ENTSO-E Public Workshop on NC HVDC

Towards a European frame for offshore wind

Brussels, 4 December 2013

Darren Chan, Mark Norton
Drafting Team NC HVDC

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Reliable Sustainable Connected

Future views of the DC-Connected PPMs

NC RfG and NC HVDC Coordination

Reactive power capability requirements

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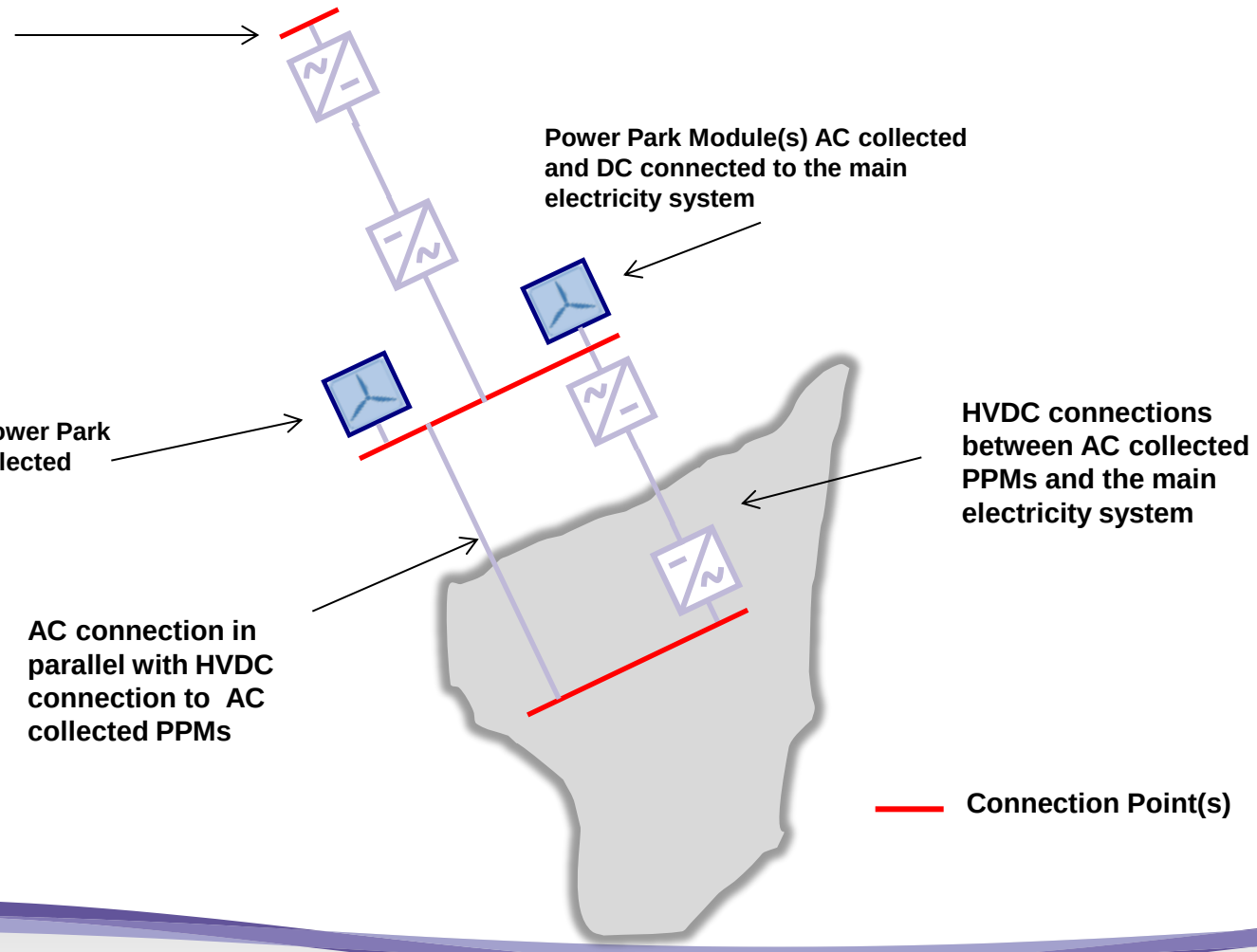
DC Connected PPMs



DC Connected PPMs

AC connections may become DC and vice versa

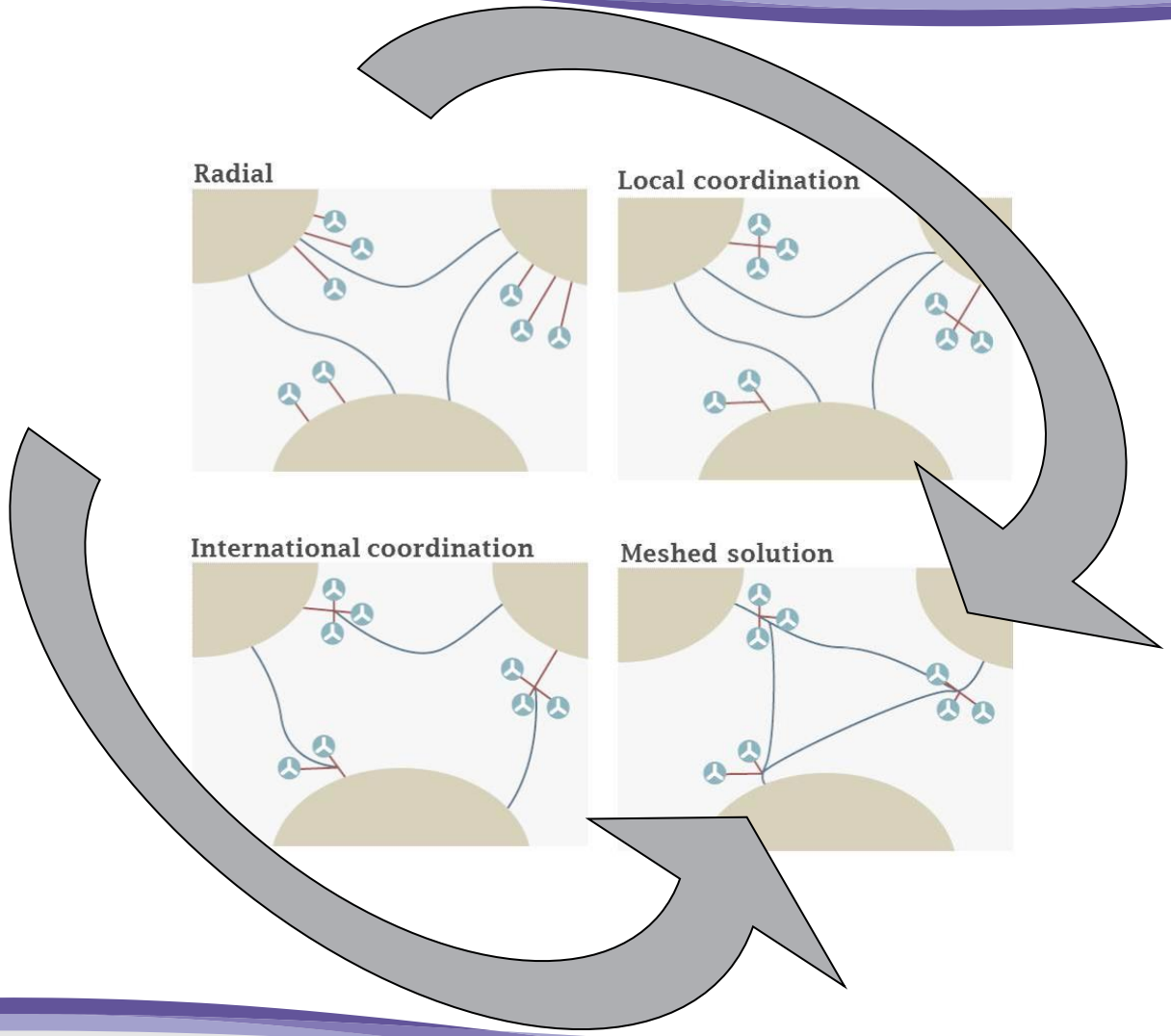
Offshore platform with DC Connected PPM may become a node in interconnection between synchronous systems

