Creating A Cleaner Energy Future For the Commonwealth

Massachusetts Department of Energy Resources

COMMONWEALTH OF MASSACHUSETTS

Charles D. Baker, Governor
Karyn E. Polito, Lt. Governor
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Ground Source Heat Pumps in the Massachusetts Alternative Portfolio Standard

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Renewable Thermal Technologies in APS

- An Act Relative to Credit for Thermal Energy Generated with Renewable Fuels (S1970) was signed into law in August 2014
- Added to the Alternative Portfolio Standard:
  - "any facility that generates useful thermal energy using sunlight, biomass, bio-gas, liquid bio-fuel or naturally occurring temperature differences in ground, air or water"
  - 3,412,000 BTU = 1 MWh = 1 Credit (AEC)
  - Since 2014, DOER has been working on designing rules and regulations for renewable thermal technologies in the APS

The APS regulations are currently in draft form, and the following information is subject to change

Program Logistics

- System must have come online after January 1st 2015 *(systems online since then will receive back credits once program launches)*
- Incentive is only for the Useful Thermal Energy used for heating, not cooling
- Systems will apply using an online application
- Small systems will receive 10 years of AECs in 1st quarter (unless they chose to meter and receive certificates quarterly)
- Intermediate and Large systems will receive AECs quarterly (with no end date)

Sizing Thresholds of GSHPs

	Small	Intermediate	Large
AEC Calculation Basis	Calculated net renewable thermal output	Calculated net renewable thermal output based on direct metering of fuel input	Metered net renewable thermal output
Ground Source Heat Pump	Output Capacity < 0.134 MMBtu/h	Output Capacity 0.134 – 1.000 MMBtu/h	Output Capacity > 1.000 MMBtu/h

Multipliers for Non Emitting Technologies

$$Q_{AEC} = E_{net,\ out} * (M + m)$$

Where:

Q_{AEC} = Number of certificates

$E_{net,\ out}$ = Net thermal energy output

M = Base multiplier

m = Additional multiplier for energy efficient homes or zero energy buildings

Base Multiplier Values (M)

Technology	AEC Multiplier		
System Size	Small	Intermediate	Large
Active solar hot water systems used for domestic hot water	3	3	3
Active solar hot water systems used for domestic hot water and/or space heating	1	1	1
Active solar hot air systems	-	5	5
Solar sludge dryer	-	-	1
Ground source heat pumps	**5**	**5**	**5**
Deep geothermal	-	-	1
Air source heat pumps (electric or engine driven) – partial system[2]	2	1	1
Air source heat pump (electric or engine driven) – all other	3	3	3
Biomass, biofuels, biogas	N/A	N/A	N/A

Additional Multiplier Values (m)

- Small systems installed in a residential building if the home achieves a Home Energy Rating System (HERS) Index rating of 50 or less as defined by the Residential Energy Services Network (RESNET) system, and as documented by a Certified RESNET Professional

- Any eligible system installed in a non-residential building if the building meets the definition of "Zero Energy" as defined by the United States Department of Energy (DOE) publication "A Common Definition for Zero Energy Buildings," dated 15 September 2015, and as documented for the application by a Massachusetts licensed Professional Engineer

Small GSHPs

- Must meet all equipment eligibility criteria and well requirements and supply 100% of a building's total annual heat load
- Number of certificates calculated based on the square footage of conditioned space

If conditioned building area is less than or equal to 1,500 sf:

$$\mathbf{E_{net,out} = 4.5}$$

If conditioned building area is greater than 1,500 sf:

$$\mathbf{E_{net,out} = \left(4.5 + (2.9 * (\frac{A - 1,500}{1,000})\right)}$$

Small GSHPs

A small, residential system installed in a 3,000 sq ft, energy efficient home:

$$E_{net,out} = 4.5 + 2.9 * (\frac{3{,}000 - 1{,}500}{1{,}000})$$

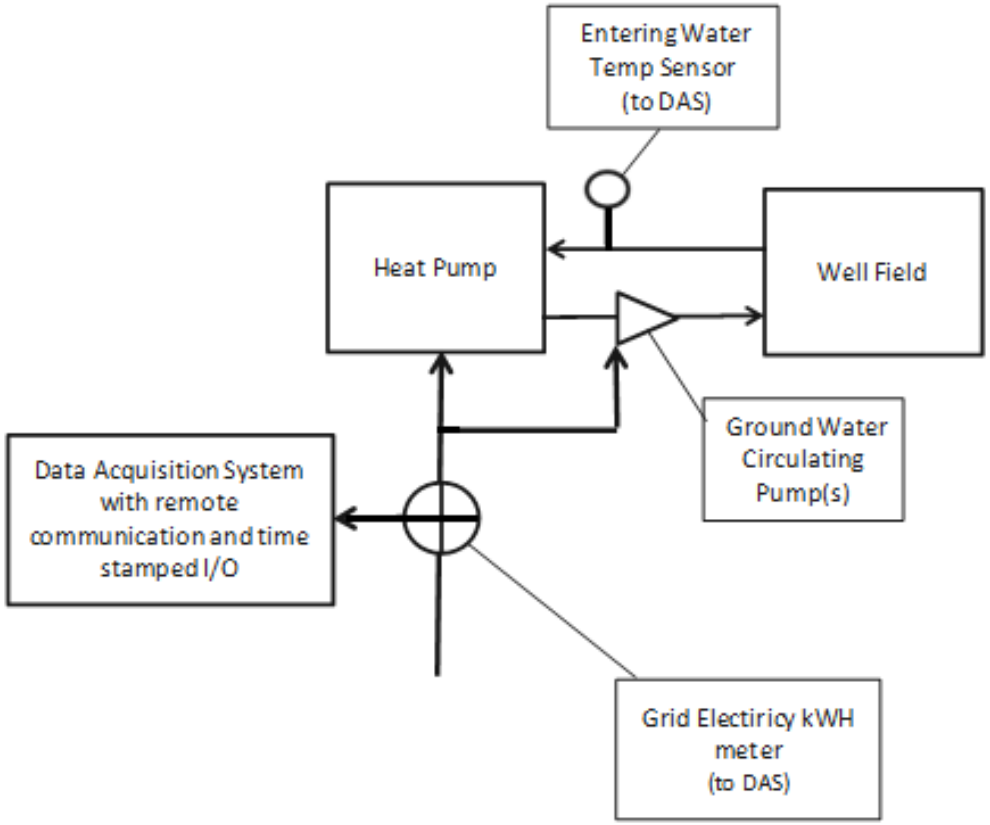
$$E_{net,out} = 8.85$$

$$Q_{AEC} = 8.85 * (5+2) * 10 \text{ years}$$

$$Q_{AEC} = 619$$

Intermediate GSHPs

Number of certificates calculated using kWh pump run time, entering water temperature, and COP lookup table provided by the equipment's OEM, minus any grid electricity



