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Energy Efficiency

Switchover Guide

Ducted Dual-Fuel Air Source Heat Pumps

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Introduction

ComEd's commitment to a low-carbon energy future is outlined in the "ComEd 2030" vision. Key to this vision is advancing the policy goals of the Climate and Equitable Jobs ACT (CEJA) legislation for a clean and equitable energy future through its investments in infrastructure and customer programs. As renewable energy supply on the grid increases, electrifying heating and cooling of buildings is just as important as transportation electrification in the transition to a clean energy future. ComEd believes that heat pumps, both all-electric and dual-fuel systems, are an important component to achieving economywide decarbonization as part of its 2030 goals. »

In order to drive heat pump adoption by customers, we must ensure they have a positive experience with them. Contractors can ensure this positive experience by understanding customers' needs for comfort & affordable energy bills, setting expectations, and educating consumers on the best way to manage their heat pump and its supplemental heating sources.

Likewise, all recommended practices must work for contractors to ensure that contractor businesses are positively impacted through participation. To that end, this switchover temperature guide is designed to provide options and opportunities that align with a contractor's experience and business models, particularly with ducted dual-fuel air source heat pumps. All electric systems are not included in this guide as they are intended to perform with simultaneous operation of the primary heat pump and the supplemental electric resistance strip/plenum heater.

In this document, utility rates are used as examples. These rates are for demonstration purposes only. Actual rates for natural gas, electricity, and delivered fuels will change over time and should always be updated in your own calculations to reflect either the clients current bill or the anticipated bill for the next heating or cooling season.

» ComEd 2030 Roadmap

Balance Points/Switchover Temperatures

Definitions: the balance point is a TEMPERATURE (setting) at which switchover happens from the heat pump to the supplemental heating source.

Some manufacturers do not use either term in the thermostats and manuals, instead rely on the term “compressor lockouts” for dual-fuel heat pump switchover temperatures.

Thermal or Capacity Balance Point:

The thermal or capacity balance point is the outdoor temperature below which the heat pump can no longer satisfy the heating load of the home. The installer can determine this temperature value by analyzing the heating load calculation and the heating capacity curve of the heat pump itself. This is the easiest balance point to calculate as it does not change much over time.

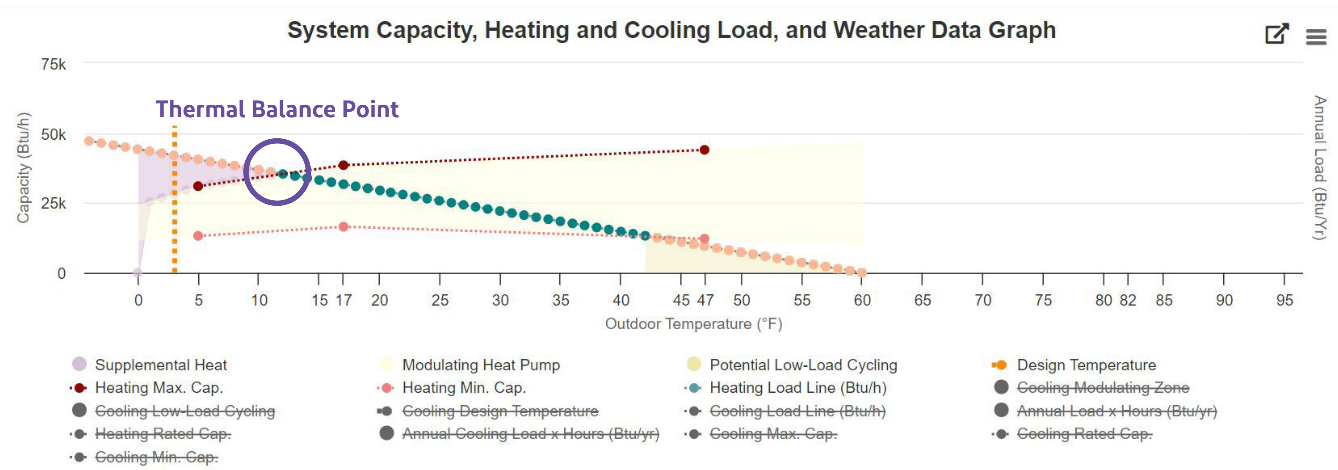


Image courtesy NEEP’s Cold Climate Air Source Heat Pump Product List and Advanced Sizing Tool

Economic Balance Point:

The economic balance point is the outdoor temperature at which switching over to the supplemental heat source results in equal costs or provides savings when operating the heat pump. This will vary greatly depending on the supplemental fuel source, efficiency of the equipment, and local utility rates. The ideal economic balance point is set such that operating the new heat pump system costs just as much as the old system would have had it not been replaced (assuming the supplemental heating system size and efficiency remains the same.) Determining this temperature usually requires software or can be estimated using a break-even coefficient of performance (BeCOP).

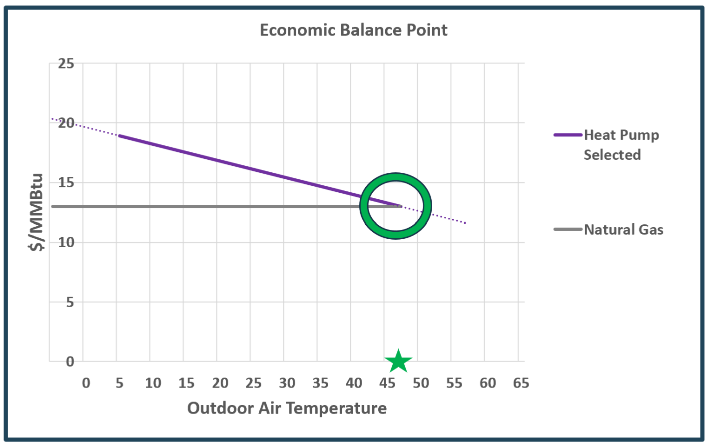


Image courtesy of Dan Wildenhaus

The BeCOP is an estimate, or starting point setting as it requires the utility rates/costs available at the time of installation or setting of the economic balance point, which do not reflect real world experiences and can over or under-estimate based on utility rate changes month over month. It is possible that an economic switchover temperature could be a lower temperature than the thermal balance point. **Systems should not be set up to switch over to supplemental heat below the thermal balance point!** For more details on the Break-even COP, please see the section below on calculating break-even COPs.

