



Grid Transformation in the United States of America

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President, US National Committee

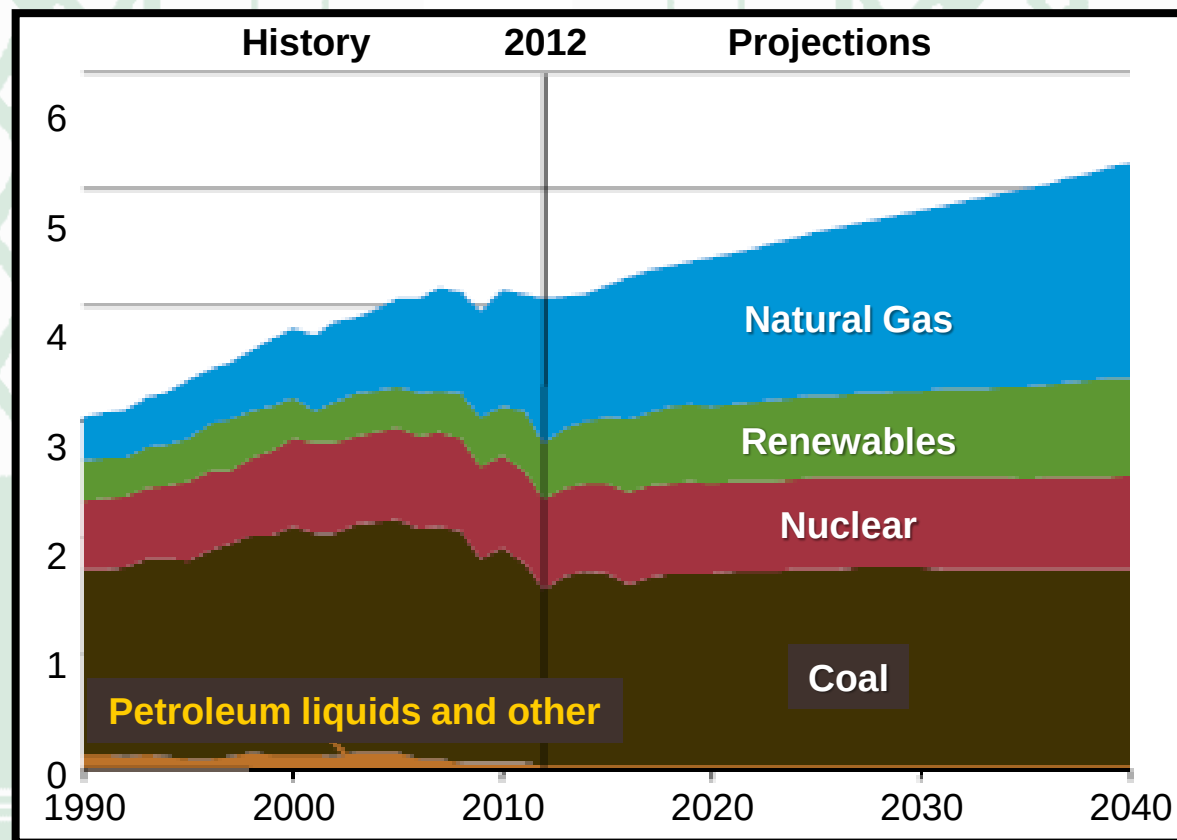
CIGRE

August 2014



US Electricity Generation Transformation

Trillion
kWhs

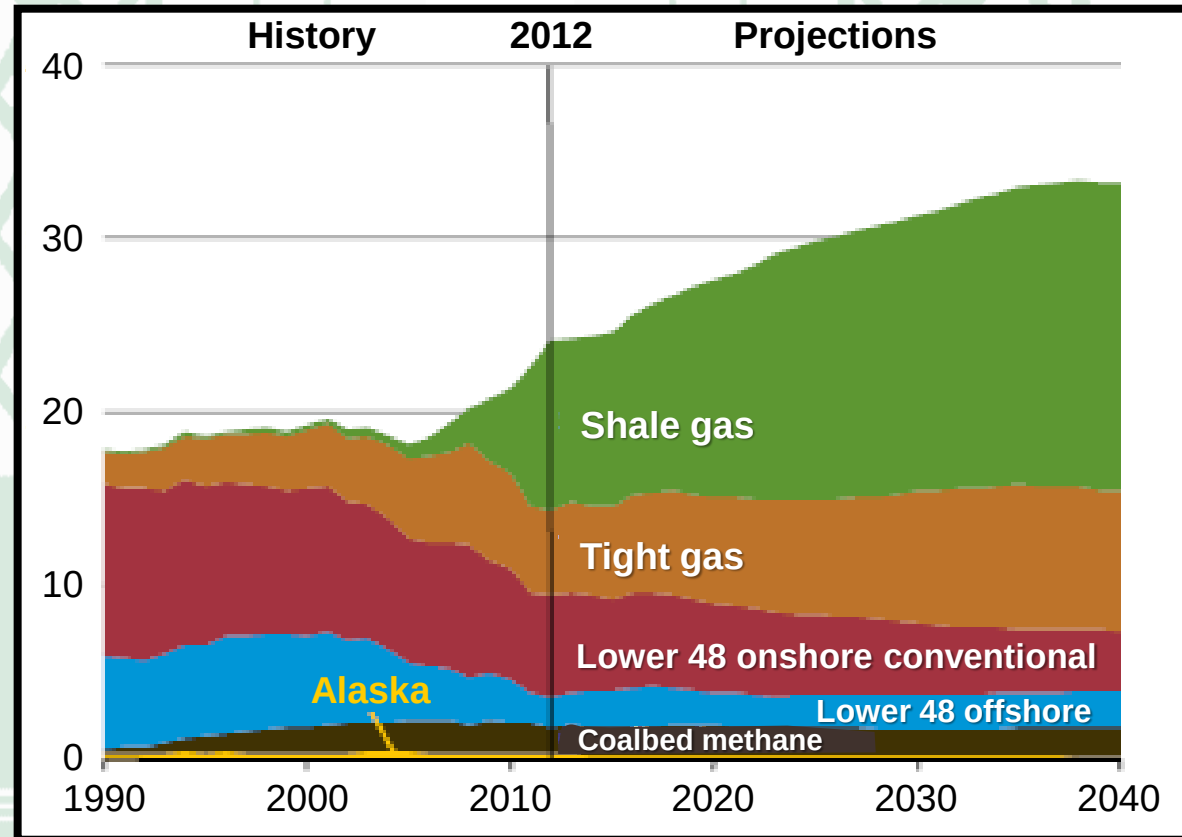


GAS Exceeds COAL in 2035; 50+ GW COAL Retired
More COAL Retirements Probable; NUCLEAR Stressed



