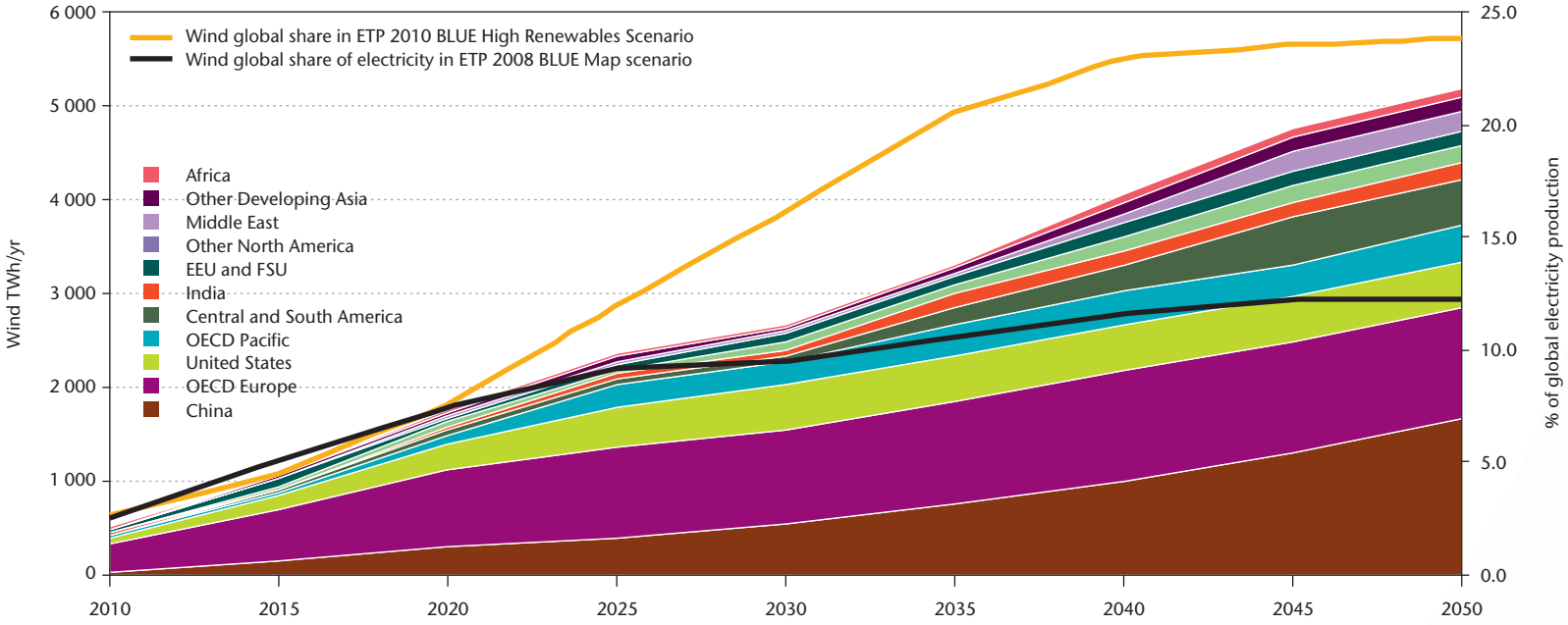
WIND ENERGY ROADMAP

International Energy Agency

