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NEON

Undertaking the coordination and support activities towards introduction of next-generation integrated services for Citizen Energy Communities (CECs), as introduced by Directive (EU) 2019/944, targeted to enhance the life quality of European citizens, while improving the performance of energy system.

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INTRODUCTION

NEON is a H2020 project financed by the from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101033700, that aims to undertake coordination and support activities to advance the leveraging technologies and concepts in order to deliver the next-generation integrated energy services for communities, either as single or multiple buildings, targeted to enhance the quality of life of European citizens, while improving the performance of energy system at the same time. In this endeavour, NEON will exploit building energy efficiency, renewable energy generation and storage, and demand flexibility to increase energy savings, reduce CO2 emissions, and provide cost savings across sectors. For such services to become a reality, NEON intends to engage grid stakeholders, service providers and final consumers to establish, in a cocreation process, the cross-sectoral arrangements and underlying service concepts. Under the context introduced by Directive (EU) 2019/944 (link), the concept of Citizen Energy Communities (CECs) will be leveraged to set the legal and business foundations to enable faster uptake of the proposed services, and facilitate European communities, both residential and nonresidential, in becoming energy-efficient

NEON'S CITIZEN ENERGY COMMUNITIES

NEON will address the objectives in an integrated manner that will be demonstrated across different demonstration locations. In total, four Citizen Energy Communities activities will be carried out in three different European countries, namely France, Spain, and Italy. Following the beginning of the NEON project, to develop a homogeneous description of each pilot, the following categories for pilot technical characterization have been proposed:

- Location
- Pilot stakeholders and roles
- Building type
- Energy sources and infrastructure
- Current operations
- Energy demand characteristics
- Flexibility potential

The "**Location**" category describes the location as well as important geographical and meteorological characteristics of the pilot. Meteorological conditions are important variables that impact energy demand and local production forecasts.

"**Pilot stakeholders and roles**" are used to describe the actors of the pilots and their relationships with the NEON project. Building type describes the technical assets that are known to be existing and available at the pilot sites. These are three general characteristics of the pilot sites, which will be refined when specific households are recruited, as some individual building types or appliances may vary between households. The

“**Energy sources and infrastructure**” category includes the external energy infrastructures, such as shared local renewable generation plants, heating networks, electric distribution networks, IT networks and their characteristics.

The “**Current operation scenarios at pilot sites**” category details user stories, control strategies, communities, or involvement of inhabitants at the pilot sites, in case such initiatives have already been implemented.

The “**Energy demand characteristics**” category describes the current understanding of the local energy demand characteristics, based on the available data for each pilot site.

The “**Flexibility potential**” category outlines the first assessment of the flexibility potential of the pilot site according to the “prerecruitment” knowledge. It outlines the types of energy uses that could be candidates for demand response/load shifting, communication devices that are in place or could be installed in the near future, or existing interfaces for flexibility incentives or interaction with the end users.

CEC 1.BERCHIDDA, Berchidda Municipality, Italy

Located on the southern slopes of Mount Limbara, in the north of Sardinia Island, Berchidda is a village with 3,000 inhabitants, with Neoclassical and Art Nouveau houses positioned in a “crescent" shape town. The land covers approx. 201km2 and it is located at an average altitude of 300 m. The anthropic structures, vegetation and climatic conditions are typical for the inland areas of Sardinia, with average temperatures of 15°C.

Pilot stakeholders and roles The Berchidda pilot can in turn provide valuable insights on how to implement, communicate and incentivize participatory CEC in small/medium towns, which represent the most common settlement configuration not only in Italy but also in Europe. Berchidda Municipality is already engaged in the Covenant of Mayors, with the aim of achieving energy independence and reduce energy dissipation, regain, and strengthen the local economy, increase the resident population, home renovation. Berchidda is one of the few municipalities in Italy which owns the electricity grid. The Municipality owns the last mile, and together with Azienda Elettrica Comunale (AEC) operates of a DSO. Recently, the Administration acquired the electricity network of the rural area from Enel Distribution with the plan to upgrade its facilities to an urban microgrid. They aim at merging the rural and the urban grids. More specifically:

Berchidda has carried out a major renovation of the agricultural grid with the construction of the new electrical cabins.

- It has planned to extend the use of smart meters to the historic centre as well.
- It is building a free communication network that interconnects all users.
- It will be possible to integrate the energy production that takes place in the municipal area, photovoltaic and wind power. There’s also a plan for extension with offshore wind power

In Berchidda there is a smart grid – Berchidda Energy 4.0 – for remote management and control, smart billing, balancing. Berchidda Municipality operates a platform for energy management, grid balancing and reporting of network faults. Specifically:

- There are 25 MV/LV power substations, equipped with transformers of 100 kVA-500 kVA, for a total power installed of about 5000 kVA.
- There will be 400 buildings equipped with smart power meters for total consumption that will be installed by GridAbility.
- There is the possibility of registering hourly to 15 minutes granularity data for all these buildings, both for production and consumption
- There's an extensive PV production already in place: 67 active PV plants with a total capacity of 608 kW and energy production about 820 MWh/yr.
- 62 private PV plants (800 kWp)
- 3 municipal plants (220 kW)
- 2 industrial plants (130 kW)
- Planned for decentralized PV system (aprox 1,100 MWh production)
- 12% is local production, while 82% is energy purchase from the grid.

Instantaneous self-consumption; the surplus of electricity produced is sold back to the grid. The first installation of PV for self-consumption dates to 2011, followed by other installations until today. The development of local PV production has been prompted by individual emulation rather than a collective, coordinated move. In Berchidda, the electricity distribution system operator is a public body that operates beyond commercial logic. It is in the public interest to:

- Develop the use of renewable energy
- Federate cabinets (thus going beyond 120 households) under the same REC
- Maximise the reliance on local production
- Sell to the network only extra production

Since the Municipality owns the electricity distribution network, it is not bound by the current regulatory limits of the Renewable Energy Communities but allows the use of all the technologies and services of the smart grids. The goal of the Italian legislation is to gradually allow the transition from a "virtual" management of energy grids and balances to a more "physical" management where space is given to "prosumer aggregators". Having the Municipality as DSO allows implementing a physical configuration of CER and enact RED II fully:

- The PV is connected to individual households and there is a shared POD (Point Of Delivery)
- It is possible to match physical configuration with the virtual one
- It is possible to propose economic incentives to align consumption with PV production
- Last-mile data are accessible

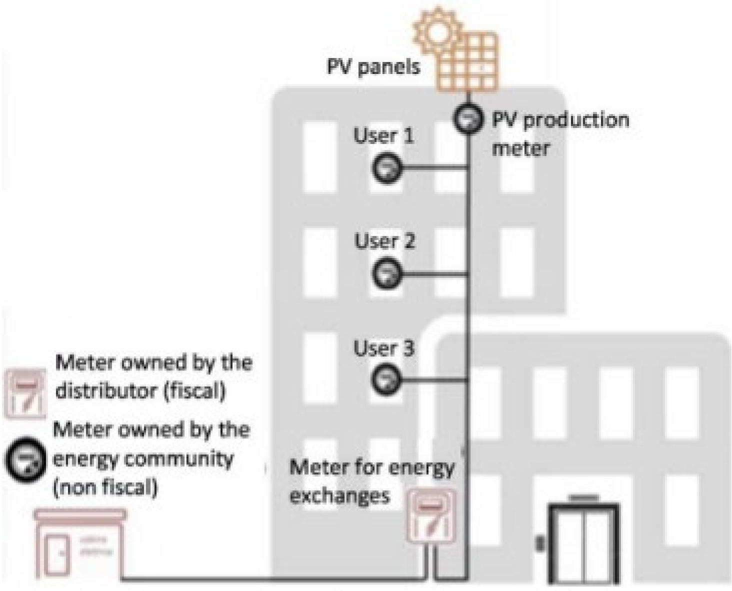

Figure 1. Physical configuration for the "energy community" foreseen in Berchidda.

