In [1]:
```
import pyspark
from random import random
from operator import add

from pyspark.sql import SparkSession
```

In [2]:
```
spark = SparkSession.builder.appName("LoadEnergyDataset").master("spark:/
```

```
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setL
ogLevel(newLevel).
25/04/07 19:47:52 WARN NativeCodeLoader: Unable to load native-hadoop libr
ary for your platform... using builtin-java classes where applicable
```

In [3]:
```
df = spark.read.format("csv").option("header", "true").option("inferschem
```

In [4]:
```
# df.show(5,70)
```

In [5]:
```
df2 = df.select("country","year","population","electricity_demand").where
```

In [6]:
```
df2.show(5)
df2.printSchema()
```

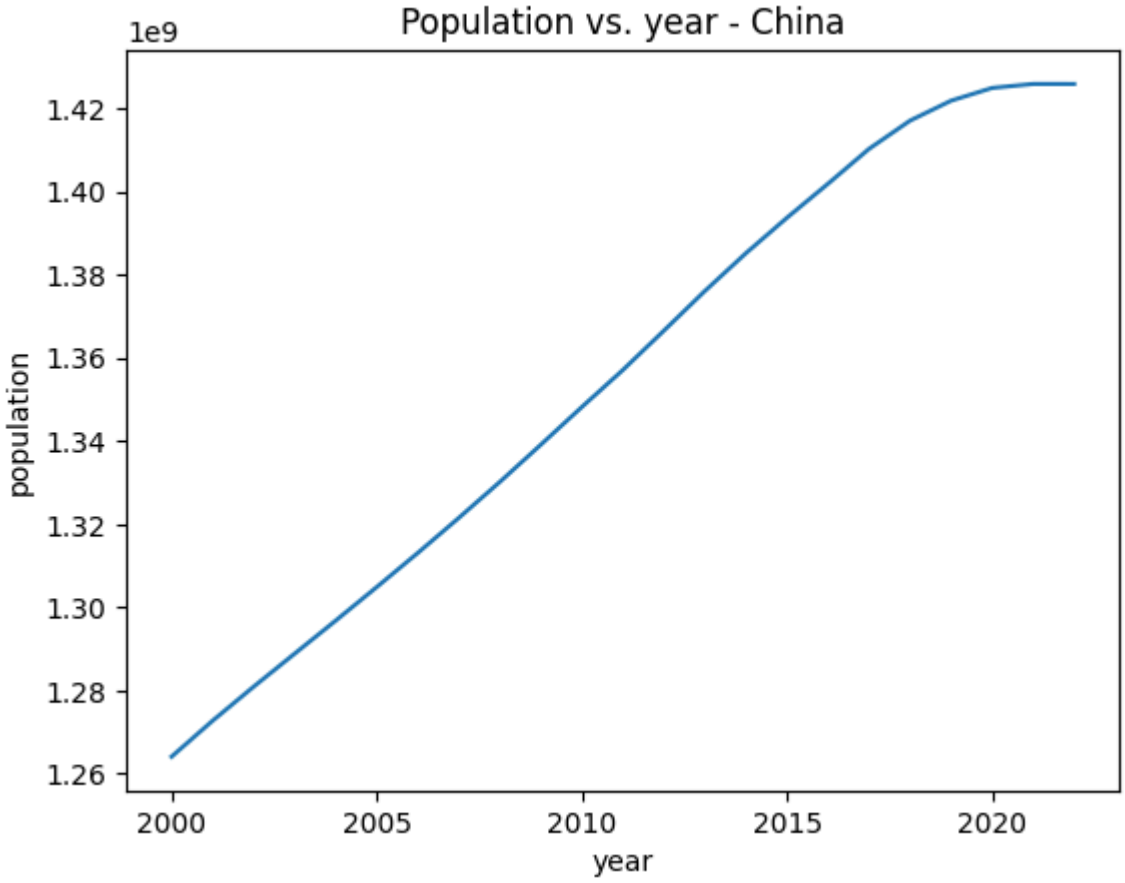
```
+-------+----+----------+------------------+
|country|year|population|electricity_demand|
+-------+----+----------+------------------+
| Poland|2000|  38504432|            136.81|
| Poland|2001|  38662860|            136.99|
| Poland|2002|  38647476|            135.42|
| Poland|2003|  38621536|            139.85|
| Poland|2004|  38596040|            142.97|
+-------+----+----------+------------------+
only showing top 5 rows

root
 |-- country: string (nullable = true)
 |-- year: integer (nullable = true)
 |-- population: long (nullable = true)
 |-- electricity_demand: double (nullable = true)
```

In [7]:
```
df_ch = df.select('year','population','electricity_demand').where(("count
df_ch.show()
```

