Energy Storage in Vermont

VT Department of Public Service

Act 53 Storage Report

- On or before Nov. 15, 2017, Commissioner of Public Service "shall submit a report on the issue of deploying energy storage on the Vermont electric transmission and distribution system."
  - Summarize existing state, regional, and national actions or initiatives affecting deployment of energy storage;
  - Identify and summarize federal and state jurisdictional issues regarding deployment of storage;
  - Identify the opportunities for, the benefits of, and the barriers to deploying energy storage;
  - Identify and evaluate regulatory options and structure available to foster energy storage, including potential cost impacts to ratepayers; and
  - Assess the potential methods for fostering the development of cost-effective solutions for energy storage in Vermont and the potential benefits and cost impacts of each method for ratepayers.
- Report can be accessed at: http://publicservice.vermont.gov/content/energy-storage-study

Report Process

- Act 53 signed into law May 30, 2017
- July 2017: PSD issued request for comments and input on proposed study outline
- August 2017: PSD received input from stakeholders (including electric transmission & distribution utilities, renewable energy and storage project developers, nonprofits, land use planners, neighboring states, and the regional transmission organization.
- October 2017: PSD issued a draft report for public comment
- November 15, 2017: PSD submitted the final report to HET

Written comments on the proposed outline and the draft report are available at http://publicservice.vermont.gov/content/energy-storage-study.

Report Outline

- Introduction
- Benefits and Costs of Storage Systems in Vermont
- Ownership Options and Delivery Pathways for Promoting Storage
- Other Considerations
- Potential Programs and Policies to Encourage Storage in Vermont
- Recommendations
- Appendix A: Act 53 Storage Report Language
- Appendix B: Energy Storage in the State, Region, and Nation

Act 53 Storage Study

"....we view energy storage as a means to an end – rather than an end in and of itself – and thus many of our recommendations focus on pursuit of storage within the broader pursuit of a clean, efficient, reliable, and resilient grid in the most cost-effective manner for ratepayers."

State energy policy

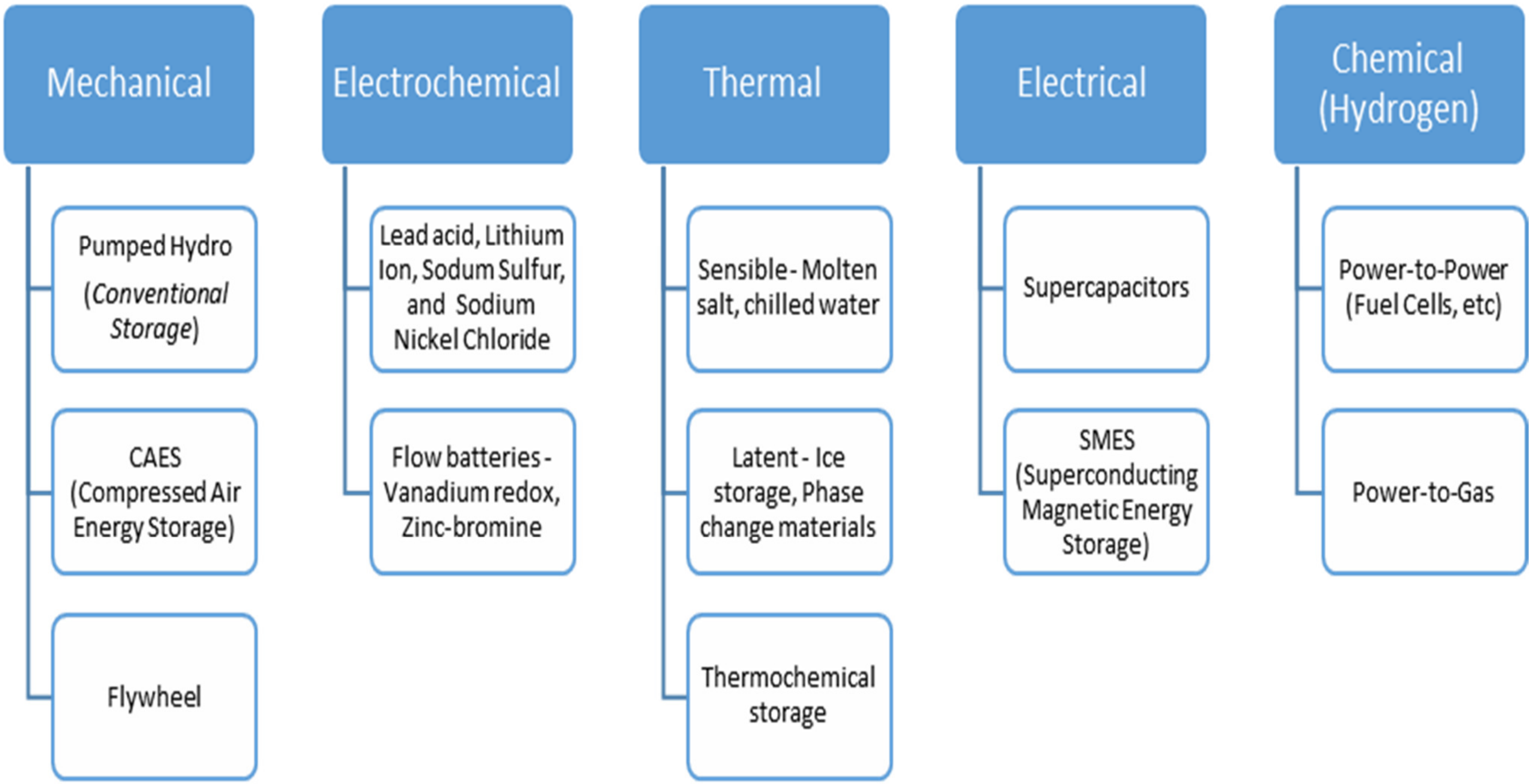
30 V.S.A. § 202a

It is the general policy of the State of Vermont:

(1) To assure, to the greatest extent practicable, that Vermont can meet its energy service needs in a manner that is adequate, reliable, secure, and sustainable; that assures affordability and encourages the State's economic vitality, the efficient use of energy resources, and cost-effective demand-side management; and that is environmentally sound.

