SERENE

# SUSTAINABLE AND INTEGRATED ENERGY SYSTEMS IN LOCAL COMMUNITIES

## e-Newsletter 5/8 December 2023

## In This Issue




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# *Is a transformer failure at Aardehuizen a taste of things to come in the Netherlands?*

**The energy transition has far reaching implications in many areas, including on the operation and design of the electricity grid. Local energy generation has increased rapidly, at times going beyond the design capacity of low voltage grids. One of SERENE's demonstrator sites, Aardehuizen in Olst, recently experienced a power outage due to a transformer failure. The transformer could simply not cope with the high energy load – is this a taste of things to come for the Netherlands?**

On July 18th 2023, the transformer connected to the Aardehuizen community in Olst, the Netherlands failed (Fig.1). At approximately 12:00 o'clock local time, the residents of Aardehuizen, as well as an adjacent neighbourhood, experienced a power outage. At the time of the failure, the transformer, including its oil, was overheated, leading to an eruption of oil. It took more than an hour before the transformer had cooled down enough to be examined.

The electricity network of the Aardehuizen neighbourhood was designed in 2011. At the time, the neighbourhood was expected to draw a worst-case peak load of 70 kVA, meaning about 3 kVA of power was reserved per house. During the original analysis by Enexis (a local Distribution System Operator), the focus was on proposed electrified loads, such as heat pumps, induction cookers and Electrical Vehicles (EVs). Local power generation was not considered, but when the neighbourhood was finished, a total solar panel capacity of about 70 kVA was installed. Furthermore, in 2020, a solar parking lot was added, which generates an additional 60 kVA peak, resulting in a total of 130 kVA. Additionally, many houses in the adjacent neighbourhood are also equipped with PV.

Fig. 1 Faulty 400 kVA transformer at the Aardehuizen, with oil leaking from top left corner (Ferdi Hummelink, Vereniging Aardehuis Oost Nederland, 2023).

**What caused the transformer failure?**

At the moment of the transformer failure, Enexis measured a peak feed-in of 440 kVA, 10% above the transformer rating. However, this in itself is not necessarily a problem in the short term, as Enexis claims that the transformer should be able to handle 25% more power for shorter periods of time. While the exact reasons for the failure are unknown at the time of writing this article, three factors most likely contribute. First, overloading the transformer may be acceptable within certain bounds for some time, but contributes to wearing[1]. Therefore, if the transformer was overloaded on a regular basis, which could be the case given the feed in from the connected

[1] https://www.electrical4uonline.com/transformer-overloading/?expand_article=1)

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neighbourhoods, the transformer's wearing may lead to a shorter time before failure. Second, the local PV inverters may be causing high levels of harmonic distortion. While inverters tend to have harmonic filters which limit the distortion[2], enough currents in higher harmonics could increase the transformer load, which could also lead to a decrease in the lifetime of the transformer[3,4]. Third, as most solar panels are connected to single phase inverters, it is possible that the feed in energy is unevenly distributed among the three phase network. That is to say, one or two phases may be overloaded, which in turn could have consequences for the transformer[5]. These hypotheses are based on current knowledge, further and more elaborate investigations are necessary to be sure about the actual cause.

Fig. 2 Earthships in the Aardehuizen Community in Olst, (Gerwin Hoogsteen, 2022).

**When failure at one point demonstrates success elsewhere.**

To quickly restore power, a diesel generator was connected after approximately 2 hours. The choice was made to replace the faulty transformer with a new (temporary) 400 kVA transformer in order to end the power outage for both neighbourhoods. The transformer was successfully installed at 17:00 o'clock. In the Aardehuizen community (Fig.2), there was general acceptance of being without electricity for a short time. Due to the time of day (in the afternoon), the impact was limited as many people were not at home. However, some were concerned about the duration of the outage; if it were to last past 6:00 PM, there would be no (electric) cooking possible. There was also some minor inconvenience due to the unavailability of drinking water as the neighbourhood uses an electric pump for the water supply. But surprisingly, for a few there was even a sense of pride due to the unique event. Inhabitants were quoted as saying *hooray, we generate so much energy that even the electrical grid can't handle it, and this shows how far we've already come with the energy transition here.*

**How to avoid such failures in the future?**

Although the power outage in this case had a low impact, future power losses should be avoided. As stated, the 400 kVA transformer is a temporary solution, and a further redesign is necessary. There are four options. First, the transformer could be replaced by one with a larger capacity of 630 kVA. While this would perhaps solve the problem, it would also require a substantial investment (25k euro) for the transformer itself, as well as costs for installation and possibly reinforcement of cables. Second, an extra transformer could be added to the network, to meet the extra power requirements. However, this has many of the same drawbacks as the first option, while potentially increasing the investment costs further due to new cable and enclosure installation. Third, the voltage of the current transformer could be increased. Practically, this would mean that the solar panel inverters would curtail the power production (disconnect the panels from the grid) at a lower feed in peak. While this is the cheapest option, it is only a temporary solution as it would financially hurt the inhabitants (they would produce less energy over a year period). Furthermore, the DSOs would be in violation of the current netcode by not providing the inhabitants with sufficient power quality.

[2] https://www.ijert.org/reduction-of-harmonics-in-output-voltage-of-inverter
[3] https://doi.org/10.1016/j.proeng.2017.09.696
[4] https://hyteps.com/power-quality/supraharmonics/
[5] https://digital-library.theiet.org/content/journals/10.1049/oap-cired.2017.0340

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**SERENE aims to identify the solution**

Another option are solutions developed within Work package 5 of the SERENE project, specifically the introduction of Decentralized Energy Management (DEM). By buffering energy locally in batteries, the high feed in peaks can be handled locally. Furthermore, the buffered energy can then be used later to power devices at peak times which, in combination with shifting loads such as EV chargers, can reduce the dependence and burden on the already congested grid at times of peak demand. The installation of the required batteries, inverters and smart systems does have a cost, which for the Aardehuizen neighborhood is around 60,000 euros for the installed battery system of 120 kWh. We will investigate the financial feasibility of such systems further in the SERENE project.

