ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

Energy Stories Compilation

PLAN. INNOVATE. ENGAGE.

Introducing ETIP SNET Energy Stories for the Citizen

Since 2014, the strategy of the European Union has been clear: **we need to drive a clean, secure and efficient energy transition to face climate and energy challenges**. This strategy has been reinforced by the strong commitment of the European Union towards the signature of the landmark Paris agreement. It is also why the Commission proposed in November 2016 an ambitious "**Clean Energy for All Europeans**" package.

It is in everyone's long term interest to have a rapid transition towards a cleaner, more sustainable and less carbon intensive energy future. Indeed, **many projects across Europe are developing the necessary technologies to make Europe's transition to greener energy as smooth and effective, as possible.**

As stated in the **ETIP SNET Vision 2050**, serving Europe's clean energy needs will require major investments for the large-scale deployment of energy conversion and storage devices, the upgrade and extension of the energy networks, and the use of digital solutions. While policy makers, industry and researchers need to lead the way and lay down the foundations for the transition towards a cleaner energy system, **the citizen is the fundamental player that will make this transition possible**.

It is citizens that have the potential to play a key role in Europe's energy transition and **change the course of current climate change trends.** Informed of the latest technological developments, they have the power to select the technologies that will not only meet their energy needs in a more efficient and cost-effective way, but also determine the greening of the energy system as a whole.

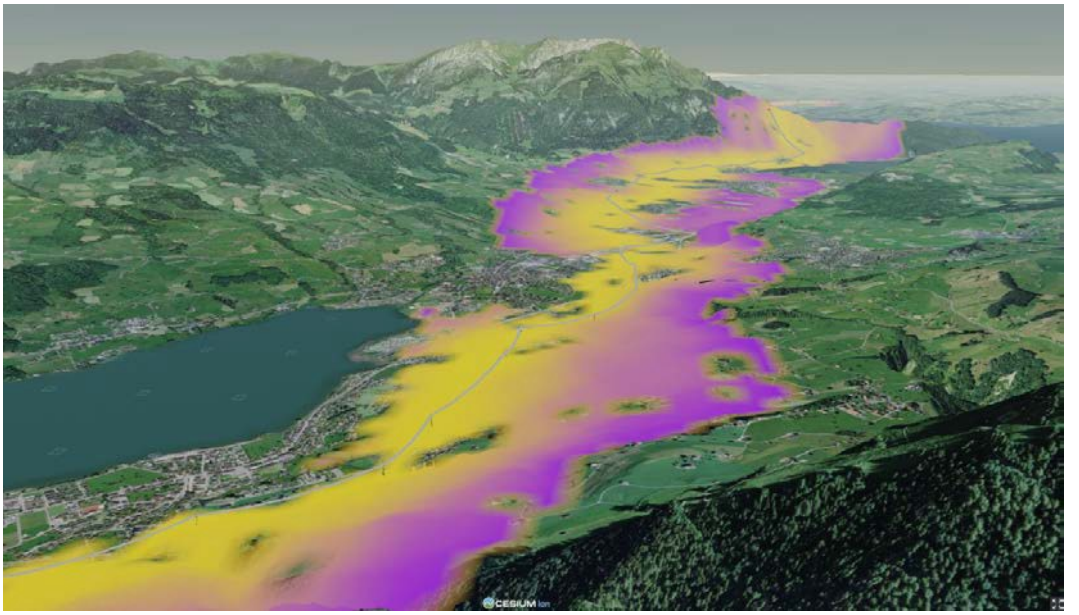
The "**ETIP SNET Energy Stories**" are designed to bring successful applications in energy transition technologies, often developed through public funding, closer to the citizen, highlighting whenever possible the direct benefits of the latest technologies to the energy consumer.

Index

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION



ENERGY STORY:

A new tool visualizes and models the routes for power line projects

The 3D Decision Support System developed at ETH Zurich supports the planning of the electricity grid in Switzerland by lowering time and costs needed for planning

Our world is in continuous change: with higher welfare and new technologies arising from advancing digitalization, the demand on electricity is steadily increasing. Simultaneously, the energy transition towards renewable energy sources – like solar or wind power – leads to more electricity being transported over the existing power grid, which might bring it to its capacity limits in the future. According to the European Network of Transmission System Operators for Electricity (ENTSO-E) ten-year network development plan, if the existing power grid is not extended, European citizens would waste 40 billion euros per year as of 2040. This is because more than 150 TWh electricity produced by renewable sources would be lost due to the current grid's infrastructure limitations. In contrast, investing in the grid would contribute to a high reduction of the greenhouse gas emissions by the power sector in the order of 80 percent until 2040. Thus, transmission system operators are aiming at extending their power grid in the nearfuture.

However, where should future power lines go through? This is what many experts and decision-makers have been asking themselves in order to minimize the impact on the environment while offering a financially viable and technically feasible solution. To date, it takes a long time until a sketch from the desk can become real in form of lines and pylons.

Speeding up sustainable energy solutions through new ways of planning

There is a new, computational way of planning power lines, developed by ETH Zurich and Swissgrid, the Swiss transmission system operator. Their 3D Decision Support System (3D DSS) allows decision-makers to determine the optimal path for a new power transmission line based on the areas they want to protect. If, for instance, a decision-maker is especially interested to protect natural reserves and residential areas, the 3D DSS considers these specifications while respecting legal prerequisites. The resulting 3D map shows which areas meet these specifications best. As the 3D DSS is easy to handle and the computation takes only a few seconds, it allows to easily compare different alternatives from different stakeholders.

On the one hand, this tool makes it easier to plan a new power line, whereas on the other hand, it supports the communication with the major stakeholders, as e.g., the citizens living in the according region by visualizing it – said Joshu Jullier, communication manager at Swissgrid. According to a recent survey conducted by Swissgrid, overhead lines are perceived to be disturbing by most of the Swiss citizens. They mentioned health risks, landscape disruption, and audible noises as the three main problems. A best solution does not exist because of conflicting interests among different stakeholders, but the 3D DSS helps them to find a good compromise while considering all interests as far as possible.

On the technical side, the eligible routes highlighted by the 3D DSS can be refined through specified criteria, as for example, avoiding forests, lakes, or residential areas. Whereas the results from a recent study show that the 3D DSS is able to model overhead lines reliably, the developers are currently including earth cables alternatives into the 3D DSS as well. In this way, the 3D DSS could determine areas that are too sensible for an

overhead line, but feasible for earth cables, so that both line types can be combined and the overall impact on the environment can be minimized.

Impact

Project Benefits

- Social acceptance
- Enhanced stakeholder participation
- Economic profit

The Swiss electricity grid was mainly built in the 1950's and the 1960's. Obviously, these lines were not designed to handle renewable energy. Thus, Joshu Jullier underlined that the grid needs to be modernized to comply with the energy transition. For example, many hydropower plants, which produce a significant amount of clean energy, are located in the mountainous region in the south of Switzerland, while the electricity is mostly consumed in the northern flatlands of the country. Thus, the electricity must be transmitted from south to north, which, in turn, requires that the grid must be extended in order to prevent future capacity issues. In this way, the 3D DSS could increase public acceptance for new power lines and therefore, lower the time of the planning phase and the costs of grid projects compared to the traditional way of route planning.

Keywords: powerlines, stakeholder engagement, visualization

More info at: https://3ddss.ethz.ch/ + project video

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

Advance dispatching & LoadForecast: Accurate forecasting facilitates more clean energy

Advance dispatching & LoadForecast assist the system operators to make more accurate decisions, which enables to integrate more renewables into the Italian system and improves security of supply

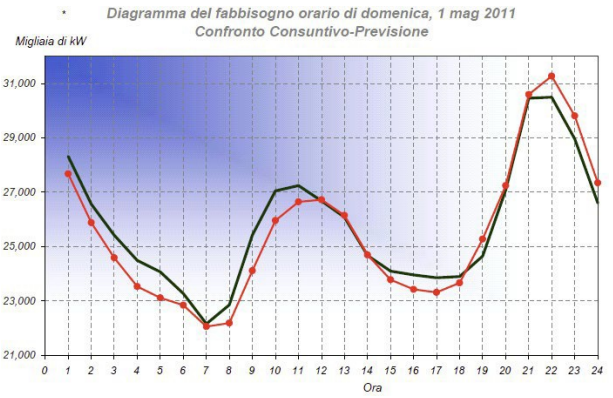
From the dawn of mankind to our modern era there is one constant goal humans try to achieve: the ability to predict the future. Though according to the law of physics as we know today, to predict perfectly what is going to happen is impossible, a few thousand people in the world put their best effort day by day to do so. What makes their job a little bit easier is that they only have to focus on future electricity consumption – as they are called the system operators.

In order to make their work more efficient however they don't turn to tea leaves, oracle bones or the observation of birds like our ancestors, but rather to artificial intelligence.

Why is forecasting needed?

Electricity is a commodity that is very hard to store at large scales. Hence system operators always have to make sure that the electricity supply in the system is matching the demand. For doing so, they need to forecast how much electricity will be consumers for the next days, the next hours or even for the next minutes.

To make this work – called dispatching – more efficient, Terna, the transmission system operator in Italy introduced a new platform. Advance Dispatching is an IT tool that uses complex algorithms to assist the control room operators to manage dispatching with the aim of optimizing the mix of power generation – mostly from economic point of view.



- *Italian load demand (red curve) predicted one day in advance*
- *Real-time load demand (green curve) calculated from actual measures*

The other algorithm helps system operators in forecasting the load. The aim of the so called LoadForecast is to estimate the electricity consumption along a future time horizon on the basis of the available information. This information means historical data on consumption, real time energy data, and also historical and real time data on weather combined with real time weather forecast.

Building on this huge amount of data, with the help of machine learning this algorithm made forecasting for Terna more accurate and based on this, their processes in the control room related to dispatching became even more reliable.

"We started the project in 2011 and introduced it to our system step by step. We applied the whole platform into our everyday work in 2015" – said Cristiano Martarelli, who is specialist at the Rules, Systems and Defence Testing. But the platform is always under further development, like a "neverending story". According to Mr Martarelli, there is

always room for deploying new and better algorithms to make the platform able to adopt new techniques.

Impact

If you are that kind of a person, who likes polluted air, stronger effects of climate change or old, dusty power plants, than you should not be happy about this project at Terna. While, if you prefer clean energy, zero-carbon economy and would like to see more renewable sources to be exploited, then you should consider it as a very positive achievement. Because Advance Dispatching and LoadForecast is on the path for the Italian power system to integrate more wind, solar or other kind of renewable energy. Though these sources are clean, they are very unpredictable as we cannot control the wind and the sun. But with increasing the accuracy of forecasting energy needs it becomes easier to connect more of these kinds of generators to the system as this platform can mitigate their negative impact on stability.

Project Benefits

- Improved network management
- Decreased carbon emissions
- Decreased network costs

The platform also further improves the security of supply, which is also a very important aspect – if you don't think so, just try to remember how you felt the last time there was a power outage at home even only for a couple of minutes! System operators work twentyfour-seven to "keep the lights on" and to develop tools which would help to keep the balance between demand and supply.

The effects of the Advance Dispatching and LoadForecast could also be measured moneywise. According to Cristiano Martarelli, since the first deployment the cost efficiency has been one of the key driver of the development. First it appears on the books of the transmission system operator, but then it circles down to the energy prices as well. And at the end of the day that is tangible for every energy consumer..

Keywords: system operation, load forecasting, artificial intelligence

More info at: Advance Dispatching & LoadForecast

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

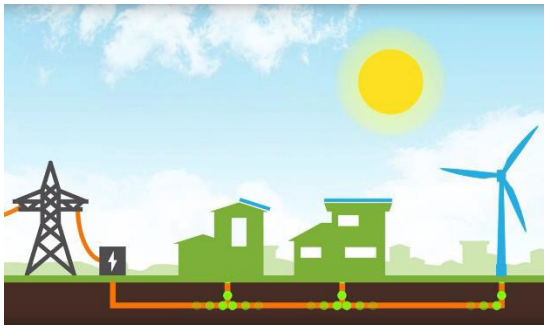
ENERGY STORY:

How to optimize the energy system with a flexible approach

The DYNAMO Flexmarket project seeks to stimulate a flexible consumption among customers to help solve congestions in the grid.

In order to limit the rise in global temperatures our societies must decarbonise and bring harmful emissions to a minimum. Huge amounts of renewable energy have therefore been installed all over Europe, from large scale windfarm and solar photovoltaic fields, to solar roofs turning households into prosumers. While the prosumers are good news for the energy transition, much can still be done to ensure optimal use of the energy they produce. The problem is that the production from the solar roofs results highest during the day while the average household demand peaks in the evening during weekdays, i.e. after finishing school and work. The excess energy from the prosumers is sent into the grid, where it risks producing congestion if the supply is very high. When the prosumers consumption exceeds its generation i.e. in the evening, energy is sent from larger renewable energy installation, or if not available from less clean sources.

