CMP213 – Workgroup Meeting 1

10th July 2012

ENA, London

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Agenda

Item	Topic	Lead
1	Introductions / Apologies for Absence	Patrick Hynes
2	Review of Terms of Reference and Meeting Objectives	Patrick Hynes
3	Presentation of CMP213 Original Proposal	Ivo Spreeuwenberg
4	Identify Areas of Proposal to be Developed	Jackeline Crespo-Sandoval
5	Agree Actions and Initial Timetable	Jackeline / Patrick
6	Next Steps	Patrick Hynes

Workgroup Objectives

- To develop the Original proposal
  - A wide range of considerations
  - NGET is the 'owner'
- To evaluate the Original
  - Need to be clear on all aspects of the Original
  - Against the CUSC applicable charging objectives
- Develop and evaluate Alternatives that could better meet the objectives
  - Adressing the proposals defect / issue
- Seek wider Industry views
- Carry out analysis and impact assessment
- Report on wider issues as described in the ToRs
  - Implementation, environmental, impact on customers etc.
- Agree legal text
- Finalise the report on Original and any agreed Alternatives

Ways of working 1

- Must develop an Original based on proposers ‘envelope’
  - Understand the defect (this meeting’s main objective)
- Capture relavant pros and cons in the Workgroup report
- Whilst developing Original, record possible Alternatives
- Focus on each issue in turn
  - Once an issue has been discussed – it has been discussed
- ‘Living’ Workgroup report
  - Close off as much as possible each meeting
  - Limit reopening previous discussion / decisions
- Maintain a list of actions – completed and ongoing
- Virtual car park – issue to be progressed at a future meeting
  - Incl. possible Alternatives

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Ways of working 2

- Assuming Workgroup members are experts or have relevant experience (CUSC 8.20.3)
- Send Alternates - we will review progress, not repeat a meetings
- Everyone has a view, all views will be represented
  - The best views are those that are evidenced….
- Members will be expected to contribute
  - Particularly where they 'own' / raise an issue
  - Write a paper on the issue, circulate for wider group views (worked well on 192)
- Chair is independent / answerable to Panel / carrying out ToRs

Terms of Reference

- Review of ToR
  - Circulated prior to meeting
- Any feedback to the CUSC Panel ?
- Any other concerns?
- Any other suggestions?

CUSC Objectives

Use of System Charging Methodology:

- that compliance with the use of system charging methodology **facilitates effective competition** in the generation and supply of electricity and (so far as is consistent therewith) facilitates competition in the sale, distribution and purchase of electricity;
- that compliance with the use of system charging methodology results in **charges which reflect, as far as is reasonably practicable, the costs** (excluding any payments between transmission licensees which are made under and in accordance with the STC) incurred by transmission licensees in their transmission businesses and which are compatible with standard condition C26 (Requirements of a connect and manage connection);
- that, so far as is consistent with sub-paragraphs (a) and (b), the use of system charging methodology, as far as is reasonably practicable, properly **takes account of the developments** in transmission licensees' transmission businesses.

CUSC Objectives:

- the **efficient discharge by the Licensee of the obligations** imposed on it by the Act and the Transmission Licence; and
- **facilitating effective competition** in the generation and supply of electricity, and (so far as consistent therewith) facilitating such competition in the sale, distribution and purchase of electricity.
- **compliance with** the Electricity Regulation and any relevant legally binding decision of **the European Commission and/or the Agency**.

Anticipated CUSC Process

- Likely to require longer than standard 4 months

May

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

June

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

July

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

August

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

September

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

October

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

November

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

December

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Meeting dates currently booked into industry calendar

Potential additional meetings – <u>may extend into 2013</u>

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Elements of the Modification Proposal

- Modification to reflect network investment cost impact of different generation technologies (capacity sharing)

1 Capacity Sharing

- Addition of parallel HVDC link charging methodology

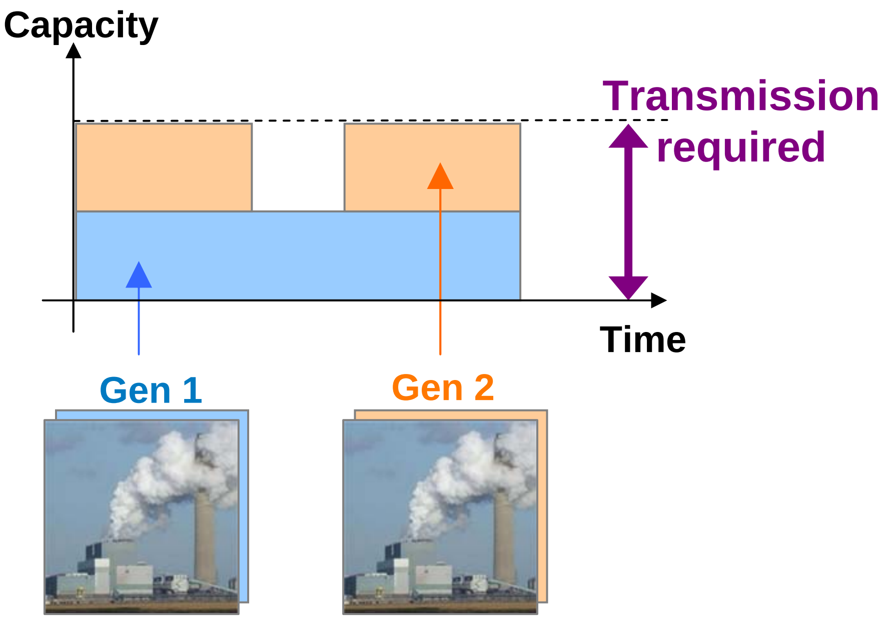
2 Parallel HVDC

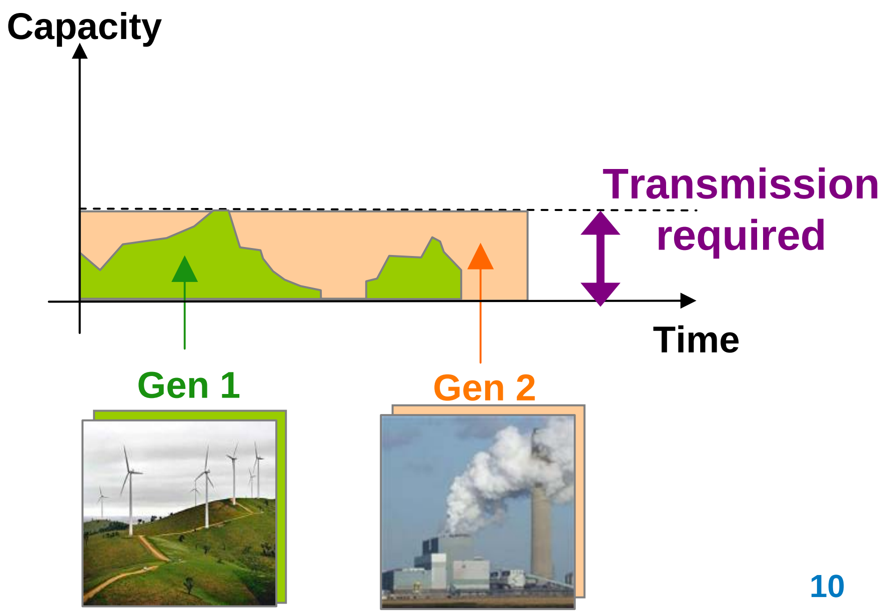
- Addition of islands charging methodology

3 Islands

Capacity Sharing – Background

- Not all users drive the same requirement for investment
- TAR focus on connection timing; models reflecting network usage not taken forward
- Is there a proxy that could be included in charges?





