

Fully Integrated Renewable Energy Communities and their Implications for the Power Grid and Market Structure

(4) Aktive Endkunden-/Prosumerpartizipation & Gebäudesektor
(Promoting the new energy system era through a holistic vision)

Helmut BRUCKNER⁽¹⁾, Albana ILO⁽²⁾, Marketa ADAMCOVA⁽³⁾, Karthik BHAT⁽⁴⁾
(¹)Sonnenplatz Großschönau, (²)TU Wien, (³)LEEF Technologies, (⁴)FH Technikum Wien

Motivation und zentrale Fragestellung

With the growth of Distributed Energy Resources (DER) and specific requirements for reliable electricity supply, TSOs and DSOs face new operation challenges requiring greater coordination between all actors. Energy Communities fully integrated into the power system enable automated participation within the energy market and new services for its members. Fully Integrated Renewable Energy Communities (FIRECs) presented in this paper are durable, more affordable than the existing partial solutions, promote energy independence, and contribute to energy security and societal resilience.

Methodische Vorgangsweise

Energy Communities (ECs) are in the early stages of integration within the power grid. Our analysis shows that neither the technical nor the market-side integration is currently state of the art. As a solution, a pathway on how to achieve a successful FIR-EC was defined, based on four main steps:

- Assessing and Evaluation of existing approaches – Evaluation the state of the art of current Energy Communities. It focused on assessment criteria for the success of Energy Communities based on existing project experience.
- Characterisation of current & expected future state of the specific energy communities - A common methodology for analysing and integrating energy resources, automation used, and existing ICT infrastructure was defined.
- Design of the *LINK*-based Energy Community with respect to Stakeholder Needs - According to the holistic *LINK* solution, the Fully Integrated Renewable Energy Community was designed by defining well-designed use cases and technical and market-related interfaces.
- Contracting Models and Regulatory Framework - Based on the current legal framework, the future design of the electricity market and the grid is outlined, and a strategy for integrating energy communities was developed. Regional differences among the regulatory frameworks were analysed identifying the main barriers to establishing energy communities.

Finally, within a Roadmap, we defined a set of instructions and recommendations to implement FIRECs all over Europe.

Ergebnisse und Schlussfolgerungen

Within INTERACT[1] an optimal organisation and structure for FIRECs (see figure 1) were designed, based on:

- Success factors from a competence network of existing PED/PEN approaches,
- Stakeholder needs and motivation,
- The available technologies, and
- A holistic architecture of the power system.

¹ Sonnenplatz Großschönau GmbH, 3922 Großschönau, Sonnenplatz 1, +43 2815 / 77270, h.bruckner@sonnenplatz.at, www.sonnenplatz.at

² TU Wien, Institute of Energy Systems and Electrical Drives, Gußhausstraße 25/370-1, 1040 Wien, +43 1 58801 370114, albana.ilo@tuwien.ac.at, www.tuwien.at/etiit/nes

³ LEEF Technologies s.r.o., Forum Karlín, Pernerova 676/51, 186 00 Prague 8, Czech Republic, +420 602 260404, marketa.adamcova@leeftech.com, www.leeftech.com

⁴ FH Technikum Wien, Competence Center Resilient Energy Systems, Giefinggasse 6, 1210 Wien, +43 1 3334077 7413, karthik_subramanya.bhat@technikum-wien.at, www.technikum-wien.at

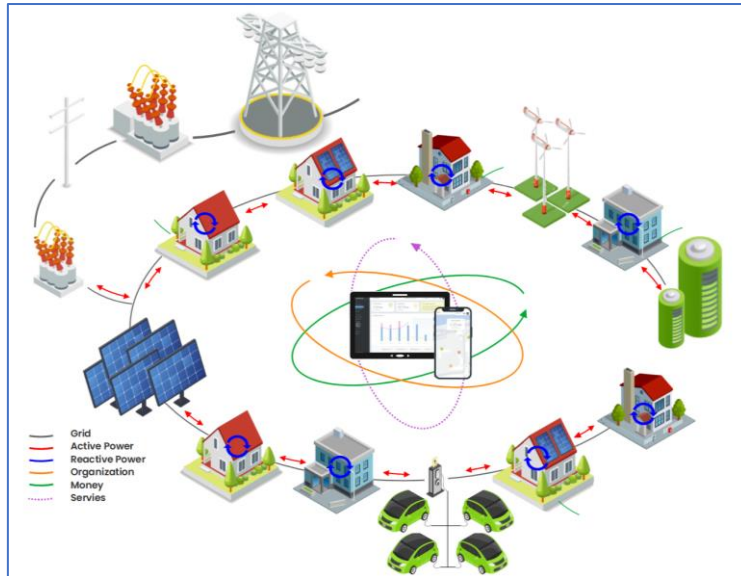


Figure 1: Designed Fully Integrated Renewable Energy Community

The FIREC is based on the *LINK*-based holistic system architecture[2]. The holistic architecture considers all voltage levels of power grids, electricity producers regardless of size and technology, electricity storages, consumers and prosumers, all power system operation processes, data privacy protection, avoidance of significant data transfer, market aspects, standardised structure, and a transition process. Considering the Smart Grids' integrity for the architectural design is necessary to achieve reliable and sustainable solutions.

