



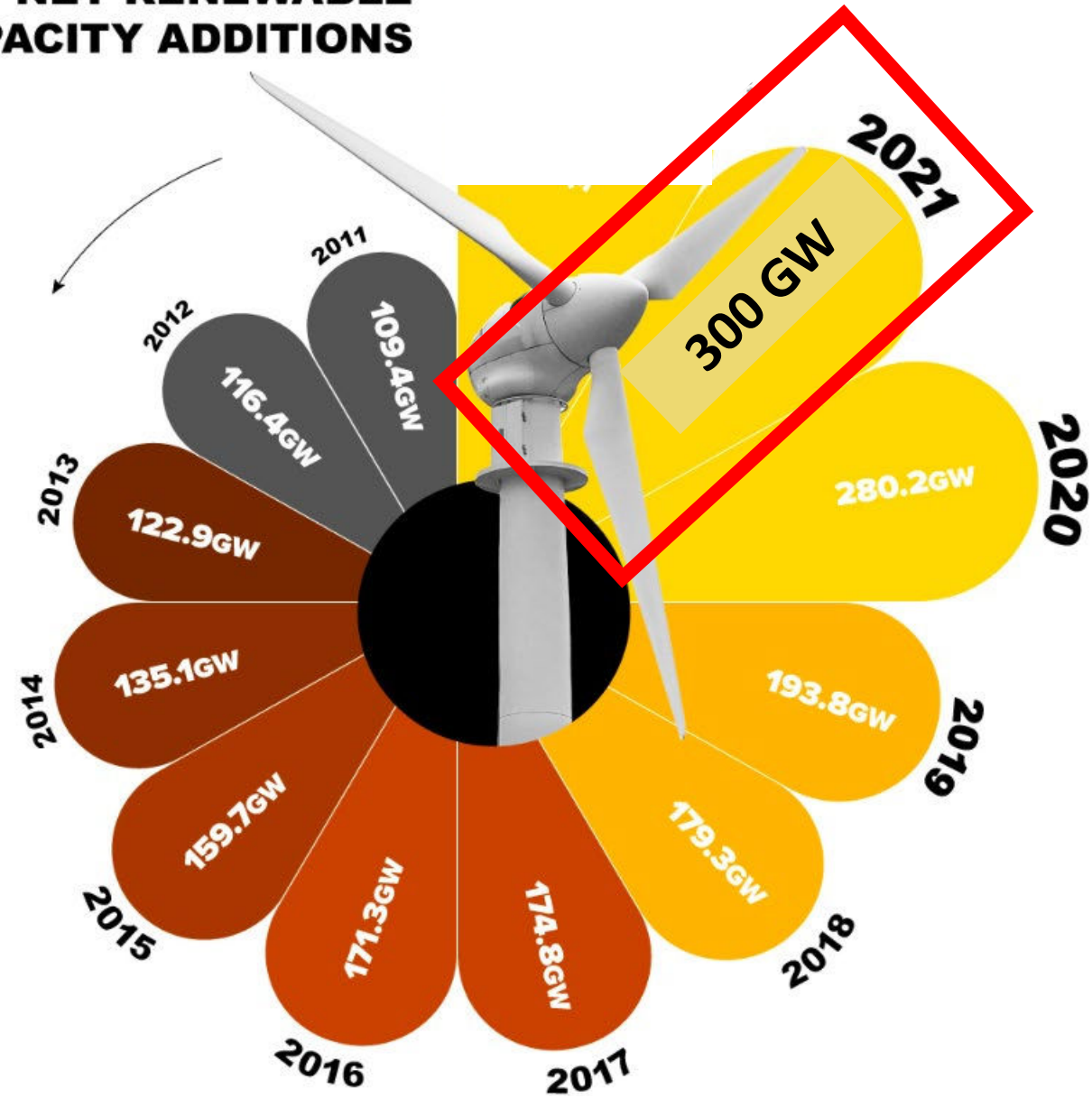
decisions with confidence

SPE Asia Pacific Oil & Gas Conference and Exhibition

“Pivoting Our Profession-
Petroleum Engineering in a Net Zero Carbon World”



