

Energy Storage and the Smart Grid



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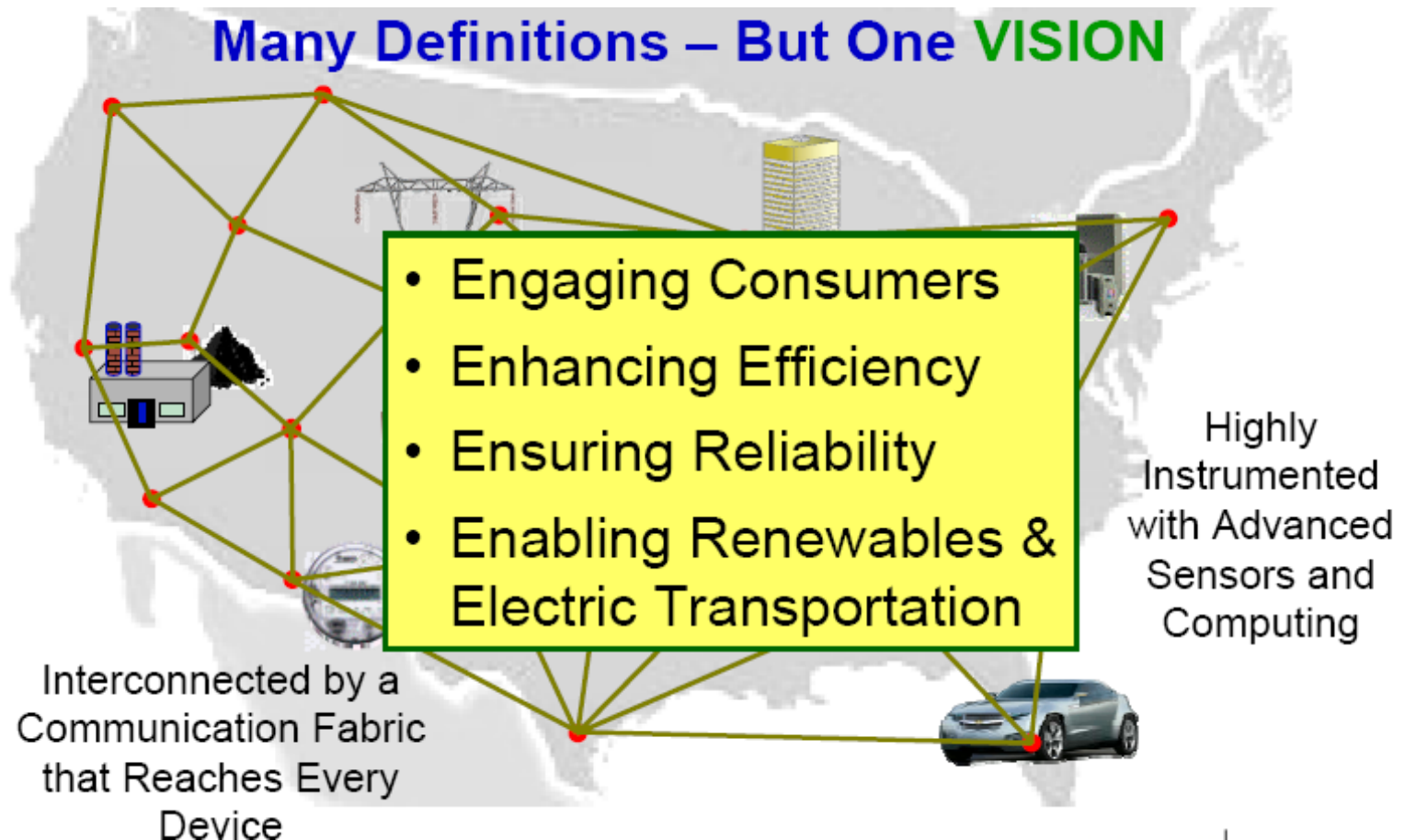
Today's Agenda

- What is the Smart Grid
- What Benefits it Provides
- Energy Storage's Role
- Exide's Place in the Grid

