Electricity industry participants
and other interested parties

Promoting choice and value for all customers

Your Ref:
Our Ref: NET ETP GEN 05
Direct Dial: 020 7901 7430
Email: Steve.Smith@ofgem.gov.uk

14 May 2008

Dear colleague,

Long-Term Electricity Network Scenarios (LENS) – interim report and consultation

This letter accompanies the interim report on GB electricity network scenarios for 2050, which has been prepared by Ofgem's academic partners, led by the Institute for Energy and Environment (InstEE) of the University of Strathclyde. It gives an update on the LENS project following our second consultation[1] and workshop[2]. It also sets out consultation questions about the interim report and describes next steps.

The **main objective** of the LENS project, as stated in our previous letters, is to facilitate the development of a range of plausible electricity network scenarios for Great Britain for 2050, around which industry participants, Government, Ofgem and other stakeholders can discuss longer term network issues. From the start, the focus of the LENS project has been on electricity networks, as the project followed from the May 2007 Energy White Paper[3] within the context of long-term scenario planning for electricity networks and we decided in our initial scoping letter[4] to retain this focus.

The **interim report** is a key milestone in the scenario development process, as it presents for the first time a set of scenarios for 2050, expressed in qualitative terms, on which we are seeking feedback from stakeholders through a consultation. We will undertake a further consultation on the draft scenarios report that is scheduled for publication by the end of June. By that stage, the scenarios will have been enhanced by additional qualitative refinements and quantitative work that is currently being undertaken by our academic partners, as explained below. It is our intention that the qualitative scenarios contained in the interim report will broadly be retained in the draft scenarios report, and that next steps will only involve further refinement of the existing scenarios. We therefore consider this to be a suitable point for an **interim consultation**, before we consult again on the updated draft scenarios in June.

[1] Ofgem (5 December 2007), Long-term Electricity Network Scenarios (LENS) – report on scenarios inputs and second consultation (Ref. No. 287/07).
[2] Materials relating to the second stakeholder workshop, which took place on 14 December 2007, can be found on the LENS page of Ofgem's website http://www.ofgem.gov.uk/Networks/Trans/ElecTransPolicy/lens/Pages/lens.aspx
[3] Department of Trade and Industry (May 2007), Meeting the Energy Challenge, A White Paper on Energy, pp141-142.
[4] Ofgem (15 June 2007), Long Term Electricity Network Scenarios – Initial thoughts and workshop invitation (Ref. No. 146/07).

Project update

Incorporating stakeholder feedback

The second stakeholder workshop, held in London on 14 December, was primarily used to obtain stakeholder feedback on the LENS 'inputs' and 'themes' that had been proposed in our second consultation of 5 December. At the workshop, our academic partners explained the role of inputs and themes as intermediate steps in the process of developing scenarios, and participants provided many useful comments and ideas in two breakout sessions. All the materials presented at the workshop, including the feedback slides from the breakout sessions, as well as a summary note of the full day are available on our website[5]. The consultation period for the report on scenarios inputs closed on 18 January. We received nine (non-confidential) responses which can be found on our website. A summary of these responses, and of our views, is provided in the **appendix** to this letter.

The project team (consisting of Ofgem and its academic partners) has since reviewed stakeholder feedback from the second consultation and workshop, as well as other relevant information, in order to update and finalise its views on the inputs and themes to be used for the LENS project. Thereafter, the project team's focus has been on using the analysis from these intermediate steps in order to develop draft scenarios in accordance with the project methodology[6].

'Energy scenarios' and 'network scenarios'

Based on stakeholder feedback, a revised set of **themes** was adopted, for reasons set out in the interim report, namely:

- environmental concern
- consumer participation, and
- institutional governance.

These themes are defined in the interim report. While exploring the interactions between the themes (which, as explained at the second workshop, is the next step in the scenario development process) and taking into account stakeholder feedback from the second consultation and workshop, two issues became apparent. First, the interactions between the themes resulted in broad scenarios for the GB energy/electricity sector in 2050, but these scenarios did not yet have the project's intended focus on electricity *networks*. Second, it appeared that some individual GB energy/electricity scenarios could give rise to more than one kind of electricity network, and correspondingly that some could result in the same kind of network. Furthermore, taking into account stakeholder feedback from the second consultation and workshop, we were keen to avoid artificially restricting the outcome of the scenario development process, as a subsidiary objective of the project is to develop a set of scenarios that, between them, span a suitably wide range of plausible outcomes for GB electricity networks in 2050.

