A123Systems' Smart Grid Vision

5TH ANNUAL CARNEGIE MELLON CONFERENCE ON THE ELECTRICITY INDUSTRY

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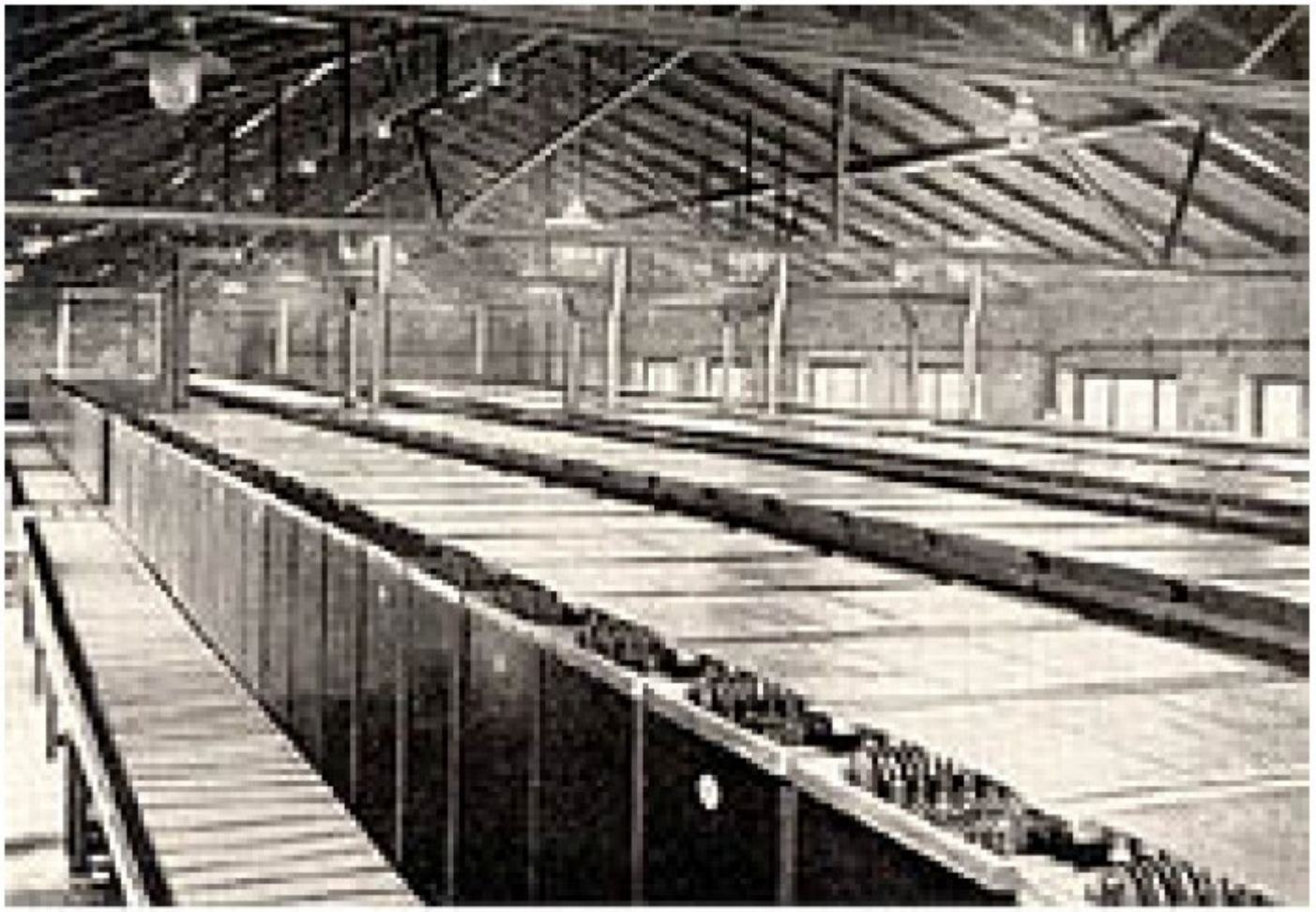
Storage



2MW Hybrid – Ancillary Power Unit (H-APU) Battery Based Grid Stabilization Systems

Manufacturing Hopkinton, MA

Rapid Deployment (shovel ready)

