Value of Energy Storage in the Integrated Grid

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2019 NY Solar+Storage Summit

New York

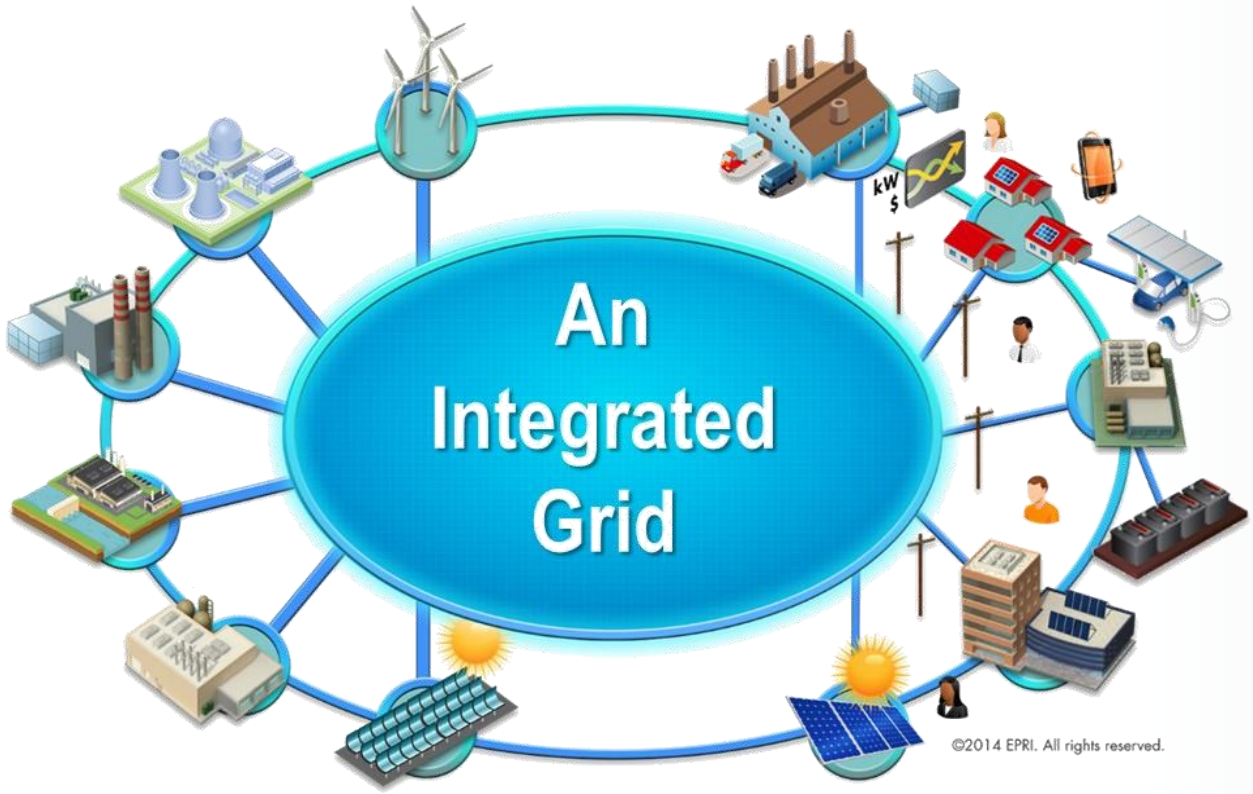
June 13, 2019

https://nysolarmap.com/ny-solarplusstorage-summit/

Understanding the Value of Energy Storage in the Integrated Grid

Energy storage has multiple value streams but they may not all be realizable depending on the location, grid requirements, resiliency needs, flexibility needs, and control system limitations. Assessing the potential value for an energy storage application requires an understanding of customer tariffs, local distribution system constraints, grid flexibility needs and policy considerations. This presentation describes functionality and applications of a public-domain tool designed to take these various factors into account and provide an economic evaluation of the potential value for specific applications and circumstances.

The Vision – An Integrated Grid

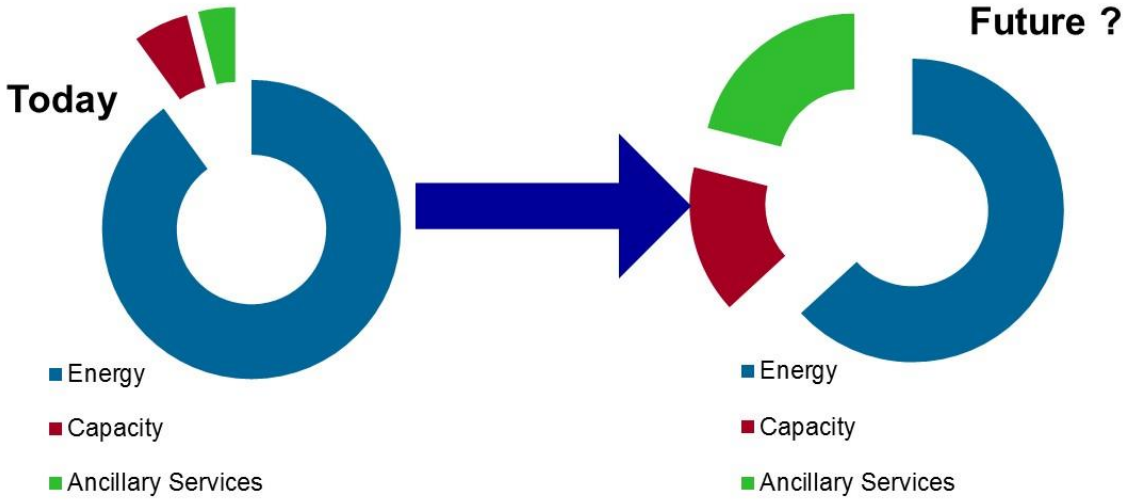


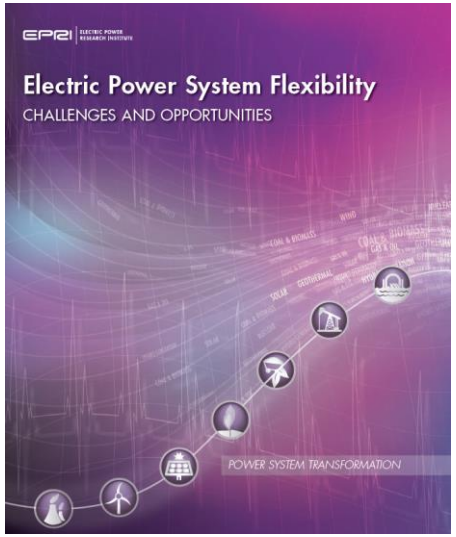
Integration of:

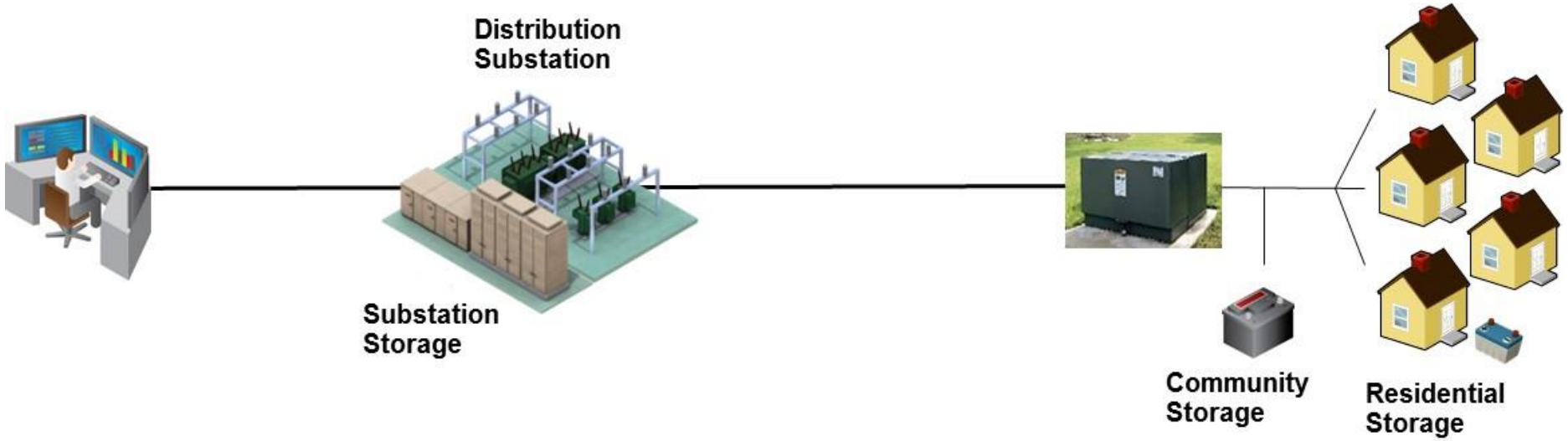
Electricity, Telecommunications, and Customer Local Energy Networks

The Integrated Grid makes *Local Energy Optimization* Part of *Global Energy Optimization*

The Integrated Grid – Flexibility is a Resource

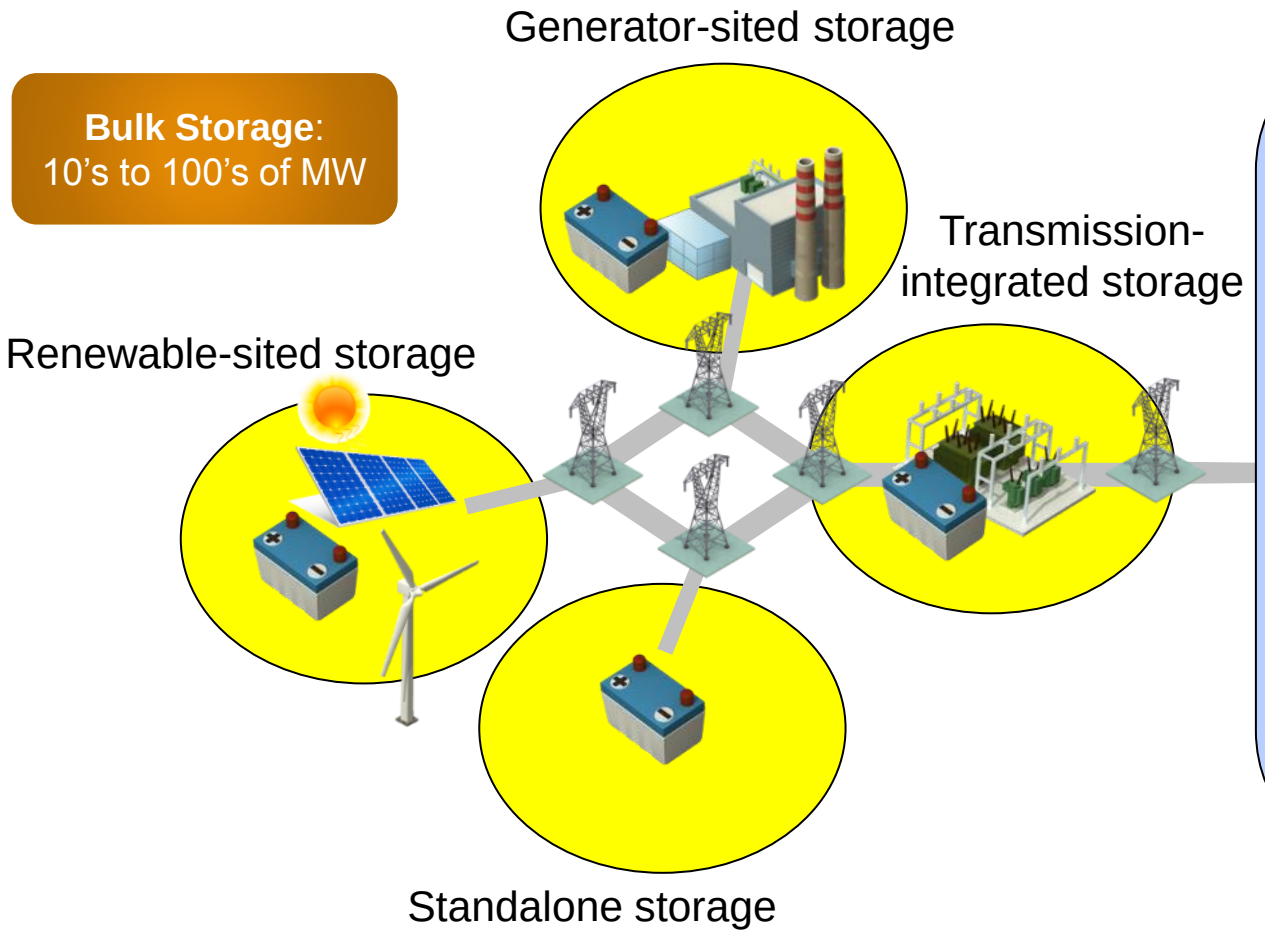






Energy Storage Applications – Generation & Transmission

Bulk Storage:
10's to 100's of MW



Transmission-Connected Storage

May provide:

- Generation capacity (resource adequacy)
- Black start
- Increased transmission capacity
- Energy time-shifting
- Ancillary services