Citizens, SMEs and Industries are the primary beneficiary of the Berchidda Smart Grid 4.0 and the key actor in enhancing demand response and adjusting their energy behaviours and consumption to reach the communities' objectives. Berchidda inhabitants will be addressed with general communications to improve the adoption of the innovative solutions and increase the number of members of the energy community in the long run.

Building type

Berchidda counts 1792 buildings, made of single houses and blocks of flats: over 88% of residential buildings have 1 to 2 floors above ground; buildings with 3 or more floors represent only 12% of the total residential building stock. 50% of the buildings have been built before 1961. Over 98% of the buildings are built with load-bearing masonry, mostly made of "cantonetti" (granite portative elements). In Berchidda homes, typical common household energy systems include:

- Heating: fireplaces.
- Cooling: possibility of individual air-conditioning on a case-by-case. The control of these appliances will be performed by their users based on behavioral demand response.
- Domestic hot water: electric boilers controllable with an on/off systems.
- Appliances: standard such as lighting, fridges, washing machines, dishwashers. Cooking stoves and ovens are powered by gas. The characteristics of these specific appliances will be obtained for each pilot participant after the recruitment phase.
- Fiscal meters: the installation of 30 smart meters is foreseen at first in households participating to the HESTIA project, to additional 20 households participating to the LocalRES project, and will be extended over time to reach 100 users by the end of 2030. Smart meters will be owned by the Municipality and provided by Landys and NesosNet (the second is part of the GridAbility joint venture).

Energy sources and infrastructure

Berchidda counts 68 PV plants (800 kWp total), of which 62 are owned by individual citizens, while the others belong to local companies and the Municipality. The PV installations provide 12% of energy on an annual basis (comparison between annual energy needs of Berchidda and annual PV generation). The rest of the energy is purchased from the grid. The access to PV load curve data will be made possible within LocalRES with the installation of the previously described smart meters and the associated local radio transmitter and gateway. The precise technical characteristics of the installed PV plants for each recruited household will be obtained from the pilot participants after the recruitment phase. The installation of additional 20 heat pumps, storage capacity and public EV charging stations is envisioned as part of the LocalRES project.

Current Operations

Four hundred buildings are monitored with smart power meters for total consumption (15 min/hourly data). Additional smart metering is envisioned under EPC models to disaggregate the energy loads, with deployment of home automation devices to enable demand adjustments. There are different tariffs for electricity depending on the time of use and wholesale market indexes.

Energy demand characteristics

The current aggregated electricity demand for the city of Berchidda is 6500 MWh, which also includes the energy consumption of around 200 SMEs. The largest part of households' energy demand comes from DHW, lighting, and the other specific electric appliances. The average household consumption amounts to 2,436 kWh/year. Following figure illustrates the typical daily net and gross load for the city of Berchidda.

Flexibility potential

Flexibility in Berchidda will be driven by two main forces: load-shifting and digitalization. For what concerns load shifting, the goal is to stimulate more efficient use of energy by shifting part of the evening consumption to the production times of the photovoltaic plants. This provides a loadshifting of 20% of the load in terms of power included in the time range 18:30-23: 00 to transfer it to the 11:30-16: 00 time slot, which corresponds to about 5% of daily energy, or about 800 kWh/day (292 MWh/year). The estimate is based on the whole population of Berchidda and existing literature.

Here follows a list of the existing CEC services in the Berchidda Municipality.

Local Energy Community Building

The Local Energy Community Building is a non-technical service that aims to set up the social engagement and energy awareness among all the Berchidda electricity residential customers that want to engage into behavioral change and citizen community engagement, differing from other community practices with no explicit collective energy saving goals. Involved partners in this service provision are GridAbility and Energy4com, working in tandem with the Berchidda Municipality. Several activities are put in place to deliver the service to the target users, including social engagement and animation community meetings, awareness-raising events, social media, and editorial activities. Ethnographic research methodologies have been deployed to deliver the service, including survey questionnaire, interviews and focus groups organized involving main stakeholders (citizens, SMEs, industries, local municipality representatives, etc).

Collective self-consumption of PV production

The collective self-consumption of PV production is an energy-sharing service tailored the electricity residential customers of the Berchidda CEC that already have PV panel installed (prosumer) and to aims at exploiting the national incentives for RES self-consumption, unlike other residents with PV panel installed not belonging to the CEC. Involved partners in this service provision are GridAbility (via Nesosnet and Prosume), together with AXPO, in tandem with the Berchidda Municipality (via AEC). Several activities are put in place to deliver the service to the target users, including several community meetings, as well as technical meetings with the partners involved in the service provision. Moreover, the Nesosnet Community Platform and the Prosumer App are in the development phase and target to be delivered to the end users (first beta version) in April 2022.

The service is, furthermore, leveraging on available means including active control of storage capacity (connected to 30 MIDAC storage batteries), demand response (connected to DEVELCO smart monitoring system in 30 homes), the Nesosnet fiscally certified smart meters (IOT Energy Hub) and community platform, as well as the municipality distribution grid and baseline electric consumption data. While Service 1 and Service 2 are, at the very moment of production of this deliverable, the only 2 existing services we can highlight at the Berchidda Pilot site, it is worth being mentioned a wide array of energy-flexibility and energy-efficiency services are planned to be delivered within the soon-to-be established Energy Community. These include, but not limit to 15 RES energy services have been identified as follows:

1. P2H (and H2P)

2. Building heating optimization (systems and electricity consumption optimization)

3. Collective Peak shaving

4. REC/Collective self-consumption

5. Optimisation of energy flows within the REC

6. Demand response (Implicit and explicit)

7. V2G services

8. P2P energy trading

9. Aggregated (REC-level) energy trading

10. Public EV (Electric Vehicles) charging stations

11. Smart Storage Management System 12. Capitalisation of monitored data

13. Legal advice

14. Preliminary feasibility assessment 15. End-user engagement

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CEC 2. DOMAINE DE LA SOURCE Villard de Lans, France

Location

"Domaine de la source" CEC is located in a town Villard de Lans, a ski resort of the massif "Vercors" in the French Alps. It represents the town with the largest available lodging in the Vercors Regional Natural Park. Pilot stakeholders and roles. The service provider is ALB (CTX as LTP).

Building type

The buildings of the CEC have been erected in 2016, and occupied from early 2017, for both lodging and permanent residence. They are made in accordance with the French Thermal Regulation, out of a poured concrete with exterior insulation. Currently this community consists of 25 dwellings in 3 buildings with a potential outreach of 500 dwellings in town under service.

Energy sources and infrastructure

Currently, 3 air-source heat pumps (HP) of 9 kW are in place for hot water production. For heating, the HPs are coupled over the 500L hot water tank and pipelines to the radiant floor. The DHW is produced by two electric boilers of 28.8kW each. DHW is also preheated by the HPs, coupled with the electric boilers over 1000 l water tank. PV panels with 45kWp are installed in 2019 on the south oriented rooftops (15% RES share).

Current Operations

The electricity produced is used for self-consumption, the remaining being sold to the grid. Electricity consumption of individual apartments is monitored, as well as the HPs used for hot water production. Diehl Sharky meters are used for thermal energy and DHW metering. Through "Linky" meters, production, self-consumption, and energy export are monitored. Currently, electricity is provided to the final customers only with Time-of-Use (ToU) tariffing.

Energy demand characteristics

Electricity consumption breakdown: boiler room 140 MWh/y (approx. half for HPs and half for electrical boilers); common areas 65 MWh/y (ventilation, elevators, electric snow melting, common lightning; 1750 kWh/y per apartment.

