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

FINAL DESIGN

Stakeholder Meeting 12/16/2014
Westborough, MA

Agenda

1:00 – 3:00 – General meeting

- Technologies
- Metering
- Minting
- Biomass/gas/fuels

3:00 – 3:30 – Break and building visit

3:30 – 5:00 – Metering subgroup

- Air Source Heat Pumps

Technologies – per the Statute

- Add any facility that generates useful thermal energy using:
  - Sunlight, biomass, biogas, liquid biofuel or naturally occurring temperature differences in ground, air or water
- Strike carbon capture and storage, gasification, paper derived fuel
- Additionally exclude construction & demolition debris

Specifications in the Statute

1 credit (MWh) shall be earned for every 3,412,000 Btu of **net** useful thermal energy produced and **verified** through an on-site utility grade meter **or other means satisfactory to the department**.

- Non-emitting on-site renewable thermal technologies can get a credit for **less** than 3,412,000 Btu, *or in essence, a credit multiplier*.

DOER has to establish for biomass, biogas and liquid biofuel technologies (with MassDEP):

- **Air emission performance standards** for PM2.5 and CO;
- A requirement of **50% reduction in life-cycle GHG emissions**;
- Requirements for **thermal storage** or other means to minimize deterioration of efficiency or emissions due to boiler cycling, if feasible;
- Fuel conversion **efficiency performance standards**;
- Requirements that fuel shall be provided by means of **sustainable forestry practices** (with DCR).

Enters into force 1/1/2015

DOER Regulatory Process

- Stakeholder/industry engagement
  - Meetings preceding formal regulatory process
  - Formal public hearing and comment period
  - Subgroups on metering, biomass, biofuels
  - Final Design Presentation on 12/16/2014
- Regulatory proceeding
  - Draft regulation and commence rulemaking in Jan/Feb 2015
  - Final regulations by summer 2015
- Use guidelines according to RPS/APS custom

Technologies

Commercial Operation Date

- Eligible systems to be put in service on or after 1/1/2015 (date the statute enters into effect)
  - DOER will provide retroactivity for systems installed after 1/1/2015 but prior to the finalization of the regulations (expected summer 2015)
  - Project that received MassCEC rebate prior to finalization of APS regulations cannot qualify

Eligible Technologies

- Active solar thermal using evacuated tubes or flat plate collectors
  - Space heating, domestic & process hot water
  - Further analysis needed for guideline (performance & metering)
    - Transpired solar collectors
    - Glazed solar thermal air-heating
    - Hybrid solar thermal and PV
    - Solar active sludge dryer
- Heat pumps delivering space and/or water heating
  - Air source, ground source, water source
    - Climate weighted annual average COP > 2.5
    - COP @5° F ≥ 1.75 (at maximum capacity operation) / EER @95° F > 12
  - Gas engine ASHP
    - Climate weighted annual average COP > 2

Eligible Technologies (ctd.)

- Woody biomass heating
  - Automatically fed biomass boilers and furnaces using wood pellets, chips, cordwood
  - Pyrolysis oil
- Biogas/methane from anaerobic digestion, landfill gas or biomass gasification
  - Used on site or off site (transported in natural gas distribution network)
- Liquid advanced biofuels meeting ASTM Standard D6751, produced from organic waste feedstocks, so as to support the MassDEP commercial food waste ban

Net Energy Generation

$$E_{net} = E_{thermal,\ out} - E_{non\text{-}renewable,\ in}$$

- Non-renewable energy input is calculated as primary energy, so for electricity:
  - Assume average heat rate and electric transmission/distribution losses (ISO-NE)
  - Established as 41% factor (DOER will reassess periodically)
  - $E_{non\text{-}renewable,\ in}$ = Electricity input / 0.41
  - $E_{thermal,\ out}$ = heat load served (heat transferred to a useful load)

Consideration of Cooling

- Cooling from heat pumps will not be credited
  - Heat pumps in cooling mode deliver heating energy from the conditioned space to the environment, rather than bring energy in from the environment
- Renewable heat can be used to provide cooling through absorption chillers
  - In commercial & industrial uses
  - Thermal energy delivered as process heat to the absorption chiller will be credited as useful thermal energy

Non-emitting AEC Multiplier

Purpose of multiplier = stimulate development of certain new on-site non-emitting renewable thermal technologies

1 Alternative Energy Credit
= 1 MWh = 3.412 MMBtu

- Multiplier: 1 AEC = 3.412 MMBtu / X
- Basis for X = align levelized cost of energy of renewable thermal technologies
- DOER will re-evaluate periodically based on market uptake

