



SUPPORTING INNOVATIVE SOLUTIONS FOR **SMART GRIDS AND STORAGE**

Horizon 2020

Project Examples



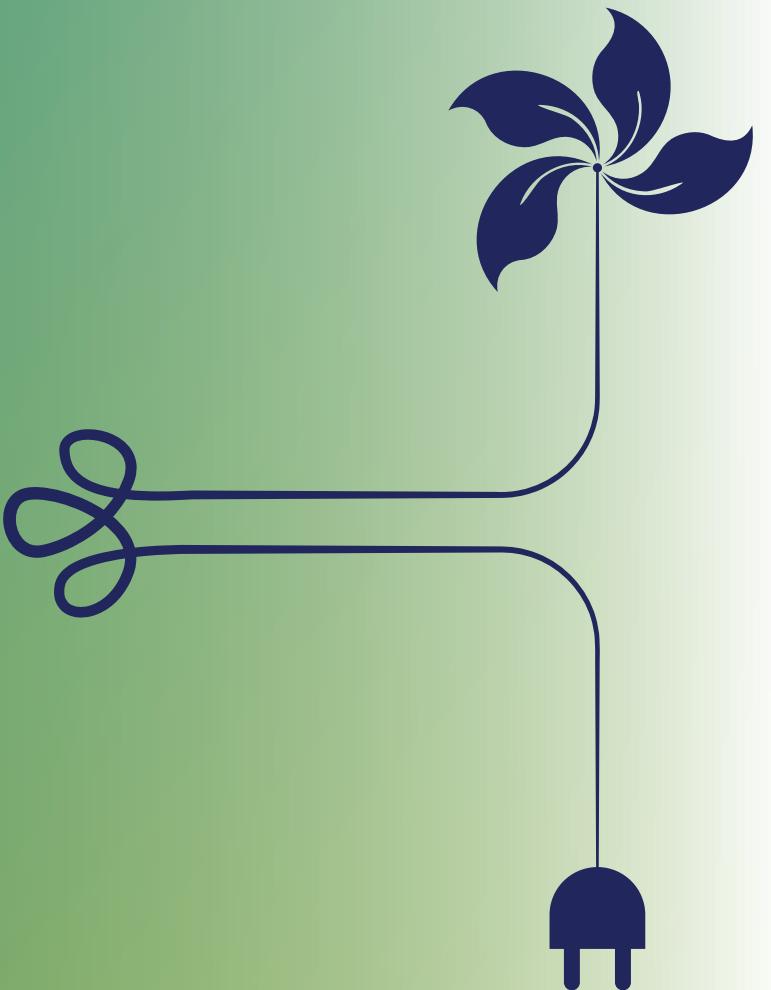
Innovation
and Networks
Executive Agency

October 2019

INEA

Innovation and Networks Executive Agency

Making implementation happen



Funding R&I projects for cleaner and more sustainable energy and transport

INEA, the Innovation and Networks Executive Agency, is responsible for managing parts of the energy and transport research funded by the European Union's Horizon 2020 programme. The Agency supports the European Commission in selecting and funding projects in the areas of secure, clean and efficient energy, and smart, green and integrated transport. Around €5.3 billion of EU funding is available to support projects in these fields from 2014 to 2020, of which €3 billion has been earmarked for funding R&I initiatives in the field of energy and €2.3 billion for transport.

The Energy Challenge

The Energy Challenge of Horizon 2020 is designed to support the transition to a reliable, sustainable and competitive energy system by overcoming a number of challenges, such as increasingly scarce resources, growing energy needs and climate change. It is structured around seven specific objectives and research areas:

- Reducing energy consumption and carbon footprint
- Low-cost, low-carbon electricity supply
- Alternative fuels and mobile energy sources
- A single, smart European electricity grid
- New knowledge and technologies
- Robust decision making and public engagement
- Market uptake of energy and ICT innovation

SUPPORTING SMART GRIDS AND STORAGE PROJECTS

Electricity is at the centre of the EU energy system. Smarter and better connected distribution and transmission grids, as well as increased storage support the movement towards an integrated energy system.

In its Horizon 2020 energy portfolio, INEA manages **354 energy systems projects¹**.



Since 2014 the EU has invested **€2.47 billion** in these projects.



2680 organisations from 65 countries take part in the projects, including technology providers, R&I bodies, regulated operators, electricity market players, local energy communities and consumers.



Electricity generation, energy markets and ancillary services are all **covered** by the projects.



The **BRIDGE initiative²** unites the Horizon 2020 smart grids and storage projects. It fosters the exchange of information, experience, knowledge and best practices among them.



This brochure presents examples of EU's Horizon 2020 projects.

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CAPTURE

FULLY DISPATCHABLE SOLAR POWER GENERATION – THE CAPTURE SOLAR-POWERED COMBINED-CYCLE

At the moment, we are right at the beginning of the age of renewable energies. The large-scale application of renewable energy technologies (Solar, Wind) will change the energy sector dramatically. With an ever increasing share of renewable energy technologies that are, for the most part, not dispatchable, cost effective energy storage solutions are the most promising opportunity for the coming years. The biggest threat that can be seen at the moment is the fact that current power grids are not yet prepared for high shares of variable renewable energy. Grid stability issues become more and more a real threat. The promoting of dispatchable renewable energy technologies like Concentrated Solar Power (CSP), with cheap large-scale thermal energy storage (TES) is one promising solution.

The main objective of the CAPTURE project is to significantly reduce costs of CSP, in order to pave the way for its competitiveness on the power market. Specifically, the solar-to-electric conversion efficiency of the plant will be maximized by increased receiver operating temperatures ($\approx 1000^{\circ}\text{C}$) as well as an innovative power cycle configuration. The global objective of the CAPTURE project is to increase plant efficiencies and reduce levelized cost of electricity (LCOE) by developing all relevant components that allow implementing an innovative plant configuration (see Figure 1). It applies the open volumetric air receiver technology, high-temperature thermocline, packed-bed TES

and the CAPTURE regenerative system coupling the high-temperature atmospheric air stream with the pressurized air loop of the topping Brayton cycle. The preliminary results of an extensive parametric optimization study show that a multi-tower (6 towers, 306 MW nominal solar thermal power) configuration is the techno-economic optimum power plant configuration. The innovative combined cycle plant configuration reaches an LCOE of 12.4

PROJECT DETAILS

Project full title	Competitive SolAr Power Towers – CAPTURE
Total funding	€6,461,970
EU contribution	€6,104,033
Duration	01/05/2015 - 30/04/2020
Website	http://capture-solar-energy.eu/

c\$/kWh, which represents a highly competitive solution taking into account the great value of fully dispatchable renewable energy generation for tomorrow's power grid with very high shares of non-dispatchable renewables.



COMPILE

INTEGRATING COMMUNITY POWER IN ENERGY ISLANDS

COMPILE focuses on showing the benefits of cooperation through energy communities that will solve current grid problems in a coordinated way, avoiding costly network reinforcement while leading to an increased Renewable Energy Sources (RES) share.

COMPILE aims to activate and use local energy systems to support the fast growth of energy production from variable RES in constrained networks, fostering the transition from a centralized system with passive users into a flexible network of active users featuring energy communities.

COMPILE is uniting the efforts of communities of active consumers, market actors and DSOs since increasing decentralization needs more consumer engagement and participation.

The project aims to better understand the way emerging decentralized solutions and the existing centralized infrastructures operate together in an economically efficient way. The pilot cases test different approaches to coordination of consumers, technology and business models, having different “starting points”: technologies, organizational levels, community sizes, composition (industry/houses/retail), and national regulatory perspectives, yet sharing a high replicability potential. Our vision is an interplay between flexible energy community-

supported networks and the current centralized system, increasing societal benefits with optimized planning. Cooperation with international partners in India and China will ensure worldwide robustness of COMPILE solutions.

