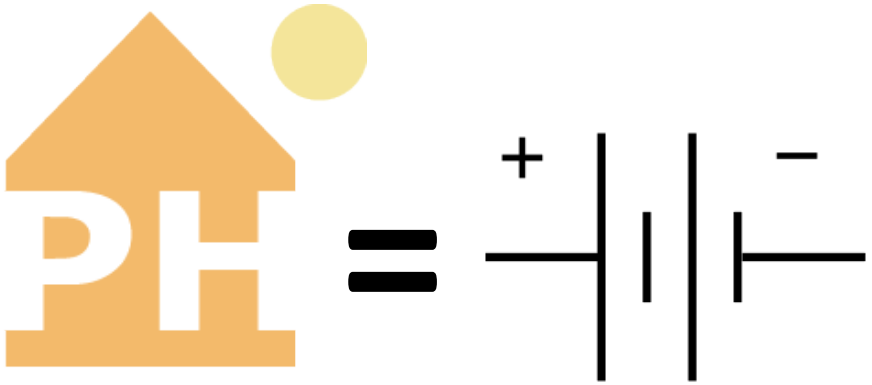
Untapped Potential

Passive Houses as Demand Side Storage



North American Passive House Conference

Chicago, IL, September 12, 2014

Graham Irwin

Principal, Essential Habitat Architecture

www.essentialhabitat.com

ESSENTIAL HABITAT ARCHITECTURE

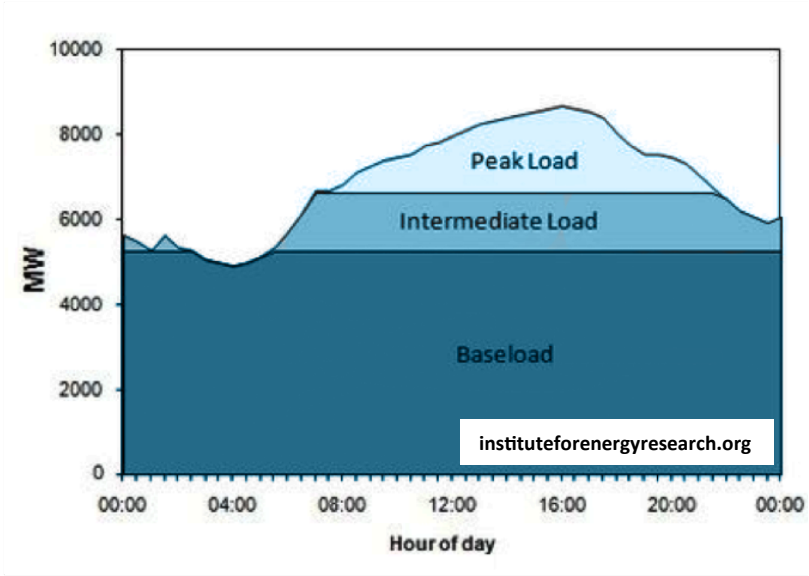
The “Secret” Paradox

Energy is cheap

…but supplying it is expensive.

Where's the Money?

It's in the power (kW)



…not the energy (kWh).

How Much Money?

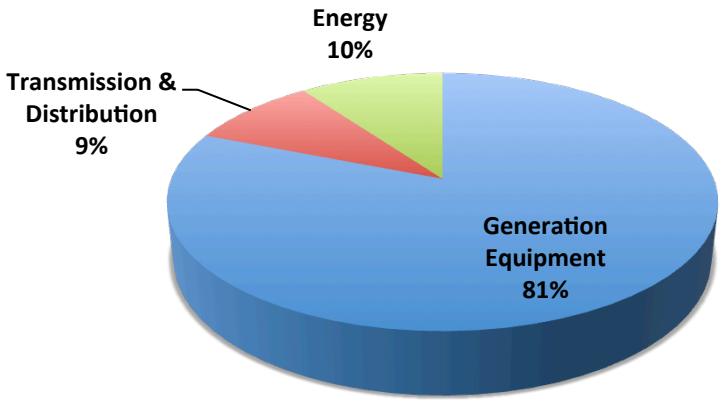
- 10% US peak electrical load

< 1% of the year[1]

- 10% peak load reduction

= $8-$28 billion/yr[2]

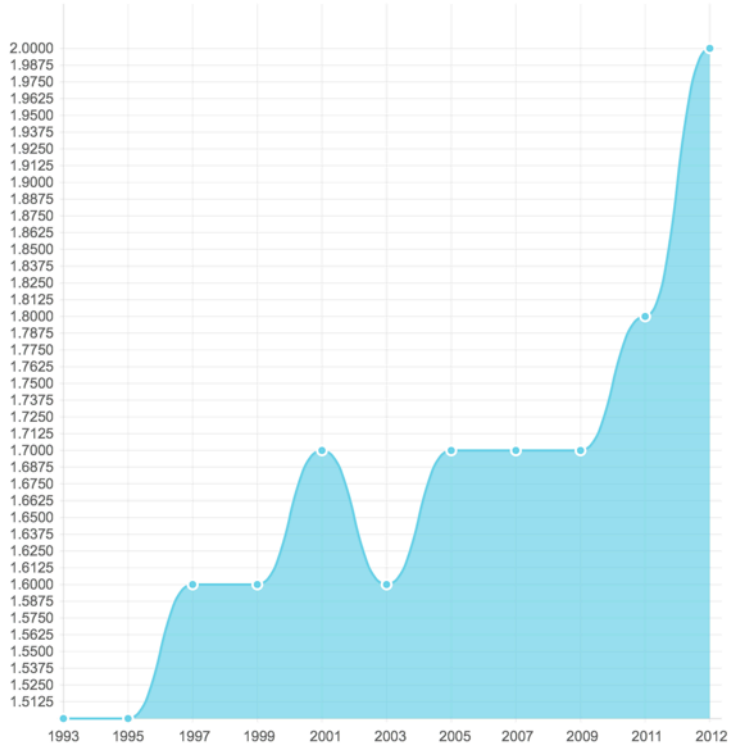
5% Reduction ($3 Billion)[3]



[1] EnerNOC, Inc. Demand Response: A Multi-Purpose Resource for Utilities and Grid Operations. 2009.
[2] Spees, K and Lave, L. Demand Response and Electricity Market Efficiency. CEIC, 2006.
[3] The Brattle Group. The Power of Five Percent, How Dynamic Pricing Can Save $35 Billion in Electricity Costs. May 16, 2007.

In the Future?

It's getting worse and solar won't help!



Peak-to-Average Demand Ratio (New England), 1993-2012[1]

[1] Kennedy, J. Peak-to-average Electricity Demand Ratio Climbing Across The U.S. Today in Energy, yourenergyblog.com, February 26, 2014.

Grid = "Big ~~Battery?~~ Fuel Cell"