AC and DC connections should be interchangeable

DC connected PPMs will have low inertia and be more volatile

DC connected PPMs will be required to contribute with system services into the network which they are providing power to

Grid Configuration

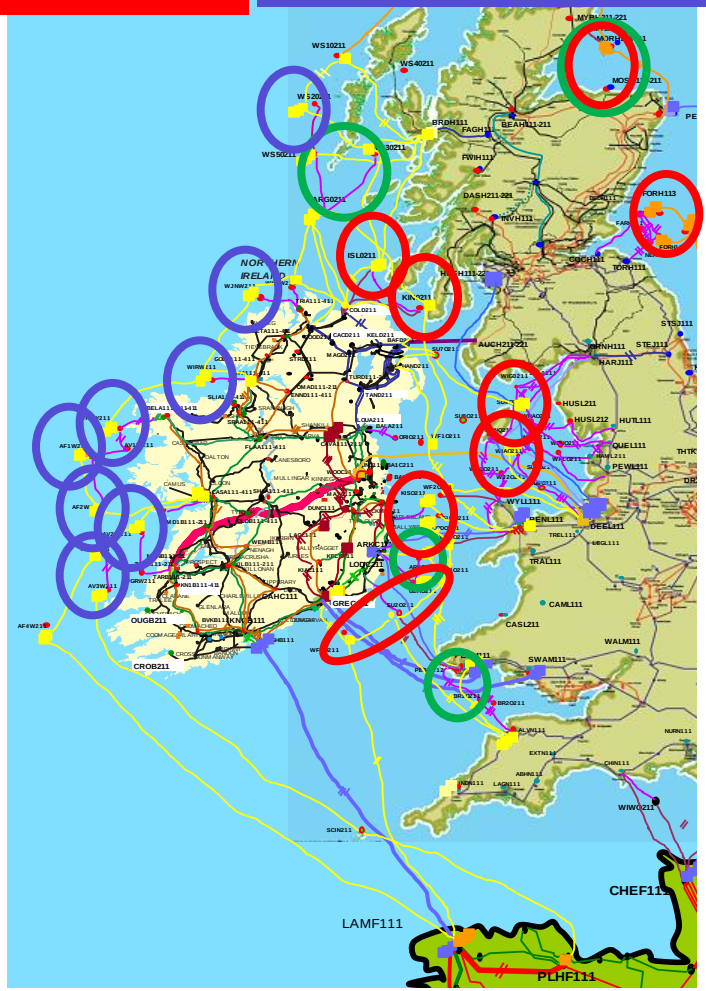


EirGrid offshore grid study

DC link later paralleled with AC

AC link later paralleled with DC

Other newly DC AC parallel developments

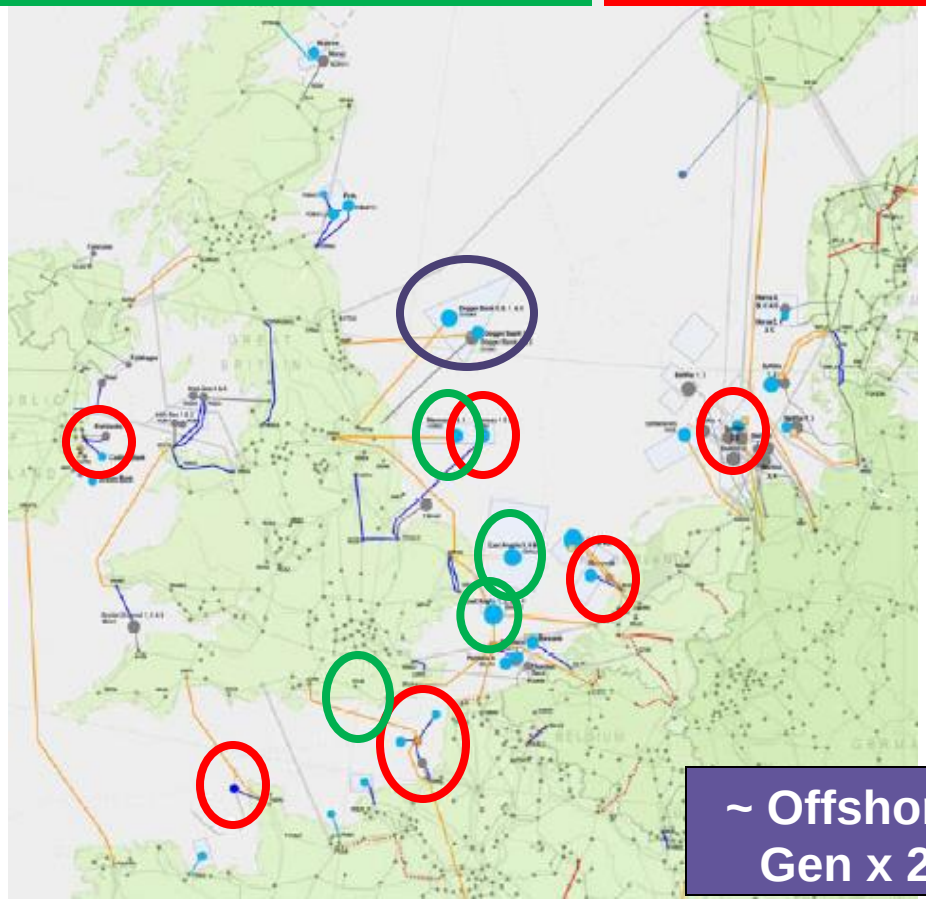


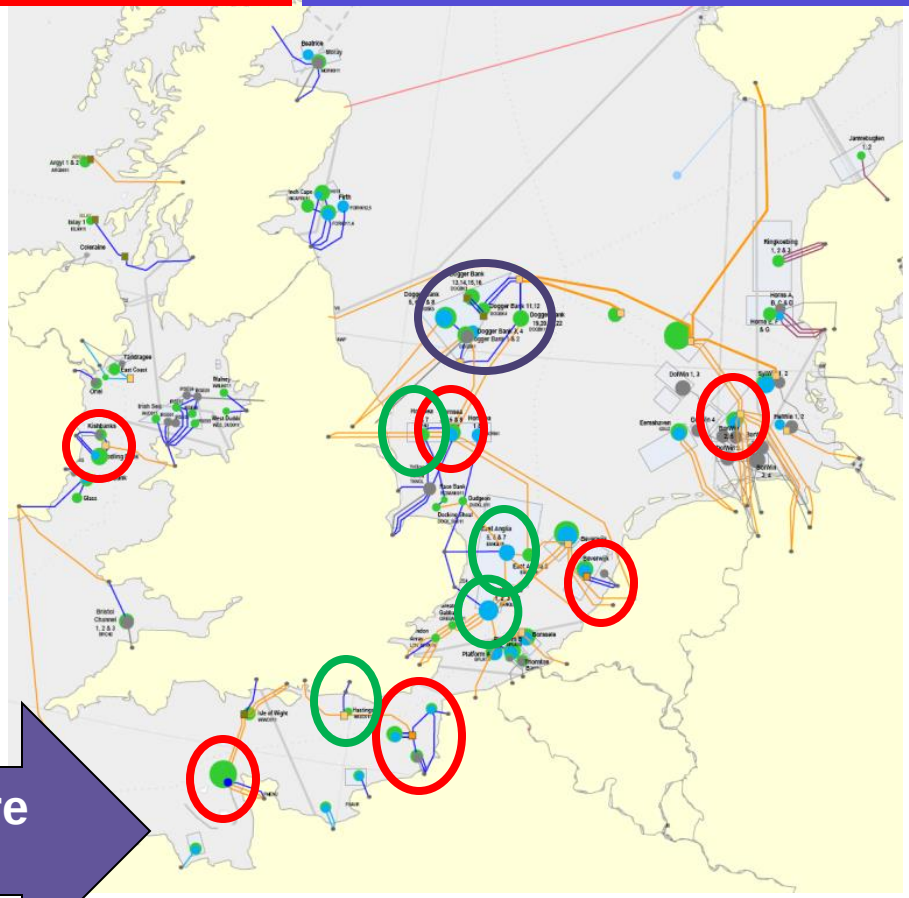
NSCOGI – Grid Configuration – meshed design

