 x 30% = 6,044,400 kWh

As for the cluster of three 0.8 MW turbines, the ROC system gives a higher return than the FIT system with the figures used in this example. The annual return is very similar to the cluster of three 0.8 MW turbines (total

2.4 MW) as the slightly higher income from the three 0.8 MW cluster is offset by higher annual costs.

As for the 0.8 MW turbine calculations, farmer developers should be aware that ROC prices on the market now are slightly lower than values used here and also that the FIT system provides a guaranteed level of income for 20 years, which is not provided in the ROC system.

Although there is a slightly lower assumed capacity of the 2.3MW turbine compared to the 0.8MW machine (30% rather than 32%), output from a 2.3MW machine is otherwise proportional to its theoretical production, demonstrating the benefits of installing a single 2.3MW turbine rather than a 0.8MW turbine if there is room at the site.

4 Factors affecting financial output

4.1 Sensitivity analysis

There are a number of key variables affecting the viability of any wind energy project. Sensitivity analysis provides a better understanding of the combination of factors required for a successful wind project.

Key variables are:

- Capacity factor
- Electricity price
- ROC payment
- Connection costs
- Exchange rate

Capacity factor

The capacity factor of wind turbine operation at a site will have a major bearing on the viability of the project. This is closely connected to the average wind speed at a site. A 32% capacity factor has been assumed in the calculations here for the 0.8MW turbine options with 30% assumed for the 2.3MW turbine. Many sites in Aberdeenshire will have a slightly higher capacity factor and therefore higher production.

Raising the capacity factor by 2% to 34% will give actual power production of 2,382,720 kWh (calculated from the theoretical power production of an 800 kW machine; 7,008,000 kWh x 36%). This is an additional 140,160 kWh electricity production compared to 32% capacity, equivalent to £14,717 additional return per year (at £0.105/kW for electricity plus renewable support (ROCs, LECs, embedded benefits and REGOs). This emphasises the commercial desirability to select a site with high average wind speed to ensure that capacity factor is maximised.

Electricity price

The electricity price and renewable energy payments received, either under the FIT or ROC system, are clearly key factors in determining the return from a wind energy project.

The calculations undertaken in this study are based on an electricity price of 5p/kWh. This is typical of agreements obtained by many of the operational wind turbine projects in Aberdeenshire; however farmer developers should be aware that electricity prices vary over time and the optimal pricing may not be available when they are ready to sign a contract.

Risks of changes in electricity price can be minimised by selecting an agreement which provides a guaranteed electricity price for a number of years. Locking into the electricity price for 3 years, with an option for a further 7 years is a possible option.

ROC payment

ROCs are traded on the market; therefore value fluctuates over time as demonstrated in Figure 4.1. The value selected in the calculations shown in Chapter 3 is representative of recent projects.

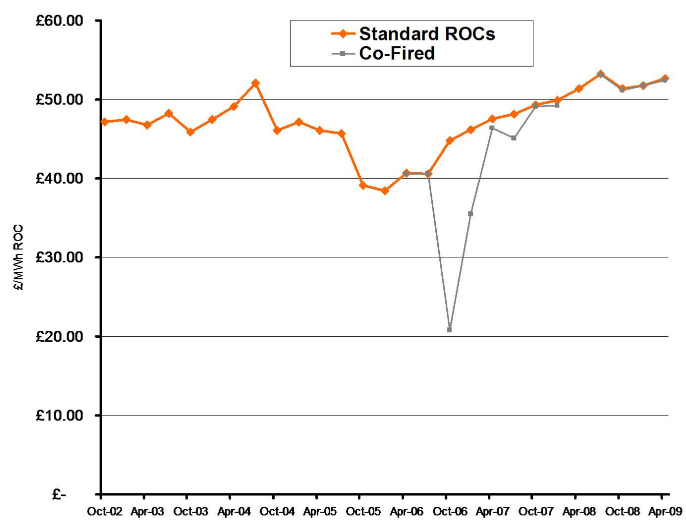

Figure 4.1 ROC value 2002 - 2009

In the Renewables Obligation as currently constituted, there is a risk that ROC prices crash if the Obligations target of 20% energy generation from renewables is reached. The UK Government's recent Energy Review proposes introducing a new mechanism, a 'guaranteed headroom' to ensure that this is avoided[9],[10].

A further potential risk that could significantly affect returns from wind energy projects is that Government reduces the ROC allocation for onshore wind to less than the current reward of one ROC per MWh produced. The Energy Review proposes that there will be a commitment on 'grandfathering' in that currently operational project will continue to receive 1 ROC/MWh for their lifetime, so addressing this issue[9].

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9 www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/res/res.aspx
10 www.bwea.com/pdf/realpower/rp06RO.pdf

Grid access and connection costs

Access to the electricity grid is currently a constraint in some locations, with limited capacity for incoming generation meaning that substantial upgrades are necessary before some wind turbines can be connected. The expense and delays involved can lead to some projects being non-viable. Work to upgrade sections of the grid is being undertaken with plans for significant improvement by 2015[11].

Connection costs can vary markedly depending on distance from a suitable electricity line. Costs can range from £70k - £80k upwards. The viability of a single turbine project will be particularly affected by connection costs. For wind clusters with multiple turbines, costs can be spread over a greater electricity generation capacity and therefore a bigger connection cost can be tolerated.

Exchange rate

Turbines used at a 'farm cluster' level are mainly Enercon, or Vestas types which are both imported. As the turbine cost is the major component of the capital cost of a project, changes in the exchange rate can have a significant effect on overall project cost.

The turbine maintenance agreement for some manufactures may also be based in Euros, so exchange rate will affect annual payments.

4.2 Availability of finance

Although a 100% example is given here for ready comparison of financial performance, it should be noted that banks will seek adequate security for this level of borrowing which may make the option unattractive or not possible for

[11] Our Electricity Network: a vision for 2020. A report by the Electricity Network Strategy Group, March 2009.

some farm scales. Some banks currently offer non-recourse deals, offering the advantage that security is taken over the project itself rather than property, although legal requirements are more onerous. A proportion of equity contribution is required for many deals.

