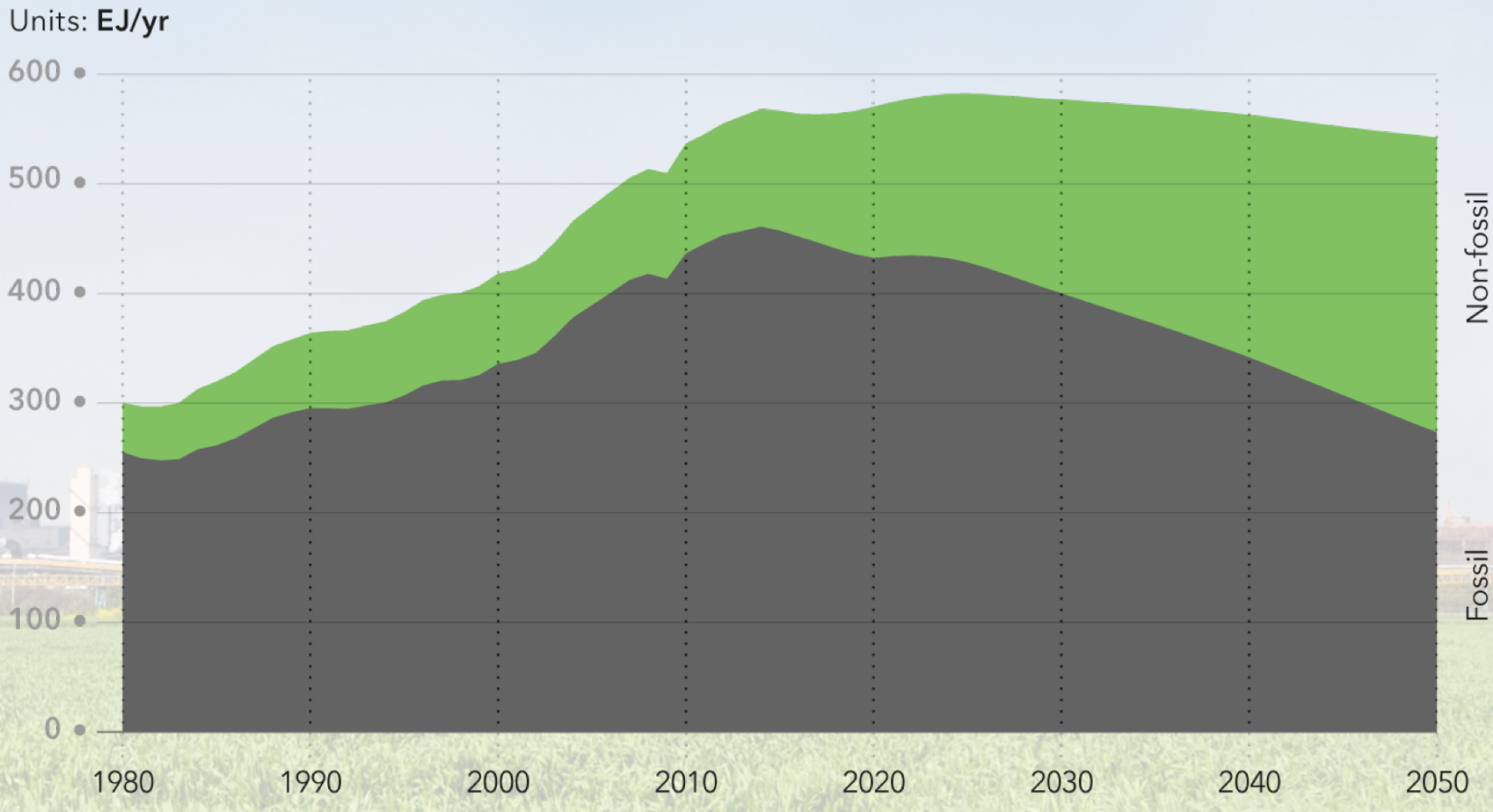
Energy Transition Outlook – the role for gas in a greener Europe

