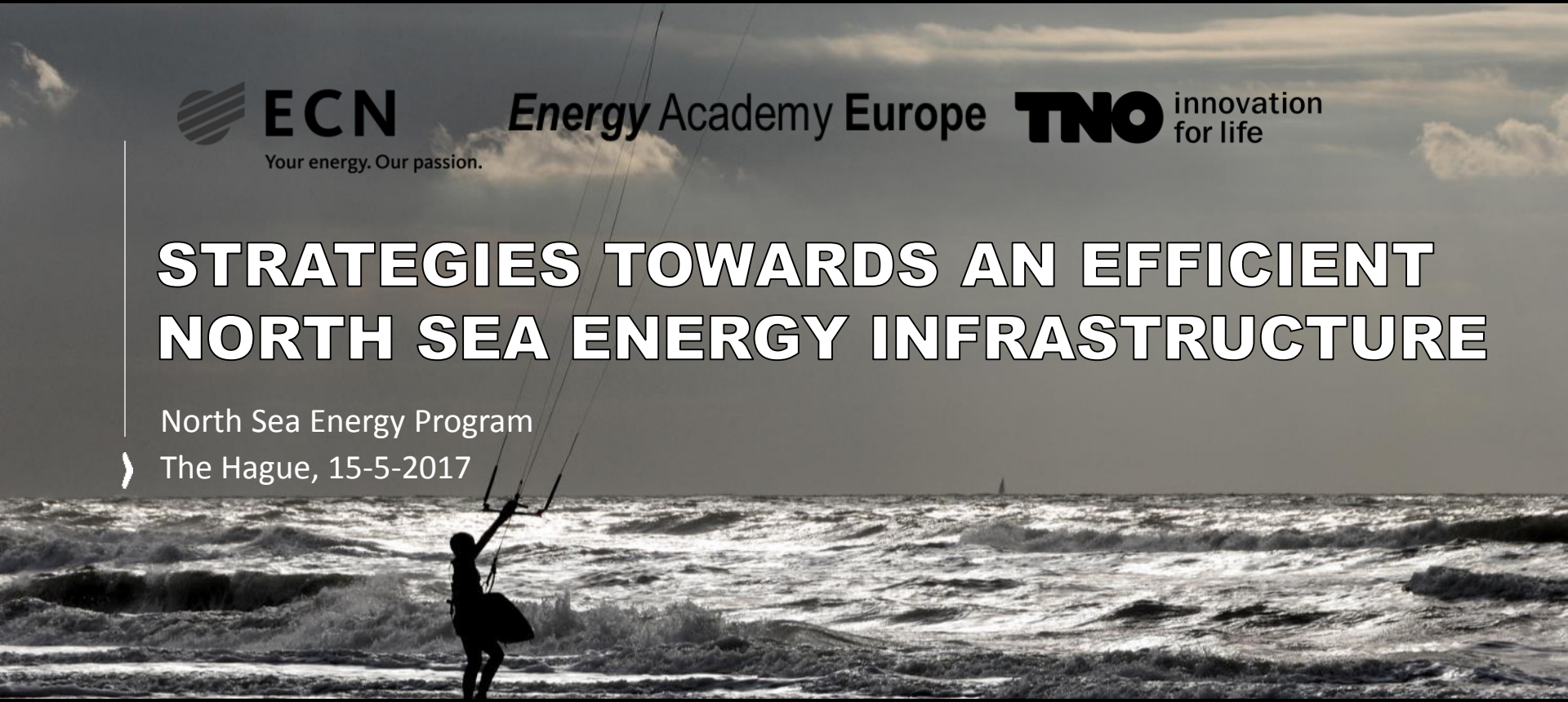
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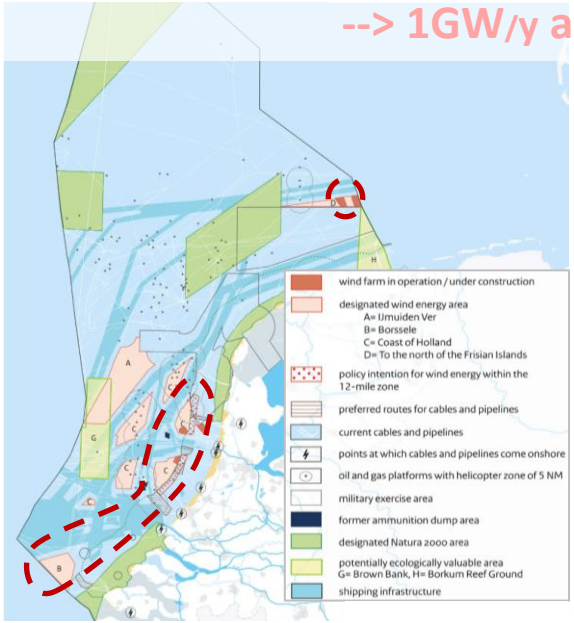
STRATEGIES TOWARDS AN EFFICIENT NORTH SEA ENERGY INFRASTRUCTURE
North Sea Energy Program
The Hague, 15-5-2017