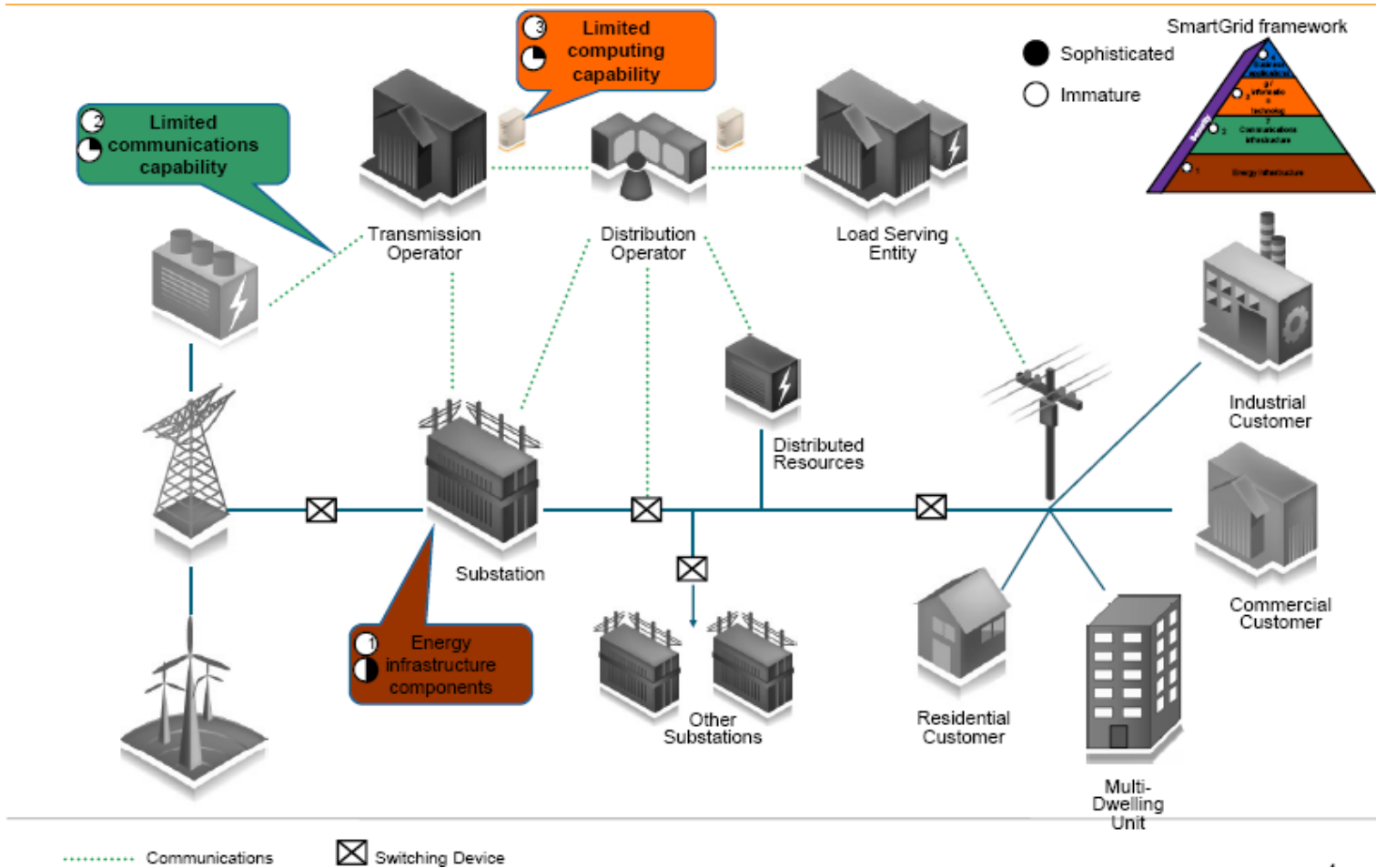
Edison Vs. Bell: The Case for Revitalization