PROJECT DETAILS

Project full title	Integrating community power in energy islands
Total funding	€6,933,605
EU contribution	€5,431,906
Duration	01/11/2018 - 30/04/2022
Website	https://www.compile-project.eu/

© COMPILE



DSOs-TSOs COORDINATION TOWARDS RELIABLE AND EFFICIENT GRID SERVICES

The CoordiNet project aims at demonstrating how Distribution System Operators (DSO) and Transmission System Operators (TSO) can act in a coordinated manner to procure and activate grid services in the most reliable and efficient way. The CoordiNet project's main objectives are:

1. To demonstrate to what extent coordination between TSO/DSO will lead to a cheaper, more reliable and more environmentally friendly electricity supply.
2. To define and test a set of standardized products and services, including reservation, activation and settlement processes.
3. To specify and develop a TSO-DSO-Consumers platform which will pave the way for the interoperable development of a pan-European market that will allow all market participants to provide energy services and open up new revenue streams for consumers providing grid services.

In total, eight demonstration activities will be carried out in Greece, Spain, and Sweden. In each demonstration activity, different products will be tested, in different timeframes and relying on the provision of flexibility by different types of resources.

The goal of the project is to identify (standardized) products, grid services, and coordination schemes to incorporate them into the future CoordiNet platform for the realization of the planned demonstration activities.

PROJECT DETAILS

Project full title

Large scale campaigns to demonstrate how TSO-DSO shall act in a coordinated manner to procure grid services in the most reliable and efficient way

Total funding

€19,191,479

EU contribution

€15,077,588

Duration

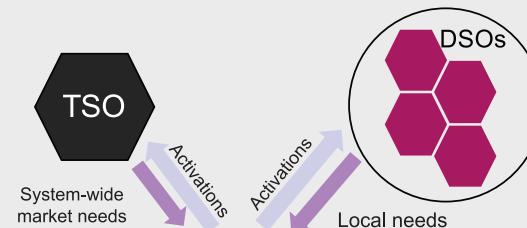
01/01/2019 - 30/06/2022

Website

<https://coordinet-project.eu/>



Ongoing work to unlock the potential for flexibility



Flexibility Platforms
Interface with DSO/TSO systems,
data requirements, algorithms for
market clearing, demand and
generation forecasting

BIDS $\uparrow\downarrow$ ACTIVATIONS

consumers,
prosumers,
aggregators, storage
and generators

Identification of the most valuable coordination schemes
Different ways of organizing the coordination between system operators. Each coordination scheme is characterized by roles detailed market design

Grid services
▪ Type of service: Balancing, congestion, voltage control...
▪ Timeframe: Day ahead, Intra Day and real time
▪ Type of customers providing the service

Tentative list of standardized products by service providers
▪ Frequency Containment Reserves (FCR)
▪ Automatic Frequency Restoration Reserves (aFRR)
▪ Steady State Reactive Power
▪ Congestion Management Product

Bottom-up approach

Definition and test of «standard» products and services can affect the assessment of the most valuable coordination schemes

CROSSBOW

CLEAN ENERGY ACROSS EUROPE

CROSSBOW, a transmission system operators (TSOs) driven project, develops 9 tools that enable and increase the shared use of resources to foster cross-border management of variable renewable energies and storage units, providing a higher penetration of clean energies whilst reducing network operational costs.

The objective is to demonstrate several different and complementary technologies, offering TSOs higher flexibility and robustness through:

- better control of exchange power at interconnection points;
- new storage solutions (distributed and centralized) offering ancillary services to operate Virtual Storage Plants;
- better ICT communications - e.g. better network observability, enabling flexible generation and Demand Response schemes;
- the definition of a transnational wholesale market, proposing fair and sustainable remuneration for renewables through the definition of new business models.

The results are evaluated by 8 TSOs in South Eastern Europe, grouped to form clusters that validate each outcome in at least three different countries, demonstrating how CROSSBOW tackles

the transnational challenges faced by the region.

CROSSBOW products and services will contribute to create thousands of jobs, provide better quality energy services for millions of citizens, reduce greenhouse gas emissions by 3 Million tonnes and increase the renewables in the energy mix by 10%.

PROJECT DETAILS

Project full title

CROSS BOrder management of variable renewable energies and storage units enabling a transnational wholesale market

Total funding

€21,970,065

EU contribution

€17,287,743

Duration

01/11/2017 - 31/10/2021

Website

<http://crossbowproject.eu/>

© CROSSBOW



DOMINOES

DYNAMIC AND ACTIVE MANAGEMENT OF GRID BALANCE BY DSOs IN THE FUTURE ENERGY SYSTEM

The DOMINOES project aims to lower the entry barriers to the European energy system for distributed resources and flexibility capabilities. The project focuses on the creation and development of new demand response, aggregation, grid management and peer-to-peer trading service capabilities. For this purpose, DOMINOES is designing, developing and validating a transparent and scalable local energy market structure with enabling ICT components and processes. The project also proposes and evaluates six new local market business models.

DOMINOES will show how distribution system operators (DSOs) can dynamically and actively manage grid balancing in the future energy system, with a high share of energy independent communities, micro grids and ultradistributed energy generation.

The project hopes to raise the value of local flexibility by proposing new venues for flexibility use: resources will no longer have to be put on reserve if not used, but can be used on a dynamic basis when most needed. All stakeholders can benefit from this solution, therefore minimising overinvestment in infrastructure.

DOMINOES will also validate its concept at three demonstration sites: a DSO environment in Évora (Portugal), a virtual power plant (Portugal), and a microgrid site in Lappeenranta (Finland).

PROJECT DETAILS

Project full title

Smart Distribution Grid: a Market Driven Approach for the Next Generation of Advanced Operation Models and Services

Total funding

€3,996,125

EU contribution

€3,996,125

Duration

01/10/2017 - 31/03/2021

Website

<http://dominoesproject.eu/>



ELECTRIFIC

BETTER USER EXPERIENCE FOR E-VEHICLES

The ELECTRIFIC project focused on aspects of e-vehicles (EV) such as their attractiveness, social acceptance, and pressure on the power grid. Its goal was to improve driving and charging experience for EV users. The concept included coordinated charging of multiple EVs, predicting energy consumption and power demand from e-mobility and monitoring their impact on the power quality in the grid. At the same time, ELECTRIFIC aimed to maximise the share of local renewable energy when charging EVs.

To achieve these objectives, ELECTRIFIC facilitated the collaboration between various actors in the e-mobility ecosystem. It also provided them with three different software components. An advanced driver assistance system (ADAS) helped EV drivers to better plan charging and navigate their trips. A smart charger adjusted the charging capacity of each charging station, considering the power grid's needs. Finally, a charging scheduler optimised the charging of EV fleets, also taking battery-friendly charging into account.

As a complement, ELECTRIFIC analysed user profiling variables and investigates which kind of incentives could foster users' behaviour towards a more sustainable mobility. The evaluation of these strategies, as well as testing of technical solutions, take place in Barcelona (Spain), Bavaria (Germany) and the National Park Šumava (Czech Republic).

The project developed novel technologies for enabling seamless and sustainable electro-mobility services through smart vehicle-grid integration

These solutions are expected to make the use of EVs more convenient and attractive, while optimizing the grid and the EV infrastructure utilization.

PROJECT DETAILS

Project full title

Enabling seamless electromobility through smart vehicle-grid integration

Total funding

€6,152,119

EU contribution

€6,152,118

Duration

01/09/2016 - 31/08/2019

Website

<http://electrific.eu/>

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DEMAND RESPONSE FOR ENERGY COOPERATIVES

As Europe's energy system is shifting to more and more renewables, flexible resources are becoming fundamental. Residential end-users represent a massive potential for flexibility and are key to make the energy transition happen. FLEXCoop equips energy cooperatives with innovative tools to exploit pro/consumer flexibility as dynamic Virtual Power Plants (VPPs) providing the required resources to maintain grid stability in a RES-dominated energy system.

FLEXCoop brings together a range of baseline technologies to build an open Demand Response optimisation framework including a fully-fledged tool suite for energy cooperatives and prosumers involved in the Demand Response value chain. FLEXCoop is an end-to-end interoperable solution built around a market place which enables the information to flow from households to the aggregator who can best valorise the flexibility in a non-discriminative manner.

