EDA experiment 2: Time Series Analysis

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Importing time-series data

In [3]:

```
import pandas as pd
import numpy as np
```

In [4]:

```
# Load time series dataset
df_power = pd.read_csv("opsd_germany_daily.csv")
df_power.columns
```

Out[4]:

```
Index(['Date', 'Consumption', 'Wind', 'Solar', 'Wind+Solar'], dtype='object')
```

In [5]:

```
df_power.tail(10)
```

Out[5]:

	Date	Consumption	Wind	Solar	Wind+Solar
4373	2017-12-22	1423.23782	228.773	10.065	238.838
4374	2017-12-23	1272.17085	748.074	8.450	756.524
4375	2017-12-24	1141.75730	812.422	9.949	822.371
4376	2017-12-25	1111.28338	587.810	15.765	603.575
4377	2017-12-26	1130.11683	717.453	30.923	748.376
4378	2017-12-27	1263.94091	394.507	16.530	411.037
4379	2017-12-28	1299.86398	506.424	14.162	520.586
4380	2017-12-29	1295.08753	584.277	29.854	614.131
4381	2017-12-30	1215.44897	721.247	7.467	728.714
4382	2017-12-31	1107.11488	721.176	19.980	741.156

Clearly we have records of all type of power consumption by 2017.

In [6]:

```
df_power.shape
```

Out[6]:

```
(4383, 5)
```

In [7]:

```
df_power.dtypes
```

Out[7]:

```
Date            object
Consumption    float64
Wind           float64
Solar          float64
Wind+Solar     float64
dtype: object
```

In [8]:

```
#convert object to datetime format
df_power['Date'] = pd.to_datetime(df_power['Date'])
```

```
In [9]: df_power.dtypes
```

```
Out[9]: Date           datetime64[ns]
        Consumption           float64
        Wind                  float64
        Solar                 float64
        Wind+Solar            float64
        dtype: object
```

Now that the Date column is in correct datatype, let's set it as the DataFrame's index because in time series analysis the index column is always datetime column.

```
In [10]: df_power = df_power.set_index('Date')
         df_power.tail(3)
```

Out[10]:

	Consumption	Wind	Solar	Wind+Solar
Date				
2017-12-29	1295.08753	584.277	29.854	614.131
2017-12-30	1215.44897	721.247	7.467	728.714
2017-12-31	1107.11488	721.176	19.980	741.156

```
In [11]: df_power.index
```

```
Out[11]: DatetimeIndex(['2006-01-01', '2006-01-02', '2006-01-03', '2006-01-04',
                        '2006-01-05', '2006-01-06', '2006-01-07', '2006-01-08',
                        '2006-01-09', '2006-01-10',
                        ...
                        '2017-12-22', '2017-12-23', '2017-12-24', '2017-12-25',
                        '2017-12-26', '2017-12-27', '2017-12-28', '2017-12-29',
                        '2017-12-30', '2017-12-31'],
                       dtype='datetime64[ns]', name='Date', length=4383, freq=None)
```

```
In [16]: # Add columns with year, month, and weekday name
         df_power['Year'] = df_power.index.year
```

```
df_power['Month'] = df_power.index.month
df_power['Weekday Name'] = df_power.index.day_name
```

In [17]:

```
# Display a random sampling of 5 rows
df_power.sample(5, random_state=0)
```

Out[17]:

	Consumption	Wind	Solar	Wind+Solar	Year	Month	Weekday Name
Date							
2008-08-23	1152.011	NaN	NaN	NaN	2008	8	<bound method _inherit_from_data.<locals>.meth...
2013-08-08	1291.984	79.666	93.371	173.037	2013	8	<bound method _inherit_from_data.<locals>.meth...
2009-08-27	1281.057	NaN	NaN	NaN	2009	8	<bound method _inherit_from_data.<locals>.meth...
2015-10-02	1391.050	81.229	160.641	241.870	2015	10	<bound method _inherit_from_data.<locals>.meth...
2009-06-02	1201.522	NaN	NaN	NaN	2009	6	<bound method _inherit_from_data.<locals>.meth...

