

# UK Renewable Energy Strategy Consultation 2008

A Response from Imperial College Centre for Energy Policy and  
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## Introduction

This submission has been compiled by academic analysts of energy policy and its role in promoting innovation and the development of technology from Imperial College and the University of Leeds.

The submission is in two parts; the first provides commentary in response to each of the consultation questions where we have views and analysis to offer. This part is concerned with the policy challenges of meeting the 2020 targets in *general terms*, though with a focus on technology development. The second part provides a contribution that is relevant to several questions with a particular focus on the *promotion of innovation*, reflecting particular research skills amongst the contributors to this response to the consultation. This section has been developed following discussions on innovation and longer term technologies with BERR officials.

It should be noted that the following response is primarily focused on the implications of the regulatory regime for renewable energy generation from wind power. The implications for bioenergy have not been considered here.

### Preliminary remarks

At the most general level we observe that the Commission's draft directive sets targets for the development of renewable energy with an unprecedented level of ambition. We believe that the target is achievable and that stretching targets of this nature are of considerable value in promoting technological development and associated infrastructural and other changes.

We are concerned, however, that the ambition and scale of the targets is not reflected in the policies the strategy consultation proposes. The target requires a policy package that is transformative and radical. In particular it is essential that Britain overcomes obstacles to development related to planning and grid connection that have not hindered development in other parts of Europe. It is also essential that development is taken forward in a range of technologies and that support in the UK is delivered in a cost effective fashion attractive to investors.

We welcome many aspects of the strategy, which identifies the main obstacles to renewables development in Britain and the main issues that concern the industry and independent analysts. We are concerned, however, that a strategy that comprises primarily incremental changes and minor modifications to existing policies is unlikely to be successful, not least because renewables development in Britain has lagged behind leading countries in Europe. For example, during 2007 around 2 GW of wind power was installed in Germany and nearly 4 GW was installed in Spain, more than the cumulative total in the UK over the last 20 years. Britain installed less than 500 MW. This suggests both that rapid progress with renewables is possible if the policy environment is right - and that the policy environment in Britain is not yet right. The remaining sections provide comments in response to each of the questions, often elaborating on these general remarks.

## Chapter 1 - Renewables and the Energy and Climate Challenge

**Q1: How might we design policies to meet the 2020 renewable energy target that give enough certainty to business but allow flexibility to change the level of ambition for a sector or the level of financial incentive as new information emerges?**

Considerable emphasis is given to policy certainty in Britain. The RES consultation document suggests that this is a significant reason for maintaining the RO rather than moving to alternative schemes, particularly to ‘Feed in Tariff’ type arrangements. There will always be a delicate balance between minimising perceived regulatory risk and adapting to changing circumstance and allowing for ‘policy learning’. This is made more difficult in the UK because our principal policy instrument, the RO, is in itself complicated in comparison to the types of feed in tariff arrangements common in many other EU countries. Work undertaken by ICEPT and collaborators for the UKERC report ‘Investment in electricity generation’ suggests that international investors view the UK policy scene with some scepticism (Gross *et al* 2007; Hamilton 2006). As part of this process, we solicited commentary from industry and the investment community. While the comments are confidential, and we appreciate that anecdotes can be misleading, we believe the following remarks to be enlightening.

- A workshop participant from an international energy company described a scenario where having explained the complexities of the RO to the company’s board, it was then necessary to further explain that the mechanism was being reviewed and revised.
- Other industry sources commented that the overall size of even the offshore wind sector in the UK is small in financial terms compared to both the investments and to the returns with which oil majors and international utilities normally deal. Put another way, materiality may be marginal. Under such circumstances, investors may find other countries more attractive if they find the policy environment complex.

The message is that with renewable energy markets growing strongly around the world, and with simpler and stronger schemes of support available elsewhere, the UK is not the most attractive place to invest in renewables. Complexity is, of course, compounded if schemes are perturbed by frequent revisions, but it is important to be clear where the problem lies – with policy revision or with policy design?

It is not clear that the principal problem investors perceive lies with *changes* to the RO, rather than the inherent complexity of the mechanism and the other obstacles to renewables development in the UK (planning and grid connection, discussed with reference to Qs 5 and 6 below). We suggest, however that industry expects policies to be modified, not just in the UK but in all countries. This suggests not that policy modifications are unacceptable but that the means by which changes are made is the key issue. Indeed, one investment community contributor to the UKERC report cited above suggested that a substantive benefit of the Energy Bill’s proposals related to

banding is that they encompass a strong element of grandfathering. This sets an important precedent which will encourage future investment.