Flexibility potential

Considering that demo buildings are in fact individual prosumers, NEON will aim to enable an optimized interaction between the consumers and grid. Storing the thermal energy and HP operation will be considered for optimization to provide optimal building operation, improved indoor environment and flexibility services. This will be enabled by remote integration with the central control unit which manages HP operation. It is expected that NEON enables higher RES exploitation, while unlocking the demand flexibility (both electrical and thermal). Currently, electricity is provided to the final customers only with Time-of-Use (ToU) tariffing, which is expected to evolve to variable pricing scheme during the NEON project. Joint EPC and P4P contracting will be considered to enable further building improvements and flexibility sharing. Services will be delivered by ALB, while providing aggregation of community-level demand.

Here follows a list of the existing CEC services in DOMAINE DE LA SOURCE

Power to Grid

The objective of this service is to connect the solar power plant to the grid and to sell the produced energy to EDF through the grid manager Enedis.

The value generated is coming from selling the electricity not used in the CeC (around 40%). The selling price is around 90€/MWh; It is defined by the law and the national “commission de régulation de l’énergie” and must be compared with the price of energy in France 180/MWh. This revenue is warranted and is easily shareable between the flat's owners, but 90€/Mwh is a low price and approximately equal to the price of heat.

This question is in debate between the members of “Conseil syndical“helped with the syndic ORPY.

The energy produced is coming from the 45kWpeak solar power plant installed on the roof. The main problem is that there has been no integration between all the systems during the design phase of the energy systems of the building. Integration means energy production and consumption systems but also economic value analysis including capex and opex costs. Setting up the service power to grid follow a process well defined and manage by Enedis. All details are described within the legal document “arrêté du 6 octobre”. Key data for this service are:

- Solar Installation economic study
- Production prevision
- Price of energy sold

Energy systems maintenance

The objective of this service is to warranty the comfort of inhabitants with the right energy maintenance services that free the installation from a long outage. The beneficiaries of this service are the inhabitants and the proprietary if they are different if the apartment is rented. This service is decided by selecting the right energy service company. It is decided by the “conseil syndical” and executed by the syndic ORPY. This job required basis plumber maintenance skill but more important, heat pump skill with Qualipac certification. To avoid breakdown this service is organized in two parts, predictive and corrective maintenance.

The added value for this service is the comfort and it could be evaluated through efficiency (€/°comfort). What is the cost per degree of comfort? The service follows a process:

- Maintenance planification
- Security procedure

- Spare parts order
- Possible assistance of the equipment's system expert
- Work preparation
- Repairing
- Test
- Close the maintenance operation

Comfort and systems measurements data are critical for this service.

Solar Power plant maintenance

The objective of this service is to warranty the solar power plant production. All the energy Is sold to EDF, so failure in the production affect directly flat owners' revenues. The maintenance is mainly periodic maintenance (yearly). The operation consists in visual examen of the panels dirty and IR vision to check eventually overheat problems. This service is decided by selecting the right energy service company. It is decided by the "conseil syndical" and executed by the syndic ORPY. This job required basis electricity maintenance skill but more, in particular solar PV panels and converters skill with QualiPV certification. To avoid breakdown this service is organized in two parts, predictive and on request corrective maintenance. The added value for this service is the revenue of selling electricity it could be evaluated through efficiency (solar insolation / PV production). The service follows a process:

- Maintenance planification
- Security procedure (on the ground)
- Visual inspection with IR camera and drone
- Spare parts order
- Eventual action on the roof
- Possible assistance of the equipment's system expert
- Repairing
- Test
- Close the maintenance operation
- Sensible data for this operation are remote solar data production measurements.

CEC 3. POLÍGONO INDUSTRIAL LAS CABEZAS, Villacañas (Toledo), Spain

Location

CEC is in a town Villacañas (Toledo) about 100km from Madrid. Traditionally it has maintained an important industrial development linked to the agro-food industry and the construction of wooden doors, with exports all over the world.

Pilot stakeholders and roles

The service provider is APPA (GFM as LTP). GFM will assume the role of an energy provider and ESCO, engaged in service delivery. The business models will include dynamic pricing schemes (only a ToU tariffing now), designed on top of the distributed energy resource management programs (e.g., integrating EV charging).

Building type

The CEC is composed of 5 industrial facilities/buildings of the industrial park Las Cabezas (3 companies manufacturing wood doors, 1 company cheese and 1 catering company) and 10 preselected residential houses, while 10 more will be engaged during the project. GFM is a company based in the industrial area, specialized in the installation and maintenance of RES, mainly PVs. This community has a potential outreach of 100 companies and 25 houses under service.

Energy sources and infrastructure

GFM has PV installations on its building's rooftops with a power of 64 kW for self-consumption and 400 kW for integration into the network. GFM obtained financing for a Phase 2 SME Instrument project called SunninBox, which realized a decentralized portable PV energy network capable of providing 10 kW in each installation point. In addition, the demo site has a wind turbine, 3 EV chargers and a lead-acid battery.

Current Operations

Generated electricity will be used for self-consumption, while selling the excess energy to grid. Monitoring infrastructure for electricity consumption and PV production is already in place.

Energy demand characteristics

In total, 560 kW of electricity production is available. In addition, the demo site has 30kWp wind turbine, 3 EV chargers (90kW fast, 2x7.4kW allowing V2G/V2B) and 40kWh lead-acid battery (OPzV).

Flexibility potential

Leveraging the optimal energy asset scheduling, NEON will set up a Virtual Power Plant (VPP) by uniting all the existing renewable plants at a single point, so the demo site behaves as a single network. This way, NEON will form a portfolio of 'dispatchable' and 'non-dispatchable' energy sources, capable of performing the optimal energy dispatching and building control while respecting the needs of the end consumers (both industrial and residential), to provide sufficient flexibility, reliable energy supply and network services. As a result, NEON will enable cheaper energy for local community, improve the impact on the environment, reduce interruptions due to peak demand in the network and offer greater flexibility to the grid. Optimal operation of buildings (electrical loads, heating/cooling) will be provided, while ensuring higher exploitation of locally produced energy, and unlocking the demand flexibility. Upgrading the storage capacities or building improvements (e.g., wall insulation) will be considered as part of the underlying business models and operational strategies. Peer- to-Peer (P2P) trading will be considered for transactions and energy exchange between producers.

Here follows a list of the existing CEC services in POLÍGONO INDUSTRIAL LAS CABEZAS, Villacañas (Toledo), Spain

This pilot is in Villacañas (Spain). Existing services are installed on headquarters of GFM (Polígono Industrial Las Cabezas) and they are working on their own, according to the Spanish regulations. Each energy service has its own regulatory aspects. The aim of this CEC is to join the existing services to achieve a share use of energy and money from them with every partner of energy community.

PV Self consumption system

The owner (GFM) of this existing energy service uses the energy generated by its PV selfconsumption system for own uses and reducing the dependence of grid company. GFM needs electricity for its activities and its prices are increasing considerably. That is the reason one of these kinds of solutions is installed. All electricity which is produced is directly consumed. The surplus generation is stored in batteries (third energy existing service) and if batteries are full is fed into the grid (a special discount in electricity bills is done thanks to this energy). There are two others involved collaborators. Theses ones will not participate in our future energy community, but they are mandatory for electrical supply to GFM according to Spanish regulation.

On the one hand, there is Unión Fenosa which is the grid company. It oversees carrying electricity to GFM headquarters (voltage and frequency). It is also needing for an appropriate PV selfconsumption behaviour. If there is not voltage and frequency, PV inverters will not work due to an anti-islanding protection. On the other hand, we find Gesternova (market agent). It is the responsible for billing for electricity.

