Electricity Distribution Price Control Review

Regulatory Impact Assessment for Registered Power Zones and the Innovation Funding Incentive

March 2004

Summary

This document is the final Regulatory Impact Assessment (RIA) for Ofgem's proposed policy relating to research, development in demonstration (RD&D) in the distribution network operator (DNO) companies.

Ofgem's policy is realised through two incentive mechanisms:

- Innovation Funding Incentive – a mechanism to encourage DNOs to invest in appropriate R&D activities; and
- Registered Power Zones – a mechanism to encourage DNOs to develop and demonstrate new, more cost effective ways of connecting and operating generation on their systems.

The primary objective of introducing these incentives is to secure benefits for consumers.

This RIA considers the current levels of DNO investment in RD&D, the regulatory constraints in this area, the potential for innovation and the likely benefits that it could deliver.

This RIA is supported by an independent assessment of the value of innovation carried out by Mott MacDonald and BPI which will be published separately.

This RIA concludes that the potential value to be derived through innovation is likely to considerably exceed the cost of the IFI and RPZ incentives. It therefore provides appropriate justification to proceed with the IFI and RPZs.

Table of contents

1. Introduction

Regulatory Impact Assessments (RIAs)

1.1. Ofgem is required to produce RIAs by the Sustainable Energy Act (SEA) which amends the Utilities Act 2000.

1.2. The SEA introduces a new section 5A to the Utilities Act which requires the Authority to carry out an RIA or publish the reasons why it considers that an RIA is unnecessary before implementing its proposals:

- ♦ whenever it proposes to do anything for the purposes of, or in connection with, the carrying out of any function exercisable by it under or by virtue of Part 1 of either the Electricity Act or the Gas Act; and
- ♦ where it appears to it that the proposal is 'important'.

1.3. Ofgem considers that policy decisions are important if they are likely to lead to significant costs and/or benefits for consumers; if they are likely to result in significant transfers between consumer 'groups'; and if they represent a significant change in Ofgem's approach to carrying out its functions. Where appropriate, Ofgem will produce a RIA for new policies introduced as the price control review progresses.

1.4. Where possible the costs and benefits will be quantified although it should be recognised that this not possible in all cases.

Ofgem's statutory objectives

1.5. Ofgem's principal objective as set out in the Electricity Act 1989 as amended by the Utilities Act 2000 is to protect the interests of consumers (present and future), wherever appropriate by promoting effective competition. The Electricity Act also sets out other important duties for Ofgem[1], including:

- ♦ securing a diverse and viable long-term energy supply;

[1] See sections 3(A) – 3(C) of the Electricity Act 1989 as amended by the Utilities Act 2000

- ensuring that licence holders are able to finance their statutory and licensed obligations;
- having regard to the effect on the environment of activities connected with the generation, transmission, distribution or supply of electricity; and
- having regard to the interests of individuals who are disabled or chronically sick, of pensionable age, living on low incomes, or residing in rural areas.

1.6. Ofgem also must have regard to the guidance provided to it by the Secretary of State on social and environmental issues.

1.7. The policies outlined in this document and the RIAs have been developed against the background of Ofgem's statutory objectives.

2. Regulatory impact assessment for RPZs and IFI

Introduction

2.1. Since early in 2002, Ofgem has been exploring the broad issue of technical innovation in the DNOs. This has included consultation in three documents[2], the most recent being December 2003. It has made initial proposals for two incentive mechanisms, the IFI and RPZs. This RIA is intended to:

- consider the need for innovation incentives in the light of the consultations;
- review the options for such incentives; and
- consider the impact of them, particularly on consumers.

2.2. Throughout this RIA, research, development and demonstration are collectively referred to as RD&D.

The drivers for RD&D

2.3. It is almost a truism that RD&D is essential in any industrial/technological company to address new technical challenges and to achieve general enhancements in efficiency. Most successful businesses need to invest in RD&D to continually improve their products/services. What is not clear is whether, under the current regulatory environment, the DNOs are undertaking an appropriate level of RD&D activity.

---

[2] Discussion Paper of 16 July 2003; Price Control Update of October 2003; 2nd Price Control Consultation of December 2003.

2.4. In a competitive business environment there is a natural pressure for companies to invest appropriately in RD&D. However, this does not apply in the monopoly DNO businesses which respond instead to the regulatory framework under which they operate. It is therefore appropriate for Ofgem to review the impact of the current framework on the companies' RD&D activities in the context of the principal objective of the Authority.

2.5. Ofgem has decided to review the RD&D issue at this time because two significant developments are taking place that are expected to cause the business environment of the DNOs to change substantially. The first is the potential need, identified by a number of DNOs, for an increasing rate of end-of-life asset replacement. This means that capital investment in networks could increase through the next price control period by comparison with current levels.

2.6. Secondly, the DNOs expect the penetration of generation into distribution systems to continue to increase. Their estimates that were published in the October update document[3] show that some 10GW of distributed generation (DG) could be connected through the next price control period. Ofgem understands that this is likely to present significant new technical challenges to the DNOs and consequently a requirement for additional capital expenditure.

2.7. The potential for increased capital expenditure on assets that have nominal lifetimes of 40 years requires Ofgem to pay particular attention to capital efficiency on behalf of consumers and generators. Capital efficiency requires that the DNOs employ the most cost effective network development strategies. The better the knowledge base that these investment decisions are made from the more likely they are to represent good value for consumers. An appropriate level of RD&D is therefore necessary to ensure the quality of this knowledge base and the availability of an optimal range of proven equipment and solutions.

