THE ROLE OF GAS TO THE DEEP DECARBONIZATION

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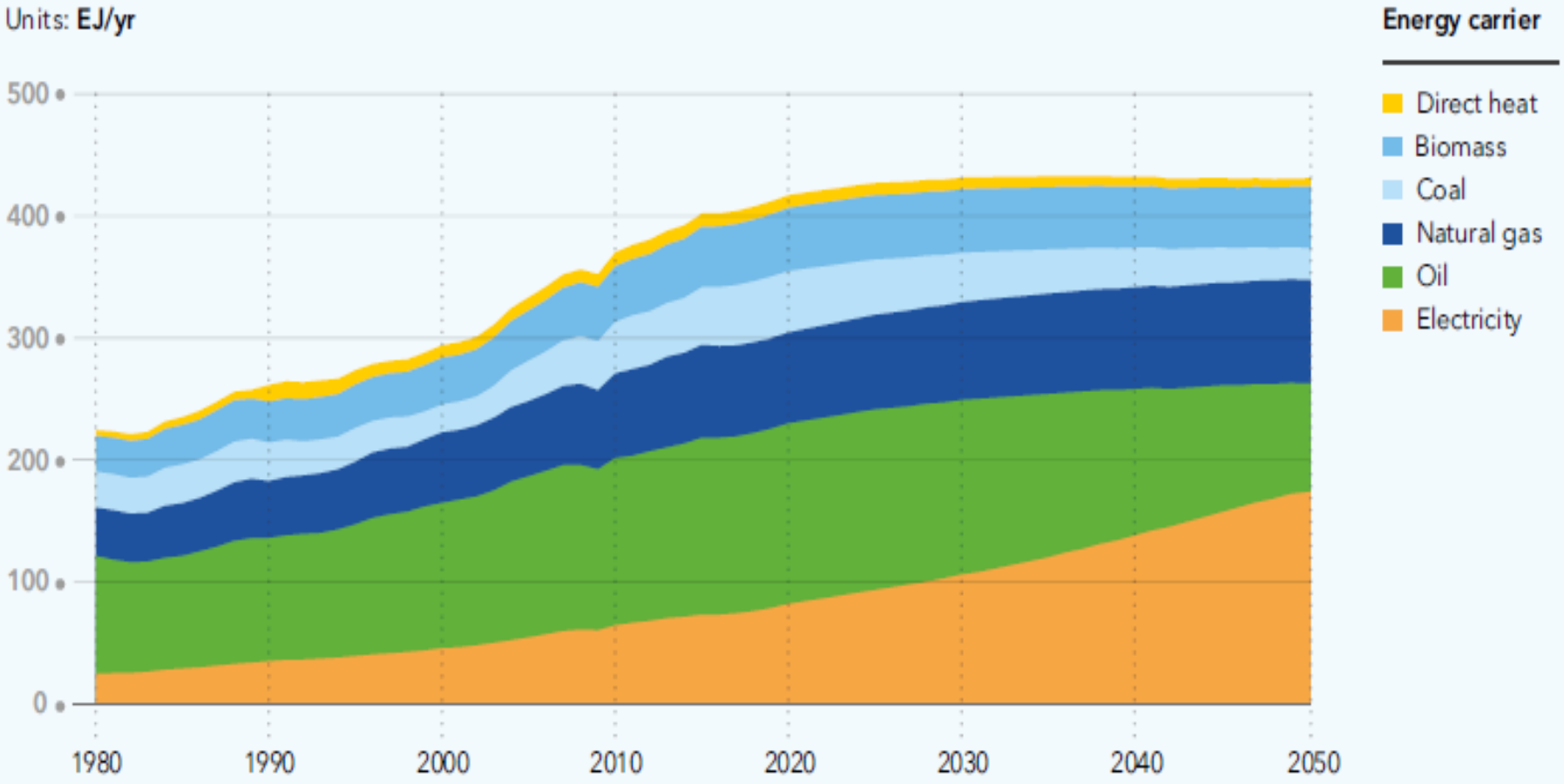
ENERGY TRANSITION

