What's Hot in Clean Heating & Cooling:

Latest Technologies & Incentives for Commercial Installations

Josh Kessler
jkessler@masscec.com

MASSACHUSETTS CLEAN ENERGY CENTER

What is the Mass. Clean Energy Center?

ADOPT

Spur deployment of renewable energy technologies.

CONNECT

Connect employers, job seekers, students, communities, and investors to the clean energy industry.

INNOVATE

Promote innovation through infrastructure, funding, and other support.

MassCEC is a quasi-state agency whose mission to help grow the Commonwealth's clean energy industry and meet its climate goals.

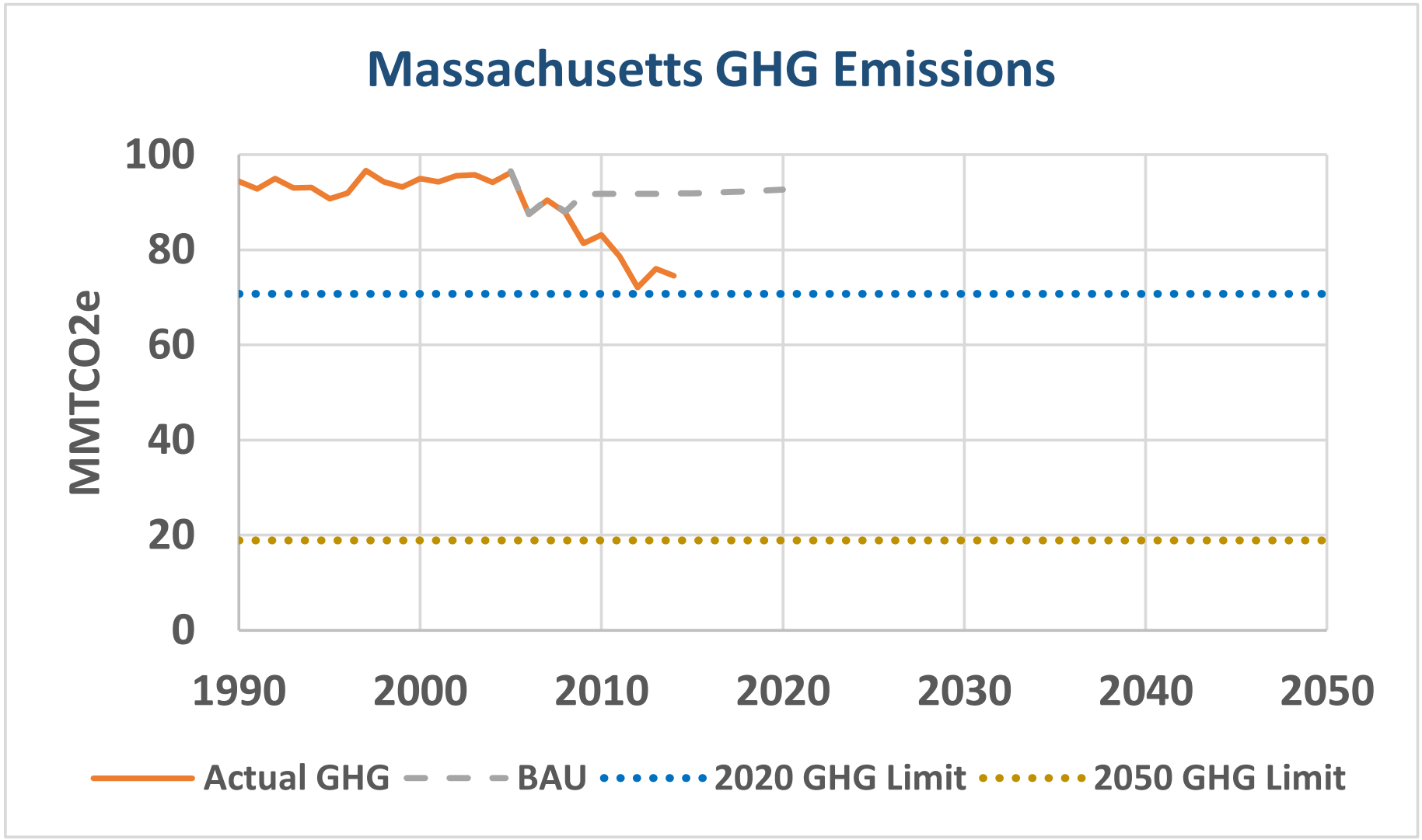
Future state of heating & cooling

Questions

