NERA & Imperial College report to RWE npower "Assessing the Cost Reflectivity of Alternate TNUoS Methodologies"; a critique prepared for SSE

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Disclaimer

Executive summary

This report has been commissioned by Scottish & Southern Energy to review the analysis set out in the document "Assessing the Cost Reflectivity of Alternative TNUoS Methodologies", prepared by NERA and Imperial College (ICL) for RWE npower, and to provide a critique of the main conclusions.

In their report, NERA/ICL note that neither Ofgem nor the CMP213 Workgroup explicitly compared the cost-reflectivity of alternative charging options, despite the focus on cost-reflectivity in the Authority's Direction to National Grid. In view of this perceived omission, NERA/ICL used the Dynamic Transmission Investment Model (DTIM) to compare the cost-reflectivity of Ofgem's preferred charging methodology option, WACM2, with the existing TNUoS charging methodology (the Status Quo), on the basis of the Long Run Marginal Cost (LRMC) of transmission.

NERA/ICL's analysis clearly shows that WACM2 produces charges that are closer to the LRMC of transmission than the Status Quo for all boundaries, other than for the particular case of the Scottish boundaries post commissioning of the Western HVDC bootstrap. However, based on this particular outcome, which makes the extreme assumption that all future reinforcement of the principal Scottish boundaries will be HVDC, NERA/ICL conclude that WACM2 is less cost-reflective than the Status Quo and that no case exists for its introduction.

This report outlines that NERA/ICL's conclusions are not supported by the analysis they carried out. This report also shows that, had a less extreme assumption been made about future Scottish boundary reinforcement, WACM2 would be shown to be more cost-reflective than the Status Quo in virtually all situations.

In addition, this report challenges the rationale for assessing the cost-reflectivity of transmission charging options on the basis of how closely they reflect a scenario-based estimate of the LRMC of transmission. While the approach is theoretically correct, it ignores the complexities and subjective processes involved in estimating the LRMC of transmission over an extended timescale, and the dangers of reaching false or misleading outcomes. The current Investment Cost related Pricing (ICRP) methodology, on which both WACM2 and the Status Quo are based, charges transmission users on the basis of costs they impose on the existing transmission system, and therefore does not suffer from these problems.

Finally, this report notes that DTIM appears to produce some counter-intuitive outcomes that cannot readily be explained, and which tend to undermine confidence in the model.

This report supports Ofgem's position that WACM2 better facilitates the CUSC objectives than the Status Quo.

1. Introduction

1.1 Background to Project TransmiT

Following the conclusion of Ofgem's Significant Code Review (SCR) in May 2012, National Grid was directed to raise a CUSC modification proposal to address the defects identified in the existing TNUoS charging methodology, the Status Quo. National Grid submitted a modification proposal (CMP213) to the CUSC Modifications Panel in June 2012, who decided that the modification should be considered by a Workgroup (the CMP213 Workgroup) who were to report back to the Panel following a Workgroup consultation.

During their deliberations, the CMP213 Workgroup considered National Grid's Original proposal set out in CMP213, and identified potential options and alternatives. Ultimately, the Workgroup identified 41 potential Workgroup Alternative CUSC Modification (WACM) proposals, and voted to take forward eight proposals that were considered to most improve on baseline (the Status Quo) or the National Grid Original proposal, in terms of the CUSC applicable objectives. The eight proposals taken forward included National Grid's Original proposal and Diversity options 1, 2 & 3, which proposed alternative methods of dealing with the issue of sharing between non-carbon and carbon-emitting generation.

On 1 August 2013 Ofgem published a consultation and Impact Assessment of CMP213, indicating that it was minded to approve WACM2 on the basis that the option was consistent with its statutory duties and better met its principal object of protecting the interests of customers compared with the other CMP213 alternatives or the existing TNUoS methodology. At the time, Ofgem also indicated that it was minded to implement the new charging arrangements in April 2014.

In response to Ofgem's consultation, RWE npower commissioned NERA/ICL to provide a review of Ofgem's Impact Assessment and "minded to" decision paper. The NERA/ICL report concluded that, inter alia, the WACM2 charging methodology did not fully reflect the costs incurred by Transmission Owners in adhering to the requirements of the NETS SQSS and that neither the Workgroup nor Ofgem had carried out any analysis to demonstrate that the methodology was more cost reflective than the Status Quo, a major requirement of the Authority's Direction to National Grid. Based on this and other information received from respondents to their consultation, Ofgem announced in December 2013 that they intended to take more time to examine the evidence and delay the implementation of new charging arrangements.

