D6.7 – Initial Interfaces for Professional and Residential Users

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0.1	2017-06-08	FRAUNHOFER	First draft of TOC
0.2	2017-08-03	FRAUNHOFER	Added initial content
0.3	2017-08-04	FRAUNHOFER	Some restructuring, added introduction, scope
0.4	2017-08-07	FRAUNHOFER, ISMB	Added content for Section 3 and 4
0.5	2017-08-07	FRAUNHOFER	Restructuring in chapter 2, added conclusion and next steps, part of executive summary
0.6	2017-08-07	FRAUNHOFER, ISMB	More content chapters 3 and 4
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0.8	2017-08-09	FRAUNHOFER	API content, chapter 5
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1.0	2017-08-23	FRAUNHOFER	Final version to be submitted

Internal Review History

Review Date	Reviewer	Summary of Comments
2017-08-21 (V0.92)	Vasco Delgado-Gomes (UNINOVA)	Approved: • Minor suggestions to improve readability • Minor typos corrections are needed.
2017-08-23 (V0.92)	Rasmus Rode Mosbæk (LIBAL)	Approved: • Minor suggestions for API connections

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Executive Summary

This deliverable presents the first results of the task 6.3 which is about the development of GUIs to allow residential and professional users to interact with the Storage4Grid system. The GUI design and development is driven by the Storage4Grid high-level and primary use cases documented in D2.1. For the initial GUIs, a subset of the use cases were considered, according to their relevance to professional or to residential users.

Several design methods offered by UCD came into use, depending for example, on the availability of users and/or resources, on technical restrictions, etc. Chapter 2 introduces the design process as a whole whereas section 2.1 presents details about the design methods applied so far: semi-structured interviews and questionnaires of different users, co-creation workshops. Resulting from that, first GUI drafts for professional as well as for residential users were designed iteratively during co-creation workshops involving FRAUNHOFER, ENIIG, ALPERIA, and ISMB, as given in sections 3 and 4, respectively.

The initial Storage4Grid professional GUI for ENIIG has been designed based on the web application currently used by ENIIG professional users, which was created during the GreenCom[i] project as shown in section 3.1. There are two kinds of professional users at ENIIG, namely grid planners and grid operators. The former is responsible for analysing and planning changes related to the grid, the latter is responsible for monitoring the grid operation and intervening on alarm situations.

Wireframes for a desktop application are shown in 3.2 where the workflow of the task activities performed by the grid planner are first described. The drafts of the GUI as needed by the grid operator follow one of the main outcomes of the co-creation user workshops, i.e. the grid operator does not interfere with the storage operation as it takes place fully automatic, but he/she is just interested in the storage status.

Wireframes for the professional user interface for a car park in ALPERIA are presented in section 3.4. They are based on a paper prototype developed during co-creation workshops. Here the energy flow between the PV installation, the grid, and the EV charging points is in focus. This may still change, since grid planning activities concerning EV charging came into play during the workshop.

As for the residential user interfaces, ALPERIA's case foresee monitoring of PV, local storage, and EVs, as the wireframes in section 4.3 shows. Considering ENIIG's case, the Fronius' solar.web[iv] interface is shown. It offers all features the user finds important at the moment. Additionally, it has a high user acceptation rate, so the need for making additional features available is still under evaluation among project members, since the purpose of the project is not to rebuild tools that are highly accepted, but to leverage on them.

Finally, Application Programming Interfaces are presented, so to provide the means for the GUIs to access functionality from the lower-level Storage4Grid components, as needed.

1 Introduction

The deliverable D6.7 Initial Interfaces for Professional and Residential Users documents the first results of T6.3 Interaction with Residential and Professional Users, which is the development of GUIs to allow residential and professional users to interact with the Storage4Grid system. The professional user interfaces are to be integrated with the DSF and the DSO infrastructure whereas the residential GUIs are to have an interface with the USM extensions, like presented in D3.1.

This deliverable describes the general design process in chapter 2 with a set of design methods applied until now and the definition of different design stages. Chapter 3 shows initial GUI drafts for professional users of ALPERIA according to HLUC-2-PUC-2 as well as of ENIIG, HLUC-3-PUC-2, -PUC-3, and -PUC-4 as in D2.1. Initial GUI drafts for residential users are presented in chapter 4 for ALPERIA's as well as ENIIG's cases, respectively for HLUC-2-PUC-1 and HLUC-3-PUC-5. The latter has been added after the release of D2.1 and handles the residential prosumer getting access to information about the energy flux and DSO access to his or her residential storage. It will further be described and specified in D2.2 (M18). Chapter 5 introduces the Application Programming Interfaces (API) through which the GUIs are able to access lower-level functionality. Finally, chapter 6 discusses the conclusions and next steps.

1.1 Scope

This deliverable describes the initial outcomes of Task T6.3. It will be refined according to results of T6.3 into D6.8 Updated Interfaces for Professional and Residential Users in M21 as well as into D6.9 Final Interfaces for Professional and Residential Users in M33. The work in T6.3 is intertwined with the work in WP2, especially in T2.1 and T2.3.

1.2 Related documents

ID	Title	Reference	Version	Date
D2.1	Initial Storage Scenarios and Use Cases		V1.1	2017-06-08
D2.5	Initial Lessons Learned and Requirements Report		V1.0	2017-05-30
D4.8	Initial USM Extensions for Storage Systems		V1.0	2017-08-31
D6.1	Test Site Plans		V1.0	2017-08-31
D3.1	Initial Storage4Grid Components, Interfaces and Architecture Specification		V1.0	2017-08-31

2 Design process

For designing the initial interfaces, the iterative user-centred design (UCD) framework[ii] was applied. This framework and its process has already been described in D2.1 and will not further be discussed in this deliverable.
During the single iteration cycles, produced prototypes are further enhanced and optimized according to input from stakeholders and end-users. This ensures that the result of T6.3 will be usable, relevant and high-quality GUIs. The process of GUI enhancement is being introduced in Section 2.2 Applied methods for requirements elicitation and user workshops are summarized in section 2.1.
To mention are the stakeholders who have been involved in the design process: domain experts as the project partners DSOs, professional end users, i.e. DSO's grid operator and grid planner, as well as residential users. Additionally, to the DSOs, members from the Storage4Grid External Stakeholder Group (ESG) were involved. The ESG is a group of external, independent experts in different areas of expertise, including market, technological trends, and standards.

2.1 Design methods applied

The UCD process offers multiple methods which are built on close interaction and discussion with users. This ensures the best possible information and feedback gathering from a human perspective as well as their relevance for the tasks the user needs to carry on at work. The choice of applicable methods during the development phase is influenced by multiple factors, such as the availability of users and/or resources, technical or law restrictions, user expertise, etc. The methods are chosen with respect to the desired outcome (e.g. knowledge gathering, prototype evaluation) as well as the available resources.

In Storage4Grid, a diverse set of methods was and will be applied. The most used ones during the work presented in this deliverable are further listed.

- **Semi-structured interviews and questionnaires of different users**
  Those are questionnaires and interviews that consist of both close-ended (e.g. yes, no) and open-ended questions. Interviews and questionnaires were conducted mostly online during telcos and with the use of suitable tools. The applied questionnaires can be found in the appendixes.
- **Scenario thinking**
  To generate new ideas, tasks as they are executed at work were imagined and discussed in an environment with new technology. This was especially relevant for the discussion with the professional end-users of ENIIG. Due to the current grid situation, they do not yet have much experience with planning and/or operating storage.
- **Prototyping**
  Developing rapid prototypes to elaborate understandings and ideas about a certain task or problem; for the initial user workshops, paper prototyping with modular prototypes was used.
- **Persona**
  To enhance the understanding of user needs, example users were created based on the results from end-user questionnaires. Those example users allowed for a structured analysis of user needs, working processes, goals and issues during their tasks fulfilment.
- **Co-creation workshops**
  Co-creation workshops were conducted with the end-user partners ALPERIA and ENIIG. Group wise, a modular paper prototype was discussed, content was defined and rearranged on a pre-build prototype.

The results of the work conducted using these methods are also input for WP2, tasks T2.1 and T2.2, as well as the deliverables D2.2 (M18) and D2.5 (M6). System end-users, for example grid operators, grid planners, and

residential users, were asked to fill out questionnaires created by FRAUNHOFER and distributed by the test-site leaders ENIIG and ALPERIA.
Face-to-face workshops were conducted as co-creation discussions and prototyping sessions with FRAUNHOFER, ENIIG, ALPERIA, and ISMB.

2.2 Design stages

During the development process of user interfaces, the constructed prototypes pass through different levels of fidelity:

- **Low fidelity** (low-fi) prototypes are used for rapid idea development and initial interaction design. Its development is cheap, and mistakes can be filtered out very quickly. Usually, they consist of scribbles (digital or paper) and wireframes.
- **Medium fidelity** (mid-fi) prototypes are the enhanced version of low-fi prototypes. The content and purpose of the interface as well as the target system is already clear and was evaluated in previous iterations. Based on mid-fi prototypes, initial software prototypes can be developed, which are already modelling architecture and technical interfaces for application systems and data sources. Mid-fi prototypes can for example be click-dummies (interactive wireframes created using mock-up tools, e.g. moqups[iii] or similar software).
- **High fidelity** (high-fi) prototypes are almost finalized interfaces with applied graphical design, fully modelled transitions (animation, gestures), etc.

With respect to the early state of the Storage4Grid project, the prototypes presented in this deliverable are low- to mid-fi. The documentation on high-fi prototypes are expected with the next version of this deliverable in M21.

3 Low-Fi GUI for professional users

3.1 Currently used GUIs

The island of Fur already has been a test site in the GreenCom project[i]. As one outcome of this project, a professional GUI for DSOs was developed and is presented in Figure 1. This interface was used as an inspiration for the presented professional user interfaces presented in sections 3.2 and 3.3.

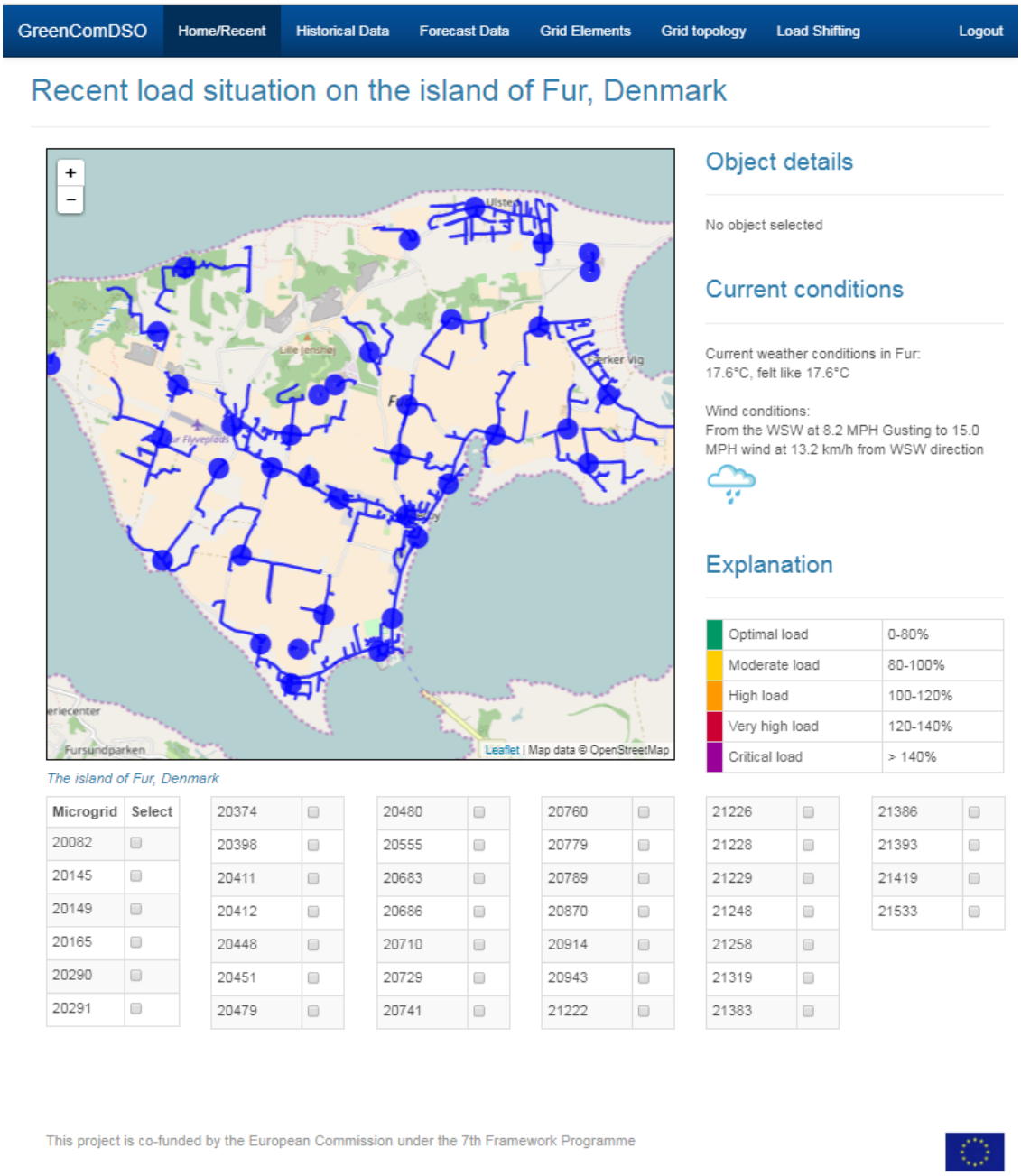

Figure 1 – GUI for DSOs developed in the GreenCom Project[i]

