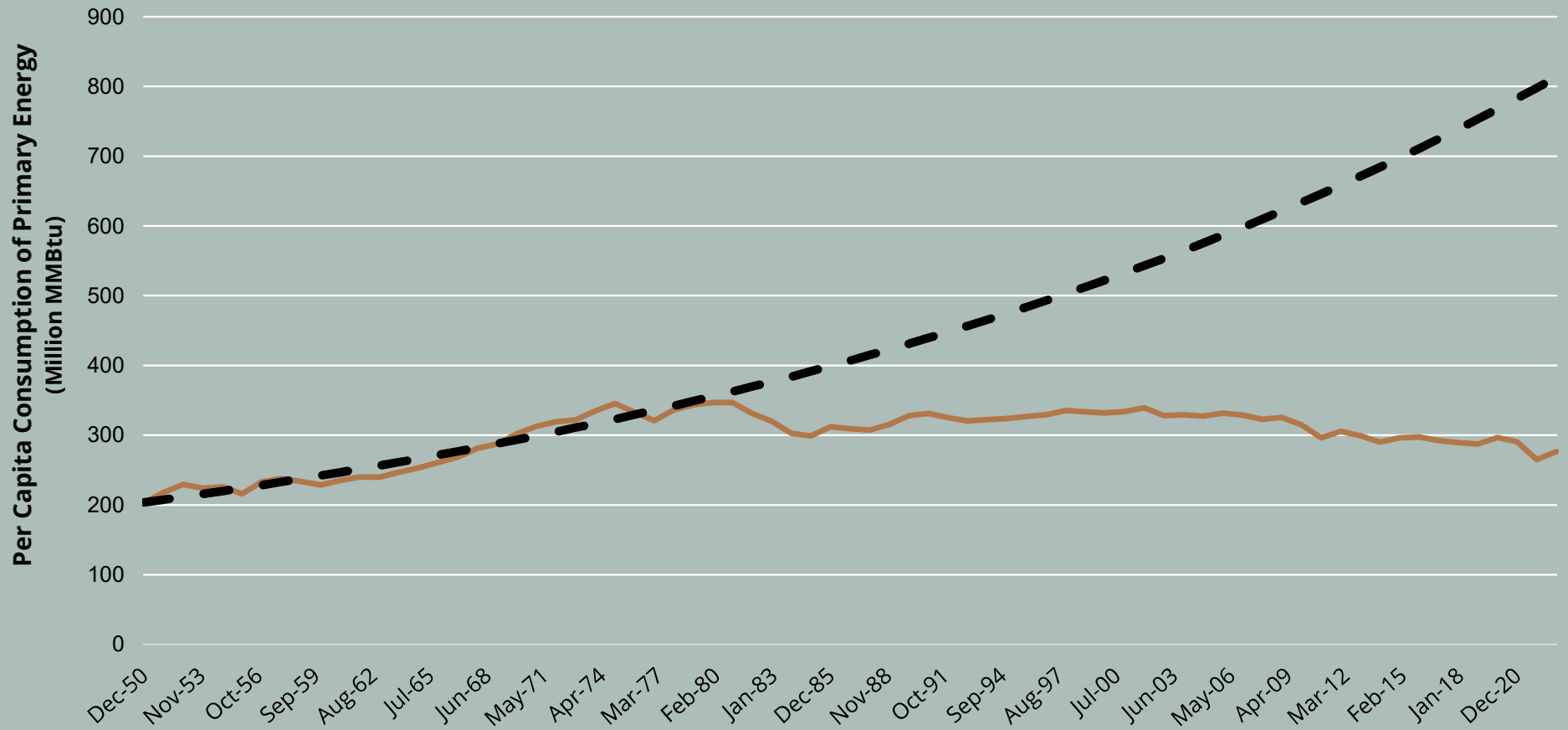


MacroVoices
Holiday Special
Series

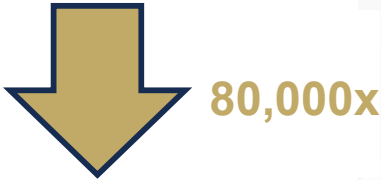
Broken Energy
With Lyn Alden

US Energy Consumption per Capita



