Worth The Candle?

The Economic Impact of Renewable Energy Policy in Scotland and the UK

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Verso Economics

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Key messages for policymakers

One aspect of UK policy to reduce carbon dioxide emissions is a push to install an increasing amount of renewable electricity generating capacity to replace existing power stations. For Scotland, this means in effect giving priority for wind power above other alternatives.

The technical problems with relying on a rising contribution of intermittent wind power are well recognised. Despite this, both Whitehall and Holyrood continue to provide subsidies and other incentives to the industry, with the cost ultimately borne by taxpayers and consumers. A reason used to justify this approach is that investing in the renewable energy sector is economically beneficial.

This report looks at this economic justification for subsidising the renewable energy sector in terms of jobs created and lost. It finds that in the UK 3.7 jobs are foregone elsewhere in the economy for every job created in the renewable energy sector. Funding of renewable energy polices imposes extra taxes and higher energy bills on households and industry.

In Scotland too there is no net benefit from government support for this sector, and probably a small net loss of jobs. The figures are less severe than for the UK as a whole because Scotland benefits from a large fiscal transfer from the rest of the UK. The reason is that a greater proportion of renewable energy generators are based in Scotland. In 2009/10, the year for which the figures in this report are taken, this transfer amounted to c £330m. If Holyrood were to pursue the same policies in isolation from the rest of the UK, the net costs would rise towards UK levels.

The likelihood is that the cost-benefit ratio of government support for renewable energy will remain negative for the foreseeable future. So as support rises and the sector expands, so will net job losses.

Economic benefits from renewable energy can be harnessed in those regions or countries that export equipment to others (though across the piece the costs still outweigh the benefits). There is little to suggest that Scotland or the rest of the UK are well placed to exploit this aspect of the market.

The political leadership in Scotland and elsewhere in the UK needs to engage in a more honest debate about renewable energy. It should recognise and enumerate its economic and environmental costs, and focus more on the scientific and technical issues that arise.

Executive Summary

I. This report examines the costs and benefits of government policy to support the renewable energy industry in Scotland and the UK. The Scottish Government in particular is promoting the renewables sector as an economic opportunity, and the purpose of this report is to assess whether this is justified. The report therefore does not investigate measures designed to reduce carbon emissions directly, nor does it consider the merits of renewable technology as part of the attempts to slow climate change.

II. The report's key finding is that **for every job created in the UK in renewable energy, 3.7 jobs are lost. In Scotland there is no net benefit from government support for the sector, and probably a small net loss of jobs.**

III. The lower level of job displacement in Scotland is because of the greater concentration of renewable energy generation in Scotland. This means that **electricity consumers and UK taxpayers subsidised the Scottish industry by c £330m** in 2009/10 over and above subsidies paid for by Scottish taxpayers and consumers. To the extent that the Scottish industry is a success, it is reliant on the wider UK policy making framework, in particular the Renewables Obligation Certificate (ROC) scheme.

IV. The main policy tool used to promote renewable energy generation is the Renewables Obligation, which effectively raises the market price paid for electricity from renewable sources. This scheme cost electricity consumers £1.1bn in the UK and around £100m in Scotland in 2009/10. The UK government plans similar schemes to promote renewable heat and renewable fuels.

V. In addition, both the UK and Scottish Governments have introduced a wide range of grants and subsidies for the renewables industry. These are estimated at £188m UK wide and an additional £22m in Scotland in 2009/10. Further, an exemption from the Climate Change Levy for renewable generation costs HMRC £77m UK wide and £25m in Scotland in lost tax revenue.

VI. The renewable energy sector imposes other indirect costs on the economy, mainly from its impact on the local environment and landscape. While there has been some research into aspects of this, there is no conclusive data, so these costs are not included in the calculations used in this report. In total, measurable policies to promote renewable energy cost £1.4bn UK wide and £168m in Scotland in 2009/10.

VII. A number of studies have attempted to measure the wider impacts of such policies. Research in Spain, Germany and by the EU suggests that net employment effects are negative with the likely opportunity cost, or costs associated with higher energy prices, outstripping the creation of green jobs. Many of these studies cite possible localised benefits during the construction phase of renewable energy infrastructure and the potential for longer term benefits if export markets can be established.

VIII. This report uses the Scottish Government's own macroeconomic model for Scotland to assess the impact of identified costs on jobs. A similar model was used by the Scottish Government to measure the opportunity cost of the cut in VAT implemented in 2008-09. Based on this, policy to promote renewable energy in the UK has an opportunity cost of 10,000 direct jobs in 2009/10 and 1,200 jobs in Scotland.

IX. The economic benefits that derive from the renewable energy sector are hard to assess because the industry is difficult to measure as a clearly-defined sector. However, employment figures cited by those promoting renewable energy are often greatly exaggerated, exceeding official employment figures covering the whole of the energy sector.

X. Extrapolating from wider energy industry data, and comparing this to estimates from government and industry bodies, total direct employment in renewable energy generation can be estimated at 2,700 in the UK and 1,100 in Scotland in 2009/10.

XI. In conclusion, policy to promote the renewable electricity sector in both Scotland and the UK is economically damaging. Government should not see this as an economic opportunity, therefore, but should focus debate instead on whether these costs, and the damage done to the environment, are worth the candle in terms of climate change mitigation.

XII. In Scotland, it should be recognised that the industry is reliant on UK wide support. Scottish policy making in isolation would be much more expensive. The Scottish Government, like its counterparts in the rest of the UK, should establish much more accurate figures on the extent of the industry to engender a more rational debate on the subject.

1 Introduction

Scope of the Report

1.1 Government at all levels in the UK uses a broad range of mechanisms to reduce dependency on energy from carbon based fuels. The purpose of these is to lower overall carbon emissions in an effort to mitigate damaging climate change.

1.2 The debate continues about how effective this approach will be and indeed whether it is necessary. Scientists are divided on the causes of and remedies to climate change. Even if it is established that damaging change is being caused by mankind's carbon emissions, using technologies that harness natural forces of wind, tide and wave is fraught with technical, environmental and economic problems. It is by no means certain that it will prove desirable to replace carbon emitting power with such renewable energy generation.

