CITY OF VANCOUVER

CITY CLERK'S DEPARTMENT
Access to Information & Privacy Division

File No.: 04-1000-20-2021-517

October 14, 2021

s.22(1)

Dear s.22(1)

Re: **Request for Access to Records under the Freedom of Information and Protection of Privacy Act (the "Act")**

I am responding to your request of October 5, 2021 for:

> **A report, "Analysis and Mapping of Housing and Energy Data to Inform Policy Development" by Lightspark Software Inc. 2020, as shown in another report named "Climate Emergency Action Plan" on the October 22, 2020 in Appendix J on page 71.**

All responsive records are attached.

Under section 52 of the Act, and within 30 business days of receipt of this letter, you may ask the Information & Privacy Commissioner to review any matter related to the City's response to your FOI request by writing to: Office of the Information & Privacy Commissioner, info@oipc.bc.ca or by phoning 250-387-5629.

If you request a review, please provide the Commissioner's office with: 1) the request number (#04-1000-20-2021-517); 2) a copy of this letter; 3) a copy of your original request; and 4) detailed reasons why you are seeking the review.

Yours truly,

[Signature on file]

Barbara J. Van Fraassen, BA
Director, Access to Information & Privacy
Barbara.vanfraassen@vancouver.ca
453 W. 12th Avenue Vancouver BC V5Y 1V4

*If you have any questions, please email us at foi@vancouver.ca and we will respond to you as soon as possible. Or you can call the FOI Case Manager at 604.871.6584.

Encl.

:ag

Analysis and Mapping of Housing and Energy Data to Inform Policy Development

For: Brady Faught, City of Vancouver, Sustainability
By: Andrew Wiebe, James Riley, Lightspark Software Inc.
Date: November 25th, 2019

Lightspark

Definitions

Type 1 and 2 Family Dwellings Determine the number of dwellings (1&2 Family), heating systems, energy use in the City of Vancouver

Archetype A data methodology used to define a grouping of housing types

FSA The first three letters of a postal code, called a "Forward Sortation Area"

Average Annual Energy Costs Average electricity and natural gas usage

tC02e Tonnes of carbon dioxide equivalent, which is a measure that allows you to compare the emissions of other greenhouse gases relative to one unit of CO2

GJ GigaJoule a unit of energy

Data Outcomes

1. **GHG Analysis:** How much CO_2e is emitted within the City of Vancouver by 1 & 2 Family Homes. Where are the CO_2e hot spots, what type of homes are the large emitters

2. **Energy Analysis:** How many GJ of energy are consumed within the City of Vancouver by 1 & 2 Family Homes. Where are the energy hot spots, what type of homes are the large energy consumers

3. **Energy Burden:** Where does the cost of energy exceed 10% of the average income. What type of homes are associated with high energy burdens.

Executive Summary

Carbon Reduction Opportunity

The data shows that there are 2 Archetypes (E and F) that contribute the most tCO2e within the City of Vancouver. Thes archetypes are found throughout all FSA' s and account for 81% of the housing stock and 95% of the tCO2e emitted by 1 & 2 Family homes.

Potential tCO2e Reduced

71%

if all Archetype E and F homes upgraded to a Heat Pump the cities carbon footprint would be reduced by 300,114 tCO2e

Potential GJ Reduced

56%

if all Archetype E and F homes upgraded to a Heat Pump the cities energy footprint would be reduced by 6,061,531 GJ

Potential increase in Energy Burden

NA

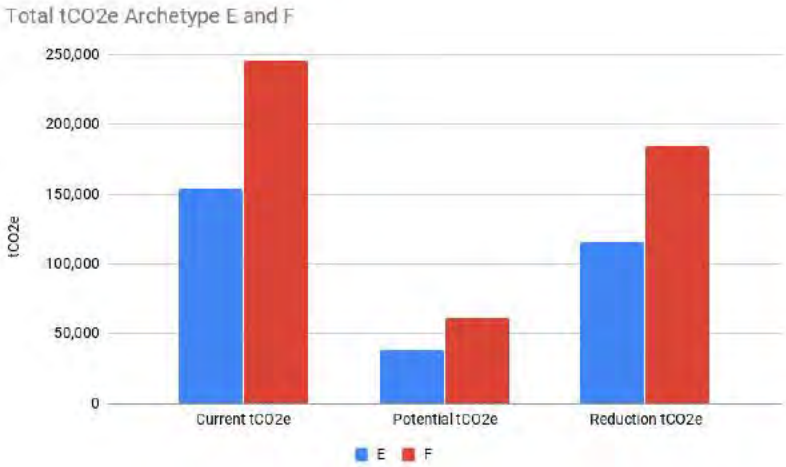
Energy Burden for these archetypes average less than 3% and this is not expected to increase with the addition of a Heat Pump

CITY OF VANCOUVER

Lightspark

Key Insights: Carbon Reduction

- There is a strong opportunity to reduce carbon using in two key archetypes, across all FSAs using electric heat pumps as a solution - E and F
  - Current carbon usage (tonnes)
    - E - 154,043 tCO2e
    - F - 246,108 tCO2e
  - **Total emission - 400,152 tCO2e**
  - Potential carbon reductions achieved by upgrading archetype E and F primary heating source to a tier 2 heat pump:
    - E - 115,533 tCO2e
    - F - 184,581 tCO2e
  - **Total reduction - 300,114 tCO2e**
- The highest energy usage is within archetypes I and G



CITY OF VANCOUVER

Lightspark

Energy Burden

Energy Burden is the percentage of income spent on heating/cooling

Archetypes I and G have the highest burden.

Using V5K as an example, 4.5% of the average income is spent on the heating and cooling bill in Archetype I

In Archetype G, 3.4% is spent on heating and cooling.

However, I and G only account for 8.9% (465) of the dwellings in V5K

Archetype Generation

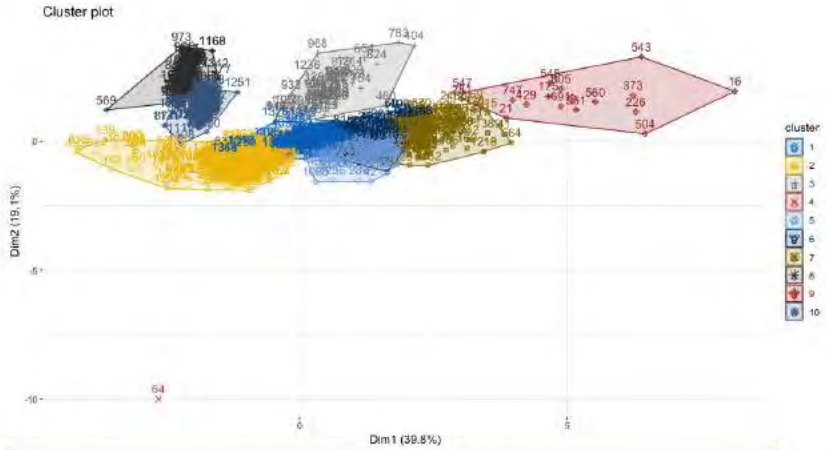
EnerGuide Home Audit

01

Over 20,000 EnerGuide home audits have been conducted on single detached dwellings within the city of Vancouver in the past 10 years. Lightspark utilised an unsupervised machine learning algorithm to sort the audit data into clusters of dwelling types that exhibited similar characteristics, such as year built, size, location, energy consumption and tCO2e production.

Client Implications:

9 clusters were identified as representative of the City of Vancouver's housing stock: Archetype A - I



Dwelling Clusters

A total of ten clusters were identified. One cluster was represented by 2 dwellings with Propane or Oil based heating systems. With 20,924 dwellings audited this cluster was removed from the analysis.

CITY OF VANCOUVER

Lightspark

Archetype A

02

Large multi-storey homes, built post 2000 but mostly post 2010. These homes are Natural Gas heated with high efficiency furnaces and high efficiency natural gas hot water systems. They have high levels of insulation in the ceiling, walls and foundation, as well as energy star rated windows and doors.

Average annual energy costs: $1,927

Client Implications:

These homes are energy efficient considering their size and produce **3.5 tCO2e** on average. They represent 20.5% of dwellings that have been audited and only 6% of the housing stock in the City of Vancouver.

Variable	Archetype A
Decade Built	2000-2010
Floor Area (m2)	294.9
Primary Heat Source	Condensing Boiler/Furnace
Primary Fuel Type	Natural Gas
Primary Efficiency (%)	95
Heat Pump	No
Hot Water System	Instantaneous-condensing
Hot Water Fuel Type	Natural Gas
Hot Water Efficiency (%)	0.82
Ventilation Type	Heat Recovery Ventilator
Ceiling Insulation (RSI)	6.48
Wall Insulation (RSI)	3.43
Foundation Insulation (RSI)	2.75
Windows	32
Doors	3
Windows (RSI)	0.82
Doors (RSI)	0.89
Electricity Consumption (kWh)	9017.52
Natural Gas Consumption (GJ)	66.33
Energy Score (GJ)	98.79
Carbon Score (tCO2e)	3.52

CITY OF VANCOUVER

Lightspark

Archetype B

03

Extra large multi-storey homes, built post 2000 but mostly post 2010. These homes are Natural Gas heated with high efficiency furnaces and moderately efficient natural gas hot water systems. They have lower levels of insulation in the ceiling, walls and foundation than the Archetype A dwellings and do not have energy star rated windows and doors.

Average annual energy costs: $2,383

Client Implications:

These homes are relatively energy efficient for their size and produce **6.6 tCO2e** on average. They represent 8% of dwellings that have been audited and only 0.9% of the housing stock in the City of Vancouver.

Variable	Archetype B
Decade Built	2000-2010
Floor Area (m2)	394.6
Primary Heat Source	Condensing boiler
Primary Fuel Type	Natural Gas
Primary Efficiency (%)	95
Heat Pump	No
Hot Water System	Direct vent (sealed)
Hot Water Fuel Type	Natural Gas
Hot Water Efficiency (%)	0.79
Ventilation Type	Heat Recovery Ventilator
Ceiling Insulation (RSI)	6.16
Wall Insulation (RSI)	2.87
Foundation Insulation (RSI)	2.42
Windows	32
Doors	3
Windows (RSI)	0.69
Doors (RSI)	0.72
Electricity Consumption (kWh)	9235.20
Natural Gas Consumption (GJ)	124.24
Energy Score (GJ)	157.48
Carbon Score (tCO2e)	6.57

Archetype C

04

Small single to 1.5 storey homes, built post 2010. These homes are Natural Gas heated with high efficiency furnaces and instantaneous natural gas hot water systems. They have moderate levels of insulation in the ceiling, walls and foundation and energy star rated windows and doors.