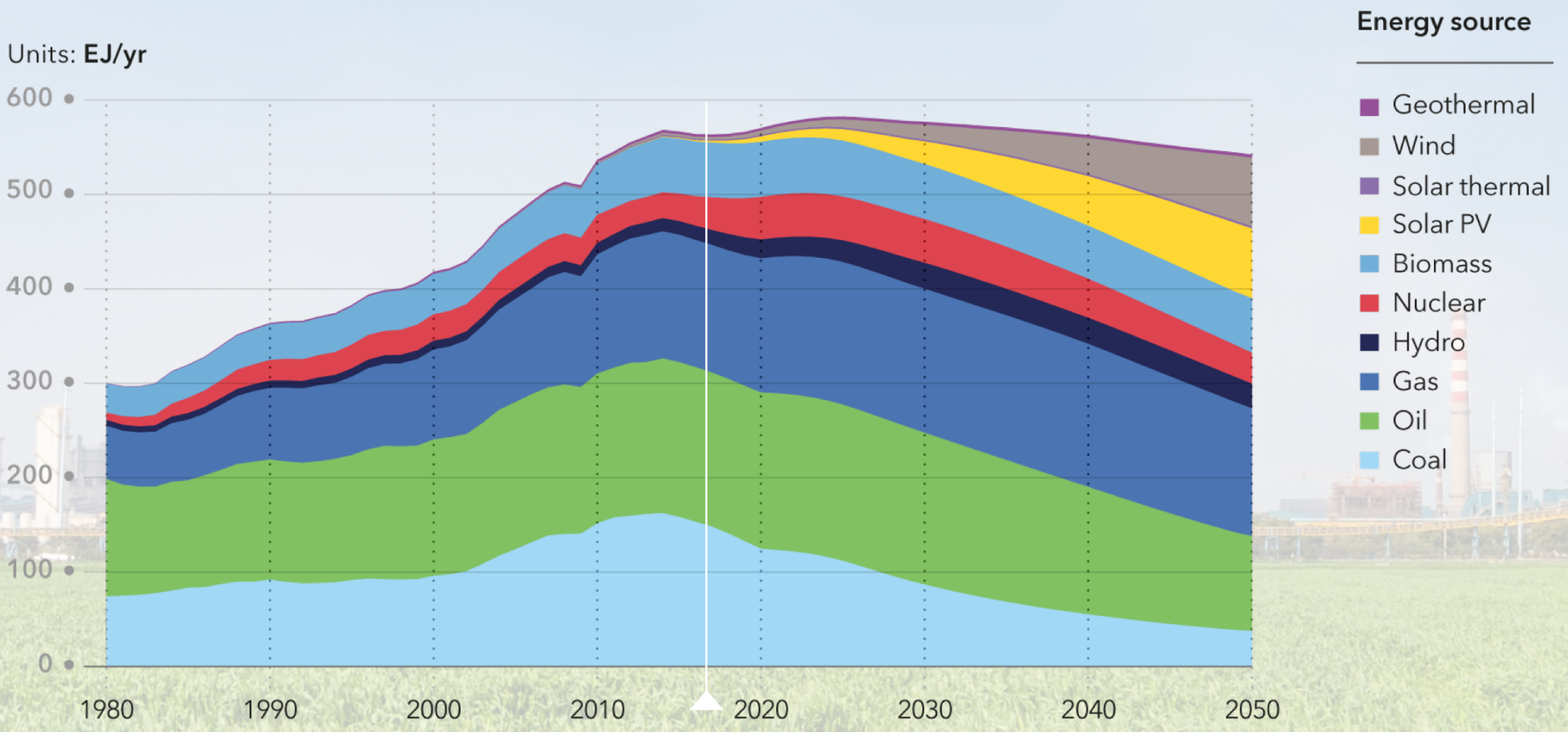
19th European Gas Conference, 29-30 May 2018, Oslo