1.3 While acknowledging that these wider scientific, technical and economic issues are still to be resolved, this study focuses on one aspect of the debate. Increasingly, claims are made that the shift to 'green' energy presents the country with an economic opportunity. The argument is that the development of a renewable energy industry will create jobs and economic growth. So regardless of the environmental merits of renewable technology, its development is beneficial in its own right. Such claims threaten to distort the wider debate because, if proven, they render it meaningless.

1.4 If the shift to green energy is costless, it carries no risks and should be undertaken whatever the scientific merits. The subsidies currently needed would be a prudent investment which would pay dividends in years to come.

1.5 Nowhere is this agenda promoted more enthusiastically than in Scotland. A central plank of the devolved Scottish Government's policy programme is to promote the renewable energy sector as a major economic opportunity for Scotland. The idea is that Scotland's geographic exposure to wind and wave provides it with huge natural advantages offering something akin to an economic bonanza. As the Finance Minister John Swinney has stated:

> *"Moving to a low carbon economy is an economic and environmental imperative - it is Scotland's biggest opportunity this century. Scotland can become a leader in the global low carbon market, and reduce our impact on the planet, if we seize new opportunities and capitalise on our vast comparative advantages…. The move to a low carbon economy will see the development of low carbon goods, processes and services in rapidly expanding markets, alongside high levels of efficiency. We can grow the economy, generate wealth and create new green jobs"*
>
> Scottish Government Low Carbon Economy Strategy (November 2010)

1.6 The economic possibilities of renewable energy are even seen as an aid to recovery from the recent economic crisis and recession. The First Minister Alex Salmond has said:

> *".. as the world moves shakily into the economic recovery phase, I see investment in the green economy as a key to that general world recovery... Current economic difficulties should be a spur and not a hindrance to that effort... I see the current economic difficulties as a spur to getting this green economic revolution right"*
>
> Low Carbon Investment Conference (28 September 2010)

1.7 The purpose of this study is to examine the justification behind these economic claims. It looks at the costs of government policy to promote renewable electricity generation in the UK and Scotland (Section 2), with the impact of these costs on the UK and Scottish economies analysed in Section 3. The paper examines the size of the sector in the UK and Scotland and the economic benefits that accrue from it (Section 4). Then it draws conclusions about the net costs of policy in these areas (Section 5). Because the costs are mostly UK wide while the benefits highly regionalised this study considers the implications in terms of cross border economic transfers between Scotland and the rest of the UK. Finally, the paper concludes with some policy implications from the findings (Section 6).

1.8 Government has also introduced numerous policies to reduce carbon emissions from existing industrial and domestic activity. These include emissions trading at the European Union level, the Climate Change Levy imposed by the UK government, and measures imposed at the local or devolved levels of government such as buildings regulations or requirements for public sector departments to reduce carbon emissions.

1.9 Many of these policies are impossible to measure accurately because they impose additional costs on other forms of activity such as property use that cannot be measured in isolation. Besides, few claims are made for the economic benefits of the emissions reduction effort, and it seems to be accepted that these measures are a burden to be borne. Except where they benefit the renewable energy sector directly (such as providing exemptions from carbon levies), they do not come into the scope of this report.

2 The Costs of Renewable Energy Policy

Overview

2.1 With conventional energy prices in their current range, renewable energy technologies (with the exception of hydro power) are economically uncompetitive. Nevertheless, the Westminster and Holyrood governments have decided that they must be supported as a major part of an overall greenhouse gas emissions policy. To encourage investment, a system of 'Renewables Obligations' has been introduced.

2.2 The price of renewable energy is thus artificially raised to a level which justifies the additional investment cost to generators, with electricity consumers bearing the burden. The market has now been engineered further by capping the total support for biomass and introducing differential pricing for different forms of renewable energy.

2.3 To complement this market intervention for larger scale generation, the government has also introduced feed-in tariffs which provide an attractive rate of return for domestic and other smaller scale investments in renewables. Again, the cost is recovered in the form of higher electricity prices. A range of other subsidies and incentives are used to promote renewables. These various aspects of the costs of current policy are estimated and discussed in more detail in this section.

The Renewables Obligation Certificate Regime

2.4 The main policy tool used in the UK to promote renewable energy is the Renewables Obligation (RO) system, which involves market intervention to increase the value of renewable energy. The Renewables Obligation Certificate (ROC) scheme is administered by the Office of the Gas and Electricity Markets (Ofgem). Ofgem issues ROCs to generators of renewable energy, who can then sell them to electricity suppliers.

2.5 Suppliers are obliged to supply a certain proportion of their electricity from renewable sources each year to 2037. The suppliers' obligation is discharged by owning ROCs bought either from generators at a market price, or from Ofgem by paying a "buy-out" charge. This charge is fixed, and rises every year in line with the Retail Price Index (RPI). The proceeds of the buy-out charge are recycled to suppliers who purchased ROCs from generators in proportion to the quantity they bought.

2.6 The system works so that the traded market value of a ROC tends towards the value of the buy-out charge plus the value of the recycled buy-out funds. In effect, therefore, Ofgem sets the price of renewable energy which commands a premium for generators over conventional energy. This encourages investors to develop more renewable energy capacity.

Since the number of ROCs issued increases over time[1] the government can sustain this premium even as capacity increases.

2.7 The initial intention of the ROC system was to introduce a price for renewable energy that was 'technology blind', with one ROC representing 1MWh. So long as the obligations were met, the methods of generating renewable energy would be left to commercially driven decisions. The technologies eligible for ROCs are: biogas from anaerobic digestion, biomass, hydro-electric (developed after 2002), tidal power, wind power, photovoltaic cells, landfill gas, sewage gas and wave power.

2.8 There is now a cap of 12.5% that can come from biomass co-fired with coal, to prevent the market being flooded from this source. In addition, Ofgem is now intervening further in the market to favour certain technologies by varying the numbers of ROCs per MWh generated from different sources[2].

2.9 In Scotland the ROC system is governed by separate Scottish legislation. Proportionately, a larger number of ROCs are issued in Scotland, and Scottish Ministers can decide to band technologies differently to other parts of the UK in terms of the numbers of ROCs per MWh.

