

Time to stop experimenting with UK renewable energy policy

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Dr Robert Gross (robert.gross@imperial.ac.uk)
Phil Heptonstall (philip.heptonstall@imperial.ac.uk)

Imperial College Centre for Energy Policy and Technology

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Introduction

This paper is concerned with the rationale for and effectiveness of various measures to promote the development of renewable energy technologies. It is focused upon technologies that generate electricity and connect to the wider electricity network. However, it has relevance to technologies that do not produce electricity (such as those that directly produce renewable heat) and for other emerging non-renewable sources of low carbon power, for example carbon capture and storage.

The paper draws upon the international evidence base that has grown up around renewable energy over the last 20 years. It is focussed upon UK policies, since change to a range of energy policies is mooted in government proposals and consultations. The government is currently consulting over reform to British energy market regulation (HM Treasury & DECC 2010). One of the principal rationales is a perception that the current environment may not be doing enough to facilitate investment in low carbon sources, including renewables. Of the various reform packages presented by the government and energy regulator, Ofgem, four out of five include some sort of modification to the support environment for renewable energy (HM Treasury & DECC 2010; Ofgem 2010). In addition, the Coalition Government recently published a political statement on energy which also promises to increase support for renewables (DECC 2010a).

Consultation over market reform follows a suite of recent modifications to the UK's Renewables Obligation and the creation of a feed in tariff for microgenerators (DECC 2009b; DECC 2009c). The UK *is* making progress with renewables, but as yet has failed to deliver as rapidly, cost effectively or capture commercial benefits as successfully as other countries in Europe and elsewhere. Some recent commentators have been highly critical of key UK policies to promote renewables, claiming that they represent poor value for money (McIlveen 2010). Clearly there is room for improvement, but this critique even questions the need to promote deployment of emerging technologies. This suggests that the well-established link between deployment and innovation, cost reduction and various forms of 'learning' needs to be restated. This paper therefore addresses the following questions:

- The importance of technology deployment – why have a renewables policy?
- UK and international experience – what works, what doesn't work and why?
- What might be the way forward for UK policy?

Supporting technology deployment – why have a renewables policy?

The case for supporting low carbon energy technology directly has been laid out variously by the IEA, World Energy Council and OECD (IEA 2008; UNDP 2000), in government reports (PIU 2002) and the Stern Review (2007) as well as the author and colleagues (Anderson et al. 2001). The rationale for low carbon technology deployment policy is built upon a wide body of economic analysis including that which seeks to understand innovation systems (Nelson & Winter 1977; Utterbach 1994) and various forms of increasing return to adoption (Arrow 1962; Arthur 1989; Arthur 1994). The literature on innovation, learning, path dependence and related concepts is broad (for a review see Foxon (2003)). Two main tenets can be identified which have direct relevance to the need for a renewable energy deployment policy:

- The first tenet is that increasing returns to adoption create benefits in the form of learning by doing/using and various network externalities (Arthur 1989; Arthur 1994; Pierson 2000). Put simply deployment begets cost reduction and efficiency gains (it also creates 'lock-in', which we return to below).
- The second is that learning and other sources of increasing return are usually facilitated through various niche markets (Geels 2002; Kemp et al. 1998; Utterbach 1994). Products are differentiated qualitatively and niches emerge because consumers (so called early adopters) are willing to pay a premium for the advances associated with a new technology. However, on the whole, in the case of electricity product differentiation is zero and consumers are largely passive, so for the most part niches can only emerge when policies permit. Put simply, in the low carbon electricity sector deployment requires policy, and policy needs to provide a range of market niches.

It is important to be clear that support needs to be sustained *throughout* the deployment and dissemination phase rather than stop with government funded R&D or demonstration projects. Numerous academic analyses of innovation have explained the need for policies that provide *both* 'demand pull' (a market for low carbon technologies) *and* 'supply push' (R&D into low carbon technologies) (Grubb 2004). Moreover, effective support for innovation requires that policies are not subject to a 'missing middle' (also referred to as the valley of death), where innovation and development falter when grant funded R&D ends and fully commercial deployment remains a remote prospect (Foxon et al. 2005).

The simple lesson for policy from the extensive literature on innovation systems is that policy needs to provide targeted support that matches support levels to technological maturity. A fuller understanding suggests that it may be beneficial to consider innovation systems in terms of 'system failure'. These may occur for a number of reasons including the skill sets of system participants, technological limits and through problems with information, intellectual property, funding and access to capital (Foxon et al 2005). Policy may not always be able to help, and where it can have an impact it might not only be through provision of a subsidy. For example, the Carbon Trust *Marine Accelerator* sought to assist in making a match between prospective equity investors with appropriate commercial expertise and start up or spin out companies developing new products, hence overcoming a variety of systemic problems with modest government financial input (Carbon Trust 2010).

