# Nexus between poverty, housing and energy efficiency



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## **Problem statement**





### **Datasets analyzed:**

- Fredericton residential energy assessment dataset
- Census 2021 Community profiles

### Additional sources of information (used for reference only):

- GHG Inventory and 2050 forecast
- Population projections
- Provincial & Territorial Energy Profiles





## **Data cleansing overview**



Record count before and after clean up





- Property coordinates were mapped to 2021 Census Tract boundaries using shapely package in Python
- Linear Regression was derived with SKlearn Linear Regression package in Python
- Outliers were excluded by inspecting box and whisker plot
- For properties with no year specified (i.e year = '9999'), year was imputed by averaging the age of all the houses in the 1 Km radius of the target house
- Property type some manual clean-up and using regex library in Python





Fredericton population is expected to grow dramatically

Fredericton Population 2021 vs 2041

170,000 108,610 90000 63116 2021 2021 2041 Eredericton (City) Fredericton (CMA)

*Source: Demographics Technical Background Report, City of Fredericton. Projections prepared by MetroEconomics Inc.* 

The city has higher than average poverty rates in Canada

#### % of low-income population in select CMAs



Source: Statistics Canada, Census 2021

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# **Energy consumption in Fredericton and GHG emissions in NB**

New Brunswick has higher than national average per capita GHG Emission

## GHG Emissions per capita (MT) by province & territory



Main source of GHG emission in Fredericton is from residential housing sector

## GHG Emissions by source (2020)



#### Source: 2019 GHG Inventory and 2050 forecast, Stantec

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# **Exploratory analysis: Energy consumption in Fredericton**

Heating is the largest source of energy consumption

Heating and insulation upgrades provide highest savings

## Heating energy savings by upgrade type







# **Exploratory analysis: Community Profiles**



	Mean heating consumption	Median household income	% Population in Core
	(sq mt)	(2020)	Housing need
West Plat/Sunshine Gardens	0.41	\$ 66,000.00	10%
Queen's Square	0.41	\$ 64,500.00	12%
College Hill	0.37	\$ 54,000.00	13%
Murray Avenue/South Devon	0.36	\$ 70,000.00	12%
Barker's Point/ Lower St. Mary's	0.36	\$ 63,600.00	9%
Total	0.38	\$ 63,620.00	11%



	Mean heating consumption		dian household income	% Population in Core
	(sq mt)	(202	20)	Housing need
Garden Creek/ Silverwood/Bishop Drive	0.29	\$	80,000.00	5%
Chateau Heights	0.26	\$	87,000.00	5%
Southwood Park/Lincoln Heights	0.26	\$	89,000.00	9%
New Maryland	0.26	\$	116,000.00	2%
Royal Road/Brookside Drive	0.26	\$	70,500.00	11%
Total	0.27	\$	88,500.00	6%

Source: Statistics Canada, Census 2021

Source: Statistics Canada, Census 2021



# Insights: Household Income characteristics and energy efficiency



There is a **strong** correlation between % of people in community below poverty line and average energy spent on heating. **Pearson's R = 0.70** 

For every percentage point increase in % community's poverty level there is an increase in average consumption of energy spent on heating (per sq mt) of 0.007 GJ in respective community. **Regression line: y = 0.007x+ 0.23 Coefficient of determination (R-squared): 0.50 P Value = 0.0003**  % in Core Housing Need vs Energy consumption - Heating (per sq mt)



There is a **moderately strong** correlation between % of people in core housing need and energy consumption for heating in respective community. **Pearson's R = 0.64** 

For every percentage point increase in % core housing need the energy consumption for heating (per sq mt) increases by 0.98 GJ in respective community. **Regression line:** y = 0.98x + 0.25

Coefficient of determination (R-squared): 0.41 P Value = 0.0021



# **Insights: Floor area of residential Housing in Fredericton**



Floor Area (sq mt) by building age

Newer housing tends to have large floor area and while more efficient on a per square ft basis is overall more energy consuming than smaller housing. Floor Area (sq mt) vs Total Energy Consumption



Coefficient of correlation: 0.83 (strong correlation)

For every additional square meter in floor area of the house, overall heating consumption increases by 0.18 GJ/yr. Regression equation: y = 0.18x + 16 Coefficient of determination (R-squared): 0.69

### **Poverty reduction:**

- Fully subsidized heating system upgrades for low-income residents of (11.6% in CMA and 13.5% in the City) – cost of upgrades for the whole city ~ 72M/CAD.
- 0% interest financing for / tax credits for insulation upgrades

#### Next steps:

- Expand Canada Greener Homes Grant Initiative program currently maximum eligible amounts are too low, furnaces are not eligible
- Make furnace/heating system upgrades a forgivable loan/grant for qualifying individuals





Reduction in heating consumption by type of upgrades (in GJ/yr) 743,418.58 (386,591.57) -80% (50,420.39) (96,545.92) 149,833.49 (60,027.21)Heating System Upgrade Celling Upgrade opeson lien Air sealing upgrade Potsh heating energy. Heating consumption ...

- Reduction of overall heating energy consumption by up to 80%
- Potential savings on heating of more than \$1200 CAD/yr
- Up to 38% reduction in overall GHG emissions from housing

## Sustainable housing:

- Partnerships with private sector and incentives such as carbon credits to all contributors to the municipal retrofit fund.
- Efficiency certificate system for residential housing and taxation for less efficient homes for households above certain income level.

### Next steps:

- Make Energy Star certification for all new residential housing mandatory
- Adopt energy efficiency certification for older housing similar to EU
  - and make energy audits mandatory during sale

Poverty	Sustainable
reduction	housing
Enviro	onment

#### **Environment:**

Additional property taxes for new housing > 1,600 sq ft to reduce total energy consumption or generate contributions to the retrofit fund. This will help either reduce overall energy consumption by up to 15% or contribute to the retrofit fund in the form of taxes.

#### Next steps:

Conduct review of municipal by-laws and property tax code to assess feasibility of capping or incremental taxation for new housing with excessive floor area.





## Conclusion

#### Fredericton GHG emissions (tCO2e) 2021 vs 2030

- Existing housing heating energy can be reduced by up to 80%
- New housing heating consumption can be reduced by up to 15% if floor area is capped
- Heating makes up 48% of total energy consumption
- Outcome :
  - Total GHG reduction of 16% from 2021 levels by 2030 from the residential sector
  - Put back > 1,200 CAD/yr into pockets of needing families



Source: 2019 GHG Inventory and 2050 forecast, Stantec; Huskies own estimates





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