Comfort Balance Point:

The comfort balance point is completely experiential and will change based on occupants' perceptions and experiences. Due to heat pumps delivering warm air, while fossil fuel furnaces deliver hot air at registers when the heat pump is operating, the first step to addressing comfort is recognizing supply air register location and orientation of grills and registers. If possible, consider removing, moving, or altering grills/registers that direct air to feet in kitchens and bathrooms or directly at primary seating in common rooms (living rooms, dining rooms, family rooms, etc..) to alternative locations/directions. When altering supply delivery is not possible and comfort is identified as a top priority for cold climate systems, it's recommended that the comfort balance point be set at 1°F to 5°F higher than the economic balance point. Both the comfort and economic balance points should be revisited with occupants on an annual basis.

THERMAL BALANCE POINT

- **The outdoor temperature at which the heat pump can no longer produce the heat needed for the home.**
- **Also called capacity balance point.**

ECONOMIC BALANCE POINT

- **The outdoor temperature at which the cost to heat the home with the HP is the same or more expensive than the backup heat cost.**
- **Depends on both the primary and supplemental heat fuel cost.**

COMFORT BALANCE POINT

- **The outdoor temperature at which the homeowner experiences discomfort when running the heat pump.**
- **Typically the economic balance point + 1°F to 5°F or controlled with a supply air temperature sensor**

Thermal or Capacity Balance Point

Heat Pump Capabilities

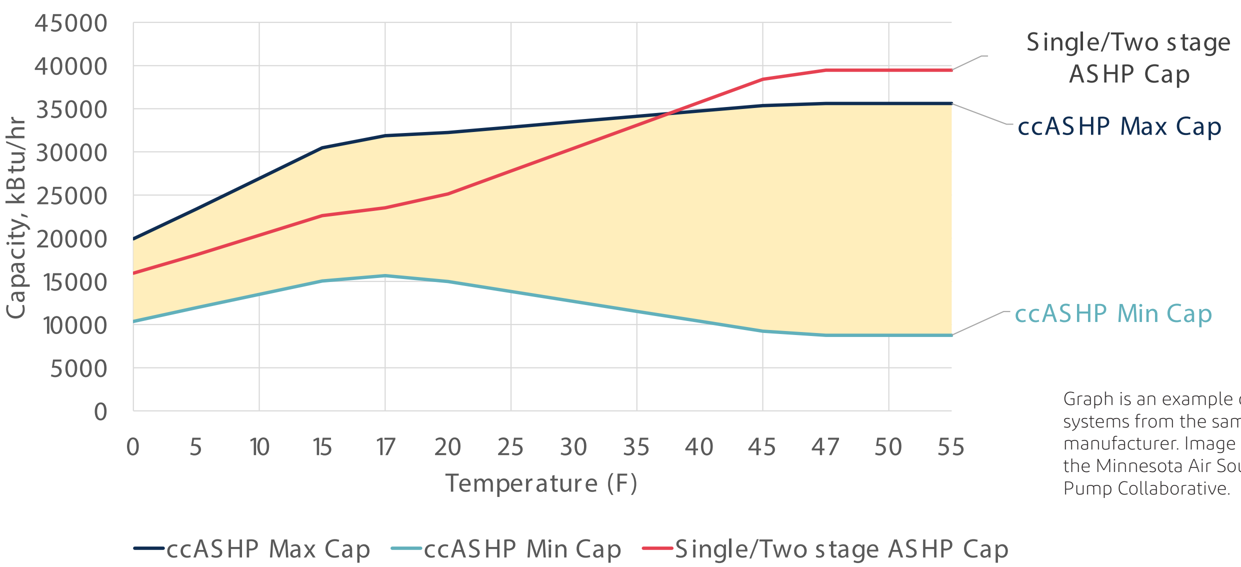
Centrally ducted heat pumps come with a variety of compressor types and speeds. With each different type of compressor, there are recommended matches for: the natural gas/propane furnace that will act as supplemental heat, and ideal **starting point** for switchover temperatures. The recommended lowest switchover temperature in the table below would be true for any fossil fuel supplemental heating system. This table does not indicate which temperature should be selected as that will be determined by the customer's motivations and the costs of both primary and secondary fuel sources.

Compressor Type	Single Stage HP	Two Stage HP	Inverter HP	Standalone Inverter HP	Cold climate ASHP
Lowest Switchover Temperature	Economic or Comfort BP	Economic or Comfort BP	Economic, Thermal, Comfort BP	Economic, Thermal, Comfort BP	Economic, Thermal, Comfort BP

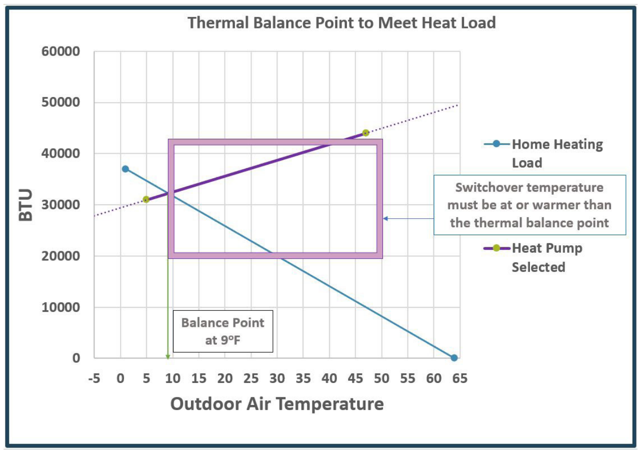
The starting point for a selected switchover temperature is the recommendation in the thermostat settings but should always be finalized by understanding the consumers' motivations and primary concerns. Adjusting the switchover temperature based on a more complete understanding of the customer's desired goals is not just recommended but is the ideal approach.

Determining the Thermal or Capacity Balance Point

To determine the thermal or capacity balance point, it will be necessary to understand both the home's heating load as well as the system's capacity curves. Home heating loads represent the needs of the building in terms of maintaining steady temperatures at a given set point (70^{0}F winter, 75^{0}F summer) and should be calculated using the ASHRAE Handbook of Fundamentals math behind ACCAs Manual J (or equivalent calculators/software) or via utility bill analysis of the existing equipment. Capacity curves are based on the extended performance data provided by the heat pump manufacturer. The maximum capacity curve is the determining factor for multi-speed, variable capacity, and cold climate air source heat pumps.