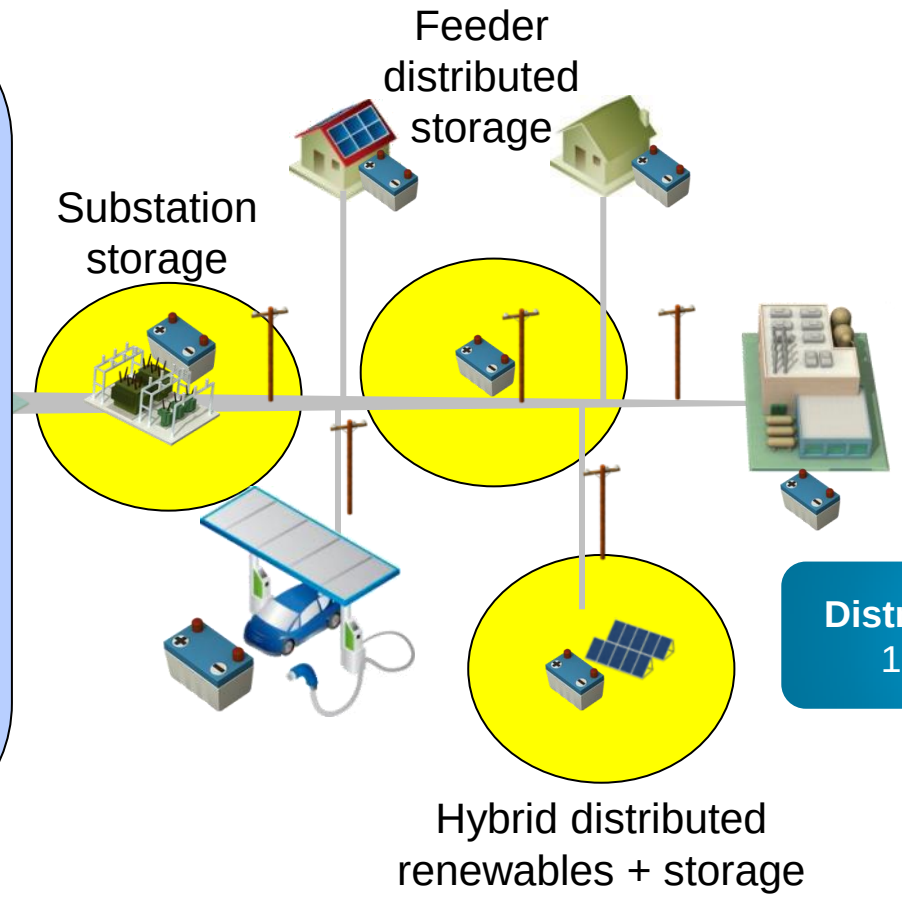
Bulk storage may complement generators or transmission assets

Energy Storage Applications – Distribution

Distribution-Connected Storage

May provide:

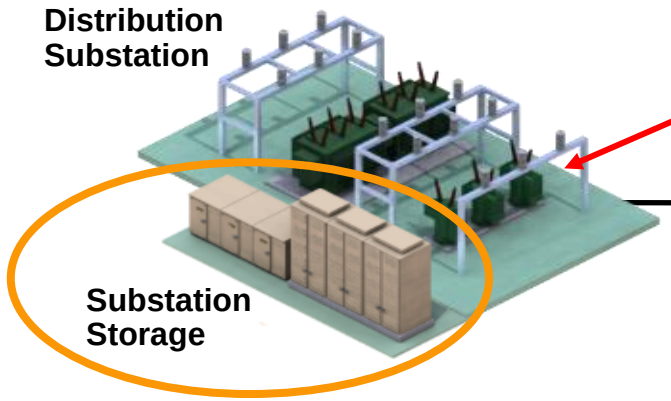
- Virtual distribution capacity
- Enhanced power quality (e.g. voltage support)
- Resiliency / backup power / microgrid
- **Bulk system benefits (depending on priorities and distribution service limitations)**

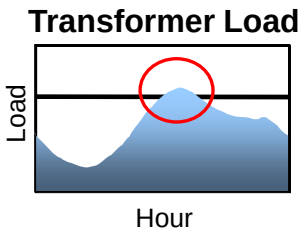


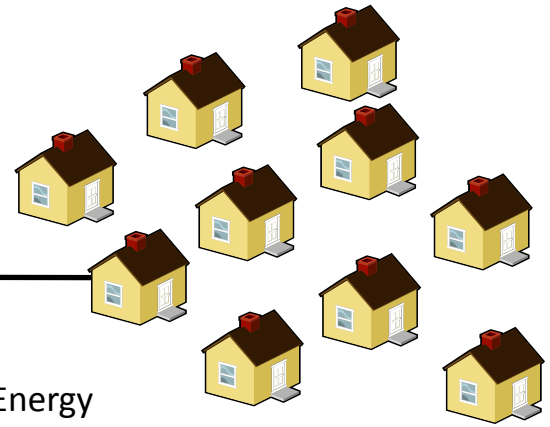
Distribution Storage: 10kW to 10MW

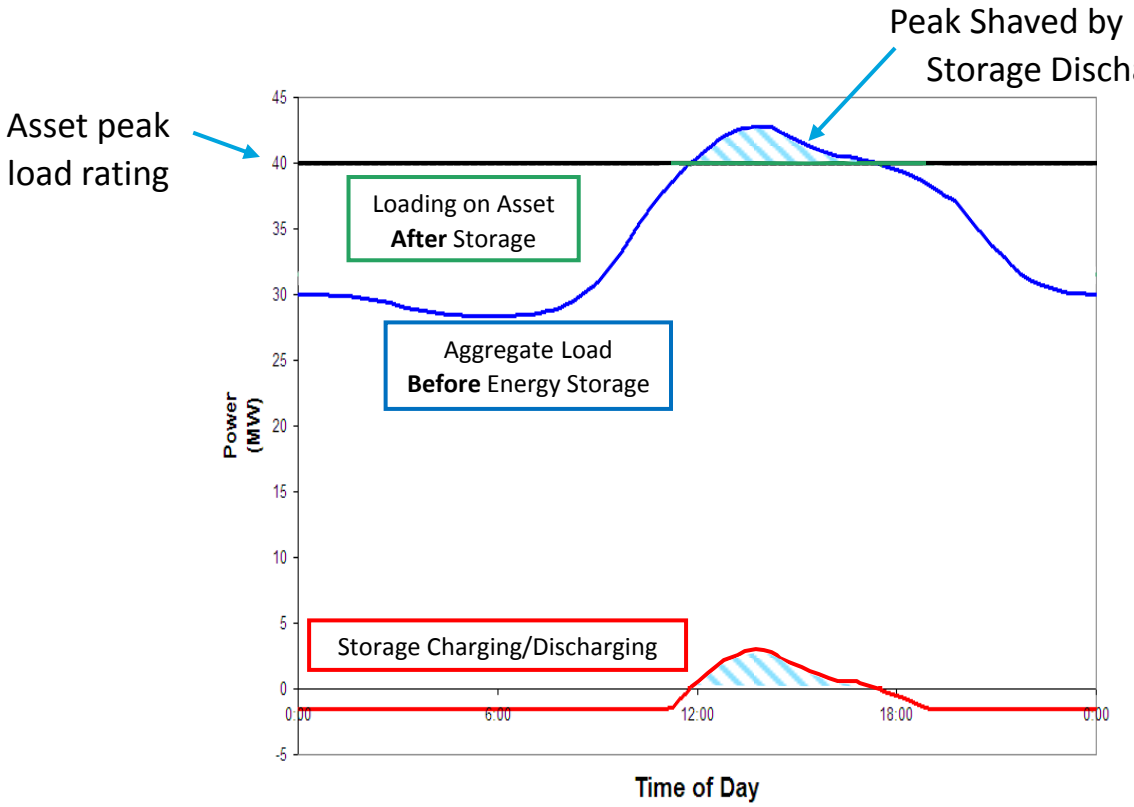
Technical and Regulatory complications currently exist for multiple-use applications. Advanced storage controls and DERMS solutions facilitate this vision.

