Regulating energy networks for the future: RPI-X@20

Working paper 2

Innovation in energy networks:

Is more needed and how can this be stimulated?

Abstract

In our first RPI-X@20 working paper[1] we outlined that we want the future regulatory frameworks to encourage networks to facilitate the delivery of a sustainable, low carbon energy sector whilst providing value for money for existing and future consumers. Greater innovation by the networks will be key to the delivery of both outcomes. Stimulating innovation has been a central theme of RPI-X regulation since privatisation and has been addressed across the energy networks in recent price reviews (including DPCR5).

In RPI-X@20 we are taking a step back to consider a range of different options for stimulating more innovation in the future, building on incentive mechanisms that are already in place. We are considering ways to stimulate more innovation in electricity and gas transmission and distribution. Going forward we will need to consider whether any option(s) developed can be introduced by Ofgem under the existing legal and regulatory framework or whether some changes may need to be facilitated by Government.

This paper presents our early thinking regarding the energy networks and innovation. It first addresses the question of why more innovation may be needed. Our initial view, supported by the views of stakeholders, is that a step change in innovation is likely to be needed to facilitate the move to a low carbon economy. However, the energy networks may not undertake the type of innovation required unless the regulatory regime provides an appropriate stimulus and rewards. Such a stimulus may be needed to drive cultural change in the businesses, towards more innovation. It may also be necessary to replicate the financial incentives and rewards that an unregulated business would face when innovating. This paper assesses a number of potential models that could stimulate further innovation in the future. Our assessment of the models links to the desirable outcomes in our first working paper.

We are presenting this work at an early stage consistent with the guiding principles to the review of transparency and "no surprises" and to stimulate debate. The ideas set out in the paper may change as our thinking develops. We intend to provide further clarification in our winter 'Emerging Thinking' consultation paper.

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[1] Regulating energy networks for the future: RPI-X@20, What should a future regulatory framework for energy networks deliver? Ofgem's current thinking, available from: http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=27&refer=NETWORKS/RPIX20/FORUM

1. Introduction

1.1. RPI-X@20 is a "root and branch" review of the RPI-X framework that has been used to regulate the transmission and distribution energy networks successfully for the past 20 years. Our first consultation document regarding RPI-X@20 was published in February[2] and our recommendations on RPI-X@20 will be provided to Ofgem's governing Board, the Gas and Electricity Markets Authority (GEMA), in summer 2010.

1.2. A guiding principle of RPI-X@20 is to ensure active engagement with stakeholders. As part of this, we aim to publish a series of working papers on our web forum outlining our current thinking on key issues. This paper follows the publication of our RPI-X@20 working paper on what we want a future regulatory framework for energy networks to deliver[3]. In this paper, we suggested that the future regulatory frameworks should encourage networks to facilitate the delivery of a sustainable energy sector and to provide value for money for existing and future consumers, which is consistent with recent government interpretation of our primary duty[4]. We also set out that innovation by the networks is expected to be key to the delivery of both of the outcomes that a future regulatory framework should deliver. We are intending to publish a further working paper on the options for a regulatory incentive framework that encourages efficient delivery of the outcomes over time.

1.3. The RPI-X framework provides energy networks with incentives which stimulate innovation of particular types and over particular time horizons. In particular, energy networks have innovated to reduce operating expenditure (opex) and have introduced innovative corporate and financial structures. Specific mechanisms, aimed at stimulating more R&D by energy networks, were introduced in recent price reviews and, as part of DPCR5, we are considering options for extending these schemes to stimulate innovation by the distribution network operators further.

1.4. In RPI-X@20 we have the opportunity to take a step back and consider the range of potential mechanisms that could help to stimulate innovation on energy networks. These potential mechanisms include those that may not be immediately feasible or compatible with the existing regulatory framework. The nature of RPI-X@20 also allows us to consider concurrently potential solutions for all of the energy networks as well as approaches that could sit outside of the price control regime. Some of our ideas may require changes to the existing legislative or regulatory framework. In developing options for innovation as part of RPI-X@20, we will also need to consider the existing legal baseline, what can be introduced by Ofgem and whether some changes may need to be facilitated by Government. RPI-X@20 therefore provides a unique opportunity to consider the best way to stimulate innovation. In this context, we are keen to determine whether the step-change in innovation that is needed to facilitate achievement of the climate change targets can be met under the existing framework or whether changes will be needed to deliver against these.

1.5. The ideas in this paper reflect Ofgem's current thinking and may be subject to change over the course of the review. We intend to consult formally on the issues discussed here in our winter 'Emerging Thinking' consultation paper.

[2] See for instance: http://www.ofgem.gov.uk/Networks/rpix20/publications/Presentations/Documents1/RPI-X@20%20workshop%20-%207%20November%20-%20Ofgem%20presentation.pdf

[3] This paper is available from http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=27&refer=Networks/rpix20/forum

[4] This was set out in the UK Low Carbon Transition Plan, available from: http://www.decc.gov.uk/en/content/cms/news/pn081/pn081.aspx

1.6. This paper is not a consultation or decision paper. The proposals in this paper have been developed for the RPI-X@20 project alone and do not in any way bind or constrain GEMA's flexibility – both now or in the future – when taking decisions and in interpreting its legislative powers and duties. Consistent with the guiding principles to the review, the initial ideas presented will not be applied retrospectively, including in the context of DPCR5.

2. What do we mean by innovation?

2.1. Established definitions of innovation emphasise that it is a process which, in its broadest sense, captures all stages involved in exploiting new ideas, in the form of new or improved products or processes.[5] In this context it is difficult to separate changes that can be classified as innovation from those that can simply be seen as the natural progression of a company.

2.2. There are a number of different phases in the development of an innovative product or solution, from R&D to small-scale trials and pilots to commercial deployment of the solution. There are also a number of areas where innovation can be focussed including: equipment, operations, corporate/financial structure, management, commercial practices, communications, culture and new markets.

2.3. At this stage we are considering all types of innovation related to energy networks. However, in discussions with stakeholders, the following areas have been identified as those where change may be needed.