Yes

- Renewables offset fossil fuels

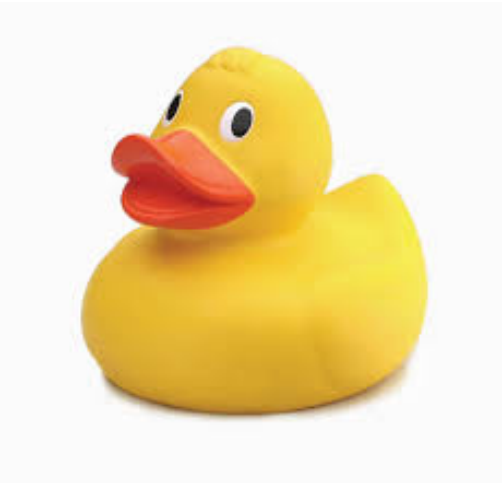
No

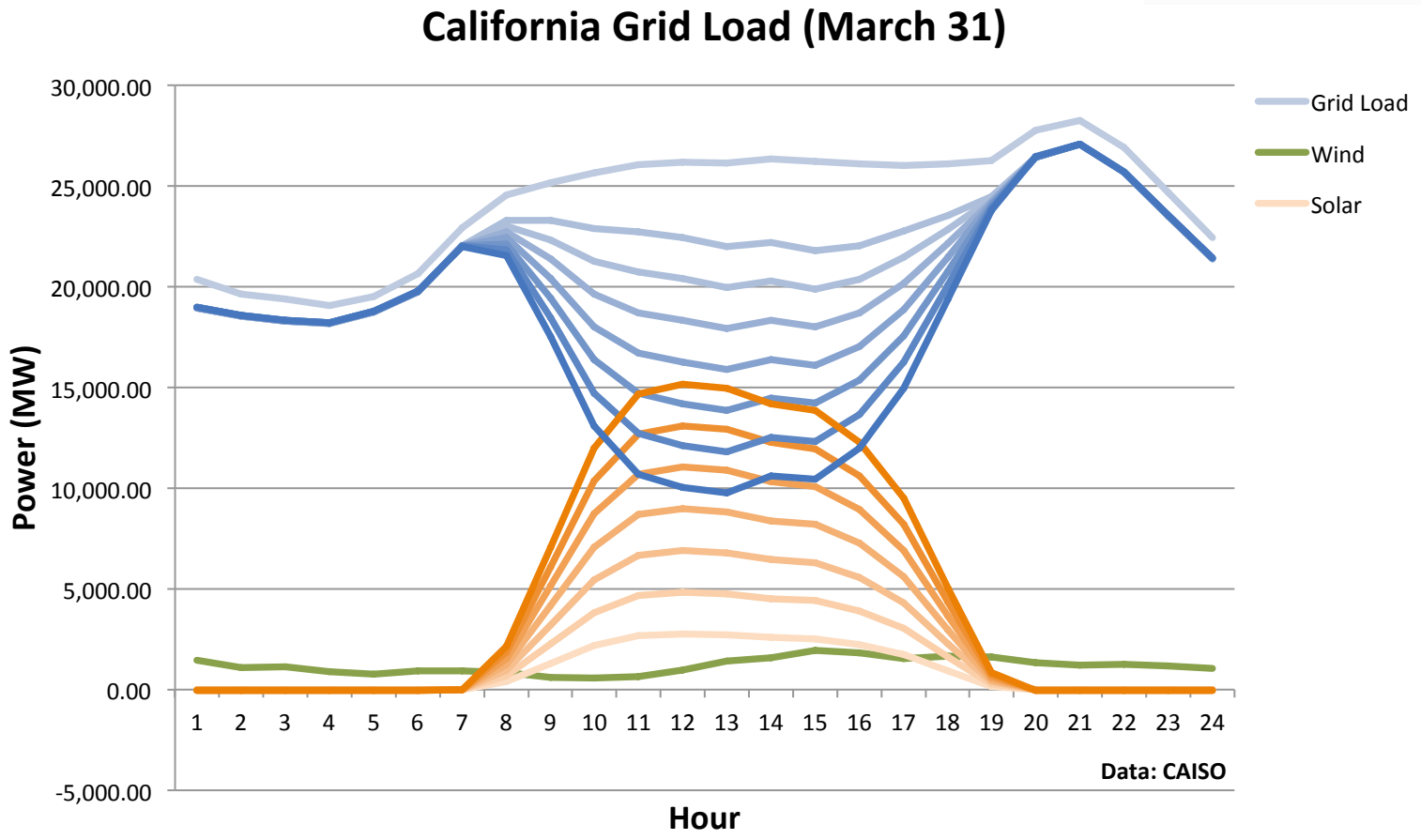
- "Storage" is unused fuel (except ~7% hydro)
- No "back feed" from distribution upward

IER INSTITUTE FOR ENERGY RESEARCH

The "Duck Curve"

and the End of Net-Zero?





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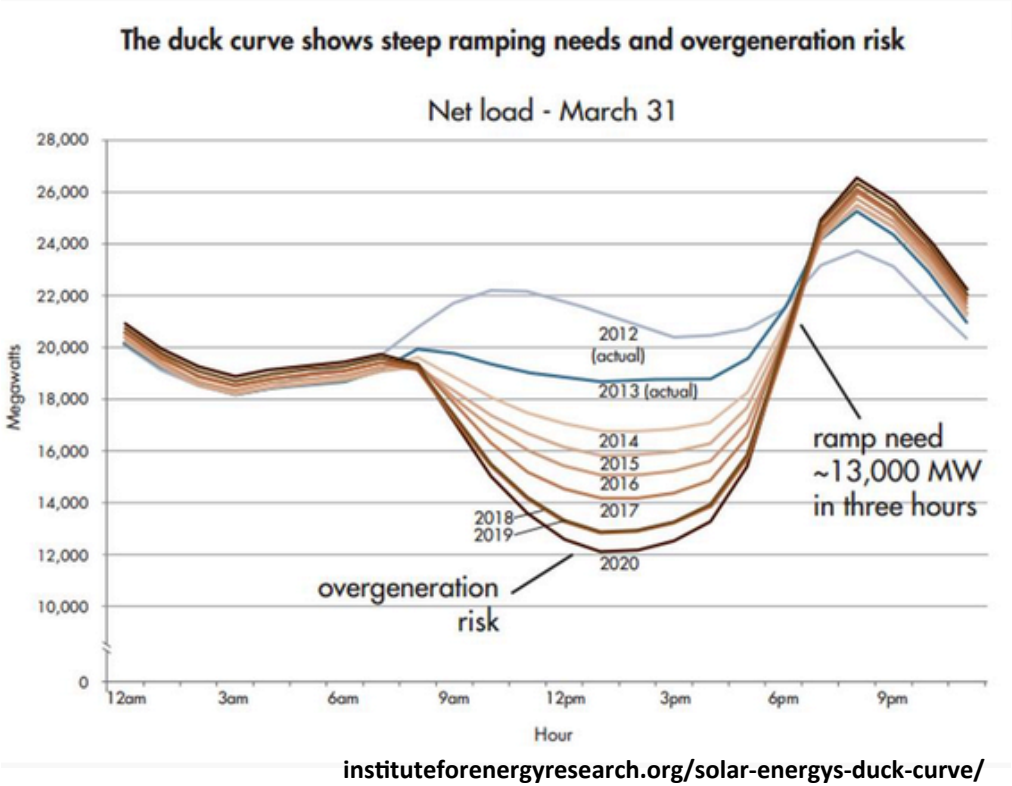
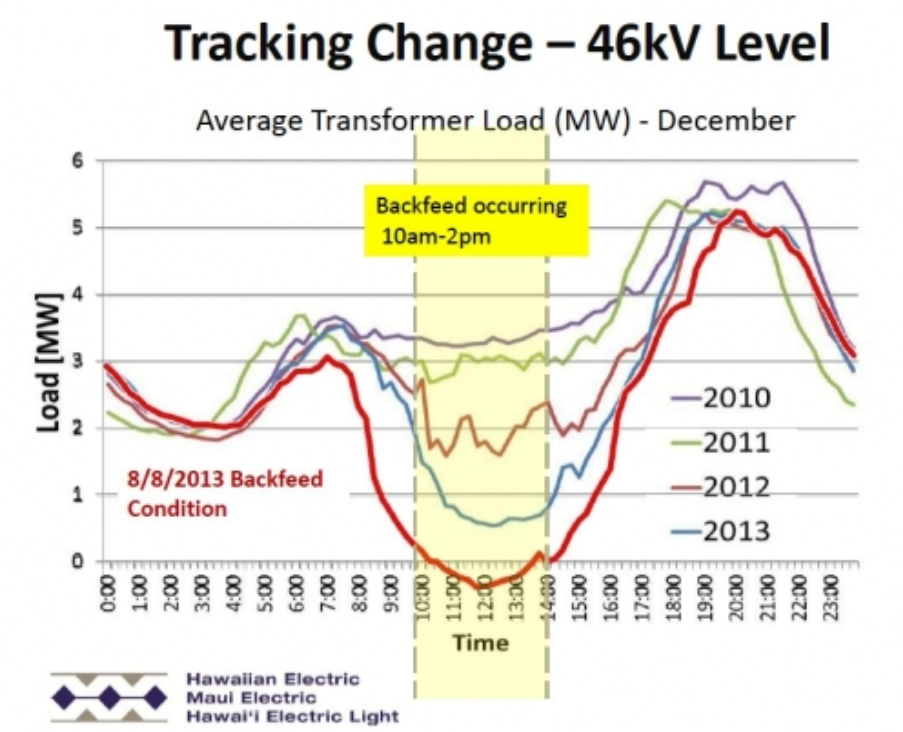


instituteforenergyresearch.org/solar-energys-duck-curve/

California: 12% Renewable in 2014; 50% Renewable by 2050

The "Duck Curve"

and the End of Net-Zero?