Inside View

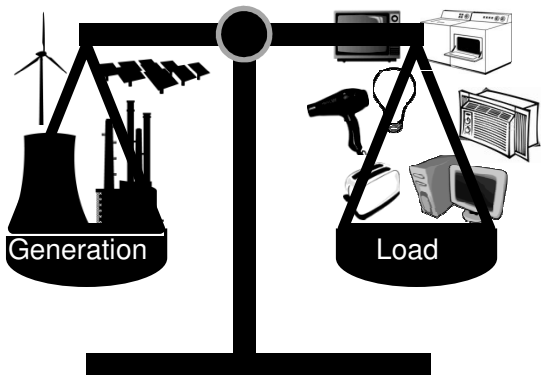
Background: Meeting One Fundamental Grid Challenge

Energy storage fundamentally decouples supply and demand

Electricity is the most perishable of all commodities: the instant it is created, it must be consumed

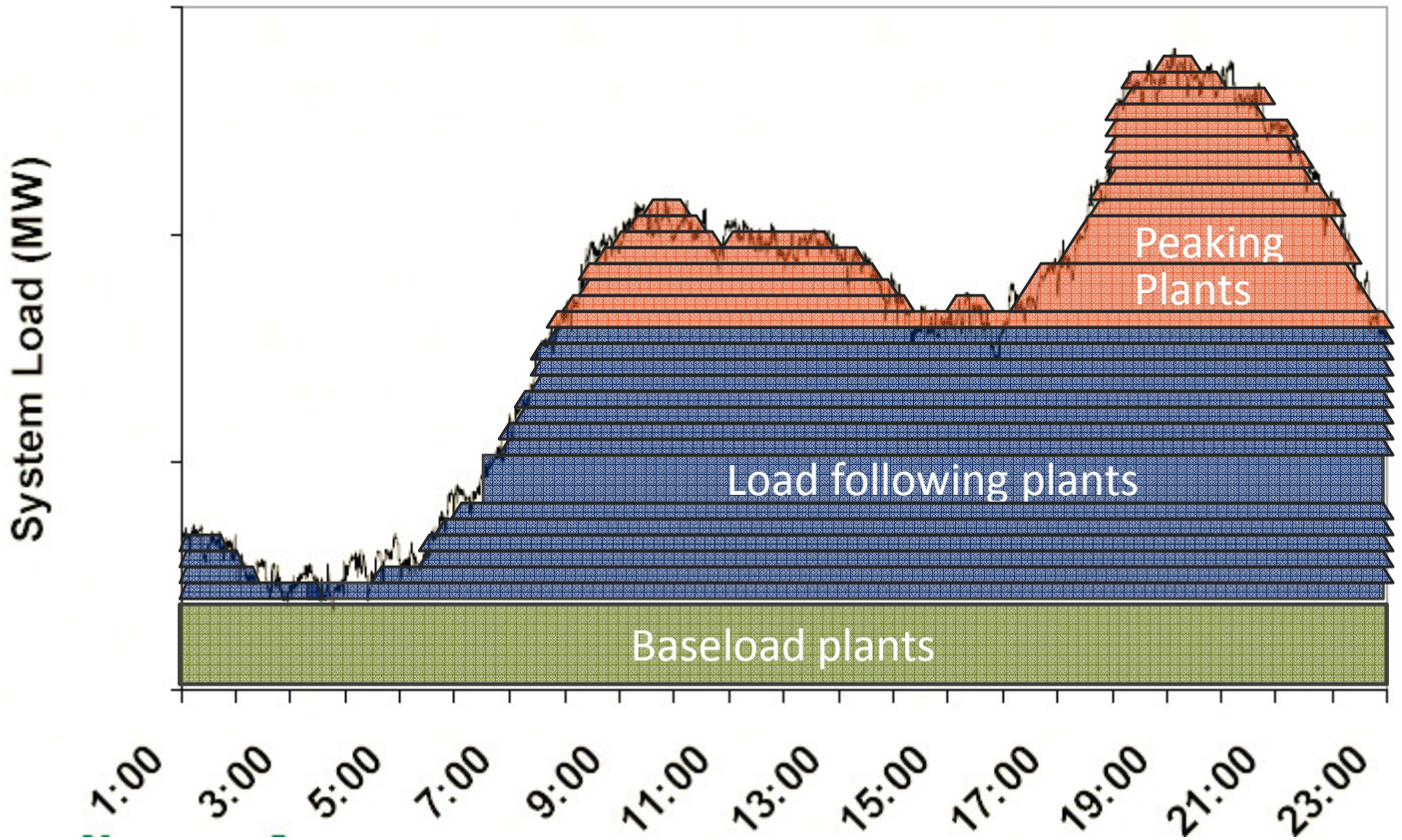
This balancing of generation and load must be done nearly (thanks to some unintended storage)instantaneously.

The ability to store or discharge electricity instantaneously changes the equation.



