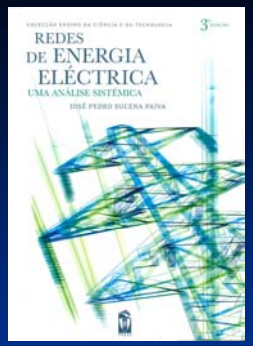
TÉCNICO LISBOA



PUBLIC POLICIES FOR ENERGY

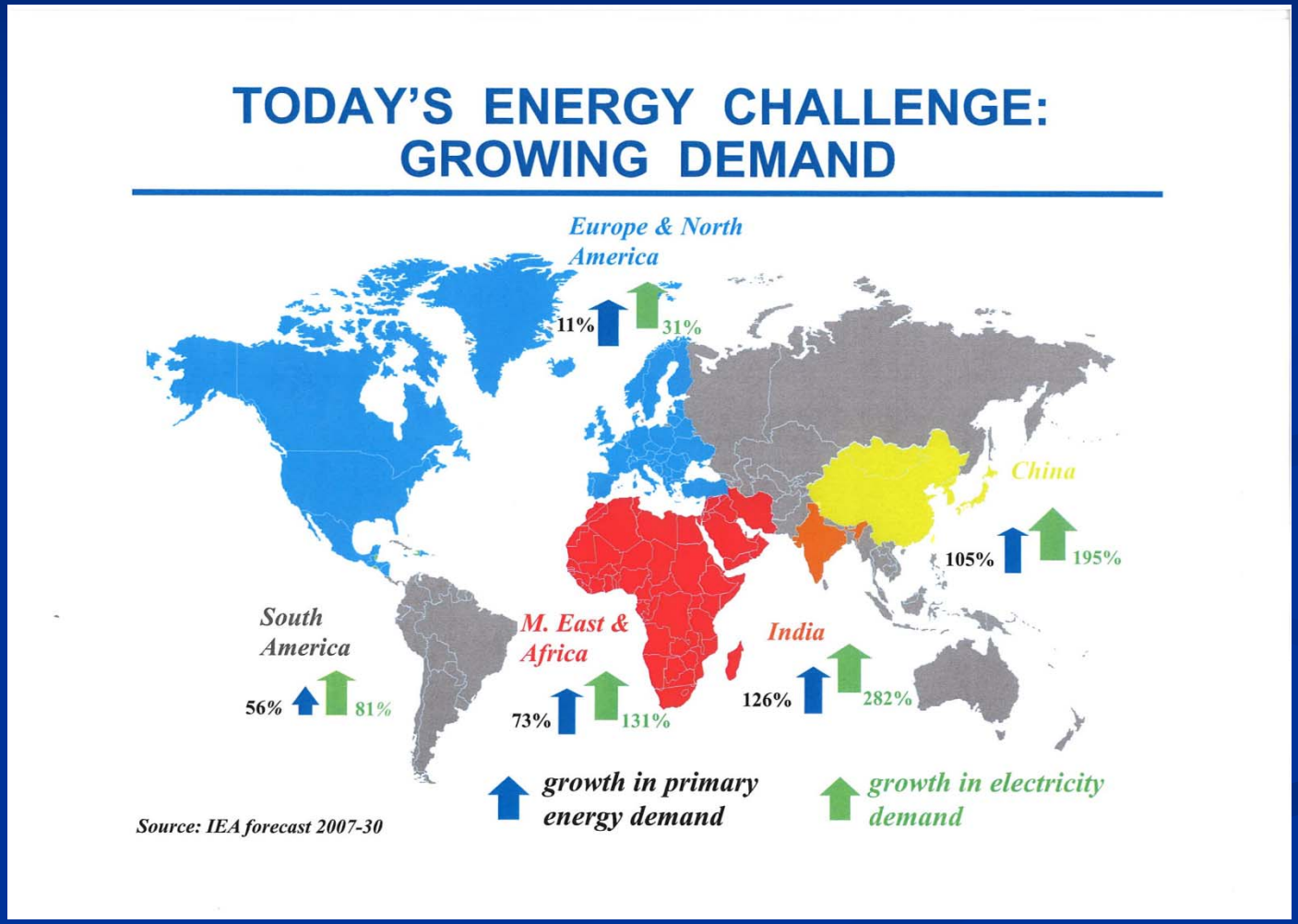
ELECTRIFYING THE ENERGY SUPPLY

José P. Sucena Paiva

Prof. Emeritus do IST

GROWTH IN PRIMARY ENERGY AND ELECTRITY DEMAND, 2007-30

[Source: IEA, World Energy Outlook 2011]

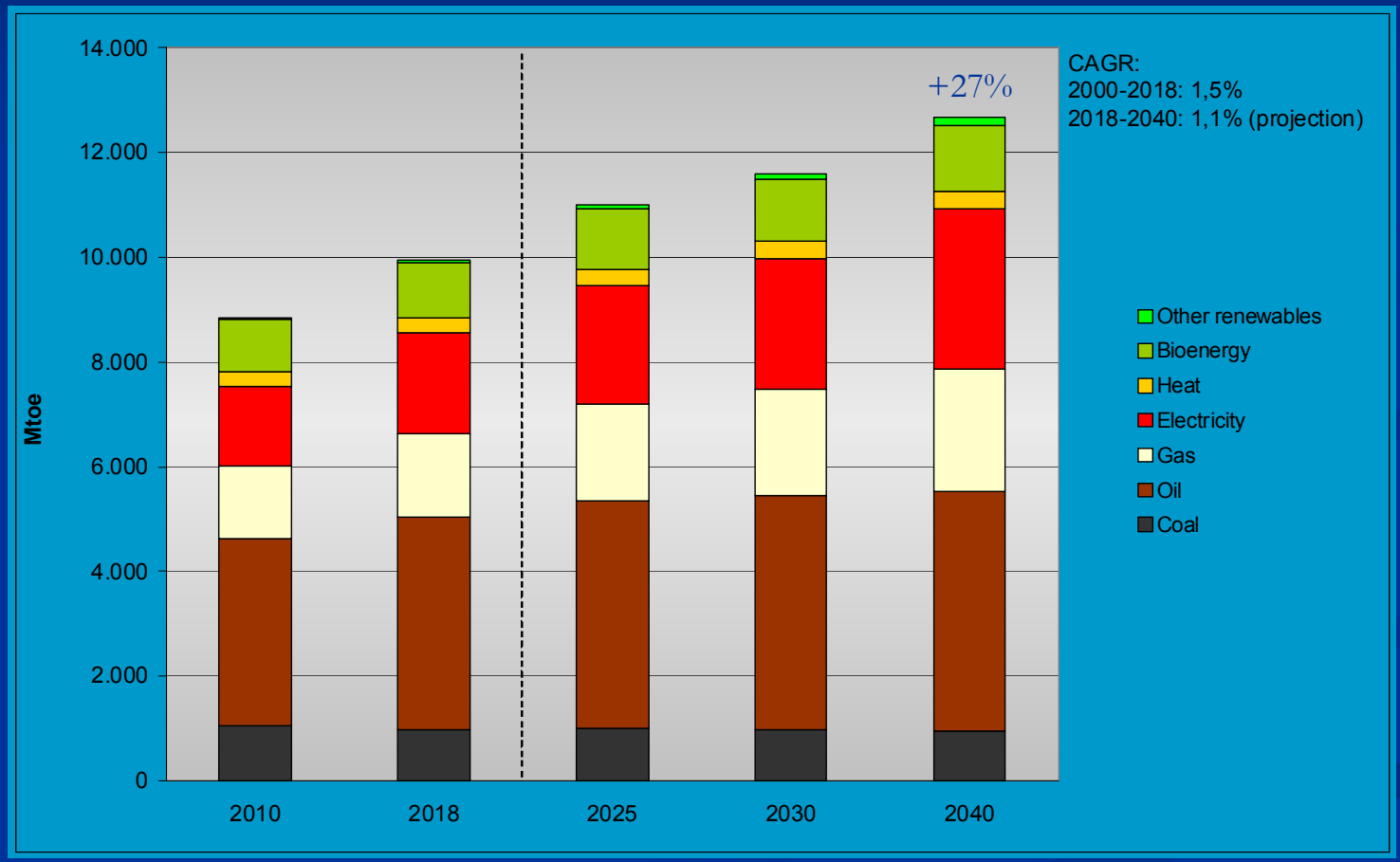


ELECTRIC ENERGY

- 20-25% of final energy demand
- 40% of primary energy demand
- 40% of total CO_2 emissions

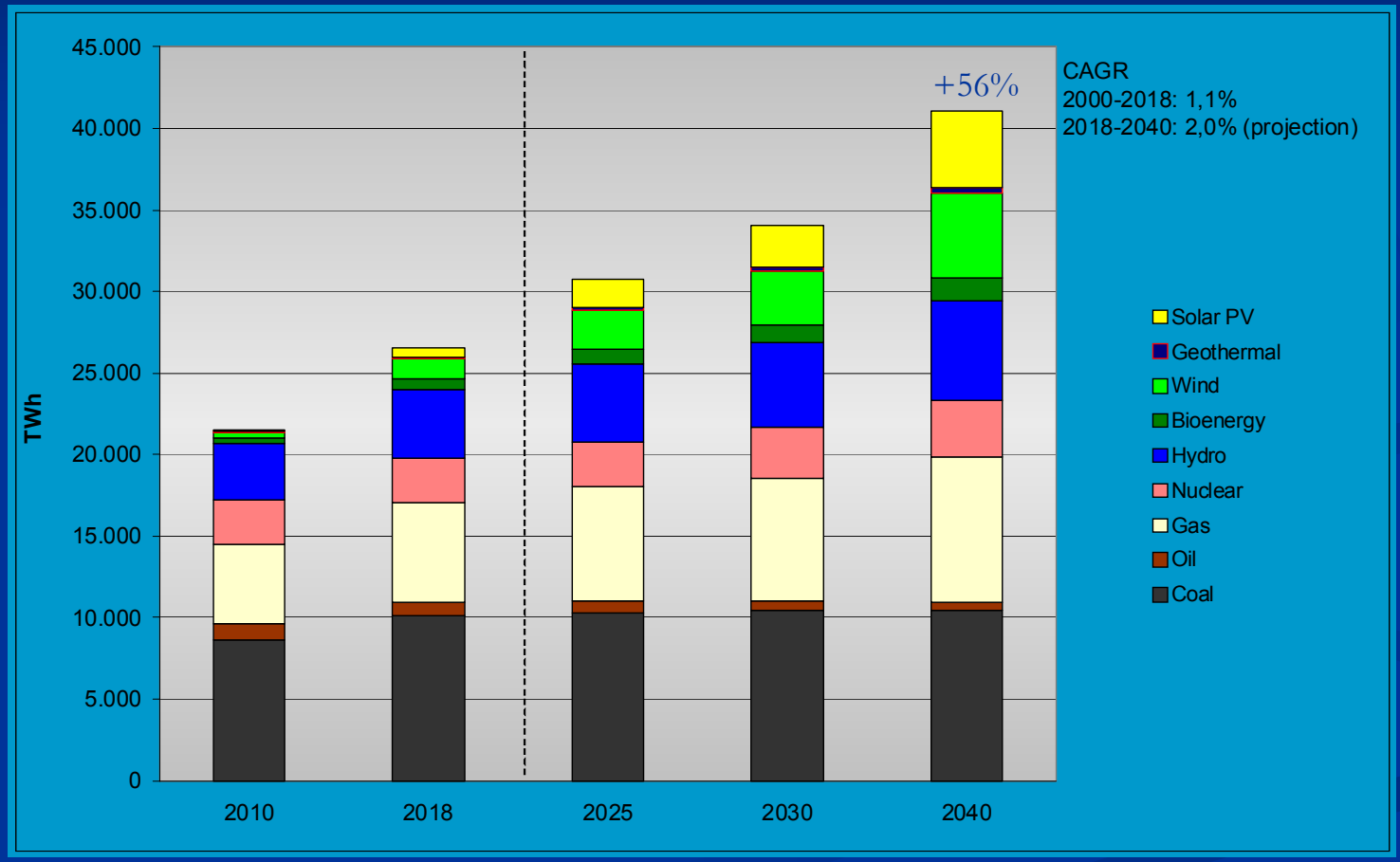
TOTAL FINAL CONSUMPTION, WORLD, 2010-2040 (Mtep)

