

Summary

Canada's Renovation Wave

A plan for jobs and climate

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A renovation wave of decarbonization retrofits over the next 20 years could create up to 200,000 long-lasting well-paid jobs, generate more than \$48 billion in economic development each year, create significant savings in healthcare costs, and pay for themselves twice over through increased tax revenue.

This wave will require about \$15 billion per year for residential buildings and \$6 billion per year for commercial and institutional buildings.

The federal government, in partnership with the provinces, will need to commit public investments on the order of \$10-15 billion per year over the next 20 years to enable this renovation wave.

To meet climate targets, we need to eliminate carbon pollution from Canadian homes and buildings before mid-century. This will be achieved by phasing out on-site combustion of fossil fuels and connecting to clean energy, mainly electricity from wind, solar, and hydro. This fuel-switching needs to be combined with upgrades to envelope and ventilation systems to reduce energy waste, improve community health, and protect occupants and housing infrastructure from extreme weather and earthquakes.

In this analysis, we use a heuristic model to calculate the benefits of a nation-wide *renovation wave*¹ that would see most of Canada's buildings be retrofitted over the next 20 years. Investing in energy renovations is an excellent way for government to accelerate recovery and sustain economic growth because the actions needed to decarbonize buildings — manufacturing and installing windows, installing heat pumps, insulation, etc. — are labour-intensive, and located where people live: in big cities, suburbs, and small towns. They create well-paid jobs in the trades, manufacturing, and professional services, for small-scale contractors and larger firms. They also strengthen community fabric and reduce social inequity by preserving affordable housing, preserving heritage, and improving health of residents.

The renovation wave

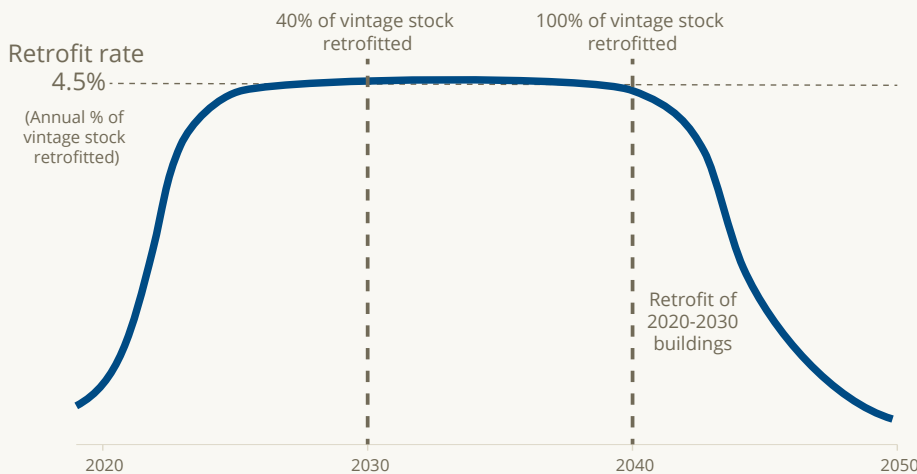
There are several ways in which the building sector can reach deep decarbonization by installing electric heat pumps in all buildings, and envelope retrofits on 50% of the building stock by 2040. To estimate incremental costs and benefits, here are the assumptions we have made on the 'shape' of the renovation wave:

2021-2025 Ramp up: capacity building and incentives lead to a rapid ramp-up in fuel-switching from current levels to ~ 4.5% of stock per year.²

2025-2040 Steady state: all heating equipment replacements are with low-carbon systems, combined with efficiency and resiliency upgrades. 4 to 5% of vintage stock is retrofitted each year.

2040-2050 Ramp down: retrofitting of the 'contemporary' stock: buildings built between 2020 and 2030 that were not built to a zero-carbon standard.

Assuming an average demolition rate of 1% per year (or 20% over the next 20 years), this scenario would see about 40% of the pre-2020 building stock be retrofitted by 2030, with all remaining stock retrofitted by 2040.



