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Renewable energy policy in the UK 1990–2003

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Abstract

The UK's renewable energy policy has been characterised by opportunism, cost-limiting caps and continuous adjustments resulting from a lack of clarity of goals. Renewable electricity has had a specific delivery mechanism in place since 1990. The Non-Fossil Fuel Obligation (NFFO) did not deliver deployment; did not create mentors; did not promote diversity; was focussed on electricity and was generally beneficial only to large companies. A new support mechanism, the Renewable Obligation, began in April 2002. This may result in more deployment than the NFFO, but is also beneficial to electricity-generating technologies and large, established companies only. The UK Government published a visionary energy policy in early 2003 placing the UK on a path to cutting carbon dioxide emissions by 60% in 2050. This paper argues that unless the Government 'learns' from it's past results, mistakes and difficulties, clarifies the reasons for supporting renewable energy and then follows through with a focussed policy aimed at delivery, diversity and the creation of mentors, it is likely to be no more successful than the previous 13 years of renewable policy.

Keywords: Renewables obligation; Innovation; Learning

1. Introduction

The recent UK Government White Paper set out a bold vision of a sustainable energy future and announced the Government's intention to place the UK on a path to achieve 60% cuts in carbon dioxide emissions by 2050 (DTI, 2003a). Such a statement heralded a new, sustainable phase in the UK's energy policy. Despite the White Paper stating that renewables will play a 'vital' (para. 4.2) part in achieving the vision, it created uncertainty about the future of renewable energy support in the UK in a number of ways (discussed below) while the only practical difference in support for such a vision was an additional £60million of capital grants in 2005–2006. Because of this, and despite the 60% headline aspiration, it was met with a lukewarm response from across the energy sector, with the exception of the British Wind Energy Association (Praseg, 2003).

An energy system which could meet a 60% cut in carbon dioxide emissions will require an energy system change (Berkhout et al., 2003; ESRC/PSI, 2003). The UK, while not at the bottom of the list of European countries in terms of deployment, is well behind the high achieving countries of Europe (see Table 1). This paper explores the history of renewable energy policy in the UK and assesses the potential of the UK making a step change in deployment of renewables.

- This paper is set out in the following way:
- It describes UK renewable energy policy from 1990–2003.
- It details three case studies which illuminate the opportunistic nature of UK renewable energy policy; the way that policies have not been followed through; the way that support for renewables is undermined; and the way re-adjustments regularly occur:
  - energy crops (i.e. technological decisions),
  - the imposition of the new electricity trading arrangements in 2001 (i.e. the creation of a new barrier at a time when policy was to remove barriers),
  - the creation of uncertainty by the White Paper, the outcome of which was intended to create certainty, and then re-adjustments to policy.
- It argues for a number of key changes, all of which should derive from Government 'learning', if renewable energy is to become a central supplier of energy in a low carbon economy.

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Table 1
The deployment of wind energy in Europe (MW)

	1990	End 1995	End 1999	End 2001	End 2002	Late 2003
Germany	68	1136	4445	8753	12001	13184
Spain	7.2	145	1530	3335	4830	5198
Denmark	343	619	1742	2556	2880	2927
Italy	2.9	25	211	697	785	800
Netherlands	49	236	410	483	688	829
UK	9.9	200	356	485	552	588
Sweden	8	67	220	280	325	364
Greece	1.8	28	87	272	276	354
Portugal	0.5	13	60	127	194	217
France	0.3	7	23	85	145	219

Source: WPM (1999, 2001, 2003).

2. The history of renewable energy policy in the UK, 1990–2003

The UK has had a delivery program for renewable electricity since 1990, initially the Renewable Non-Fossil Fuel Obligation (NFFO) (Mitchell, 1995, 2000) and, since 2002, the Renewables Obligation (RO) (Mitchell et al., 2004).

The NFFO was primarily set up as a means to subsidise nuclear generation, which had proved too difficult to privatise (Mitchell, 1995; Surrey, 1996). The UK Government was required to ask the European Commission for permission to support nuclear power. The Government preferred to ask formally to support 'non-fossil fuel'. The Electricity Act, 1990, enabled the raising of a fossil fuel levy to pay for the Non-Fossil Fuel Obligation and specified renewable energy technologies were included in the definition of eligible non-fossil fuel technologies.

This beginning epitomises the subsequent history of renewable energy support in the UK. An opportunity arose to support renewable energy, as a result of another policy demand. The justification behind the support of renewable energy was never clarified or widely agreed. The policy was opportunistic or the equivalent to 'a foot in the door'. Once opened, the door has proved impossible to close by those who do not support a renewables-specific policy. The latter group see the reason for supporting renewables as fundamentally confined to carbon reduction. From an economic point of view, a sector-wide carbon reduction policy—whether a carbon tax or a carbon trading scheme—is more efficient. This latter policy is based on the view that the market will decide the most economic means to reduce carbon.

The argument of whether to support renewables by a specific mechanism versus a general carbon mechanism has rumbled on since 1990. The Government has so far always come down in favour of a renewable-specific policy, arguing that there are valuable reasons for supporting renewables other than carbon reduction. Examples include: as part of an innovation policy; to provide energy options; to support diversity and for broader industrial and local benefits (PIU, 2002; DTI, 2003a). Nevertheless, the strength of support for a sector-wide carbon reducing policy is powerful, especially from business and the Treasury. As a result, support for specific renewable energy policies has never been powerful or widespread across Whitehall. This lack of clarity and agreement over the reasons for, and goals of, a renewable energy policy has dogged and constrained the design, success and cost of renewables energy policy in England and Wales ever since.

A further important question is whether the ability to support renewables in another way was closed off as a result of renewables inclusion in the NFFO. For example, did it exclude the use of a feed-in tariff type mechanism which was becoming prevalent throughout Continental Europe at that time? This is not discussed further here, although it is the view of the authors that there was no chance that a non-competitive mechanism, such as the feed-in mechanism, could have been established in the UK at that time (Mitchell, 1996, 2000).