Entering water temperature (°F)	COP
32	3.1
40	3.4
50	3.8
60	4.2
70	4.5
80	4.9

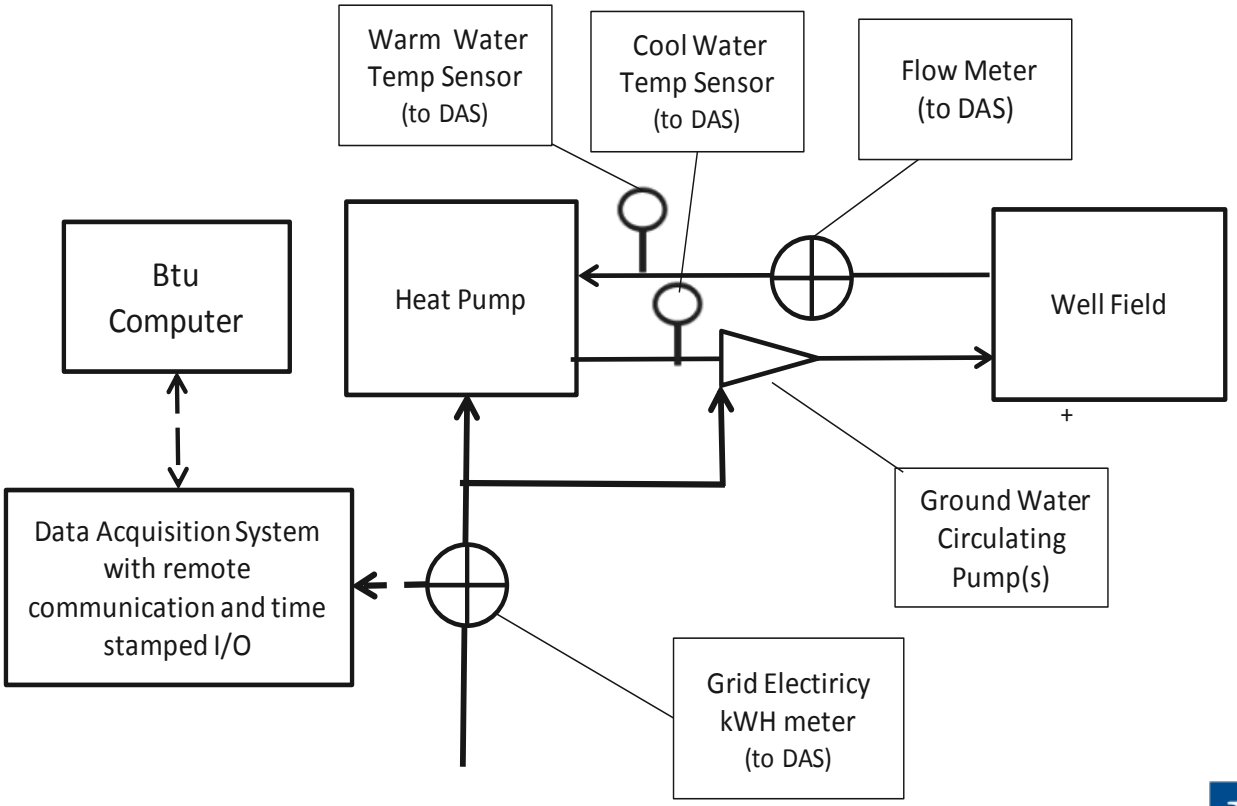
Intermediate GSHPs

Time Stamp (hh:mm)	Grid Power (running total) (kWh)	Grid Power (5 min interval) (kWh)	Entering water temperature (°F)	COP	Useful Thermal Energy (kWh)
04:30	47,510,508	-	-	-	-
04:35	47,510,533	25	64.1	4.31	51.03
04:40	47,510,508	20	64.1	4.31	40.83
04:45	47,510,571	18	64.0	4.31	36.68
04:50	47,510,593	22	63.9	4.31	44.74
04:55	47,510,608	15	63.7	4.30	30.39
05:00	47,510,625	17	63.7	4.30	34.45
05:05	47,510,644	19	63.7	4.30	38.50
05:10	47,510,661	17	63.5	4.29	34.32

Q_{AEC} = Sum of Useful Thermal energy * 5

Large GSHPs

Number of certificates calculated using the actual thermal output of the system, minus any grid electricity



Large GSHPs

Time Stamp (hh:mm)	Grid Power (running total) (kWh)	Grid Power (5 min interval) (kWh)	Entering Water Temperate (F)	Leaving Water Temperature (F)	Flow (lb/5-min)	Useful Thermal Energy (kWh)
04:30	5,685,509		52.5	43.5	40,500	
04:35	5,685,546	36.85	52.5	43.3	41,000	63.7
04:40	5,685,581	35.65	52.3	42.7	38,010	61.6
04:45	5,685,614	32.92	52.1	43.0	37,025	56.9
04:50	5,685,645	30.95	52.0	43.0	35,200	53.5
04:55	5,685,678	32.38	51.9	42.4	34,890	55.9
05:00	5,685,711	33.17	51.9	42.2	35,005	57.3
05:05	5,685,744	32.72	51.9	42.3	34,890	56.5
05:10	5,685,780	36.38	51.8	42.0	38,000	62.8

Q_{AEC} = Sum of Useful Thermal energy * 5

Program Participants

- System Owners
- Installers
- Authorized Representatives
- Aggregators
- Independent Verifiers
  - MassCEC will be the Independent Verifier for all small systems

APS Renewable Thermal Rulemaking

- May 20th : Regulations filed
- June 15th and 17th : Public Hearings held
- June 30th : End of Public Comment period

- DOER is completing its review of comments and expects that amended regulation will be released for a second round of comments very soon
- Following second revision to the regulation, DOER will file the regulation with the joint TUE committee for their review and comment
- Final regulation expected to be promulgated in 2017

Questions?