Conceptual model of retrofit wave: fraction of vintage residential building stock fuel-switched each year, 2020 to 2050

Results

We used a calculator developed by Ralph Torrie for Efficiency Canada with some of our own assumptions for the residential sector,^{3,4} and simple calculations to estimate the costs and economic impacts for the commercial sector.

We estimate this renovation wave will require an incremental investment of about \$400 billion over the next 20 years; about \$15 billion per year for residential buildings and \$6 billion per year for commercial and institutional buildings (see Table 1).⁵ To put this figure in perspective, Canadian home and building owners invested \$80.1 billion in renovations in 2019.⁶

These investments will create up to 200,000 long-lasting well-paid jobs, generate more than \$48 billion in economic development each year, and pay for themselves twice over through increased tax revenue. The renovation wave will have decarbonized most residential and commercial buildings by 2040 by electrifying them — but efficiencies gained along the way will allow us to reach this goal *while decreasing* the overall quantity of electricity used in the building sector. This will create more headroom to allow us to electrify transportation and industry.

Unlocking these investments will require significant investments from government, and a paradigm shift in how we structure funding programs. Current rate of energy retrofits vary across Canada, but hover around 1% of stock per year. The renovation wave would see the retrofit rate more than quadruple, to reach a ‘cruising speed’ of 4 to 5% per year. We estimate the public investments needed to meet these objectives at about \$10 to \$15 billion per year, every year between now and 2040 (or until appropriate regulatory drivers are in place). This is an order of magnitude higher than the boldest investments made to date, both in spending envelope, and in longevity of programs. Utility⁷, federal⁸ and provincial incentives announced or in place today offer a cumulative \$2 billion annually, leaving a funding gap of approximately \$8-13 billion.

Table 1. Key impacts of the renovation wave

	Residential			Commercial
	Detached homes	Attached homes	Apartments	
Retrofits per year	340,000	71,000	188,000	32 million m ²
	Total: 598,000 dwellings			
Total Investment needed	\$277 billion by 2040			\$120 billion by 2040
Electricity demand	-10%			n/a*
Carbon reductions from sector achieved by 2050	89% ⁹			n/a*
Annual energy bill savings in 2050	\$10.8 billion			n/a*
GDP growth per year ¹⁰	\$33.6 billion			\$14.6 billion
Jobs created ¹¹	138,000			60,000

Note: annual investments, GDP and jobs are based on the average spend between 2020 and 2040 (i.e. adjusted downward to reflect the 2020-2025 ramp-up period)

Bridging this funding gap requires a shift in how retrofit incentive programs are perceived – from a short-term stimulus meant to provide limited support to as many Canadians, to a long-term investment in the resilience and affordability of the housing infrastructure of this country. But these are fiscally sound investments:

- They more than pay for themselves through public revenues generated by taxation, **returning \$2 to \$5 to public coffers per program dollar spent.**^{12,13}
- They have been shown to create significant health benefits that could lead to savings in health care costs.¹⁴
- They are an effective avenue for economic stimulus, through immediate spending on upgrades, long-term returns from real estate, and energy bill savings that are re-invested locally in economic sectors that typically create more jobs than the energy sector.
- Every dollar invested in climate change adaptation for our infrastructure is estimated to save \$3 to \$6 in recovery costs.¹⁵

Using these funds efficiently to transform markets quickly and enable the phasing-in of regulations requiring these upgrades will require a shift in how federal funds for retrofits are typically disbursed. A most effective approach should prioritize leveraging provincial market transformation strategies (where they exist) and coordinating innovation across all levels of government (see upcoming paper from Efficiency Canada on this topic).

Recommendations

1. Target setting

- The federal government should create a vision for a nation-wide renovation wave aiming for decarbonization of the vintage stock by 2040.