2.8. RD&D also has the potential to deliver environmental benefits. In this context, examples of this include the following:

---

[3] Table 5.1 - Electricity Distribution Price Control – Update Document – 16 October 2003

- achieving higher utilisation of existing assets is a way to reduce the need for new lines and substations, thus reducing the impact of the distribution networks in terms of land use and visual amenity;
- more cost effective DG connections could increase the rate at which renewable generation can be connected to the system, displacing fossil-fired generation, thus reducing CO_2 emissions; and
- new products and operating strategies could reduce system losses, having benefit for a number of the environmental impacts of the overall electricity supply chain.

2.9. Qualitatively therefore the case for cost effective DNO investment in RD&D is evident. This RIA considers in more quantitative terms whether the current regulatory regime will deliver this or whether the incentives proposed by Ofgem offer a better way forward from the consumers' and generators' perspectives.

Current RD&D investment

2.10. The level of a company's investment in R&D is commonly stated as its R&D Intensity. This is the ratio of R&D expenditure to company turnover. The DTI tracks R&D Intensity for different industrial sectors in the UK and internationally. The results are published annually as the DTI's R&D Scoreboard[4].

2.11. Analysis of data available to Ofgem shows that the average R&D Intensity for the DNOs was less than 0.1% for 2001-02 and 2002-03. This compares with a UK average (all sectors) of 2.5% shown by the Scoreboard. It is accepted that some DNO R&D expenditure may not be captured by the data available but any omissions are not expected to materially increase the figure quoted here.

2.12. It must be assumed that this low level of R&D Intensity is judged by the regulated companies, taking all related technical and regulatory factors into account, to be consistent with meeting their licence obligations in the current technical environment; a relatively stable one. The network challenges now anticipated make it important to understand the factors that influence the RD&D

---

[4] DTI's R& D Scoreboard – http://www.innovation.gov.uk/projects/rd_scoreboard/

activities of the companies, particularly how the regulatory framework interacts with this type of expenditure.

Ofgem's goals

2.13. The IFI and RPZs have been developed to help meet the Authority's objectives and to ensure that consumers benefit from RD&D investments that companies make.

2.14. This RIA assesses the case for the IFI and RPZs and concludes by making recommendations that should be reflected in Ofgem's policy relating to RD&D in the DNOs.

Objectives

2.15. The two mechanisms proposed by Ofgem are designed to deliver benefits to consumers and generators. Their specific objectives can be summarised as follows:

- **IFI** – to develop a mechanism that will encourage DNOs to invest in appropriate R&D activities that focus on the technical aspects of network design, operation and maintenance. The principal objective of the IFI is to deliver benefits to consumers by enhancing efficiency in operating costs and capital expenditure.

- **RPZs** – to develop a mechanism to encourage DNOs to develop and demonstrate new, more cost effective ways of connecting and operating generation that will deliver specific benefits to new distributed generators and broader benefits to consumers generally.

2.16. Funding under the IFI can be used by the companies for R&D activities relating to any technical development of a distribution system including design and operation. RPZs are in contrast focused on the connection of generation. The IFI and RPZs are designed to be complementary. IFI projects that relate to DG connection might typically be further developed through RPZs before widespread adoption as proven solutions.

2.17. Ofgem jointly chairs the Distributed Generation Coordinating Group (DGCG) with the DTI. The Technical Steering Group of the DGCG is bringing forward ideas that need to be demonstrated on real networks before being widely adopted. RPZs are expected to lend themselves well to this kind of project.

Overview of key issues

Constraints on RD&D in DNOs

2.18. The current RPI-X regulatory environment has resulted in material cost savings that have delivered real benefits to consumers. However, whilst Ofgem has not in any way prohibited RD&D investment, the view has been expressed by a number of respondents to recent consultations that the specific implementation of RPI-X in the distribution price control is not generally considered to be conducive to RD&D. Evidence from one leading R&D provider bears this out. Its annual income from DNO R&D projects in the current price control period has reduced by 85% since 1990 and is approximately a third of its level in the previous price control period.

2.19. In Appendix 1 to this RIA a simple example is provided which lends weight to this argument. It considers investment in an RD&D project spread over a five year period that subsequently generates benefits for a 20 year period. It shows that if the DNO keeps all the benefit then the Net Present Value (NPV) of the investment is strongly positive. If the DNO only captures the first five years of the benefit (as would happen under traditional price control methodology) the NPV turns negative and the project would be unlikely to proceed. If the project is funded under the IFI scheme with 80% pass-through the business environment is made more favourable and both the DNO and consumers see a positive NPV. This simple example helps illustrate the sensitivity of timing and consumer capture of benefits under RPI-X treatment.

2.20. Additionally, consultees have made the point that effective management of RD&D activities itself has a cost, which is a further potential barrier. This is related primarily to the need to employ professional engineering staff who have the competences to develop and manage RD&D programmes that will deliver business benefits successfully. Experience in this sector and elsewhere demonstrates that simply funding an RD&D provider is unlikely to deliver success. A close partnership is necessary guiding the establishment and the progress of a project. This necessitates the commitment of time and professional resource by the DNO.

2.21. It can be viewed that over the last decade the needs of the system have not justified significant investments in RD&D and that, encouraged by RPI-X, the companies have been limiting their activities in an appropriate way. However, given the changing circumstances now anticipated a change in behaviour is considered appropriate and it is therefore timely to address the incentives for RD&D.

