Smart Energy Systems ERA-Net

Joint Programming Platform ERA-Net Smart Energy Systems

Focus Initiative Smart Grids Plus

Success stories from Joint Calls 2015 and 2016 projects

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1 ABOUT THE JOINT PROGRAMMING PLATFORM ERA-NET SES

ERA-Net SES is a transnational Joint Programming Platform (JPP) with more than 30 funding partners from European and associated countries. It functions as a network of owners and managers of national and regional public funding programs in the field of research, technical development and demonstration. It provides a sustainable and service-oriented mechanism to finance transnational RDD projects, developing technologies and solutions in thematic areas like smart power grids, integrated regional and local energy systems, heating and cooling networks, digital energy and smart services.
www.eranet-smartenergysystems.eu

The goal of JPP ERA-Net SES is to support RDD projects and to help organize the learning to enable the right technologies, market designs and customer adoption to achieve the smart energy system vision & goals of Europe. The joint programming platform started out with a focus initiative on Smart Grids. In 2018, the second focus initiative on Integrated Regional Energy Systems, announced its first call. Based on the funding provided by the national and regional funding partners, both focus initiatives receive additional top-up grants from the European Union's Horizon 2020 research and innovation programme (grant agreements no. 646039 and no. 775970).

PARTICIPATING FUNDING AGENCIES

Since the first call with funding programmes from 20 European countries and regions participating, JPP ERA-Net SES constantly attracted new partners. Today, 25 countries and regions are part of the joint programming platform.

ERA-NET SES FUNDING PARTNER COUNTRIES AND REGIONS

FUNDED PROJECTS

So far, a total of 69 projects have been awarded funding in five multilateral calls for transnational research, development and demonstration projects projects. Since 2015, the initiative has organised a joint call each year and currently the Joint Call 2020 „Unleashing the potential of digital transformation for the energy transition" is being prepared.

In this brochure, the significant results of the first concluded projects on Smart Grids, funded within JPP SES via the Joint Calls 2015 and 2016, are proudly presented to the public.

What makes ERA-Net SES projects stand out from the crowd is the JPP's three layer approach. According to this approach, projects tackle not only technological aspects, but also consider market conditions and business models as well as issues related to the societal adoption of the developed solutions.This shall substantially increase the impact of the RDD projects by improving the opportunities for market uptake of the developed solutions.

THREE LAYER RESEARCH MODEL

OUTCOMES OF THE JOINT CALLS 2015 AND 2016

2.1 JOINT CALL 2015

Core Aspects

The Joint Call 2015 for transnational RDD projects by JPP ERA-Net SES aimed at pushing smart grids solutions to high Technology Readiness Levels (TRL). Projects tackling critical solutions for the transition to clean energy, enabling efficient and effective smart grids have been awarded.
To achieve these high levels of technological readiness, projects including the validation, scale-up and replication of smart grid solutions have been prioritized for funding.

Outcome of the Joint Call 2015

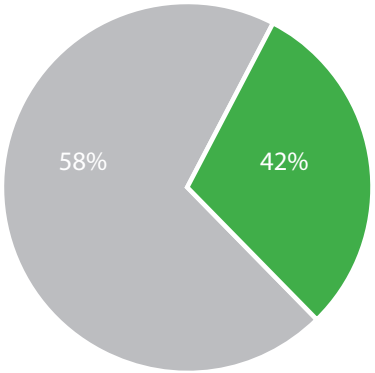
The call resulted in:

- 50 full project proposals from 20 regions and countries with a total project budget of EUR 104 Mio. submitted to the call by June 2015
- 21 approved projects from 19 regions and countries with a total funding of EUR 31 Mio. and a total project budget of EUR 47 Mio.
- project consortia involving a total of 128 partners based throughout Europe, 48,5 % of which are industry partners

The awarded projects started in 2016 and closed by 2019.

Success Rate

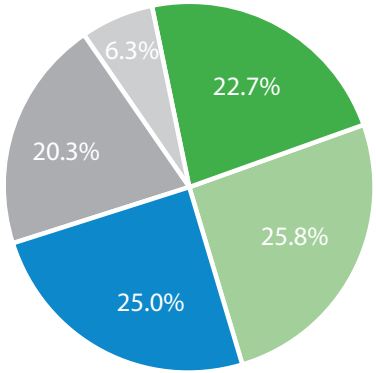
42% Success Rate in Joint Call 2015
N = 50 project applications



Non-funded Projects | 29
Funded Projects | 21

Industry Involvement

48,5% Industry Involvement in 21 Funded Projects
N = 128 funded project partners



Research – University | 32
Industry – Utility | 29
Industry – Technology | 33
Miscellaneous | 8
Research other | 26

2.2 JOINT CALL 2016

The Joint Call 2016 was directed at transnational projects which, beyond complying with the core aspects above, delivered to the following three goals:

1. Enable an increased flexibility of the power system to cope with the growing share of intermittent, variable and decentralised renewable generation and managing the complex interactions.
2. Increase network capacity to support increased generation and transmission resulting from renewables and in support of the internal energy market.
3. Provide information, services, market architectures and privacy guarantees to support open markets for energy products and services, whilst facilitating the active participation of customers.

