Global Observatory on Peer-to-Peer Energy Trading

UsersTCP

Image from: https://www.ft.com/content/6d62b494-209a-11e9-b126-46fc3ad87c65

CommUNITY

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Key facts

Location (town + country)	London, UK
Duration (start/end dates)	*Phase 1: 01.05.2018 – 30.04.2019, Phase 2: 16.07.2019 - 30.06.2022*
Funding source	*UR Research and Innovation and EDF Energy*
Project lead (organisation)	*EDF Energy*
Project partners	*EIFER EWIV, Kaufmann Bau GmbH, Easy Smart Grid GmbH, Energiedienst AG, Weider GmbH, BSH GmbH, Energiewerkstatt GmbH, Flotteladen GmbH, Stadtwerk Haßfurt, Stadtwerke Trier and others*
No. of participants	*(Residents of a block of flats in Brixton)*
Case study type	*Technical demonstration*

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Case study statistics

Parameter	As designed	As built
No. of participants	a block of 62 two-bed properties	25 households (appr. 60 inh.)
Generation (kWp)	70 kWp PV, 20 kWel CHP	88 kWp PV, 21 kWel CHP
Storage (kWh)	virtual battery*: 1178 kWh *storage by shifting operation time	virtual battery*: 564 kWh (real), battery 41 kWh
Unit price ($/kWh)	- (use existing flexibility)	-
Project cost ($)	-	400.000 Euro (research funding)

Impact highlights

- The project demonstrates the activation and orchestration of flexibility of every type, power, energy consumption and availability to compensate volatile availability of renewable energy sources.
- Dynamic tariffs provide financial incentive for flexibility, to activate and integrate customers as consumers and prosumers into the energy system. While conventional market approaches rely on negotiations and schedules for energy exchange in the future, the SoLAR technology deduces prices in real-time directly out of grid state. This way, correct prices to maintain balance and prevent grid congestion are derived at any time, while minimizing effort for market transactions.
- The demonstrated technology represents a paradigm shift and has potential to boost the energy system transition. The technology is not only simple and cost effective, but solves upcoming problems of stability, resiliency, privacy and cyber security.
- Goal of the project was to demonstrate the feasibility of the technology. Moreover, the partners worked on concepts, how to integrate the technology into the energy system and how a transition roadmap could look like.

Project aims and objectives

The project set out to address a number of objectives:

- To design a replicable, local energy market model which can help deliver future community energy schemes
- To deliver savings to consumers while providing wider community benefits
- To demonstrate the efficacy of a peer-to-peer local trading platform
- To demonstrate the application of blockchain in enabling local energy markets
- To conduct research on the key drivers and enablers for consumers to engage into a local energy market based on peer-to-peer trading
- To assess the impact of community self-consumption and peer-to-peer energy trading schemes on energy salience and engagement with energy and energy services

- To test consumer engagement and response in a peer to peer energy trading trial and provide robust evidence outputs for government and industry

Xavier Mamo, Director of Research & Development at EDF Energy:

“At EDF Energy, we are committed to making energy easier for our customers and unlocking the benefits that new technologies are bringing to the sector.

“By collaborating with our partners and using block chain technology, this project in Brixton aims to show how small communities in dense urban areas could benefit from a low carbon and local energy system in a new and transformative way.”

Image from: https://www.politicshome.com/members/article/edf-energy-empowers-social-housing-residents-to-trade-solar-energy

Summary of case

Project CommUNITY, a collaborative effort between EDF Energy's Research & Development department, Repowering London, and UCL's Energy Institute, sought to revolutionize urban energy consumption by harnessing the power of community-owned renewable energy. With a focus on increasing residents' access to local low-carbon energy sources while simultaneously reducing overall costs, the project aimed to address pressing societal challenges such as fuel poverty and climate change. The CommUNITY aimed to empower urban communities, help enhance the utilization of local low-carbon energy among residents while simultaneously reducing their overall expenses.

The project was centered around Elmore House, a residential block in Brixton, where a solar PV system was installed on the rooftop to generate clean electricity. Residents were provided access to this renewable energy through a peer-to-peer trading platform facilitated by blockchain technology. This platform allowed residents to manage and share their energy resources amongst themselves, promoting community engagement and fostering a sense of ownership over the energy they consumed.

Throughout the trial period, CommUNITY yielded promising results. Residents were able to source an average of 42% of their electricity needs from the solar PV system, resulting in tangible financial savings and a reduction in dependency on traditional energy suppliers. Moreover, the initiative demonstrated the viability of decentralized energy systems and underscored the importance of community-led initiatives in driving the transition to a sustainable energy future.

By showcasing the potential of community-owned renewable energy projects to address fuel poverty, promote sustainability, and foster community empowerment, CommUNITY provided valuable insights and lessons for policymakers, energy stakeholders, and communities alike. Moving forward, the project's success serves as a beacon of inspiration, highlighting the transformative impact of collaborative efforts in reshaping the energy landscape and advancing towards a more resilient, equitable, and sustainable future for all.

Description of case

Market value proposition and key activities

The market value proposition of the CommUNITY project lies in supporting shared consumption of electricity generated through a shared ownership of a PV array in a multi-occupancy residential building.

This pilot addresses the challenge of providing access to energy generation and trading market for the urban populations living in flats. The pilot realises this through installing a peer-to-peer electricity trading platform within a single building comprised of 62 rental family apartments.

Under this pilot, the residents share a common generation source – a roof mounted PV array, receive an equal share of the generated electricity which they can consume, exchange with neighbours or trade.

The site of this pilot study was a block of 62 two-bed properties in Brixton that had had a 37kWp photovoltaic array retrofitted by the building owner. The array was also part-owned by some of the residents (from now on the term owner will be used to refer to both the primary owner (i.e., main owner of the array and the building) and the part-owners for brevity).

Prior to the pilot, the wiring of the building was separated for each resident and the generation from the retrofitted array was solely used for powering the building's elevator with the remaining electricity exported to the grid. This resulted in over 90% of the generated electricity being exported directly to the grid. The array owner had established a power purchase agreement with an electricity supplier for 7p/kWh. However, this setup did not maximise the value of the generation asset. The owner of the generation received only the minimum monetary value from each generated electricity unit and the residents received no benefit at all. Therefore the objective of this project was to better utilise the available generation, maximising its benefit to both owner and residents while also providing increased control and sense of community to the participants.

Financing/funding (who contributed funding and under what terms)

The CommUNITY project received funding through UK Research and Development scheme whereby the UK Research and Innovation Council (UKRI) and EDF co-funded the study.

In addition, this study was supported by several partners, as outlined below:

1. UKRI co-funded the project.
2. EDF Energy managed the project, provided financial support, developed the peer to peer trading platform for the energy sharing and trading, as well as handled the metering, billing and commercial arrangements for the pilot participant households.
3. PassiveSystems provided hardware for data collection (as smart meter data was not accessible at the time).
4. Electron provided support with blockchain platform for recording trade transitions.
5. Ofgem provided the project with a status of regulatory sandbox pilot, allowing it to operate outside the current regulatory framework and receive guidance from Ofgem as needed.
6. Repowering London social enterprise facilitated interactions with the community during the construction of the photovoltaic array and supported community engagement.

7. University College London (UCL) provided additional academic input during the design and development of the project as well as supported community engagement (along with Repowering London).

<u>Legal structure (co-operative; partnership; social enterprise; etc)</u>

The pilot led to setting up of a community benefit company, where all gains from the peer to peer trading were integrated and re-distributed to the Elmore House residents.

The project itself (before the community benefit company set up) operated within a partnership structure. It involved collaboration between multiple entities, including EDF Energy, Repowering London, and University College London (UCL). This partnership allowed for the pooling of resources, expertise, and funding to achieve the project's objectives of designing, piloting, and evaluating a local peer-to-peer energy trading market. Each partner brought unique contributions to the project, such as financial support, regulatory guidance, community engagement, and academic input.

<u>Timeframes including for project initiation; funding cycles; detailed design; legals and contracts; participant recruitment; trial duration; decommissioning; etc</u>
<u>Stakeholders/project partners involved (organogram)</u>

The CommUNITY projec's timeline followed several phases [7], as shown in Fig. x below:

Concept Formulation: The project began with discussions and planning among the partners involved including EDF Energy, Repowering London and University College London (UCL). Given the complexity of the project, this phase had taken several months and resulted in defining the project's goals and scope, as well as expanding the partnership for the project. The led to application for funding to UKRI, which was awarded, leading to the further work on the project, including:

Techno-Economic Feasibility analysis carried out by EDF energy, evaluating potential benefits to the residents and the technological feasibility of the project.

Customer and Stakeholder Engagement followed once the technical feasibility was established, and it was shown how the pilot is likely to provide financial and social benefits to the residents as well as business opportunity to the participating companies.

Detailed Design phase involved designing the peer-to-peer energy trading platform, regulatory frameworks, and market mechanisms. This phase required collaboration between technical experts, regulatory bodies, and stakeholders.

Site Installation work consisted of installing hardware (the data collection clamps at householder's meters) and software (the peer to peer trading trading platform).

The Pilot Exploitation and Operation followed.

Participant types and characteristics: residents (social housing, private rented, private ownership; socioeconomic status); SMEs (types and loads); social institutions (schools, etc).

The participant types and characteristics in the CommUNITY project included:
Residents:

- Residents living in the Elour House house building where the project was implemented. The residents differed based on their co-ownership of the PV array:
    - Residents Co-Owners had invested into part ownership of the PV array and rented an apartment within the building;
    - Residents without co-ownership simplify rented an apartment within the building.
- Building owen who was also the co-owner of the PV array. The building owner was the Lambeth Council, so it is a non-profit government agency.
- EDF Energy undertook the role of platform provider and project manager, as well as energy supplier which bought excess generation and sold electricity to the residents when self-generation was insufficient.
- Repowering London community organization supported community engagement;
- Electron supported the peer-to-peer trading platform development and deployment over blockchain, working closely with EDF.
- PassiveSystems supplied data collection hardware;
- UCL supported community engagement and provided academic support for the project design.

What were the inclusion/exclusion criteria for participating in the case?

The main inclusion criteria for this pilot was **residency** in the Elmor House. As this was the building within which the project was implemented, all individuals residing within the building where eligible to participate.
Interest in energy trading was also necessary, as participants were to express interest in engaging in peer-to-peer energy trading and had to be willing to opt in with this project.
Finally, the participants had to be **willing to share their electricity use data** for the purposes of the project's research and implementation.
All residents of the Elmor House participated in this pilot.

Participant recruitment methods, incentives and protection (opt-in or opt-out; were participants paid to participate; were they exposed to financial losses or other risks; etc)

Participant recruitment was carried out through an extensive process of **community engagement** via workshops, discussions and information sessions carried out by the community partners organisations (Repowering London, Lambeth Council, and University College London).
Incentives for participation were both financial and nonfinancial:

- Financially, the participants were gained through receiving cheaper energy from own generation and peer-to-peer trading.

- Nonfinancial benefits included increased control over energy consumption, and fostering a sense of community within the building.

As part of **participant protection**, the participants were provided with **informed consent** before participating in the project and were given the option to **opt-in voluntarily**, rather than being automatically enrolled in the project. To minimize any **financial losses risks**, the project design ensured that all participants paid less for equal to the current grid price for any unit of electricity used form the project. Similarly, as owners of the generated electricity, the participants sold it at the price equal or better to what would be received though sending it to grid. Participants' **privacy and data protection rights** were also safeguarded as part of the study/technology design.

Participants' role in co-creation of project and objectives (if any)

The project participants contributed to the shaping of the project's design and objectives through a wide range of stakeholder and customer engagement activities.
Two community engagement partners (Repowering London and UCL) carried out a set of workshops with the community to ascertain their energy-related needs, challenges, and preferences. Their input, particularly the focus on wishing to provide community benefit and community creation, informed the project's objectives by highlighting the energy sharing and exchange preferences, as well as equitable distribution of generation through the peer-to-peer energy trading platform.
Throughout the project several co-design workshops were also held to collaborate on the design of the features of the peer to peer energy trading platform and the user interface of the resultant application.
All these community engagement activities helped to foster a sense of ownership and empowerment among community members.

Case study functional requirements.

The functional requirements of the CommUNITY project in terms of peer-to-peer platform services provided and equipment used can be summarized as follows:

1. Peer-to-Peer Trading Platform: The project required a robust peer-to-peer trading platform that facilitated the exchange of excess electricity among residents within a single building. This platform needed to support automated trading, recording, and enable final settlement of transactions between participants.
2. Avoid rewiring and ensure replicability of the solution in other buildings: Instead of physical rewiring, the project implemented a virtual trading mechanism to simulate direct trading between residents without the need for altering the building's wiring infrastructure. This virtual trading approach enabled participants to trade electricity as if direct wires existed, utilizing a platform to record and settle trades at a later date.
3. Data Collection and Management: The project needed the platform to support accurate data collection and management for both electricity generation, consumption, and trading activities. Smart meter data or alternative metering solutions were not available, so electricity clamps were used to track electricity flows within the building and facilitate peer-to-peer transactions.
4. Algorithm Development: Custom algorithms were developed to manage the trading process. These algorithms determined the distribution of excess electricity

generation among participants, allocated generation fairly, and facilitated trading decisions based on user preferences.
5. Privacy and Security Measures: Given the sensitive nature of energy consumption data, the platform incorporated privacy and security measures to protect participants' personal information and ensure compliance with data protection regulations.
6. Integration with Existing Infrastructure: The peer-to-peer trading platform needed to integrate seamlessly with existing electricity infrastructure within the building, including metering systems, grid connections, and generation sources such as photovoltaic arrays. Compatibility with regulatory requirements and industry standards was also essential for successful implementation.
7. User Interface and Experience: The project developed a user-friendly app to enable participants to monitor their electricity usage, track trading activities, and manage preferences. Intuiti.

Regulatory structure and requirements (beyond compliance with existing law), e.g. constraints imposed by regulatory sandboxes.

The regulatory sandbox constraints on the CommUNITY project required compliance with existing frameworks while allowing for the project to operate outside traditional regulatory boundaries for buying and selling electricity between study participants. The compliance related to:

Energy regulations and standards, ensuring safety or the project and reliability or electricity supply, where the self-generation is insufficient. For this the grid connection was always maintained for the Elmore House.

Ensuring **data privacy and security** meant that the project had to adhere to data protection regulations and any personal information from participants had to be collected, stored, and managed securely (as per GDPR). To comply with this, the CommUNITY pilot undertook careful review of data collection hardware devices and platform set up options. It was ensured that the selected hardware supported encryption of data before transmission. Similarly, all records stored on blockchain were pseudo-anonymised, and an intermediate de-anonymization table was developed for community building needs. The challenge of implementing the “Right to be Forgotten” over public blockchain platforms remains an issue. This led to the design decision of making blockchain private (instead of the previously planned public solution).

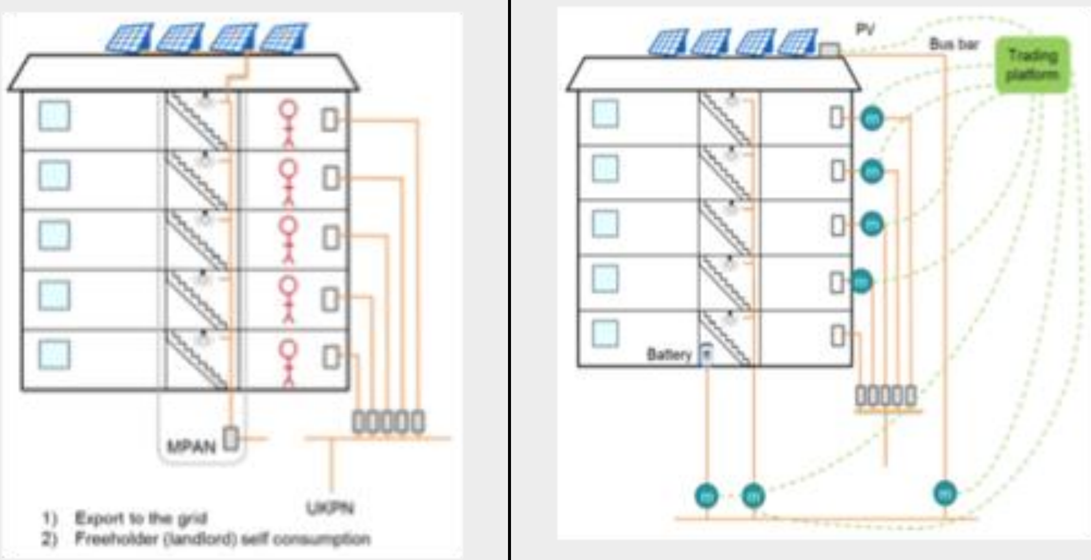
Finally, in compliance with the **consumer protection regulations**, the pilot ensured that the interests of all study participants were protected. To ensure fair treatment, transparency, and accountability in all transactions and interactions facilitated by the peer-to-peer trading platform, a fixed price for all purchases and exchanges between participants was set. The price ensured that all customers were better financially better off with the pilot participation then they were prior to it.

Stakeholder requirements (trial design requirements) and Technical architecture (representation of assets: generation; storage; control; load types (electric vehicles

<u>(EVs); heating, ventilation and air conditioning (HVAC); small and medium-sized enterprises (SMEs); etc)</u>

The technical components of the pilot are sketched in Fig. ?x? below.

Fig ?x? (a) shows the pre-pilot state of the Elmore House, where each flat has its own access point to the grid, and the PV array is used to power the common area and the lift.



To provide the CommUNITY project with the generation sharing capability the pilot considered various rewiring options that would allow the generation to be distributed amongst the residents prior to reaching the grid. Using a rewiring approach would avoid any regulatory issues, but would introduce limitations and cost to the project.

The final design of the pilot is shown in Fig ?x? (b), where the meters for each flat are augmented with a data collection clamp, and the Trading Platform supports the CommUNITY energy trading process (further detailed below, with some key requirements shown in italics).

Minimising any changes necessary to the building's wiring infrastructure was therefore considered vital to ensure the system retained flexibility whilst also *maximising the applicability to other buildings* in similar scenarios if it were determined to be a successful model.

The energy trading platform provided a non-wire option, using the concept of "virtual trading" whereby residents would trade as if direct wires existed, instead using a platform to record and settle these trades at a later date.

This allowed for ***the simplest installation*** by removing the need for altering the wiring in the building but is n*ot* ***considered by current regulation***.

A DNO would be required to operate and maintain the network, but residents would retain the flexibility to join and leave the community as necessary. In this system, electricity meter data would be collected at source and fed into a separate trading mechanism that would ***determine the distribution of excess electricity generation amongst the residents***. At predetermined intervals, this trading information would then be used to ***adjust customer bills to reflect their interactions*** in this secondary market.

Beyond the technical requirements, the project was strongly focused on ensuring that the ***benefits of the electricity trading are distributed to the residents in a fair and equitable manner***.

Data architecture (including data ontology/standards where used)

The project was initially designed around the use of smart meter data to minimise the barriers to entry for participants, however in practice using smart meter data within a live environment was not possible at this stage of the smart meter rollout.
Along with rollout still ongoing, the use of smart meter data was also heavily restricted and as such would introduce a number of data privacy limitations.
Nevertheless, the smart meter.
The project instead chose to use third-party electricity meters (hereby referred to as clamps) and an additional ETP-Link module was developed to provide this data to the Oracle.

Financial model (representation of financial flows and markets)

CommUNITY used a fixed pricing structure which focused on the social-element of peer-to-peer interaction where participants were only given the options to 'use, 'share' or 'sell' their electricity. This pricing mechanism means the trading decisions were be purely based upon user decisions.
Trading was divided into half-hourly trading periods to remain inline with the wholesale market and reflect the time-based nature of the electricity being traded. In each trading period, the generation of the photovoltaic array was allocated equally to each of the participants, with any remainder exceeding total participant demand being exported to the grid.
Participants then first use the maximum amount possible of this allocation to meet their own demand. Any remaining allocation that is not consumed by the participants demand may then be traded within the market. Participants can elect to either **share** this excess to a particular individual or into a community pot that any participants may use or to **sell** their excess to another participant.
To ensure that this platform remains beneficial for all involved, the **pricing is fixed** such that participants pay 7p/kWh (equal to the PPA price) to the PV owner for each unit allocated to them, each share within the system is then also fixed at 7p/kWh, such that a share is providing the electricity at cost to the receiver. A sell on the other hand is priced at 8p/kWh so the participant with excess earns a small profit.

Geographical scale

The geographical scale of the CommUNITY project was local or community-based. It focused on enabling peer-to-peer energy trading **within a single building** in a block of 62 two-bed properties in Brixton. The project's scope was relatively small, targeting a specific community rather than a broader geographic area such as a city or region.

Governance structure

The project involved several stakeholders and partners collaborating on various aspects of the project:

1. Project Management was handled by EDF Energy.
2. Regulatory Oversight was carried out by Ofgem. The pilot was granted a regulatory sandbox status and guidance from Ofgem was also provided, as necessary. In addition, UKRI monitored compliance to the funding terms.
3. Implementation Partners included all other previously noted partners (PasiveSystems, UCL, Repowering London, Electron).

Electricity network ownership (public or private)

Since the project involved trading electricity within a single building in the urban neighborhood, it comprised both publicly owned infrastructure (through grid connections), and privately owned infrastructure through the distribution systems within the building. The trading platform (i.e., the software infrastructure) was also privately owned – it belonged to the EDF – the main platform development partner.

Outcomes and achievements

The CommUNITY project aimed at enhancing the consumption of local low-carbon energy among residents, while reducing their overall energy costs. This initiative facilitated residents' ownership in a communal solar photovoltaic (PV) system installed on their block's rooftop. It empowered residents to use, store, and directly trade electricity generated from solar panels within their community.

The project was also anticipated to demonstrate to broader society how small communities in densely populated urban areas can benefit from a low-carbon and locally sourced energy system in an innovative and transformative manner by implementing blockchain technology to facilitate peer-to-peer energy trading among residents.

The project achieved its goals by providing residents access to electricity produced by rooftop solar panels, allowing them to share or sell surplus energy. This setup not only led to reduced electricity expenses for the community members but also showcased the potential benefits of innovative and transformative technologies in the energy sector, particularly the viability of blockchain for system deployment.

Following the success of its initial phase, the CommUNITY project progressed to a three-month trial second phase which was named the Urban Energy Club project (also called “CommUNITY+” by DEF). At this stage, the project incorporated components of energy storage and network flexibility, where UK Power Networks (UKPN) was invited to participate. A communal battery with a capacity of 10kW/20kWh was installed and connected to the existing 37kWh solar PV system in December 2020, enhancing the ability of residents to utilise solar energy more effectively, especially during the evening.

In 2021, residents of the building were included in a trial with the Urban Energy Club project, co-managed by Repowering London, EDF, and UKPN, to experiment with how residents could contribute to the local electricity grid by providing flexible power services from the communal battery to UKPN.

The primary objective of this second phase was to create economic empowerment of residents and the local community by allowing them to participate in the flexibility market and derive income by selling flexibility to UKPN. This phase is also intended to benefit the local electricity network by providing flexible power services to balance supply and demand. Additionally, the consortium expected that the experiences and insights gained from the project would help them to understand how domestic, and local energy markets can interact with the grid and thus guide them in the design and development of future services.

The project reported significant achievements. The trial resulted in savings of £7.50 on monthly electricity bills for residents from using the solar energy generated and selling flexibility to UKPN. Stored clean solar energy has provided 42% of household electricity consumption on average.

Not only did the project deliver an economic advantage, but it also provided an important social benefit for the community by offering people who live in flats the opportunity to engage in solar energy production. Previously, these individuals were excluded from self-producing renewable energy.

Repowering London, one of the project's developers, highlighted that what the company learned from the project has already been used to inform new ventures and encouraged the company to support local energy and community-scale renewable energy initiatives.

What was the primary goal of the project? (please tick one)

☐ **Grid integration** - e.g. management of grid constraints; balancing of demand and supply; promote/include distributed energy resources (DER) generation; optimisation of energy behaviour to benefit system; aggregation of participant energy loads.

☐ **Environmental benefits** - e.g. promote or include renewable energy (RES) generation.

☐ **Empowering individuals** - e.g. participants have greater control over preferences; self-sufficiency (autarky); autonomy.

☒ **Local benefits** - e.g. improvement to local economy (job creation etc); independence from other regions; community as focal point for engagement; shared benefits across the community.

☐ **Creating market value** - e.g. economic incentives for participants; access wholesale, balancing and ancillary service markets.

Were there any secondary goals of the project? (please tick as many as apply)

☒ **Grid integration** - same description as above

☒ **Environmental benefits** - same description as above

☒ **Empowering individuals** - same description as above

☒ **Local benefits** - same description as above

☒ **Creating market value** - same description as above

Key takeaways

The project achieved the triple advantages of local economic empowerment, social inclusion and environmental benefit through increased consumption of solar energy.

Local energy systems can be successfully implemented in small, densely populated community.

Blockchain technology can be deployed in peer-to-peer energy trading.

Obstacles encountered when conducting the pilot

Data Accessibility and Privacy Concerns

The necessity of real-time smart meter data for P2P markets clashed with privacy concerns. The unavailability of smart meter data led to using electricity clamps as a temporary solution, which is not scalable for large deployments. The handling and usage of smart meter data, while necessary, pose significant challenges due to data privacy regulations and restrictions from energy suppliers.

Blockchain and Data Privacy

Similar to the issue with smart meter data, concerns around data privacy also affect how data is stored, particularly due to its personal nature. Public blockchains, ideal for ensuring trust and transparency, face challenges with the EU GDPR regulations, notably the 'right to erasure,' which allows individuals to have their data deleted. The immutable nature of traditional blockchains conflicts with this right. A possible solution could be a consortium blockchain, regulated by authorized entities, with modifications like obfuscation layers to hide personal data, ensuring GDPR compliance.

Data Availability and Blackouts

Many P2P platforms assume uninterrupted data access for transactions. In reality, disruptions like equipment malfunctions or network outages can lead to data unavailability, posing challenges for trading. These 'data blackouts' can limit the impact on trades, allowing for deferred settlements until data is accessible again. However, in a fully operational P2P market, such interruptions could significantly affect market settlements, necessitating robust management strategies, including potential backup arrangements with energy suppliers, to ensure continuous operation and system stability despite data inconsistencies.

Blockchain Limitations on User Experience and Analytics

Blockchain technology enhances user control and system transparency but introduces challenges in user experience and data analysis, especially when deployed widely. Ideal scenarios involve direct node operation by users for efficient data access, but practical use often relies on remote connections, reducing system functionality. This shift impacts blockchain's inherent benefits, necessitating workarounds like proxy servers for better data handling. Despite these challenges, ongoing efforts aim to balance user convenience with blockchain advantages, exploring solutions like specialized mobile devices and protocols for improved interaction without compromising data integrity.

Regulatory Adaptations

Testing the solution in a real-world setting provided insights into regulatory compatibilities and the feasibility of implementing NW1. It revealed various implementation paths that align with regulatory allowances, focusing on collective switching or maintaining existing energy suppliers. This analysis identifies three prime methods for NW1's application, each compliant with current licensing but necessitating amendments to the Balancing and Settlement Code to proceed.

Key takeaways

Real-time smart meter data is essential for P2P markets but raises privacy concerns, leading to temporary solutions like electricity clamps which aren't scalable.
Data privacy concerns extend to blockchain, where the immutable nature challenges GDPR's 'right to erasure', potentially solved by consortium blockchains with obfuscation layers.
Data blackouts due to technical failures challenge P2P trading, requiring robust management and backup arrangements to ensure market continuity.
Blockchain enhances control and transparency but limits user experience and analytics, necessitating workarounds for efficient data handling.
Real-world testing revealed the need for regulatory adaptations to accommodate new

Key learnings for other pilots

Throughout the CommUNITY project, numerous hurdles were discovered. Below will detail some key lessons learned and take away messages for other projects.

This project provided trial participants with electricity clamps to provide access to their electricity meter data due to the unavailability of smart meter data. This alternative is not scalable, and the use of smart meter data would be necessary for a large-scale deployment to be successful.

However, when smart meter data is to become available, accessing and using this data may prove difficult due to data privacy risks for participants. A successful P2P energy trading will rely on successful use of privacy enhancing technologies so that sensitive smart meter data is handled in a secure and privacy-preserving manner.

A public blockchain does not comply with the EU GDPR regulation including the `right to erasure' allowing participants the ability to have their information deleted upon request. In addition, its use within a live environment imposes limitations that affect both analytics and user experience. For instance, analytics within the trial required retrieving all trades within a given market period. As the chain grows, this search becomes increasingly slower, such that additional information must be stored to efficiently limit the search space.

In practice, data will not always be available for all participants during each market period. A simple equipment failure or the data transmission network having an outage will result in 'data blackouts' for participants. Handling these blackouts will be key to a robust deployment of a P2P market.

Key takeaways

Consider how access to smart meter data will be provided at the planning stage.

Consider how to tackle the privacy issues raised by using smart meter data.

Consider carefully the need and type of blockchain technology used.

Plan for scenarios when data is not available due to failures.

Avoid single point of failures, e.g., a failure of a single device should not

Recommendations for policymakers / Request to scientific community

Based on learnings from CommUNITY project, the following recommendations are proposed to the policy makers:

1. **Regulatory Reform**: Advocate for regulatory reforms that facilitate peer-to-peer energy trading and enable greater flexibility in energy markets, allowing communities to participate more actively in the generation, distribution, and consumption of renewable energy.
2. **Financial Incentives**: Introduce financial incentives such as feed-in tariffs or tax credits to encourage investment in community-owned renewable energy projects and ensure their economic viability.
3. **Community Empowerment**: Promote policies that empower communities to take ownership of their energy resources and participate in decision-making processes related to energy infrastructure development and management.
4. **Education and Awareness**: Invest in public education and awareness campaigns to increase understanding of the benefits of renewable energy and community-led initiatives, encouraging widespread adoption and support.
5. **Collaborative Partnerships**: Foster partnerships between government agencies, energy companies, community organizations, and research institutions to leverage collective expertise and resources in advancing sustainable energy solutions at the local level.

Further information

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