A Universal Solution Tested in the Netherlands



The DYNAMO project aims to reduce the imbalance between demand and supply by tests a *flexibility market* as a solution to the hourly imbalance between electricity supply and demand. During the project, which was initiated by the Dutch electricity distribution system operator (DSO) Liander in 2015, prosumers were encouraged to be more flexible in their electricity consumption. For the prosumers, this means relocating consumption, which is not bound to occur at peak hour, to a moment of the day when the prosumer's own production is high but their consumption low, i.e. at midday. The consumption shift is then offered as a flexibility product to the DSOs on the previously mentioned flexibility market.

For the DSOs the offer of flexibility not only helps smoothen out the imbalance between demand and supply, it is also a viable alternative to costly grid reinforcements. For the flexibility market solution to function, it must be both affordable and reliable in the long term. Thus, the DYNAMO project tested the market model proposed by the Universal Smart Energy Framework (USEF). The idea behind USEF's model is that if we work together playing by the same rules, we can improve the resilience of the energy system and bring down the costs, to the benefit of all.

If we all give a little bit of flexibility

The project involved a trial field consisting of 100 prosumer households in the Dutch town Heerhugowaard. In the participating households, smart devices controlled by a smart IT system were installed. The installed system allowed for automatic and more optimal adjustments of the prosumers' electricity generation and demand. When the prosumer was producing alot but consuming little or no energy, the IT system could turn on devices, who consumption is not bound to the peak hours i.e. water boilers. Likewise, during moments of high production of renewable energy, the system would limit the power transfer from the prosumers' solar panels to the grid to ease the pressure and

reduce the risk for congestions. By better matching their own production and generation, the prosumers contribute to an easing of the consumption and production peaks in the energy system.

As prescribed by the USEF model, the link between the prosumer households and the DSOs is provided by an aggregator. The aggregators summons the flexibility offered by the prosumers and forwards the total flexibility offer to the DSOs who uses it solve to congestion issues.in the grid Thanks to the smart energy devices, the aggregator can respond quickly to imbalances in the grid and to the consequent needs of the DSOs by applying the prosumers' flexibility.

Impact

One of the main outcomes of the project is that it proved that the USEF flexibility market model worked. project furthermore showed that by helping to solve upcoming congestion problems in the energy system, flexibility markets created an added value for all involved parties not least for the DSOs.

The test proved that the flexibility market can contribute to mitigating the peaks in energy demand and supply, both in their duration and intensity. By reducing congestions, it also mitigated the risk of power outages.

Project Benefits

- Minimizing of congestions in the grid
- Better use of the generated renewable energy
- Reduction of risk of power outages
- Creation of value for all parties

In the short term, the uptake of large-scale flexibility sources from large consumers such as bigger business, is foreseen. In the long term, the lessons learnt throughout the project will be extended to other parts of the Netherlands via a gradual extension of the Flexmarket.

Keywords: Flexibility market, smart grids, demand response, USEF

More info at: website + video

Note: Project Benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

A sustainable second chance for batteries

The ELSA project demonstrates that the life cycle of electric vehicle batteries does not need to end after replacement – they can have a second life and a second chance to support the energy system.

Energy storage is an essential accessory for an efficient use of electricity, allowin g prosumers[1] to store part of their energy production throughout the day and distribute it according to their needs. Thanks to the acknowledgement of the role of storage for the energy transition, the production and use of batteries are increasing at a high speed in Europe. How can their use be optimised in order to allow a better penetration of renewable sources in the energy system?

A Second Life for Electric Vehicle Batteries: the ELSA Project

The H2020 project ELSA (Energy Local Storage Advanced systems) offers an answer to such query, looking at a specific type of batteries – the ones used in electric vehicles. The electric vehicle sector is growing in Europe, with global forecasts suggesting 100-200 million vehicles in circulation by 2030[2], , which poses a question: what can be done with the batteries after the vehicle is not in use anymore.

The life of an electric vehicle and the life of its battery do not always coincide. Used overtime, a battery can lose power and needs to be replaced. This does not mean that it becomes useless: it can be separated from the vehicle and keep performing the same service, but with another scope – having a “second life”.

The ELSA project, started in 2015, collected used electric vehicle batteries and installed them in buildings to optimise the use of energy from the grid or from solar panels. Batteries for mobile and stationary storage use the same technologies and materials; their difference lies in the voltage that they are able to support. Electric vehicle batteries have a lower voltage than the electricity that comes from distribution grids, which required building new, specific suited converters that could adapt the electricity flow for the second life batteries that were installed.

Each of the six pilots that ELSA managed throughout Europe was unique. The Ampere building in Paris, France, has installed second life batteries coming from Renault Kangoo cars to support its solar panels, which helped the facility to win an award for being a “Smart Building”. The Gateshead College in Sunderland, United Kingdom, has seen three batteries coming from Nissan Leaf cars able to support 191 solar panels in the building’s rooftop. The European office of Nissan in Paris, France, required 6 power converters, and was essential to test the scalability of the ELSA system. Six Renault Kangoo second life batteries support a set of solar panels and a small wind turbine at

1 The term comes f rom the merge of the words “consumers” and “producers”, indicating those actors of the energy system who consume energy coming both f rom the distribution grids and from their own production through solar panels.

2 *Global EV Outlook*, International Energy Agency, 2018

the E.On Energy Research Center building in Aachen, Germany. The city of Kempten, Germany, runs mostly on renewables; the project pilot took place in a residential area of 81 houses and involved six Renault Kangoo second life batteries. In the city of Terni, Italy, a similar configuration helped support a solar panel farm.

The project has seen batteries performing at 70% of their capacity after the reinstallation in the pilots, a high rate for batteries which have already performed for 6 years on average as electric vehicle batteries. After they are installed as second life batteries, it is estimated that they will last for additional 10 years.

Impact

ELSA brings many advantages to the energy system: first, it supports the management of the energy demand of a certain site and the penetration of renewable energy sources. Second, it finds a sustainable destiny for used electric vehicle batteries: their dismantling is a necessary process that allows to repurpose some of its materials which are finite, such as lithium and cobalt. By reinstalling them in buildings, they are used thoroughly, avoiding unnecessary costs and waste.

Project benefits

- Improved network management
- Decreased carbon emissions
- Reduced energy bills
- Improved social acceptance

It has also had a positive societal impact: the people involved directly in the pilots - workers, citizens, students - have well-received the idea of having a refurbished storage system in their buildings. One potential worry from the project's stakeholders was safety: however, because the second life batteries of ELSA come from electric vehicles, they are completely safe (impact-resistant) and have gone through additional checks by local fire departments. In some pilots, ELSA has also installed charging points for electric vehicles and low-consumption LED lighting systems – incentivising more conscious behaviour. The project has also allowed consume rs to lower their electricity bills – and contributed to the overall reduction of CO2 emissions.

ELSA has found some obstacles to overcome. Throughout the European Union, there is no unified regulation for the installation and use of energy storage; for every pilot, permits from national and local authorities were required. Nevertheless, the project offers a reduction of costs and the facility in replacing the reinstalled batteries with other second life ones, making it a self-standing initiative with a potential to be replicated.

ELSA puts together two worlds, offering a solution that is in full compliance to the circular economy: giving a second life to electric vehicle batteries in an environmentally friendly manner, while supporting an efficient deployment of renewable energy.

Keywords: stationary energy storage, second life batteries, buildings, renewable energy

More info at: https://www.elsa-h2020.eu/Home.html + video

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

ENERGISE: promoting active energy citizenship

The ENERGISE project identifies cultural change as a key ingredient for a successful energy transition and promotes changing practices for a more sustainable pattern of energy consumption.

Each and every one of us has an impact on the stream of energy that feeds our society. Energy is embedded in our lives and we live in symbiosis with it, sometimes not fully understanding the control we have over why, when and how we consume. Improved societal norms and routines can play a major role in changing energy consumption patterns. ENERGISE is a Horizon2020 project (GA no. 727642) that specifically tackles the community weight on energy consumption. The main purpose of the project was to try and understand better the social and cultural factors of energy use, demonstrating the significance of using social sciences as a ground for evidence-based policy making in the energy sector.

ENERGISE Living Labs: creating new energy cultures

The core of the project were the ENERGISE Living Labs (ELLs), 16 energy communities set up in 8 different countries (Denmark, Finland, Germany, Hungary, Ireland, Netherlands, Switzerland and the UK), comprising 308 households. The aim of these labs was to promote sustainable energy use through a change of habits and their social roots, by working with and for the community. The main outcome of the Living Labs was the creation of a method for the reduction of the energy use that embraces not only the quantity but also the everyday mindset towards energy consumption. To this end, the ELLs comprised very different types of household including families with children, elderly people and students.

ELLs' multi-phased working process started with the definition of the condition of energy usage in the interested community, through a survey that was distributed to the participants. The second step was the identification of the set of changes in practices that would result in a more sustainable behaviour. In particular, the method that was used in the experiment was to challenge the participants to decrease their energy use in two domains of everyday life: house heating and laundry. The aim was to reduce the indoor daytime temperature to 18 °C and washing laundry by half. After exchanging ideas, concerns and expectations, the participants then proceeded with the implementation of the challenges in the testing phase. To promote a proactive attitude towards the challenge, two boxes were provided to all the households containing useful tips and tools to ease the transition: some examples are hot beverages, wool socks and products for dry cleaning.

At the end of the experiment the households had the chance to reflect together on the lessons learnt and discuss their perception of 'comfort', as well as alternative ways they found in order to maintain an appropriate level of comfort, even with a reduced energy use. A common example is simply wearing warmer clothes instead of increasing the indoor temperature. Participants also had a chance to reflect on their attitudes toward cleanliness, and what it means to be 'clean' in different social situations. In general, results show that households could reduce their temperature by one degree and reduce their laundry cycles by one per-week, without compromising levels of comfort or cleanliness.

Impact

Project Benefits

- Reduced energy bills
- Citizen empowerment

The University of Geneva, Swiss partner of the project, calculated the consequences of the fluctuation of energy use if these results were achieved by all the households in Switzerland. It was estimated that a reduction of 1 °C in indoor heating, which amounts to a 6% energy saving, corresponded to twice the energy needed for all laundry and drying requirements in Switzerland for a year. Moreover, cutting the laundry cycles by 1 per week would mean saving 30 million m3 of water (more than 5000 Olympic-size pools), 10 million litres of laundry products and the equivalent of the annual electricity consumption of ninety thousand households. Another example: it was calculated that if all the households in Hungary were to achieve the results found in the ELLs, the reduction in CO2 emissions would equal the annual CO2 emissions of almost seven thousand Hungarian citizens.

Some of the outcomes of the experiment are already being applied in contexts outside of the project life: for example the university of Aalborg, the implementing authority of the ELLs in Denmark, has been asked by the municipality of Roskilde to help develop educational materials in relation to energy saving practices for school children. Moreover, in Hastings, England, the local ENERGISE partner (Energise Sussex Coast) is engaging with the Muslim community to extend the advice work of the ELLs to refugee groups.

Given the fundamental importance that was dedicated to concrete, immediate and effective energy saving practices for everyday life, the project was greatly covered by the media, with more than 500 entries among national and local newspaper, radio interview and also TV reports. Furthermore, the project forms the basis of an impact case-study, to be submitted for a forthcoming national research evaluation (the UK Research Excellence Framework, 2021).

The ENERGISE project shows just how much our impact on the energy flow is fundamental and in what practical ways we can change habits and behaviors to render our print more sustainable. Overall, a keyword of ENERGISE was “energy culture” and the success of the experiment led to the promotion of an active energy citizenship, boosting the interest in moving from passive energy consumers to interested actors, developing an understanding of the importance of energy saving and having a greater role in energy democracy.

Keywords: Energy Culture, Sustainable Consumption, Active Citizenship

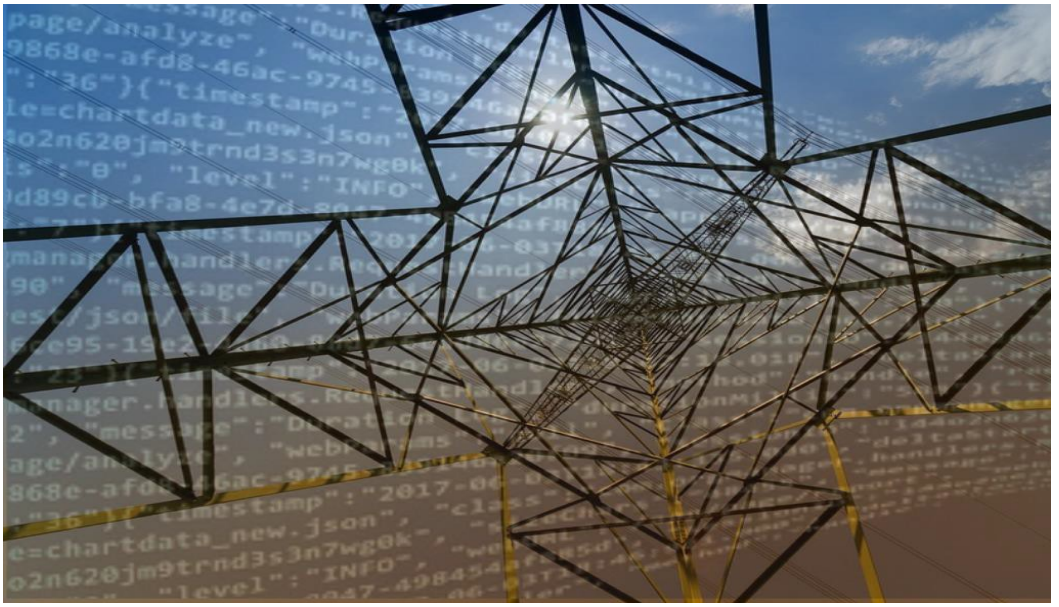
More info at: http://www.energise-project.eu/

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION



ENERGY STORY:

How can smart meter data lead to more consumer-centric services and lower prices?