For making possible these services some activities are required: engineering project, legalization (administration and grid company), equipment installation (PV modules and PV inverters), device programming n and maintenance tasks (O&M).

The available means are:

- 104 PV modules
- 6 PV inverters
- PV structure
- Monitoring system
- Meter

EV Recharging station

The owner (GFMCA) of this existing energy service uses the energy which is bought from the grid to provide electricity to Electric Cars for mobility. GFMCA could be an intermediate actor between owners of EV cars and the grid company.

There are five others involved collaborators. Except of GFM, all of them will not participate in our future energy community. Some are mandatory for electrical supply to GFMCA according to Spanish regulation (Gesternova and Unión Fenosa). Electromaps is recommended for economic transaction for recharging services. Electrical cars' owners are the end users. GFM is the installer and O&M responsible. Unión Fenosa which is the grid company. It oversees carrying electricity to GFM headquarters (voltage and frequency). It is also needing for an appropriate EV recharging station behavior. If there is not voltage and frequency, EV station will not work. Gesternova (market agent). It is the responsible for billing for electricity. For making possible these services some activities are required: engineering project, legalization (administration and grid company), equipment installation (EV recharging station), device programming activities, payment platform development and operation and maintenance tasks (O&M). The available means are: EV recharging station (50 kW DC / 40 kW AC).

Energy storage

The owner (GFM) of this existing energy service uses the surplus energy generated by its PV selfconsumption system for storage using lead acid batteries. It is a way for reducing the dependence of grid company. There are two others involved collaborators.

Theses ones will not participate in our future energy community, but they are mandatory for electrical supply to GFM according to Spanish regulation.

On the one hand, there is Unión Fenosa which is the grid company. It oversees carrying electricity to GFM headquarters (voltage and frequency). It is also needing for an appropriate storage system behaviour. If there is not voltage and frequency, battery will not work due to an anti-islanding protection. Despite this, there would be a circuit for critical loads always available.

On the other hand, we find Gesternova (market agent). It is the responsible for billing for electricity.

For making possible these services some activities are required: engineering project, legalization (administration and grid company), equipment installation (lead acid batteries and batteries inverters), device programming activities and operation and maintenance tasks (O&M).

The available means are:

- 48 batteries (2V, 1000Ah). Voltage level: 48V
- 3 inverters/chargers' batteries.
- Monitoring system
- Meter

CEC 4. STAIN City, Stains, FRANCE

Location

Under" Inventons la Metropole du Grand Paris" competition, the consortium managed by ENGIE was chosen as the winner to develop a real estate complex for office, business, parking use and services (catering, retail, hotel). The complex is located on two sites, with an area of 29,185m2 for business establishments, and 5,330m2 for services and parking areas, respectively. ENGIE lab CRIGEN building located on the primary site, consists of 8,773m2 accommodating offices, industrial premises, and laboratories.

Pilot stakeholders and roles

The service provider for this energy community is ENGIE.

Building type

This energy community currently consists of 2 buildings/sites, area of approximately 34,500m2 with a potential outreach of 4 similar office buildings under service. Thanks to the concept of digital BIM, the building meets the requirements of E+C- French label. The main framework of the building is based on metal posts, beams, and purlins, while the facade walls are made of crosslaminated solid wood panels.

Energy sources and infrastructure

Gas absorption HPs and reversible chillers ensure the low heating and air conditioning. Heat recovery is provided on AHUs using a plate exchanger. The heating room is transformed into a living lab thanks to the bypass installation on the primary network of innovative technologies for performance tests, e.g., fuel cells (natural gas and hydrogen). Fan coils and radiant panels are used to achieve uniform temperature across building area, and to provide flexibility from the grid point of view. Innovative technologies on the roof: last generation PV (minimum 30m2), H2 panel thanks for solar electrolysis (15m2), and solar thermal panel (10m2). The neighbors with PV potential are already made part of the energy community after the first design phase.

Current Operations

The control functions are enabled by a BMS with 4000 data points, allowing remote access and supervision. The ventilation flow is controlled based on occupancy.

Energy demand characteristics

Flexibility potential

Electricity and thermal consumption of the demo site will be compensated by the local production. The H2 production from the H2 panels will be stored and used thanks to the fuel cells. Installation of batteries and additional PVs will be considered for provision of electricity for recharging 2 EV stations. The office building of the ENGIE lab CRIGEN will be a part of the wider CEC. Activity for expanding the local energy community, considering the business model as well, will be partial done in NEON. The excess electricity from PVs will be distributed to the neighbourhood or exchanged with the grid. Innovative business models based on investment cost in energy assets will be explored as part of the EPC contractual arrangements. The hybrid heat pumps installed for heating and cooling of the offices, which run on electricity and/or gas will be exploited to provide the flexibility for improved grid operation, while coupling energy and nonenergy benefits. The objectives of demo activities are to identify the viability of relevant business models owing to preliminary energy performance assessment, and to implement costeffective use cases while enhancing the sector coupling at building and district level. Local authorities such as the city major will be involved in the valorization and scale up of the results.

Here follows a list of the existing CEC services in STAIN City, Stains

Facility management

This service concerns all the office e complex, it is used in both ENGIE building and Industreet building, the main participants on CEC STAINS CITY. This service is mainly used by the complex office's occupants but also used by the property manager who assure that an efficient exploitation and technical maintenance of the building equipment. The facility management is an operation services that aims to reduce the global energy consumption of the building, secure an efficient operation by optimally control the different assets, create flexibility using optimal scheduling and load shifting mechanisms and improve the environmental impact of the building while guaranteeing the comfort and security of the office occupants.

This service is provided by a facility manager who is hired in general by the property manager to supervise and maintain the building operation. However, facility management service strongly impacted by the energy providers that sells the energy to be consumed by the building occupants to perform their activities and by the Building Management System integrator responsible for setting up the control system of the building and it different zones and managing the HVAC consumption.

PV production and self-consumption

The PV production self-consumption in an energy supply service, provided by the INDUSTREET that owns a 300 KWp rooftop PV installation. This installation produces local renewable energy for individual self-consumption. This service is used by Industreet by producing, local and direct self-consuming the solar energy produced to satisfy partially the building occupants energy demand.

The PV self-consumption service allows, through green and local energy production, to reduce the energy supply cost for the office building, limit the dependency on the grid, control the energy bill by consuming free energy at the peak periods. This service also generates extra incomes for INDUSTREET by selling the surplus of their daily production.

Today, IDUSTREET targets to maximize as much as possible the self-consumption to avoid cutting off a part of the surplus when the energy produced is not required in totality by the building occupants, but also to avoid any injection to the grid to avoid the constraints pushed by the DSO

