

Energy Transition Delusion & The Physics of Money

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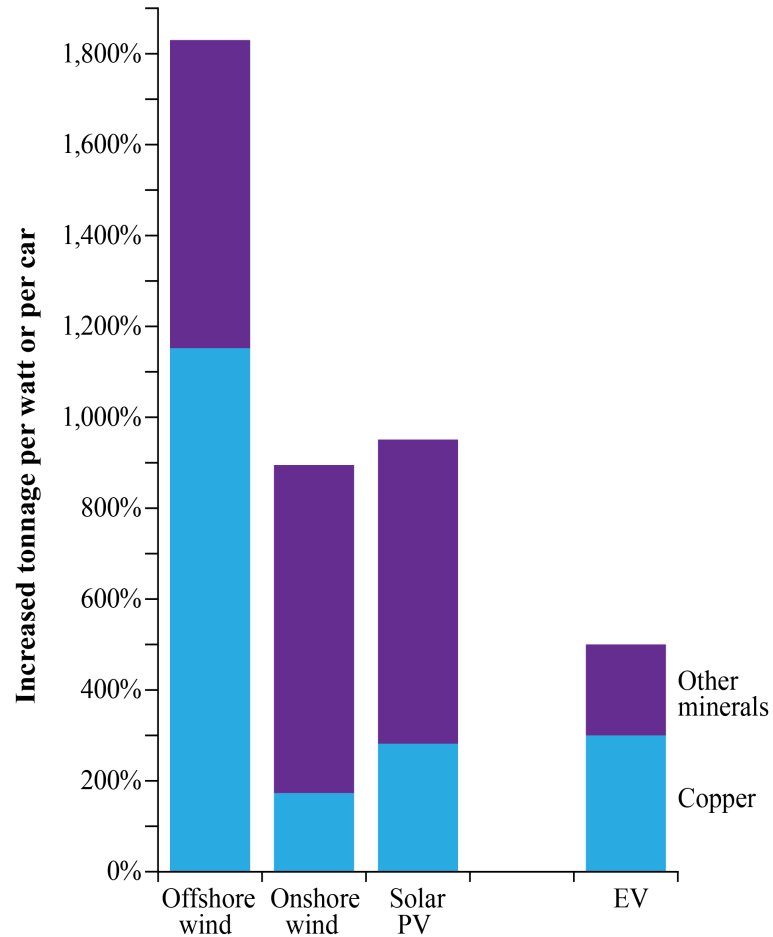
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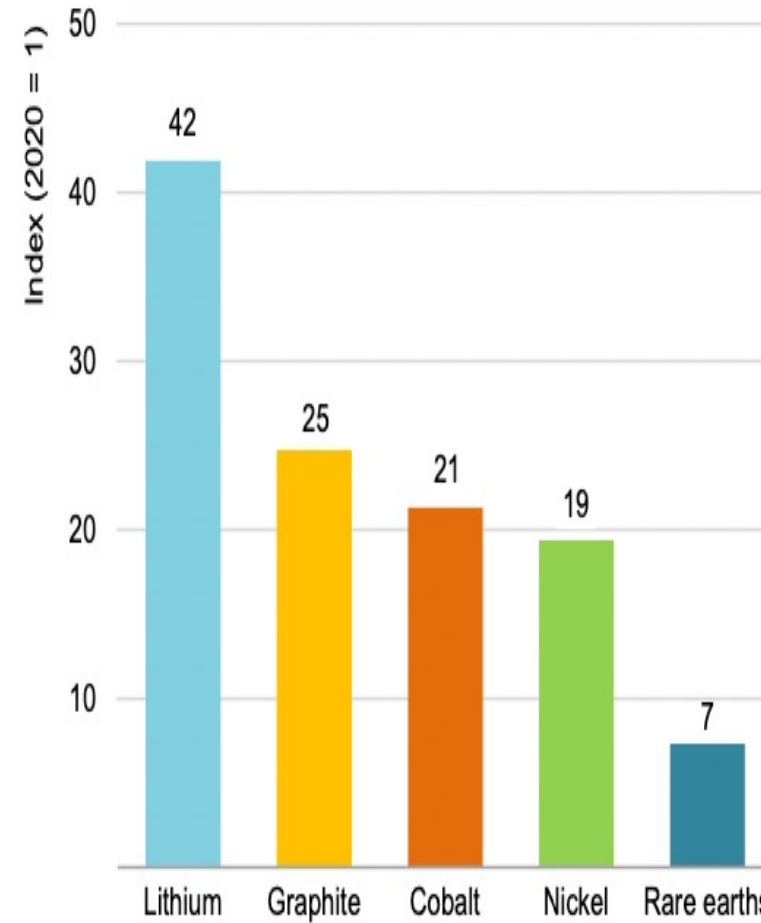
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The elephant in the room: Mineral demands rise >1,000%

