Modelling the Impact of Transmission Charging Options

Preliminary results for Working Group review

5th October 2011

Date: 21 October 2011 **Client**: Ofgem

Disclaimer

While Redpoint Energy Limited considers that the information and opinions given in this work are sound, all parties must rely upon their own skill and judgment when interpreting or making use of it. In particular any forecasts, analysis or advice that Redpoint Energy provides may, by necessity, be based on assumptions with respect to future market events and conditions. While Redpoint Energy Limited believes such assumptions to be reasonable for purposes of preparing its analysis, actual future outcomes may differ, perhaps materially, from those predicted or forecasted. Redpoint Energy Limited cannot, and does not, accept liability for losses suffered, whether direct or consequential, arising out of any reliance on its analysis.

The results presented in this pack are of a provisional nature, and were circulated with the express aim of gathering feedback from the Working Group, in order to ensure that the final results of the modelling are robust. This feedback has been taken into account in revised modelling, the results of which will be circulated in due course.

Outline

- Introduction
- Objectives of the study
- Modelling methodology
- Description of policy options
  - Status Quo
  - Improved ICRP
  - Socialised
- Recap of key assumptions
- Provisional results under imperfect foresight for each scenario, including
  - Generator and demand tariffs
  - Generation new build and retirement by location
  - Constraint costs
- Next steps

Introduction

- The pack includes some ***provisional*** results from modelling of the three Transmit options:
  - Status Quo
  - Improved ICRP
  - Socialised
- The analysis presented explores the interactions between generation investment/retirements and transmission charging
- For this initial analysis we have assumed:
  - Constant transmission background (in the final analysis this will be fully endogenised)
  - Equivalent levels of low carbon support (RO/CfDs) across the three options in order to isolate the impacts of the different charging options
- We gratefully acknowledge National Grid's support during the model development, in particular for providing the ELSI model and for developing the Transport & Tariff models for the policy options, and for providing expert advice
- We are seeking feedback from the Working Group on these provisional results – with specific questions highlighted in green boxes throughout the pack

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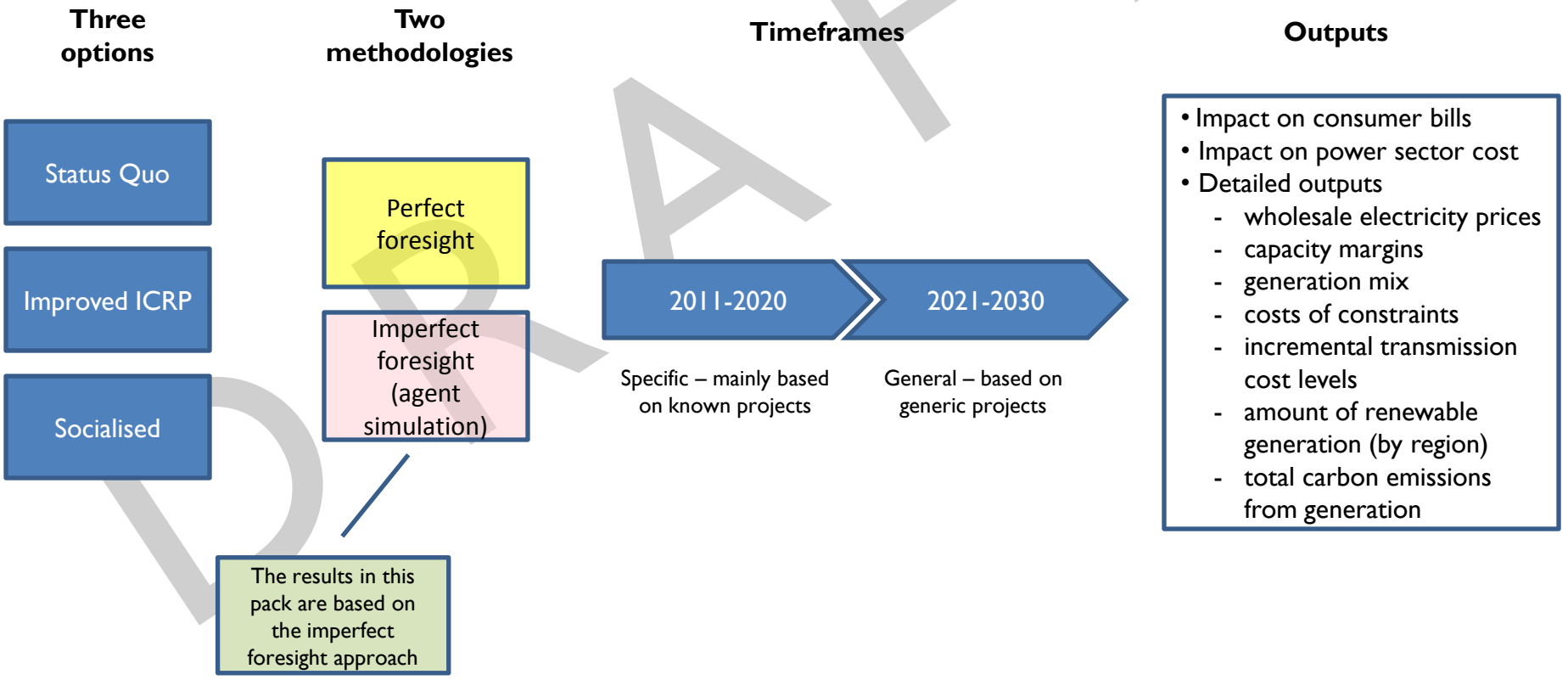
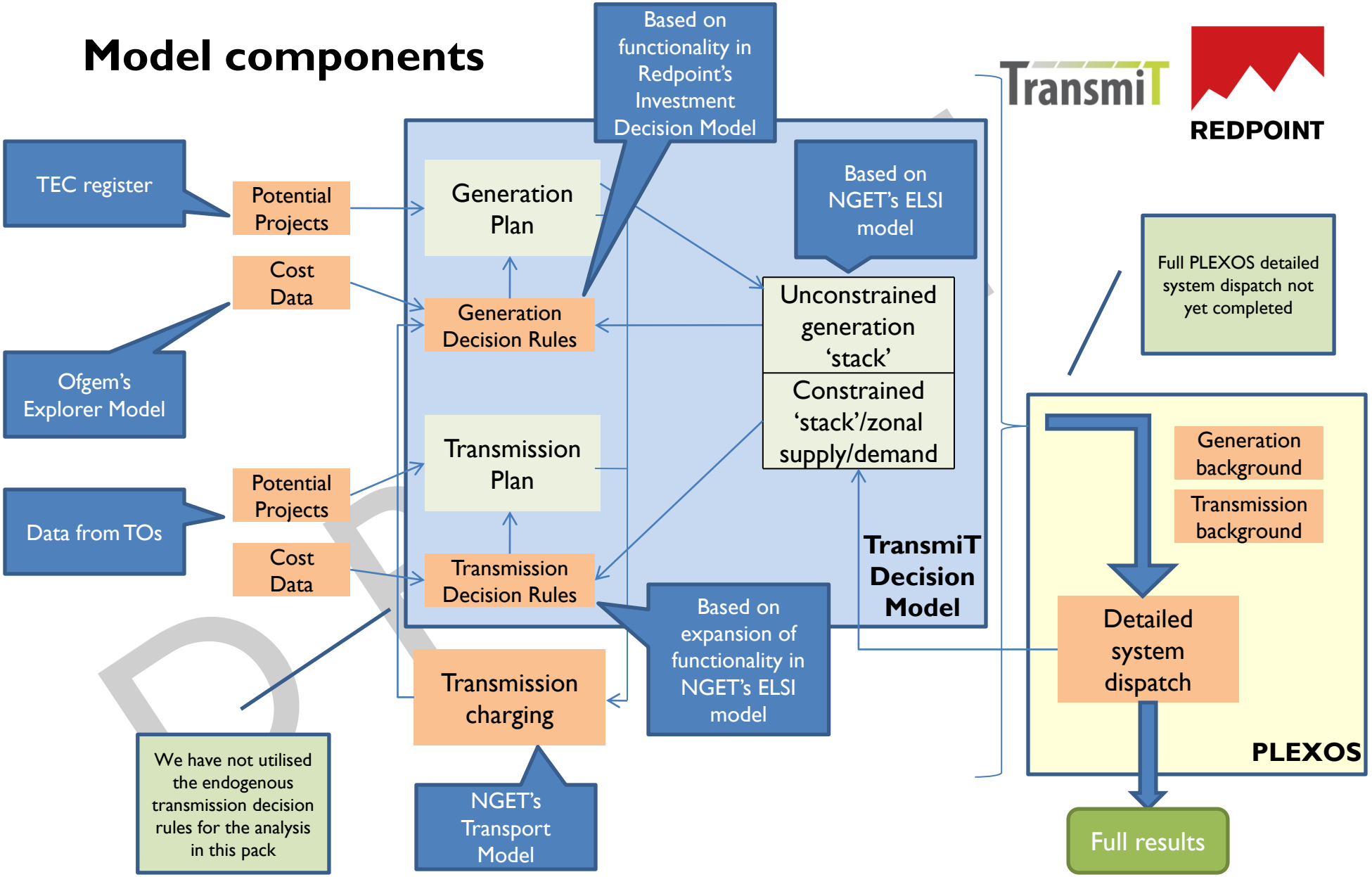
Methodology and assumptions