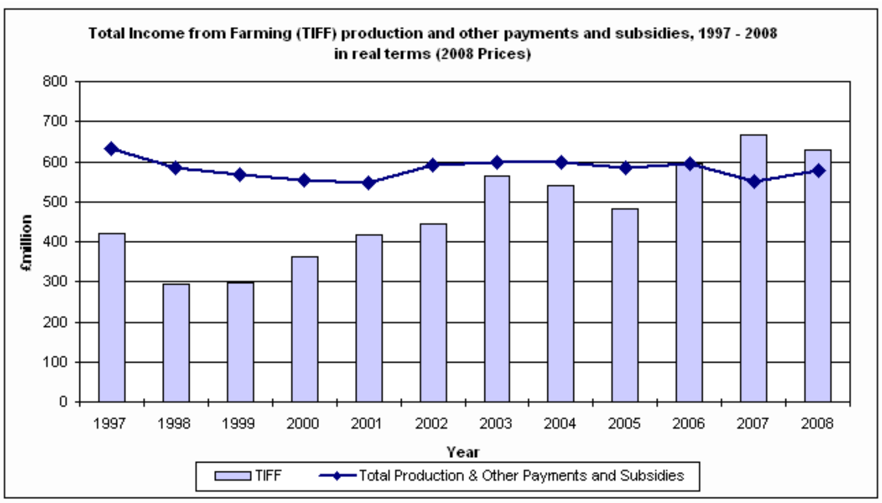
On-farm project financed so far have centred on 0.8/0.85MW turbines, or in a few cases 2.3MW scales. With the upsurge of interest in turbines falling within the 100 – 500 kW FIT bank with lower capital requirements, there is a need to ascertain appropriate structures for this scale.

5.0 The need for agricultural diversification in Aberdeenshire

5.1 Farm income in Scotland

Farm incomes in Scotland have risen steadily over the last decade from a low of around £300m in 1998 to a high of around £660m in 2007. Over the same period subsidy payments have been relatively stable with the result that in 2007 Scottish agriculture generated a profit net of subsidies for the first time in over 10 years. The overall conclusion is that Scottish agriculture has increased the level of returns from the market place significantly in recent years but that the sector as whole remains highly dependent on subsidy to generate a net return.

Figure 5.1: Total Income from Farming in Scotland



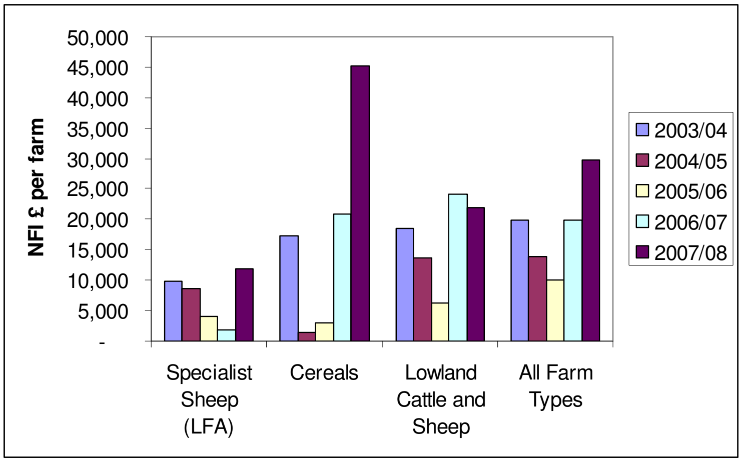
Source: Scottish Government

5.2 Incomes by farm type

Looking more closely at individual farm types as classified under the Farm Accounts Scheme (FAS) a wide disparity in income levels is seen. Income levels are generally significantly higher in non-Less Favoured Areas particularly in the more intensive sectors such as cereals, general cropping and dairy. By contrast returns on LFA farm types are sharply lower.

While all farm types recorded a rise in net farm income in 2007/08, this was on the back of exceptionally high global commodity prices and a weakening sterling exchange rate and may turn out to be an exceptional year. The chart below shows Net Farm Income (NFI) on selected farm types in Scotland over the last 5 years. Incomes on cereal farms were exceptionally high relative to the long term trends.

Figure 5.2: Net Farm Income by selected farm type in Scotland



Source: Scottish Government and SAC

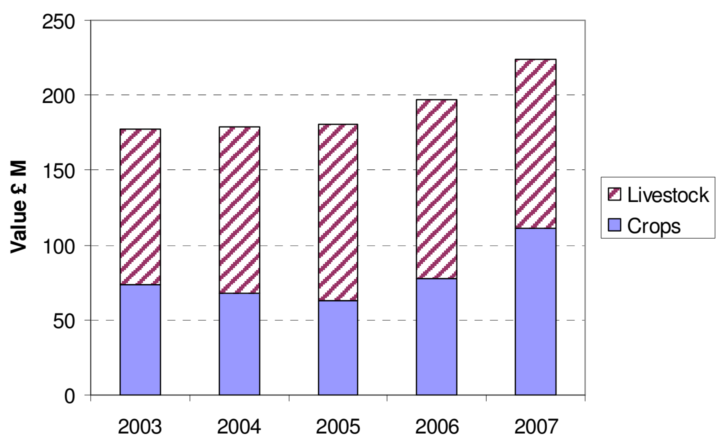
Looking more closely at individual farm types it is apparent that some farm types are far more reliant on subsidy than others. In 2007/8 LFA sheep and beef farms were the most dependant at over 50% of output provided by subsidies compared to arable and dairy units were subsidies represented less than 20% of output. The financial viability of beef and sheep farms in upland areas without subsidies therefore looks extremely vulnerable. With the downturn in commodity prices since 2007/08, the share of subsidies as a proportion of farm output is also expected to rise in the cropping and dairy sectors.