MOTIVATION
INTEGRATION OPTIONS
STRATEGIES

THE CASE OF DUTCH NORTH SEA REGION (1/2): OFFSHORE WIND IS GROWING RAPIDLY …

- Designated areas **--> 4.5GW in 2023**
  --> 1GW/y after 2023

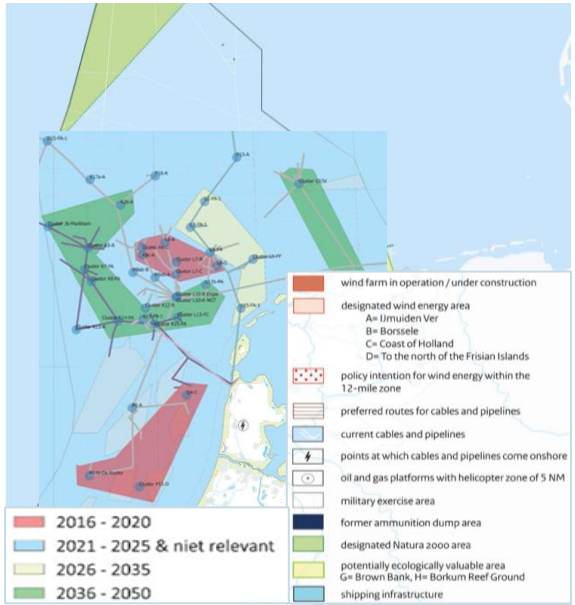


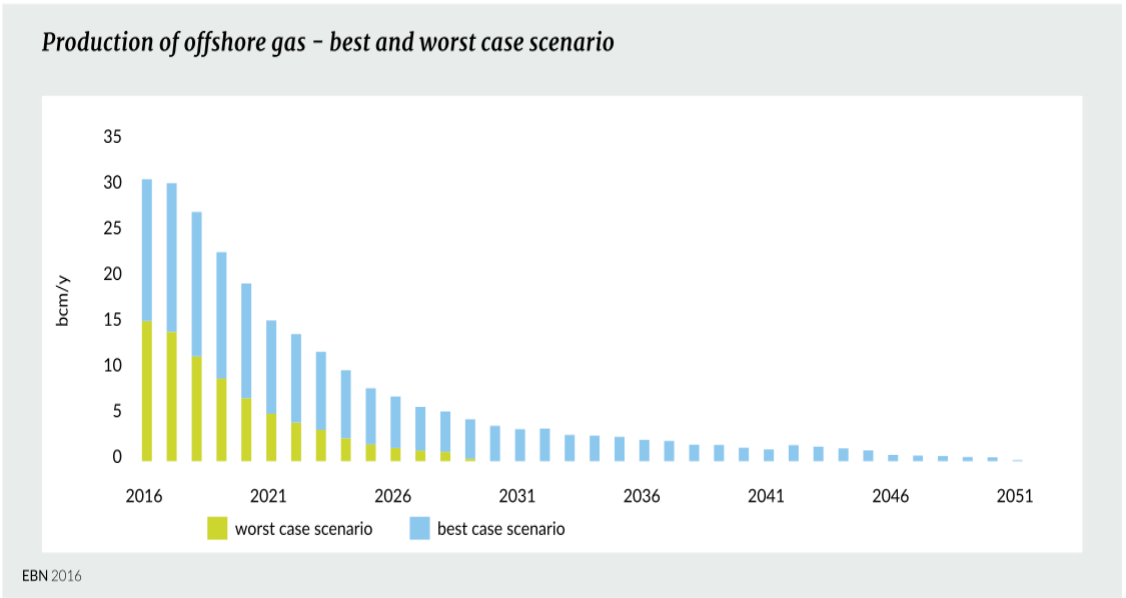
Source: Beleidsnota Noordzee 2016-2021, Noordzeeloket.nl

- EU-scenario for 27% renewables share and 40% CO_2 reduction, from Paris agreement

EU net capacity additions by type (GW) and share of electricity from variable renewables (%) in the INDC scenario: 27% renewables and 40% CO_2 emission reduction compared to 1990.

THE CASE OF DUTCH NORTH SEA REGION (2/2): …WHILE OFFSHORE GAS PRODUCTION IS DECLINING

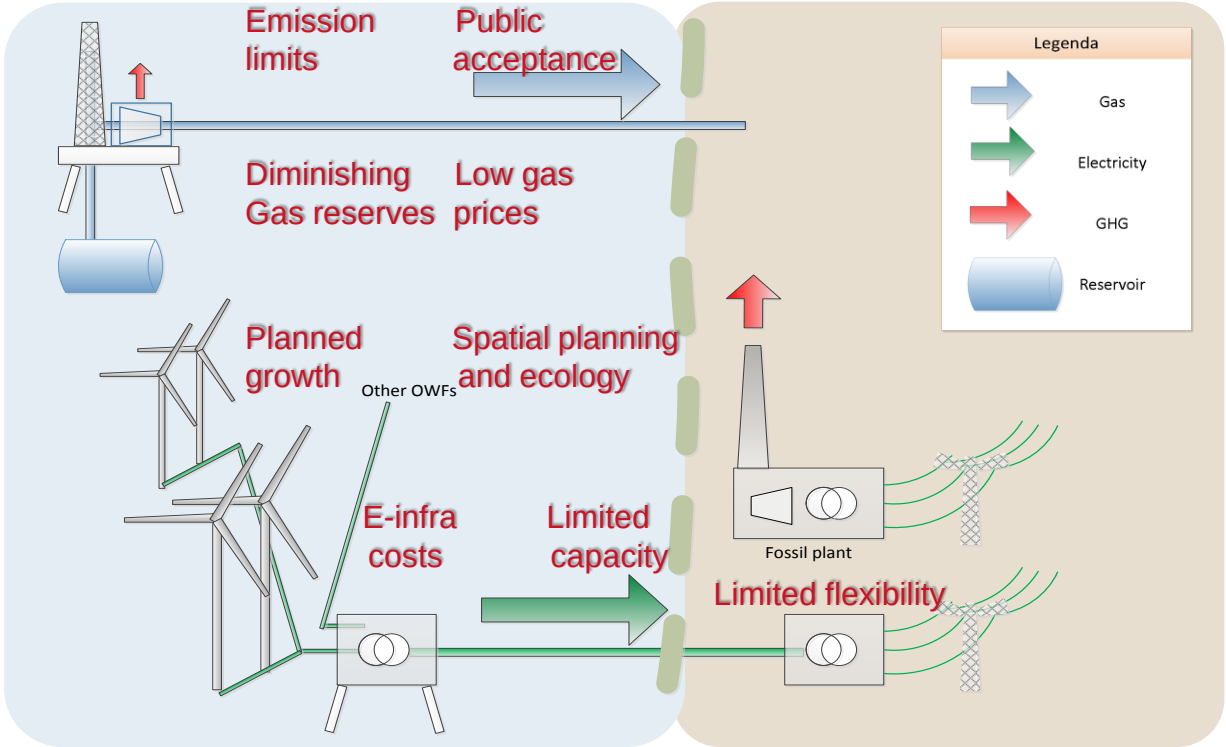




TNO, Shell, Siemens, EBN. (2016). System Integration Offshore Energy: Innovation Project North Sea Energy. Retrieved 11 02, 2016, from https://www.tno.nl/media/8512/system_integration_offshore_energy_final-report_tno_r11234.pdf

