Power Data

In [50]:

```
from PIL import Image
Image.open('renewable_energy_sources-e1551858601606.jpg')

#https://watchwire.ai/procuring-green-energy/

#Student Name : Parth Vachhani
#Enroll Id    : 44192
```

Out[50]:

In [51]:

```
import numpy as np
import pandas as pd
from datetime import datetime
import matplotlib.pyplot as plt
import seaborn as sns
```

Power Data of United States(Los Angeles)

In [52]:

```
df=pd.read_csv("POWER_Point_Daily_20210101_20210331_040d4408N_099d5280W_LST.csv", skiprc
df
```

Out[52]:

	YEAR	MO	DY	ALLSKY_SFC_SW_DWN	CLRSKY_SFC_SW_DWN	WS2M	T2M	TS
0	2021	1	1	3.57	3.57	2.57	11.42	10.68
1	2021	1	2	3.16	3.45	1.30	11.70	10.68
2	2021	1	3	2.55	3.32	0.94	11.15	10.57
3	2021	1	4	2.80	3.39	1.40	11.94	11.07
4	2021	1	5	2.35	3.55	2.02	11.80	11.13
...	...	...	...	...	...	...	...	...
85	2021	3	27	6.99	7.01	1.69	15.40	15.32
86	2021	3	28	7.09	7.10	1.91	18.86	17.85
87	2021	3	29	6.84	6.99	1.84	17.99	17.57
88	2021	3	30	6.28	7.02	1.53	15.91	16.65
89	2021	3	31	7.02	7.29	2.55	18.59	17.77

90 rows × 13 columns

Data Cleaning

In [53]:

```
df = df.rename({'YEAR':'year','MO':'month','DY':'day','ALLSKY_SFC_SW_DWN':'Allsky_downwa
                'CLRSKY_SFC_SW_DWN':'Clrsky_downward_irradiation', 'WS2M':'Windspeed_2met
                'QV2M':'Specific_humidity_2meter', 'RH2M':'Relative_humidity_2meter', 'PR
                'WS10M':'Windspeed_10meter', 'WS50M':'Windspeed_50meter','TS':'Earth_skir
df.head()
                                                                                    #re
```

Out[53]:

	year	month	day	Allsky_downward_irradiation	Clrsky_downward_irradiation	Windspeed_
0	2021	1	1	3.57	3.57	
1	2021	1	2	3.16	3.45	
2	2021	1	3	2.55	3.32	
3	2021	1	4	2.80	3.39	
4	2021	1	5	2.35	3.55	

Combining Year, Month and Day as Date

In [54]:

```
df['date']=pd.to_datetime(df[['year','month','day']])
df.head()
```

Out[54]:

	year	month	day	Allsky_downward_irradiation	Clrsky_downward_irradiation	Windspeed_
0	2021	1	1	3.57	3.57	
1	2021	1	2	3.16	3.45	
2	2021	1	3	2.55	3.32	
3	2021	1	4	2.80	3.39	
4	2021	1	5	2.35	3.55	

Removing some columns

In [55]:

```
df = df.drop(['year','month','day','Precipitation'],axis=1)
df.head()
```

Out[55]:

	Allsky_downward_irradiation	Clrsky_downward_irradiation	Windspeed_2meter	Temp_2met
0	3.57	3.57	2.57	11.4
1	3.16	3.45	1.30	11.7
2	2.55	3.32	0.94	11.1
3	2.80	3.39	1.40	11.9
4	2.35	3.55	2.02	11.8

In [56]:

```
titles = list(df.columns)
titles[0],titles[9]=titles[9],titles[0]
```

In [57]:

```
df = df[titles]
df.head()
```

Out[57]:

	date	CIrsky_downward_irradiation	Windspeed_2meter	Temp_2meter	Earth_skintemp	Sp
0	2021-01-01	3.57	2.57	11.42	10.68	
1	2021-01-02	3.45	1.30	11.70	10.68	
2	2021-01-03	3.32	0.94	11.15	10.57	
3	2021-01-04	3.39	1.40	11.94	11.07	
4	2021-01-05	3.55	2.02	11.80	11.13	

In [58]:

```
df9=df.iloc[0:5,:]
df9
```

Out[58]:

	date	CIrsky_downward_irradiation	Windspeed_2meter	Temp_2meter	Earth_skintemp	Sp
0	2021-01-01	3.57	2.57	11.42	10.68	
1	2021-01-02	3.45	1.30	11.70	10.68	
2	2021-01-03	3.32	0.94	11.15	10.57	
3	2021-01-04	3.39	1.40	11.94	11.07	
4	2021-01-05	3.55	2.02	11.80	11.13	

In [59]:

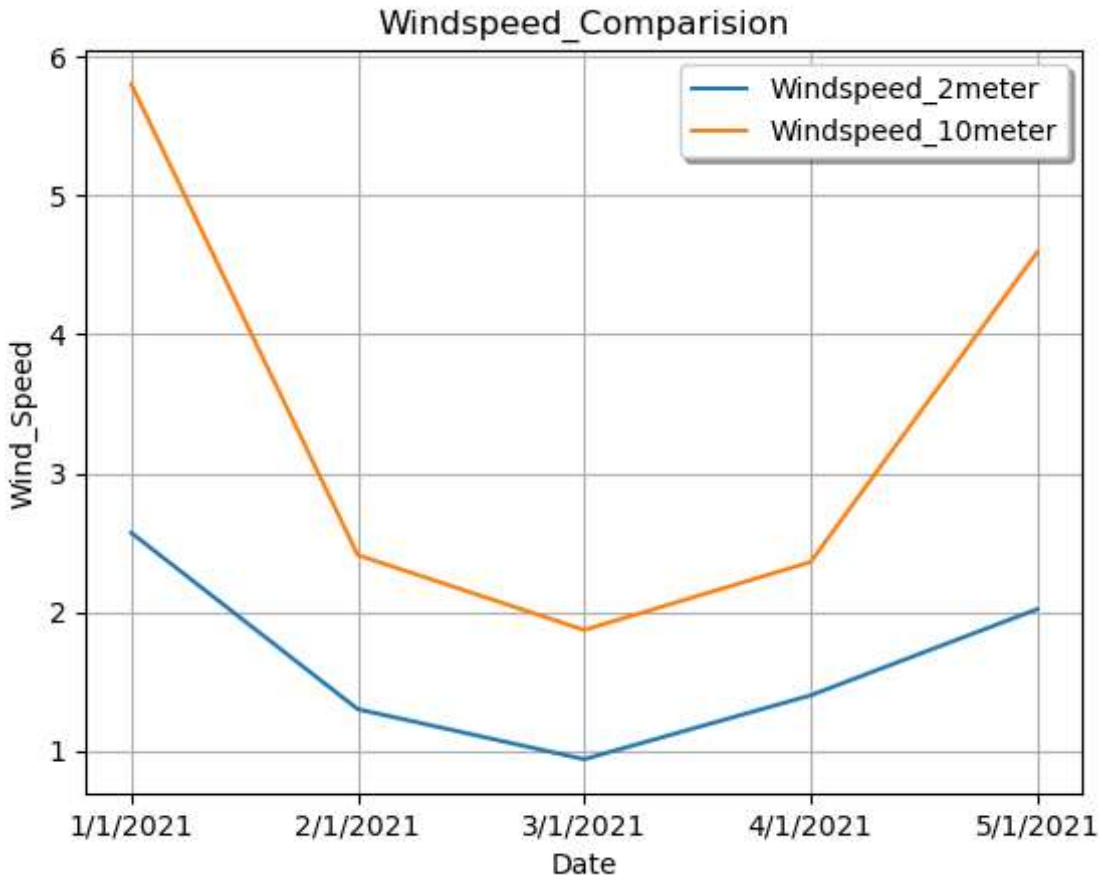
```
df.describe()                                                    #describ
```

Out[59]:

	Clrsky_downward_irradiation	Windspeed_2meter	Temp_2meter	Earth_skintemp	Spec
count	90.000000	90.000000	90.000000	90.000000	
mean	5.027889	2.378333	12.518222	12.417111	
std	1.148856	0.954081	2.823486	2.272872	
min	3.320000	0.940000	5.930000	6.990000	
25%	3.942500	1.700000	11.097500	11.152500	
50%	4.875000	2.130000	12.380000	12.335000	
75%	5.965000	2.905000	13.877500	13.415000	
max	7.290000	6.250000	19.640000	17.850000	