5.3 Agricultural output in Aberdeenshire

Agricultural output (excluding subsidies). in Aberdeenshire was estimated at £223.90m in 2007 (14% of Scotland's total) according to a recent report for

Aberdeenshire council[12]. This represented a 25% increase from £178m in 2003, due largely to a rise in crop prices (grain, potatoes).

Figure 5.3: changes in Aberdeenshire agricultural output (excluding subsidies)

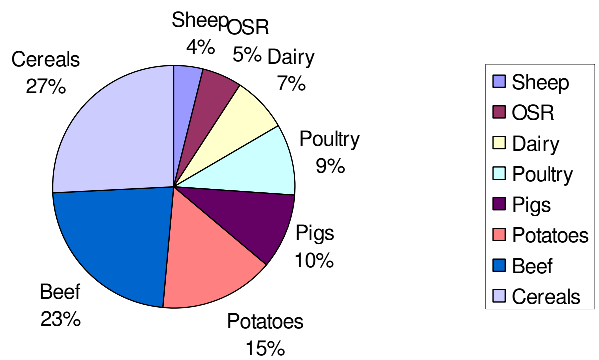


Source: Cook et al 2008

Livestock output has traditionally dominated agricultural output in Aberdeenshire; however rises in crop prices boosted the income from crops substantially in 2007 and 2008. However, since then crop income has declined significantly due to lower crop prices and higher fertiliser prices. Beef and sheep income has however increased on the back of higher stock prices. In 2007 cereals, beef and potatoes were the largest sources of farm income in Aberdenshire.

[12] Agriculture in Aberdeenshire – looking to the future,(2008), P Cook, J Booth, A Copus, G Dalton, J Grieve, B Ferguson, a study for NESAAG, Aberdeenshire Council and Scottish Enterprise

Figure 5.4 share of 2007 Aberdeenshire agricultural output of £223M by enterprise



Value of farm subsidies in Aberdeenshire

Farm subsidies are dominated by the Single Farm Payment (SFP) followed by lesser amounts of Less Favoured Area Support Scheme (LFASS), Beef Calf Premium Scheme (BCPS) and environmental payments.

In total these subsidies represented £82m of additional income equal to 38% of the £223market income received by agriculture in Aberdeenshire in 2007. These figures demonstrate the high dependency of agriculture in the region on subsidy payments.

Table 5.1 – Agricultural subsidies in Aberdeenshire 2007

	£m
SFP	71
LFASS	2.7
Other	8.2
	81.9

Source; Cook et al, 2008

5.4 Future trends – reductions in subsidies

Reform of the CAP is currently being decided which will impact on the level of subsidies that farms in Scotland receive from 2014 and beyond. There are many factors being considered but the overall implication is that subsidies on most farms will fall. There are three main reasons for this assumption;

- CAP's reducing share of the EU budget
- Redistribution of CAP money to New Member States
- Inflationary trends

(i) CAP's reducing share of the EU budget

- Agra Europe reports that some analysts are already predicting a 20-30% cut in the overall CAP budget[13].

- Commission President Jose Manuel Barroso is believed to have made his views know through a leaked Commission draft (which has since been "binned"). The draft suggested that CAPs share of the EU budget could fall from roughly 40% currently to 32% in 2013; that the Single Farm Payment system should be linked more explicitly to "the provision of public goods", and that a significant proportion of current CAP expenditure could be repatriated[14].

- A new DG Agri study has mapped out a likely decline in EU agricultural incomes, and a concentration of production in the most competitive areas, over the coming decade based on the following three scenarios – all of which consider at least a 20% reduction in the CAP budget:

– a 'Reference' model involving a 20% downsizing of the CAP budget in real terms and conclusion of the Doha deal along current lines
– a 'Conservative' scenario, again assuming a 20% budget reduction but largely at the expense of Pillar Two

[13] Agra Europe issue: AE2395, Friday January 15 2010
[14] Agra Europe issue: AE2384, Friday October 23 2009.

– a 'Liberalisation' scenario, where almost all CAP payments (except Pillar Two) are phased out, and all trade barriers are removed.

The updated version maps out arable and livestock farming patterns, income levels, land prices, and other variables under three different market orientation scenarios[15].

(ii) Redistribution of CAP money to New Member States

The addition of 12 new member states since 2004 has added 7 million farmers and 40% more agricultural land area. Direct payments are based on production and support in the reference period and as we move further away from this period, the greater the calls for redistribution[16].

(iii) Inflation and currency effects

Agricultural subsidies are not index linked and are therefore continually being eroded by inflation. An additional factor in the UK, which lies outside the euro zone, is that exchange rate fluctuations can have a major effect on UK subsidy payments to farmers made in sterling.

5.4 The benefits of farm diversification in Aberdeenshire

Generating renewable energy represent an important form of diversification for farm businesses. A study of farms in the North Pennines by Bowler et al (1996)[17] reports that the major motivating factors for farm diversification are as follows; the need to maintain or increase farm incomes (63%), reacting to a market opportunity (22%) and the need to create employment for family (16%) or non-family (12%).

[15] http://ec.europa.eu/agriculture/analysis/external/scenar2020ii/index_en.htm
[16] Pack Report 2009, page 17.
[17] Bowler, I, Clark, G., Crockett, A., Ilbery, B., Shaw, A. (1996). The Development of Alternative farm Enterprises; A study of family labour farms in the north Peninnes of England, journal of Rural Studies; 12 (3), 285-295

Farm incomes relative to the wider economy have declined steadily in recent years. Employment in agriculture has also declined significantly. Diversification is an important activity in order to support farming incomes and employment. Diversification options vary widely but many are highly dependant on location close to urban populations. Aberdeenshire has a relatively low population density and many areas are not close to a large urban population reducing the viability of farm diversification. However, these very areas are also well suited to wind power production.

