Phase 2: Exploring the relationship between environmental regulation and competitiveness

A case study on the Renewable Obligations

A research report completed for the Department for Environment, Food and Rural Affairs by SQW Consulting

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1 Introduction

1.1 SQW were commissioned by DEFRA in 2006 to conduct a literature review of the available evidence on the relationship between environmental regulation and competitiveness to establish the robustness of the conclusions from the available evidence and their relevance to the UK. This study highlighted the need to conduct further research on the impact of regulatory design & implementation and regulatory form on competitiveness.

1.2 As a result, SQW were commissioned to conduct Phase Two of the research, which sought to 'gather and analyse evidence on the impact of the design of environmental regulation on competitiveness' through the undertaking of a set of case studies. The research examined the following policy issues:

- The impact of business design and implementation of regulation on SMEs as compared to larger businesses
- The forms of regulation most likely to induce innovation
- The importance of context in determining the extent of inducement effects of regulation on innovation.

1.3 Although the study is primarily focused on the UK, the intention was to consider, where available, the impacts of policies elsewhere in Europe and in other parts of the world where they are similar to those implemented in the UK in order to provide comparative evidence.

1.4 This case study discusses 'the relationship between the Renewables Obligation Order (hereafter referred to as the RO) in the UK and the influence it has played on stimulating innovation and the competitiveness/productivity of the renewables energy sector. Comparison is also made to an alternative instrument used to reach similar environmental goals - the Renewable Energy Feed- in Tariff (hereafter referred to as REFIT), with a particular focus on the German experience'. This case study was selected as the RO acts as one of the key instruments currently used by the UK to tackle climate change, with a particular focus on the commercialisation of renewable technology and energy policy, a topic which is of interest to a wide range of policy makers. The study also allowed us to compare two different instruments with similar environmental aims.

1.5 The material used to produce the case study has been derived from an extensive review of the literature and consultations with individuals covering

the areas of policy, industry and academia. More details on the sources of evidence can be found in Annex B.

1.6 The next section of the case study describes the RO in more detail, the environmental problem that it is attempting to address and how this relates to the renewable energy sector. Section three outlines any evidence on the effectiveness of the regulation to date in terms of its economic and environmental outcomes. In Section four, the discussion focuses on the influence the regulation has had on innovation, productivity and competitiveness[1]. A summary of the case study and concluding observations are set out in Section five.

[1] Comparison is made to the German REFIT system throughout the case study.

2 The Renewables Obligation

The environmental problem and its nature and extent

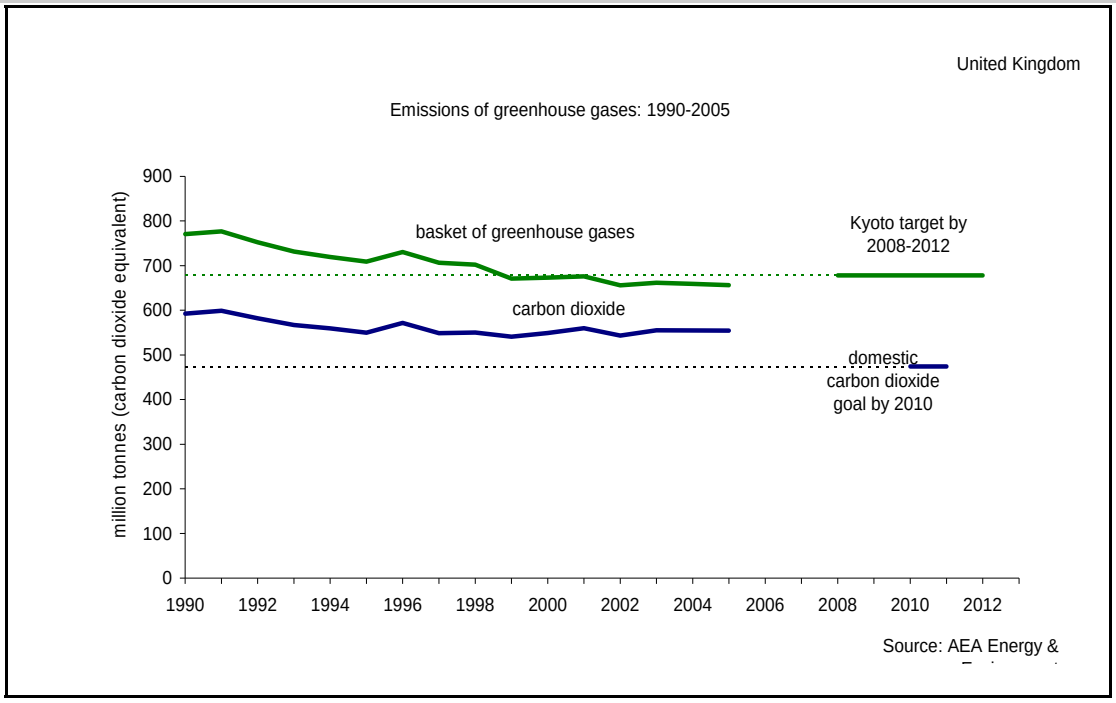
2.1 A major contributor to the problem of climate change is the combustion of fossil fuels to produce electricity. The replacement of these types of fuel with energy generated from renewable sources is one of the key mechanisms taken by the UK Government to tackle this issue, aiming in some form to stimulate the generation of renewable electricity, and through this, to reduce carbon dioxide emissions.

2.2 The rationale for Government intervention in this case lies in the fact that renewable technologies are not market-ready and hence are more expensive to produce than their counterpart fossil fuels. Therefore, in order to induce renewable energy production, Government support is required to create a market for the technologies, with a long term aspiration to enable the sustainability of the renewables sector. The UK chose to use a market mechanism to support the creation of a market for its renewables sector. This initially took the form of the Non-Fossil Fuel Obligation, which was replaced by the Renewables Obligation in 2002.

2.3 For the UK, where carbon dioxide is the main man-made contributor to global warming, accounting for about 85 per cent of the 'basket' of greenhouse gas emissions in 2005[2], climate change means warmer temperatures, wetter winters and drier summers, less snow, and higher sea levels, leading to flooding of coastal areas. 2006 was the warmest year on record in the UK with a mean temperature of 9.7 °C, 1.1 °C above the long-term average. Across the globe, there may be severe problems for regions where people are particularly vulnerable to changes in the weather. Flooding, droughts, food shortages and the spread of disease are commonly predicted. The social, environmental and economic costs of climate change are potentially huge[3].

[2] http://www.defra.gov.uk/environment/statistics/globatmos/gagccukem.htm
[3] http://www.defra.gov.uk/environment/climatechange/about/index.htm

Figure 2-1: Emissions of greenhouse gases: 1990 - 2005



Source:AEA Energy and Environment

2.4 The figure above shows that emissions of the 'basket' of six greenhouse gases fell by 15.3 per cent between the base year and 2005. (The base year is 1990 for carbon dioxide, methane and nitrous oxide, and 1995 for fluorinated compounds). It is worth noting that although emissions of carbon dioxide fell by 6.4 per cent between 1990 and 2005, they actually rose 2 per cent in the period 2002 (when the RO came into effect) – 2005. Whilst the UK has agreed to reduce total greenhouse gas emissions by 12.5 per cent relative to the base year over the period 2008-2012 to meet its commitment to the Kyoto Protocol, it aims to move beyond these targets towards its goal of reducing emissions of carbon dioxide by 20 per cent below 1990 levels by 2010, and to put itself on a path to reduce carbon dioxide emissions by 60 per cent by 2050[4].

Alleviating the problem: the regulatory history

The renewables energy sector

2.5 Stimulus of the growth and development of the renewables energy sector has been used as one of the main methods to tackle climate change throughout the developed world since the early 1980s. The instruments used to provide this stimulus have varied in their nature and in combination with the differing contextual environments in which they were set, have resulted in the development of a range of renewable technologies.

[4] gov.uk/environment/statistics/globatmos/download/xls/gafg05.xls

2.6 The renewables energy sector encompasses a varied number of technologies, which include:

- On-shore and Off-shore wind farms
- Solar energy – photovoltaics
- Landfill and sewage gas
- Wave and tidal energy
- Co-firing and biomass technologies
- Hydro and geothermal power
- Energy crops.

The Non-Fossil Fuel Obligation (NFFO)

2.7 During the 1990s (1990-1998), the development of renewable energy sources in the UK was supported by the Non-Fossil Fuel Obligation (NFFO). The NFFO acted as a Government stimulus for the development of those renewable technologies which were considered to be close to the market and hence had the potential to become commercially viable on the open market. This was administered via a series of competitive orders in which generators were invited to submit tenders for contracts under their particular order which specified the energy price at which they proposed to develop and deliver renewable energy. These tenders were then subject to a vetting process, conducted by the Department of Trade and Industry (DTI), who determined the level of capacity for different technology bands and consequently, selected the lowest tenders in each band which would meet the expected capacity. The Regional Electricity Companies were then obliged to purchase all NFFO generation offered to them at the contracted price.

2.8 There were five Orders under the NFFO, where the third, fourth and fifth Orders were set to cover periods between 18-20 years to enable generators to hold longer term contracts and hence inject a level of certainty into the market. This was reported to support contracts for the generation of a variety of technologies including: wind, hydro, municipal and industrial waste, energy crops and agricultural waste, sewage gas and landfill gas.