The transition to active systems

2.22. Until the early 1990s the amount of generation connected to DNO systems had been decreasing for several decades. This allowed the networks to be most efficiently developed as essentially passive systems. This means that the number of system components that are required to respond intelligently to changing network conditions is reduced with consequent capital and operating cost savings.

2.23. Since the early 1990s, the amount of DNO connected generation has increased and this trend is forecast to continue through the next price control period. Most of the distributed generation commissioned in the last decade has been connected on a fit-and-forget basis, consistent with a passive system design philosophy. However, Ofgem considers that this will not deliver the most cost-efficient approach as the penetration of distributed generation increases further. The transmission system is in contrast operated as an active network, accommodating bi-directional power flows and variable generator infeeds. A distribution system with multiple sources of generation is fundamentally no different and a transition to increasingly active management can be expected. This new phase in the development of distribution networks presents significant new technical challenges to the DNOs. Investment in RD&D will enable them to respond efficiently to this challenge on behalf of consumers (including generators).

The Government's targets for CHP and renewable generation

2.24. In its Energy White Paper[5] the Government set out its long-term ambition for a 60 percent reduction in the UK's carbon dioxide emissions by 2050[6] and for the reduction in emissions to be on course in 2020 to achieve this goal. The White paper also set an aspiration of 20 percent renewable generation by 2020.

2.25. As part of the UK Climate Change Programme the Government has also set a target for 10 percent of electricity supplied in the UK to be generated from renewable sources by 2010 and for there to be 10 GW of CHP installed by the same date. The Renewables Obligation requires suppliers to provide a proportion of their supplies from qualifying renewable sources, rising to 10.4% by 2010 and 15.4% (proposed) by 2015. Together, the Renewables Obligation and Climate Change Levy exemption provide significant support to investment in renewables, likely to be of the order of £1 billion per annum by 2010. If the 2010 targets are to be met, up to 14 GW[7] of new capacity may be required, much of which could be connected to distribution networks.

2.26. The Authority is concerned that the development of new generation sources should not be constrained by the inability of networks to accommodate them. Development and demonstration of new products and solutions is an important element in securing technical progress and cost-efficient solutions. Importantly, the manufacturers cannot take these steps without the support of the DNOs. It is not possible to prove fully new network equipment in the laboratory. It is a requirement to undertake a proving stage (demonstration) on a real system exposed to the full range of operating conditions.

2.27. The establishment of the DGCG jointly by the DTI and Ofgem was driven by the need to remove network constraints to the connection and operation of DG. It is a rational step for Ofgem to encourage the recommendations of the DGCG to be implemented on networks in a cost efficient way. The IFI and more particularly RPZs are designed to help achieve this objective.

---

[5] *'Our energy future – creating a low carbon economy',* DTI (February 2003)
[6] Including the policies contained in the UK climate change programme, 2020 emissions are forecast to be around 135 MtC (18% below 1990 emissions). The Energy White Paper sets out the Government's aim for 2020 emissions to be 15-25 MtC below this target.
[7] See Ofgem's website under 'Distribution explained/Distributed generation'

Views of other parties

2.28. During 2003, Ofgem met individually with a number of manufacturers of distribution plant and equipment. The manufacturers responded with a consistent view about the DNOs' RD&D strategies. The manufacturers find that first-cost is a key criterion that dominates buying decisions with much less emphasis on through-life cost assessment. They also report that they find it increasingly difficult to work with DNOs to develop new products that could deliver cost and performance benefits over the medium to long term.

2.29. The DTI's Renewables Advisory Board has welcomed Ofgem's initial proposals for mechanisms to encourage relevant network RD&D[8]. The Science and Technology Select Committee has recommended that Ofgem "should establish a more supportive framework for innovation and R&D toward the new "climate friendly" technologies"[9].

2.30. Finally, the responses to the three consultations[10] already carried out have been overwhelmingly supportive of the IFI and RPZs in principle. Such responses have been received from DNOs, energywatch, the Renewable Power Association, manufacturers, consultants and academia. Many issues of detail have been raised and these are being taken into account in the further development of the proposed incentive mechanisms.

---

[8] Renewables Advisory Board 2003 Annual Report – page 19

[9] Science & Technology Select Committee – April 2003 - Towards a Non-Carbon Fuel Economy: Research, Development and Demonstration

[10] Discussion Paper, July 2003; Price Control Update, October 2003; Price Control 2nd consultation, December 2003.

Options

The status quo – no explicit price control allowance for RD&D

2.31. It is an option to continue to rely on the existing regulatory framework to deliver appropriate RD&D investment and the DG Hybrid incentive to encourage innovation in connections. Taking R&D investment first, as already discussed, there is evidence that the existing framework has delivered a decreasing level of R&D activity amongst DNOs. The widespread support that the IFI proposals have received from diverse parties suggests that some refinement to the regulatory environment is needed. The proviso to this is that consumers are given reasonable assurance that R&D investments will deliver value for money and the Authority must put in place reasonable controls to ensure this. Regarding DG connection, it should be noted that the DG Hybrid incentive has not been designed to encourage innovation in connections and the average returns that it delivers are not intended to balance the risks of deploying innovative connection technologies and solutions.

2.32. If no targeted measures are put in place to encourage R&D activity there is a risk that it will continue at a low level and consumers will not gain the potential benefits anticipated. In the following paragraphs options are discussed firstly to encourage research and development (IFI Options) and then demonstration (RPZ Options).