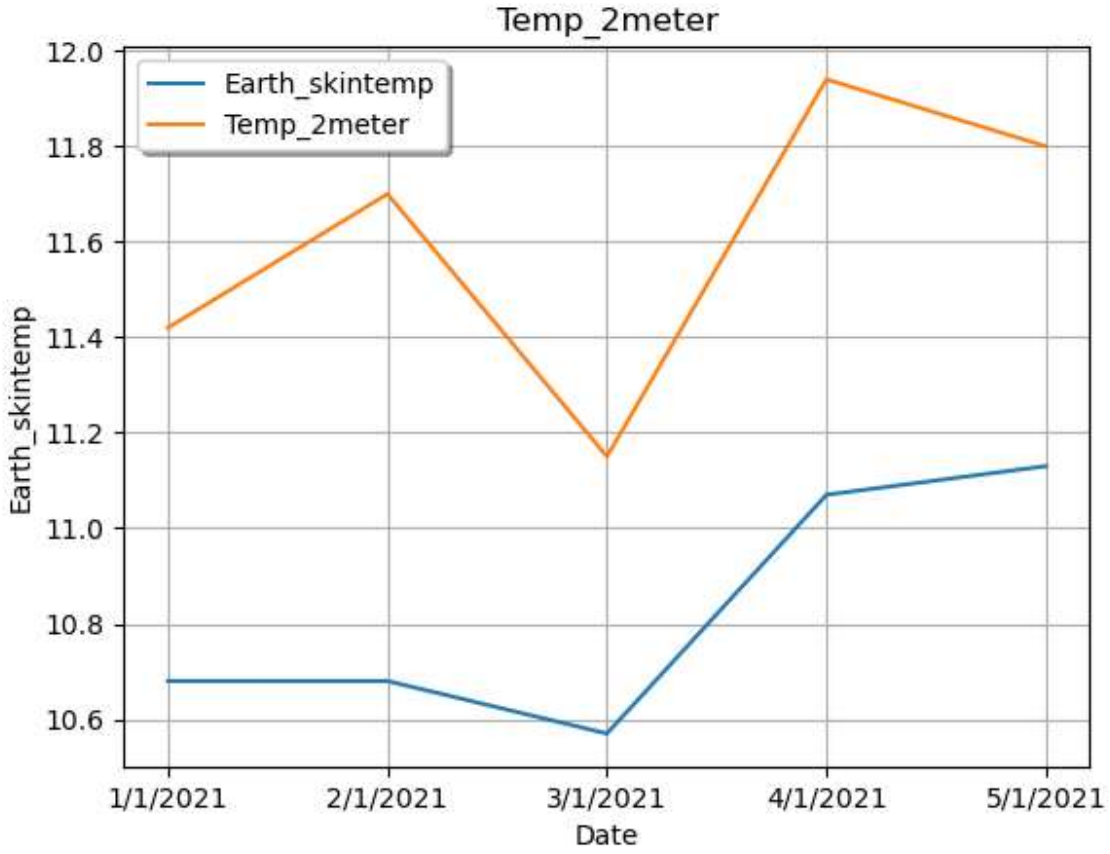
In [60]:

```
Date = df9['date']
Windspeed_2meter = df9['Windspeed_2meter']
Windspeed_10meter = df9['Windspeed_50meter']
plt.plot(Date,Windspeed_2meter,label='Windspeed_2meter')
plt.plot(Date,Windspeed_10meter,label='Windspeed_10meter')
plt.grid()
plt.xlabel('Date')
plt.ylabel('Wind_Speed')
plt.xticks(Date,['1/1/2021','2/1/2021','3/1/2021','4/1/2021','5/1/2021'])
plt.title('Windspeed_Comparision')
plt.legend(shadow=True)
plt.show()                                    #windspeed comparision at 2 different distar
```



In [61]:

```
Date = df9['date']
Earth_skintemp = df9['Earth_skintemp']
Temp_2meter = df9['Temp_2meter']
plt.plot(Date,Earth_skintemp,label='Earth_skintemp')
plt.plot(Date,Temp_2meter,label='Temp_2meter')
plt.xlabel('Date')
plt.ylabel('Earth_skintemp')
plt.xticks(Date,['1/1/2021','2/1/2021','3/1/2021','4/1/2021','5/1/2021'])
plt.title('Temp_2meter')
plt.grid()
plt.legend(shadow=True)                                                    #comparing e
plt.show()
```



Specific data of January month

In [62]:

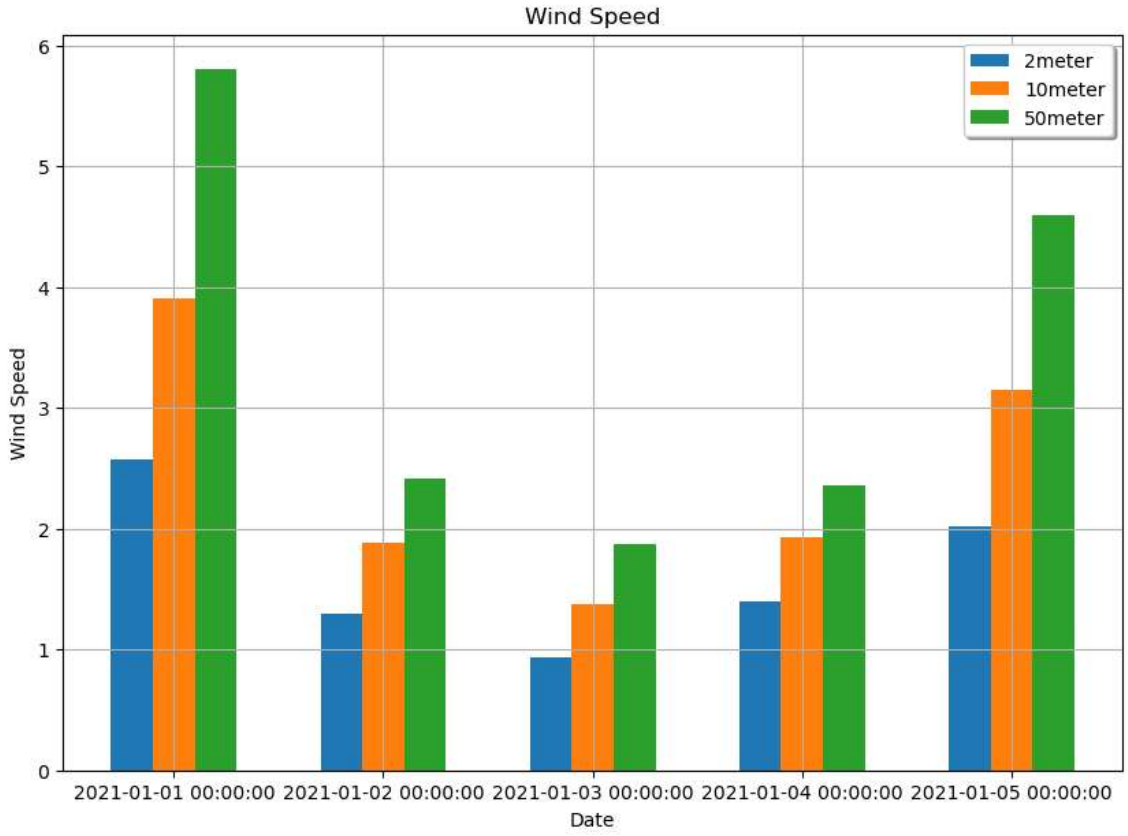
```
df2=df.iloc[0:5,:]                                                    #value of specific
df2
```