Objectives

Modelling of three pricing options to provide analytical support for Project TransmiT



Model components



Policy options

- Three policy options being modelled
  - Status Quo
  - Improved ICRP (further detail in attached National Grid document)
  - Socialised (includes full socialisation of local tariffs, including offshore links)
- No change in treatment of constraint costs and losses under all policy options

	Wider investment	Local asset charges	G:D split	Capacity or energy (wider tariff)	HVDC: expansion factor	HVDC lines: treatment in load flow modelling	Local security factors
Status Quo	Locational	Asset specific	15%:85% from 1 April 2015	Capacity (MW)	Full costs, including converter stations	Apportioning flows in proportion relative to circuit ratings	(i) Onshore and island link connected to onshore local network: Generator specific, 1.0 or wider factor (ii) Offshore: Generator specific (1.0-1.8) (iii) Island links connected directly to the MITS: Security factor (1.8) applied in zonal tariff calculation.
Improved ICRP	As for Status Quo	As for Status Quo	As for Status Quo	Dual criteria, based on two part 'peak' and 'year round' tariff	No change from status quo	No change from status quo	As for Status Quo, but for Island links, security factor effectively reduced to 1.0 where there is no redundancy
Socialised	Socialised	Uniform: no locational differentiation (onshore, offshore and islands)	As for Status Quo	Energy based	Not relevant	Not relevant	Not relevant

Build potential and maximum annual build rates

Build potential and maximum annual build rates

MW	Cumulative maximum potential build		Annual maximum build
	2020	2030	
New nuclear	1,670	21,650	4,000
Coal + CCS	6,690	6,690	4,000
CCGT + CCS	0	6,786	4,000
Onshore wind	12,188	13,609	2,000
Offshore wind	16,560	36,900	5,000
Biomass	4,130	6,551	2,000
Tidal and wave	411	1,325	2,000

- Biomass co-firing/conversions of 1.6 GW in 2020,1.9 GW in 2030

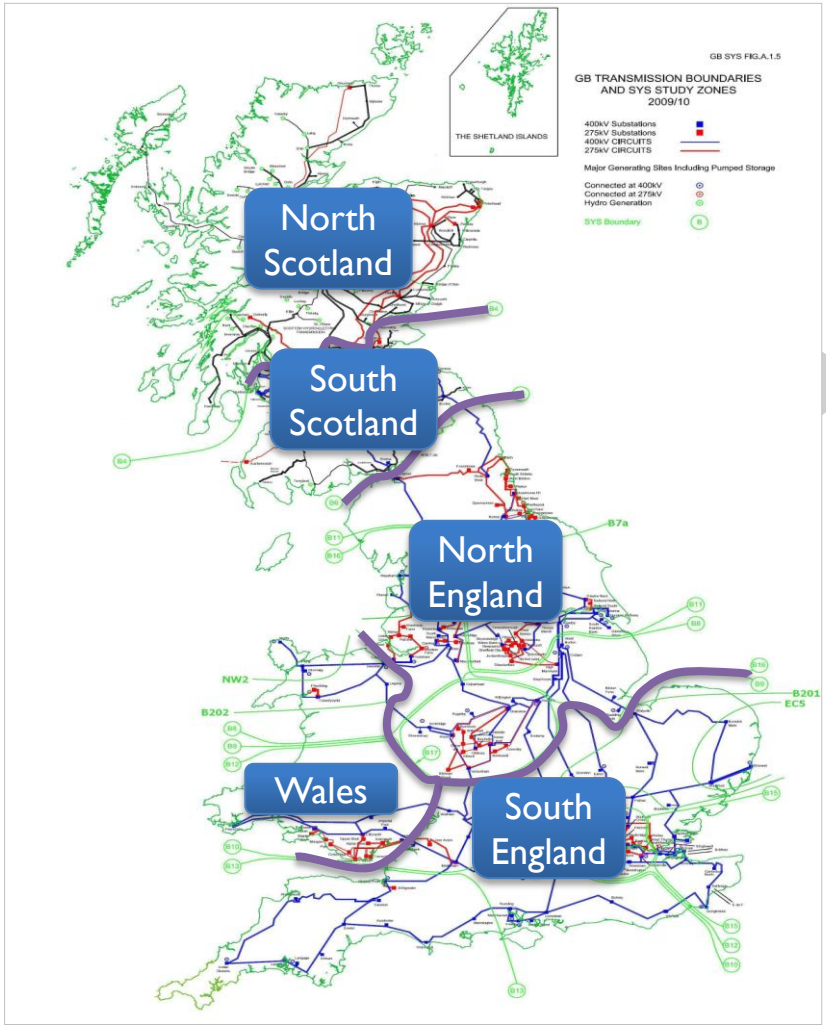
Q1: Does the Working Group have any views on the overall potential and maximum annual build rates?

Interaction between transmission charging and low carbon support

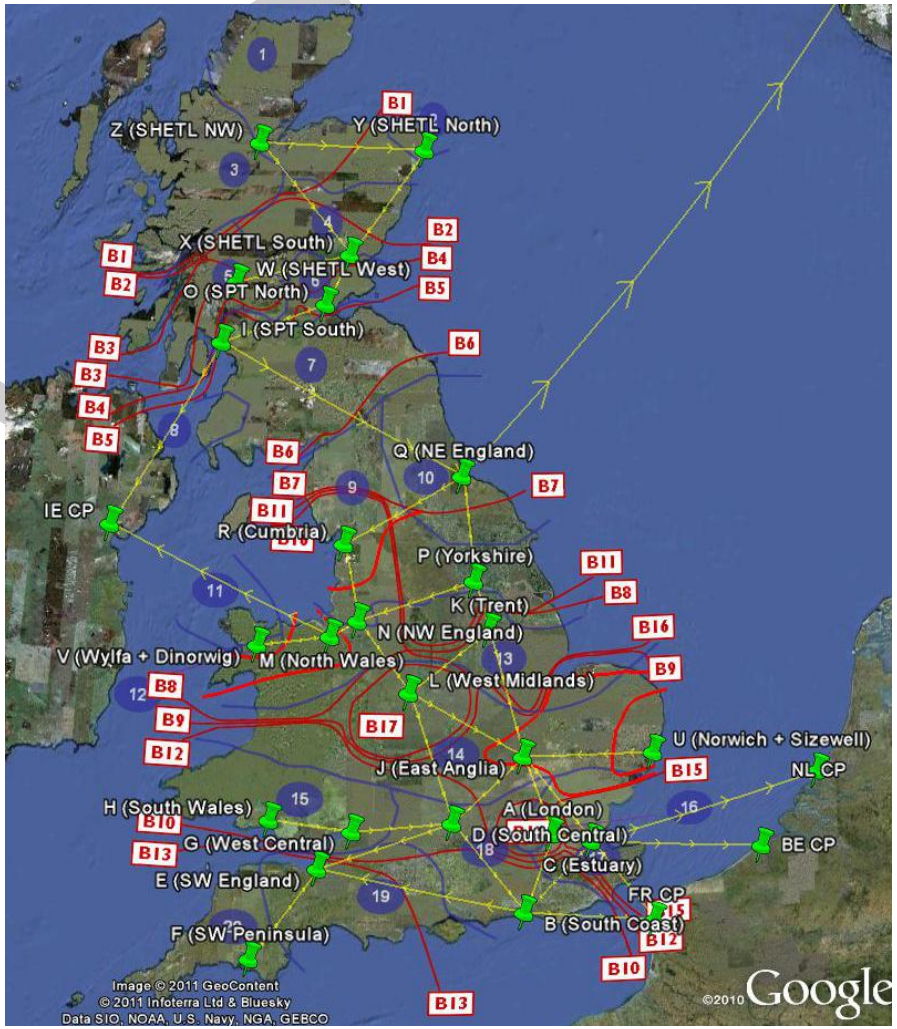
- The different charging options lead to significantly different costs for different forms of low carbon generation
- If low carbon support (RO, CfDs) is not adjusted accordingly then very different outcomes will result in terms of the levels of decarbonisation
- The interactions between transmission charging and low carbon support are therefore complex
- In order to make the results as transparent as possible we have agreed with Ofgem the following two stage approach:
  - **Stage 1.** Under SQ, set low carbon support at levels that deliver the 2020 renewables target in 2020 and achieve around 100 g/kWh carbon intensity in 2030 – then apply same low carbon support levels under Socialised and Improved ICRP
  - **Stage 2.** Adjust the levels of low carbon support under Socialised and Improved ICRP to deliver the same 2020 renewables and 2030 carbon intensity outcome as Status Quo
- The analysis in this pack is based on Stage 1 – it allows us to see the impact of the different charging options all other things being equal
- The Stage 2 results will be more reflective of what might happen in light of Government actions to meet renewables/decarbonisation targets