- Decarbonization is probably the biggest challenge facing our generation.
- The Industry is going through a profound change , but the energy transition will not happen overnight !
- Global energy demand is going increased and the new goal of the energy industry, should be to meet the world's needs, while decarbonising the energy system.
- It is obvious that we live in a hydrocarbons world and we will do so for the near future. Hydrocarbons will account 44% of the total energy mix in 2050 from 53% of today (DNV outlook 2020)
- The world continue to need oil & Gas for decades to come, because same sectors of the economy are hard to electrify

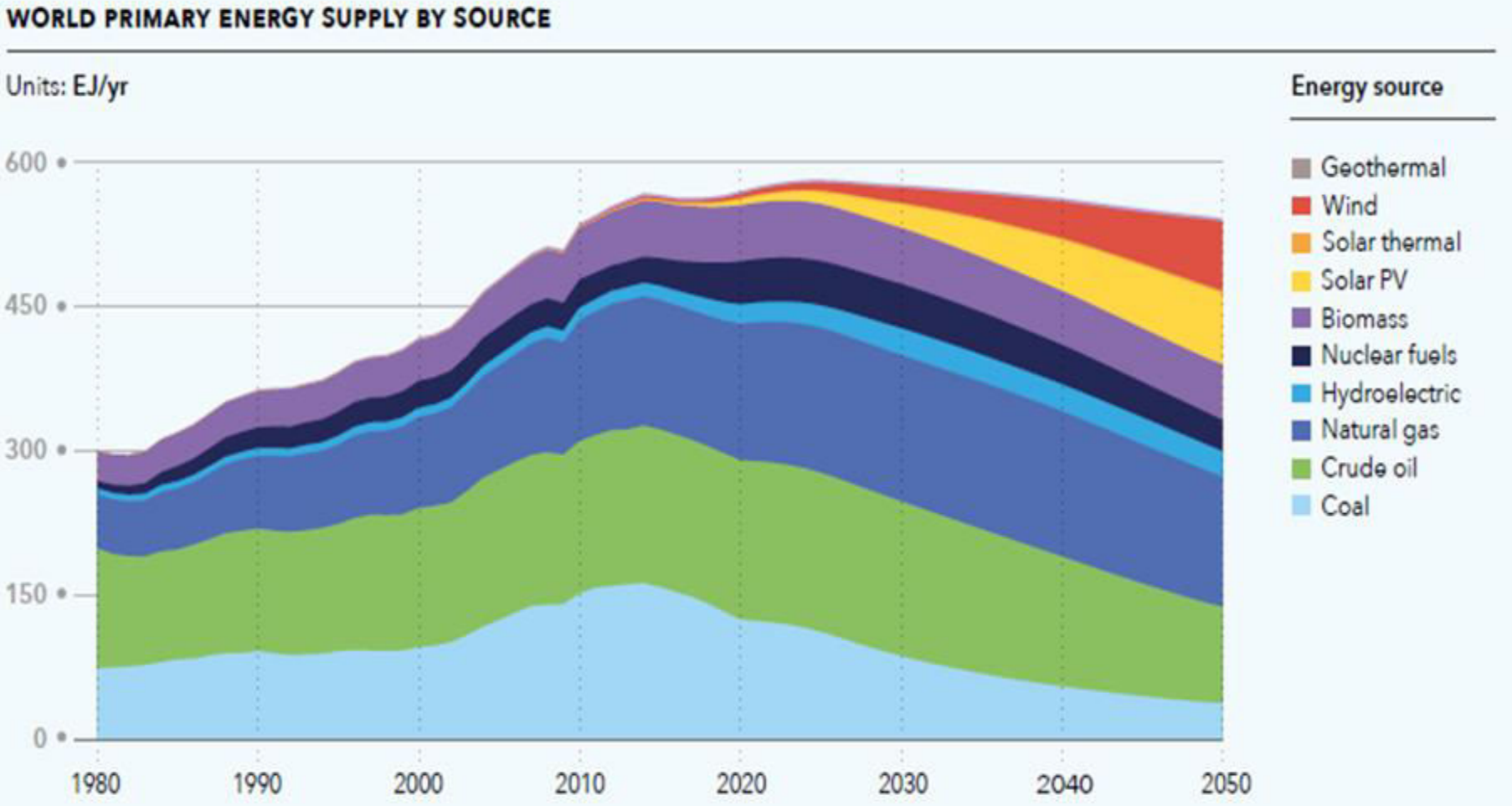
GAS THE DOMINANT FOSSIL FUEL

- Gas will be the single most important energy source towards 2050 and the largest energy carrier from 2033.