NET RENEWABLE CAPACITY ADDITIONS



The Metals Behind **CLEAN POWER**

1 gigawatt (GW) = 1 000 megawatt (MW)
300GW = 300 000 MW

Material requirements
per megawatt (kg):

Solar PV



Copper
2,822kg



Silicon
3,948kg

Other
62kg

Offshore wind



Copper
8,000kg



Zinc
5,500kg

Other
1,903kg

Electric cars

kg per vehicle



Graphite
66kg



Copper
53kg



Nickel
40kg



Manganese
24.5kg



Cobalt
13.3kg

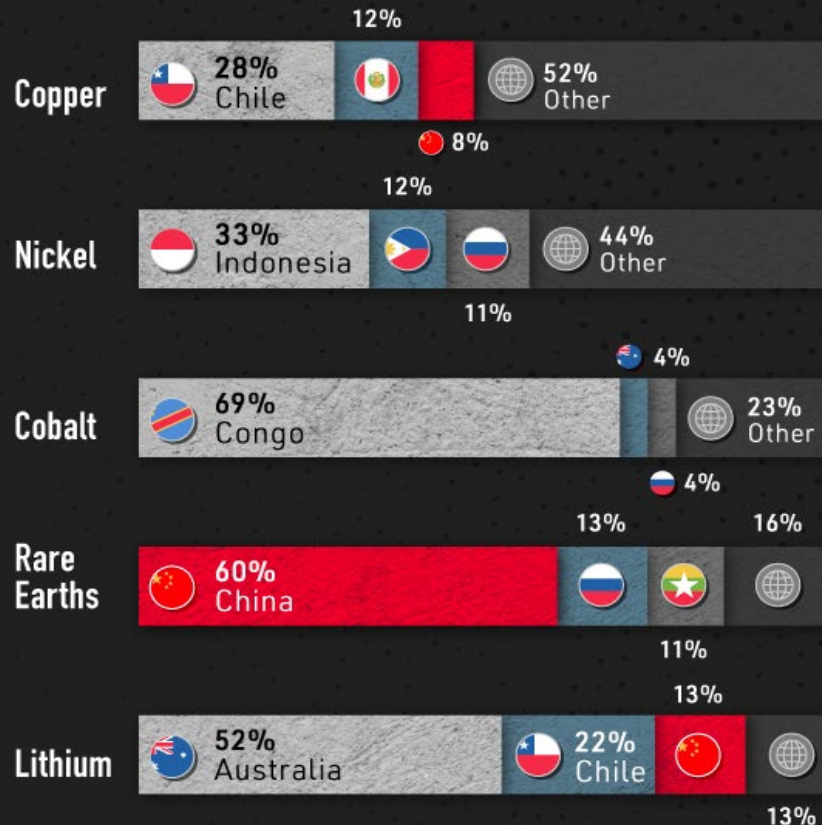


Lithium
