

**City of Austin
Resource Management Commission**

***Dispatchability:
The Next Step for a
Clean Energy Grid in ERCOT***

**Paul Robbins
April 17, 2018**

Austin's Clean Energy Progress Step-By-Step

2017 – Established 65% Renewable Goal

2015 – First Conservation Voltage Regulation

2011 – First Utility Solar Purchase

2006 – Electric Vehicle Program Begins

2004 – First Rooftop Solar Rebates

1995 – First Wind Power Purchase

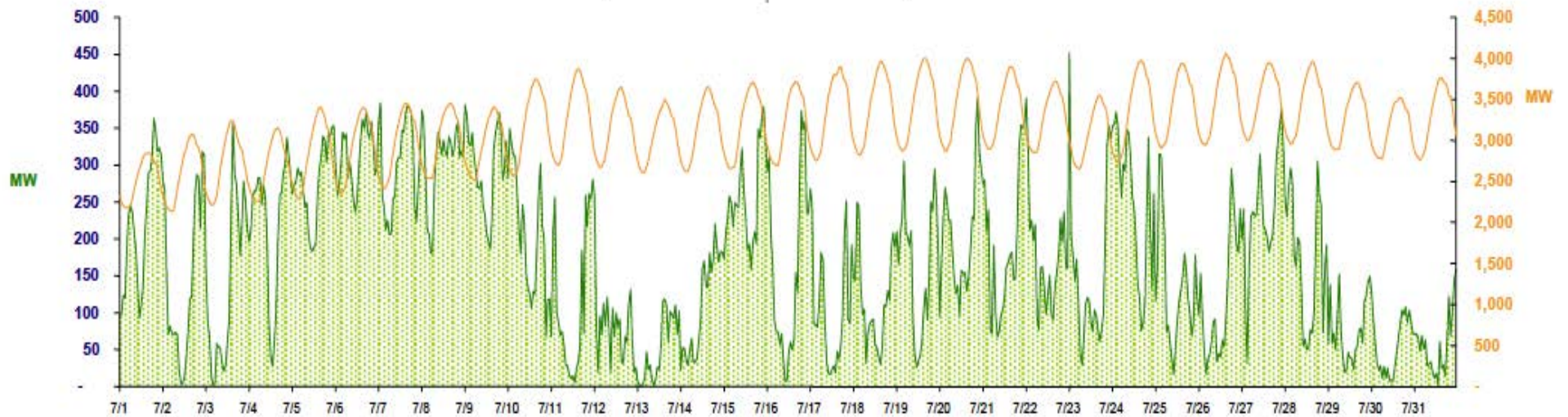
1987 – First Commercial Energy Efficiency

1982 – First Residential Energy Efficiency

1981 – First Progressive Residential Rate

Wildly Erratic West Texas Wind Profile

V-3 a Wind Hourly Production – Unshaped
Starting Date --Jul-1



TONIGHT'S PRESENTATION

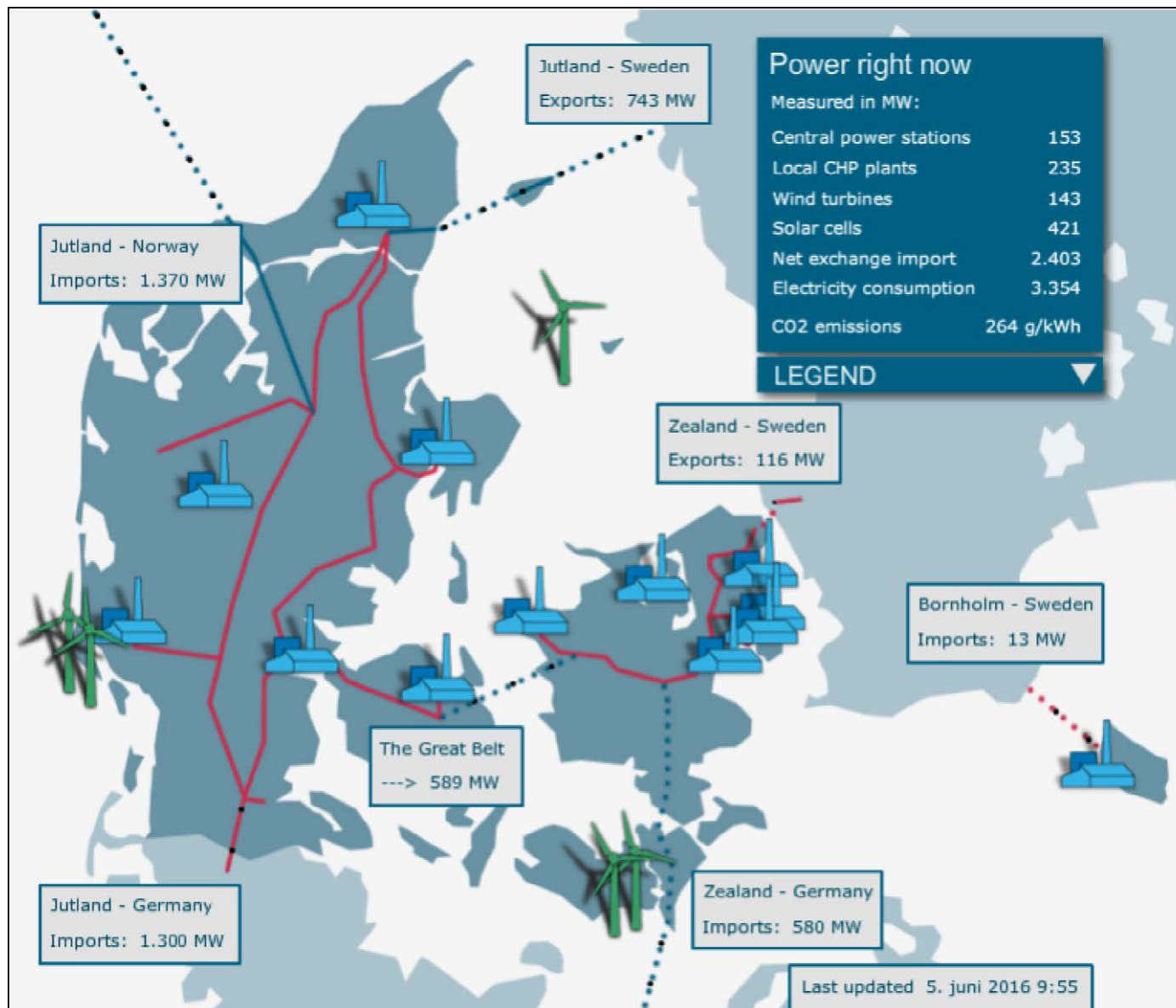
- 1. Ways that other places have dealt with dispatchability (or not)**
- 2. Options for dispatchable renewable electricity in Texas**
- 3. Strategies to put more renewable energy on the electric grid**



