In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
from scipy.stats import ttest_ind
df = pd.read_excel("FEV-data-Excel.xlsx")
df.head()
```

Out[1]:

	Car full name	Make	Model	Minimal price (gross) [PLN]	Engine power [KM]	Maximum torque [Nm]	Type of brakes	Drive type	Battery capacity [kWh]	Range (WLTP) [km]	...	Permissable gross weight [kg]	Maximum load capacity [kg]	Number of seats	Number of doors	Tire size [in]	Maximum speed [kph]	Boot capacity (VDA) [l]	Acceleration 0-100 kph [s]	Maximum DC charging power [kW]	mean - Energy consumption [kWh/100 km]
0	Audi e-tron 55 quattro	Audi	e-tron 55 quattro	345700	360	664	disc (front + rear)	4WD	95.0	438	...	3130.0	640.0	5	5	19	200	660.0	5.7	150	24.45
1	Audi e-tron 50 quattro	Audi	e-tron 50 quattro	308400	313	540	disc (front + rear)	4WD	71.0	340	...	3040.0	670.0	5	5	19	190	660.0	6.8	150	23.80
2	Audi e-tron S quattro	Audi	e-tron S quattro	414900	503	973	disc (front + rear)	4WD	95.0	364	...	3130.0	565.0	5	5	20	210	660.0	4.5	150	27.55
3	Audi e-tron Sportback 50 quattro	Audi	e-tron Sportback 50 quattro	319700	313	540	disc (front + rear)	4WD	71.0	346	...	3040.0	640.0	5	5	19	190	615.0	6.8	150	23.30
4	Audi e-tron Sportback 55 quattro	Audi	e-tron Sportback 55 quattro	357000	360	664	disc (front + rear)	4WD	95.0	447	...	3130.0	670.0	5	5	19	200	615.0	5.7	150	23.85

5 rows × 25 columns

Task 1: A customer has a budget of 350,000 PLN and wants an EV with a minimum range of 400 km.

a) Your task is to filter out EVs that meet these criteria.

b) Group them by the manufacturer (Make).

c) Calculate the average battery capacity for each manufacturer.

In [2]:
```
#Task 1.a) Apply filters for budget and range
filtered_df = df[
                (df['Minimal price (gross) [PLN]'] <= 350000) &
                (df['Range (WLTP) [km]'] >= 400)]
filtered_df.head()
```

Out[2]:

	Car full name	Make	Model	Minimal price (gross) [PLN]	Engine power [KM]	Maximum torque [Nm]	Type of brakes	Drive type	Battery capacity [kWh]	Range (WLTP) [km]	...	Permissable gross weight [kg]	Maximum load capacity [kg]	Number of seats	Number of doors	Tire size [in]	Maximum speed [kph]	Boot capacity (VDA) [l]	Acceleration 0-100 kph [s]	Maximum DC charging power [kW]	mean - Energy consumption [kWh/100 km]
0	Audi e-tron 55 quattro	Audi	e-tron 55 quattro	345700	360	664	disc (front + rear)	4WD	95.0	438	...	3130.0	640.0	5	5	19	200	660.0	5.7	150	24.45
8	BMW iX3	BMW	iX3	282900	286	400	disc (front + rear)	2WD (rear)	80.0	460	...	2725.0	540.0	5	5	19	180	510.0	6.8	150	18.80
15	Hyundai Kona electric 64kWh	Hyundai	Kona electric 64kWh	179400	204	395	disc (front + rear)	2WD (front)	64.0	449	...	2170.0	485.0	5	5	17	167	332.0	7.6	100	15.40
18	Kia e-Niro 64kWh	Kia	e-Niro 64kWh	167990	204	395	disc (front + rear)	2WD (front)	64.0	455	...	2230.0	493.0	5	5	17	167	451.0	7.8	100	15.90
20	Kia e-Soul 64kWh	Kia	e-Soul 64kWh	160990	204	395	disc (front + rear)	2WD (front)	64.0	452	...	1682.0	498.0	5	5	17	167	315.0	7.9	100	15.70

5 rows × 25 columns

In [3]:
```
#Task 1.b) Group by 'Make' and count models that meet the criteria
grouped_by_make = filtered_df.groupby('Make')
grouped_by_make.size().reset_index(name='EV Count')
```

Out[3]:

	Make	EV Count
0	Audi	1
1	BMW	1
2	Hyundai	1
3	Kia	2
4	Mercedes-Benz	1
5	Tesla	3
6	Volkswagen	3

In [4]:
```
# Task 1.c) Calculate the average battery capacity for each manufacturer
average_battery_capacity = grouped_by_make['Battery capacity [kWh]'].mean().reset_index(name='Average Battery Capacity [kWh]')
display(average_battery_capacity)
```

	Make	Average Battery Capacity [kWh]
0	Audi	95.000000
1	BMW	80.000000
2	Hyundai	64.000000
3	Kia	64.000000
4	Mercedes-Benz	80.000000
5	Tesla	68.000000
6	Volkswagen	70.666667

Task 2: You suspect some EVs have unusually high or low energy consumption.

Find the outliers in the mean - Energy consumption [kWh/100 km] column.

In [5]:
```
energy_consumption = df["mean - Energy consumption [kWh/100 km]"]

