



WHEN TRUST MATTERS

The Energy Transition Outlook – Power Grids

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Narada®



MAN Energy Solutions



An independent assurance and risk management company

158
years

~12,000
employees

100,000
customers

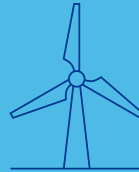
100+
countries

5% R&D
of annual revenue

Ship and offshore
classification and advisory



Energy advisory, certification,
verification, inspection and
monitoring



Management system certification,
supply chain and
product assurance



Software, platforms and **digital** solutions

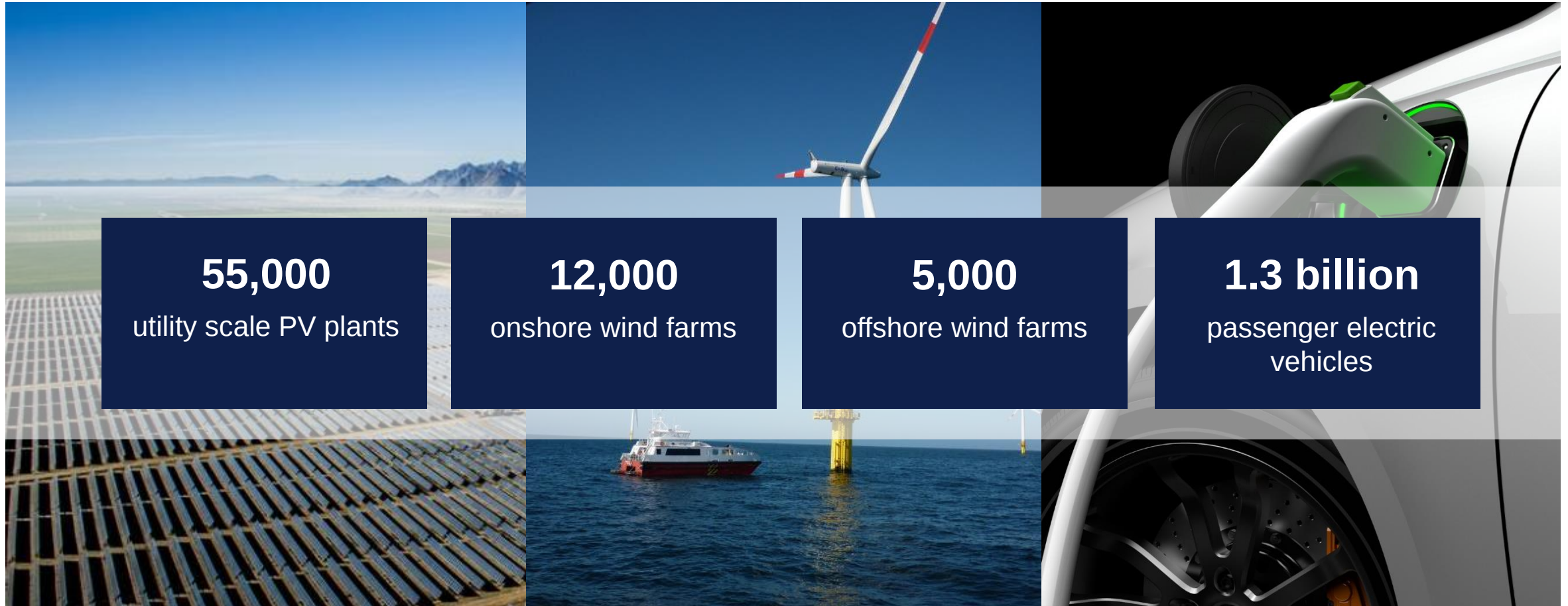


A great deal of attention, investment, and policy is rightly focused on clean energy generation and the decarbonization of industry. But the role of power grids is sometimes under-appreciated and misunderstood

“Power Transmission is key to our clean energy future. If we address the barriers standing in the way of that future, it will lead to lower emissions, cleaner air, more jobs, fewer blackouts, more energy and economic security, and healthier communities.”

- Bill Gates, January 2023

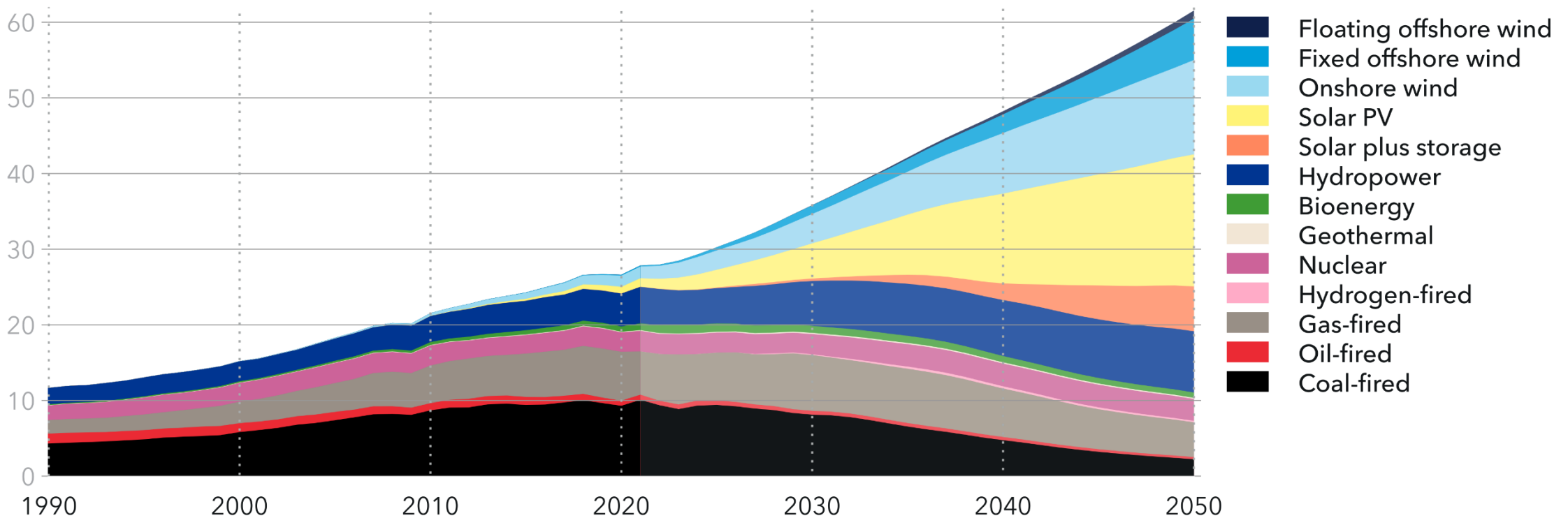
In 2050, the electricity system will be dramatically different than today