- What building and energy use opportunities spring from aggressive energy and climate policy? How will they shape our future?
- What will our buildings and energy infrastructure look like in 2025, 2050?

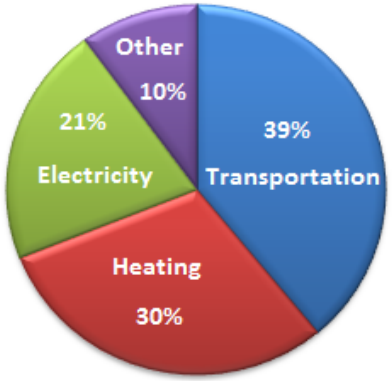
How is this relevant?

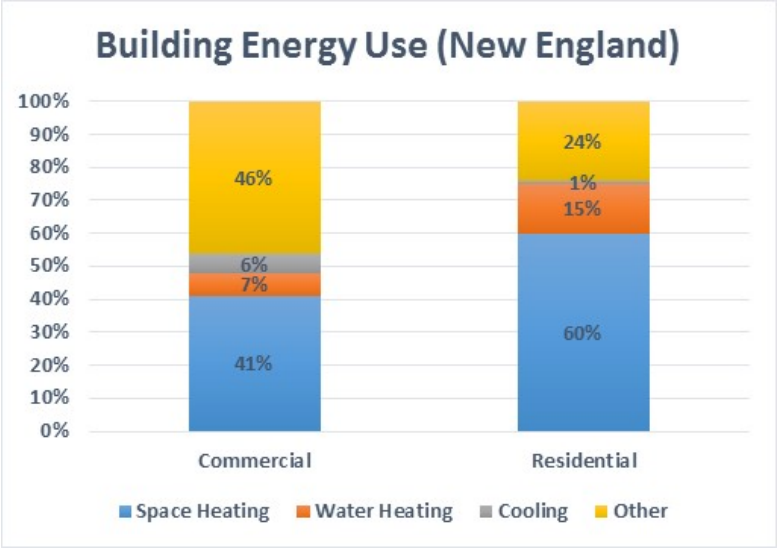
- ➢ Decisions made today will affect facilities' performance for 15-30 years
- ➢ Between now and 2050, there are only 1-2 chances to address each building's heating system.


Massachusetts GHG Emissions
MMTCO2e
100
80
60
40
20
0
1990
2000
2010
2020
2030
2040
2050
Actual GHG
BAU
2020 GHG Limit
2050 GHG Limit

Case for Clean Heating

GHG Emissions (MA)





