Tesla Powerwall

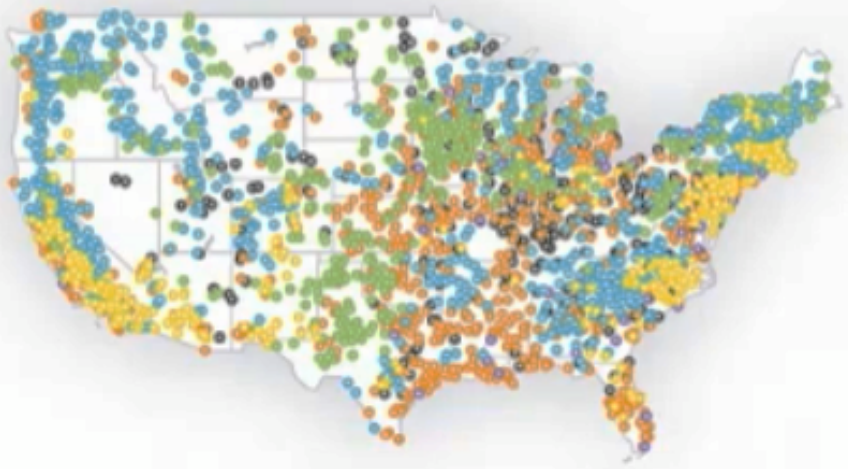
HEJC, 18 October 2016


TESLA

In Elon Musks's own words

https://vimeo.com/126637913

Claim 1: large difference in peak and trough usage



COAL

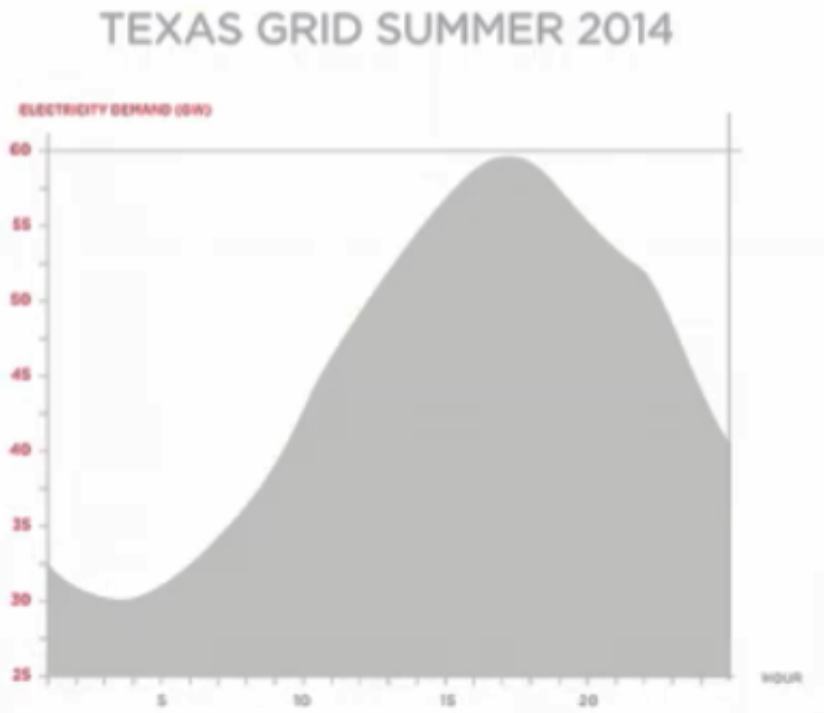
NATURAL GAS

NUCLEAR

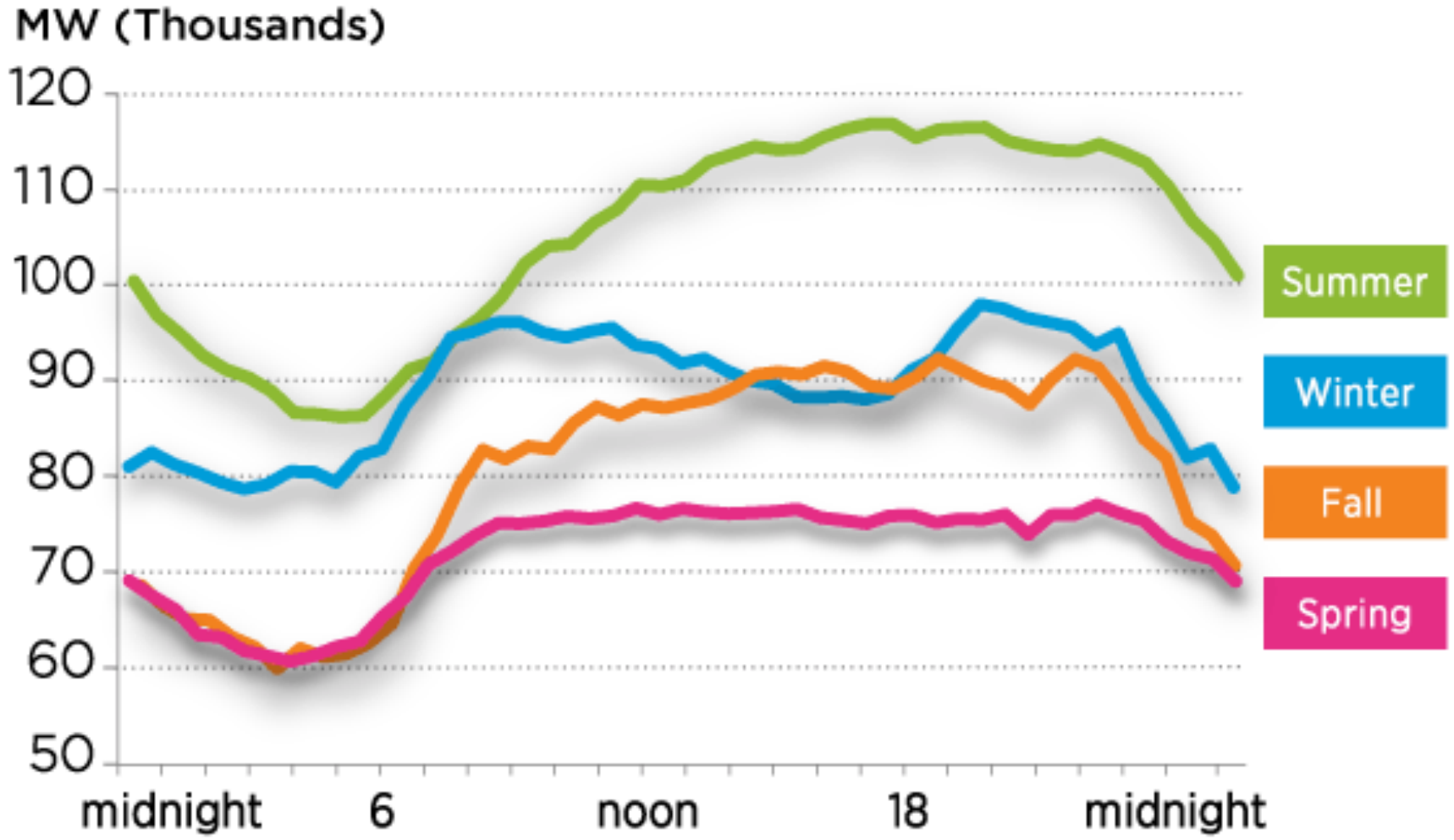
HYDRO

WIND

SOLAR



Load profile for ERCOT is accurate, but looks a little different in places with seasons



PJM load profiles (https://learn.pjm.com/three-priorities/keeping-the-lights-on/how-energy-use-varies.aspx)

Claim 2: this is the area necessary to generate electricity for US electricity

Area on map: ~5000 sq mi = 13000 km^2

~1000 W/m^2 of sunlight reaches the earth's surface

SolarCity solar module efficiency: 22% (http://www.solarcity.com/newsroom/press/solarcity-unveils-world%E2%80%99s-most-efficient-rooftop-solar-panel-be-made-america)

Assume ~8 hours sunshine/day
Austin, TX has ~60% sunny days (https://www.currentresults.com/Weather/US/average-annual-sunshine-by-city.php)
= 8/24 * 0.6 = 0.2

Net: 1000 W / m^2 * 0.22 * 0.2 = 44 W / m^2

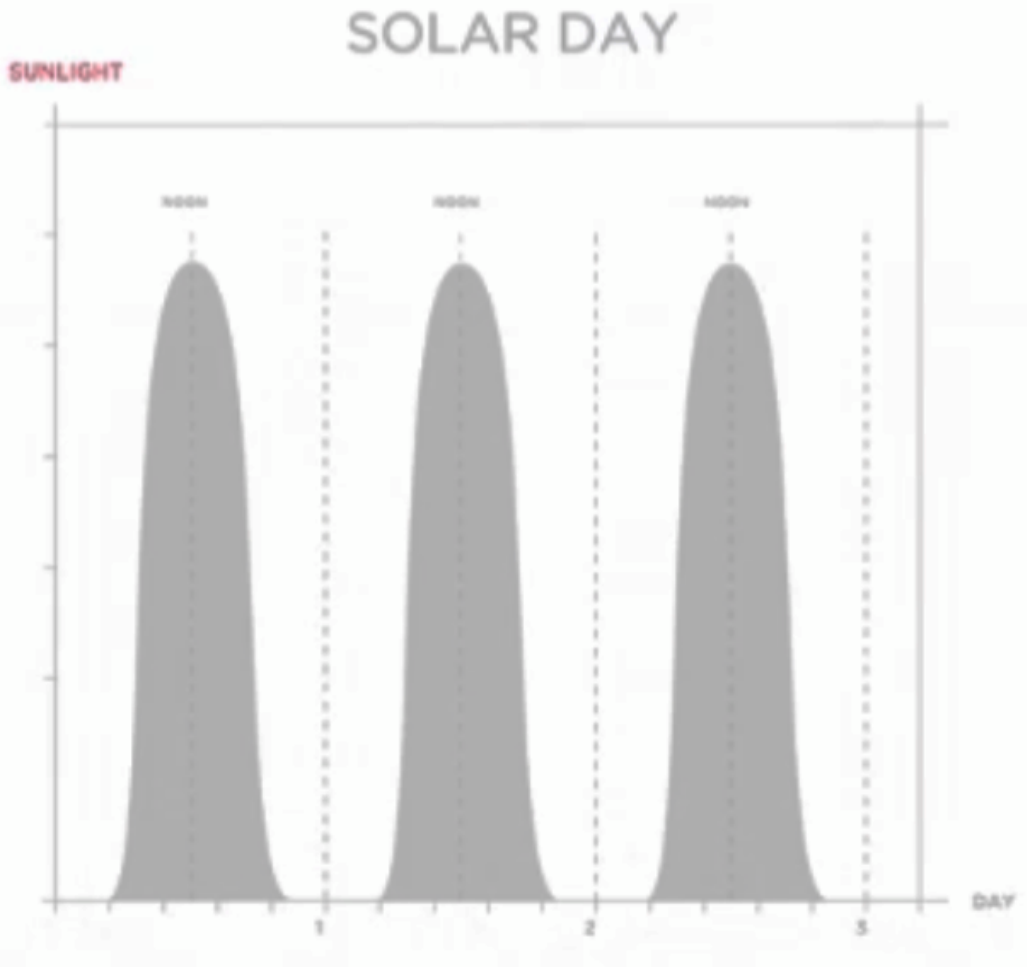
Electricity consumption in the US (EIA data for 2014): 3,764,700,000 MWh / (8760 h / year) ~= 430 GW

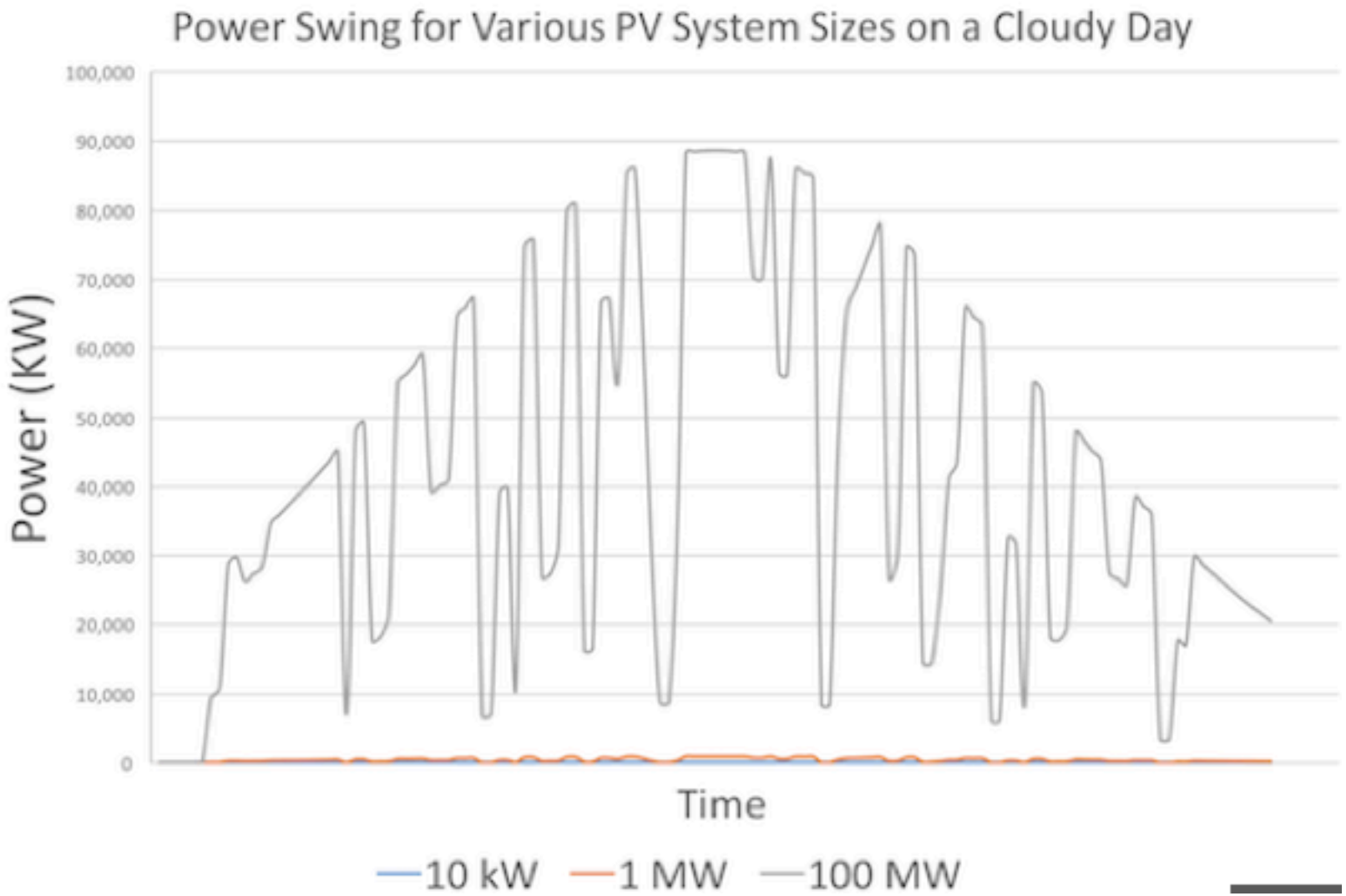
Area required: 1 m^2 / 44 W * 430 GW = 9772 km^2

Claim 3: large difference in day vs. night energy generation

PART 1:
PROBLEM

INTERMITTENT SUNLIGHT





http://www.renewableenergyworld.com/articles/2016/10/finding-solar-energy-s-sweet-spot.html

Claim 4: this is the area needed for batteries

Claim 5: existing batteries suck

PART 2:
PROBLEM

EXISTING BATTERIES:

- EXPENSIVE
- UNRELIABLE
- POOR INTEGRATION
- POOR LIFETIME
- LOW EFFICIENCY
- NOT SCALABLE
- UNATTRACTIVE

Lead-acid battery

Claim 6: wall-mounted means it’s accessible to every household, it doesn’t take up any room

Claim 7: you can go completely off grid

Each powerwall has 6.4 kWh energy storage capacity
According to the EIA, the average daily electricity consumption per use household is ~30 kWh per day. So you would need at least 5 Powerwalls if you want to go completely offgrid.
Temperature range: -20C – 50C
Can deliver 2kW of continuous power and 3.3 kW of peak power

Peak power is an issue: a spin dryer uses 3kW of power, toaster 1kW, electric kettle 3kW, hair dryer 1.5kW

Claim 8: costs $3500

Inverter not included, estimates around $1500
There is installation cost on top of that
7kWh model: $3000

Cost of storage: $0.15/kWh
Average residential electricity price in the US: $0.13/kWh (EIA)
New England: $0.18/kWh
California: $0.19/kWh ($0.28 on peak, $0.13 off-peak)
Texas: $0.11/kWh
→ Makes more sense where electricity prices are high, or in places where grid infrastructure is not as good
→ Average electricity price in Germany: $0.32/kWh
→ American Samoa: $0.38/kWh

Claim 9: Powerpack scales infinitely and can (eventually) power the world

1 Powerpack == 100 kWh of storage

1 GWh for a small city
16,000 GWh for the US
90,000 GWh for the world
200,000 GWh for the world's electricity + transport + heating

Powerpack currently priced at $445/kWh, Gigafactory aims to reduce price by 30%

Still a long way to go!
During the first quarter of 2016, Tesla delivered 25MWh of energy storage to customers.
Over 2500 Powerwalls and nearly 100 Powerpacks.
38,000 reservations available for Powerwall and 2500 reservations available for PowerPack through mid-2016, sold out within the first few weeks in 2015

Looking forward: Powerwall 2.0

Main changes: simplification to handling and wiring requirements for installers
Greater compatibility with low-cost inverters

Tesla current in process of acquiring SolarCity
Elon Musk announced that on October 28th he will unveil Powerwall 2.0, which integrates SolarCity roof and Tesla charger
Part of Elon Musks's master plan of solar powered energy for both home and transportation,