In [1]:
```
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
import seaborn as sns
from sklearn.linear_model import LinearRegression,LogisticRegressio
from sklearn.model_selection import train_test_split
```

In [2]:
```
df=pd.read_csv("/Users/bob/Downloads/FP1_air/csvs_per_year/csvs_per
df
```

Out[2]:

	date	BEN	CH4	CO	EBE	NMHC	NO	NO_2	NOx	O_3	PM10	PM25	SO_
0	2017-06-01 01:00:00	NaN	NaN	0.3	NaN	NaN	4.0	38.0	NaN	NaN	NaN	NaN	5
1	2017-06-01 01:00:00	0.6	NaN	0.3	0.4	0.08	3.0	39.0	NaN	71.0	22.0	9.0	7
2	2017-06-01 01:00:00	0.2	NaN	NaN	0.1	NaN	1.0	14.0	NaN	NaN	NaN	NaN	Na
3	2017-06-01 01:00:00	NaN	NaN	0.2	NaN	NaN	1.0	9.0	NaN	91.0	NaN	NaN	Na
4	2017-06-01 01:00:00	NaN	NaN	NaN	NaN	NaN	1.0	19.0	NaN	69.0	NaN	NaN	2
...	...	...	...	...	...	...	...	...	...	...	...	...	
210115	2017-08-01 00:00:00	NaN	NaN	0.2	NaN	NaN	1.0	27.0	NaN	65.0	NaN	NaN	Na
210116	2017-08-01 00:00:00	NaN	NaN	0.2	NaN	NaN	1.0	14.0	NaN	NaN	73.0	NaN	7
210117	2017-08-01 00:00:00	NaN	NaN	NaN	NaN	NaN	1.0	4.0	NaN	83.0	NaN	NaN	Na
210118	2017-08-01 00:00:00	NaN	NaN	NaN	NaN	NaN	1.0	11.0	NaN	78.0	NaN	NaN	Na
210119	2017-08-01 00:00:00	NaN	NaN	NaN	NaN	NaN	1.0	14.0	NaN	77.0	60.0	NaN	Na

210120 rows × 16 columns

In [3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 210120 entries, 0 to 210119
Data columns (total 16 columns):
 #   Column   Non-Null Count   Dtype  
---  ------   --------------   -----  
 0   date     210120 non-null  object 
 1   BEN      50201 non-null   float64
 2   CH4      6410 non-null    float64
 3   CO       87001 non-null   float64
 4   EBE      49973 non-null   float64
 5   NMHC     25472 non-null   float64
 6   NO       209065 non-null  float64
 7   NO_2     209065 non-null  float64
 8   NOx      52818 non-null   float64
 9   O_3      121398 non-null  float64
 10  PM10     104141 non-null  float64
 11  PM25     52023 non-null   float64
 12  SO_2     86803 non-null   float64
 13  TCH      25472 non-null   float64
 14  TOL      50117 non-null   float64
 15  station  210120 non-null  int64  
dtypes: float64(14), int64(1), object(1)
memory usage: 25.6+ MB
```

In [4]:
```
df1=df.dropna()
df1
```

Out[4]:

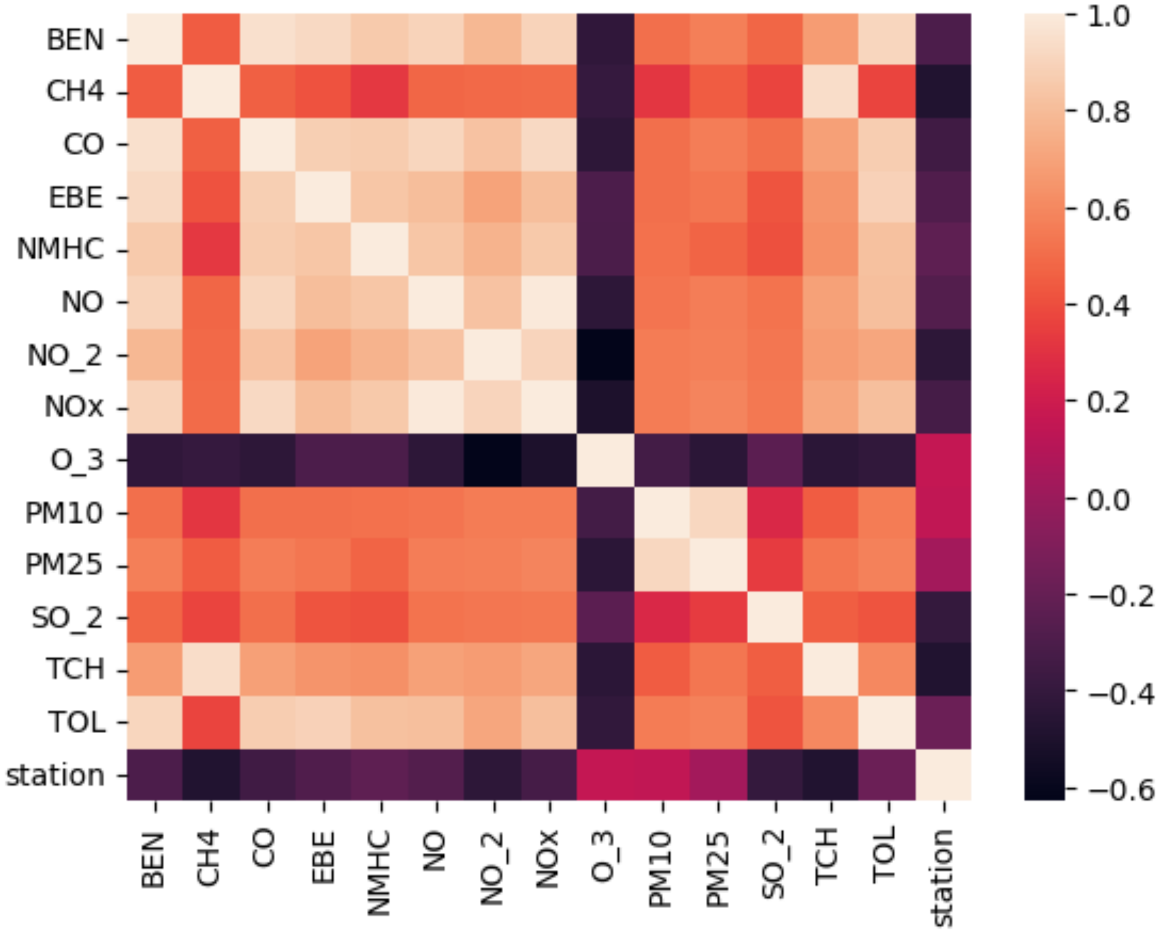
	date	BEN	CH4	CO	EBE	NMHC	NO	NO_2	NOx	O_3	PM10	PM25	SO_:
87457	2017-10-01 01:00:00	0.6	1.22	0.3	0.4	0.09	4.0	54.0	60.0	43.0	12.0	9.0	13.(
87462	2017-10-01 01:00:00	0.2	1.18	0.2	0.1	0.09	1.0	26.0	28.0	42.0	14.0	6.0	3.(
87481	2017-10-01 02:00:00	0.4	1.22	0.2	0.2	0.06	2.0	32.0	36.0	53.0	14.0	10.0	13.(
87486	2017-10-01 02:00:00	0.2	1.19	0.2	0.1	0.07	1.0	15.0	17.0	51.0	18.0	8.0	3.(
87505	2017-10-01 03:00:00	0.3	1.23	0.2	0.2	0.06	2.0	27.0	29.0	57.0	15.0	10.0	13.(
...	...	...	...	...	...	...	...	...	...	...	...	...	..
158238	2017-12-31 22:00:00	0.3	1.11	0.2	0.1	0.03	1.0	8.0	9.0	73.0	3.0	1.0	3.(
158257	2017-12-31 23:00:00	0.6	1.38	0.3	0.1	0.03	6.0	42.0	51.0	47.0	7.0	4.0	3.(
158262	2017-12-31 23:00:00	0.3	1.11	0.2	0.1	0.03	1.0	6.0	8.0	72.0	6.0	3.0	3.(
158281	2018-01-01 00:00:00	0.5	1.38	0.2	0.1	0.02	2.0	20.0	23.0	69.0	4.0	2.0	3.(
158286	2018-01-01 00:00:00	0.3	1.11	0.2	0.1	0.03	1.0	1.0	3.0	83.0	8.0	5.0	3.(

4127 rows × 16 columns

In [5]:
```
df1=df1.drop(["date"],axis=1)
```

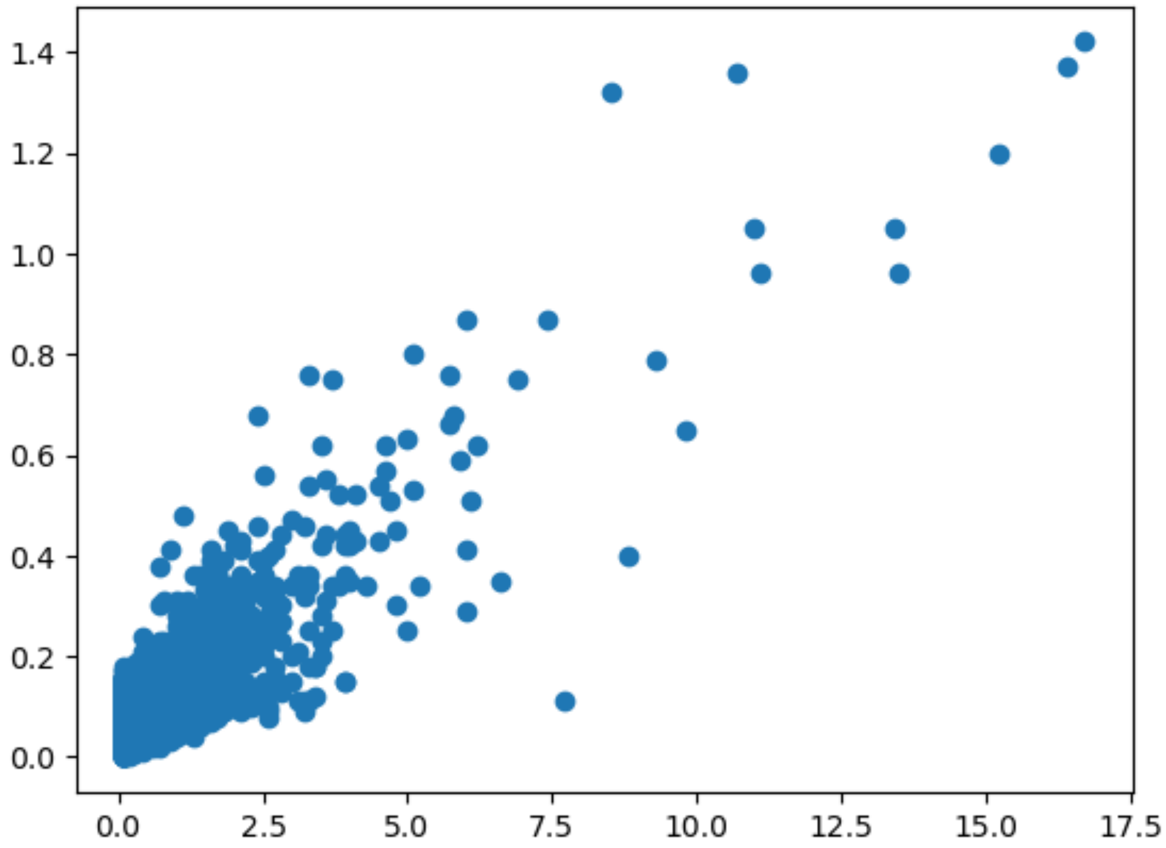
In [6]:
```
sns.heatmap(df1.corr())
```

Out[6]: <Axes: >



In [7]:
```
plt.plot(df1["EBE"],df1["NMHC"],"o")
```

Out[7]:
```
[<matplotlib.lines.Line2D at 0x7fe3e8c2f910>]
```



In [8]:
```
data=df[["EBE","NMHC"]]
```

In [9]:
```
x=df1.drop(["EBE"],axis=1)
y=df1["EBE"]
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

