HSLU Lucerne University of Applied Sciences and Arts

Technik und Architektur
MSE Business Engineering
Master-Thesis

Development of a business model for the second life of an e-bike battery

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1. Initial situation

Biketec is a system integrator for e-bikes which also sells different components such as motors, batteries, cables and other components to their customers. The main customers of Biketec are e-bike OEMs and e-bike dealers. Currently, the e-bike batteries are only sold to be used for newly manufactured e-bikes and no other purpose. There are also e-bike batteries which are for example returned by the e-bike dealers which would still be functioning but with less capacity. The question which occurs is, how the already used e-bike batteries could be used for a different purpose in as second life batteries (SLBs). Therefore, the goal is to propose a business model for Biketec with the usage of second life e-bike batteries, or also with new e-bike batteries.

2. Material and methodology

Methodology

The chosen method to generate, evaluate and test ideas is the design thinking process, as this process is suitable for the business model generation. The generated information from the design thinking process is then used to fill out the business model canvas, as shown in Figure 1, which is the chosen tool to describe the business model.

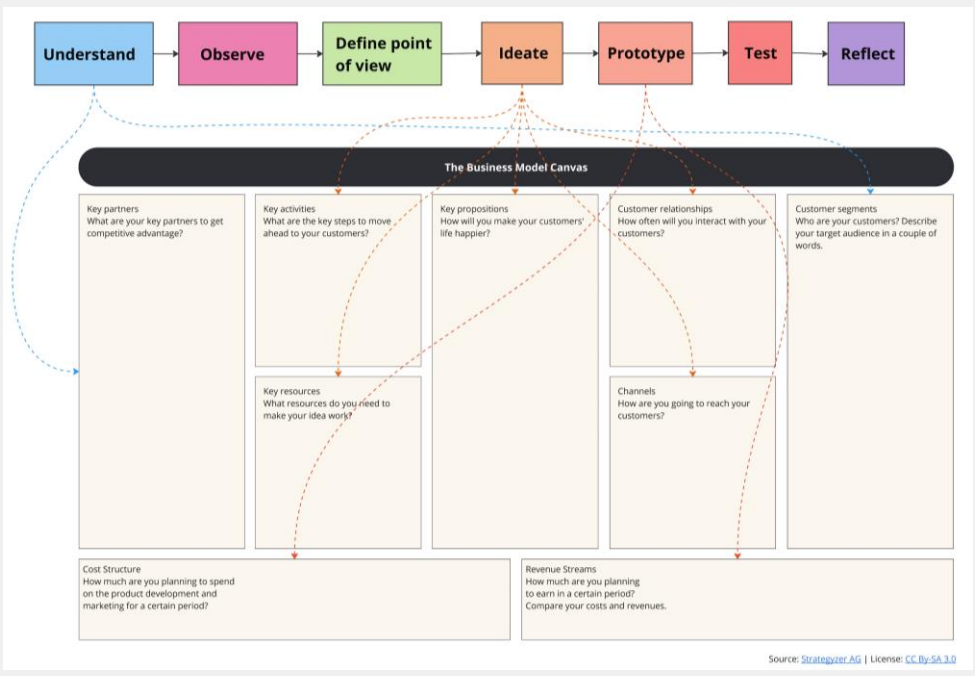

Figure 1: Methodology

Material, data, tools

The used material for the prototype (Fig. 2) and tools are cables, inverters, batteries, measuring devices, batteries, remotes and power supply units. The data is from specification sheets.

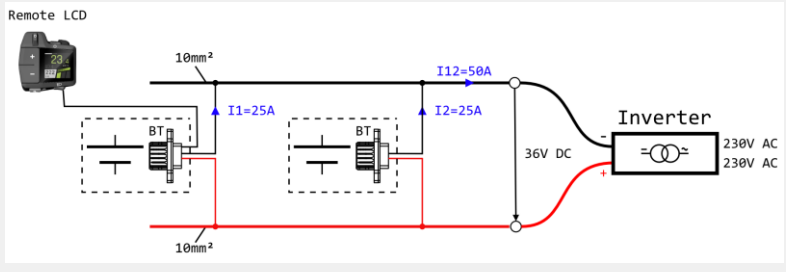

Figure 2: Material for prototype

Biketec GmbH

3. Results and discussion

The generated idea for the business model is a battery system made from second life e-bike batteries, which allows residents (customers) to store the excessive energy which is produced from solar panels, as shown in Figure 2. The problem statement can be described as follows with a tool from the design thinking process: How might we **improve the energy management** of **the residents** solar plants so that the excessive energy can be **used economically more efficient**. According to the analysis, the average price for selling energy to the power plant is approximately 13.38 Rp per kWh., while the energy buying price is approximately 32.14 Rp. per kWh. Therefore, 18.76 Rp. per kWh could be saved, if the generated solar energy would be used for the own energy consumption instead of selling the excessive energy to the energy plant. The most essential part is to determine the value of the battery based on the State of Health (SOH) of the battery, as shown in Figure 4, with fictional data.

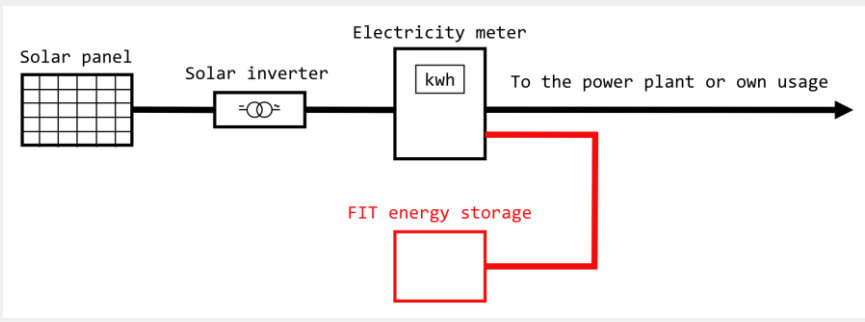

Figure 3: Principle scheme of solution

Currrent SOH (in %)	SOH fade from 100% (in %)	Available cycles	Average available capacity (in Ah)
95%	5	100	20
90%	10	90	18
85%	15	75	16
80%	20	52	12
75%	25	35	8
70%	30	20	3
65%	35	5	0.5

Figure 4: SOH estimation method

4. Conclusion and recommendations

The analysis shows that new battery solution could provide a value of 264.04 CHF over the two years of warranty time of the battery. This exceeds the costs of the system and would therefore not be rentable for Biketec. If the warranty time could be extended or the costs optimized, it could still be rentable for Biketec. For the SLB system, the value of each system still needs to be defined with the explained SOH estimation method, to be able to draw a definite conclusion regarding the costs.

Literature

Pistoia, G., & Liaw, B. (2018). Behaviour of lithium-ion batteries in electric vehicles: Battery health, performance, safety, and cost. Springer international publishing.

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