A thoroughgoing review of the literatures on innovation systems, increasing returns effects and transitions is beyond the scope of this paper. We return to the main implications for policy below. Before we do so, it is important to highlight further two issues associated with innovation and emerging technologies:

The first issue is the concept of *path dependence*, and its outcome *lock-in* (Arthur 1994; Pierson 2000); closely associated with the increasing returns effects mentioned above this is both a problem and an opportunity for policymakers. The importance of lock-in is subject of some debate in economics (Liebowitz & Margolis 1995). However, the notion that industrial economies are 'locked-in' to a high carbon system is extremely compelling and it follows that the challenges involved in overcoming lock-in are profound (Unruh 2002). Yet the very same effects that created lock-in to *high carbon* systems offer the potential to decrease the costs and improve the commercial/consumer attractiveness of low carbon energy. Path dependence, properly understood as an economic phenomenon that occurs as the components of technological systems co-evolve through time, is not something that it is possible to avoid. Indeed it is not even desirable to do so because increasing returns result in lower costs and an integrated set of technologies and systems that *work together*. *Lock-in* to today's energy system emerged because throughout the 19th and 20th centuries, the more the human race used fossil fuels the better we got at extracting and using them. *Path dependence* has created a cheap, convenient and reliable energy system. If we can create the conditions for widespread adoption, learning and co-evolution of systems that do not use fossil fuels we can do the same for a low carbon system.

The second issue that deserves a specific mention is the need for policy to create conditions that *investors* can buy into. As with the economics of innovation, the needs of financiers are too often ignored in conventional economic analyses of policies for tackling environmental problems (Blyth & Yang 2006; Gross et al. 2007; Hamilton 2006). A range of factors need to be considered. For example will market participants be able to pass through price-based policies such as a carbon tax to consumers? How do the investment profiles of low carbon options compare to conventional generation, regardless of what highly abstract comparisons of 'levelised costs' tell us about subsidy or tax levels? The evidence from international experience suggests that targeted and technologically specific interventions are more attractive to investors and deliver deployment more quickly and at lower cost than more 'market based' systems that pretend to provide technological neutrality (IEA 2008).

The role of learning and importance of market deployment is not merely an abstract concept of interest to academic innovation economists; it is also an empirically proven phenomenon, subject to real world assessment and offering real world technological and policy lessons. Learning curves, which chart empirically the relationship between market growth and cost reduction, are widely used in industry and commercial marketing strategies. They are well documented for a wide range of products, including energy technologies (IEA 2000). The logic of the learning curve suggests that it is possible for policy to 'buy down' costs by stimulating markets. It is important to note here that if a technology is not cost competitive, yet the existence of learning is well established (for example say solar photovoltaics) then we can estimate (approximately) the total cost of the period of buy down (Ibid). Moreover, for technologies that are currently considerably more expensive than conventional alternatives, the *total cost of buy down will be much lower* if policy targets that *specific* market than if a more generalised measure is used, such as a carbon tax. The authors have explained elsewhere that in the absence of cost effective low carbon alternatives the demand response to carbon price signals will be muted, may raise hackles, and will deliver little (Anderson et al 2001; Gross & Foxon

2003). Using learning to deliver cost reductions by targeting support at specific markets is a more effective and economically efficient alternative (Ibid). Indeed it can help facilitate a gradual approach to carbon pricing.

An excellent real world case study in policy induced learning effects is offered by the wind power sector. In the late 1980s commercial wind machines were crude 55kW affairs and attempts to create MW scale machines from scratch had largely failed, despite ambitious R&D programmes in several countries involving large engineering firms. R&D efforts continued and there was considerable sharing of the lessons from attempts to build large machines, but in the meantime market stimulation measures in Denmark, Germany and California created an infant industry and began a process of learning by doing. Over the intervening 20 years levelised costs have roughly halved in real terms (EWEA 2009) and modern wind turbines are typically highly sophisticated 2 or 3 MW devices, with 5 MW machines being developed for offshore installation (Ibid). Onshore wind is now judged to be the lowest cost low carbon option currently available in the UK, with levelised costs lower than both coal and nuclear power, and only 17% higher than gas fired generation (Mott MacDonald 2010).

The analysis above provides a clear case for renewables deployment policies which encourage diffusion. The important questions surround how best to do so, whilst minimising costs to consumers and with most benefits for UK companies or investors, minimal environmental impact and maximised long run carbon abatement (including the creation of new low carbon options). These are difficult questions and before we can attempt an answer it is important to consider how *not* to answer them:

- Recent arguments that policy should avoid 'lavishing huge levels of subsidy in attempt to mass deploy technologies earlier than is efficient, not waiting for technologies to prove themselves nor develop down the cost curve' (McIlveen 2010) fail to attend to the basic point that in the absence of appropriate policy technologies *cannot* prove themselves, and *will not* move down the cost curve.
- Similarly the proposition that 'mass deployment... should be driven by technology neutral carbon pricing...' (Ibid) fails entirely to understand that setting carbon prices high enough to do so is far more economically disruptive and less likely to be effective than targeted support for markets in emerging technologies, using measures which investors can have confidence in.
- Lastly, the notion that 'ensuring that technologies are not locked out... should not lead one to lock-in to something else instead' (Ibid) fundamentally misunderstands the dynamic processes associated with learning and path dependence. It misunderstands the very nature of increasing returns and seeks to avoid the inevitable. If lock-in could somehow be avoided (which amounts to keeping all options open indefinitely), to do so would deny low carbon technologies the opportunity to benefit from lower costs and improved performance.

