UNIVERSITY OF TWENTE.

DESIGNING AND EVALUATING A SOLAR CHARGING STATION FOR E-BIKES IN HOME ENVIRONMENTS

Industrial Design Engineering

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DESIGNING AND EVALUATING A SOLAR CHARGING STATION FOR HOME ENVIRONMENTS

This assignment is part of the Solar Powered E-bike Project of the University of Twente. This project is divided in three situational categories. Charging the e-bike before trips at home, during trips, or in the middle of trips. These separate assignment topics are also executed separately. This assignment is about developing and evaluating a solar charging station for home environments and is in an early stage of development. A product being in such an early stage, requiring research, design processes and evaluations, is ideal for an Industrial Design Engineering student. Once each assignment of the Solar Powered E-bike Project has been completed, the charging situations and methods can be compared and evaluated to determine their efficiencies with reference to each other.

The main goal of this assignment is to combine sustainability and e-bikes in a product that users can install at their home locations. This objective means that the product (called the home charging kit) developed during this assignment, interacts with the users in a satisfying way on a daily basis.

The research question is aimed at a design proposal. Can the home charging kit be designed for its target group in a way that it charges purely with solar energy, while still fitting the needs of the target group? This research question focusses on gathering information by analyzing specific topics.

The analyzing stage first of all concerns the target group. The target group of the home charging kit concerns users aged from 18 to 65. The target group mostly includes e-bike owners that use their e-bikes for commuting, shopping and recreation. The environment research of this target group showed that there were some issues regarding the placement of the home charging kit. 25% Of the people included in the target group own rental properties. This means that they can't install new products that affect their homes without permission of their landlords. Additional to people owning rental properties, there are users that already own solar panels. This implies that they have no room left for additional solar panels on their roofs. Since the home charging kit was in such an early design stage, it was important to include the largest target group as possible. This leads to the design decision to allow the placement of the solar panel on a flat surface supported by a frame. This allows users from the target group to install the solar panel on any flat surface that is available at their home location.

Subsequently, the design of the home charging kit could be focused on its own placement, the safety of the users and the user interaction.
The prototype of the home charging kit has been tested with users from the target group. Test results showed that users were able to use the home charging kit without unfixable errors. The issues that occurred were related to the display of the home charging kit, and the socket. 40% Of the test users had difficulties while using the display. The buttons of this bought-in display are not provided with indications, and the functions of these buttons are not predictable.

The pre-and posttest surveys of user test also showed that most users would place the solar panel on the garage or shed and the home charging kit itself inside the garage or shed, as can be seen in figure 1. ••▸
Other relevant results of the pre-and posttest surveys can also be seen in figure 1.