70% of renewables will come from solar and wind

World grid-connected electricity generation by power station type

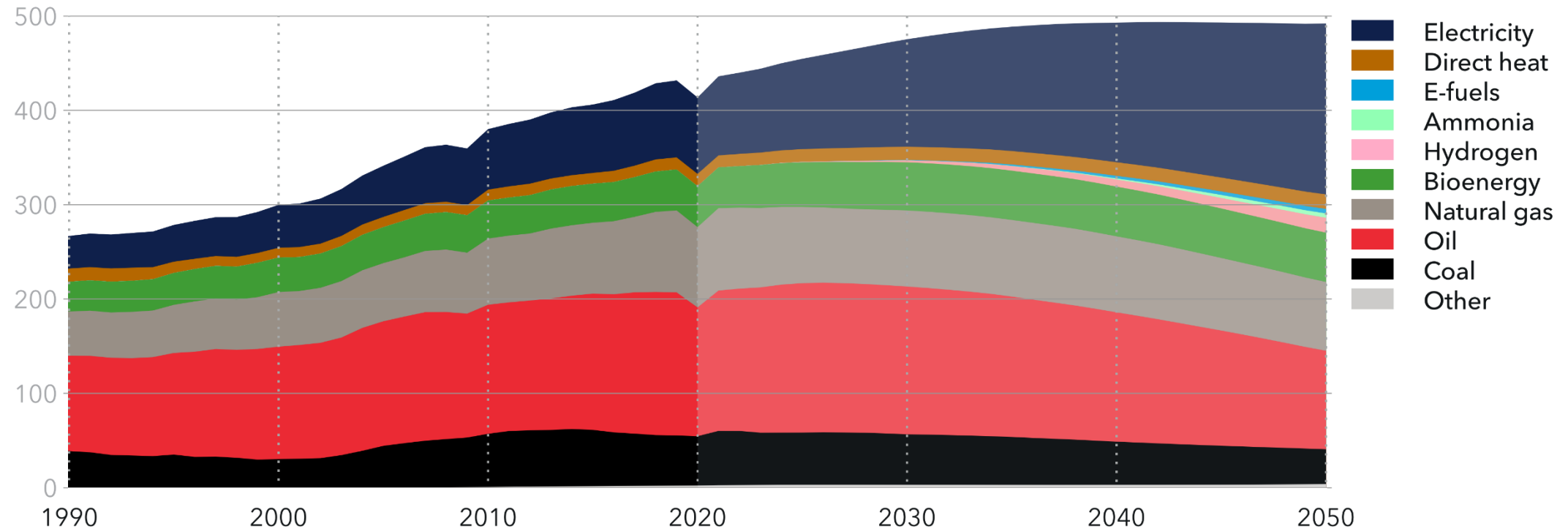
Units: PWh/yr



The share of electricity in the final energy demand mix doubles

