Promoting choice and value
for all gas and electricity customers

Strengthening strategic and sustainability considerations in Ofgem decision making

Discussion Paper

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Overview:

The energy sector faces a future characterised by a growing dependence on energy imports, potentially higher energy prices and the need for continuing action to reduce greenhouse gas emissions. In this context, the sector will face the accompanying challenge of ensuring that energy and heating costs remain affordable to all.

Ofgem's principal objective is to protect the interests of both existing and future consumers. The interests of gas and electricity consumers include their interests in the security of the supply of gas and electricity to them, and reduction of greenhouse gases. In addition, Ofgem has a duty to contribute to the achievement of sustainable development.

In view of the above, we have reviewed how we consider strategic and sustainability issues in support of our decision making and within our Impact Assessments (IAs).

A decision making approach which incorporates long-term and often qualitative considerations is already implicit in our IA guidelines. Our aim is therefore to bring greater transparency to, and aid consistency in our treatment of, complex, long-run issues, by setting out structured guidance on what we should consider when assessing the strategic and sustainability dimensions of major decisions.

These proposals underline our important and developing role in shaping the future of gas and electricity industries in a sustainable manner.

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Executive Summary

Introduction
Ofgem's[1] principal objective is to protect the interests of both existing and future consumers. These include their interests in the reduction of greenhouse gases and in the security of the supply of gas and electricity to them. We also have a duty to contribute to the achievement of sustainable development.

In meeting both the present and future components of our principal objective, we are proposing a framework to enhance the way in which we consider strategic and sustainability issues in support of our decision making. Following a process of stakeholder engagement, our intention is to reflect these considerations as part of broader revisions to our Impact Assessment (IA) guidelines.

Scope of our proposals
This discussion document sets out our initial thinking and proposals to ensure greater consistency and clarity in our treatment of these issues, including how to strike an appropriate balance between complexity and transparency. Our aim is to:

- support well-informed, evidence-based decision making
- provide a systematic approach to considering issues with long-run, strategic and sustainability implications
- provide a transparent assessment on which to base decisions which protect the interests of both present and future consumers.

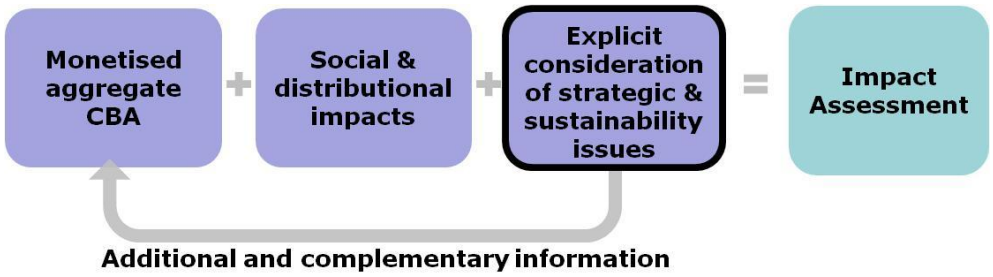
Note that our proposed approach would not conclusively determine any decision. In meeting our principal objective, we need to consider the balance of costs, benefits, risks and opportunities between current and future consumers, taking into account other relevant factors. These are ultimately matters for the Gas and Electricity Markets Authority (GEMA) to determine. Our proposals aim to support this decision making, by strengthening the underpinning evidence base and providing a more structured and transparent approach to long-term and often qualitative considerations.

Our proposed approach
Strategic and sustainability considerations are often complex, uncertain, hard to monetise and/or extremely sensitive to assumptions underpinning monetisation. As a result, we set out a more structured approach on what should be considered regarding strategic and sustainability considerations in our IAs, in ways that can both complement, and contribute to, efforts to monetise the costs and benefits of a decision (illustrated overleaf).

We conclude that this is ultimately the most useful and transparent approach, providing GEMA with the insight and evidence necessary for it to reach an informed decision, if there are tradeoffs to be considered. Our IAs have never relied purely on monetisation and already include some consideration of both distributional and sustainability issues. The figure overleaf helps to illustrate this and should be

[1] Ofgem is the Office of the Gas and Electricity Markets Authority. In this discussion paper we use the term "Ofgem" to mean both "Ofgem" and the "Gas and Electricity Markets Authority" (GEMA), except where we refer expressly to "GEMA" in its statutory decision-making role.

understood as offering a structure for grouping the main components of an IA; this paper focuses upon the contents of the third box.



The topics considered imply attention to extended timescales (broadly the period 2020-2050, and possibly beyond), and structure our approach around two conceptual 'legs': **mid-term strategic** effects, and **long-run sustainability** effects. The distinction between these is not rigid. In particular the sustainability leg may also usefully be informed by analysis of the mid-term strategic factors. Our proposed approach (set out in the table below) involves a **stress and security assessment** of the potential implications of a decision in relation to energy security, extreme price risks and the UK's legal obligations (drawing on analysis of characteristics including *optionality* and *diversity and resilience*); and a **natural asset and greenhouse gas (GHG) assessment** of potential implications over the longer term.

Mid-term strategic effects	Long-run sustainability effects
Stress and Security Implications Component analyses of *optionality* and *diversity and resilience* can help to inform assessment of the following 'stress and security implications':	**Natural Asset and GHG Implications** Component analyses of *learning-by-doing / supply chain*, and *system pathways*, can help to inform assessment of the following 'natural asset and GHG implications':
• **Security of supply failure** in electricity and gas supplies, and consideration of the interactions between the two fuel sources • **Potential risk of extreme energy prices and volatility** to a degree which might affect personal security (e.g. winter deaths), even when the likelihood of these events arising may be very small • **UK's legally binding energy targets**, to ensure that our decisions do not impede the UK's achievement of its legally binding national targets, and to assess potential contributions of our decisions to these targets, taking account of our legal duties and objectives under both UK and European law.	• **Consistency with the UK's 2050 GHG target** (interpreted as a 90% reduction in GHG emissions from the electricity and gas sectors)[2] • **Cumulative GHG** emission implications, which is the most scientifically robust indicator of relative impact on climate change and which also captures implications in terms of potential timing • Impact on **wider environmental assets** (such as biodiversity, water quality, air quality, marine habitats and landscape amenity) as appropriate to the specific decisions in question.