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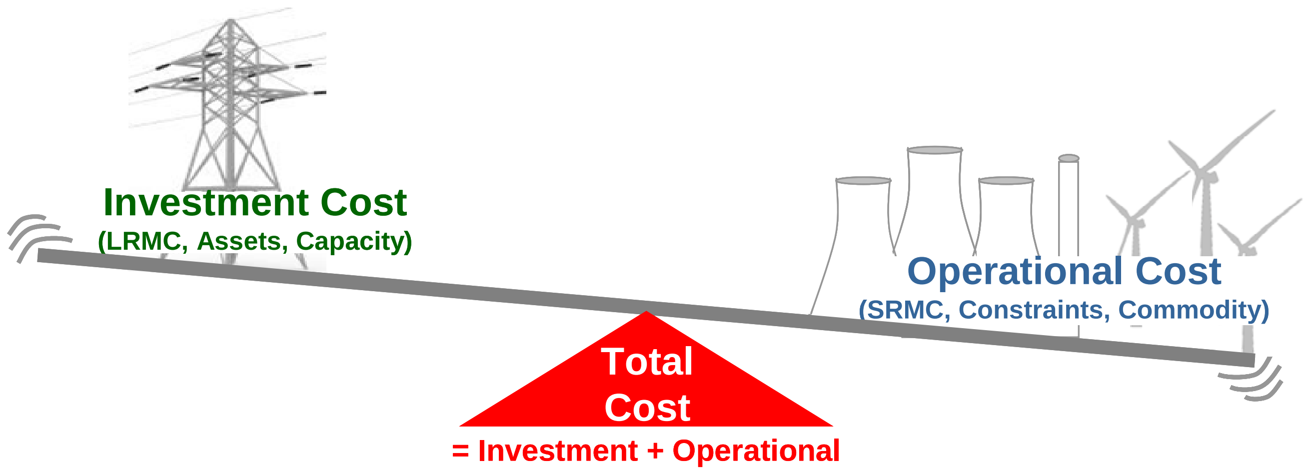
Background

- Network capacity vs. future savings in operational costs
- Some investment remains demand security driven



- Charging methodology should develop to reflect
- Must remain simple, transparent and non-discriminatory
- Use long term convergence of LRMC and SRMC

Sharing

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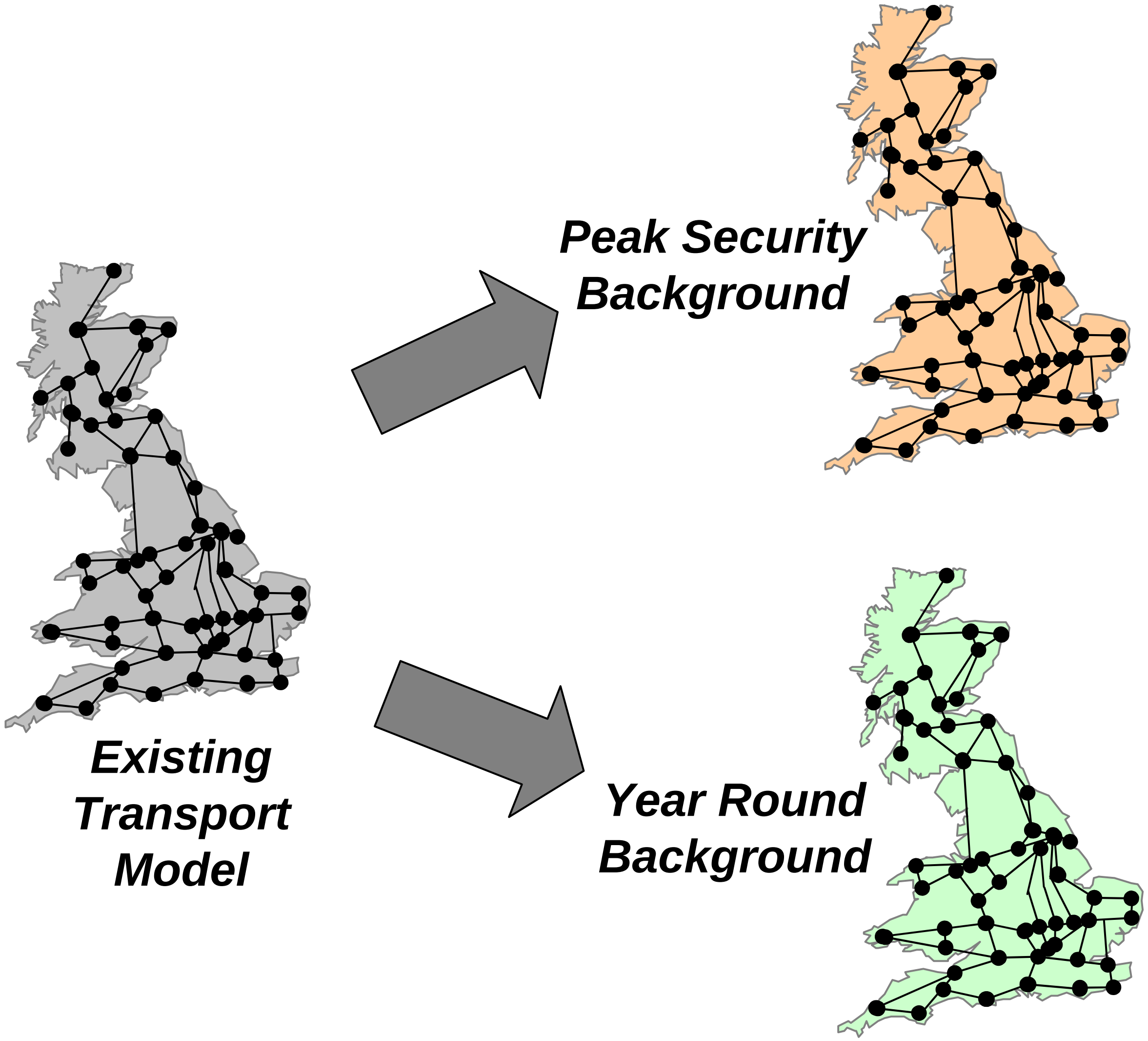
Transport Model Background



Generator Type	Background
Intermittent	0%
Controllable	variable

Generator Type	Background Setting
Intermittent	70%
Nuclear & CCS	85%
Interconnectors	100%
Hydro	variable
Pumped Storage	50%
Peaking	0%
Other (conventional)	variable

Sharing

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Translation into Tariff Model

- Revised model allocates circuits to a given background

Max Line Flow

Peak Security
MWkm

OR

Year Round
MWkm

- Calculates three tariffs

Peak Security
£/kW

Year Round
£/kW

Residual
£/kW

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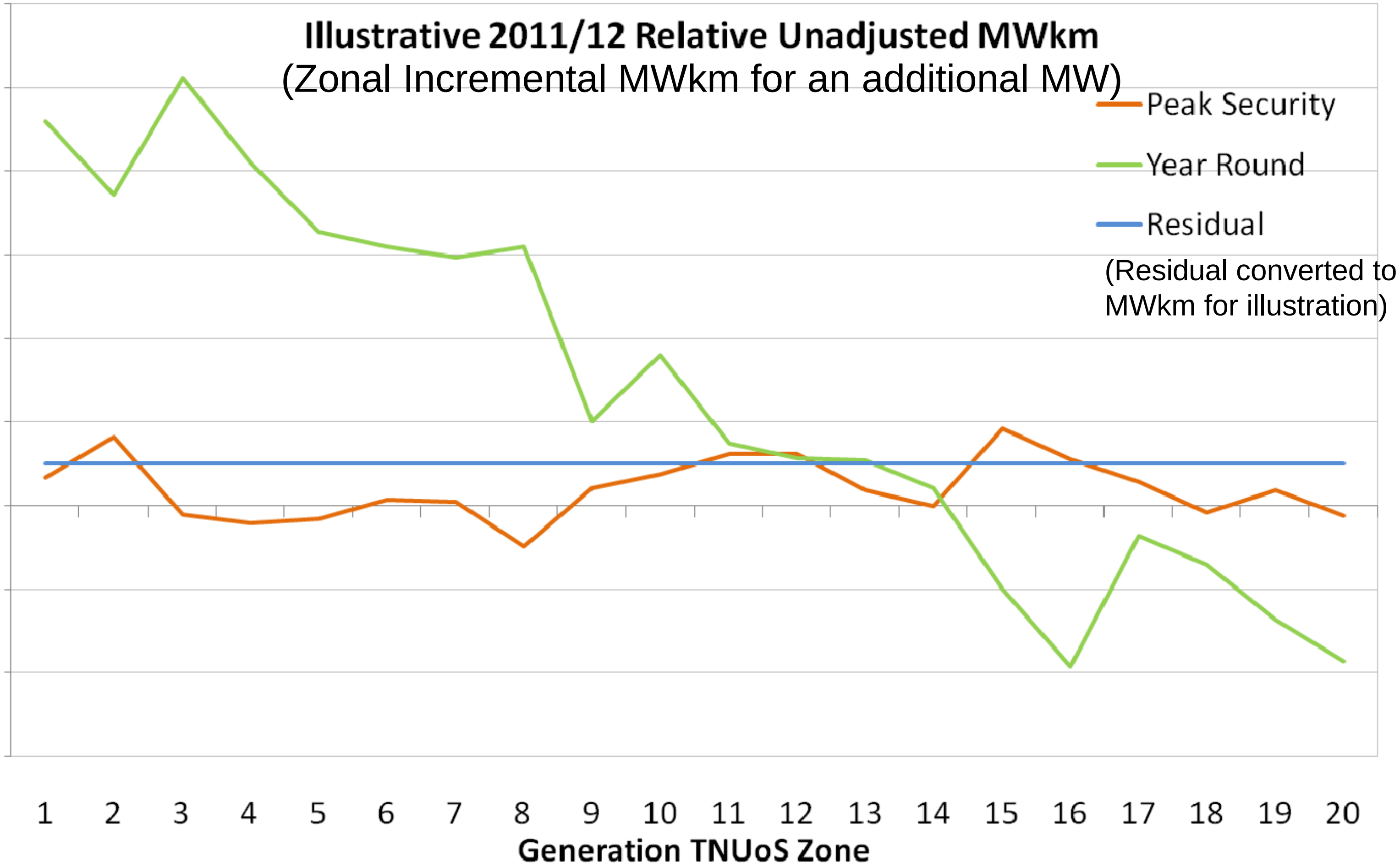
Illustrative Transport MWkms – Generation



Is the impact of every MW the same?