**Georgetown – 100%...On Paper
But ERCOT is 83% Gas, Coal, and Nuclear**

Paula Gold-Williams, CEO of CPS Energy:

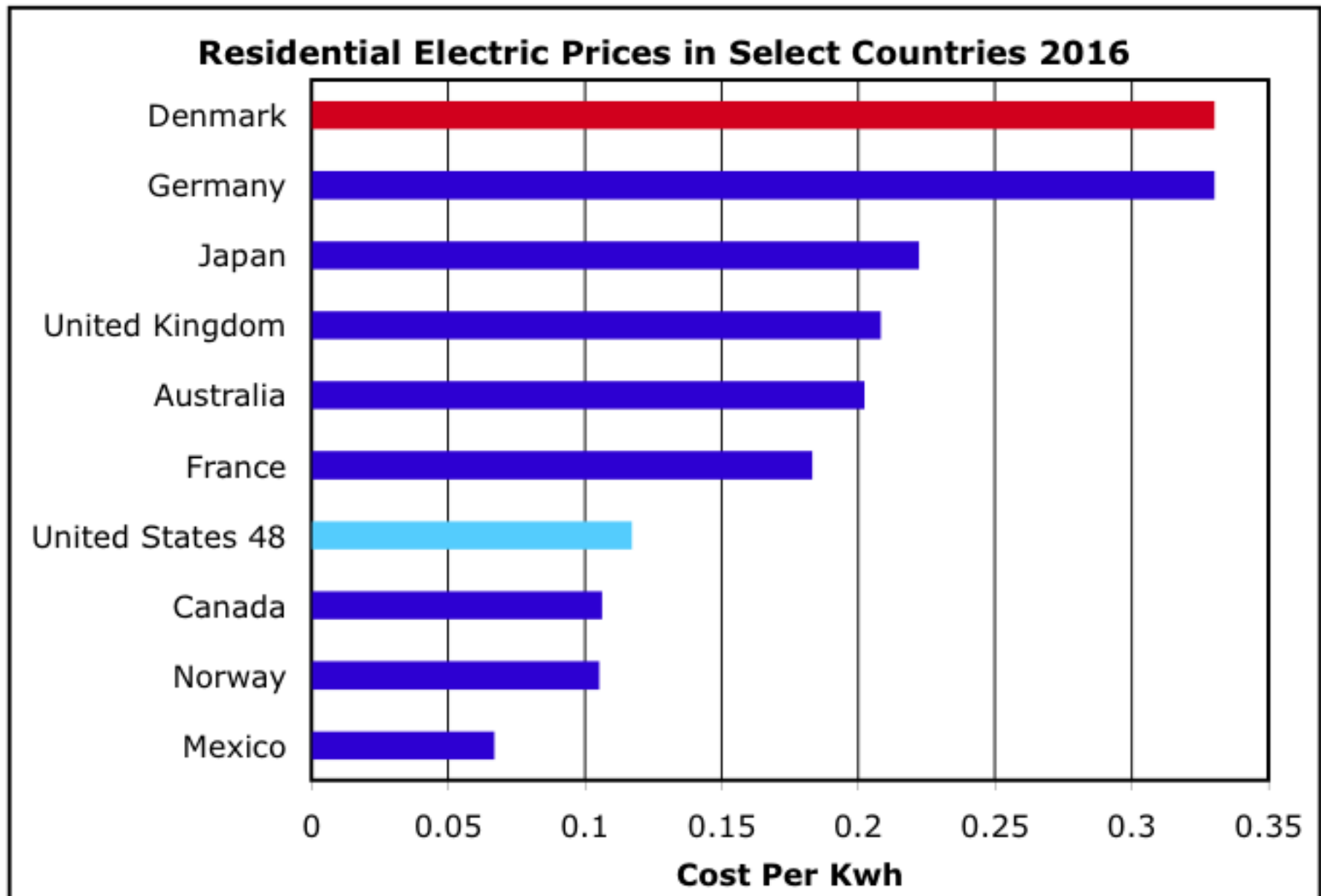
*“electrons love everybody, and in reality
...they’re getting power from other units.”*



Denmark - 46% Intermittent Electricity, But only 16% in Region (Germany, Denmark, Norway, Sweden)



In 2016, Denmark Generated 13% of Its Electricity from Biomass Including Domestic Straw, Imported Wood Pellets, and Domestic and Imported Solid Waste



Denmark Has Very High Electricity Costs



25% of Denmark's 2016 electricity from combustion was in Combined Heat & Power plants. Heat storage tanks allow them to function as reserve when there is too much power on the grid.