- Natural gas demand is projected to rise by 1.3% /y from 3,924bn cm in 2018 to 5,966bn cm by 2050 according to Gas Exporting Countries Forum (GEFC) .
- Between now to 2050 the world population is expected to grow from 7.5bn to over 9bn and energy demand will grow alongside. In future energy mix, gas can have a key role, as a reliable source of power, to supplement renewable energy ,when wind and solar power is not available
- Moving too fast to an extreme position would face huge cost. Natural gas will remain the cheapest alternative probably for the next years, wile we wait for a technological way to balance the energy system over the year at a reasonable cost

FIGURE 4. FORECAST WORLD FINAL ENERGY DEMAND BY ENERGY CARRIER



Source: DNV-GL, ''Outlook Transition''



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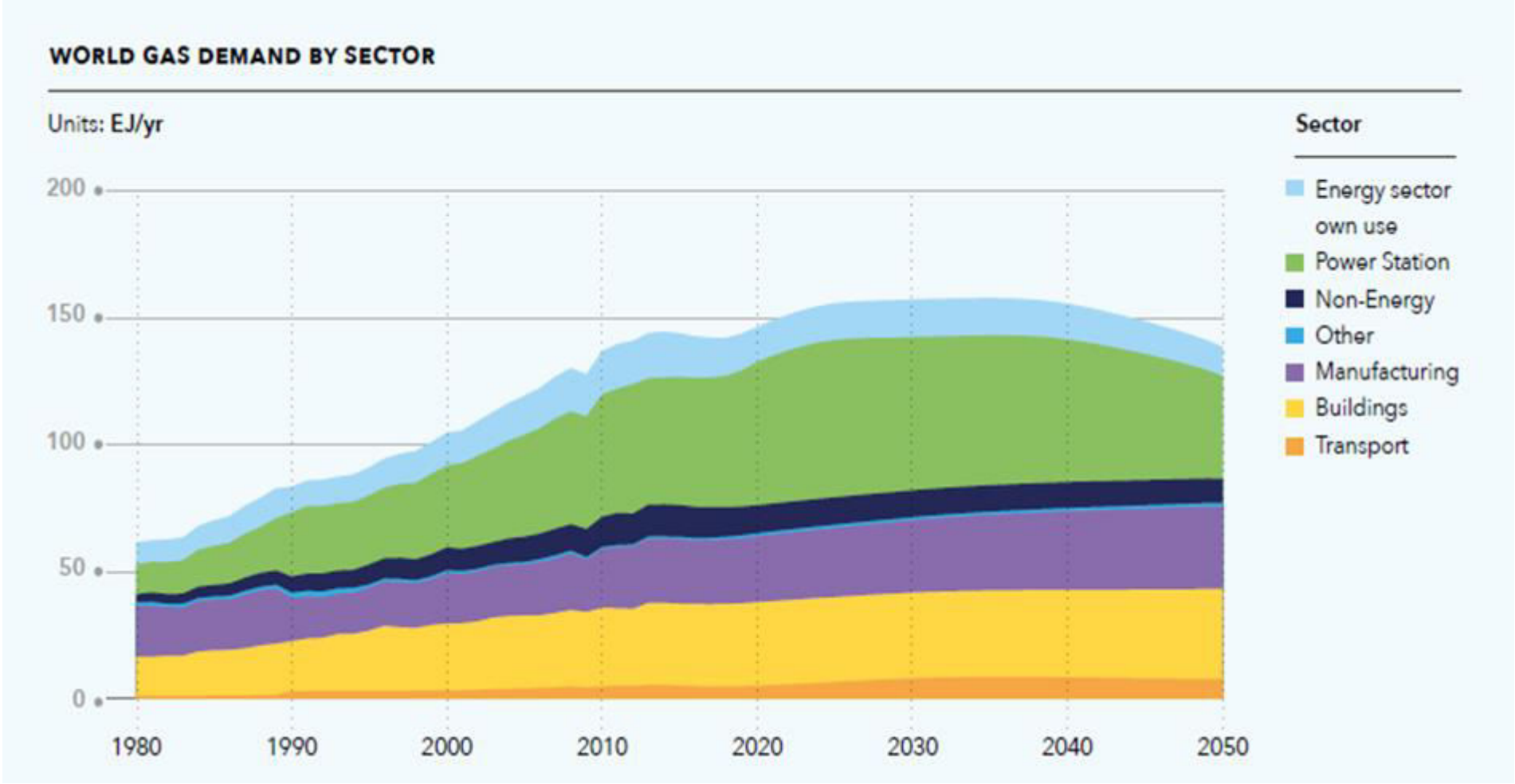


