



Department for
Business, Energy
& Industrial Strategy

WHOLE POWER SYSTEM IMPACTS

Addendum on Peer Reviews

March 2017

Summary Response to Peer Review Comments

The purpose of the peer reviews was to impartially scrutinise and quality assure the content of the research carried out by Frontier Economics for the Whole Power System Impacts of Electricity Generation Technologies project. To do so, the peer reviews assessed whether the framework and evidence base gathered are impartial, robust and fit for the purpose by considering the quality of the research, with regards to the methodology and inputs used, as well as outputs. The peer reviewers were Dr Robert Gross (Imperial College), Dr Lion Hirth (Neon), and Andy Boston (The Energy Research Partnership). The published report takes into account the peer review comments. This addendum sets out at a high level how the main peer review comments, which often relate to specific sections in a previous draft of the report, have been addressed. The tables in the Annex show how Table/Figure numbers have changed between versions.

General Comments

1. The purpose of the published report was to establish a methodological framework, which would provide the theoretical framework but not necessarily all detail for later stages of the project, which focused on the detailed exploration of the various framework components and how they could be modelled. Therefore, some of the comments regarding lack of detail, particularly in relation to the modelling framework, have not been addressed through this report.
2. The topic of whole system impacts is complex and DECC and Frontier Economics were keen to ensure that the framework discusses all relevant categories and drivers in sufficient detail. This required a longer than originally envisaged report.

For ease of reading, Frontier Economics further improved the executive summary, structure and clarity of the main report.

3. The published report on its own cannot be used to influence policy making, but it forms the methodological basis for further systematising DECC's internal modelling capability, which eventually can be used to inform future policy decisions.

Executive Summary

4. The original report contained a summary of the previous whole system impact estimates that had been found in the course of the literature review. The peer reviewers, alongside Frontier Economics, noted that these estimates were highly context (system) and methodology specific and, in some cases, were not credible. As a result the summary, though an accurate reflection of the literature, had the potential to mislead readers. DECC and Frontier Economics therefore agreed to remove any reference to the numerical estimates in the Executive summary and the main report.
5. Some of the peer reviewers commented that the clarity of definitions, e.g. what is meant by a "cost" and "benefit" when talking about whole system impacts, could be further improved. Frontier Economics addressed this and the report now discusses the main whole system impact categories more precisely in the main part of the report.
6. To address some other more specific comments, the published report:
 - (a) discusses in more detail the different options to reduce system costs and the importance of storage, DSR and interconnection throughout the report;
 - (b) excludes a table on capacity credits from the executive summary as it was not essential for the high level summary (an updated table and accompanying text have been kept in the main part of the report);
 - (c) clarifies the wording on who internalises balancing costs and who does not (e.g. small generators);
 - (d) highlights that all technologies can be affected by constraint management;
 - (e) highlights that the true benefit of low carbon technologies may not be appropriately priced, thereby distorting assessments of these technologies' whole system impact;

- (f) explains more clearly the conditions under which new generators added to the system will result in generation cost savings;
 - (g) explains that single in-feed loss needs to be considered as a balancing issue; and
 - (h) reflects various comments on the 'who bears the costs' section of the report, e.g. highlighting the fact that, while it is generally appropriate to make generators internalise their wider costs and benefits, there may be cases where this is inappropriate.
7. Frontier has also addressed some other minor points flagged by the peer reviewers.

Introduction

8. Frontier has addressed some minor points flagged by the peer reviewers.

What Are Whole Systems Impacts?

9. The peer reviewers commented that this section would benefit from further clarifying early on: the scope and definitions of power system costs; that the report is considering long-term scenarios (but flagging that the approach assumes e.g. existing network infrastructure); that system impacts will depend on the technology itself but also on its market share and, crucially, the make-up of the rest of the system; and that it is important to decompose whole system impacts and also what the risks around the approach are, for example around where to count certain costs and how to avoid overlap between categories. Frontier Economics have addressed all of these points.
10. To address some other more specific comments, the published report:
- (a) highlights that a significant system benefit of low carbon technologies, namely avoided carbon, is currently not appropriately priced and therefore distorts the assessed whole system impacts of different technologies;
 - (b) provides more clarity on the difference between financial and resource costs;
 - (c) shows an updated "Defining Whole System Costs" figure, where system impacts can be positive or negative;

- (d) discusses more clearly the costs of re-optimising the system in the main text and in an additional box;
 - (e) gives a better explanation of the graphs showing the optimal dispatchable power mix with and without variable renewables;
 - (f) shows an updated system costs and benefits framework diagram to ensure all potential balancing cost elements are reflected;
 - (g) explains more clearly the role of the system operator in the balancing impacts section; and
 - (h) clarifies where curtailment costs sit within the framework.
11. Frontier has also addressed some other minor points flagged by the peer reviewers.

Characteristics That Drive These Impacts

12. To address the peer reviewers' comments, the published report:
- (a) points out that all technologies can be affected by constraint management;
 - (b) better highlights the challenges of building a framework that is relevant for all technologies given the strong focus on variable renewables;
 - (c) shows an updated "Capacity Credits" table, which is now consistent with National Grid's assessment, and narrative around the table;
 - (d) more clearly explains the LOLE target and capacity market and their interdependence with system balancing;
 - (e) shows an updated "Mapping of drivers to technologies" table to clarify that wind can also provide flexibility other than curtailment; that CCS's flexibility will depend on its design specification; that nuclear is limited by local acceptance; that wind can have a negative correlation with demand (anti-cyclone effect); and that interconnectors have the ability to share inertia across systems;
 - (f) clarifies the text in and around the tables on Technology Characteristics, Power System Characteristics and Location Characteristics;
 - (g) excludes a couple of tables that were deemed unhelpful or unclear;

- (h) further clarifies that the capacity credit of wind can be significantly reduced by anti-cyclones, where cold and still periods produce coincident high demand; and
 - (i) clarifies the wording around storage and capacity credit.
13. Frontier has also addressed some other minor points flagged by the peer reviewers.

Who Bears Whole System Impacts?

14. In general, it is important to note that Section 5 discusses the degree of socialisation of whole system costs qualitatively. The intention was not to attempt to estimate the percentage shares of costs that are internalised.
15. The peer reviewers had several comments on Section 5.1, the “Cost Allocation for Technologies Connecting to the GB Network” table and Annex 2. Frontier Economics have addressed these comments by substantially rewriting parts of section 5; by amending the table, which now specified that full internalisation of network reinforcement/extension can only be achieved with a locational marginal pricing regime; and by amending Annex 2.
16. Some of the peer reviewers commented that there was a need for more clarity around displaced generation costs. Frontier Economics have addressed this point.

Conclusions

17. There were no comments that needed addressing on the Conclusion section.

Annex

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Executive Summary	pp 1-12	pp 1-14
Introduction	pp 13-14	pp 15-16
What Are Whole System Impacts?	pp 15-44	pp 21-44
Characteristics That Drive These Impacts	pp 45-88	pp 45-84
Who Bears Whole System Impacts?	pp 89-98	pp 85-94
How Large Are Whole System Impacts?		pp 95-110
Conclusions	pp 99-100	pp 111-112

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