ESTFEED is an Estonian platform for energy service providers to access consumer smart meter data in a legal and highly secure way based on end-consumer consent in order to integrate retail markets, offer new smart services and lower costs

Data – and especially big data – is considered the crude oil of the 21st century. However, it is almost invisible for the most of us, it has become the most precious resource despite being abundant worldwide. Every single tool from the smallest gadget in the household to enormous industrial equipment collects tons of data every day. But this resource is only precious if it is convertible to useful information and compatible with other sources of data upon which smarter decisions could be made. For example, to choose services according to personal needs or to change behaviour and lower energy costs according to more data about personal consumption patterns.

Data now lies at the foundation of smart energy networks as well. Energy retail markets (selling energy to homes and businesses) are fragmented in Europe by region and by country. One of the main aims of European energy policy is to integrate energy markets to facilitate the energy transition towards a low carbon and more flexible[1] energy system that can benefit the consumers through, for example, more accurate energy pricing. Integration of retail markets requires that all European energy companies are on the same page when collecting and processing data. It means that the basic rules of the game should be agreed, for instance data is owned by the end-consumer who, is able to access and share data with different energy service providers if she or he so chooses. These rules have now been agreed in the EU's Clean Energy Package - a series of EU laws (Directives) that aim to move towards a cleaner European Energy system.

How can consumers monitor and grant consent on data processing?

ESTFEED is a platform developed by the Estonian transmission system operator (the operator that manages the electricity and gas highways in Estonia) , ELERING, that aims to connect smart meter data from various hubs and sources across Europe with energy services who want to use this data but only with end-consumer consent. Basically, it is a highly secure and transparent data transport layer with a consent management system that enables the consumer to be in control of his or hers energy data and to choose with whom to share data with and also have an overview who has accessed the data.

By data, we mean mostly consumer smart meter data, for example how much gas or electricity each household has consumed but also produced if they have their own solar panels and sell energy back to the grid. But there is more. ESTFEED gives access to stock market prices of electricity, or weather forecasts etc. – basically all data that if put together, helps energy service providers and other market players to optimize their services and develop new smarter ones.

Why is it good for consumers?

Sharing our personal data to companies to learn more about our habits can be a delicate issue. But if it results in lower energy costs and you can be sure that your data cannot end up in wrong hands and is used only for those purposes you agreed to? That's what ESTFEED enable at the end of the day. With access to consumer personal data, smart utility providers can find different kinds of approaches to offer more personalized services – which leads to better energy prices for the consumers and an increasing range of

[1] A "flexible" energy system is one that can more easily integrate multiple energy sources, like for example solar and wind.

products and services they can request. Most importantly, the consumers can be in charge of their data, manage who uses it and for what purposes.

Through ESTFEED consumers can also keep track of their own energy consumption. That is not only important from a budget point of view, but they can also see their own impact on the environment. The European Commission is committed to involve consumers in the energy market as 'prosumers' (a consumer that also provides energy). To make this possible it is essential to have access to the data related to their consumption and that of the energy generation of their small-scale solar panels or wind turbines.

In terms of applications, ESTFEED has already enabled end-consumers to share their data with building monitoring service providers to optimize their consumption and lower energy costs in business buildings. It also allows end-consumers to share their consumption history with energy package comparison tools and all the electricity and gas suppliers in Estonia to receive personalized offers and enable consumer switching.

Impact

ESTFEED went Live in September 2017 and every month there are about one thousand new end-consumers who sign-in to ESTFEED customer portal to study their electricity and gas metering data and give about 500 to 1000 consents in one month to energy suppliers or other energy services to access their data. "At present, energy service providers can access all electricity and gas metering points in Estonia (around 800 000 in total) if the end-consumer with the grid contract has given the access right to this specific energy service provider" – said Kaija Valdmaa, project manager of ESTFEED at Elering. But the eventual goal is much bigger. Due to EU regulation, data protection and access requirements from the Clean Energy Package and General Data Protection Reform, much international interest towards ESTFEED and how to adapt it to other countries has emerged. The aim for Elering is to reach 100 million electricity meters throughout Europe that share their data through ESTFEED by 2020.

Project Benefits

- Efficient business models and market designs
- Reduced energy bills

Consequently, Elering is setting up a Europe-wide alliance with other transmission system operators to start the provision of energy data access and management service in Europe. It would be worth it: according to Georg Rute, Digitalization Manager and Head of Smart Grid unit at Elering, the impact of a joint platform compared to everybody building their own would be to facilitate as much as a 2 billion euros savings if rolled out across the whole EU.

Keywords: Consumer in the centre, smart meter data, integration of energy markets

More info at: https://elering.ee/en/smart-grid-development + Project Video

Note: Project Benefits based on specific criteria outlined in the Project monitoring report

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

FLEXCoop project: Empowering communities to elevate European energy transition

Energy cooperatives seeking new ways to manage their consumption in order to provide services for the power grids thus supporting integration of local renewable energy sources

Imagine a community of consumers – households, small or medium-scale enterprises together – who organize themselves in order to make their power supply sustainable. Some of them install photovoltaic panels on their rooftops, some have electric heatpumps, some others electric cars, others batteries in their basements. All together, they decide to mutualize these assets and to have the biggest positive impact on the grid.

Today, this scenario is not yet an everyday reality. The European research and innovation project FLEXCoop investigated real-life scenarios that could elevate energy cooperatives to the next level. The aim of the project was to exploit flexibility which can be achieved on the demand side. In other words, if energy consumption could be better matched with those time periods when power generation is abundant, it could provide other services either for the community itself or the energy system operators at larger scale.

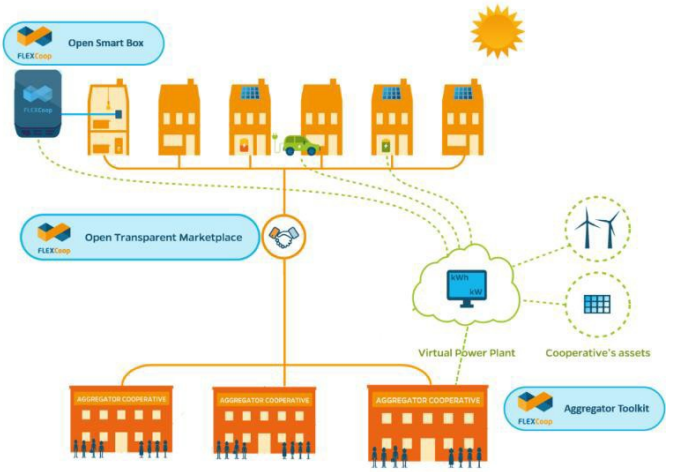
Power generation resources in these cooperatives are highly dependent on weather conditions – you may not have a lot of electricity from solar powers in cloudy weather, while you have more than enough power from these generators on a long sunny day. Therefore, the capability of energy consumers to adapt their consumption to the varying to the power generation intensity is becoming more and more valuable.

Being able to decrease (or increase) one's consumption upon request can help stabilise the grid (in which supply and demand of power must be perfectly balanced at all times), support the network management, or simply help source electricity at the right time, when it is cheaper and cleaner.

Automatized energy management

To facilitate these functions, the FLEXCoop project developed a tool which aimed to manage the consumption of one's household or small business and in addition, enable communication with the aggregator [1]who collects all these sources of power and flexibility. Aggregation is key as these sources, when taken singularly, are too small and if the aim is to capitalize on their service to the power grid, larger volumes must be created by aggregation.

[1] An aggregator is a new type of energy service provider which can increase or moderate the electricity consumption of a group of consumers according to total electricity demand on the grid. An aggregator can also operate on behalf of a group of consumers producing their own electricity by selling the excess electricity they produce



- The tool consists of three major parts. The first is a smart box which was installed on the premises of consumers who had power generation capacity (e.g. solar panels) or manageable consumption (e.g. water boiler or heat pump). The second is an interface for the aggregators to enable them to use the flexibility provided by the consumers. The third is a virtual marketplace between these two parties - described Roland Tual, project manager at one of FLEXCoop's consortium partners, REScoop.eu.

The smart boxes were deployed in two pilot areas each in already existing energy cooperatives in Spain and in the Netherlands. In Spain the aim was to investigate the usage of the consumers' flexibility to optimize their consumption according to the power generation of the local solar panels. One of the advantages of the FLEXCoop tool is that it fully automatizes the consumers' energy system. – *There is no need for human intervention in order to align consumption with power generation, the smart box is able to calculate the optimal consumption curve according to the current and expected power generation and adjust the manageable consumption units* – explained Roland Tual.

In the Netherlands the project investigated how this accumulated flexibility could support the balance of the national grid. Here the cooperatives playing the role of independent aggregator set up use cases in which they can provide balancing services to the power system by shutting down residential heat pumps. Moreover, they cooperated with the national transmission system operator in order to provide similar services with wind generation curtailment. Together, they are looking at the right magnitude at which these sources of flexibilities can be utilized in the power system being compatible to defined service requirements and having a potential impact on the system state.

Impact

Despite certain regulatory barriers, positive impact was eminent throughout the project. The first was to align the quantity of energy consumed more closely with the hours of weather-defined, natural energy production, be it locally through matching roof-top solar power generation, or at system level when matching hours of abundant and cheap energy on wholesale markets.

Project Benefits

- Improved network management
- Reduced energy bills
- Decreased network costs
- Improved social acceptance

The second was to support the quality of electricity by assisting overall grid stability. The flexibility provided by the energy cooperatives, securing two of the key parameters of the system – voltage and frequency – could be easier, cheaper and greener, giving cooperative members extra financial benefits.

Thirdly, these kind of services – could reduce the need in infrastructure investment by avoiding 'peaks' in consumption. The size of an electric cable – like a water pipeline – should be linked to the maximum flow it will receive; reducing the consumption peaks enables to reduce investment in the infrastructure. Use cases like the above mentioned will support the growing of energy cooperatives which could be key assets for the ongoing energy transition.

Keywords: energy cooperatives, renewable energy sources, flexibility, prosumers, network management

More info at: http://www.flexcoop.eu/+ project video

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

Bridging the trust gap between powerline operators and citizens

The INSPIRE-Grid project helps citizens engage in the energy system of the future to reach consensus on how to expand electricity grid infrastructure while also safeguarding the environment.

Power lines are a familiar sight in European landscapes, so familiar that we hardly notice them anymore unless they are built in our backyard. But who draws the route of power lines? How is their construction decided? Multiple voices want to make themselves heard, including local inhabitants (who may not like the towers in their backyards or too near to where they live); policy-makers at local, regional and national level (who may need to establish the right rules, for example, for the payment of the land which the towers use); environment protection associations (who may not want the towers to go through protected nature areas) and Transmission System Operators (TSOs) who build and operate the high-voltage power lines (who search for highest operational quality). How do you ensure that all voices are heard, while not making the planning and approval process drag on for years or even decades?