[2] Chapter 6 of the Climate Change Committee's 4th Carbon Budget Report http://www.theccc.org.uk/reports/fourth-carbon-budget

Strengthening strategic and sustainability considerations in Ofgem decision making

During 2012-13 we intend to review and if appropriate update our guidance on Impact Assessments. This discussion paper focuses on the strategic and sustainability dimensions of this broader updating process. We intend to continue developing our proposals throughout 2012, and would welcome stakeholder feedback and engagement during this period.

1. Introduction

Our principal objective is to protect the interests of future as well as existing consumers. These include their interests in the reduction of greenhouse gases and in the security of the supply of gas and electricity to them. We also have a duty to have regard to the need to contribute to the achievement of sustainable development. These requirements, set alongside the rapidly changing regulatory context and the move to a low carbon energy sector, have led us to consider enhancing the way in which we assess strategic and sustainability issues in support of our decision making.

As part of a broader intention to update our Impact Assessment (IA) framework, we have reviewed the way we consider the evidence underpinning decisions, with the aim of increasing transparency and consistency over issues with long-run, strategic and sustainability implications. This discussion document sets out our thinking in this area and proposes structured guidance on what should be considered regarding the sustainability of a decision.

1.1. The Energy Act 2008 clarified that our principal objective is to protect the interests of future as well as existing consumers. Our duty to have regard to the need to contribute to the achievement of sustainable development was first introduced in the Energy Act 2004. The Energy Act 2008 promoted this duty, placing it on an equal footing with our duties to meet reasonable demand and financing authorised activities.

1.2. Under the Energy Act 2010, our principal objective was further amended to make it clear that the interests of consumers include their interests in the reduction of emissions of greenhouse gases and their interests in security of supply. The principal objective was again amended in 2011 to reflect our role as National Regulatory Authority, which includes a duty to pursue the objectives of the Gas and Electricity Directives[3]. These changes underline our important and developing role in shaping the future of gas and electricity industries in a sustainable manner.

1.3. Historically, the main role of the energy regulator was to deliver consumer protection, optimise markets, maximise the benefits of competition and drive out inefficiency. Whilst the emphasis on consumer protection remains, the regulatory context has broadened. We have to take account of environmental, social and security considerations, amongst other factors, in order to fully protect the interests of current and future consumers.

1.4. The nature of decision making in the energy sector is becoming increasingly complex and long-term in outlook. Within the scope and remit of our powers and duties, this increasing complexity points to the need for a systematic and transparent treatment of these issues, in order to provide policy makers,

[3] See Appendix 3 for a description of the Authority's duties and powers.

industry representatives and consumers with assurance that our decisions are made in the interests of both current and future consumers.

1.5. Since 2003 we have had a statutory duty[4] to carry out IAs on proposals which we consider to have a significant impact, or to publish a statement setting out why we think that it is unnecessary. We may also wish to carry out an IA where it is not required, but felt to be consistent with good practice.

1.6. We intend to review and if necessary update our IA framework to reflect a range of developments over the past few years including the European Third Package[5]. As part of this process, we have examined how we might enhance our decision making process, as informed by IAs, to improve transparency and consistency with our objectives. This paper focuses on the strategic and sustainability dimensions of this updating process. The first chapter outlines the broader nature of assessment challenges in this area. Subsequent chapters focus upon our proposals to develop our assessment framework against this background.

Wider context – improving the reliability, robustness and transparency of public policy making

1.7. Within the UK regulatory policy context, the broad approach to and methodology for assessing the impacts of a course of action (both individually and relative to similar options) has developed over many years through the use of IAs. These aim to increase the reliability, robustness and transparency of decision making.

1.8. To consistently compare options, the IA (in its current form) most commonly uses a monetised cost benefit analysis (CBA) as a means of reducing complex information to a single, comparable figure, the net present value (NPV). In the context of public policy making, the need to reflect non-private costs and benefits and consider distributional impacts led to the further development of CBA into the more comprehensive form of social cost benefit analysis (SCBA).

1.9. For most situations and in most instances, a well-applied SCBA captures the relevant issues. For certain areas, however, monetisation is extremely challenging and there may be a more appropriate way of addressing these issues.

1.10. In 2009, the Government Economics Service (GES) undertook a review into the Economics of Sustainable Development. It concluded that, whilst SCBA

[4] Section 5A of the Utilities Act 2000.
[5] Page 6 of the Ofgem Simplification Plan 2012-13, http://www.ofgem.gov.uk/About%20us/BetterReg/SimpPlan/Documents1/Ofgem%20Simplification%20plan_WEB.pdf

was appropriate in most cases, certain circumstances required other specific tools in order to assess whether policy proposals were consistent with sustainability.

1.11. These circumstances arise when policy options have "large, non-marginal or irreversible impacts; on taking social impacts into account more systematically; on dealing more transparently with the consequences for future generation; and on improving the way we value externalities (such as damage to environmental assets)"[6].

1.12. Within the UK, a number of appraisal methods have emerged with the aim of assessing these more complex, longer-term aspects of public policy making, ranging from highly-detailed environmental methods (eg Life-Cycle Assessments and carbon footprinting), and social appraisals (equality impact assessments/EqIAs) through to more integrated approaches (eg Strategic Environmental Assessment, Defra's SD Specific Impact Test and the Department of Transport's NATA Framework).

1.13. These approaches have the common purpose of providing decision makers with analysis of the key impacts of their policy options in order to support well-informed, evidence-based decision making. However, in practice, different sectors raise somewhat different issues and different institutions may benefit from more tailored frameworks, according to their characteristics and specific responsibilities.

Managing complexity in decision making

1.14. Continuing economic research has highlighted several factors which point to the need for a systematic approach to assessing strategic and sustainability issues in decision making. Several, relating particularly to critical assets and social impacts, are covered in the GES Review. The recent OECD Environmental Outlook to 2050 also underlines the growing strains and risks associated with a number of strategic trends and the difficulty that countries have in handling these appropriately with traditional analytic tools[7].

1.15. Other avenues of economic research underline the complexity of decision making in relation to uncertainty and risk, and the evolutionary nature of economic systems. Behavioural economics charts ways in which decision making tends to be biased towards the status quo and "business as usual" ("Anchoring") and also tends to have a poor grasp of uncertainties and the resulting value of options (Real Options theory helps to illuminate particularly the value of timing in relation to uncertainty).