Benefits of income diversification

- increasing revenue
- supporting existing employment
- creating new employment
- spreading risk

The potential for on farm wind generation to support farm incomes and create employment is explored in the following section.

5.5 Income stability

Agriculture incomes are very variable and unreliable year to year due to swings in weather conditions, crop yields and quality, market prices, exchange rates and input costs such as fertiliser and fuel. Chart 5.2 previously illustrates the large income swings witnessed by typical farm types in Scotland between 2003 and 2007.

Where farmers are entering into renewable energy production this represents an important means to diversify income and reduce risk. While costs and incomes fluctuate significantly in the wind power sector these swings are generally less than seen in agriculture particularly the volatile arable sector. In addition there are greater opportunities to lock into longer term power purchasing agreements in wind power than is always the case in agriculture. The main cost in wind development is capital and this can be fixed for 20 years whereas in agriculture fertiliser and fuel prices can rarely be hedged more than a year ahead and grain prices more than two years ahead.

The following two charts illustrate fluctuations in the income for electricity generation and wheat production. Electricity income comprises the ROC subsidy and the wholesale electricity price. Wheat income comprises the Single Farm Payment and the wheat price.

Figure 5.5 – changes in combined electricity income (pence per kwh)

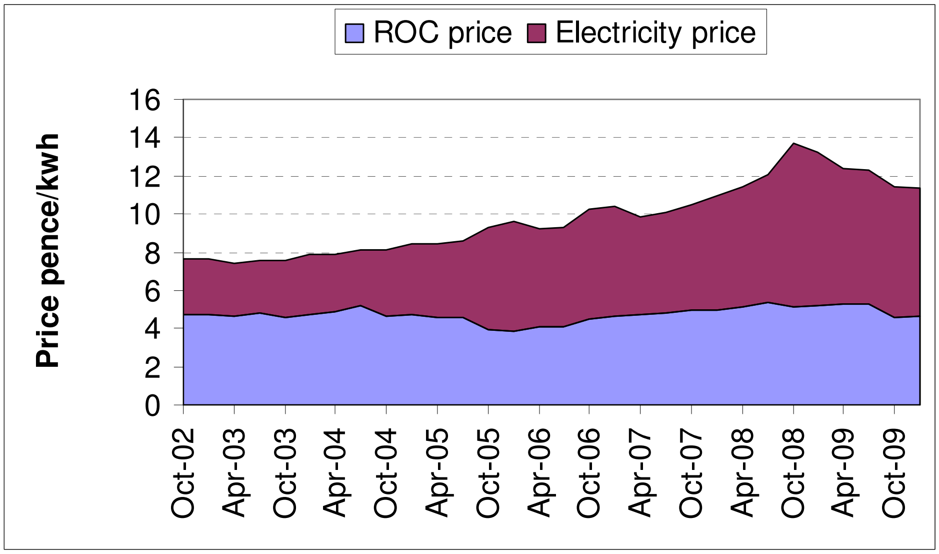
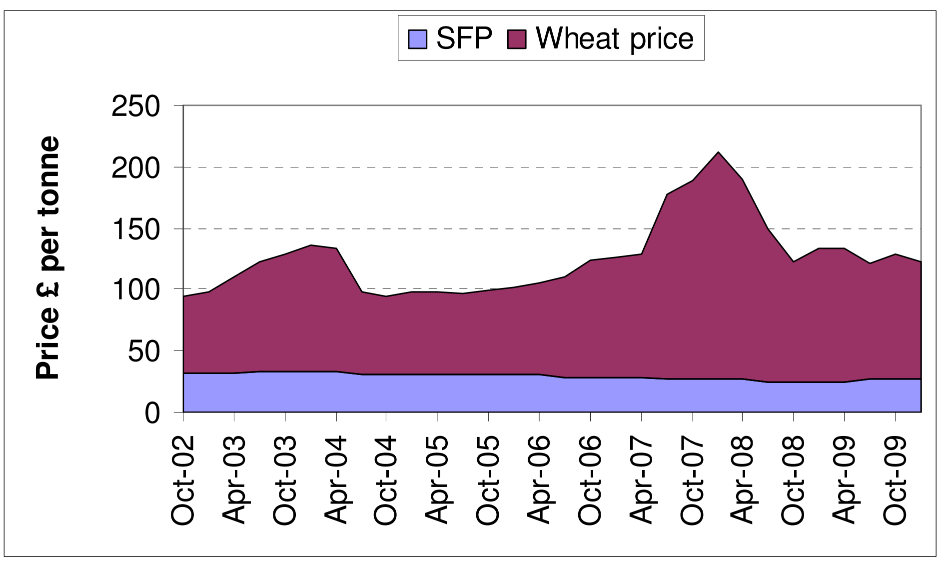


Figure 5.5 – changes in combined wheat income (£ per tonne)



While significant volatility is seen in both sectors, this is less evident in electricity with lower ranges in price and more gradual transitions which greatly aids financial planning compared to the abrupt shifts in grain prices

5.6 Role of wind farm income in offsetting subsidy decline and stabilising agricultural income

- Agricultural output (excluding subsidies) in Aberdeenshire was estimated at £223.90m in 2007 (14% of Scotland's total).

- Agricultural subsidies in Aberdeenshire totalled an estimated £85m in 2007 including £71m of Single Farm Payments.

- Reform of the Common Agricultural Policy (CAP) is expected to see cuts in the CAP budget of 20% to 30% from 2014. Redistribution of agricultural subsidies is also expected towards new member states such as Poland and Hungary. As a result Single Farm Payments (SFP) in Scotland could be cut by 20% to 30%.

- For Aberdeenshire this could represent a cut income of between £14.2m and £21.3m in SFP alone depending on exchange rates from 2014 onwards.

- Development of on farm wind power owned and managed by existing farmers and landowners represents an opportunity to bring additional income to offset any decline in agricultural income and employment.

