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InEExS
ENERGY SERVICES ON THE BLOCKCHAIN

BUSINESS MODELS AND CONTRACTUAL SCHEMES FOR SMART SERVICES AND SECTOR INTEGRATION

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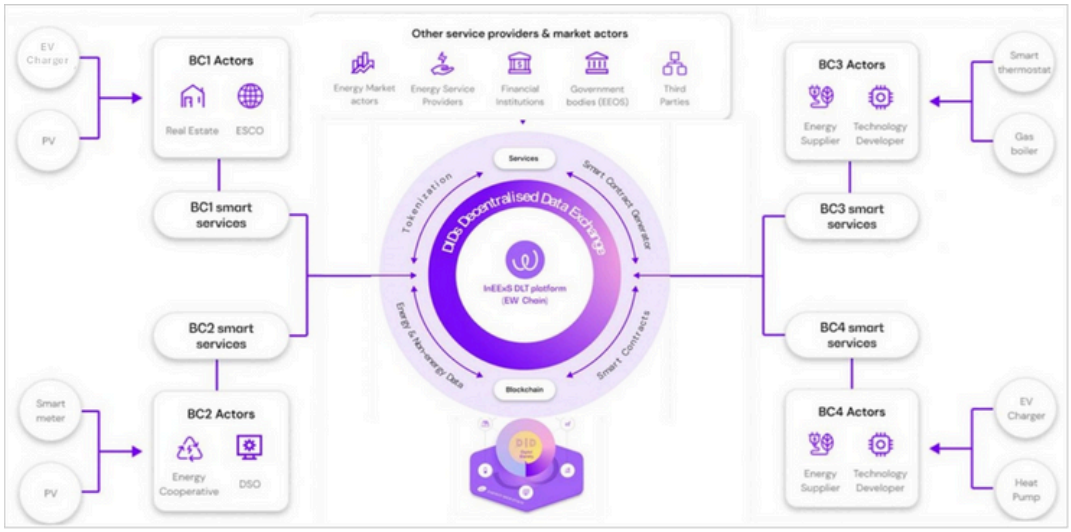
This document outlines the five business models developed under the InEExS project aiming at the deployment of integrated energy services across sectors and carriers, the tokenization of energy saving data in a public blockchain and facilitating cooperation among market segments and actors. Each business model is carried out in a country, namely Germany, Spain, Greece and Sweden (the fifth model is conceptual) and support the implementation of sector-integrating smart energy services and the deployment of a wide range of sustainable technologies, as distributed renewable energies, demand response, electromobility, heat pumps, IoT controls and energy efficiency measures.



The InEExS Blockchain platform and services enabling service integration across the 4 BCs

A business model was prepared for each business case, including the specific smart services to be provided and target customers, a cost-benefit assessment, the market conditions or the steps to put the smart service into the market. InEExS also included regulatory frameworks and legal considerations, measurement and verification (MRV) procedures and the process to integrate smart services with the Distribution Ledger Technology (Blockchain platform) (DLT).

Each one of the InEExS business model shows in an easy-to-understand way the strategic view and key components on how the smart energy service can be viable in the country where it is developed. At the same time, the use of a unique blockchain platform and the focus on smart energy services optimisation constitutes the common connection for all InEExS business models.

The overall experience allows us to assess the implementation of these four business case smart services in other EU countries, with a previous assessment of their regulatory and market frameworks.

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Business Model : Improved Self-Consumption of Distributed Energy Resources (DER) in Energy Cooperatives

ENERCOOP, ESCAN Consultores energéticos, Verdia Legal (Spain)

The primary objective of this business case is to enhance the self-consumption of solar photovoltaic (PV) energy in energy communities through incentivization mechanisms. These mechanisms include personalized messaging, token-based rewards, and smart contracts, all supported by Distributed Ledger Technology (DLT). The goal is to encourage energy-efficient behaviours by motivating users to adjust their consumption patterns based on PV production, real-time electricity market prices, and grid conditions.

To facilitate this transition, a mobile application will be developed to provide users with real-time insights and tailored recommendations for optimizing their consumption. This will enable users to align their energy use with peak PV production times, helping to reduce bills while contributing to grid stability. Additionally, the use of tokens will incentivize energy-efficient actions in a transparent and secure manner.

Context

Energy communities are adopting demand-side management (DSM) strategies and leveraging innovative technologies such as Distributed Ledger Technology (DLT) and smart contracts.