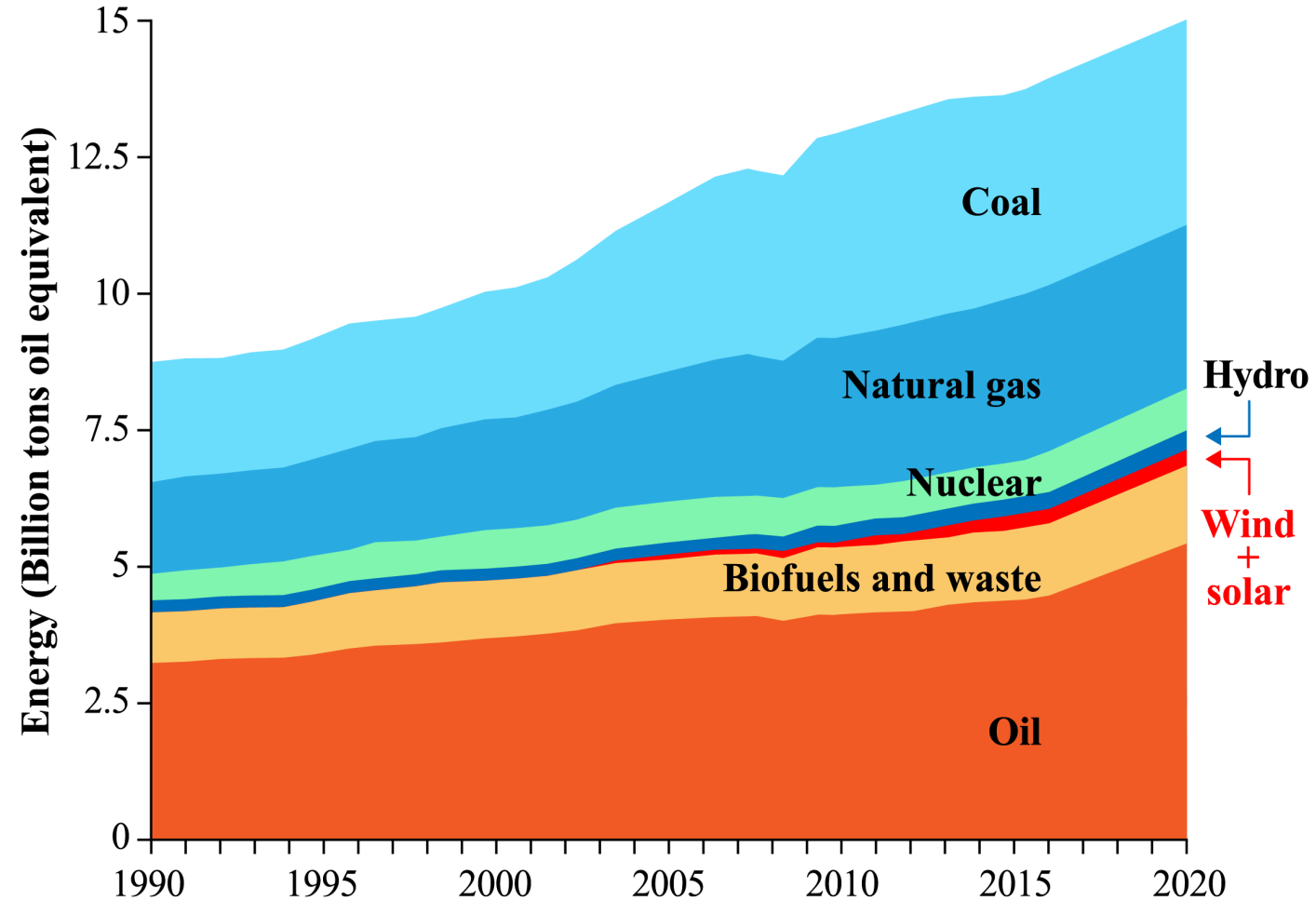


Increases in **minerals** per energy machine

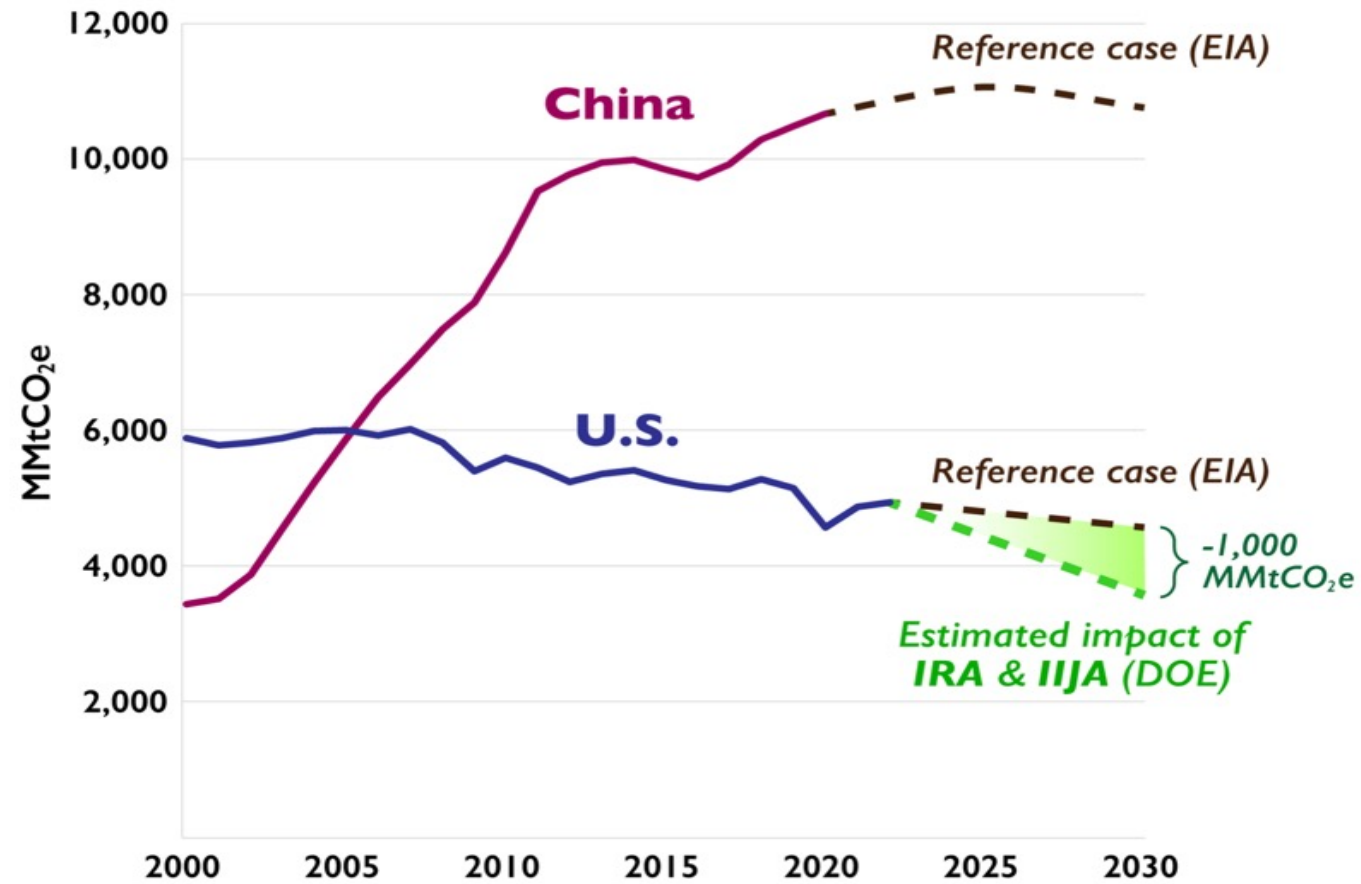


Increases in global **mining** to meet demand

Global energy: 20 years and \$5 trillion



