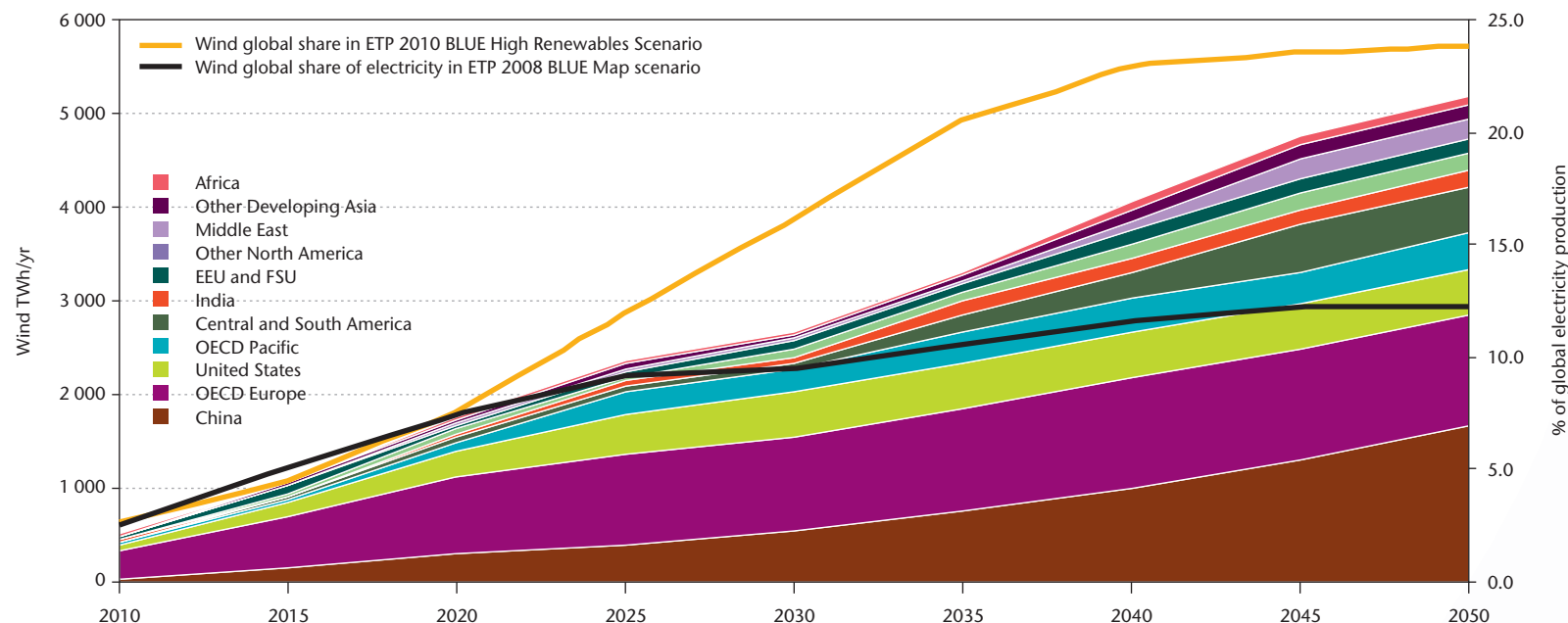


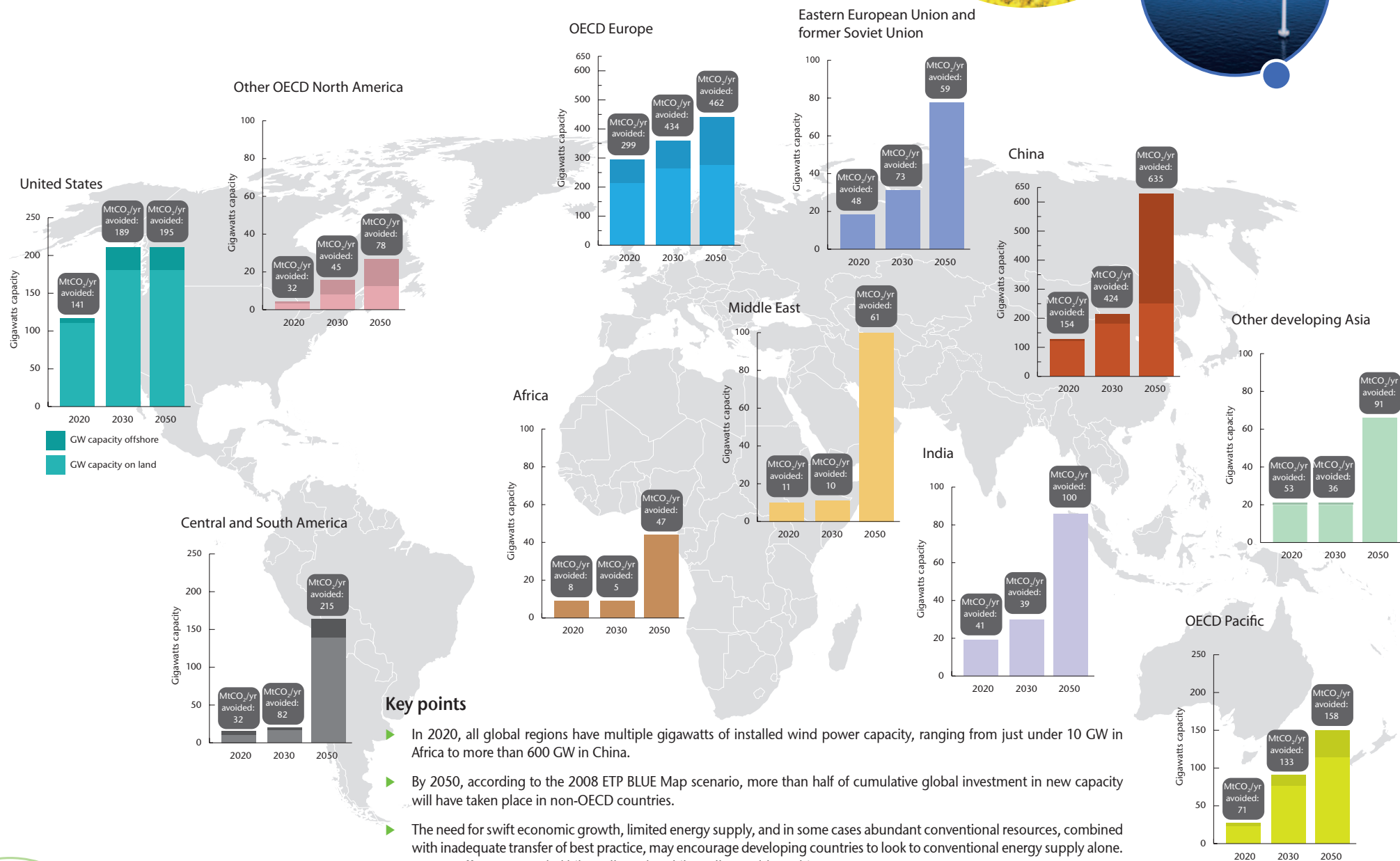
Regional wind power shares of global electricity (TWh), 2000-2050



Key findings

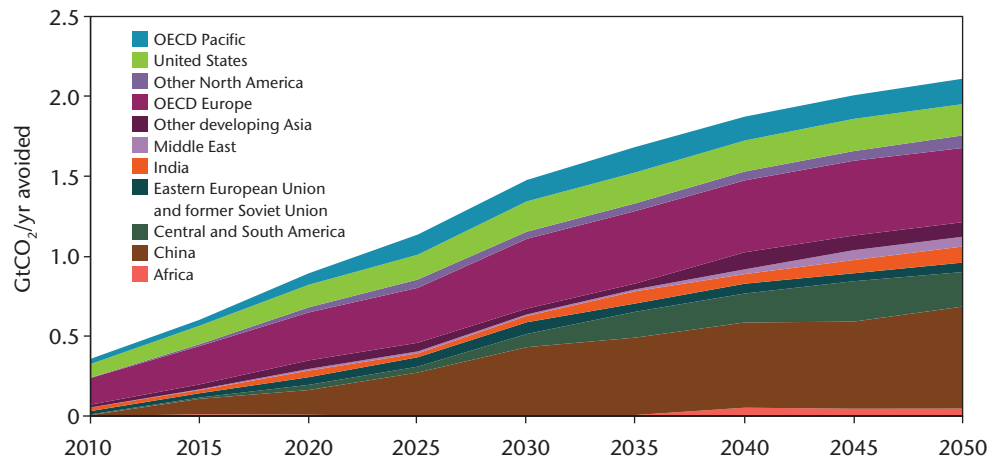
- ▶ The ETP 2008 BLUE scenario sees 12% of global electricity from wind energy by 2050. 2 000 GW of capacity would annually avoid the emission