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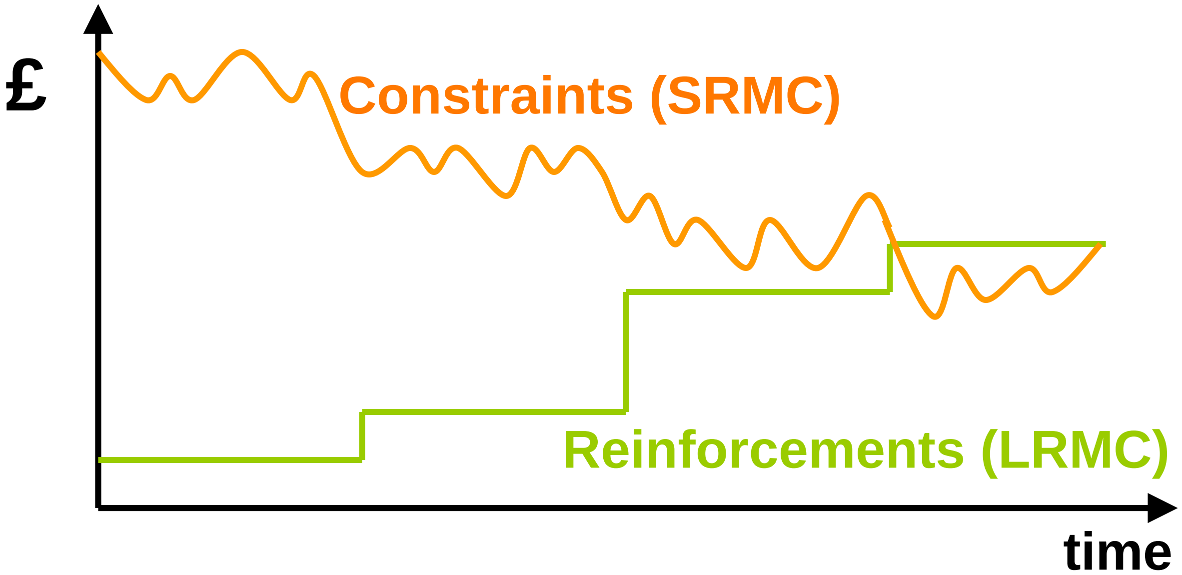
How to incorporate plant type

- Explicit information is not available (TAR)
- Implicit assumptions must be made
- For investment driven by “year round” conditions, these should reflect assumptions made in CBA



- TSOs incentivised to balance SRMC and LRMC

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Generator Specific Assumptions

CBA Inputs:

Gen Unit

- TEC
- Unit Avail.
- Fuel Avail.
- Efficiency

Prices

- Fuel Price
- CO_2 Price
- ROC/FiT Price

BM

- Bid Price
- Offer Price

- Generators unable to provide TSO with information
- Significant complexity

Is there a simple alternative?

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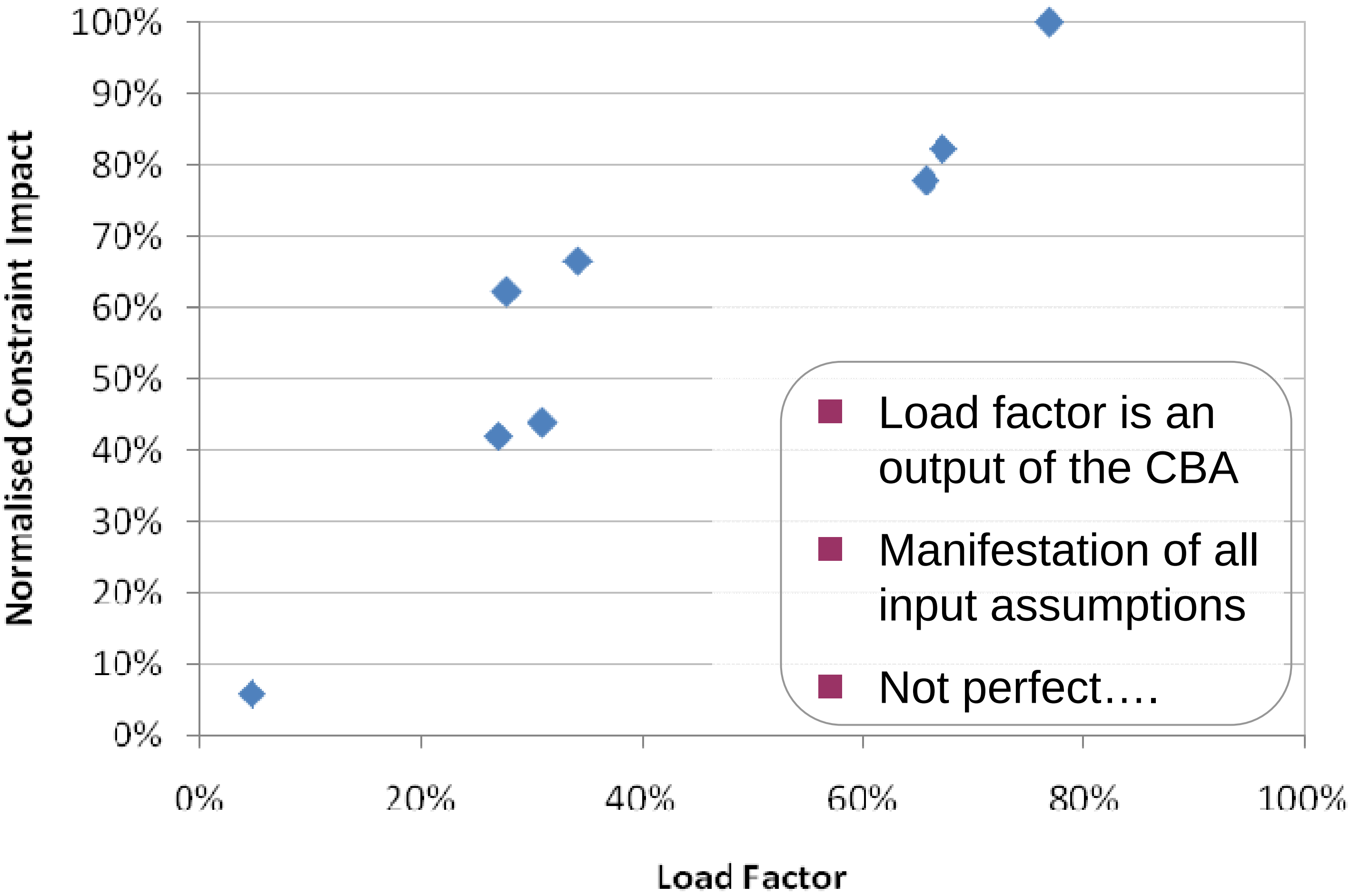
Plant Type Impact on Constraint Costs?



- Load factor is an output of the CBA
- Manifestation of all input assumptions
- Not perfect….