It is important therefore, that concern about regulatory risk is not used as an excuse for inaction when policies do not deliver. It is possible to revise policies in the light of experience and according to circumstance, provided that a clear timetable for review and assessment is laid out in advance, and existing arrangements are protected through grandfathering. It is also important to act swiftly, since a prolonged period of consultation and review can create a 'self fulfilling prophecy': Market participants perceive option value in waiting (delaying investment) for new policies to be revealed. If all wait then no investment is forthcoming and policy revision becomes essential. If processes to facilitate detailed policy adjustments are designed and announced at an early stage, further primary legislation can be avoided, and adjustments to tariffs, bands or derogations can be made without delay.

### **To summarise:**

- Regulatory risk is a significant factor for investors, and we do have evidence that investors are concerned about excessive 'meddling' in the UK
- We believe, however, that other factors are more significant, notably the nature of the RO as an instrument and the other obstacles to renewable development. These factors drive investors elsewhere
- Policy certainty should not be used as an excuse for inaction. If policies are not delivering they must be changed
- A clear timetable for assessment and adjustment, swift action when change is needed and grandfathering of investment should all ensure policy can be adjusted without undermining investor confidence

## **Chapter 2 - Saving Energy**

**Q3: In the light of the EU renewable energy target, where should we focus further action on energy efficiency and what, if any, additional policies or measures would deliver the most cost-effective savings?**

A strong focus on energy efficiency is essential. By effectively lowering the denominator it makes any percentage target easier to meet in absolute terms. We note that this is to be subject of a separate consultation in the autumn. It is somewhat disappointing to see these consultations run as distinct activities, given the interaction between energy supply and demand. We hope this does not represent either an absence of 'join up' between the policies or any sense that energy efficiency and demand side issues are less important than supply.

## Chapter 3 - Centralised electricity

### **Q4: Are our assessments of the potential of different renewable electricity technologies correct?**

We note that UKERC, BERR and RAB have all come up with broadly similar analyses of the potential share of each option in meeting the target. UKERC have presented further evidence related to this and we refer you to their evidence. We share the UKERC view that the BERR estimate of the potential contribution from heat might be ambitious. One result is that even more may be required of the power sector.

In the power sector the main issue for the UK is not one of absolute resource, since numerous studies have established this (DTI 1998; DTI, 2002). Rather the determinants of a renewable resource mix will be the well discussed issues of: 1. costs, since some renewable options are closer to market now; 2. constraints since planning and grid connection problems are major hindrances in the UK; and, 3. policy adequacy, in terms of the effectiveness of the RO. All these issues are discussed elsewhere in this response. We agree with BERR's analysis that wind power is likely to be the most significant contributor to electricity generation. We know that build rates of the order required are possible from evidence overseas (see table 1). However the progress of wind is particularly susceptible to planning related problems, to which we now turn.

**Table 1: Table of installed capacity of wind power in five countries. All figures in megawatts.**

Country	Start 2007	Start 2008	Installed capacity for 2007
US	11699	16971	5272
Spain	11615	15145	3530
China	2594	5906	3312
Germany	20622	22247	1625
UK	1958	2425	467

### **Q5 & Q6: What more could the Government or other parties do to enable the planning system to facilitate renewable deployment?**

And

### **What more could the Government or other parties do to sure community support for new renewable generation?**

We have taken Q5 and Q6 together because we believe they are closely linked.

Planning system reform in the UK appears to look at renewable energy from the wrong end of the telescope. The current Planning Bill is of relevance only to

renewable projects larger than 50 MW onshore and 100 MW offshore. We do not deny the significance of several large onshore wind schemes (predominantly in Scotland) and anticipate the emergence of offshore schemes each of several hundreds of MW. Yet it is perfectly feasible that small developments, with close links to local communities, could provide a substantial fraction of onshore wind development. A development of perhaps ten turbines would be at most 30 MW, a two or three turbine scheme perhaps 6 MW. A model of *dispersed* wind such as this has been successful in Denmark and in parts of Germany. This model should be a key part of Britain's strategy. The discussion below considers first the issues related to planning then issues related to community engagement.