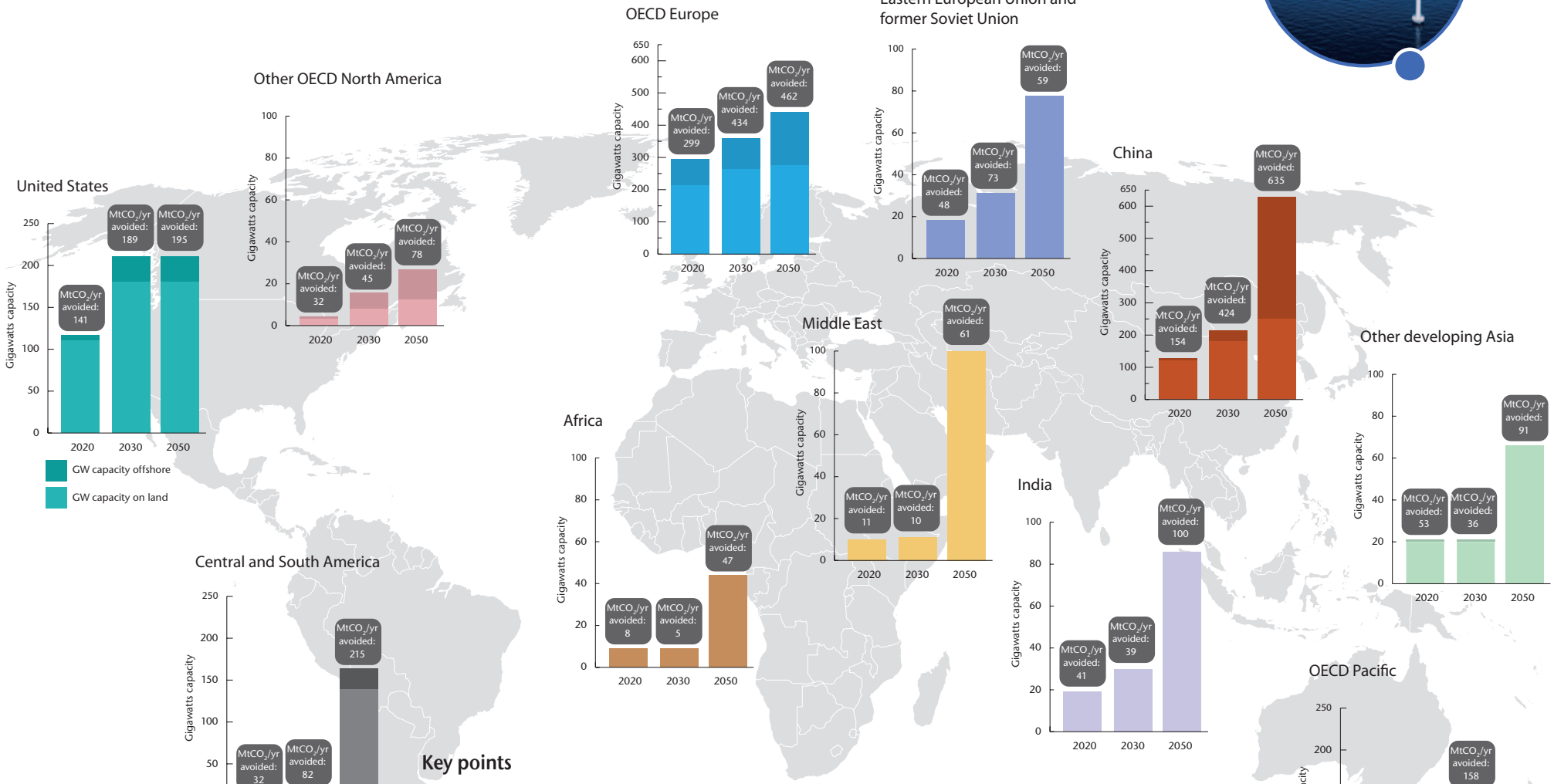
Regional wind power shares of global electricity (TWh), 2000-2050



