

Energy Storage: a Critical Component of Future Energy

Future Energy Forum

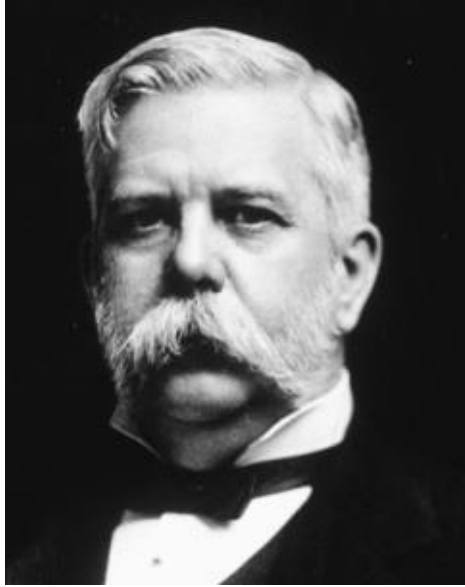
Astana, Kazakhstan
July 13, 2017

The Future of Storage is Long™

Primus Power offers long duration, fade-free
energy storage solutions for the smart grid

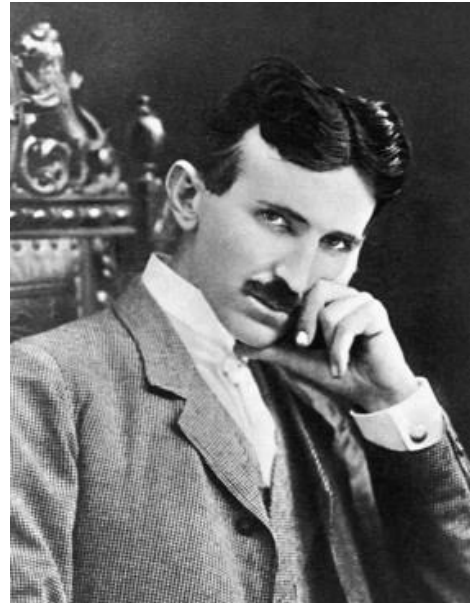


Electricity debuted at the 1893 World's Fair

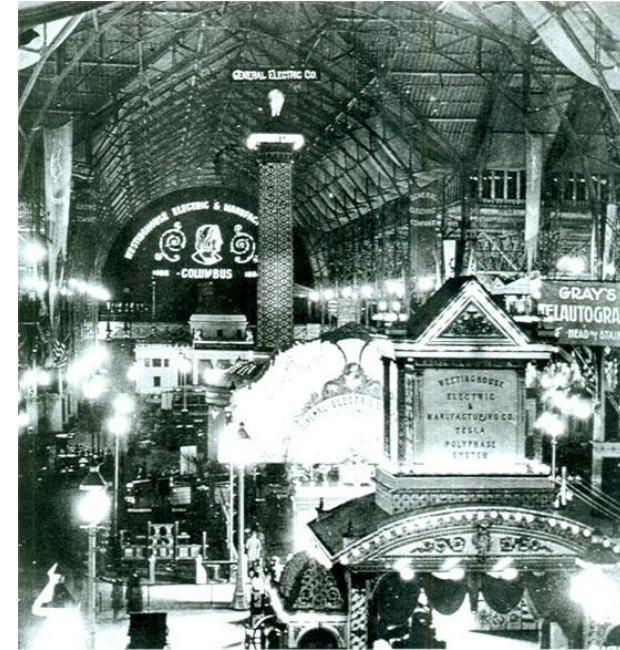


Thomas Edison
Direct current
JP Morgan

vs.