Q1 = energy_consumption.quantile(0.25)
Q3 = energy_consumption.quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
outliers = df[(energy_consumption < lower_bound) | (energy_consumption >upper_bound)]
# Display results
print("Energy Consumption Statistics:\n")
print(f"Q1 (25th percentile): {Q1:.2f} kWh/100 km")
print(f"Q3 (75th percentile): {Q3:.2f} kWh/100 km")
print(f"IQR: {IQR:.2f} kWh/100 km\n")
print(f"Lower bound: {lower_bound:.2f} kWh/100 km")
print(f"Upper bound: {upper_bound:.2f} kWh/100 km")
print(f"\nFound {len(outliers)} outliers in mean - Energy consumption [kWh/100km]:")
outliers[['Car full name', 'Make', 'mean - Energy consumption [kWh/100 km]']].sort_values('mean - Energy consumption [kWh/100 km]')
```

```
Energy Consumption Statistics:

Q1 (25th percentile): 15.60 kWh/100 km
Q3 (75th percentile): 23.50 kWh/100 km
IQR: 7.90 kWh/100 km

Lower bound: 3.75 kWh/100 km
Upper bound: 35.35 kWh/100 km

Found 0 outliers in mean - Energy consumption [kWh/100km]:
```

Out[5]:

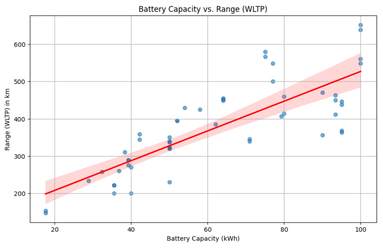
Car full name	Make	mean - Energy consumption [kWh/100 km]

Task 3: Your manager wants to know if there's a strong relationship between battery capacity and range.

a) Create a suitable plot to visualize.

b) Highlight any insights.

In [6]:
```
plt.figure(figsize=(10, 6))
sns.regplot(
    data=df.dropna(subset=['Battery capacity [kWh]', 'Range (WLTP) [km]']),
    x='Battery capacity [kWh]',
    y='Range (WLTP) [km]',
    scatter_kws={'alpha': 0.6},
    line_kws={'color': 'red'}
)
plt.title('Battery Capacity vs. Range (WLTP)')
plt.xlabel('Battery Capacity (kWh)')
plt.ylabel('Range (WLTP) in km')
plt.grid(True)
plt.show()
```



In [7]:
```
correlation = df['Battery capacity [kWh]'].corr(df['Range (WLTP) [km]'])
print(f"\nCorrelation between Battery Capacity and Range: {correlation:.2f}")
```