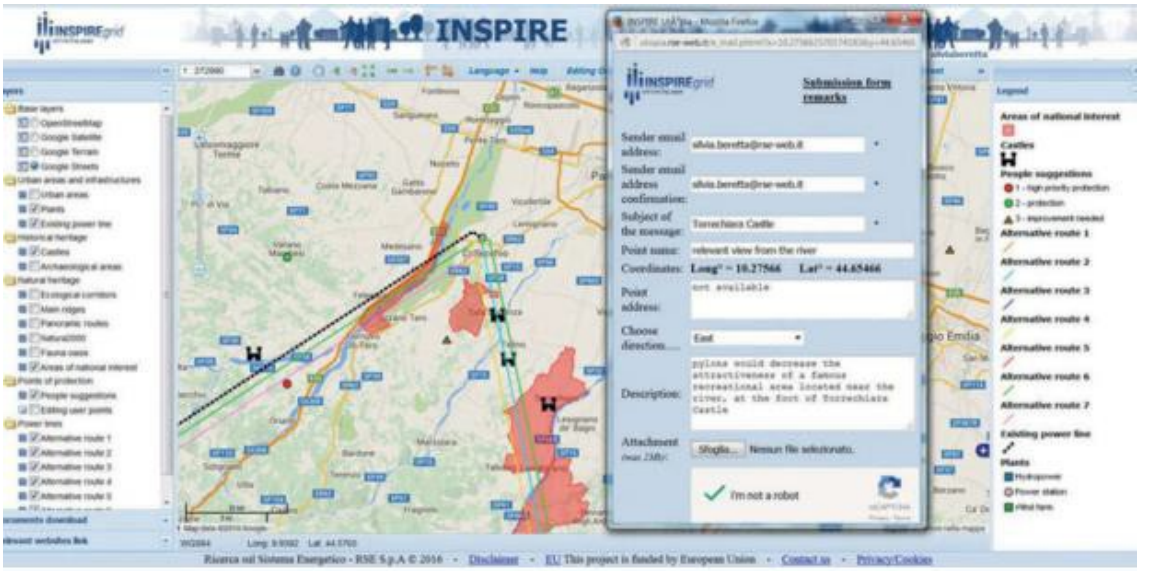
How to bring power line operators and other stakeholders together?

A solution was needed, that combined state-of-the-art engagement tools with easy decision-making. Particularly challenging is to enable citizens to provide informed opinions on related complex issues. The 'information gap' between experts working with electrical grid systems and the general public generates a lack of trust that has proven to be a long-lasting challenge to the completion of infrastructure projects.

The goal of INSPIRE-Grid ("Improved and eNhanced Stakeholders Participation In Reinforcement of Electricity Grid."), an EU funded project with partners including three electrical grid system operators from France (RTE), Norway (Statnett) and the UK (National Grid) and a research institution from Italy (RSE), was to tackle that challenge by developing, through an interdisciplinary method (with social and technical scientists), several tools that facilitate collaboration and participation between all communities and stakeholders.

Among these is a web-interface "Geographic Information System" (GIS), allowing local inhabitants to visualise the possible routes of a power line and express their opinion. This visualisation web-interface requires no particular knowledge in data, analysis or software. Such tools are increasingly used in current projects; for example, a GIS was used in the planning of the SuedLink project, a power line crossing Germany from North to South and at Swissgrid for finding the path for transmission lines in Switzerland.

Other tools tackle the difficulty in communicating the expected benefits of a project. The construction of a new power line may be justified by the need to link renewable energy to the electricity system, or to increase security of supply (meaning: making power available without any interruptions; having no blackouts, etc). However, benefits for society at large are often not so easily visible at local level, where the construction of a new line is seen as a nuisance. INSPIRE-Grid developed a "Life-Cycle Assessment" tool (LCA) to better evaluate and communicate the environmental impacts of future power lines and to explain the need for grid extensions. Tools like the LCA have been already implemented in a real-world environment after the project ended by the French electricity operator RTE.



Impact

Project Benefits

- Social acceptance

The INSPIRE-Grid project was born from the observation that, although the modernization of the current electricity infrastructure is recognized as one of the most important enablers for the energy transition toward a low carbon economy, many projects are delayed or even cancelled – mostly due to challenges related to the permitting procedure and to the opposition of the local stakeholders and residents.

Through the interdisciplinary approach and tools pioneered by INSPIRE-Grid which have already been implemented in real world scenarios, the views and voices of not only scientists but also practitioners, public authorities and administrations, civil society organizations and the general public can be better taken into account.

It is hoped that in future, a deeper comprehensive knowledge of everyone's needs and admitting to consensus as a key principle will ensure that Europe's energy system can meet its efficiency needs and decarbonization targets; and not only, the INSPIRE-Grid approach could also potentially be applied to other large-scale infrastructure projects that require public consultation and approval.

Keywords: Powerlines, stakeholder engagement, co-decision making

More info at: http://www.inspire-grid.eu/ + Project Video

Note: Project Benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

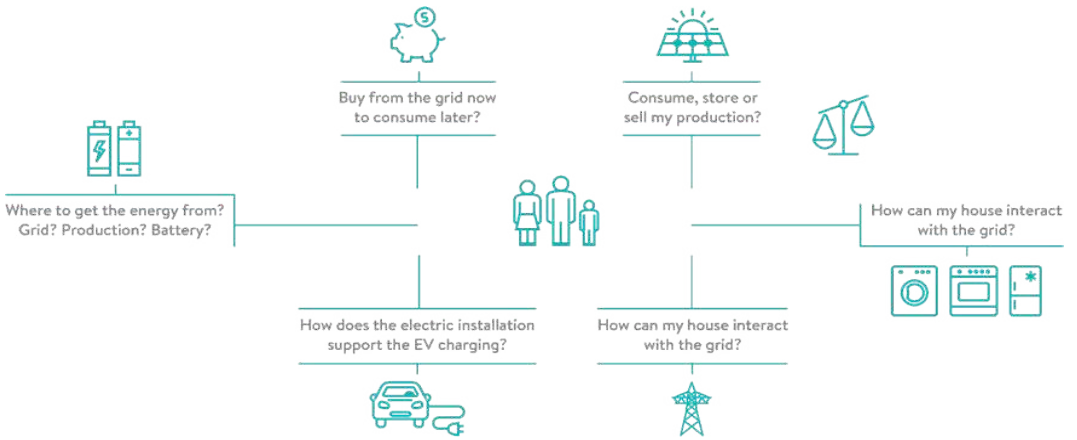
Empowering energy consumers

Energy distribution operators as a neutral, active market facilitator: A key enabler bridging the gap between citizens and technology solution providers in the energy sector

We live in a world where carbon neutral energy consumption is becoming ever more important. However, many of us are not likely to change our behaviour to reduce our CO2 footprint at the price of lower comfort in living, mobility, or at the risk of missing out on the benefits induced by digitalisation. Hence, there is a strong need for a rapid transition to cleaner energy sources and for innovation in the energy transport and distribution system to maximize the positive impact of these sources for the decarbonisation.

For an efficient and successful energy transition, one of the main requirements is that consumers understand and play a central role. Consumers won't just be simple electricity, gas or heat users anymore but "prosumers", who participate with their own energy generation (distributed energy) and provide the system operators with data and information regarding their own consumption. Data management, flexibility and distributed energy resources (DER) are pivotal for the smart grid development and are also the focus of the InteGrid project.

How to bridge the gap between citizens and technology through Distribution System Operators (DSOs)?



The H2020 project InteGrid, coordinated by EDP Distribuição, intends to pave the way for smart grid development. The main purpose of the project is to use DSOs as a bridge to different stakeholders enabling them to participate in the energy market, providing a flexible energy system fuelled by renewables in a stable, secure and economic way. It is being carried out by several organizations across Europe and has demonstration sites in Sweden, Slovenia and Portugal, each of which focuses on a specific project area.

The Swedish demonstration aims at testing new home energy management solutions by implementing new user engagement strategies based on socio-economic incentives and platforms that motivate flexibility actions. This aim is to enhance consumer engagement while maintaining a secure and reliable grid-based system and promoting climate-friendly energy use behaviour. The demo will facilitate demand management by providing energy forecasts that facilitate home automation and better consumption decisions.

In the Slovenian demo a Virtual Power Plant (VPP) is being developed. This remote, cloud-based, distributed powerplant, aggregates the capacities of diverse energy resources with the aim of enhancing power generation, as well as the trading or selling of power on the electricity market. This technology allows for a more efficient generation and consumption of energy, while balancing the fluctuations stemming from renewable energy. An effective VPP can be a strategic instrument to provide efficient measures of flexibility to support the distribution grid in times of peak demand.

In Portugal, the consumer engagement strategies demonstrated in Sweden and the Slovenian VPP concept are implemented in a large-scale demo. Here lies the most disruptive development of InteGrid project – the Grid-Market Hub: a multi-service, multi-user service-based platform where the DSO acts as market facilitator. This enables disruptive business models, where the consumers' energy consumption flexibility is inserted in an integrated architecture. This aim is to improve the flexibility management of commercial, industrial and residential consumers in a context with high penetration of renewables while reducing grid constraints and ensuring the reliability of the network.

To move from single solutions to an integrated management at a higher scale, InteGrid integrates the activities in the three different demo regions. This way, the project ensures that the knowledge and developments from the three demo sites are replicated at the other sites, thus demonstrating the replicability and scalability of the solutions.

Impact

InteGrid is providing innovative ways of managing flexibility assets across consumers for a more efficient operation of the grid. Through this action, investment in grid infrastructure can be deferred and postponed, generating savings for the distribution system and, consequently, **lower prices to the consumers**.

The DSO acts as a market facilitator ensuring simultaneously the reliability and efficiency of distribution grid under a context of high penetration of renewables through a clean, reliable and cost-effective energy system. It does that also by empowering the consumer, which is at the same time a strategic actor of the system and one of its main beneficiaries.

Project Benefits

- More efficient management of the distribution grid
- Enhanced distribution grid reliability and resilience in a context of high penetration of renewables
- New energy services and business models

Keywords: DSO; DER; Flexibility; Disruptive Business Models

More info at: https://integrid-h2020.eu/

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

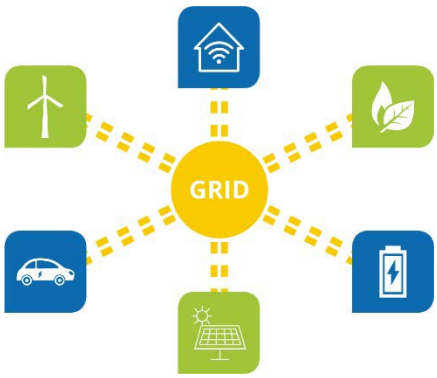
EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

Reversing energy perspective: consumers first

How a local flexible energy market can benefit customers, environment, and retailers



Over the last decades, widespread deployment of renewable energy sources, electric vehicles and storage technologies are radically changing the one-way production-to-consumption concept of the electrical grid. Customers can now be actively involved in the electricity grid strategy of the future by producing their own energy (with e.g. solar panels) and consuming it themselves (making them "prosumers"). They can also save the energy in batteries making them independent from energy taken from the grid. However, these changes make the work of the energy system operators, such as Distribution System Operators (DSO), a little more complex and challenging.

The **InterFlex project** addresses this challenge, enabling a range of technical and practical innovations to smoothly transition to cleaner energy sources and boost the decarbonisation of mobility and heating sectors. By activating flexibility and interactions between energy market participants (i.e. prosumers, consumers, storage managers, distribution grid operators), the InterFlex project allows DSOs to give signals to energy producers and consumers, who can adjust their generation and/or consumption patterns accordingly to optimise the operation of the system. The InterFlex solution serves to avoid disruptions in energy distribution thanks to improved control of energy system flexibilities, thereby unlocking potential savings for end customers.

InterFlex relies on a set of innovative use cases: six industry-scale demonstrators are set up in different European cities, together with 20 Partners, including energy companies, universities, and technology specialists.

Local flexibility solving current and future energy grid challenges.

Throughout the three years of project execution, five paths of action were identified to produce new business models and innovative technologies.

A *local flexibility market* was realised with an IT platform that points out time independent energy consumption and production, so called flexibilities in the energy grid. Activating this flexibility makes it possible to adjust the consumption around peak time avoiding high energy pricing. This solved the complicated issues of managing various independent generation sources, by implementing a communication which allows the exchange of information among several energy players simultaneously.

End consumers are playing a key role in obtaining the right *demand response* and therefore, use of the electricity grid. Depending on the level of demand and the energy requested/consumed by the customer, a modulation of controllable loads is activated. Loads can be electrical appliances such as washing machines, stoves, and other energy consuming devices. A market-based approach selects the most suitable demand response patterns, which means to consume during times with low energy pricing and to reduce consumption in peak energy demand intervals. InterFlex attracted numerous customers, allowing end-users to trade privately the generated energy within their neighbourhoods, and developed a platform that displays the household's energy balance.

Smart functions and grid automation enables households' automatic fast switching from grid connection to self-consumption (islanding), directly impacting power quality[1] and customer comfort. The stabilised voltage grid power quality creates reduced stress on electrical household equipment which increases their lifetime at lower cost. Islanding of individual homes makes them less dependent from the grid and is enabled by automatic actions based on price signals.

Cross energy carrier synergies focus on the entangling of heating and electricity systems to achieve a cost optimisation and better efficiency of energy resources. Unlocking the potential of distributed energy resources surplus and using them for district heating contributes to the decarbonisation of the heating sector.

Multi-service storage & islanding makes individual homes more independent from disturbances on the main electricity network while being more energy and environmentally friendly. Maximising the efficient usage of batteries increases the wider use of renewable energies and reduces greenhouse gas emissions. Consequently, customers increase their self-consumption and significantly reduce their costs whilst participating actively in grid services.