In April of this year Ofgem published a further consultation providing an analysis of information received, including a second report by NERA/ICL entitled "Assessing the Cost-reflectivity of Alternate TNUoS Methodologies", which provides further information on the analysis presented in their original report. This second NERA/ICL report is the subject of this critique. In their further consultation, Ofgem indicated that, subject to the responses received, they are minded to implement the WACM2 charging methodology in April 2016

2. Scope of this report

The purpose of this report is to review the analysis set out in the report "Assessing the Cost Reflectivity of Alternate TNUoS Methodologies" prepared by NERA and Imperial College for RWE npower and provide a critique of its conclusions.

The remainder of the report is structured as follows;

- Section 3 reviews the NERA/ICL assessment of the WACM2 charging methodology to date and provides a brief overview of their modelling process
- Section 4 considers the LRMC approach and its validity as a tool to assess the cost-reflectivity of the WACM2 charging methodology and the Status Quo
- Section 5 considers the outcome of NERA/ICL's analysis and the extent to which it supports the conclusions drawn
- Section 6 considers other aspects of the NERA/ICL analysis and modelling that potentially undermine their conclusions
- Finally, section 7 provides a summary and conclusions.

3. The NERA/ICL assessment of the WACM 2 methodology

In Chapter 2 of their original review of Ofgem's Impact Assessment and "minded to" decision paper, NERA/ICL considered the issue of whether the WACM2 charging methodology reflected the costs incurred by Transmission Owners in accommodating incremental generation capacity in accordance with the requirements set out in the NETS SQSS. They concluded that no such analysis had been specifically carried out by either Ofgem or the CMP213Workgroup during the Project TransmiT process, while their own preliminary assessment against the LRMC of transmission suggested that WACM2 was no more cost-reflective than the Status Quo.

Further information on their analysis is presented in the second NERA/ICL report which is the subject of this critique. Specifically, this second report makes the case for using the LRMC of transmission as the benchmark for assessing cost-reflectivity, provides some information on the modelling assumptions and provides a more detailed description of the method used to estimate LRMCs applicable to individual generation technologies and to calculate transmission charges under both the Status Quo and WACM2 regimes.

3.1 Overview of NERA/ICLs modelling process

Using the Dynamic Transmission Investment Model (DTIM) developed by Imperial College, a cost benefit analysis (CBA) is carried out to balance congestion and reinforcement costs

and minimise the net present value (NPV) of those costs over the period to 2030[1]. The planning horizon is divided in to five "epochs", with generation capacity and transmission investment set at the beginning of each epoch. DTIM uses a simplified topological representation of the GB transmission system. The model is radial in nature, with each major system boundary represented by a single circuit whose length is set according to the "thickness" of the system boundary, and each node representing a system zone.

The DTIM programme estimates the LRMC of transmission investment together with the Status Quo and WACM2 tariffs using the generation and demand backgrounds set out in National Grid's latest "Gone Green" and Slow Progress" scenarios. The "Gone Green" scenario assumes that significantly more wind, other renewables and nuclear capacity will commission by 2030 (57GW, 26GW & 13GW respectively) than in the "Slow Progress" scenario (34GW, 11GW & 9GW respectively), allowing the impact of different generation mixes to be assessed.

A uniform cost of reinforcement of £60/MW/km is assumed for all onshore circuits, although the authors recognise that, in practice, a range of costs will apply depending on the nature of reinforcement undertaken. A higher cost of £160/MW/km is assumed for the offshore HVDC reinforcement, ie the HVDC bootstraps. This figure is significantly higher that assumed by National Grid (£113/MW/km) for the Western HVDC bootstrap, but results in a similar overall cost once differences in circuit length assumptions are taken into account.

3.2 Method for estimating the LRMC of transmission

A partial description of the methodology for estimating the LRMC of transmission allocated to individual generation technologies in the various system zones is given in the NERA/ICL cost-reflectivity report. Essentially, the DTIM is run twice, once to establish the optimum generation dispatch and transmission investment, and again to establish the shadow cost of an increment of generation in each of the system zones. From these shadow costs combined with information on the running regime of individual generators provided by the initial DTIM run, the LRMC of transmission expansion caused by different generation technologies in different locations is computed. It is not clear from the report how the running regime of individual generators influences the LRMC calculation. What is clear however is that the LRMC of transmission is assumed to have a non-zero value only during those hours when an individual boundary is constrained.