(2) To identify and evaluate, on an ongoing basis, resources that will meet Vermont's energy service needs in accordance with the principles of least-cost integrated planning; including efficiency, conservation and load management alternatives, wise use of renewable resources, and environmentally sound energy supply.

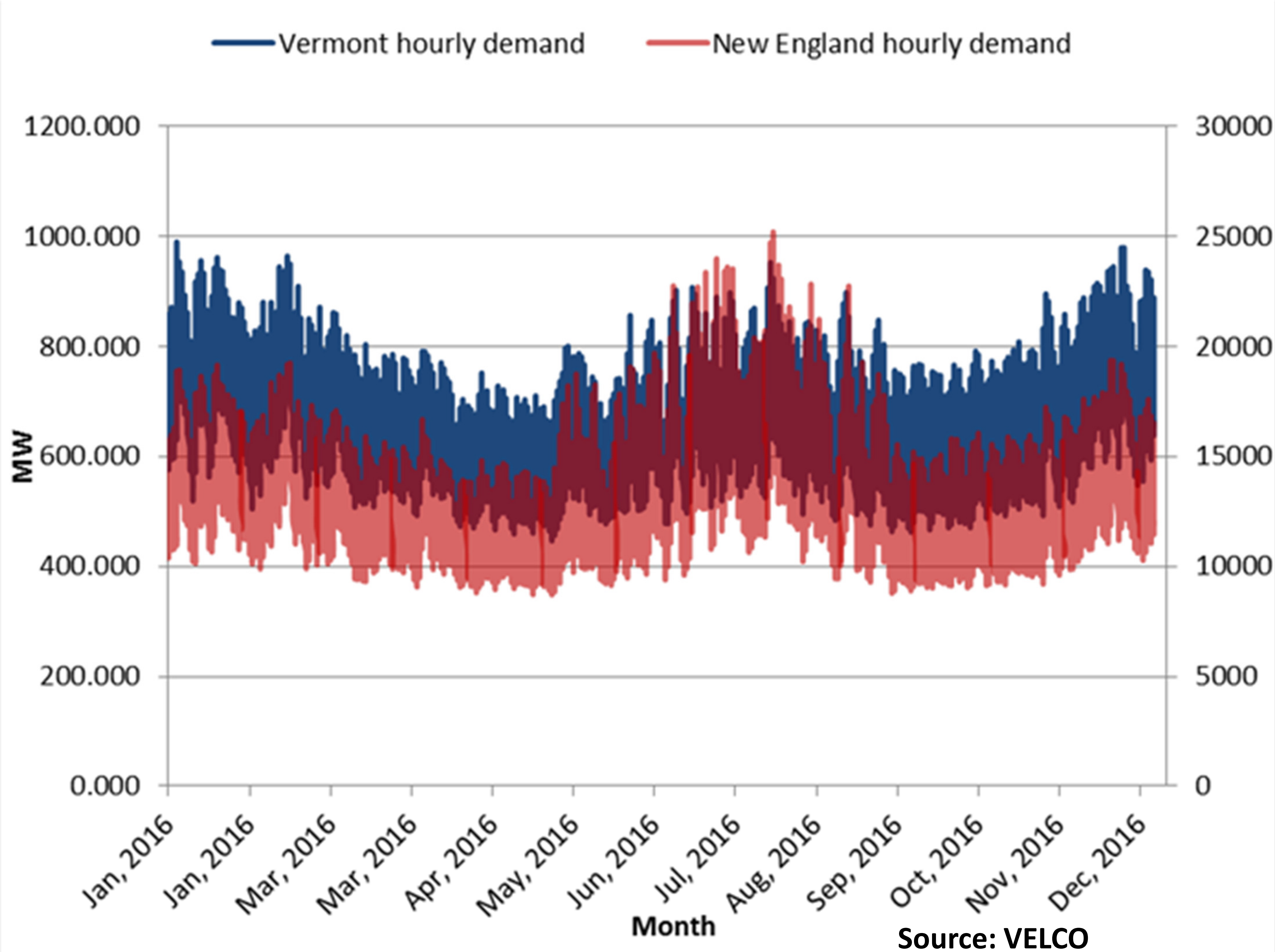
Energy storage technologies

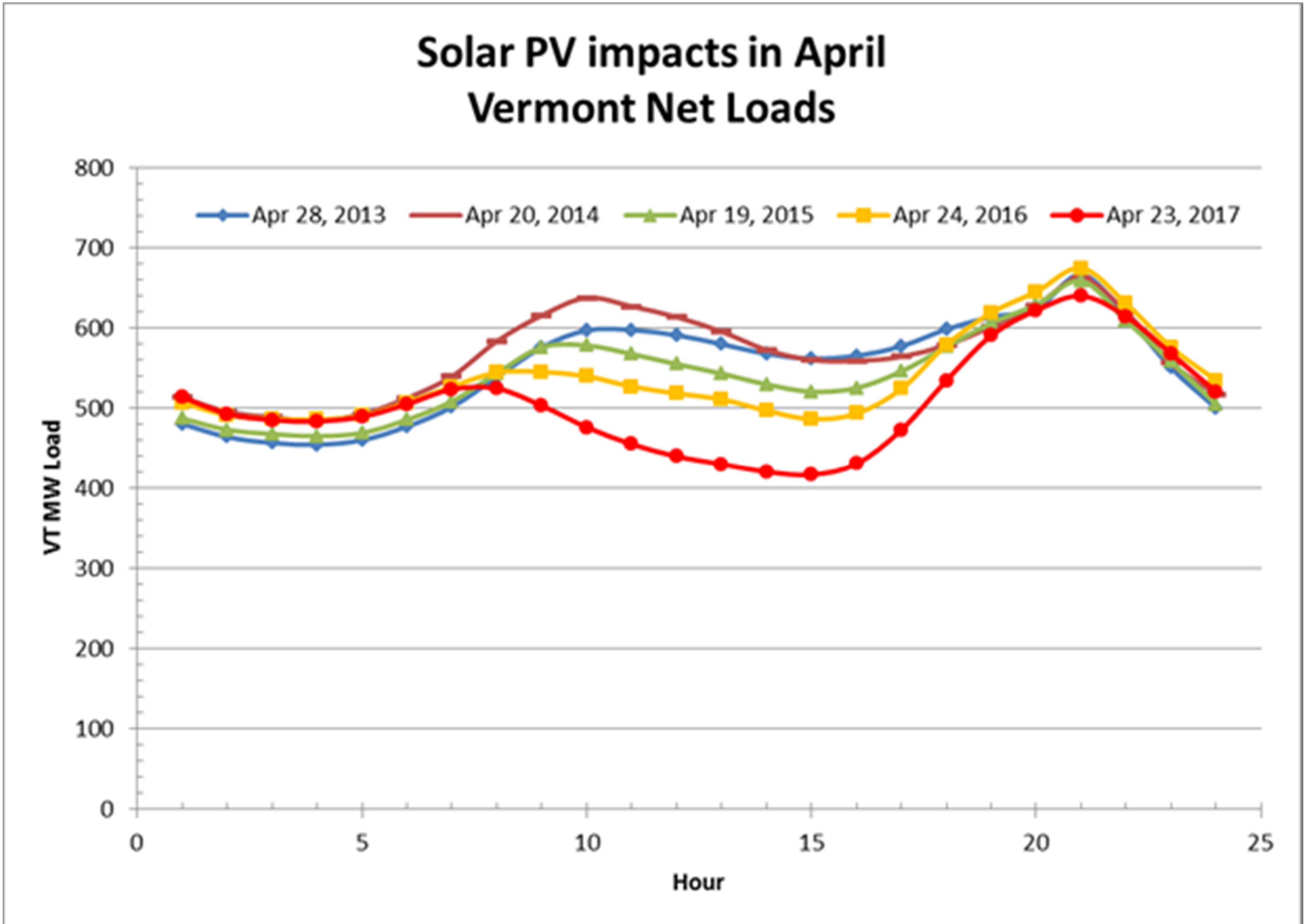


Courtesy Massachusetts Department of Energy Resources, from “State of Charge”

Storage benefits

- Peak shaving
- Other electricity market services
- Renewables integration
- Resilience


Vermont hourly demand
New England hourly demand
1200.000
1000.000
800.000
600.000
400.000
200.000
0.000
30000
25000
20000
15000
10000
5000
0
MW
Jan, 2016
Jan, 2016
Mar, 2016
Mar, 2016
Apr, 2016
May, 2016
Jun, 2016
Jul, 2016
Aug, 2016
Sep, 2016
Oct, 2016
Nov, 2016
Dec, 2016
Month
Source: VELCO



