



5TH E-Mobility Forum

Challenges & Solutions

BELGRADE 6-7/10/2022



DECARBONIZATION OF THE ENERGY SECTOR

Alternative power sources

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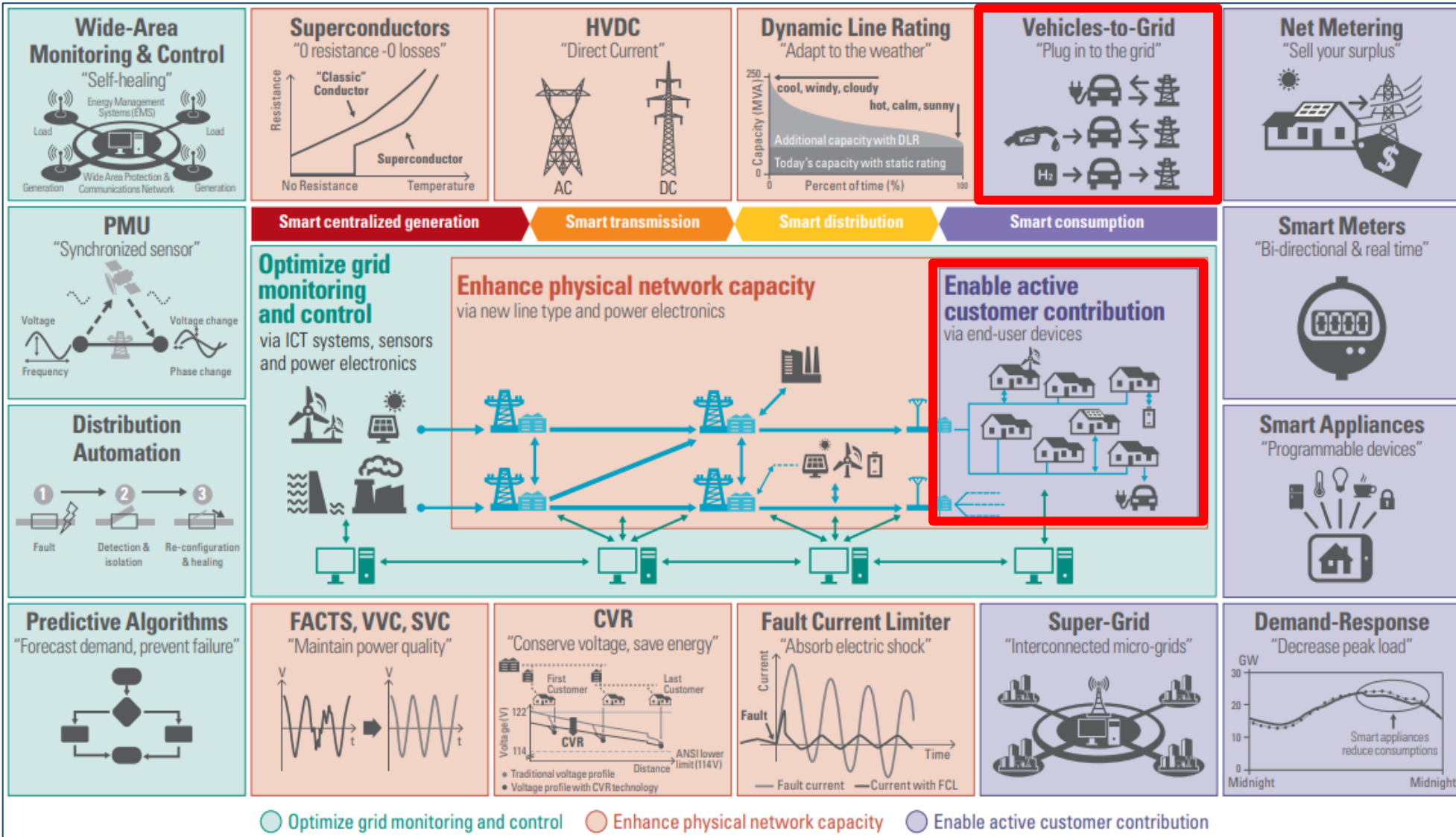


•Challenges of modern power systems

•Importance of decarbonization

•Alternative power sources

•Role of EVs in power systems



The following decades will bring 4 main challenges to power systems:

Demand growth

- Electrical energy – production capacity
- Peak power – electrical stress



Aged infrastructure

- Increased losses – higher CO₂ emission
- Decreased reliability



Increased share of RES

- RES intermittency asks for flexible reserve
- Large RES (offshore wind) distance from consumption point