- Year round (pseudo-CBA) includes contribution to peak periods

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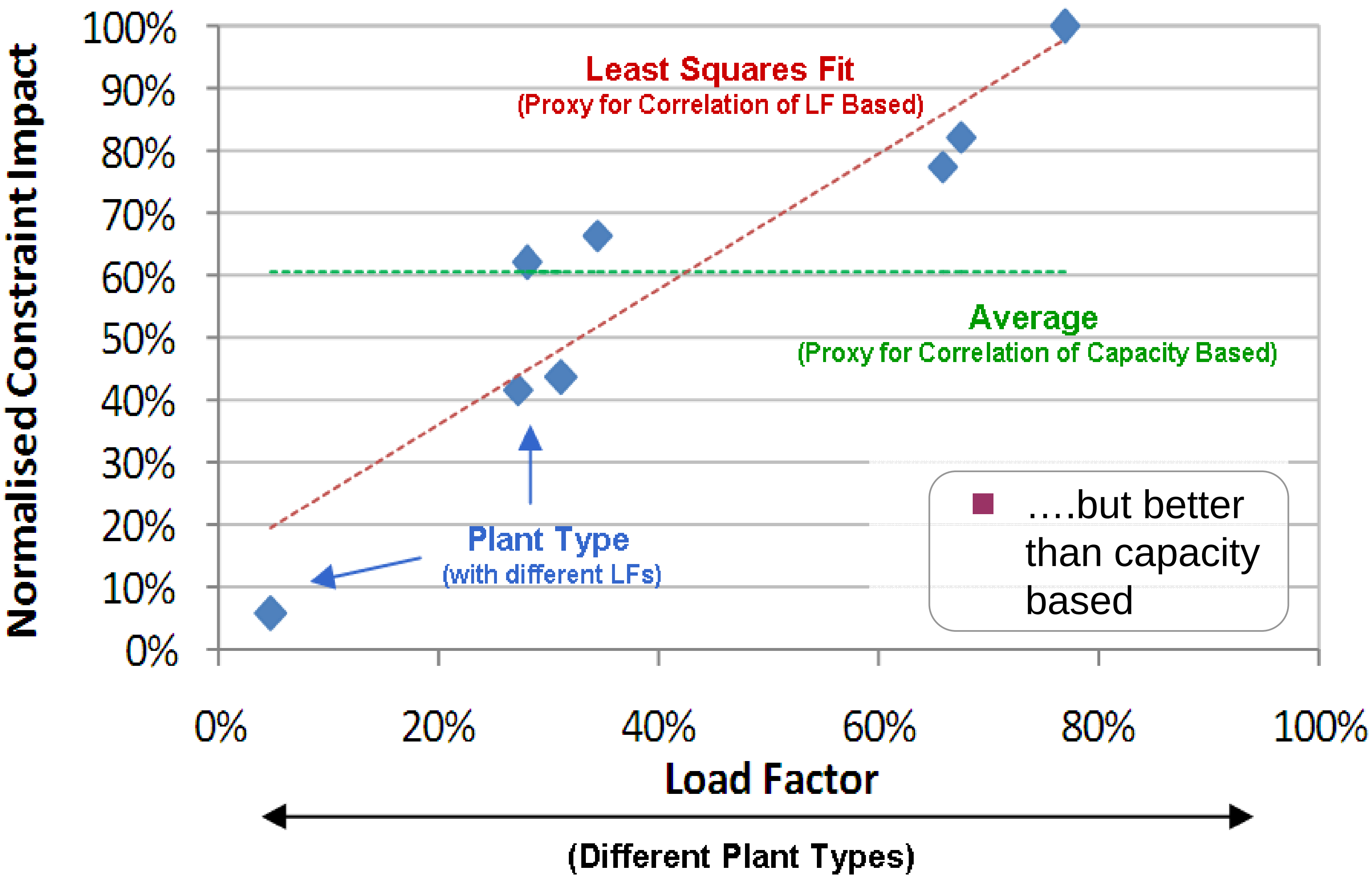
Plant Type Impact on Constraint Costs?



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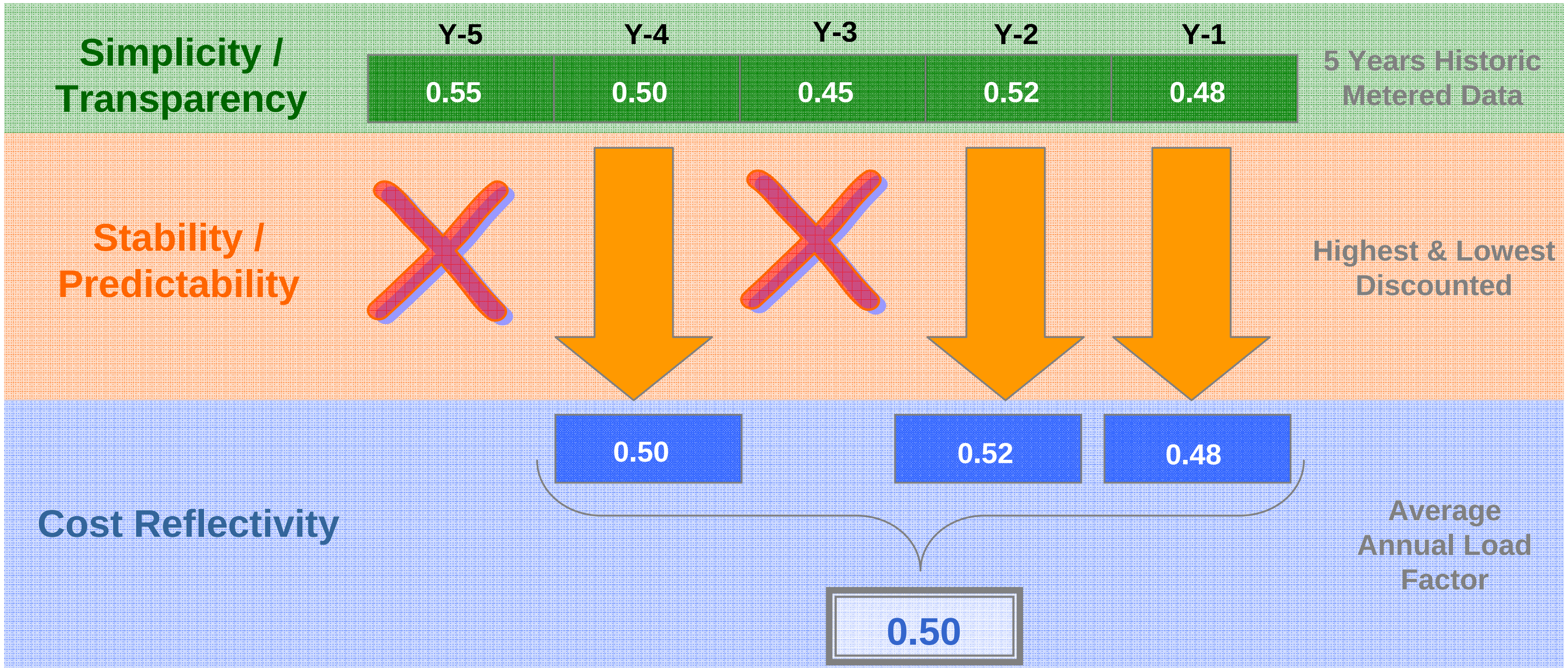
Derivation of Annual Load Factor

- Maintain link back to assumptions made when planning investment to avoid future constraint costs



- On balance best meets objectives; compared with alternatives such as MWh, User supplied forecast, NGET forecast, etc.

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Calculation of Tariffs

Conventional Tariff =

Peak Security £/kW + (Year Round £/kW x Specific Load Factor) + Residual £/kW

Intermittent Tariff =

(Year Round £/kW x Specific Load Factor) + Residual £/kW

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Sharing Proposal Overview

Transport

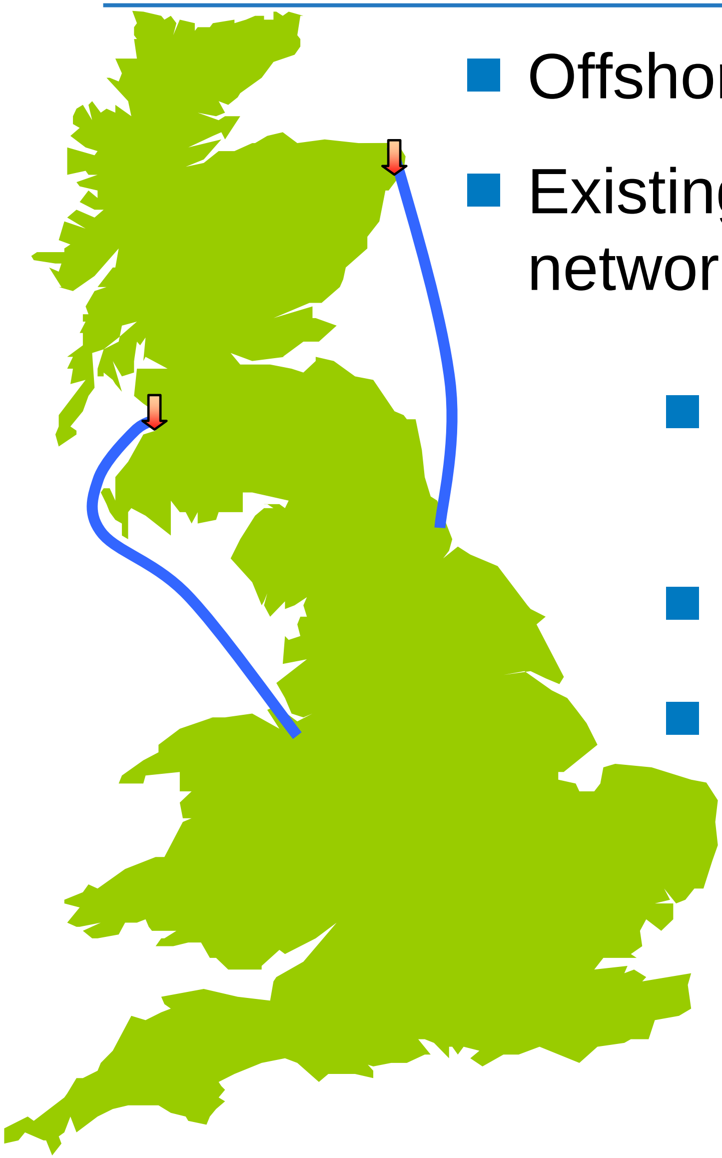
- Dual background
- SQSS based scaling
- Circuit MWkm 'binning'
- Incremental MW
- Locational differential
- Cost reflective signal