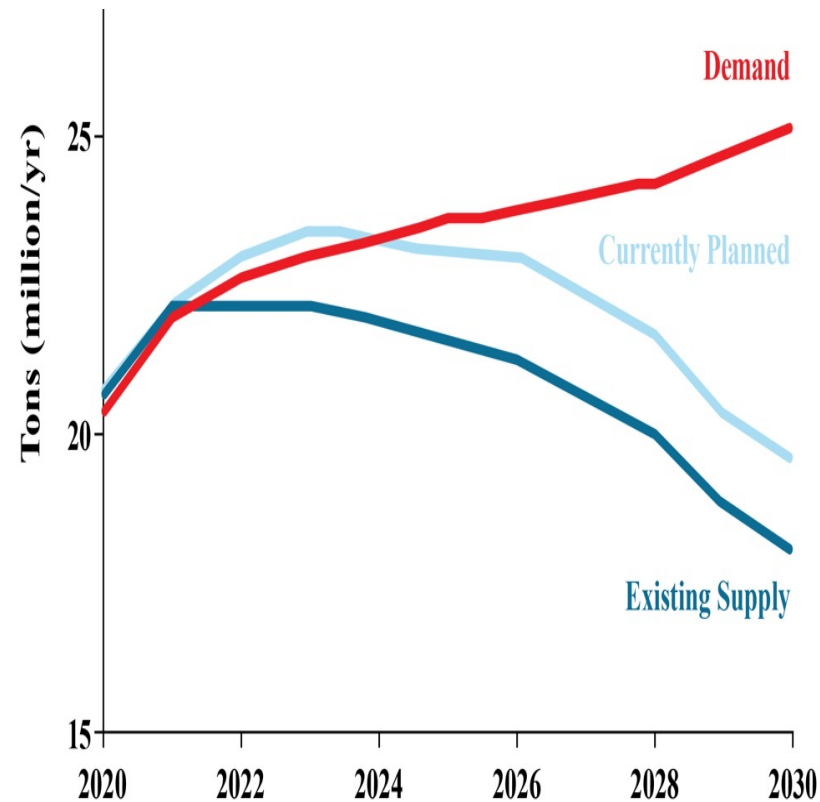
Carbon impact of U.S. GND & \$1 trillion



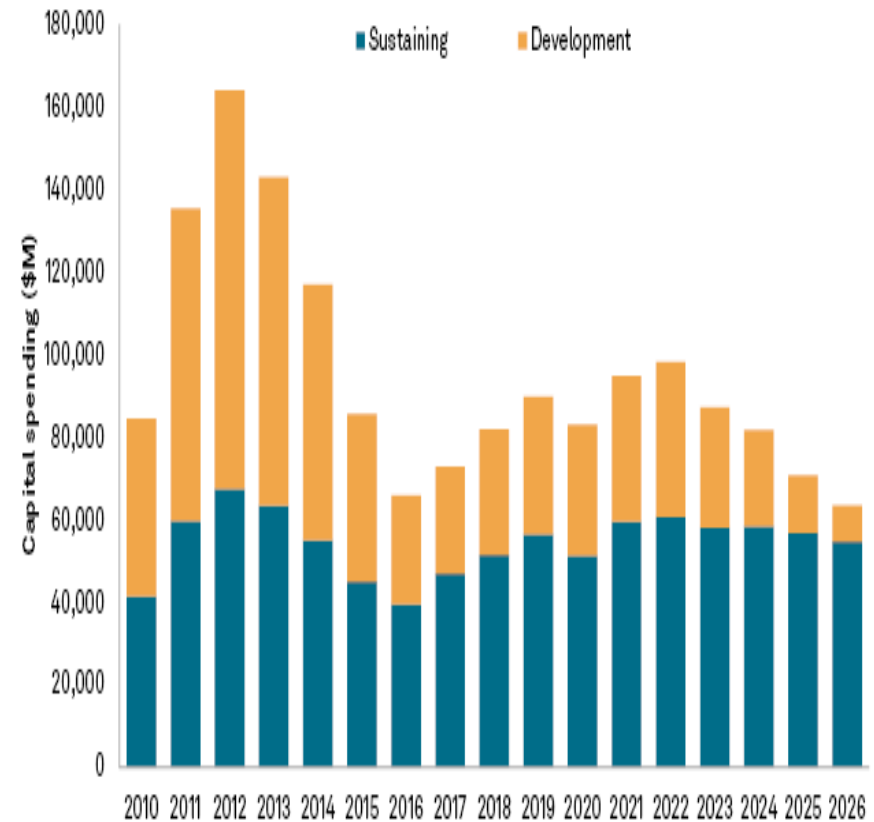
IEA: 100s of new mines needed & \$100s billions

“Will the looming [copper] supply gap short-circuit the energy transition?”

