Leveraging data for a Business Energy and Emissions Profile to target policies and investment to maximize low-carbon benefits for small and medium-sized businesses

- Exploring potential approaches to advance the BEEP

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Disclaimer

This report was produced as part of the UBC Sustainability Scholars Program, a partnership between the University of British Columbia and various local governments and organizations in support of providing graduate students with opportunities to do applied research on projects that advance sustainability across the region.

This project was conducted under the mentorship of Climate Smart staff. The opinions and recommendations in this report and any errors are those of the author and do not necessarily reflect the views of Climate Smart or the University of British Columbia.

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Contents

1. Introduction

Sustainability Scholars Program

The Sustainability Scholars Program is part of a UBC sustainability initiative to connect UBC graduate students with on- and off-campus sustainability partners through a paid internship program and provides opportunities to work on applied research projects (*Sustainability Scholars Program*, 2019).

Climate Smart

Climate Smart is an award-winning certified B Corp that has developed a practical and solutions-based program for small and medium-sized enterprises (SMEs) to profitably track and reduce greenhouse gas (GHG) emissions. Climate Smart emphasizes the business case for GHG reduction: operational efficiencies, cost savings, and competitive advantage.

Using an SME tailored approach, Climate Smart provides innovative tools and programming for "host partners" on the front lines—cities, ports, airports, chambers, and financial institutions—to disrupt old economic trajectories and invest in more efficient technologies to deliver cleaner products and services.

Since 2007, Climate Smart has worked with 40+ host partners to engage over 1000 businesses to prepare for and participate in the low-carbon economy. Case studies from a sampling of 78 Climate Smart businesses show a total annual cost savings of $4.7 million.

Project description

Climate Smart provides an innovative carbon mapping tool, called a business energy and emissions profile (BEEP). While Climate Smart has created a novel SME data set in the BEEP, it has not uncovered its full potential. Climate Smart partnered with the Sustainability Scholars Program to identify opportunities in the tool to support and gain insight into climate strategy.

2. Background

Business Energy and Emissions Profile (BEEP)

Climate Smart links SMEs to global impacts through harnessing the power of SME-derived data to inform emissions estimates from SMEs at different geographical scales through our BEEPs. Climate Smart was awarded the Grand Prize in the 2016 MIT Climate CoLab contest and was the judges' choice in 2018 for our BEEPs.

The BEEP, a carbon mapping tool, unlocks SME business data to help cities and on-the-ground partners work strategically with their local businesses to reduce greenhouse gas emissions and develop data-driven storytelling on climate action. The BEEP showcases an interactive analysis of emissions and energy use of SMEs across 13 industry sectors. Climate Smart has produced BEEP dashboards for cities across North America.

3. Approach

Description of research approach

This project focused on three aspects of the BEEP and looked for potential approaches to enhance the functionality of the BEEP.

Objective 1: Present quantitative and qualitative data

- Objective 1 focused on developing a novel way to present various quantitative and qualitative SME data in the BEEP.
- This phase included a review of the BEEP 2.0 to identify gaps in data presentation and best practices for presenting data. Based on the gaps and best practices, concepts for presenting quantitative and qualitative data were developed in the form of a Tableau dashboard.

Objective 2: Identify potential analysis

- Objective 2 aimed to identify potential analysis that can be potentially deployed in the BEEP.
- This phase involved a review of emissions related analysis from other organizations and demonstrated compatibility of potential analysis in the BEEP. Specifically, this phase focused on analysis that may contribute to further understanding on potential emission reductions and financial benefit.

Objective 3: Review underlying methodology

- Objective 3 reviewed the underlying methodology on cost savings in the BEEP 2.0 and provided recommendations on the process to estimate the cost savings.

4. Project Outcomes

Objective 1: Concepts for presenting data

This objective developed concepts for presenting key insights, emission analysis, and sector-specific reduction analysis. These concepts were developed to fill the gaps in the current dashboard. Best practices were reviewed and applied.

