Electricity sector participants and
other interested parties

*Promoting choice and value for all customers*

Your Ref:
Our Ref: NET ETP GEN 05
Direct Dial: 020 7901 7009
Email: Stuart.Cook@ofgem.gov.uk

29 August 2008

Dear colleague,

**Long-Term Electricity Network Scenarios (LENS) – draft scenarios report and consultation**

This letter accompanies the LENS project draft scenarios report, which contains draft electricity network scenarios for Great Britain for 2050. The report has been prepared by Ofgem's academic partners for this project, the Institute for Energy and Environment (InstEE) of the University of Strathclyde, and King's College London.

This letter provides an update on the LENS project following our third consultation[1] and workshop[2]. It also sets out consultation questions about the draft scenarios report and describes next steps for bringing the project to a conclusion.

**Context and background**

The LENS project followed on from the May 2007 Energy White Paper[3] within a context of long-term scenario planning for electricity networks. The **main objective** of the 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. Based on our initial scoping[4] letter, the **project team** (consisting of Ofgem and its academic partners) has also set out to:

- quantify the scenarios (through energy system modelling)
- develop a consistent set of 'way-markers' for 2025, and
- establish a set of 'key issues' for networks and for the regulation of networks.

The **draft scenarios report** follows the consultation on our academic partners' interim report, which we issued with our letter of 14 May.[5] The interim report followed our academic partners' report on scenarios inputs[6] and contained for the first time a set of

[1] Ofgem (14 May 2008), Long-Term Electricity Network Scenarios (LENS) – interim report and consultation (Ref. No. 63/08).
[2] Materials relating to the third stakeholder workshop of 5 June 2008 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).
[5] See footnote 1.
[6] Ofgem (5 December 2007), Long-Term Electricity Network Scenarios (LENS) – report on scenarios inputs and second consultation (Ref. No. 287/07).

scenarios for 2050, expressed in qualitative terms, on which we sought stakeholder views through a consultation (our 'interim consultation'). As intended, and explained in our letter of 14 May, the five scenarios from the interim report have been broadly retained in the draft scenarios report. However, they have now been enhanced by additional qualitative refinements, the addition of 2025 'way-markers', and the incorporation of a scenario quantification exercise, as explained in more detail below. These enhancements were made in light of stakeholder feedback from the third consultation and workshop and ongoing work by the project team. As the scenarios are now approaching their final form, we are consulting on them once more, through this letter, before issuing the **final scenarios report** in the autumn. This letter therefore constitutes the fourth and final consultation for the LENS project.

The **recipient group** for the network scenarios was defined in the project methodology[7], where we set out that parties with the most direct stake in GB electricity networks include electricity consumers (and organisations that represent them), network companies, power generators, suppliers, Government and Ofgem. These parties are therefore amongst the key stakeholders for the LENS project.

## Project update

*Incorporating stakeholder feedback*

We received a significant amount of stakeholder feedback in response to our third consultation and workshop on the interim report.

The **third workshop** for the LENS project took place on 5 June and was used to present and obtain stakeholder feedback on the scenarios contained in the interim report and on further work undertaken by our academic partners since the publication of that report. We also sought initial feedback on issues (or implications) for networks, including transitional issues, and for the regulation of networks. Participants generally considered that the scenarios spanned a suitably wide range of plausible outcomes for GB electricity networks in 2050, although some expressed reservations about particular aspects of certain scenarios. All the materials presented at the workshop and a **summary note** of the full day are available on the LENS page of our website.[8]

Our formal **consultation on the interim report** closed on 10 June. We received seven (non-confidential) responses which can be found on the LENS page of our website. A summary of these responses, and of our views, is provided in the appendix to this letter. Respondents raised a number of detailed comments and expressed some concerns (for example, about security of supply and the role of transmission networks in some of the scenarios), but otherwise indicated a broad level of support for the scenarios. Further details are provided in the appendix.

Stakeholder feedback from the third consultation and workshop has since been reviewed and analysed by the project team. Stakeholders' detailed comments on the scenarios themselves have led to further **refinements to the network scenarios**, as presented in the draft scenarios report. Stakeholder feedback on the implications of the scenarios has been taken into consideration by our academic partners to develop their initial views on scenario implications, as presented in the draft scenarios report, and for Ofgem's own initial work on this aspect of the project, as explained below.

*Merging the 'energy scenarios' and 'network scenarios' from the interim report*

The interim report contained two sets of scenarios, namely 'energy scenarios' (setting out plausible futures for the GB energy/electricity sector in 2050) and 'network scenarios'

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



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(doing the same but specifically for GB electricity networks). The latter were derived from the former through a 'mapping exercise'. For reasons explained in our letter of 14 May, 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 GB electricity networks within a broader context.

