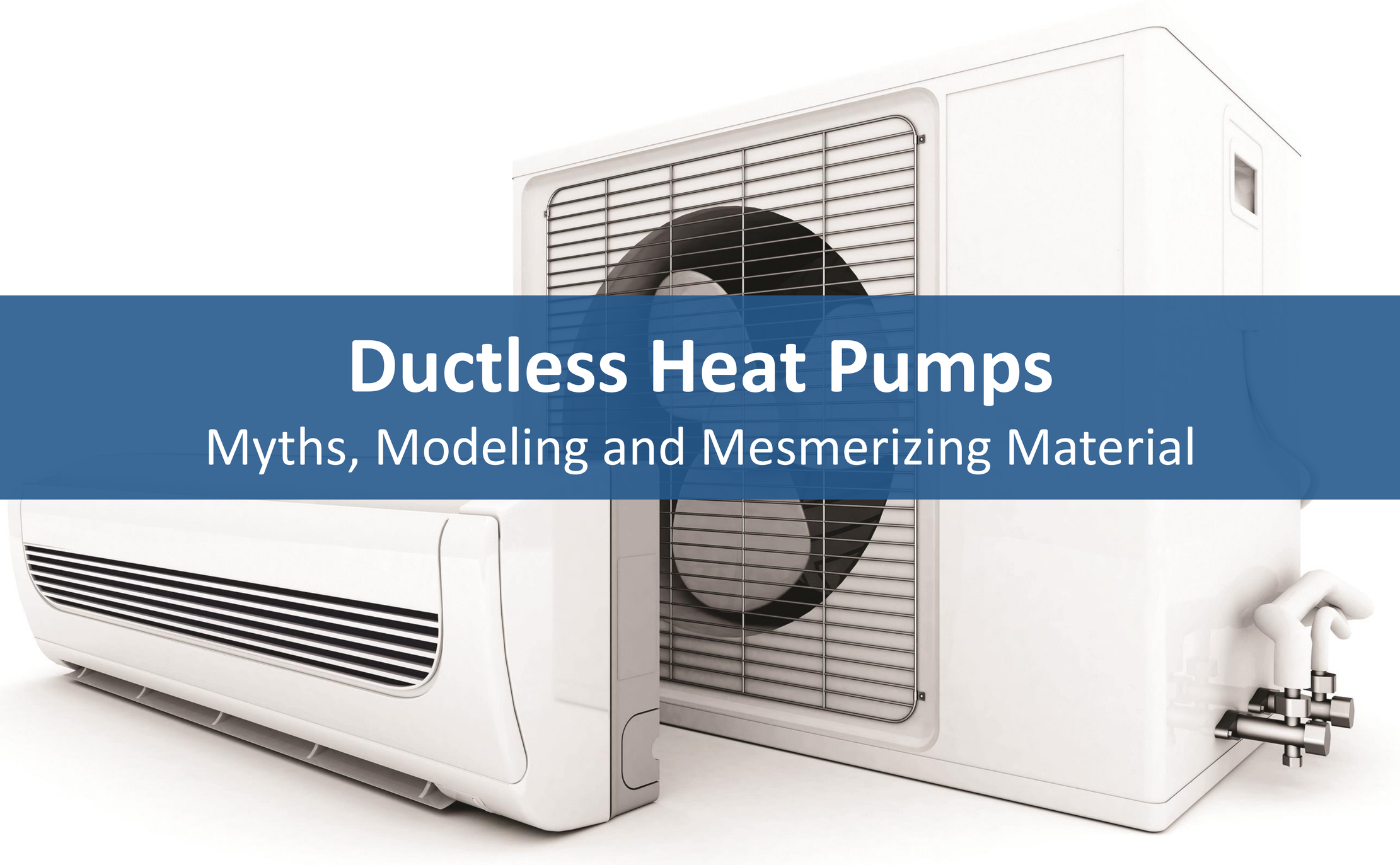
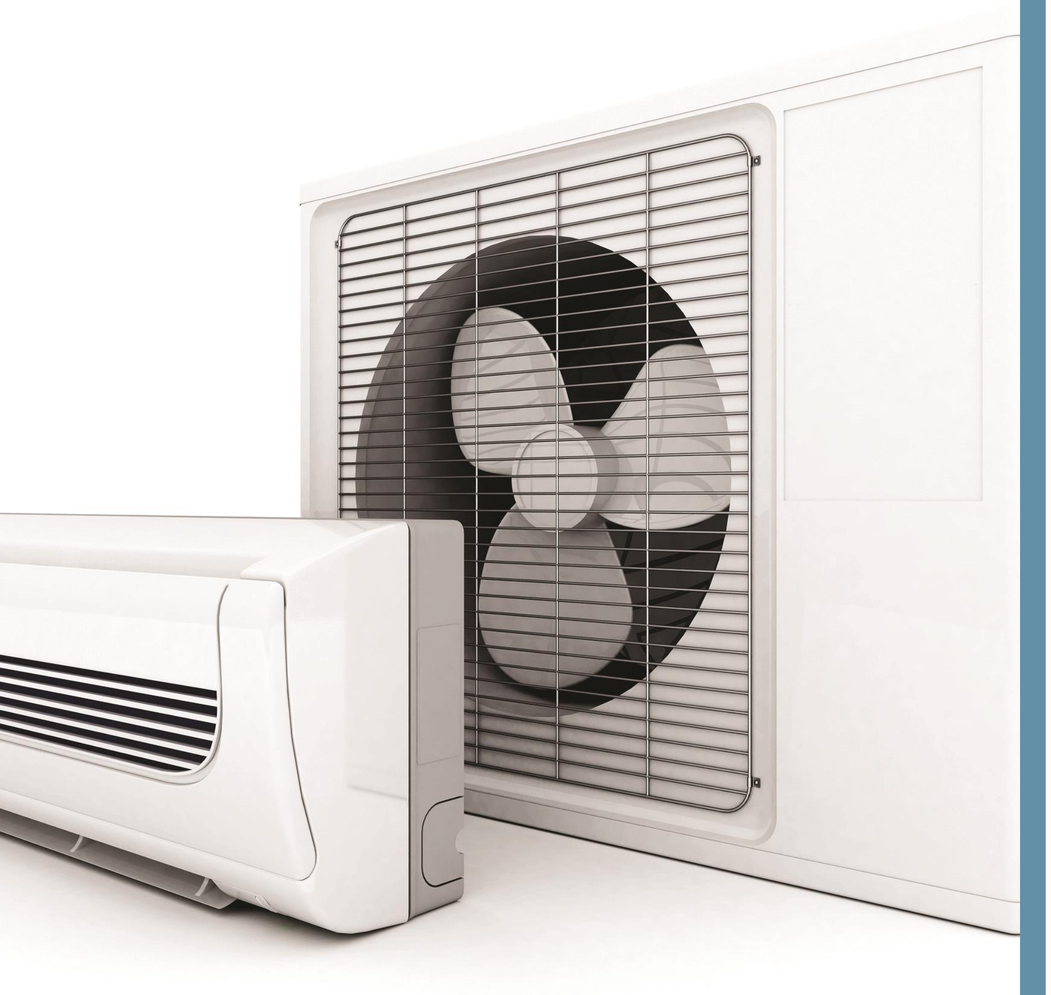
Ductless Heat Pumps

Myths, Modeling and Mesmerizing Material

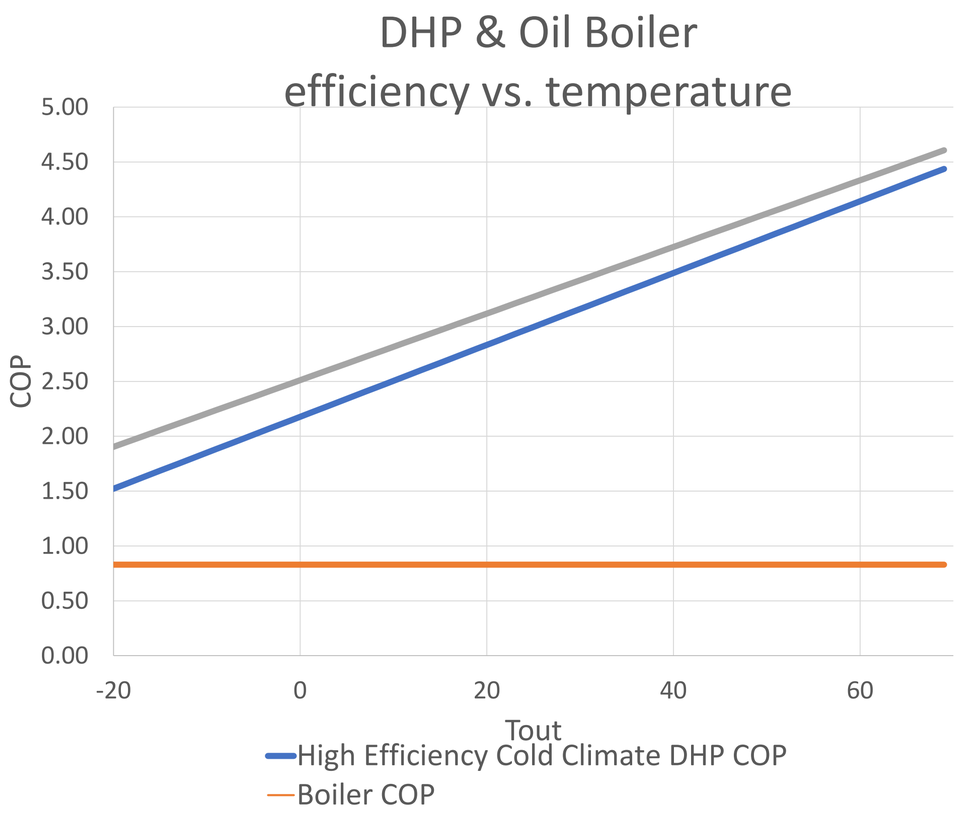


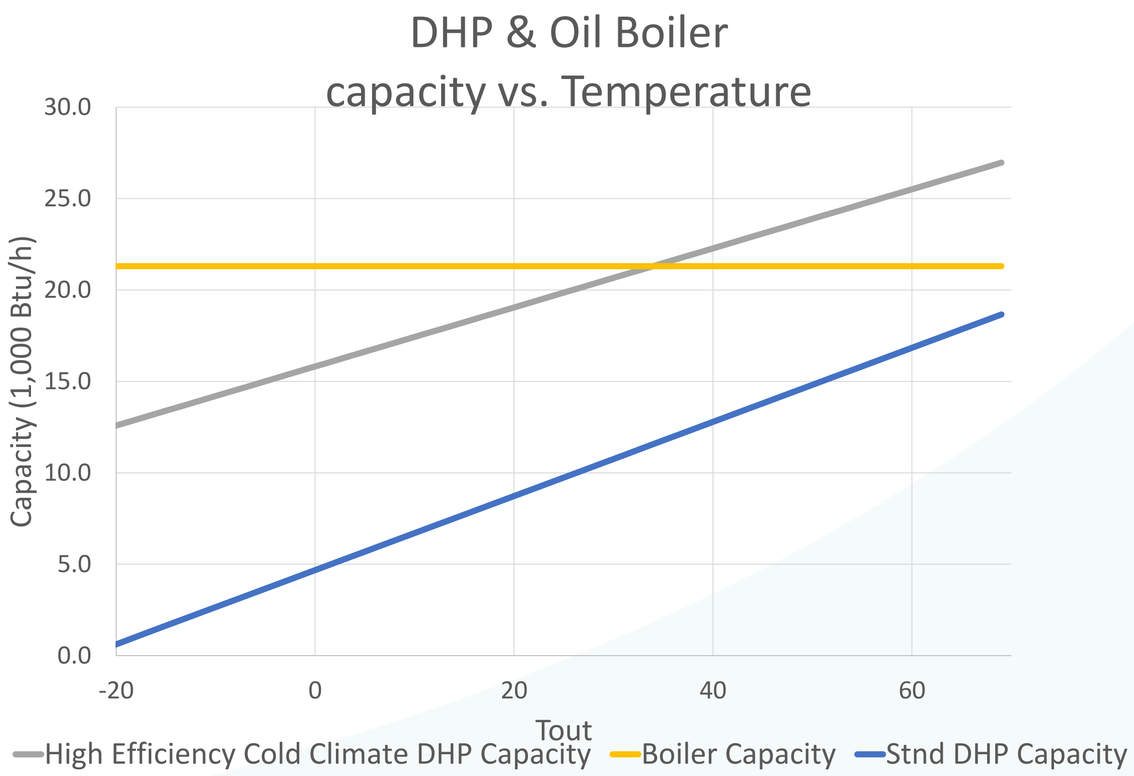


Myth:

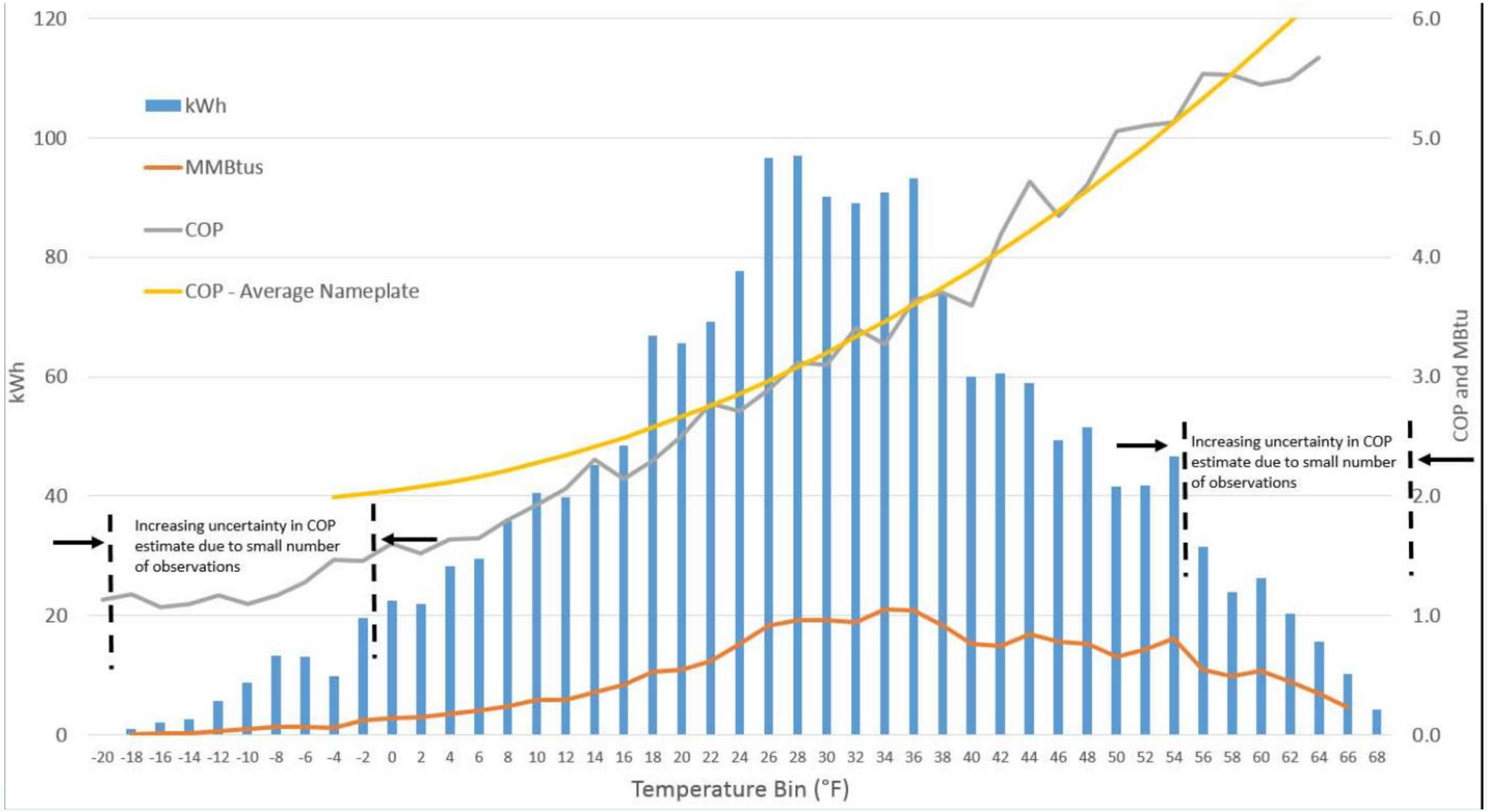
Ductless Heat Pumps don’t work when it is cold out.

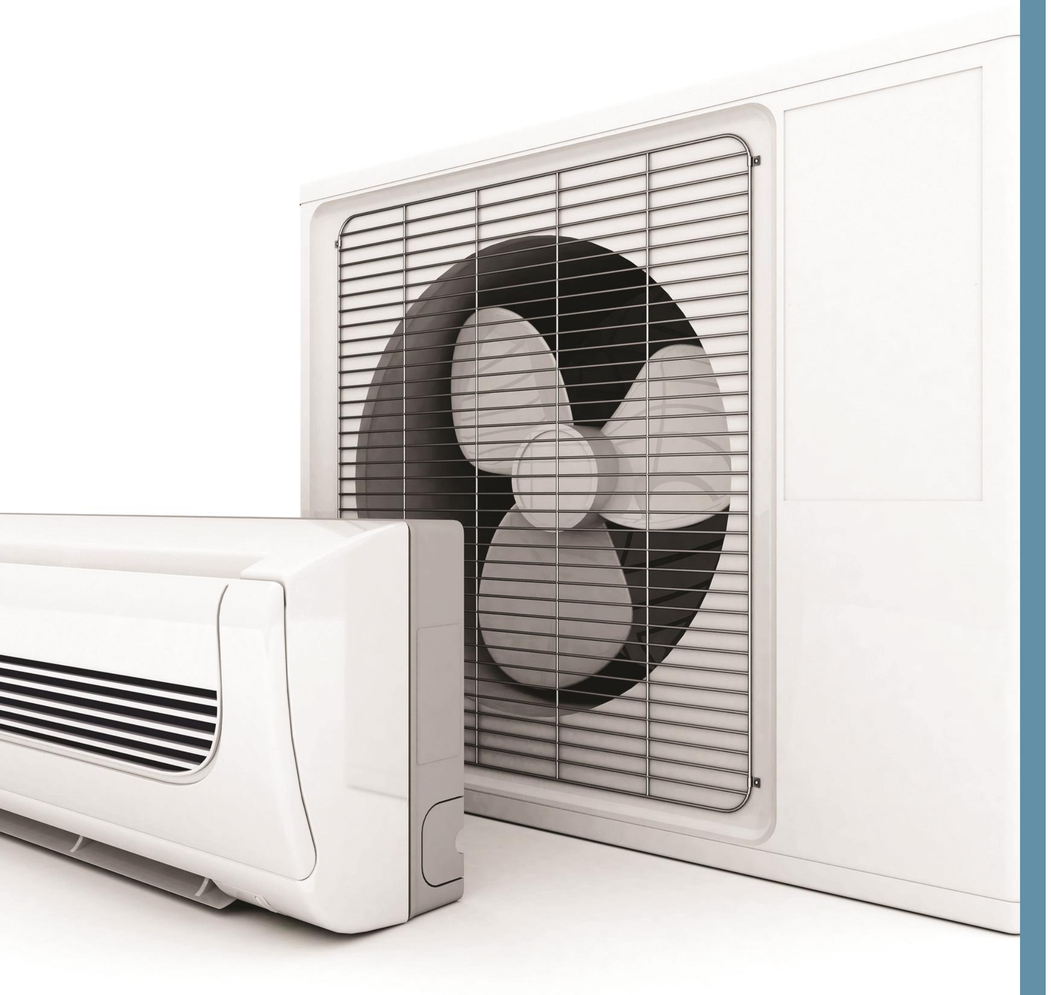
Heating System Performance versus Outdoor Temperature





Metered COP: VT Evaluation

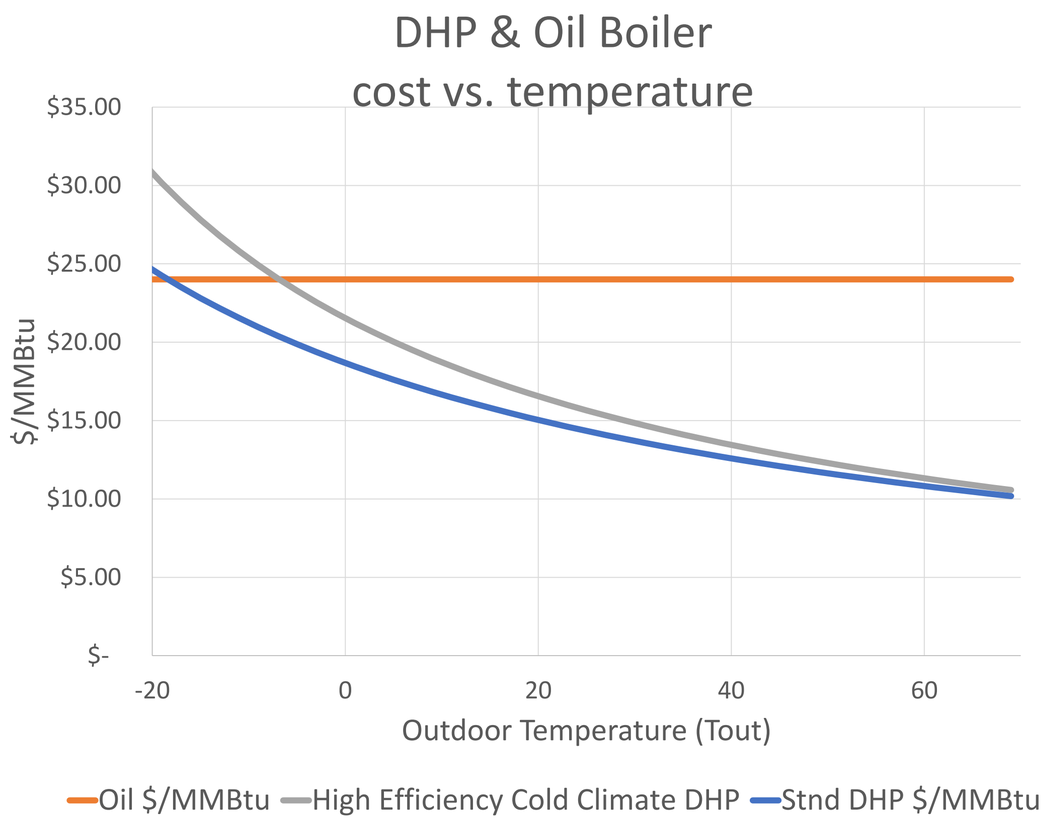




Myth:

Ductless heat pumps cost more than your oil system to run when its cold out.