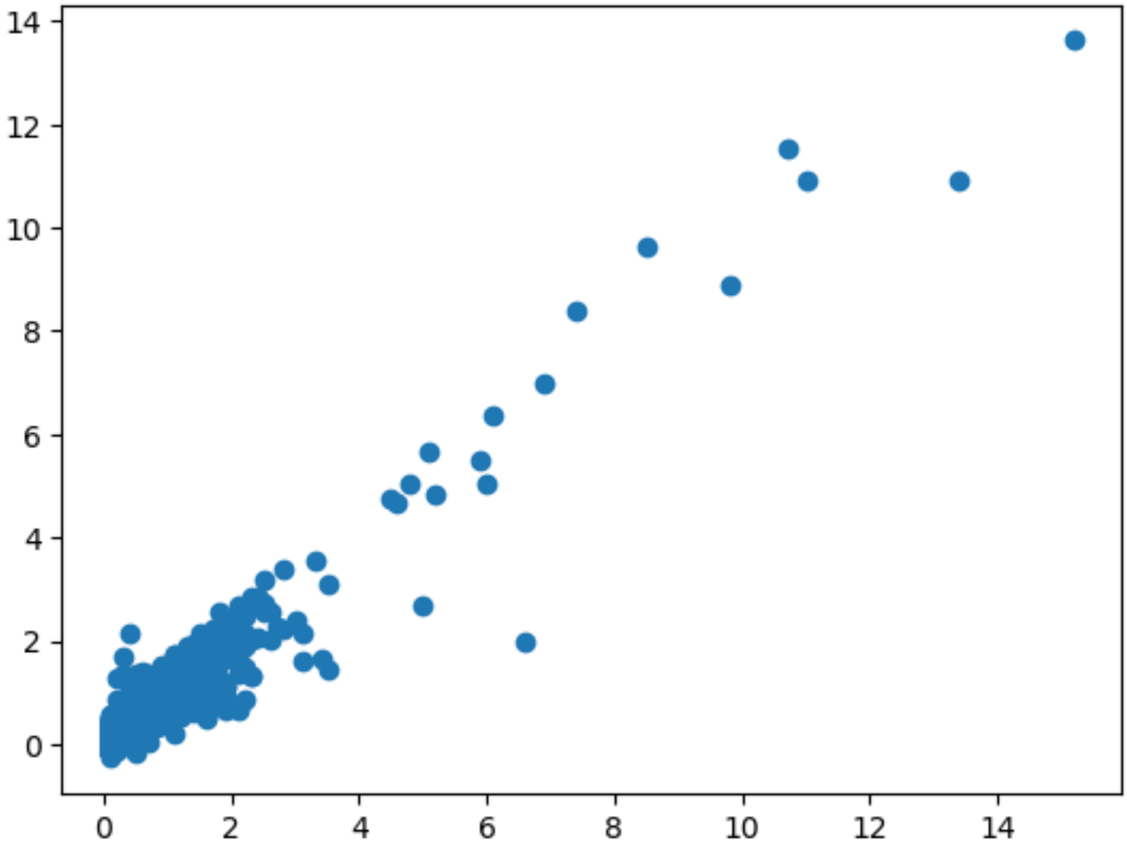
Linear

In [10]:
```
li=LinearRegression()
li.fit(x_train,y_train)
```

Out[10]:
```
▾ LinearRegression
LinearRegression()
```

In [11]:
```
prediction=li.predict(x_test)
plt.scatter(y_test,prediction)
```

Out[11]:
```
<matplotlib.collections.PathCollection at 0x7fe409097e20>
```



In [12]:
```
lis=li.score(x_test,y_test)
```

In [13]:
```
df1["TCH"].value_counts()
```

Out[13]:
```
1.24    124
1.36    118
1.26    112
1.25    110
1.33    107
       ...
3.17      1
3.22      1
3.02      1
2.75      1
2.71      1
Name: TCH, Length: 164, dtype: int64
```

In [14]:
```
df1.loc[df1["TCH"]<1.40,"TCH"]=1
df1.loc[df1["TCH"]>1.40,"TCH"]=2
df1["TCH"].value_counts()
```