Asset Upgrade Deferral with Storage as a Substitute



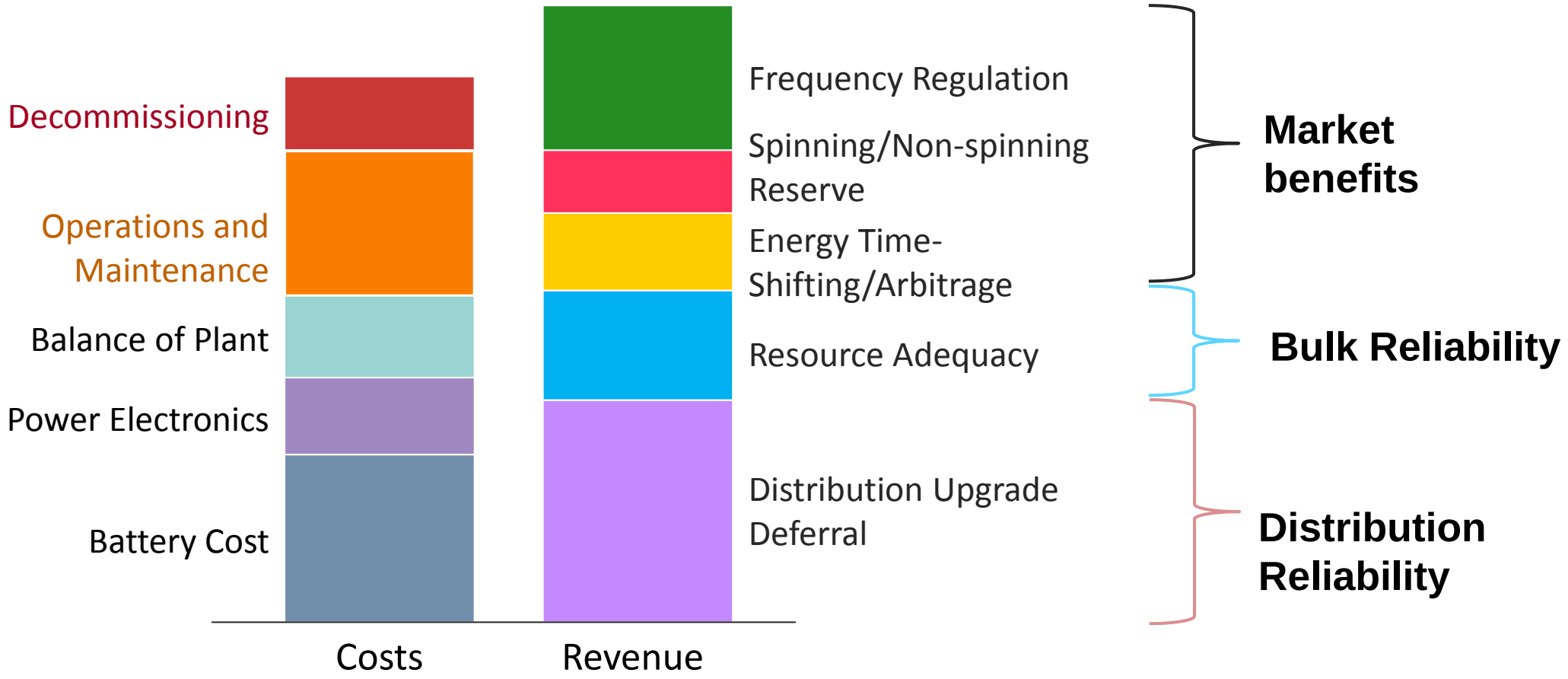






Stacking Benefits – The Vision

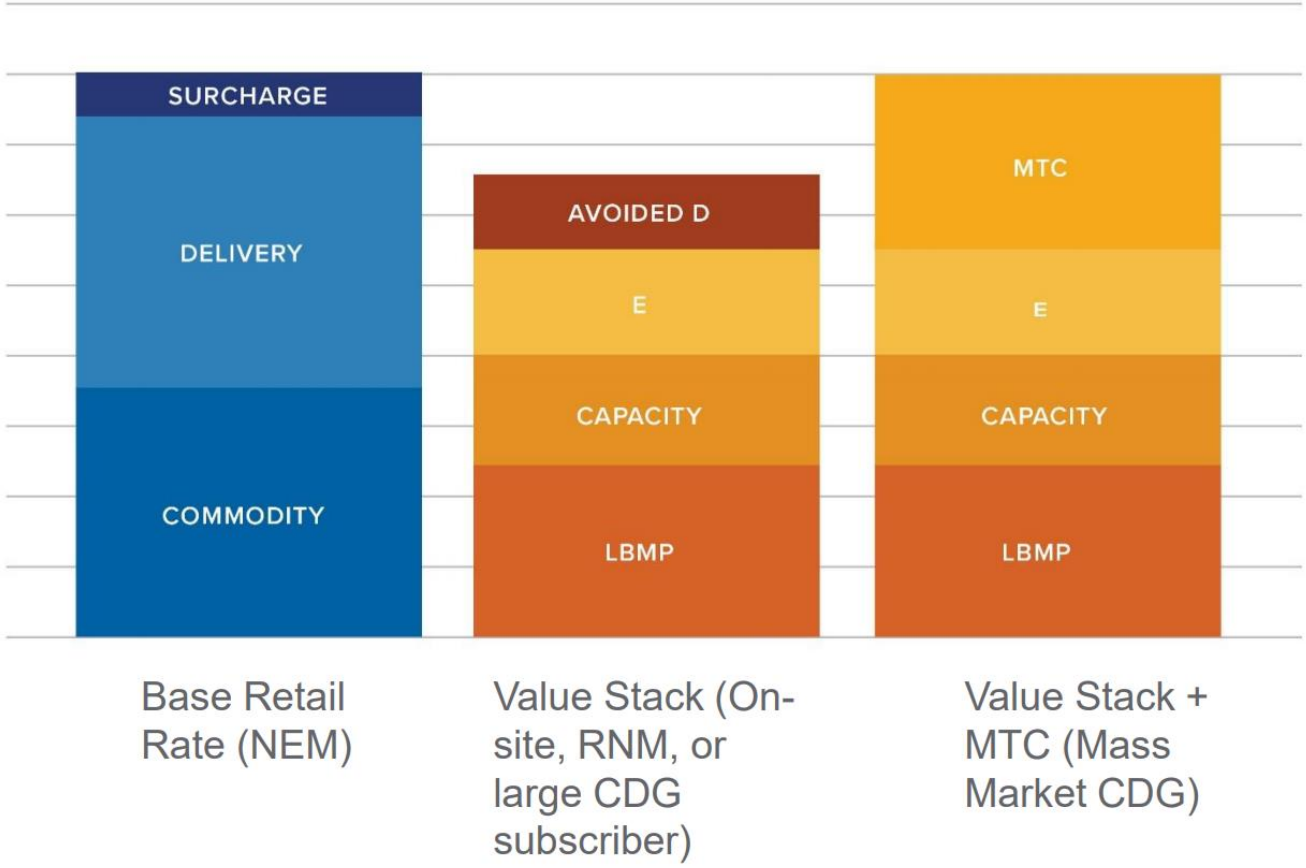
*For Illustration Only



Technical and Regulatory complications currently exist for multiple-use applications. Advanced storage controls and DERMS solutions facilitate this vision.

New York – Value Stack Order

Review – Overview of Original Value Stack



- Avoided D – avoided demand
- E – environmental benefit
- Capacity – ICAP
- LBMP – energy commodity
- MTC – market transition credit for CDG