Regions and zones

Summary regions

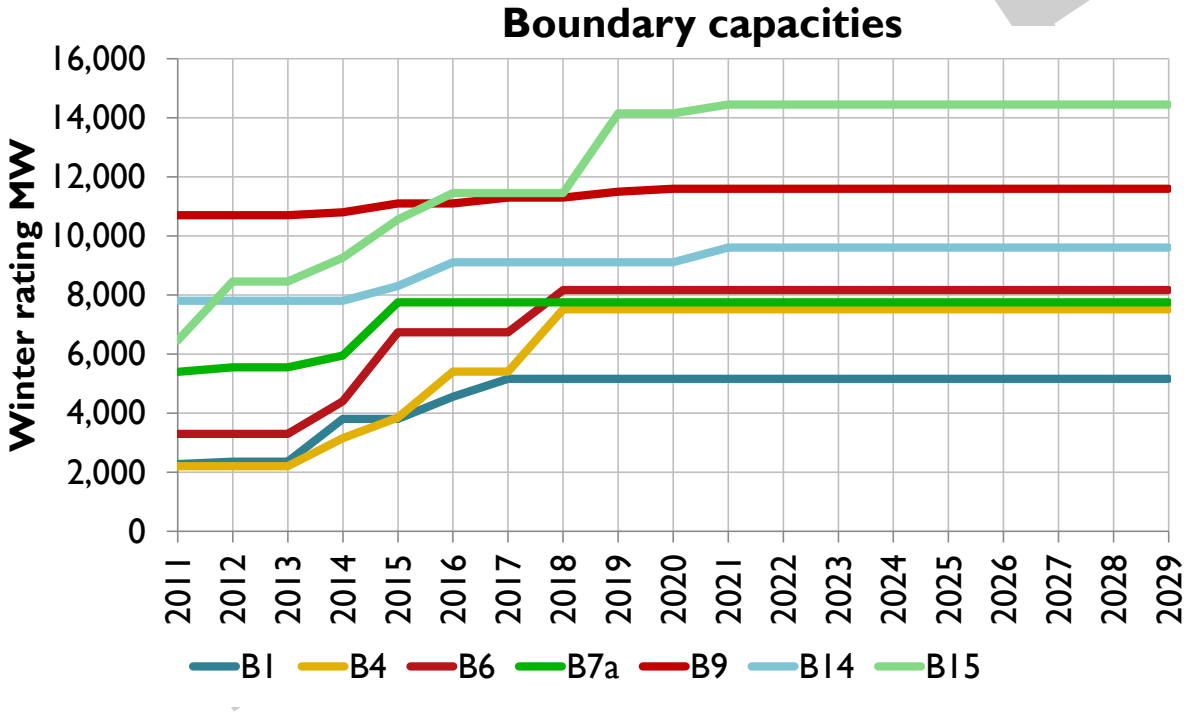


Zones and boundaries



Transmission reinforcements

Transmission reinforcement assumptions are held constant across all policy options, isolating the effect of generation decisions on tariffs and constraint costs. In the final analysis reinforcement will be fully endogenised.



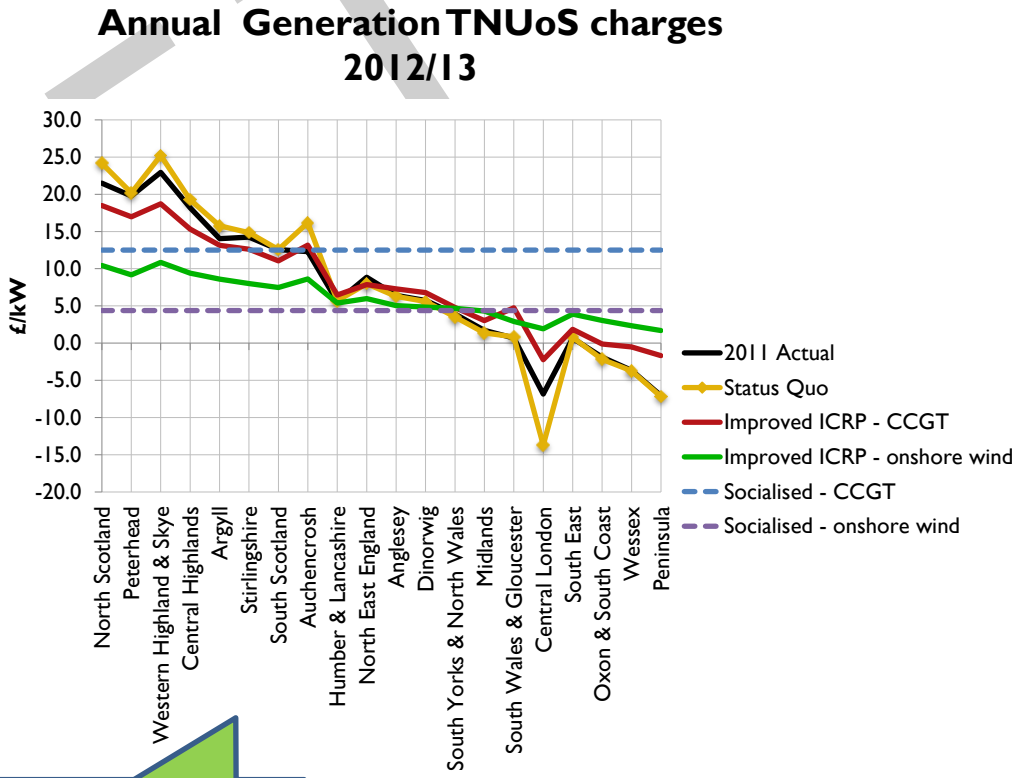
Based on National Grid's Gone Green and published RIIO business plans from Scottish TOs.

No further generic reinforcements are modelled after 2021

Provisional results

Generator tariffs (2012/13)

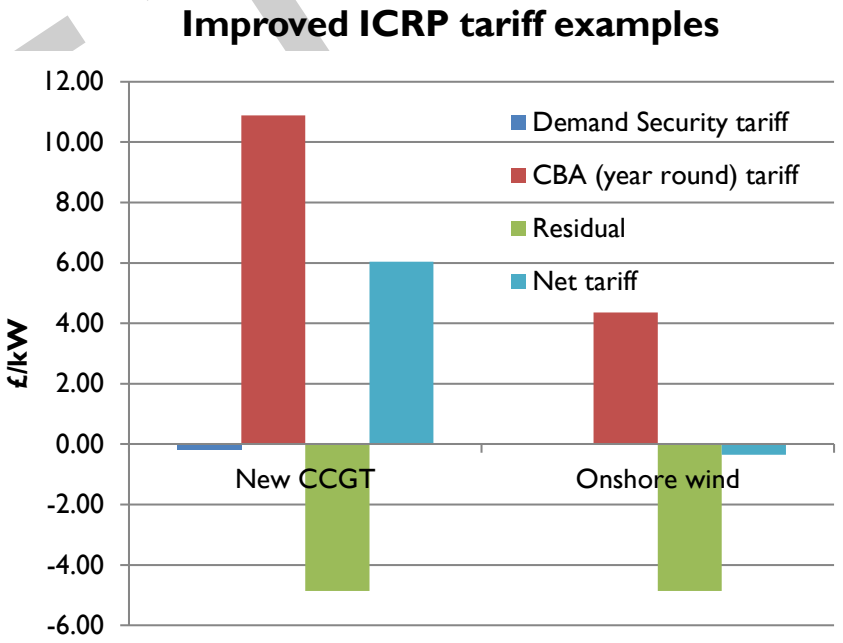
- The chart shows generator tariffs under the three policy options for 2012/13
- Status Quo tariffs for 2012/13 are similar to actual published 2011/12 tariffs, with the exception of Central London
- Socialised tariffs are calculated on a commodity (£/MWh) basis but converted to £/kW/yr for comparison (load factor assumptions: CCGT – 80%, onshore wind 28%)
- Improved ICRP tariffs for wind show a significantly reduced location spread relative to Status Quo (see NG methodology for load factor assumptions)



Q2: Does the Working Group have any particular observations on the generation TNUoS charges?