Heating System Costs v Outdoor Temperature



Assumptions:

$0.16/kWh

$2.75/gallon of oil

The cost of each unit of heat (btu) produced by a DHP varies as a function of outdoor temperature.

High efficiency ductless heat pumps cost less to operate than standard efficiency ductless heat pumps.

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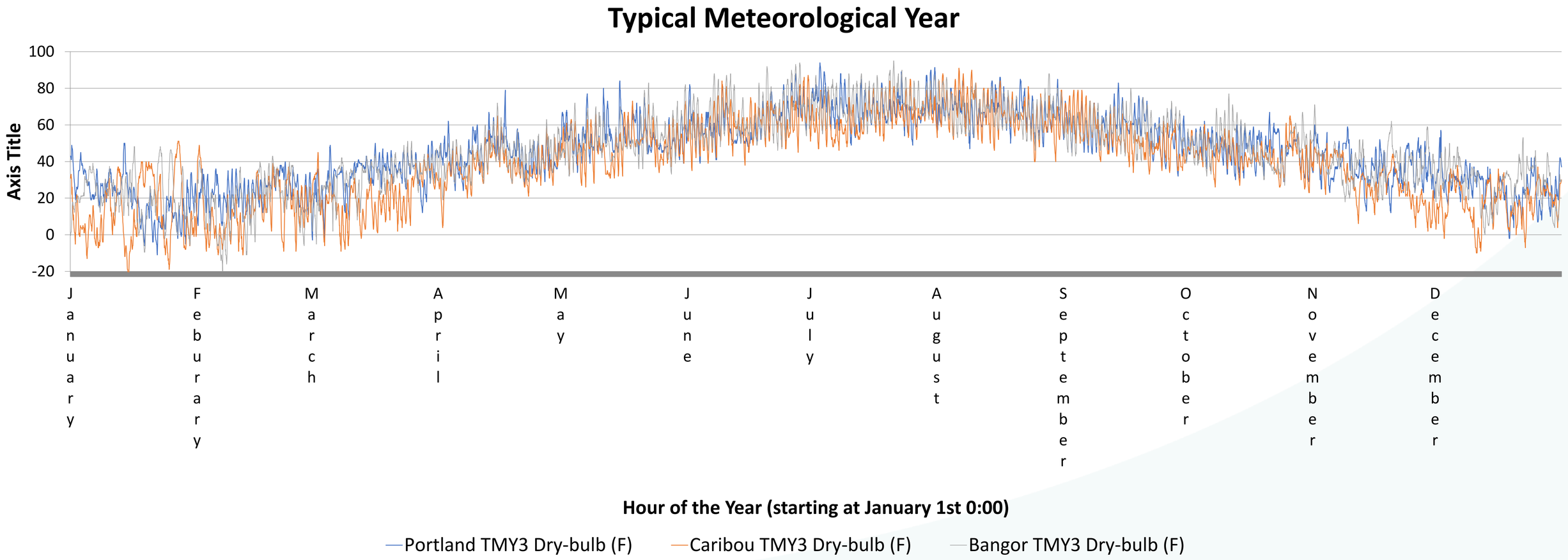
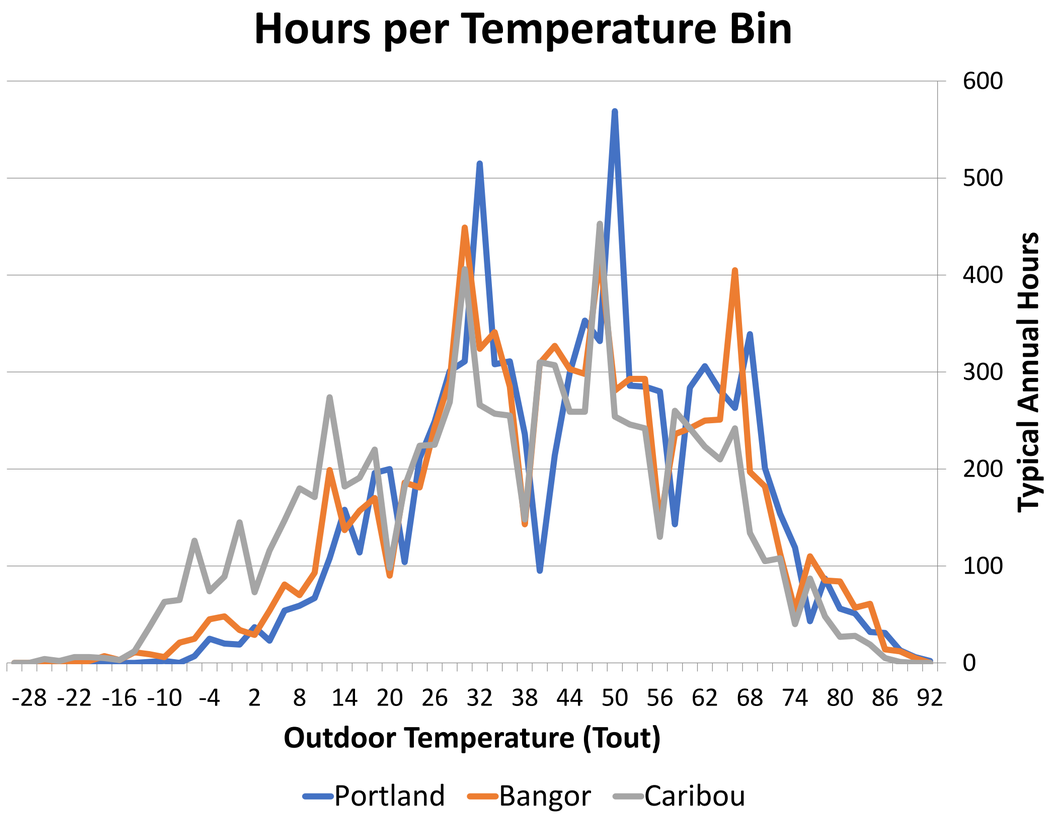
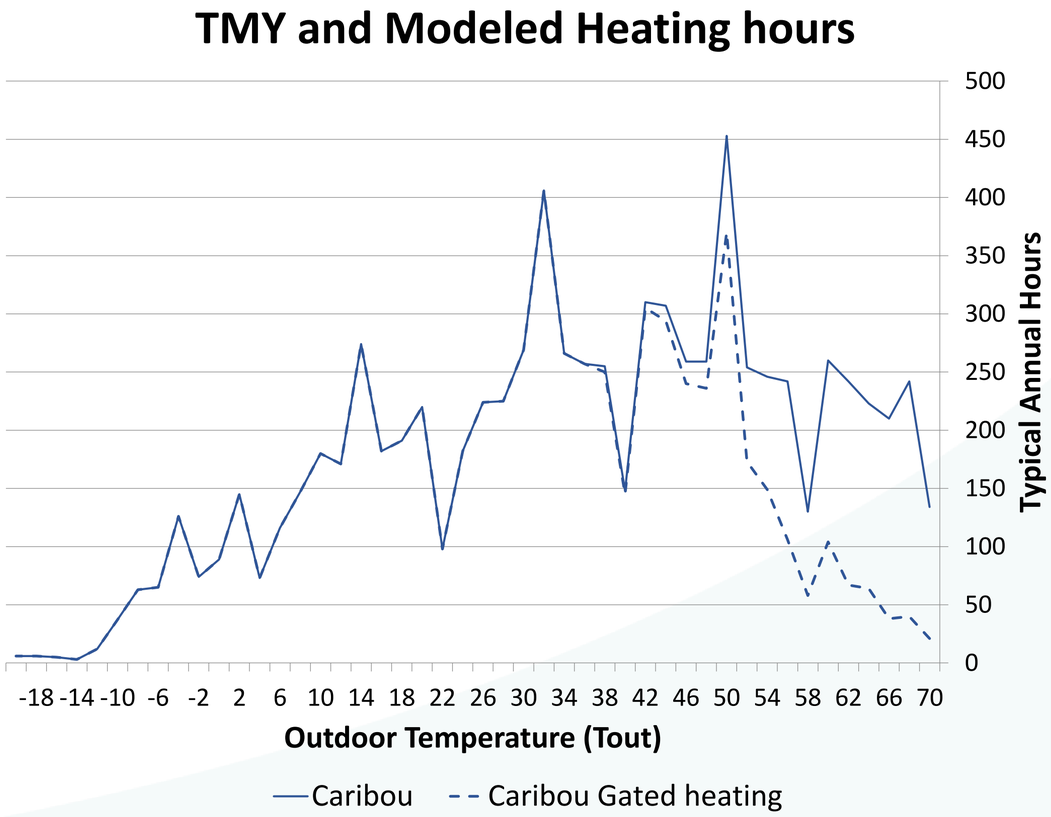
Temperature Time Series (hourly data)



