

**TransmiT**



# **Modelling the Impact of Transmission Charging Options**

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Project TransmiT Stakeholder Event, Glasgow

17<sup>th</sup> November 2011

# 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 analysis presented in this pack is the result of Redpoint Energy's modelling and does not necessarily represent Ofgem's views. The analysis will feed into Ofgem's own assessment, which will form part of the consultation due to be published in December.*

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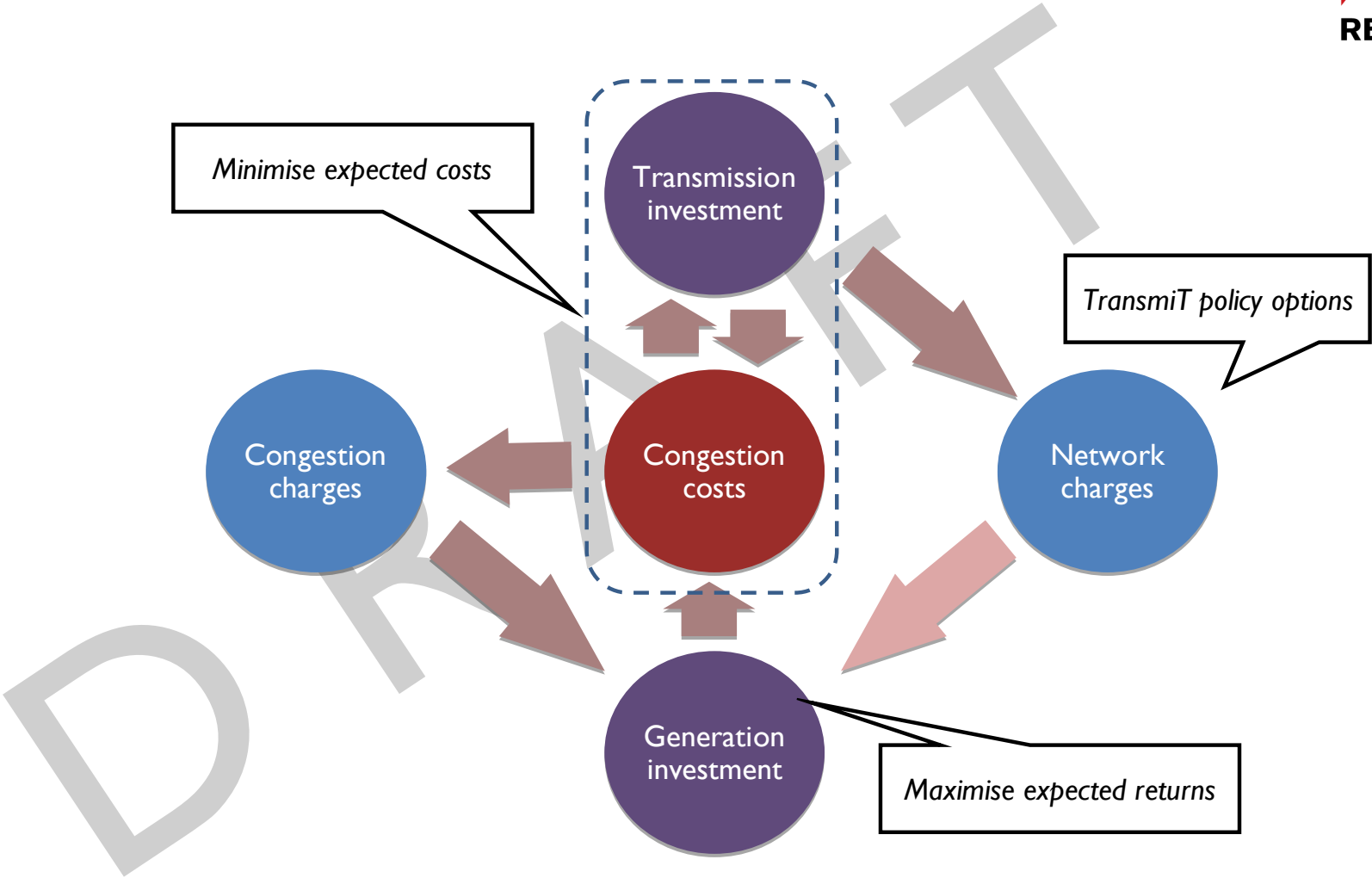
## **Approach**

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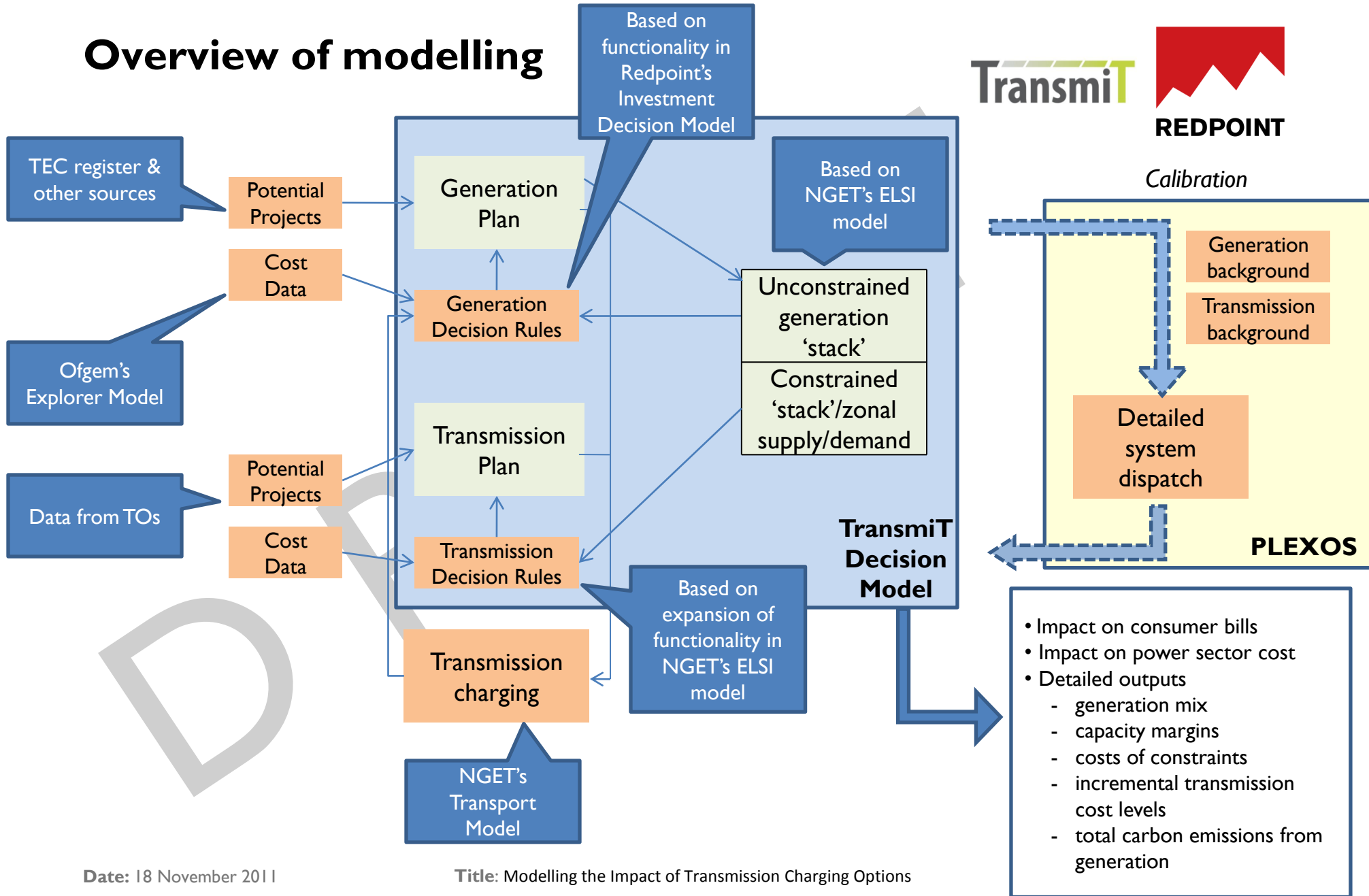
# Transmission Charging Options