3.2 Grid Planner at ENIIG: HLUC-3-PUC-2, PUC-3 & PUC-4

The interface wireframes for grid planners are shown in Figure 2. Based on the results from the user questionnaires, the interface was designed as a desktop application (resolution: 1920p x 1080p, the final version

shall be adaptive to the screen size) and will be further explained. More interaction and content features might be added in future versions of the dashboard.
The envisioned workflow is as follows:

1. **Specifying the topology** in which storage should be added using the dashboard, see Figure 2. The interactive map allows for interaction with the grid topology on the island of Fur. As envisioned now, the grid planner can simulate the behaviour of adding new storage, adding a new PV, or calculating the optimal solution for a problem occurring in the network. However, only adding new storage is in scope of Storage4Grid; therefore, the additional symbols might be removed in further developed versions of the dashboard. The grid topology should always be up-to-date, also considering existing or new generation storage.
2. **Provide available data** (full set of data), see Figure 3. By dropping the battery symbol on a specific area, the interface will prompt a window and ask for the upload of available data measured in the grid, such as load profiles or voltage progression. The upload allows for multiple data sources. The data to be uploaded is expected to be recorded on specific points in the grid where a problem occurred.
3. **Calculate**, see Figure 4. The overlay screen displays the progress of the calculation as a percentage.
4. **Browse results**, see Figure 5. After the calculation, the 3 best positions of storage as well as corresponding parameters such as size, costs, and position (grid-side or user-side) are displayed on the map. More detailed information is displayed beneath the map as a tabular comparison between the baseline-parameters (traditional grid strengthening) and the storage installation with a prediction for a specific time frame, for example the expected battery lifetime. The comparison can be downloaded as a report.

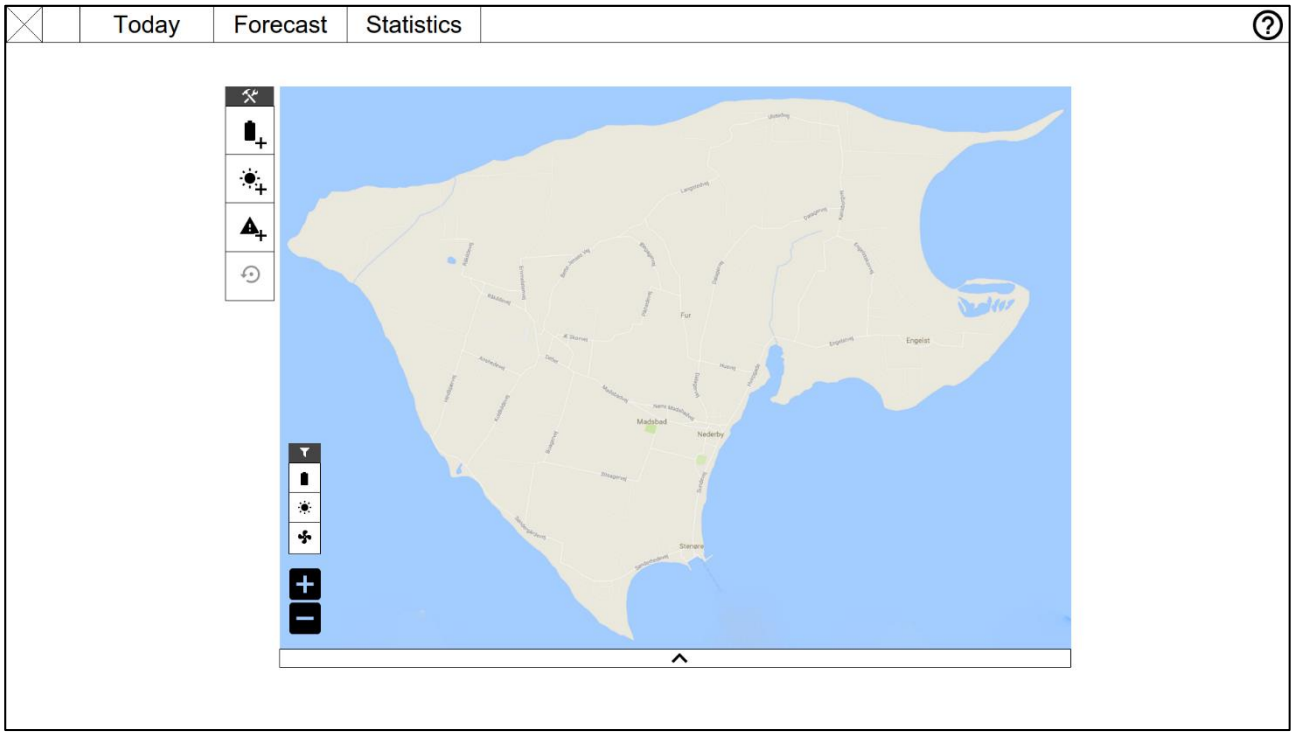

Figure 2 – Dashboard of the professional GUI for grid planners, available online at https://app.moqups.com/vkrauss/NbUeyEZfHk/view/page/aa9df7b72