[6] GES Economics of Sustainable Development Review, 2009.
[7] OECD (2012) Environmental Outlook to 2050: the consequence of inaction.

1.16. Studies of technological change and the long-run development of economic systems emphasise how technologies and systems evolve over long periods, in ways influenced by existing capital and investment, infrastructure and institutions. Some kinds of decisions may therefore have enduring consequences, either in terms of learning, capital stock or capacity, or the overall 'direction of evolution' of the system, and exhibit clear features that may tend to "lock-in" or "lock-out" future options. The implication is that such decisions need to be taken with awareness of their consistency with long-run sustainability.

1.17. In theory, increasingly complex modelling can be used to inform a monetised CBA approach to these issues (such as stochastic modelling, which involves numerous runs of computer models with varying input assumptions). However with longer timescales also tends to come more uncertainty, more complexity, and greater relevance accorded to environmental and other sustainability dimensions. Trying to monetise all these factors involves increasingly arbitrary assumptions and growing sensitivity of results to these assumptions; this increase in complexity may be in practice almost unmanageable to monetise in any well-grounded and objective way. This tends to diminish transparency, and/or risks neglecting factors that may be important but are hard to monetise.

1.18. These factors and the techniques used to understand them may be particularly important for decision making in the regulated energy sector, in which there are large uncertainties (as evidenced by the consistently poor history of energy price forecasts), long-lived capital stock and complex interrelated systems, notably in the interplay between generation and transmission.

Addressing strategic and sustainability considerations in the regulated energy sector

1.19. Given the scope of our duties and the increasingly complex nature of our decision making, we felt it was prudent to draw from existing sustainability assessment approaches. In this way we were able to design a means of enhancing our ability to assess the mid- and long- term implications of major decisions, in ways tailored to the kinds of issues of most significance in the regulated energy sector.

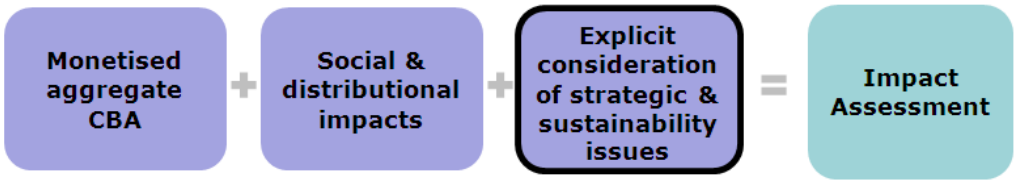
1.20. In developing our approach, we took the view that a balance needed to be struck between complexity and transparency. We can then be confident that we fully understand the breadth of issues involved and stakeholders can make informed representations on the proposals.

1.21. Our starting point was to consider the scope of our existing powers and duties (summarised in Appendix 3). We then developed our thinking with reference to the principles of best regulatory practice and the avoidance of unnecessary burdens on the regulated energy sector.

1.22. We were also clear that our approach should supplement and enhance the monetised CBA and distributional impact components of the IA. This would ensure that wider impacts could be combined and considered alongside monetised costs and benefits.

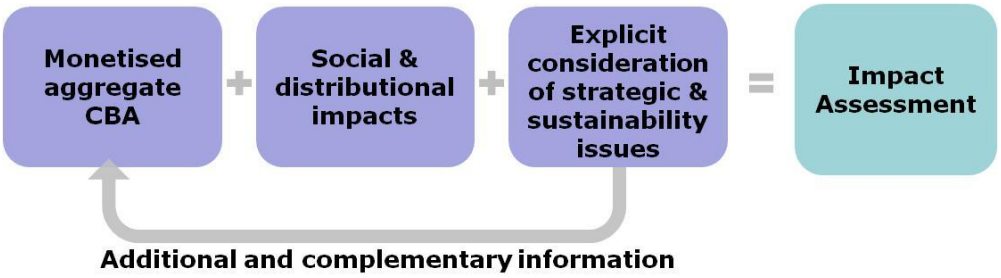
1.23. Within the context of our IA process, our proposed approach firstly considers strategic and sustainability issues in a more explicit and systematic manner (figure 1 below and detailed more fully in Chapter 2).

Figure 1: Strengthening our approach to strategic and sustainability considerations



1.24. Secondly, in order to reduce the risk of overlaps or inconsistencies, our proposal is to iterate monetised CBA and distributional impact assessments alongside a consistent and transparent consideration of more strategic and/or sustainability issues (figure 2 below).

Figure 2: Considering strategic and sustainability considerations consistently and transparently alongside (and in support of) monetised CBA



1.25. The combination of monetised CBA, distributional impacts and wider strategic and sustainability factors can help to clarify and illuminate the assumptions used for monetisation and more direct assessment of long-term issues and critical constraints. The aim is to provide us with a more transparent assessment on which to base decisions which protect the interests of both present and future consumers.

2. Strategic and sustainability considerations

We are proposing to enhance consideration of strategic and sustainability issues in our decision making by incorporating long-term and often qualitative considerations into our Impact Assessments. Our aim in doing this is to bring greater transparency and consistency to the treatment of complex, long-run issues and to set out structured guidance on what should be considered when we assess the sustainability of a decision.

Our proposed approach involves a **stress and security assessment** of the potential implications of a decision in relation to energy security, extreme price risks and the UK's legal obligations (drawing on analysis of characteristics including *optionality* and *diversity and resilience*); and a **natural asset and greenhouse gas (GHG) assessment** of potential implications over the longer term.

Adopting a systematic approach

2.1. As the previous Chapter sets out, considering issues of a complex, long-term and non-marginal nature in decision making, and presenting conclusions in an accessible manner, can be challenging. To help bring greater transparency and consistency to our treatment of these issues, we have developed a structured approach which has been shaped by and helps to reinforce our core responsibilities and principal objective[8].

2.2. The topics considered imply attention to extended timescales, broadly the period 2020-2050 (possibly even beyond). Over these time horizons, trends and consistency with strategic goals may be important to the interests of future consumers, and uncertainties and ranges of variables may restrict the applicability of detailed modelling. We have found it useful to structure our approach around two conceptual 'legs': assessment of **mid-term strategic** effects, and assessment of **long-run sustainability** effects.