Gaps in BEEP 2.0

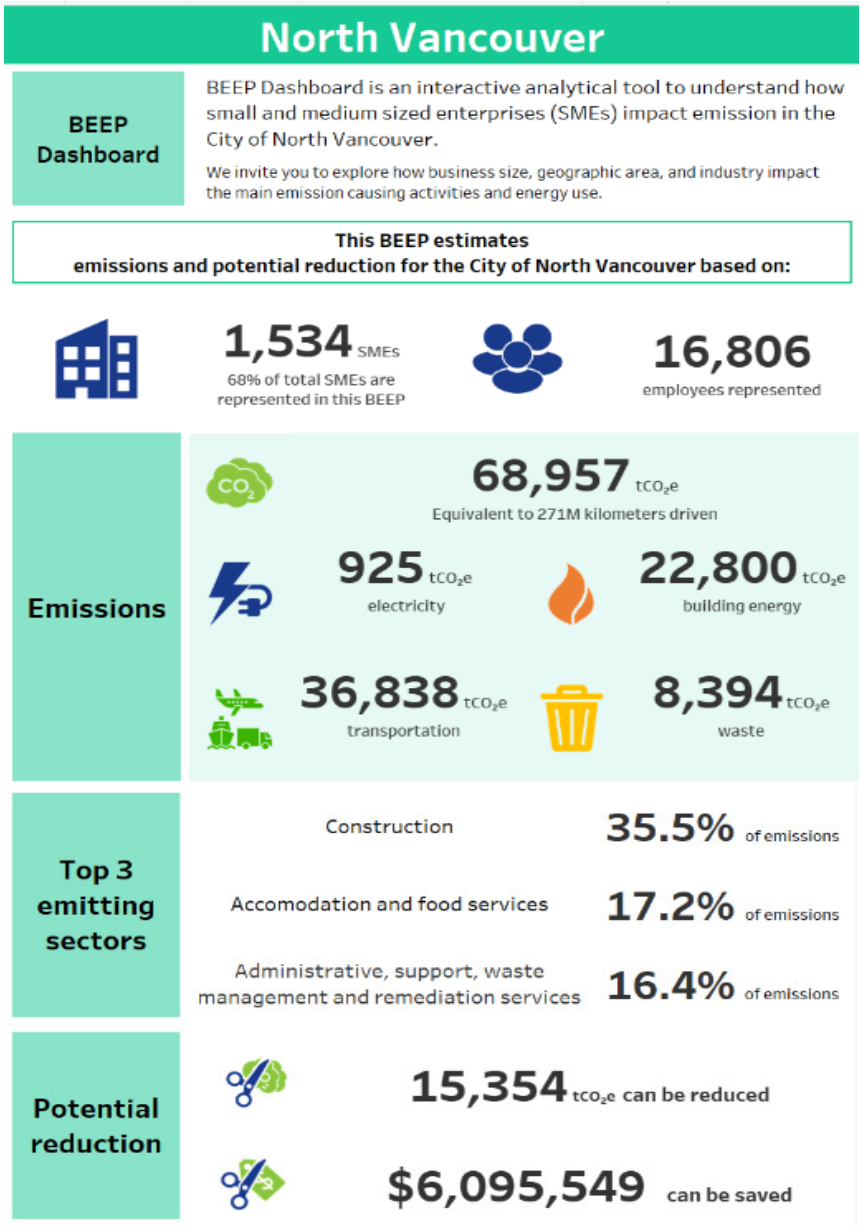
Target audience. Current BEEP dashboards may be more appealing to municipalities because it provides city-level analysis. The BEEP can be tailored to target various audiences such as business owners. Providing targeted analysis for business owners may be beneficial to encourage them to take action.

Qualitative information. The BEEP dashboards provide qualitative case studies and reduction strategies. These two types of information are presented by sector along with reduction analysis. Potentially, presenting this information with other types of quantitative data could deepen the users' understanding of reduction opportunities.

Reduction analysis. The BEEP provides reduction analysis across and within industry sectors, which provides a better understanding on reduction estimates. However, there is a lack of data visualization to effectively deliver this information.

Concept 1 – Key insights

This concept provides a quick and intuitive introduction to the BEEP for a target city. It presents key insights by highlighting key numbers and icons.



BEEP description briefly introduces the dashboard for new users.

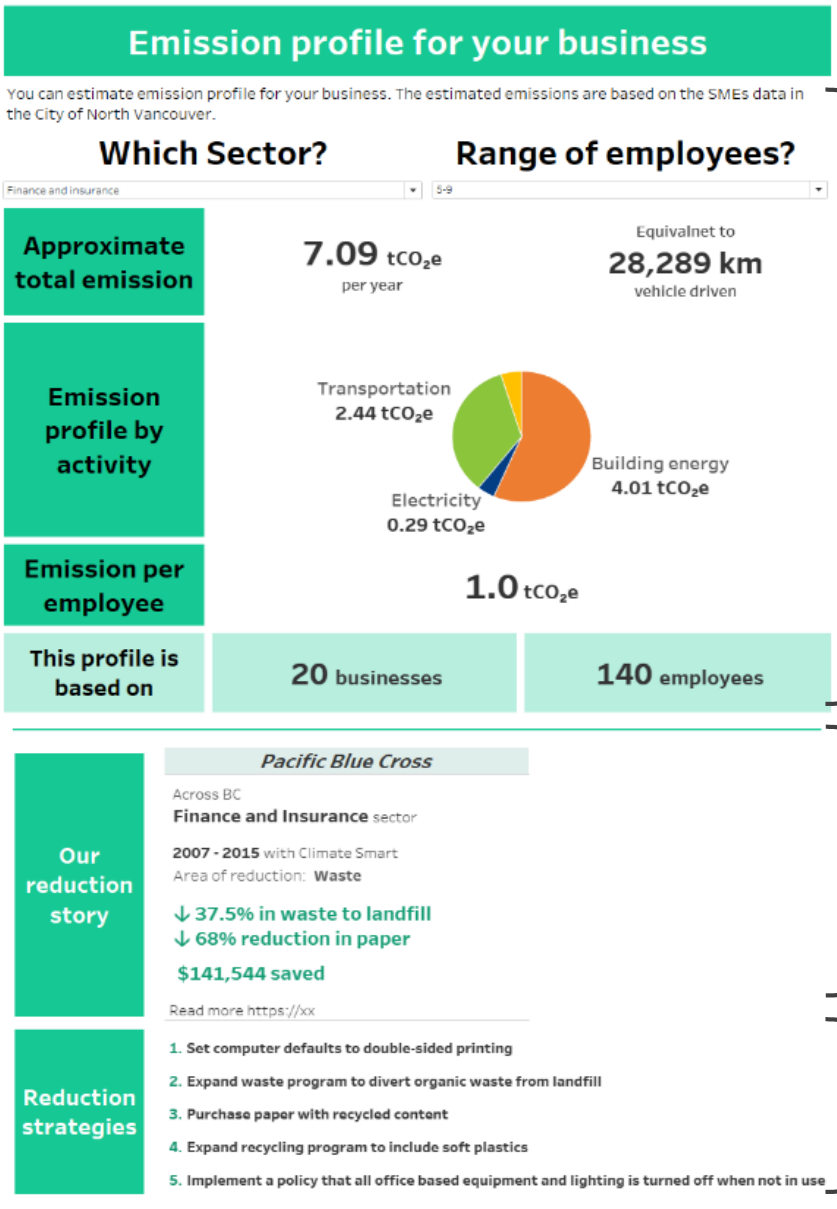
General emission analysis shows a city's overall emission profile.