The analysis of the current electricity market structure shows that the participation of an EC alone is impossible. Therefore, a different market structure is proposed in line with the physical flows of electricity, that supports automated and fair participation in the market at different market levels (see figure 2). In line with the fractal structure of the power grid itself, the market is also structured in a fractal way: a national/international market, a regional market, and a local market[3].

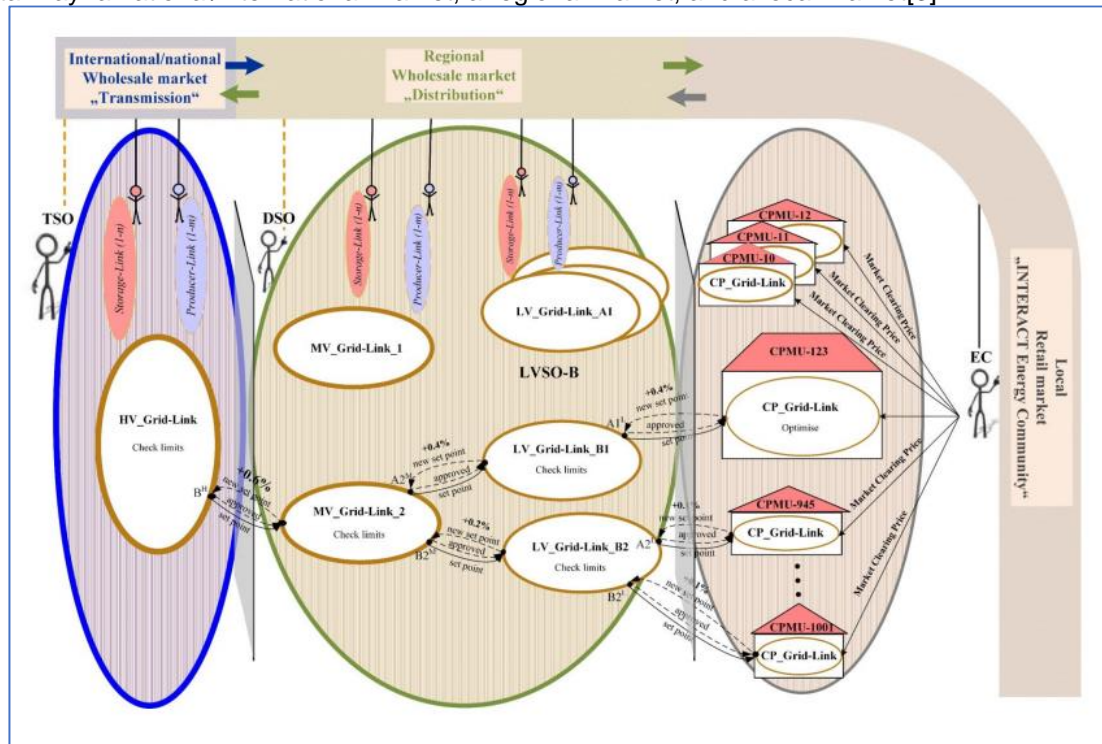


Figure 2: Harmonisation of the proposed market structure with the power grid structure

Energy Communities can live to their full potential by integration from a technical side to the power grid and from an economic side to the market. The proposed holistic architecture for ECs enables their full integration in a viable way.

Acknowledgements

This paper is written within the INTERACT project, which receives funding in the framework of the PED Programme, which is implemented by the Joint Programming Initiative Urban Europe and SET-Plan Action 3.2. The project is supported by the Austrian Ministry of Climate Action, Environment, Energy, Mobility, Innovation, and Technology, Technology Agency of the Czech Republic and Swedish Energy Agency / Viable Cities, Sweden.

Literatur

- [1] INTERACT - Integration of Innovative Technologies of PEDs into a Holistic Architecture, www.ped-interact.eu
- [2] Ilo A., Schultis D. (2021), A holistic Solution for Smart Grids based on LINK-paradigm, Springer, <https://link.springer.com/book/10.1007/978-3-030-81530-1>
- [3] A. Ilo, H. Bruckner, M. Olofsgard, M. Adamcova, Deploying e-mobility in the INTERACT energy community to promote additional and valuable flexibility resources for secure and efficient grid operation, CIRED workshop on E-mobility and power distribution systems, 2-3 June 2022, Porto, Portugal.