



## No 883710 edgeFLEX

### Success stories & Best practices

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## 1. edgeFLEX assessment approach

### 1.1 Platform performance assessment criteria

The success of any platform lies in its ability to meet the needs and goals of its users. With this in mind, the developers of the edgeFLEX control service platform took a multifaceted approach to assess its performance. By viewing the platform from both a technical perspective and the perspective of the end user, they were able to ensure that the platform met the technical standards while also aligning with the user's goals and needs. This comprehensive assessment process not only guarantees that the platform is technically sound but also that it delivers the user experience that meets their expectations. This success story highlights the importance of a user-centric approach to platform development and the value of a thorough assessment process.

- Technical Assessments criteria
  - Electrical: solutions are assessed with the electrical system in mind. It is evaluated whether the control service can be deployed and can control the asset, as well as the impact of the control service on the grid and whether it is beneficial.
  - Communications: This assessment will view the control service requirements, the communications available at the trial site and the platform architecture chosen for the site and will assess all three for their suitability to the running of the trial.
  - Software: The assessment of this software aims to ensure that it is robust, scalable, secure and fault tolerant so that it can fulfil the primary goal of the control service or platform component.
  - Algorithm: The assessment ensures desired outputs are produced with appropriate constraints. It's iterative and aims to improve performance of control service.
  - Hosting: This assessment will centre on ascertaining if the hosting capabilities of the trial site are adequate to host the software components and data flows required for the control service to operate at its optimal level.
  - Security: This assessment criteria are based on the three main principles of cyber security, which are confidentiality, integrity and availability. This assessment will examine each software component and control service under these principles. Furthermore, the security of the devices deployed at the edge, like the edgePMU, will be assessed from a physical perspective to ensure that the devices are safe and secure from weather and from unsolicited human tampering or interference.
  - Data Access: This data access can be assessed under the criteria of whether there is enough data, that data is of sufficient quality, the data is format compatible and the data is provided at an adequate sampling rate for the control service to operate in an optimal way
- User Experience Assessments

- Information: The assessment question evaluates if users have access to complete, understandable, and relevant information. This builds trust in the system and assures users of its proper functioning.
- Interaction: The interaction question assesses if user actions are clear and understandable for proper service implementation. Users should be informed of required actions and their location.
- Configuration: The aspect assesses if users can input or execute all necessary configurations for proper system operation. Standards, grid codes, regulations, or contracts may predefine specific parameters in relevant system parts, making this assessment relevant.
- Technical Expectations: This question evaluates if the user's technical functionality expectations are met, which may differ from the developer's. It identifies differences and misunderstandings in understanding technical functions and functionalities in early deployment stages.
- Use case realization: This aspect aims to determine if the edgeFLEX solution deployed on the user's system can realize the intended use case.

## 1.2 Assessment Template

*This assessment is a tool that was used within the edgeFLEX project as part of the feedback loop that will get the results of the assessments from the trials to the integration and implementation tasks and back to the technical work packages so that the services can be refactored and redeployed as part of the edgeFLEX deployment pipeline.*

### Description:

*Describe the trial site here briefly*

This form is designed to assess the services and platform on two levels. First, in terms of if they can be deployed, where the components should be deployed for whatever reason, where they are deployed, is the output of the service actionable on the grid and such things. In a second part, the usability will be assessed.

### Technical assessment:

The assessment of the services and the platform implementation can be categorised into the following:

- Electrical: meaning that for whatever reason or constraint the electrical system will not allow the component to interact with it or be deployed on it.
- Communications: meaning that the communications capabilities on the trial are not at an acceptable level to allow to enable the service to run effectively in terms of data flows or monitoring.
- Software: meaning that the required component is not developed to a level that allow them to be deployed in the intended way on the trial site.
- Hosting: meaning that at the trial the service cannot be hosted as intended, one example would be having a database outside company boundaries because it cannot be hosted.
- Algorithm: meaning that the algorithm is not performing to a level or it is not having the desired results.
- Security: meaning that the trial site is not secure or that the edgeFLEX components do not have an adequate level of security built into the platform.
- Data Access: meaning that the required data is not available at the trial at either an adequate volume, sampling rate or payload format for it to be picked up by the platform.

The above reasons will have an explanation of the issue and a potential solution if one can be apparent upon at the time the assessment is being carried out.