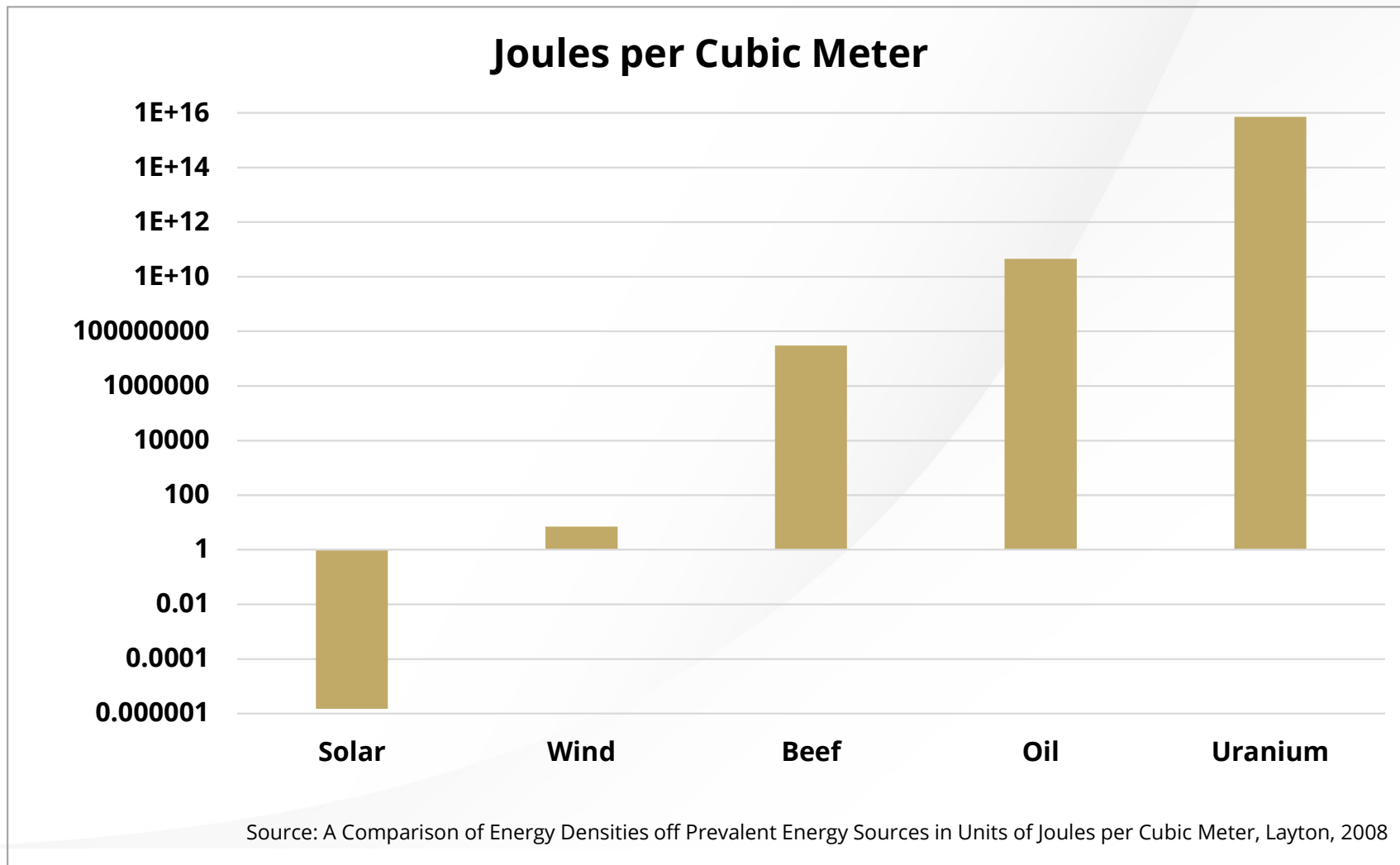
Source: EIA, Simplify calculations

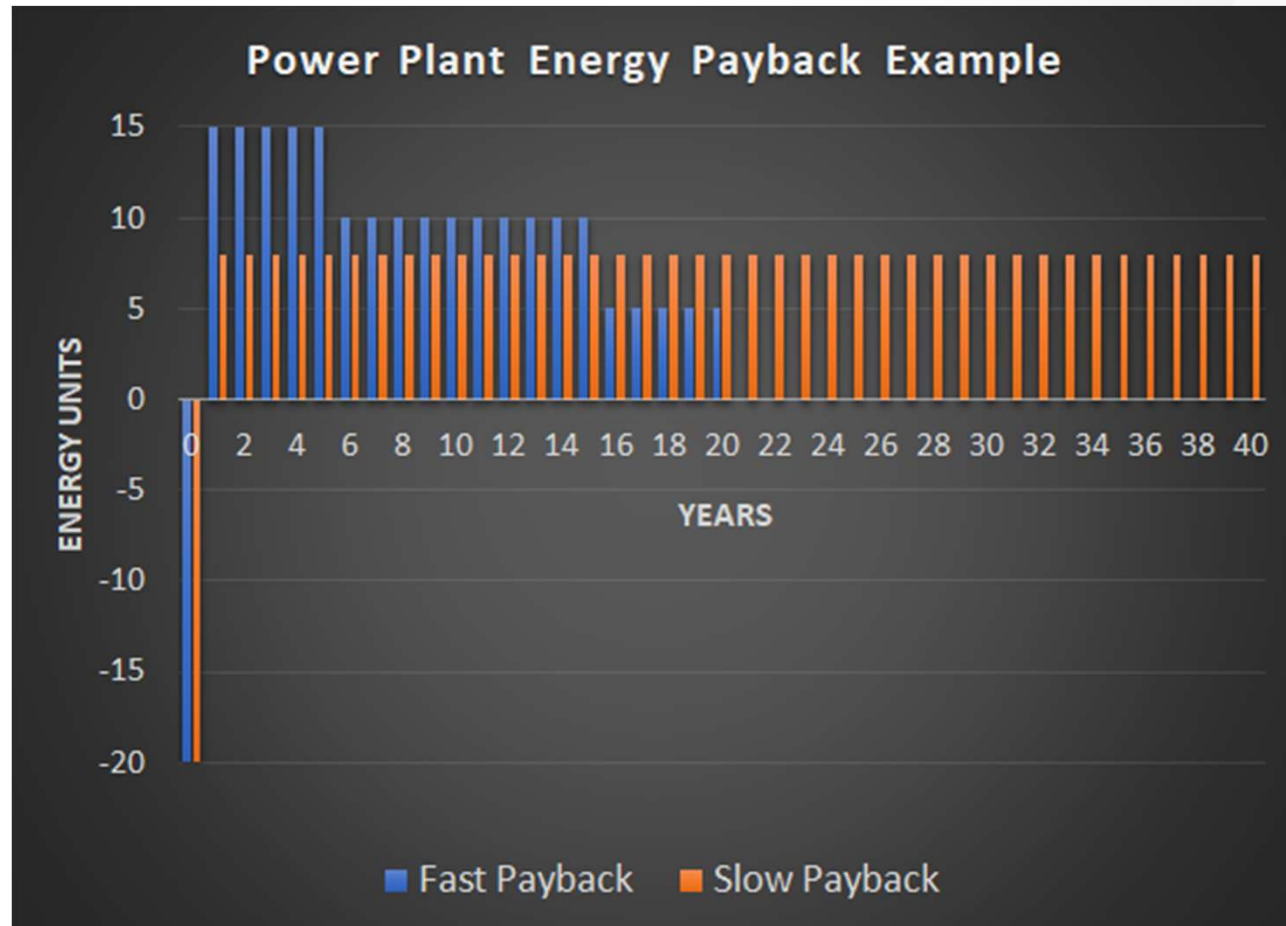
The Energy Density of Fuels

FUEL SOURCE	ENERGY DENSITY (J/g)
Combustion Of Wood	1.8×10^4