9kg

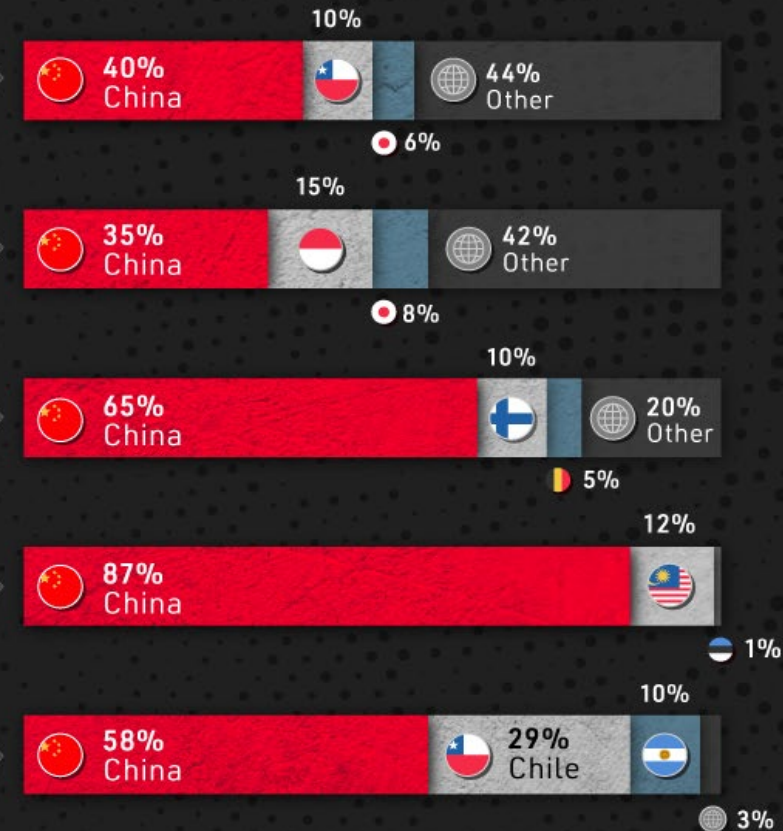
Other
0.5kg

VISUALIZING CHINA'S DOMINANCE IN CLEAN ENERGY METALS

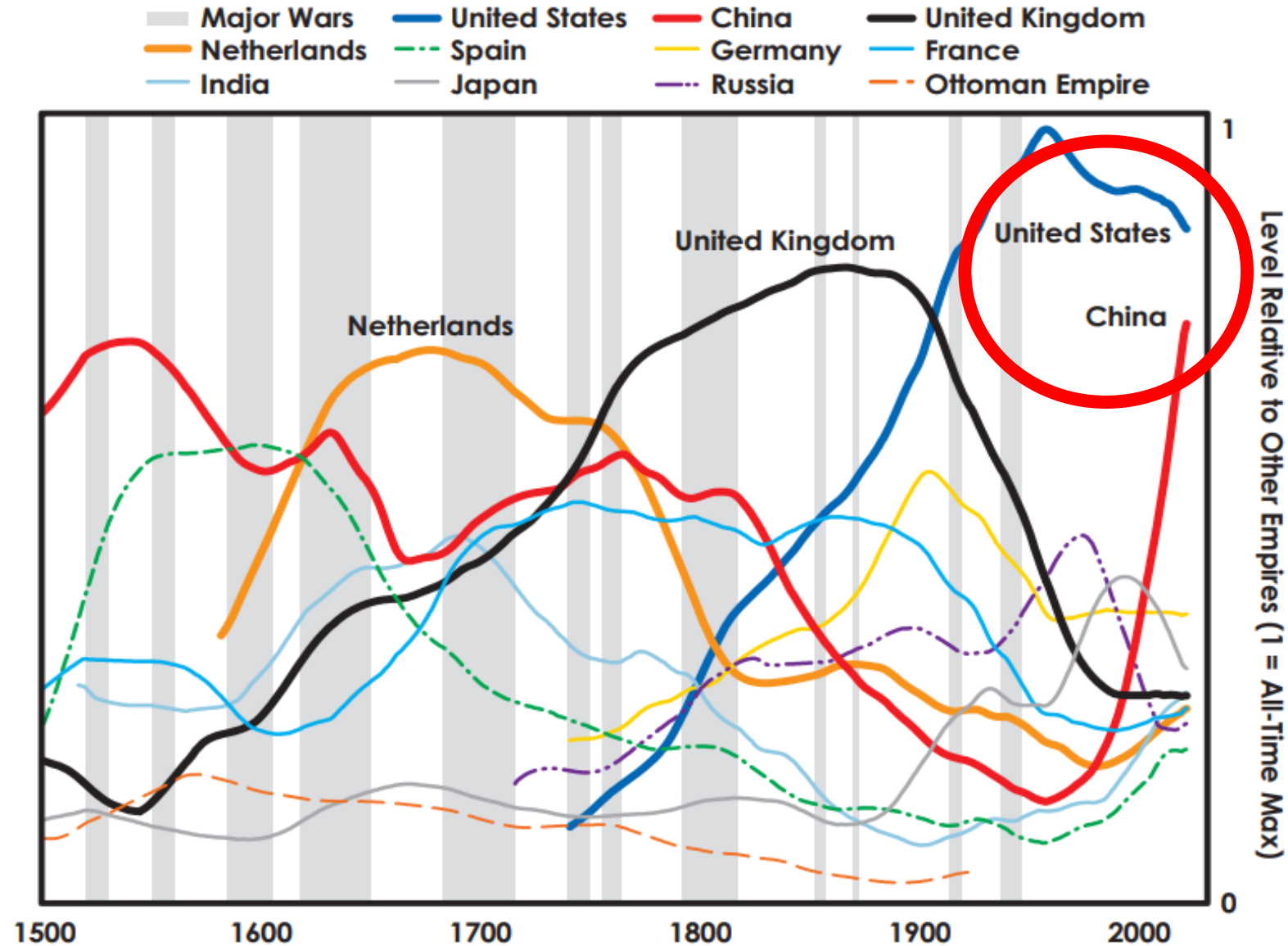
Where Clean Energy Metals are Produced



Where Clean Energy Metals are Processed