- In the Scottish Farm Accounts Survey (FAS) for 2007/08, large cereal farms (those with the likely capital to invest in large scale wind at the farm level) generated a Net Farm Income of £90,863 (up from £46,577 the year before due to higher cereal prices and expected to fall significantly in 2008 and 2009).

- Subsidy payments in 2007/08 totalled £71,743 on large cereal farms of which SFP totalled £64,700. Reductions in SFP post 2014 of between 20% and 30% could see incomes on these farms fall by between £12,940 and £19,410 due to cuts in Single Farm Payments.

- Development of a single on farm 0.8MW turbine scheme is likely to boost incomes by between £68,000 - £156,000 per year on average and would help offset expected cuts in both subsidy income and market income.

- Wind power also represents an important means of diversifying income with lower risk than that seen in agriculture from both weather and also the market place.

- Farm businesses in Aberdeenshire are therefore going to have to develop alternative sources of income over the next 5 years in order to maintain or increase income levels. On farm wind developments offer a key source of potential income.

6.0 Economic and employment benefits of on farm wind development in Aberdeenshire

6.1 Outline

The financial assessment of individual on farm wind developments now allows estimates to be generated of the wider economic and employment benefits for Aberdeenshire as a whole. The key issue is what benefits arise from local ownership of smaller wind turbine developments as opposed to larger projects owned by outside investors?

The economic benefits of wind farm development

Economic benefits arise during two separate phases of development;

(i) Construction
(ii) Operation

Employment results directly from the activities involved as well as indirectly through the benefit to the local economy of increased expenditure in the area by both companies and households.

6.2 Methodology

The following steps have been taken to estimate local economic and employment benefits from a 0.8MW on farm wind turbine –

(i) <u>Project expenditure</u> – taken from Section (3) Financial, then broken down into recognised Standard Industrial Classifications

(ii) Employment multipliers – relevant values for each sector taken from the latest Scottish Input-Output tables[18] (Type II). This gives an estimate of how many direct, indirect and induced jobs are created by expenditure in each sector.

(iii) Scottish employment effect – an estimate of how much of the resulting employment is likely to result in Scotland. Values taken from O'Herlihy (2006)[19]

(iv) Aberdeenshire employment effect an estimate of how much of the resulting employment is likely to result in Aberdeenshire. Values estimated by SAC in discussions with industry.

(v) Figures are then presented – per 0.8MW scheme, per 1MW and across the 53Mw of farmer owned schemes planned (see summary table overleaf and full calculation in Appendix 2)

[18] http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output

[19] O'Herlihy & Co, (2006), Windfarm construction; economic impact appraisal, a report for Scottish Enterprise

6.3 Results

(i) Jobs created in total

Estimate of total jobs created by project expenditure and income are detailed in the following table.

Table 6.1 - Estimates of TOTAL jobs created per 0.8MW turbine (FIT income)

	Project spend (£)	Spend (£) per job created	Jobs created
1) Wind assessment and feasibility review	80,000	47,596	1.68
2) Planning process	2,000	42,937	0.05
3) Construction (roads)	90,000	51,177	1.76
4) Construction/erection services		51,177	0.00
5) Internal grid and grid connection	150,000	74,405	2.02
TOTAL I - construction	**322,000**		**5.50**
6) Operation and maintenance	20,000	47,596	0.42
7) Land agreement - local owned	156,029	75,988	2.05
TOTAL II - annual	**176,029**		**2.47**

From this total, the proportion retained in Scotland and then locally in Aberdeenshire has then been estimated.

(ii) Note on categories

1) *Wind farm assessment and feasibility review* – the cost of feasibility studies and preparation of the planning application and supporting documents, generally conducted by locally and Scottish based companies.

2) *Planning process* – direct planning fees.

3) *Construction (roads)* – generally entirely local contractors.

4) *Construction/erection services* – in this instance these services were provided entirely by contractors outside Aberdeenshire and predominantly from outside the UK and have therefore been excluded. Inevitably some limited local benefits from accommodation etc. have therefore also been omitted.

5) *Internal grid and grid connection* – cabling and grid connection from generally locally based contractors.

6) *Operation and maintenance* – annual average costs. Whilst spares are mostly imported most of the staff are locally or Scottish based.

7) *Landowner agreement* – this represents the annual income to the landowner. Where the site is leased out this represents a much lower value but also much lower risk payment from the wind farm developer. Where the farmer/landowner takes on development themselves the potential income is greatly increased reflecting the considerable risk and investment required. If planning fails then the landowner must absorb this high cost with no benefit. Once approved the landowner also carries considerable risk from issue such as grid connection, equipment performance, energy yield and fluctuations in energy and incentive payments.

(iii) Jobs created in Scotland and Aberdeenshire

Estimates of the proportion of employment from each spending or income category have then been determined.

Table 6.2 - Estimates of LOCAL jobs created per 0.8MW turbine (FIT income)

	Share of jobs retained in Scotland	- of which in Aberdeenshire	Jobs in Aberdeenshire
1) Wind assessment and feasibility review	100%	50%	0.84
2) Planning process	100%	100%	0.05
3) Construction (roads)	100%	100%	1.76
4) Construction/erection services	33%	100%	
5) Internal grid and grid connection	50%	80%	0.81
TOTAL I - construction			**3.45**
6) Operation and maintenance	66%	50%	0.14
7) Land agreement - local owned	100%	65%	1.33
TOTAL II - annual			**1.47**

(iv) Employment benefits of local vs external ownership

A comparison has then been made between the employment benefit where turbines are owned locally or externally.

Construction

Construction generates an estimated 3.45 jobs for each 0.8MW turbine constructed on farm in total for the assumed 1 year construction period. This figure is the same for locally or outside owned projects.

Annual impacts

Once the turbine is operational income and expenditure are generated in two main areas; (a) operations and maintenance and (b) Land agreement – income to landowner.

Operations and maintenance are estimated to generate 0.14 jobs per 0.8MW turbine on an annual basis; this is the same for both locally and externally owned projects

Land agreement generates 1.33 jobs per 0.8MW turbine on an annual basis when locally owned and just 0.09 jobs when externally owned.