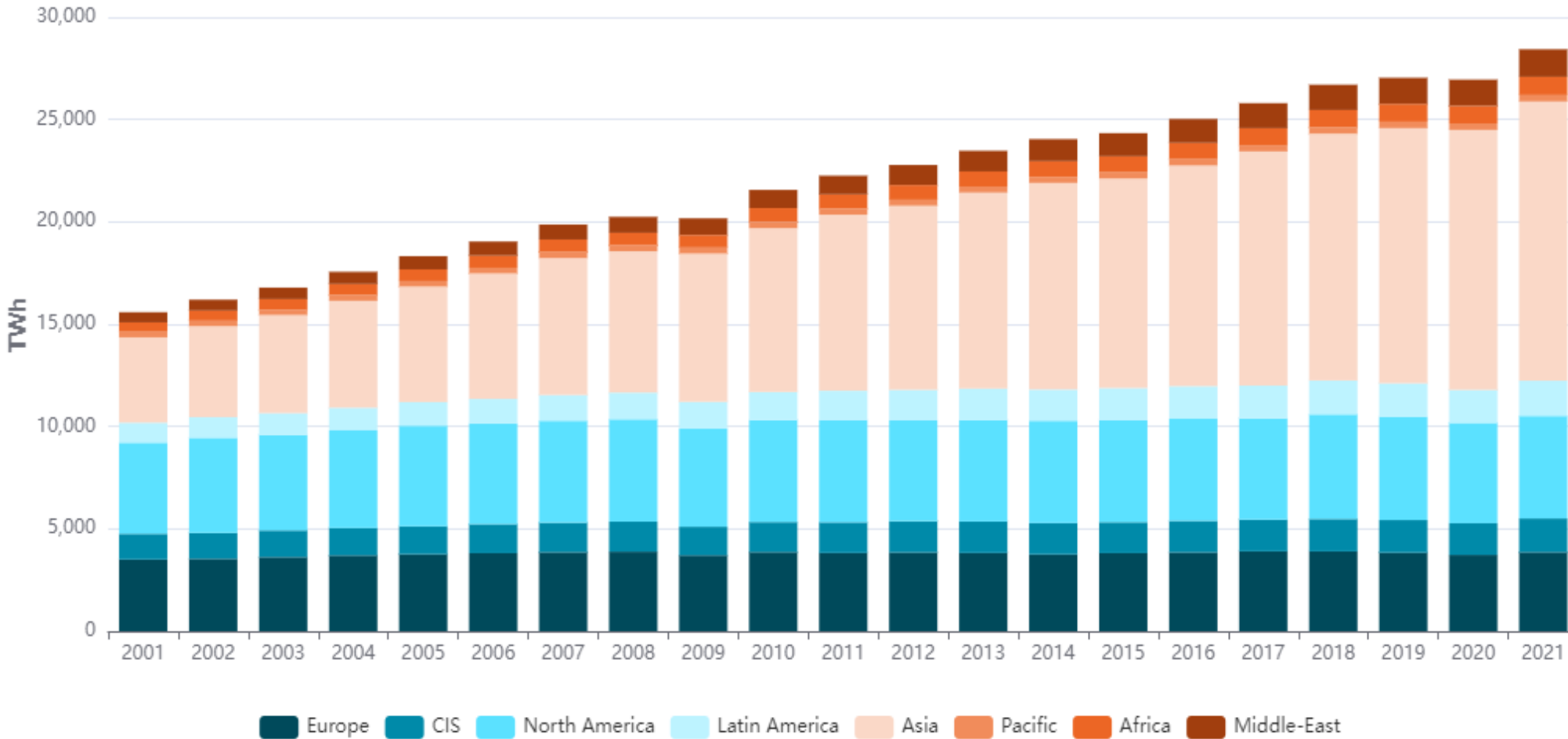


Increased share of DG and EV

- Power quality and bidirectional power flow
- Uncoordinated charging of EV



Electricity generation



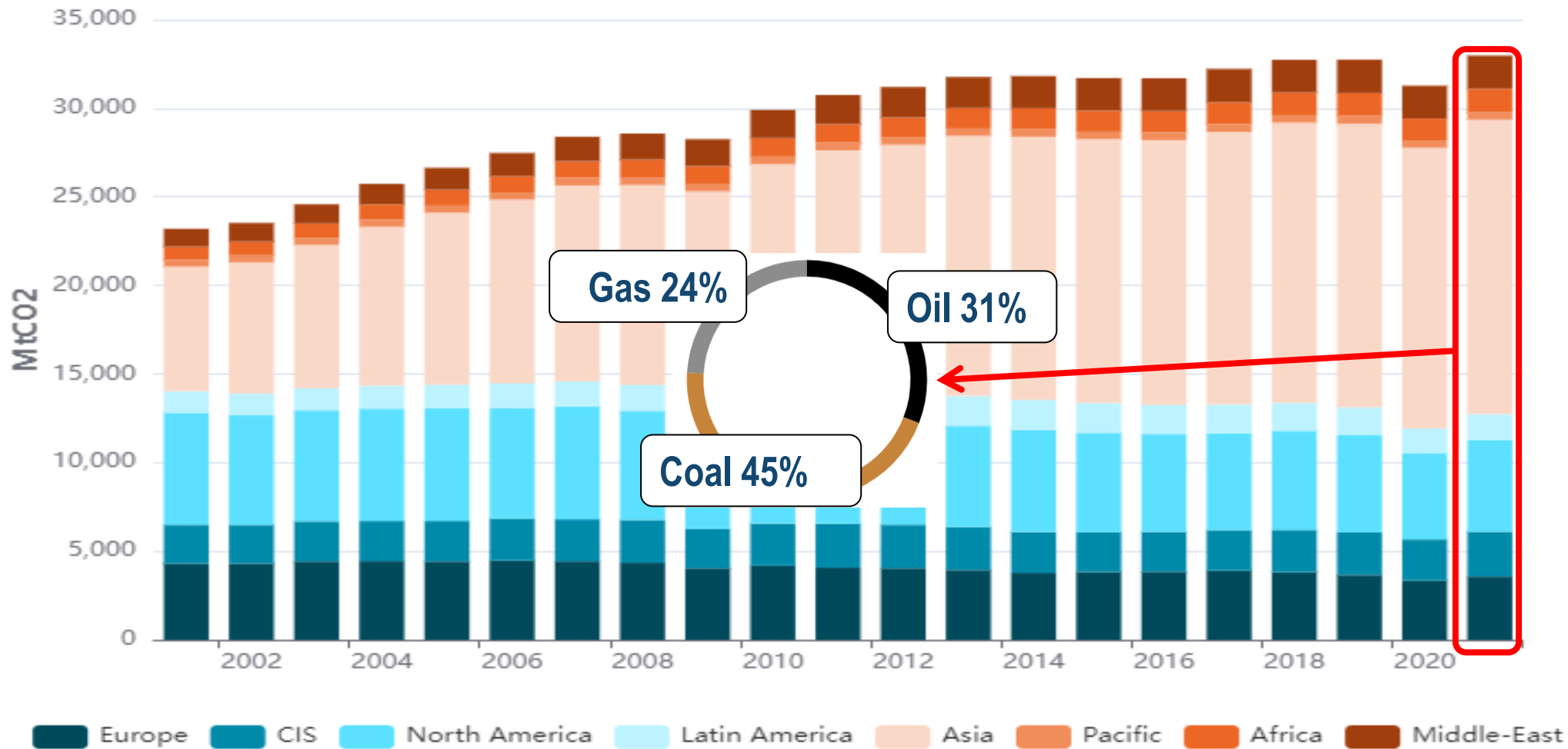
+5.5%

Global electricity generation growth accelerated in 2021.