FLEXCoop aims at realising new business models for citizen energy communities that enable them to become aggregators and valorise the prosumer resources either for their own benefit (self-consumption maximisation) or for grid services. FLEXCoop acts towards residential energy consumer empowerment and their transformation into active market players, providing them access to new

revenue streams and opportunities to actively support the energy transition.

PROJECT DETAILS

Project full title

Democratizing energy markets through the introduction of innovative flexibility-based demand response tools and novel business and market models for energy cooperatives

Total funding

€3,979,190

EU contribution

€3,979,190

Duration

01/10/2017 - 30/09/2020

Website

<http://www.flexcoop.eu/>



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FutureFlow

DESIGNING E-TRADING SOLUTIONS FOR ELECTRICITY BALANCING AND REDISPATCHING IN EUROPE

Active energy consumers, such as commercial and industrial consumers, prosumers and distributed renewable generators, could become the guardians of the power system, contributing to balancing services of transmission system operators (TSOs). As a result, Europe's dependence on fossil fuels will be reduced and electricity prices could go down significantly. FutureFlow's goal is to smooth this transition by providing today's energy consumers with key elements to become active actors in the electricity market.

FutureFlow aims to accelerate the regional integration of balancing markets. It provides consumers and distributed generators with the infrastructure which enables them to offer flexible balancing and redispatching services. The goal is also to validate whether they are actually capable of providing services of the same quality as conventional actors.

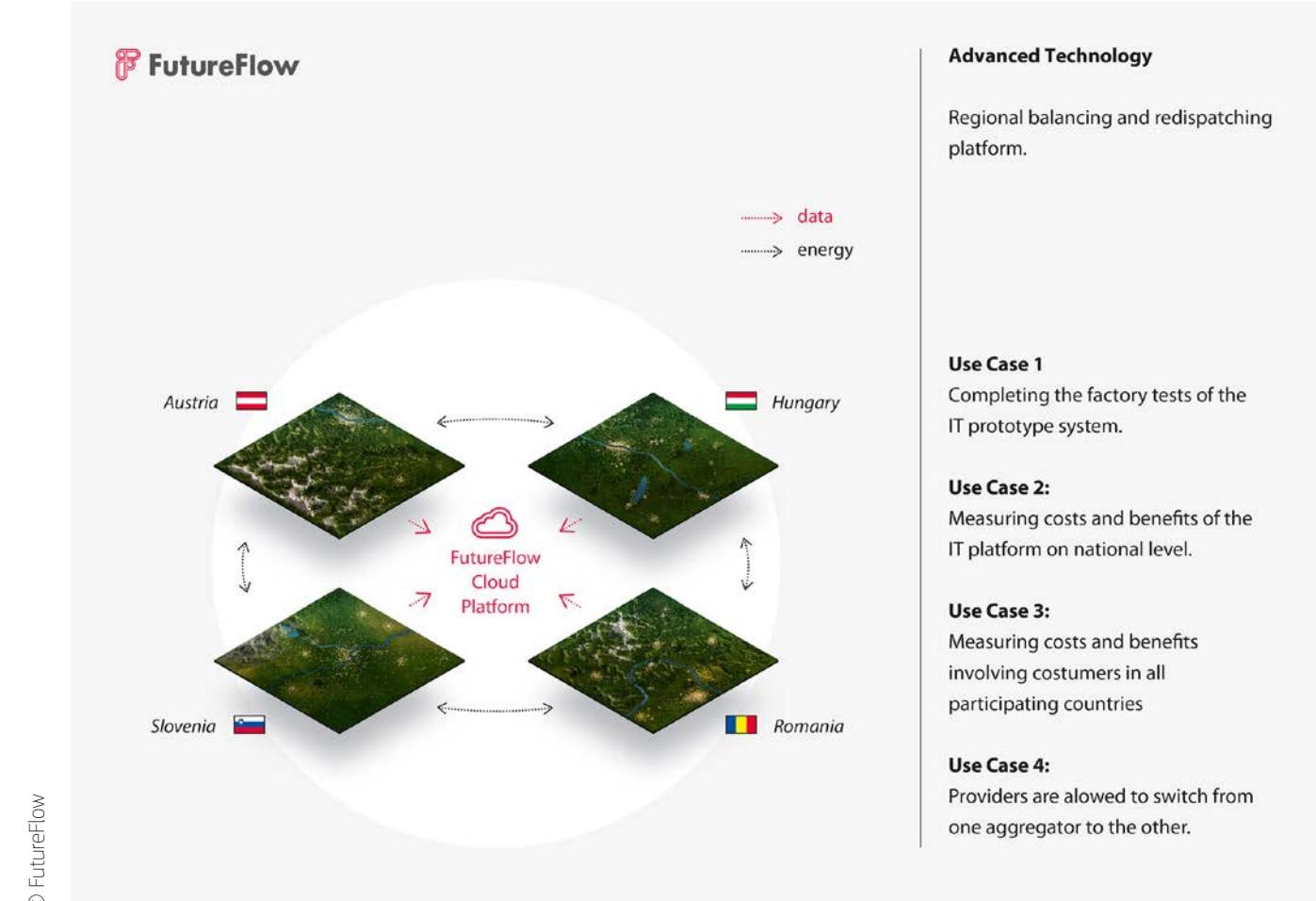
The project already delivered a number of innovative solutions. One of them is a method for selecting the automatic frequency restoration reserve (aFRR) target model based on real-time data in a multi-TSO regionally interconnected power system.

FutureFlow also provides information architecture solutions for real-time testing of distributed energy in a multi-TSO environment. Four demonstrations,

with a total capacity of 40 MW of distributed energy running in a second-to-second control loop, are under way in Austria, Hungary, Romania and Slovenia. A comprehensive list of recommendations coming from these tests is on its way.

PROJECT DETAILS

Project full title	Designing eTrading Solutions for Electricity Balancing and Redispatching in Europe
Total funding	€12,985,243
EU contribution	€12,985,243
Duration	01/01/2016 - 31/12/2019
Website	http://www.futureflow.eu/



GOFLEX

INTEGRATED SYSTEM FOR AUTOMATIC EXTRACTION, AGGREGATION, AND TRADING OF ENERGY FLEXIBILITY

The GOFLEX project developed a marketplace for distributed flexibility in energy systems with selectable cloud-based services and a unique way of collecting available flexibilities which are traded as flexibility offers (Flex-Offers). A modular system with automated dynamic pricing fits the needs of all market actors who want to smartly use, provide or trade flexibility as a service. Every Flex-Offer collected can be set up exactly depending on the owner's needs, e.g. energy aspects, times, repeats, etc. Artificial Intelligence-based algorithms aggregate small offers to relevant market size and disaggregate them to specific switching commands once they are activated.

The bottom-up approach with customers offering their flexibility on a local market has many advantages for the whole energy system as well as for the buyer and seller:

- the network load of the TSO is reduced;
- costs for balancing energy are reduced;
- DSOs as especially relevant stakeholders for GOFLEX can use flexibilities for congestion avoidance and balancing of the local grid;
- the energy system has a non-discriminatory solution process instead of curtailment;
- new customer needs like e-mobility, storage

or local energy communities can easily be integrated.

The GOFLEX system is being validated in three demonstration sites in Cyprus, Germany and Switzerland involving over 400 prosumers.

PROJECT DETAILS

Project full title	Generalized Operational FLEXibility for Integrating Renewables in the Distribution Grid
Total funding	€11,234,125
EU contribution	€6,826,393
Duration	01/11/2016 - 29/02/2020
Website	https://www.goflex-project.eu/

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GRIDSOL

SMART RENEWABLE HUBS FOR FLEXIBLE GENERATION

Renewable energy generation has increased significantly led by solar photovoltaics and wind energy, reaching economic competitiveness against conventional power plants. However, both renewable technologies are not dispatchable, which often require polluting power plants to ensure the security of supply and grid stability.

To address these flexibility needs, the GRIDSOL project presents a new concept to increase renewable energy penetration in a grid-friendly manner: "Smart Renewable Hub". A flexible hybrid power plant that combines primary Renewable Energy Sources (RES) and storage technologies under a Dynamic Output Manager of Energy that dispatches the electricity on a single output according to the availability and cost-effectiveness of each technology.