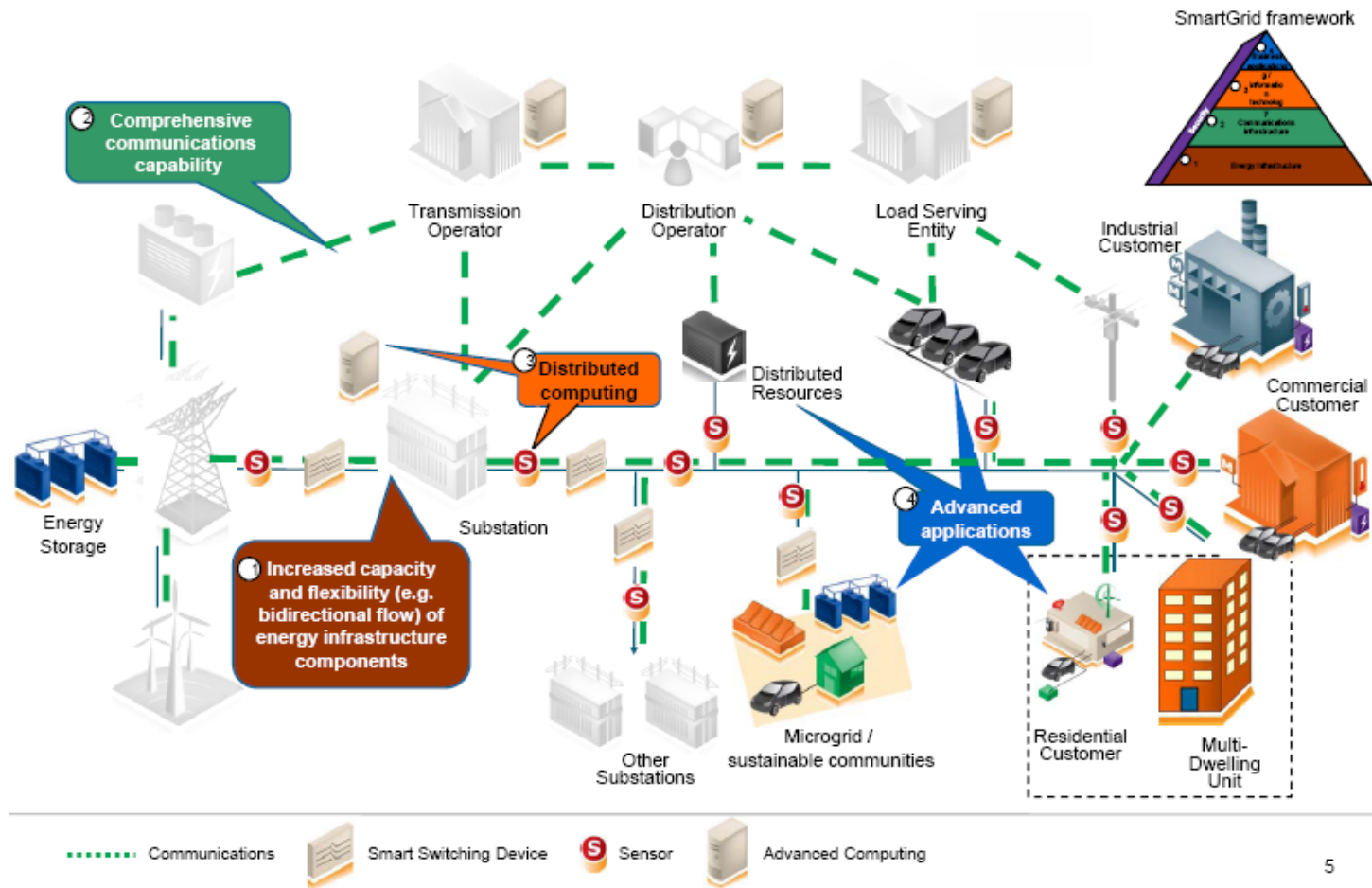
What is the Smart Grid?