2.10 However, because the British market is integrated, the buy-out price for ROCs, and therefore market prices, remain the same across the island. The Scottish Government recently held a consultation on proposed changes to the Renewables Obligation Scotland (ROS) arrangements. The consultation suggested that the same changes would be implemented to the ROS system as had been proposed following a consultation on the RO system south of the border (see web links in the reference section).

2.11 For the purposes of calculating the economic cost of the ROC system it is sufficient to know the number of ROCs issued and the net cost to electricity suppliers of ROCs. This is their market price minus any receipts from the buyout fund. This closely follows the method used by House of Lords Select Committee on Economic Affairs (House of Lords, November 2008) in calculating the overall cost of ROCs, and this is applied in Table 2.1 below.

Table 2.1: UK Cost of ROCs (£ millions)

Year	2006/07	2007/08	2008/09	2009/10
Cost of ROCs	£719.0	£876.4	£1036.2	£1,121.5

SOURCE: House of Lords (November 2008), Ofgem and Verso Economics calculations

[1] Rising from 3% of total electricity supply in 2003 to 11.1% in 2011.
[2] Until 2009 all renewable technologies received one ROC for each MWh of electricity generated. From 1 April 2009, ROC 'banding' was introduced to provide a higher level of incentive for the less mature technologies.

2.12 Electricity suppliers pass on these costs to consumers in the form of higher electricity bills. This can be allocated between Scotland and the rest of the UK on the basis of electricity consumption, resulting in Scottish and total UK costs in 2009/10 of £100.2m and £1,121.5m respectively[3].

Feed-in Tariffs

2.13 From April 2010 the UK government introduced a new system of Feed-in Tariffs for small scale renewable energy production under 5MW capacity. The idea is to pay varying rates for different types of generation designed to produce a rate of return to the investor of 5%-8%, making such smaller schemes viable outside the ROC system. Producers are paid by the electricity supplier both for electricity consumed at home or exported to the market.

2.14 An impact assessment was published by the Department for Energy and Climate Change (DECC) in February 2010. Its central estimate was that the scheme would add 1.3% to domestic bills by 2015 and 1.9% by 2020. The equivalent costs for industrial bills were 1.3% and 1.8% respectively[4].

Other Incentive Schemes

2.15 The UK government has also begun to develop schemes to promote renewable heat generation and the use of renewable transport fuels. In October 2010 the UK government confirmed plans to promote renewable heat generation along the lines of the ROCs scheme for renewable electricity.

2.16 The details of how this will work in practice have not yet been decided. However, an impact assessment by the DECC estimated that the scheme would add 5% to domestic gas bills by 2015, rising to 23% by 2020. The equivalent figures for industry are 6% and 30%.

2.17 A similar Renewable Transport Fuels Obligation scheme obliges transport fuel suppliers to source a growing proportion of fuels from renewable sources. In 2009/10 the target is for 3.25%, rising in 2010/11 to 5% of fuel to come from renewable sources. The objective is to increase this percentage to 20% by 2020.

Grants and Subsidies

2.18 In addition to these market-based incentive regulations, the costs of which are met by consumers, government in the UK also awards the renewable energy sector various grants, subsidies and tax exemptions which are paid for out of general taxation. According to the DECC, spending on 'Bringing about a low carbon UK' reached £188m in 2009/10. In July 2010 the DECC announced cuts of £34m in spending on climate change reduction measures.

[3] The Scottish share of electricity consumption in 2008 was 8.9%, *Digest of UK Energy Statistics* (DUKES).

[4] These estimates are probably conservative, since government impact assessments tend to underestimate final cost outcomes.

Table 2.2: DECC Spending on Renewable Energy Policy

Year	2007/8	2008/9	2009/10
Spending	£118m	£154m	£188m

SOURCE: DECC Resource Accounts

2.19 These spending figures include programmes to promote geothermal energy, bio-energy infrastructure, off-shore wind, and bodies such as the Energy Savings Trust and the Carbon Trust. They do not all fall into our criteria of promoting renewable energy rather than carbon reduction, but nor do these departmental figures capture all the various subsidies that support renewable energy, some of which come via other bodies such as development agencies and the Department of Transport.

2.20 The UK Government does not publish a comprehensive list of subsidies with the elements designated for renewable energy support clearly delineated. The departmental figures above are a conservative estimate of UK government grants and subsidies to the industry.

2.21 In addition to these subsidies, renewable energy generators are exempt from the Climate Change Levy imposed on conventional generators at £4.30 per MWh. The actual costs imposed by the Climate Change Levy were £711m across the UK and £66m in Scotland in 2008/9, implying a UK cost of the exemption to renewable generators of £77m and a Scottish cost of £25.4m[5]. These costs are included in our calculations as they are effectively a further subsidy to renewable energy producers.

2.22 On top of UK policy, the Scottish Government has also launched numerous initiatives designed to stimulate the renewable energy sector. Like its UK equivalent, the Scottish Government does not publish a fully costed list of these policies, and this makes the overall picture unclear, not least because many grants to the sector are made from more general pools of funding such as the European Regional Development Fund, the Scotland Rural Development Programme, and the budgets of Scottish Enterprise and Highlands and Islands Enterprise.

2.23 In response to a question asked in the Scottish Parliament[6] in May 2010, the Energy Minister said that Expenditure for Renewable Energy and Microgeneration Initiatives was £32.4m in 2010-11, adding that

> *"In addition to the expenditure outlined below, energy efficiency and renewables are supported through a number of other schemes that focus on*

[5] The Climate Change Levy figures are from Government Expenditure and Revenue Scotland (GERS) and are the most recent available (2009-10 figures are probably higher). The exemption value is based on the proportion of ROCs issued in Scotland.

[6] Question 33123 "To ask the Scottish Executive how much it spends on energy efficiency initiatives, also broken down by (a) directorate and (b) funds channeled through agencies."

other policy objectives. It is not possible to accurately estimate the level of energy efficiency and renewables expenditure which such schemes will incur in 2010-11. Similarly, energy efficiency and renewables expenditure by agencies is an operational matter for those agencies."