Non-emitting AEC Multiplier

- Non-emitting technologies with higher levelized cost of energy:
  - Solar: DHW & combi systems
  - Ground source heat pumps

	AEC Multiplier
Solar DHW	5
Solar Combi	2
Ground Source Heat Pumps	3

These are proposed initial multipliers, values will be re-evaluated periodically

Example Residential Installation

Building characteristics		
Heat Load	MMBtu/y	100
Cool Load	MMBtu/y	5
Domestic Hot Water Load	MMBtu/y	15

Illustrative example, including multiplier, actual calculation will depend on final regulations

		BIO	ccASHP	GSHP	Solar Combi	Solar DHW
Efficiency/COP		0.85	3	4	1	1
Load served	%	100%	80%	100%	40%	60%
AEC/year		34	4	34	27	13
Pre-minted AEC value	$	$5,056	$633	$5,078	$4,045	$1,978

Calculation assumes 10 years pre-minted AECs are sold at $15/AEC

Metering

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Large Systems

Goal of Metering

- Determine the credits generated by the specific system performance
- Ensure long-term and optimal operation
- Avoid rebound effect

  - Right (accurate), Reliable, Replicable, Reported
    - Metering heat, steam, fuel
    - Standards
  - 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

Metering Approach

- Large systems: continuous accurate **metering** and **automatic reporting** to independent verifier
  - Available equipment / standards / industry best practice
- Small systems: **calculate** projected output
  - Meant to cover residential, small multi-family and small commercial
  - Verification of ongoing operation through spot checks and run-time monitoring

Large Systems

Thermal technology	Large 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

Large System Metering - General Principles

- Boundary for thermal measurement (Btus)
  - Before delivery to distribution or rejection of excess heat systems
- Measuring the net renewable thermal energy transferred to a facility's heating or cooling thermal load:
  - Air/Water Systems: based on flow, temperature, and specific heat
  - Steam systems: based on flow and specific enthalpy (temp. & pressure)

Accuracy of Metering

- For liquid or air based systems:
  - Must meet accuracy of EN1434 standard; or
  - Must meet accuracy of ±5% (AECs discounted)
- For steam systems:
  - Must meet accuracy of ±3%; or
  - Must meet accuracy of ±5% (AECs discounted)

Upfront Minting

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Small Systems

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

Small system monitoring/verification

- Small systems: **calculate** projected output
  - Meant to cover residential, small multi-family and small commercial
    - No upfront minting for biogas/fuels
  - Verification of ongoing operation through spot checks and run-time monitoring
    - Integration with smart thermostat and connected devices

Upfront Minting of AECs

- Upfront minting will be default for non-metered (small) systems
- In lieu of lifetime AECs, systems will receive a one-time strip of AECs, equivalent to 10 years projected output
  - AECs will be year of APS qualification vintage
  - Upfront minting allowed as far as APS minimum standard can accommodate
  - Combination with MassCEC rebate can not exceed 50% of capital cost of project
    - AEC award will be adjusted to not exceed this cap, if necessary
    - Project that received MassCEC rebate prior to finalization of APS regulations cannot qualify

Upfront Minting of AECs

- DOER contracts with Third Party (Agent)
  - Default AEC aggregator to transact AECs and return revenue to owner
  - System verification
- DOER is considering market options to enable forward purchase of pre-minted AECs to provide up-front project capital (not for inclusion in regulations)

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
  - Biomass: operating hours, average thermal efficiency, heat capacity

Biomass

Biogas

Biofuels

Biomass Sustainability

- Options to demonstrate sustainable forest management:
  - Licensed forester attests
    - Long term forest management plan, Best Management Practices, Forest Guild biomass guidelines
  - Independent certification of forest resource
    - Sustainable Forestry Initiative, Forest Stewardship Council, Tree Farm
    - Commonwealth Quality Program (MA only)

      Incl. provisions for downed wood and soil condition
  - Use non-forest derived residues (as defined in MA RPS Class I woody biomass regulations)
- Chain of custody from forest to fuel supplier

Biomass Sustainability

- DOER will provide list of qualified pellet suppliers that demonstrate meeting biomass sustainability criteria
- DOER will require wood chip systems users to provide chain of custody records from suppliers that demonstrate biomass sustainability criteria
- Verification
  - Qualified biomass system owners required to keep record of invoices to demonstrate eligible fuel is used
    - Spot audits by DOER or Agent
  - DOER tracks and reports average aggregate share of residues/thinnings from pellet & chip producers/suppliers
    - Includes information to demonstrate sustainable forest management practices were used