instituteforenergyresearch.org/solar-energys-duck-curve/

Hawaii: Backfeed with 11% Rooftop PV (15-18% overall); 100% Renewable by 2045

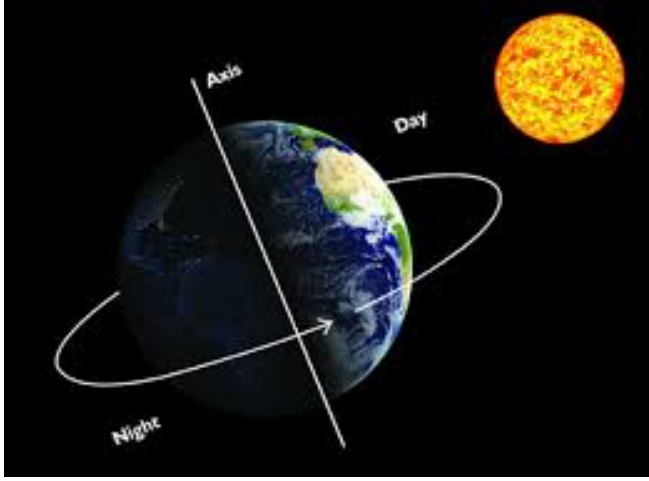
The “Duck Curve”

and the End of Net-Zero?

energytransition.de/2014/05/german-power-prices-negative-over-weekend/

Germany: Negative Prices with 27% Renewable; 80% Renewable by 2050

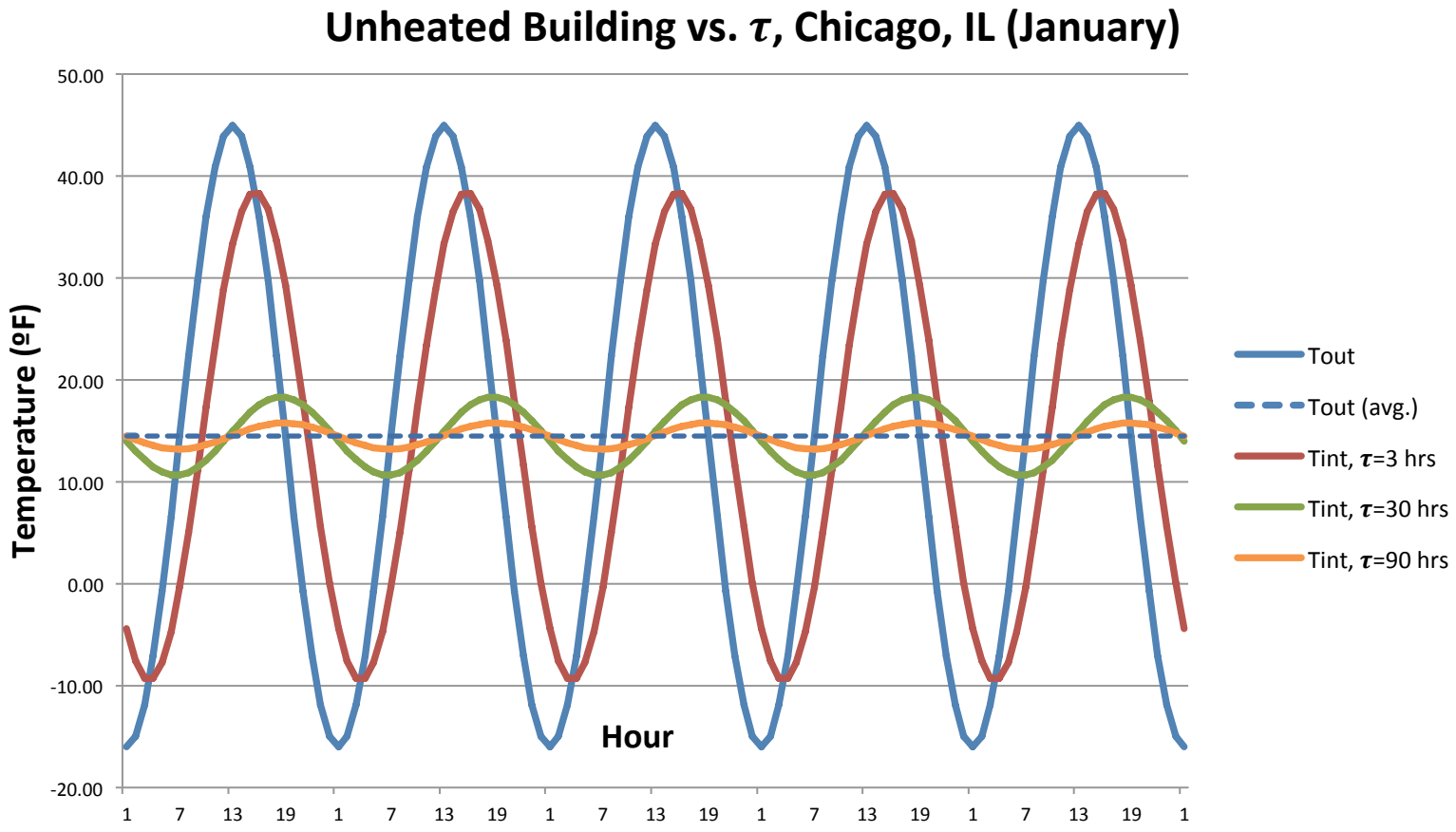
Daily Storage



- Pumped Hydro
- Concentrated Solar Plants (CSP)
- Solar Thermal (Small Tank)
- Interruptible Tariff/Direct Load Control
- Dynamic Demand Appliances
- Smart Inverters
- Batteries
- Passive House