Scottish Parliament (May 2010)

2.24 The Scottish Government budgets and draft budgets give allocations for renewable energy shown in Table 2.3. These figures include, inter alia, a £10m 'Saltire Prize' fund for innovation in the sector, a £15m WATERS fund[7] started in 2010, a 'Climate Challenge Fund' of £27.4m over three years to 2010/11, and a Community Renewable Energy Scheme of around £6m annually.

Table 2.3: Scottish Government grants and subsidies and for renewable energy

Year	2009/10	20010/11	2011/12
Value	£22m	£33m[8]	£34.6m

SOURCE: Scottish Government Draft Budgets

2.25 As the energy minister implied, it is as difficult to be accurate on the full scale of subsidy to this industry as it is at the UK level. Our report uses the overall budget figures, which is probably a conservative estimate given that it does not include budgets allocated to enterprise agencies and other governmental bodies.

2.26 It is clear that, despite the current budgetary restrictions placed on government at all levels in the UK, the trend is for increased spending on renewable energy subsidies in Scotland. For example, from 2010/11 renewable energy companies benefit from considerable relief from Non-Domestic Rates, and the Scottish Government has committed itself to a £70m 'Renewable Infrastructure Fund' (with a £17m contribution to it in 2011/12).

Other Costs of Renewable Energy

2.27 Renewable energy imposes other costs on the economy that are harder to quantify, resulting in particular from its impact on the environment. For example, the fact that development of any kind often has a negative impact on surrounding property holders is demonstrated by the existence of the restrictive planning rules themselves and the politically sensitive nature of planning decisions. In other words, the environmental amenity of the surrounding area is to some extent undermined by development. For instance, a scenic view can be ruined by a new wind farm.

[7] Wave and Tidal Energy Research, Development and Demonstration, which includes £3m of European Regional Development Fund suppport.

[8] The 2010/11 draft budget included £32m for 'renewable energy' and a further £9.4m for 'energy markets', which appears to be included in the 2011/12 draft budget statement in a composite figure of £42.3m for that year.

2.28 One element of these costs of development is their impact on property prices. Of the various types of renewable energy development, land based wind farms obviously impose the great bulk of loss of visual amenity. There is some evidence that property prices of houses within view of a wind farm development are reduced (Etherington 2006).

2.29 The loss of visual amenity potentially has an impact on tourism income, which can also be estimated. A 2008 study by the Scottish Government found a possible loss of £13.1m of Gross Value Added (GVA) up to 2015 in the regions of Caithness & Sutherland, Dumfries & Galloway, the Scottish Borders and Stirling, Perth & Kinross. This would suggest a loss of perhaps £30m throughout Scotland, or c. £6m annually.

2.30 In addition, renewable energy plant costs include marine and land based flora and fauna loss, pollution levels from construction, road use, inhibited shipping lane use, noise pollution and the costs of the planning process in dealing with developments.

2.31 Set against this are the 'savings' from avoiding the conventional energy development needed if the renewable energy had not gone ahead. However, since conventional energy plants are much more compact than their renewable equivalents it is fair to conclude that there is a significant net cost in environmental amenity from renewable development, particularly wind farms. Since it is so difficult to quantify accurately the environmental impact of development, we do not include this element in the main calculations in this report, in line with its conservative approach to calculating the costs of renewable energy policy.

Total Costs in Scotland and the UK

2.32 The following table summarises the costs of government support for the renewable energy sector in the UK as a whole and in Scotland in 2009/10, not including the environmental and other costs described above, and not including the incentive schemes for renewable heat and fuel, which have not yet come on stream.

Table 2.4: Government Support for the Renewable Energy Sector (2009/10 values[9])

Costs	UK 2009/10	Scotland 2009/10
ROCs cost	£1,121.5m	£100.2m
Subsidies & grants[10]	£188.0m	£42.7m
Tax exemptions	£77.0m	£25.4m
Total cost excluding environmental costs	**£1,386.5m**	**£168.3m**

SOURCES: Ofgem, GERS, UK & Scottish Governments

[9] With the exception of the tax exemption figures, which are from 2008/9 (the latest available).
[10] According to the DECC resource accounts for 2009/10, 11% of total spending was attributable to Scotland, and we use that figure to calculate a Scottish allocation of UK government subsidy for the sector.

2.33 These figures are corroborated by evidence given by Ofgem that suggested that costs associated with renewable energy strategies account for around 8% of household electricity bills (House of Lords, November 2008). The overall selling value of domestic electricity in the UK is shown in Table 2.5 along with the estimated renewable energy element (8%). This approach suggests that the additional costs associated with renewable strategies is around £1.2 billion, a figure compatible with our calculations.

Table 2.5: Selling value domestic sector electricity (£ millions)

Year	2005	2006	2007	2008	2009
Total selling value	£9,205	£10,799	£11,943	£14,176	£14,664
Estimated environmental cost	£736	£864	£955	£1,134	£1,173

SOURCE: Digest of UK Energy Statistics & Ofgem

3 The Economic Impact of Renewable Energy Costs

Overview

3.1 The costs of subsidies and incentives for renewable energy generation (about £170m for Scotland and £1.4bn for the whole of the UK last year) represent money which is not available to spend in other ways. The benefits which could have accrued from alternative spending, or opportunity costs, must be included in any overall assessment of policy.

3.2 The economic impact of renewable energy policy has been the subject of a number of studies in Europe and elsewhere. Our approach is similar to a method already used by the Scottish Government to assess the impact of changes to the rate of VAT. It models the impact on jobs of putting the same sum of money back into the economy, either as a tax cut or to fund capital projects.

The evidence so far

3.3 This section of the report investigates the likely impacts arising from renewable energy policies and their costs as outlined in Section 2. The most useful approach to assess the impact of these costs is to consider how these resources might have been deployed elsewhere in the economy and how many jobs could have been created from that. In other words, we attempt to measure the opportunity costs of the various subsidies and regulations.

3.4 Several studies from around the OECD have attempted to measure the impact of renewable energy policy. Before attempting to do the same for the UK, it is worth reviewing these briefly.

