RPI-X @20 Investment Working Group Report

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This paper should be read with reference to the RPI-X@20 project. It is an overall summary of the group's discussions.

Final version

1. Introduction

This document has been produced by the RPI-X @20 Investment Working Group which held three meetings between May and September 2009, and is a summary of more detailed discussion papers. It does not seek to recommend detailed solutions to the changing needs of the network investment framework, but does serve to record the inputs, issues and ideas of the participating members spanning transmission, distribution and retail companies.

The RPI-x framework originally introduced in 1990 has generally served customers well, with substantial operating cost reductions during the post privatisation period. The industry has also delivered on safety performance, customer service, network performance and increasing levels of technical innovation. The application of the framework has however generally resulted in it being most effective in dealing with existing investment drivers that mostly relate to the incremental replacement, reinforcement and extension of the extensive asset bases of gas and electricity infrastructure. Historically the degree of uncertainty over future asset investment needs has been minimal, and further contained by careful analysis and planning. The key question is whether the approach will be less effective in accommodating or encouraging some of the investments required in the developing, and less certain future energy world.

It is important to identify the drivers of the investments required to help facilitate future energy provision, as these may well not be limited to networks themselves. They could, for example include heat provision, energy efficiency installation, local power generation, system operator requirements, innovation developments, partnerships, community engagement etc. The real challenge is to start from an examination of the output services required, whether they be power, heat or light, and then consider how, and by whom, these could be most effectively provided.

Whilst the industry's commercial and regulatory structure has delivered many successful outcomes against the original requirements, there may now be barriers emerging that have the potential to inhibit the delivery of beneficial solutions such as demand side management which might impact the entire energy chain. Existing standards such as the network security standard, P2/6 also may require

repositioning if security requirements are to become more flexible in the accommodation of distributed generation or demand.

Traditionally network investment is initiated as a contract upon receipt of the user's direction. This has been entirely appropriate in dealing with power demands, but is less effective when seeking to accommodate large changes in renewable generation connection in relatively short timescales. In these situations, in order to ensure delivery, some level of investment ahead of need can be required to facilitate the anticipated connections. This naturally heightens the risk of the assets becoming stranded should the expected plans not fully materialise. It is important in this context to consider the extent to which the company has acted in the best interests of UK, and in particular to be aware that the risks associated with a general lack of investment can far outweigh those arising from imperfect foresight. Future flexibility is potentially valuable, and some proper recognition of the value of the option provided by the network operator in accommodating future uncertainty would be beneficial.

The network industry rightly concentrates on the requirement to develop an 'economic, efficient and coordinated system', though the time frame might now be usefully defined to include the long term efficiency for society . Similarly this could also introduce the need to consider the wider societal benefits within the financial evaluation process, where for example generation or demand connections with attractive carbon credentials may be associated with network reinforcement costs of a scale that effectively prohibits the realisation of the benefits if the connectee meets all of the costs.

In considering the future development of energy infrastructure, there has been much deliberation over the need for and extent of a form of overall direction, or 'guiding mind', that might ensure some degree of coordination between the strategies developed around energy, including transport and heat. As such a role could take many forms from strict government direction to strongly market led model, it is important to develop this theme to ensure clarity of understanding of the potential purpose of such guidance. In general this could be helpful in closing gap of uncertainty to support the introduction of appropriate investment activity.

Regulators and companies have a particular responsibility to ensure the ability to finance infrastructure investment. This has always been important, but needs to be particularly effective in facilitating the extensive energy infrastructure requirements in all market conditions.

Associated with finance is the subject of the risk and asset stranding costs arising from imperfect foresight. In general, risks should be aligned with those best able to deal with them. However, the framework needs to recognise these risks, enable their apportionment between investing companies and customers, with appropriate rewards for their management, and ensure that society meets the costs where options are considered worthwhile and efficient.

Carbon reduction has developed into a core issue requiring effective and rapid solution, and there are new questions around the ability of the market to deliver consistently along the energy chain, in a way that is efficient in both the short and long term. The question remains about the extent to which networks are either amenable to contestable activity or naturally more effective as a monopoly. The market can indeed drive efficient and timely delivery, though conversely it can be difficult to avoid perverse market pressures, where for example in a merchant led market place an

interconnector could be sized, not for the most efficient long term solution, but to provide the greatest return on investment. The practicalities of specifying network services in a way that they can be delivered competitively need huge functional specifications that themselves could drive inefficiency.

It is important to ensure customer affordability of energy and associated efficiency measures. Costs need to be efficiently incurred, then equitably distributed, and the services levels appropriately defined. There may well be trade-offs between investment and desired service levels, and it could also be necessary to extend the cost recovery period to make provisions for future customers more affordable for today's.