2.3. Mid-term strategic assessment is concerned with identifying potential risks to **security of supply**, exposure to **extreme price volatility**, and **consistency with the UK's legally binding targets**[9]. In addition to traditional modelling

[8] To protect the interests of existing and future consumers where, taken as a whole, those interests include the reduction of greenhouse gases, security of supply and fulfilment of the general objectives of the Gas Directive and Electricity Directive.

[9] Under EU law, the UK is obliged to meet certain targets for reducing carbon and increasing the proportion of renewable energy sources. These have been implemented in domestic legislation by the Climate Change Act 2008 and the regulations transposing the Renewables Directive which place duties on the Secretary of State for Energy to ensure that the targets are met.

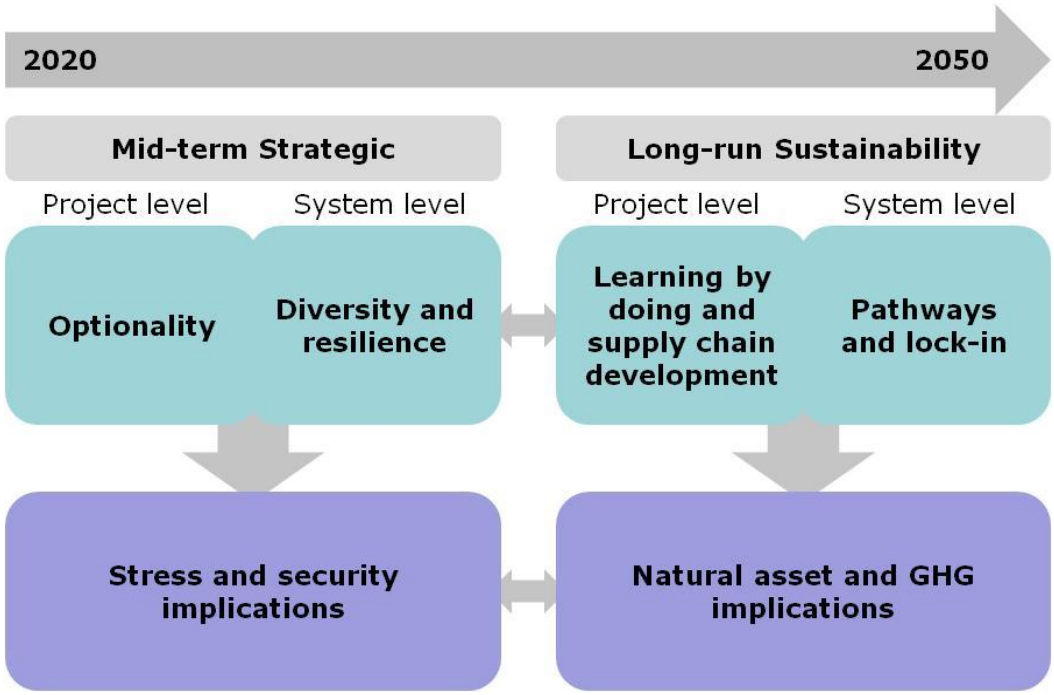
and scenario approaches, important inputs to an assessment may include the *optionality* inherent in a decision and how it may influence the *diversity and resilience* of the energy system.

2.4. Long-run sustainability assessment is particularly concerned with identifying **climate change implications,** including the **2050 greenhouse gas (GHG) target** enshrined in UK primary legislation, and implications for **other potential ecological impacts**. Important inputs to this assessment may include the potential impact of a decision on innovation potential and direction of travel, expressed respectively by *learning by doing* and *supply chain development* of low-emission technologies and systems. Another important input considers how a decision may influence the *pathway* of the UK energy system, including whether it may tend to *lock in* (or lock out) future system structures or technologies that are important with respect to sustainability goals.

2.5. The distinction between the two legs is not rigid. In particular, the sustainability leg may also usefully be informed by analysis of the mid-term strategic factors; nevertheless this provides a useful framework for organising and explaining the analysis.

2.6. Under each leg, the component analyses (turquoise boxes) feed into specific 'implication tests' (purple boxes) which relate closely to our core responsibilities and principal objective (figure 3 below).

Figure 3: A framework for considering strategic and sustainability issues are met.



2.7. The component analyses are designed to provide a structured approach to **key** strategic and sustainability considerations for the energy sector. The nature of the decision, however, may point to other factors of significance. The proposed approach allows for these to be incorporated as appropriate.

2.8. It should be noted that this represents a 'neutral' framework and does not imply specific values or weighting. It simply represents those areas of most importance to the energy system and sets out a process for considering the strategic and sustainability implications of a decision.

2.9. Ultimately, it is for GEMA to determine the relative weightings to apply between the interests of current and future consumers, and other relevant factors.

Considering the mid-term strategic effects

2.10. The first leg applies systematic tests to help illustrate mid-term strategic implications related to Ofgem's principal objective and duties. Input components include consideration of *optionality* and *diversity and resilience*.

2.11. Optionality is a consideration of specific, realistic options that may be enabled or precluded by a decision. Consideration of optionality helps to ensure that a decision retains as much flexibility as possible to help accommodate future uncertainty. In March 2012, Ofgem issued a separate consultation paper on the use of Real Options techniques in relation to investment decision making[10]. This consultation has now closed, and responses will be published on our website shortly.

2.12. In the context of the energy system, considerations of diversity and resilience are significant because a diverse system is more likely to foster innovation and be less vulnerable should one part of the system fail. However, diversity may also have less beneficial effects and involve trade-offs, so other influences on resilience should also be considered.

2.13. Although numeric methods of calculating diversity and optionality exist[11], a quantified assessment is not always possible. The nature of our decisions means that the influence on the trend of diversity is often as useful as an absolute measure.

[10] Real Options consultation paper, http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=354&refer=Networks/GasDistr/RIIO-GD1/ConRes

[11] We consider possible techniques which may enhance the overall assessment, including numerical approaches to assessing these characteristics, in Appendix 2.

Mid-term strategic effects	
Analysis of optionality considers the impact of a decision on:	Analysis of diversity and resilience considers the impact of a decision on:
• **Significant subsequent options created or facilitated** by the decision • **Significant options precluded** by the decision • **Optionality in timing**: risks and benefits of deferring a decision.	• **Diversity** of fuels, technologies, types of players, business models and/or services, including influence of a decision on the trend of diversity, highlighting critical stages of low diversity / substitutability • Other characteristics influencing the **resilience** of the system including capacity to absorb disruptions, and investor confidence.
Stress and Security Implications These component analyses can help to inform assessment of the 'stress and security implications', for which we propose the following specific tests: • **Security of supply failure** in electricity and gas supplies and consideration of the interactions between the two fuel sources • **Potential risk of extreme energy prices and volatility** to a degree which might affect personal security (eg winter deaths), even when the likelihood of these events arising may be very small • **UK's legally-binding energy targets** – to ensure that our decisions do not impede the UK's achievement of its legally-binding national targets, and to assess potential contributions which our decisions would make to these targets, taking account of our legal duties and objectives under both UK and European law[12].	

Considering the long-run sustainability effects

2.14. The second leg applies systematic tests to help illustrate the long-run sustainability implications related to our responsibilities. Optionality and diversity and resilience, as discussed above, can have long-run as well as mid-term implications. Additional input components include consideration of *learning by doing and supply chain development*, and *pathways and lock in*, to the extent that these have longer-term, sustainability-related implications.

2.15. Learning by doing and supply chain development reflect assessments of the cost reductions and other learning and capacity related benefits that may occur in the future, related to a decision. Unit costs typically decline with experience, which may lower future costs to UK consumers of developments that incur costs today. The extent to which this occurs may also depend upon the likely extent of UK versus international learning (the latter implying both

[12] See footnote on page 11.

investment costs and benefits accruing elsewhere). As with the diversity and optionality assessments, where data are available a quantified estimation of the impact of learning rates can be developed to complement the qualitative assessment[13]. This may give a sense of whether benefits associated with future cost reductions are likely to outweigh any additional short-term costs.

2.16. Pathway and lock-in analysis is an evaluation of what a decision may imply for the future 'direction of travel' of the UK energy system and, in particular, whether it tends to 'lock in' or 'lock out' certain alternatives. This assessment involves an awareness of the intended destination and incorporates consideration of the effects of system inertia. Pathway lock in can be extremely difficult to avoid, but is not always negative. It only becomes a problem when it may conflict with longer-term goals or lock out potentially superior future options.

2.17. Although this component has strong links to the optionality component, this assessment is meant to be applied at the GB / system level.

Long-run sustainability effects	
Analysis of learning by doing and supply chain development considers the impact of a decision on:	Analysis of pathways and lock-in considers the impact of a decision on:
• **Potential to gain UK experience which can benefit future projects**, including risk reduction, learning and skills base etc • **Avoiding supply chain bottlenecks -** the pace of development can be constrained by the capacity/capability of the supply chain • **Learning rates** to inform cost projections in quantified scenarios.	• **Implications for the direction of travel** of the energy system, taking account of the interplay between generation and transmission • **Relationship** of this trend with the ability to adapt to long-run sustainability constraints and wider environmental impacts.
Natural Asset and Greenhouse Gas (GHG) Implications The natural asset and GHG implication test focuses on the most relevant natural assets for the energy system context, and whether decisions may improve or degrade their condition. The assessments above include consideration of depletable assets, natural / renewable assets and waste (CO_2, nuclear). Conceptually this could be considered to be the 'safe carbon space', but could also include reference to spent nuclear wastes, and pollutants associated with shale gas.	

[13] See Appendix 2.

Importantly, the criticality of natural assets needs to be viewed from both a domestic and international perspective. For example, biodiversity assets can have both location specific and global importance, whereas carbon and methane emissions are globally significant in their effects. Additionally, the nature of energy system and natural asset interactions may change over time (adaptation to a changing climate).

The specific tests we propose for understanding the natural asset and GHG implications include consideration of:

- **Consistency with the UK's 2050 GHG target** (interpreted as a 90% reduction in GHG emissions from the electricity and gas sectors)
- **Cumulative carbon** emission implications, which is the most scientifically robust indicator of relative impact on climate change and which also captures implications in terms of potential timing
- Impact on **wider environmental assets** (such as biodiversity, water quality, air quality, marine habitats and landscape amenity) as appropriate to the specific decisions in question.

2.18. It is important to note that the process of applying the above assessments does not determine a decision. Instead, it aims to provide information to GEMA about some of the longer term implications of decisions.

3. Stakeholder engagement and next steps

We have engaged with government, other regulators, academics and NGOs in order to test our initial thinking. This engagement has confirmed that our proposals are conceptually robust, but also highlighted the need for further engagement with industry participants and other interested parties.

Having developed proposals on a more structured approach to strategic and sustainability considerations, we now intend to consult more widely over the implementation of our approach, with the intention of incorporating our proposals within our Impact Assessment guidelines.

3.1. To date, we have undertaken consultation with the Department for Energy and Climate Change, the Department for Environment, Food and Rural Affairs, the Department for Business, Innovation and Skills, the Treasury and the Competition Commission, and held a series of stakeholder workshops with UK government, regulators, academics and non-governmental organisations in March and May 2012.

3.2. This feedback confirmed that our high-level approach was robust, but also highlighted the need for further engagement with industry participants and other interested parties.

3.3. Having developed and tested our initial proposition, we are now in a position to engage with industry and other parties to seek their views on our approach. We propose to do this through both informal and formal means during 2012-13, commencing with the publication of this discussion paper.

3.4. This will be followed by a workshop in autumn 2012, to provide an opportunity for industry participants to feed in their views and help to ensure that we have considered the full range of implications associated with our proposals (including any procedural implications, such as linkages to code modification panels and industry technical groups).

3.5. In order to reflect a range of developments over the past few years, we have commited to review and if necessary update our Impact Assessment guidelines[14] during 2012-13. Ultimately, we intend to incorporate our proposals around enhancing strategic and sustainability considerations as part of this broader updating process.

[14] Ofgem Simplification Plan 2012-13.

Appendices

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Appendix 1 –Discussion Paper responses

1.1. This document is a discussion paper and is intended to share our thinking and stimulate debate amongst interested parties. Although not a formal consultation, several of the issues under discussion may prompt reactions and we would welcome any feedback.

1.2. In Chapter 3 we set out our intended next steps, including an intention to enhance the treatment of strategic and sustainability considerations as part of broader plans to revise our Impact Assessment guidelines.