Our academic partners explained their approach for merging the scenarios at the 5 June workshop. The approach is again explained in the draft scenarios report, which also presents the **merged scenarios**. Although the merger of the two sets of scenarios from the interim report has led to some changes in the scenario narratives (particularly on the 'context' or 'energy scenario' side) in order to keep the scenarios 'whole' and internally consistent, our academic partners have confirmed that the scenarios continue to provide a rich description of plausible futures for GB electricity networks, with the added benefit of providing a clearer link with the underlying driving forces.

*Quantification of scenario narratives through Markal modelling & caveats*

As explained in our letter of 14 May and at the 5 June workshop, the modelling work for the LENS project is intended to add a quantitative dimension to the scenario narratives and to shed further light on scenario plausibility and internal consistency, including from an economic perspective. Initial modelling results, derived from the Markal-ED (MED) [9] model, were presented at the 5 June workshop, based on an initial set of model runs that our academic partners had undertaken by that time. Our academic partners have since revised some of the input assumptions[10] underlying their initial model runs, in light of their ongoing work and stakeholder feedback from the third consultation and workshop. Further details on the input assumptions used for the model runs can be found in the draft scenarios report. This revised set of model runs formed the basis of the quantification of the five scenario narratives presented in the report.

The model runs relate to the merged scenarios, derived from the previous step explained above. As discussed in our 14 May letter, since the MED model is an energy system model and not a network planning tool, it does not provide a detailed quantification of electricity network-specific aspects of the scenarios, such as data on network expansion/contraction at different voltage levels.[11] Instead, the model has been used primarily to quantify 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 has also allowed for analysis of the interactions between the electricity sector and related sectors (including gas, transport and heat), which we consider to be a major benefit for a project of this kind where such interactions are of particular importance because of the longer-term time horizons.

It is important for all stakeholders and other interested parties to note that, fundamentally, the **qualitative scenario narratives drove the modelling/quantification exercise and not vice versa**.[12] Based on the scenario narratives, our academic partners developed a set of model input assumptions for each of the scenarios, as explained in more detail in

[9] 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. Further details about the MED model and its use for the LENS project are provided in the draft scenarios report.

[10] The revised input assumptions can be summarised as follows: (1) a more detailed and plausible approach to the 'forcing' of key technology types at different times, to represent successive government policies, in the Multi-Purpose Networks run; (2) a reduction in the assumed number, and extent of, simultaneously applying assumptions on 'accelerated technology development' in all model runs; and (3) a refinement of the constraints imposed on access to electricity supplies from the transmission grid to certain 'demand sectors', in the Distribution System Operators and the Microgrids runs.

[11] Nevertheless, our academic partners have been able to derive some high level data on electricity-network specific aspects, such as the amounts of generation connected at the transmission versus the distribution level. They have also been able to draw out various *qualitative* insights for electricity networks from their *quantitative* analysis, as described in the draft scenarios report.

[12] For avoidance of doubt, this statement about the nature of the modelling exercise holds in spite of (and is consistent with) our additional comments below, on 'Integration and consolidation of qualitative and quantitative analysis'.



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the draft scenarios report, which then formed the basis of a model run – with one run performed per scenario.

Great care should therefore be taken in interpreting the model results. Like the scenario narratives themselves, the **model outputs contained in the draft scenarios report do not constitute in any way predictions or forecasts** relevant to future GB electricity networks, endorsed either by Ofgem or by its academic partners. Nor is it the case that there exists a unique relationship between a scenario narrative and a single set of model outputs. On the one hand, for each *individual* scenario narrative, our academic partners could in principle have developed various different sets of model input assumptions (producing different model outputs), all broadly consistent with the scenario narrative in question.[13] The single set of model input assumptions chosen by our academic partners was, in their opinion, the *most* appropriate for the purpose of quantifying this particular narrative using the Markal energy system model. However, alternative sets of model input assumptions may have been appropriate too, and could have produced quite different model outputs, for example for the generation mix or $CO_2$ emissions.[14] On the other hand, looking *across* the scenario narratives, although model input assumptions may vary significantly between the narratives they can produce similar or identical model outputs with respect to certain aspects of the scenarios.[15]

The added value in quantifying the scenarios lies in adding an additional layer of quantitative detail to the scenario narratives, and to test at a high level their plausibility and internal consistency, including from an economic perspective, based on driving forces and trends that can be observed today. Such quantification can then lead to **further insights** regarding the scenarios themselves and for any subsequent development of strategy by stakeholders in light of the scenarios. The levels of uncertainty over a 40-50 year horizon (or even over a shorter horizon to, say, 2025) are considered far too high, both by us and our academic partners, for the scenarios and their quantification to be interpreted as predictions or forecasts of the future.

Although we consider the Markal model to be a suitable modelling tool given the LENS project's focus on long term scenarios, we note that in principle it may have been possible to use different kinds of models to quantify the scenarios, and that different models could have produced different sorts of insights into plausible futures for GB electricity networks. Each model will have its particular pros and cons, and future modelling work undertaken by stakeholders could focus on other, relevant aspects of the scenarios.

The role of the Markal model and the relationship between the scenario narratives and their quantification is explained in more detail in the draft scenarios report.