It should be noted at this point that NERA/ICL use the marginal costs of transmission expansion rather than the average incremental transmission expansion costs as used by National Grid in their Investment Cost Related Pricing (ICRP) approach to calculating transmission charges. As noted by Redpoint/Baringa in their analysis of consultation responses[2], this fundamental difference in approach is bound to produce different results in

[1] It is not clear from the NERA/ICL report what discount rate is applied in calculating the NPV of congestion and transmission costs

[2] CMP213: further analysis and review of consultation responses (pages 37 &40). Report by Redpoint/Baringa to Ofgem, April 2014
https://www.ofgem.gov.uk/publications-and-updates/project-transmit-further-consultation-proposals-change-electricity-transmission-charging-methodology

terms of transmission charges, particularly where the LRMC of transmission diverges from the average incremental cost of transmission reinforcement over a sustained period of time.

3.3 Method for estimating Status Quo and WACM2 tariffs

In order to compute Status Quo and WACM2 transmission charges and ensure consistency, NERA/ICL developed transport and tariff models for the same simplified radial network used by the DTIM. As part of this simplified approach, expansion costs of £60/MW/km and £160/MW/km for onshore and the HVDC bootstraps respectively were assumed, ie the same values used in estimating the LRMC of transmission. These single figures replace the expansion constant, security factor and various expansion factors used by National Grid in their transport and tariff models.

In calculating WACM2 transmission charges, circuits were allocated to either the peak security or year-round background according to which produced the highest circuit flow, while the incremental MWkm was split between shared and non-shared tariff components in accordance with the proposed "diversity 1" methodology. The report gives no information on the background assumptions underpinning these calculations however, such as the zonal generation capacity by technology or generation load factors assumed.

4. Assessing the cost-reflectivity of the WACM2 and the Status Quo charging methodologies

In addition to noting that neither Ofgem nor the CMP213 Workgroup had compared the various TNUoS charging options on the basis of cost-reflectivity, ie the extent to which they reflect the actual costs imposed by generators on the transmission system, NERA/ICL also propose that any such comparison should be on the basis of the LRMC of transmission,. Recognising the practical difficulties of reliably predicting transmission developments over an extended timeframe, they do not argue for the implementation of a LRMC-based charging approach. However, they do consider that the cost-reflectivity of alternative charging mechanisms should be assessed on the basis of how closely they mirror the LRMC of transmission, and consequently use this approach in their analysis. This is in contrast to the WACM2 ICRP-based methodology, which imposes charges that reflect the cost of extending the existing system and uses a generator's contribution to congestion costs as a proxy for the contribution to the cost of reinforcement

4.1 Is the LMRC of transmission an appropriate benchmark for comparing the cost-reflectivity of alternative charging options?

In examining the NERA/ICL analysis and their conclusions concerning the cost-reflectivity of WACM2 compared with the Status Quo, it is first necessary to consider whether or not the LRMC of transmission is in fact the best measure of cost-reflectivity.

Economic theory suggests that, in a perfectly competitive world, efficient locational signals are delivered through locational energy pricing and that, in the absence of locational pricing, the same efficient locational signals can be delivered though transmission charges that adhere closely to the LRMC of transmission. However, this view ignores the practical difficulties of

predicting demand growth, the capacity and siting of generation necessary to satisfy that demand growth and the associated transmission reinforcements necessary to accommodate both demand and generation in compliance with the NETS SQSS out to the planning horizon. Deciding what scenarios to adopt in order to reliably estimate the LRMC of transmission would be an immensely complicated and subjective task, and would therefore be potentially discriminatory. In their further consultation document[3], Ofgem indicated that they considered carrying out their own LRMC analysis. However, due to the uncertain and subjective nature of the process, and the fact that any conclusions would be open to debate, they decided not to proceed.

4.2 National Grid's Review of transmission charging methodologies

In should be noted at this juncture that National Grid's ICRP charging methodology differs fundamentally from a LRMC-based approach. In fact when deciding to adopt an ICRP methodology, National Grid considered and rejected a LRMC-based charging methodology in part due to the scenario selection difficulties referred to above. In their assessment of the LRMC–based approach, National Grid refer to the need for "*myriad planning studies of each element of any proposed scenario*" in order to achieve the necessary quality of investment appraisal[4]. It is also worth noting that National Grid's comments referred to the development of a winter peak based charging methodology. Developing a dual background charging methodology that is consistent with the NETS SQSS as required by the Authority's direction to National Grid, would amplify the scenario definition difficulties considerably.

National Grid's concerns about overcoming the uncertainties in scenario building over an extended planning horizon led to a more fundamental objection to adopting a LRMC-based charging approach. This related to the danger of transmission system users being charged, not for the services they received, but on the basis of future costs that may or may not occur. These concerns do not apply to ICRP-based charging methodologies as transmission users are charged on the basis of their use of the existing system and the need to determine what transmission investment will occur out to the planning horizon is no longer an issue.

