



Energy Storage Systems in Emerging Smart Grid Applications

October 22nd 2009



Presentation Outline

- A123 Systems Overview
- Our Challenge
- Smart Grid Vision
- Renewable Sources
- Critical Business Issues
- Energy Storage Requirements
- Digital Interface and Controls
- Conclusion



A123 Systems Energy Solutions Group

- Who we are
- What we do
- Grid/Stationary systems
 - Frequency Regulation
 - Spinning Reserve
 - Wind and PV Ramping
- Transportation
 - EV
 - PHEV
 - HEV

Example of Current Smart Grid Product

Clip 1.mov

Clip 2.mov

Our Challenge

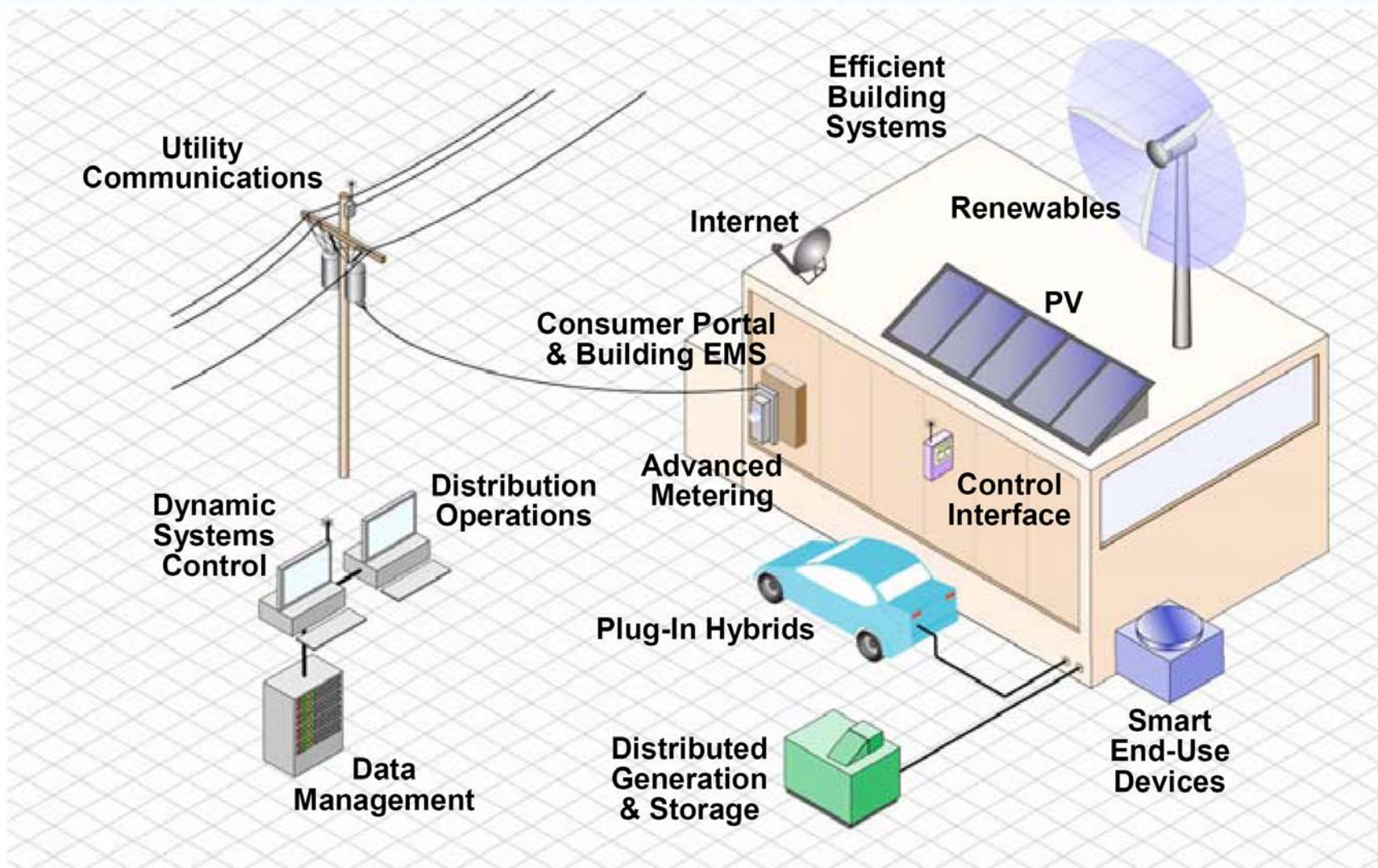
- Enabling energy independence and CO₂ reduction by reducing fossil fuel consumption and facilitating more renewable sources on the grid
- Entering a market with game changing technology
- Market is in a state of major change/evolution (Regulatory, technology and economic)
- Business: Cost of the technology has to provide value to end user
- Depending on the region, energy demand is rising at a rate between 2.2% and 4.9% each year
- No clear unified standards