NEON'S CECS CROSS-SERVICES AND RELATED BUSINESS OPPORTUNITIES

CEC 01 –BERCHIDDA

	Dimensions	Name of the existing service	Name of the existing service
Strategic	**Objectives**	**LEC Building**	**Collective Self consumption of PV production**
	Interests	LEC non-technical service that aims to set up the social engagement and energy awareness	LEC energy sharing service
Organizational / social	**Customers / users**	all the Berchidda Municipality electricity residential customers	Electricity residential customers (prosumers)
	Customers' needs and pains / requirements	want to engage into behavioral change and engagement	Maximizes the exploitation of locally produced RES
	Suppliers (internal)	Ener4com	Nesosnet, Prosume Energy, R2M Energy
	Partners (external)	Berchidda Municipality	AXPO, Berchidda Municipality (DSO)
	Suppliers and partners skills	Pre-established contacts with the local community	Midac (residential storage Batteries)
	Suppliers and partners constraints	Energy4com: Covid-19 pandemic hampered in-presence community meetings	Nesosnet: Delay in Smart Meter installations (commodity shortage, Covid-19 pandemic)
Spatial	**Location / places**	Berchidda Municipality	Privately owned residential roofs citizens Berchidda Municipality Storage Batteries installed in 20 homes
Temporal	**Key timelines / moments**	Recursive community meetings and events (min 2/year)	Energy storage (Midac). To support load shifting for DR 20 residential batteries of 5.1 kW of storage will be installed by March 2022
Environmental	**Infos and impacts**		
Business	**Type of business model**	Cooperative model	Service contract
Business	**Costs and revenue items**	Costs = Event organization Revenues = membership association to Ener4com	Costs = solar power plant installation and maintenance Revenues = incentives energy sold to grid
Legal	**Type of contracts, infos**	Cooperative Association (LEC legal entity)	Smart contracts / PPA
Processes	**Processes**		
Functional	**Activities / tasks**	Community meetings, events	PV installation, Smart meter installation & connection, data flow establishment to the community platform, Prosumer DLT and APP enablement
Procedural	**Procedures / standards / norms**	LEC non-technical service that aims to set up the social engagement and energy awareness	
Technical	**Tools / software**	all the Berchidda Municipality electricity residential customers	Nesosnet Smart Meters and community platform, Prosume DLT and APP
Functional	**Functionalities**	want to engage into behavioural change and engagement	Demand response, Smart energy storage management, Collective peak shaving, Optimisation of electric flows within the REC
Technical	**Equipment**	Ener4com	Nesosnet Smart Meters (IOT energy Hub blockchain enabled): to cover at least 300 homes Energy storage (Midac): 20 residential batteries of 5.1 kW of storage
Informational	**Key datas**	Berchidda Municipality	PV production, domestic consumption, household composition, time of the day, weather forecast, day-ahead energy price, national incentives RSE, ARERA tariffs

Table 1. CEC 01 existing energy services comparison table

Both of Berchidda CEC's existing services pursue the objective of providing environmental and socio-economic benefits, in addition to energy benefits, for the members and the local community in which they operate. Both also aim at a radical change of the market (demand side the former, the latter) by putting the production and distribution of electricity back in the hands of the citizens.

The community of Berchidda shows, starting from its strategic objectives and interests, a clear alignment with the will to involve citizens in an active participatory process of supply, management, and optimization of renewable energy resources. This is evident, in principle, from the Municipality's participation in electricity distribution services, through AEC, and its willingness to return an innovative electricity grid capable of distributing the burdens (and benefits) of autonomous renewable energy management within the CEC. Since its foundation, the Berchidda CEC has seen a strong organizational synergy between the actors supporting the establishment of the CER, actors linked to the social, regulatory, and behavioral nature of the community, see for example Energy4com. The integration mechanisms arise from the complementarity of the actors involved in the creation, management, and provision of optimization services of three front-end companies: GridAbility, its consortium companies Nesosnet and Prosume, and Ener4com, an innovative cooperative in close operational connection with them.

The following mechanisms can be used to exploit the existing services:

- Leveraging Citizen Engagement: Leveraging the existing community of practice for the formation of the CEC services, tight personal connection, sense of cohesion will be leveraged with old-time Berchidda residents in a Municipality of 3000 people
- Connecting distributed resources: Leveraging already installed distributed energy resources (photovoltaic + storage batteries) on top of the planned installations (20 heat pumps + 4 community EV charging stations) to increase the flexibility services that can be offered by the CEC grid while providing self-sufficiency in the Municipality
- Diversification of PV installation by end-users: Berchidda targets 100 people for the setup of the CEC and the installation of PV production including (1) Residential users (prosumer), (2) Local wineries and cork industries (3) Public Municipality buildings and lighting, allowing better exploitation of energy efficiency (i.e. via demand response, MEVPP)

Already in the establishment of the Energy Community, two clear opportunities for integration with the services offered for the optimization of PV self-consumption emerge:

1. Assessment of production and consumption profiles for the collection of CEC memberships
2. Creation of a social (people), digital and physical (energy) network, regulated, monitored and self-managed.

The integration of its services creates value for community members to:

- Reduce the energy expenditure of individual citizens and the community
- Contribute to the transition towards distributed generation of energy from renewable sources.
- Increase the know-how of collective management of energy produced from PV and develop the local CEC economy
- Improve the energy performance of individual members (consumer and prosumer) as well as the energy management costs of the municipality

• Make technologically, economically, and financially aware energy decisions at the individual and community level

• Invest part of the proceeds in projects of general interest to the local community, i.e. new installations at the individual and community level, supporting a sustainable entrepreneurial mindset in the area.

CEC02 -DOMAINE DE LA SOURCE

Dimensions		Power to grid	Energy systems maintenance services	Solar Power plant maintenance
Strategic	**Objectives**	sell energy at the best price to Enedis grid	energy services continuity	energy production continuity
	Interests	Revenue's warranty Potential power-price independency	Long outage free warranty Comfort warranty	Warranty the production
Orga / social	**Customers / users**	Apartment owner	Apartment owner	Apartment owner
	Customers' needs and pains / requirements	Solar power plant ROI	Comfort warranty	Solar plant production
	Suppliers (internal)	Conseil syndical & general owner assembly	Conseil syndical & general owner assembly	Conseil syndical & general owner assembly
	Partners (external)	Syndic-Enedis- Solar power plant installer?	Syndic- ESCO	Syndic- ESCO
	Suppliers and partners' skills	Solar power plant design, Enedis relation knowledge, economic ROI calculation	Maintenance energy systems Heat pump maintenance qualification QualiPAC	Maintenance power plant qualification QualiPV
	Suppliers and partners' constraints	Low price for studies, solar prediction uncertainty	service continuity demand	Solar energy production
Spatial	**Location / places**	Residence roof	technic room in the residence	Residence roof

Temporal	**Key timelines / moments**	from building design to commissioning	Periodic visit and on breakdown event	Periodic visit and on breakdown event
Environmental	**Information and impacts**	Solar power plant = 40 g /kWh	to be evaluated	to be evaluated
Business	**Type of business model**	Energy	Services	Services
Business	**Costs and revenue items**	Costs = solar power plant installation and maintenance Revenues = energy sold to grid	Costs: energy systems studies, equipment, and commissioning Revenues = comfort efficiency (€/°comfort)	Costs: periodic maintenance and spare parts repair costs Revenues: solar production
Legal	**Type of contracts, information**	Standard Enedis contract	Maintenance contract	Maintenance contract
Processes	**Processes**	1. Register the installation on Enedis Website 2. Enedis connect (physically) the production on the grid 3. Production start injection to the grid 4. EDF to send the agreement validated 5. EDF to pay the energy each period	1. Maintenance planification 2. Spare parts order 3. Possible assistance of the equipment's system expert 4. Work preparation 5. Repairing 6. Test 7. Close the maintenance operation	1. Maintenance planification 2. Spare parts order 3. Possible assistance of the equipment's system expert 4. Work preparation 5. Repairing 6. Test 7. Close the maintenance operation
Functional	**Activities / tasks**	1. Register 2. Connect 3. Start solar production 4. Payment each period	1. Maintenance planning 2. Order spare & services 3. Repairing 4. Close operation	1. Maintenance planning 2. Order spare & services 3. Repairing 4. Close operation
Procedural	**Procedures / standards / norms**	Energy Code (code de l'énergie)	Security procedure Maintenance procedure	Security procedure Maintenance procedure
Technical	**Tools / software**	Enedis web site Electric specific tools	Plumber tools	Electrician tools
Functional	**Functionalities**	The main part of solar power is self-consumed by common areas, melting of snow, the rest (#40%) is sold to EDF at a low price #90€/MWh)	The PAC systems require electricity from self-consumption (free after amortization) and grid (170€/MWh)	
Technical	**Equipment**	solar panels	PAC and energy system	
Informational	**Key data**	Solar Installation economic study, Production prevision, Price of energy sold	Comfort and systems measurements data	Remote solar data production measurements

Table 2. CEC 01 existing energy services comparison table

The main common element between the services listed in the previous table is the price of energy, so the question that arises is how to optimize consumption and solar power plant production to reduce the costs of energy for the stakeholders.