While NERA/IC do not advocate a move to LRMP-based transmission charging in their report, the objections to such an approach identified by National Grid also serve to undermine the use of LRMC as the basis of assessing the cost-reflectivity of alternative charging methodologies. In other words, the difficulties in predicting what transmission will actually be built in an uncertain world and the distinct possibility that transmission users could be charged for costs never actually incurred, make the LRMC of transmission an unsuitable benchmark for comparing charging methodologies.

In making a case for comparing the cost-reflectivity of charging options on the basis of the LRMC of transmission, NERA/ICL refer to the fact that National Grid carried out such an assessment as part of their analysis which led to the rejection of an LRMC-based charging

[3] Project TransmiT: Further consultation on proposals to change the electricity transmission charging methodology. Ofgem 2014
https://www.ofgem.gov.uk/publications-and-updates/project-transmit-further-consultation-proposals-change-electricity-transmission-charging-methodology

[4] Transmission Use of System review: Proposed Investment cost Related Pricing for Use of System. National Grid, 1992.

methodology in favour of current ICRP based approach[5]. National Grid assessed the performance of the ICRP approach against two scenarios, one high demand growth with generation mostly commissioning in the North, the other with low demand growth and generation closures concentrated in the South. National Grid observed that, with an ICRP charging methodology, incremental revenue failed to match incremental investment costs in the case of the high growth scenario, but that in the low growth scenario incremental revenue followed incremental investment cost closely[6]. Rather than supporting the case for comparing the cost-reflectivity of charging methodologies on the basis of the LRMC of transmission, the example exposes the dangers of doing so. In other words, choosing the "wrong" scenario would result in users being charged on the basis of investment costs that were not in the event incurred or, alternatively, not being charged for investment costs that were actually incurred, thereby potentially giving a false view as to the cost-reflectivity of transmission charging options.

Attempting to overcome the inevitable subjectivity of such an approach by "averaging" the outcome of a number of scenarios will result in an "averaged" LRMC of transmission and seems likely to deliver an estimate closer to the values used in the ICRP-based charging methodologies. This therefore argues for an ICRP rather than LRMC approach to transmission charging, in order to avoid the need for complex and difficult scenario building.

4.3 The Scottish boundaries

As ICRP-based mechanisms impose charges that reflect a generator's usage of the existing system based on an average of investment costs reflecting a range of possible reinforcements, it would not be surprising if those charges do not coincide with the estimated LRMC of transmission – particularly if that estimate did not take an inclusive view of the range of transmission investments likely to be made over time. This is particularly true of the Scottish boundaries, where the current requirement to build HVDC results in a LRMC of transmission that diverges significantly from the values applicable elsewhere on the transmission system.

In predicting the LRMC of transmission for reinforcing the connections between Scotland and Northern England, NERA/ICL use the unit cost of the Western HVDC bootstrap. However National Grid's 2012 Ten Year Statement[7] shows a range of proposed reinforcement across the Northern system boundaries, including HVDC bootstraps or links, AC circuit rebuilding and reconductoring, series compensation etc. The use of HVDC unit costs alone to define the LRMC of transmission therefore represents an extreme case and seems unlikely to reflect the range of transmission investment costs incurred over an extended time period.

A related issue is that the constraint cost implications and extended timescales of upgrading the two existing AC transmission routes out of Scotland were a significant part of the

[5] What are Marginal Costs and how to estimate them? Ralph Turvey, 2000. See http://www.bath.ac.uk/management/cri/pubpdf/Technical_Papers/13_Turvey.pdf

[66] Transmission Use of System review: Proposed Investment cost Related Pricing for Use of System. National Grid, 1992.

[7] National Grid Ten Year Statement 2012, Appendix 3. http://www.nationalgrid.com/NR/rdonlyres/F4E4ADC3-C867-49AC-80E6-5997CEDF0A80/57727/ETYS_2012_Appendix_A3.pdf

economic rationale for the construction of the Western and Eastern HVDC bootstraps[8]. However, once these HVDC links are completed, it seems reasonable to expect that the additional dispatchable boundary capacity and doubling the number of transmission routes out of Scotland will reduce the congestion cost consequences of AC outages. This would result in AC reinforcement becoming a more attractive option and undermine the case for further HVDC reinforcement.

Summarising, the NERA/ICL analysis effectively assumes that all future reinforcement of the major boundaries impacted by generation capacity connecting in Scotland will be HVDC, thereby resulting in a high LRMC of transmission. A less extreme and more plausible scenario would be for a combination of HVDC and AC reinforcement to take place. This would result in a scenario-based LRMC of transmission that was closer to the averaged costs used by the ICRP-based charging methodologies and seems likely to undermine the contention that Scottish wind generation is undercharged compared with the costs it imposes on the transmission system.