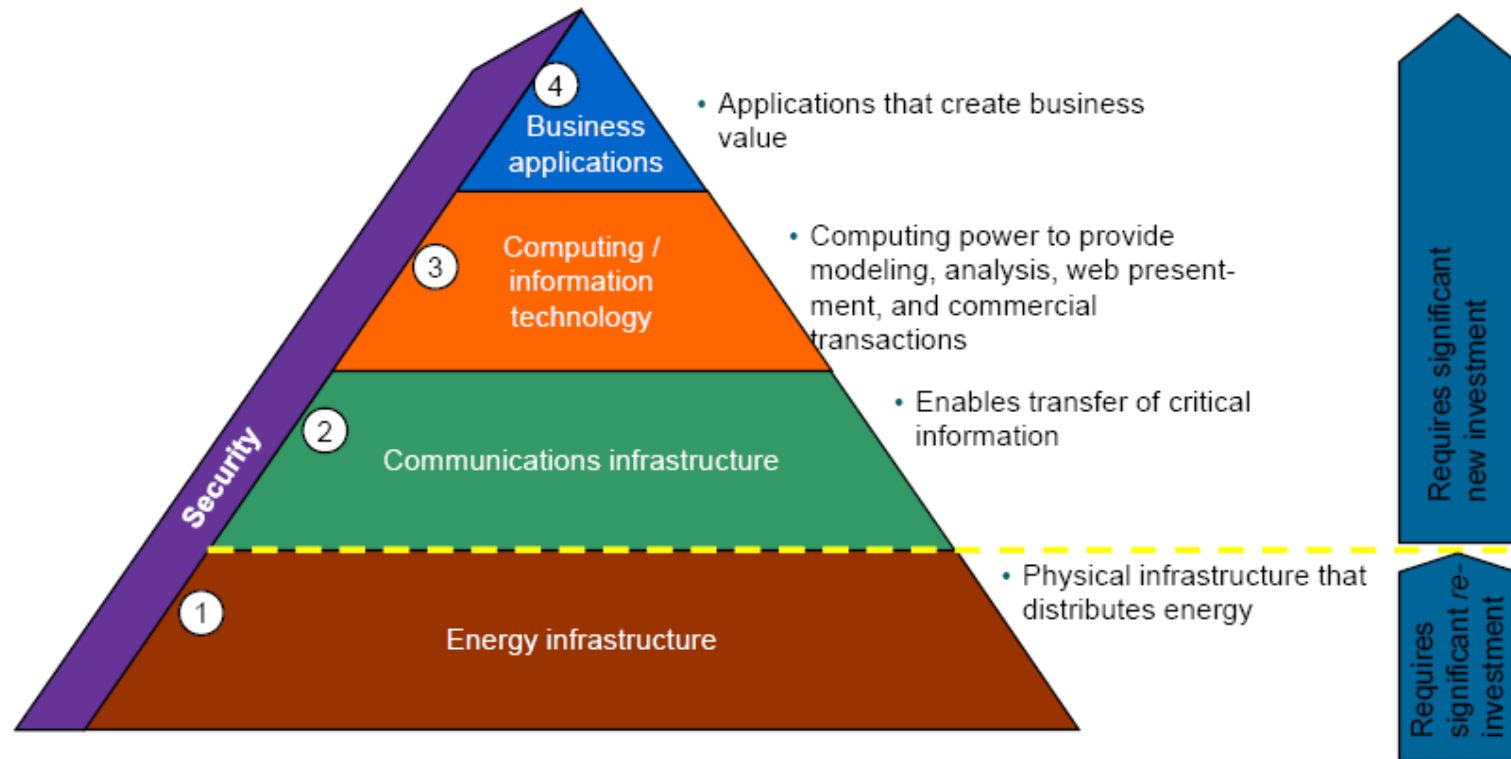
Today's Grid



Future Smart Grid



The Smart Grid Framework



Why Pursue the Smart Grid?

A Smart Grid can enable:

Customer benefits

- Improved service reliability
- Increased power quality management capabilities
- Improved ability to manage customers' total energy costs
- Improved energy efficiency
- Improved distributed and renewable resource and storage integration
- Enables SmartCharging and Grid to Vehicle (G2V)
- Enhanced product pricing options

