ADOPTING A SUSTAINABLE 2050 VISION FOR NORTH SEAS INFRASTRUCTURE TO DEFINE A WAY FORWARD

MARCH 23, 2017

ECOFYS

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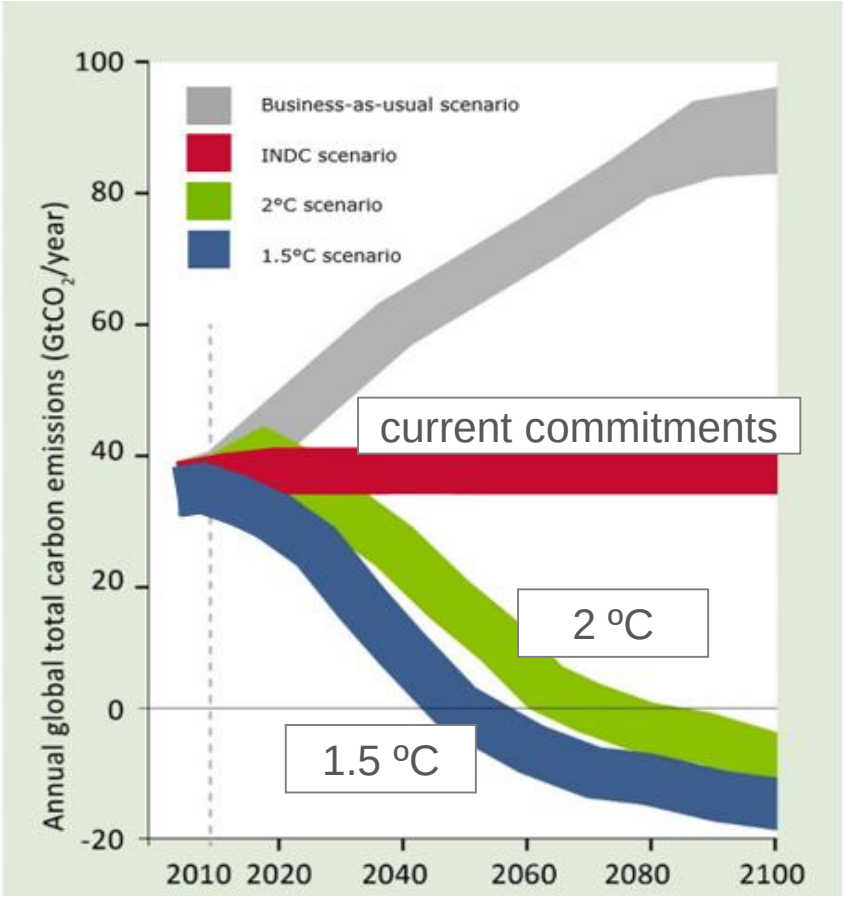
NAVIGANT

COP21: A LEGALLY BINDING COMMITMENT TO HOLDING GLOBAL WARMING WELL BELOW 2 ^{O}C, PURSUING < 1.5 ^{O}C

PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Requires

- zero CO_2 emissions before 2050
- a 50% reduction in total energy demand in 2050 (relative to 2010)
- a full de-carbonization of the electricity supply as early as 2045



