Case Book

PV Direct Use on Community Level

Cases and Living Labs

SET-Plan Action 4 – Energy Systems
Innovation Action A4-IA2.2-5

Version 1 – August 2019

This edition was substantially supported by:

Federal Ministry
Republic of Austria
Transport, Innovation
and Technology

avantsmart

BECQUEREL INSTITUTE

0 Imprint

About Innovation Action A4-IA2.2-5 (SET-Plan Action 4)

The Innovation Action **A4-IA2.2-5 Families of living labs to develop technology – service systems for direct use of PV energy on an aggregated level of multi-family buildings, districts or communities** aims to optimize direct consumption of PV energy on an aggregated level of multifamily buildings, districts or communities. This can be seen not only as a starting point for business model development and consumer empowerment, but also for mobilising flexibility potentials for power grids, integrating the end user. This case book represents the status of projects and Living Lab initiatives from stakeholders as of August 2019.

Contact

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1 Preface

Time to act!

EU Member states representatives from 15 countries and industry experts from relevant Technology and Innovation Platforms, gathered in a Working Group supervised by the European SET-Plan Governing Board, to elaborate an **Implementation Plan for SET-Plan Action 4** "Increase the resilience and security of the energy system" (January 2018).[1] The document leverages the consensus of participating countries around the R&I actions to be implemented in coordination, in order to achieve the challenging targets of decarbonised European energy system. More than 20 Innovation Activities are identified, clustered under two complementary **Flagship Initiatives: 'Develop an Optimised European Power Grid' and 'Develop Integrated Local and Regional Energy Systems'.**

Defining common goals and coordination is important but not sufficient: we need to act! To this aim, the involvement of **Implementation Stakeholder Groups** including industry, SME and R&D partners as well as critical stakeholders from the particular innovation ecosystem, is necessary to foster the development of the required technologies and solutions for the energy transition. This brochure is a first attempt in the field of PV Direct Use on Community Level, collecting engaged innovative stakeholders and initiatives all over Europe.

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Vienna/Milano August 2019

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1 https://setis.ec.europa.eu/system/files/set_plan_esystem_implementation_plan.pdf

2 In a nutshell

The four Ds – decarbonization, decentralization, digitalization and democratization - are the main drivers for energy transition in Europe. The Clean energy for all Europeans package of the European Union provides a new framework for the transition process.
It places consumers at the heart of the Energy Union. Energy systems, markets and regulation are undergoing profound changes while active consumers are more integrated into the energy system. By the definitions of **energy communities**, the Clean Energy Package opens up new possibilities for smart services and innovative business models. It can be seen as enabler and game changer for energy innovation as it gives the opportunity to remove some existing regulatory boundaries.

All over Europe project consortia are currently developing new business models and smart services, taking advantage of digital technologies. This development goes beyond R&D of renewable technologies. New collaboration and community models are investigated in order to implement renewable and smart technologies as basis for scaling up and making a significant impact to reaching the climate and energy targets.
On the one hand these projects are fostering the installation of PV power, on the other hand new concepts are developed where renewable energy is consumed and stored locally within a certain region. Energy consumers are playing a central role - in Living Lab environments, they have an active part as co-creators in the innovation process.

The SET-Plan Innovation Action **A4-IA2.2-5 Families of living labs to develop technology - service systems for direct use of PV energy on an aggregated level of multi-family buildings, districts or communities** targets at optimizing direct consumption of PV energy on an aggregated level of multifamily buildings, districts or communities. To reach the targets, a **stakeholder initiative** was launched to exchange knowledge and to initiate new projects.

The goal of this paper is to give an overview of the stakeholder landscape and of European frontrunner projects.

It provides a compact overview on PV self-consumption projects and Living Lab initiatives that are currently in progress or have been finished recently in different European countries. The projects are bundled in the following five thematic clusters:

1. Living Labs and Energy Community Initiatives
2. Energy Trading, Community Models and Advanced Services
3. Energy Grids and Integration of E-Mobility
4. Sector Coupling (heating, interseasonal storage, hydrogen)
5. Blockchain and AI-based Business Models and Services

At the end of this document relevant contact data and links are provided, as well as an outlook on upcoming activities, organised by the stakeholder initiative.

3 Table of content

4 Motivation and goal

This paper is motivated by the European SET-Plan and the consequent Implementation Plan. The Innovation Action A4-IA2.2-5 Families of living labs to develop technology - service systems for direct use of PV energy on an aggregated level of multi-family buildings, districts or communities aims to optimize direct consumption of PV energy on an aggregated level of multifamily buildings, districts or communities. This can be seen not only as a starting point for business model development, but also for mobilising flexibility potentials for power grids, integrating the end user.

By the definitions of energy communities, the Clean Energy Package opens up new possibilities for innovative smart services and business models. The concept of Citizen Energy Communities (CEC), which is contained in the EMDII, and Renewable Energy Communities (REC), which is contained in the REDII. The new regulation and the implementation of Energy Communities is a real game changer in energy transition, because new business models will become economically reasonable and profitable for the operating organisations.

In many European countries, consortia of technology providers, utilities, researchers and startups are working together with municipalities and communities of consumers on new Energy Community solutions. They have the same intention and many of them are struggling with similar regulatory boundaries, that hinder the implementation and scaling up of their concepts.

The goal of this paper is to provide an overview of European frontrunner projects, categorised in five different clusters. We invite all interested people to browse through this document and to use this information for future projects and collaboration.

Our intention is to bring people together and to build up an industry stakeholder initiative, where participants are interested in learning from each other and start to build up new projects to optimize PV self-consumption on a local and regional level. Since October 2018 we organised workshops in different countries (Belgium, Germany and Austria) and we will continue this dialogue process in 2020.

We also support the knowledge exchange with regulators and political decision makers on the European and national level. Representatives of the European Commission are part of the stakeholder initiative. Since the framework of the European directives will have to be translated into national law, the dialogue with national authorities is crucial for the long-term success of Energy Community and PV self-consumption projects. Therefore, this paper also aims to feed the national implementation processes.

5 About the SET-Plan and the Implementation Plan: Bringing strategy into action

The European Strategic Energy Technology Plan (SET-Plan) is the technology pillar of the EU's energy and climate policy. Adopted by the European Union in 2008, it is a first step to establish an energy technology policy for Europe. It is the principal decision-making support tool for European energy policy, with the goals of:

> Accelerating knowledge development, technology transfer and up-take.
> Maintaining EU industrial leadership on low-carbon energy technologies.
> Fostering science for transforming energy technologies to achieve the 2020 Energy and Climate Change goals.
> Contributing to the worldwide transition to a low carbon economy by 2050.

5.1 Ten Key Actions for research and innovation

The SET-Plan has identified 10 actions for research and innovation, based on an assessment of the energy system's needs and on their importance for the energy system transformation and their potential to create growth and jobs in the EU.
This ten Key Actions of the SET-Plan are shown in the following graphic:

Figure 1: Source https://setis.ec.europa.eu

This initiative aims at contributing to Key Action 4 of the Implementation Plan, increase the resilience and security of the energy system:

> ***"The overarching goals driving the SET-Plan Implementation Plan for Action 4 are the development and operation of energy systems showing an appropriate level of resilience, reliability, energy and economic efficiency, leveraging the use and integration of all types of bulk and local resources, with special reference to integrate variable renewables at all-time scales. The required flexibility can be achieved by means of innovative technologies enhancing customer participation, integrating better storage, making the best use of connections between electricity grids at all voltage levels and other networks (e.g. gas, heat and cold or transport) and optimizing the use of flexible sustainable combined power and heat generation. The implementation of smart and integrated energy systems is not only a technological practice, but also a social, cultural, commercial and political practice where cooperation and coordination are pivotal ingredients. It entails a change in the relationship between production, distribution, consumption and storage, going beyond capacity optimization."***

5.2 Innovation Activity A4-IA2.2-5

To translate the 10 Key Actions of the SET-Plan into action, a set of innovation activities was elaborated. The full document can be accessed via:

https://setis.ec.europa.eu/system/files/set_plan_esystem_implementation_plan.pdf

This stakeholder initiative was established to contribute to **A4-IA2.2-5 Families of living labs to develop technology - service systems for direct use of PV energy on an aggregated level of multi-family buildings, districts or communities**, which is described in the following section.

Targets

Optimizing direct consumption of PV energy on an aggregated level of multifamily buildings, districts or communities can be seen not only as a starting point for business model development, but also for mobilising flexibility potentials for power grids, integrating the end user. It is expected that synergies can be leveraged by aggregation of users and assets. At the same time, the development of comprehensive technology-service systems for potential procurers (communities, property developers, building managers) is complex. Economic potentials and opportunities for the energy systems often are not exploited.

Solutions will have to provide a sufficient service-depth in order to meet the actual demand of potential procurers and users, leveraging on the opportunities provided by digitalisation. They will have to be able to integrate regional optimization goals (of users and operators of the technology-service systems) as well as overarching system-optimization goals (contribution to system control, flexibility potentials, etc.). In order to reach critical scale, they shall be ready to be effectively implemented under actual framework conditions (technologies, business processes, legal and contractual issues, licences, etc.)

The overall goals of this activity are:

- Facilitate the development of such comprehensive technology-service systems that enable optimized direct consumption of PV energy on an aggregated level of multi-family buildings, districts or communities.
- Provide innovation ecosystems, in which potential procurers and providers work together in co-creation processes in order to develop and test prototypes under real-life or close to real-life-conditions.
- Leverage on the opportunities provided by digitalisation and enable sustainable business models by promoting trans-regional platform solutions.

Description of RD&I or Programming Activities

> Coordinate and link Living Labs on national or regional level that facilitate an innovation ecosystem for the development and testing of prototypes.
> Share real-live (or close-to-real-live) development and test environments, in which technology-service systems and their components (energy management systems, business processes and platforms, etc.) can be developed and tested.
> Connect those to networks of procurers, that gather potential buyers and users of the solutions at an early stage, in order to help to understand the needs and requirements
> Develop and implement methodologies and tools to enable effective co-creation of „need owners" (potential users and procurers) and solution providers (involvement, building competences, working methods, etc.).
> Develop and implement dynamic decision support models that enable optimization among different ways of utilisation of produced PV energy (direct use, storage, provide grid and system services, trade, etc.) under actual and upcoming legal and regulatory framework conditions (EU Winter package).
> Link those Living Labs to the European knowledge base in this field of smart energy systems (e.g.: ERA-Net SG+ knowledge community).

Joint Activities

JI-1: Create a transnational platform for Living Labs:
> Facilitate the sharing of test environments.
> Facilitate the sharing of co-creation methods and tools.
> Facilitate the knowledge exchange across different legal, cultural and technical environments.

JI-2: Start a transnational initiative with the living labs to co-create with need owners and solution providers:
> Provide information about technical and legal possibilities as well as already existing practical examples for potential procurers and customers (communities, building operators, etc.)
> Develop standardized need profiles („what do people dream of")[2]

2 Source: https://setis.ec.europa.eu/system/files/set_plan_esystem_implementation_plan.pdf

5.3 First results

The current and planned initiatives (see chapter 8) as well as this case book aim to contribute to the targets defined in A4-IA2.2-5. This paper is one outcome of the industry stakeholder process that started in October 2018. The process is mainly driven by experts from Austria, Belgium and the Netherlands.

Figure 2: Impressions from the first meetings in Brussels (Belgium) and Stegersbach (Austria)

6 Latest developments on regulatory framework

This section was extracted from the report Collective self-consumption and energy communities: Overview of emerging regulatory approaches in Europe established in the framework of the EU Horizon 2020 project COMPILE (Frieden et. al, 2019).[3]

With the "Clean energy for all Europeans" package (in the following "Clean Energy Package"), the European Union (EU) introduced new provisions on the energy market design and frameworks for new energy initiatives. The recasts of the renewable energy directive (REDII) and the electricity market directive (EMDII) provide basic definitions and requirements for the activities of individual and collective self-consumption as well as for two types of energy communities. Specifically, "renewable energy communities" (RECs, defined in the REDII) and "citizen energy communities" (CECs, defined in the EMDII), allow citizens to collectively organise their participation in the energy system. These new concepts open the way for new types of energy initiatives aiming at, in particular, the empowerment of smaller actors in the energy market as well as an increased decentral renewable energy production and consumption (prosumption). The mandatory transposition into national law provides significant room for specific provisions and needs to be finalized during the two years to come. Since a few years, the discussion and first implementation of collective self-consumption schemes (CSC) is ongoing in some EU Member States (MS) while the legislative processes on energy communities is in its very early stage in most countries. Some MS, as well as Switzerland, have already introduced a regulatory framework allowing collective self- consumption in, e.g., multi-apartment buildings, an activity that is also promoted by the REDII.