Impact

Thanks to the engagement with customers in the demonstration sites, the final InterFlex result is a cost-effective solution that has increased the grid's capacity to host distributed energy resources. Forecasting algorithms enable DSOs to adapt to constantly changing flows in the grids by using suitable power control equipment.

InterFlex demonstrates new business models that accommodate the fast-increasing share of renewable energies, in line with EU energy target of reaching, at least, 32% of renewable share by 2030. The project outcomes can be highly beneficial in similar geographical area and customer / RES environments due to easy adaptation and mitigation of the current setup, as well as by engaging the project partners for further collaboration.

Project Benefits

- Improved network management.
- Decreased carbon emissions
- Efficient business models & market design.
- Economic profit
- Decreased network costs.
- Improved social acceptance

Keywords: Flexibility market; ICT; DSO; demand response; customer engagement; end users;

More info at: InterFlex website and Closing event video

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

[1] Electric power quality, or simply power quality, involves voltage, frequency, and waveform. Good power quality can be defined as a steady supply voltage that stays within the prescribed range, steady a.c. frequency close to the rated value, and smooth voltage curve waveform (resembles a sine wave

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

Integrated electric vehicles and batteries to empower distributed and centralised storage in distribution grids

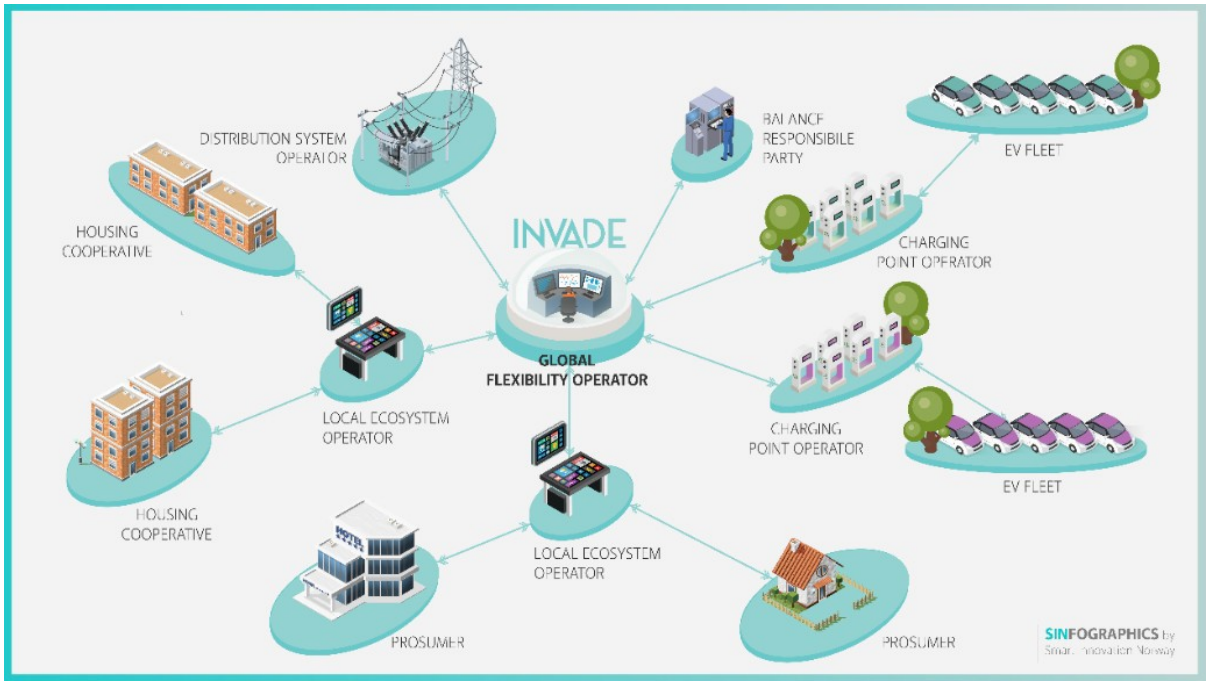
The goal of the Horizon 2020 project INVADE is to greatly speed up the energy transition process by using today's technologies to solve the energy system challenges of tomorrow.

The increasing advancement of distributed renewables in Europe comes with a set of challenges for today's electrical infrastructure. In fact, renewable energy sources are typically *intermittent*: the electrical energy they produce is not continuously available since it derives from non-stored, volatile generating sources (e.g. wind, sun, etc.) that vary in their conditions on a fairly short time scale. Given the imbalance between renewable power generation and demand on the grid, increasing the share of renewable energy sources in the European energetic system requires a higher degree of resilience and flexibility from the current grid.

Renewable energies and electric vehicles (EVs) change the way we consume and produce electricity. It also changes the way for those who manage and distribute it; they must think about the electricity system – to always provide the best possible service for the connected customers. The traditional solution would be a new system infrastructure able to better accommodate the increasing use of renewables: This is, however, very expensive. Therefore, a more viable solution is to focus on a better use of the existing system, combining it with innovative but less expensive smart (ICT) technologies. Flexible management of energy demand together with an improved use of energy storage in the distribution grid can greatly increase grid reliability.

INVADE: using the technologies of today enhanced by smart technologies to solve the energy system challenges of tomorrow

The combination of existing technologies into a new framework to improve the resilience and flexibility of the existing grid is at the basis of the INVADE project, a three-year initiative funded under Horizon 2020[1]. The 12 participants focused on the development of a **cloud-based flexibility management platform integrated with electric vehicles and batteries** empowering energy storage to increase the share of renewables in the *smart grid*.



[1] This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under Grant Agreement No 731148

A smart grid is an electricity network based on digital technology that is used to supply electricity to consumers supported by two-way digital communication. This system allows for monitoring, analysis, control, and communication within the supply chain to help improve efficiency, reduce energy consumption and cost.

Basically, INVADE uses a communication gateway to manage in a smart way the charging of stationary and EV batteries. Let's take the example of charging an electric car: when a vehicle is using 'smart charging', the charger is essentially 'communicating' with your car, the charging operator and the utility company through data connections. Vehicles are often plugged in for a longer time than they need to take power to load the battery. Thanks to smart charging, cars can be plugged in, but charged when it is the most efficient, both cost-wise and grid-use wise, always based on EV users preferences of when and how fast they need the EV battery to be charged and to what level. The management system of INVADE transmits information in such a way that enables ordinary users, operators, and automated devices to quickly respond to changes in conditions of the smart grid system.

The project has integrated the INVADE platform with existing infrastructure and systems at pilot sites in Bulgaria, Germany, Spain, Norway, and the Netherlands. Multiple solutions have been investigated, demonstrated and compared. This is done technically and at business model level. The project also focuses on current regulations in different countries and how they stimulate or just inhibit the necessary innovations.

Impact

The implementation of batteries and data technology of INVADE allows the support of the distribution grid and electricity market while coping with grid flow and voltage limitations, weather and demand uncertainty and electricity production variability. Additionally, the system allows for a smart control of domestic, electricity consuming appliances that will aid in load-balancing over the course of the day.

Project Benefits

- Improved network management
- Reduced energy bills
- Decreased network costs
- Efficient business models and market

In its pilots, INVADE has shown that it is possible to coordinate different flexibility operations in different areas of Europe simultaneously and from the same platform. As a result, large-scale, synchronized cross-border operations can achieve significant impact on grid operations overall and in terms of positive climate impact. **INVADE has contributed to a reduction of electricity congestion across borders and helps in deferring transmission grid investments**.

The smart use of energy storage can help to overcome the challenges of energy fluctuations and price variations in the market. As a consequence, new marketplaces will emerge to trade energy and energy services leading to **better end-user service**. INVADE puts in place a holistic and ambitious strategy to manage the flexibility of today's electricity grid and guarantees a stable and cost-efficient system with increasing penetration of renewables.

Keywords: Smart grids, EVs, smart charging, grid flexibility

More info at: https://h2020invade.eu/the-project/

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring report

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

How to enable citizens to take an active role in the energy market?

The LEAFS project wants to make citizens more involved in Europe's Energy Transition by establishing new ways of interacting with the energy market and grid operators.

The consumer's behaviour regarding their own energy needs will change in the future. Energy users won't just be simple electricity, gas or heat consumers anymore but "prosumers"[1] who produce energy through, for example, photovoltaic panels (a.k.a: solar panels) installed on or around their houses and using innovative equipment such as heat pumps, energy storage devices (i.e: batteries) and electric vehicles that will interact with the energy market through different pricing mechanisms such as time variable tariffs[2]. This can create new business models and bring additional economic benefits to the newly empowered energy consumer, but how does one become a fully-fledged "prosumer"?

Becoming a prosumer implies addressing several challenges. For example, problems will arise for the energy distribution grids if many prosumers react to a low or high market price at the same time. Simultaneous reactions can bring about system failures that could potentially lead to power outages. A solution to address this kind of problem can come from new communication technologies: new phone or computer apps could aid in the management of prosumers' energy supply in the market place by automatically taking into account the electricity price which is shaped in part by how all other prosumers interact with each other in the marketplace. Such apps would be used to intelligently control devices (on/off, temperature setpoints, etc) for balancing prosumers' own energy needs and the effect of their actions on the stability of the electricity system. However, before such comprehensive apps can become common use, some research on the tools that can provide the energy grid with the necessary flexibility is needed. By "flexibility" we mean the ability of the energy system to quickly react and adapt to changes in energy supply and demand while maintaining a steady balance between the two.

How to efficiently increase the flexibility of the energy system?

The LEAFS project led by the Austrian Institute of Technology wants to show how to activate flexibility from prosumers connected to the low-voltage grid in a "grid friendly"[3] way and without subsequent expensive reinforcements of the grid infrastructure.

To do so, LEAFS conducts field trials in three different regions of Austria with different approaches:

© Energie Steiermark / Symbol

- **Community storage operated by the energy supplier.** In the village of Heimschuh, LEAFS implemented a large storage system (100kW/100kWh) which is operated by the local energy supplier. The large storage acts for a community of up to 10

[1] A person who both consumes and produces a product, in this case energy
[2] For instance, buying electricity when it's cheap and selling it when it is expensive.
[3] Meaning no power overload or no additional voltage rise or higher peak power (consumption and generation).

prosumers. It is also able to provide grid stability and market services at the same time. For instance, the large storage system can participate in the spot market by buying electricity when it's cheap and selling it when it is expensive.

- **Financial incentives for customers.** An additional test in Eberstalzell was performed to analyse the effect of new incentives for prosumers to activate flexibility in a grid friendly way and at the right time. More than 100 households receive a bonus when they consume electricity at a time where there is a high local generation by photovoltaic systems (like solar panels). The customers are informed on the availability of the bonus via an app.
- **Photovoltaic home storage providing grid and market services.** In the villages of Eberstalzell and Köstendorf, LEAFS installed three photovoltaic home storage systems which can be used for additional market and grid services. A grid monitor and controller operated by the local Distribution System Operator[4] communicates grid flow and electricity system limitations to avoid power outages.

Impact

The LEAFS project shows how the three actors (prosumer, operator, market) can dynamically interact without creating power outings or other problems to the infrastructure or for the consumers. After several months of successful field testing, LEAFS partners are confident that the tested infrastructures will lead to positive outcomes for prosumers. Indeed, the project contributes to the EU's energy transition by facilitating energy prosumers' and consumers' entry into the energy market – by producing and selling their stored energy they will contribute to the creation of a flexible energy market enabling grid friendly activation of flexibility. The more prosumers embrace technologies such as those tested by LEAFS, the more flexibility options grid operators will have, meaning more possibilities for the integration of renewable energy sources into the market and more prosumer control over energy consumption.