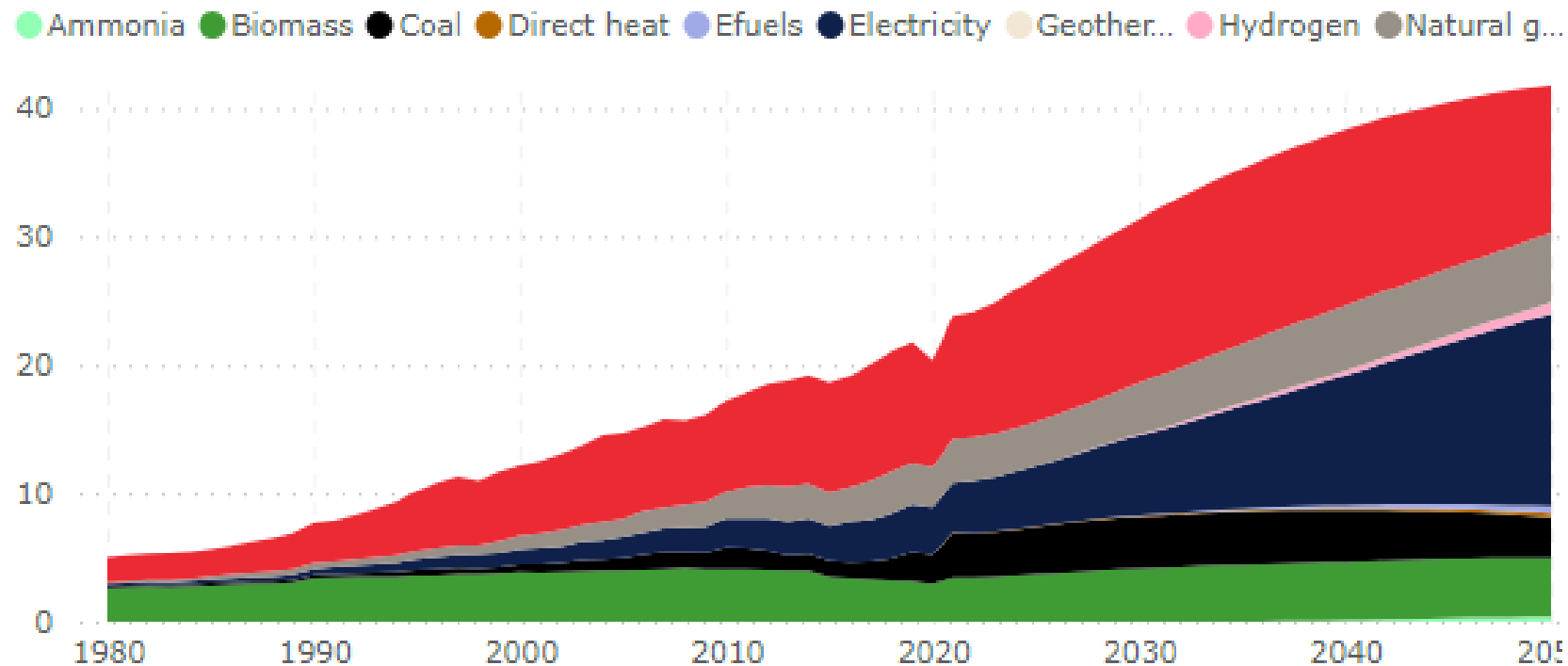
World final energy demand by carrier

Units: EJ/yr

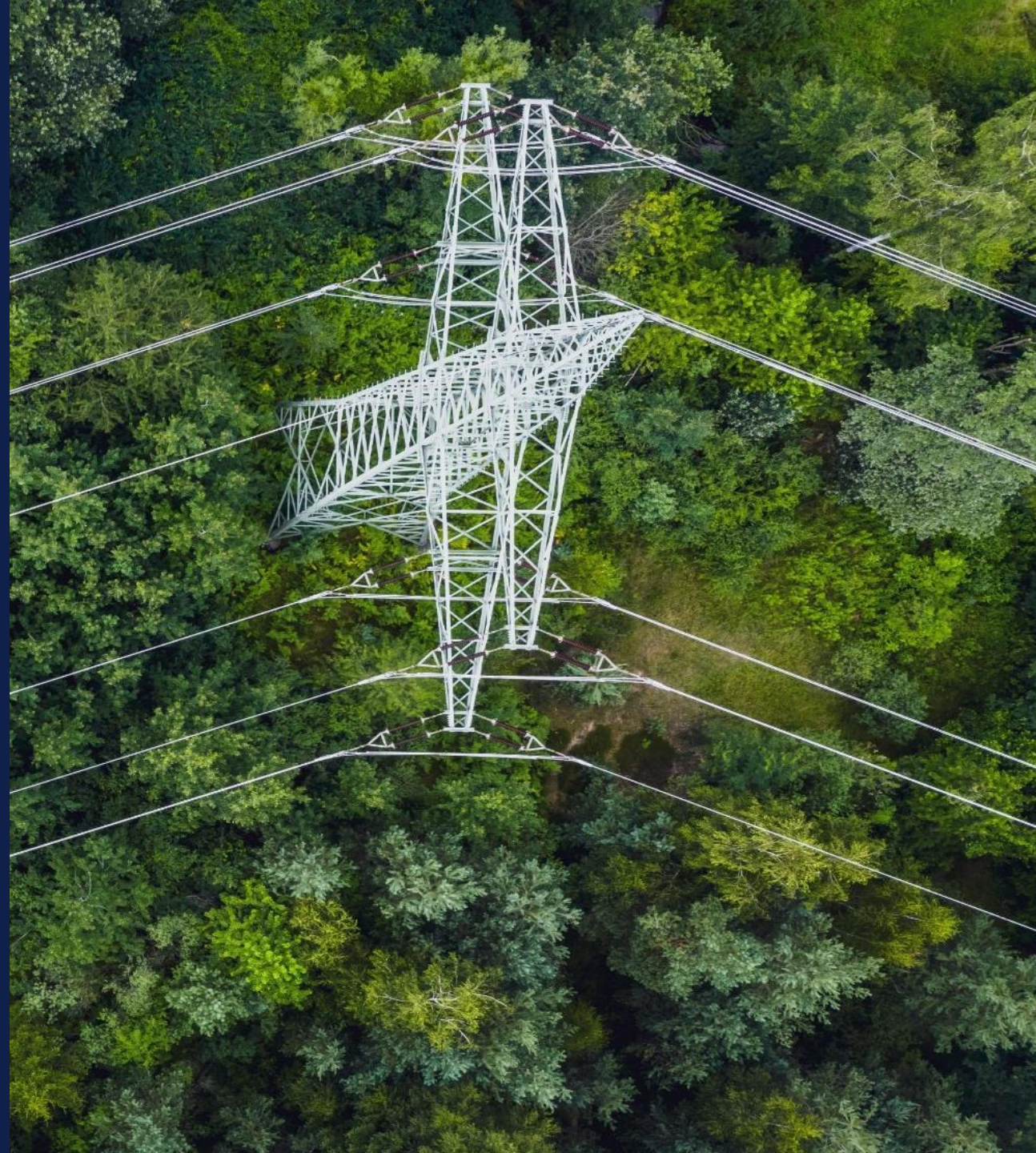


In South East Asia the share of electricity in the generation mix will grow 4 times what it is today