The Clean Energy Package frames energy communities as a non-commercial type of market actor. This is one of the major reasons why Member States are required to ensure they have a level playing field to operate across the market without discrimination. This requirement is specifically embedded in both directives. Table 1 provides an overview of the definition, actors, purpose and potential fields of activity of the two types of energy communities. These represent the final content that was agreed in the legislative process to the Clean Energy Package. They therefore serve as the basis for transposition of new EU rules into national legislation. Note that the term "Local energy community" was abandoned during the legislative process.

3 Frieden, D., A. Tuerk, J. Roberts, S. d'Herbemont, A. Gubina (2019): Collective self-consumption and energy communities: Overview of emerging regulatory approaches in Europe. COMPILE Working paper, June 2019. https://www.compile-project.eu/news/working-paper-collective-self-consumption-and-energy-communities-overview-of-emerging-regulatory-approaches-in-europe

Article 2(16) Recast Renewable Energy Directive
'Renewable Energy Community'

A legal entity:
1. which, in accordance with the applicable national law, is based on open and voluntary participation, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity;
2. the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities;
3. the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.

The REDII further states that RECs shall be entitled to produce, consume, store and sell renewable energy, including through renewables power purchase agreements.

Article 2(11) Recast Electricity Directive
'Citizen Energy Community'

A legal entity that:
1. is based on voluntary and open participation and is effectively controlled by members or shareholders that are natural persons, local authorities, including municipalities, or small enterprises;
2. has for its primary purpose to provide environmental, economic or social community benefits to its members or shareholders or to the local areas where it operates rather than to generate financial profits; and
3. may engage in generation, including from renewable sources, distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles or provide other energy services to its members or shareholders.

In several Member States, framework legislation is being established that still needs to be detailed or that implements only elements of EU legislation as a first step. In particular, several MS have started to establish REC and CSC provisions within the same legislative proposals while not yet fully addressing CECs (except Greece). Linking the implementation of the activity-based CSC to REC concepts seems a pragmatic approach as both aim for the expansion of and self-supply with renewable energy. Also, the local nature of CSC is reflected in the requirements of RECs to retain the effective control by those community members that are located in the proximity of the renewable projects. However, constituting primarily an activity rather than an organisational structure, the CSC framework has lower requirements regarding its governance but has a spatial limitation to the same building or multi-apartment block. CSC may enable a faster roll out as compared to RECs and a few MS such as Germany and Austria already have corresponding legislative frameworks in place. These frameworks are, however, limited in scope and address only electricity. RECs, in contrary, allow for the use of the public grid and cover a broader range of activities and all forms of renewable energy (e.g. heating, cooling). They may therefore enable the creation of new multi-energy business cases.

In cases where CSC is still bound to joint supply by a common electricity supplier due to the requirement to deal with the distribution of locally produced energy internally (e.g. Denmark and Sweden), finding consensus appears to be a major element for allowing actual implementation and goes far beyond energy related regulation. While legal advancements for CSC reduce the need for consensus by allowing for individual participation (or opt-out), the issue of partial participation remains and can be expected for energy communities as well. While both types of energy communities have a range of commonalities, some distinguishing features such as limitations to membership and effective control as well as proximity aspects are fundamental. Therefore, care should be taken that the specificities of CSC, RECs and CECs are appropriately distinguished and addressed in national frameworks and that all of these are enabled in a coordinated but independent way on national level.

7 Project Clusters and Project Descriptions

This chapter provides an overview of European frontrunner projects, categorised in five different clusters:

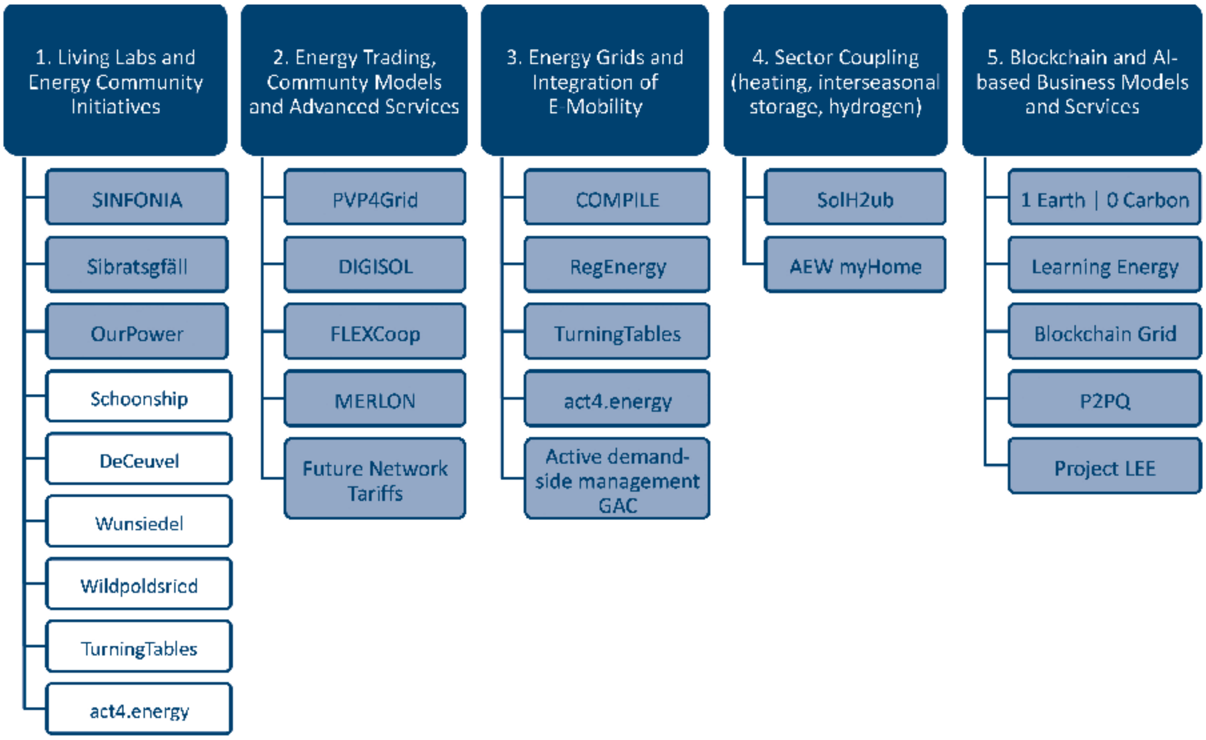

Figure 3: Cases and Clusters: Overview and Examples.

This collection is a result of research and networking activities during the last 10 months and represents a list of important research and innovative work.

> The listed as well as further project information can be downloaded from the expera platform: https://expera.smartgridsplus.eu
> In the future, even more projects and companies can join the stakeholder initiative.

We invite all interested people to browse through this overview and use this information for future projects and collaboration.

Disclaimer: The following information was provided by the project teams. The publisher is not responsible for any content, link, or picture in the project descriptions.

7.1 Cluster 1: Living Labs and Energy Community Initiatives

The first project cluster summarizes Living Lab and Energy Community Initiatives that are already up and running. They were started either by a private initiative or they are a result of or accompanied by a research project.

In the following section three projects descriptions are given:

1. Living Lab Project **SINFONIA** is a five-year initiative to deploy large-scale, integrated and scalable energy solutions in mid-sized European cities.
2. A Living Lab and Local Energy Community Business Models are explored in the alpine village **Sibratsgfäll**, in Austria.
3. **OurPower** Energy Cooperative, is a Vienna-based peer-to-peer platform for trading PV energy.

Further, interesting projects can be found in the Netherlands, Germany or Spain:

- Schoonship, The Netherlands: http://schoonschipamsterdam.org
- DeCeuvel, The Netherlands: https://deceuvel.nl/en/
- Wunsiedel, Germany: https://www.s-w-w.com/startseite.html
- Wildpoldsried, Germany: https://www.wildpoldsried.de/index.shtml?energie_homepage
- TurningTables, Spain (for details see 7.3): https://www.turningtables.global
- act4.energy, Austria (for details see 7.3): https://www.act4.energy/de/

7.1.1 SINFONIA - Smart Initiative of cities Fully cOmmitted to iNvest in Advanced large-scaled energy solutions

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B) Project Information

Project Title	SINFONIA Smart INitiative of cities Fully cOmmitted to iNvest in Advanced large-scaled energy solutions
Location	Innsbruck, Austria
Time Period	01.06.2014 – 31.05.2020
Funding	Government: EU-Commission FP7 Private Sector
Participating Organisations	Coordinator: > RISE Research Institutes of Sweden Pilot District Bolzano: > City of Bolzano > TIS Techno Innovation South Tyrol KAG > eurac research > Istituto per l´Edilizia Sociale (IPES) > Alperia > Agenzia CasaClima Pilot District Innsbruck: > Landeshauptstadt Innsbruck > Innsbrucker Kommunablbetriebe AG (IKB) > ATB-Becker e.U. > Neue Heimat Tirol > University of Innsbruck > Standortagentur Tirol > alpS GmbH > TIGAS Erdgas Tirol GmbH > Innsbrucker Immobilien Gesellschaft (IIG) > Tiroler Wasserkraft AG > e3 consult Early adaptor cities: > City of Borås > City of La Rochelle

> Municipality of Pafos
> Corporacion de Empresas Municipales de Sevilla
> City of Rosenheim
> AB Bostader I Borås & Borås Energi och Miljö

Website http://alpsthu.bplaced.net/wordpress/
http://www.sinfonia-smartcities.eu/

Keywords #smartcity #energyefficientbuilding #districtheating
#intelligentelectricitygrid

C) Project Summary

Background & challenges

With 80% of European citizens living in urban areas, cities have a crucial role to play in the transition towards a low-carbon economy. Faced with the challenge of ensuring the quality of life of their citizens while becoming more energy efficient, cities must look at the system level and develop integrated urban development strategies that will make them both sustainable and better places to live.

Objectives of the project

The SINFONIA project is a five-year initiative to deploy large-scale, integrated and scalable energy solutions in mid-sized European cities. At the heart of the initiative is a unique cooperation between the cities of Bolzano and Innsbruck, working hand in hand to achieve primary energy savings and increase the share of renewables in two pioneer districts. This was done through an integrated set of measures combining the retrofitting of around 100,000m² of living surface, optimization of the electricity grid, and solutions for district heating and cooling.

Current status & results

All projects of IKB are finalized and in the monitoring status.

Projects with focus on self-consumption:

> eco buildings:
  Tenants based projects: "Mieterstrom" tenant-based electricity supply PV
> IKB-Smart-City-Lab: Hybrid grid with sector coupling. Self-consumption of so far around 35% of electricity. Set up of Local Energy Community. 330 kWp of PV were installed.
> In total over 400 MWh are annually produced through PV modules within SINFONIA and most modules have surplus feed-in tariffs.

Barriers & obstacles

The tenants self-consumption business model was developed during SINFONIA. It enables the tenants with now own property to consume electricity from PV modules from their own roofs. Two further projects shall be realized this year (2019) with the project partners IIG and NHT. To invent the "Mieterstrom" tenant-based electricity supply PV, lot of obstacles occurred.

Within SINFONIA a similar project was invented a year ago, but it was still necessary that each PV module was directly connected to each tenant. So, for each flat (consumer) a inverter was mandatory. Now, after the amendment, it is possible to have on a multi-party house one PV plant with only one inverter.

Key regulations, legislations & guidelines

One of the key regulations, that enabled the "Mieterstrom" tenant-based electricity supply PV for the apartment buildings, was the amendment of the § 16a ElWoG (Kleine Ökostromnovelle).

7.1.2 Living Lab: Energy Community Sibratsgfäll

A) Author Information

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B) Project Information

Project Title	Living Lab: Energy Community Sibratsgfäll
Location	Sibratsgfäll, Austria
Time Period	Preproject: June 2019 to December 2019 Living Lab: Summer 2020 to summer 2022
Funding	Preproject: IMEAS, Alpine Space Living Lab: to be defined
Participating Organisations	> Energy Institute Vorarberg > University of Applied Sciences, Vorarlberg > Community Sibratsgfäll > Country Vorarlberg > Illwerke VKW (energy provider and net provider)
Website	www.energieinstitut.at
Keywords	#pvtotal #electricityautonomousvillage #futurevillage

C) Project Summary

Background & challenges

The goal is to produce as much of the electricity as possible within the village itself. Only when all pantographs in the village are supplied and surpluses have filled the battery storage, should be fed into the regional grid. It is undisputed that the power grid is an indispensable part of the concept (no island operation). The use of the electricity network within the village is subject to network charges. The production of the required electricity in Sibratsgfäll currently takes place only to a small extent in the village. A computational full supply would be possible, for example with PV systems on one third of the sloping roof areas.