Source: EBN. (2016). Focus on Dutch Oil & Gas, Retrieved from https://www.ebn.nl/publicatie/focus-on-dutch-oil-gas-2016/

CHALLENGES FOR OFFSHORE WIND AND GAS



- ***Offshore system integration may resolve challenges and bring additional benefits***
- ***Systematic overview of the many options is needed***

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SUPPORT FOR OFFSHORE SYSTEM INTEGRATION

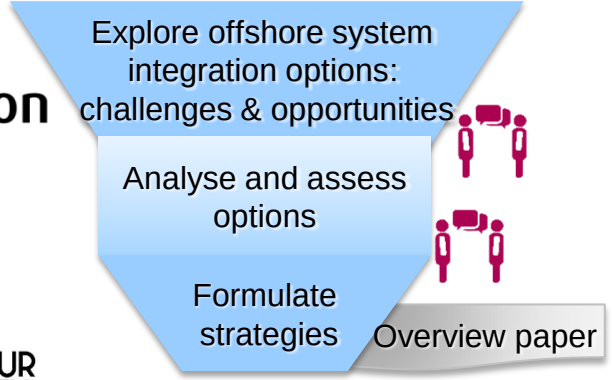
- **June 6, 2016, EU Energy Council:**
  "North Sea Declaration" - Regional coordination on offshore energy

- **June 15, 2016, Oil and gas producers (NOGEPA), NWEA, Natuur en Milieu, TenneT, TNO:**
  "Gas meets Wind" - Declaration of Coordination and Cooperation in the North Sea Region

- **June-Dec. 2016:** Project **SENSEI**

"Strategies towards an Efficient future North Sea Energy Infrastructure"

Project partners: TNO innovation for life; ECN Your energy. Our passion.; Energy Academy Europe; ESTRAC; Energy Systems Transition Centre



Supported by wind and gas sector and NGOs:

TenneT; TKI Wind op Zee; ENGIE; ebn; NAM; NWEA; Royal HaskoningDHV; SIEMENS; Natuur & Milieu; NOGEPA; TKIgas


MOTIVATION
INTEGRATION OPTIONS
STRATEGIES

INTEGRATION OPTIONS IN "SENSEI" PROJECT

Development of large-scale offshore wind can be integrated with offshore gas infrastructure along the following main options:

Electrification of offshore gas platforms

Power to Gas/X (P2G/X)

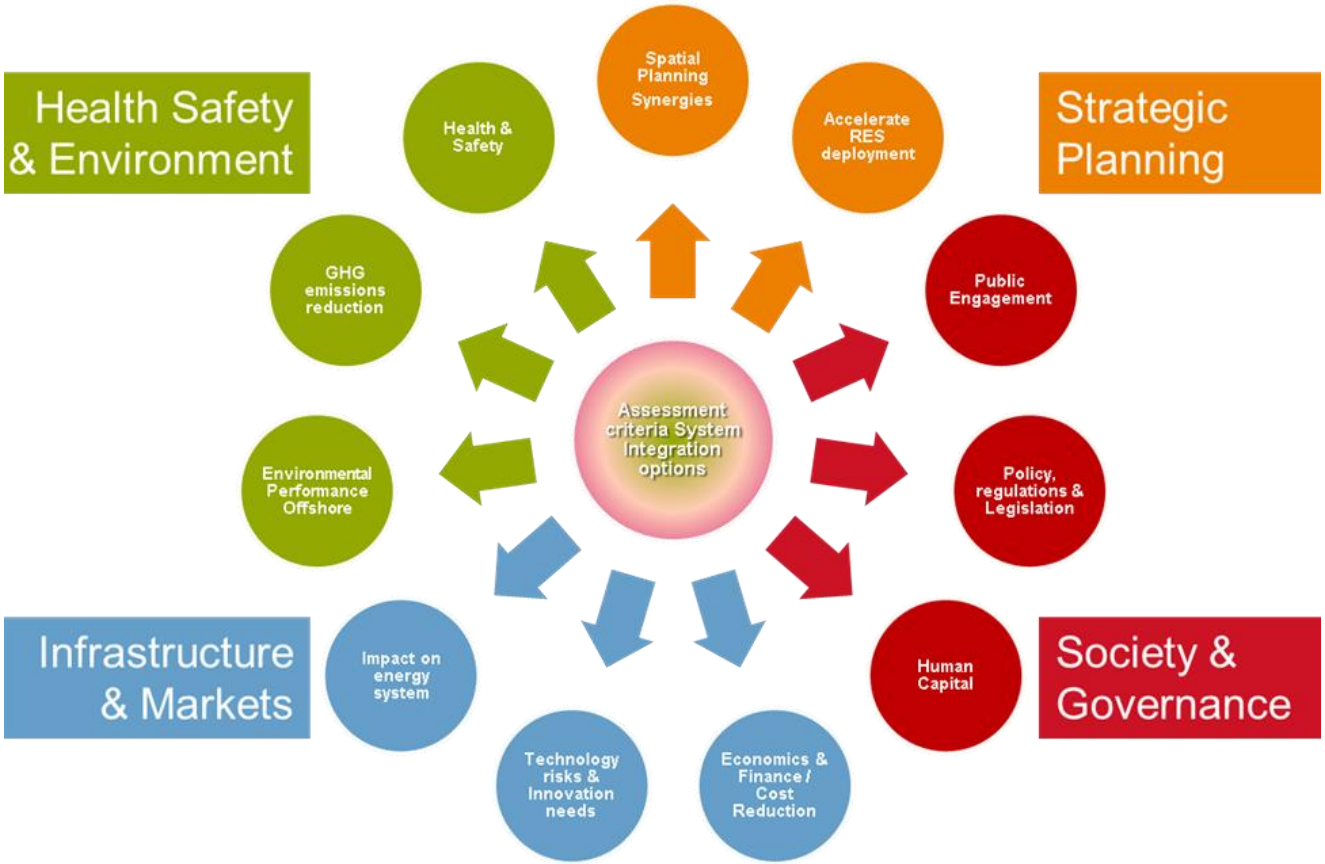
Carbon Capture and Storage (CCS)

Presented

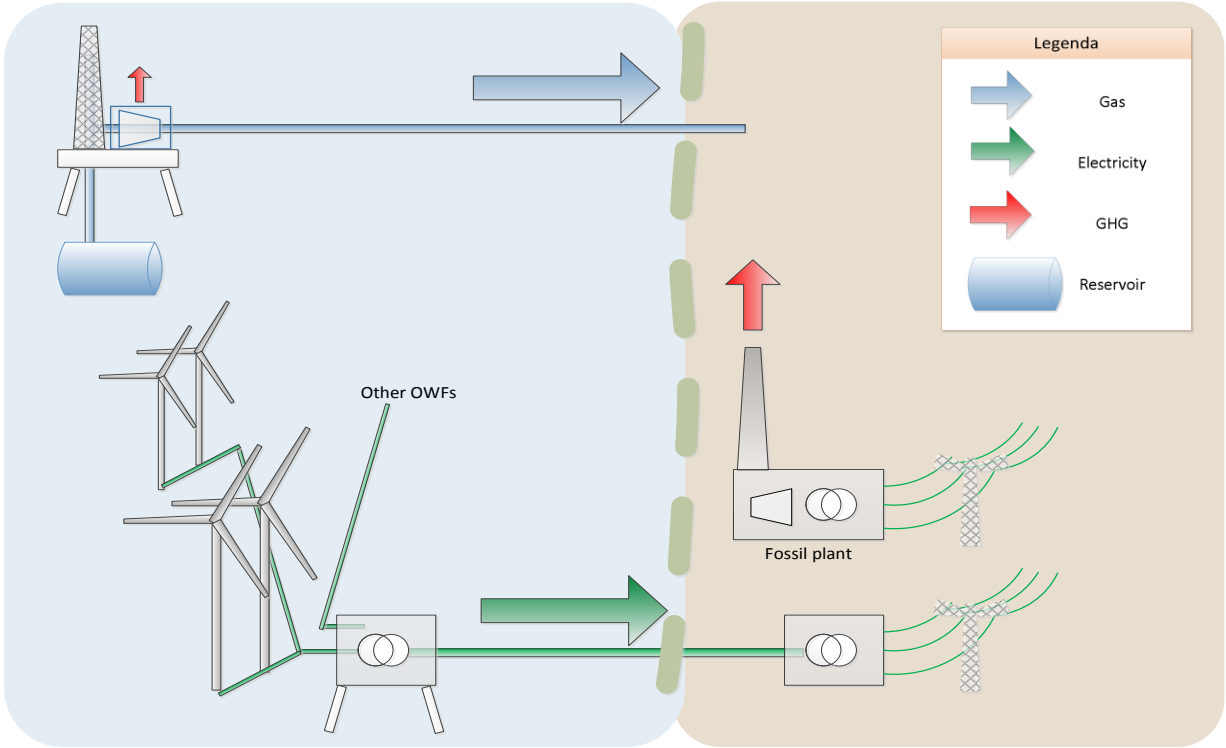
Gas to Wire

Energy storage

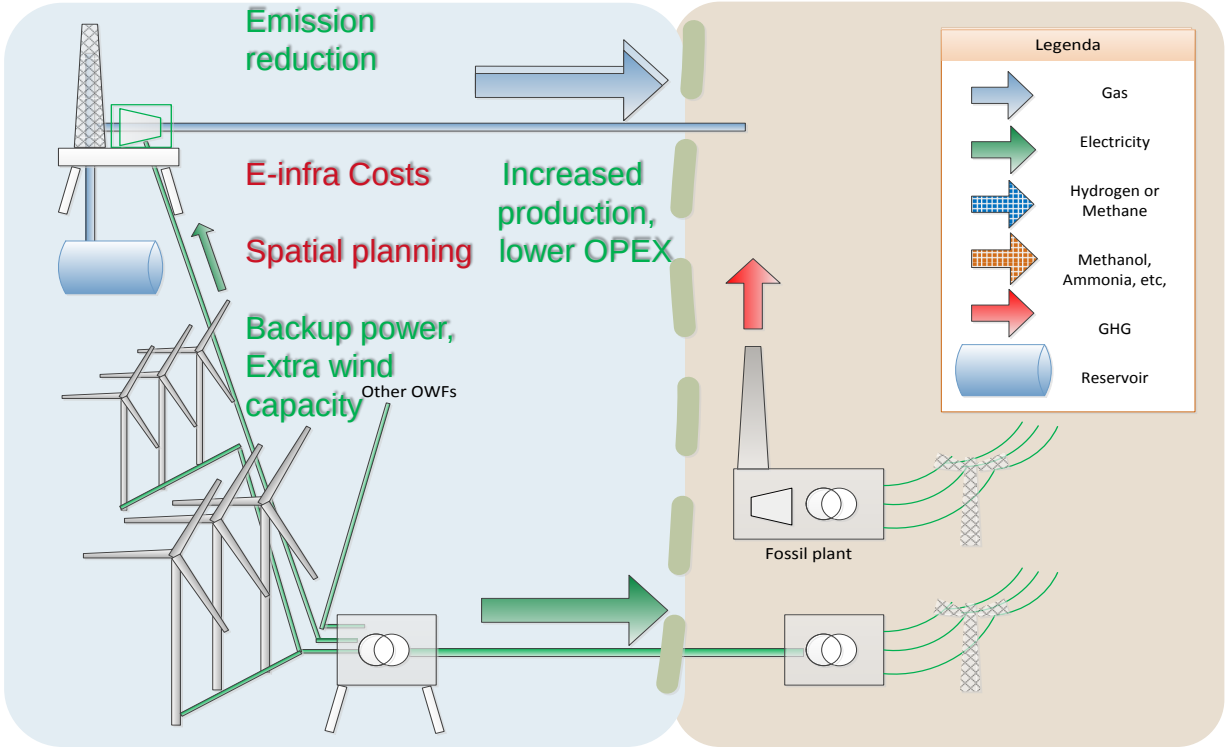
ASSESSMENT FRAMEWORK “SENSEI” PROJECT



BASE CASE: SEPARATE DEVELOPMENTS

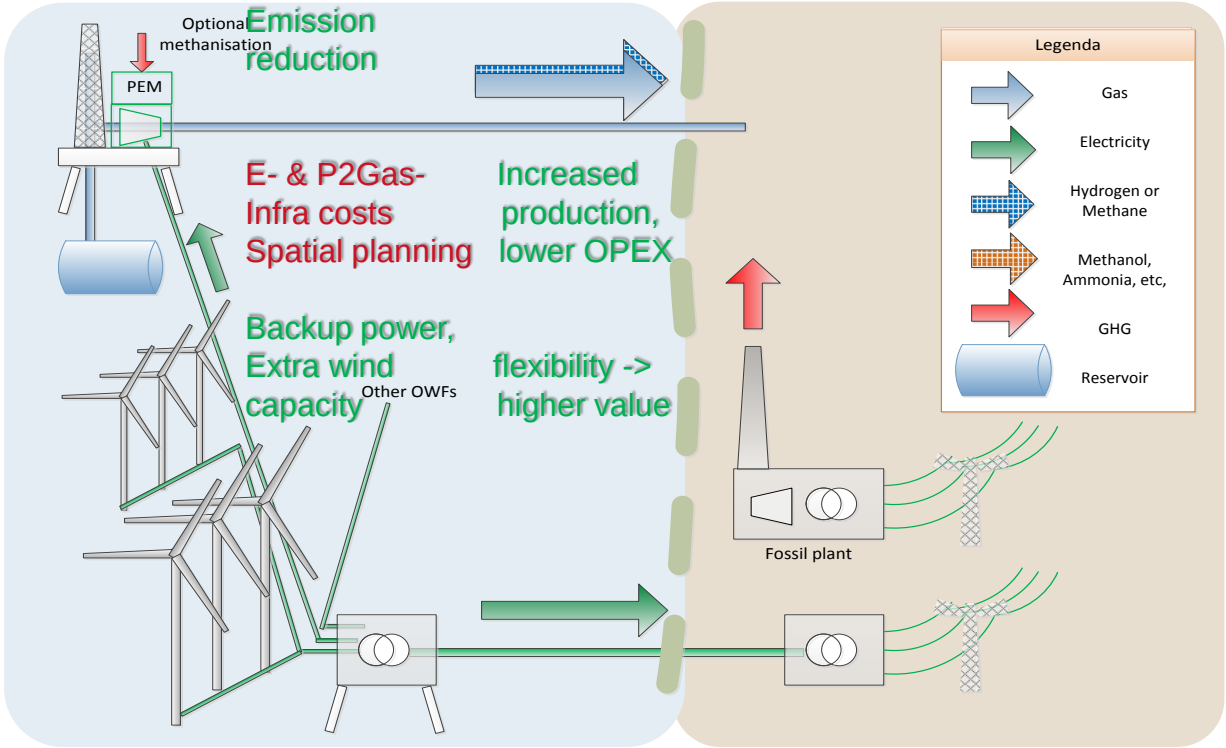


ELECTRIFICATION



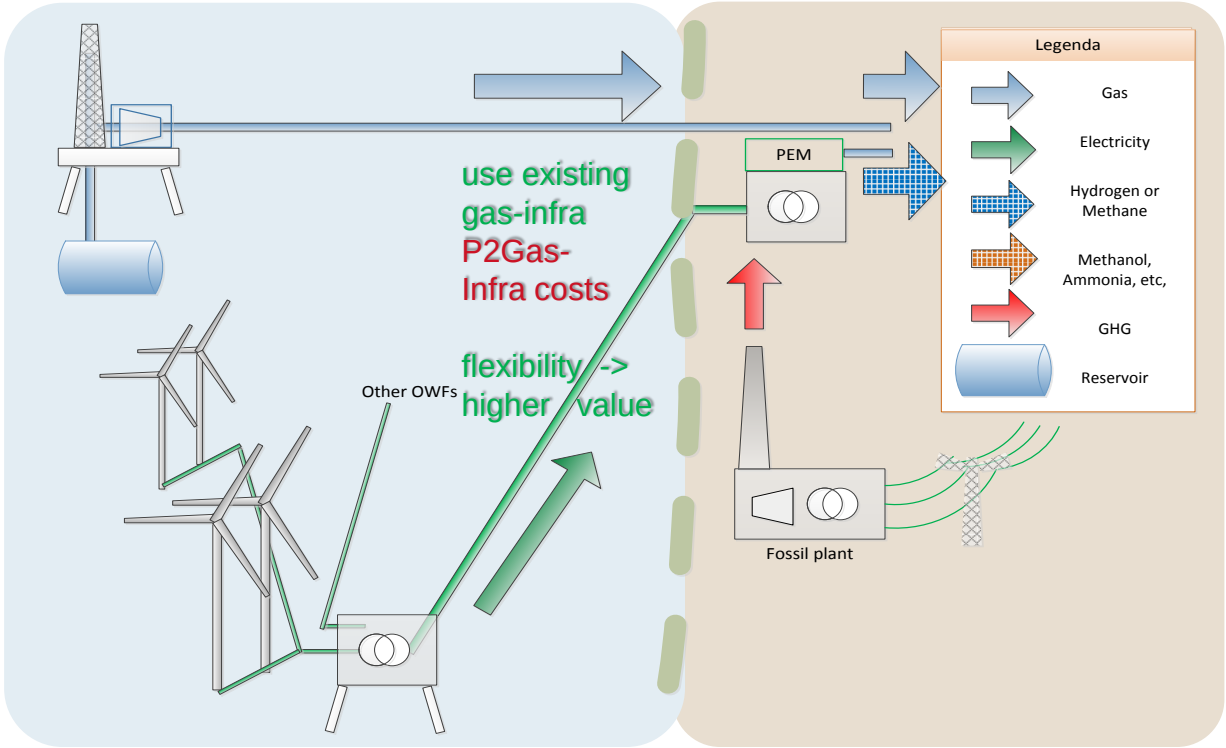
Electrification | P-to-Gas/X | CCS | Gas to Wire | Energy Storage

POWER TO GAS



Electrification | P-to-Gas/X | CCS | Gas to Wire | Energy Storage

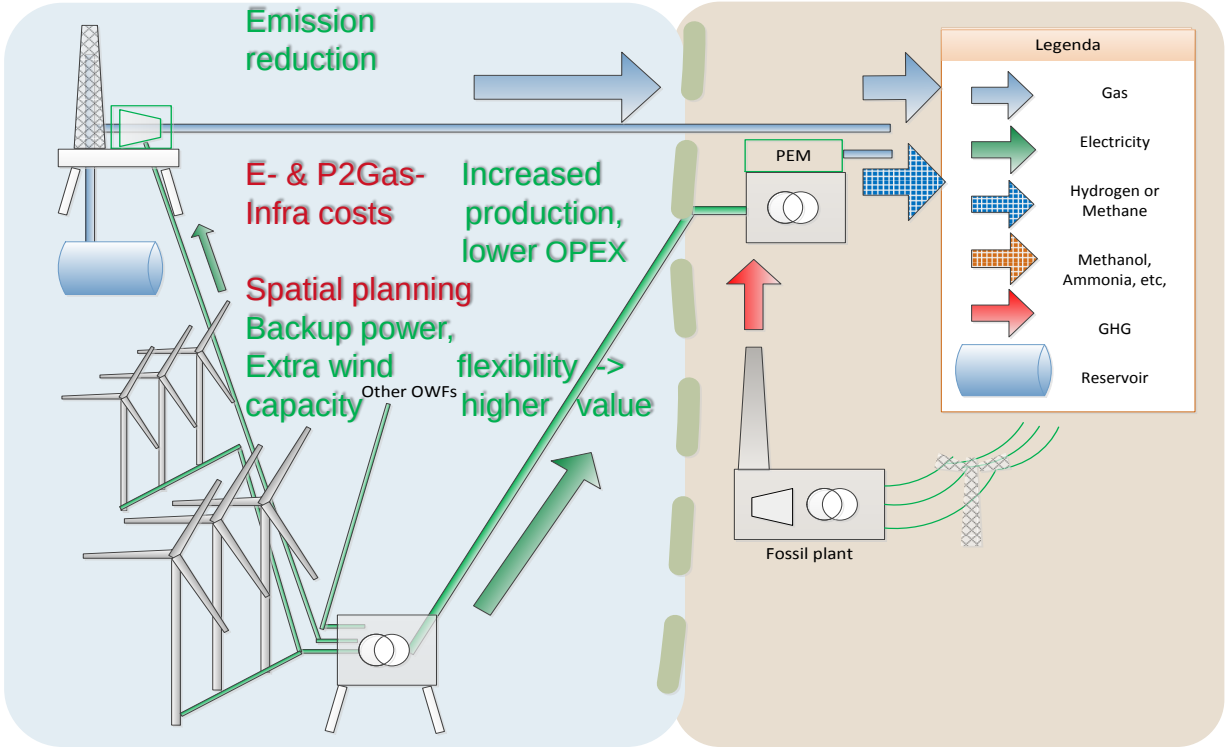
POWER-TO-GAS ONSHORE



Electrification | P-to-Gas/X | CCS

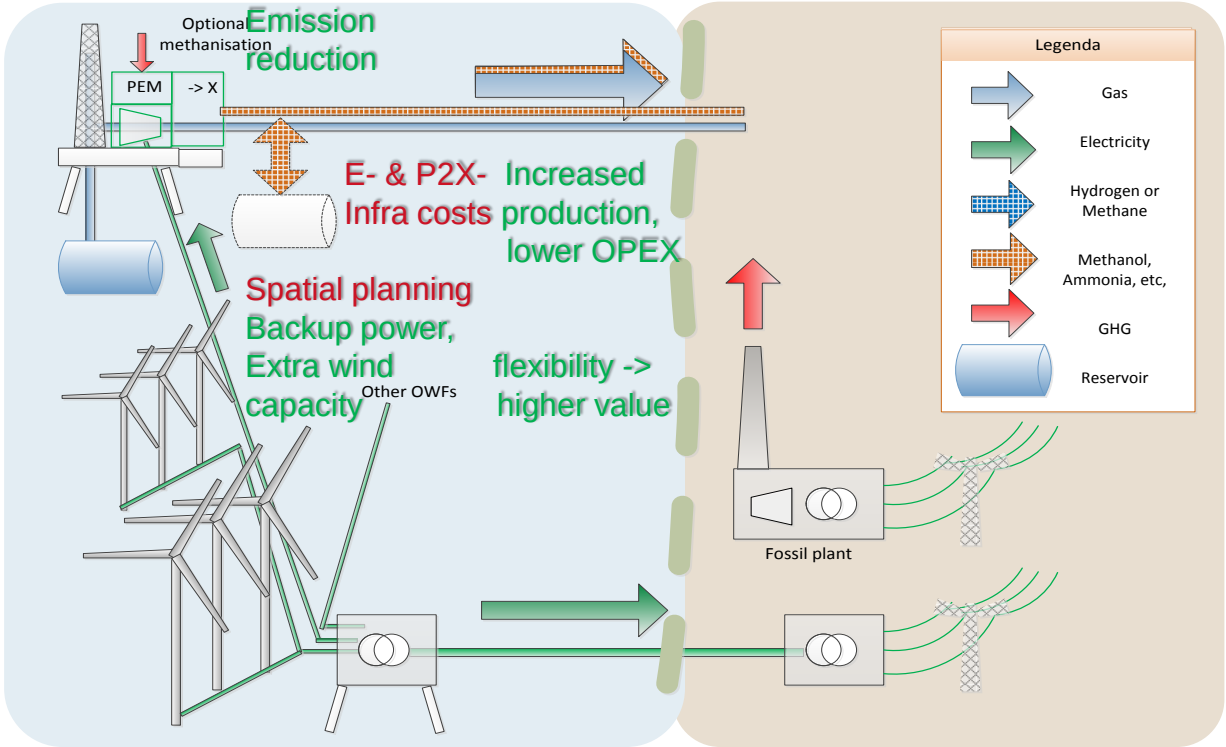
Gas to Wire | Energy Storage

POWER-TO-GAS ONSHORE



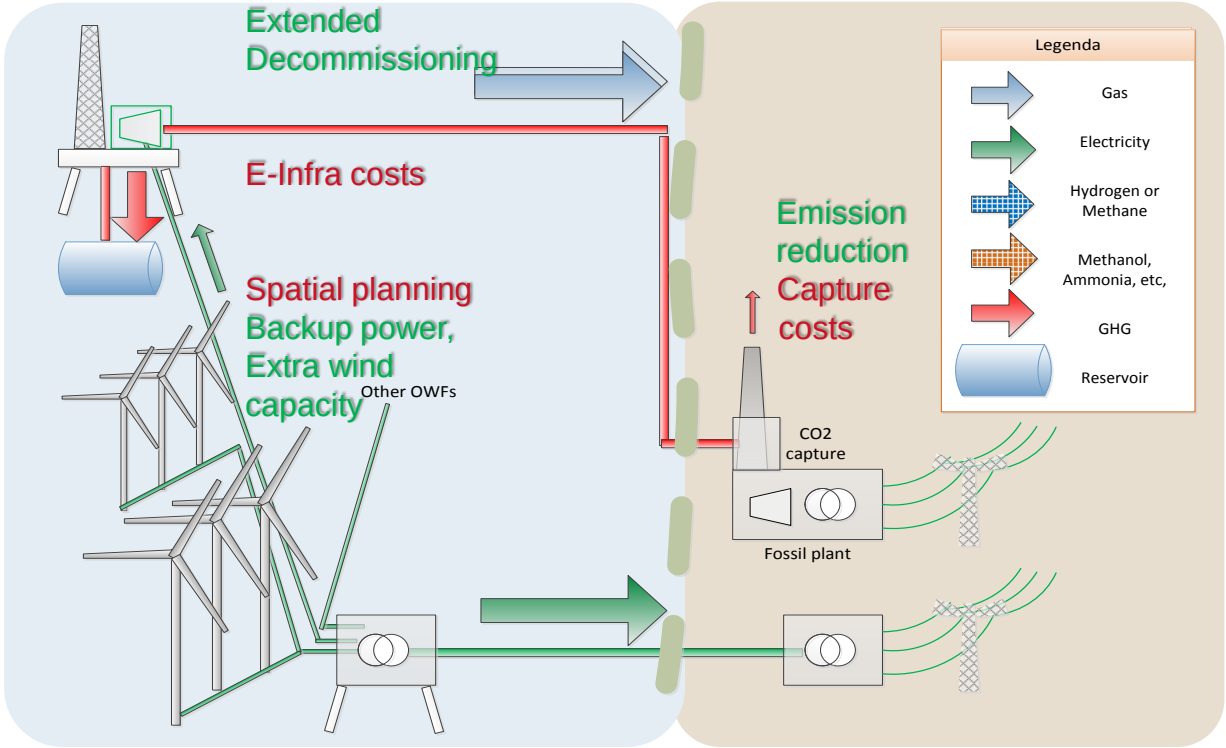
Electrification | P-to-Gas/X | CCS | Gas to Wire | Energy Storage

POWER-TO-X



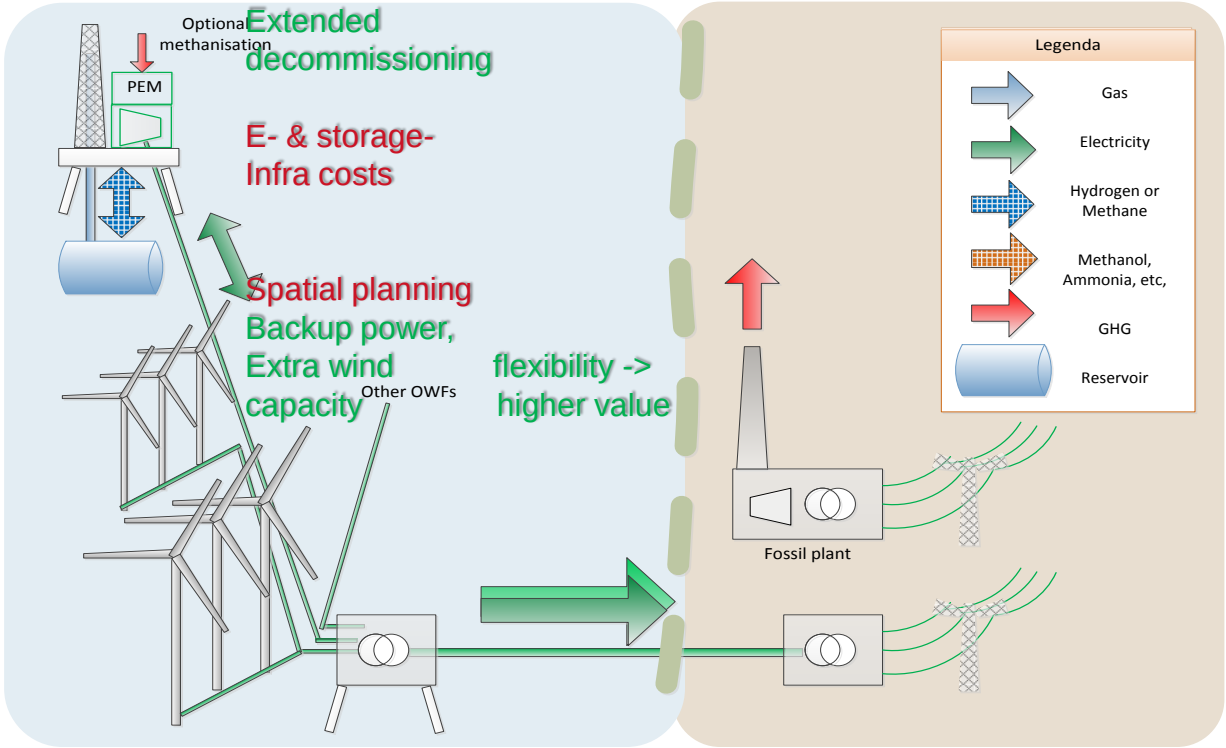
Electrification | P-to-Gas/X | CCS | Gas to Wire | Energy Storage

OFFSHORE CCS



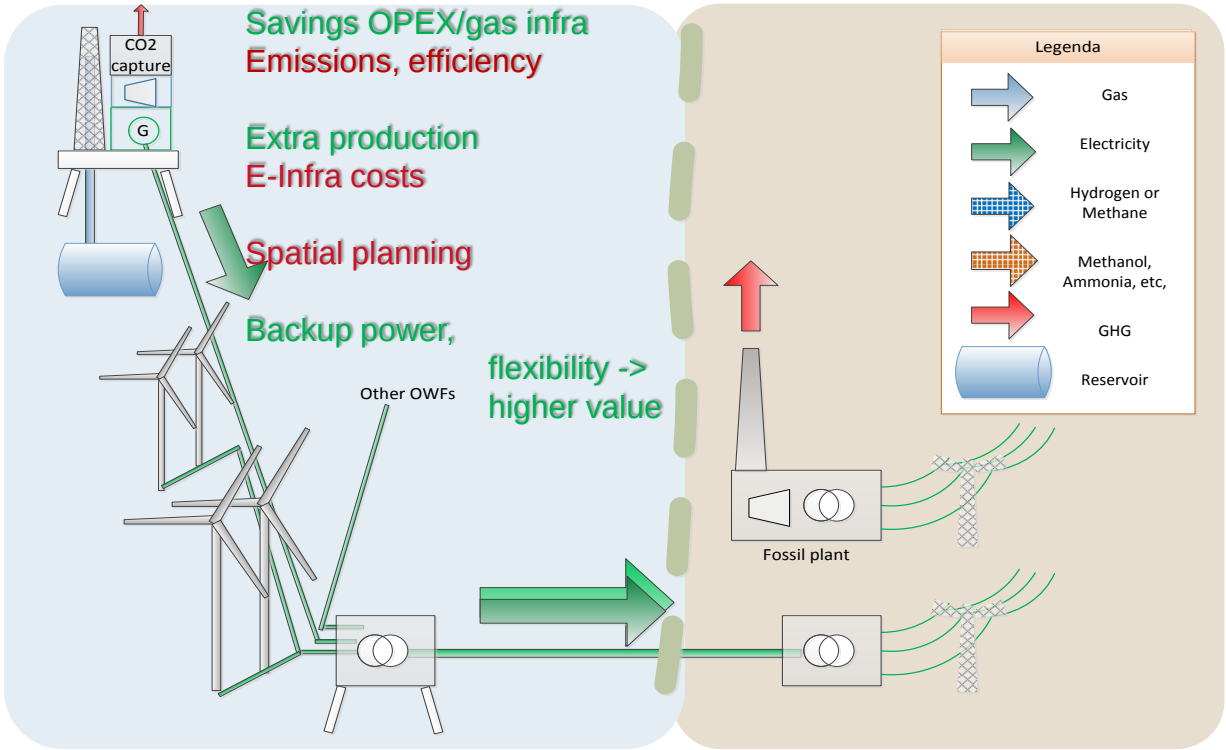
Electrification | P-to-Gas/X | CCS | Gas to Wire | Energy Storage

ENERGY STORAGE



Electrification | P-to-Gas/X | CCS | Gas to Wire | Energy Storage

GAS-TO-WIRE + CCS



Electrification | P-to-Gas/X | CCS

Gas to Wire | Energy Storage

SUMMARY OF DRIVERS AND BARRIERS

Main drivers:

- Higher market value for offshore wind from increased flexibility and reliability
- Lower development costs for offshore wind through savings on grid infrastructure
- Higher offshore gas production at lower operational costs
- Reduction of GHG emissions

Main barriers:

- Regulations (e.g. spatial planning, tight time schedules, support schemes)
- Uncertainty in market prices (electricity / gas / CO_2) lead to uncertain business case
- Development needed on offshore conversion technology
- Public acceptance


MOTIVATION
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STRATEGIES

DEVELOPMENT STRATEGIES (1/2)

Time horizon / System integration options	Short-term <2023	Mid-term 2023 - 2030	Long-term 2030 - 2050
Electrification	Platform electrification near-shore	Platform electrification, far-offshore & stand-alone	Platform electrification, offshore grid
P2G / P2X	Power2Gas, onshore (demo)	Power2Gas, offshore	Power2X, offshore
CCS	CCS + electrification near-shore	CCS + electrification (depleted gas fields)	
GTW	GTW near shore (end-of-field)		GTW far offshore, through offshore grid
Energy storage			Energy storage offshore (H_2, CAES)

- ***Electrification is basis for further system integration options (develop in steps)***
- ***Favorable short-term options identified, although arranging regulatory issues takes time***

DEVELOPMENT STRATEGIES (2/2)

Actions for the short-term:

- Set-up **integral strategic vision and roadmap** for North Sea energy transition
- Identify **shortlist of business cases** that can lead to pilot projects
- Mobilize **international coordination** (share experience, e.g. on electrification)
- Develop **regional action plans and strategies** (align investment development)
- Engage with **stakeholders** (e.g. manage spatial claims, secure value chains)

R&D needs are broad:

- **Technology** development and demonstration -> set-up **pilot projects**
- **System impact** analysis -> develop transition scenarios **roadmap** with spatial planning
- **Ecological impact** analysis
- **Socio-economic, societal and governance** analysis -> policy recommendations

CONCLUSIONS AND RECOMMENDATIONS

- **Comprehensive overview** of system integration options in North Sea available
- Options show **significant economic and ecological potential** and can accelerate energy transition

- Need to quantify benefits and barriers in order to **identify business cases**
- Tight offshore wind planning and accelerated phase-out of offshore gas require **swift action**


Thank you for your attention
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WWW.GASMEETSWIND.EU
North Sea Energy Challenge
SEARCHING FOR SYNERGIES
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