*Integration and consolidation of qualitative and quantitative analysis*

Using their model runs for the scenario narratives, our academic partners then went through a further exercise of considering the implications of the quantitative analysis for the qualitative narratives. Where appropriate, they made some further refinements to the scenario narratives, for example in areas where they considered that the modelling results

[13] One related observation is that, although the Markal model often displayed a preference for one particular generation technology over others, a different balance in the generation technology mix could have been equally plausible and consistent with the scenario narrative.

[14] Given the nature and scope of the LENS project, we did not consider it appropriate to run additional sensitivities on the individual model runs for each scenario. The volume of output data from a single MARKAL run provided sufficient material for detailed scenario analysis in the report, and the project team considered it was more beneficial to focus on comparing the existing five runs than on generating additional sensitivities.

[15] When they do produce similar model outputs, however, it does not necessarily follow that *other* sets of model input assumptions (that are still appropriate) would have produced similar model outputs as well - nor does it follow that there can't be other plausible futures captured through scenario narratives that, by contrast, would have produced *different* model outputs.
One implication is that similarities in model outputs, observed when comparing across scenarios, cannot necessarily be interpreted as 'all' plausible futures producing the same quantitative outcomes.



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pointed at an internal inconsistency within the narrative that required a change. Our academic partners also drew out many qualitative insights from the quantitative analysis.

The scenario narratives in the draft scenarios report reflect the outcome of this exercise.

*Development of 2025 'way-markers' for 2050 scenarios*

Our academic partners have also developed a consistent set of 2025 'way-markers'. The development of way-markers was explained at the 5 June workshop, and the approach for developing them is also described in the draft scenarios report. Draft way-markers for 2025 are now presented in the draft scenarios report, for review by stakeholders. Our academic partners have developed one set of 2025 way-markers for each of the five network scenarios, as explained at the 5 June workshop.

It is our intention that a final set of 2025 way-markers, amended as appropriate in light of the responses to this final consultation, will be included in the final scenarios report.

*Our academic partners' initial views on scenario implications*

In light of the feedback received through the third consultation and workshop as well as their ongoing work, our academic partners have set out their initial views on scenario implications for networks and their regulation in the draft scenarios report.

Our academic partners' views will form a key input into Ofgem's work on assessing scenario implications.

*Developing Ofgem's views on scenario implications*

As indicated in our letter of 14 May, we have started developing our views on 'key issues' for networks and for the regulation networks in light of the scenarios. At the 5 June workshop and through the third consultation, we sought initial views from stakeholders on key issues in light of the scenarios contained in the interim report. This stakeholder feedback has informed the project team's initial thinking about scenario implications.

At the 5 June workshop, we set out a conceptual framework[16] for the discussion about issues (or implications) for networks and their regulation, which is reproduced in the diagram below (with some minor amendments). We explained how identifying key issues differs from the development of *strategy* by individual stakeholders, which is a potential next phase of work that lies outside the scope of the LENS project (as already explained in our earlier letters[17]). We defined *issues for networks* as: implications raised by the 2050 scenarios (including necessary conditions and possible obstacles) that are important for considering the future of GB energy networks.[18] In the diagram below, issues for networks correspond to the second column headed 'Issues (or implications)'. We then defined *issues for the regulation of networks* as: implications raised by the 2050 scenarios (and the issues they raise for networks, as defined in the previous sentence) that are important for considering the future regulation of GB energy networks.[19] In the diagram below, issues

[16] Available at http://www.ofgem.gov.uk/Networks/Trans/ElecTransPolicy/lens/Documents1/5-June_Collated_Presentations.pdf, see in particular slides 79-81.
[17] Available on the LENS page of Ofgem's website: http://www.ofgem.gov.uk/Networks/Trans/ElecTransPolicy/lens/Pages/lens.aspx
[18] In order to identify 'issues for networks' for a single network scenario, we asked workshop participants the following question: What would need to happen for this network scenario to come about, including any aspects of implementation, and what obstacles may prevent it from coming about?
Issues for networks include *transitional* issues for networks, which we defined as: Implications raised by *the transition to* the 2050 scenarios (including necessary conditions and possible obstacles) that are important for considering the future of GB energy networks.
[19] In order to identify 'issues for the regulation of networks' for a single network scenario, we asked workshop participants the following question: What are the advantages and disadvantages of this network scenario (i.e. from the perspective of GB society's 'total welfare'), and how could any disadvantages potentially be mitigated through regulation (or otherwise)?