In total local ownership is expected to generate an additional 1.24 jobs locally per year over the lifespan of the project compared to external ownership as the table details.

Table 6.3 - Estimates of local jobs created per 0.8MW turbine (FIT income)

	FARMER owned	EXTERNALLY owned	
	Aberdeenshire jobs created		*Difference*
TOTAL I - construction	**3.45**	**3.45**	*0*
Operation and maintenance	0.14	0.14	*0*
Land agreement	1.33	0.09	*1.24*
TOTAL II - annual	**1.47**	**0.23**	***1.24***

Income and employment resulting from ongoing maintenance and land agreement payments brings benefits to the local community for the entire 25 year expected operational life of the turbines. Where the turbines are owned by local farmers this benefit is over 6 times as great as that resulting from turbines owned externally.

Clearly local ownership brings far greater local employment benefit than either the construction phase or where the project is externally owned.

(v) Income generated locally

The financial comparison between farmer and external ownership is detailed below.

Table 6.4 - Estimates of local income generated per 0.8MW turbine (FIT income)

	FARMER owned	**EXTERNALLY owned**	
	Output/expenditure(£)		*Difference*
TOTAL I - construction	**322,000**	**322,000**	*0*
Operation and maintenance	20,000	20,000	*0*
Land agreement	156,029	9,000	*147,029*
TOTAL II - annual	**176,029**	**29,000**	***147,029***

(vi) Summary and conclusions

FIT payments

Local ownership of on farm wind turbines brings;

- ADDITIONAL annual income to the local economy of - £147,000 per 0.8MW turbine and in Aberdeenshire;

- £9.7m for operational/approved projects*[12]
- a further £13.4m from projects in planning#[13]

- ADDITIONAL employment to the local economy of 1.24 jobs per 0.8MW turbine and in Aberdeenshire;

82 jobs for operational/approved projects*[20]
a further 113 jobs from projects in planning#[21]

These are general estimates, based on the assumption that all turbines are single 0.8MW schemes benefiting from the FIT scheme.

In reality many projects will be larger in scale reducing the income per turbine substantially through the ROC scheme payments.

ROC payments

Local ownership of on farm wind turbines brings;

- ADDITIONAL annual income to the local economy of - £59,500 per 0.8MW turbine and in Aberdeenshire;

- £3.95m for operational/approved projects*[12]
- a further £5.43m from projects in planning#[13]

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[20] farmer owned projects *53MW in operation or permitted,

[21] farmer owned projects #73MW in planning

- ADDITIONAL employment to the local economy of 0.5 jobs per 0.8MW turbine and in Aberdeenshire;

33 jobs for operational/approved projects*[12]

a further 46 jobs from projects in planning#[13]

These estimates exclude the large number of projects which have not yet reached planning which could be as large again as all those already approved or in planning.

Assessing the total jobs and income effect across Aberdeenshire of local ownership of wind turbines in practice would depend on a wide range of variables including;

- The number and size of wind turbine projects finally approved and built
- the size of individual wind projects and whether they receive FIT or ROC income
- the cost of wind turbine construction (euro exchange rates, contractors costs, speed and complexity through planning, grid connection charges)
- the profitability of on farm wind turbines (ROC or FIT payments, electricity prices)
- the actual spending patterns of local farmers resulting on additional income received from wind turbine development (how much will remain locally and how much will leave the local economy?)

By promoting smaller scale projects, the FIT system means that turbines are more likely to be owned by local farmers or residents than the larger schemes favoured under the ROC payment system. Or put another way, for a given level of wind output in a specific area, the FIT system is likely to result in a greater total income and of this a greater proportion is likely to stay in the local area.

Overall farmers are particularly good at recycling extra income back to the farm & local economy. Data from the Scottish Income-Output Tables[22] demonstrates that agriculture displays high multiplier effects. Agriculture is within the top 10% of

[22] http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output

industries for generating additional income in other industries and within the top 25% for generating additional employment in other industries. Previous studies[23] have also demonstrated that in Grampian, agricultural activity is particularly effective in supporting local economic activity and employment.

As a new farm activity, what is less clear is how much of the income from wind farm development on farm will be invested in the farm or spent locally. Assessing this more accurately will require a more detailed study involving a survey of actual spending patterns from operational on farm wind turbines.

[23] Johns, PM, Leat PMK, (1986) An approach to regional economic modelling; the case of Grampian, North of Scotland College of Agriculture

Appendix 1 – table of wind farm projects in Aberdeenshire

Operational

Date	Wind farm	Make, Model	Size of turbines MW)	No. turbines	MW capacity	Developer	Farmer/ landowner based?
Feb 10	Hill of Fiddes	Enercon E70	2.3	3	6.9	Broadview Energy	No
Feb 10	Cowhill	Enercon E48	0.8	1	0.8	Mr Michael Davis	Yes
Dec 09	Ednie Farm	Enercon E48	0.8	1	0.8	Bruxiehill Wind Energy Ltd	Yes
Dec 09	Hill of Skelmonae	Enercon E48	0.8	4	3.2	David C Smith	Yes
Dec 09 and Jun 09	Strath of Brydock	Enercon E70	2.3	3	6.9	A J Duncan	Yes
Dec 09	Newstead	Enercon E48	0.8	1	0.8	Mr R Hay	Yes
Oct 09	Hill of Burns	Enercon E48	0.8	1	0.8	Hill of Burns	Yes
Jul 09 and Jul 07	Hill of Balquindachy	Vestas	0.85	3	2.55	Grant Mackie	Yes
Jul 09	St John's Wells	Enercon E48	0.8	3	2.4	St John's Wells Wind Farm Ltd	Yes
Jul 09	Cairnhill	Enercon E48	0.8	3	2.4		Yes
Jul 08	North Redbog	Enercon E48	0.8	2	1.6	Redbog Renewables Ltd	Yes
Jul 07	Hill of Eastertown	Vestas V52	0.85	3	2.55	Mackies	Yes
Apr 07	Dummuie	Vestas V66	1.75	7	12.25	Eco2	No
May 06	Boyndie Airfield	Enercon E70	2	7	14	RDC	No
Jul 05	Glens of Foudland	Bonus	1.3	20	26	RES	No
total					83.95		

