



Concentrated Solar Thermal
and Solar Chemistry Technologies
Athens, May 27th 2016

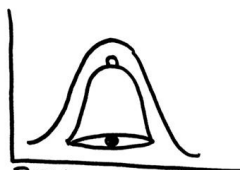
CST as part of the European 2030 strategy: Perspectives, barriers and potential

Professor Agis M. Papadopoulos

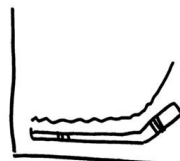


PEDL Aristotle University Thessaloniki
School of Mechanical Engineering
Process Equipment Design Laboratory

Gallery of Famous Curves



BELL CURVE
(population distributions)



HOCKEY STICK CURVE
(temperature + climate)



BATH TUB CURVE
(engineering failures)

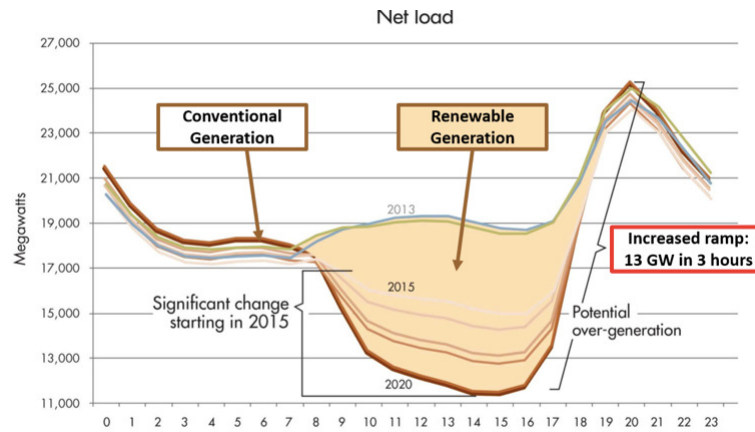


DUCK CURVE
(renewable challenge for grid)



Jordan Wirfs-Brock | Inside Energy

The Californian duck

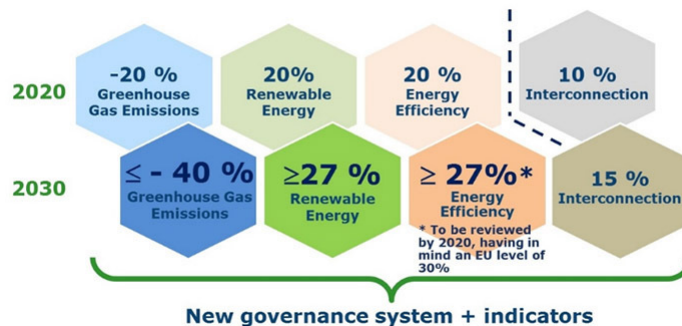


Net load curves for March 31, from 2012 to 2020, based on analysis by California ISO. Source: California ISO.