EU +3.6%

China +9.7%

CO₂ emission due to fuel combustion

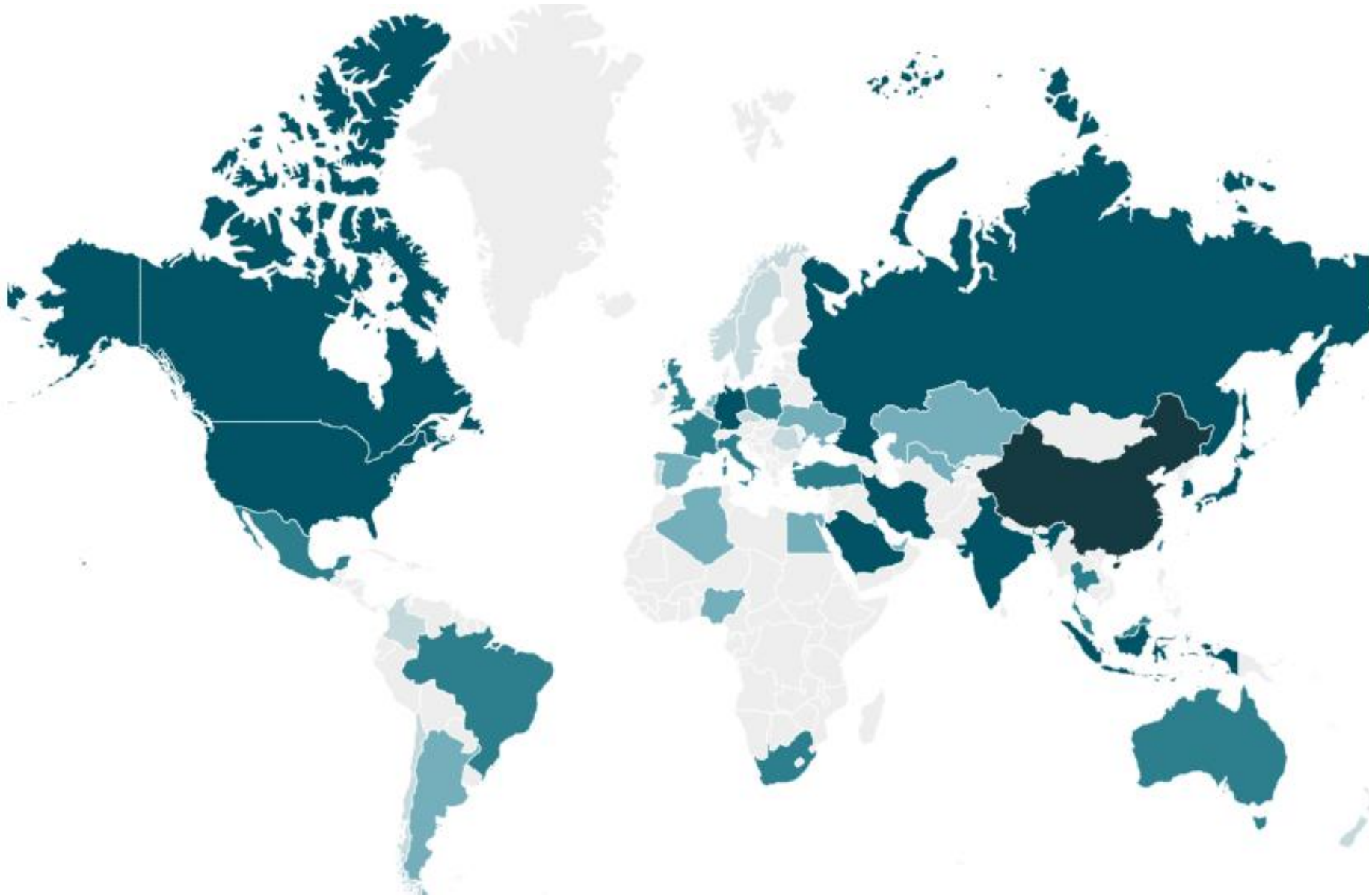


+5.4%

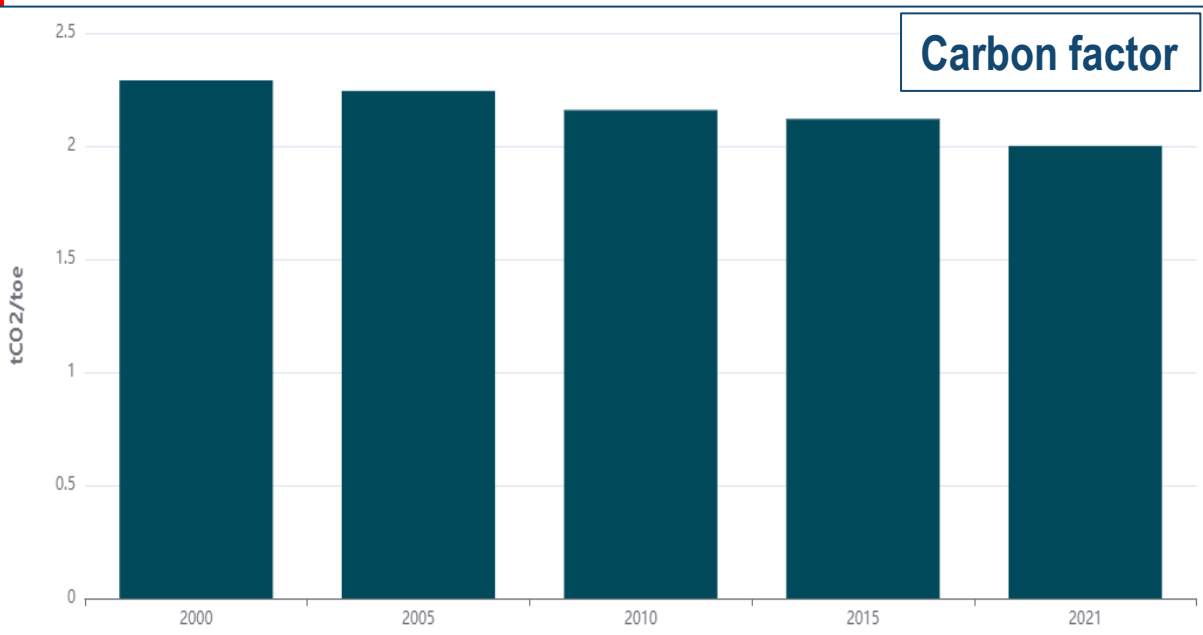
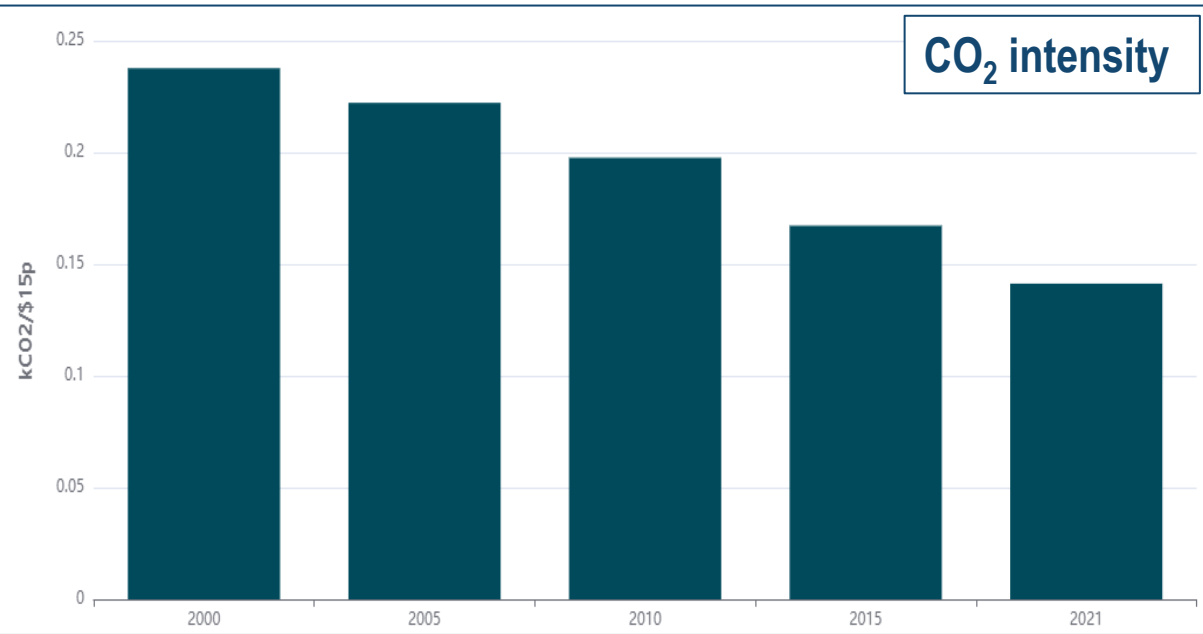
Australia -3.6%
mainly due to a
4.3% contraction in
the power sector.

tCO₂/MWh

Coal	1.0
Oil	0.8
Gas	0.4
Biofuel	0.5



China	10,398
United States	4,632
India	2,251
Russia	1,795
Japan	1,014
Germany	652
Iran	621
South Korea	614
Canada	546
Indonesia	537
Saudi Arabia	513
Brazil	450



