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Energy Communities: tools to build them and make them thrive

Case study #5

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1. Building Energy Communities to meet the 2030 objectives

1.1 Context

The transition to a carbon neutrality in Europe by 2050 imposes profound changes in energy systems including enhanced digitalisation and further renewable energy integration while ensuring energy affordability and security of supply.

Important European regulations such as the clean energy for all Europeans package (CEP, 2019), with the recast of the Renewable Energy Directive and the Internal Electricity Market Directive, have introduced new instruments to empower citizens and put energy communities at the forefront of the action against the climate crisis and the transformation towards 100% renewable energy.

Thanks to several demonstration projects funded by the European Commission, this is becoming a growing movement across Europe and it is even estimated that by 2030, energy communities could own some 17% of installed wind capacity and 21% of solar and that by 2050, half of all European Union citizens could be producing their own electricity, meeting 45% of the EU's energy demand.[1]

1.2 Benefits

The Clean energy for all Europeans package gives consumers more choice in their homes and more flexibility to reduce their energy use when it is expensive and consume or store energy when it is cheap. The package creates a regulatory framework which enables new services to compete more efficiently and transparently in order to achieve the following ambitions (without specific order of priority or importance):

- Increase citizen involvement and consumer empowerment, cutting energy consumption.
- Mobilise private capital and expanding customers rights: millions of citizens have savings sitting in the bank that are unknowingly fuelling the climate crisis as banks and pensions invest in dirty energy projects. Giving communities the chance to get involved in the energy transition can redirect this money to climate solutions and the local economy.
- Introduce flexibility to the grid and increase the security of supply.
- Increase local acceptance of renewable energy projects by engaging people in the projects.
- Provide environmental, economic, social community benefits for members or the local areas (e.g., stronger communities, job creation, redistribution of profits, etc.).

Overall, this democratisation of energy tackles climate change and energy poverty at their roots, protects vulnerable consumers and supports the local economy.

[1] https://friendsoftheearth.eu/wp-content/uploads/2019/12/community_power_booklet_v5-screen.pdf

1.3 Challenges addressed in this case study

Despite the EU legal frameworks, how can energy communities actually begin and how to make them thrive?

Although the variety of tools available today is creating ample opportunities for European citizens to participate and benefits from energy markets there are needs for tools that on one hand facilitate optimal investment decisions and on the other hand enable an optimal operation of local energy systems, also making the projects compatible with local values and communities to avoid internal group conflicts and local opposition to renewables.

In addition, energy communities still may face national regulatory and economic barriers, as well as uncertainties in administrative procedures and bureaucracy, that disproportionately affect them.

Several EU-funded projects aim to provide and demonstrate how new technologies (from enhanced digitalisation to smart grids and smart appliances) as well as non-technical tools can support local energy networks and energy communities.

This case study aims to bridging the gaps between technological tools and local engagement processes and describe the tools developed by some of the BRIDGE projects, how they have been implemented and provide recommendations on what should be further developed.

2. Setting up the conditions of Energy Communities feasibility

This case study focuses on three main building blocks that are investigated by a selection of H2020 funded projects:

TOOLS for DESIGN and PLANNING to enhance the local integration of Distributed Energy Resources within the concept of energy communities. This block explores the tools for multi-carrier energy systems.

TOOLS for OPTIMAL OPERATION. This block provides an overview of the different tools used for an optimal operation of local energy networks and to facilitate grid and market interaction.

TOOLS for SOCIAL and CITIZEN ENGAGEMENT to gain acceptance from different community members throughout the establishment and operation phases, and to maximise the value of the energy community. This block addresses the engagement strategy that should be developed when building a LEC project.

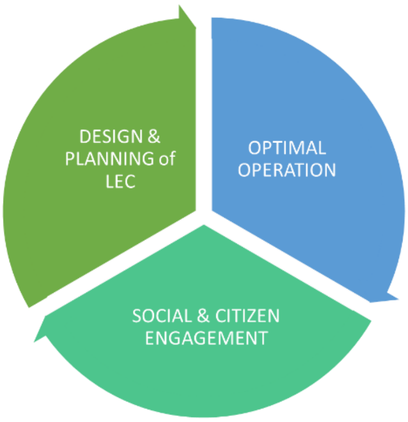

Figure 1:
The three building blocks to build and make viable Energy Communities

This case study focuses on five H2020 projects that address these different buildings blocks complementarily, as each project may address more than one of them (see the table below). Furthermore, it should be noted that the tools presented can simultaneously address more than one of the three building blocks proposed in this case study.

E-LAND
Dec 2018-Nov 2022

E-LAND develops a toolbox to optimally manage Multi-vector LES and isolated communities, replying to technological, societal and business challenges that the energy sector faces. **E-LAND** toolbox is modular, customisable to specific local requirements, expandable to incorporate new tools as new challenges arise and interoperable with standards-based legacy systems.

Energy communities/pilots type: University Campus, Technology Park, Port (Logistics/Industrial Companies & Local authorities), Urban to rural townships.

Services[2]: Generation – Consumption & sharing – Energy services – Electromobility - Information and awareness raising campaigns (Citizen Empowerment)

DESIGN AND PLANNING OF LEC | OPTIMAL OPERATION OF LEC | SOCIAL AND CITIZEN ENGAGEMENT

Compile
Nov 2018-Oct 2022

The main aim of **Compile** is to demonstrate the opportunities offered by remote areas or areas weakly connected to the grid—the so-called energy islands—for the decarbonization of energy supply, community building, and creating environmental and socioeconomic benefits.

Energy communities/pilots type: Urban to rural townships, Technology Park, Residential area, Port

[2] According to JRC report categories Caramizaru, A. and Uihlein, A., Energy communities: an overview of energy and social innovation, EUR 30083 EN, Publications Office of the European Union, Luxembourg, 2020,ISBN 978-92-76-10713-2, doi:10.2760/180576, JRC119433.

Services: Generation – Consumption & sharing – Energy services – Electromobility - Information and awareness raising campaigns (Citizen Empowerment)

OPTIMAL OPERATION OF LEC | SOCIAL AND CITIZEN ENGAGEMENT

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eneuron

Nov 2020-Oct 2024

Drawing on the concept of micro and macro energy hubs (mEHs), **eNeuron** project develops a range of cloud-based tools to optimise the design and operation of LEC abs seamlessly integrate multi-carrier energy systems and simulate peer-to-peer energy trading in local, real-time markets.

Energy communities/pilots type: City and its major energy nodes, Naval district, University Campus, Football Stadium.

Services: Generation – Consumption & sharing – Energy services – Electromobility

DESIGN AND PLANNING OF LEC | OPTIMAL OPERATION OF LEC | SOCIAL AND CITIZEN ENGAGEMENT

Hestia

Nov 2020-Oct 2023

Hestia develops a mix of Technological, Innovative and Social Sciences & Humanities models approaches to improve the management and use of energy by and for residential consumers.

The project aims to develop a cost-effective solution for the next-generation demand-side response services by encouraging residential consumers to engage in flexibility sharing and grid balancing. User-personalised services will help lay the foundation for an open marketplace and new grid reality.