486kWp
Buildings operational from 2023 and expanded with a 3MWp plant in 2024

298 kWp
3 additional PV installations on public school roofs from 2024 to 2025

250 households & 600 users
3 new PV installations by 2025, with 250 kWp capacity and total annual production of 362.5 MWh

1MWp
Additional PV plant is also set to become operational by the end of 2025

Barriers limit the optimization of collective self-consumption

Regulatory complexities create delays in establishing energy communities and deploying solar PV projects.

High investment costs and financial risks deter adoption, particularly during economic downturns.

User management issues arise when members leave a community, disrupting energy sharing arrangements.

Scaling self-consumption further complicates logistics, requiring advanced infrastructure and coordination among diverse users.

Target group

- Members of the ENERCOOP Cooperative (90% of Crevillent's population ~ 30,000 residents)
- Electricity Consumption Points: ~14,000
- Focus on residential households. Reasons:
  - Less experience with energy efficiency and renewable technologies
  - More vulnerable to rising energy costs and market fluctuations compared to businesses

Expected impacts

Total Energy Savings =

Reduction in Distribution Grid Losses

6% of the self-consumed energy

- More energy generated and consumed locally
- Minimizes transmission losses

+

Increased Users Energy-saving Awareness

Estimated reduction: 5% of Annual Energy Consumption

- Use of digital tools
- Educational initiatives

	2023	2024-2025	2030
Energy Savings	0.12 GWh/y	2.54 GWh/y	3.97 GWh/y
Renewable energy production	678 MWh/y	15.71 MWh/y	51.64 GWh/y
Avoided CO2 emissions	206.48 tCO2eq/y	4,696.59 tCO2eq/y	14,458.56 tCO2eq/y
Total investment planned	5,033,000€		


PSFV Campillo (2024)

- **2023 - Short term:** six PV installations and the 571 metering points associated to these PV collective self-consumption installations.
- **2024-2025 - Medium term:** expansion to 11,000 consumption points.
- **2030 - Long term:** one PV plant of 1MW capacity as well as at least other three to six smaller PV installations.

Key Regulations for Improved Self-Consumption

- **Royal Decree-Law 15/2018** - Right to self-consume energy without penalties.
- **Royal Decree 23/2020** - Supports collective self-consumption, defines roles of energy communities, allows shared use of renewable energy installations.
- **Royal Decree 244/2019** - Energy sharing among multiple consumers.
- **Legal Framework for Blockchain and Tokens –** Still evolving in Spain, but there should be a careful management of token exchanges, as they may involve financial transactions that could trigger VAT or other tax liabilities. Any incentives provided through blockchain must also respect the GDPR requirements for data privacy and user consent, particularly in regard to how energy consumption data is collected and processed.

MRV (Measurement, Reporting, and Verification)

The performance reporting and visualization will be done through an app (web and mobile compatible) for the members of the energy community to track electricity consumption, PV self-consumption, energy savings, economic savings, and CO2 reduction.

Monitoring data: Hourly consumption data from energy community members will be collected, but to comply with GDPR policies, the profiles will be converted into monthly aggregates before being sent to the DLT platform.

Data Reporting: Energy savings will be calculated for both periods (with and without PV), showing the differences in self-consumption for each hour, aggregated monthly. The results will be stored off-chain, while the calculations will be performed on-chain on the DLT using blockchain technology.

Data verification: Aggregated data will be calculated and hashed using a Merkle tree algorithm on blockchain software. The resulting hash will be validated across multiple nodes to ensure consensus and stored for MRV purposes