RELATIVE STANDING OF GREAT EMPIRES

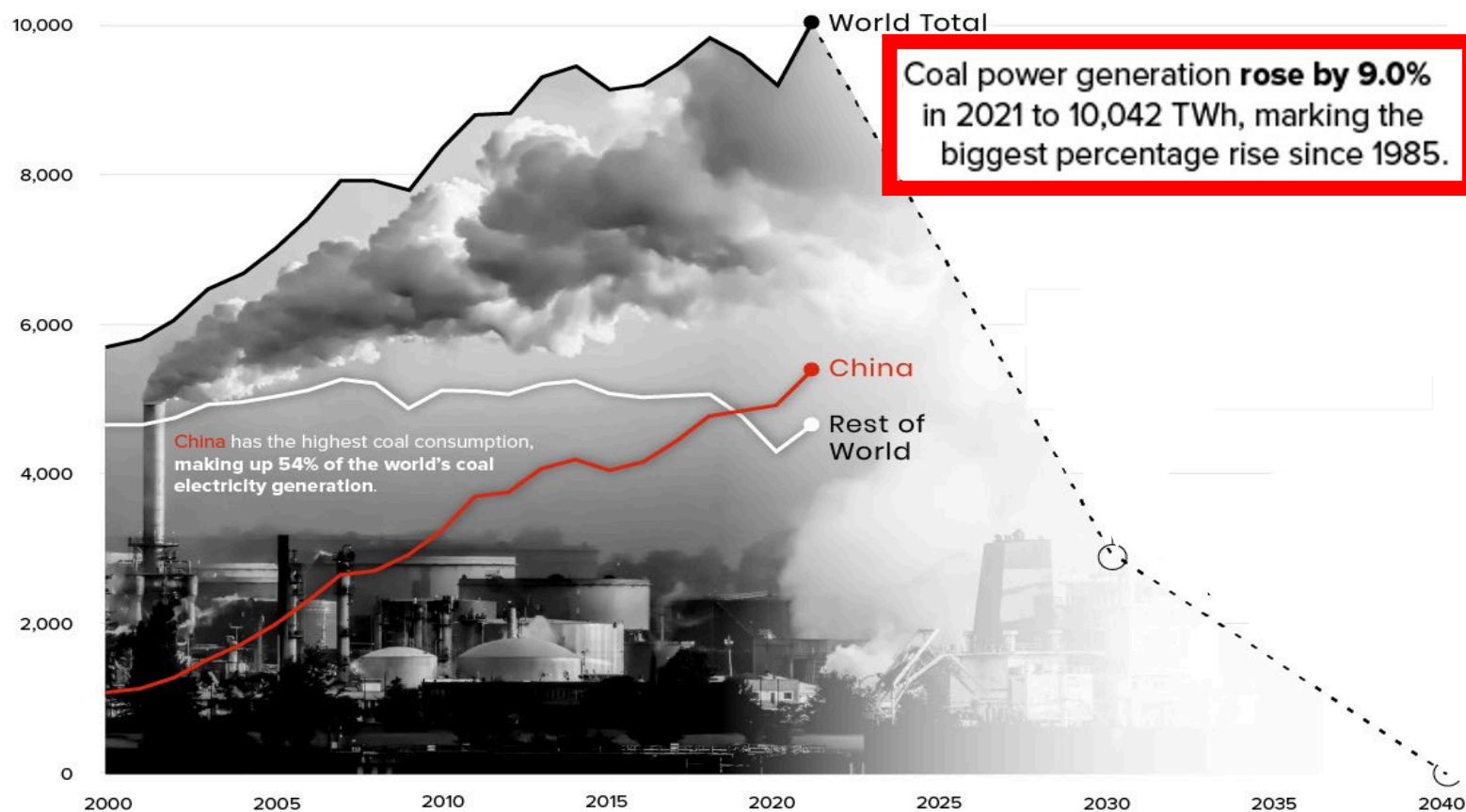


How far are we from **PHASING OUT COAL?**

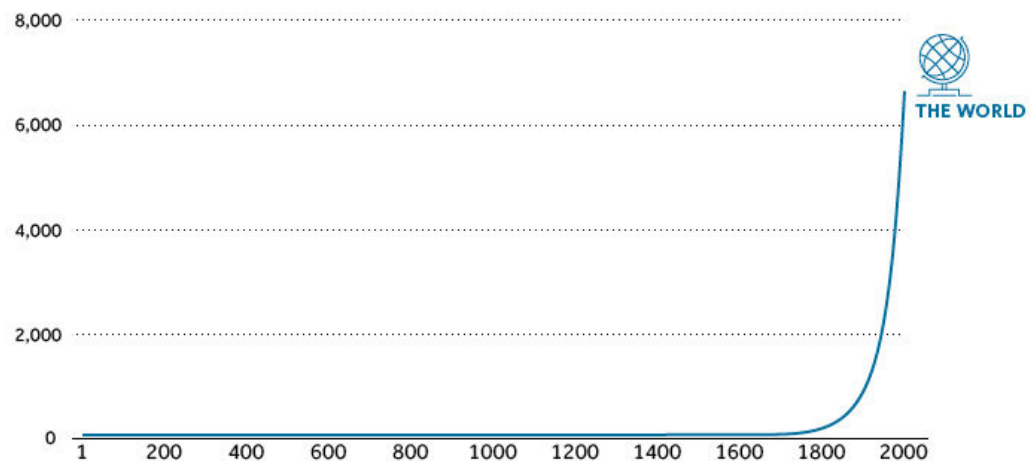
10 042 Terawatt Hours = 10 042 000 GW for one hour