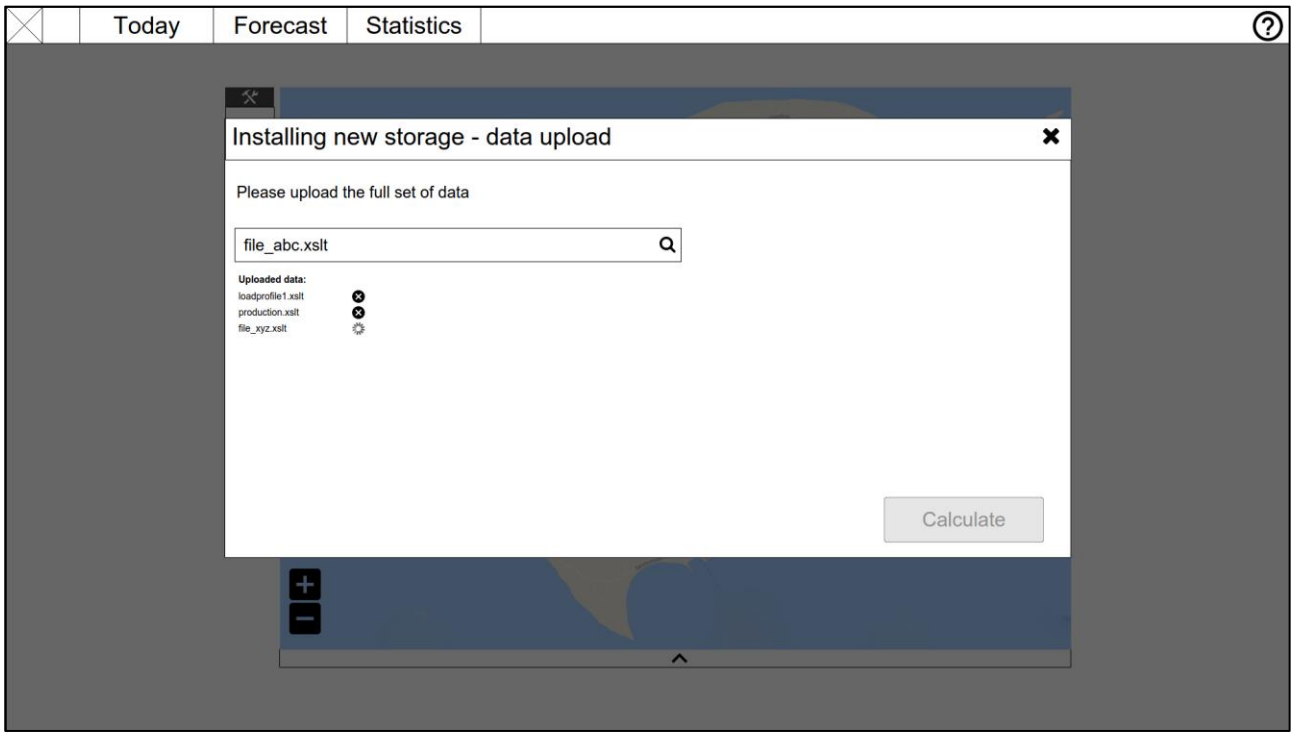

Figure 3 – Data upload prompt

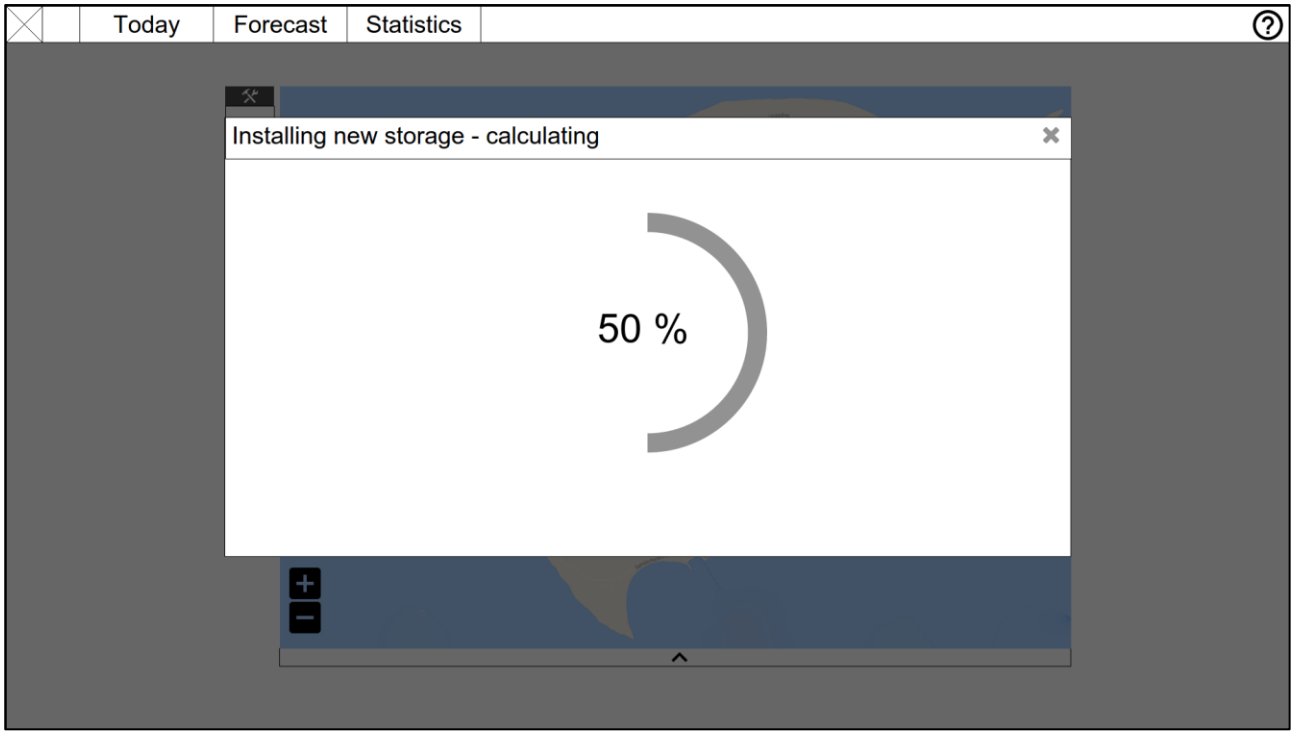

Figure 4 – The calculation progress is stated on an overlay screen

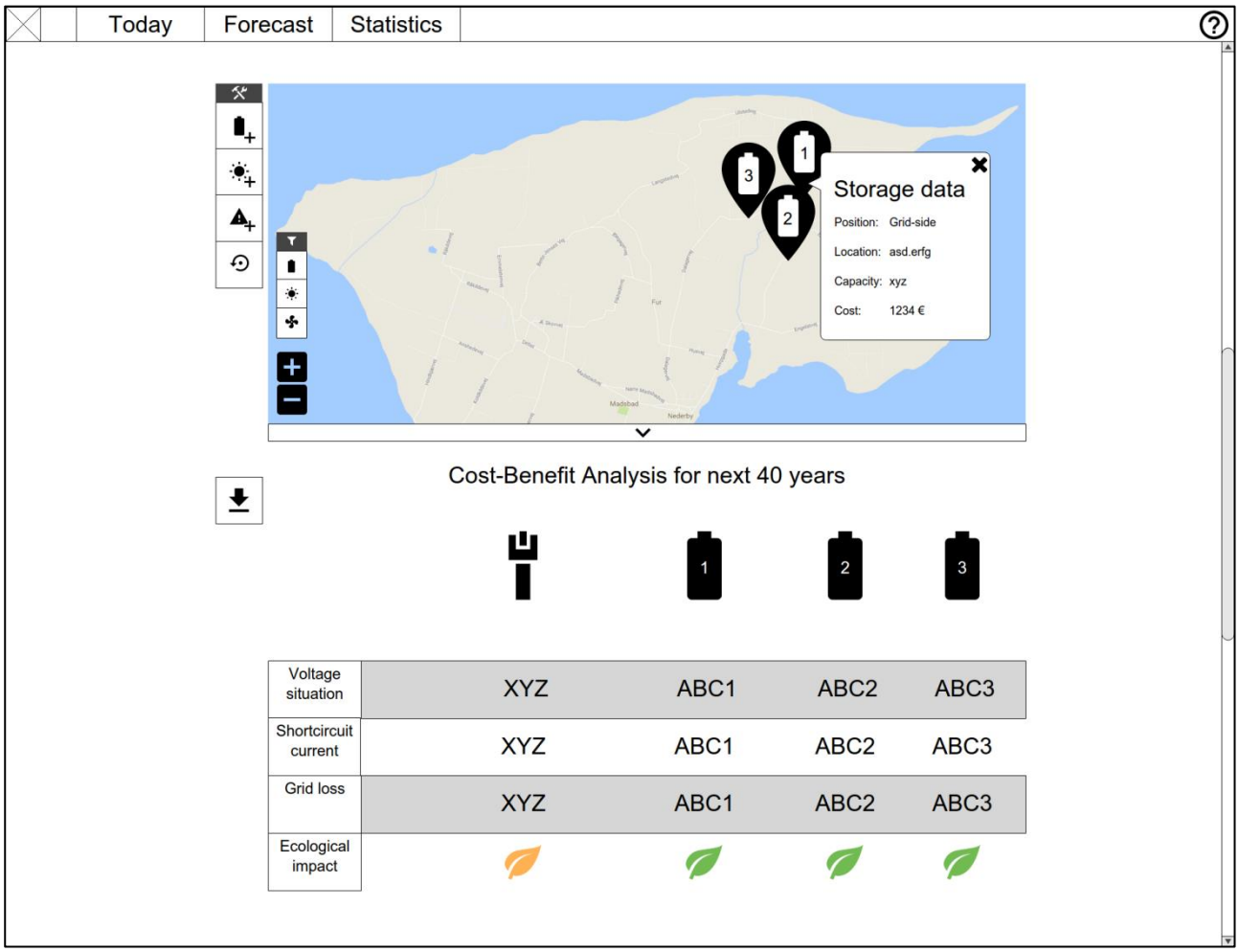

Figure 5 – Cost-Benefit analysis as a result of the calculation

3.3 Grid Operator at ENIIG: HLUC-3-PUC-2, PUC-3 & PUC-4

One of the main outcomes of the user workshops was that grid operators have difficulties imagining a grid in which storage is placed and can be operated. Additionally, they do not really interfere with the grid operation since the systems usually work fully automated, so the grid operators have a monitoring role. To determine a feasible level of information, the current interface is designed with the minimum set of data namely if the storage works or not. Additional information such as down- or uptime might be added in later versions but should be grounded in user requirements. The visualization of the grid topology as well as the radials is not yet included in the GUI drafts, but was requested during the workshops and will therefore be considered in future versions.

The interface draft is based on the assumption that the battery provider offers services for storage system monitoring. Similar to the interface for grid planners, it is designed as a desktop application on a 1920p x 1080p sized screen. Figure 6 depicts the visualization of available storage in the grid in case everything is working fine, whereas Figure 7 indicates occurring problems by highlighting faulty storage systems in red.

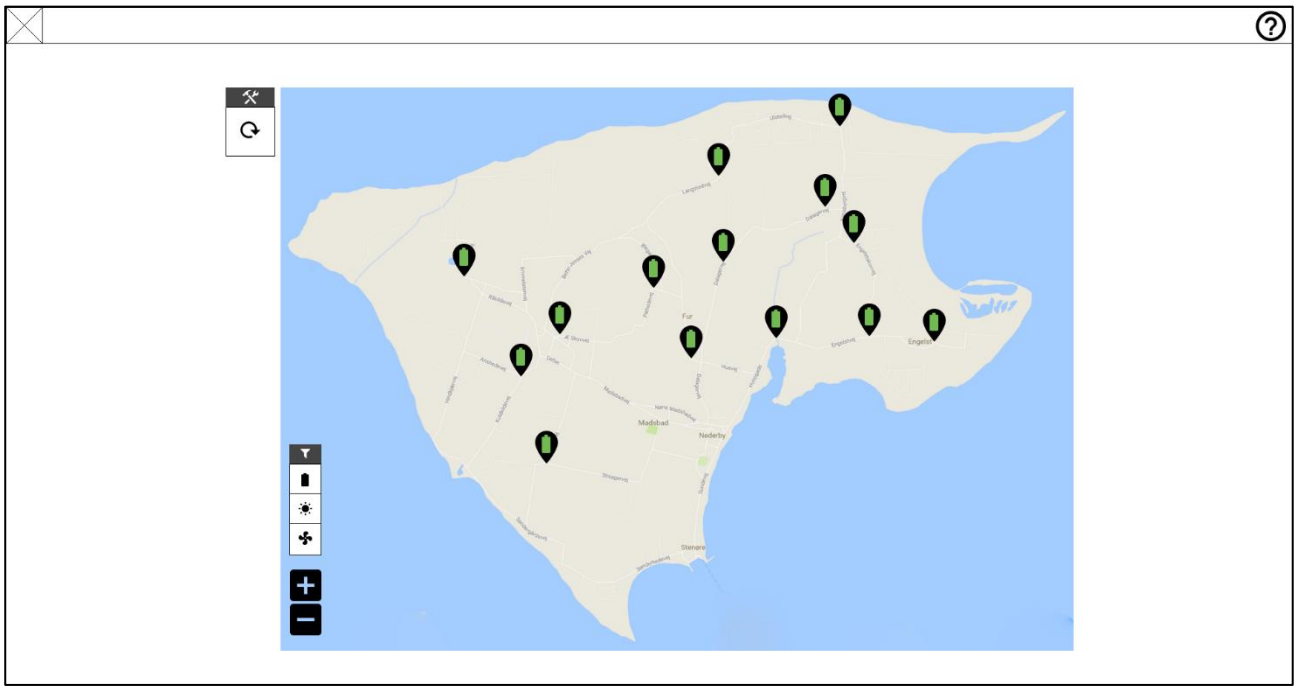

Figure 6 – First draft of the grid operator interface where all installed storage systems are working

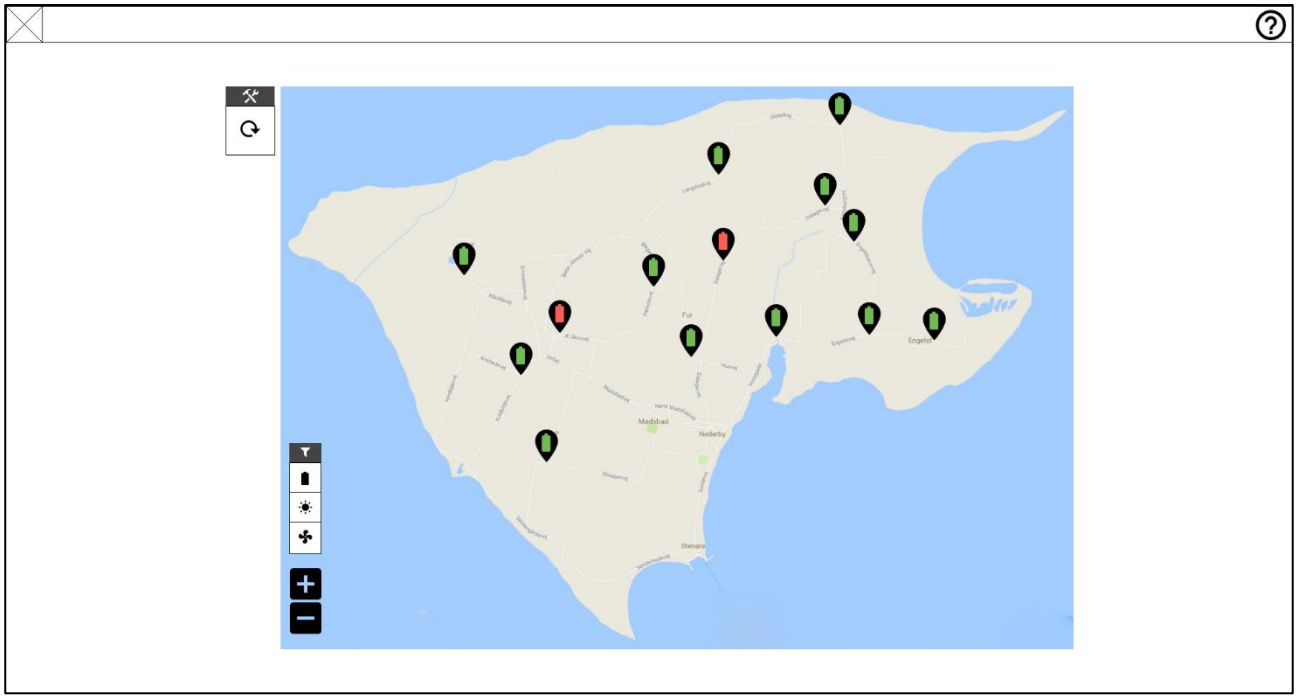

Figure 7 – Status change of two storage systems; red indicates that the system is facing issues

3.4 Professional User at ALPERIA: HLUC-2-PUC-2

The test site in Bolzano features electric vehicles (EVs) for both residential and professional users. The main difference between the two interfaces is the amount of featured charging stations and the devices used to query the interfaces. However, the content is similar and consists mainly of observational actions.
During the workshop in Bonn (August 2017), a new possible use case for the professional GUI was mentioned, such that the resulting interface might introduce functionalities for grid planners, e.g. battery and charging points placement, and therefore shift the focus accordingly.
Since there is at ALPERIA no clear professional user defined, this needs to be evaluated further. The first draft shown in Figure 9 is based on the modular paper prototype shown in Figure 8, which was used in the user workshops. The resulting GUI allows for both querying the status of the charging stations as well as for pulling data about the energy distribution (amount from the grid, amount from the PV, storage, PV state). Charging stations can be prioritized or shut down for maintenance.