S&P Global

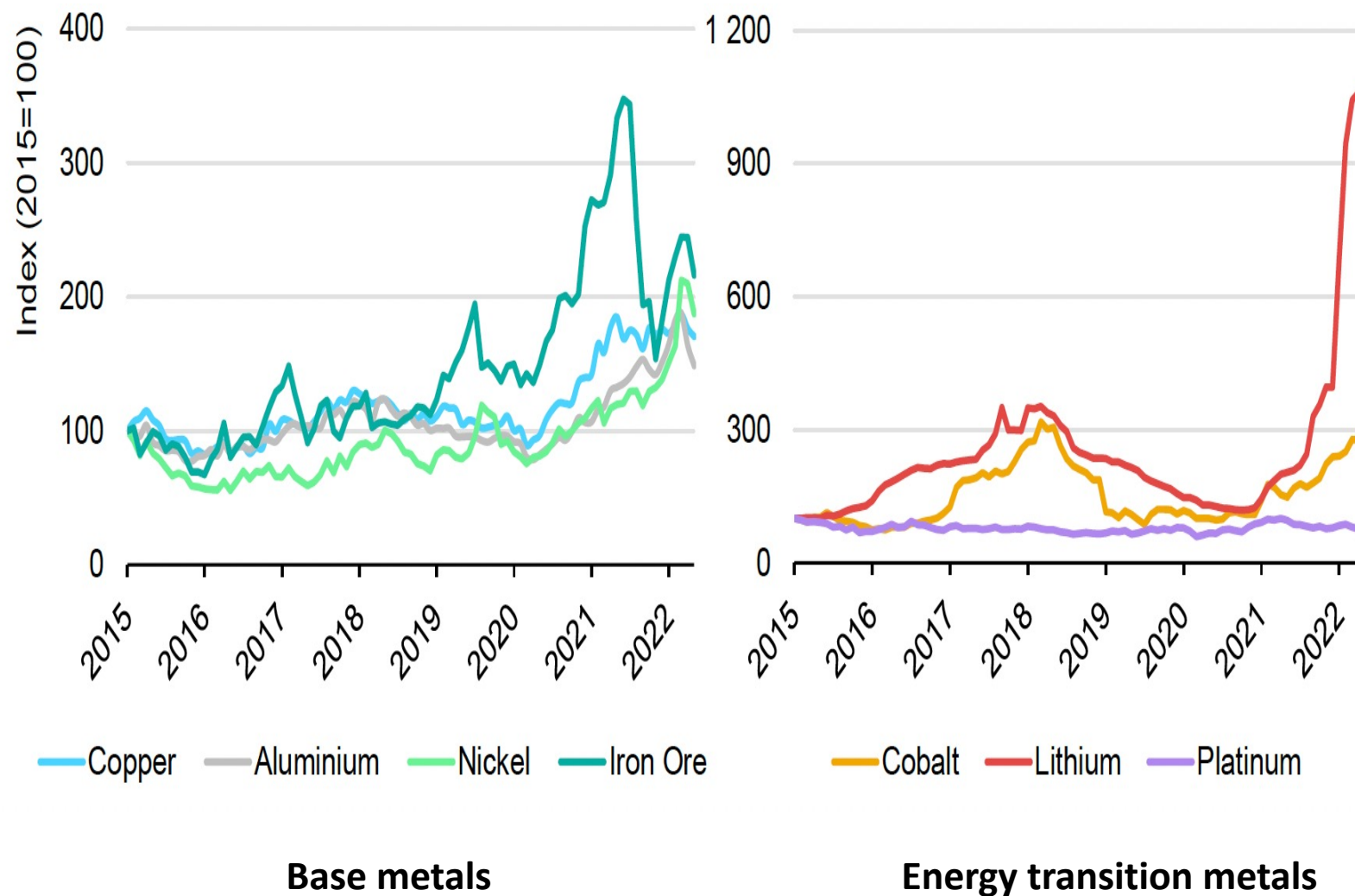


Global **copper** demand vs supply



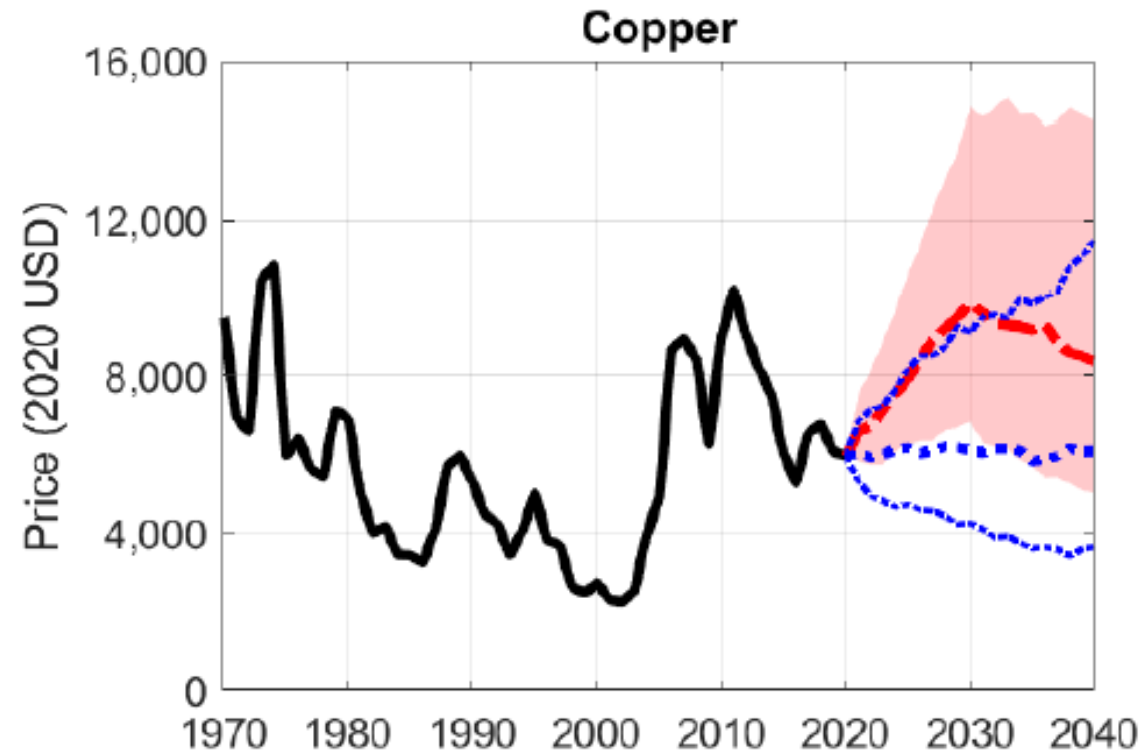
Global spending to expand **metals** supply

Near-term cost impact of chasing minerals

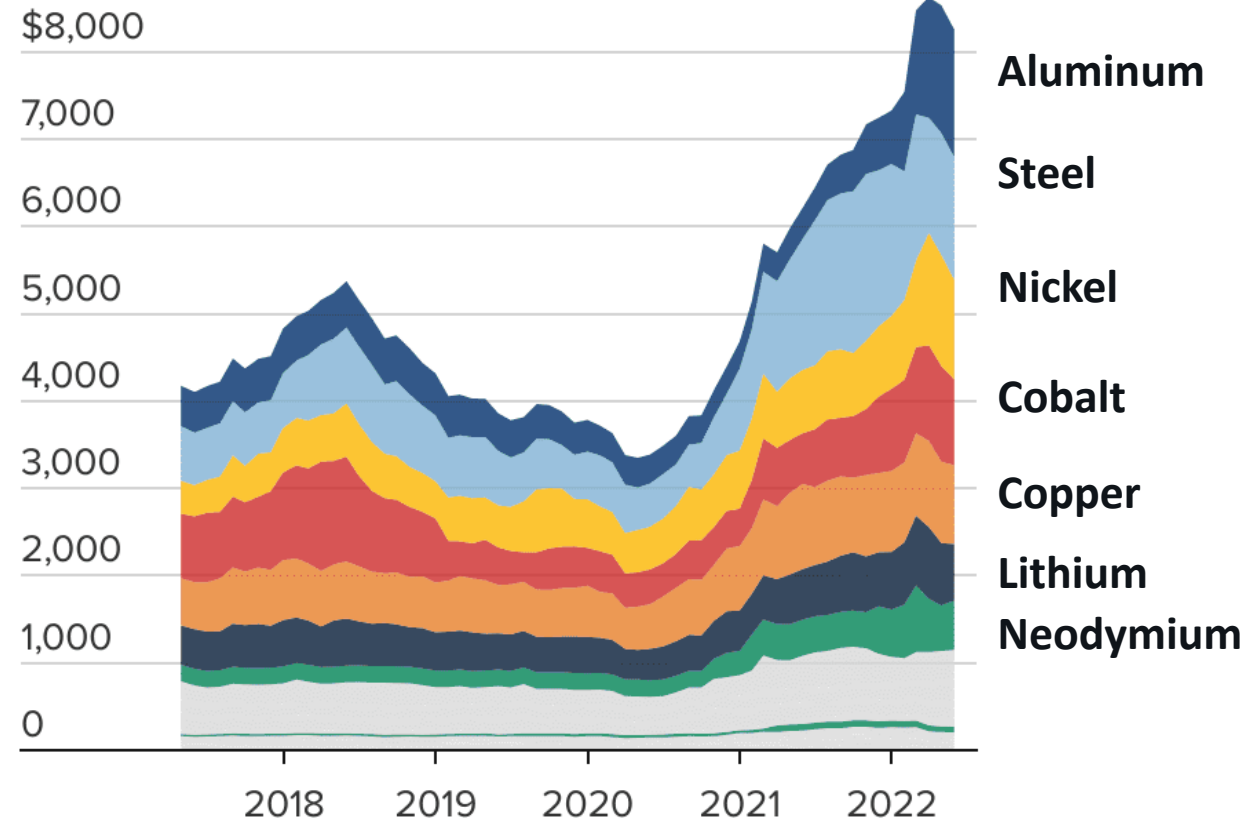


Long-term impact reverses a century of declining metal prices

IEA transition policies would cause metal prices to “reach **historical peaks** . . .for an **unprecedented, sustained period** of roughly a decade.” *IMF*