The Smart Renewable Hub combines non-synchronous generation (photo voltaic) with synchronous turbines (Concentrated Solar Power and biogas) and delivers an optimal configuration at each location. Every possible solution considers market and grid requirements, providing ancillary services and relieving pressure on the transmission system operators (TSOs).

In this context, GRIDSOL represents a major drive to integrate RES thanks to flexible generation. The project has demonstrated the adequacy of Smart Renewable Hubs for European Continental and Island grids in order to achieve a more secure, reliable and clean energy system.

PROJECT DETAILS

Project full title	Next generation technologies of renewable electricity and heating/cooling
Total funding	€3,421,447
EU contribution	€3,421,447
Duration	01/10/2016 – 30/11/2019
Website	http://www.gridsolproject.eu/

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CONSUMER-CENTERED APPROACH THROUGH CITIZENS ENERGY COMMUNITIES

IElectrix started in response to the growing need for creating innovative technical solutions and business models that facilitate the implementation of Citizens Energy Communities (CEC) and the integration of distributed Renewable Energy Sources (RES).

IElectrix contributes to the European ambition by adopting a consumer-centered approach and increasing its involvement, particularly through CEC. This project is also a way to accelerate the integration of RES into the distribution networks and the decarbonisation of the energy system. In this context, Distribution System Operators play an important role by ensuring the connection of RES within the grid and facilitating the energy transition.

To reach such goals, IElectrix brings forward innovative technical solutions:

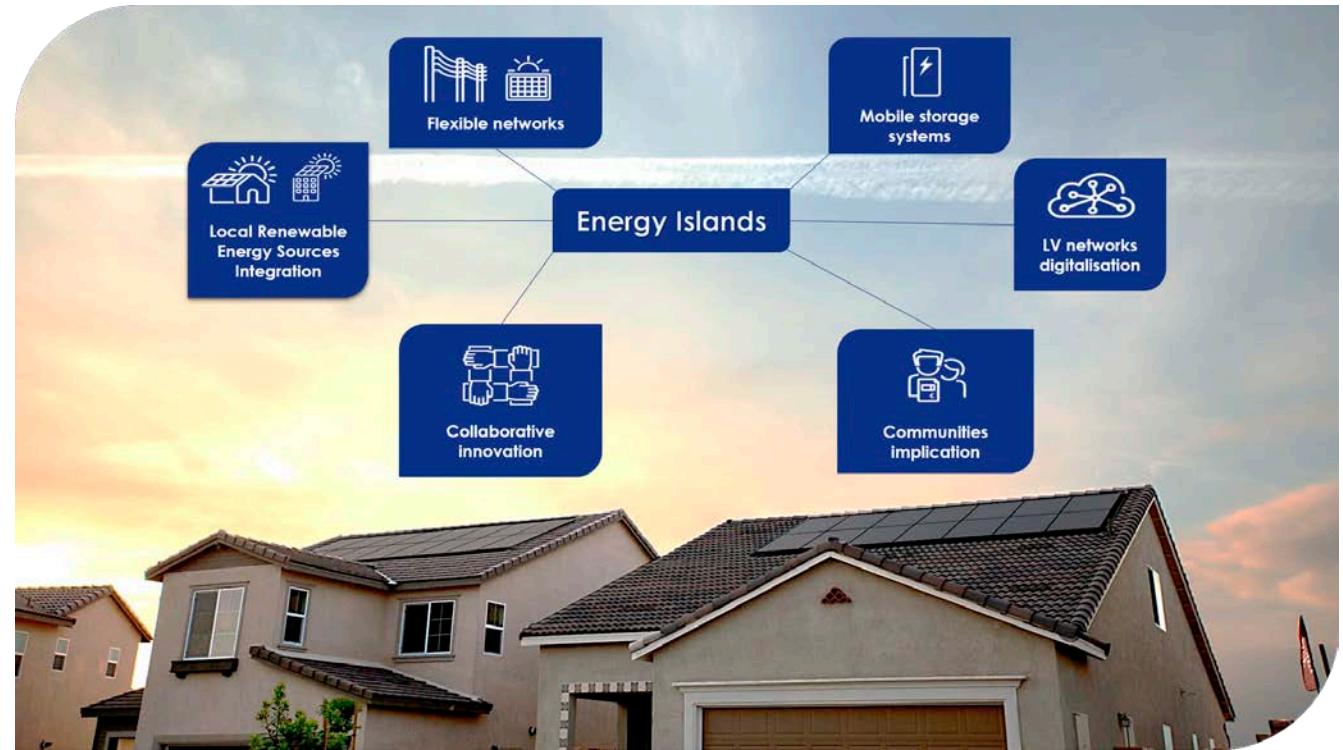
- mobile storage systems and smart substations;
- the implementation of demand-side management schemes;
- low voltage grid digitalisation.

The project brings together 15 European partners and one Indian partner in order to experiment, through 5 demonstrators, on the technical and economical relevance of CEC in different regulatory and system contexts. There will be two demonstration sites in Hungary, one in Austria, one in Germany and one in India.

PROJECT DETAILS

Project full title	Indian and European Local Energy Communities For Renewable Integration and the Energy Transition
Total funding	€10,000,000
EU contribution	€7,900,000
Duration	01/05/2019 – 31/10/2022
Website	N/A

© IElectrix



SMARTER GRIDS FOR SMARTER CITIZENS

InteGrid has the ambition to bridge the gap between citizens and technology providers such as utilities, aggregators and manufacturers. The project's main goal is to demonstrate innovative solutions for smart grids in three pillars:

- distribution grids flexibility;
- integration of residential and industrial consumers through energy management technology devices;
- a grid-market hub to connect consumers and grids.

The project has three demonstration locations. In Sweden, InteGrid is testing a tool that merges consumer feedback with Locallife social network, with a high focus on energy use and energy efficiency. The early results show that this combination is an effective tool to reduce consumption, especially during colder months.

In Slovenia, the focus is on commercial and industrial customers who also produce renewable energy. InteGrid is analyzing the interactions of a local distribution system operator (DSO) with its energy storage in a fully functional Virtual Power Plant environment, while also monitoring e-vehicles charging stations and domestic customers connected to the same power grid.

In Portugal, some of the solutions developed in the other 2 demonstrations and the resulting lessons

learned will be replicated and integrated with novel predictive grid management tools, based on flexibility, looking forward to an efficient and resilient distribution grid. The Portuguese demonstration involves 3 different locations (Caldas da Rainha, Valverde and Alcochete), engaging both residential and commercial consumers.

The experience gained in the project will result in proposals for new business models and conclusions on the scalability of InteGrid concepts.

PROJECT DETAILS

Project full title

Demonstration of INTElligent grid technologies for renewables INTEGRATION and INTEractive consumer participation enabling INTEroperable market solutions and INTErconnected stakeholders

Total funding

€14,533,618

EU contribution

€11,320,811

Duration

01/01/2017 - 30/06/2020

Website

<https://integrid-h2020.eu/>

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inteGrid
bridging
the gap

CONNECTING STAKEHOLDERS OF THE ENERGY VALUE CHAIN

The inteGRIDy project investigates how to cope with peak demand and grid balancing by integrating novel solutions at a grid level, focusing on demand response, storage capabilities and use of electric vehicles. The aim is to achieve successful cooperation between energy stakeholders and to validate inteGRIDy innovations at a large scale.

The project plans to integrate cutting-edge technologies, solutions and mechanisms in a series of replicable tools connecting various stakeholders of the energy value chain. The goal is to facilitate optimal and dynamic operation of the distribution grid, foster the stability and coordination of distributed energy and enable new collaborative storage schemes with a high share of renewables.

inteGRIDy carries out ten pilots, with existing infrastructure, in eight European countries. The pilots focus on aspects such as demand response, smart distribution grid, energy storage and smart grid integration of electric vehicles.

The main outcome of inteGRIDy will be a tool framework proposal, integrating and coordinating the proposed innovations and already existing technologies. inteGRIDy's overall progress is continuously monitored, measured and verified based on specific quantitative and qualitative indicators.