There also needs to be continued encouragement for innovation in investment, asset standards and network operation to ensure that the most effective and timely short and long term solutions are delivered.

Finally, in assembling a future framework, it is accepted that there may need to be a number of mechanisms that deal specifically with particular investment drivers, and it is vital that these work in concert to provide an effective and workable overall solution, and one which is socially and politically viable with overall benefits for national prosperity.

2. Investment Drivers and Framework Options

This section examines at high level the need for new network investment, the current regulatory framework in terms of the way it has evolved, and some potential options for change.

Need for investment – asset classes

The investment working group identified the following immediate areas of need for energy network investment, which the group recommends the RPI-X team should have regard to:

1) Accommodating new energy sources and new patterns of energy use. For example, renewable generation, electric vehicle charging, biogas injections to networks, etc.

2) Maintaining existing network function by renewing worn out network assets either on a like-for-like basis or with new technology options.

3) Extending network functionality, for example, by incorporating information processing and communication technologies to support new ways of using energy networks (perhaps implementing part of a wider 'smart' grid approach with other parties).

4) Adapting to climate change. For example, improving flood protection, revising cooling equipment, etc.

5) Meeting new legislative requirements. For example, improving safety, mitigating environmental impacts, implementing social policies, etc.

These needs suggest the following asset classes:

Specific customer serving classes:	Entry & Exit
Often general customer serving classes:	Renewal, Control, Adaptation & Compliance

These 6 categories are relevant to transmission and distribution networks in both gas and electricity. They may also be relevant to new networks like heat & CO2 transportation. They are not necessarily mutually exclusive and, in particular, licence obligations to comply with security standards (like the DNO P2/6 standard) mean that the need to respond to customer entry and exit needs is likely to also be a compliance duty for monopoly networks.

Current investment incentives

The ability of companies to keep operating cost savings made within a price control period under RPI-X provides an innate incentive to invest in business improvements that will pay-off within the price control period. Other investments that may be beneficial to customers (e.g. those which bring benefits in future controls and therefore includes the majority of investments in long-life network assets) must receive 'specific' treatment to provide companies with confidence that financing revenues will be available. The current mechanism that provides this confidence is the Regulatory Asset Base (RAB) - effectively a regulatory tally of investment that should be financed by allowed revenues from customers in the current and future price controls.

An important subset of the considerations relevant to network investment therefore concerns:

- the basis on which investments enter the RAB;
- the risk that investments may not remain in the RAB until they are fully financed; and
- the specific revenues that will be allowed to finance these investments (the regulated return) compared to the actual financing costs companies will actually incur.

Other issues relevant to the current investment incentives include:

- The potential for bias between decisions to invest, incur operational costs or lower the delivered service quality (e.g. via lower reliability) and arrangements that avoid such bias.
- The benefits to companies of having a well defined RAB in terms of raising finance (especially as finance at attractive rates becomes harder to obtain).
- The difficulty for regulators of establishing, on a forward looking basis, an allowed cost of capital that will be sufficient to attract investment (given future uncertainty from volatile markets) but not over-reward investors for the risks they actually face.
- The potential for setting the cost of capital on a different basis for approved past investments and future assets as yet not established.
- The potential for discovering cost of capital by competitive tendering of specific network services (including the issues of how such services are specified so they do not affect other assets and who should procure such services).

The user commitment approach

The need for certain investments can be triggered directly by customers contracting for specific services (usually in the entry and exit asset classes). RPI-X price controls have developed specific mechanisms to encourage network companies to respond to such contracts (and enable companies to finance such responses).

However, in the case of access for new renewable generation, such mechanisms have raised concerns that networks may act only in a responsive manner once customers are able to provide firm long-term commitments. Such a stance from networks can produce barriers to entry for these customers (e.g. the network needs sufficient customers to commit, but they can't until they have confidence that enabling reinforcements will progress).

Such concerns prompt questions concerning how existing incentives under RPI-X depart from those that might be found in a fully competitive activity which would anticipate customer need. The investment groups' analysis identifies the following areas in which network investments depart from those that might be found in a competitive market:

1) There are currently few opportunities under existing commercial arrangements for network companies to obtain revenues that reflect the value users might express in receiving outputs faster or with quality characteristics customised for specific users. (The exception is gas transmission entry and enduring exit regimes which offer some scope for short-term customer valuations of capacity to provide incentive information).

2) Similarly, there is currently limited scope for network companies to gain from anticipating the need for outputs by investing before firm evidence of need is available. (Although such opportunities are being considered for electricity transmission and may result in DNO distributed generation connection incentives if parameters are appropriately set).

3) Certain asset classes do not have output definitions that identify volume requirements. Total revenue allowances for such asset classes (e.g. renewal activities) drive capital efficiencies but limit the scope for approaches that could give long-term benefits.