Smart Grid Vision

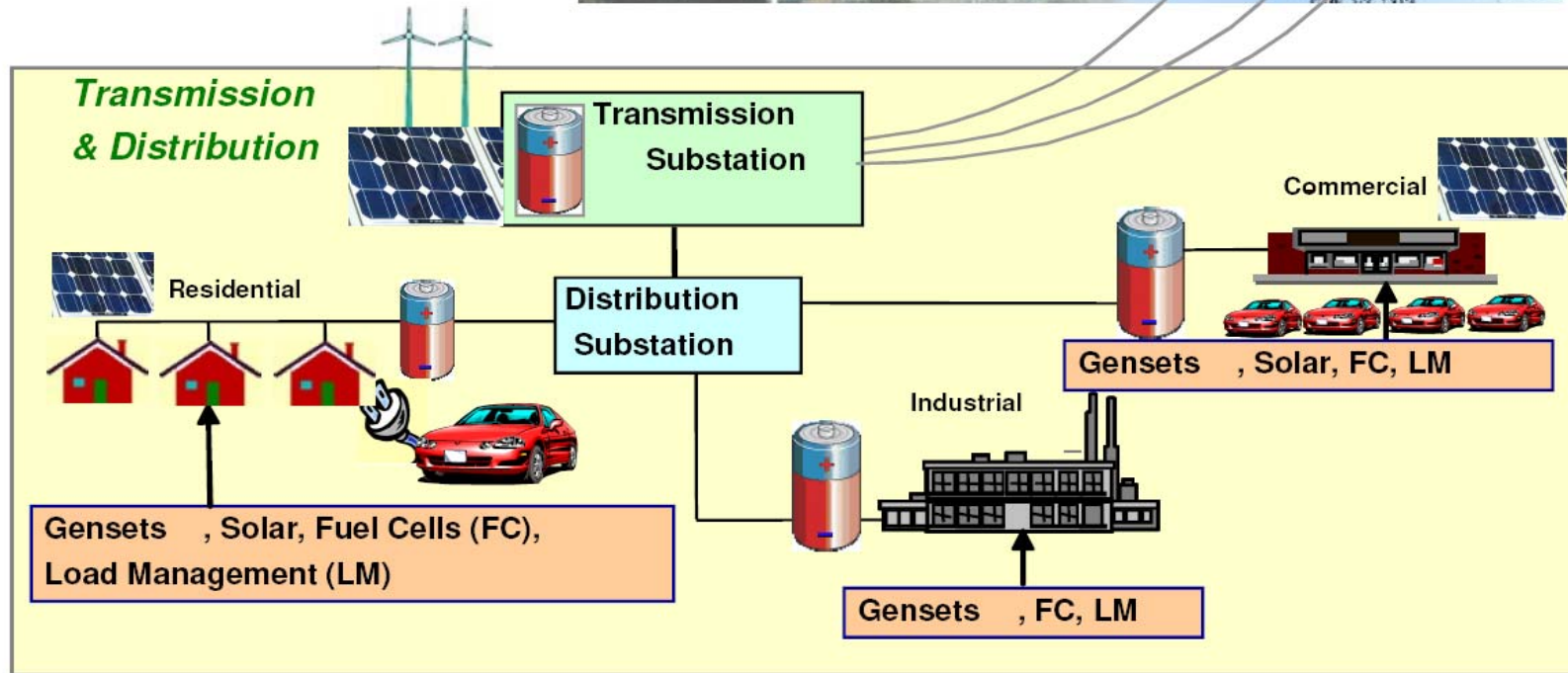
- What is a Smart Grid? What does it do?
- Thinking about building Smart Grids is similar to saying that we are going to “build the internet”
- Opportunities expand and technology matures
- Current infrastructure limits what is currently achievable
- Cost of capital investment requires long term deployment of smart grid assets (The investment needs to be capitalized over a long period of time)