Key findings

- The ETP 2008 BLUE scenario sees 12% of global electricity from wind energy by 2050. 2 000 GW of capacity would annually avoid the emission of 2.8 gigatonnes of CO_2 equivalent. In the recently developed High Renewables scenario, penetration reaches 23% by 2050.
- Achieving the ETP 2008 BLUE scenario targets requires investment of some USD 3.2 trillion. 47 GW would need to be installed on average every year for the next 40 years – a 75% increase – amounting to USD 81 billion/yr.
- In 2030, non-OECD economies will produce some 17% of global wind energy, rising to 57% in 2050.
- Wind power can be competitive today where the resource is strong and when the cost of carbon is reflected in markets. Costs per MWh range from USD 70 to USD 130.
- Costs are expected to decrease further as a result of technology development, deployment and economies of scale – by 23% by 2050. Transitional support is needed to encourage deployment until full competition is achieved.
- Offshore costs are at present twice those on land, although the quality of the resource can be 50% higher. This roadmap projects cost reductions of 38% by 2050.
- To reliably achieve high penetrations of wind power, the flexibility of power systems and markets must be enhanced and, eventually, increased. Flexibility is a function of access to flexible generation, storage and demand response, and is enhanced by interconnection, larger and faster power markets, smart grids and forecasting.
- Intensified R&D is particularly needed in the offshore sector to develop a new generation of turbines and sub-surface structures fundamentally designed for the marine environment with minimum operating and maintenance requirement.

Global map of regional wind power capacity development and avoided CO_2 emissions in the ETP BLUE 2008 scenario

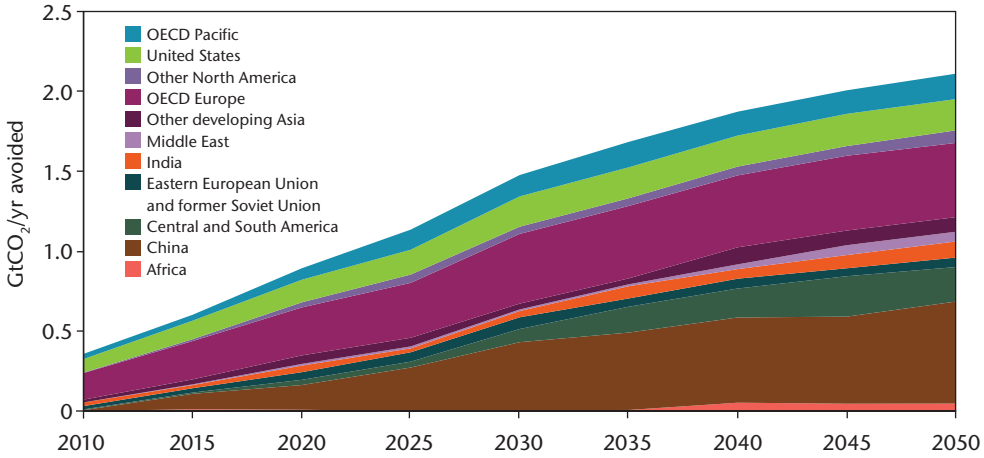


Key points

- In 2020, all global regions have multiple gigawatts of installed wind power capacity, ranging from just under 10 GW in Africa to more than 600 GW in China.
- By 2050, according to the 2008 ETP BLUE Map scenario, more than half of cumulative global investment in new capacity will have taken place in non-OECD countries.
- The need for swift economic growth, limited energy supply, and in some cases abundant conventional resources, combined with inadequate transfer of best practice, may encourage developing countries to look to conventional energy supply alone. Greater efforts are needed bilaterally and multilaterally to address this concern.

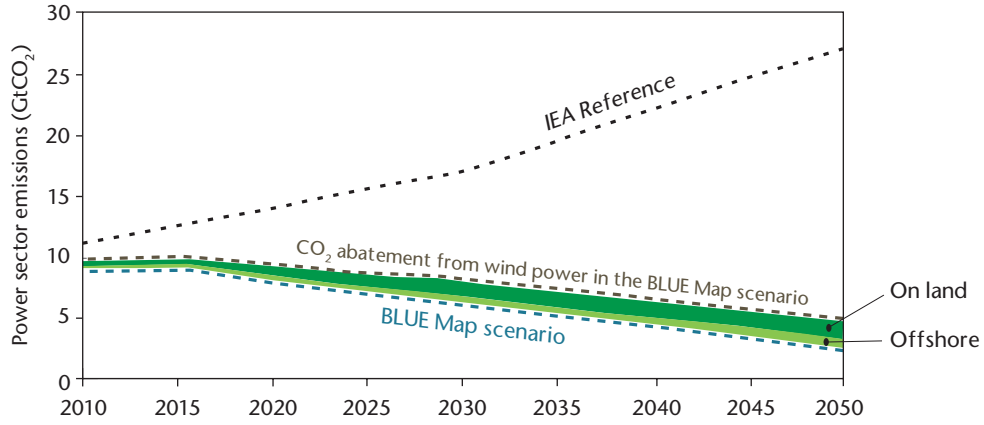
Global development and CO_2 emissions reductions