Planning permission granted/granted subject to conditions

Date	Wind farm	Size of turbines MW)	No. turbines	MW capacity	Developer	Farmer/ landowner based?
APP/2009/3776	Mains of Bogfechel	0.8	1	0.8	Mr Charles Simmers	Yes
APP/2009/1044	Little Byth	0.8	3	2.4	Lovie Ltd	Yes
APP/2008/4159	West Cockmuir	0.8	1	0.8	Aberdeen and Northern Eggs Ltd	Yes
APP/2008/1722	House o'Hill	0.8	3	2.4	Gavin Catto and Patrick Catto	Yes
APP/2008/1486	Cairnmore Farm	0.85	3	2.55	Grant Mackie	Yes
APP/2008/0753	Clochnahill	1.3	4	5.2	Hugh Gordon	Yes
APP/2007/4747	Upper Ardgrain	0.8	3	2.4	Mr Hamish Garland	Yes
APP/2007/3775	Gairnieston Farm	2.3	1	2.3	Mr Philip Benzie	Yes
APP/2006/4452	Mains of Hatton	0.8	3	2.4	ECO2 Ltd	?
APP/2006/3651	Denhill	2.3	1	2.3	Mr E Lee, Mr John Lind and Mr John K Lind	Yes
APP/2006/3646	Courtstone	2.3	1	2.3	Mr E Lee, Mr John Lind and Mr John K Lind	Yes
APP/2006/3637	Haddo	2.3	2	4.6	Mr E Lee, Mr John Lind and Mr John K Lind	Yes
APP/2003/1662	Mid Hill	2.5	25	62.5	Fred Olsen Renewables	No
APP/2003/0756	Tullo	2.5	7	17.5	Tullo Wind Farm Ltd	No
Total				110.45		

Planning permission pending

Application code	Wind farm	Size of turbines MW)	No. turbines	MW capacity	Developer	Farmer/ landowner based?
APP/2010/1147	Cairnhill extension	0.8	3	2.4	James Norrie	Yes
APP/2010/1117	Mosseye Farm	0.33	1	0.33	Mr M Davis	Yes
APP/2010/0755	Cairncake Farm	2.3	2	4.6	Alan Twatt (Potatoes)	Yes
APP/2010/0487	Jacksbank	2.0 – 2.3	3	6.0 – 6.9	East Coast Viners	Yes
APP/2010/0432	Cloffrickford, Skilmafilly, Denmore	2.3	3	6.9	Mr D Smith	Yes
APP/2010/0405	Burnside of Idoch	0.8	4	3.2	Scottish and Southern Renewables	No
APP/2010/0305	Mains of Cairnbrogie	2.3	3	6.9	Arthur Simmers	Yes
APP/2010/0202	Hill of Fechel	0.8	1	0.8	Mr E Simmers	Yes
APP/2010/0177	Auchtygills Farm	2.0 – 2.5	1	2.0 – 2.5	Triodos Mellinsus Projects Ltd	No
APP/2010/0175	Clayfords Farm	2.0 – 2.5	1	2.0 – 2.5	Triodos Mellinsus Projects Ltd	No
APP/2010/0067	Castle of Auchry	0.8	3	2.4	Rubislaw (XXXI) Ltd	Yes
APP/2009/4121	St Johns Wells	0.8	4	3.2	St John Wells Wind Farm Ltd	Yes
APP/2009/4072	Shielburn Farm	2.3	3	6.9	Duncan Greenenergy	Yes
APP/2009/3684	Old Maud	0.8	1	0.8	Mr E Gibson	Yes
APP/2009/3637	Ednie Farms	0.8	2	1.6	Bruxiehill Wind Energy Ltd	Yes
APP/2009/3610	Auchenten	0.8	3	2.4	Dr G Masson	Yes
APP/2009/3583	Upper Wheedlemont Farm	0.85	2	1.7	J & A Wilson Ltd	Yes

APP/2009/3567	Hillhead of Auquhirie	2.3	3	6.9	Auquhirie Land Company Ltd	Yes
APP/2009/3565	Muirake	2.3	2	4.6	Vento Ludens Ltd	No
APP/2009/3456	Greenhill Croft	2.3	2	4.6	Alan Twatt (Potatoes)	Yes
APP/2009/2439	West Knock	0.8	3	2.4	Mr A Howie	Yes
APP/2009/1988	Tillymaud	0.8	1	0.8	Udny Community Wind Turbine Company Ltd	Yes
APP/2009/1541	Bogenlea Farm	2.3	1	2.3	Eco2 Ltd	No
APP/2009/1484	Droop Hill	2.3	2	4.6	Macphie of Glenbervie Ltd	Yes
APP/2009/1380	Clashindarroch Forest	2.75	18	49.5	Vattenfall Wind Power Ltd	No
APP/2008/4244	Gordonstown	2.5	5	12.5	Novera	No?
APP/2008/2874	Cairnton Road	2.3	1	2.3	Hamlyn's of Scotland Ltd	Yes
APP/2008/0237	Pressendye	2.3	7	16.1	Cushnie Wind Energy Co.	No
APP/2008/0147	Hill of Tillymorgan	0.8 – 1.0	3	2.4 – 3.0	Mr Callum Burnett	Yes
APP/2006/4911	Kildrummy	2	8	1.6	Npower renewables	No
APP/2006/4436	Toux Farm	0.8	1	0.8	Deer Community Council	Yes
APP/2006/4063	Herscha Hill	0.8	1	0.8	Mr Colin McLean	Yes
APP/2006/3934	Meikle Carewe	0.85	12	10.2	RES Developments Ltd	No
APP/2004/4666	St John's HIll	1.3	9	13	SSE Renewables	No
Total				192.03		