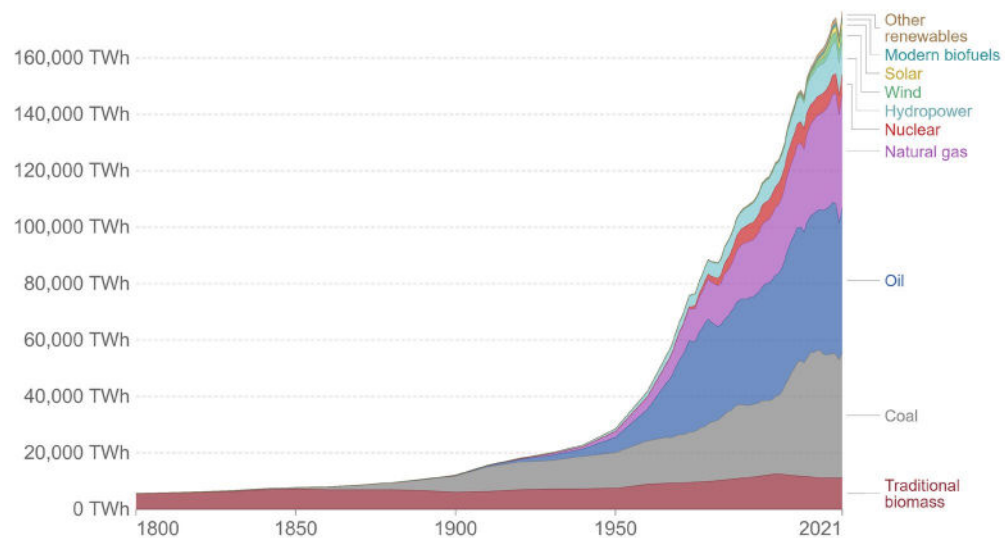
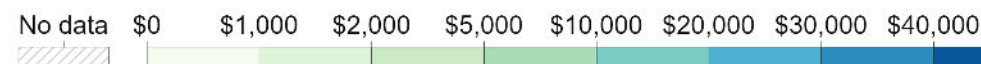
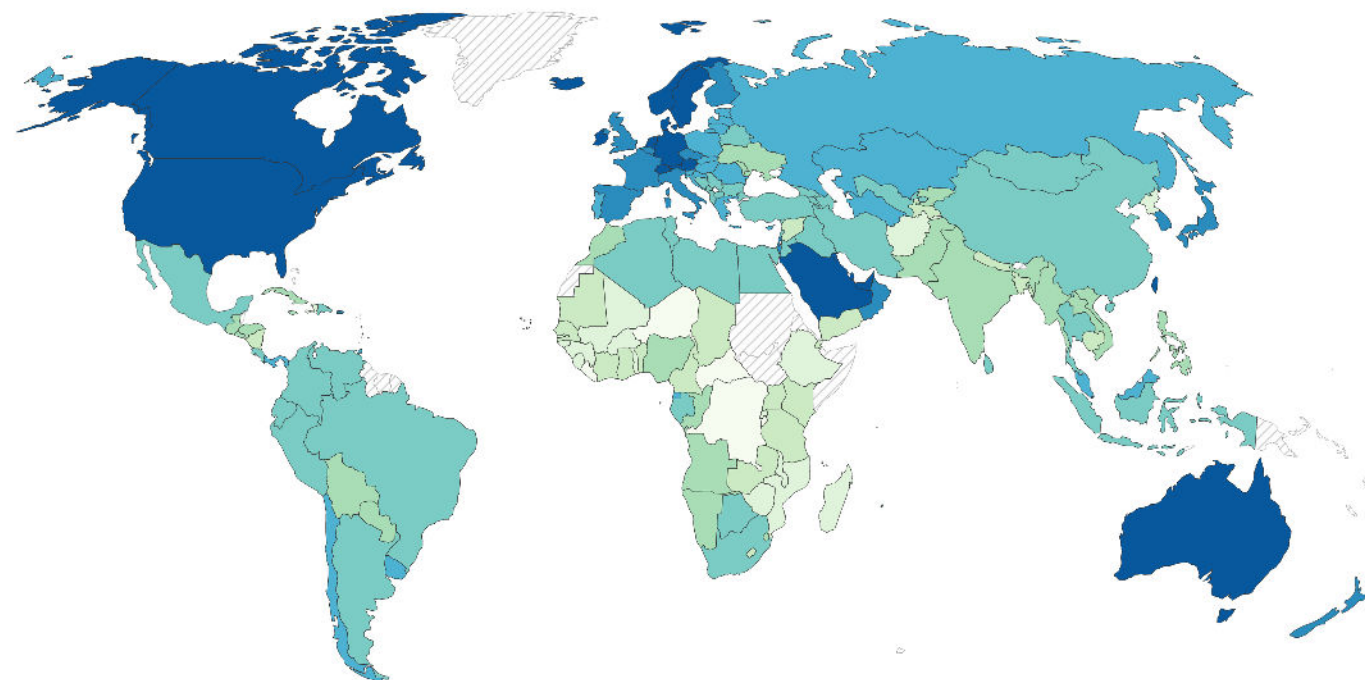
COAL ELECTRICITY GENERATION Terawatt hours