US Electricity Generation Game Changer – Shale Gas

Trillion
Cubic
Feet



Shale Gas Supply Boom; Potential LNG Exporter
U.S. Nears Goal of Energy Independence

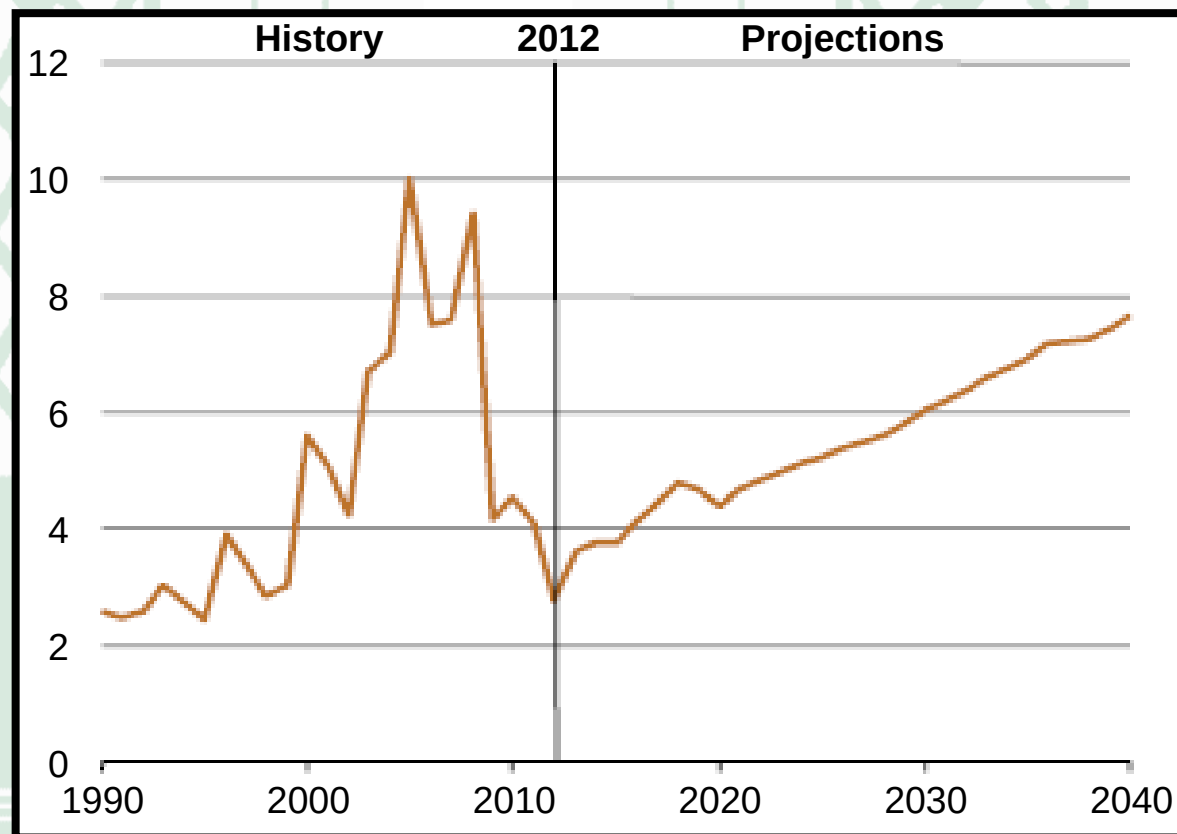


US Electricity Generation

Gas & Market Prices Drop

Henry Hub
Spot Natural
Gas Prices

2012
\$/MBtu



Market Prices Stress Coal and Nuclear Economics
Lower Prices Create Headroom For Grid Modernization