Objectives of the project

In a concrete project - as Living Lab - we want to investigate:

> To what extent economic advantages for the producers as well as for consumers are given in the example of the village Sibratsgfäll?
> To what extent is it possible to attract a large proportion of citizens to contribute to the local supply of electricity, either as a prosumer or as a consumer?
> How is it possible to generate the electricity needs of the village from its own renewable sources (small hydropower, PV)?
> Which organisational form is suitable for the operation of such a model?
> How is the billing organised between producers, consumers and prosumers?
> How about the power company and the grid operator? Which tariff models are sustainable?
> What are the technical challenges at the home access level, at the level of the network provider and the energy supply company?
> How can electricity flows within the village be measured and taken into account in the billing?
> To what extent are battery storage systems an economic supplement in the project and at what time?
> To what extent could heat generation from the biomass heating plant be generated by PV power in summer? How could it be managed by the existing thermal storage?
> Which legal requirements are necessary to realize the model?

Current status & results

> First simulation for several prosumer scenarios and for variants of EAG2020 by FH Vorarlberg.
> Insights from the simulated energy balances and the resulting economic efficiency: Saving is at a low level.
> Concrete further economic simulations planned for the summer of 2019 with concrete projects (financed from EU project IMEAS):
> PV systems at the dairy, school, Dornerhof and a private household; possibly existing PV systems in the village center. Plant size total approx. 150 - 200 kWp.

- Additional customers: Relieve bakery, local shops, guest house, detached houses, BM local heating network with hot water supply in the summer.
- Concrete results on economic scope for financing and settlement modalities in implementation.
- In-depth dynamic simulation of different concrete, realistic settings (scenarios) of electricity production from PV systems and specific customer objects based on load profile or power consumption data. The virtual energy flows are considered in kWh per ¼ h.
- A total of at least 5 scenarios are considered. Size of the LEC from approx. 100 kW to approx. 200 kW.
- Detailed consideration of a „Power to Heat“ variant with sensitivity analyses: Integration of the hot water supply of the existing biomass local heating supply. The goal is the representation of the storage potential and the temperature increase by the LEC entry in case of overproduction.
- Output of the simulations: PV power production, self-sufficiency object, self-sufficiency object, self-sufficiency LEC, occupancy rate LEC, LEC relation.
- Evaluation of the total cost of electricity purchased by all LEC participants.
- Cost-effectiveness analysis: Calculation of costs with consideration of various framework conditions for network tariffs, feed-in tariffs, electricity procurement costs, settlement costs.

7.1.3 OurPower

A) Author Information

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B) Project Information

Project Title	Development, promotion, and operation of a peer-to-peer online market place for renewable electricity
Location	Vienna, Austria
Time Period	Company founded October 2018
Funding	Private Sector: Mainly financed by growing number of coop members Government: Supported by Vienna Business Agency
Website	ourpower.coop
Keywords	#peertopeermarketplace, #regional power, #green electricity, #cooperation

C) Project Summary

Background & challenges

Re-think consumer scale power markets

Todays the gigantic potential of private engagement and investment into small scale renewables investment is untapped, and citizens are hard to motivate even to buy green electricity.
Main reason is the systematic deprivation of transparency, involvement, and democratic structure. Power producers have factually no market access to consumers and no means to negotiate fair prices. Ecologically motivated consumers who want to buy green have no choice as to rely on greenish utilities, i.e. power traders and green certificates. They cannot buy from next door solar or wind plants. The demotivating evidence finally is, that todays green buyers cannot help their e.g. solar power producing neighbours, see biogas plants in their village default, regional wind farm starve, and CO2 emissions soar.
OurPower is there, to empower citizen engagement in real green power.

Objectives of the project

Establish a peer-to-peer market place platform for renewable electricity

On OurPower.coop power producers from solar, wind, small hydro and biomass sources can sell their power at prices they choose or negotiate themselves to their neighbours and friends. Customers can compose their individual power seller portfolio and buy from people they know or soon may know.
The platform provides for partner matching and the necessary background support for the parties: power balancing and trading, market communication, grid and tax clearing, accounting and payment service etc., as well as community building and integration.

Current status & results

Successful start, Crowd Investment & first customers

OurPower.coop has been founded as European Cooperative (SCE) on Oct 11 2018.
The business model has been detailed out on terms of legal basis and necessary IT requirements. The first round of crowd investment, i.e. attraction of new members, will reach its financial target end of July. The Minimum Viable Product (MVP) of OurPower market platform is due in August 2019. Marketing for end customers has started in the focus region of Upper Austria. First producers and customers transactions are under contract and will set operational as well in August 2019, i.e. first customers to be supplied from OurPower seller.

Barriers & obstacles

Lack of resources

For the start the lack of financial and personal resources is the biggest obstacle to speed and the hardest of hardships. However, we belief this will actually turn out to be the most valuable driver for cooperative identity.
The real wall to overcome is the unbelievable stronghold of incumbents in the market, in regulatory bodies and politics, in education, universities and the industry, and even in the mindsets of most innovation or ecologically minded experts.

Key regulations, legislations & guidelines

Open Grid Regulation, energy democracy & contraction of incumbents

The EU Citizen / Renewable Energy Communities is pointing the right way: we need room for market players with long term ecological and social objectives and protect them from financial interested players.

Grid regulation must provide for easy usability for small players: easy access to grid, low administrative, fair access to grid data, democratization of grid operators: citizen cooperative, reversal of proof concerning grid capacities, fair grid tariffs accounting for regional, social, ecological, and climate strategical benefits of peer-to-peer communities.

Social backing of energy market transformation

Installation of an ombudsman to supervise incumbents' fair service to small producers, active consumers, prosumers, and citizen energy communities. Advisory body with 50% citizen energy representatives

7.2 Cluster 2: Energy Trading, Community Models and Advanced Services

The following section contains European research projects that are developing energy trading and community models as well as advanced services:

1. **PVP4Grid** aims at a better power system integration of PV with a focus on market integration. New management and business models to combine PV, storage, flexible demand and other technologies into a commercially viable product, will be assessed, improved, implemented and evaluated.
2. **DIGISOL** primarily encounters economic barriers incidental to collective self-consumption legal regime.
3. **FLEXCoop** introduces an end-to-end Automated Demand Response Optimization Framework. It enables the realization of novel business models, allowing energy cooperatives to introduce themselves in energy markets under the role of an aggregator.
4. **MERLON** introduces an Integrated Modular Local Energy Management Framework for the Holistic Operational Optimization of Local Energy Systems in presence of high shares of volatile distributed RES.
5. The goal of the project **Future Network Tariffs** is to show new possibilities for the design of the network tariffs in this field, which satisfy the fundamental requirements of social compatibility, fairness, equal treatment, technical feasibility, net serviceability, security, and comprehensibility.

Another interesting project is ROLECS (Roll-Out of Local Energy Communities, which is coordinated by Th!nk E (https://www.think-e.be).
Within ROLECS, a total of 25 companies and 5 research institutes kick-off an ambitious, interdisciplinary cooperative research project that aims to maximize the impact of energy communities by enabling them at different scales: residential, industrial, commercial and mixed communities. The local aspect is key, hence the term Local Energy Communities (LECs).

7.2.1 PV-Prosumers4Grid (PVP4Grid)

A) Author Information

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B) Project Information

Project Title	PV-Prosumers4Grid (PVP4Grid)
Location	Europe, focused on 8 target countries, incl. DE, BE, AT, IT, PT, ES, NL & FR
Time Period	01.10.2017 – 31.03.2020
Funding	By the European Union's Horizon 2020 research and innovation programme
Participating Organisations	> Bundesverband Solarwirtschaft (BSW-Solar) Germany (Coordinator) > Ambiente Italia (AMBIT) Italy > Associação Portuguesa de Empresas do Sector Fotovoltaico (APESF) Portugal > Becquerel Institute – ICARES Consulting (BI) Belgium > Eclareon (ECL) Germany > European Renewable Energies Federation (EREF) Belgium > Fronius International (FRO) Austria > FUNDACION TECNALIA RESEARCH & INNOVATION (TECNALIA) Spain > Laboratório Nacional de Energia e Geologia (LNEG) Portugal > TU Wien – Energy Economics Group (TUW-EEG) Austria > Unión Española Fotovoltaica (UNEF) Spain > Universiteit Utrecht (UU) Netherlands
Website	https://www.pvp4grid.eu/
Keywords	#prosumers, #grid, #energy, #community

C) Project Summary

Background & challenges

Europe's electricity sector is in the midst of major transformation moving from public monopolies into competitive private companies in liberalized markets. The liberalization of the market is expected to deliver more competitive and therefore more efficient and cheaper energy. Due to its cost and growth perspective, photovoltaics (PV) will be a key driver of this development throughout Europe because PV has reached a level of competitiveness that allows moving to self-consumption schemes in many European countries and eventually to peer-to-peer selling of the self-produced energy.

Such a "prosumption" role empowers consumers to participate actively in the electricity market by producing energy themselves. Additionally, technical developments such as battery systems or smart meters, and advanced business models promoting self-consumption change the technical design of the electricity systems. The success of these developments depends, however, on the regulatory and administrative framework in terms of energy policy and regulation, grid financing, taxation and legal relationships amongst the involved entities and it requires innovative solutions coupled with suitable business and management models to achieve sustainable system integration. Consequently, with the rapid growth of the share of electricity produced by variable renewable sources, especially by PV, innovative business and management concepts for private and commercial prosumers are a key element to facilitate PV market and system integration (PVP4Grid concepts).

Objectives of the project

PVP4Grid aims at a better power system integration of PV with a focus on market integration. New management and business models to combine PV, storage, flexible demand and other technologies into a commercially viable product, will be assessed, improved, implemented and evaluated.

With a strong involvement of all relevant key stakeholders for self-consumption, with an effective validation of the business and management concepts and with tailor-made recommendations derived on national and European level, this project will positively influence the overall regulatory and market conditions in the longer-term.

Current status & results

- Quantitative analysis of the PV prosumer market potential with focus on home owners, landlords, housing cooperatives, commerce, retail, services, and with 2nd priority industry and real estate companies. Qualitative assessment of technical benefits, grid environments, market options and barriers for PV prosumer business models and distortions for market-compatible PV market integration.
- Identification of existing management and business models for PVP4Grid concepts and improvement of these concepts by taking the interdependence with different market frameworks into account. For this the project concept approach features an in-depth analysis of the PV competitiveness of the implementation of the developed improved PVP4Grid concepts into European electricity markets by means of implementation scenarios for different market design.
- Investigation of the market readiness of PVP4Grid concepts with real-life testing for market implementation with an increased level of renewable energy shares.

The achieved results of the PVP4Grid project include

> Analysis of the PV self-consumption models, incl. the identification of the potential and the barriers at national level.
> Improvement of PV prosumer models for the grid infrastructure: through the validation of PVP4Grid concepts.
> Prosumer guidelines: designed to answer the questions that are most frequently raised by potential prosumers during the design and implementation of a particular PV project (at national level).
> PVP4Grid calculator: answers the question about the profitability of investing in a PV system, incl. the use of heat and e-mobility by comparing the cost per kilowatt hour (kWh) PV electricity with the current grid electricity and heat generation costs.

Please visit the website for further information: https://www.pvp4grid.eu/

Barriers & obstacles

Individual self-consumption is allowed and feasible all of the target countries analysed. However, collective self-consumption, independently of the scale (individual building – residential, commercial- and at larger scale in districts / group of buildings), is currently not feasible in most of the countries. Despite the fact that PV Prosumer (PVP) concepts that use the public grid to sell excess PV electricity to third parties are legally allowed, such schemes are hardly ever seen operational in real life, due to economic / administrative / regulative barriers.
The analysis of the barriers per country (in the national language) and an English summary can be found in the “Report on PVP4Grid concepts” on the website.

Key regulations, legislations & guidelines

The key regulations in each of the target countries and an English summary can be found also in the “Report on PVP4Grid concepts” on the website.
Until now the consortium has developed “Prosumer Guidelines” at national level. These guidelines answer the main questions that are most frequently raised by potential prosumers during the design and implementation of a particular PV project. The guidelines were developed in the 8 target countries (in the national language), as well as an English summary.