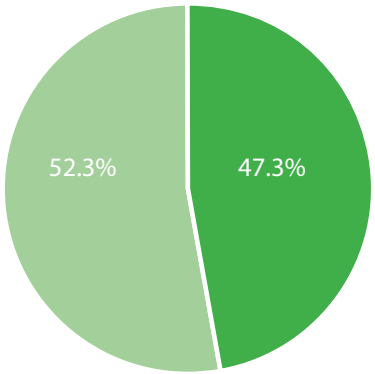
The Joint Call 2016 resulted in

- 19 full project proposals from 11 regions and countries
- 9 approved projects from 8 regions and countries with a total funding of EUR 13 Mio. and a total project budget amounting to EUR 17 Mio.
- project consortia involving a total of 51 partners based throughout Europe, 40,4% of which are industry partners.

Success Rate

47% Success Rate in Joint Call 2016

N = 19 project applications



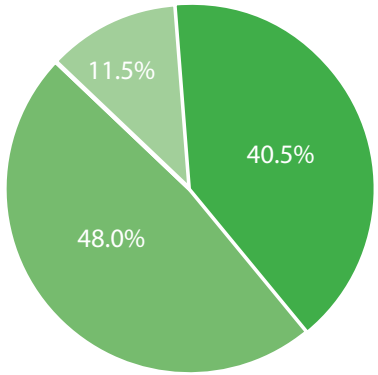
Non-funded Projects | 10

Funded Projects | 9

Research Industry

40% Industry Involvement in 9 Funded Projects

N = 21 involved industry organisations



Industry | 29

Research | 10

Other

3 EXCELLING AT STRATEGIC INITIATIVE GOALS

Each awarded transnational project, individually, has achieved remarkable results (see chapter 4). Beyond the sum of results of all funded projects, the JPP ERA-Net SES Knowledge Community provided the frame and guided experts in nurturing as well as exploiting the insights of their funded projects beyond its consortia. Focused as well as cross-topic, open formats for exchange made funded research results available to the European community. No single project could ever achieve the quantity and quality of the jointly generated insights displayed in the Joint Call 2015. The performance analysis of the Joint Call 2015 projects regarding the 11 Key Performance Indicators (KPI) of the Focus Initiative on Smart Grids reveals some of the impact generated. The results are complemented by some additional evaluations of the Joint Call 2016 projects.

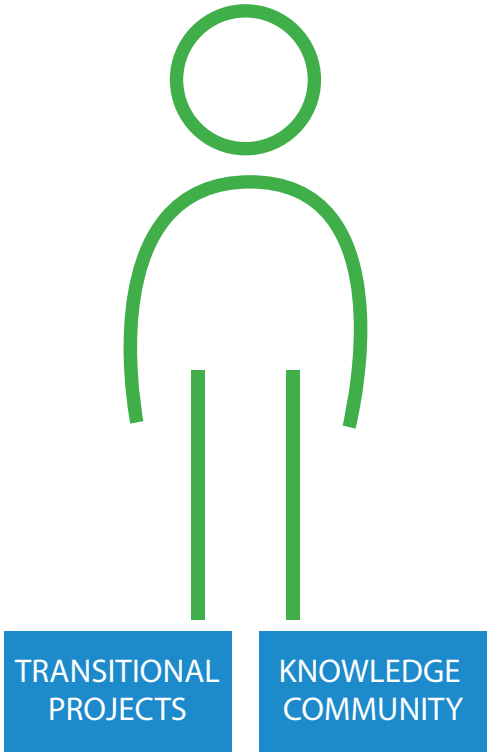
Walking on two Legs

Transnational Projects

- national funding with EU top-up funds
- selected in ERA-Net SES Calls
- communication and evaluation by support team

Knowledge Community

- from and for the ERA-Net SES projects
- national and international experts
- unique networking and knowledge base

