

# Review of the NERA/Imperial College London report on the impact of ‘Improved incremental cost-related pricing’

Prepared for SSE

July 16th 2013

## Summary

This review of the 2012 NERA/Imperial report<sup>1</sup> suggests that, although improvements to its 2011 analysis<sup>2</sup> have been made by NERA/Imperial, some major concerns already set out by Oxera in 2011<sup>3</sup> remain. In particular, the conclusions of the NERA/Imperial analysis are driven in large part by the particular assumptions used, rather than being representative of the effects of all potential models of transmission charging under Improved ICRP.

Given that the NERA/Imperial analysis finds that the introduction of Improved ICRP may lead to only slightly higher costs to the power sector in the period 2014 – 2030 (estimated to be in the range of £0.1bn and therefore only marginally reduces welfare), it seems to be even more important that the sensitivity of this finding is robust to reasonable changes of the assumptions made in the analysis. Such sensitivity analysis is not presented in the 2012 NERA/Imperial report. The modelling presents a single case and given the sensitivity to a number of assumptions the headline results might not be representative of the potential range of estimates of the impact of Improved ICRP.

<sup>1</sup> NERA and Imperial College London (2012), ‘Project TransmiT: Modelling the impact of ‘Improved ICRP’, report prepared for RWE npower, October 12th.

<sup>2</sup> NERA and Imperial College (2011), ‘Project TransmiT: Impact of uniform generation TNUoS’, report prepared for RWE npower, March 31st.

<sup>3</sup> Oxera (2011), ‘Review of the NERA/Imperial impact assessment of introducing a uniform transmission charge’, report prepared for Scottish Power and ScottishPower Renewables, November 14th.

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For example, the key considerations underlying NERA/Imperial's conclusions in relation to retirement decisions include assumptions on fuel prices, capital and operating costs of new entrants, cost of capital, capacity payment mechanism, and electricity demand.

Moreover, the 2012 NERA/Imperial report still shows the instability of the model regarding the locational decision of thermal generation. As the 2012 NERA/Imperial report identifies, the process of completing several iterations that provide the feedback between generation investment decisions, network investment decisions, and the transmission charging model does not lead to a single, stable equilibrium, but one in which location decisions 'flip' between regions in alternate iterations.<sup>4</sup>

In contrast to its estimates of the limited impact on overall welfare, consumer costs are estimated by NERA/Imperial to increase by about £15,868m with Improved ICRP, with some 94% (£14,916m) of this due to the modelled increase in wholesale electricity prices. However, determining the impact of the introduction of Improved ICRP on wholesale electricity prices is not straightforward and the 2012 NERA/Imperial analysis does not appear to capture the locational incentives of the existing arrangements and their implications for wholesale prices.

In particular, the NERA/Imperial modelling uses a profitability-driven approach to determine the siting of new plant, whereas in reality, it is not clear that this is how sites would be developed in practice. There is clear evidence that developments are not progressed along the lowest TNUoS charge path first in the way that NERA/Imperial have assumed. Instead, investors are building plant at a mix of locations, e.g. with new CCGT developments being considered in Scotland. This spread of plant location would imply that the scale of the impact of improved ICRP charges on the long-run marginal costs of new entrants and consequently on power prices could be smaller than that envisaged if plant were developed on a strict order of profitability and that any difference in electricity prices due to the introduction of Improved ICRP, as modelled by NERA/Imperial, may therefore not be as significant as the authors suggest. The history of new investment location over the past decade supports this view rather than that assumed by NERA/Imperial.

It would therefore not appear possible to conclude from the NERA/Imperial report that under Improved ICRP, the extent to which an increase in the costs of a price-setting new entrant relative to the existing arrangements would result in longer-term price rises. In fact, Redpoint find that according to its analysis the likely increase in costs to consumers is 90% less (in the range of £1.4bn in 2011 prices) than estimated by NERA/Imperial.<sup>5</sup>

On renewables modelling, the 2012 NERA/Imperial report appears to have made changes to the 2011 modelling approach and assumptions, although the interdependence between subsidy levels and deployment renewable generation in the NERA/Imperial analysis remains unclear. That notwithstanding, the NERA/Imperial 2012 report concludes that improved ICRP charges could reduce renewables subsidy costs by £162m.