In [18]:

```
df_power.loc['2015-10-02']
```

Out[18]:

```
Consumption                                                1391.05
Wind                                                        81.229
Solar                                                      160.641
Wind+Solar                                                  241.87
Year                                                          2015
Month                                                           10
Weekday Name    <bound method _inherit_from_data.<locals>.meth...
Name: 2015-10-02 00:00:00, dtype: object
```

In [19]:

```
df_power.loc['2017-01-01':'2017-12-30']
```

Out[19]:

	Consumption	Wind	Solar	Wind+Solar	Year	Month	Weekday Name
Date							
2017-01-01	1130.41300	307.125	35.291	342.416	2017	1	<bound method _inherit_from_data.<locals>.meth...
2017-01-02	1441.05200	295.099	12.479	307.578	2017	1	<bound method _inherit_from_data.<locals>.meth...
2017-01-03	1529.99000	666.173	9.351	675.524	2017	1	<bound method _inherit_from_data.<locals>.meth...
2017-01-04	1553.08300	686.578	12.814	699.392	2017	1	<bound method _inherit_from_data.<locals>.meth...
2017-01-05	1547.23800	261.758	20.797	282.555	2017	1	<bound method _inherit_from_data.<locals>.meth...
...	...	...	...	...	...	...	...
2017-12-26	1130.11683	717.453	30.923	748.376	2017	12	<bound method _inherit_from_data.<locals>.meth...
2017-12-27	1263.94091	394.507	16.530	411.037	2017	12	<bound method _inherit_from_data.<locals>.meth...
2017-12-28	1299.86398	506.424	14.162	520.586	2017	12	<bound method _inherit_from_data.<locals>.meth...
2017-12-29	1295.08753	584.277	29.854	614.131	2017	12	<bound method _inherit_from_data.<locals>.meth...
2017-12-30	1215.44897	721.247	7.467	728.714	2017	12	<bound method _inherit_from_data.<locals>.meth...

364 rows × 7 columns

Visualization for time series analysis

In [20]:

```
import matplotlib.pyplot as plt
import seaborn as sns
sns.set(rc={'figure.figsize':(16, 4)})
plt.rcParams['figure.dpi'] = 150
```

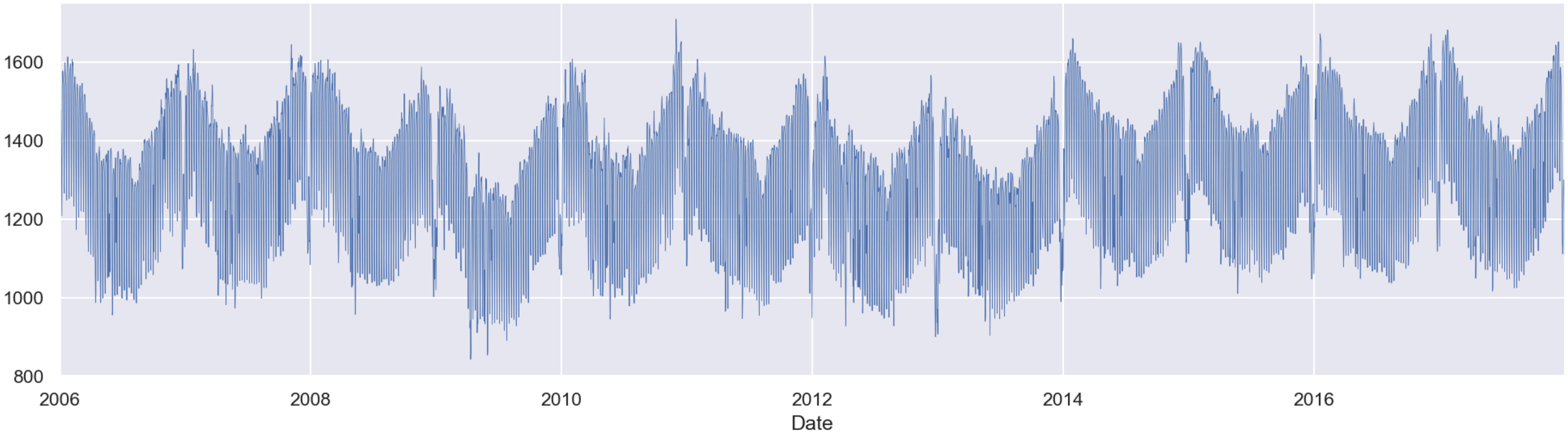
Let’s create a line plot of the full time series of Germany’s daily electricity consumption, using the pandas's plot() method.

