The challenge of the next power plant generation

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The challenge

- Reduce global greenhouse gas reductions by 20-50% in 2050 (compared to 1990)
- European communion (negotiation position)
  15-30% in 2020
  60-80% in 2050

- Substitution of about 300 GW power plant capacity by 2020
- Comply with a growing need for additional capacity

How to match climate goals and future electricity needs?

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Options for CO_2 emission reductions and fulfillment of a growing demand for electricity

Energy efficiency improvement:

- Buildings
- Transport
- Manufacturing industry

Zero-emission energy sources:

- Renewables: biomass, wind, solar
- Carbon dioxide removal
- Nuclear energy

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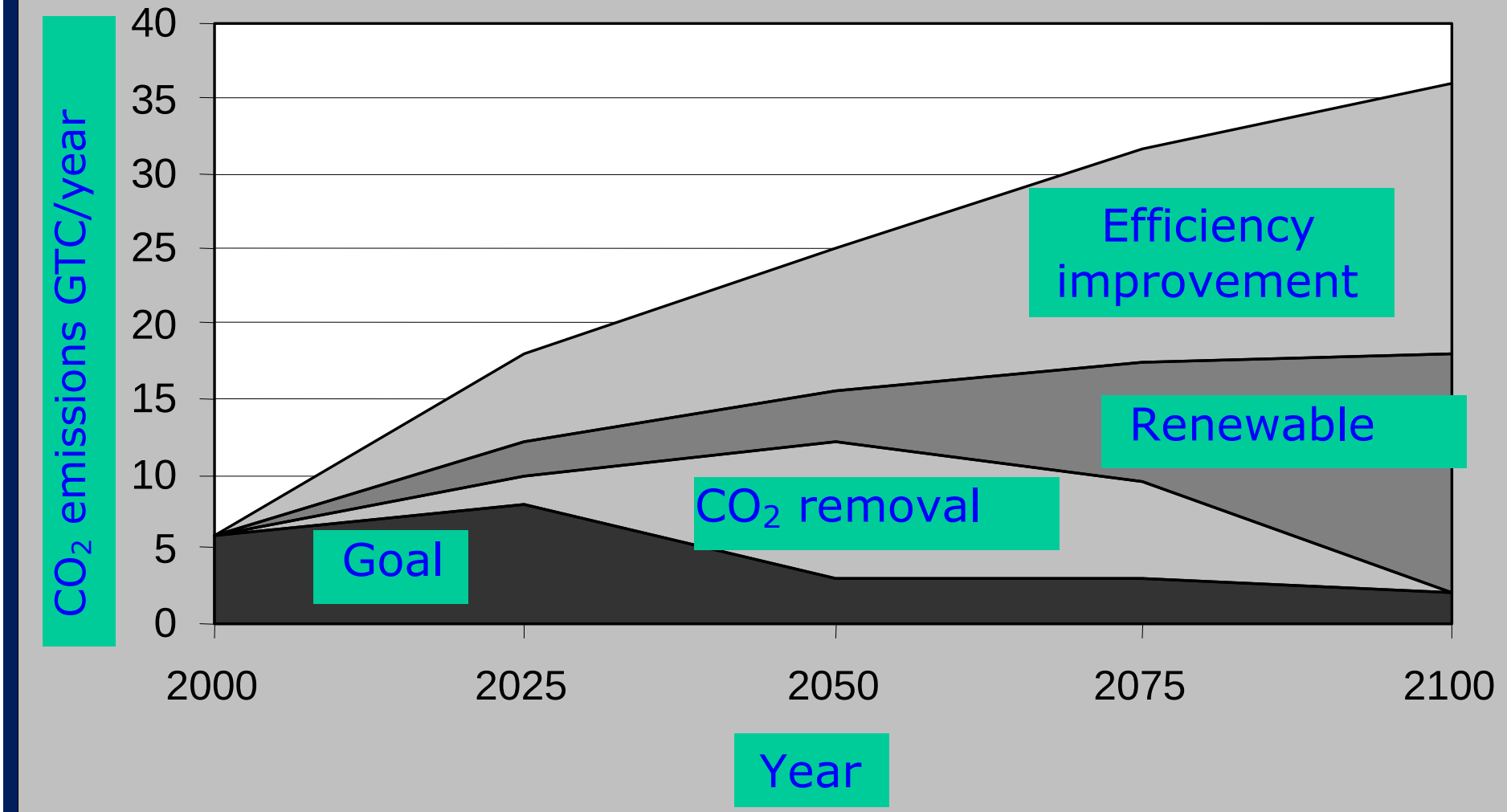
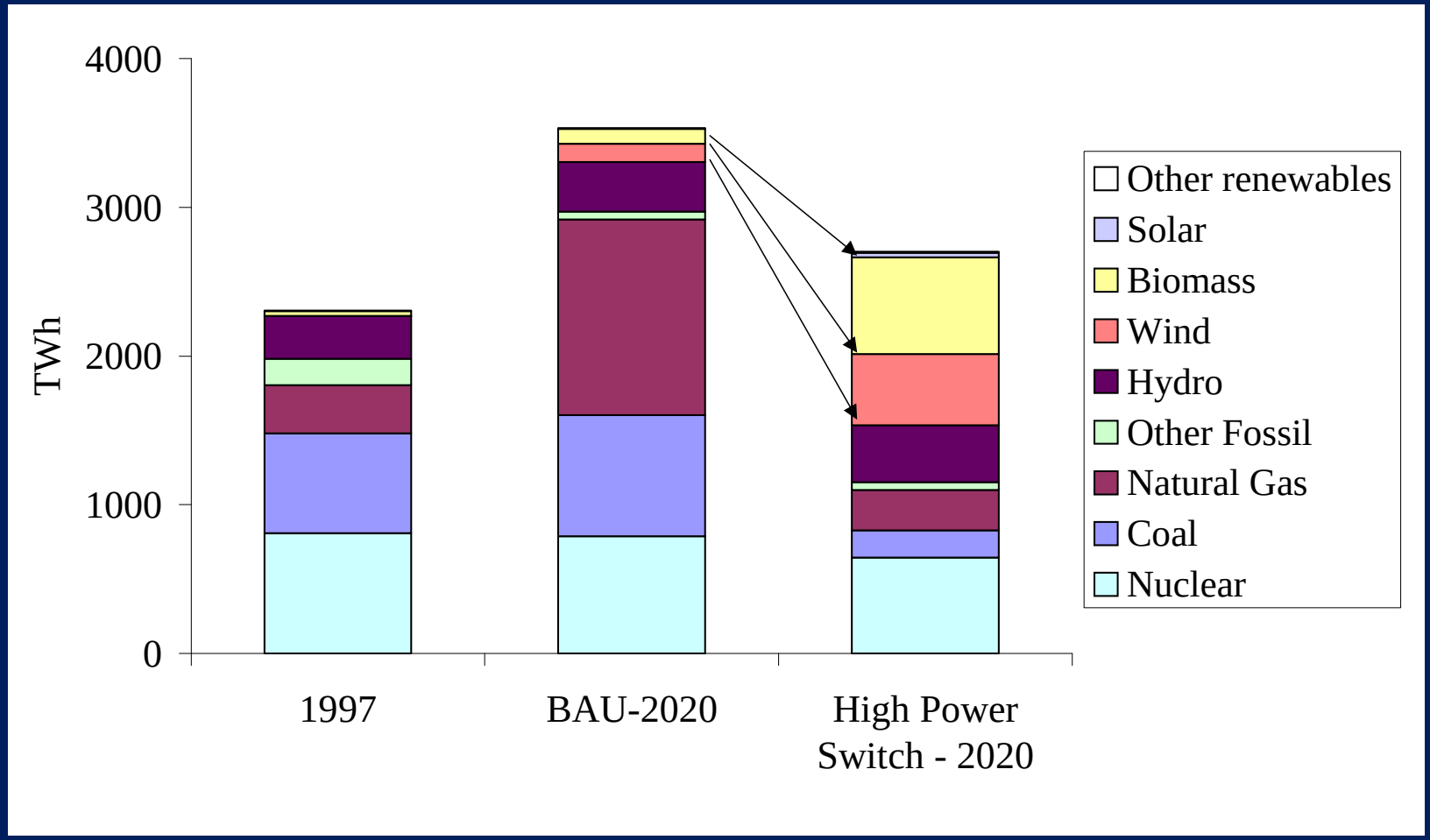