Supply ≠ Demand
(at least for short period of time)

ISO's manage changing load by ramping power plants up and down throughout day

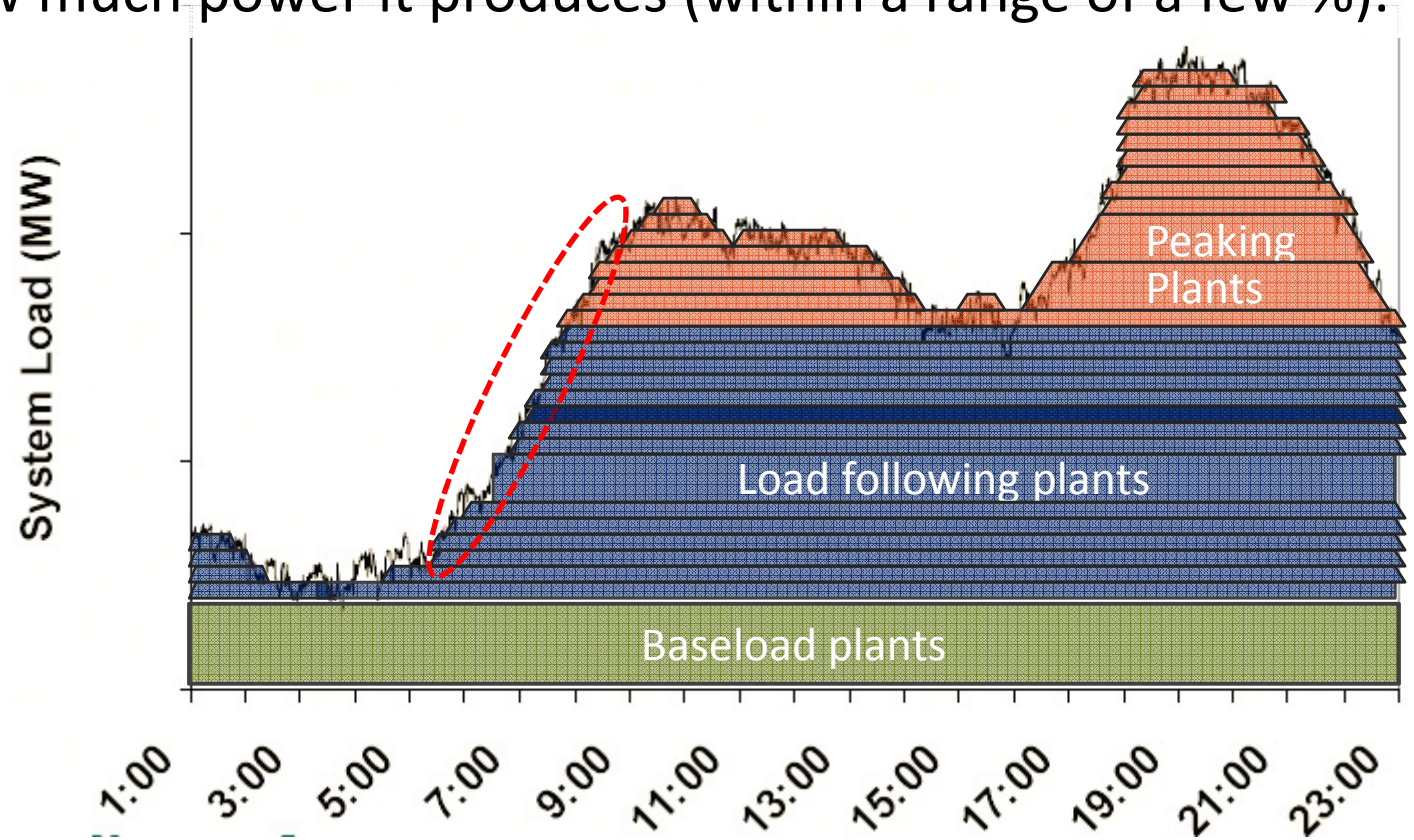


Problem: thermal plants take time to ramp up and down

Difficult to “fine-tune” generation

When you turn it on and how long it runs.

How much power it produces (within a range of a few %).