Source: VELCO

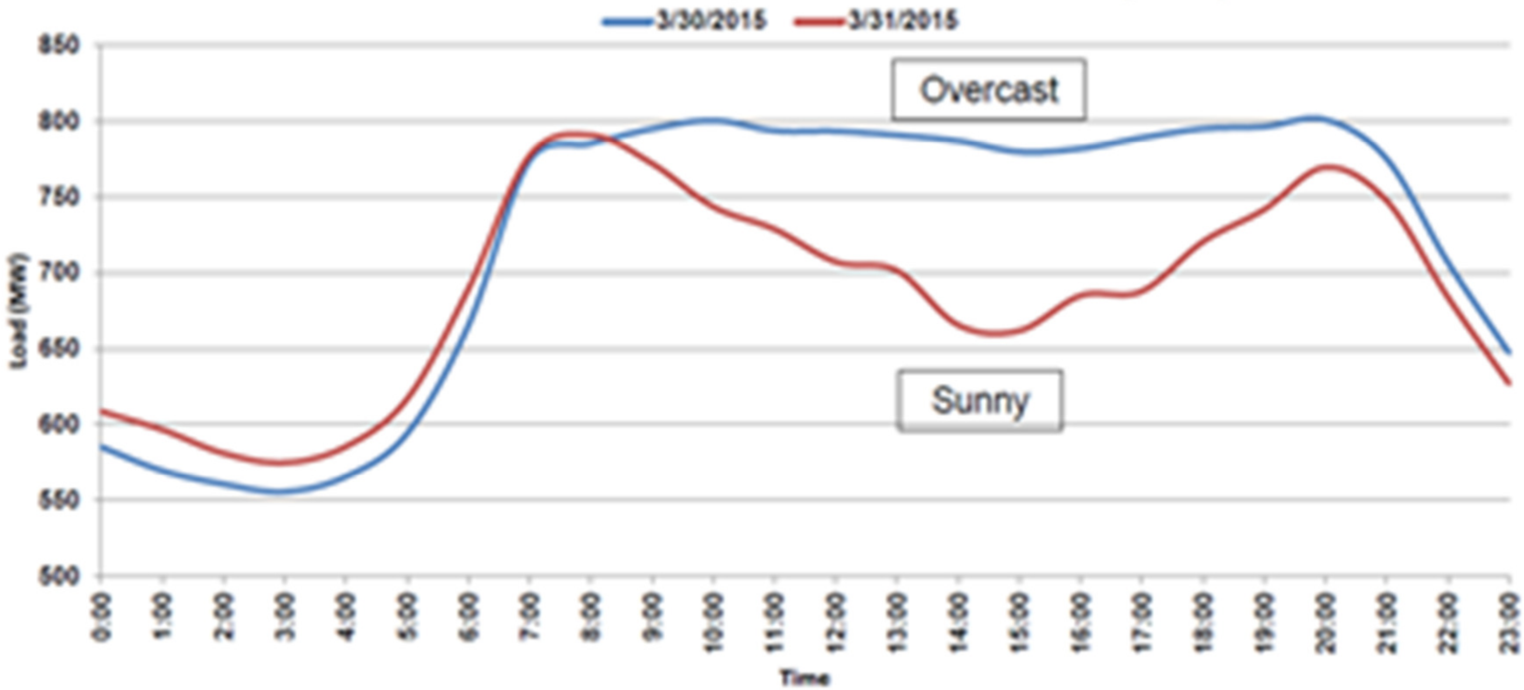
VELCO Load Curve Study

Case #1

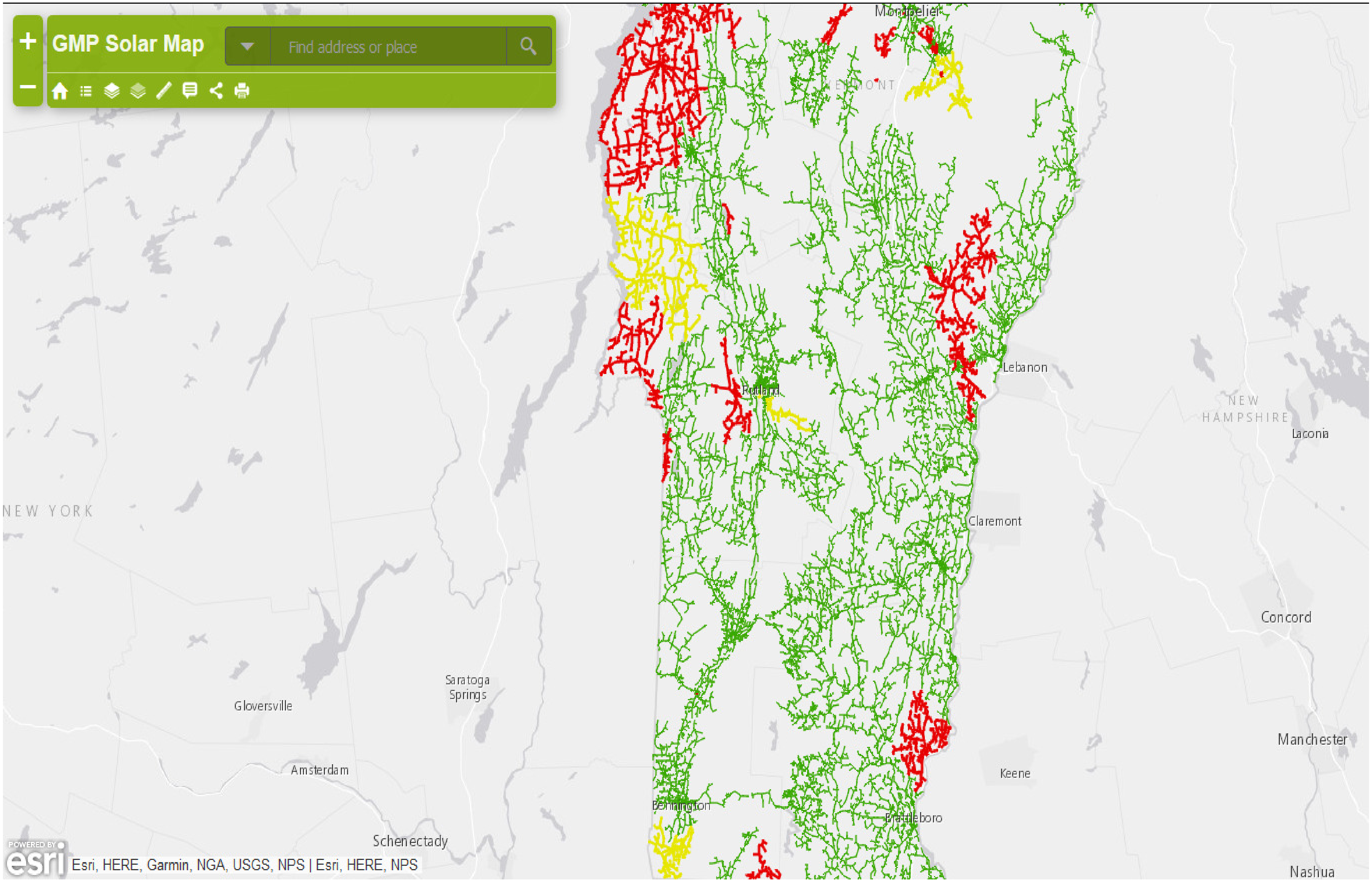
Increase of solar generation "behind the meter" is offsetting VELCO demand curve