Path dependence is value neutral, a process which always occurs as technologies diffuse and systems evolve. It is not an ill to be avoided; it merely describes a learning process through which technologies get cheaper, better, more integrated with one another. In short, any prescription which fails to engage with the economics of innovation, with learning, path dependence and the empirical evidence already available on policy support for innovation is likely to result in continued lock-in to high carbon energy. UK policy has tried to create a learning space for renewables; with some success. This is not to say that all is well with current UK policies, since other countries have done rather better. The next

section considers how UK policy could be improved. To do this we begin with a short historical review.

A short history of UK renewables policy since 1990

Support for Auctions – the NFFO

British support for renewable energy began in 1990 with the Non Fossil Fuel Obligation¹. NFFO was a device established to provide financial support for nuclear power when the British electricity system was privatised (MacKerron 1996; Mitchell 1995; Mitchell & Connor 2004), and it was funded from a levy (the Fossil Fuel Levy FFL) placed on all consumers. The newly privatised Regional Electricity Companies (RECs) were obliged to purchase power from nuclear and renewable generators at a premium price. The levy receipts were used to reimburse the RECs for the difference between this premium and the average monthly 'pool' purchasing price (Mitchell 1995; Mitchell & Connor 2004). In seeking state aid approval for the NFFO the UK government included renewable as well as nuclear energy, which set the stage for a series of NFFO renewable energy rounds.

NFFO rounds each took the form of capacity auctions, where developers were invited to submit competitive 'bids' for NFFO contracts. The NFFO calls were for tiny amounts of capacity compared to current aspirations, the largest being a little over 600 MW (Mitchell 1995). The use of auctions distinguished the British approach from pioneering schemes in Denmark and Germany, which offered a fixed premium determined by statute (so called Feed in Tariffs, described below). The auctioning system was developed in order to facilitate cost reduction (Mitchell 1996) and in an attempt to avoid 'picking winners' or fixing prices. The decision to auction rather than fix prices opened up a decisive distinction between revenue support schemes in Britain and those in many other countries. This distinct (though not unique) *British approach* to market support has sustained through almost two decades (IEA 2008). NFFO was not an overwhelming success, and NFFO processes were criticised for a number of reasons, which we briefly explore here:

Planning problems: It is arguable that the British planning system is by its very nature likely to impede the development of renewable technologies since its adversarial nature lends it to capture by vociferous lobby groups. Certainly planning has been an important source of delay to nuclear power, wind generation and other major energy projects such as power lines². Nevertheless the nature of the NFFO was argued to exacerbate planning opposition: First, because the auction process was of itself argued to drive wind farms into the windiest, often most scenic locations. Second, because tendering in successive rounds created batches of parallel projects and gave rise to a perceived 'rush' on the best sites. This in turn may have created exaggerated perception of the scale and pace of development and hence increased opposition (Mitchell 1996). The presence of local 'stakeholder investors' in Germany and Denmark (aided by the policy environment, see below) has been argued to have contributed to the low levels of planning opposition experienced therein relative to the UK (Krohn & Damborg 1999).

¹ Other than the construction of hydroelectric stations and through R&D activities pre-privatisation

² For this reason, the Labour government laid out plans to remove altogether aspects of energy infrastructure planning from the local planning system (DTI 2007; OPSI 2008).

Gaming, new entrants and smaller developers: The NFFO did not have any penalty for companies who won at auction but did not take up a contract. This created the potential for companies to bid low simply to prevent competitors from securing contracts (Mitchell & Connor 2004). The potential for large companies to absorb development costs that do not deliver revenue is, other factors being equal, higher than that of smaller companies and this may have discouraged smaller, new entrant companies. Moreover, the relative complexity of the NFFO application process (compared to fixed price schemes in particular), uncertain degree of success for bidders and perceived financial risks associated with all forms of renewable generation in the 1990s resulted in a predominance of large firms in the NFFO rounds, typically subsidiaries of the established utility companies. This contrasts sharply with the early emergence of small (often local) investors in the German and Danish instances, and of small developers and manufacturers (Mitchell 1996). In choosing auctions over fixed prices, the UK government created greater obstacles for small, local investors.

The UK supply chain: Despite a stated objective to 'encourage an internationally competitive renewables supply industry' (Charles Wardle, then Under Secretary of State for Industry and Energy, quoted in (Mitchell 1996)), the NFFO created two interacting drivers toward imported rather than British wind turbine plant. First, financiers operating in the uncertain and short return environment created by the NFFO required the maximum level of assurance that relatively new products (wind turbines) would work. German, Danish and Dutch manufacturers, with secure domestic markets and something of a 'head start' in terms of market size, had better proven commercial offerings than UK companies (Mitchell 1996). Second, the rush to develop in line with the NFFO's initially short subsidy periods led to a similar preference for imported machines from established companies able to meet demand for projects seeking to commission as fast as possible (Mitchell & Connor 2004). It is of course possible that a British supply chain would not have emerged even if the policies in place here were identical to those elsewhere. However, the evidence appears compelling that the presence or absence of a stable and supportive home market, particularly in the early stages of development, can be decisive in the formation of a domestic supply chain (The Carbon Trust 2009).