Top emitting sectors analysis

Reduction analysis summarizes total potential emissions reductions and cost savings.

Concept 2 – Emission profile for business owners

This concept presents emission analysis for business owners by providing information more relevant to an individual business.



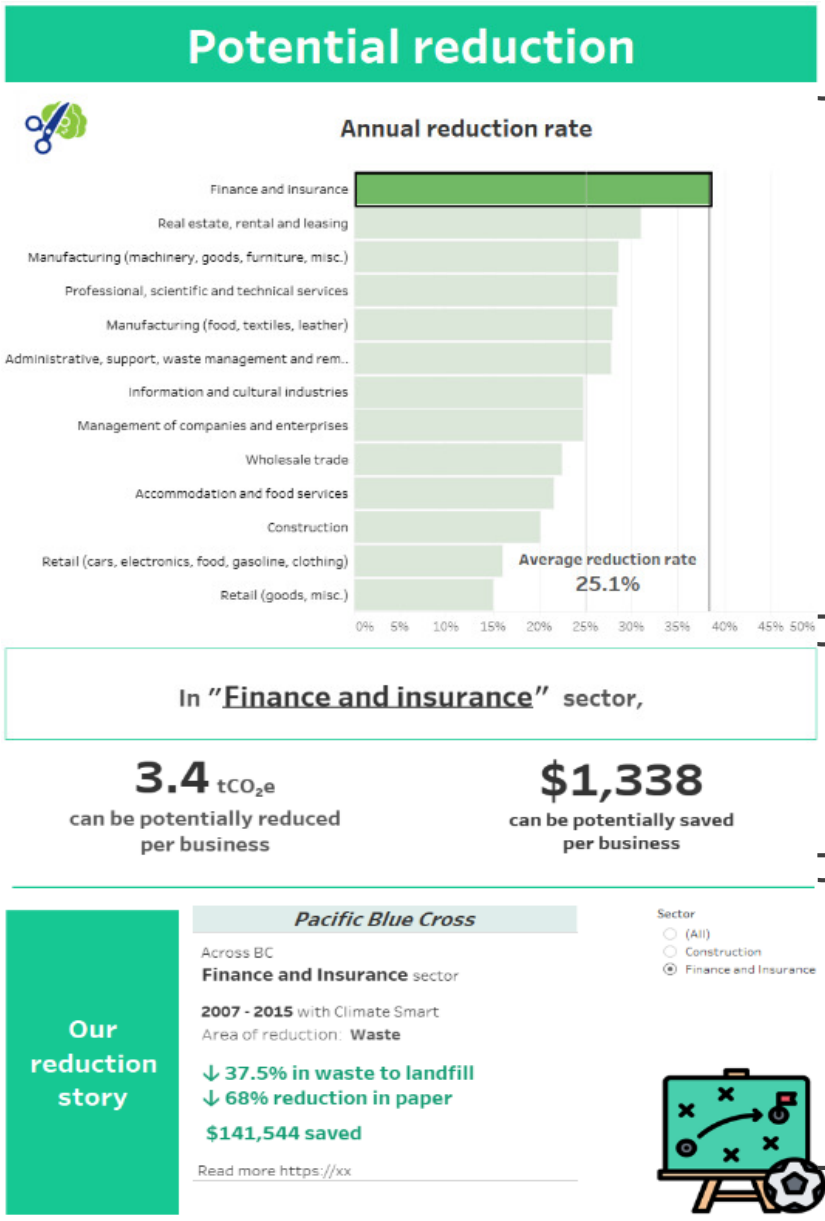
Emission data for business owners: Calculate emission profile per business based on sector and range of employees. This can be used by business owners to approximate their emission profiles.

Sector specific case study shows how similar businesses take action for emissions reductions and cost savings.

Sector specific reduction strategies can further inform business owners on taking action.

Concept 3 – Interactive reduction analysis

This concept provides interactive reduction analysis by sector.