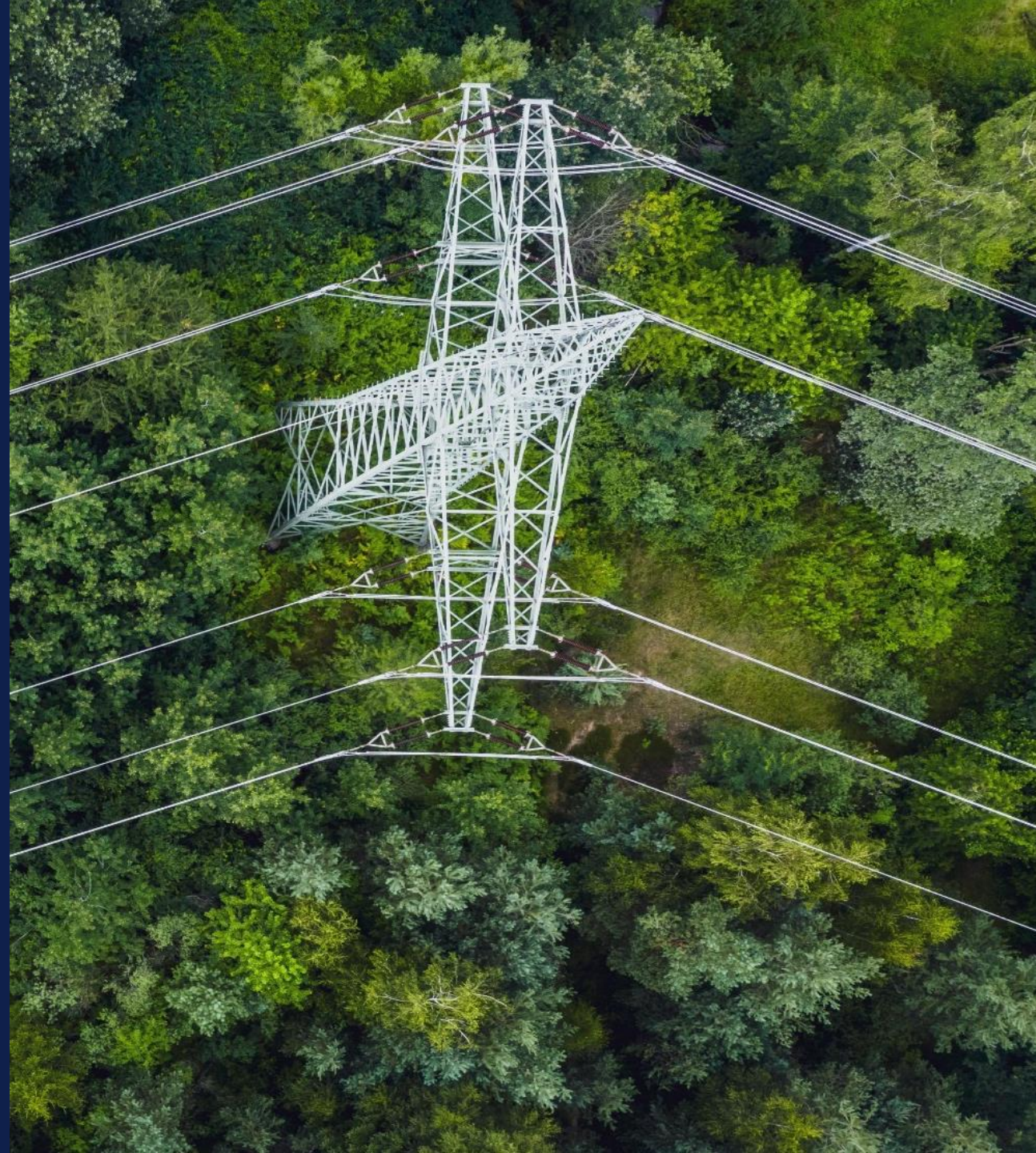
Energy demand by carrier (Units: EJ/yr)



Our Power Grids across South East Asia are changing



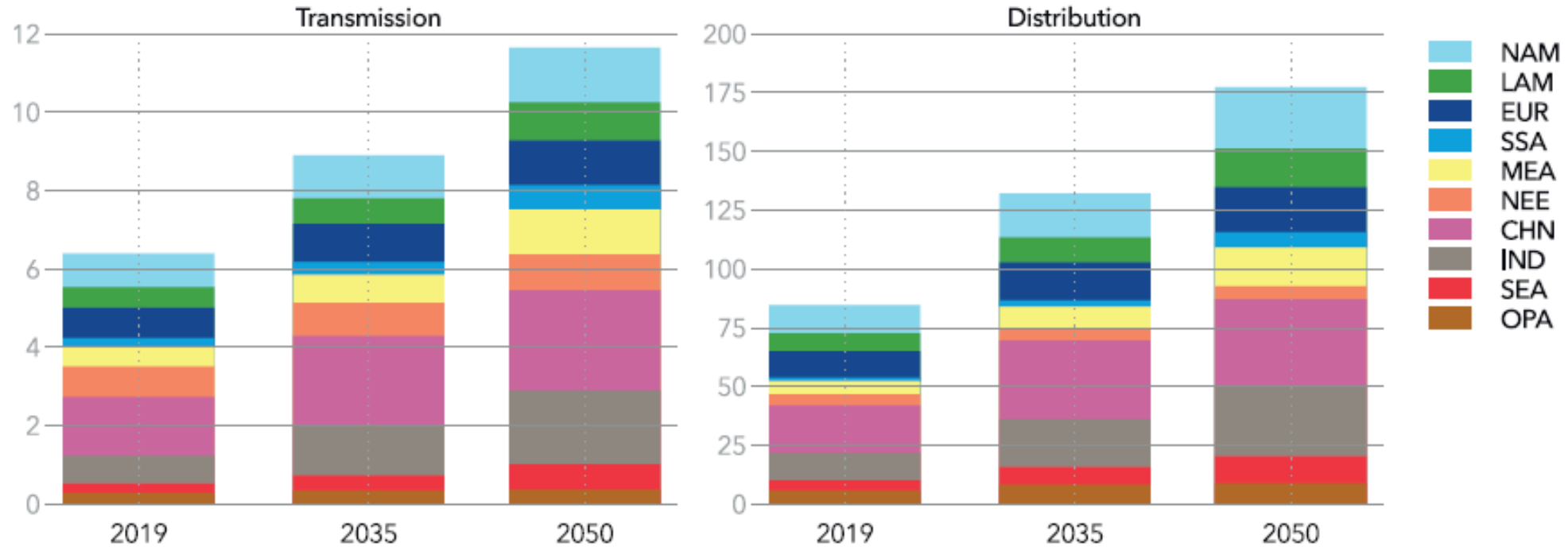
- **Onshore Distributed Energy Resources and electrification** drive the expansion, reinforcement and enhanced complexity of system operations
- **Networks need to be operated closer to limits** while maintaining reliability of aging assets
- **Great electricity interconnection** across South East Asia will lead to greater value for all countries – lower overall cost, and maximising the potential of natural resources across the region
- **Growth of offshore wind** will require massive expansion of resilient transmission grids and introduction of (interoperable) HVDC / HVAC / hybrid grids
- **(Near) real-time decisions are needed to ensure cost effective reliability.** This requires the digital transformation, based on standardized data and information exchange, interoperability and modularity of IT/OT systems