We note that the government is *not* consulting over the potential to lower the threshold for planning applications to be removed from the local authority decision process (see also below). We understand the reasons for this, but believe that the alternatives set out in the consultation are far less likely to overcome the 'planning logjam'. By far the simplest way to get renewable developments out of their current problems with planning would be to remove renewables from the local process altogether and devise alternative means by which to represent local interests.

Our understanding of what *is* currently proposed is that the government proposes revised planning guidance, perhaps a new PPS for renewable energy drawn from the model used for housing development, requiring regional bodies to make robust provision for renewables development. This would be a step forward, as would the suggestion that responsibility for delivery against renewables targets is devolved down to the local authority level. The consultation notes that there is no precedent for this. We hope that lack of precedent is not a reason for inaction. We note that where legislation places direct responsibilities on local authorities, for example to meet recycling targets, local authorities act accordingly. Welcome though such a change might be it will take time to implement. Adequate assessment of local authority resource potentials will take time to develop and could be controversial. In the meantime renewables development will continue to be hindered by the British planning scheme.

More fundamentally we are not sure that improvements to local processes will be sufficient to overcome the systemic problems created by the adversarial nature of local planning in Britain, and the susceptibility of our local planning system to manipulation by vociferous lobby groups. Such groups can have a profound impact on the planning process irrespective of whether they actually represent a substantial fraction of community interests. Indeed there is considerable evidence to suggest that the various lobby groups that exist to oppose wind power in the UK are *not* representative of local communities (Wolsink, 2000; Toke, 2002). It is not clear that *any* changes to the detailed operation of planning processes will overcome the problems created by such groups. The proposed changes may of course lead to a higher fraction of positive outcomes for renewable developers, but this is not assured. And the delays created by local enquiries will not be reduced.

Planning problems can be tackled from in two ways: 'top down' would remove renewables from local processes. We believe that this is the simplest way forward for renewables development in Britain at present. 'Bottom up' would create additional



engagement with renewables projects from local communities. We now turn to this possibility.

To return to the cases of Germany and Denmark; in both countries local communities frequently own, or have substantial shares in, the turbines in their neighbourhood. The model has been successful in terms of MW installed. It also appears to have avoided at least some of the controversy and opposition that has been experienced by wind developers in Britain (Krohn and Damborg, 1999).

If Britain is to replicate this model we need to make investment *by* local communities in renewable energy easier and more attractive. The consultation document observes that the community owned model in Germany and Denmark is being superseded in those countries as development moves offshore and to larger sites. However this is on the back of many GWs of small dispersed developments (in Denmark many are currently being repowered with new turbines). In the UK we are going down the large/offshore route *but have yet to build* the dispersed onshore capacity. The government is therefore overlooking a key opportunity to unblock some of the potential for onshore wind. Local ownership is not *essential* to the development of wind power, as the American and Spanish models demonstrate. The key issue is whether it has a role in Britain, and we believe that it could have.

A form of support that allows investors in small wind schemes much greater certainty is likely to encourage the development of small schemes. We believe that the simplest way to deliver this is through a Feed in Tariff type of arrangement. We understand the arguments against a wholesale move to a Feed in Tariff at this stage, we are also aware that none of the major utility renewable energy companies or many of the small independent developers support a move away from the RO. However we believe that it would be prudent to explore the potential for community owned developments to benefit from any feed in tariff implemented for micro-generation. The key principle is to allow access to the feed in tariff for relatively small commercial wind developments, perhaps up to a threshold of 30 MW. The evidence from Germany and Denmark suggests that low administrative barriers to access feed-in tariffs were essential in garnering community support for small-scale wind developments, thus securing a stake for all participants in the success of such projects (Toke, 2002; Stenzel *et al*, 2003)).

### **To summarise:**

- The simplest and most certain change to the planning system for renewables would be to lower the threshold for central government (Section 36) consent to well below 50MW.
- The detailed changes the government has mooted for the planning system would certainly be a step forward and we endorse the idea of effectively placing targets on local authorities through devolving regional strategy targets to them
- However we are not convinced that detailed planning changes will be sufficient to overcome the planning logjam, could take too long to implement and do not address fundamental issues relating to the capture of local processes by lobby groups.

- Greater local ownership of renewables could assist in renewables development in the UK. A simple and low risk remuneration scheme would help and we recommend extending the government's proposals related to a microgeneration FiT to include smaller wind schemes (up to a few 10s MW).

**Q8: Taking into account decisions already taken on the offshore transmission regime and the measures set out in the Transmission Access Review, what more could the Government or other parties do to reduce the constraints on renewable development arising from grid issues?**

Our understanding is that 'connect and manage' is proposed as an interim solution to the grid queue. We believe that it could and should be adopted on a permanent not a temporary basis. We note that the government opposes priority access for renewables. Given the scale of the challenge the targets represent, the ability of renewables to save fuel and carbon but (with the exception of biomass) not to substitute in a similar way for conventional *capacity* (Gross et al. 2006), we believe priority access should be given serious consideration. Note also our remarks related to security of supply, below.

We welcome the proposals in TAR related to strategic rather than responsive development of the national grid. It is imperative that the proposals to allow the TSO to invest in a pre-emptive not merely responsive way are taken forward rapidly and that they work. We believe that proposals that would allow the TSO to make higher returns on riskier strategic investments are in principle right. We also welcome moves to identify the strategic needs for future network investment. It is imperative that regulation moves away from its current ahistorical orientation to a recognition that the system is in a process of change from its current configuration to a low carbon system. Such a change cannot be optimised under a regulatory environment designed solely to ensure efficient utilisation of existing assets.

**Q9: What more could the Government or other parties do to reduce supply chain constraints on new renewables deployment?**

We welcome the government's attention to the supply chain problems facing renewables developers, particularly in offshore wind. We are aware of the work the government has commissioned from Douglas Westwood on the nature of the supply chain constraints.

However we are disappointed that the government proposes to take almost no action to address the supply chain problems. The role it does propose essentially takes the form of improving market information through its proposed 'strategy' involving RDAs, UK T&I and others. This is welcome, but is it enough?

The standard British policymaking assumption is that provided the government puts in place a long term and stable policy, with enough incentive, the supply chain will fix

itself. This is not based on analysis, merely received wisdom that governments cannot intervene in markets, ‘pick winners’ or otherwise behave in an ‘interventionist’ manner. Given the scale of the challenge and the significance of the supply chain constraints this is almost certainly not good enough. Government needs to understand the supply chain much better, not just in terms of the size and nature of the constraints, but also the steps needed and tools available to overcome the constraints. Can the government take more active steps lower down the supply chain?

We believe there is an urgent need for more research into overcoming supply chain bottlenecks. This needs to take stock of policies overseas, for example Spanish success in developing its wind industry. Although a relative ‘late comer’ to that industry, Spanish companies are now able to deliver an order of magnitude more capacity per year than is typical in Britain whilst also supplying export markets. Such research needs to be permitted think creatively and without dogmatic boundaries. Is effective government action lower in the supply chain really impossible? Even if the government ultimately takes the view that it does not wish to engage directly with supply chain constraints it is not unreasonable for it to equip itself with information about whether such intervention is possible, rather than ruling it out a priori for essentially ideological reasons.

**Q10: Do you agree with our analysis on the importance of retaining the Renewables Obligation as our prime support mechanism for centralised renewable electricity?**

We believe that there is clear evidence that Feed in Tariffs generally provide a more successful and cost effective means to support renewable energy than certificate trading schemes such as the RO. We note that both California and Australia have recently enacted Feed in Tariff type arrangements. We believe that they represent the ‘first best’ means to support renewables because of their simplicity and ability to insulate renewable investment from price risks created by fossil fuel price volatilities. Unlike the RO they do not create further price risks (Gross *et al*, 2007; Mitchell & Connor 2004). The government is committed to implementing ‘evidence based’ policy and practice where possible. Irrespective of academic arguments the practical experience of fixed price FiT schemes is that they are effective at delivering renewable capacity, as the consultation document recognises.

It is notable that the government’s rationale for continuing with the RO has moved from ideological adherence to the RO (on the basis that markets are better) (DTI, 2003) to a pragmatic view (we can’t change policies now). It is not inevitable that a move to a FiT would destroy investor confidence, but we do have sympathy with the argument that as the moves to introduce banding are not yet through the parliamentary process a further change to the renewables regime at this stage would probably be inappropriate and could compromise investor confidence in the UK regulatory system, at least temporarily. We note also that most renewable developers do not support a move away from the RO at this stage (other than for micro-generation). It is very much in the interests of incumbent market participants to keep the RO, since its complexities comprise a barrier to entry, in itself that does not mean that the RO should not be changed. Pragmatically we accept the government’s analysis that

attempting to rescind the RO at this stage is likely to delay investment and could compromise the 2020 target.