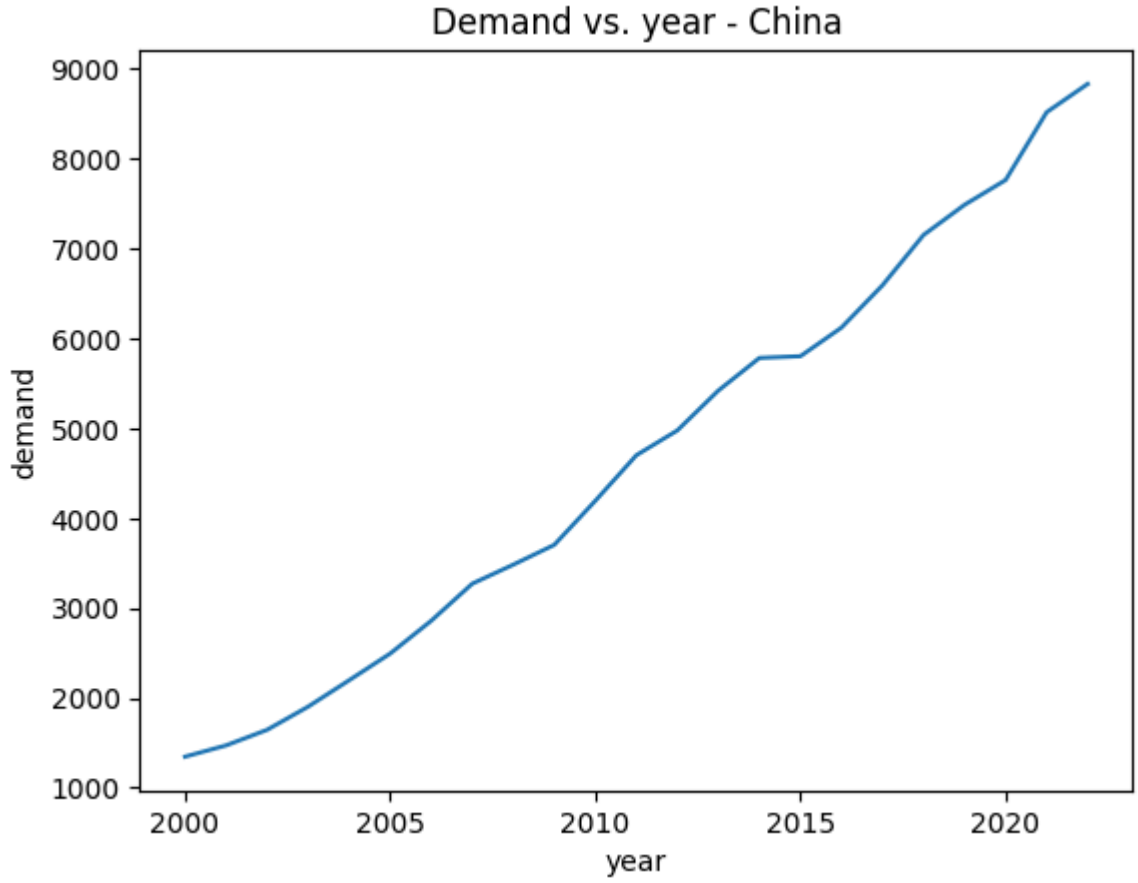
```
+----+----------+------------------+
|year|population|electricity_demand|
+----+----------+------------------+
|2000|1264099072|           1346.85|
|2001|1272739584|           1472.19|
|2002|1280926080|           1645.61|
|2003|1288873344|           1903.22|
|2004|1296816768|           2197.23|
|2005|1304887552|           2494.08|
|2006|1313086592|           2858.84|
|2007|1321513216|           3271.23|
|2008|1330167168|           3482.96|
|2009|1339125632|           3703.26|
|2010|1348191360|           4193.65|
|2011|1357095424|           4700.28|
|2012|1366560768|           4976.76|
|2013|1376100352|            5420.4|
|2014|1385189632|           5783.04|
|2015|1393715456|           5802.14|
|2016|1401889664|           6120.44|
|2017|1410275968|           6591.39|
|2018|1417069440|           7150.92|
|2019|1421864064|           7486.63|
+----+----------+------------------+
only showing top 20 rows
```

In [8]:
```
import matplotlib.pyplot as plt
df_ch = df_ch.orderBy('year')
y = df_ch.select('year').rdd.flatMap(lambda x: x).collect()
pop = df_ch.select('population').rdd.flatMap(lambda x: x).collect()
dem = df_ch.select('electricity_demand').rdd.flatMap(lambda x: x).collect
```

