WIND POWER, BUT DONE RIGHT

For Germany to reach climate neutrality by the middle of this century, renewable sources need to generate a whole lot more power than the roughly 500 terawatt hours that they produce today. After all, electricity will also need to replace the fossil fuels that are currently still in use for heat generation, transport, and industrial production. Besides the question of where to build photovoltaic systems and wind turbines, this expansion should also consider the power that the various forms of renewable energies can generate – especially wind power.

POWER GENERATION BY RENEWABLES

Potential power supply

by renewables in Germany

8,600 GW
Photovoltaics

390 GW
Wind

260 GW
Biomass

15 GW
Geothermal

5 GW
Water

Energy requirements

2021

3,390 TWh/year = 387 GW
of which roughly 80 percent is imported

To produce the 387 gigawatts needed to meet all of Germany's energy needs, current photovoltaic systems would cover around 4.5 percent of the country while wind turbines could provide a maximum of 390 gigawatts throughout Germany. Even today, the electricity supplied by wind power and photovoltaics is often cheaper than that produced using lignite.

Costs (€ cent / kWh)

2018

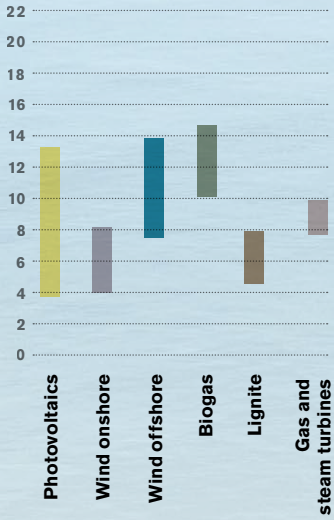


CHART: GCO BASED ON A TEMPLATE BY FRAUNHOFER ISE

MANY TURBINES SLOW DOWN THE WIND

As turbines draw energy from the wind and create a slipstream, they are usually erected at a distance of four to six rotor diameters (around 600 to 800 meters) from each other to allow additional energy to be supplied from above. But there are limitations: as the number of wind turbines in a region increases, the atmosphere is less able to balance the losses and the power of the wind decreases. This effect could reduce the electricity yield for the planned onshore expansion in some regions and will be an important factor in the targeted expansion in the North Sea.

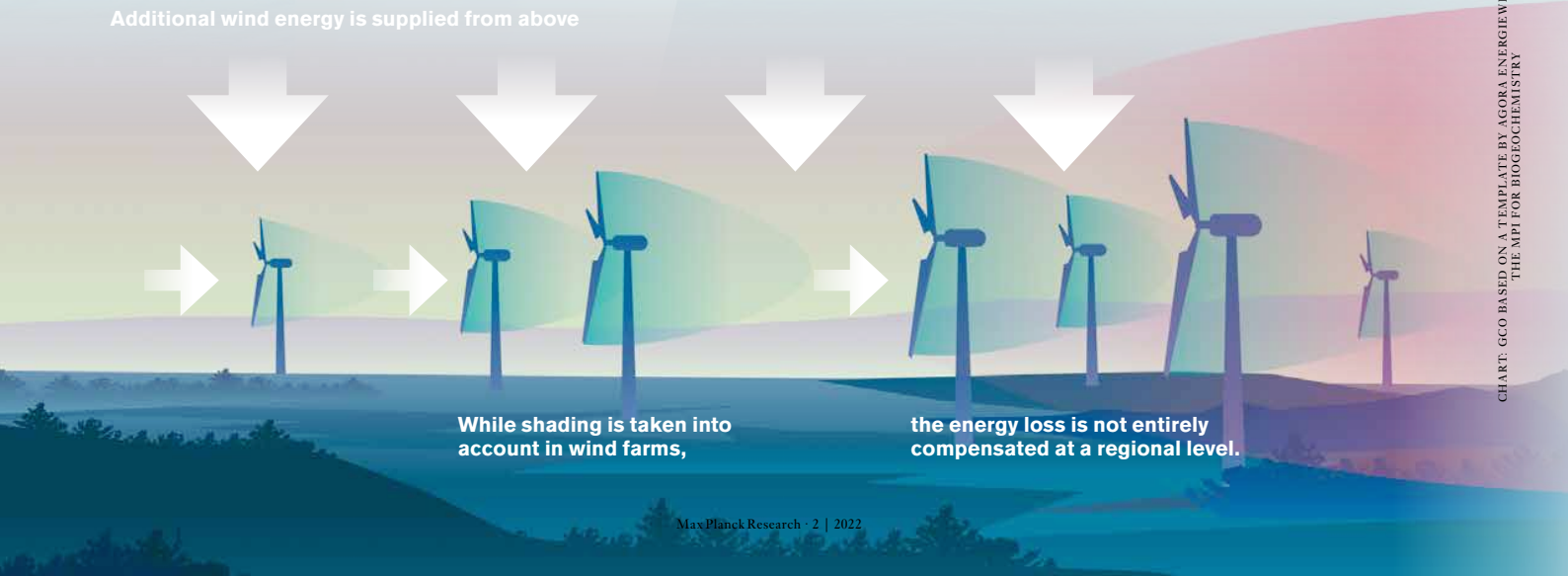
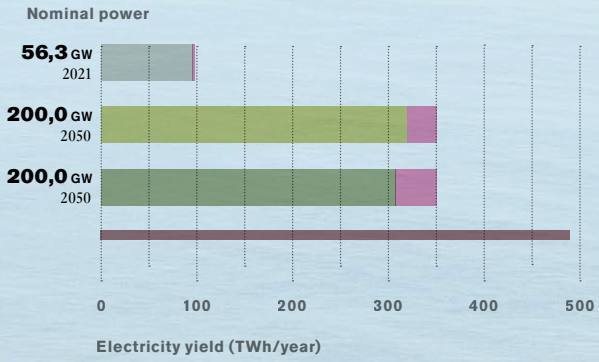