IFI Option – Costs allowed ex-post

2.33. It would be possible for actual R&D expenditure to be allowed on an ex-post basis. This allowance could be linked to some measure of success and demonstrable consumer benefit. It would provide some incentive for DNOs but it is judged that it would not be sufficient to balance the risks that a DNO would be taking. The risk profile of this approach is still inconsistent with shareholders' expectations of a DNO's business model. Perhaps more importantly, it would not encourage those DNOs that take R&D risks to share the results with DNOs that do not.

IFI – Costs allowed ex-ante

2.34. If R&D costs were allowed on a simple ex-ante basis under the price control the consumer would be carrying an unacceptable risk. The DNO could simply avoid the expenditure to enhance short-term profitability. This is not offered as a viable way forward.

R&D classed for Regulatory purposes as capital

2.35. In place of the proposed IFI incentive, an alternative might be to treat R&D expenditure as capital and allow it in to the Regulatory Asset Value so providing DNOs with a guaranteed return at the cost of capital rate. This would have some attractions but would need detailed evaluation to understand how it compares to IFI and RPZ as an incentive on DNO behaviours. A monitoring framework would still be needed to ensure 'use it or lose it' treatment and transparency mechanisms would continue to be required to promote peer pressure for high quality work and encourage the sharing of best practices. On balance it is Ofgem's view that this alternative does not offer sufficient advantages to warrant detailed evaluation at this stage. It however remains an option to be considered for the longer term and will be reconsidered at the 2007 review point when experience of IFI and RPZ has been gained.

IFI – Costs allowed ex-ante and ring-fenced

2.36. By ring-fencing the R&D allowance and attaching a 'use it or lose it' condition the risk to the consumer is significantly reduced. This is the basis of the IFI. It is considered that this approach offers a risk profile for a DNO that is consistent with its business model (depending on the level of pass-through and the actual costs that are allowable). At the same time it offers consumers the potential benefits that R&D can bring together with a reasonable level of financial protection. There remains a risk that the allowed expenditure may deliver little or no value. The requirement for the DNOs to part-fund IFI projects and the potential rewards should act to reduce this risk. Peer visibility and the pressure it provides together with the use of Asset Risk Management surveys should also be effective here. Ofgem also recognises the value of collaborative projects involving two or more DNOs; this approach is not only cost-effective but also encourages effective and more widely-applicable outcomes.

RPZ Options

2.37. Two options have been considered to encourage innovation in DG connections. The first was to allow a DNO to retain the financial benefit of an innovative solution where it enabled lower connection costs to be achieved. The second was simply to enhance the £/MW element of the Hybrid incentive for registered RPZ connections. The potential difficulties of establishing the financial benefit in a straightforward and auditable manner under the first option led to a preference for the second option. (It would be particularly problematic for Ofgem to verify what traditional investment would have been undertaken had an innovatory approach not been adopted.) This preference is enhanced by the fact that this option offers a logical extension of the Hybrid DG incentive.

Further options

2.38. A cost-efficiency case can be made for centralised RD&D along the lines that existed pre-privatisation. This is not common practice in competitive markets where most companies would pursue R&D alone. Also, this option is considered to be potentially unresponsive to individual companies' needs and inconsistent with the liberalised structure of the industry. It is not judged appropriate for Ofgem to seek to impose such a model.

2.39. RD&D capital grants can be sought on occasions under DTI and EU technology-specific schemes. These typically require industrial sponsorship and the DNOs have shown little enthusiasm to engage with this in the past. Being technology specific, and a competitive process, it makes the development of a coherent RD&D strategy by a company more difficult. Ofgem sees capital grants as complimentary incentives to IFI and RPZ, which can be expected to bring forward greater DNO participation as industrial co-sponsors.

2.40. Finally, a number of parties have suggested that RPZs should be broadened into distribution Network Innovation Zones not restricted solely to the connection of new generation. This has some attractions as it would allow the full range of successful outputs from IFI funded developments to be demonstrated on a network and proven for wider applications. It is judged that this suggestion should be given further consideration at the 2007 review point proposed for IFI and RPZs.

Costs and benefits

2.41. RD&D activities deliver knowledge that, when applied, is expected to produce value in excess of its cost. No definitive cost/benefit analysis can be carried out to prove ex-ante that RD&D investment will deliver appropriate returns as, by definition, RD&D has an element of uncertainty. However, it is possible to assess scenarios of potential value that RD&D could deliver, combined with the likelihood that a successful outcome will be achieved, to allow an estimate of its financial value to be obtained.

2.42. The valuation presented here has been carried out by Ofgem's consultants, Mott MacDonald/BPI (MM/BPI)[11]. Mott MacDonald has recently completed a study into the network impacts of renewable generation for the Carbon Trust and has also been advising Ofgem on the price control impacts of DG. This experience has been drawn on to support their analysis.

2.43. Before carrying out their analysis of the value of innovation, MM/BPI met with representatives of the manufacturing community, a DNO, a leading research institute and a commercial R&D provider to the DNOs. A literature search was also carried out as part of the process of establishing a list of innovation opportunities. MM/BPI also attended a workshop organised by Ofgem to address the quantification of innovation benefits.

2.44. The methodology that MM/BPI has adopted to carry out the valuation is as follows. A range of innovations for both DG connections and more general network developments has been identified. For each innovation the following parameters have been assessed - the:

- potential capital and/or operating cost benefits;
- likelihood of successful adoption;

---

[11] MM/BPI – Innovation in Electricity Distribution Networks, March 2004.