2.1. The first result of opportunism

Adoption of the NFFO to support nuclear power was sanctioned by the European Commission for 8 years only, from 1990 to 1998. At this stage, how renewable energy was going to fit into the NFFO was uncertain. At the time of the announcement of the NFFO mechanism in 1990, there was no specific capacity target for renewables at all although this was set at 600 MW DNC, when the NFFO-1 contracts were announced. Two-thirds of the NFFO-1 contracted capacity was with renewable energy power plants already generating or with power plants where owners had already pressed the Government for support (Mitchell, 1994). The payments per kWh for NFFO-1 contracts were agreed between civil servants and generators before they entered their contract bids so that little competition occurred. NFFO-2 was different. Unlike the NFFO-1 contracts, most of the NFFO-2 contracts were for 'new' capacity and competition occurred to a limited degree.

There have been serious and continuing impacts from the opportunism of integrating renewables into the NFFO. Premium payments were paid from the point of commissioning the contract power plant to the end of 1998. Revenue for generators began as soon as plants were commissioned so they were heavily incentivised to maximise the available resource (i.e. to go to high wind speed sites) and to commission the power plants as soon as possible. In addition, because of the competitive nature of the NFFO, contracts were given out following competitive bidding on a particular day. Developments

of power occurred more or less at the same pace in parallel: planning permission was asked for at more or less at the same time, wind farms were being built at more or less the same time, and wind farms were sited in similar sites. Concerns about the nature of wind developments from NFFO-1 and -2 created a small but well-organised campaign against wind farms (Welsh Affairs Committee, 1994). This creation of anxiety about the 'wind rush' was wholly unnecessary and a direct result of the Renewable NFFO contracts ending in 1998, which was in turn a direct result of its link to the Nuclear NFFO. The anti-wind feelings engendered in 1990 and 1991 are still felt in some parts of the UK and is an important reason why onshore wind developments have been so slow.

Other technologies found the economics of the contracts even more difficult. The NFFO-2 waste-to-energy power plant contracts found that the length of time taken to obtain planning permission and the foregone revenue from the process meant that they could not make an economic return by 1998. Thus, it became clear that another NFFO round, i.e. NFFO-3 with contracts until end-1998 would be unworkable, except with extremely high prices.

The Government decided to ask the European Commission to extend the NFFO contracts for renewable energy only. The rules for NFFO-3 to NFFO-5 were changed so that:

- there was up to 5 years 'grace' period after the contract was awarded in order to obtain planning permission followed by a 15 year, index-linked premium payment;
- wind energy was split between smaller and larger sized wind farm bands, to enable community projects; competition within the NFFO already occurred within technology-specific bands but this move allowed wider access for actors;
- energy crops had a 'new' dedicated technology band.

This policy for NFFO-3 through -5 was far closer to that which the Government would have put in place had they had no constraints in 1990. Nevertheless, the NFFO was a complex mechanism compared to the feed-in mechanism, the other main support measure widely in place in Europe (Mitchell, 1996).

2.2. Optimism and reality

The simultaneous announcement in 1993 that there would be three more rounds of the NFFO; that there were new contract rules for the award of the first new round, NFFO-3 (with contracts to be awarded the following year); and the raising of the national target to 1500 MW DNC (or 3% of electricity supply, from the 1000 MW DNC made at the announcement for NFFO-2) was a moment of real optimism for the British renewables community. Optimism seeped away between 1994–1997, as reality of delivery became clear. Deployment proved very slow with planning permission continuing to be difficult to obtain, partly as a result of the implications of NFFO-1 and -2. With hindsight, it became clear there were two key problems with the NFFO:

- A too low total cost cap. There was always only ever going to be a certain amount of capacity supported by the cost-cap. The pent-up demand meant that the NFFO was 'too' competitive. This, combined with the lack of penalty and over optimistic assessments of the various project cost factors (e.g. obtaining planning permission; overestimating the extent of cost reductions through technology development during the five 'grace' years) meant that the later NFFO bids were often 'best-situation' bids and too low. They were therefore uneconomic and were not taken-up. A higher cost cap would have reduced competition and enabled higher bids which may have enabled development.
- A lack of a penalty for those companies which did not take up their contract. Given the cost-cap and the very great demand, there was limited chance of obtaining a contract. However, the lack of penalty allowed low bids which at least provided the possibility of a contract and which did not have to be taken up if it turned out to be uneconomic. It also had the benefit of ensuring that competitors did not have a contract.

The second moment of optimism was in 1997 when the Labour Party came to power with:

- a manifesto policy for renewables to supply 10% of electricity by 2010;
- a very vocally supportive Minister for Energy, John Battle; and
- the ushering in of a period of discussion about the future of renewable energy policy within energy policy.

NFFO-4 was quickly announced in 1997 and provided 1700 MW DNC of new contracts to the renewables industry after a gap of 3 years. The NFFO-5 Order was announced at the end of 1998 with a total of 261 projects were contracted, with a total capacity of 1177 MW DNC (Mitchell, 2000). Table 2 shows the average prices for different technologies over the five rounds of the NFFO.

The majority of NFFO-4 and -5 contracts have still not been developed. The bids were too low and there have been difficulties with obtaining planning permission. Thus, optimism seeped away between 1998 and 2002, with the announcement of the Renewable Obligation to follow on from the NFFO but also as it became clear that delivery was slowing rather than improving, as demonstrated in Fig. 1.