One of the principal goals of the NFFO was to drive down costs. Superficially this appears to have been successful, since bid prices fell rapidly from round one through to round five (Mitchell 1996). However wind turbine prices fell globally during the 1990s as a result of a range of technological learning and scale effects (Cockerill et al. 1998). The UK was a small fraction of a global market, unlikely to be a major driver of cost reduction in its own right, particularly given that most of the technology was imported. Overall, it appears highly unlikely that the competitive bidding approach adopted for NFFO had much, if any, impact on falling wind prices. It is also highly debatable as to whether an auction based approach drove cost reductions any more successfully than the simple tactic of regular tariff regressions adopted in the feed in tariff nations.

Despite these shortcomings the NFFO did at least get renewable energy out of the starting blocks in Britain. Commercial, financial and engineering expertise began to develop in the sector, despite the relative absence of UK equipment makers. The extent to which the NFFO could have been reformed in order to overcome its shortcomings is a matter for conjecture. The NFFO was scrapped in 2002 and replaced with the Renewables Obligation (RO), to which we now turn.

Economic elegance? The Renewables Obligation

The England and Wales markets were reformed in the Utilities Act 2000, and the New Electricity Trading Arrangements (NETA) came into operation in April 2001. NETA had a profound impact on renewables policy, since the RECs were unbundled into regulated distribution network companies and competitive supplier (retail) functions. This made the NFFO unworkable in its original form. Policymakers also wanted to create a mechanism that overcame the delivery problems of the NFFO but which continued to use competitive markets to deliver the least cost renewable energy solutions. It was argued that policy should be technology neutral and that renewables generators should participate fully in the electricity market, albeit with a form of subsidy (Mitchell & Connor 2004). The resulting Renewables Obligation took the form of an obligation on suppliers with compliance demonstrated through a tradable certificate scheme, described in detail elsewhere (see e.g. (House of Lords 2008a)).

Trading-based support schemes like the RO (variously described in different parts of the world as Renewable Portfolio Standards and Green Certificate Schemes) emerged in several countries in the early 2000s. Many of the arguments put forward in support of this approach were common to those advanced for conceptually similar emission trading schemes (Green 2007). The main benefit was argued to be that by setting a target but allowing the trade in green certificates (Renewable Obligation Certificates, ROCs), market mechanisms will deliver the lowest cost renewable generation. Moreover, it was argued that the best information about costs resides with market players not policymakers. Whilst fixed price schemes require policymakers to determine the appropriate level of the tariff, a green certificate scheme obviates this since it allows the required support levels to emerge from market trades. At the time it was also widely expected that schemes like the RO would come to dominate renewable energy policy (CEC 1999; Komor 2004), replacing fixed price or fixed premium schemes in place elsewhere.

The RO has had some success, Britain now secures around 7% of its electricity from renewables, compared to less than three percent before the RO (DECC 2010b). Britain has installed around 5 GW of wind power, with over 1 GW offshore. Yet relative to near neighbours and global trends the UK has performed relatively poorly. Installation rates for a range of renewable technologies in countries as diverse as the US, China, Spain, Germany and India have been much higher than the UK. Moreover, the UK's approach has been shown to be relatively expensive, providing a higher level of subsidy than elsewhere in Europe per unit of electricity produced by wind turbines for example, despite better wind conditions (IEA 2008). Much of the debate around UK renewable energy policy focuses on the UK's target under the EU Renewables Directive (see e.g. House of Lords 2008a). However Britain is also committed to a long term target for carbon abatement, a policy with near universal political support (Ibid). Numerous analyses suggest that this is likely to require decarbonisation of the electricity sector during the 2020s and that renewable energy is likely to have an important role in doing so (CCC 2009; DECC 2009b; UKERC 2009)). The next sections therefore review UK policies relative to policies elsewhere.

Theory and reality: Fixed price vs certificate trading schemes

Despite the theoretical benefits that they were thought able to deliver, certificate trading schemes have not been widely introduced. Only seven of Europe's twenty five countries have RO type arrangements, the rest have fixed price or fixed premium schemes, which we refer to as Feed in Tariffs or FiTs (see below). FiTs feature in Brazil, Canada, China, India, Korea, and Switzerland (IEA 2008), and several countries have abandoned certificate trading in favour of fixed price schemes.

Feed-in Tariff schemes set a total fixed price per unit of electricity, premium payment schemes set a premium to be paid to the producer on top of the market price for electricity. Typically the tariff or premium is set for 10 to 20 years; this varies by country and technology. After this period the price returns to market rates. Such schemes do not involve any form of certificate trading and do not set a target or quota for renewables. Some countries combine both schemes but for simplicity the FiT approach is briefly described here. The German FiT model (Erneuerbare-Energien-Gesetz, or EEG) is a good example. It provides renewable generators with a technology specific fixed premium per unit for a fixed period of time. More expensive options such as photovoltaics receive a higher premium than cheaper options such as wind power. Each year the premium given to new developments is altered to reflect technological improvements, with progressive reductions over time being the norm.