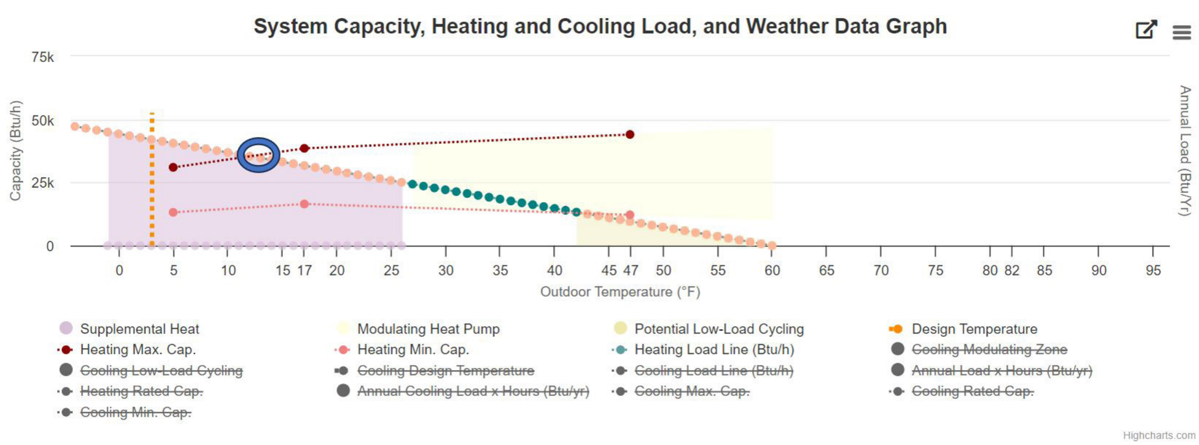


Graph is an example of two systems from the same manufacturer. Image courtesy of the Minnesota Air Source Heat Pump Collaborative.



Graph courtesy of Dan Wildenhaus and the Minnesota Air Source Heat Pump Collaborative

The switchover temperature should always be set at the thermal/capacity balance point or higher than the thermal/capacity balance point. While some manufacturers provide capacity curves, it's much more common that they will simply provide extended performance data tables. Contractors can graph these capacities against the home's heating load themselves or use tools available in the market, such as the Northeast Energy Efficiency Partnership (NEEP) tool linked immediately below. The majority of variable capacity and cold climate heat pumps are currently listed on the NEEP's cold climate product list.



Graph and table courtesy of the NEEP ccASHP Product List and Advanced Sizing Tool

Product Sizing For Heating

View Oversizing Effects

Definition/Use Cases

Capacity Balance Point (°F)	12
Minimum Capacity Threshold (°F)	42
Maximum Capacity at Design Temp (Btu/h)	28,667
Percent Design Load Served	0.0%
Annual Heating Load (MMBtu)	89.1
Percent Annual Heating Load Served	63.5%

Definition/Use Cases

Annual Btu's Covered by Supplemental Heat (MMBtu)	32.5
Hours Requiring Supplemental Heat	253
Percent Hours Requiring Supplemental Heat	4.5%
Percent Annual Load Modulating	81.0%
Percent Annual Load with Low-Load Cycling	17.3%

On this graph, produced by the NEEP cold climate heat pump product list's Advanced Sizing Tool, the capacity balance point is shown both on the graph where the maximum system capacity intersects with the home's heating load, as well as reported in the table below the graph, along with the percent annual heating load served by the heat pump and the hours requiring supplemental heat.

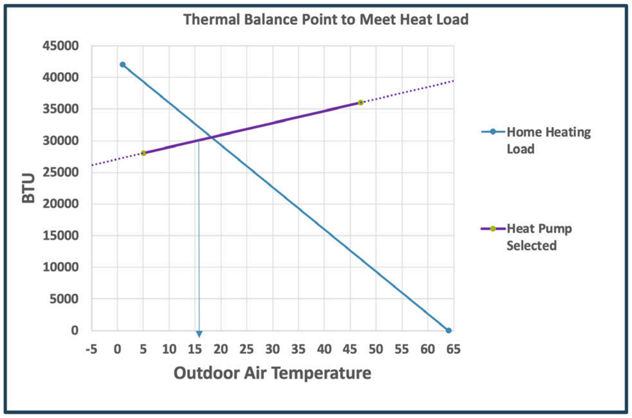
» **For more information on using the NEEP tool, please visit and download the User's Guide: Cold Climate Heat Pump Sizing Support Tools.**

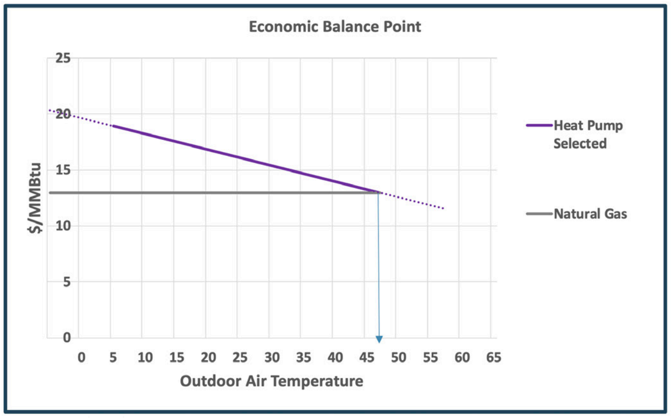
Economic Balance Point

Use Case

The economic balance point is used when the consumer's primary or secondary goal is operational equivalence or cost savings when compared to their existing system. The economic balance point is the switchover temperature at which the annual cost of operating the dual-fuel heat pump system is equal or similar to that of the old fossil fuel heating system and air conditioner.

The economic balance point is very rarely the same or lower than the thermal/capacity balance point for a dual-fuel system with natural gas supplemental heat but may be so for propane furnace systems due to fuel costs.





Assumptions – 42,000 btu heating load, 80% gas furnace with natural gas rates at $1.15/Therm, and a 3-ton heat pump with a COP at 47^{0}F of 3.5 with electric rates at $0.16/kWh. Fixed fees are not included in this calculation. Charts courtesy of Dan Wildenhaus

Using the example in these images, when looking at an example 3-ton heat pump maximum capacity curve, the thermal/capacity balance point, or switchover temperature, is around 11^{0}F. In this scenario, the heat pump is more expensive to operate than the supplemental heat when outdoor temperatures go below 49^{0}F. Given expected heat pump performance and the expected costs of electricity and gas, setting the switchover to 46^{0}F to 50^{0}F will minimize changes to customer bills, keeping operating costs similar to the old system.