Table 2
NFFO prices

Technology band	NFFO-1	NFFO-2	NFFO-3	NFFO-4	NFFO-5
	Cost-justification	Strike Price (p/kWh)	Average Price (p/kWh)	Average Price (p/kWh)	Average Price (p/kWh)
Wind	10.0	11.0	4.43	3.56	2.88
Wind subband	—	—	5.29	4.57	4.18
Hydro	7.5	6.0	4.46	4.25	4.08
Landfill gas	6.4	5.7	3.76	3.01	2.73
M&TW[a]	6.0	6.55	3.89	—	—
M&TW[b]	—	—	—	2.75	2.43
Sewage gas	6.0	5.9	—	—	—
EC&A&FW[c]	—	—	8.65	5.51	—
EC&A&FW[d]	—	5.9	5.07	—	—
EC&A&FW[e]	6.0	—	—	—	—
M&IW/CHP[f]	—	—	—	3.23	2.63
Total	7.0	7.2	4.35	3.46	2.71

(Mitchell, 2000).
[a] Municipal and industrial waste with mass burns technology.
[b] Municipal and industrial waste with fluidised bed technology.
[c] Energy crops and agricultural and forestry waste with gasification technology.
[d] Energy crops and agricultural and forestry waste with residual technologies.
[e] Energy crops and agricultural and forestry waste with residual anaerobic digestion.
[f] Municipal and industrial waste with combined heat and power.

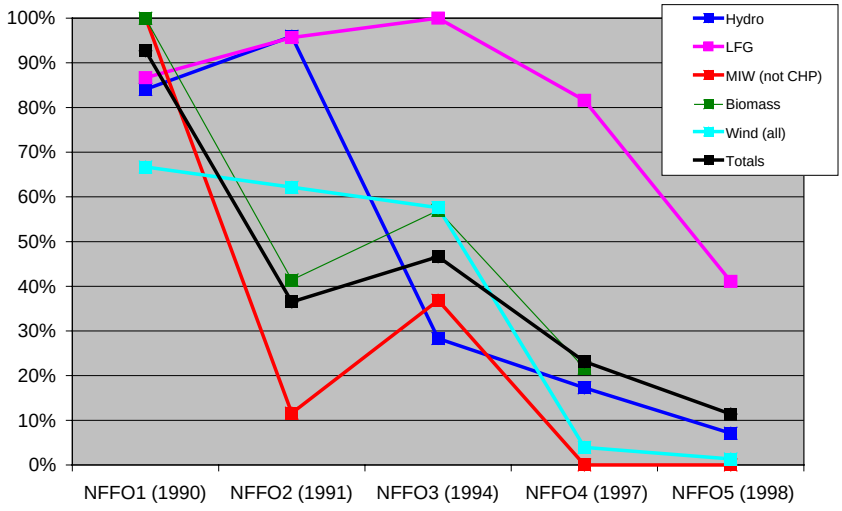

Fig. 1. Overall completion rates for NFFO contracts in 2003. Hartnell (2003).

The NFFO could have been a very good mechanism of support for renewables if there had been a penalty and if the cost-cap had been higher. However, there was a desire on the part of the DTI to reduce the average price per kWh of each Order, thereby signifying that the policy was working. The DTI was effectively more interested in showing that their competitive renewables policy had 'worked' in principle than in achieving deployment on the ground.

2.3. Following on from the NFFO—the renewables obligation

The new Labour Government undertook numerous policy reviews once it gained office in 1997 so that changes to energy (and renewable) policy were slow. However, by 1998 a Utilities Bill Team was established in the Department of Trade and Industry. This Bill was initially intended to alter the basis of utility regulation (gas, electricity and water) in the UK.

The Utilities Bill ended up only dealing with energy and led to three major implications for renewables:

- The Regional Electricity Companies (RECs) were the legal entities on which the NFFO was placed. The Utilities Act separated the RECs into distribution and supply companies, thereby removing the legal basis of the NFFO and requiring either that the NFFO was transferred within the new legislation or that a new mechanism was put in place;

- New Electricity Trading Arrangements (NETA) were implemented in April 2001;
- The Duties of the Regulator, Ofgem, were slightly altered but the thrust still remained competitive: 'protecting customer interests wherever possible using competitive means'. The regulator's role with respect to the environment was marginally increased by 'having regard to' Guidance from the Government and publishing an annual Environmental Action Plan.

The mechanism to replace the NFFO—from the perspective of the Government—had to counter its supposed defects, including;

- its inability to deliver deployment (as was argued above, primarily the result from a low cost-cap rather than the NFFO itself);
- providing an alternative to the must-take (or priority access) contracts placed on regional electricity companies (the latter having by now been dissolved by the Utilities Act). Must-take contracts were thought to separate the renewable generators too much from the reality of the market place, although it was the key reason why the NFFO was perceived to be a risk-free contract for those companies lucky enough to get one;
- that it shouldn't 'pick winners' as the NFFO technology bands were deemed to do.

The RO began in April 2002 and reversed the rules of the NFFO (Mitchell et al., 2004). The obligation is on suppliers to purchase and supply a certain amount of *generated electricity* not a contract for generation from specific projects. Thus, suppliers must supply 3% of their total annual supply in the period 2002–2003 (initially rising to 10.4% in the period 2010–2011 (this was revised upwards in December 2003, discussed below) from a list of specific renewable technologies. There is no must-take contract for renewable electricity and no price or contract length is stipulated within the RO. Developers have to negotiate with a supplier for all agreements. Suppliers offer differing lengths of contract depending on the price they pay per kWh. However, in general, suppliers prefer flexibility and do not wish to become contracted for specific generation for too long if they think that prices may go down in the future. The risk involved in the RO is therefore greater for developers than with the NFFO:

- Price risk (generators do not know what they will be paid beyond the (short-term) contract);
- Volume risk (generators do not know if they will be able to sell their generation in the future, certainly once the current 10% target for 2010 is met);
- Market risk (generation value varies according to market rules).

The RO is far more of a market mechanism than the NFFO and was intended to force the renewable developers to take part in the electricity market, and in this sense has been successful. The RO is technology non-specific; all eligible generation technologies (whether landfill gas or wind energy) receives roughly the same payment, and prices are currently significantly higher than those awarded under the later rounds of the NFFO. Indeed the payment is now equivalent to that currently guaranteed for a minimum of 5 years for wind energy in the almost risk-free EEG in Germany (Mitchell et al., 2004). Thus, the supposed primary goal of the RO of achieving low prices is some distance away, so this supposed major benefit to the consumers is lacking while developers must carry its risks.