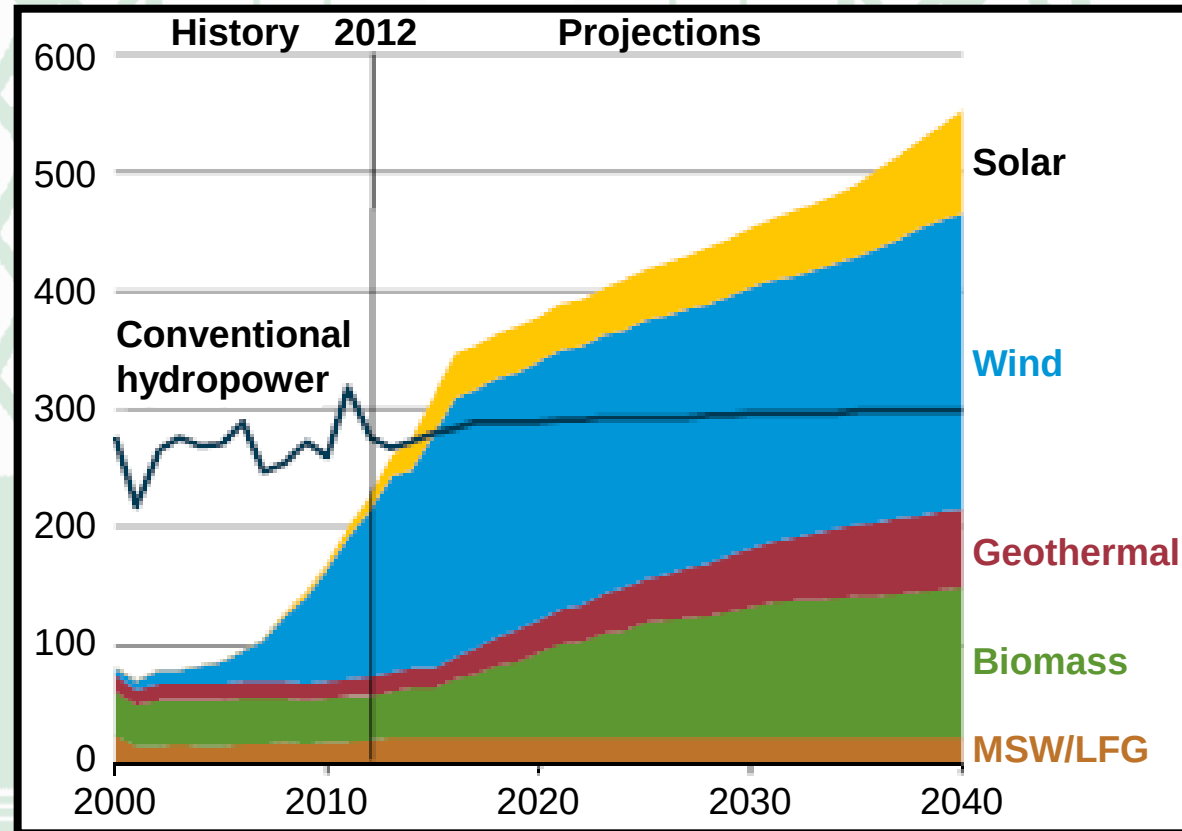


US Electricity Generation

Renewables Advance

Billion
kWhs

Includes
Distributed
Resources

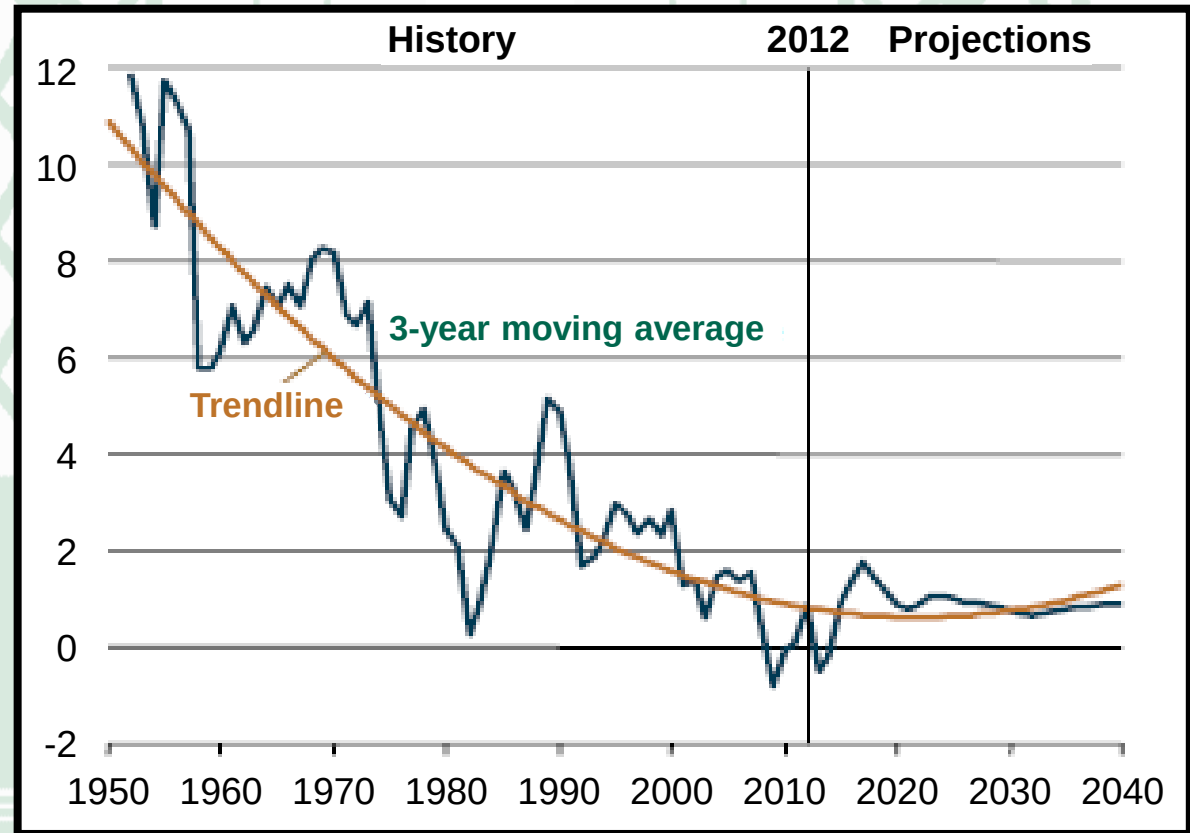


Non-Hydro Renewable Sources Grow 3.2% Annually
Game Changer – Solar Grows 7.5% Annually



US Electricity Demand Stagnation

% Growth



2012 to 2040 > Typical Home Down 4% (to 11.6 MWh/yr)
2012 to 2040 > Lighting Down 65%