Source: Aberdeenshire Council Planning

Appendix 2a – economic and employment multipliers – FIT payments

On farm wind clusters - locally owned - employment effects - 0.8Mw turbine

Cost element	Expenditure	Standard industrial classification	Input-output sector from Scottish table	Employment multiplier * (Type 2)#	Output per employee	Total employment (Type 2)	Scottish portion	Impact on Scottish employment	Of which Aberdeenshire portion	Impact on Aberdeenshire employment (gross) Per 0.8Mw	PER 1Mw	PER 60Mw
	A	**B**	**C**	D	E	F	G	FxG	H	FxH		
1) Wind assessment and feasibility review	80,000	74.30 or 74.20	112	21.01	47,596	1.68	100%	1.68	50%	0.84	1.05	63.03
2) Planning process	2,000	74.12/2, 74.12/	110	23.29	42,937	0.05	100%	0.05	100%	0.05	0.06	3.49
3) Construction (roads)	90,000	45.2/3	88	19.54	51,177	1.76	100%	1.76	100%	1.76	2.20	131.90
4) Construction/erection services		45	88	19.54	51,177	0.00	33%	0.00	100%			
5) Internal grid and grid connection	150,000	31.2	70	13.44	74,405	2.02	50%	1.01	80%	0.81	1.01	60.48
TOTAL I - construction	**322,000**					**5.50**		4.49		3.45	4.31	258.90
6) Operation and maintenance	20,000	74.2	112	21.01	47,596	0.42	66%	0.28	50%	0.14	0.17	10.44
7) Land agreement - local owned	156,029	Consumption Multiplier	Households (Type 2)	13.16	75,988	2.05	100%	2.05	65%	1.33	1.67	100.10
TOTAL II - annual	**176,029**					**2.47**		**2.33**		**1.47**	**1.84**	**110.54**
8) Land agreement - leased	9,000	Consumption	Households (Type 2)	13.16	75,988	0.12	100%	0.12	75%	0.09	0.11	6.66
TOTAL III - annual										**0.23**	**0.29**	**17.10**

Notes

A - expenditure based on 0.8MW turbine in Abderdeenshire, source SAC and industry
B - Source, Scottish Government
C - Source Scottish Government
D - Scottish Input Output tables (Type2@) 2004 except "Land agreement" O'Herlihy & Co, 2006, #
E - as per D

F = A/E
G = O'Herlihy & Co (2006)
H - local employment estimatedbased on 0.8MW turbine in Abderdeenshire, source SAC and industry
I - estimated impact of 1MW of schemes based on 0.8MW example
J - estimated impact of 60MW of schemes based on 0.8MW example

O'Herlihy & Co, (2006), Windfarm cosntruction; economic impact appraisal, a report for Scottish Enterprise
@ Type 2 employment - direct+indirect+induced
* Impact on Scottish employment refers to the number of jobs generated per aditional £1M of sectoral output

Appendix 2b – economic and employment multipliers – ROC payments

On farm wind clusters - locally owned - employment effects - 0.8Mw turbine

Cost element	Expenditure	Standard industrial classification	Input-output sector from Scottish table	Employment multiplier * (Type 2)#	Output per employee	Total employment (Type 2)	Scottish portion	Impact on Scottish employment	Of which Aberdeenshire portion	Impact on Aberdeenshire employment (gross)		
										Per 0.8Mw	PER 1Mw	PER 60Mw
	A	B	C	D	E	F	G	FxG	H	FxH		
1) Wind assessment and feasibility review	80,000	74.30 or 74.20	112	21.01	47,596	1.68	100%	1.68	50%	0.84	1.05	63.03
2) Planning process	2,000	74.12/2, 74.12/	110	23.29	42,937	0.05	100%	0.05	100%	0.05	0.06	3.49
3) Construction (roads)	90,000	45.2/3	88	19.54	51,177	1.76	100%	1.76	100%	1.76	2.20	131.90
4) Construction/erection services		45	88	19.54	51,177	0.00	33%	0.00	100%			
5) Internal grid and grid connection	150,000	31.2	70	13.44	74,405	2.02	50%	1.01	80%	0.81	1.01	60.48
TOTAL I - construction	**322,000**					**5.50**		4.49		3.45	4.31	258.90
6) Operation and maintenance	20,000	74.2	112	21.01	47,596	0.42	66%	0.28	50%	0.14	0.17	10.44
7) Land agreement - local owned	68,569	Consumption Multiplier	Households (Type 2)	13.16	75,988	0.90	100%	0.90	65%	0.59	0.73	43.99
TOTAL II - annual	**88,569**					**1.32**		**1.18**		**0.73**	**0.91**	**54.43**
8) Land agreement - leased	9,000	Consumption	Households (Type 2)	13.16	75,988	0.12	100%	0.12	75%	0.09	0.11	6.66
TOTAL III - annual										**0.23**	**0.29**	**17.10**

Notes

A - expenditure based on 0.8MW turbine in Abderdeenshire, source SAC and industry
B - Source, Scottish Government
C - Source Scottish Government
D - Scottish Input Output tables (Type2@) 2004 except "Land agreement" O'Herlihy & Co, 2006, #
E - as per D

F = A/E
G = O'Herlihy & Co (2006)
H - local employment estimatedbased on 0.8MW turbine in Abderdeenshire, source SAC and industry
I - estimated impact of 1MW of schemes based on 0.8MW example
J - estimated impact of 60MW of schemes based on 0.8MW example

O'Herlihy & Co, (2006), Windfarm cosntruction; economic impact appraisal, a report for Scottish Enterprise
@ Type 2 employment - direct+indirect+induced
* Impact on Scottish employment refers to the number of jobs generated per aditional £1M of sectoral output