	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	
Core	<b>Status Quo</b>	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.
	<b>Improved ICRP</b>	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
	<b>Socialised</b>	Socialised	Uniform: no locational differentiation (onshore, offshore and islands)	As for Status Quo	Energy based	Not relevant	Not relevant	Not relevant
Variants	<b>Improved ICRP (HVDC sensitivity)</b>	As for Improved ICRP	As for Improved ICRP	As for Improved ICRP	As for Improved ICRP	<b>Costs exclude converter station costs</b>	As for Improved ICRP	As for Improved ICRP
	<b>Socialised (wider only)</b>	As for Socialised	<b>As for Status Quo – local asset charges retained</b>	As for Socialised	As for Socialised	Not relevant	Not relevant	Not relevant

# Conceptual framework



# Overview of modelling



# Interactions between transmission charging and EMR



- Changes to transmission charging could:
  - Accelerate or decelerate the rate of low carbon deployment, *and/or*
  - Change the level of support required to achieve a certain level of deployment
- We have undertaken the analysis of two different bases:
  - **Equivalent** levels of low carbon support (RO/CfDs) across the three options in order to isolate the impacts of the different charging options on deployment rates (“Stage 1”)
  - **Adjusted** levels of low carbon support to deliver the same 2020 renewables output and 2030 carbon intensity to facilitate the comparison of costs across the transmission charging options (“Stage 2”)

# Process



- TransmiT modelling project began in June 2011
- Input from the Technical Working Group from the outset
  - Input on the policy options to model (with the final decision being made by Ofgem)
  - Feedback on assumptions, modelling approach and provisional model results
- National Grid provided extensive support during the model development phases, through the provision of the ELSI model, and in developing the Transport & Tariff model for the different transmission charging options
- The analysis will feed into the Authority's provisional decision
- Final report due to be published alongside Ofgem's Consultation Document in December

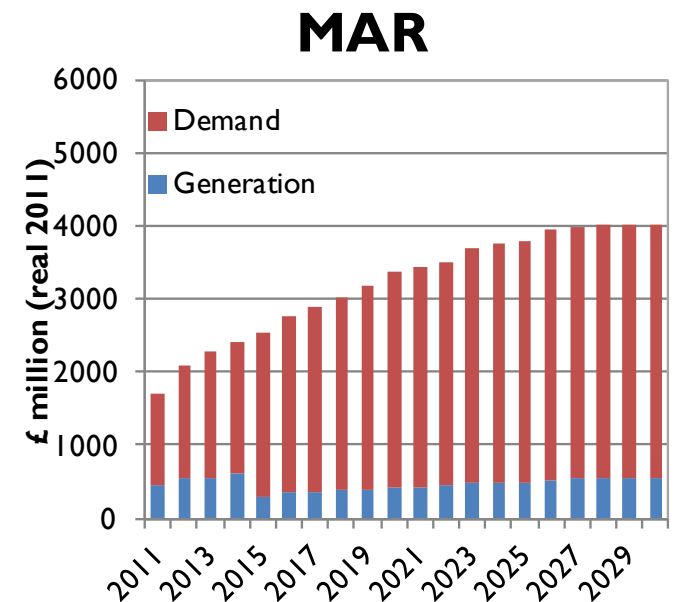
## **Impact on tariffs**

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## Maximum Allowed Revenue (Status Quo)



- It is anticipated that the allowed transmission revenues will increase over the next twenty years as new generation capacity (particularly renewables) is connected to the system
- In April 2015, the G:D split is assumed to change to from 27:73 to 15:85 in order to comply with EU tariffication guidelines
- This will reduce the amount of revenue recovered from generators and increase the revenue recovered directly from consumers

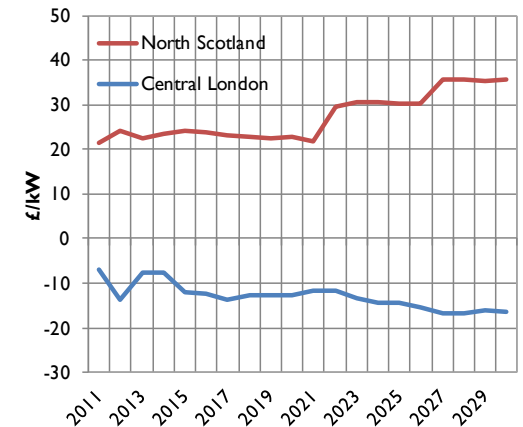


# Generator and Demand tariffs (Status Quo)

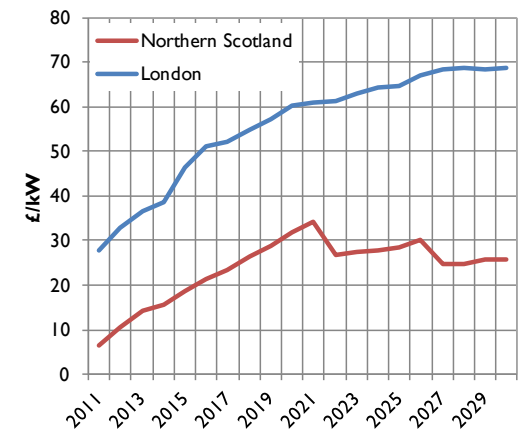
- The Generator tariffs are the sum of wider and residual charges, but exclude local asset charges
- For Scottish generators, the commissioning of the Western HVDC link in the same year offsets the reduction in tariffs
- Further HVDC links in 2022, 2023, and 2027 produce step changes in Scottish G & D tariffs



**Generator TNUoS**



**Demand TNUoS**

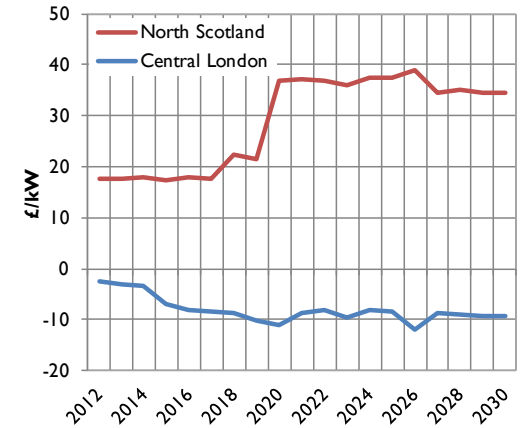


# Generator tariffs (Improved ICRP)

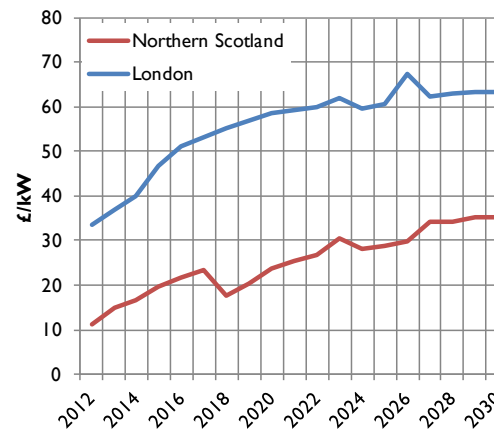
- Range in Generator TNUoS charges more compressed under Improved ICRP
- Biggest impact on intermittent and low load factor generators:
  - Tariffs lower in positive TNUoS zones
  - Tariffs higher in negative TNUoS zones
- No impact on Demand TNUoS for the same generation and transmission background



