

THE ENERGY TRANSITION PATHWAY TO 2050

Opportunities and Risks
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PRESENTATION OUTLINE

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The Energy Transition Outlook to 2050

2

The Opportunity for Infrastructure

3

Points to Consider



OUTLOOK

BUILDING BLOCKS OF THE ENERGY TRANSITION

Demand:

How will energy demand evolve?

Infrastructure:

Critical to successful delivery

Supply:

A resilient low carbon energy supply

Investment:

Investment for both change and adaptation.

Government Action:

Stable and supportive policies and regulations

Consumer Behaviour:

Are we willing to accept change?

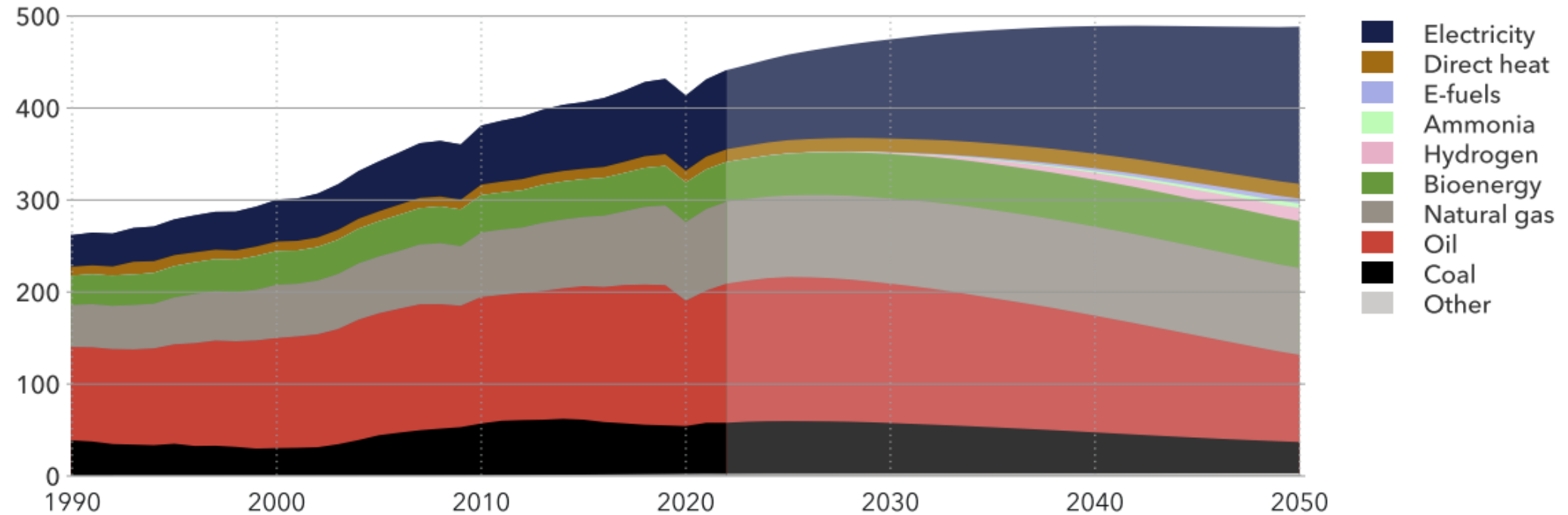




GLOBAL ENERGY DEMAND PEAKS LEVELS OFF TOWARDS 2050

World final energy demand by carrier

Units: EJ/yr

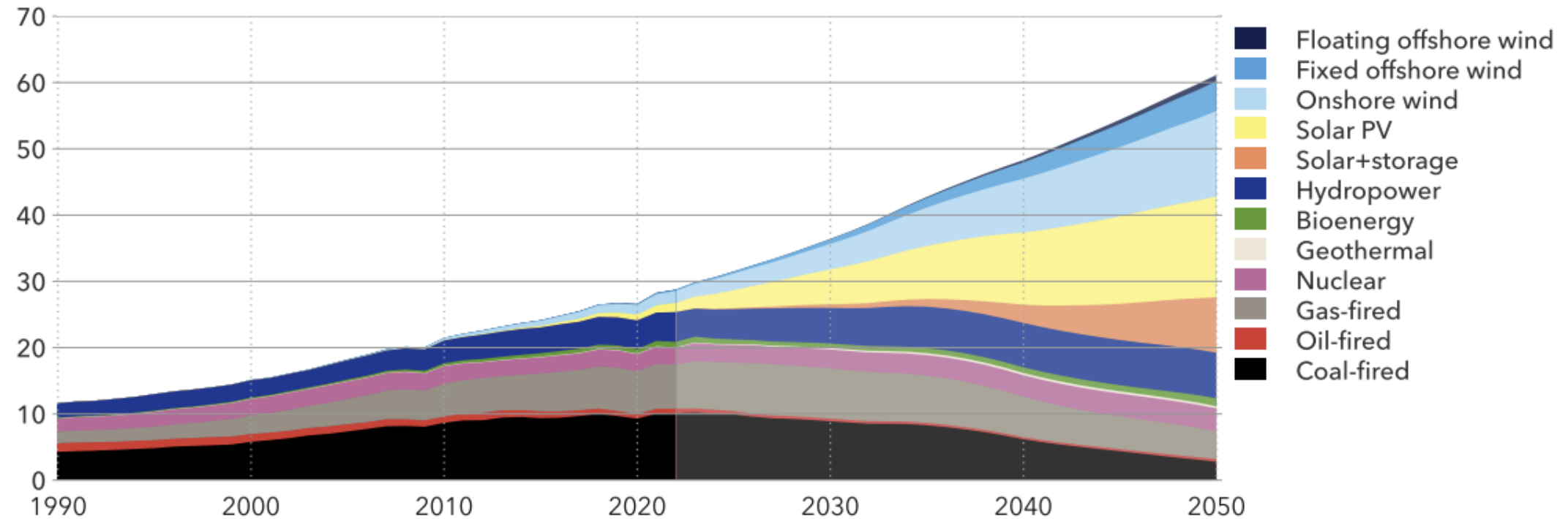


Historical data source: IEA WEB (2023)

80% OF GLOBAL GRID ELECTRICITY SUPPLY WILL COME FROM RENEWABLES AND NUCLEAR IN 2050

World grid-connected electricity generation by power station type

Units: PWh/yr



Historical data source: IEA (2023), GlobalData (2023)