2. Financing and incentives

- The federal government, in partnership with the provinces, should commit public investments on the order of \$10-15 billion per year over the next ten years to enable this renovation wave, including:
 - \$10 billion per year to fund deep retrofits for residential and commercial buildings, with programs covering 50-75% of retrofit costs.
 - \$2 billion per year to fund no-cost deep retrofits for low-income households¹⁶ and top-up for the renovation of social housing through the National Housing Strategy.¹⁷
 - \$300 million per year for skill development, capacity building and recruitment,¹⁸ with funds earmarked to increase diversity in the retrofit economy.¹⁹
 - \$100 million per year to fund market development initiatives to resolve systemic barriers to deep retrofits and facilitate large-scale roll out of new integrated retrofit offerings.²⁰
 - \$100 million per year to fund research, development and demonstration of key retrofit technologies.²¹
- Retrofit funding should be disbursed through a small number of large programs, to minimize market confusion and ensure efficacy of public investments. This could include channelling funds through established programs (municipal, provincial, utility).
- Access to federal funds for the renovation wave should be made contingent on provinces committing and implementing regulatory roadmaps for a zero-carbon building sector.
- The federal government should capitalize a loan guarantee program to reduce the risk to private financing of building retrofits,²² and CMHC should support the roll out and harmonization of PACE financing across Canada.

3. Regulation

- The federal government should partner with provinces to accelerate regulatory commitments towards a zero-carbon building sector, including:
 - Carbon intensity limits for new and existing buildings.²³

- Energy performance standards requiring all heating equipment to have a coefficient of performance greater than 100% sometime between 2025 and 2030 (i.e. ahead of the ‘aspirational’ target set for 2035).^{24,25}
- Benchmarking, labelling, and public disclosure policies to inform real estate market assessment of performance, comfort, climate risks, and carbon risks.

4. Data and transparency

- Open-data policies, data quality standards, and data exchange protocols to enable big-data driven user-centered decision tools for energy investment and market potential analysis.

Provincial breakdown

The following tables outline the retrofit rates, carbon and energy impacts, and cost of retrofits by province. We used a more rigorous model for the residential retrofits and therefore have a wider range of estimates, including impact on electricity demand, carbon reductions, and energy bills for this sector (Table 2) than for the commercial-institutional sector.

Table 2. Energy and carbon impacts of residential renovation wave, by province

	# of buildings retrofitted per year			Electricity load % of 2017 load in 2050	Carbon reductions % below 2017 by 2050	Energy bill savings per year, in 2050 (\$ billion)
	Detached homes	Attached homes	Apartments			
CANADA	339,800	70,700	188,200	89%	89%	\$10.8
BC	40,400	10,200	27,700	88%	95%	\$1.4
AB	42,800	7,600	13,100	181%	70%	-\$0.2
SK	13,500	1,200	3,300	161%	78%	-\$0.03
MB	13,800	1,300	5,100	86%	99%	\$0.3
ON	128,300	33,900	64,700	126%	99%	\$2.5
QC	70,900	13,500	66,500	53%	98%	\$5.1
NB	9,700	800	2,300	63%	99%	\$0.6
NS	11,500	1,200	3,800	97%	86%	\$0.5
PE	1,800	200	500	154%	100%	\$0.1
NL	7,100	900	1,300	57%	98%	\$0.5

Table 3. Economic growth and job creation impact of renovation wave, by province

	Total Investment (\$ billion/year)			Gross GDP growth (\$ billion/year)			Gross jobs per year		
	Residential	Commercial	TOTAL	Residential	Commercial	TOTAL	Residential	Commercial	TOTAL
CANADA	\$14.6	\$6.3	\$20.9	\$33.6	\$14.6	\$48.2	138,700	60,200	198,900
BC	\$1.9	\$0.9	\$2.8	\$4.3	\$2.1	\$6.4	17,800	8,500	26,300
AB	\$1.6	\$0.9	\$2.5	\$3.7	\$2.1	\$5.8	15,200	8,800	24,000
SK	\$0.5	\$0.2	\$0.7	\$1.1	\$0.5	\$1.6	4,400	2,000	6,400
MB	\$0.5	\$0.2	\$0.8	\$1.2	\$0.5	\$1.7	4,900	2,200	7,100
ON	\$5.6	\$2.4	\$8.0	\$12.8	\$5.6	\$18.4	52,900	23,100	76,000
QC	\$3.5	\$1.2	\$4.7	\$8.1	\$2.8	\$10.9	33,500	11,500	45,000
NB	\$0.3	\$0.1	\$0.5	\$0.8	\$0.3	\$1.1	3,200	1,300	4,500
NS	\$0.4	\$0.2	\$0.6	\$1.0	\$0.4	\$1.4	4,000	1,600	5,600
PE	\$0.1	\$0.0	\$0.1	\$0.1	\$0.1	\$0.2	600	300	900
NL	\$0.2	\$0.1	\$0.3	\$0.6	\$0.2	\$0.8	2,300	800	3,100