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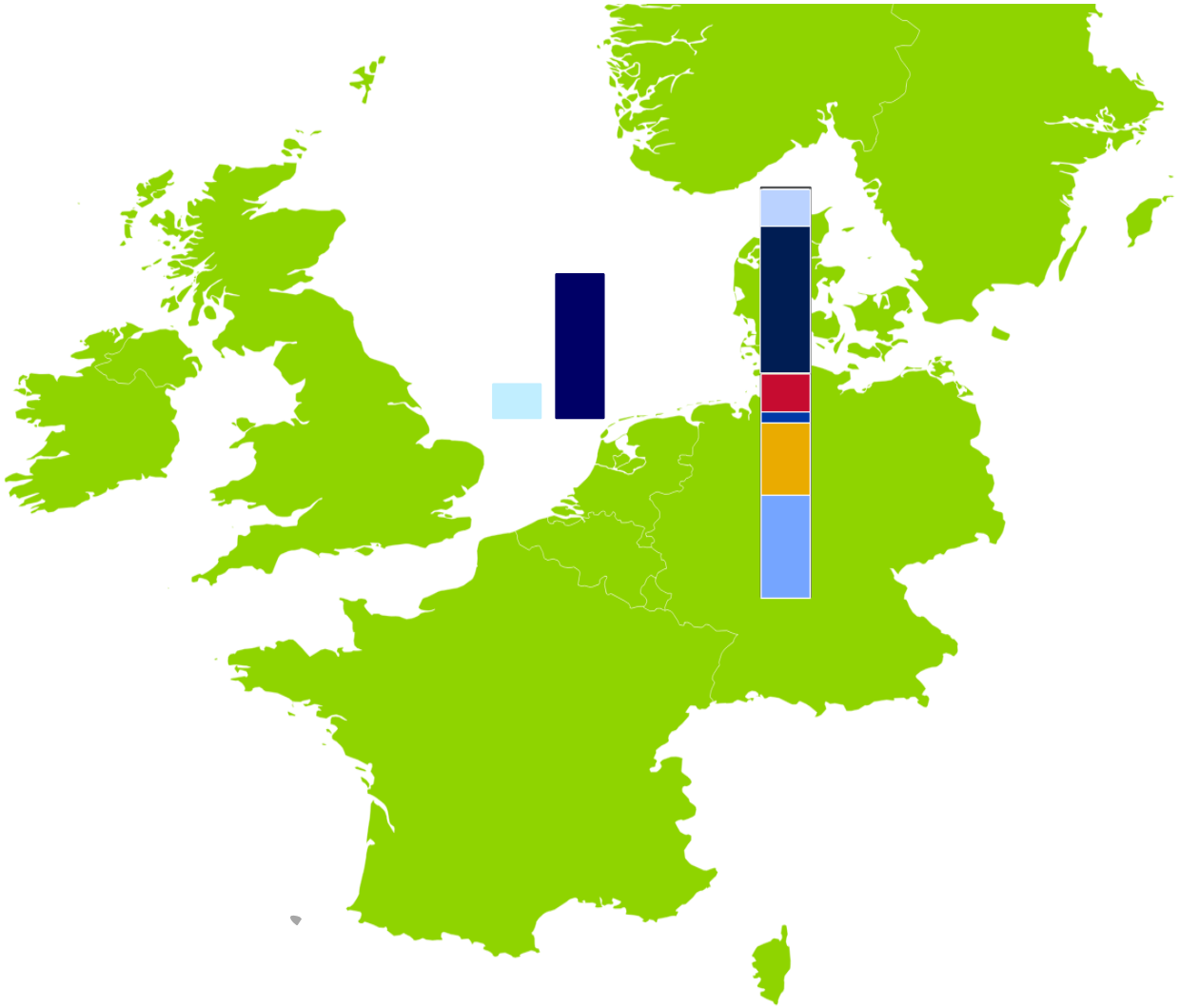
NORTH SEAS OFFSHORE WIND IS PIVOTAL TO REALIZE A 100% DECARBONIZATION OF THE ELECTRICITY SUPPLY

per country in 2045

Electricity demand

Onshore generation resource (wind, solar, hydro, bio, nuclear)

Required offshore wind capacity to meet annual electricity demand



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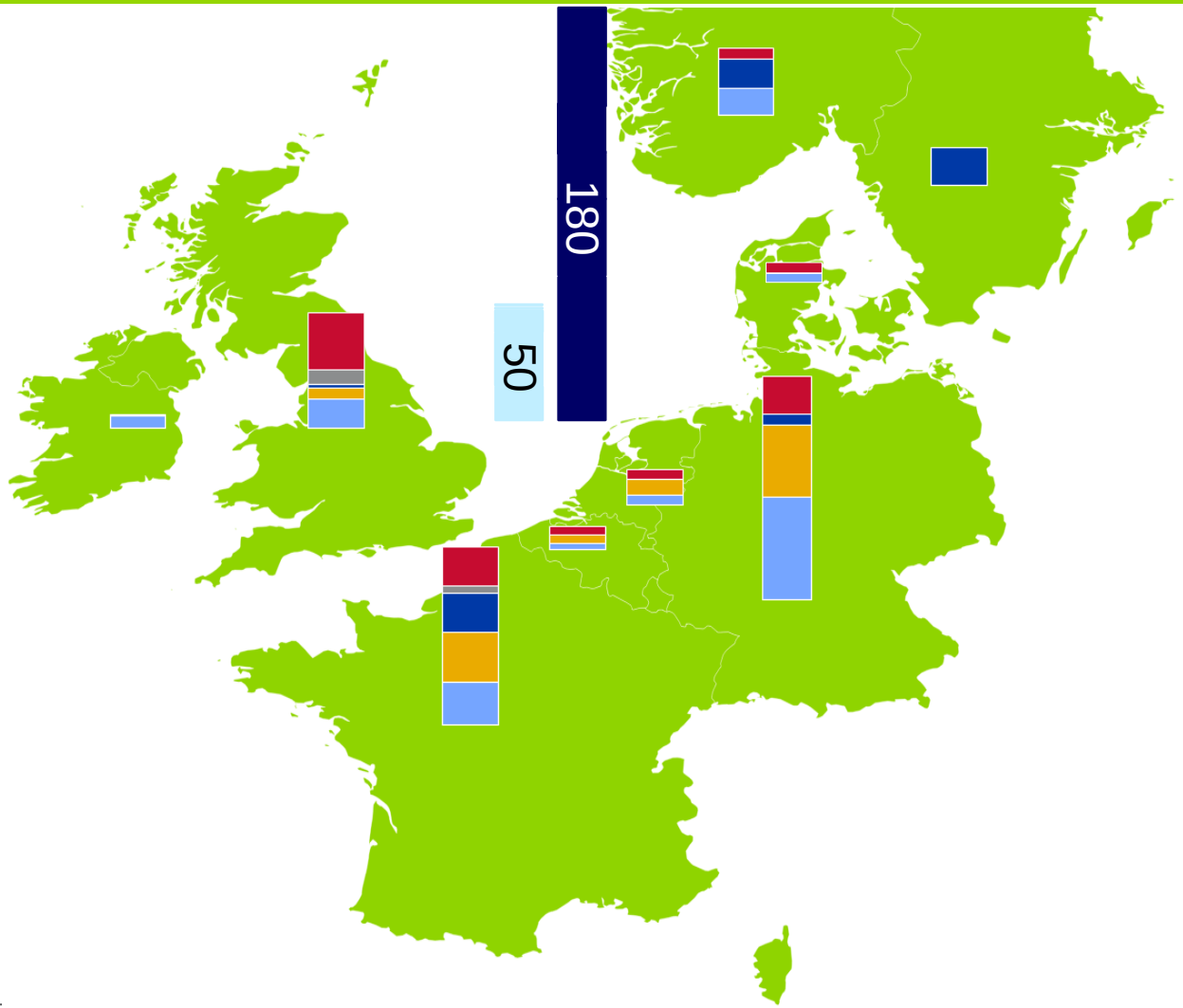