In [21]:

```
df_power['Consumption'].plot(linewidth=0.4)
```

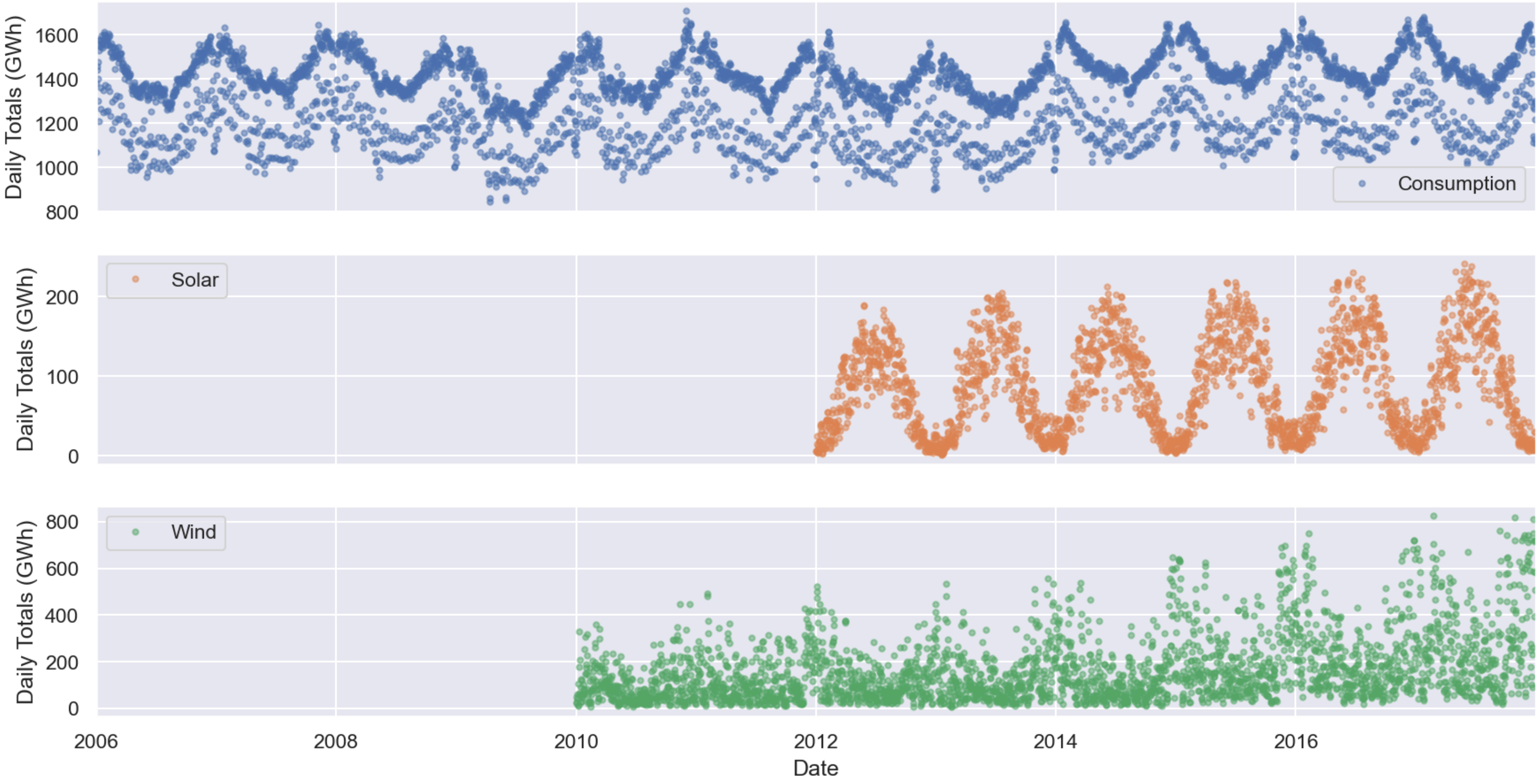
Out[21]:

```
<Axes: xlabel='Date'>
```



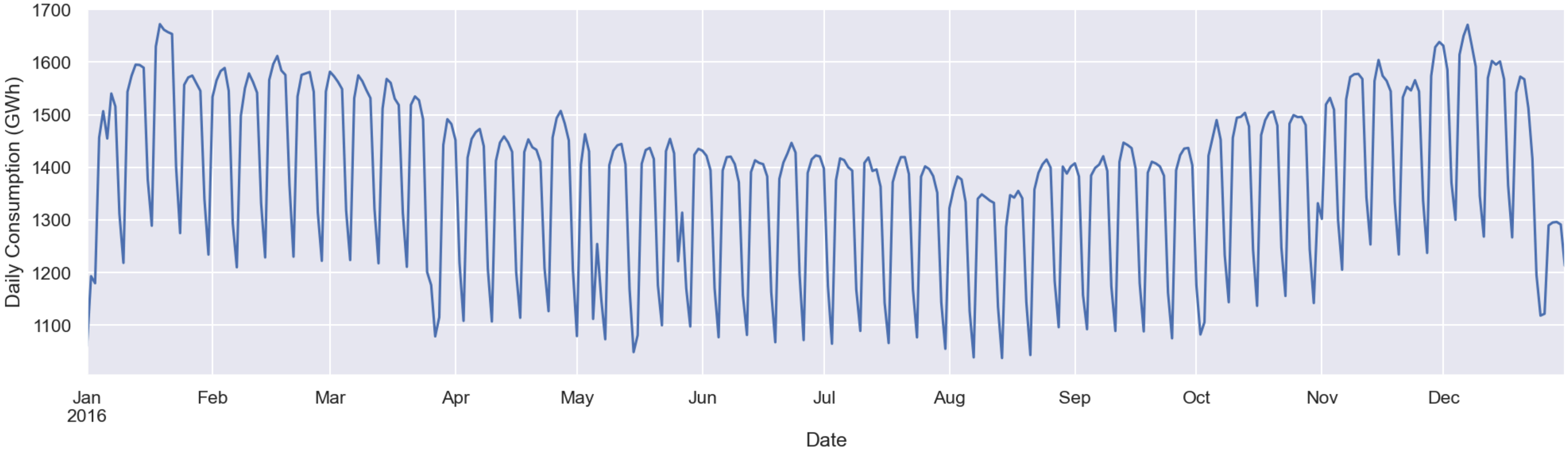
In [22]:

```
cols_to_plot = ['Consumption', 'Solar', 'Wind']
axes = df_power[cols_to_plot].plot(marker='.', alpha=0.5, linestyle='None',figsize=(14, 7), subplots=True)