Energy communities/pilots type: 3 Residential areas covering different climatic and socio-economic environments

Services: Generation - Consumption & sharing – Energy services – Electromobility

OPTIMAL OPERATION OF LEC | SOCIAL AND CITIZEN ENGAGEMENT

LocalRES

May 2021-April 2025

LocalRES aims to be a shuttle for the setting up of Renewable Energy Communities (RECs) by developing digital tools that support the co-design of the local energy landscape and enable an optimal management of local energy systems through a sector-coupling approach. The project is developing a Planning Tool to enable citizen participation in the REC planning decision-making processes, and a Multi-Energy Virtual Power Plant (MEVPP) approach to optimize in real time different energy vectors and different energy and flexibility services provided by the REC according to their community preferences. The project will deploy innovative local energy systems driven by RECs in four demonstration sites across Europe to validate the **LocalRES** solutions and promote a socially fair energy transformation that puts renewable energy into the hands of communities and people.

Energy communities/pilots type: Remote communities **with a weak connection to the national electricity grid**. Two of these pilot sites are isolated communities (Ispaster and Ollersdorf), and two are located in geographical islands (Kökar and Berchidda).

Services: Generation – Consumption & sharing – Energy services

DESIGN AND PLANNING OF LEC | OPTIMAL OPERATION OF LEC | SOCIAL AND CITIZEN ENGAGEMENT

More information concerning the time-stage of these projects can be found in Section 7.

3. Tools for planning and design

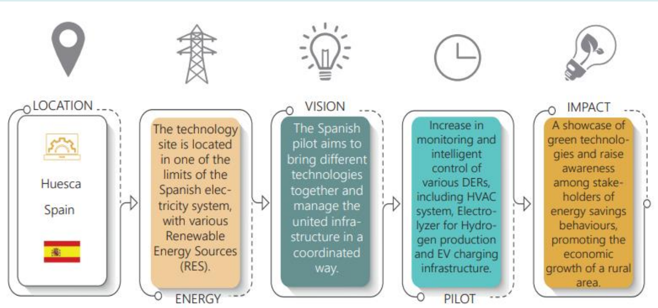
This section details the projects' results with regard to planning, evaluation and design models to enhance the local integration of Distributed Energy Resources within the concept of energy communities. While many of these tools are available in the literature, most of the works address this design problem by focusing primarily on the electricity sector. The projects studied below aim at integrating multi-carrier energy systems.

3.1 The future representation of the system and its assessment are key to determine optimal investment options

Local Energy Communities (LEC) are dynamically changing ecosystems, with multiple objectives, which makes them challenging to design and operate. To determine optimal investment options into power generation and storage assets, solutions are needed to enable flexible modelling of scenarios and solve complex optimisation tasks, with a comprehensive overview of the interactions and synergies among distributed energy resources and different energy vectors and networks.

- **E-LAND multivector simulator (MVS)** allows users to optimally define their personal multi-vector energy systems (i.e., electricity, heat and gas, as well as production, consumption, conversion and storage assets) by providing **optimal capacities and allocation to project sites as well as validation of economic and technical performance, in order to minimise energy supply costs**. Based on the open energy modelling framework, the MVS is presented along a Graphic User Interface (GUI), the **Energy Planning Application (EPA).** It allows users to graphically define their energy systems, guiding them through design, data input, simulation and analysis of optimisation results.
- This set of tools enables to perform a quick **pre-feasibility analysis and avoid costs**:
    - Potential investment options can be explored with low effort,
    - Trajectory of future assets capacities, necessary for sales inquiries, are estimated
    - Internalizing the pre-feasibility analysis allows to avoid costs: the decision process within a company to invest into future supply options is sped up, while costs otherwise necessary to pay for an external review are skipped.

Showcasing the use of E-LAND-Multivector simulator at the Walqa Technology Park[3]



The ambitions of Walqa Technology Park, as an energy island, are to increase the local renewable share of their energy system and achieve self-sufficiency as much as possible thanks to an increase in self-consumption and improve H_2 usage and EVs.

The **E-LAND MVS tool** helps Walqa in assessing the optimal sizing of new assets to increase the long-term efficiency of the Local Energy System and define what is financially beneficial for the park.

E-LAND investigates the expansion of local RES production and how this can be utilized for different purposes:
- Several simulations have been conducted under current market conditions to determine what degree of autonomy and renewable share (through PV) are beneficial at the project location (short and long term).
- An evaluation of the changes in the park with the inclusion of an electric vehicle demand is conducted.
- With the aim of increasing sector coupling of electricity and H_2 in the technology park, the feasibility of investing in H_2 for transport, H_2 generation with sales to the grid, and H_2 generation plus seasonal storage is investigated.

[3] Deliverable D6.1 – First pilot results

- **eNeuron** promotes integrated Energy Communities, as there is a need to describe how people can achieve common benefits and approaches through cooperation and **planning of multi-carrier energy system**, i.e. not only electricity-based. The **eNeuron** solution covers different functionalities, **including an investment planning tool that takes into account the technical details of how the community should be built and extended over a long-term horizon:**
  - The tool is modular and built over Integrate[4], an existing software system. It optimises the development of an energy system while considering the projections in energy demand, the different technological possibilities for energy supply (at the district level), conversion between energy carriers, distribution, storage, end-use measures and restrictions on CO_2 emissions.
  - The tool provides **a cost-effective development plan for a given period**.
- In eNeuron, the multi objective optimisation approach of an energy hub **has been studied under different prisms and individual topics** to make sure that a global perception is captured. The eNeuron toolbox aims to help decision makers understand the benefits of optimal planning and management of local energy resources. This holistic approach ensures **a high potential of replication across Europe**. *[Deliverable D4.1]*

- **LocalRES** develops a **planning tool** to support local actors in the design and planning phases of an Energy Community and reconcile the global vision of the community and the particular interest of individual actors by promoting a collaborative approach. The greatest innovation of the planning tool lies in its double objective:
  - To give energy experts and decision makers a **more accurate vision of the energy system and assess long-term scenarios with associated indicators** (related to costs, carbon emissions, sustainability and safety). The tool will provide a kind of **pre-feasibility studies** and support the optimal design of REC according to the local context and community preferences.
  - **To support the direct involvement of citizens of the** community in the co-design of the energy community[5], providing them with comprehensive information to understand the different actions and their associated impacts, and allowing them to propose their own scenarios.

Figure 2:

Examples of questions that the LocalRES Planning tool could assess *[Project partner - Artelys]*

[4] Previously known as eTransport software
[5] see section 5 for more information on LocalRES co-design approach

3.2 Energy communities bring a different logic and new thinking on how we produce and use energy that has to be taken off by the business model approach

While conducting a market analysis and background research, it was observed that many generic business model innovation tools are available in the market. **InteGRIDy** is one such tool relevant for overall energy sector. However, a clear need of developing a business model tool to support energy communities was observed by the following projects.