**The scope of this challenge is far beyond the Aardehuizen demonstrator**

The solution to the transformer failure should be robust enough to be applicable at other sites, as incidents such as this are occurring at a higher frequency in the Netherlands. Enexis currently manages about 142,000 km of electrical cables. Between 2016 and 2021, they have seen a 300% increase in the number of houses and businesses that feedback energy into the grid between 2016 and 2021[6]. Furthermore, Enexis observes a rapid growth in disturbances due to overloaded transformers. In 2022 a total of 267 disturbances were observed, whereas in the first half of 2023 disturbances have already doubled to more than 500[7] . Enexis therefore has increased their investments in their networks to 556 million euros in the 1st half of 2023. However, as far back as 2015, researchers have been warning of this overloading due to electrification and local generation. In that year, the University of Twente conducted an experiment where a real-world service interruption was caused by melting a network fuse. Back then, we were shocked how relatively easy it was to cause a service interruption, tells Gerwin Hoogsteen. With only 20 electric vehicles and electric ovens, we created a 2025 expected load during winter days. The experiment unveiled some systematic problems, such as hardened rules of thumb that do not apply anymore, and the problems of phase unbalance due to lack of documentation he continues. Yet, despite these warnings and practical advice, mitigating actions by Dutch DSOs have not emerged.
This incident shows just how vulnerable the electricity grid can be as a result of energy transition related changes. The SERENE project is more relevant than ever, and it will be interesting to see how SERENE can contribute to making the electricity network, both at Aardehuizen as well as throughout the Netherlands, more reliable and show what we need to make the energy transition a success.

*Edmund Schaefer (Saxion UAS/University of Twente) and Ferdi Hummelink (VAON)*

[6] https://nl.wikipedia.org/wiki/Enexis
[7] https://www.enexisgroep.nl/nieuws/enexis-ziet-druk-op-elektriciteitsnet-ook-in-woonwijken-toenemen

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# *DANISH DEMONSTRATOR: Engaging villages in common heating.*

**As part of SERENE, a roadmap for reaching the goal of energy islands based on smart renewable energy sources in Skanderborg must be created. The roadmap includes e.g. expansion of district heating, cooperation with villages outside district heating, municipal pool, charging stations and a plan for much more renewable energy.**

63 % of consumers in Skanderborg municipality have district heating. Even more is on the way. If those areas succeed, 70% of consumers will be supplied with district heating. The district heating in Skanderborg is largely $CO_2$-neutral, as it is made from heat pumps, biomass and waste.
According to its Climate Policy, Skanderborg Municipality has a goal of becoming $CO_2$ neutral by 2050 in order to comply with the Paris Agreement. As a partial goal, $CO_2$ emissions must be reduced by 70% in 2030 compared to emissions in 1990. One of the important ways to reduce $CO_2$-emmissions is to replace oil and natural gas boilers with district heating or heat pumps.

Fig. 1 Citizen meeting in the Municipality of Skanderborg in March 2023 (Susanne Skaarup, 2023).

**Pro energy transition activities undertaken in the Municipality of Skanderborg**
The Skanderborg municipality helps local villages transform their energy systems through the active facilitation and contribution of alternatives, all of which is done in close cooperation with the citizens (Fig.1).

This approach has resulted in the following list of actions which shows that the Municipality of Skanderborg:

1. has in collaboration with the villages in the municipality, prepared a Rural Policy with 3 focus areas, one of which is climate and sustainability. This focus area is mainly about energy.
2. has in collaboration with existing energy companies, including the existing district heating companies, drawn up a Strategic Heating Plan, identifying which villages have the potential to be connected to district heating and which do not. This plan was approved by the City Council in December 2022.
3. has sent a letter to all consumers outside existing district heating areas informing them about this whether they can expect district heating or not.
4. has collaborated with one heating plant on the expansion of their supply areas to 6 new areas that are currently supplied with individual natural gas.
5. has screened the 7 largest villages outside the district heating areas for prices of alternative heating.
6. has held a larger citizens' meeting for all villages outside the existing district heating areas. At the meeting citizens were grouped together depending on village area.
7. has encouraged all villages to apply for funds from the Region's pool for joint energy solutions. Five villages have applied together with the municipality. All five received funding.
8. participates in citizen meetings organized by the

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villages.

9. creates a municipal pool that the active villages can apply for in the process of establishing a common heat supply.
10. has approved a charging station strategy for the municipality, so that by 2023 there will be 74 new locations with public charging stations.
11. is currently asking the public for proposals for the location of solar and wind power, so that in 2030 as much electricity can be produced from renewable energy as is used within the municipal boundary per year. Not least the villages have been encouraged to join together to point out suitable places.

**The concept called 'termonet'**

The larger and more dense cities must of course have district heating, while single houses in the countryside must change to heat pumps. But what about all the villages in between? There are 5 of these in Skanderborg that are actively establishing their own local common heating supply.

The village of Sjelle has come the furthest in the process towards a local shared heat supply. They are driven by the knowledge that they cannot get district heating and that natural gas must be phased out. Shared heat supply provides cheaper initial costs for the individual, and the village avoids the noisy outdoor parts from air-water heat pumps, which would otherwise be the alternative. Sjelle has had various calculations made, a questionnaire survey and held several citizen meetings. As a result, Sjelle has opted for a solution involving the concept called 'termonet'. A 'termonet' grid can be considered as a 'collective geothermal heating system' (https://termonet.dk/). This is where a joint company both owns the water pipes outside and the heat pumps inside the individual households. The next step will be to establish a local company to handle the applications and finances for the project.

Last but not least, with a shared heat supply, it could be possible and highly advisable to use results from SERENE's cases in Laasby and Hylke, both located in the Skanderborg municipality, for controlling e.g. operation of heat pumps, so that the electricity grid can cope with so many new heat pumps.

## Skanderborg Municipality:

- 65.000 inhabitants.
- 417 km$^2$.
- 4 larger cities and about 40 villages.
- 63 % on district heating from 4 different heating plants. (Three of the plants are owned by the consumers, while the 4$^{th}$ is owned by Aarhus Municipality).

## Village community (LandsbyFællesskabet):

- Organization for all the 40 villages within Skanderborg municipality.
- Has a contact person for each of all the villages.
- Has a board of 7 members.
- They are an easy way for the municipality to communicate with the villages in the municipality.
- Every second year they hold a village conference.
- Every other second year they have a "top meeting" with all the chairmen of all the political committees on activities for the next two years.

## The Termonet concept consist of:

- A common ground heating system within a village.
- Each house has a heat pump connected to the common ground heating system. The heat pump can be owned by the house owner, or by the same company who owns the common ground heating system.
- An energy source. Often it is a horizontal brine in a field. This can also be other sources like vertical tubes, surplus of energy from a company, or houses/companies that give heat and gain cooling.

## SERENE's Danish demo:

- The Danish demo sites in the villages of Laasby and Hylke. In these demo sites all the inhabitants have the same heating solution, that is run by a smart online system, which ensures the use of as much renewable energy as possible.