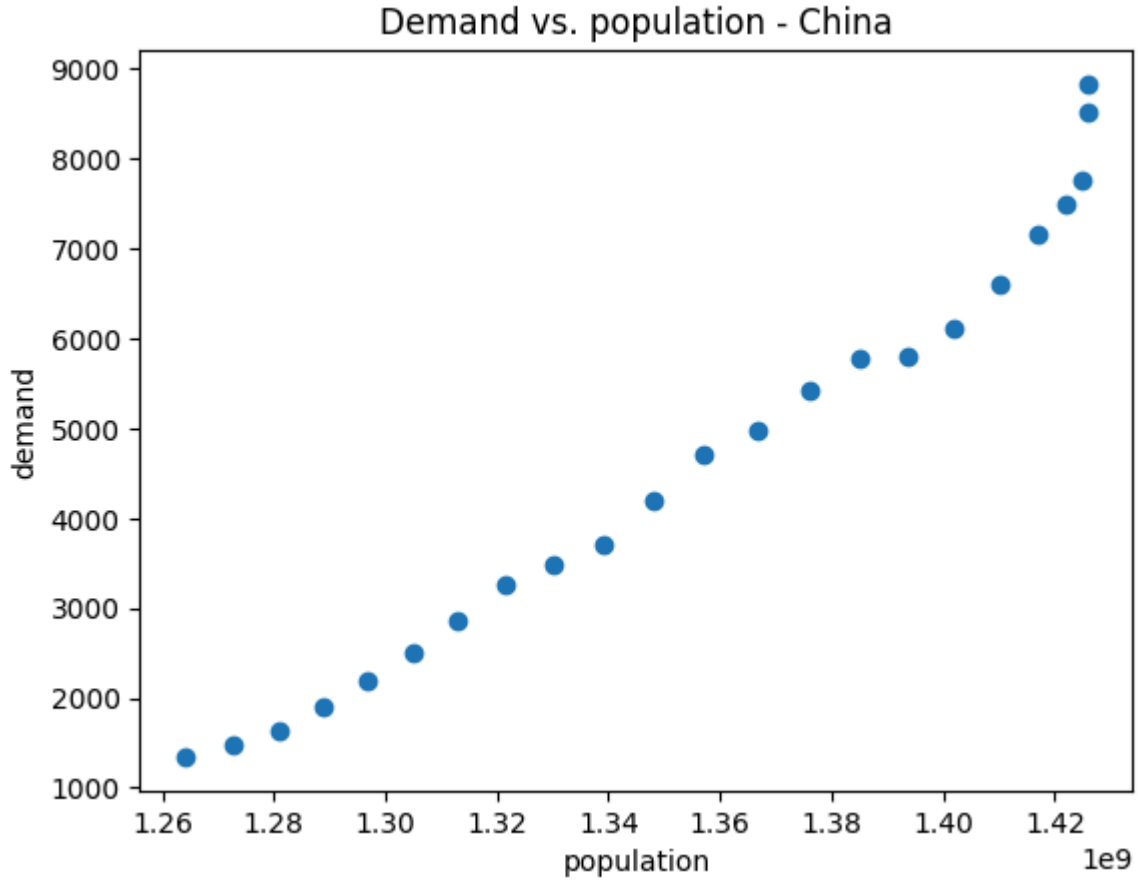
In [9]:
```
plt.plot(y,pop)
plt.xlabel('year')
plt.ylabel('population')
plt.title('Population vs. year - China')
plt.show()
```



In [10]:
```
plt.plot(y,dem,label='demand')
plt.xlabel('year')
plt.ylabel('demand')
plt.title('Demand vs. year - China')
plt.show()
```



In [11]:
```
plt.scatter(pop,dem)
plt.xlabel('population')
plt.ylabel('demand')
plt.title('Demand vs. population - China')
plt.show()
```



In [12]:
```
from pyspark.ml.regression import LinearRegression
from pyspark.ml.feature import VectorAssembler

va=VectorAssembler().setInputCols(["year"]).setOutputCol("features")
df_plf = va.transform(df_ch)
df_plf.show(5)

lr = LinearRegression()\
  .setMaxIter(10)\
  .setRegParam(3.0)\
  .setElasticNetParam(0.5)\
  .setFeaturesCol("features")\
  .setLabelCol("electricity_demand")
model = lr.fit(df_plf)
```

```
+----+----------+------------------+--------+
|year|population|electricity_demand|features|
+----+----------+------------------+--------+
|2000|1264099072|           1346.85|[2000.0]|
|2001|1272739584|           1472.19|[2001.0]|
|2002|1280926080|           1645.61|[2002.0]|
|2003|1288873344|           1903.22|[2003.0]|
|2004|1296816768|           2197.23|[2004.0]|
+----+----------+------------------+--------+
only showing top 5 rows
```

```
25/04/07 19:47:59 WARN InstanceBuilder: Failed to load implementation fro
m:dev.ludovic.netlib.blas.JNIBLAS
25/04/07 19:47:59 WARN InstanceBuilder: Failed to load implementation fro
m:dev.ludovic.netlib.blas.VectorBLAS
```

In [13]:
```
print(f'RMSE: {model.summary.rootMeanSquaredError}')
print(f'r2: {model.summary.r2}')
print(f'iterations: {model.summary.totalIterations}')
print(f'demand = {model.coefficients}*year {"+" if model.intercept > 0 el
```

```
RMSE: 197.62738324653978
r2: 0.9926039840377885
iterations: 3
demand = [344.7007425311926]*year  -688510.1175780544
```

In [14]:
```
import numpy as np
# from pyspark.sql.types import StructType, StructField, DoubleType
from pyspark.ml.linalg import Vectors

xmin = np.min(y)
xmax = np.max(y)
xx = np.linspace(xmin-1,xmax+1,100)

yy = [model.predict(Vectors.dense([x])) for x in xx]

plt.scatter(y,dem,label='demand')
plt.plot(xx,yy,label='fitted function',c='orange')
plt.legend()
plt.title('Electric energy demand in years - China')
plt.show()
```