

ENERGYSMART HEAT PUMP REBATE

OPTIONS FOR EQUIPMENT EFFICIENCY REQUIREMENTS

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Background | Efficiency requirements for existing incentive programs

With the exception of Xcel’s ductless incentive, existing rebate options for Boulder County residents do not emphasize heating performance

Program/Standard	Incentive Amount	HSPF	SEER	EER	Notes
<i>Federal Minimum Efficiency Standards¹</i>	<i>(Central and Ductless)</i>	≥8.2	≥14	N/A	These standards went into effect 1/1/15.
<i>ENERGY STAR ASHP baseline²</i>	<i>(Central and Ductless)</i>	≥8.5	≥15	≥12.5	These standards went into effect 9/15/15.
Energy Smart ENERGY STAR ASHP Rebate	25% of cost up to \$400	≥8.5	≥15	≥12.5	Version date 1/2/18
Xcel Energy High Efficiency Cooling Rebates (Central ASHP)³	\$350 (+\$500)	-	≥15	≥12.5	No heating performance requirements; 3 tiers of efficiency; lists new equipment rebates (+ trade-in rebate for old equipment); excludes “tier 0” (trade-in only for below ENERGY STAR requirements)
	\$500 (+\$500)	-	≥16	≥13	
	\$650 (+\$500)	-	≥17	≥13	
Xcel Energy Mini-Split Heat Pumps (Ductless ASHP)⁴	\$300 per outdoor unit	≥9	≥15	-	
<i>ENERGY STAR 2017 Most Efficient⁵</i>	<i>(Central)</i>	≥9.6	≥18	≥12.5	~1% of heat pump models in AHRI directory
<i>ENERGY STAR 2017 Most Efficient⁵</i>	<i>(Ductless)</i>	≥10	≥20	≥12.5	~2% of heat pump models in AHRI directory

Sources: ¹ https://appliance-standards.org/sites/default/files/1009hvac_fact.pdf; ² https://www.energystar.gov/products/heating_cooling/heat_pumps_air_source/key_product_criteria; ³ https://www.xcelenergy.com/programs_and_rebates/residential_programs_and_rebates/heating_and_cooling/cooling; ⁴ https://www.xcelenergy.com/programs_and_rebates/residential_programs_and_rebates/heating_and_cooling/mini-split_heat_pumps; ⁵ https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Most%20Efficient%20Stakeholder%20Webinar_1.pdf

Background | Goals for Enhanced Efficiency Requirements

- » Encourage installation of higher-efficiency equipment with **greater emphasis on year-round performance**
 - › Program aims to ensure that homeowners are using heat pumps for heating and cooling to raise awareness (and not just promote air conditioning)
- » Ensure that efficiency requirements are **manufacturer agnostic** and do not greatly favor one manufacturer's products over another
- » Enable contractors to offer a **range of rebate-eligible equipment options** to fit a diverse range of customer needs
- » Align **equipment standards with marketing approaches** to present unified program messaging

Summary of Options Proposed

Option	HSPF	SEER	EER	Notes
Option 1: Cold-climate ASHP incentive program	≥10	≥17	≥12.5	Must be NEEP-certified; encompasses ductless and central
Option 2: Tiered ASHP incentive program	≥9	≥16	≥12.5	Does not require NEEP-certification, encompasses ductless and central; Assumes higher incentive for Tier 2 vs Tier 1
	≥10	≥18	≥12.5	

Premises for proposed options:

- » Gap between ENERGY STAR-baseline and federal minimum standards is minimal—and existing incentives are available for ENERGY STAR-baseline through Xcel or have previously been offered by EnergySmart
- » Existing incentives do not sufficiently emphasize heating performance to encourage year-round use
- » EnergySmart does not have cost-effectiveness test/TRM requirements necessary to set/justify incentive levels
- » Higher-HSPF and NEEP-certified models are available from all manufacturers

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	≥10	≥18	≥12.5	

Premises for proposed options:

- » Therefore, Boulder’s new heat pump incentive could take one step beyond existing rebate efficiency requirements and **match higher-efficiency programs in other cold-climate jurisdictions** (see Appendix)
 - › Distinction between ductless and central systems could be included, but proposed options set requirements at levels that can be achieved by both types of systems and align with other programs
- » Two options represent **differing prioritization of program goals** rather than fixed efficiency numbers
 - › Ratings can be adjusted, depending on interests of City/County

Option 1 | Cold Climate ASHP Incentive

» Goals:

- › Seeks to encourage installation of systems that will be used for more than just air conditioning
- › Seeks to raise awareness of suitability of ASHPs for year-round performance in Boulder climate
- › Use of NEEP specification provides additional heating performance benchmark beyond HSPF (see Appendix for more information on NEEP spec and HSPF issues)
 - › Higher SEER requirement beyond NEEP spec maintains high-efficiency cooling performance and can align with higher-tier Xcel cooling rebate
 - › 844 models (490 central, 354 ductless)

» Cons:

- › Size of incentive may not be enough to motivate installation of more expensive/efficient cold-climate equipment for cooling-focused applications
- › Contractors may be unfamiliar with NEEP spec/question applicability to Boulder

Benchmarking proposed standard vs. other similar incentive programs

Option	\$	HSPF	SEER	EER	Notes
Option 1: Cold-climate performance incentive program		≥10	≥17	≥12.5	Must be NEEP-certified; encompasses ductless and central
Efficiency Maine Heat Pump Incentive	\$500 (single)	≥12	-	-	NEEP-certification not required, but most models are NEEP-certified
	\$750 (multi)	≥10	-	-	
MassCEC Clean Heating & Cooling Program	\$625/unit (single) or ton of capacity at 5F	≥10	≥15	≥12.5	Must be NEEP-certified + provide 100% of rated heating capacity at 5F
NYSERDA Cold Climate ASHP Program	\$500	≥10	≥15	≥12.5	Must be NEEP-certified; Delivered to contractor
New Jersey Cold Climate Mini-Split Heat Pump	\$500 (+\$200 per indoor unit if displacing ER in non-gas homes)	≥10	≥15	≥12.5	Must be NEEP-certified

Option 2 | Tiered ASHP Incentive

» Goals:

- › Offers more flexibility for models to meet incentive requirements
 - › Tier 1 above ENERGY STAR baseline, Tier 2 matches ENERGY STAR 2017 "Most Efficient"
- › More emphasis on cooling efficiency without NEEP requirement (and many homes will be focused on cooling)

» Cons:

- › Requires significant enough incentive difference between tiers to encourage uptake of higher efficiency
 - › Smaller Tier 1 incentive could not be worth the added administrative burden to contractor/customer
- › Systems installed will not necessarily be optimized for cold-climate performance
 - › Tier 1 models will not be NEEP-certified, no built-in requirement for variable speed compressors

Benchmarking proposed standard vs. other similar incentive programs

Option	\$	HSPF	SEER	EER	Notes
Option 2: Tiered ASHP Incentive	(Tier 1)	≥9	≥16	≥12.5	
	(Tier 2)	≥10	≥18	≥12.5	(Could add NEEP-certification to this)
Mass Save Central Heat Pump Rebate (Utility Rebate)	\$250	≥8.5	≥16	-	NEEP-certification not required
	\$500	≥9.6	≥18	-	
Mass Save Mini-Split Heat Pump Rebate	\$100/ indoor unit	≥10	≥18	-	
	\$300/ indoor unit	≥12	≥20	-	
New Jersey Central ASHP Rebate	\$300	≥10	≥16	≥13	
	\$500	≥10	≥18	≥13	
New Jersey Mini-Split Heat Pump Rebate (non-cold climate)	\$500	≥10	≥20	≥12.5	

Discussion

- » Option selected by Boulder should reflect program priorities and alignment with marketing messaging
 - › Consider balancing: cold climate performance, cooling performance, complexity, distinctions between central and ductless systems, flexibility vs. restrictiveness on level of efficiency, etc.
- » Option 1 reflects emphasis on variable-speed, cold-climate equipment
- » Option 2 reflects emphasis on greater flexibility
- » Adjustment of efficiency requirements for both options is possible
- » Does not include standards for HPWHs or GSHP
 - › Both are often just based on ENERGY STAR requirements in other jurisdictions

APPENDIX SLIDES

Definition of Common Efficiency Performance Ratings

Performance Rating	Applications	Technologies	Definition
Heating Seasonal Performance Factor (HSPF)	Space heating	ASHP	The ratio of heating energy output (Btu) over the course of the heating season to the net electricity input (Wh)
Coefficient of Performance (COP)	Space heating	ASHP, GSHP	The ratio of energy output (Wh) to net energy input (Wh) (<i>dimensionless</i>)
Annual Fuel Utilization Efficiency (AFUE)	Space heating	Conventional furnaces	The percentage of fuel consumed converted into usable heat
Energy Factor (EF)	Water heating	HPWH and other water heaters (not solar)	The ratio of heating energy output (Wh or Btu) to net energy input (Wh or Btu) over a 24-hour standard test period
Seasonal Energy Efficiency Rating (SEER)	Space cooling	ASHP	The ratio of cooling energy output (Btu) over the course of the cooling season to the net electricity input (Wh)
Energy Efficiency Ratio (EER)	Space cooling	ASHP, GSHP	The ratio of cooling energy output (Btu) to the net electricity input (Wh) (<i>dimensionless</i>)

Challenges with HSPF as a metric for heating performance in cold climates

- HSPF assumes Climate Zone IV test conditions (mid-Atlantic)
- HSPF only tests down to 17°F, assumes use of backup electric resistance, and tests in steady state (no modulation/variable speed)
- Researchers from FSEC in 2004 created an estimate conversion factor for colder climates for traditional unitary ASHPs
 - E.g. HSPF 8.5 = 5.8 in Denver

NEEP Cold Climate ASHP Specification

Context

- » Standard performance rating for measuring heating performance (HSPF) is inadequate for cold-climate regions
- » Northeast Energy Efficiency Partnerships (NEEP) developed and manages a specification certifying over 800 models of ductless and central ASHPs as “cold climate”
- » Does not emphasize cooling output, though does require ENERGY STAR certification

Requirements:

- » Variable-speed compressor, ENERGY STAR-certified, indoor/outdoor units part of AHRI-matched system
- » HSPF ≥ 10
- » Must achieve COP ≥ 1.75 at 5°F (at max capacity), provide lab testing/engineering data demonstrating performance at 5°F

MassCEC Clean Heating & Cooling Program

Context

- » NEEP specification is valuable starting point for cold climate performance, but MA wants to encourage the market to develop systems that can provide whole-home performance in MA climate.
- » Also want to ensure strong cooling performance, given low penetration of central AC in MA and warming climate

Requirements:

- » NEEP specification
- » SEER \geq 17 (multi-zone/central) or 20 (single-zone)
- » Must also be able to provide 100% of rated capacity at 5°F (at max capacity)
 - › This is very challenging for most central ducted systems to meet (higher loss of output at 5 °F compared to ductless). Of 155 NEEP-certified ducted systems, only 5 meet MassCEC
- » Registered installers must provide proof of at least 4 hours of manufacturer training completed within last 5 years (+ 2 potential inspections)

Mass Dept. of Energy Resources: Alternative Portfolio Standard

Context

- » MassCEC has taken steps with higher rebate eligibility requirements to move the market towards whole-home, but no requirements on usage means a lot of displacement, cooling-oriented systems are being installed.
- » Systems awarded Alternative Energy Certificates (Thermal RECs) will be limited to whole-home or near-whole-home (replacement) systems

Requirements:

- » NEEP specification
- » COP ≥ 1.9 at 5°F (at max capacity), ≥ 2.5 at 17°F (at rated capacity)
- » Must be whole-home system with no backup
 - › Exception: must serve 90%+ of load, be centrally ducted, and provide 50% of rated capacity at 5°F (at max capacity)

Other ASHP incentive requirements in the Northeast/mid-Atlantic

(Updated October 2017)