Smart Grid Concept, Electric Power Research Institute



Source: EPRI

Smart Grid Concept, American Electric Power

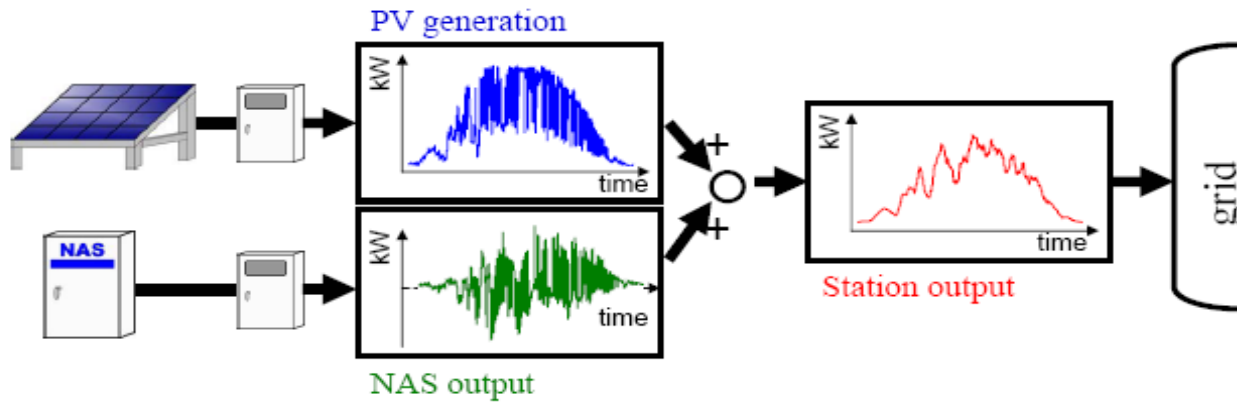




Renewable Sources

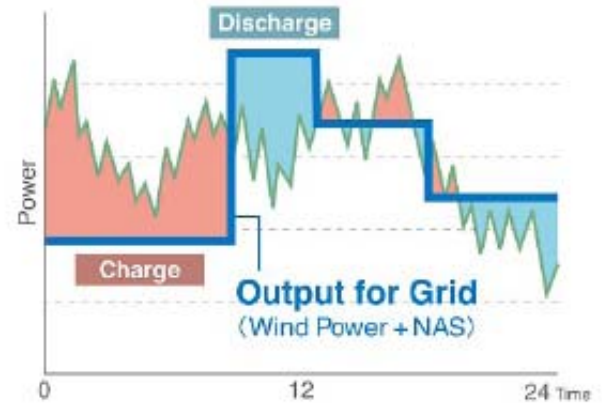
- Legislation is driving deployment of renewable assets
- Differences in renewable sources generate different energy storage requirements. Some need short term smoothing and most could use long term storage.
- Variety of renewable sources presents a significant challenge for energy storage systems
- Energy storage enables the creation of viable renewable solutions.

Renewable Integration Challenges and Solutions (Japan)