7.2.2 DIGISOL

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B) Project Information

Project Title	DIGISOL
Location	France
Time Period	2017-2020
Funding	Government Private Sector
Participating Organisations	> TECSOL (Coordinator) > Sunchain > Roussillon Aménagement
Website	https://www.ademe.fr/digisol
Keywords	#collectiveselfconsumption, #solarenergy, #blockchain

C) Project Summary

Background & challenges

Self-consumption of solar electricity has been recognised in French law for more than 3 years. France can then be considered as an EU pioneer on this topic. But there are two realities. Whereas individual self-consumption is well established with 40 000 households equipped in 2018 and 47 000 in Q1 2019, collective self-consumption progresses far more slowly with only around 10 projects operational to date. Within the framework of the national multi-annual energy programming (PPE) being discussed, French Government plans between 65 000 and 100 000 self-consumption installations by 2023, which is not a lot. According to transmission system operator RTE estimations, the number of self-consumers could double each year and amount to 4 million by 2035 representing 9 to 20 TWh (maximum 4% of the total French electricity consumption).

Objectives of the project

DIGISOL is an ambitious collaborative innovation project carried by solar engineering company TECSOL, start-up focused on energy & blockchain Sunchain, and public local land developer Roussillon Aménagement. It is supported by the French funding system called Investment of the Future, managed by the French Environment and Energy Management Agency ADEME.
This consortium aims at implementing a blockchain solution in order to optimise the sharing of energy in collective self-consumption operations. It is targeted to deploy the solution in up to 500 multi-family buildings and eco-districts by 2021.

Current status & results

First pilots are operational. For instance, a municipality in Southern France (Prémian) has recently become a producer with nearly 30 kWp decentralised PV installed on the local culture and art center providing cheap solar electricity to other public buildings in the village (school, post office...) as well as to several other users (bakery, inhabitants...) nearby. Thanks to Sunchain's service, the municipality can count on a reliable and certified energy management system and value this digitally enabled system towards all Prémian citizens in order to further energy transition locally.

Barriers & obstacles

DIGISOL primarily encounters economic barriers incidental to collective self-consumption legal regime. That is to say that collective self-consumers are not exempted from taxes and network tariff on electricity locally produced and consumed. Thus, there is barely no economic incentive on the invoice to participate to such communities. Furthermore, the administrative process is complicated as you need to dispose of or create a more or less specific legal entity organising the operation towards the distribution system operator and clustering each participant. DIGISOL comprises a sociological study, which is ongoing and may reveal other issues at stake.

Key regulations, legislations & guidelines

Collective self-consumption was first defined with ordonnance n°2016-1019 of July 27th 2016 after which a structuring application decree was published in 2017. New legal rules have been implemented in May 2019 with so-called PACTE law. In particular, the scope has been expanded. Initially, participants needed to be located below one same substation. Now, they have to be on the low-voltage grid and respect a geographical condition: French Government announced the possibility of 1 km beams, but a ministerial decree is expected to precise it.
The DSO (Enedis covering 95% of the territory) calculates the electricity attributed to each consumer on a time step of 30 minutes and according to rules defined by the legal entity organising the operation. This requires communicating meters set up on all generation and consumption sites.

7.2.3 FLEXCoop

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B) Project Information

Project Title	FLEXCoop
Location	EU
Time Period	10/2017 – 9/2020
Funding	Government / EC

Participating Organisations	> Fraunhofer > ETRA > Som Energia > ODE > REScoop.EU > CIMNE > CIRCE > DTU > Hypertech > Grindrop > Koncar > MERIT > Suite5
Website	http://www.flexcoop.eu/
Keywords	#energycooperative, #selfconsumption, #flexibility, #smartgrids, #demandresponse

C) Project Summary

Background & challenges

Residential buildings comprise a huge source of flexible energy demand and storage, potentially providing distribution and transmission system operators with the needed services to balance demand and supply and manage power quality. As it becomes apparent, the participation of European residential and small commercial/industrial users, accounting for ca. 70% of final electricity consumption has been limited, not only due to the lack of real time metering infrastructure and smarter electricity grids, but also due to the non-availability of a robust regulatory framework in most EU Member States. This prohibits small demand units from teaming up, aggregating their flexibilities (under the umbrella of Demand Side Aggregators) and bidding aggregated/ large volumes of flexibility in the energy markets as a highly competitive and attractive commodity. Most EU countries which have opened their product requirements to Demand Response have allowed aggregated load to participate, however market penetration remains extremely low due to both technological and market operation barriers.

Objectives of the project

FLEXCoop introduces an end-to-end Automated Demand Response Optimization Framework. It enables the realization of novel business models, allowing energy cooperatives to introduce themselves in energy markets under the role of an aggregator. It equips cooperatives with innovative and highly effective tools for the establishment of robust business practices to exploit their microgrids and dynamic VPPs as balancing and ancillary assets toward grid stability and alleviation of network constraints.
Optimisation in FLEXCoop applies to multiple levels. It spans local generation output, demand and storage flexibility, as well as the flexibility offered by EVs (in their dual

role as demand and storage assets) to facilitate maximum RES integration into the grid, avoidance of curtailment and satisfaction of balancing and ancillary grid needs. This is achieved via automated, human-centric demand response schemes with the participation of appropriately selected residential prosumers. To enhance prosumer acceptance, the FLEXCoop innovative, value-adding services will feature non-intrusiveness, comfort and well-being preservation, non-violation of prosumer daily schedules as well as maximization of benefits through transparent and open participation in markets.

Current status & results

At the moment the main outcomes of FLEXCoop are exclusively technological solutions that will soon be validated in the project's demo sites. In the following, only a few tools are listed. Please visit the Expera platform to view the full description of this project: https://expera.smartgridsplus.eu.

Tools for energy cooperatives

> To accurately forecast Demand Response potential and demand flexibility of prosumers
> To optimally segment, classify and cluster/ aggregate demand and storage assets for the formulation of spatio-temporal VPPs for the provision of flexibility services to the distribution grid
> To continuously monitor the evolution of Demand Response events and signals and revise pre-defined strategies with the re-configuration of dynamic VPPs.

Tools for prosumers

> To increase their awareness and knowledge of their consumption patterns, generation forecasts and demand/ storage flexibility capacity
> To increase their local intelligence via the Human-Centric Energy Management and Control Decision Support framework that locally optimizes demand response.

Barriers & obstacles

Several critical barriers may affect the realization of FLEXCoop impact:

> Going into a new business, dealing with new project funding schemes, assimilating new skill-sets for trading in the balancing/ancillary service markets, operating and maintaining novel ICT tools, new ICT infrastructures, leveraging new revenue streams and accounting for cost centres, etc. require a fundamental restructuring of the organizational and operational structure of the cooperative.
> The proliferation of explicit demand side flexibility also faces barriers. In many countries, independent Demand-Side Flexibility aggregators are currently hindered from entering the energy market, and a clear regulatory framework is missing. Also, many flexibility markets are closed for demand products, as outlined in the SEDC Demand Response Map. Even though participation of demand will be permitted in all Member States on the short-term, the abolishment of all regulations on code that discriminate against it will apparently still take some time.

Read full text on the expera platform: https://expera.smartgridsplus.eu

Key regulations, legislations & guidelines

The introduced concept and envisaged activities in FLEXCoop are in full compliance and capable to contribute to the realization of the recently published directives included in the Energy Union Winter Package - Clean energy for all Europeans.

In addition, FLEXCoop directly addresses the core priorities of the European Research, Innovation and Competitiveness SET-Plan relevant to the demand response domain.

Read full text on the expera platform: https://expera.smartgridsplus.eu

7.2.4 MERLON

A) Author Information

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B) Project Information

Project Title	MERLON
Location	EU
Time Period	1/2019 – 12/2021
Funding	Government / EC
Participating Organisations	> Imperial College London > University of Newcastle > SOREA > MERIT > Energie Güssing > EEE > Suite5 > University of Peloponnese > Hypertech > COBRA > ATOS
Website	https://www.merlon-project.eu/
Keywords	#localenergycommunity, #storage, #blockchain, #smartgrids

C) Project Summary

Background & challenges

Renewable Energy Sources (RES) have and will continue to spearhead the race for clean electricity generation. A paradigm shift is ongoing, however, that fundamentally transforms their interaction with the electricity grids. Hydro-electric power generators, which used to dominate clean generation, have been surpassed by large-scale, off-shore wind farms that have fewer deployment constraints and leverage a resource that is not geographically limited. These in turn are expected to be overshadowed by the proliferation of decentralized intermittent RES by 2030 and beyond. This type of generation systems includes de-centralised, small-scale wind farms and photovoltaic systems that are connected directly to the distribution grid, in contrast to centralised generation plants that are typically connected to the transmission grid. This evolution effectively combines two major trends: i) electricity generation decentralisation, and ii) progressive loss of generation control and accurate predictability. Both are mainly caused by the economics of generation infrastructure, but are also actively supported by EU policies in order to advance the goals of the competitive, secure and sustainable energy system and the establishment of the EU Internal Energy Market.
Despite their obvious benefits for the energy system as a whole (e.g. decarbonisation, security of supply, reduction of energy imports, transition to an internal energy market), the grid integration of variable and intermittent RES (VRES) presents major challenges in matching their non-deterministic output to electricity demand. At a national and macro-European level, projections over increased RES uptake entail capacity gaps. Capacity gaps have traditionally been filled with carbon intensive base and peak generation plants such as coal, nuclear and gas fired stations, supported by national interconnectors coupled at the transmission system with different levels of controllability. Further increase of RES uptake would beget augmented levels of curtailment to reduce the amount of investment required to accommodate generation peaks; such curtailment levels are estimated to reach 217 TWh by 2050.

Read full text on the expera platform: https://expera.smartgridsplus.eu

Objectives of the project

MERLON introduces an Integrated Modular Local Energy Management Framework for the Holistic Operational Optimization of Local Energy Systems in presence of high shares of volatile distributed RES. MERLON will enable the realization of novel business models, allowing local energy communities to introduce themselves local flexibility markets (for local energy system optimization), while paving the way for the realization of novel Microgrid-as-a-Service models, assigning to local DSOs the role of "Aggregator of Aggregators" for the provision of added value services to the overlay distribution grid. It equips local stakeholders (DSOs, energy cooperatives, prosumers) with innovative and highly effective tools for the establishment of robust business practices to exploit their microgrids and dynamic VPPs as balancing and ancillary assets toward grid stability and alleviation of network constraints.

Optimization in MERLON applies to multiple levels. It spans local generation output, demand and storage flexibility, as well as the flexibility offered by EVs (in their dual role as demand and storage assets) and interconnection with heterogeneous energy vectors (CHP) to facilitate maximum RES integration into the grid, avoidance of curtailment and satisfaction of balancing and ancillary grid needs. This is achieved via integration of innovative technologies for local energy systems integration (Smart Inverters with grid forming and islanding capabilities), human-centric demand response, optimized energy storage, G2V realization, Virtual Thermal Energy Storage and coordination with local CHP plants and their operational optimization under a holistic Integrated Local Energy Management System.

Current status & results

The project is currently at its early implementation phase, with first results being expected soon.

Barriers & obstacles

The MERLON solution eliminates a number of barriers for the consumer empowerment through demand response and electricity market participation according to the EC pertaining to: i) demand flexibility discovery and aggregation, ii) system interconnection and interoperability, iii) availability of demand response management systems to optimally utilise and mobilise demand flexibility, and iv) definition, elaboration and validation of business models to enable cooperatives operate as aggregators. Several critical barriers remain, however, to realize the MERLON impact beyond project duration. In the following, only a few key points are listed. Please use the expera platform to view the full description of this project: https://expera.smartgridsplus.eu

> The necessary business model transformation at local energy systems will be a challenging process.
> In many countries, independent Demand-Side Flexibility aggregators are currently hindered from entering the energy market, and a clear regulatory framework is missing.
> Another possible concern stems from market conditions pressing the value of flexibility.
> Roll-out of smart meters and penetration of smart appliance is very slow.
> User acceptance of smart appliances and intelligent energy management systems is low.

Key regulations, legislations & guidelines

The introduced concept and envisaged activities in MERLON are in full compliance and capable to contribute to the realization of the recently published directives included in the Energy Union Winter Package - Clean energy for all Europeans.

In addition, MERLON directly addresses the core priorities of the European Research, Innovation and Competitiveness SET-Plan relevant to the demand response domain.

7.2.5 Future Network Tariffs

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B) Project Information

Project Title	FNT
Location	Austria
Time Period	03/2019-02/2020
Funding	Government Private Sector
Participating Organisations	> Energieinstitut an der Johannes Kepler Universität Linz (EI-JKU) > Fachhochschule Salzburg GmbH (FHS) > Salzburg Research Forschungsgesellschaft GmbH (SRFG) > E-Control (E-CONTROL) > Salzburg Netz GmbH (SNG) > Netz Oberösterreich GmbH (NOG)
Website	https://projekte.ffg.at/projekt/3205642
Keywords	#futurenetworktariffs

C) Project Summary

Background & challenges

The current financing system of the public electricity grid is called into question by the continuous expansion of decentralized generation facilities, the digitalisation of electricity grids, and the changing demands of end-users. With the introduction of smart metering there is the opportunity for completely new tariff models to finance electricity grids.