Combustion Of Coal (Bituminous)	2.7×10^4
Combustion Of Petroleum (Diesel)	4.6×10^4
	
Typical Nuclear Fuel	3.7×10^9
Direct Fission Energy Of U-235	8.2×10^{10}
Deuterium-Tritium Fusion	3.2×10^{11}
Annihilation Of Antimatter	9.0×10^{13}

EROEI	
Hydro	50
Nuclear	75
Coal	31
Natural Gas	28
LNG	6
Solar	4
Wind	16

Weissbach, 2013

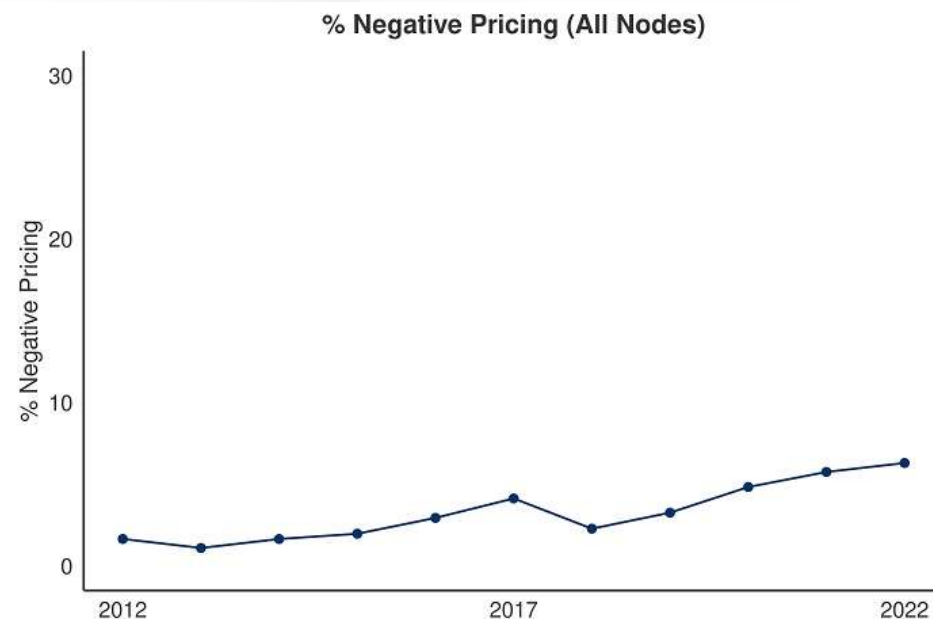
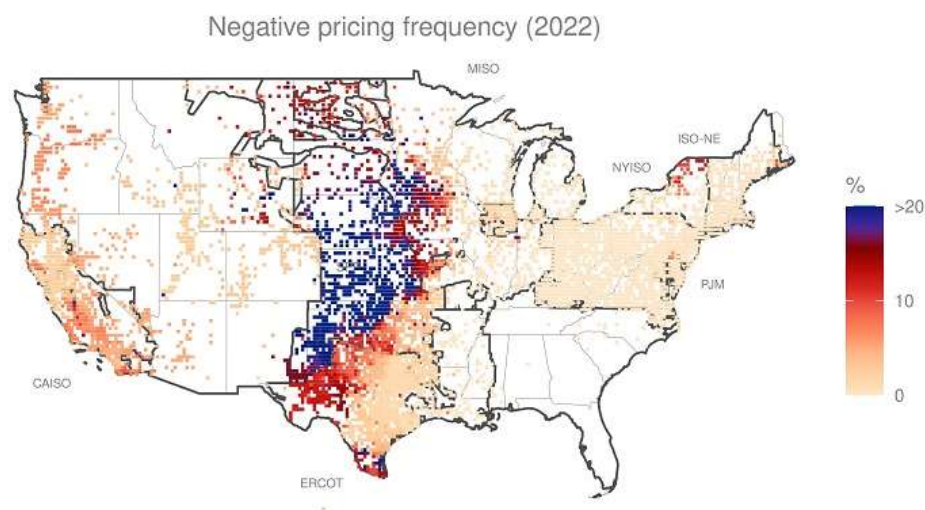