Tariff

- 2 part wider tariff
- Remains £/kW based
- Intermittent = YR only
- Specific historic load factor
- Minimal impact on local
- Minimal impact on demand

HVDC

Including Parallel HVDC in Charging



- Offshore HVDC links – 'Bootstraps'
- Existing charging model based on passive network elements
    - HVDC represents an active component of the network
    - High relative £/MWkm cost
    - Some precedent offshore

1. Which costs go into EF calculation?
2. Where does incremental MW flow?

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Reflecting HVDC in Transport Model

- Impact on tariffs is combination of:

Cost Components £/MWkm	Marginal MW flow MWkm

- Which **cost components** are included in the model?
  - Need to calculate cost relative to 400kV OHL – Expansion Factor
- How much of the **marginal MW** flows down the link?
  - Need to calculate an impedance for the model
- Are HVDC links that parallel the AC network different from those that are radial in nature?

HVDC

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Cost Components

£/MWkm

Expansion Factor

Annuity Factor:	0.06567
Asset Life:	50
Rate:	0.0625
Overhead Factor %	1.8
Expansion Constant (£/MWkm)	11.142856

Existing Expansion Factor Parameters			
Projected Relative Cost of Asset	NGC	SP	SSE
400kV cable factor	22.390	22.390	22.390
275kV cable factor	22.394	22.394	22.394
132kV cable factor	30.220	30.220	27.790
400kV line factor	1.000	1.000	1.000
275kV line factor	1.137	1.137	1.137
132kV line factor	2.796	2.796	2.238

Calculations

HVDC Details:	370.0	Length (km)
	2,000.0	Rating (MW)
	1,000.0	Total Cost (£m)
	65.7	Annuitised cost
	18.0	Overheads cost
	83.7	Total Annual Cost (£m)
£/MWkm:	113.1	£/MWkm
	10.1	HVDC expansion factor
Transport Model:	167.7	Equivalent length of 400kV cable
		or
	3754.4	Equivalent length of 400kV OHL

Assumptions for illustration

Bus 1	Bus 2	R	X	OHL Length	Cable Length
DEES40	HUER40	0.000	????	3754.400	0.00

HVDC

Cost Components

£/MWkm

Expansion Factor

Option A	Option B	Option C
No suitable onshore alternative	SO flexibility akin to SVC or QB	Full marginal signal
▪ Treat as 400kV OHL ▪ Little impact on tariffs ▪ Regardless of MW flow	▪ Remove converters from EF ▪ Some impact on tariffs ▪ Varies by MW flow	▪ Include all elements in EF ▪ Significant impact on tariffs ▪ Varies by MW flow

Discounted due to lack of cost-reflectivity

Calculation - Option A

HVDC Details:	370.0	Length (km)
	1,000.0	Total Cost (£m)
	-	Annuitised cost
	-	Overheads cost
	-	Total Annual Cost (£m)
£/MWkm:	11.1	£/MWkm
	1.0	HVDC expansion factor
Transport Model:	16.5	Equivalent 400kV cable km
		or
	370.0	Equivalent 400kV OHL km

Calculation - Option B

HVDC Details:	370.0	Length (km)
	2,000.0	Rating (MW)
	550.0	Total Cost (£m)
	36.1	Annuitised cost
	9.9	Overheads cost
	46.0	Total Annual Cost (£m)
£/MWkm:	62.2	£/MWkm
	5.6	HVDC expansion factor
Transport Model:	92.2	Equivalent 400kV cable km
		or
	2064.9	Equivalent 400kV OHL km

Calculation - Option C

HVDC Details:	370.0	Length (km)
	2,000.0	Rating (MW)
	1,000.0	Total Cost (£m)
	65.7	Annuitised cost
	18.0	Overheads cost
	83.7	Total Annual Cost (£m)
£/MWkm:	113.1	£/MWkm
	10.1	HVDC expansion factor
Transport Model:	167.7	Equivalent 400kV cable km
		or
	3754.4	Equivalent 400kV OHL km

Existing Expansion Factor Parameters			
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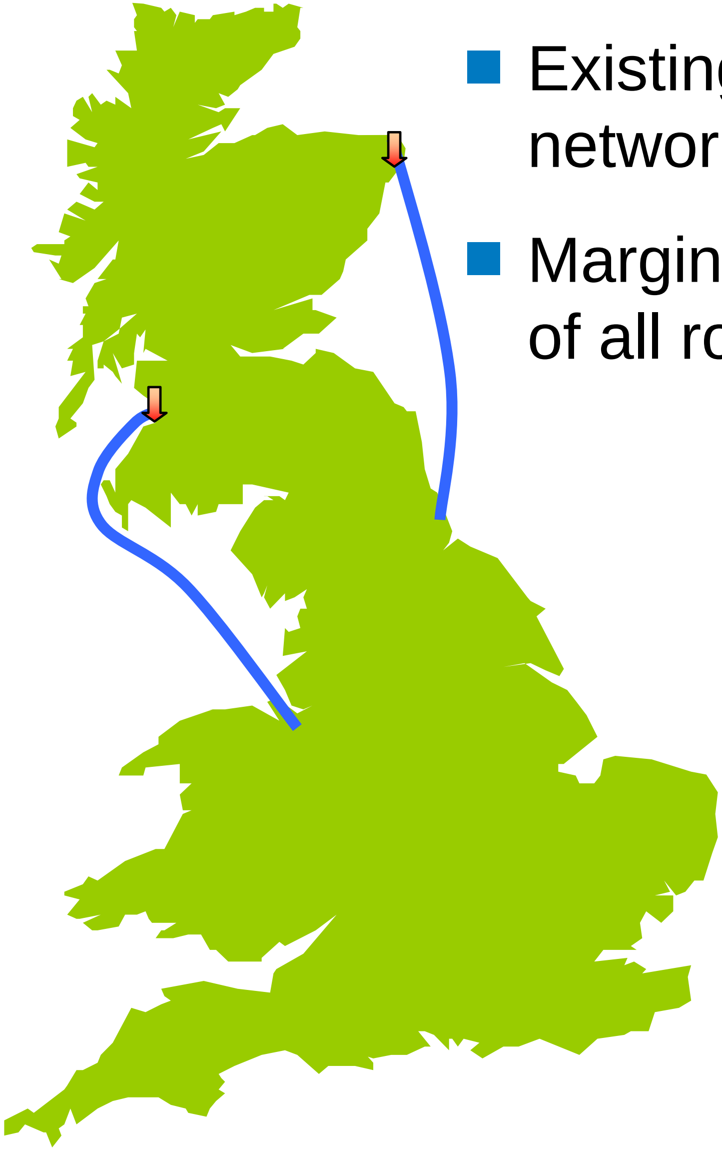
HVDC

Transport Model

Marginal MW flow
MWkm



- Existing charging model based on passive network elements
- Marginal flow dictated by relative impedance of all routes to centre of the network
  - HVDC represents an active component of the network
  - Technical WG accepted principle of modelling as a pseudo-AC circuit
  - Therefore in Transport model need to;
    1. estimate level of power flow
    2. calculate desired impedance

