

Modelling the Impact of Transmission Charging Options

Addendum: treatment of transmission costs

May 2012

Version History

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I Introduction

Redpoint Energy's report "*Modelling the Impact of Transmission Charging Options*" was published in December 2011, alongside Ofgem's consultation document, "*Electricity transmission charging: assessment of options for change*". During the consultation period, further scrutiny of the quantitative results has highlighted an area where the treatment of transmission costs in the cost benefit analysis (CBA) should be revised.

The revision impacts on the CBA results only: all other modelling results from the original report are unchanged. The spreadsheet of supporting numerical results, published alongside the report in December 2011, remains valid and the numerical results within this spreadsheet are unaffected.

This addendum presents the revision we have made and the impacts of that revision. This document is structured as follows:

- Section 2 outlines the revision required and the reason for this,
- Section 3 describes the impact of the change on the CBA and on the conclusions of the study as presented in the published report, *and*
- Appendix A presents additional CBA results for policy variants and sensitivities
- Appendix B contains extracts of text from the published report showing changes to the quoted numerical values.

2 Revision to transmission asset costs

Since publication of our original report in December 2011, an additional review of the modelling results has identified an issue in the treatment of transmission costs in the CBA. Here we describe the issue and the revision to the results that we make in this Addendum.

The CBA is described in pages 83-84 of our report. Power sector costs are comprised of generation costs, constraint costs, transmission costs and carbon costs. Transmission costs include onshore, offshore and island links, comprising:

- Annuitised capital cost: the regulated capital charge and depreciation costs for transmission assets,
- Annual operating cost: cost of operating and maintaining the transmission network, *and*
- Transmission losses: power losses in transmission, valued at the system marginal price.

The first two of these elements can be considered jointly as the transmission asset cost. It is this element of the power sector costs that is the subject of the proposed revisions.

When calculating tariffs for the year ahead, the Transport Model must necessarily be supplied with a forecast of Maximum Allowed Revenue (MAR) for the next year. This is a forecast of the total cost of transmission to be recovered for that year. This forecast is used in the calculation of the Transmission Network Use of System (TNUoS) tariffs for that year. This may differ from the actual outturn costs of transmission, which the model calculates ex-post on an annual basis.

For transmission infrastructure costs, we have the choice of using the MAR forecast or the ex-post calculated transmission costs as discussed above. For the published analysis we used the MAR forecast as the input for transmission asset costs in the CBA. This parameter demonstrates some variation from the ex-post transmission costs.

The differences between forecast and outturn transmission costs are not systematically of similar magnitude or in the same direction for different model runs. In particular, Improved ICRP shows a larger variation between forecast and outturn transmission costs than the other model runs, and as a result we believe that forecast transmission costs are not a reliable indicator of the true transmission costs.

Hence, having scrutinised the issue further with Ofgem, and understood the magnitude of the differences, we believe that it was erroneous to use the forecast costs from the Transport Model rather than the outturn costs, and we recommend that the results are restated accordingly.

Below we demonstrate the impact on the CBA of making the adjustment to the treatment of transmission costs.

3 Impact of revision

3.1 Impact on Cost Benefit Analysis for core options

Table 1 and Table 2 show the power sectors costs respectively before and after the change in treatment of transmission costs is applied, and Table 3 shows the differences between the results. The full CBA tables for these model runs are shown in the following section. Note that the changes are of the order of <0.05% of the total (absolute) power sector costs estimated. However, the CBA is presented on relative terms, compared to the Status Quo.

The change is most significant for the Improved ICRP results. It leads to a change in the sign of the overall power sector costs relative to Status Quo in the period 2012-2020. The small positive benefit of £122m becomes a small dis-benefit of £141m. There is also a more significant increase in transmission costs in the period 2021-2030.

For Socialised, the magnitude of the change is smaller in absolute terms and is also small when compared to the large differences in costs between Status Quo and Socialised.

Table 1 Power sector costs (published values)

	NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>		
Improved ICRP Stage 2	122	-543
Socialised Stage 2	-2,769	-10,823

Table 2 Power sector costs (adjusted values)

	NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>		
Improved ICRP Stage 2	-141	-1,425
Socialised Stage 2	-2,684	-10,806

Table 3 Difference between forecast and outturn transmission asset costs

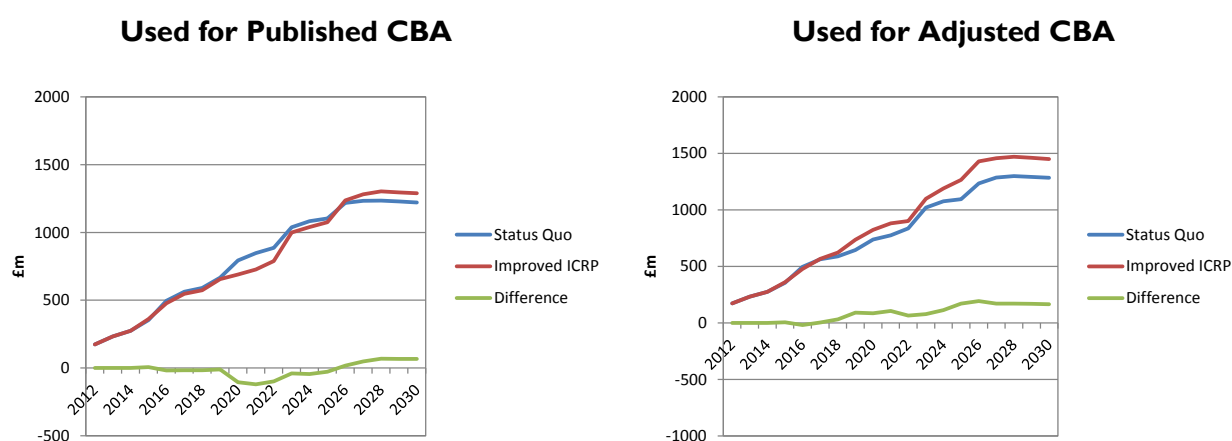
	NPV 2011-2020	NPV 2021-2030
Status Quo	-56	33
Improved ICRP Stage 2	207	916
Socialised Stage 2	-142	17

In the following sections we present additional detail on the impact of the revision on the CBA, for Improved ICRP and Socialised in turn.

3.1.1 Improved ICRP Stage 2

In Figure I below, each chart shows the annual transmission costs for Status Quo, Improved ICRP and the difference between these. The left hand chart shows the values based on the forecast MAR approach. These formed the input into the published CBA values. The right hand chart show values based on ex-post costs, that are used for the adjusted CBA results presented in this note. The change in transmission infrastructure costs is small up to 2020. There is greater difference in the 2021-2030 period, of the order of £100m per annum.

Figure I Status Quo and Improved ICRP Transmission reinforcement costs



Below we show the impact on the full Improved ICRP CBA table (as opposed to just the impact on the power sector cost line in the preceding section). Table 4 shows the published CBA values, whereas Table 5 shows the table with adjustments.

Adjustments are made to the transmission costs and to the Demand TNUoS. Demand TNUoS is affected as a direct proportion (73% then 85% from April 2015) of the impact on transmission infrastructure costs. These are the only two changes to the CBA tables.

Table 4 Published CBA: Improved ICRP Stage 2

		Improved ICRP (£m real 2011)	
		NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>			
Power sector costs	Generation costs	313	965
	Transmission costs	-8	-418
	Constraint costs	-171	-1,089
	Carbon costs	-11	-2
	Decrease in power sector costs	122	-543
Consumer bills	Wholesale costs (inc. capacity payments)	-1,227	-182
	BSUoS	-85	-547
	Transmission losses	-123	-491
	Demand TNUoS charges	98	62
	Low carbon support	441	644
	Decrease in consumer bills	-897	-512

Table 5 Adjusted CBA: Improved ICRP Stage 2

		Improved ICRP (£m real 2011)	
		NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>			
Power sector costs	Generation costs	313	965
	Transmission costs	-271	-1,300
	Constraint costs	-171	-1,089
	Carbon costs	-11	-2
	Decrease in power sector costs	-141	-1,425
Consumer bills	Wholesale costs (inc. capacity payments)	-1,227	-182
	BSUoS	-85	-547
	Transmission losses	-123	-491
	Demand TNUoS charges	-126	-688
	Low carbon support	441	644
	Decrease in consumer bills	-1,120	-1,263

3.1.2 Socialised Stage 2

Table 6 shows the published CBA results for Socialised Stage 2 and Table 7 shows the adjusted results.

Table 6 Published CBA: Socialised Stage 2

Socialised (£m real 2011)			
		NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>			
Power sector costs	Generation costs	453	1,803
	Transmission costs	-1,569	-7,873
	Constraint costs	-1,452	-4,535
	Carbon costs	-201	-218
	Decrease in power sector costs	-2,769	-10,823
Consumer Bills	Wholesale costs (inc. capacity payments)	-6,157	-6,843
	BSUoS	-723	-2,276
	Transmission losses	-553	-2,693
	Demand TNUoS charges	-849	-4,402
	Low carbon support	1,406	3,342
	Decrease in consumer bills	-6,876	-12,873

Table 7 Adjusted CBA: Socialised Stage 2

Socialised (£m real 2011)			
		NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>			
Power sector costs	Generation costs	453	1,803
	Transmission costs	-1,484	-7,856
	Constraint costs	-1,452	-4,535
	Carbon costs	-201	-218
	Decrease in power sector costs	-2,684	-10,806
Consumer Bills	Wholesale costs (inc. capacity payments)	-6,157	-6,843
	BSUoS	-723	-2,276
	Transmission losses	-553	-2,693
	Demand TNUoS charges	-776	-4,388
	Low carbon support	1,406	3,342
	Decrease in consumer bills	-6,803	-12,859

3.2 Summary

Table 8 summarises the changes to the CBA results for the core scenarios, the two policy variants (Improved ICRP HVDC sensitivity and Socialised (wider only) sensitivity) and the low gas price sensitivity. It shows the power sectors costs for the 2011-2020 period and 2021-2030, before and after the adjustment. Complete CBA tables for the policy variants and sensitivities can be found in Appendix A.

Table 8 Summary of power sector costs before and after adjustment

Net Present Value £m	Published		Adjusted		Difference	
	2011-2020	2021-2030	2011-2020	2021-2030	2011-2020	2021-2030
Improved ICRP Stage 2	122	-543	-141	-1,425	-263	-883
Socialised Stage 2	-2,769	-10,823	-2,684	-10,806	86	16
Improved ICRP (HVDC sensitivity)	-82	-1,968	-138	-1,891	-56	77
Socialised (wider only) sensitivity	-1,424	-8,914	-1,480	-8,882	-56	33
Improved ICRP (Low Gas Price sensitivity)	-316	-3,433	-164	-3,467	153	-35
Socialised (Low Gas Price sensitivity)	-322	-9,348	-170	-9,318	151	30

3.3 Conclusions

The conclusions we draw in the published report for Improved ICRP and Socialised in general hold following the revision to the CBA results.

In our report we state that “...Improved ICRP appears broadly neutral with Status Quo with respect to power sector costs”. This statement continues to hold true for the 2011-2020 period, where the differences in power sector costs between Improved ICRP and Status Quo continue to be small. The significance of the sign change in the 2021-2030 period should not be overplayed given the uncertainty in modelling assumptions, and the fact that the differences represent a small fraction (<0.05%) of total power sector costs in this period. Beyond 2020, the model results for Improved ICRP show a greater increase in power sector and consumer costs, and hence the differences to the Status Quo option are more significant. For example, the average increase in consumer bills for the period 2021-2030 increases from £1/MWh to £2.3/MWh.

The differences between Improved ICRP and Status Quo should be considered in the context of other factors which may dominate over the transmission charging approach. We believe these factors may fall into three broad categories:

1. The problem is heavily constrained by the availability of sites for new low carbon generation, and deployment rates for renewables technologies, and hence the relatively subtle changes in locational signals under Improved ICRP have less of an impact than might otherwise be the case.
2. The differential support levels for low carbon generators under the Renewables Obligation and assumed under EMR are a much stronger driver of investment behaviour than relatively small changes in transmission charges.
3. Constraint costs may increasingly become ‘polluted’ by low carbon support payments with low carbon generators bidding below their true short run costs in order to continue to receive support payments (which we assumed would also be the case under Contracts for Differences based on the Government’s EMR publications). This appears to result in constraint costs, which we should

expect to increase under Improved ICRP to an extent, being inflated and then exceeding the benefits in terms of reduced generation costs.

This last point highlights the difficulties in assessing the impact of changes in transmission charging given the uncertainties surrounding the outcomes of EMR, particularly in the 2020s. Different designs for contracts for differences (particularly whether they are paid on availability or output) or the capacity mechanism from those assumed in the modelling could materially affect the results.

The conclusions for Socialised are robust to the change in transmission cost treatment, as the changes in CBA results have a smaller absolute magnitude and are relative smaller compared to the differences between Socialised and Status Quo.

A Revised CBA results

Revised CBA tables for the policy variants and low gas sensitivities are shown below.

A.1 Improved ICRP HVDC Sensitivity

The published and adjusted CBA results for the Improved ICRP HVDC Sensitivity are shown in Table 9 and Table 10 respectively.

Table 9 Published CBA: HVDC Sensitivity (Stage 2 modelling)

HVDC sensitivity (£m real 2011)			
		NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>			
Power sector costs	Generation costs	332	698
	Transmission costs	-225	-1,332
	Constraint costs	-183	-1,500
	Carbon costs	-5	166
	Decrease in power sector costs	-82	-1,968
Consumer Bills	Wholesale costs (inc. capacity payments)	-1,421	323
	BSUoS	-91	-753
	Transmission losses	-128	-485
	Demand TNUoS charges	-82	-720
	Low carbon support	458	560
	Decrease in consumer bills	-1,265	-1,075

Table 10 Adjusted CBA: HVDC Sensitivity (Stage 2 modelling)

HVDC sensitivity (£m real 2011)			
		NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>			
Power sector costs	Generation costs	332	698
	Transmission costs	-281	-1,254
	Constraint costs	-183	-1,500
	Carbon costs	-5	166
	Decrease in power sector costs	-138	-1,891
Consumer Bills	Wholesale costs (inc. capacity payments)	-1,421	323
	BSUoS	-91	-753
	Transmission losses	-128	-485
	Demand TNUoS charges	-129	-654
	Low carbon support	458	560
	Decrease in consumer bills	-1,312	-1,009

A.2 Socialised (wider only) Sensitivity

The published (Table 11) and adjusted (Table 12) CBA results for the Socialised (wider only) sensitivity are shown below

Table 11 Published CBA: Socialised (wider only) Sensitivity (Stage 2 modelling)

		Socialised (wider only) (£m real 2011)	
		NPV 2011-2020	NPV 2021-2030
Benefit relative to Status Quo			
Power sector costs	Generation costs	325	1,285
	Transmission costs	-559	-4,519
	Constraint costs	-1,089	-6,072
	Carbon costs	-101	391
	Decrease in power sector costs	-1,424	-8,914
Consumer bills	Wholesale costs (inc. capacity payments)	-4,311	-2,957
	BSUoS	-542	-3,048
	Transmission losses	-433	-3,128
	Demand TNUoS charges	-107	-1,183
	Low carbon support	621	595
	Decrease in consumer bills	-4,772	-9,720

Table 12 Adjusted CBA: Socialised (wider only) Sensitivity (Stage 2 modelling)

		Socialised (wider only) (£m real 2011)	
		NPV 2011-2020	NPV 2021-2030
Benefit relative to Status Quo			
Power sector costs	Generation costs	325	1,285
	Transmission costs	-615	-4,486
	Constraint costs	-1,089	-6,072
	Carbon costs	-101	391
	Decrease in power sector costs	-1,480	-8,882
Consumer bills	Wholesale costs (inc. capacity payments)	-4,311	-2,957
	BSUoS	-542	-3,048
	Transmission losses	-433	-3,128
	Demand TNUoS charges	-154	-1,155
	Low carbon support	621	595
	Decrease in consumer bills	-4,819	-9,692

A.3 Low Gas Price Sensitivity (Stage 2 modelling)

Improved ICRP (Low Gas Price Sensitivity)

Table 13 and Table 14 show the published and adjusted CBA results for the Improved ICRP (Low Gas Price Sensitivity).

Table 13 Published CBA: Improved ICRP (Low Gas Price Sensitivity)

		Improved ICRP (£m real 2011)	
		NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>			
Power sector costs	Generation costs	302	-1,442
	Transmission costs	-299	-1,314
	Constraint costs	-316	-1,011
	Carbon costs	-3	334
	Decrease in power sector costs	-316	-3,433
Consumer bills	Wholesale costs (inc. capacity payments)	-2,200	2,809
	BSUoS	-157	-507
	Transmission losses	-184	-479
	Demand TNUoS charges	-98	-710
	Low carbon support	526	-1,633
	Decrease in consumer bills	-2,112	-519

Table 14 Adjusted CBA: Improved ICRP (Low Gas Price Sensitivity)

		Improved ICRP (£m real 2011)	
		NPV 2011-2020	NPV 2021-2030
<i>Benefit relative to Status Quo</i>			
Power sector costs	Generation costs	302	-1,442
	Transmission costs	-147	-1,348
	Constraint costs	-316	-1,011
	Carbon costs	-3	334
	Decrease in power sector costs	-164	-3,467
Consumer bills	Wholesale costs (inc. capacity payments)	-2,200	2,809
	BSUoS	-157	-507
	Transmission losses	-184	-479
	Demand TNUoS charges	32	-739
	Low carbon support	526	-1,633
	Decrease in consumer bills	-1,983	-549

Socialised (Low Gas Price Sensitivity)

Table 15 and Table 16 show the published and adjusted results for Socialised (Low Gas Price Sensitivity)

Table 15 Published CBA: Socialised (Low Gas Price Sensitivity)

Socialised (£m real 2011)			
		NPV 2011-2020	NPV 2021-2030
Benefit relative to Status Quo			
Power sector costs	Generation costs	2,009	808
	Transmission costs	-1,307	-7,266
	Constraint costs	-697	-2,446
	Carbon costs	-327	-444
	Decrease in power sector costs	-322	-9,348
Consumer Bills	Wholesale costs (inc. capacity payments)	-6,713	-5,642
	BSUoS	-347	-1,227
	Transmission losses	-423	-2,309
	Demand TNUoS charges	-751	-4,214
	Low carbon support	2,806	3,314
	Decrease in consumer bills	-5,428	-10,077

Table 16 Adjusted CBA: Socialised (Low Gas Price Sensitivity)

Socialised (£m real 2011)			
		NPV 2011-2020	NPV 2021-2030
Benefit relative to Status Quo			
Power sector costs	Generation costs	2,009	808
	Transmission costs	-1,156	-7,236
	Constraint costs	-697	-2,446
	Carbon costs	-327	-444
	Decrease in power sector costs	-170	-9,318
Consumer Bills	Wholesale costs (inc. capacity payments)	-6,713	-5,642
	BSUoS	-347	-1,227
	Transmission losses	-423	-2,309
	Demand TNUoS charges	-623	-4,188
	Low carbon support	2,806	3,314
	Decrease in consumer bills	-5,299	-10,052

B Revisions to CBA results quoted report text

In the report we quote CBA results in a number of places in the text. Below we show the revisions to these values. These revisions are a direct result of the adjustment to CBA shown above. The adjusted values are shown in ***[bold italics]*** after the original values.

Executive Summary (page 8)

The impact of Improved ICRP on consumer bills is small over the period 2012-2020, averaging an additional £1.50 ***[£1.90]*** per year for each domestic customer. The average increase per year for each domestic customer is £1 ***[£2.30]*** per year from 2021 to 2030.

Executive Summary (page 11)

The results of the HVDC variant are similar to Improved ICRP up to 2020, but over the period 2020-2030 an increase in transmission and constraint costs is observed, to accommodate more generating capacity in North Scotland and offshore Scotland, as a consequence of less cost-reflective charging for HVDC links. The increase in consumer bills above Status Quo from 2021-2030 is still relatively small at £2 ***[£1.90]*** per year (compared to £1 ***[£2.30]*** per year under Base Case Improved ICRP).

The Socialised (wider only) variant leads to higher tariffs for offshore wind that reflect the costs of the offshore links. As a result, relative to the fully Socialised option, there are savings in transmission costs from a reduction in offshore transmission costs. The average impact on consumer bills in the period 2012 to 2020 of £9 ***[£8]*** per year is still significant but is slightly less than under fully Socialised charging. However, there is an increase in constraint costs from 2025 onwards.

5.6.2 Cost Benefit Analysis results (page 52)

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 ***[£1.90]*** per year for each domestic customer.

5.7.2 HVDC sensitivity (page 61)

Table 8 presents the CBA results for the HVDC sensitivity (relative to Status Quo) over two ten year time periods, 2011 to 2020 and 2021 to 2030. The results to 2020 are similar to core Improved ICRP, with little change in power sector costs relative to Status Quo. Results to 2030 show an increase in power sector costs and consumer bills relative to both Status Quo and core Improved ICRP. The increase in power sector costs over this period (NPV of -£1,968m ***[-£1,819m]***) relative to core Improved ICRP (-£543m ***[-£1,425m]***, Table 8) is due to higher transmission and constraint costs to accommodate more generating capacity in North Scotland and offshore Scotland, as a consequence of less cost-reflective charging for HVDC links. ~~The increase in consumer bills relative to Improved ICRP is due to the pass through of higher transmission and constraint costs to consumers.~~ The increase in consumer bills above

Status Quo from 2021-2030 is still relatively small at £2 [**£1.90**] per year (compared to £1 [**£2.30**] per year under core Improved ICRP).

5.7.3 Socialised (wider only) sensitivity (page 63)

Table 9 shows the CBA results for Socialised (wider only) sensitivity relative to Status Quo. As for fully Socialised option, there are still significant increases in power sector costs from a change to Socialised (wider only) charging (-£1,424m [**-£1,480m**] to 2020 compared to -£2,769m [**-£2,825m**] under core Socialised, Table 6). Relative to the core Socialised option, there are savings in total transmission costs from a reduction in the costs of offshore cables. However, there is an increase in onshore constraint costs from 2025 onwards as more offshore generation is connected into Scotland. The average impact on consumer bills in the period 2012 to 2020 of £7.80 [**£7.90**] per year is slightly less than under core Socialised charging.

5.8.1 Low Gas Price Sensitivity (page 67)

Table 10 presents the CBA results for Improved ICRP (relative to Status Quo) under the Low Gas Price Sensitivity. In general the Improved ICRP option appears relatively less favourable when compared with Status Quo than under the Base Case assumptions, both in terms of power sector costs and consumer bills. In the period to 2020, the small difference in power sector costs (-£316m [**-£164m**] under the Low Gas Price Sensitivity compared with +£122 [**-£141m**] in the Base Case) is a result of relative increases in constraint costs and transmission costs under Improved ICRP Low Gas Price, relating to lower deployment of onshore wind in North Scotland under Status Quo Low Gas Price. Consumer bills in this period are higher under Improved ICRP than Status Quo Low Gas Price by £3.50 [**£3.30**] per year because of the pass through of transmission costs into BSUoS and TNUoS, and also because of changes in wholesale prices related to changes in capacity margin.

In the period 2021-2030 the increase in power sector costs (-£3,433m [**-3,467m**] under the Low Gas Price Sensitivity compared with -£543m [**-£1,425m**] in the Base Case) is made up of increases in generation costs and transmission costs due to deployment of higher cost renewables. In particular, there is an increase in the relative deployment of biomass and tidal and wave generation under Improved ICRP in the Low Gas Price Sensitivity. However, the majority of these additional costs are not passed through to consumers due to a decrease in wholesale costs, and the impact on consumer bills is almost identical to the Base Case Improved ICRP results (-£519m [**-£549m**] under the Low Gas Price Sensitivity compared with -£512m [**-£1,263m**] in the Base Case).

5.9 Summary of modelling results (page 73)

The results of the HVDC variant are similar to Improved ICRP up to 2020, but in the 2020s an increase in transmission and constraint costs is observed, to accommodate more generating capacity in North Scotland and offshore Scotland, as a consequence of less cost-reflective charging for HVDC links. The increase in consumer bills above Status Quo from 2021-2030 is still relatively small at £2 [**£1.90**] per year (compared to £1 [**£2.30**] per year under core Improved ICRP).

The Socialised (wider only) variant leads to higher tariffs for offshore wind that reflect the costs of the offshore links. As a result, relative to the fully Socialised option, there are savings in transmission costs from a reduction in offshore transmission costs. However, there is an increase in constraint costs from 2025 onwards. The average impact on consumer bills in the period 2012 to 2020 of £9 [**£8**] per year is slightly less than under fully Socialised charging.