Project Benefits

- Increase of the % of integration of renewables
- Reduction in CO2 emissions
- Decrease of energy cost
- Self-consumption

Keywords: Community Storage, PV, Market Services

More info at: Austrian Institute of Technology

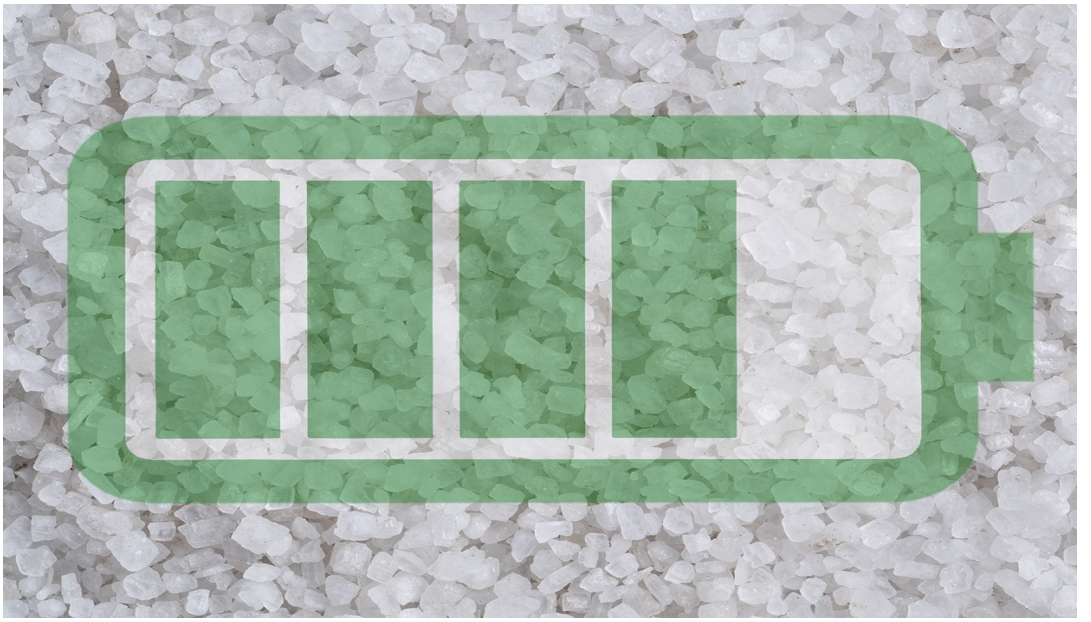
Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

[4] a.k.a "DSO" - a company licensed to distribute electricity

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION



ENERGY STORY:

How to make battery storage more affordable and sustainable?

The NAIADES project aims to develop and demonstrate the Sodium-ion battery as an effective alternative to the Lithium-ion battery for electric energy storage application, thereby increasing the technology's public acceptance.

Batteries are part of our daily life. They are not just central to mobile and automotive applications (to power smartphones, computers, electric vehicles etc), but as the energy system changes, energy storage devices can play a significant role in creating a stable and reliable power supply. They will become one of the essential conditions to support the development and integration of intermittent renewable energies sources such as wind, sun and waves. When the sun is not shining, and the wind is not blowing, extra capacity must be available to respond rapidly to consumers' energy needs.

Thanks to "stationary storage" i.e. batteries installed in fixed locations, like in the basement of citizen's apartments for example, users can still maintain their total daily levels of energy consumption while having more choices on *what* energy source to consume from taking into account market prices. During energy demand peaks, when prices for electricity "from the grid" are higher and/or when there is not enough energy coming in from local renewable electricity generation systems (e.g. solar panels), citizens can choose to rely on the electricity acquired and stored up in their batteries previously, when prices were lower (i.e. overnight or when there was high production of energy thanks to the wind and/or the sun electricity generation). In doing so citizens can reduce their total yearly energy bills.

Today, most battery storage technology is currently based on Lithium-ion and the use of such batteries is expected to accelerate. However, their high cost - mainly due to material scarcity and the manufacturing process - is driving research to develop affordable and efficient battery storage alternatives.

More sustainable storage technologies: beyond Lithium-ion batteries

The goal of NAIADES, an EU funded project supported by several European industries, research institutes and universities, was to develop a new generation of battery based on sodium-ion technology aiming for a radical decrease in battery cost for stationary energy storage compared to traditional lithium-ion technology.

Before 1990, research was equally dedicated to both lithium and sodium-based compounds for batteries, but sodium research almost came to a halt due to the successful commercialisation of the lithium battery technology. Part of the reason is that sodium-ion batteries have lower energy density[1], meaning that more battery volume is needed to achieve the same performance, thus making it not as efficient to power lightweight mobile devices like laptops, phones and electric cars.

However, for large scale renewable energy storage applications - where costs and lifetime are usually more important than energy density (since volume and weight are less critical) - sodium-ion batteries could represent a real alternative to Lithium-ion technology, particularly thanks to the fact that sodium is far more abundant (2.6% sodium can be found in the Earth's crust, compared with barely 0.06% lithium).

[1] Energy density is the amount of energy stored in a given system or region of space per unit volume.

In an attempt to enable better comparative studies between lithium-ion and sodium-ion batteries, the project sought to create a module demonstration in a realistic application environment: a 1 kW[2] sodium-ion battery in a small 1.8 cm by 6.5 cm cylinder, a.k.a. the "18650" format – a common format for lithium batteries that is used in portable computers as well as in Tesla cars (by combining several thousand of them). Following successful tests of the sodium-ion 18650 battery, one of the project partners announced the creation of "Tiamat", a start-up company based in France that intends to use this battery prototype to start the large-scale production by 2020. In 2018, a Sodium battery module with an energy content of 300 Wh[3] was also released which can power, for example, a 1500W hair dryer for 12 minutes.

The sodium-ion battery technology also demonstrated, at larger volumes, a high-power density[4], which makes it particularly suitable for stationary applications requiring high power demands, like, for example, a fast charging stations for electric cars.

Impact

Wide scale implementation of renewable energy will require growth in production of inexpensive, efficient energy storage systems. While energy density challenges for sodium-ion batteries still remain, particularly for small portable electronic devices, the NAIADES project demonstrated that they could potentially secure a privileged position in the electric vehicle market, as well as in the storage of intermittent renewable energies, such as wind or solar power. Furthermore, a recent Life-Cycle Assessment study showed that, overall, sodium-ion batteries have fewer toxic impacts than lithium-ion batteries[5].
If citizens adopt this battery technology in future, they could actively support Europe's energy transition towards a more sustainable energy system. Low-cost, safer and more abundant, sodium-ion batteries could soon be a valid choice for large scale renewable integration by meeting gird energy storage needs.

Project Benefits

- Improved Network Management
- Efficient Business models and market designs

Keywords: stationary energy storage, Sodium-ion, abundance, sustainability, public acceptance
More info at: website + video
Note: Project Benefits based on specific criteria outlined in ETIP SNET monitoring exercise

2 Watts (W) is the instantaneous power generated or consumed by a given device.
3 The kilowatt hour (symbol kW h) is commonly used as a billing unit for energy delivered to consumers by electric utilities.
4 Power density is the amount of power in a given mass, - high power density means it can give off energy more quickly.
5 https://pubs.rsc.org/en/content/articlelanding/2016/ee/c6ee00640j#!divAbstract

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

How to Store and Use Electricity in a Smart Way?

The REALVALUE project seeks to revolutionise home storage heating by giving energy consumers more benefits in terms of cost, comfort and control.

Energy is essential to the comfort of our everyday living. For example, it makes the heating of our homes possible in cold and rainy weather. However, when talking about the best ways to deal with heating at home, there is still a crucial question we are frequently faced with: how can heating energy be used efficiently and conveniently indoors, and at what cost does this come?

The answer to that can be found by analysing the traditional electric storage heating still used in many homes in Europe, where heat/electricity is stored during the night to take advantage of more abundant low-cost energy, and then released during the day when it is actually needed, and demand and energy prices are higher. Even though this technology was game-changing when it was first introduced in the UK in the 1970s – after all, it allowed citizens to lower their energy costs significantly – over time, it has gained a reputation for being inefficient and difficult to control especially with the upcoming renewable energies. A good example of a more sustainable and user-friendly solution is the **Smart Electric Thermal Storage Systems**. It can address the drawbacks of older heat storage technologies with advanced insulation and electronic controls. This means that they are easier to use and, at the same time, they use less electricity to produce the same amount of heat required. The newer storage systems are up to 20% more efficient[1] and compatible with smart-grid electricity systems, thus allowing for a more economical use of energy and ultimately savings for the consumer. The systems can also be charged at any time of the day when electricity is most abundant and cheap (e.g. when there is lots of renewable generation), and then stored until it is needed. This has the positive side effect that more renewables can be used instead of CO_2-emitting fossil generators.

A joint European effort to advance the Smart Electric Thermal Storage technology

To unlock the potential of this technology across the energy system, 13 partner organisations from five EU Member States, representing the entire electricity value chain, joined forces as part of an ambitious research project coordinated by Glen Dimplex. The three-year REALVALUE project ran from June 2015 to May 2018 and received financial support from the Horizon 2020 programme of the European Commission, which went towards technology development, research personnel costs and deployment of real-world demonstration sites.

1 DNV KEMA Energy & Sustainability Report: Potential for Smart Electric Thermal Storage: Contributing to a low carbon electricity system

The technology, installed in 750 properties across Germany, Ireland and Latvia, and connected to the electricity grid in each country with advanced IT, successfully demonstrated how small-scale energy storage devices can help increase uptake of renewable energy use.

Consumers needs were at the very heart of REALVALUE, reaping benefit from this system in terms of cost, comfort and control. Not only were they consulted extensively through surveys, interviews and focus groups, but they were also able to easily track their energy consumption by means of a newly developed, easy-to-use app. With this app, consumers can remotely monitor and control their own heating system. The project's interest was to involve consumers and users from all walks of life (social housing, single-family houses, public, commercial, private or residential buildings, etc.), most of whom did not know the concept of an intelligent energy system at all. They were thus able to become familiar with the newly developed technology and its effects on their own heating needs.

Impact

To deploy the Smart Electric Thermal Storage technology, the correct market conditions and infrastructure must be in place, for example, smart metering in domestic properties. Hence, it is important for public authorities to promote the use of these new technologies. For this reason, the project has also developed a list of recommendations to adapt the operating rules of the European energy market to better accommodate these promising innovations, which will bring benefits to consumers through better electricity tariffs.

Project Benefits

- Economic profit
- Improvement of the management of the grid
- Decrease of energy cost
- Reduction in CO2 emissions

The project yielded valuable results in terms of developing and refining the technical solution, gaining a deep understanding of how consumers interact with it, and identifying opportunities for commercial rollout. Indeed, Smart Electric Thermal Storage presents a great opportunity to make EU citizens energy use more efficient and cheaper.

Keywords: Smart Electric Thermal Storage Systems, Home heating, energy efficiency, consumer control.

More info at: www.realvalueproject.com

Note: Project Benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

Developing the electricity grid for a sustainable society

The Smart Grid Gotland project wants to make the most of Gotland's wind power production, with the help from consumers and smart grid technology.

In the past fifty years the way we produce and consume electricity has changed dramatically. European city population density has risen, increasing the energy consumption per subscriber and per square meter. The number of coal and nuclear power plants has been reduced while more and more renewable distributed energy sources – i.e. small production units, like household solar panels, have been developed allowing consumers to produce their own clean electricity. The grid which distributes the electricity towards consumers has to deal with these increased needs of the decentralised power production as well as with the increasing demand from the growing cities. The challenge across Europe therefore is to modernise the power grid, preferably without incurring massive extra costs on the consumers and users of the grid to make up for it.

Gotland – the perfect test ground for greener energy technology

Some 90 kilometres of Sweden's east coast we find Gotland, the largest Swedish island. Located in the middle of the Baltic sea, Gotland is characterised by beneficial conditions for wind power generation. Most of the wind power production is in the south, while the majority of Gotlanders live in Visby in the north. The variable character of wind power combined with grid capacity limits, means that Gotland is forced to limit further development of wind power in order to handle power quality issues and avoid that consumers experience power cuts. These challenges are not merely a Gotlandic issue but are becoming more common across the rest of Sweden as well, as the integration of renewable energy increases, and the electricity demand in Swedish cities rises. Gotland is therefore the perfect test site serving as a miniature of Sweden.

"Smart Grid Gotland" was a large-scale demonstration, research, and development project, managed by the local distribution grid operator, GEAB, Vattenfall, ABB, SvK (the Swedish transmission system operating authority), Schneider Electric and financed by the Swedish Energy Agency. The aim was to test grid management solutions, using smart grid technology, which could later be replicated in mainland Sweden.

How to smarten the electricity grid and make it fit for a sustainable society?

The project's smart grid technology makes it possible for the electricity grid operators to monitor the consumption and production of electricity on the island, in order to detect infrastructural hot spots and bottle necks in the system.

The aim of the Smart Grid Gotland project was to make the most of the island's renewable sources while maintaining or even improving the power quality by use of smart grid technology. To this end, the project consisted of three main objectives:

- **Increasing the capacity for renewable energy by use of the existing network.** The intention was to reach this without costly infrastructure investments, such as a

new sub-sea cable from mainland Sweden. Hence, the project planned to adjust the consumption to the intermittent production as well as propose accurate and automatic algorithms for control of renewable power production plants. In addition, it aimed to increase the capacity to integrate micro production of renewable electricity, such as that from roof solar panels.

- **Improve the power quality on the Island.** By implementing the smart grid management system and smart meters while applying also a zone concept to the grid, the grid operators were able to rapidly detect and isolate faults affecting the electricity on the island. This combination of solutions thus made it possible to limit both the disturbance time and the number of affected costumers.
- **Test customer demand response program.** A central idea was to increase the grid flexibility and make better use of the renewable energy by involving the customer. Smart plugs installed in homes across the island would inform the grid operator about the consumption – and production in the case of a household with e.g. solar panels on the roof. This information together with data from other consumers and producers connected to the grid, is used by the operator to forecast potential flow bottlenecks and take reactive measures. The consumers participated in the project by testing the technical solutions - a mobile app which gave, via dynamic price signals, incentives to adjust their consumption.