bio
nuclear
hydro
solar
onshore wind

Offhore wind
other seas
North Seas

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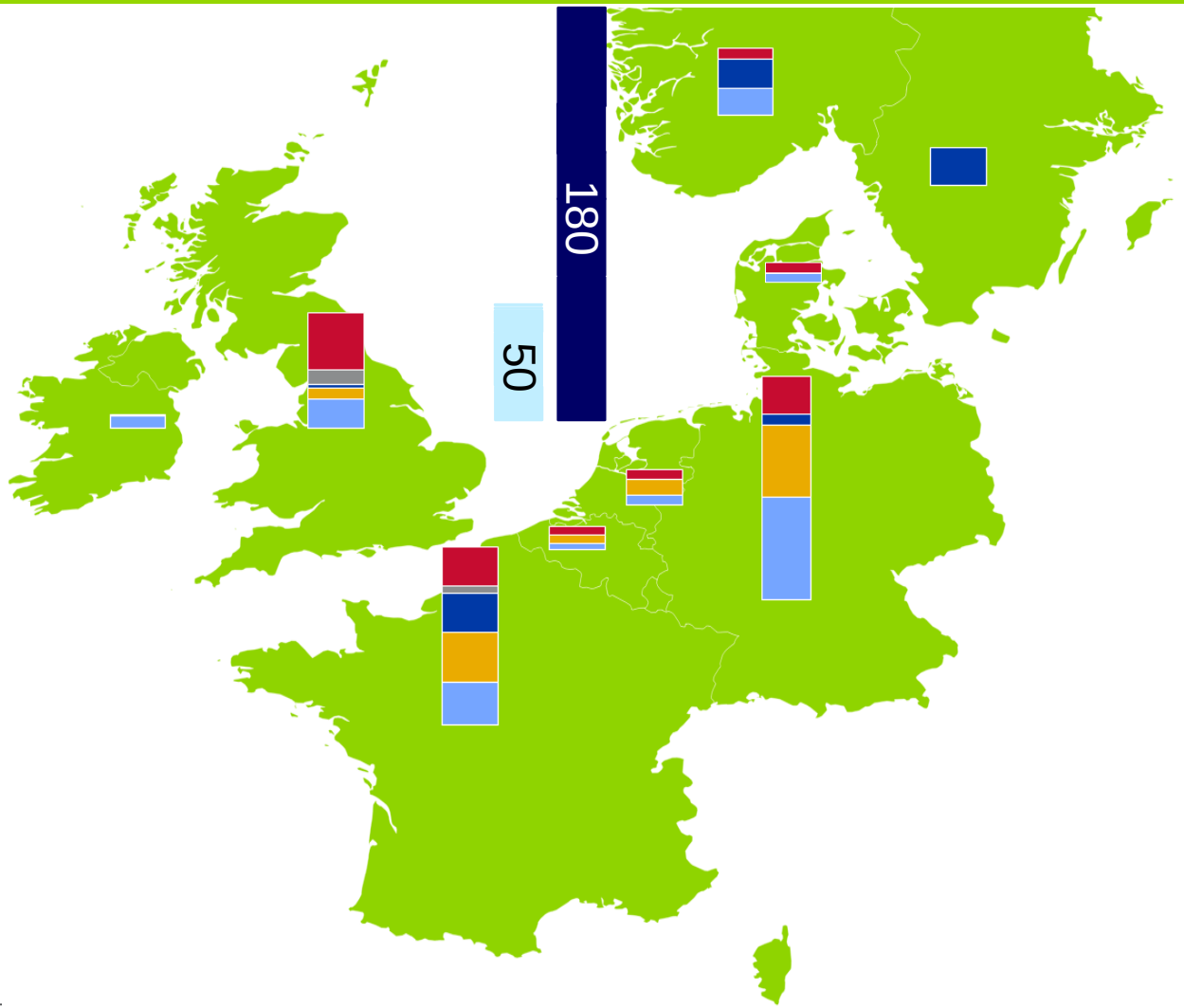
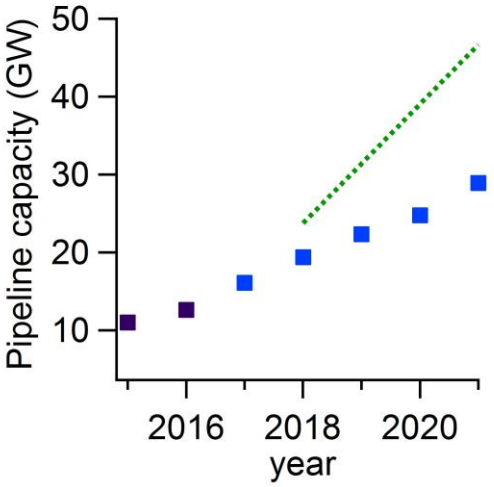
NORTH SEAS OFFSHORE WIND IS PIVOTAL TO REALIZE A 100% DECARBONIZATION OF THE ELECTRICITY SUPPLY