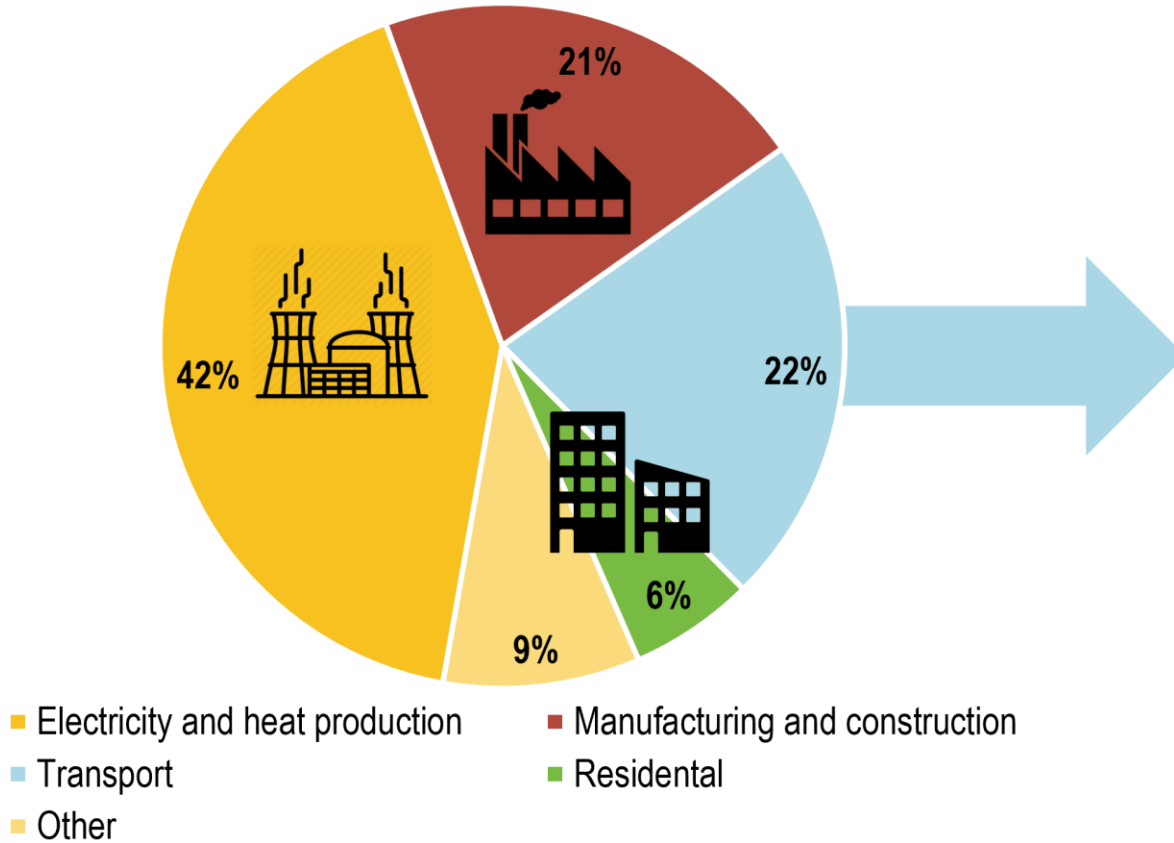
USA
5.000 MtCO₂

Europe
3.500 MtCO₂

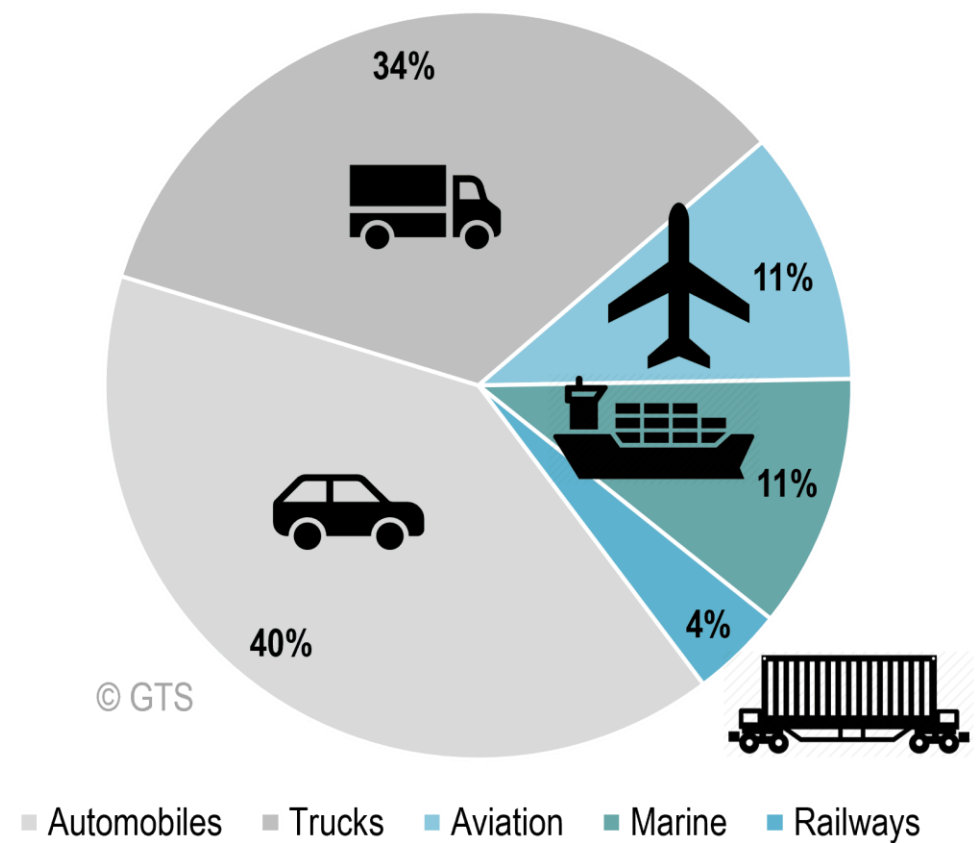
China
10.000 MtCO₂



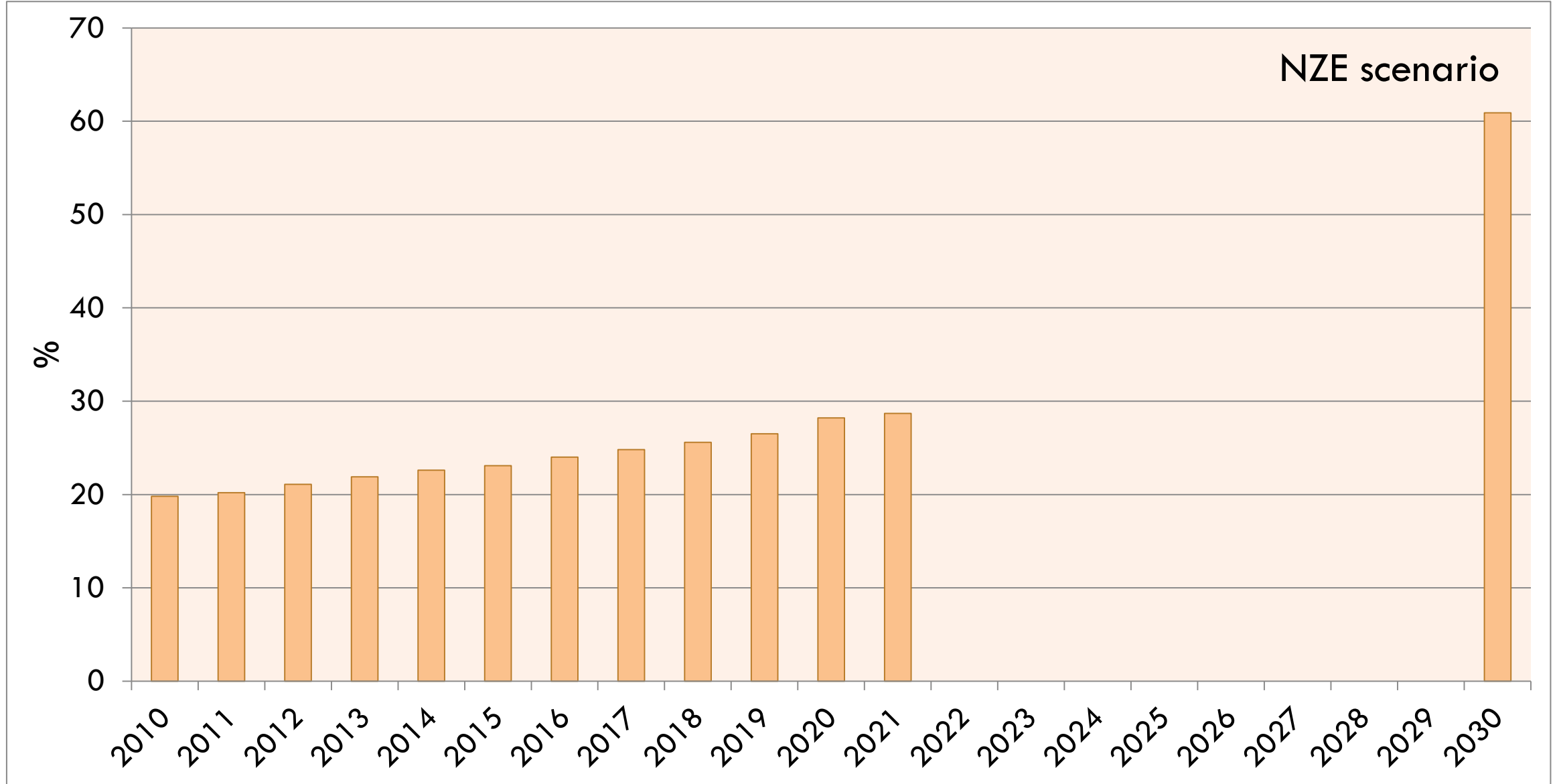
CO₂ Emissions by Economic Sector



CO₂ Emissions by the Transport Sector



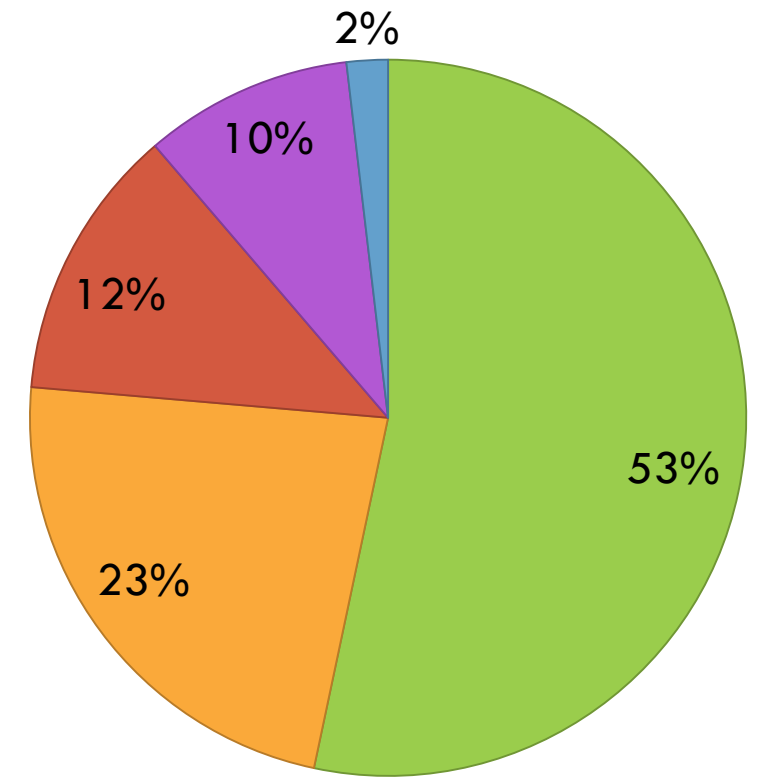
Renewable energy sources in electrical power systems and EV in transportation represent the main CO₂ reduction resources.