Regional CO_2 abatement through wind power in the 2008 BLUE Map scenario, 2010 – 2050, over the reference scenario



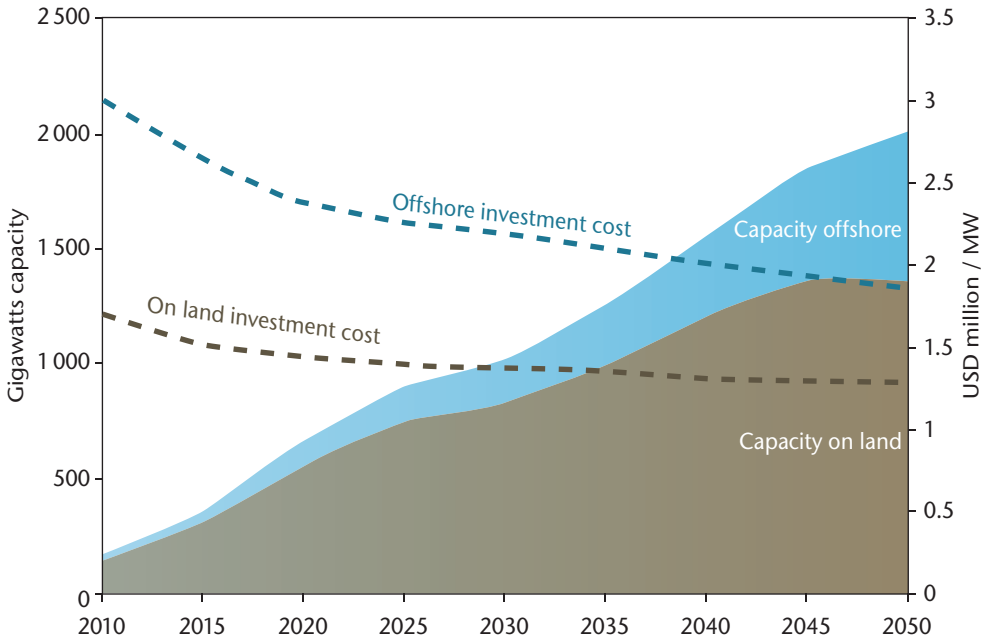
▶ Key point: In 2050, China (30%) and OECD Europe (22%) deliver the greatest shares of CO_2 emissions abatement through wind power, followed by Latin America (10%) the US (9%) and OECD Pacific countries (6%).

The wind power contribution to avoided CO_2 emissions in the 2008 BLUE Map scenario, 2010 – 2050, over the reference scenario



▶ Key point: In 2050, power sector CO_2 emissions rise to 27 $GtCO_2$ / yr in the reference scenario and fall to 3 $GtCO_2$ /yr in the 2008 BLUE Map scenario. Wind power provides 2.1 $GtCO_2$ /yr (9%) of the difference, 0.76 $GtCO_2$ /yr of which is from offshore.

Wind power capacity development and investment cost reduction offshore and on land in the 2008 BLUE Map scenario, to 2050



▶ Key point: by 2050, 32% of wind capacity will be located at sea, up from 19% in 2030. Offshore technology is currently further from market than land based technology.

Offshore tasks:

- Intensified research and development to improve reliability, facilitated through shared industry databases of offshore operating conditions and experiences.
- Strengthened supply chains; sufficient purpose-designed installation vessels and harbour space; improved installation strategies.
- New generations of turbines and sub-surface structures fundamentally designed for the marine environment with minimum operations and maintenance requirement.