- **To define the value and profitability of an Energy Community**, **COMPILE** has developed a decision support tool for consumers or communities who want either to get started, join the energy community or simply invest into RES or energy efficiency measures. **The COMPILE Value Tool** allows them to explore different business models and their profitability.

- **E-LAND's Business Model Innovation** (BMI) tool provides a framework to combine generic business model patterns in a simple way, and develop profitable and locally tailored business models for energy communities and related stakeholders:
    - **The framework is constituted by five basic elements** and describes the fundamental structure of a business model for an energy community (value proposition, key functions, threshold for break-even members, services and revenue/savings streams, relevant BM configurations)
    - The business model patterns fill the framework with concrete specifications. The **25 business model patterns reflect the approaches of pioneering companies and pilot projects** related to multi-vector energy communities.
    - Finally, in a step-by-step process, stakeholders of an energy community are guided to use the business model framework and customize the patterns to the local context. *[Project website]*

- The E-LAND business model innovation approach considers:
    - specific energy island conditions such as regulation,
    - energy vectors (single vs multiple),
    - **local infrastructures and capacities**,
    - **community and behavioural change**,
    - the fact that each active actor involved in an energy community must have a business model that works for them.

> ***"A regular prosumer who provides his extra solar power to the system must also have a business model that works for him too."*** *[WP6 Leader]*

E-LAND BMI tool: Return of Experience

The Business Model Innovation (BMI) tool has been tested at 4 pilot sites through organisation of various workshops, including internal community members and external members of the Stakeholder Innovation Group *[Deliverable D6.1]*

Starting from the challenges to be tackled by a specific demo site, the innovation process resulted in 2 to 4 business model configurations.

As a result, **E-LAND's BMI tool allows companies to be agile, to quickly change their business model and to react to changing local market needs.** The tool enables to manage the value network in the energy community, to develop strategies to initiate and reinforce network effects and supports new market entrants to launch new offers in the energy market with sound business models.

- The **eNeuron** project will provide **innovative business models** having in mind the baseline provided by the extensive state-of-the-art review. An exhaustive list of conversion technologies, actors and their roles will be considered **to present the value chain of the integrated grid in which different carriers exist in addition to electricity.** *[Deliverables D2.2 and D3.2]*

- **LocalRES** promotes the developments of a **blockchain-based platform**, the PROSUME platform, that guarantees an autonomous, independent, and digitized smart place permitting users to exchange different energy sources, **promoting and accelerating new energy community models**. In addition, for each demo site, **LocalRES** defines 1 use case with a respective **business model for the deployment of services by energy communities,** which will serve as a reference for their potential replication in other cities.

4. Tools for an optimal operation of local energy communities

This section provides an overview of the different tools developed and used by the above-mentioned projects for the optimal operation of local energy networks and to facilitate grid and market interaction.

4.1 Measuring and assessing the performance of scheduling options is an important part of operating the system

To optimise the operation of existing local distributed energy resources, a set of tools is needed to provide a plan of when and in which form energy should be consumed or stored, to achieve the Local Energy Community objectives. To this extent, Artificial Intelligence is key for the long-term prediction of energy consumption/production and load/demand forecast.

- **E-LAND's energy forecaster** provides predictions for electrical and thermal loads, as well as PV and wind generation. The energy forecaster harnesses data gathered at the local energy system. **E-LAND'**s data pre-processing application detects and corrects inaccurate or missing records and resamples them if needed, increasing the usability of data.
- The **optimal scheduler** tool devises the optimal dispatch of controllable multi-vector energy assets in day-ahead and intraday time horizons, considering the forecasted local energy production and consumption, state of operation, energy costs, and user preferences.
- The Data Visualisation Application (DVA) provides a graphical user interface in which the operator and the community of local energy system can monitor KPIs enabled by the operational planning tools. Indeed, **measuring and assessing the performance of scheduling options is an important part of operating the system**.
- **E-LAND** toolbox needs to interface with existing EMS to be able to monitor and control local assets. The toolbox **incorporates an integration solution, the enterprise service bus (ESB), to create seamless and secure communication channels among its tools and the local system** while providing modularity, extensibility, and scalability to the solution.

Deploying these tools in real life poses various integration challenges

One main difficulty that have experienced the pilots is **to decide on the necessary parameters** in order to configure the E-LAND solution to their own needs and wish.

In fact, the configuration of the solution is tailored-made for each use and technology that the pilot site owns. One document to better understand the configuration files and how to supplement the parameters in the E-LAND toolbox is the deliverable D5.4 Pilot and system integration test plan and test report[6] . This document is referencing the schedule and the steps required to develop and install the E-LAND solution toolbox.

[E-LAND Deliverable D6.1]

- In **eNeuron** a set of tools is being developed to optimise Local Energy Communities (LEC) operation, with new technology configurations while ensuring economic and environmental sustainability. The **eNeuron optimisation toolbox** deals with both **long and short-term operation optimisation** and provides a model of the day-ahead operation of the system, hour by hour in different seasons.

[6] D5.4 Pilot and system integration test plan and test report – E-LAND deliverable

> The analysis of the day-ahead objectives and settings with real-time operation of the market allows to provide to the prosumers a day-ahead planning conveyed by the market operating in real time as well as the freedom to operate their own assets under the framework of the Energy Community.
>
> *[eNeuron Project Coordinator]*

- Micro-energy hubs (mEH/prosumers) are provided with **energy management systems** (software and hardware) that locally **coordinate the operation of multiple carriers,** accelerating the development of multi-energy technologies and improving the energy efficiency.

  The Energy Hub (EH) is composed of heterogeneous mEHs belonging to **industrial, commercial and residential sectors** and its aim is to coordinate them and manage the multiple carriers to achieve the energy community objective, while considering the consumer needs (multi-objective optimisation framework).

- **ComPilot** is a digital socio-technological platform that allows the creation of **Virtual Social Energy Communities** in order to help cooperatives or other communities manage their operation. It benefits the network operators or community managers when learning about their energy community performance and **organising cooperation agreements**.
- ComPilot interface provide some information **regarding market price, energy mix, and the forecast and actual energy demand and production in the selected period**. With its various functionalities the tool offers user-friendly management of energy communities and **shows the areas for potential improvement and further development.** *[Project website]*

4.2 P2P trading allows both producers and consumers to benefit financially from the local presence of renewable and decentralised generation assets and provides an incentive for participation in an energy community and for local investment in renewables

- **LocalRES Multi-Energy Power Plant (MEVPP tool)** enables to offer collective services both within the community and to the external system operator(s), so that the energy networks can operate smoothly based on self-management mechanisms. The LocalRES MEVPP aims at **optimising in time-ahead and in real-time, different energy vectors and different energy and flexibility services** provided by the REC, according to the community's preferences. Among others, the MEVPP will offer different services, which can be categorized into three groups:
  - ***End-user(customer)'s friendly services***: minimizing the energy cost, respecting community preferences.
  - ***Grid friendly services***: These services can be divided into two sub-categories:
    - local (internal) services like collective self-consumption (minimize the needs to import energy from the grid), collective peak-shaving (reduce peak load, bringing economic incentives to the REC).
    - grid services like frequency control, congestion management, voltage control to assure the power quality within the internal and external power grid.
  - ***Peer-to-Peer energy sharing***.
- Providing all these services will be possible thanks to **the high-resolution data-handling communication architecture of the MEVPP** with the demonstration assets.