Liv A. Hovem, CEO, DNV GL – Oil & Gas

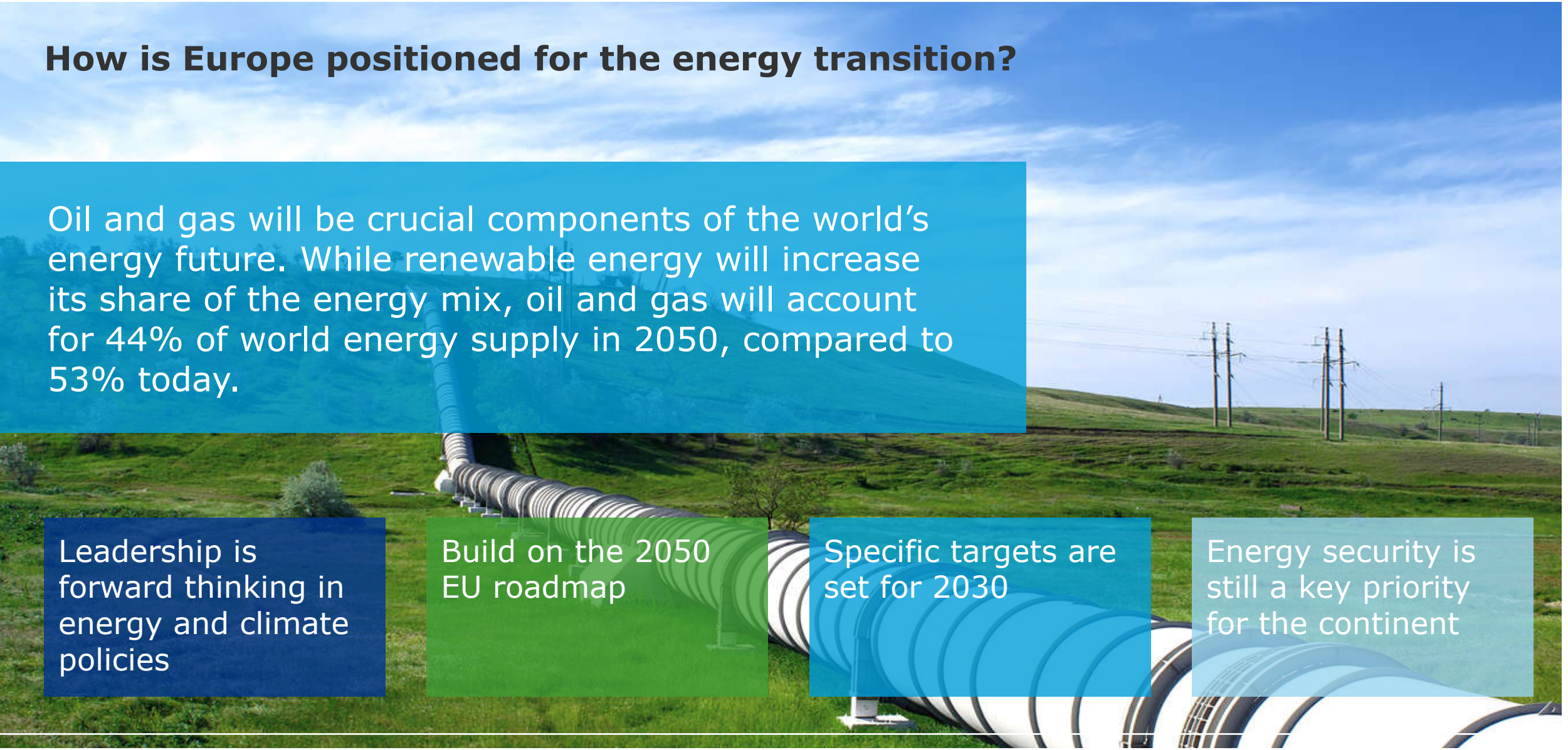
Forecast world primary energy supply



Forecast world primary energy supply by source



How is Europe positioned for the energy transition?



Oil and gas will be crucial components of the world's energy future. While renewable energy will increase its share of the energy mix, oil and gas will account for 44% of world energy supply in 2050, compared to 53% today.