for ax in axes:
    ax.set_ylabel('Daily Totals (GWh)')

plt.show()
```



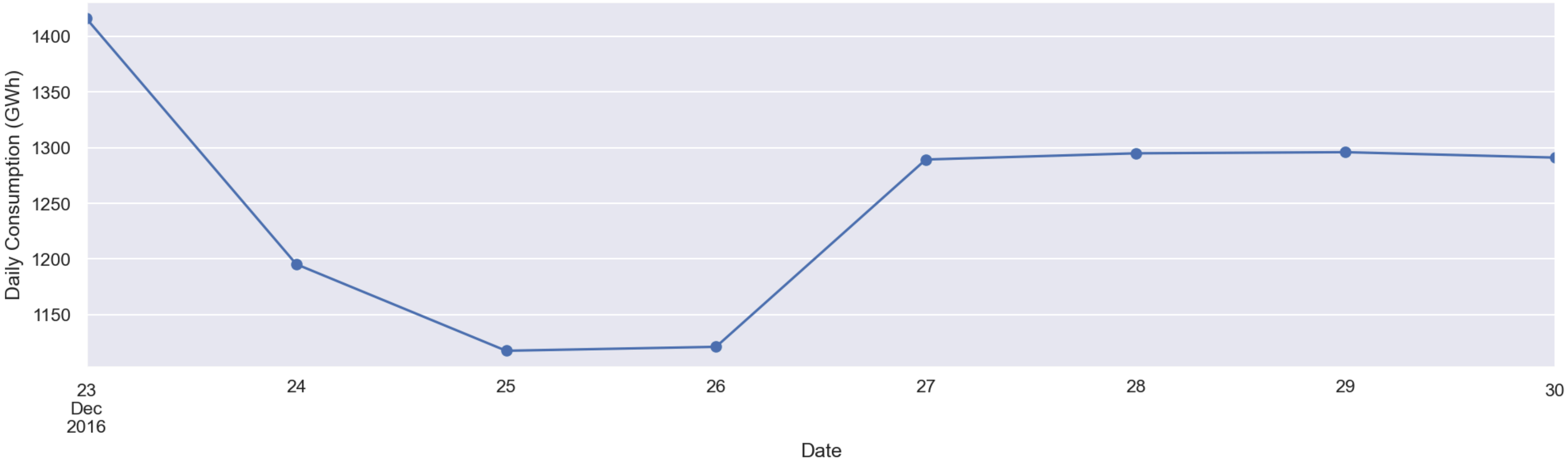
```
In [24]: ax = df_power.loc['2016', 'Consumption'].plot()
         ax.set_ylabel('Daily Consumption (GWh)')
```

```
Out[24]: Text(0, 0.5, 'Daily Consumption (GWh)')
```