Reduction rate analysis allows users to compare annual emissions reduction rate between sectors. Average reduction rate across sectors is used as a reference line.

Reduction estimates further inform through sector specific details.

Sector specific case study can show a concrete example of emissions reductions and cost savings for each sector.

Objective 2: Compatibility of potential analysis in BEEP

This objective identified decarbonization profile and payback period for potential analysis, and demonstrated its compatibility in the BEEP. This approach may contribute to further understanding of potential emissions reductions and financial benefit.

Review of emission analysis

- In general, there are four types of emission analysis:
  - Emission profile by categories: This analysis presents the level of emissions by various categories (e.g., emissions by country, economic sector).
  - Historical emission trends: This analysis tracks historical emission data at the global and national levels, and presents how emissions have changed over time.
  - Contribution analysis: This type of analysis focuses on understanding the contribution of countries/cities to tackle emissions. Contribution is often measured based on Nationally Determined Contributions (countries' commitments under the Paris Agreement to reduce emissions).
  - Decarbonization profile: This analysis predicts future emission trends based on emission reduction strategies (e.g., related policies and practices). The trends are often presented at the global and national levels.
- Payback analysis is often adopted in a business setting to understand the financial benefit. This analysis can be potentially applied to understand the financial benefit of emissions reductions.
- Following the relevant analysis, this objective focused on the compatibility of decarbonization profile and payback period analysis.

Decarbonization profile

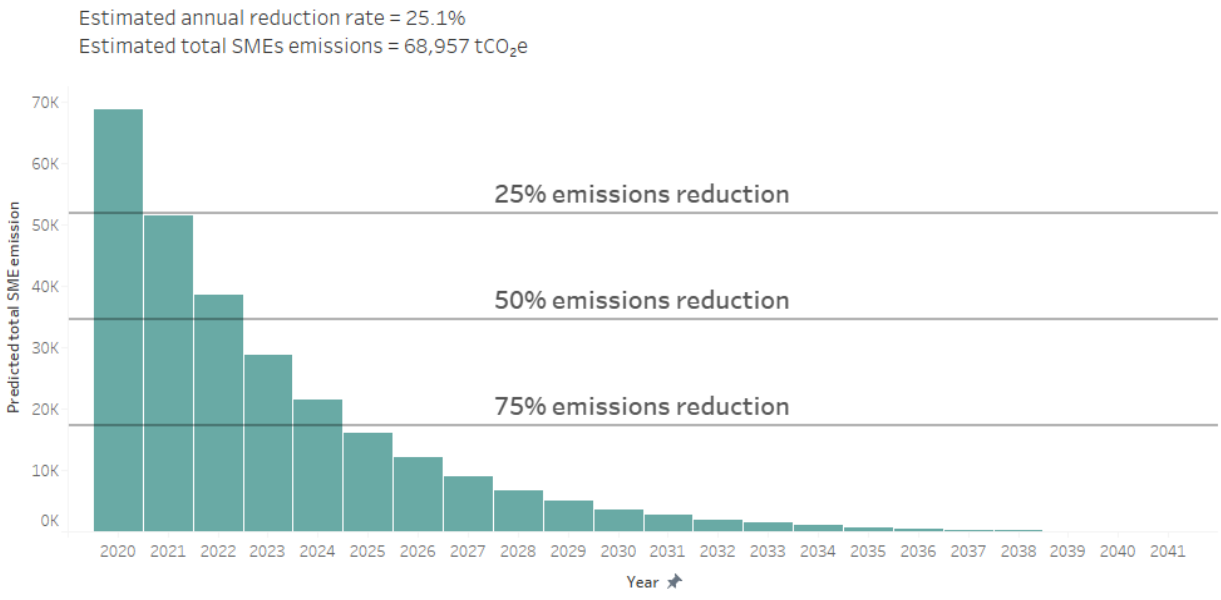
Three decarbonization profiles were proposed to show potential SME emission trends. These profiles were developed based on the annual reduction rate estimated in the BEEP. The example data used are presented in appendix A.

1. Overall decarbonization profile for SMEs

This profile presents a general emission trend across all business sectors.

North Vancouver

<SMEs Decarbonization profile>



Total SME emissions in 2020 are estimated based on the total SME emissions currently estimated in the BEEP

Future SME emissions are calculated based on the estimated annual reduction rate. For example,

Estimated total SME emissions in 2021 = Estimated total SME emissions in 2020 – Estimated SME emissions reductions in 2021 (i.e., Estimated total SME emissions in 2020*annual reduction rate)

Emission reduction reference lines show approximate years to reach 25%, 50%, and 75% emission reduction from emissions in 2020.

