How to Reduce Home Heating Emissions by 95%

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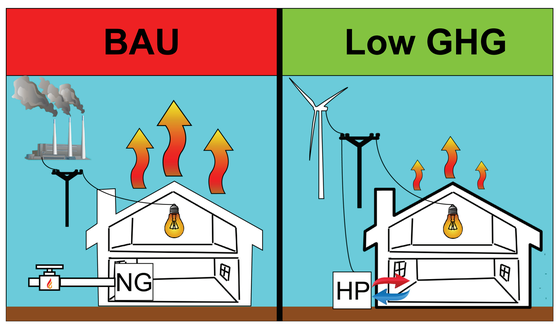
INTRODUCTION

Experts agree that to achieve our 2°C goal, individuals cannot produce any end-use emissions by mid-century. [1]

Heating in single detached homes is projected to contribute 10.9 Mt of CO_2 emissions in 2060. It can be lowered to 0.6 Mt of CO_2 using the following strategies:

- Electrification of Home Heating
- Building Envelope Upgrades (BEU)
- Grid Greening
- Retrofits
- Increased Home Turnover Rate



METHODS

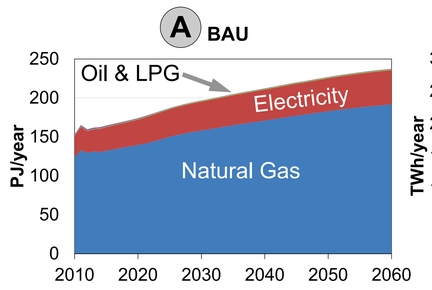
	BAU Scenario	Low GHG Scenario
Electrification of Heating	Stable at 20% of energy usage (A)	Efficiency: ER (100%) HP (234%) (B)
Building Envelope Upgrades	No Change	30% Thermal Loss Reduction (C)
Grid Greening	Removal of Coal by 2030	Imported Hydro after 2030 (D)
Furnace Retrofits	No Retrofits	50/50 ER & HP mix (E)
Increased Home Turnover Rate	No Change	Replace Old Homes Twice as Quickly (F)

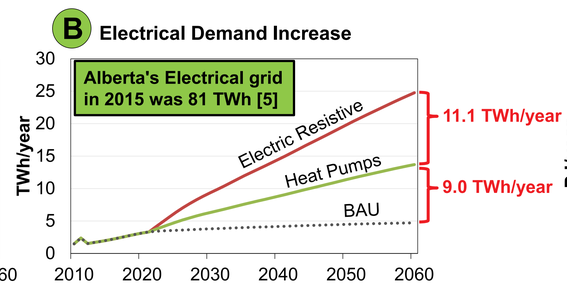
- Data from CanESS model. [2]
- Natural gas emissions factor taken from EPA. [3]

Economic Analysis:

- Carbon tax starts from $0/ton to $50/ton in 2022 and increases by $5/ton/year, capping at $100/ton.
- Natural gas (NG) and electrical prices after 2016 are tied to National Energy Board's [4] NG price projections.

RESULTS





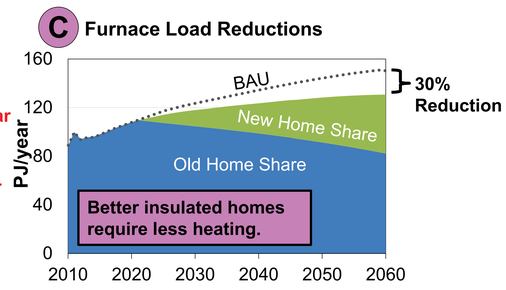
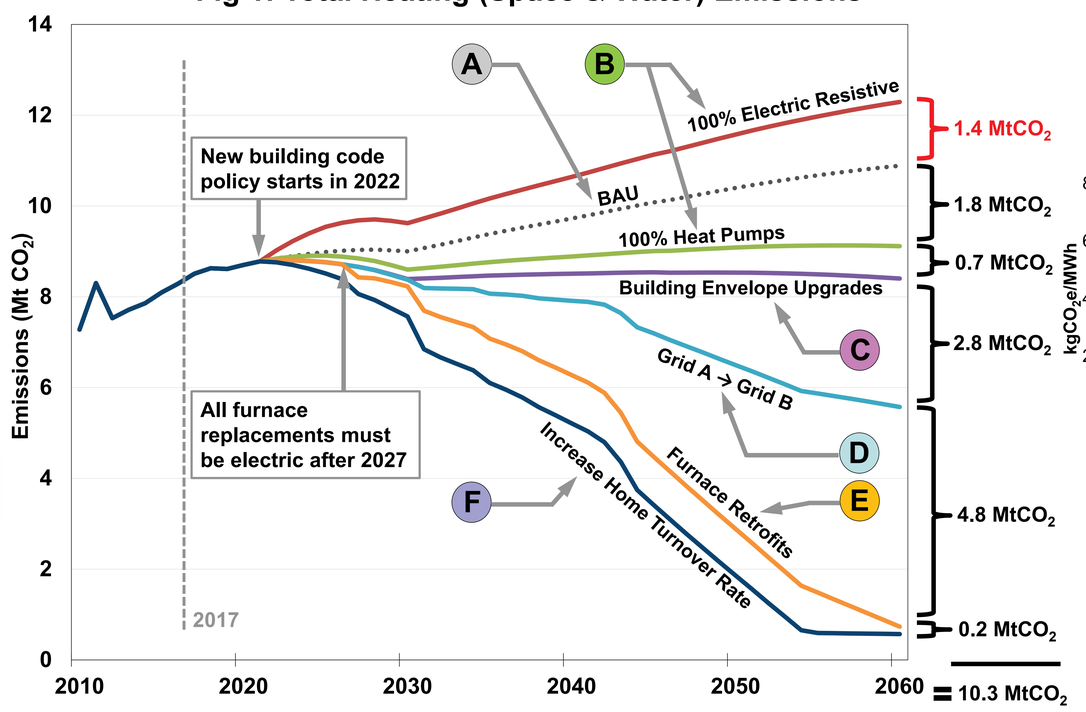
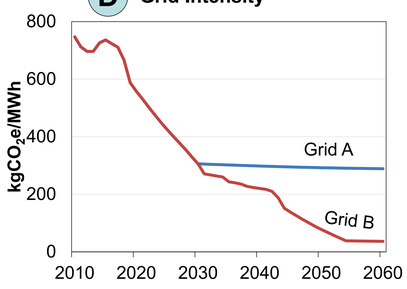


