NEW HAMPSHIRE'S THERMAL RENEWABLE PORTFOLIO STANDARD PROVISIONS

Elizabeth Nixon
NH Public Utilities Commission
September 23, 2014

RPS Legislation

- Enacted in July 2007. RSA 362-F.
- Established REC requirement for 4 classes:
  - Class I: New sources (wind, biomass, methane gas, etc.) and new capacity added to existing biomass, LFG, and hydro facilities (Began operation after January 1, 2006)
  - Class II: Photovoltaic systems
  - Class III: Existing biomass < 25 MW and landfill gas facilities
  - Class IV: Existing small hydro facilities < 5 MW

RPS Legislation –Thermal

- SB218 became effective June 19, 2012.
- Created Class I sub-class for useful thermal renewable energy.
- Class I REC requirement of 0.2% to be met with thermal resources beginning 2013; delayed by an Order of the Commission to January 1, 2014 at 0.4%.
- Legislation (SB 148 and HB542) in 2013 revised the % obligation to ramp it up faster
- *Requires NHPUC to adopt procedures for the **metering**, verification, and reporting of useful thermal energy output.* RSA 362-F:13 VI-a

% Obligation

Calendar Year	Total Requirement	Total Class I	Thermal Class I	Class II	Class III	Class IV
2008	4.00%	0.00%	0.00%	0.00%	3.50%	0.50%
2009	6.00%	0.50%	0.00%	0.00%	4.50%	1.00%
2010	7.54%	1.00%	0.00%	0.04%	5.50%	1.00%
2011	9.58%	2.00%	0.00%	0.08%	6.50%	1.00%
2012	5.55%	3.00%	0.00%	0.15%	1.40%	1.00%
2013	5.80%	3.80%	0.00%	0.20%	0.50%	1.30%
2014	9.70%	5.00%	0.40%	0.30%	3.00%	1.40%
2015	15.80%	6.00%	0.60%	0.30%	8.00%	1.50%
2016	16.70%	6.90%	1.30%	0.30%	8.00%	1.50%
2017	17.60%	7.80%	1.40%	0.30%	8.00%	1.50%
2018	18.50%	8.70%	1.50%	0.30%	8.00%	1.50%
2019	19.40%	9.60%	1.60%	0.30%	8.00%	1.50%
2020	20.30%	10.50%	1.70%	0.30%	8.00%	1.50%
2021	21.20%	11.40%	1.80%	0.30%	8.00%	1.50%
2022	22.10%	12.30%	1.90%	0.30%	8.00%	1.50%
2023	23.00%	13.20%	2.00%	0.30%	8.00%	1.50%
2024	23.90%	14.10%	2.00%	0.30%	8.00%	1.50%
2025 and thereafter	24.80%	15.00%	2.00%	0.30%	8.00%	1.50%

Est. MWH RECs

Calendar Year	Total Retail Sales to Retail Customers (MWh)*	Total Class I	Thermal Class I	Class II	Class III	Class IV	Total Obligation
2008	10,550,550	0	0	0	369,269	52,753	422,022
2009	10,202,233	51,011	0	0	459,100	102,022	612,134
2010	10,631,756	106,318	0	4,253	584,747	106,318	801,634
2011	10,610,657	212,213	0	8,489	689,693	106,107	1,016,501
2012	10,681,310	320,439	0	16,022	149,538	106,813	592,813
2013	10,904,567	414,374	0	21,809	54,523	141,759	632,465
2014	11,068,136	553,407	44,273	33,204	332,044	154,954	1,073,609
2015	11,234,158	674,049	67,405	33,702	898,733	168,512	1,774,997
2016	11,402,670	786,784	148,235	34,208	912,214	171,040	1,904,246
2017	11,573,710	902,749	162,032	34,721	925,897	173,606	2,036,973
2018	11,747,316	1,022,016	176,210	35,242	939,785	176,210	2,173,253
2019	11,923,526	1,144,658	190,776	35,771	953,882	178,853	2,313,164
2020	12,102,379	1,270,750	205,740	36,307	968,190	181,536	2,456,783
2021	12,283,914	1,400,366	221,110	36,852	982,713	184,259	2,604,190
2022	12,468,173	1,533,585	236,895	37,405	997,454	187,023	2,755,466
2023	12,655,196	1,670,486	253,104	37,966	1,012,416	189,828	2,910,695
2024	12,845,024	1,811,148	256,900	38,535	1,027,602	192,675	3,069,961
2025	13,037,699	1,955,655	260,754	39,113	1,043,016	195,565	3,233,349

*2008 -2012 figures are based on MWH Sales reported on the E2500 RPS Compliance Reports. 2013 is based on estimates provided by the distribution utilities. 2014 to 2025 figures assume 1.5 percent annual growth in sales based on ISO New England's 2011 Regional System Plan.