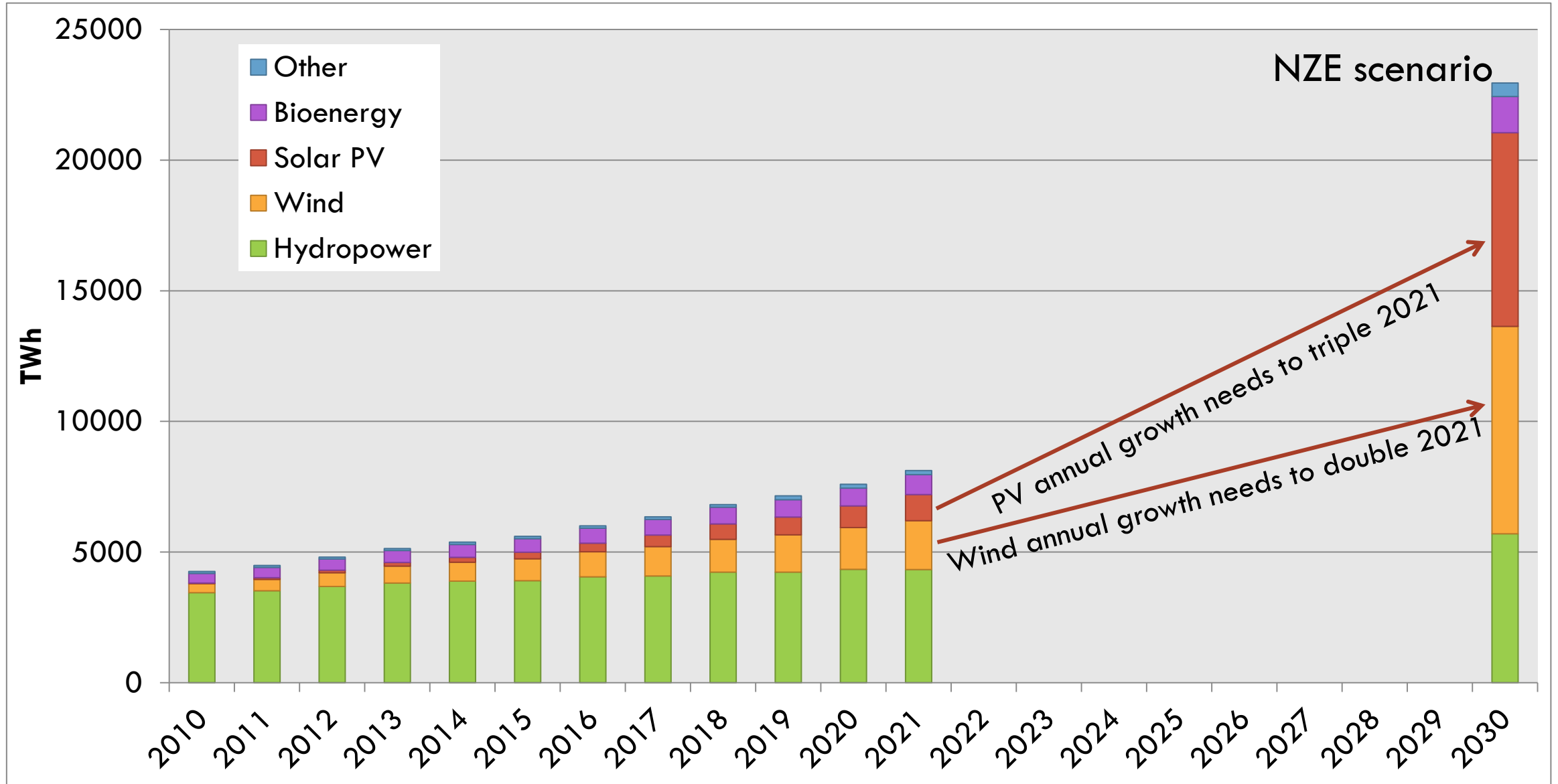


Renewable energy sources:

1. Hydropower **53%**
2. Wind **23%**
3. Solar PV **12%**
4. Bioenergy **10%**
5. Other **2%**
(CSP, geothermal, ocean)

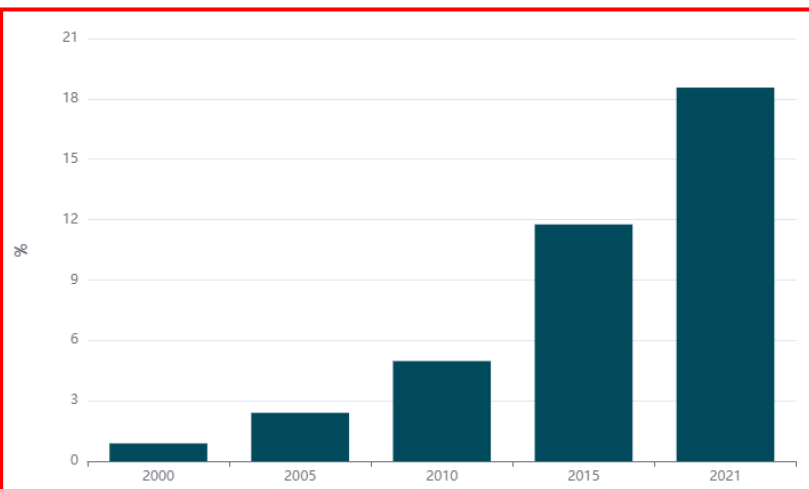
■ Hydropower ■ Wind ■ Solar PV
■ Bioenergy ■ Other





Wind and solar share [%]