In light of these two issues, the project team developed an approach to move from scenarios setting out plausible futures for the GB energy/electricity sector in 2050 (described as '**energy scenarios**' in the interim report) to scenarios doing the same but specifically for GB electricity networks ('**network scenarios**') within the broader energy context. Through this approach, we explicitly wanted to allow for the possibility that an energy scenario could result in more than one kind of network, but also for the possibility that different energy scenarios could result in the same kind of network.

The approach thus developed by the project team for 'mapping' energy scenarios into network scenarios is explained in more detail in the interim report. It focuses on the

[5] http://www.ofgem.gov.uk/Networks/Trans/ElecTransPolicy/lens/Pages/lens.aspx
[6] Ofgem (12 November 2007), Long-Term Electricity Network Scenarios (LENS) – methodology, general project update and second workshop, Ref. No. 273/07.

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electricity generation, demand and quality of supply variations inherent within each of the energy scenarios, and on the functional requirements of transmission and distribution networks under different potential futures for the GB energy/electricity sector.

The process described above, including the 'mapping exercise' between energy and network scenarios, resulted in five energy scenarios and, separately, five network scenarios, each with their own narrative. The five energy scenarios are:

- Switch Me On
- Fix It For Me
- Government Led Green Agenda
- Dynamic Green Markets, and
- Reactive Approach.

The five network scenarios resulting from the mapping exercise are:

- Big Transmission & Distribution
- Energy Services Market Facilitation
- Distribution System Operators (Lean Transmission)
- Microgrids (Small Transmission & Distribution), and
- Multi-Purpose Networks.

The narratives for all of the energy and network scenarios, and a detailed explanation of the process by which they were derived, are contained in the interim report.

Merging the scenario narratives

We consider that, given how the scenarios work progressed, the mapping exercise was a necessary step on the way to developing a set of plausible electricity network scenarios for Great Britain for 2050. One of the reasons for undertaking the mapping exercise was to help demonstrate to stakeholders that the network scenarios, between them, span a suitably wide range of plausible outcomes for GB electricity networks in 2050.

Having discussed the outcome of the mapping exercise with the project's academic peer reviewers and bearing in mind the main objective of the LENS project, we decided that the obvious next step in the scenario development process was to merge the energy and network scenarios into single, combined narratives (with each narrative clearly placing a plausible outcome for the electricity network within a broader context). One of the drawbacks of having separate narratives for energy and network scenarios is that the network scenarios can appear disjointed from their broader socio-economic, political and environmental context, as described more fully in the energy scenarios. This can make it more complex for scenario end users to link the underlying driving forces to the different network scenarios that can plausibly result from them.

Our academic partners considered that the energy and network scenarios turned out to be sufficiently closely related to each other to enable the scenario narratives to be merged, and that this can be achieved without losing the 'richness' within the energy scenario narratives. The main argument is that having a single set of (electricity networks oriented) scenarios, clearly set within a broader context that sets out underlying driving forces, is likely to improve the usefulness of the final scenarios to end users. It also enables a more appropriate fit for subsequent work on modelling the scenarios and developing a consistent set of 2025 'way-markers' (discussed below under Next steps).

DPCR5 and 'RPI at 20' projects

As noted in the appendix to this letter, several respondents commented on the relation between the LENS and DPCR5 projects, asking about the extent to which the LENS project

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would inform Ofgem's thinking on the distribution price control review. We noted last year[7] that although the outcome of the LENS project will help set the context for DPCR5 and future price control reviews, there would be no direct link between the output of the LENS project and DNOs' business plans requested for DPCR5. Instead, we envisaged that the project would facilitate subsequent strategic thinking for the sector concerning the medium to longer term future. Our initial consultation[8] on DPCR5 was published at the end of March and reiterated this position, and also recognised that the strategic thinking concerning the medium to longer term will help inform discussions on the short term investment requirements for DPCR5.

Earlier in March, we announced[9] that we would be undertaking a two-year review of the current regulatory regime for energy networks, covering both gas and electricity networks (the 'RPI at 20 review'). We envisage that the outcome of the LENS project will feed into this review. As explained further below, we plan to use the final phase of the LENS project to develop our views on key issues for networks and for the regulation of networks, in light of the scenarios. However, any revisions of regulatory policy in light of the scenarios and the issues they raise will not form part of the LENS project. Instead, they are likely to be considered as part of the RPI at 20 review (or other Ofgem projects).