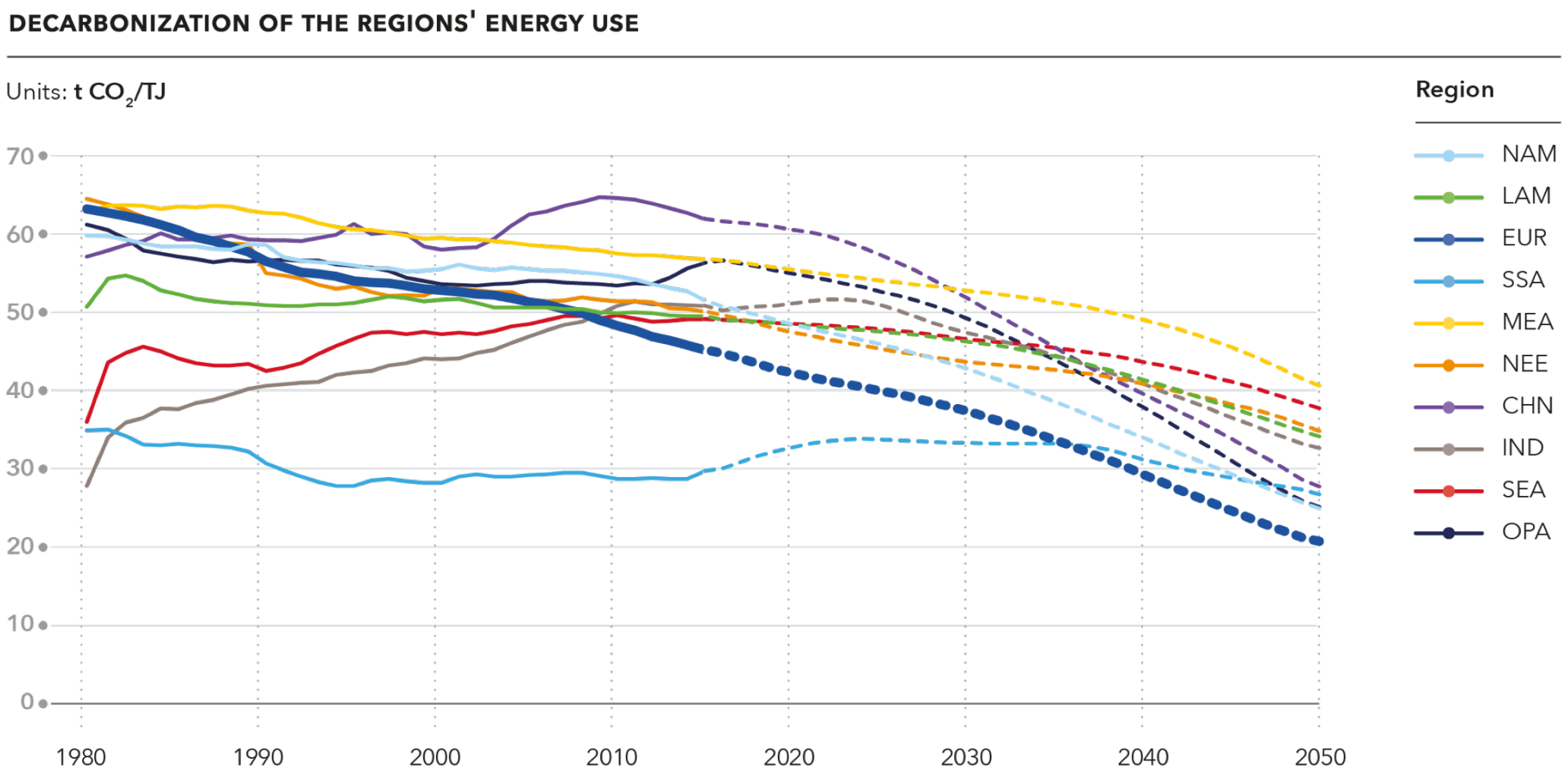
Leadership is forward thinking in energy and climate policies

Build on the 2050 EU roadmap

Specific targets are set for 2030

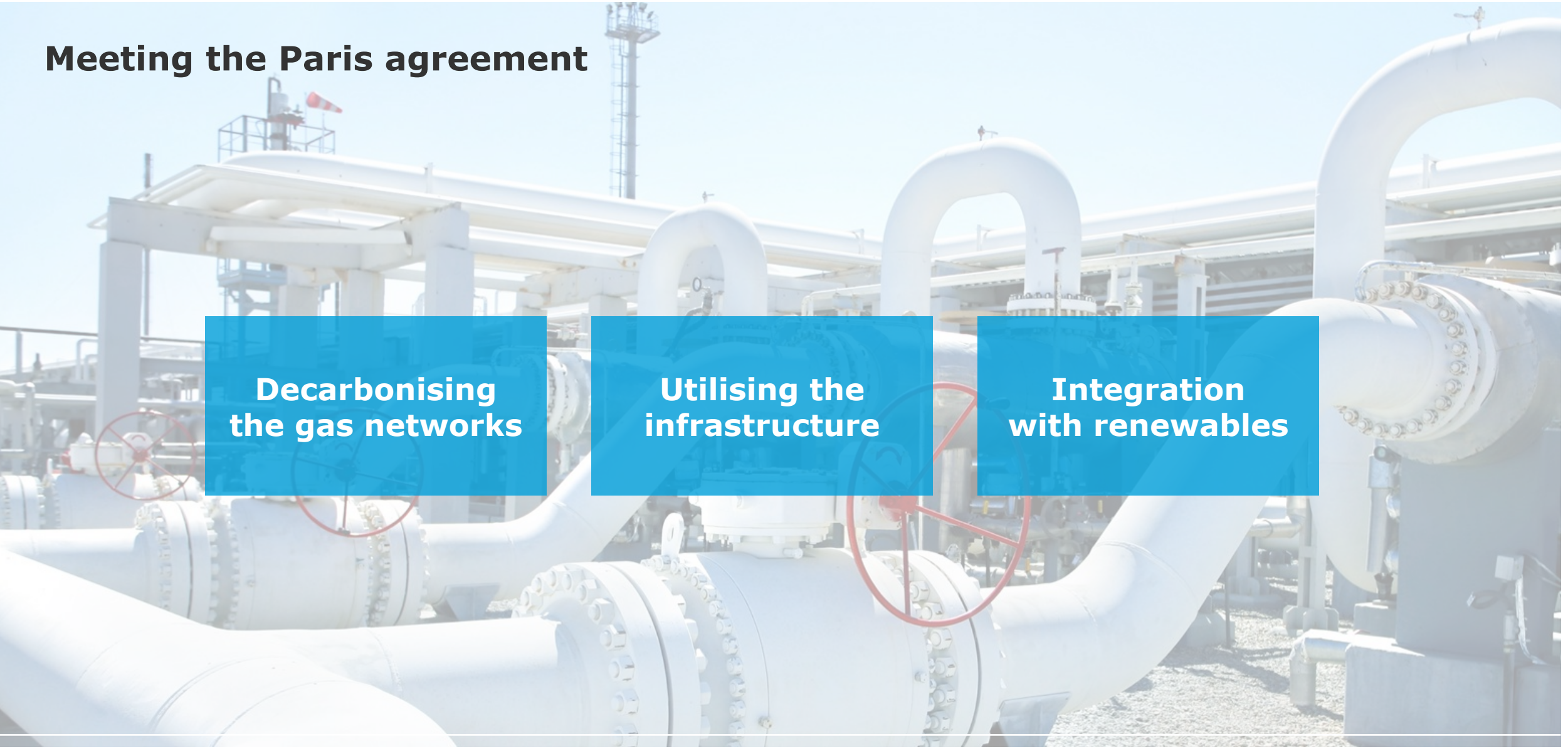
Energy security is still a key priority for the continent