A need for ...

Coordinated roll-out effectively doubling the current rate to

~7 GW/year until 2045





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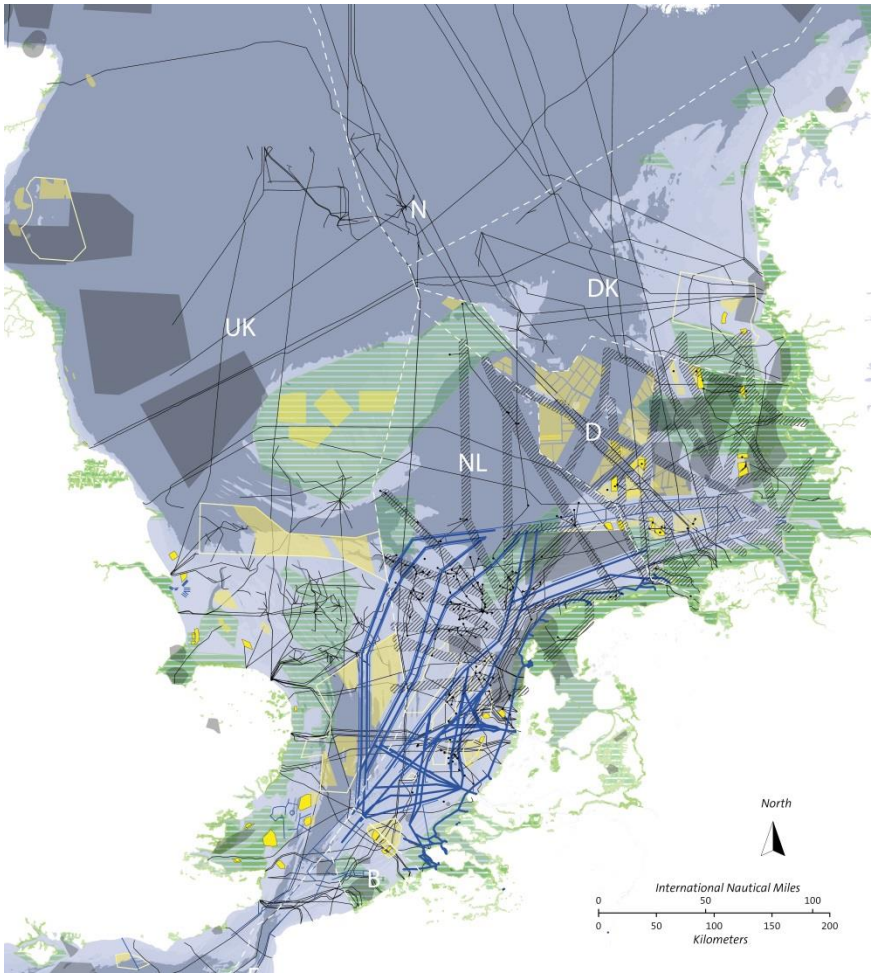
COST EFFICIENT REALIZATION OF OFFSHORE WIND CAPACITY REQUIRES CROSS BORDER COOPERATION ...



North Seas ...

- an important nature area
- with intense use by a wide variety of economic sectors
- where cost of offshore wind depends on wind resource, depth, distance to shore/port, grid connection concept, inter-array wakes ....
- requires a regional view on resource use, deployment and operation based on a common sustainability commitment and an integrated market .