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# *DUTCH DEMONSTRATOR: Progress at Aardehuizen.*

**At the Dutch demonstrator, Aardehuizen or "Earth houses" neighbourhood the goal is to decrease energy imports from the national grid, by applying energy storage (both electric energy and heat energy storage) and smart energy management. To that end four partners: Loqio, University of Twente, Saxion University of Applied Sciences and the Aardehuizen neighbourhood association (VAON), work together towards a common goal. The first step, soon to be completed, is the placement of monitoring and control systems, notification dashboards and energy storage systems in the neighbourhood.**

With *smart energy* we mean managing existing energy consumption and production (e.g., by solar panels) in such a way that the over-all energy usage follows a desired profile, making use of the flexibility that exists in some energy consuming activities. For instance, doing the laundry, if the user wants their washing machine to be finished at the beginning of the evening, it doesn't matter if the machine starts early in the morning or late in the afternoon, this "playing room" in the starting time is referred to as flexibility. Some constraints are placed on this flexibility because wet laundry can only remain in the washing machine for a limited time.

The University of Twente has developed algorithms that make use of weather forecasts, occupancy profiles and real-time measurements to predict energy usage. These predictions are used to make informed decisions on how to use flexibility to achieve a desired energy usage profile. In this case the desired energy usage goal is to minimise energy exchange with the wider grid.

**Handling energy flexibility: by EMS and by users**

The handling of the flexibility is envisioned in two ways. First, some flexibility handling is automated. The charging or discharging of energy storage devices will be handled automatically by the energy

Fig. 1 The Aardehuizen or "Earth houses" community in Olst, the Netherlands (Vereniging Aardehuis Oost Nederland).

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management system (EMS). The user can set some personal preferences to which the energy storage must comply, but other than that the operation is automated. Secondly, some flexibility is handled by the users and cannot be controlled by the energy management system. The users are informed using a dashboard or mobile application when there is an overview of predicted surplus or shortage of energy in their houses as well as in the neighbourhood, so the user can use more or less energy accordingly.

**Real time energy monitoring and e-boilers at Aardehuizen**

The real-time energy monitoring is handled by Loqio. Currently, monitoring systems have been installed in five houses, and an additional six to eight systems will be installed in October. All these houses should have a fully functional monitoring system before the end of November.

Moreover, all the houses at Aardehuizen make use of electrical boilers (e-boiler) for hot water. These existing e-boilers have no smart-grid control capabilities. Therefore, the Sustainable Energy Systems (SES) group at Saxion UAS is working on a solution to provide smart monitoring and control functionalities for these existing e-boilers. By measuring the flow and temperature of the water through the e-boiler, its state of charge (SOC) is determined. Furthermore, the e-boiler solution enables remote activation, hence the charging and discharging of the heat energy storage can be automated and optimized by the energy management system.

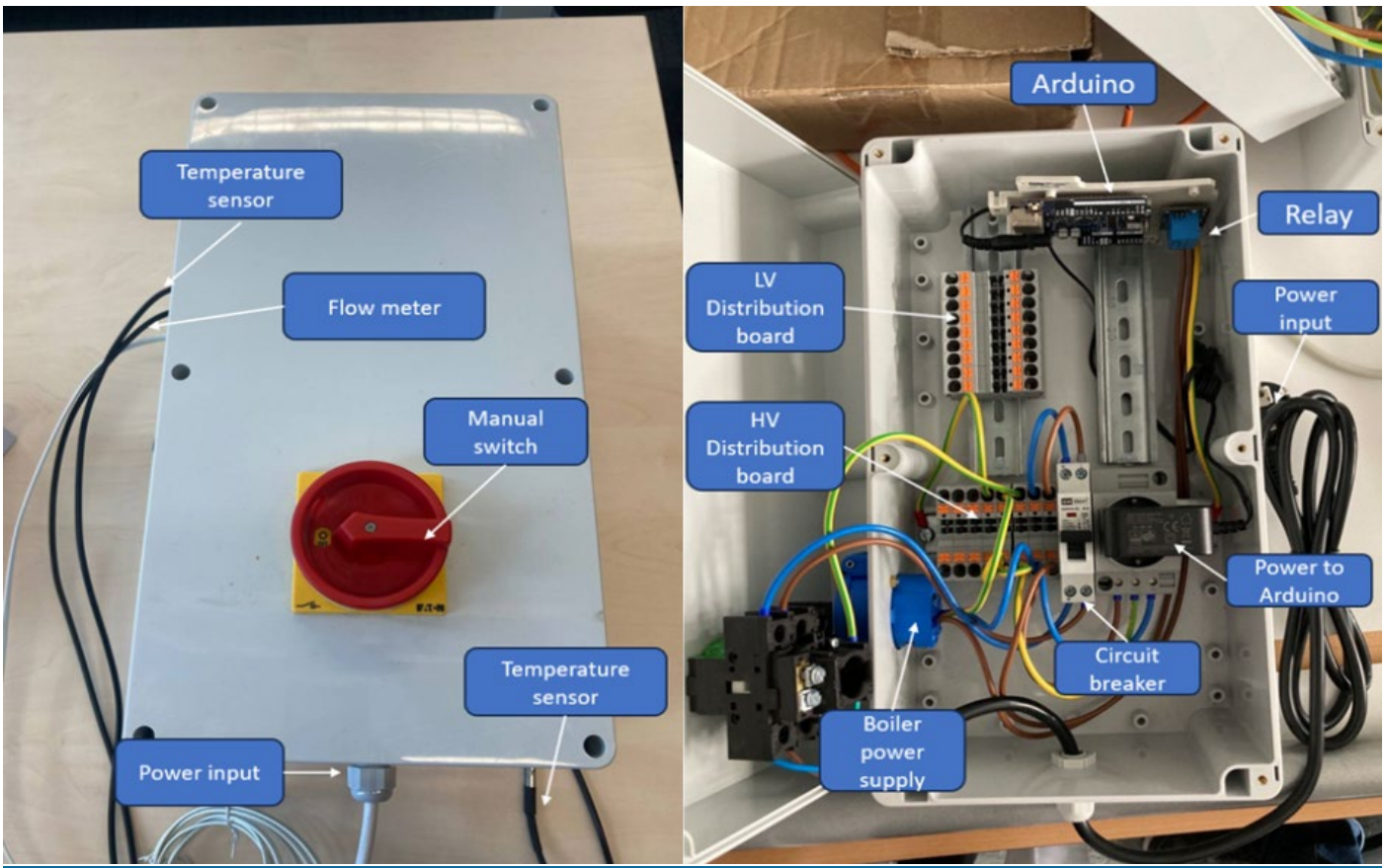


Fig. 2 a,b The e-boiler controllers, designed and manufactured by Saxion UAS, ensure that the “dumb” boilers can be operated in a “smart” way (SAXION, 2023).

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Currently, one e-boiler system is installed and being tested at Aardehuizen. Six more systems, in varying configurations, tailored for the heating system in each individual home at Aardehuizen, are in preparation and will be installed in the coming months.