DC link later paralleled with AC

AC link later paralleled with DC

DC link to large AC offshore Island

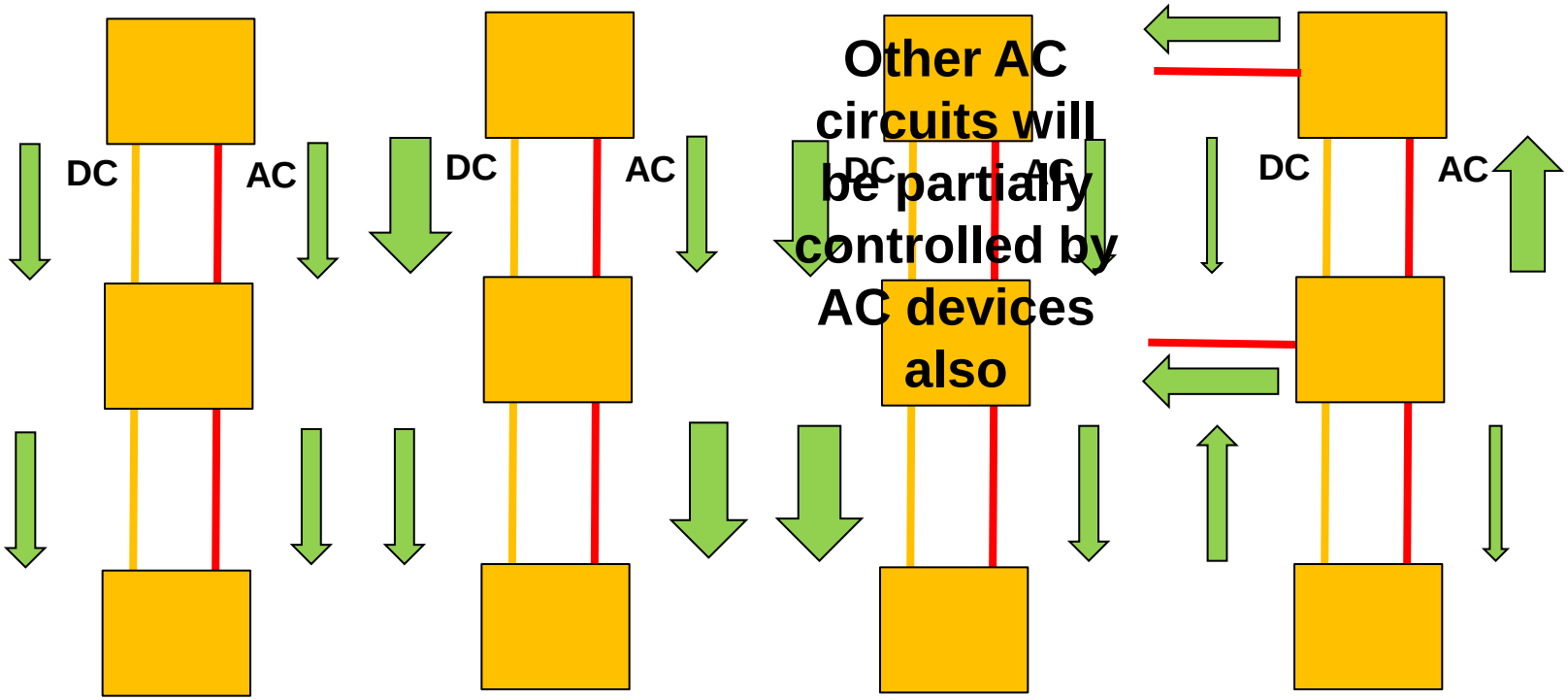




~ Offshore Gen x 2

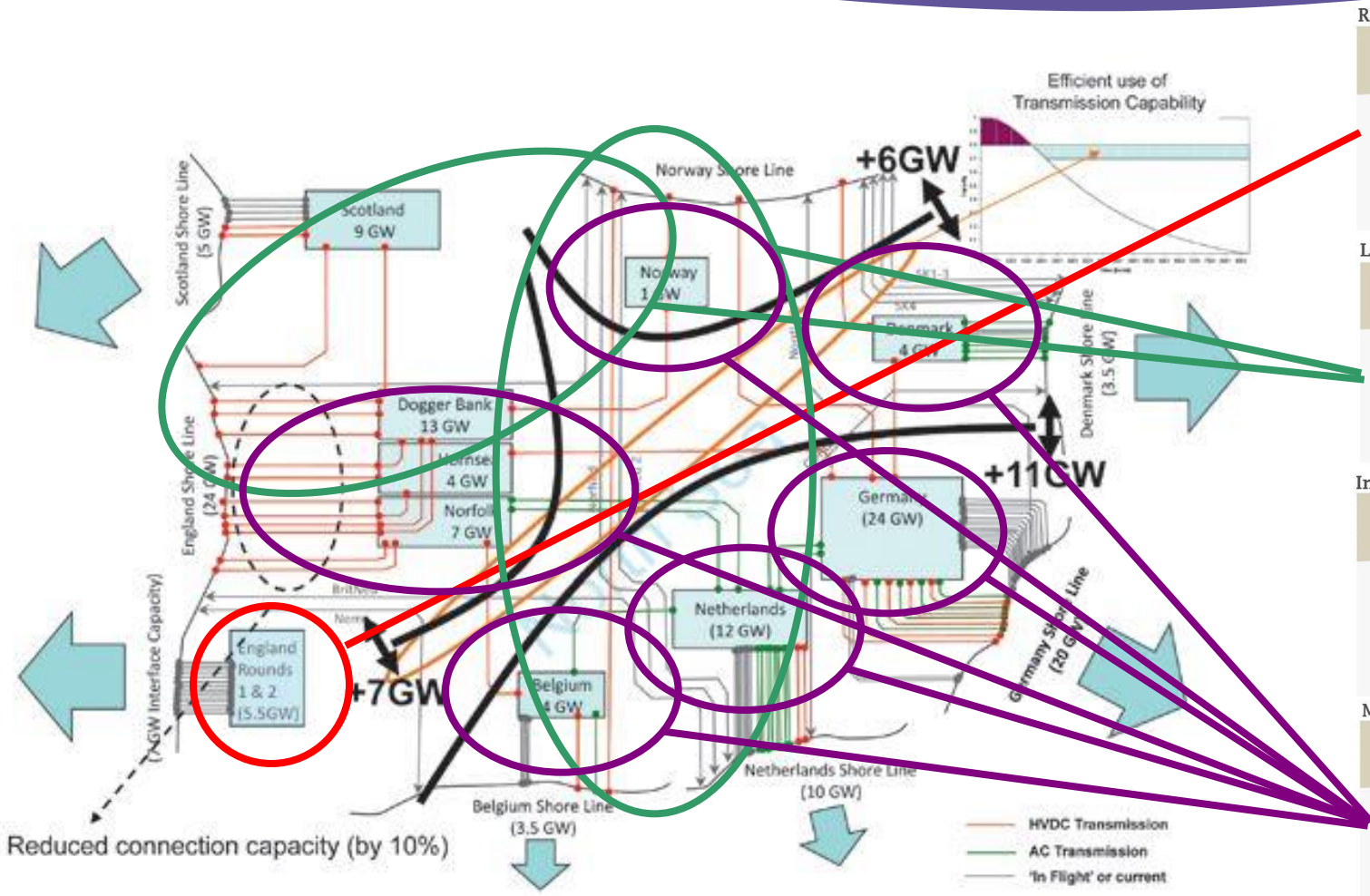
DC and AC parallels – Why?

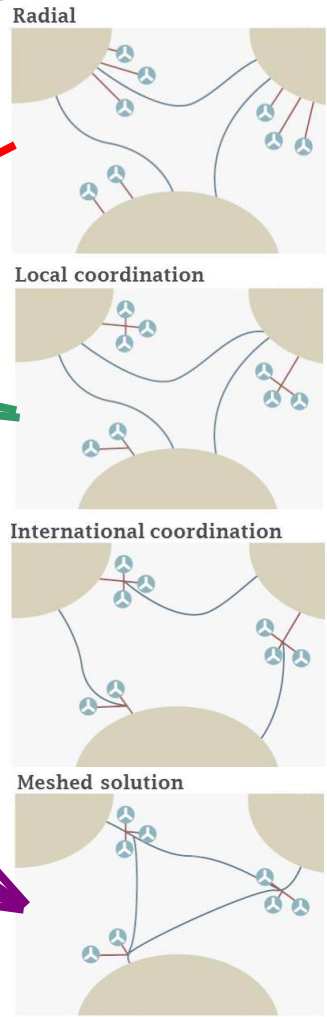
Each decision unique but probable due to:



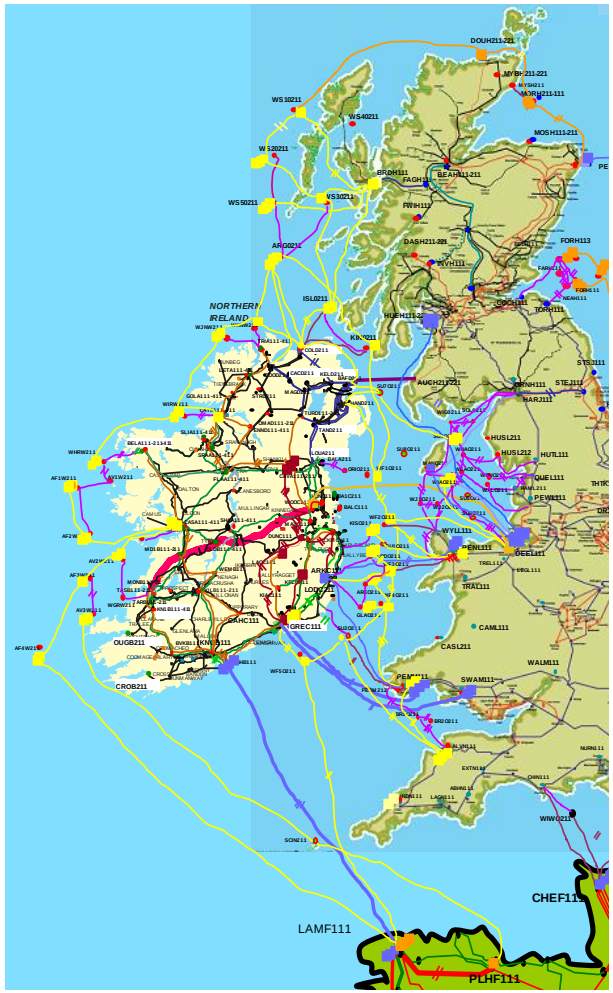
AC parallel circuits power flow controlled by DC parallel cct, cheaper higher capacity controllable link

DC Connected PPMs – towards large clusters of offshore wind, integrated in the European system