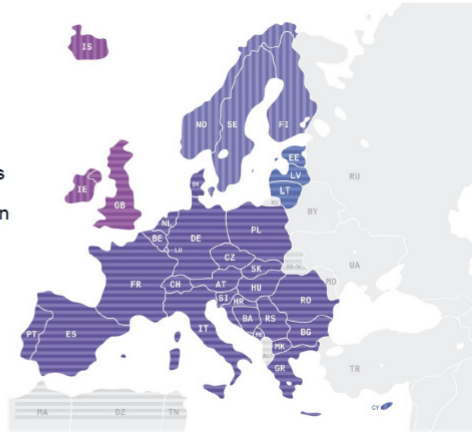
European goals for 2030

2030 Framework for Climate and Energy

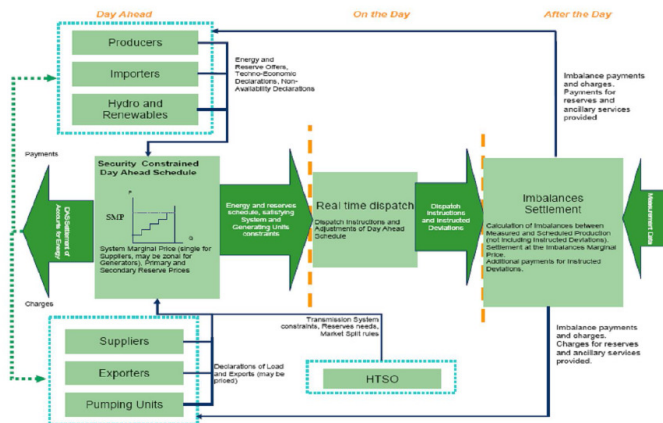


The unified European electricity market

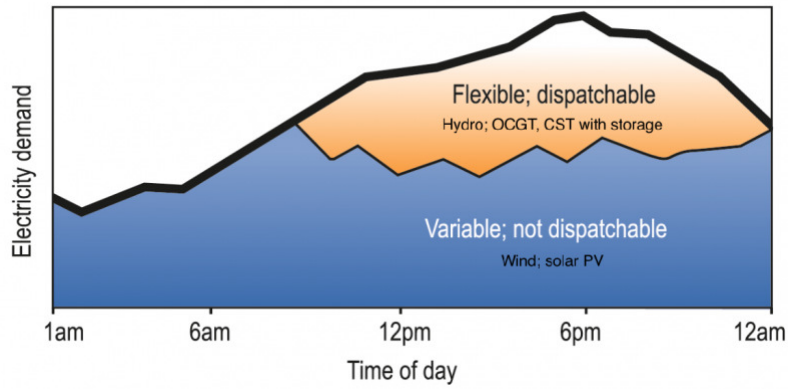
- 41 TSOs from 34 countries
- A trans-European network
 - 534 million citizens served
 - 910 GW generation
 - 305,000 Km of transmission lines
 - € 104 bil ten year investment plan
 - 3,400 TWh/year demand
 - 400 TWh/year exchanges
- A legal mandate
 - Regulation (EC)714/2009



Running the electricity market

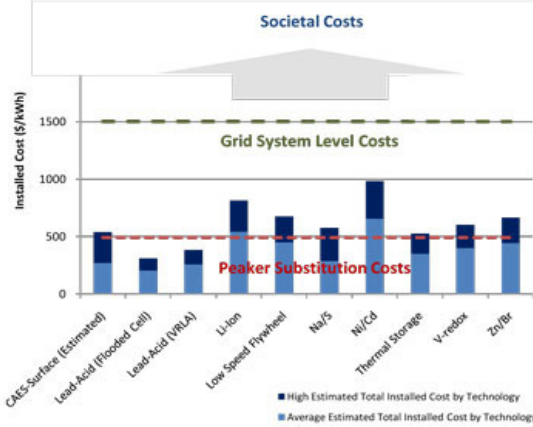


Making renewables base loaders



Energy storage: cost, price and value

Fossil Fuel Societal, Grid, and Peaking Costs vs. Energy Storage Costs^{1,2}



Avoided Costs Realized

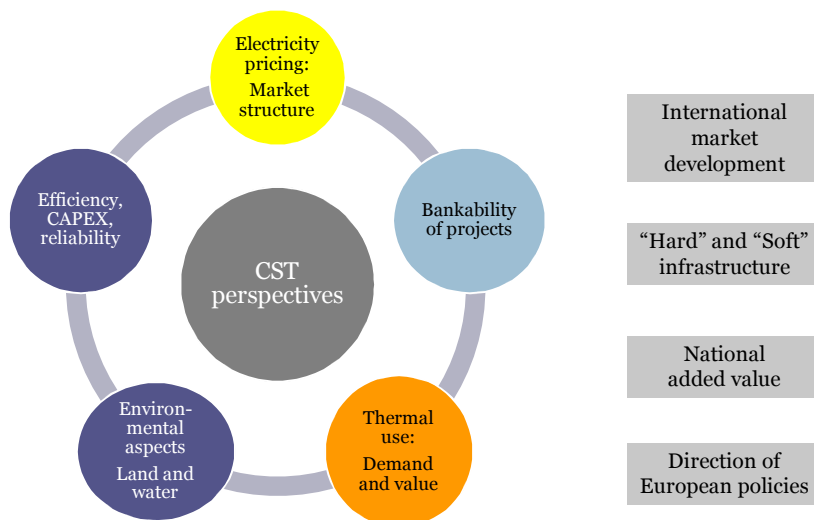
- Societal Level:**
 - GHG & Air Quality
 - Renewables Integration
 - Smart Grid Implementation
 - Streamlined Permitting
- Grid System Level:**
 - Electric Energy Time-Shift
 - Voltage Support
 - Electric Supply Reserve Capacity
 - Transmission Congestion Relief
 - Frequency Regulation
- Peaker Level:**
 - Peaker Plant Substitution



CST: A solution?



Yes - but there are points to be discussed



One more curve: Where does CST stand?

Gartner hype cycle.