World GDP Per Capita



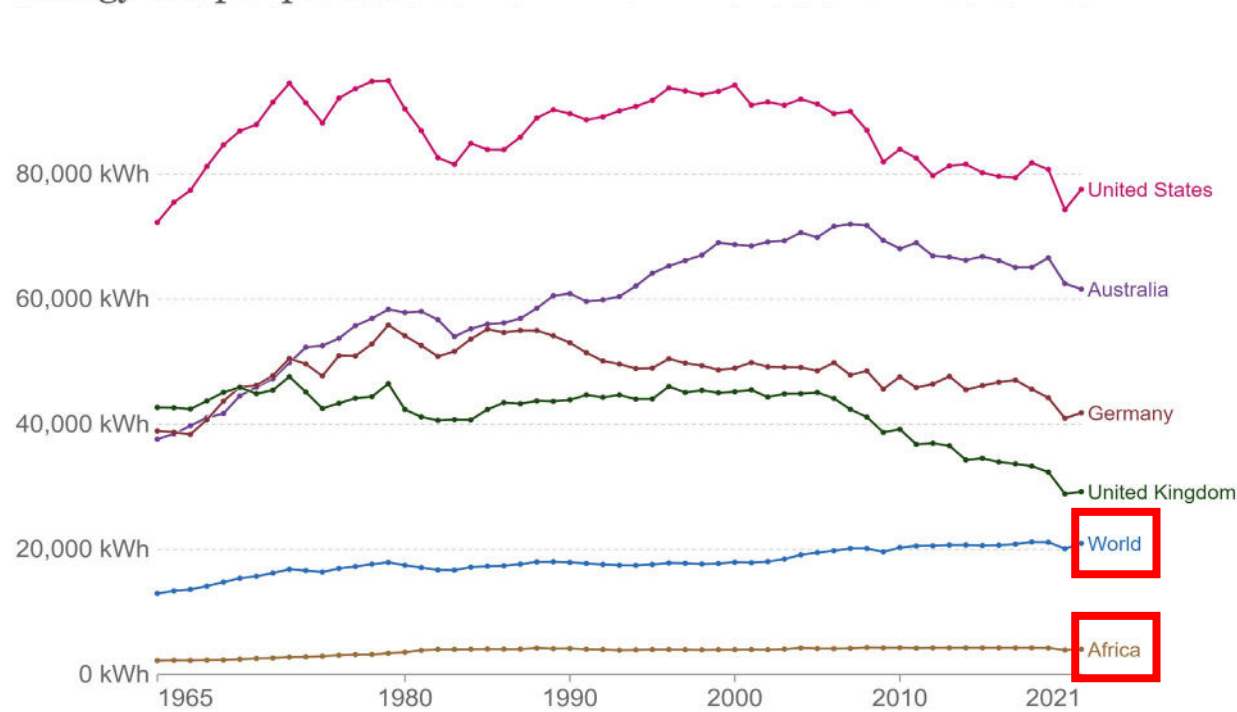
GDP per capita



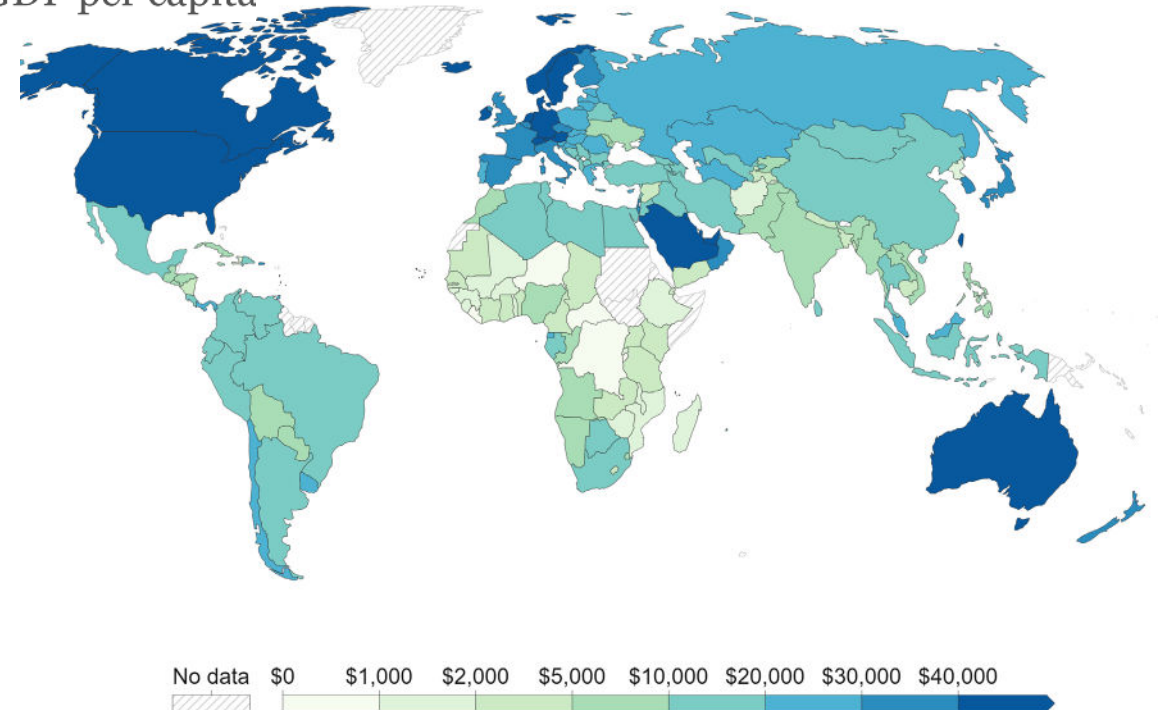