- **Products/equipment:** There are a number of innovative products that have been/are being developed which could be deployed on the energy networks to facilitate the sustainability challenges, e.g. smart grids. Companies will need to consider the potential for these to be trialled/deployed;
- **Communications/commercial interactions:** Discussions are ongoing regarding the potential deployment of smart technology, e.g. smart meters and smart grids, to facilitate communication between networks and their end users. This could allow greater demand side participation but innovations in communications may be required to facilitate this. Commercial innovation may also be required to ensure contracts are available to facilitate demand side response to maximise benefits from the use of smart technology or to facilitate active demand side participation; and
- **Culture:** There is a general perception that the networks are low risk and that innovation may therefore be needed in terms of the culture of these companies to encourage them to be more proactive. Suggestions have been made that the network companies have traditionally followed a business as usual approach and have been reluctant to engage in relatively more risky and innovative projects, particularly on a larger scale. While this generalisation does not apply equally to all networks, it is an area where there may be scope for the networks to innovate going forward. It has also been suggested that the reticence of the networks to progress innovation is increased by their limited access to appropriate skills.

2.4. These ideas are presented here as examples of the areas where innovation may be needed but we intend to retain a broad view of what is needed. In particular, we are not identifying specific types of technology innovation that the regulatory framework should focus on (i.e. we are not considering 'picking winners'). However, as highlighted by the

[5] See, for example, http://www.oecd.org/dataoecd/57/36/32163700.pdf

Stern review, it is important that climate change policies incorporate mechanisms to support the development of a range of low carbon, high efficiency technologies[6].

2.5. We note that the emphasis on innovation to facilitate the 2020 and 2050 climate change targets has tended to be focussed upon electricity rather than gas. While we recognise that there is scope for innovation in gas transmission and distribution, we anticipate that a reduced need for innovation in gas may mean that actual levels of innovation may be lower. Therefore, the absolute amount of money spent in gas will likely be of a multitude smaller than in electricity. We are keen to hear the views of interested parties on the scope for innovation on the gas networks and, in particular, any examples they may have of completed, ongoing or planned innovations in this area.

2.6. We are aware that a number of schemes already exist to provide support for innovation in the energy sector (e.g. through the Government environmental transformation fund (ETF)). At the same time, the RPI-X framework provides energy networks with incentives which stimulate innovation of particular types and over particular time horizons. Ideally, any additional stimulus for innovation should not displace or crowd-out innovation that would already happen under a separate innovation scheme (ensuring consumers do not pay for an innovation that could have been funded elsewhere). We want to limit situations where consumers pay for changes by or on the network that would have happened without that support. As discussed in more detail below, the way in which innovation is stimulated will impact on these ambitions.

3. Is more innovation needed for the future?

Historic trends

3.1. The importance of innovation as a means of driving long-term improvements in consumer prices, quality, and service is well established.[7] We recognise that network companies have been innovative in the areas where they are incentivised to do so: indeed this was a primary objective of regulation post privatisation and an expected benefit of private ownership (and capital market competition). In this respect, the energy networks have sought to innovate to achieve costs reductions, with the most notable example provided by opex [8]. Energy networks have also sought to innovate in relation to corporate/ financial structures and we have heard anecdotal evidence of certain types of technological innovation but these have not been widespread.

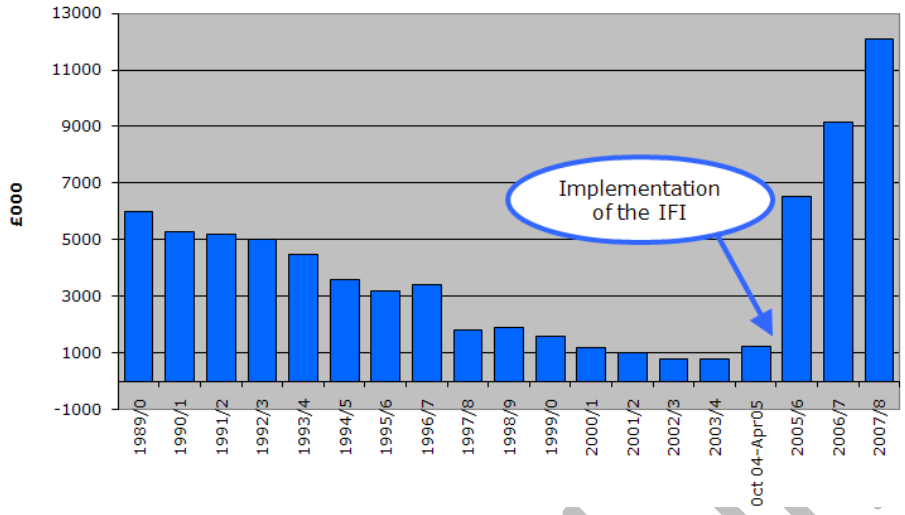
3.2. Despite indications of positive benefits of innovation and the returns it can deliver, evidence of a declining trend in R&D spend in the GB electricity distribution sector by the DNOs since privatisation is well documented.[9] We have heard anecdotal evidence that technological innovation on the other energy networks has also been limited. There have been suggestions that while early stage innovations, such as ideas, are being progressed e.g. by academics, ESCos and local councils, they are not being trialled on the networks.

3.3. We recognised the need for more innovation at the most recent price controls for all the energy networks and introduced a specific innovation (R&D) mechanism (the innovation

[6] Stern review on the economics of climate change, available from http://www.occ.gov.uk/activities/stern.htm
[7] See , for instance, http://www.defra.gov.uk/environment/water/industry/cavereview/pdf/cavereview-finalreport.pdf
[8] Evidence suggests that operating efficiency has increased quite significantly, in real terms, since privatisation. See: Regulating Energy Networks for the Future: RPI-X@20, Performance of the Energy Networks under RPI-X http://www.ofgem.gov.uk/Networks/rpix20/publications/CD/Documents1/Performance%20of%20the%20Energy%20Networks%20under%20RPI-X%20FINAL_FINAL.pdf
[9] See, for instance: http://www.smartgrids.eu/documents/2ndGA/JScott.pdf; http://www.eprg.group.cam.ac.uk/wp-content/uploads/2009/02/main-body1.pdf; and http://www.intertic.org/Policy%20Papers/Sterlacchini.pdf

funding incentive (IFI)). Figure 1 shows the greater level of R&D spend seen in the electricity distribution networks since the implementation of the IFI as part of DPCR4. While there has been limited time to undertake a specific assessment of this spend, the feasibility of assessment will increase over time as we obtain a greater understanding of the extent to which the IFI has facilitated successful innovations.

Figure 1: UK electricity distribution R&D spending



Future requirements

3.4. The need for more innovation is driven by the role of the energy networks in facilitating the transition to a low carbon energy system and continuing to ensure security of supply at an efficient cost. The Climate Change Committee envisages a critical role for the electricity sector in achieving 2020 and 2050 climate change targets[10]. However, the conclusions of the Long-term Electricity Network Scenarios (LENS)[11] project illustrated that there is significant uncertainty over the future direction of networks, particularly beyond 2020. A number of different types of technology may need to be trialled to determine the options that are most feasible, efficient and effective. To support this, it is important that the networks have incentives to engage in innovative projects even though, by the very nature of innovation, some of these initiatives will fail. In the long term, if we and networks learn from the successes and failures of innovation, we expect to be better placed to identify and understand how to facilitate the efficient delivery of the low carbon energy sector.