Objectives of the project

The goal of the project FNT is to show new possibilities for the design of the network tariffs in this field, which satisfy the fundamental requirements of social compatibility,

fairness, equal treatment, technical feasibility, net serviceability, security, and comprehensibility. In addition, these new dynamic network tariffs will support the efficient use of energy, as well as innovative business models, for example in the area of self-consumption optimization.
The best possible fulfilment of these various, often competing requirements is currently developing into a major research topic across Europe. What is missing so far, especially for the Austrian case, is an interdisciplinary consideration of the topic including the involvement of all relevant stakeholders, to holistically analyse the challenges of new network tariffs from the technical, economic, social, political, regulatory and organizational perspectives and identify critical interactions.

The consideration of this topic in FNT is based on the concrete use cases, such as:

> The effect of price incentives on consumer behaviour, and consequently network-level behaviour
> Local energy communities (LECs)
> Electric mobility

The research agenda is developed by the consortium with the involvement of additional stakeholders from across the value-chain spectrum. The consortium consists of the regulator E-Control, two network operators, as well as research partners, who can cover the various important perspectives across individual research disciplines. Energy suppliers, business partners and other stakeholders will be involved through workshops. The consortium for a follow-up project will be expanded according to the results of this exploratory project (especially for additional energy suppliers and business partners). The exploratory project FNT prepares the research agenda for an overall systemic analysis of dynamic tariffs and their environment. The research is carried out from the perspective of Austria, taking into account European framework conditions and existing findings and results.
In addition to the preparation of an integrated research approach for a follow-up project, the first evaluations of tariff models are already being carried out in selected areas, specifically with regards to their socioeconomic implications, technical feasibility, and requirements for IT security and user acceptance.

Current status & results

Identifying Use Cases of Energy Communities in Austria and further develop network tariffs for the whole system. Analysis of the challenges of new network tariffs from the technical, economic, social, political, regulatory and organizational perspectives and identify critical interactions.

Barriers & obstacles

Legislation has to be changed in order to fulfill the changes by the new directives of the European Union. Furthermore, legislation concerning the property or rent of flats and houses often impede the installation of solar photovoltaic panels on the rooftop of houses, because all the owners have to agree on it.

Key regulations, legislations & guidelines

ElWOG
Clean Energy Package (EU)
Electricity Directive (EU)

7.3 Cluster 3: Energy Grids and Integration of E-Mobility

In the following section projects are listed that try to solve challenges related to energy grids and the integration of e-mobility. Some of them are sub-projects of bigger programs or Living Lab initiatives.

1. The pilot location **Luče** (as part of Horizon 2020 **COMPILE** project) is looking for opportunities of remote areas or areas weakly connected to the grid (energy islands).
2. The project **RegEnergy** aims to study the technical and economic opportunity represented by the creation of a self-consumption consortium (SCC) including load management by stationary and/or mobile storage systems (via electromobility) for technopark, industrial zone and/or commercial zone type areas.
3. **TurningTables** is an energy ecosystem working hands on with innovators to build, validate and scale disruptive technologies and business models.
4. The Living Lab **act4.energy** focuses on solving the problems of renewable energies integration with a focus on photovoltaic power paired with local consumption, linked to the high fluctuation of renewable energies.
5. **Active demand-side management – GAC** offers a solution for remotely piloting the household equipment in order to optimize the consumption at the house and neighborhood levels.

7.3.1 Pilot location Luče (as part of Horizon 2020 COMPILE project)

The main aim of COMPILE is to show the opportunities of remote areas or areas weakly connected to the grid (energy islands) or decarbonisation of energy supply, community building and environmental and socio-economic benefits. These opportunities will be demonstrated at five pilot sites with the help of six COMPILE tools.

The main objectives of COMPILE are:

> Empowering Local Energy Systems (transition from a centralized system into a flexible but secure decentralized network)
> Optimal integration and control of all energy vectors, storage and electromobility options to maximize decarbonisation and energy savings
> Foster the creation of energy communities considering positive effects on the local economy and user acceptance including vulnerable groups
> Create new ways to stimulate actors in the value chain to cooperate to maximize the societal benefit, to foster the adoption of the technological solutions and enable a large-scale replication of the developed technological solutions and business models.

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B) Project Information

Project Title	Pilot location Luče (as part of Horizon 2020 COMPILE project, grant agreement N° 824424)
Location	Community of Luče, Slovenia
Time Period	November 2018 – April 2022
Funding	Government (EU Commission) Private Sector
Participating Organisations	> Local population (energy generation, consumption) > Petrol d.d. (Energy Supplier, Electric Mobility Manager, Storage manager, Aggregator) > Elektro Celje, d.d. (DSO) > ELES d.o.o. (TSO) > Biomasa d.o.o. (local energy generation) > ETREL (smart charging software supplier) > University of Ljubljana (Academia) > JOANNEUM RESEARCH (Research institute)
Website	https://www.compile-project.eu/
Keywords	#energycommunities, #gridreinforcement, #pv, #storage

C) Project Summary

Background & challenges

The pilot site Luče is situated in the remote Upper Savinja Valley in the Slovenian region of Štajerska. The municipality counts 400 people in 160 households. Luče is a small rural alpine village with a weak supply connection with the near-by town Ljubno through an MV overhead line leading to frequent power outages due to weather events. The low capacity of the local LV network also results in curtailment of the distributed renewable energy generation as the voltage during the day rises above the allowed limits.

Objectives of the project

Within the project COMPILE, different scenarios will be tested and analysed such as the inclusion of electric vehicles and a high share of renewable energy production on a micro grid level. It should also be proved that reliability of supply issues on micro grid level can be successfully addressed with a suitable energy management within an Energy Community (EnC). In order to be able to test the planned scenarios the following set of hardware will be used:

- 102 kW PV panels on 9 houses
- 5 household batteries (5 - 20 kWh)
- a community battery storage with 150kW/333kWh
- smart meters.

Current status & results

The onsite examination of needs is carried out and individual offers for PV and batteries were received. Contracts for PV are signed between Petrol and the nine household members of the EnC Luče. The total installed power is 102 kW. For three member households, contracts for batteries were signed with Petrol, two additional household batteries will be donated by Petrol. The storage selection procedure was performed and contracts between Petrol and the storage provider were signed. Smart meters are installed.

Barriers & obstacles

In order to reach the energy transition objective of the village and population of Luče, there are two sets of challenges. For the integration of an optimal amount of renewable energy in the local energy system, the local grid has to be reinforced. Also, in order to empower the local citizens to understand and support the technical actions, COMPILE will implement a community engagement strategy.

The main technical challenges are:

- Connecting community batteries to the transformer station. Therefore, modifications of the transformer station will be made, allowing also island mode operation.

- Establishing robust communication between all elements in the grid (e.g. communication between the microgrid control tool “GridRule” and the “HomeRule” Home Energy Management System).
- Operating the EnC in a way that the production from existing and newly installed PV is not curtailed.

The local village has proved willing and able to perform engaging actions, the next step is to get collectively organised, i.e. to:

- Formalize the energy community organisation in order to have a clear partnership and to represent and engage the citizen community.
- Expand the community engagement process in order to enable participation for the entire village (today only a small part of the village has access to the scheme).
- Enhance the relationship with the municipality in order to explore new collective investment opportunities.

Key regulations, legislations & guidelines

Slovenia has adopted a new regulation on self-supply for electricity from renewable energy sources that entered into force on May 1st 2019. Slovenia does not yet regard the new regulation as a transposition of the Clean Energy Package but as a way to stimulate private investments into renewable energy and as an important step towards a later transposition of the related EU directives. In this framework, collective self-consumption of multi-apartment buildings but also of RES communities is enabled. RES communities can be formed by customers in various types of dwellings. The RES production unit can be located at a separate building and is connected to a dedicated production metering point on the LV distribution grid. The consumers participating in the RES community can consume electricity through two or more consumption metering points. These metering points need to be connected to the LV distribution grid of the same LV transformer station as the metering point of the RES production unit. It is important that the RES production unit is not (and has never been) taking part in a RES support scheme. With this new bylaw, a first basis has been created to allow for the organisation of energy communities such as in the Luče case.

7.3.2 RegEnergy

A) Author Information

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B) Project Information

Project Title RegEnergy: Swiss case study - Development of business models supporting a coordinated deployment of PV and storage in industrial zones

Location	Yverdon-les-Bains, Switzerland
Time Period	2018-2022
Funding	Public funding: State level (SECO/ARE) Regional level (Canton de Vaud) Local level (Ville d'Yverdon-les-Bains)
Participating Organisations	> HEIG-VD > GreenMotion > GridSteer > Service des énergies de la Ville d'Yverdon-les-Bains (SEY)
Website	http://www.nweurope.eu/projects/project-search/regenergy-renewable-energy-regions/
Keywords	#selfconsumption, #mobilestorage, #RESintegration

C) Project Summary

Background & challenges

Since the beginning of 2018, the framework conditions for promoting the production of electricity from photovoltaic (PV) sources in Switzerland places self-consumption at the centre of the solar industry's business models. The feed-in tariff scheme has been replaced by an investment aid and the legal framework for the creation of self-consumption consortiums (SCC), allowing several consumers to be integrated as a single point of consumption for the electricity network, has been created. These new framework conditions aim to accelerate the deployment of PV in order to achieve the objectives set out in the Energy Strategy 2050. However, once a certain level of deployment has been reached, PV panels complicate load management on the distribution network by creating overvoltage problems, particularly because of their intermittent nature.
On the other hand, Switzerland targets 15% of electric vehicle registrations by 2022, and technical progress is leading to the design of vehicles whose battery life exceeds by far the needs of mobility use. Indeed, a 100 kWh battery supporting 4,000 cycles can cover 2,000,000,000 km. The dual use of these storage facilities will therefore play a central role: their use to increase the integration of decentralized energies brings economic and ecological advantages that the market will quickly grasp. The keyword Vehicle to Grid (V2G) has already made a notable appearance.
In this technical-legal context, the creation of self-consumption consortiums combined with stationary and/or mobile storage systems via electromobility has several advantages:

> optimization of self-consumption: mainly economic advantage resulting from the saving of network costs and taxes for the electricity produced and consumed within the consortium

> smoothing of power peaks (production and consumption): economic advantage in the case of network pricing with power component (CHF/kW) but also and in particular better management of the load on the network at the consortium level

From a load management point of view, storage optimization at the consortium level allows a higher PV penetration rate for the same electricity grid capacity. In this context, what is the role of stationary storage vs. electromobility (mobile storage)? And according to which business models? Our project consists in a case study on Y-Parc in Yverdon-les-Bains with the attempt to answer these questions.
Y-Parc is a technological innovation cluster. Like many areas of this type, it is located on the border between rural and urban areas. This configuration generates a lot of commuting by employees and passing persons, often by car. This represents a unique opportunity to develop innovative business models, combining local PV production with electromobility. In addition, the electricity consumption of companies located in this type of area is often high (e.g. industrial) and can follow very different profiles. In this context, grouping and managing the grouped load by stationary and/or mobile storage is therefore particularly promising to accelerate PV deployment.

Objectives of the project

The present project aims to study, on the basis of the Y-Park in Yverdon-les-Bains, the technical and economic opportunity represented by the creation of a self-consumption consortium (SCC) including load management by stationary and/or mobile storage systems (via electromobility) for technopark, industrial zone and/or commercial zone type areas.

- Identify through different series of simulations the optimal storage deployment from a technical (stabilization of the network load) and economic (minimization of overall electricity supply costs) point of view at the Y-Park scale for scenarios with 100% PV deployment and 100% electromobility
- Develop attractive business models for Y-Park type zones (technopark, industrial and/or commercial zone) to support a coordinated deployment of PV and storage based on deployment simulations and a study of stakeholders' interests
- Validate the simulations and business models proposed through a pilot project realization on Y-Parc

Current status & results

The project has just started. So far, we have made progress in the following areas:

- Collection of electricity consumption data at Y-Parc: for the optimization algorithm to work we need ¼ hour or hourly electricity consumption data of all the relevant consumers. For that, proxy requests for receiving them directly from the local distribution system operator (SEY) have been sent to all the companies based at Y-Parc. We have had a 50% response rate and made sure to have all the main consumers covered. In a second phase, we received 10 min monitoring data from SEY covering the consumption at all the electrical substations within Y-Parc. We have now all the necessary consumption data we need to start the simulations.
- Grid structure data: through several exchanges with SEY, we now know how the electricity grid is structured within and around Y-Parc, the location of the substations, the cable capacities, etc. We have entered this information into our simulation model so that the technical constraints related to the grid capacity can be taken into account. A key finding here is that, for our project, only the low-voltage grid capacity will be limiting. Due to local specificities, the medium voltage grid is oversized.