- eNeuron envisages an **integrated local real time market** where all carriers are intertwined and that is the means of interfacing Peer-to-Peer (decentralised) and central dispatch operation within the Local Energy Community. **Simulation of Peer-to-Peer energy trading will provide an architecture for**

the interaction of the Energy Hub with the markets and their realistic operation. This will enable eNeuron solution to be applicable in general terms in every EH and local markets. To this extent, price-based schemes will be investigated and the short-term optimal operation layer might require to be subdivided into several sublayers so as to deal with the intraday operation of the energy hub in the electricity and gas intraday markets, and in the electricity balancing markets as well. *[Deliverable D4.1]*

- In **COMPILE, HomeRule** tool help operate energy communities, with a focus on managing one building/home energy needs. It is an energy building management application enhanced with new algorithms for co-optimisation of different technologies and energy vectors to better manage consumption, production, stored energy, etc. of users and integration of RES in the congested grid. In contrast to some practices of limiting PV production to a particular amount, **HomeRule limits output depending on real network conditions and hence increases PV output.**

Showcasing the use of HomeRule in one of COMPILE's main pilot sites, Lǔce in Slovenia

HomeRule have enabled the installation of more PV than it was originally allowed by local DSO rules (120 kW instead of 10kW) and not jeopardize the operation of the grid. The results revealed that a single house's PV output climbed by 320%, while the entire community's production increased by 180% on average. With the installation of a community battery, the COMPILE partners were the first in Slovenia to set up and test the island mode operation on a low voltage level that can provide power for 2–3 days depending on the weather. The use of the battery in island-mode operation can also power communication towers and fire stations, as well as permitting the operation of critical infrastructure in the case of extreme weather events, thus improving the safety of the whole town of Lǔce. *[Conference Proceedings - Sustainable Places, 2021]*[7]

- Another technical tool developed by **COMPILE** is the **GridRule tool**. GridRule was designed to enable the actors in an energy community to **operate, manage and control the local grid within the network limits while improving their flexibility, stability and security**. It includes functionalities specific for Energy Community's needs, taking into consideration users' preferences, detailed prediction of their consumption, as well as the interaction with different actors in the community. The tool sets up the coordination of individual community members and enables the optimisation of the whole community's energy needs.

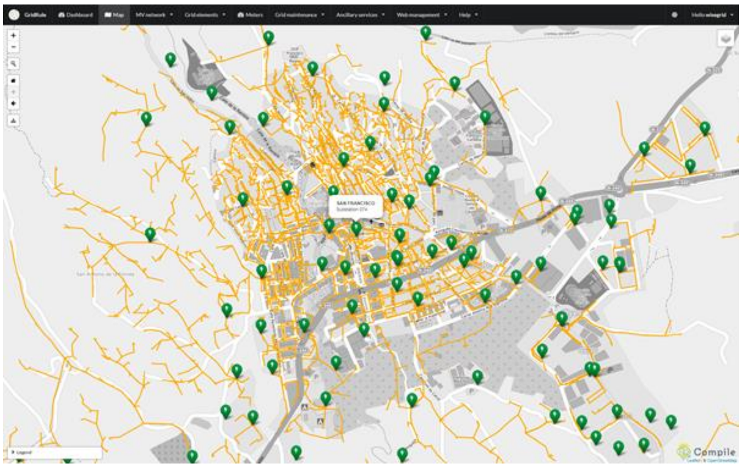


Figure 3: Screenshot of the Map section of the GridRule tool. *Lines, substations, usage points, renewables and their maintenance status are visualised.*

The GridRule **enables data collection and presentation in a user-friendly manner**, which helps the operators with their everyday work. GridRule also features various control strategies that optimize all the available flexibility in the network to maximize the benefits of the community. These features include community battery management and community self-consumption optimisation. **The community optimisation is possible due to GridRule – HomeRule communication which enables the control of all flexible loads in the community.** *[Project website]*

- The goal of **Hestia** is to encourage and help end-users optimise the way they use energy so that it is more efficient, flexible, and beneficial in terms of both monthly expenditure and for environment. **Hestia** creates a methodology that involves society, in which **end-users commit to sustainable daily or**

[7] Cuneo, A.; Quellec, P.-J.L.; Choné, T.; Comodi, G.; Valalaki, K.; Samari, K.; Medved, T. Energy Communities: How Tools Can Facilitate Their Enhancement. *Environ. Sci. Proc.* **2021**, *11*, 13. https://doi.org/10.3390/environsciproc2021011013

weekly practices and responsibility, assisted by ICT tools that help them exercise this new role in an open market. **Hestia** deploys its efforts in **developing a platform that will encourage end-users to streamline energy use.**

- A User Interface has been implemented based on an easy to use, yet powerful energy management visualization in the form of a **web-based dashboard serving as a Hestia platform client.** As a result, the Energy Community Dashboard is a **responsive web design (RWD) and an App for Android/iOS** where the users can interact with information collected by the smart meters and sensors, as well as to receive notifications triggered by the different HESTIA services. *[Deliverable D2.4]*

4.3 Limitations and shortcomings for optimal use of local resources

Several technologies are expected to contribute efficiently to the energy transition. However, several limitations and shortcomings have been highlighted, in particular by **eNeuron** in its extended review of existing technologies, strengthening the necessity of a holistic approach with dedicated and tailorable optimisation tools. *[Deliverables D2.2, D2.3 & communication from the Project Coordinator]*.

Some of the shortcomings are presented below:

- Very diverse maturity level among the technologies with, for some of them, uncertain efficiency and economic feasibility,
- The current legislation related to heat, gas, transportation and electricity is isolated from the others and does not consider the multidisciplinary nature of these multi-energy carrier facilities,
- Uncertainty and especially the absence of clear regulatory provisions are possibly two of the most significant barriers to establishing new services, since this uncertainty could strongly discourage potential investors from developing the necessary infrastructure assets,
- Several of the screened technologies appear to have low flexibility since they are designed to operate at constant output ratio. This requires hybridisation with others, which can handle vast variations imposed by control systems.
- Several Technologies require large spaces for production and storage of energy,
- The complexity of the problem and variety of the available solutions and combination of these both on a single consumer level as well as on an energy community level.

4.4 A wide variety of demonstrations support the replicability and scalability of energy communities, with an important role for knowledge sharing

The effective development and operation of energy communities relies on them being able to access a range of technical, financial and business knowledge to choose the right solution at the right time and set-up a community.