Average annual energy costs: $1,612

Client Implications:

These homes are energy intensive using nearly 1 GJ of energy per square meter and produce **1.5 tCO2e** on average. They represent 2.5% of dwellings that have been audited and 1% of the housing stock in the City of Vancouver.

Variable	Archetype C
Decade Built	2010
Floor Area (m2)	65
Primary Heat Source	Condensing Boiler
Primary Fuel Type	Natural Gas
Primary Efficiency (%)	95
Heat Pump	No
Hot Water System	Instantaneous
Hot Water Fuel Type	Natural Gas
Hot Water Efficiency (%)	0.79
Ventilation Type	25% HRV, 25% Fans, 50% None
Ceiling Insulation (RSI)	5.00
Wall Insulation (RSI)	3.57
Foundation Insulation (RSI)	3.30
Windows	24
Doors	3
Windows (RSI)	0.82
Doors (RSI)	0.89
Electricity Consumption (kWh)	8854.30
Natural Gas Consumption (GJ)	26.70
Energy Score (GJ)	38.97
Carbon Score (tCO2e)	1.50

Archetype D

05

Small single to 1.5 storey homes, built post 2010. These homes are electrically heated with baseboards/hydronic/plenum and electric conserver hot water systems. They have moderate levels of insulation in the ceiling, walls and foundation and energy star rated windows and doors.

Average annual energy costs: $2,136

Client Implications:

These homes are energy intensive using nearly 1 GJ of energy per square meter but produce only **0.2 tCO2e** on average. They represent 0.33% of dwellings that have been audited and 0.3% of the housing stock in the City of Vancouver.

Variable	Archetype D
Decade Built	2010
Floor Area (m2)	60
Primary Heat Source	Baseboard/Hydronic/Plenum
Primary Fuel Type	Electricity
Primary Efficiency (%)	100
Heat Pump	No
Hot Water System	Conserver Tank
Hot Water Fuel Type	Electricity
Hot Water Efficiency (%)	0.86
Ventilation Type	None
Ceiling Insulation (RSI)	5.00
Wall Insulation (RSI)	3.48
Foundation Insulation (RSI)	3.50
Windows	24
Doors	3
Windows (RSI)	0.82
Doors (RSI)	0.89
Electricity Consumption (kWh)	14990.00
Natural Gas Consumption (GJ)	0.00
Energy Score (GJ)	53.96
Carbon Score (tCO2e)	0.19

Archetype E
06

Large multi-storey homes, built pre-1950. These homes are natural gas heated with natural gas hot water systems. They have low levels of insulation in the ceiling, walls and foundation and do not contain energy star rated windows and doors.

Average annual energy costs: $2,831

Client Implications:
These homes are very energy intensive and produce **9.6 tCO2e** on average. They represent 8% of dwellings that have been audited and 27% of the housing stock in the City of Vancouver.

Variable	Archetype E
Decade Built	pre-1950
Floor Area (m2)	226
Primary Heat Source	Furnace Continuous Pilot
Primary Fuel Type	Natural Gas
Primary Efficiency (%)	80
Heat Pump	No
Hot Water System	Conventional (pilot)
Hot Water Fuel Type	Natural Gas
Hot Water Efficiency (%)	0.554
Ventilation Type	None
Ceiling Insulation (RSI)	2.17
Wall Insulation (RSI)	1.22
Foundation Insulation (RSI)	0.92
Windows	24
Doors	3
Windows (RSI)	0.39
Doors (RSI)	0.59
Electricity Consumption (kWh)	9325.20
Natural Gas Consumption (GJ)	183.39
Energy Score (GJ)	216.96
Carbon Score (tCO2e)	9.64

Archetype F

06

Large multi-storey homes, built between 1950 and 1990. These homes are natural gas heated with natural gas hot water systems. They have low levels of insulation in the ceiling, walls and foundation and do not contain energy star rated windows and doors.

Average annual energy costs: $2,383

Client Implications:

These homes are energy intensive and produce **6.6 tCO2e** on average. They represent 46% of dwellings that have been audited and 54% of the housing stock in the City of Vancouver.

Variable	Archetype F
Decade Built	1950-1990
Floor Area (m2)	218
Primary Heat Source	Boiler/Furnace Continuous Pilot
Primary Fuel Type	Natural Gas
Primary Efficiency (%)	80
Heat Pump	No
Hot Water System	Conventional Tank (pilot)
Hot Water Fuel Type	Natural Gas
Hot Water Efficiency (%)	0.554
Ventilation Type	None
Ceiling Insulation (RSI)	3.19
Wall Insulation (RSI)	1.77
Foundation Insulation (RSI)	0.98
Windows	32
Doors	3
Windows (RSI)	0.69
Doors (RSI)	0.72
Electricity Consumption (kWh)	9151.20
Natural Gas Consumption (GJ)	125.85
Energy Score (GJ)	158.80
Carbon Score (tCO2e)	6.60

Archetype G

07

Large multi-storey homes, built between 1950 and 1990. These homes are electrically heated with baseboards/hydronic/plenum and conventional electric hot water systems. They have moderate to low levels of insulation in the ceiling, walls and foundation and do not contain energy star rated windows and doors.

Average annual energy costs: $3,934

Client Implications:

These homes are relatively energy intensive for their size but only produce **0.57 tCO2e** on average. They represent 0.9% of dwellings that have been audited and 5.6% of the housing stock in the City of Vancouver.

Variable	Archetype G
Decade Built	1950-1990
Floor Area (m2)	212.5
Primary Heat Source	Baseboard/Hydronic/Plenum
Primary Fuel Type	Electricity
Primary Efficiency (%)	100
Heat Pump	No
Hot Water System	Conventional Tank
Hot Water Fuel Type	Electricity
Hot Water Efficiency (%)	0.82
Ventilation Type	None
Ceiling Insulation (RSI)	4.14
Wall Insulation (RSI)	1.95
Foundation Insulation (RSI)	1.68
Windows	32
Doors	3
Windows (RSI)	0.69
Doors (RSI)	0.72
Electricity Consumption (kWh)	27675.20
Natural Gas Consumption (GJ)	0.00
Energy Score (GJ)	99.63
Carbon Score (tCO2e)	0.57

Archetype H
08

Large multi-storey homes, built within the last decade (2010). These homes are electrically heated with baseboards/hydronic/plenum and conventional electric hot water systems. They have moderate to high levels of insulation in the ceiling, walls and foundation and contain energy star rated windows and doors.

Average annual energy costs: $2,089

Client Implications:
These homes are energy efficient and only produce **0.22 tCO2e** on average. They represent 12.5% of dwellings that have been audited and only 1% of the housing stock in the City of Vancouver.

Variable	Archetype H
Decade Built	2010
Floor Area (m2)	219
Primary Heat Source	Baseboard/Hydronic/Plenum
Primary Fuel Type	Electricity
Primary Efficiency (%)	100
Heat Pump	No
Hot Water System	Conventional Tank
Hot Water Fuel Type	Electricity (96%)/Natural Gas 4%
Hot Water Efficiency (%)	0.86
Ventilation Type	Yes (63%)/No (37%)
Ceiling Insulation (RSI)	5.09
Wall Insulation (RSI)	3.48
Foundation Insulation (RSI)	0.2985
Windows	16
Doors	3
Windows (RSI)	0.82
Doors (RSI)	0.89
Electricity Consumption (kWh)	14653
Natural Gas Consumption (GJ)	0
Energy Score (GJ)	63
Carbon Score (tCO2e)	0.2198

Archetype I

09

Large multi-storey homes, built pre-1950. These homes are electrically heated with baseboards/hydronic/plenum and conventional natural gas hot water systems. They have low levels of insulation in the ceiling, walls and foundation and do not contain energy star rated windows and doors.

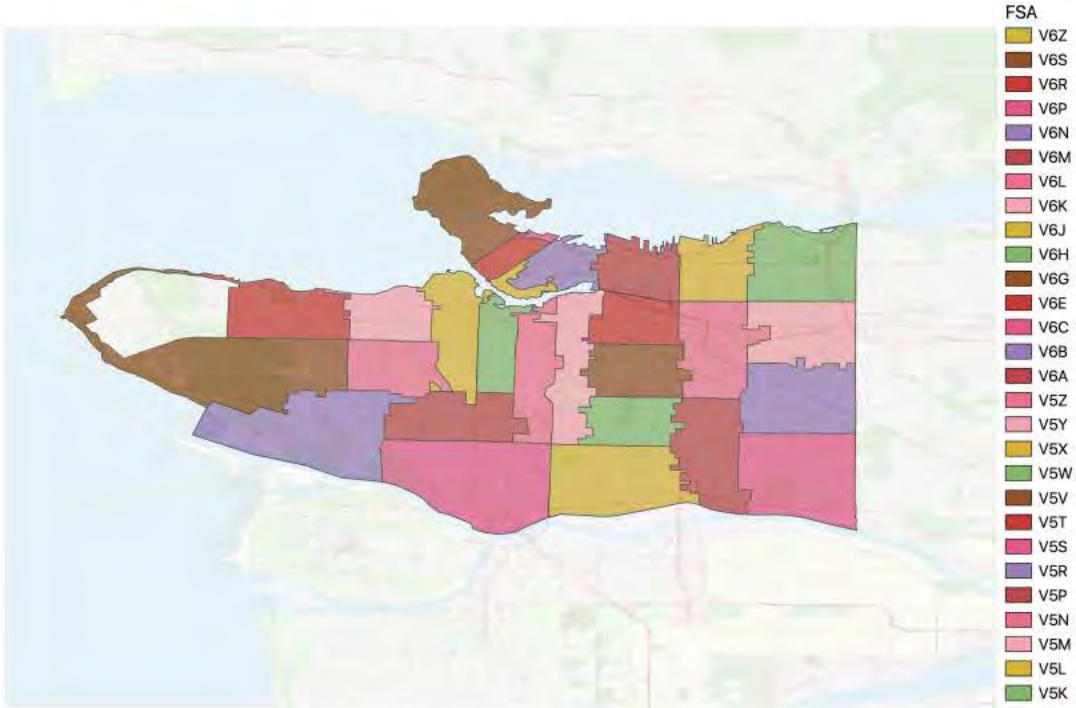
Average annual energy costs: $4,982

Client Implications:

These homes are energy intensive and produce **1.3 tCO2e** on average. They represent 0.9% of dwellings that have been audited and 4.5% of the housing stock in the City of Vancouver.