The way most FiTs work is that regional or national electricity companies are obligated to buy electricity from renewable generators (subject to technical and safety constraints) at premium rates set by the government. Generally FiTs therefore offer a combination of some form of priority access to grid (though in Spain wind farms are now subject to centralised dispatch) as well as fixed prices for power generated. They have been associated with a large growth in wind power in Spain, Germany and Denmark (and elsewhere). Wind provides these countries with 9%, 5% and 20% of their electricity respectively. They have also been associated with rapid uptake of household scale solar photovoltaics in Germany and Spain. (House of Lords 2008a)

Recent analysis by the EU Commission (CEC 2008) finds that fixed price systems often score highly in terms of effectiveness when compared to trading schemes like the RO. The Commission also finds that in the case of onshore wind the premium paid over and above estimates of cost of generation is lower under Feed in Tariffs than under RO type schemes. A 2008 review of OECD countries finds that fixed price schemes are more effective at delivering renewable capacity and do so in a more cost effective fashion (IEA 2008), a view endorsed by investment analysts (Deutsche Bank 2009).

It is therefore interesting to consider why despite its *economic elegance* the RO is less effective than the crude practice of setting a fixed premium for renewables. There are two primary reasons: Firstly, the RO creates uncertainty for investors, since future ROC prices are uncertain and could even conceivably collapse if excess renewable generation is built. This makes the cost of capital higher and makes investment most attractive to large companies able to manage risks and finance development on the balance sheet (Gross et al 2007). Secondly, until recently ROCs were awarded per MWh regardless of the method of generation. Because of this the RO effectively favoured mature, lower cost generation

technologies like landfill gas over less mature, more expensive technologies like offshore wind and wave power.

Conversely, fixed price schemes provide investors with security of income (provided the technologies perform well), which allows them to finance their developments at lower cost and permits the engagement of smaller investors. Moreover, differentiation by technology is straightforward, which allows countries to target support according to the technological maturity of each technology and adjust support as technologies improve. For example, Germany and Spain have generous support for solar PV (IEA 2008), and Portugal has a dedicated tariff for wave power (EC 2009). Feed in Tariffs are also simpler in operation than RO type schemes, which (together with the secure revenue stream they create) may explain further the substantial involvement of small investors in renewable energy in countries such as Denmark and Germany.

The argument that market-based schemes such as the RO will find a low cost solution also neglects the temporal dimension involved in any market process, particularly where considerable capital investment is required to meet demand. *At some point in time* a set of minimum cost renewable options may emerge from market processes. But any assumption that markets can move *swiftly* to such a minimum cost equilibrium may be unrealistic, given the time needed to build renewables capacity. Markets may be *out of equilibrium* (meaning targets not met) for a long time, resulting in high prices for renewables certificates. This may lead to criticisms based on 'overpayment' relative to feed in tariffs or developers getting 'supernormal' profits (high returns on investment) (NAO 2005; Ofgem 2007), which may not be politically acceptable. Even the notion that the RO obviates the need for policymakers to obtain information about costs is questionable. If developments cannot proceed because of grid limitations or planning (see below), or if the obligation is simply set too high relative to feasible levels of renewable output, then consumers will pay a high price. Since government is responsible for setting the level of the obligation, a judgement about the tariff needed to encourage a particular renewable technology is simply replaced by a judgement about the appropriate *volume* of renewable electricity. Put another way, whereas feed in tariffs set price, obligations using tradable certificates set quantity - which determines price - so in either case a social (or political) choice ultimately determines the level of subsidy given to renewables.

Evolving solutions and emerging pragmatism – UK policy changes since 2006

At the time that the RO was being created there was considerable debate in policy circles about 'banding' the mechanism in order to differentiate support by technology. However the government decided against banding for reasons set out in the RO Consultation documentation (DTI 2000). Until the early 2000s British policy was largely defined by the liberalisation experiment, indeed the high level goal of policy was defined in exactly this way. The RO was set up as a 'pure' trading scheme; within the confines of renewable energy no technological differentiation was allowed.

The government continued with a largely ideological adherence to the RO (on the basis that markets are better) in the 2003 Energy White Paper and indeed until its Energy Review of 2006. In the period to 2006 there is little recognition in official publications of any of the problems associated with the RO, or the impact of related policies. Instead official sources concentrated on the UK's success in reducing emissions below the trajectory needed to meet Britain's Kyoto commitments.

However developments that took place in 2006 changed both the profile and the tone of UK policy related to climate change and renewable energy. The 2006 Stern Review resulted in a substantial increase in the political profile of climate policy. Meanwhile the 2006 Energy Review provided a far more explicit recognition than any previous government review or policy statement that all was not entirely as it could be with the UK's renewable energy policy (DTI 2006).

The 2006 Review set out some fundamental changes to the operation of the Renewables Obligation and mooted a form of fixed price support for renewables. In both cases policymakers explicitly acknowledged for the first time that there are limits to the ability of the RO to deliver all of the government's objectives for renewable energy. In particular the Review acknowledges that a technology blind certificate trading mechanism inevitably favours the least cost, most mature technologies and that this is not compatible with the desire to promote a wide range of renewable technologies. It also acknowledged the investment risk associated with certificate trading schemes, particularly for less well-established technologies. The government went on to create 'banding' for the RO and a Feed in Tariff aimed at very small scale renewables (DECC 2009b). In an effort to assuage investor uncertainty created by the risk of future ROC price collapse the government also created 'guaranteed headroom'³ in the Obligation.