- In **eNeuron**, tools are being tested at four pilot schemes to **increase their replication potential for other settings across Europe**. The alignment to the pilot context is critical and calls for:
    - different engagement strategies targeting different stakeholder types to build the community,
    - investigating drivers, barriers, issues and conflicts that may arise between different actors when integrating various micro energy hubs into one LEC,
    - defining how the data will be shared,
    - defining how to deal with the regulation.
- In addition, the validation of energy hub solutions through simulation and testing in a lab environment implies to manage multiple reference data and models such as energy components models and time series found for the different energy generation, storage and consumption resources. It **then calls for**

the creation of an Open DataBase, based on eNeuron activity, that would serve the RD&I community.

- To help the stakeholders to be better prepared and aware of the possibilities offered by **E-LAND** tools, problem stories and scenarios have been gathered from the experience of the three pilot sites.

- **LocalRES** includes four demonstration cases across Europe. All four demonstration sites have in common being remote communities with a weak connection to the national electricity grid. Two of these pilot sites are isolated communities (Ispaster and Ollersdorf), and two are located in geographical islands (Kökar and Berchidda). In all cases, maintaining minimum conditions with regard to grid stability represents a challenge, so **each of them has committed to promote the creation of a REC** to overcome this barrier.
  Relying on the lessons learnt from the demo sites, LocalRES will develop an impact evaluation framework to provide stakeholders with best practices for future cases, increase citizen engagement and serve as information for islands, isolated communes and technology providers.

- **In all COMPILE pilots, the lack of information, knowledge and capacity at the municipal, but also at the citizens, level has been the most difficult challenge to face**. The project also faced the spread of disinformation on the definitions and the purpose of energy communities**. It is crucial that Member States make a specific effort to communicate on the nature and benefits of energy communities to citizens.** This is the only way to put this concept at the service of consumers throughout Europe. Member States are requested by the Renewable Energy Directive to create enabling frameworks for Renewable Energy Communities. This enabling framework is key to the development and scaling of the energy communities concepts. Without efforts from European and national authorities, the concept of Energy Communities will become a missed opportunity. At the project level, the overcome this barrier, the **COMPILE COOLKIT** is proposed (see adjacent textbox).

> The COMPILE COOLKIT proposes a series of reports and dashboards related to community management and the development of Energy Community. This repository is meant for community leaders and members looking to create an energy community. In this toolbox, the following elements can be found:
>
> - **The Best Practice guide,** collecting experiences for the community energy movement across Europe. It provides examples for all types of activity, energy services and citizen-led partnerships.
> - **The Stakeholder Engagement guide,** providing tools and techniques to build community groups and organizations. It provides examples and methods to engage people in a neighborhood.
> - **The Financing guide,** explaining how to finance Energy Community projects and structure its ownership. It provides templates and examples on how to structure a community energy project.
> - **The Technical Tools guide,** describing the technical tools developed by the COMPILE project. The features of each tool is described and explained.

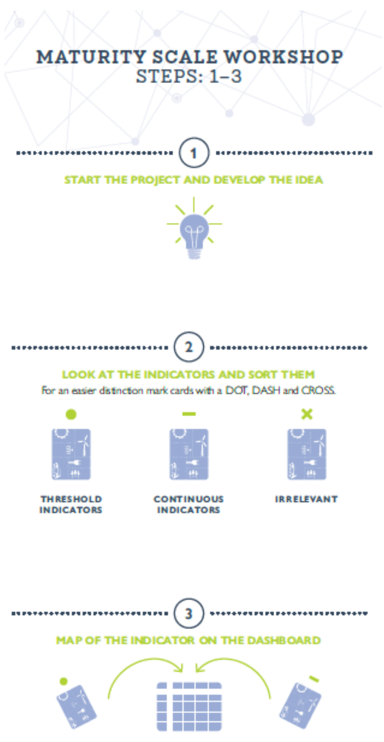
5. Tools for social and citizen engagement

Implementing a clean and local energy systems requires, beyond functional technology, the acceptance of energy innovations among local stakeholders and community members.

According to the BRIDGE working group on Citizen and Consumer Engagement,[8] there are already several mature tools for engagement of consumers, optimising around the notion of comfort for the user as a key driver for the use of the tool. However, there is a lack of tools that includes a user-centric approach and supporting a partnership with the consumer. Indeed, there is a heavy bias around the notion of individual benefit, vs an idea of collective benefits or community benefits. An additional conclusion was reached by the subgroup working on smart tools linked to the user profiles served by tools identified. In general, projects tend to overwhelmingly have an approach based on volunteering which prevents from diverse and inclusive samples. This bias might damage the relevance of the tools developed and speaks for a more inclusive people centred approach to development. This also reinforced **the need for an engagement strategy that will build representative samples for technological innovation.**

"A successful and long-lasting local energy system requires not just a functioning technology and a sustainable business model, but also acceptance from different local stakeholders and community members"

5.1 For a successful establishment and persistence of an energy community, be realistic of what could be achieved and identify local ambassadors



- To help Energy Communities persist in the market, **the self-assessment of community maturity appears to be a promising tool.** A surprisingly successful result from **COMPILE** was indeed the Maturity Scale Framework. The tool consists of a set Key Performance Indicators (KPI) that provide leaders and representative of LECs with insights into the level of readiness, stability and socio-economic environment of an energy community, anticipating future steps and identifying potential challenges and perspectives for growth and development. The Maturity Scale can be used as a game and allows to identify what participants consider important and what is not relevant to build an energy community. [9]

COMPILE partners tested the tool with a wide range of actors and representatives of more than 25 energy communities and citizens' groups from 8 European Countries. For the majority of participants, it appeared important:

- to have a shared vision when initiating an energy community,
- to define the rules among members,
- to create a business plan and identify the license/permit and legal form that will enable to build and operate the community.

The profit margin, transfer to other communities, multiple value proposition or multiple service provisions were judged as irrelevant**. As establishing an Energy Community is already complex, there is no need to add more and more complexity and just focus on making it work.**

[8] BRIDGE report « Exploration of citizen engagement methodologies in European R&I projects », Consumer & Citizen Engagement Working Group, April 2021.
[9] Seebauer, S., Brenner-Fliesser, M., Tuerk, A., D'Herbemont, S. (2022). Developing a tool to assess the maturity and growth of energy communities. COMPILE Working Paper, https://www.compile-project.eu/downloads/

- **E-LAND's community engagement tool**, the Common Impact Model (CIM), is designed to help a local partner to **identify stakeholders who matter for the successful establishment of a LES or who are affected by the LES operation**, and to design the local energy solution in a way that it is compatible with local values and priorities, as well as create a strategy to maintain local stakeholders engaged.
- E-LAND's Common Impact Model is **a hands-on methodology**, relying on the inclusive infrastructure planning approach, consisting of 3 phases and complimentary tools to help the user at each step, as illustrated in the figure below.