Europe is likely to remain best in class



DNV GL – Europe Energy Transition (2017)

Meeting the Paris agreement



Decarbonising the gas networks

Utilising the infrastructure

Integration with renewables

Biogas

An increasing number of biomethane **injection plants** and/or **gas-fired power plants** using renewable feedstock/fuel is expected in regions with **well-developed natural gas infrastructure**

Biomethane expected to be a transition fuel for **residential heating**

In the long term biomethane will predominantly be used to **fuel the transport sector**.

Hydrogen has great flexibility and a variety of potential uses

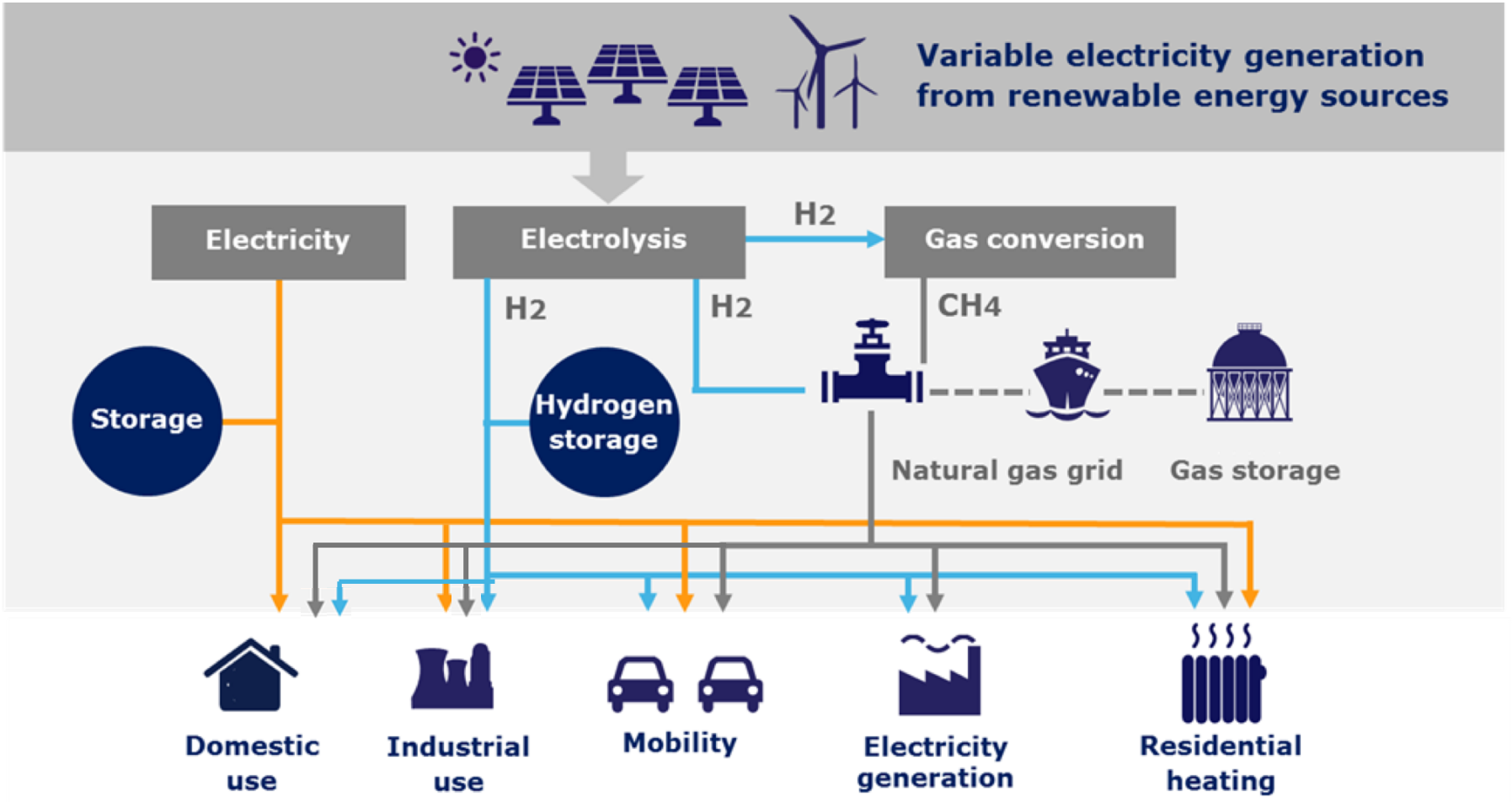
Heating

Mobility

Storage

Power generation

The role of power-to-gas in enhancing flexibility



Power to Gas – Storage & Transmission option: Energy island in North Sea?

News 03/23/2017

Three TSOs sign agreement on North Sea Wind Power Hub

TenneT TSO B.V. (Netherlands), Energinet (Denmark) and TenneT TSO GmbH (Germany) today signed a trilateral agreement for the development of a large renewable European electricity system in the North Sea. This so-called 'North Sea Wind Power Hub' has the potential to supply 70 to 100 million Europeans with renewable energy by 2050.