Out[14]:
```
1.0    2428
2.0    1699
Name: TCH, dtype: int64
```

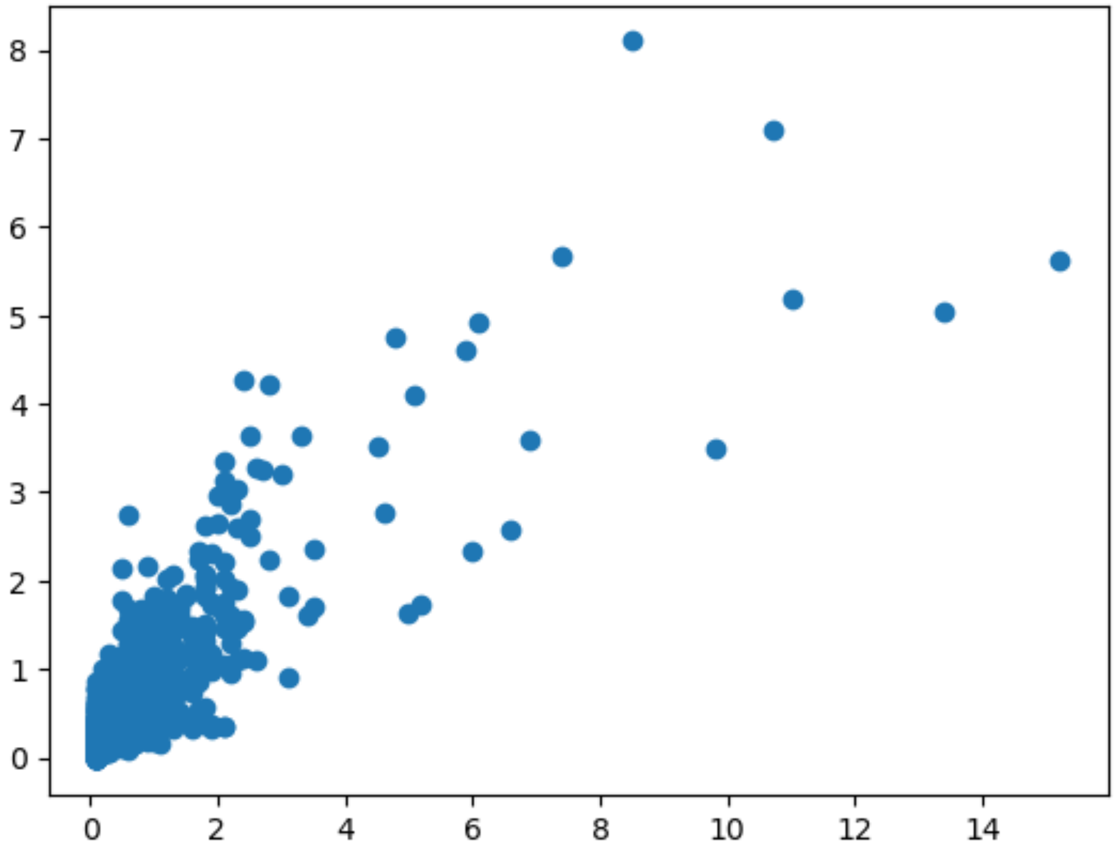
Lasso

In [15]:
```
la=Lasso(alpha=5)
la.fit(x_train,y_train)
```

Out[15]:
```
▾ Lasso
Lasso(alpha=5)
```

In [16]:
```
prediction1=la.predict(x_test)
plt.scatter(y_test,prediction1)
```

Out[16]: <matplotlib.collections.PathCollection at 0x7fe4097671f0>



In [17]:
```
las=la.score(x_test,y_test)
```

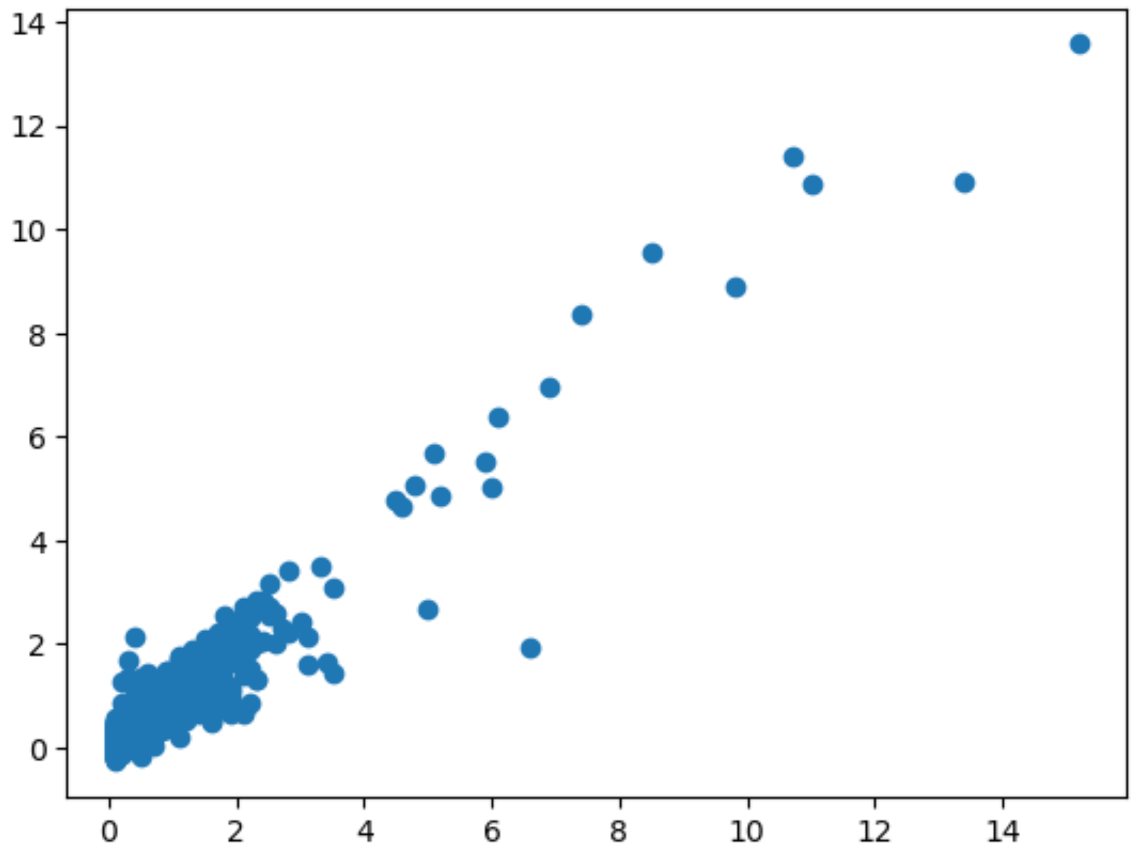
Ridge

In [18]:
```
rr=Ridge(alpha=1)
rr.fit(x_train,y_train)
```

Out[18]:
```
Ridge
Ridge(alpha=1)
```

In [19]:
```
prediction2=rr.predict(x_test)
plt.scatter(y_test,prediction2)
```

Out[19]: <matplotlib.collections.PathCollection at 0x7fe4097fb3a0>



In [20]:
```
rrs=rr.score(x_test,y_test)
```

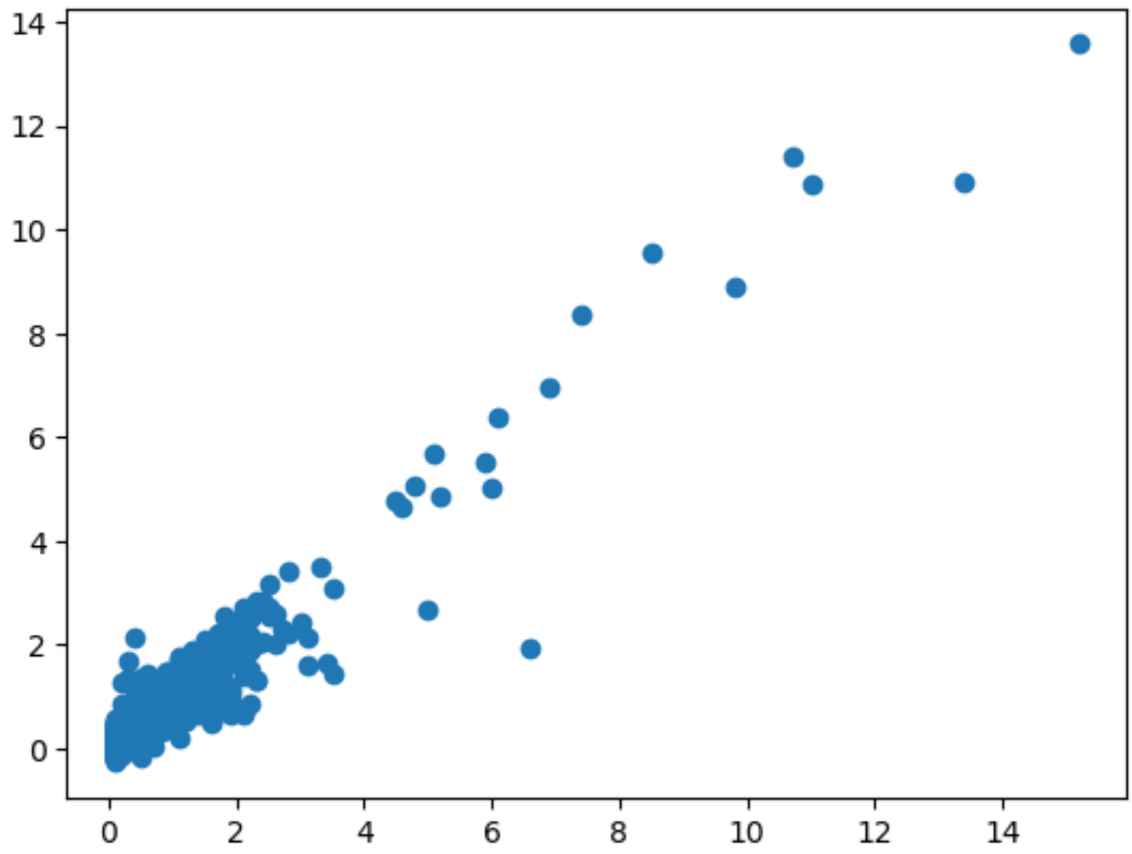
ElasticNet

In [21]:
```
en=ElasticNet()
en.fit(x_train,y_train)
```

Out[21]:
```
▾ ElasticNet
ElasticNet()
```

In [22]:
```
prediction2=rr.predict(x_test)
plt.scatter(y_test,prediction2)
```

Out[22]: <matplotlib.collections.PathCollection at 0x7fe409566980>



In [23]:
```
ens=en.score(x_test,y_test)
```

In [24]:
```
print(rr.score(x_test,y_test))
rr.score(x_train,y_train)
```

```
0.9059346080236226
```