Thermal energy price is valuated at 90€/MWh, electricity on the grid costs 180 /MWh and the solar energy cost must be evaluated in regard of the installation and maintenance costs. So, it becomes very clear that the optimization must be done starting with an economic calculation. The calculation will need data that probably we don't have yet and need to be measured on the site. This analysis also must be done in regard of emergent needs like electric mobility and storage.

Create new opportunities and generate value for Domaine de la source energy community stakeholders could be achieved by:

Analyze existing pains

The cross-integration mechanism should be based on an economic analysis of energy balance of the systems. I think it should be straightly connected with a carbon balance analysis because environment is also a question of the CEC stakeholders.

Maybe having a helicopter view with carbon and economic filters on the CEC systems optimization processes. In fact, the cross-integration mechanism inherits of the stakeholders' requests and life analysis. So, probably a social analysis is a prerequisite of any cross-integration mechanism.

Open mind – similar problems

Another way of cross-integration is to analyze other activity market, in their energy transition. By example how automotive did this transition. What is a difference using a fuel motor car and an electric motor car? This analysis could open new ideas in this cross-integration process. The first opportunity is the analysis describe above but probably, doing it will be possible to discover other opportunities new and valuable.

There are several opportunities we can explore:

- Energy travel: How is it possible to optimize the way of using energy considering that solar energy has a discontinuous production?
- The new service “energy travel” is very similar to the travel organization with an electric car. There is a need of maintaining a level of comfort in the flats (global usage of the flat functions: heat, air quality, hot water, cooking, lighting...), with a limited quantity of energy during a slot of time depending on the meteorology. This is the same problem we had managing the energy of a high mountain refuge. This new service needs a new approach with a new methodology, technology, behavior analysis and acceptance of the change.
- Cross-optimization: What is the best solution for scheduling energy systems usage regarding simultaneously economics, carbon, and comfort costs optimization?
- This new service needs cross skills including legal rules knowledge, energy market, technology of energy production and systems, behavior, carbon balance. Combining in a team these skills, it could be possible to define a new methodology able to generate in a dynamic way the right, just, schedule for the usage of energy.

CEC 03- POLÍGONO INDUSTRIAL LAS CABEZAS

For analyzing possible business opportunities for different possibilities of CEC using the existing energy services (PV self-consumption, EV recharging points and storage), we must compare them and focusing about some aspects about strategic objectives and interests, typical customers and users, social achievements, legal aspects, technical issues and needs, way of management, etc.

For this reason, we have compared all these aspects in the following table for a better understanding:

Dimensions		PV Self consumption system	EV Recharging point	Storage
Strategic	**Objectives**	Energy Saving / Money Saving	Providing energy for e-mobility / Positioning in a booming sector / Studying economic payback rate for future investment	Energy Saving / Money Saving
Strategic	**Interests**	Cheap technology	Booming sector	Surplus generation from PV system stored
Organizational / Social	**Customers / users**	GFM (owner)	Owners of electrical vehicles	GFM (owner)
	Customers' needs and pains / requirements	Reducing electrical bill / Being more efficient	Obtaining energy for recharging electrical Vehicles / minimizing recharging times / savings for mobility (compared to refuelling)	Reducing electrical bill / Being more efficient / Being more independent from the grid / Taking advantage of surplus generation
	Suppliers (internal)	GFM (owner)	GFMCA (owner) / GFM (installer and O&M)	GFM (owner)
	Partners (external)	Unión Fenosa / Gesternova	Unión Fenosa / Gesternova / Electromaps	Unión Fenosa / Gesternova (only for legal aspects and administrative register).
	Suppliers and partners' skills	Unión Fenosa (measuring energy fed and purchased from the grid) Gesternova (electricity bill and special discount for surplus energy)	Unión Fenosa (measuring energy purchased from the grid) Gesternova (electricity bill) Electromaps (payment platform for end users)	Unión Fenosa (not working during lifetime) Gesternova (not working during lifetime)
	Suppliers and partners' constraints	Unión Fenosa (delay in administrative works, paying economic rates) Gesternova (reduced monetary quote for surplus production)	Unión Fenosa (delay in administrative works, paying economic rates) Gesternova (being careful about wrong prices for electricity) Electromaps (transactions errors for recharging, not alarms enough when something goes wrong)	Unión Fenosa (not working during lifetime) Gesternova (not working during lifetime)
Spatial	**Location / places**	Villacañas (Polígono Las Cabezas. Calle Las Cabezas 16. 45860 Villacañas - Toledo - SPAIN)	Villacañas (Polígono Las Cabezas. Calle Las Cabezas 16. 45860 Villacañas - Toledo - SPAIN)	Villacañas (Polígono Las Cabezas. Calle Las Cabezas 16. 45860 Villacañas - Toledo - SPAIN)
Temporal	**Key timelines / moments**	Legalization and installation: 4 months System Lifetime: 30 years	Legalization and installation: 4 months System Lifetime: 25 years	Legalization and installation: 4 months System Lifetime: 6 years
Environmental	**Infos and impacts**	There is not environmental impact (everything is integrated in the building)	There is not environmental impact (everything is integrated in the building)	Special treatment for a longer lifetime Special treatment for recycling.
Business	**Type of business model**	Electricity uses (using energy for ourselves)	Electricity uses (for EV recharging)	Electricity uses (using energy for us, taking advantage of the generation surplus).
	Costs and revenue items	Costs: corrective works, tools cost and worker's salary for O&M Revenue: 40% saving money from electrical bills	Costs: corrective works, tools cost and worker's salary Revenue: paying for end users payment platform managing.	Costs: corrective works, tools cost and worker's salary for O&M Revenue: 10% saving money from electrical bills
Legal	**Type of contracts, information**	Contract 1: GFM (owner) - Unión Fenosa (Grid Company) Contract 2: GFM (owner) - Gesternova (Market Agent)	Contract 1: GFMCA (owner) - Unión Fenosa (Grid Company) Contract 2: GFMCA (owner) - Gesternova (Market Agent) Contract 3: GFMCA (owner) - GFM (installer – O&M)	Contract 1: GFM (owner) - Unión Fenosa (Grid Company) Contract 2: GFM (owner) - Gesternova (Market Agent)