4) The allocation of stranding risk between network companies and users is largely binary and determined by the efficiency tests and timing factors associated with investment entry to the RAB.

Directed investment approach

In the future there may be a shift in the extent that the drivers for network investment arise from a) participants in energy markets themselves requesting network services; to b) government or other agencies directly acting to achieve security, environmental or social policy outcomes. The increasing importance and urgency of various policy objectives could mean that those investments driven by legislative or compliance requirements may increase in scope.

On the other hand, certain rules and requirements which currently direct the type of network investment undertaken may also need to evolve and potentially become less directive in terms of the technical solutions that should be adopted. Already, the form of network planning obligations on electricity distribution licensees has been modified to reflect the stochastic characteristics of wind generators and a review of the corresponding obligations on electricity transmission licensees is underway. The development of transmission access arrangements and smart metering will bring new information and options for meeting user requirements.

These two aspects of network investment are illustrated by the following matrix:

	Network investments driven by participants within market frameworks	Network investments driven to directly achieve policy goals
Network investments selected on basis of commercial incentives	Commercially driven need & solutions	Policy directed need, commercially selected solutions
Network investments restricted to specific solutions that meet policy requirements	Commercially driven need & policy directed solutions	Policy directed need & solutions

In practice, different network investment decisions span all four elements of this matrix. For example, planning conditions on network developments and safety regulations dictate overhead line and pipeline design even though the need for such lines and pipes may result from parties operating in the electricity market (lower left quadrant). Similarly, policy directives concerning green house gas emissions generally provide commercial discretion on how they are achieved (upper right quadrant).

Conclusions on Investment Approaches

Further development of entry and exit related commercial access regimes may give greater scope for improved signals to networks concerning the nature of beneficial investment. However, there is a danger that increased focus on market signals (especially the subset where market participants are able to provide longer-term financial commitments) may further encourage unduly short-term or only responsive network behaviours to the detriment of customers' wider interests.

For renewal, compliance and other asset investment classes, the financial incentive is likely to remain on the regulatory agreement concerning desired outputs and efficient costs. However, the concern that companies may become unduly focused on optimising their position under the regulatory mechanism rather than the underlying customer interest is valid, especially as key strategic decisions concerning the nature of network renewal and service development need to be made. In these areas, improved customer engagement (as Ofgem have encouraged in the current electricity distribution price review) may improve confidence that network transforming investments are appropriate and facilitating regulatory mechanisms should be established.

Regulatory mechanisms which reward anticipatory investments in return for companies taking more exposure should such anticipation prove wrong may address the risk of unduly responsive or short-term investment behaviour. Such an approach requires objective quantification of outcomes which may be difficult and require increased reliance on ex-post regulatory assessments. There is also a risk that such incentives may end up reflecting (and compensating) the particular risk appetite of an incumbent company. This gives a further potential benefit to opening network investment to potential new companies by holding a competition when procuring a new service.

Contestability in network provision should offer, in theory, an efficient way of incentivising delivery of the most appropriate service at the most efficient price to customers. Its development is also consistent with the primary duties of the Authority and Secretary of State. However, the introduction of effective competition in networks is challenging because of the characteristics of network businesses and, in particular, the interactions between network components.

The above issues taken together suggest that there is no simple magic bullet for improving investment incentives and removing obstacles to network investment. Fundamentally, regulators will need to worry both about there being too much and too little investment in each asset class and will need to use whatever evidence and incentives are available to address these concerns. Whatever investment is required, its financing costs will tend to be reduced if unnecessary uncertainties concerning the process for remunerating investment costs are avoided.

Given, the increasing political urgency for various environmental, security and social policy outcomes there is a significant opportunity to remove uncertainties and investment obstacles by increasing transparency of how regulatory priorities align and aim to deliver policy goals.

3. Network Investment and the Guiding Mind

Introduction

Despite significant uncertainty on how the UK will make its low carbon transition the future regulatory framework needs to take account of future network requirements. An option to support decisions on future network investment is the concept of a "guiding mind" which could address the fundamental need for clarity on who decides what the networks should be delivering, including the role of the networks and how they should they respond to risk and uncertainty brought about through energy policy. The concept could also incorporate the role of the network user, regulator and Government in determining what should be delivered?

The group held mixed views on both the need for a Guiding Mind and who or what might carry out that function.

Current Issues:

Although there is a number of initiatives in play e.g. Smart Metering plans, neither consumers, industry, regulators nor government have all the answers on how the UK will achieve the low carbon transition. In this context, a number of issues were highlighted:

- The degree of uncertainty in the future energy networks arena is unprecedented - key decisions are not being made in a timely fashion
- Most stakeholders do not want to return to central management - but the need to balance efficiency with sustainability is proving difficult.
- User led investment will not deliver the Government targets in time.
- Network owners need comfort that investment ahead of need will be appropriately funded
- There is significant uncertainty and no "correct" most efficient route for networks to 2020/50.
- Delays in networks risk the timely delivery of 2020
- Consistency / continuity of policy is critical to success.