Out[24]: 0.8762721659976673

Logistic

In [25]:
```
g={"TCH":{1.0:"Low",2.0:"High"}}
df1=df1.replace(g)
df1["TCH"].value_counts()
```

Out[25]:
```
Low     2428
High    1699
Name: TCH, dtype: int64
```

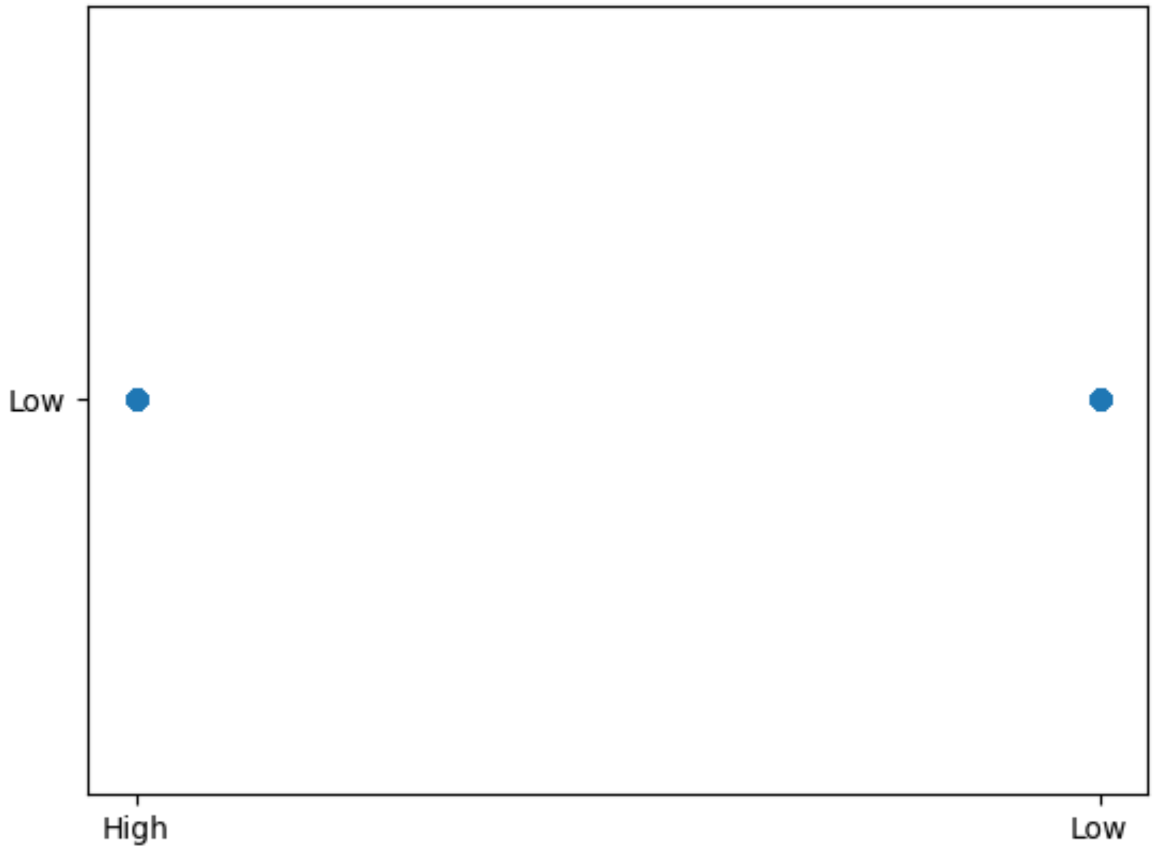
In [26]:
```
x=df1.drop(["TCH"],axis=1)
y=df1["TCH"]
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

In [27]:
```
lo=LogisticRegression()
lo.fit(x_train,y_train)
```

Out[27]:
```
▾ LogisticRegression
LogisticRegression()
```

In [28]:
```
prediction3=lo.predict(x_test)
plt.scatter(y_test,prediction3)
```

Out[28]: <matplotlib.collections.PathCollection at 0x7fe409609bd0>



In [29]:
```
los=lo.score(x_test,y_test)
```

Random Forest

In [30]:
```
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV
```

In [31]:
```
g1={"TCH":{"Low":1.0,"High":2.0}}
df1=df1.replace(g1)
```

In [32]:
```
x=df1.drop(["TCH"],axis=1)
y=df1["TCH"]
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

In [33]:
```
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[33]:
```
▾ RandomForestClassifier
RandomForestClassifier()
```

In [34]:
```
parameter={
    'max_depth':[1,2,4,5,6],
    'min_samples_leaf':[5,10,15,20,25],
    'n_estimators':[10,20,30,40,50]
}
```

In [35]:
```
grid_search=GridSearchCV(estimator=rfc,param_grid=parameter,cv=2,sc
grid_search.fit(x_train,y_train)
```

Out[35]:
```
▸ GridSearchCV
▸ estimator: RandomForestClassifier
    ▸ RandomForestClassifier
```

In [36]:
```
rfcs=grid_search.best_score_
```

In [37]:
```
rfc_best=grid_search.best_estimator_
```

In [38]:
```
from sklearn.tree import plot_tree

plt.figure(figsize=(80,40))
plot_tree(rfc_best.estimators_[5],feature_names=x.columns,class_nam
```

Out[38]:
```
[Text(0.4816666666666667, 0.9285714285714286, 'EBE <= 0.25\ngini =
0.485\nsamples = 1802\nvalue = [1697, 1191]\nclass = Yes'),
 Text(0.25833333333333336, 0.7857142857142857, 'O_3 <= 40.5\ngini
= 0.26\nsamples = 823\nvalue = [1115, 202]\nclass = Yes'),
 Text(0.14333333333333334, 0.6428571428571429, 'SO_2 <= 6.5\ngini
= 0.392\nsamples = 409\nvalue = [485, 177]\nclass = Yes'),
 Text(0.07333333333333333, 0.5, 'SO_2 <= 2.5\ngini = 0.329\nsample
s = 358\nvalue = [462, 121]\nclass = Yes'),
 Text(0.02666666666666667, 0.35714285714285715, 'BEN <= 0.45\ngini
= 0.46\nsamples = 28\nvalue = [14, 25]\nclass = No'),
 Text(0.013333333333333334, 0.21428571428571427, 'gini = 0.42\nsam
ples = 7\nvalue = [7, 3]\nclass = Yes'),
 Text(0.04, 0.21428571428571427, 'CH4 <= 1.38\ngini = 0.366\nsampl
es = 21\nvalue = [7, 22]\nclass = No'),
 Text(0.02666666666666667, 0.07142857142857142, 'gini = 0.0\nsampl
es = 7\nvalue = [7, 0]\nclass = Yes'),
 Text(0.05333333333333334, 0.07142857142857142, 'gini = 0.0\nsampl
es = 14\nvalue = [0, 22]\nclass = No'),
 Text(0.12, 0.35714285714285715, 'station <= 28079016.0\ngini = 0.
```

In [39]:
```
print("Linear:",lis)
print("Lasso:",las)
print("Ridge:",rrs)
print("ElasticNet:",ens)
print("Logistic:",los)
print("Random Forest:",rfcs)
```