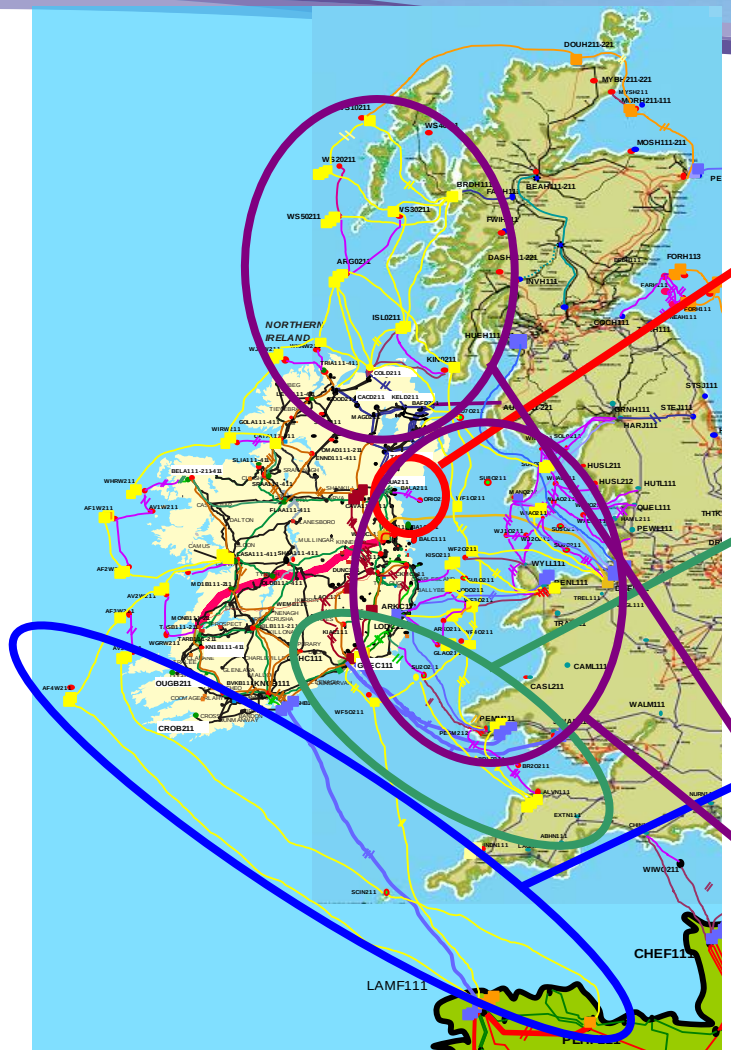


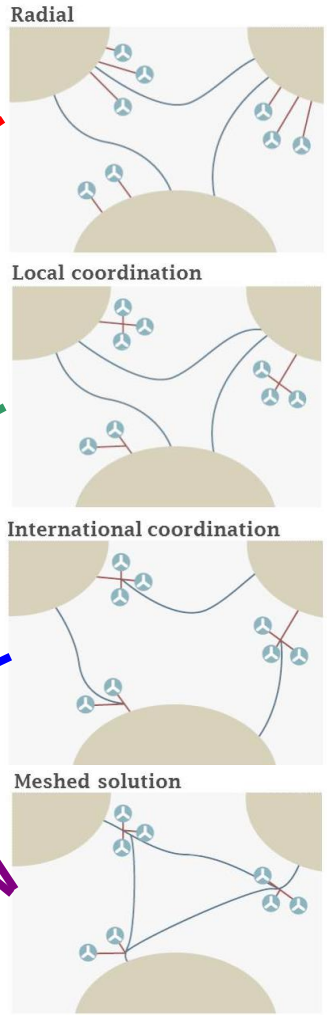
EirGrid offshore grid study



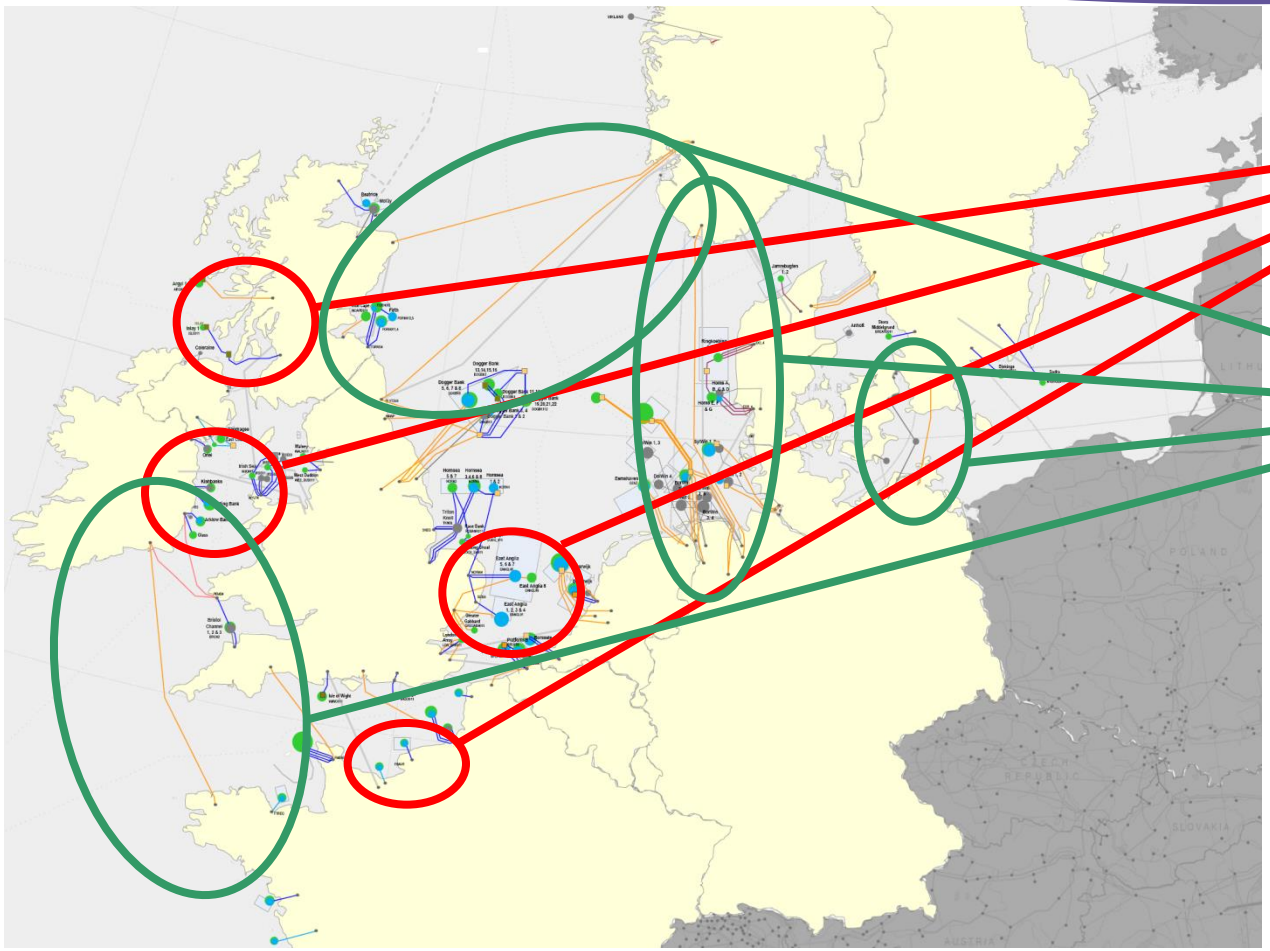
- 3 to 5GW offshore by 2030
- Incremental development: ensure that each step still allows to capture a wide range of scenarios
- Symbiotic nature of onshore and offshore grid
- Choice for AC, HVDC VSC or HVDC LCC depends on various parameters and project specific assessments
- Results eventually in meshed hybrid AC/DC connections