2.9 As can be seen from Table 2-1, the average electricity price of the contracts awarded under each Order has fallen significantly as the scheme has progressed:

Table 2-1 : NFFO Orders

NFFO Order	Date of inception and termination (where possible)	No of contracts and capacity	Average Price of contracts (p/kWh)
NFFO 1	Start: October 1990 Completed: December 1998		1990 – 7.51
NFFO 2	Start: January 1992 Completed: December 1998		1991 – 8.78
NFFO 3	Start: April 1995 Completed: Long term	141 contracts 672MW capacity	1994 – 4.85
NFFO 4	Start: February 1997 Completed: Long term	195 contracts 83 MW capacity	1997 – 3.59
NFFO 5	Start: September 1998 Completed: Long term	261 contracts 1,777 MW capacity	1998 – 2.71

Source: Non-Fossil Purchasing Agency Ltd

Prices are indexed to 1998/99 price levels, and weighted according to projected output from each contract

2.10 Smith and Watson (2002) reported an increase from just under 2 per cent of the supply of electricity from renewables generation in 1990 when the NFFO was introduced, to 3 per cent in 2002. This increase represented only a slight improvement which is likely to be the result of the competitive bidding process, which led some generators to submit bids which were too low and hence some projects selected by the scheme have not been developed.

2.11 The NFFO was also poor at stimulating stable UK companies as it came in irregular rounds, leading to spikes in demand. For example, it forced developers to construct wind turbines as quickly as possible, which resulted in the importing of wind turbines from Germany, as UK production could not cope with the increase in demand.

2.12 The Renewables Obligation was developed as a successor to the NFFO in response to its limited results.

The Renewables Obligation (RO)

Policy objectives

2.13 The 1999 New & Renewable Energy consultation paper proposed that the main instrument to achieve the renewable electricity generation target should

be a market based mechanism. Consequently, the RO was announced as a potential instrument for this purpose in January 2000, and following a two year period of consultation, it came into force in April 2002 as part of the Utilities Act (2000). The Obligation requires electricity companies to source an increasing proportion of their supply from renewable technologies over the period 2002-2027. The obligation for suppliers was set at 3 per cent in 2003, is 6.7 per cent for 2006/07 and will rise gradually to 10 per cent by 2010 and 15.4 per cent by 2015/16.

2.14 The long term nature of the Obligation is intended to show the commitment of the Government to the policy instrument and hence create long-term security for the renewables market - a necessary component to ensure the financial viability of the market and hence to stimulate the long term, sustainable development of renewable technologies.

Policy implementation

2.15 The Obligation allows renewable generators to apply to Ofgem, the enforcement body, for accreditation to prove their eligibility as a renewable source. The accredited generators are then issued with Renewable Obligation Certificates (ROCs) corresponding to energy produced, where 1 ROC is equal to 1 megawatt hour (MWh) of generation.

2.16 The ROC is based on market principles, whereby a shortage of renewable energy generation will increase the value of the ROC, which in turn will encourage market entry and lead to a decline in the price of renewable energy. Therefore, the ROC seeks to encourage the development and deployment of the most economical and closest to market renewable technologies.

2.17 Electricity suppliers can meet their obligation in three ways:

- By producing ROCs to show that they have generated or bought electricity from recognised energy generators
- By buying ROCs on the open market from other suppliers with a surplus
- By paying the buy-out price to make up the shortfall between their stock of ROCs and their statutory target.

2.18 The buy-out price is annually adjusted to reflect changes in the retail price index. This was initially set at £30 per MWh and was increased to £31.39 over the period April 2004 – March 2005 and currently stands at £33.24 in 2006/07. All buy-out receipts are recycled to suppliers who have met their Obligation, in

2.19 There is also the potential to bank ROCs for use in the subsequent year, where a supplier can meet up to 25 per cent of its target in this manner.

Policy enforcement

2.20 Ofgem is responsible for administering the RO on behalf of the Department of Trade and Industry, the Scottish Executive and the Department of Enterprise Trade and Investment (via an agency agreement). Their remit includes the monitoring of compliance by renewable generating stations and licensed electricity suppliers.

2.21 In relation to the renewable generators, Ofgem accredits generating stations as being able to generate electricity from renewable sources. This process includes a pre-accreditation check to ensure that an individual station meets the requirements of the RO.

2.22 Once accredited, operators of generating stations are required to provide monthly/yearly generation output data in order to claim ROCs. This process is subject to verification in the form of a number of internal checks before ROCs are issued to ensure the data provided is reliable and accurate. ROCs are withheld where there is any doubt about the accuracy of the data provided, until the issue can be resolved. As an additional check, Ofgem undertakes a number of audits throughout the year, where representatives visit a sample of stations (targeted and random selection) and check whether the information they provided at accreditation and the monthly data is accurate and meets the requirements of the RO. 20 stations were visited in the 2005-06 obligation period. In addition to the general auditing process, audits of biomass stations are also conducted to ensure their fuel measurement and sampling procedures are robust. To date, 16 fuel measurement and sampling audits have been undertaken. The audited process has identified some minor irregularities, misunderstandings and departures from good practice and in these cases, the relevant stations have been contacted and asked to resolve the issues that arose.

2.23 Looking specifically at the administration on the supply side, Ofgem undertakes a number of checks to ensure each supplier has correctly calculated its obligation and has complied in full by presenting ROCs or making a buy-out payment. This process is accompanied by visits to a random selection of suppliers each year to ensure the data they have provided is robust.

2.24 The Authority has the power to take enforcement action or place a financial penalty against any supplier who has failed to meet its obligation. To date, the Authority's powers have not been used.

Policy eligibility and exemptions: the affected technologies

2.25 The following renewable sources are currently eligible to receive ROCs under the RO:

Table 2-2: RO Eligible Renewable Sources

Source	Eligibility
Landfill gas	Yes
Sewage gas	Yes
Hydro exceeding 20 megawatts declared net capacity (dnc)	Only stations commissioned after 1 April 2002
Hydro 20 megawatts or less dnc	Yes
Onshore wind	Yes
Offshore wind	Yes
Co-firing of biomass	Any biomass can be co-fired until 31 March 2009 with no minimum percentage of energy crops 25 per cent of co-fired biomass must be energy crops from 1 April 2009 until 31 March 2010 50 per cent of co-fired biomass must be energy crops from 1 April 2010 until 31 March 2011 75 per cent of co-fired biomass must be energy crops from 1 April 2011 until 31 March 2016 Co-firing ceases to be eligible for Renewable Obligation Certificates (ROCs) after 31 March 2016.
Other biomass	Yes
Geothermal power	Yes
Tidal and tidal stream power	Yes
Wave power	Yes
Photovoltaics	Yes
Energy crops	Yes

Source: http://www.dti.gov.uk/energy/sources/renewables/policy/obligation/what-is-renewables-obligation/page15633.html

2.26 Similarly, the following waste generation is eligible under the RO:

Table 2-3: RO Eligible Renewable Sources

Type of generation station	Mixed waste	Waste that is purely biomass	Energy crops, agricultural waste and forestry material
Incineration	Ineligible	Eligible*	Eligible*
Pyrolysis, gasification and anaerobic digestion	Eligible for the biomass fraction of waste	Eligible*	Eligible*
Combined heat and power (CHP)	Eligible for the biomass fraction of waste produced as good quality CHP**	Eligible*	Eligible*
Co-Firing	Ineligible	Eligible until 31 March 2016 (25 per cent energy crops from 1 April 2009; 50 per cent energy crops from 1 April 2010; 75 per cent energy crops from 1 April 2011)	Eligible until 31 March 2016

Source: http://www.dti.gov.uk/energy/sources/renewables/policy/obligation/what-is-renewables-obligation/page15633.html

Subject to a maximum fossil-derived energy content of 10 per cent.

*** CHP stations must be accredited under the CHP Quality Assurance scheme to be eligible. For schemes that are fully compliant with the Good Quality benchmark, they receive ROCs on the electricity generated from the biomass fraction of the waste. For schemes that are partially compliant, this is scaled back depending on their efficiency.*

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Only stations first commissioned or re-equipped on or after 1 January 1990 (except micro-hydro and co-firing stations) are eligible.

All stations must be located within the UK , its territorial waters or the Continental Shelf.

2.27 The current obligation resulted in the generation of 4 per cent of the electricity supply from renewable sources in 2005, which rises to 4.2 per cent if non-eligible sources are included.

2.28 In relation to complementary measures, the generation of renewable energy is exempt from the Climate Change Levy, as a means of providing further stimulation for the production of renewable energy.

Comparative instruments used across other countries

Renewable Energy Feed-in Tariff (REFIT)

2.29 The main alternative policy instrument to the RO is the renewable energy feed-in tariff (REFIT), which enables a government to legally guarantee renewable energy producers access to the power grid at a guaranteed price. Therefore REFIT seeks to increase the amount of renewable energy by creating certainty and security in the market through the setting of a fixed price, thereby ensuring a fixed rate of return for investors. As a result, the quantity of renewable energy supplied by renewable sources is determined by the market.

2.30 As the renewables energy market is currently not competitive with the traditional energy market, REFIT sets the price of electricity at a higher rate than the traditional price, thereby creating an incentive for the production of renewable energy. Such policies have been adopted in Germany, Spain, Denmark, France and the USA.

2.31 The Feed-In-Tariff was first introduced in California under the Public Utility Regulatory Policies Act (1978)[5]. This obliged electricity suppliers to purchase energy from 'Qualifying Facilities' at 'avoided cost' rates, which reflected the marginal costs of acquiring the same amount of energy from an alternative source. The rates were determined by individual state supplier commissions, who often tied the rates to high oil prices, which produced security in the market and by offering highly favourable guaranteed payment, stimulated the development of renewable technologies.

2.32 Looking specifically at the German system, REFIT legislation was first implemented in 1991 as part of the Strom-Einspeisungs-Gesetz (StrEG), which introduced fixed prices for electricity generated from renewable sources. This legislation set the tariff at 90 per cent of average electricity prices for wind and solar energy until 1999 and restricted the tariff to a ceiling of 5 per cent of power supplied from renewable sources. It also obliged the regional utility companies to purchase all renewable electricity generated in their catchment area[6]. This measure was complemented by the provision of soft loans for capital investment from the state-owned Deutsche Ausgleichsbank and from the federal promotion scheme.

2.33 This programme was succeeded by the introduction of the Erneruerbare Energien Gesetz (EEG) in 2000. The EEG placed an obligation on German

[5] Butler and Neuhoff (2004), *Comparison of Feed-in Tariff, Quota and Auction Mechanisms to Support Wind Power Development*, Cambridge Working Papers in Economics CWPE 0503, Work Paper 70
[6] Szarka and Bluhdorn (2006), *Wind Power in Britain and Germany: Explaining contrasting development paths,* Anglo-German Foundation for the Study of Industrial Society

transmission systems operators to purchase all electricity generated from renewable sources, where the same share of renewable electricity was incorporated into the electricity mix of all suppliers. It also stipulated that grid costs were paid for by the developer and upgraded by the operator.

2.34 EEG was implemented as part of a wider package of policy instruments which provide support for renewable energies. These include: the Biomass Ordinance, which entered into force on 28 June 2001, and provides support for electricity generation from renewable raw materials, as well as biogenic residues and wastes; the Market Incentive Programme, which offers investment subsidy for most renewable sources with the exception of wind; Income tax regulations on wind energy investments; the Environment and Energy Efficiency Programme, which offers subsidised loans for major shares of wind investments; and the full exemption from the mineral oil tax and environmental tax for all pure liquid and solid biofuels in heat and transport[7].

2.35 It should also be noted that there is a review carried out by the German Government every other year, to take technological and market developments into account. This review may result in a change to both the energy price and its associated reduction rates. However, these changes will only be relevant for plants that have not yet been commissioned, so as to retain certainty for the established market.

2.36 The early REFIT systems introduced in Germany and Denmark had guaranteed prices regardless of the renewable energy technology, location, or generation costs. However, in order to create a more sustainable market environment for renewable technologies, amendments made in the German system in 2000 and 2004 provided for fixed payments that varied according to technology type, plant size, location, and costs of generation. The new compensation rates are reduced over the years, ensuring that renewable energies are cost-effective. These variations reflect differences in efficiency potentials for different technologies. For example, the new German REFIT law, which enters into force on 1 August 2004, limits fees paid for electricity generated from landfill gas to 15 years, restricted to plants commissioned after 31 December 2006 (previously 20 years) [8].

2.37 REFIT legislation has resulted in a large increase in the production of electricity produced by wind technologies, where for example in Germany in mid-2004, 15,790 wind power installations with a total output of approximately

[7] Commission of the European Communities; Commission Staff Working Document (2004). 'The Share of Renewable Energy in the EU; Country Profiles: Overview of Renewable Energy Sources in the Enlarged European Union'
[8] http://www.iges.or.jp/APEIS/RISPO/spo/pdf/sp1403.pdf

15,325 megawatts were installed in which amounted to a share of 54 per cent of total power generation from renewable energy sources[9].

2.38 The remainder of the report will focus on the RO, accompanied by a comparative discussion of the German REFIT system.

[9] Germany Federal Ministry for Environment, Nature Conservation and Nuclear Safety 2004. [http://www.bmu.de/en/1024/js/english/renewable/information/?id=1076&nav_id=11526&page=1] (25 September 2004).

3 Effectiveness of policy

Effectiveness of policy form and design in achieving environmental outcomes

Policy design and implementation

3.1 Several rounds of consultation were held during the design of the RO. This included a preliminary exercise to discuss the general problem of how to tackle climate change, where the RO was proposed as one of the options, a second consultation which presented the RO as the best means of alleviating the problem and discussed the details behind the policy and lastly, a consultation which proposed the mechanisms by which the RO would work in practice. Therefore, it was largely felt that the development of the RO had been subject to a comprehensive consultation process which had benefited the overall shape of the final policy instrument.

3.2 Discussions with key industry and policy stakeholders also highlighted the importance of advanced prior notice of implementation of the RO, as a means of facilitating the ability to create long term investment, a factor which is crucial in the development of renewable technologies. In the case of a market instrument, advanced warning of implementation also generates the opportunity for first mover advantage in the market. For example, statistics from the British Wind Energy Association, showed an increase in the number of planning applications after the announcement and prior to the implementation of the Obligation.

3.3 It is important to note that the RO was designed to further the development of the most economical and advanced technologies as a means of achieving the renewables target in the most cost effective manner. Therefore, the policy instrument was not intended to be flexible in this manner and as a result has not reflected the differences between technologies and their varying stages of development. Consultees added that this element of the Obligation has furthered the deployment of the larger scale renewables generation in the form of on-shore wind farms and landfill gas sites.

3.4 The consultation process indicated the consensus that the RO was currently seen as a stand-alone instrument and would be more effective if implemented alongside a complementary set of instruments which would enable the recognition and support of technologies which lie at different stages of the development cycle. The additional menu of support proposed included:

- The use of capital grants to support technologies which are embryonic or at an early stage of development
- Reforms to the planning system to ensure decisions are made within a year
- The use of a 'connect and manage' as opposed to an 'invest and provide' approach in relation to connection to the national grid.

3.5 It was also noted that the other existing measures could be used in conjunction with the RO as a means of enhancing its effectiveness for smaller scale generators. These included instruments which encourage micro generation such as the zero carbon homes scheme.

3.6 Looking specifically at the enforcement of the Obligation, to date, the regulator has not identified any cases of fraudulent activity by renewable generation stations and therefore it appears that the enforcement of the regulation effectively discourages fraudulent behaviour. However, the majority of consultees felt that the policy had been enforced too rigorously in the sense that the mechanism had not accommodated the differing needs and circumstances of the various technologies. It was suggested that there was a need to remove the administration component out of the statute and replace this with a form of management code which would act as a flexible means of administering and enforcing the Obligation.

3.7 It was also noted that although the current enforcement arrangements had proven to be robust, this was largely the result of the small and self contained nature of the market. Therefore, as the market expanded into technologies such as micro generation, there would be an increasing need to modify the mechanisms of enforcement.

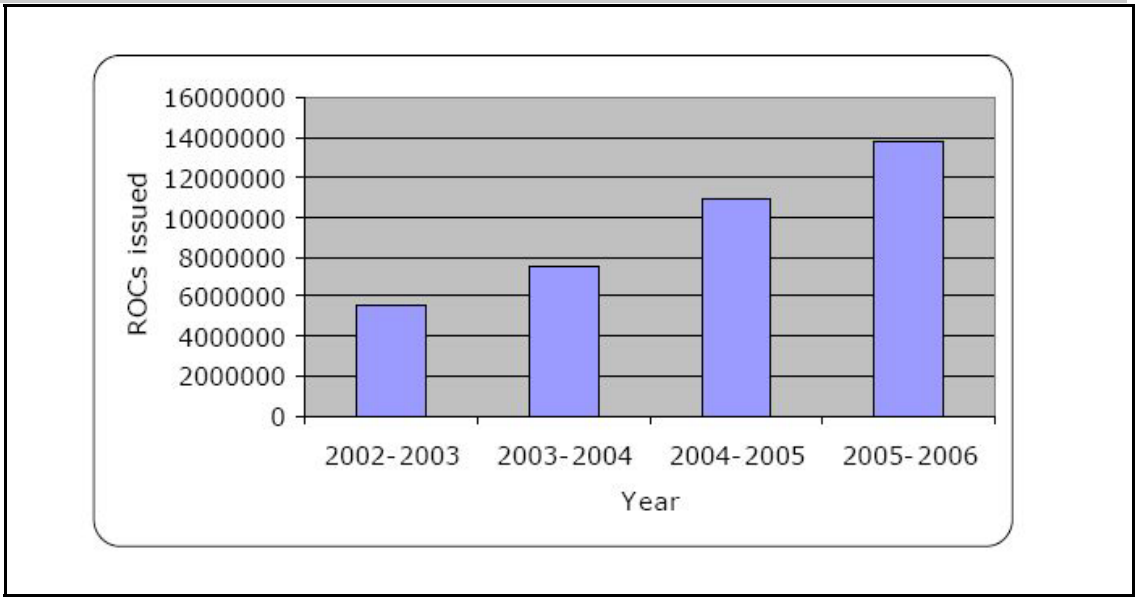
Progress towards environmental outcomes

3.8 The RO is viewed as an effective market mechanism which through its obligatory nature, has actively engaged the six main electricity suppliers in the UK and as a result, has doubled the production of renewable energy within the first three years of operation. However, although the Obligation has been the key driver in the renewables sector, it is largely felt that the production of renewable energy has been constrained by difficulties with access to the national grid/transmission and barriers to planning permission and hence that the RO has not fulfilled its potential.