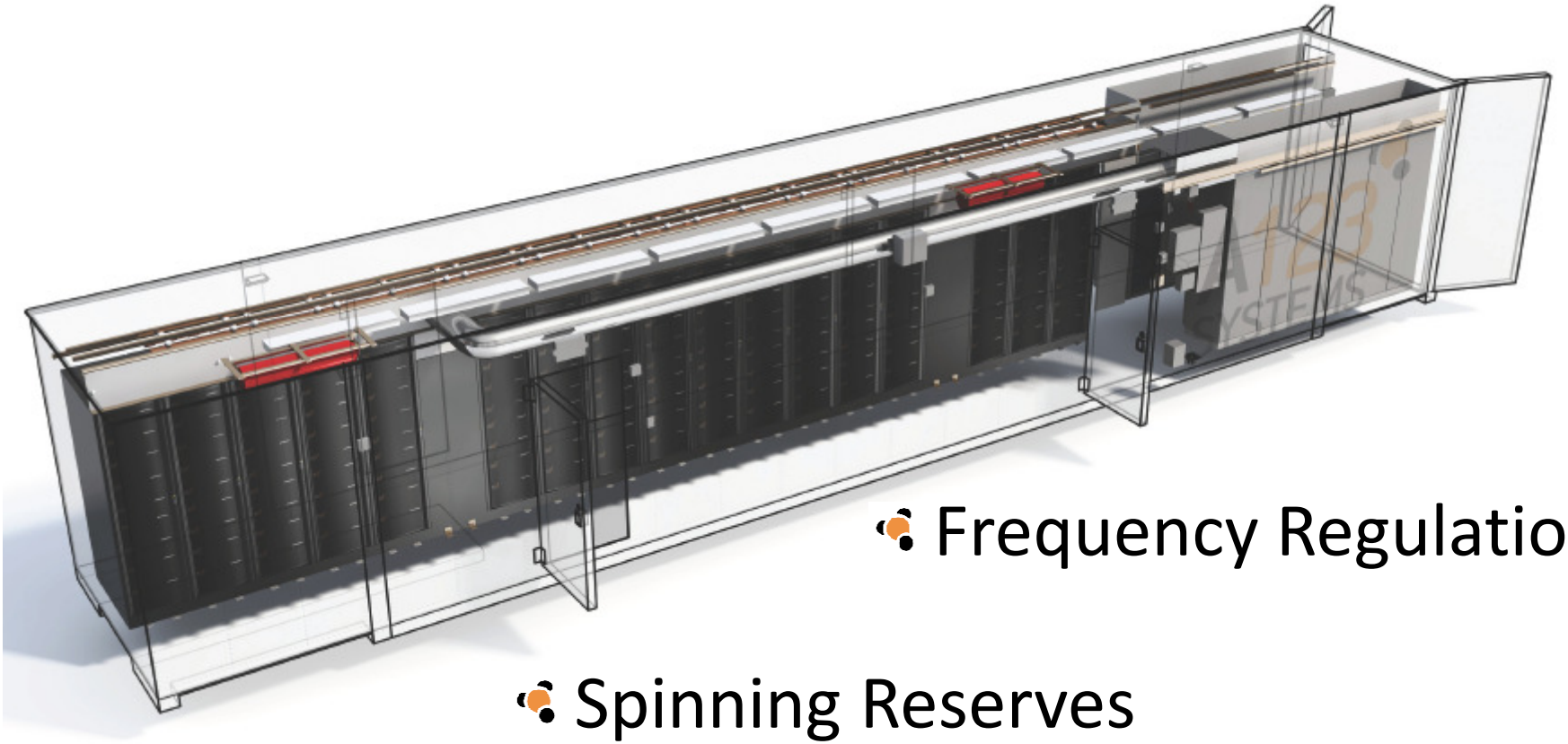


Difficult to match short fluctuations in load

TODAY'S SOLUTION

MW-Scale Grid Stabilization System (GSS) for Frequency Regulation, In Service Today

A123's Existing GSS Implementation, our Hybrid-Ancillary Power Unit (Hybrid-APU)