Variable	Archetype I
Decade Built	Pre-1950
Floor Area (m2)	196
Primary Heat Source	Baseboard/Hydronic/Plenum
Primary Fuel Type	Electricity
Primary Efficiency (%)	100
Heat Pump	No
Hot Water System	Conventional tank/pilot
Hot Water Fuel Type	Electricity (62%)/Natural Gas (38%)
Hot Water Efficiency (%)	0.74
Ventilation Type	None
Ceiling Insulation (RSI)	3.08
Wall Insulation (RSI)	1.57
Foundation Insulation (RSI)	1.41
Windows	20
Doors	3
Windows (RSI)	0.39
Doors (RSI)	0.59
Electricity Consumption (kWh)	33121
Natural Gas Consumption (GJ)	17.4
Energy Score (GJ)	137
Carbon Score (tCO2e)	1.32

City of Vancouver FSA Level



Forward sortation areas (FSA) are the first 3 letters of a post code and provide a means to segment the city using a uniform methodology.

Number of FSA's:	21
Total number of single family dwellings:	62,984
Total tCO2e:	421,533
Average per dwelling tCO2e:	6.7
Total GJ:	10,832,177
Average per dwelling GJ:	173

Archetype Distribution

Total number of archetypal single detached dwellings in the city of Vancouver by FSA.

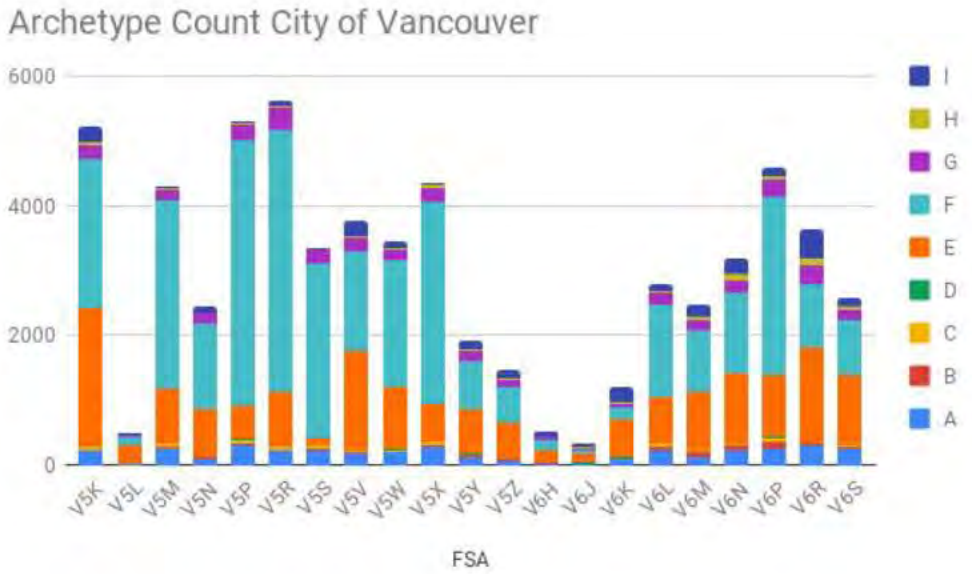
62,984 Single Detached Dwellings

9 Archetypes

Archetype F and E are the most numerous across all FSA's

E - 16,910 dwellings

F - 33,901 dwellings



Energy Distribution

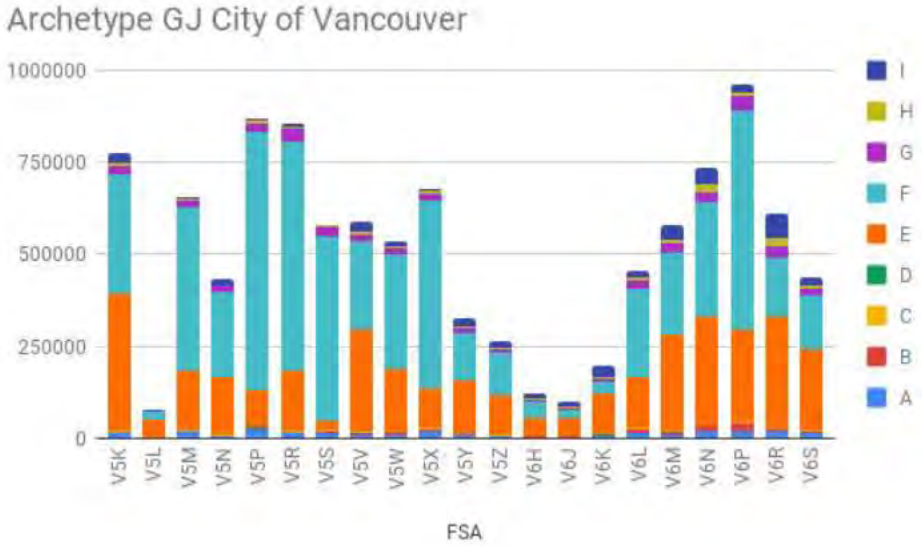
Total GJ by archetype distributed across FSA's:

10,832,177 GJ consumed

Archetype E and F consume the highest amount of energy:

E - 3,523,992 GJ

F - 5,915,745 GJ



Tonnes CO2e Distribution

Total tCO2e by archetype distributed across FSA's:

421,533 tCO2e

Archetype F and E contribute the highest amount of CO2e.

E - 154,043 tCO2e

F - 246,108 tCO2e

CITY OF VANCOUVER

Lightspark

Energy Burden Distribution

Energy burden by archetype distributed across FSA's:

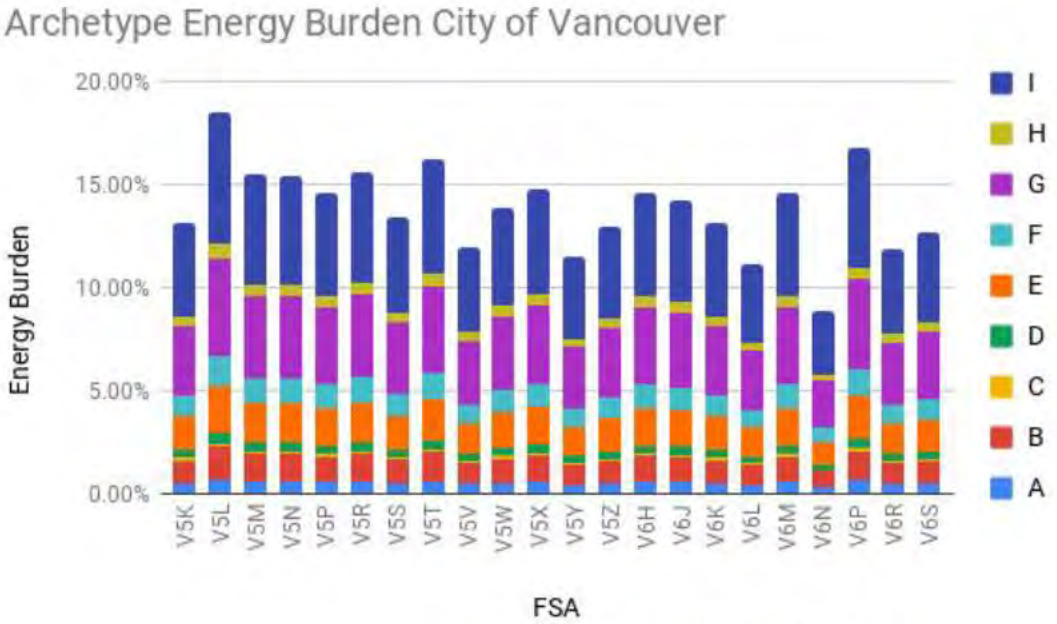
Maximum 6.35% for archetype I in FSA V5L

Average across all FSA and archetypes - 1.52%

Archetype G and I have the highest energy average burden

G - 3.52%

I - 4.72%



CITY OF VANCOUVER

Lightspark

V5K Breakdown

Total number of dwellings:
5,213 dwellings

Annual average income:
$74,645.00

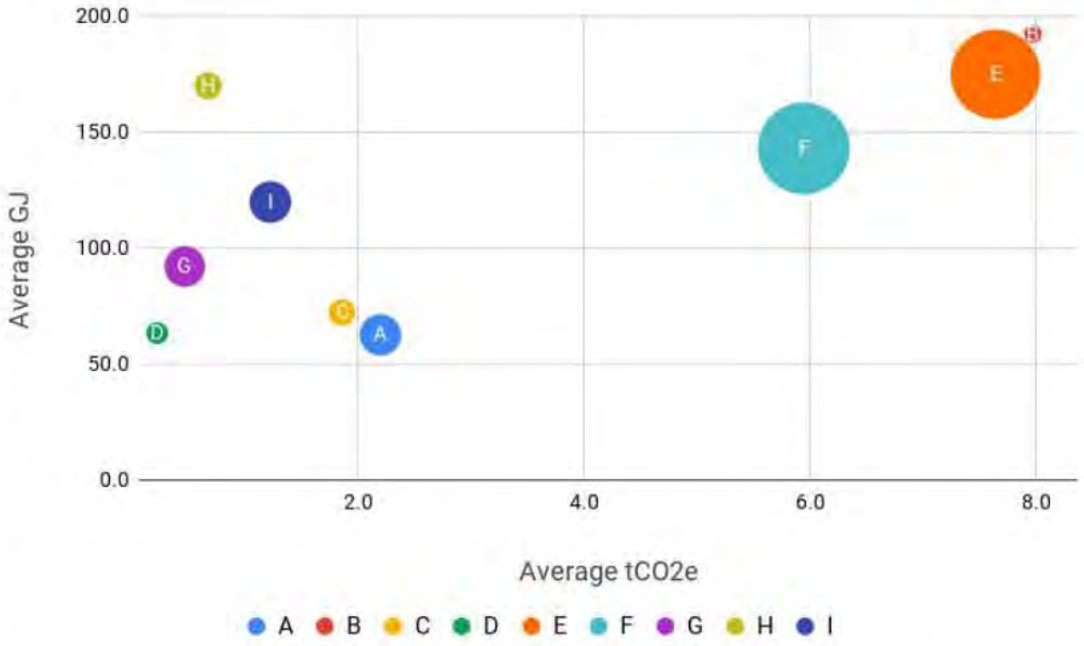
Average occupancy per dwelling:
2.7

Owner to renter ratio:
63%

Total tCO2e:
30,985

V5K Carbon and Energy by Archetype

V5K	Count	Total tCO2e	Total GJ
A	236	519	14,761
B	4	32	769
C	35	65	2,527
D	11	2	696
E	2,144	16,388	374,911
F	2,279	13,552	325,745
G	223	104	20,520
H	39	26	6,625
I	242	296	28,991
Total	5,213	30,985	775,545

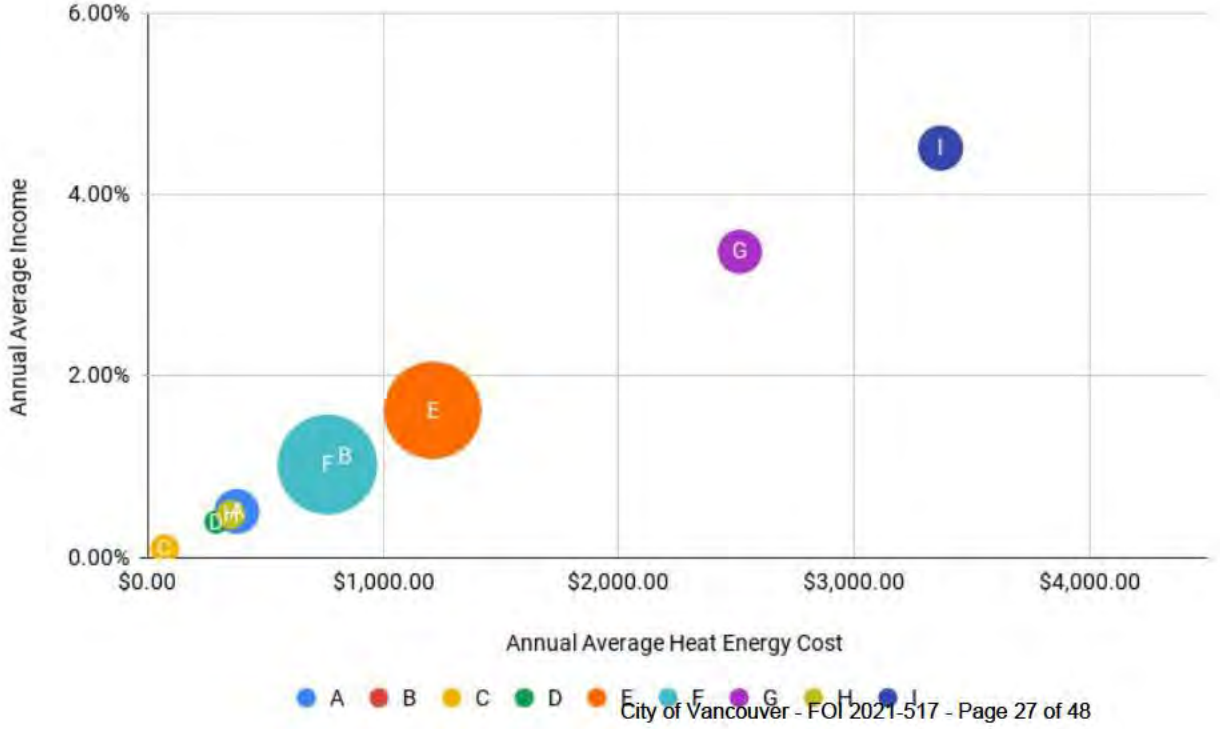


V5K Energy Burden

Energy Burden: % of income spent on heating/cooling

Archetypes I and G have the highest burden at 4.5% and 3.4%

but only account for 8.9% (465) of the dwellings in V5K



V5K Carbon Reduction Potential

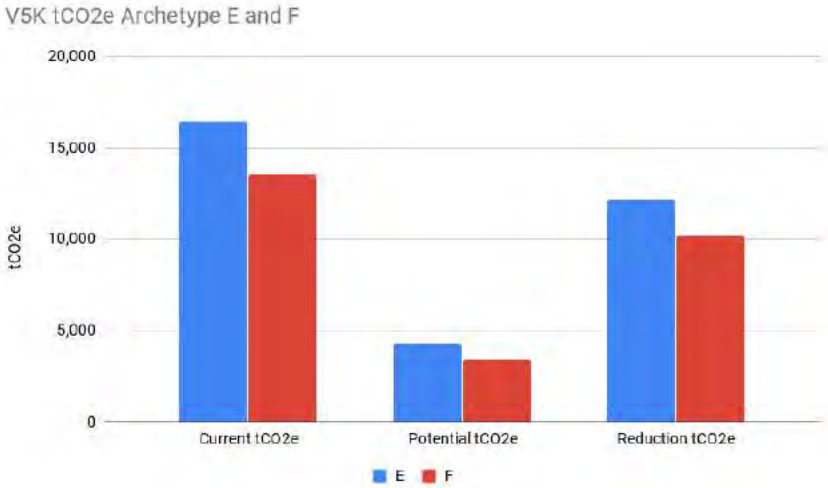
Archetype E (2,144) and F (2,279) are the most numerous dwelling types in the this FSA accounting for **85%** of all dwellings. They also account for **97%** of the total tCO2e emitted in this FSA:

Total emission - 29,939 tCO2e

Potential carbon reductions achieved by upgrading archetype E and F primary heating source to a tier 2 heat pump:

Total reduction - 22,291 tCO2e

65% reduction in total tCO2e by targeting Archetype E and F dwellings in FSA V5K



CITY OF VANCOUVER

Lightspark

V5V Breakdown

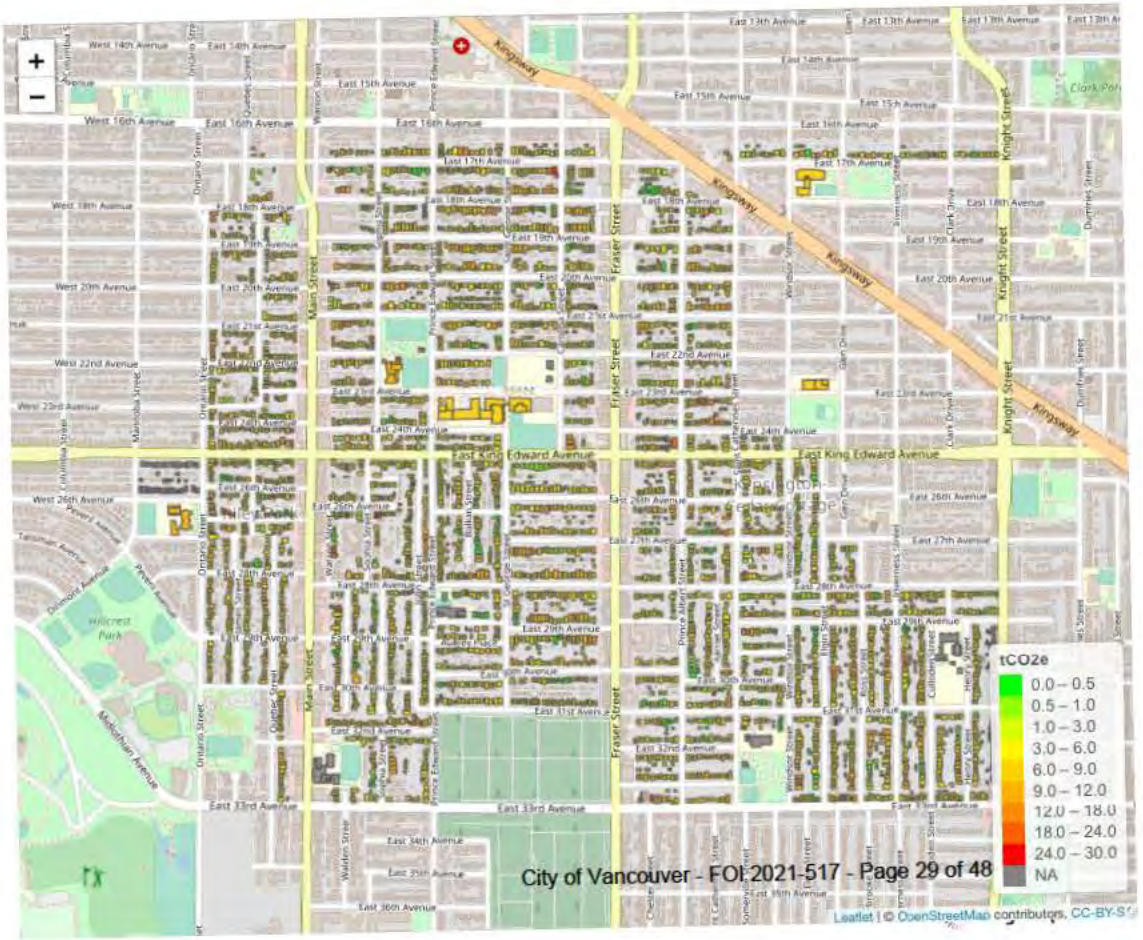
Total number of dwellings:
3,758 dwellings

Annual average income:
$81,653

Average occupancy per dwelling:
2.6

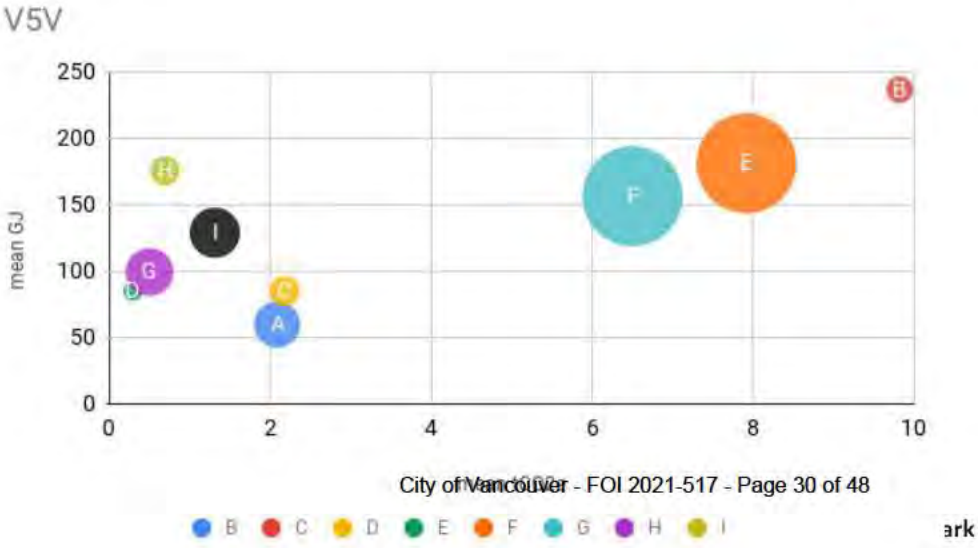
Owner to renter ratio:
61%

Total tCO2e:
23,120 tCO2e



V5V: By Archetype

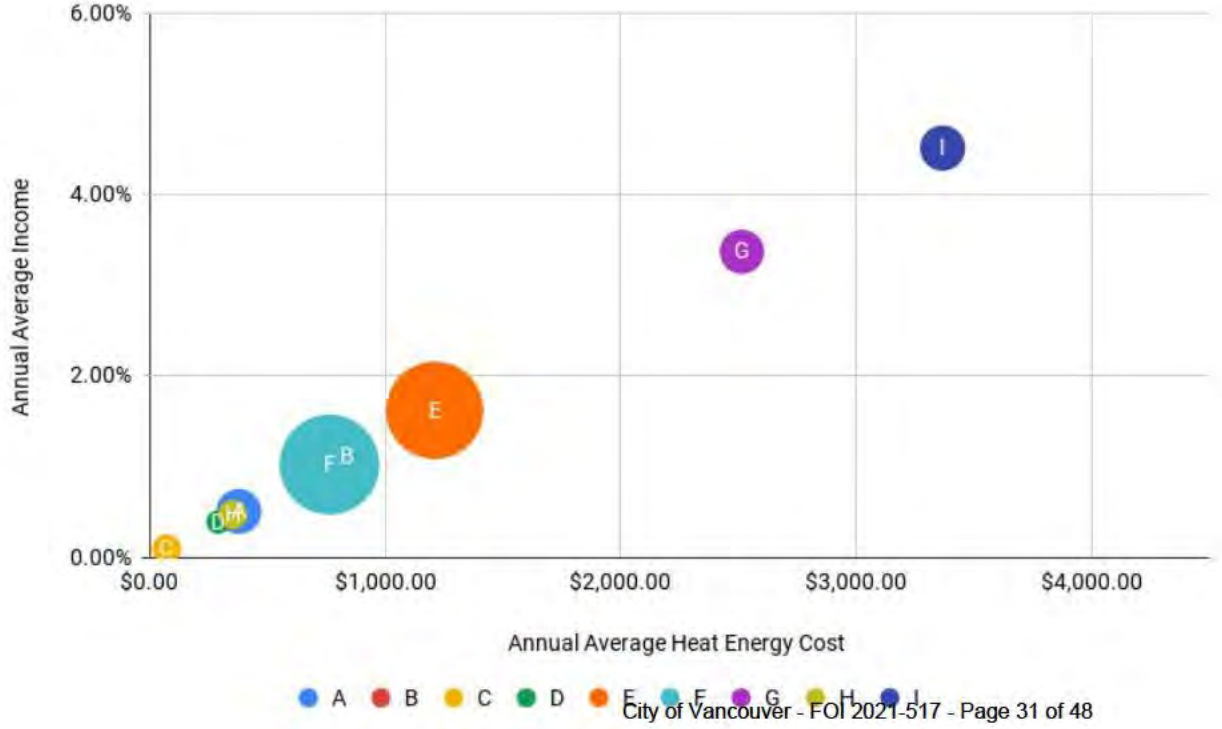
V5V	Count	Total tCO2e	Total GJ
A	176	368	10,462
B	21	206	4,971
C	35	76	2,968
D	8	2	677
E	1,525	12,074	276,204
F	1,533	9,968	239,595
G	196	99	19,434
H	32	22	5,619
I	232	305	29,868
Total	3,758	23,120	589,798



V5V: Energy Burden

Energy Burden: % of income spent on heating/cooling

Archetypes I and G have the highest burden at 4.5% and 3.4% but only account for 8.9% (465) of the dwellings in V5K



V5V

Archetype E (1,525) and F (1,533) are the most numerous dwelling types in the this FSA accounting for **81%** of all dwellings. They also account for **95%** of the total tCO2e emitted in this FSA:

Current State:
E - 12,074 tCO2e
F - 9,968 tCO2e
Total emission - 22,041 tCO2e

Potential State:
Carbon reductions achieved by upgrading archetype E and F primary heating source to a tier 2 heat pump:

E - 8,934 tCO2e
F - 7,376 tCO2e
Total reduction - 16,311 tCO2e

70% reduction in total tCO2e by targeting Archetype E and F dwellings in FSA V5V

V6J

Total number of dwellings:
329 dwellings

Annual average income:
$68,910

Average occupancy per dwelling:
1.8

Owner to renter ratio:
44%

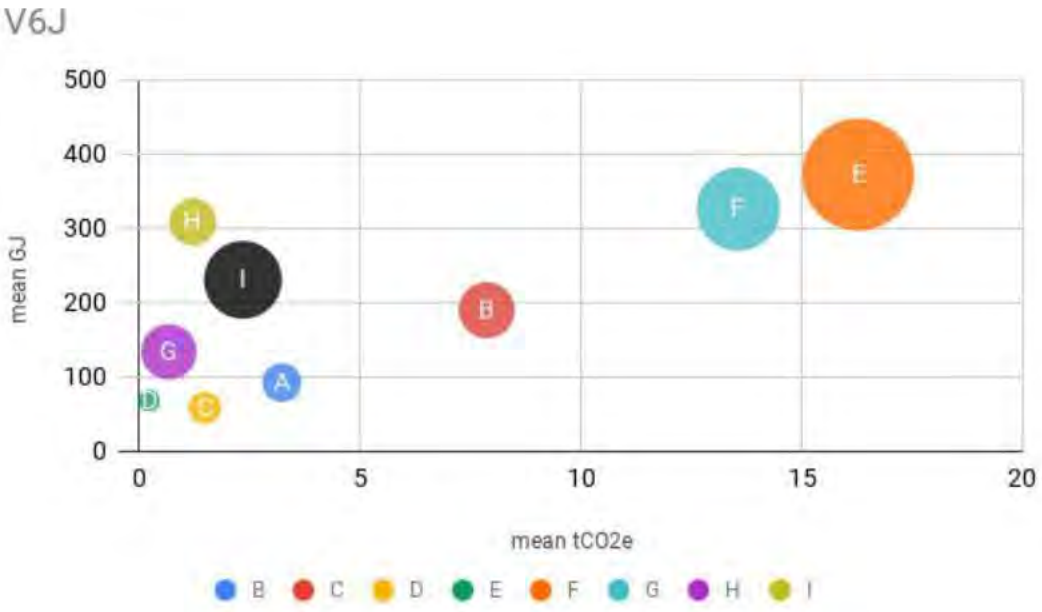
Total tCO2e:
3,520 tCO2e

CITY OF VANCOUVER

Lightspark

V6J

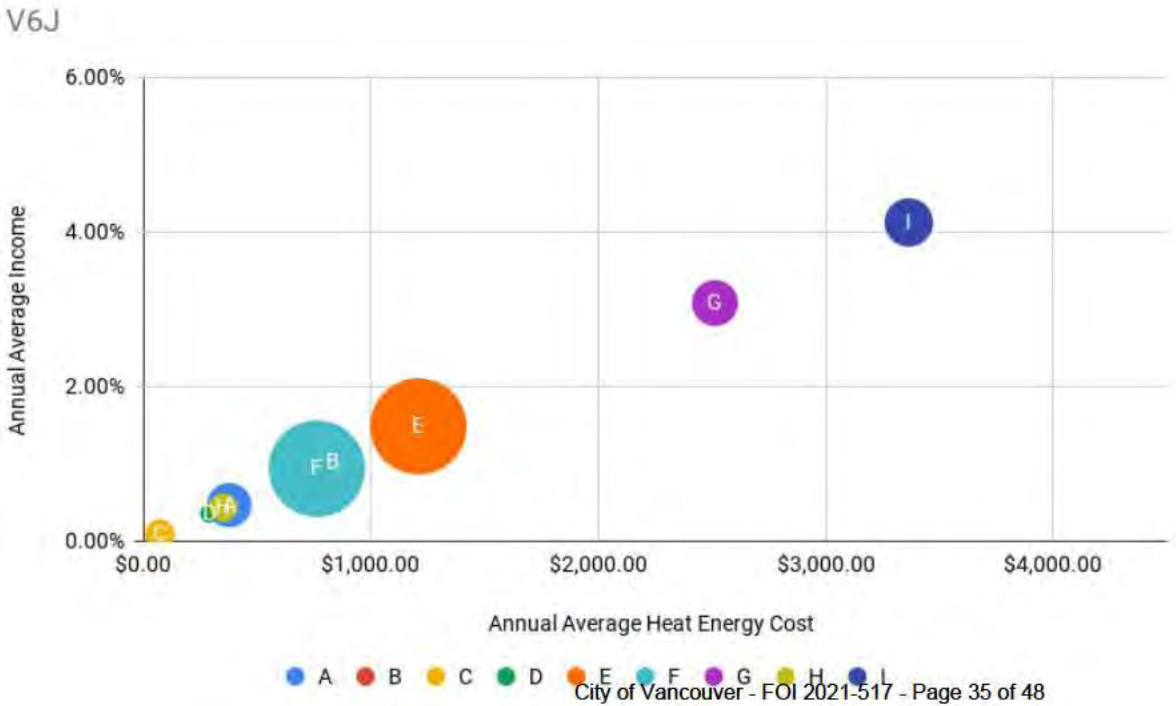
V6J	Count	Total tCO2e	Total GJ
A	7	23	644
B	22	173	4,175
C	4	6	232
D	2	0	136
E	139	2,262	51,758
F	66	895	21,517
G	21	14	2,805
H	13	16	4,015
I	55	130	12,680
Total	329	3,520	97,962