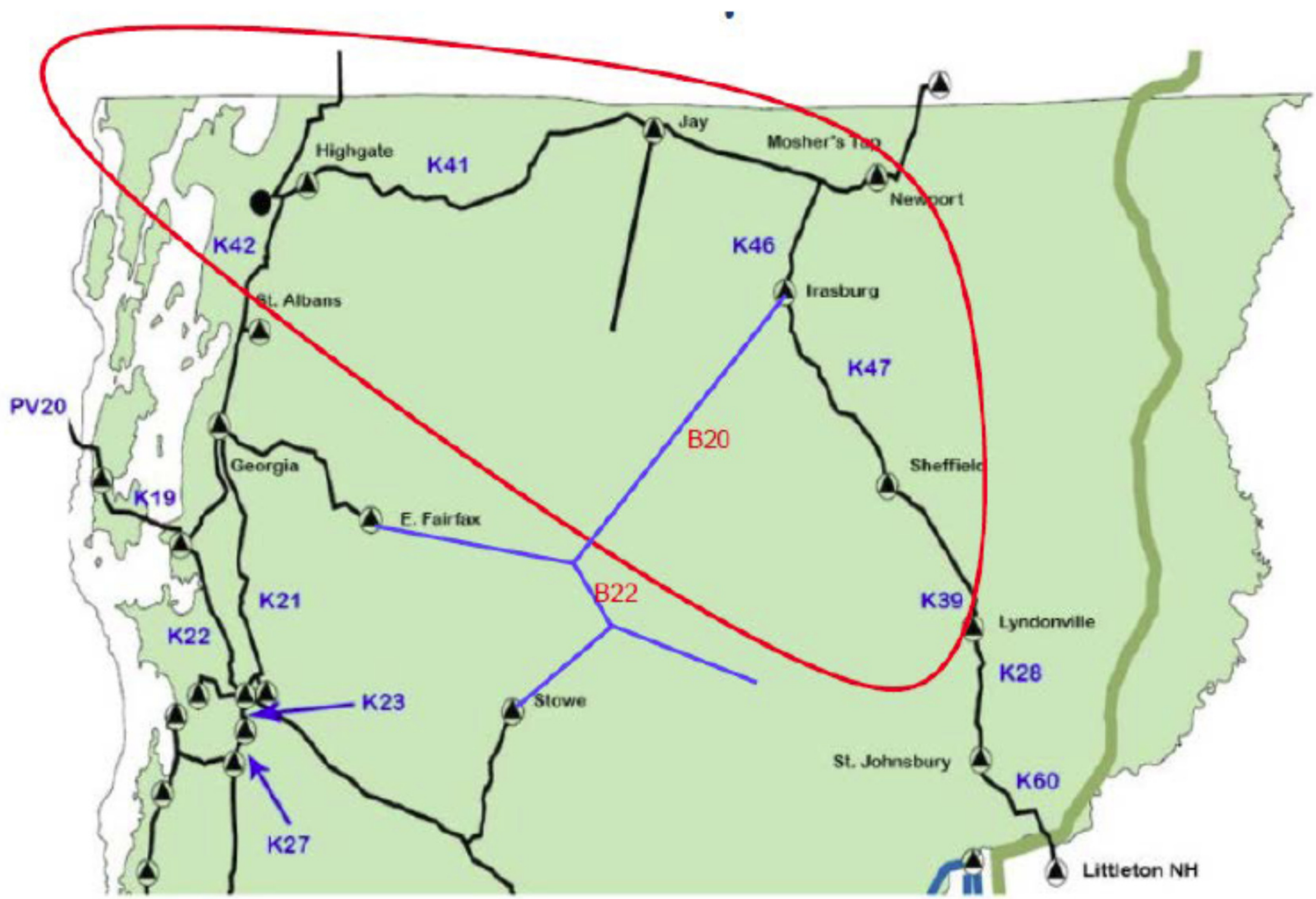
	3/30/2015	3/31/2015
Cloud Cover	Overcast	Sunny
High/Low (°F)	41/26	42/24
Max Radiation (w/m^2)	241	965