Next steps

As a result of the various developments described in this letter, we have made some revisions to the work programme previously presented to stakeholders.

Markal modelling

The academic team's work on merging the energy and network scenario narratives, explained above, is underway as it is the obvious next step in the process. The outcome of this work will be reflected in the June draft scenarios report. The modelling work for the LENS project will be progressed on the basis of the merged scenarios, and is intended to add a quantitative dimension to the scenario narratives and to shed further light on scenario plausibility (including their link to the present) and internal consistency, as explained at the second stakeholder workshop.

Our academic modelling experts have advised that the LENS modelling work will now be undertaken using a variant of the MARKAL model known as the MARKAL-ED[10] model. This variant has certain advantages over the MARKAL-MACRO[11] model that the academic team had previously intended to use, which make it more suitable for the LENS project. Although the macro-economic component of the previous variant will be lost, the MARKAL-ED model concentrates more on the energy system. In particular, it allows for improved flexibility in detailed behavioural responses[12] to energy prices.

In terms of the distinction between energy and network scenarios described earlier in this letter, the modelling work will be primarily used to shed further light on the broader energy/electricity sector aspects of the scenarios, including energy and electricity demand, generation and storage profiles as well as sectoral carbon emissions. It will not provide a detailed quantification of the electricity network-specific aspects of the scenarios, such as data on network expansion/contraction at different voltage levels, as the MARKAL model is not a network planning tool. However, the modelling work will allow for analysis of the interactions between the electricity sector and other related sectors (including gas,

[7] See Ofgem's open letters on the LENS project of 12 November 2007 and 5 December 2007.
[8] Ofgem (28 March 2008), Electricity Distribution Price Control Review, Initial consultation document, Ref. No. 32/08.
[9] Ofgem (6 March 2008), Ofgem to review regulatory regime for energy networks, press release.
[10] Chen, W., Wu, Z., He, J., Gao, P., Xu, S. (2007), Carbon emission control strategies for China: A comparative study with partial and general equilibrium versions of the China MARKAL model, *Energy*, 32 (1) 59-72.
[11] Instead of minimising total system costs subject to various constraints (which is equivalent to maximising 'producer surplus' or profit), as is done by the MARKAL-MACRO model, the MARKAL-ED model maximises the sum of 'producer surplus' and 'consumer surplus' (which is a measure of social welfare).
[12] ED stands for 'Elastic Demand'.

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transport and heat). It may also shed some light on other, high level network-specific aspects of the scenarios. The academic team will be investigating this possibility as part of their ongoing modelling effort.

2025 'way-markers'

The project team will also develop a consistent set of 2025 'way-markers', again on the basis of the merged scenarios. This will in part be driven by the modelling work, as this is expected to shed further light on scenario plausibility and internal consistency. The outcome of this work is intended to be included in the June draft scenarios report.

Third stakeholder workshop

The third stakeholder workshop for the LENS project will be held on Thursday 5 June. Its main purpose will be to present an update on the scenarios work, in light of the interim report and the ongoing qualitative refinements and modelling exercise described in this letter, and to seek stakeholder feedback on this work. We also intend to use the workshop to obtain stakeholder input on transitional issues and way-markers for 2025 and to seek initial views on issues for networks and for the regulation of networks, in light of the existing scenarios.

Details on how to register for the workshop are provided at the end of this letter.

Draft scenarios report and final report

In our recent Corporate Strategy[13], we already set out at a high level the other revisions in the work programme, namely that we would publish a draft scenarios report in June 2008 and expect to publish a final report in September 2008.

The draft scenarios report will contain the updated scenarios as well as the outcome of the MARKAL modelling work, and reflect stakeholder feedback on the interim report that we are consulting on through this letter and from the third workshop. We also intend to include in this report a consistent set of 'way-markers' for 2025. We will hold a formal consultation on the draft scenarios report, and could organise a stakeholder presentation during the consultation period if there is sufficient interest. We will ask stakeholders about this at the third workshop. Stakeholders are also asked to indicate in their responses to this interim consultation if they see benefit in such a fourth (and final) stakeholder event for the LENS project, after publication of the draft scenarios report (see question Q4 below).