Note: Totals may not be exact due to rounding

Read the full report, *Canada's Renovation Wave: A plan for jobs and climate* at www.pembina.org/pub/canadas-renovation-wave.

¹ The 'Retrofit Wave' was coined by the European Commission in 2020. European Commission, "Renovation Wave: doubling the renovation rate to cut emissions, boost recovery and reduce energy poverty." https://ec.europa.eu/commission/presscorner/detail/en/IP_20_1835

² For simplicity, we express all retrofit rates as a percentage of today's stock, ie pre-2021 (hereafter labelled 'vintage' stock), and NOT a percent of the evolving stock (which grows over time with population growth).

³ See full report for detailed assumptions, and see upcoming report from Efficiency Canada for further details on the model.

⁴ We modified the assumptions for the emissions intensity of electricity grid based Canada Energy Regulator 'Evolving Energy System Scenario'.

⁵ \$15 billion is the average annual investment between now and 2040. The investment required will be lower during 'ramp up' phase, and will be ~\$18 billion at the 'cruising speed' with 4.5% of the building stock retrofitted per year.

⁶ Altus Group. "COVID-19 pit a dent in Canadian home renovation spending." <https://www.altusgroup.com/data/insights/covid-19-puts-a-dent-in-canadian-home-renovation-spending/>

⁷ James Gaede, Brendan Haley, and Madeleine Chauvin, *2020 Canadian Provincial Energy Efficiency Scorecard* (Efficiency Canada, 2020), 281. <https://www.scorecard.efficiencycanada.org/wp-content/uploads/2020/11/2020-Provincial-Energy-Efficiency-Scorecard.pdf>

⁸ Funding includes CMHC co-investment fund of \$4.7 billion over 10 years; \$2.6 billion over seven years committed by the federal government; FCM \$1.01 billion assumed to be delivered over five years; the estimated value of the interest for the \$4.4 billion in interest free financing (2% interest rate over 10 years, loan term \$40,000); and the \$2 billion for commercial retrofits from the Canadian Infrastructure Bank.

⁹ The remaining 11% of carbon emissions result from electricity use in Alberta, Saskatchewan, and Nova Scotia; in the 'Evolving' scenario from the CER used in this model, these provinces don't reach a decarbonized grid in 2050. The CER notes that grid emissions will need to be reduced beyond the projections made in their scenario if Canada is to meet its net-zero goal (see footnote below).

¹⁰ Gross GDP growth from a \$15 billion annual investment in retrofits. Using the estimate of \$2.30 in GDP growth for every dollar spent. Efficiency Canada, *Written Submission for the Pre-Budget Consultation in Advance of the Upcoming Federal Budget* (2020). <https://www.efficiencycanada.org/wp-content/uploads/2020/09/EffCan-2020-Advocacy-federal-Pre-budget-submission.pdf>

¹¹ 138,000 gross jobs per year means that 138,000 jobs are created each year, with each job lasting for 12-months; equivalently, 138,000 people would be employed continuously between now and 2040.

¹² Modelling by Dunsky and the Center for Spatial Economics in 2018 estimates the spending cost for the PCF+ scenario at \$154.7 billion over 13 years, and the resulting net additional provincial and federal tax revenue to be \$348.7 billion over that period: 2.3 times the program spending. Dunsky Energy Consulting, *The economic impact of improved energy efficiency in Canada* (2018) Table 15, Table 27, Table 28. Available at https://cleanenergycanada.org/wp-content/uploads/2018/04/TechnicalReport_EnergyEfficiency_20180403_FINAL.pdf

¹³ A 2011 study compared the costs of the program to the public revenues generated by Germany's KfW development bank's "energy efficiency renovation" program through taxes concluded that the program returned nearly four times more to the public coffers than it costs; more than five times if reduction in unemployment benefits were included. KfW Bankengruppe, *Impact on Public Budgets of KfW Promotional Programmes in the Field of 'Energy-Efficient Building*

and Rehabilitation,' 2011, 8. Available at <https://www.actu-environnement.com/media/pdf/news-22153-etude-kfw.pdf>

¹⁴ A 2015 study found that retrofitting residential buildings in Toronto to comply with minimum building code regulations can save US\$2.3 billion/year in health care. Source: "Impact of residential building regulations on reducing indoor exposures to outdoor PM_{2.5} in Toronto," *Building and Environment* (2015), 89. <https://www.sciencedirect.com/science/article/abs/pii/S0360132315001171>

¹⁵ *Investing In Canada's Future*, 13.

¹⁶ Brendan Haley, "Low-income households should be a priority for federal energy efficiency funding," *Policy Options*, February 23, 2021. <https://policyoptions.irpp.org/magazines/february-2021/low-income-households-should-be-a-priority-for-federal-energy-efficiency-funding/>

¹⁷ Currently, renovations funded through the NHS must only reach a 25% reduction in carbon emissions, making it difficult for cash-strapped housing societies to justify spending more to achieve deeper emissions reductions and integrate climate adaptation measures.

¹⁸ This mirrors the recommendations of the Canada Green Building Council, "Ready, set, grow: CaGBC tables recommendations for Canada's post-COVID-19 economic recovery," media release, May 5, 2020, https://www.cagbc.org/News/EN/2020/20200513_News_Release.aspx ; and Efficiency Canada, *Written Submission for the Pre-Budget Consultation in Advance of the Upcoming Federal Budget* .

¹⁹ This echo's The Atmospheric Funds 2021 Budget recommendations (TAF). TAF, *2021 Federal Budget Recommendations*, (2021). <https://taf.ca/wp-content/uploads/2021/02/TAF-fedbudgetsubmission-2021-02-19.pdf>

²⁰ In the Netherlands, the "Energiesprong" (energy leap) is a successful example of such a market development approach (David Dodge, "Energiesprong: a leap forward for net-zero building retrofits," *Pembina Institute*, February 8, 2017. <https://www.pembina.org/blog/gef-energiesprong>), which is now being incorporated in initiatives across Canada, including Pembina's Reframed Initiative (Reframed deep retrofit supply chain, <https://tinyurl.com/DeepRetrofitMap>). See also the upcoming paper by Efficiency Canada on mission-driven innovation.

²¹ This echo's The Atmospheric Funds 2021 Budget recommendations (TAF). TAF, *2021 Federal Budget Recommendations*, (2021). <https://taf.ca/wp-content/uploads/2021/02/TAF-fedbudgetsubmission-2021-02-19.pdf>

²² Équiterre and the Pembina Institute, *Federal Policies for Low-Carbon Buildings: A blueprint to implement the PanCanadian Framework buildings strategy* (2017), 22. <https://www.pembina.org/pub/federal-buildings-blueprint>

²³ Steven Nadel and Adam Hinge, *Mandatory Building Performance Standards: A Key Policy for Achieving Climate Goals* (ACEEE, 2020), 1. https://www.aceee.org/sites/default/files/pdfs/buildings_standards_6.22.2020_0.pdf

²⁴ Energy and Mines Ministers' Conference, *Market Transformation Strategies for Energy-Using Equipment in the Building Sector* (2017), 3. http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/emmc/pdf/Market-Transformation-Strategies_en.pdf

²⁵ International Energy Agency is calling for a ban on installation of all fossil fuel boilers starting in 2025. International Energy Agency, *Net Zero by 2050: A Roadmap for the Global Energy Sector*, (2021), 19-20. <https://iea.blob.core.windows.net/assets/4482cac7-edd6-4c03-b6a2-8e79792d16d9/NetZeroby2050-ARoadmapfortheGlobalEnergySector.pdf>