3.9 As the figure below shows, there have been year on year increases in the total number of ROCs issued by Ofgem since the RO began. There has also been an increase in the proportion of suppliers' obligations met by presenting

ROCs – from 59 per cent in 2002 to 76 per cent across England and Wales in 2006, which means there has been a decrease in the incidence of suppliers making buy-out payments to cover shortfall in the presentation of sufficient ROCs.

Figure 3-1: Total number of ROCs issued since 2002

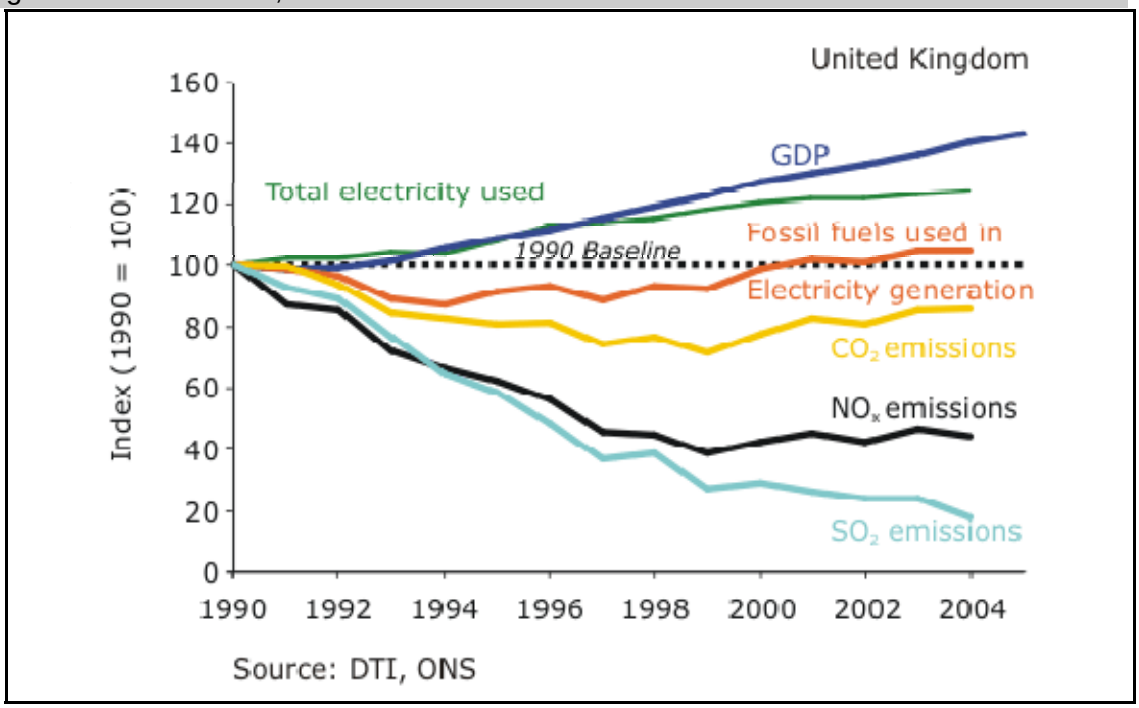


Source: Ofgem Annual Report 2007

3.10 The figure below shows that CO2 emissions from electricity generators fell over the period 1990 – 1999, however they have risen by 28 per cent since then. This can be attributed to an absolute increase in the use of fossil fuels to generate electricity, in line with an overall increase in electricity use[10].

[10] http://www.sustainable-development.gov.uk/progress/national/5.htm

Figure 3-2: Electricity generated, CO_2, NO_x and SO_2 emissions by electricity generators and GDP, 1990 to 2004

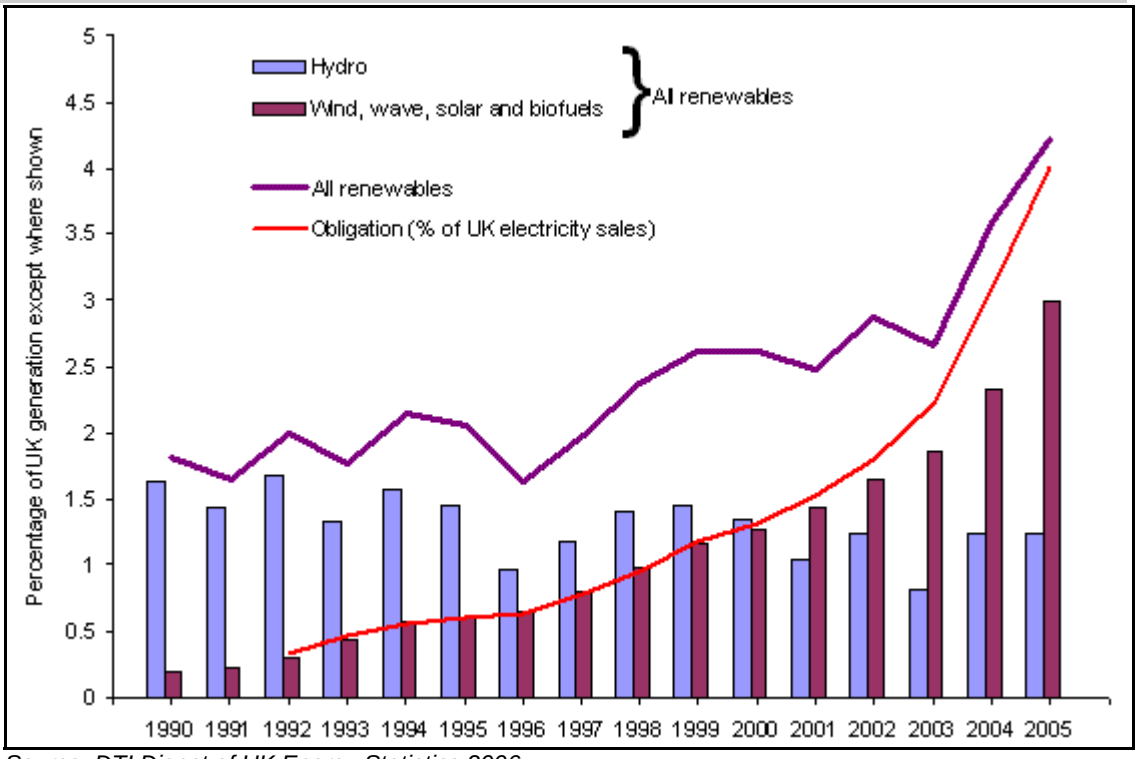


Source::DTI, ONS

3.11 Although the absolute amount of fossil fuels used to generate electricity has been rising, a growing proportion of electricity is being generated from renewable sources. The graph below shows electricity generated from renewables eligible for the Renewables Obligation as a percentage of electricity sales by licensed suppliers in the UK was 4 per cent in 2005, compared to 1.5 per cent in 2001, the year before the RO was introduced. The target is to achieve 10 per cent by 2010. In their guide to the Renewables Obligation, published in 2004, DTI states that 'renewable electricity supply is forecast to reach about 10 per cent by 2010…. there is sufficient UK practical wind resource to fulfil the 2010 target, so wind development dominates the near-term forecast of renewables growth'[11].

[11] Department of Trade and Industry (2004) 'Renewable Energy'

Figure 3-3: Growth in electricity generation from renewable sources since 1990



Source: DTI Digest of UK Energy Statistics 2006:

3.12 Total electricity generation from renewables in 2005 was 19.4 per cent higher than in 2004. The increase in the installed generating capacity of renewable sources in 2005 occurred primarily as a result of a 67 per cent increase in onshore wind capacity and a 75 per cent increase in offshore wind capacity. There was also a 13 per increase in the capacity fuelled by landfill gas and a 7.5 per cent increase in sewage gas capacity. Large-scale hydro capacity is 6 per cent lower than it was in 2001 as some stations have been adapted to fall within the capacity limits specified by the renewables obligation. The capacity to generate from solar photovoltaics showed a 33 per cent increase and has thus quadrupled in 4 years[12].

Effectiveness of policy form and design in achieving economic outcomes

3.13 The major regulatory burden imposed by the Renewables Obligation lies in the fact that, in order to provide additional support for the generation of electricity from renewable sources, costs to all electricity consumers are increased. The cost of the Renewables Obligation to consumers is limited by a price cap – this is the buy out price which is currently set at £34.30 per megawatt hour (MWh). The Carbon Trust estimates that the Renewables Obligation will cost consumers c. £14bn by 2020 and c. £18bn by 2027 (in present value terms), and concludes that overall, the existing renewable

[12] http://www.restats.org.uk/electricity.html

energy policy suffers from inefficiencies, resulting in a unit cost of renewable energy to consumers that is higher than necessary given the current technology cost[13].

3.14 Aside from issues of costs to consumers, the Renewables Obligation imposes some regulatory burdens on renewable generators and the electricity supply industry in relation to the administration that is required to benefit from and comply with the scheme. In their amendments to the RO 2007, the DTI have included a small number of detailed changes that will make it easier for renewable generators to benefit from the Obligation and electricity suppliers to comply with it. This will reduce the regulatory burdens on business[14]. Some of the changes have the potential to increase costs for Ofgem, the administrator of the Obligation, and any such additional costs would be passed on to the electricity industry through increased license fees[15].