“Binning” of Temperature for Analysis





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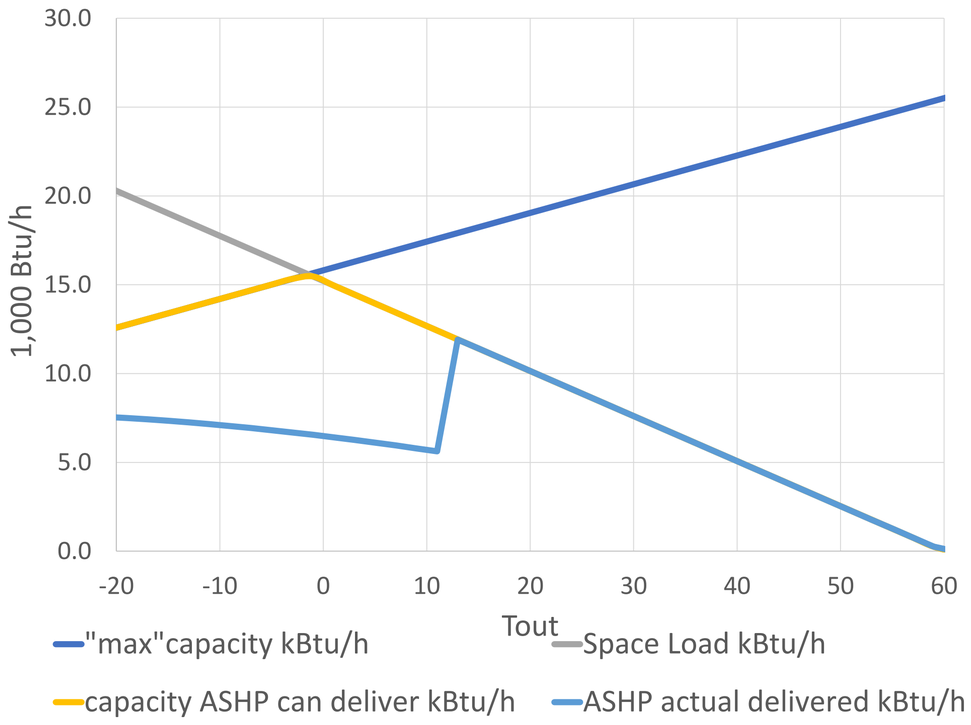
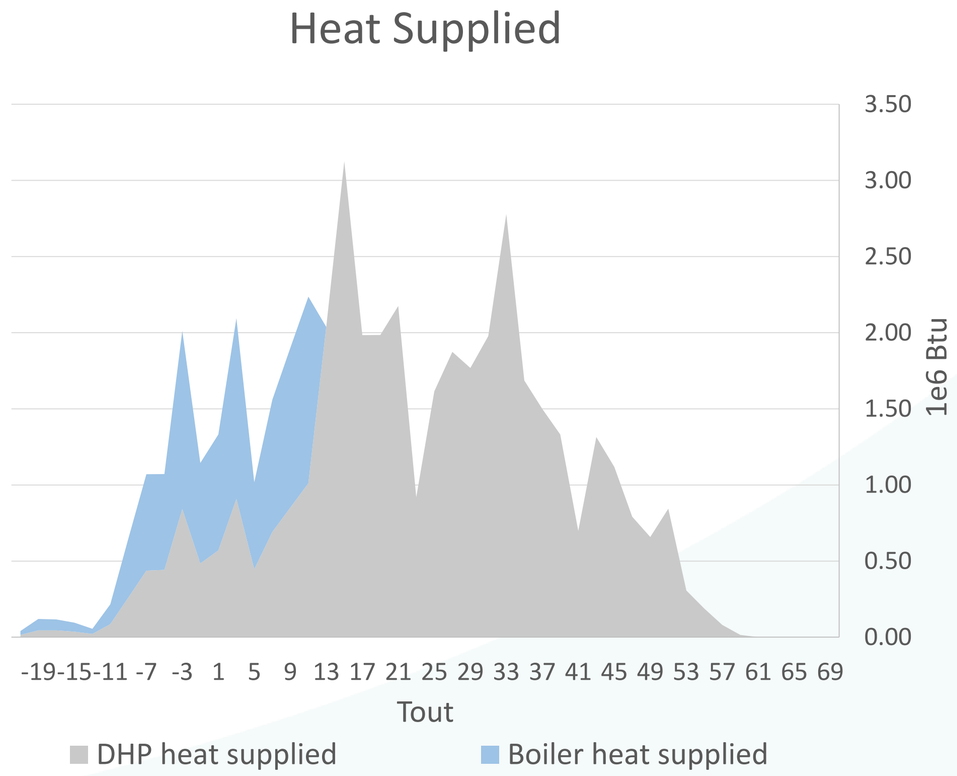
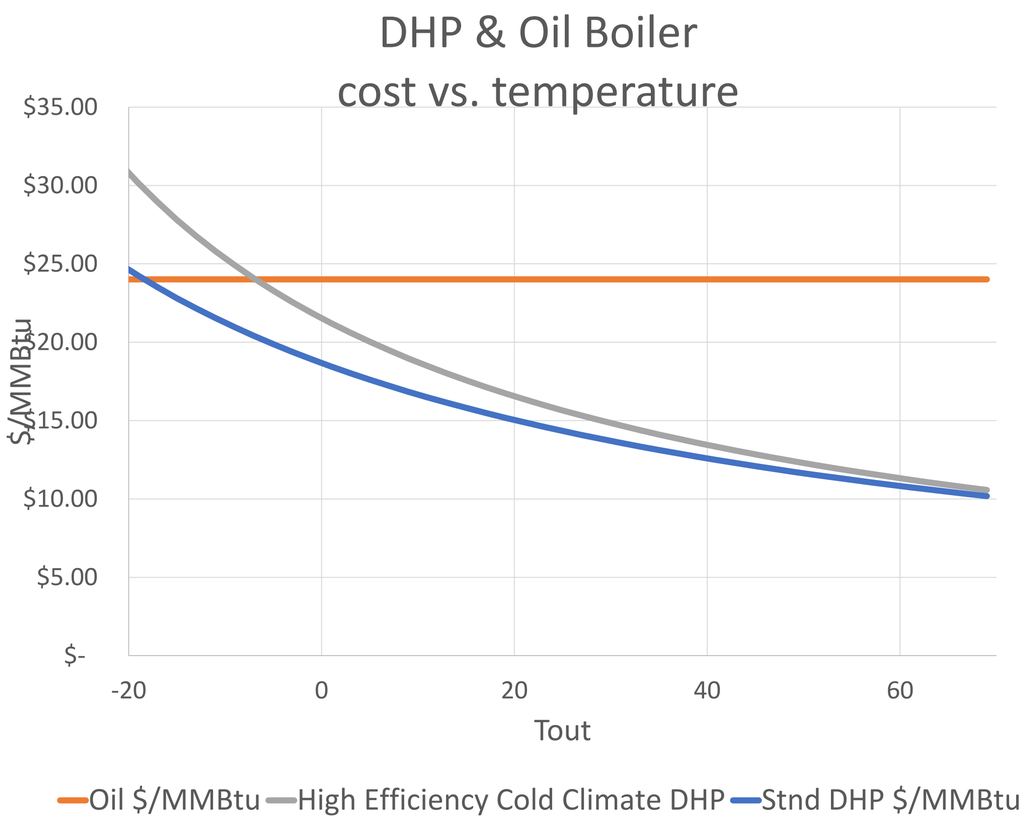
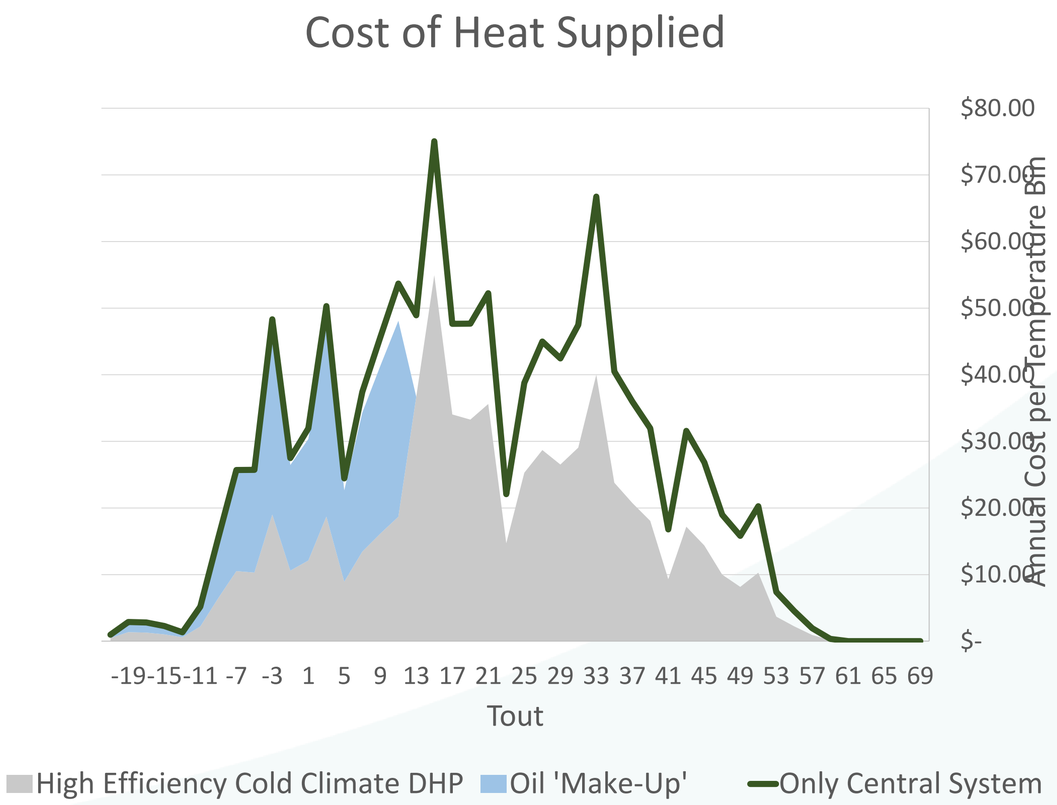
Modeled Results: Heat Supplied – High Efficiency Cold Climate DHP vs. Oil Boiler



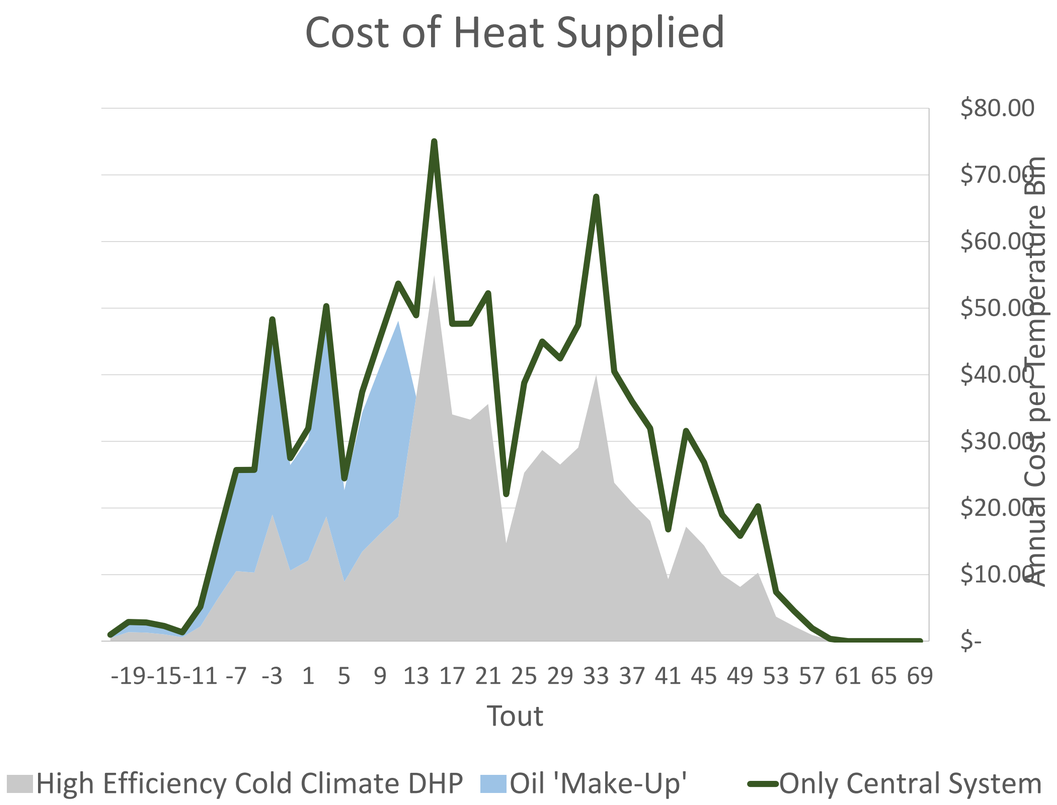


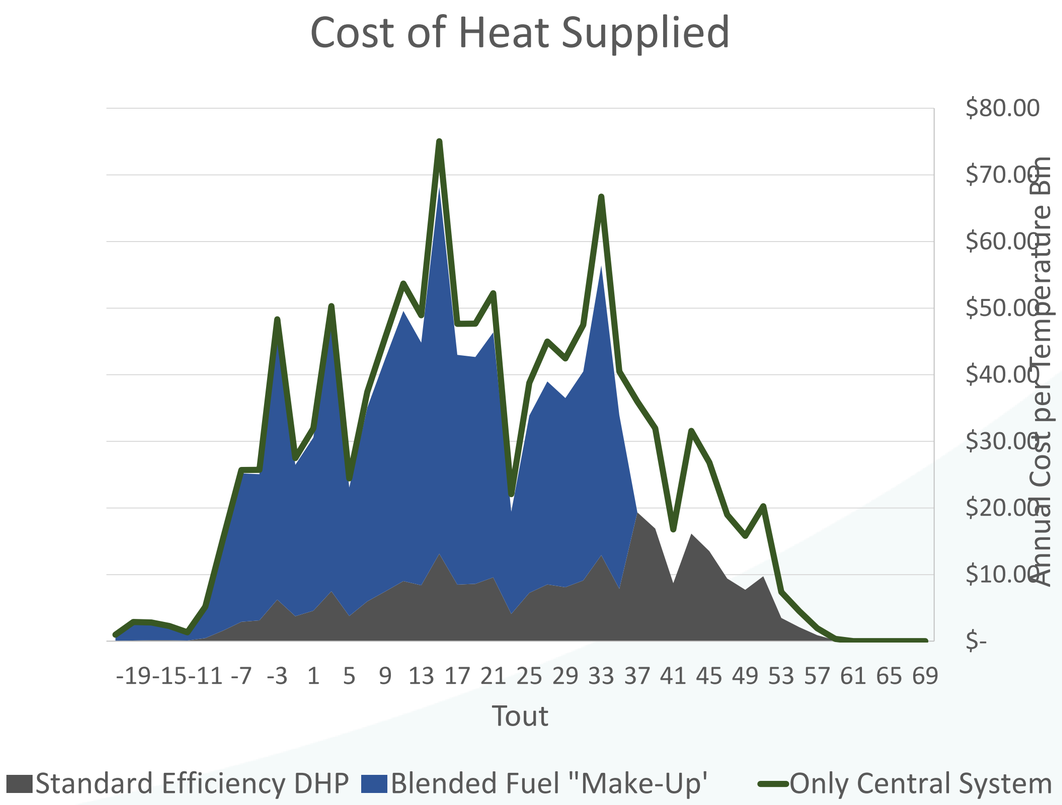
Modeled Results: Cost of Heating – High Efficiency Cold Climate DHP vs. Oil Boiler