Key Provisions - Definition

Useful Thermal Energy means

renewable energy derived from Class I sources that can be metered and is delivered in NH to an end user in the form of direct heat, steam, hot water, or other thermal form that is used for heating, cooling, humidity control, process use or other valid thermal end use requirements and for which fuel or electricity would otherwise be consumed. RSA 362-F:2, XV-a.

Alternative Compliance Payments

- ACPs in 2013 (2012 prior to legislation):
  - Class I - $55 ($64.02),
  - Class I thermal - $25
  - Class II - $55 ($168.13)
  - Class III - $31.50 ($31.39)
  - Class IV - $26.50 ($31.39)
- Adjustments changed
  - Consumer Price Index for Class III and Class IV; and
  - ½ of percentage change of CPI for Class I and Class II.

Eligible Technologies

- Solar Thermal
- Geothermal - Ground Source Heat Pumps
- Thermal Biomass Renewable Energy Technologies
- Biomass Combined Heat and Power Facilities
- To be REC eligible, systems must begin operation after January 1, 2013.

Emission Requirements - Biomass

- PM: 0.1 lb/MMBtu for 3-30 MMBtu/hr;
  0.02 lb/MMBtu for >30 MMBtu/hr
- NOx: 0.075 lb/MMBtu for ≥ 100 MMBtu/hr
- Best Management Practices (annual tune-ups; combustion efficiency) for <100 MMBtu/hr
- Additional emission requirements for electric REC eligibility

Measuring and Metering Thermal Energy Proposed Approaches

- Boundary for thermal measurement – before delivery to distribution
- Measuring thermal energy:
  - Air/Water Systems: based on flow, temperature, and specific heat
  - Steam systems: based on flow and specific enthalpy (temp. & pressure)
- Metering
  - Must meet accuracy of EN1434 standard for air/water systems
  - Must meet accuracy of ±3% for steam systems; or
  - Must meet accuracy of ±5% or better; RECs discounted; or
  - Alternative methodology

Measuring and Metering Thermal Energy Proposed Approaches (cont'd)

- Parametric monitoring for small sources allowed:
  - Solar Thermal: operating hours of pump and SRCC rating taking into account shading/orientation losses
  - Geothermal: operating hours of pump and HC and COP
  - Thermal Biomass: operating hours and fuel input and purchase records

- ***Small/Large Threshold - 150,000 Btu/hr ??***

Proposed REC Calculation

- Measure thermal output
- Discount for meter accuracy if meter does not meet standard for air/water or ±3% for steam systems
- Discount for operating energy and thermal energy storage losses for large sources
- RECs reported to NEPOOL GIS in mWh (1 mWh = 3.412 MMBtu)

Proposed REC Calculation– Parasitic Energy Discount Factors

- Solar thermal: 3.0%
- Geothermal: 3.6%
- Thermal biomass: 2.0%
- Actual Metering of Parasitic Load
- Only for large sources

Verifying and Reporting Thermal Energy

- RECs retroactive to January 1, 2014 if source certified to be eligible to create RECs
- Professional Engineer must attest to the thermal energy metering/measurement methodology
- Independent monitor must inspect facility initially
- Independent monitor must verify and report thermal output to NEPOOL GIS

Verifying and Reporting Thermal Energy – Independent Monitor Qualifications

- Electric:
  - Electrician
  - Professional Engineer
  - Certified Building Analyst Professional or Certified Mechanical Professional
  - Certified Energy Manager
  - Home Energy Rater
  - IM in another state
- Thermal:
  - Professional Engineer
  - For geothermal: IGSHPA Accredited Geothermal Installer
  - For solar thermal: NABCEP Certified Solar Heating Installer
  - Certified Energy Manager?
  - ??