The Dao of Tau

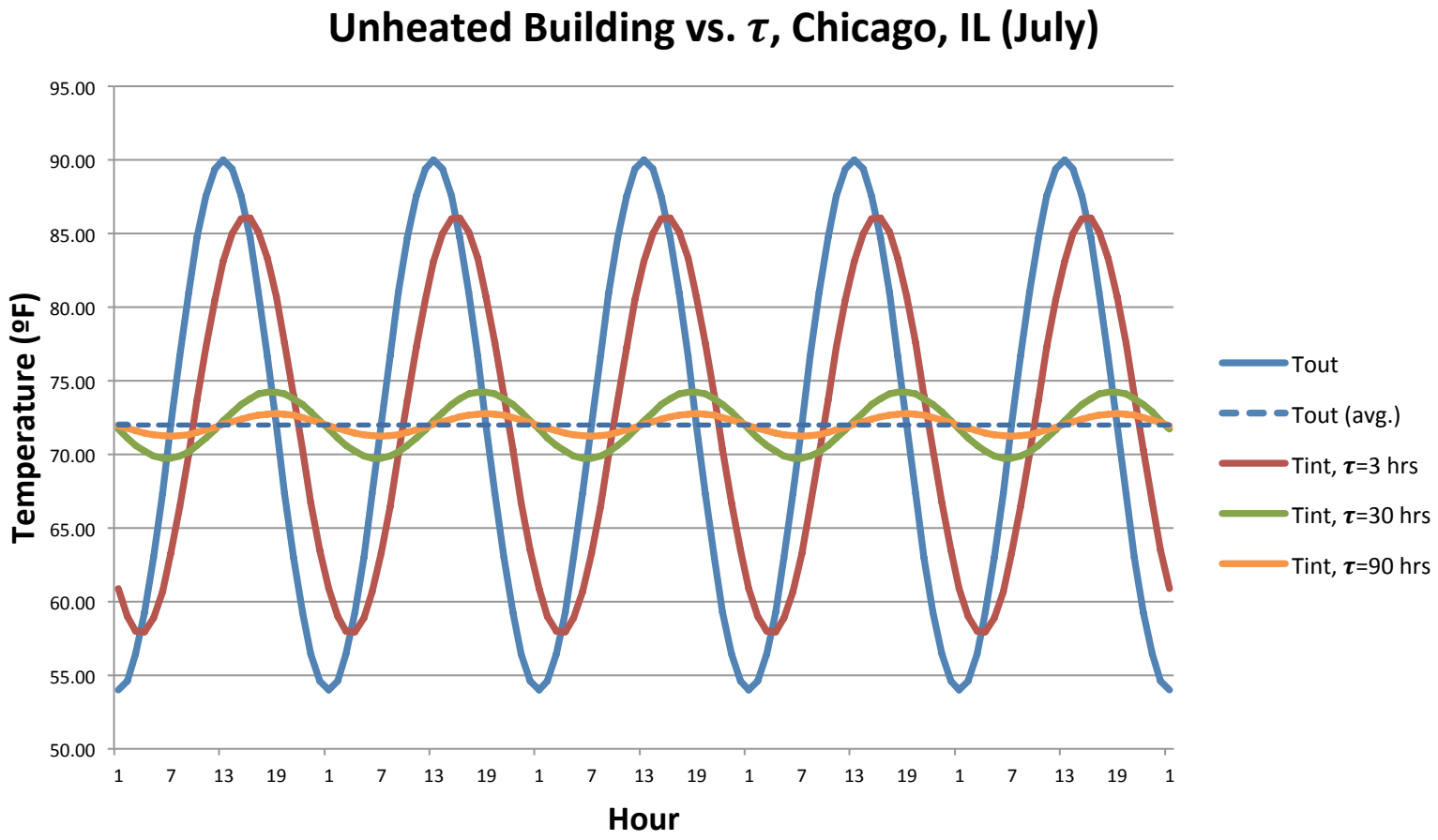
葡 of τ



Time constant (τ), along with solar gains & air changes, affects "reaction speed."

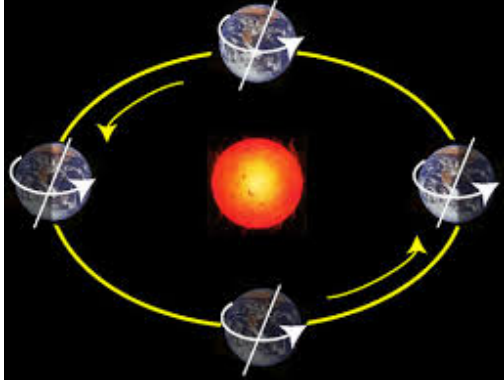
The Dao of Tau

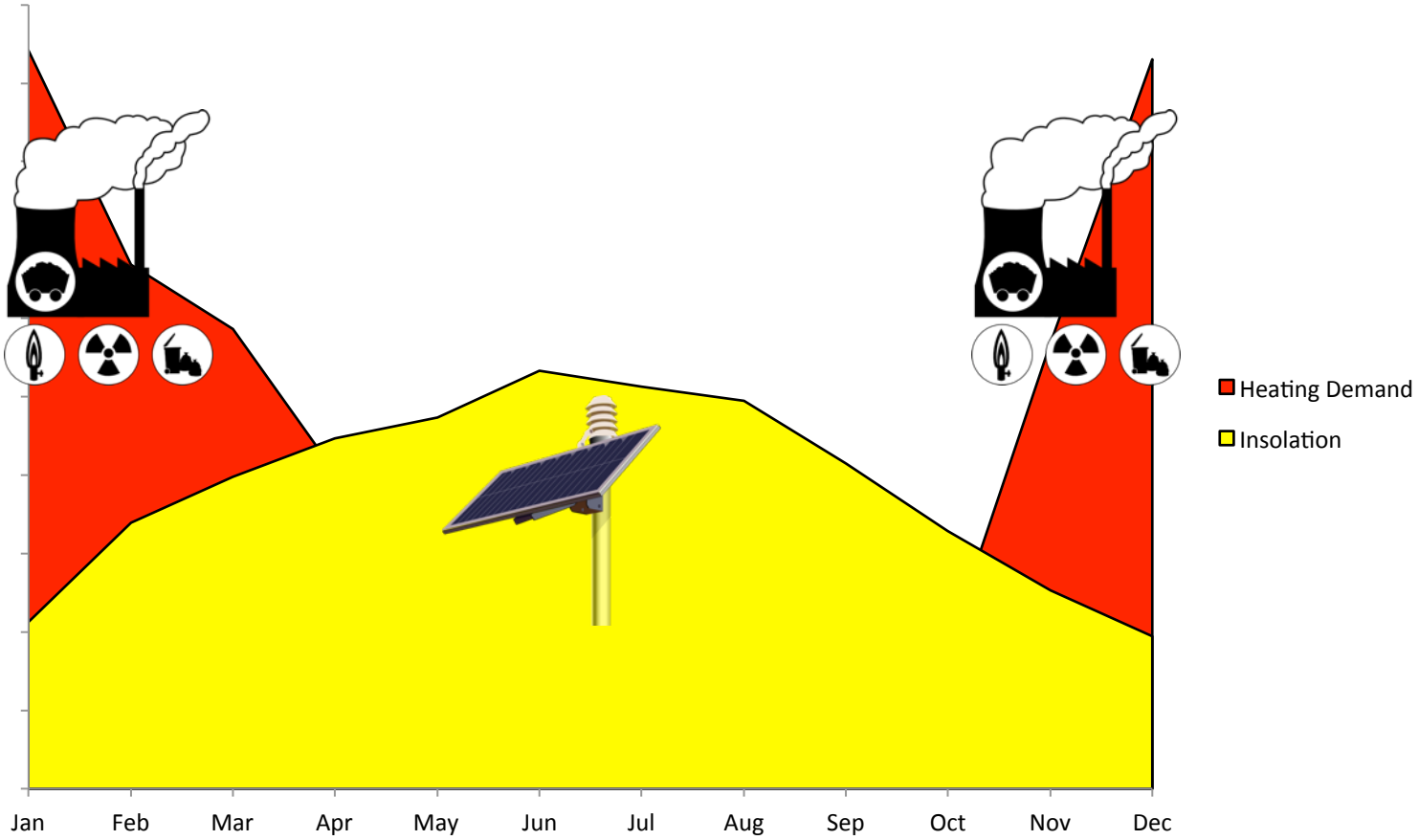
蓟 of τ



Time constant (τ), along with solar gains & air changes, affects "reaction speed."