Fast payback = 200 energy units, frontloaded

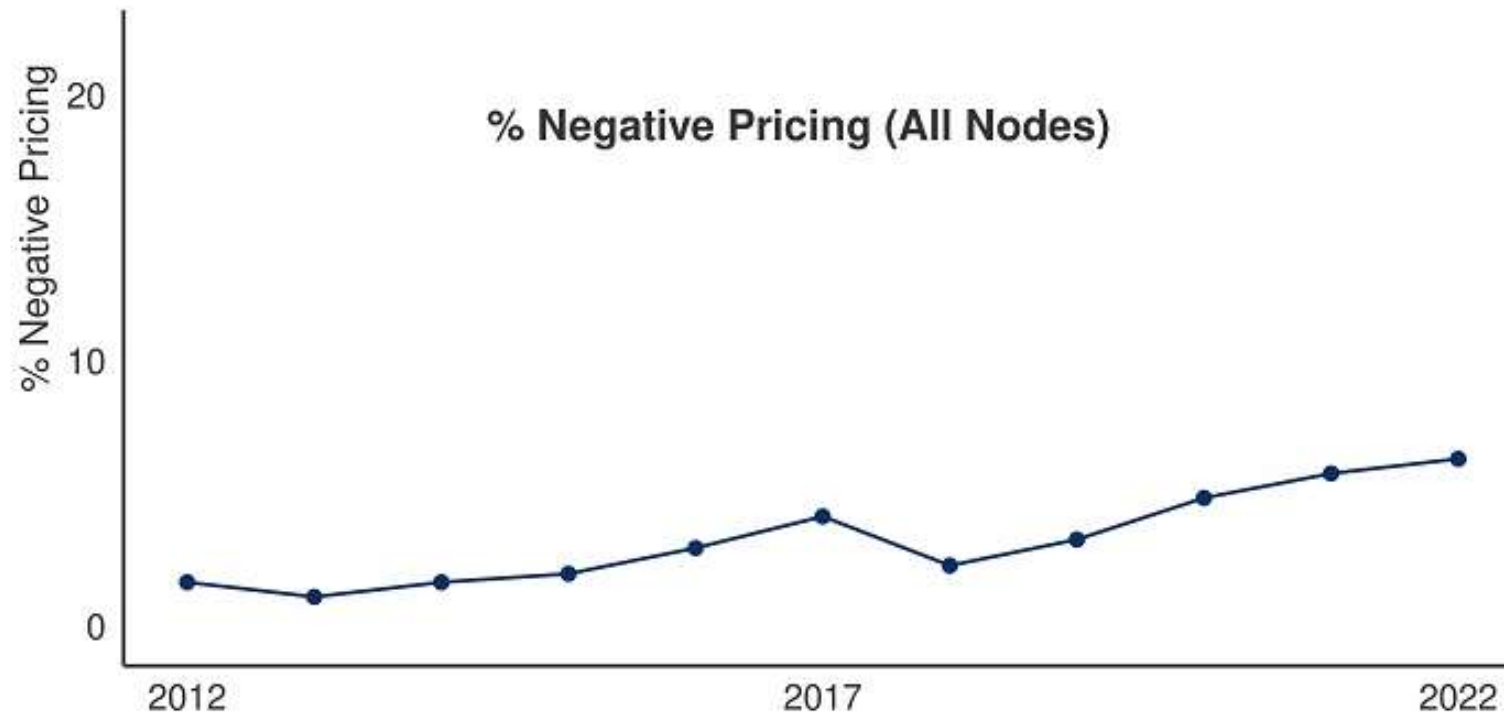
Slow payback = 320 energy units, over more time