The project is currently more than half way. The framework of tools is being developed and the integration in the pilots is ongoing.

PROJECT DETAILS

Project full title

Integrated Smart GRID Cross-Functional Solutions for Optimized Synergetic Energy Distribution, Utilization Storage Technologies

Total funding

€15,743,171

EU contribution

€12,329,013

Duration

01/01/2017 - 31/12/2020

Website

<http://www.integridy.eu/>



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INTERFLEX

DSOs ACTING AS ENABLERS OF GENERATION/CONSUMPTION FLEXIBILITY

The European electric power systems are undergoing dramatic changes. Currently, more and more power is being generated from renewable energy sources, predominantly connected to the distribution grid. On that same grid, millions of electric vehicle charging stations are likely to be deployed all over Europe within the coming years. The distribution grid needs to urgently adapt to these rapidly changing energy flows. In this context, distribution system operators (DSOs) play a major role in exploring innovative ways to manage energy flows on a local scale and to relieve the grid's constraints.

InterFlex is built upon six demonstration projects in five EU countries (Czech Republic, France, Germany, The Netherlands and Sweden) dealing with grid automation and digitalisation, and covering multiple interactions between renewable power generation and multi-energy consumers (electricity, heat, gas) in the context of new customer needs and behaviours.

The idea is that DSOs in the demonstrations act as enablers, giving market signals to power producers, consumers, prosumers, their aggregators, or even to third parties such as municipalities, which in return stimulate the market players to offer generation and/or consumption flexibilities.

InterFlex prepares the deployment of new

electricity grid solutions and business models, while formulating policy recommendations and replication rules coming from the results obtained in the six demonstration projects.

PROJECT DETAILS

Project full title

Smart system of renewable energy storage based on INtegrated EVs and batteries to empower mobile, Distributed and centralised Energy storage in the distribution grid

Total funding

€16,305,955

EU contribution

€13,273,627

Duration

01/01/2017 - 31/12/2019

Website

<https://interflex-h2020.com/>



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INVADE

FLEXIBILITY MANAGEMENT PLATFORM FOR E-VEHICLES AND BATTERIES

INVADE is a big research and innovation project in the field of smart grids and storage. Its main objective is to deliver a cloud-based flexibility management platform integrated with electric vehicles and battery storage at mobile, distributed and centralised levels. The goal is to change the way energy is used, stored and generated by utilising renewable energy more effectively, optimising the supply of electricity and making services more user-centric.

Twelve European partners cooperate on designing new business models and the INVADE platform which is being tested at sites in Bulgaria, Germany, the Netherlands, Norway and Spain.

Exploitation of the project results has been at the core of the project since its launch. An exploitation user group with members from various energy and technology companies has been working on the commercialisation of the project findings. This has resulted in several exploitation pilots where business models and technical solutions developed in the INVADE projects have been applied successfully at new locations. All pilot results will be presented by videos at the end of the project.

PROJECT DETAILS

Project full title

Smart system of renewable energy storage based on INtegrated EVs and bAtteries to empower mobile, Distributed and centralised Energy storage in the distribution grid

Total funding

€16,305,955

EU contribution

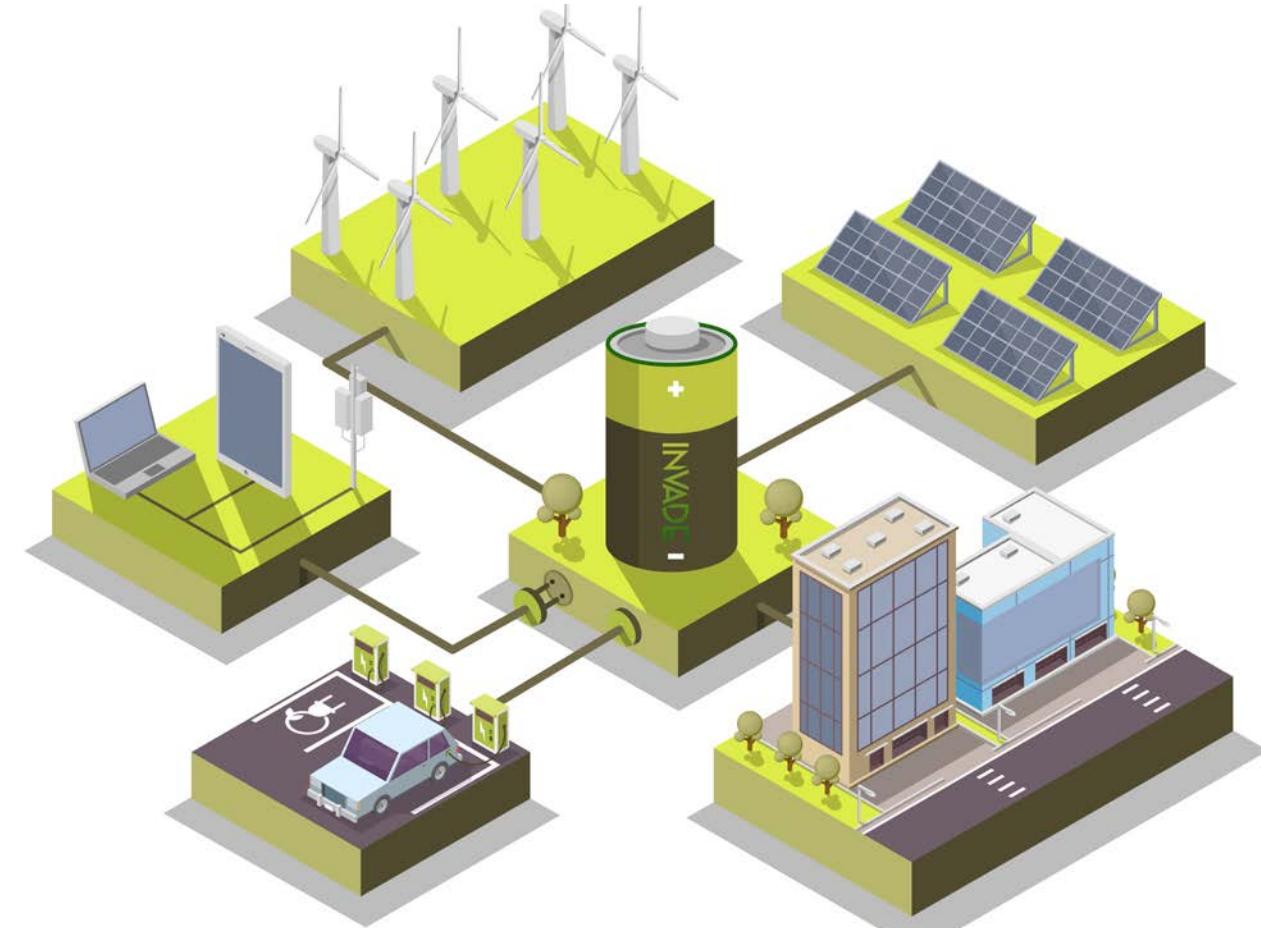
€13,273,627

Duration

01/01/2017 - 31/12/2019

Website

<http://www.invadeh2020.eu/>



MIGRATE

PREPARING THE POWER SYSTEM FOR RENEWABLE ENERGY

In 2016, twelve European transmission system operators (TSOs) launched the EU-funded project MIGRATE. Its goal is to find solutions for the technological challenges that the power grid is currently facing, and will face even more in the future, due to an increasing number of power electronics, such as wind turbines or PV panels, which harness renewable energy.

In order to keep the future power system stable in a scenario where the transmission grid is heavily impacted by the shutdowns of conventional power plants, TSOs have to provide new requirements, i.e. protection schemes.

First results of MIGRATE have already shown that a huge share of renewable energy sources can be added to the power system while keeping it stable, and complying with the existing grid codes. Furthermore the project has investigated the demand of converters for a grid forming control in a scenario with a power grid operating with 100% renewable energy.

MIGRATE will also provide new recommendations and requirements for the currently converter-dominated power system in order to support the European policy implementation and to allow more renewable energy in the power system.