- timescale for successful adoption; and
- duration of the benefit once deployed.

By combining these parameters an estimate of the present value (PV) of the benefit of deploying each innovation can be determined. This methodology has been applied to both RPZ and IFI innovations and these are discussed in turn here.

RPZ - MM/BPI cost/benefit analysis

2.45. Over twenty DG connection innovation possibilities have been assessed. These link closely to the work being carried out by the Technical Steering Group of the DGCG[12]. They address voltage control, fault level management and power flow management. For each connection innovation the potential cost saving it could deliver is established as a proportion of estimated annual DG connection costs. These cost savings have been calculated using the generic distribution model used in the Carbon Trust study.

2.46. These cost savings are then factored by the likelihood of success, the likely date of deployment and the period of time for which the benefit would endure. A PV is then calculated for each innovation. Summing these estimates for the identified RPZ connection innovations gives a total PV of £121 million. The innovations considered and the factors applied are shown in Appendix 2.

2.47. The equivalent maximum present value, assuming full take-up, of the RPZ incentive is £29 million. It cannot be guaranteed that this incentive will deliver the full £121 million benefit identified here. The actual benefit could be higher or lower. However, as the potential benefits of a specific RPZ project will be identified as part of the registration process, it can be expected that the most attractive opportunities will be pursued increasing the likelihood that net benefits will be delivered.

---

[12] www.distributed-generation.org.uk

IFI - MM/BPI cost/benefit analysis

2.48. Some twenty further general network innovations were analysed using a similar methodology. These are also shown in Appendix 2 together with the parameters used to assess their value. These innovations are related to improvements in asset management, control and communications and a number of specific technological developments.

2.49. The estimated potential benefit was again factored by the likelihood of success, the expected date of deployment and the lifetime of the benefit to calculate a PV. Summing these estimates for the identified IFI innovations gives a total PV of £443 million.

2.50. The PV of the cost of the IFI to consumers (assuming 80% pass through) is £57 million. As noted for RPZs, it cannot be guaranteed that this level of IFI funding will deliver the estimated benefit in full. For example, the IFI projects under the title "Other more general areas" are likely to require additional funding. If the value of these innovations is ignored the £443 million total value reduces to £372 million. Given the information now available, it is Ofgem's judgement that the value that IFI will deliver will be significantly greater than the funding invested. Furthermore, the total funding being made available under IFI can reasonably be expected to bringing forward a substantial proportion of the projects on the MM/BPI schedule (or equivalents). Additionally, as the DNOs will be investing their own funds in IFI projects they will assess the value of each project so that those with the best prospects of high returns will be pursued first. Combining this with the additional checks and balances being proposed, it is expected that the better opportunities will be self-selecting and that net benefits will be delivered to consumers.

Additional evidence

2.51. In Appendices 3 and 4 further evidence is summarised supporting the case for the IFI and RPZs. Appendix 3 provides a case study of a successful innovation that is now being adopted. Appendix 4 is obtained from extracts of the December consultation responses and a summary of the presentations given at a workshop event held in January 2004 to address the quantification of innovation benefits.

Additional benefits

2.52. Other potential benefits from RD&D investment have been identified, including the following:

- quality of supply – both in the context of continuity and quality (i.e. voltage control and waveform quality) consumers are becoming more aware of the issue of quality of supply. This is because of the increasing use of electronic equipment that is sensitive to these parameters. RD&D in this area can be expected to offer the option of enhanced quality in all its dimensions;

- reduction of losses – incentivisation of loss reduction is already addressed by the regulatory framework. However, RD&D projects in this area have the potential to enable DNOs to meet or exceed their performance targets;

- environment (amenity) – there is already great pressure to avoid the construction of new lines (often required for renewable generators). As connection constraints on rural networks are often voltage related there is potential to achieve higher utilisation of assets using novel techniques and reduce the need for new lines and substations. This is an evident amenity gain. Work at UMIST and a DNO demonstration project have already made progress here; and

- skills and recruitment - DNOs are having increasing difficulty in recruiting and retaining new graduates, qualified in power system engineering, into their businesses. Greater involvement in innovation will, arguably, raise the intellectual challenge and opportunities for professional engineers and have a positive overall effect.

Environmental impacts

2.53. Probably the most significant environmental benefit associated with these incentives is that related to renewable generation itself. While the IFI and RPZs do not in themselves incentivise any extra renewable generation to be built, the benefits, from RPZs in particular, may facilitate its more rapid implementation and unconstrained operation. This will assist in the achievement of the Government's environmental objectives. No direct financial benefit is claimed here to justify Ofgem's proposals however, the following illustrations of potential environmental benefits should be noted.

2.54. It is possible that more than 10GW of new distributed generation may be connected over the next ten years. If 100 MW (i.e., 1 per cent) of capacity were to be connected five years earlier it would potentially result in the avoidance of carbon dioxide emissions of the order of half a million tonnes[13]. If an additional 100 MW of capacity were to be connected that would otherwise not be connected, benefits in terms of avoided emissions might be in excess of 2 million tonnes of carbon dioxide[14].

2.55. This illustration is not intended to be a forecast of the likely magnitude of the impacts of the policy proposals; it is presented to quantify the relationship between possible outcomes and possible benefits.