3.5 A high profile report was published by King Juan Carlos University (Alvarez et al. March 2009) investigating the effects of public sector support to renewable energy in Spain. The study concluded that despite aggressive green jobs policies, Spain created a surprisingly low number of jobs in the sector. The analysis showed subsidies of more than €1 million per wind industry job. Most jobs were in construction, fabrication, installation and administrative positions. Only one in ten jobs was created on a more permanent basis in the operation and maintenance of renewable sources of electricity.

3.6 There were further claims that Spanish renewable energy polices had “destroyed jobs elsewhere in the economy”. The study calculated that, since the year 2000, renewable energy policies in Spain had “resulted in the destruction of nearly 110,500 jobs elsewhere in the economy”. These losses implied that more than two jobs were lost across the Spanish economy for every green job created.

3.7 Some of the claims made in the King Juan Carlos University report were the subject of heated debate. However, similar findings have been found elsewhere in Europe. For example an econometric approach was applied to the German renewable energy market (Hillebrand et al, 2006) suggesting an expansive effect from initial investment and then a contractive effect from increasing energy costs. The paper concluded that once the construction of facilities had been completed, then a contractive effect would dominate from 2010, resulting in a negative impact on employment.

3.8 A more recent paper (Lehr et al, 2008), and a paper by the same author presented to the International Association for Energy Economics (IAEE), also outlined potential scenarios under which renewable energy policies in Germany would result in a net loss of employment. The latter paper concluded that "sensitivity analysis show that increasing exports drive the model more significantly than energy price assumptions. A mere increase of domestic investment leads to a positive labor effect, but it is rather small".

3.9 This suggestion is supported by a report recently commissioned by the European Commission (Ragwitz et al, April 2009). Four policy scenarios were considered; all were predicted to sustain net employment growth up to 2020, although only a minority of employment gains fell within longer term operation and maintenance activities. A significant driver of economic growth and job creation was found in exports, with big winners likely to include Denmark and Germany.

3.10 The UK was found to experience net employment decline in most of the policy scenarios considered. This may be attributed to the relatively weaker position of the UK in renewable energy related export markets. The implication is that net employment gains can only result from exporting to other jurisdictions, and that globally there is a net employment loss when longer term employment is considered.

3.11 The National Renewable Energy Laboratory (NREL), the national laboratory of the U.S. Department of Energy (DOE), published a white paper (Lantz and Tegen, August 2009) reviewing the study on Spain's renewable energy policies (Alvarez et al. March 2009). It criticised the Spanish study as it compared the capital employed in renewable energy with that of the average across the Spanish economy. The NREL suggested that an 'Input-Output' modelling approach would be preferable.

3.12 The NREL white paper also criticises the Spanish report for assuming that subsidies to renewable energy represent a like-for-like reduction in investment in the private sector. Additionally the NREL white paper questions the suggestion that private sector jobs in the Spanish economy have been "destroyed" on the scale claimed.

Our approach

3.13 Our approach uses an Input-Output modelling framework. This has the advantage of using a similar approach to many of the studies outlined above such as the European Commission report, and is advocated by the U.S. DOE's National Renewable Energy Laboratory. A second advantage is that both Scotland and the UK are well served in terms of Input-Output data (published by the Scottish Government and the Office for National Statistics respectively).

3.14 Our approach does not presume, as the Spanish study does, that renewable energy support simply displaces private sector activity. Rather, this report considers what the impacts might be if resources were deployed by government elsewhere or passed on to the economy in the form of tax cuts. Therefore this report does not consider what jobs may have been "destroyed" by renewable energy policies but rather attempts to measure the opportunity costs associated with these policies.

3.15 This chimes with the approach of the Scottish Government's Office of the Chief Economic Advisor (OCEA), which has published research (Scottish Government, December 2008) to demonstrate the likely impacts arising from alternative uses for the cut in VAT[11]. This research used an Input-Output model to show the likely impacts arising from a programme of public infrastructure development compared to benefits passed directly to households in the form of tax cuts.

3.16 By drawing on this empirical work published by the Scottish Government, the investigation of opportunity costs becomes a less conceptual exercise. For example, projects of national strategic importance cry out for financial backing to which the resources committed to renewable energy production could be redeployed. Our report models both a pure tax cut scenario and a public infrastructure investment scenario.

Opportunity costs

3.17 The Scottish Government (Office of the Chief Economic Advisor, December 2008) suggested that a cut in VAT from 17.5% to 15.0% would be the equivalent of around £1bn in tax cuts for Scotland's economy creating 5,400 jobs directly, 1,700 jobs indirectly and 7,100 jobs in total measured in Full-Time Equivalent (FTE) employment.. But it suggested that if these tax cuts were instead used to support public infrastructure projects (including transport, education and health) then this would create around 10,000 jobs directly, 4,900 jobs indirectly and 14,900 jobs in total (measured in FTE employment).

[11] Which was implemented by the UK Government in December 2008 to stimulate the economy during the recession.

3.18 Under this model, the number of jobs created through public infrastructure projects significantly outweighed the number of jobs stimulated through the reduction in VAT. This led to calls from the First Minister to receive the funding for a public infrastructure programme instead of the proposed cut in VAT.

3.19 An important modelling assumption made in this scenario was that the VAT cut would be only temporary and households would save half of the VAT cut in anticipation of the tax rising again. With hindsight this assumption was well made.

3.20 When considering the opportunity costs of renewable energy policy it would be more appropriate to treat tax cuts as permanent. This assumes that resources are permanently redeployed without any additional saving on the part of households, resulting in a bigger impact than with the VAT scenario described above. An additional adjustment was made to the original Scottish Government calculations to show that even if all tax cuts are spent, rather than saved, a proportion will be spent outside of Scotland.

3.21 We use similar modelling approaches outlined above (with the model adjusted to 2009 values[12]) to show the number of jobs generated through alternative uses of the ROCs scheme and the other renewable energy subsidies. Tables 3.1 and 3.2 show an employment impact based on the costs of renewable energy policy outlined in Section 2 for 2009/10.

3.22 Two different modelling approaches have been used, the Input-Output model used by OCEA (December 2008) for the VAT cut comparison (Model A), and a more up to date Input-Output model (Model B) also published by the Scottish Government (see web links). In addition, as with the VAT test, the models are run to simulate the opportunity cost of the money being spent on capital projects, and being used to reduce taxes. The same models are used to show the jobs impact for the UK.