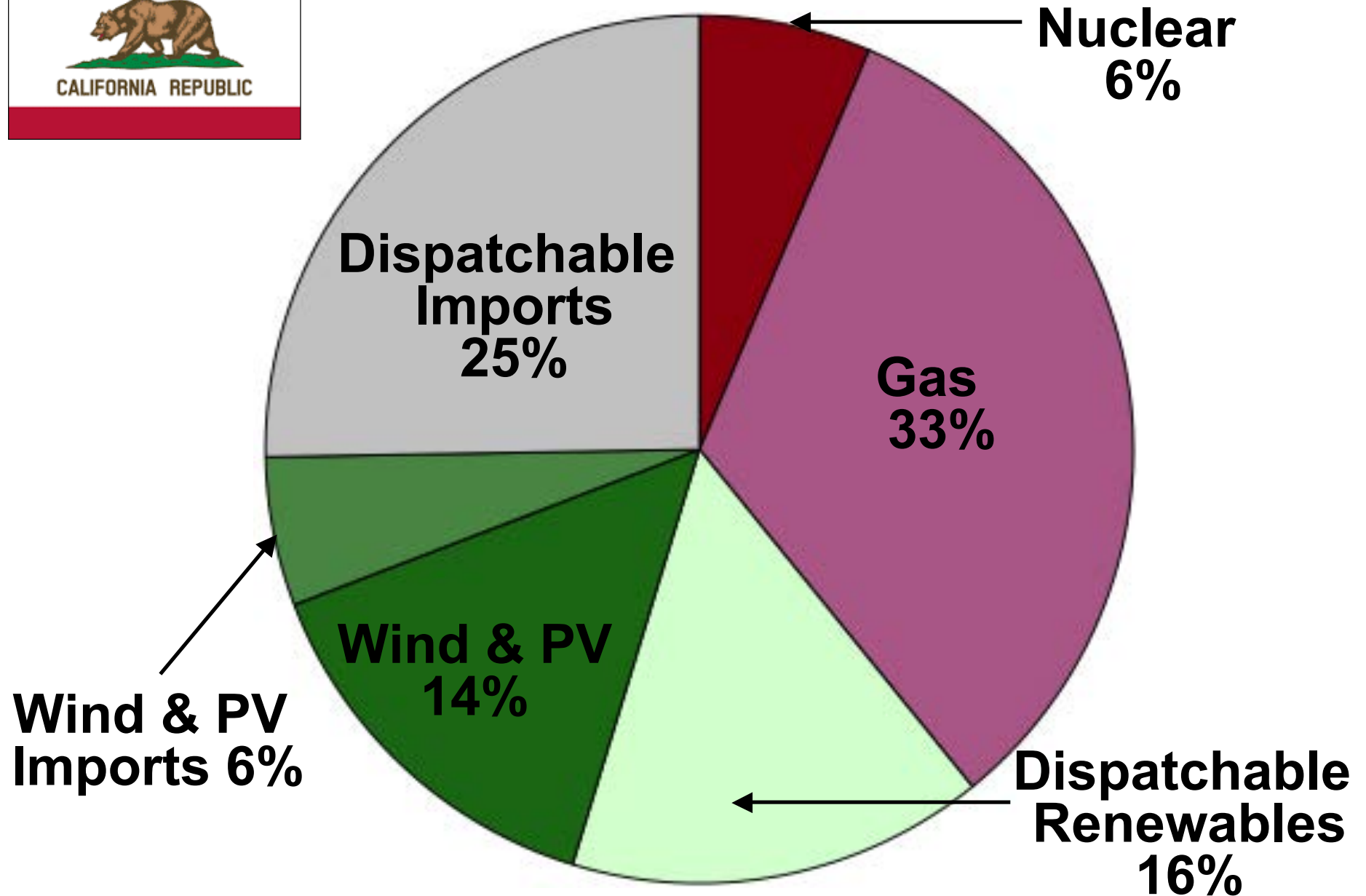
Iowa Transmission Grid (Purple)
37% Wind-Share Traded With Other States...
But the Heartland Only Got 12% from Wind in 2017