3.15 The current situation has also led to the over-rewarding of a deployment-ready collection of technologies, such as onshore wind and landfill technologies, to the detriment of those technologies which are still in need of advancement and hence are not competitive enough to survive in the current market (under the conditions of the RO). This economic outcome has come about as a result of the 'technology-blind' approach of the RO, a factor which is currently under review.

Comparison with the German REFIT system

3.16 The relatively high feed-in-tariffs combined with investment subsidies and loans has generated a considerable renewables energy market in Germany. This market is largely based around wind technologies, where the European Commission (2004)[16] reported wind energy showing the strongest growth of all the technologies and as a result, German wind installations accounted for approximately 50% of the European wind energy capacity. Hydro-power had the second largest renewable energy source electricity (RES-E) share, with biomass electricity representing the third most important source. The Renewable Energy Act (largely made up of REFIT) had also resulted in strong growth in photovoltaics, which is illustrated in table 4-1 below, with comparative figures for the UK shown in brackets (it is important to note that the UK figures pre-date the implementation of the RO 2002).

[13] Carbon Trust (2006) Policy Framework for Renewables
[14] Department of Trade and Industry (2006) 'Reform of the Renewables Obligation and Statutory Consultation on the Renewables Obligation Order 2007'
[15] Department of Trade and Industry (2006) 'Regulatory Impact Assessment Renewables Obligation Order'
[16] Commission of the European Communities; Commission Staff Working Document (2004). 'The Share of Renewable Energy in the EU; Country Profiles: Overview of Renewable Energy Sources in the Enlarged European Union'

Table 3-1: RES electricity production in 1997 and 2002 in GWh

RES-E technology	1997 (GWh)	2002 (GWh)	Average annual growth (per cent)
Biogas	746 (1,326)	2,913 (3,076)	31 (18)
Solid Biomass	505 (199)	700 (870)	7 (34)
Biowaste	1,168 (483)	2,035 (958)	12 (15)
Geothermal electricity	0 (0)	0 (0)	0 (0)
Hydro-large scale	11,696 (4,005)	26,340 (4,584)	7 (3)
Hydro-small scale	6,772 (164)	7,660 (204)	2 (4)
Photovoltaics	27 (0)	176 (3)	45 (-)
Wind onshore	3,034 (665)	17,200 (1,251)	41 (13)
Wind offshore	- (0)	- (5)	- (-)
Total	**23,948 (6,842)**	**47,024 (10,951)**	**14 (12)**
Share of total consumption	4.50% (1.70%)	8.1% (2.8%)	

Source: Commission of the European Communities; Commission Staff Working Document (2004). 'The Share of Renewable Energy in the EU; Country Profiles: Overview of Renewable Energy Sources in the Enlarged European Union'

3.17 The comparative success of the RO and REFIT can be assessed in terms of installations deployed, where the German system is considered to be more successful than that of the UK. For example, Butler et al (2004) found that in the case of wind energy, under the EEG, installed wind capacity rose from 4500MW in 2000 to 14,609MW at the end of 2003, whereas the installed wind capacity in the UK was only 649MW at the end of 2003.

3.18 More recently, there is a clear contrast between Germany's wind power capacity of 18,427 MW and the UK's 1,324 MW in January 2006, but this is likely to be partly the result of the more established nature of the German system (REFIT legislation was first implemented in 1991 as part of the Strom-Einspeisungs-Gesetz (StrEG), which introduced fixed prices for electricity generated from renewable sources and was reported[17] to cause a step-change in the wind power sector) as compared to the UK RO, which was only recently implemented. In their 2006 paper 'Wind power in Britain and

[17] Szarka and Bluhdorn (2006), *Wind Power in Britain and Germany: Explaining contrasting development paths,* Anglo-German Foundation for the Study of Industrial Society

Germany: explaining contrasting development paths', Szarka and Bluhdorn also point out that the Germany system is superior in efficiency terms. The table demonstrates this, showing the differing prices of wind generated electricity for various European countries.

Table 3 -2: Prices of wind generated electricity, 2004-05 (in eurocents per kWh)

REFITs		RPS	
Germany	8.5 (6.5)*	UK	10.1
France	8.4	Italy	15.5
Portugal	7.5–7.9		
Austria	7.8		
Spain	6.3–7.5		
Greece	6.4		

Source: BWE (2005: 17).
*Once the reference yield is passed, generators are remunerated at a lower level.

Source: BWE 2005

3.19 However, the contextual background within which a policy instrument is applied acts as a key influence on its success and therefore, a simple comparison of electricity prices is unlikely to yield an accurate comparative assessment. For example, Toke (2006)[18] examines the assumption that market based systems such as the RO will necessarily prove more cost effective than the REFIT system, and finds that the RO is not more cost-effective compared to the German feed-in tariff. He examines this assumption in the context of wind power, as this will contribute the bulk of new renewable energy in the UK and across the EU. Although the nominal rates of payment per kWh of renewable energy are higher in Germany than in the UK, adjusting for differences in wind speed and using this to calculate for the actual return per unit of installed capacity that developers actually receive, shows that in the UK the annual return for any investment in a kWh of wind power is £121.33 whilst for Germany it is £88.91. So, in fact, the German feed-in tariff gives a much lower subsidy per quantity of installed capacity than is the case in the UK.

3.20 Similarly, the differing nature of the instruments create a distinctive set of incentives for the renewables market, where evidence constructed by Mitchell at al (2004) found that the RO facilitates an incentive to 'under-meet' the environmental target, as the price of ROCs will fall as the supply of eligible renewable energy increases. Whereas in the case of the German REFIT system, the absence of a quota mechanism and price cap (i.e. the buy-out price of the RO) does not create a similar incentive and hence creates an

[18] Toke, D (2005), *Are green electricity certificates the way forward for renewable energy:, An evaluation of the UKs Renewables Obligation in the context of international comparisons*

unconstrained inducement for the development and production of renewable energy.

3.21 The following chapter looks at these issues in more detail, focusing on the influence of both the RO and REFIT on innovation, productivity and competitiveness.

4 Evidence on the influence of regulatory form on innovation, productivity and competitiveness

Assessment of innovation effects

4.1 Consultations with key stakeholders indicated that Government policy arising from the carbon reduction agenda is viewed as the main factor driving innovative activity in the renewables sector. The RO is viewed as one of the key instruments within this agenda, without which, there would be no market for renewable energy, as the constituent technologies would not be economically viable or competitive in the absence of this mechanism. Therefore, the Government is seen to play a key role in establishing an element of certainty for the market and consequently enables the market to make a return, thereby encouraging investment in the cases where projects can make money without exceeding the ceiling of support they are granted.

4.2 Further exploration indicated that the RO was the primary driver of innovation for larger scale renewable energy generation. However, the smaller scale generation at the level of the household or building was not driven by the Obligation, as the schemes were generally too small to register for ROCs given the large administrative burden associated with the process.

Creation of a market for renewable energy and its current limitations

4.3 In general, the development of new technology requires the support of policy instruments which introduce certainty to the market. This certainty provides market security and therefore facilitates the opportunity for long term financial investment. This is particularly relevant to the renewables sector, which cannot currently compete with the more traditional energy sources e.g. coal and nuclear power, and hence requires long term investment in order to gain this competitive position.

4.4 The RO has created a market to sell renewable energy, where in practice, a significant number of generators are engaged in long term contracts with suppliers through the ROC market. Although this market is not visible to the consumer, the instrument has been effective in establishing a demand for renewable energy and a supply chain between electricity suppliers and renewable generators. It is important to note that the market has only favoured those technologies which were close to market and in that sense have enhanced the rapid development of only a small number of technologies e.g. on-shore wind and landfill gas. This finding was supported by Foxon et al

(2004), who reported the incentives offered by measures such as the RO, were not attracting investment into high risk technologies that were at an early stage of development.

4.5 Although discussions indicated that in creating a market for green energy, small niches of development have occurred within the marine technology sector, evidence suggests that the current form of the RO limits its ability to stimulate innovation in those technologies which are not market ready. Therefore, it was suggested that if the RO wishes to offer the opportunity of support to these technologies, a form of development-cycle differentiation will be required. This could be potentially implemented through the introduction of a complementary instrument which offers grants to those technologies which are embryonic in their nature, in order to allow them to progress to the point where they can compete within the ROC market. Or alternatively, amendments could be made to replace the single price nature of the RO to take account of the differing needs of individual technologies.

4.6 The DTI has made some progress to addressing the need for differing forms of support for those technologies that are not close to market in the form of their current capital grant programme for offshore wind schemes. This offers between 5-10 per cent in value of the capital costs of a scheme. However, the limited nature of the capital support has led to only marginal progress in the development of offshore wind farms, as they have struggled to obtain the remainder of the finance[19].

4.7 It was also noted that future development of the RO must also take into consideration the saturation of opportunities to stimulate innovation, which become more limited and difficult to afford as a technology matures and margins become smaller.