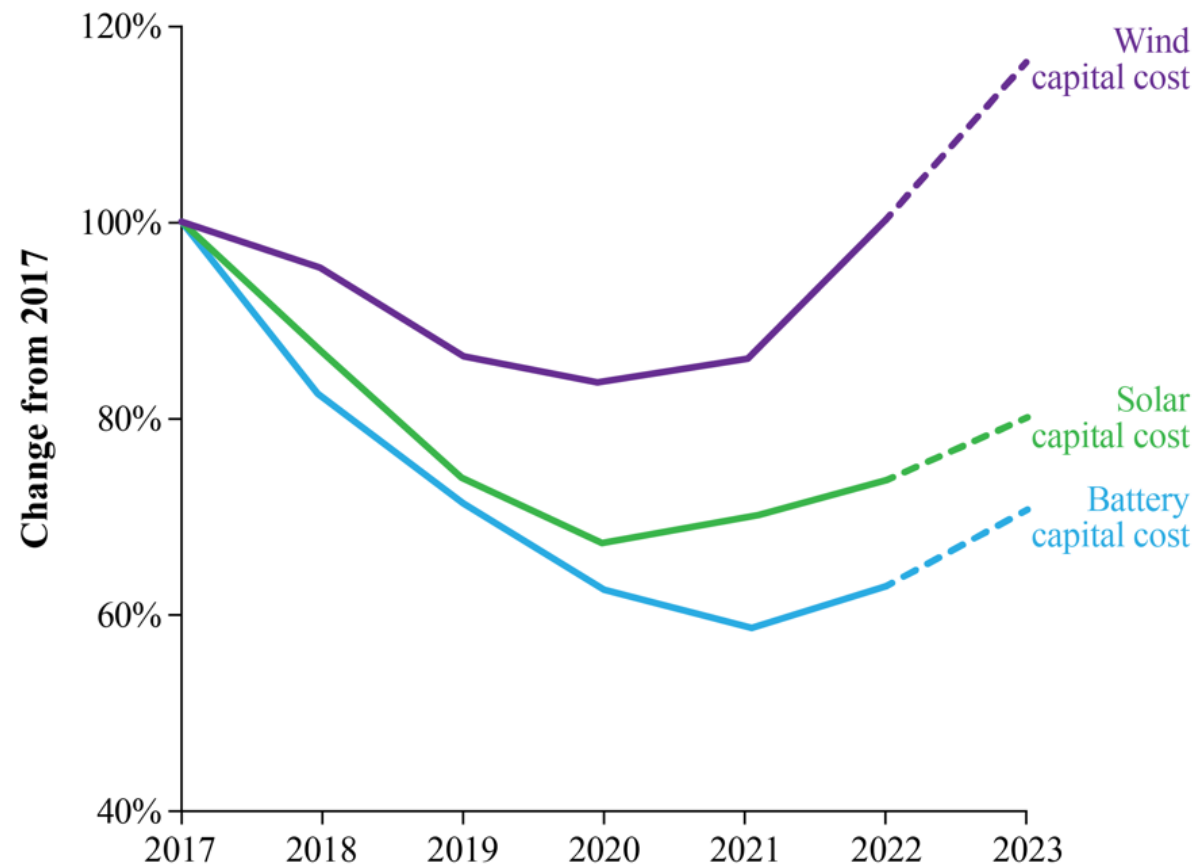


Cost of raw materials *per EV* @ 10% of global sales



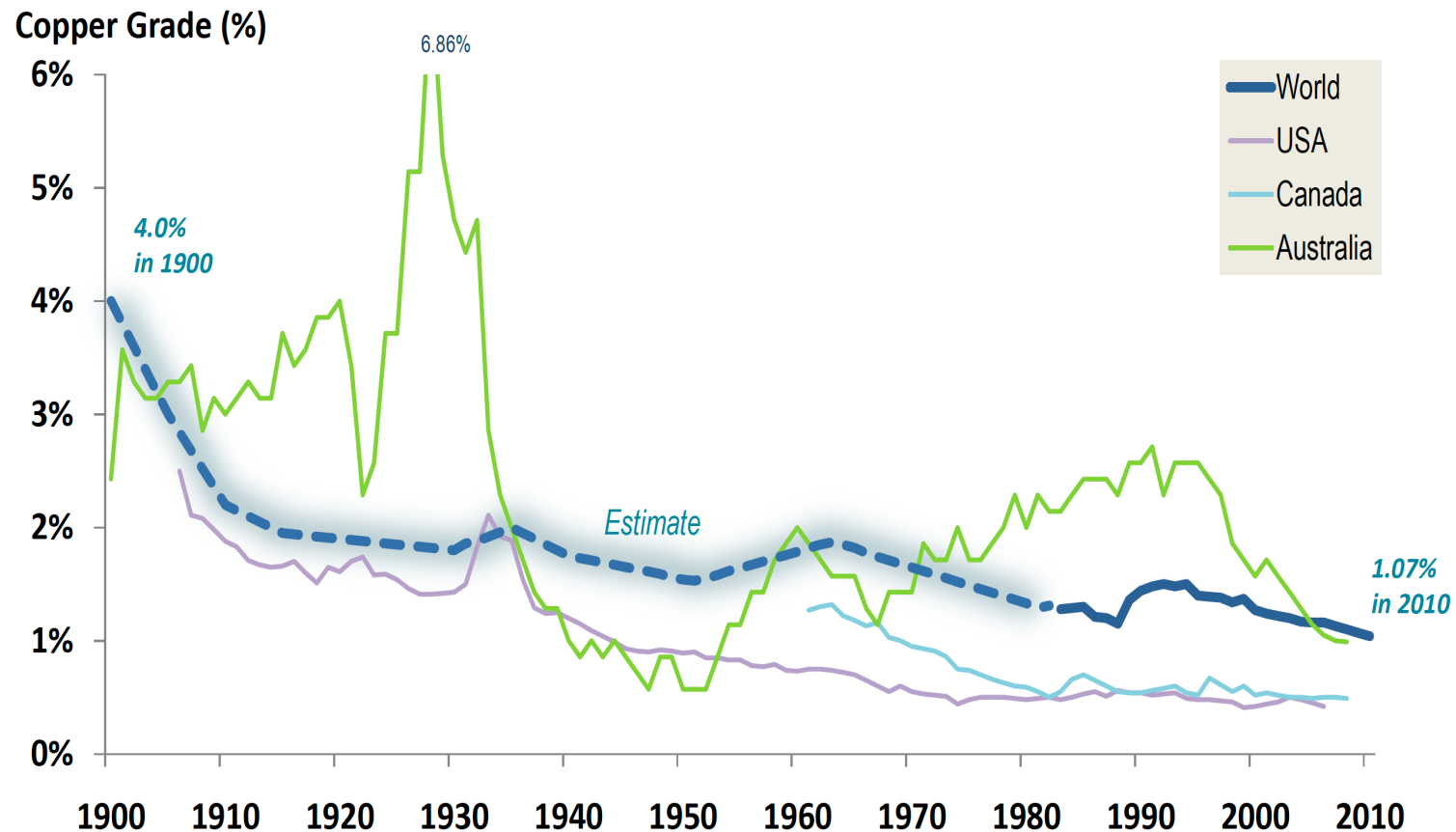
Cost of green machines *rising*