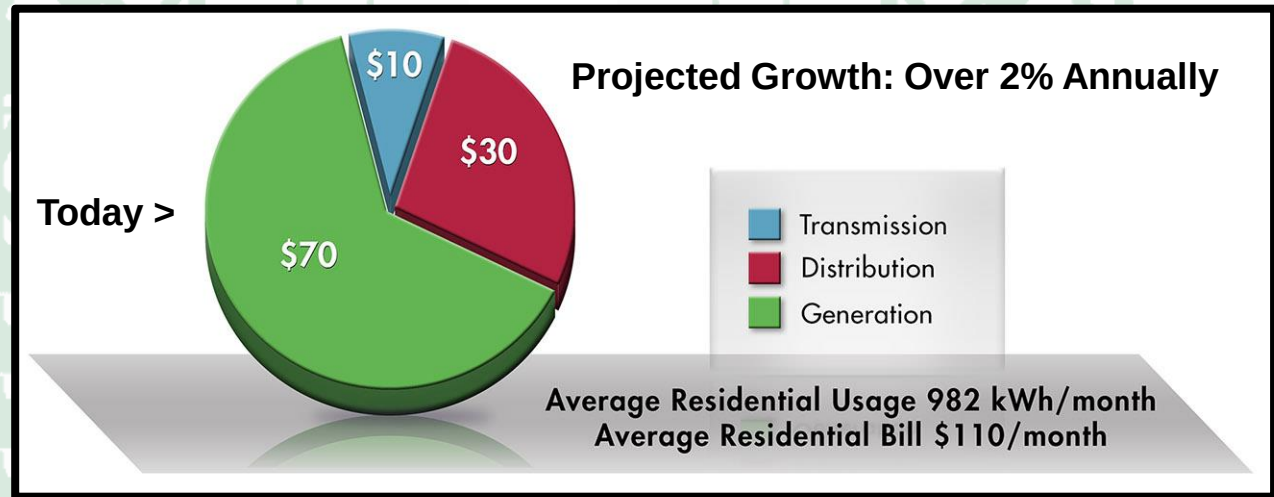


US Utility Business Model At Risk

Stagnating
Demand

Behind
Meter
Resources

Increasing
Costs

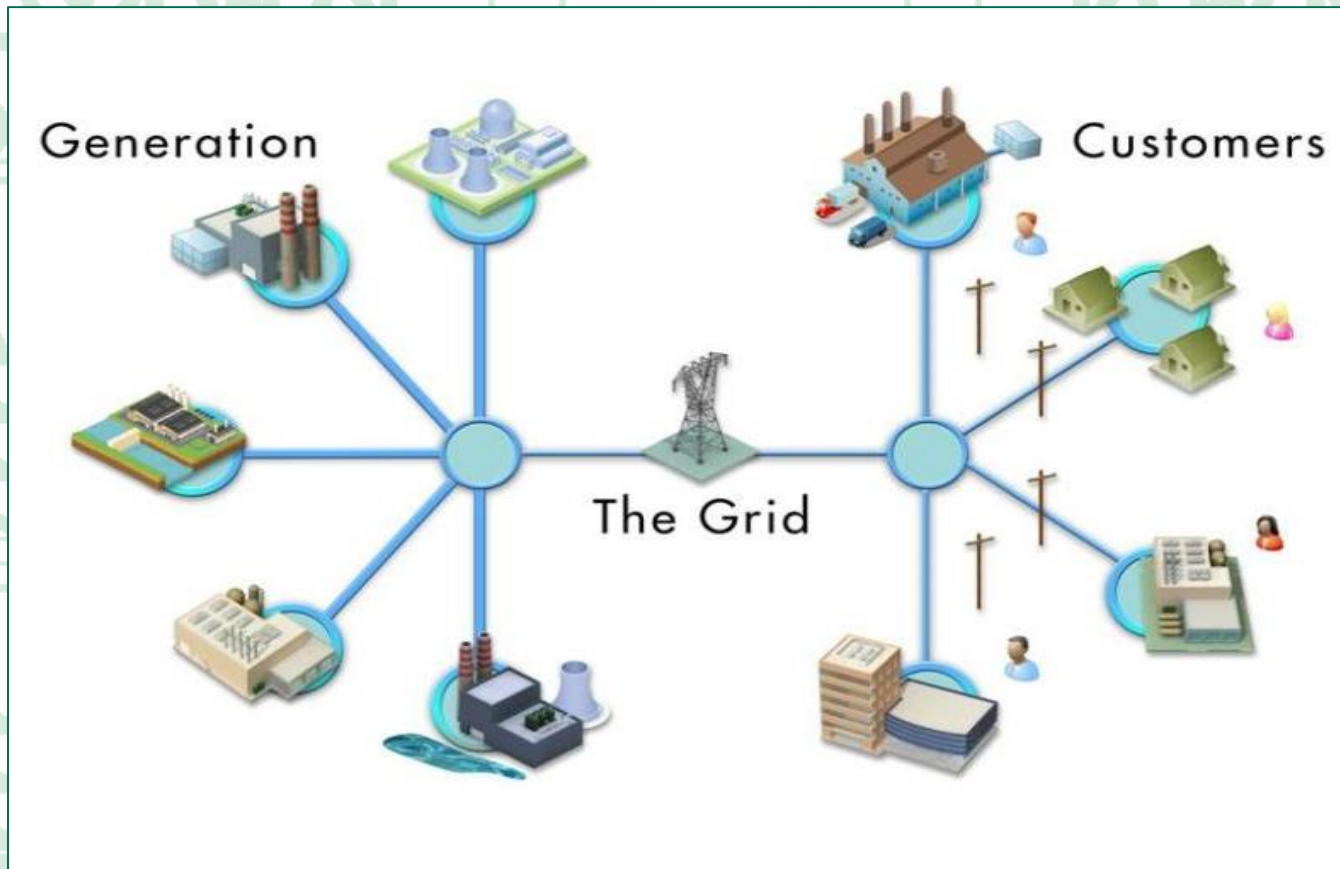


“Rate X kWh” Model at Risk?

Threat or Opportunity?