Productivity and competitiveness effects

The market based nature of the RO

4.8 The RO has enabled the development of the most efficient and productive firms in the renewables sector, as a result of the market based structure of the Obligation. Therefore, within a technology, there is competition between developers to gain both consent and finance and to become cost effectiveness in production and as a result, inefficient firms will be pushed out of the market.

[19] Toke, D *Are green electricity certificates the way forward for renewable energy:, An evaluation of the UKs Renewables Obligation in the context of international comparisons*

4.9 Owing to the market based and hence competitive nature of the RO, it has been viewed as effective in creating the necessary incentive for generators to increase efficiencies and therefore reduce their costs in order produce the maximum output from each source. Therefore, in the areas where the RO has been successful[20], the market has witnessed an increase in both profitability and productivity.

4.10 Consultations also revealed that the RO had also resulted in a consolidation of the sector, whereby a number of the big suppliers have acquired renewable energy generators in order to create economies of scale. This has generated a set of vertically integrated electricity suppliers, who are able to trade internally. For example, in December 2004, approximately 70 per cent of wind power capacity was owned by the four major electricity suppliers[21]. However, although the occurrence of consolidation is a common consequence of competitive markets, this form of dominance is a concern for the independent generators, who may not benefit from this imbalance of market power.

4.11 Unlike the NFFO, which resulted in the big players pushing down prices to the extent that the market was not viable for smaller players, it was largely felt that the RO had facilitated an increase in the ability for smaller developers to become involved in the market, as smaller generators can often develop their product more rapidly than the larger generators. However, the formation of supply chains with the electricity suppliers may be hampered by existing arrangements with other generators and the trend towards vertically integrated systems. Szarka and Bluhdorn (2006) re-iterate this shortcoming by noting the presence of a small number of major players in the ROC market, who have been active in building their own portfolio of renewable generation, leaving the 'independent generators', who supply 60 per cent of the market, in a less competitive position where they can only extract such values from ROCs as suppliers will allow them.

4.12 In a similar vein, Toke (2005) reported that in order to gain contracts from electricity suppliers, renewable generators had to exchange part of the value of the ROCs for the security offered by the long term contract from a credible electricity supplier. Therefore, the returns to the renewable generators are largely determined by the suppliers and their judgements on the long term shape of the market which in turn limits the profitability of the generator over the long term.

4.13 Looking specifically at the buy-out price, it was generally thought that the current price was too low and needed to be considerably higher level than the

[20] As previously stated, the RO has been successful in supporting the development of onshore wind and landfill gas in particular.
[21] Idem footnote 19

certificate price in order to further stimulate the productivity of the renewables sector.

4.14 Consultations also revealed that an unanticipated outcome of the RO has been the associated growth in the requirement for environmental consultancy, especially in relation to off-shore wind farms.

The technology 'blind' nature of the RO

4.15 The Carbon Trust and the DTI stated in the conclusions to the Renewables Innovation Review (2004), that although biomass (including landfill gas) accounted for the largest percentage of RP generation, several forms of the technology were constrained by limited resources (e.g. landfill gas) or by regulation (e.g. the co-firing of resides in coal-fired power stations). Therefore, there was likely to be a reliance on wind power (both onshore and offshore), which was the only economically viable and scaleable technology under the RO regime and in combination with this, wind technology could effectively deliver almost all the required growth in renewable energy to meet both the 2010 and 2020 targets.

4.16 Limits have been imposed on the production of co-firing, in order to address its over-dominance within the market, where following the introduction of the RO, the number of coal plants co-firing has increased from two in 2002/03 to sixteen in 2005/06[22]. This is likely to lead to a fall in the production of co-firing energy and further the opportunities for other forms of renewable technology to increase their productivity and market share.

4.17 Again, in order to further enhance the productivity of the lesser developed technologies, such as off-shore wind, which is currently not economically viable under the RO, and for the micro generation end of the sector, there is a need for more direct regulation i.e. capital grants. Consultees also added that the potential demand for these technologies could also be increased through the dissemination of improved information on what could be available and how this may be used. For example, it is thought that a large proportion of building developers are not aware of how the renewables sector could be used to create more sustainable infrastructure. By increasing awareness and demand, development and productivity are likely to increase.

Future developments of the RO

4.18 The RO has been subject to a continuous monitoring and evaluation process, involving both Ofgem, which produces an annual report on the

[22] Department of Trade and Industry (2006). 'The Economics of Co-Firing'.

accomplishments of the RO[23] and the DTI, which conducted a formal review of the Obligation in 2005.

4.19 The review led to the implementation of a **'pre-accreditation'** mechanism, to alleviate uncertainty for financers in the development phase i.e. originally renewable generators had to be accredited to be eligible for ROCs, which only took place after a site had been built. This acted as a barrier to accessing finance, as there was no guarantee that a site would be accredited during its development stage.

4.20 The following set of recommendations are currently subject to consultation:

- The principal proposal focuses on the idea of **'banding'** which arose to address the issue of over-rewarding. That is, evidence suggests there is a need to differentiate the current single price in order to increase the potential for other technologies to develop and reach deployment stage. The proposed banding mechanism will act as a means of re-distributing the support more efficiently. This mechanism will also act to increase the production of renewable energy and therefore ensure that the long term targets of the Obligation are met, which may not be the case were the UK to remain dependent on the current favoured set of technologies. For example, Landfill gas has been favoured by the RO but is subject to capacity constraints and therefore is not likely to produce the volume of energy required, whereas offshore wind, which houses a large potential capacity is not favoured by the current RO, as it is not yet cost effective.

- The second proposal involves a **'ski slope mechanism'** which seeks to mitigate against a price crash should the obligation be met.

- The third and final proposal involves the notion of **'grandfathering'** to ensure that the RO is obliged to meet the expectations of those who have already invested in renewable technology.

4.21 Ofgem is also currently reviewing the costs associated with gaining accreditation and the monthly monitoring process, in order to address the large burden placed on generators such as those in the biomass industry, who find it very expensive to frequently record how much energy they have burnt.

Concerns

4.22 The consistency and continuity provided by the RO in comparison to the situation prior to its implementation, was felt to have thus far enhanced the

[23] Latest publication - Ofgem Annual Report 2007

strength of the renewables market, as investors had become comfortable and confident about the current arrangements. In conjunction with this, the degree and frequency of review was raised as a concern by industry stakeholders, who indicated that even in the absence of changes, continuous reviews caused uncertainty in the market. Therefore, it will be important to consider the potential introduction of risk and uncertainty into the market during the design of revisions and additions to the Obligation, as these may significantly affect investor confidence.

4.23 Our consultations highlighted the general concern of the Academic community that although the proposed banding system may have a positive effect on innovation, it will undercut the premise of the RO by driving up prices and thereby removing the element of competition that currently underlies the mechanism. Therefore as a collective[24], it has been proposed that the UK replaces its system with a tariff mechanism to decreased uncertainty and decrease costs in the market. However, it was also noted that although it was widely felt that REFIT was a more effective, lower cost instrument, a change in the UK system would be extremely disruptive to the market and hence may not be feasible.

Comparisons with the REFIT system

4.24 Historically, the feed-in tariff has been the primary mechanism used to support the development of renewable energy in both Europe and the USA. It is also evident that countries with tariff systems have witnessed a higher rate of deployment in comparison to quota based scheme such as the RO. For example, Germany, Spain and Denmark, which all house a REFIT system, have seen the largest growth in renewable energy sourced (RES) electricity. Therefore a significant proportion of current perceptions favour a tariff system as they have created a better environmental outcome for a given price.

4.25 A report produced in 2001 for the EU, based on the EIGreen computer model, which reviewed the options for supporting a RES-E system, stated that the major advantage of a feed-in-tariff lay in its flexible, fast and easy to establish nature, combined with an ability to adapt to difficulties[25]. However this effective result is only the case when the system is carefully designed and implemented, where past experience has shown in the cases of Spain and Austria, that there is a need to remove administrative burdens and low ceilings of total system power. There is also a need for a favourable legal and administrative framework, where for example building regulations and grid-access procedures are also addressed.

[24] http://environment.guardian.co.uk/energy/story/0,,1926735,00.html
[25] The EIGREEN project (2001), *Action Plan for a Green European Electricity Market*, European Communities.

4.26 The following design features[26] were proposed as the means by which to develop a successful REFIT system:

- Long-term contracts (15-20 years)
- Guaranteed price that offers reasonable rates of return for producers, easing access to financing sources due to clear payback periods
- Integration into long-term planning with other policy options (i.e. investment conditions)
- Annual rate decrease to technological progress for newly installed systems
- Independence from state budgets
- Simple structure
- Low administrative costs and demands
- Supportive in the changing macroeconomic environment (e.g. currency exchange rate).

4.27 The European PV Association reported in their 2005 position paper on a feed-in-tariff for photovoltaic solar electricity, state that alternative market support mechanisms, including a quota system, will only prove effective when all sources of energy acquire the same level of competitiveness. They also propose that in stimulating PV market growth, a feed-in-tariff is the single most important and most successful driver, when applied correctly.

4.28 The European Renewable Energies Federation in their 'Prices for Renewable Energies in Europe' 2006/2007 report strongly favour the REFIT system and offer the following as the main advantages of such a system:

- Rapid growth of renewable energies within good and sustainable planning procedures without any cap or artificial restrictions by quota
- Investment security and efficient financing schemes with much lower risk assessment than in certificate schemes
- Incentive to create RES based independent power production
- Enormous benefit in economic value for SEMs and for formerly deprived rural or peripheral areas in Europe

[26] European Photovoltaic Industry Association (2005) ''European PV Associations' Position Paper in a Feed-In Tariff for Photovoltaic Solar Electricity'.