3.5. In this context, the DPCR5 December policy paper[12] noted DNO concerns that funding available under the IFI may be insufficient to support testing of high cost network equipment. In addition, it highlighted concerns that the IFI would not be sufficient to overcome the low risk, business as usual ethos of the DNOs. As such, under DPCR5 there are proposals to retain the IFI and to provide an additional mechanism to facilitate trialling of innovative solutions to ensure that spend in all phases of the innovation process is appropriately incentivised. We hope that this will encourage the DNOs to anticipate how future changes in policy will impact on their networks and to be proactive in developing these networks. There are also proposals to strengthen existing governance arrangements

[10] The national targets on carbon emission reductions require an 80% on 1990 levels by 2050 and a 34% reduction by 2020.
[11] Final report is available at: http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=67&refer=Networks/Trans/ElecTransPolicy/lens
[12] Electricity Distribution Price Control Review, Policy paper, December 2008, available from: http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=132&refer=Networks/ElecDist/PriceCntrls/DPCR5

to ensure that designated funds are allocated to the projects which have the most potential to deliver innovative outcomes. Respondents have not yet had the opportunity to signal whether the innovation schemes to be developed under DPCR5 will effectively stimulate the required innovation.

A particular market failure

3.6. As noted earlier, energy networks do innovate in response to regulatory and capital market incentives. Innovations are driven by an expectation that discounted private benefits will be higher than discounted private costs.

3.7. However, the types of innovation required to deliver the low carbon energy sector may not easily meet this test, for a number of reasons.

- The expected benefits of innovation may not accrue for some time and may be heavily discounted at commercial discount rates.
- The expected benefits of innovation may accrue to a wide range of parties, beyond the innovator itself.
- The upfront costs of innovation may be significant (including potential contracting costs with other parties where relevant).
- The long-term private cost to network companies from choosing not to innovate are not significant, particularly where energy networks do not face a significant carbon price[13] and the costs associated with existing technologies are funded under a price control.

3.8. The question is how to provide the stimulus for this innovation by regulated network companies through the regulatory framework.

Current thinking on the need for innovation in the future

3.9. Consistent with developments in DPCR5 and the government's ambitions for the transition to a low carbon energy system, our current thinking is that significant innovation is needed if energy networks are to facilitate delivery of a low carbon economy efficiently. The need to deliver a low carbon economy will increase costs for existing and future energy consumers. It may be possible to deliver a decarbonised electricity sector using current network technology but there is a concern that this option is very costly. We anticipate that innovation could allow for alternative routes to be identified that deliver the same outcomes at lower costs to consumers. The scale of the costs will depend on the type of innovation involved (e.g. adapting available technologies for GB energy networks or taking ideas from R&D stage to 'market ready' stage) [14]. There will also be times when innovations fail and consumers do not see direct benefits. However, over time it is likely that learning, including from 'failed' innovation, and increased innovation will limit the extent of the overall increase in costs.

3.10. Our engagement with a range of stakeholders suggests that this is a view that is widely supported. We think, based on trends to date, that a step-change in innovation will

[13] The EU Emissions Trading Scheme (EU ETS) represents a step in the right direction but has yet to establish a single carbon price. The EU ETS carbon price also represents the short-term cost of carbon which does not incorporate the long-term cost of environmental damage.
[14] We are progressing a research project looking at the types of technologies being developed which could potentially be deployed on the energy networks. This project is also looking into the issues preventing the full roll-out of these technologies as we have heard that GB companies are at the forefront of technological developments but the networks do not appear to fully deploying them.

be needed, involving trials on networks, and adapting existing technologies to GB energy networks. As noted earlier, at this stage we think the step change in innovation is most relevant for the electricity networks but we welcome views on whether there is the need for a similar change in the gas networks.

3.11. We think that the regulatory framework has a role to play in stimulating the step change in innovation. This role will need to be consistent and compatible with other schemes to encourage innovation (e.g. government funding) and other incentives in the regulatory framework. In the rest of this paper we consider whether the existing regulatory framework can stimulate innovation at the level required and, if not, what alternative models might be considered.

4. Can the existing framework deliver innovation?

4.1. In the absence of the 2020 and 2050 climate change targets and the government's associated commitment to the decarbonisation of the electricity sector, we do not think that significant changes to the regulatory regime would be needed to deliver the required level of innovation. However, the scope and scale of these targets will require change.

4.2. It is generally accepted that the best way to stimulate innovation is through effective competitive markets. However, GB energy networks are regulated monopolies (traditionally termed natural monopolies) and therefore the potential to introduce effective competition within these markets is more limited. Where feasible, we are keen to stimulate innovation through the regulatory framework and using competitive processes where possible.

4.3. There has been innovation in the energy networks since privatisation and therefore it is not necessarily the regulatory framework that is a barrier to some types of innovation. Nevertheless, the need to stimulate significant innovation should be considered in the context of the range of actual and perceived barriers that have been identified. The most often cited barriers to increased innovation by the GB energy networks include:

- the perceived lack of clarity over the way that any profits, and losses, resulting from innovation will be treated in the regulatory regime;
- the absence of competition, which removes the need for the network companies effectively to 'compete' to retain market share;
- the 5-year price control periods, which give networks short-term focus and reduce incentives to progress innovative projects as benefits may not materialise over the short term. This is in conflict with climate change objectives which are long term;
- the low risk nature of the energy networks, which has been shaped by the regulatory regime and makes the companies averse to engagement in more risky innovation;
- risks associated with potential deviations from minimum standards with which the networks must comply; and
- the loose definition of network outputs and differential incentives for opex and capex, which potentially reduces incentives to ensure efficiency in capex spend.

4.4. In addition, a number of parties have suggested to us that innovation is happening beyond the core regulated licensed networks (e.g. R&D in universities) but that there are

barriers in the regulatory regime that prevent these innovations becoming 'market ready' because of difficulties trialling the innovation on real GB networks.