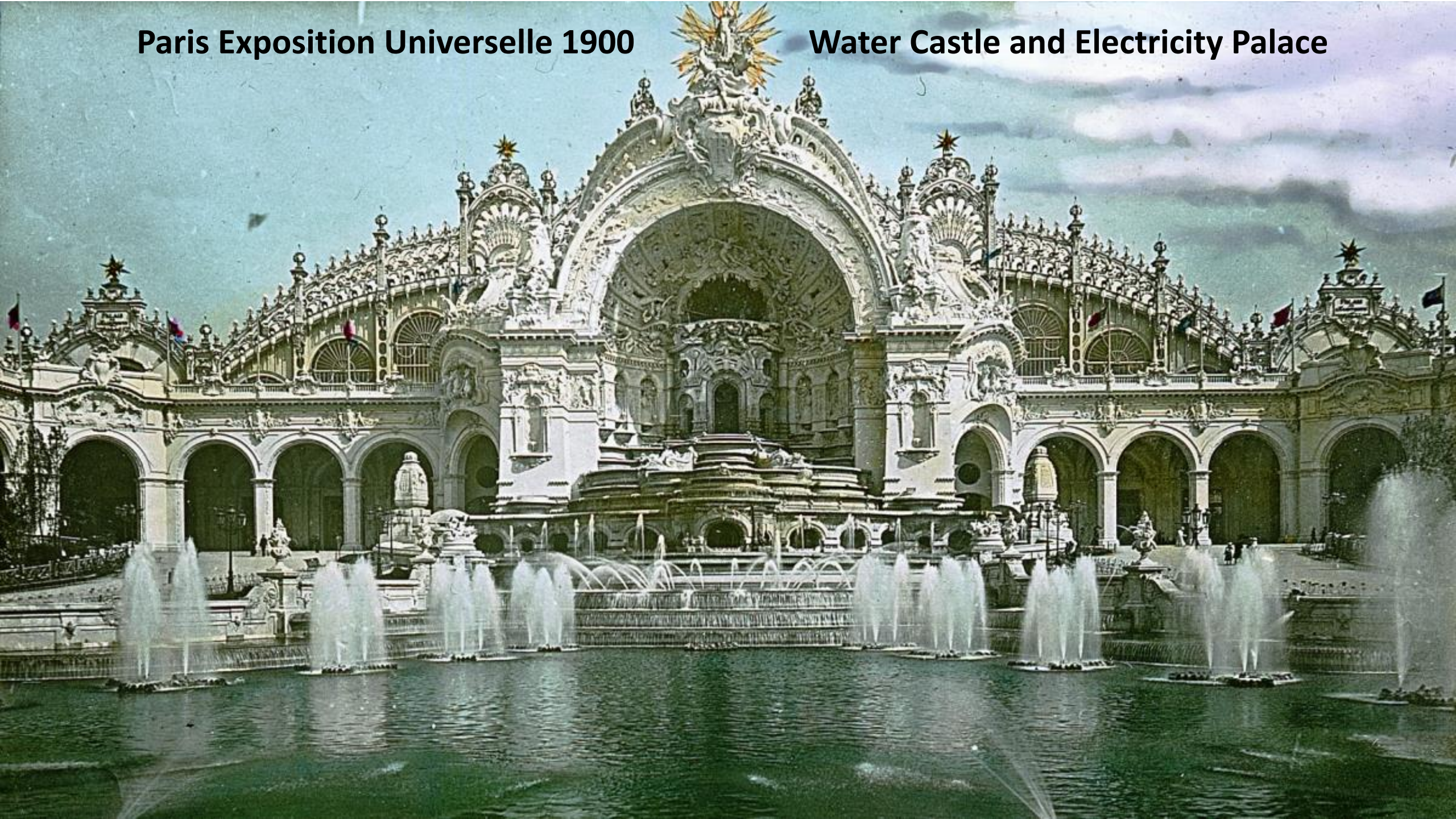


Nikola Tesla
Alternating current
George Westinghouse



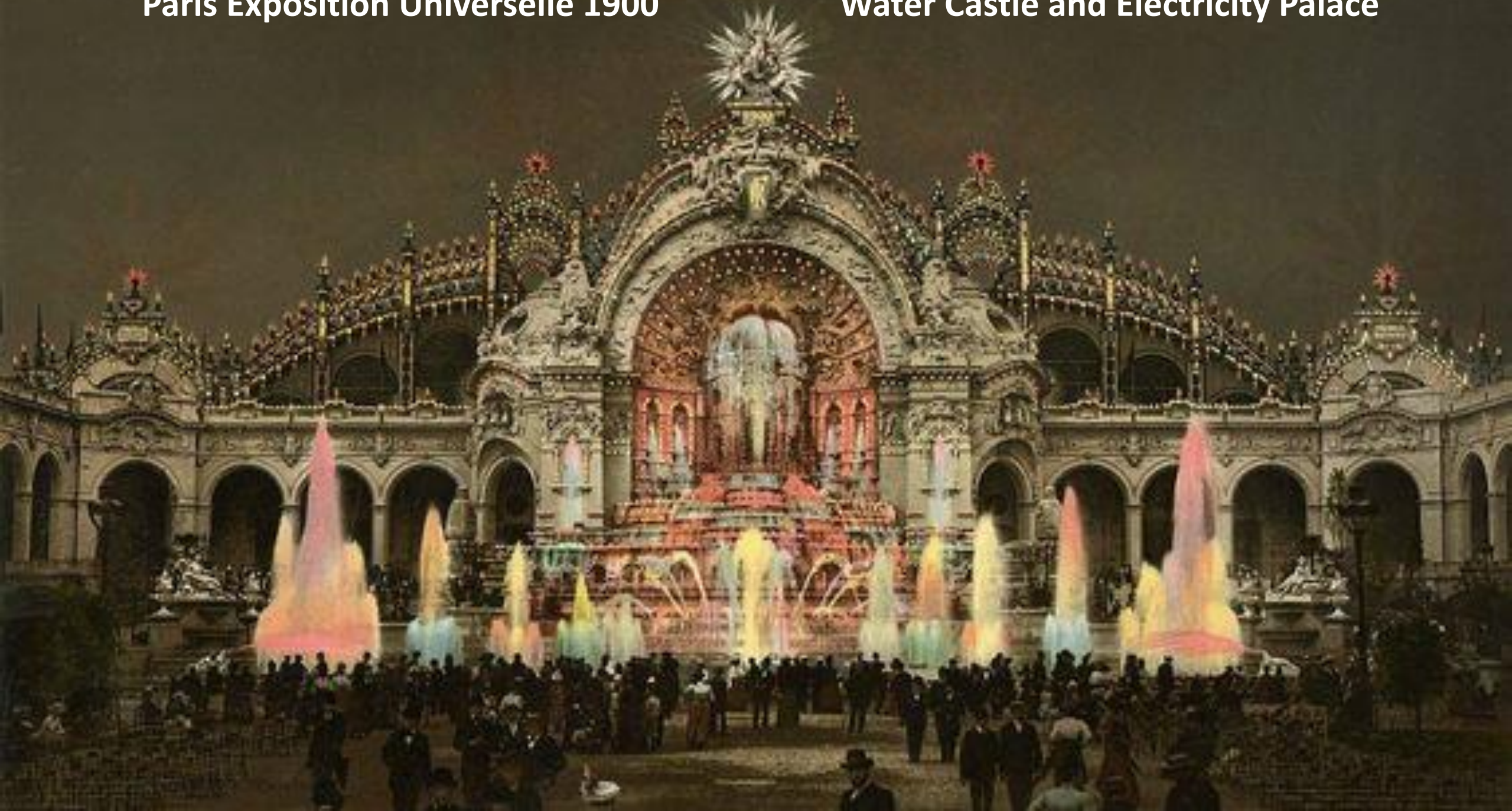
Paris Exposition Universelle 1900

Water Castle and Electricity Palace



Paris Exposition Universelle 1900

Water Castle and Electricity Palace



Paris December 2015

UN Climate Change Conference



Making electricity is a dirty business ...

70% from fossil fuels

#1 of CO₂ emissions

... and is fraught with inefficiency ...