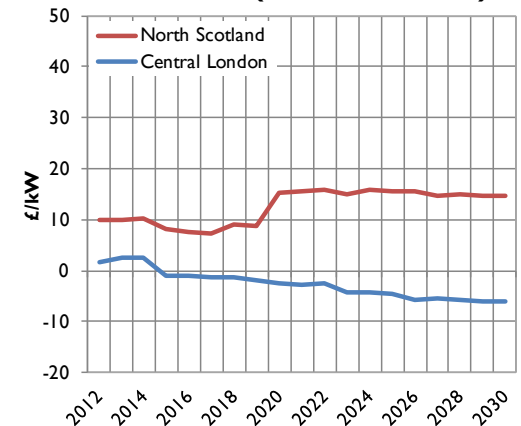
**GTNUoS (baseload)**



**Demand TNUoS**



**GTNUoS (intermittent)**

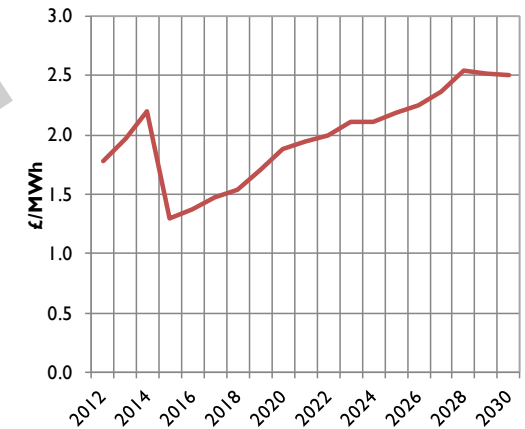


## Generator tariffs (Socialised)

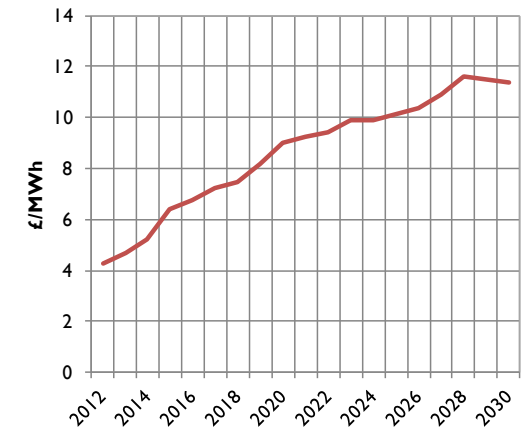
- Socialised tariffs are charged on a variable (£/MWh) basis the same for all generators
- Socialised tariffs recover the full generator split of MAR, i.e. equivalent to sum of (Wider + Residual + Local) under Status Quo



**Generator TNUoS**



**Demand TNUoS**



## Island tariffs

TransmiT



- We have calculated tariffs for the three modelled island groups
- Input capital costs and capacities based on publically available data<sup>1</sup>
- Security factors under Status Quo based on whether island would be considered part of MITS (“wider”, 1.8) or not (“local”, 1.0)
- Under Improved ICRP, we have assumed that all security factors are 1.0.
- Tariffs shown are the island component only – excluding mainland tariffs
- “Mainland” component must be added - typical values in 2012 for TNUoS zone 1 are:
  - Status Quo: +24 £/kW
  - Improved ICRP: +10 £/kW

### Island component of tariff

	Status Quo		Improved ICRP	
	Security factor	Final Island tariff £/kW/yr	Security factor	Final Island tariff £/kW/yr
Orkney	1.8	94	1.0	52
Shetland	1.0	57	1.0	57
Western Isles	1.8	121	1.0	67

<sup>1</sup> SHETL’s publically available RIIO submission

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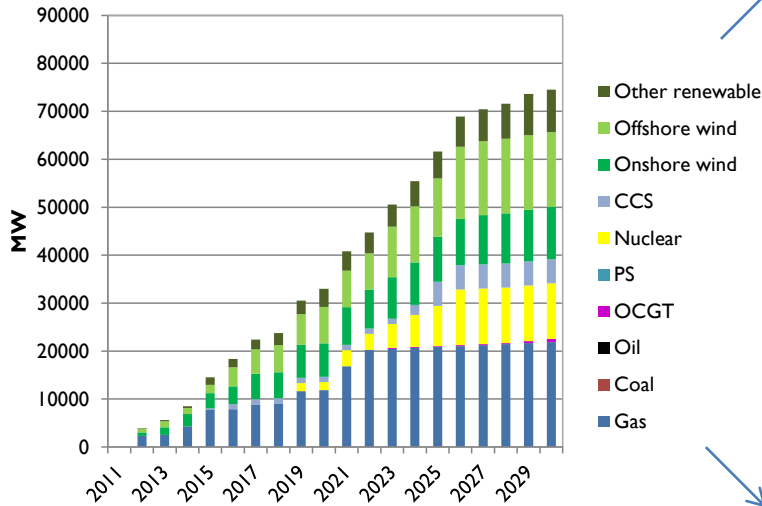
## **Impact on sustainability goals**

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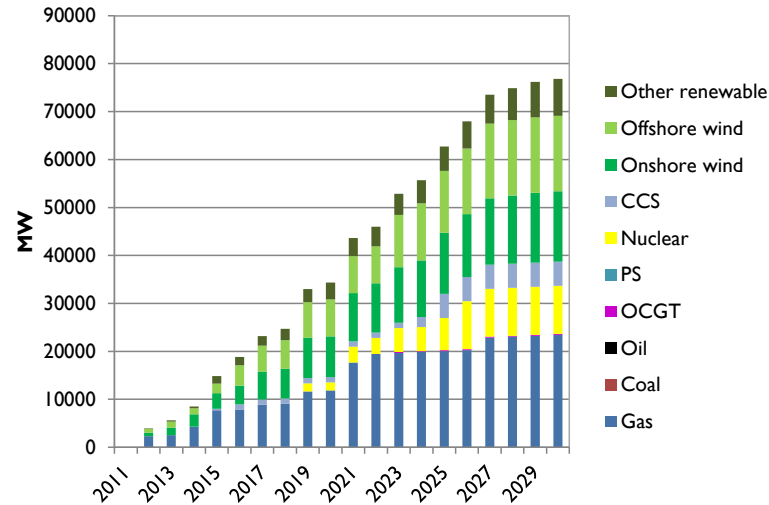
# New plant build (Stage I modelling)