Contact info

- Website: http://www.puc.nh.gov/Sustainable%20Energy/Class%20I%20Thermal%20Renewable%20Energy.html
- Liz Nixon: elizabeth.nixon@puc.nh.gov
  603-271-6018
- Jack Ruderman: jack.ruderman@puc.nh.gov
  603-271-6012
- Mike Sheehan: michael.sheehan@puc.nh.gov
  603-271-6028

Specific Metering Methodologies

Measuring and Metering Thermal Energy Proposed Methodology – Solar Thermal

- $Q_g = (dm/dt) * c_p (To - Ti) * t$

Where:

- Q_g = heat generated in the collector loop (Btu)
- dm/dt = mass flow of the collector working fluid measured near the inlet to the solar storage tank (lbm/hour)
- c_p = specific heat of the collector fluid (Btu/lbm-°F)
- Ti = collector loop inlet temperature measured near the outlet of the solar storage tank (°F)
- To = collector loop outlet temperature measured near the inlet to the solar storage tank (°F)
- t = total time during the current reporting period (hr)

Measuring and Metering Thermal Energy Proposed Methodology – Geothermal

- $Q_g = (dm/dt) * c_p * [To - Ti] * t$

Where:

- Q_g = heat generated in the ground loop (Btu)
- dm/dt = mass flow measured near the outlet of the ground loop (lbm/hour)
- c_p = specific heat of the working fluid (Btu/lbm-°F)
- t = total time during the current reporting period (hr)
- Ti = ground loop inlet temperature measured at the inlet to the ground loop (°F)
- To = ground loop outlet temperature measured at the outlet from the ground loop (°F)

Measuring and Metering Thermal Energy Proposed Methodology – Biomass

- $Q_g = [dm_{out}/dt * (h_{out}) * t] - [dm_{in}/dt * (h_{in}) * t]$

Where:

- Q_g = Thermal energy generated from biomass (in Btu)
- dm_{out}/dt = mass flow (lbm/hr) metered upstream of distribution and downstream of parasitic loads
- h_{out} = specific enthalpy (Btu/lbm) at metering point determined by temperature and pressure (for superheated steam) data
- dm_{in}/dt = mass flow (lbm/hr) of water into the pumps
- h_{in} = specific enthalpy at metering point (Btu/lbm), which will be a function of the enthalpy of incoming condensate and make-up water prior to the first condensate or feedwater pumps; and
- t = total time during the current reporting period (hr)

Measuring and Metering Thermal Energy Proposed Methodology – Small Solar Thermal

- Q = (R * P *t*(1-L)*1000) / h

Where:

- Q = thermal energy generated (Btu)
- R= SRCC OG100 rating on Mildly Cloudy C (kBtu/day)
- P=Number of panels
- L = Orientation and shading losses calculated based on solar model such as Solar Pathfinder, T-sol, Solmetric,or other model approved by the Commission(%)
- t = total operating run time (hrs) of the circulating pump as metered
- h= 11 hours/day (conversion factor)

Measuring and Metering Thermal Energy Proposed Methodology – Small Geothermal

- $Q = [HC * (COP - 1) * t] / COP$

Where:

- Q = thermal energy generated (Btu)
- HC = AHRI certified heating capacity at partial load (Btu/hr)
- COP = AHRI Certified Coefficient of Performance
- t = total operating run time (hrs) of pump as metered during heating mode (Entering Water Temperature > Leaving Water Temperature)

Measuring and Metering Thermal Energy Proposed Methodology – Small Biomass

- Q = (D * R * V* EC * ASE * t)

Where:

- Q = thermal energy generated by the biomass system (Btu)
- D = default pellet density (lbm/in^3) = 0.0231 lbm/in^3
- R = auger revolutions per hour
- V = auger feed volume (in in^3/auger revolutions)
- EC = default energy content of pellet fuel (Btu/lbm) = 7870 Btu/lbm
- ASE = default thermal efficiency expressed as percentage based manufacturer's warranty of average seasonal thermal efficiency or a default thermal efficiency of 65%
- t = total operating run time (hr) as metered