Electricity consumption

Real life acquisition of Electric Cars

Marc-André Beck

Kamoo AG Electrocars

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Outline

1 Kamoo AG Electrocars
   Battery Technology
   Vehicle
Kamoo - Partner for Electric Cars

- Manufacturing
- Service
- Sales
- Integration
- Development

- Twingo Elektra
- 500 Elektra
- 500 220i
- Sam EV II
- Fleet Management
- Fleet Surveillance
- Car Sharing Solutions

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Zebra Battery from FZsonick

- $2\text{NaClNi}$-battery
- Operating temperature: 242 degree Celsius
- Weight: 180kg
Twingo Elektra

- Weight: 933 kg
- Battery: FZSonick Z5
- Usable Rated Energy: 16.96 kWh
- Autonomy: 120 km
Twingo Elektra

- 200 Twingo Elektras in use
- 120 Twingo Elektras with a Kamoo service contract
- Customers are reporting max range higher than 200km
Kamoo 500c 220i

- **Weight:** 1050 kg
- **Usable Rated Energy:** 23.76 kWh
- **Autonomy:** 180 km
Outline

2 Evaluation
  Testdrive Zebra
  Testladung
Testdrive from Wetzikon to Schlieren
Wetzikon to Schlieren

Torque and Speed in dependency

- Motor Torque (Nm)
- Vehicle Speed (km/h)

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Electricity consumption
**Wetizkon to Schlieren**

Distance: 37.1 km  
Energy consumption: 4.982 kWh  
**13.4 kWh/100km**

<table>
<thead>
<tr>
<th>Efficiency area</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 90%</td>
<td>9.6%</td>
</tr>
<tr>
<td>85%-90%</td>
<td>69.5%</td>
</tr>
<tr>
<td>80%-85%</td>
<td>16.9%</td>
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<tr>
<td>&lt; 80%</td>
<td>3.9%</td>
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</table>
Schlieren to Wetzikon

Torque and Speed in dependency

Motor Torque (Nm)  Vehicle Speed (km/h)

Time (s) 0 200 400 600 800 1000 1200 1400 1600 1800 2000
Torque (Nm) -80 -60 -40 -20 0 20 40 60 80
Speed (km/h) 0 20 40 60 80 100 120

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Electricity consumption
Schlieren to Wetzikon

Distance: 37.1 km
Energy consumption: 6.466 kWh

17.4 kWh/100km

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<td>32.1%</td>
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<td>&lt; 80%</td>
<td>5.5%</td>
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</table>
Charging behaviour Zebra

State of Charge in dependency of input current

Current (A)  SoC (%)

SoC (%)
Charging Efficiency: > 85%

Loss | Item
--- | ---
7% | Charger
7.5% | Battery Heater
< 0.5% | Cables and Fuses
3 Conclusion
14 kWh/100km nominal case
16.5 kWh drawn from mains

11 kWh/100km best case

High thermal loss of Zebra battery
80% in 8 days

200kg battery is enough for 200km
Energy consumption of Twingo Elektra

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Kamoo AG Electrocars
Evaluation
Conclusion

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Outlook for the Kamoo 500c 220i

- 200 km range possible with 200 kg battery
- Lithium-Cobalt battery would allow ranges up to 350km with the same car design
- Lithium-Cobalt not allowed yet (explosive)
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Driving behaviour

- 15kW motor is enough (high torque and low weight < 50kg)
- Total weight needs to be reduced
- Electric cars are fun!
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