World transmission lines will increase from just over 6 million circuit-kilometres in 2019 to almost 12 million by 2050

Transmission and distribution power-line length by region

Units: Million circuit-km

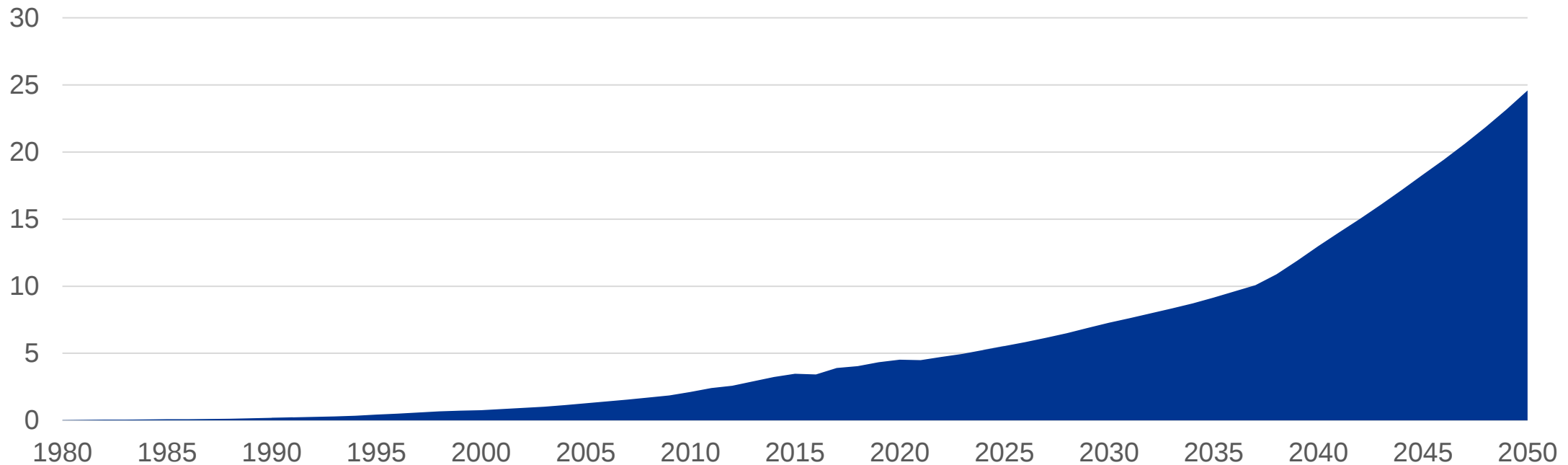


Historical data source: GlobalData (2021)