There is also an electrical assessment that can be filled out if there is an issue identified in terms of the impact that the service is having on the electrical system.

|                   |  |
|-------------------|--|
| Service           | <i>Name the service</i>                      |
| Intended Trial    | <i>where is the trial</i>                    |
| Backbone Services | <i>What are the backbone services needed</i> |
| Enablers          | <i>What enablers are needed, eg 5G API</i>   |
| Assessment Date   | <i>Date assessment was carried out on</i>    |

| Service                 | Category       | Reason (if any) | Remedial Steps |
|-------------------------|----------------|-----------------|----------------|
| <i>Name the service</i> | Electrical     |                 |                |
|                         | Communications |                 |                |
|                         | Software       |                 |                |
|                         | Hosting        |                 |                |
|                         | Security       |                 |                |
|                         | Data Access    |                 |                |
|                         | Algorithm      |                 |                |

| Component          | Category       | Reason (if any) | Remedial Steps |
|--------------------|----------------|-----------------|----------------|
| <i>Component 1</i> | Electrical     |                 |                |
|                    | Communications |                 |                |
|                    | Software       |                 |                |
|                    | Hosting        |                 |                |
|                    | Security       |                 |                |
|                    | Data Access    |                 |                |

| Component          | Category       | Reason (if any) | Remedial Steps |
|--------------------|----------------|-----------------|----------------|
| <i>Component 2</i> | Electrical     |                 |                |
|                    | Communications |                 |                |
|                    | Software       |                 |                |
|                    | Hosting        |                 |                |

|  |             |  |  |
|--|-------------|--|--|
|  | Security    |  |  |
|  | Data Access |  |  |

| Component          | Category       | Reason (if any) | Remedial Steps |
|--------------------|----------------|-----------------|----------------|
| <i>Component n</i> | Electrical     |                 |                |
|                    | Communications |                 |                |
|                    | Software       |                 |                |
|                    | Hosting        |                 |                |
|                    | Security       |                 |                |
|                    | Data Access    |                 |                |

| Electrical Assessment |                  |                           |                       |
|-----------------------|------------------|---------------------------|-----------------------|
| Expected Behaviour    | Actual Behaviour | Suggested Changes(if any) | Any Other Information |
|                       |                  |                           |                       |

Assessment of user experience:

In addition to technical functionality, it is also important to assess if persons getting in contact and working with the services or platform are able to easily use it. Relevant questions can be categorised as following:

- Information: meaning that all information given to user were available, understandable and complete as needed for user
- Interaction: meaning that all actions asked from user were clear and understandable
- Configuration: meaning that all configurations essential for operation (grid codes, national regulations, etc.) can be executed by the user
- Technical expectations: meaning that the implemented edgeFLEX solutions enable / support technical goals of the user (such as: protection of other components, prolonging lifetimes of other assets)
- Use case: meaning that targeted use case can be realized
- Anything else: How is your world changing though the new service? Any other comments/issues that need investigation e.g., to make developed tools most usable for other users? Hurdles for further usage of service?

|                 |  |
|-----------------|--|
| User of service | <i>Type of user of the above-mentioned service (e.g., technical DSO employee in the field, DSO employee in control room, VPP operator, etc.)</i> |
| Used UI         | <i>Which UI was used</i>   |

| Category              | Everything ok (Y/N) | Reason (if any) | Remedial Steps | Position / Person talked to in trial |
|-----------------------|---------------------|-----------------|----------------|--------------------------------------|
| Information           |                     |                 |                |                                      |
| Interaction           |                     |                 |                |                                      |
| Configuration         |                     |                 |                |                                      |
| Technical expectation |                     |                 |                |                                      |
| Use case              |                     |                 |                |                                      |
| Anything else?        |                     |                 |                |                                      |

### 1.3 Actor Targeted Assessment

The edgeFLEX project successfully conducted assessments on control services to draw conclusions on business cases and models development. This assessment was carried out not only at an organizational level but also at the level of individual actors involved with the solution in their organization. The approach of defining the number and types of actors depends on the nature of the assessment and how actors interact with the item assessed. Within the edgeFLEX project, the following four actor types were identified. By taking a comprehensive approach to assess the solution from multiple perspectives, edgeFLEX has ensured that its services are aligned with user goals and needs, which will lead to widespread adoption of the technique.

- **Business Focused Actor:** This actor is mainly concerned with the corporate affairs of the organisation. Their main goal is to ensure that the actions of the company are financially viable and that the company activities are managed in a responsible way.
- **Compliance and Governance Focused Actor:** This actor would have the goal of ensuring that the operations at a grid and corporate level would comply with the company best practice on security, privacy, quality criteria and with regulatory and standards directives imposed by sectoral governing bodies.
- **System Focused Actor:** This actor ensures the safe and efficient operation of the grid. They use control tools to identify faults, plan upgrades, and restore service. They maintain the grid within operational limits and make decisions to ensure stability.
- **Technically Focused Actor:** This actor is responsible for maintaining the grid assets and ensuring grid stability at a local level. They may be field operatives or grid technicians, whose main priority is the physical safety of the grid and the maintenance of devices required for the edgeFLEX platform. They also deal with resetting breakers and switches in the event of a trip or replacing damaged physical assets in the grid.