Redpoint/Baringa make a similar point in their review of consultation responses[9], noting that while the high cost of HVDC transmission represents a divergence from the more averaged reinforcement costs underpinning ICRP-based charging methodologies, the divergence may only be temporary. Averaged over a sustained period, ICRP-based tariffs based on both HVDC and AC reinforcement costs may well produce transmission tariffs that are a close match to the LRMC of transmission. Again, this suggests that the NERA/ICL analysis can be considered as representing one, rather extreme, view of the range of possible investment cost outcomes.

It would have been useful if NERA/ICL had investigated the effect of relaxing the Scottish boundary HVDC reinforcement constraint as a sensitivity case, allowing a return to AC reinforcement at some point during their 20 year planning horizon. This would have shown that both the ICRP-based charging methodologies produced charges closer to the LRCM of transmission and, in all probability, shown WACM2 to be more cost-reflective than the Status Quo.

It is also worth noting that the incremental cost of the Scottish transmission system attributed by ICRP is substantially higher than the incremental cost of 400kV expansion. If future expansion is assumed to be at 400kV, then this would result in a LRMC of transmission lower than that assumed by the ICRP methodology. This supports the observation that depending on the cost of individual reinforcements, some may be lower and some may be higher than implied by the averaging approach of ICRP.

[8] Assessment of overall robustness of the transmission investment proposed for additional funding by the three GB Electricity Transmission Owners. Report by KEMA to Ofgem, 2009
https://www.ofgem.gov.uk/Networks/Trans/ElecTransPolicy/tar/Documents1/091224_FINALREPORT_KEMA_PUBLICPDF.pdf

[9] CMP213: further analysis and review of consultation responses (pages 37 &40). Report by Redpoint/Baringa to Ofgem, April 2014
https://www.ofgem.gov.uk/ofgem-publications/87397/redpointenergyreportonfurtheranalysisandreviewofcmp213consultationresponses.pdf

5. Cost-reflectivity, does the NERA/ICL analysis justify their conclusions?

Notwithstanding concerns over using the LRMC of transmission as a benchmark to test the cost-reflectivity of ICRP-based charging methodologies, there is also the issue of whether the NERA/ICL LRMC analysis actually justifies the conclusions they draw.

5.1. NERA/ICL's contention that WACM2 is less reflective of the LRMC of transmission than the Status Quo.

Based on their analysis, NERA/ICL come to the overall conclusion that "*the WACM2 charging methodology is less cost-reflective than the Status Quo*". They also conclude that "*while the WACM2 charging methodology does make changes to TNUoS charges that (on the face of it) recognise the dual drivers of transmission reinforcement (peak security and "year-round" investment requirements), these changes are applied through a series of heuristic and approximate calculations. Our analysis shows that the combination of these approximations used in the WACM2 methodology produces locational charging signals that reflect the LRMC of transmission less well than the Status Quo"*

A review of the outcome of the NERA/ICL analysis, usefully summarised in figures 5.2 and 5.3 of their report, suggests that these overall conclusions are hardly justified. While, in the case of the Scottish boundaries the NERA/ICL analysis shows that the charges for wind produced by the existing TNUoS methodology are closer the LRMC of transmission post the construction of the HVDC bootstraps, for most other situations and most other generation technologies the reverse is true. For example, prior to the commissioning of the Western HVDC bootstrap when the LRMC of transmission presumably reflects the costs of marginal AC reinforcement, WACM2 clearly results in charges that are more cost-reflective than the Status Quo for all boundaries and for all generation technologies. This supports the outcome of previous analysis to compare WACM2 charges with the Status Quo using National Grid's "Initial view of TNUoS tariffs for 2015/16" for the 27 GB generation charging zones[10][11]. This analysis, which includes all tariff elements and not just the locational element, confirms the superiority of WACM2 over the Status Quo in terms of producing charges that are more reflective of the average investment costs faced by TOs in developing the transmission system to comply with the SQSS.