- Survey for Y-parc employees: our partners at the HEIG-VD are helping us surveying the employees at Y-Parc around their commuting habits and their willingness to exchange their current vehicles for an electrical one based on different factors (autonomy, availability of charge stations, cost and length of charge, vehicle to grid considerations). The results on the commuting habits will help us feed the simulations with mobility flows specific to Y-Parc and the results on the readiness to switch to electric will feed into the business model development
- Simulation tools: the simulation tools that we need for this project build up on simulations tools that were previously developed by Planair. One of them especially is a tool serving for the sizing of a PV-storage systems based on self-consumption and peak-shaving optimization. One of the needed developments for RegEnergy is to add mobile storage (e-mobility) to the sizing algorithm. This has been done successfully, we are now ready to start the simulation.

Barriers & obstacles

Here are the main barriers and obstacles we have faced so far:

- The local distribution grid structure at Y-Parc is too intertwined with the rest of the distribution grid. The electricity flows crossing Y-Parc are far greater than what's consumed there. Each electrical substation is supplied by different rails. This makes the initial plan of creating one self-consumption consortium (SCC) on the entire Y-Parc impossible. We thus have to study the creation of several SCC at substation levels. However, the advantage of creating SCC is usually smaller when less consumers are involved. SEY, as the local DSO, would be open for the creation of a virtual SCC. This would solve the problem but for now it's not allowed by the law fixing the rules for the financing of the electrical grid infrastructure.
- Limitations in computing capacities with the optimization algorithm taking into consideration electrical mobility: we had to convert our 10 min and ¼ hour electricity consumption data into hourly ones and we had to limit ourselves to two main types of e-mobility users profiles: private electrical cars belonging to commuters working in Y-Parc and car fleets belonging to companies based in Y-Parc.

Key regulations, legislations & guidelines

- Legal framework for the creation of self-consumption consortiums (in effect since 2018)
- Investment aid for PV: The government subsidies 20-25% for all investments in PV power plants

7.3.3 TurningTables Living Lab

A) Author Information

Country	Spain
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B) Project Information

Project Title	TurningTables Living Lab
Location	Granada, Spain
Time Period	Long-term project
Funding	Private Sector
Participating Organisations	> Grupo Cuerva > TurningTables > Lawrence Berkeley National Lab > Repsol > University of Granada > Láchar-Peñuelas city hall > Escúzar city hall
Website	www.turningtables.global www.vergy.es
Keywords	#livinglab

C) Project Summary

Background & challenges

TurningTables is an energy ecosystem working hands on with innovators to build, validate and scale disruptive technologies and business models. Our vision is to empower innovators to positively impact on people, society and the planet trough 100% sustainable energy. Our mission to bring the resources that enable energy innovators full speed building, validation, and scaling.
We found out that the main obstacles preventing innovation in energy are:
> Lack of long-term incentives for innovation for utilities
> Startup and innovators don't have access to energy system agents' resources
> Lack of good quality source of energy data

To make that possible TurningTables is developing a Living Lab open to the community of re-searchers, innovators, and entrepreneurs working in the energy field. We're doing it in collaboration with high level partners:
> Grupo Cuerva: 70+ years of activity in the energy sector. Present in the generation, distribution and energy trading space.
> Lawrence Berkeley National Lab: Lawrence Berkeley National Laboratory (LBNL) is synonym of "excellence" in the energy research area. 13 Nobel prizes are associated with this lab. 60 of their researches are members of the National Academy of Sciences (NAS).
> University of Granada: One of the most prestigious academic institutions in Europe and worldwide. Especially relevant in the AI and Computer Science field, where the university ranks 33 in the Shanghai world index, 7 in Europe and 1 in Spain. It has 3 of the top 10 worldwide most cited researchers in AI.

> Repsol: one of the largest energy companies, present in the entire value chain: exploration and production, transformation, development and commercialization of efficient, sustainable and competitive energy.

Objectives of the project

TurningTables Living Lab aims to create a building and validation platform to implement new technologies and business models supported by the digital utility of the future. The main characteristic that differentiates TurningTables Living Lab from other real-life demonstrators is:
1. Open data philosophy
2. Community engagement
3. Public institutions engagement

Some of our goals are:
> To develop grid technology infrastructure as a building block for experimenting ideas and business models.
> To set up a smart energy platform to create opportunities for established companies and start-ups to evaluate and test business models.
> To open data for the research community enabling concept demonstration.
> To create a link between education, policy makers, and energy industry.

To increase the knowledge of the Living Lab partners on the emerging technologies and business models that will define the grid of the future.

Current status & results

> We've already signed a collaboration agreement with the city halls of the 2 villages part of the LL
> We've characterized more than 700 households
> We have launched a project related to energy communities. It includes PV+battery deployment in 5 households. Planning more installations in the coming months
> We have launched a project related to health and the smart home. It includes full sensing of this households
> We've already provided 15 households with energy submetering and planning new installations in the coming weeks
> Medium voltage simulation platform already developed and working on low voltage simulation platform

Barriers & obstacles

Main challenges are around:
> Community engagement (how to build the community and involved rural areas in an innovative project)
> Communication structure (connectivity)

Not a barrier so far but legal processes are important and sometimes have reduced agility on specific projects.

7.3.4 Living Lab act4.energy

A) Author Information

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B) Project Information

Project Title Innovation Lab act4.energy

Location Stegersbach, Austria
Time Period 1.1.2018 – 31.12.2022
Funding Government: 50%
Private Sector : 50%

Participating Organisations
> Ministry of Transport, Innovation and Technology (via FFG funding agency and City of Tomorrow program)
> 10 municipalities (Bocksdorf, Burgauberg- Neudauberg, Kemeten, Kukmirn, Litzelsdorf, Oberwart, Olbendorf, Ollersdorf, Rauchwart, Stegersbach)

Website www.act4.energy

Keywords #pvselfconsumption, #localenergycommunity, #regionalenergysystems, #openinnovation, #cocreation

C) Project Summary

Background & challenges

The Innovation Lab act4energy is set up as an innovation laboratory project. Its focus is to solve the problems of renewable energies integration with a focus on photovoltaic power paired with local consumption, linked to the high fluctuation of renewable energies.

The region Oberwart-Stegersbach is situated in the province Southern Burgenland in Austria. It qualifies itself by several factors, including an already existing dense network of partners. The geographical and demographical structure (easy to replicate), a well-developed photovoltaic-scene backed by the photovoltaic initiative Sonnenkraftwerk Burgenland and several already established topic-specific R&D projects. Based on the associated synergy effects, as well as based on the inclusion of open minded and motivated stakeholders the area is especially suitable for the realization of an innovation laboratory.

Objectives of the project

The aspired solutions and concepts aim to stabilize the energy production of renewable energy sources, with the underlying objective of easing their breakthrough. To achieve this goal a permanent, optimised energy-load-shift and the implementation of storage-options combined with a comprehensive energy- management-system (sector coupling) is necessary.
The intended individual coverage of usage-bound energy supply includes the segments electricity, heat and mobility. With regard to a holistic solution, the development is linked to a close collaboration with its potential users. This demo-region is implemented according to the target to design an innovative future scenario. The key factors are the establishment of an open-innovation-approach as well as the creation of a know-how-pool, with the goal of defining an explicit, comprehensible, praxis oriented and reproducible concept.

Current status & results

The Innovation Lab act4energy is positioned to be an open innovation community. Its goal is to link the population, social organisations, the representatives of economy and unions and the so called „inner network" of the open innovation community, with each other.

The inner network includes research centers, corporations, municipalities and organisations, which are related to renewable energy / energy flexibility / energy efficiency and energy availability.

> Access: For the approached target group a fair opportunity is created to contribute and benefit from the open innovation community.
> Know-how transfer: Experience gathered from the executed co-creation processes, as well as expertise from economy, science, unions and administration are freely available.
> New energy supply: The active contribution to engage a „renewable energy supply concept" creates individual, public, regional and international possibilities concerning the future energy supply.
> Business opportunities: Provider of products/services related to energy logistics awaits a corresponding future market, which leads to the benefit of all actors. Additionally, access to know- how, involvement in projects, opportunities of business deals and network expansions are expectable.

Barriers & obstacles

The Innovation Lab aims to demonstrate energy solutions in real-life situations. As such more often than not technically and economically feasible solutions are prohibited by regulations. Navigating in the regulatory framework to develop and test decentralized, local energy solutions is the biggest challenge.

Key regulations, legislations & guidelines

Regulatory framework as set by the Austrian regulator E-Control.

7.3.5 Active demand-side management – GAC

A) Author Information

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B) Project Information

Project Title	Active demand-side management – GAC
Location	Wallonia, Belgium
Time Period	38 months
Funding	Government Private Sector
Participating Organisations	> CETIC (Research institute) > haulogy (private company) > AREWAL (private company) > ULB (University)
Keywords	#pvselfconsumption, #smartenergysystem, #demandsidemanagement

C) Project Summary

Background & challenges

We are facing nowadays an increasing consumption of electricity in residential neighborhoods, more specifically with the upcoming trend of electric cars and the household electrification. Also, there is an increase in the decentralized electricity production, especially with Photovoltaic (PV) production units. There is usually a mismatch between the production (mainly during the day) and the consumption (peaks in the morning and evening) that results in additional stress on the electricity grid and increasing electricity bills for the consumers. Indeed, tariff incentives are commonly introduced by the grid operators but they cannot be manually followed by the users, resulting in extra costs.

The challenge in the future will be to control the residential electricity generation and consumption in order to avoid major issues on the grid and limit the required investments. It is thus necessary to push towards local consumption of electricity and use the flexibility of the grid users to act in real-time in function of the grid conditions.

Objectives of the project

The solution offered in this project consists in remotely piloting the household equipment in order to optimize the consumption at the house and neighborhood levels. A gateway is placed in each household to exchange information with a central platform and receive commands to pilot the loads. The monitoring and optimization aim at increasing the local consumption of electricity, consuming directly from the PV production within the same house or from neighbors. Also, the idea is to help the customers follow the tariff incentives from the grid operators. Indeed, these incentives will depend on the time of the day and the production of electricity but they will be variable and impossible to manually follow for the users. The optimization of the consumption we offer will take these different criteria into account. Also, the central platform will manage exchange of information with the market actors to valorize the piloting of the loads and will manage all customers- or grid operators-related constraints. Thus, the optimization objectives are the following: increase individual and collective self-consumption, match tariff incentives, follow distribution system operator requests and load balancing requests by market actors.

Current status & results

The solution is currently being tested on a 50-house neighborhood. Each house has accepted participating in the project and the specific requirements for installing the solution have been analysed. Thus, the technical solution will be implemented soon. The technical solution has already been tested internally and partially implemented in other projects. In particular, the gateway GWio that collects the data and send the control orders is used in other energy-management projects and functions properly. The data is retrieved through GPRS communication. The Z-Wave communication with the smart devices has been successfully developed and tested in the laboratory, with smart plugs and relays. The 4G/GPRS collection of data from the gateway to our databases at GreenWatch is working properly as well. A few adjustments will need to be made to that central platform to allow the communication with the market actors and perform the relevant algorithms on the collected data. Relevant analysis has been made already with real consumption and generation data from the participants, together with their inputs on available flexibility: we could increase the individual self-consumption by 10 % and the collective self-consumption by 20 %.

Barriers & obstacles

The main hurdles encountered so far are the following:

- Variety of the loads to control: even though the gateway is developed to adapt to different communication protocols, we want to standardize the load control solution. However, most load configurations are different with very specific connections and settings, which makes it difficult to have one standard solution suited to all cases. We have not entirely overcome this solution yet and are still looking at integrating more loads into the solution.
- Availability of the customers: in order to integrate the solution to the specific installations of the customers, it is necessary to spend some time working with them. However, they have a limited amount of availability, which slows down the process.