## 1 Introduction

SSE asked Oxera to provide an independent, qualitative assessment of the report prepared for RWE npower by NERA and Imperial College London (the '2012 NERA/Imperial report')

<sup>4</sup> NERA and Imperial College London (2012), op. cit., p. 30.

<sup>5</sup> Redpoint (2011), 'Modelling the impact of transmission charging options', December, p. 53.

assessing the likely costs and benefits of introducing the improved incremental cost-related pricing ('Improved ICRP') transmission charging model.<sup>6</sup>

Building on a previous study by NERA and Imperial College London (the '2011 NERA/Imperial report'<sup>7</sup>), the 2012 NERA/Imperial report reflects recent changes in the policy environment and accounts for some of the concerns about the robustness of its modelling raised, among others, by Oxera in its 2011 report.<sup>8</sup>

The remainder of this note is structured as follows:

- section 3 summarises the main conclusions of the 2012 NERA/Imperial report;
- section 4 sets out Oxera's assessment of the analysis presented in the 2012 NERA/Imperial report; and
- section 5 concludes.

## 2 Summary of the main conclusions of the 2012 NERA/Imperial report

The 2012 NERA/Imperial report compares the current system of transmission charges with the proposed Improved ICRP transmission charging model, and assesses how Improved ICRP might affect the cost to the power sector to meet demand. The results are presented in terms of the estimated consequent impacts on social welfare and cost to consumers from a move to Improved ICRP.<sup>9</sup>

NERA/Imperial's modelling framework integrates several models covering the dynamics of the wholesale power market, transmission network requirements, and TNUoS charges. This includes a wholesale power model, a renewables investment model, a transmission investment model, and a transmission charging model.

The models are integrated, in that they are 'solved' by completing several iterations that provide the feedback between generation investment decisions, network investment decisions, and the transmission charging model. However, as the 2012 NERA/Imperial report identifies, this process does not lead to a single, stable equilibrium, but one in which location decisions 'flip' between regions in alternate iterations.<sup>10</sup>

The high-level findings of the 2012 NERA/Imperial report on power sector costs and consumer costs are summarised in Table 2.1.

<sup>6</sup> NERA and Imperial College (2012), op. cit., p. 30.

<sup>7</sup> NERA and Imperial College (2011), op. cit.

<sup>8</sup> Oxera (2011), op. cit.

<sup>9</sup> NERA/Imperial approximates the impact on social welfare by assessing whether the cost to the power sector increases under Improved ICRP, which would mean a reduction in social welfare because the same generation can be achieved at lower cost, or decreases, which would imply an increase in social welfare. Social welfare is split between the welfare of consumers and producers. Therefore, an increase in consumer costs resulting from Improved ICRP describes a reduction in consumer welfare, which, in turn, implies that producer welfare increases by the same amount if social welfare remains unchanged.

<sup>10</sup> NERA and Imperial College (2012), op. cit., p. 30.

**Table 2.1 2012 NERA/Imperial estimate of the impact of introducing Improved ICRP on power sector and consumer costs, 2014–30**

<b>Power sector costs</b>	<b>Net present value (£m, 2010 prices)</b>	<b>Consumer costs</b>	<b>Net present value (£m, 2010 prices)</b>
Generation costs	-1,071	Power purchase costs	14,913
Transmission investment	574	Low-carbon subsidies	-162
Constraints	30	D—TNUoS	488
Losses	599	Constraints	30
		Losses	599
<b>Total</b>	<b>132</b>		<b>15,868</b>

Note: All figures are in 2010 prices. Positive numbers indicate an increasing cost following the introduction of Improved ICRP. Net present values (NPVs) assume a discount rate of 3.5%.  
Source: NERA and Imperial College (2012), op. cit.

The key findings and dynamics within the NERA/Imperial analysis that lead to these results are as follows.

- Power sector costs (ie, the costs of conventional and renewable generation, transmission investment, constraints and losses) are estimated to increase by about £132m after the introduction of Improved ICRP.
- Consumer costs (ie, wholesale prices, renewables subsidies and network costs recovered from demand charges, constraints and losses) are estimated to increase by about £15,868m after the introduction of Improved ICRP. About 94% of the estimated increase in costs is due to the modelled increase in wholesale electricity prices.