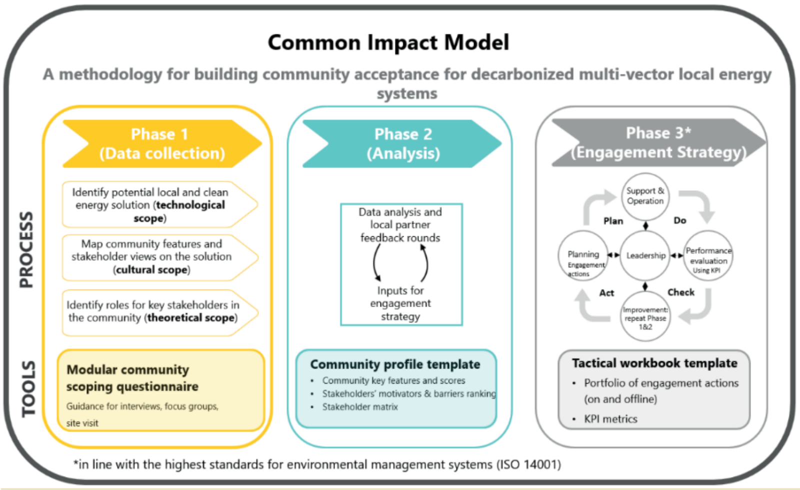


Figure 4 E-LAND Community engagement tool

With the help of the tactical workbook, **engagement recommendations** are co-created with the local partner.

Tips on how to use E-LAND's CIM

The CIM is a dynamic model - and therefore, phases 1 and 2 could (and maybe should) be repeated overtime after phase 3 to ensure the changing dynamics of the community are captured and factored into future engagement recommendations.

- In **eNeuron**, the pilot sites are not already established Local Energy Communities. This provides a good opportunity for the community members to think about what they want to become. **eNeuron's** engagement strategy is to establish local committees to ensure full interaction with local stakeholders and consumers and to start the processes of engaging, building and operating LECs. Piloting in different context involves defining different approaches to community building. Each local committee has the freedom to develop its own approach to engage with the communities so that it's tailored to their motivation, context, and needs.

- One conclusion of the **LocalRES** participatory workshops was that **local heroes or energy champions**, which represent the energy community from the inside but at the same time have a close contact with energy experts and the municipality, **can support the communication between citizens and experts as well as engage more potential interested parties**.

- In **Hestia**, the three pilot sites already implemented in residential areas in France, Italy, and the Netherlands, allowed to determine and to analyse end-users' energy habits and thus understand their preferences and needs when using energy and its infrastructure. By conducting participatory workshops for the development of the **Hestia** platform (the Energy Community Dashboard), Hestia partners have been able to **identify the level of engagement of pilot users**. This strategy has enabled to determine different engagement strategies depending on the pilots and the actors involved.

5.2 Delivering information in an easy language enables citizen participation in the energy community decision-making processes

- The **LocalRES** Planning Tool supports the decision-making processes to assess the design and planning of a community energy project, and give required information on how to generate, store, consume and sell their own energy, according to their preferences and local conditions. The **tool is being developed for both experts and non-professional stakeholders** and will deliver necessary technical, economic, environmental, and social information, including benefits and drawbacks of each scenario**, in an easy way so that the general public can understand it and informed decisions can be made.**
- Four citizens workshops in the four different LocalRES pilot sites were organised **to co-create the planning tool and ensure that all relevant information in an appropriate language for the citizens is included**. The co-creation workshops were held in three phases:
    1. Initial working session amongst the project partners and local stakeholders from the LocalRES demo sites **to gain a common understanding of the existing communities** and identify potential topics of interest.
    2. Workshop with local representatives, **to build energy community scenarios** based on community requirements.
    3. Presentation of the scenarios to the citizens in the four pilot sites **as the starting point for the discussions**, and exchange and feedback collection for the benefit of the project.

Example of LocalRES good practices
In order to achieve the highest level of interest from the citizens, the workshop mut be useful for them, so knowing in advance what would be of interest for the participants and organizing the session accordingly should be part of the preparation.
Maps and pictures of the town and relevant buildings were used to visualise the described scenarios. The description of the scenarios was followed by potential questions which the planning tool could answer and the importance of the opinion of participants.

- One conclusion from the **LocalRES** participatory approach is that **when using co-design workshop, design-reality gaps or participation gaps may occur:**
    - Only interested parties, who already have some basic knowledge about the energy project in their community and who could better understand and anticipate the usefulness of the planning tool may have showed up to the workshops;
    - Small towns or communities have their own dynamics when it comes to the interaction between people, which could have an impact on who took part and who did not;
    - Another aspect which raises concerns is the fact that mainly older people participated and the majority of them were male (see section below). *[Deliverable D2.1]*

- One of the objectives of **HESTIA** is to motivate end-users to become active prosumers and participants, which is why **residents where the pilot projects have been implemented are already involved in designing solutions through participatory processes**.
- HESTIA starting point is that the technical understanding of energy, developed by professionals, is different from that of consumers, such as householders (Shove, 2000). **Sharing expertise should therefore not be taken for granted: it is important to share understandable information that reply to consumer needs and to consider equally the expectations of users and technical experts.** *[Sustainable Places, 2022]*
- In order to design, develop and integrate with adequate visualization means the necessary data to consumers, the **HESTIA Energy Community Dashboard** has been co-designed with the end-users. Several **participatory workshops** were conducted with the residents, organized by the Pilot Leaders and other relevant HESTIA partners, to serve as inspiration for the design of the platform look & feel as there is no “one-size fit all”. The residents have played a crucial role in defining how the data should be represented and how customisable and flexible the platform should be. *[Deliverable D2.4]*
- The following project findings can be highlighted:

  - Co-creation as the active engagement of participants in the design of Demand Response solutions, has been found to make the **transition processes (to a smart or more efficient grid) more meaningful and relevant for HESTIA's participants**, while it has brought attention to the need for coordination with all stakeholders involved in the process.
  - Co-creation is recognised as a way to assist the empowerment of citizens as consumers, through collaborative processes (such as their engagement in participatory workshops), where they can codevelop their vision for new services and products. *[Deliverable D2.2]*

5.3 Gender, age and stage of life are important factors to consider when building an Energy Community

- In **LocalRES** a shift in the participation towards older ages was observed and with male participants being the biggest group. Such shifts in age and gender can have a variety of reasons: for example, younger people might have small children they have to take care of and therefore do not have the opportunity to join such meetings in the evening without organising someone who can take care of the children. Another point can be that younger people might not own their property they live in yet and do not feel that they can contribute much to an energy community, because they cannot for example install PVs or have the financial resources to make alterations or improvements to their property.
- Still in **LocalRES**, male participants were more likely to believe that others would take part in the community while female participants were less likely to believe that others would take part in the community. *[Local RES Deliverables D2.1 & D2.2]*
- Analysing gender inclusion wasn't into **Hestia** initial plan but as the project partners investigated everyday practices at home, they came across the findings that **everyday housekeeping is gendered and characterised by divisions of labour**:
  - Most women perform the ordinary, everyday housekeeping, while men, in their majority perform the digital housekeeping and also express the biggest interest in new energy technologies.
  - **Most women**, as housekeepers or coordinators of everyday routines, **are the gatekeepers for introducing new ways of performing everyday practices such as adopting flexibility suggestions.**
- HESTIA also identified a gap or mis-coordination between the ordinary and the digital housekeeping. The findings highlight the **need to bring on board all members of a household in order to introduce and stabilise new practices** or alternative performances of existing routines. Therefore, the **coordination of tasks and negotiation between household members is essential** in order to make any suggested changes sustainable.
- In addition, Digital literacy is not uniform across and within the pilots. **Gender, age and stage of life are important factors to consider when designing DR interventions and solutions**. Participants need appropriate support and guidance, by both familiar people (peers) and professionals throughout the whole process of transition. *[Deliverable D2.2 & Sustainable Places 2022]*

These different interests in energy systems between man and women were also highlighted in other energy communities projects: while men are typically interested/engaged in technical issues, in general women are more interested in energy justice and climate change mitigation although they have a reduced interest to engage in technical issues.

