Topics

• Orientation of regulated entities and policies
• Regional markets and transmission
• Vermont’s electric system and trends
• Implications for system costs and ratepayer impacts
Regulated Entities and Policies
Who is the Public Service Department?

The Public Service Department = represents the interests of the people of the state as a whole

- Represents public interest in utility cases
- Provides long-range planning for the state's energy and telecom needs
- Ensures all Vermonters share in the benefits of modern communications
- Administers federal energy programs
- Resolves utility customer complaints
- Informs public about utility-related matters
- Makes and administers power purchase contracts

http://publicservice.vermont.gov/

Commissioner June E. Tierney
Vermont Electric Utilities
- 1 IOU (serving ¾ of VT load or 260,000 customers)
- 2 Coops
- 14 Municipals
- 1 transmission utility (VELCO)

Vermont Renewable Deployment
- 300 MW Solar PV
- 150 MW Wind
- 200 MW In-State Hydro
- 70 MW Biomass
- 8 MW Landfill Gas
- 5 MW Methane Digesters

**1000 MW Peak**
Energy Efficiency Utilities

• Efficiency Vermont (EVT)
• City of Burlington Electric Department
• Vermont Gas Systems

• Funding source and Responsibilities
  • Responsible for reducing electric and thermal usage
  • Funded by energy efficiency charge on customers’ bills
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.
Requirements in Statute

Renewable Energy Standard (30 V.S.A. § 8005)

• Total renewable energy (55% growing to 75%)
  • Any size/vintage renewable resource, contract and attribute-based system provided it delivers into New England

• Distributed generation (1% to 10%, carve-out of Tier 1)
  • Under 5 MW, commissioned after 6/30/15, connected to VT distribution

• Energy transformation (2% to 12%, not a carve-out)
  • Fossil fuel reduction

Standard Offer Program (30 V.S.A. § 8005a)

• Long-term contracts for resources 2.2 MW or less, up to 127.5 MW

Net Metering (30 V.S.A. § 8010)

• Compensation based on residential rate with adjustors for siting and RECs
Goals in Statute

• Meet energy needs in a reliable, secure, sustainable, and affordable manner. (30 V.S.A. § 202a)

• Renewable policies that promote economic benefit, efficient use of resources, stable prices, market development, air and water quality, grid stability, climate change mitigation, and diversity of resources. (30 V.S.A. § 8001)

• 25% renewable by 2025. (10 V.S.A. § 580(a))

• 50% GHG emission reduction by 2028, and 75% (if practicable) by 2050. (10 V.S.A. § 578(a))

• Building efficiency – weatherize 25% of housing stock by 2025. (10 VSA. § 581)
Regional Context:
Vermont as a part of ISO New England
ISO New England

• Regulated by the Federal Energy Regulatory Commission

• Responsible for:
  • Designing and implementing wholesale electricity markets
    • Day-ahead and Real-time Energy Markets, Forward Capacity Market, Ancillary Services
  • Operating the New England transmission system
    • VELCO owns but operation is under the direction of ISO-NE
  • Power system planning to meet federal reliability standards
- 7.1 million households and businesses; population 14.7 million
- More than 1,500 generating resources:
  - Approximately 340 resources modeled in the Energy Management System
  - More than 1,200 settlement-only generating resources
  - More than 100,000 grid-connected and behind-the-meter solar PV installations
- Approximately 400 participants in the marketplace (those who generate, buy, sell, transport, and use wholesale electricity and implement demand resources)
- About 9,000 miles of transmission lines
- 13 interconnections to electricity systems in New York and Canada
- 136,355 gigawatt-hours (GWh), all-time annual energy served, set during 2005
- All-time peak demand of 28,130 megawatts (MW), set on August 2, 2006
- 22,818 MW all-time winter peak demand, set on January 15, 2004
- Approximately 30,500 MW of total generating capability for 2017 (summer seasonal claimed capability; SSCC)
- Approximately 2,800 MW of demand resources for 2017 (active demand response and energy efficiency)
- Market value in 2016—$5.4 billion total; $4.1 billion energy market; $1.2 billion capacity market; $0.1 billion ancillary services market
- Approximately $8.35 billion in transmission investment since 2002; approximately $4.0 billion planned

Source: ISO-NE Regional System Plan 2017
https://www.iso-ne.com/system-planning/system-plans-studies/rsp
Source of New England production cleaner with natural gas and renewables