The monitoring data from the home devices, collected by Loqio and the e-boiler control systems, is gathered using the *"Internet of Things Edge computing for carbon neutral communities"* or IECON IoT system designed by the Ambient Intelligence (AmI) research group at Saxion UAS. Usage of the IECON system makes it possible to gather, store and share the data with relevant actors, as well as providing the connection for the different mobile applications and user dashboards. The IECON system provides real-time data to the energy management system application, which is at the University of Twente, and is used as input for their control algorithms. Secondly, selected data is provided to the inhabitants via a mobile app. For instance, inhabitants can monitor their electricity consumption and production, and the CO2 emissions from their energy consumption.

**Co-creation workshops with the inhabitants of Aardehuizen**

Currently the IECON IoT infrastructure is deployed and running. The interface to the monitoring systems from Loqio is complete, and the gathered data is being stored, while the interface of the e-boiler systems is planned for November 2023. Furthermore, an important task is the arrangement of focused session groups with the Aardehuizen inhabitants to arrange co-creation workshops to create dashboards and mobile applications that will provide the best information for the management of their own energy as well as at the community level.

Under the direction of VAON, local electrical energy storage, in the form of 124,8 kWh of Lithium-Iron-Phosphate batteries are being installed, as well as installation of the inverters and other necessary equipment. These batteries provide much of the


Fig. 3 The mobile application prototype, designed by Saxion UAS in collaboration with Aardehuizen residents, providing t information which enables residents to make well informed, smart decisions about their energy usage (SAXION, 2023).

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flexibility needed for the smart energy management.

In conclusion, the installation of all systems in Aardehuizen is well underway and given the current progress will be fully operational at the beginning of 2024.

*Viktor Nikolayev, Javier Ferreira Gonzalez and Bart Homan (Saxion UAS)*

Fig. 4 Battery pack installed at Aardehuizen (SAXION, 2023).

# *POLISH DEMONSTRATOR: Electric cars have other uses besides clean mobility.*

**The electric vehicle charger was installed near Arena Przywidz as a part of the Polish demonstrator in 2022, but it was this autumn that saw the Polish team able to test its full potential – reversing the energy flow and powering the Arena Przywidz from the e-car!**

The so-called V2G (vehicle-to-grid) technology enables the energy to flow not only from the grid to connected electric cars, but also from the electric cars back to the grid. Due to certain technological and standardization problems there are currently almost no V2G type chargers on the market, but most producers declare that they will release such capabilities in the next few months. The project managed to use the EV chargers installed near Arena Przywidz to discharge Nissan Leaf and feed the power to the Arena Przywidz and charge the school bus at the same time (Fig. 1)

While this was an experimental setup, this success presents a first step towards the concept of using an EV in the same way as any other battery. One of the goals in the project is to investigate the benefits of this alongside the other electrical storages that are already installed.

The works on the installation of the hardware are progressing. In October 2023 the installation of the Vanadium Redox Flow Battery was finalised (Fig. 2). It is a storage unit located near the school playground which is connected to the electrical network of Arena Przywidz. Flow battery assures extraordinary cycle life (>20 000 cycles) as well as fire safety. Its maximum charge and discharge power is 20 kW, the capacity is 80 kWh and it will be used to store the excess energy from the 40 kWp rooftop photovoltaic installation to use this energy at other times of the day. The

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communication network for the Energy Management System is connected and tested, the most important servers are in place and devices such as power analysers and EV chargers are being connected. The next steps are to implement the storage management system and provide data visualisation for the stakeholders.

protecting the grid from overvoltage. While this saves the grid, it causes the owner of the PV installation to lose potential profits from energy production. So, would it be possible to know when such problems will start to occur? Is it at all possible to predict that e.g. the transformer will not fail? The answer to these questions is yes, it can be calculated, but it requires a

Fig. 1a, b V2G charger near Arena Przywidz during the tests (W. Radziszewska, IMP PAN).

**Why do photovoltaic panels sometimes switch off in full sunlight?**

There is no doubt that the growth of local energy generation is occurring in Poland at a speed which is exceeding anyone's expectations[1]. The reason is simple: a photovoltaic installation pays off and is easy to obtain.

Unfortunately, when the generation of energy exceeds the consumption in a certain area, it can cause some negative impacts on the energy quality in the grid, and this is yet another issue that SERENE's Polish Team aims to tackle. This can be prevented by upgrading the existing grid infrastructure, e.g. by installing transformers with On-line Tap Changer (OLTC) possibilities, but this is a costly and long process which cannot catch up with the large number of small PV installations appearing across the country. Therefore, to save the grid a different solution was implemented: every PV inverter must switch off when the quality of power is outside the specified limits, detailed knowledge about the grid, the grid topology and the current state of all nodes and lines in the area. Such data are only available to the Distribution System Operator (DSO) and the SERENE project has the advantage that Energa Operator SA, the local DSO for the Przywidz area, is a partner in the project that can perform a full analysis in various scenarios. Extreme scenarios can help to pinpoint when problems would occur, to answer questions such as: how many PVs can be installed or how many houses can have heatpumps.

**How would the grid manage on a sunny day in July at noon with all PVs producing to the max?**

The first stage of the research was to test the impact of the photovoltaics on the grid, so the situation with the maximum production was simulated; subsequently both the size and the number of

[1] Report „Photovoltaic Market in Poland 2022" by Institute for Renewable Energy, https://ieo.pl/en/86-en/news/1592-report-photovoltaic-market-in-poland-2022

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photovoltaic installations was increased to the point where an overload of the lines is observed. This resulted in the very positive conclusion that the cabling is very capable and made with a huge reserve – overloading the lines needs at least quadrupling the existing installations, which would require more than the available non-shaded surface. Another positive conclusion is that the transformer can manage with the current installations, and it can even cope with twice the installed PV peak power. A slightly less positive outcome is that the margin is much smaller if the problems with voltage are considered. The voltage is regulated at the level of the medium power grid, so the disturbances might come also from the medium voltage grid and worsen the local situation or improve it. If the voltage in medium voltage grid is relatively high (107.3% of the nominal value) then the problems start to appear when the PV power is doubled. In the considered area in Przywidz a new transformer with OLTC will be installed. It should manage better in such a situation, the future experiments and demonstrate its real impact. A number of alternative setups to counteract the problems were also considered: the installation of energy storage (both a single unit and distributed storage), the use of electric vehicle chargers as controllable load, etc. The preliminary results of these setups are very promising. More information will be gathered when the installations of the mobile energy storage and the new transformer will be finalized, as that will offer a great opportunity to perform real-life tests.


Fig. 2 The Vanadium Redox Flow Battery installed near Arena Przywidz (W. Radziszewska, 2023).