However, we believe that the effectiveness of the banded RO should be reviewed 'root and branch' when the bands are reviewed in 2013. At this stage a more thoroughgoing regime change should not be ruled out. The timetable for a move could be signalled clearly. As discussed above the, possibility of running a FiT at least up to community wind scheme scale (tens MW) alongside the RO should be considered.

We believe that the contention in the consultation that the differences between the RO and FiTs in terms of economic costs are marginal is misleading. Analysis by the commission clearly demonstrates that the UK and other countries with RO-like schemes pay considerably more on a £/MWh basis for wind power and biomass. Moreover the Commission analysis shows that the 'premium' over and above estimated levelised costs is higher in countries with RO-like schemes (Council of the European Union, 2008).

We are intrigued by the assertion in the consultation document that the RO could somehow be amended to link ROC support to wholesale power prices. We would be interested in learning how this could be achieved without turning the RO into a 'contract for difference' as in the Netherlands, or the similar scheme available as an option in Spain.

### **To summarise**

- We believe that there is clear evidence that Feed in Tariffs generally provide a more successful and cost effective means of renewable energy support than that which is provided by certificate trading schemes such as the RO.
- Pragmatically, we accept the government's analysis that attempting to rescind the RO at this stage is likely to delay investment and could compromise 2020 targets.
- However, we believe that the RO should be reviewed comprehensively in 2013
- We believe that there is evidence suggesting overpayment in an RO regime (when compared to a FiT regime) is considerable and not marginal as some have suggested.

### **Q11: What changes (if any) should we make to the Renewables Obligation in the light of the EU 2020 renewable energy target?**

If the RO is to be retained then increasing the timescale and level of the Obligation are clearly essential and we welcome the proposals to do this.

### **Q12: What (if any) changes are needed to the current electricity market regime to ensure that the proposed increase in renewables generation**

***does not undermine security of electricity supplies, and how can greater flexibility and responsiveness be encouraged in the demand side?***

Further research is needed into the variety of options for managing the network with large penetrations of RE and nuclear, including much greater attention to both active DSM and storage. It is not clear either that the technology options are fully understood or that the government has fully engaged with the potential for changes to the regulatory regime to offer the best mix of technologies in a future where up-to 40% of our power comes from renewables. Of particular importance is the means by which the range of services generators, storage operators and demand side players offer the system are rewarded.

We suggest that a system that only rewards generation may not be the most appropriate given the need for thermal capacity to provide system margin to maintain reliability (at high penetrations most renewables have a capacity credit lower than their load factor and thermal plant will operate with lower load factors and some plant is in effect retained largely to provide adequate levels of firm capacity at peak periods). We note that capacity payments would provide additional incentives for biomass plants and might incentivise storage. The existing arrangements reward only generation. Plant (and demand response/storage) that exists largely to provide ‘back up’ will require very high marginal prices for its output (‘spikes’). We recommend that the role of capacity payments is reviewed in the light of the renewable strategy.

## **Chapter 4 – Heat**

The strategy envisages a major role for heat, but as yet renewable heat markets in the UK are almost non-existent and the policy challenges at least as great as those for renewable power. We would also note that small scale renewable heat options (e.g. heat pumps, solar hot water (SWH), biomass) share many characteristics with micro-generation and indeed energy efficiency, when considered from a household perspective. Larger scale heat schemes are also possible of course, but not our main focus here.

Developing support for heat offers the potential to learn from the experience of support for renewable electricity. It is essential that policies that seek investment from small investors, in particular householders, maintain a high degree of simplicity of operation and offer secure returns on investment. We are concerned therefore that the model proposed for a renewable heat obligation (RHO) appears to draw heavily from the RO. Since a FiT is part of the government’s consultation precisely because the RO has proved to be so ineffective at promoting small scale renewables we are surprised that a RHO is even being considered for the domestic/small scale heat sector.