Security of supply

2.56. In the short and medium term there is no direct linkage between the IFI and RPZs and security of supply. However, there are opportunities to enhance supply security with DG and combined with the IIP incentives it is quite likely that security of supply benefits will flow from investment in the IFI and RPZs.

2.57. In the longer term, with high penetration levels of DG in certain parts of the network, it is reasonable, from a technical perspective, to anticipate generator stability difficulties. This will need considerable innovation to address and thereby avoid generator cascade tripping and risks to supply security. When the proportion of DG becomes significant in the national context, such cascade tripping could jeopardize national security of supply by exceeding NGT's holding of fast response, required to secure the system against instantaneous generation losses.

---

[13] Assuming capacity brought forward 5 years.
[14] Assuming a 25 year lifetime for a wind farm at 30% load factor.

Costs and benefits to consumers

2.58. If the IFI funding was fully taken up, assuming 25 million consumers and an 80% pass through, the average annual cost to consumers would be about 60 pence. It is essential to ensure that the benefits that result from IFI projects are shared appropriately with consumers and this would be achieved through normal price review mechanisms.

2.59. The cost of the RPZ scheme is less easy to define. Its proposed cap of £35 million is less than 50% of the IFI funding cap but it is proposed that RPZ costs are met by generators as a class in a DNO's area and not by demand consumers. This issue will be addressed as part of the implementation process for the Structure of Charges project.

2.60. The analysis presented here gives confidence that the benefits that will flow from the IFI and RPZs, considered as a present value, will significantly exceed their cost.

Conclusion

2.61. The costs would appear to be reasonable and will be controlled by capping mechanisms. The benefits indicated by the independent modelling give reasonable grounds for confidence that they will exceed the costs and indeed could do so significantly.

Risks and unintended consequences

Risks

2.62. In view of the potential consumer benefits identified, it is not appropriate to consider a 'Do Nothing' option. This would carry the risk that the DNOs would continue to develop their networks by applying extant technology and potential efficiency gains will be lost. However, as this approach has the minimum short term risk profile it does have attractions to the companies. If the RPI-X cost reduction driver is not in balance with the risks involved in developing new solutions the status quo will be maintained. There is therefore a risk that consumers will not see the benefits that innovation could deliver.

Risk Management - IFI

2.63. There remains a risk that IFI funding will be properly spent but will not deliver benefits that produce an acceptable return. This is the case with R&D expenditure in any business. However, whereas in a competitive environment the shareholder takes this risk, under IFI the consumer takes most of it (depending on the pass-through rate). It is essential therefore that adequate controls and safeguards are put in place to limit the consumer's exposure.

2.64. As a condition of allowing IFI expenditure, a DNO will be required to participate in the development of an industry good practice guide to innovation management. It will also be required to produce a public domain annual report of its IFI activities. This report will describe the work being carried out, its relevance in terms of potential consumer benefit, the money spent in the reporting year and the planned activities and budget for the next two years. This will promote best practice between companies and act as a driver for high quality activity. Compliance with the good practice guide can be audited by Ofgem at the time of periodic Asset Risk Management Surveys.

2.65. This risk will be further reduced by the requirement for DNOs to part-fund IFI projects and the potential rewards for success.

2.66. A review of the IFI initiative will be carried out by Ofgem after the publication of the second annual reports (2007). At this stage, the level of IFI funding will be reviewed for each company. Ofgem will retain the option to audit IFI activities and to reduce the IFI cap for a DNO if considered necessary.

Risk Management - RPZ

2.67. RPZ projects could also fail if the innovation technology involved is unsuccessful, resulting in money wasted, quality of supply jeopardised and DG output constrained. Again, appropriate risk management measures must be put in place to reduce these risks to a minimum.

2.68. Ofgem has a role in the initiation of RPZ schemes as it is required to register each one. There will be clear guidelines and performance criteria for RPZ projects and the risks and benefits could be assessed on a scheme specific basis.

Each scheme could therefore be measured against the criterion of protecting consumers' interests. A further safeguard will be provided as the approval of the connecting generator will be required for an RPZ to proceed.

Unintended consequences

2.69. These proposals are focused on specific issues. The IFI activities will be openly reported and the RPZ schemes will be individually registered by Ofgem. The possibility of unintended consequences of real materiality is small. Ofgem has said that it will not have any part in the control of intellectual property generated as a result of either of these initiatives. There is a possibility therefore that a company could establish a particular market position through its ownership of such intellectual property.

Competition

2.70. Ofgem do not consider there to be any material issues in relation to competition. Ofgem expect that the IFI and perhaps RPZs will cause the companies to work collaboratively in some areas. This is expected to encourage industry-wide sharing of new ideas. However, there is scope for companies to work alone and if their performance improves as a result it will assist Ofgem in the future comparisons between companies.

Distributional effects

2.71. Ofgem does not see any adverse distributional effects relating to the IFI. Consumers and DNOs will fund the IFI and it is expected that both groups will gain benefits.

2.72. RPZs will be funded by generators wishing to connect to distribution systems and it is this class of system user that will benefit from these schemes. Again therefore, Ofgem do not see any adverse distributional effects.

Review and compliance

2.73. The open reporting of the IFI projects combined with Ofgem's ability to selectively audit projects should ensure compliance with the objectives of this incentive. A review is planned in 2007 to assess the initial success of the IFI.

2.74. RPZs will be registered with Ofgem and will again be the subject of open reporting. There are therefore no material issues relating to review and compliance.