Spatial analysis performed by

Royal HaskoningDHV
Enhancing Society Together

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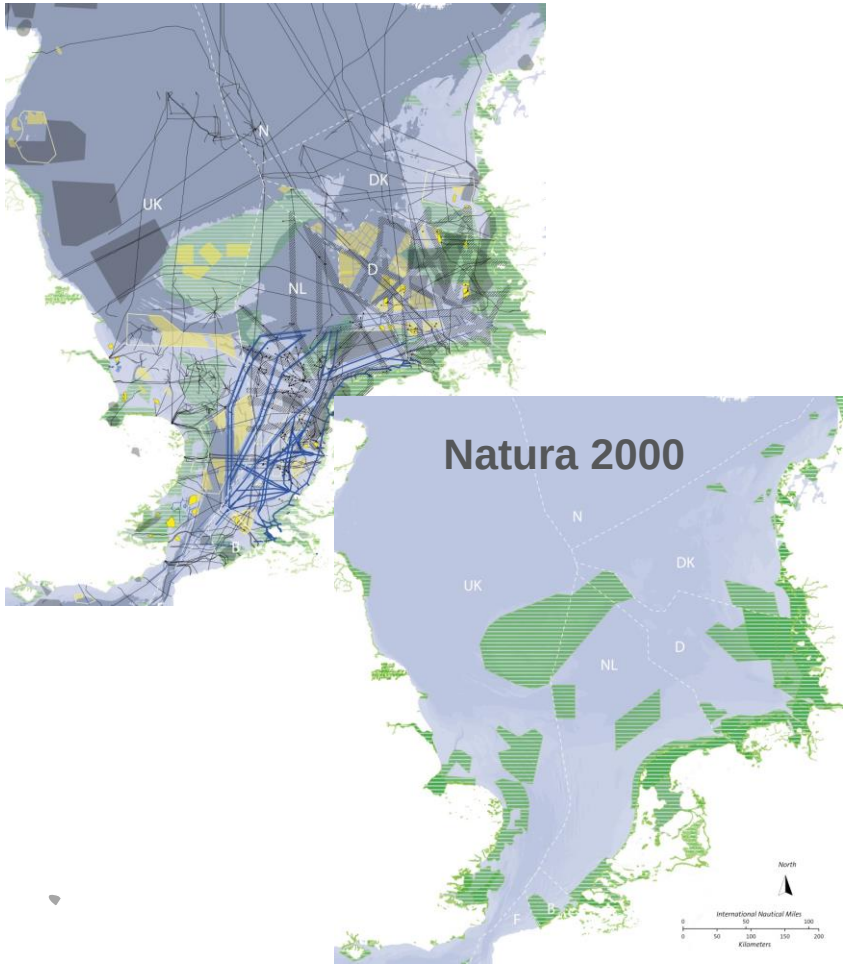
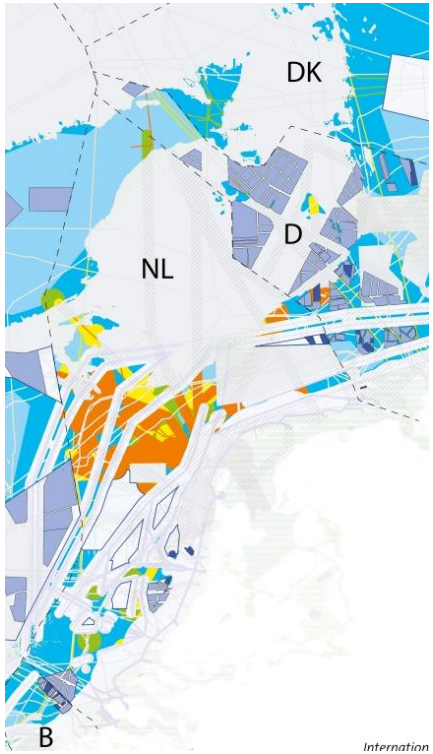
... AND A STRATEGIC APPROACH TO OVERALL SPATIAL PLANNING OF OFFSHORE WIND IN THE NORTH SEAS

Current constraints



Oil & gas decommissioning

(example Netherlands)



A need for ...

An international spatial planning strategy that ensures **cost efficient** utilization of the resource, aligned with **off- and onshore grid developments** and with maximum benefit for the **environment**