CHART: GCO BASED ON A TEMPLATE BY AGORA ENERGIEWENDE AND THE MPI FOR BIOGEOCHEMISTRY

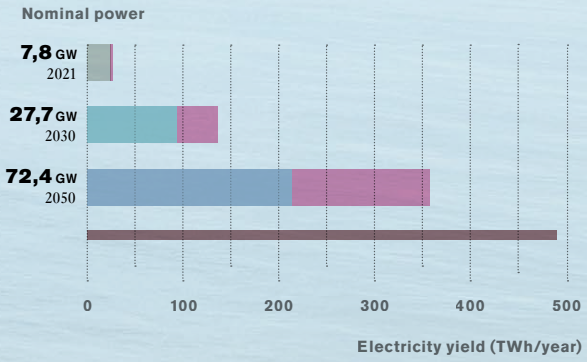
WIND POWER NEEDS SPACE

In 2021, onshore wind turbines with a nominal power output of 56 gigawatts were installed; this could increase to 200 gigawatts by 2050. According to the calculations by researchers at the Max Planck Institute for Biogeochemistry, the electricity yield will be reduced by 8 percent due to a fall in wind energy if the turbines are proportionately distributed throughout the country (scenario A). In this case, a large number of new turbines would be erected in the southern federal states. If turbines are erected proportional to the turbines currently in place (scenario B), primarily in the northern federal states, the yield will decline by over 10 percent. The area available for wind turbines in the North Sea is much smaller than the German land mass, yet it is expected to account for the production of 70 gigawatts, one-third of the targeted onshore power, by 2050. This leads to a calculated yield reduction of 40 percent, which would significantly increase the costs of electricity production.