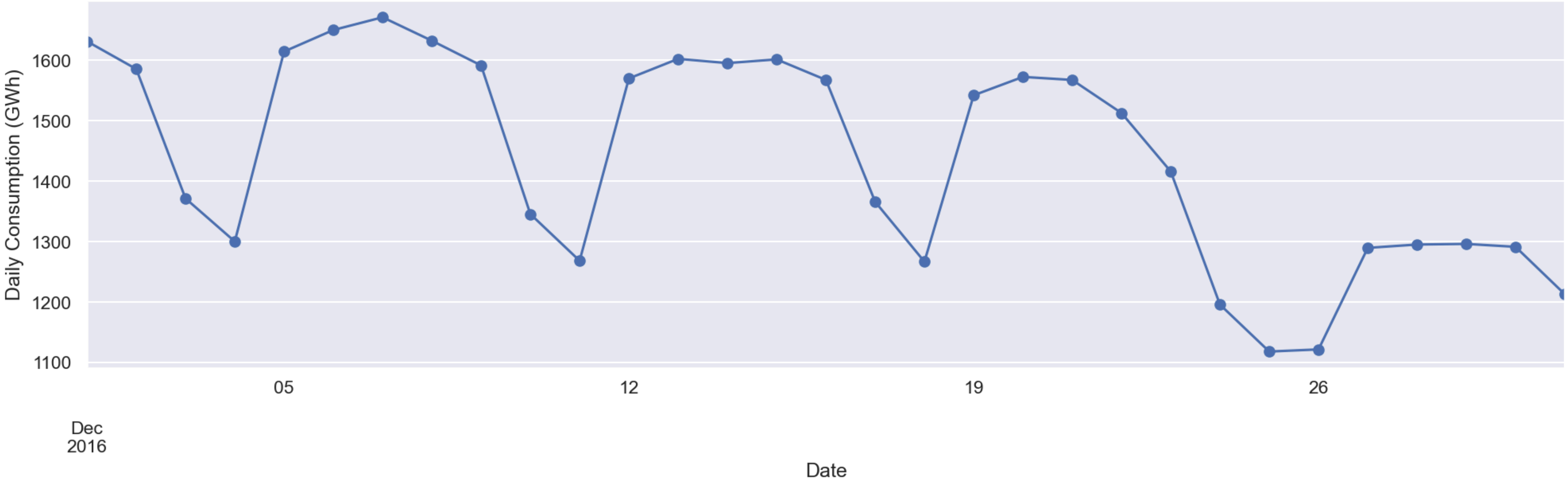
```
In [25]: ax = df_power.loc['2016-12-23':'2016-12-30', 'Consumption'].plot(marker='o', linestyle='-')
         ax.set_ylabel('Daily Consumption (GWh)')
```

```
Out[25]: Text(0, 0.5, 'Daily Consumption (GWh)')
```

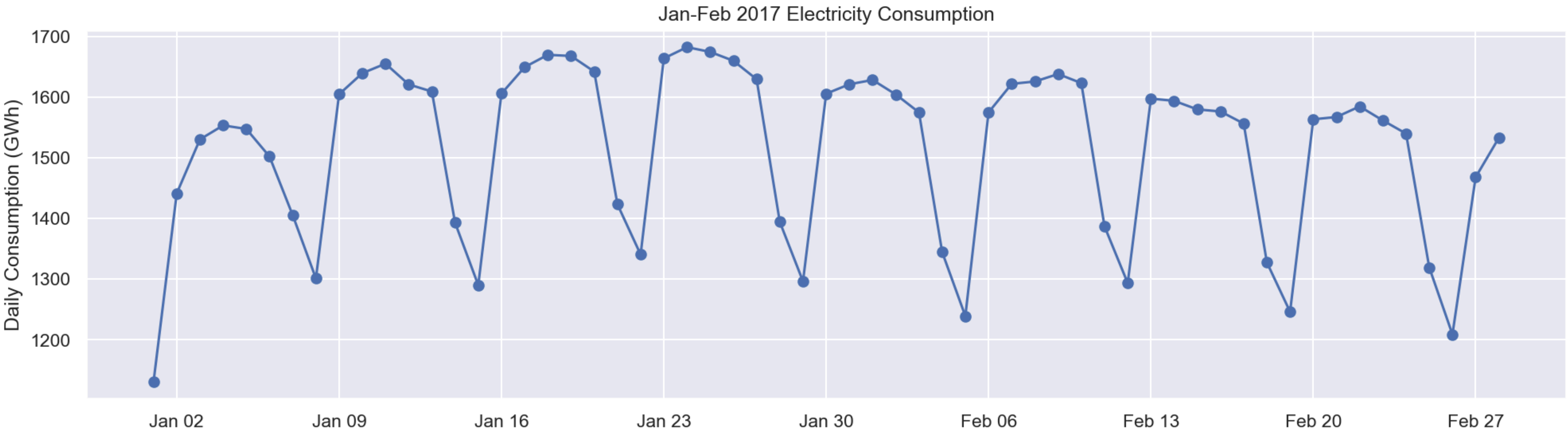


In [26]:
```
ax = df_power.loc['2016-12', 'Consumption'].plot(marker='o', linestyle='-')
ax.set_ylabel('Daily Consumption (GWh)')
```