In 2009 the UK government published another White Paper on energy. This *Low Carbon Transition Plan* sets out additional measures by which ambitious plans for carbon abatement are to be met (DECC 2009b). It also trails yet another modification to the RO, a revenue stabilisation mechanism, which would seek to reduce the impact of electricity wholesale price (and possibly ROC price) fluctuations on renewable energy investment (DECC 2009a). ROC prices would be managed by a regulatory body; provided with a floor and ceiling price. The government is still consulting over the detail of this arrangement, which would come into effect in 2013. It is not possible to go into the details here but it is

³ This provision ensures that the obligation will be raised a given amount above actual renewable generation and hence maintain a degree of scarcity for ROCs, thus holding up ROC prices (BERR 2008)

important to note that the primary objective is to make the RO more akin to a fixed price (FiT style) scheme, at least from the perspective of investors.

Hence it appears that the principles on which the RO was founded have finally been abandoned. The government no longer maintains that the particular manifestation of market based subsidy it created in the RO is the best way to support renewable energy. It has accepted, at least tacitly, that fixed price support schemes, differentiated by technology, are more effective ways to create markets for early stage technologies. Nevertheless, there have been strong arguments from industry and other sources that abandoning the RO would risk disruption to investment and could further undermine confidence in the UK's regulatory consistency (House of Lords 2008a). It therefore appears as if the government's main objective now is to make the RO behave as much like a fixed price scheme as possible.

Now that a new government has come into office political commitment to the development of renewable energy appears secure, but details are yet to emerge. Wider developments in the British energy market will also affect renewables, and are more difficult to foresee. There are fundamental tensions between the wholesale changes all the main political parties wish to pursue and the investment environment created by BETTA (Gross et al 2007; Gross et al. 2010). It is at least possible that the UK is set to abandon its faith in a regulatory environment created to optimise the utilisation of existing assets and in the ability of markets to determine the amount and nature of electricity capacity (HM Treasury & DECC 2010; Ofgem 2009). Whether the new order will be more or less favourable to renewable energy also remains to be seen.

In the final section of the paper we discuss a way forward for UK policy that seeks to balance a range of competing demands on policy. However before we move on to solutions it is important to touch briefly upon the factors outside the design of the RO itself that have impeded the development of renewables in Britain.

Impeding progress – planning and grid access

The design and operation of the RO is far from being the only impediment to renewables. Indeed some argue that the RO itself was not at fault and that the slow progress the UK experienced with renewables was far more a result of impediments created by the wider policy landscape, particularly planning and grid access (House of Lords 2008b). This paper is primarily focused on how to get incentive design right. However there are important interrelationships between incentives, planning and grid, which we explore briefly here.

Planning

Planning problems beset the NFFO period as we have explained, and were identified as a significant obstacle to renewables even before the RO was finalised (PIU 2002). Changes to planning guidance featured in the 2003 Energy White Paper and in the planning policy of 2004 (ODPM 2004). Planning received attention again in the 2006 Energy Review and subsequent (2007) White Paper. Yet government appears as yet to have been unable to find a resolution to the planning problems affecting wind power in particular. The Planning and Energy Bills passed in 2008 both include provisions aimed at power lines and power stations but since they explicitly exclude developments of less than 50 MW large numbers of onshore wind farms will not benefit. It remains to be seen whether detailed changes to the obligations on local authorities announced in the summer of 2009 will be effective (DECC 2009b; DECC 2009c). The new government's plans are as yet unclear.

The UK's particular form of price support has implications for planning system outcomes. One of the reasons the RO has been more successful than the NFFO is that it increased the rewards to wind generators permitting development in less windy, less environmentally sensitive locations. This may have eased planning problems somewhat. However in pursuing a complexly designed certificate trading policy the government also created an environment that continued to favour large generation companies over small and which was not attractive to community based schemes. As already discussed with respect to the NFFO, this contrasts dramatically with the situation in Germany and Denmark where the secure returns offered by their feed in tariffs continued to encourage the formation of vehicles for direct investment by local people in local renewable energy schemes, such as the German closed mutual funds (Toke et al. 2008). Research evidence suggests that there is a direct relationship between the extent to which local people can take a meaningful stake in a wind farm and the extent to which local people object to wind development. In Britain wind farms are perceived as an *imposition from above*; big companies headquartered in Germany or France build wind farms backed by a government many rural people do not support (Moss 2009). Hence, whilst the way in which different publics relate to wind farms is a complex subject there is clear evidence of a causal link between the nature of the support scheme and the level of local opposition. FiTs are much more amenable to local stake-holding and this in turn can create local support that neither the RO nor the NFFO has been able to garner to date in Britain.