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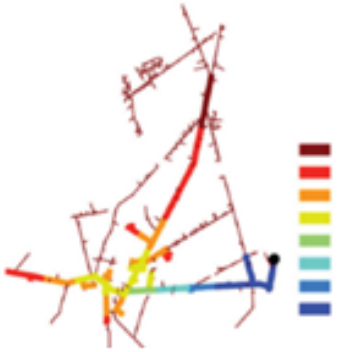
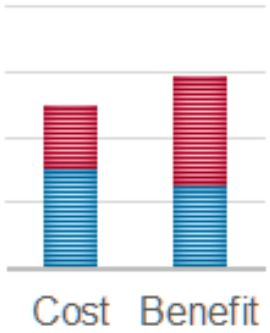
Evaluating the Economics



Detailed Distribution System Analysis

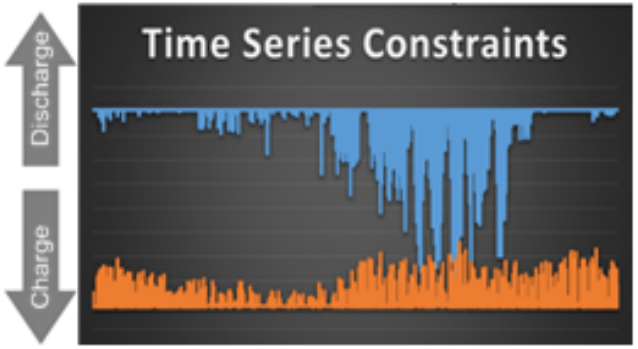
Time Series Constraints and Dispatch

Co-Optimized Economic Dispatch



Tools: EPRI DRIVE, OpenDSS, Cyme, etc.

Thermal, Voltage, and Protection Violations



Tools: StorageVET

Grid and Customer Services

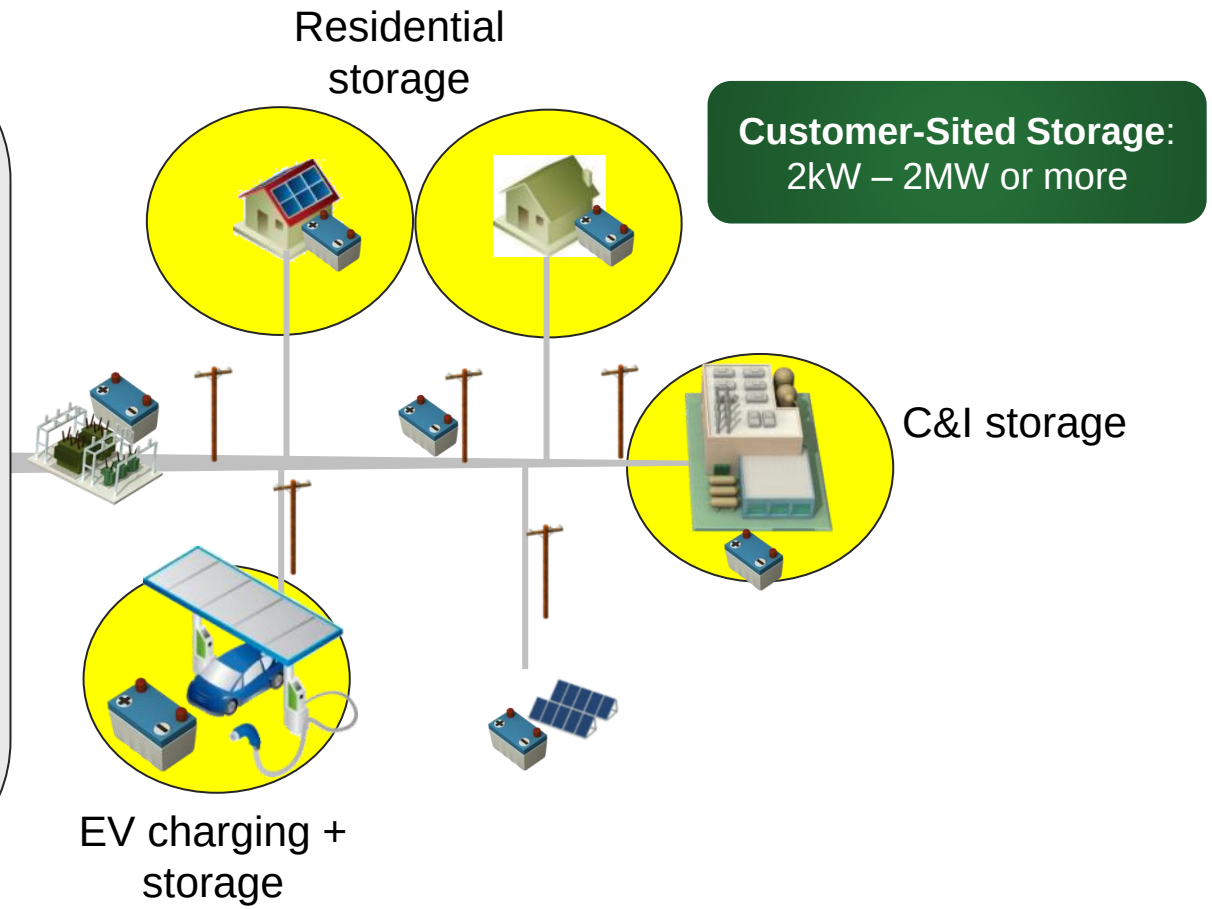
There is no one comprehensive analysis tool that does everything