As Fig. 2 shows, applications for planning permission have soared since the introduction of the RO.

To comply with the RO, suppliers have to prove to Ofgem, the Energy Regulator, that they have met their obligation by providing the requisite amount of Renewable Obligation Certificates (ROCs, where 1 ROC = 1 MWh). Suppliers can obtain these either directly from a generator (by buying both the energy and the ROC); by buying the ROC only directly from the generator; or by buying the ROC in a trading market. Moreover, the supplier can 'buy-out' of the obligation if they do not want to participate by paying 3p/kWh for every unit of renewable electricity they should have bought to meet their obligation. The buy-out price increases annually in line with inflation. This 'buy-out' revenue is then recycled back to the suppliers who have participated. A supplier submitting 5% of the total ROCs submitted would receive 5% of the recycled 'buy-out' or premium. This effectively gives renewable electricity in the RO a current (i.e. 2003) value of:

- Around 3p for the ROC (as long as demand exceeds supply),
- 1.5–1.8p for energy (at mid 2003 levels),
- 0.086p for the levy exemption certificate,

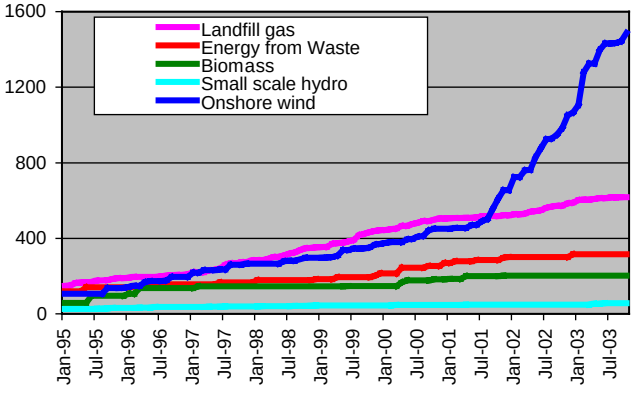

Fig. 2. Cumulative MW granted planning permission. Hartnell (2003).

- 1.5p for the recycled premium (as demand currently exceeds supply).

This gives a total value of 6–7p/kWh. This is considerably higher than prices available in the later rounds of the NFFO. However, a further source of price risk became apparent at the end of the first period of the RO. The period ran from April 2002 to March 2003, and suppliers then have 6 months to demonstrate they have met their obligation, either through the submission of ROCs or by paying the buy-out price. The failure of two supply companies (TXU and Maverick) during the period meant that the amount paid in to the recycling fund was lower than was expected, resulting in a reduced pay-out. It also became apparent that the regulations governing the fund meant that any late payments into the buy-out fund could not legally be passed on by Ofgem to those companies who had submitted ROCs. Five further supply companies failed to meet their obligations for the period 2002–2003, within the prescribed time limit. The disparity in buy-out recycling was resolved when each agreed to make voluntary payments to the companies negatively affected. It is hoped that the issue will be resolved through regulation by the end of the next period (Ofgem, 2003, 2004).

Of the four revenue streams, the ROC value and recycled premium is related to supply and demand of renewables, and therefore cannot be the basis of finance. The closer the supply of renewable generated electricity comes to meeting the annual obligation, the smaller the value of the recycled premium. Once the annual target is met, there is no recycled premium. As supply of renewables outstrips demand, suppliers can choose which generator to buy from. This means that generation which does not win contracts to fulfil the RO will have neither the ROC value nor the recycled premium. Further, the value of the ROC should fall as suppliers have more supply to choose from. When the RO was announced, the 10% target was due to be reached in the period 2010–2011, and then to remain at the same level until 2027. Following the meeting of the 10.4% target, the only new renewables generation will be that which is cheaper than the most expensive of the already operating capacity.

Large, integrated generating companies which have impressive assets can take the RO risks themselves, thereby obtaining finance on their capital assets. The rewards are the current high prices. The RO is therefore supported by financially strong companies. Nevertheless, those large companies will only invest while they can see high returns over a long enough period. As 2010 nears, the number of years of high returns becomes shorter. A Government advisory board said that they expect financing to dry up under these conditions (RAB, 2003). Independent, emerging companies are unable to either obtain finance or take the risks themselves. The RO is therefore an even stronger mechanism in support of large companies than the NFFO.

The success of the RO, in terms of meeting the 10% target in 2010, rests on whether the integrated energy companies can deploy an additional 7% or so of renewable electricity in the next 7 years. This will require investment of about £1.1–1.5 billion/year according to both the White Paper and the Renewable Power Association (DTI, 2003a). If generators cannot find this from their balance sheet, then they will have to look to project finance. As integrated generator–supplier companies, suppliers should be able to offer their in-house generators long-term contracts for off-take at a fixed price, thereby giving sufficient comfort to financiers. This, however, opens the parent company to new risks and the central issue is thus whether the risk/reward of the RO is sufficient.

The Government finally accepted the validity of these warnings in December 2003 (DTI, 2003c) when it announced that it had increased the renewable obligation and target for renewable electricity to 15% by 2015–2016. Only by increasing the obligation to this level could it reduce the risk of the RO sufficiently to induce investment. That this occurred within a year of the publication of the White Paper, which was to set out Energy Policy for the next decade, shows again the Government's limited understanding of how technology and innovation policy interacts with economics.

2.4. Promoting diversity

As described in Sections 2.1–2.2, the NFFO was not successful in creating diversity—whether technological diversity, diversity of project size or diversity of generators, investors or customers.