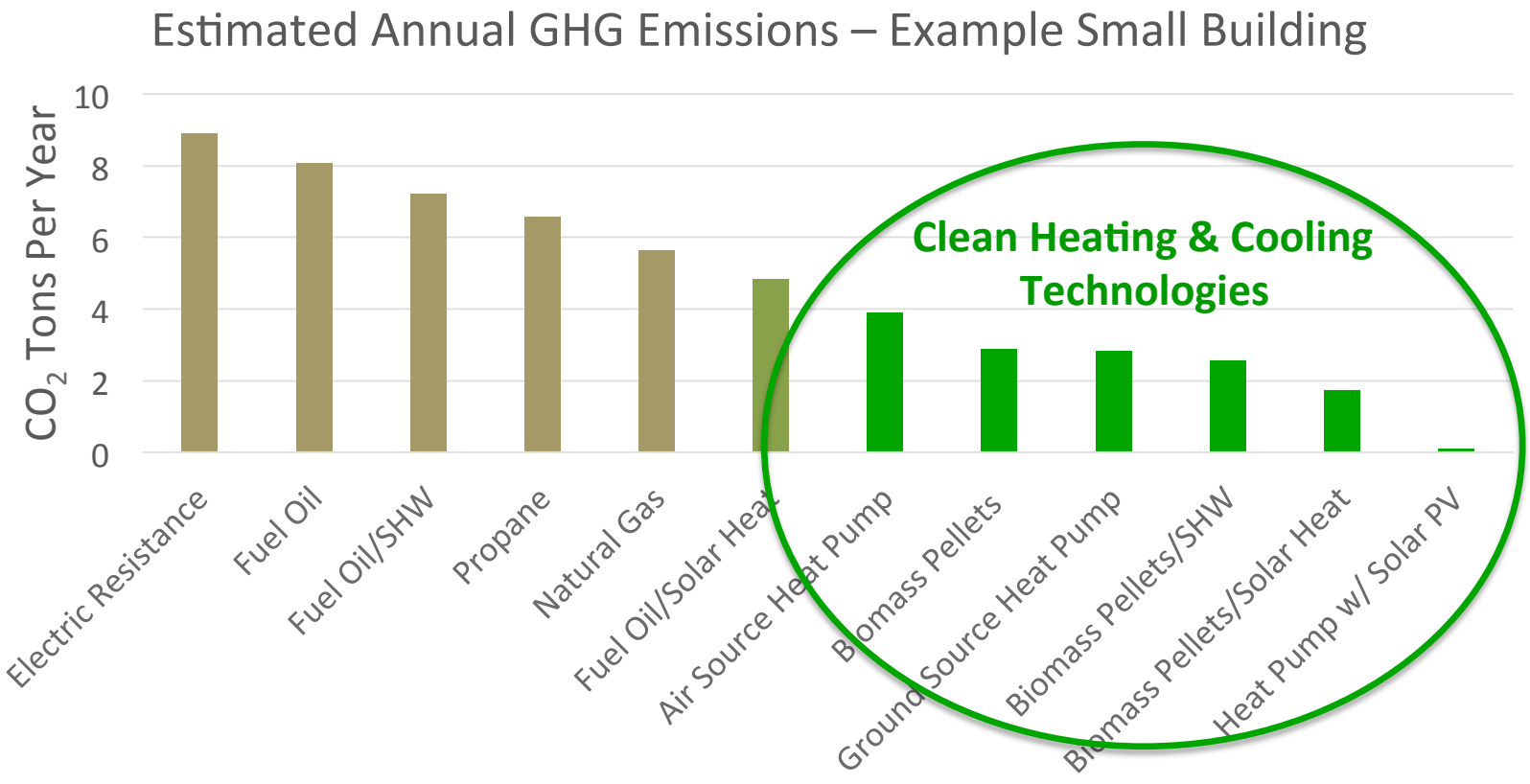
MA GWSA reduction targets:

- 25% by 2020
- 80% by 2050
  - ➢ Does not specify how to do it

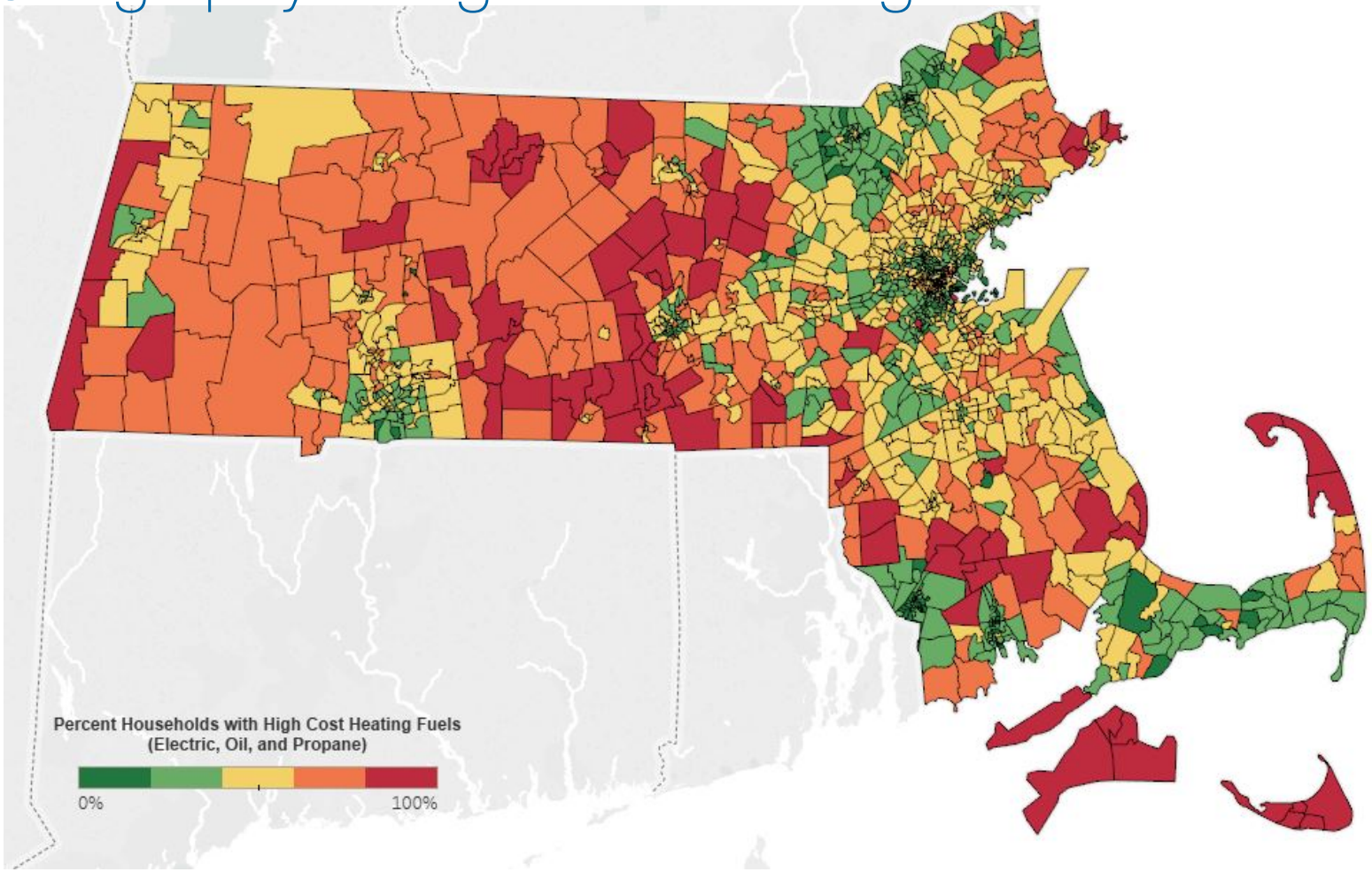
Clean Heating & Cooling:
a multi-benefit solution