1.3. In order for stakeholder views/reactions to feed into this process, we would be grateful if comments could be received by 12/09/2012 and should be sent to:

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Sustainable Energy Policy
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020 7901 7186
Email: sustainable.energy@ofgem.gov.uk

1.4. Unless marked confidential, we may publish responses to the discussion paper by placing them in our library and on our website: www.ofgem.gov.uk. Respondents may request that their response is kept confidential. We shall respect this request, subject to any obligations to disclose information, for example, under the Freedom of Information Act 2000 or the Environmental Information Regulations 2004.

1.5. Respondents who wish to have their responses remain confidential should clearly mark the document/s to that effect and include the reasons for confidentiality. It would be helpful if responses could be submitted both electronically and in writing. Respondents are asked to put any confidential material in the appendices to their responses.

1.6. Any questions on this document should, in the first instance, be directed to:

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020 7901 7186
Email sustainable.energy@ofgem.gov.uk

Appendix 2 - Quantitative approaches to considering strategic and sustainability issues

This Appendix explains the additional component inputs (beyond the normal processes of model-based projections of costs, benefits, emissions etc) that we have identified, and outlines numerical approaches that could be used to inform them.

Optionality

This element draws attention to the options created or precluded by a certain decision, and the option value associated with timing.

Options created. Some decisions may facilitate a wider range of options that could be utilised in the future. Typical examples could include funding for innovation (as in the Low Carbon Networks Fund); supporting multi-functional infrastructure (eg standards for gas infrastructure that could also facilitate future use for transporting more hydrogen-rich fuels, or CO_2); or allowing anticipatory funding of transmission assets which facilitate the connection of generation, not yet contracted, in the future.

Options precluded. Some decisions may preclude alternatives, or make them much more difficult to implement. For example the functionality of smart meters may well restrict the range of possible smart grid market designs that could later be developed, and narrowing a choice to particular technologies may preclude other, ultimately preferable options from emerging.

Optionality in timing. The timing of a decision will influence costs and benefits. A decision to delay may deter investment, perhaps at a potentially critical stage. However, delay will also defer costs and may enable more information about the decision and possible alternatives. However the costs and benefits of "too early" versus "too late" may be highly asymmetric and this should also inform a prudent choice.

A number of numerical techniques can be brought to bear to assess these factors. Stochastic modelling with uncertain input factors or a range of future technology cost and deployment scenarios may give insight into the potential value of innovation or of facilitating options. Real Options theory represents a well-developed body of literature and techniques to assess the value associated with timing and learning.

In some cases, it can be possible and appropriate to use Real Options theory to estimate an economic value associated with optionality considerations. This does however require a much fuller view of the potential follow-on options, the timescales on which subsquent options might be implemented, and some quantification of the riskiness of a project's cash-flow and the probabilities of different circumstances

which might lead to subsequent options being exercised. Some examples are illustrated in the separate Ofgem consultation paper on Real Options and Investment Decision making[15].

As with the other elements of the strategic and sustainability framework presented here such monetisation can be useful where appropriate, but if it is not practical, qualitative consideration of optionality can still provide important information.

Diversity and Resilience

Diversity tends to be a desirable characteristic of system for several potential reasons: it may reduce the impact of interruption of any one element, or otherwise increase resilience; it helps to hedge against volatility of any given input cost; a more diverse portfolio of technologies or market participants may increase the potential for innovation and/or increase competitive pressures.

Energy insecurity is often equated with dependence on imported fuels, but this may be a poor guide (given the potential impact of strikes, blockades or accidents, it is not automatic that domestic resources are more secure). Diversity offers a more neutral input to security considerations. However diversity may not guarantee security and may sometimes not be desirable, and can come at a cost if it means using more of smaller, more costly inputs; judgement is required.

Quantified assessment of changes in diversity (or market concentration) may be useful. Two common measures of diversity are the Herfindahl-Hirschman Index (HHI) used for competition studies, and the Shannon-Wiener Index.

The Herfindahl-Hirschman Index (HHI) is a measure typically applied to assess market concentration and is calculated using the formula:

$$HHI = s_1^2 + s_2^2 + s_3^2 + ... + s_n^2$$

Where s_n is the market share of the n^{th} firm. Typically s_i is a percentage share and hence the HHI can range from close to zero to 10,000. The closer a market is to being a monopoly, the higher the market's concentration and the higher the HHI.

The alternative Shannon-Wiener Index is derived from ecosystem studies used to assess the robustness of an ecosystem in terms of the range of species, and it has been argued to be a more appropriate measure for security-related assessments. It is calculated using the formula:

$$-D = s_{1.}\ln(s_1) + s_{2.}\ln(s_2) + s_{3.}\ln(s_3) ... + s_{n.}\ln(s_n)$$

Typically s_n is the fractional proportion of the total. The higher the resulting value, the stronger the system's diversity, with a score of 2 or more indicating a particularly diverse system. Scores below 1.5 may signal vulnerability, and below 1 indicates a very concentrated system.

[15] See Annex 4.

The way in which components are defined as independent and/or aggregated can have a significant impact on these indices. Caution and clarity is thus needed in interpreting the results.

Depending on the context it may also be relevant to consider the way in which different components can substitute for each other, at different stages of the energy system. Electric heating may for example help in event of difficulty with gas supplies, but not if the electricity system itself is also heavily dependent on gas.

Where a quantitative assessment does not seem appropriate, qualitative consideration of diversity effects such as the possibility of increasing the scope of new entrants, technologies, options or companies can be considered.

System resilience is not however purely a function of diversity. For example, a stronger transmission system will also tend to increase resilience in the face of interruption.

Learning and supply chain development

Substantial evidence has now accumulated concerning learning and other sources of cost reduction in technology development. Beyond an initial phase of learning (in which the evolution of costs may be highly unpredictable), costs generally decline with the scale of deployment. Cost reductions and other benefits may occur in the later stages due to the experience gained in completing complex projects, feedback, risk reduction, economies of scale, alleviated bottlenecks and skills base increases. Such cost reductions are generally represented as:

$$C_t = C_0 \left(\frac{K_t}{K_0}\right)^{-\beta}$$

Where K_t is cumulative installed capacity at time t relative to starting capacity k_0, and is the learning rate. Learning rates tend to vary between technologies, but for heavy engineering technologies a typical rate would be a 10% cost reduction for a doubling of capacity.