CO_2 emissions GTC/year
40
35
30
25
20
15
10
5
0
2000
2025
2050
2075
2100
Year
Efficiency improvement
Renewable
CO_2 removal
Goal

Electricity production



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POSEIDON

Sustainable energy supply sets out to sea

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Econcern Vision

The world's oceans and seas could easily supply the worlds energy needs in a sustainable way

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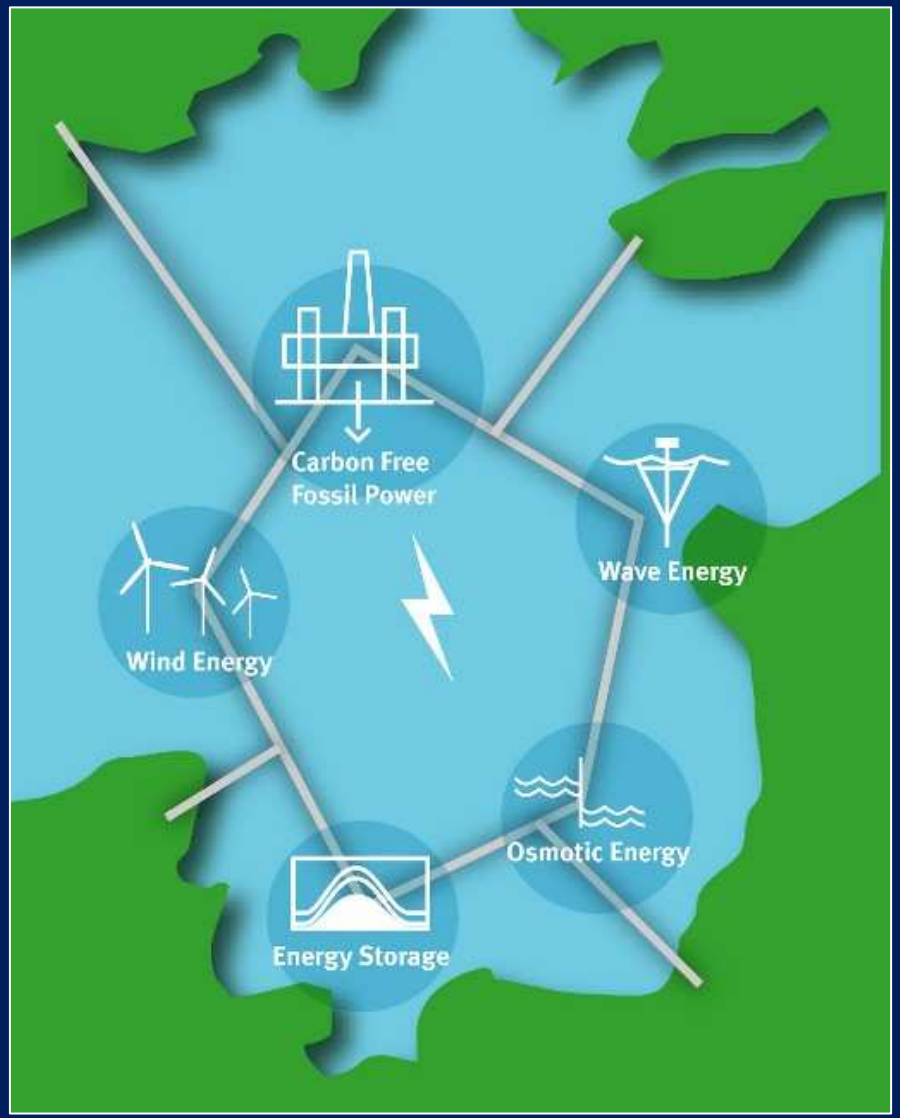
Poseidon