Seasonal Storage





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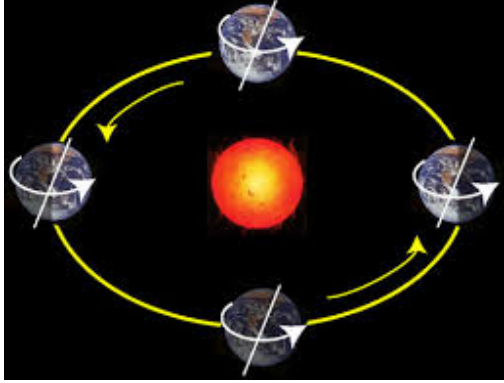
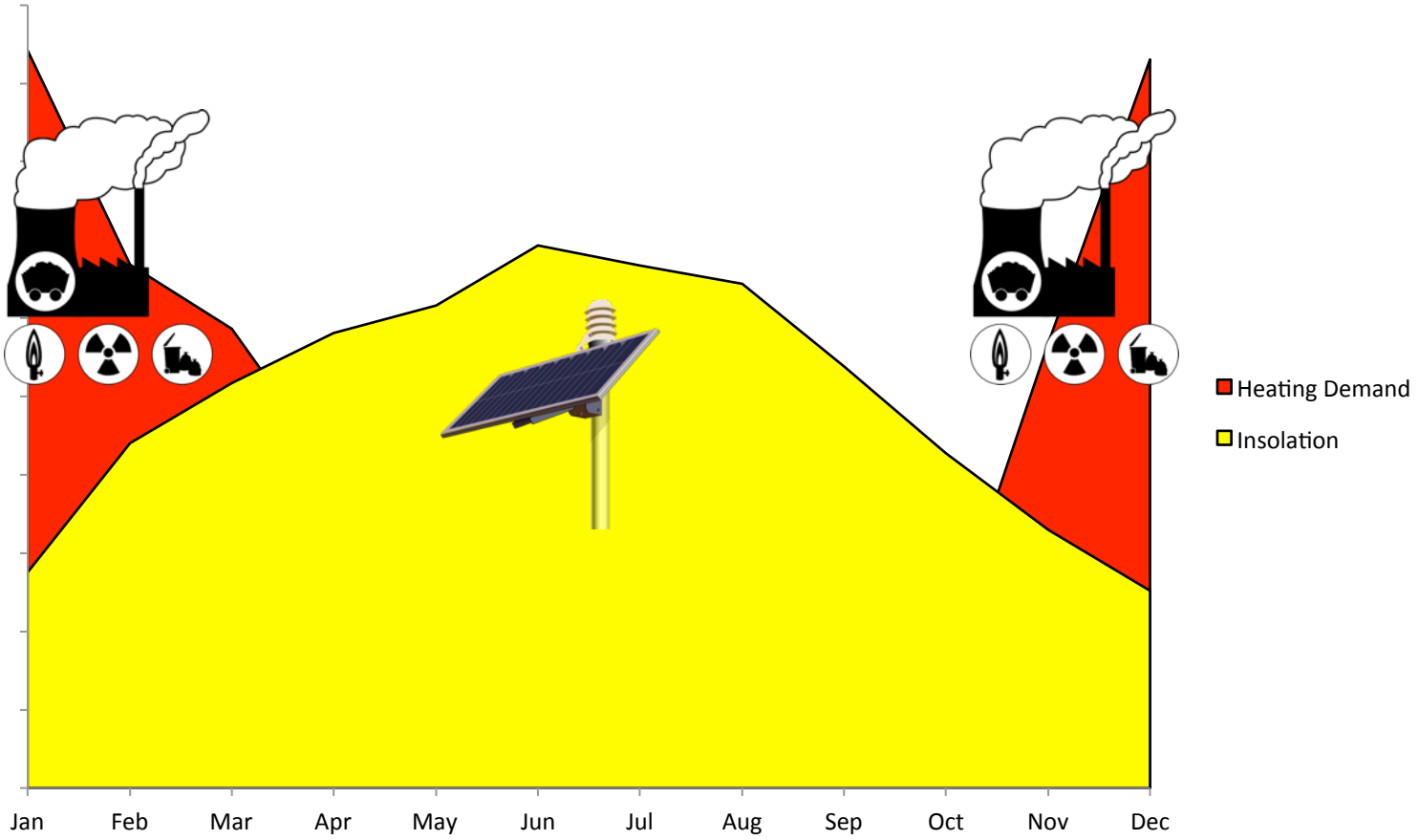




2007: Pre-Passive House

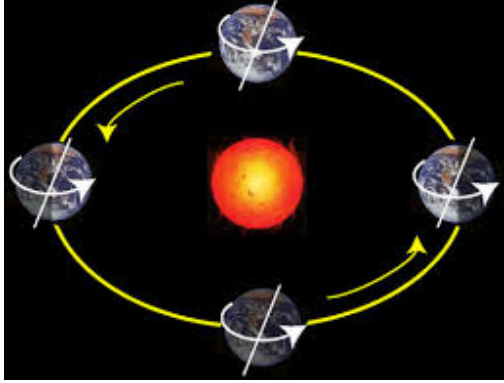
…I am becoming more convinced that it is not practical to heat a home with PV alone, even with a geothermal heat-pump, and that passive solar, as well as solar thermal and PV are required. For an existing home, the passive solar could take the form of a add-on sunspace which, if designed with proper overhangs and orientation, could provide a good deal of heating in the winter and not overheat in the summer.

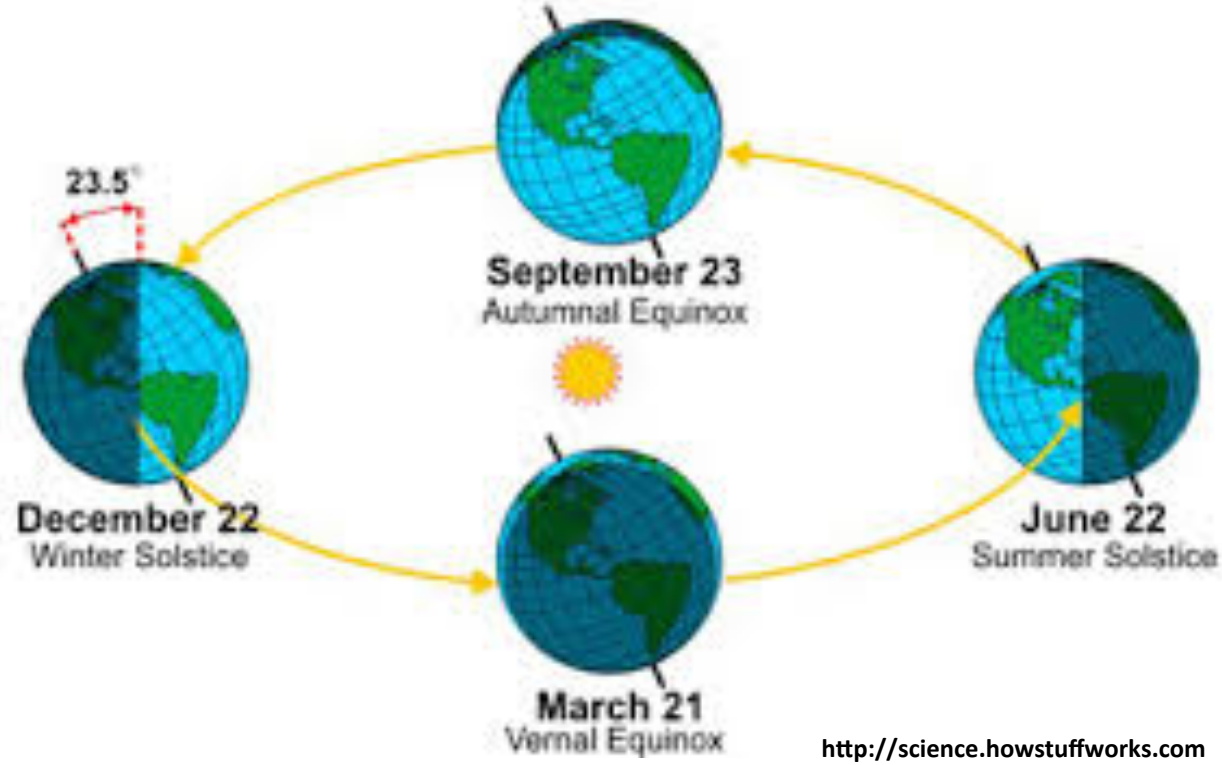
Anyhow, I'm very interested in the zero-energy quest and would welcome the opportunity to learn from your conclusions on your current project/share thoughts, etc.