Key regulations, legislations & guidelines

The economical viability of the solution we propose depends to some extent on the following regulations/legislations in Wallonia which we identified as relevant based on discussions with the different market actors. They are either entering in force shortly or will be considered in the coming years:

> Prosumer tariff: it will enter in force in Wallonia in January 2020 and aims at taking into consideration the grid costs for the PV electricity injected on the grid. It is equivalent to an incentive for individual self-consumption.
> Collective self-consumption/grid tariff: legal frames about self-consumption have been defined in some countries like France or Germany. A new proposition is being discussed in Wallonia to allow local entities to valorize their local consumption of electricity and formalize the exchange of electricity between avantsmart e.U. | SET Plan Action 4 PV Self Consumption_GreenWatch | 3 von 3 neighbors. Indeed, the electricity which is self-consumed within the neighborhood does not use the medium or high-voltage grid and the participants may be exempted from some grid fees.
> Peak tariff: the main issue for the grid in the future will most likely come from the consumption peaks (for example from electric vehicles) due to the fact that the lines have not been initially sized for that. Therefore, it is most likely that penalties will be applied for clients with high consumption peaks.
> Flexibility/Load shift: load shift to guarantee a proper balance between generation and consumption on the national grid is already remunerated on the electricity market.
> Dynamic tariff: this is expected to enter in force in the coming years but no official information is available in that regard.

7.4 Cluster 4: Sector Coupling (Heating, interseasonal storage, hydrogen)

In the following two projects sector coupling solutions are developed:

1. The objective of **SolH2ub** is to develop a decentralized system where green hydrogen is produced with local available renewable energy, which is then locally stored and used either for emissions-free mobility or re-electrification.
2. The objectives of the **AEW myHome** project are to develop business models for home energy with power and heat, to scale it to residential community PV and to create an interoperable solution for future energy communities in a microgrid.

7.4.1 SolH2ub – Decentralized Hub for Solar Energy with Green Hydrogen

A) Author Information

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B) Project Information

Project Title	SolH2ub – Decentralized Hub for Solar Energy with Green Hydrogen
Location	Thalheim, Austria
Time Period	1 year
Funding	No funding
Participating Organisations	> HyCentA GmbH > Wels Strom GmbH > SKS Limited
Website	No public project website
Keywords	#greenhydrogen, #fuelcellelectricvehicles, #sectorcoupling, #decentralization, #electrolysis

C) Project Summary

Background & challenges

Hydrogen has the potential to play a crucial role in decarbonizing the sectors heat, industry and transport as it is more versatile applicable as electricity. Moreover, it's an energy carrier who is able to store and transfer excess energy from renewables into seasons when sun and wind is not available.
Commercial and service enterprises as well as municipalities have a demand for emission free transport. At the same time, they often own a lot of potential space for photovoltaic (PV) installation and with this, a source for green energy. Battery electric vehicles (BEV's) are able to use directly the generated energy from PV. Nevertheless, BEV's are not suitable for every mode of transport. For long distances or heavy loads, they cannot compete with conventional drives based on fossil fuels. In this field of application fuel cell electric vehicles (FCEV's) represents a reasonable emissions free alternative to conventional transport.

Objectives of the project

Objective is to develop a decentralized system (SolH2ub) where green hydrogen is produced with local available renewable energy, which is then locally stored and used either for emissions free mobility or re-electrification. Furthermore, waste heat is used within existing buildings for heating purposes.

Current status & results

The installation was successfully erected and approved in 2018 and is currently in operation. The produced hydrogen is used for the inhouse FCEV's. Waste heat is actually recooled. With construction progress of the adjoining building, the waste heat will be utilized.

In a next step a public accessible version of the installation shall be realized.

Barriers & obstacles

Less knowledge of local authorities regarding hydrogen and permission processes. Few experienced suppliers for hydrogen installation and components. Long delivery time for certain components.

7.4.2 AEW myHome

A) Author Information

Country	Austria
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B) Project Information

Project Title	AEW myHome
Location	Switzerland
Time Period	Since 2017
Funding	None
Participating Organisations	> AEW Energie AG > Aarau, Switzerland
Website	https://myhome.aew.ch/
Keywords	#integratedenergymanagement, #homeenergy, #communitypv

C) Project Summary

Background & challenges

The basic motivation of the white label customer AEW Energie AG was to enhance their commodity energy portfolio with an innovative product for residential building owners. The key issue was the development of solutions for PV self-consumption without subsidies by coupling the sectors power, heat and e-mobility. After starting bottom-up with home energy solutions for the private house owner currently the market launch of community PV for residential buildings (ZEV-Zusammenschluss für den Eigenverbrauch) is under way.

Objectives of the project

> Business model for home energy with power and heat
> Scalability to residential community-PV
> Interoperable for future energy communities in a microgrid

Current status & results

> More than 100 installations in the field
> Retrofit solution for existing residential buildings
> Customer base for upselling energy services

Barriers & obstacles

> Need for more qualified installers
> High price-level for installing services
> Design restrictions for PV by swiss landscape authority

Key regulations, legislations & guidelines

> Good guidelines for ZEV-installations with one DSO-metering point
> Only regional regulation on Kanton-level
> Direct transmission lines for renewables will be allowed in the near future

7.5 Cluster 5: Blockchain and AI-based Business Models and Services

The following projects focus on digital technologies like Blockchain and AI, and on the development of smart services.

1. **1 Earth | 0 Carbon** is a Blockchain-based investment mechanism to speed up the financing and realization of energy community projects.
2. In the **Learning Energy** project Machine Learning is used to optimize energy flows.
3. **Blockchain Grid** aims to make the flexibility of prosumer available to the local distribution process using a distributed Blockchain application.
4. The main goal of **P2PQ** is to optimize the self-consumption of PV-generated electricity within the quarter. Additionally, the results of this optimization are analyzed regarding the influence of peer-to-peer applications towards the general equilibrium within the urban quarter.
5. The business model of **Project LEE** is an intelligent, self-regulating power grid, without a central entity. Local grids are operated independently from each other. Similar to a swarm of bees, the control and regulation of such a system is carried out by every prosumer under regards of the power grid.

7.5.1 1 Earth | 0 Carbon

A) Author Information

Country	Austria
Contributor	Thomas Zeinzinger
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B) Project Information

Project Title	1 Earth | 0 Carbon
Location	Execution: Austria Application: Global
Time Period	03/19 – 04/20
Funding	Government: Application for Grants Private Sector: Self-Funding
Participating Organisations	> lab10 collective eG > act4.energy Innovation Lab > further partners will be included
Website	www.1earth.vision www.0carbon.fund
Keywords	#commons, #investment, #blockchain, #sustainability

C) Project Summary

Background & challenges

If we look at the current investment for renewable energy (PV, wind, etc.), it seems to be impossible that we meet 0-net-carbon by 2040 in developed countries and achieve the IPCC RCP2.6 goal and limit global warming to less than 2°C. We think that now the opinion is changing, and politicians are finally starting to consider implementing drastic enough measures via carbon tax and the extension of certificate trading systems across sectors. Also, the public awareness is changing rapidly, and people are evaluating their everyday behaviour and adapt their diet or traveling behaviour to reduce their impact on climate change.

We have calculated that an investment of 20 – 30 €/month/person in the EU will be sufficient to transform most parts of our energy system towards renewables. While this is very surprising for many people, we should not underestimate the scale of the undertaking. As an example: For Austria this would mean that we need to install about one thousand (1000) 4kWp PV-Systems every day for the next 20 years. We want to build a global, highly efficient and transparent, blockchain based investment system, to allow every citizen a way to be part of this challenge and earn a reasonable rate of return for their money.

Objectives of the project

> Develop a Minimum Viable Product (MVP) for the lab10 collective internal carbon offset investment via Cryptocurrencies
> Develop the coordination mechanism for various service providers on the platform
> Digitize the whole business process to make the platform scalable
> Provide measurements to monitor region specific renewable power production additions
> Extend the investment possibility towards Fiat currencies on the investor side
> Provide means to handle cryptocurrencies for non-technical investors

Current status & results

Energy Kompass (Operator of the act4.energy Living Lab) has developed an investment model where capital can be provided which is then invested into PV installations on pre-selected and -evaluated houses. The investors will get their money back with interest after the agreed upon time period and the PV plant will pass into the property of the house owner once it has been paid for by self-consumption and feed-in earnings.
The lab10 collective has started to collect money from cooperative members which will be invested into a PV installation at one of the members house. The software architecture is currently developed, but it is likely following to some extend the structure of Commons Stack presented by Giveth, which by itself is inspired by Elenor Ostrom's work about the commons.
The result will be a blockchain-based system, which is scalable, transparent, tamperproof and can connect further partners to ramp-up the rate of renewable power production installations in an economically feasible manner.

Barriers & obstacles

> Blockchain systems are fairly new and still under heavy development which leads to frequent modifications and extended cost.
> People believe that blockchain systems are always consuming high amounts of energy – which is not true for the ARTIS blockchain, but we might face prejudice regarding that.
> Legal regulations are different in every country and it needs local knowledge to structure the right investment packages.
> Getting a global momentum for investments via a decentralized platform into a renewable energy generation and storage will be hard.
> Governments and companies could have their own agenda and might dislike the people driven investment into renewables.

Key regulations, legislations & guidelines

> GDPR General Data Protection Regulation
> Clean Energy Package and national implementations
> Various national regulations in the energy and investment sector

7.5.2 Learning Energy

A) Author Information

Country	Austria
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B) Project Information

Project Title	Learning Energy
Location	Thalheim, Austria
Time Period	02/2018 - 01/2020
Funding	European Regional Development Fond (ERDF) and the Government of Upper Austria "Investitionen in Wachstum und Beschäftigung 2020" Maßnahme 15 "F&E&I-Projekte in CO2-relevanten Bereichen"
Participating Organisations	> Fronius International GmbH > Heuristic and Evolutionary Algorithms Lab, University of Applied Sciences Upper Austria Hagenberg > University of Applied Sciences Upper Austria Wels > Austria Solar Innovation Center > ThermoCollect
Website	https://www.schule-alm.at/learning-energy https://www.fronius.com/de/ueber-fronius/foerderungen/learning-energy
Keywords	#AI, #energymanagementsystem, #heuristicoptimization

C) Project Summary

Background & challenges

Energy management systems are often unstructured and designed through piles of expert rules. The meaningfulness and consistency of rules can usually not be verified, the expected energy consumption and savings potential through energy management systems are often unknown. For a new system topology, expert knowledge has to be built up again and a set of rules derived from this has to be drafted.
Instead of expert rules, optimal controls (MPC, LQG, ...) can be used as part of an energy management system. For simple, linear systems this works without problems. However, the handling of complex, non-linear energy systems requires very detailed system knowledge. The existing methods are computationally time-intensive and can only deal insufficiently with general nonlinear as well as switching systems.

Objectives of the project

The main objective of the project is to replace the mathematically complex step of numerical online optimization by a static law of rules, which is stored in characteristic maps. In addition, the rule law can be calculated continuously, while the optimizations have to be performed time-discretely (e.g. only every 15 minutes).

This global project objective is divided into 4 sub-areas:
> Goal 1: Realistic representation of a hybrid energy system to be controlled in a simulation environment
> Goal 2: Simplification (linearization) of the system (around relevant working points or along a trajectory) and development of an optimal controller (MPC)
> Objective 3: Identification of mathematical models of the MPC by means of symbolic regression (i.e. identification of a controller surrogate) in order to be able to represent it as closed formulas and to make it online ready.
> Goal 4: Principle functional tests of the designed controller or the identified controller surrogate on the real system

Current status & results

Comparing the newly developed algorithms/controllers with an already existing Linear Optimizer, we achieve cost reductions up to 10%. Even when comparing them with the almost optimal own consumption optimization currently implemented in the Fronius Inverters, the costs could be reduced further up to 5%.
A first paper is going to be published soon under the Springer Link publishing house.

Barriers & obstacles

Hardware problems in the real-world environment where the newly developed controllers should be tested, therefore delays in the data collection.
Possibly not optimal results due to missing parameters and optimization procedures which are not yet implemented

7.5.3 Blockchain Grid

A) Author Information

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B) Project Information

Project Title	Blockchain Grid - Blockchain-enabled flexibility activation for distribution grid management

Location Heimschuh, Austria
Time Period 01.11.2018 – 31.10.2020
Funding Austrian Research Promotion Agency (FFG)

Participating Organisations
> Energienetze Steiermark GmbH
> AIT Austrian Institute of Technology GmbH
> Siemens AG Österreich
> Energie Burgenland GmbH

Keywords #localenergycommunities, #blockchain, #peertopeertrading

C) Project Summary

Background & challenges

New requirements on low voltage distribution grids have to be fulfilled due to an increased number of renewable producers, but also due to electric vehicles as new network participators. This goes along with a paradigm shift. It can be expected that with increasing connection of electric vehicles supply equipment in distribution networks, infrastructure dimensioning can no longer be based on worst-case assumptions in all cases. State-of-the-art 22 kW charging power by far exceeds the 2…4 kW estimate for a residential grid connection in central Europe.
Blockchain Grid is able to turn the conventional approach of most congestion management approaches for distribution grids upside down. The project does not consider how to deal with excess utilization, but rather how to make most use of remaining free grid resources (time varying power and voltage bands) to the merit of prosumers. This approach is enabled by the high level of trusted automation provided by Blockchain technology. In particular, the approach is to implement a distributed Blockchain-based application that enables prosumers themselves to share free grid resources for their surplus generation and load, whereas the distribution system operator acts as a facilitator.