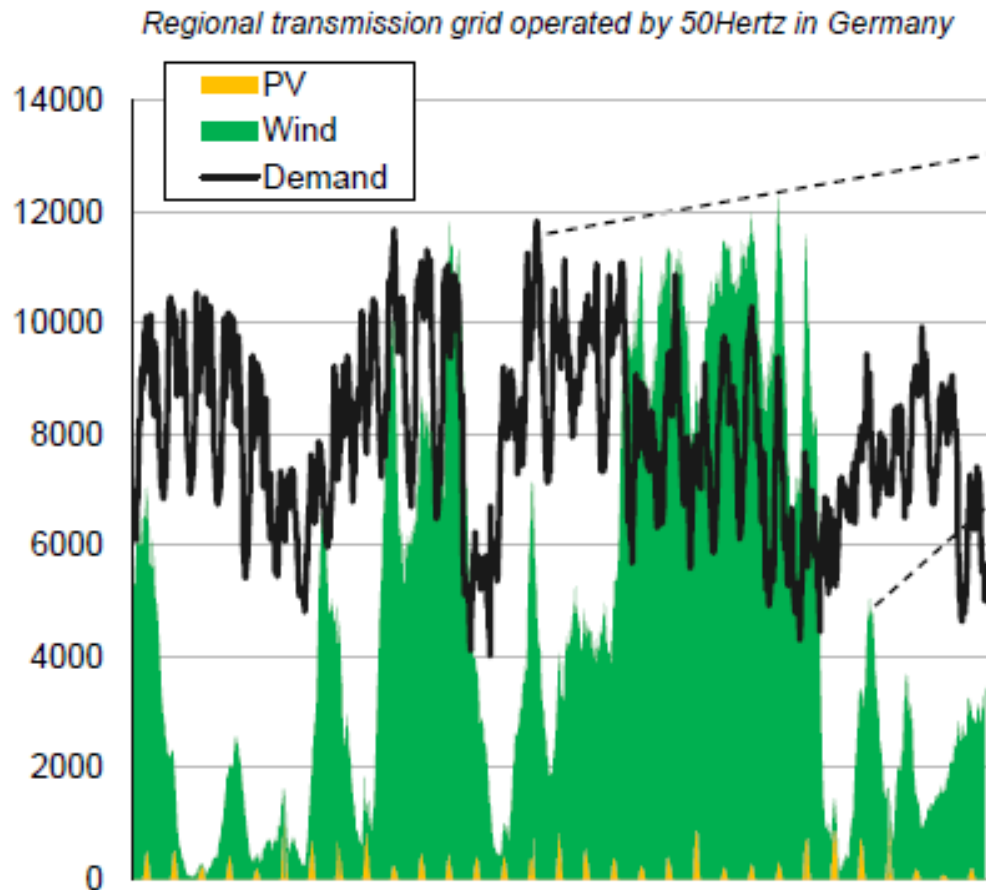
In two decades the share of wind and solar in Europe raised to 19%.



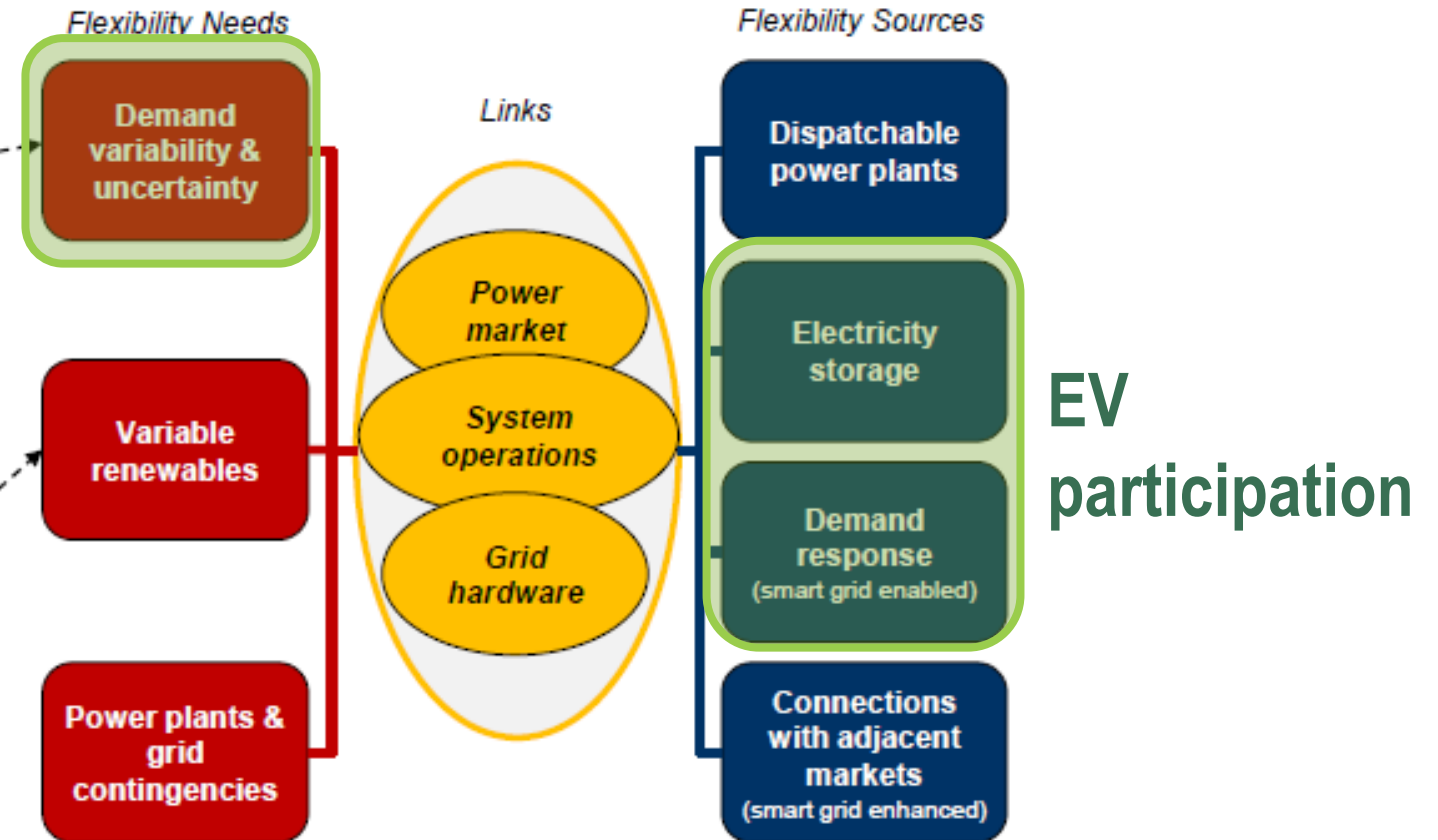
Spain	32.7
Portugal	31
Germany	28.9
United Kingdom	25.2
New Zealand	24.8
Netherlands	24.1
Chile	21.1
Australia	19.7
Italy	18.3
Belgium	17.6
Sweden	17.2
Turkey	17