Whilst the issues above potentially increase the need for a Guiding Mind,it is important to differentiate between 1) charging another "party" with the risk of making a poor decision, and 2) the challenge of identifying a more balanced approach to complex issues – e.g. waiting for innovations and consequently risking failure to meet climate change targets.

Who or What could be the Guiding Mind

Who determines the role of networks, the future investment needs, assumptions and risk profiles has been debated in many fora with no clear front runner. This may be because the range of stakeholders and vested interests is so wide that a solution that sets such power with one individual or organisation is neither reasonable nor achievable. It may be that a framework of principles, together embodying the guiding mind, may be a more practical outcome.

The issues require a co-ordinated risk management approach that balances the risks and benefits to determine the least risky network investment route to deliver the Government targets. The risks, in terms of limiting stranded assets (efficiency), costs (economic), and missing the environmental targets (climate change implications) need to be appropriately balanced against the wider societal benefits (the environment) and maintaining the most viable options open (optionality and flexibility). In addition, the greater risks of "doing nothing" on network investment, compared with the risks associated with embarking on a particular network investment route, (based on a set of scenarios / assumptions) need to be explicit.

A possible approach for a Guiding Mind

Preliminary analysis suggests the Guiding Mind may best be provided by a body, comprising of a cross section of qualified stakeholders across the entire energy supply chain, that determines the risk management approach and decides, on balance, the appropriate route for the UK.

A Guiding Mind still requires endorsement, not least because a decision for networks, with so much uncertainty, will undoubtedly be a compromise. Power ultimately must lie with Government – the "Directing Mind" - (with DECC as its representative) to determine the compromises, appeals and disputes. At times decisions made by the Guiding Mind may need to be enshrined in law to provide investor confidence in a stable regime.

As a group the Guiding Mind needs to:

- focus and take responsibility for current and future customers, making judgments in terms of balancing costs and services across customers and time frames with the longer term wider societal benefits as the ultimate goal;
- balance priorities for society as a whole, both present and future priorities for society, and therefore would benefit from a democratic mandate;
- provide the long term strategic view, and be able to balance this with the shorter term cycles of Government and the democratic process;
- be responsible for energy (gas, elec, heat) because of the high degree of interdependency;
- understand the requirement for consistency and predictability over time to support investor confidence for long term investments;
- be able to develop and evaluate long term scenarios;
- provide a "light touch" approach. If too prescritptive there is a risk of the wrong outcome being selected. In addition, there also needs to be a definition for small / local non-strategic investment that is dealt with separately via a BAU approach;
- be able to translate policy into direction and / or provide guidance concisely and limited in volume;
- manage (limited) check points over time; and
- be transparent and explicit – facilitating consutation and debate with the wider industry.

The Guiding Mind Constituency

As no one organisation can deliver the necessary Guiding Mind requirements it needs to be made up of a cross section of stakeholders, elected for appointments (say) for a set number of years.

The ENSG work was [universally] recognised by the Investment Group as a successful model which could be built upon to form the basis for a Guiding Mind. For example, the Energy Guiding Mind could be similarly constituted

There can only be one energy "Guiding Mind" (i.e. covering gas, electricity, heat, CO2 etc.) to avoid paralysis due to conflicting "Minds" in the energy arena. The energy "Guiding Mind" does, however, need to engage closely with other "Guiding Minds" (e.g. transport), as energy underpins and is influential in many other sectors. This suggests a need for a national cross-sector approach to delivery of the wide societal benefits associated with addressing climate change.

Further work:

Clearly more work needs to be done to develop the Guiding Mind solution. In particular, if the Guiding mind is an "elected body" how would the body be elected,by whom and for how long? Other issues requiring careful consideration include the duration of the appointments; replacements; and continuity across "terms".

Examples of Guiding Minds in other industries and or countries should be reviewed for best practice. For example:

National Institute for Health and Clinical Excellence (NICE). Guidance, often difficult, is developed using the expertise of the NHS and the wider healthcare community including NHS staff, healthcare professionals, patients and carers, industry and the academic world.

UK Monetary Policy Committee (MPC). A single panel consisting of a mix of executives, academics and appointed (by Chancellor) members that also makes far reaching decisions with much uncertainty.

4. Why are Barriers Preventing Future Investment

A key requirement of any regulatory framework is to ensure that the confidence of the financial market is retained. Given the amount of investment required, it is highly unlikely that investors will be prepared to take an increased stranding risk. Should the current difficult economic period persist, it will mean higher financing costs and more restrictive debt covenants and may actually require stronger regulatory and governmental guarantees round about network investment if the investment is to take place.

