IBM Data Science Capstone Project

Building an Electrical Vehicle Charging Station plus Amazon Hub Locker in Calgary, Alberta, Canada

Dec 25, 2020

Introduction: Business Problem

The world is shifting fast towards new direction. Renewable energy and electrical vehicle are taking momentum and becoming more popular. People's working style and lifestyle are also changed a lot by COVID-19 and we rely more and more on the online shopping. Amazon is gaining more revenue and become an inseparable part of our community.

Calgary is the largest city in Canada's prairie provinces and capital of Canada's energy industry. There are 1.3 million people living in Calgary. It is a vibrant city with high percentage of young people and engineers. They are willing to adopt the new lifestyle and lead the energy transition of the world.

Opening an electrical vehicle charging station plus an Amazon hub locker as a combo will be a good business idea in Calgary. It will be an important part of our community, people can work on their Amazon package while waiting for the car to be charged. Investors who grab this opportunity will be the business leader in the community as there are not many electrical vehicle charging stations and Amazon hub locker in Calgary yet.

We will use data science approach to gather information about Calgary's communities, current gas stations, electrical charging stations and Amazon hub lockers, then we will find the optimal locations to set up business for future success. Investors interested will be willing to invest on the future business based on our research.

Data

1. Calgary communities data from Wikipedia. We will use web scrapper to extract useful information for us.

https://en.wikipedia.org/wiki/List_of_neighbourhoods_in_Calgary

2. Calgary's existing gas stations. We will use FourSquare API to find gas stations in Calgary.

3. Calgary's electrical vehicle charging station. We utilize Phantombuster to download location information from google map search. The data is saved as .csv file.

4. Calgary's Amazon hub lockers. Phantombuster is also used. The website is

https://phantombuster.com/7908605527940361/phantoms/6696986033648658/console

5. "Geopy" library is used to get longitude and latitude information

6. "folium" library is used to create an interactive map.

Methodology:

The ideal location should have the following criteria: 1. Communities with high population density, and we choose 1,000 people/km^2 as criteria for this project. 2. Communities with high concentration of regular gas stations. The actual purpose of electrical vehicle charging stations are to replace gas stations gradually instead of competing with gas stations. More gas stations mean good business environment and large number of vehicles around, which means great opportunity for future transition.

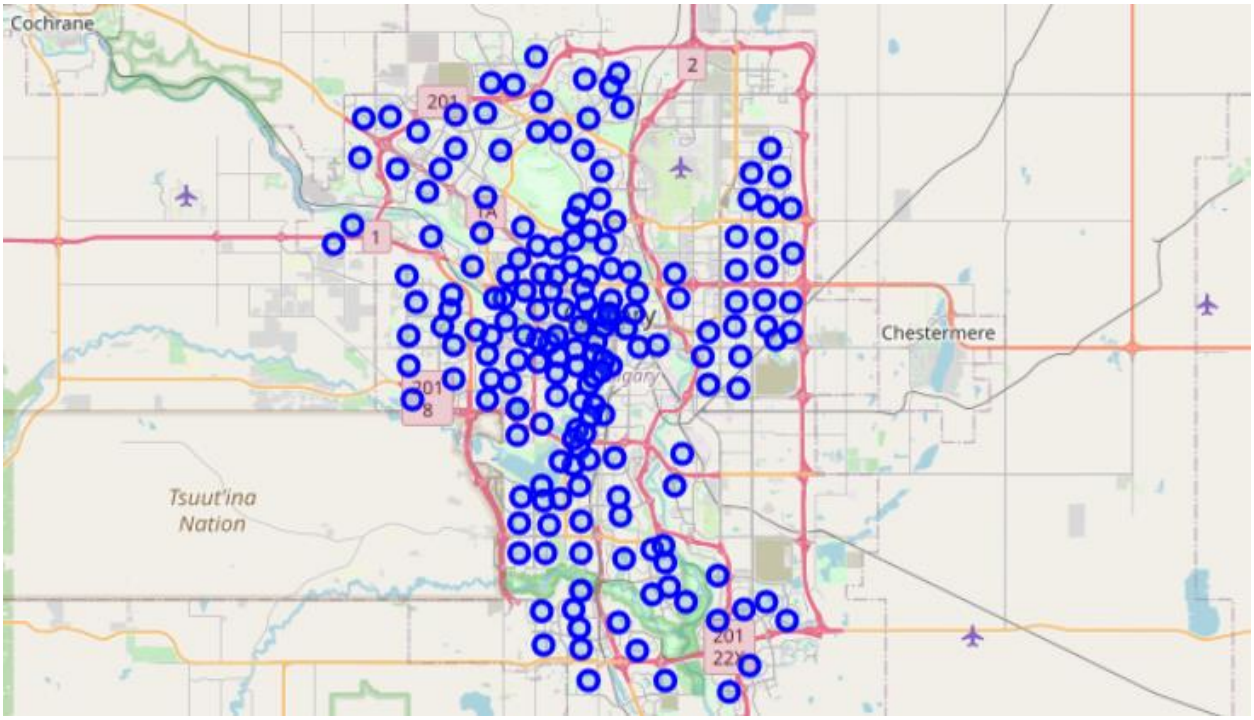
The location should have enough distance from existing electrical vehicle charging stations and Amazon hub lockers as there are competition between them. In this project, we choose 3.5 km as the minimum distance.