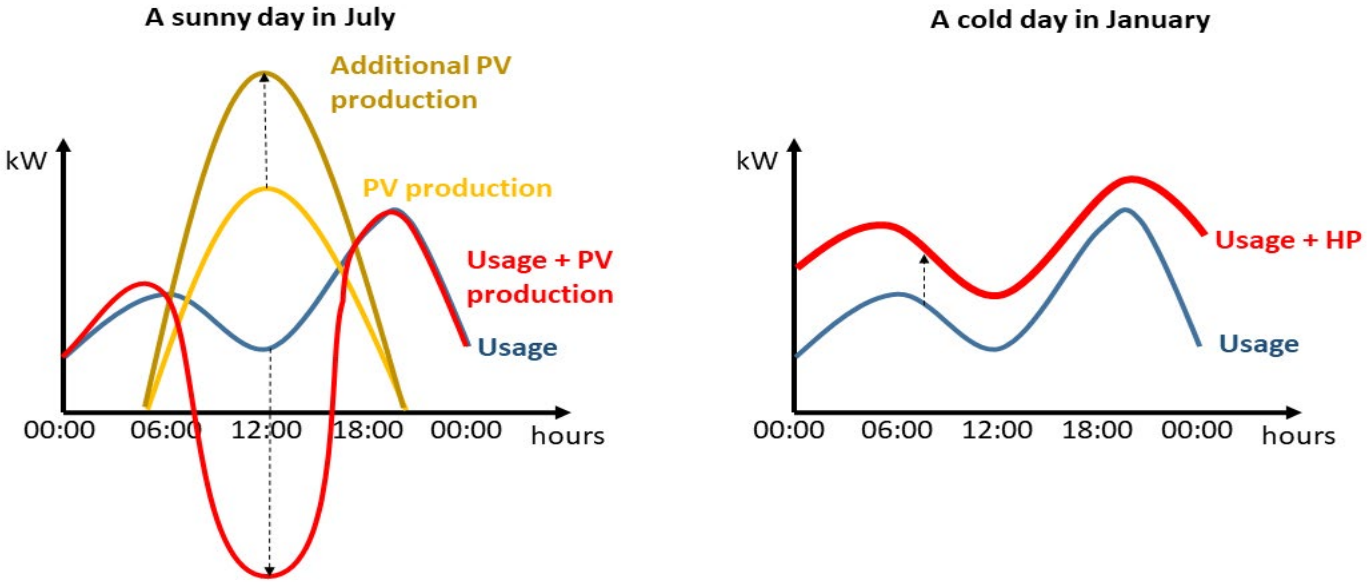


Fig. 3 Schematic scenarios for analysis of the impact of photovoltaic on the grid and additional heat pumps

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**What if each house had a heat pump and an electric car?**

The second stage was to test the impact of increased power usage by heat pumps and EV chargers in a situation of no production from renewable energy sources (Fig.3).

A cold day in winter was chosen, and the simulations were performed for the morning peak hour (7:00). The assumption was that a heat pump is installed in each household as the main source of heat. In this case, the grid and transformer manage to deliver power without problems. Adding EV chargers to these scenarios shows that charging a few cars simultaneously should not cause problems (the limit is 9 cars charged from the socket at 3.5 kW) while all heat pumps are in operation.

In conclusion, the analytical works described above show that the grid in the municipality is more than sufficient to allow the integration of additional energy sources or devices like heat pumps or EV chargers. It also identified the transformer as potentially the weakest link in more futuristic scenarios, thus defining the limits that are very valuable when needing to ensure the safety, stability and sustainability in planning the local energy infrastructure.

Summing up, analytical works show both the potential and the limits of the development of the area, the knowledge of which will prove essential for developing a plan for the local integrated energy system to ensure safety, stability and sustainability in the Municipality of Przywidz.

*Weronika Radziszewska,*
*IMP PAN/KEZO Research Centre*

# PROJECT NEWS

## *SERENE completes the HRB Business Plan Development service.*

The Horizon Results Booster (HRB) is an initiative of the European Commission that aims to maximize the impact of research projects funded by FP7, Horizon 2020, or Horizon Europe programmes. It brings together HRB advisory organizations and research projects to help them improve their exploitation strategies through a provision of targeted consultancy services, supported by comprehensive set of tools and methodologies. The services are provided to projects free of charge [1].

To ensure that the exploitation of SERENE's results will be done in the best possible manner, members of the SERENE Dissemination and Exploitation Board (DEB) have applied for a selection of services under the HRB initative.

As a result, SERENE Partners have already completed PDES Module C service: *"Portfolio Dissemination & Exploitation Strategy: Improving existing exploitation strategy"*. Thanks to this service, project Partners have identified "Key Exploitable Results (KERs)" of SERENE, and have chosen three of them, which underwent a thorough analysis, using HRB tools and methodology in terms of its strategy of exploitation.

Next, SERENE H2020 project partners selected one

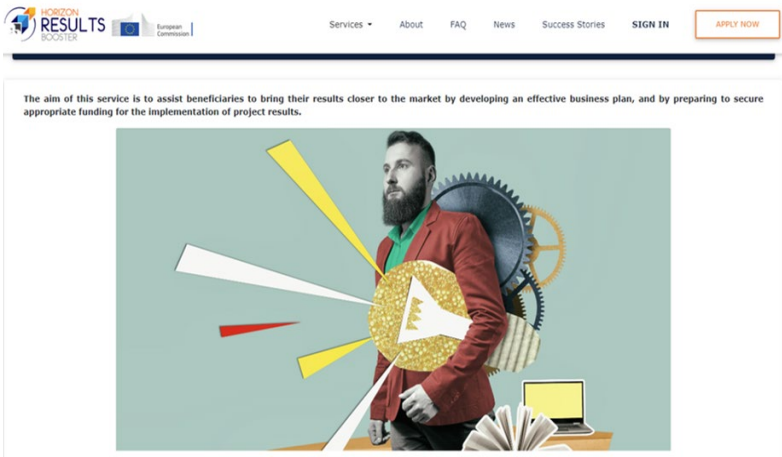


Fig. 1 Source: www.horizonresultsbooster.eu.

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KER to undergo the *"Business Plan Development* (BPD)" service. It provided the dedicated consultancy with respect to the development of Business Plan for the KER under consideration. Interestingly, the latter service has come to the end with a final exercise entitled „pitching in practice". It turned out to be a very inspirational experience not only for the business partners of SERENE, but also to all of those who „dared" to „pitch" on various project related topics on the 15th of September 2023.