This formula can be adjusted according to the relative degree of international deployment and the domestic supply chain.

This approach also encourages qualitative consideration of whether a supply chain would be developed for the project or whole industry and if investment in a project may signal demand to producers and lead to growth of the market. This element also looks to see if a comparative advantage may arise for future projects using the same technology. This could arise due to certainty of demand, gain in experience of use of technology and economies of scale.

Pathways, lock-in and lock-out effects

Indirect consequences of a decision may:

- Restrict or facilitate the use of existing technologies, systems or institutional structures
- Facilitate niche markets or provide hybrid possibilities that encourage the emergence of new technologies
- Create or reinforce dependency on existing infrastructure – by definition, existing infrastructure accommodates incumbent technologies most closely, which can lead to high switching costs to use alternative technologies.

Evolutionary economics is a field of study that has illustrated the importance of such effects, and the degree of historical dependence in economic and technological systems. Interactions between networks, generation and demand may have particularly strong features of this nature. Thus in some areas, Ofgem-related decisions may exert very long-term influences on the evolution of the UK energy system. This may be particularly important in the presence of long-term constraints such as those associated with climate change.

Applying quantitative techniques can be problematic, but some insights may be gained by extrapolating the results of detailed models over longer periods in ways that reflect the potential costs of rapid subsequent changes. Assessments indicate that the potential value of learning and pathway effects for technologies in a low carbon energy system may be several times the project-level assessment of benefits (eg transitioning to a 'smart grid' could bring multiple and enduring benefits; offshore transmission is an essential component of tapping the UK's biggest low carbon energy resources).

Our proposed approach encourages consideration of time horizons beyond those normally employed in detailed modelling, and whether a decision has more enduring implications for the long-term trajectory of the UK system, and if so whether this is in a more or less sustainable direction.

Appendix 3 – The Authority's duties and powers

1.1. This Appendix summarises the primary powers and duties of the Gas and Electricity Markets Authority (the Authority). It is not comprehensive and is not a substitute for reference to the relevant legal instruments (including, but not limited to, those referred to below).

1.2. Ofgem is the Office of Gas and Electricity Markets which supports the Authority, the regulator of the gas and electricity industries in Great Britain.

1.3. The Authority's powers and duties are largely provided for in statute (such as the Gas Act 1986, the Electricity Act 1989, the Utilities Act 2000, the Competition Act 1998, the Enterprise Act 2002 and the Energy Acts of 2004, 2008 and 2010) as well as arising from directly effective European Community legislation.

1.4. References to the Gas Act and the Electricity Act in this appendix are to Part 1 of those Acts[16]. Duties and functions relating to gas are set out in the Gas Act and those relating to electricity are set out in the Electricity Act. This description must be read accordingly[17].

1.5. The Authority's principal objective is to protect the interests of existing and future consumers in relation to gas conveyed through pipes and electricity conveyed by distribution or transmission systems. The interests of such consumers are their interests taken as a whole, including their interests in the reduction of greenhouse gases and in the security of the supply of gas and electricity to them.

1.6. The Authority is generally required to carry out its functions in the manner it considers is best calculated to further the principal objective, wherever appropriate by promoting effective competition between persons engaged in, or commercial activities connected with,

- the shipping, transportation or supply of gas conveyed through pipes
- the generation, transmission, distribution or supply of electricity
- the provision or use of electricity interconnectors

1.7. Before deciding to carry out its functions in a particular manner with a view to promoting competition, the Authority will have to consider the extent to which the

[16] Entitled "Gas Supply" and "Electricity Supply" respectively.
[17] However, in exercising a function under the Electricity Act the Authority may have regard to the interests of consumers in relation to gas conveyed through pipes and vice versa in the case of it exercising a function under the Gas Act.

interests of consumers would be protected by that manner of carrying out those functions and whether there is any other manner (whether or not it would promote competition) in which the Authority could carry out those functions which would better protect those interests.

1.8. In performing these duties, the Authority must have regard to:

- the need to secure that, so far as it is economical to meet them, all reasonable demands in Great Britain for gas conveyed through pipes are met;
- the need to secure that all reasonable demands for electricity are met;
- the need to secure that licence holders are able to finance the activities which are the subject of obligations on them[18]; and
- the need to contribute to the achievement of sustainable development.

1.9. In performing these duties, the Authority must have regard to the interests of individuals who are disabled or chronically sick, of pensionable age, with low incomes, or residing in rural areas[19].

1.10. Subject to the above, the Authority is required to carry out the functions referred to in the manner which it considers is best calculated to:

- promote efficiency and economy on the part of those licensed[20] under the relevant Act and the efficient use of gas conveyed through pipes and electricity conveyed by distribution systems or transmission systems;
- protect the public from dangers arising from the conveyance of gas through pipes or the use of gas conveyed through pipes and from the generation, transmission, distribution or supply of electricity; and
- secure a diverse and viable long-term energy supply,

and shall,must in carrying out those functions, have regard to the effect on the environment.

1.11. In carrying out these functions the Authority must also have regard to:

- the principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed and any other principles that appear to it to represent the best regulatory practice; and
- certain statutory guidance on social and environmental matters issued by the Secretary of State.

[18] Under the Gas Act and the Utilities Act, in the case of Gas Act functions, or the Electricity Act, the Utilities Act and certain parts of the Energy Acts in the case of Electricity Act functions.
[19] The Authority may have regard to other descriptions of consumers.
[20] Or persons authorised by exemptions to carry on any activity.

1.12. The Authority may, in carrying out a function under the Gas Act and the Electricity Act, have regard to any interests of consumers in relation to communications services and electronic communications apparatus or to water or sewerage services (within the meaning of the Water Industry Act 1991), which are affected by the carrying out of that function.

1.13. The Authority has powers under the Competition Act to investigate suspected anti-competitive activity and take action for breaches of the prohibitions in the legislation in respect of the gas and electricity sectors in Great Britain. It is a designated National Competition Authority under the EC Modernisation Regulation[21] and therefore part of the European Competition Network. The Authority also has concurrent powers with the Office of Fair Trading in respect of market investigation references to the Competition Commission.