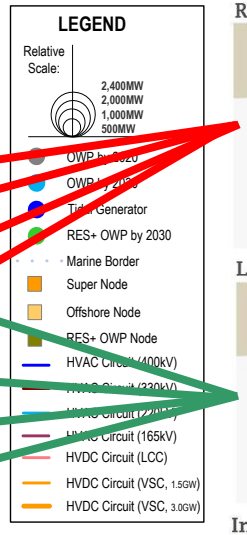
EirGrid offshore grid study

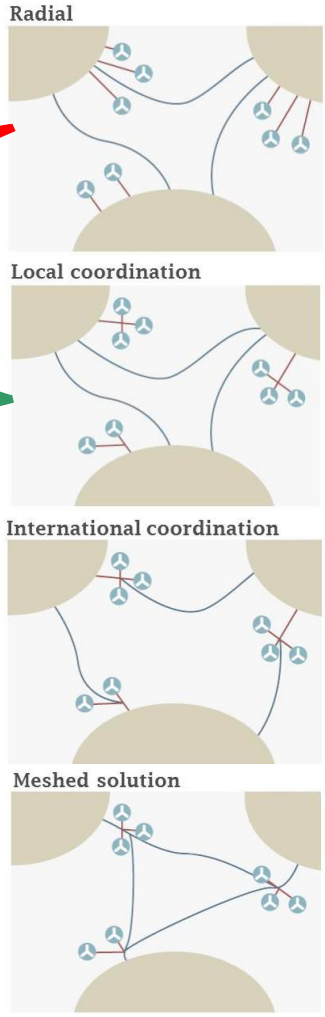




NSCOGI – Grid Configuration – radial design

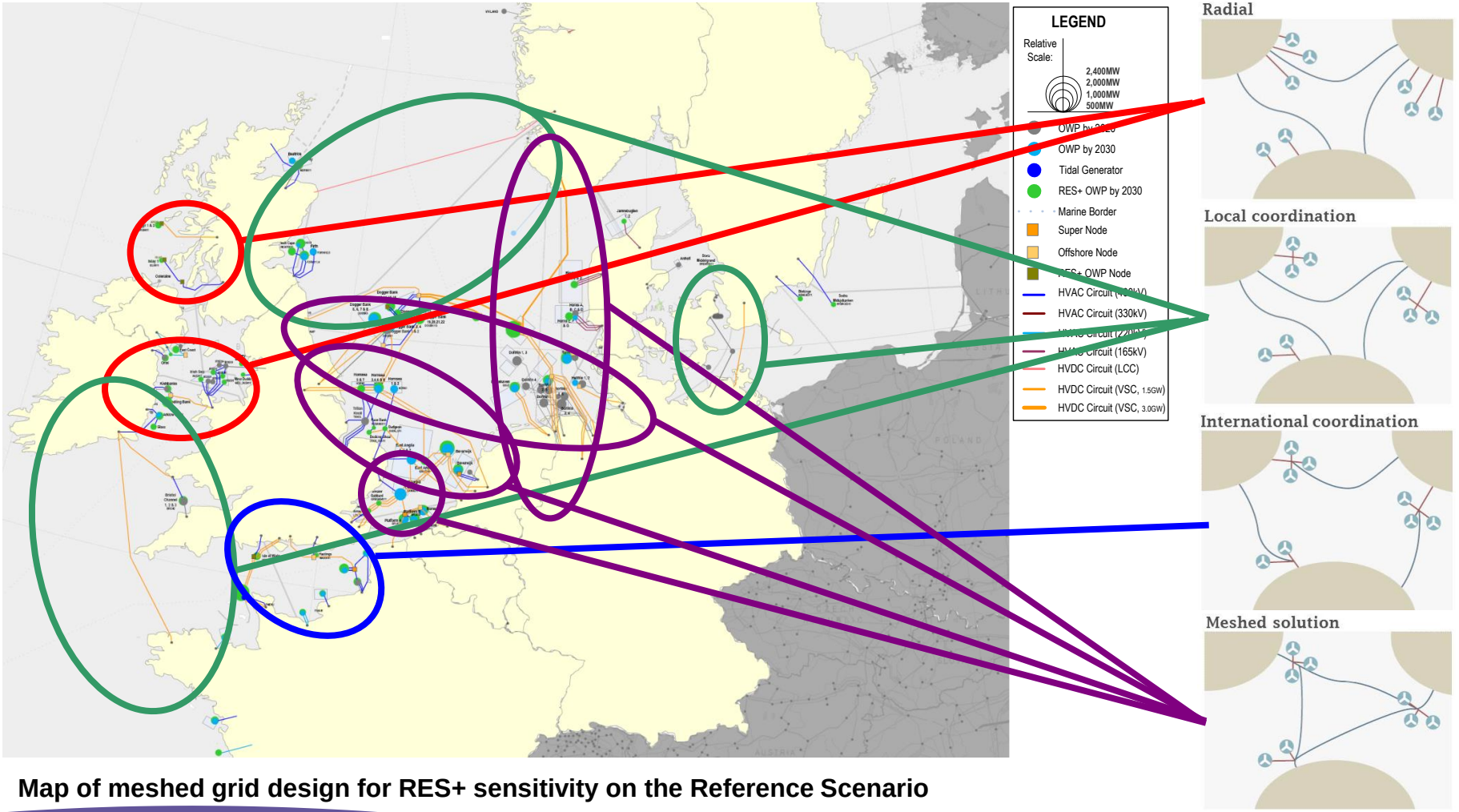






Map of radial grid design for RES+ sensitivity on the Reference Scenario

NSCOGI – Grid Configuration – meshed design



Map of meshed grid design for RES+ sensitivity on the Reference Scenario

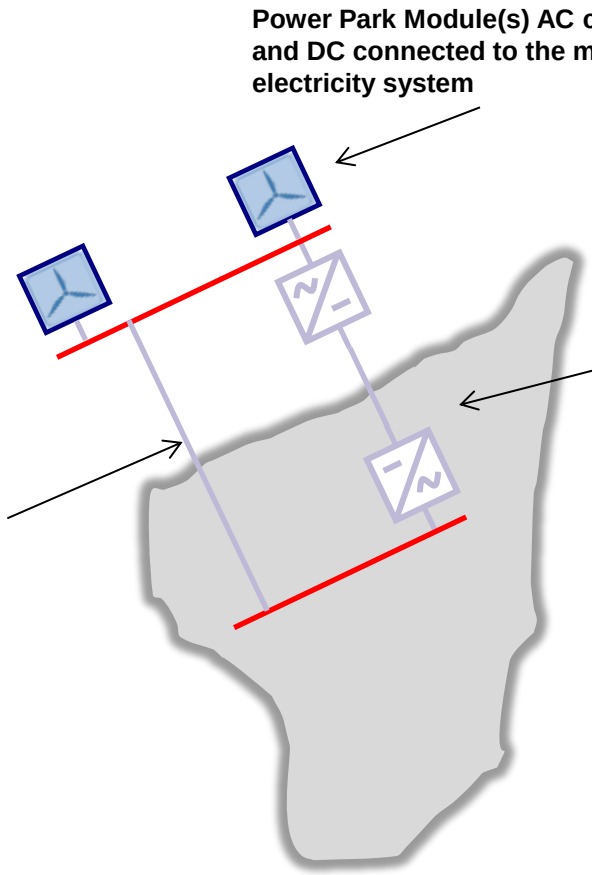
Future views of the DC-Connected PPMs

NC RfG and NC HVDC Coordination

Reactive power capability requirements

AC connected offshore PPMs and DC Connected PPMs

NC HVDC Applies
NC RfG Applies



NC HVDC and RfG interaction

Power Park Modules