V6J

Energy Burden: % of income spent on heating/cooling

Archetypes I and G have the highest burden at 4.5% and 3.4% and they account for 23% (76) of the dwellings in V6J



V6J

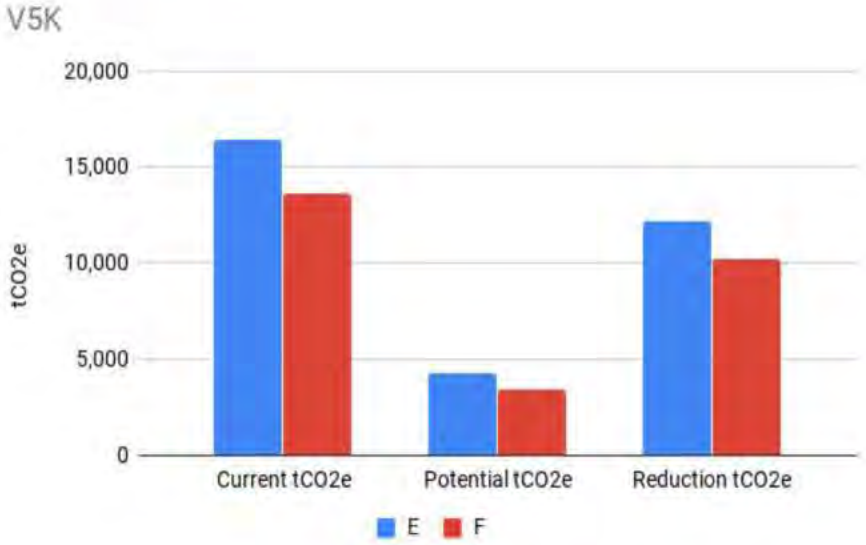
Archetype E (139) and F (66) are the most numerous dwelling types in the this FSA accounting for **62%** of all dwellings. They also account for **90%** of the total tCO2e emitted in this FSA:

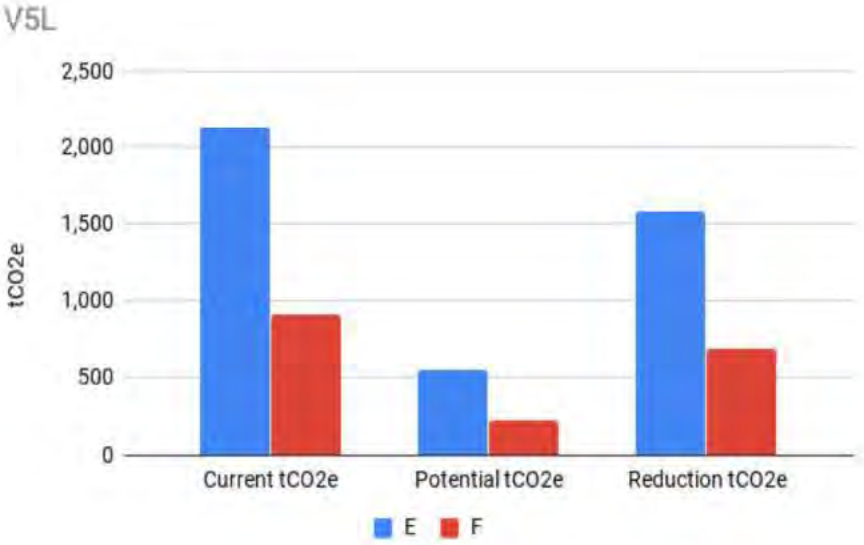
E - 2,262 tCO2e
F - 895 tCO2e
Total emission - 3,158 tCO2e

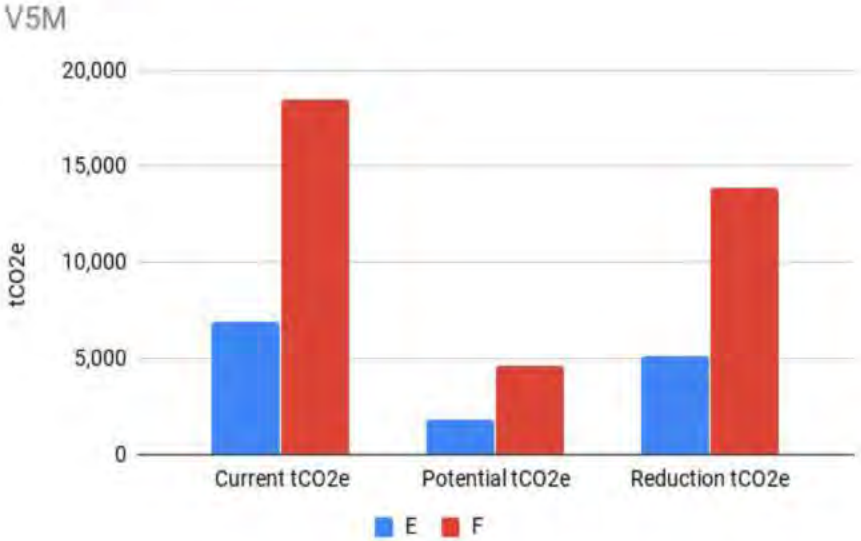
Potential carbon reductions achieved by upgrading archetype E and F primary heating source to a tier 2 heat pump:

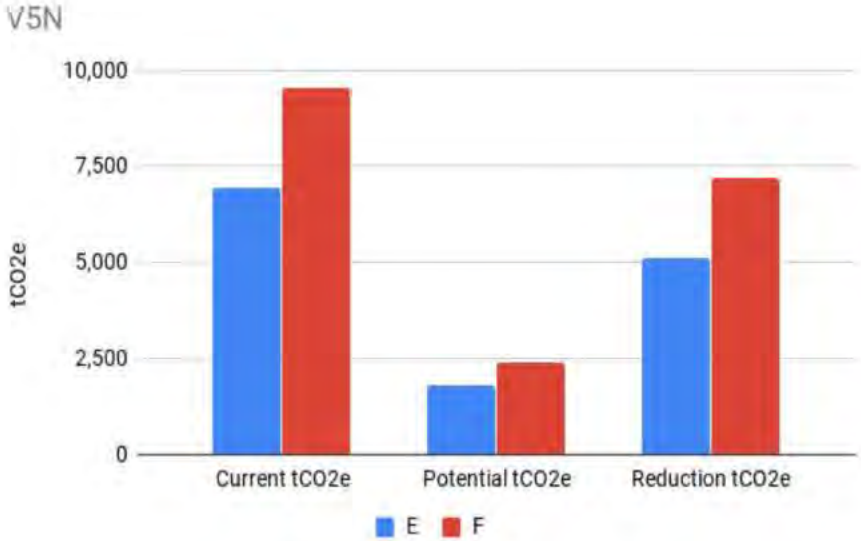
E - 1,674 tCO2e
F - 671 tCO2e
Total reduction - 2,346 tCO2e

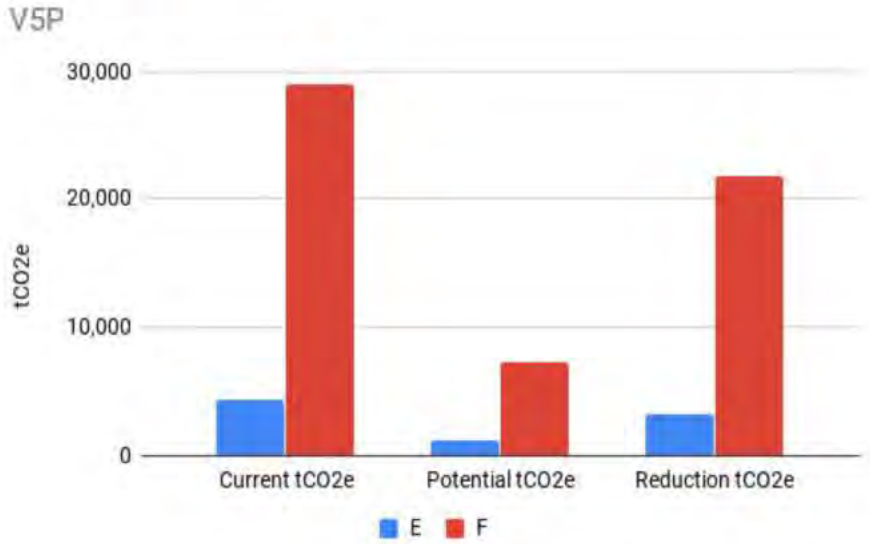
67% reduction in total tCO2e by targeting Archetype E and F dwellings in FSA V6J