```
Linear: 0.9056106323408553
Lasso: 0.6651452631235361
Ridge: 0.9059346080236226
ElasticNet: 0.8167044214155901
Logistic: 0.5819209039548022
Random Forest: 0.9639889196675899
```

Best Model is Random Forest

In [40]:
```
df2=pd.read_csv("/Users/bob/Downloads/FP1_air/csvs_per_year/csvs_pe
df2
```

Out[40]:

	date	BEN	CH4	CO	EBE	NMHC	NO	NO_2	NOx	O_3	PM10	PM25	S
0	2018-03-01 01:00:00	NaN	NaN	0.3	NaN	NaN	1.0	29.0	31.0	NaN	NaN	NaN	
1	2018-03-01 01:00:00	0.5	1.39	0.3	0.2	0.02	6.0	40.0	49.0	52.0	5.0	4.0	
2	2018-03-01 01:00:00	0.4	NaN	NaN	0.2	NaN	4.0	41.0	47.0	NaN	NaN	NaN	N
3	2018-03-01 01:00:00	NaN	NaN	0.3	NaN	NaN	1.0	35.0	37.0	54.0	NaN	NaN	N
4	2018-03-01 01:00:00	NaN	NaN	NaN	NaN	NaN	1.0	27.0	29.0	49.0	NaN	NaN	
...	...	...	...	...	...	...	...	...	...	...	...	...	
69091	2018-02-01 00:00:00	NaN	NaN	0.5	NaN	NaN	66.0	91.0	192.0	1.0	35.0	22.0	N
69092	2018-02-01 00:00:00	NaN	NaN	0.7	NaN	NaN	87.0	107.0	241.0	NaN	29.0	NaN	-
69093	2018-02-01 00:00:00	NaN	NaN	NaN	NaN	NaN	28.0	48.0	91.0	2.0	NaN	NaN	N
69094	2018-02-01 00:00:00	NaN	NaN	NaN	NaN	NaN	141.0	103.0	320.0	2.0	NaN	NaN	N
69095	2018-02-01 00:00:00	NaN	NaN	NaN	NaN	NaN	69.0	96.0	202.0	3.0	26.0	NaN	N

69096 rows × 16 columns

In [41]:
```
df2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 69096 entries, 0 to 69095
Data columns (total 16 columns):
 #   Column   Non-Null Count  Dtype  
---  ------   --------------  -----  
 0   date     69096 non-null  object 
 1   BEN      16950 non-null  float64
 2   CH4      8440 non-null   float64
 3   CO       28598 non-null  float64
 4   EBE      16949 non-null  float64
 5   NMHC     8440 non-null   float64
 6   NO       68826 non-null  float64
 7   NO_2     68826 non-null  float64
 8   NOx      68826 non-null  float64
 9   O_3      40049 non-null  float64
 10  PM10     36911 non-null  float64
 11  PM25     18912 non-null  float64
 12  SO_2     28586 non-null  float64
 13  TCH      8440 non-null   float64
 14  TOL      16950 non-null  float64
 15  station  69096 non-null  int64  
dtypes: float64(14), int64(1), object(1)
memory usage: 8.4+ MB
```

In [42]:
```
df3=df2.dropna()
df3
```

Out[42]:

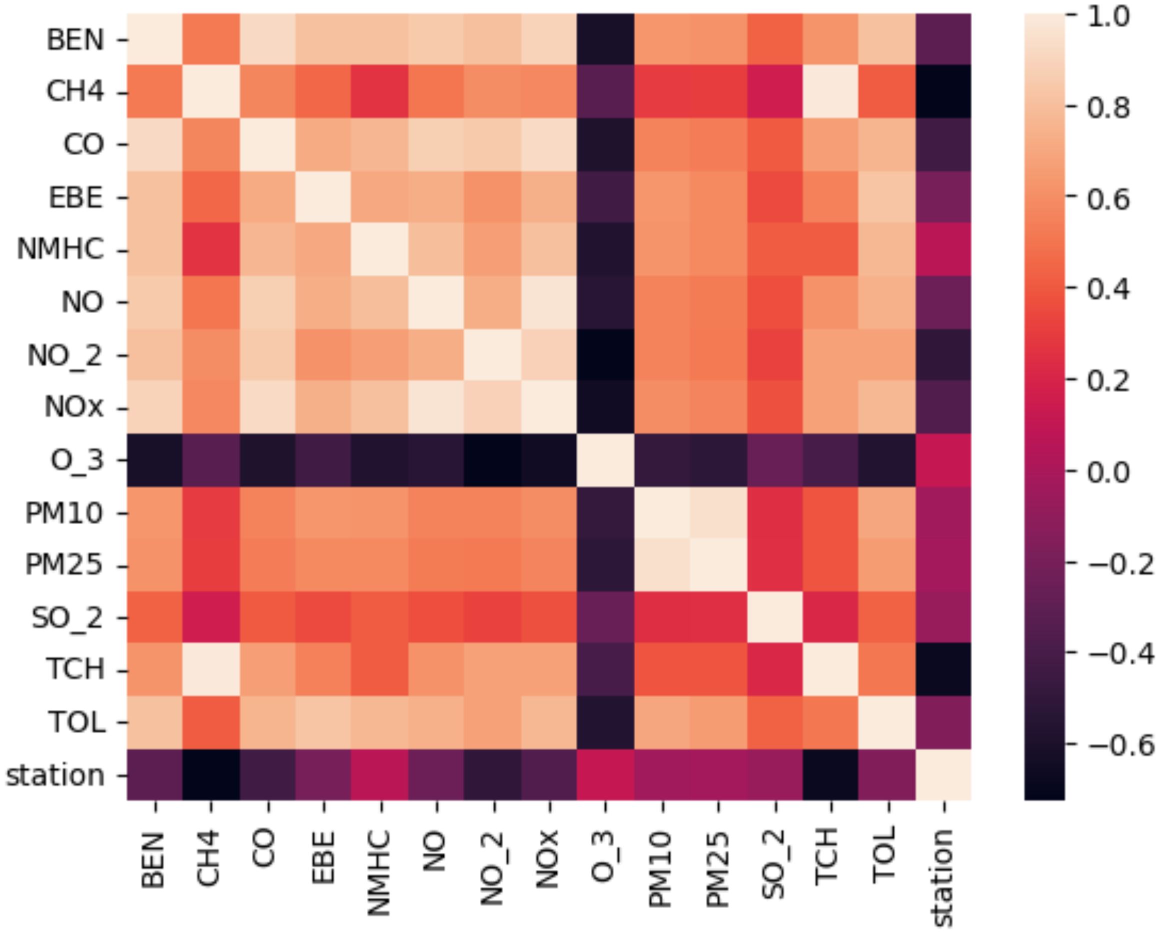
	date	BEN	CH4	CO	EBE	NMHC	NO	NO_2	NOx	O_3	PM10	PM25	SO
1	2018-03-01 01:00:00	0.5	1.39	0.3	0.2	0.02	6.0	40.0	49.0	52.0	5.0	4.0	[illegible]
6	2018-03-01 01:00:00	0.4	1.11	0.2	0.1	0.06	1.0	25.0	27.0	55.0	5.0	4.0	[illegible]
25	2018-03-01 02:00:00	0.4	1.42	0.2	0.1	0.01	4.0	26.0	32.0	64.0	4.0	4.0	[illegible]
30	2018-03-01 02:00:00	0.3	1.10	0.2	0.1	0.05	1.0	12.0	13.0	69.0	5.0	4.0	[illegible]
49	2018-03-01 03:00:00	0.3	1.41	0.2	0.1	0.01	3.0	16.0	20.0	68.0	3.0	2.0	[illegible]
...	...	...	...	...	...	...	...	...	...	...	...	...	
69030	2018-01-31 22:00:00	1.8	1.21	0.7	1.7	0.19	151.0	129.0	361.0	1.0	45.0	26.0	[illegible]
69049	2018-01-31 23:00:00	3.1	1.87	1.2	2.0	0.35	296.0	162.0	615.0	3.0	39.0	23.0	[illegible]
69054	2018-01-31 23:00:00	1.6	1.17	0.6	1.4	0.15	127.0	106.0	301.0	1.0	43.0	25.0	[illegible]
69073	2018-02-01 00:00:00	3.2	1.53	1.0	2.1	0.19	125.0	117.0	309.0	3.0	37.0	24.0	[illegible]
69078	2018-02-01 00:00:00	1.3	1.14	0.4	0.8	0.10	54.0	73.0	155.0	1.0	27.0	16.0	[illegible]

4562 rows × 16 columns

In [43]:
```
df3=df3.drop(["date"],axis=1)
```

In [44]:
```
sns.heatmap(df3.corr())
```

Out[44]: <Axes: >



In [45]:
```
x=df3.drop(["TCH"],axis=1)
y=df3["TCH"]
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