Source: DNV-GL, ‘‘Outlook Transition’’

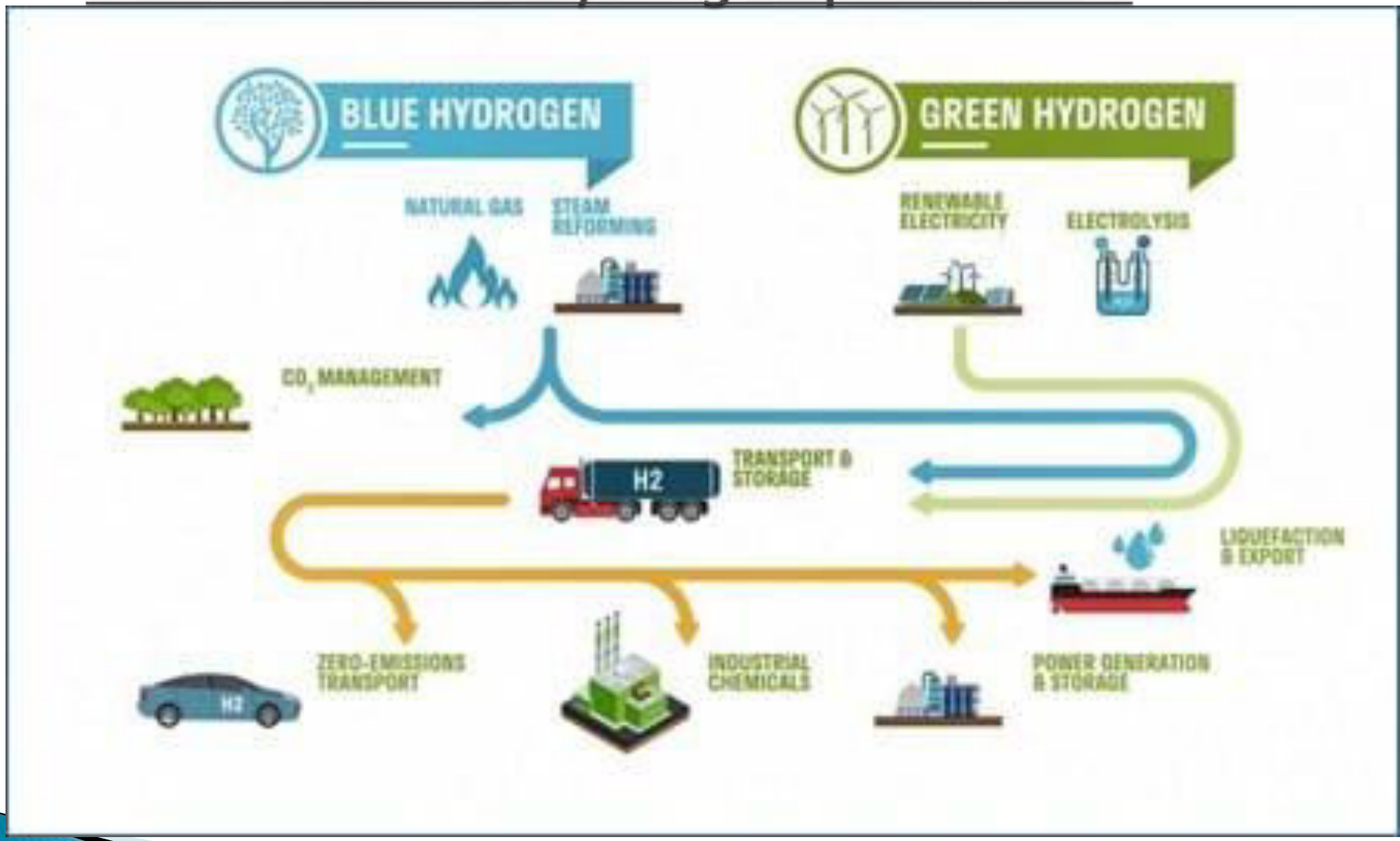
GAS A DESTINATION FUEL FOR THE ENERGY TRANSITION