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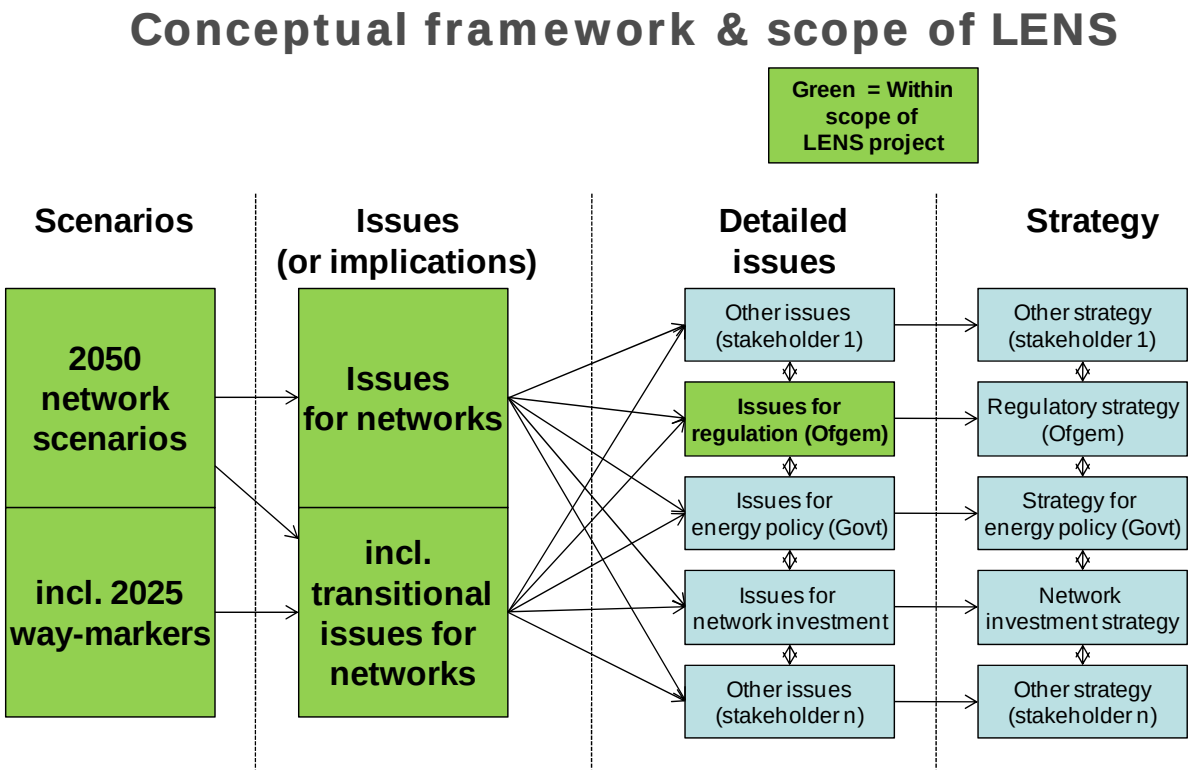
for the regulation of networks correspond to the 'Issues for regulation (Ofgem)' box in the third column. We then used these definitions to facilitate the subsequent breakout group discussions on scenario implications at the workshop.




In summary, and to aid stakeholders' understanding of what we mean by the terms used in the consultation questions set out in this letter, we therefore define:

- 'issues for networks' as the implications of the 2050 scenarios and 2025 way-markers (including necessary conditions and possible obstacles) for GB energy networks in the short/medium/long-term future – hereafter referred to as '**scenario implications for networks**', and

- 'issues for the regulation of networks' as the implications of the 2050 scenarios and 2025 way-markers (and the issues they raise for networks, as defined above) for the regulation of GB energy networks in the short/medium/long-term future – hereafter referred to as '**scenario implications for the regulation of networks**'.

Scenario implications for networks and for the regulation of networks are jointly referred to hereafter as '**scenario implications**'.

We presented our initial high levels views on scenario implications at the Transporting Britain's Energy (TBE) seminar[20] on 10 July (as work in progress), distinguishing between implications for networks and for the regulation of networks. Next steps for developing Ofgem's views on scenario implications are discussed below.

*DPCR5 and RPI@20 projects*

As noted in the appendix to this letter, some respondents to the interim consultation again commented on the relation between the LENS and DPCR5 projects. Our position remains as set out in our 14 May letter, in which we recognised that, although there would be no

[20] Ofgem slides are available at http://www.nationalgrid.com/uk/Gas/OperationalInfo/TBE/

direct link between the two projects, the LENS project would help inform discussions on the short term investment requirements for DPCR5.

We also observed in our 14 May letter that we envisage that the outcome of the LENS project will feed into the RPI@20 review announced in March[21] this year, and that any revisions of regulatory policy in light of the final scenarios and the issues they raise are likely to be considered as part of this review (or other Ofgem projects).

**Next steps**

The remaining work programme and timetable for the project, in light of recent developments, is presented below.

*Final stakeholder workshop*

We asked stakeholders, through our interim consultation and at the 5 June workshop, whether they saw benefit in a fourth (and final) stakeholder workshop for the LENS project, following publication of the draft scenarios report. At the 5 June workshop, although some stakeholders expressed an interest, we did not receive a strong response either in favour or against such a workshop. However, the majority of respondents who submitted written comments to the 14 May consultation did favour a fourth workshop.