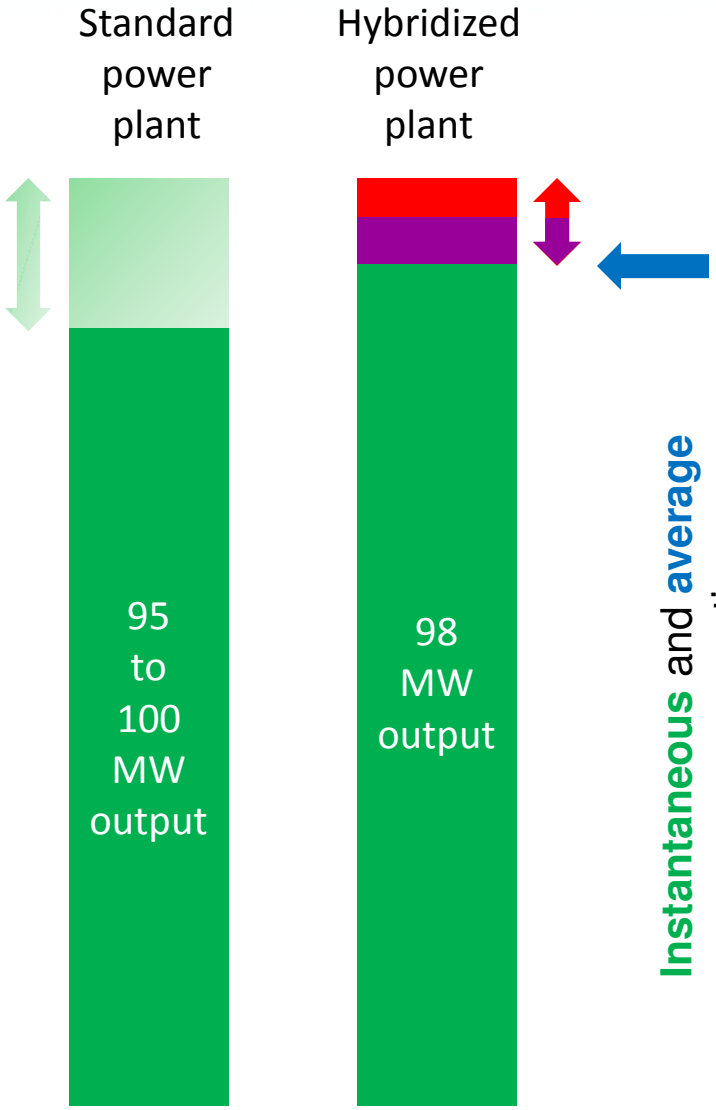


- Frequency Regulation
- Spinning Reserves

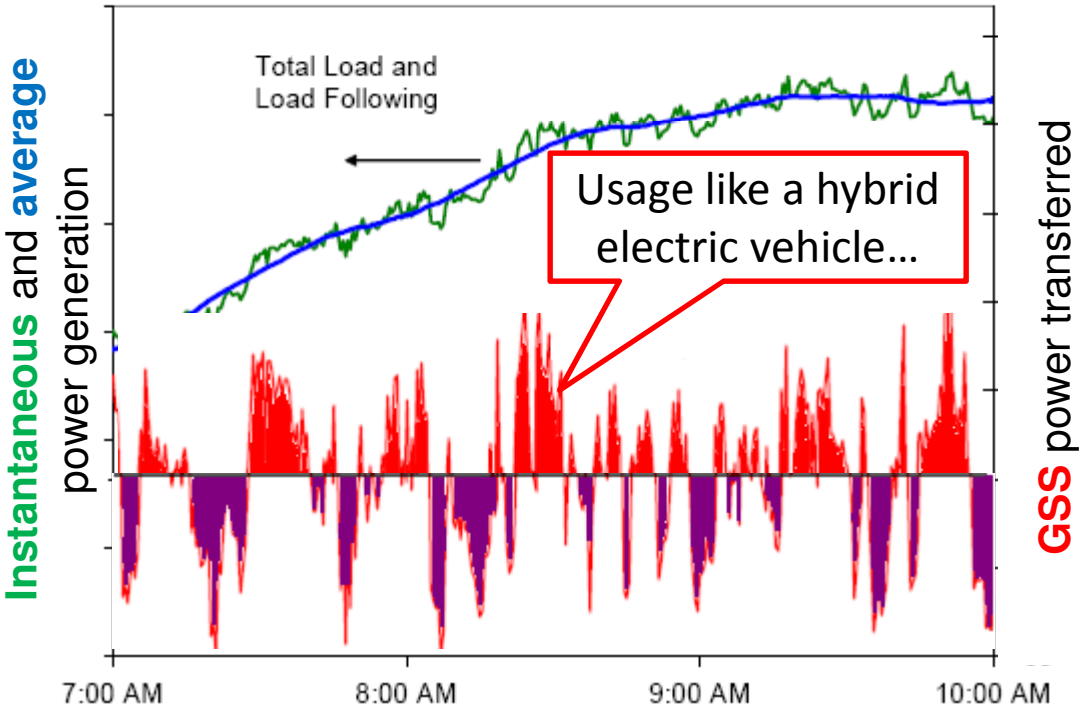
A123's Existing GSS Implementation, our Hybrid-Ancillary Power Unit (Hybrid-APU)

- 2MW, 500kWh, 20ms response
- 480 VAC 3 Phase
  - Via 4-quadrant PCS grid interface
- 960 VDC
- Operating Temperature: -10 to +40 o C
- High Efficiency
- Rapid Deployment
- More H-APU info at:
  http://www.a123systems.com/applications/grid-stabilization

Hybridized Power Plants With GSS



GSS provides power (discharges)
Average output of power plant
GSS is charged by power plant