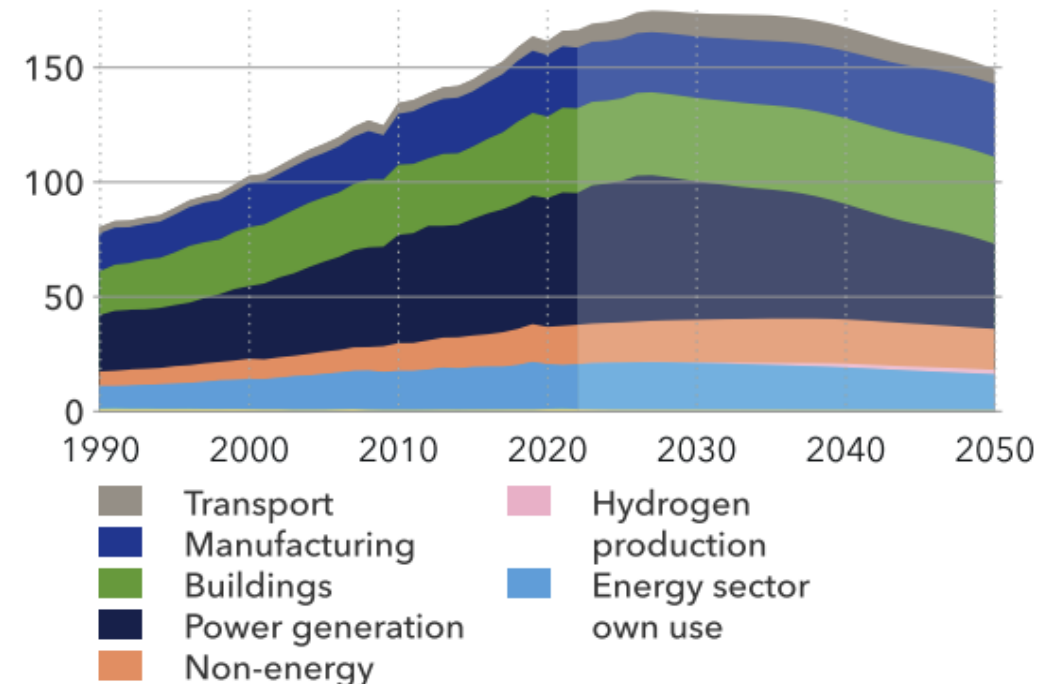
GLOBAL GAS DEMAND

KEY POINTS

- In 2022, annual global gas demand was 4,795 billion m³, 25% of global primary energy demand
- In 2050, gas will still provide 21% of global primary energy demand
- Gas demand is forecast to continue to grow until 2028, when it will plateau, then only decline slowly by 2050, when it will be 10% lower than today
- Demand will grow in manufacturing and transport, but decline in power generation, and remain static in buildings
- Production will grow fastest in Middle East & North Africa (+33%)
- Demand will grow fastest in Greater China (+28%) and India (+300%)
- LNG and pipeline transport will increase due to a shift in demand patterns between regions

World natural gas demand by sector

Units: EJ/yr



Includes natural gas liquids and biomethane. Historical data source: IEA WEB (2023)

KEY POINTS

- Despite increasing electrification and improvements in the efficiency of thermal insulation and heating/cooling equipment, global energy demand for buildings is set to grow nearly 30% over the next three decades
- In 2022, 28% of the world's energy and nearly 50% of global electricity was consumed in buildings. About three-quarters (92 EJ) of this demand was in residential buildings, and the rest (33 EJ) in commercial buildings including private and public workspaces, hotels, hospitals, schools, and other non-residential buildings.
- Total CO2 emissions from this sector amounts to 3 GtCO2, about 8% of total energy-related CO2 emissions.
- The floor area of residential buildings is expected to grow globally by nearly 50% through to 2050, while commercial floor area will more than double in line with the growth in economic activity.
- Space cooling accounted for only 6% of the energy demand of the buildings sector in 2022 but DNV predict an increase to 17% by 2050, split roughly 70:30 between residential and commercial buildings
- Regions with the fastest economic growth also happen to be those that will demand the greatest increase in cooling