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



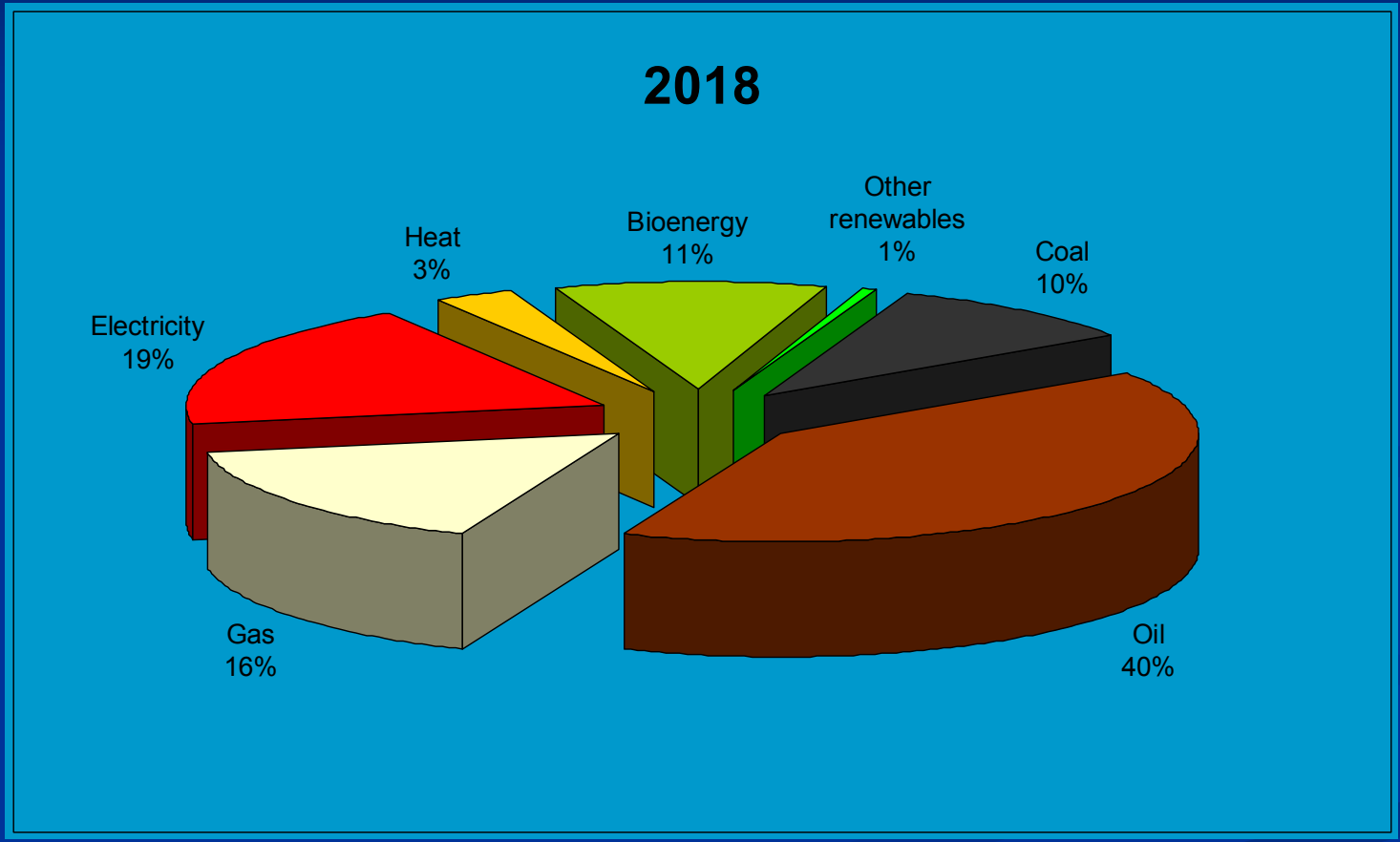
ELECTRIC ENERGY GENERATION WORLD, 2010-2040 (TWh)

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



WORLD TOTAL FINAL CONSUMPTION, 2018

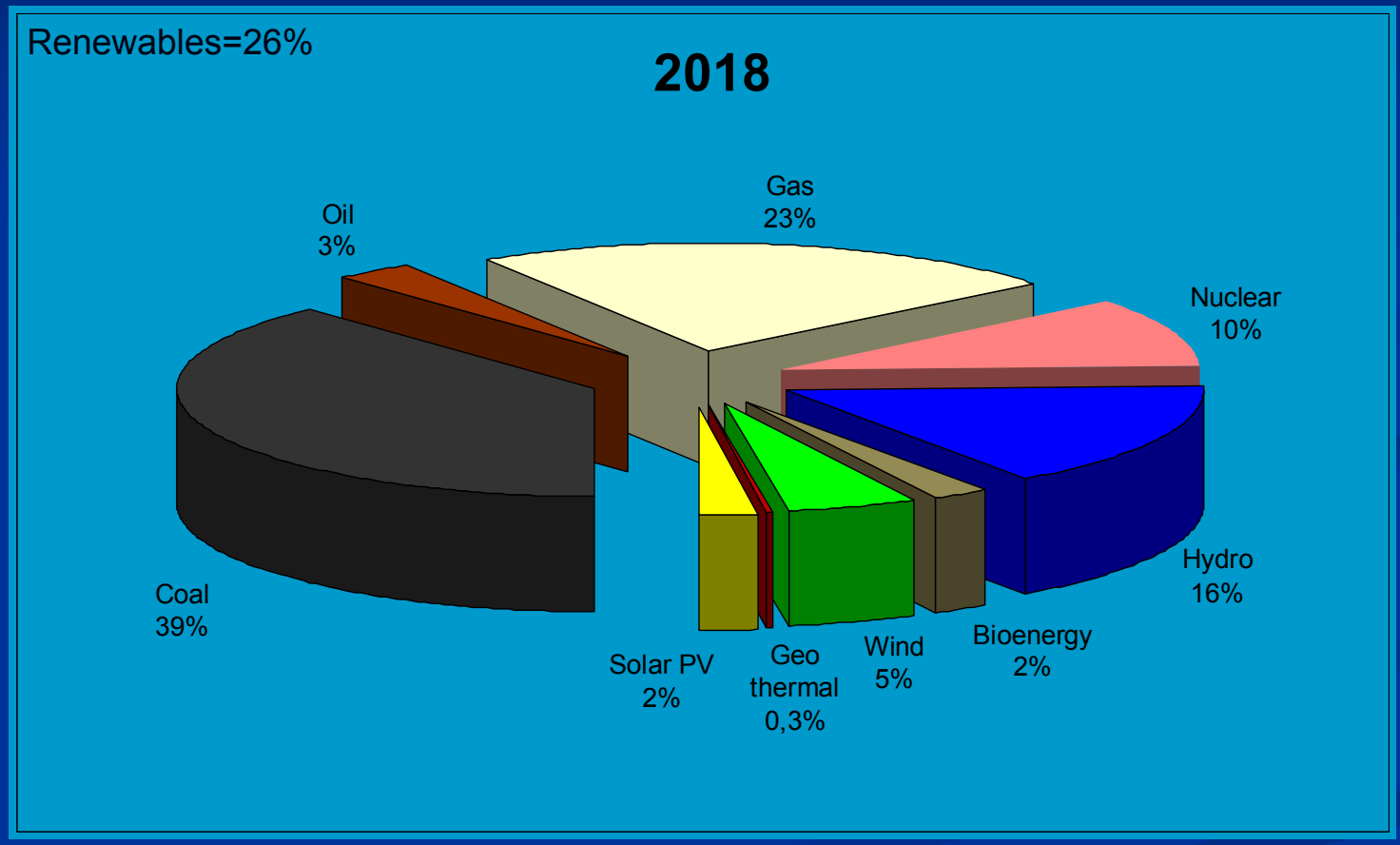
[Source: IEA World Energy Outlook 2019, Stated Policies Scenario]



Average power:13 TW
Average power per capita: 1,9 kW

ELECTRIC ENERGY GENERATION WORLD, 2018

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]