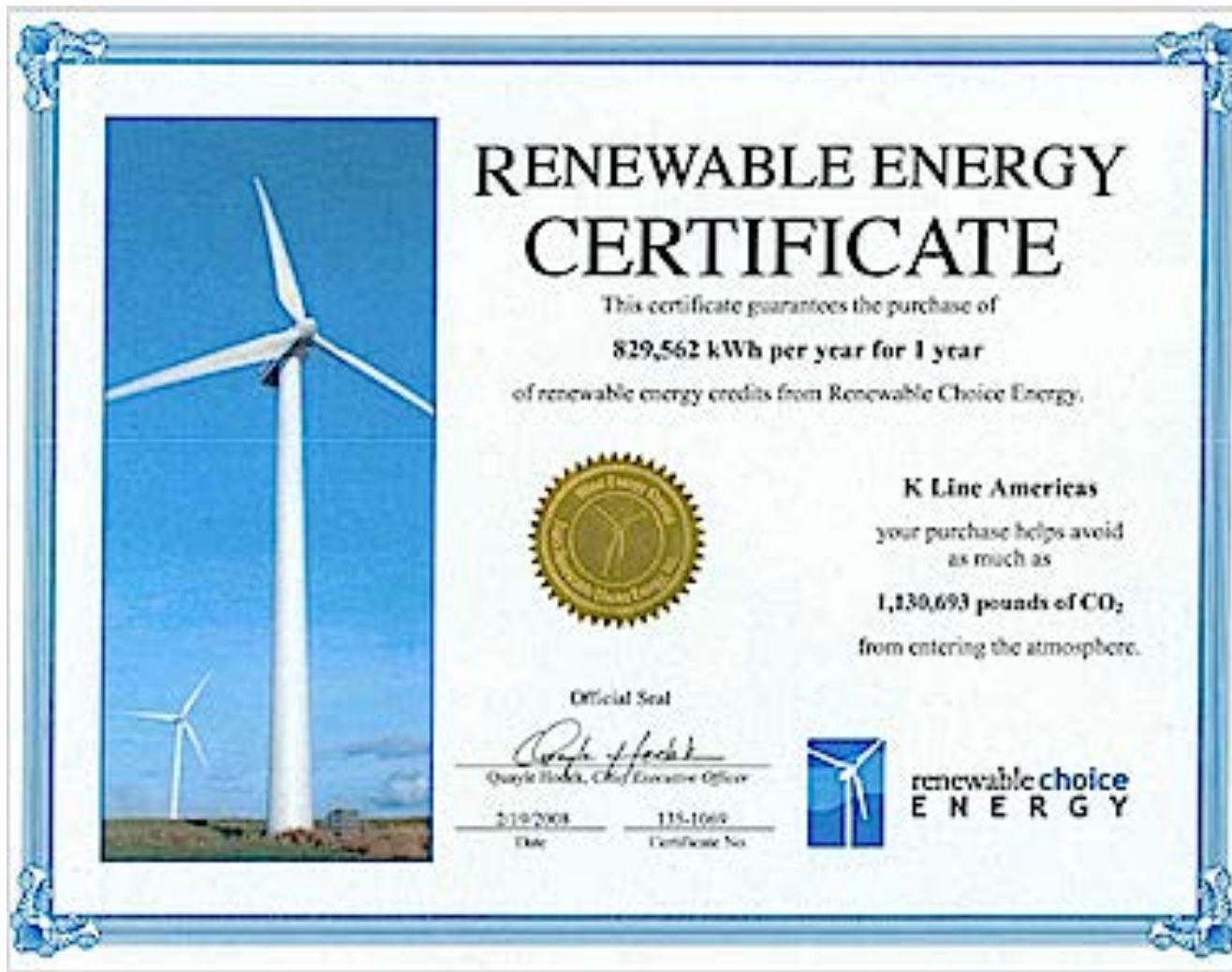




Lithium Storage Batteries: Adjust Your Expectations
More Than 40% Subsidy
Storage Does Not Match Production

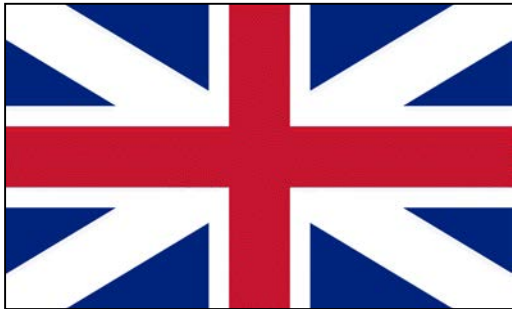
California Electric Supply By Source 2016





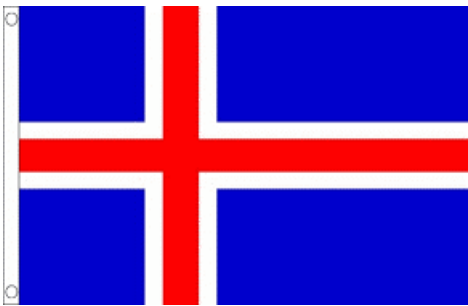
California RECs can come from production as far away as West Texas or Alberta, Canada

OTHER COUNTRIES WITH HIGH SHARE OF RENEWABLES



UK/Ireland: 25% Renewables /19% Intermittent

- Imported 4% of its Electricity from 4 Under-Sea lines
- Building \$2.4 billion Cable to Norway
- World's Largest Biomass Plants