For the years 2020 and 2030 with the commissioning of the Western bootstrap followed by the Eastern bootstrap, the NERA/ICL analysis shows that WACM2 produces charges that track the LRMC of transmission more closely than the Status Quo for the England and Wales boundaries for all generation technologies in almost all instances. In other words, rather than demonstrating that WACM2 charges are less reflective of transmission LRMC than the Status

[10] Review for Scottish & Southern energy of Poyry's Report to Centrica Energy "Review of Ofgem's Impact Assessment on CMP213"
https://www.ofgem.gov.uk/ofgem-publications/87402/reviewforsseofpoyrysreporttocentricaenergytitledreviewofofgemsimpactassessmentoncmp213.pdf

[11] "Initial view of TNUoS tariffs for 2015/16. A tariff information paper published by National grid
http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=31095

Quo, the NERA/ICL analysis actually demonstrates that WACM2 is more cost reflective for the majority of generation connected to the GB transmission system. While the analysis for 2020 and 2030 does suggest that the Status Quo results in charges that are closure to the LRMC of transmission for wind connected in Scotland, this needs to be viewed in the context of the concerns about using the LRMC of transmission to assess cost-reflectivity expressed above and the extreme assumption that all future reinforcement will be HVDC.

In fact NERA/ICL do rather grudgingly accept that WACM2 does produce charges that are closer to the LRMC of transmission than the Status Quo in a number of instances. However, these are often dismissed as being insignificant or not materially improving cost-reflectivity. For example, in 5.2.2 of their report, NERA/ICL note that for nuclear and base load gas, both charging mechanisms produce similar charges and that the introduction of WACM2 would therefore result in no material improvement. However, figure 5.2 clearly shows that WACM2 produces charges that are closer to LRMC that the Status Quo and is therefore to be considered more cost-reflective. Similarly, for marginal gas, figure 5.4 shows WACM2 to produce charges that are consistently closer to LRMC that the Status Quo, particularly in the North. This is dismissed as being of no consequence as charges are lower in the South and that this is where any peaking plant would therefore be built. Whether or not this is correct, the fact remains WACM2 is shown to be more cost-reflective that the Status Quo.

5.2 NERA/ICL incorrectly claim that WACM2 does not adequately reflect the dual drivers of transmission investment

In claiming that WACM2 fails to fully recognise the dual drivers of transmission investment, NERA/ICL offer no alternative other than the implied retention of the Status Quo. If NERA/ICL are concerned that WACM2 is inadequate in this respect, it is incumbent on them to suggest how the methodology could be improved or alternative options for complying with the Authority's Direction to National Grid, to propose a charging methodology that "*better reflects the differing impacts (i.e. costs and benefits) of individual generators on the TO's costs in a manner which is consistent with the principles set out in the National Electricity System Security and Quality of Supply Standard (SQSS)*". Clearly, the Status Quo fails this test in that it is inconsistent with the principles underpinning the NETS SQSS, while WACM2 is consistent with those principles and represents a reasonable compromise between accuracy and complexity.

Furthermore, in its use of average load factors, rather than generic scaling factors as used in the SQSS, WACM2 also has the advantage of being able to distinguish between individual generators of the same technology in terms of the costs they impose on the system. This is clearly something that the Status Quo cannot accommodate, and would for example allow the impact of changing generator running patterns, possibly influenced by operating efficiency, emissions Directives or carbon pricing, to be taken into account over time.

The test for the Authority's decision is whether WACM2 is better than the Status Quo, not whether WACM2 is perfect. WACM2 is superior to the Status Quo in that it introduces a range of benefits, including:

- A revised demand security background which takes account of the requirement to meet peak demand when there is no wind generating
- A new year round background that aligns with the revised SQSS
- The use of average load factor to take account of individual station operating characteristics

These benefits are significant. However, if over time, potential improvements to WACM2 are identified that would result in further benefits, a more appropriate balance between accuracy and complexity, or otherwise improve the methodology, then those improvements could be progressed via the CUSC modification process.

National Grid, Redpoint/Baringa, the Authority, other independent consultants and industry participants, all agree that WACM2 is more cost reflective in all, or almost all, aspects compared with the Status Quo. The dissenting minority view questions the cost-reflectivity of WACM2 under very specific circumstances regarding Scottish wind post the commissioning of the Western HVDC bootstrap. However, it is demonstrated by this paper, other papers commissioned by SSE[12], Ofgem's consultation and Redpoint/Baringa's additional modelling that the evidence put forward to support this view is not valid. Therefore any decision to continue the use of the Status Quo methodology would be discriminatory to all technology types in all locations.

6. Other issues surrounding the NERA/ICL analysis

Leaving aside the issue of whether the conclusions drawn by NERA/ICL are supported by the underlying analysis, there are concerns about the modelling and assumptions used in carrying out that analysis.

6.1 Counter-intuitive outcomes

In their review of the responses to Ofgem's CMP213 consultation[13], Redpoint/Baringa note that the NERA/ICL modelling suffers from a number of weaknesses and produces counter-intuitive outcomes that cannot be adequately explained. For example, in their review of Ofgem's Impact Assessment they note that NERA/ICL conclude that both transmission *and* generation costs will increase under WACM2, a direct contradiction of the conclusions reached by National Grid. As the impact of WACM2 will be to reduce the costs seen by Scottish generation, the expectancy of modelling in this area would be for transmission costs to increase and generation costs to decrease.