Spatial analysis performed by

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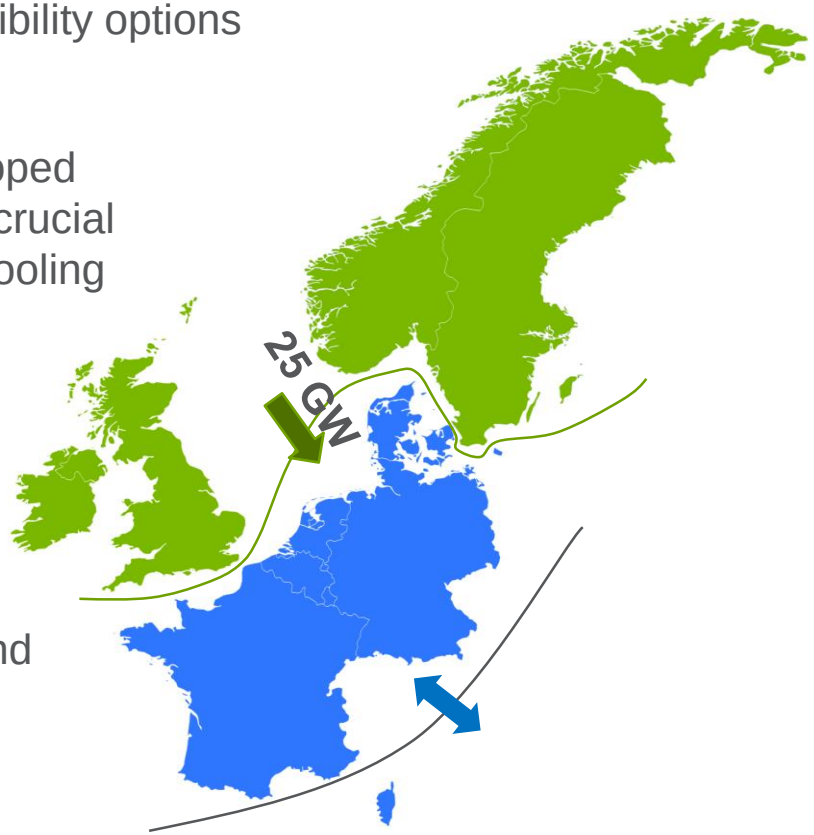
HIGHER LEVELS OF RENEWABLE ENERGY SOURCES REQUIRE INCREASED INTERCONNECTIVITY

- A higher share of variable sources requires increased flexibility options
- A well-developed network is a crucial enabler for pooling of flexibility resources
- 2045 interconnectivity assessment based on first order adequacy, regional correlations, and flexibility potential estimates



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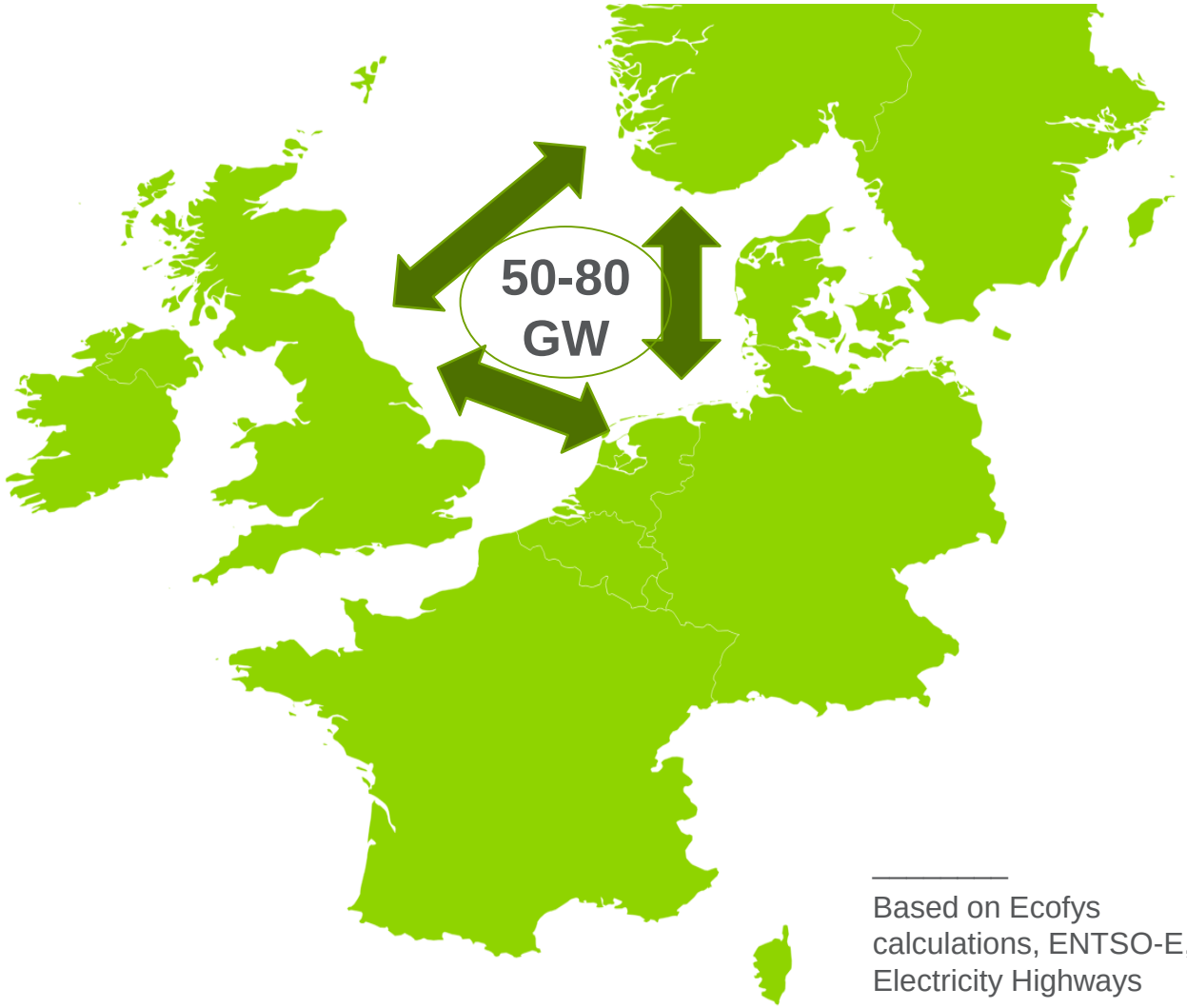
230 GW OF OFFSHORE WIND IMPLIES 50-80 GW INTERCONNECTOR CAPACITY FOR FLEXIBILITY OPTIONS AND MARKETS TO FUNCTION