Finding the Economic Balance Point

The economic balance point is dependent on a number of factors, some of which change regularly, such as the price of electricity, the price of the supplemental fuel, time-of-use rates, and specialty "all-electric" or "dual-fuel" rates. In addition, the heat pump and supplemental system's efficiencies, having an accurate home heating load, properly sized and selected heat pump, quality installation and commissioning, as well as other control strategies such as droop settings and staged heating can also impact this balance point. For the sake of this guide, we'll focus on the fuel costs, home heating load, and the rated capacity curve of the heat pump (while thermal/capacity balance points always use the maximum capacity curve for the selected equipment, economic balance point typically utilizes the rated capacity curve as systems tend to run between the maximum and minimum capacity for most of their run time).

» **For more information on control settings and options, see the ComEd Controls Guide, available on the GoElectric website: GoElectric.ComEd.com on the For Contractors page.**

Due to these complex factors, this guide will describe and compare four approaches to determining an economic balance point/switchover temperature.

For each of the following, we will use an Amana 3.5-ton air source heat pump with a rated efficiency/COP of 3.61 at 47^{0}F, with a natural gas rate of $1.15/therm and an electric rate of $0.16/kWh.

Using Extended Performance Tables To Determine Average Coefficients Of Performance At Different Outdoor Temperatures

To perform most economic balance point calculations, a contractor will need to access the extended or expanded performance tables for the equipment they are selecting. This data can either be found in manufacturer supplied data, ACCA approved Manual S software, or in the NEEP cold climate product list (most variable capacity equipment is now posted on the NEEP list).

HEATING/ COOLING	OUTDOOR DRY BULB	INDOOR DRY BULB	UNIT	MIN	RATED	MAX
Cooling	95^{0}F	80^{0}F	Btu/h	14,600	44,000	44,000
			kW	1.23	4.34	4.34
			COP	3.48	2.97	2.97
Cooling	82^{0}F	80^{0}F	Btu/h	15,100	-	47,040
			kW	0.73	-	3.85
			COP	6.06	-	3.58
Heating	47^{0}F	70^{0}F	Btu/h	12,200	44,000	44,000
			kW	0.75	3.57	3.57
			COP	4.77	3.61	3.61
Heating	17^{0}F	70^{0}F	Btu/h	16,500	28,000	38,500
			kW	1.67	3.07	5.66
			COP	2.9	2.67	1.99
Heating	5^{0}F	70^{0}F	Btu/h	13,200	31,000	31,000
			kW	1.58	4.1	4.1
			COP	2.45	2.22	2.22

Table courtesy of the NEEP ccASHP Product List

Rules of Thumb

Rules of thumb can be helpful guides in life but should always be recognized for what they are: a simplistic and easily applied rule that may at times represent the most average answer but may also be based on faulty assumptions or those that are not nuanced enough to provide specific answers associated with the home you are at and the equipment you have selected.

For air source heat pumps, many contractors use a rule of thumb of a COP of 3 from the expanded performance tables to determine the outdoor temperature for a switchover. From the table above, a corresponding outdoor temperature that aligns with the rated COP of 3 would be approximately halfway between 17^{0}F and 47^{0}F, or 32^{0}F. This is estimated as at 17^{0}F, this system has a rated COP of 2.67, while at 47^{0}F, this system has a rated COP of 3.61.

» **Level of difficulty:** Relatively easy » **Accuracy:** Sometimes accurate, often inaccurate

» **Rule of Thumb estimate would be 32^{0}F for this example.**

Static Table Estimates

Occasionally, utility programs, local governments, or even manufacturers may produce "static lookup tables" for calculating an economic balance point/switchover temperature. These tables make decision making simple and allow for fluctuating fuel costs. This said, there are a number of assumptions used behind the scenes regarding the capacities and efficiencies of an "average" heat pump that could be selected. When using these tables, it's also important that the climate zone or average winter temperatures and winter design temperature are similar to the region that a contractor is installing heat pumps in. ComEd does not utilize these types of tables.

In this example from the Minnesota Air Source Heat Pump Collaborative, an "average" cold climate heat pump is used to build out the table. The climate in Minnesota is typically a bit cooler for the coldest months of the year. It is not recommended to utilize static tables found on the internet without best understanding the assumptions used for heat pumps efficiencies, capacities, and environmental conditions (winter design temperature, heating degree days, and climate zone). Without a firm understanding of these variables, this method does not provide repeatable accuracy.

ECONOMIC BALANCE POINT FOR DUAL-FUEL

The chart below shows how to select the economic switchover temperature of a dual-fuel ASHP installation

Note: this assumes cold climate product is sized to meet the heating load of the home.

Electric rate, $/kWh (ASHP) \ Natural gas rate, $/therm, (furnaces and boilers)	$0.60	$0.65	$0.70	$0.75	$0.80	$0.85	$0.90	$1.00	$1.15	$1.33	$1.50	$2.00	$2.50	$2.75
$0.05	25°	20°	15°	10°	5°	0°	-5°	-10°	-10°	-10°	-10°	-10°	-10°	-10°
$0.06	35°	30°	25°	20°	15°	15°	10°	0°	-10°	-10°	-10°	-10°	-10°	-10°
$0.07	45°	40°	35°	30°	25°	25°	20°	10°	0°	-10°	-10°	-10°	-10°	-10°
$0.08	50°	45°	40°	40°	35°	30°	25°	20°	10°	0°	-10°	-10°	-10°	-10°
$0.09	60°	55°	50°	45°	40°	40°	35°	30°	20°	10°	0°	-10°	-10°	-10°
$0.10	60°	60°	55°	50°	50°	45°	40°	35°	25°	15°	10°	-10°	-10°	-10°
$0.11	60°	60°	60°	60°	55°	50°	45°	40°	30°	25°	15°	-5°	-10°	-10°
$0.12	60°	60°	60°	60°	60°	55°	50°	45°	35°	30°	20°	0°	-10°	-10°
$0.13	60°	60°	60°	60°	60°	60°	55°	50°	40°	35°	25°	5°	-10°	-10°
$0.14	60°	60°	60°	60°	60°	60°	60°	55°	45°	35°	30°	10°	-5°	-10°
$0.15	60°	60°	60°	60°	60°	60°	60°	60°	50°	40°	35°	15°	0°	-5°
$0.16	60°	60°	60°	60°	60°	60°	60°	60°	55°	45°	40°	20°	5°	0°
Propane rate, $/gallon, (furnaces and boilers)										$1.22	$1.37	$1.83	$2.29	$2.52

Table courtesy of the Minnesota Air Source Heat Pump Collaborative

» **Level of difficulty:** Very easy

» **Accuracy:** Sometimes accurate, often inaccurate due to the number of variables and applicability to local weather conditions.