Table 3.1: UK jobs impact of alternative use of renewable funding[13]

Measure	Direct	Indirect & Induced	Total
Capital projects (Model A)	13,800	6,800	20,600
Tax Cut (Model A)	14,900	4,900	19,800
Capital projects (Model B)	9,200	11,000	20,200
Tax Cut (Model B)	**10,000**	5,100	15,100

SOURCE: Scottish Government (Office of the Chief Economic Advisor) and Verso Economics calculations

[12] Based on HM Treasury GDP Deflators to ensure employment per unit of output (from the model) and costs are specified in the same price base.

[13] It is reasonable to assume that multiplier effects (indirect and induced employment) will be larger across the UK economy. This suggests that the total employment impact figures shown in Table 3.1 are likely to be conservative but the direct measures are likely to be reasonable.

Table 3.2: Scotland jobs impact of alternative use of renewable funding

Measure	Direct	Indirect & Induced	Total
Capital projects (Model A)	1,700	800	2,500
Tax Cut (Model A)	1,800	600	2,400
Capital projects (Model B)	1,100	1,300	2,400
Tax Cut (Model B)	**1,200**	600	1,800

SOURCE: Scottish Government (Office of the Chief Economic Advisor) and Verso Economics calculations

3.23 Scrapping all the mechanisms of supporting the renewable energy sector would be more akin to a tax cut than spending on capital projects because the majority of costs fall on electricity consumers in the form of higher bills. Higher bills are very similar in impact to increased taxes.

3.24 **Using the more up to date Model B (which gives a more conservative figure), we estimate the direct employment opportunity cost of the ROCs system and other subsidies to have been 1,200 jobs in Scotland and 10,000 throughout the UK in 2009/10. These losses are recurring, that is to say the impact would be the same every year with this level of government intervention.**

4 Renewable Energy - Economic Benefits

Overview

4.1 We have seen that there are significant costs associated with conversion to renewable energy. However, the real measure of whether a policy is justified or not is the benefit to cost ratio. If benefits are considerably higher than the cost, then even the most expensive policy can be justified, assuming the money is available in the first place.

4.2 In this section, we try to estimate these benefits, but this is not a simple or straightforward task. If it was, then currently available estimates would be broadly similar and consistent. But this is certainly not the case, with some estimates much higher than the total known employment in the electricity generation and distribution sector. Although some of these figures claim to take account of indirect job creation, the validity of the figures should be viewed with some scepticism.

4.3 Another key aspect of the employment picture is the extent to which short-term jobs are created to install new infrastructure. The number of people employed long term for maintenance and operation is far smaller.

Overall measurement

4.4 The scale and economic impact of renewable energy is difficult to measure accurately because it is not defined by Standard Industry Classification (SIC) codes which form the usual basis of sectoral statistics.

4.5 The UK Office for National Statistics is due to publish measures of the green economy later this year (summer 2011) in line with a framework proposed by Eurostat. However, other countries have already published measures of the environment goods and services sector (Livesey, December 2010) with greatly varying results. For example, the Netherlands claims to have employment of around 8,000 Full-Time Equivalent (FTE) whilst Poland supposedly has employment of around 262,000 FTE in the green economy. This suggests that, even with a consistent framework, significant variations in measurement remain, due to the use of different assumptions and definitions.

4.6 This section provides a more detailed review of the information available to measure activities within the renewable energy sector. A reasonable starting point is overall employment in the electricity production sector.

4.7 According to the ONS (Business Register and Employment Survey) at the UK level employment in the production of electricity accounts for c.25,000 jobs (as shown in Table 4.1). When considering public subsidies and incentives for renewable energy, it is the production of electricity that is of principal interest as transmission, trade and distribution activities are necessary regardless of source. The equivalent Scottish figure is 5,300.

Table 4.1: Electricity production employment

Scotland	UK
5,300	25,000

SOURCE: BRES (ONS) for 2009.

Estimating renewable energy employment

4.8 Table 4.2 below provides estimates for Scottish renewable energy employment building on the figures shown in Table 4.1. According to the Scottish Government (Scottish Government, December 2010) 16.5% of Scotland's installed generation capacity was from non-hydro renewable sources in 2009. This percentage can be applied to the 5,300 figure for employment (Table 4.1) in Scottish electricity production to estimate renewable electricity production employment as 900 jobs, as shown in Table 4.2.

4.9 Another approach for Scotland is to estimate the likely share of UK renewable energy employment made from the proportion of ROCs issued to producers based in Scotland, 36.4% in 2009-10 (Ofgem, February 2010). Renewable energy figures for the UK show that in 2008, 8.7% of plant capacity relied on renewable sources (DECC, July 2010) applying this figure to the 25,000 UK employees in electricity production (Table 4.1) results in a total UK figure of 2,200 employees in renewable electricity production.

Multiplying the 2,200 UK renewable electricity production employees by the Scottish ROCs proportion (36.4%) suggests Scottish renewable electricity production employment of c. 800 jobs. A summary of these estimates is shown in Table 4.2.

Table 4.2: Renewable energy employment estimates

Sector	UK	Scotland	
		based on generation	*based on share of UK*
Renewable energy production	2,200	900	800

SOURCE: ONS and Calculations by Verso Economics

4.10 Table 4.2 demonstrates that overall employment associated with renewable energy is relatively small, with production employing up to 900 people[14] in Scotland and around 2,200 people across the UK. It also shows that the two different approaches to measuring employment in Scotland provide reasonably similar results, suggesting the scale of these employment estimates is broadly correct.

4.11 In addition to long term employment secured in the production of renewable energy there are also temporary employment gains in the construction and deployment of

[14] These estimates do not include most employment in hydro power, which does not benefit from the government support schemes outlined in Section 2.

infrastructure. These temporary employment gains are difficult to measure, and are likely to vary significantly depending on the technology deployed, but some estimates are made in a number of the studies referred to in this report.

4.12 For example a recent report into the Scottish offshore wind industry (Scottish Renewables, August 2010) suggests a total of 2 direct jobs in construction will be sustained for every direct job in operation and maintenance. This estimate seems reasonable as a study for Germany (Lehr, 2008) suggests that in a base year every job sustained through operation and maintenance was associated with two jobs in domestic infrastructure investment.