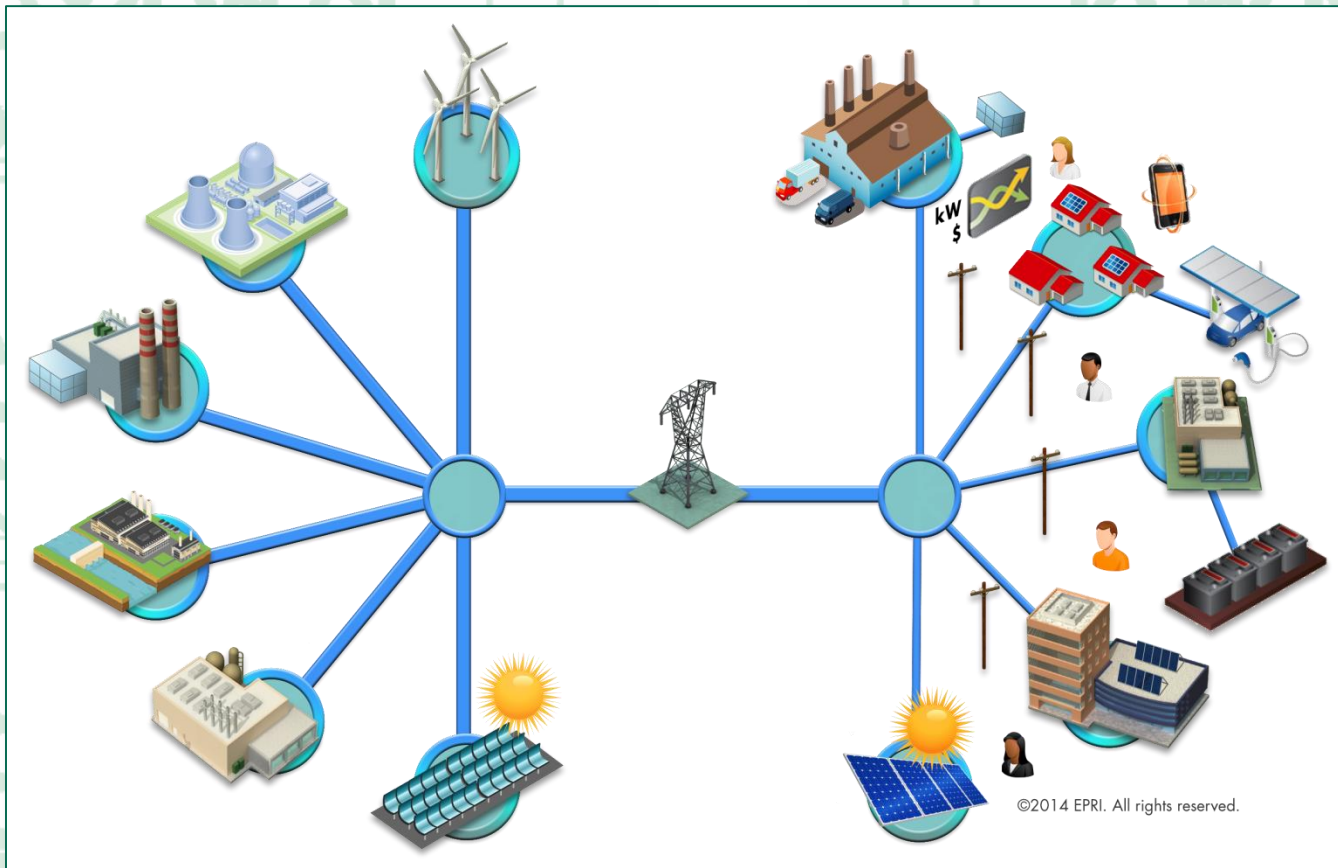
Possible Future: **Fixed Charge for Grid? Variable for Supply?**
Price for Packaged Energy Services?