» **Static Table estimate would be 55°F for this example.**

Break-even Coefficient of Performance (BeCOP) Calculation

A more advanced and typically more accurate calculation of the economic balance point/switchover temperature is using the break-even COP for the specific system selected. This method has the benefit of accounting for fuel prices as well as utilizing published rated COPs at 5°F, 17°F, and 47°F. The challenge with this method is that it does involve math and is most accurate when graphed out.

Calculation math using the same electric and gas rates as the previous example would look like this:

$$\text{BeCOP} = \frac{(E \times C \times e)}{G}$$

Where:

- BeCOP is your break-even COP
- For power bill, subtract any fixed fees first as these will remain the same regardless of use
- E is $/kWh (Take your power bill less fixed fees and divide by kWh = 0.16 average in example)
- C is kWh/Therm which is 29.3 (a constant value)
- e is the efficiency of your specific furnace (.90 average for the example)
- G is $/Therm (Take your gas bill $/Therm less fixd fees $1.15 for example)
- Then plug in the numbers and solve. **Example is 3.3!**

Using Break-even COP to estimate Economic Balance Point/Switchover Temperature

To turn a BeCOP into a switchover temperature is the same process as described in the rule of thumb section. From the table below, a corresponding outdoor temperature that aligns with the BeCOP of 3.3 would be somewhere between 17⁰F and 47⁰F. This is estimated as at 17⁰F, this system has a rated COP of 2.67, while at 47⁰F, this system has a rated COP of 3.61. Using a spreadsheet to graph this out can be incredibly helpful as seen below as well.

- **BeCop = 3.3**
- **COP @ 47 = 3.61**
- **COP @ 17 = 2.67**
- **Educated guess = 34⁰F-36⁰F**

Well designed, installed, and controlled systems will likely run at their minimum capacity during winter months but ARE likely to operate at a COP somewhere between 33% and 60% of difference between minimum and maximum capacity of COPs. Using the rated COP is the safest estimate.

Right sizing, intelligent design, homeowner education, and proper commissioning ensure BeCOP switchover temperature to be reasonable guesses.

HEATING/ COOLING	OUTDOOR DRY BULB	INDOOR DRY BULB	UNIT	MIN	RATED	MAX
Cooling	95⁰F	80⁰F	Btu/h	14,600	44,000	44,000
			kW	1.23	4.34	4.34
			COP	3.48	2.97	2.97
Cooling	82⁰F	80⁰F	Btu/h	15,100	-	47,040
			kW	0.73	-	3.85
			COP	6.06	-	3.58
Heating	47⁰F	70⁰F	Btu/h	12,200	44,000	44,000
			kW	0.75	3.57	3.57
			COP	4.77	3.61	3.61
Heating	17⁰F	70⁰F	Btu/h	16,500	28,000	38,500
			kW	1.67	3.07	5.66
			COP	2.9	2.67	1.99
Heating	5⁰F	70⁰F	Btu/h	13,200	31,000	31,000
			kW	1.58	4.1	4.1
			COP	2.45	2.22	2.22

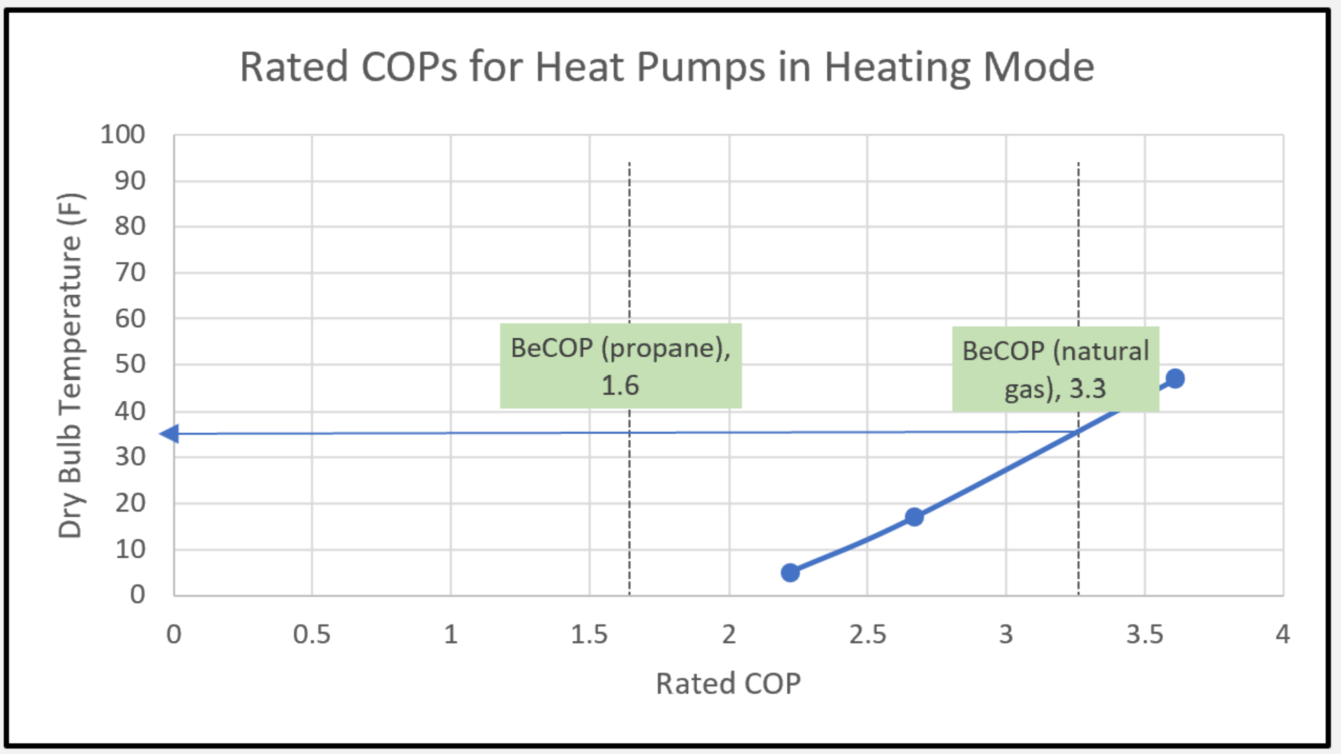
Table courtesy of the NEEP ccASHP Product List

This can also be shown as calculated in a spreadsheet:

BECOP	=	(E	X	C	X	EF)	/	G
Break-even COP	=	$ / kWh	X	kWh / Therm	X	Efficiency of furnace	/	$ / Therm Gas
3.3	**=**	**.16**	**X**	**29.3**	**X**	**90%**	**/**	**1.15**

Example 3.5 ton Amana air source heat pump

DRY BULB TEMPERATURE (F)	RATED COP
47	3.61
17	2.67
5	2.22



In the lower graph, the curve was created by plotting the 47⁰F, 17⁰F, and 5⁰F Coefficients of Performance against outdoor temperatures as taken from our expanded performance table for the example system. The BeCOP has been superimposed on the graph as per our BeCOP calculation.
Graph courtesy of the Center for Energy and the Environment.

