ECOSINT - Developing a well-rounded LEC architecture that integrates well into the grid

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Abstract – Numerous studies, including the results of the FFG-funded exploratory study "Future Network Tariffs", clearly show, that the integration of Local Energy Communities (LECs) into the energy grid is associated with challenges as well as with opportunities. It has also become clear, that a holistic view on LECs from all relevant perspectives is necessary to ensure that the goals can be met and that LECs are integrated into the grid in a way that is beneficial to it (e.g., by providing flexibilities, reducing feed-in and consumption peaks or maintaining resilience) rather than detrimental (e.g., by increasing peaks or negatively influencing simultaneities). The research project ECOSINT deals with the intelligent, digital integration of LECs into the overall system. To that end, a system-holistic analysis is performed to identify the goals, opportunities, and requirements regarding the integration of LECs. Based on this analysis, an extensible, modular, and scalable IT system architecture that incorporates security and privacy by design will be conceptualized to serve as a basis for the integration of LECs into the overall system as well as for their operation. Thereby, a consistent foundation that enables system-friendly and safe integration of LECs is created. This document provides a brief overview of the background, the goals, the planned results as well as of the project flow and the current progress of the project.

1. Background

Local Energy Communities (LECs), particularly in the sense of Renewable Energy Communities (RECs), have the potential to facilitate the energy transition and are politically and socially supported on EU and national levels. While the definition of the regulatory and legal frameworks is currently underway, the technical implementation is still largely undefined.
A smart and efficient approach for the integration of LECs into the overall system is necessary, to allow LECs to meet their own goals (e.g., maximizing the consumption of locally generated energy, increasing the degree of self-sufficiency), as well as to make a meaningful contribution to the energy system in general (e.g., reducing consumption and feed-in peaks, providing flexibilities, ensuring resilience). Conversely, an uncoordinated integration of LECs could have a negative impact on the energy system as a whole and be detrimental to its resilience (e.g., by negatively influencing simultaneity in consumption and generation and the associated increase in load peaks).

2. Goals

Currently, there is no common vision regarding the digital integration of LECs. This bears the risk of uncontrolled proliferation of different individualized solutions that are inefficient and complex to set up and maintain, uncoordinated (in the sense of lacking interoperability) and not extensible. Project ECOSINT seeks to remedy this situation by enabling the smart integration of LECs into the overall system. To this end, three main goals have been defined:

- A comprehensive analysis of the goals and possibilities of LECs as well as an investigation of all legal, regulatory, technical, and economic requirements concerning LECs.
- The design of an open, secure, modular, and scalable IT system architecture for the integration and operation of LECs.
- The simulative validation and proof-of-concept evaluation of the designed architecture based on key use cases.

3. Planned Results

The definition of different LECs and their internal requirements, but also the external requirements that should be met will be comprehensively analyzed in ECOSINT. The broad-ranging composition of the consortium (regulators, grid operators, energy suppliers, service providers, industrial corporations, and research institutions) allows an analysis from all relevant perspectives. Further expertise is obtained via stakeholder workshops. One result of the project is the systematic and formal classification of all goals and requirements for the smart integration of LECs.

Another important result is a modular IT system architecture for LECs, which is based on the comprehensive analysis of all framework conditions. This architecture is to provide internal and external interfaces for effective integration into the energy system, consider important requirements such as IT security and privacy protection natively and thus, form an essential basis for future communities, regardless of their characteristics, sizes and external providers of community services. For example, in the case of the maximization of the consumption of self-produced electricity, a LEC should be able to choose from a set of possible approaches and individually decide on the preferred method (e.g., based on machine learning methods).
The IT system architecture will be available as a complete, digital UML model; based on the comprehensive requirements analysis. An instantiation of the system architecture for individual LECs will be exemplarily demonstrated, validated in simulations, and jointly evaluated with stakeholders.
Overall, the project will provide the basis for the efficient and secure integration and operation of LECs by allowing them to meet their internal goals, minimizing complexity and at the same time optimizing the benefit LECs can provide for the overall energy system.

4. Project Flow and Current Progress

The project launched in March 2021 and is scheduled to run for three years. As of November 2021, it is nearing the completion of the analysis phase and beginning the transition to the architecture phase on schedule (planned project flow see Figure 1). One stakeholder workshop with more than 50 participants has already been held, the results of which are currently being analyzed, catalogued, and refined. Key findings from it are requirements such as a unified architecture, interoperability, more versatile tariffs and tariff structures, simple handling, tools to facilitate planning and operation, the availability of fine-grained measurement data for accounting and control, cost transparency, civic participation, fairness, and low entry barriers.

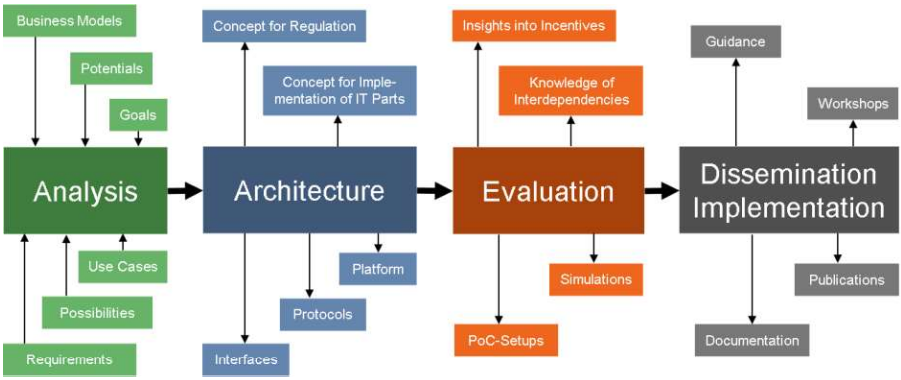

Figure 1. Project flow with in- and outputs

Author

DI Oliver Langthaler, BSc received his Master's degree in engineering from the Salzburg University of Applied Sciences in 2014. He then remained at the University as a researcher at the Center for Secure Energy Informatics, where he has been contributing to Smart Grid and energy-related research projects such as OpenNES, VirtueGrid, Future Network Tariffs and ECOSINT. He also founded cappatec, where he develops custom hard- and software solutions, including power metering infrastructure for DSOs. In 2019, he began to focus on LECs as a topic of research and to pursue a PhD at the Paris Lodron University of Salzburg.