Out[26]:
```
Text(0, 0.5, 'Daily Consumption (GWh)')
```

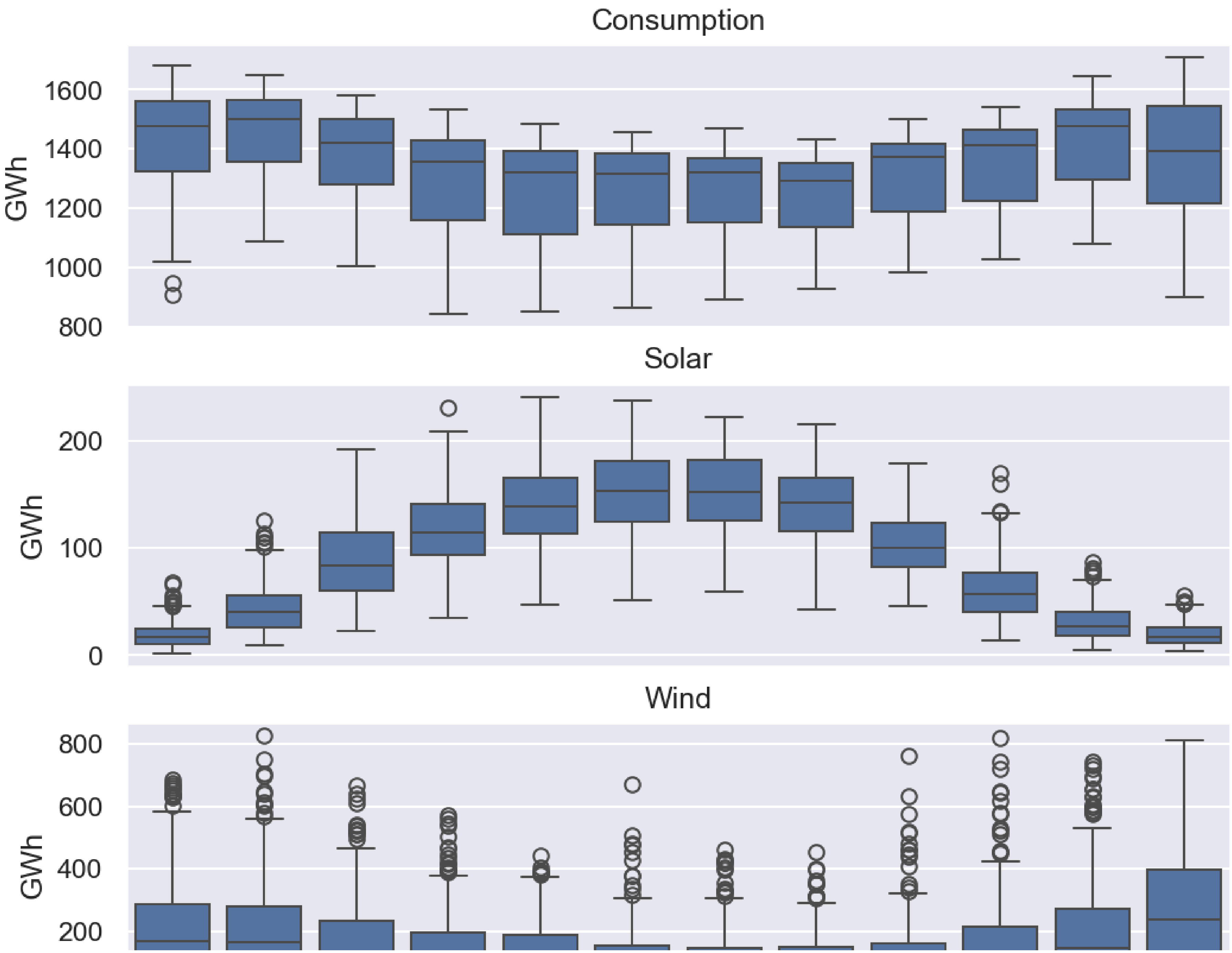


In [27]:
```
# import dates module from matplotlib
import matplotlib.dates as mdates

# plot graph
fig, ax = plt.subplots()

ax.plot(df_power.loc['2017-01':'2017-02', 'Consumption'], marker='o', linestyle='-')
ax.set_ylabel('Daily Consumption (GWh)')
ax.set_title('Jan-Feb 2017 Electricity Consumption')

# to set x-axis major ticks to weekly interval, on Mondays
ax.xaxis.set_major_locator(mdates.WeekdayLocator(byweekday=mdates.MONDAY))
# to set format for x-tick labels as 3-letter month name and day number
ax.xaxis.set_major_formatter(mdates.DateFormatter('%b %d'))
```



Seasonality

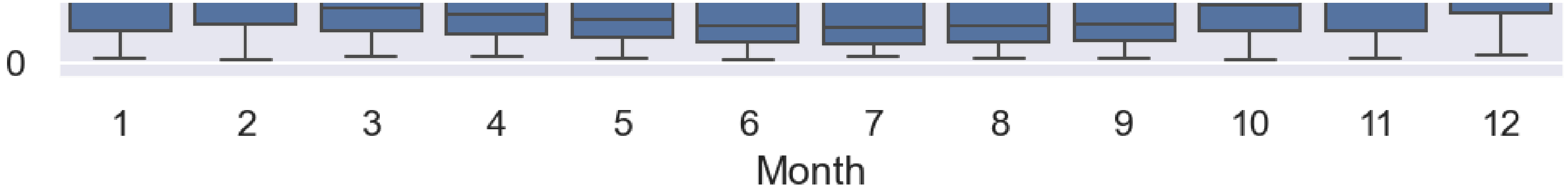
In [28]:
```
fig, axes = plt.subplots(3, 1, figsize=(8, 7), sharex=True)
for name, ax in zip(['Consumption', 'Solar', 'Wind'], axes):
  sns.boxplot(data=df_power, x='Month', y=name, ax=ax)
  ax.set_ylabel('GWh')
  ax.set_title(name)
  if ax != axes[-1]:
    ax.set_xlabel('')
```