HVDC

Marginal MW flow
MWkm

Options for Power Flow

1. Optimal Power Flow

   Derive power flow from optimal operation calculation - complex

2. Transmission Routes

   Assume equal power flow on each double circuit equivalent route

3. Transmission Circuits

   Assume equal power flow on each major circuit

4. Circuit Ratings

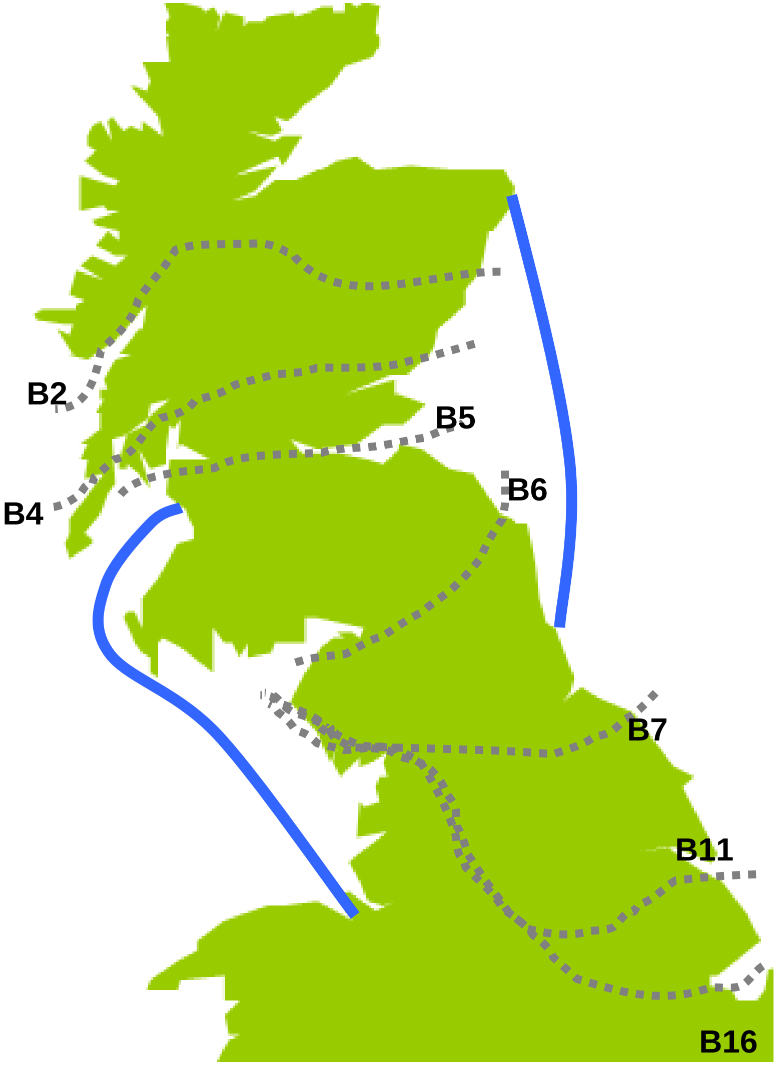
   Pro-rata flows based on circuit ratings

HVDC

Marginal MW flow

MWkm

Managing Multiple Boundaries



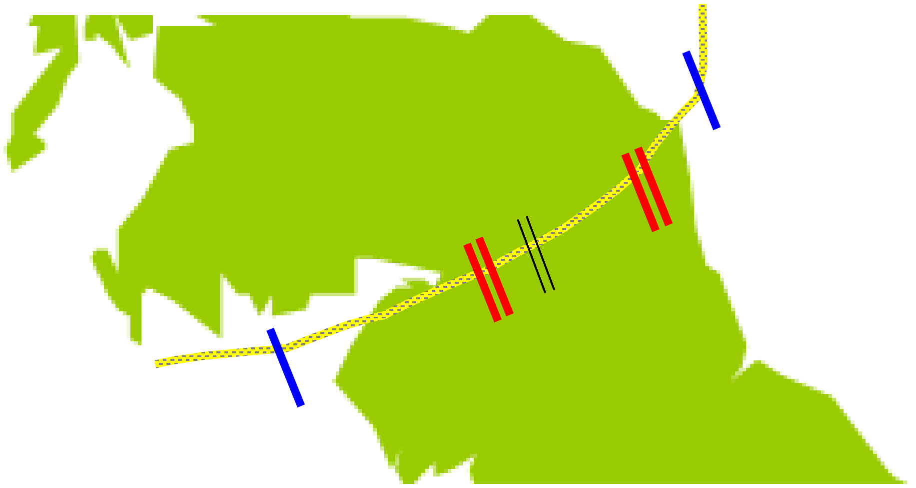
- Options 2-4 assume flow setting based on single boundary management
- In reality each bootstrap crosses multiple boundaries
- Option 4B – managing multiple boundaries through ratings

HVDC

Marginal MW flow
MWkm

Proposed simplifying assumptions

- Flows based on Transport Model background (Year Round)
- Boundary with fewest onshore circuits used for single boundary approach – most constrained boundary; B6
  - 3 onshore double circuit routes
  - 132kV circuits ignored for options 2&3, i.e. 4 circuits on 2 routes considered, due to relatively small size (capacity approx. 6% of 400kV)

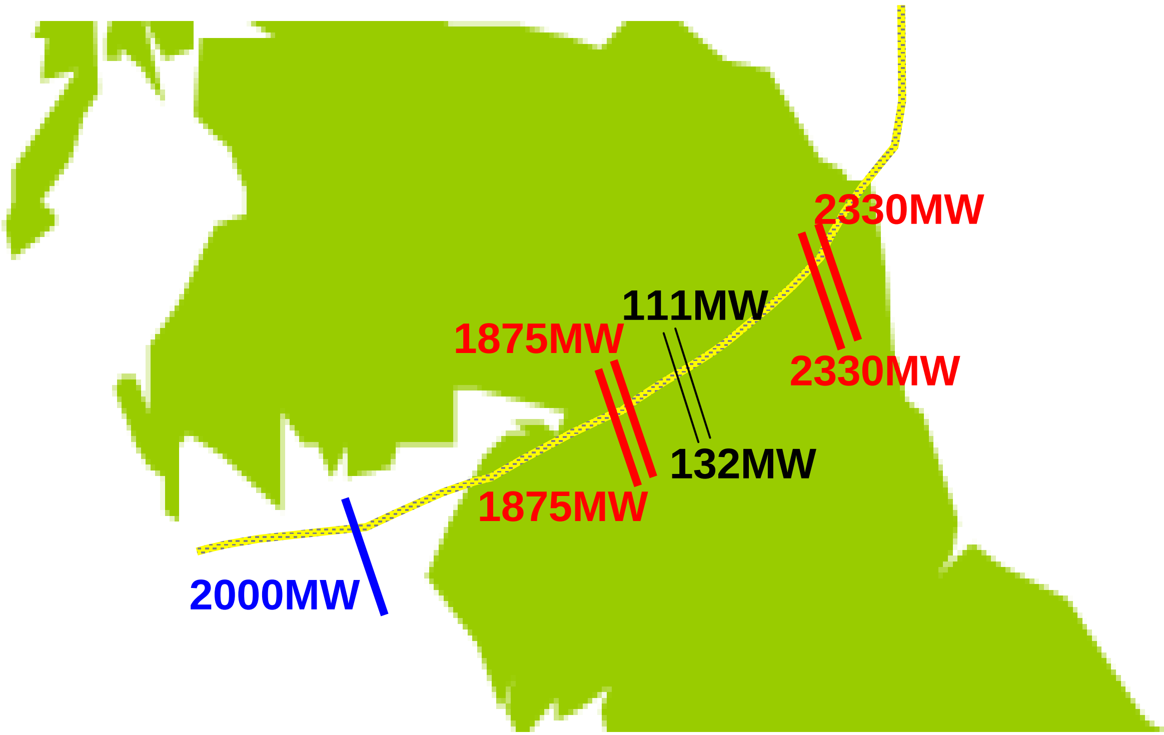


HVDC

2015 Western HVDC Example

Marginal MW flow
MWkm

- Step 1 – Ascertain total rating of circuits across boundary in Transport model including HVDC
  - B6 total = 10844MW