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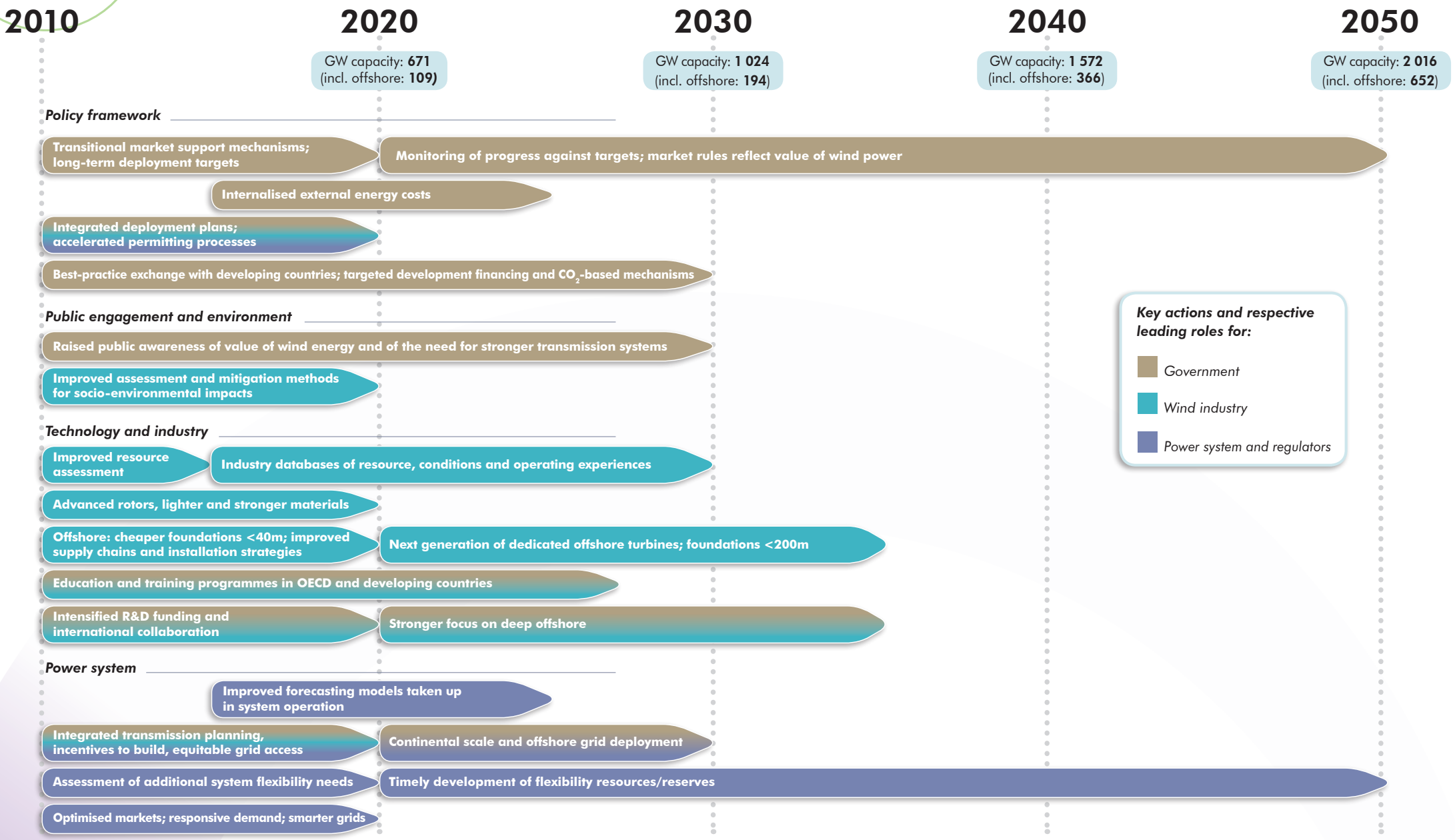
Wind energy roadmap milestones



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