Maslow's Hierarchy of Needs

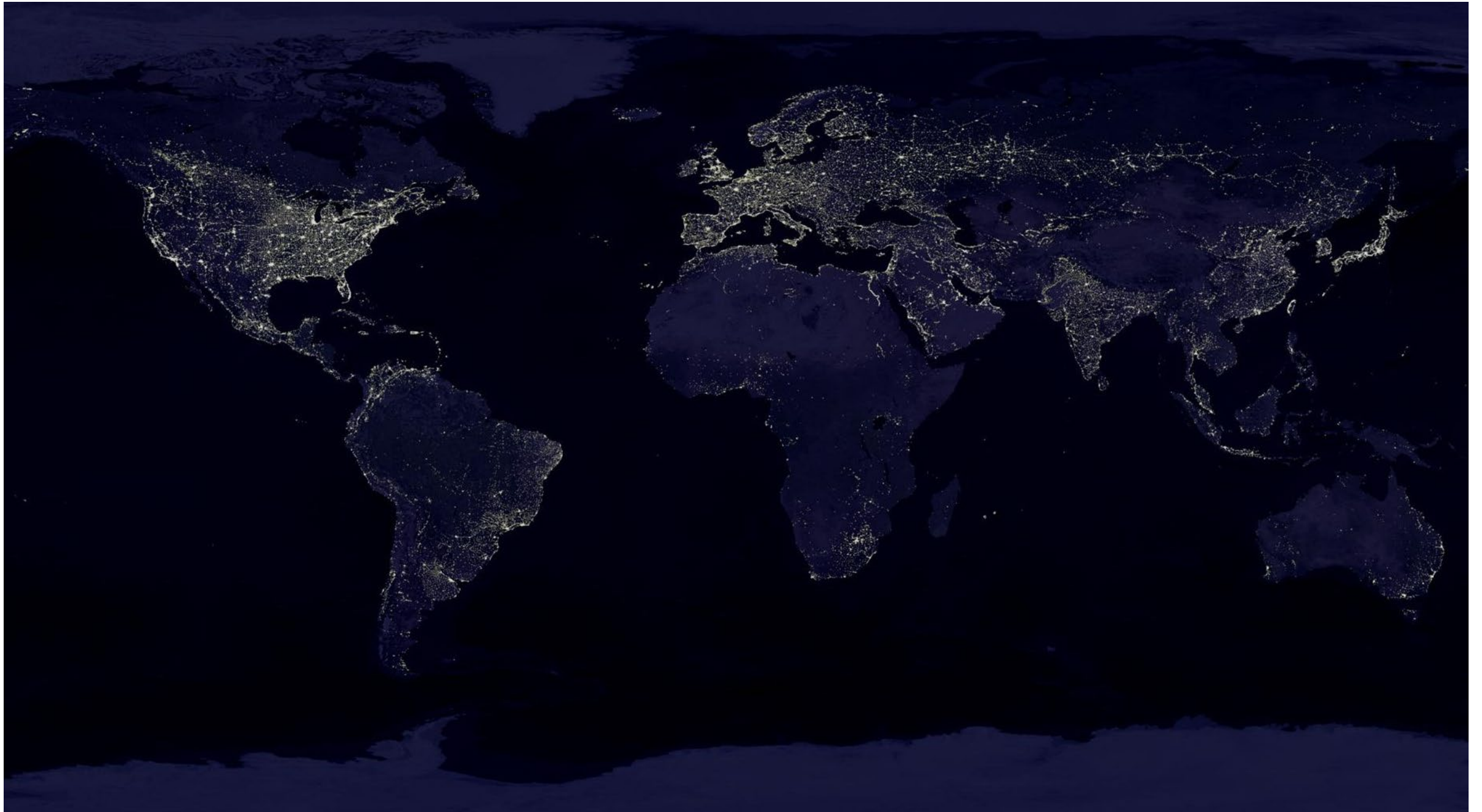


Energy use per person



GDP per capita





Source: NASA