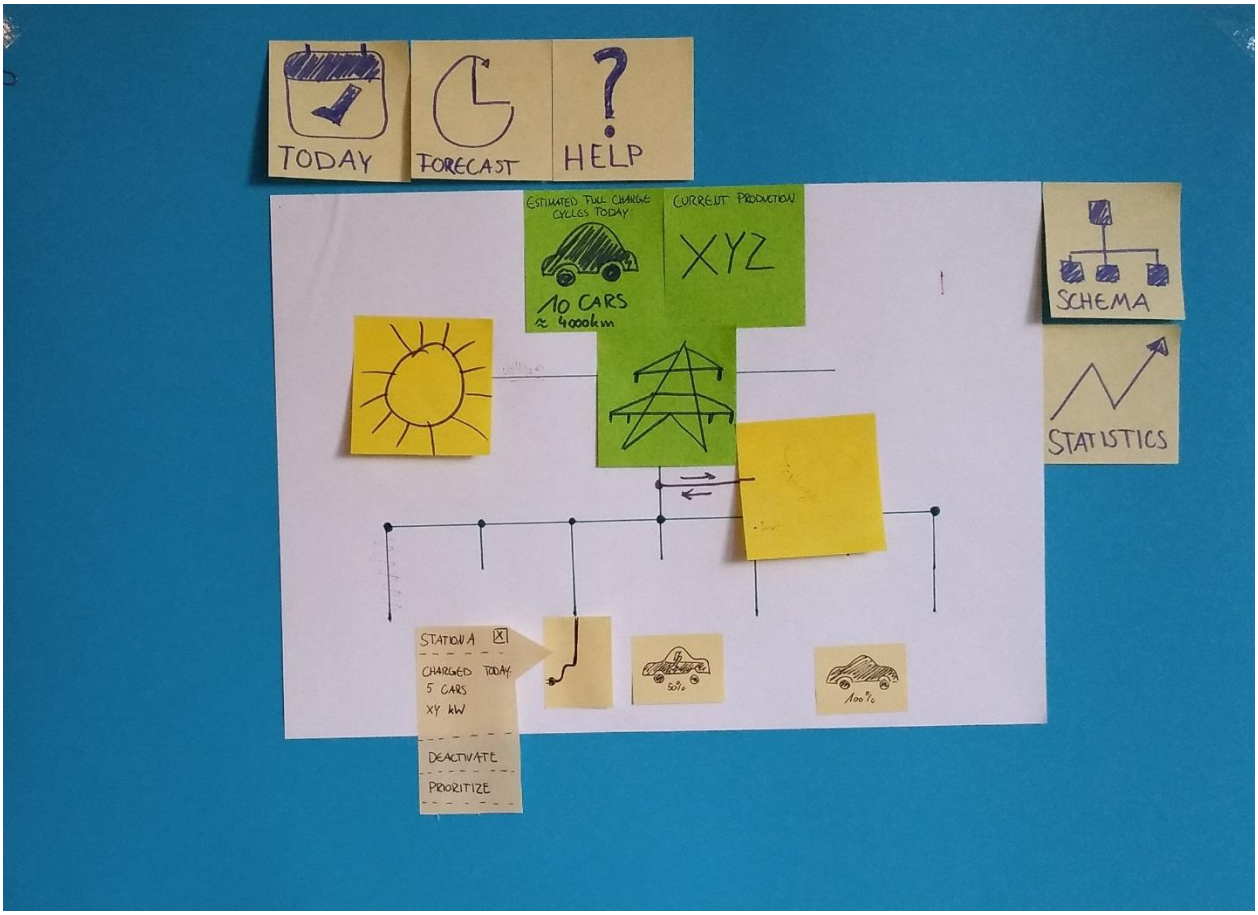

Figure 8 – Modular paper prototype for the professional interface for ALPERIA

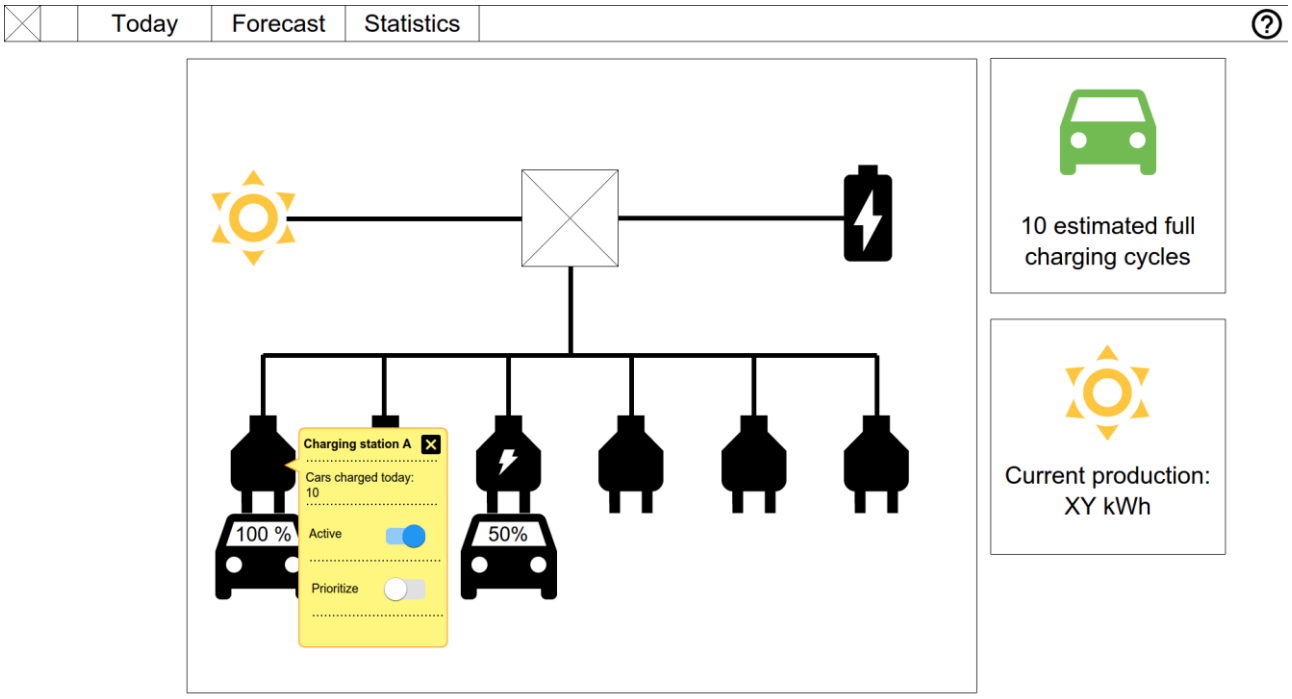

Figure 9 – Professional user interface for a car park, available online at https://app.moqups.com/vkrauss/NbUeyEZfHk/view/page/aa9df7b72

4 Low-Fi GUI for residential users

4.1 Currently used GUIs

Smart energy management is a hot topic. That is why multiple applications exist for this field, addressing the needs and wants of residential users. Most of them are proprietary software and cannot be adapted.

The residentials on the island of Fur are familiar with the solar.web interface created by Fronius[iv]. The simple GUI allows for a quick animated overview of the current state of the local energy storage system, current PV production and consumption, as well as for deeper analysis by querying statistics. The Fronius interface will be further described in section 4.2.

4.2 Residential User at ENIIG: HLUC-3-PUC-5

The main results of the questionnaire pointed to one thing: ENIIG's residential users are happy with the Fronius interface because it already satisfies all their needs. The main interests of the questioned users lie in the money they earn or save, how much of their own PV production is consumed, and what is the current charging level of the installed storage (see also Figure 10). Furthermore, the interface enables the users to perform analytical tasks, such as querying production and bough energy data (Figure 11) or viewing consumption profiles (Figure 12). Energy flux as well as the weather forecast and if or when the DSO regulates the energy stored in the local battery was considered as being of minor interest. This opens up the question if a new interface needs to be developed. The already installed Fronius interface[iv] is only missing the information about storage access from the DSO, which was rated as not being so relevant and could also be realized as weekly or monthly report sent out by mail. However, to finally conclude on this question, a more meaningful study needs to be conducted, reaching more users than the already conducted one.

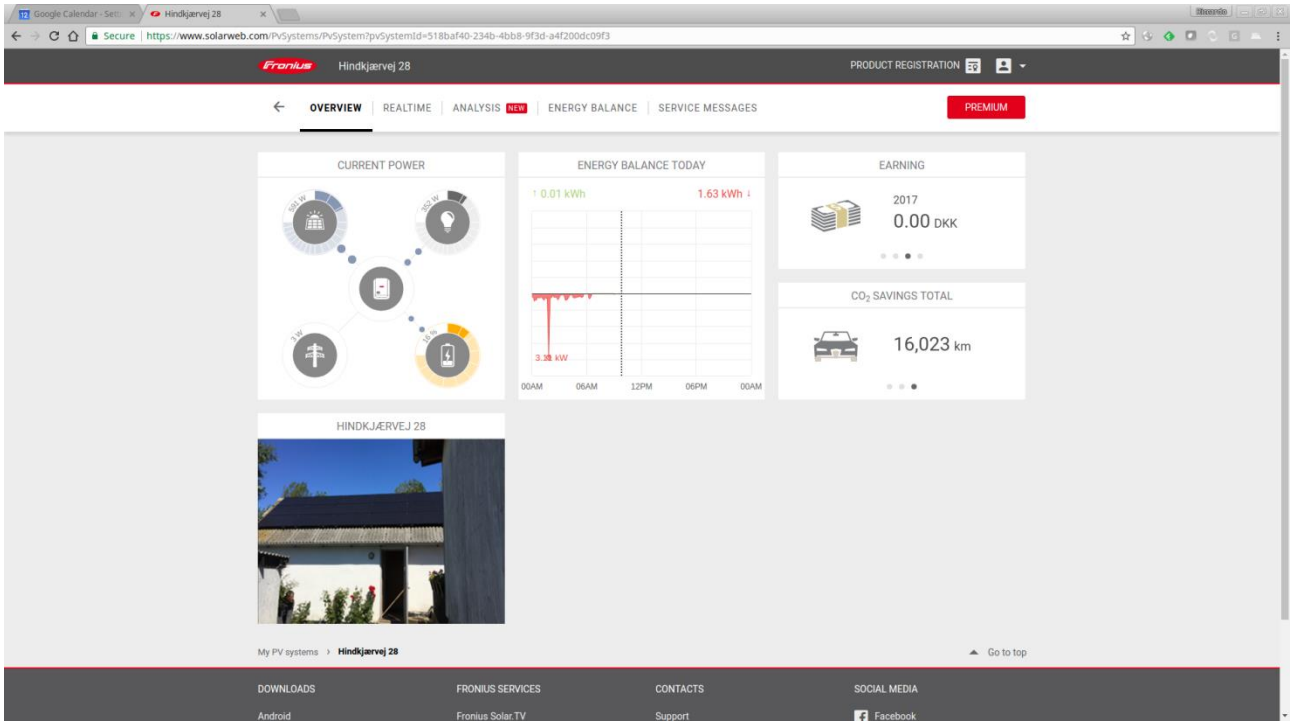

Figure 10 – Dashboard of Fronius' solar.web[iv] interface, which provides a general system state overview