Grid access

The UK, grid connection, or Transmission Entry Capacity (TEC) is only granted to a new generator once the GB System Operator (National Grid Electricity Transmission) has assessed, and implemented, the transmission system reinforcements required for the new generation capacity. Crucially, the assessment of the reinforcements required is based on the premise that the network must be able to cope with the maximum rated output of the new plant. Whilst this was appropriate when such plant was primarily thermal generation that would have been expected to run at close to peak output during times of high demand, this is not necessarily the case for variable renewable generation which in practice would expect to run well below rated capacity for most of the time (Krohn et al. 2009). The result of these access arrangements is that renewable generation must pay for a level of transmission reinforcement that is well in excess of what may be required, and that projects are delayed whilst they are processed through the connection queue – a problem that is particularly acute in Scotland (Baker et al. 2009).

One alternative is the 'connect and manage' approach where new generators are granted accesses to the network without reinforcement, and any resultant power flow congestion is managed by the System Operator. Whilst this may overcome some of the development delays that have occurred to date, it does of course raise questions as to how constrained generators will be compensated for being required by the System Operator to reduce or curtail output. If the price paid to constrain generation under the balancing mechanism is high relative to the cost of doing so this may perpetuate a situation where there are excessive incentives for grid reinforcement (Baker et al 2009). The Transmission Access Review (TAR) was announced in the 2007 Energy White Paper (DTI 2007) was a recognition of the grid connection problems faced by renewable energy developers. At the time of writing, the Review is still ongoing and it is important to note that wider changes to the design of the UK electricity market will also have implications for this problem.

The operational and electricity market issues associated with large amounts of renewables are explored by the author elsewhere (Steggals et al. 2010). Grid access is also a complex topic that deserves many papers to itself. In the next section we consider the main principles of policy design related to grid access.

A way forward

This final section attempts to translate the findings from the history and analysis provided in the sections above into a set of options for future policy. Mindful of the considerable flux and uncertainty that surrounds the wider energy policy realm at the present time it focuses on principles for policy design. It is important that we do not place undue 'blame' on the RO, nor make a simplistic claim that replacing it with a FiT would overcome all the UK's problems. Reassessment of the primary support scheme for renewables is not likely to yield benefits if substantial impediments to progress are not addressed as well. The section therefore considers both incentive structures and grid/planning issues.

1. A route from the RO to FiTs

Few analysts now dispute the advantages offered by fixed price schemes. Arguments for retaining the RO instead focus on the potential for delays to renewables projects whilst new policies are discussed and consulted over, and on the regulatory risks associated with abandoning the UK's primary support instrument for renewables.

We accept the regulatory risk point in principle, but believe that it deserves further, empirical analysis, which could be taken forward through research with investors. It clearly cannot be the case that policy certainty (hence investor confidence) requires that policies are left intact for extended periods. Since introduction in 2002, the RO was modified almost incessantly, as Box 1 shows.

Box 1: changes to the RO – regulatory certainty?

- 2002 – Renewables Obligation Order 2002 comes into force. Obligation level set to rise from 3% in 2002/2003 to 10.4% by 2010/2011, and then to remain at that level until 2027. Maximum contribution from co-firing set at 25% of a suppliers obligation.
- 2004 – Renewables Obligation (Amendment) Order comes into force. Rules amended so that very small generators qualify for Renewable Obligation Certificates (ROCs), and changes to the rules for co-firing to encourage the establishment of dedicated energy crop supplies.
- 2005 – Renewables Obligation Order 2005 comes into force. Obligation level extended so that it will rise from 10.4% in 2010/2011 to 15.4% in 2015/2016 and then remain at that level until 2027.
- 2006 – Renewables Obligation Order 2006 comes into force. Modifications to make energy from waste-fuelled Combined Heat and Power generation eligible for ROCs). Suggested that support for lower-cost technologies should taper.
- 2006 – Energy Review proposes to extend the obligation level to 20% on a 'guaranteed headroom' basis, with the buyout price frozen from 2015, and to consult on differentiating the level of RO support through banding by technology type.
- 2006 – First consultation on banding the RO
- 2007 – Renewables Obligation Order (Amendment) Order 2007 comes into force. Further changes to the co-firing rules to provide support in the interim period between the announcement of banding proposals (see above), and banding coming into force.
- 2007 – Energy White Paper and second consultation on banding the RO.
- 2008 – Energy Act 2008 comes into force, providing the statutory basis for the introduction of RO banding.
- 2008 – Pre-budget report announces that the RO will be extended to at least 2037, subject to statutory consultation and inclusion in a future Renewables Obligation Order.
- 2009 – Renewables Obligation Order 2009 comes into force. Introduces banding (ROC multiples) by technology so that higher-cost technologies earn more ROCs per unit of electricity than lower-cost technologies.
- 2009 – The ROC multiple for offshore wind comes under review in response to concerns over steeply rising costs for this technology.
- 2009 – Consultation on renewable electricity financial incentives raises the possibility of looking at mechanisms to stabilise electricity and ROC prices.

Despite these modifications the RO has continued to disappoint, particularly in comparison to other EU countries (noticeably Germany and Spain), but there is no evidence that investment has been *frozen* due to policy uncertainty. Indeed throughout recent changes the UK has established a firm commitment to grandfathering. We suggest that the potential to move swiftly to a FiT based environment may be greater than some argue, provided this is done carefully.