- **Level of difficulty:** Somewhat difficult and somewhat time consuming (at first).
- **Accuracy:** Potentially accurate when system is sized, designed, selected, installed, commissioned, and the homeowners are properly educated. BeCOP assumes systems perform at rated efficiencies and capacities on a seasonal basis, which may not reflect real world performance. Still, this is an excellent method of creating an initial estimated switchover temperature.
- **BeCOP estimate would be 36⁰F for this example.**

Savings Calculator Method

ComEd has invested in a dynamic savings calculator, now available on the GoElectric website: **GoElectric.ComEd.com** on the For Customers landing page.

This calculator will ask a few questions about the existing home, utilizes real utility rates, and provides both energy costs and environmental savings associated with different switchover temperatures. An example of the questions asked includes age of home, size of home, whether the home has been weatherized, and whether the furnace will be replaced.

For this example, the utility costs were adjusted in the background to align with the other examples, not necessarily what the utility rates are at the time of use on the website ($0.16/kWh and $1.15/Therm).

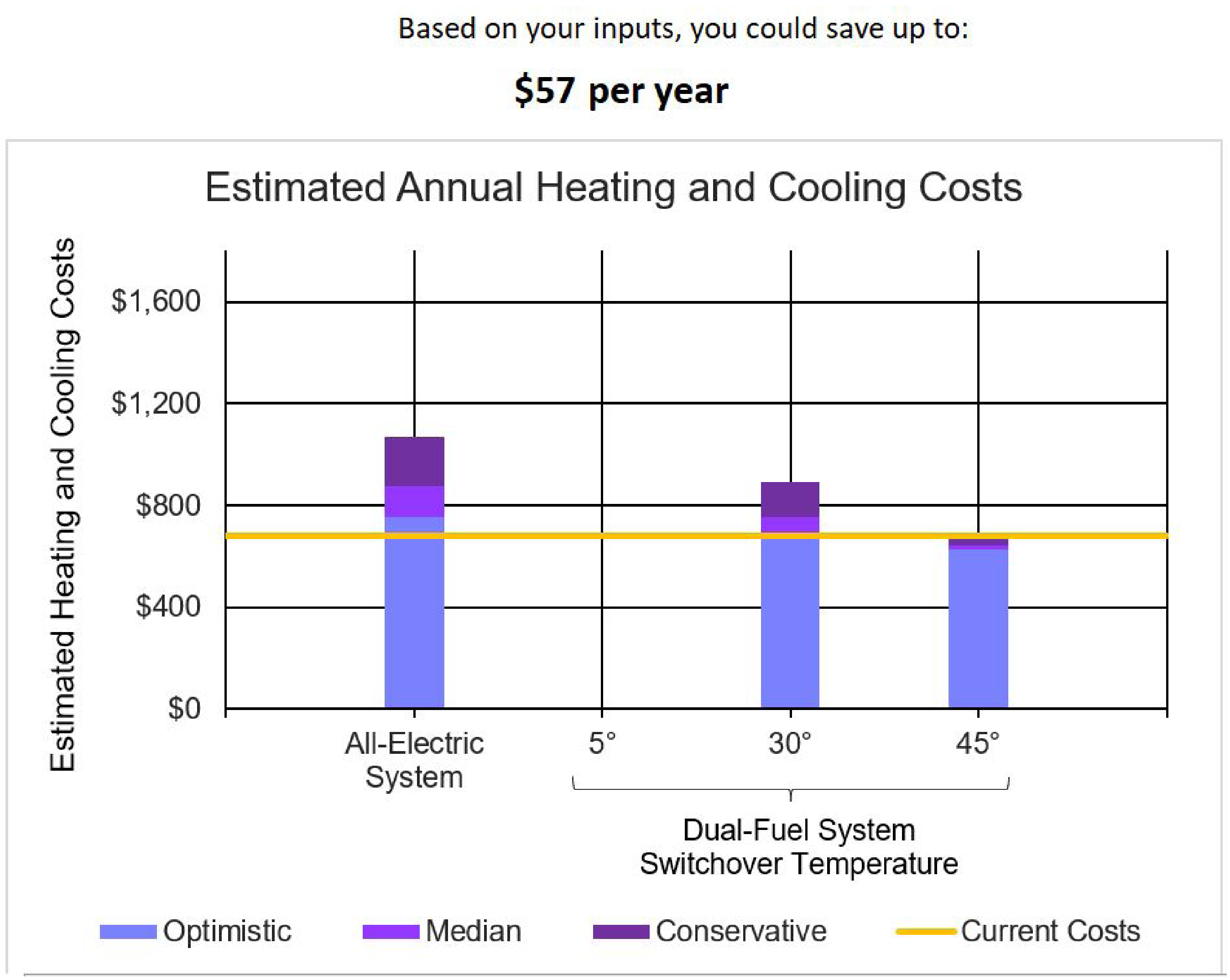


Chart courtesy of GoElectric.ComEd.com

Now that estimated annual heating and cooling costs have been calculated, it's worth addressing that this calculator makes assumptions about the heat pump performance and efficiency. In part to provide honest estimations, the anticipated operational costs are shown for the optimistic (20% of homes will see this pricing most likely), median (average 60% of homes will see this pricing most likely), and conservative (20% of homes will see this pricing most likely) realities of heat pump installation. True heat pump performance can be anywhere in this range depending on factors governing installed COP, including product selection, weatherization/leakage, operation, changes in weather, etc. The chart compares these costs to the estimated current costs for houses that align with the selections made. As this tool does not accept true home heating load inputs, a given customer can have heating loads that are significantly different than the median home assumed in this calculation.