Iceland: 100% Hydro and Geothermal

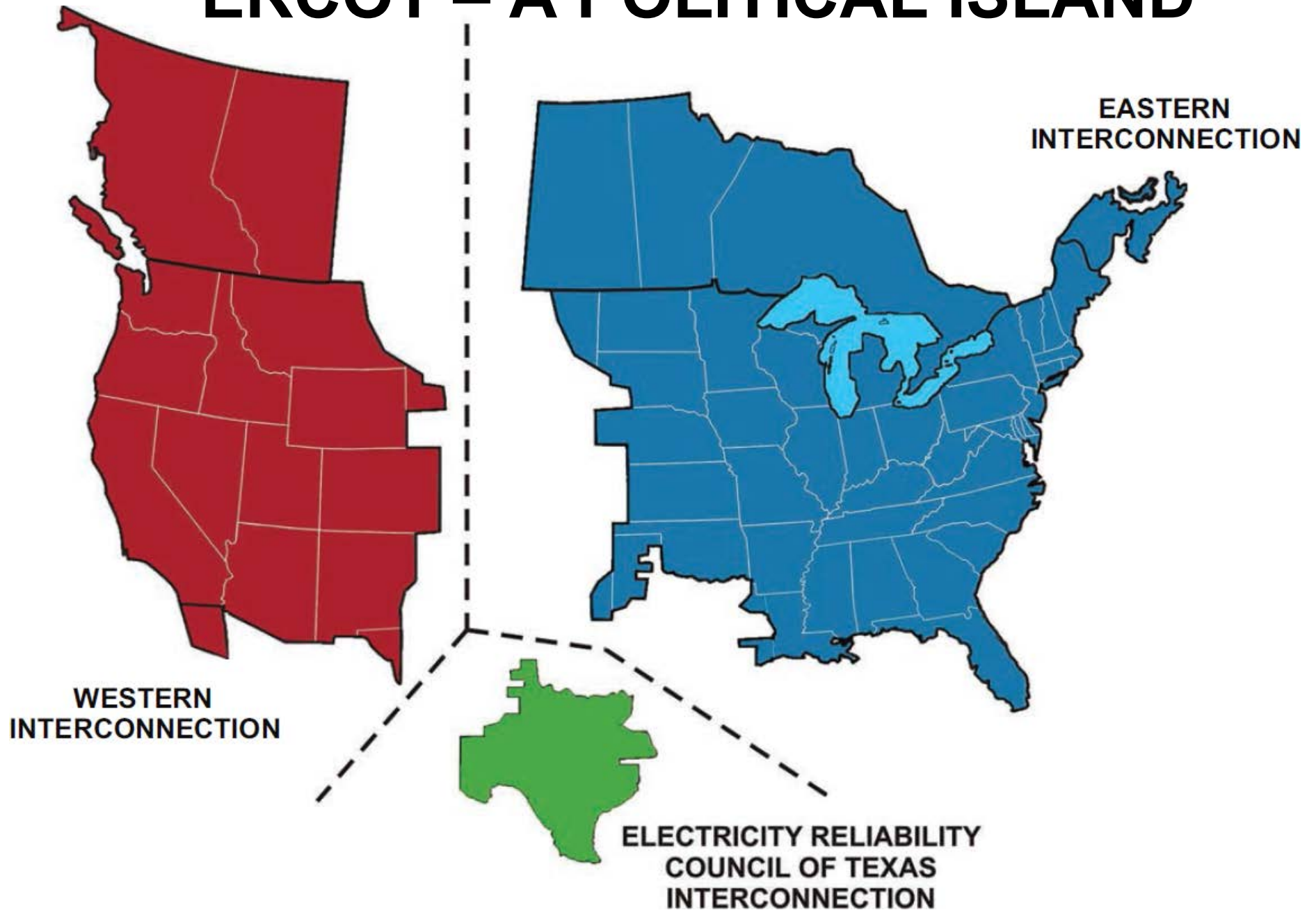
- Nothing Intermittent
- Discussion of Exports to UK via Longest Undersea Electric Cable in the World



South Australia: 39% Wind & PV

- Supported by East-coast Grid
- HIGH Electric Costs
- LOW PV Costs
- Aspires to 75% Renewables w/25% Dispatchable or Storage

ERCOT – A POLITICAL ISLAND



DISPATCHABILITY CHALLENGES

- **In Texas, Hydroelectric Potential is Minuscule**
- **Geothermal Electricity Does Not Exist**
- **Transporting Power from Other Regions is Politically Tenuous**
- **Wood chips and pellets are expensive and would require many years to establish supply chains**
- **Lithium Battery Costs Are VERY High – 28¢ per kwh according to Lazard's (2017)**

DISPATCHABLE ALTERNATIVES IN TEXAS?

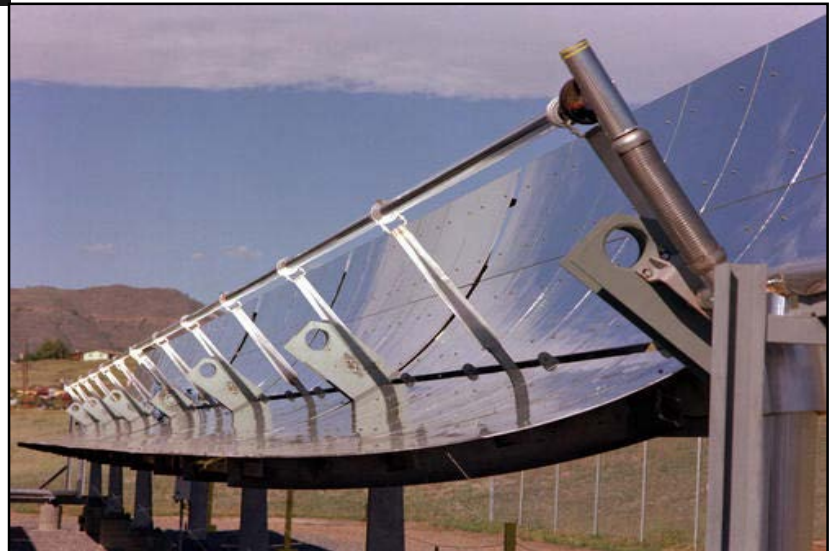
- **Biogas**
- **Concentrating Solar Power w/ Storage**
- **Thermal Storage**
- **Compressed Air Energy Storage**
- **Pumped Hydro**



Biogas From Anaerobic Digestion

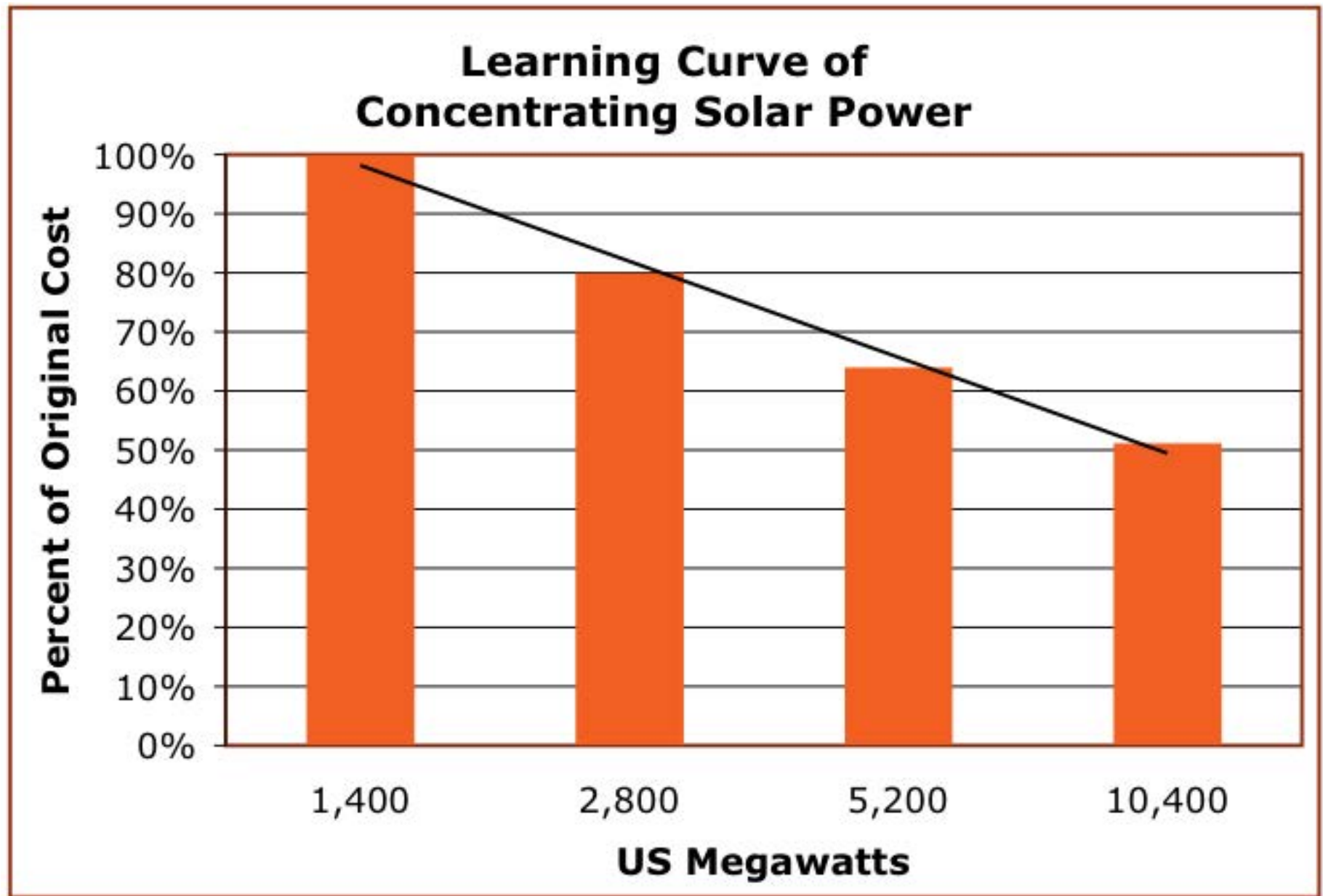


Desert Star – Concentrating Solar Power Tower



Desert Star – Concentrating Solar Power Troughs



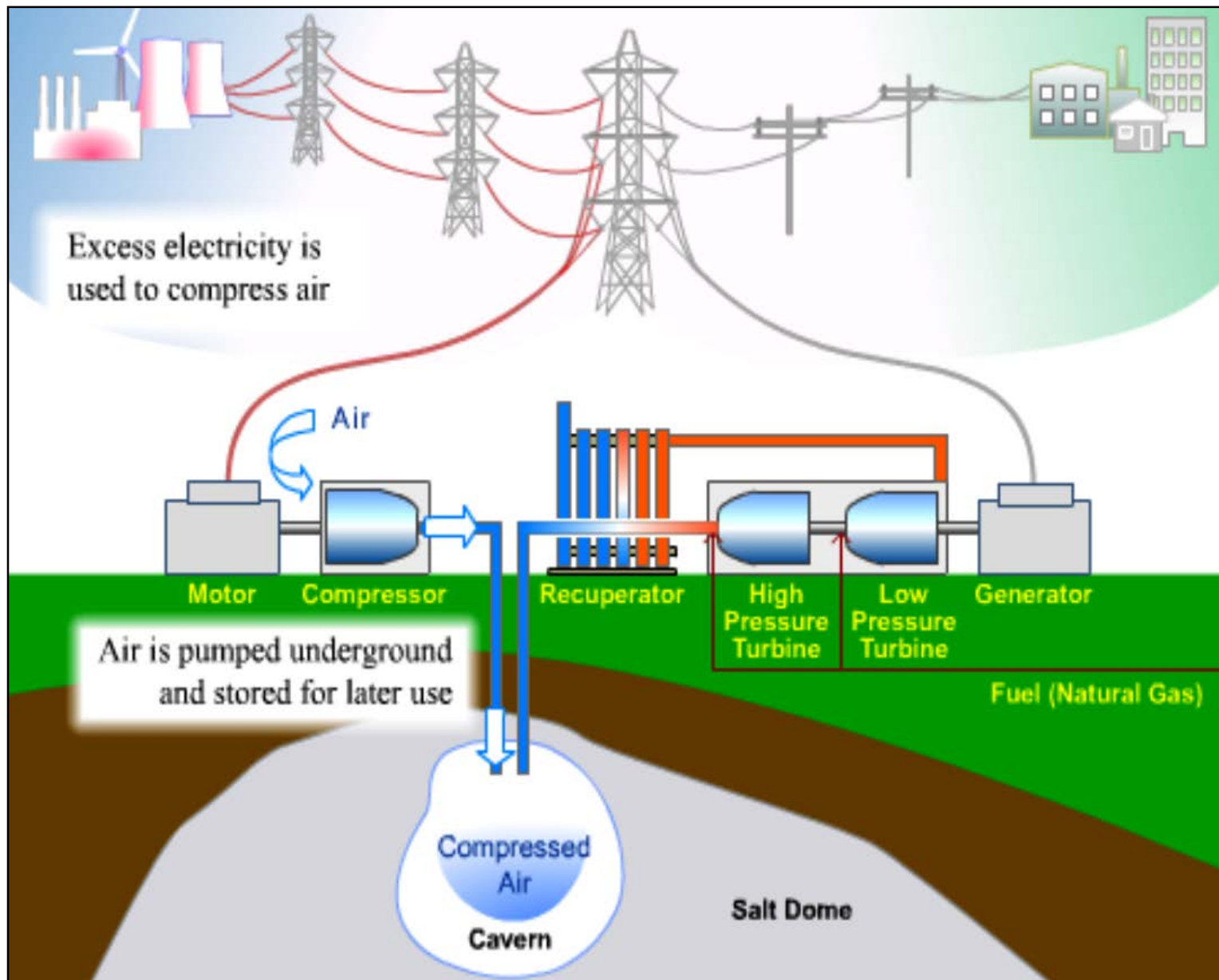


20% REDUCTION PER DOUBLING OF CAPACITY

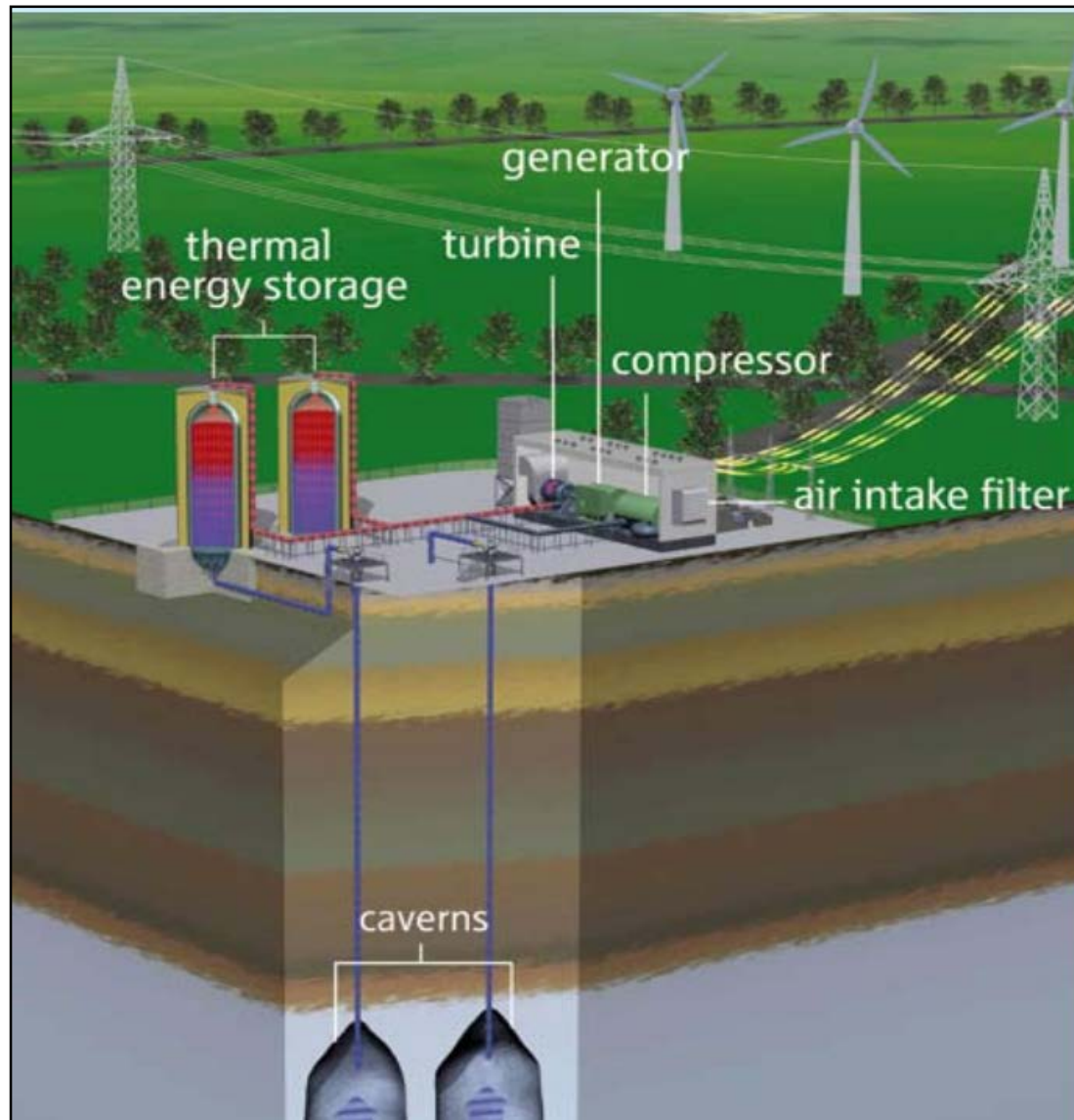
Thermal Energy Storage



*COST EFFECTIVE IN COMMERCIAL APPLICATIONS
BUT INCENTIVES AND MANDATES ARE NEEDED*



Air Mine – Compressed Air Energy Storage (CAES)