Step 1: Find all the communities in Calgary, clean the data and only keep communities with population density over 1000 people/km^2 as the potential location.

```
calgarydata= calgarydata[calgarydata["Population Density"] > 1000]
calgarydata = calgarydata.reset_index(drop=True)
calgarydata
```

	Neighborhood	Population Density
0	Abbeydale	3480.6
1	Acadia	2744.9
2	Albert Park/Radisson Heights	2493.6
3	Altadore	3143.4
4	Applewood Park	4061.3
...	...	...
177	Willow Park	1537.9
178	Windsor Park	3173.8
179	Winston Heights/Mountview	1297.0
180	Woodbine	2853.4
181	Woodlands	2214.6

Step 2. We use “Geopy” library to get the location data for these communities and we display all of them on the map.



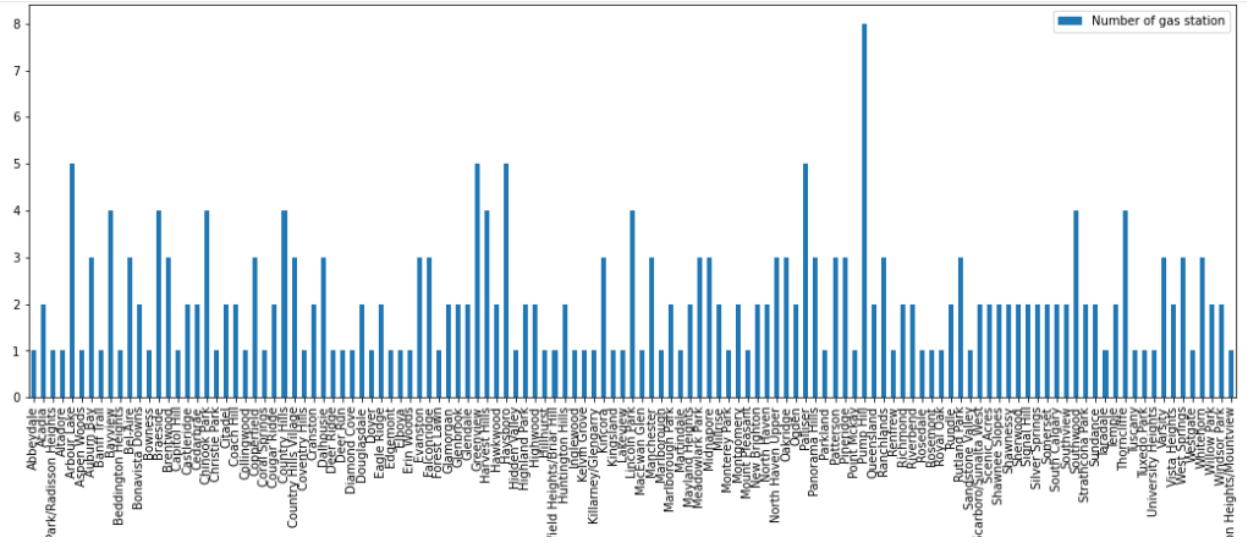
Step 3. We use “FourSqaure API” to find all the gas stations in Calgary

```
[29]: calgarygasstation=calgaryvenuelocal[calgaryvenuelocal["Venue Category"] == "Gas Station"]
      calgarygasstation.reset_index(inplace= True, drop= True)
      calgarygasstation
```