The next step for the results shown is to interpolate between the median cost at 30 and 45°F. If a project is confirmed to be sized, designed, selected, installed, commissioned, and the homeowner understands how to control the system, the optimistic costs could be used. Upon interpolation, where the new line intersects with the current costs can produce a starting point for setting the economic balance point/switchover temperature.

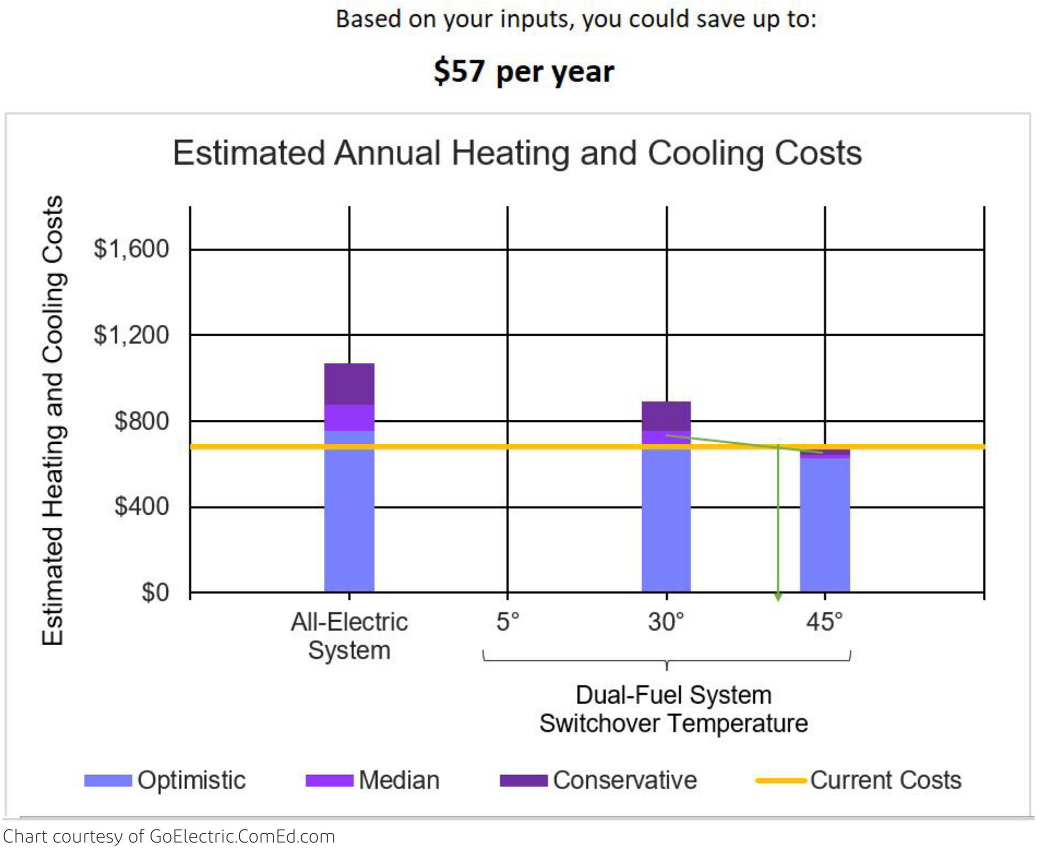


Chart courtesy of GoElectric.ComEd.com

With these entries and assumptions, it is estimated that an economic balance point/switchover temperature of 40°F would be an ideal initial setting.

In addition to being able to estimate costs and produce an economic balance point/switchover temperature, this tool will also provide estimated environmental impacts by comparing carbon savings to the number of trees planted and grown for 10 years.

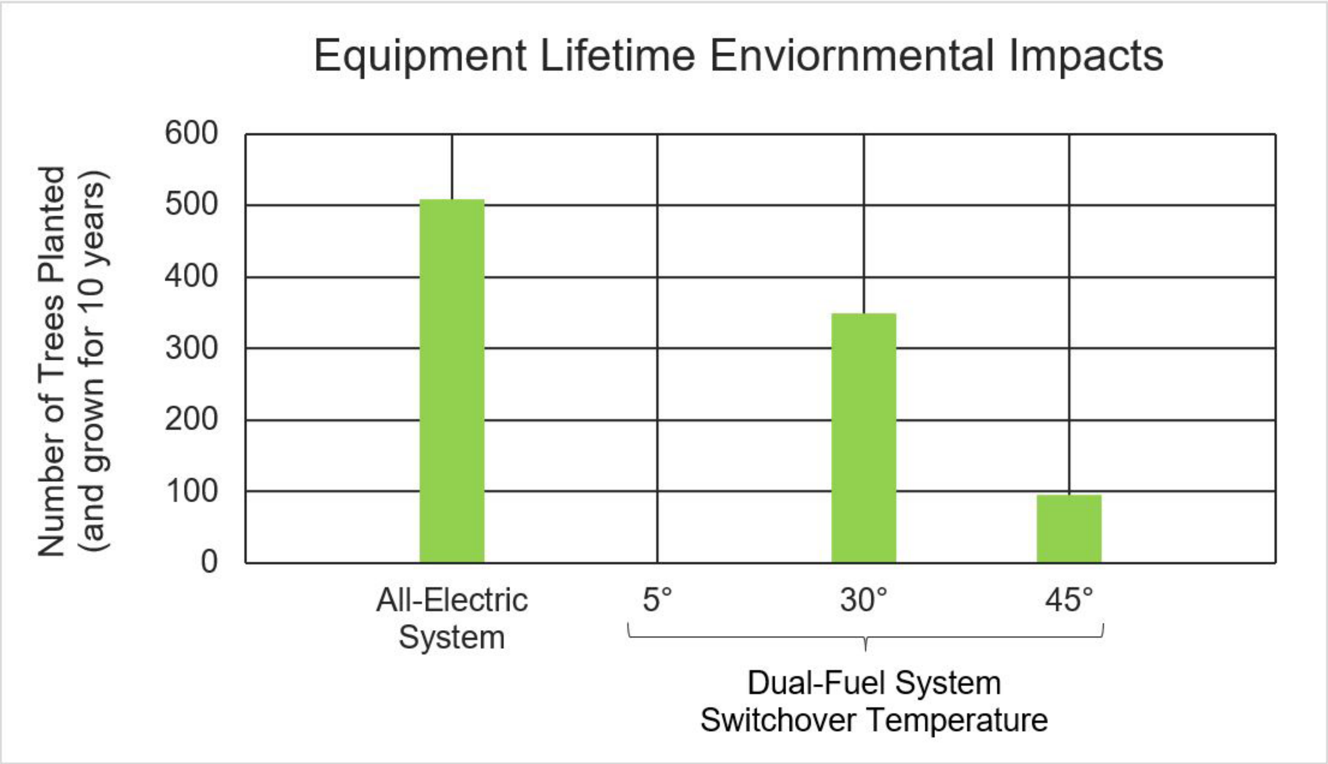


Chart courtesy of GoElectric.ComEd.com

- **Level of difficulty:** Very easy
- **Accuracy:** Potentially accurate when system is sized, designed, selected, installed, commissioned, and the homeowners are properly educated. This is an excellent method of creating an initial estimated switchover temperature.
- **Savings Calculator estimate would be 40°F for this example.**