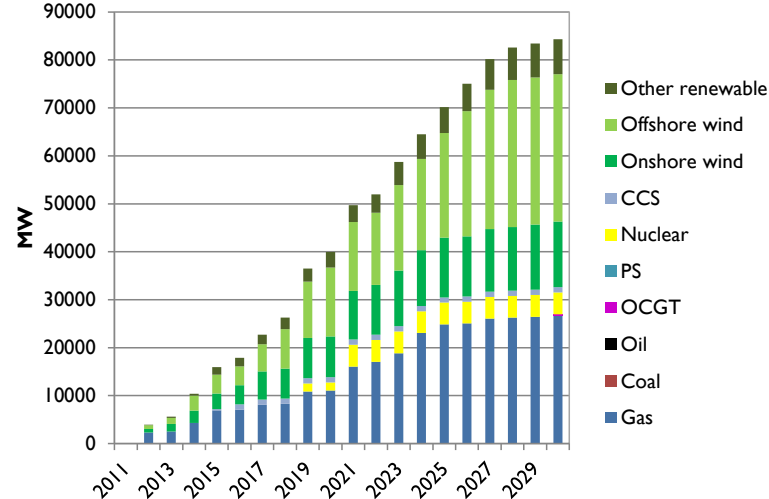
**Status Quo**



**Improved ICRP**



**Socialised**



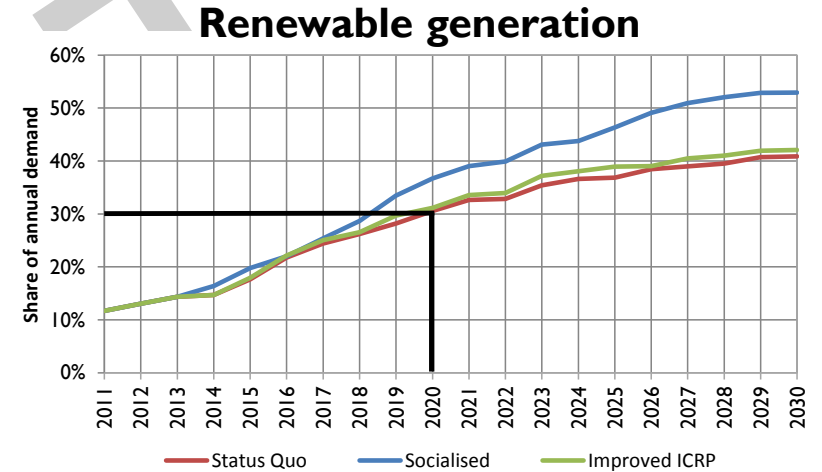
Similar new build

More renewables and gas, less nuclear and CCS

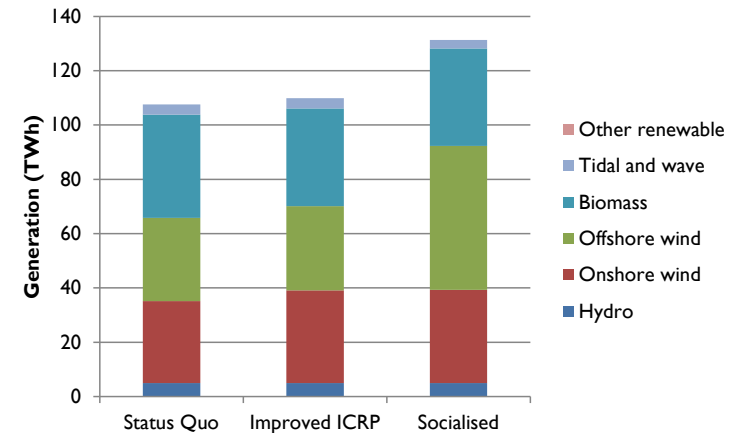
# Renewables deployment (Stage I modelling)



- Total renewable deployment higher under Socialised than Status Quo or Improved ICRP mainly due to increased offshore wind deployment
- Increased renewables under Improved ICRP after 2020 compared to Status Quo explained by greater onshore wind deployment, which is favoured in positive TNUoS zones



### Breakdown of renewables generation 2020

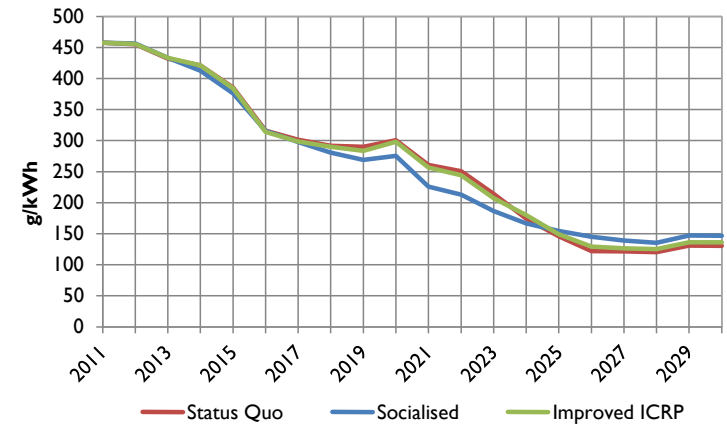


## Carbon intensity (Stage I modelling)



- Lower carbon intensity in 2020 under Socialised due to additional renewables
- By 2030, this impact on carbon intensity is offset under Socialised by having lower nuclear and CCS capacity than under Status Quo
- Nuclear and CCS face higher TNUoS charges under Socialised charging leading to less investment for the same level of support

**Carbon Intensity**



## **Impact on costs**

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## Low carbon support levels (Stage 2 modelling)



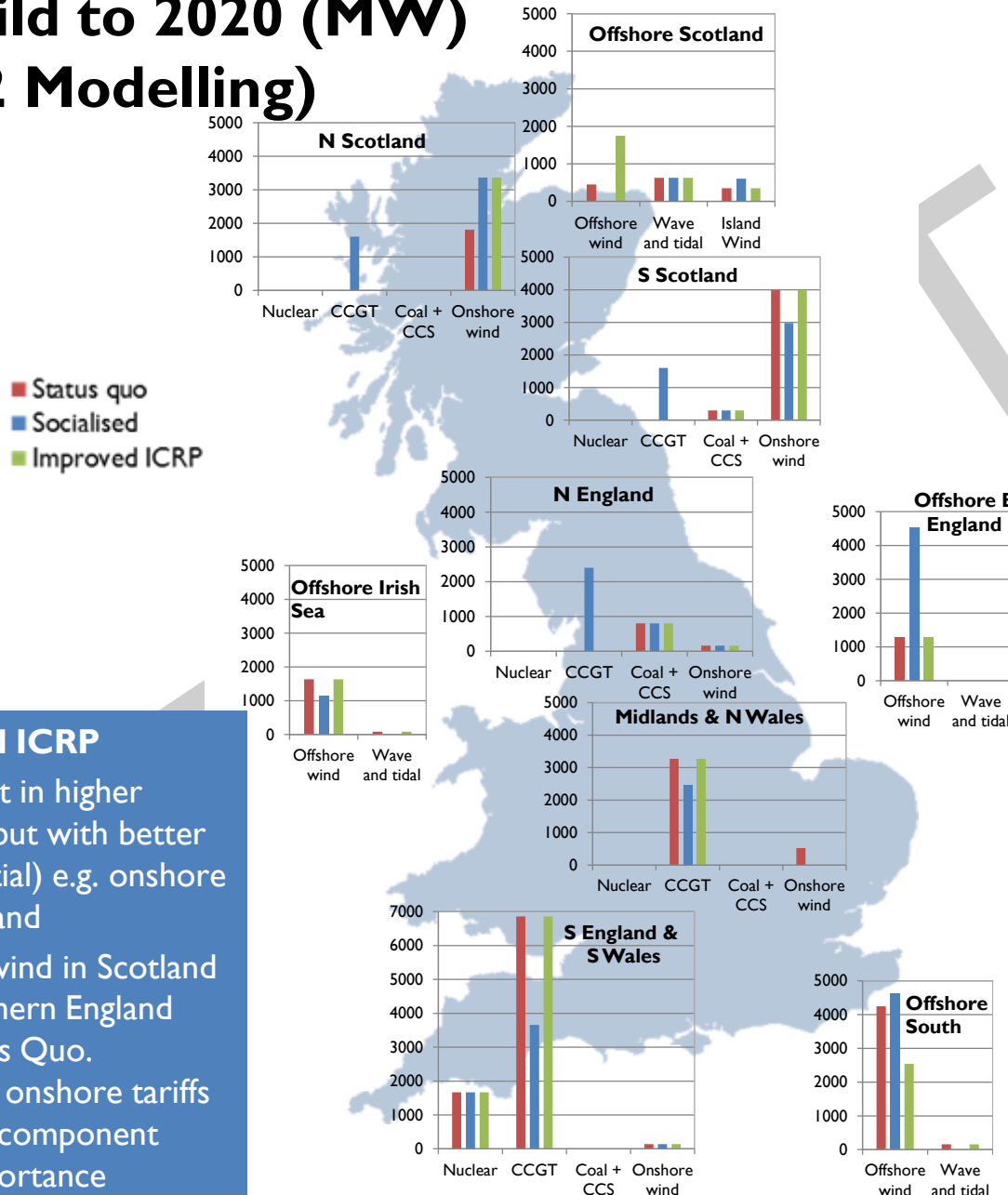
- Improved ICRP
  - Only small variations in transmission charges compared to Status Quo
  - CfD level for onshore wind can be reduced marginally whilst achieving same level of deployment as Status Quo
- Socialised
  - CfDs for nuclear and CCS need to be increased in order to achieve same level of decarbonisation as Status Quo
  - CfDs for offshore wind can be materially reduced, and small reductions for onshore wind possible whilst still meeting renewables targets