Clearly a key requirement of any regulatory framework will then be to ensure flexibility in investment mechanisms and to ensure efficiency of investment continues by also ensuring that the confidence of the financial market is retained. It is essential that network companies be allowed to undertake the task of delivering a network and established need upgrades that will ensure new generation plants can be connected without undue constraints. However this should not be at undue cost or risk to the protection of customers.

The traditional regulatory arrangements do not create any incentive for investment in advance by network companies for future need. There has been some headway made in this area where there have been more flexible revenue adjusters/incentives built into the regulatory regime associated with transmission investment that protects consumers and allows companies more flexibility.

The Investment Working Group identified and discussed a number of barriers to future investment in the networks which are summarised in this section.

Planning

Planning remains a significant barrier to the development of the necessary infrastructure required to accommodate new forms of generation. Critical to the delivery of the 2020 targets is Government support and recognition of the need to investment in network infrastructure and the creation of a more efficient and supportive planning framework in addition to regulatory reform. Historically, the timeline for constructing new transmission network has taken longer than that for the new generation, whereas the future networks may now require investment ahead of construction of new generation.

A co-ordinated and strategic approach to network development will enable the development and delivery of renewable, nuclear and other forms of low carbon generation, rather than act as a barrier to their development. However, if it is the market that is to deliver in the current environment, then Government must also provide greater co-ordination than they currently do.

The regulator must also accept that any change in approach from the existing network development and investment may result in under-utilised network assets, or delay in their utilisation, given the uncertainty of generation connections and their timing.

Delivery of a sustainable energy system will require a joining up of mechanisms, including, building standards, building regulations, planning system, planning for major infrastructure developments, transport planning and delivery and funding.

Regulatory

The regulatory regime has without doubt served it's purpose and delivered successfully over the years, however with the changing challenges for Network Companies, Ofgem's remit must become more strategic, supporting both the need for networks expansion and considering the total costs to consumers now and in the future, including the cost of delivering climate change targets.

One of the most significant barriers to the delivery of a low carbon economy is network access. The connection process must therefore introduce flexibility and be more responsive in it's nature.

Financial barriers are inherent within the existing regulatory framework in that new network investment is in response to firm demands for new generators or customers. As a result, the approach to investment is often disjointed and does not result in coherent network development. It would assist greatly if more account was taken of the potential tensions that exist in the current regulatory arrangements and the objectives companies are being asked to meet. The current objective of encouraging network companies to strive for greater efficiency and only constructing assets where there is tangible and demonstrable need could be seen as encouraging a more short-term approach and delaying provision of infrastructure capacity.

Offshore networks have been identified as a key building block of the Government's renewable energy policy. In order to cater for new offshore generation, a significant amount of new grid infrastructure offshore is required in addition to substantial reinforcement of the onshore network. However the piecemeal nature of the framework will make it difficult to deliver targets, with little scope for anticipatory investment.

Technology

Even without 19 years of RPI-X pressures and it's affects on engineering resource in the UK, there would be a natural delay in the delivery of innovative solutions to the networks moving from such a low starting point. It is an accepted fact that network related R&D has longer timescales in comparison to many other sectors, for example, pharmaceuticals, vehicles, mobile phones etc, where their end product life-expectancy and competition are on a different scale to that of network companies. However it should be recognised that the behaviour of network companies, within the RPI-X framework, has been innovative.

It is apparent that a wider form of cross sector participation is required to facilitate a low carbon energy system. There is a greater need for active engagement with suppliers, generators, planning authorities and other key stakeholders (e.g. car manufacturers) in order to fully understand the risks and opportunities presented by changes outside of the current networks arena.

Establishing cross industry forums could enable developments to move forward in an effective and co-ordinated manner. To meet these challenges network companies must be appropriately resourced to engage directly with customers, other industry parties and policy makers. Concerns around aspects of business separation (between network operators, suppliers/generators, Meter Operators for example) and industry structure should not become a barrier to tackling these issues.

Supply Chain

An important issue for both network builders and developers is acquiring assets, for example turbines, transformers etc from suppliers and manufacturers in reasonable timescales. Under capacity of the supply chain places a significant risk to timely delivery of sufficient network capacity. A consequence of the volume of activity being undertaken in the replacement and assembly of new network assets is the ability of suppliers to deliver short timescales. Currently, forecast lead times for delivery of equipment is prohibitive in completing projects on a timely basis. In addition, the UK is now heavily reliant on sourcing equipment from oversees suppliers leaving it exposed to global markets and volatility when placing procurement contracts.