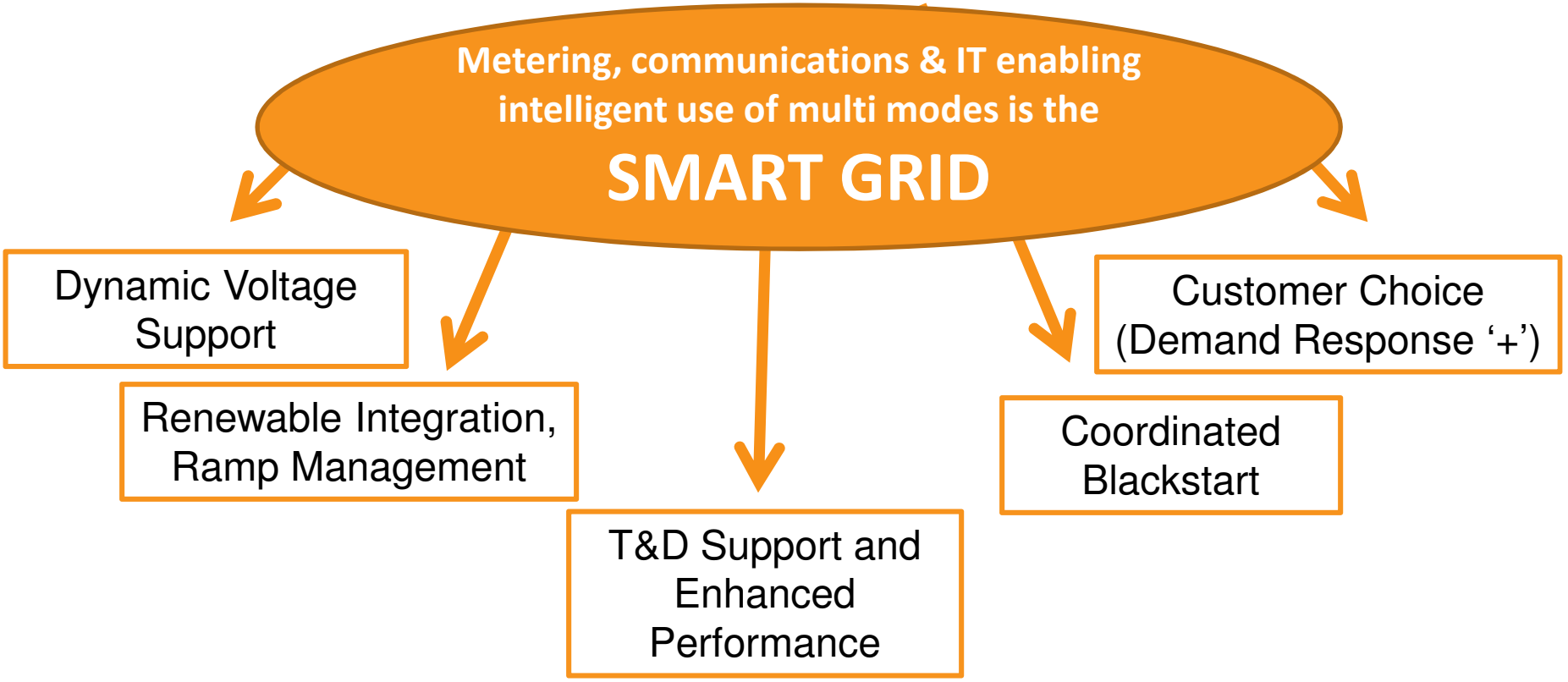


TOMORROW,
Our Smart Grid Contribution

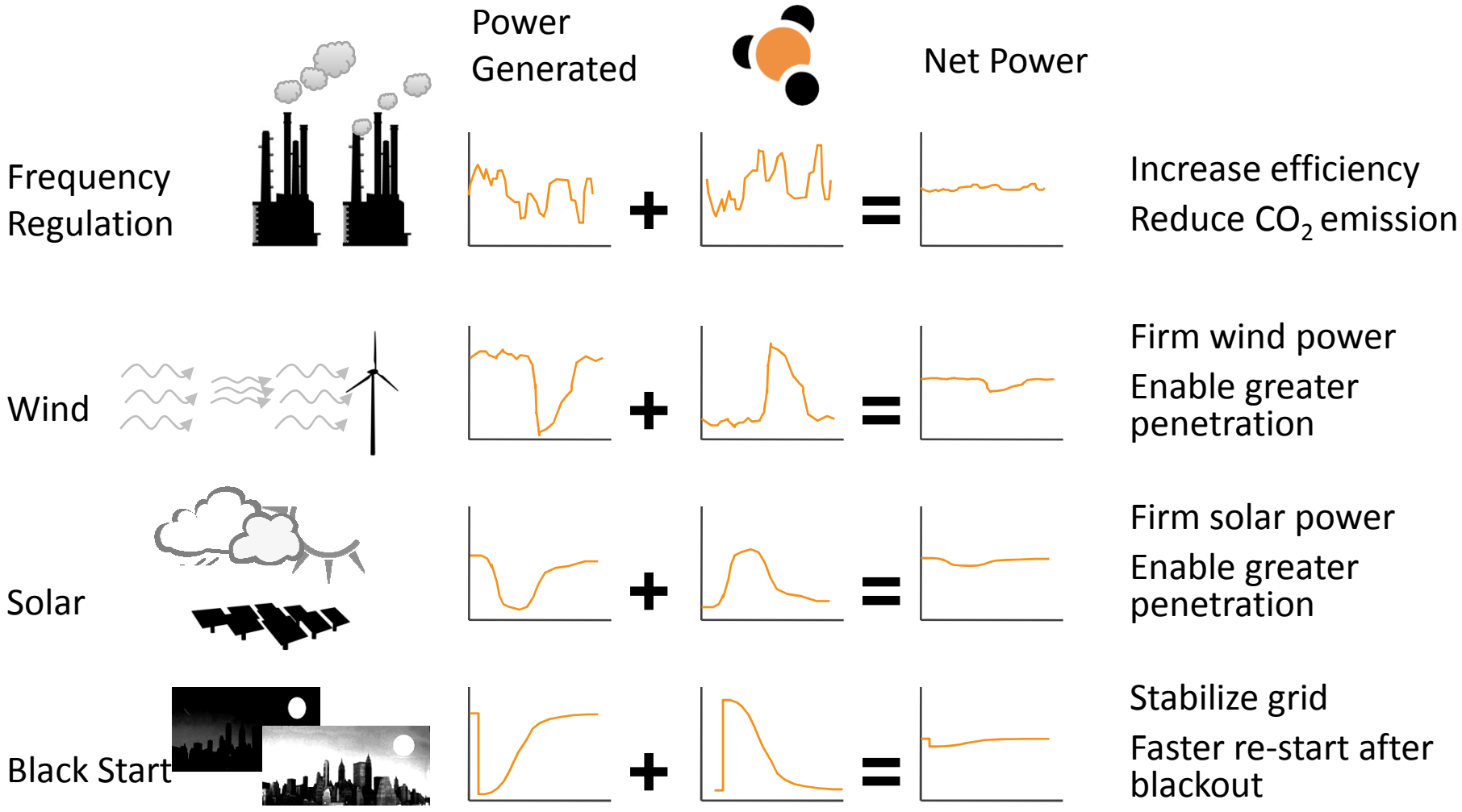
Single Mode → Multi Mode → Smart Grid