### Assumed CfD levels (2020)

	Improved ICRP	Socialised
	% of Status Quo	% of Status Quo
Nuclear	100%	104%
Gas + CCS	100%	104%
Coal + CCS	100%	102%
Onshore wind	99%	99%
Offshore wind	100%	93%
Biomass	100%	102%

# New build to 2020 (MW) (Stage 2 Modelling)

Impact on costs



**Improved ICRP**

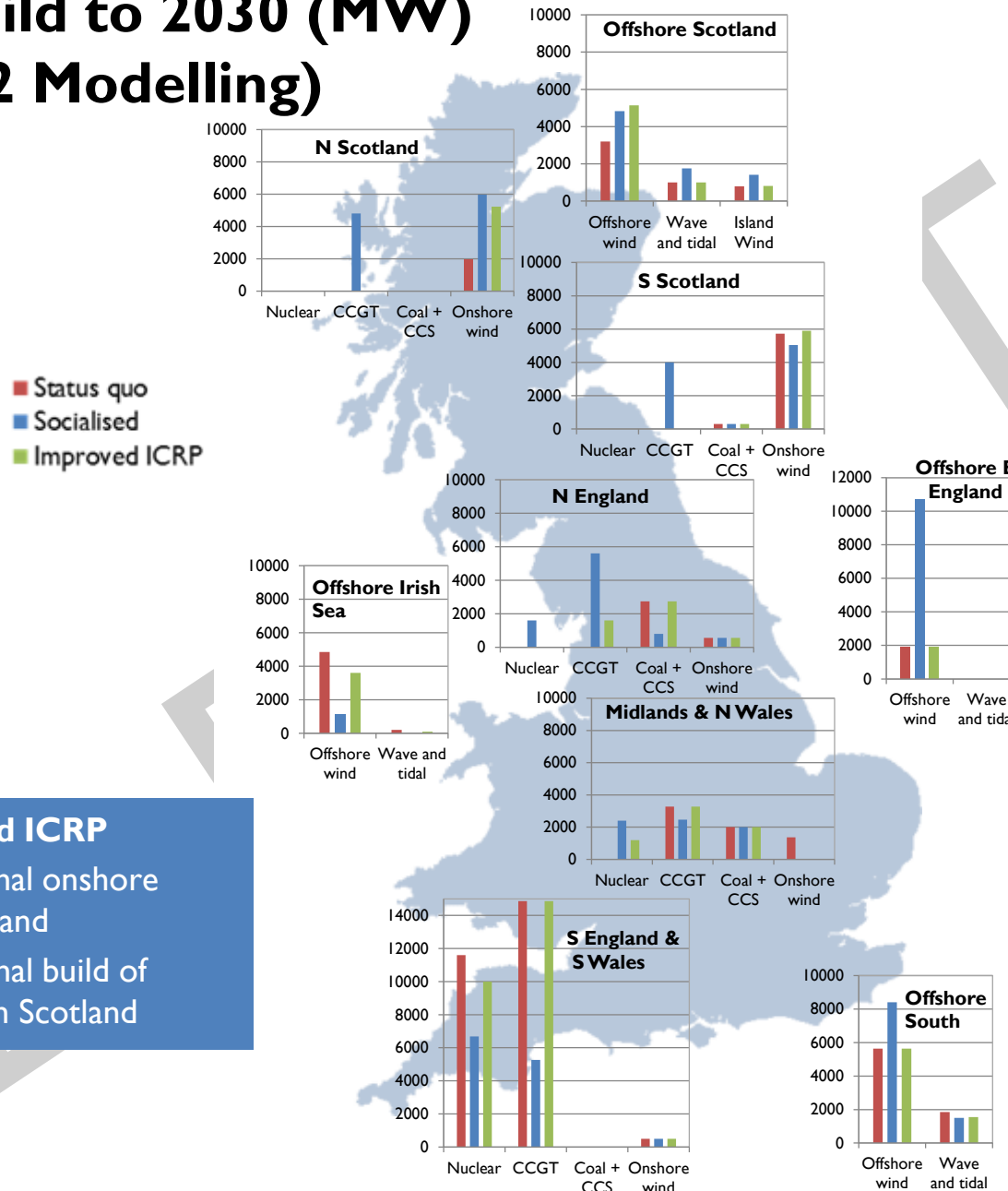
- Advantages plant in higher TNUoS zones (but with better resource potential) e.g. onshore wind in N Scotland
- More offshore wind in Scotland and less in Southern England relative to Status Quo. Compression in onshore tariffs means offshore component increases in importance

**Socialised**

- Less new build S England
- More build N England, N Scotland and Islands
- More build of offshore wind in zones further offshore (E England)

# New build to 2030 (MW) (Stage 2 Modelling)

Impact on costs



**Improved ICRP**

- Further additional onshore wind in N Scotland
- Further additional build of offshore wind in Scotland

**Socialised**

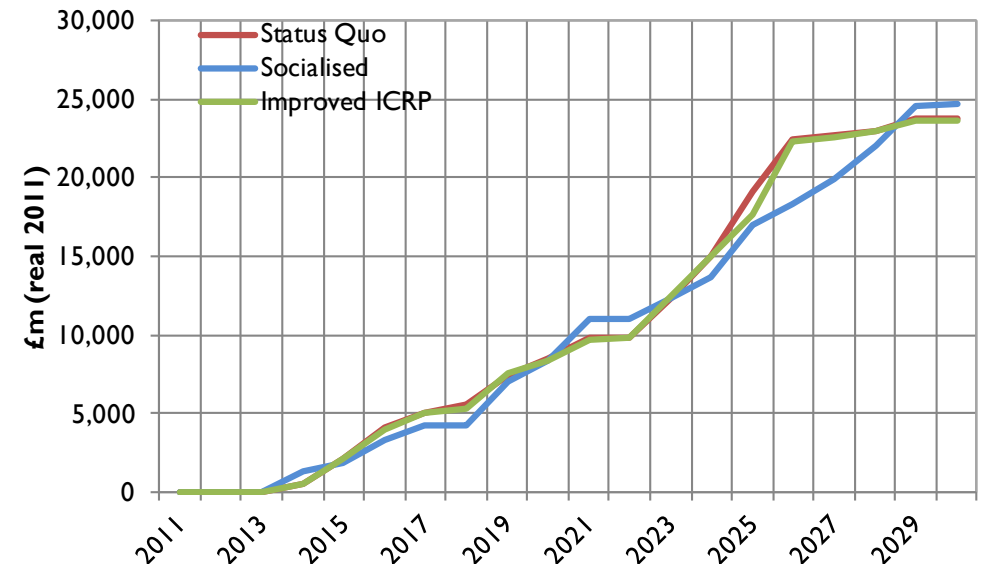
- Weaker locational signals leads to geographical spread of nuclear and CCGT build
- Offshore wind build extends to Dogger Bank
- Favours best resource sites (ignoring transmission costs)

## Costs of new low carbon generation



- Cost of new low carbon generation built under CfDs, measured as the gross cost of each contract (Output x Strike Price)
- Under Socialised, there are savings in low carbon generation costs compared to Status Quo for the majority of years:
  - due to better exploitation of renewables resources
  - costs of OFTO & island transmission are not paid to generators through CfDs