The cost of the RO, in contrast to the NFFO which had to be published each year in a very visible manner, is within the price paid by suppliers and therefore relatively invisible to customers. Customers will pay about a £1 billion a year as the RO tends towards the 10.4% in 2011 (DTI, 2001) (34TWh multiplied by the 3p/kWh buy-out/ROC value assuming that demand is greater than supply). The 15% obligation will be higher still and this represents a considerable expenditure and is a big positive step forward from the level of the NFFO cost cap. Provided the integrated energy companies can finance new capacity, the RO should improve deployment. While the risks associated with the RO may still undermine development, this aspect of the RO does represent an improvement.

However, as noted, the RO is a risky and complex mechanism which has a number of shortfalls:

- It does not induce or enable new entrants or smaller players into the market and therefore does little to develop mentors for renewable energy.

Table 3
UK government funding for renewables 2003–2006 (as far as is known)

DTI	Offshore wind capital grants	102
	Bio-energy (combustion) capital grants	33
	Bio-energy (pyrolysis) capital grants	5
	Bio-energy (heat) capital grants	27.7
	PV capital grants	20
	Clear skies (community and household) capital grants	10
	DTI New and Renewable Energy Programme R&D indirect spend	52
	DTI New and Renewable Energy Programme R&D direct spend	4.5
	Wave and tidal	5
	Embedded generation (metering, storage and control demos)	4
	Planning facilitation	2.5
	Unallocated SR2002	35
	Unallocated White Paper	32
Defra	Bioenergy Infrastructure Scheme	3.5
	Energy Crop Scheme	29
Research Councils	TSEC	28
	SuperGen	25
	Tyndall Centre	10
	Carbon Vision	14
Other	Carbon Trust	15
Devolved Admin	Scottish Community and Householder Initiative	4.7
	Scottish Intermediate Technology Institute	45
	Promotion of RE by Scottish Executive	3
	Raise awareness of renewable energy (NI Assembly)	4.5
TOTAL		514.4
ROC expenditure	Based on Hansard figures above	1200
EU Framework 6	Estimate	60
Overall total: 2002–2005		£1780 million

DTI (2002), Carbon Trust (2003), Defra-ERDP (2003), ESRC (2003).

- it is only electricity based, so non-electricity technologies are not supported;
- it only supports technologies which are cheaper than the 6–7p/kWh. That is, the technologies which are already closest to market. It does not therefore support emergent technologies.

In order to develop technologies other than (large) wind energy turbines, the Government realises they need to bring generation from emergent technologies into the RO, or at least to provide support outside the RO. Other generation technology—for example wave power, tidal power, energy crops and photovoltaics—is more expensive than the effective RO price cap. Government created a new bidding mechanism for capital subsidies for certain technologies, thereby reducing the cost of the generation. For example, if the cost per kWh from a wave project was 7p/kWh then the developer could bid in to the capital grant fund for a capital grant which would effectively bring their bid down by 1p/kWh, to take them to 6p/kWh, which should receive an RO contract, provided all other risks are acceptable.

The Government has also made an effort to put money into overcoming the barriers to renewables; to support non-electricity renewables; and to support community and small-scale renewables. The value of available grants and funds has increased since March 2001, when the Prime Minister announced £100m for renewables as the first tranche in the move towards a sustainable energy economy. The total available is now around £500m for 2002–2005 (as shown in Table 3) in addition to the annual expenditure on the RO (around £300m in 2003, rising to around £1bn in 2010). However, renewables which are non-electricity based and which are not sold to suppliers are not eligible for the RO. They therefore do not receive ROCs and have no access to the recycled buy-out fund, together the highest value components of the renewable premium payments. Non-electricity and self-generation should theoretically have diversity and option value. Until they are eligible for some equivalent to the ROC, they will not deploy widely.

Government strategy under the RO supports 'big' electricity technology (i.e. onshore and offshore wind farms) and large companies, because this, they assume, provides the cheapest electricity. This has been the case right from the start of the R&D programme in the UK (National Audit Office, 1994). However, the total costs and benefits of technology development are not encapsulated within a price/kWh. For example, large offshore wind farms require major infrastructure development which, when costs are fully accounted for, may or may not alter their competitiveness relative to other technologies. However, alternatives such as small-scale,

urban or domestic wind energy turbines have extremely limited support. Given the renewable and non-renewable micro-technologies increasingly available, current policy is deterministic towards large-scale and marine developments.

This section began with the determination that the NFFO did not promote diversity. This section has shown that the same can be said of the RO. However, the Government, as shown in Table 3, has increased expenditure on renewables considerably and to this extent has attempted to increase diversity—although this is considerably undermined by NETA, discussed below.

3. Case studies: examples of UK renewable energy policy

The next section provides a series of case studies which illuminates the inconsistent and ill-thought out renewable energy policy in the UK. The case studies are:

- the support of energy crops (i.e. as a technology);
- the undermining influence of economic regulation (i.e. the creation of a new barrier at a time when barriers where trying to be removed);
- the uncertainty caused by the White Paper (i.e. the opposite of the intended result and the subsequent re-adjustments to policy within a year of publication).

3.1. Energy crop promotion (1994–2003)

The use of energy crops for electricity requires the development of a complex supply chain. That is, a series of new technological developments (planting, tending, harvesting, drying, storing and gasification (or other final technological treatment) which together form the 'energy crop technology package'. If one of those stages is not working, the package is less than efficient. The development of energy crops is therefore much more complex at an organisational level than, for example, wind farms which are made up of a series of modular turbines. Unlike wind energy, generation from energy crops requires an efficient linking of several stages from the planting of the energy crops through to its final burning. This demands focussed and specific technology support, something that the UK had never attempted for renewables.