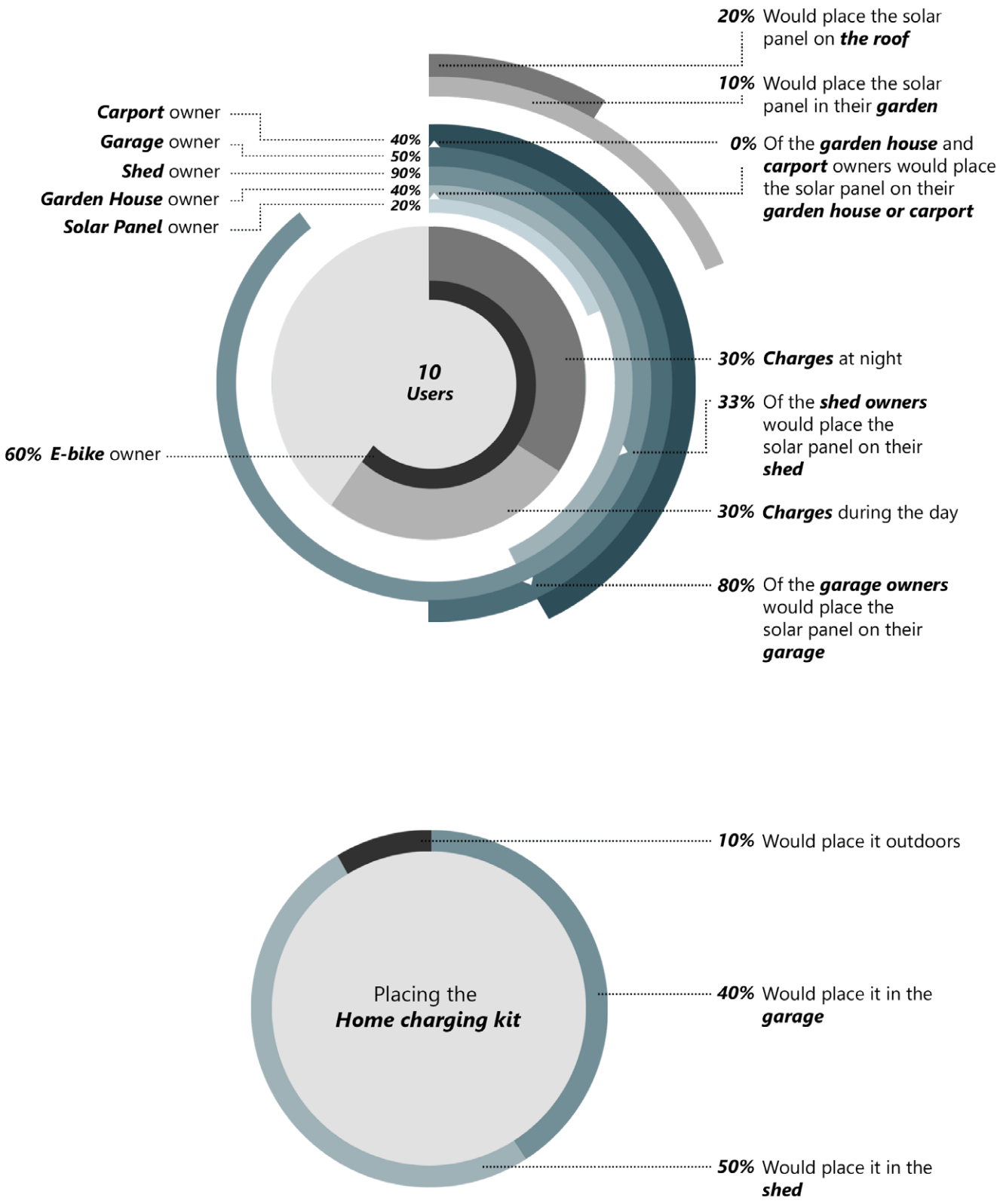
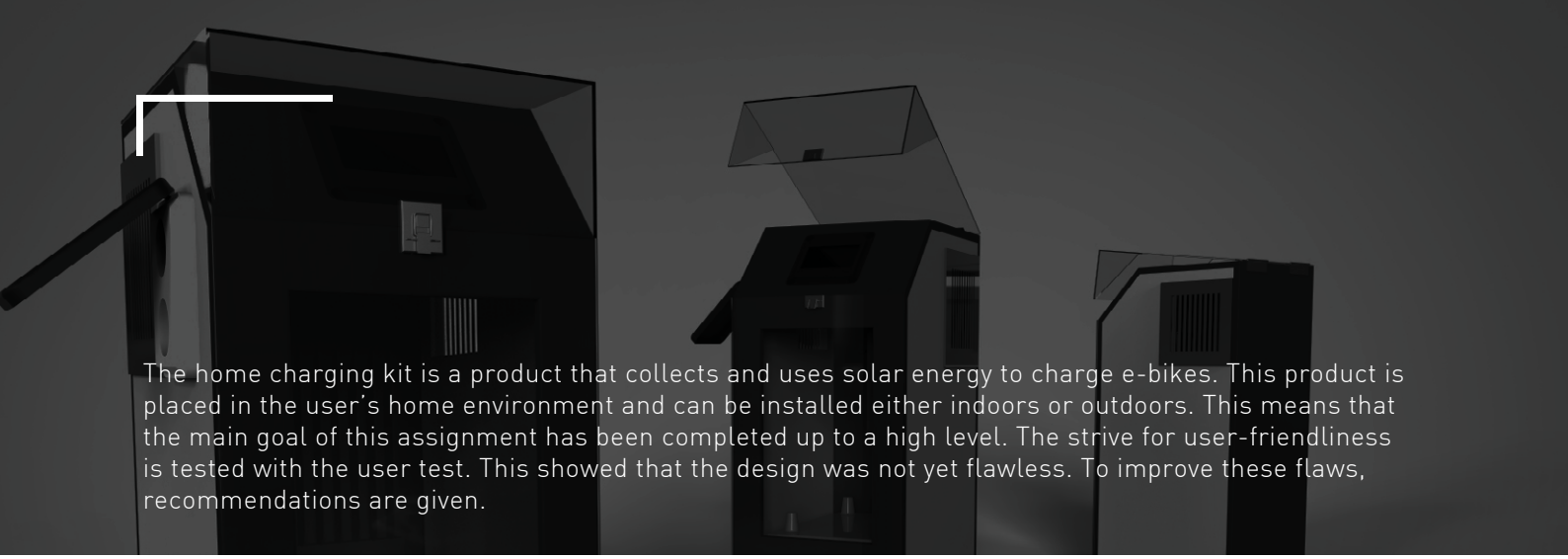


***FIGURE 1**) Test - survey results*



The home charging kit is a product that collects and uses solar energy to charge e-bikes. This product is placed in the user's home environment and can be installed either indoors or outdoors. This means that the main goal of this assignment has been completed up to a high level. The strive for user-friendliness is tested with the user test. This showed that the design was not yet flawless. To improve these flaws, recommendations are given.

The recommendations are focused on the future of the home charging kit. This includes improvements, considerations and next steps that can be taken to develop the home charging kit.

Starting with the basis, some of the electrical components should be adapted. This recommendation can be based on the weight and dimensions of the home charging kit. Because of the difficulty to lift and rotate the home charging kit, it would be recommended to use lighter components. This would increase its transportability and also the amount of home charging kits that could be transported at once, lowering the transport costs. The counterpart of this adaption is its loss in capacity.

The second recommendation is related to the dimensions of the home charging kit. The empty space in the casing is used to get a proper air flow and ventilation. The home charging kit could be made more compact by adding a fan that increases the air flow. The usage of a fan would make the empty spaces obsolete. This implies that the casing of the home charging kit could form a tighter fit around the components.

Another recommendation is related to the angle of the solar panel. For the prototype, a frame has been selected that fitted the solar panel and was recommended by expert source of the solar panel. This frame has an angle of 20°. The optimum yearly calculated angle for solar panels in the Netherlands is, however, 43°. This means that the frame that is currently used will not cause the most sun exposure, implying that it is not as effective as it can be. It is recommended to increase the angle of the solar panel by using a different frame.
An additional recommendation is related to the test results. The display is not self-explaining and it is not supported with indications. This means that either the display should be adapted, or display indications should be integrated into the home charging kit.