[29]:

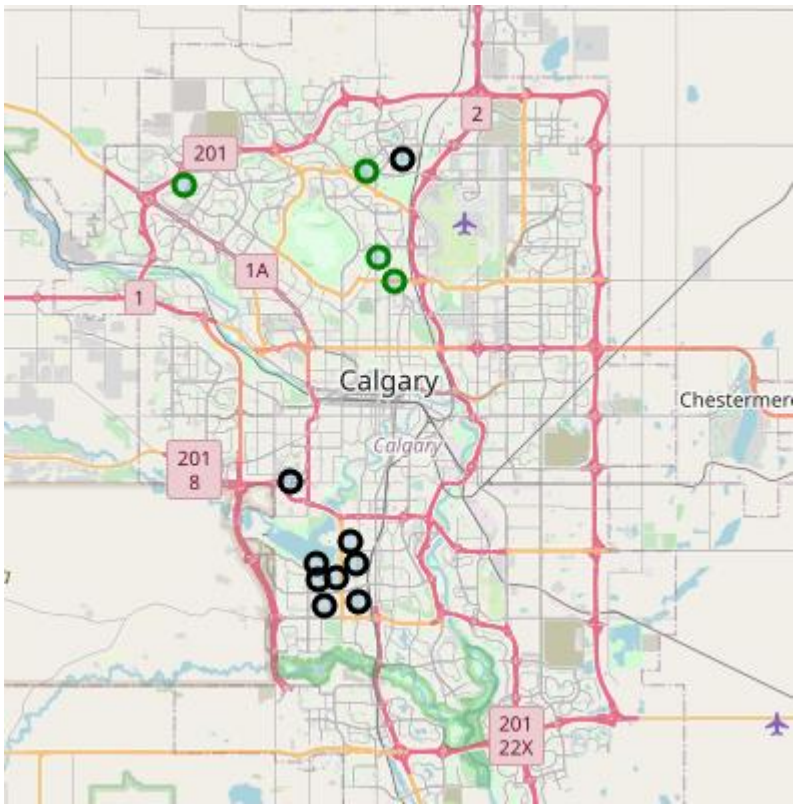
	Unnamed: 0	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	6	Abbeydale	51.058836	-113.929413	Petro-Canada	51.069370	-113.933826	Gas Station
1	76	Acadia	50.968655	-114.055587	Petro-Canada	50.963716	-114.058331	Gas Station
2	97	Acadia	50.968655	-114.055587	Petro-Canada	50.969694	-114.070863	Gas Station
3	178	Albert Park/Radisson Heights	51.044845	-113.990195	Husky	51.058815	-114.000803	Gas Station

We found 125 communities have gas stations and we visualize the distribution as follows:



We decide only to keep communities with more than 3 gas stations and we found 14 target communities.

	Neighborhood	Population Density	Latitude	Longitude	Decision
0	Arbour Lake	2462.7	51.136786	-114.202355	Keep
1	Bayview	1705.0	50.973577	-114.112561	Keep
2	Braeside	2970.0	50.955784	-114.106816	Keep
3	Lincoln Park	4932.5	51.009168	-114.129843	Keep
4	Chinook Park	2845.0	50.983123	-114.089301	Keep
5	Country Hills	1962.1	51.143001	-114.078536	Keep
6	Greenview	3950.0	51.095382	-114.058469	Keep
7	Harvest Hills	3364.5	51.148198	-114.053778	Keep
8	Haysboro	2571.5	50.973967	-114.085193	Keep
10	Palliser	3293.0	50.967469	-114.110772	Keep
11	Pump Hill	1793.3	50.968121	-114.098906	Keep
12	Southwood	2253.7	50.957248	-114.083819	Keep
13	Thorncliffe	2634.2	51.106096	-114.069411	Keep