A key question is then how to change perception and stereotypes as attracting and upgrading the participation of women will allow to scale-up the energy communities memberships? To get younger people and females involved in decision-making, the energy community maybe needs to extend its purpose and offer topics which are of interest to such groups, accommodating different needs, like childcare, for participants. *[More women in renewables and energy communities - EUSEW 2022]*

5.4 B2B Energy communities require to define one entity managing it

- **E-LAND** tools have been piloted at Walqa Technology Park, in Aaragon region (Spain). The technology park houses 14 buildings, half of which are owned and operated by the company that occupies them, offering a strong potential for synergies between all members of the Walqa community (60 companies and about 1000 employees). E-LAND looked at **how to establish relationship and contracts among the members** and making sure that the model proposed for energy exchange will be socially accepted.
- Although innovation and technology are well accepted in the Park, **it has been impossible in practice to build an energy community.** At the time of writing this case study, building owners are following individual paths to invest in renewable energy, although sharing some of the assets, or sharing the energy produced, could be mutually beneficial.
  Indeed, sharing energy between large companies or industrials can be complex legally wise: **a gap in the EU regulation and its translation** in the MS limit opportunities for sharing energy between companies (especially over certain size).
- In addition, **sharing is a foreign concept for many companies, hence generating hesitant reaction**. If given choice, company managers preferred an outside operator as energy provider. This is even more true for very large companies but they might be willing to accept other options if their concerns will be addressed.
- This observation led the E-LAND partners to think **about how to reorganise the non-residential community in practice**. After several interactions (survey, meetings, interviews) to understand user preferences and regulatory limitations, it was concluded that **creating a local company to own and operate the system** would have convinced the companies to join the local energy community, as it would have addressed the unknowns and concerns of members.

5.5 With new tools arise new risks that has to be understood and assessed

With new functionalities of a toolbox arise new risks and users can be challenged in the evaluation of the risk for their existing systems. For example, how the connectivity of a solution will impact the management of data from the assets and how the users' roles and responsibility regarding their own infrastructure data will be changed? As the gap to assess the new risks can be big for the users, it is important to emphasize the risk understanding and mitigation through clear methodology and communication.

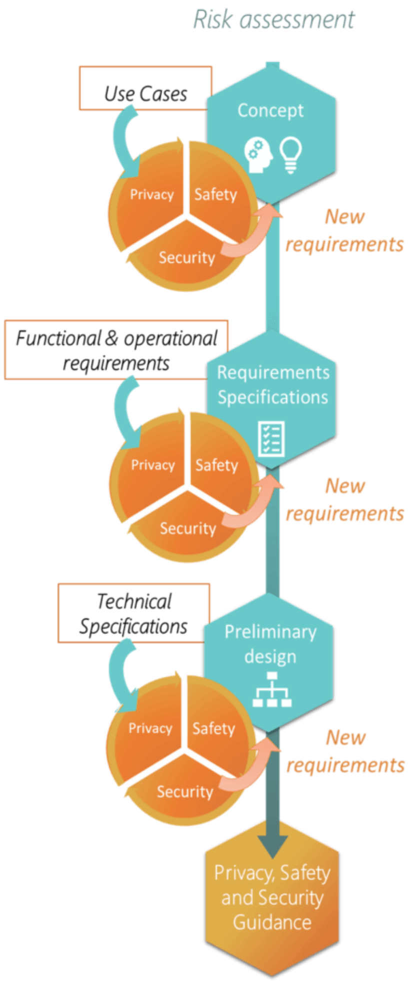


Figure 5 E-LAND risk assessment flow where risks are addressed at each step of the solution development

- **E-LAND** has implemented a risk management approach, taking into consideration the different stakeholders and partners concerns and their business needs, to ensure that the E-LAND concept and product are sufficiently reliable for the stakeholder to introduce it to their existing installation. [10]

The novelty of the risk assessment in E-LAND resides in the risk awareness process, where risks were explained in a one-to-one meeting with a dedicated focus on the partner risk. These meetings help to clarify the status of mitigations from the risk register with different design partners.

The experience from E-LAND's pilot sites will guide future users through potential risk faced during toolbox implementation

- One challenge for the pilot site is **to internally assess their competences, the management structures, culture at site, the applicability and understanding** of the risks and the process, the impact of the solution on their results and infrastructure. The pilot sites also need to assess own much of the solution implementation and use should depend upon their own resources versus third parties.
- From the risk manager point of view, the risk management process has built trust and improved the risk understanding among the partners. Now the risk managers continue monitoring the Pilot sites.
- For the future users of the E-LAND toolbox, several flyers are available describing the solution, the risk assessment process and activities to communicate how to better understand and how to best inform on Data Privacy or warn Cyber risks
- The risk toolkit will be improved by integrating a Security and Privacy requirements notice.

5.6 Common engagement recommendations and practical tips from the studied BRIDGE projects

Based on the experience gained by the studied projects in designing and piloting their own tools in different contexts, a list of recommendations and practical tips for citizen and consumer engagement in local energy systems and energy communities can be drafted as follows:

About stakeholder mapping

- Allow time in your planning for engaging with stakeholders and community members - it may take time, but it is usually time well invested – and **start really early in the project**.
- Identify and map local stakeholders, and determine the level of information you need from them in order to **identify the most relevant communication channels** to approach them and maximise the recruitment rates (i.e., survey, interviews, deeper meeting, information session etc.).