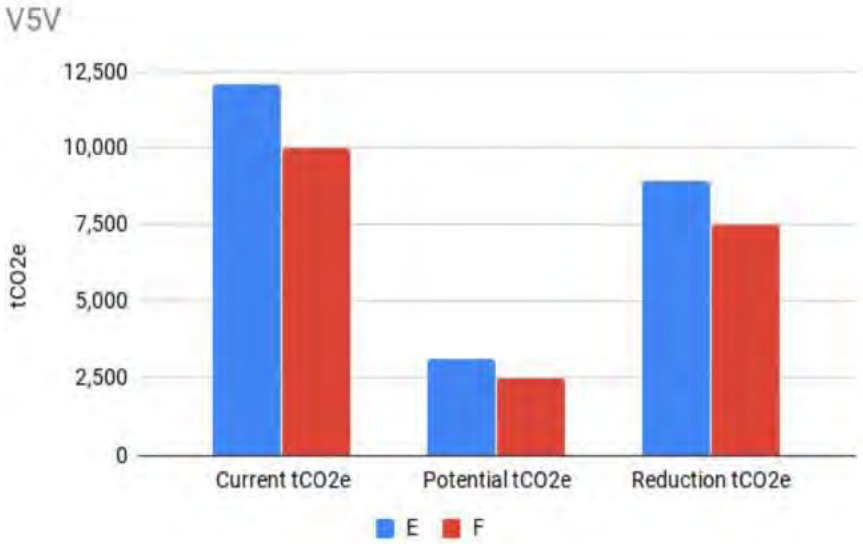




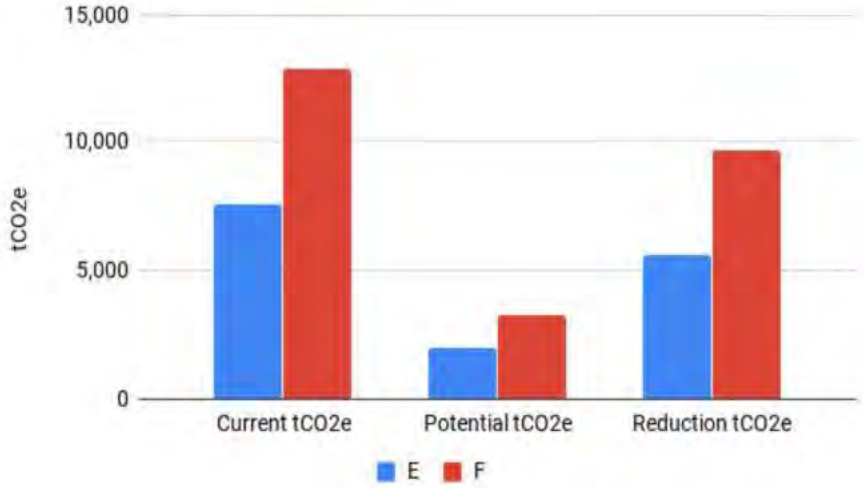

V5M
20,000
15,000
10,000
5,000
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F


V5N
10,000
7,500
5,000
2,500
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F

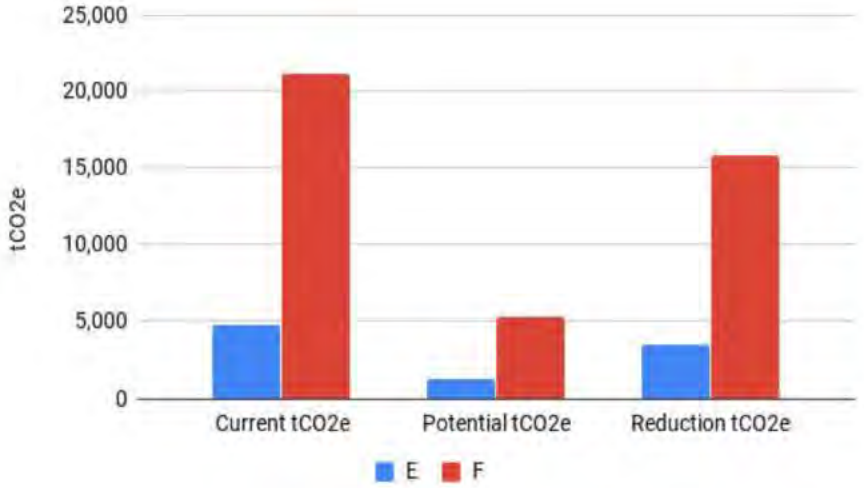

V5P
30,000
20,000
10,000
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F

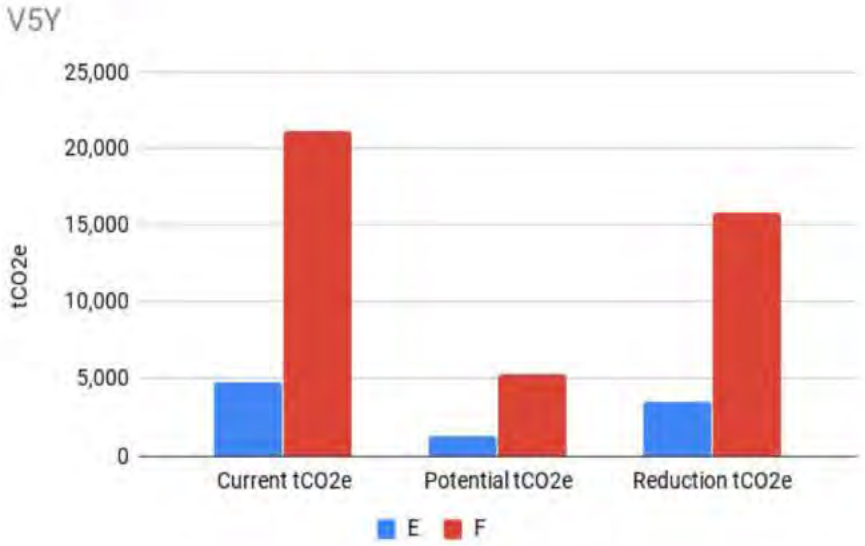

V5V
12,500
10,000
7,500
5,000
2,500
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F

