Where Should There Be More Electric Charging Hubs in New York State?

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CIS512

New York State is a leading state in clean and renewable energy, with a commitment to have 50% of the state's electricity supplied by renewable sources by 2030. Thanks to impressive growth in solar, wind, hydro and biomass power in New York State, plug-in electric vehicles (EVs) have particularly low greenhouse gas emissions here.

EVs are a cheap and clean alternative to gas-fueled vehicles. However, small battery storage capacity limits the amount of electric fuel that can be carried on board the vehicle. In order to make the use of EVs more convenient, and help extend vehicle mileage, there is a need to expand the electric power grid and create more public fueling stations.

In this study I will look at vehicle registrations in NYS to determine where electric vehicles are registered. I will look at where charging ports are located in the state and compare to the zip codes with high electric vehicle registrations to determine which zip codes have the highest demand for new charging ports.

Data Sources:

Data on Charging Stations [https://data.ny.gov/d/7rrd-248n?category=Energy-Environment&view_name=Electric-Vehicle-Charging-Stations-in-New-York (https://data.ny.gov/d/7rrd-248n?category=Energy-Environment&view_name=Electric-Vehicle-Charging-Stations-in-New-York)](https://data.ny.gov/d/7rrd-248n?category=Energy-Environment&view_name=Electric-Vehicle-Charging-Stations-in-New-York)

Data on Electric Vehicle Registration [https://data.ny.gov/d/uu25-czyc?category=Transportation&view_name=Electric-Vehicles-per-County (https://data.ny.gov/d/uu25-czyc?category=Transportation&view_name=Electric-Vehicles-per-County)](https://data.ny.gov/d/uu25-czyc?category=Transportation&view_name=Electric-Vehicles-per-County)

Bibliography:

How New York Uses Renewable Energy. (n.d.). Retrieved from [http://www.dec.ny.gov/energy/83070.html (http://www.dec.ny.gov/energy/83070.html)](http://www.dec.ny.gov/energy/83070.html)
Date Visited: 10/29/18

How New York Uses Renewable Energy. (n.d.). Retrieved from [http://www.dec.ny.gov/energy/83070.html (http://www.dec.ny.gov/energy/83070.html)](http://www.dec.ny.gov/energy/83070.html)
Date Visited: 10/29/18

```
In [29]:  %matplotlib inline

          import pandas as pd
          import numpy as np
          import matplotlib.pyplot as plt
          import seaborn as sns; sns.set()

          sns.set(style="darkgrid")
```

Electric Vehicle Registration Data

Import and read data table

```
In [ ]:  vehicle_reg = pd.read_csv('Vehicle__Snowmobile__and_Boat_Registrations.c
         sv')
```

```
In [3]:  vehicle_reg.head()
```

Out[3]:

	Record Type	VIN	Registration Class	City	State	Zip	County	M
0	VEH	8995	PAS	BUFFALO	NY	14207	ERIE	19
1	VEH	607SR2131A	PAS	N SYRACUSE	NY	13212	ONONDAGA	19
2	VEH	537LS7D46CT083476	PAS	NEWFANE	NY	14108	NIAGARA	20
3	VEH	53TBH2MC1BE900166	PAS	ROCKVILLE CTR	NY	11570	NASSAU	20
4	VEH	53G1B4A47DB000347	PAS	BROOKLYN	NY	11223	KINGS	20

Create a new table with only the relevant information to my study

```
In [4]: veh = vehicle_reg[['City','State','Zip','County']]
        veh[:5]
```

Out[4]:

	City	State	Zip	County
0	BUFFALO	NY	14207	ERIE
1	N SYRACUSE	NY	13212	ONONDAGA
2	NEWFANE	NY	14108	NIAGARA
3	ROCKVILLE CTR	NY	11570	NASSAU
4	BROOKLYN	NY	11223	KINGS

There are 9222 registered electric vehicles in NYS

```
In [30]: len(veh)
```

Out[30]: 9222

Create a data series showing the number of electric vehicles per zip code in New York State

```
In [7]: veh['Number of Vehicles'] = ''
        reg_car = veh.groupby(['Zip'])
        count_car = reg_car.agg({'Number of Vehicles':'count'}).sort_values(['Nu
        mber of Vehicles','Zip'], ascending=[False, True])
        count_car[:5]
```

```
/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:1: Setting
WithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-d
ocs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
```

Out[7]:

Zip	Number of Vehicles
10583	200
11746	114
11791	109
10580	103
11743	101

In [28]:
```python
ax = sns.countplot(x = "Zip", data = veh)
ax.set_xticklabels(ax.get_xticklabels(),
                   rotation = 40,
                   ha='right')
ax.figure.set_size_inches(12,4)
ax.axes.set_title("Electric Vehicles Registered by Zip Code in NYS",font
size=18)
ax.set_xlabel("Zip Code",fontsize=12)
ax.set_ylabel("Number of Vehicles",fontsize=12)
#ax_seg = plt.legend(bbox_to_anchor = (1.05, 1), loc = 2, borderaxespad
 = 0.)
plt.tight_layout()
plt.show()
#The best way to display this would be in GIS
```
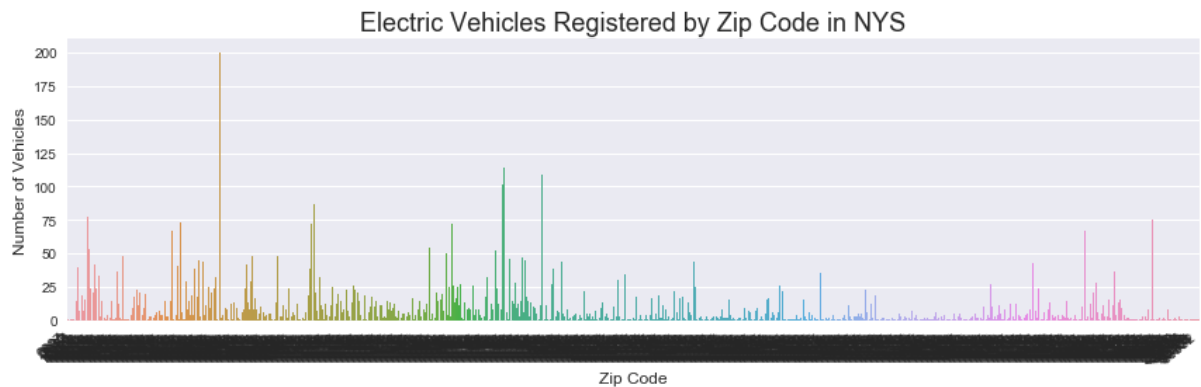

In [9]:
```python
vehicle_reg_zip = vehicle_reg.groupby(['Zip'])
vrzip = vehicle_reg_zip.size().sort_values(ascending = False)
```

```
In [10]: vrzip = vrzip[:25]
         vrzip
```

```
Out[10]: Zip
         10583    200
         11746    114
         11791    109
         10580    103
         11743    101
         11050     87
         10538     81
         10013     77
         14850     75
         10514     73
         11030     72
         11576     72
         14534     67
         10504     67
         10011     65
         10023     60
         11797     58
         11747     55
         11545     54
         10014     53
         11733     52
         10528     51
         11568     50
         11201     49
         10956     48
         dtype: int64
```

Charging Hubs in New York State

Import and read data

```
In [11]:  charge_hub = pd.read_csv('Electric_Vehicle_Charging_Stations_in_New_Yor
          k.csv')
          charge_hub.head()
```

Out[11]:

	Fuel Type Code	Station Name	Street Address	Intersection Directions	City	State	ZIP	Plus4	Station Phone	Sta C
0	ELEC	Hudson Valley Community College - TEC-SMART Bu...	345 Hermes Rd	NaN	Malta	NY	12020	NaN	518-629-7075	E
1	ELEC	EDISONPARKFAST	451 9th Ave	LOC #250 #2 LOT#250; ChargePoint America Program	New York	NY	10018	NaN	888-758-4389	E
2	ELEC	CARCHARGING	350 W 50th St	ICON MERCURY; Icon parking see attendant for a...	New York	NY	10019	NaN	888-758-4389	E
3	ELEC	CARCHARGING	310 W 39th St	ICON 310 W 39TH; Icon Parking systems see vale...	New York	NY	10018	NaN	888-758-4389	E
4	ELEC	EDISONPARKFAST	50 W 44th St	LOC #100 LEVEL3; Located in basement level of ...	New York	NY	10036	NaN	888-758-4389	E

5 rows × 32 columns

Create a new table with only the relevant information to my study

```
In [12]: hub = charge_hub[['City','ZIP','Latitude','Longitude',]]
         hub[:4]
```

Out[12]:

	City	ZIP	Latitude	Longitude
0	Malta	12020	42.971670	-73.774182
1	New York	10018	40.754512	-73.995938
2	New York	10019	40.763245	-73.988648
3	New York	10018	40.755440	-73.992027

There are 1030 charging ports in New York State

```
In [31]: len(hub)
```

Out[31]: 1030

Create a data series showing the number of charging hugs per zip code in New York State

```
In [13]: hub['Number of Charge Hubs'] = ''
         ch_hub = hub.groupby(['ZIP'])
         count_hub = ch_hub.agg({'Number of Charge Hubs':'count'}).sort_values([
         'Number of Charge Hubs','ZIP'], ascending=[False, True])
         count_hub[:5]
```

```
/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:1: Setting
WithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-d
ocs/stable/indexing.html#indexing-view-versus-copy
  """Entry point for launching an IPython kernel.
```

Out[13]:

	Number of Charge Hubs
ZIP	
10019	34
10016	22
12401	21
10021	17
10022	17

```
In [27]: charge_hub_zip = charge_hub.groupby(['ZIP'])
         chzip = charge_hub_zip.size().sort_values(ascending = False)
```

```
In [30]:  chzip = chzip[:25]
          chzip
```

```
Out[30]:  ZIP
          10019    34
          10016    22
          12401    21
          10022    17
          10021    17
          10023    16
          14850    16
          10065    15
          12866    15
          10028    14
          10011    14
          10024    13
          11201    12
          10025    12
          10003    12
          10036    11
          10014     9
          14221     9
          10013     9
          10075     8
          11790     8
          10001     8
          11901     7
          12205     7
          11215     7
          dtype: int64
```

Next Steps

1. Combine count_car and count_hub data series into one data frame to compare the number of cars in each zip code and the number of charging hubs. This will help give an idea of demand for hubs.
2. Map number of cars per zip code and the locations of charging hubs using geocoding and ArcGIS