We agree entirely with the points in the consultation about the very large number of market participants in the heat sector and the difficulties that surround a RHO. We note the consultation’s point about an RHO being compatible with the UK’s preference for market based instruments but also note that this preference has led to a much less effective support regime for renewables than some of our more pragmatic EU partners. It is very hard to see how an RO type arrangement could possibly be the

most effective way to promote renewable heat. Moreover, given the government's arguments for retaining the RO are pragmatic and acknowledge the benefits of FiTs, it is hard to understand why an RO type arrangement is even being considered for large scale heat applications. An obligation akin to (or merely extending) the CERT is likely to be a more productive route, combined with a feed in tariff style RHI, capital grants and strong regulation.

It is important that any RHI is designed to maximise simplicity, minimise transaction costs and offer stable and secure returns on investment. We refer the government to the discussion of FiT for community wind schemes above, and to the extensive literature on the type of support schemes best suited to small investors. As with renewable power there is a strong argument in favour of capital grants for domestic schemes. We note various concerns related to the performance of schemes funded through grants (which do not reward output), however linking grants to regulation would provide considerable certainty as to the quality of installation.

As with energy efficiency it is likely the direct regulatory route (building and related regulation) is in some cases the most effective policy tool. Obligations and incentives are likely to have an important role; EEC and CERT have clearly made an impact on suppliers, while feed in tariffs have been effective in promoting micro-renewables in many countries. However just as building regulation has been at least as important as the EEC, so heat related regulation is likely to have a role at least as important as obligation and incentive for some key renewable heat technologies. The consultation refers to building regulations and the zero carbon homes initiative. It is far more important to consider retrofit applications since the turnover rate for homes is low. Regulation has rapidly driven the UK market for condensing boilers. A similar approach could be taken to renewable heat in the form of SWH and heat pumps.

### **To summarise:**

- Creating a market for renewable heat is a challenge, given the virtual absence of such a market in the UK. However there is an opportunity to learn from experience with the RO and other mechanisms. The market for heat will be best stimulated through a combination of a simple premium tariff, capital grants, direct regulation and CERT.

## **Chapter 5 - Distributed Energy**

### **Q19: Do you agree with our analysis of the mechanisms for support of small-scale renewable electricity?**

We strongly support the suggestion that a fixed premium arrangement akin to a Feed in Tariff is adopted for small scale generators. We are concerned that the model the government seeks views on in Annex 1 appears complex. This risks running counter to the most fundamental reason for instigating a fixed premium for small generators – giving households and small businesses access to a simple scheme with low transaction and information costs. We note also the success of various forms of capital

subsidy for domestic photovoltaics in particular in Germany, parts of the US and elsewhere. A combination of grants and premium tariffs is likely to be the most appropriate mix in the UK as well.

It is important to consider interactions between micro-generation FiTs and the renewable heat incentive for the case of biomass CHP schemes. It is important to avoid the situation where CHP is run less than efficiently in order to maximise electrical output and benefit from electricity only FiT payments.

## Chapter 8 – Innovation

**Q35: How can we adapt the Renewables Obligation to ensure that it effectively supports emerging as well as existing renewable technologies? Are there more effective ways of achieving this?**

Please see our accompanying discussion of support for innovation (below). We believe that this question is somewhat misplaced. The RO is inherently ill-suited to supporting early stage renewables because it creates price risk for prospective investors. For reasons explained in more detail in the UKERC report on investment decisions (Gross et al 2007), we believe there is a case for socialising this element of investment risk for early stage options. In practice this requires the development of a fixed price support scheme for early stage renewables and we recommend that such technologies are able to benefit from Feed in Tariff type arrangements.

### Innovation specific commentary

This section of our response addresses issues raised by questions in the UK Renewable Energy Strategy Consultation document. We were grateful for the opportunity to raise some of these issues in a meeting with Dr Jeannie Cruickshank and colleagues at Imperial College on 20<sup>th</sup> August 2008, and now set out our further thoughts. This draws on our research experience and findings in the area, and on previous commissioned input to the policy process, including three reports for the DTI Renewables Innovation Review in 2003: Anderson et al 2003, Stenzel et al 2003, Foxon et al 2003.