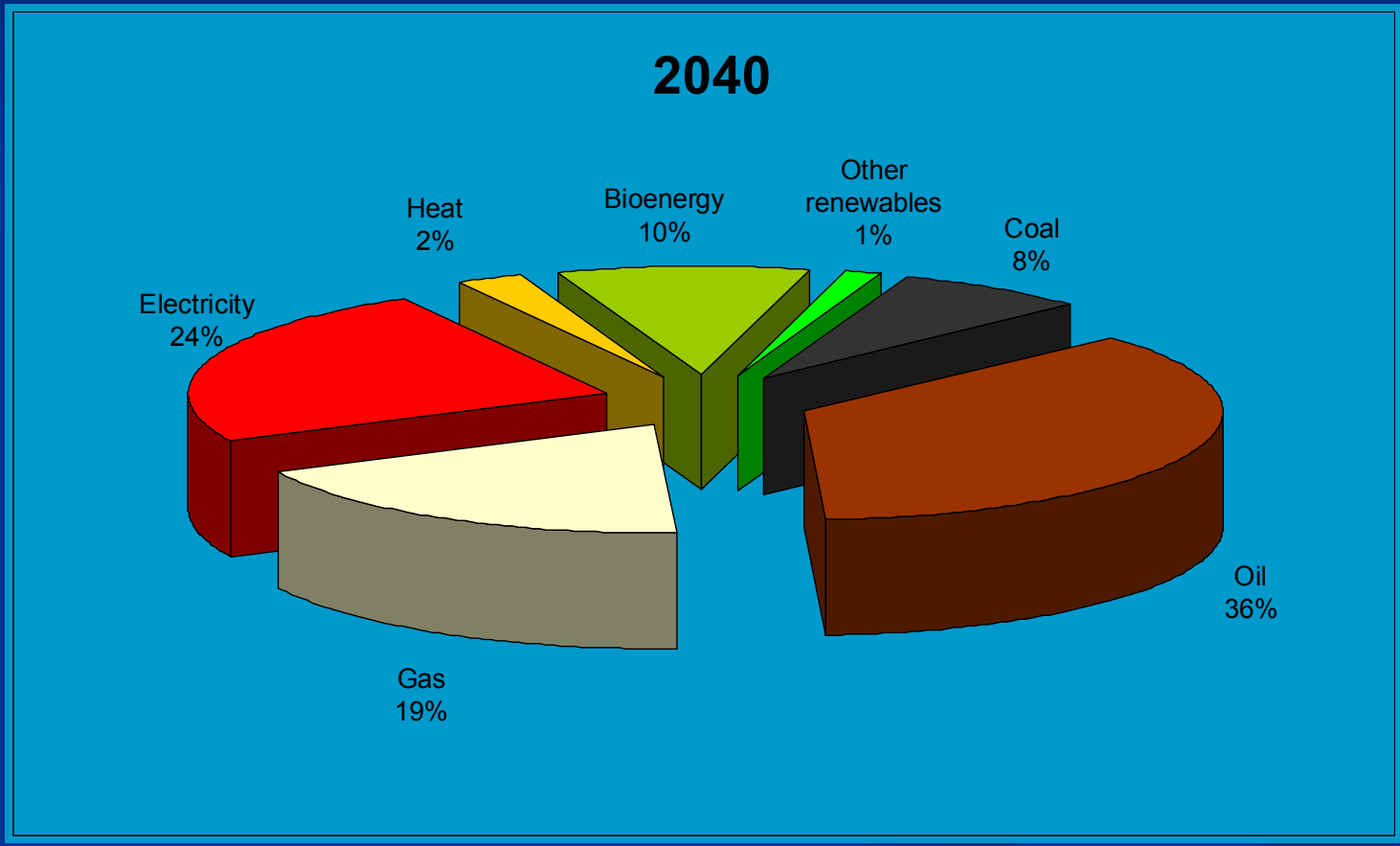


Average power:3,0 TW

Average power per capita: 0,40 kW

WORLD TOTAL FINAL CONSUMPTION, 2040

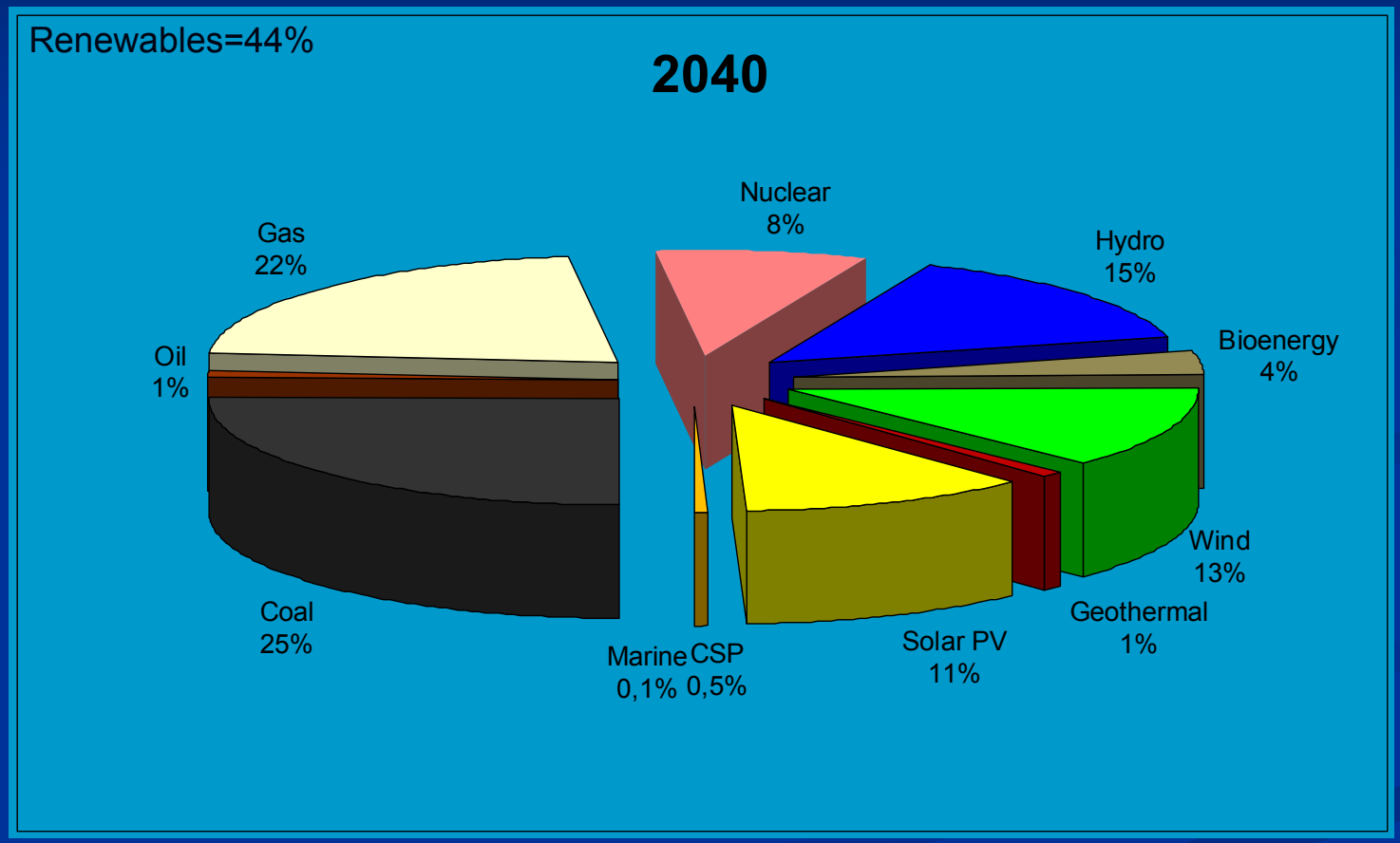
[Source: IEA World Energy Outlook 2019, Stated Policies Scenario]



Average power: 17 TW
Average power per capita: 2,4 kW

ELECTRIC ENERGY GENERATION WORLD, 2040

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]