The apparent reason for this outcome was that the DTIM model selected higher cost wind development and rejected lower cost options, consequently increasing generation costs. The

[12] Project Transmit: Impact Assessment Consultation (Reference 137/13) SSE Response: Appendices https://www.ofgem.gov.uk/ofgem-publications/85163/consultationresponsefromsse3.pdf

[13] CMP213: further analysis and review of consultation responses. Report by Redpoint/Baringa to Ofgem, April 2014 https://www.ofgem.gov.uk/ofgem-publications/87402/reviewforsseofpoyrysreporttocentricaenergytitledreviewofofgemsimpactassessmentoncmp213.pdf

inability of NERA/ICL to adequately explain why this should have occurred undermines confidence in the ability of their analysis to accurately assess the cost-reflectivity of alternate charging mechanisms.

Other examples where the DTIM modelling produces counter-intuitive outcomes include the treatment of high load-factor (base-load) gas generation located in Scotland. Figure 5.2 in the NERA/ICL report suggests that, for 2013, the LRMC of transmission associated with Scottish base-load gas generation has a non-zero value somewhat lower than Scottish wind. However, for 2020 and 2030, figure 5.2 shows Scottish base-load gas to have a zero transmission LRMC. This is explained as being due to base-load gas either being "out of merit" or constrained off during high-wind periods when boundary capacity is constrained. While it is accepted out of merit generation will not contribute to the need for additional transmission capacity, it seems likely that some Scottish base-load gas generation will be required to run. If that plant is constrained off in preference to constraining wind, then the associated constraint cost will clearly contribute to the case for additional transmission capacity and the generation should therefore be subject to some locational signal. This would be the case even if the associated congestion costs were insufficient to trigger the need for additional (expensive) HVDC transmission capacity.

In fact the logic and methodology adopted by NERA/ICL seems to imply that, in the event of cheaper AC transmission reinforcement options being available and the costs of constraining base load gas generation in Scotland triggering reinforcement, a transmission LRMC related charge would apply. However, if the cost of reinforcement increases and the costs of constraining gas fired plant are no longer sufficient to trigger a reinforcement, no locational signal would apply. A charging methodology that applies a locational charge to generation only when the costs of resolving congestion are sufficiently high to trigger reinforcement does not seem to be consistent with established charging principles or reflective of the costs actually incurred by TOs in adhering to the requirements of the NETS SQSS. This maybe an issue with a LRMC-based charging methodology rather than a problem with the NERA/ICL modelling, but the outcome should be contrasted with that of ICRP-related charging methodologies which applies a locational signal that reflects a generator's incremental impact on transmission costs, irrespective of whether an actual reinforcement is triggered or not.

The NERA/ICL modelling is useful in illustrating the potential consequences of a LRMC of transmission approach to transmission charging and particularly in highlighting the complexities introduced by HVDC. However, the potential for both the DTIM programme and modelling approach to produce outcomes that are either counter-intuitive or that run counter to established charging principles, undermines confidence in its use as a means of assessing the relative merits of ICRP-based transmission charging options.

6.2 Other modelling Issues

The credibility of the NERA/ICL analysis is also undermined by a lack of information on the assumptions made, both in terms of the calculation of the LRMC of transmission and the modelling of the ICPR tariffs, as mentioned earlier. For example, no information is given on

the discount rates assumed in deriving the NPV of transmission projects, the capacity assumptions by zone or what load factors have been assumed for the various generation technologies. Both zonal generation capacity by technology and load factor are significant parameters in calculating the transmission charges produced by WACM2 charges and inappropriate assumptions could result in misleading outcomes. In the absence of any information on what values have been assumed, it is difficult to have confidence in the comparison of Status Quo and WACM2 charges.

The rather selective zonal presentation of results, where no information on LRMC and Status Quo/WACM2 charges are given in the event of a generation technology not being present within a particular zone, is also a distraction. The comparison of Status Quo and WCM2 charges with the LRMC of transmission would have been enhanced if information had been presented for all zones on a consistent basis.