Out[62]:

	date	CIrsky_downward_irradiation	Windspeed_2meter	Temp_2meter	Earth_skintemp	Sp
0	2021-01-01	3.57	2.57	11.42	10.68	
1	2021-01-02	3.45	1.30	11.70	10.68	
2	2021-01-03	3.32	0.94	11.15	10.57	
3	2021-01-04	3.39	1.40	11.94	11.07	
4	2021-01-05	3.55	2.02	11.80	11.13	

In [63]:

```
Dates = df2['date']

wind2m = df2['Windspeed_2meter']
wind10m = df2['Windspeed_10meter']
wind50m = df2['Windspeed_50meter']
w=0.2

plt.figure(figsize=(10,7))
wind2m_bar = np.arange(len(Dates))
wind10m_bar = [i+w for i in wind2m_bar]
wind50m_bar = [i+w for i in wind10m_bar]

plt.bar(wind2m_bar,wind2m,width=w,label='2meter')
plt.bar(wind10m_bar,wind10m,width=w,label='10meter')
plt.bar(wind50m_bar,wind50m,width=w,label='50meter')

plt.xticks(wind2m_bar+w,Dates)
plt.xlabel('Date')
plt.ylabel('Wind Speed')
plt.title('Wind Speed')
plt.grid()
plt.legend(shadow=True)
plt.show()
```