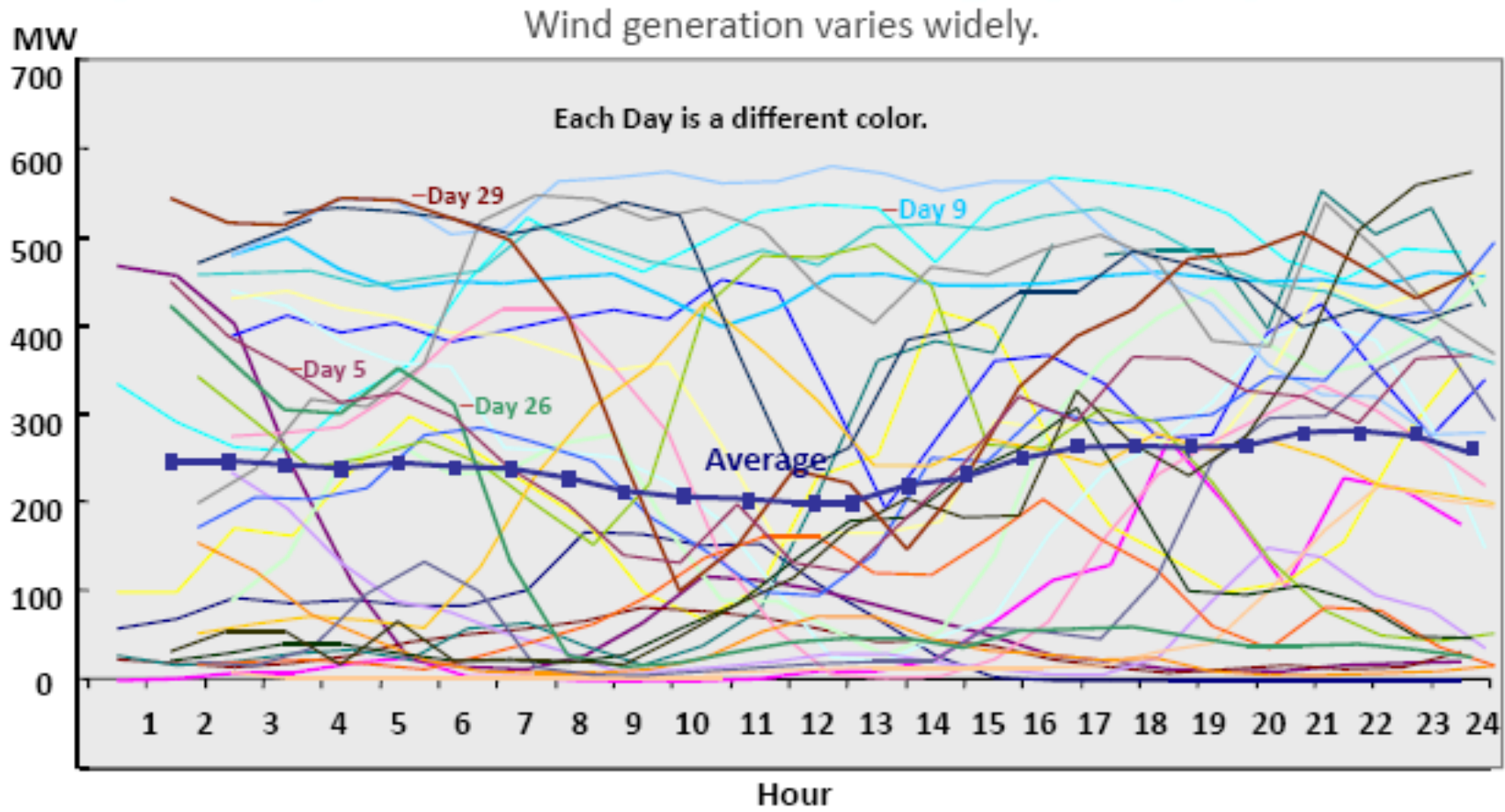
*STORAGE for
PV Integration*

*STORAGE for
Wind
Integration*



From, Hara /Hokkaido Univ., Nakama,/NEDO, 2008 Symposium on Microgrids, June 2 2008