SERENE Partners are now looking forward to the last HRB service that they applied for, namely: PDES Module A Service: *"Portfolio Dissemination & Exploitation Strategy: Identifying and creating the portfolio of R&I project results"*, which will be kicked-off in the middle of October 2023. Module A is expected to assist SERENE in implementation of dissemination activities together with a selected group of projects, to broaden its outreach and the potential impact of its results and activities.

Source:
[1] https://www.horizonresultsbooster.eu/

*Katarzyna Bogucka-Bykuć,*
*Institute of Fluid-Flow Machinery*
*Polish Academy of Sciences*

# *SERENE at CIRED 2023 in Rome, Italy.*

We are delighted to inform that prof. Birgitte Bak-Jensen, the project coordinator of SERENE, was among the panelists of the debate on „Power distribution systems fostering Sustainability", which was held as a part of the Opening Forum of CIRED (International Conference & Exhibition on Electricity Distribution) on the 12th of June 2023.

CIRED, the Leading Forum where the Electricity Distribution Community meets, holds the major International Electricity Conference & Exhibition every two years in different venues in Europe with a worldwide perspective and participation.

CIRED is always evolving and the 2023 event is the conference 27th edition, which this year takes place in Rome, located in the heart of Italy on 12-15 June 2023.

*It was a great honor to be a member of the opening panel at the CIRED 2023. We had very good discussion on how*


CIRED
ROME, ITALY
12-15 JUNE 2023

Fig. 1 Birgitte Bak-Jensen among the panelists of the Opening Forum of CIRED 2023 (source: linkedin.com).

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*the distribution grids have to participate in the green transition by providing capacity for flexibility provision from consumers for the overall balancing of the electricity system as well as for enhancing the hosting capacity of the grid. Some future focus areas seen from the academic point of view is concerning local energy communities where private costumers can go together and use local produced energy as well as help in provision of flexibility for the local grid. This is for instance explored in the SUSTENANCE H2020 project, SERENE H2020 project and RE-EMPOWERED EU-India Project, where both technical solutions as well a more social aspects such as business cases, regulation as well as user engagement are considered* – concludes Birgitte Bak-Jensen.

Further, *another future aspect is about considering multi-energy systems and how industry can contribute to the green transition and at the same time get benefits for their own companies. New very electricity consuming industries like P2X and data centers will be important new players, and the distribution infrastructure has to accommodate these together with the general electrification of other industries in port and industrial areas as well* – adds prof. Bak-Jensen.

Participation in CIRED 2023 offers an opportunity to meet with up to 2500 experts and benefits from face-to-face interaction with key decision leaders in the field of Electricity Distribution.

An exhibition gathering over 140 companies will be running throughout the conference.

More information about the event: https://www.cired2023.org/

# *SERENE at SUSTAINABLE ENERGY DAYS under #EUSEW2023.*

We are pleased to announce that Krzysztof Rafał from STAY-ON has introduced the SERENE H2020 project at the „Energy transition and its financing" conference (Fig. 1), which took place in Torun Technology Park on 22 June 2023 in Poland, as a local event held under "Sustainable Energy Days" of the EU Sustainable Energy Week (#EUSEW2023).

Sustainable Energy Days are activities and events organised by local public and private organisations around the world to promote renewable energy and energy efficiency. They are a key component of the European Sustainable Energy Week.

More details about this event, which was organized by the Enterprise Europe Network at the Toruńska Agencja Rozwoju Regionalnego - TARR S.A. can be found under those links:

- Find a Sustainable Energy Day near you: https://sustainable-energy-week.ec.europa.eu/sustainable-energy-days/energy-transition-and-its-financing-2023-06-22_en
- Event website: https://een.tarr.org.pl/


Fig. 1 Dr Krzysztof Rafał presenting works carried out within SERENE project at the „Energy transition and its financing" conference, 22.06.2023.

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# *SERENE project meeting in Deventer, the Netherlands.*

The partners of SERENE have met for a 2 day-long project meeting in Deventer, the Netherlands on 5-6 October 2023 (Fig. 1). The project gathering included the Consortium and the General Assembly meetings, and a field visit to the Dutch demonstrator.

The assembly meetings were held in the Saxion building in Deventer, which is located close to the two sites of the Dutch demonstrator: the local communities of Aardehuizen ("Earthhouses") and Vriendenerf ("Friends' Garden") in Olst, which we visited in the afternoon of the first meeting day.

Fig. 1 Participants of the SERENE meeting in Deventer (Jörg Verstraete, IMP PAN).

How is the concept of smart energy actually being implemented in the Olst communities? The visit made it possible for the Partners to witness the energy transition taking place in the Dutch demonstrator (Fig.2-5), where the Dutch Team introduces smart solutions which enable the control of energy flexibility options, interlinked with the real time energy monitoring. This will soon be upgraded with the addition of control functionalities to the existing e-boilers and the neighbourhood battery.

The visit was opened with a welcoming speech by Hans Olthof (Fig. 2), alderman of the municipality in which he addressed the importance of the SERENE project to find new ways of dealing with grid congestion problems within the municipality and the inspiring example it shows for the wider region, province and the country. He also reflected on the municipality's vision on sustainability, private and community ownership and their support for sustainable initiatives. Then Ferdi Hummelink, inhabitant and spokesman for VAON (Fig. 3, 4) introduced the Aardehuizen sustainable building and energy concept and the goals of the inhabitants. This was followed by a round tour to show the solutions developed within the SERENE project (Fig. 5, 6, 7).

Fig. 2 Welcome speech by alderman Hans Olthof of the Olst-Wijhe municipality (Richard van Leeuwen, Saxion University of Applied Sciences).

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Fig. 3,4 Ferdi Hummelink's presention (VAON) and discussions at the demo site in the Aardehuizen community (Gerwin Hoogsteen, University of Twente).

Additionally, the visit to Olst created the opportunity for the SERENE Partners to see a new sustainable neighbourhood called "Olstergaard" (Olst yard) next to Aardehuizen. There we had a meetup with Marjolein (https://www.marjoleininhetklein.com/), a sustainable tiny house enthusiast who has been building her own "off-grid" tiny house (Fig. 8). Her enthusiasm and the solutions she showed us, made this an inspiring visit.

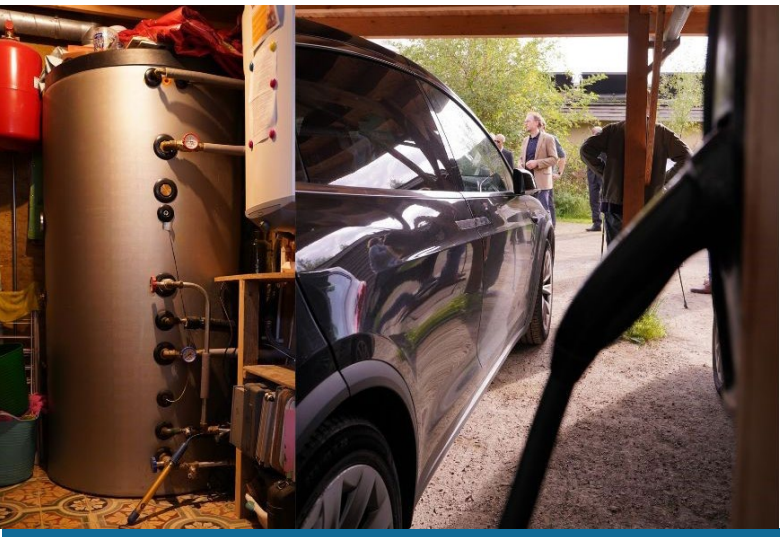

Fig. 5,6 E-boilers (left) and electric vehicle chargers being part of the integrated smart energy system under development (Gerwin Hoogsteen, University of Twente).


Fig. 7 Neighbourhood battery system currently being installed at Aardehuizen (Richard van Leeuwen, Saxion University of Applied Sciences).

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After that, we walked on to Vriendenerf to hear about the sustainable building solutions that they implemented (Fig. 9). We visited one of the houses to see one of the heat pumps that is part of the smart control solutions that will be implemented as part of the Serene project.

Fig. 8 Involvement of users, which is one of the crucial aspects of the energy transition, is where Dutch demo is already a pro (Gerwin Hoogsteen, University of Twente).

When we returned, we experienced a special "walking diner", in an inspiring round tour we had different meals at 4 of the Aardehuizen homes with most of the ingredients coming from the Aardehuizen terrain or from neighbourhoods close by (Fig. 10). So it was not only about local energy but also about local food and drinks!

The visit has taught us that an energy community should be about more than just generating and sharing energy. Social activities and other sustainable initiatives like local food growing projects could also be important to become an energy community.

**Thank you Dutch Partners for the excellent organization of this project gathering!**

Fig. 9 Explanation by one of the inhabitants of Vriendenerf about the sustainable building solutions that were implemented (Richard van Leeuwen, Saxion University of Applied Sciences).

Fig. 10 Desert preparation from local ingredients during walking diner at Aardehuizen (Richard van Leeuwen, Saxion University of Applied Sciences).

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# *SERENE at the „11th Wdzydzeanum Conference on Fluid-Solid Interaction" in Poland.*

Weronika Radziszewska from KEZO Research Centre PAS has recently participated in the „11th Wdzydzeanum Conference on Fluid-Solid Interaction", where she presented the analysis of the data from Central Emission Register of Buildings from the Municipality of Przywidz, which was possible thanks to works carried out within SERENE (Fig. 1).

The Institute of Fluid-Flow Machinery Polish Academy of Sciences (IMP PAN) in cooperation with the IPPT PAN - Institute of Fundamental Technological Research Polish Academy of Sciences and Warmińsko-Mazurski University in Olsztyn organised the „11th Wdzydzeanum Conference on Fluid-Solid Interaction" between 3-7 September 2023 in Wdzydze Kiszewskie in the Northern Poland. It was already the second time during the realisation of SERENE, that our project was present at that event.

Interestingly, the conference continues the history of the Fluid-Solid Interaction Workshops organized so far, however this year the organisation team decided to modify its format. While the main sessions remained traditionally focussed around thermodynamics and material science, there were new social topics added. Human aspects of energy technologies and promoting new technologies to people was a new perspective added, and this was the session during which Weronika Radziszewska presented SERENE.


Fig. 1 Weronika Radzieszewska presenting SERENE at the „11th Wdzydzeanum Conference on Fluid-Solid Interaction" (IMP PAN, 2023).

# *SERENE at the #EURegionsWeek in Brussels.*

It gives us pleasure to report that prof. Birgitte Bak-Jensen, the project coordinator of SERENE and SUSTENANCE, was among the speakers at the workshop held on 11th of October 2023, organised as a part of the 21st European Week of Regions and Cities in Brussels.

The workshop event entitled „Energy transition – making local and regional solutions replicable for Europe" gathered many participants and turned out to be an excellent platform for discussions about energy transition to be done locally, and its challenges (Fig. 1,2).

How can we best stimulate user engagement? How can we successfully replicate the findings? What should be the means to also involve rental citizens? These were some of the major social issues addressed during the workshop, and it was a great advantage to listen


Fig. 1 Prof. Birgitte Bak-Jensen presenting SERENE and SUSTENANCE (Urszula Sokołowska, Pomorskie Region in EU, 2023).

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to three presentations, which treated social, technical and economical challenges from different angles.
Prof. Birgitte Bak-Jensen from AAU Energy gave her presentation about local paths towards the energy transition based on experiences from two international projects covering altogether 9 demos located in EU and India, whereas other speakers were Mr Iñigo Ansola Kareaga, Director General from Basque Energy Agency and Mrs Janina Wilkos-Gad, a representative from the Municipality of Pruszcz Gdański from Poland. Ewa Domke, from the Institute of Fluid-Flow Machinery, Polish Academy of Sciences (IMP PAN), also a partner of both SERENE and SUSTENANCE, was the moderator at the workshop (Fig. 3).

Fig. 2 Prof. Birgitte Bak-Jensen answering questions from the participants
(European Committee of the Regions, 2023).


Fig. 3 Ewa Domke from Institute of Fluid-Flow Machinery, Polish Academy of Sciences (IMP PAN) moderating the workshop
(European Committee of the Regions,2023).

## *SERENE enters ENLIT WORLD.*

We are excited to announce that **SERENE** is now a part of **ENLIT World**. You can visit its profile in the projects directory here: SERENE | Enlit World
Further, we invite you to watch the introduction to the SERENE project, including the objectves of its 3 European demonstrators, presented in a one, combo video:
https://www.enlit.world/projects-zone/video-introducing-the-serene-project/

Last but not least, we are happy to inform you that prof. Birgitte Bak-Jensen, SERENE project coordinator together with prof. Richard van Leeuwen (see below) participated onsite in the Enlit Europe Conference held in Paris on 28-30 Nov 2023. It was an outstanding opportunity for networking!

Fig. 1 Prof. Birgitte Bak-Jensen from Aalborg University and prof. Richard van Leeuwen from SAXION at the EU Project Zone area of ENLIT Europe Conference.