Network companies not only need to evolve, but as an industry, we must also review the end-to-end energy supply chain. Perhaps the most fundamental challenge revolves around the lack of coordination between generation, network and electricity supply development in the UK. In particular in relation to energy services, with an expectation that supply companies will move away from the selling of energy as a commodity to energy solution providers.

Skills

In order to deliver combined DNO investment plans, it is estimated that approximately 9000 new posts in engineering and crafts across the industry is required. The unavailability of suitably skilled individuals needed to deliver the required investment represents huge barrier and risk. The industry also faces the dilemma with many of the existing skilled workers approaching the end of their careers. This combined with the lead-time to fully train suitable replacements collectively represents a significant barrier. Where there is under-investment in the workforce, the industry is at risk of being too reactive with desired skilled workforce delivered too late or with the wrong/inadequate skill set.

While it is recognised that skills and industry capacity are a barrier, this would not be so significant an issue if a strategic programme of work was developed to deliver a planned programme of network development.

Customers

The investment needs in delivery of the 2020 targets is heavily dependent upon the end customers. Not only must there be a customer drive towards energy efficiency, there is also a need to raise customer awareness of essential requirement for infrastructure investment. General public/customer awareness should be included in overall energy network policy to ensure all key stakeholders are suitably informed.

Locational Pricing

Restricted grid capacity and transmission charging mechanisms may disadvantage and discourage developers. Short-term measures such as the rationing of capacity through an auction process or the introduction of locational charging will deter potential developers investing in areas rich in renewable resource but lacking in network infrastructure.

The current regime of locational pricing at transmission was developed for high load factor, baseload generators, and does not recognise the characteristics of low load factor generators. However there are now examples of locational pricing at transmission being levied on low load factor, intermittent generators. On the other hand, cost reflective charges help ensure an overall economic development of network, generation and demand by avoiding network charges becoming a cross-subsidy for users in high cost network areas. For example, ensuring offshore wind is not selected in preference to more economic onshore developments such as may be viable in Scotland.

Whilst the charging regime aims to encourage generation close to where it is needed, this inevitably means that distant renewables have greater charges to pay. Some would argue this leads to a bias in the UK transmission regulatory system and creates higher less predictable charges, creating a particular disadvantage for Scottish based renewable energy projects with an adverse impact of both the development of renewable generation and on the future investment in the thermal generation fleet. Others however would argue that current charges do not currently reflect the variability of wind and should be calculated to reflect very short-run costs. To correctly signal the benefits and network costs of wind generators, more volatile charges may be needed. However, market participants might then choose to achieve stability and predictability of their charges by explicit hedging

Interconnection with Europe

There is of course a wider context to consider when thinking about in the move towards a low carbon economy – interconnection with Europe. Business as usual for the UK is simply no longer an option. In a European context, that will mean there will be some major changes ahead, both in terms of the way in which we generate electricity and identifying new technology opportunities. Our aging transmission and distribution electricity networks will need to embrace the possibility of accommodating clean energy sourced from geographically differing locations.

Interconnection with Europe is now being supported by many member states, however much of the regulatory framework is still being debated and the EU has yet to commit any major funds towards the massive works required to upgrade and connect the infrastructure or secure funds to support development of a range of low carbon technologies. The lack of funding, delays in agreeing the regulatory framework, combined with the EU unbundling debate, means any move towards a fully interconnected EU market is likely to be a difficult and tricky process and gives little incentive for network companies to take steps towards facilitating the move of full EU interconnection.

Appendix A: Framework Options

This table takes the drivers and barriers discussed in previous sections, and discusses the potential regulatory mechanisms that could be used to address them