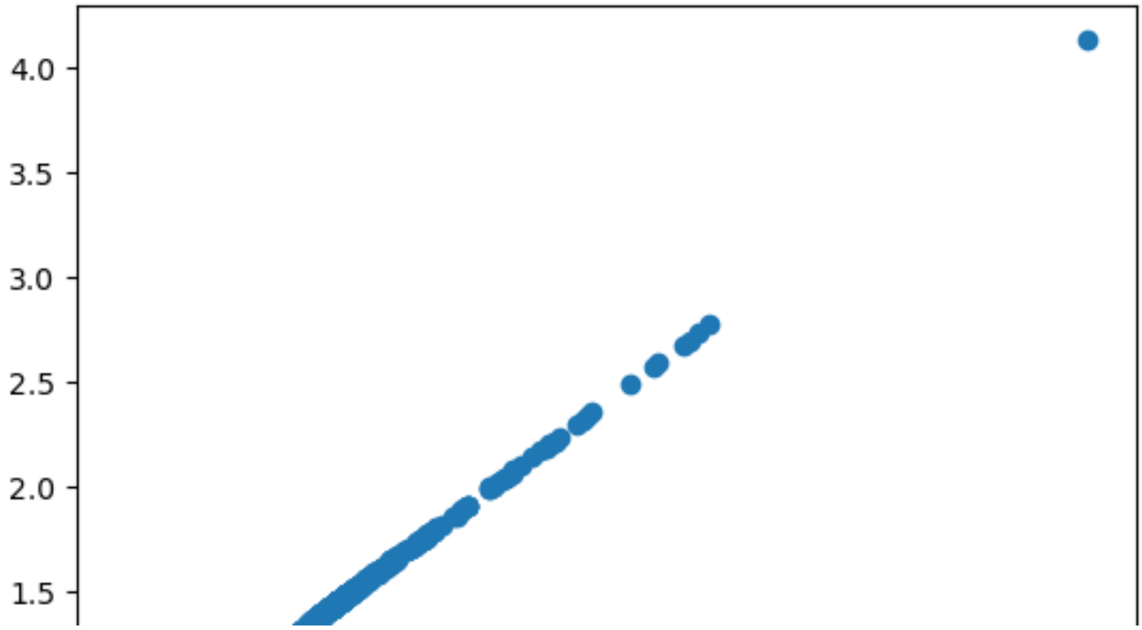
Linear

In [46]:
```
li=LinearRegression()
li.fit(x_train,y_train)
```

Out[46]:
```
▾ LinearRegression
LinearRegression()
```

In [47]:
```
prediction=li.predict(x_test)
plt.scatter(y_test,prediction)
```

Out[47]: <matplotlib.collections.PathCollection at 0x7fe419825b70>



In [48]:
```
lis=li.score(x_test,y_test)
```

In [49]:
```
df3["TCH"].value_counts()
```

Out[49]:
```
1.15    246
1.43    232
1.44    223
1.14    210
1.13    201
       ...
2.68      1
2.43      1
2.45      1
2.12      1
2.35      1
Name: TCH, Length: 143, dtype: int64
```

In [50]:
```
df3.loc[df3["TCH"]<1.40,"TCH"]=1
df3.loc[df3["TCH"]>1.40,"TCH"]=2
df3["TCH"].value_counts()
```

Out[50]:
```
2.0    2477
1.0    2085
Name: TCH, dtype: int64
```

In [ ]:

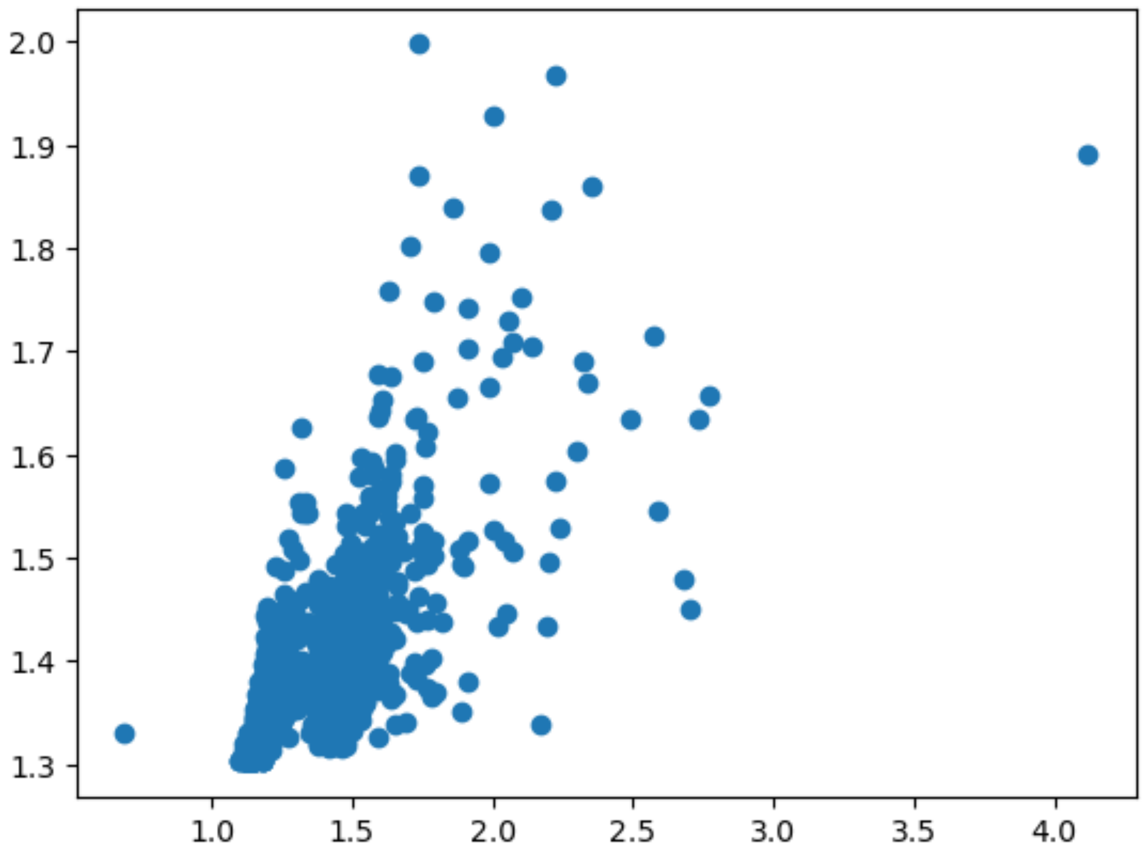
Lasso

In [51]:
```
la=Lasso(alpha=5)
la.fit(x_train,y_train)
```

Out[51]:
```
▾ Lasso
Lasso(alpha=5)
```

In [52]:
```
prediction1=la.predict(x_test)
plt.scatter(y_test,prediction1)
```

Out[52]: <matplotlib.collections.PathCollection at 0x7fe419690670>



In [53]:
```
las=la.score(x_test,y_test)
```

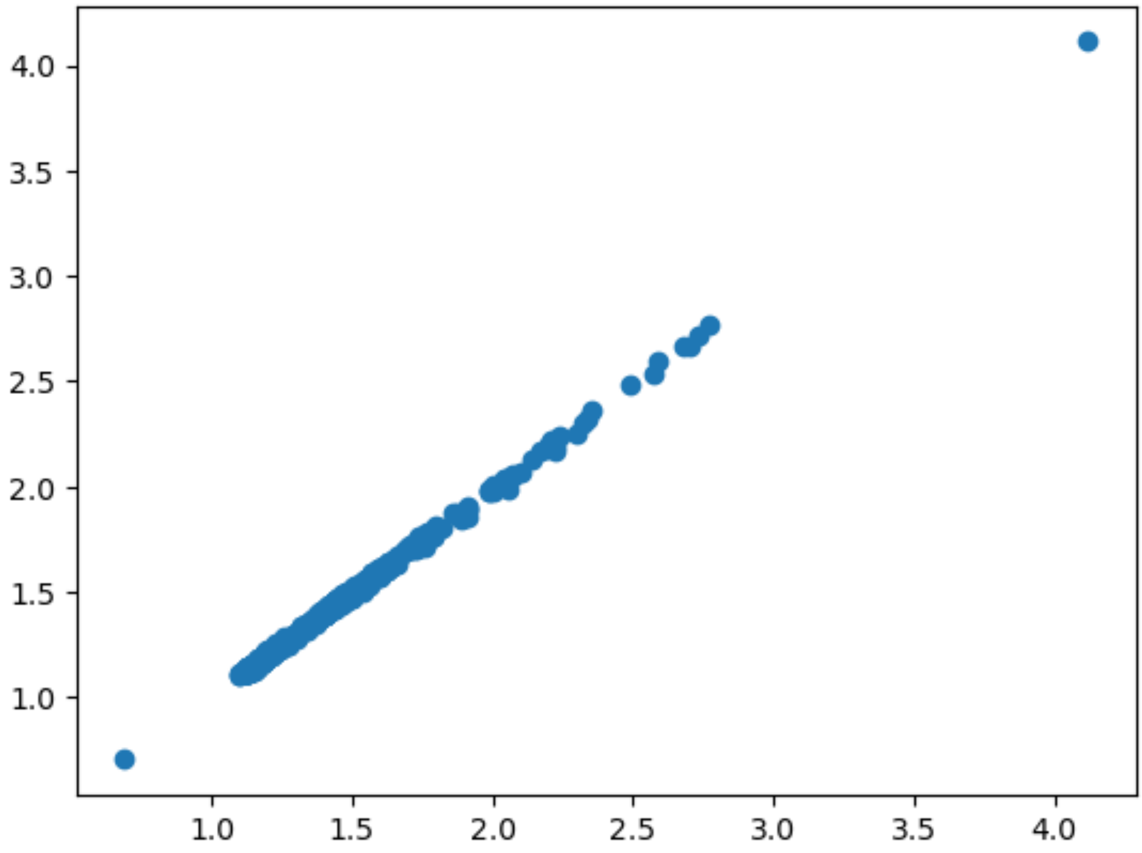
Ridge

In [54]:
```
rr=Ridge(alpha=1)
rr.fit(x_train,y_train)
```

Out[54]:
```
▾     Ridge
Ridge(alpha=1)
```

In [55]:
```
prediction2=rr.predict(x_test)
plt.scatter(y_test,prediction2)
```

Out[55]: <matplotlib.collections.PathCollection at 0x7fe3d852dde0>



In [56]:
```
rrs=rr.score(x_test,y_test)
```

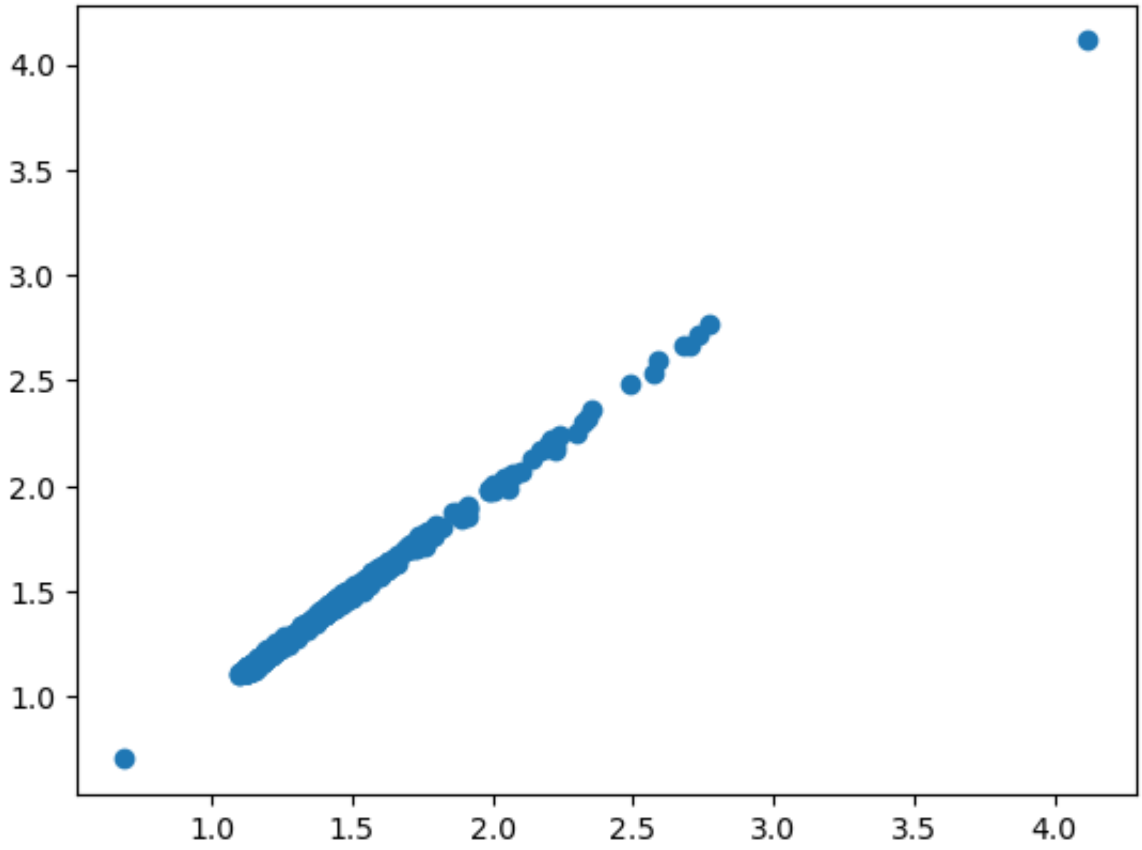
ElasticNet

In [57]:
```
en=ElasticNet()
en.fit(x_train,y_train)
```

Out[57]:
```
▾ ElasticNet
ElasticNet()
```

In [58]:
```
prediction2=rr.predict(x_test)
plt.scatter(y_test,prediction2)
```

Out[58]: <matplotlib.collections.PathCollection at 0x7fe4198f1510>



In [59]:
```
ens=en.score(x_test,y_test)
```

In [60]:
```
print(rr.score(x_test,y_test))
rr.score(x_train,y_train)
```

```
0.9983120614140699
```

Out[60]: 0.9981277627436985

Logistic

In [61]:
```
g={"TCH":{1.0:"Low",2.0:"High"}}
df3=df3.replace(g)
df3["TCH"].value_counts()
```

Out[61]:
```
High    2477
Low     2085
Name: TCH, dtype: int64
```

In [62]:
```
x=df3.drop(["TCH"],axis=1)
y=df3["TCH"]
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

In [63]:
```
lo=LogisticRegression()
lo.fit(x_train,y_train)
```

Out[63]:
```
▾ LogisticRegression
LogisticRegression()
```

In [64]:
```
prediction3=lo.predict(x_test)
plt.scatter(y_test,prediction3)
```

Out[64]: <matplotlib.collections.PathCollection at 0x7fe419921510>

In [65]:
```
los=lo.score(x_test,y_test)
```

Random Forest

In [66]:
```
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV
```

In [67]:
```
g1={"TCH":{"Low":1.0,"High":2.0}}
df3=df3.replace(g1)
```

In [68]:
```
x=df3.drop(["TCH"],axis=1)
y=df3["TCH"]
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3)
```

In [69]:
```
rfc=RandomForestClassifier()
rfc.fit(x_train,y_train)
```

Out[69]:
```
▾ RandomForestClassifier

RandomForestClassifier()
```

In [70]:
```
parameter={
    'max_depth':[1,2,4,5,6],
    'min_samples_leaf':[5,10,15,20,25],
    'n_estimators':[10,20,30,40,50]
}
```

In [71]:
```
grid_search=GridSearchCV(estimator=rfc,param_grid=parameter,cv=2,sc
grid_search.fit(x_train,y_train)
```

Out[71]:
```
▸ GridSearchCV
▸ estimator: RandomForestClassifier
    ▸ RandomForestClassifier
```

In [72]:
```
rfcs=grid_search.best_score_
```

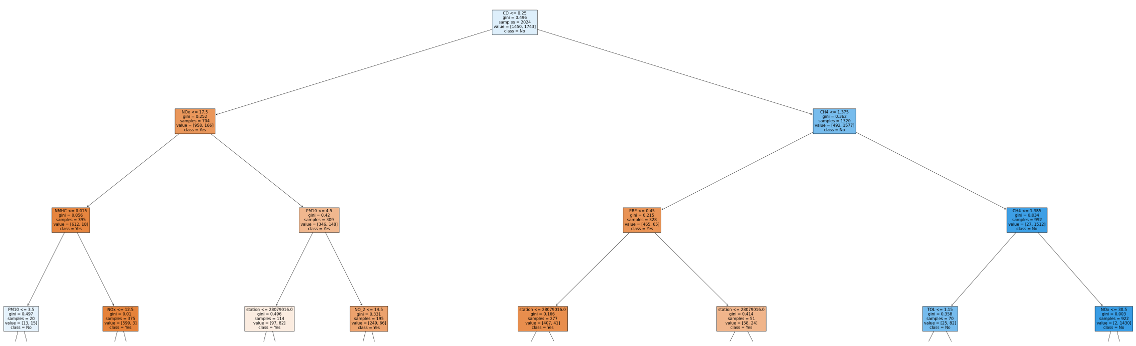
In [73]:
```
rfc_best=grid_search.best_estimator_
```

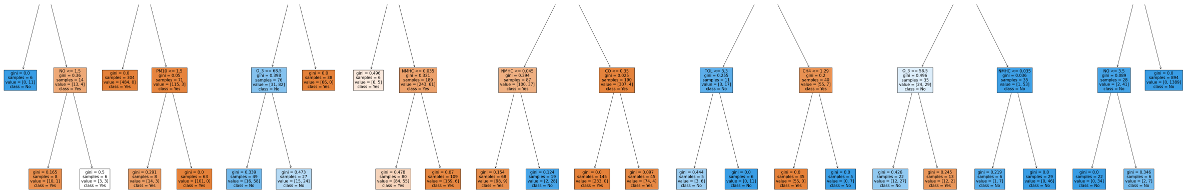
In [74]:
```
from sklearn.tree import plot_tree

plt.figure(figsize=(80,40))
plot_tree(rfc_best.estimators_[5],feature_names=x.columns,class_nam
```

Out[74]:
```
[Text(0.4557291666666667, 0.9166666666666666, 'CO <= 0.25\ngini =
0.496\nsamples = 2024\nvalue = [1450, 1743]\nclass = No'),
 Text(0.1875, 0.75, 'NOx <= 17.5\ngini = 0.252\nsamples = 704\nval
ue = [958, 166]\nclass = Yes'),
 Text(0.08333333333333333, 0.5833333333333334, 'NMHC <= 0.015\ngin
i = 0.056\nsamples = 395\nvalue = [612, 18]\nclass = Yes'),
 Text(0.041666666666666664, 0.4166666666666667, 'PM10 <= 3.5\ngini
= 0.497\nsamples = 20\nvalue = [13, 15]\nclass = No'),
 Text(0.020833333333333332, 0.25, 'gini = 0.0\nsamples = 6\nvalue
= [0, 11]\nclass = No'),
 Text(0.0625, 0.25, 'NO <= 1.5\ngini = 0.36\nsamples = 14\nvalue =
```