			Contract 4: GFMCA (owner) - Electro maps (payment platform for end users)	
Processes	**Processes**	Energy generated from PV system involves a reduced energy imported from the grid. Surplus generation is stored in batteries at first and it could be fed into the grid if batteries are full. During night hours batteries are discharged. It involves a reduced consumption from the grid if we compare with the situation before the PV system installation. Every month, the grid company (Unión Fenosa) measures how much power has been imported and how much power has been exported by the owner of PV System (GFM). Unión Fenosa sends to the agent market (Gesternova) this information. The agent market (Gesternova) issues the electrical bill to GFM (owner) for paying for the electrical energy imported from the grid. This bill will show a special discount due to energy fed into the grid from surplus production.	Energy is imported from the grid for recharging electrical vehicles. It is measured by the Grid Company (Unión Fenosa) and they send to the market agent (Gesternova) this kind of information. Using this information, the market agent (Gesternova) issues the electrical bill to GFMCA (owner) for paying for the electrical energy imported from the grid. In parallel, when recharging process is being done, Electro maps collect money from end users due to this service. At the end of the month, Electro maps gives to GFMCA (owner) all the collected money, and GFMCA (owner) pays a quote for the management of payment platform to Electro maps. Once per year, GFMCA (owner) pays to GFM as installer for O&M. GFM does one or two reviews for ensuring everything is working properly.	Linked to self-consumption system
Functional	**Activities / tasks**	Energy and money savings due to directly consumed energy from PV systems. Surplus production is fed into the grid. It involves a special discount in electrical bills.	Energy purchased from the grid for selling to end users for recharging electrical Vehicle's process.	Energy and money savings due to directly consumed energy from batteries, which has been stored during sunny hours from surplus generation
Procedural	**Procedures / standards / norms**	RD 244/2019	ITC-BT 52. REBT (RD 842/2002)	RD 244/2019
Technical	**Tools / software**	Monitoring software systems specific for Fronius inverters: Data manager 2.0. Fronius Solar Web online website for monitoring.	Webserver integrated in EV recharging stations. Electro maps manager website platform.	Monitoring software systems for Victron inverter / chargers: Venus GX. Victron VRM online website for monitoring.
Functional	**Functionalities**	Electrical current is fed into existing circuits by PV inverters. It needs to synchronize with existing voltage and frequency. PV inverters can make PV work in its efficient highest point thanks to a MPPT algorithm. All the electricity taken from the PV system is not taken from the grid. If more energy is needed, the grid will provide it.	Energy purchased for electrical vehicles recharging process.	Energy is stored in batteries from surplus production during sunny hours. Batteries are discharged for own use during night hours.
Technical	**Equipment**	104 PV modules, 6 PV inverters, meter for monitoring system	EV Recharging station. 50 kW DC (ChadeMo, CCS) and 40 kW AC (Mennekes)	Forty-eight lead-acid batteries (2V, 1000AH). 3 inverters / chargers, meter for monitoring system
Informational	**Key data**	Monitoring system, Electrical Bill, self-consumption rate, autarchy rate	Monitoring system, electrical bills, number of recharging processes, number of transaction errors, revenues from recharging services.	Monitoring system, Electrical Bill, self-consumption rate, autarchy rate

Table 3. CEC 03 existing energy services comparison table

As one can see, in the previous table, there are some common, similar, and complementary elements which could easily be exploited for cross-integration.

The main aspect is the complementary way of working between two of the currently existing services: PV self-consumption system and storage. Surplus production from PV self-consumption system (energy not consumed at the same time while it is being generated) is stored in batteries for an appropriated and efficient way of energy usage (for example during night hours). –This has been observed as both services are linked to the same installation and end user. PV self-consumption and storage have the same objective: energy and money savings (the most appreciated aspect for stakeholders).

The same location for the three existing services is a clear advantage for cross-integration. External partners like Unión Fenosa (Grid Company) and Gesternova (market agent) is another similarity between the three existing services. They will not participate in the future Energy Community because they do not have interest on it. However, there is some important information related to the energy requirements on their websites and it could be used if it is necessary. GFM is the owner of two existing services (PV self-consumption system and storage) and it is the responsible for O&M of the third existing service (EV recharging points, whose owner is GFMCA). It could be a possibility for a barter between GFM and GFMCA.

GFM carries out O&M tasks and GFMCA allows free recharging process instead of paying.

Electricity uses the common way of working of three existing services, so it is another similarity. A similar lifetime of three existing services components is another advantage because the model for a future energy community is valid for all three ones. There is not any service in a weaker position for future years. For legalization, we need the same period for three existing services. It is good because it does not involve delays for energy community development due to a certain energy service lags administrative works.

Three existing services have a very good monitoring system so the information for the energy community will be easily available for the cross-integration process.

Our recommendations for cross-integration mechanism for existing services are following ones: Combination of services:

Self-consumption and storage can work together (as it happens in our case). Combination of these two services is not an obligation, but it is highly recommended. We could find also other devices that can be integrated and ensure independence of the system in the future. It is also technically possible to combine the three existing energy services. The state of art for EV recharging points allows connecting PV modules and batteries for an integral way of operation. It involves a direct connection between existing services, so the energy can flow from one to another, and it is a very efficient way of use.

Virtual Balance:

Sometimes it is not possible to install the devices close ones to each other's. In this case we could install the equipment wherever we could or where we have permission from the administration and/or the grid company. They will work by their own (there is no interconnection between them). Energy flow is measured, and it is agreed a shared used of it. At the end, the result is the same as if all existing energy services are connected, even though there is not any electrical connection. This is possible thanks to an internal agreement between all stakeholders (energy providers and end users). All of them compensate ones to each other's using energy (kWh) and money (euros). It is an interesting way for cross-integration process, and it is exactly which it is expected to implement in this energy community for this pilot: POLÍGONO INDUSTRIAL LAS CABEZAS.

Energy barter:

This scenario is very similar to the previous one. It is another way for cross integration of these three existing services (storage, pv self-consumption, EV recharging points) and others. In this case, there could be a barter between different stakeholders. For example, according to our case. GFMCA is the owner of one EV recharging point. For O&M works, GFM is signed. Once O&M works have been done by GFM, GFMCA does not pay money to GFM. Instead of this, GFM could charge their electric cars in this EV recharging station free.

Let us imagine another possible example. Some storage systems are portable. Some people use these kinds of solutions for working activities in remote areas. There could be two stakeholders: owner of one solar panel-based self-consumption system and owner of portable batteries. Five batteries could be charged using surplus production from PV self-consumption system. The owner of the batteries uses four of his own batteries for some works wherever they could be. However, one battery is lent to the owner of self-consumption system for reducing their consumption from the grid during night hours.

It is seen that money is not used. There are some energy barters for compensating due to energy services.

Some great opportunities emerge from these cross-integration mechanisms.

There is one big opportunity thanks to these cross-integrations processes. It is the possibility of increasing the number of energy services development. Many times, there are many projects that are not possible due to administrative restrictions, a lack of permission from the electrical grid company, economic aspects, constructive reasons, etc. The possibility of combining energy services, enabling them for working together, multiplies the probability of success for many renewable projects (PV systems, storage, Wind systems, EV recharging stations, etc.).

For example, let's imagine we would like to install some EV recharging stations. However, the grid company does not allow us because there is not a strong connection to the grid due to a small size of distribution wires in our area. Therefore, we decide to install PV modules and batteries to reduce the electricity needs from the grid. This entails the disappearance of the argument put forward by the electricity company.

CEC 04 -STAINS CITY

To analyze possible business opportunities for CEC STAINS based on the existing energy services provided by STAIN energy community stakeholders, a comparison of these services thought various dimensions has been performed in the table below, focusing on the objectives and the value of the services, the users of the services and their needs, the technical and functional activities, the business, social and environmental impacts. The results from this analysis should allow to identify the most promising mechanisms for CEC STAIN services cross integration and to envisage the cross-integration between two or more existing energy services