Conclusions

2.75. The conclusions drawn from this RIA can be summarised as follows:

- the technical challenges that the DNOs currently face are likely to be met more efficiently if appropriate RD&D investment is made;
- current RD&D investment is at a very low level and it is likely that, without some change to the regulatory environment, this will not change significantly;
- there are reasonable grounds for confidence that the potential benefits for consumers of successful innovation are significant;
- incentives for RD&D investment must properly protect consumers whilst giving reasonable freedom to DNOs to pursue innovation, without hindrance to collaborative work between companies. The potential benefits of RD&D collaboration between DNOs are considered to be significant and mechanisms to encourage collaboration and the sharing of results/solutions should be actively considered;
- the cost to consumers of the IFI is judged to be modest. It is important that mechanisms are put in place to ensure that consumers gain an appropriate share of the benefits that flow from IFI funded RD&D; and
- the costs and benefits of RPZ projects will be assessed individually. DNOs should provide details of project funding (i.e. – connection charges, costs annuitised to GDUoS – costs to fall on generators) with the application for RPZ registration.

2.76. This RIA concludes that the IFI and RPZs are in principle appropriate mechanisms to incentivise RD&D activities. Their further development should take account of the following:

- RD&D costs that are to be met by consumers should only be committed if they can be justified by the potential benefits that they are intended to deliver.
- RD&D projects should be managed using best practice methods and reporting should be transparent and in the public domain.
- safeguards and controls should be incorporated in the incentives to identify and react to under-performance.

Appendix1 Regulatory constraints on RD&D

An RD&D project could have the potential to deliver a product or solution that could reduce costs for many years. Under the current arrangement the DNO will only see the benefit for a five year period before it is captured for the consumer. This can significantly reduce the economic case for the original investment and therefore presents a strong disincentive to take the risk.

<u>As an example:</u>

An RD&D investment of £5m over 5 years has the potential to generate a saving of £1m per annum for a period of 20 years.

The NPV of this investment (@ 6.5% discount rate) is £3.6m and this would be the benefit to the DNO if it retained all the benefit.

<u>If this benefit is captured for consumers after 5 years the benefit seen by the DNO is dramatically reduced:</u>

The investment of £5m now only produces £5m of cash savings spread over 5 years. This causes the NPV (@ 6.5% discount rate) to fall to -£1.1m.

As a result, the DNO would not be likely to make the investment.

<u>Now assume that the investment is funded, under IFI, 80% by consumers and 20% by the DNO:</u>

The DNO retains the £1m saving for the first 5 years - its NPV on the investment is £2.1m.

The consumers benefit from the £1m saving for the remaining 15 years and the NPV on their investment is £1.6m.

Under this arrangement therefore the investment would be more likely to proceed and the DNO and consumers would see approximately equal benefits.

Appendix 2 Extracts from the MM/BPI Report

Evaluation of the Value of RPZ Innovations

Table 1 - Innovations for RPZ	
Voltage Control	
VC0	Active voltage control *
VC1	Cancellation CTs *
VC2	Virtual VTs *
VC3	FACTS (Flexible AC transmission systems)
VC4	Line voltage regulators *
VC5	Upgrade conductors *
Fault Level Management	
FL0	Network reconfiguration (network splitting) *
FL1	Is limiters *
FL2	Superconductivity (HTS) fault limiter *
FL3	Sequential switching *
FL4	Increase network impedance - e.g. bus section reactors *
FL5	Active fault level management - controlled bus section isolators *
FL6	Converter interface technology (and generator transformers?)
FL7	Fault anticipators
FL8	Fault level monitor
Power Flow Management	
PF0	Post-fault constraint (intertripping) - multiple generators *
PF1	Post-fault constraint (dynamic, including use of short-term ratings) - multiple generators *
PF2	Energy storage technologies

Table 2 - Likely Return

	Voltage	Fault	Energy storage
	L	M	H
on Capex	1.5%	4.0%	7.0%
on Fault Related	0.3%	0.8%	1.4%
on Opex	0.3%	0.8%	1.4%

Table 3 - Time Scale

In (years) time applied to

	Short S	Medium M	Long L
Capex	3	7	12
Faults	3	7	12
Opex	3	7	12

Table 4 - Success Factor

Low	Medium	High
L	M	H
25%	50%	75%

Table 5 - Duration of Benefit

Years			
5	10	20	40

Commentary

Each of the innovations in Table 1 is assessed individually. It is first allocated a likely return from Table 2 according to the category of solution. The percentages in Table 2 relate to total DG connection costs. This allows a maximum annual benefit to be calculated based on total DNO costs for the related activity. It is then allocated a likely deployment date from Table 3. This allows the present value of the annual benefit to be calculated for its first year of deployment. This is then scaled by the appropriate success factor from Table 4. Finally, the innovation is allocated a likely period for the duration of the benefit (Table 5) so that an overll value for the lifetime of the innovation can be established.

The sum of the present values for all of the connection innovations listed is £121 million (6.5% discount rate) .

Note: * means that the innovations listed are alternative solutions to the same problem. The total PV is adjusted accordingly.