4.13 Based on these ratios, operation and maintenance employment of 800 to 900 jobs is likely to be associated with an additional 1,800 to 2,000 jobs in the initial construction phase. The key issue is considering an appropriate timeframe over which to measure these temporary jobs; considering employment over 10 years results in around 200 jobs each year based on the production jobs figures above[15].

4.14 **In conclusion, a reasonably optimistic employment estimate for the renewable electricity sector in Scotland for 2009 (excluding hydro power) would be 1,100. Applying the same methodology raises the UK figure from 2,200 to 2,700 jobs.**

The likely scale of renewable energy employment outlined above is based on statistics published by the Scottish Government and the UK ONS. This can be contrasted with other measures of renewable energy employment and green jobs inferred by the Scottish Government, Scottish Enterprise and other organisations.

Benchmarking renewable energy employment measures

4.15 Table 4.3 summarises some other estimates of renewable energy employment. At the upper end of the measures are the estimates published by the UK Department for Business Enterprise and Regulatory Reform[16] (BERR) in March 2009. The report gave a market value for the renewable energy sector in 2007-08 of £31.1bn across the UK, with 257,000 employees. The equivalent figures for Scotland were £2.6bn and 22,200 employees respectively.

4.16 The above figures published by BERR do not wholly account for the indirect employment supported by the renewable energy sector. This suggests overall employment supported by the renewable energy sector will be much closer to 50,000 employees in Scotland and 500,000 employees across the UK.

[15] This is a generous treatment of temporary construction employment as the asset life of such infrastructure is usually considered to be around 25 years and guidance on the appraisal of public sector investment suggests timeframes well in excess of 10 years should be considered.
[16] Now the Department for Business Innovation and Skills

4.17 Scottish Renewables and Scottish Enterprise (Scottish Renewables, August 2010) commissioned a study to investigate the offshore wind industry in Scotland. The study outlined that up to 48,600 jobs could be retained in the Scottish offshore wind industry by 2020. This measure includes wider employment supported through supply chains and other indirect effects.

4.18 Much smaller estimates are provided by Scottish Enterprise (6,000 jobs), the Scottish Government website (3,000) and Strathclyde University (1,100 excluding hydro) with the latter estimate also including indirect supply chain effects. Assuming the first two figures include hydro power, these and the Strathclyde University estimates are much closer to our own.

Table 4.3: Electricity and renewable energy employment*

Source	Scotland	UK
Scottish Renewables & Scottish Enterprise (future)	48,600	-
BERR (current)	22,200	265,700
Scottish Enterprise (current)	6,000	-
Scottish Government (current)	3,000	
Strathclyde University (published 2005)	1,100	-

SOURCE: Scottish Renewables, BERR, Scottish Enterprise, Scottish Government and Strathclyde University

4.19 As stated above, there are numerous approaches to measuring the scale and scope of the renewable energy industry. Scottish Enterprise variously estimates the sector at £84 m GVA with 6,000 jobs in 2006 (Scottish Key Facts, July 2010) and £104m GVA in 2005. The Scottish Government's Low Carbon Economy Strategy (Scottish Government, November 2010) suggests an additional 60,000 jobs could be created in the sector by 2020 rising from 70,000 jobs currently to 130,000 by 2020.

4.20 These additional 60,000 jobs within the low carbon sector include an additional 26,000 jobs in renewable energy. This includes wind, wave and tidal, biomass, geothermal, hydro and photovoltaic energy generation and the services that support them, including renewable energy consultancy.

4.21 The numbers shown in Table 4.3, and others cited above, reveal two clear patterns; firstly a number of attempts to measure the current size of the renewable energy sector, and components thereof, have produced exceptionally large estimates. The current employment estimate for renewable energy produced by BERR (265,700) for the UK is more than three times all energy employment in the UK (81,400). The BERR estimate for Scotland (22,200) is almost double all energy employment currently in Scotland (11,700).

4.22 Secondly, a number of studies have produced exceptionally large figures on the likely future employment growth in the renewable energy sector. The offshore wind sector is projected to provide up to 48,600 jobs whilst Scottish Government estimates suggest 26,000

jobs could be created by 2020. The former estimate is more than four times the size of all current energy employment whilst the latter estimate is more than double.

Creating an industry

4.23 Potential employment in the Scottish offshore wind industry is estimated to be up to 48,600 by 2020 (Scottish Renewables, August 2010). This was summarised in the report as follows:

> *"In 2020, this creates more than 28,000 full-time equivalent jobs directly in the offshore wind sector. Indirect and induced effects could create another 20,000 jobs in 2020."*

4.24 Both the media and the Scottish Government cited the outcomes of the study as showing the potential to create nearly 50,000 jobs. Jim Mather, Minister for Enterprise, Energy and Tourism stated:

> *"It highlights the considerable economic opportunities for Scotland, supporting up to 48,000 Scottish jobs while delivering energy security and cutting emissions."*

4.25 The above statements are misleading because most of the jobs cited are generated through the installation of infrastructure. Overall demand for nearly 50,000 jobs may arise up to 2020 but most of this demand will be temporary and recede once infrastructure has been deployed in the North Sea. The report itself provides the best guide to the likely long term employment impacts from the offshore wind industry.

> *"Once the peak of offshore wind capacity development has passed, employment focus will turn towards O&M[17] of existing capacity. Major benefits for the Scottish economy in terms of long-term employment lie within the O&M sector. With full supply chain capabilities (skilled workforce, infrastructure, equipment and vessels), we assume that up to 100 jobs for each 500MW installed capacity could be available in 2020 in offshore wind O&M." (page 15)*

4.26 This suggests that for each 1GW installed capacity up to 200 jobs could be created by 2020. Table 4.4 shows the employment likely to be sustained through the operation and maintenance of offshore wind facilities by 2020 based on the above ratio of jobs to installed capacity. Four scenarios are outlined in the Scottish Renewables report with varying capacities installed (scenario A: 10.8GW, B: 5.4GW, C: 10.8GW and D: 1.4GW). These estimates also assume full supply chain capabilities with a skilled workforce, deployed infrastructure, equipment and vessels.