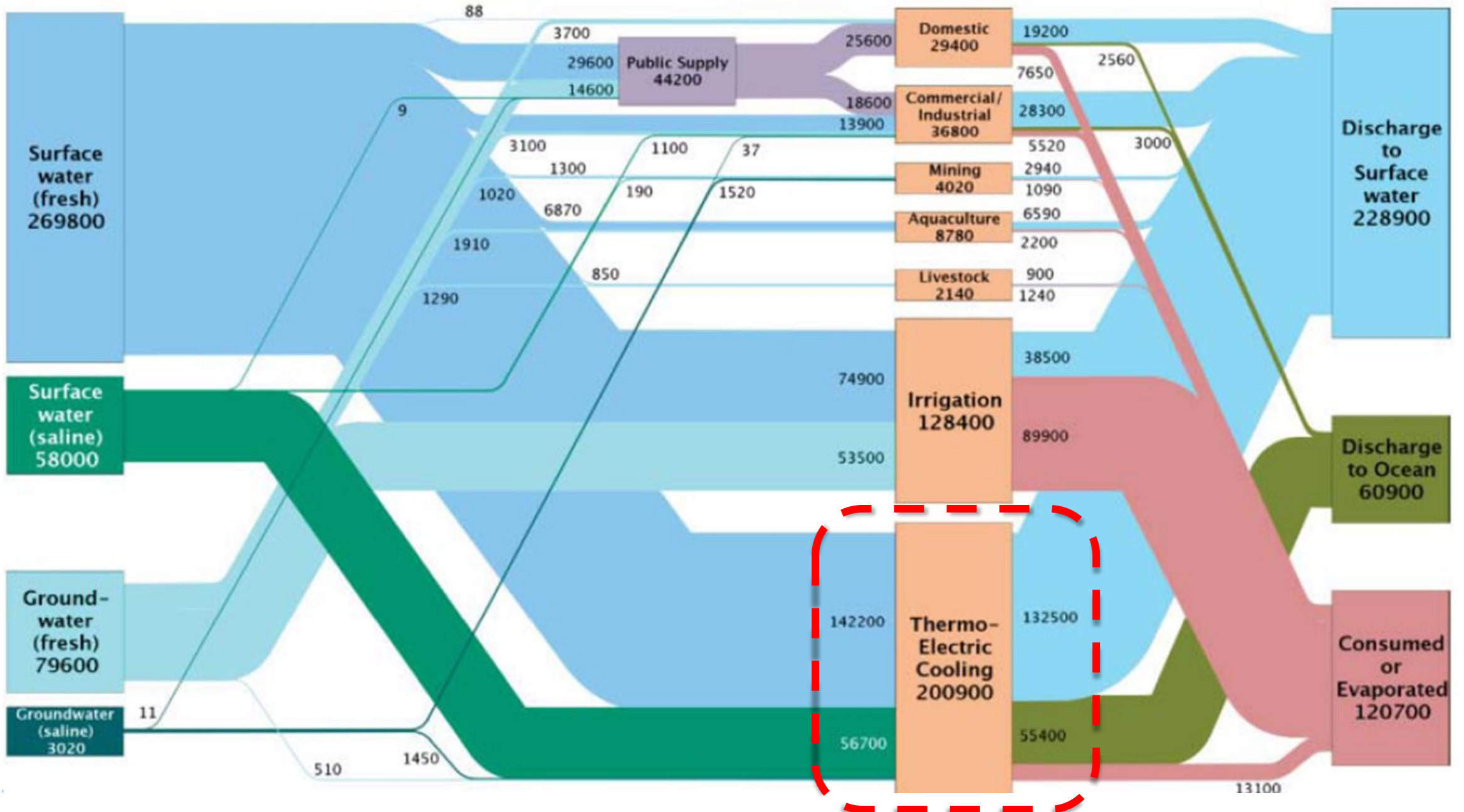
25% of distribution infrastructure and

10% of generation assets are used only

<5% of the year



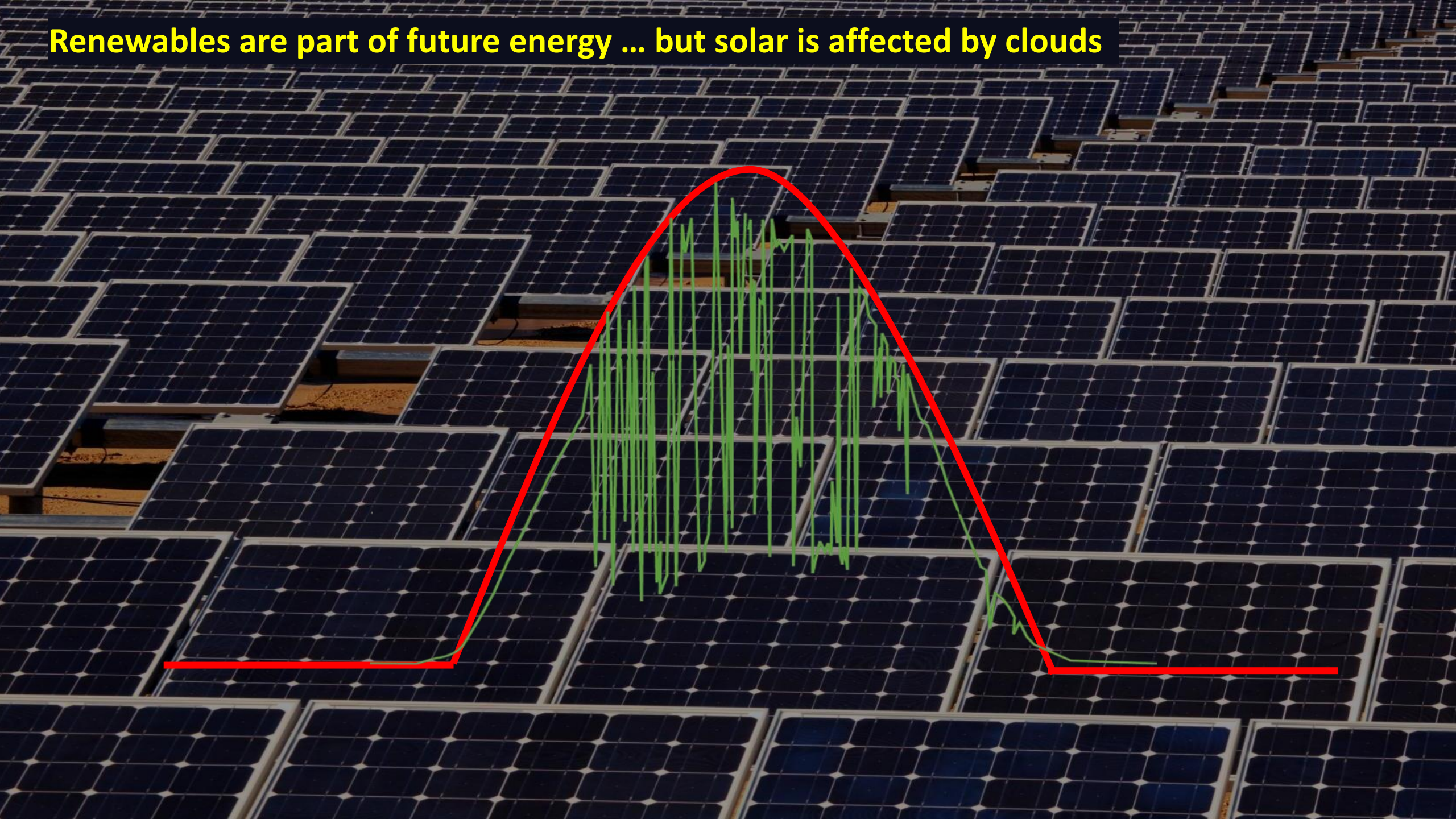
... and is very water intensive