### Sources of Electricity Production

Major shift from oil and coal to natural gas over the past 17 years

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural Gas</th>
<th>Nuclear</th>
<th>Renewables</th>
<th>Hydro</th>
<th>Coal</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>15%</td>
<td>31%</td>
<td>6%</td>
<td>7%</td>
<td>18%</td>
<td>22%</td>
</tr>
<tr>
<td>2017</td>
<td>48%</td>
<td>31%</td>
<td>11%</td>
<td>8%</td>
<td>2%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Source: ISO-NE
Regional declining loads and peak

Electricity Demand Growth Has Slowed in New England

Compound annual growth rates for peak demand and overall electricity use, net of energy efficiency and solar photovoltaic (PV), 2017-2026

Source: ISO-NE

New England Wholesale Prices Spike in Winter

Average LMP in Vermont, Annual and Monthly (nom. $ per MWh)

Source: VT PSD
New England regional market price has been declining

Vermont utilities are hedged for generation

- ~20% of generation from owned units
- Long term contracts
  - System power contracts (e.g., HQ)
  - Unit contingent contracts (mostly weather contingent like wind and solar)
- Standard offer contracts and net metering
Vermont Electric Prices
Many factors go into customers’ electric bills

Electric Utility Cost of Service, 2016

- Power supply, $464,214,653
- Transmission, $132,520,979
- Distribution, $122,877,012
- Customer sales, $255,227
- A & G, $71,123,030
- Amort, $16,725,460

Source: VT PSD
Vermont retail prices are currently low relative to other states in the region, save Maine.
Electricity prices in Vermont are below the region but well above national

Source: EIA.GOV
Vermont kWh Sales
Retail sales in Vermont have been flat to declining since 2005..., sales in 2016 below 2001

Source: EIA.GOV
Forecast is for continued flat and below historic levels

Source: VELCO, Draft Long Range Transmission Plan
Vermont has developed more solar than New Hampshire, Rhode Island and Maine combined.

Policy drivers of sales trends

Down
• Energy efficiency
• Net metering
• Federal appliance standards

Up
• Beneficial electrification
  • Custom projects (electrifying sugaring operations and saw mills)
• Electric Vehicles
• Cold Climate Heat Pumps
Moving Forward
The practical affect of some programs is that there is re-spreading of some costs...

• Average Rates ~ 15 cents/kWh

• Marginal/avoided costs/ratepayer costs/societal costs~
  • Energy 3-4 cents/kWh
  • FCM 1.5 – 2 cents/kWh
  • RNS 1.5 – 2 cents/kWh
  • Carbon at $100/ton ~ $5/MWh or ½ cent per kWh (assumes 10% regional power)
  • T&D – negligible
  • Total avoided ratepayer costs – 6-8 cents per kWh

• Margin lost on sales to be re-spread ~ 7 - 8 cents per kWh
Challenges for integrating solar looking forward...
Challenges associated with export of energy from northern Vermont ...

https://www.vermontspc.com/grid-planning/shei-info
System Planning is Increasing in Importance

• Vermont has several planning requirements in place:
  • Integrated Resource Plans are required of utilities
  • VELCO Long-Range Transmission Plan
  • Demand Resources Plan required of energy efficiency utilities

• Location Matters
  • Generation or energy efficiency in a constrained area provides positive value to the individual customer but likely negative value to the system (and to other customers)
  • Beneficial Electrification will have more value in a generation constrained area than elsewhere

• Need to Choreograph Load and Generation (Timing Matters)
  • Utilities electrification efforts should not increase T&D costs
  • Charging an EV after dark doesn’t help ease generation constraints caused by solar generation
Questions?
National and global trends, declines in wholesale electricity from impacts from shale gas

Source: EIA  https://www.eia.gov/dnav/ng/hist/n3045us3m.htm
Shale gas production in the US..., demand is roughly 75 Bcf/d
Coal is on the decline, natural gas on the rise

Source: EIA
Transmission costs have been on the rise nationally.
“Price of Solar Energy in the United States Has Fallen to 5¢/kWh”

DOE 2020 targets for solar (sans incentives) met in 2017

Source: DOE
https://www.energy.gov/eere/solar/articles/2020-utility-scale-solar-goal-achieved
Major components of cost of electricity, US
US Demand and Production roughly in balance in recent years at about 75 Bcf/d
Transmission investments have been on the rise regionally and nationally.