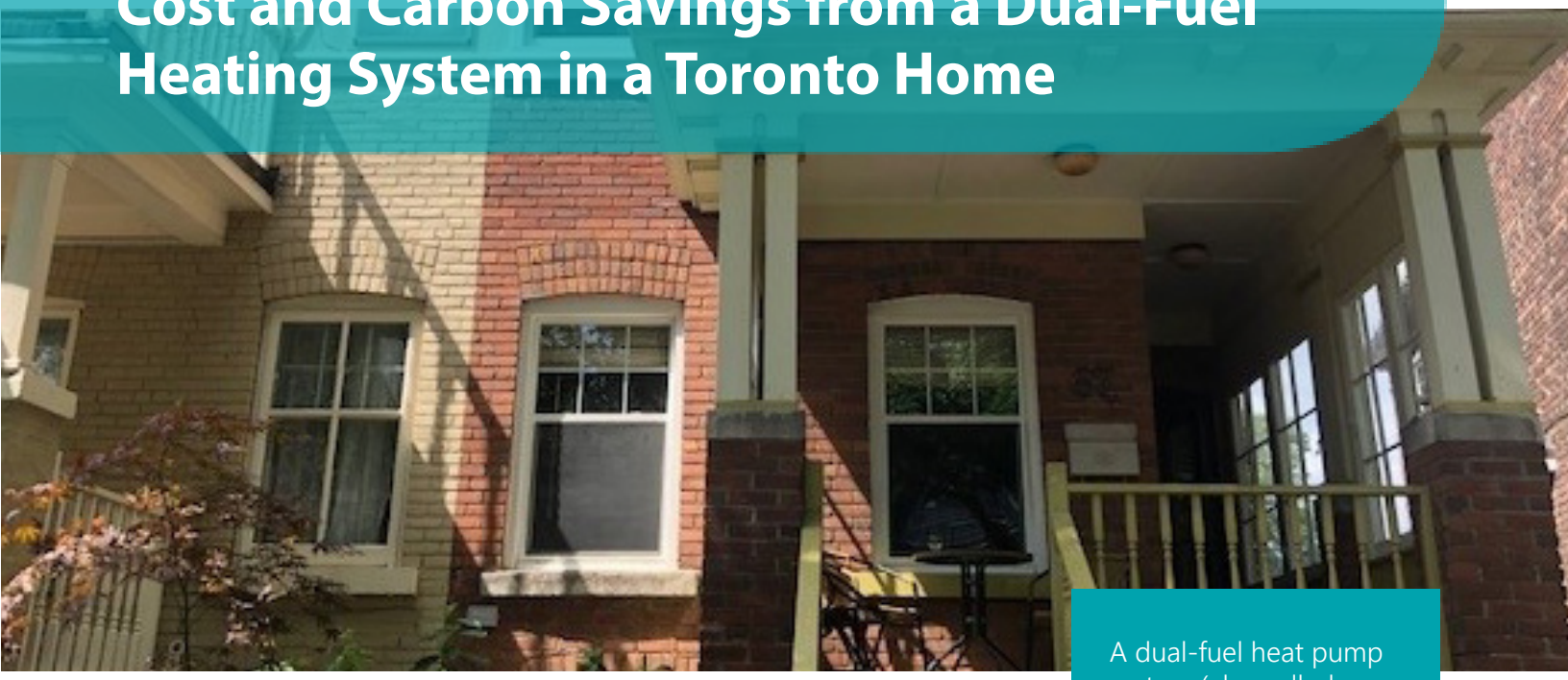
Sustainable Technologies
EVALUATION PROGRAM

Supported by Toronto and Region Conservation Authority

TECHNICAL BRIEF

Cost and Carbon Savings from a Dual-Fuel Heating System in a Toronto Home



The Sustainable Technologies Evaluation Program (STEP) is a collaborative non-profit research initiative within the Toronto and Region Conservation Authority (TRCA). Among other priorities, STEP partners with government, utilities, non-profits, academic institutions, and private companies, to pilot and evaluate emerging low-carbon technologies for buildings with the aim of providing real-world data, analysis, tools, and outreach that promotes effective technological solutions for climate change mitigation.

INTRODUCTION

In Ontario, the natural gas used to heat buildings is one of the largest sources of carbon emissions. In single-family homes, electrically-driven air-source heat pumps (ASHPs) offer a more efficient and greener heating alternative to natural gas furnaces but deployment has been low historically due to cost. However, costs are changing. A new federal carbon pricing schedule was announced in late-2020 that may nearly double the current cost of natural gas by 2030 and also, a new federal rebate for heat pump systems was announced in May 2021, offering up to $5,000 per household. There is now growing interest in dual-fuel heat pump systems as a cost-effective heating and cooling option for homeowners. This case study evaluates upfront costs and utility bill impacts of an actual dual-fuel system installed in a Toronto home.

SITE AND EQUIPMENT

The dual-fuel heat pump system was installed in late-2020 and commissioned in early January 2021 in a 2,100 ft^2 pre-1935 3-bedroom 2-storey semi-detached home in Toronto's East End. The homeowner's A/C was at end-of-life and they opted to replace a 12-year-old mid-efficiency furnace as well, choosing a dual-fuel system to achieve a greener home for a reasonable cost. The ASHP was planned to provide heating above -5°C and the furnace to be used below. For Toronto's climate, this would mean that the ASHP is used for the vast majority of the heating season. Table 1 shows the equipment schedule. Also shown is example invoice data for a conventional furnace-A/C system.