```
Correlation between Battery Capacity and Range: 0.81
```

Task 4: Build an EV recommendation class. The class should allow users to input their budget, desired range, and battery capacity. The class should then return the top three EVs matching their criteria.

In [8]:
```
df_clean = df[['Car full name',
               'Minimal price (gross) [PLN]',
               'Range (WLTP) [km]',
               'Battery capacity [kWh]']].dropna()

class EVRecommender:
    def __init__(self, data):
        self.data = data

    def recommend(self, budget, min_range, min_battery):
        filtered = self.data[
            (self.data['Minimal price (gross) [PLN]'] <= budget) &
            (self.data['Range (WLTP) [km]'] >= min_range) &
            (self.data['Battery capacity [kWh]'] >= min_battery)
        ]

        top3 = filtered.sort_values(
            by=['Range (WLTP) [km]', 'Battery capacity [kWh]'],
            ascending=[False, False]
        ).head(3)

        return top3[['Car full name',
                     'Minimal price (gross) [PLN]',
                     'Range (WLTP) [km]',
                     'Battery capacity [kWh]']]

recommender = EVRecommender(df_clean)

user_budget = 350000
user_range = 400
user_battery = 60

top_ev_recommendations = recommender.recommend(user_budget, user_range, user_battery)
top_ev_recommendations
```

Out[8]:

	Car full name	Minimal price (gross) [PLN]	Range (WLTP) [km]	Battery capacity [kWh]
40	Tesla Model 3 Long Range	235490	580	75.0
41	Tesla Model 3 Performance	260490	567	75.0
48	Volkswagen ID.3 Pro S	179990	549	77.0

Task 5: Inferential Statistics – Hypothesis Testing: Test whether there is a significant difference in the average Engine power [KM] of vehicles manufactured by two leading manufacturers i.e. Tesla and Audi. What insights can you draw from the test results? Recommendations and Conclusion: Provide actionable insights based on your analysis. (Conduct a two sample t-test using ttest_ind from scipy.stats module)

In [9]:
```
tesla_power = df[df['Make'] == 'Tesla']['Engine power [KM]'].dropna()
audi_power = df[df['Make'] == 'Audi']['Engine power [KM]'].dropna()
tesla_mean = tesla_power.mean()
audi_mean = audi_power.mean()
tesla_std = tesla_power.std()
audi_std = audi_power.std()

print(f"-------------------------------")
print(f"Tesla vehicles: {len(tesla_power)}")
print(f"-------------------------------")
print("Tesla Engine Power Stats:")
print(f"Mean: {tesla_mean:.2f} KM")
print(f"Std Dev: {tesla_std:.2f} KM\n")
print(f"-------------------------------")
print(f"Audi vehicles: {len(audi_power)}")
print(f"-------------------------------")
print("Audi Engine Power Stats:")
print(f"Mean: {audi_mean:.2f} KM")
print(f"Std Dev: {audi_std:.2f} KM\n")
print(f"-------------------------------")



t_stat, p_value = ttest_ind(tesla_power, audi_power, equal_var=False)  # Welch's t-test

print(f"\nT-statistic: {t_stat:.4f}")
print(f"P-value: {p_value:.4f}\n")

significance_level = 0.05
if p_value < significance_level:
    print("Reject the null hypothesis: There is a significant difference in engine power between Tesla and Audi.")
else:
    print("Fail to reject the null hypothesis: No significant difference in engine power between Tesla and Audi.")
```

```
-------------------------------
Tesla vehicles: 7
-------------------------------
Tesla Engine Power Stats:
Mean: 533.00 KM
Std Dev: 184.66 KM

-------------------------------
Audi vehicles: 6
-------------------------------
Audi Engine Power Stats:
Mean: 392.00 KM
Std Dev: 88.51 KM

-------------------------------


T-statistic: 1.7940
P-value: 0.1068

Fail to reject the null hypothesis: No significant difference in engine power between Tesla and Audi.
```

----------Task 6) Project Video Explanation----------

https://drive.google.com/file/d/1Z73gcg_2p3GOY3F6CMHTFGYfd9tDF-AV/view?usp=sharing