EB-2022-0157

Undertaking Responses by Dr. Heather McDiarmid

Undertaking J1.1

To comment on whether the upfront cost of the cold climate heat pump used in Dr. McDiarmid's analysis included the cost of backup resistance heater and generally on the cost of backup resistance heating.

Response:

The upfront cost of the cold climate heat pump used in my analysis was sourced from Enbridge's analysis of heat pump cost effectiveness in the demand-side management ("DSM") proceeding (EB-2021-0002, Exhibit 10h.STAFF77). This analysis included the cost of a backup resistance heater.

In response to interrogatory I.10.EGI.ED.38 in the DSM proceeding, Enbridge stated as follows:

> "For the average home the estimated cost to completely replace a furnace with a cold climate heat pump ("CCHP") is on average $11,100[1]. For a furnace replacement scenario, it is assumed that a CCHP would require backup heating due to ductwork limitation highlighted by NRCan's sizing guide.[2] The cost above includes the replacement of the furnace with an air handler, resistance electric backup heat and the condenser[3]."
>
> Footnotes:
> 1. Contractor provided quotes & invoices.
> 2. Natural Resources Canada, CanmetENERGY, Air-Source Heat Pump Sizing and Selection Guide, Version 1.0 (December 21, 2020). https://www.nrcan.gc.ca/maps-tools-and-publications/tools/modellingtools/toolkit-for-air-source-heat-pump-sizing-and-selection/23558
> 3. As a practical matter in these scenarios, several manufacturers package their CCHPs with a matching air handler containing an electric resistance backup. See, for example, the Mitsubishi Zuba: https://cdn.agilitycms.com/mesca/productdownloads/mem-202103-e-zuba-brochure-final.pdf

I further reached out to some heat pump installers to estimate the cost of backup resistance heaters. The cost depends on the heat pump system being installed and many cold climate heat pumps come already paired with a backup heater. When the backup heater is paid for separately it can cost $150 to $950.

Undertaking J1.2

To review page 22 of Exhibit K1.5 (IESO, Need for Bulk System Reinforcements West of London) and assess whether the assumptions in Dr. McDiarmid's evidence corresponds with the IESO low reference or high forecast, or if it doesn't correspond with any of those, what does it correspond to.

Response:

I am unable to answer this question.

Undertaking J1.3

How having a poorly insulated home would impact the cost effectiveness and effectiveness of a heat pump.

Response:

A poorly insulated home will have even higher savings from a heat pump compared to a gas furnace, other things equal. A poorly insulated home will have a higher heating load. That is, more energy will be needed to keep the home warm in winter. Such a home would require a larger than average heat pump system but there is no question that a heat pump can be effective in such a home if sized correctly. Building envelope upgrades are often recommended in these homes because they reduce the cost to heat the home regardless of the heating system used.

In the Panhandle area, the cost of producing one unit of heat energy is less with a heat pump compared to a gas furnace. The difference between the two heating systems is expected to increase in future as the carbon price increases. The result is that a poorly insulated home will save more money with heat pumps than with gas systems. This increased operational savings will more than offset the cost of installing a larger electric heat pump system capable of providing all the heat needed by the building.

For example, if I double the assumed home's heating and cooling loads and assume a 30% higher upfront cost for a larger heat pump system, the average homeowner's savings increase from $4,012 to $8,276 (NPV) over the 15-year lifetime of the systems and the energy bill savings would increase from $12,000 over the lifetime to $17,600 over the lifetime (using ED_EvdAttachement2_20231012 spreadsheet).