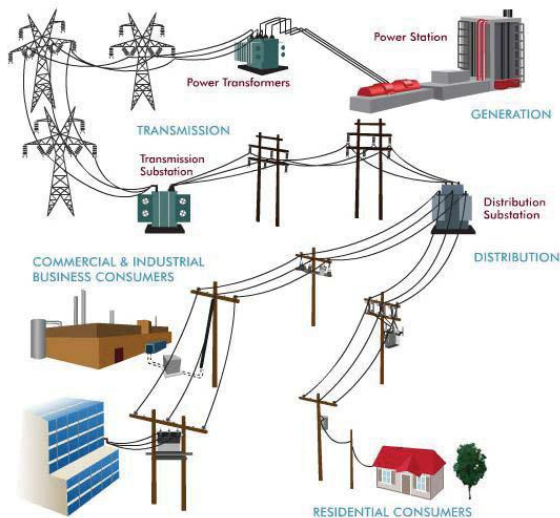
System benefits

- Improved system reliability
- Improved system efficiency
- Reduced congestion costs
- More effective planning capability
- Enhanced power management
- Continued safety improvements
- Improved integration of renewable and other distributed resources
- Integrated customer products and grid operations – “future-proof system”
- Effective integration of microgrids and “sustainable” communities

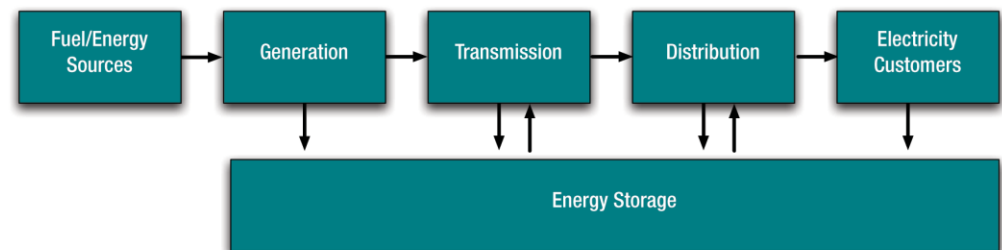
Energy Storage in the Smart Grid

Factors influencing the adoption of distributed grid scale energy storage:

1. Development of renewable and/or distributed energy sources
2. Utilities desire for more efficient use of generation, transmission and distribution assets
3. Public's desire for carbon reduction and more efficient use of fuel resources
4. Increasing power quality/reliability requirements from end users



Energy Storage Becomes the enabling technology for the entire Electricity Value Chain