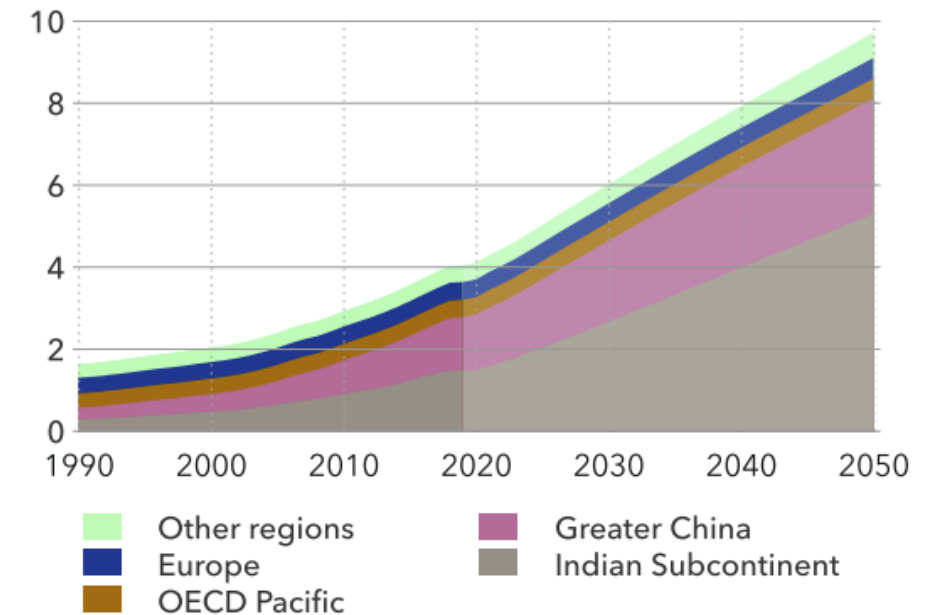


KEY POINTS

- Rail travel has the lowest energy consumption and CO2 emissions per passenger mile
- Global passenger numbers are expected to more than double (+140%) led by significant growth in demand for China and India. The Indian Subcontinent is forecast a 57% share of global rail passenger transport in 2050 with Greater China contributing 27%
- Substantial regional differences exist in rail freight growth, but rail freight is forecast to increase by 90% by 2050.
- Bio and synthetic fuels will grow beyond 2030
- Emissions reductions will be led by electrification and efficiency gains. Primarily through electrification, but also improvements in diesel and diesel electric hybrid performance

Rail passengers by region

Units: Trillion passenger-km/yr



Historical data source: IEA UIC (2019)

THE OPPORTUNITY



INTERNATIONAL
PUBLIC
PARTNERSHIPS

IMAGE

Northfleet Technology College, Kent, UK
Photo credit: Bob Wheeler Photography

IN 2050, THE ELECTRICITY SYSTEM WILL BE DRAMATICALLY DIFFERENT THAN TODAY – CONNECTIVITY WILL BE KEY



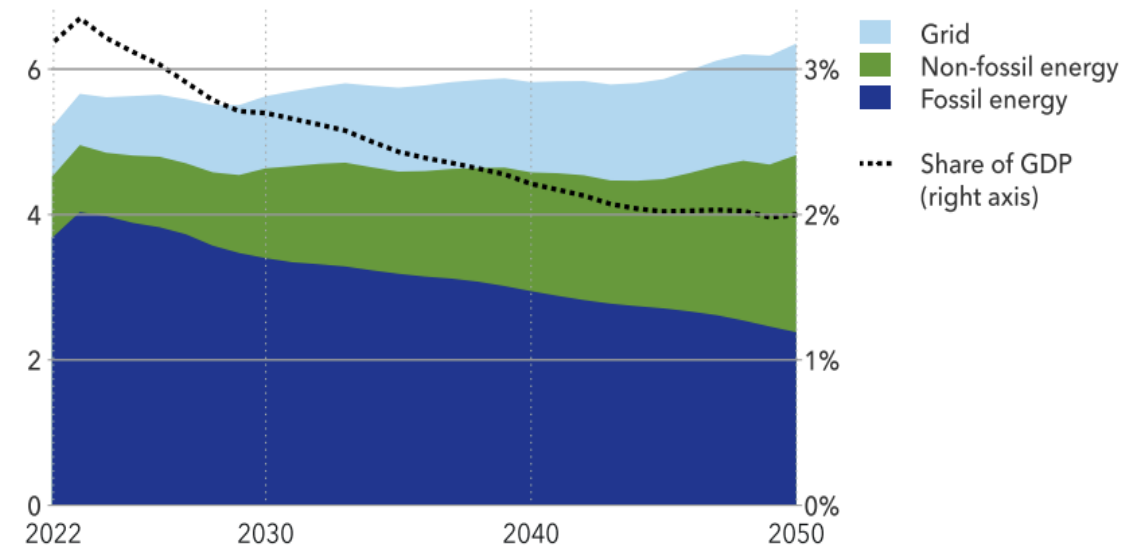
DNV ETO 2023

UPSTREAM ENERGY COSTS

- Global annual energy expenditure was USD 5.2trn in 2022
- DNV projects world energy annual expenditure to increase 22% to USD 6.4trn by 2050
- Although this is a significant increase, when taking into account the growth of GDP over the same period, it actually represents a decline in % of GDP from 3.2% to 2%
- In 2022, fossil fuel investment made up 71% of the total world energy expenditure but it is expected that this share will almost halve to 36% by 2050
- Additional transition costs will have to be borne by end-users in a more electrified energy system. These may or may not be subsidised by governments.