Renewable Integration, CA Wind Challenge

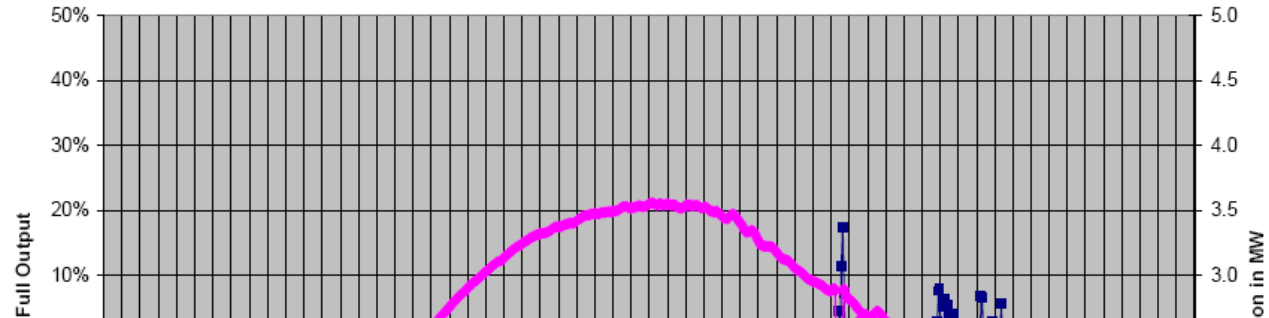


Source: California Independent System Operator

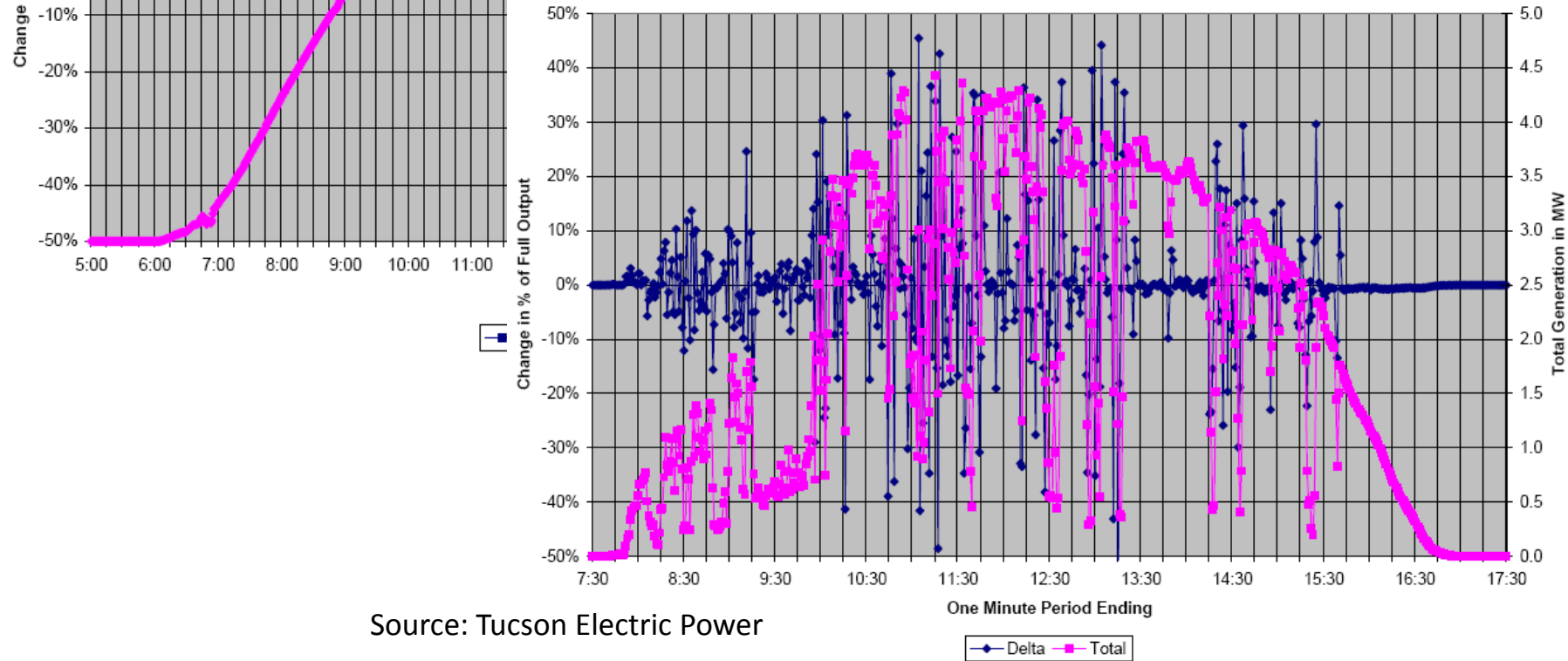
Renewable Integration, AZ PV Challenge



SGSSS 08/11/2004 1 Minute Power Changes for the Full System



SGSSS 12/3/2006 1 Minute Power Changes for the Full System



Source: Tucson Electric Power

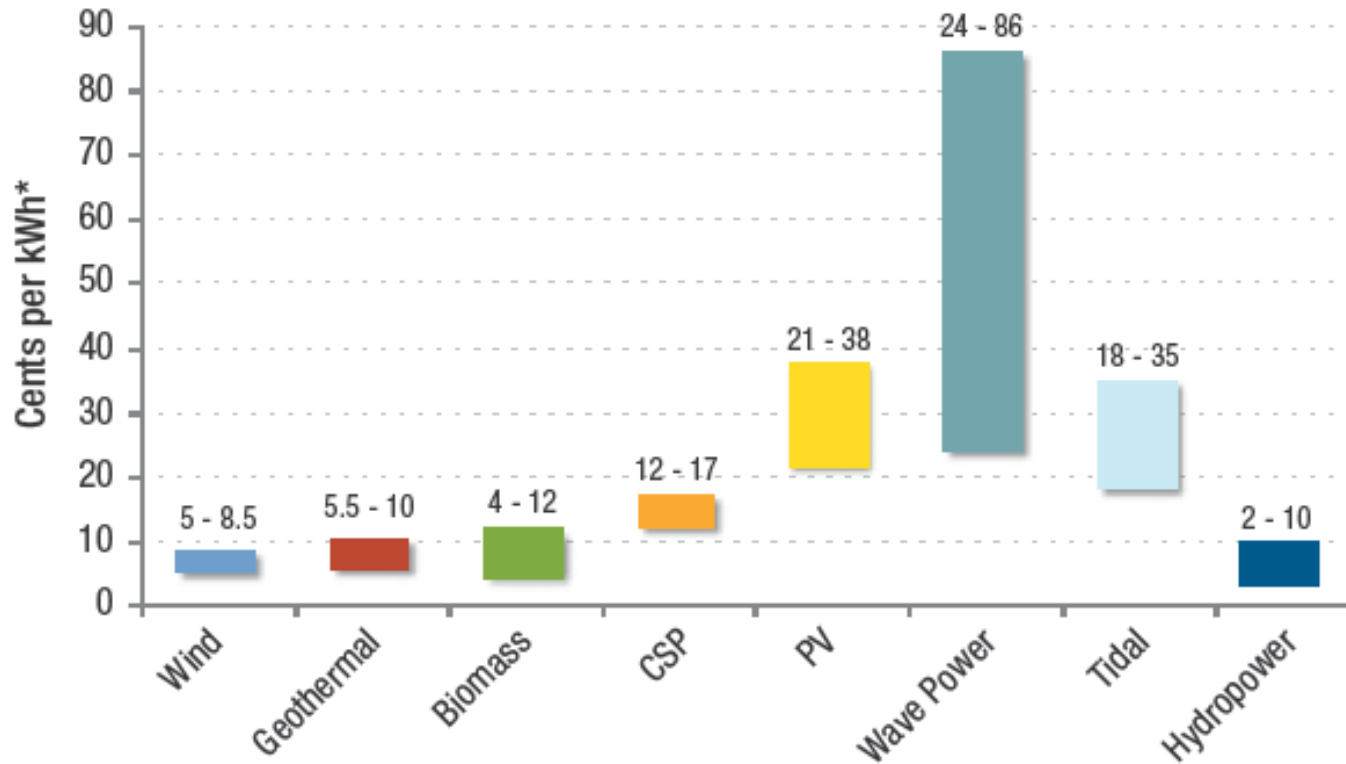


Critical Business Issues

- Cost of the technology must provide value to each consumer.
- Solutions must be flexible enough to be compatible with both today's systems as well as tomorrow's. (Asset lifecycle)
- Dynamic buy / sell prices will significantly impact how technology is deployed
- Federal incentives have the ability to be a significant catalyst in the deployment of new enabling technologies