VELCO Load Curves (Overcast vs. Sunny Days



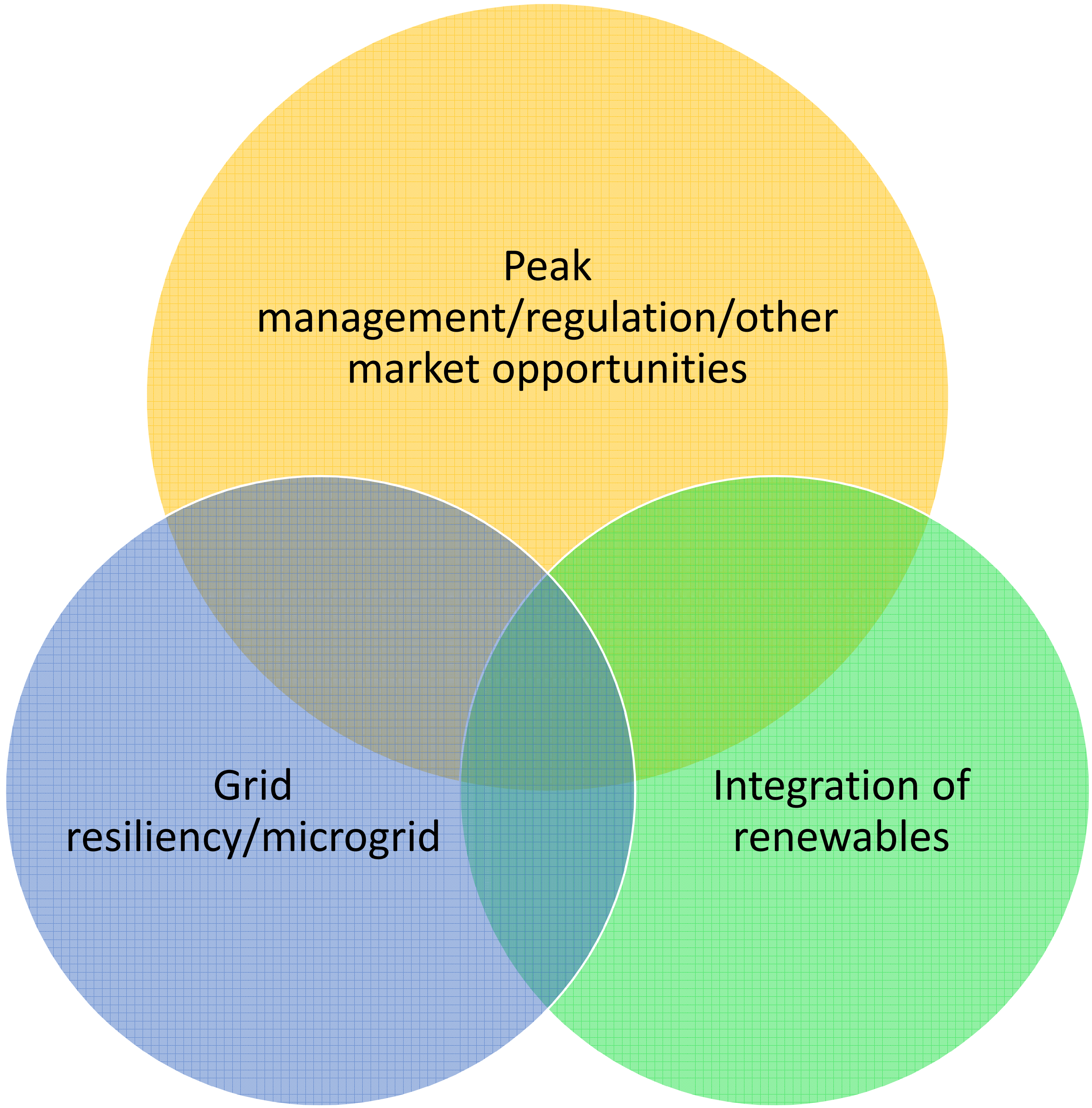
Source: VELCO


GMP Solar Map
Find address or place
Montpelier
VERMONT
Lebanon
Rutland
NEW HAMPSHIRE
Laconia
NEW YORK
Claremont
Concord
Saratoga Springs
Gloversville
Manchester
Amsterdam
Keene
Bennington
Brattleboro
Schenectady
Nashua
POWERED BY esri
Esri, HERE, Garmin, NGA, USGS, NPS | Esri, HERE, NPS



Source: VELCO

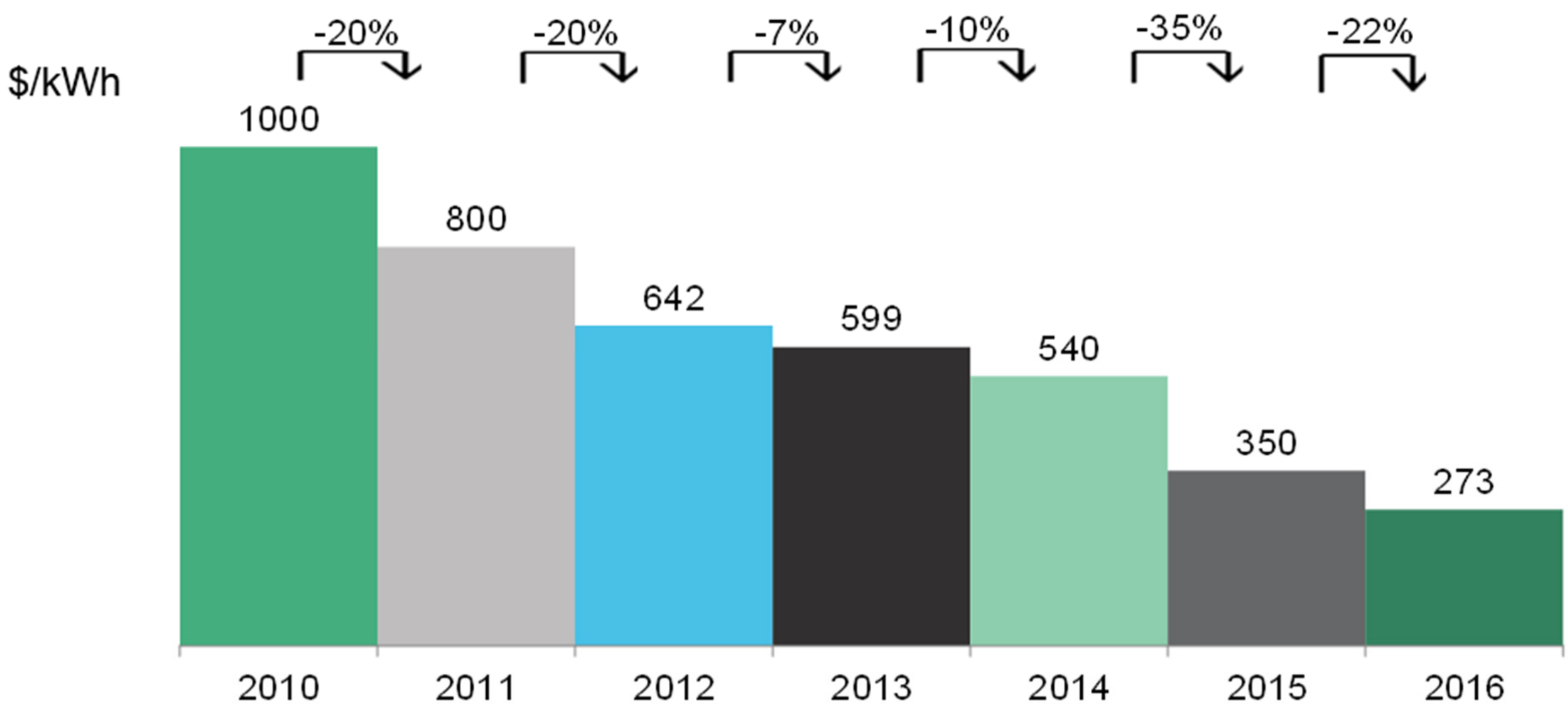
Top left: Paul Bierman; Bottom left: By HopsonRoad - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=30591776