PROJECT DETAILS

Project full title	Massive InteGRATion of power Electronic devices
Total funding	€17,855,205
EU contribution	€16,733,999
Duration	01/01/2016 - 31/12/2019
Website	http://www.h2020-migrate.eu/

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INNOVATIVE COMPONENTS FOR CONCENTRATED SOLAR POWER PLANTS

To accelerate the fight against climate change, and to reach the EU target of at least a 32% share of renewable energies by 2030, Europe needs to rapidly expand the use of all renewable energy sources. This requires developing further new solutions that are emerging today, particularly technologies that solve the key issue of energy storage.

The Next-CSP project responds to this need and addresses significant improvements related to concentrated solar power (CSP):

- heat transfer fluids, which can be used for direct thermal energy storage;
- solar field;
- high temperature receivers allowing new cycles.

The project proposes a breakthrough innovation: a fluidised particle-in-tube concept, which opens the route to the development of a new generation of CSP plants. It would allow high efficiency new cycles (50% and more), a 20% improvement of CSP plant efficiency, a modular concept and an electricity cost reduction by 38%.

Next-CSP will demonstrate the validity of the particle-in-tube concept atop the THEMIS solar power tower in France, at a large prototype scale. A 4-MWth tubular solar receiver able to heat particles up to 700-800°C will be tested, as well as the rest

of the conversion loop (a two-tank particle heat storage and a particle-to-pressurized air heat exchanger coupled to a 1.2 MWel gas turbine). The full system will be tested and evaluated in 2020 and will pave the way for future demonstration and commercial development.

PROJECT DETAILS

Project full title

High Temperature Concentrated Solar Thermal Power Plant with Particle Receiver and Direct Thermal Storage

Total funding

€4,947,420

EU contribution

€4,947,420

Duration

01/10/2016 - 30/09/2020

Website

<http://www.next-csp.eu/>



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DEMONSTRATING FLEXIBLE SOLUTIONS ON THE TRANSMISSION GRID

OSMOSE is addressing the identification and development of flexibilities required to enable Energy Transition to a high share of renewables. This approach captures synergies across needs (energy balancing, ancillary services, congestion management) and sources of flexibility (generation, demand response, grid, storage), such as multiple services from one source, or hybridizing sources, thus resulting in a cost-efficient power system.

A major objective is to demonstrate flexibility solutions enabling synergies across flexibility sources and applications via four large-scale demonstrators on the transmission grid:

- grid forming for the synchronization of large power systems by multi-services hybrid storage;
- multi-services by the coordinated control of different storage and FACTS devices;
- multi-services by grid devices, large-demand response and RES generation coordinated in a smart management system;
- near real-time cross-border energy market.

In addition, the project also aims to:

- increase the techno-economic scalability of these solutions;
- forecast the economically optimal mix of

flexibilities for the European power system, taking into account their synergies;

- propose evolutions of market designs and regulations leading to this mix and capturing these synergies.

PROJECT DETAILS

Project full title	Optimal System-Mix Of flexibility Solutions for European electricity
Total funding	€28,316,380
EU contribution	€21,852,099
Duration	01/01/2018 - 31/12/2021
Website	https://www.osmose-h2020.eu/



MODELLING THE PAN-EUROPEAN INTERCONNECTED ELECTRICITY SYSTEM

The EU's carbon reduction targets are calling for significant changes in our energy system: more flexibility, more active involvement of stakeholders and more collaboration to enable least-cost integration of variable renewable energy sources. Plan4Res aims at filling the gaps between the increasing complexity of the future energy system and analysis tools that are currently available.

In the first 18 months, Plan4Res delivered and shared:

- insights into case studies;
- a detailed description of the required models including investment planning, seasonal storage optimization, a European unit commitment for simulating the operation of all flexible assets, and transmission grid calculations for electricity and gas;
- data and data transformation algorithms and tools;
- advanced solution algorithms for solving linear and large stochastic problems;
- software components/architecture, based on an innovative C++ modelling framework, and workflow coordination processes.

By project end, Plan4Res will deliver:

- an end-to-end planning and operation suite, composed of a set of optimization models based on an integrated modelling of the European Energy System;
- an IT platform for seamless access to data and high-performance computing resources, catering for flexible models (modular and

equipped with efficient solution algorithms);
• public datasets and comprehensive studies highlighting the tool's adequacy, relevance and performance, focused on multi-energy

integration, uncertainties and flexibility cost assessment.



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PROJECT DETAILS

Project full title

Synergistic approach of multi-energy models for an European optimal energy system management tool

Total funding

€3,905,060

EU contribution

€3,905,060

Duration

01/11/2017 - 31/10/2020

Website

<https://www.plan4res.eu/>

USING ENERGY CONVERSION FOR FUTURE ENERGY STORAGE SYSTEMS

Renewable energy sources (RES) are a viable substitute to fossil fuels that could drastically reduce CO₂ emissions. However, due to the high variability of the energy demand and supply, new energy conversion/storage systems integrating RES are needed to avoid energy curtailment. The PLANET project is tapping into the potential of conversion technologies such as power-to-gas, power-to-heat and virtual energy storage to overcome this challenge.

Through the development of an ICT tool that enables simulation, optimisation and decision support, PLANET allows stakeholders, such as network operators, to alleviate the imbalance triggered by the massive distributed RES interconnected to the electricity grid. The PLANET platform offers possibilities for estimating the impact of deploying various storage and conversion units on the energy system overall and considering possibilities of coupling between the different energy grids, namely electricity, gas and heat. This leads to increasing flexibility to better respond to local energy generation, grid conditions and market variation.

The system will help the user to leverage innovative energy conversion in alternative carriers and storage technologies to explore, identify, evaluate and assess optimal grid planning strategies for future scenarios for a fully decarbonised energy

system.

PLANET, after 20 months of activities, has the following results:

1. Definition of use cases and scenarios to study the synergies between the energy vectors and definition of the architecture framework.

PROJECT DETAILS

Project full title

Planning and operational tools for optimising energy flows and synergies between energy networks