      Forester attestation

      Independent certification

Biomass GHG Balance

- Need to demonstrate 50% lifecycle GHG savings compared to default traditional heating source
  - Time horizon: 20 years
  - DOER calculation, no individual reporting
    - Based on representative reported mix of residues and thinnings
    - Include in sustainability criteria
  - Residue versus thinnings share in pellet feedstock should be about 50/50

    (Indicative results based on the MA RPS Class I GHG Calculation Guideline)

Air Emissions

Pollutants	Pellets	Chips	Cordwood
Small Scale < 3 MMBtu/hr heat input)			
$PM_{2.5}$	0.08 lb/MMBtu heat input	0.10 lb/MMBtu heat input	reserved
CO	270 ppm @ 7% O_2	270 ppm @ 7% O_2	reserved
Large Scale (equal to or >3MMBtu/hr heat input)			
NOx, CO, $PM_{2.5}$	MassDEP permit required		

DOER will review air emission requirements every 2 years, with MassDEP

Biomass System Performance

- Requirements for **thermal storage** or other means to minimize deterioration of efficiency or emissions due to boiler cycling:
  - Properly insulated buffer tank (min. R12)
  - Demonstrate to DOER the heating system (incl. distribution) is designed to match fluctuating load
    - Air emission requirements met down to 20% of max. capacity
    - Will include monitoring requirements
- Fuel conversion **efficiency performance standards**
  - Min. thermal efficiency: 80% (HHV)

Biomass Fuel Quality

- Combine sustainability with fuel quality requirements
  - Dimension (length, diameter)
  - Heating value
  - Moisture content
  - Ash content
  - Contaminants
- Available standards
  - ENplus (EN 14961-2, ISO 17225-2) > PFI

Biomass Fuel Quality

	Pellet fuel standards
Calorific value	> 8,000 Btu/lb
Moisture	< 10%
Ash	< 1%
Chlorine	< 0.03% (dry)
Source materials	Only wood
	> 50% wood residues
	Chain of custody for forest management
Excluded	Grass, construction & demolition waste

DOER will consider chip quality requirements for inclusion in Guideline

Biogas

- Biogas from landfills, anaerobic digestion or biomass gasification
  - Used for thermal energy generation
  - Need to reduce lifecycle GHG emissions by 50%
  - When using woody biomass as feedstock: demonstrate implementation of sustainable forest management
- Allow for blending of biogas with natural gas in distribution system
  - Similar to RPS Class I
    - Physical deliverability into MA (document with contracts)
    - Biogas produced entirely within the ISO-NE Control Area or an adjacent Control Area
  - AEC calculation for delivered energy, taking into account transmission and distribution losses and qualified units' conversion efficiency

Eligible Biofuels

- Biofuels need to be “advanced” biofuels
  - 50% lifetime GHG savings per unit of delivered energy, in comparison to the petroleum distillate fuel displaced

    An Act Relative to Clean Energy Biofuels, M.G.L. 94, § 295G1/2 2008
- Biofuels eligible to qualify in the APS: organic waste derived biodiesel
  - In support of the commercial food waste disposal ban (MassDEP)
  - Other fuels considered case by case

Biofuels Qualification

- The facility (user) qualifies
  - Information about oil furnace/boiler
  - Demonstrates purchase of advanced biofuel
    - Tracked with Renewable Identification Number

      Suppliers participate in EPA Quality Assurance Plan
    - Share of advanced biofuel needs to be significant
  - Administrative burden for residential/small customers
    - Fuel supplier could act as aggregator
- Only AECs for energy **generation** with advanced biofuel
  - Takes into account conversion efficiency

Upstream Qualification

- Upstream qualification: supplier of fuel used in eligible renewable thermal technology qualifies portfolio of (customer) installations
  - Would result in much lower administrative burden for biogas/fuel/mass participation in APS
    - Supplier qualifies and receives credits, leading to lower fuel price point
    - Tracking through supply contracts and delivery receipts
    - Average efficiency of furnaces/boilers
  - Legal basis uncertain, therefore <u>not included</u>
    - Facility has to qualify
    - Potential solution: suppliers act as aggregators

Logistics

Stakeholder Comments

- Stakeholders invited to provide written feedback on this presentation
  - Comments, suggestions, information resources
  - E-mail before 12/31/2014 to bram.claeys@state.ma.us

Enjoy the Holidays