US Grid Yesterday



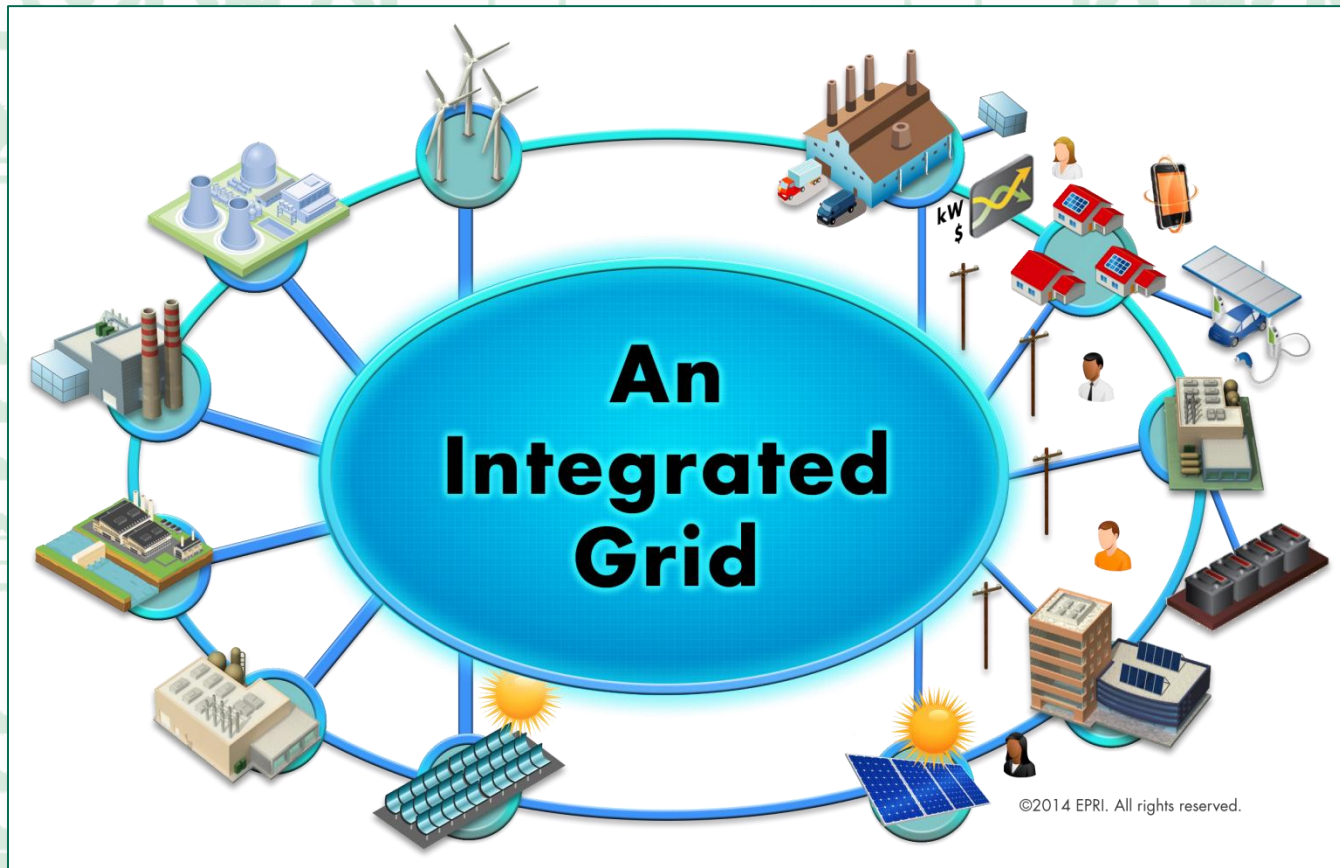
**Grid Yesterday: Generation to Wires to Customers;
100+ Minutes Out Per Year “OK”**