Modeled Results: Cost of Heating – High Efficiency Cold Climate DHP vs. Standard Efficiency DHP





Base-only annual operating cost	$1,189
EE DHP + base annual operating cost	$879
$ saved estimated	$310
ASHP annual operating cost	$650

Base-only annual operating cost	$1,189
EE DHP + base annual operating cost	$996
$ saved estimated	$193
ASHP annual operating cost	$271

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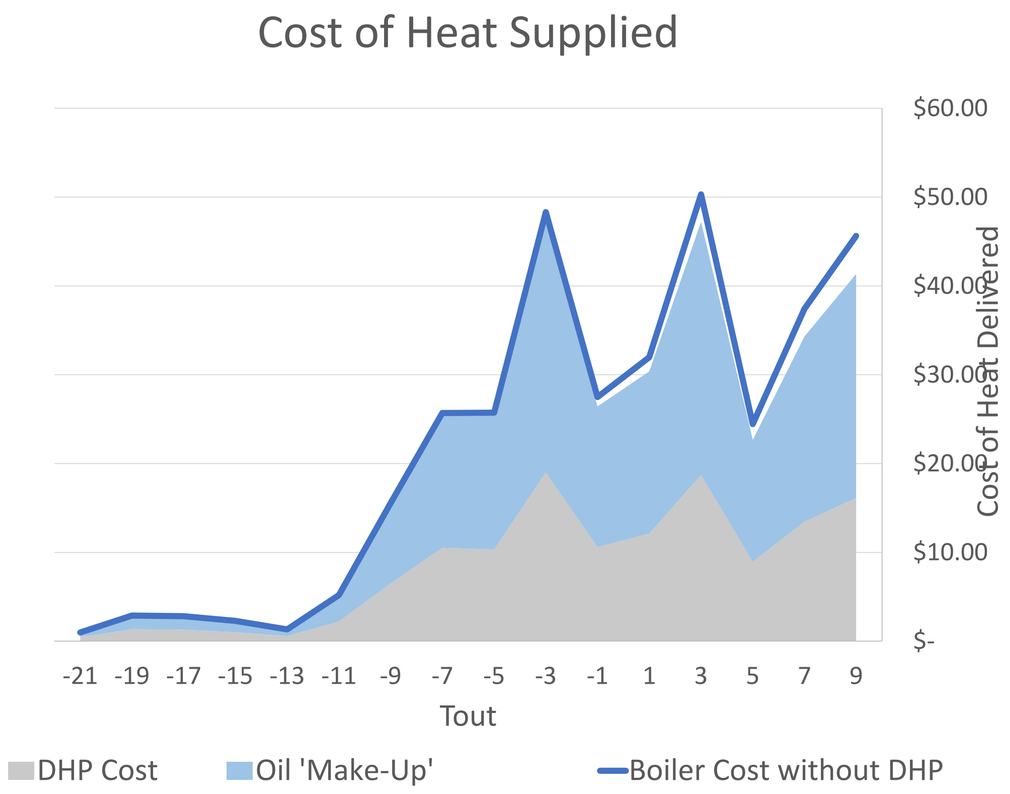
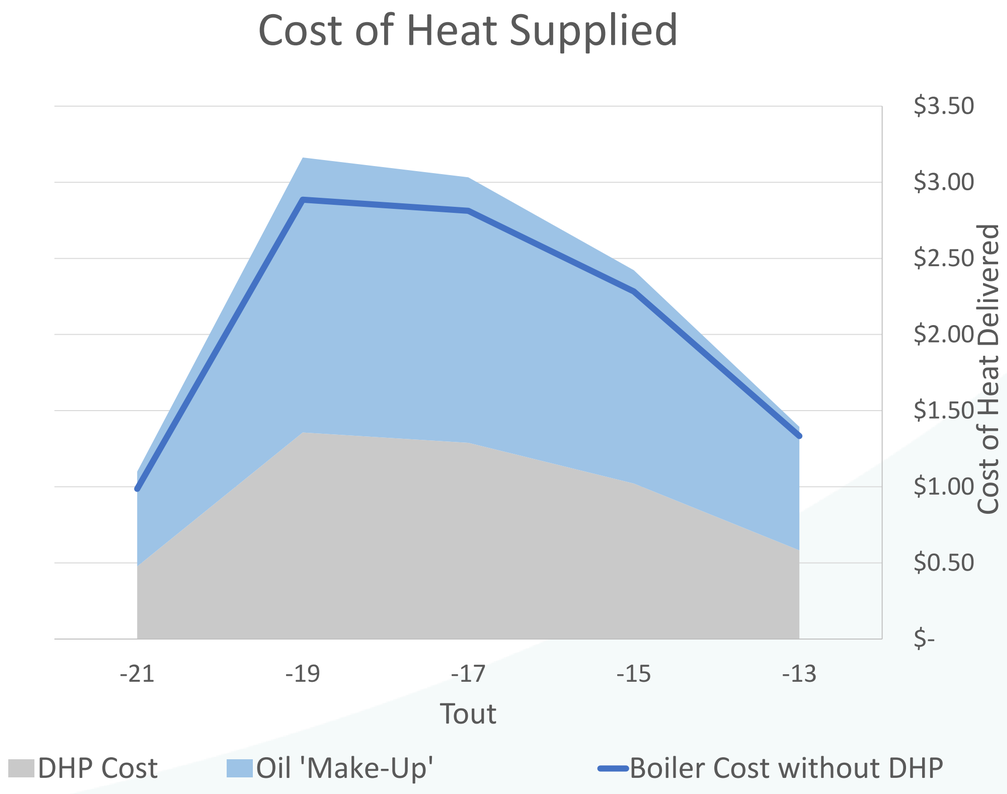
Modeled Results: “Cutover”



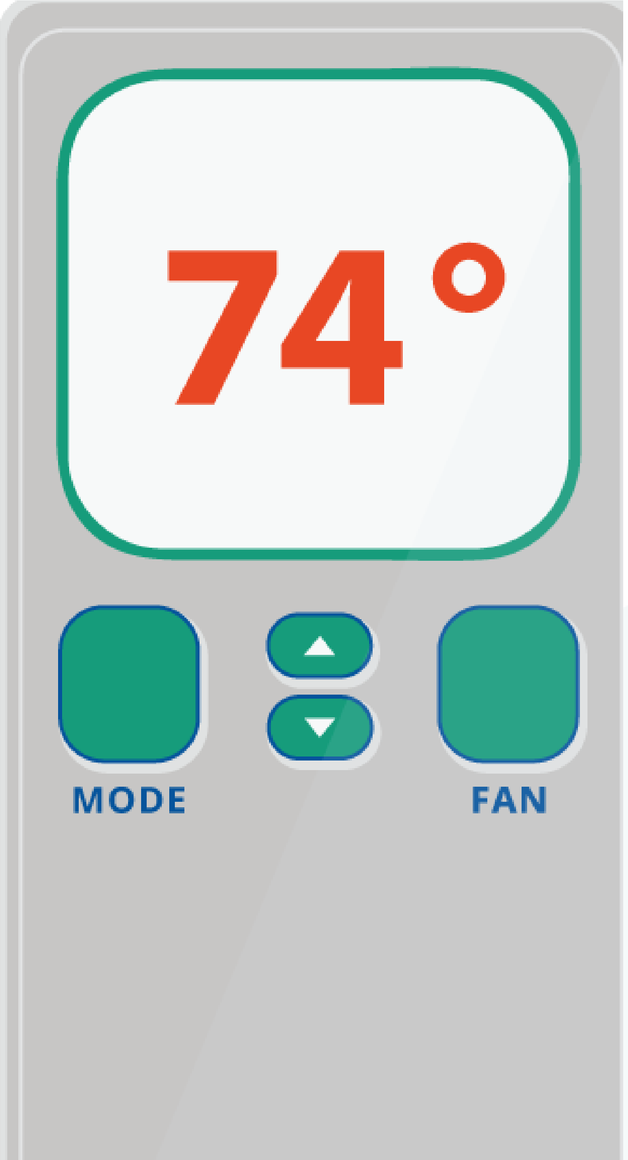


"lost" savings from not cutting off DHP $ 1.22

Heat Pump User Tips

Maximize usage of your heat pump as your primary heating system.

Experiment with your heat pump settings to find the right balance. Consider setting your older system's thermostat to at least 10 degrees cooler than your heat pump thermostat. By doing this, you will be using your older system only as back-up.



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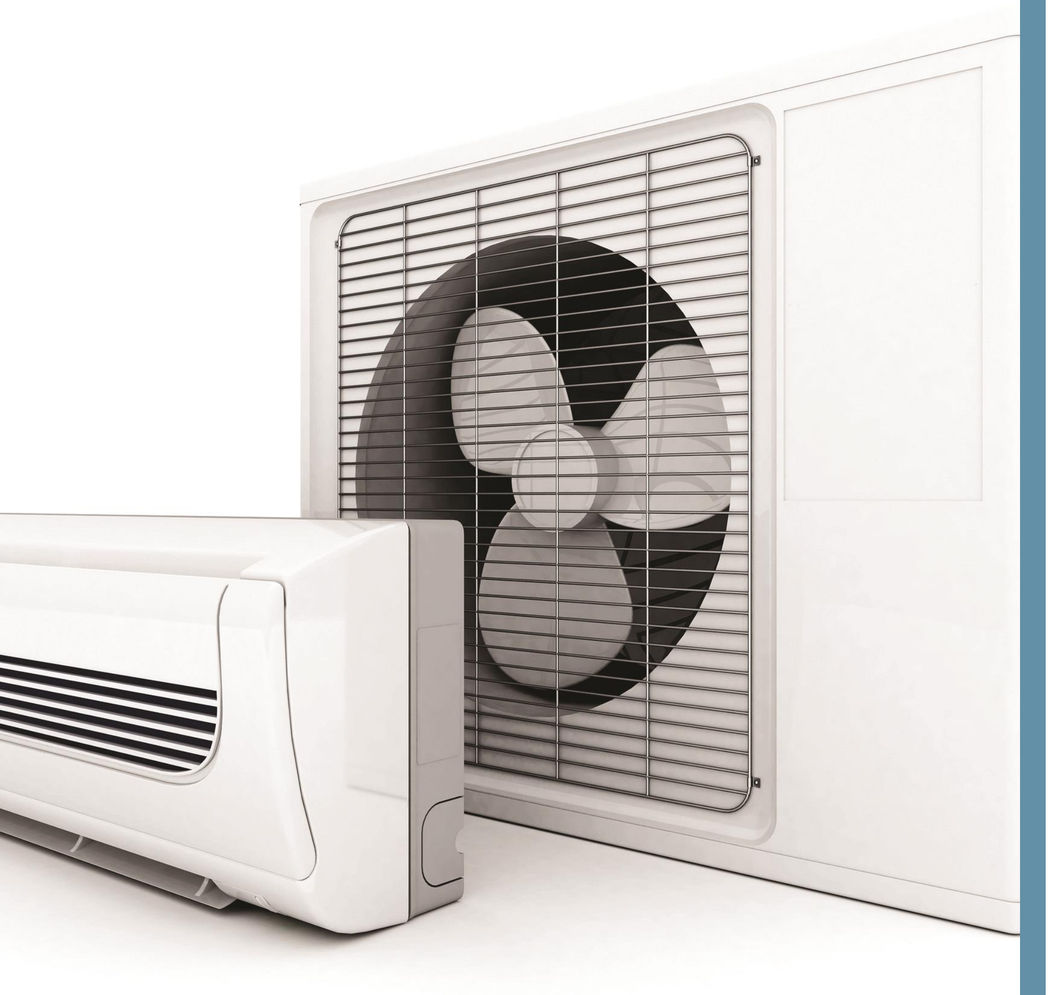