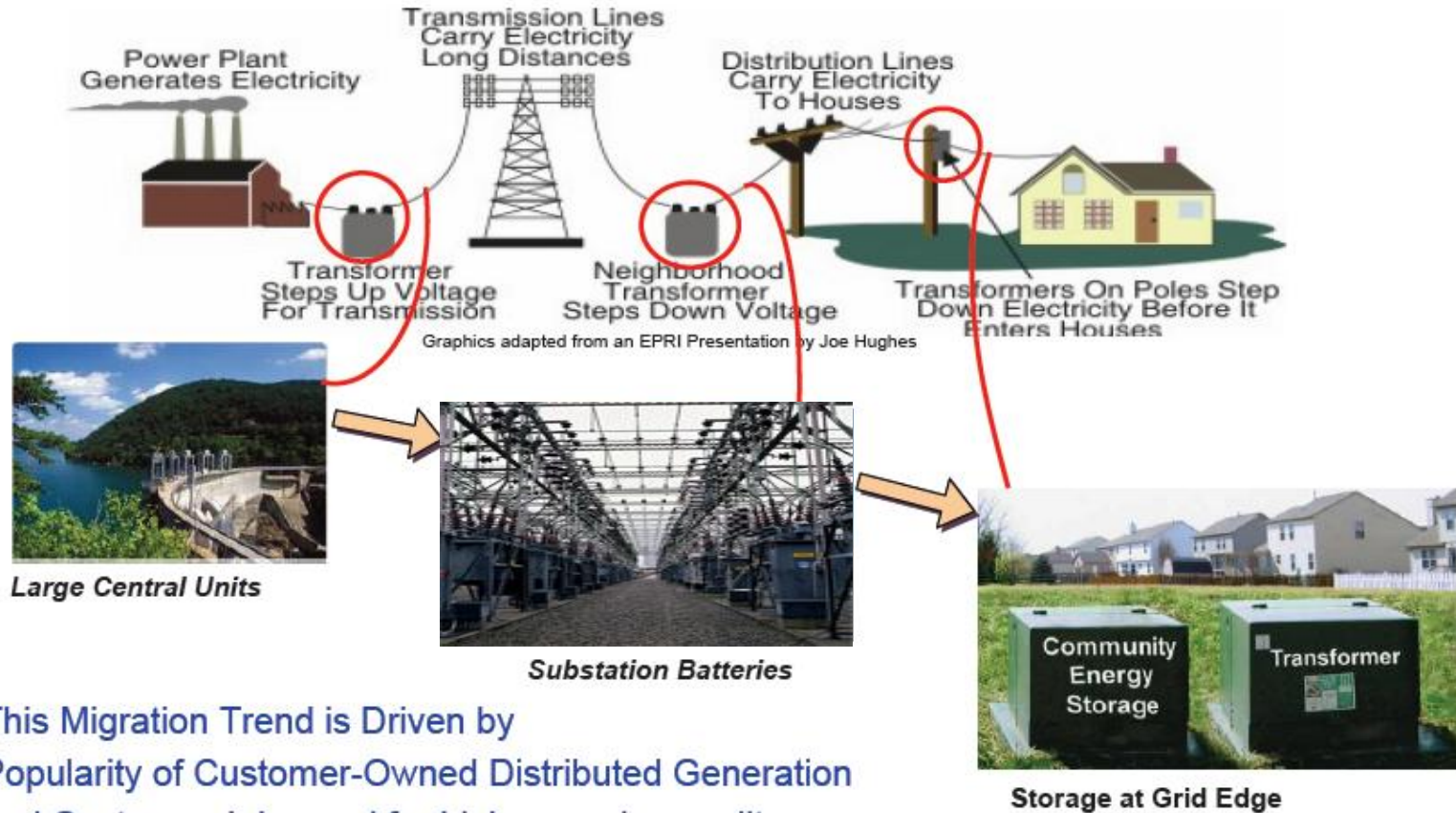


(Source: GTM Research-2009)

Energy Storage Value Streams

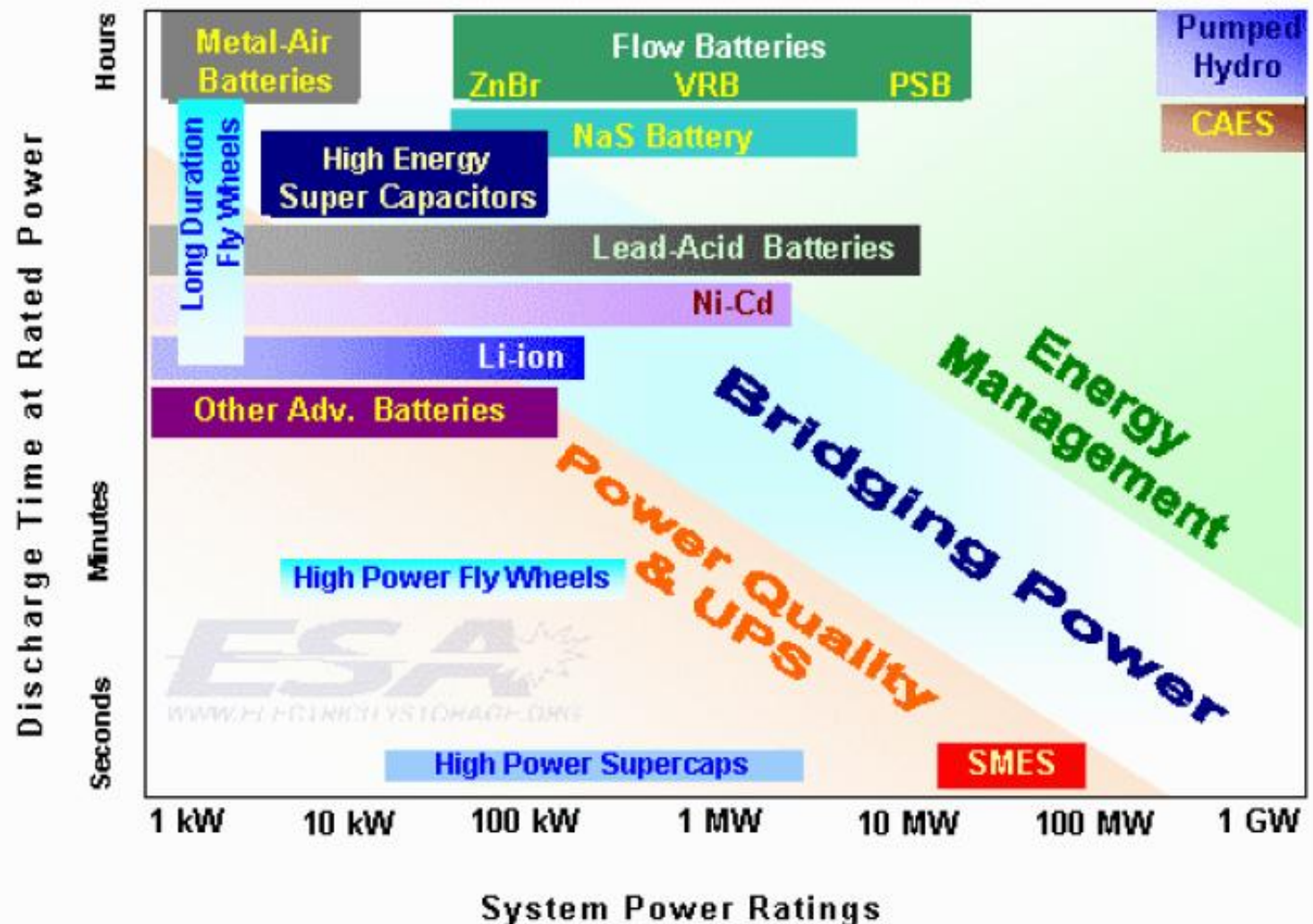
- Utility Oriented Applications
 - Bulk Electricity Time-Shifting
 - Electric Supply Capacity
- End User Oriented Applications
 - Cost reduction for businesses resulting from time-shifting
 - Service reliability
 - Community Support
- Renewable Energy Applications
 - Renewable energy production time-shift
 - Reduces problems with intermittency