US Grid Today



Grid Today: Generation to Wires to Customers; Some Behind Meter Resources; Better Reliability Demanded

US Grid Tomorrow



**Grid Tomorrow: Seamless Macro and Micro Coordination;
21st Century Reliability; Energy Packages; Opportunity!**



US Grid Tomorrow

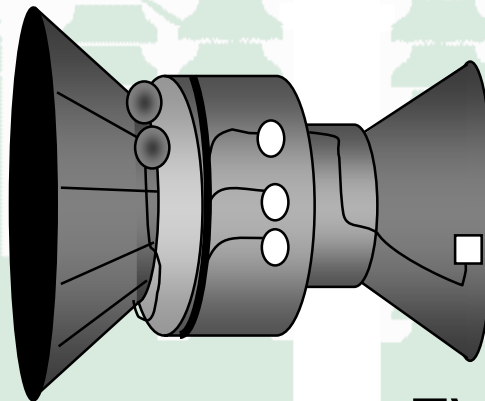
Rooftop Solar



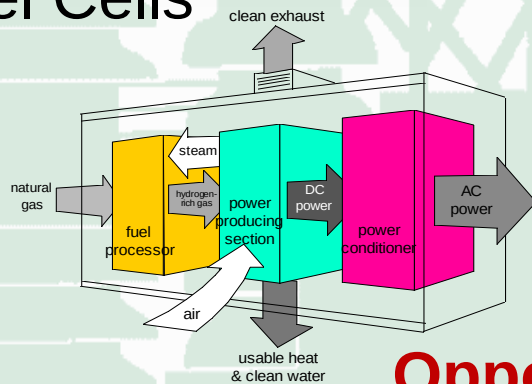
Storage



Micro-Generation



Fuel Cells



EVs



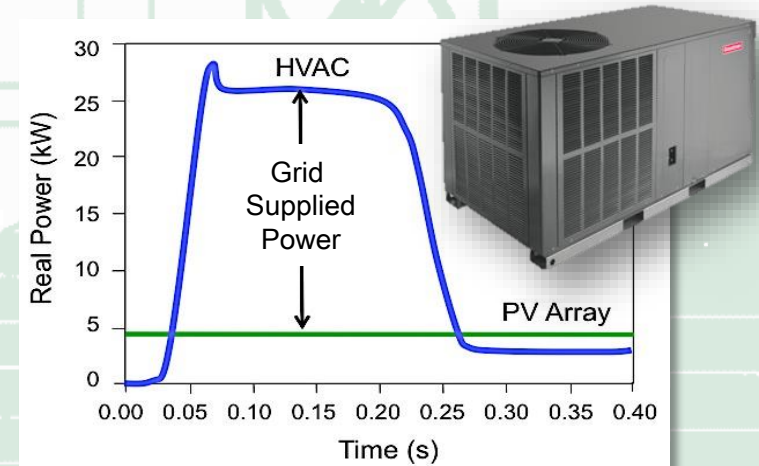
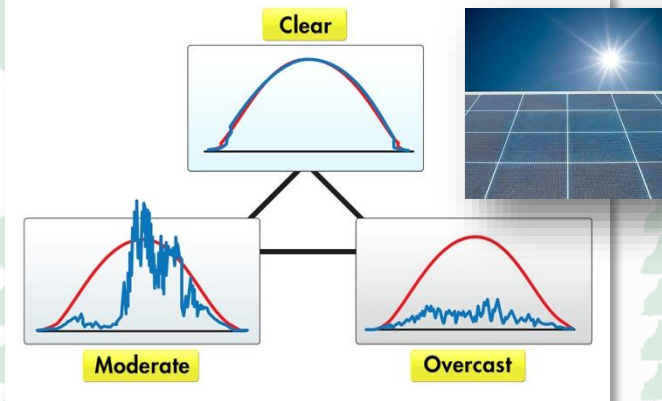
Opportunities to GROW !

Grid Tomorrow: Distributed Energy Resources Will Compete or Complement Central Station Resources?

