

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

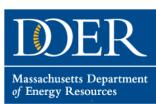
Agenda

- 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
- <u>Strike</u> carbon capture and storage, gasification, paper derived fuel
- Additionally <u>exclude</u> 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).



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° $F \ge 1.75$ (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

Massachusetts Department of Energy Resources

Net Energy Generation

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

- 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)
 - \triangleright E_{non-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

		ВІО	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 onetime 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
СО	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

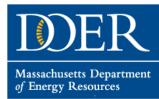
- Combine sustainability with fuel quality requirements
 - Dimension (length, diameter)
 - > Heating value
 - Moisture content
 - > Ash content
 - > Contaminants
- Available standards
 - > ENplus (EN 14961-2, ISO 17225-2) > PFI



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

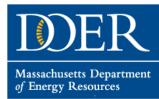
An Act Relative to Clean Energy Biofuels, M.G.L. 94, § 295G1/2 2008

- 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 not included
 - 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