Sufficient interconnection capacity is essential to **maintain operational security**

An increased roll-out of interconnector capacity requires a cost-benefit appraisal that goes **beyond current economic triggers** of operational cost savings

The **onshore grid** is an essential part of the North Sea grid too, and needs to cope with new flow patterns.



Based on Ecofys calculations, ENTSO-E, Electricity Highways

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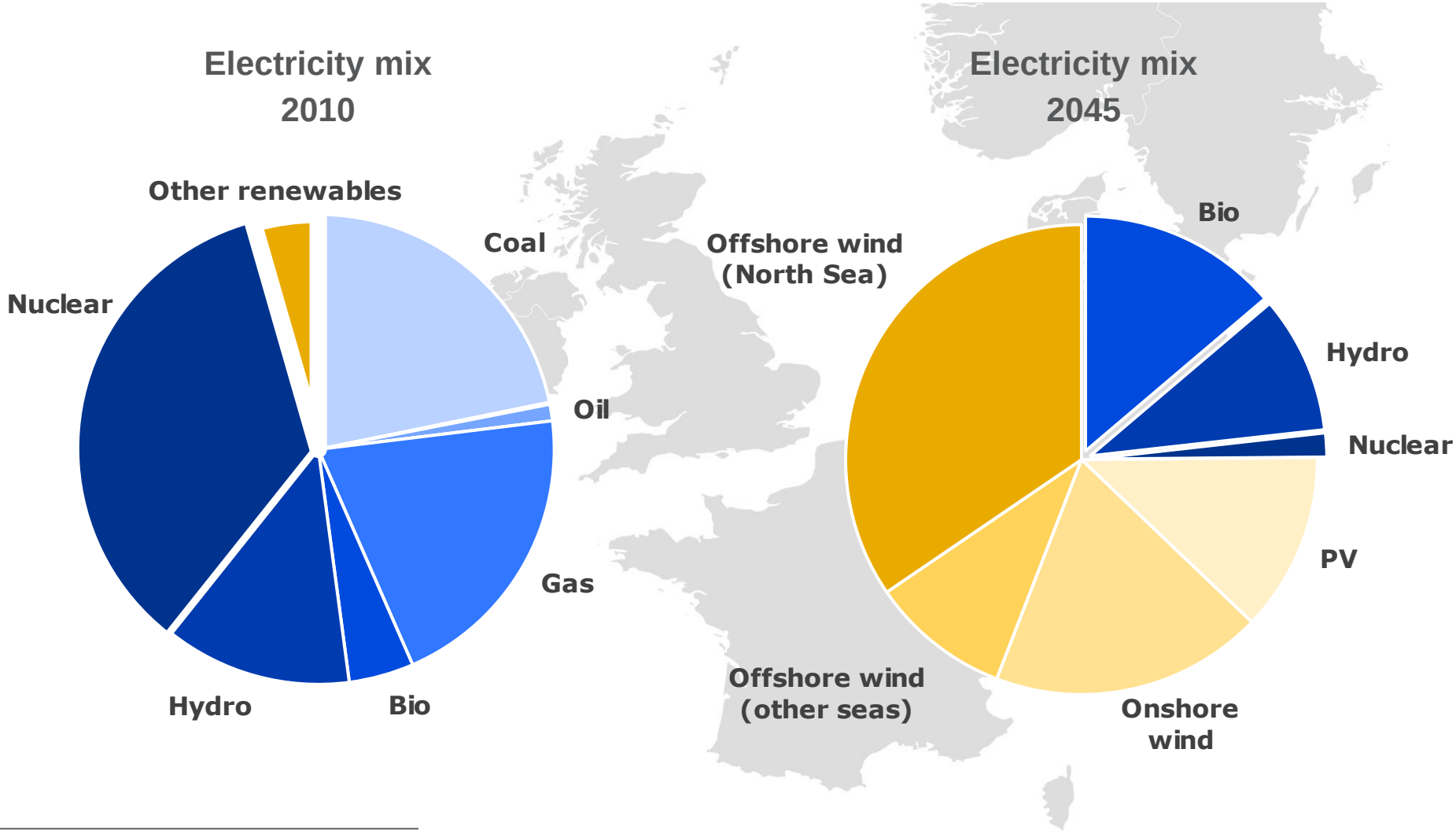
THE TRANSITION TO A DECARBONIZED ELECTRICITY SUPPLY MARKS THE END OF DEPENDING ON CONVENTIONAL RESERVES ...