Objectives of the project

Blockchain Grid aims to make the flexibility of prosumer available to the local distribution process using a distributed Blockchain application. The goals are therefore twofold:
Goal 1 is to experimentally implement a Blockchain-based platform that enables prosumers to share free grid resources for their surplus generation and load.
Goal 2 is to analyse the relevant regulatory framework and – based on learnings from the implementation – make informed proposals for a future system design.

These two overall goals are to be achieved in the framework of the Energy Model Region Green Energy Lab, where synergetic additional activities will also take place. The projects LocalTEX and Smart Grid Control will look into Blockchains as well, however the focus there is primarily on Blockchain as means to implement local energy markets.

Current status & results

In the initial phase of the project, the following use cases have been elaborated and will be implemented within the next months:

- Peer-to-peer energy trading: Based on a Blockchain-based trading platform, the participants of the energy community can sell their PV surplus energy on the one hand or buy energy from other participants on the other hand. In general, all customers can decide if they want to active self-consumption optimization. In this case, their surplus will be stored in a community battery storage and can be used later. Further surplus will be offered in the community. If the self-consumption optimization is not activated for a particular customer, his surplus will be offered in the community first and stored in the battery if it cannot be sold.
- Grid Capacity Management: On top of the peer-to-peer trading use case a grid capacity management algorithm will be implemented. Based on actual measurement values and a centralized load-flow calculation, information on free grid resources are distributed within the low voltage network to coordinate the control of high loads within the network (e.g., charging stations or other controllable loads with high power).

Both use cases will be implemented within smart contracts as part of the blockchain. At the customer level, measurement devices will be installed containing a blockchain node.

Barriers & obstacles

One of the main barriers is to guarantee that all privacy issues are handled correctly. Therefore, only the devices will have direct access to the blockchain, the users will get a view on the relevant accounting data. Another technical barrier is the scalability of the blockchain technology. Although the project will use the Ethereum technology, the number of blocks within one period is limited. Nevertheless, in our project, all customers will have the chance to participate.

Key regulations, legislations & guidelines

- GDPR
- Peer-to-peer trading not allowed at the moment

7.5.4 P2PQ

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B) Project Information

Project Title P2PQ - Peer2Peer im Quartier

Location Vienna, Austria
Time Period 01.06.2018 – 31.05.2020
Funding Austrian Research Promotion Agency (FFG)

Participating Organisations
> Wien Energie GmbH
> AIT Austrian Institute of Technology GmbH
> RIDDLE&CODE GmbH

Keywords #localenergycommunities, #peertopeertrading, #blockchain

C) Project Summary

Background & challenges

The research project Peer2Peer im Quartier deals with applications optimizing the self-consumption of PV-generated energy within urban quarters by enabling peer-to-peer relations among energy prosumers based on Blockchains. Aim is to develop and validate these applications in real operation. The benefits of using Blockchain technology are reaching from data security to confidential billing platforms for prosumers. Beside the research and implementation activities, new business models for operators of energy infrastructure in quarters from the viewpoint of an energy provider are conceptualized, validated in a test phase, and – based on the results – recommendations for future concepts are elaborated. By relying on blockchain technology and its associated advantages, the project aims to establish fast and easy methods for completing contracts between two or more parties in order to trade and transfer energy within a city quarter. Within this project, a framework regarding digital contracts for peer-to-peer energy provision relations is defined and options for straightforward participation and withdrawal ("easy-in/easy-out") are investigated. For an optimal usability, a user interface will be implemented and made available to the test users – being both energy providers and consumers. For finding adequate partners in the peer-to-peer network, an innovative discovery mechanism will be implemented. To guarantee a high usability and an optimal distribution of the generated energy, 1:1 as well as n:m relations will be available to the participants (several providers, several consumers).

Objectives of the project

The main goal of the project is the optimization of the self-consumption of PV-generated electricity within the quarter. Additionally, the results of this optimization are analysed regarding the influence of peer-to-peer applications towards the general equilibrium within the urban quarter. Forecast data (e.g., consumption data for working days, weekends and holidays; driving distance and consumption of electric vehicles; etc.) for users and the quarter are used as input data for the optimization.

Current status & results

The basic infrastructure has been developed within the first months of the project including the relevant hardware and software parts of the Blockchain.
The peer-to-peer trading will be done every 15 minutes. In particular, the accounting will be done for the past 15 minutes, based on an optimization algorithm and forecasting values. The optimization will be twofold – on one hand, each customer should be optimized to have minimal energy costs, on the other hand, the overall community should be optimized. The input of the optimization are the last measurement values of all customers, their preferences, price/tariff information, and the forecast of demand and generation for the upcoming 24 hours. The forecast methodology is based on neural networks showing major advantages compared to other forecasting approaches on single customer level.
A user interface is already developed showing customer data, accounting information, information on demand and generation (historical and forecast values).
The field validation will start in autumn 2019 in the second district of Vienna ("Viertel 2").

Barriers & obstacles

> GDPR
> Peer-to-peer trading not possible at the moment due to regulatory/legal framework. Therefore, Wien Energie will be the intermediate player responsible for the accounting.

Key regulations, legislations & guidelines

> GDPR

7.5.5 Project LEE

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B) Project Information

Project Title Project LEE

Location Liechtenstein
Time Period Started 2017 – we are a start-up so no expiry date planed
Funding Private Sector

Participating > S.I.E. System Industrie Elektronik

Organisations
> Enercoutim
> TU Wien
> NTB Buchs
> OpenEMS Association
> Technology Platform Smart Grids Austria
> Innova IT
> ee consult
> Blockchainbüro Liechtenstein

Website www.project-lee.com

Keywords #reliable, #affordable, #scalable

C) Project Summary

Background & challenges

Today there are about 400 fossil and nuclear power stations which provide electric energy to 56 million consumers in central Europe. This central supply is also reflected by the power grid infrastructure and the energy trading markets. The politically wanted and promoted decentralized and renewable energy supply increases the complexity and demands by a multiple. Every prosumer can produce, store and consume electric energy. This leads us to the biggest problem of the energy industry for the energy transition – the legacy central controlled infrastructure cannot guarantee the integrity of the distribution and transmission systems for the emerging decentralized infrastructures. A renewable power supply brings the need to trade decentralized, green and demand-driven produced energy.
For the new energy trading markets new economically viable solutions and new technologies are needed to make such micro transactions possible.

Objectives of the project

Our business model is an intelligent, self-regulating power grid, without a central entity. We implement local grids that operate independently from each other. Similar to a swarm of bees, the control and regulation of such a system is carried out by every Prosumer under regards of the power grid. The power grid is a common good and belongs to all of us! What we do is reduce the costs of the common good or rather make it more transparent and then give back these savings to the prosumers. LEE gives reliable energy transition with scalable and affordable Plug & Play products. Our solution for the Energy sector is collective intelligence for power grid stabilisation (Local Grid Management) and energy trading via DLT (distributed ledger technologies). We connect the present physical power grid with tomorrow’s digital energy trading markets -> we are the missing link between utilities and prosumers. The power grid friendlier energy is produced, consumed and transported, the higher are the revenues and savings for the prosumers. Energy transition means the whole legacy infrastructure will be replaced by digitalization and artificial intelligence. There will be millions of infrastructure relevant devices installed in homes, commercial buildings and municipalities which need to be connected and managed in a responsible, trustworthy and reliable way! In order to be successful in the long run, AI technologies will be implemented to enhance the users long term experience. Gamification is a key feature that are has already shown huge success in various applications and LEE will bring that to the electricity domain, while ensuring high standards in cybersecurity and optimized PV self-consumption supported by AI and DLT.

Current status & results

Finished proof of concept. Busy with funding for market launch. Proud founding member of the OpenEMS Association, which aims to achieve more efficient and effective connectivity and control of technical assets while broadening their application capabilities. Our software stack is based on the stable and successful OpenEMS platform (1000+ OpenEMS units in field & operational by partners). We are promoting open source solutions and the need for standardized interoperability procedures for making energy transition finally happening.

Barriers & obstacles

> High financing requirements
> To a degree depending on legacy and upcoming infrastructures e.g. mobile networks
> Strong political influence on the market
> Energy market is undergoing transformation: Regulations may change
> Lobbying still slows down the development of renewable and smart energy markets
> Multidomain environment brings new aspects to consider for future work plan
> IP protection very challenging
> Because of product complexity and certifications processes quiet long time to market (approx. 12 months for new products)
> GDPR
> Meet highest cyber security standards

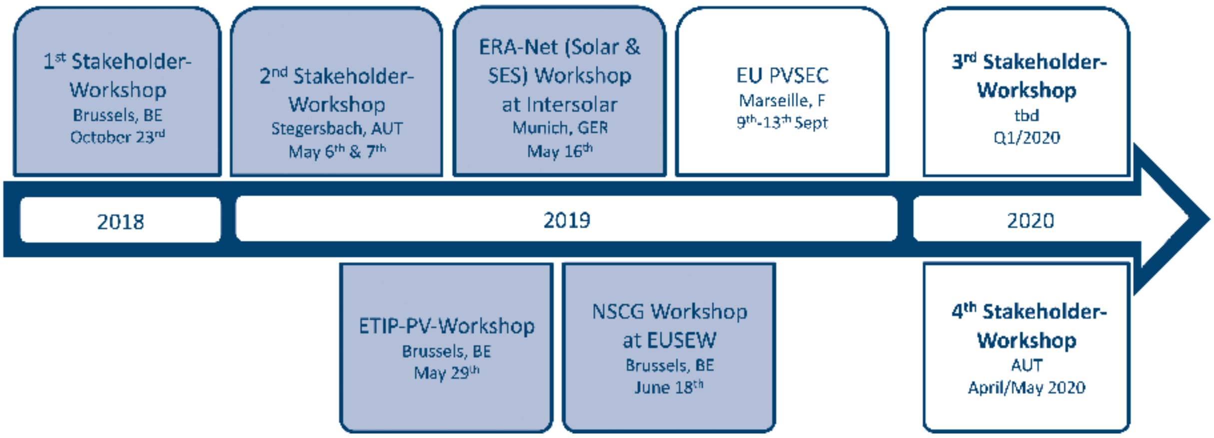
Key regulations, legislations & guidelines

We developed a future proof business case! In order to achieve and monitor the success of the required behavioral changes, local experimental cells should be implemented. This is one of many steps to develop dynamic optimization models for PV energy optimizations in local grids, (either multi-family buildings, districts or local regional communities) that are futureproof with regard to the legal and regulatory framework conditions of the EU Winter package. Working for example on the need profiles, we can contribute to the question why 93% of all Germans want the energy transition – 70% of them are ready to invest – but just 2% have a PV system? Therefore, a close look towards the following key topics is given:

> Electricity Directive (EU)
> Clean Energy Package (EU)

8 Overview and outlook

The following chart gives an overview on all activities that took place since October 2018. To continue the dialogue process, the next event will take place in Marseille (France) from 9th to 13th of September 2019. For 2020 two events are planned so far:
The 3rd Stakeholder Workshop in the first quarter, further information will be determined.
As well as the 4th Stakeholder Workshop at the end of April 2020 in Austria.



9 Relevant links and references

Knowledge Exchange

We use **Expera** - The Knowledge Community Platform - for our **Knowledge Exchange** and **Collaboration.**

Expera, the cooperation platform of the ERA-NET Smart Energy Systems, allows for intensive communication between and cooperation of registered members of the Knowledge Community. With its Living Documents, Spotlights and access to Working Groups it is a unique opportunity for experts to exchange their knowhow, opinions and expectations.

Please register for free on the Expera knowledge platform to gain full access to the project information and further contents:

> Expera platform: http://www.smartgridsplus.eu
> Use Case Repository

SET-Plan

Relevant background information about the SET-Plan and the Implementation Plan can be found here:

> SET-Plan Action 4
> SET-Plan Action 4 Implementation Plan

10 Authors and Acknowledgments

This case book was developed in a ten months process by Hemma Bieser, avantsmart, in close collaboration with Gaëtan Masson, Becquerel Institute.

Please find here our contact data.

We are open and grateful for feedback, input and contribution to the upcoming next steps.

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In parallel, Job Swens, is working on a Living Document on relevant regulation and legislation.

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Acknowledgments

We would like to thank everybody who contributed to this case book by providing her expertise, interesting project details, project outcomes, energy and time.

SET-Plan Action 4 – Energy Systems
Innovation Action A4-IA2.2-5
Version 1 – August 2019