Today, GSS for Frequency Regulation

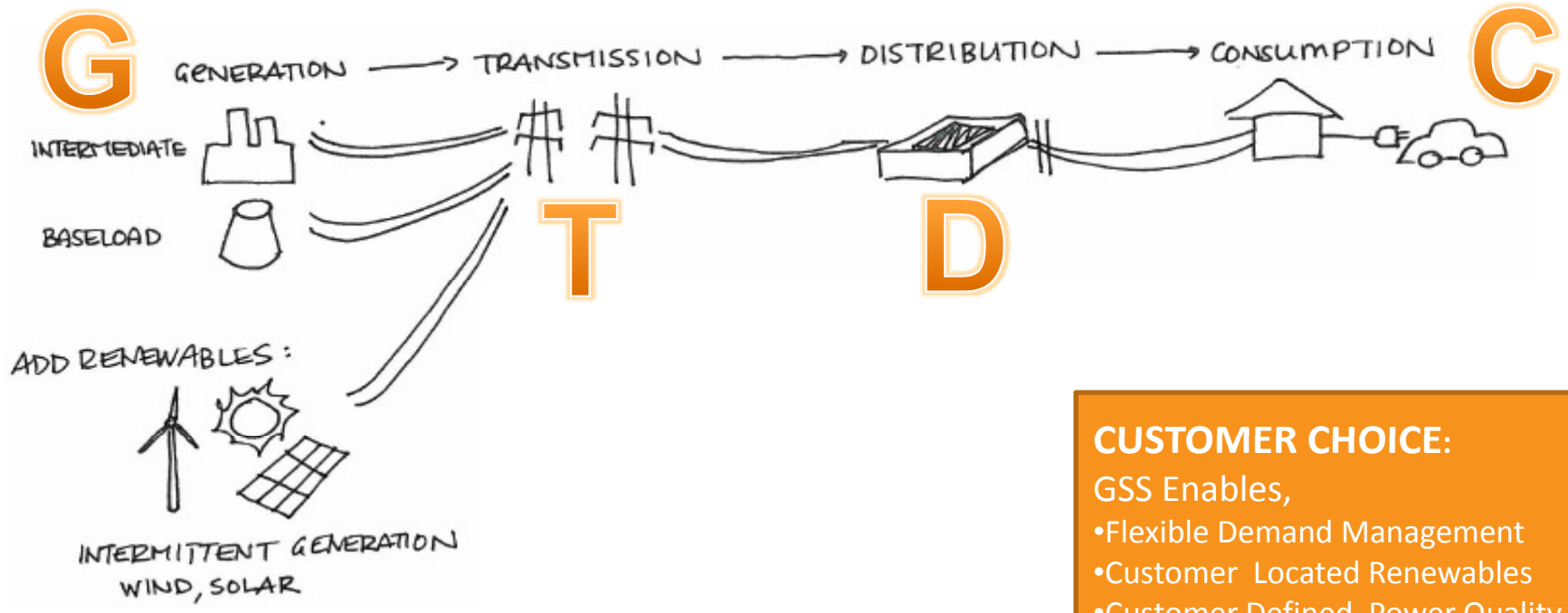
Next, extend GSS functionality (speed, control) to deliver additional operating modes of value



