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Showcasing eNeuron's 12 Use Cases: Insights and Methodology

Local energy communities offer a decentralised and bottom-up approach to producing, managing, and using energy. They are set to play a significant role in the energy transition, integrating multiple energy carriers such as electricity, gas, heat, cooling, hydrogen, mobility, and water.

To achieve these results, a total of twelve use cases were developed using the IEC 62559-2 methodology, enhancing their potential replicability. The eNeuron use cases will leverage the latest software and hardware solutions, including a cloud-based management platform, to dynamically balance supply and demand from multiple energy carriers.

Key Points

- **Replicability of use cases**
- **Multi-carrier aspects fostered**
- **Alignment for all stakeholders**
- **Optimisation of the integrated use of distributed resources**
- **Improvement of flexibility from load and generation**

Energy communities for a greener future: the eNeuron perspective

The eNeuron project aims to develop innovative tools for the optimal design and operation of integrated local energy communities (ILECs), incorporating distributed energy resources and multiple energy carriers at various scales. Regulatory and technical bottlenecks within existing local energy communities were mapped before building use cases and business models aimed at delivering customer value and achieving higher-level targets.

Developing Use Cases: Methods, Quantity, and Purpose

According to ISO/IEC 19505-2: 2012, "A use case is the specification of a set of actions performed by a system, which yields an observable result that is, typically, of value for one or more actors or other stakeholders of the system". This broad definition enables the identification of various actors and their objectives in constructing use cases, a principle that guided eNeuron's approach. Initially, the project consortium outlined a set of 12 use cases, considering activities, objectives, and outcomes related to ILECs, with an awareness of regulatory framework limitations and existing practices.

Following this, all identified use cases underwent validation according to the following categories:

- Dependency: Examining potential dependencies among use cases for smooth integration.
- Conflicts: Identifying and addressing conflicting scenarios.
- Objections: Considering and addressing possible objections.
- Goal Alignment: Consolidating use

cases with similar objectives.
- Scope Evaluation: Ensuring alignment with project goals and scope.
- Revision: Reviewing and refining all aspects to ensure coherence and effectiveness.

The resulting 12 eNeuron use cases are the following:

1. Maximisation of renewable energy sources share and reduction of the environmental impact in the energy hub, i.e., energy community: This use case shows the actors involved, their roles and the exchange of information that must take place to obtain an optimised design and operation (in terms of environmental aspects and costs) of the candidate technologies of the ILEC, with emphasis on renewable energy sources and storage technologies.

Actors: EH operator, end users/prosumers, energy suppliers, aggregators, market operators.

2. Maximisation of micro-energy hubs (e.g. building) efficiency and reduction of imported energy: This use case is dedicated to the real-time optimal operation of a micro-energy hub managed by an energy services company. It aims to achieve two main objectives: providing efficient energy strategies for micro-energy hub assets and various energy carriers and conducting real-time optimization of the micro-energy hub operations based on external signals to minimize energy imports.

Actors: end users/prosumers, energy service companies, technology suppliers, DSO, DHO.

3. Increased flexibility from load and generation of micro-energy hubs, e.g. buildings: This use case aims to increase the flexibility of micro-energy hub load and generation units, so that an electrical system can maintain the balance between load and generation under uncertain conditions.

Actors: end users/prosumers, energy service companies, aggregators.

4. High reliability of supply: This use case aims to illustrate a highly reliable local energy system within an energy context prone to frequent extreme weather events.

Actors: end users/prosumers, DER, DSO.

5. Green electric vehicle charging: The development of a use case where excess generation arising from renewable energy sources is stored and used in the electric vehicles of the ILEC's residents, reducing renewable energy sources curtailment and grid congestion while controlling load variation.

Actors: end users/prosumers, technology suppliers (ICT), energy storage owners, government, policymakers and regulators, local authorities.

6. Contribution of ancillary services, e.g., by mitigating voltage problems or congestion, to the local distribution grid at the customer connection point: By implementing demand response in ILECs, it is possible to influence the quality and reliability of energy distribution. This use case aims to show the actors involved, their roles, actions and the exchange of information that must take place to assist the distribution system operator in maintaining the grid at the optimal point of operation, mitigating voltage or congestion problems that can result from a high renewables penetration.

Actors: end users, technology suppliers, government, policymakers and regulators, balance responsible party, local authorities, local energy market service, load balancer, EMS.

7. Peer-to-peer energy and flexibility trading: In this use case, roles and actors are described to balance the production and demand to maximise the local generation while reducing energy losses and securing the normal grid operation. This is conducted at the local level through a real-time market that allows peer-to-peer trading.

Actors: end users, aggregators, DSO, energy supplier, technology supplier.

8. Minimisation of users' energy costs within ILECs: This use case aims to show the actors involved, their roles and the exchange of information and energy flows that must take place to obtain an optimized operation of the various technologies within the ILEC to minimize users' energy costs.

Actors: energy manager, end users, ESCO, DHO, DSO.

9. Minimisation of ILEC's operational expenditure and reduction of carbon emissions for environmental benefits: The intermittent nature of local production and demand may lead to energy losses. In this use case, roles and actors are described to design generation and storage according to the energy needs of the ILEC while minimizing operational expenditure costs.

Actors: end users, aggregators, DSO, energy supplier, technology provider.

10. Investigation of environmental/economic trade-off solutions for long-term planning: The development of optimized configuration schemes is crucial to providing a clean energy supply of the energy system at competitive costs. From this perspective, this use case describes the actors involved, their roles and the exchange of information that must take place to obtain an optimized design for the candidate technologies.

Actors: planner, end users, technology suppliers, government, policymakers and regulators, local authorities, energy market service.

11. Assessment of the introduction/replacement of new energy carriers in the ILEC through economic and environmental criteria: This use case investigates the introduction of additional energy carriers to an ILEC, or replacement of energy carriers and assets in an assigned configuration, from an economic and environmental point of view.

Actors: ILEC, end user, energy producers, government, policymakers and regulators, local authorities, energy suppliers, energy producers, DSO, DHO, research actors, technology suppliers.

12. Identification of possible local energy sources investment optimally exploited (optimal sizing and location) for minimization of capital expenditure and CO_2 emissions of the ILEC: Accurate planning is required to minimize the total initial costs of an ILEC. Minimising costs and emissions may be conflicting objectives. Hence, multi-objective optimization techniques are required, based on the interests of the main stakeholders.

Actors: planner, end users, energy producers, ESCOs, technology suppliers, DSO, government, policymakers, regulators, non-profit organizations, research actors, banks.

Conclusions

Seeking customer-centric solutions involves testing cost-effective and low-carbon alternatives while coordinating all energy carriers within demonstration activities, which are organized as use cases and subsequent pilot sites. These endeavours aim to foster the deployment and implementation of this innovative energy paradigm across Europe.

Learn more about eNeuron:
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References

- **D3.3 - Use cases and innovative business models for the eNeuron pilots**