Creating A Cleaner Energy Future For the Commonwealth

DOER
Massachusetts Department of Energy Resources

Acts 2014, Ch. 251 - 225 CMR 16.00

Renewable Thermal Technologies in the Alternative Portfolio Standard

METERING SUBGROUP

Stakeholder Meeting 12/16/2014
Westborough, MA

Agenda

- Large Hydronic Solar Heating Systems
- Air Source Heat Pumps
  - Small
  - Large

Small Systems

Thermal technology	Small system threshold (total system capacity)
Solar	Collector surface < **660 sq ft** (20 panels)
Biomass, Heat Pumps	Rated capacity < **340 kBtu/h** (100 kW; 28 ton)
	Heat Pump capacity rated at 47˚F (dry bulb)
Biogas/fuels	N/A

Output Projections for Pre-Minted AECs

- Based on thermal load served in building and rated capacity and performance of system
- Verify against building load (cannot exceed)

$$AEC/y = E_{th,\ net} = HC * t * P * O_{source}$$

$E_{th,\ net}$ = net useful thermal energy output

HC = seasonal average heating capacity

t = time (hours/y)

P = performance factor

O_{source} = operating energy factor (source energy)

Output Projections – Factors to consider

- Technologies
  - Solar Thermal: calculation (eg. RETscreen), using SRCC OG100/300 rating, taking into account shading/orientation losses
  - ASHP/GSHP: operating hours of pump, seasonal heat capacity and seasonal COP

Goal of Metering Large Systems

- Calculate appropriate incentive credits
- Ensure long-term and optimal operation
- Avoid rebound effect
- Metering Performance Needed:
  - Right (accurate), Reliable, Replicable, Reported
  - Reasonable (cost, effort)

Heating and Cooling in the Massachusetts Alternative Portfolio Standard, Report to the Legislature, EEA/DOER with assistance from Meister Consultants Group and MassCEC, 2012

Large System Metering - General Principles

- Boundary for thermal measurement (Btus)
  - Before delivery to distribution or rejection of excess heat systems

- Measuring the net primary renewable thermal energy transferred to a facility's heating or cooling thermal load:
  - Air/Water Systems: based on flow, temperature, and specific heat

Metering Approach

- Large systems: continuous accurate **metering** and automatic reporting
  - Available equipment / standards / industry practice

- Small systems: **calculate** projected output
  - Verification of ongoing operation through spot checks and run-time monitoring

Large Hydronic Solar Thermal System Metering

- Working Assumption: A system with a collector area > 660 SF can be assumed to include an unfired pre-heated solar hot water storage tank which Is plumbed in series with and functions as a pre-heater for a non-solar heated hot water heating system.
- Metering:
  - Solar (renewable) energy (Btus) transferred to the user's facility thermal load.
    - Btu meter: Flow meter on city cold water supply + 2 thermal sensors one on cold water supply and one on hot water discharge + Btu computer.
    - Run hour meter on collector circ pump(s)

Large Hydronic Solar Thermal System Metering

- Non Renewable Energy:
  - Either ANSI C12.1 class kWh meter on circulating pumping system OR
  - For constant collector flow systems use the field established operating kW draw of the pumping system times the pump run hours.
- Data Acquisition System with remote access and transmission capability
  - Btus; pump run hours; kWh pumps

Large Air Source Heat Pump Systems Metering

- **Air Source Heat Pumps**: quantify the consumption of the site grid electricity and the supply of renewable heat energy terms by combining
  - Directly metered:
    - Heating mode run hours
    - kWh using an ANSI C12.2 rated meter
  - Nominally rated system performance
    - Original equipment manufacturer certified (AHRI) performance
    - OEM supplied TMY climate weighted COP

Large Air Source Heat Pump Systems Metering

AECs = MWH grid ((TMY wtd. avg. COP) – 1/.41))

- Data Acquisition System with remote access and transmission capability
  - kWh, heating mode run hours
- Other: For ducted systems: the applicant would be required to document that the static discharge air pressure of the installed unit at full heating mode fan power is within a TBD set percentage of the pressure at which the unit nominal performance was developed by the OEM.

Small Air Source Heat Pump Systems

- **Net Renewable Thermal Output is Calculated not Directly Metered but Based on**
  - The average TMY weighted COP as provided by the OEM
  - The average annual heating profile of the load (e.g. detached, semi-detached residence)
  - The expected (quarterly or annual) output of the ASHP system.
  - The site to source fuel conversion factor for grid supplied electricity (= 1/0.41)

Small Air Source Heat Pump Systems

- AEC formula (all units in MWH)

AEC = APSHout – (APSHout(1/COP * 1/0.41)

Where COP = TMY wtd avg COP.

- Example: Boston

Unit: 18,000 BTUH with a TMY wtd avg COP of 3.0

TMY Heating Season = 4853 hrs

Output a 100% each heating hour

Ouput = 25 MWH

AECs = 4 = $69 at $15/AEC