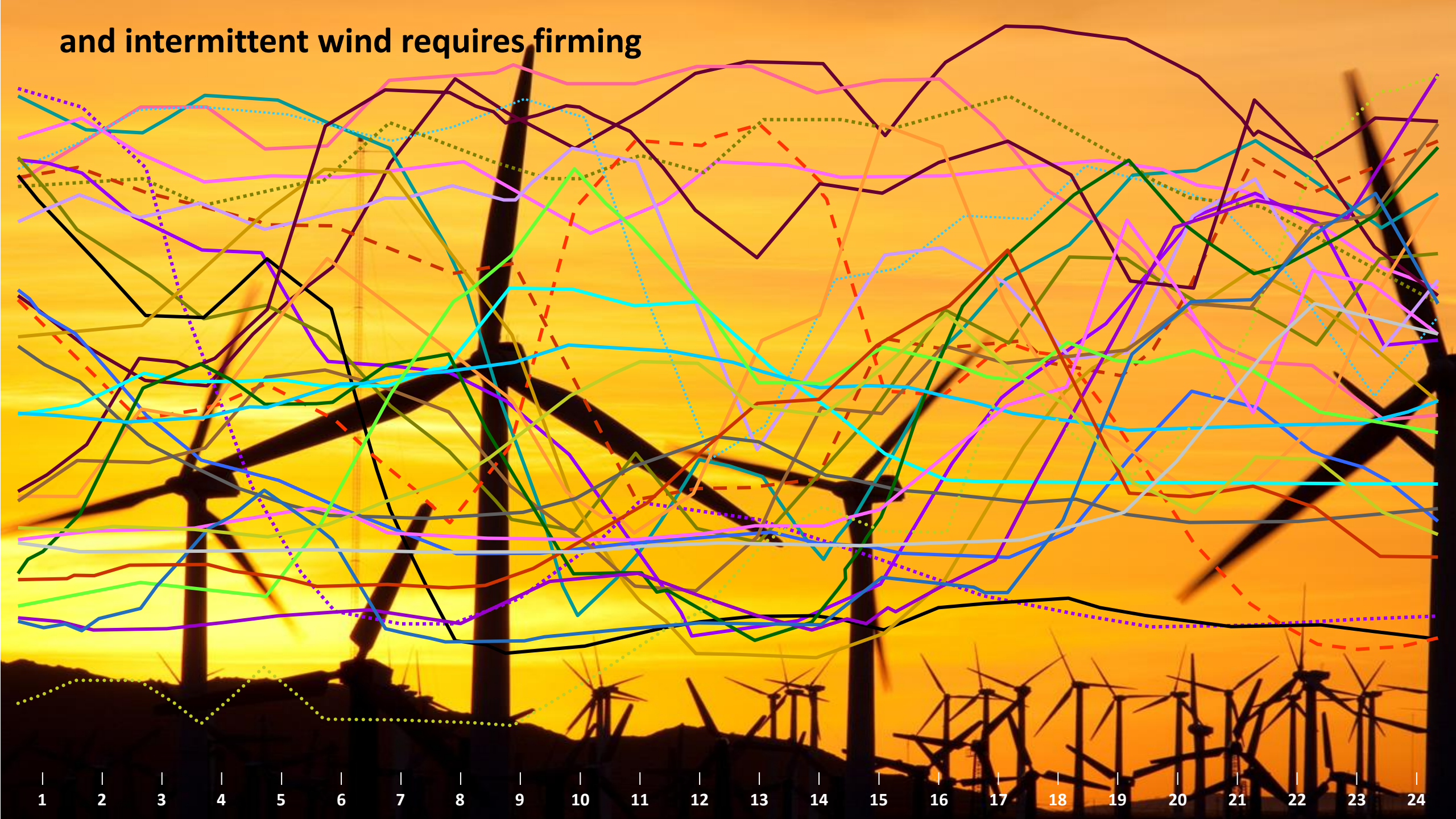
Astana Expo 2017 • Future Energy



Renewables are part of future energy ... but solar is affected by clouds



and intermittent wind requires firming

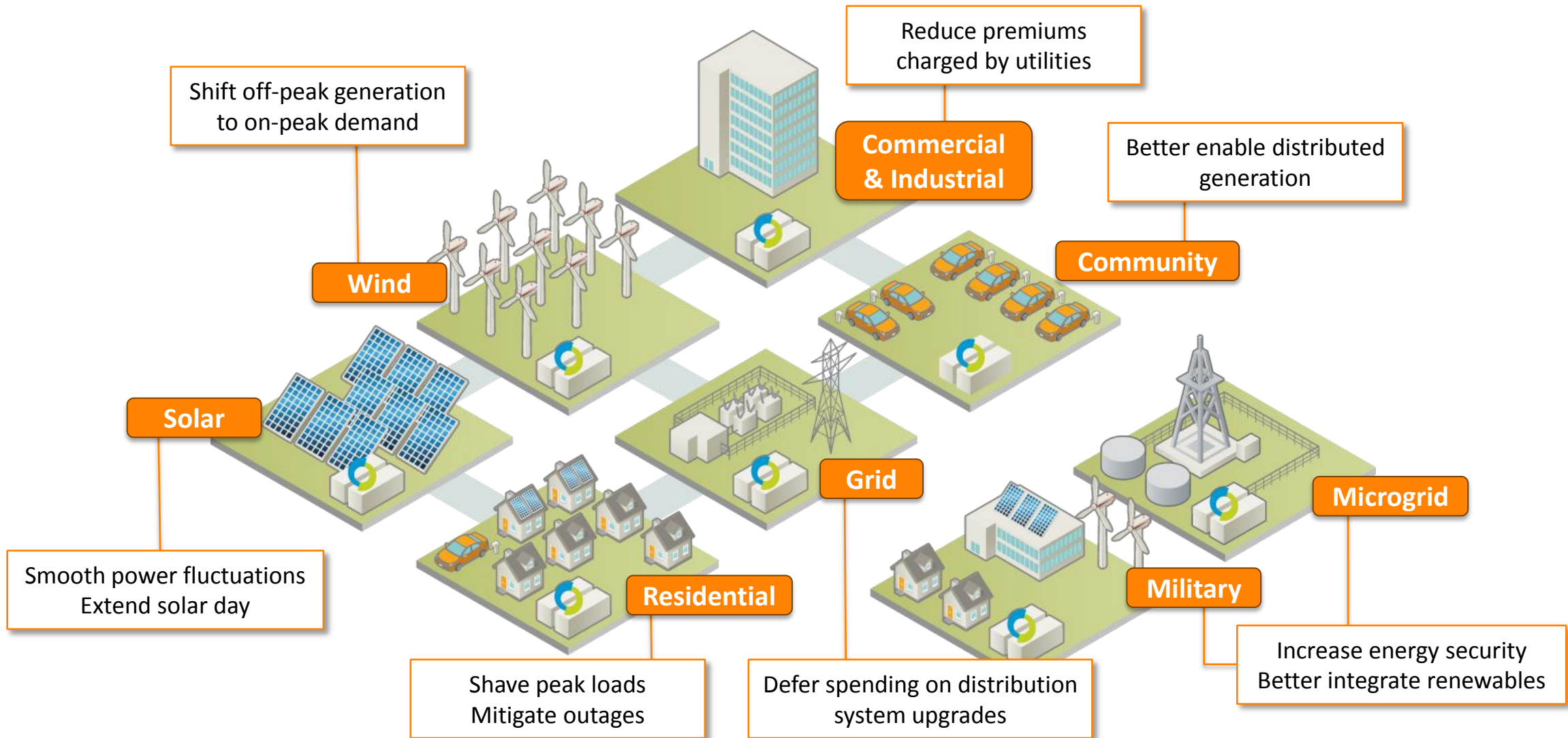


Electricity supply must always in balance with demand

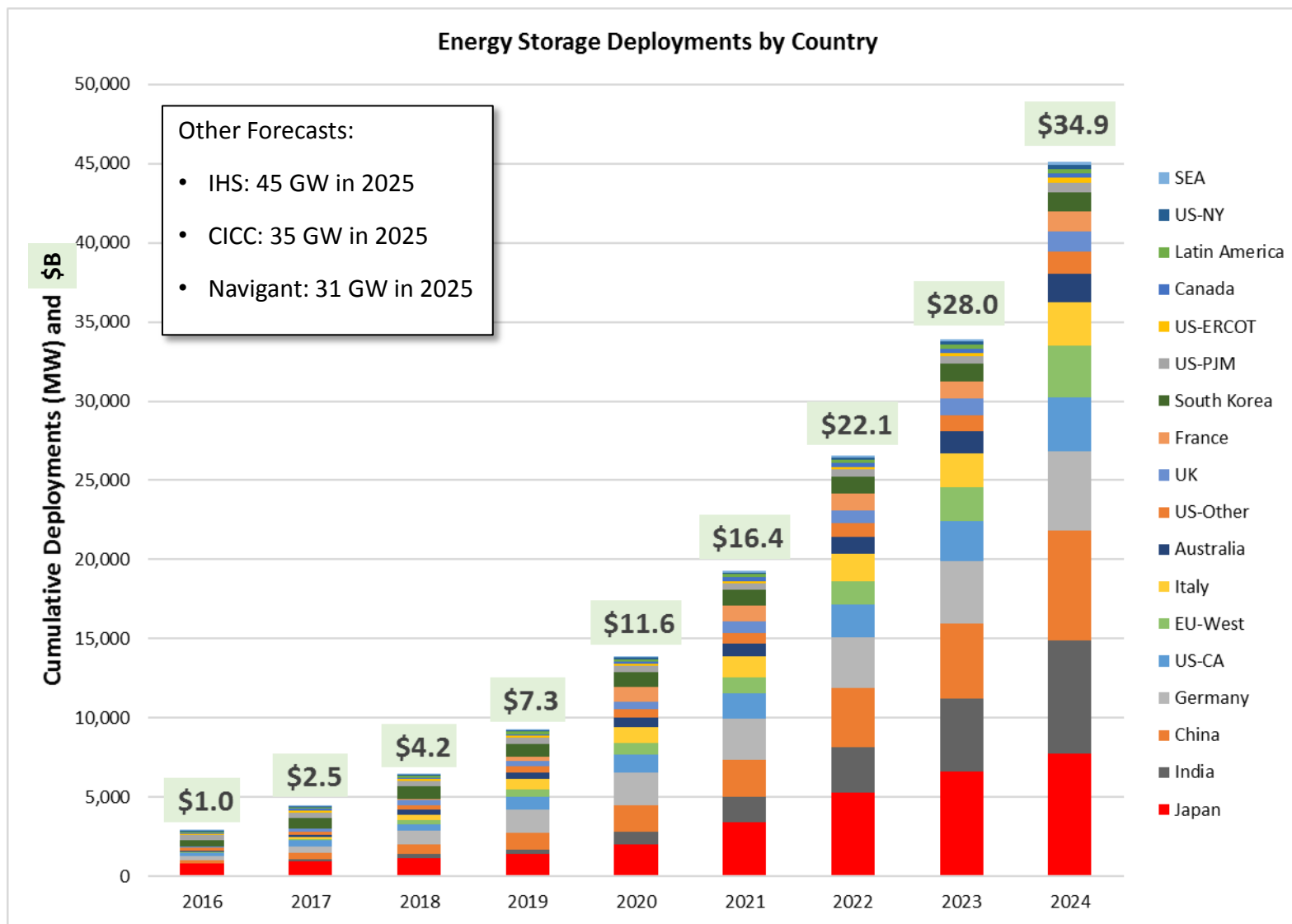


Energy storage systems are needed to solve critical electric grid challenges

