IISD International Institute for Sustainable Development

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SAVi Sustainable Asset Valuation

SIMULATIONS

What-If SAVi Simulations on a Sustainable Recovery 2020

Why Low-Carbon Renovation Is a Pragmatic Recovery Plan: **The case of Canada**

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Andrea M. Bassi
Georg Pallaske
Abigail Schlageter
Ronja Bechauf
Oshani Perera

The Rationale for the *What-If* Sustainable Asset Valuation (SAVi) Simulations

Planning a sustainable recovery requires that we look ahead and forecast how spending today will play out in the national and global economies in the years to come. It is also essential for the ongoing, unprecedented wave of public spending to trigger a sustainable recovery, one that has the environment, climate, and social cohesion at its core. The *what-if* SAVi simulations are designed to inform this debate. We use the SAVi simulations to run *what-if* scenarios to understand the economic and societal benefits that can be realized when public spending is targeted at sustainable infrastructure. Simulations are inspired by ongoing recovery plans and are based on authoritative data and real science.

Section 1: About This *What-If* Simulation

This simulation forecasts the economic benefits of investing in energy efficiency and flood resilience in buildings in Canada. We welcome the Canada Federal Stimulus Framework, which has identified buildings as one of the 10 focal areas for public spending. We are proud that the IISD President and CEO, Dr. Richard Florizone, serves on Canada's Task Force for a Resilient Recovery. The Task Force is an independent group of 15 finance, policy and sustainability leaders that are working to support recovery policies that will result in a "future that Canadians want: clean, prosperous and resilient."

We designed this simulation to contribute to the work of the Task Force. We recognize that Canadian policy-makers are seeking solutions that will not only boost output but also reduce public spending and help keep public budget deficits and debt under control. Investment in buildings promises to fulfill both requirements.

The building sector regularly features in stimulus spending, since both construction and the making of building materials involve substantial economic activity, increasing jobs, labour income, industrial output, and boosting consumption across many sectors. In countries such as Canada, where large proportions of the building stock are already built, but stakeholders continuously complain about ageing and ailing infrastructure, low-carbon renovation can make particularly good sense. As this simulation shows, it can reduce greenhouse gas emissions, improve productivity, increase jobs and wages, reduce public spending on health care, and boost GDP over the long term.

Section 2: The SAVi Simulation Results

Overview

We focus this SAVi simulation on the economic benefits that the Canadian economy will realize by undertaking:

- Energy-efficiency renovations on 1.5 million residential homes, 752,000 multi-unit residential dwellings, and 113 million square metres of commercial and institutional building space. This represents approximately 16% of its residential building stock and approximately 14% of its commercial and institutional building stock.
- Flood-resilience retrofits made today on 2.2 million at-risk homes. As incidences of extreme weather become more frequent, frequent floods and resulting losses are becoming increasingly problematic.

Both the energy-efficiency renovations and the flood-resilience retrofits are assumed to commence in 2020.

Drawing from research conducted by Efficiency Canada and their June 2020 presentation to the Canada Task Force for a Resilient Recovery (as well as from the June 2020 National Resilient Retrofit Program Proposal of the Intact Centre on Climate Adaptation [Intact Centre] and the Insurance Bureau of Canada [IBC]), we estimate that the total investments required to get the intended benefits from energy efficiency and flood resilience are CAD 127 billion. Building further on estimates from Efficiency Canada, the SAVi simulations on the resulting economic gains (additional GDP, employment, avoided spending on property damage, health care, insurance premiums, and greenhouse gas abatement) show returns that are 18.76 times higher, reaching CAD 2,381.9 billion by 2060. See details in the table and chart below.

Renovation waves are particularly valuable, as they crowd in domestic suppliers and small and medium-sized enterprises (SMEs). They also provide economies of scale that can be large enough to boost innovation in green buildings, which will further contribute to economic output.

In the longer term, we observe that while jobs and labour income begin to taper off, the consumption, investment, and productivity triggered by the renovation wave continue to enhance GDP and reduce public spending significantly.