Fig 1: Total Heating (Space & Water) Emissions



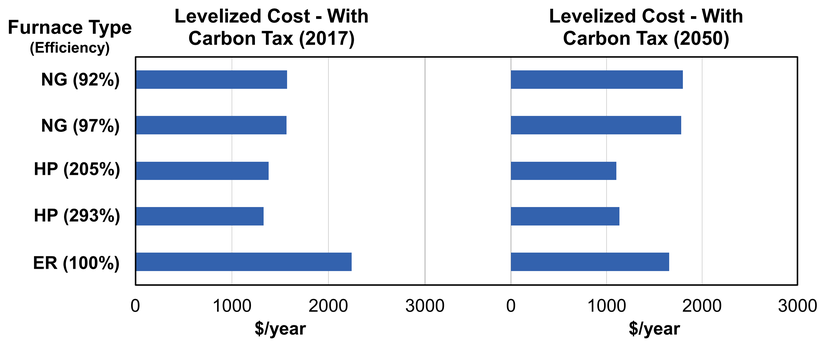
Coal is phased out of Alberta's Electrical grid by 2030 (Grid A).

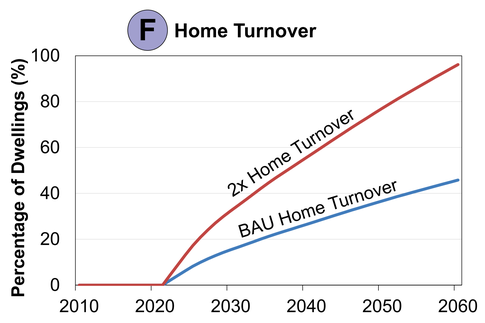
After 2030, imported hydro is implemented (Grid B).



E Retrofitting old houses in 2027 with heat pumps and electric resistive furnaces.

Increase home turnover rate to achieve 100% new homes in the housing stock by 2060





DISCUSSION

Steps (A) to (F) are implemented consecutively and summed on Fig 1. Note:

(A) In the BAU scenario (dotted black line, Fig 1), emissions are projected to rise from 8.5 MtCO2/year in 2017 to 10.9 $MtCO_2$/year in 2060.

(B) **ADDING**: Electrification of heating (space & water) in new homes could either increase GHG emissions by 1.4 $MtCO_2$/year if done as electric resistive or decrease by 1.8 $MtCO_2$/year with heat pumps (future calculations assume heat pumps).

(C) **ADDING**: Building envelope upgrades on all new homes could reduce thermal losses by 30% and decrease GHG emissions by 0.7 $MtCO_2$/year.

(D) **ADDING**: Grid greening could occur by supplementing the removal of coal (by 2030) with imported hydro (after 2030), potentially decreasing GHG emissions by 2.8 $MtCO_2$/year.

(E) **ADDING**: Electrification of heating (see methods for furnace mix) in all old homes could reduce GHG emissions by 4.8 $MtCO_2$/year.

(F) **ADDING**: A doubled home turnover rate could increase the amount of buildings with envelope upgrades and decrease GHG emissions by 0.2 $MtCO_2$/year.

CONCLUSIONS

With current technology, it is possible to achieve a 95% reduction in emissions, only when combining multiple actions from different sectors.

Future policies should include mandatory electric heating in new homes, incentives for electric furnace replacement, strict thermal loss standards in new homes and actions to reduce the electrical grids GHG intensity.

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REFERENCES

[1] J. Sachs, G. Schmidt-Traub and J. Williams, "Pathways to Zero Emissions", Nature Geoscience, vol. 9, Nov 2016.

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