- There is no doubt that the gas market has been hit by the global COVID 19 pandemic and the looming storm of a global recession, but Gas is a key player in mitigating the worst of climate change – a major threat that far outlasts the pandemic or global recession.
- Gas will continue to play a critical and even a growing role in the long term global energy configuration, including the energy performance of gas based technologies complementary between gas and intermittent renewables and the emergence of LNG, reinforce gas's role in improving energy access and security.
- The global energy transition faces many challenges to ensure a sustainable ,reliable and affordable energy source and fuel gas will continue to play an important role. However looking forward, decarbonizing existing gas infrastructure will lead to greater utilisation of greener fuels such as hydrogen.

BLUE HYDROGEN

- It is widely acknowledged that hydrogen has the ability to contribute to the decarbonization of the energy and assist with global efforts to achieve emission control requirements , **but blue hydrogen** produced from **natural gas** with **carbon capture and storage** (CCS) to minimise greenhouse gas emissions is increasingly considered a viable solution, to support decarbonization until green hydrogen matures and its cost decrease.
- EU is targeting carbon -neutrality by 2050 and states hydrogen is a key part of the European Green Deal.
- The EU recognises in the sort to medium term significant volumes of hydrogen would need to be produced from natural gas with carbon capture and storage (CCS), i.e. blue hydrogen as a bridge technology

Blue and Green hydrogen production



DECARBONISED GAS

- The blue hydrogen facilitates a rapid development of a hydrogen-based economy by providing the required volumes in a cost and environmentally effective manner, given some of practical constrains associated with the built out of renewable energy.
- Renewable power generation is expected to replace forecast electricity grid demand , therefore suggest support for short-to medium, let alone having spare renewable capacity to use in green hydrogen production. Therefor support for sort to medium-term demand for blue hydrogen.
- Hydrogen Council and the International Renewable Energy Agency which estimate global potential for 78EJ of hydrogen production in their forecast for 2050 , see the majority coming from blue hydrogen