NERA/Imperial estimates that the benefits of moving to Improved ICRP due to a reduction in generation costs of about £1.1 billion are outweighed by the estimated costs due to higher required transmission investments, losses and constraints (about £1.2 billion). The overall impact on social welfare resulting from the introduction of Improved ICRP is given by the difference between the estimated cost and benefits—that is, it is estimated to be in the range of £0.1 billion. However, the overall finding of a negative impact on social welfare seems to be small when compared with the level of both costs and benefits.<sup>11</sup>

The 2012 NERA/Imperial analysis is based on some important model dynamics (discussed in the next section), which are the drivers of the report's findings.

- Investment decisions respond to small changes in the relative returns of projects in different locations. This sensitivity to changes in transmission charges is highlighted in NERA/Imperial's analysis by the instability between model iterations.
- Improved ICRP increases the long-run marginal cost of a new entrant and this is assumed to lead directly to increases in power prices, resulting in the substantial increase to consumer costs (see Table 2.1).

Other factors influencing investment and siting decisions have been modelled using assumptions for which little evidence has been provided in the report. Moreover, the report

<sup>11</sup> The fact that the overall result of the cost–benefit analysis is finely balanced is also demonstrated by NERA/Imperial's statement (on p. 37) that 'This reduction in power sector costs proxies the improvement in overall social welfare caused by "Improved ICRP", which is in contrast to the findings presented in the body of the report and appears to be a drafting error.'

does not include any assessment of the sensitivity of the model results to changes in these assumptions.

The particular assumptions underlying NERA/Imperial's analysis are likely to have a material impact on the results.

### **3 Amendments made to the 2011 NERA/Imperial report and their likely impact on the results of the NERA/Imperial cost–benefit analysis**

Oxera considers that the results of the 2012 NERA/Imperial report are sensitive to the underlying assumptions. There are some potential concerns with a number of these assumptions, even though NERA/Imperial has improved several aspects of its modelling approach relative to the 2011 report.

Specifically, the potential concerns relate to assumptions on:

- conventional generation developments and the impact on power prices;
- renewables modelling.

#### **3.1 Conventional generation and power prices and welfare**

The 2011 and 2012 reports both conclude that power purchase costs could increase with uniform/Improved ICRP charges relative to the status quo. Although the methodology underlying these conclusions has been improved, some concerns around the robustness of NERA/Imperial's results remain.

##### **3.1.1 2011 approach**

The 2011 report concluded that the power prices required to stimulate new investment were higher under the alternative scenario compared to the status quo. This finding was the result of the assumption that, under the existing charging regime, new plant located in England & Wales regions that have negative charges but would no longer be incentivised to locate in these regions as charges increase with the introduction of uniform charges. Under the modelling approach then used, siting decisions were also sensitive to gas NTS exit charges, shifting new build to Scotland where these charges were relatively low. This increased the long-run marginal cost of price-setting, new-entrant CCGTs, thereby significantly increasing wholesale electricity prices, as well as exacerbating transmission losses.

NERA itself recognised the sensitivity of its results to assumptions on gas NTS exit charges, and indicated that it had not considered a number of other siting factors.<sup>12</sup>

##### **3.1.2 2012 approach**

As in the 2011 report, the prices required to stimulate new investment are still found to be higher under the Improved ICRP scenario than the status quo in the 2012 NERA/Imperial report.

The 2012 report finds that, although new plants continue to be developed in England & Wales zones under both charging scenarios (instead of shifting entirely to Scotland and northern England), the transmission charges in these zones are higher under the Improved ICRP than under the status quo. Therefore, the power prices required to stimulate new investment are

<sup>12</sup> NERA and Imperial College (2012), op. cit., p. 62.

higher with Improved ICRP, the reason being that power prices need to rise to recover greater fixed and variable costs associated with new generation assets.

The 2012 NERA/Imperial report also finds that the higher TNUoS charges in England & Wales under the Improved ICRP approach result in some CCGT capacity retiring earlier than under the status quo. However, NERA/Imperial has not indicated the extent to which TNUoS charges affect the medium- to long-term economic viability of these plants. Furthermore, NERA/Imperial has not explained the extent to which this reduction in capacity could be expected to lead to an increase in power prices. The result is that it is difficult to validate NERA/Imperial's modelling results.