Energy Storage Applications - Customer

Customer-Connected Storage

May provide:

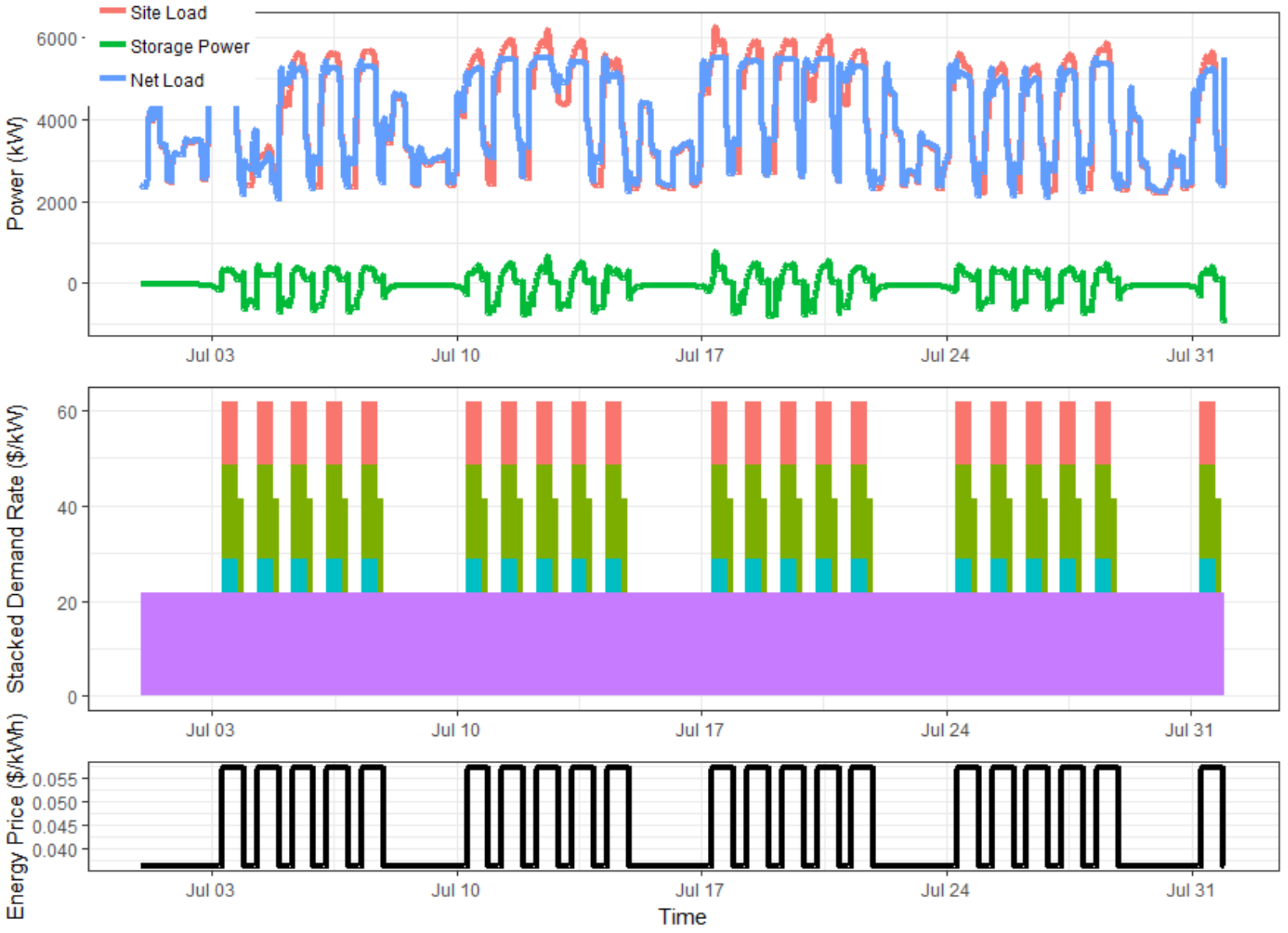
- Customer bill savings
  - Retail time-of-use tariff energy shifting
  - Demand charge management
- Backup power (resiliency)
- **Upstream T&D benefits – dependent on control priorities and limitations, integration platform availability**



Innovative demand response programs with advanced integration and control may enable more upstream grid value streams

Customer Sited

- Example dispatch to reduce demand charges
- One month (July) of a large, 4-hr storage system reducing demand charges at a ~6MW load.



Storage as part of overall customer resources

IoT makes it possible

SHARED INTEGRATED GRID

Imagine an energy future when customers' assets become shared energy solutions that enhance reliability, resiliency, and value for all.

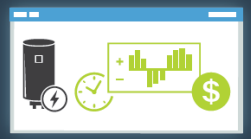
An electricity customer's water heater needs to be replaced. Instead of visiting a store or website or calling service providers, the customer uses a mobile app connected to the network operator platform to purchase and install a smart water heater with a single click.

Peace of mind
The app connects the customer to a list of trusted service providers.

Incentives
The customer opts in and instantly qualifies for incentives based on the exact location and grid needs.

Seamless integration
The energy asset automatically integrates with the electric grid.

Direct customer benefits
The water heater automatically adjusts to off-peak use, and the app delivers energy-saving tips and service alerts– cost-effectively enhancing comfort, choice, convenience and control.