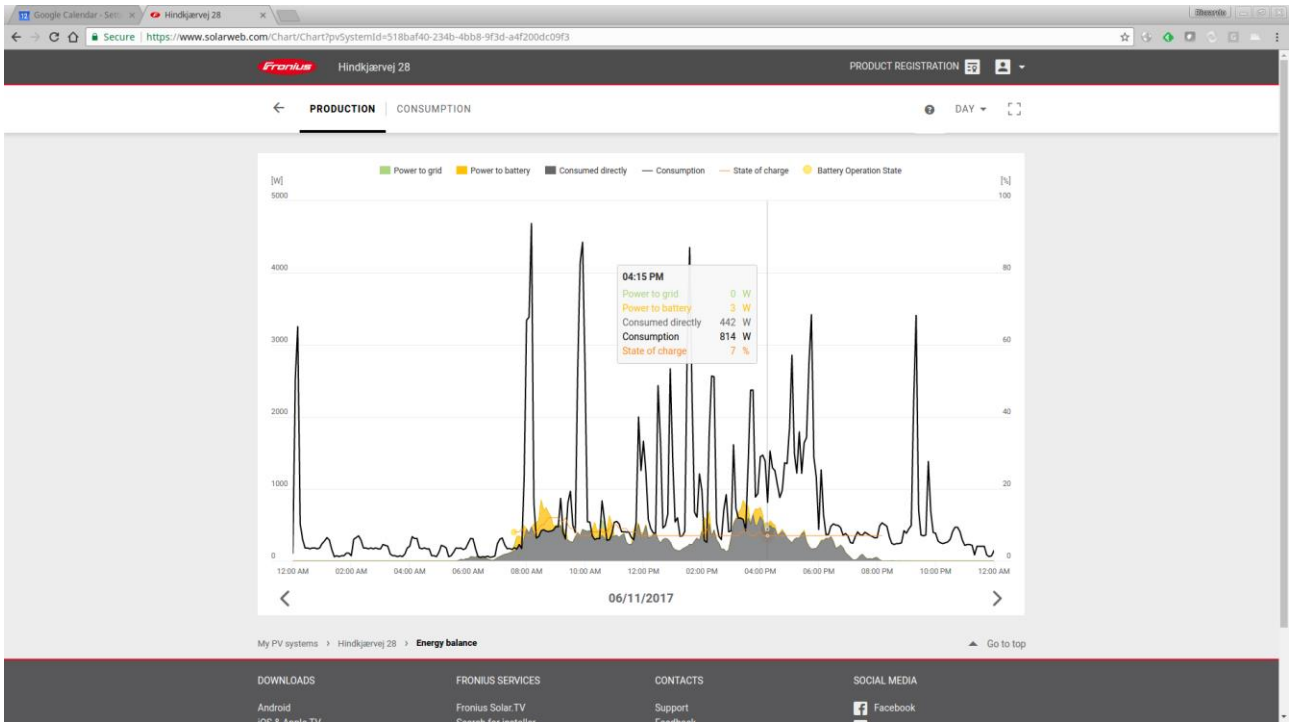

Figure 11 – Visualization of production data and bought energy using the Fronius interface[iv]

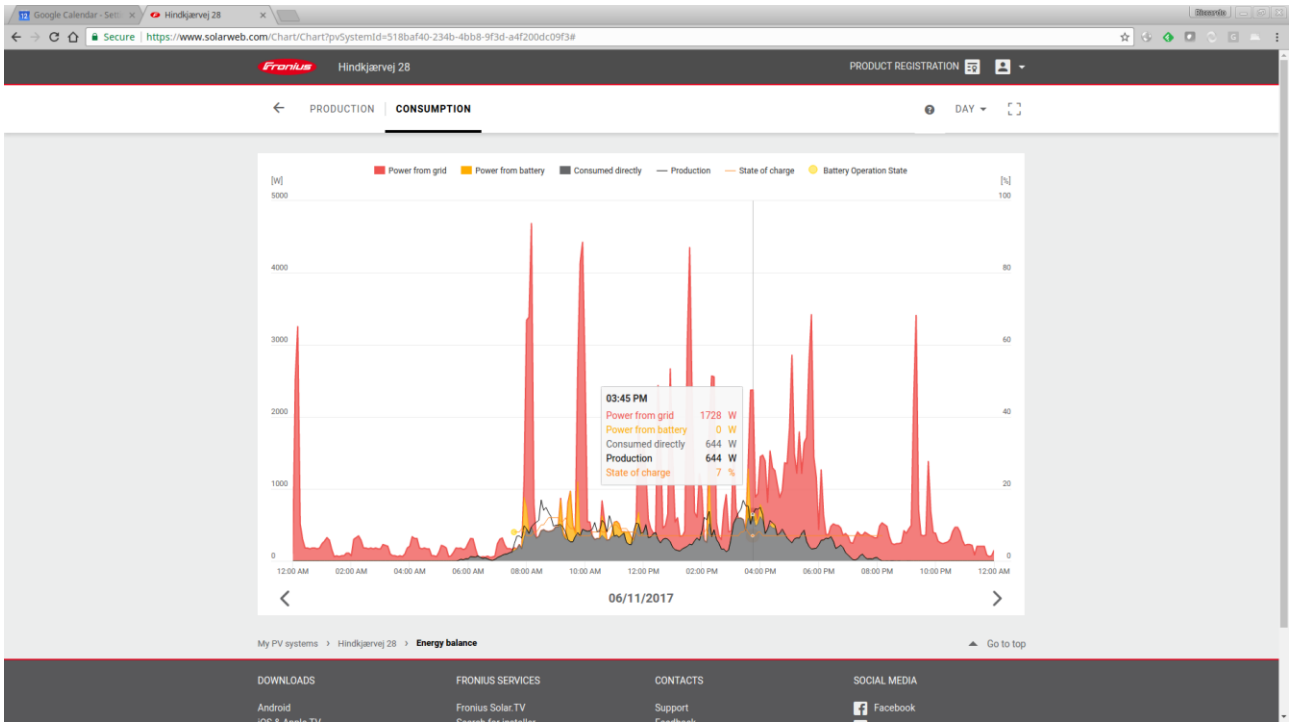

Figure 12 – Visualization of consumed energy

4.3 Residential User at ALPERIA: HLUC-2-PUC-1

ALPERIA is going to provide their residential users with a Fronius interface as it is used on the island of Fur. One of the major points the user criticised in the ALPERIA's questionnaire was the complicated way of analysing data as well as the missing information about the EV. The former is addressed by the solar.web interface, since it offers multiple ways of browsing and analysing the data collected. The latter might not be solvable technically since only specific EVs allow to access their state of charge from outside the car (by a 3rd party system). It further needs to be evaluated what kind of information about the car is needed. Additionally, it needs to be investigated how well the features offered by the solar.web interface cover the user needs and if the car information is really required to be added.

Based on the current findings, a simplified interface was developed and is depicted in Figure 13. More detailed analysis of the provided statistics still needs to be discussed. Additionally, a mobile version fitting for tablets and smartphones should be developed based on the user questionnaire.

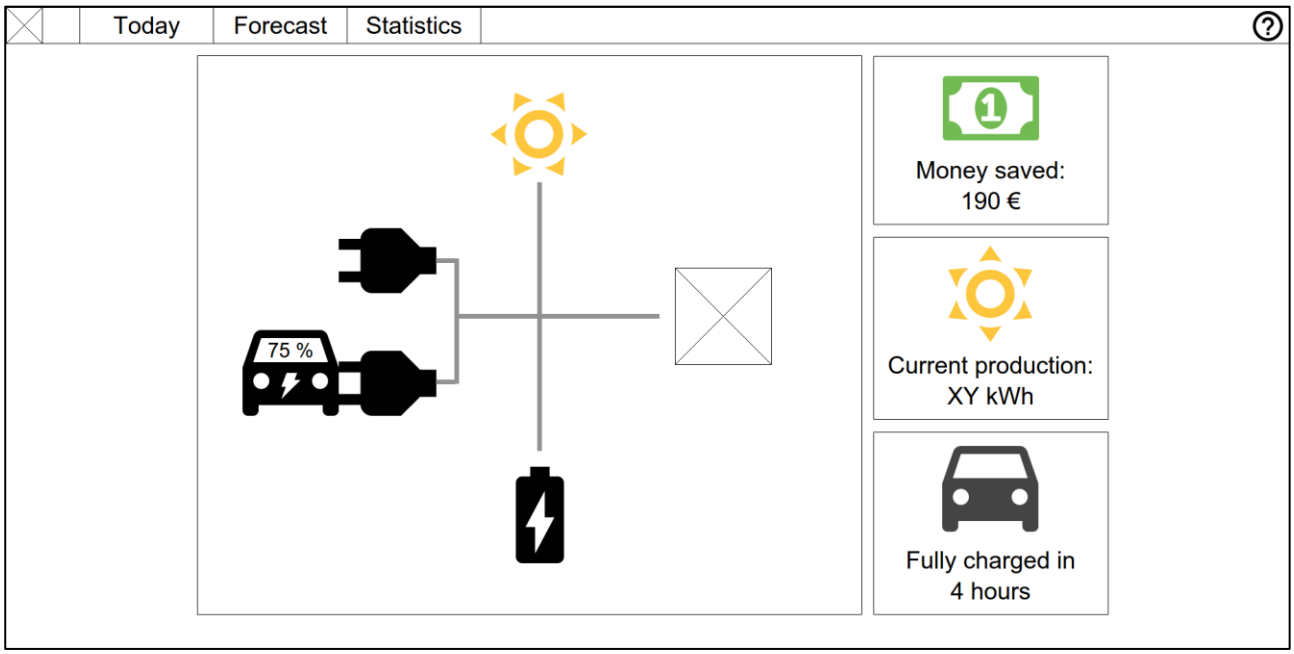

Figure 13 – Residential user interface for monitoring PV, local storage and the EVs

5 Application Programming Interfaces

This chapter introduces the preliminary services that are consumed for enabling the described GUIs. Although the functionality is presented as methods, the implementation will be done via REST services. This will be refined in D6.8.

Table 1 describes the data produced by the API in conjunction with the data source components and the GUIs for which the data is relevant. The DSF Data warehouse (DSF-DWH) acts as the main data source for professional GUIs; however, the Grid Side ESS Controller (GESSCon) might also be able to provide some of the requested data. This needs to be specified as the project develops.

Table 1 – List of required data and corresponding sources

Data produced	Method	Data source	GUI
GridTopology	getGridTopology(String filter)	DSF-DWH	Professional ENIIG (grid planner, grid operator)
StorageCurrentPosition	getStorageCurrentPosition(String filter	DSF-DWH (GESSCon)	Professional ENIIG (grid planner)
StorageIdealPosition	getStorageIdealPosition(String filter	DSF-DWH (GESSCon)	Professional ENIIG (grid planner)
StorageProperties	getStorageProperties(String StorageId) Note: properties can mean position, capacity, location, and cost, SoH	DSF-DWH (GESSCon)	Professional ENIIG (grid planner)

StorageCost	getStorageCost(String StorageId)	DSF-DWH	Professional ENIIG (grid planner)
StorageSoC	getStorageSoC(String StorageId)	DSF-DWH (GESSCon), LESSAg	All
StorageSoH	getStorageSoH(String StorageId)	DSF-DWH (GESSCon), LESSAg	All
StorageStatus	getStorageStatus(String StorageId)	DSF-DWH (GESSCon)	Professional ENIIG (grid operator)
Voltage	getVoltage(String Filter)	DSF-DWH (GESSCon)	Professional ENIIG, Professional ALPERIA
ShortcircuitCurrent	getShortcircuitCurrent(String Filter)	DSF-DWH	Professional ENIIG (grid planner)
GridLoss	getGridLoss(String Filter)	DSF-DWH	Professional ENIIG (grid planner)
EcologicalImpact	getEcologicalImpact(String Filter)	DSF-DWH	Professional ENIIG (grid planner)
PvProduction	getPvProduction(String Id)	DSF-DWH (GESSCon), LESSAg	All
ChargingPointProperties (including status as of free, occupied, disabled, charging, etc.)	getChargingPointProperties(String ChargingPointId)	DSF-DWH, LESSAg	Professional ALPERIA, Residential ALPERIA
	setChargingPointProperties(String ChargingPointId, ChargingPointProperty value) Note: to set for example the status for priotization	DSF-DWH, LESSAg	Professional ALPERIA, Residential ALPERIA
CarSoC	getCarSoC(String StorageId) Note: based on getStorageSoC	DSF-DWH (if available)	Professional ALPERIA, Residential ALPERIA
CurrentEnergyPrice	getCurrentEnergyPrice(String Filter)	DSF-DWH, LESSAg	All
EnergyFlux	getEnergyFlux(String Filter)	DSF-DWH, LESSAg	All
CurrentConsumption	getCurrentConsumption(String Filter)	DSF-DWH, LESSAg	All
HistoricalConsumption[]	getHistoricalConsumption(String Filter, String Granularity)	DSF-DWH, LESSAg	All