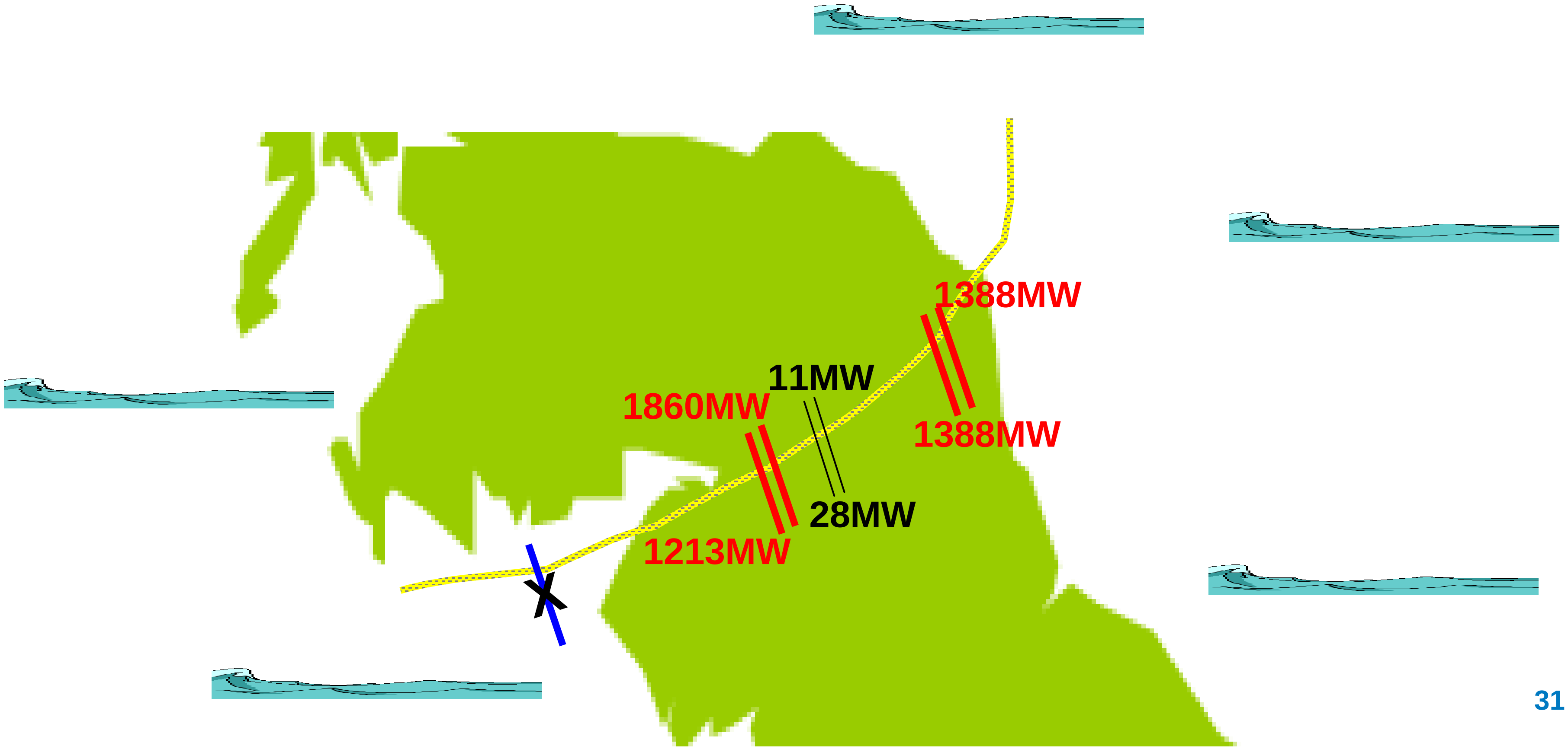
HVDC

2015 Western HVDC Example

Marginal MW flow

MWkm

- Step 2 – Ascertain flow across boundary in Transport model YR background without HVDC
  - B6 total = 5889MW



HVDC

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Marginal MW flow
MWkm

2015 Western HVDC Example

Step 3 – Calculation of desired HVDC flow. For single boundaries*;

2. Transmission Routes $BF_{MW} * HVDC_{cap} / N_R$
3. Transmission Circuits $BF_{MW} * HVDC_{cap} / N_C$
4. Circuit Ratings;
   a. single boundary $BF_{MW} * HVDC_{cap} / BR$

Where;

BF_{MW} = MW boundary flow from Transport model with no HVDC

$HVDC_{cap}$ = MW capacity of HVDC circuit

N_R = No. of routes across boundary

N_C = No. of circuits across boundary

BR = total rating of boundary

*Note: Optimum power flow method not investigated

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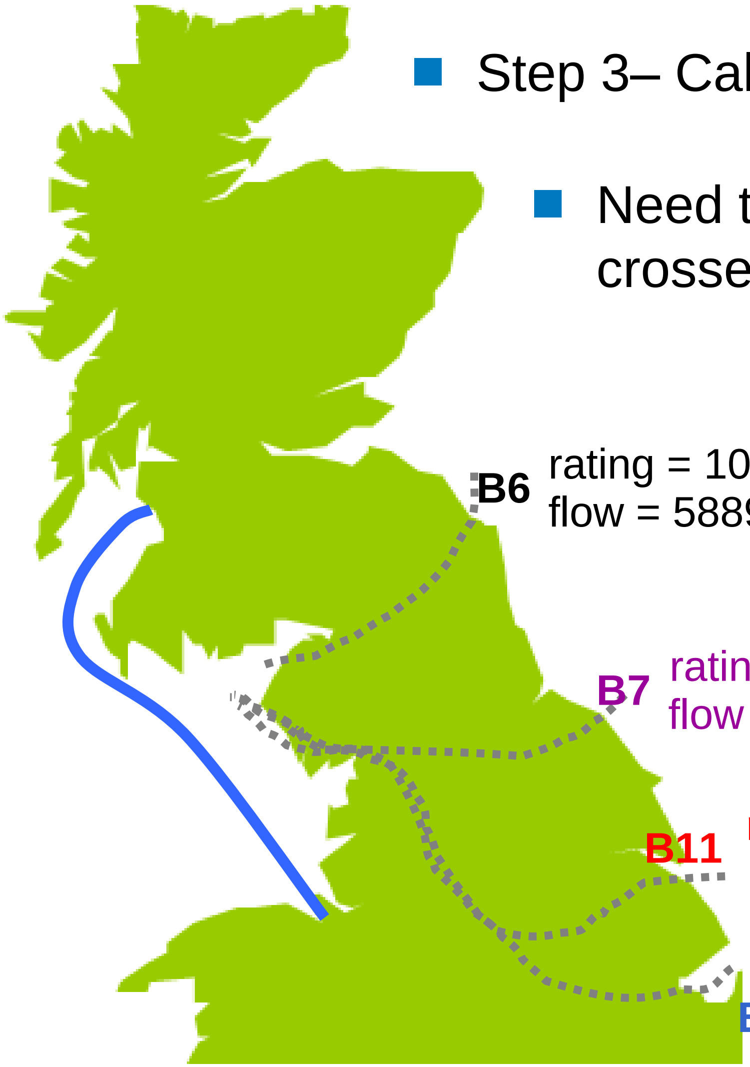
Marginal MW flow
MWkm

2015 Western HVDC Example



- Step 3– Calculation of HVDC flow. For option 4B;
  - Need to repeat 4A calculation for each boundary crossed
- In this case;
  - **B6 required HVDC flow = 1086MW**
  - **B7 required HVDC flow = 740MW**
  - **B11 required HVDC flow = 651MW**
  - **B16 required HVDC flow = 753MW**
- Multiple boundary result is average of four boundaries

HVDC

2015 Western HVDC Example Result

Marginal MW flow MWkm

2. Transmission Routes *Desired flow: 1963MW*

3. Transmission Circuits *Desired flow: 1178MW*

4. Circuit Ratings;
   a. single boundary *Desired flow: 1086MW*
   b. multiple boundaries *Desired flow: 808MW*

- Higher ‘desired flow’ = lower impedance = bigger impact on marginal MW flow

Including Island Links in the Methodology

- Harnessing renewable energy sources on the northern islands of Scotland will require new transmission circuits
- The existing charging methodology does not accommodate this
- Requires consideration of:
  - Expansion Factors
  - Local/Wider
  - Security Factor

Including Island Links in the Methodology

Expansion Factor

- Island links will be constructed of sub-sea cables
- *Expansion factors* represent the various technologies on the network
- Whether ‘local’ or ‘wider’ for charging purposes, the calculation of expansion factors for island cables is required
- These would be technology specific and would logically be calculated in the same manner as onshore expansion factors

Local or Wider Circuit

- Under existing definition, some islands may become classed as wider
- As the nodal marginal cost of islands will be greater than the +/- 1£/kW, Islands would become their own generation charging zones under the existing zoning criteria
- With the same expansion factor for local and wider; the tariff would be the same except for the security factor

Islands

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Including Island Links in the Methodology

Expansion Factor

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- *Expansion factors* represent the various technologies on the network
- Whether 'local' or 'wider' for charging purposes, the calculation of expansion factors for island cables is required
- These would be technology specific and could logically be calculated in the same manner as onshore expansion factors

Existing Factors

400kV cable factor:	22.39
275kV cable factor:	22.39
132kV cable factor:	30.22
400kV line factor:	1.00
275kV line factor:	1.14
132kV line factor:	2.80

$$Annuityfactor = \frac{1}{\left[\frac{\left(1-(1+WACC)^{-AssetLife}\right)}{WACC}\right]}$$

Capital Cost

Annuity

Overhead

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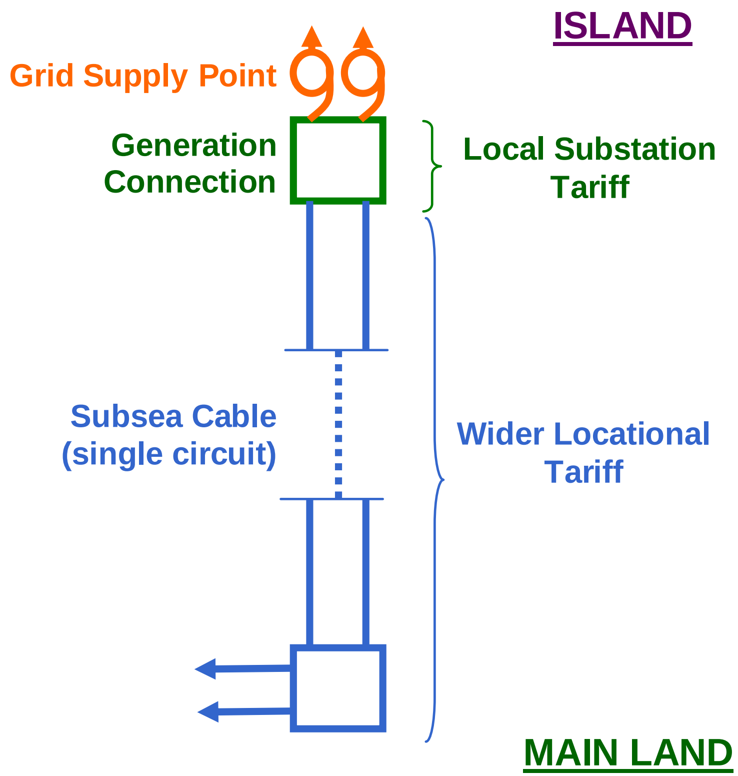
Including Island Links in the Methodology

Local/Wider

- Capacity sharing covered under sharing element of mod.
- Security factor issue remains

Security Factor

- Specific for ‘local’
- Currently 1.8 is applied for all wider
- Technical WG agreed that reduced security could be reflected in the Expansion Factor (EF) calculation
- EF x (1.0/1.8)
- Tariff should be commensurate with access rights



Areas of Proposal to be Developed

Elements of the Original Modification Proposal

- Modification to reflect network investment cost impact of different generation technologies (capacity sharing)

1 Capacity Sharing

- Addition of parallel HVDC link charging methodology

2 Parallel HVDC

- Addition of islands charging methodology

3 Islands

- Original Proposal flexible; as per Ofgem Direction

Sharing

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Identify Areas of Proposal to be Developed

Defect	Original	Considerations from Direction	Potential Changes to Original
Sharing	-Applies to 'wider' network only **<u>Locational Differential</u>** -Dual background approach *(Direction 14a)* -NETS SQSS based scaling for backgrounds *(Direction 14b)* -Circuit MWkm 'binning' based on max. flow **<u>Plant Type Impact</u>** -2 part wider tariff (£/kW) -Intermittent = YR only -Unique historic ALF	a) How charging structures should be applied geographically; in particular where zones are dominated by one type of generation technology *(Direction 15a)*	i. … ii. … iii. … iv. … v. …
		b) Alternative approaches to ALF for reflecting user characteristics into charging *(Direction 15b)*	i.… ii.… iii.… iv.… v.…
		c) Whether intermittent technology types should be exposed to the peak element of tariff *(Direction 16)*	i.… ii.… iii.… iv.… v.…

References to the Authority's Direction in orange

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Identify Alternatives to be Developed

Defect	Original	Potential Alternatives	Justification Against Objectives
Sharing	-Applies to ‘wider’ network only **Locational Differential** -Dual background approach *(Direction 14a)* -NETS SQSS based scaling for backgrounds *(Direction 14b)* -Circuit MWkm ‘binning’ based on max. flow **Plant Type Impact** -2 part wider tariff (£/kW) -Intermittent = YR only -Unique historic ALF	i. …	i. …
		ii. …	ii. …
		iii. …	iii. …
		iv. …	iv. …
		v. …	v. …
		vi. …	vi. …
		vii.…	vii.…
		viii.…	viii.…
		ix. …	ix. …
		x. …	x. …
		xi. …	xi. …
		xii.…	xii.…
		xiii.…	xiii.…
		xiv.…	xiv.…
		xv.…	xv.…

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Identify Areas of Proposal to be Developed

Defect	Original	Considerations from Direction	Potential Changes to Original
HVDC	- Modelled as pseudo-AC circuit - All costs included in Expansion Factor (EF) - Impedance calculated assuming HVDC circuit is loaded to the same extent on average as the equivalent AC circuits it parallels *(Direction 19)*	a) Whether the cost of HVDC converter stations should be included in the expansion factor calculation *(Direction 20)*	i. Remove converter costs from the EF calculation
			ii.…
			iii.…
			iv.…
			v.…
			vi. …

References to the Authority's Direction in orange

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Identify Alternatives to be Developed

Defect	Original	Potential Alternatives	Justification Against Objectives
HVDC	- Modelled as pseudo-AC circuit - All costs included in Expansion Factor (EF) - Impedance calculated assuming HVDC circuit is loaded to the same extent on average as the equivalent AC circuits it parallels *(Direction 19)*	i. …	i.…
		ii. …	ii.…
		iii. …	iii.…
		iv. …	iv.…
		v. …	v.…
		vi. …	vi. …

Islands

Identify Areas of Proposal to be Developed

Defect	Original	Considerations from Direction	Potential Changes to Original
Islands	- Technology specific Expansion Factors (EF) consistent with current approach - EF calculation reflects lack of redundancy where islands become 'wider' - HVDC converters included in EF calculation consistent with offshore	a) Whether Islands classed as 'wider' for charging purposes should have a 2 part wider tariff as determined by the sharing element of the proposal *(Direction 24a)*	i…. ii…. iii…. iv…. v….
		b) Whether islands classed as 'local' for charging purposes should have tariffs consistent with the current existing methodology for local circuit and local substation tariffs *(Direction 24b)*	i…. ii…. iii…. iv…. v….
		c) Whether the expansion factor should be calculated using the existing annuitised capital cost approach or whether the expansion factor should be calculated to recover the actual cost of island links *(Direction 24c-i -)*	i…. ii…. iii…. iv…. v….
		d) Whether, for islands classed as 'wider', the global locational security factor should be used without further modification or whether any lack of redundancy should be reflected in the expansion factor calculation *(Direction 24c-ii -)*	i…. ii…. iii…. iv…. v….

References to the Authority's Direction in orange

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Identify Areas of Proposal to be Developed

<table>
<tr><th>Defect</th><th>Original</th><th>Considerations from Direction</th><th>Potential Changes to Original</th></tr>
<tr><td rowspan="10">Islands</td><td rowspan="10">- Technology specific Expansion Factors (EF) consistent with current approach
- EF calculation reflects lack of redundancy where islands become 'wider'
- HVDC converters included in EF calculation consistent with offshore</td><td rowspan="5">e) Whether the expansion factor calculation for radial island links comprising HVDC technology should be the same as that for HVDC links that parallel the AC network. (Direction 24d)</td><td>i.…</td></tr>
<tr><td>ii.…</td></tr>
<tr><td>iii.…</td></tr>
<tr><td>iv.…</td></tr>
<tr><td>v.…</td></tr>
<tr><td rowspan="5">f) Whether an anticipatory application of the MITS definition to islands is appropriate and how this could be done. (Direction 24e)</td><td>i.…</td></tr>
<tr><td>ii.…</td></tr>
<tr><td>iii.…</td></tr>
<tr><td>iv.…</td></tr>
<tr><td>v.…</td></tr>
</table>

References to the Authority's Direction in orange

Identify Alternatives to be Developed

Defect	Original	Considerations from Direction	Potential Changes to Original
Islands	- Technology specific Expansion Factors (EF) consistent with current approach - EF calculation reflects lack of redundancy where islands become 'wider' - HVDC converters included in EF calculation consistent with offshore	i. …	i.…
		ii. …	ii.…
		iii. …	iii.…
		iv. …	iv.…
		v. …	v.…
		vi. …	vi.…
		vii.…	vii.…
		viii.…	viii.…
		ix. …	ix.…
		x. …	x. ……

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Initial Timetable

Date	Meeting Focus	
July 10th	Introduction; Work plan	
July 24th		
July 25th		
August 7th		
August 8th		
August 28th		
August 29th		
September 4th		
September 5th		
September 11th		
September 12th		
October 8th		
October 9th		
October 15th		
October 16th		
November 5th		
November 6th		
November 15th		
November 16th		

Next Steps