The total length of power lines in South East Asia will increase 4 times by 2050

Power line Length SEA

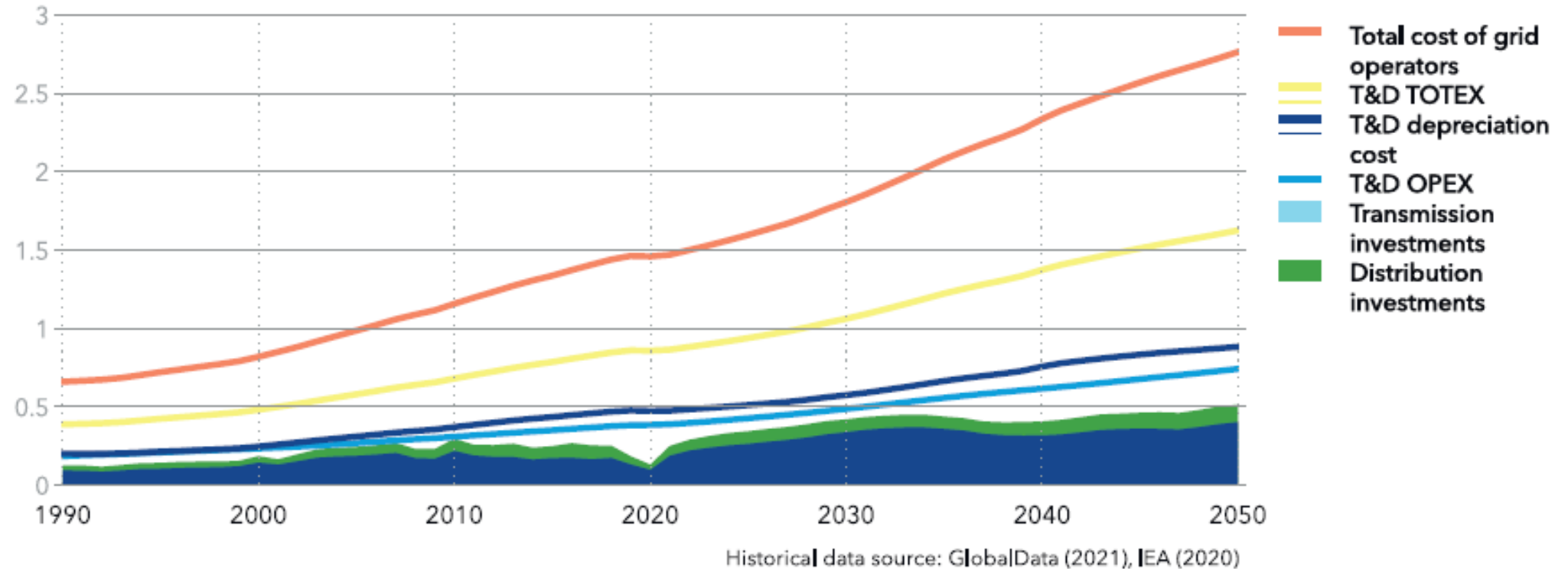
Units: Circuit- km



There will be a steady increase in grid investments until the 2030s, reaching levels of USD 400-500bn/yr.

World power grid investments, expenditures and total cost

Units: Trillion USD/yr



Accelerating Innovation and Digital Transformation

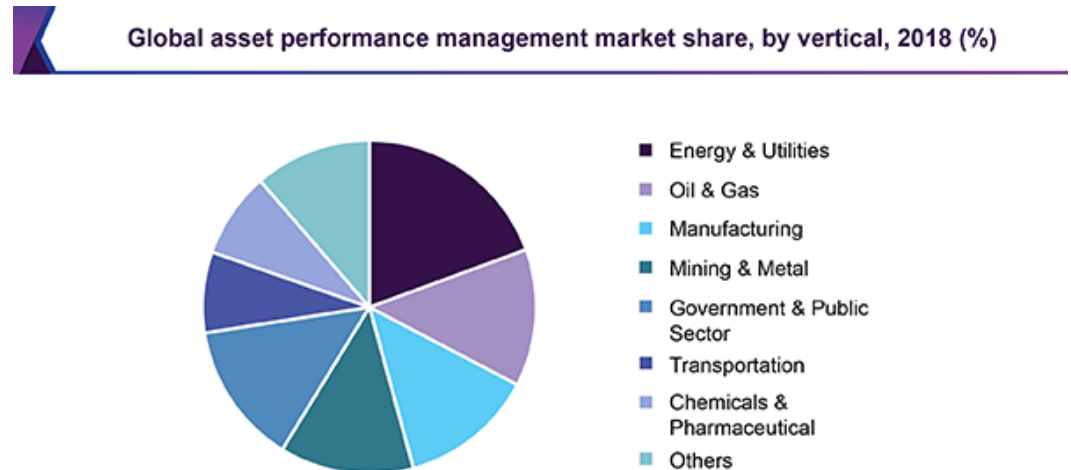
Investments are not only for grid expansion:

- Some 15% of grid investment will go into digital infrastructure
- To address the complexity of a more-decentralized power system and to support decision making in asset management and operations. Investments in digital tools will expand to enable collection of data and information from the grid and feed these to core processes. These tools include
 - Advanced analytical algorithms enhanced with machine learning
 - Asset conditions
 - IT infrastructure
 - Data Storage
 - Cyber security
 - Sensor arrays



Digitalization: APM becomes solution for utilities to improve asset mgmt. and operations

- Utilities changing from **reactive** to **preventive and predictive** maintenance schemes by means of APM insights
- **Typical APM capabilities**
 - Condition monitoring, health indexing, predictive forecasting
 - Risk & reliability centred maintenance
- **Typical APM use cases**
 - Optimising substation maintenance and replacement plans
 - Optimising vegetation and wildfire management
 - Dynamic rating
 - Support power system planning
 - Develop real-time (and near-time) digital twins
- Both **cloud based and on-premise** solutions



Source: www.grandviewresearch.com

Part of our Industry Insights thought leadership series



The view from the transmission and distribution sector



401

senior energy
professionals surveyed



25%

of respondents
are C-level



75

countries
represented



24%

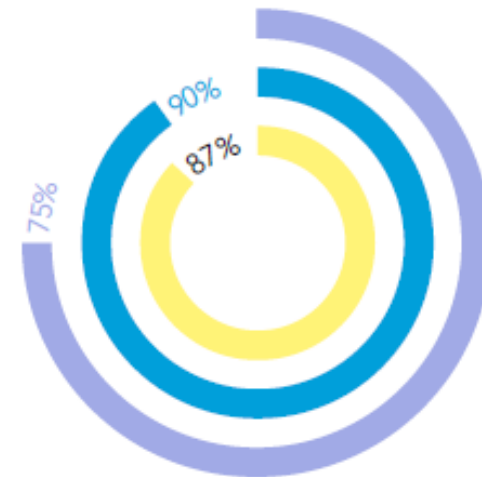
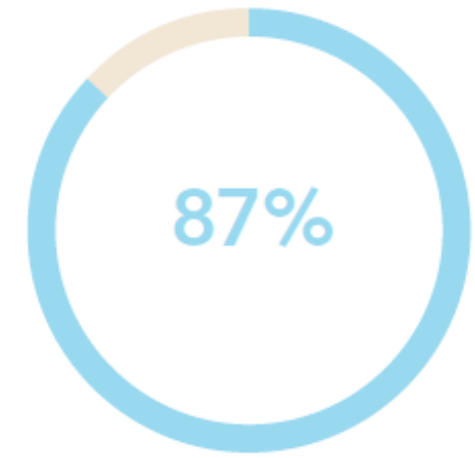
24% annual revenue
over USD 1 billion



9

in-depth
interviews

There's an urgent need for greater investment in the power grid



Europe
North America
Asia Pacific

*The data shows the total respondents and regional split. Percentages reflect net agreement with the statement.