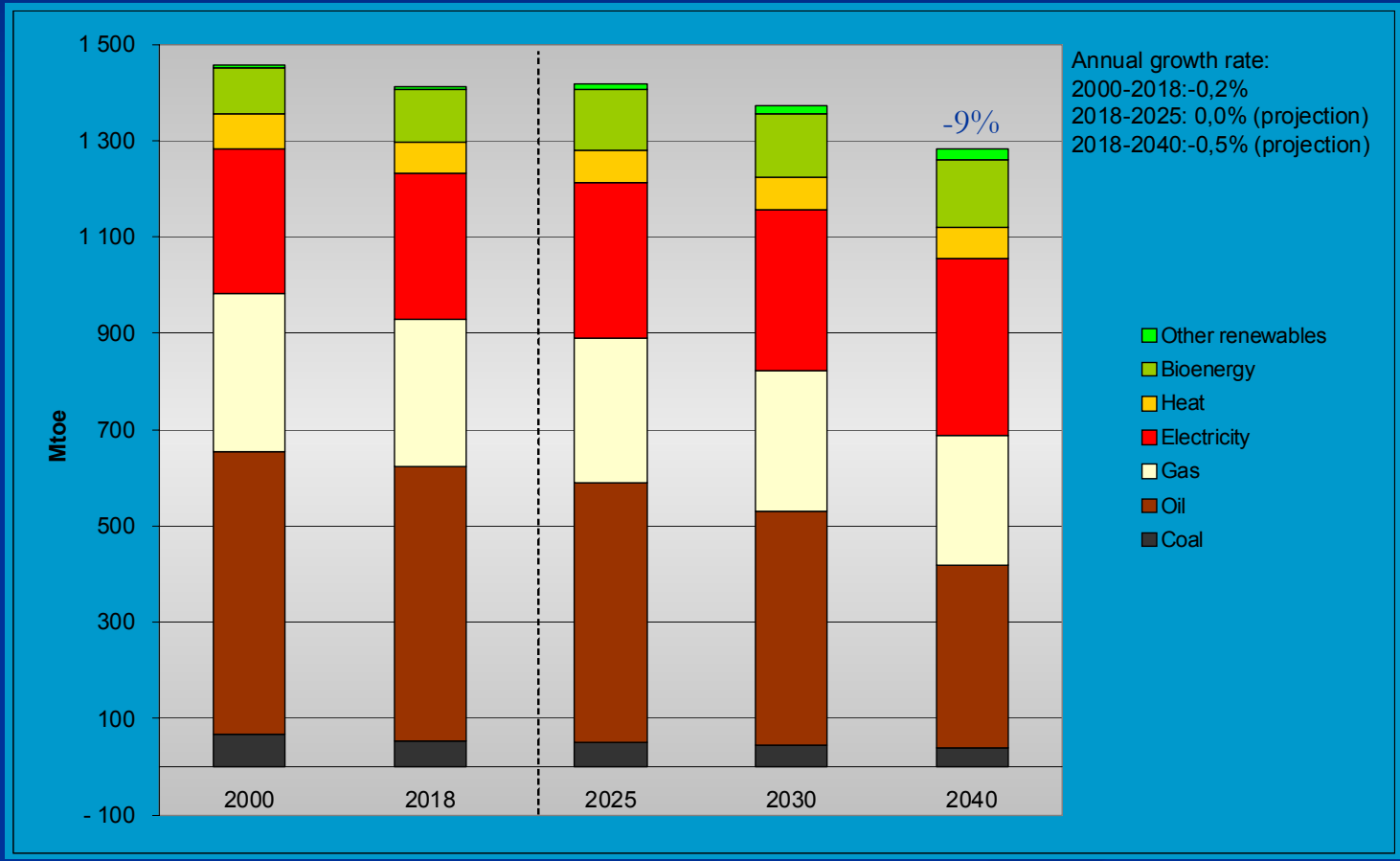


Average power: 4,7 TW

Average power per capita: 0,56 kW

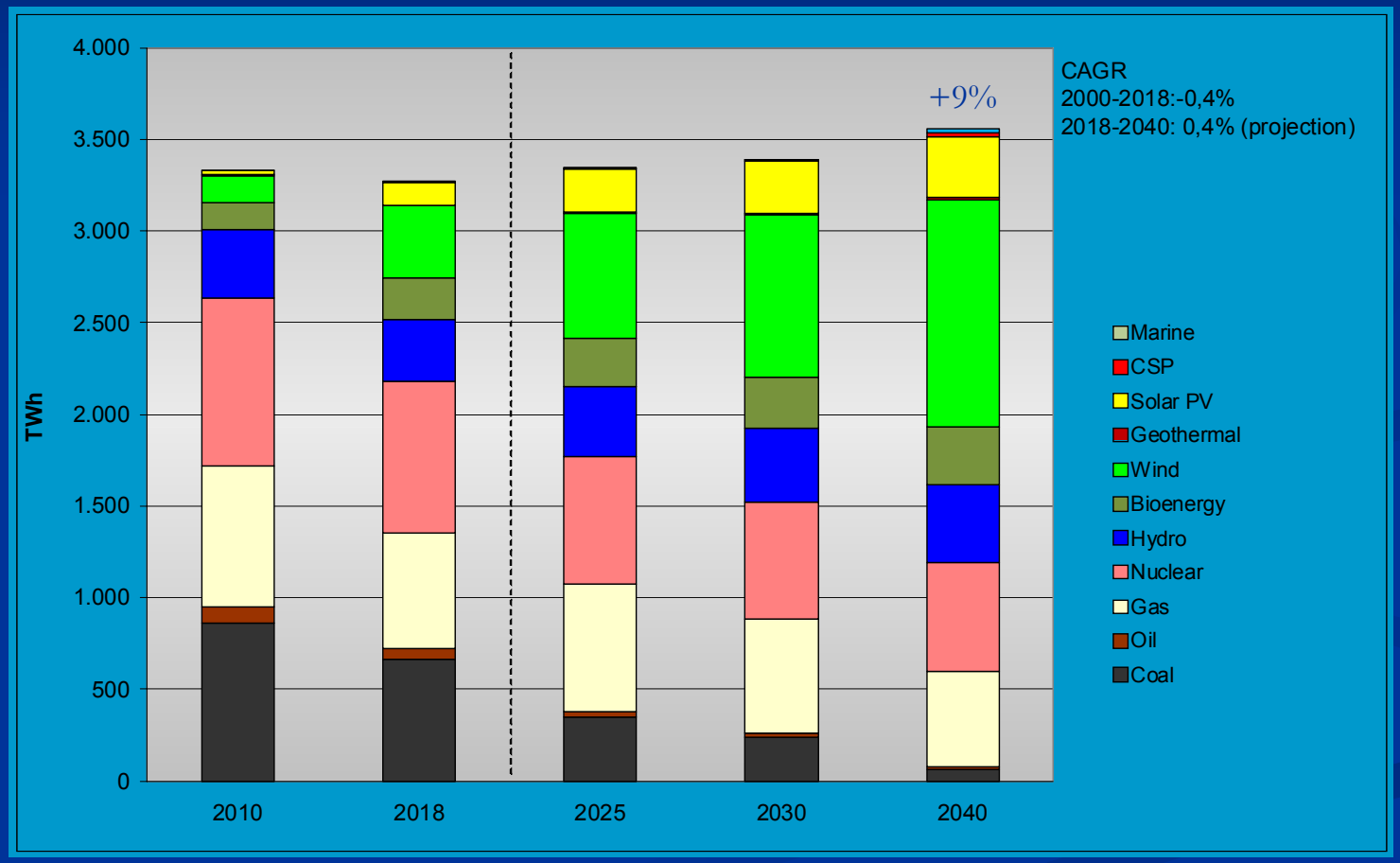
EU TOTAL FINAL CONSUMPTION, 2000-2040

[Source: IEA World Energy Outlook 2019, Stated Policies Scenario]



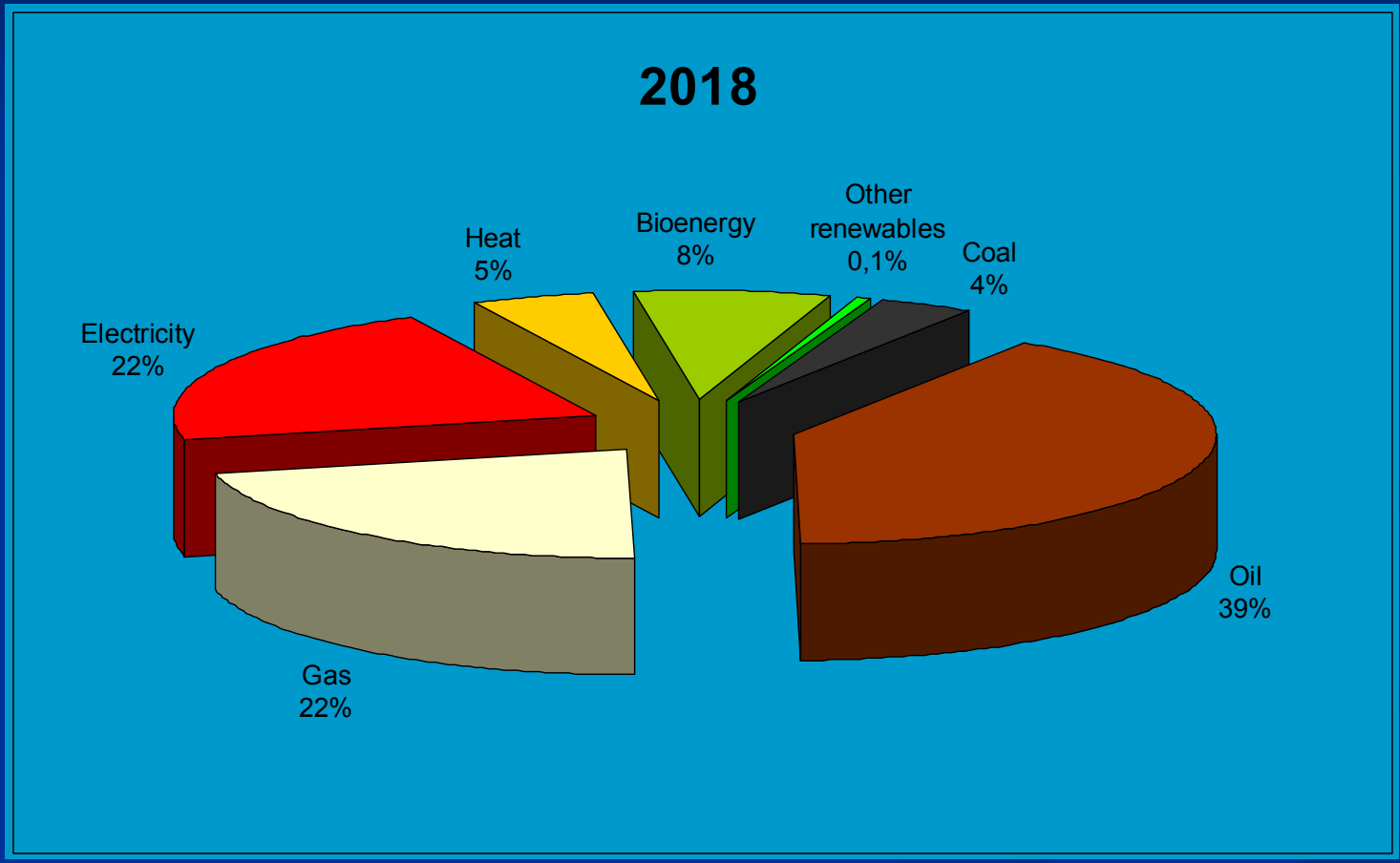
EU ELECTRIC ENERGY GENERATION 2010-2040

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



EU FINAL ENERGY CONSUMPTION, 2018

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]