The final report will take into consideration stakeholder feedback on the June draft scenarios report and contain the final scenarios for GB electricity networks in 2050 and way-markers for 2025. We also intend to set out in the final report our views on the key issues for networks and how they are regulated, in light of the final scenarios.

Summary

In summary, the revised work programme for the remainder of the project looks as follows:

- Third stakeholder workshop — 5 June 2008
- Draft scenarios report — end of June 2008
- Consultation on draft scenarios report — July – August 2008
- Final report — September 2008

[13] Ofgem (31 March 2008), Corporate Strategy and Plan (2008-2013), Decision Document, Ref. No. 34/08.

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Consultation questions on interim report

We seek views from respondents on the following five questions:

Q1. Do you have any comments on the energy and network scenarios for 2050 set out in the interim report, or on the method used to derive them? In particular:

> **Q1(a).** Do you agree that all of the network scenarios are plausible? If not, please explain *why* you think that one or more of the scenarios are not plausible.
>
> **Q1(b).** Do you agree that the interim report demonstrates that the network scenarios, between them, span a suitably wide range of plausible outcomes for GB electricity networks in 2050? If not, what essential features do you think are missing and could these potentially be accommodated within the existing scenarios?

Q2. What are your initial views on transitional issues and 'way-markers' for 2025, in light of the scenarios for 2050 set out in the interim report?

Q3. What are your initial views on the most important issues for networks and for the regulation of networks that arise in light of the scenarios for 2050 set out in the interim report?

Q4. Do you see benefit in a fourth (and final) stakeholder event for the LENS project, following publication of the June draft scenarios report?

Q5. Do you have any other comments or views about the LENS project that you wish to raise at this stage of the scenario development process?

Respondents are asked to answer these specific questions in their written responses and use the question numbering set out above.

When answering questions Q2 and Q3, respondents should bear in mind that further qualitative and quantitative refinement of the scenarios is being undertaken by the project team, as explained in this letter, and that this will lead to some further changes to the scenario narratives. However, we would like to hear any initial views from respondents at this point, as it is our intention to broadly retain the existing scenarios in the June draft scenarios report.

Responding to interim consultation & registration for third stakeholder workshop

We welcome views from all interested parties on the consultation questions set out in this letter. Written responses should be received by **Tuesday 10 June 2008** and should be addressed to:

Erik Sleutjes
Senior Manager
Ofgem
9 Millbank
London SW1P 3GE

It would be helpful if responses could be submitted electronically at LENS@ofgem.gov.uk.

Unless marked confidential, all responses will be published by placing them in Ofgem's library and on its website www.ofgem.gov.uk. Respondents may request that their response is kept confidential. Ofgem 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. Respondents who wish to have their responses remain confidential should clearly mark the document(s) to that effect and

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include the reasons for confidentiality. Respondents are asked to put any confidential material in the appendices to their responses.

The **third stakeholder workshop** will be held at a central London venue on **Thursday 5 June 2008**. Like the previous two stakeholder workshops for the LENS project, it is likely to be an all-day event. Further details on the location and agenda will be issued nearer the time. It is essential to register in advance for this event - please email your name, company/organisation and contact details to us at LENS@ofgem.gov.uk by **Thursday 22 May 2008**. If you have any questions about this event, please contact Jennifer Swan on 020 7901 7043 or Jennifer.Swan@ofgem.gov.uk. Places at the workshop will be limited, but we will aim to ensure that there will be at least one place for each organisation wishing to attend.

Any questions about the project or this letter should, in the first instance, be directed to Erik Sleutjes on 020 7901 7329 or Erik.Sleutjes@ofgem.gov.uk. InstEE, our lead academic partner, can be contacted through Graham Ault on 0141 548 2878 or G.Ault@eee.strath.ac.uk, although on any regulatory aspects of the LENS project stakeholders should contact Ofgem instead.

Yours sincerely,

Steve Smith
Managing Director, Networks

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Appendix: Stakeholder responses to second consultation and Ofgem's views

In our second consultation of 5 December 2007 (Ref. No. 287/07), we asked stakeholders a number of questions about the accompanying report on scenarios inputs.

We received a total of nine (non-confidential) responses, from the following parties:

- CE Electric UK
- EDF Energy Networks
- Electricity North West Limited
- Energy Networks Association
- Energywatch
- E.ON Central Networks
- National Grid
- Scottish and Southern Energy
- Scottish Power Energy Networks

This appendix summarises the responses and sets out our views. It starts with a summary of general comments made by respondents in relation to the LENS project, before considering their responses to the specific questions we had posed.