E.g., 75% emission reduction can be achieved by 2025

Potential applications

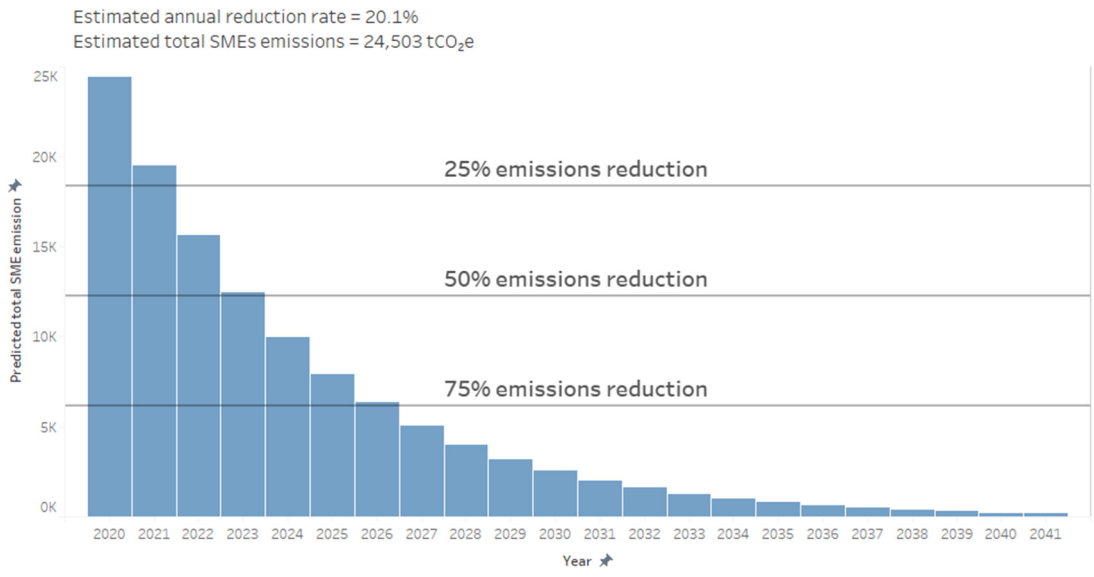
- Different profiles can be calculated by changing annual reduction rates
- Interactive decarbonization profile may be useful for users to explore different reduction rates

2. Sector specific decarbonization profile for SMEs

With sector-specific estimated total SME emissions and annual reduction rate, a decarbonization profile can be created by sector. For example, the following graph shows the decarbonization profile for the construction sector in North Vancouver.

Construction

<SMEs Decarbonization profile>



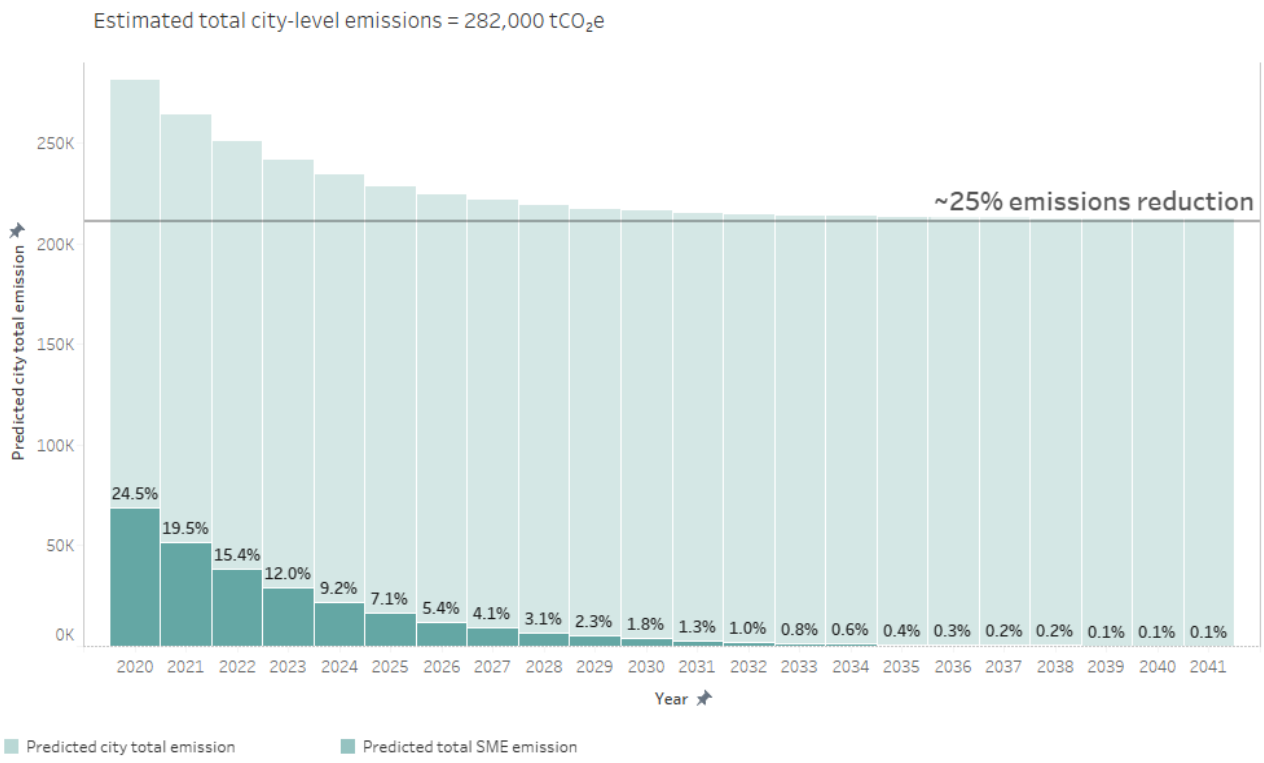
3. Impact of SME emissions on city-level decarbonization profile

The city-level decarbonization profile was proposed to understand how SMEs' emissions reductions can impact at the city-level. This profile shows the relationship between municipal and SME emissions.