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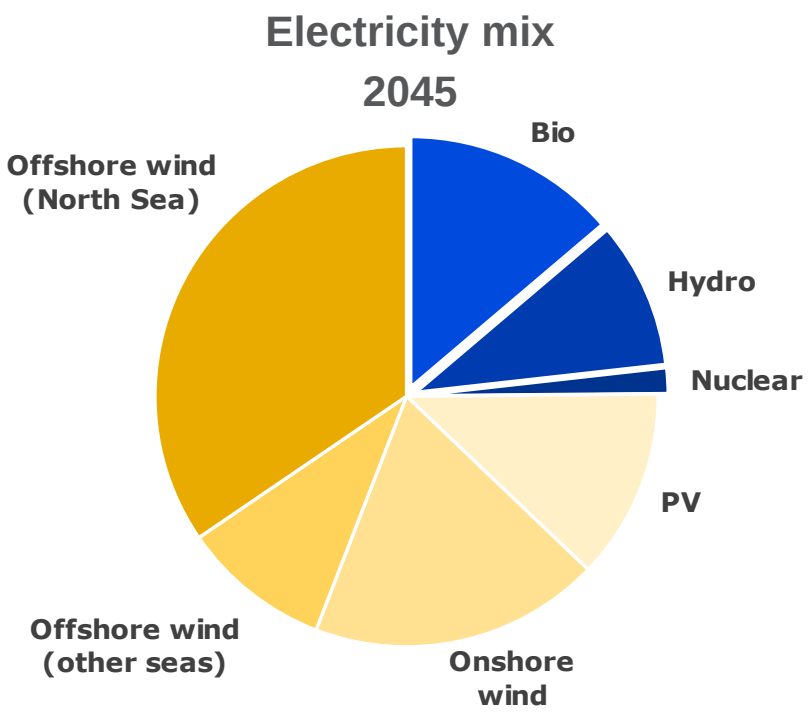
... AND THUS REQUIRES A SIGNIFICANT INCREASE IN FLEXIBILITY OPTIONS



- There is need for **better understanding of market/operation issues** resulting from this energy mix, including economic triggers and additional capacity reserves
- **Increased use of cost efficient flexibility options**, such as demand response, small/large-scale storage, power-to-gas, etc., will become essential in the 2045 scenario in face of decreasing dispatchable generation capacity.
- A **realistic and robust potential roadmap** is needed for all flexibility options by 2045, including a trade-off of some flexibility options with interconnection levels.

Based on IEA, Fraunhofer ISI, PRIMES, WindEurope studies and Ecofys expert

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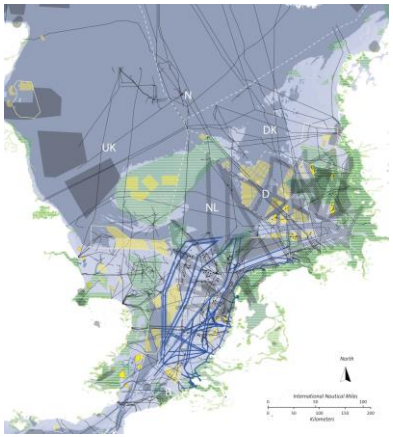
DELIVERING ON THE PARIS AGREEMENT REQUIRES IMMEDIATE ACTION ON THREE FRONTS

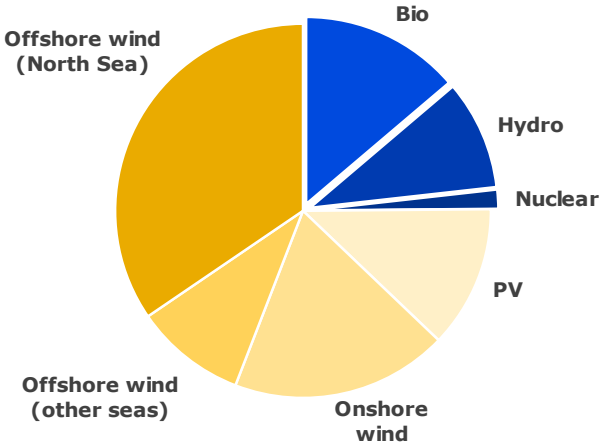
230 GW offshore wind | 50-80 GW interconnection | 25% dispatchable

Spatial planning
Development of **long term spatial planning strategy** (internationally coordinated roll-out, benefit to environment, maximise grid integration, at low cost)

Interconnectivity
Development of methodology to **value grid stability** that incentivizes interconnector capacity to maintain operational security

Flexibility
Development of **2045 roadmap for flexibility options** (storage, demand response, capacity reserves, and other energy sectors)





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