7. Conclusions

NERA/ICL's analysis of the cost-reflectivity of the proposed WACM2 transmission charging methodology and the Status Quo is a useful addition to the analysis carried out by National Grid, Redpoint/Baringa and others. In particular, it provides a useful insight into the complexities introduced by the addition of HVDC circuits into transmission charging. However, its principal conclusion that WACM2 is less reflective of the LRMC of transmission than the existing TNUoS charging methodology, and that there is therefore no case for its introduction, can be challenged on three levels;

- the assertion that the cost-reflectivity of alternative ICRP-based charging options can only properly be assessed against the LRMC of transmission takes no account of the difficulties in estimating LRMC over an extended planning horizon
- NERA/ICL's conclusions are not supported by their analysis,
- the tendency for the DTIM model to deliver counter-intuitive results and the lack of information about critical modelling assumptions undermines confidence in their analysis

7.1 Assessing the cost-reflectivity of charging options

While a cost reflective charging methodology should impose charges that reflect the actual costs imposed on Transmission Owners in operating the system in accordance with the NETS SQSS, there are genuine difficulties in estimating the LRMC of transmission over an extended planning timeframe. These difficulties and the attendant risk that transmission users may be charged on the basis of costs that may or may not actually be incurred rather than for the service they receive, has prevented the adoption of LRMC-based charging to date.

These same concerns undermine the use of LRCM to determine the cost-reflectivity of charging options. NERA/ICL's analysis, which uses the LRMC of HVDC transmission for the Scottish boundaries rather than some average of the cost of different reinforcement methods likely to be implemented over the planning horizon, can be considered to be based

on an extreme case. It is therefore likely to give a misleading assessment of the cost-reflectivity of transmission charging options.

7.2 NERA/ICLs conclusions are not supported by the results of their analysis

Leaving aside concerns about the use of a scenario-based LRMC of transmission to assess the cost- reflectivity of transmission charging options, NERA/ICL's conclusion that "the WACM2 charging methodology is less cost-reflective than the Status Quo" is not supported by the results of their analysis. Prior to the commissioning of the Western HVDC bootstrap, their analysis clearly shows that WACM2 results in charges closer to the assumed LRMC of transmission than does the Status Quo - this being true for all boundaries. Following the commissioning of the Western HVDC bootstrap, their analysis shows that WACM2 is more cost reflective for almost all situations, generation technologies and locations, apart from the single case of wind north of the Scottish boundary. Even in the case of the northern wind, NERA/ICL only reach the conclusion that the LRMC would be greater than the cost applied by WACM2 because they have made use of extreme assumptions regarding the LRMC of transmission. If more moderate assumptions regarding LRMC were used, then this could show that WACM2 would be more cost reflective in every case modelled, including northern wind as well as all other technologies and locations. The only conclusion to be drawn from their analysis is that, overall, WACM2 is more reflective of the LRMC of transmission than the Status Quo and, if cost-reflectivity is to be assessed on this basis, that WACM2 is more cost-reflective than the Status Quo.

NERA/ICL's conclusion that WACM2 fails to reflect the dual drivers of investment underpinning the NETS SQSS is also misplaced. Although representing a compromise between accuracy and undesirable charging complexity, WACM2 is designed to reflect the dual background approach of the NETS SQSS and is clearly superior to the Status Quo, which only considers peak demand conditions. WACM2 therefore represents an improvement over the Status Quo in this respect. However, if potential improvements to the WACM2 methodology are identified, these can be progressed though the CUSC modification process over time.

Implementing WACM2 would also deliver a number of "dynamic effects" referred to by Ofgem in their further Consultation document. The more cost-reflective locational signals delivered by WACM2 would result in benefits such as more efficient policy decisions such as the substitution of expensive offshore wind with cheaper onshore capacity, more efficient transmission investment, and more efficient investment decisions regarding new stations and in relation to the maintenance, operation and life-extension of existing generation plant.

7.3 Modelling Issues

The ability of the DTIM model to deliver counter-intuitive results undermines confidence in the outcome of the NERA/ICL analysis. As noted by Redpoint/Baringa, the NERA/ICL modelling suffers from a number of weaknesses and produces counter-intuitive results that cannot readily be explained. One such anomaly is that both transmission and generation costs

will rise under WACM2, a contradiction of the conclusion reached by National Grid. Another counter-intuitive outcome of the modelling approach is that LRMC-based charges are only allocated to generation when congestion costs are sufficient to trigger a reinforcement. This may be a feature of LRMC-based charging rather than the modelling itself, however, the outcome conflicts with ICRP principles where all generation receives a locational signal reflecting the incremental costs imposed on the system.

The credibility of the NERA/ICL analysis is also undermined to some extent, probably unnecessarily, by a lack of information on some critical assumptions used. For example, the discount rate in arriving at the NPV of transmission investment is not stated, while neither the disposition of generation technology across the various zones nor the generation load factors assumed are given. Both parameters are significant in terms of deriving WACM2 charges and the lack of information prevents any consideration of whether the computed charges are realistic.