Note that this profile only considers SME emissions reductions to predict future city emissions. Other emissions reductions factors (e.g., policy) are not considered in the calculation.

North Vancouver

<Impact of SMEs emission reduction on total city emissions>



Total city-level emissions in 2020 are estimated based on the recent North Vancouver emission estimates (2019) in Google Environmental Insights Explorer (EIE) data (https://insights.sustainability.google/places/ChIJQSsj-UZwhlQRWuz71EvLhW8).

Google EIE provides city-level emission estimates based on building and transportation. In this demo, city-level emissions are calculated by summing up the

Future city-level emissions are calculated based on estimated SME emissions reductions. For example,

Estimated total city emissions in 2021 = Estimated total city emissions in 2020 – Estimated SME emissions reduction in 2021

Percent of SME emissions in city shows the contribution of total SME emissions within city emissions.

Percent of SME emissions = Estimated total SMEs emissions / Estimated total city emissions*100

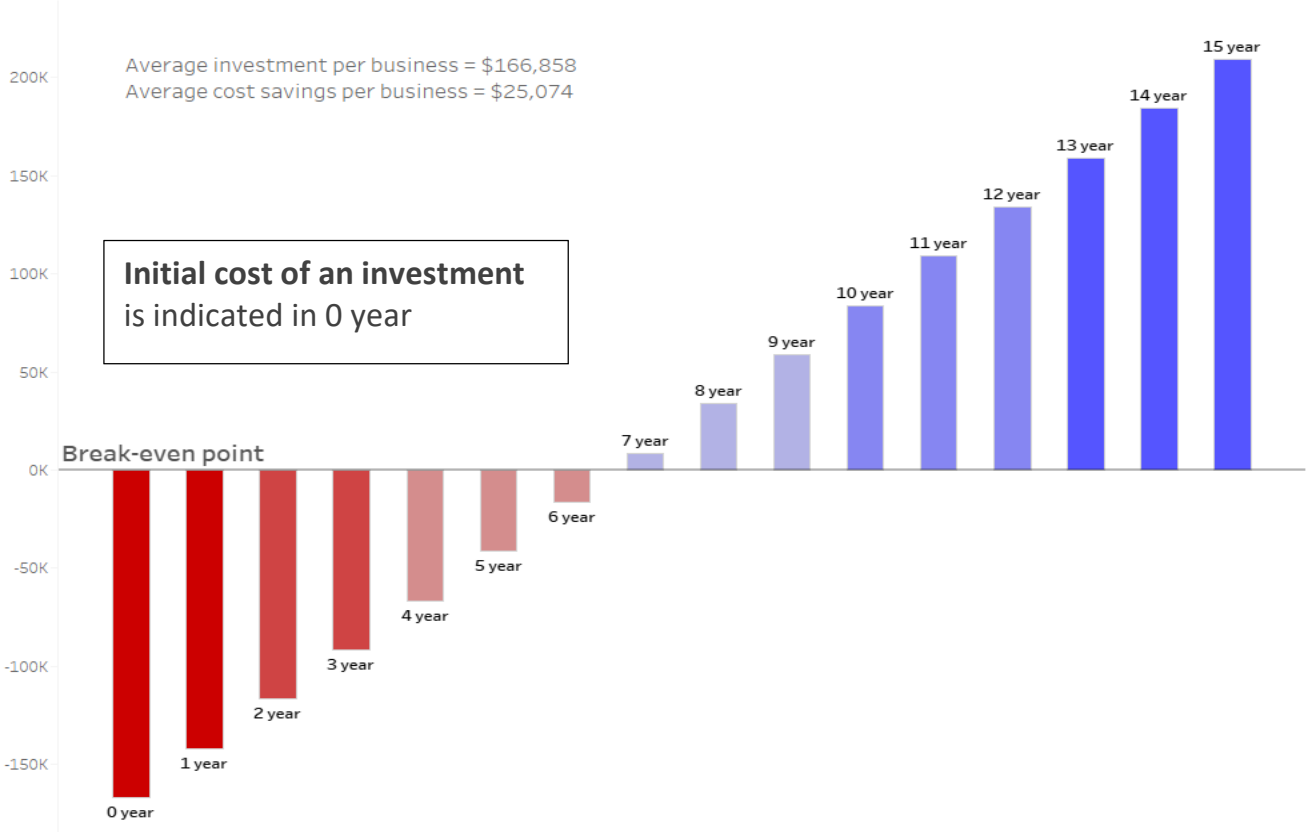
Potential applications

- Incorporating city specific targets might be useful to see how SME emissions reductions can help achieve targets.

Payback period analysis

Payback period analysis was proposed to show how long it takes for SMEs to recover the cost of investing in emissions reductions. The following example employed Climate Smart case study data. To calculate the payback period, average investment amount per business and average cost savings per business (assumed as annual reduction) were used. The example data used are presented in appendix B.