In light of stakeholder feedback and how the project has progressed since then, we therefore intend to offer a **final stakeholder workshop** at the close of the LENS project later his year. The purpose of this workshop will be both to conclude the project and present its main findings and to start discussing next steps. Since the workshop will not formally feed into the LENS consultation process, we specifically **encourage all interested parties to submit written responses** to the consultation questions set out in this letter – as these responses will remain instrumental for the purpose of developing the final outputs of the project (including the final network scenarios as well as our views on scenario implications).

We will send out further details on the final stakeholder workshop (including details on how to register) nearer the time.

*Final scenarios report*

In light of progress made to date, we expect to publish the final scenarios report of our academic partners in the autumn, reflecting stakeholder feedback on the draft scenarios report received through this written consultation and the project team's ongoing work.

We anticipate that the final scenarios report will look broadly similar to the draft scenarios report, in that it will contain: the final scenarios for GB electricity networks for 2050 (with quantification and 2025 way-markers); a summary of the process by which the scenarios were derived; our academic partners' final views on scenario implications; and appendices containing further details on scenario quantification and other relevant information.

*Scenario implications – finalising Ofgem's views*

As explained above, stakeholder feedback received through the third consultation and workshop and input received from our academic partners has informed the development of our own initial views on scenario implications.

We observed in our letter of 14 May that it was our intention to broadly retain the scenarios from the interim report in the draft scenarios report. Since the scenarios from the interim report have indeed been broadly retained, the initial views on scenario implications expressed by stakeholders in response to the third consultation and workshop continue to

[21] Ofgem (6 March 2008), Ofgem to review regulatory regime for energy networks, press release.



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be of relevance going forward. However, through this letter we invite stakeholders to submit any further views on scenario implications, in light of the qualitative and quantitative scenario refinements incorporated in the draft scenarios report, as described above.

We intend to publish our final views on scenario implications in light of: initial stakeholder feedback received through the third consultation and workshop; further stakeholder feedback in response to this final consultation; the views of our academic partners on scenario implications as set out in their reports; and any other relevant information. This publication is likely to be in the form of an Ofgem open letter, issued soon after the publication of the final scenarios report.

We **encourage stakeholders to set out any further views on scenario implications** in their written responses to the consultation questions set out in this letter, as this will be the final opportunity to do so through the LENS consultation process.

*Summary*

In summary, our expected timetable for bringing the project to a conclusion looks as follows:

- Consultation on draft scenarios report — late August – late September 2008
- Final scenarios report — October 2008
- Open letter on scenario implications — October/November 2008
- Final stakeholder workshop — November 2008

**Consultation questions on the draft scenarios report**

We seek views from respondents on the following questions:

**Q1.** Do you have any further comments on the draft electricity network scenarios for Great Britain set out in section 4 of the report, or the method used to derive them, in light of (i) the scenario merger and quantification exercise, (ii) the addition of 2025 way-markers, and (iii) the additional refinements made in light of stakeholder feedback? In particular:

> **Q1(a).** Do you agree that all five scenarios are plausible? If not, please explain *why* you think that one or more of the scenarios are implausible.
>
> (When answering this question, respondents are asked to bear in mind that possible concerns about the quantification of a scenario need not necessarily bring into question the plausibility of the scenario as a whole, for reasons explained elsewhere in this letter and in the draft scenarios report. Each model has its own limitations and a model's role in this context is not to predict and forecast the future, but mainly to provide further insights about the future that may be of use to stakeholders.)
>
> **Q1(b).** Do you agree that the draft scenarios report demonstrates that the five scenarios, between them, span a suitably wide range of (plausible) outcomes for GB electricity networks in 2050? If not, what essential features (if any) do you think are missing and could these potentially be accommodated within the existing scenarios?

**Q2.** What are your final views on the scenario implications for networks, as defined elsewhere in this letter, in light of the draft electricity network scenarios for Great Britain set out in section 4 of the report?

**Q3.** What are your final views on the scenario implications for the regulation of networks, as defined elsewhere in this letter, in light of the draft electricity network scenarios for Great Britain set out in section 4 of the report?



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**Q4.** Is there follow-on work that, in your opinion, Ofgem and the Authority (or other relevant stakeholders) should consider undertaking in light of the draft electricity network scenarios for Great Britain set out in section 4 of the report, after the close of the LENS project?

**Q5.** Do you have any other comments or views about the LENS project that you wish to raise at this final 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.

**Responding to this final consultation**

We welcome views from all interested parties on the consultation questions set out in this letter. Written responses should be received by **Friday 26 September 2008** and should be addressed to:

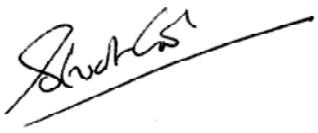
Erik Sleutjes
Senior Manager
Ofgem
9 Millbank
London SW1P 3GE

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

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.