[21] Council Regulation (EC) 1/2003.

Appendix 4 – Related reading

Impact Assessment and cost-benefit analysis background

Ofgem Guidance on Impact Assessment (2009)
http://www.ofgem.gov.uk/About%20us/BetterReg/IA/Documents1/REVISED%20GUIDANCE%20ON%20IMPACT%20ASSESSMENTS%2015%20DECEMBER%202009.pdf

HM Treasury The Green Book, Appraisal and Evaluation in Central Government (2003)
http://www.hm-treasury.gov.uk/data_greenbook_index.htm

GES Review of the Economics of Sustainable Development (2010)
http://archive.defra.gov.uk/evidence/economics/susdev/documents/esd-review-report.pdf

Defra Guidance for SD Specific Impact Test (2010)
http://www.defra.gov.uk/corporate/about/how/policy-guidance/sd-impact/

John Rhys, Cumulative Carbon Emissions and Climate Change: Has the Economics of Climate Policies Lost Contact with the Physics? (June 2011)
http://www.oxfordenergy.org/2011/07/cumulative-carbon-emissions-and-climate-change-has-the-economics-of-climate-policies-lost-contact-with-the-physics/

Joint Regulators Group, Discounting for CBAs involving private investment, but public benefit (2012)
http://stakeholders.ofcom.org.uk/consultations/discounting-for-cbas/

David Pearce, Giles Atkinson and Susana Mourato, Cost-benefit Analysis and the Environment: Recent Developments, Organisation for Economic Co-operation and Development (Feb 2006)
http://www.oecd.org/document/62/0,3746,en_2649_34281_36144679_1_1_1_1,00.html

Real Options literature

Ofgem, Real Options and Investment Decision Making (March 2012)
http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=354&refer=Networks/GasDistr/RIIO-GD1/ConRes

Dixit, A, and Pindyck, R. (1994) Investment Under Uncertainty, pp 6 & 7

Copeland, T., and Antikarov, V., (2002) Real Option, A practitioner's guide, p.56

Diversity literature

Skea, J. 2010. Valuing diversity in energy supply, Energy Policy, Vol. 38.

Stirling, Andy. 2010. Multicriteria diversity analysis: a novel heuristic framework for appraising energy portfolios, Energy Policy, Vol. 38.

Learning and path dependence literature

Carrillo-Hermosilla, J. 2006. A policy approach to the environmental impacts of technological lock-in, Ecological Economics, 58(4):717-742.

Dolsma W, Leydesdorff L. Lock in & break out from technological trajectories: Modelling and policy implications, Technological Forecasting and Social Change, 2009

Grubb M, Chapuis T, Ha Duong M. The economics of changing course, implications of adaptability and inertia for optimal climate policy, Energy Policy, Vol.23 No 4/5, pp. 417-432, 1995

Ha-Duong M, Grubb M, Hourcade JC, Emission pathways towards CO_2 concentration targets: the influence of inertia and uncertainty, Nature, Vol 390, 20 November 1997

Marechal K, Lazaric N Overcoming inertia: insights from evolutionary economics into improved energy and climate policies Climate Policy, Volume 10, Number 1, 2010, pp. 103–119(17)

Maréchal K, Not irrational but habitual: The importance of "behavioural lock-in" in energy consumption, Ecological Economics, Volume 69, Issue 5, 15 March 2010, Pages 1104-1114

Raven R. Niche accumulation and hybridisation strategies in transition processes towards a sustainable energy system: An assessment of differences and pitfalls. Energy policy 35 (2007)

Voght-Schilb A, Hallegatte S. When starting with the most expensive option makes sense: Use and misuse of marginal abatement cost curves. The World Bank sustainable development network, September 2011

Appendix 5 - Glossary

A

Authority

See Gas and Electricity Markets Authority (GEMA) overleaf.

C

Cost-benefit analysis

Analysis that quantifies in monetary terms as many of the costs and benefits of a proposal as is feasible, including items for which the market does not provide a satisfactory measure of economic value.

Carbon footprinting

The process of calculating the total greenhouse gas emissions caused by an organisation or activity, usually measured in carbon dioxide equivalent.

D

Department of Transport's NATA Framework

The New Approach to Transport Appraisal (NATA), developed following the Government's White Papers "A New Deal for Transport and A New Deal for Trunk Roads".

Defra's Sustainable Development (SD) Specific Impact Test

The Sustainable Development Specific Impact Test enables Government departments conducting policy appraisal to identify key impacts of their policy options relevant to sustainable development and to give informed advice to ministers on sustainability-related issues.

Discounting

A method used to convert future costs or benefits to present values using a discount rate.

E

Equality impact assessments or EqIAs

The process of finding out whether an existing or proposed policy/procedure/practice has a differential impact on different groups. It is about assessing the impact of actual or proposed policies/procedures/practices in relation to their consequences for equality.

G

Gas and Electricity Markets Authority (GEMA)

GEMA is the governing body of Ofgem and consists of non-executive and executive members and a non-executive chair. The Authority's powers and duties are largely provided for in statute (such as the Gas Act 1986, the Electricity Act 1989, the Utilities Act 2000, the Competition Act 1998, the Enterprise Act 2002 and the Energy Acts of 2004, 2008 and 2010) as well as arising from directly effective European Community legislation.

L

Life-Cycle Assessments

A technique for measuring the environmental impacts of any product, process or activity according to each stage of its life cycle from the extraction of raw materials to final disposal.

N

National Regulatory Authority

A public authority or government agency responsible for exercising regulatory or supervisory authority, in this case over the gas and electricity markets in the UK

Net present value (NPV)

Net present value is the discounted sum of future cash flows, whether positive or negative, minus any initial investment.

R

Real Options theory

Analyses an alternative or choice that becomes available with a business investment opportunity. Real Options can include opportunities to expand and cease projects if certain conditions arise, amongst other options.

S

Social cost

The total cost associated with an activity, including both the cost to private individuals engaging in the activity and the cost to society.

Stochastic modelling

A method of modelling in which one or more variables within the model are random, used to estimate the probability of outcomes within a forecast to predict what conditions might be like under different situations.

Strategic Environmental Assessment

A Strategic Environmental Assessment is intended to increase the consideration of environmental issues during decision making related to plans, programmes and strategies.