Impact

The results from the Smart Grid Gotland project contribute to the growing body of knowledge on the design and development of future smart grids.

The project showed that it is possible to make better use of renewable energy by incentivizing consumers to lower their energy consumption at times of limited renewable production. The consumers who participated in the project had a positive experience and did not suffer any deterioration of their comfort from the consumption adjustment.

Project Benefits

- Improvement of the management of the grid
- Decreased carbon emission
- Decreased Network costs
- Reduced energy bills

With regards to the power quality, the results were also positive, with a 20 % improvement of outage statistics while minimizing the environmental impact and presenting several cost-efficient solutions. Moreover, the control algorithm for renewable power production plants proved to work in a satisfactory way and led to a decrease in power spillage (waste), during distribution grid down times.

Keywords: Smart Grids, Wind Power, Customer participation

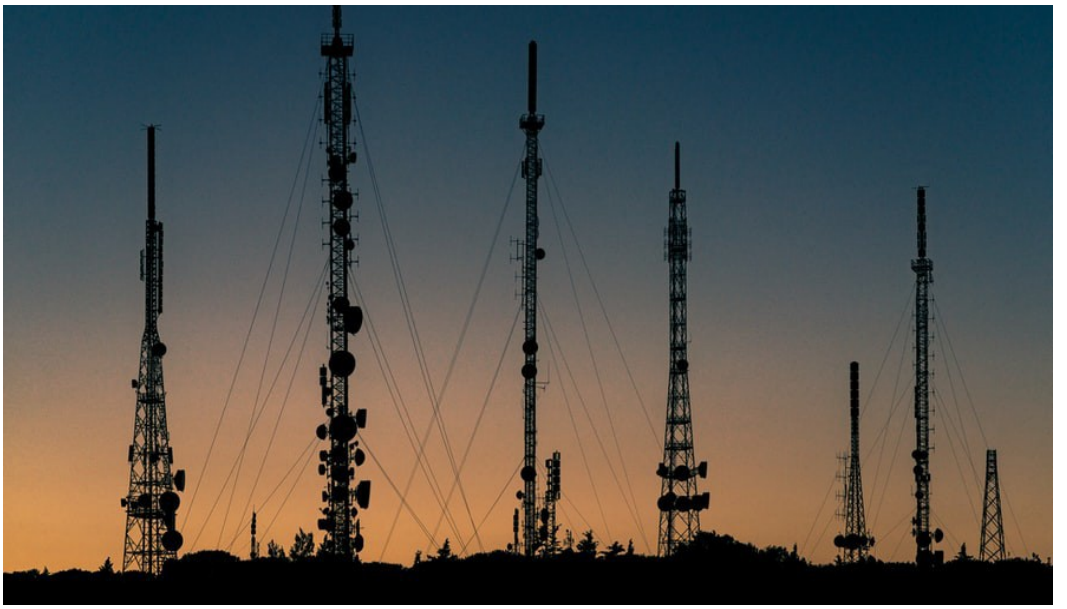
More info at: http://www.smartgridgotland.se

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION



ENERGY STORY:

SmartNet project: Smart ways for a flexible energy system

Back-up batteries of telecommunication towers and smart ways of heating pools can provide much needed flexibility to the energy system in order to enable integration of more renewable energy sources.

The European electricity system is in transition. The traditional, centralized power generation scheme with controllable hydro, coal, gas or nuclear plants is in transition to a decentralized one, where sources of energy are much more scattered.

This trend brings the issue of energy storage into the scope, because consumers may want to use surplus energy generated by their photovoltaic rooftops on a sunny day at night for charging their electrical vehicles. Batteries and other types of energy storage can support the stability of power grids in the near future.

Although the rapidly growing usage of renewable sources is providing a way towards a much cleaner energy system, it brings new challenges too. As the output of these generation sources depend on the intensity of sunshine or the wind, they are hardly able to be controlled directly. However, due to the physical need to balance power at all times, the power system controls must be more flexible in order to allow the integration of solar, wind and other renewable energy generators.

Building new traditional types of large-scale power generators to keep the balance of the energy system would not get us closer to achieve carbon neutrality. Another way is to tap into those flexibility sources which can be provided by masses of smaller scale energy generators, electrical vehicles and energy storages of any kind.

Flexibility is everywhere

Flexibility source providers can be found in the most extraordinary places: for example, in the telecommunication sector. Within the frame of SmartNet project, it was demonstrated in Spain how radio towers of the mobile phone network operators could also play a role in balancing the energy supply and demand. The central back-up batteries of these towers have capacities that were able to store surplus electricity when demand was lower than production and feed it back to the system in times when demand increased, or the level of production dropped.

The experience brought positive results and the method is up-scalable, therefore it can be viable also on a larger geographical level. Only this one single service provider in the demonstration has the capacity of more than 250 megawatts of flexibility throughout Europe which is equivalent to the capacity of middle-sized gas-fired powerplants.

Another demonstration within the project was set up in Denmark where the heating of indoor pools of summer houses served as flexibility providers to the system. In this case, pool owners received periodic price signals; electricity was cheaper in those periods when the production was high, and more expensive, when there was a need from the system operator to lower demand.

The SmartNet project demonstrated that management of consumption could be mutually beneficial: providing new tools for balancing the system on one hand and saving money for the consumer on the other. According to the results of the demonstration in Denmark each of the 16 summer houses involved was able to save 1600 euros a year by using electricity for the pool at the right times.

The third demonstration of the project was set in Italy, where, through a newly developed telecommunication-based device, several hydro power plants in the Alpine region of the country were connected, thus being able to provide real-time information for distribution grid monitoring. In addition to that, these plants could play an important role to keep voltage and frequency of the grid stable.

The SmartNet project made progresses beyond this: it achieved a much further-looking aim, by deep-diving into the complexity of enabling all kinds of flexibility sources and their integration into the system. To achieve this, the system operators of high (transmission) and low (distribution) voltage levels must develop new ways of cooperation.

The main challenge here is to access these sources of flexibility for system operators on both levels to exploit their full potential. This means a new energy market which currently does not exist - to find the best structure and design for it was the focus of SmartNet project. Experts of the 24-party project consortium – led by the Italian public research center, RSE – examined four different schemes for cooperation between transmission and distribution system operators to determine which version would be the most beneficial for all parties.

Impact

By testing and analysing these coordination schemes in various scenarios, SmartNet project was able to form recommendations for how the system operators and consumers should work together, taking the most cost-effective option. Their contribution to the future regulation of energy markets will be very important to facilitate the energy transition in Europe.

Project Benefits

- Reduced energy bills
- Decreased carbon emissions
- Efficient business models & market design

Implementing these schemes will enable smaller scale electricity generators to provide flexibility services to the system, thus paving the way for them to enter the market. This way all three parties (transmission, distribution system operators and prosumer) can take advantage of a new approach, which results in reduced cost of operations and leads to reduced electricity and grid-use costs for consumers.

On a larger scale, this project support the easier integration and growth of renewable energy sources in the power generation mix and brings us closer to a carbon-neutral Europe by 2050 while the security of energy service stays as high as we are used to.

Keywords: renewable energy sources, flexibility, security of supply, prosumers

More info at: http://smartnet-project.eu/ + project video

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY

Measuring the impact of smart meters on consumers

The Smart Synergy Project was launched to pilot smart metering roll out and obtain practical experiences on operating the power grid both from the suppliers' and users' side.

In recent years, smart meters have become commonplace in homes and properties across Europe. By allowing energy consumers and suppliers to have immediate access to their consumption data, smart meters have proven to be a fundamental element of the energy transition and a necessity in the energy landscape of the future. Smart meters encourage and facilitate the active participation of the consumer in the energy retail market, which opens up unprecedented possibilities for consumers to directly control and manage their individual consumption patterns. In turn, this provides strong incentives for efficient energy use. For example, smart metering facilitates the penetration of energy from renewable sources into the grid, by allowing consumers – citizens and companies alike – to buy electricity at competitive prices. An increase in energy from renewable sources in the grid leads to a decrease in price and smooths out peaks in the energy consumption.

In its EU 2020 Strategy, the European Union included the development of smart grids and the dissemination of smart meters as a vital element of the energy transition. With more EU policies emphasizing the urgency of this technology, the challenges to be addressed become apparent.

Understanding what it takes to make smart meters attractive

Integrating smart meters in today's energy system is far from easy. Aspects to be taken into account range from technical challenges, like the definition of common standards, over regulatory questions, such as data protection, to social ones, such as consumer acceptance and behavioural changes. This is why a consortium of Hungarian energy suppliers started a pilot project in 2012 to bring smart-metering technology into the market while paying attention specifically to its uptake by consumers. These meters are still producing data today and provide a detailed, long-term insight into the challenges.

The Smart Synergy project installed smart meters in Hungary with the aim of bringing smart-metering technology to the market that combined technical functionalities with real-time information tools and support services that make the active participation of users as easy as possible. The acceptance of the new tool by the consumers is crucial, so a media campaign has been accompanying the project.

A total of 3,000 electricity meters were installed in different types of households. The data collected during the metering period were complemented by a consumer web portal and survey, which analysed, for example, consumer behaviour and public awareness of

smart meters. For example, this helped the project partners analyse when electricity was used in the households, how keen participants were to use multi-media devices to monitor their energy consumption, whether they used ventilation and air-conditioning, and the daytime and night-time use of electricity. It was shown that 56% of respondents are willing to restructure their electricity consumption patterns, provided that they saved 3-5 €/month – so apparently, small savings are already an incentive. The respondents who are willing to embrace the new technology can mostly be identified as: big businesses, people living in rural areas, the young generation and people with higher education levels. On the other hand, 42% of respondents remained indifferent or reluctant and can be mostly identified as: the elderly population, people living in Budapest, small businesses and people with lower education attainment.

Impact:

The Smart Synergy project was able to contribute to investigating the main challenges surrounding smart metering. In essence, the project analysed the attitude of consumers towards smart metering, examining the technological possibilities of multi-utility smart metering, and defining possible business models for smart metering. This goes together with the overall objective to learn more about the acceptance of this technology by the consumers and tailor it to their needs.

Project Benefits

- Improved social acceptance
- Reduced energy bills

The metering period is ongoing and reinforced by SET-UP, a European-level project co-financed by the Interreg Europe Programme that builds on the findings of the Smart Synergy project. Through cooperation of eight regions across Europe, this project aims to improve regional energy policies by analysing common challenges, exchanging good practices and defining efficient actions.

Keywords: Smart grid, energy retail market, consumer attitude.

More info at: website + SET-UP project

Note: Project Benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

TILOS: Independent smart energy islands

Coupling energy storage and renewable energies for enhanced grid resilience against blackouts on Islands

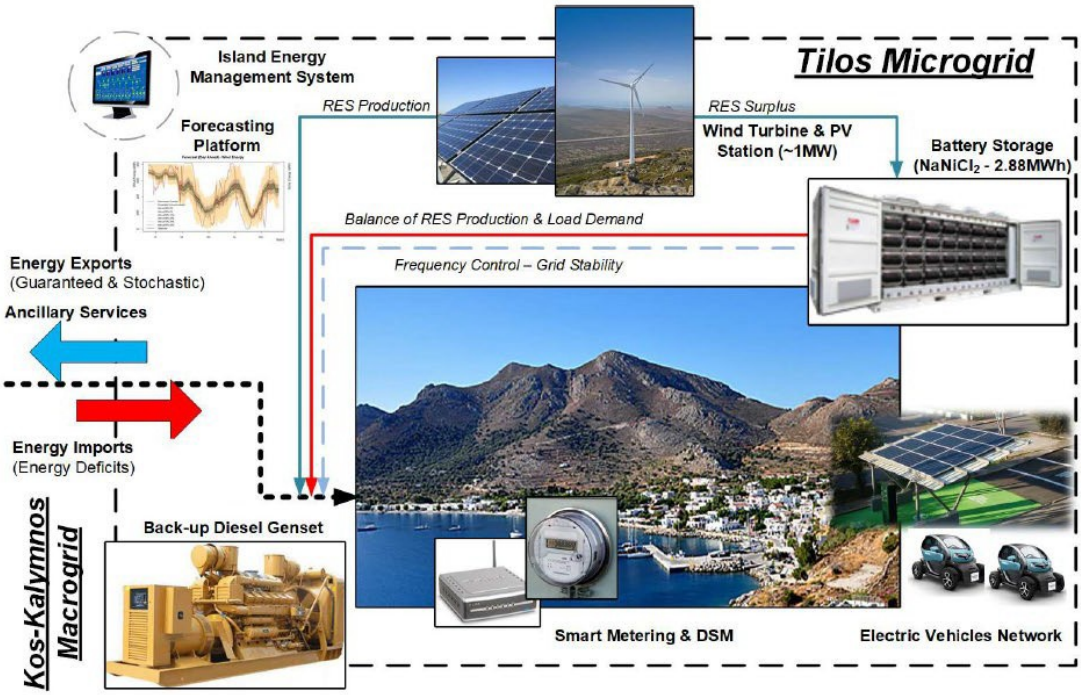
Even though human beings have overcome many of the impacts of geographical distance thanks to ever more advanced and efficient information and communication technologies, transport systems and energy supply infrastructures, we have not yet found a seamless, low-cost way to connect the electricity systems of islands which are separated by water. Connecting islands by putting cables on the seabed is possible but very expensive, especially at long distances. There is no wireless solution in sight "beaming" electricity from one island to the next. For these reasons enabling islands to balance at every moment their total electricity generation and total electricity demand, at an affordable cost for the electricity users of the island and by using volatile, renewable energy sources is a big operational challenge. However, the rapidly decreasing costs of renewable energies can now allow islands to use sustainable energy generation even in remote island areas, without the need of being connected by expensive high voltage cables. The namesake of the TILOS project, and the island Tilos, have vowed to make this dream of energy independence initially for parts of the islands and eventually for the whole island a reality.