General comments

Respondents were generally supportive of the LENS project. However, respondents asked for further clarity on various issues, including how LENS scenarios will translate into policy and how LENS may influence future price reviews. One respondent also asked about our views on ongoing refinement of the scenarios and their development beyond the 2050 horizon. Another comment was that success shouldn't be measured against capturing *every* set of futures.

Several respondents commented on LENS in relation to DPCR5. Various respondents felt that LENS should inform DPCR5. Two respondents mentioned the Energy White Paper, which stressed the importance of flexible five year allowances set at price controls being compatible with 'any plausible longer term outlook for the network'. One respondent noted that although it is important for DPCR business plans to be linked to plausible outcomes, they supported that the LENS project does not have an objective to prescribe particular strategies for regulated companies, as it is down to individual companies to determine these strategies.

One respondent outlined various other points to consider, including the interplay between UK and EU electricity and gas networks, the transport sector, and the decarbonisation of space heating.

One respondent noted that scenarios should be detailed and tangible enough to inform debate. Another mentioned that it is important that the project addresses the 'focal question' from a regional (not simply GB) perspective.

Ofgem's views

Our position on the relation between the LENS and DPCR5 projects is set out elsewhere in this letter. In terms of how the LENS scenarios will translate into (regulatory) policy and how the project may influence future price control reviews, Ofgem's recent announcement of the 'RPI at 20 review' is of relevance, and our position on the relation between the LENS project and this review is again set out elsewhere in this letter.

Other comments that respondents raised under this heading, for example regarding the interplay with other networks and the regional dimension, have generally been captured in the draft scenario narratives. Some are also being considered through the LENS modelling work.

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With respect to ongoing refinement of the scenarios, we anticipate that an exercise of this nature would need to be repeated periodically in the light of new information, probably once every five years or so.

Question one

Do you agree that the "proposed inputs" set out in sections 4.1 and 4.2 of the report identify all the relevant inputs for the scenarios, given the project's focus on GB electricity networks in 2050? As appropriate, please identify any other inputs that you consider should be taken into account, including reasons why.

Of the eight responses to this question, five noted that they agree with the proposed inputs, with one respondent stating that they find them comprehensive. One suggestion was that we should avoid creating more inputs as this adds further complexity. One respondent suggested the inputs are generic, so they may be interpreted incorrectly.

Consumer behaviour was mentioned by a few respondents. One respondent noted that it is too narrow, and that consumer and business behaviour is preferable to capture the changing attitudes and needs of the range of network users. Another respondent noted that the affordability of energy and of equipment required to enable consumers to proactively participate in energy related lifestyle changes may affect participation.

Two respondents mentioned transport as a potential input and two noted that 'transmission and distribution network design architecture' is an output as opposed to an input. Another respondent highlighted the interdependencies of inputs. For example, energy demand and electricity demand are linked; also, the political agenda is a driver *of* and is driven *by* consumer behaviour, environmental landscape, and economic landscape.

One respondent commented on carbon markets and noted the importance of global developments leading to a firm carbon price, as this could be a precursor of environmentally driven change in society. Another respondent commented on the effect of climate change on the design and operation of networks.

Ofgem's views

The list of proposed inputs has been updated in light of stakeholder feedback, and a final list included in the interim report. Respondents' comments on inputs have also fed into the subsequent process of developing scenario narratives.

Terms such as 'consumer behaviour' (and 'consumer participation') are intended to include not only domestic consumers, but also other types of consumers including commercial and industrial consumers, as clarified in the interim report.

Question two

Do you agree with the input areas earmarked for further investigation in section 4.4 of the report? As appropriate, please identify any other areas that you consider warrant further investigation, including reasons why.

Of the eight responses to this question, many agreed with the inputs that we earmarked for further investigation. Three respondents discussed consumers. Two of these commented on the effect of the green agenda (including climate change) on consumer behaviour. Another respondent suggested that it would seem appropriate to translate demographic changes into assumptions about household growth and types, and consider the consequent impact on energy demand patterns. Another respondent noted the potential of taxation to change behaviour. They argued that consumer behaviour is driven largely by the price of commodities and to a lesser extent by the desire to act environmentally. One respondent mentioned the effect of technology, such as smart meters, on consumer behaviour.