### 3.1.3 **Assessment of the approach adopted by NERA/Imperial**

Although it is reasonable to expect that an increase in costs of new entrants is likely to increase power prices, concerns about NERA/Imperial's estimate of the scale of this impact remain.

In particular, NERA/Imperial might have overestimated the impact on consumers of introducing Improved ICRP. For example, Redpoint Energy's assessment for Ofgem finds a significantly lower increase in wholesale cost (about £1.4 billion in NPV terms over the period 2011–30, or less than 10% of the impact estimated by NERA/Imperial).<sup>13</sup> Overall, Redpoint Energy considers that:

The impact on consumer bills is somewhat greater than the change in power sector costs over the period 2011 – 2020, but still small, averaging an additional £1.50 per year for each domestic consumer.<sup>14</sup>

Moreover, Redpoint Energy finds that:

Under Improved ICRP charging, a small increase in wholesale costs relative to the Status Quo is driven by an increase in modelled market prices during the period 2018–2020, when capacity margins are somewhat lower [...] This represents a very small transfer from consumers to producers during the period 2011–2020 (an increase of about 0.5% in the net present value of consumer bills over the period).<sup>15</sup>

The significantly larger increase in consumer cost estimated by NERA/Imperial appears to be driven mainly by an increase in the generation cost of a marginal source of new entry to the market, estimated by NERA/Imperial to be in the range of £1–£16/kW/year. NERA/Imperial then reports that this increased cost translates into an additional cost of between £0.5 and £6 per MWh of production, which generators need to recover through wholesale power prices, if they enter the market.<sup>16</sup>

There is some degree of uncertainty around these estimates of the impact of Improved ICRP on the cost of marginal generators. However, NERA/Imperial provides no further evidence to support its figure and, in light of significantly the lower overall impact on wholesale cost found by Redpoint Energy, the NERA/Imperial estimates appear to be overstated.

As stated above, NERA/Imperial has recognised the anomalies in the siting decisions in its 2011 report. In that report, there was an over-reliance of siting decisions on TNUoS charges and gas NTS exit charges, with the absence of consideration of other siting drivers. This led to a substantial amount of new investment being modelled to take place in northern transmission zones under the uniform charging approach. In the 2012 report, NERA/Imperial

<sup>13</sup> Redpoint Energy (2011), 'Modelling the impact of transmission charging options', December, p. 53.

<sup>14</sup> Redpoint Energy (2011), op. cit., p. 52.

<sup>15</sup> Redpoint Energy (2011), op. cit., p. 55.

<sup>16</sup> NERA and Imperial College (2012), op. cit., p. 638.

has improved its modelling approach by placing constraints on zonal deployment potential. These constraints are a function of current new build proposals in these zones, as well as the volume of capacity that closes. These factors provide a proxy of the availability of land and cooling water, both of which have impacts on siting decisions.

However, NERA/Imperial's modelling still does not take into account other siting drivers such as the impact of the planning process. Its approach in 2012 was still to assume that plants would be built in an order of profitability, albeit subject to a zonal deployment cap.

In reality, it is not clear that sites will be developed in strict order of profitability as modelled by NERA/Imperial, at least not on a national scale. There is evidence that investors do consider building plant at a mix of locations, with new CCGT developments being considered in Scotland despite transmission charges being higher than in a number of England & Wales zones. For example, ScottishPower has received planning permission to build a new CCGT plant at the Cockenzie site in Scotland.<sup>17</sup> This illustrates that developers may consider building a number of plant as long as they are profitable, instead of building plants in strict order of profitability.

As new investment could take place in a number of locations with differing transmission charges, it is difficult to determine with great precision which transmission charging zone is truly 'marginal'. Indeed, considering that investment could take place at a mix of locations with different transmission charges would imply that the scale of the impact of Improved ICRP charges on the long-run marginal costs of new entrants and consequently on power prices could be smaller than that envisaged if plant were developed in strict order of profitability. That is, any difference in electricity prices due to the introduction of Improved ICRP, as modelled by NERA/Imperial, may therefore not be as significant as they suggest if, under the current locational TNUoS charging regime, marginal new investment is not currently taking place in zones with negative (or other relatively low) TNUoS charges.