	Barriers	**Short-/long-term auctions with buyback**	**Revenue drivers**	**Hybrid (partial pass-through) scheme**	**repex**	**logging-up**	**re-opener**	**fixed ex-ante allowance with sharing/efficiency factor**
Entry	being certain that customers pay for no more than is necessary, and being certain that shareholders will be rewarded for their investment, requires clear user commitment	There is a potential mismatch between user signals over a shorter term than the life of assets. Tomorrow's customers will pay for today's decisions. They also cannot predict the needs of a new customer wanting to connect in the medium term	These provide flexible funding to match uncertain user requirements, but tend to lag need. They may therefore better suit business as usual than anticipatory investments, unless network owners are prepared to accept a radically different risk profile for a small part of their asset base and regulators are prepared to ask customers to pay out at a high rate for success	the incentive rate required to remunerate reinforcement directly related to identifiable customer connections may be significantly lower than that required to encourage meaningful anticipatory investment. Paying at the first, low rate discourages anticipation; paying at the second, high rate may ask customers to pay too much for responsive schemes		could be applied to investments that pass a generic 'used and useful' test defined by a guiding mind. Something similar applies, on a smaller scale, to R&D under the Innovation Funding Incentive	highly flexible, but ex-post funding at the regulator's discretion may be seen as too risky for shareholders	TIRG is effectively this approach, where ENSG as guiding mind has defined a set of investments that Ofgem has asked customers to fund. This is already unwieldy at transmission level (hence the development of enhanced incentives) and therefore perhaps unworkable for those aspects of distribution where user requirements are changing
	waiting for clear user commitment (reasonably) delays project commitment, so capacity is not always readily available	if this approach is implemented for transmission entry, an agent needs to be found for DG access, or non-contracted DG must be allowed a free ride						the proposed Low Carbon Networks Fund Tier 2 flagship project funding also falls into this category, although sharing factors are slightly different
Exit	as with entry, there is a tension between anticipating the need for capacity and being absolutely certain that investment is efficient	conflict with requirements to secure demands	These provide flexible funding better to match uncertain user requirements, but tend to lag need. This may be less of an issue with exit than entry, even if only at transmission level	the incentive rate required to remunerate reinforcement directly related to identifiable customer connections may be significantly lower than that required to encourage meaningful anticipatory investment. This may be less of an issue with exit than entry, even if only at transmission level		could be applied to investments that pass a generic 'used and useful' test defined by a guiding mind	highly flexible, but ex-post funding at the regulator's discretion may be seen as too risky for shareholders	may not be sufficiently flexible for emerging needs
Renewal	as requirements are stable and therefore well understood, the current scheme works well		These require clear output measures, which may be excessive where needs are predictable		useful for financing large programmes	could be applied as a fixed rate ex-ante against defined standard if volumes cannot accurately be predicted	highly flexible, but ex-post funding at the regulator's discretion may be seen as too risky for shareholders. This may be an excessive solution for this area, where requirements are generally well understood	output measures may be required as an 'efficiency' or 'used and useful' test, particularly where there is significant underspend (a scenario that may be less likely in future)
adaptation	requirements are less certain than for renewal, but a 'guiding mind' has evolved by default to address issues such as flood defences		It is difficult to define in advance revenue drivers for changing requirements. Once requirements are clear then, as for renewal, revenue drivers require clear output measures, which may be excessive where needs are predictable			could be applied as a fixed rate ex-ante against defined standard if volumes cannot accurately be predicted, but unit costs can	highly flexible, but ex-post funding at the regulator's discretion may be seen as too risky for shareholders. This can be addressed by ex-ante funding for emerging requirements	where requirements can be agreed in detail up front, a programme can be funded as for other non-load-related investment
Compliance	generally, requirements are stable and therefore well understood, so the current scheme works well. As for adaptation, recent changes in legislation have been absorbed because the impacts have been able to be resolved to investment programmes agreed by a de facto guiding mind		For example, this could be applied to a carbon reduction incentive on a £/tCO2e basis. Robust and accurate measurement may be an insurmountable obstacle			could be applied as a fixed rate ex-ante against defined standard if volumes cannot accurately be predicted, but unit costs can	highly flexible, but ex-post funding at the regulator's discretion may be seen as too risky for shareholders. This can be addressed by ex-ante funding for emerging requirements	where requirements can be agreed in detail, a programme can be funded ex-ante