Yours sincerely,



**Stuart Cook**
**Director of Transmission**



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## Appendix: Stakeholder responses to third consultation and Ofgem's views

Our third consultation of 14 May 2008 (Ref. No. 63/08) invited stakeholder views on a number of questions about the accompanying interim report on GB electricity network scenarios for 2050.

We received seven (non-confidential) responses to the interim consultation, from:

- CE Electric UK
- EDF Energy Networks
- Electricity North West Limited
- ARUP
- E.ON Central Networks
- National Grid, and
- SP Energy Networks.

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

*General comments*

Respondents were generally pleased with the content of the interim report and supportive of the LENS project. Ofgem's co-ordination of the project was largely welcomed, and there was a belief that the work Ofgem is doing on this goes some way to ensuring that the sector develops a view on long-term direction.

One respondent noted that there was clear evidence that the views and inputs of stakeholders to date throughout the process (both through consultation and co-ordinated workshops) had been largely considered and incorporated into a coherent interim report. They observed that the interim report demonstrated a culmination of thorough research, effective consultation and a robust audit trail of the decisions that had ultimately led to the final energy and network scenarios of the LENS project.

One respondent observed the project's success to date, but cautioned that key challenges still remained, including the production of tangible benefits to stakeholders by demonstrating the economic and sustainable viability of such scenarios as a guide to future direction.

Overall, respondents expressed appreciation of the project outputs to date and of the steps taken by Ofgem to lead debate and provide the opportunity for stakeholders to make an effective contribution.

*Ofgem's views*

We are encouraged by the comments from several respondents that the draft outputs of the project (including the interim report) have assisted and facilitated debate amongst stakeholders regarding longer term network issues, as from the outset this has been one of the key aims of the project.

We were aware of the outstanding challenges following the publication of the interim report, and consider that these have now generally been addressed in the updated, draft scenarios report. However, we welcome any further stakeholder feedback through this final consultation, which could lead to some further refinement of the network scenarios (as appropriate). By this stage of the scenario development process, we do not expect that substantive, fundamental changes to the scenarios will be required, but this position is subject to final views expressed by stakeholders in response to the questions raised in this letter.



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We hope that the final outputs of the project, following incorporation of stakeholder feedback from this final consultation, will continue to facilitate discussion amongst stakeholders about longer term network issues.

*Question 1*

*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:*

*1a) 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.*

Most respondents agreed that the approach taken in developing the five network scenarios was logical and appropriate and that each scenario constituted a plausible outcome.

Some respondents noted that the network scenarios could benefit from quantitative economic analysis and greater consideration of whether demand could be met under the hypothesised network structures.

One respondent suggested that 'load flow analysis' was essential in order to test the network architecture and its operation and assess the validity of the network scenarios. A further respondent echoed this view, commenting that a feasibility study or economic assessment of each scenario would give greater credibility to the scenarios.

Two respondents agreed with the plausibility of scenarios that called for greater consumer self sufficiency, considerable use of renewables and diminishing use of large scale transmission. One of these respondents questioned the probability of the Big T&D scenario for 2050, given that in their opinion the natural development of technology would most likely produce a "smarter" network despite the prevailing market model.

Another respondent, however, questioned scenarios that rejected the reliance on some form of developed transmission infrastructure, given their opinion that the UK would struggle to cope with peak demand requiring the bulk transfer of power from remote generation in the north to high demand areas in the south.

Three respondents noted security of supply was an issue that should be given greater consideration within the network scenarios. One of these respondents mentioned that a possible weakness of the scenarios was their tendency to treat GB as a near self sufficient island. The second respondent expressed it was necessary to assess not only the adequacy of supply in terms of access to the primary source and its energy conversion, but also the reliability of that supply to meet demand and cope with failures. The third respondent noted that when narrowing down the scenarios it had been inappropriate to discard 'option 7' (from the analysis in the interim report), since energy security issues would be equally as important and relevant in 2050 as environmental concerns, for example, and thus required an independent scenario and subsequent analysis.

Another respondent challenged the plausibility of the microgrids scenario, quoting a "lack of security of supply consideration" as a reason to bring it into question, and argued that obstacles may arise from the heavy reliance on gas to meet peak demand coupled with a possible lack of access to sufficient spare capacity and storage on the microgrid. The respondent suggested that a more direct link between price and security of supply could generate a "merit order" of appliances whereby people would prioritise the level of security of supply that they received, coupled with increased demand-side responsiveness and load management.

One respondent considered that the fifth scenario of Multi-Purpose Networks was likely to be the most "realistic" outcome for 2050 given a "non linear pathway of evolution", but constituted a composite rather than a distinct scenario in itself.



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*1b) 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.*

All seven respondents were of the opinion that the five network scenarios discussed in the report covered a suitably wide range of plausible outcomes for 2050. Three respondents considered that no significant features to the scenarios were missing, whilst one commented that a scenario accommodating energy security issues could be added.