```
[13, 4]\nclass = Yes'),
 Text(0.041666666666666664, 0.08333333333333333, 'gini = 0.165\nsa
mples = 8\nvalue = [10, 1]\nclass = Yes'),
 Text(0.08333333333333333, 0.08333333333333333, 'gini = 0.5\nsampl
es = 6\nvalue = [3, 3]\nclass = Yes'),
 Text(0.125, 0.4166666666666667, 'NOx <= 12.5\ngini = 0.01\nsample
s = 375\nvalue = [599, 3]\nclass = Yes'),
 Text(0.10416666666666667, 0.25, 'gini = 0.0\nsamples = 304\nvalue
= [484, 0]\nclass = Yes'),
 Text(0.14583333333333334, 0.25, 'PM10 <= 1.5\ngini = 0.05\nsample
s = 71\nvalue = [115, 3]\nclass = Yes'),
 Text(0.125, 0.08333333333333333, 'gini = 0.291\nsamples = 8\nvalu
e = [14, 3]\nclass = Yes'),
 Text(0.16666666666666666, 0.08333333333333333, 'gini = 0.0\nsampl
es = 63\nvalue = [101, 0]\nclass = Yes'),
 Text(0.2916666666666667, 0.5833333333333334, 'PM10 <= 4.5\ngini =
0.42\nsamples = 309\nvalue = [346, 148]\nclass = Yes'),
 Text(0.25, 0.4166666666666667, 'station <= 28079016.0\ngini = 0.4
96\nsamples = 114\nvalue = [97, 82]\nclass = Yes'),
 Text(0.22916666666666666, 0.25, 'O_3 <= 68.5\ngini = 0.398\nsampl
es = 76\nvalue = [31, 82]\nclass = No'),
 Text(0.20833333333333334, 0.08333333333333333, 'gini = 0.339\nsam
ples = 49\nvalue = [16, 58]\nclass = No'),
 Text(0.25, 0.08333333333333333, 'gini = 0.473\nsamples = 27\nvalu
e = [15, 24]\nclass = No'),
 Text(0.2708333333333333, 0.25, 'gini = 0.0\nsamples = 38\nvalue =
[66, 0]\nclass = Yes'),
 Text(0.3333333333333333, 0.4166666666666667, 'NO_2 <= 14.5\ngini
= 0.331\nsamples = 195\nvalue = [249, 66]\nclass = Yes'),
 Text(0.3125, 0.25, 'gini = 0.496\nsamples = 6\nvalue = [6, 5]\ncl
ass = Yes'),
 Text(0.3541666666666667, 0.25, 'NMHC <= 0.035\ngini = 0.321\nsamp
les = 189\nvalue = [243, 61]\nclass = Yes'),
 Text(0.3333333333333333, 0.08333333333333333, 'gini = 0.478\nsamp
les = 80\nvalue = [84, 55]\nclass = Yes'),
 Text(0.375, 0.08333333333333333, 'gini = 0.07\nsamples = 109\nval
ue = [159, 6]\nclass = Yes'),
 Text(0.7239583333333334, 0.75, 'CH4 <= 1.375\ngini = 0.362\nsampl
es = 1320\nvalue = [492, 1577]\nclass = No'),
 Text(0.5625, 0.5833333333333334, 'EBE <= 0.45\ngini = 0.215\nsamp
les = 328\nvalue = [465, 65]\nclass = Yes'),
 Text(0.4791666666666667, 0.4166666666666667, 'station <= 2807901
6.0\ngini = 0.166\nsamples = 277\nvalue = [407, 41]\nclass = Ye
s'),
 Text(0.4375, 0.25, 'NMHC <= 0.045\ngini = 0.394\nsamples = 87\nva
lue = [100, 37]\nclass = Yes'),
 Text(0.4166666666666667, 0.08333333333333333, 'gini = 0.154\nsamp
les = 68\nvalue = [98, 9]\nclass = Yes'),
 Text(0.4583333333333333, 0.08333333333333333, 'gini = 0.124\nsamp
les = 19\nvalue = [2, 28]\nclass = No'),
 Text(0.5208333333333334, 0.25, 'CO <= 0.35\ngini = 0.025\nsamples
= 190\nvalue = [307, 4]\nclass = Yes'),
 Text(0.5, 0.08333333333333333, 'gini = 0.0\nsamples = 145\nvalue
```

```
= [233, 0]\nclass = Yes'),
 Text(0.5416666666666666, 0.08333333333333333, 'gini = 0.097\nsamp
les = 45\nvalue = [74, 4]\nclass = Yes'),
 Text(0.6458333333333334, 0.4166666666666667, 'station <= 2807901
6.0\ngini = 0.414\nsamples = 51\nvalue = [58, 24]\nclass = Yes'),
 Text(0.6041666666666666, 0.25, 'TOL <= 3.3\ngini = 0.255\nsamples
= 11\nvalue = [3, 17]\nclass = No'),
 Text(0.5833333333333334, 0.08333333333333333, 'gini = 0.444\nsamp
les = 5\nvalue = [3, 6]\nclass = No'),
 Text(0.625, 0.08333333333333333, 'gini = 0.0\nsamples = 6\nvalue
= [0, 11]\nclass = No'),
 Text(0.6875, 0.25, 'CH4 <= 1.29\ngini = 0.2\nsamples = 40\nvalue
= [55, 7]\nclass = Yes'),
 Text(0.6666666666666666, 0.08333333333333333, 'gini = 0.0\nsample
s = 35\nvalue = [55, 0]\nclass = Yes'),
 Text(0.7083333333333334, 0.08333333333333333, 'gini = 0.0\nsample
s = 5\nvalue = [0, 7]\nclass = No'),
 Text(0.8854166666666666, 0.5833333333333334, 'CH4 <= 1.385\ngini
= 0.034\nsamples = 992\nvalue = [27, 1512]\nclass = No'),
 Text(0.8125, 0.4166666666666667, 'TOL <= 1.15\ngini = 0.358\nsamp
les = 70\nvalue = [25, 82]\nclass = No'),
 Text(0.7708333333333334, 0.25, 'O_3 <= 58.5\ngini = 0.496\nsample
s = 35\nvalue = [24, 29]\nclass = No'),
 Text(0.75, 0.08333333333333333, 'gini = 0.426\nsamples = 22\nvalu
e = [12, 27]\nclass = No'),
 Text(0.7916666666666666, 0.08333333333333333, 'gini = 0.245\nsamp
les = 13\nvalue = [12, 2]\nclass = Yes'),
 Text(0.8541666666666666, 0.25, 'NMHC <= 0.035\ngini = 0.036\nsamp
les = 35\nvalue = [1, 53]\nclass = No'),
 Text(0.8333333333333334, 0.08333333333333333, 'gini = 0.219\nsamp
les = 6\nvalue = [1, 7]\nclass = No'),
 Text(0.875, 0.08333333333333333, 'gini = 0.0\nsamples = 29\nvalue
= [0, 46]\nclass = No'),
 Text(0.9583333333333334, 0.4166666666666667, 'NOx <= 30.5\ngini =
0.003\nsamples = 922\nvalue = [2, 1430]\nclass = No'),
 Text(0.9375, 0.25, 'NO <= 3.5\ngini = 0.089\nsamples = 28\nvalue
= [2, 41]\nclass = No'),
 Text(0.9166666666666666, 0.08333333333333333, 'gini = 0.0\nsample
s = 22\nvalue = [0, 34]\nclass = No'),
 Text(0.9583333333333334, 0.08333333333333333, 'gini = 0.346\nsamp
les = 6\nvalue = [2, 7]\nclass = No'),
 Text(0.9791666666666666, 0.25, 'gini = 0.0\nsamples = 894\nvalue
= [0, 1389]\nclass = No')]
```





In [75]:
```
print("Linear:",lis)
print("Lasso:",las)
print("Ridge:",rrs)
print("ElasticNet:",ens)
print("Logistic:",los)
print("Random Forest:",rfcs)
```

```
Linear: 0.9996090192033011
Lasso: 0.3875640304973138
Ridge: 0.9983120614140699
ElasticNet: 0.609503466089908
Logistic: 0.5507669831994156
Random Forest: 0.9793305665541436
```

Best model is Random Forest