The diverse (business) goals of the different actor groups indicate that a one-size-fits-all approach to assessments would not suffice. However, through engaging with each group to understand their needs and concerns, specific assessments tailored to each group can be developed. This personalised approach ensures that assessments are relevant to each group, enhancing their confidence in the service. Furthermore, by developing a multi-actor assessment process, every actor group has a mechanism to assess the service that meets their specific requirements, resulting in a thorough and effective assessment process.

## 1.4 Assessment Process

The assessment process for the component is an iterative one that involves evaluating it at various stages of development and testing. The early assessments allowed us to evaluate the platform components that were essential to integrate the control services into a proof-of-concept version of the platform. By conducting these assessments, we were able to identify potential issues early on and ensure that the component was developed in a way that would enable it to function seamlessly with the platform. This approach has been highly effective, and we have been able to create a robust and reliable component that meets the needs of our users.

In the edgeFLEX project there are 5 environments in which the services are assessed:

- Development - where the algorithm or component is researched and developed, the data streams identified, and the code written.
- Simulation - where the algorithm or component is containerised and hooked to data streams from simulated data streams and handed over for the initial stages of integration.
- Integration - where the containerised component is deployed integrated with the relevant data interfaces, data streams and supporting components.
- Lab - where the integrated system is deployed in a laboratory environment for assessment or trialling under varying criteria for demonstration, 5G testing and stability testing for example.
- Trial - where the integrated system is deployed in the physical trial with real data from in situ systems and with real grid and end user assets.

These environments, from development to trial vary in complexity and move closer to the user and their goals and as such the assessment process mirrors this with the focus shifting from a simple algorithm and software assessment to a more complex and deeper assessment at the trial where security, usability and grid impact are in focus.

The whole approach is described in D4.4, where it was conducted to assess the platform performance. It includes the definition of assessment criteria as well as the Actor Targeted Assessment. For the assessment of developed business scenarios / models, the approach of the Actor Targeted assessment was again used, surely slightly adapted to fit its purpose of assessing business aspects primarily. It is documented in D6.2. In general, the approach was experienced as very useful and inclusive for all actors coming in touch with edgeFLEX. It is therefore considered a best practice as it can be used for the assessment of many different solutions implemented in the field.

## 2. Consumer and prosumer engagement in German trial site

User engagement is a crucial part for achieving not only the goals of research projects like edgeFLEX but more importantly reach grid operation efficiency. The benefits of the latter can be reached by combining all three pillars of a sustainable development, namely economic, environmental, and societal. This is due to the allocation of resources and usage, which involves less losses of power generation, and support community empowerment.

The SWW trial builds on the results acquired and infrastructure developed within a former project conducted in Wunsiedel, called GOFLEX. SWW has started promoting the mentioned approach on sustainable development as part of the GOFLEX project, where consumers and assets owners, with the aid of various incentive methods, were recruited and equipped with new Energy Management Systems (EMS) and intelligent measuring equipment to enable automated energy and flexibility trading. To engage users, design thinking workshops were conducted, and newspaper articles were published. Those actions assisted in exploiting the willingness to participate in the energy supply chain to benefit all parties involved, which led to some users to share their thoughts and ideas, showing the engagement of those users. This enabled SWW to co-create the to-be-established flexibility system leading to higher acceptance, as customers were involved from the very beginning.

These EMS systems and measurement devices were successfully integrated into the edgeFLEX plan as communication between this system and the technologies developed in edgeFLEX was established. An Energy Community was created and implemented in all forms but legal with stakeholders from Wunsiedel signing contracts to participate and to be engaged. The tests conducted in this trial involved power grid

supporting services for normal-condition operation and stability support services using flexibility potentials. These tests aimed to focus on voltage control and grid balancing measures. The communication between the EMS and the edgeFLEX technologies has made it possible to create flexibility offers both for a singular asset as well as from multiple assets simulation an Energy Community acting as a VPP. The results show that voltage control issues can be tackled by utilising flexibility offer schemes and the Energy Community assets acting as a VPP can support balancing services for power grid operations on a local scale.

As GOFLEX was concluded, interest of participants to continue taking part in the supply system was growing. In addition, the importance of user engagement was identified in early stages of the edgeFLEX project. This has led to SWW managed to keep all customers during a period of observation after the end of the GOFLEX project on board until they could join during the edgeFLEX project's duration. Throughout the project, SWW has been and still is engaged in promoting the concept of citizen participation through design thinking and co-creation workshops and engagement workshops for stakeholder.