Moreover, the 2012 NERA/Imperial report does not set out how plant retirement decisions have been determined or the sensitivity of its results to changes in its underlying commodity price and demand growth assumptions. Oxera's 2011 analysis suggested that there may be significant year-on-year volatility in existing plant returns and, therefore, that the extent to which the closure decisions of existing southern plant is marginal. Hence the sensitivity of retirement to changes in transmission charges might be lower than assumed by NERA/Imperial.<sup>18</sup>

In addition, the key considerations underlying NERA/Imperial's conclusions in relation to retirement decisions include assumptions on fuel prices, capital and operating costs of new entrants, cost of capital, the form of any future capacity payment mechanism, and electricity demand levels and shape. No sensitivities of the results of NERA/Imperial's analysis to changes in these assumptions have been presented that enable the robustness of the conclusions to be assessed. Such sensitivities appear to be of particular importance given the narrow margin of the outcome of NERA/Imperial's welfare analysis. For example, NERA/Imperial appears to have used different sources for forecasting commodity prices in the 2011 and 2012 reports: it appears to have used DECC forecasts in the 2011 report, but IEA forecasts in the 2012 report.<sup>19</sup> The potential impact of this change on the result of the CBA is unclear and no rationale has been given.

<sup>17</sup> ScottishPower (2011), 'Planning consent for Cockenzie Combined Cycle Gas Turbine Power Station', press release, October 5th.

<sup>18</sup> Oxera (2011), op. cit., p. 18.

<sup>19</sup> NERA/Imperial (2011), op. cit., p. 29; and NERA/Imperial (2012), op. cit., p. 45.

## 3.2 Renewables modelling

### 3.2.1 2011 approach

The main findings and modelling approach underlying the 2011 NERA/Imperial report were as follows.

- **Renewables output capped at the renewables target.** The 2011 NERA/Imperial report found that the introduction of uniform charges would not improve the UK's ability to meet its renewables target.
  - The build rates and resource potential assumed in its analysis resulted in the renewables target being met under the status quo charges.
  - It further assumed that, once the renewables target is met, no additional renewable generation receives subsidies. This assumption meant that although the introduction of uniform charges would reduce TNUoS charges in Scotland, a region abundant with wind resource potential, there was no increase in overall renewables deployment.
- **Socialisation of local asset charges.** The 2011 NERA/Imperial report concluded that uniform charging could lead to an increase in offshore wind deployment and a displacement of onshore wind deployment, thereby increasing renewables subsidy costs given that the capital costs of offshore wind tend to be higher than those of onshore wind.
  - This was because NERA/Imperial assumed that, under the uniform charging approach, the local asset charge component of TNUoS charges would be socialised along with the wider zonal charge component. Given that offshore wind currently faces high local asset charges, this would improve offshore wind economics to a greater extent than onshore wind economics.

### 3.2.2 2012 approach

The modelling approach in the 2012 NERA/Imperial report appears to have made changes to the 2011 modelling approach and assumptions, although the dependence between subsidy levels and deployment of renewable generation in the NERA/Imperial analysis remains unclear.

Indeed, the NERA/Imperial 2012 report concludes that Improved ICRP charges could reduce renewables subsidy costs by £162m.

- The 2012 report assumes that the renewables support is set at different levels under the status quo and the Improved ICRP charges, which ensures that the renewables target is met in both scenarios.
- The reduction in TNUoS charges in Scotland (a region with abundant potential for wind deployment) implies that 600MW of wind shifts from England & Wales to Scotland following the introduction of Improved ICRP. In addition, within Scotland there is a shift from offshore wind to onshore wind on the Scottish islands. This results in a reduction in subsidy costs.

### 3.2.3 Assessment of the approach adopted by NERA/Imperial

Although NERA/Imperial finds that low-carbon subsidies could be reduced through Improved ICRP, the subsidy saving estimated appears to be small. For example, the analysis undertaken by Redpoint Energy finds significantly larger subsidy savings suggesting that



these savings might have been underestimated by NERA/Imperial by almost £900m in NPV terms over the period between 2011 and 2030.<sup>20</sup>

NERA/Imperial's conclusions on zonal deployment levels and subsidy costs are likely to be sensitive to assumptions on the cost of capital, capital and operational costs, zonal load factors and zonal resource potential.<sup>21</sup>

NERA/Imperial states that 'a key intention of the CFD FIT scheme is to reduce the risks borne by investors in low carbon generation, thus reducing the cost of capital faced by wind investors and boosting investment.' However, it has not considered the likely impact of a change in the cost of capital, stating that 'as the details of the scheme have yet to be announced, we have not made any specific assumption on the impact on the cost of capital developers would face with CFD FITs rather than the RO, which in practice could be positive or negative'.<sup>22</sup>

For example, NERA/Imperial's cost of capital assumptions are based on work undertaken by Oxera in 2011.<sup>23</sup> However, these estimates might have changed since the time they were made, and there remains uncertainty around what level of cost of capital would be reasonable to assume in the current policy context.