Cost of Renewable Technology

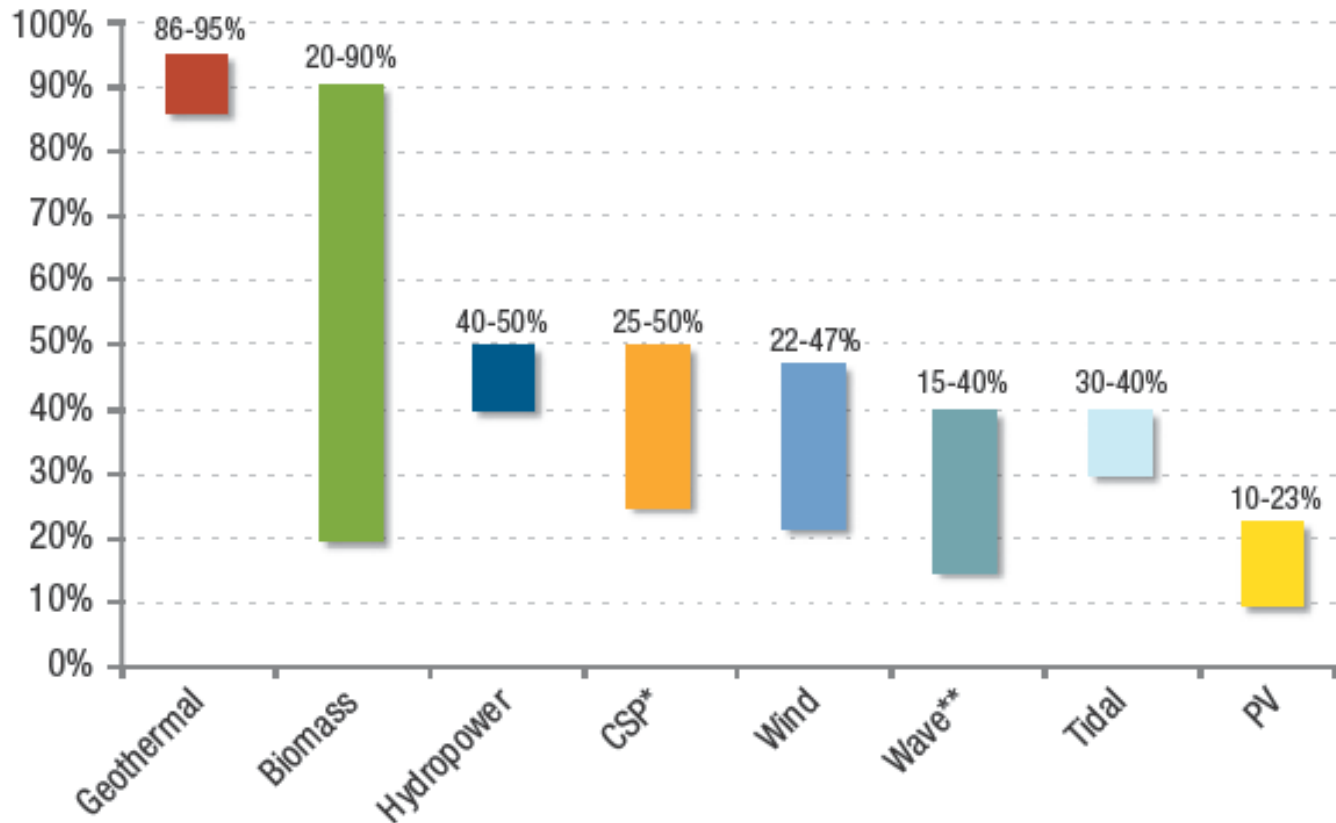
Price Range of Renewable Electricity by Technology (2007)



From Renewable Energy Data Book, DoE EERE, Sept. 6, 2008

Cost of Renewable Technology

Capacity Factor for Renewable Resources (2007)



From Renewable Energy Data Book, DoE EERE, Sept. 6, 2008



Energy Storage Requirements

- “Ramping” pre peak demand into and through peak demand (Energy/Cycle life)
- “Frequency Regulation” for grid frequency stability (Power)
- “Spinning Reserve” (Power, Energy, and Life)
- Intelligence of new battery systems allow for increased availability and accessibility not previously leveraged in legacy battery systems.



Digital Interface and Controls

- Digital protocol
 - Lack of standard
 - HW layer
 - SW layer
 - Reach or control of local networks.
 - Security
- Digital boundaries may not be the same as power transmission or business boundaries
- Each type of resource deployed with have a finite response time and energy capability.



Conclusion

- System's approach required to successfully identify and map out future energy storage system requirements.
- Energy storage assets must be flexible enough to withstand the rapid evolution of Smart Grid technologies.