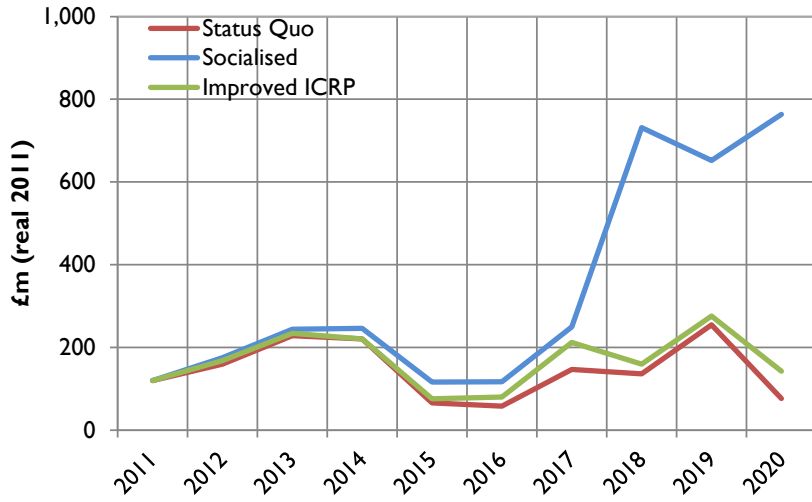
Annual costs of new low carbon generation



# Constraint costs (Stage 2 modelling)



**Annual constraint costs to 2020**

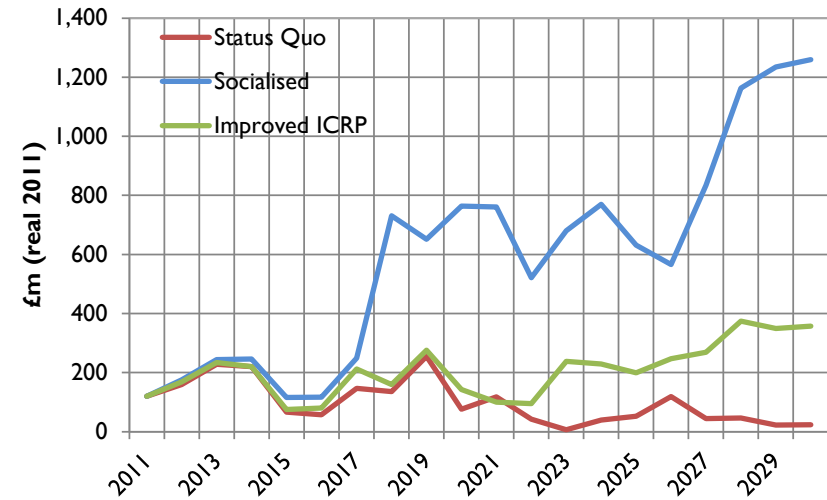


- Constraint costs slightly higher under Improved ICRP relative to Status Quo due to greater Scottish renewables deployment
- Effect more pronounced under Socialised but not significant before 2017



- Significantly higher constraint costs in the 2020s under Socialised although these could be reduced if more transmission reinforcement options were available

**Annual constraint costs to 2030**

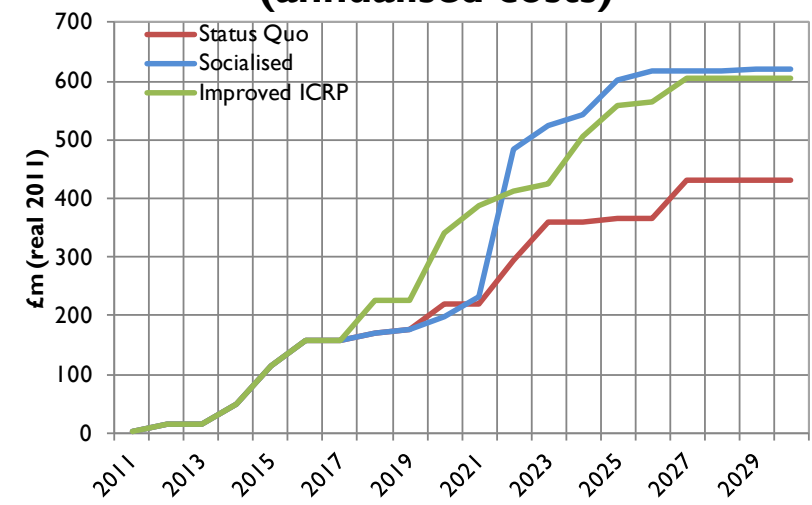


# Transmission reinforcement (Stage 2 modelling)



- Western HVDC link is built as soon as feasible in all cases
- Under all charging options all four of the Scotland-England HVDC links are built
- Under Improved ICRP the HVDC reinforcements occur earlier than in Socialised
- Improved ICRP has more Scottish onshore wind earlier, making reinforcement of Scottish boundaries beneficial earlier

**Modelled MITS reinforcements  
(annualised costs)**

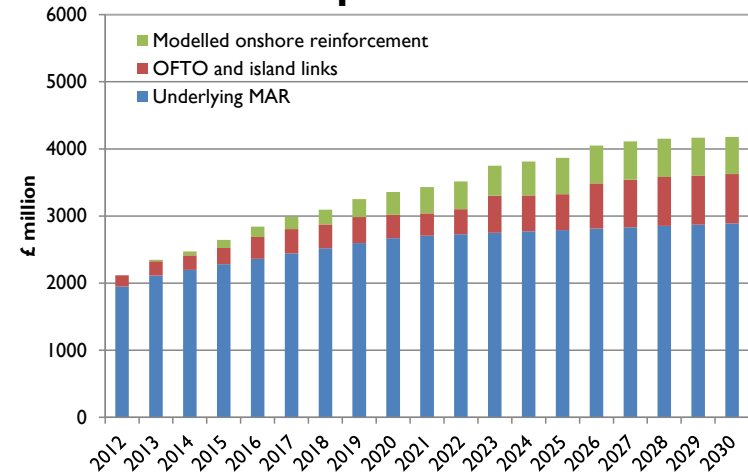


Reinforcement	Capacity (MW)	Cost (£m, real 2011)	Boundaries reinforced	Assumed earliest feasible date	Status Quo	Socialised	Improved ICRP
Western HVDC Link	2000	866	B6, B7a	2015	2015	2015	2015
Western HVDC Link #2	2000	866	B6, B7a	2020	2023	2022	2020
Eastern HVDC Link	2000	891	B2, B4, B5, B6, B7a	2018	2022	2022	2018
Eastern HVDC Link #2	2000	891	B2, B4, B5, B6, B7a	2020	2027	2025	2024
Wylfa-Pembroke 2GW HVDC link	2000	834	B202, NW2	2018	-	-	-
Caithness - Moray HVDC	600	800	B1	2017	-	2022	2020
Humber - Walpole HVDC	2000	595	B8, B9, B11, B16	2020	-	2023	2027

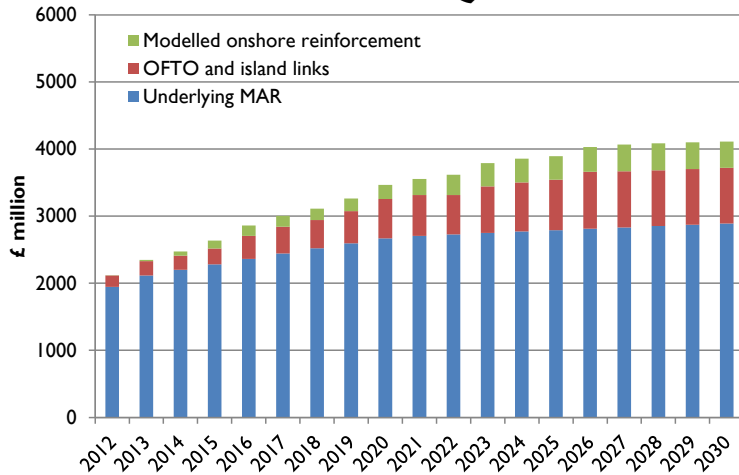
# Transmission costs (Stage 2 modelling)