Migratory Path of Storage



This Migration Trend is Driven by
Popularity of Customer-Owned Distributed Generation
and Customers' demand for higher service quality

Energy storage options for Renewable Energy and UPS applications



Where does Exide Fit



- ❑ Grid Tied Units for Renewable and Grid Stabilization
 - 2V Lead Acid
- ❑ Substation Batteries
 - Flooded
- ❑ CES
 - LiIon/Onyx
- ❑ PHEV, EV
 - Advanced batteries
- ❑ Focused on Advanced Technologies

Application Notes –

Battery Energy Storage Systems

- ***Metlakatla, Alaska Utility 1.2 MW / 1.4 MWh***
 - ***Turnkey system (GE partnership)***
 - ***commissioned January 1997***
 - ***power system stabilization, frequency control, & VAR support***
 - ***VRLA battery technology***
 - ***Displaced 3 MW diesel generator***

Metlakatla BESS Facility

Battery Room holds 1,134 VRLA Cells



MP&L Battery Energy Storage System – A Great Success

- **Battery Energy Storage Is An Economic / Environmental Success**
 - Saved Metlakatla Over \$6.5 Million In 12 Years Of Operation
 - Saved Almost 59,000 Tons Of Carbon Dioxide Emissions
 - Virtually Eliminated Reliance On “Imported” Petroleum Fuels
 - MP&L Grid Is Almost 100% Renewable
- **Battery Energy Storage Is A Technological Success**
 - Won Energy 100 award from DOE, designating it as one of the best scientific and technological advancements of the 20th Century
 - Met Every Operational Challenge
 - Industrially Robust Equipment and Installation
 - Readily Integrated with Other Generating Resources
 - Exceeded Life Projections By Wide Margin
- **Battery Energy Storage Is NOW!**
 - All Components Are Commercially Available
 - Components Are Modular and Readily Scaled
 - Battery Manufactured Using Recycled Materials / Is Readily Recycled
 - Systems Can Be Up and Operating In Matter Of Months, Not Years

Recycling at Exide

- ❑ One of the largest secondary lead recyclers in the world with 10 recycling facilities worldwide
- ❑ One of the few companies in our industry with the capability to recycle its own product in its facilities
- ❑ Battery recycling produces benefits for Exide, its customers and the environment