HistoricalProduction[]	getHistoricalProduction(String Filter, String Granularity)	DSF-DWH, LESSAg	All
ForecastConsumption[]	getForecastConsumption(String Filter, String Granularity)	DSF-DWH, LESSAg	Professional ENIIG (grid planner), Professional ALPERIA Residential ALPERIA
ForecastProduction[]	getForecastProduction(String Filter, String Granularity)	DSF-DWH, LESSAg	Professional ENIIG (grid planner)
Forecast about amount of full charging cycles for the next 24 hours foreseen for a specific charging point	getForecastChargingCycles(String Filter, String ChargingPointId)	DSF-DWH (GESSCon), LESSAg	Professional ALPERIA Residential ALPERIA
Energy supplied from grid	getGridEnergySupply(String Filter)	LESSAg	Residential ALPERIA, Residential ENIIG

6 Conclusion and next steps

This deliverable presents the first results of the task 6.3 which is about the development of GUIs to allow residential and professional users to interact with the Storage4Grid system. The GUI design and development is driven by the Storage4Grid high-level and primary use cases documented in D2.1 and to be refined in D2.2. For the initial interfaces for professional and residential users, a subset of the use cases were considered, i.e. ALPERIA's HLUC-2-PUC-2 and ENIIG's HLUC-3-PUC-2, -PUC-3, and -PUC-4 for professional as well as ALPERIA's HLUC-2-PUC-1 and ENIIG's HLUC-3-PUC-5 for residential. The latter has been added after the release of D2.1 and handles the residential prosumer getting access to information about the energy flux and DSO access to his or her residential storage.

Several design methods offered by UCD were used, depending for example on the availability of users and/or resources, on technical restrictions, etc. Section 2.1 presents details about the design methods applied so far. Based on scenario thinking, on the definition of persona, prototyping, as well as on interviews and user questionnaires, first low-fi GUI for professional and residential users were designed iteratively during co-creation workshops involving FRAUNHOFER, ENIIG, ALPERIA, and ISMB, as given in section 3 and 4, respectively.

Due to the early stage of the project and the small number of residential users involved in the Bolzano test site (1 user) as well as in the Fur test site (5 users) the results of the interviews and questionnaires are at the moment not as representative. As an example, it was found out that the residential users at Fur do not seem to value monitoring the reasoning of the storage coordination by the DSO. They seem to be eager to accept the coordination by the DSO just as it is and do not be bothered by taking action to find out the reasoning behind it. This finding would probably lead to the decision of not developing a new residential GUI nor extending the GUI which is already available through the Fronius storage system.

As next steps, it is planned that more residential users are going to be enrolled in the Bolzano test site, since ALPERIA reported about a greater number of residential customers (owning an EV and a PV installation) calling their hotline and informing themselves about the coordination between the PV production and the EV charging. These users can be classified as relevant for the Storage4Grid project, since they share some of the characteristics of the problems that Storage4Grid aims to solve. The new acquired ALPERIA test users will also be involved in the Fur use cases in order to confirm or revoke the findings previously described.

The focus of ALPERIA's professional GUI will be reviewed further. Until now, it has highlighted the energy flow between the PV installation, the grid, and the EV charging points. During the co-creation workshops, we have found out that putting or adding focus onto grid planning from a battery and charging points placement perspective may have advantages.

After the evaluation of the new round of questionnaires is done, we will start a new UCD iteration to produce medium- and high-fidelity GUIs to be evaluated by the user himself. The updated professional and residential GUIs will be documented in D6.8 and D6.9.

Acronyms

Acronym	Explanation
API	Application Programming Interface
DSF	Decision Support Framework
DSF-DWH	Decision Support Framework Data Warehouse
DSO	Distribution System Operator
ESG	External Stakeholder Group
EV	Electric Vehicle
GESSCon	Grid Side ESS Controller
GUI	Graphical User Interface
High-Fi	High Fidelity
HLUC	High-Level Use Case
LESSAg	Local ESS Control Agent
Low-Fi	Low Fidelity
Mid-Fi	Medium Fidelity
PUC	Primary Use Case
PV	Photovoltaic
PX	Pixel
REST	Representational State Transfer
SOC	State of Charge
SOH	State of Health
UCD	User-centred Design

List of figures

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References

[i] *GreenCom Consortium, "GreenCom EU Project," 08 08 2017. [Online]. Available: http://www.greencom-project.eu/.*

[ii] *I. O. f. Standardization, ISO 9241-210:2010 - Ergonomics of human-system interaction -- Part 210: Human-centred design for interactive systems, International Organization for Standardization, 2010.*

[iii] *S.C Evercoder Software S.R.L., "Online Mockup, Wireframe & UI Prototyping Tool - Moqups," S.C Evercoder Software S.R.L., 2017. [Online]. Available at: https://moqups.com/*

[iv] *Fronius International GmbH, "Fronius Solar.web," Fronius International GmbH, 2017. [Online]. Available at: https://www.solarweb.com/.*

Appendix A – Questionnaire for ENIIG – Professional GUI for Grid Planner

Questionnaire for professional users: Grid Planner

Introduction Storage4Grid Project

Thank you for your participation! This questionnaire was developed for the Storage4Grid project. Our aim is to boost the uptake of storage technologies between the distribution grid level and the end-user level, by developing a novel, holistic methodology for modeling, planning, integrating, operating and evaluating distributed Energy Storage Systems. The Storage4Grid methodology encompasses storage at user premises and storage at substation level, Electrical Vehicles, innovative energy metering and energy routing technologies.
Storage4Grid is a Research and Innovation Action funded by the European Union's Horizon 2020 Programme.

Scope and purpose of this questionnaire

The results of this questionnaire will be used as input for developing the graphical user interfaces (GUI). This interface should enable the user to interact with distributed storage systems, the grid and the Decision Support Framework at various levels. As a professional user, you can provide valuable input for the development of those GUIs.

With your participation in this questionnaire, you confirm that you are participating out of free will.

Your answers and statements will not be published in combination with personal data. If you have questions, contact us using veronika.krauss@fit.fraunhofer.de. The questionnaire consists of 5 sections and 18 questions. Please read the instructions carefully and provide honest answers.

Please answer the questionnaire and send it back to veronika.krauss@fit.fraunhofer.de until Friday, 30th of June 2017.

Your availability in July 2017

We would like to deepen the insights we get from this questionnaire in a short phone call interview (max 30 minutes). Those interviews will take part in the second half of July 2017. Therefore, we need your help! Are you available during that period and willing to participate in those interviews?

I am available from Klick here to select a date **to** Klick here to select a date.
Please contact me using this email address: Klick here to enter text.

A Demographic Information

1 How old are you?

Please select your age group from the drop-down menu below.

Age: Select your age groups.

B Devices

2 How frequent are you using the following devices:

This question addresses the average use of those devices without any specific purpose. Please select only one frequency per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never / I do not own this device*
Smart phone	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐
Desktop PC	☐	☐	☐	☐	☐

C Working environment

The following question block is about your usual working environment. It helps us to understand what kind of issues you might encounter during your work.

3 How often do you use the following device at work?

Please select only one answer per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never /This device is not available*
Desktop PC	☐	☐	☐	☐	☐
Tablet PC	☐	☐	☐	☐	☐
Wall/Remote displays with Touch-Input	☐	☐	☐	☐	☐
Wall/Remote displays without Touch-Input	☐	☐	☐	☐	☐
Other (please enter the device): Klick here to enter text.	☐	☐	☐	☐	☐

4 How physically demanding is your work?

We address your usual working situation. Please select only one answer per activity.

Activity	*Very often*	*Fairly often*	*Often*	*Seldom*	*Never*
Sitting	☐	☐	☐	☐	☐
Standing	☐	☐	☐	☐	☐
Walking	☐	☐	☐	☐	☐
Other (please enter the activity): Klick here to enter text.	☐	☐	☐	☐	☐

5 Where do you usually perform your work?

We address your usual working situation. Please select only one answer per location.

Activity	*Very often*	*Fairly often*	*Often*	*Seldom*	*Never*
Indoor at a desk	☐	☐	☐	☐	☐
Indoor at no specific location	☐	☐	☐	☐	☐
Outdoor	☐	☐	☐	☐	☐
Other (please enter the location): Klick here to enter text.	☐	☐	☐	☐	☐

6 How collaborative is your work?

We address your usual working situation. Please select only one answer per option.

Activity	*Very often*	*Fairly often*	*Often*	*Seldom*	*Never*
Alone / single work	☐	☐	☐	☐	☐
Collaborative Planning	☐	☐	☐	☐	☐
Mixed (working alone, presenting results to a group)	☐	☐	☐	☐	☐
Other (please specify): Klick here to enter text.	☐	☐	☐	☐	☐

D Software, applications and workflows

In the following block, we want to investigate on the software, applications and workflows you are currently using to perform your tasks as a Grid Planner.

7 Which tasks are you performing as a Grid Planner?

Please give us a short overview about your daily tasks (max 10 sentences).

Klick here to enter text.

8 What is (are) the type(s) of the application(s) you are currently using to perform your tasks as a Grid Planner?

You can select multiple answers.

☐ Web-based (operated in a browser, such as Google Chrome, Microsoft Edge, Mozilla Firefox, ...)
☐ Desktop application
☐ Other (please specify): Klick here to enter text.

9 Which applications are you using to perform your tasks as a Grid Planner?

Please list the top 5 applications including their main functionality.

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.
4. Klick here to enter text.
5. Klick here to enter text.

10 What is the basic workflow you follow to perform your Grid Planner tasks?

Briefly describe the workflow you follow to perform Grid Planner tasks, e.g. "Opening application <name> and loading data from <system name> ...". Please use max 10 sentences.

Klick here to enter text.

11 Which are the top 3 issues you encounter when performing regular tasks as a Grid Planner?

Please list for example software issues, missing information, missing functionalities, bad screen design, bad workflow...

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.

E Input and output data

In the following block, we want to investigate on the data you need to perform your tasks as well as the data you expect to gather. In case you do not already work with distributed storage at various grid levels, please imagine that installing and operating ***distributed storage at various grid levels*** *is part of your tasks as a Grid Planner.*

12 Which is the most relevant input data for you to perform your Grid Planner tasks?

Please provide only one answer per option. If data is missing, please add it using the empty fields.

Input data	*Very important*	*Fairly important*	*Important*	*Seldom important*	*Never important*
Grid topology	☐	☐	☐	☐	☐
Voltage fluctuation	☐	☐	☐	☐	☐
State of charge of installed storage	☐	☐	☐	☐	☐
Real-time consumption data	☐	☐	☐	☐	☐
Real-time production data	☐	☐	☐	☐	☐
Averaged consumption data (load profiles)	☐	☐	☐	☐	☐
Averaged production data (production profiles)	☐	☐	☐	☐	☐
Long-term weather forecast	☐	☐	☐	☐	☐
Real-time weather	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐

13 Is there important data missing in Question 12?

Please add missing data in the text field below. If no data is missing you can skip Question 13.

Klick here to enter text.

14 Which are desirable output data you gather after performing your Grid Planner tasks?
Please provide only one answer per option. If data is missing, please add it using the empty fields.