of 2.8 gigatonnes of CO₂ equivalent. In the recently developed High Renewables scenario, penetration reaches 23% by 2050.
- ▶ Achieving the ETP 2008 BLUE scenario 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 CO₂ emissions in the ETP BLUE 2008 scenario



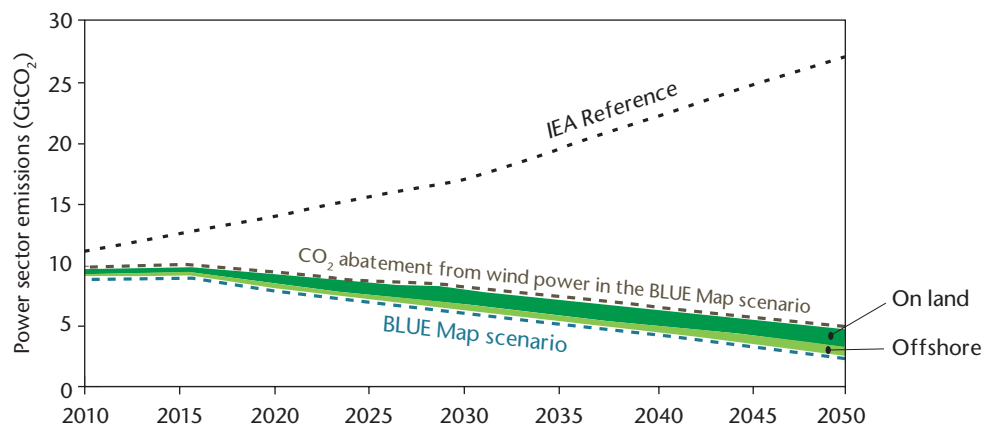
Global development and CO₂ emissions reductions