1. Superior quality and comfort
2. Decreased operational costs
3. Much lower GHG emissions

Renewable Heating & GHG



Geography of high-cost heating fuels



Air-Source Heat Pumps

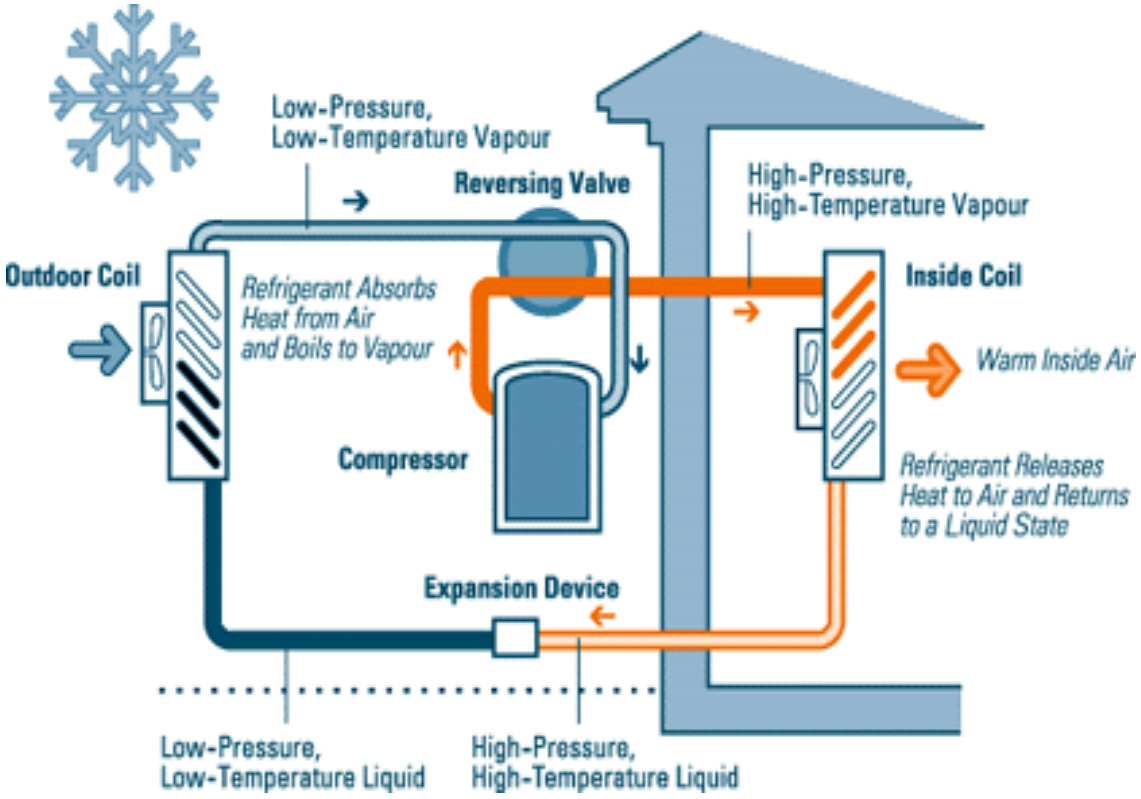
What is an Air-Source Heat Pump?

A system that transfers heat between spaces using a compressor and a condenser to absorb heat at one place and release it to another via a refrigerant pipe network.

Benefits:

- Provides both heating and cooling in a single unit
- Eliminates mechanical room and limits ductwork
- Flexible, modular configuration → zonal control
- Indoor units can be floor-, ceiling-, or wall-mounted
- Moderate up-front installation costs
- Operating costs competitive with oil, propane, or electric resistance heat.
- Modern units operate efficiently EVEN in cold climates like New England.

How Does it Work?



ASHPs use a refrigerant loop to leverage differences in temperature and pressure to move heat between spaces. These systems can provide heating AND cooling.

VRF vs mini-splits: What's the difference?

CHARACTERISTIC	MINI-SPLIT	VRF
LEVEL OF CUSTOMIZATION	LOW	HIGH (APPLIED PRODUCT)
UNIT CAPACITY (BTU/HR)	UP TO 65,000	65,001 – 500,000
INDOOR HEADS PER OUTDOOR COMPRESSOR	UP TO 8	UP TO 60
PIPE CONFIGURATION	SEPARATE PIPE FOR EACH INDOOR HEAD	SINGLE PIPE NETWORK WITH BRANCHES FOR INDOOR HEADS
SIMULTANEOUS HEATING & COOLING	NOT AVAILABLE	AVAILABLE

Successful Applications for VRF Technology

- MULTI-TENANT FACILITIES
- SENIOR LIVING FACILITIES
- K-12 SCHOOLS
- PLACES OF WORHSHIP
- COLLEGES & UNIVERSITIES

Sample VRF Projects

Clark University Alumni Center

- 35,000 sf building (Event Spaces & Offices)
- 100% heated and cooled by Air-Source VRF
- Advanced controls optimize energy savings