Stationary storage market is growing to >\$30 billion in 2024



Stationary energy storage is expected to grow to >30 GW and >\$30B over next 8 years

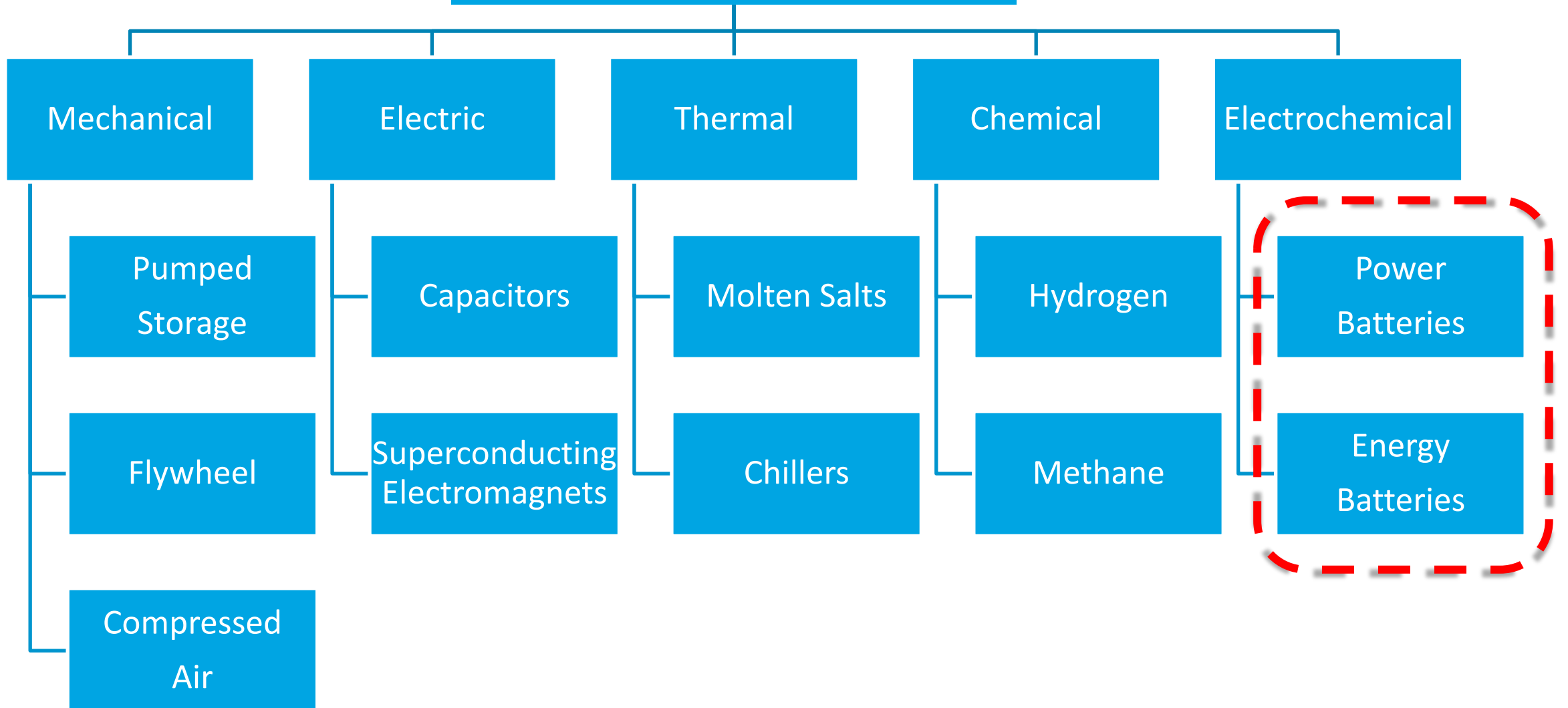


Goldman Sachs: The Great Battery Race

“The stationary energy storage opportunity is massive ... and virtually untapped”

October 18, 2015

Stationary Electrical Energy Storage



Miramar microgrid: demand charge reduction and energy security for critical facilities