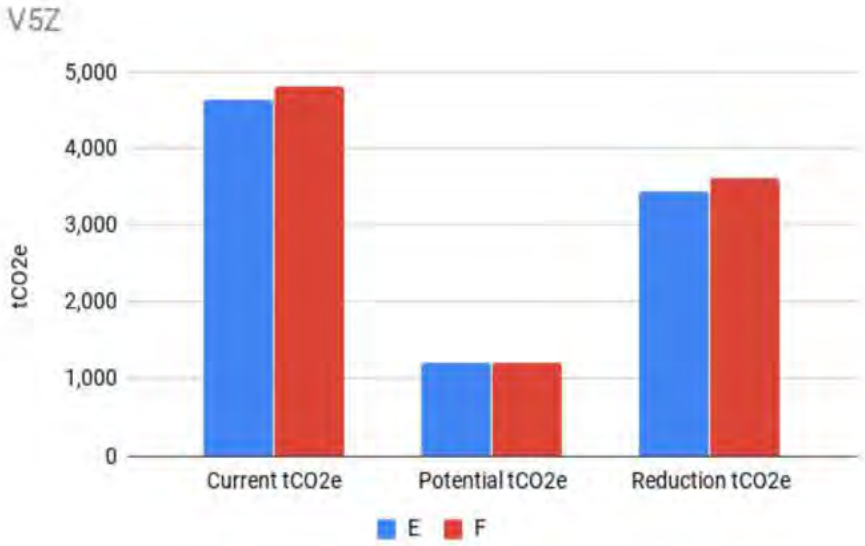
V5W



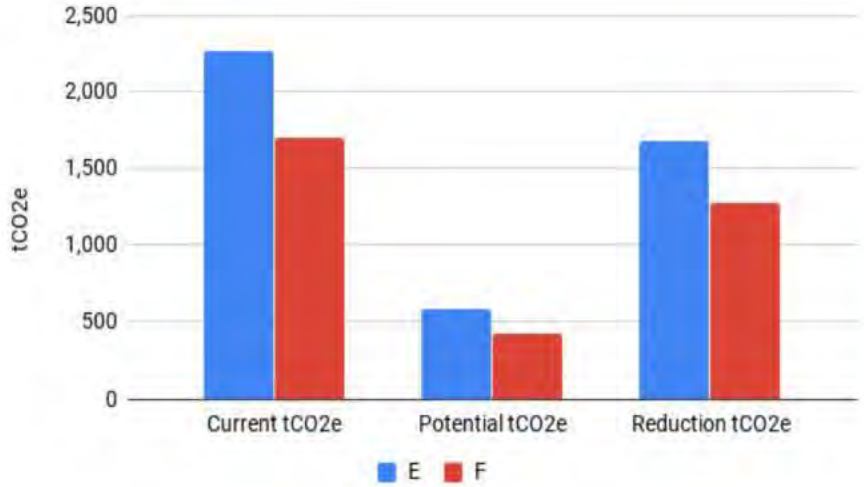
V5X



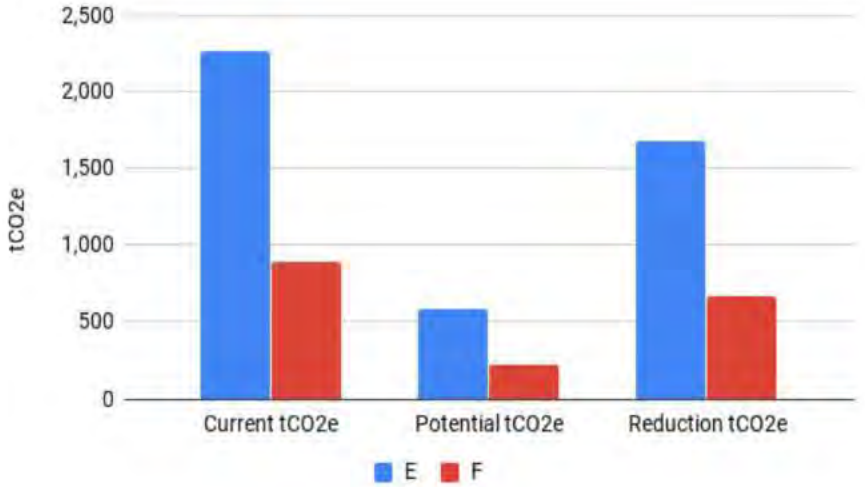


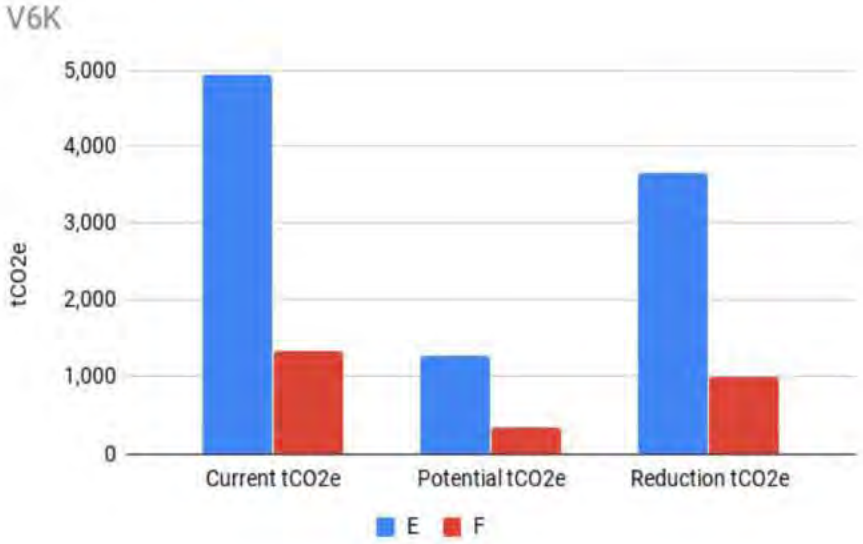


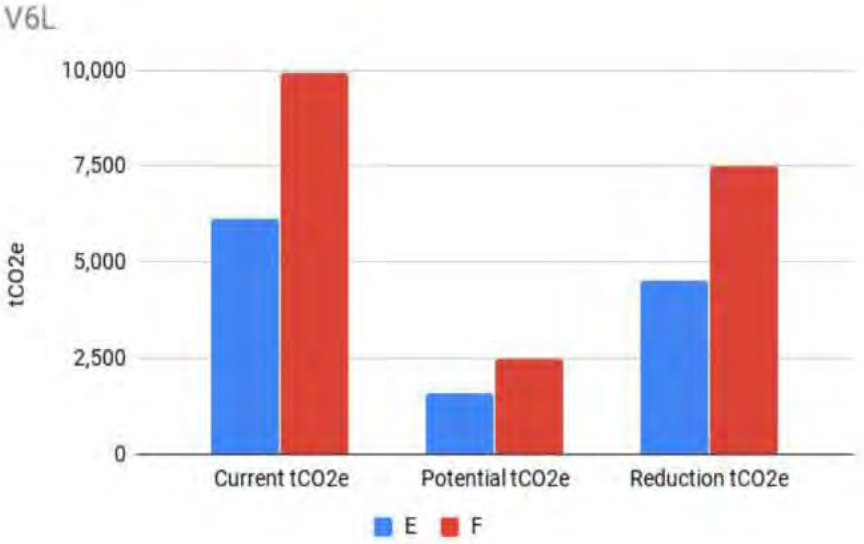
V6H

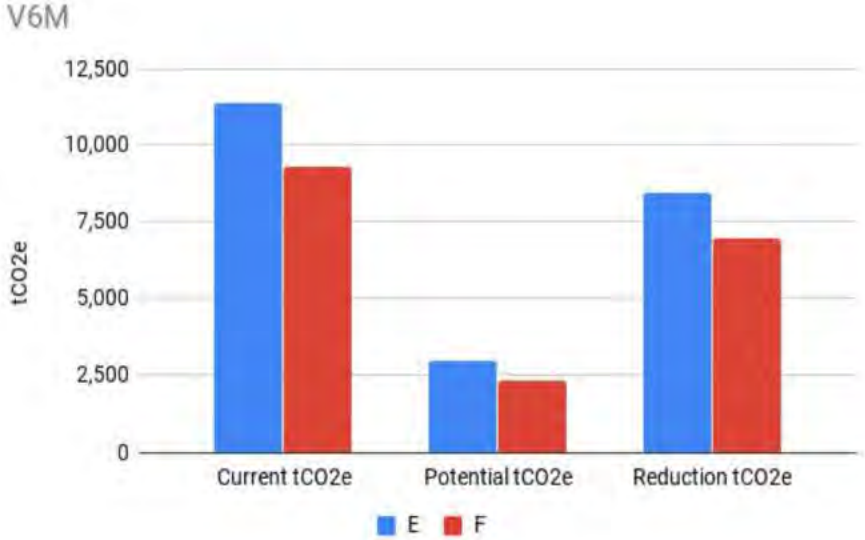


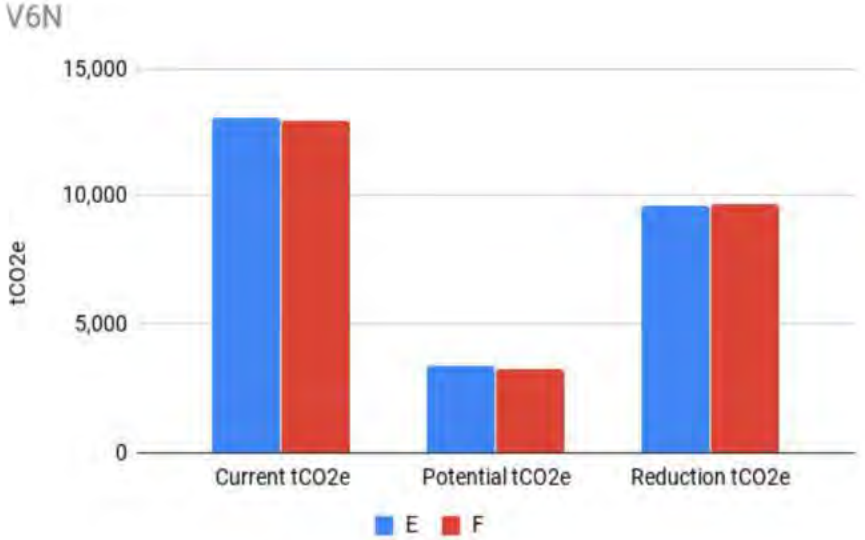
V6J



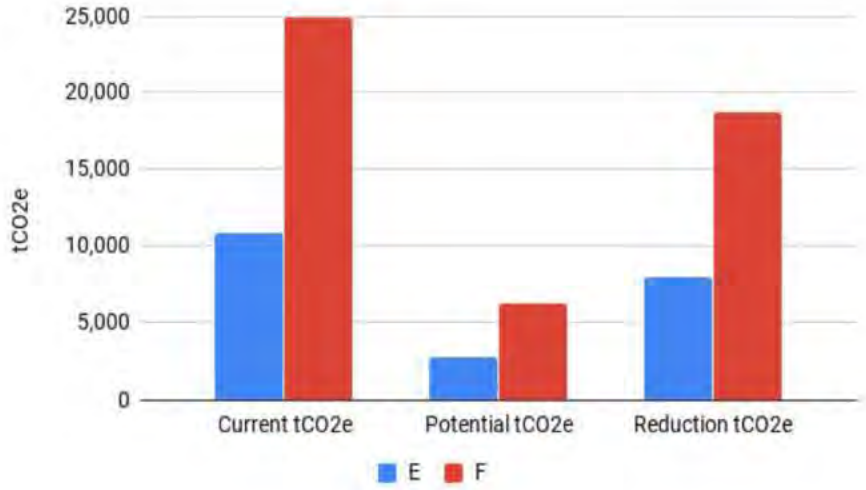

V6K
5,000
4,000
3,000
2,000
1,000
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F


V6L
10,000
7,500
5,000
2,500
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F

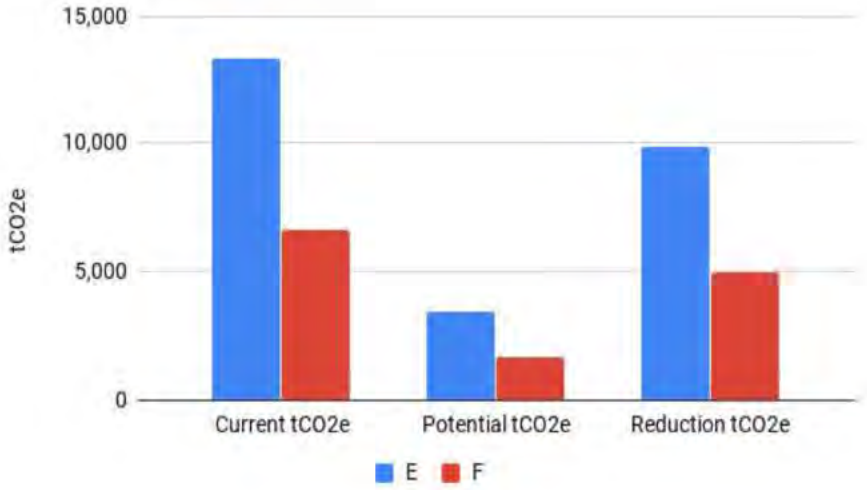

V6M
12,500
10,000
7,500
5,000
2,500
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F

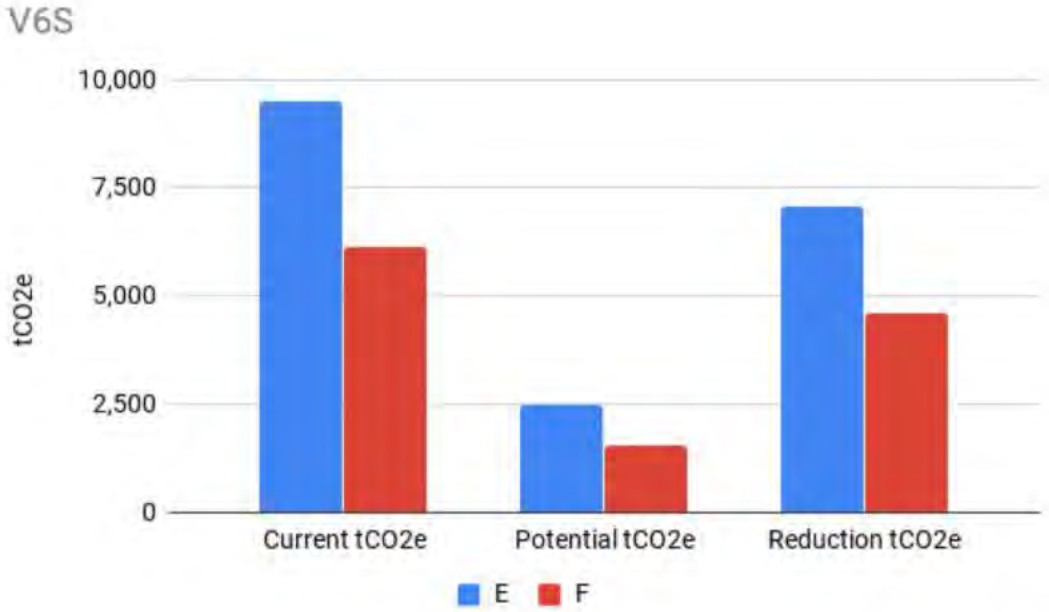

V6N
15,000
10,000
5,000
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F

V6P



V6R




V6S
10,000
7,500
5,000
2,500
0
tCO2e
Current tCO2e
Potential tCO2e
Reduction tCO2e
E
F

Thank you.

Contact

James Riley
Lightspark Software
(778) 223-6745
james.riley@lightsparkinc.com