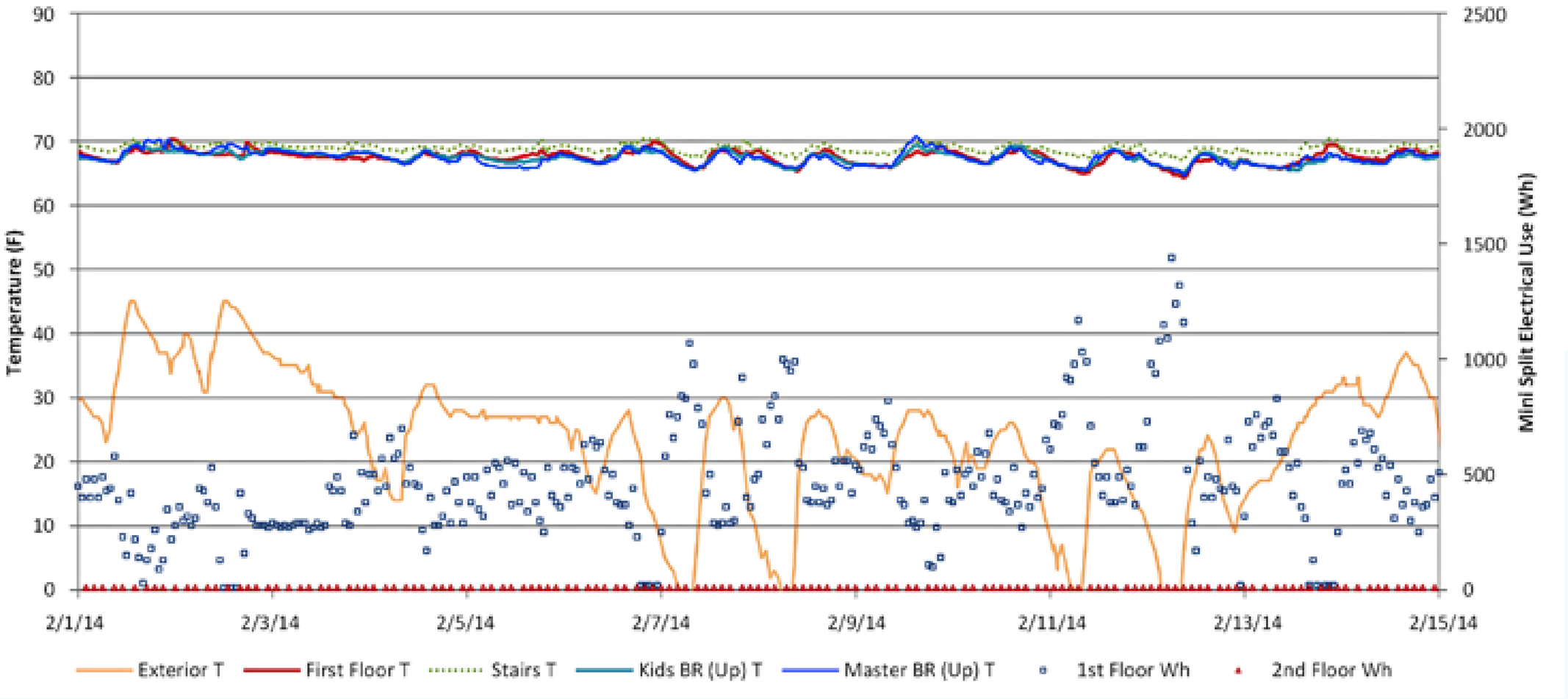
Myth:

You should turn down the temperature setting on your ductless heat pump at night and when you’re not home.

National Renewable Energy Laboratory Case Study

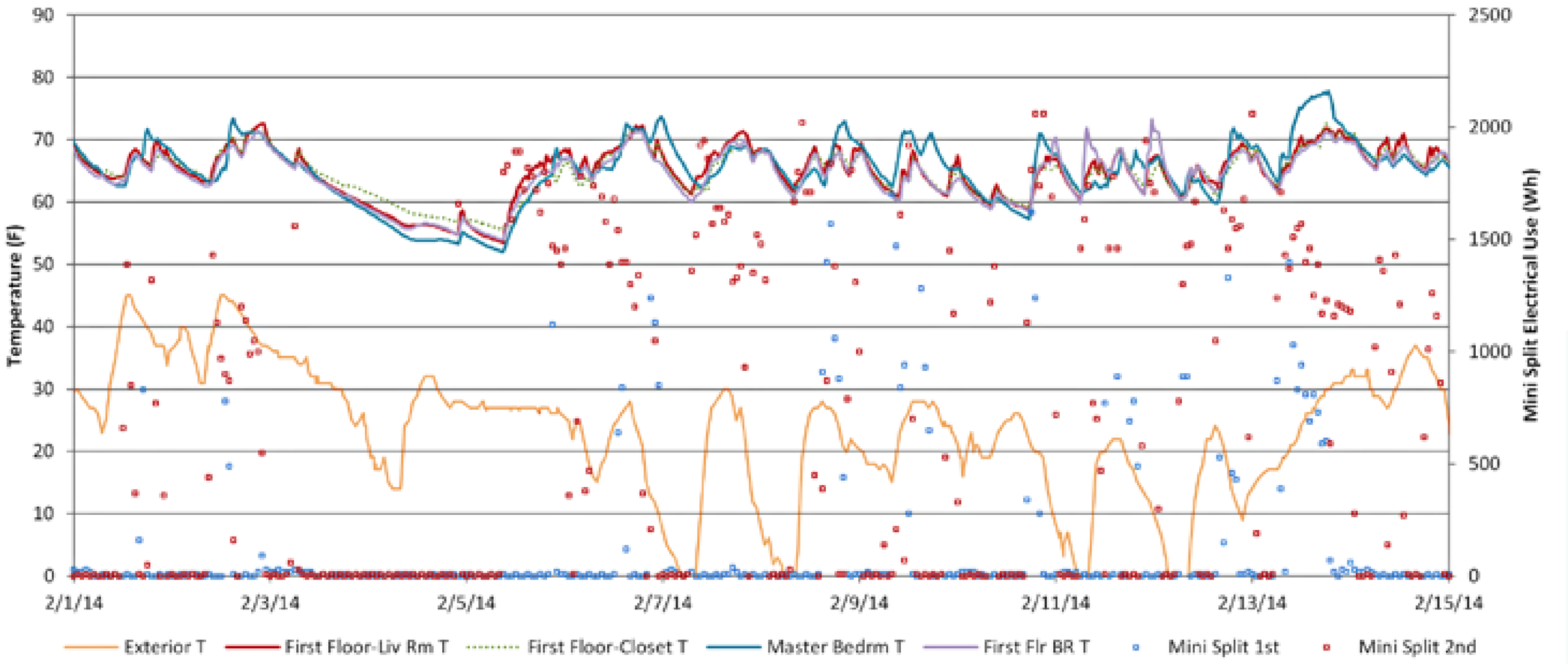
- Comparison of two identical houses using DHP's as primary heat sources
  - One home sets the thermostat based on comfort and occupancy
  - One home sets the thermostat
- Long term Monitoring
- Short Term Comparison

Constant Set Point



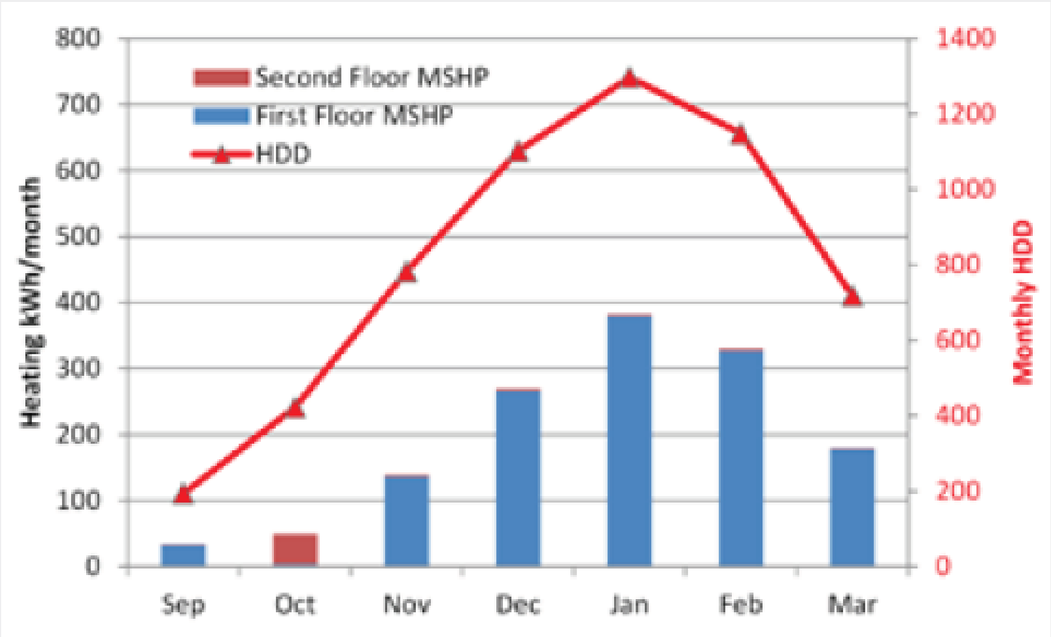
From: https://www.nrel.gov/docs/fy15osti/63080.pdf