LOW –CARBON HYDROGEN BRIDGE TO RES PRODUCTION

- Decarbonised gas should be used as a bridging solution to produce hydrogen, before green varieties made from renewable electricity, become commercially available.
- A motion on the EU's hydrogen strategy won support from the European Parliament on Wednesday (19 May), backing the use of "low-carbon hydrogen" made from fossil gas as a bridge towards 100% renewable production

BLUE HYDROGEN DEVELOPMENT

- Hydrogen production cost is typically quoted in levelized cost of hydrogen (LCOH) terms, which relates to the average cost of hydrogen generation over the lifetime of a project.
- Blue hydrogen is primarily produced using a combination of steam methane reformers(SMR's) with the addition of CCS . Today there are seven blue hydrogen operating projects, producing nearly 0.4mnt/y of hydrogen and capturing nearly 6mntCO2/y
- SMR technology is mature and there is a limited scope for improvements in efficiency. Carbon Capture and Storage(CCS), the key part of the blue hydrogen Levelized Cost of Hydrogen(LCOH), at first view appears to be a novel technology but the extraction , compression ,transportation and injection into an underground geological formation , represent a number of mature industries combined together.

BLUE HYDROGEN PRICING

- The current LCOH of blue hydrogen is between $1.50/kg - $3.50/kg depending on natural gas prices and cost of labor.
- At current natural gas prices :SMR lifecycle cost around 30% of LCOH of blue hydrogen , CCS 30% , transportation and storage only up to 5%.
- According the analysis by Gaffney Cline , improvement technology by 2030, the forecasting total unit cost for blue hydrogen is between $1.25/kg -3.00/kgr.

GREEN HYDROGEN

- The green LCOH comprises 3 building blocks : Electrolyser, cost accounts for 20-25% of LCOH , renewable electricity, whith a lion's share, pricing between 70-75% of LCOH, and operating costs about 5%.
- Current estimated LCOH cost for green hydrogen estimated between $2.5/kg - $10 .00/kg.
- Forecasting electrolyser cost, with new technology, may fall and green hydrogen could easily be priced by 2030 at a range between $1,25/kg to $5/kg.
- However if green hydrogen surpass blue on price commercially quite soon , is required careful consideration, because market scale will be limited by availability of renewable energy.

IEA's NET-ZERO REPORT 18/5/2021

- No investment is needed for new oil & gas fields, for all countries and companies that produce this fuels, from now, in order to achieve net zero emissions by 2050.
- OPEC's share of the must reduced global oil supply, grows from 37% now to 52% by 2050.
- The new IEA's roadmap to accelerate the net zero by 2050 , may cause serious effects to the global energy security.

conclussions

- Gas prospect vary :a) In developing & emerging regions huge growth in energy demand offering large opportunities for gas expansions, b) in developed regions, gas play a considerable role in energy mix as a substitute of coal ,transport fuel and a flexibility source in power from renewables.
- Blue" hydrogen (derived from fuel gas with carbon capture, utilization, and storage [CCUS]) play a decarbonisation role where electricity produced from renewables can not be used in sectors like: high temperature industries, road tracking, marine and aviation.
- Hydrogen produced from gas is viewed not only as a bridge in the energy transition, but also, as an energy performance of gas based technologies and the emergence of LNG , while the cost of renewably driven electrolysis of water to produce "green" hydrogen continues to fall.
- 100% green hydrogen economy may fail to deliver on the potential for hydrogen or delay progress. Renewables alone have a potential limited as their intermittency or land availability.

Building a Greener Future with the Use of Natural Gas

- **Further Exploitation of new oil & gas fields,**
- **Bigger share of N.G. in electricity production,**
- **Large-Scale CCUS projects for production of Blue Hydrogen,**
- **Large and Small-Scale LNG projects,**

will be needed for a greener, safer future, growth and maturity of gas markets , to help guarantee energy security for the world's around 10bn people in 2050.

Thank you for your attention!

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