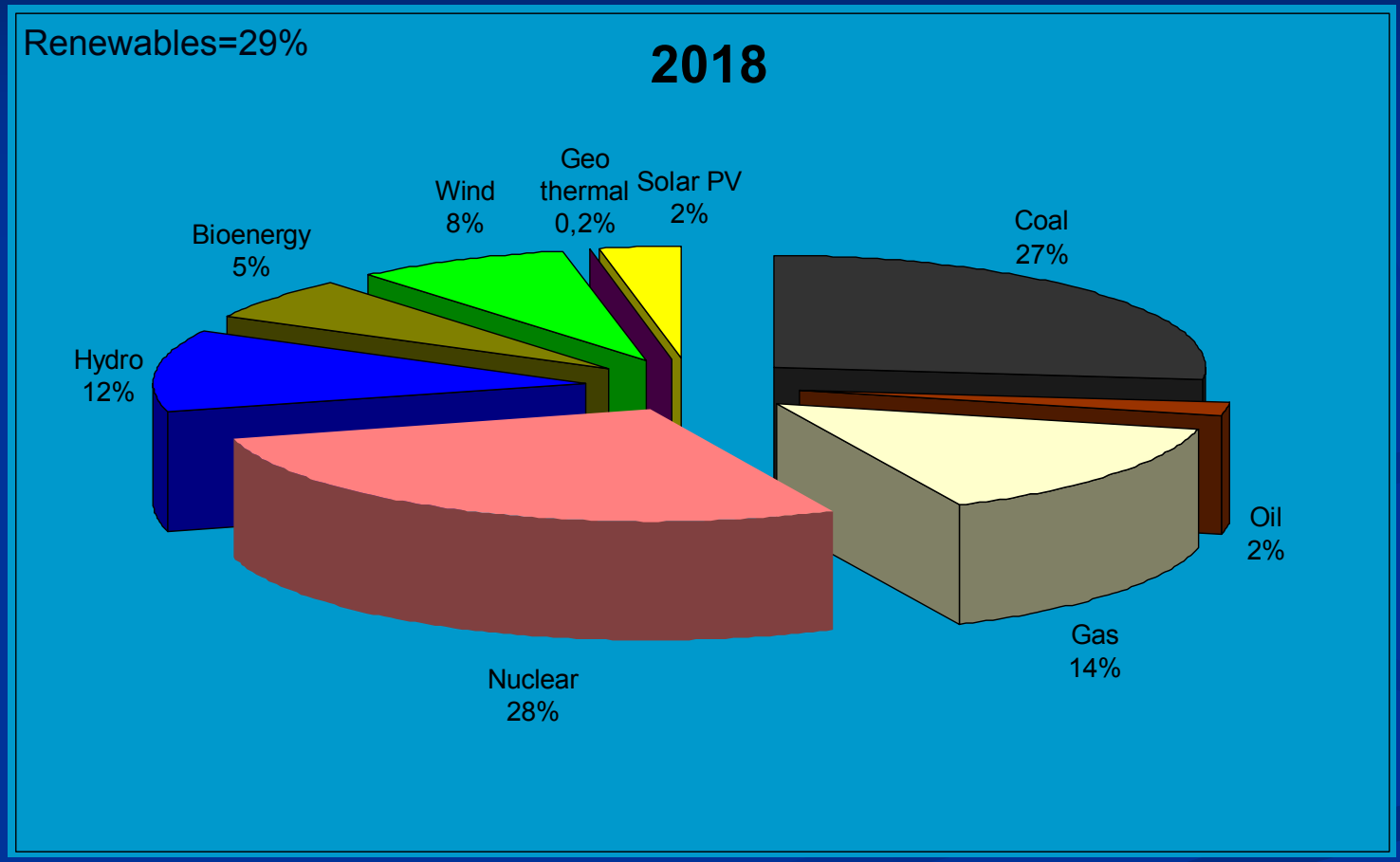


Average power 2018: 1,9 TW

Average power per capita: 3,7 kW

EU ELECTRIC ENERGY GENERATION, 2018

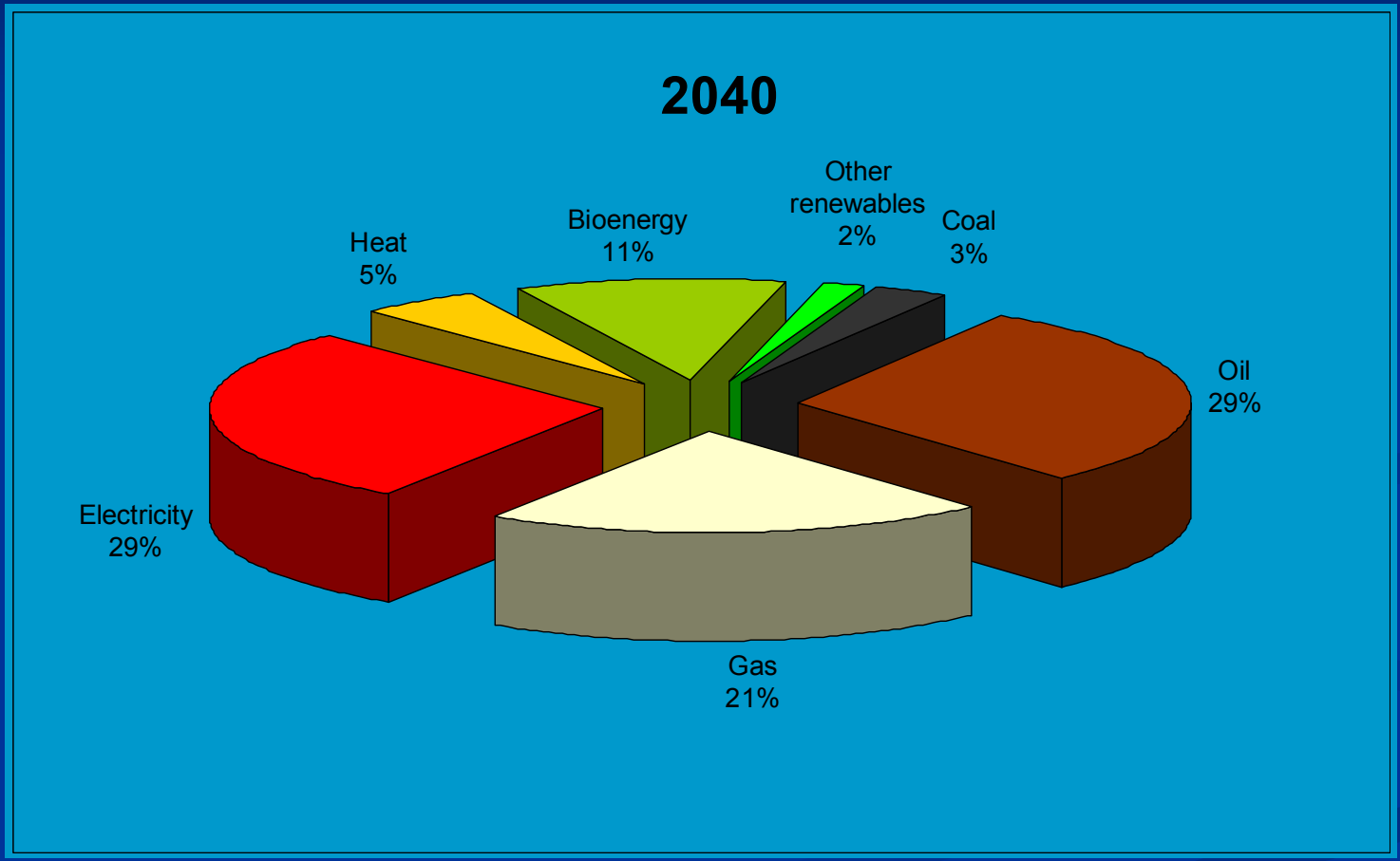
[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



Average Power: 374 GW
Average Power per capita: 0,75 kW

EU FINAL ENERGY CONSUMPTION, 2040

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]

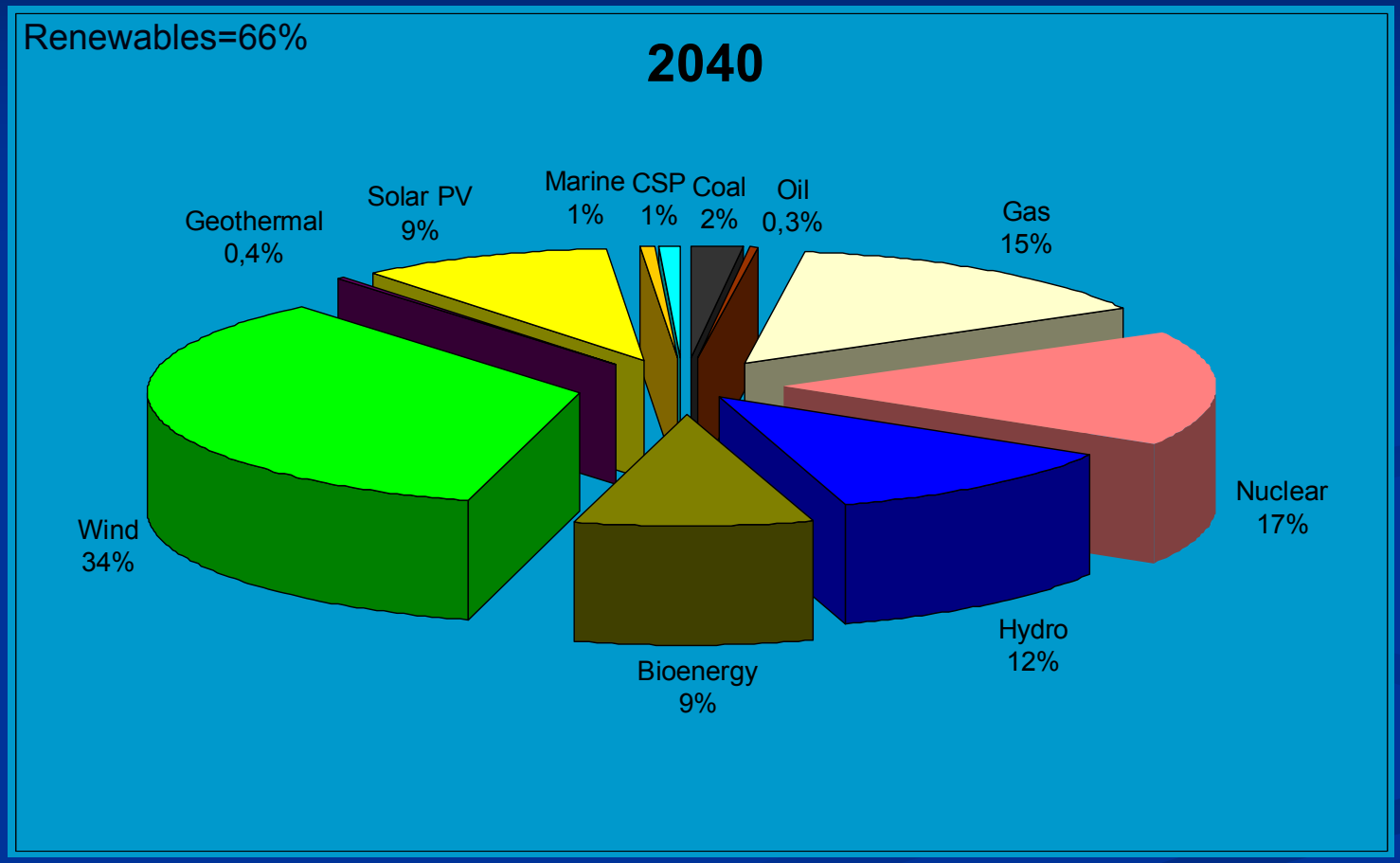


Average power 2040: 1,7 TW

Average power per capita: 3,4 kW

EU ELECTRIC ENERGY GENERATION, 2040

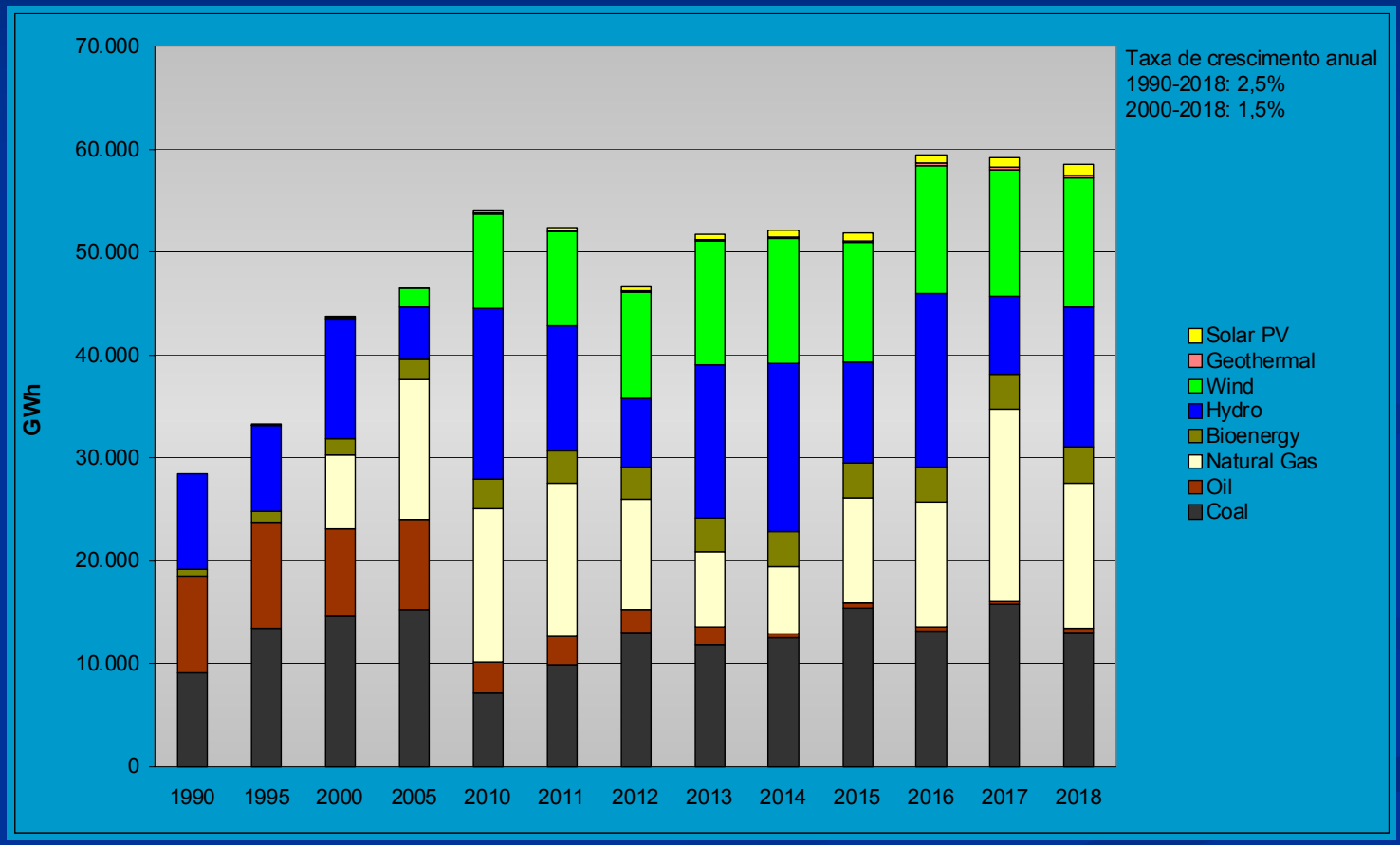
[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



Average Power: 407 GW
Average Power per capita: 0,81 kW

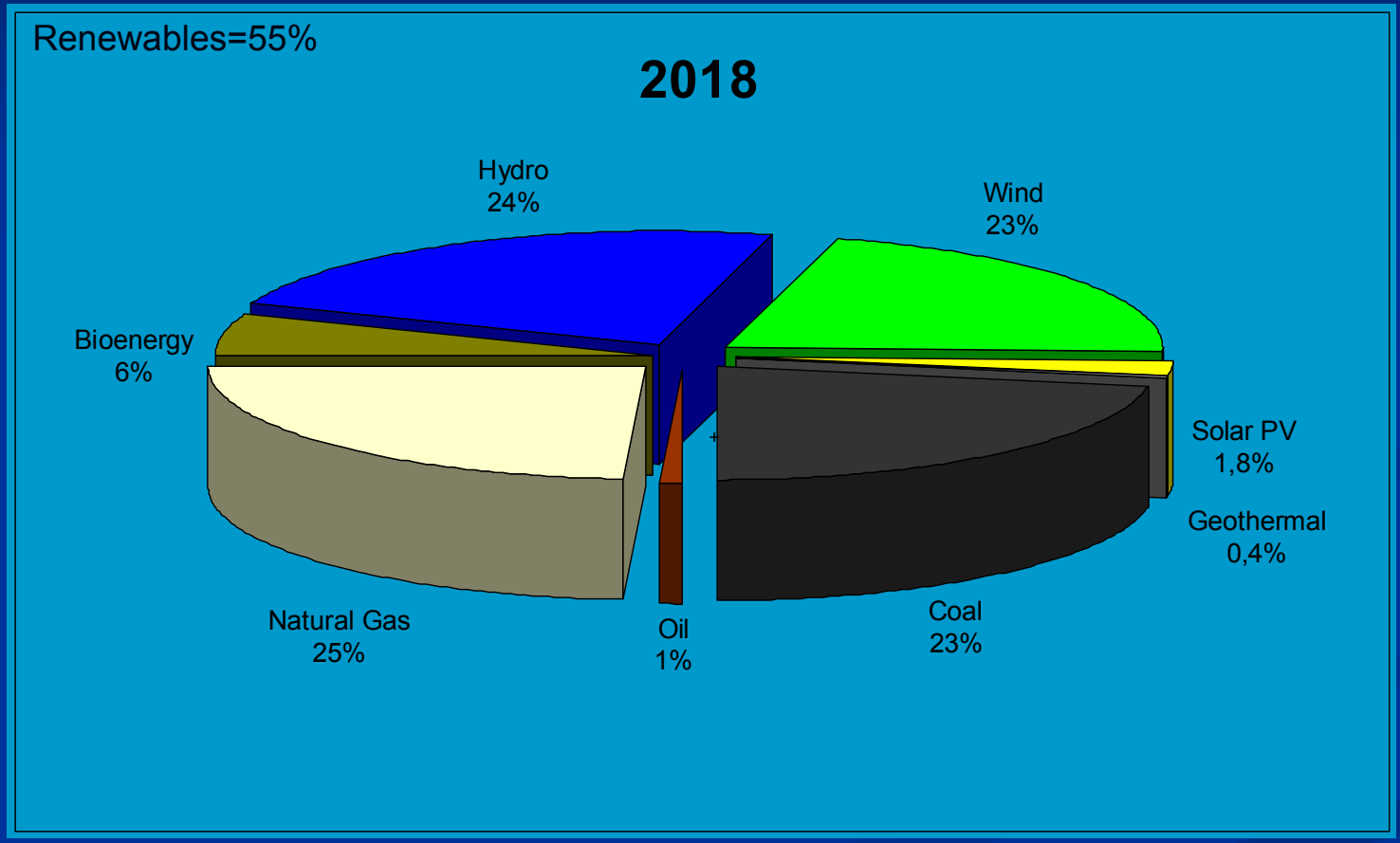
ELECTRIC ENERGY GENERATION PORTUGAL, 1990-2018

[Source: DGEG, REN]



ELECTRIC ENERGY GENERATION PORTUGAL, 2018

[Source: DGEG, REN]



Average Power 2018: 6,1 GW
Average Power per capita: 0,58 kW

ELECTRIC ENERGY GENERATION PORTUGAL (CONTINENT), 2019

[Source: APREN]

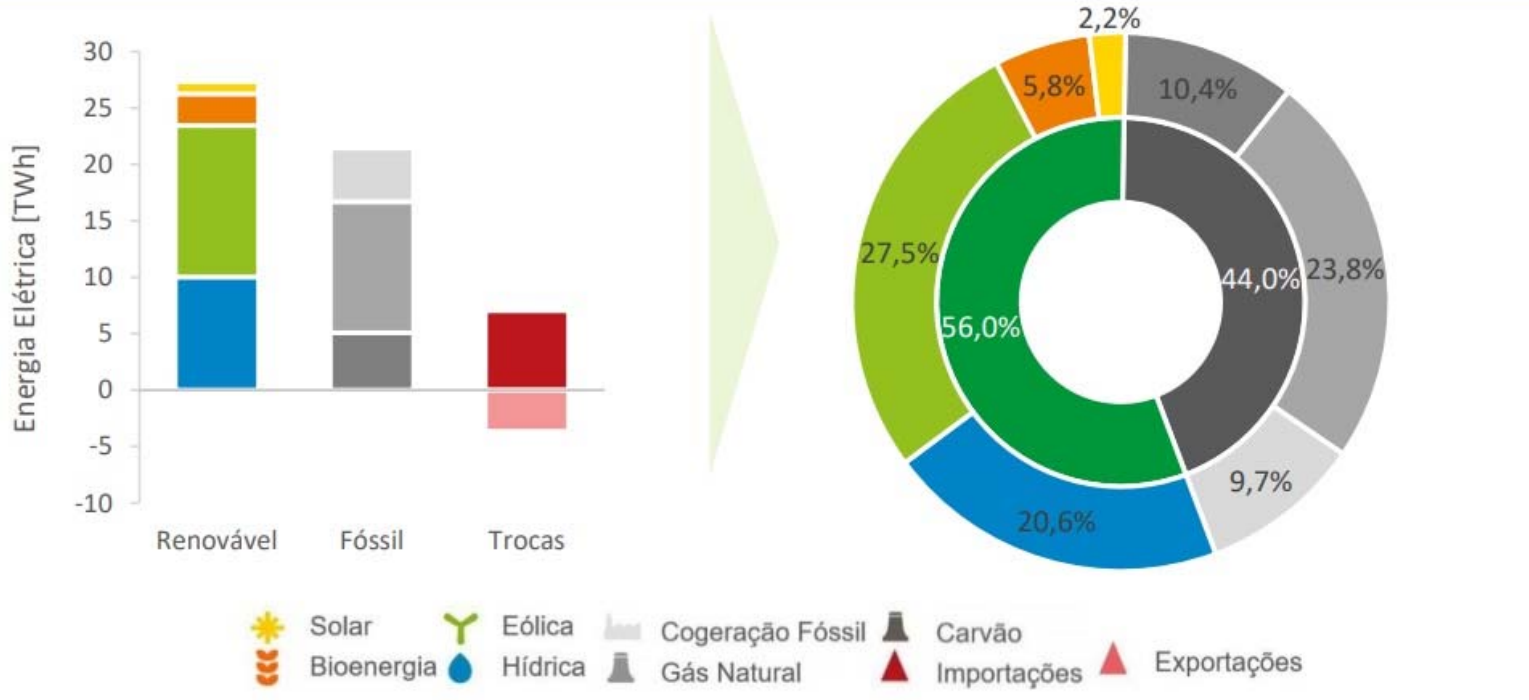
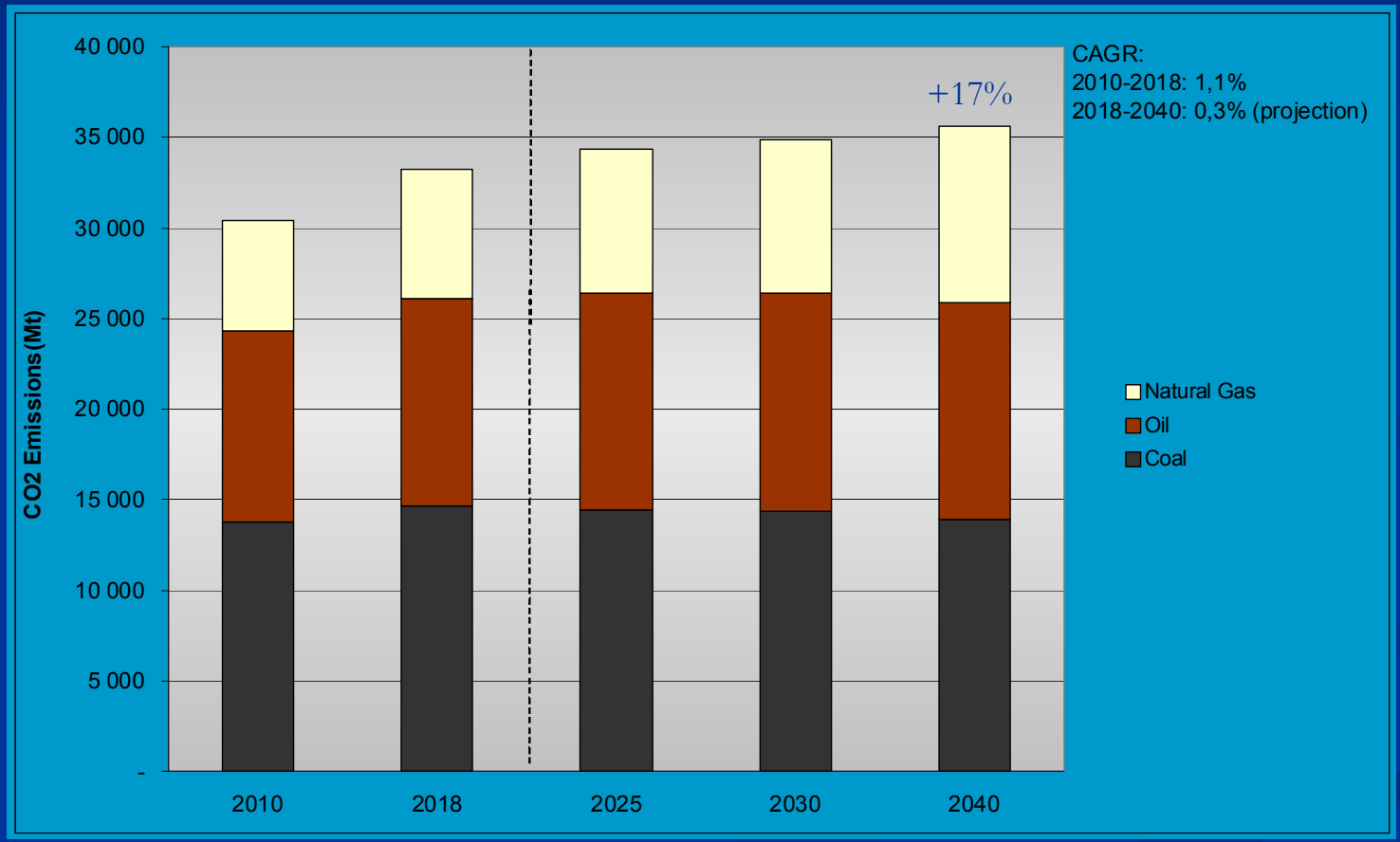


Figura 1. Repartição das fontes na geração de eletricidade em Portugal Continental (dez-2019).

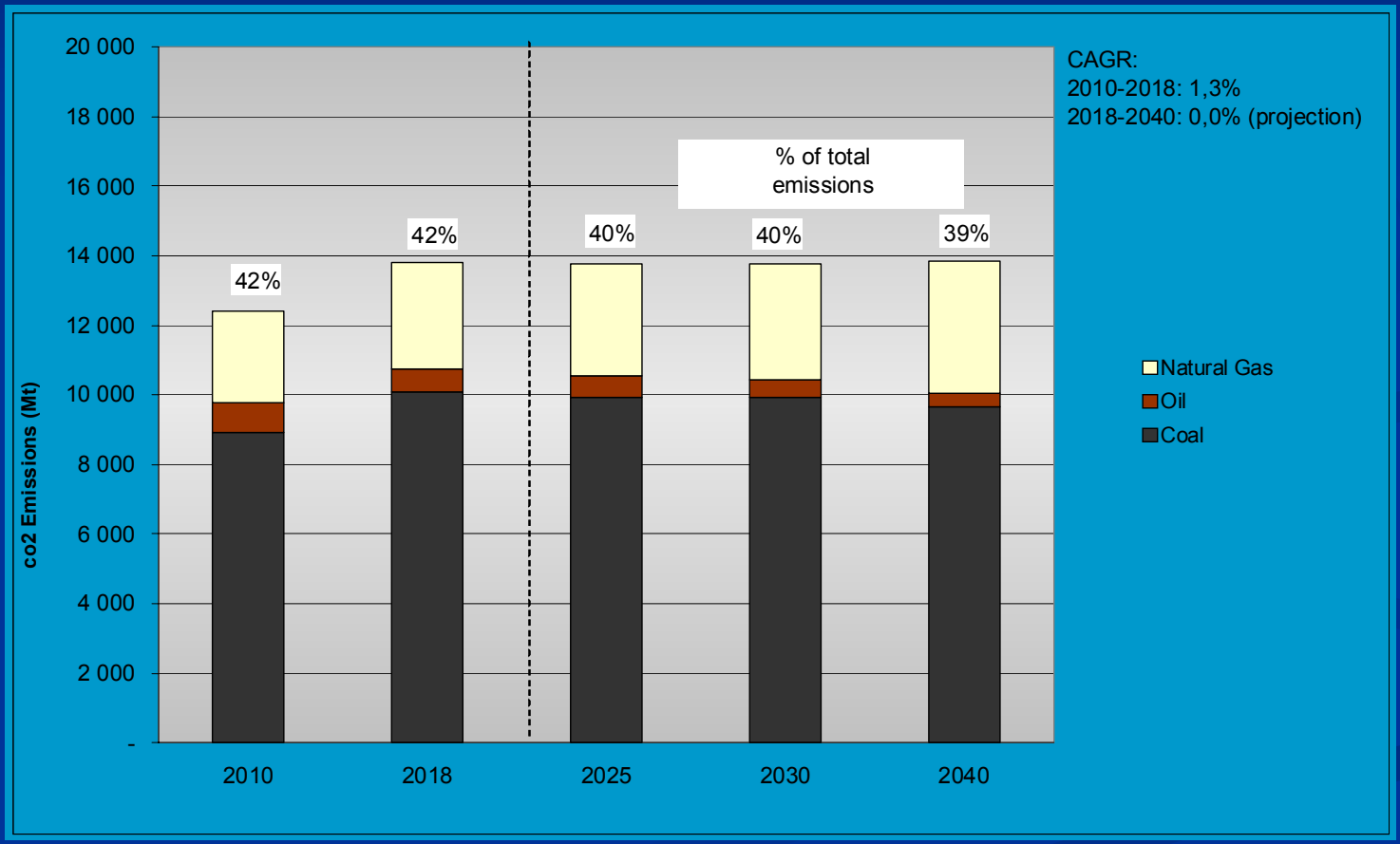
TOTAL CO_2 EMISSIONS WORLD , 2010-2040

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



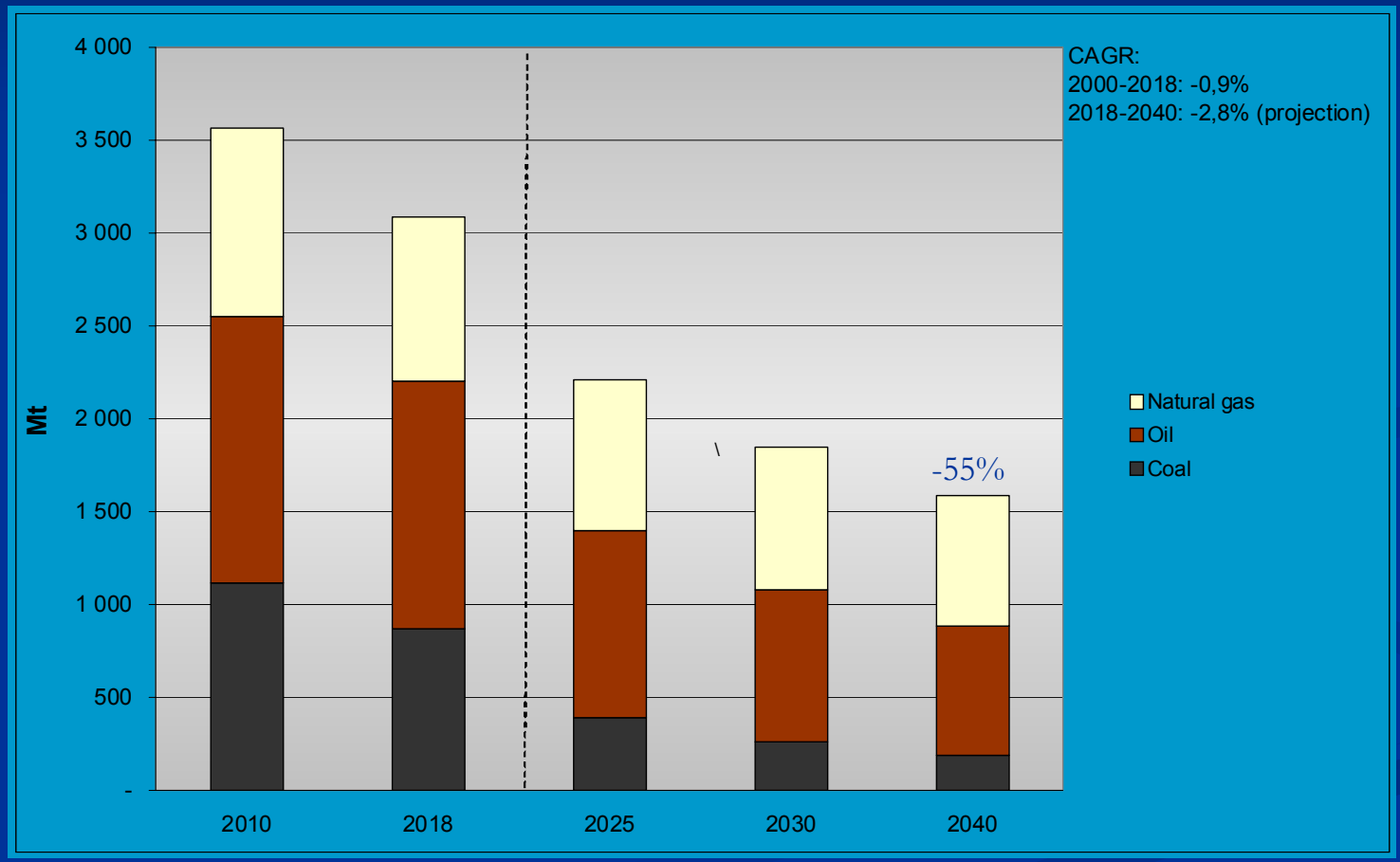
CO_2 EMISSIONS DUE TO ELECTRICITY GENERATION, WORLD , 2010-2040

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



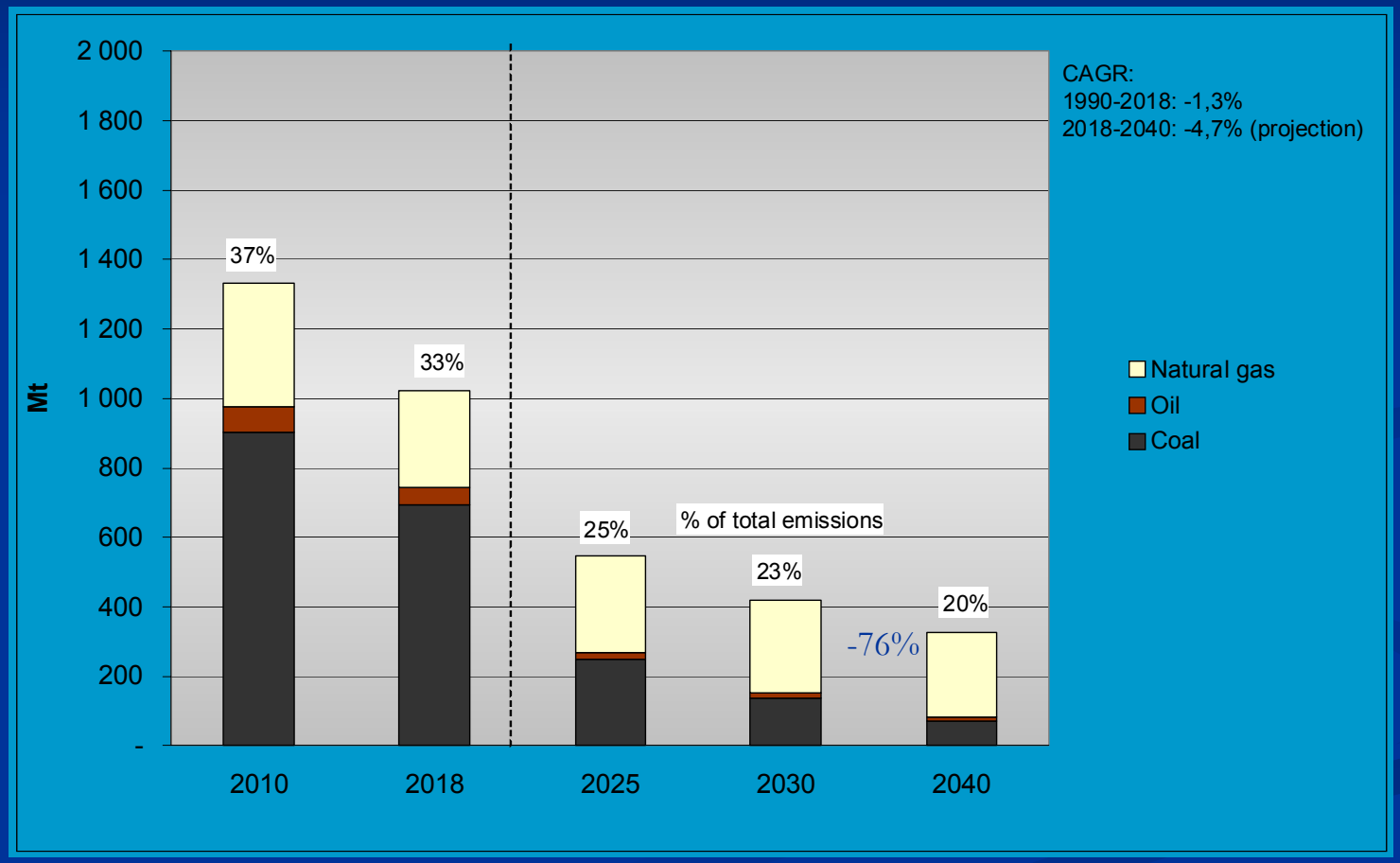
TOTAL CO_2 EMISSIONS EU, 2010-2040

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



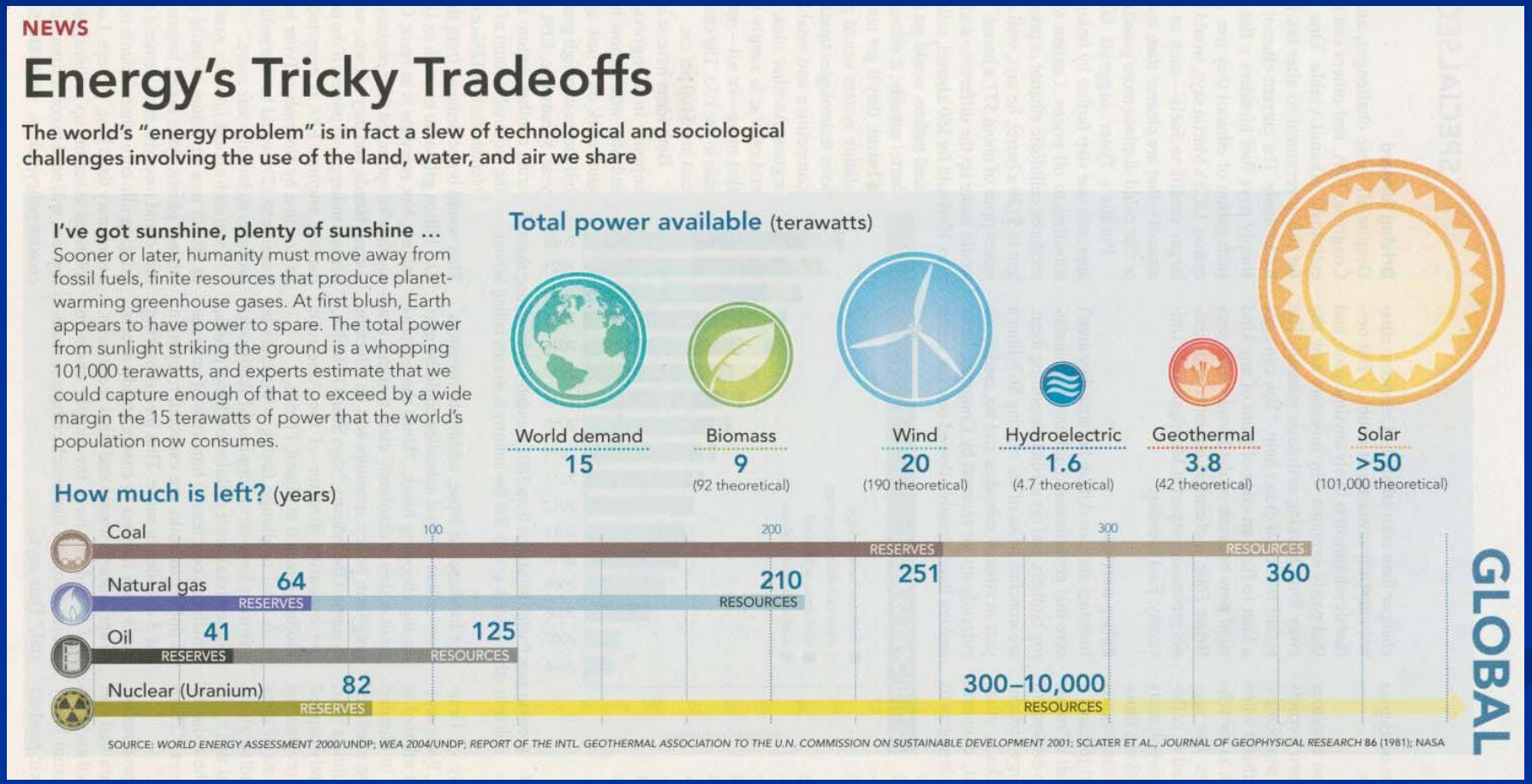
CO_2 EMISSIONS DUE TO ELECTRICITY GENERATION, EU , 1990-2040

[Source: IEA, World Energy Outlook 2019, Stated Policies Scenario]



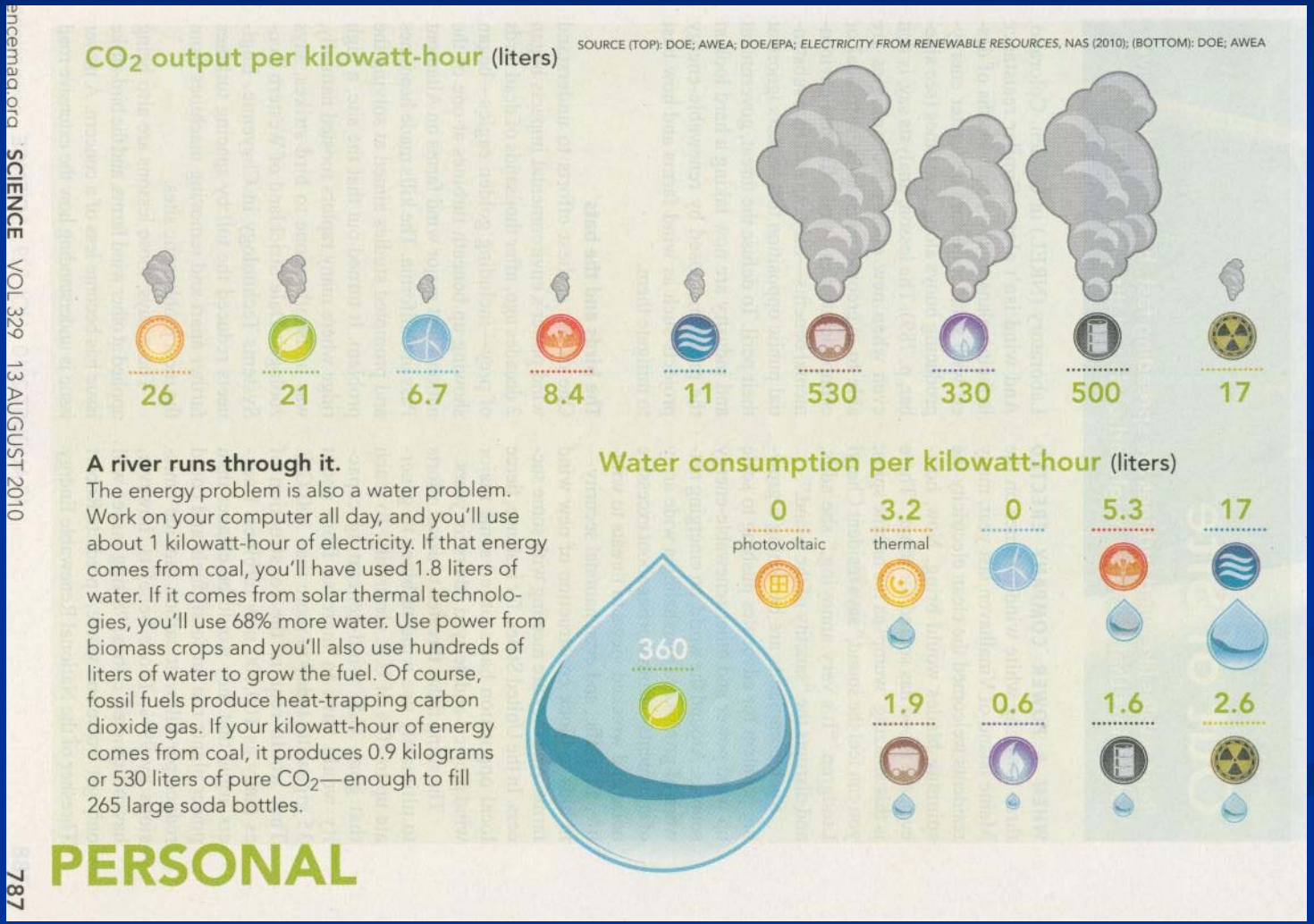
POWER AVAILABLE FROM ALTERNATIVE ENERGY SOURCES

[Source: Science, August 2010]



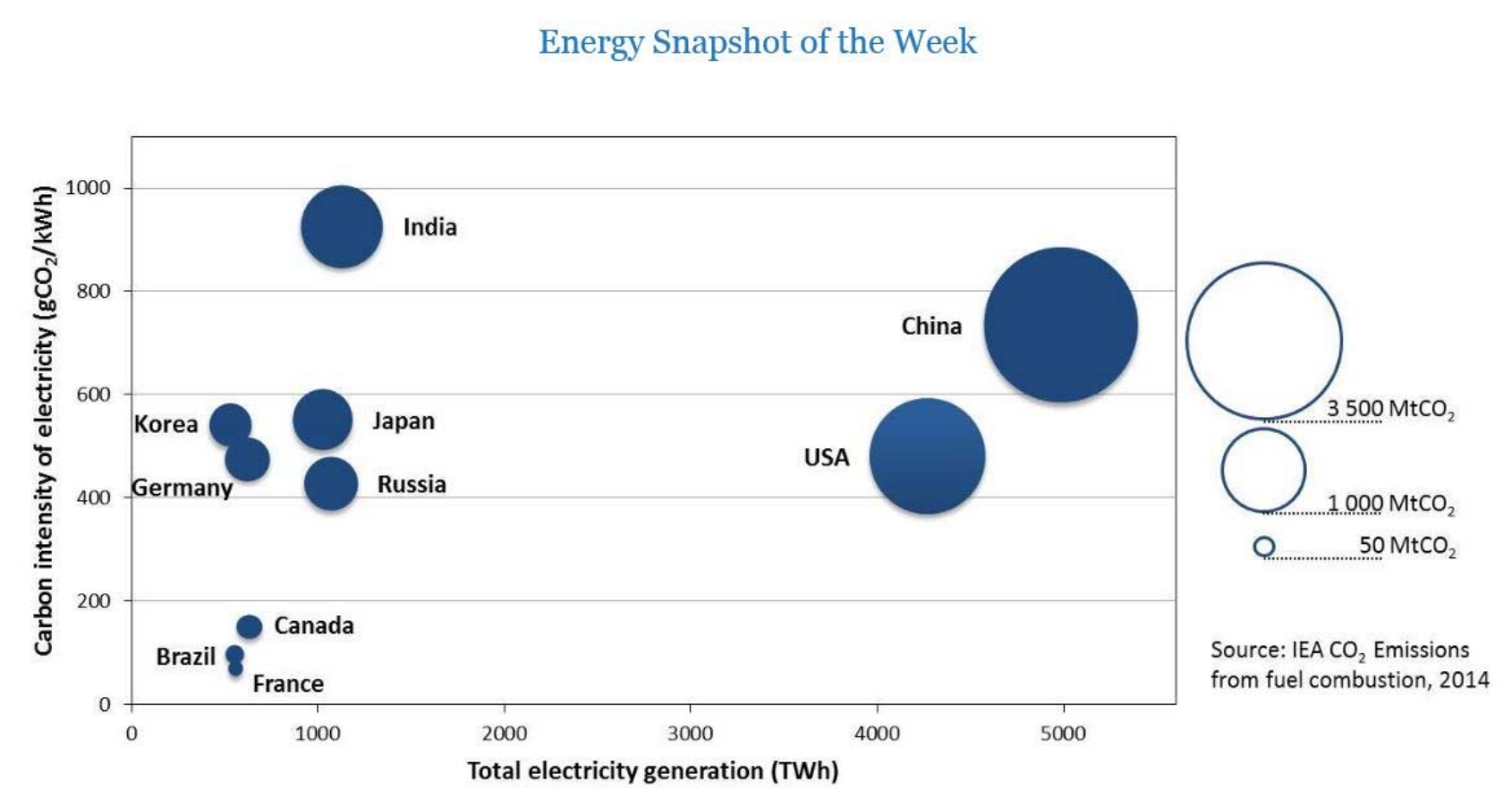
CO_2 EMISSIONS AND WATER CONSUMPTION

[Source: Science, August 2010]



CARBON INTENSITY OF ELECTRICITY

[Source: IEA, 2014]



DECARBONIZING ELECTRICITY SUPPLY

- Renewable energy
- Clear price for CO_2 (tax or market price)
- Energy efficiency
- Energy storage
- Electric vehicle
- Natural gas (especially CHP)
- Green hydrogen
- Clean coal (CO_2 capture and storage)