Respondents suggested various areas that require more consideration, including carbon capture (if renewable and nuclear energy does not dominate), the availability and market

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price of resources (i.e. human resources and products), and advanced technologies such as nuclear fusion and hydrogen networks.

One respondent discussed the relative contribution from gas and electricity to (domestic) space heating. They suggested that in a scenario with high environmental drivers, electric heating of better-insulated homes (powered by renewables or nuclear generation) may be incentivised above gas domestic heating. They also observed that micro CHP may facilitate greater bi-directional power flows and referred to the potential impact of (gas-fired) district CHP.

Some respondents commented on the impact of new building regulations and legislative requirements on the sector.

Ofgem's views

Areas that were already earmarked for further investigation in the report on scenarios inputs, as well as other relevant areas highlighted by respondents, have been explored by the academic team. They are reflected in the interim report and in the draft scenario narratives, and will continue to be considered in the ongoing scenario development work.

Question three

Are you aware of any further sources of information not yet identified in the report that may be relevant for the LENS project, for example in relation to other inputs that you consider should be taken into account (Question 1) or other areas that you consider warrant further investigation (Question 2)? If so, please provide references.

Respondents suggested various articles and studies that may be of interest to the LENS project. Various studies were mentioned that focus on environmental issues. Two of these studies focus on reducing carbon emissions by 80% by 2050 and one focuses on the transition to zero carbon homes. One respondent noted a Met Office study into the effects of climate change on the design and operation of networks.

Some of the studies and reports that were suggested focused on technology. One report covered technology policy. Another report focused on the transport fleet, including the potential of fuel cells and the hydrogen economy.

Two respondents suggested looking outside of the UK. One suggested looking at Smart Grids across Europe and the United States. Another respondent suggested looking at the long term modelling of the Danish energy system.

Ofgem's views

Studies quoted by respondents have been reviewed by the academic team and relevant information has been fed into the LENS scenario development process. An appendix to the interim report presents a short summary of various studies.

Question four

Do you agree that the "potential themes" stated in section 5 of the report are suitable (in light of the methodology, objective and focal question for the project)? As appropriate, please identify alternative themes that you propose for developing scenarios, including reasons why.

We received eight responses to this question. Some respondents agreed with the potential themes, but one respondent was concerned that the LENS structure is too complex, and questioned whether themes are necessary for developing scenarios. Someone asked for clarity as to what themes actually are, and questioned the purpose of developing themes. Similarly, someone questioned how the themes will influence the LENS inputs.

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Some respondents commented on the proposed 'external landscape' theme. One respondent suggested that external landscape is the broadest theme, with another respondent suggesting that it be split into more themes, including global economics and environment. One respondent suggested that consumers may be a subset of external landscape.

One respondent commented on the use of the 'orthogonal axis' approach for developing scenarios. They questioned how external landscape, network role, and consumers could be modelled on an orthogonal axis. They also suggested that the assumption that 'generation' has poles of centralised and decentralised is too simplistic. Furthermore, although demand may be considered on a high or low axis, it is more important to consider how daily and seasonal demand profiles might change under possible scenarios.

Someone suggested that network role is an *input* as opposed to a *theme*. Someone else suggested that network role is more an *output* than an *input*. One respondent argued that the economic landscape and the availability of capital are a constraint on network development.

Ofgem's views

The project team has taken many of these comments on board, and revised its proposed set of themes as set out in the interim report. The final set of themes became: environmental concern, consumer participation, and institutional governance. We consider that this final set of themes formed an appropriate basis on which to proceed with the scenario development process.

The role of themes within the scenario development process was explained in earlier LENS documentation, and is clarified further in the interim report. Effectively, themes are a tool that is often used in scenario studies as an intermediate step in the scenario development process. The relation between inputs and themes is also clarified further in the interim report.

Question five

Do you agree that the "proposed inputs" (and "potential themes") identified in the report will enable us to produce four or five sufficiently distinct scenarios that, between them, cover the full spectrum of plausible outcomes for GB electricity networks in 2050? If not, how can we best address this?

We received six responses to this question. One comment was that further consideration needs to be given to the role that themes have in the process. One respondent highlighted five themes that they believe will have a significant impact on the quantum or relative weighting of the high level inputs that the LENS team have identified. They were economic climate, political landscape, global sustainability, technological advancement, and international/national culture.