Marine Corps Air Station Miramar
San Diego • California



Problem	High demand charges and grid outage
Solution	280 kW • 1,000 kW-hr EnergyPod®
Economics	80% reduction in demand charges, energy security

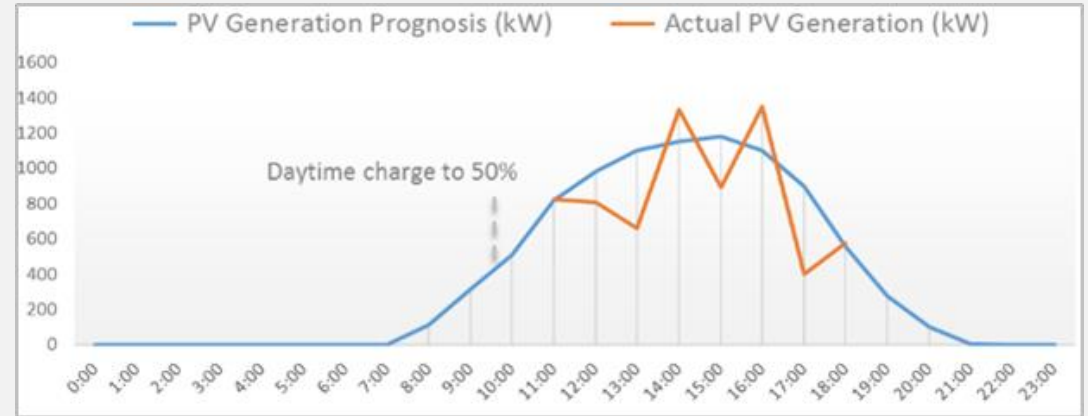
Data center backup at Microsoft

Redmond • Washington • USA

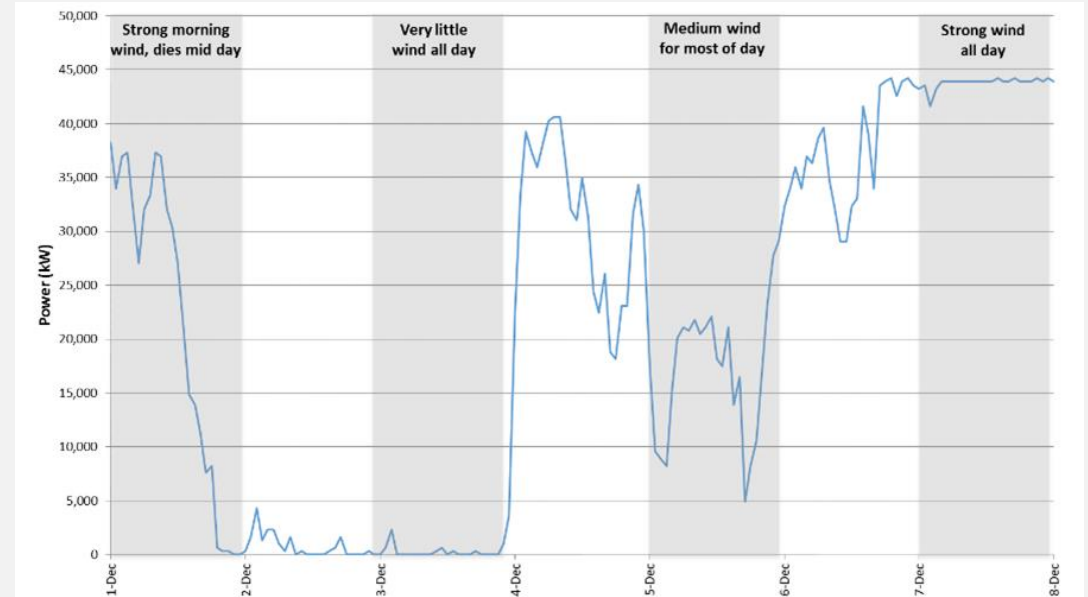


Utility renewable integration: Samruk-Energy

2 MW solar farm in Kapchagay



45 MW wind farm in Yereymentau



Primus EnergyPods are shipping to customers worldwide



 Current and future customers

Key stationary energy storage growth drivers

Increasing renewable penetration and changing electricity mix



- Solar PV added 46 GW in 2016 to 302 GW (+18%)
- Wind added 55 GW in 2016 to 487 GW (+13%)
- US coal plant retirements in 2015: 15 GW to 313 GW (-5%)

Climate and energy storage regulations



- Paris COP21 signed by 195 countries
- Renewable energy goals set by numerous nations
- Renewable Portfolio Standards in most US states
- California's AB2514: 1,325 MW of energy storage by 2020

Needed investments in grid infrastructure



- Grid investment not keeping up with electricity growth rates
- Distributed generation is challenging the historically unidirectional grid system
- Microgrids for energy security
- Smart grid initiatives

Vehicle electrification



- Vehicle and industrial electrification to reduce carbon and other emissions

Battery improvements



- Capital cost reductions
- Power and energy performance increases
- Improvements in battery cycle life



Dubai Expo 2020: connecting the minds, creating the future ...