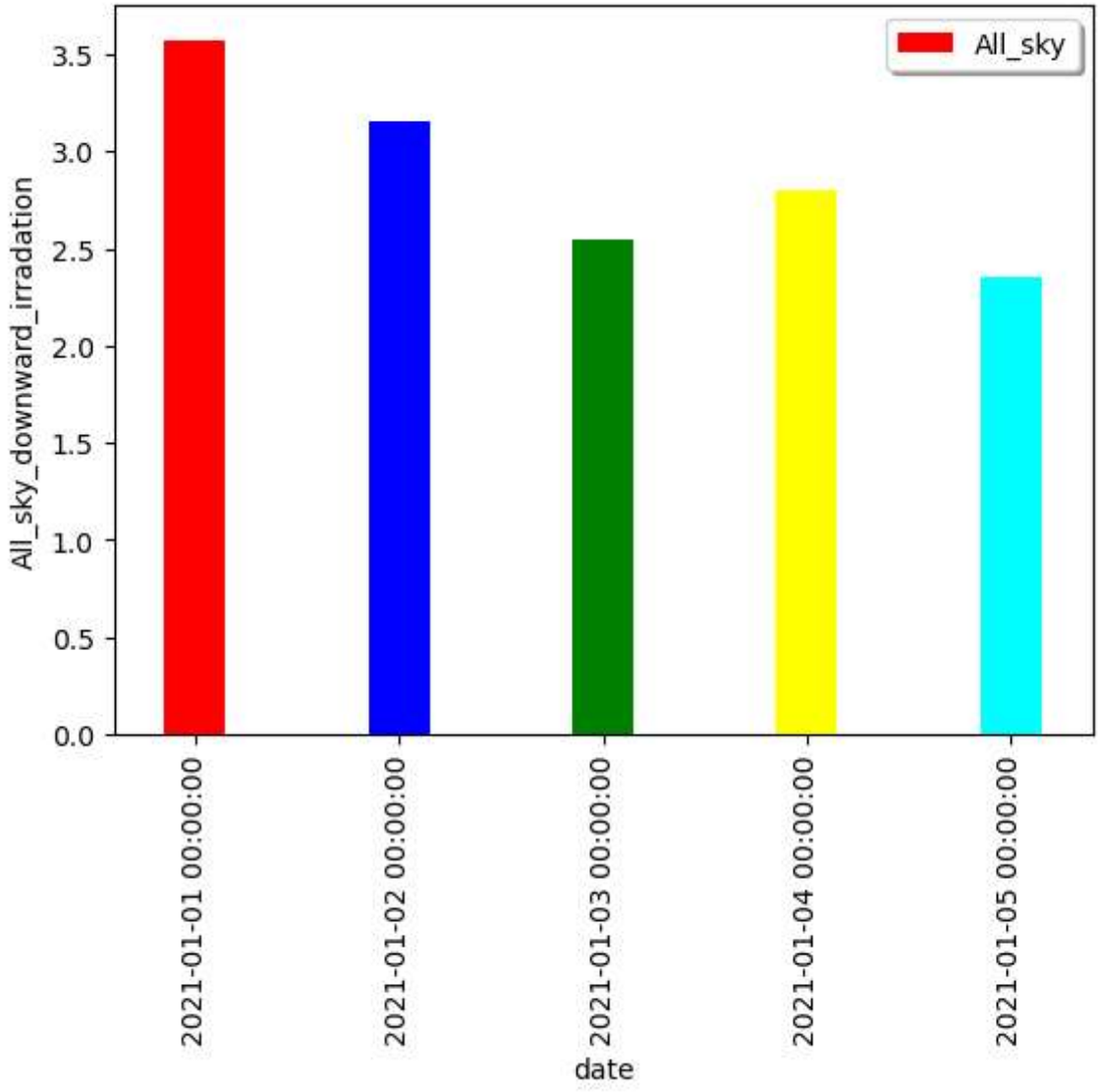


In [64]:

```
a=['red','blue','green','yellow','cyan']
df2.plot.bar(x='date',y='Allsky_downward_irradiation', color=a ,width=0.3, label='All_sk
plt.ylabel('All_sky_downward_irradation')
plt.legend(shadow=True)
#plt.grid()
#according to specific date the specific values of allsky_downward_irradation in USA
```

Out[64]:

```
<matplotlib.legend.Legend at 0x20e00955880>
```



Power Data of Germany(Frankfurt)

In [65]:

```
df1=pd.read_csv("POWER_Point_Daily_20210101_20210331_050d1101N_008d5761E_LST.csv", skipr
df1
```

Out[65]:

	YEAR	MO	DY	ALLSKY_SFC_SW_DWN	CLRSKY_SFC_SW_DWN	WS2M	T2M	QV2M
0	2021	1	1	0.42	1.08	0.85	-0.13	3.60
1	2021	1	2	0.59	1.20	1.41	-1.37	3.17
2	2021	1	3	0.35	0.99	2.02	-0.88	3.36
3	2021	1	4	0.27	0.93	1.52	-0.98	3.36
4	2021	1	5	0.40	0.98	2.25	-0.93	3.36
...	...	...	...	...	...	...	...	...
85	2021	3	27	2.76	5.18	4.38	6.07	4.82
86	2021	3	28	3.53	4.89	2.41	6.94	4.94
87	2021	3	29	5.13	5.24	1.98	10.42	5.68
88	2021	3	30	5.54	5.54	1.04	13.71	5.92
89	2021	3	31	5.34	5.36	1.55	14.08	6.59

90 rows × 13 columns

Data Cleaning

In [66]:

```
df1 = df1.rename({'YEAR':'year','MO':'month','DY':'day','ALLSKY_SFC_SW_DWN':'Allsky_dowr
                  'CLRSKY_SFC_SW_DWN':'Clrsky_downward_irradiation', 'WS2M':'Windspeed_2met
                  'QV2M':'Specific_humidity_2meter', 'RH2M':'Relative_humidity_2meter', 'PR
                  'WS10M':'Windspeed_10meter', 'WS50M':'Windspeed_50meter','TS':'Earth_skir
df1.head()
```

Out[66]:

	year	month	day	Allsky_downward_irradiation	Clrsky_downward_irradiation	Windspeed_
0	2021	1	1	0.42	1.08	
1	2021	1	2	0.59	1.20	
2	2021	1	3	0.35	0.99	
3	2021	1	4	0.27	0.93	
4	2021	1	5	0.40	0.98	

Combining Year, Month and Day as Date

In [67]:

```
df1['date']=pd.to_datetime(df1[['year','month','day']])
df1.head()
```

Out[67]:

	year	month	day	Allsky_downward_irradiation	Clrsky_downward_irradiation	Windspeed_
0	2021	1	1	0.42	1.08	
1	2021	1	2	0.59	1.20	
2	2021	1	3	0.35	0.99	
3	2021	1	4	0.27	0.93	
4	2021	1	5	0.40	0.98	

Removing some columns

In [68]:

```
df1 = df1.drop(['year','month','day','Precipitation'],axis=1)
df1.head()
```

Out[68]:

	Allsky_downward_irradiation	Clrsky_downward_irradiation	Windspeed_2meter	Temp_2met
0	0.42	1.08	0.85	-0.1
1	0.59	1.20	1.41	-1.3
2	0.35	0.99	2.02	-0.8
3	0.27	0.93	1.52	-0.9
4	0.40	0.98	2.25	-0.9

In [69]:

```
titles1 = list(df1.columns)
titles1[0],titles1[9]=titles1[9],titles1[0]                                    #rec
```

In [70]:

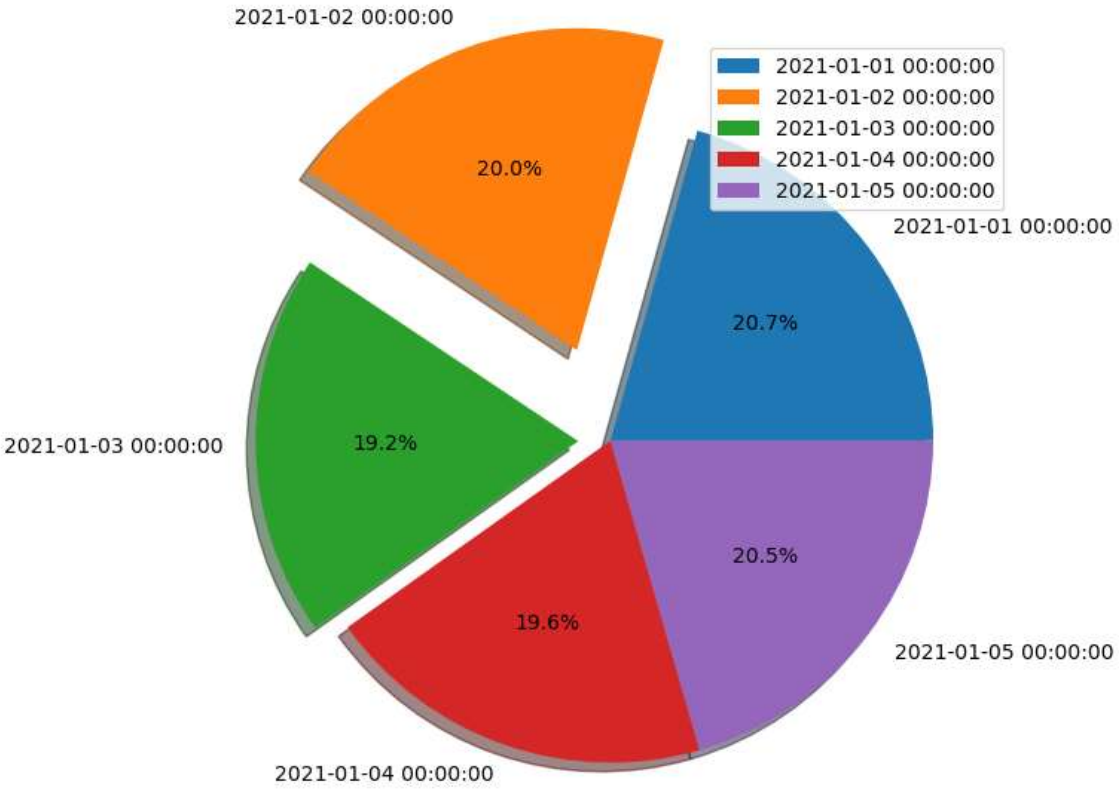
```
df1 = df1[titles1]
df1.tail()
```

Out[70]:

	date	Clrsky_downward_irradiation	Windspeed_2meter	Temp_2meter	Specific_humidity_
85	2021-03-27	5.18	4.38	6.07	
86	2021-03-28	4.89	2.41	6.94	
87	2021-03-29	5.24	1.98	10.42	
88	2021-03-30	5.54	1.04	13.71	
89	2021-03-31	5.36	1.55	14.08	

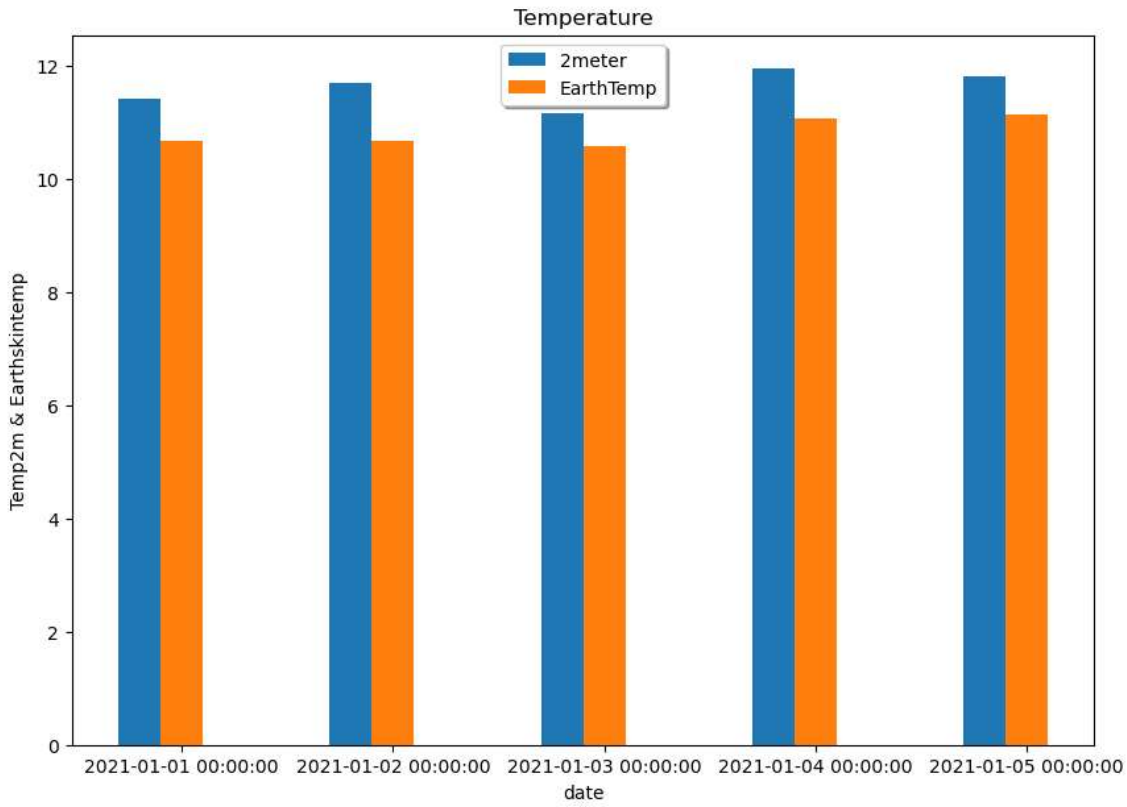
In [71]:

```
x = df2['date']
y = df2['Clrsky_downward_irradiation']
plt.figure(figsize=(7,10))
plt.pie(y,labels=x,explode=[0,0.3,0.1,0,0], shadow=True, autopct='%2.1f%%')
plt.legend()
plt.show()
```