- To ensure network development practical NC RfG used as basis for many requirements for example:
  - *Frequency Requirements*
  - *Voltage Requirements*
  - *Control modes*
  - *Protection*
- Certain requirements need to be adapted due to:
  - *Economics, and/or*
  - *Changes in network configuration*

Converters

- Converters must be compatible with NC RfG requirements
- Principle of network [HVDC] being last to disconnect is reflected in DC Connected PPM converters

Future views of the DC-Connected PPMs

NC RfG and NC HVDC Coordination

Reactive power capability requirements

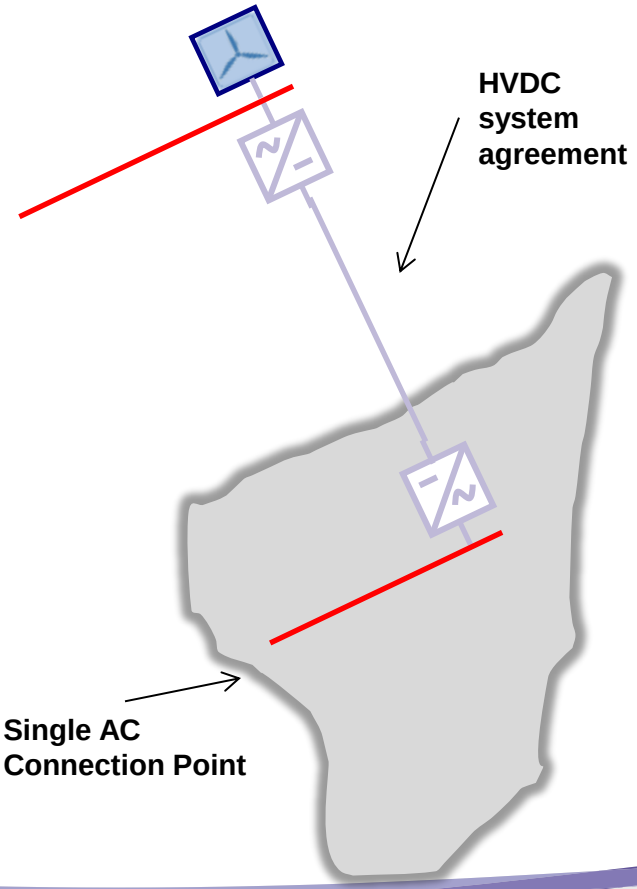
PPM DC Connected Single AC connection point Article 40.2.a

For Generators with agreement with HVDC system owner:

- **Fit and be tested with reactive requirements (defined in Article 40.2.b)**
- **Do not fit reactive requirements (defined in Article 40.2.b) now but agree with TSO when and how it is to be provided if required later**
- **Generator has the right not to install reactive capability if CBA performed by TSO does not show requirement within the timescale**

HVDC system requirements to stabilise the generators local node is local issue

Future network development met by agreement on reactive power provision



PPM DC Connected Reactive Power Article 40.2.b

For Generators without agreement:

•Meet TSO defined reactive power requirements [any shape] within range in table below

•As required compensate cable/line connections from connection point

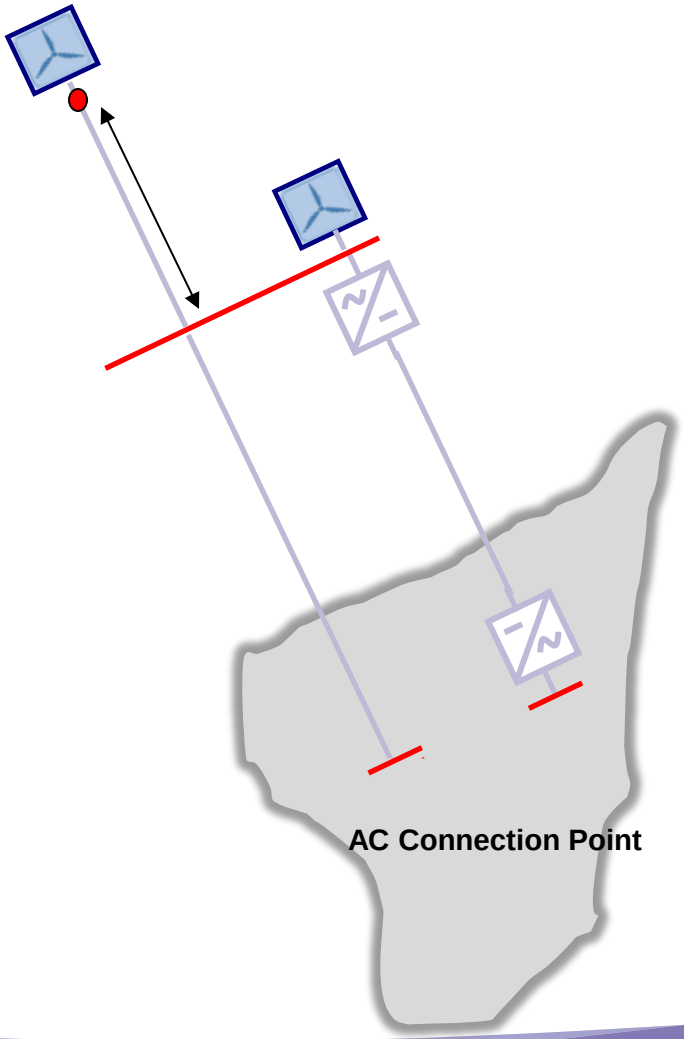
•If there is a future AC connection to a synchronous network, reactive power should be consistent with the NC RfG and either be provided at the time of connection or demonstrate and agree with TSO how it is to be provided in future when AC connected

Reactive power can be impacted by local area existing and future network [both local collector network and other connection]

Network assets for a generator linked contractually and finacially to it

Future network development must be considered to be equitable to all users

Range of width of Q/Pmax profile	Range of steady-state Voltage level in PU
0.33 - 0.95	0.1 - 0.225



HVDC Converters Reactive Power Article 40.3

Remote -end HVDC Converter Stations shall:

•Meet TSO defined reactive power requirements [any shape] within the range in table below

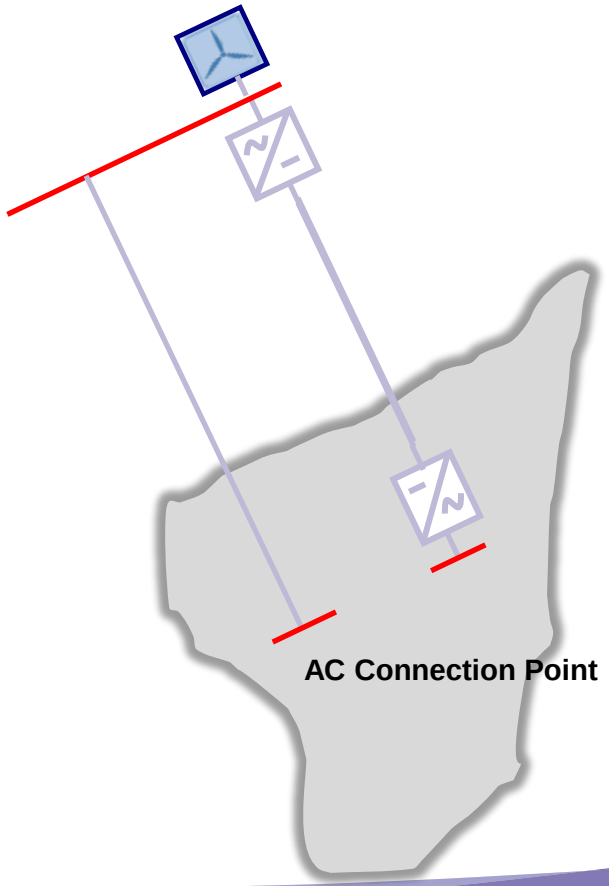
•If there is a future AC connection to a synchronous network, reactive power should be consistent with AC connected PPM NC RfG and either be provided at the time of connection or agree with TSO how it is to be provided in future when AC connected

Reactive power can be impacted be local area existing and future network [both local collector network and other connection]

Future network development must be considered to be equitable to all users

NC RFG reactive power requirements for PPMs in meshed and remote nodes sized to provide stabilised nodes – Equitable requirement on converters for same

Range of width of Q/Pmax profile	Range of steady-state Voltage level in PU
0.33 - 0.95	0.1 - 0.225



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Thank you for your attention!

Questions?

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