Overview of total economic gains when investing in energy-efficiency and flood-resilience retrofits

Indicator	Unit	By 2025	By 2040	By 2060
Total investment in building retrofits as outlined by Efficiency Canada, IBC, Intact Centre, and complementary SAVi simulation	CAD billion	127	-	-
Total benefits as outlined by Efficiency Canada, IBC, and Intact Centre and complementary SAVi simulation	CAD billion	254.5	1,053.2	2,381.9
Benefit per dollar invested	**CAD**	**2.00**	**8.29**	**18.76**

As this simulation was being designed, the Canadian Ministry for Natural Resources announced an investment of over CAD 2 billion for new net-zero residential buildings across Canada. The funds would support housing projects such as those proposed by the Canadian Home Builders' Association (CHBA). The full press release can be viewed at https://www.newswire.ca/news-releases/investing-in-net-zero-energy-residential-buildings-across-canada-829333647.html

A Closer Look at the Simulation on Energy Efficiency

To recap, we designed the simulation on the baseline assumption that energy-efficiency renovations will be undertaken on:

- 1.5 million residential homes and 752,000 multi-unit residential dwellings, which represents 16% of the Canadian residential building stock
- 113 million square metres of commercial and institutional building space, 14% of its commercial and institutional building stock

The renovations are assumed to commence in 2020.

The total investment is assumed to be CAD 27.8 billion from public capital and CAD 44.2 billion from private capital providers. These assumptions were based on Efficiency Canada's proposal to the Canada Task Force for a Resilient Recovery in June 2020.

The SAVi simulations show that the mid- and long-term economic gains on the retrofits are well worthwhile.

As the research by Efficiency Canada already indicates, the medium-term gains in terms of additional jobs—and additional labour income associated with these jobs—is significant, with over 2 million new jobs and CAD 135 billion in labour income by 2040. This illustrates the value of renovation and infrastructure expansion in stimulus plans, as they mobilize cross-disciplinary and cross-sector consumption, create jobs, and boost labour income across the economy.

The benefits are even larger when renovation is targeted at improvements in green technologies, advanced building management systems, and sustainable design more broadly. The SAVi simulation shows that the avoided spending on healthcare and the reduced social costs of carbon (SCCs) total CAD 71 billion in 2040. Given that extreme weather incidents will increase in the coming years—and climate change-triggered spending on health, maintenance, and adaptation will rise accordingly—an energy-efficiency renovation wave becomes even valuable.

Results of the simulation on energy-efficiency (EE) retrofits

Indicator	Unit	2025	2040	2060
Assumed investment in EE				
Public Investment as recommended by Efficiency Canada in their presentation to the Task Force on Resilient Recovery	CAD billion	27.8	-	-
Private investment as recommended by Efficiency Canada in their presentation to the Task Force on Resilient Recovery	CAD billion	44.2	-	-
Total investments as recommended by Efficiency Canada in their presentation to the Task Force on Resilient Recovery	CAD billion	72	-	-
Economic benefits from EE retrofits, as estimated by Efficiency Canada, as presented to the Task Force on Resilient Recovery				
Additional GDP from EE retrofits	CAD billion	160	640	1,280
Amount of additional GDP that contributes to additional government revenue	CAD billion	24	96	192
New jobs related to EE retrofits	Jobs	660,860	2,643,440	5,286,880
Wages associated with new jobs	CAD billion	33.8	135	270.1
GHG reduction from EE retrofits	$MtCO_2$	102	408	816
Additional simulation using SAVi				
Avoided spending on health care due to lowered greenhouse gas emissions costs	CAD billion	13.78	55.14	110.27
Avoided SCC	CAD billion	4.18	16.73	33.46
Benefit per dollar invested	**CAD**	**2.945**	**11.762**	**23.526**

A Close Look at the SAVi Simulation Results on Flood-Resilience Retrofits

To recapitulate, the simulation begins from the baseline assumption that flood-resilience retrofits will be undertaken on 2.2 million at-risk homes. The simulation also assumes that CAD 55 billion will be invested in flood-resilience retrofits for all at-risk homes by 2025. In making this assumption and designing the simulation, we drew heavily on the June 2020 National Resilient Retrofit Program Proposals of the Intact Centre and the IBC.

The results of the simulation demonstrate the longer-term economic benefits of flood retrofits and, at the same time, make a strong case for investment in climate adaptation.

To undertake these retrofits, the at-risk homes would require upfront investments of CAD 55 billion. Assuming there is an annual 1% chance for an at-risk home to be flooded, implementing flood-resilience retrofits would avoid costs associated with property damage, spending on health care, insurance claims, and lost work hours. The benefits from these avoided costs accumulate as time goes on. This means that by 2060, the benefits would greatly outweigh the upfront capital costs of retrofits.