Material inputs ~70% cost solar module, battery

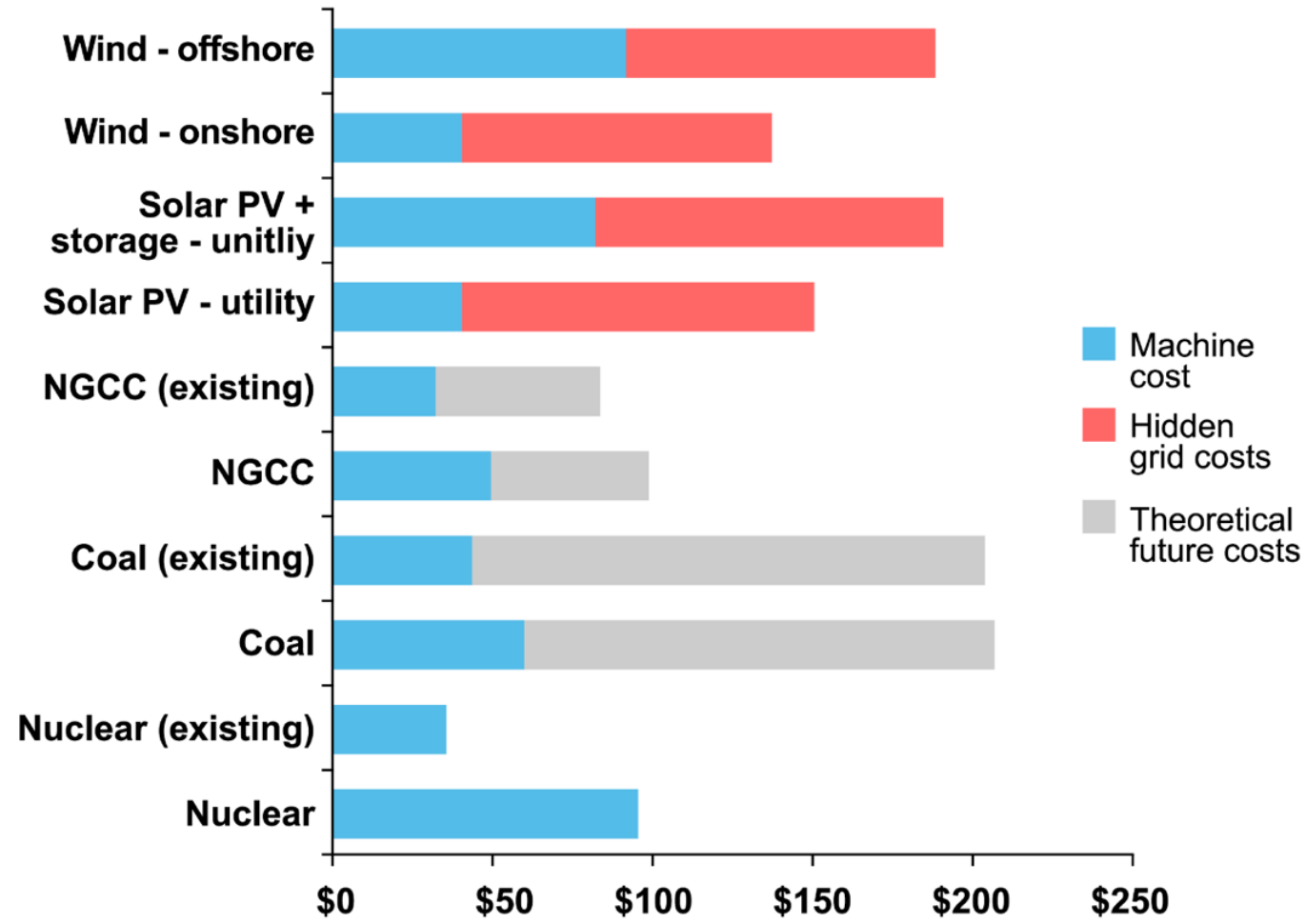


Future metals costs & *iron law of declining ore grades*

Mining today: 40% global industrial energy