SWW has been working to understand how DSOs in general and of different sizes and types can be involved in the edgeFLEX ambitions. In the Wunsiedel trial, the local municipal service provider has already started a new initiative, including edgeFLEX solutions, the so-called "Zukunftskraftwerk" (Future Power Plants), which will be combined with the implementation of the local Energy Community. This approach aims at singular "energy cells" formed by each participating houses which shall act as individual power plants equipped with storages. These cells will be aggregated by the DSO or an aggregation entity via IoT platforms. The cells shall optimise their self-supply and trade flexibility with each other. They will offer flexibility as an aggregated entity (VPP) to other parts of the grid – local, regional and national levels, tackling fast and slow dynamics issues.

Customers' attitudes and acceptance towards the proposed solutions are extremely valuable for the implementation of edgeFLEX's strategic plans. To this end, the benefits to relevant stakeholders, barriers to implementation, and their knowledge of energy supply and community involvement were identified. It was found that they had basic knowledge and were willing to learn more. They were very satisfied with the results and benefits that had been achieved, especially through the completed GOFLEX project.

The investigation regarding acceptance levels and potentials was carried out in three phases:

**Phase 1** involved data collection, potential participants and assets already implemented were identified and the Energy Community roles were defined.

**In Phase 2**, the engagement strategy was determined. This was done by means of workshops, personal interviews and incentives offer. The scheme for determining was as follows:



**Figure 1 – Customer Engagement Circle**

**Phase 3** focused on future engagement and included ensuring of involvement in the Energy Community, increasing the willingness to participate in future projects and guaranteeing continuous communication and contact to customers. The measures to those means involve "word-to-mouth" marketing, sharing project outcomes, enhancing engagement strategies and introducing the potentials, advantages and possibilities of utilizing the edgeFLEX platform developed within the edgeFLEX project.

Several points were observed during the engagement process:

- Energy communities and citizen participation offer high potential for flexibility services.
- Cost efficiency while ensuring energy stability and security with low carbon emissions and high sustainability are strong incentives for citizen participation.
- Customers who are already engaged tend to engage further. They are more likely than others to contribute ideas for the development and implementation of new energy solutions and are willing to support them.
- When innovators and early adopters of the new concepts can network with each other, attracting new customers benefits from this network. It is simplified because existing networking is an incentive in itself, proof of concepts for some solutions already exists, and their implementation and function can be captured.

Citizen participation complements SWW's existing strategy for grid optimization and reinforcement. This includes the physical improvement of assets in the grid, e.g. cables and distribution stations, which will lead to better energy and asset management while improving the transparency of the grid condition. To this end, buffer storage will be deployed and innovative business plans applied, in addition to the edgeFLEX platform and VPP concepts developed as part of the project. These measures will lead to a high potential for flexibility services by the energy community and will ultimately enable a higher penetration rate for renewable energy sources. In general, we see customer engagement as empowering citizens to generate energy and sell it in a more flexible and social way. It also allows them to become more independent in their energy supply. It is the way towards future systems that are designed to be customer-centric and transparent.

This long-term engagement of customers of SWW in the Wunsiedel trial is surely a success story of the edgeFLEX project. The approach of the engagement and ongoing information activities can be used in other engagement activities in trial sites of this kind.

### 3. FlexCommunity – Knowledge exchange network and platform

The COVID-19 pandemic reduced face-to-face dissemination and communication possibilities drastically, so new measures had to be envisioned. After several strategic discussions, it was decided to establish an online community with other projects that focusses on flexibility in the energy system. The target outcome were to broaden the outreach of the project, create support for the development of the edgeFLEX ICT tools, promote their adoption by a critical mass of stakeholders and foster the necessary changes in legislation.

Together with the H2020 projects Platone and FEVER, edgeFLEX developed the idea of the *FlexCommunity*. By joining forces, the number of relevant experts joining the community could be maximised thus reaching a critical mass of stakeholders and creating a bigger impact. This was achieved by having partners from different project consortia on board as well as being attractive to stakeholders not involved in any projects (yet). The FlexCommunity was officially kicked off on February 2, 2022 with a participation of more than 150 experts from the energy sector.

The FlexCommunity is a network for different stakeholders from academia, politics, and industry to discuss, exchange knowledge, and work together for leveraging distributed flexibility in the energy system. From technical to market design, organisational and regulatory questions to solutions for energy communities and DSOs, the FlexCommunity covers all relevant topics and facilitates cooperation at national, transnational and international level.

A dedicated website and community platform was set up with subsections for specific topics and the different working groups (the *FlexGroups*): [www.flex-community.eu](http://www.flex-community.eu). The FlexCommunity has more than 200 members at present, 10 FlexGroups meetings have taken place and a memorandum of understanding of the tasks and goals has been developed and published. In February 2023, a big online conference celebrated its first anniversary.

This concept of joint work, knowledge exchange and networking beyond research projects will drive change in the energy system as it ensures continuity of research and inclusion of non-researching stakeholders.