	Barriers	Short-/long-term auctions with buyback	Revenue drivers	Hybrid (partial pass-through) scheme	repex	logging-up	re-opener	fixed ex-ante allowance with sharing/efficiency factor
scheme characteristics		As the title suggests, the network owner (or system operator on their behalf) auctions capacity. Where the outcome of the auction reveals an unsatisfied demand, the bids made indicate the value placed by users on the provision of additional capacity. Capacity is financially firm, as any shortfalls have to be covered by capacity bought back by the NO/SO. There is also the facility to provide short-term/non-firm capacity	This is defined here as an explicit increase in income linked to measurable outputs delivered, e.g. £/kW. This is similar to logging up at a fixed unit rate. The difference between the two mechanisms is in the required speed of money, as a revenue driver delivers 'fast' money while logging up delivers 'slow' money. It is possible it combine the two by using the revenue driver to provide short-term funding and logging-up to true up long-term funding This can be run as a stand-alone/bottom-up scheme, providing all funding from a zero base. The risks of incorrect calibration and the benefits of under-spend are shared between customers and shareholders, with the apportionment largely driven by the chosen unit rates. The risks of incorrect calibration can be reduced by instead flexing income around a central case	Here, investment is funded partly by simple pass-through, without formal efficiency test, and partly by a revenue driver fixed ex-ante. The pass-through element reduces the risk to shareholders that out-turn costs are very high and the risk to customers that out-turn costs are very low. The revenue driver element provides an incentive to the network operator to deliver higher volumes and reduce unit costs. The administrative burden is low, requiring only routine reporting and audit. The parameters, particularly the revenue driver, are calibrated to give a defined and reasonable return on a defined and reasonable unit cost. For example, the DPCR4 DG hybrid combines an 80% pass-through and a £1.50/kW-yr revenue driver so that investment at the assumed average cost of £50/kW would earn 7.9% compared to the standard 6.9% return This can be run as a stand-alone/bottom-up scheme, providing all funding from a zero base. The risks of incorrect calibration and the benefits of under-spend are shared between customers and shareholders, with the apportionment largely driven by the chosen unit rates. The risks of incorrect calibration can be reduced by instead flexing income around a central case generally, this approach is less risky for both shareholders and customers than a pure revenue driver, as the pass-through element better reflects out-turn costs. This scheme is already in place for DG connections, and has been proposed for transmission	this is a logging-up scheme with a set of fixed unit rates, dependant on work carried out. The funding released is a mix of 'fast' and 'slow' money, i.e. part expensed and part capitalised	This could be completely at the regulator's discretion, i.e. make the investment now and we'll consider the funding afterwards, which might create a risk unacceptable to shareholders. Ofgem's 'modified ex-ante incentive framework' paper refers to a 'commitment about ex-post adjustments', which could provide shareholders with greater certainty over likely returns on their investment. It becomes most effective when based upon the information available before the investment is made: tests applied on information available only later are closer to the revenue driver approach, rewarding proven success rather than honest intent There is also scope to log up at a unit rate fixed ex ante, moving some cost risk from shareholders to customers. The balance of risk between the two comes in setting the unit rate, and requires robust metrics. This approach is currently applied to undergrounding in AONBs etc. For anticipatory investment, defining a 'unit' may be so difficult as to thwart the scheme, except perhaps for generic solutions to make networks 'renewables-ready'	This could be completely at the regulator's discretion, i.e. make the investment now and we'll consider the funding afterwards. This might create a risk unacceptable to shareholders. Ofgem's 'modified ex-ante incentive framework' paper refers to a 'commitment about ex-post adjustments', which could provide shareholders with greater certainty over likely returns on their investment. Alternatively, ex-ante re-opener settlements could be similar to either: logging-up using unit rates fixed ex-ante, which reduces the administrative burden on regulators and licensee; or a fixed ex-ante allowance There is a tension here, because of the perceived risk. Network owners may be reluctant to commit to investment signalled by regulators as subject to a re-opener unless the re-opener is decided before the investment is made: for example, a distributor might simultaneously submit applications for a re-opener; and for a derogation against planning standards until that reinforcement is funded and then made	this is the classic capex funding, where a programme of works is 'agreed' and commensurate funding provided. At DPCR4, Ofgem made clear that the settlement did not require any particular capital programme to be delivered. At DPCR5, the practical implication of an effective output regime would be that the funding became much more tightly linked to deliver of the programme initially discussed

Appendix B: Stakeholder Guiding Mind Analysis

This table summarises the various Guiding Mind options discussed earlier in the document

DECC / Government	• Responsible for driving the delivery of a sustainable low carbon energy sector • Sets the environmental targets – universally recognised as necessary but potentially costly to deliver • Represents an elected body	• Acknowledges security of supply requirements – yet sets no targets per se • Qualifications / expertise? • Potentially operates to a 4 year cycle	
Ofgem	• Responds to the needs of current and future consumers. • Environment duties albeit secondary to those of protecting the consumer.	• Required to remain independent of government - therefore not wholly aligned with Gov energy policy e.g. Ofgem restricted by its primary duty to protect customers. • Not elected	• Is Ofgem able to facilitate the delivery of a sustainable energy network to meet the environmental targets? • Will Ofgem enable appropriate and timely investment in the networks? • Ofgem may require a new duty - and hence new legislation? • Would Ofgem still remain independent? • Would membership of the Authority have to change?

Consumers	• Ultimately pay for the provision of energy.	• Driven by price and service – value for money, choice and quality of service; not the environment. • Only one half of the network user community • Do not necessarily represent future customers. Little interest in future wider environmental issues. E.g. propensity to nimby-ism • Customer representative groups are not necessarily qualified or democratic	
Market (Energy Retailers / Generators)	• Provide useful tension / challenge with networks	• Are only one half of the network user community • Can be unduly influenced by shareholders	• Can climate change objectives and security of supply be delivered purely through market forces?
Networks	• Can identify the network needs and does take into account the needs of future customers	• Lacks wider strategic direction • Can be unduly influenced by shareholders	
Hybrid (Networks, users, DECC, Ofgem) ENSG model	• Addresses the shareholders issues when networks and users jointly determine network investment • Better, more balanced decision making approach • Could incorporate an elected element • Could define excluded non-strategic investment for BAU investment.		• May delay decision process unless a process for allowing local decisions for small / non-strategic investment.