4.5. These actual and perceived barriers, resulting from the regulatory framework, were identified prior to the implementation of the IFI but, to some extent, appear to remain following the introduction of this mechanism. They have been recognised in other reviews, including DPCR5 and TAR, and we are seeking to develop measures to deal with them as part of the existing framework. For example, in DPCR5, we are looking at options to link outputs more closely to spend and remove potential distortions between opex and capex incentives as well as looking at barriers to innovation more specifically. In TAR, we are developing short-term enhanced incentives to encourage Transmission Owners (TOs) to consider longer term investment needs and anticipatory investment with different risk-return profiles.

4.6. The barriers identified with the current regulatory framework are arguably more significant the greater the level of required innovation and the greater the urgency of the need for change. DPCR5 is already looking into these issues to determine whether there are more effective ways in which innovation could be stimulated. Under RPI-X@20 we are taking a step back from the existing arrangements to determine whether something different is needed to facilitate achievement of the 2020 and 2050 climate change targets. We discuss in this paper three potential models that could be adopted to stimulate a step change in innovation on the energy networks[15]. The models we consider are:

- A competitive market model;
- An enhanced regulatory framework; or
- A specific scheme, within a broader regulatory framework, designed to stimulate innovation.

4.7. These models are not mutually exclusive. Options incorporating combinations of these models could be considered. We discuss the models in turn below.

5. Can we simply rely on competitive forces?

5.1. Economic theory tells us that there is a link between competition and innovation. This relationship was recognised in the Cave Review of the water sector[16]. The energy networks are generally considered to be natural monopolies but we think it is important to take a step back and consider whether competitive pressures can be injected into them[17]. This is consistent with our general view that, where the right frameworks are in place in the energy industry, market mechanisms will deliver but, where it is not possible to achieve effective competition, regulation should be used as a proxy for this.

5.2. There are a range of ways that competitive pressures might be introduced.

- **No regulation:** In the original paper on RPI-X regulation[18], Littlechild cites that competition (with no sectoral specific regulation) is the most effective means of

[15] We intend to publish a separate working paper looking at the form of the regulatory framework needed to encourage the efficient delivery of outcomes, incorporating general incentives to improve efficiency and performance (both of which may encourage innovation in a wider context).
[16] The final report is available from: http://www.defra.gov.uk/environment/water/industry/cavereview/pdf/cavereview-finalreport.pdf
[17] We will be undertaking further work internally to consider the potential options that could be introduced to facilitate competition and hence stimulate innovation.
[18] Regulation of British Telecommunications Profitability, Stephen C Littlechild, Professor of Commerce, University of Birmingham, Report to the Secretary of State, 1983.

protecting consumers from monopoly power, with regulation a means of 'holding the fort' until competition arrives. He also highlights the benefits that competitive forces can deliver through facilitating efficiencies and stimulating innovation. However, there are concerns that effective competition will not emerge in the energy networks due to the monopoly position that the companies hold and that resulting desirable behaviour will not emerge in the absence of regulation. We therefore have concerns that a "no regulation" approach may not be effective in terms of protecting the interests of consumers.

- **Competition for the market:** Networks could be subjected to competitive pressures by introducing competition for the market. This could be done through tendering arrangements, as adopted in offshore transmission, or franchising. Under a tendering model, contracts with third parties would be established for specific areas of work. This may create a step-change in innovation and deliver potential efficiency savings, as parties interested in the tender would seek to compete on the terms of their contract. The extent to which there would be ongoing efficiencies and innovation would depend on the behaviour of the tender winner after the contract was awarded, which in turn would be dependent on the terms of the contract. Under a franchising model, third parties could assume responsibility for operating a certain part of the network. To ensure efficiencies were achieved under this model, and hence innovation was stimulated, the arrangements governing access to the franchise would be important. Under both approaches, there would need to be arrangements in place to allow third party network access.

- **Competition in energy services:** There are potential benefits from the implementation of competition in energy services, at the margins. The paper we published by Pollitt in February,[19] draws on the experience in telecoms, and illustrates the link between introducing competition in energy service provision and stimulating innovation. It may be possible that, where innovative technologies are adopted, the changes in the networks, and the wider industry, may change the scope for effective competition.

5.3. While each of the options outlined above could have benefits for innovation, it is unlikely that effective competition could fully replace the current monopolies in electricity and gas networks, in the immediate future. This does not preclude the introduction of these models but does suggest that a regulatory framework will still be needed to sit alongside any of these models. In the RPI-X@20 review we will consider where there is scope to increase competitive pressure but anticipate that this will not be the only way to regulate incumbent monopolies and stimulate innovation. As noted earlier, innovation and technological change may change the nature of the energy networks and we think that a review of the scope for further competition will be warranted periodically.

5.4. We recognise that adopting any of these options may require changes to the existing legislative or regulatory framework (e.g. licence changes) but, our initial assessment is that these would not be insurmountable. We are undertaking further work to understand the merits and feasibility of the options.

[19] Does Electricity (and Heat) Network Regulation have anything to learn from Fixed Line Telecoms Regulation? Michael Pollitt, University of Cambridge, April 2009, available from http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=23&refer=Networks/rpix20/forum

6. Could an enhanced regulatory framework stimulate innovation?

6.1. There are inherent incentives to innovate under the existing regulatory regime. These relate to the reduced costs that innovation could facilitate, the advantages for the networks in comparative benchmarking, and possible improvements in customer service. There are also more explicit incentives to innovate in the form of the IFI, as well as the registered power zone (RPZ) incentive in electricity distribution. As outlined above, we recognise that since privatisation network companies have sought to innovate through improvements in opex efficiency, amendments to their financial/corporate structures and changes in management. However, the level of innovation in other areas has been relatively low.

6.2. We think that to stimulate innovation it is important to develop a regulatory framework that provides strong incentives to deliver pre-specified outputs efficiently, including those relating to a move to a low carbon economy, over the long term. In RPI-X@20 we are considering two broad alternative regulatory frameworks and we intend to publish ideas on both. At this stage of the review we remain open to both ideas. The two broad regulatory frameworks we are considering, alongside the potential to introduce more competitive pressures, are:

- **Enhanced ex-ante regulation:** A number of different models of ex-ante regulation could be considered, building on the successes of the ex-ante framework of RPI-X regulation. The aim of any regime for the future would be to deliver the desired outcomes efficiently over the long term. This is likely to involve a focus on the long term, a review of options for delivery, delivery of outputs, innovation, learning and adaptation over time.

- **Ex post regulation:** A number of different models of ex-post regulation could be considered. In general under this approach the network companies would operate under a set of agreed guidelines/rules. Where they were able to exploit efficiencies through innovation, they would be able to retain these savings, therefore creating incentives towards this type of behaviour. We intend to examine this model further for our 'Emerging Thinking' consultation paper.