The UK potential energy crop resource is large. Energy crops can be either perennials or annuals. Energy crops and agricultural wastes could provide electricity, combined heat and power; biogas (the latter for both small scale use but also for injecting into the gas network; and biofuels. Timothy Eggar, the Conservative Energy Minister from 1992–1996, was a great champion of energy crops and a dedicated energy crop band was agreed in NFFO-3, in 1994. At that time, it was not clear what payment (p/kWh) an energy crop power plant should receive. This was due to a wide range of factors;

- It was not known whether energy crops counted as a woodland crop (tax-free) or an agricultural crop (subject to 25% or 40% tax, depending on the farmer's income). Bids were entered on the former basis, although the latter basis was finally agreed with Customs and Excise but only after contracts were awarded.
- Dedicated technologies were not available for planting, harvesting and drying so costs were not known.
- There was limited links between DTI and MAFF (Ministry of Agriculture, Fisheries and Food) so that joint energy/agricultural policies had not joined-up to the degree it has today. For example, no planting grants were available from MAFF/Defra.
- A network of farmers to plant the crops (grow the resource) was not in place and greater take-up by farmers was projected than occurred because of the hoped-for tax free basis.
- The basic technologies—whether the power plants should be steam or gasification based—and the optimum size of the power plant (i.e. the most economic and efficient way of planting, cutting and transporting the resource between the farmers and power plants) was unknown.
- Plant breeding (as opposed to gene manipulation) is on-going and has shown very positive results, but at that time was in its infancy.

Thus, energy crops were essentially at the technology demonstration stage yet were placed in the market delivery mechanism because of opportunism. If energy crops were not placed within the NFFO, they would not receive adequate R, D&D funds outside of it, given the falling R&D budget at the time, as shown in Table 4.

Gasification was chosen as the eligibility basis of the NFFO because it was more theoretically efficient, thereby requiring less crop growth. Arguably, allowing steam technologies to be eligible for the NFFO-3 contracts—well-known and therefore reasonably risk-free—could have reduced the other new, riskier technological aspect enough to provide energy crops with initial stimulation. The use of a new gasification technology with a fuel stream that was also new constituted a very risky combination.

However, there are many advantages related to energy crops. They could, for example, provide a new income for farmers, in an industry which needs new products. Energy crops, along with agricultural wastes, can provide large amounts of reliable electricity or biogas. Biofuels could be a relatively easy and important carbon-neutral additive to petrol for transport. Work following on from the PIU Energy Review and the White Paper (discussed below) has shown that the

Table 4
Comparison of cost of renewable energy R&D, RO and NFFO 1990–2003 (£m)

	Research grants[a]	RO	NFFO	Other capital grants[b]
1990–1991	21.3		6.1	—
1991–1992	24.8		11.7	—
1992–1993	26.6		28.9	—
1993–1994	26.8		68.1	—
1994–1995	20.5		96.4	—
1995–1996	21.6		94.5	—
1996–1997	18.5		112.8	—
1997–1998	15.9		126.5	—
1998–1999	14.4		127.0	—
1999–2000	14.9		56.4	—
2000–2001	15.9		64.9	—
2001–2002	24		54.7	—
2002–2003[c]	27.6	282.0	—	60.0
2003–2004[d]	29	405.0[d]	—	131.0

Wilson (2001).
[a] Combined DTI R&D and Research Councils through Science Budget.
[b] Provisional.
[c] Estimated.
[d] Due to rise to around a £1bn by 2010.

cheapest way to move to a sustainable electricity economy is to deploy a diverse set of technologies throughout Britain (ILEX and Strbac, 2002). A central advantage of energy crops is that, since they essentially provide an easily stored fuel stuff which can be burned as will, they can be used as a reliable electricity-generating source. Wind energy, wave energy, tidal energy and so on provide many benefits, including diversity. However, they do not bring the same reliability that energy crops can provide. Thus, energy crops are one of the few renewable energy 'balancing' technologies (along with the gases from wastes) which has the ability to bring down the market and network costs of a sustainable electricity system considerably. Thus energy crops are an important renewable technology to promote for reasons outside simply generating environmentally benign electricity within the context of the RO.

The NFFO-3 contract prices (p/kWh), which were more or less agreed between generators and civil servants, turned out to be too low, for the reasons already noted. This trapped developer's into uneconomic NFFO contracts. Moreover, as the farmers realised they would have to pay tax on their crop revenues, they either increased their price or pulled out. Only one of the NFFO-3 contracts, ARBRE, was developed.

In parallel, the DTI was anxious to reduce the average price of the NFFO Orders and were not sympathetic to higher bids or a broadening of the eligible energy crop technology base. NFFO-4 in 1997 did not increase the energy crop technology band price and NFFO-5 in 1998 did not even contain a technology band for energy crops. The NFFO effectively stopped energy crop development in its tracks. Farmers were put off. The price was too low for developers to make an economic return. Technology was 'determined' by NFFO rules.

Despite the destructive effect of the NFFO on energy crops, the very large resource and the 'balancing' and network cost benefits, it might be hoped that the RO would overcome the policy inertia. This has not been the case, and looks unlikely to change should current circumstances prevail. If they are to benefit from the RO, their only current option is capital grants, as described above to bring their price down under the RO price cap. The amount of capital grants available for energy crops (i.e. around £70m for technologies and £29m for planting, as shown in Table 3) is not enough to support enough capacity and enough types of technologies for the technology 'winner' to come through or for the rest of supply chain required for their progress (within planting, growing, harvesting, and so on) to develop.