There is now compelling international evidence that things can be done better than they have been in the UK. Policy needs to create conditions conducive to investment, attractive to a wider constituency of investors, with transparency, simplicity and clear long term signals for cost reduction. It is also important to control the overall burden on consumers. Whilst floor prices in the RO can help with price risks they exacerbate the complexity associated with its operation and do nothing to make investment more attractive to a wider set of constituents. Since the entirety of the policy environment is currently being reassessed we believe the regulatory certainty arguments against the creation of FiTs for a wider set of technologies are less compelling. We also believe it is possible to guard against some of the negative impacts.

We suggest the following route forward for policy:

- Acknowledge now that a FiT or similar would be a more effective approach to support for UK renewables, for all but the nearest commercial options (landfill gas, onshore wind, co-firing).
- Announce an intention to replace support for all positive ROC multiple options with a FiT when current multiples are reviewed in 2014. To prevent an investment hiatus, make clear that it is by no means assured that the FiT will be more generous than the ROC multiple. Guarantee that all investments made in the interim will be grandfathered fully.
- Extend the micro-generation FiT to 25 or 30 MW for community owned schemes (further work is needed on how this should be defined).
- Mature technologies could have the option of transferring to a FiT or moving to participate in a wider low carbon obligation should one be established.

Some commentators have suggested that the current (micro-generation) FiT regime is too costly and is socially regressive. In fact negative impacts on poorer consumers can be avoided or reversed given innovative financing/energy service arrangements that allow investors to benefit from FiT revenues whilst lower income householders benefit from bill reduction. This paper is not focused on social equity, but the overall impact of a FiT scheme on consumer bills can be controlled in two ways:

- Volume based restrictions can be placed on the capacity of higher cost options that will be able to claim FiTs. For example a maximum total installed MW of PV, micro-wind, etc that will be eligible for a given FiT rate. This is common in other countries and would be simple to implement.
- Ambitious forward targets can be set for cost regression. This would also be useful in sectors such as offshore wind, where current costs are high.

The changes above only address some of the issues associated with UK renewables development. Additional work is needed on a wide range of other issues including the policy overlaps recently highlighted by (McIlveen 2010) and measures to promote innovation in marine and other early stage options. The authors also argue in a forthcoming UKERC report on the costs of offshore wind that far more attention needs to be paid to developing the UK supply chain, especially in offshore wind.

2. Grid access and planning constraints

Grid access needs to prioritise current needs

Much of the debate around market reform focuses on the challenges associated with integrating large volumes of variable renewables into electricity markets in the mid 2020s. If the development of renewables is successful then system optimisation will indeed become a priority. However we are a long way away from this outcome at present and current arrangements are complex, cumbersome and expensive. Interim arrangements that extend up to ten years into the future, based upon principles of connect and manage would appear the most appropriate route forward. Changes to BETTA will affect the mechanisms and costs of doing this, and it is important that new arrangements offer a cost reflective approach that is designed with priority access for renewables as its primary objective. It is extremely important that ongoing analysis of transmission access retains this temporal perspective. At the present time *investment* incentives are the key requirement (for both renewable generation and plant able to balance wind cost effectively). Optimisation of large amounts of renewables, once built, may require a different set of market conditions. There is nothing inherently inappropriate about tailoring market rules first to investment then subsequently to system optimisation. This, with priority access for low carbon options, is the main principle immediate arrangements should adhere to.

Planning provisions need to be strong but local engagement is essential

The various commitments laid out by the government in the low carbon transition plan are likely to assist with renewables, particularly through additional obligations on local authorities related to renewables development. The Coalition has expressed intent to protect the best aspects of the Infrastructure Planning Commission whilst returning more of it to political control. Planning is immensely important and it is essential to the development of many aspects of the energy system that reform and political commitment sustains.

However, changing the way renewables are supported could also help. One way to think about the planning-incentive linkage is that during the 1990s Denmark, Germany and others created (perhaps fortuitously) a 'supporting public' for wind power and other renewables. With local investors involved and local farmers, workers and others benefitting a strong constituency with a stakeholding in renewables emerged. In contrast, the same period in the UK created an 'opposing public'. Vociferous opposition to wind farms is now the norm in rural areas. The challenge for UK policy is to create a means by which to counteract this legacy issue. A feed in tariff accessible to medium sized wind farms offers the prospects of far greater community engagement; whilst this may not deliver vast volumes of capacity it could create a 'supporting public' along German or Danish lines. Additional research on this could work out the details.

To conclude, Britain has run simultaneous experiments in particular forms of both liberalisation and support for renewables, which differ markedly from conditions in other relatively similar countries. There is good evidence that Britain's approach has been less successful than that pursued by our near neighbours or indeed in the US, China and elsewhere. Moreover, other impediments, notably planning opposition, are directly affected by the form of support that Britain chose for renewable energy. In short, in very simple terms, Britain's peculiar adherence to a highly rarefied form of market design, based on a particular

interpretation of economic principles, has almost certainly impeded the development of renewables in this country. Cost effective, investable, transparent and differentiated support for the deployment of low carbon technologies continues to be a key response to the climate problem. This paper has sought to provide some thinking about routes forward.

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