Results of the simulation on flood-resilience improvements

Indicator	Unit	2025	2040	2060
Investment in flood-resilience retrofits				
Total investment on retrofitting 2.2 million at-risk homes, as estimated by the IBC, Intact Centre, and complementary SAVi simulation	CAD billion	55	-	-
SAVi-simulated resilience retrofit benefits				
Avoided costs of damage to property (cumulative)	CAD billion	13.305	169.638	632.474
Insurance premium savings	CAD billion	0.506	2.024	4.048
Avoided health cost due to mental trauma of flood victims (cumulative)	CAD billion	0.168	2.144	7.992
Number of additional jobs created through retrofit projects	# of jobs	556,875	-	-
Wages earned through the additional jobs related to retrofit projects	CAD billion	28.448	-	-
Avoided wage loss from days of work lost due to flooded homes (cumulative)	CAD billion	0.319	4.065	15.155
Benefit per dollar invested	**CAD**	**0.777**	**3.751**	**12.511**

Section 3: Using the Results of This Simulation

The simulation demonstrates that it pays to invest in energy efficiency and flood resilience. The forecast provides predictability and certainty to policy-makers that investments that seem expensive today will bring longer-term economic prosperity and help curtail public spending even in the immediate term. Opportunities to lower public spending on reducing greenhouse gas emissions and adapting to changing climates are particularly significant.

The building industry, including architects, designers, and construction firms, will also find this simulation useful to support their net zero-carbon ambitions in the years ahead.

In terms of innovative green financing, we hope that this simulation will trigger debate on concessional lending for owners and occupants of greener buildings. For example, can tweaks be made to the Canada First-Time Home Buyer Incentive to offer even more attractive terms for first-time buyers of greener buildings? The incentive provides a shared equity mortgage, offering first-time buyers loans equivalent to 5% to 10% of the property value to be used as down payments. Full details are provided at the Government of Canada National Housing Strategy website at https://www.placetocallhome.ca/fthbi/first-time-homebuyer-incentive

Other green financing options can include tax incentives under which percentages of proven expenses for improving energy efficiency and flood resilience can be made tax deductible.

On the supply side, Canada has a flourishing market for green project bonds, energy-efficiency contracting, pay-for-performance arrangements and the like that can be easily targeted to raise both public and private capital for sustainable buildings.

Section 4: The Design of the Simulation

This simulation draws from authoritative data and sound science. Data sources and assumptions are presented in the table below.

Data and assumptions used for the simulation on EE retrofits

Assumed investment in EE

Indicator	Explanation
Public investment as recommended by Efficiency Canada in their June 2020 presentation to the Task Force on Resilient Recovery	Efficiency Canada proposed that CAD 27.8 billion in public sector investment is required between 2020 and 2025.
Private investment as recommended by Efficiency Canada in their June 2020 presentation to the Task Force on Resilient Recovery	Efficiency Canada proposed that CAD 44.2 billion in private sector investment is required between 2020 and 2025.
Total investments as recommended by Efficiency Canada in their June 2020 presentation to the Task Force on Resilient Recovery	By adding the public and private sector investments as recommended by Efficiency Canada, investments total CAD 72 billion over the next five years to obtain the proposed benefits.

Economic benefits from EE retrofits, as estimated by Efficiency Canada in their June 2020 presentation to the Task Force on Resilient Recovery

Indicator	Explanation
Additional GDP from EE retrofits	Efficiency Canada estimated a CAD 32 billion annual GDP increase from the suggested investments. Assuming these benefits persist, the total GDP increase would be CAD 1,280 billion by 2060
Amount of additional GDP contribution to government revenue	According to the Government of Canada (2019), government revenues as a percentage of GDP are estimated at 15%. This means that the additional GDP from EE retrofits could add up to an additional CAD 192 billion in government revenues by 2060.
New jobs related to EE retrofits	Efficiency Canada, in their June 2020 presentation to the Task Force on Resilient Recovery, estimated that implementing the suggested investments would create 132,172 jobs annually. If the benefits from the investments persist, this would total 5,286,880 additional jobs by 2060.
Indicator	**Explanation**
Wages associated with new jobs	Assuming an average hourly wage of CAD 27.83 and an average 35.3 hours worked weekly, as estimated by Statistics Canada in 2019, the total additional wages earned by the 132,172 annual jobs created from EE retrofits would be CAD 6.8 billion annually. This would total CAD 270.1 billion by 2060
GHG reduction from EE retrofits	Efficiency Canada, in their June 2020 presentation to the Task Force on Resilient Recovery, estimates that making the suggested investments would lead to an annual GHG reduction of 20.4 $MtCO_2$ annually. This would total 816 $MtCO_2$ by 2060.