Dimensions		Facility Management	PV Self consumption Scheme	Green H2 production
Strategic	**Objectives**	Efficient exploitation of the building and its technical equipment. Reduction of OPEX cost while maximizing comfort in the building.	Produce local renewable energy, with individual self-consumption as much as possible and share locally the surplus of energy available.	Production of green H2 energy for research and learning purposes.
	Interests	Reduce the global energy consumption (with possible energy savings) and improve the environmental impact of the buildings and the businesses.	Reduce the energy supply cost for the building and improve the environmental impact with the generation of a local renewable energy source.	Test and validate new technologies. New area of expertise to develop for a renewable and green energy.
Organizational/ Social	**Customers / users**	Offices and buildings users/occupants (ENGIE CRIGEN and Industreet)	Industreet (producer and direct self-consumption) and CRIGEN (with a collective self-consumption scheme)	ENGIE Collaborators (and mainly ENGIE Lab H2)
	Customers' needs and pains / requirements	Comfort and security in the building, problem with technical equipment and maintenance, energy bill consumption in the building	Use of local energy production to reduce the dependency on the grid and control the energy bill. Sell electricity surplus to generate extra revenue.	Hydrogen provision for testing new technologies.
	Suppliers (internal)	Facility managers	Industreet (owner)	ENGIE Lab H2
	Partners (external)	Energy providers, Equipment manufacturers (for support), BMS integrator (for support)	DSO, PV surplus electricity buyer for grid reinjection, facility management, Enogrid	H2 equipment manufacturer
	Suppliers and partners' skills	Facility managers: supervise the building operation Energy providers: sell energy to the building occupants BMS integrator: can provide support and help regarding the use of the BMS.	Industreet + facility management: Supervision of the PV production and the overall operation of the self-consumption scheme. DSO: supervise the collective self-consumption scheme. Enogrid: follow the energy transfer between the member of the collective self-consumption.	ENGIE Lab H2: Supervision of the H2 production. H2 equipment manufacturer: provide support on the request for a proper operational usage of their equipment.
	Suppliers and partners constraints	Facility managers: technical equipment usability.	DSO: providing an accurate breakdown of the energy consumption/distribution between the different partners.	ENGIE Lab H2: availability of the electrolyze and management of the different experimentations using the same equipment.

Spatial	**Location / places**	Pierrefitte-Stains, Île-de-France	Pierrefitte-Stains, Île-de-France	Pierrefitte-Stains, Île-de-France
Temporal	**Key timelines / moments**	Periodic visit and supervision, intervention on breakdown event	Digital supervision in real time	Regular supervision of the production
Environmental	**Information and impacts**	Reducing energy consumption has a positive impact on the environmental footprint of the building	Producing and consuming local renewable energy help to reduce the environmental footprint of the buildings and the businesses	Production of an innovative energy vector, whose carbon content can be very low (if produce with green electricity) and doesn't produce any pollution when used.
Business	**Type of business model**	O&M contract between the facility manager or Energy Performance Contract (with engagement on energy reduction)	Investment (PV installation) to realize energy bill savings and sell PV to the local partner (collective self-consumption scheme) or the grid	H2 Energy production that can be sold.
	Costs and revenue items	Manpower to operate the maintenance in the building, energy savings if EPC contract	Energy bill reduction, injection to the grid and market sale	Costs: electricity sourcing, equipment and supervision
Legal	**Type of contracts, info's**	O&M Contracts between the building occupants and the facility manager (ENGIE CRIGEN Buildings and Industreet)	Agreement and participation to the collective self-consumption scheme	Energy furniture agreement/contract
Processes	**Processes**	Supervision of equipment, maintenance and security, supervision of thermal comfort in the building, follow the water and energy consumption in the building	Production of renewable electricity thanks to the PV panels. The energy available is first used as much as possible on the building of Industreet and the surplus available can be sold to ENGIE CRIGEN for their own use.	Electricity is used in a electrolyze to produce hydrogen. The hydrogen is then stored under pressure (bottles) for transportation.
Functional	**Activities / tasks**	Supervision of equipment, maintenance, supervision of comfort in the building	Follow-up of the energy transfer and billing of the energy transfer from Industreet to ENGIE CRIGEN.	Production of H2 gas from electricity. Storage in H2.
Procedural	**Procedures / standards / norms**	OEM standards	DSO procedure for self-consumption scheme	French "IPCE" regulation
Technical	**Tools / software**	Monitoring and BMS	PV inverters and Enogrid platform	Monitoring (to be confirmed)
Functional	**Functionalities**	Optimize energy consumption	Production and self-consumption (local or collective) of local renewable PV production	Production of H2
Technical	**Equipment**	Building management systems are available to monitor the different equipment.	PV panels, inverters and Enogrid platform for supervision.	H2 Electrolyser, compressors, and high-pressure H2 storage.
Informational	**Key data**	Water and energy consumption, temperatures in the building, HVAC operational data	Electricity consumption/injection, Total PV production, Self-consumption rate	H2 production and equipment availability.

Table 4. CEC 04 existing energy services comparison table

Both services listed in the previous table (the facility management and the PV self-consumption) aim to reduce the energy bills and the environmental impact of the buildings and the businesses, for both ENGIE CRIGEN and Industreet, regarding the pilot scenarios. In terms of environmental impact, H2 production is particularly relevant in combination with the local renewable production of electricity.

The need for electricity to power building energy systems and to produce Hydrogen make them mutually complementary and reinforcing with the local PV production that is now capped by the system owner to avoid any grid injections. The surplus of renewable electricity could be sold or transfer to ENGIE CRIGEN. There is as well a certain flexibility in the H2 production by using storage and BMS control that is complementary with the intermittency and variation of the PV production.

The same localization and the involvement of the same actors are a key element to make first requirement is the introduction of a collective self-consumption scheme. The proximity of local hydrogen production in ENGIE CRIGEN is also an opportunity for Industreet who would be interested in developing new training and expertise around hydrogen for their students.

The NEON cross-integration mechanisms that could be used in the project are mainly combination mechanism of the different services. Now, Industreet is artificially limiting the PV production because he doesn't have any possibility to reinject it on the national grid. If the surplus of energy was made available to ENGIE CRIGEN, it could be used for the electrical need of the building, and it would be as well possible to use it for the H2 production.

The H2 production being associated to some storage capacities, it would be possible to pilot the H2 production to prioritize the production when PV electricity id available and not consumed. On a similar way, the building energy systems could be controlled to some extent to adapt its energy consumption to maximize the energy consumption when there is a PV production. Being both interested in innovation and new technologies around energy, ENGIE CRIGEN and Industreet could potentially share skills and expertise around hydrogen. Some common work or partnership on the subject could be a way to proceed. The main opportunities of these cross integration would be the following:

- Maximizing the use of the energy that is produced locally and reducing the environmental impact of the buildings and the local activities and businesses. It requires new way of piloting and optimizing energy consumption at the community level when there is a local energy production.
- Reducing the energy bills through the self-consumption scheme or lowering the dependency on the energy market, in a general context of increasing prices.
- Share the possibility of working with an innovating resource (H2) in terms of training and expertise as it is a promising energy vector for a decarbonized future.
- Testing the possibilities regarding the deployment of new services dedicated to local energy communities.

SUMMARY AND KEY TAKEAWAYS FOR NEON

In NEON project, four Citizen Energy Communities have been selected BERCHIDDA, DOMAINE DE LA SOURCE, POLÍGONO INDUSTRIAL LAS CABEZAS, and STAINS CITY distributed among three

European countries, namely, Italy, France, and Spain. In this deliverable a characterization of the pilot sites is given, while the main differences between the four pilot sites (taking into consideration the type of energy uses to be addressed by local renewable energy production, the level of progress regarding the installation of smart devices inside homes, and the type of flexibilities) will be studied during the pilot experiments.

- In Berchidda, the energy uses such as domestic hot water and specific uses of electricity will be studied to shift them to moments of local PV generation.
- In Domain de la source, particular attention will be given to the optimization of storing thermal energy and HP operation for space heating, jointly with the flexibly on other electricity uses inside homes.
- In Poligono industrial las Cabezas that consists of multiple PV installations, a wind turbine, 3 EV chargers and a lead-acid battery, the goal is to operate the assets as a single network and to utilize all the existing renewable plants at a single point.
- Finally, Stain city building meets the requirements of E+C- French label with H2 panels, installation of batteries and PVs. where any excess electricity will be distributed to the neighborhood or exchanged with the grid.

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