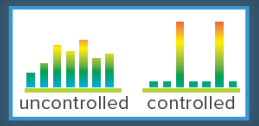
Customer Value Stream

Network Operator Value Stream

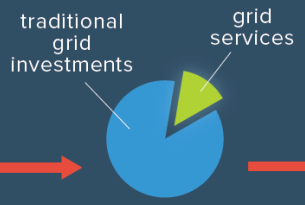
Bridging customer resources and the grid
The app connecting customers to the network operator platform can be developed by:

a. Transmission and distribution system owners and operators
b. Retail energy service companies
c. Aggregators or third-party service providers
d. Appliance and device vendors
e. Energy solution providers

Network operator platform
Secure interfaces enable real-time operation and planning, connect customers' assets to utility planning systems and distribution operation systems, and link to aggregated services for the bulk power system.



Grid services from customers' assets
The "connected" water heater is optimized to use energy based on grid needs, heating water during low electricity demand without impacting comfort.



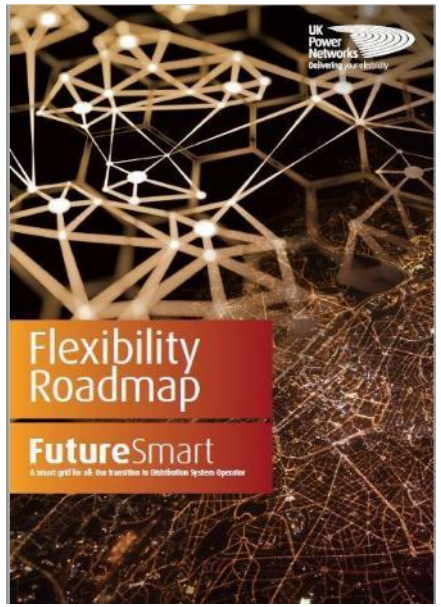
A new type of grid investment
The definition of grid investments expands to include grid services delivering value to customers and all levels of the grid.

Societal benefits
The shared integrated grid delivers greater reliability, resiliency and value for the grid and all customers.

Integrating with the Advanced Energy Community

Alabama Power Smart Neighborhood (Birmingham)