On Off Operation

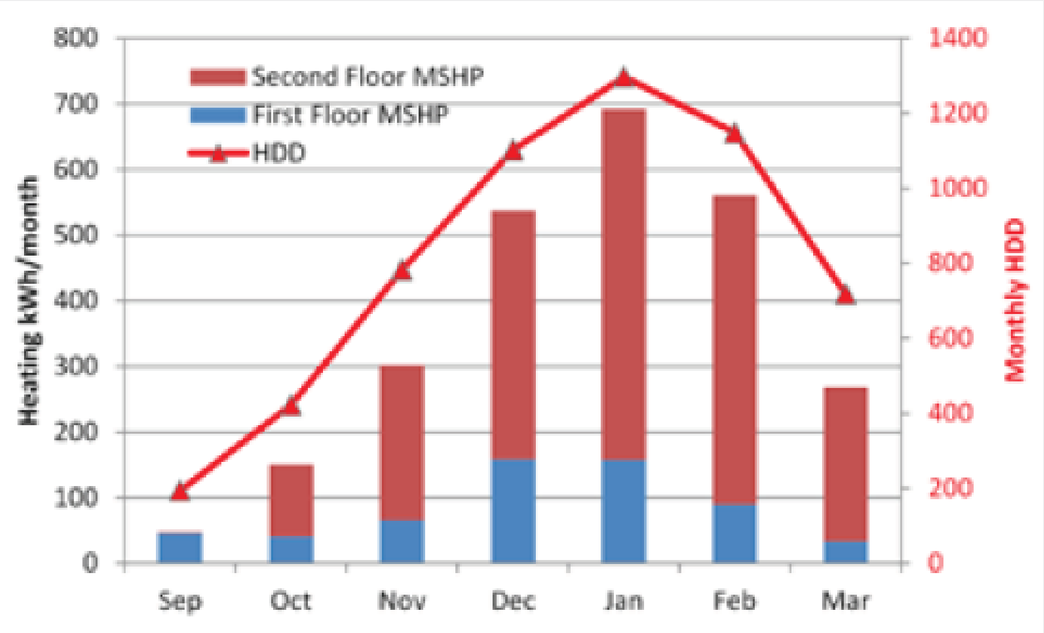


https://www.nrel.gov/docs/fy15osti/63080.pdf

Setback and Constant Operation



Constant set point house



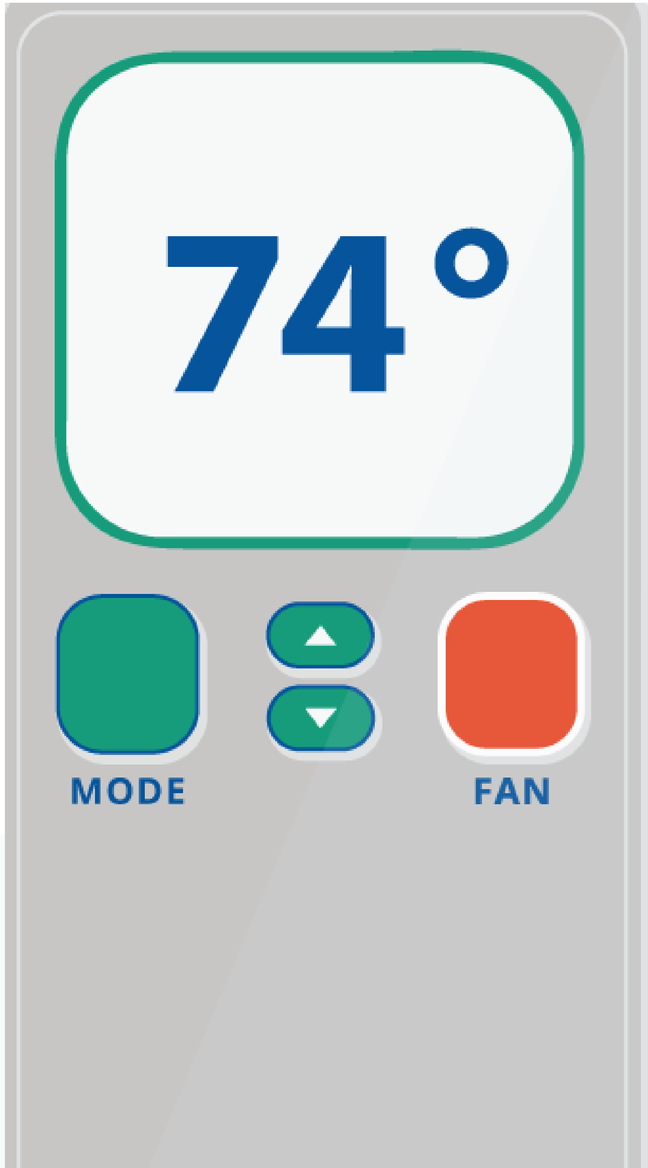
On-off operation house

https://www.nrel.gov/docs/fy15osti/63080.pdf

Heat Pump User Tips

Set it and Forget it.

Set your heat pump to a comfortable level. Then leave it alone. They are designed to maintain a steady temperature. Unlike with older heating systems, turning it down at night may not save energy.



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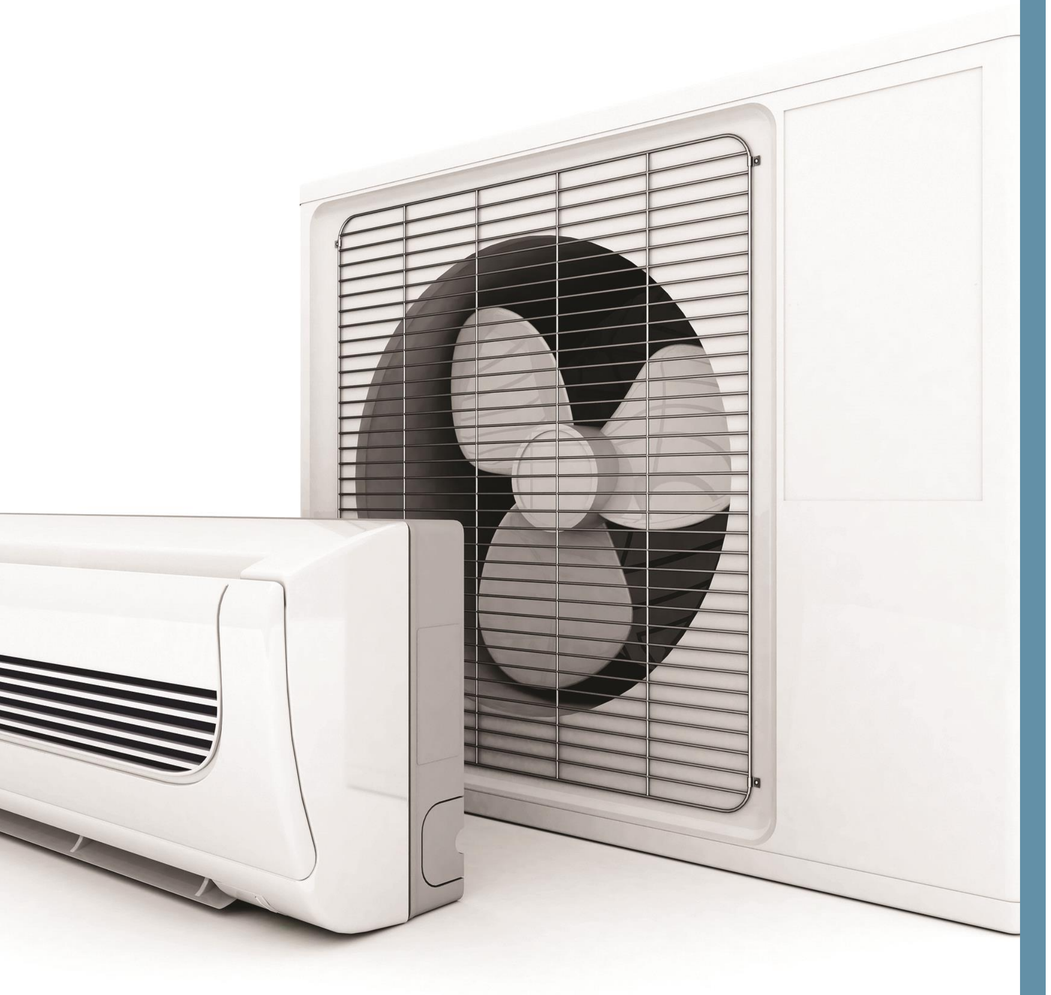

Myth:

Ductless Heat Pumps will be used for air conditioning and break the grid in the summer.

DHP Reduce Air Conditioning's Impact on Peak Load

- Vermont published the evaluation of DHP's in November, 2017
- The evaluation found that on average DHP's reduce cooling load:

Savings Type	Baseline Category			Proportion from Homeowner Interviews			Weighted Average
	Window Air Conditioner	No Previous Cooling	14.5 SEER Heat Pump	Window Air Conditioner	Load Building	14.5 SEER Heat Pump	
Energy (kWh)	286	-146	93	15%	20%	65%	74
Peak Demand (kW)*	0.284	-0.190	0.158				0.11

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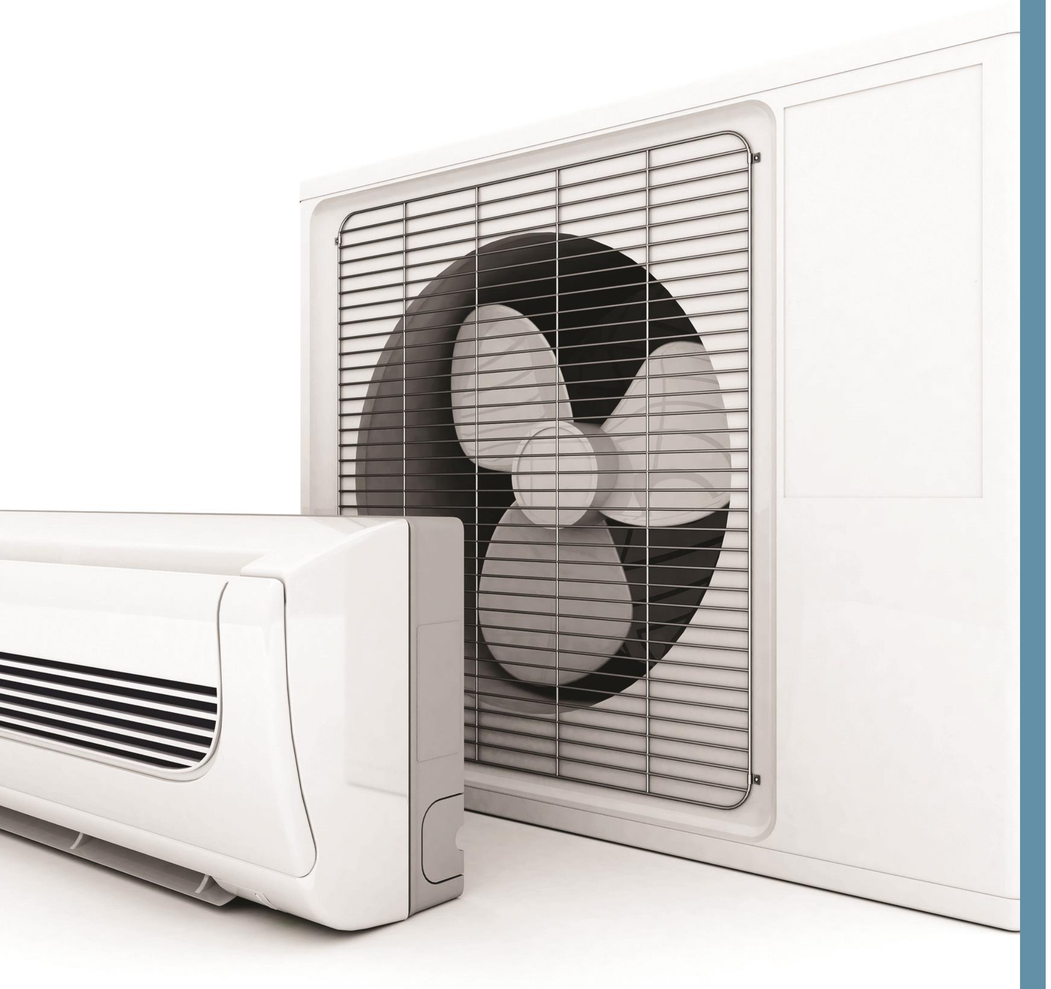
Cooling (cont)