- Strong growth in new, qualified jobs (e.g. 175,000 in Germany in 2006)
- Rapid decrease in costs for RES technology.

4.29 The following section discusses the merits and disadvantages of a REFIT system in comparison to a quota based system, with a specific emphasis on German REFIT vs. the UK RO.

The German REFIT system

Price certainty, security and obligatory purchase

4.30 Our discussions highlighted the main difference between the systems to be the absence of price volatility of the REFIT as opposed to the RO, where in the latter case there is no price certainty and therefore less investor confidence[27]. The fixed price is also supported by the obligatory purchase of all renewable energy in Germany, whereas the RO stipulates that electricity suppliers must either buy the target amount or pay a buy-out charge, which increases the dependence on the utilities to create demand in the market[28] and hence provides a *limited protected market for renewable energy*[29]. This combination of price and purchase certainty has stimulated the development of a larger number of long term contracts in Germany, whose renewable energy market is perceived to exhibit higher levels of security. However, pricing policies such as REFIT laws require substantial financial support from government and therefore can prove to be expensive.

4.31 In addition, the removal of price risk within the REFIT system is likely to benefit both large and small renewable generators, where the latter are perceived to be more risk averse and hence require more certain conditions to join a market[30]. Whereas in the UK, the RO does not provide price or volume certainty (where the latter refers to the obligatory purchase of all renewable energy) and hence is less likely to enable the involvement of smaller firms.

4.32 Both the RO and German REFIT systems offer a level of security for the market. However, the fixed price guarantee of the REFIT guarantees fixed remunerations for a period of 20 years, whereas although the RO offers a commitment to support the renewables sector over a period of 25 years, the returns to investment are less clear and hence less certain.

[27] This observation was also reported by the European Renewable Energies Federation in their *Prices for Renewable Energies in Europe 2006/2006* report.
[28] This finding is also supported by Szarka and Bluhdorn (2006), *Wind Power in Britain and Germany: Explaining contrasting development paths,* Anglo-German Foundation for the Study of Industrial Society
[29] Toke, D *Are green electricity certificates the way forward for renewable energy:, An evaluation of the UKs Renewables Obligation in the context of international comparisons*
[30] Mitchell et al (2004)

4.33 Comparisons between wind energy development in the UK and Germany have found that policies adopted in the UK have established a competitive regime and therefore driven down the price paid for wind energy[31], whereas the German system does not expose the renewable energy developers to price competition and therefore does not deliver wind power at the lowest possible cost[32]. However, Menateau (2003) also states that the introduction of degressive remuneration under the EEG is likely to reduce this price differential.

4.34 The fixed price also facilitates a lack of incentive to maximise or increase productivity in the case of REFIT, whereas the price competitive nature of the RO leads generators to maximise productivity as a means of reaping bigger rewards. Therefore, the market based nature of the RO drives down the costs of production in comparison to the REFIT system.

4.35 Mitchell et al (2004) also note that the German REFIT system does not give generators any incentive to reduce their load fluctuation or benefit renewables which produce reliable power, as the electricity distribution network operator is obliged to accept the generation of all renewable electricity.

High renewable energy prices

4.36 The relatively high fixed renewable energy price had led to high levels of development and deployment of renewable technologies in Germany, which has resulted in a larger increase in the production of renewable energy in comparison to the UK. However, renewable energy prices in Germany have been set significantly above the market price and therefore could be seen as less cost-effective than the RO. The high price has also led to the over-rewarding of technologies, where for example significant investment has been made within the wind farm sector, where a number of farms have a much smaller wind capacity (lower wind speeds) than sites in the UK.

Technology specific remuneration

4.37 Bechberger (2004) [33] proposes that the 2004 changes to the German system, which focused on the implementation of technology specific remuneration, have furthered the effectiveness of the system. This change in practice meant that remuneration depended on the technology used, the size of plant and in the case of wind energy, also depended on the age and the generated power output of the installation.

[31] Klassen, G. Miketa et al (2003), *Public R&D and Innovation: The Case of Wind Energy in Denmark, Germany and the United Kingdom,* IIASA Interim Report IR-03-011.
[32] Menanteau et al (2003), *Prices versus Quantities: Choosing Policies for Promoting the Development of Renewable Energy,* Energy Policy 31(8) pp. 799-812
[33] http://web.fu-berlin.de/ffu/akumwelt/bc2004/download/bechberger_reiche_f.pdf

4.38 Szarka and Bluhdorn (2006) refer to the advantage of the cost-reflective approach, achieved by price differentiation in relation to different renewable technologies and the digressive rates of support being two of the advantages of the German system in comparison to the RO in the UK. However, the implementation of banding in the UK may reduce this advantage.

Effective planning and grid access system

4.39 Historically, development of onshore wind has been concentrated in those countries with effective policies and public support. This development has been limited in the UK, which has witnessed local planning objections based on perceived visual intrusion and grid access constraints as a result of the grid system being originally designed to mainly distribute centrally produced electricity as opposed to de-centrally produced electricity. Therefore, the deployment of wind technology is impeded by the fact that local grids need to be reinforced before large scale generation can occur. Whereas in Germany, the REFIT system ensures connection to the grid is automatic once renewable energy is produced, where the market structure in Germany is built around a more regionally based and vertically integrated (suppliers own the grid, therefore it is feasible to put the obligation on the supplier) set of electricity companies, which facilitates easier grid connections.

4.40 This finding is supported by Bechberger (2004) who states that in Sweden, wind power is hindered by the fact that local grids need to be reinforced before being able to deploy higher levels of wind power electricity, which also applies to Spain, Portugal, Greece and the UK. In Spain, for example, it is expected that only 20–50 per cent of the 13000 MW wind target for 2010 could be reached if no measures for a net extension will be taken. The report goes on to suggest in order to alleviate this problem, a new financing scheme where all investors with building permissions for one region pay together for the accession to the grid or for a necessary grid enlargement which reduces the costs for all involved actors.

Complementary policy instruments

4.41 The German system is complemented by the opportunity for renewable generators to access interest free loans to support the development of sites, which has created a stable demand for renewable technology. However, although the REFIT system works well in combination with its supporting instruments e.g. the soft loans, the overall system is complex and therefore the perceived price of the German system may not reflect the full costs.

4.42 Alternatively and a previously discussed, key stakeholders indicated that the RO was viewed as a stand-alone instrument and although it had been

combined with an exemption to the Climate Change Levy, complementary measures which could further enhance the environmental and productivity outcomes of the instrument were not apparent. Therefore, the German REFIT system was widely considered to be more effective as a result of its more inclusion in a basket of support measures and hence more integrated policy nature.

4.43 Anecdotal evidence also states that in the UK, the New Electricity Trading Arrangements (NETA) act as a deterrent for small independent generators[34], as it places a premium on reliable generation and penalises intermittent generation.

The form of installation development

4.44 The UK has witnessed the generation of new capacity from both utilities and specialist developers, with little development in the non-corporate sector e.g. farmers, co-operatives and citizen investment initiatives. Alternatively although Germany has also exhibited large scale development from utilities and developers, the non-corporate sector has also produced significant growth in the generation of renewable energy[35].

4.45 Toke D, in his paper on the evaluation of the RO in the context of international comparisons, concludes that there is evidence to support the finding that cultural factors have a bigger influence on the patterns of ownership of wind power schemes than the market based or fixed price nature of the instrument in question. This re-iterates the importance of context when evaluating the success of comparative policies.

Summary

4.46 In summary, the literature dictates that although the German system has witnessed higher energy costs, this has been offset by environmental gains, technological leadership, employment creation and export opportunities in a new industry. However, discussions with key stakeholders indicated that it was important to couch any comparisons between the two systems within the differing institutional and market structures of the two countries, which can often act as a significant part of the reasoning behind the differing results of the two systems.

[34] Mitchell and Connor (2004), *Renewable Energy Policy in the UK 1990-2003*, Energy Policy 32(18) pp. 1935-1947.
[35] Szarka and Bluhdorn (2006), *Wind Power in Britain and Germany: Explaining contrasting development paths,* Anglo-German Foundation for the Study of Industrial Society

5 Concluding statements

The impact of the RO

5.1 The RO was designed to further the development of the most economical and advanced technologies as a means of achieving the UK renewables target in the most cost effective manner. Therefore the policy instrument was not intended to reflect the differences between technologies and their varying stages of development. Therefore, the Obligation has furthered the deployment of those technologies which are closest to market, thereby favouring the larger scale renewables generation in the form of on-shore wind farms and landfill gas sites.

5.2 Total electricity generation from renewables in 2005 was 19.4 per cent higher than in 2004, where the increase in the installed generating capacity of renewable sources in 2005 occurred primarily as a result of an increase in onshore wind capacity. There have also been year on year increases in the total number of ROCs issued by Ofgem since the RO began and an increase in the proportion of suppliers' obligations met by presenting ROCs – from 59 per cent in 2002 to 76 per cent across England and Wales in 2006. Therefore, there has been a decrease in the incidence of suppliers making buy-out payments to cover shortfall in the presentation of sufficient ROCs.