Multifamily Affordable Housing, Lawrence MA

- 430,000 sf of residential space
- Renovated historic mill building
- 60% savings anticipated vs electric heating + rooftop chillers
- Selected for energy savings, small physical footprint, improved comfort/noise, sustainability commitment

ASHP Rebates

VRF Rebate Amount

($ per 12,000 BTU/hr of rated heating capacity @ 17°F)

Owner Type	No Heat Recovery	Heat Recovery	Max. Grant (HR / no HR)
Private	$800	$1,200	$120,000 / $180,000
Public/Non-Profit	$1,000	$1,400	$150,000 / $210,000
Affordable Housing	$1,600	$2,000	$240,000 / $250,000

Mini-Split Rebate Amount

($ per 12,000 BTU/hr of rated heating capacity @ 5°F)

Owner Type	$ per unit or per 12 kBTU/hr	Max. Grant
Private	$625	$93,750
Public/Non-Profit	$800	$120,000
Affordable Housing	$1,500	$225,000

Other MA Incentives

- MassSave Heat Loan
- MassSave Rebates
- Alternative Energy Credits

Ground-Source Heat Pumps

Ground-Source Heat Pumps

- Most common in new construction or major renovations
- Highest efficiency clean heating technology
- Vertical or horizontal wells
  - ➢50+ year asset lifetime
- Typically forced air distribution
  - ➢VRF and hydronic/radiant also common
- Best applications:
  - ➢Space heating & cooling
  - ➢Lower temperature process loads

Phillips Andover Academy GSHP

- Building: Sykes Wellness Center
- GSHP Type: Closed Vertical Loop
- Capacity: 70 tons
- Certification: LEED

Ground-Source Heat Pump Rebates

- Award based on system capacity, with adder for efficiency
- Award cap of $250,000