News 09/13/2017 Innovation Offshore Project Corporate

Gasunie to join North Sea Wind Power Hub consortium

- **North Sea Wind Power Hub will make a major contribution to the EU's offshore wind energy targets for 2050**
- **Consortium expanded to include four electricity and gas grid operators: TenneT Netherlands, TenneT Germany, Energinet and Gasunie**
- **Project helps pave the way for hydrogen economy**
- **Power-to-Gas solutions to be used on 'Power Link Islands'**

Example: Gas and Electricity transmission compared
Large scale transporting of gas more cost efficient than transmitting electricity

Electricity transmission

Gas transport

BritNed Interconnector

Length	260 km
Investment	600 MEUR
Capacity	1 GW
Specific investment	€ 230 per kW/100 km

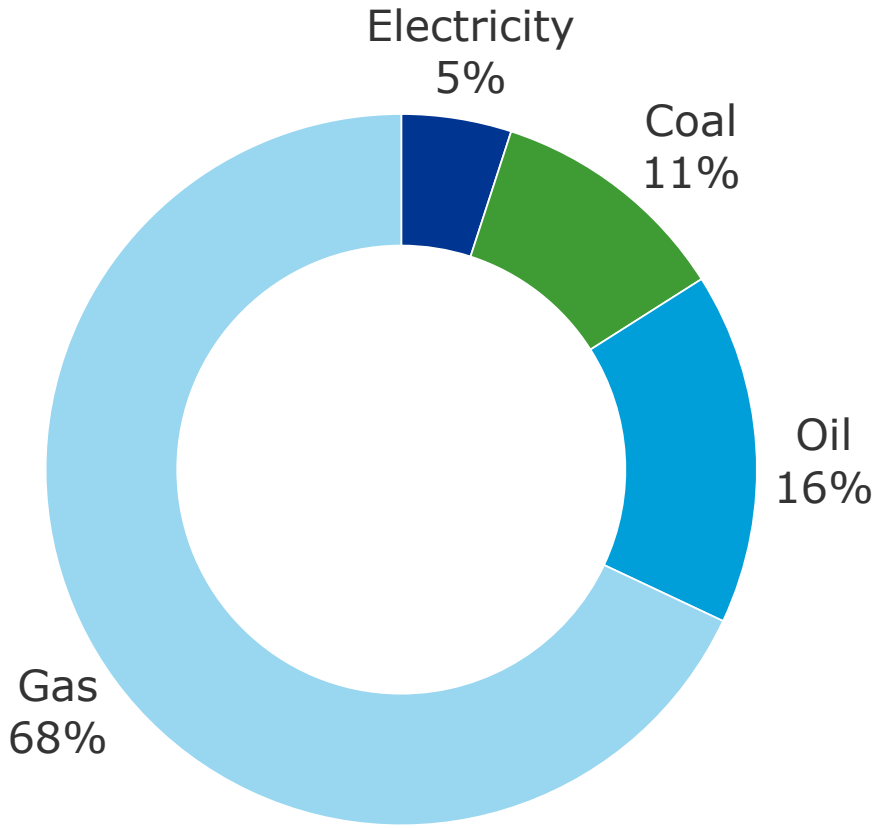
Bacton-Balgzand Gas Pipeline

Length	230 km
Investment	600 MEUR
Capacity	20 GW capacity
Specific investment	11 EUR per kW/100 km