Given the likely sensitivity of required subsidy levels to the cost of capital (and other cost/resource assumptions), it appears necessary to test the impact of changes of these assumptions on the results in order to arrive at a robust estimate of the cost and benefits of introducing Improved ICRP and its impact on consumers.

## 4 Conclusion

This review of the 2012 NERA/Imperial report suggests that, although NERA/Imperial has made improvements to its 2011 analysis, some concerns already set out by Oxera in 2011 remain. For example, NERA/Imperial has changed the assumptions it made about siting decisions and the relationship between low-carbon subsidies and renewables deployment. However, a key concern previously raised by Oxera was that NERA/Imperial has not explained the extent to which the reduction in capacity resulting from earlier plant closures and the possible increase in Transmission Network Use of System (TNUoS) charges could lead to an increase in power prices.

The main findings of this note are summarised below.

- The estimated overall impact on social welfare seems to be more plausible compared to the figure estimated in the 2011 report given that it is based on an assessment of certain incremental improvements to ICRP, and not a comparison of ICRP with uniform charges, as was the case in the 2011 NERA/Imperial report.
- Notwithstanding the fact that the baseline for assessment has changed and that the differences between the Improved ICRP and the existing ICRP may seem more

<sup>20</sup> Redpoint Energy (2011), op. cit., p. 53.

<sup>21</sup> The cost assumptions are based on ARUP (2011), 'Review of the generation costs and deployment potential of renewable electricity technologies in the UK', October; cost of capital on Oxera (2011), 'Discount rates for low carbon and renewable generation technologies', April, report prepared for the Committee on Climate Change; and zonal resource potential based on SKM (2008), 'Quantification of constraints the growth of UK renewable generating capacity, June.

<sup>22</sup> NERA/Imperial (2012), op. cit., p. 5.

<sup>23</sup> NERA/Imperial (2012).

nuanced compared with a move to uniform charges, the estimated impact on consumers in the 2012 NERA/Imperial report remains very large.

- It is notable that, whereas the *reduction* in social welfare (ie, power sector costs) was 98% lower in the 2012 study than in the 2011 study, the reduction in consumer costs was only 20%. Indeed, the largest component of consumer costs estimated by NERA/Imperial was the impact of the increase in wholesale power prices, and this was estimated to have *increased* by 7%. This may suggest that NERA/Imperial's estimate of the increase in consumer costs continues to be overstated.
- Related to the above finding, the 2012 NERA/Imperial report does not explain the extent to which the reduction in capacity arising from earlier plant closures could lead to an increase in power prices. Given this lack of transparency, it is difficult to validate NERA/Imperial's modelling results. Furthermore, NERA/Imperial's modelling assumes that the siting of new thermal plants is in order of profitability according to TNUoS charges, albeit subject to an overall regional cap for new plants. However, evidence suggests that developers may not consider TNUoS charges as the primary driver of site selection, which would imply that TNUoS charges do not have as significant an impact on power prices as estimated by NERA/Imperial.
- The overall impact on consumers appears to be based on a single set of assumptions about key drivers such as the impact of plant closure and siting decisions on wholesale power prices. No sensitivity analysis has been presented and NERA/Imperial has provided only limited evidence to support the specific assumptions used. Moreover, and as the 2012 NERA/Imperial report recognises, the modelling approach adopted does not lead to a single, stable equilibrium; it therefore remains unclear whether the results presented are robust. This strongly suggests that it might not be possible to conclude from NERA/Imperial's analysis that Improved ICRP would result in higher power prices (and therefore higher consumer costs) in the long term. About 94% of the estimated increase in costs is due to the modelled increase in wholesale electricity prices.