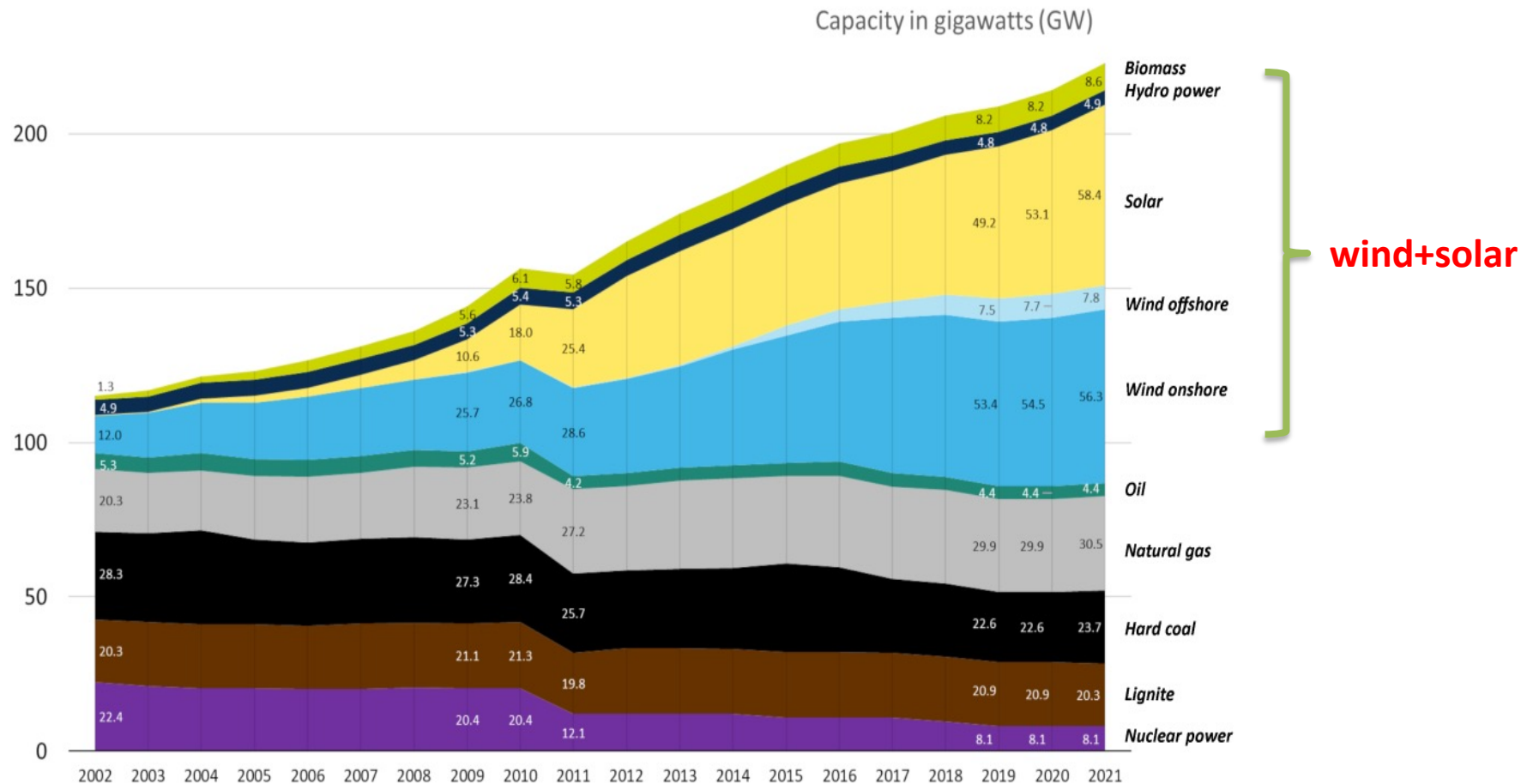


At today's costs wind-solar grid parity is a myth



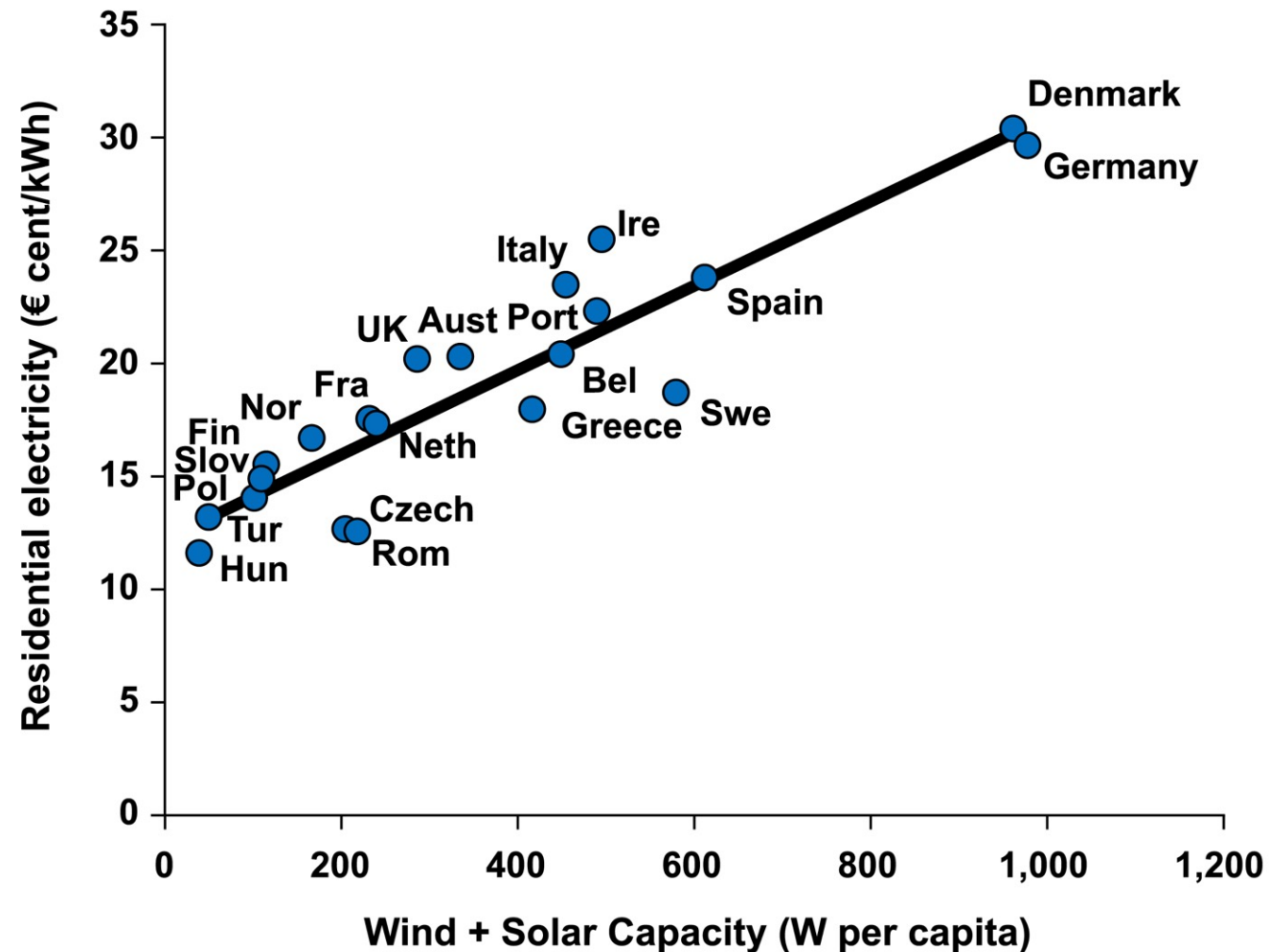
The German example: 2x grid and 2x electricity rates