<Payback period>



Break-even point is the point where total cost and profit become equal. From this point, the cost is recovered and profit is gained. A year after reaching this point is considered an average payback period.

E.g., average payback period is 7 years in this example

Annual cost recovery is estimated based on the average cost savings. For example,

Cost recovery in year 1 = Initial cost of an investment – average cost savings*1

Cost recovery in year 2 = Initial cost of an investment – average cost savings*2

Potential applications

- Payback period by emissions reduction strategies (e.g., payback period for changing LED lighting) can be estimated.
- With city-specific data for investment and cost savings, city-level payback period can be estimated.

Things to consider

- To apply payback period in the BEEP, data for cost savings should be annualized.
- The expected cost savings may be different every year. In such cases, the method for payback period with uneven cash flows can be considered.
- For a more accurate prediction, other factors such as asset life span, additional investment, and cash flow complexity can be taken account for in the analysis.

Objective 3: Recommendations on cost savings method

This objective reviewed methods for quantifying cost savings associated with emissions, and provided recommendations on the process to estimate cost savings.

Current approach

The current approach was summarized and reviewed with a hypothetical example.

- The current approach calculates cost savings based on costs for commodities (e.g., electricity, natural gas, waste, paper, jet fuel, gasoline, diesel). Locally-specific commodity costs (e.g., BC-based costs) are researched and averaged across multiple years (i.e., 2006 - 2010) and regions. For example,

Commodity	Average commodity cost per unit
Gasoline	$1.023 (/L)
Diesel	$1.025 (/L)
Propane	$0.898 (/L)

- The commodity costs are then linked with the Climate Smart data (average usage for each commodity, annual reduction rate, number of businesses) to calculate cost savings as follows:

Commodity	Total usage (unit)	Commodity cost per unit	Total cost	Annual reduction rate	**Cost savings per business**	**Total cost savings per business**
Gasoline	1,367,020	$ 1.023	$ 1,398,461	-5.80%	**- $317**	
Diesel	447,126	$ 1.025	$ 458,304	-5.80%	**- $104**	
Propane	1,653,078	$ 0.898	$ 1,484,464	-5.80%	**- $336**	**- $757**

- Total cost = Total usage*Commodity cost per unit
- Cost savings = (Total cost*Annual reduction rate)/Number of businesses (Number of businesses is set to be 256 in the current approach)

Recommendations

1. Update data

Update the commodity costs: The current approach is based on the commodity prices researched in 2006-2010. It is recommended to research and update recent locally-specific commodity prices for calculating cost savings. Yearly updates would be ideal.

Update usage and reduction rate with the recent Climate Smart inventory data: The usage data and reduction rate in the current approach may be based on the old data. If so, it is recommended to use the recent inventory data and update commodity usage data and reduction rate.

2. Cost savings broken down by various factors

Further analysis broken down by various factors such as sector, business size, and reductions strategies is recommended. This would be beneficial to provide a deeper understanding on the pattern of cost savings internally and externally. Specifically, the following analyses are recommended.

Cost savings by sector. Cost savings by sector would highlight sector-specific cost savings and explain how cost savings differ among business sectors. This analysis can be conducted based on sector specific average usages and annual reduction rates. See the example analysis in Appendix C.

Cost savings by business size. Cost savings by business size would help compare cost savings between different business sizes and evaluate sensitivity. See the example analysis in Appendix D.

Cost savings by reduction strategy. This analysis would be useful to understand the connection between reduction strategies and cost savings. Specifically, it would help identify reduction strategies that can lead to large cost savings. See the example analysis in Appendix E.

5. Next steps

Several next steps are suggested for the Climate Smart team.

Consider applying the concepts in the BEEP

- In this project, several concepts were developed to present quantitative and qualitative data, including key insights, emissions profiles for business owners, and interactive reductions analysis. The Climate Smart team may consider applying the concepts in the BEEP dashboard.

Examine feasibility of potential analysis

- Decarbonization profiles and payback period analysis were proposed as potential analysis. The Climate Smart team may further examine the feasibility of these analyses in the BEEP.

Update underlying methods

- This project reviewed underlying methods on cost savings and provided several recommendations. The Climate Smart team may consider updating the current method based on the recommendations.

6. References

Sustainability Scholars Program. (2019, January 9). UBC Sustainability. https://sustain.ubc.ca/teaching-applied-learning/ubc-sustainability-scholars-program