Evaluation of the Value of IFI Innovations

Table 1 - Innovation	
Communications improvement	
1	Power line communications (PLC)
2	Use of mobile telephone technology capable of supporting bi-directional and broadcast data communications
3	Move SCADA networking to TCP/IP (Transmission control protocol/internet protocol) suite and associated technologies.
Asset management improvement	
1	Improved tap changers
2	Stored coolth for transformers
3	Online condition monitoring (including e.g. condition monitoring from oil)
4	End-of-life recognition including condition based risk management using health indices
5	Data management and improved decision making (including expert systems e.g. KEMA MainMan and RCM: reliability centred maintenance)
6	Cost effective asset management strategies (e.g. operation, investment, and design strategies) including strategic development recognising uncertainty.
7	Improved Network Automation
8	Move away from air-breathing transformers
9	Melting ice on power cables
10	Asset replacement development
Other more general areas	
1	Superconductivity
2	Demand side management – real time load management
3	Intelligent transformers
4	Solid state switching
5	Self healing cables

Table 2 - Likely Return	Low L	Medium M	High H
	L	M	H
Capex	0.5%	1.5%	3.0%
Fault Related	0.5%	1.5%	3.0%
on Opex	0.5%	1.5%	3.0%

Table 3 - Time Scale In (years) time applied to	Short S	Medium M	Long L
Capex	3	7	12
Fault related	3	7	12
Opex	3	7	12

Table 4 - Success Factors		
High	Medium	Low
H	M	L
75%	50%	25%

Table 5 - Duration of Benefit			
Years			
5	10	20	40

Commentary

Each of the innovations in Table 1 is assessed individually. It is first allocated a likely return from Table 2. The percentages in Table 2 relate to total DNO costs divided between capex, opex and fault related costs. Some innovations may have beneficial cost savings in more than one of these cost areas. This allows a maximum annual benefit to be calculated based on total DNO costs for the related activity. It is then allocated a likely deployment date from Table 3. This allows the present value of the annual benefit to be calculated for its first year of deployment. This is then scaled by the appropriate success factor from Table 4. Finally, the innovation is allocated a likely period for the duration of the benefit (Table 5) so that an overll value for the lifetime of the innovation can be established.

The sum of the present values for all of the innovations listed is £443 million (6.5% discount rate) .

Appendix 3 Short R&D Case Study

Short R&D Case Study:

Cable Fault Sniffer for faster underground cable fault location

This device was developed as a collaborative R&D project by a group of DNOs through E A Technology's Strategic Technology Programme. It enables underground cable faults on low voltage mains to be located by detecting traces of arc products that percolate through the soil to pavement level. These underground faults can be particularly problematic for DNOs to locate, resulting in abortive work that creates additional costs and causes supply restoration delays.

The key facts of this case study are as follows:

This project can be viewed as an example of the type of project that IFI funding might support. It results in benefits for operating cost savings and Quality of Supply improvement through reduced Consumer Minutes Lost.

Actual development period: 7 yrs

R&D investment was £130k (first cost)

Repeat cost is less than £5,000 per device. It has been successfully 'productionised' and is supplied by EA Technology.

Estimated application 5-10 faults per day per D- licensee

(which represents some 50% of the cable faults that arise where location is not obvious)

Performance to date indicates device is successful for 80% of applications in field

Demonstrated operating cost saving c. £750 per LV fault

with 25% reduction in consumer mins lost for this type of fault

Full UK deployment of the device has been calculated to deliver some **+£47m** net saving pa assuming, average fault rate statistics and projected device purchase volume and costs

Sales already exceed 100 devices and strong interest is coming forward from the DNOs. Ofgem understands that 50 are shortly do be ordered by one DNO, and 90 by another.

It is instructive to note that the DNO's collaboration rules now require a 3 year maximum development period, so this project would not commence if being considered today.

Appendix 4 R&D examples and opportunities

Examples identified to Ofgem	Estimated Saving
Cable Fault Sniffer (EATechnology) See separate case history – project delivered successfully	**£47m pa**
Overall return from IFI (EATechnology) Their estimate of overall benefit of R&D funded by the IFI; based on benefits pro-rata to the benefits which will result from past investment in STP over a three year period.	**£500m pa**
Novel Voltage Regulator (DNO) One DNO has successfully deployed a device new to the UK system to achieve a more cost-efficient 2MW wind generator connection. 11kV active voltage management has avoided a 33kV connection being required. £50/kW unit connection cost achieved.	**some 90% saving on wind generator connection cost**
Unit Connection costs for DG (EATechnology) EATL estimate that unit connection costs (DPCR submissions have identified a range of £35/kW to £220/kW) might be reduced by £40/kW. This is a saving of some 50% against the average of the range identified, or some 20% against the upper bound.	**20-50% reduction on £/kW DG connection cost**
Total DG connection costs (EATechnology) EATL estimate that some 10% of new DG capacity might benefit from innovative solutions providing savings of the order shown above. This would equate to some £40m over the period to 2010 assuming successful RPZ demonstration of new technologies, and brought forward through IFI funding. Larger savings would be likely in the following period as network spare capacity is used up and average connection costs start to rise.	**£40m saving in DG connection costs to 2010; and greater savings in the period following**
New Line design to replace steel structures (NEDL) For historical reasons, NEDL have steel lattice line designs, and YEDL have steel girder designs for 33kV and 66kV that are approaching replacement. They estimate that a new design, using wood poles, might cost £200k to develop and test but would have potential net benefits of £20m over 10 years.	**£20m saving on line refurbishment over 10 years**
Fault level Monitoring device (NEDL) One DNO sees strong benefit in developing a device that could measure the fault level (the prospective power that will flow under short-circuit conditions). This could be developed for £100-£250k but might save £3m on a single large DG connection scheme by avoiding switchgear replacement. (Fault level limits are a significant DG connection issue)	**£3m saving on certain DG connections**