Peak management/regulation/other market opportunities
Grid resiliency/microgrid
Integration of renewables

Storage costs

- Equipment (battery, inverter, containers, etc.)
- Soft costs (interconnection, engineering, etc.)
- Software
- O&M

Lithium-ion battery price declines



Source: Bloomberg New Energy Finance

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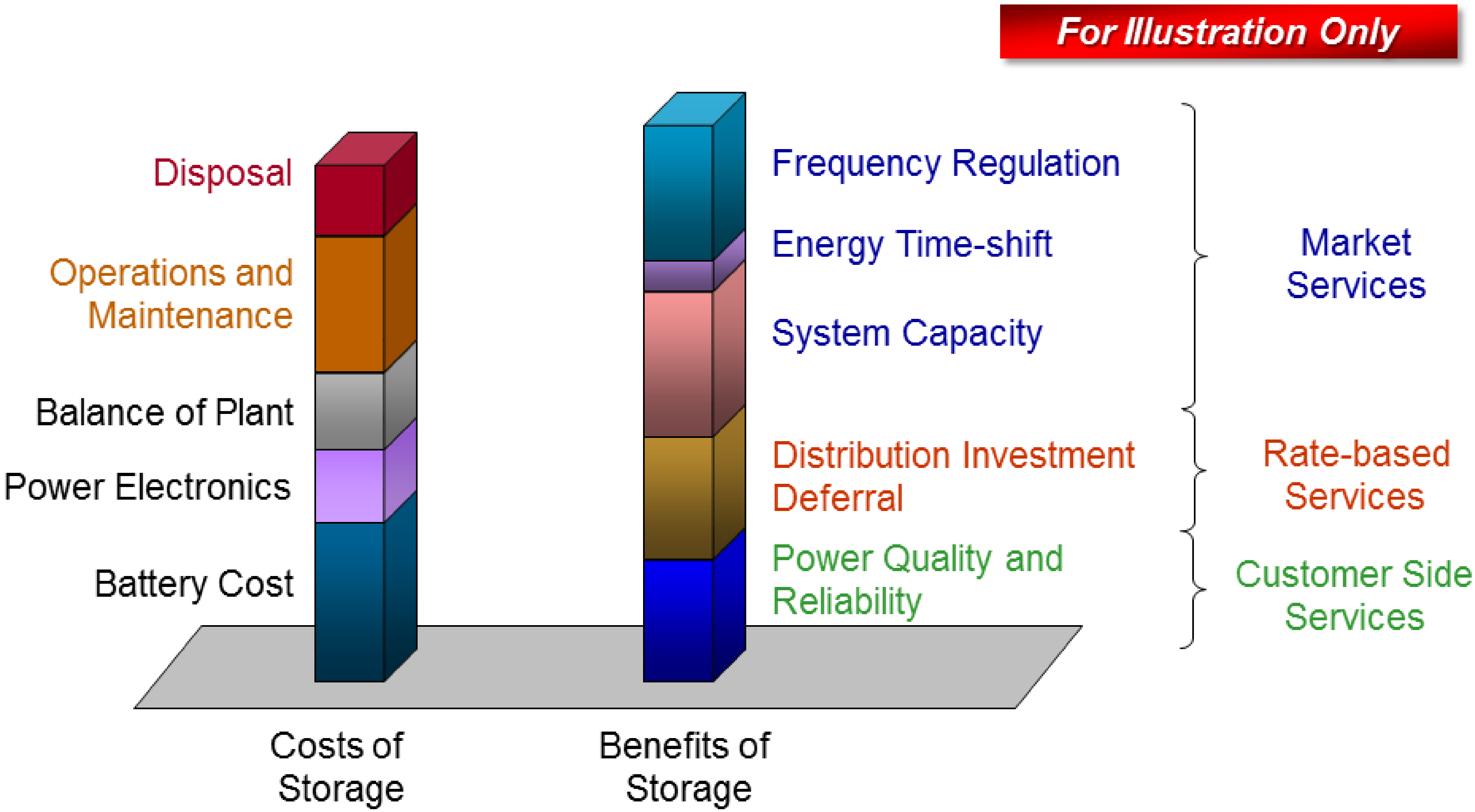
Analyzing the Value of Storage