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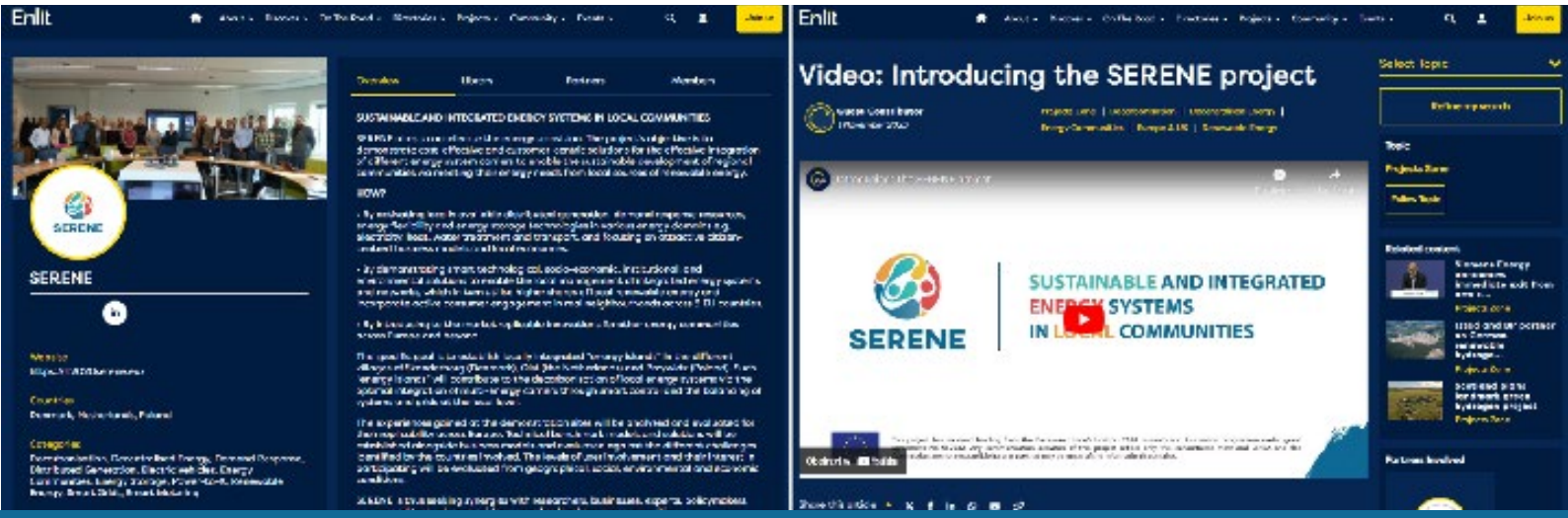


Fig. 2 SERENE profile on Enlit World Platform.

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# PARTNERS IN THE SPOTLIGHT

Energa operator

https://energa-operator.pl/

ENERGA-OPERATOR SA (EOR) is a distribution network operator (DSO) responsible for developing and maintaining the distribution grid located in the northern and central parts of Poland. EOR is also a member company of Capital Group ENERGA SA. ENERGA SA is the owner of 47 hydropower plants, Ostroleka coal power plant with a rated capacity of 722 MW. The total capacity of wind turbines connected to EOR's grid is equal to 2540 MW. 9800 micro generations are connected to the LV network of 68,5 MW installed power. EOP supplies electricity in an area covering almost ¼ of Poland's landmass. EOP supplies electrical energy to 3.2 mln customers, including 0.29 mln business customers. The company operates 193 thousand km of power lines of all voltages, used to transmit 21.5 TWh of electricity to end-users annually.

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IMP PAN GDAŃSK

https://imp.gda.pl

The Szewalski Institute of Fluid-Flow Machinery Polish Academy of Sciences (IMP PAN), located in Gdańsk, is a leading centre of scientific technology in Northern Poland. It employs about 212 staff, including 100 researchers. IMP PAN was founded in 1956 for conducting fundamental research in the area of operating principles, design and construction of machines used for energy conversion in flows.

Currently, research is carried out in the following areas: fluid mechanics, multiphase flows, thermodynamics and heat transfer, combustion, plasma physics, laser technology, machine mechanics, mechanics of smart structures, technical diagnostics, tribology, aeroelasticity and other fields of engineering and technical sciences. The research of the Institute has always addressed the current needs of industry. In recent years IMP PAN has developed a new scientific specialisation: small-scale distributed power engineering based on renewable energy sources, especially domestic cogeneration power systems. IMP PAN has a long track record in managing and participating in European research projects such as FP5, FP6, FP7, H2020 as well as INTERREG programme.

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KEZO Energy Conversion and Renewable Resources PAS Research Center

https://kezo.pl

KEZO Research Centre ("Energy Conversion and Renewable Resources" Centre), located in Jabłonna near Warsaw, is a laboratory base for IMP PAN in terms of research and cooperation also with other Institutes of Polish Academy of Sciences, universities, R&D units as well as with leading companies in the energy sector.

One of the main objectives of the Centre is to conduct research into new sources of renewable energy and energy conversion. KEZO Research Centre is a complex of laboratories (a facility), but simultanously it also plays a role of a living laboratory itself, with all of its modern installations onsite in the building itself. Centre is a test-side for devices producing and storing heat, cold and electrity from RES as well as of software for management of generation and consumption of energy technologies, including a dedicated Building Management System designed for research purposes. KEZO also serves as a demonstration site for small-scale RES technologies and their application in energy systems.

IMP PAN has created an international network of energy stakeholders around the KEZO Research Centre (so called "Friends of KEZO") consisting of research and business partners as well as for policy makers, municipal authorities, NGOs, and wider public, including the youngest citizens. This network is an excellent forum for knowledge exchange, discussions and, through its members - for dissemination of up-to-date developments in energy sector.

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STAY·ON

STORAGE ENGINEERING

https://stay-on.pl/

STAY-ON Storage Engineering is a company offering products, services and consultancy in the field of Energy Storage Systems (ESS). The offer includes all-in one ESS products for residential and commercial applications as well as individual projects for industrial and grid applications. Offered products are equipped with self-designed Energy Management System (EMS). The company specialises in redox flow battery technology (VRFB).

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SERENE

# SUSTAINABLE AND INTEGRATED ENERGY SYSTEMS IN LOCAL COMMUNITIES

## PROJECT FACTSHEET

SERENE H2020 project
#H2020SERENE

www.h2020serene.eu
contact@h2020serene.eu

**Total budget:** €5,1m of EU contribution
**Duration:** May 2021 – April 2025
**Project Coordinator:** Birgitte Bak-Jensen, AAU, Denmark
**13 PROJECT PARTNERS FROM 3 EUROPEAN COUNTRIES**
**3 DEMO SITES** in Denmark, the Netherlands & Poland

Birgitte Bak- Jensen

Professor in Intelligent Control of the Power Distribution System at Aalborg University (AAU)

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Skanderborg Kommune
AURA
NEOGRID TECHNOLOGIES
Bjerregaard Consulting
UNIVERSITY OF TWENTE.
SAXION UNIVERSITY OF APPLIED SCIENCES
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