System approach

- Optimized utilization of offshore energy resources
- Transportation networks
- Energy storage
- Carbon dioxide storage

System benefits

- Security of supply
- Environment
- Economy



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Poseidon benefits

Security of supply	• Huge endogenous energy resources • System approach ensures reliable supply • Flexible in terms of technology selection
Environment	• No/low emissions of greenhouse gases or pollutants
Economy	• Most cost-effective sustainable energy system for the long-term (with increasing carbon constraints) • Boost for innovation, technology development and employment.

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Resources – fossil fuels

Example North Sea

North Sea countries' oil and gas production

(UK, NO, DK, DE, NL, BE) (2002):

- Equals 70% of the region's primary energy consumption
- Could equal 2400 TWh/yr or 2 times the region's electricity consumption (350 GW)
- Economic with Enhanced Oil Recovery
- Carbon neutral with CO_2 storage

North Sea	Production (EJ/yr)	Reserves (EJ)
Oil	13	80 - 90
Natural Gas	10	95 – 105

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Why offshore electricity production?

- Carbon free electricity production
  - Enhanced Oil Recovery: Capture of CO_2 and re-injection into the oil(/gas) field generates extra oil(/gas) and income
  - CO_2 capture and storage without enhanced recovery
- Power plant can be re-used at other site after exploration
- Oil/gas based offshore electricity production can compensate for intermittent nature of electricity from renewable energy sources

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Resources – renewables

- Wind energy
- Wave energy
- Tidal energy
- Osmotic energy
- Bio-energy from sea organics
- Ocean thermal energy conversion (OTEC)

… and combined configurations

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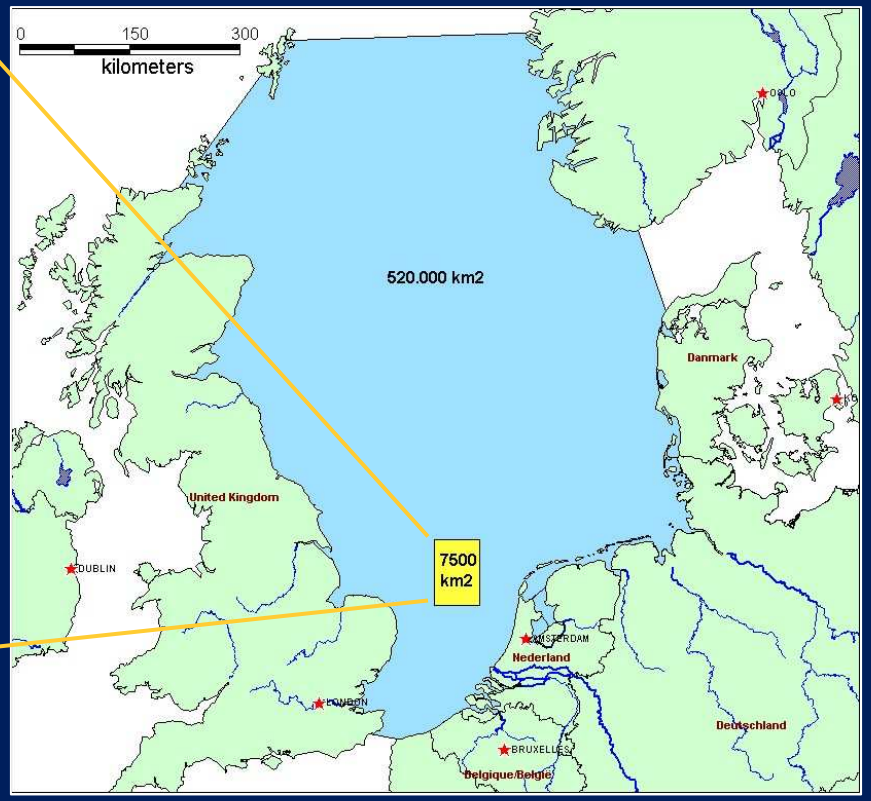
Example: Wind energy