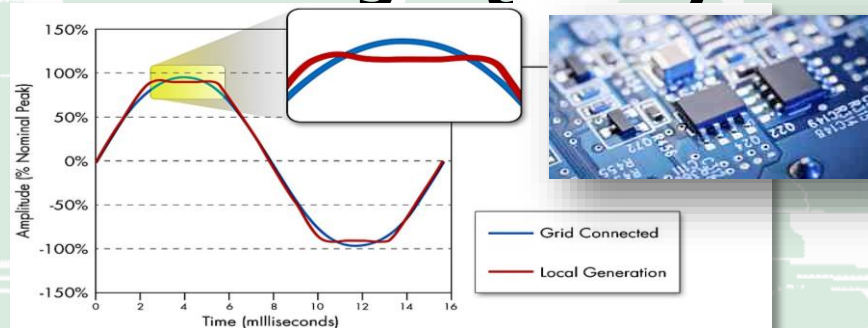
US Grid Micro Challenges

24/7 Back-Up

Startup Power



Voltage Quality



Interconnection Standards

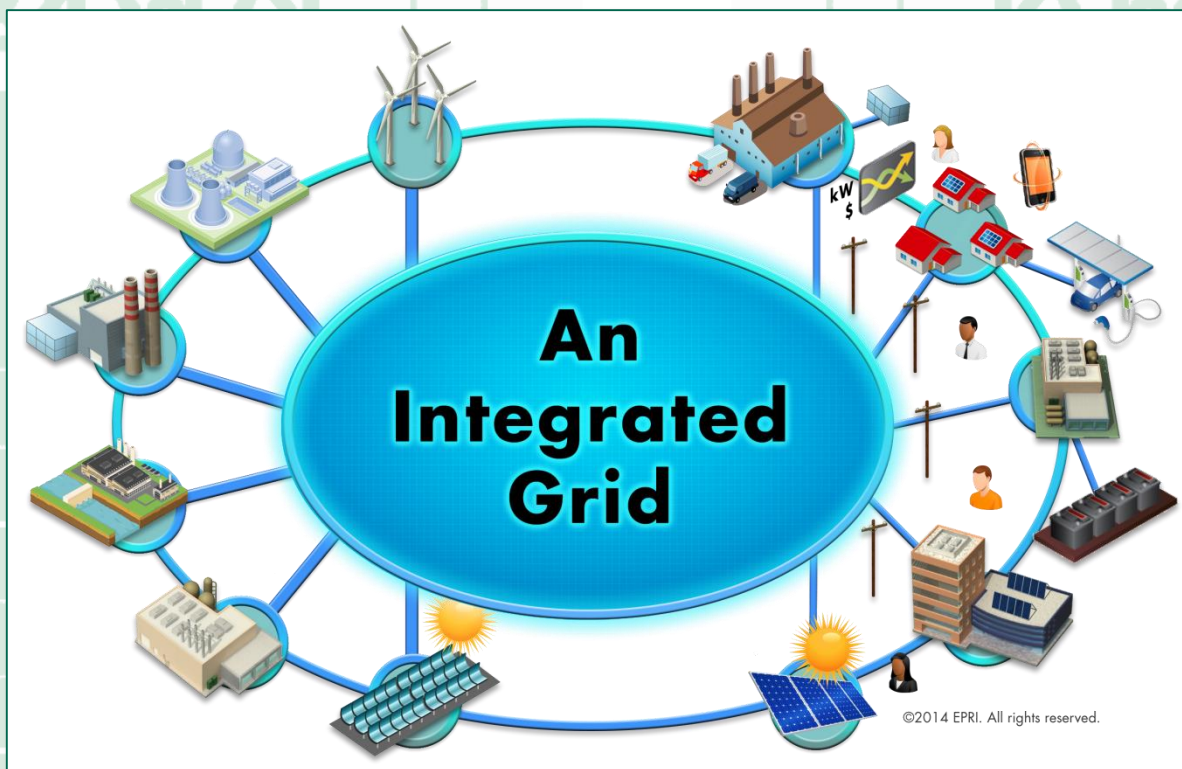
Grid Tomorrow: Distributed Resources Face Challenges; But NO Show Stoppers!



US Grid Macro Challenges

**Data
Challenges**

EMS
& PMUs



**Control
Challenges**

EMS
& DMS

Grid Tomorrow: Transmission Enables U.S. Fuel Transformation and Grid Integration; Next Generation EMS Needed for Data and Control Challenges



- Grid Modernization
- Communications Standards
- Interconnection Rules
- Integrated Planning and Operations
- Informed Policy and Regulations

An illustration in the top right corner showing a green printed circuit board (PCB) with various electronic components, connected by blue lines to a white multi-pin connector. The background of the slide features a faint, repeating pattern of green stylized human figures.



**Special Thanks to Clark Gellings,
Past-President, USNC
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Institute (EPRI) for
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**Other sources include US Energy
Information Administration
(EIA.gov)**

**2014 Annual Energy Outlook
(Reference Case)**