Output data	*Very desirable*	*Fairly desirable*	*Desirable*	*Seldom desirable*	*Never desirable*
Cost estimation for storage installation	☐	☐	☐	☐	☐
Future plans for specified location	☐	☐	☐	☐	☐
Comparison between current and future grid situation (e.g. voltage flickering, …)	☐	☐	☐	☐	☐
Current and/or future law regulations	☐	☐	☐	☐	☐
Optimal positioning of new storage	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐

15 Is there important data missing in Question 14?
Please add missing data in the text field below. If no data is missing you can skip Question 15.

Klick here to enter text.

16 Is there an existing function / view / interface that should be integrated in a newly developed user interface?
Please list all the functionalities or interfaces you want to have integrated if a new graphical user interface is to be developed. If possible, please also provide screen shots (e.g. email attachment when you send the questionnaire back).

Klick here to enter text.

17 Is there anything missing you want to add?

Klick here to enter text.

18 Is there anything that needs to be improved concerning your day-to-day-work?
When you think about improvements on your day-to-day-work, please formulate 3 whishes.

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.

You reached the end of the questionnaire.

Please save the document before closing it.

Please send it to veronika.krauss@fit.fraunhofer.de.

Thank you very much for your participation!

Appendix B – Questionnaire for ENIIG – Professional GUI for Grid Operator

Questionnaire for professional users: Grid operator

Introduction Storage4Grid Project

Thank you for your participation! This questionnaire was developed for the Storage4Grid project. Our aim is to boost the uptake of storage technologies between the distribution grid level and the end-user level, by developing a novel, holistic methodology for modeling, planning, integrating, operating and evaluating distributed Energy Storage Systems. The Storage4Grid methodology encompasses storage at user premises and storage at substation level, Electrical Vehicles, innovative energy metering and energy routing technologies.
Storage4Grid is a Research and Innovation Action funded by the European Union's Horizon 2020 Programme.

Scope and purpose of this questionnaire

The results of this questionnaire will be used as input for developing the graphical user interfaces (GUI). This interface should enable the user to interact with distributed storage systems, the grid and the Decision Support Framework at various levels. As a professional user, you can provide valuable input for the development of those GUIs.

With your participation in this questionnaire, you confirm that you are participating out of free will.

Your answers and statements will not be published in combination with personal data. If you have questions, contact us using veronika.krauss@fit.fraunhofer.de. The questionnaire consists of 5 sections and 18 questions. Please read the instructions carefully and provide honest answers.

Please answer the questionnaire and send it back to veronika.krauss@fit.fraunhofer.de until Friday, 30th of June 2017.

Your availability in July 2017

We would like to deepen the insights we get from this questionnaire in a short phone call interview (max 30 minutes). Those interviews will take part in the second half of July 2017. Therefore, we need your help! Are you available during that period and willing to participate in those interviews?

I am available from Klick here to select a date **to** Klick here to select a date.
Please contact me using this email address: Klick here to enter text.

1 of 8

A Demographic Information

1 How old are you?

Please select your age group from the drop-down menu below.

Age: Select your age groups.

B Devices

2 How frequent are you using the following devices:

This question addresses the average use of those devices without any specific purpose. Please select only one frequency per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never / I do not own this device*
Smart phone	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐
Desktop PC	☐	☐	☐	☐	☐

C Working environment

The following question block is about your usual working environment. It helps us to understand what kind of issues you might encounter during your work.

3 How often do you use the following device at work?

Please select only one answer per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never /This device is not available*
Desktop PC	☐	☐	☐	☐	☐
Tablet PC	☐	☐	☐	☐	☐
Wall/Remote displays with Touch-Input	☐	☐	☐	☐	☐
Wall/Remote displays without Touch-Input	☐	☐	☐	☐	☐
Other (please enter the device): Klick here to enter text.	☐	☐	☐	☐	☐

4 How physically demanding is your work?

We address your usual working situation. Please select only one answer per activity.

Activity	*Very often*	*Fairly often*	*Often*	*Seldom*	*Never*
Sitting	☐	☐	☐	☐	☐
Standing	☐	☐	☒	☐	☐
Walking	☐	☐	☐	☐	☐
Other (please enter the activity): Klick here to enter text.	☐	☐	☐	☐	☐

5 Where do you usually perform your work?

We address your usual working situation. Please select only one answer per location.

Activity	*Very often*	*Fairly often*	*Often*	*Seldom*	*Never*
Indoor at a desk	☐	☐	☐	☐	☐
Indoor at no specific location	☐	☐	☐	☐	☐
Outdoor	☐	☐	☐	☐	☐
Other (please enter the location): Klick here to enter text.	☐	☐	☐	☐	☐

6 How collaborative is your work?

We address your usual working situation. Please select only one answer per option.

Activity	*Very often*	*Fairly often*	*Often*	*Seldom*	*Never*
Alone / single work	☐	☐	☐	☐	☐
Collaborative Planning	☐	☐	☐	☐	☐
Mixed (working alone, presenting results to a group)	☐	☐	☐	☐	☐
Other (please specify): Klick here to enter text.	☐	☐	☐	☐	☐

D Software, applications and workflows

In the following block, we want to investigate on the software, applications and workflows you are currently using to perform your tasks as a grid operator.

7 Which tasks are you performing as a grid operator?

Please give us a short overview about your daily tasks (max 10 sentences).

Klick here to enter text.

8 What is (are) the type(s) of the application(s) you are currently using to perform your tasks as a grid operator?

You can select multiple answers.

☐ Web-based (operated in a browser, such as Google Chrome, Microsoft Edge, Mozilla Firefox, …)
☐ Desktop application
☐ Other (please specify): Klick here to enter text.

9 Which applications are you using to perform your tasks as a grid operator?

Please list the top 5 applications including their main functionality.

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.
4. Klick here to enter text.
5. Klick here to enter text.

10 What is the basic workflow you follow to perform your grid operator tasks?

Briefly describe the workflow you follow to perform grid operator tasks, e.g. "Opening application <name> and loading data from <system name> …". Please use max 10 sentences.

Klick here to enter text.

11 Which are the top 3 issues you encounter when performing regular tasks as a grid operator?

Please list for example software issues, missing information, missing functionalities, bad screen design, bad workflow…

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.

E Input and output data

In the following block, we want to investigate on the data you need to perform your tasks as well as the data you expect to gather. In case you do not already work with distributed storage at various grid levels, please imagine that installing and operating ***distributed storage at various grid levels*** *is part of your tasks as a grid operator.*

12 Which is the most relevant input data for you to perform your grid operator tasks?

Please provide only one answer per option. If data is missing, please add it using the empty fields.

Input data	*Very important*	*Fairly important*	*Important*	*Seldom important*	*Never important*
Grid topology	☐	☐	☐	☐	☐
Voltage fluctuation	☐	☐	☐	☐	☐
State of charge of installed storage	☐	☐	☐	☐	☐
Real-time consumption data	☐	☐	☐	☐	☐
Real-time production data	☐	☐	☐	☐	☐
Averaged consumption data (load profiles)	☐	☐	☐	☐	☐
Averaged production data (production profiles)	☐	☐	☐	☐	☐
Long-term weather forecast	☐	☐	☐	☐	☐
Real-time weather	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐

13 Is there important data missing in Question 12?

Please add missing data in the text field below. If no data is missing you can skip Question 13.

Klick here to enter text.

14 Which are desirable output data you gather after performing your grid operator tasks?

Please provide only one answer per option. If data is missing, please add it using the empty fields.

Output data	*Very desirable*	*Fairly desirable*	*Desirable*	*Seldom desirable*	*Never desirable*
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐
Klick here to enter text.	☐	☐	☐	☐	☐

15 Is there important data missing in Question 14?

Please add missing data in the text field below. If no data is missing you can skip Question 15.

Klick here to enter text.

16 Is there an existing function / view / interface that should be integrated in a newly developed user interface?

Please list all the functionalities or interfaces you want to have integrated if a new graphical user interface is to be developed. If possible, please also provide screen shots (e.g. email attachment when you send the questionnaire back).

Klick here to enter text.

17 Is there anything missing you want to add?

Klick here to enter text.

18 Is there anything that needs to be improved concerning your day-to-day-work?
When you think about improvements on your day-to-day-work, please formulate 3 whishes.

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.

You reached the end of the questionnaire.

Please save the document before closing it.

Please send it to veronika.krauss@fit.fraunhofer.de.

Thank you very much for your participation!

Appendix C – Questionnaire for ENIIG – Residential GUI

Questionnaire for residential users

Introduction Storage4Grid Project

Thank you for your participation! This questionnaire was developed for the Storage4Grid project. Our aim is to boost the uptake of storage technologies between the distribution grid level and the end-user level, by developing a novel, holistic methodology for modeling, planning, integrating, operating and evaluating distributed Energy Storage Systems. The Storage4Grid methodology encompasses storage at user premises and storage at substation level, Electrical Vehicles, innovative energy metering and energy routing technologies.
Storage4Grid is a Research and Innovation Action funded by the European Union's Horizon 2020 Programme.

Scope and purpose of this questionnaire

The results of this questionnaire will be used as input for developing the graphical user interfaces (GUI). This interface should enable the user to interact with the storage and photovoltaic plant (PV) installed at his or her premise. As a user, you can provide valuable input for the development of those GUIs.

With your participation in this questionnaire, you confirm that you are participating out of free will.

Your answers and statements will not be published in combination with personal data. If you have questions, contact us using veronika.krauss@fit.fraunhofer.de. The questionnaire consists of 4 sections and 16 questions. Please read the instructions carefully and provide honest answers.

Please answer the questionnaire and send it back to veronika.krauss@fit.fraunhofer.de until Friday, 30th of June 2017.

Your availability in July 2017

We would like to deepen the insights we get from this questionnaire in a short phone call interview (max 30 minutes). Those interviews will take part in the second half of July 2017. Therefore, we need your help! Are you available during that period and willing to participate in those interviews?

I am available from Klick here to choose a date. **to** Klick here to choose a date..
Please contact me using this email address: Klick here to enter text.

1 of 7

A Demographic Information

1 How old are you?

Please select your age group from the drop-down menu below.

Age: Please select your age group.

B Devices

2 How frequent are you using the following devices:

This question addresses the average use of those devices without any specific purpose. Please select only one frequency per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never / I do not own this device*
Smart phone	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐
Desktop PC	☐	☐	☐	☐	☐

C Information access

The following question block investigates on the average usage of the information display of the set-up at your home (storage + PV).

3 What kind of information are you accessing in the control panel of your local photovoltaic generator and your local energy storage?

Please provide short answers (max 5 items)

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.
4. Klick here to enter text.
5. Klick here to enter text.

4 How often do you access your electricity consumption and production information?

Please select only one answer.

Multiple times a day	*Once a day*	*Multiple times a week*	*Once a week*	*< Once a month*
☐	☐	☐	☐	☐

5 How frequent are you using the following devices to access the information about your electricity consumption and production?

Please select only one answer per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never / I do not own this device*
Desktop PC (web interface)	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐
Smartphone	☐	☐	☐	☐	☐
Meter / PV On-Board interface	☐	☐	☐	☐	☐
Other (please enter the device): Klick here to enter text.	☐	☐	☐	☐	☐

6 Depending on the device you use the most to monitor your electricity consumption and production information, why do you prefer it?

Please provide a short answer (1-3 sentences)

Klick here to enter text.

7 If you access your electricity consumption and production information, which is the most interesting data for you?

Please provide 3-5 options that you would rate as most relevant

Klick here to enter text.

8 Is there information you would like to have additionally? Which one?

Please provide 1-3 options that you would rate as most relevant; type "none" if there is no relevant information missing.

Klick here to enter text.

9 Does your current interface display data which is not important for you? Which one?

Please provide 1-3 options you would rate as most irrelevant; type "none" if there is no irrelevant data displayed.

Klick here to enter text.

D New features

Please read the following description in detail – the next questions will be based on the situation depicted in the short story.

Recently, Rosaria has installed a photovoltaic (PV) generator as well as a storage system at her house. When her PV generates more energy than she consumes, this energy is stored into the storage system and used in periods of high demand. This way, she needs to buy less electricity from the utility company and can optimize her self-supply.
In a contract, she allowed the utility company to access her storage system and regulate its charge and discharge as long as the electrical supply of her home is secured in the best possible way.