Germany: 6% primary energy from wind+solar



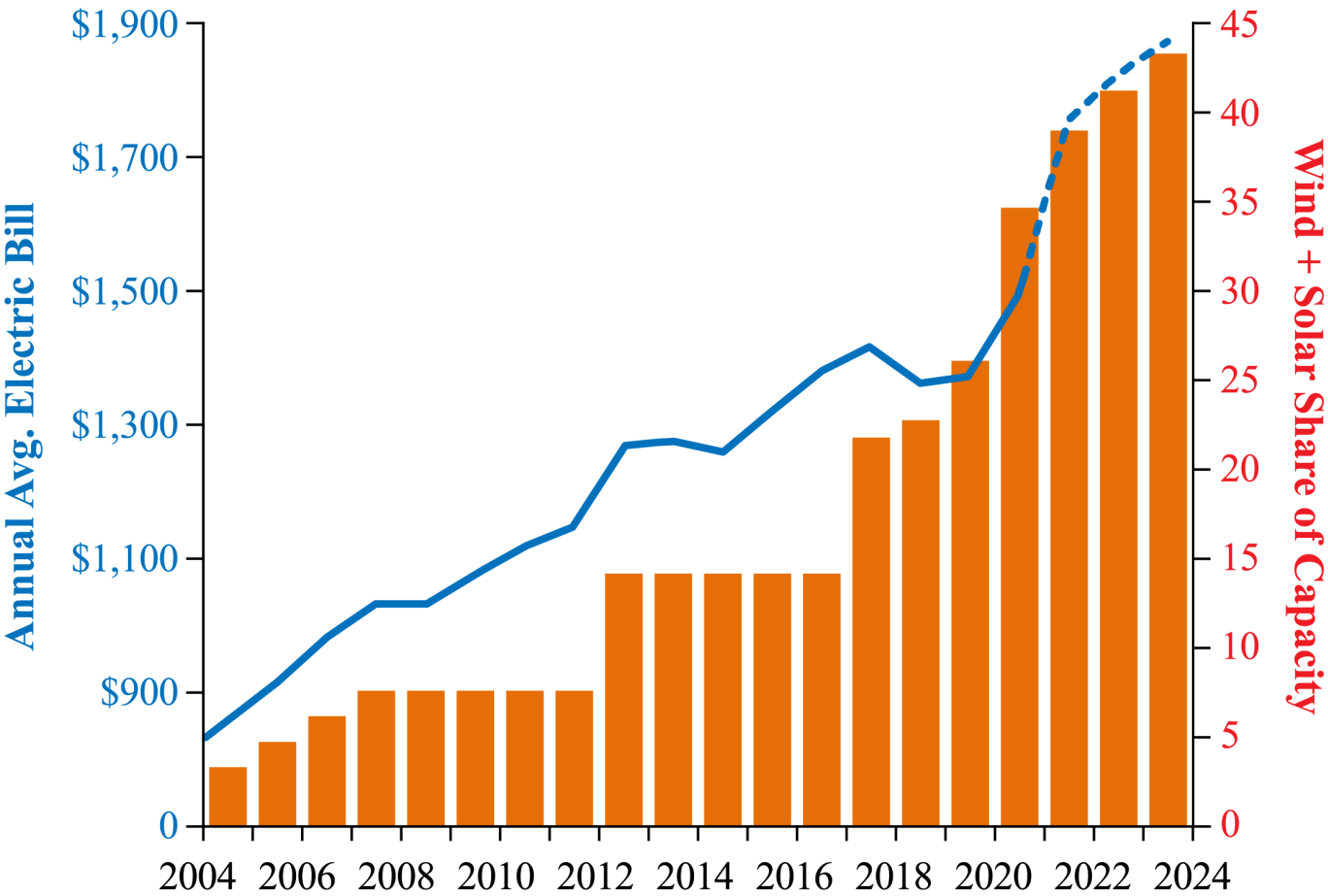
The European experiment: rising wind/solar → rising rates

More wind + solar → higher grid costs

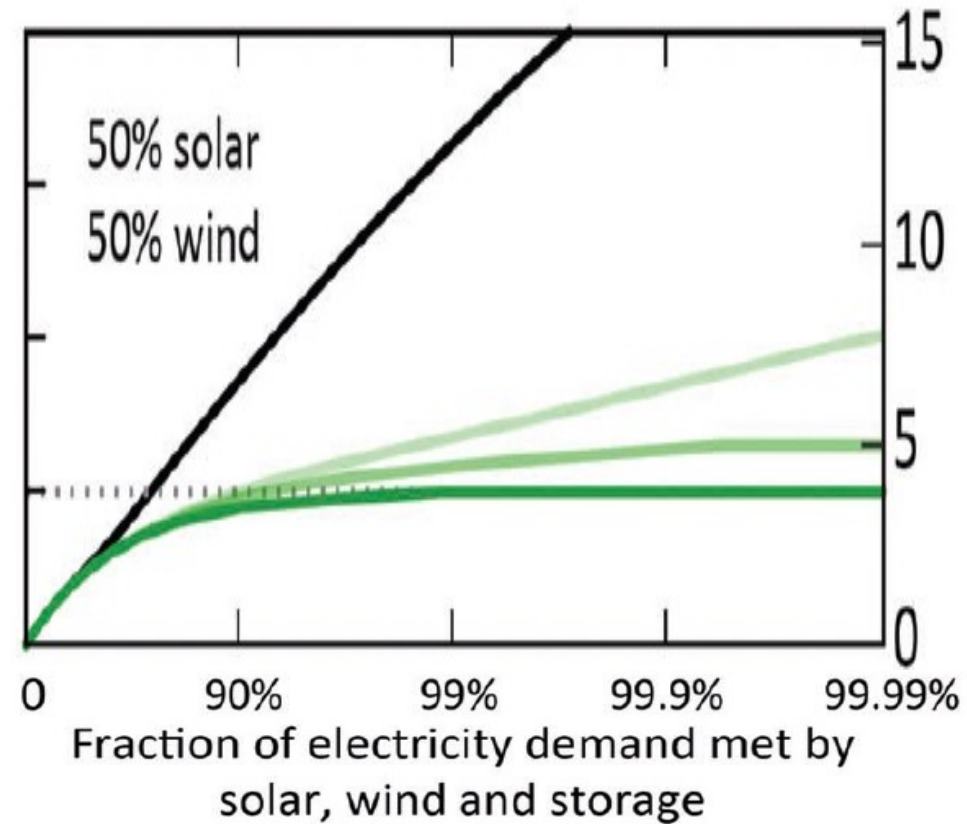


The U.S. experiment: rising wind/solar → rates up 300%

Xcel's 4 million customers in Midwest



An all solar-wind-battery America → 5x grid + \$15 trillion storage



Excess size of grid needed

Days of **total outage** over 3 decades

140

14

1.2