One respondent noted that the scenarios take the "middle ground" of each theme and do not allow for any extremes to be reached. This was echoed by another respondent who suggested that market volatility may require a readjustment of the scenarios to more extreme cases for the publication of the final report.

One respondent suggested that whilst the scenarios represented an "acceptable" set of outcomes, it was also important to develop some contingency scenarios in consideration of potential events, making it necessary to consider each scenario's sensitivities to extrinsic influences. The same respondent commented further that in their opinion the scenario analysis would also benefit from being re-run without the specific Markal modelling constraints imposed on the use of the existing network infrastructure.

*Ofgem's views*

We observe that most respondents generally felt that the set of five scenarios in the interim report were plausible, although some respondents expressed concerns about the plausibility of one or two of the scenarios and/or how certain features applying across the scenarios, such as security of supply, had been captured. The project team has considered these comments and concerns, and amended the scenarios accordingly (as they best saw fit). We welcome final views from stakeholders as to whether, following these amendments, there are any remaining concerns regarding the general plausibility of the updated scenarios contained in the draft scenarios report.

We also observe that respondents generally agreed that the five scenarios in the interim report, between them, spanned a suitably wide range of plausible outcomes for GB electricity networks in 2050. Again, some more detailed comments were raised, for example with respect to the possibility of more extreme circumstances materialising in future than those that had been captured in any of the scenarios. We do not disagree in principle that more extreme circumstances could come about, however the aim of the project has been to develop a range of plausible scenarios. The decision not to consider the most extreme ends of the spectrum of plausible outcomes has been a deliberate one, as explained earlier on in the scenario development process (for example, in the interim report).

The scenarios from the interim report have been broadly retained in the draft scenarios report, subject to the additional refinements described elsewhere in this letter and set out in more detail in the updated report. We consider that comments and concerns raised by respondents have been addressed adequately in the updated, draft scenarios report, and that the amended scenarios are plausible and, between them, span a suitable wide range of plausible outcomes for GB electricity networks in 2050. We welcome final stakeholder views on whether they agree, in response to question 1 of this final consultation.

*Question 2*

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

Three respondents considered the way-markers as integral to this project and the overall development of the final scenarios. Other respondents highlighted the use of way-markers



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as a means of testing and evaluating the plausibility of the scenarios themselves and identifying barriers.

Two respondents noted that the way-markers could be used as a means of tracking the performance and progress towards the scenarios and the attainment of UK targets (acting as Key Performance Indicators). One example was that one could use such way-markers to assess whether the need for change is incremental or more radical and also to help determine the course of action to achieve a desired scenario.

Whilst way-markers were considered important, two respondents expressed that other factors would have a greater influence on whether the scenarios are achievable. One considered that other key influences included greater demand side management, the widespread introduction of smart meters and zero carbon homes. The other respondent identified changes in social trends, technologically smarter networks and metering capability (limited by physics), and Government commitments as three main "signposts" with the ability to shape and influence investment and thus determine the outcome of certain scenarios.

One response suggested that the Multi-Purpose Networks scenario was in itself a way-marker for 2025 that would set the conditions for one of the remaining scenarios by 2050. This was rationalised through the view that evolutionary development is non-linear and often composite, giving rise to "multi dimensional" development of the network.

Overall, respondents recognised the importance of way-markers, not only in terms of aiding scenario development, but also their ability to influence transitional development factors such as investment, innovation, technology and a facilitating regulatory regime.

*Ofgem's views*

Stakeholder feedback on transitional issues and way-markers for 2025 has fed into the LENS scenario development process. In particular, the draft scenarios report now contains a set of 2025 way-markers for each of the five network scenarios, as explained elsewhere in this letter, which has been based (in part) on this feedback. It also contains our academic partners' initial views on scenario implications (which include transitional ones).

We agree that the 2025 way-markers form an integral part of the network scenarios for 2050. Given the scope of the project we do not consider it appropriate however (nor do our academic partners) for the way-markers to turn into fully-fledged 'scenarios' in their own right.

We consider that, nevertheless, the 2025 way-markers are of sufficient interest in their own right to help facilitate stakeholder thinking about scenario implications for networks and for the regulation of networks (as defined elsewhere in this letter), including any 'transitional' implications for the short/medium-term future.

We welcome stakeholder feedback on the 2025 way-markers contained in the draft scenarios report, through question 1 of this final consultation. We also welcome any further stakeholder feedback on scenario implications, in light of the 2025 way-markers contained in the draft scenarios report and the broader network scenarios for 2050 that they relate to, in response to questions 2 (on networks) and 3 (on the regulation of networks) of this final consultation. Such feedback will be considered carefully for the purpose of producing the final outputs of the LENS project.

*Question 3*

*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?*



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Several respondents viewed Government intervention and leadership as one of the most critical issues for networks. The need for a clear and stable legislative framework was seen as an important prerequisite for investment.

Technology was cited by the majority of respondents as another important issue. The general view expressed was that technology and innovation are necessary in order to deliver the replacement of assets required, but that consideration needs to be given to ensure that it is achieved within time and minimises the risk of stranded assets.