Consumption

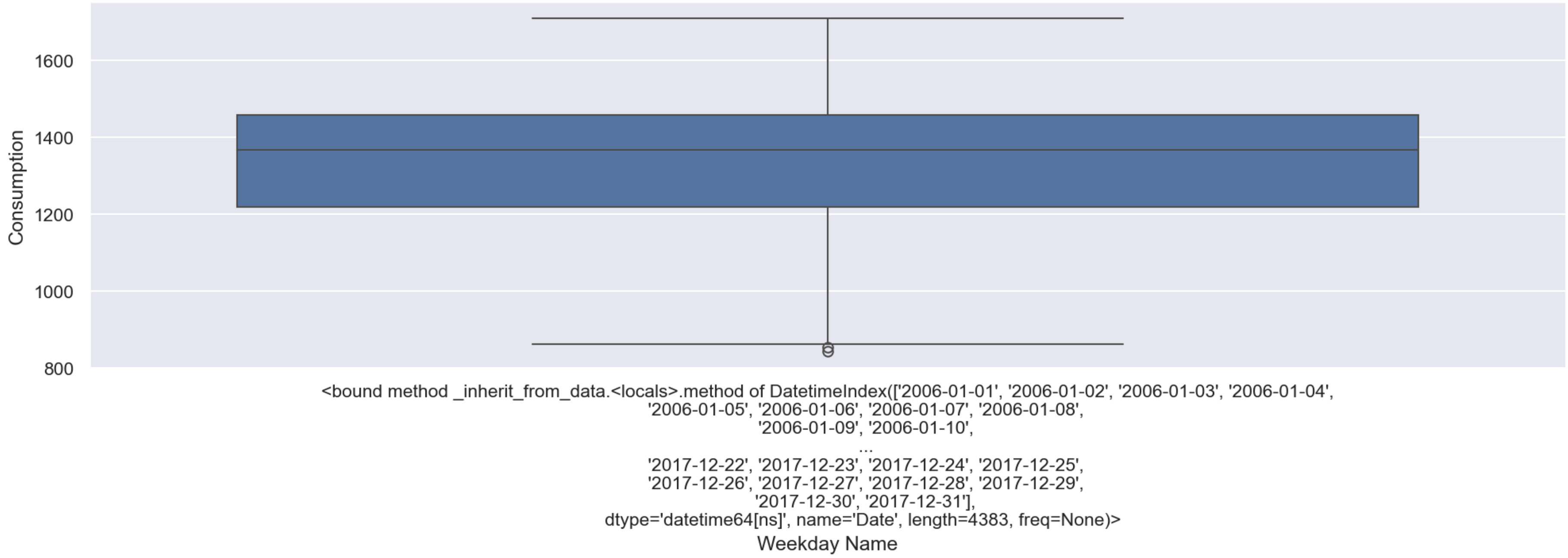
Solar

Wind



In [30]:
```
sns.boxplot(data=df_power, x='Weekday Name', y='Consumption')
```

Out[30]:
```
<Axes: xlabel='Weekday Name', ylabel='Consumption'>
```



In [31]:
```
columns = ['Consumption', 'Wind', 'Solar', 'Wind+Solar']

power_weekly_mean = df_power[columns].resample('W').mean()
power_weekly_mean.head(10)
```

Out[31]:

	Consumption	Wind	Solar	Wind+Solar
Date				
2006-01-01	1069.184000	NaN	NaN	NaN
2006-01-08	1381.300143	NaN	NaN	NaN
2006-01-15	1486.730286	NaN	NaN	NaN
2006-01-22	1490.031143	NaN	NaN	NaN
2006-01-29	1514.176857	NaN	NaN	NaN
2006-02-05	1501.403286	NaN	NaN	NaN
2006-02-12	1498.217143	NaN	NaN	NaN
2006-02-19	1446.507429	NaN	NaN	NaN