Energy crops had one main demonstration project in Great Britain—the NFFO-3 contracted, 30 MW ARBRE gasification project. The RO was intended to begin in April 2001 but finally came on line in April 2002. This lost year of ROC revenue (no more than £1 million assuming 14% efficiency on 30 MW output at 3p/kWh) tipped ARBRE—already heavily subsidised by Government and the EU—into bankruptcy. The 'staff' were sacked, including the experts in energy crop gasification. The farmers contracted as fuel suppliers, although now banding together to try to sell their product elsewhere, have lost confidence, and the failure is likely to impact on the potential for influencing farmers to switch to energy crops in the future. The bankruptcy deal has confidentiality agreements. Those most closely involved are not allowed to talk in public about the reasons for the bankruptcy. Thus, lessons of what went wrong and what could be learnt, despite Government and EU funds put in to the project, cannot be publicly disseminated. At the same time as the bankruptcy negotiations for ARBRE were occurring, the UK Government underwrote a debt of £650m to British Energy, the nuclear generating company which provides around 20% of UK electricity capacity but which will drop to 2% by 2020 (PIU, 2002).[1]

If energy crops are to become a real renewable resource, there needs to be more focussed support on the technology needs. The issue of energy crops illuminates the difficulty that both the NFFO and the RO has with fostering innovation and diversity. The nearest market technologies (i.e. wind and landfill gas) have benefited

[1] A statement of the events concerning British Energy's debt problems can be found at http://www.british-energy.com/mn_main.shtml#

from the NFFO and the RO. In terms of support for emergent, new and/or complex technologies, both mechanisms have been failures.

3.2. An opportunity lost—2002–2003: the years of the PIU energy review and white paper process

February 2002 saw the publication of the Performance and Innovation Unit (PIU) Energy Review (the equivalent of a Green Paper) and February 2003 saw the follow-up publication of the White Paper: Our Energy Future—Creating a Low Carbon Economy (PIU, 2002; DTI, 2003a). Detailed analysis took place to back up both Reviews.[2] The White Paper set out a visionary future of a very different energy system and one that would produce 60% cuts in carbon dioxide emissions by 2050 from 1990 levels. However, limited substance underlay its vision.

The White Paper confirmed that, just to meet the existing 2010 target of 10% of electricity coming from renewables an estimated new investment of between £1.1bn and £1.5bn each year would be required. To deploy renewables at the rate required to meet 60% cuts by 2050 would require substantially higher investment levels. However, far from increasing confidence the policies outlined in the White Paper increased uncertainty renewable energy policy in four key ways;

- It did not increase the target from 10% of electricity from renewable sources by 2010 target to 20% by 2020, as was expected;
- It sets carbon trading as the centre of environmental policy, undermining confidence in the long-term existence of the renewable specific RO;
- It set up a review of the future of the Renewable Obligation (RO, the current renewable deliver mechanism) in 2005/6, which in the absence of a 2020 target, raised uncertainty about change;
- It set up a review of co-firing rules within the RO, offering the potential to increase eligibility for specific technology use, thus increasing the number of ROCs likely to be generated and as a result undermining confidence in the value of ROCs.

The only positive, concrete outcome of the White Paper for renewables was an additional £60m of capital grants over the 2002–2005 spending review period.

Effectively, the RO—put in place in 2002 and intended to last until 2027—was being questioned by the White Paper within a year of its inception. The contractual value of ROCs, as described in Section 2.3 above, is linked to estimates of supply and demand. Although a review of the co-firing rule may appear at first sight unimportant, this is not the case.

- Any expansion of technology eligibility relating to the RO is likely to increase the number of ROCs and if there is no parallel increase in obligation, the value of ROCs will go down. Such uncertainty is bad for investment.
- Secondly, the 2005/6 renewable review would be too early to judge the success or otherwise of the renewables obligation and the EU carbon trading scheme will not have got going until then.
- Thirdly, by setting the EU trading scheme at the centre of energy policy, there were concerns that support for renewables-specific policy might be under threat, particularly given the 2005/6 renewables review.

The White Paper, published in February 2003, presented a visionary future yet managed to undermine policy which was implemented in April 2002. Already, by December 2003 concerns about the feasibility of the White Paper's renewable energy policy caused the Government to increase the obligation to 15% by 2015. That this occurs within a year of the 'definitive' energy policy White Paper underlines the UK Governments seeming inability to establish long-term, workable policies.

3.3. Creating rather than removing barriers

The UK's New Electricity Trading Arrangements (NETA) came into operation on 27 March 2001, following Ofgem's submission of its initial proposals in July 1998. This was before the PIU Energy Review or the White Paper.

The aim of NETA is to act as far as is possible like a commodity market. Generators are no longer centrally dispatched but instead inform the system operator of their contracted output and make bids and offers to move away from their contracted position. All contracts are to be submitted to central settlement 1 hour (initially 3.5 h[3]) ahead of the half hour dispatch period. After this 'gate closure' generators, suppliers and customers can submit offers and bids to deviate from their expected levels at specified prices into the Balancing Mechanism. The system operator can then accept or reject these to ensure the system is balanced, the quality of supply is maintained and short-term transmission constraints are dealt with. Prices in the Balancing Mechanism dictate the prices that must be paid by any generators or suppliers for any differences in their actual position and their contracted position after real time Imbalance Settlement. If a generator has a shortfall in its contracted generation it must pay for that shortfall at the System Buy Price and if it exceeds it at the System Sell Price. The same system works for out of balance suppliers.

[2] See http://www.number10.gov.uk/output/page4250.asp and http://www.dti.gov.uk/energy/whitepaper/index.shtml#wp.

[3] Adjusted on 2 July 2002.

NETA was always a worry to small generators. Discussions concerning its creation coincided with the last NFFO Order and the development of the Renewables Obligation. It was always clear that the NFFO generators would be looked after and they continue to be paid their NFFO generation price. However, ex-NFFO (i.e. NFFO-1 and -2) generators, new projects and small generators (i.e. under 100 MW) were made subject to the new market rules, and would have to negotiate the sale of their electricity and the price to be paid against the background of the development of a new support mechanism. This effectively put a halt to renewable energy deployment in the UK between 1998 and 2002.

Peter Hain, then Minister of Energy asked for a Review of NETA with regard to its Impact of the First Three Months on Small Generators (Ofgem, 2001). Ofgem sent out 500 questionnaires in compiling the report. The 40 respondents represented 106 sites, of which 40 provided comparable year on year data. The data indicated that Exports had reduced by 44% for small generators on average, with independent CHP seeing the largest fall of 61%. Taken together, the fall in exports and prices meant considerable impact on generator revenue, for example, the average reduction in revenue for wind power was 34.8%.