Now imagine that you are in a similar situation.

10 Would you like to see if the utility company has accessed your storage?
Please select only one answer.

☐ Yes
☐ No

11 Would you like to see if the utility company is currently accessing your storage?
Please select only one answer.

☐ Yes
☐ No

12 What would be the most relevant information for you?
Please provide a short answer (max. 3 sentences)

Klick here to enter text.

13 How relevant is the following data for you?

Please provide only one answer per data. If data is missing, you can enter it in the empty fields on the bottom of this table.

Data	*Very relevant*	*Fairly relevant*	*Relevant*	*Slightly relevant*	*Not at all relevant*
For how long has the utility company accessed your storage	☐	☐	☐	☐	☐
Is the utility company currently accessing your storage?	☐	☐	☐	☐	☐
Is the utility company planning to access your storage?	☐	☐	☐	☐	☐
Amount of redirected energy (charge/discharge)	☐	☐	☐	☐	☐
How full is your battery (*percentage*)	☐	☐	☐	☐	☐
How full is your battery (*kW*)	☐	☐	☐	☐	☐
Next day energy production forecast	☐	☐	☐	☐	☐
Energy redirected to grid	☐	☐	☐	☐	☐
Power redirected to storage	☐	☐	☐	☐	☐
Power generated from PV	☐	☐	☐	☐	☐
Consumption of household	☐	☐	☐	☐	☐
Directly consumed energy from own PV	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐

14 Would you like to have the option to view the data listed in question 12 over a certain period?

Please select only one answer.

☐ Yes
☐ No

15 Which period would be interesting?

If you answered "No" in Question 13, you can skip this question. If you answered "Yes", please select only one answer.

Period	*Very interesting*	*Fairly interesting*	*Interesting*	*Slightly interesting*	*Not at all interesting*
Day	☐	☐	☐	☐	☐
Week	☐	☐	☐	☐	☐
Month	☐	☐	☐	☐	☐
Year	☐	☐	☐	☐	☐

16 Is there anything that needs to be improved concerning the matter of interacting with or viewing your energy consumption and production interface?

When you think about improvements, please formulate 3 whishes.

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.

You reached the end of the questionnaire.

Please save the document before closing it.

Please send it to veronika.krauss@fit.fraunhofer.de.

Thank you very much for your participation!

Appendix D – Questionnaire for ALPERIA – Residential GUI

Questionnaire for residential users

Introduction Storage4Grid Project

Thank you for your participation! This questionnaire was developed for the Storage4Grid project. Our aim is to boost the uptake of storage technologies between the distribution grid level and the end-user level, by developing a novel, holistic methodology for modeling, planning, integrating, operating and evaluating distributed Energy Storage Systems. The Storage4Grid methodology encompasses storage at user premises and storage at substation level, Electrical Vehicles, innovative energy metering and energy routing technologies.
Storage4Grid is a Research and Innovation Action funded by the European Union's Horizon 2020 Programme.

Scope and purpose of this questionnaire

The results of this questionnaire will be used as input for developing the graphical user interfaces (GUI). This interface should enable the user to interact with the storage and photovoltaic plant (PV) installed at his or her premise. As a user, you can provide valuable input for the development of those GUIs.

With your participation in this questionnaire, you confirm that you are participating out of free will.

Your answers and statements will not be published in combination with personal data. If you have questions, contact us using veronika.krauss@fit.fraunhofer.de. The questionnaire consists of 4 sections and 16 questions. Please read the instructions carefully and provide honest answers.

Please answer the questionnaire and send it back to veronika.krauss@fit.fraunhofer.de until Friday, 30th of June 2017.

Your availability in July 2017

We would like to deepen the insights we get from this questionnaire in a short phone call interview (max 30 minutes). Those interviews will take part in the second half of July 2017. Therefore, we need your help! Are you available during that period and willing to participate in those interviews?

I am available from Klick here to choose a date. **to** Klick here to choose a date..
Please contact me using this email address: Klick here to enter text.

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Questionnaire for residential users

Introduction Storage4Grid Project

Thank you for your participation! This questionnaire was developed for the Storage4Grid project. Our aim is to boost the uptake of storage technologies between the distribution grid level and the end-user level, by developing a novel, holistic methodology for modeling, planning, integrating, operating and evaluating distributed Energy Storage Systems. The Storage4Grid methodology encompasses storage at user premises and storage at substation level, Electrical Vehicles (EV), innovative energy metering and energy routing technologies.
Storage4Grid is a Research and Innovation Action funded by the European Union's Horizon 2020 Programme.

Scope and purpose of this questionnaire

The results of this questionnaire will be used as input for developing the graphical user interfaces (GUI). This interface should enable the user to interact with the storage and photovoltaic plant (PV) installed at his or her premise. As a user, you can provide valuable input for the development of those GUIs.

With your participation in this questionnaire, you confirm that you are participating out of free will.

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Please answer the questionnaire and send it back to veronika.krauss@fit.fraunhofer.de until Friday, 14th of July 2017.

Your availability in July 2017

We would like to deepen the insights we get from this questionnaire in a short phone call interview (max 30 minutes). Those interviews will take part in the second half of July 2017. Therefore, we need your help! Are you available during that period and willing to participate in those interviews?

I am available from Klick here to choose a date. **to** Klick here to choose a date..
Please contact me using this email address: Klick here to enter text.

A Demographic Information

1 How old are you?

Please select your age group from the drop-down menu below.

Age: Please select your age group.

B Devices

2 How frequent are you using the following devices:

This question addresses the average use of those devices without any specific purpose. Please select only one frequency per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never / I do not own this device*
Smart phone	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐
Desktop PC	☐	☐	☐	☐	☐

C Information access

The following question block is about the access of information concerning your photovoltaic, electric car, and storage.

3 What kind of information are you accessing in the control panel of your local photovoltaic generator and your local energy storage?

Please provide short answers (max 5 items)

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.
4. Klick here to enter text.
5. Klick here to enter text.

4 How often do you access your electricity consumption and production information?

Please select only one answer.

Multiple times a day	*Once a day*	*Multiple times a week*	*Once a week*	*< Once a month*
☐	☐	☐	☐	☐

5 How frequent are you using the following devices to access the information about your electricity consumption and production?

Please select only one answer per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never / I do not own this device*
Desktop PC (web interface)	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐
Smartphone	☐	☐	☐	☐	☐
Meter / PV On-Board interface	☐	☐	☐	☐	☐
Other (please enter the device): Klick here to enter text.	☐	☐	☐	☐	☐

6 Concerning the device you use the most to monitor your electricity consumption and production information, why do you prefer it?

Please provide a short answer (1-3 sentences)

Klick here to enter text.

7 Considering your electricity consumption and production, which is the most interesting information for you?

Please provide 3-5 options that you would rate as most relevant

Klick here to enter text.

8 Is there information you would like to have additionally? Which one?

Please provide 1-3 options that you would rate as most relevant; type "none" if there is no relevant information missing.

Klick here to enter text.

9 Does your current interface display information which is not important for you? Which one?

Please provide 1-3 options you would rate as most irrelevant; type "none" if there is no irrelevant information displayed.

Klick here to enter text.

10 Does your current interface display information concerning your electrical vehicle (EV)? Which information?

Please list 1-5 options; type "none" if there is no EV related information displayed.

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.
4. Klick here to enter text.
5. Klick here to enter text.

11 How often do you access your EV information?

Please select only one answer.

Multiple times a day	*Once a day*	*Multiple times a week*	*Once a week*	*< Once a month*
☐	☐	☐	☐	☐

12 How frequent are you using the following devices to access the information about your EV?

Please select only one answer per device.

Device	*Multiple times a day*	*Once a day*	*Multiple times a week*	*Once a week*	*Never / I do not own this device*
Desktop PC (web interface)	☐	☐	☐	☐	☐
Tablet	☐	☐	☐	☐	☐
Smartphone	☐	☐	☐	☐	☐
Meter / PV On-Board interface	☐	☐	☐	☐	☐
Car-internal interface	☐	☐	☐	☐	☐
Other (please enter the device): Klick here to enter text.	☐	☐	☐	☐	☐

D New features

Please read the following description in detail – the next questions will be based on the situation depicted in the short story.

Recently, Rosaria has installed a photovoltaic (PV) generator as well as a storage system at her house. She also owns an EV and has a private charging point in her garage. When her PV generates more energy than she consumes, this energy is stored into the storage system and used in periods of high demand. This way, she needs to buy less electricity from the utility company and can optimize her self-supply. If her car is plugged in, her energy management system automatically charges the car without interfering with Rosaria's house working and energy consuming tasks (like washing, cooking, watching TV, etc.).
Now imagine that you are in a similar situation.

13 In the situation described above, if you had a display available, what would be the most relevant information you would like to see on the display?

Please provide a short answer (max. 3 sentences)

Klick here to enter text.

14 Would you like to have the option to prioritize specific tasks such as charging your EV, your house consumption, etc.?

Please select only one answer. Prioritization means that this task is ensured to be fulfilled with your currently produced energy. Tasks with higher priority will be fulfilled before tasks with a lower priority. If you would not define a prioritized task, the system would evenly distribute produced energy among all consuming tasks, such as charging your electric vehicle, cooking, etc.

☐ Yes
☐ No

15 What would be your prioritization settings?

Please provide only one answer per line. If you have some information to be added, you can enter it in the empty fields on the bottom of this table. Please rank the tasks below according to their importance to you.

Information	*Very important*	*Fairly important*	*Important*	*Slightly important*	*Not at all important*
Charging your electric vehicle (100%)	☐	☐	☐	☐	☐
Charging your electric vehicle up to a predefined percentage (e.g. 75%)	☐	☐	☐	☐	☐
Charging your electric vehicle up to a specified range (km)	☐	☐	☐	☐	☐
Charging your storage	☐	☐	☐	☐	☐
House consumption	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐

16 How relevant is the following information for you?

Please provide only one answer per line. If you have some information to be added, you can enter it in the empty fields on the bottom of this table.

Information	*Very relevant*	*Fairly relevant*	*Relevant*	*Slightly relevant*	*Not at all relevant*
Amount of redirected energy (charge/discharge)	☐	☐	☐	☐	☐
How full is your battery (*percentage*)	☐	☐	☐	☐	☐
How full is your battery (*kW*)	☐	☐	☐	☐	☐
How full is your car battery (*percentage*)	☐	☐	☐	☐	☐
How full is your car battery (*kW*)	☐	☐	☐	☐	☐
How full is your car battery(*estimated remaining travel distance*)	☐	☐	☐	☐	☐
Energy production forecast for the next day	☐	☐	☐	☐	☐
Energy redirected to grid	☐	☐	☐	☐	☐
Power redirected to storage	☐	☐	☐	☐	☐
Power generated from PV	☐	☐	☐	☐	☐
Total Consumption of household	☐	☐	☐	☐	☐
Amount of energy consumed from own PV	☐	☐	☐	☐	☐
Amount of energy bought from the provider	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐
Klick here to enter missing data.	☐	☐	☐	☐	☐

17 Would you like to have the option to view the information listed in question 16 over a certain period?

Please select only one answer.

☐ Yes
☐ No

18 Which period would be interesting?

If you answered "No" in Question 17, you can skip this question. If you answered "Yes", please select only one answer.

Period	*Very interesting*	*Fairly interesting*	*Interesting*	*Slightly interesting*	*Not at all interesting*
Day	☐	☐	☐	☐	☐
Week	☐	☐	☐	☐	☐
Month	☐	☐	☐	☐	☐
Year	☐	☐	☐	☐	☐

19 Do you have any improvement suggestions concerning the current way you get information about your energy consumption and production as well as about your EV?

When you think about improvements, please formulate 3 whishes.

1. Klick here to enter text.
2. Klick here to enter text.
3. Klick here to enter text.

You reached the end of the questionnaire.

Please save the document before closing it.

Please send it to veronika.krauss@fit.fraunhofer.de.

Thank you very much for your participation!

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