Source: Gasunie (2014)

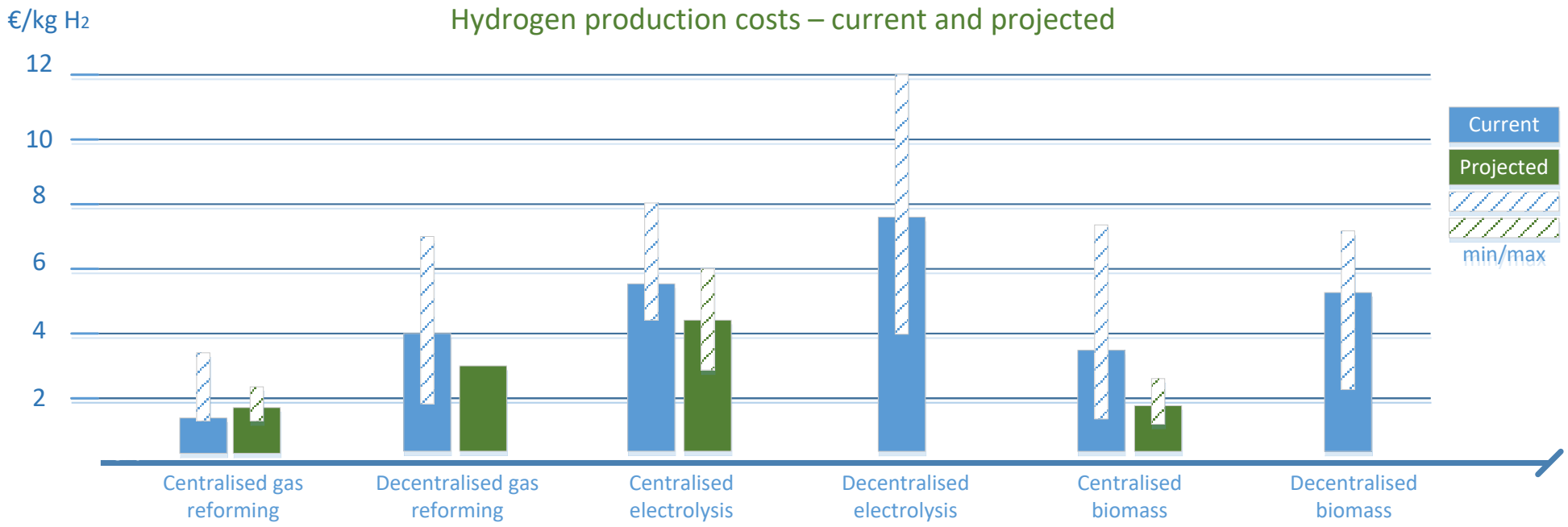
Hydrogen is today primarily produced from natural gas

- Hydrogen from fossil fuels ca 95% - Hydrogen from electrolysis ca 5%
- Global production: ca 50 Mt
- Predominantly used (on-site) by producer, only ~4% is traded freely



Costs are coming down – Economy of scale and further cost compression may be achieved

- Large-scale production preferable – more efficient & economies of scale
- Cost of electricity and value of grid balance and storage key to bring costs down
- Cost of carbon and CCS important for entire value chain



Source: Shell Hydrogen Study, Shell Deutchland Oil Gmbh (Own diagram)

Hydrogen without CCS will not contribute to a greener energy system

Converting to a hydrogen economy based on fossil fuels would have no advantage in reducing CO2 emissions unless the CO2 can be isolated via CCS

Carbon capture and storage (CCS)

CCS will not take off rapidly, but will start to gain momentum towards **2050**

A **higher cost of carbon** is critical for the role of CCS in the mitigating climate change

Carbon prices expected to increase, but remain lower than real emission costs

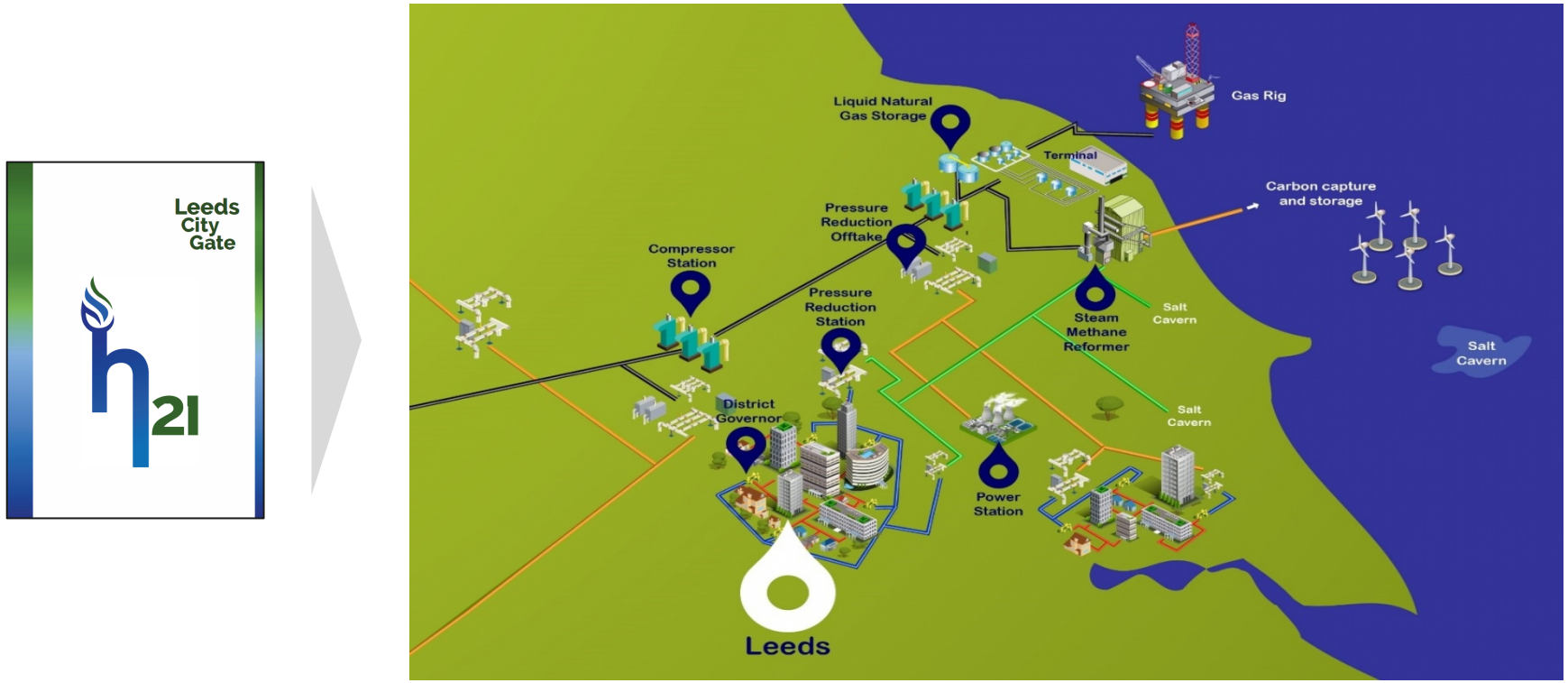
CCS cost per tonne of CO_2 assuming limited uptake of this technology:				
2010	2020	2030	2040	2050
115	115	110	88	71

12 CCS development projects expected to come to fruition before **2035**.

Image courtesy of Technology Centre Mongstad (TCM)

Major efforts drive hydrogen forward – H21 project in UK

- Convert City of Leeds to 100% Hydrogen
- 75% per cent reduction in CO_2 - 1.5million tonnes captured per year
- "..converting the gas network to hydrogen is technically feasible and economically viable.."



DNV GL and hydrogen

- For the H21 NIC project the initial investigation will give critical evidence in validation of the technicalities surrounding the conversion of the existing natural gas network in Leeds.
- DNV GL was chosen as a primary partner and the work will involve the DNV GL's Spadeadam research and testing site and advisory services team.
- It will cover three critical areas to be subsequently used in the quantitative risk analysis: ground and air concentration testing; background consequence testing and operational testing. Results from these tests will be used to identify any modifications to operational working practices that may need to be considered.

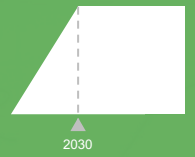
Get prepared for hydrogen addition to natural gas, get HYREADY!

Joint Industry Project / started January 2017

DNV·GL

Summary

Oil and gas account for **44%** of world energy supply by **2050**



Energy demand will **PLATEAU** after **2030**

GAS becomes the **LARGEST** single energy source with peak demand by **2035**

P2G

Could help balance the intermittency of renewables

H_2

Hydrogen has potential to re-use existing gas infrastructure

CCS

CCS is key for a sustainable gas use, but needs acceleration

www.dnvgl.com

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