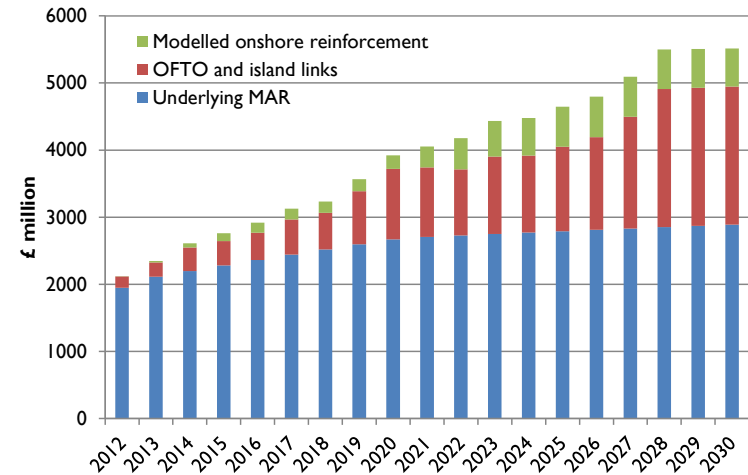
- Transmission costs (excluding constraints) are similar under Improved ICRP and Status Quo
- They are significantly greater under Socialised mainly due to greater OFTO expenditure



**Status Quo**



**Socialised**



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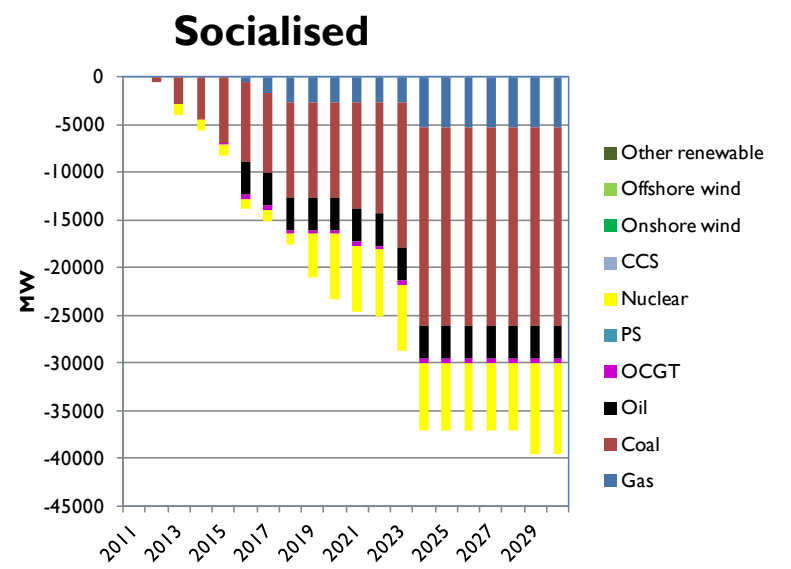
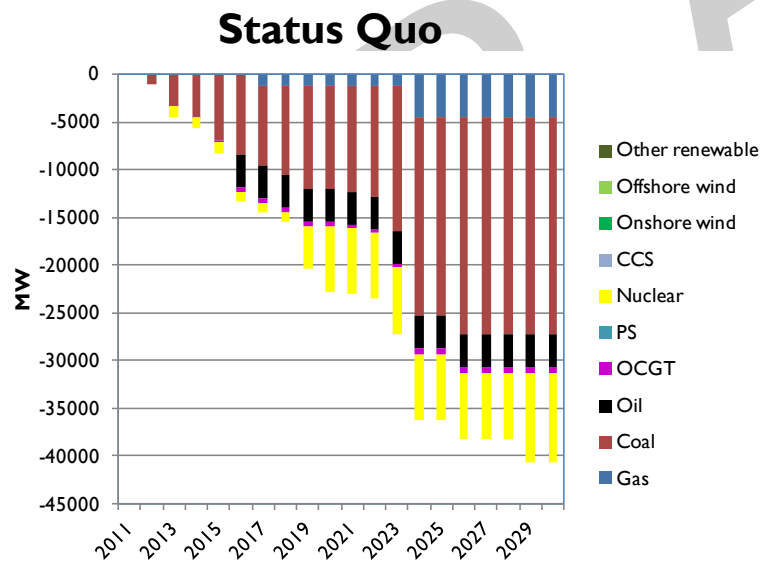
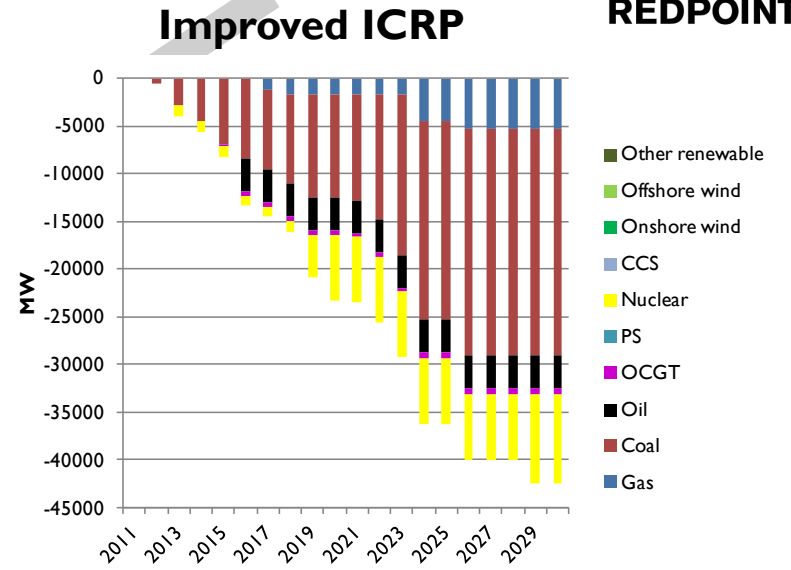
## **Impact on security of supply**

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# Cumulative retirements (Stage 2 modelling)



- Majority of retirements in the near term are pre-determined: LCPD opt-out, nuclear AGRs
- There is some variations between the options – under Socialised some gas plant currently in negative TNUoS zones close earlier

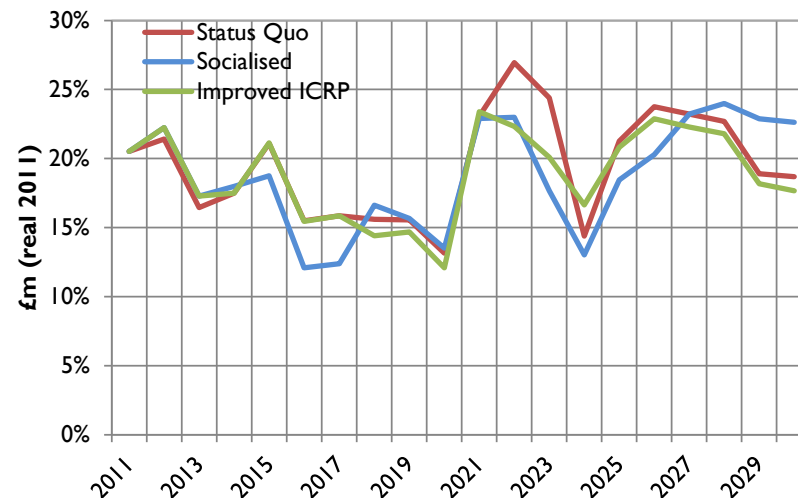


## De-rated capacity margins (Stage 2 modelling)



- The de-rated capacity margin provides an indication of security of supply, and is calculated using the de-rating factors shown
- We have assumed a simple version of a universal capacity mechanism is implemented
- De-rated capacity margins are similar across the three policy options to 2020 with a capacity mechanism in place
- Modelling suggests no specific locational security of supply issues for these levels of capacity margin (and transmission reinforcements)

De-rated capacity margins<sup>1</sup>



De-rating factors

Plant type	De-rating factor
Conventional thermal	90%
Nuclear	90%
Hydro	70%
Pumped Storage	100%
Wind	15%
Tidal & Wave	30%
Biomass	90%

1. De-rated capacity margin related to top 1% of winter demand (not absolute peak hour)

# Key messages

- Impact on sustainability
  - Improved ICRP may encourage some additional renewables investment (for the same level of support)
  - Socialised could lead to significantly more renewables (particularly offshore and island wind) but may result in less nuclear and CCS (for the same level of support)
- Impact on costs
  - Improved ICRP could lead to better exploitation of generation resources but at the cost of higher transmission costs
  - Socialised could further this effect
  - Ofgem currently reviewing overall cost/benefit analysis of the options
- Impact on security of supply
  - Small differences between the options
  - Other factors e.g. design of any capacity mechanism likely to be more important

## Next steps



- Sensitivities being finalised
- Ofgem currently reviewing full cost benefit analysis
- Preliminary decision from Authority expected in December
- Redpoint report to be published alongside Ofgem's consultation document

# Contacts



Redpoint Energy ([www.redpointenergy.com](http://www.redpointenergy.com)) is a specialist economic and commercial energy consultancy, advising clients on investments, strategy, policy and regulation across Europe's power, gas and carbon markets.

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**QUESTIONS?**

## **Appendix – additional materials**

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## Change in build relative to Status Quo – CCGT

- Limited variations in new CCGT Capacity under Improved ICRP
- Significant locational differences in CCGT build under Socialised charging
  - CCGT geographical spread under Socialised is determined predominately by gas exit charges
- Whereas Socialised Stage 1 had significantly more CCGT, Socialised Stage 2 CCGT build is more similar in aggregate to Status Quo

Status Quo	2015	2020	2025	2030
CCGT - South England	1,600	4,800	12,800	12,800
CCGT - Midlands & Nth England	3,270	3,270	3,270	3,270
CCGT - Wales	2,060	2,060	2,060	2,060
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	0	0	0
CCGT - Midlands & Nth England	0	0	1,600	1,600
CCGT - Wales	0	0	0	0
CCGT - South Scotland	0	0	0	0
CCGT - North Scotland	0	0	0	0

Socialised (change from Status Quo)	2015	2020	2025	2030
CCGT - South England	-800	-3,200	-9,600	-9,600
CCGT - Midlands & Nth England	0	1,600	3,200	4,800
CCGT - Wales	0	0	0	0
CCGT - South Scotland	0	1,600	4,000	4,000
CCGT - North Scotland	0	1,600	4,800	4,800

# Change in build relative to Status Quo – onshore wind



- Reduction in onshore wind in both Improved ICRP and Socialised Stage 2 results compared with equivalent Stage 1 results
- Wind capacity is lost from the least favourable location under each of the options (central Wales – connected into Midlands & Nth England)
- Reminder: all English wind is assumed to be embedded
- North Scotland wind category includes build on Scottish islands

Status Quo	2015	2020	2025	2030
Onshore wind - South England	42	98	134	348
Onshore wind - Midlands & Nth England	221	605	1,087	1,650
Onshore wind - Wales	51	118	161	420
Onshore wind - South Scotland	1,696	3,984	5,368	5,723
Onshore wind - North Scotland	1,215	2,147	2,648	2,767

Improved ICRP (change from Status Quo)	2015	2020	2025	2030
Onshore wind - South England	0	0	0	0
Onshore wind - Midlands & Nth England	-137	-411	-685	-685
Onshore wind - Wales	0	0	0	0
Onshore wind - South Scotland	0	0	46	176
Onshore wind - North Scotland	55	1,564	3,124	3,273

Socialised (change from Status Quo)	2015	2020	2025	2030
Onshore wind - South England	0	0	0	0
Onshore wind - Midlands & Nth England	-137	-411	-822	-959
Onshore wind - Wales	0	0	0	0
Onshore wind - South Scotland	-229	-1,007	-1,362	-687
Onshore wind - North Scotland	139	1,818	4,101	4,605

## Change in build relative to Status Quo – offshore wind

- Reductions in offshore wind build from Socialised Stage 1 to Socialised Stage 2 occurs in Offshore South, Irish Sea and North Sea
- Under Improved ICRP Stage 2, Offshore Scotland maintains increased levels over Status Quo, with reductions in Irish Sea and North Sea

Status Quo	2015	2020	2025	2030
Offshore wind - Offshore South	1,045	4,245	5,145	5,645
Offshore wind - Offshore Irish Sea	233	1,633	3,033	4,857
Offshore wind - Offshore North Sea	425	1,275	1,875	1,875
Offshore wind - Offshore Scotland	0	450	2,105	3,195

Improved ICRP (change from Status Quo)	2015	2020	2025	2030
Offshore wind - Offshore South	0	-1,700	-1,200	0
Offshore wind - Offshore Irish Sea	0	0	0	-1,250
Offshore wind - Offshore North Sea	0	0	0	0
Offshore wind - Offshore Scotland	180	1,300	1,640	1,940

Socialised (change from Status Quo)	2015	2020	2025	2030
Offshore wind - Offshore South	370	370	670	2,770
Offshore wind - Offshore Irish Sea	765	-493	-1,893	-3,717
Offshore wind - Offshore North Sea	295	3,248	4,581	8,803
Offshore wind - Offshore Scotland	0	-450	-110	1,630

## Change in build relative to Status Quo – nuclear

- Status Quo and Improved ICRP Stage 2 have very similar nuclear build
- Under Socialised Stage 2, nuclear build is more widely distributed around England and Wales than under Status Quo

Status Quo	2015	2020	2025	2030
Nuclear - South England	0	1,670	8,350	11,600
Nuclear - Midlands & Nth England	0	0	0	0
Nuclear - Wales	0	0	0	0
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	0	-1,600
Nuclear - Midlands & Nth England	0	0	0	0
Nuclear - Wales	0	0	0	1,200
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	0	-1,670	-4,920
Nuclear - Midlands & Nth England	0	0	1,600	1,600
Nuclear - Wales	0	0	1,200	2,400
Nuclear - South Scotland	0	0	0	0
Nuclear - North Scotland	0	0	0	0

# Change in build relative to Status Quo – CCS



- The tables include the CCS demo plants, the assumptions for which are constant across all options
- Less CCS built under Socialised Stage 2
- This offsets the greater levels of renewables compared to Status Quo

Status Quo	2015	2020	2025	2030
Coal + CCS - South England	0	0	0	0
Coal + CCS - Midlands & Nth England	0	800	4,740	4,740
Coal + CCS - Wales	0	0	0	0
Coal + CCS - South Scotland	300	300	300	300
Coal + CCS - North Scotland	0	0	0	0

Improved ICRP (change from Status Quo)	2015	2020	2025	2030
Coal + CCS - South England	0	0	0	0
Coal + CCS - Midlands & Nth England	0	0	-1,940	0
Coal + CCS - Wales	0	0	0	0
Coal + CCS - South Scotland	0	0	0	0
Coal + CCS - North Scotland	0	0	0	0

Socialised (change from Status Quo)	2015	2020	2025	2030
Coal + CCS - South England	0	0	0	0
Coal + CCS - Midlands & Nth England	0	0	-3,940	-1,940
Coal + CCS - Wales	0	0	0	0
Coal + CCS - South Scotland	0	0	0	0
Coal + CCS - North Scotland	0	0	0	0