[17] O&M - Operation and Maintenance.

Table 4.4: Electricity and renewable energy employment

Scenario	Scottish Renewables Report			Offshore Wind Impact
	Direct	Indirect	Total	
Scenario A: Vision	28,400	20,200	48,600	2,200
Scenario B: Moderate	19,100	13,300	32,300	1,100
Scenario C:No change	6,100	5,000	11,100	2,200
Scenario D: Failure	900	700	1,600	300

SOURCE: Renewables Scotland and calculations by Verso Economics

4.27 The employment figures shown in Table 4.4 show that with moderate success the offshore wind industry could sustain "long-term employment" of around 1,100 full-time equivalent workers. Up to 2,200 jobs could be sustained if 'Scotland's vision' is achieved but just 300 jobs are sustained in the worst case scenario. These figures appear to be more consistent with our estimates for renewable energy (based on official statistics).

4.28 The disparity between estimates of 48,600 jobs and 1,100 jobs is mainly due to the treatment of temporary construction employment generated whilst infrastructure is installed and deployed. The report focuses extensively on the impact of the offshore wind industry in terms of its ability to support temporary construction and manufacturing jobs in Scotland. Whilst this is may be helpful in terms of additional benefits it does not provide a compelling reason for government support.

4.29 The wider temporary employment benefits are estimated using a fairly general approach to infrastructure investment. Using this general approach, similar supply chain benefits would be realised from any form of infrastructure investment such as new nuclear facilities or a programme of increased rail or airport infrastructure.

4.30 Consideration of government support should be based on the impact arising directly from the operation of new infrastructure as this is the source of long-term growth in the Scottish economy. At minimum, if an investment case is to be made based on temporary employment, it should be expressed in terms of person-years worth of employment[18].

[18] This point is reinforced in the evaluation guidance published by Scottish Enterprise (November 2008). The worked example for infrastructure investment provided in the guidance shows a case where all construction employment is omitted from the estimate of net employment impacts.

5 The net cost of renewable energy policy

5.1 Having estimated the various positive and negative impacts on jobs in Scotland and the UK as a whole, we can bring the figures together to arrive at an overall net impact on employment. The net cost in terms of renewable energy policy is summarised below:

Table 5.1: Direct employment measures

Sector	UK	Scotland
Renewable energy production	+2,700	+1,100
Opportunity cost (tax cut)	-10,000	-1,200
Net employment impact	-7,300	-100

5.2 **Based on the direct employment figures highlighted above, in the UK in 2009/10, for every job created in the renewable electricity sector, 3.7 jobs were foregone. In Scotland, the figure was 1.1.**

5.3 In other words, **there is no net benefit in Scotland from government support for the sector.** Indeed, our analysis shows a small net loss of jobs despite using generous assumptions for employment in the sector, and a conservative approach for subsidy costs.

Scotland & the rest of the UK

5.4 Because Scotland produces a larger proportion of renewable electricity to its overall consumption of electricity, it benefits from the Renewable Obligation system and also the climate change levy exemption. The reason is that while the costs fall on UK consumers and taxpayers generally, the benefits accrue to generators. This is why the ratio of jobs lost to those created is not as large for Scotland as it is for the UK as a whole.

5.5 Scottish based generators benefited from the ROCs system by c. £410m in 2009/10 and a further £25m from the exemption. But Scottish consumers and taxpayers contributed only £100m and £7m respectively. This suggests that **the net transfer to Scotland from the rest of the UK was worth c. £330m to Scotland in 2009/10.**

5.6 The renewable electricity industry in Scotland is dependent to a large extent for its viability on UK subsidies, and being part of the UK market and policy making framework. Given that some of the greatest enthusiasts for the renewable energy sector in Scotland also advocate leaving that UK framework, it is pertinent to point out that the economics of renewable electricity in Scotland would demonstrate an even greater net loss if that framework were dissolved.

6 Policy Considerations

6.1 UK and Scottish Government policy to stimulate the renewable electricity sector costs jobs. This should be no surprise since subsidising one industry at the expense of the wider economy usually has this effect. To claim that renewable energy presents Scotland or the UK with an economic opportunity is misleading.

6.2 In 2009/10, the year taken for this report's analysis, the costs of government policy were relatively modest. But the amount of renewable electricity generated was correspondingly small. The ratio of jobs lost from policy interventions to those created in the subsidised industry will remain similar (or worse given the likely impact on fuel bills of renewable heat and fuel obligations), so if the industry is expanded to fulfil a significant proportion of the UK's energy needs, with renewable fuel and heating added in, the net economic costs will rise to a point where they start to have a serious impact on economic performance.

6.3 The Scottish figures are relatively benign because a disproportionate amount of renewable electricity is generated north of the border, and it is paid for mostly by the generality of UK taxpayers and electricity consumers. In effect, UK consumers and taxpayers are subsidising the Scottish industry (by c. £330m in 2009/10). Scottish policymakers should recognise this fact. A separate Scottish policy framework would be much more expensive.

6.4 Both the UK and Scottish Governments need to establish a much clearer picture of the scale and impact of the renewable energy sector. Official figures lack clarity and consistency, and are thus prone to misinterpretation and use as propaganda.

6.5 Policy makers should develop ways of assessing the environmental costs of renewable energy developments such as wind farms and including them systematically in the decision making process.

6.6 In the light of the net costs of renewable electricity generation, debate needs to focus even more clearly on its impact on climate change. The public is entitled to a more rational debate on whether renewable energy policy is worth the candle.

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List of abbreviations

DECC	Department for Energy and Climate Change
DOE:	Department of Energy
DUKES	Digest of UK Energy Statistics
FTE:	Full-Time Equivalent
IAEE	International Association for Energy Economics
MWh	Megawatt hour
NREL:	National Renewable Energy Laboratory
OCEA:	Office of the Chief Economic Advisor
Ofgem:	Office of the Gas and Electricity Markets
RO:	Renewables Obligation
ROC:	Renewables Obligation Certificate
ROS	Renewables Obligation (Scotland)
RPI:	Retail Price Index