Cheers,

Graham

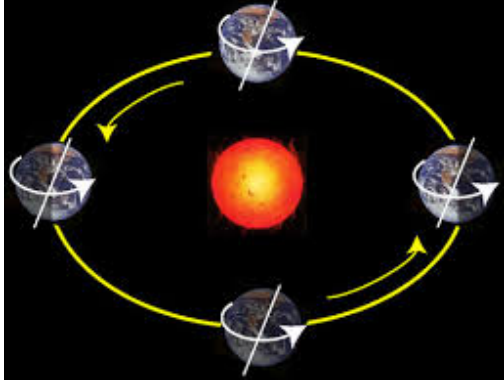
Seasonal Storage





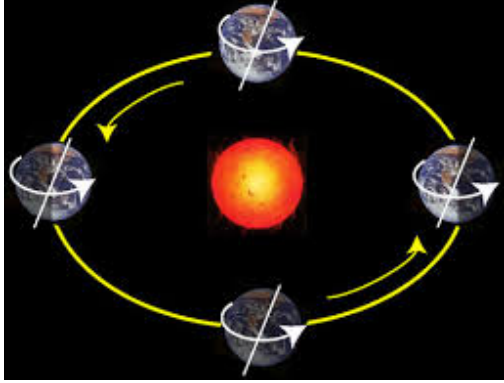
http://science.howstuffworks.com

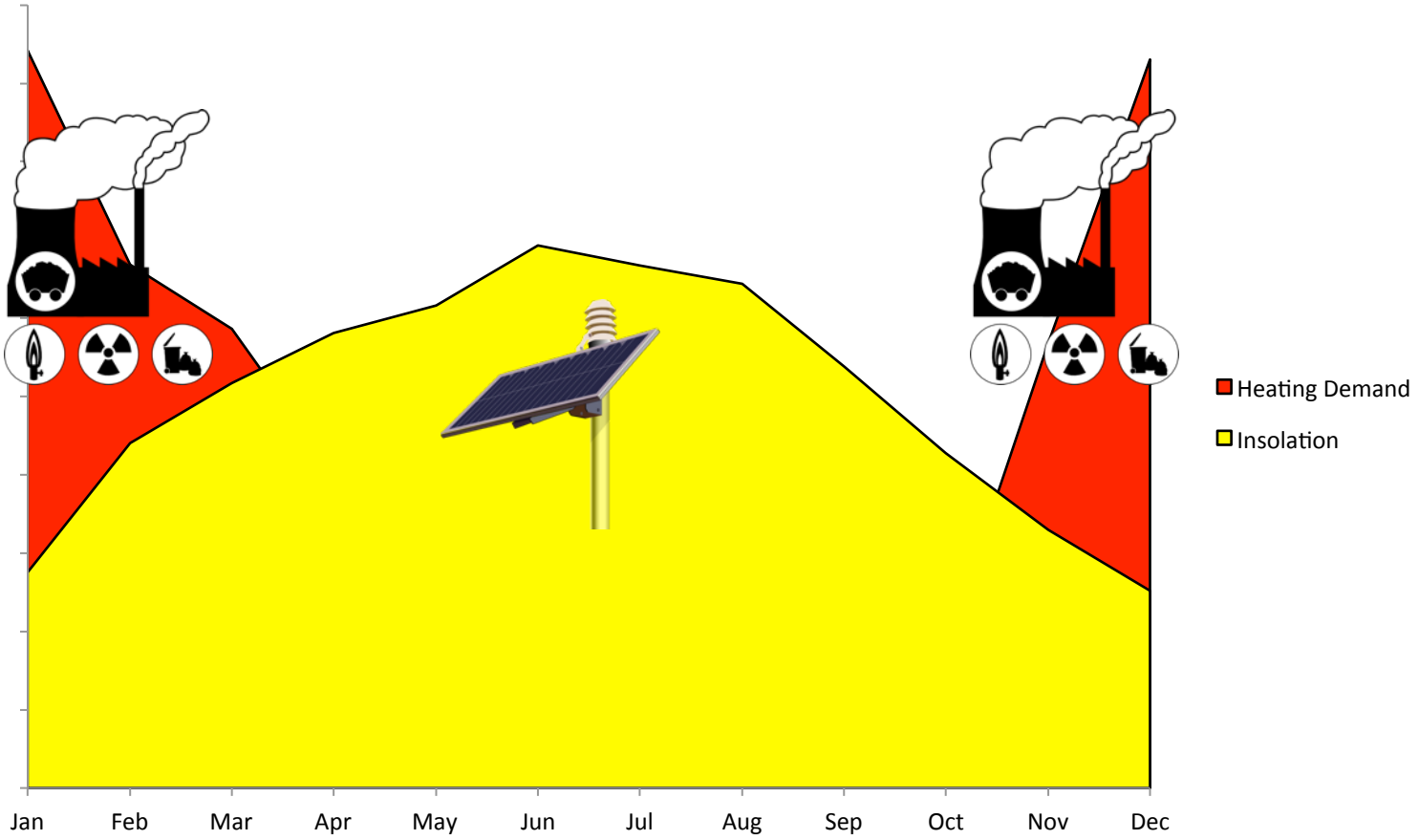
Seasonal Storage



- Pumped Hydro
- Biomass
- Solar Thermal (Large Tank)
- Synthetic Methane
- Smart Inverters
- Passive House

Seasonal Storage





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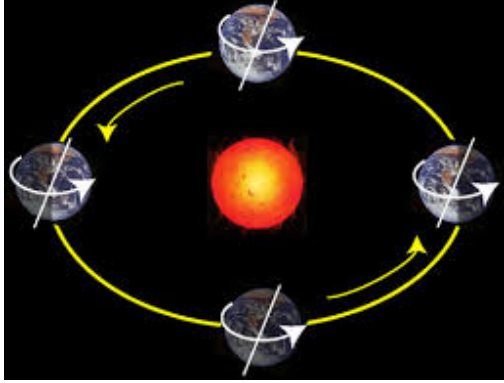

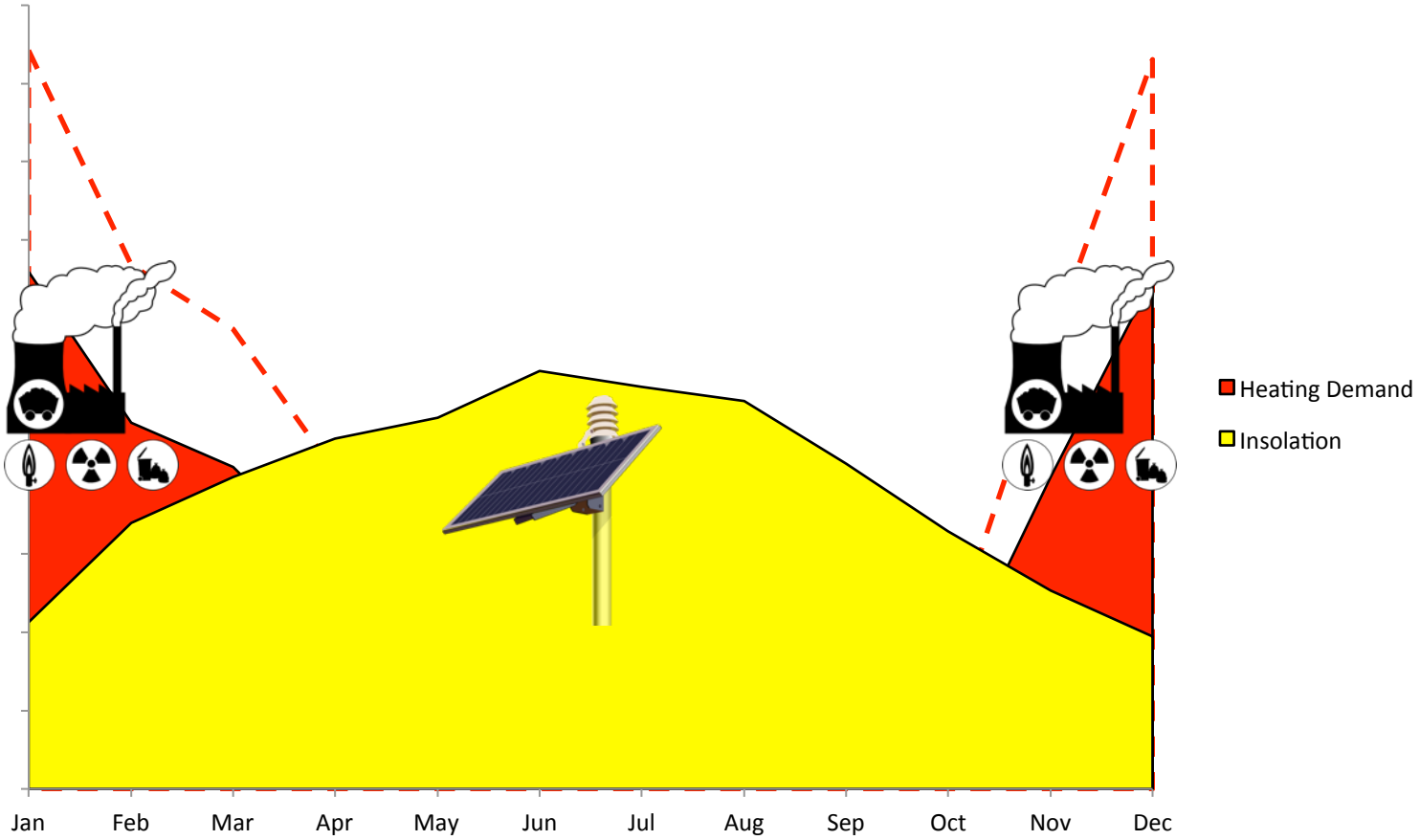

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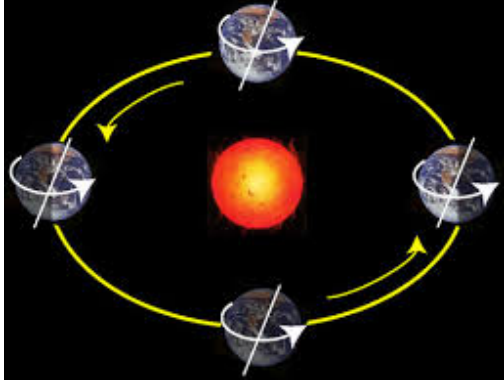

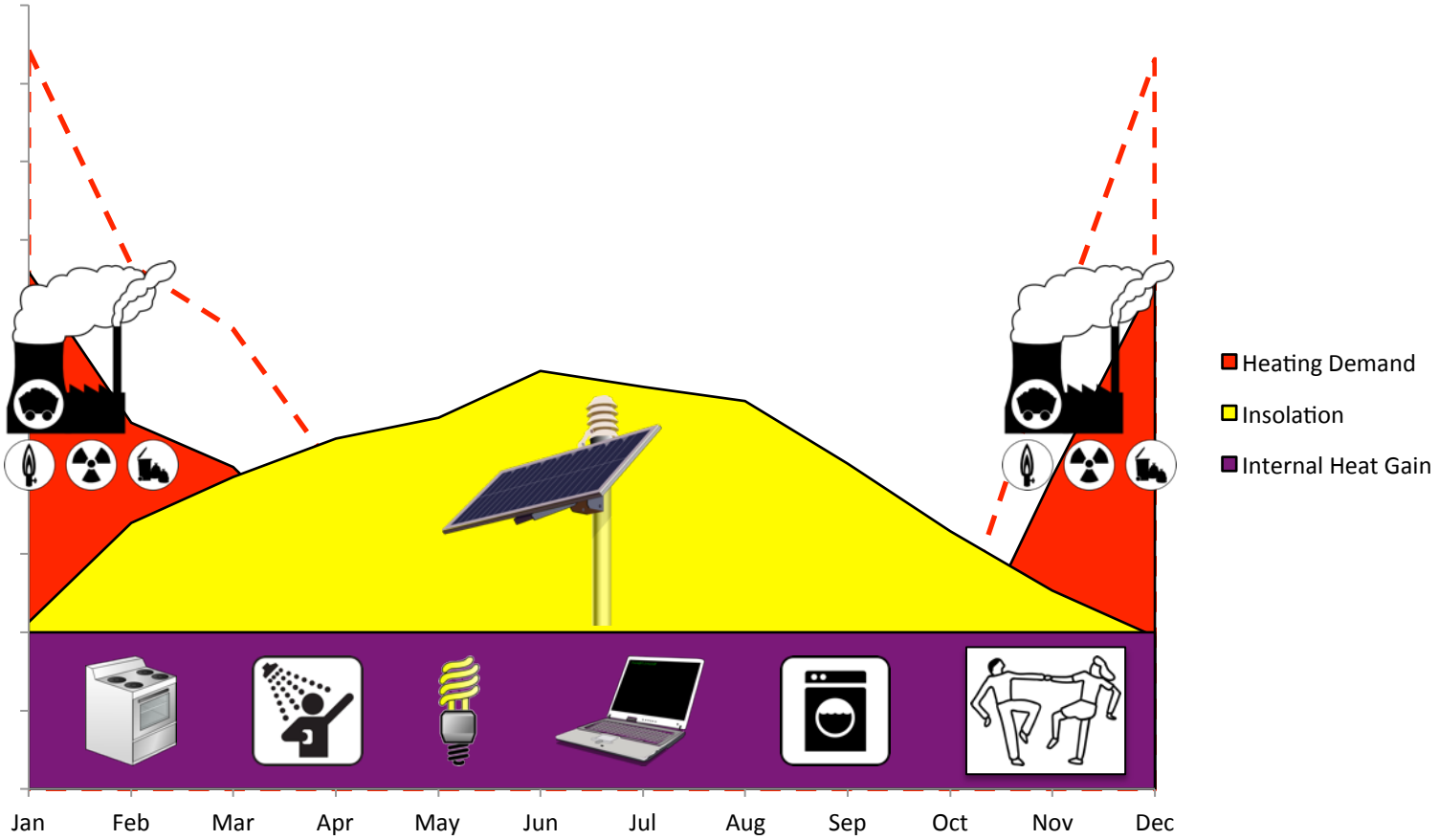

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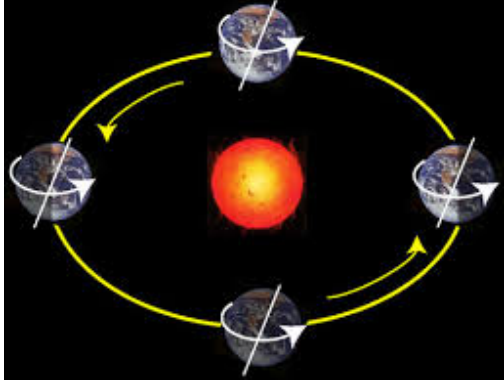
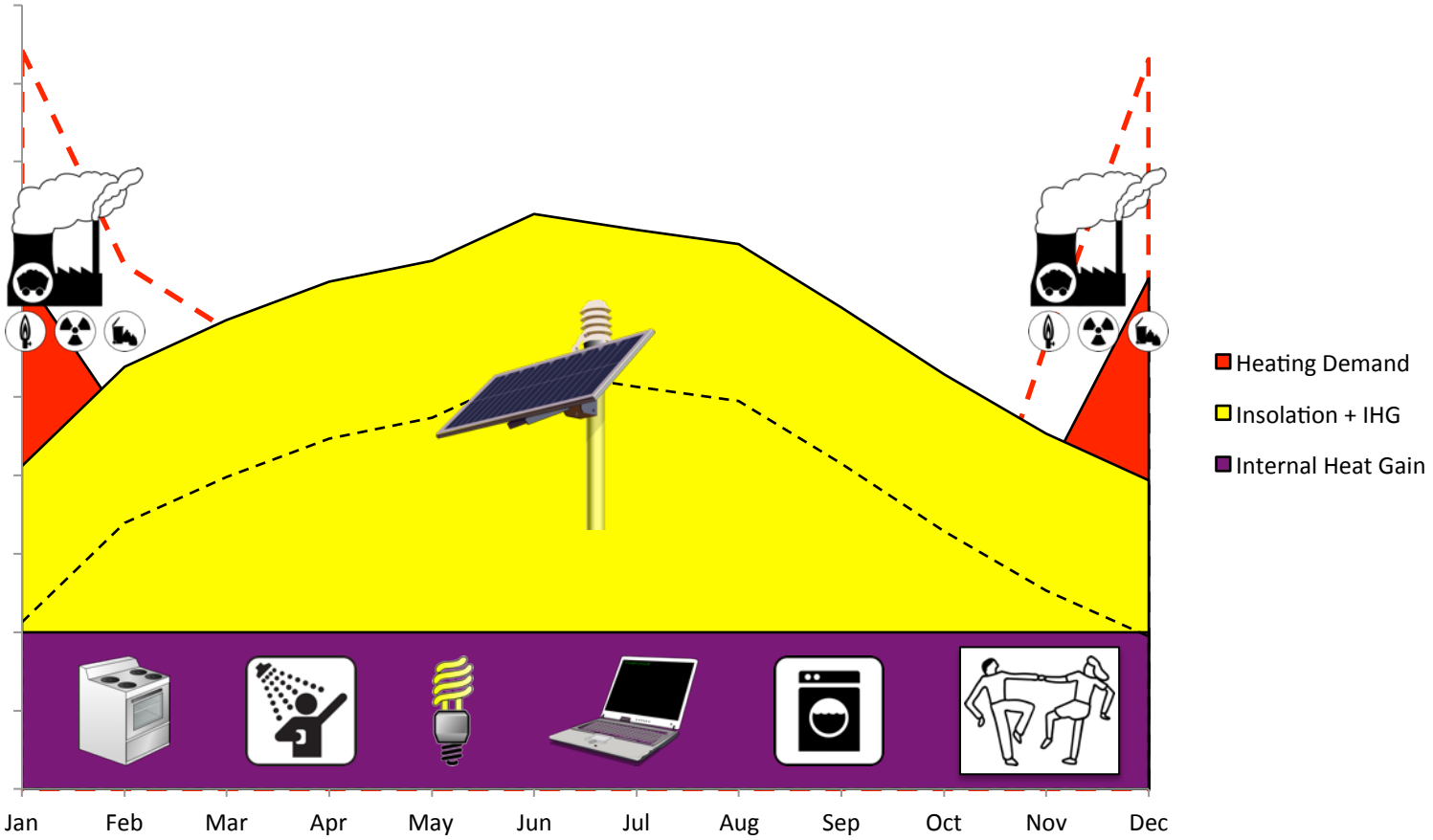
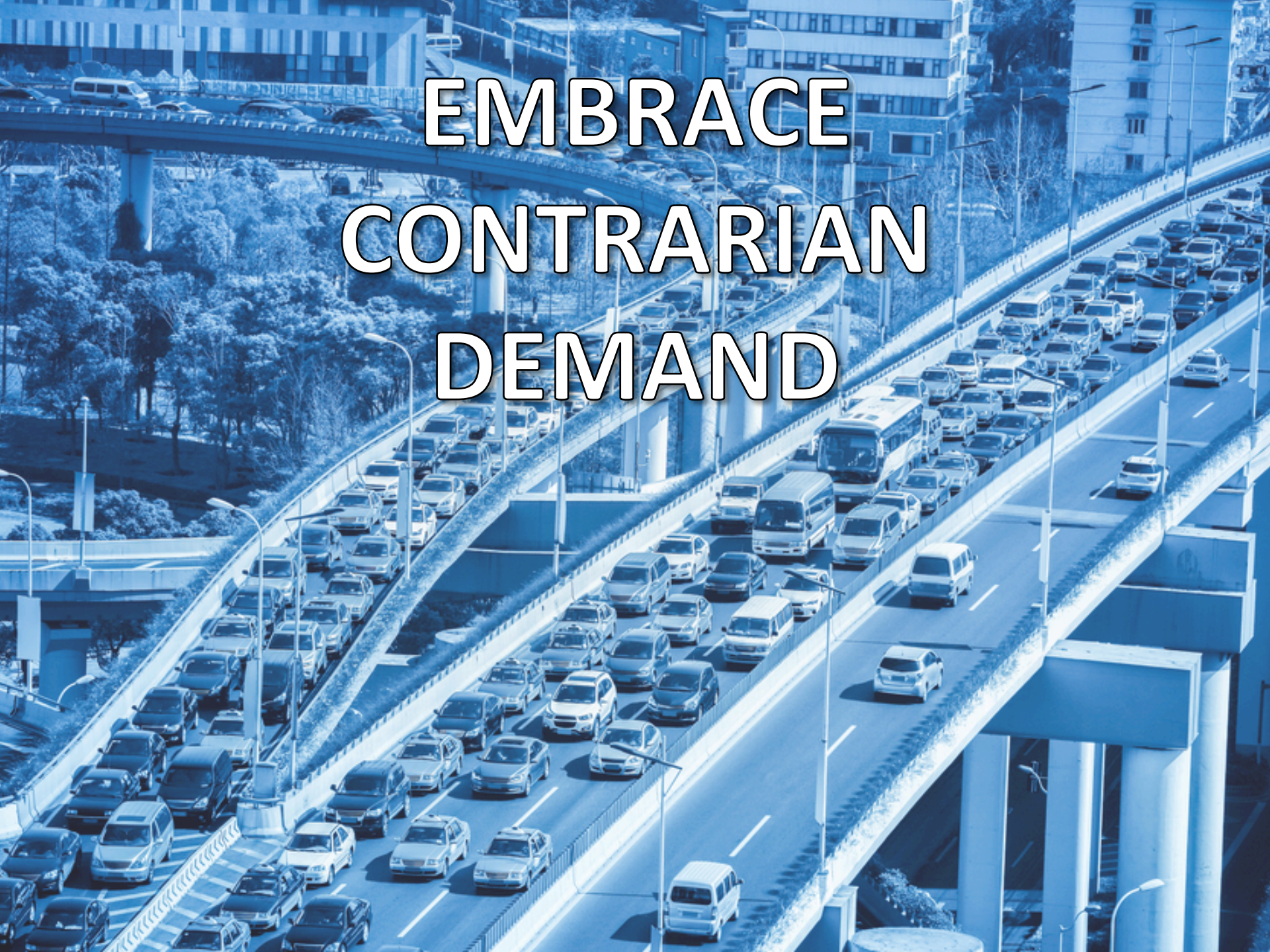


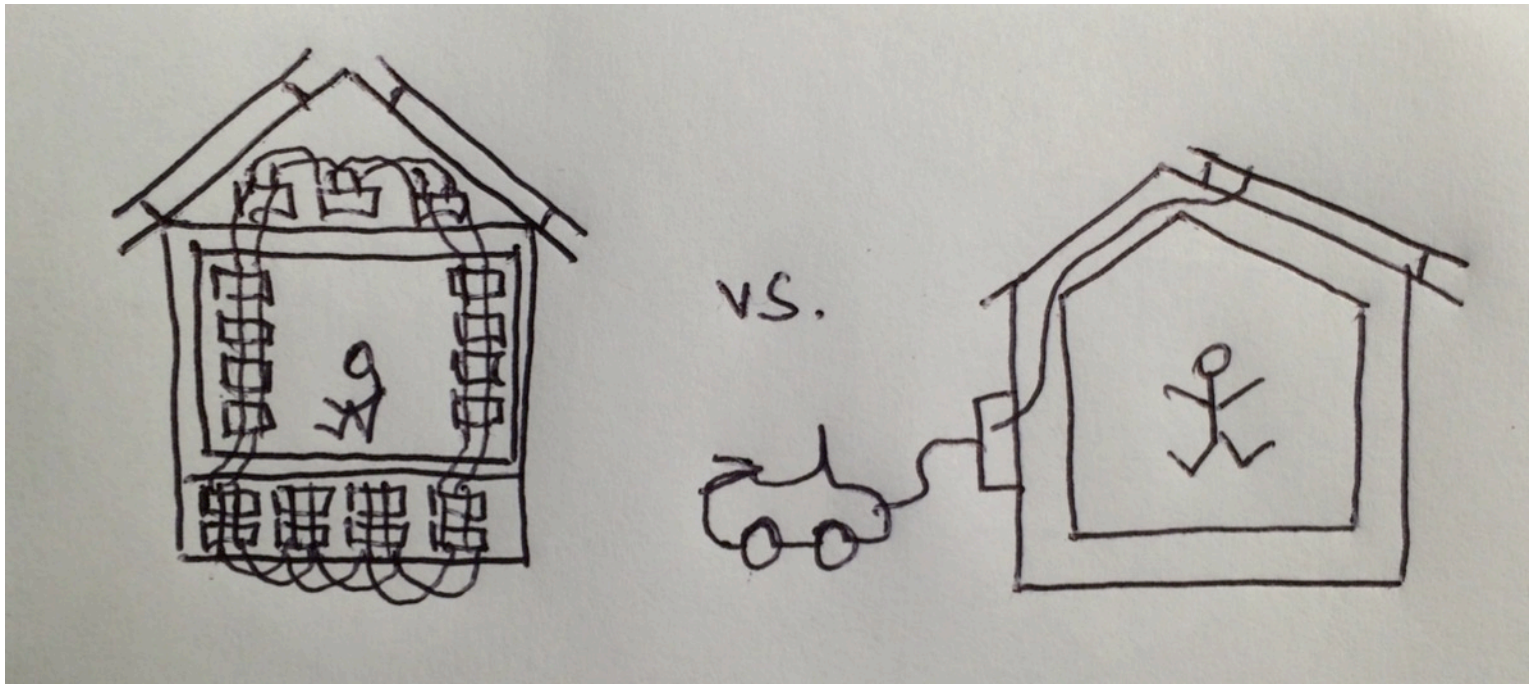


Grid Business Model

- Buy
  - 1 Day Ahead
  - Price Varies Hourly
- Sell
  - Bill Monthly
  - Priced After the Fact
- Not for Long!


EMBRACE
CONTRARIAN
DEMAND

Thank You! Questions?



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