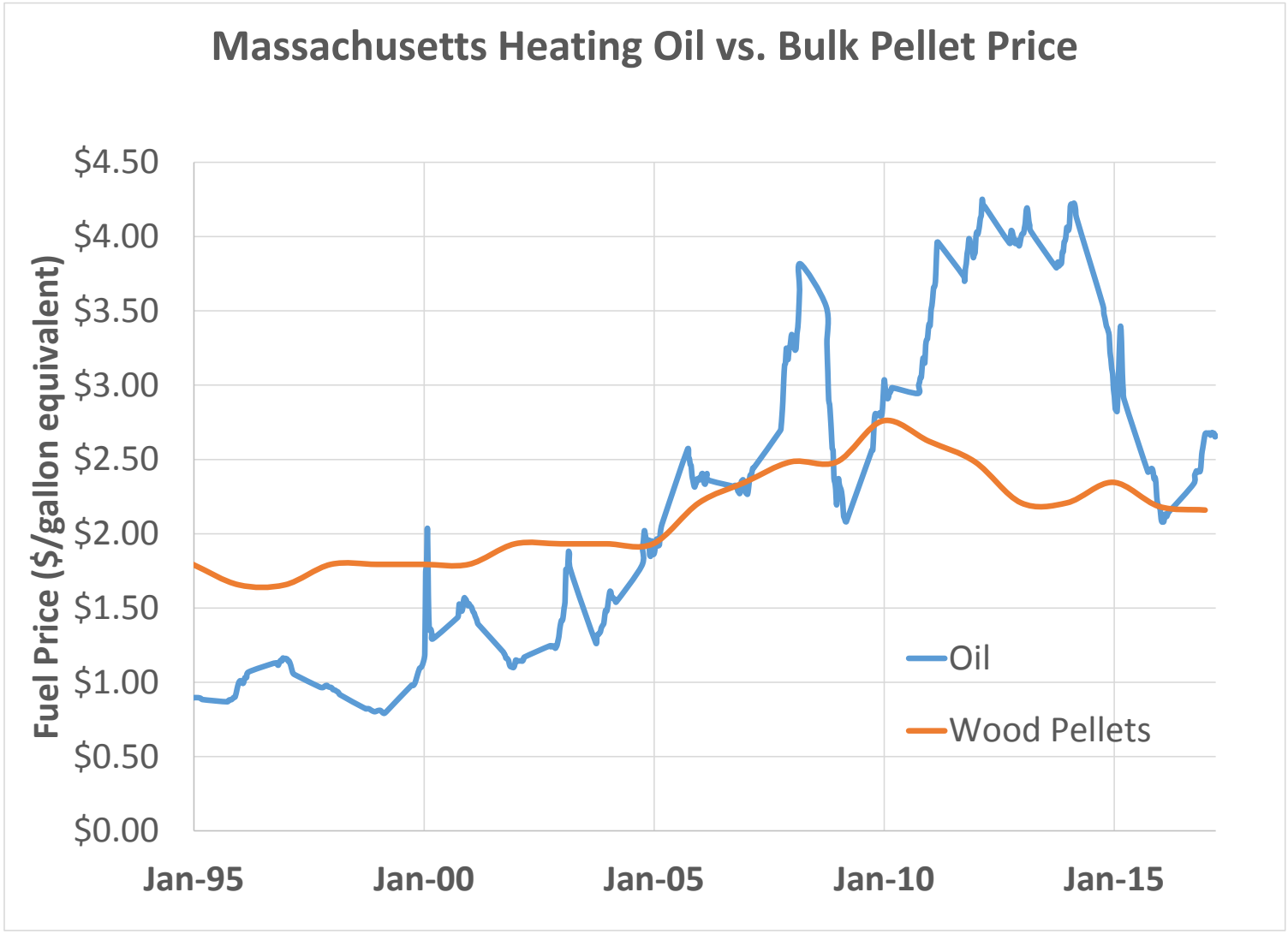
Rebate Amount ($/12,000 BTU/hr)	
Base Grant	$2,000
Efficiency Adder (per 1.0 COP above min.)	$1,000
Public/Non-Profit Adder	$750
Affordable Housing Adder	$1,000

- Other incentives: Alternative energy credits

Modern Biomass Heating

Central Biomass Heating

- High-efficiency, clean-burning technology
- Pellet and wood chip boilers
- Fully automated systems
- Bulk fuel delivery available
- Best applications:
  - ➢Replacement for hydronic heating systems, esp. oil
  - ➢Process heat (food processing, brewing, etc.)
  - ➢Agricultural heating, including greenhouses


Massachusetts Heating Oil vs. Bulk Pellet Price
Fuel Price ($/gallon equivalent)
$4.50
$4.00
$3.50
$3.00
$2.50
$2.00
$1.50
$1.00
$0.50
$0.00
Jan-95
Jan-00
Jan-05
Jan-10
Jan-15
Oil
Wood Pellets

Amherst College

- Building: Library Bunker
- Boiler Type: Pellet
- Capacity: 670 kBTU/hr

Modern Biomass Heating Rebates

Award Amount
Based on % of eligible project costs

Award Component	% of Project Costs	Max. Value
Base	35%	$175,000
Thermal Storage Adder	5%	$25,000
Cascading Systems Adder	2.5%	$12,500
Distribution System Efficiency Adder	2.5%	$12,500
Public/Non-Profit/ Affordable Housing Adder	5%	$25,000
Maximum Rebate	**50%**	**$250,000**

Solar Hot Water

Solar Hot Water & Solar Heating

- Primary end use is domestic hot water, but heating and process applications also exist
- Ties in with most domestic hot water systems
- Roof or ground space needed
- Excellent applications:
  - Housing
  - Food production
  - Washing process

Solar Hot Water Rebates

Grant based on SRCC OG-100 eff. rating, # of collectors, and adders, subject to caps