Benefits: Multi Mode A123 GSS + Smart Grid



A123 GSS + Smart Grid = Grid Wide Benefits



CUSTOMER CHOICE:
GSS Enables,
- Flexible Demand Management
- Customer Located Renewables
- Customer Defined Power Quality

ENVIRO: Lower CO2

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GRID RELIABILITY: Outage Prevention, Event Mitigation

RESOURCE EFFICIENCY: Capacity Release, Asset Optimization, and Loss Reduction

ENERGY SECURITY: Expand Resource and Locational Diversity

Ultimate Impacts - The Big Picture

- Global Carbon Reduction
- Expand U.S. Renewable Resources
- Contribute to U.S. Economic Health
  - Create green collar jobs
  - Establish U.S. as technology exporter
- Reduce U.S. Reliance on Foreign Oil
  - Electrify transportation
- Decrease U.S. Cost of Utility Disruptions

Carbon Napkin Calculation

Gas turbine FR								
Total Wh through-put 100kwh at 60% efficiency (most efficient CCT) = 166 KWh of carbon fuel								
When a turbine ramps 100kwh is more like 35% efficiency (assumption) =257 KWh of carbon fuel								
90% gas turbines			=257 KWh of carbon fuel					
10% pumped hydro			= 13Kwh of carbon fuel					
Total			270	Kwh				
Batterie FR								
Total Wh through-put 100kwh batteries								
35% is nuclear,wind, solar , hydro			=0 Kwh of carbon fuel					
65% is gas and coal so its steady state so 60%efficier			=108Kwh of carbon fuel					
Efficiency loss			= 4KWh of carbon fuel					
Total			112	Kwh				
This indicates storage frequency regulation uses only half (112Kwh)								
of the carbon based fuel of turbine frequency regulation of (270KWh)								

Getting To The Smart Grid Vision

- U.S. Energy Independence and Security Act (EISA) 2007 defines characteristics:
  - Digital information and controls
  - Deployment and integration of distributed resources (includes Storage) and generation, including renewables
  - Smart technologies for metering, grid communications and distribution automation
  - Advanced storage and peak-shaving technologies, including PHEVs and thermal-storage A/C
  - Develop standards for communication and interoperability of appliances and equipment connected to the grid, including grid infrastructure
  - Identify and lower barriers to adoption of smart grid technologies, practices and services
- U.S. 2009 Stimulus Bill provides funding for EISA 2007 Smart Grid programs. Accelerate getting solutions in the field? We're ready.

What Should Be Next

- **Wide scale commercial deployment of GSS for frequency regulation (Legacy Regulations is biggest barrier)**
- **Lower barriers** to commercial entry and sustained success through consistent standards and level/fair market access
- **Fund development** and demo of next generation GSS, to achieve full multi-mode operation.
- **Demonstrate use** *of existing* advanced technology *for emerging* and advanced Smart Grid applications
- **Model and quantify impacts** of new technologies in context of traditional grid planning to increase industry-level awareness and comfort with new grid-supportive technologies
  - Extend modeling to interdependent systems to quantify the larger societal benefits feasible with a smarter, cleaner, more efficient grid
- **Industry, Academic, and Government collaboration** to surface best ideas and practices.

Thank You

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