Additional simulation using SAVi

Indicator	Explanation
Avoided spending on healthcare due to lowered greenhouse gas emissions costs	The United Nations Economic Commission for Europe (2016) estimates that the health-related co-benefits, such as avoided premature deaths and morbidly, of CO_2 emission reductions at CAD 135.14 per $MtCO_2$. This means that the 20.4 $MtCO_2$ reduction in emissions proposed by Efficiency Canada can reduce health costs attributable to GHG emissions by CAD 2.76 billion annually, amounting to a total of CAD 110.27 billion avoided health costs by 2060
Avoided SCC	According to Equiterre (2018), the Government of Canada estimated the SCC to be CAD 41/ton CO_2 emitted. The estimated 20.4$MtCO_2$ reduction in emissions results in a potential avoided cost of CAD 0.84 billion annually. This would amount to CAD 33.46 billion by 2060.
Benefit per dollar invested	Divide the total net costs of each investment by the total net benefits

Data used for the simulation flood-resilience improvements

Investment in flood resilient retrofits

Indicator	Explanation
Total investment in retrofitting 2.2 million at-risk homes, as estimated by IBC and the Intact Centre	In their June 2020 National Resilient Retrofit Program Proposal, Craig Stewart from IBC, and Natalia Moudrak from the Intact Centre estimated that retrofitting buildings to be resilient to flood risks requires investments of approximately CAD 2,500 per home. In addition, the IBC (2019) suggests that there are 2.2 million Canadian homes at risk of flooding. If all of these homes were retrofitted to be flood resistant, the estimated upfront costs would be CAD 55 billion.

SAVi-simulated resilience retrofit benefits

Indicator	Explanation
Avoided costs of damage to property (cumulative)	In the June 2020 National Resilient Retrofit Program Proposal from the IBC and the INTACT Centre, the average residential cost from flooding is CAD 41,000 per event. We assumed the likelihood of an at-risk home being flooded to be 1% annually and used this to estimate the avoided cost due to property damage. If resilience is made a priority in building back, we estimate the avoided costs of property damage to be CAD 632.5 billion by 2060.
Insurance premium savings	Based on data from RateLab.ca (2020), it is estimated that the average home in Canada pays CAD 850 annually for house insurance. Direct communication with Natalia Moudrak, Director of the Intact Centre, stated that if homes took measures to reduce their risk of flooding, this premium could be reduced by 5%–15%. Even the low-end estimate of these insurance savings would amount to CAD 4 billion in household insurance savings by 2060.
Avoided health costs due to mental trauma of flood victims (cumulative)	Many flood victims have shown symptoms of Post-Traumatic Stress Disorder (PTSD), anxiety, and depression as a result of their losses. Using estimates from a compilation of case studies in Fernandez et al. (2015), we estimate that 21.5% of those who experience a flood event suffer emotional trauma—most commonly PTSD. Again, assuming that 1% of at-risk homes are flooded annually, and assuming an average annual treatment cost of CAD 2,404.05 per person affected, as estimated by Walker et al. (2003), we estimate that the avoided health costs of implementing flood-resilience retrofits to be CAD 8 billion by 2060.
Number of additional jobs created through retrofit projects	The Bay Area Council Economic Institute (2020) has estimated that for every USD billion invested annually in flood-resilience retrofits, 13,770 jobs would be created. With the CAD 55 billion invested in flood-resilience retrofits—and assuming that there would be a similar level of job creation total for retrofits in Canada—this translates to 556,875 jobs created if all at-risk homes are retrofitted.

Indicator	Explanation
Wages earned through the additional jobs related to retrofit projects	Using the estimated 556,875 jobs created and assuming an average hourly wage of CAD 27.83 and an average 35.3 hours worked weekly (as estimated by Statistics Canada in 2019), the total additional wages earned from resilience retrofit projects would be CAD 28.44 billion.
Avoided wage loss from days of work lost due to flooded homes (cumulative)	The Intact Centre (2018) has suggested that an estimated seven days of work are lost per flooded house. Again, assuming an average hourly wage of CAD 27.83 and an average 35.3 hours worked weekly as estimated by Statistics Canada in 2019, retrofitting homes could avoid CAD 11.4 billion in wage losses by 2060.
Benefit per dollar invested	**Divide the total net costs of each investment by the total net benefits**

About SAVi

The SAVi is a simulation service that helps governments and investors value the many risks and externalities that affect the performance of infrastructure projects. It integrates best-in-class climate data from the EU Copernicus Climate Data Store.

The distinctive features of SAVi are:

- Valuation: SAVi values, in financial terms, the material environmental, social, and economic risks and externalities of infrastructure projects. These variables are ignored in traditional financial analyses.
- Simulation: SAVi combines the results of systems thinking and system dynamics simulation with project finance modelling. We engage with asset owners to identify the risks material to their infrastructure projects and then design appropriate simulation scenarios.
- Customization: SAVi is customized to individual infrastructure projects.

Check out the SAVi track record, on-line demo, and academy at www.iisd.org/savi.

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