6.3. We consider that there are three main areas in which changes to the regulatory regime could be implemented to facilitate increased innovation. These are relevant to ex-ante regulation and to the establishment of guidelines/rules of what is 'acceptable' in ex-post regulation:

- **The definition of outputs:** Clearer definition of outputs that the networks should deliver, including those relating to a move to a low carbon economy, could signal priorities for them. We have recognised this as part of DPCR5 and have worked with DNOs to develop appropriate output measures. To deliver against these outputs, and keep costs at an efficient level, the networks should have greater incentives to innovate. The definition of outputs should also help to remove existing bias toward achieving opex over capex efficiencies, by requiring confirmation of delivery, and hence encourage opex in seeking to innovate. In addition, it should allow us to determine whether companies are using capex allowances efficiently to effectively deliver these outputs;

- **Focus on total cost incentives:** The regulatory framework of the future will need to ensure that outputs are delivered. We want energy networks to make efficient

choices about what needs to be done (e.g. make use of existing assets or expand the asset base) and when changes need to be implemented. These decisions should not be distorted by the existence of separate incentives for different types of costs or by varying incentives over time. The current regimes include a bias toward capital investment (capex) over opex[20]. This could potentially be dealt with by focusing the regulatory framework on total costs rather than treating capex and opex differently. Alternatively, as discussed in DPCR5, similar results may be achieved by retaining a distinction between capex and opex but ensuring there are equalised returns from a pound saving on each. This would allow the networks to take decisions on innovation in the absence of any bias toward capex solutions;

- **Efficient delivery over time:** In our first RPI-X@20 working paper on the outcomes that a regulatory framework for energy networks should deliver, we suggested that a broader definition of efficiency could be used, focussed on long-term considerations. This could help to ensure that the networks are focussed on the needs of both existing and future consumers in terms of choice, value and quality of service. The network companies may innovate to provide these services efficiently, particularly where they have clarity over the outputs they should deliver against. A narrow definition of efficiency, focussing on the delivery of outcomes at the lowest cost today, may therefore no longer be appropriate. Instead, the regulatory framework may need to consider the long term and promote options that are expected to be least cost for consumers over time; and

- **Learning**: As emphasised in a number of our papers, there is significant uncertainty about what are the most efficient options for delivering a sustainable energy sector in the long term. The energy networks therefore need to operate within a regulatory framework that facilitates and encourages learning over time. We will also need to learn and adapt our assessments in line with this. In the context of innovation, we need to recognise that some innovations will fail but that lessons from failed initiatives may have some positive benefits for the networks. Similarly there are lessons to be learned from successful innovations, in addition to the benefits from the innovation itself.

6.4. We think that amendments to the regulatory framework in these areas could deliver positive benefits for innovation. We will consider these issues further during the course of the review.

6.5. However, we have concerns that this approach, even in combination with enhanced competitive pressures where appropriate, may not facilitate changes needed to meet the sustainability targets in a timely manner. We recognise that implicit incentives can be effective in delivering benefits, e.g. on opex efficiencies, but they are likely to involve a period of learning for parties to appreciate the potential benefits. In addition, a crucial factor determining the effectiveness of output measures will be the extent to which the definitions developed are 'right' and deliver the outcomes intended.

6.6. Importantly, incentives in the regulatory framework are provided to the private firm. Energy networks generally respond where potential returns exist (i.e. where the expected private benefits exceed the expected private costs). As noted earlier, however, innovations related to delivery of a low carbon economy may not meet these tests because of the presence of a carbon externality. In time, appropriate definitions of outputs and a carbon

[20] This results from the structure of the regulatory regime, under which network companies retain the benefits achieved through reductions in opex for the duration of the price control and a guaranteed return on capex is provided.

price may allow for this externality to be taken into account by the energy networks. This is likely to take some time.

6.7. In this context, a specific stimulus for innovation may be needed, at least to encourage a step-change in innovation to deliver the 2020 and 2050 targets[21]. Such a scheme could have a defined lifetime until an enhanced regulatory framework was bedded down. This is consistent with the approach we have adopted at recent price reviews but RPI-X@20 provides us with an opportunity to step back and consider what such a scheme might look like. An adaptable regulatory framework of the future would need to allow for such an innovation scheme to be reviewed over time. While we have not taken a decision on whether a specific innovation scheme offers the most suitable solution to stimulate innovation, we consider it appropriate to assess the options available at this stage.

7. What might a scheme to stimulate innovation look like?

7.1. The IFI and RPZ were introduced under DPCR4 with the intention of stimulating greater levels of innovation. Therefore we know that, in principle, it is possible for a specific innovation scheme to be implemented as part of the regulatory framework. However, we recognise that as we are considering these issues from a first principles perspective, some of the options available may require legislative change. For example, options to allow third parties to participate in a specific innovation scheme or changes to introduce new governance arrangements may require some legal change. As we develop our ideas, we will consider whether decisions of this nature can be made on the basis of the powers available to us or whether they would need to be facilitated via primary legislation.

7.2. In designing a scheme to stimulate innovation, provisions should be in place to allow the scheme to be removed in the event that embedded incentives for efficient delivery and key outcomes (e.g. choice, quality of service, security of supply, sustainability and social objectives) are deemed sufficiently strong to stimulate innovation. It is also important that other innovations are not 'crowded out' and that provisions are implemented to facilitate innovation that is additional to that which would have taken place in the absence of the scheme. This requires consideration of what the regulatory framework itself already incentivises and what support is provided from other sources (e.g. government innovation schemes). As far as possible, a specific innovation scheme should complement rather than replace these schemes.

7.3. There are many forms that a model to stimulate innovation could take. We describe a number of features of potential models here and discuss three particular example models in the next section.

Features of a specific innovation scheme

7.4. Figure 2 illustrates the different aspects or features of a potential innovation scheme, and the spectrum of options related to each individual feature. These include:

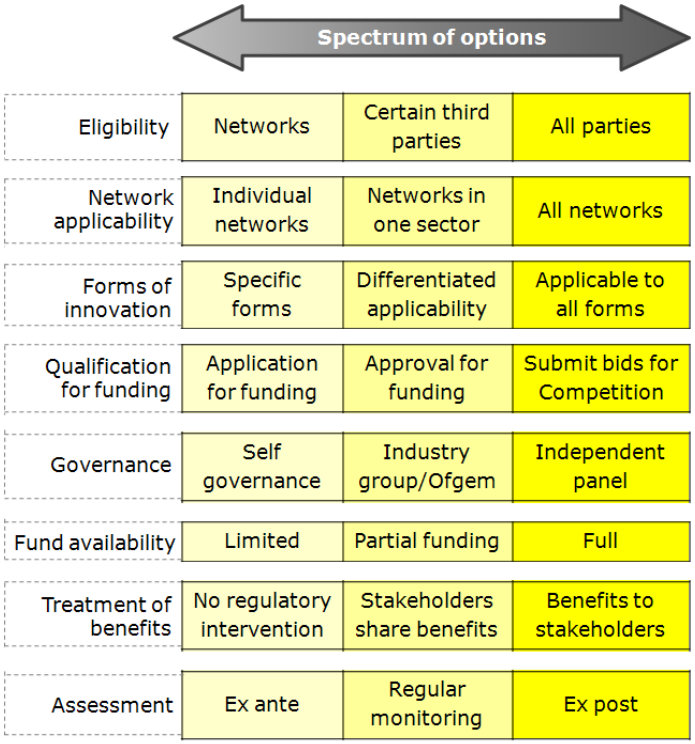
- The parties that are eligible to participate in the scheme;
- The network sector(s) to which the scheme is applicable;
- The forms of innovation, e.g. R&D and/or trials, which can be funded;
- The way that qualification for funding is determined;

[21] We recognise that some innovation will impact on multiple objectives e.g. cost and quality of supply as well as sustainability.

- Governance arrangements for the scheme;
- The proportion of funds to be made available via the regulatory framework;
- The way that benefits from innovation will be treated; and
- The point at which assessment of the innovative proposal/initiative will take place.

7.5. We describe each of these features in more detail in Annex 1.

Figure 2 Spectrum of options for a specific innovation scheme



7.6. When designing a scheme to stimulate innovation a decision needs to be taken on what to do with respect to each feature outlined above, taking account of the spectrum of options available for each. There are a large number of potential schemes, reflecting different permutations of these options, and we will use our outcomes framework from our first working paper to consider which option is most appropriate in our winter 'Emerging Thinking' consultation paper. In this paper we focus on three examples to illustrate the potential models that are available.

How would the scheme be financed?

7.7. We recognise that there are a number of government schemes that seek to facilitate certain outcomes in the energy industry, for example the Environmental Transformation Fund (ETF), and that these could potentially assist with the delivery of innovation required to transition to a low carbon economy. However, our view is that something additional may be needed to stimulate the required level of innovation by and on energy networks. We think there are two key sources of funding for a specific innovation scheme. These include:

- **Network charges (in price control):** Funding for innovation could be incorporated as an allowance in the network price control, along the same lines as the approach adopted for the IFI in electricity and gas transmission and distribution.

- **Levy on consumer bills (outside price control):** Under this approach, funding would be derived *directly from consumers as a levy* on bills. This option could be thought of as similar to the arrangements to fund the Renewables Obligation (RO) and the Carbon Emissions Reduction Target (CERT), which are funded directly from consumers via a charge levied by suppliers. This levy would not be part of the price control but would be determined by Ofgem in developing the regulatory framework. We need to consider further, with legal advice, whether it is within our vires to introduce a levy of this type, recognising that changes to the existing legislative or regulatory framework may be required.

7.8. Both of these options would incorporate certainty that the required funding could be raised to finance either an ex ante or ex post regime. The benefit of raising funds via network charges is that this method is already used for the IFI and there are established processes. A levy on consumer bills has not previously been used to raise network financing and therefore there may be legal or logistical issues associated with this. However, by taking the funding arrangements outside of the price control, this option may simplify the process to remove the specific innovation stimulus in the event that innovation can be effectively stimulated through competitive forces or the enhanced regulatory framework. This approach would also provide greater transparency to consumers over the contributions that they were making to the progression of innovation on the networks. In addition, this approach may facilitate a pan-network approach through raising funds from consumer bills across gas and electricity without being attributable to transmission or distribution.

8. Three example models of a specific innovation scheme

8.1. Table 1 below illustrates three examples of schemes that could be developed to provide a specific stimulus for innovative projects to facilitate a low carbon energy system. As noted earlier, such a stimulus scheme may have a shelf life depending on how incentives develop under an enhanced regulatory framework.

Table 1: Examples of short term stimulus schemes for innovation

	Eligibility	Network applicability	Forms of innovation	Qualification for funding	Governance	% of funding	Assess[t]	Benefit sharing
1	Networks	Individual networks	Specific phase	Application	Low level	Partial	Ex ante	Not explicit
2	3rd parties that meet criteria	Networks in one/all sectors	All types	Competition	Strong	Partial	Ex ante	Portion of benefits to consumers
3	All parties	Networks in all sectors	All types	Ex post assessment	Post review	TBC	Ex post	Retain all benefits

Option 1 = Pre-specified network-specific innovation

Option 2 = Contestable innovation

Option 3 = Ex post 'prize'

8.2. The rationale for the options in Table 1 are outlined below. The options presented are not comprehensive of all of the possible combinations of features for a scheme but are intended to demonstrate the range of schemes that could be envisaged and to act as strawmen for exploration. We would welcome ideas on potential alternative schemes that could be considered.

- **Pre-specified network specific innovation:** Under this approach, only networks could participate and a separate scheme would be applicable to each of the four network sectors. The scheme would be targeted at one phase of innovation, e.g. R&D, and eligibility for funding would be determined based on an application, implying fairly low level governance. Funding would be partial and availability would be determined on an ex ante basis. This option has many similarities with the existing IFI.

- **Contestable innovation:** This option retains the ex ante, partial funding features of the 'pre-specified innovation' approach but expands on other features of the scheme. It incorporates an open competition for funding, allowing parties that meet specified criteria to compete to take forward innovative projects in any of the network sectors. Such a competition could take various forms including a multi stage process whereby parties compete first for the ability to research and design the innovative solution and then compete to construct and trial this solution. The scope of such a scheme may be wide, with applicability across all the networks and all phases of innovation, therefore allowing the funds to be allocated where they are needed most. In light of the potentially significant funding available under this approach, the governance arrangements would be relatively strong.

- **Ex post 'prize':** The key difference between this option and the two above is the timing of funding approval. Where network companies or third parties thought there were potential benefits from innovation, they may progress relevant projects. If these projects were successful, the networks/third parties would approach the regulator to seek funding/a 'prize' for their innovative activity. Alternatively, the regulator could identify areas where innovation may be required, with success measures determined to act as criteria for evaluation and a 'prize' available for successful solutions proposed/achieved. These prizes could be available for different stages of innovation, e.g. for completing required R&D, for developing a solution or for getting the solution to market. Under this option, the regulations would be less prescriptive and assessment would take place ex post.

8.3. In paragraph 4.3, we identified a number of barriers to further innovation in the energy networks and table 2 below provides an indication of the extent to which each of the options in Table 1 (above) are successful in overcoming these barriers. It provides an indication of our current thinking on each of the example innovation schemes.

Table 2: Comparative effectiveness of short-term innovation schemes

	Pre-specified innovation	Contestable innovation	Ex post 'prize'
Uncertainty over treatment of benefits	Certainty of funding Ex ante rules for treatment of benefits	Certainty of funding Ex ante rules for treatment of benefits	Increased uncertainty over funding
Absence of competition	Minimal impact – network only scheme	May facilitate some competitive pressure	May facilitate some competitive pressure
Network culture	Not addressed as limit to the networks	Presence of 3rd parties may facilitate change	Presence of 3rd parties may facilitate change
Internalising an externality	Not addressed – networks still perceive limited benefits	Potential benefits for third parties involved may incentivise	Potential benefits for third parties involved may incentivise
Implications of failure	Consumers / networks bear cost (depending on % of funding)	Consumers / networks bear cost (depending on % of funding)	Innovative party bears all of the cost
Potential for stranding	Reduced incentives to find alternative uses	Reduced incentives to find alternative uses	Incentives to find alternative uses

8.4. We have also undertaken a high-level assessment of each of the models relative to the outcomes we are likely to want a future regulatory framework for energy networks to deliver. The details of this assessment are provided in Annex 2. The main messages from our assessment are as follows.

- Long-term efficiency may be facilitated by a scheme that is applicable to all phases of the innovation process and across all network sectors by helping to ensure that funding is allocated in the right areas.

- The extension of eligibility to third parties should ensure that those parties best placed to innovate can lead on innovative solutions. This may stimulate a greater number of innovative ideas, therefore facilitating long-term efficiency. This effect may also be evident where there is competition for funding.

- Under any approach, arrangements would need to be in place to ensure that quality and security of supply was maintained.

- Where there is stronger governance or a 'prize' for innovation, this could direct where innovation may be needed e.g. to facilitate the 2020 and 2050 targets.

- Ex ante approaches would provide certainty to parties over the availability of funding but there would be less certainty under an ex post approach.

8.5. All of these examples may potentially facilitate the stimulation of network innovation depending on the precise form they took. We think that further analysis of these examples and other options is required to understand fully their merits and the implications for the

regulatory regime. However, at this point, we are not ruling out any options and would welcome views/ideas of interested parties regarding the best way to progress these issues.

9. Concluding remarks

9.1. We have considered a range of models for stimulating innovation by and on energy networks and remain open-minded about which approach is most appropriate for the future. In time, we hope the regulatory framework will stimulate innovation through output measures, cost incentives and enhanced competitive pressures. We intend to explore the potential for this in further working papers on efficient delivery of outcomes over time. However, a specific innovation solution may be needed while the enhanced regulatory framework is bedded down, particularly given the need to meet 2020 targets.

9.2. We are aware that there are a range of forms that an innovation scheme may take and we intend to assess the various options further, in terms of both the associated costs and benefits, as well as their potential to be incorporated in the GB regulatory framework. This will include considering the options that are developed as part of DPCR5. We will also consider what steps need to be taken to implement these options (e.g. legislative changes). We would welcome ideas from interested parties regarding specific schemes that we could consider as part of this process.

9.3. We also recognise that the design of a scheme to stimulate innovation will be influenced, to some extent, by decisions taken on other aspects of the regulatory regime. For example, if a pure ex post regime were adopted, this would impact on the form that a scheme designed to stimulate innovation would take. Equally, if a government guiding mind emerged, there would potentially be less of a need for innovation. Any decision on this specific innovation scheme must therefore be taken in the context of the entirety of the proposed regulatory regime.

Annex 1: Features of a specific scheme to stimulate innovation

9.4. We described, in the main paper, the features that need to be considered when designing a specific scheme to stimulate innovation. We discuss the options for each of these features in more detail here.

9.5. Each of these various aspects are considered in turn below.

- **Eligibility to participate:** Network innovation has traditionally been led by the network companies, with contracts with third parties where desirable from the networks perspective. However, eligibility to participate in an innovation scheme could be extended to third parties that meet certain criteria, e.g. universities, technology developers or companies specialising in communications. A consortium of such parties could also emerge to progress innovation. Extending eligibility to third parties would provide greater opportunities for involvement in innovation, potentially bringing new ideas to the fore and injecting a different culture into the process. While there may be logistical issues associated with third parties trialling innovative solutions on networks they do not own, contracting arrangements to allow such cooperation could be envisaged.

- **Network applicability:** A scheme could provide funding allowances for individual networks within a sector, similar to the network specific allowances under the IFI. Alternatively a scheme could apply across a network sector, e.g. funding available for gas distribution innovation, or to energy networks as a whole, e.g. funding available for gas and electricity transmission and distribution as a whole. Specific funding for individual networks would allow all network companies to access funds for innovation. A scheme applicable across one, or all, network sectors would have these benefits as well as allowing projects to be progressed that recognise the interactions between gas and electricity or across transmission/distribution. This approach would also provide flexibility in determining the level of funds for each network sector and provide scope for the funding to be allocated to the projects that are expected to be most effective. Governance arrangements will determine the effectiveness of the allocation of funding in any of these models.

- **Forms of innovation:** The IFI provides funding for R&D and DPCR5 is exploring the possibility of expanding the scheme to incorporate funding for trials. There may be scope for an innovation scheme to allow consideration of innovative projects that cover all phases of the innovation lifecycle. The scheme could incorporate funding for projects relating to any phase of the innovative process or could make different 'pots' available for different phases of innovation. The former approach would provide funding for projects on the basis of merit while the latter would ensure that there was funding for each phase of the innovation process. As noted earlier, the scheme should ideally focus on innovation that would not have happened in the absence of the scheme.

- **Qualification for funding:** Eligibility for funding could be determined on the basis of high-level criteria, whereby companies submit applications demonstrating compliance or could require more formal approval to be obtained. Alternatively, it could be determined on the basis of a competitive process. In the event that a high-level application or approval processes were used, funding could effectively be allocated on a first come first served basis. If a competition were used, this may require parties proposing to progress innovation to submit bids setting out, for example, the costs of the project, associated timescales, expected benefits and proposed roll out plans. This

would allow competitive pressures to be drawn on to allocate limited funding effectively to the project(s) with the most chance of success in terms of facilitating the move to a low carbon economy.

- **Governance**: Access to funding could be determined through self-governance by the industry or stricter governance, such as the independent panel for R&D recommended by the Cave review[22]. Self governance arrangements are used for the IFI. To facilitate this process, and provide guidance on projects that will qualify for funding, the networks developed a best practice guide which the ENA administers. The recommendations from the Cave review proposed that an independent panel should take responsibility for determining the priorities for innovation and for coordinating efforts on this. A panel of this type could be formally established with a budget and a set of priorities or could be more informal in nature, facilitating the sharing of information and identifying areas where innovation is needed most. More formal governance of the scheme may help to ensure that funding is allocated to projects that would not have been progressed in the absence of this additional finance. There are costs associated with a panel, [give examples: administration costs; risk of picking winners? Becomes like a guiding mind?] There are also questions about ongoing governance of the scheme and whether monitoring may be required to ensure that any projects are delivering against their stated outcomes.

- **Proportion of funding**: A variety of funding options could be adopted, ranging from mechanisms with limited funding in which the parties progressing innovation must finance much of the expenditure, to ones in which innovative projects are fully funded via the regulatory regime. There are many partial funding options which could be adopted, including a mechanism similar to the IFI where funding of up to 80% of the project costs is available. Flexibility could be built into the funding arrangements depending upon whether the expected benefits are likely to accrue to the networks or to consumers and the wider economy more generally, in which case more funding could be made available. Alternatively, an approach similar to that recommended in the Cave water review could be used which requires the companies to 'match' the funding under the scheme and therefore contribute 50% of the necessary funding. Consideration also needs to be given to the absolute amount of funding under the scheme. Given the uncertainty about the way the energy networks will develop in response to the 2020 targets, and the type of innovation that will be required, it would seem most appropriate to build a level of flexibility into the scale of funding available but there are questions about how this could be effectively achieved.

- **Treatment of benefits:** We think that it is important to provide ex ante certainty over the treatment of benefits from innovation as this would help to remove some of the associated risks. This could be facilitated by developing transparent rules and processes, outlining the regulatory treatment of benefits from innovation under a range of different circumstances. There are many ways that the benefits from innovation may be treated. If there was no regulatory intervention, to the extent that benefits were not fragmented, the networks would be able to choose whether to retain the benefits or share them with consumers/stakeholders via lower costs or a higher quality service. Alternatively, specific rules on the sharing of benefits could be developed, either

[22] Independent Review of Competition and Innovation in Water Markets: Final report, Professor Martin Cave, April 2009, available from: http://www.defra.gov.uk/environment/water/industry/cavereview/pdf/cavereview-finalreport.pdf

requiring that a proportion of benefits are returned to consumers/stakeholders or that all of the benefits must be shared with them.

- **Assessment:** Assessment of an innovation project could be undertaken ex ante or ex post. Under an ex ante approach, funding would be provided for an innovative project subject to it meeting certain criteria and expectations of the benefits that may be achieved. If these benefits do not materialise, there should be clear rules surrounding subsequent treatment. Under an ex post approach, a review of the project would be undertaken following completion, with the potential for a volume of funding or a reward to be awarded. The ex ante approach would provide increased certainty on the treatment of innovation. If the ex post approach incorporated a 'prize' this would also provide a degree of certainty over the rewards available for innovation while an ex post 'prize' would allow the structure of funding/rewards to be determined in line with the project's outcome.

Annex 2: High-level assessment of example models

Outcome	Pre-specified innovation	Contestable innovation	Ex post 'prize'
Value for money			
Long-term efficiency	• **Networks may not be best placed to innovate** • **Individual netw**ork approach may miss interactions • Only one phase of innovation may not deliver efficiencies • Potentially limited funding may reduce innovation	• All phases of innovation stimulates efficiency • Applicability to cross-sector solutions • Competitive pressures to develop new ideas • 3rd parties may be best placed to progress pioneering solutions • BUT Increased funding	• Flexibility in taking forward innovation • Exposure to all costs may facilitate efficiency • Competitive pressures to develop new ideas • 3rd parties may be best placed to progress pioneering solutions • Where projects fail, this will assist learning • Uncertainty of funding may reduce innovation
Choice	• One innovation phase may reduce innovation and limit choice	• Competition may facilitate greater choice • All innovation phases – solutions not ruled out	• Competition and flexibility may facilitate greater choice
Quality of supply	• Networks only – must maintain quality of supply	• 3rd parties – need to maintain quality of supply under contract • 3rd parties/competition may pioneer new ideas, to increase supply quality	• 3rd parties – need to maintain quality of supply under contract • 3rd parties/competition may pioneer new ideas, to increase supply quality
Sustainability			
Security of supply	• Ongoing network management will ensure security of supply	• Presence of 3rd parties may increase security of supply concerns	• Presence of 3rd parties may increase security of supply concerns
Environment	• Limited governance could provide low level direction for innovation on the environment. If applications for innovation were used, this could be facilitated.	• Strong governance may lead to innovation on the environment • Competition will ensure only the best placed proposals proceed • 3rd party ideas may lead to ideas by others	• The 'prize' could target innovation on the environment • Progression of ideas to obtain a 'prize' could signal provide lessons • 'Prizes' can be effective where innovation in specific areas is needed
Social	• May be lower cost as related to one innovation phase	• Requires portion of benefits to consumers • Competition may lead	• Consumers do not face the cost of failures • No explicit return of

	and one sector • No explicit return of benefits to consumers	to increased efficiency on cost • BUT potentially higher costs associated	benefits to consumers
Desirable network behaviour			
Focus on consumers		• 3rd parties may be more proactive and forward looking	• 3rd parties may be more proactive and forward looking
Financeability	• Certainty on the level of funding	• Certainty on the level of funding • Uncertainty over scale of funding required	• Funding uncertainty • No funding for failure • Uncertainty over size of prize
Forward thinking and innovative	• Stimulus to one innovation phase	• Stimulus to all phases of innovation	• The 'prize' may stimulate innovation
Characteristics of the regulatory framework			
Better regulation	• Transparency of applications • Limited governance or ex post scrutiny	• Transparency on the competition outcomes • Governance provides rationale for decisions	• Removes the need for additional regulation • Limited transparency on failures
Feasibility	• Similar to IFI – easily achievable	• No certainty on scale of funding required • Logistics of 3rd party trialling on networks	• No certainty on size of 'prize' needed • Logistics of 3rd party trialling on networks