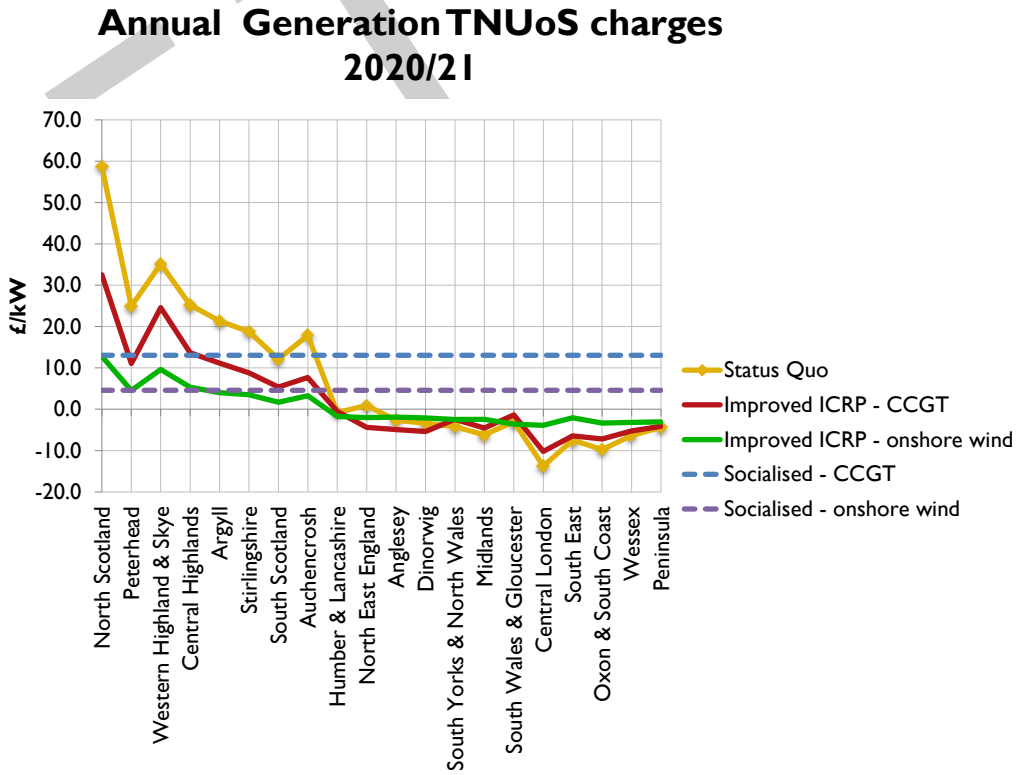
Generator tariffs under Improved ICRP charging – example: South Scotland 2015-16

- Zonal improved ICRP charges consist of two parts
  - Demand Security tariff, based on peak security
  - Year round tariff to address annual need
- Tariff scaling determines differential tariff by technology
  - Demand Security: 100% CCGT; 0% wind
  - Year round (CBA) tariff: 70% CCGT; 28% wind
- See attached National Grid document for further detail



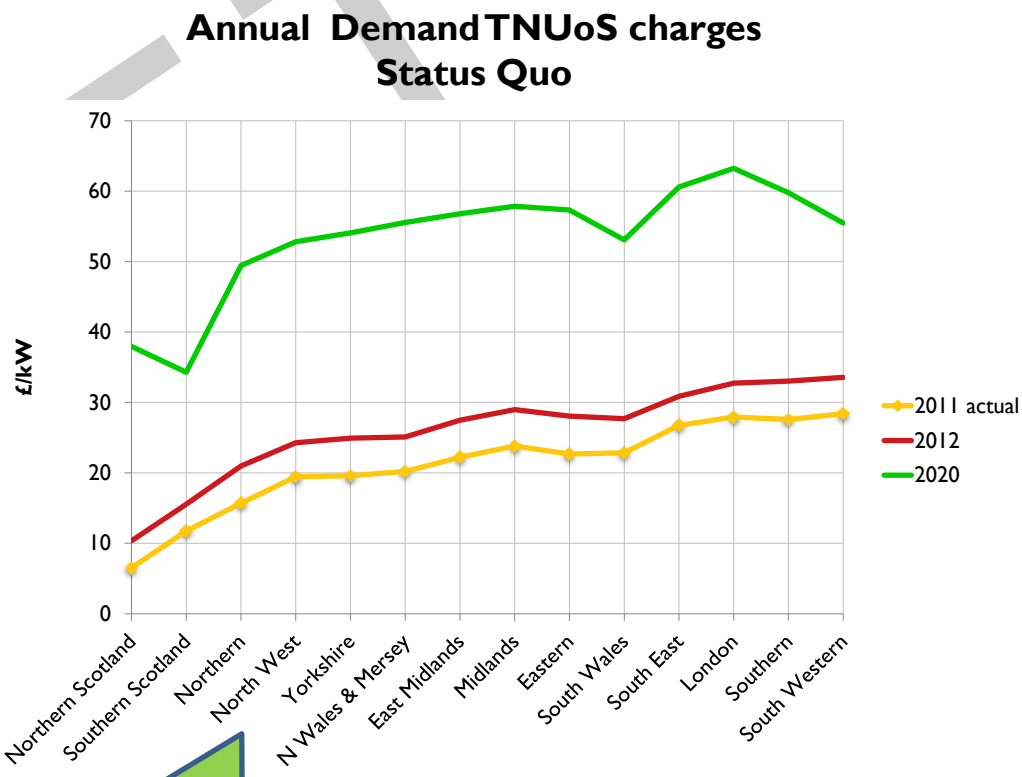
Generator tariffs (2020/21)

- By 2020, Scottish tariffs have increased significantly under Status Quo. This is largely due to the impact of the HVDC bootstraps
- Tariffs would be higher if it were not for the assumed change in the G:D split to 15:85 in April 2015
- Improved ICRP tariffs show less locational spread than Status Quo
- In both cases, there is a clear effect of positive tariffs in Scotland and mainly negative tariffs in England and Wales



Demand tariffs (Status Quo)

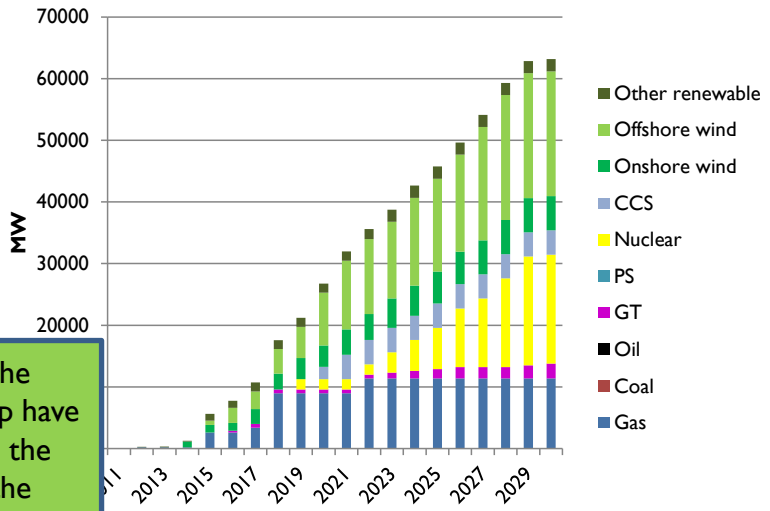
- 2012 /13 forecast tariffs are higher than 2011/12 actual due to an increase in the underlying Maximum Allowed Revenue (MAR)
- MAR will increase to 2020 based on increasing expenditure by the Tos - this includes generation related expenditure (onshore transmission reinforcements, OFTOs, HVDC bootstraps) as well as non-generation spend
- The change in the G:D split to 15:85 amplifies the increase

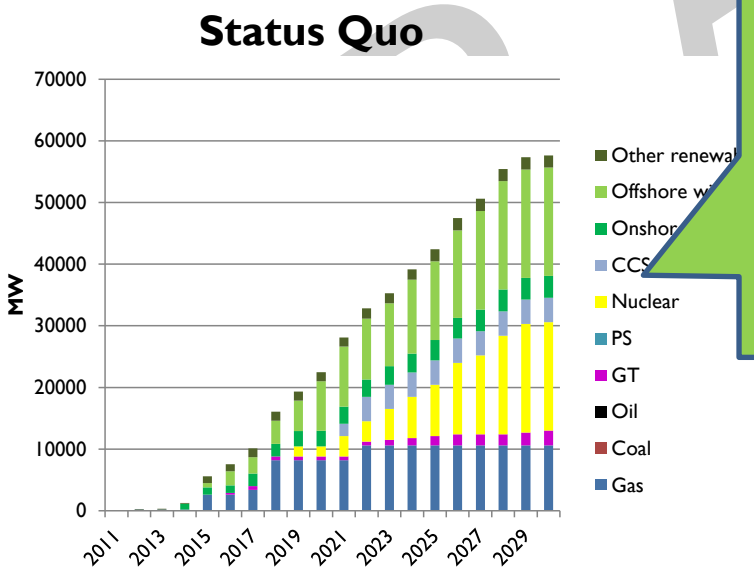


Q3: Does the Working Group have any particular observations on the demand TNUoS charges?

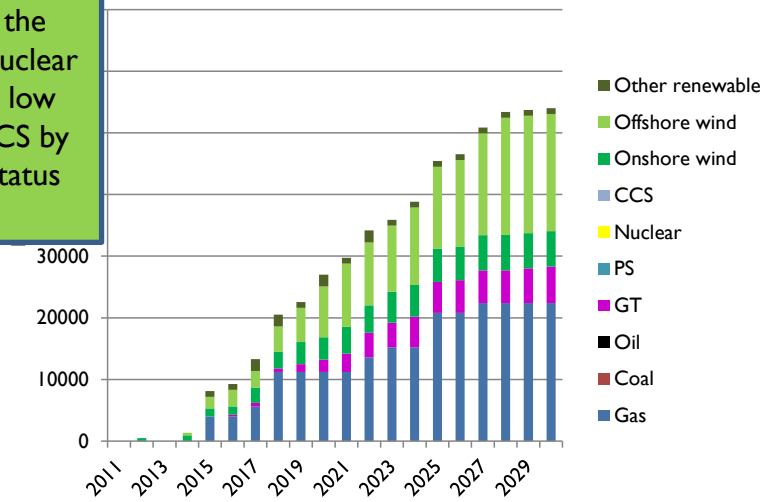
New build by generation type

- Marginally less nuclear and more onshore wind under Improved ICRP
- More wind, no nuclear build and higher CCGT investment under Socialised



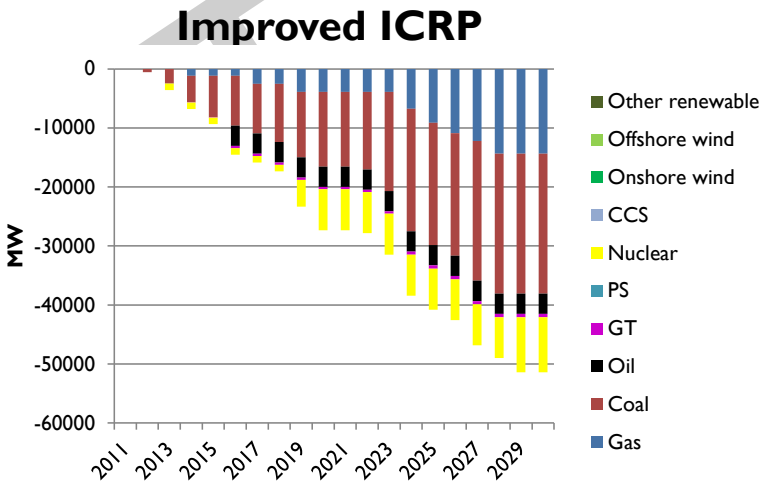


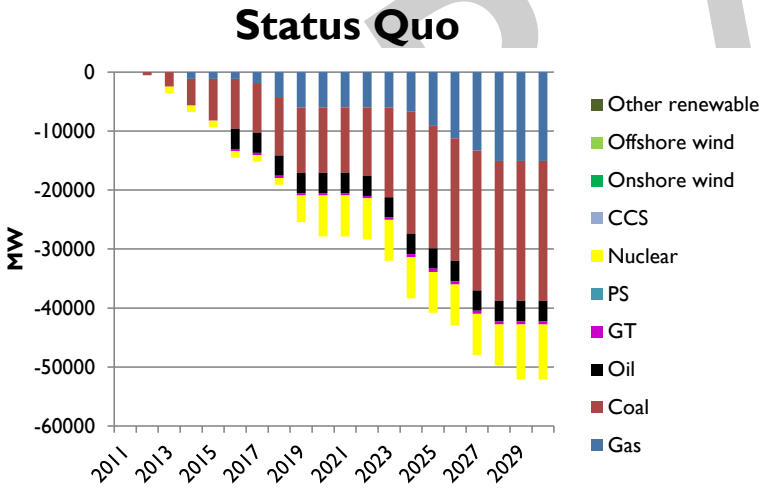
Q4: Does the Working Group have any views on the realism of the different new build under the options – in particular the levels of new nuclear and relatively low amounts of CCS by 2030 under Status Quo?

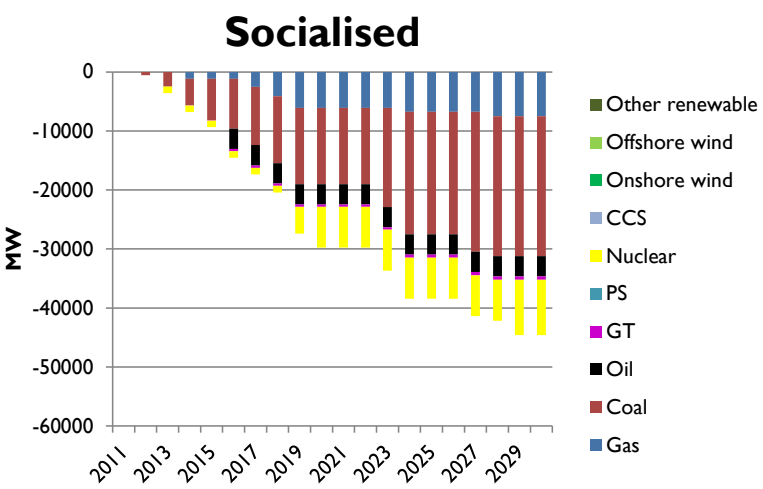


Cumulative retirements by generation type

- Majority of retirements in the near term are pre-determined: LCPD opt-out, nuclear AGRs
- Further retirements determined by earnings in wholesale market and TNUoS charges
- Less new nuclear under Socialised leads to low retirements of existing plant





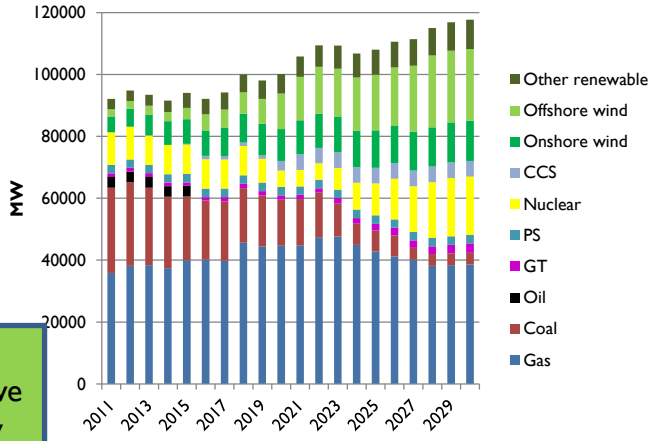


Capacity mix by generation type

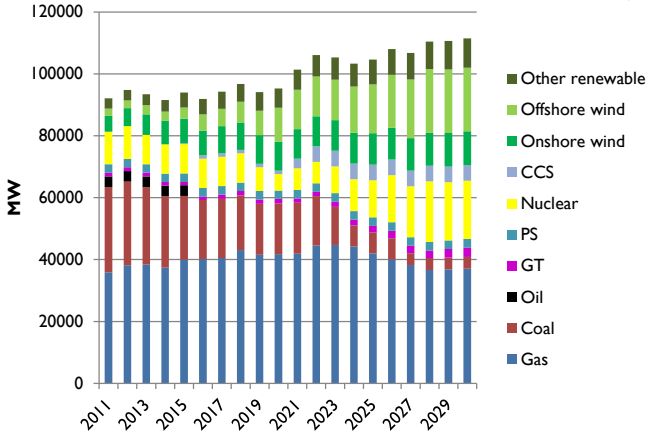
- Resultant generation mix similar between Status Quo and Improved ICRP
- Increase in gas capacity over time under Socialised charging to cover lack of nuclear build

Q5: Does the Working Group have any views capacity mixes under the different charging options

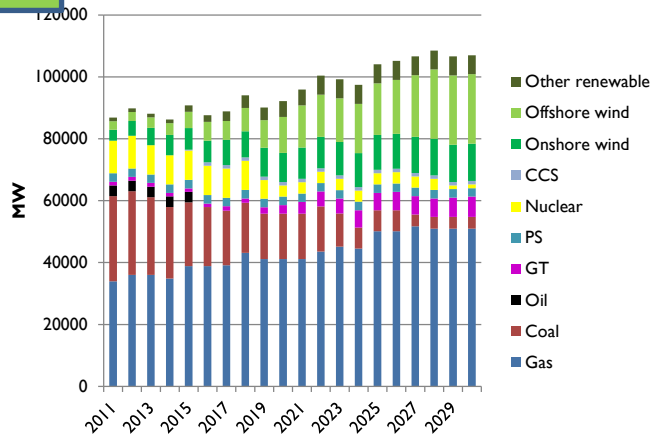
Improved ICRP



Status Quo

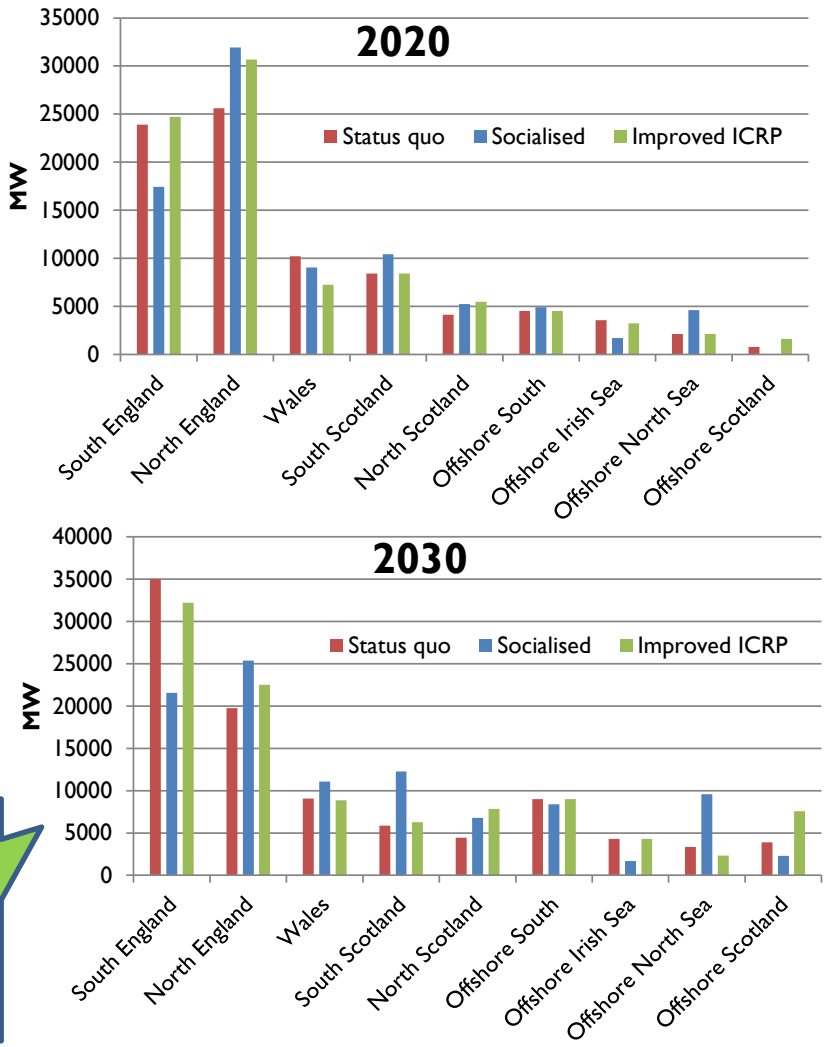


Socialised



Installed capacity by location

- Differences between Status Quo and Socialised:
  - Less capacity in South England under Socialised
  - Accordingly greater capacity in North England, Wales and South Scotland
  - More build of offshore wind in the North Sea (in particular, Dogger Bank and Hornsea) with relatively high transmission costs
- Improved ICRP increases Scottish capacity – mainly due to additional onshore wind



Q6: Does the Working Group have any views on the location capacity different between the options

Change in build relative to Status Quo – CCGT

- One additional CCGT generating unit under ICRP from 2018
- Significant additional CCGT build under Socialised charging
  - As noted earlier, required in the absence of nuclear build
  - CCGT is spread is determined predominately by gas exit charges

Status Quo	2015	2020	2025	2030
CCGT - South England	800	6,400	8,800	8,800
CCGT - North England	800	800	800	800
CCGT - Wales	800	800	800	800
CCGT - South Scotland	0	0	0	0
CCGT - North Scotland	0	0	0	0

Improved ICRP (change from Status Quo)	2015	2020	2025	2030
CCGT - South England	0	800	800	800
CCGT - North England	0	0	0	0
CCGT - Wales	0	0	0	0
CCGT - South Scotland	0	0	0	0
CCGT - North Scotland	0	0	0	0

Q7: Does the Working Group have any views on the whether this level of geographic differentiation in CCGT investment between Socialised and Status Quo is realistic?

Socialised (change from Status Quo)	2015	2020	2025	2030
CCGT - South England	0	-4,800	-5,600	-4,000
CCGT - North England	1,600	4,800	8,000	8,000
CCGT - Wales	0	1,600	3,200	3,200
CCGT - South Scotland	0	1,600	4,800	4,800
CCGT - North Scotland	0	0	0	0

Change in build relative to Status Quo – onshore wind

- More onshore wind build under Improved ICRP
  - Two-part charging regime favours wind over thermal plant in positive TNUoS zones
- Onshore wind in North Scotland also greater again under Socialised charging, due a significant reduction in the tariffs

Status Quo	2015	2020	2025	2030
Onshore wind - South England	0	0	0	0
Onshore wind - North England	82	247	494	577
Onshore wind - Wales	0	0	0	0
Onshore wind - South Scotland	614	1,491	1,774	1,875
Onshore wind - North Scotland	513	785	1,021	1,091

Improved ICRP (change from Status Quo)	2015	2020	2025	2030
Onshore wind - South England	0	0	0	0
Onshore wind - North England	0	0	0	0
Onshore wind - Wales	0	0	0	0
Onshore wind - South Scotland	0	0	0	0
Onshore wind - North Scotland	50	957	1,921	2,004

Socialised (change from Status Quo)	2015	2020	2025	2030
Onshore wind - South England	0	0	0	0
Onshore wind - North England	0	0	-82	-165
Onshore wind - Wales	0	0	0	0
Onshore wind - South Scotland	0	0	0	0
Onshore wind - North Scotland	101	1,110	2,227	2,360

Q8: Does the Working Group believe that this level of increase in onshore wind build in North Scotland is achievable?

Change in build relative to Status Quo – offshore wind

- Under Improved ICRP, onshore charges for intermittent generators in Scotland are lower
  - This benefits the Scottish offshore wind
- Under Socialised, local asset charges are socialised – this has the biggest impact on offshore wind, which is no longer exposed to OFTO costs, relatively benefiting those further offshore
- Note that we apply a global constraint on the amount of offshore wind that can be built – therefore we observe switching rather than a general increase

Status Quo	2015	2020	2025	2030
Offshore wind - Offshore South	0	2,610	5,280	7,080
Offshore wind - Offshore Irish Sea	432	2,774	3,407	3,507
Offshore wind - Offshore North Sea	250	1,875	2,095	3,095
Offshore wind - Offshore Scotland	0	750	2,000	3,894

Improved ICRP (change from Status Quo)	2015	2020	2025	2030
Offshore wind - Offshore South	0	0	-370	0
Offshore wind - Offshore Irish Sea	0	-333	0	0
Offshore wind - Offshore North Sea	0	0	0	-1,000
Offshore wind - Offshore Scotland	0	850	2,638	3,671

Socialised (change from Status Quo)	2015	2020	2025	2030
Offshore wind - Offshore South	370	370	-300	-600
Offshore wind - Offshore Irish Sea	333	-1,867	-2,500	-2,600
Offshore wind - Offshore North Sea	470	2,470	4,750	6,250
Offshore wind - Offshore Scotland	0	-750	-1,450	-1,604

Q9: Does the Working Group believe it is correct to assume that overall investment in offshore wind would be limited by other factors and hence a large overall increase under Socialised should not be expected?

Change in build relative to Status Quo – nuclear

- Under Socialised, TNUoS tariffs at the new nuclear sites are higher than under Status Quo
  - With unchanged CfD levels, new nuclear is not economic
- Under Improved ICRP, there is some variation in the location and timing of new nuclear plant but similar levels are achieved by 2030

Status Quo	2015	2020	2025	2030
Nuclear - South England	0	1,670	8,350	13,200
Nuclear - North England	0	0	0	3,200
Nuclear - Wales	0	0	0	1,200
Nuclear - South Scotland	0	0	0	0
Nuclear - North Scotland	0	0	0	0

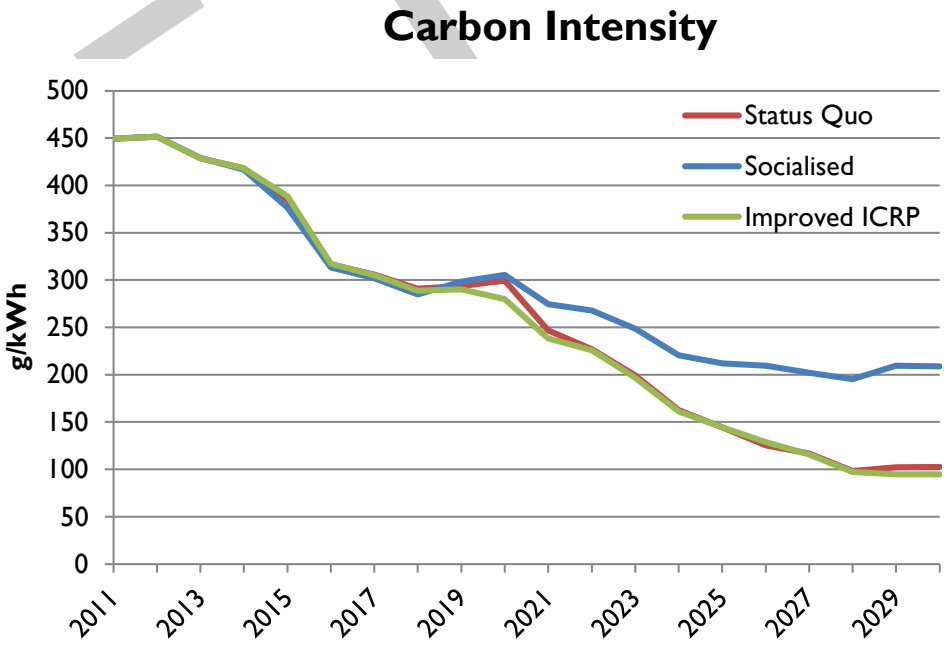
Improved ICRP (change from Status Quo)	2015	2020	2025	2030
Nuclear - South England	0	0	-1,670	0
Nuclear - North England	0	0	0	50
Nuclear - Wales	0	0	0	0
Nuclear - South Scotland	0	0	0	0
Nuclear - North Scotland	0	0	0	0

Socialised (change from Status Quo)	2015	2020	2025	2030
Nuclear - South England	0	-1,670	-8,350	-13,200
Nuclear - North England	0	0	0	-3,200
Nuclear - Wales	0	0	0	-1,200
Nuclear - South Scotland	0	0	0	0
Nuclear - North Scotland	0	0	0	0

Q10: Does the Working Group believe that the overall level of new nuclear build is achievable by 2030 under Status Quo and Improved ICRP?

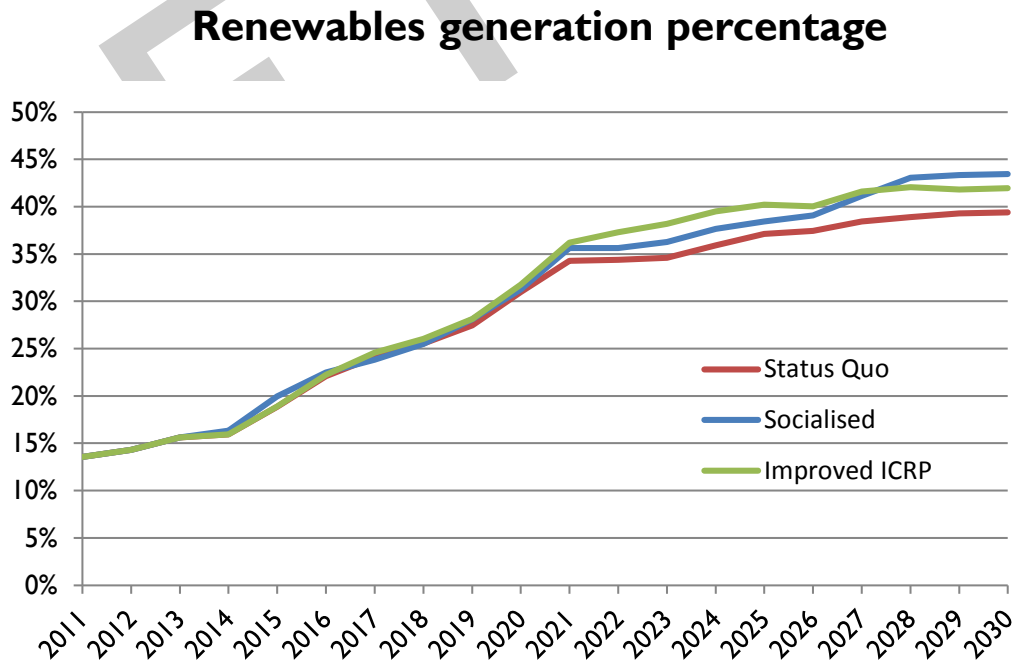
Carbon intensity

- Higher carbon intensity under Socialised due to reduced nuclear capacity and therefore greater CCGT output



Renewable share

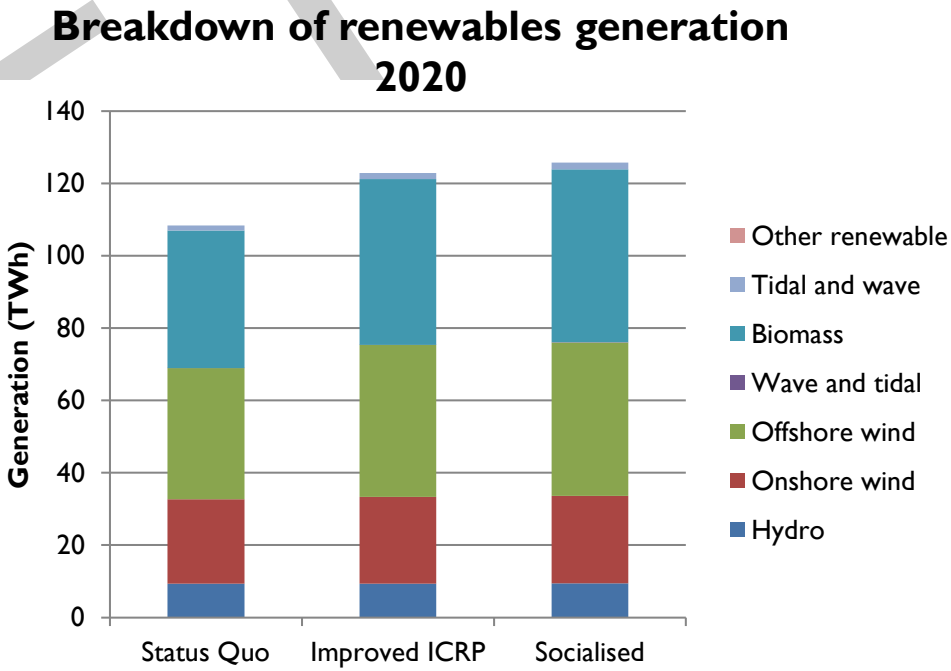
- Total renewable deployment higher under Socialised than Status Quo, although magnitude of difference is limited by assumed near term build potential
- Increased renewables under Socialised and Improved ICRP after 2020



Q11: Does the Working Group agree that the potential for significantly greater renewables investment under Socialised, and to a lesser extent Improved ICRP, is limited by other factors?

Renewable share by plant type, 2020

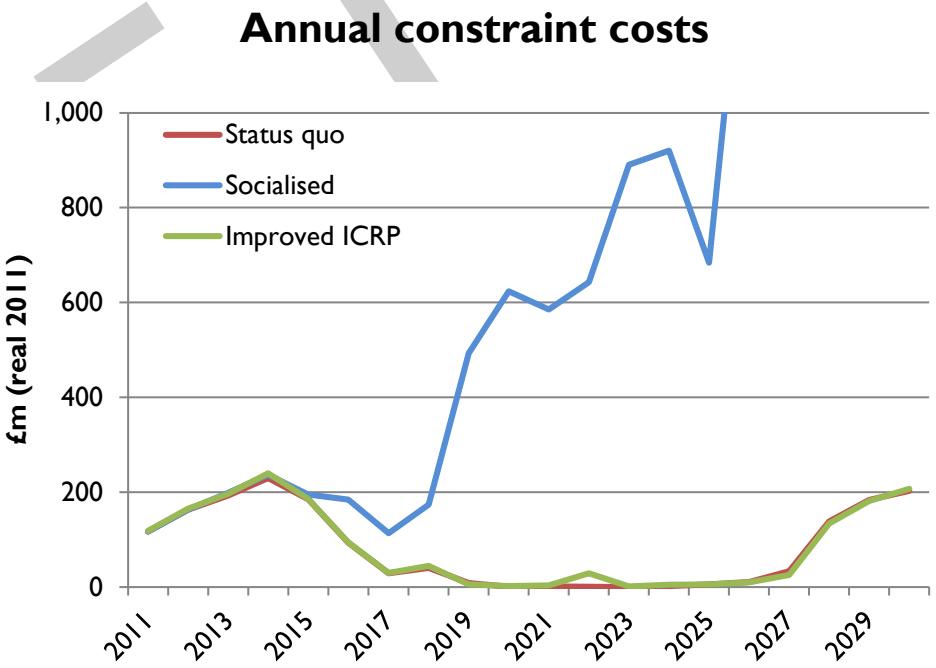
- Greatest onshore wind output under Socialised
- Greater offshore wind output under Socialised and Improved ICRP
- Significant biomass generation under all policies, due to:
  - Assumptions on growth in embedded biomass
  - Assumptions on large-scale biomass co-firing/conversions
  - Large-scale dedicated biomass projects currently in TEC register proceed



Q12: Does the Working Group agree that the balance between wind and biomass in 2020 is correct (assuming the renewables target is met)?

Constraint costs

- Indicative annual constraint costs for 2012/13 are ~£200m
- Constraint costs decrease after 2014 for all scenarios
  - Due to assumed reinforcement works
- Very high constraint costs under Socialised charging after 2020
- Differences between options will reduce once endogenous transmission investment is included



Next steps

- Working Group workshop on Monday 10th October
  - Feedback on this pack
  - Presentation of Stage 2 results
- Refinement and full incorporation of endogenous transmission investment rules
- Completion of cost benefit analysis for the three options
- Perfect foresight and sensitivity analysis
- Further Working Group session in early November
- Wider stakeholder event in Glasgow – 17th November

Appendix: Revisions to Stage 1 results

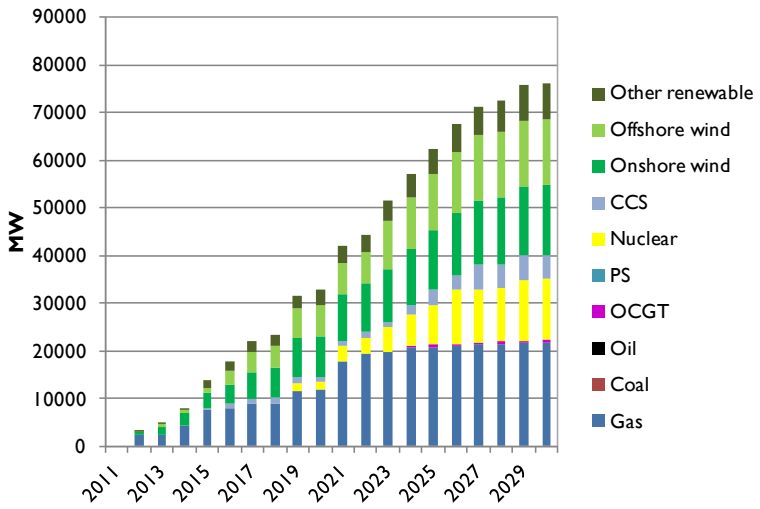
- *The provisional results in the preceding presentation were circulated to the Technical Working Group on 5th October. The Working Group provided feedback, prior to and during the Working Group meeting on 10th October.*
- *One area of feedback was on the nuclear new build under the Stage 1 models. We have adjusted our modelling approach slightly to respond to this feedback and avoid the unlikely outcome of nuclear build being driven entirely by the transmission charging regime.*
- *In the Stage 1 approach, CfD levels are set at the average LRMC (including TNUoS) of each technology under Status Quo and then held constant under Socialised and Improved ICRP. TNUoS tariffs for nuclear are slightly higher under Socialised, leading to a small increase in LRMC. Because the tariffs are tightly matched to the LRMC in a Status Quo world, a small increase in LRMC leads to the result that nuclear is not economic and does not get built under the Socialised policy option.*
- *For the revised Stage 1 model runs, we have increased CfD levels slightly for nuclear to move to a less extreme result for build under Socialised charging. Results to date are correct given the input assumptions, but are very sensitive to the level of CfDs set under Status Quo (which are an uncertain parameter as they will be set according to future Government decisions). Nuclear CfD levels are increased by no more than 3% (across all scenarios) to ensure that some nuclear build remains under Socialised charging.*
- *This will have no impact on modelling results for the Socialised and Improved ICRP scenarios in Stage 2, as CfDs will be re-set according to the average LRMC of each technology under that scenario.*
- *The following slide shows the new build under each of the options under this revised approach*

Appendix: Revisions to Stage 1 results

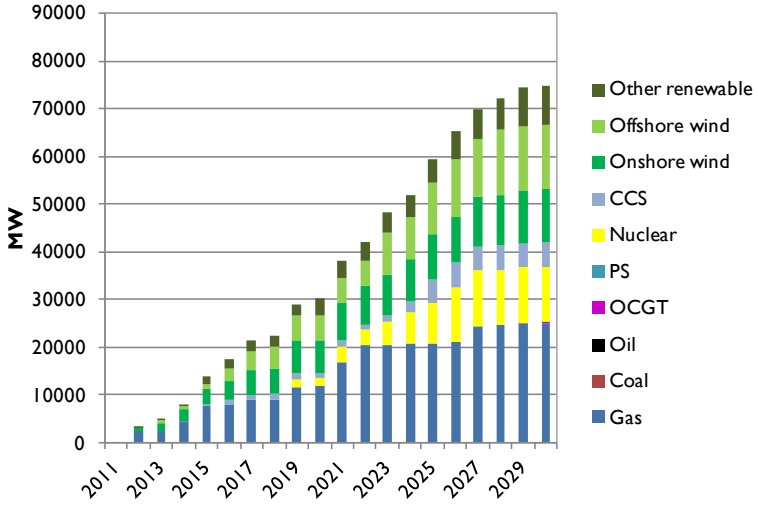
These charts show the impact of the revisions to the stage 1 results. Note the change in the nuclear CfD levels is not the only change in these revised model runs.

Full details of these revised results will be published in due course.

Improved ICRP



Status Quo



Socialised