Total funding

€3,999,695

EU contribution

€3,999,695

Duration

01/11/2017 - 31/10/2020

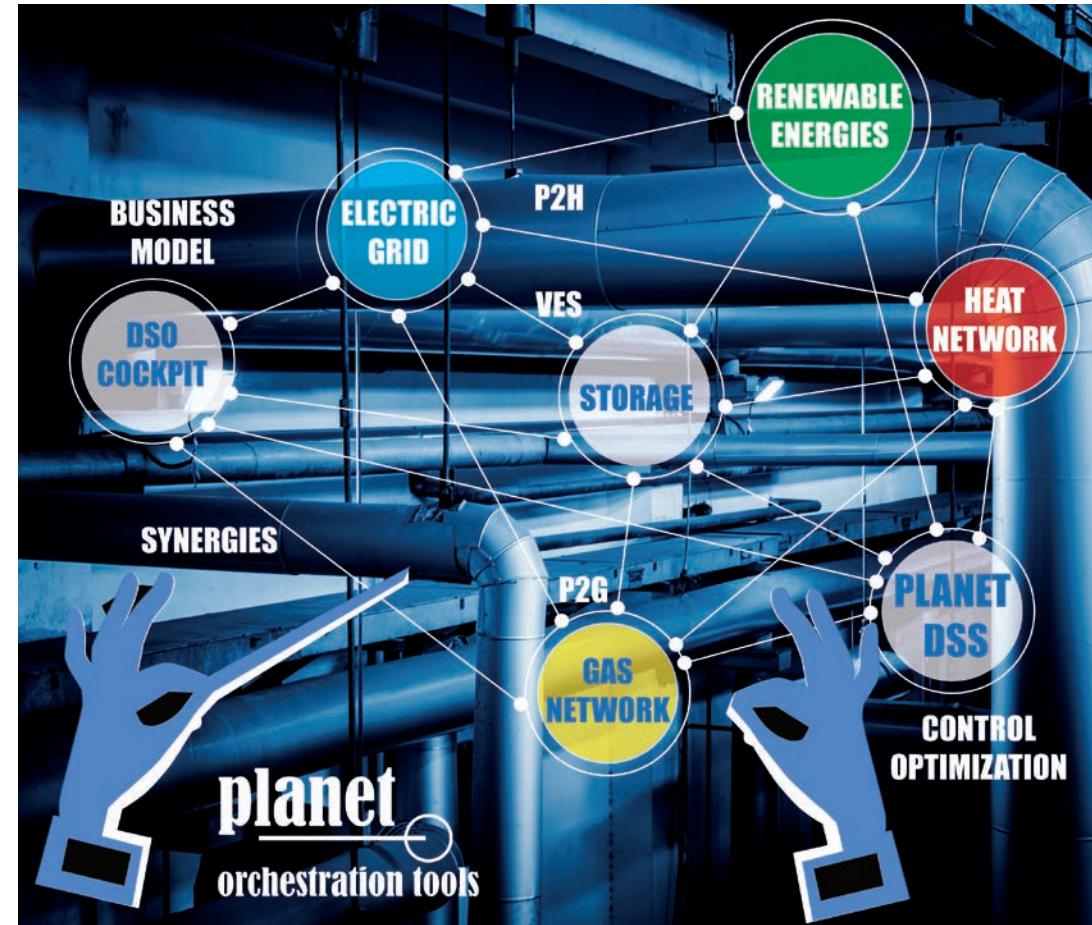
Website

<https://www.h2020-planet.eu/>

2. Definition of electricity heat and gas demand/supply models.
3. Implementation of a 1st version of a network orchestration cockpit, and a preliminary coordination engine.
4. Implementation and test of the first Proof of

Concept of the PLANET tool.

5. In-depth analysis of regulatory schemes and possibilities for innovation adoption covering the EU region.



IMPROVING EFFICIENCY AND HOSTING CAPACITY OF LOW-VOLTAGE DISTRIBUTION NETWORKS

RESOLVD is a research and innovation action that aims to convert a low voltage grid with high rates of distributed renewable generation, into an efficient smart grid. Heterogeneous storage, provided by different battery technologies, installed at the secondary substations together with advanced power electronics are used to perform local energy management. This will help to maximise the consumption of renewable energy generated locally, reduce losses and emissions, and increase grid balance and quality of supply.

RESOLVD is an integrated solution for the DSOs, that provides greater observability through phasor measurement units (PMUs) and power quality monitors (PQM) installed in secondary substations. It leads to optimal configuration of the grid and storage set points, based on demand and generation forecasting services. It is conceived as an enhancement of distribution management systems (DMS) for low voltage grids with high penetration of renewables, capable of interoperating with legacy systems in a cyber-secure environment.

PROJECT DETAILS

Project full title Renewable penetration levered by Efficient Low Voltage Distribution grids

Total funding €3,876,750

EU contribution €3,876,750

Duration 01/10/2017 - 30/09/2020

Website <https://www.resolvd.eu/>



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ENABLING DEMAND RESPONSE, SMART GRID, STORAGE AND INTEGRATION IN ISLANDS

The overall scope of SMILE project is to demonstrate, in real-life operational conditions, a set of both technological and non-technological solutions adapted to local circumstances targeting distribution grids to enable demand response schemes, smart grid functionalities, storage and energy system integration with the final objective of paving the way for the introduction of innovative solutions in the market in the near future. To this end, three large-scale pilot projects are under implementation in three island locations with similar topographic characteristics but different policies and regulations, representing the majority of the EU energy markets and offering excellent demonstration settings to deliver maximum impact in terms of replicability: Orkney (UK), Samsø (DK) and Madeira (PT).

Currently, the 3 demonstrators are testing different combinations of technological solutions according to local specificities and conditions as well as the existing infrastructure and all value chain actors needed to efficiently implement the pilots involved.

The technological solutions include the integration of different battery technologies, power to heat, electric vehicles (both cars and boats) and smart integration of grid users from transport and mobility, aggregator approach to demand side management (DSM) and predictive algorithms.

PROJECT DETAILS

Project full title	SMart IsLand Energy systems
Total funding	€14,058,909
EU contribution	€12,106,047
Duration	01/05/2017 - 30/04/2021
Website	http://www.h2020smile.eu/

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SOGNO

A NEW PHILOSOPHY OF POWER GRID MANAGEMENT

The SOGNO project is creating turnkey cloud services implementing next generation data-driven monitoring and control systems. It will simplify the life of distribution system operators (DSOs), enabling them to optimize their operations financially so they can provide a cost-effective and seamless, secure power supply for their customers.

The upcoming 5G mobile communication standard and products will enable low latency data transmission with very high levels of network availability. Cloud services for DSOs include state estimation, power quality evaluation, load and generation forecasting, power control and fault location isolation and service restoration.

The new SOGNO services help DSOs to decrease investments like grid extension and operational costs and to be ready for a future energy mix with up to 100 % renewable energy sources.

The services are validated in two laboratory trials in Estonia and Germany and in three field trials in, Germany, Ireland and Romania. With the ambitious goal of combining hardware, software solutions and research activities in different areas, such as advanced deep learning, 5G communications, and cloud virtualization, SOGNO is building a new philosophy of power grid management.

PROJECT DETAILS

Project full title	Service Oriented Grid for the Network of the Future
Total funding	€3,999,945
EU contribution	€3,999,945
Duration	01/01/2018 - 30/06/2020
Website	https://www.sogno-energy.eu/