**Q35: How we can ensure the Renewables Obligation effectively supports emerging technologies and whether there are more effective ways to achieve this?**

**Q36: Is there evidence that specific emerging renewable and associated enabling technologies are not receiving an appropriate form of support?**

**Q37: Are there other barriers to the development of renewable and associated enabling technologies that are not addressed by current or proposed support mechanisms, particularly in areas where the UK has the potential to be a market leader?**

This response addresses these questions by drawing on our own research and research by other leading European academics, which has analysed the development and take-up of renewables in the UK and other European countries, from an innovation systems perspective. A more systemic view of innovation processes is set out in the Government's 'Innovation Nation' White Paper (DIUS 2008), which states "innovation draws on a wide variety of sources and is driven as much by demand as by supply. The insights generated by basic science are critical to long-term innovation performance but the path they follow from the laboratory to the marketplace is long, complex and uncertain." Progress has been made in recent years in mapping this complex process for renewable energy technologies using innovation systems approaches.

We agree with the Government's assessment of the important role of innovation, both in improving and reducing the costs of existing renewables technologies, as well as developing new technologies. We recognise that significantly increased levels of support are now available in the UK, including through the Renewables Obligation to assist with the deployment of technologies, and assistance for research, development and demonstration of new technologies, through the Research Council's Energy Programme, Technology Strategy Board, Energy Technologies Institute and UK Environmental Transformation Fund. However, we remain concerned that there is a lack of visible coherence in these initiatives, and recommend that this support landscape is analysed taking into account the systemic aspects of innovation that are neglected in the current Strategy.

In our 2003 analysis for the Renewables Innovation Review, we used an innovation systems approach, adapted from that used by the OECD, to review UK innovation systems for six new and renewable energy sectors: *wind (onshore and offshore)*, *marine (wave and tidal stream)*, *solar PV*, *biomass*, *hydrogen from renewables* and *district and micro-CHP* (Anderson et al 2003, Foxon et al 2005). Whilst there have been significant developments since that time, notably the extension of the level of the Renewables Obligation to 15% by 2015, and the subsequent moves to further increases on a 'head-room' basis and to banding of the Obligation from 2009, we believe that the Renewables Obligation will still not provide sufficient 'market pull' to emerging technologies. In 2003, we concluded that "At a very general level, UK innovation systems for renewables appear to be failing at the intermediate stages – developing and commercialising technologies that are emerging from R&D", and we are concerned that this may still be the case.

We argue that there are two key lessons for the support of emerging technologies coming from recent research findings:

- (1) **The government must do more to reduce the risks associated with investment in early stage technologies;**
- (2) **The mix of incentives should be aimed at the creation of 'virtuous cycles' of technological learning, entrepreneurial activity and supportive frameworks, through which new technologies can progress towards commercial viability.**

#### **(1) Reducing risks associated with investment**



The need to reduce risks associated with investment in early stage technologies is addressed in our UKERC report on investment (Gross et al 2007). For this reason, we support the further consideration of feed-in tariffs for these technologies. We believe that a simpler form of feed-in tariff could be implemented than that described in Annex 2, and that this would reduce investment risks and provide greater incentives.

## **(2) Creation of ‘virtuous cycles’**

Innovation systems research has identified seven key ‘functions’ that are required for successful technological innovation to occur (Hekkert et al 2007):

- *Entrepreneurial activities*: both new entrants seeking business opportunities in new markets, and incumbent companies which diversify their business strategy to take advantage of new developments, in either case giving rise to experiments and learning.
- *Knowledge development*: R&D projects, patenting of new ideas and investments in R&D, also leading to learning within the system.
- *Knowledge diffusion through networks*: exchange of information between the different actors within the system and the networks through which they interact.
- *Guidance of search activities*: activities relating to selection between different technological options, including interactive and cumulative processes of exchanging ideas between users, producers and other actors, giving rise to changes in user preferences and the creation of positive expectations about the future potential of the technology.
- *Market formation*: activities that stimulate the creation of niche markets, either through entrepreneurial and learning activities, user demands, or specific policy incentives and measures.
- *Resources mobilization*: investment in both financial capital and human capital involving the accumulation of relevant skills and capacities.
- *Creation of legitimacy*: the action of advocacy coalitions to promote the adoption of new alternatives, and also responses to counter-actions by incumbent players seeking to maintain their current advantage.

The fulfilment of these functions is a property of the system as a whole, to which the activities of actors within the system (technology developers, investors, government agencies and users) contribute. Furthermore, these functions are not independent, but are related, giving rise either to ‘virtuous cycles’ of positive feedbacks in which activity contributing to one function stimulates activities contributing to others, or ‘vicious cycles’ of negative feedback in which failure in one function reduces activities contributing to other functions.

