MANITOBA CASE STUDY

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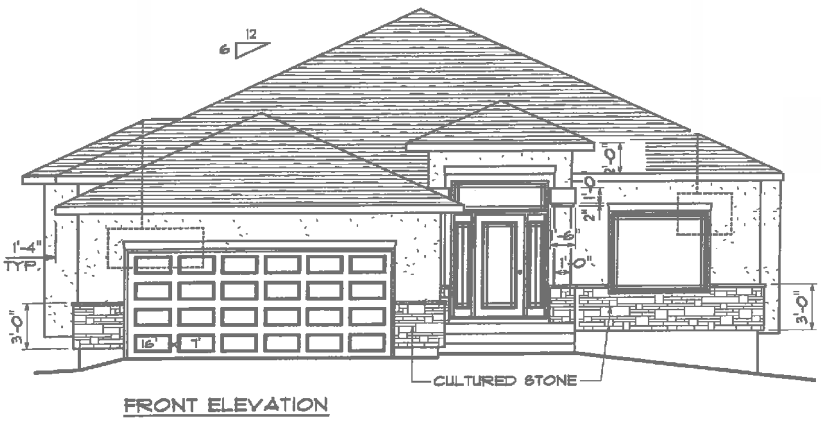
Minimum Code Compliant Home vs High Performance Home



Summary

This case study compares a Minimum Code Compliant Home (MCH) that uses natural gas heat, to a High Performance Home (HPH) with passive house features. Our findings show that the average increase in initial cost for a HPH over MCHis typically only 4% to 10%. But when the total cost of home ownership is considered, the savings are:

- $16,000 over 12-years (average time people own a home),
- $84,000 over 25-years (the typical mortgage term) and
- $375,000 over 60-years (the typical life of a home).

Background

Building owners, designers, or government economists, do not use a consistent method of determining the investment value and cost savings when it comes to investing in energy efficient and/or sustainable building features. The most common techniques used are simple payback, return on investment (ROI), or net present value (NPV). However, these parameters do not show the real value of HPH, and are often calculated over some arbitrary time period, such as 10 or 20 years, or over the useful life of a single building component. A better approach would be to:

- Evaluate the whole building, as opposed to a single component.
- Evaluate the useful life of the building, which could easily be 60-years. This period could be extended considerably by making the building more sustainable and durable.
- Determine the value by calculating the Total Cost of Building Ownership (TCBO). The TCBO is determined using the SEEFAR-Valuation© which includes all the costs of building ownership such as mortgage interest, utility costs, maintenance, GHG emission tax, property tax, insurance, etc.

It is important to understand that a High Performance Building is, *"a building that integrates and optimizes all major high-performance building attributes, including energy efficiency, durability, life-cycle performance, and occupant productivity"*.[1] This definition is important because 'high performance' is more than just energy efficiency.

The durability and sustainability of building material is important because it has an impact on how often building components need to be replaced and at what cost. An easily recyclable metal roof with a 60-year plus life Is more durable than asphalt shingles with a 20-year life that end up in landfill. In addition, occupant comfort, productivity and a building free from harmful materials is important. In an effort to simplify the analysis for this study, however we do not include a comparative analysis of options for more durable materials.

This case study is focused on a comparative analysis of the TCBO of a MCH (using natural gas heat) to a HPH (all electric) with passive house features. The tables below describe the construction features and costs of each home.

The Home Comparison Construction Features

Table 1 is a comparison of the home construction features of the MCH versus the HPH:

TABLE 1	Minimum Code Compliant Home (MCH)	High Performance Home (HPH)
Utility description summary	Natural Gas Heating	All Electric
R-value of above grade walls	R15.9	R60
R-value of attic space	R48	R100
R-value of below grade walls	R15.9	R52
R-value of foundation floor		R48
Area of conditioned space	1,700 ft^2	1,700 ft^2
Window type	Dual pane	Triple pane, Low E, Gas filled
Window area	17.2 m2	18.68 m2
Exterior door type	Two insulated steel	Two insulated fibreglass
Heating system description	Natural Gas condensing furnace	3350 watts of Electric baseboards
Cooling system description	Electric air conditioning	Sub-soil heat exchanger - 10 watt pump
Ventilation system description	HRV	High efficiency HRV
Water heating description	Electric glass lined steel tank	Electric fibreglass tank
Lighting description	CFL	LED
Appliance description	Electric	Electric

Table 2 shows the initial capital cost of the homes. The first row shows costs of the components that affect energy consumption; this includes many of the items described in the construction comparison. The first row also shows that the HPH has an 18% higher cost for energy configuration construction.

The second row shows that the cost of non energy-related components were intentionally kept identical to eliminate the impact of differences in the preferences for how the home is finished.

The last row shows the total construction cost, which is only 8% higher for the HPH.

TABLE 2	Minimum Code Compliant Home (MCH)	High Performance Home (HPH)	Total Cost Differences
Energy-related construction costs	$145,000	$170,988	18%
Non energy-related construction costs	$174,000	$174,000	0%
Total Construction Costs	$319,000	$344,988	8%

There are additional inputs to the SEEFAR-Valuation© such as equipment cost, equipment life in years, energy costs and consumption, cost escalations, etc. These all have a bearing on the TCBO, but are not shown in order to simplify for this case study.

Results

Table 3 shows the differences between the TCBO for the MCH and the HPH:

TABLE 3	Minimum Code Compliant Home (MCH)	High Performance Home (HPH)	Total Savings	Savings %
Greenhouse gas emissions (kg)	4,055	19	4,036	99.5%
Energy use index (EUI) (kWh/ft2/year)	18.5	3.8	14.7	80%
TCBO at 12-years	$102,000	$86,000	$16,000	16%
TCBO at 25-years	$266,000	$182,000	$84,000	32%
TCBO at 60-years	$980,000	$605,000	$375,000	38%

The first row shows that the greenhouse gas (GHG) emissions are 99% lower for the HPH, since the electricity in Manitoba is generated from hydro, whereas the MCH burns natural gas.

The second row shows the Energy Use Index (EUI). The energy consumption is 80% lower for the HPH. This is important because utility rates are rising faster than inflation due to the addition of the carbon tax and aging utility infrastructure that is in need of renewal.

Rows three, four and five compare the TCBO over 12-years, the average time people own a home; 25-years, the typical mortgage term; and, 60-years, the useful life of the building.

Every building has its own unique characteristics that should be accounted for to optimize the investment value. The SEEFAR-Valuation© allows the user to optimize the selection of building components in terms of energy use and durability. This will help to lower the TCBO level.

How would the TCBO be affected by using more durable materials such as ceramic tile floors, metal roofing, or adding solar photovoltaic panels, etc?

A SEEFAR-Valuation© will help answer these types of questions in the most definitive way by monetizing the relevant benefits of each option.

1. The US National Institute of Building Sciences: https://www.nibs.org/page/hpbc

A Cautionary Note on Case Study Conclusions

The SEEFAR-Valuation© demonstrates that the life-cycle variance in the total cost of building ownership (TCBO) between different designs for two similar homes can easily be in the six-figure range. Therefore, drawing '*general*' conclusions about the TCBO differences between any two home types can prove to be misleading. The same risk applies when drawing TCBO conclusions based on units of '*building area*'.

As a matter of financial logic, homes that are more sustainable are more likely to have lower TCBO levels; larger homes are more likely to have higher TCBO levels; and, homes that reduce heat loss through high performance building envelopes can be expected to have lower TCBO levels than homes that offset heat loss through mechanical systems. For that reason, it is recommended that the SEEFAR-Valuation© assessment be conducted on each home design option being considered.

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