Incentive and Requirement Summary for Ductless Heat Pumps

State	Rebate Incentive	ENERGY STAR certification	HSPF	SEER	EER	Other Requirements
Connecticut ¹	\$300/Home (Single-Zone)	X	10	20	12.5	Midstream Program.
	\$500/home (Multi-Zone)	X	9	18	12.5	
Massachusetts	\$100/indoor unit	X	≥ 10	≥ 18		
	\$300/indoor unit	X	≥ 12	≥ 20		
Massachusetts Clean Energy Center ²	\$625 (Single-Zone)	X	≥ 10	≥ 20	≥ 12.5	NEEP ccASHP Spec, 100% of rated heating capacity delivered at 5°F
	\$625/ton (Multi-Zone)	X	≥ 10	≥ 17	≥ 12.5	
Rhode Island	\$100/indoor unit	X	≥ 10	≥ 18		
	\$300/indoor unit	X	≥ 12	≥ 20		
Vermont	\$600 (Single-Zone)		≥ 10.0	≥ 20	≥ 12.0	COP @5°F ≥ 1.75; operation at -5° Midstream Program. Updated list here .
	\$800 (Multi-Zone)		≥ 10.0	≥ 17	≥ 12.0	
New Hampshire ³	\$250/ton of cooling	X	≥ 8.5	≥ 15	≥ 12.5	
	\$500/ton of cooling	X	≥ 10	≥ 18	≥ 12.5	
Maine	\$500 (Single-Zone)		≥ 12			
	\$750 (Multi-Zone)		≥ 10			
New Jersey	\$500 (\$200/Indoor Unit Bonus) ⁴	X	≥ 10	≥ 15	≥ 12.5	Must be listed on NEEP ASHP Spec
	\$500		≥ 10	≥ 20	≥ 12.5	
New York (NYSERDA)			≥ 10	≥ 15	≥ 12.5	Must be listed on NEEP ccASHP Spec, Mid-stream Program
Pennsylvania (PP&L)	\$100/ton	X	≥ 8.6	≥ 16	12.5	
	\$150/ton		≥ 9.5	≥ 17	12.5	
	\$200/ton		10.5	19	12.5	
Energy Save PA	\$100		≥ 8.5	≥ 15		
Washington D.C. ⁵	\$300		≥ 9	≥ 18	≥ 12.5	
	\$500		≥ 10	≥ 20	≥ 13	

Incentive and Requirement Summary for Ducted Heat Pumps

State	Rebate Incentive	ENERGY STAR certification ³	HSPF	SEER	EER	Other Requirements
Connecticut	\$500	X	≥ 10	≥ 16	≥ 12.5	
Massachusetts	\$250	X	≥ 8.5	≥ 16		
	\$500	X	≥ 9.6	≥ 18		
Massachusetts Clean Energy Center ⁶	\$625/ton	X	≥ 10	≥ 17	≥ 12.5	NEEP ccASHP Spec, 100% of rated heating Capacity Delivered at 5°F
Rhode Island	\$250	X	≥ 8.5	≥ 16		
	\$500	X	≥ 9.6	≥ 18		
New Hampshire	\$70/ton	X		≥ 15	≥ 12.5	
Maine	\$500	X	≥ 10			
	\$300		≥ 10	≥ 16	≥ 13	For units purchased through June 30, 2017.
\$500		≥ 10	≥ 18	≥ 13		
New York (NYSERDA)		X	≥ 10	≥ 15	≥ 12.5	NEEP ccASHP Spec Mid-stream Program
PSEG- Long Island	\$350		≥ 8.5	≥ 15		
	\$450		≥ 8.5	≥ 16		
Pennsylvania (PP&L)	\$200		≥ 8.5	≥ 16	≥ 12.5	
	\$250		≥ 8.5	≥ 14.5		
Energy Save PA	\$325		≥ 8.5	≥ 15		
	\$400		≥ 8.5	≥ 16		
	\$350		≥ 9	≥ 16	≥ 13	
Washington D.C. ⁷	\$350		≥ 9.5	≥ 18	≥ 13	
	\$750		≥ 9.5	≥ 18	≥ 13	

Source:

<http://www.neep.org/sites/default/files/resources/2017ASHPSnapshot.pdf>