How to connect to the future without depending on others?

The Greek island Tilos is located to the North West of Rhodes Island, with high mountains, steep coasts, beaches with clear waters and caves. Up till now, the local population of Tilos of about 500 islanders has covered its electricity needs through an undersea cable interconnection to the island of Kos, where a diesel-oil power station is operated. Extreme weather events and damages or faults of the undersea cable mean that Tilos suffers from quite frequent and in many cases long-lasting electricity blackouts.

The TILOS project aspired to make this small and remote island of Tilos the first global role model for a smart microgrid facilitating increased participation of renewable energy sources under the optimum exploitation of energy storage assets. Besides Tilos, the islands Pellworm in Germany, La Graciosa in Spain, and Corsica in France also took part in the project. The project's main goal was to demonstrate the potential of local / small-scale battery storage to serve a multi-purpose role within an island microgrid that – in a first step - also interacts with the main electricity network which connects some nearby islands. Among others, the project aims to achieve growth of renewable energy sources and asset value maximization through the optimum integration of a combined wind and solar renewable energy source power station. The project also covers advanced battery storage and demand side management approaches to find the most suitable time during each day when to increase consumption during low energy pricing and when to reduce consumption in peak energy intervals with usually high energy pricing. Technologies such as residential heat storage in the form of domestic hot water and smart metering enable end users to be self-sufficient and maximising the efficiency of their own energy resources. The active participation of citizens and the public engagement in the project also foster novel business models and schemes between the private and the public sector and improve the social welfare produced by the operation

of novel micro grid schemes. TILOS project aims to encourage increased levels of public engagement that will facilitate the implementation of the proposed energy solution.



Impact

TILOS Project is providing innovative ways for a resilient provision of local, renewable electricity without interruptions for consumers. As a consequence, investments in the main grid infrastructure can be deferred and postponed, lowering consumer costs, and facilitating the maintenance of expensive sea cables. The TILOS Project combined renewables, battery storage and a smart distribution grid for secure energy provision while avoiding blackouts. It has demonstrated a solution that is scalable and diminishes high oil import costs for the electricity generation by the non-sustainable diesel-oil generators which affect island inhabitants and tourists negatively. The project has shown that communal programs can make battery storage integrated with local, renewable energies a workable reality and a way forward to address sustainable energy security for islands.

Project Benefits

- decreased carbon emissions
- improved network management
- Efficient business models

Keywords: Energy Island; Smart Energy Microgrid; Flexibility; Energy Storage.

More info at: https://www.tiloshorizon.eu/

Note: Project benefits based on specific criteria outlined in ETIP SNET Monitoring Report

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

Storing sunshine

The Underground Sun Storage project uses renewable hydrogen to integrate wind and solar energy

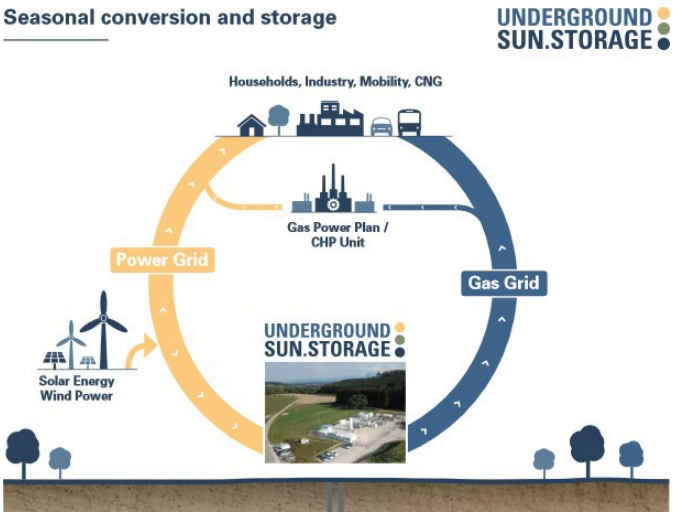
In the last years, the rapid decline in the cost of renewable power generation technologies has allowed the electricity sector to make substantial progress towards decarbonisation. Since the electricity grid cannot store energy, the operators have to adjust generation precisely to demand. All this has shed light on the significant potential, and the crucial importance, of energy storage to facilitate deep decarbonisation.

Different technologies answer different needs. Today, pumped hydro storage, hydrogen and battery storage are the most used technologies to balance supply and demand and provide more stability to the power grid. On the other hand, some solutions are needed to store energy during a long period of time. So, what if another innovative, promising solution to this issue is on the way?

An innovative underground energy storage technology

RAG Austria AG is Austria's largest gas storage company and one of Europe's leading gas storage facility operators. Its core business being gas storage, the company is using its expertise for the development of new energy technologies towards a sustainable and affordable future energy system.

Underground Sun Storage is a pilot project carried on by RAG and co-financed by Austria's Climate and Energy Fund. The project catches on the **power to gas technology**, which enables the conversion of electricity to hydrogen, which is then stored in the natural gas network. One aim of the project is to understand if hydrogen is tolerated by the underground gas storage infrastructure and if it can be used as a means for inter-seasonal energy storage in the existing infrastructure.



The project is being trialled at a small depleted gas reservoir based in Pilsbach, Austria. Within the project, laboratory experiments, simulations and a field trial are conducted by RAG, together with risk assessments, and an analysis of the legal and economic environment. Simulation tools are developed to investigate the feasibility of the project in many other facilities around the world. So far, the tests have given promising results. Further demonstrations and experiments need to be done, but the ambition of the company is to use the technology on a large scale.

Impact

The success of the project lies in the ground-breaking possibilities of an idea that could significantly impact the European storage possibilities. With their incredibly vast capacity, naturally formed gas storage reservoirs can have a huge bearing on the energy system of the future. All this without requiring **any change in the consumers' behaviour**.

Project Benefits

- Renewable energy becomes storable
- Sustainable use of existing infrastructure
- Potential for renewable gas generation

The project can be highly valuable to decision makers and public authorities. The deployment of underground sun storage would allow for a sustainable use of gas infrastructure, providing a precious means of large-scale storage for renewable energy using existing facilities.

With the Underground Sun Storage, a synergy of storing and generating renewable gas has been found. But even more is yet to come: the flagship project Underground Sun Conversion is being carried on by RAG in the same Austrian facility**. Think about this: how would it feel to turn on your gas stove and know it is being fuelled by clean energy?** In fact, the aim of the flagship project is not only to store renewable energy but also to convert renewable energy to renewable synthetic gas (methane). The hydrogen is injected together with carbon dioxide into an existing natural gas reservoir, where naturally occurring microbes generate readily available gas. This renewable green gas can be stored in the same reservoir and will be distributed to the consumers through the existing gas pipeline infrastructure, providing renewable energy all year round. The tests for the creation of this sustainable carbon cycle will continue until 2021.

To achieve a substantial reduction of carbon emissions and undertake an efficient path towards decarbonisation, storing renewable energy is a pivotal step. Finding innovative, efficient ways to do it by implementing already existing technologies and infrastructure could be a significant step forward toward a carbon neutral energy system.

Keywords: Power-to-gas, Energy storage, Hydrogen

More info at: Underground Sun Conversion

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

ENERGY STORY:

WiseGRID: defining energy democracy

The WiseGRID project supports energy communities and small energy generators in a successful energy transition towards distributed, sustainable energy systems and offers tools and practices for a more sustainable pattern of energy consumption.

Traditionally, energy has been generated in big power plants, far away from the households where it would finally be consumed. In recent years, the rapid development of renewable power generation has unlocked a change to this one-way street from power generation to the consumption. With technologies such as solar power panels, battery storage and electric vehicles, citizens have the chance to take part in the energy transition and build a clean and sustainable environment together with Pan-European market players. The WiseGRID project was setup to address the question of how each individual can participate in the energy market with fair conditions to be treated as equals among the actors of the energy market.

Contributing effectively to the transition to energy democracy

The WiseGRID project engages public authorities and citizens through a set of solutions, technologies and business models which increase the smartness, stability and security of an open, consumer-centric European energy system that ultimately empowers consumers. More specifically, the project developed 9 different tools, each concentrating on optimising specific technology.

With the **WiseCOOP** tool consumers and local communities can achieve better energy deals without confusing paperwork and bureaucratic hurdles. It provides an easy access through new innovations to a wider group. One example is Virtual Power Plants (VPP) which coordinate the data of several small power generators like rooftop solar panels through the internet to make them as powerful as traditional power plants whose generation data is usually coordinated by TSOs.

WiseCORP enables citizens to analyse their energy usage and supports the increase of self-consumption, to become an active and smarter energy player through the integration of sensors, device interoperability, energy tariffs, demand forecasts and the optimisation of asset sizes and types to reduce investment costs and environmental impact.

WiseHOME is similar to WiseCORP but adapted to individual domestic consumers and prosumers allowing them to become active energy players. Houseowners can monitor their consumption and production in real time, which helps them to adjust their behaviour to the current grid tariffs and traded energy prices to reduce the energy billing. This reduction of costs is supported by alerts, tips and price information provided by the application tools and ends up in optimally controlled smart consumer devices such as electric vehicle charging points, batteries, water heating and solar panels.

WiseEVP and Vehicle to grid (V2G): These tools support electromobility and benefit consumers in providing a good solution for increasing the use of electric cars. The tools inform the users which car should be charged next depending on the current offered energy source or which car battery is charged enough and ready to be used. The aim is that every electric vehicle is fully charged through renewable energies, decreasing related GHG emissions and the number of cars

with low battery charge in the fleet. The citizens can share electrical vehicles via apps and participate in the energy community redesign of their neighbourhood.

WGSTAAS/VPP is a tool for energy storage. This tool allows the consumers/prosumers to easily offer their unused storage capacity to the larger market. In addition, a complementary service will allow consumers/prosumers to easily combine their individually small PV energy generation capacities and offer them to the market in the form of an aggregated, large Virtual Power Plant (VPP) to have a competitive total power generation product offer on the market.

WG IOP and WGCOCKPIT are tools which support Distribution System Operators by providing IT interoperability and increased monitoring capabilities thanks to digitalisation, enabling improved customer service.

The project was run with 5 real life demonstrations - in Belgium, Italy, Spain, and Greece - under different technical, climatological, regulatory, legislative, and social conditions. The demonstration sites finally involved more than 1700 users, 700 equipped with new smart meters and applications, 23 various batteries types totalling more than 200kWh of installed capacity, 50 heat pumps, 72 electrical vehicles, 12 charging stations, 2 CHP units and various renewable energy sources such as Hydro power in Terni, wind turbines in Ghent and a wide deployment of solar panels through all demo sites.

Impact

The project successfully demonstrated how easy local communities, small business and even individual citizens can take active part on a democratic energy market. This active participation of citizens for the energy system of the future can be achieved through the coordinated collaboration of a larger number of small partners. WiseGRID has set the path for future projects involving consumer engagement by contributing valuable information for developing policy guidelines on sustainable citizen-driven energy communities.

Project Benefits

- Improved network management
- Decrease carbon emissions
- Reduced Energy Bill
- Improved Social Acceptance

Energy communities will give the possibility to sell self-generated energy inside the neighbourhood, without major interference from grid operators or marketplaces. WiseGRID is paving the way for improved services and attention to the customers of the DSO's, developing scalable innovative methodologies which secure the transfer of the solutions all over Europe.

Keywords: Energy communities, Energy storage, EV, smart meters, RES

More info at: http://www.wisegrid.eu/

Note: Project benefits based on specific criteria outlined in ETIP SNET monitoring exercise

ETIP SNET

EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM

SMART NETWORKS FOR ENERGY TRANSITION

This publication has been developed in the frame of the INTENSYS4EU project, funded by the European Union's Horizon 2020 Research and Innovation Programme under grant agreement N° 731220.

www.etip-snet.eu

PLAN. INNOVATE. ENGAGE.