Two respondents recognised regulation as a critical factor in inducing change and ensuring that technology is incentivised and that appropriate rewards for active investment in the network are provided. One commented that this required a change in the current regulatory regime, giving an example of the current ring fencing of activities of DNOs as one regulatory barrier that potentially prohibits the development of certain network scenarios. The same respondent added that Government intervention would play a greater role than at present in shaping the development of the generation mix. The other respondent noted that at the same time regulation must provide some stability and certainty in order to encourage strategic investment and the ability to reward investment decisions through effective incentivisation.

One respondent noted that markets and their associated arrangements will need to change in order to deliver some of the scenarios outlined in the report, especially those requiring localised markets and demand side management. Alongside this, the respondent saw the need for dramatic changes to system balancing, dispatch, storage and DNO licence requirements as an important issue for network development.

Respondents suggested further issues including: the immediacy of the action required especially to attain scenarios of leaner networks; the obstacles and solutions to stranded assets; the mitigation of security of supply issues; and the need for common minimum technical standards.

In general, most respondents saw the regulatory framework as crucial to network change. They noted various aspects including: the need to be conducive to and incentivise change; taking greater responsibility for leading consumer and environmental action; and being flexible and responsive to changing conditions.

*Ofgem's views*

Stakeholder feedback on this question has informed our academic partners' initial views on scenario implications set out in section 5 of the draft scenarios report. It has also informed our own initial thinking about scenario implications, as described elsewhere in this letter.

We welcome further feedback from stakeholders on scenario implications for networks and for the regulation of networks (as defined elsewhere in this letter) in response to questions 2 and 3, respectively, of this final consultation. This feedback will help us to further develop and finalise our views on scenario implications.

*Question 4*

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

Six out of the seven respondents felt that a fourth stakeholder event would hold some benefit to them and to the outcome of the project at large. Many saw a fourth event as an opportunity to finalise the report and to clarify next steps.

Several respondents expressed an interest in gaining more understanding of the Markal model, in order to apply this to their own modelling applications and techniques going forward. One respondent commented that previous events had given relatively limited time



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to running, presenting and evaluating the results of the Markal model. Another respondent expressed a desire to contribute their industry analysis expertise to such modelling and to the wider project at large.

Three respondents added that a final event would serve to further develop the 2025 'way-markers', identify relevant transitional issues and provide ratification for the report's findings and the entire process at large.

One respondent, however, felt that a fourth and final event was not necessarily needed, given that greater value could be extracted from first consolidating all the critical issues already raised during the LENS process to date through the publication of the final report, and then perhaps using that as a basis for a further workshop/event later on in the year.

*Ofgem's views*

As explained elsewhere in this letter, we consider that there would be merit in holding a final stakeholder workshop at the close of the LENS project later this year.

A detailed explanation of the Markal model and its use for the LENS project is contained in our academic partners' draft scenarios report, and we hope that this will be of use to those respondents who expressed a specific interest in this particular aspect of the LENS project (and any other interested stakeholders).

*Question 5*

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

All respondents expressed interest in seeing the publication of the final report with some commenting on their wish to explore the Markal model further.

Two respondents expressed disappointment that the project's intent was not to provide any link with DPCR5, given the LENS project's potential ability to influence the approach to investment and asset replacement. However, these two respondents were satisfied with the project's intended link and feed through into the RPI@20 review, with the potential to still have some influence on the scope of transition of new network architecture. A third respondent indicated that they intended to use certain aspects of the LENS project and its related output(s) to help support the context for their DPCR5 submission.

One respondent commented that there would be value in revisiting the scenarios and the project outputs at intervals in order to benchmark performance and progress made to date and ensure the project's longevity and reach. For example, the Government should retain some of the modelling capability beyond the project's life in order to continue to derive benefit.

One party identified that the scenarios could benefit from greater distinguishing features and that the final phase of scenario development should ensure that the most contemporaneous market events and developments have been taken into account to ensure their continued plausibility.

Another party expressed the view that issues such as security of supply and developments in gas infrastructure need to be considered further or resolved first in order to derive greater value from the final scenarios. They noted this could benefit from further analysis, in order to ensure the consistency of both energy and network scenario components.

*Ofgem's views*

We have considered the comments raised in response to this question. We remain satisfied that we have made appropriate links between LENS and other parallel work programmes,



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as set out elsewhere in this letter. Regarding the revisiting of the scenarios at appropriate intervals in light of new information, we observed in our 14 May letter that we anticipate that an exercise of this nature would need to be repeated periodically.

As to the incorporation of 'contemporaneous' market events into the draft (and final) scenarios report, we consider that this may indeed be appropriate to the extent that such events point to changes in the underlying, longer term driving forces for the network scenarios and that such changes are likely to have a material effect (over time horizons stretching out 40 to 50 years) which otherwise would not be incorporated or reflected in the scenarios.



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