Negative Electricity Prices Underscore Challenges Presented by Intermittent Sources (e.g. Wind and Solar Renewables)



Negative Electricity Prices Underscore Challenges Presented by Intermittent Sources

(e.g. Wind and Solar Renewables)



Energy Transition Alternatives



Wind & Solar

Scalability Challenges
Intermittent Supply

(requires batteries, degrades efficiency)



Nuclear



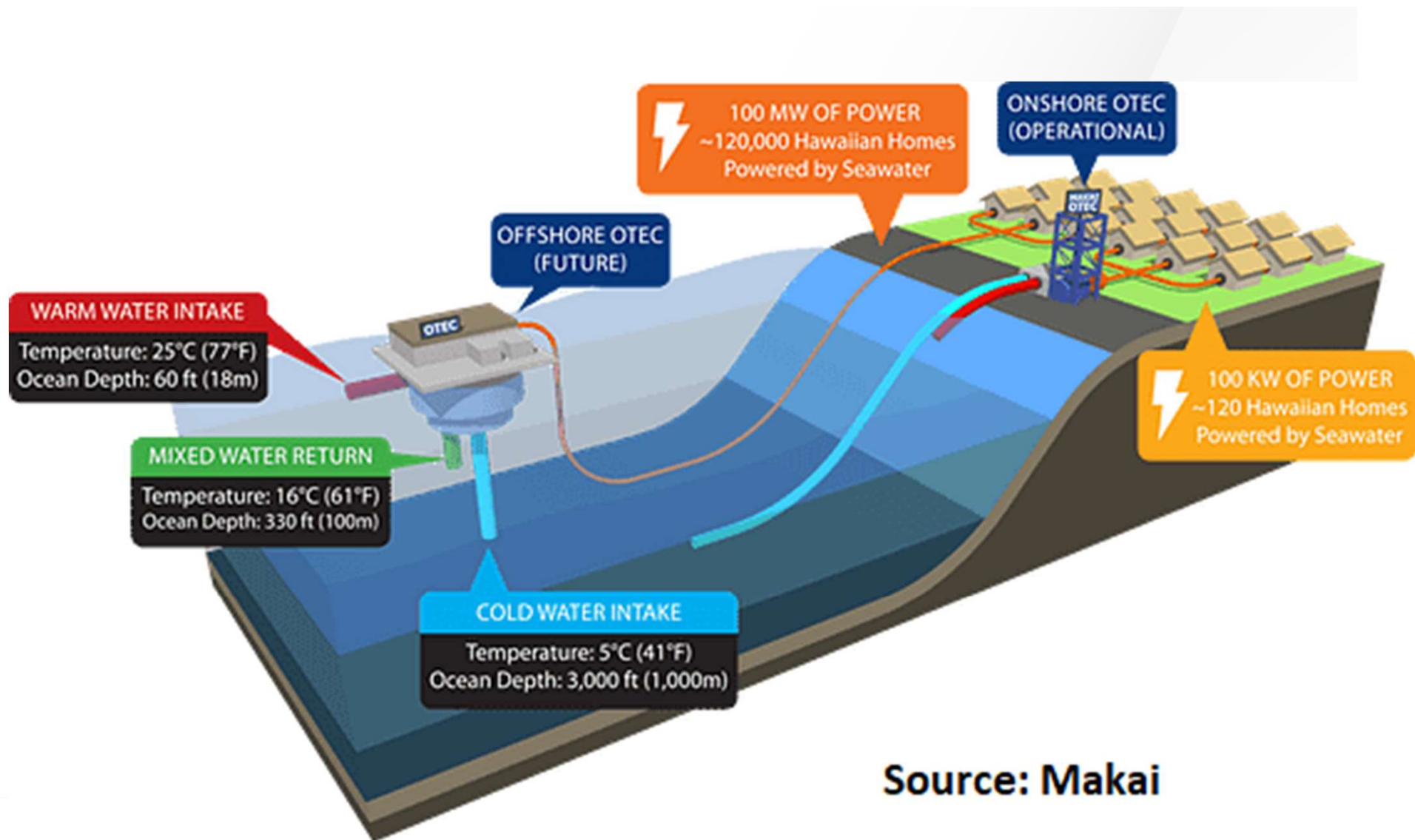
Geothermal

Not ready yet



Hydropower

Limited Growth



OUR NEXT CHALLENGE: **STEAM TURBINES**

- COST WAY TOO MUCH
- TOO BIG TO MODULARIZE
- ONLY ~40% THERMAL EFFICIENCY



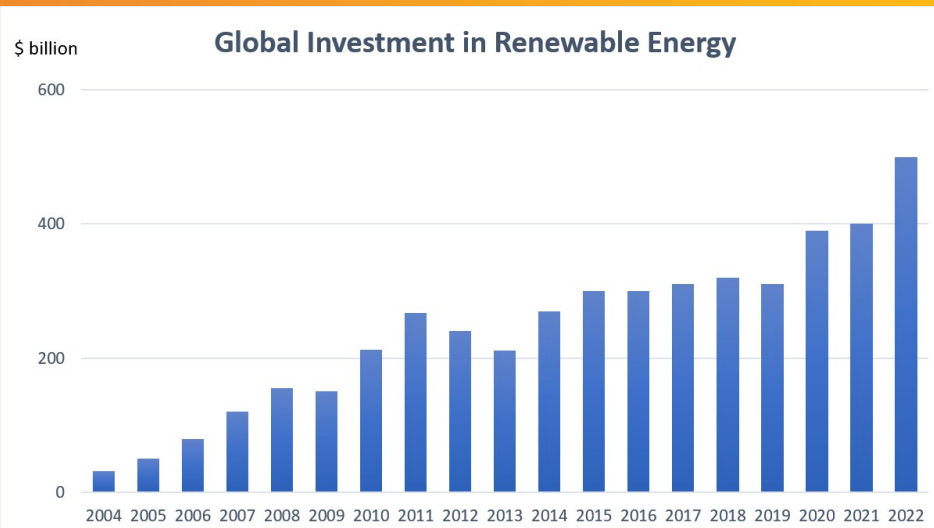
SIEMENS SST-9000 COSTS WELL OVER \$1BN INSTALLED!

SUPERCritical CO₂ TURBINES

- REPLACEMENT FOR STEAM TURBINES
- MUCH SMALLER (1/10TH SIZE/WEIGHT)
- MUCH LESS EXPENSIVE TO MANUFACTURE
- HIGHER THERMAL EFFICIENCY (50%)
- REQUIRES 20% LESS THERMAL ENERGY
- CONDUCIVE TO MODULARIZATION
- THE UNIT IN PHOTO IS 10MW. IMAGINE A 500MW MASS-PRODUCED VERSION IN A 40' SHIPPING CONTAINER



FOR WHAT'S ALREADY BEEN SPENT ON RENEWABLES...



- ❖ In the last two decades alone, more than **\$4.6 trillion** has been spent on renewable energy.
- ❖ Reduction of fossil fuel consumption as a result of that investment: **ZERO!**
- ❖ In my new video **Energy Transition: Advanced Nuclear SMRs vs. Renewables**, I'll show you how we can completely replace fossil fuels with clean modular advanced nuclear energy for **less investment** than has already been spent on renewable energy.

RENEWABLES DON'T PAY OFF!