One respondent noted that engaging industry is helpful and that provoking debate is a more relevant measure of success than adding further inputs or seeking consensus that the scenarios reflect all possible futures. They also suggested that as scenarios should cover a broad range of plausible futures we may require more than four or five scenarios.

Another respondent said that the inputs should create coherent and internally consistent scenarios, with a plausible link to the present. They also noted that the base projection of today (business as usual) should play a role.

Ofgem's views

The subsidiary objective (implicitly stated within this question) of producing four or five sufficiently distinct scenarios that, between them, cover the full spectrum of plausible outcomes for GB electricity networks in 2050 has been refined, in the light of responses to this question and comments from participants at the second stakeholder workshop.

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Instead of setting out to create four or five *sufficiently distinct* scenarios from the outset, the scenario development approach that was applied, as explained elsewhere in this letter, has explicitly allowed for the possibility of different 'energy futures' resulting in the same kind of network (as well as for the possibility of a single 'energy future' resulting in different kinds of networks). In other words, the approach that was adopted for deriving the network scenarios meant that the project team kept an open mind as to whether key driving forces would result in either similar or distinct kinds of networks in 2050. Although the outcome of this exercise was that the academic team identified five quite distinct network scenarios, this result was not driven by any upfront constraint that they *must* turn out to be distinct.

There was a separate consideration, however, that did restrict the total number of network scenarios. We understand from our academic scenario experts that it is generally considered desirable, in order for a set of scenarios to be of most benefit to their end users, to keep the total number of scenarios restricted to a relatively small figure of, say, four to six. In light of this consideration, our academic team advised that, although in theory they could have developed a larger number of network scenarios, with relatively small differences between them, they did not consider this to be a suitable outcome for the project. Hence, they restricted the total number of network scenarios that they identified to around four to six (ending up with a total of five).

The objective of developing a set of scenarios that, between them, cover the *full spectrum* of plausible outcomes for GB electricity networks in 2050 was broadly retained throughout the scenario development work (although, for clarity, it has been reworded slightly). This was based on advice from our academic partners that a scenario set as a whole should scan an acceptably wide range of the future possibility space. On this basis, we refined the subsidiary objective (as referred to in the main body of this letter) to developing a set of scenarios that, between them, span a suitably wide range of plausible outcomes for GB electricity networks in 2050.

Question six

Do you have any other comments on the inputs report or any other issues that you wish to raise at this stage of the scenario development process?

Most of the points raised in response to this question reiterated previous comments. One respondent mentioned that we should keep in mind that there is a high degree of uncertainty when modelling to 2050.

DPCR5 was mentioned again, with similar comments as made earlier. Two respondents commented on the potential for LENS to inform DPCR5. One respondent noted that there is a role for this work in shaping the context for DPCR5.

One respondent noted that scenarios should be described in sufficient detail so that they can be considered in depth by various stakeholders, as it is only by doing so that they will move the debate forward.

Another comment was that back-casting scenarios to 2025 and the present day is important. Specifically, when back-casting to 2025 it is important to recognise the starting point; i.e. the legacy network architecture that exists today. The same respondent noted that it is important to address the focal question from a regional (not simply GB) perspective. They went on to note that lessons should be learnt from other critical national infrastructure (e.g. national rail and motorway networks). For example, it is easy to underestimate future requirements for capacity and functionality. Finally, they noted that it is important not to under-invest, as retrospective reinforcement may be more costly.

Ofgem's views

Respondents' comments about modelling and back-casting to 2025 are being considered by the project team for the next phase of the project. In the context of back-casting to 2025,

The Office of Gas and Electricity Markets
9 Millbank London SW1P 3GE **Tel** 020 7901 7000 **Fax** 020 7901 7066 **www.ofgem.gov.uk**

we agree with the comment that it is important to recognise the legacy network architecture that exists today.

Some other comments relate to the process of developing views on issues for networks and for the regulation of networks, which also forms part of the next phase of the LENS project. We welcome further initial views on the most important issues for networks and for the regulation of networks arising in light of the existing scenarios, in response to this letter (see question Q3 of the interim consultation).

The Office of Gas and Electricity Markets
9 Millbank London SW1P 3GE **Tel** 020 7901 7000 **Fax** 020 7901 7066 **www.ofgem.gov.uk**