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STORY

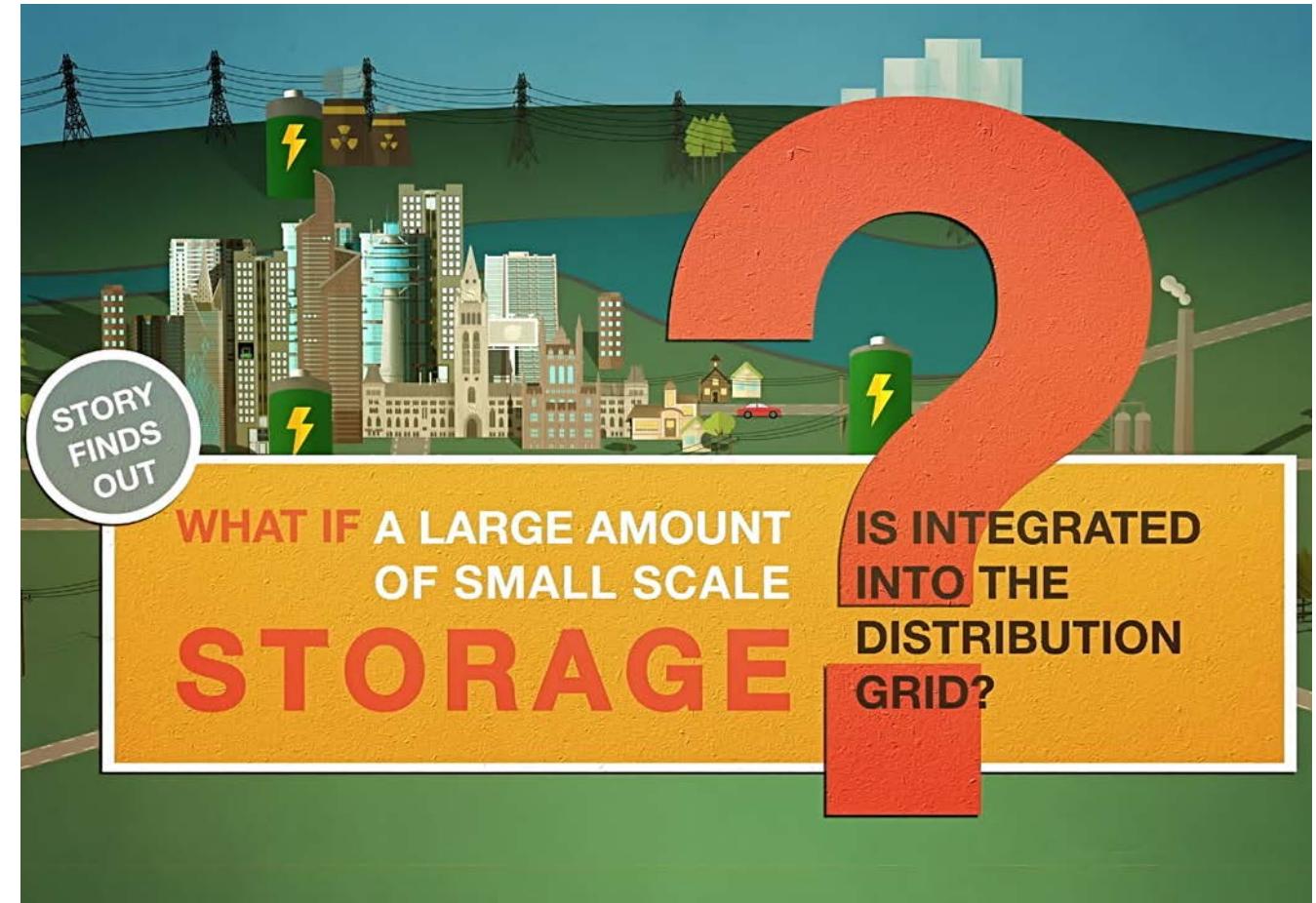
INTEGRATING STORAGE FOR A FLEXIBLE, SECURE AND SUSTAINABLE ENERGY SYSTEM

The main objective of STORY is to show the added value storage can bring for a flexible, secure and sustainable energy system. This will be achieved through efforts of the 18 STORY partners by showing the inter-relations between technologies and stakeholders as well as the potential and the impact of policy and regulation. Six demonstrations were set up to feed knowledge into the further analysis of large-scale impact assessment and on market models, policy and regulation.

The six demonstrations are located in four different Member States and cover industrial and residential environments, with the scales ranging from industrial building to neighbourhood. The demonstrations deliver input on technological performance, stakeholder acceptance and on the overall process of storage integration. An in-depth, practice-oriented analysis on grid challenges, hardware requirements and ICT delivers insights for the demonstrations that in turn supports the deployment and impact analysis. The lessons learned from STORY show that technology integration and interoperability, market and regulatory barriers, permitting, as well as social aspects affecting roll-out of energy storage innovation, are decisive issues that need to be addressed in the ongoing policy debate.

PROJECT DETAILS

Project full title	STORY- Added value of STORage in distribution sYstems
Total funding	€15,337,876
EU contribution	€12,484,339
Duration	01/05/2015 - 30/04/2020
Website	http://horizon2020-story.eu/



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TDX-ASSIST

COORDINATION OF TRANSMISSION AND DISTRIBUTION DATA EXCHANGES FOR RENEWABLES INTEGRATION IN THE EUROPEAN MARKETPLACE

This three-year project aims to design and develop novel Information and Communication Technology (ICT) tools and techniques that facilitate scalable and secure information systems and data exchange between Transmission System Operators (TSOs) and Distribution System Operators (DSOs). The three novel aspects of ICT tools and techniques to be developed in TDX-ASSIST are: scalability – ability to deal with new users and increasingly larger volumes of information and data; security – protection against external threats and attacks and interoperability – information exchange and communications based on existing and emerging international smart grid ICT standards.

The project focuses on enhanced TSO-DSO interoperability. In this context, TDX-ASSIST will also consider DSO interaction with other market-participants (DSOs, Aggregators, Distributed Energy Resource Operators, Micro-grid Operators).

This project addresses the further research and development needed to ensure that greater levels of TSO-DSO interoperability can be realized, and to harmonise a wider range of standardisation activities that are presently underway or complete.

An assessment of the final project activity will be used to quantify how scalability, security and

interoperability combine to improve real power sector ICT processes.

PROJECT DETAILS

Project full title

Coordination of Transmission and Distribution data eXchanges for renewables integration in the European marketplace through Advanced, Scalable and Secure ICT Systems and Tools

Total funding

€4,175,453

EU contribution

€4,175,453

Duration

01/10/2017 - 30/09/2020

Website

<http://www.tdx-assist.eu/>



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SMARTER SYSTEMS, EMPOWERED CITIZENS

WiseGRID's main objective is to provide a set of solutions and technologies to increase the smartness, stability and security of an open, consumer-centric European energy grid. The project will combine an enhanced use of storage technologies, a highly increased share of renewable energy sources (RES) and the integration of charging infrastructure to favour the large-scale deployment of electric vehicles.

The project also hopes to make a difference in the market by delivering nine tools which facilitate the creation of an open energy market where not only 'traditional' utilities but also players such as electric cooperatives, prosumers and small and medium enterprises (SMEs) can play an active role, contributing effectively to the transition towards energy democracy.

So far, WiseGRID has finalised the design and development of its technological products and has started the deployment phase in its five demonstration sites: Crevillent (Spain), Flanders (Belgium), Terni (Italy) and Mesogia and Kythnos (Greece).

WiseGRID results are already generating high expectations as illustrated by it winning the Good Practice of the Year Award in the Technology and Design category and two prizes at the European Sustainable Energy Week (EUSEW) in 2018: in the business category and as the Citizens' choice.

PROJECT DETAILS

Project full title

Wide scale demonstration of Integrated Solutions and business models for European smartGRID

Total funding

€17,595,500

EU contribution

€13,854,247

Duration

01/11/2016 - 30/04/2020

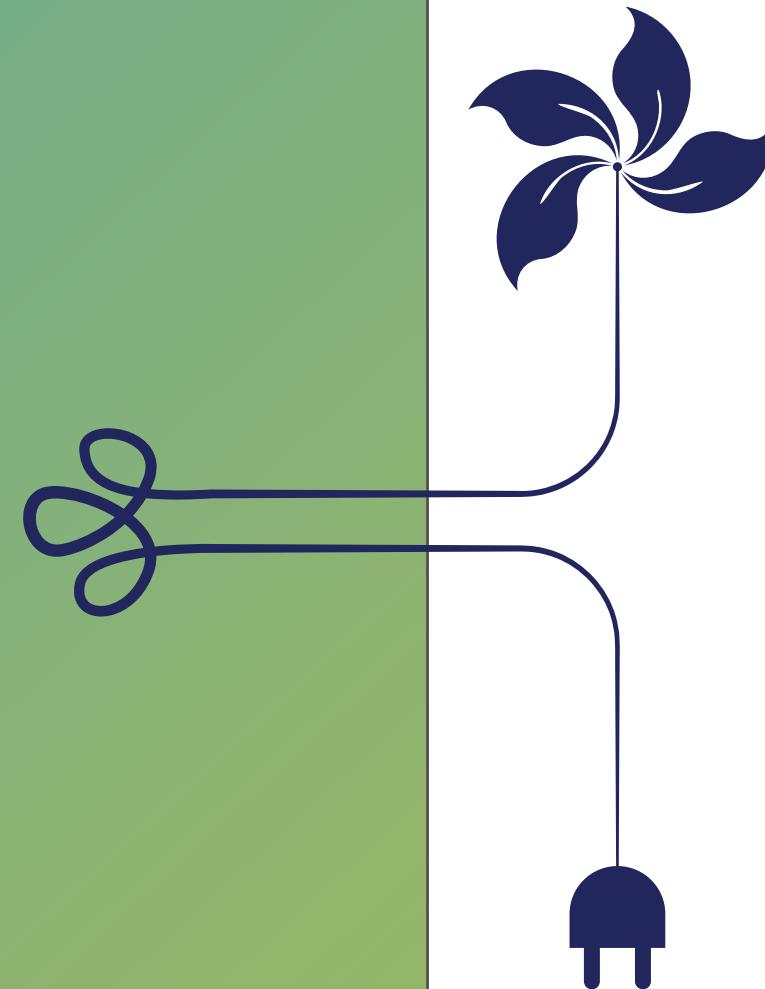
Website

<http://www.wisegrid.eu/>



This brochure presented examples of smart grids and storage projects financed by the EU's Horizon 2020 programme.

Factsheets of all INEA-managed smart grids and storage projects are available on INEA's website (www.ec.europa.eu/inea) in the Horizon 2020 section.



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Pdf: EF-01-20-026-EN-N - ISBN: 978-92-9208-073-0 -DOI: 10.2840/309895

Publications Office
of the European Union