Developing a business case usually requires stacking multiple benefits

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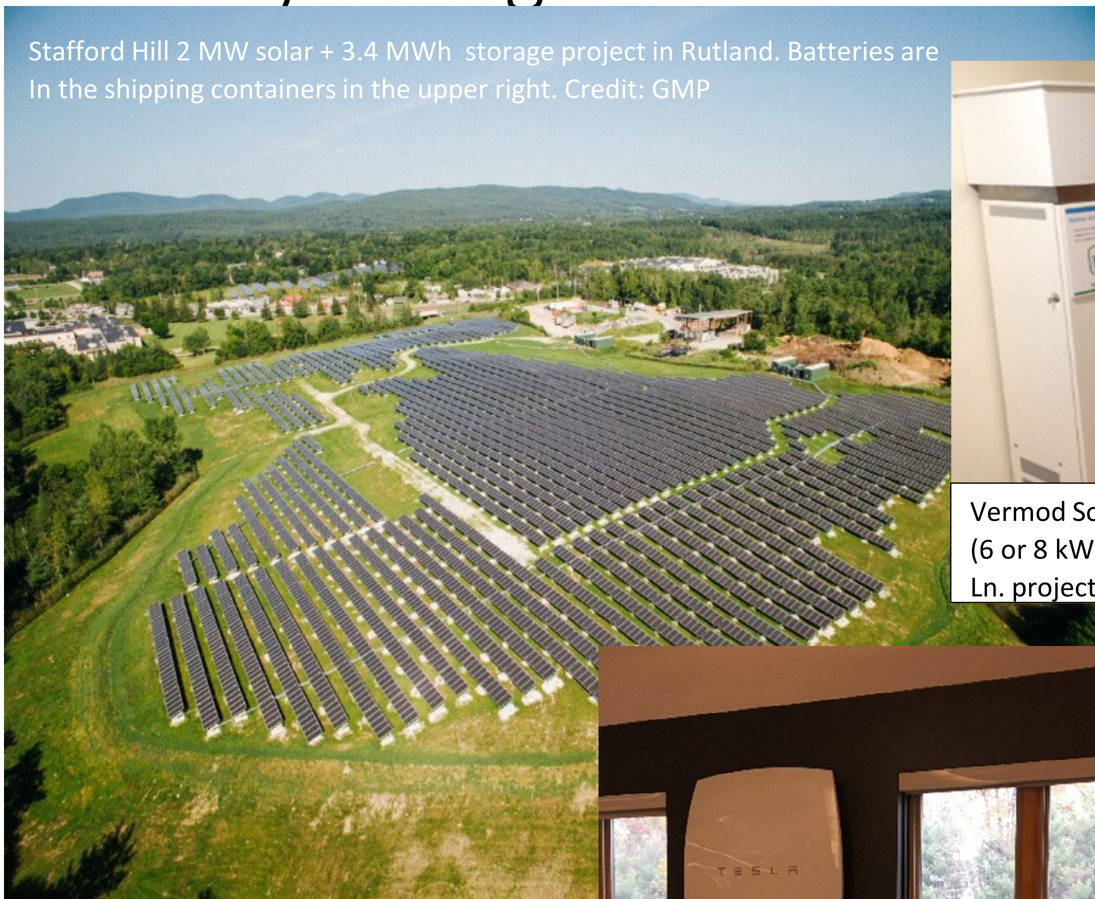
EPRI ELECTRIC POWER RESEARCH INSTITUTE

Ownership options & delivery pathways

Battery control	Benefits	Challenges
Utility	-Potentially best positioned to deploy storage where it is most beneficial to the grid, and in the near term, to hit peaks -Utility can usually capture market benefits on behalf of all ratepayers -Utility can capture reliability benefits on behalf of multiple customers -Can be grid-scale or aggregated distributed storage	-Can crowd out other entities from participating in this market space -Projects must benefit ratepayers and therefore tend to prioritize monetizable benefits -Selection of one technology or software to minimize investment and risk may discourage exploration of newly emerging products
Customer	-Potentially best positioned to address on-site reliability -Customer can tailor system to needs -Customer can place a value on reliability	-Without shared access/control by utility or third party, difficult to capture sufficient benefit streams
Third party	-Can capture market values and potentially resiliency/integration/reliability benefits for utilities and customers	-Rate design and software platforms to allow shared access and benefits still under development -Slim margins when values shared with many -Coordination to allow full realization of values by all parties challenging

Utility storage activities



Stafford Hill 2 MW solar + 3.4 MWh storage project in Rutland. Batteries are In the shipping containers in the upper right. Credit: GMP

Vermod Sonnenbatteries (6 or 8 kWh) at McKnight Ln. project in Waltham

Also.....

- BED RFP for a 1 MW, 4 MWH battery at BTV
- Pending PUC decision for GMP 1 MW/4 MWh battery on Panton PV site
- GMP petitions for 5 MW PV + 2 MW/8 MWh battery microgrid projects in Milton & Ferrisburgh
- VEC reviewing proposals for utility-scale storage in time for summer 2018 peak
- VELCO analyzing potential for storage to alleviate N. VT export constraints

Simpliphi 82 kWh system at Emerald Lake

Sunverge 8 kWh in Plymouth

GMP Tesla Powerwall 5.5 kW install

BED King St. Youth Center storage project

Non-utility storage activities

Bill Laberge of Grassroots Solar with a Sonnenbatterie

Dynapower test pad in S. Burlington

Tesla Powerwall unit installed by Peck Electric in S. Burlington.

Northern Reliability VTA solar + storage in Rochester

PowerGuru 32 kWh battery in Pownal

Other considerations

- Federal and state jurisdictional issues
- Safety training for first responders
- Sales and property tax treatment
- Software platforms
- Enabling technologies
- Emissions

Exploring Storage Programs and Policies

- Utility planning exercises
- Rate design, tariffs, and distinct pricing of storage-related services
- Energy assurance efforts
- Regulatory review process and criteria
- Interconnection standards
- Modification of existing or development of new programs/incentives
- Procurement targets

Questions?

http://publicservice.vermont.gov/content/energy-storage-study

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