Appendix

Appendix A. Decarbonization profile example data

EIE_total emissions	BEEP_total SME emission estimate	BEEP_avg_annual SME reduction	Predicted SME emission reduction	Predicted total SME emission in city	Predicted total SME emission	Predicted city total emission
282000	**68957.0**	**25.1%**		24.5%	**68957.0**	**282000**
	68957.0	**25.1%**	17308	19.5%	**51649**	264692
264691.8	51648.8	25.1%	12964	15.4%	**38685**	251728
251727.9	38684.9	25.1%	9710	12.0%	**28975**	242018
242018.0	28975.0	25.1%	7273	9.2%	**21702**	234745
234745.3	21702.3	25.1%	5447	7.1%	**16255**	229298
229298.0	16255.0	25.1%	4080	5.4%	**12175**	225218
225218.0	12175.0	25.1%	3056	4.1%	**9119**	222162
222162.1	9119.1	25.1%	2289	3.1%	**6830**	219873
219873.2	6830.2	25.1%	1714	2.3%	**5116**	218159
218158.8	5115.8	25.1%	1284	1.8%	**3832**	216875
216874.7	3831.7	25.1%	962	1.3%	**2870**	215913
215913.0	2870.0	25.1%	720	1.0%	**2150**	215193
215192.6	2149.6	25.1%	540	0.8%	**1610**	214653
214653.1	1610.1	25.1%	404	0.6%	**1206**	214249
214248.9	1205.9	25.1%	303	0.4%	**903**	213946
213946.2	903.2	25.1%	227	0.3%	**677**	213720
213719.5	676.5	25.1%	170	0.2%	**507**	213550
213549.7	506.7	25.1%	127	0.2%	**380**	213423
213422.5	379.5	25.1%	95	0.1%	**284**	213327
213327.3	284.3	25.1%	71	0.1%	**213**	213256
213255.9	212.9	25.1%	53	0.1%	**159**	213202

❯ Appendix B. Payback period example data

Year	Cost recovery	Benefit point
0	0	-166858
1	25074	-141784
2	50147	-116711
3	75221	-91637
4	100294	-66564
5	125368	-41490
6	150441	-16417
7	175515	8657
8	200588	33730
9	225662	58804
10	250735	83877
11	275809	108951
12	300883	134025
13	325956	159098
14	351030	184172
15	376103	209245

❱ Appendix C. Cost savings by sector

Sector	Commodity	Total usage (unit)	Commodity cost per unit	Total Cost	Annual reduction rate	**Cost savings per business**	**Total cost savings per business**
Sector A	Gasoline	367,020	$ 1.023	$ 375,461.46	-12.80%	- $187.73	
	Diesel	47,126	$ 1.025	$ 48,304.15	-12.80%	- $24.15	
	Propane	653,078	$ 0.898	$ 586,464.04	-12.80%	- $293.23	- $505.11
Sector B	Gasoline	25,123	$ 1.023	$ 25,700.83	-7.50%	- $7.53	
	Diesel	60,342	$ 1.025	$ 61,850.55	-7.50%	- $18.12	
	Propane	15,223	$ 0.898	$ 13,670.25	-7.50%	- $4.00	- $29.65
Sector C	Gasoline	6,342	$ 1.023	$ 6,487.87	-10.10%	- $2.56	
	Diesel	8,692	$ 1.025	$ 8,909.30	-10.10%	- $3.51	
	Propane	12,345	$ 0.898	$ 11,085.81	-10.10%	- $4.37	- $10.45

❱ Appendix D. Cost savings by business size

Range of employees	Commodity	Total usage (unit)	Commodity cost per unit	Total cost	Annual reduction rate	**Cost savings per business**	**Total cost savings per business**
1-49	Gasoline	18,342	$ 1.023	$ 18,763.87	-5.80%	- $4.25	
	Diesel	9,692	$ 1.025	$ 9,934.30	-5.80%	- $2.25	
	Propane	12,345	$ 0.898	$ 11,085.81	-5.80%	- $2.51	- $9.01
50-199	Gasoline	125,123	$ 1.023	$ 128,000.83	-5.80%	- $29.00	
	Diesel	160,342	$ 1.025	$ 164,350.55	-5.80%	- $37.24	
	Propane	115,223	$ 0.898	$ 103,470.25	-5.80%	- $23.44	- $89.68
200-499	Gasoline	367,020	$ 1.023	$ 375,461.46	-5.80%	- $85.07	
	Diesel	345,126	$ 1.025	$ 353,754.15	-5.80%	- $80.15	
	Propane	653,078	$ 0.898	$ 586,464.04	-5.80%	- $132.87	- $298.08

❱ Appendix E. Cost savings by reduction strategies

Reduction strategies	Commodity	Total usage (unit)	Commodity cost per unit	Total cost	Annual reduction rate	**Cost savings per business**	**Total cost savings per business**
Paper related	Gasoline	18,342	$ 1.023	$ 18,763.87	-5.80%	- $4.25	
	Diesel	9,692	$ 1.025	$ 9,934.30	-5.80%	- $2.25	
	Propane	12,345	$ 0.898	$ 11,085.81	-5.80%	- $2.51	- $9.01
Lighting related	Gasoline	125,123	$ 1.023	$ 128,000.83	-5.80%	- $29.00	
	Diesel	130,342	$ 1.025	$ 133,600.55	-5.80%	- $30.27	
	Propane	15,223	$ 0.898	$ 13,670.25	-5.80%	- $3.10	- $62.37
Transportation related	Gasoline	1,367,020	$ 1.023	$ 1,398,461.46	-5.80%	- $316.84	
	Diesel	545,126	$ 1.025	$ 558,754.15	-5.80%	- $126.59	
	Propane	653,078	$ 0.898	$ 586,464.04	-5.80%	- $132.87	- $576.30