A dual-fuel heat pump system (also called a hybrid heating system) looks the same as a conventional furnace and A/C system. The difference is that, in a dual-fuel system, the A/C unit is "upgraded" to an air-source heat pump (ASHP). The ASHP provides both cooling and heating. It is typically used for heating in milder outdoor conditions, and/or during off-peak time-of-use, when it is more efficient and cost-effective than a furnace. The furnace is then used in very cold conditions. In Ontario and other jurisdictions, this can result in lower utility costs and significantly lower carbon emissions.

Table 1. Equipment costs for a dual-fuel system versus conventional furnace-A/C.

	Equipment	Cost
Dual-Fuel Heat Pump System	**GMVM970603BN** Goodman furnace, modulating gas valve, 60 kBtu, 97% AFUE, 3-Ton ECM variable-speed blower **GSZC160241** Goodman two-stage heat pump, up to 16 SEER, 2 Ton Included: Evaporator coil, installation, accessories, HST	$9,996.51
Example Conventional Furnace and A/C	**TM9E060B12MP12** Luxaire furnace, 95% AFUE, ECM blower, 60 kBtu/hr **TC3B1822S** Luxaire air-conditioner, single-stage, up to 13 SEER, 1.5 Ton Included: Evaporator coil, installation, accessories, HST	$6,893.00

"I've been sweating about climate change for a while now. So, naturally, I felt prompted to put my money where my mouth was when it came to greening my own abode.I decided to set myself the task of making the DEEPEST possible cuts in my carbon emissions for the LEAST amount of money." -Homeowner

ANALYSIS

To calculate utility bill impacts post-installation, gas and electricity bill data for January to May 2021 were directly compared against data during the same period from 2020. Weather conditions were comparable for both periods (heating degree-days were within 1%). Current utility rates were used. Modeling estimated results for a full heating season.[1]

FINDINGS

Total gas consumption from January to May 2021 was 673 m^3, while that for the same period in 2020 was 1,132 m^3, a reduction of 41% and $167. During the same periods, electricity increased from 2,793 kWh in 2020 to 3,537 kWh in 2021, a change of 27% and $88. Overall, there was a $79 reduction in utility costs from direct inspection of the bills. However, $76 of the savings was estimated to be from a fridge that was unplugged in 2020, so the dual-fuel system effectively broke even with the previous system on utility costs for this period.

Modeling a full heating season from September to May, and correcting for the fridge, a gas savings of 722 m^3 (41%) and electricity increase of 1,994 kWh (50%) was estimated. Total savings was $26. Savings are expected to increase as gas rates escalate due to carbon pricing, on the scale of hundreds of dollars cumulatively up to 2030.[2] Because Ontario has low-carbon electricity, emissions for the home would be reduced by 1,304 kg in a full heating season, a savings of 38%.

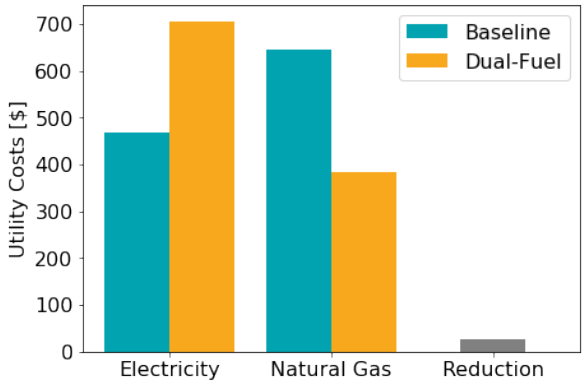


Figure 1. The change in utility costs for a full heating season was estimated at $26.

Carbon savings were lower than expected because the 2-ton heat pump did not have the capacity to match the home's heat loss much colder than 0ºC and the furnace was often used, but this will vary with each home. The homeowner should consider other home energy upgrades to reduce heat loss. They would reduce utility consumption generally, but also allow the heat pump to heat the home in colder temperatures and drive even deeper savings. Utility and federal rebates for home energy upgrades are currently available.

RECOMMENDATIONS

This case study looked at an entry-level heat pump system. It produced strong carbon savings and, compared to other heat pump options, has a much smaller upfront cost increase over conventional equipment. It is also expected to save the homeowner hundreds of dollars in the coming years. This option is worth considering for those looking for cost-effective greener heating. Notably, this heat pump is not currently eligible for the Canada Greener Homes Grant, which offers a rebate of up to $5,000 for heat pumps. The Grant currently focuses on high-efficiency (and higher-cost) heat pumps sized for the whole home. Given the potential for strong carbon savings and better financials, it is recommended that entry-level equipment also be considered in future Grant revisions. This class of equipment can help bring heat pumps into the mainstream for cost-conscious homeowners and prevent like-for-like replacement of conventional equipment.

[1]The full data analysis for this document was completed in a Jupyter Notebook.It is freely available at a public online repository, located at: https://github.com/SustainableTechnologies/DualFuelCaseStudy072021

[2]STEP. Dual-Fuel Heat Pump Home Heating Systems: Analysis of Control Approaches, Utility Costs, and Carbon Emission Reductions. https://sustainabletechnologies.ca/app/uploads/2021/05/DualFuelAnalysis052021.pdf

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Toronto and Region Conservation