Step 4. We extra google map data to find existing electrical vehichle charging station and Amazon hub lockers from third part API and saved as .csv file, these are the places that we should keep certaian distance to avoid competition. The electrical charging station and Amazon hub locker are listed below:

[38]:
```
ElectricalplusAmazon=pd.read_csv("Electrical Vehicle Charge Station Plus Amazon Hub Locker in Calgary.csv")
ElectricalplusAmazon=ElectricalplusAmazon[["title","address","latitude","longitude"]]
ElectricalplusAmazon=ElectricalplusAmazon.drop(23)
ElectricalplusAmazon
```

[38]:

	title	address	latitude	longitude
0	ChargePoint Charging Station	11527 29 St SE, Calgary, AB T2Z 0N4, Canada	50.949562	-113.997687
1	Tesla Supercharger	261055 Crossiron Blvd, Rocky View County, AB T...	51.203562	-113.989688
2	Flo Charging Station	933-33 Heritage Meadows Way SE, Calgary, AB T2...	50.980812	-114.039687
3	Flo Charging Station	7137 16 Ave NW, Calgary, AB T3B 2S6, Canada	51.078187	-114.195688
4	Flo Charging Station	192 Stewart Green SW, Calgary, AB T3H 3C8, Canada	51.015687	-114.166938
5	Flo Charging Station	135 Southland Dr SE, Calgary, AB T2J 5X5, Canada	50.964188	-114.068687
6	ChargePoint Charging Station	2620 A Barlow Trail NE, Calgary, AB T1Y 1A1, C...	51.076188	-114.000313
7	ChargePoint Charging Station	34 Heritage Meadows Rd, Calgary, AB T2H 3C1, C...	50.985188	-114.032938

Step 5: We need to find the distance between each target community and each avoid location. Thus we need to create a distance matrix as follow:

	Neighborhood	Population Density	Latitude	Longitude	Decision	11527 29 St SE, Calgary, AB T2Z 0N4, Canada	261055 Crossiron Blvd, Rocky View County, AB T4A 0G3, Canada	933-33 Heritage Meadows Way SE, Calgary, AB T2H 3B8, Canada	7137 16 Ave NW, Calgary, AB T3B 2S6, Canada	192 Stewart Green SW, Calgary, AB T3H 3C8, Canada	...	110 9 Ave SE, Calgary, AB T2G 5A6, Canada	5222 Macleod Trail, Calgary, AB T2H 0J2, Canada	Ave NW Calgary AB T3A 4N7 32 Ave NW, Calgary, AB T3A 4N7, Canada	205 5 Ave SW, Calgary, AB T2P 2V7, Canada
0	Arbour Lake	2462.7	51.136786	-114.202355	Yes	25.26	16.58	20.74	6.53	13.69	...	14.13	17.14	6.84	13.75
1	Bayview	1705.0	50.973577	-114.112561	No	8.48	26.97	5.17	13.00	6.03	...	8.66	4.92	12.50	8.87
2	Braeside	2970.0	50.955784	-114.106816	No	7.68	28.74	5.46	14.96	7.88	...	10.37	6.39	14.52	10.61
3	Lincoln Park	4932.5	51.009168	-114.129843	No	11.38	23.73	7.05	8.95	2.69	...	6.15	4.33	8.37	6.20
4	Chinook Park	2845.0	50.983123	-114.089301	No	7.42	25.48	3.48	12.93	6.53	...	7.11	3.13	12.00	7.36
5	Country Hills	1962.1	51.143001	-114.078536	Yes	22.24	9.15	18.24	10.90	15.45	...	10.97	15.05	8.60	10.64
6	Greenview	3950.0	51.095382	-114.058469	Yes	16.76	12.95	12.81	9.77	11.66	...	5.63	9.76	6.94	5.33
7	Harvest Hills	3364.5	51.148198	-114.053778	No	22.43	7.61	18.64	12.60	16.72	...	11.51	15.64	10.18	11.21
8	Haysboro	2571.5	50.973967	-114.085193	No	6.70	26.39	3.28	13.93	7.37	...	8.03	3.95	13.06	8.31

Then we use min function to find the closest competior and save the column as “mindistance”. We want the “mindistance” to be over 3.5 kilometers which means the closest competitor is at least 3.5 km away.