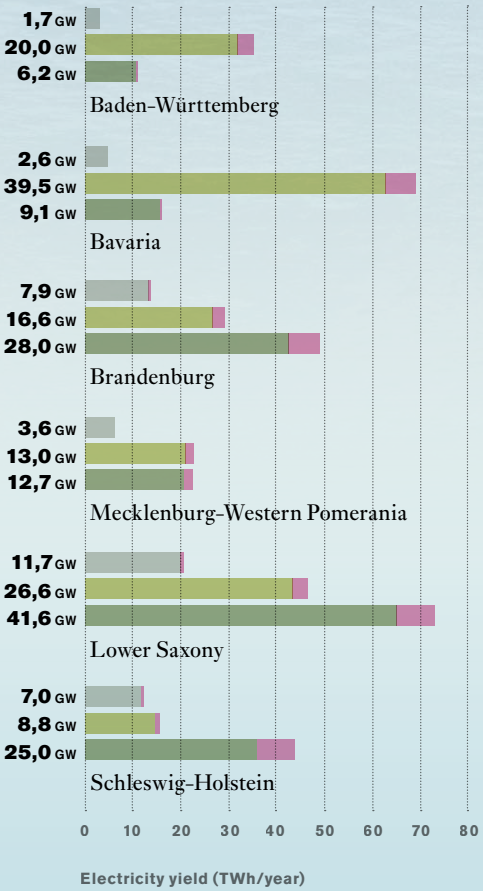
Onshore electricity yield

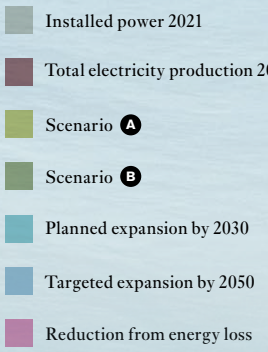


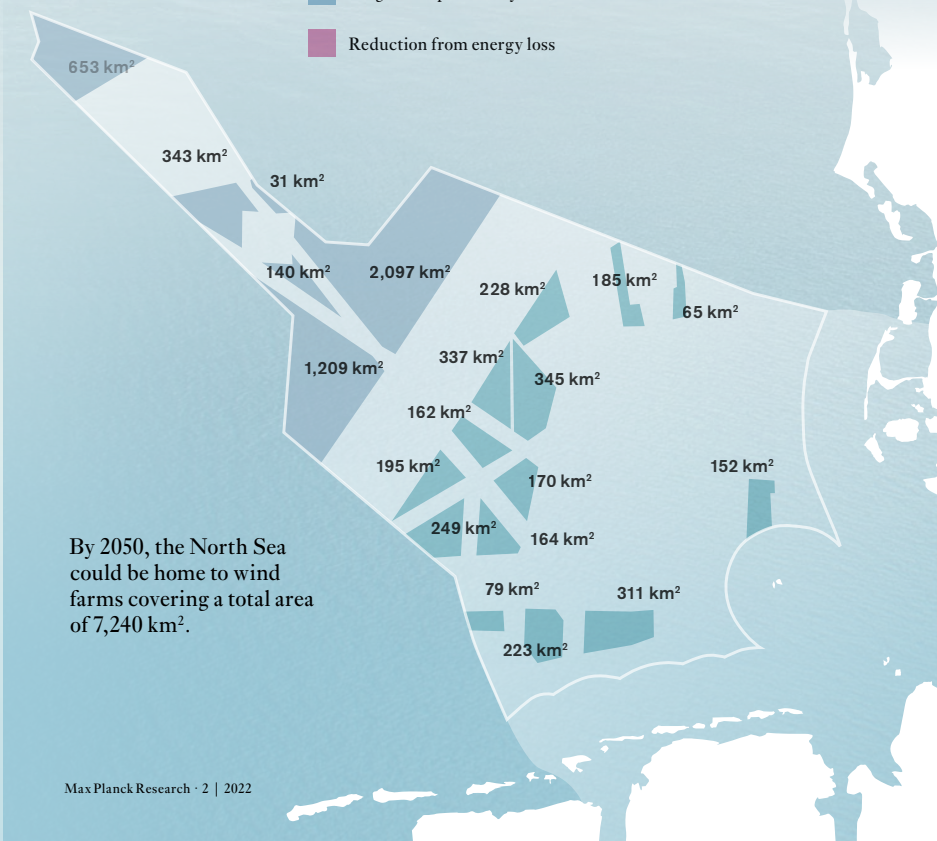
Offshore electricity yield



Northern and southern federal states







By 2050, the North Sea could be home to wind farms covering a total area of 7,240 km².

CHART OF WIND FARMS ON THE NORTH SEA: GCO BASED ON A TEMPLATE BY THE MPI FOR BIOGEOCHEMISTRY