In [72]:

```
Dates = df2['date']

Temp2m = df2['Temp_2meter']
Earthskintemp = df2['Earth_skintemp']

w=0.2

plt.figure(figsize=(10,7))
Temp2m_bar = np.arange(len(Dates))
Earthskintemp_bar = [i+w for i in Temp2m_bar]

plt.bar(Temp2m_bar,Temp2m,width=w,label='2meter')
plt.bar(Earthskintemp_bar,Earthskintemp,width=w,label='EarthTemp')

plt.xticks(Temp2m_bar+w,Dates)
plt.xlabel('date')
plt.ylabel('Temp2m & Earthskintemp')
plt.title('Temperature')

plt.legend(shadow=True)
plt.show()
```



Specific Data february month

In [73]:

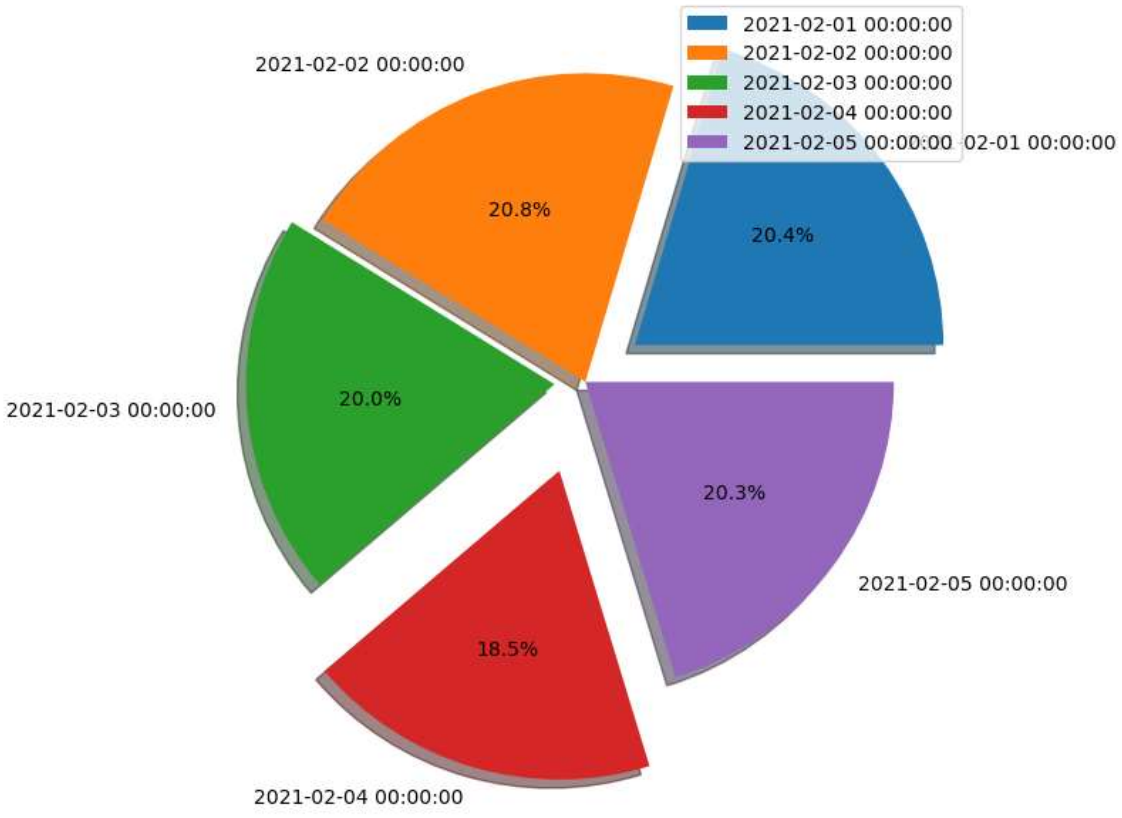
```
df3=df1.iloc[31:36,:]                                    #value of speci
df3.head()                                               #relative humid
```