Summarizing and comparing Economic Balance Points/Switchover Temperatures

When comparing these four methods of economic balance point/switchover temperatures we find:

	RULE OF THUMB	STATIC TABLE	BECOP	SAVINGS CALCULATOR
Switchover Temp	**32°F**	**55°F**	**36°F**	**40°F**

ComEd recommends using:

A. the Savings Calculator on the **GoElectric.ComEd.com** website or

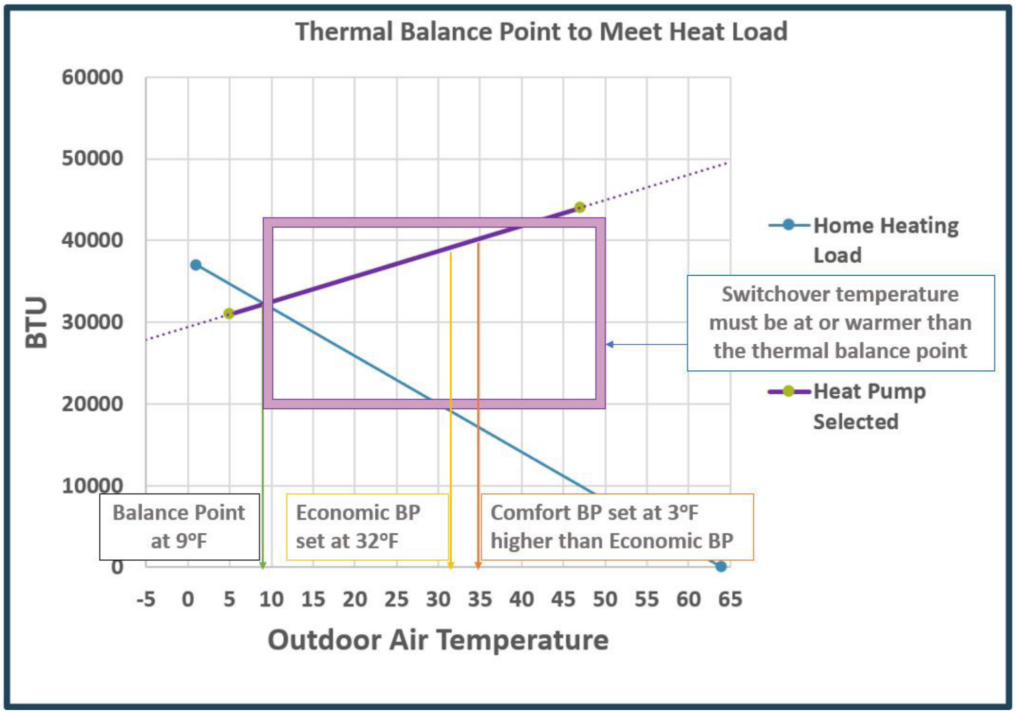
B. BeCOP method for selecting an initial economic balance point/switchover temperature.

Comfort Balance Point

Comfort balance points are intentionally written as "guestimates" as they are based on perception and not hard data points such as costs. Within this, it's commonly split into two categories; typical and comfort concerned.

For customers that state that both comfort and cost are equally important, the typical method is used. For customers that are concerned about heat pump capabilities or that have commented on current comfort issues, the comfort concerned method is used.

The Typical method is to set the comfort balance point/switchover temperature at the economic balance point or slightly higher (typically 1^{0}F-3^{0}F). For the comfort concerned method the comfort balance point/switchover temperature is most often set 3^{0}F-5^{0}F higher. For both methods, addressing the location of "toe-kick" and ceiling registers so that they do not blow delivered air onto bare/socked feet, and directly onto heads and necks is an important component of installing heat pumps with comfort in mind.



Graph courtesy of Dan Wildenhaus

An alternative to setting a comfort balance point/switchover temperature using outdoor temperatures would be to use a supply air temperature sensor. These sensors are installed in the supply ductwork, out of direct line of site from heat exchangers and set to a supply air temperature. It has been evaluated that a supply air temperature setting of 85^{0}F provides the best balance between ensuring comfort while contributing to energy savings.

Supply Air Sensor

Image courtesy of Zak Paine

Summary

Setting a switchover temperature should be based on one of the balance points outlined in order to maximize operational cost, performance, and environmental considerations. The balance point is a temperature at which the switchover of operating the heat pump to the backup heat source happens.

» For **all-electric systems** where electric strip heat can work together with the heat pump, the switchover temperature can be set at or below the thermal/capacity balance point provided the strip heat is sized appropriately.

» For **propane as the supplemental fuel in dual-fuel systems**, most often the switchover temperature should be set at the thermal/capacity balance point.

» For **natural gas as the supplemental fuel in dual-fuel systems**, the switchover temperature should be set at either the economic or comfort balance point.

» For **economic balance point/switchover temperature calculations**, it is recommended to use the ComEd Savings Calculator or the BeCOP.

» For **comfort balance point/switchover temperature**, it is recommended to first address supply grill/register location and orientation, and then if needed, set the system 1^{0}F to 5^{0}F higher than the economic balance point, or to utilize a supply air sensor to control switchover, set at 85^{0}F or lower.

Resources

For additional supporting information, the following resources have been found to be helpful and accessible:

» **NEEP Installer Resources - Guide to Sizing and Selecting Heat Pumps**

» **Air-Source Heat Pump Sizing and Selection Guide - NRCAN**

» **NEEP Size for Heating Users Guide**

» **ComEd GoElectric website** – with resources on both the For Customer and For Contractor landing pages.

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