Award Amount

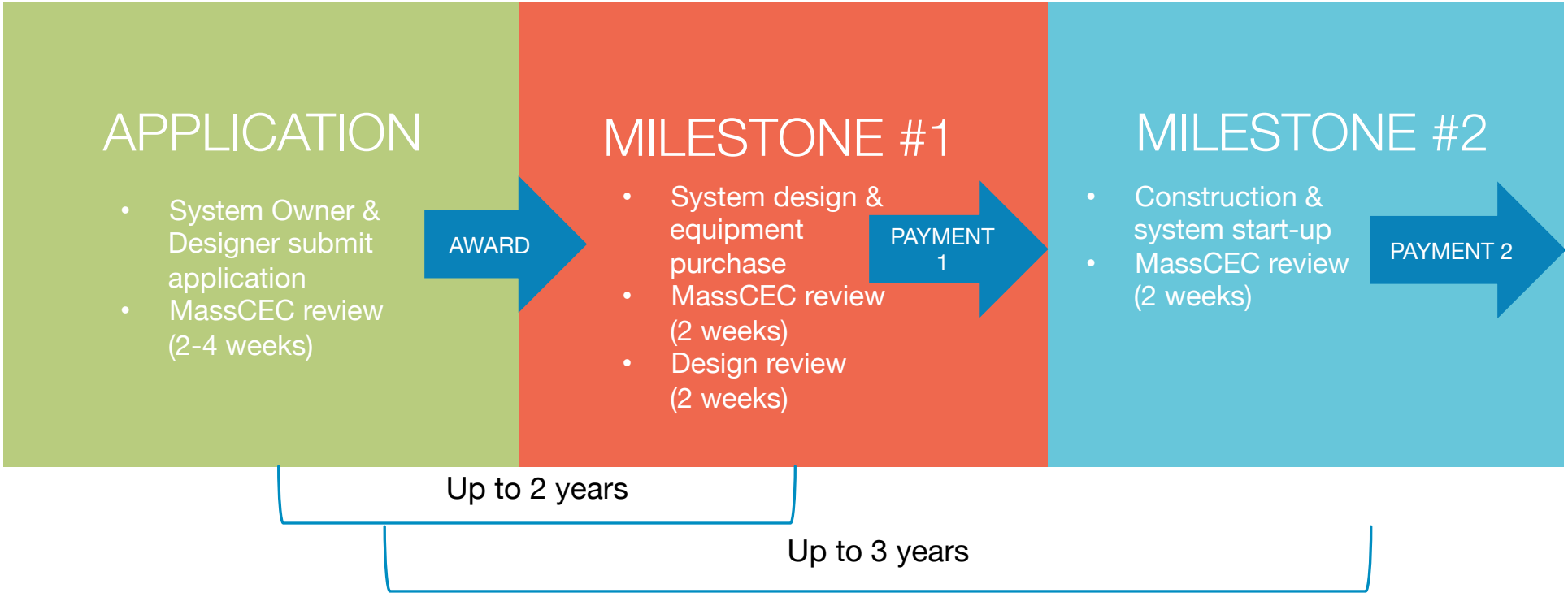
Award Component	Standard Rebate	Non-Profit/ Public Rebate	Affordable Housing Rebate
Base Rebate = SRCC Rating * # of Collectors * Rebate	$100	$150	$200
Maximum Rebate	40% of cost	65% of cost	80% of cost
Maximum Total Rebate	**$101,500**		

Other Incentives:

- 30% federal tax credit
- Alternative energy credits

MASSACHUSETTS CLEAN ENERGY CENTER

Commercial Application Process & Project Timeline



How MassCEC can help you

- Rebates for clean heating projects
  - Increase comfort, save money, reduce GHG footprint
- Advice on technologies
- Connecting interested parties with industry, other building owners
- Contact us to:
  - Talk about projects
  - Ask questions
  - Give us feedback, suggestions

Questions?

Josh Kessler
jkessler@masscec.com
617-315-9319

www.masscec.com/business/clean-heating-and-cooling