[10] https://elandh2020.eu/news/the-novelty-of-risk-assessment-in-e-land/

- Sorting the local stakeholders according to their interest in the solution and influence in its implementation **allows identifying local ambassadors and the main engagement target groups.**

About the engagement strategy

- **The local ambassador or a local committee** should then develop its own approach to engage with the community so that it's tailored to their motivation, context, needs, etc.
- Develop an **ongoing engagement strategy** with dedicated resources and leadership. The strategy consists of a limited number of specific engagement actions that overcome barriers, are designed for the main engagement target groups and involve local ambassadors/committees:
    - The strategy should not stop once the construction permit is granted or the technology is operating, **it should be adjusted after monitoring its impact using pre-defined key performance indicators.**
    - Being honest and transparent **to build a channel of trust with the citizens and promoting their sense of ownership** with the project is always more important than promising something that they may not have in the end.
    - Always provide material that is self-explanatory, easily understandable and considered of interest for the citizens.
- To introduce change, **play with everyday practices** and contextualise what it means in people's lives so that they can experience it.
- Facilitate **conflict avoidance/ resolution by providing appropriate mechanisms:**
    - Mechanisms should address concerns, prevents negative spill-overs and mitigate the risk of facing strong opposition, which usually comes from local minorities.
    - Conflicts and convergence issues in the energy market should be tackled.
- **Every effort should be made to include underrepresented groups** as women, younger people, vulnerable people, people without their own property or people who suffer from energy poverty.
- When conducting co-design workshops, various configurations may be envisaged:
    - If very specific profiles of workshop attendees are targeted, the attendance may be limited or not open to the general public;
    - **Breakout groups** are usually preferable from a certain number of attendees to promote the active involvement of all participants and to avoid that some motivated attendees take up most of the discussion;
    - During the event, the atmosphere needs to make citizens feel that they are the centre; they are important and their feedback and personal perspective is relevant for the success of the workshop.

About knowledge sharing and communication messages:

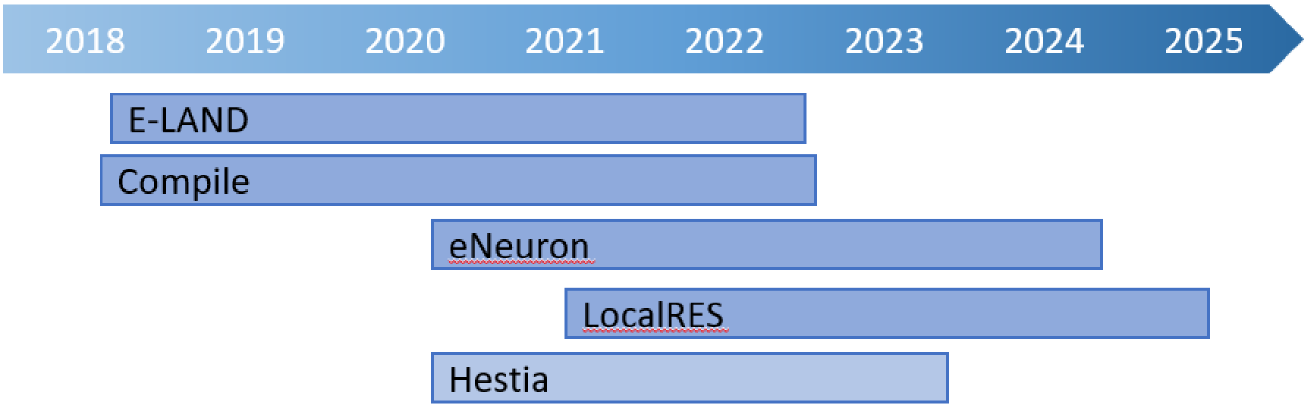
- Tacit knowledge plays an important role in a learning perspective and should be made visible through peer and professionals' interactions. Allow regular opportunities for community events, which can support the sharing of tacit knowledge.
- Explicit knowledge should be supported by appropriate intermediation, such as demonstrations and guidance to the platform and how to use it.
- Ownership of energy technologies, such as PVS, generally increased the participants' interest and engagement with their energy consumption.
- Communication on the long-term benefits for society as a whole should be strengthened in order to go beyond economic reasons as a motivational driver.
- It is important to keep participants in continuous communication with the project.

6. KEY TAKE AWAYS

Section 3: Tools for planning and design
• Projects are developing solutions to enable flexible modelling of scenarios and solve complex optimisation tasks, with a comprehensive overview of the interactions and synergies among distributed energy resources and different energy vectors and networks.
• The future representation of the system and how the community should be extended over a long-term horizon is essential to determine optimal investment options.
• Energy communities bring a different logic and new thinking on how we produce and use energy that is taken off by project's business model approaches.
Section 4: Tools for an optimal operation of local energy communities
• Measuring and assessing the performance of scheduling options is an important part of operating the system. • To this extent, Artificial Intelligence is key for the long-term prediction of energy consumption/production and load/demand forecast.
• Deploying project tools in real life poses various integration challenges. To overcome these difficulties, most projects develop tailor-made solutions that can be customised and/or integrated with the underlying energy systems and assets.
• P2P trading allows both producers and consumers to benefit financially from the local presence of renewable and decentralised generation assets. It provides an incentive for participation in an energy community and for local investment in renewable assets. • The collective services provided both within the community and to the external system operator allow energy networks to operate smoothly through self-management mechanisms.
• A wide variety of demonstrations support the replicability and scalability of energy communities, with an important role for knowledge sharing. Lessons learned, databases, best practices, impact evaluation, are some examples of materials produced and shared by the projects to support the effective deployment and operation of energy communities.
Section 5: Tools for social and citizen engagement
• For a successful establishment and persistence of an energy community, be realistic of what could be achieved, determine the level of engagement of the community members and identify local ambassadors & core engagement groups
• Deliver information in an easy language to enable citizen participation in the energy community decision-making processes and consider equally the expectations of users and technical experts
• Gender inclusion and age distribution are factors that need to be studied to increase the recruitment of members within energy communities • Projects should define how to change perception and stereotypes as attracting and upgrading the participation of women will allow to scale-up the energy communities memberships
• Pioneer non-residential energy community, where buildings are powered by locally produced, shared and stored energy is more complicated to build in practice as it is complex legally wise. A gap in the EU regulation and its translation in the MS limit opportunities for sharing energy between large companies.
• With new tools arise new risks that has to be understood and assessed through clear methodology and communication for the risk manager and his/her partners
• Finally, common engagement recommendations and practical tips from the studied BRIDGE projects are shared in chapter 5.6.

7.References

Timeline of the projects studied:



Projects information

Bridge project	Call	Goal	Website	Coordinator
E-LAND	LC-SC3-ES-3-2018-2020 Integrated local energy systems	Provide a synergistic solution between technological, societal and business challenges that the energy sector faces.	https://elandh2020.eu/	UNIVERSITAT DE GIRONA
Compile	LC-SC3-ES-3-2018-2020 Integrated local energy systems	Show the opportunities of energy islands for decarbonisation of energy supply, community building and creating environmental and socioeconomic benefits.	https://www.compile-project.eu/	University of Ljubljana
eNeuron	LC-SC3-ES-3-2018-2020 Integrated local energy systems	Optimising the design and operation of local energy communities based on multi-carrier energy systems.	https://eneuron.eu	ENEA
Hestia	LC-SC3-EC-3-2020 - Consumer engagement and demand response	Develop a cost-effective solution for the next-generation demand-side response services by encouraging residential consumers to engage in flexibility sharing and grid balancing.	https://hestia-eu.com/	SINLOC
Local RES	LC-SC3-ES-3-2018-2020 Integrated local energy systems	To be a shuttle for the setting up of RECs by developing digital tools that support the co-design of the local energy landscape and enable an optimal management of local energy systems through a sector-coupling approach.	https://localres.eu	CARTIF

Credits:
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