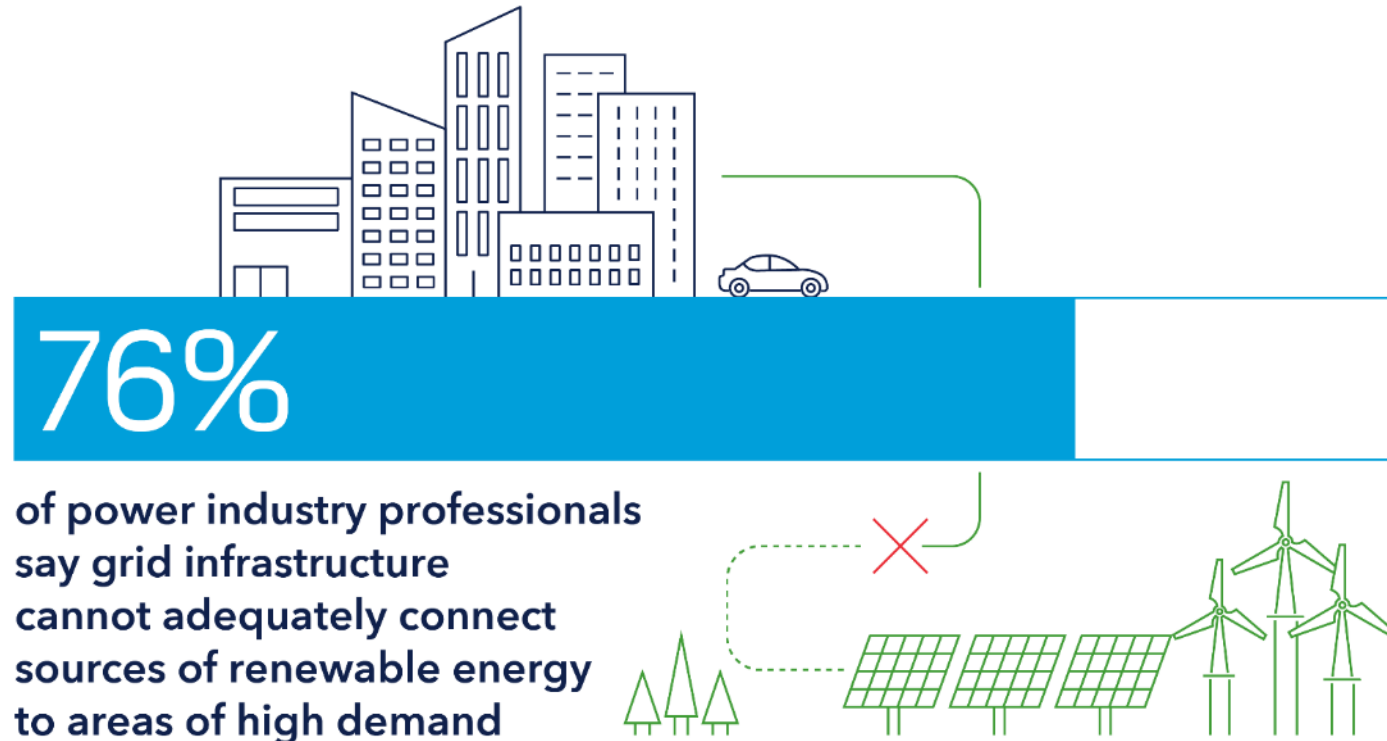
Power grids investment needs to grow by 50% in the next 10 years

This rapid investment is needed to support the influx of wind/solar and electrification of industry, transport and home appliances

15% of grid investments will be steered towards digital infrastructure, to address the complexity of a more decentralized power system

In terms of circuit-km, transmission lines will double and distribution lines more than double by 2050