World energy expenditures

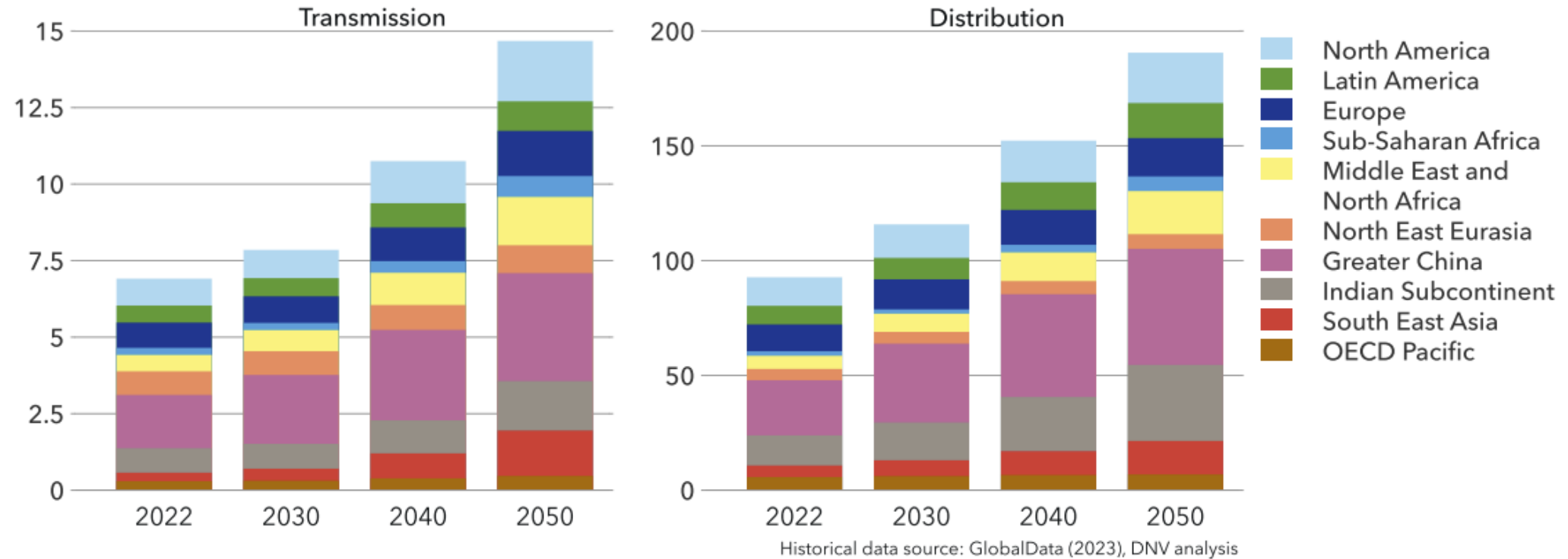
Units: Trillion USD/yr



ELECTRICAL GRID EXPANSION

Transmission and distribution power-line length by region

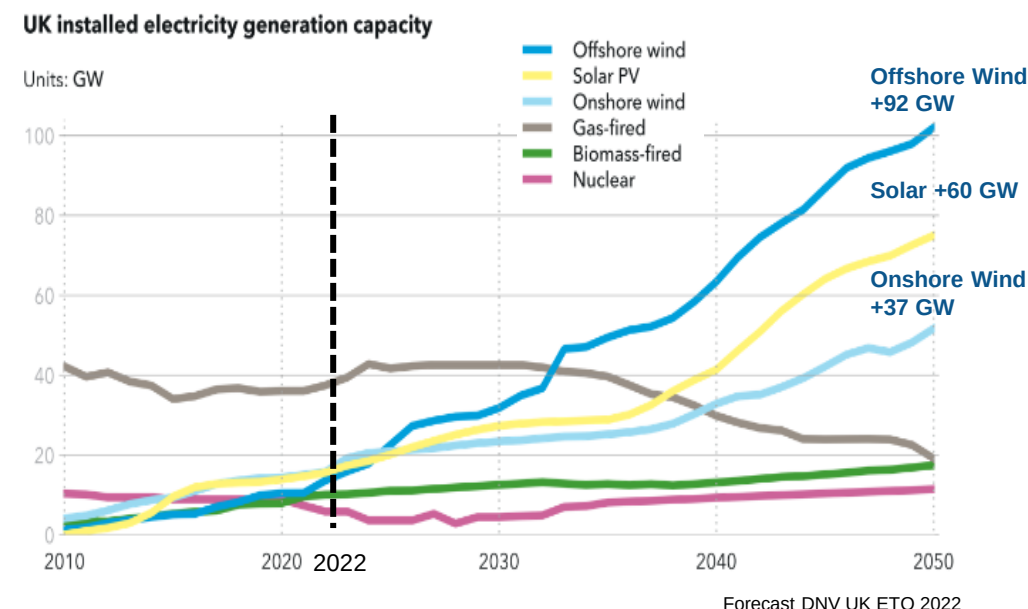
Units: Million circuit-km



THE UK WILL REQUIRE A MAJOR EXPANSION OF ELECTRICITY GENERATION & GRID INFRASTRUCTURE

KEY POINTS

- UK will require 180 GW of additional generation capacity by 2050
- 90% of new capacity will be Variable Renewables – dominated by offshore wind – both fixed and floating
- 3-fold increase in electrical grid infrastructure to handle increased throughput. Transmission network will quadruple from 38,000 km in 2021 to 155,000 km by 2050. Distribution lines will almost triple from 550,000 to 1.4 million km¹
- Grid investments in the UK have been relatively stable over the last two decades at an average of £3bn per year. Rapid grid expansion will result in an increase to £7bn per year in the 2030s and close to £10bn annually by 2050.
- Additional 190 GWh of utility-scale battery storage needed



1. Actually circuit-km.

POINTS TO CONSIDER



IMAGE
Dublin Criminal Courts, Ireland

THE GLOBAL ENERGY TRANSITION

We are not on track to meet Paris Agreement ambitions and are heading for 2.2°C warming by 2100

Geopolitical developments over the last 18 months have brought energy security into increasing focus

Electrification is increasing, but not quickly enough

Fossil fuels are still a substantial part of the energy system in 2050

The transition is affordable, and provides attractive investment opportunities

Technology obsolescence and policy uncertainty risks undermining investor confidence



UK ENERGY TRANSITION

The UK will not meet Net Zero 2050 and will fall short of its Nationally Determined Contribution commitment for 2030.

Electricity generation will shift fundamentally to variable renewables. It will be 75% of total electricity in 2050 compared to only 25% today.

Final energy demand will decline by a quarter by 2050, despite growth in population and GDP.

Decarbonising heat remains a challenge due to the complexity of technical, social and economic considerations

Infrastructure is at the core of the energy transition but is receiving insufficient attention.



THE TRANSITION WILL BRING OPPORTUNITY

THE TRANSITION TO NET ZERO WILL BRING OPPORTUNITY, BUT THERE ARE SEVERAL POINTS THAT NEED TO BE CONSIDERED

- Electricity and gas infrastructure are key enablers for delivering a resilient, low carbon energy system
- Energy production, both in the form of electrons and molecules
- Energy storage
- Climate change adaptation
- Modal shift in transport
- Synthetic/biofuels
- Energy efficiency
- Whole systems thinking
- Supply Chain
- Knowledge