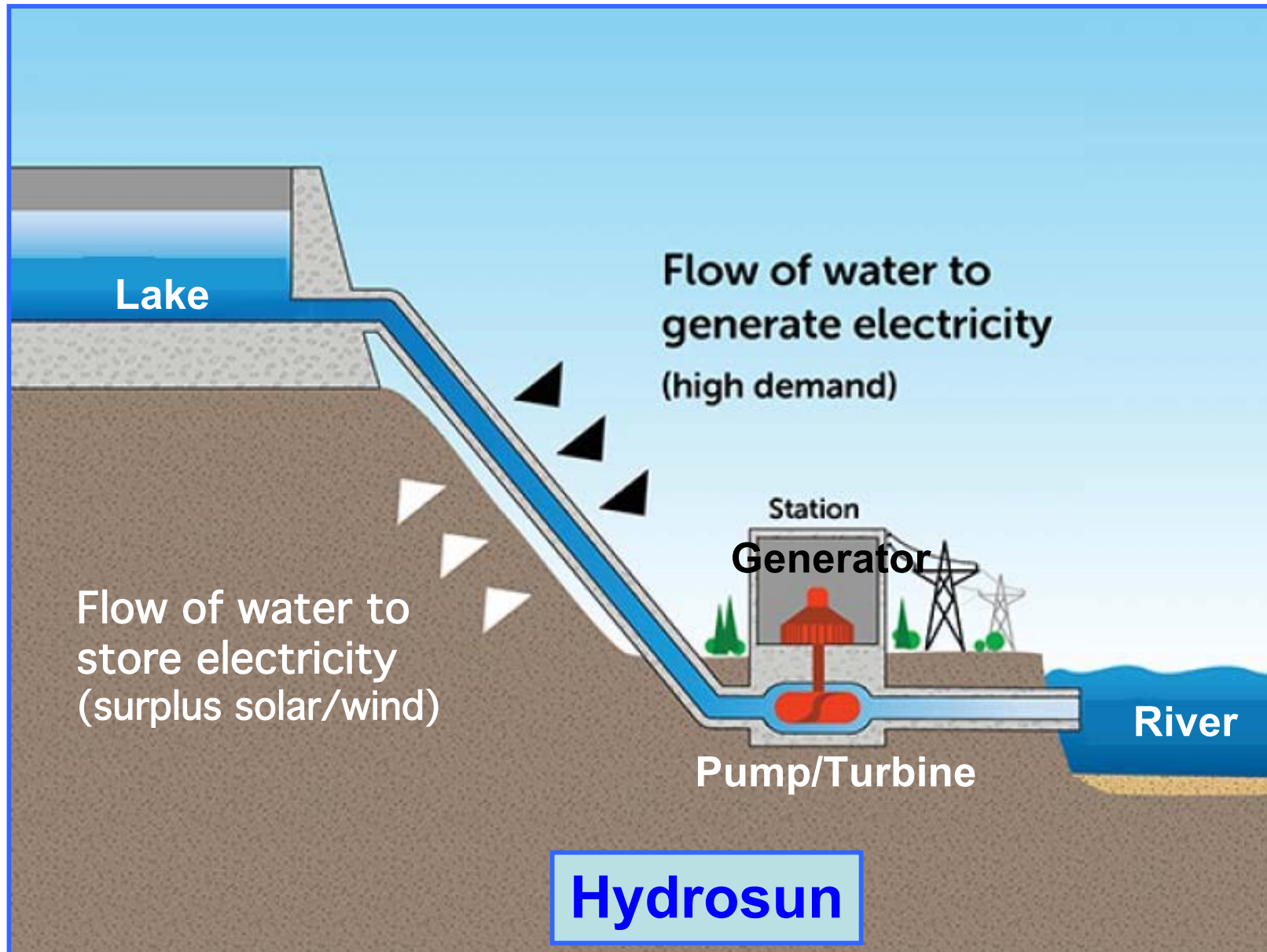


CAES With Waste Heat



CAES with Hydrogen

Highland Lakes Pumped Hydro



Hydrosun Pumped Hydro

- **295 MW / 2,000 Gwh if Cycled Daily**
- **Barely Used (13% Capacity in 2016)**
 - **Need to compensate LCRA**

DISPATCHABLE GENERATION ESTIMATED COST - 2016 DOLLARS	
Generation Type	Cost/Kwh
Combined Cycle Gas Plant	\$0.044
CAES/Wind/Gas	\$0.050
Combine Cycle Gas Plant with Biogas	\$0.059
CAES/Wind/H2 – Future	\$0.061-\$0.062
Wood Pellets in Existing Plant	\$0.061-\$0.097
Concentrating Solar Power – Now	\$.06-\$.10
Concentrating Solar Power – Future	\$0.048

*FUTURE CONCENTRATING SOLAR POWER
AND CAES WITH WIND & GAS COME CLOSE
TO COMPETING WITH NEW GAS PLANT*

Strategies to Develop Concentrating Solar Power

- 1. Consortium – Collaborative Investment
To Create Economies of Scale with Other
Texas Utilities**
- 2. Change Voluntary GreenChoice to CSP
Smaller Surcharge on Regular Customers**
- 3. Invest in CSP in Other States with Higher
Rate of Return**
- 4. Special “30-Year” Rate Class
Guaranteeing Wholesale Price for CSP
Purchasers**

Other Strategies for Dispatchable Renewable Energy

- 1. Biogas – Seek Bids**
- 2. CAES Partnership – Share in Cost of Texas Pilot Plant**
- 3. Evaluate Pumped Hydro Costs**
- 4. TES Requirement – Mandate for New Commercial Buildings & Grocery Stores**



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