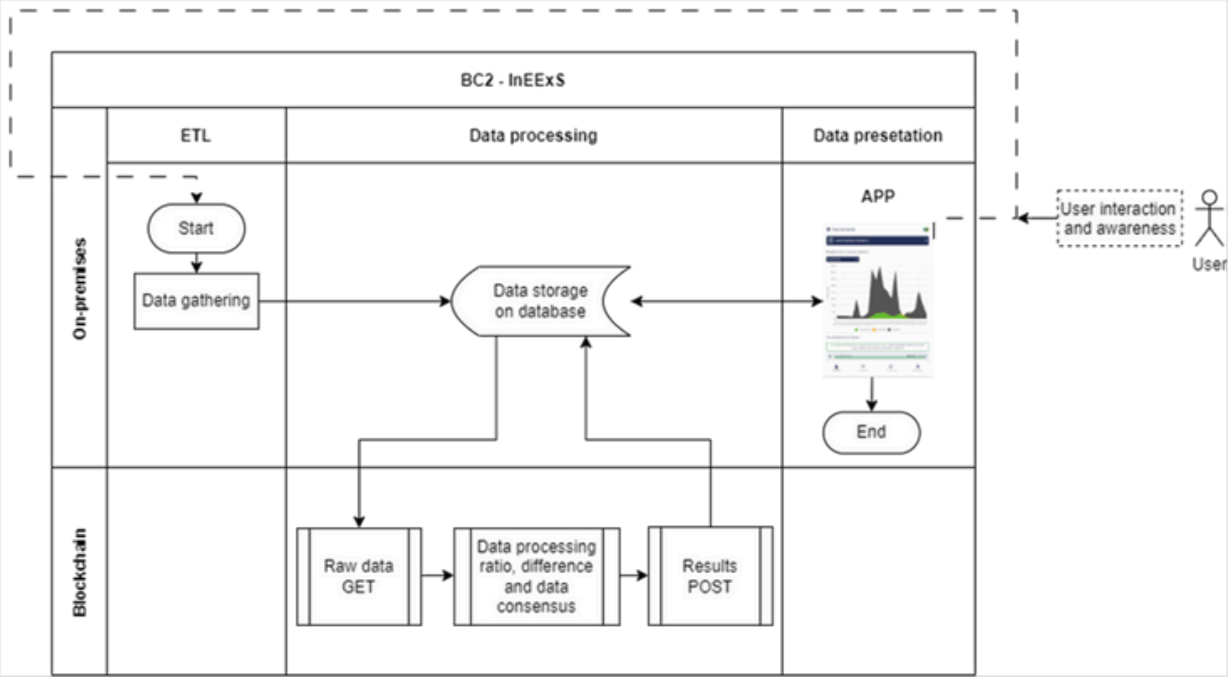
DLT (Distributed Ledger Technology)

The process starts with the user being motivated and changing its electric energy consumption hourly behavior at home, which (ideally) should lead to an increase of the home PV self-consumption. Then, the DLT platform calculates both the self-consumpton percentage and also its increase compared to a similar month of a patter year. The result is calculated and storaged in the platform and visualized by the user in the energy community APP through its smart phone.

Key calculations

1. The actual self-consumption ratio that the users achieve thanks to the incentivisation measures (through data-driven messages or the gamification process on the app).
2. The difference (delta) in self-consumed energy achieved by comparing the baseline consumption data from the previous year to the energy consumption pattern from the actual year.
3. The tokenization process resulting from the evaluation of the energy-efficient behaviours.

These calculations yield a token balance that will try to incentivize users into achieving better energy efficient behaviours, even for users not involved in collective self-consumption.



Engaging customers in a renewable energy community

Benefits

Users not participating in collective self-consumption align their energy use with production, minimising network losses and **maximizing overall efficiency**

Incentives to use the PV produced at local level

Reduction in CO2 footprint for the municipality

Reduction of energy bills and no initial cost to customers (service provided by ENERCOOP)

Specialised advice to enhance energy efficiency

Enhance **social integration**

Actions coordinated by ENERCOOP

- Production of solar PV at local level.
- Supplying energy to nearby customers.
- Incentivizing energy consumption through a token system using DLT.
- Use of Measurement and Verification methodology.
- Consider other assets as eV chargers, which are connected in the local distribution grid.

Channels to foster strong customer acceptance and attract new members to the energy community

Direct

- Information office
- Website
- Mobile app
- Social media

Indirect

- Press releases
- Energy magazines
- Promotional activities (partnerships or collaborations)

Key partners and stakeholders

- Business model expert
- Legal and financial experts (taxations and data protection)
- Smart meters expert
- App developer
- MRV expert
- DLT expert
- Training expert
- Communication and dissemination services
- Maintenance team for the PV installations
- Stakeholders for their feedback, particularly residential customers.

Revenue streams

- Residential customers will pay the local PV energy supplied at 50% of the hourly market price until the investment is paid back.
- Energy and economic savings from improved energy efficiency through advice in the app could range from 2% to 20%, based on market studies.
- Pay-for-performance (P4P) scheme due to the improvement in self-consumption.
- Lower charging costs for electric vehicles.

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