2006-02-26	1447.651429	NaN	NaN	NaN
2006-03-05	1439.727857	NaN	NaN	NaN

In [32]:

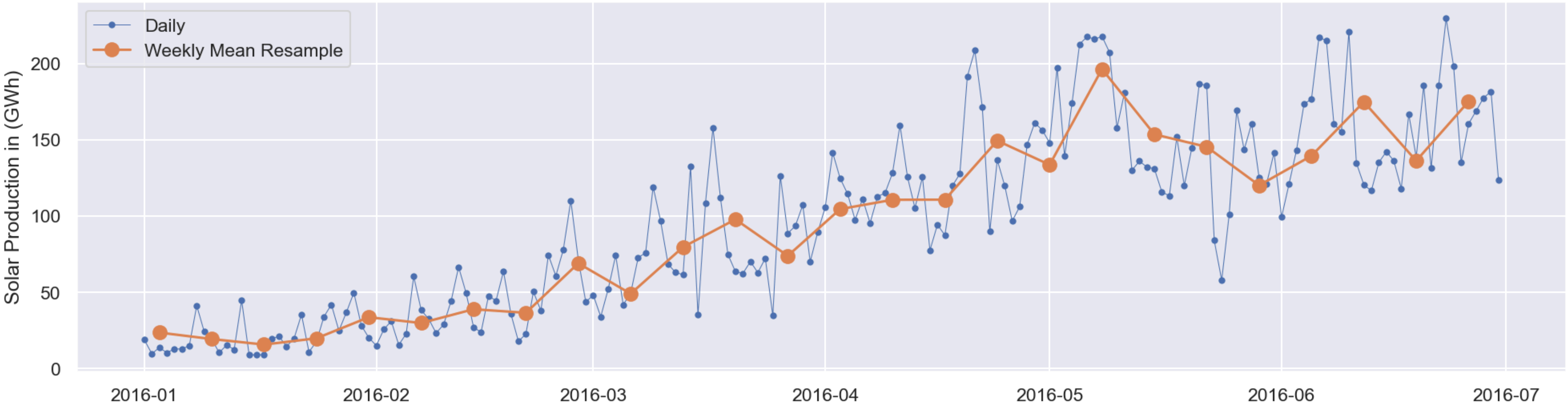
```
start, end = '2016-01', '2016-06'
```

In [34]:

```
fig, ax = plt.subplots()

ax.plot(df_power.loc[start:end, 'Solar'],
marker='.', linestyle='-', linewidth=0.5, label='Daily')
ax.plot(power_weekly_mean.loc[start:end, 'Solar'],
marker='o', markersize=8, linestyle='-', label='Weekly Mean Resample')
ax.set_ylabel('Solar Production in (GWh)')
ax.legend()
```

Out[34]:

```
<matplotlib.legend.Legend at 0x1902abdf3e0>
```


Daily
Weekly Mean Resample
Solar Production in (GWh)
0
50
100
150
200
2016-01
2016-02
2016-03
2016-04
2016-05
2016-06
2016-07

```
In [0]:
```

```
In [ ]:
```