- The Vermont evaluation examine the AMI data before and after a DHP was installed.
  - Table reflects net savings:

Previous System	Δ kWh (Normalized to Metered ccHP Size)
No Cooling	-95
Fan only	-40
Window or portable AC	202
Average	**12**

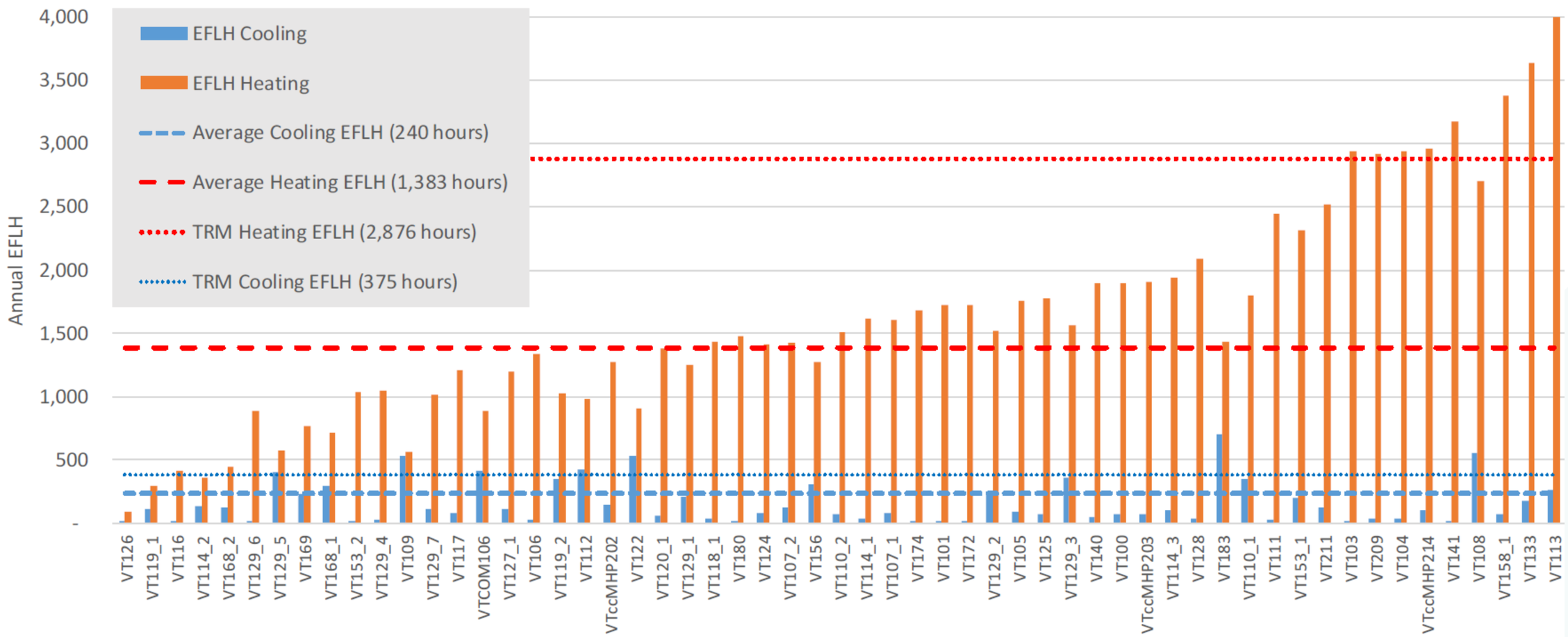


Evaluations

Evaluation Results from Vermont and Massachusetts

- Massachusetts published the evaluation of DHP's in December, 2016
- Vermont published the evaluation of DHP's in November, 2017
  - Both studies found that the units were not being used as much as anticipated
- Vermont may be most comparable to Maine

Vermont DHP Usage



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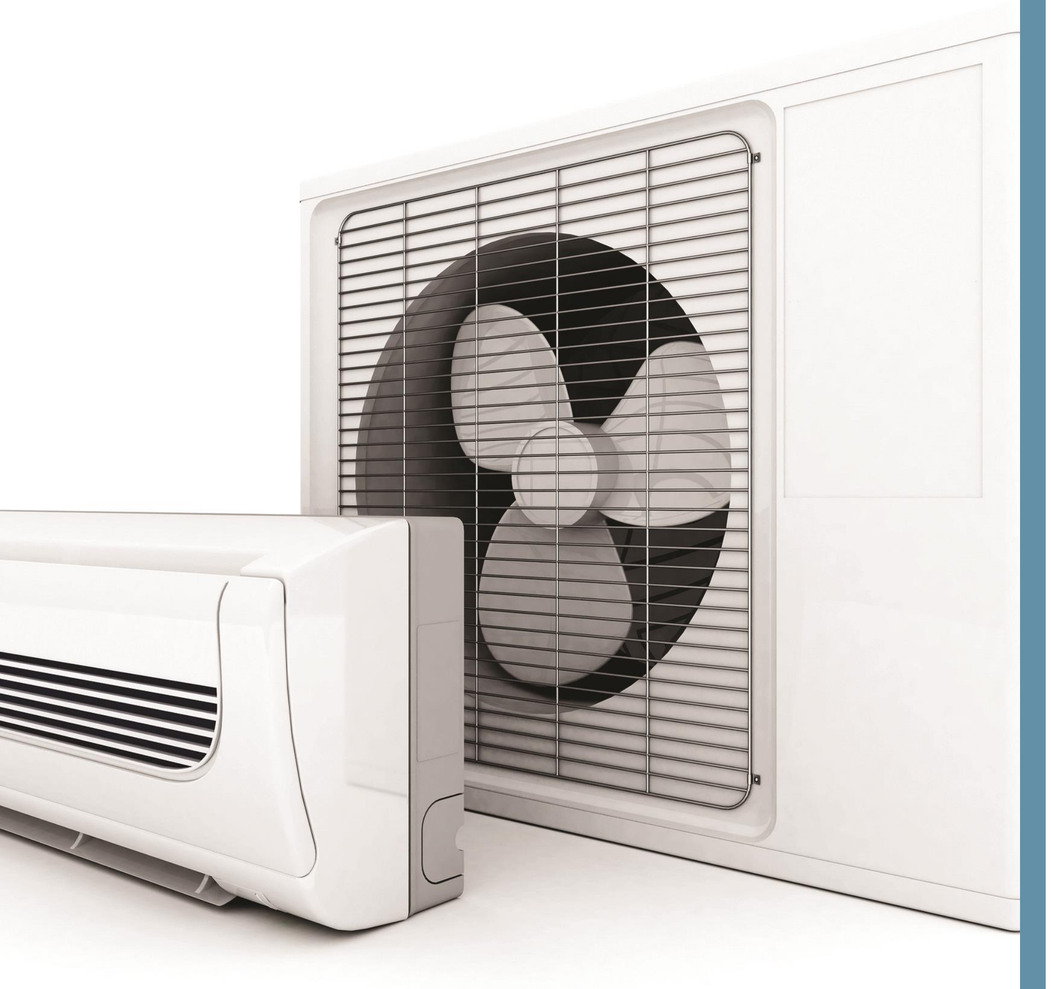

Integrated Thermostats

Integrated Thermostat

- 7 Homes with Mitsubishi DHP previously metered
- Honeywell Thermostat (VisionPRO 8000) integrated with DHP (through interface kit box PAC-US444CN-1) and Existing Central Heating System zone shared with DHP
- Remotely mounted wireless temperature sensor configured to control DHP and central system
- Droop between DHP and central system set to 2-3 deg F
- Before Thermostat Integration
  - 317 gallons of Oil offset with DHP
- After Thermostat Integration
  - 607 gallons of Oil offset with DHP

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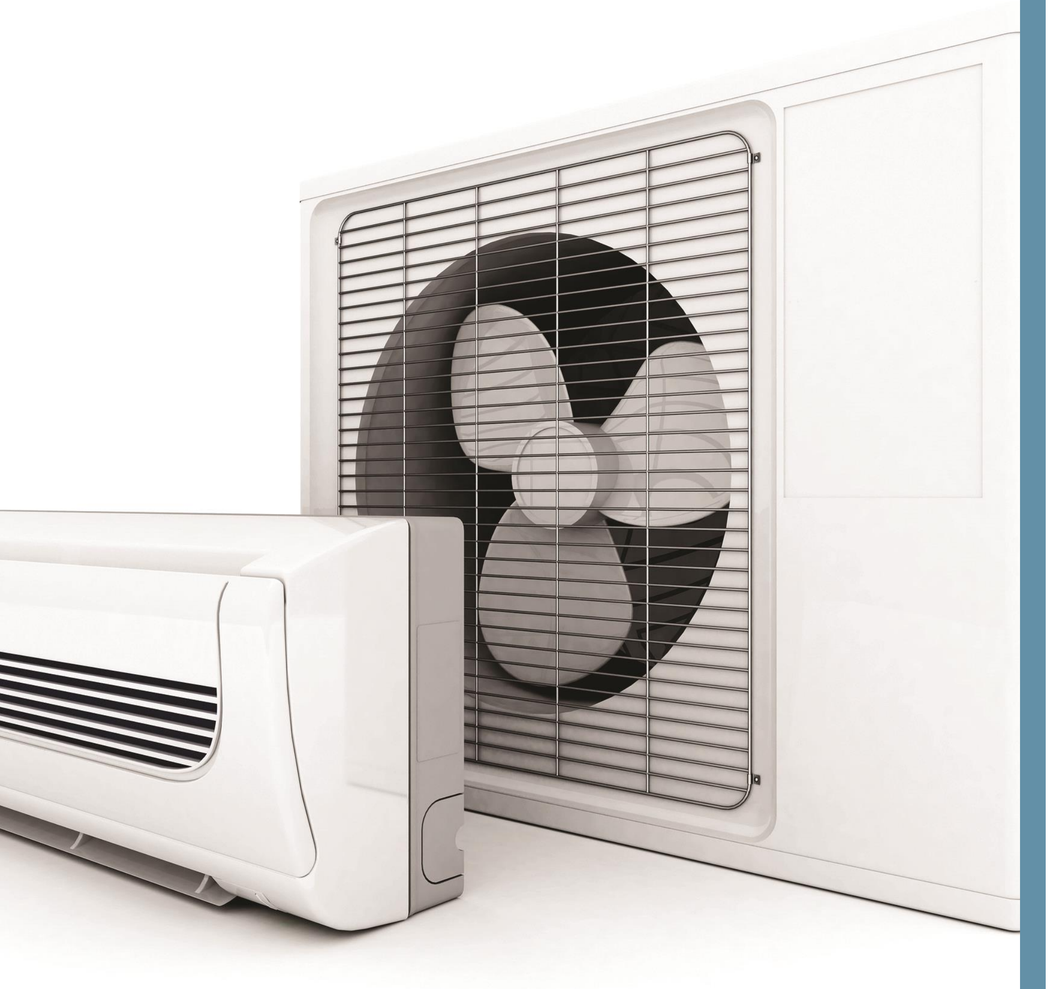

Lessons Learned

Lessons Learned

- DHP’s can deliver significant benefits to customers
- The more they are used the higher the benefits
- DHP’s operate differently that conventional systems
- Customer education and orientation is needed