5.3 The RO is viewed as an effective market mechanism which through its obligatory nature, has actively engaged the six main electricity suppliers in the UK and as a result, has doubled the production of renewable energy within the first three years of operation. However, although the Obligation has been the key driver in the renewables sector, it is largely felt that the production of renewable energy has been constrained by difficulties with access to the national grid/transmission and barriers to planning permission and hence that the RO has not fulfilled its potential.

5.4 The remainder of this chapter seeks to summarise the findings of the report within the three research propositions:

- Proposition 1: *What are the factors that are likely to be influenced by environmental regulation that prompt firms to innovate and be more productive and why?*
- Proposition 2: *How much does regulation influence innovation and productivity improvements in firms? Does this influence vary between sectors/markets? How important are other contextual factors? Does*

this influence vary by regulatory form, stringency and/or enforcement methods?

- Proposition 3: *If the variance is explained largely by form, what is the nature of this form and design? What characteristics of policy instruments are most appropriate in enhancing productivity and innovation? Which policy instruments are more effective than others in prompting firms to innovate and be productive and why? Is it the case the 'one size fits all' does not work? Are there substantial differences with regard firm and sector characteristics?*

Proposition 1

5.5 Government policy arising from the carbon reduction agenda is viewed as the main factor driving innovative activity in the renewables sector. The RO is viewed as one of the key instruments within this agenda, without which, there would be no market for renewable energy, as the constituent technologies would not be economically viable or competitive in the absence of this mechanism. Therefore, the Government is seen to play a key role in establishing an element of certainty for the market and consequently enables the market to make a return, thereby encouraging investment in the cases where projects can make money without exceeding the ceiling of support they are granted.

5.6 Further exploration indicated that the RO was the primary driver of innovation for larger scale renewable energy generation. However, the smaller scale generation at the level of the household or building was not driven by the Obligation, as the schemes were generally too small to register for ROCs given the large administrative burden associated with the process.

5.7 The RO has successfully created a market to sell renewable energy, where in practice, a significant number of generators are engaged in long term contracts with suppliers through the ROC market. Although this market is not visible to the consumer, the instrument has been effective in establishing a demand for renewable energy and a supply chain between electricity suppliers and renewable generators. It is important to note that the market has only favoured those technologies which were close to market and in that sense have enhanced the rapid development of only a small number of technologies e.g. on-shore wind and landfill gas.

Proposition 2

5.8 The RO has enabled the development of the most efficient and productive firms in the renewables sector, as a result of the market based structure of the

Obligation. Therefore, within a technology, there is competition between developers to gain both consent and finance and to become cost effectiveness in production and as a result, inefficient firms will be pushed out of the market.

5.9 Owing to the market based and hence competitive nature of the RO, it has been viewed as effective in creating the necessary incentive for generators to increase efficiencies and therefore reduce their costs in order produce the maximum output from each source. Therefore, in the areas where the RO has been successful[36], the market has witnessed an increase in both profitability and productivity.

5.10 Evidence suggests that the current form of the RO limits its ability to stimulate innovation in those technologies which are not market ready. Therefore, it was suggested that if the RO wishes to offer the opportunity of support to these technologies, a form of development-cycle differentiation will be required. This could be potentially implemented through the introduction of a complementary instrument which offers grants to those technologies which are embryonic in their nature, in order to allow them to progress to the point where they can compete within the ROC market. Or alternatively, amendments could be made to replace the single price nature of the RO to take account of the differing needs of individual technologies. This second alternative was proposed as part of the set of resultant recommendations from the 2005 review of the RO, where the concept of 'banding', which will act as a means of re-distributing the support more efficiently, is currently under consideration.

5.11 Looking specifically at the policy design and implementation of the RO, it is evident that the following underlying process has had a significant influence on the impact of the instrument:

- **Comprehensive consultation process during the formation and development of the regulation** – which facilitated the engagement of those who were likely to be affected by the instrument and allowed any preferences and concerns to be voiced and hence taken into account during the design of the RO.

- **Advanced notice of the implementation of the instrument** – this provided a market signal to potential developers and allowed the electricity suppliers time to adapt to the changing circumstances of the market. This in turn facilitated the opportunity for developers in the field to create a first-mover advantage, which was evident in the case of wind energy.

[36] As previously stated, the RO has been successful in supporting the development of onshore wind and landfill gas in particular.

- **Stringent enforcement** – enforcement is viewed as stringent by industry due to the nature of the accreditation process of the RO, which has led to the absence of fraud in the market.

- **Degree and frequency of review** - continuous reviews of the instrument caused uncertainty in the market and therefore, it will be important to consider the potential introduction of risk and uncertainty into the market during the design of revisions and additions to the Obligation, as these may significantly affect investor confidence.

- **Stand alone instrument** - RO was constructed as a stand-alone instrument and would be more effective if implemented alongside a complementary set of instruments which would enable the recognition and support of technologies which lie at different stages of the development cycle. The additional menu of support proposed included:

  - The use of capital grants to support technologies which are embryonic or at an early stage of development

  - Reforms to the planning system to ensure decisions are made within a year

  - The use of a 'connect and manage' as opposed to an 'invest and provide' approach in relation to connection to the national grid.

Proposition 3

5.12 The comparative success of the RO and REFIT can be assessed in terms of installations deployed, where the German system is considered to be more successful than that of the UK. However, the contextual background within which a policy instrument is applied acts as a key influence on its success and therefore, a simple comparison of either the increase in installations deployed or the prevailing electricity price is unlikely to yield an accurate comparative assessment.

5.13 Significant differences in the planning structure and resultant accessibility to the grid has greatly influenced the success of both policies, where the more integrated package of measures in Germany has allowed a larger deployment of renewable technology relative to the UK. Similarly, the German system has been in established in some form since 1991 and hence is more mature in its nature in comparison to the UK. Therefore, comparisons which do not take such factors into account may result in inaccurate results.

5.14 The following differences in regulatory form have significantly influenced the impact of the two instruments:

- Price certainty, security and obligatory purchase: The German instrument has removed any price and volume risk in comparison to the RO. This combination of price and purchase certainty has stimulated the development of a larger number of long term contracts in Germany, whose renewable energy market is perceived to exhibit higher levels of security. The removal of price risk within the REFIT system is more likely to benefit both large and small renewable generators, where the latter are perceived to be more risk averse and hence require more certain conditions to join a market.

- The Price competitive nature of the RO has led generators to maximise productivity as a means of reaping bigger rewards, whereas the fixed price nature offered by REFIT, facilitates a lack of incentive to maximise or increase productivity,. Therefore, the market based nature of the RO drives down the costs of production in comparison to the REFIT system.

- Technology specific remuneration - the 2004 changes to the German system, which focused on the implementation of technology specific remuneration, have furthered the effectiveness of the system. This change in practice meant that remuneration depended on the technology used, the size of plant and in the case of wind energy, also depended on the age and the generated power output of the installation. However, the implementation of banding in the UK may reduce this advantage.

- Effective planning and grid access system – The development of renewable energy in the UK has been limited as a result of poor planning processes and grid access constraints. Whereas in Germany, the REFIT system ensures connection to the grid is automatic once renewable energy is produced, which has furthered the effectiveness of the instrument.

- Complementary policy instruments - The German system is complemented by the opportunity for renewable generators to access interest free loans to support the development of sites, which has created a stable demand for renewable technology. Whereas the RO is viewed as a stand-alone instrument and although it had been combined with an exemption to the Climate Change Levy, complementary measures which could further enhance the environmental and productivity outcomes of the instrument were not

apparent. Therefore, the German REFIT system was widely considered to be more effective as a result of its more inclusion in a basket of support measures and hence more integrated policy nature.

- The form of installation development - The UK has witnessed the generation of new capacity from both utilities and specialist developers, with little development in the non-corporate sector e.g. farmers, co-operatives and citizen investment initiatives. Alternatively although Germany has also exhibited large scale development from utilities and developers, the non-corporate sector has also produced significant growth in the generation of renewable energy[37].

Conclusion

5.15 In conclusion, it is evident that the variance in the comparative performance of the UK based RO and German based REFIT systems can be largely explained by both regulatory form and the differing contextual environments within which the regulations have been implemented.

[37] Szarka and Bluhdorn (2006), *Wind Power in Britain and Germany: Explaining contrasting development paths,* Anglo-German Foundation for the Study of Industrial Society

Annex A: List of Consultees

Table A-1: Stakeholders consulted as part of the case study

Name	Organisation
Peter Connor (Lecturer in Renewable Energy Policy)	University of Exeter
Paolo Agnolucci (Senior Research Fellow, Environment Group)	Policy Studies Institute
Tim Foxon ((UKERC Energy Systems and Modelling Researcher)	Cambridge Centre for Climate Change Mitigation Research
Isabel Blanco (policy director)	European Wind Energy Association
Yvonne Naughton (Manager, Supplier Compliance (RO)	OfGEM
Phillip Wolfe (Chief Executive)	Renewables Energy Association
David Still (Work Group Leader for the Energy Review)	Renewables Advisory Board
Gordon Edge (Director of economics and markets)	British Wind Energy Association
Sarah Merrick (Head of Renewable Energy)	Association of Electricity Producers
Michael Duggan	DTI
Nicola Barber	DTI

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