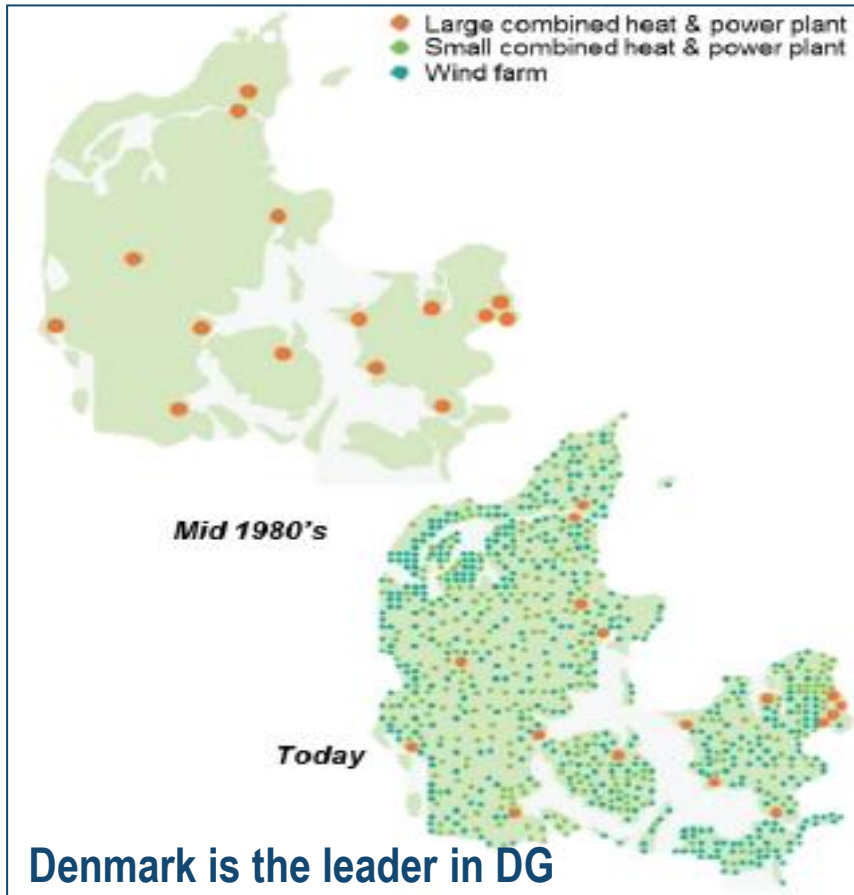
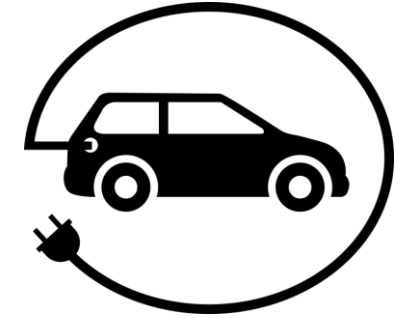
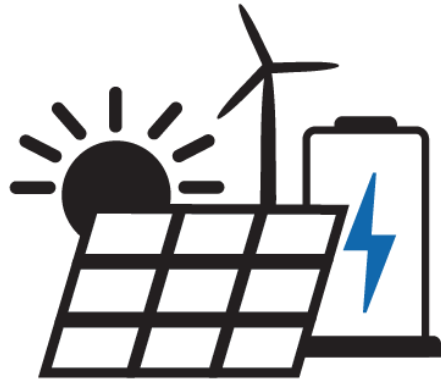
High shares of RES ask for additional system balancing flexibility

WIND AND SOLAR PV OUTPUT EXAMPLE
MW



CONCEPT OF FLEXIBILITY MANAGEMENT



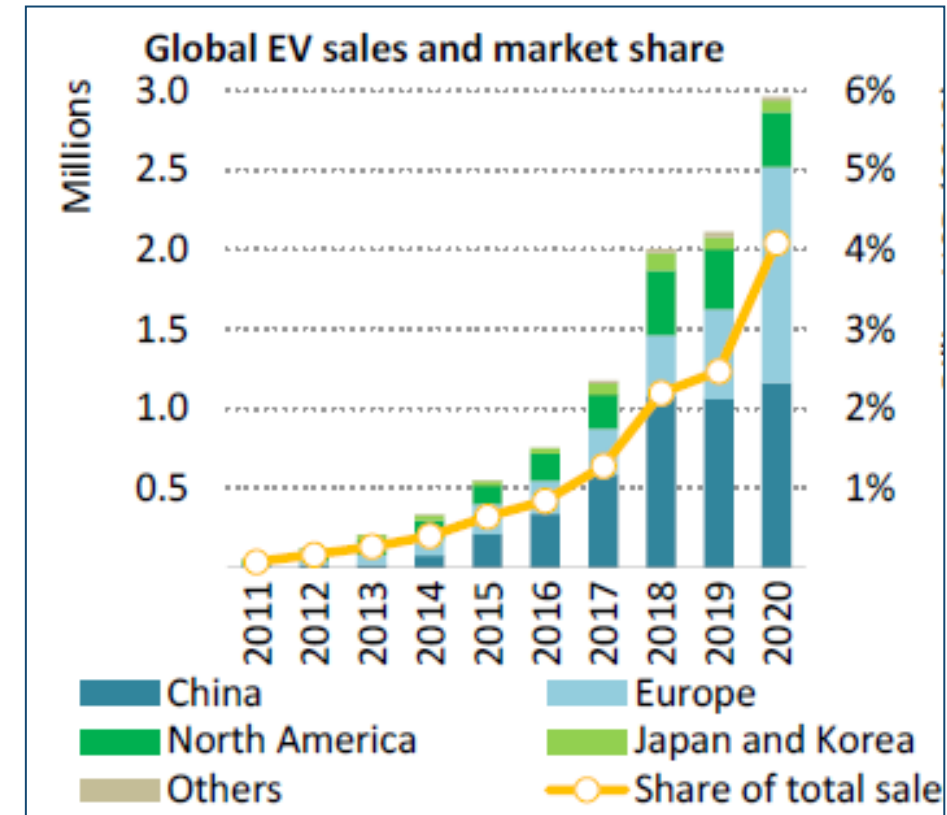


Distributed resources:

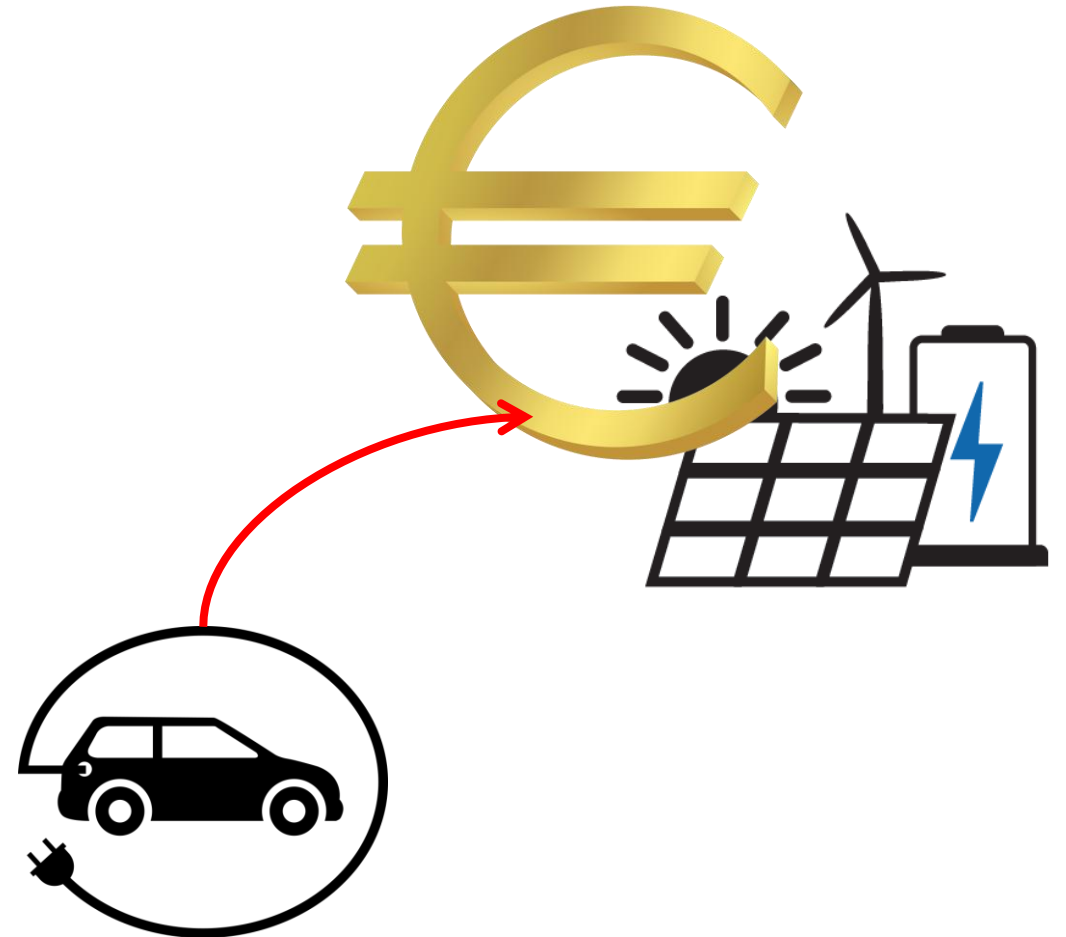
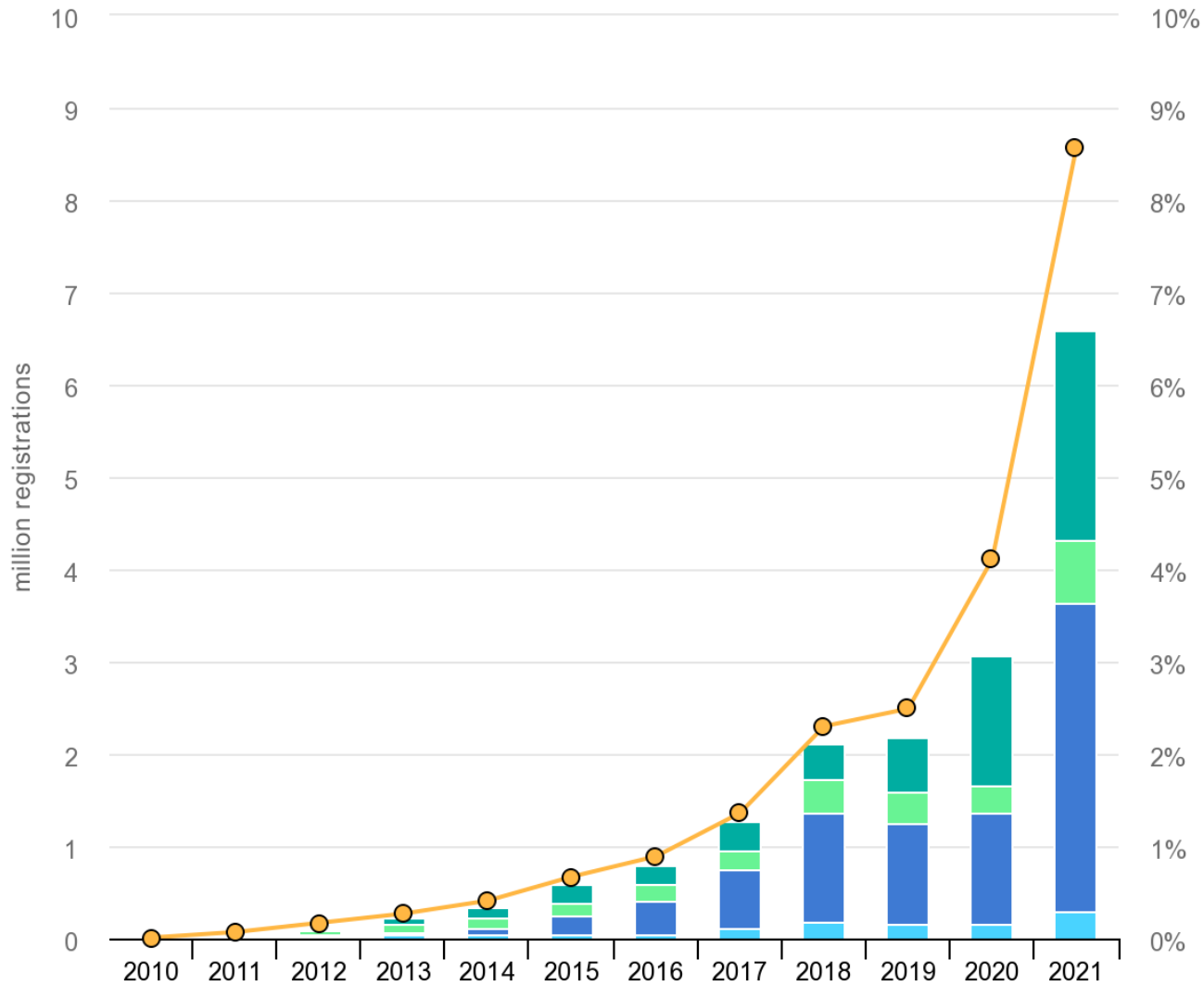
1. DG
2. Storage
3. Controllable load

Challenges:

1. Balancing
2. Voltage
3. Power quality
4. Protection



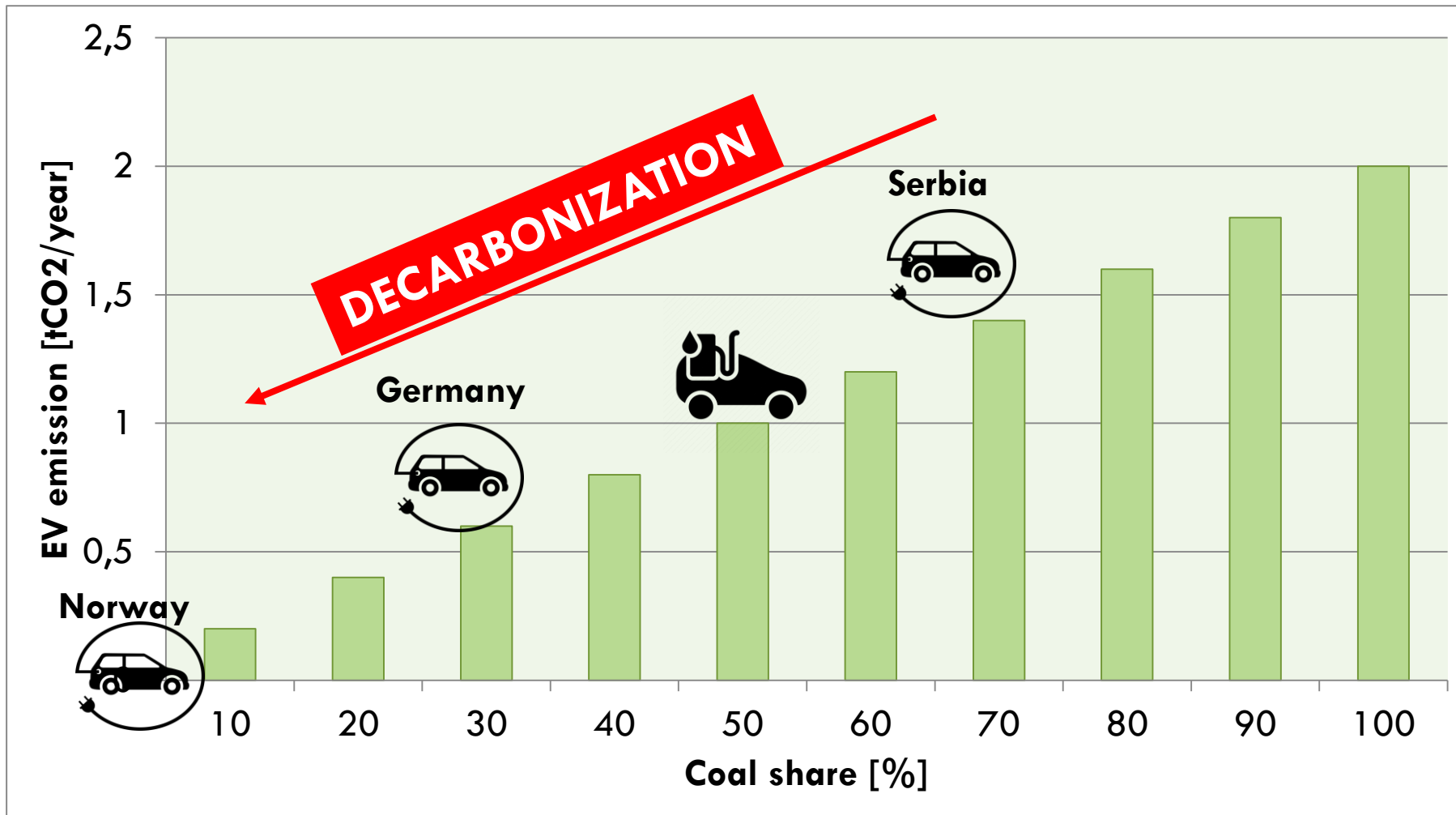
Utilization of large amount of DG and EV requires power system investments.



Conventional car 100 gCO₂/km
EV 0.2kWh/km

10.000 km/year

Conventional car 1 tCO₂/year
EV 2 MWh/year





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THANK YOU

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