ESB Networks – The Dingle Transition Initiative

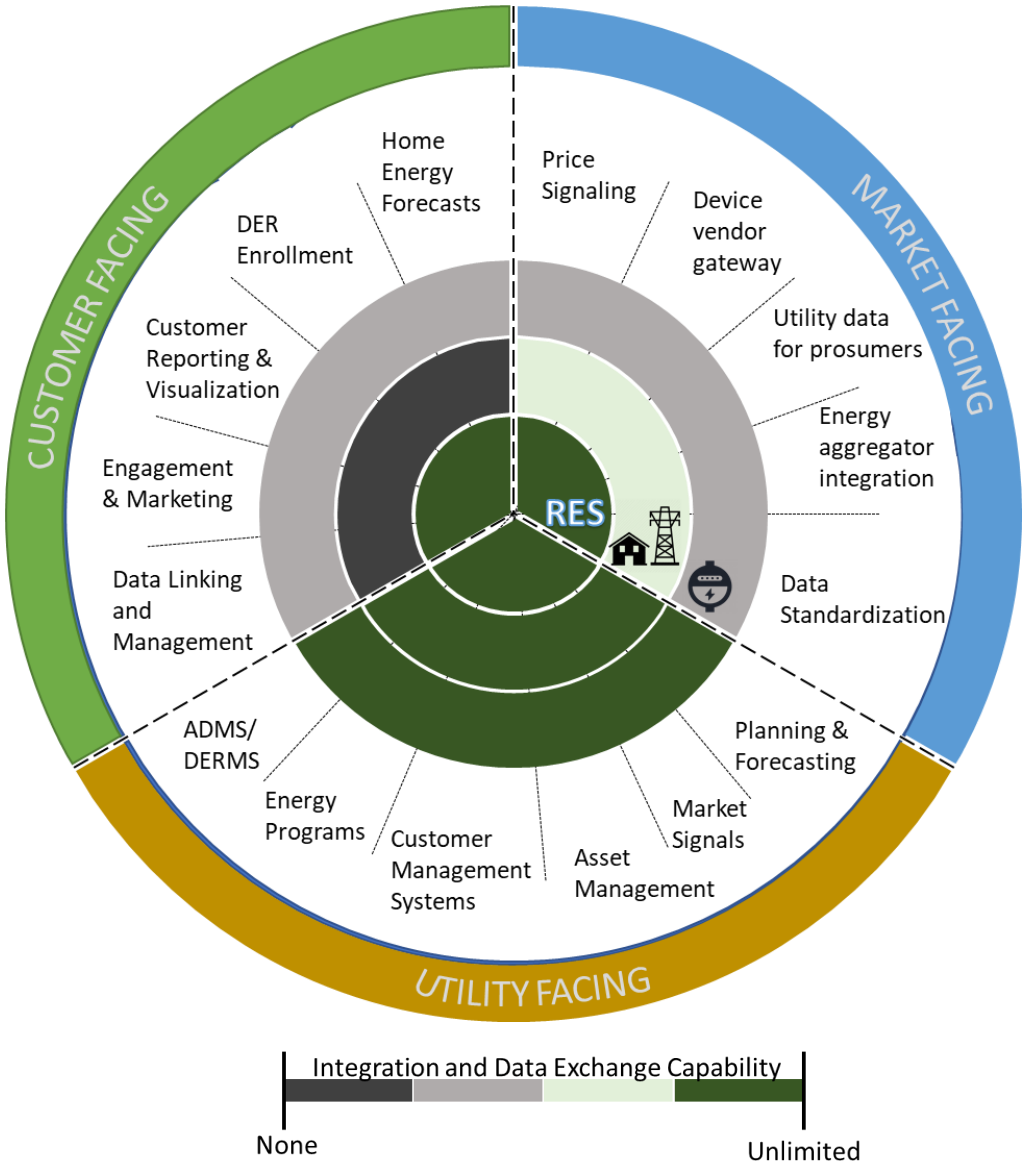


UK Power Networks Flexibility Roadmap

Exelon Com Ed – Bronzeville Smart Community

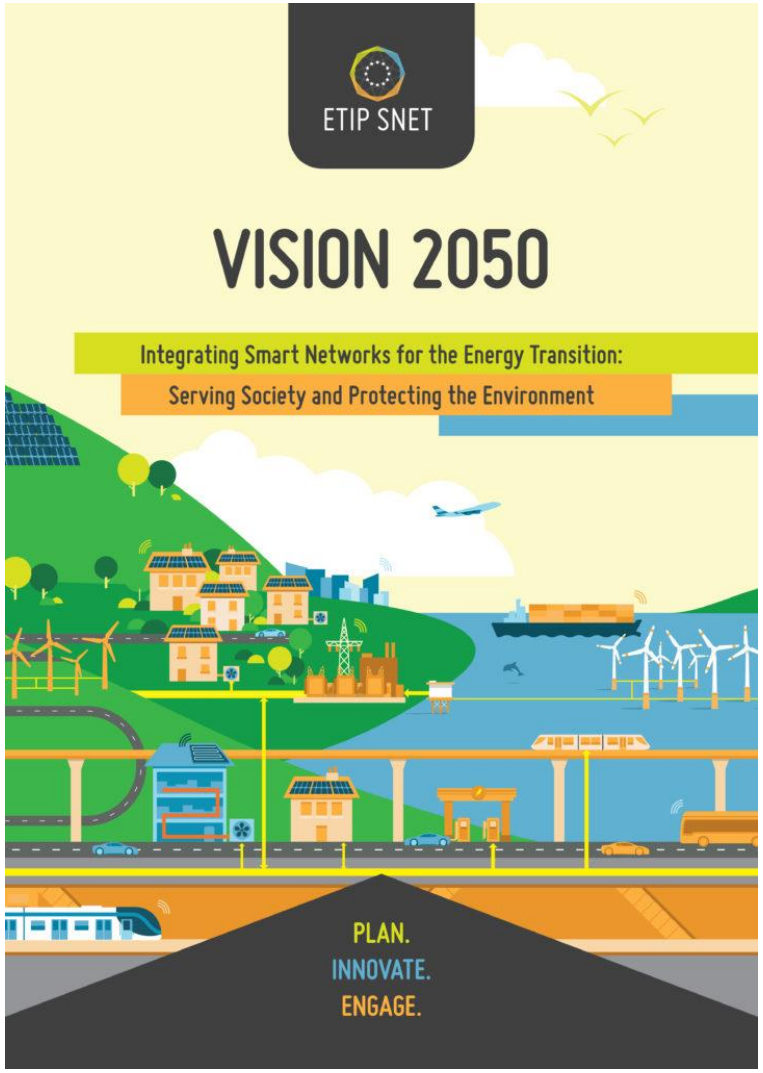
Developing the Platform for the Shared Integrated Grid

- A specialized energy data platform focusing on **data brokerage and aggregation** to facilitate engagement in the smart energy market
  - **Connect** with technology vendors and customers to collect data, integrate capability, and empower analytics and energy program opportunities
  - **Manage** data using advanced Big Data techniques to speed analytics and integration
  - **Distribute** data to new or existing systems supporting residential, C&I, vendor and utility partner programs



Challenges we have to address

1. **Architecture** for integration of resources at the customer and community levels
2. Shared **communication infrastructure** with **cyber security**
3. **Market and regulatory constructs** for flexibility and capacity
4. **Models and Tools for Planning** – Customers, Distributed Controls, Non Wires Alternatives
5. Integration of Distributed Energy Resource Management Systems **(DERMS)** with Distribution Operations
6. **Platforms** that integrate customer resources with distribution planning and real time operations
7. **Transmission/Distribution Coordination** – both planning and operations



NYS Energy Storage Regulatory Initiatives
Parallel Universes Converging

gi energy

FERC-NYISO Energy Storage Rulemaking

The federally regulated Energy Storage Wholesale Market Design Process

FERC NOPR

FERC notifies ISOs/RTOs it's thinking about making specific rules for storage

NYISO ESR & DER

NYISO responds to NOPR & starts its own ESR Market Design and DER Roadmap processes in MIWG & ICAPWG

FERC Orders 841 & 845

FERC reviews NOPR responses from ISOs/RTOs & officially orders rules for storage & DER

NYISO Issues Order 841 Compliance NYS Roadmap Leads to NYS Storage Order

NYISO takes part in DPS/NYSERDA Technical Conferences & PSC roadmap to reach NYS Storage Goal; NYISO issues Order 841 compliance to FERC; prime opportunity to combine NYISO & PSC stakeholder input

FTM distribution-tied batteries fall into grey area just being addressed in early 2019.

NYS PSC-NYSERDA-Joint Utilities Energy Storage Rulemaking

The state-regulated Utility Energy Storage Roadmap Process

REV & DSIP

Gov. Cuomo & PSC notify Joint Utilities that NYS is reforming vision for utility integration of DER & storage

REV Demos, NWS RFPs & VDER

PSC & JU test new vision for DER & Storage integration via REV Demos, NWS RFPs & VDER tariffs

NYS Energy Storage Goals & Incentives

NYS launches target of 1,500 MW of storage integrated into NYS grid by 2025 & announces $350M in incentives

NYS Roadmap Leads to NYS Storage Order

PSC asks DPS/NYSERDA for roadmap to reach NYS Storage Goal; DPS/NYSERDA hold Tech. Conferences, incl. NYISO; NYS Storage Order increases target to 3 GW by 2030; prime opp. to combine PSC & NYISO stakeholder input

Market Design & Integration Working Group

JOINT UTILITIES OF NEW YORK · ISO · Department of Public Service · NYSERDA · New York Power Authority · LIPA

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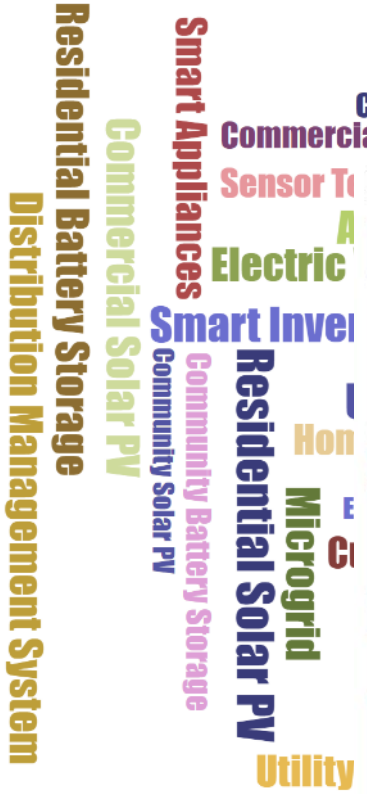
Tracking demonstrations - IGDemos.epri.com

Technologies Demonstrated

Projects included in this portal demonstrate a number of different technologies (sometimes multiple technologies). Feel free to browse the projects in any of the categories below:

- Advanced Metering
- Battery Storage
- Commercial Battery Storage
- Commercial Solar PV
- Common Information Model
- Community Battery Storage
- Community Solar PV
- Customer Integration
- Cybersecurity
- Distributed Resource Management System
- Distribution Management System
- Edge of Grid
- Electric Vehicle
- Home Energy Manager
- Long-term Forecasting
- Microgrid
- Operational Forecasting
- Residential Battery Storage
- Residential Solar PV
- Sensor Technology
- Smart Appliances
- Smart Inverter
- Solar PV
- Telecom
- Utility-scale Battery Storage
- Utility-scale Solar PV



Demonstration Project Map

Together...Shaping the Future of Electricity