A second review of the first year of NETA was published in July 2002. Again, the number of respondents was small (51 had comparable data for 2000 and 2001). Unlike the August 2001 review, Ofgem included the prices received by NFFO/SRO projects in their calculations. The contract prices of all renewables projects ranged from £33–77.50/MWh, with an average of £50.76. Including the NFFO/SRO prices with other prices received via NETA, raised the average considerably (Ofgem, 2002, Table 9.3).

There are three key points connecting NETA with renewables:

- The mechanism, which is technology and fuel blind as implemented, will promote the status quo and dominant technologies and make it harder for immature technologies.
- A large, integrated energy company has a wide portfolio of generation which requires balancing within NETA so that difficulties of intermittent, renewable energy generation is seen as part of the extra risk of that technology and is incorporated into the overall decision to support it.
- From the perspective of independent generators, intermittent generation has more risk attached to it because of the greater difficulty of balancing individual plant output to a half hour. As a result of this, the price paid for intermittent generation will be discounted. This discount is likely to be greater than the real cost to the electricity system and to this degree NETA is not cost-reflective (Milborrow, 2001; Dale et al., 2004).

The debate about the importance of NETA to renewables has rumbled on since its inception. Probably the only clear outcome is that it is another factor supporting large-scale, integrated-company development of renewables and undermining renewable energy generation by independent generators or new entrants.

NETA is now being rolled out across Great Britain as BETTA (British Electricity Trading and Transmission Arrangements). The Government has, by endorsing BETTA in the 2003 White Paper, taken the view that not only does NETA require no fundamental changes but that it is correct that is extended to Scotland. A central government policy principle is that if renewables suffered difficulties with the primary market (i.e. NETA), then means to overcome those difficulties should occur as secondary measures outside of the primary market mechanism. The primary market itself should not be interfered with. This principle of non-intervention is at the heart of UK policy for markets and regulation.

As stated above, the government clearly endorsed NETA (and BETTA) in the White Paper. Markets are social constructs and NETA was constructed prior to the PIU Energy Review and the 2003 White Paper. Its rules maintain the status quo, because, being technology and fuel blind, it will choose the cheapest technology and it contains no mechanism to overcome any path dependencies inherent in the system. Arguably, maintaining no intervention in the primary market adds costs to customers through the subsidies in secondary measures, such as the RO or carbon trading scheme, although the authors are unaware of any study to have calculated the additional costs of this principle to consumers and other stakeholders. An obvious area for discussion within the reviews was whether Government should construct a market which delivers government policy outcomes at least cost to the customer rather than continue with NETA, so recently put in place, which supports the status quo technologies and operational modes that the White Paper argues have to change. The UK is unique in Europe in that it allows no intervention in the primary market in support of sustainable energy technologies, yet no substantive intellectual debate occurred on this topic, whether in the Utility Act or White Paper processes. Only the PIU Energy Review raised concerns over the issue of NETA and embedded generation although the underlying issue of the principles of economic regulation were not questioned.

The NETA case study reflects that while on the one hand, Government undertakes measures to support renewables; it also implements policies which have major long-term implications to undermine renewables.

While at the time of NETA implementation, environmental concerns were not at the forefront of Government energy policy, this was not the case during the White Paper process, particularly since the PIU Review had raised concerns. That the issues were not openly analysed during the White Paper process represents a serious intellectual failure.

4. 'Learning' by Governments

Since 1990, the UK Government has re-adjusted its renewable energy policies several times to improve delivery and outcomes. In parallel, many other countries have implemented renewable and sustainable energy policies so that there is an abundance of evidence concerning successful renewable energy policies.[4] The changing policies over the 13 years can be summed up as:

- UK policy has maintained a commitment to the competitive basis of the renewable energy technology support mechanism and to a policy of no intervention within primary markets. This has meant that the UK mechanisms are complex relative to the more typical feed-in mechanism in Europe.
- What was (relatively) successful early on in the UK (the development of near-market technologies) continues to be the case today, although still not at the same level as many of the more progressive European countries.
- Developments generally occur as large-scale projects owned by the ex-monopoly companies.
- Promotion of emergent technologies; new entrants, creation of technological diversity; creation of a mentoring base; promotion of non-electricity technologies and promotion of small-scale schemes remains poor or negligible, although funds have increased since 2001.
- Technology determinism continues as a result of the mechanism 'picking winners'. Both the NFFO and RO promote the cheapest electricity technologies within certain rules. It may be, for example, that customer preference would be for urban, micro, heat or liquid technologies. However, such technologies provide no value to customers and suppliers.
- While applications for planning permission have increased under the RO, and the rate of deployment seems to be increasing, the ability to continue at the current rate is already being seriously questioned and adjustments are expected.
- Policies continue to be undermined by parallel issues, for example NETA and the reviews put in place by the White Paper.

At one level, this review of renewable energy policy provides evidence that the UK Government wishes to promote large-scale developments of the cheapest technology by large ex-monopoly energy companies, since that is the outcome of the market mechanisms. However, even with this fundamental concern, policies continue to require adjustments and renewables delivery continues to be undermined by other areas of Government policy. Deployment, while increasing, still lags many European countries.

The visionary policy of 60% carbon dioxide cuts by 2050 will require matching policies of delivery if it is to be achieved and this is spelt out in the various background documents to the reviews (Energy Review Advisory Group, 2001; Marsh et al., 2003). Nothing the Government has put in place since the White Paper's publication provides any evidence that they intend to do this. On the contrary, the evidence, so far, is that policy will be more of the same.

[4] E.g. the work of Staffan Jacobsson and colleagues: (Jacobsson and Johnson, 1999, 2000; Johnson and Jacobsson, 2000, 2003; Bergek, 2002; Jacobsson and Bergek, 2002).

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