Example North Sea

Wind	75,000 MW
Area	7500 km^2 (1.4% North Sea)
Electricity Production	260 TWh Equals 16% of 2030 electricity consumption of North Sea countries



9% of North Sea area could provide all North Sea countries with electricity

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Flexibility

- System approach enables adoption of new innovative technologies
  - Near term: offshore wind and oil/gas platforms, Enhanced Oil Recovery (CO_2 storage)
  - Mid-term: wave, energy storage (CAES)
  - Long-term: CO_2 storage, tidal, osmosis, biomass
- New storage concepts
- New transmission/transport concepts

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Interconnection and energy storage

- Controllable and reliable power by connecting
  - Demand regions
  - Electricity production units
  - Energy storage (electricity (e.g. CAES) or into other energy products)
- Savings on network costs as compared to business-as-usual situation
- Main challenge: organisation, financing and planning of the infrastructure

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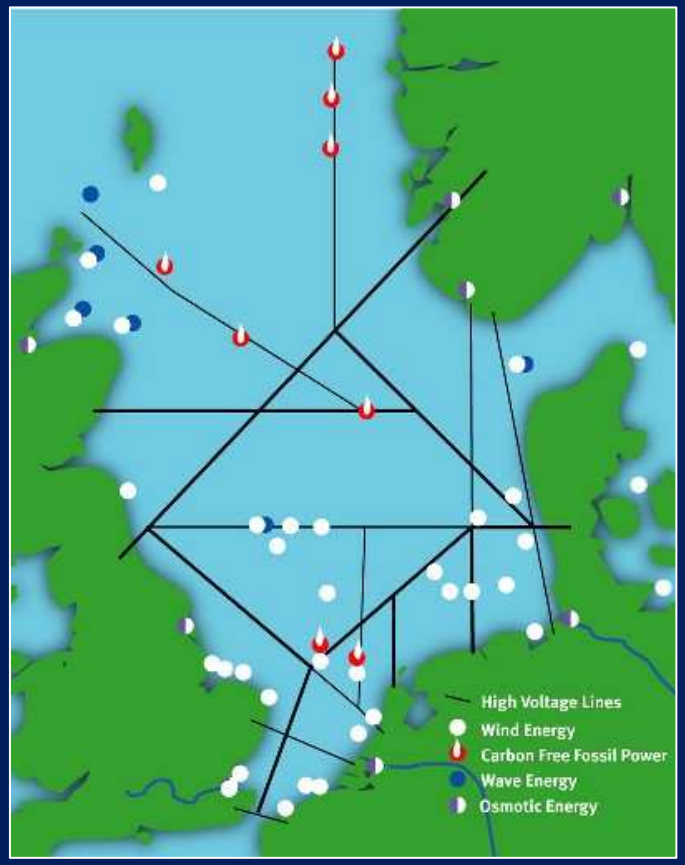
North Sea offshore network

Example North Sea

Now



Poseidon Future

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Environment

- Transition towards sustainable and climate neutral energy supply
- No environmental, health and safety impacts onshore
- 'Buying time' by using fossil fuels in combination with EOR / CO_2 capture and storage

North Sea storage capacity: **98 GtCO_2**

Oil fields	7 Gt CO_2
Gas fields	17 Gt CO_2
Aquifers	74 Gt CO_2

>**50** times annual CO_2 emissions of North Sea countries

Example North Sea

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Economy

- Wind offshore can become competitive as stand alone option
  - Cost reductions due to technological progress
  - Increased Carbon constraints
- System approach will speed up this process
  - Smart interconnection can reduce costs
  - Fossil fuels can support controllable and reliable supply (with increased market value of the produced electricity)
- 'New' renewables can be integrated

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Poseidon summary

- Reliable electricity system
- Security of supply, not depending on resources from outside the region.
- A carbon free electricity system
- No environmental, health and safety impacts onshore
- Boost for innovation, technology development and employment.
- A true sustainable electricity system


Thank you for your attention
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