Power grids cannot adequately connect renewable sources to areas of high demand



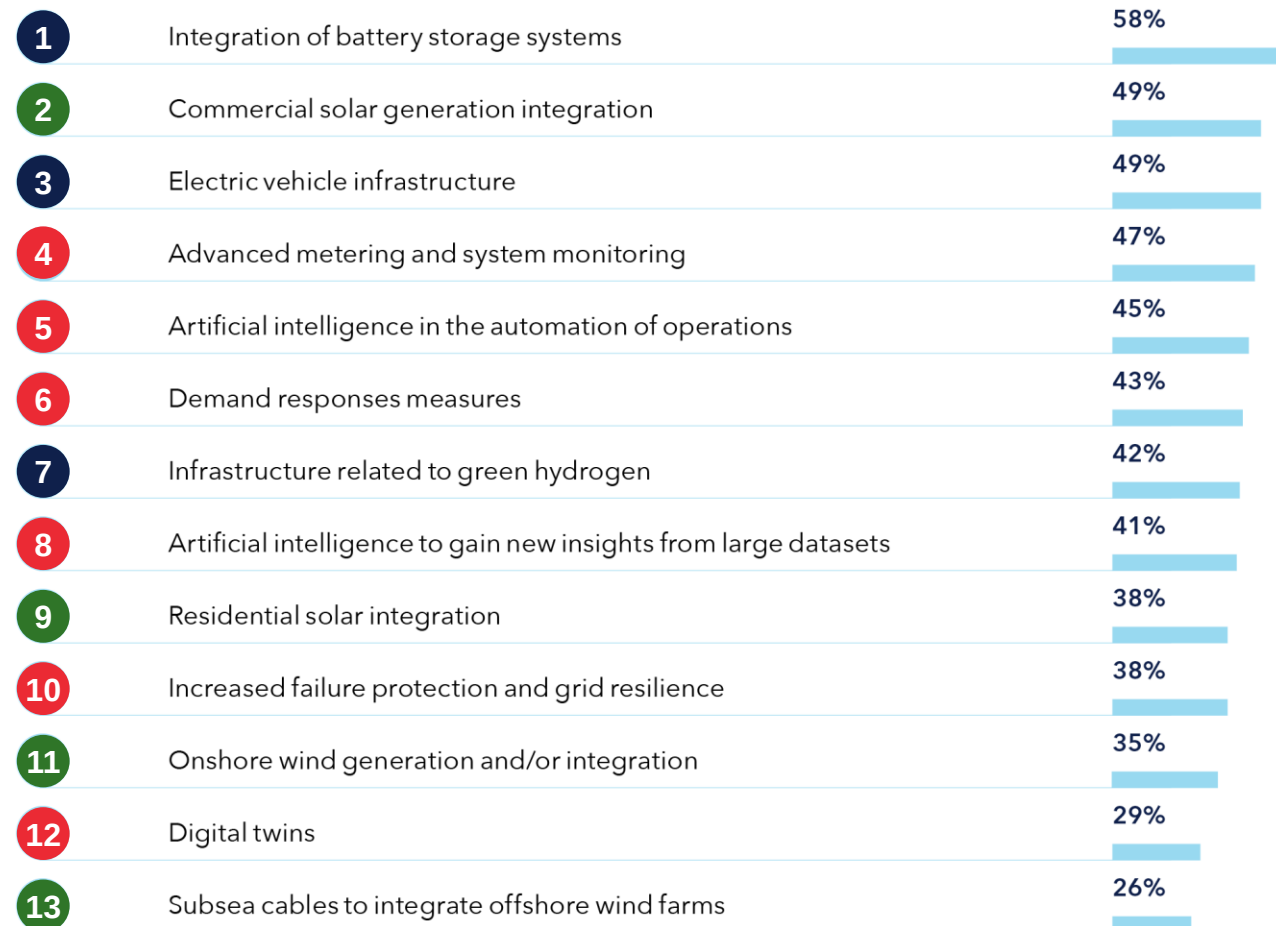
Investment priorities on the shorter term

● Storage and electrification

● Integration of RES

● Digitalization

Investment priorities over the next 12 months

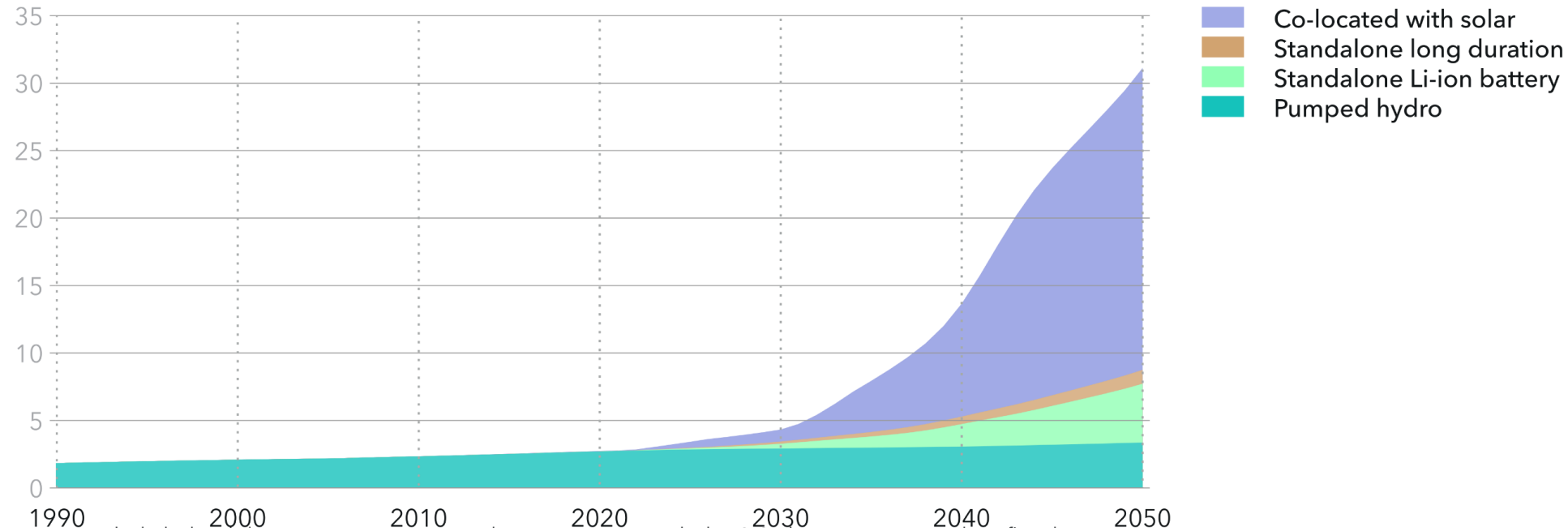


*Percentages reflect those that indicated they would be increasing investment in these areas in the year ahead.

Storage is essential for the inclusion of variable renewables in electricity - 15% of standalone storage will be provided from EVs

World utility-scale electricity storage capacity

Units: TWh





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