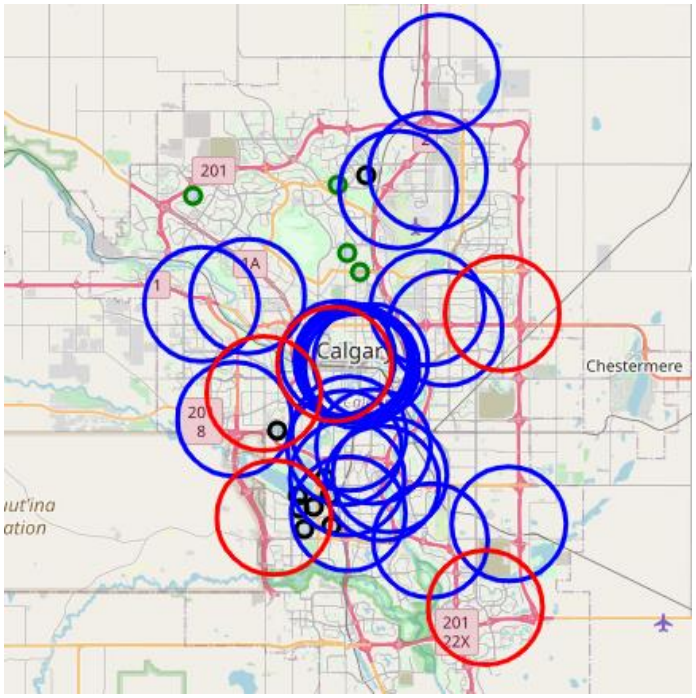
Results

The following communities are found to meet all the criteria

```
calgaryshortlist[calgaryshortlist["mindistance"] > 3.5]
```

	Neighborhood	Population Density	Latitude	Longitude	Decision	11527 29 St SE, Calgary, AB T2Z 0N4, Canada	261055 Crossiron Blvd, Rocky View County, AB T4A 0G3, Canada	933-33 Heritage Meadows Way SE, Calgary, AB T2H 3B8, Canada	7137 16 Ave NW, Calgary, AB T3B 2S6, Canada	192 Stewart Green SW, Calgary, AB T3H 3C8, Canada	...	110 9 Ave SE, Calgary, AB T2G 5A6, Canada	5222 Macleod Trail, Calgary, AB T2H 0J2, Canada	4880 32 Ave NW Calgary AB T3A 4N7 32 Ave NW, Calgary, AB T3A 4N7, Canada	205 5 Ave SW, Calgary, AB T2P 2V7, Canada	2 C
0	Arbour Lake	2462.7	51.136786	-114.202355	Yes	25.26	16.58	20.74	6.53	13.69	...	14.13	17.14	6.84	13.75	
5	Country Hills	1962.1	51.143001	-114.078536	Yes	22.24	9.15	18.24	10.90	15.45	...	10.97	15.05	8.60	10.64	
6	Greenview	3950.0	51.095382	-114.058469	Yes	16.76	12.95	12.81	9.77	11.66	...	5.63	9.76	6.94	5.33	
13	Thorncliffe	2634.2	51.106096	-114.069411	Yes	18.11	12.18	14.08	9.35	12.15	...	6.83	10.93	6.56	6.50	

And we use folium to visualize our results



The blue ones are existing electrical vehicle charging stations and red ones are existing Amazon hub locker. The black ones are community too close to competitors. The green ones will be our final picks.

Discussion:

Data is critical to make the right decision, more data are needed if we want to make better decision:

1. Distribution of electrical vehicle owners in Calgary. If we have the data, we can find out exactly how many electrical vehicles in each community and will help us a lot about the selection process.

2. Amazon transaction distribution. If we know how many amazon packages are delivered to each community on a daily base, we can set up our location at a “hot” spot.

Conclusion:

Based on the limited data we have, the Arbour Lake community is the optimal location for building an electrical vehicle charge station plus Amazon hub locker. It has good population density and lots of gas stations around which will be replaced in the future. It is also away from any competitors. Setting up a business at this strategic location will be the foundation for future business success.