Regional CO₂ abatement through wind power in the 2008 BLUE Map scenario, 2010 – 2050, over the reference scenario



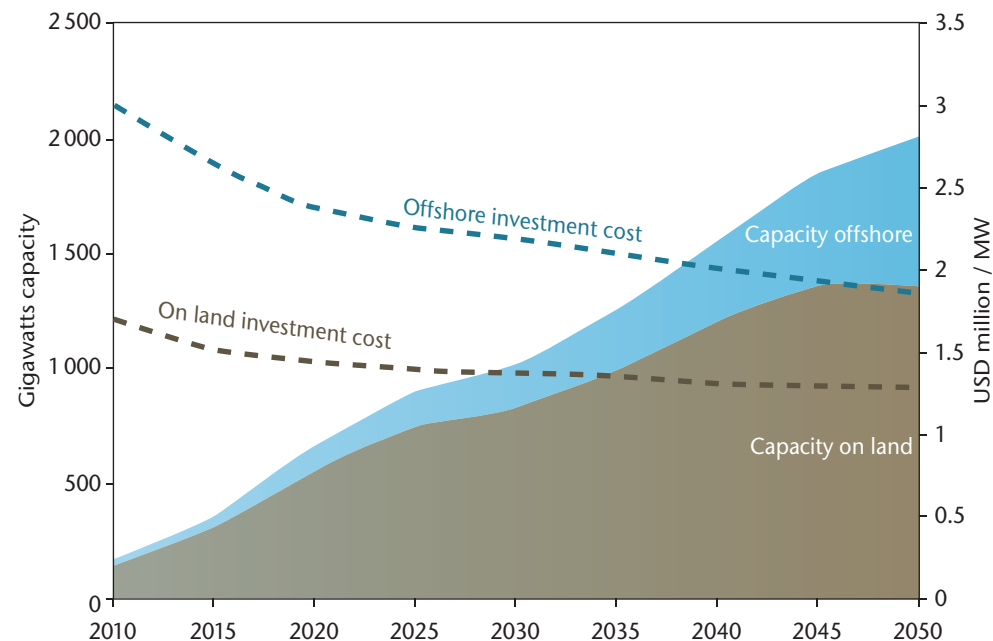
► Key point: In 2050, China (30%) and OECD Europe (22%) deliver the greatest shares of CO₂ emissions abatement through wind power, followed by Latin America (10%) the US (9%) and OECD Pacific countries (6%).

The wind power contribution to avoided CO₂ emissions in the 2008 BLUE Map scenario, 2010 – 2050, over the reference scenario



► Key point: In 2050, power sector CO₂ emissions rise to 27 GtCO₂ / yr in the reference scenario and fall to 3 GtCO₂/yr in the 2008 BLUE Map scenario. Wind power provides 2.1 GtCO₂/yr (9%) of the difference, 0.76 GtCO₂/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.

Wind energy roadmap milestones

2010

2020

2030

2040

2050

GW capacity: 671
(incl. offshore: 109)

GW capacity: 1 024
(incl. offshore: 194)

GW capacity: 1 572
(incl. offshore: 366)

GW capacity: 2 016
(incl. offshore: 652)

Policy framework

Transitional market support mechanisms;
long-term deployment targets

Monitoring of progress against targets; market rules reflect value of wind power

Internalised external energy costs

Integrated deployment plans;
accelerated permitting processes

Best-practice exchange with developing countries; targeted development financing and CO₂-based mechanisms

Public engagement and environment

Raised public awareness of value of wind energy and of the need for stronger transmission systems

Improved assessment and mitigation methods
for socio-environmental impacts

Technology and industry

Improved resource
assessment

Industry databases of resource, conditions and operating experiences

Advanced rotors, lighter and stronger materials

Offshore: cheaper foundations <40m; improved
supply chains and installation strategies

Next generation of dedicated offshore turbines; foundations <200m

Education and training programmes in OECD and developing countries

Intensified R&D funding and
international collaboration

Stronger focus on deep offshore

Power system

Improved forecasting models taken up
in system operation

Integrated transmission planning,
incentives to build, equitable grid access

Continental scale and offshore grid deployment

Assessment of additional system flexibility needs

Timely development of flexibility resources/reserves

Optimised markets; responsive demand; smarter grids

Key actions and respective leading roles for:

Government

Wind industry

Power system and regulators

International Energy Agency

www.iea.org/roadmaps