For example, the Dutch Government’s introduction of tax exemptions for local biofuels initiatives led to increased levels of R&D and enhanced entrepreneurial activity in this area, mobilising more financial and human resources and the creation of a coalition of support for this technology<sup>5</sup>. On the other hand, despite 30 years of research and trials, disappointing results from a number of Dutch biomass gasification demonstration projects and an unstable institutional environment, as incentives were brought in and then removed, led to a vicious cycle of reduced activity and diminished legitimacy of this technology (Negro et al 2007).

Of course, not all renewables technologies will be successful, but a more strategic approach is needed by government. For example, it would be valuable for the government to identify certain key technology areas (not particular technologies) and provide stable support in these areas, enabling technological learning and cost reductions to occur. The overall support schemes should also, of course, allow for the potential of surprises to occur in other technology areas.

Similar virtuous and vicious cycles were seen in our comparative study of the strategic behaviour of incumbent utilities towards investment in wind power between 1990 and 2005 (Stenzel and Frenzel 2007). In Spain, a supportive institutional framework in the form of a ‘feed-in’ tariff system providing price support for renewables encouraged investment in wind farms by incumbents as well as many new entrants, development of relevant technological capabilities by these firms and lobbying by them for further enhancement of the market integration of wind power in a virtuous cycle leading to high levels of wind power adoption by both incumbents and newcomers.

In Germany, a similar ‘feed-in’ tariff system was adopted, but the regulations prevented incumbent firms from investing in wind power in the geographical areas in which they were the main electricity supplier, though they were required to transmit all wind energy produced by other operators within that area. Hence, the incumbents perceived wind energy as a threat to their existing generation capacity and capabilities, and so they lobbied strongly against the feed-in tariff system. The system was only maintained through strong political support by the then red-green coalition government, while Germany’s high level of wind power adoption was mainly due to investments by small-scale, independent firms.

In the UK, the supporting framework provided by the NFFO, and subsequently the Renewables Obligation, enabled large incumbents to quickly dominate the UK wind power market, squeezing out small independent developers. However, among incumbents, wind power continued to be seen as a niche activity, requiring passive compliance with existing policy (i.e. a 1% increase of installation year-by-year as set by the Renewables Obligation) rather than pro-active investments. Hence, levels of wind power adoption remained relatively small compared to those in Spain and Germany.

These examples reinforce the arguments that we and others have made for a more long-term, strategic approach to renewables innovation. As we argued in our second report (Foxon et al 2003) for the 2003 Renewables Innovation Review, this should involve:

- ***Perseverance with policy frameworks*** – policy measures to support innovation should be broadly stable over the long-term and be insulated from relatively ‘capricious’ short term political changes. Research suggests that policy uncertainty and reversals in the early phases of a technology’s development can ‘sink’ an innovation no matter what its long term promise might be.
- ***Regulatory consistency and synergy*** – measures should add to the functioning of innovation support as a strategic whole, by augmenting and not disrupting existing measures.

- ***Continuity of policy measures*** – measures should ‘join up’ across the stages of the innovation chain, so that a successfully performing technology can progress smoothly towards commercialisation, with a clear strategy in place for withdrawing support at that stage.

Whilst the proliferation of different funding bodies and schemes at different stages of the innovation chain can provide a range of different funding modes which is likely to be beneficial, we think that further strategic overview is needed of the extent to which consistent and coherent support is being provided. This strategic overview role should be provided by a body which does not have a vested interest in any particular technology, for example, by the Climate Change Committee or by a new Strategic Energy Agency.

Furthermore, whilst we argue that such a ‘top-down’ strategic approach is needed, greater space for ‘bottom-up’ experimentation is also needed. The example of Woking Borough Council shows the potential for greater adoption of decentralized electricity generation and heat production, given local leadership and innovative financing approaches. The Merton Rule is an example of a technology-neutral policy with low entry barriers and little administrative burden, which proved to be effective in spurring innovation and initiating virtuous circles of investment and entrepreneurship. The use of prizes and other forms of innovative support for local leadership is also being demonstrated by NESTA’s ‘Big Green Challenge’ competition.

The authors would be happy to discuss further details of the above suggestions with the Renewables Innovation team at BERR.

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