Out[73]:

	date	Clrsky_downward_irradiation	Windspeed_2meter	Temp_2meter	Specific_humidity_
31	2021-02-01	1.79	2.20	1.50	
32	2021-02-02	1.99	2.30	3.81	
33	2021-02-03	1.96	4.44	8.44	
34	2021-02-04	2.23	2.71	5.84	
35	2021-02-05	1.87	1.36	5.12	

In [79]:

```
x = df3['date']
y = df3['Relative_humidity_2meter']
plt.figure(figsize=(7,10))
plt.pie(y,labels=x,explode=[0.2,0,0.1,0.3,0], shadow=True, autopct='%2.1f%%')
plt.legend()
plt.show()
```

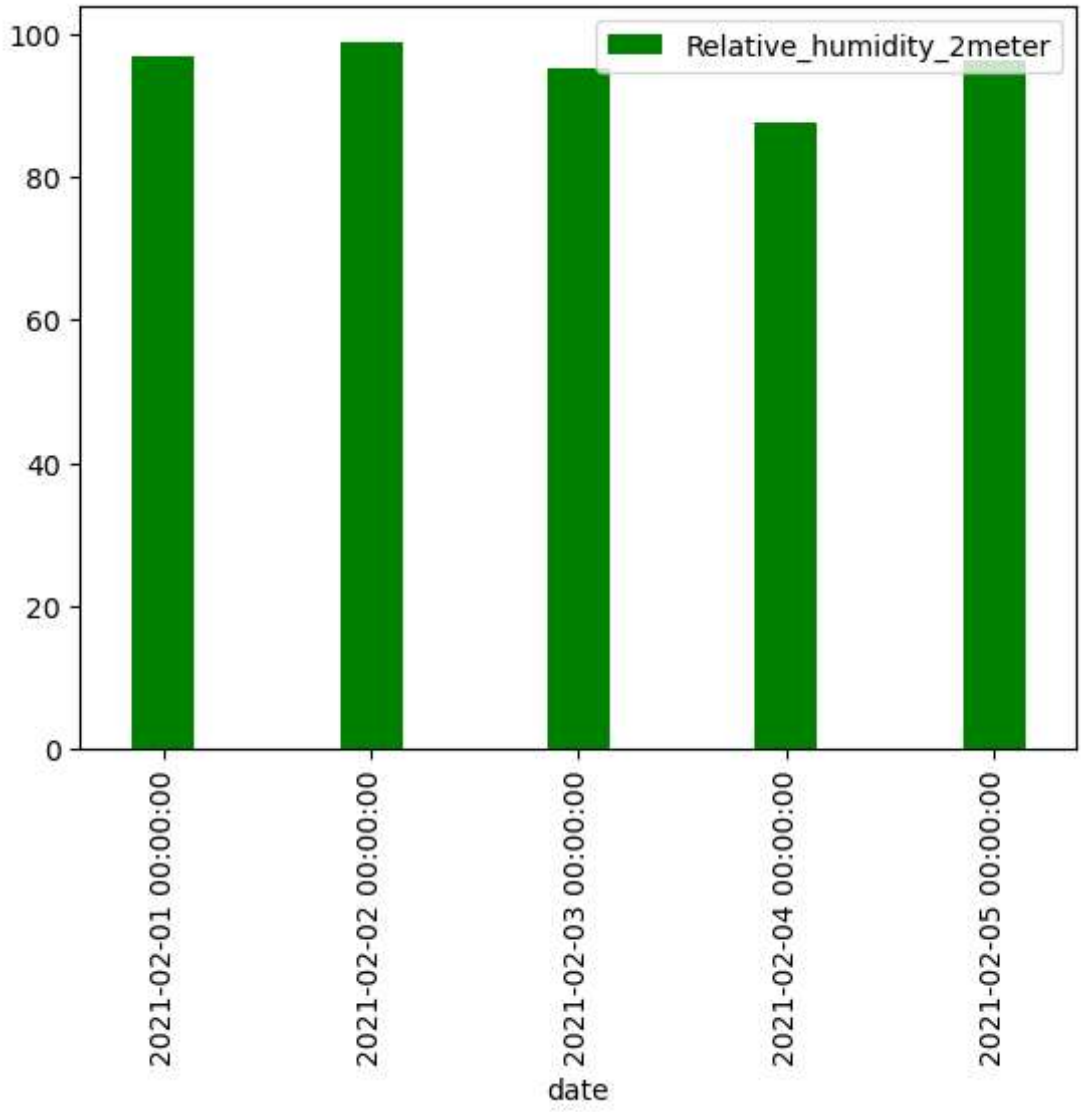


In [80]:

```
df3.plot.bar(x='date',y='Relative_humidity_2meter', color= "g",width=0.3)

#according to specific date the specific values of relative humidity at 2meter in germar
```

Out[80]:

```
<AxesSubplot:xlabel='date'>
```



In [ ]: