STRENGTHENING THE FOUNDATION OF COMMUNITY ENERGY MODELS: COMMUNITY ENGAGEMENT AND SOCIO-ECONOMIC IMPACTS OF PROJECT SENSIBLE

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ABSTRACT

In this paper, the authors start by discussing the main community engagement activities that were carefully designed and conducted to bring the local community and all relevant stakeholders in both demonstrators on board. It also highlights the on-going activities that are being used to keep participants engaged with the project. The resultant tangible socio-economic impacts of energy storage were also examined based on two questionnaires that were distributed to participants and from recorded energy generation and consumption data.

INTRODUCTION

SENSIBLE – Storage ENabled SustaInable energy for BuiLdings and communitiEs – is a Horizon 2020 funded innovation action project aiming at integrating small-scale electro-chemical, electro-mechanical and thermal storage technologies, with Distributed Renewable Energy Sources (DRES) into the distribution grid, homes and commercial buildings. The project assembles a team from the electricity sector including equipment designers/manufacturers, system operators, energy market traders and research organisations, as well as the most essential members – electricity users themselves. In Project SENSIBLE the electricity users are represented by the communities located in two of its three demonstrators – Évora in Portugal and Nottingham in the UK [1]. In both cases, the potential benefits of storage integration are being explored. To support this effort, community engagement is an essential element of the process that has worked to recruit and keep participants well informed and engaged.

COMMUNITY ENGAGEMENT

Community engagement has been a main driver for the successful implementation of Project SENSIBLE. From the onset, all related activities were carefully designed and set out in the engagement plans of both demonstrators [2].

Évora demonstrator's engagement plan

The Portuguese demonstrator of Project SENSIBLE is located in Valverde, a small rural Village near Évora, and is aimed at validating the benefits of integrating small-scale storage at the distribution grid and homes. The Évora community engagement plan was broken down into four phases: project presentation, deployment, demonstration and results dissemination.

Phase 1 – Project presentation

During 2015, the engagement activities were mainly informative and aimed at presenting SENSIBLE to key stakeholders - the inhabitants of Valverde. Firstly, EDP Distribuição and EDP Labelec met with the local mayor to garner his support and to discuss the best strategies to engage the local community. An initial dissemination session was arranged to present an overview of SENSIBLE to the community. A second session was held three months later to provide more details about the equipment to be installed at buildings/residential level and to explain the participants' selection process.

Phase 2 – Deployment

The second phase kicked off with the third session in the early 2016. The objective of this session was to administer the first socio-economic questionnaire and to record the intentions of those willing to participate in the project by receiving equipment (PV systems, batteries, electric water heater, home energy management systems and smart plugs) to be installed in their residences.

From this session, a first list of clients was realised with the support of the parish council. For those clients who were well ranked, technical visits were conducted at their properties to establish their suitability for the installation of equipment and to provide more information about the project. All the information was compiled and the final ranking was concluded. Those not selected received a formal letter from EDP. The remaining participants were invited to participate in a fourth session where the agreement for the installation of equipment was explained in detail. Contact details were also made available to facilitate interaction between participants and the EDP team. The deployment of the equipment occurred during the summer of 2017.

Phase 3 – Demonstration

Although the demonstrator is not fully functional, several public sessions have been initiated with three events taking place over the last half of 2017. The first one occurred in June and was aimed at inaugurating the residential demonstrator where the residential equipment was turned on. A second session was held in October and was aimed at explaining the online portal and the Power BI tools, where clients can find useful information about their consumption, generation, electricity costs, among other indicators to help them to manage their appliances and energy consumption. A third session was held in November, where the main objective was to explain in a more tailored manner the available tools for participants to manage their own energy.

In addition to these sessions, direct client support has been provided for participants whenever any doubt or problem has arisen. In addition, a showroom in a public building in Valverde is being built to showcase the technical functionalities of the demonstrator.

Phase 4 – Results dissemination

The fourth phase is related to the final stage of the project. It will comprise mainly the dissemination of the final results of the demonstrator to all stakeholders.

Nottingham demonstrator's engagement plan

The work being done in Nottingham is split into two different sites. The first is at the FlexElec laboratory, located at the University of Nottingham (UoN); the second is in the Meadows, a mostly residential community located just outside of Nottingham city centre. The main aim of the Nottingham demonstrator is to show how electrical and thermal energy storage within a residential community can be used to reduce energy costs for consumers. The Nottingham demonstrator is trying to achieve this aim using technology and equipment that is commercially available, thereby improving the chances of uptake by those not necessarily directly involved with Project SENSIBLE. At the core of the Nottingham demonstrator is the exploration of the concept of "Community Energy" where individual consumers work together to make the best of their own local resources including solar generation and energy storage. The key goal in this case is to show that by controlling the energy storage for a community rather than for an individual consumer, the benefit of energy storage systems can be increased. Engagement with the Meadows community has been enabled by the involvement of MOZES (Meadows Ozone Energy Services), the local community energy services company. The Meadows demonstrator was broken down into three parts. The first is a domestic component where volunteer residents would receive one of four different energy storage technologies and get them installed in their homes. The second is a community school with very variable seasonal use but a large array of existing PV's installed. The third is a planned housing development where there is the opportunity to install a private wire network for 10 houses. Thus far, only the first residential and school components have been set up – significant delays brought on by ownership and planning issues have meant that the third component has been put on hold.

The community engagement tactics used in Nottingham were devised to secure greater engagement from the Meadows community in the planning and the delivery of Project SENSIBLE. The engagement strategy was set out as a progressive process that aimed to gauge the level of support of the scheme and also to prioritise local needs, strengthen the relationship with the community and review and inform on the project. The backing that the project has received from MOZES has meant that the project team has found it easier to gain the trust and support of community members.

To begin with, general canvassing was used as a means of recruiting residential participants in the Meadows. Those who were know by MOZES to have received PVs in a previous project or to have shown interest in having more energy efficient homes were contacted to inform them of the project and of the chance to get involved. To capture more interest, the project was also advertised in a local magazine and to announce a public meeting where a database of potential participants was to be made. Following this public meeting, the interest of volunteer households was confirmed and physical surveys of their homes conducted in late 2015 and early 2016 to establish their technical suitability and location in relation to the grid. In addition, an initial pre-installation questionnaire was administered to investigate the socio-economic and occupancy characteristics of the households and to examine attitudes to community energy and energy storage. Following this, formal offers were made with details of the equipment that would be installed and the terms of the 'Householder Agreement' that was drawn up to outline and control the relationship between the participant householder, MOZES and UoN. Having already held a series of public and individual meetings to keep participants well informed, it was planned that outside of these events, each participant would be appointed mentors from MOZES and UoN team to help guide them through the installation process, monitor the process and to receive any immediate feedback. This has meant that, throughout the project, the participants have had someone to approach in case of any queries. At all times, the project has given householder participants the opportunity to withdraw at any stage. Even so, participants have remained very committed to the process. Results of the second post-installation questionnaire (distributed to those who have now received energy storage equipment in their homes) show that 94% of participants have felt adequately informed and engaged during the entire course of the project. The significantly smaller percentage of participants who differed with this view cited the issue of delays in installation of equipment brought on by delays in the delivery which was outside of the direct control of MOZES and UoN.

The community engagement process with the school has been more straightforward mainly due to the support of a progressive Headmaster. To engage the larger school population comprising of students (aged 4 to 11 years) and staff, there are plans to have a permanent display of the basic data showing how much energy the school is producing from its solar panels and how much of that energy is being stored used to power the school. More recently MOZES and UoN organised a workshop on ‘Stored Energy’ that involved a series of short presentations and games to help capture the interest of the young students on energy storage. Similar workshops are planned for the larger community to help reach out to even more members of the community on matters of energy storage and community energy.

By providing opportunities for dialogue with project participants and the larger Meadows community, Project SENSIBLE has helped to present the potential benefits of energy storage in the context of the Meadows community. Due to this approach, participants appear to have favourably compared the potential impact of energy storage in conjunction with the pre-existing PV’s that they have in their homes and community buildings with the alternatives. As with the Évora demonstrator, demonstration events are planned for to showcase project findings as the project comes to a close.

SOCIO-ECONOMIC IMPACTS

To investigate the socio-economic benefits of energy storage, two questionnaires were distributed to the participants of both communities. The first questionnaire was administered at the start of the project and was divided into five sections including: views on climate change and energy efficiency, views on community initiatives and energy storage, energy generation, supply and use characterisation, property characterisations and preferences regarding Project SENSIBLE. The second questionnaire was launched after the installation of the project equipment in order to explore the participants’ views on the benefits and drawbacks encountered following the equipment installation.

Figure 1 summarises the most important results of both questionnaires.

	Évora Demonstrator	Nottingham Demonstrator
1st questionnaire	• Half of respondents believe that their property is not energy efficient and they argue they have no financial capability to invest in high cost measures to make their properties more energy efficient. • The majority of respondents are concerned about energy prices. • The majority of respondents understand the importance of changing their energy demand according to DSO needs. • If there is any type of incentive, the majority of clients are available to provide flexibility for helping DSO to manage the grid. • 88% would be happy to have PV panels and energy storage. • The potential energy savings is the main reason respondents chose to join SENSIBLE. • Currently, no one from Évora demonstrator has PV panels.	• 60% of participants believe their property is energy efficient, and are prepared to borrow funds (82% - under £500 & 50% - over £500) to increase the level of energy efficiency. • Due to rising energy costs, 40% of the respondents were concerned about being able to pay future energy bills. • 94% of respondents were concerned about climate change and see the need to change behaviour to reduce the risk. • 90% of respondents supported the idea of shared community energy as a way to achieving greater efficiency and community cohesion with 92% willing to share excess electricity with the community. • The most important reasons for joining SENSIBLE were to be greener and to save money on energy (67%). • A substantial number of properties in the Meadows already have PV panels and the idea of battery storage in conjunction was welcome.
Post installation questionnaire	• Respondents are happy with storage equipment and 95% understand how energy storage works. • 95% would recommend other members to install batteries in their homes. • 89% state that energy storage has been useful in helping them cut down on energy bills. • 80% agree that energy storage equipment made them more energy efficient. • For 75%, the most significant benefit after the equipment installation was the energy bill (electricity or gas) reduction. • The majority of the responds prefers to engage with the equipment through the online portal. • Most participants track their energy consumption and generation on a regular basis during the week thought the online portal. • 90% believe that are more efficient thanks to being able to monitor their energy use. • 75% participants confirm that they are more aware about energy efficiency matters. • The majority of respondents have changed how they consume energy, by shifting the time of consumption. • All the participants felt adequately informed/ engaged during the course of Project SENSIBLE.	• Respondents are happy with storage equipment and 89% understand how energy storage works. • 94% believe that energy storage will revolutionise energy use in homes and communities. • 78% have found that energy storage has been helpful in helping them reduce their energy bills. • 83% would recommend other members to install batteries in their homes and 100% believe that energy storage for communities as opposed for individuals can help can help to improve energy efficiency. • 78% of respondents charged their energy storage equipment off of PVs only, 17% from the grid only and the remaining 5% from both PVs and the grid. • 77% believed that their involvement in the project had made them more energy efficient. • Majority of respondents tracked their energy storage, consumption and generation - with most preferring to do so using the online portal (44%) or the equipment display (22%). • For participants, the most significant benefit of having energy storage is lower electricity bills (82%), improved energy efficiency (64%) and lowering their carbon footprint (64%). • 50% of respondents changed how they consumed energy by shifting the time of consumption to use stored energy.

Figure 1- Main questionnaire results from Évora and Nottingham

ENERGY SAVINGS IN ÉVORA DEMONSTRATOR

The energy clients in Évora demonstrator were provided with a human machine interface through an online portal which enables each client to check in real time their PV production, consumption and energy injected in the grid, their battery state of charge and/or their thermal heater temperature. From this business intelligence tool, each client can check how much CO2 emissions they have prevented. They can also check how much they are saving each day and they are also advised whether they should change their type of tariff.

In Nottingham, participants have access to an online portal and/or smart phone apps associated with their provided equipment. Using these tools they can access information showing: PV power generation, total consumption, purchased electricity, battery status, amongst others. On provision of the equipment, each participant was visited and taken through the process of logging into the online portal and/or apps and taken through what the information means. This way participants have the chance to review how much they are generating, consuming, saving and feeding into the grid.

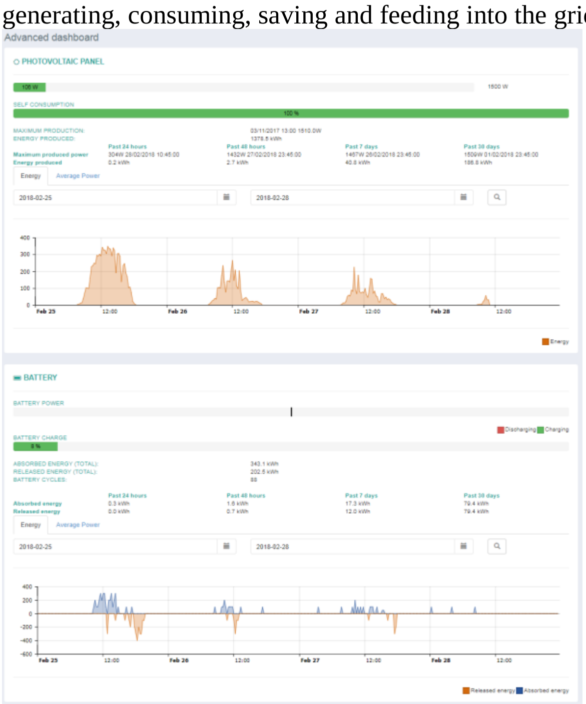

Figure 2- Example of the dashboards available to Évora's energy clients though the online portal

In Évora, the sum-total of the individual data of each client allows EDP to compute indicators for the entire demonstrator as shown in Table 1. Since the deployment of the residential infrastructure in July 2017 up until January 2018, all the 25 clients in Évora have consumed 77MWh of electricity, the PV panels have produced almost 25 MWh, which corresponds to 2,5 tonnes of CO_2 emissions saved in total. 11% of PV energy was used by the residential batteries and 16% were consumed by the water heaters. During this period of time, the 25 clients were able to reduce their electricity bill by almost €2,500. Despite the impressive results, there is still room to improve them, namely battery and water heaters are programmed to optimise the self-consumption. Their profitability could be expanded if they were also used for arbitrage. In addition, there are some specific clients' issues that should be taken into account, like HEMS's parametrised rule taking into account the seasonality of consumption and the energy profile of each client.

Table 1- Clients energy data between July 2017 and January 2018 in Évora demonstrator

	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017	Jan 2017	Total
Total consumption (kWh)	561,8	7.371,8	10.175,9	9.889,5	12.528,7	17.550,4	19.025,1	**77.103,2**
Grid consumption (kWh)	453,9	5.962,2	8.297,0	8.719,3	12.248,4	17.423,4	18.353,8	**71.458,0**
PV production (kWh)	149,6	4.894,0	5.596,6	4.637,1	3.160,7	2.774,8	3.359,8	**24.572,7**
Injected energy (kWh)	13,3	2.549,0	2.298,5	2.014,3	1.224,6	617,1	667,3	**9.384,1**
Water heater consumption (kWh)	38,6	1.223,6	1.382,2	1.595,5	2.089,1	2.553,8	2.257,8	**11.140,6**
WH consumption due to PV (kWh)	13,1	506,5	635,4	660,9	664,8	722,5	654,3	**3.857,6**
Battery consumption (kWh)	12,5	340,9	670,2	597,3	654,3	526,2	675,0	**3.476,3**
Battery consumption due to PV(kWh)	8,0	297,0	595,0	509,7	457,7	334,3	492,0	**2.693,6**
Selfconsumption (kWh)	136,3	2.345,0	3.298,1	2.622,8	1.936,1	2.157,7	2.692,5	**15.188,6**
Energy bill- Flat tariff(€)	106,7	902,1	1.259,1	1.330,0	1.777,2	2.573,2	2.660,2	**10.608,5**
Energy bill- Two time period tariff (€)	124,6	1.329,1	1.728,8	1.957,9	2.685,9	3.601,7	3.778,9	**15.206,8**
PV savings - Flat tariff(€)	22,6	401,0	522,7	421,7	324,7	350,4	429,7	**2.472,9**
PV savings - Two time period tariff (€)	26,3	450,7	628,2	511,8	371,1	395,5	521,3	**2.904,9**
Battery savings - Flat tariff(€)	1,0	29,3	69,7	58,2	93,9	85,5	109,6	**447,3**
Battery savings - Two time period tariff (€)	1,2	34,7	80,9	68,3	108,3	91,5	122,4	**507,2**
Water heater savings (€)	2,2	78,2	95,2	98,9	100,2	108,7	103,9	**587,3**
Avoided kg CO2	15,1	495,0	566,0	469,0	319,7	280,6	339,8	**2.485,2**
% injected PV into the grid	9%	52%	41%	43%	39%	22%	20%	**38%**
% of PV used in the WH	9%	10%	11%	14%	21%	26%	19%	**16%**
% of PV used in the Battery	5%	6%	11%	11%	14%	12%	15%	**11%**
% Consumption of the WH due to PV	34%	41%	46%	41%	32%	28%	29%	**35%**

CONCLUSIONS

Within the scope of community energy models and supported by energy storage technologies it is possible to achieve significant socio-economic benefits as has been indicated by the results obtained by the Évora and Nottingham demonstrators. Increasingly, community energy models are being identified as having the potential to play a strategic role in enabling the transition to a clean and affordable energy supply. These models are very much defined by the key stakeholder – the community that is the energy consumer. This being the case, local public participation and engagement is vital to their success. The extent of this engagement can be modified to include the identification of local needs and the managing of assets to enable the attainment of socio-economic impacts. Learnings obtained from Project SENSIBLE indicate that meaningful engagement can be used to help maintain momentum and encourage wider participation as the project progresses.

REFERENCES

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