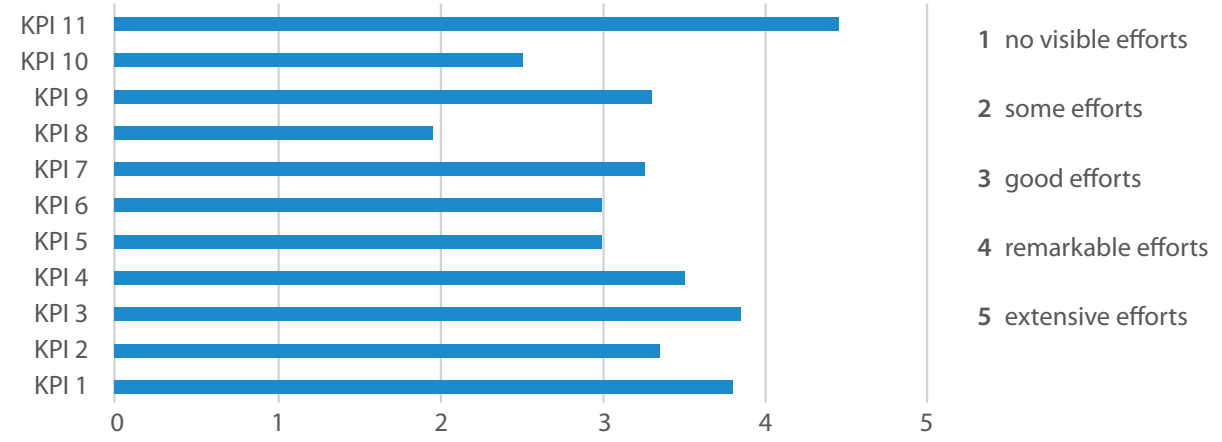


3.1 PROJECTS' ACHIEVEMENTS REGARDING KEY PERFORMANCE INDICATORS

The 11 Key Performance Indicators (KPI) of the initiative are clustered in three areas

Fulfillment of Project Requirements	Impact Generated	Results Produced
1. Cross-sectoral and interdisciplinary system innovation, covering the three layers	5. Facilitating strong co-operation	9. Promoting both horizontal and vertical learning
2. Focusing on validation, scaling and replication	6. Enabling deep knowledge exchange	10. Integrating Smart Grids and transitioning towards holistic energy systems
3. Solutions with TRL 6-7	7. Furthering the broad implementation of interoperable best practice solutions	11. Developing clean, secure and efficient energy systems with low-carbon energy technologies: 1. increased flexibility 2. increased network capacity 3. open markets
4. Building on prior research and demonstration	8. Accelerating the establishment of standards as well as critical masses for technology and service markets	

Average KPI performance of Joint Call 2015 projects

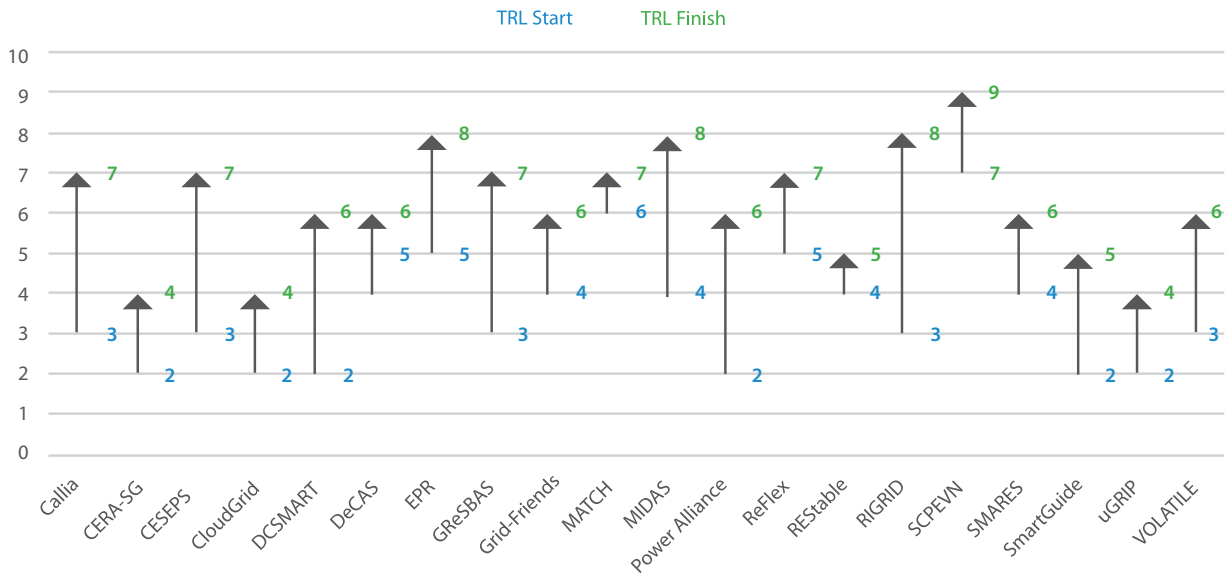


The KPI are based on the JPP ERA-Net SES Knowledge Community concept, describing its goals and set-up. The concept has been developed in close discussion with the coordination team and projects and has been adopted by the Steering Board.

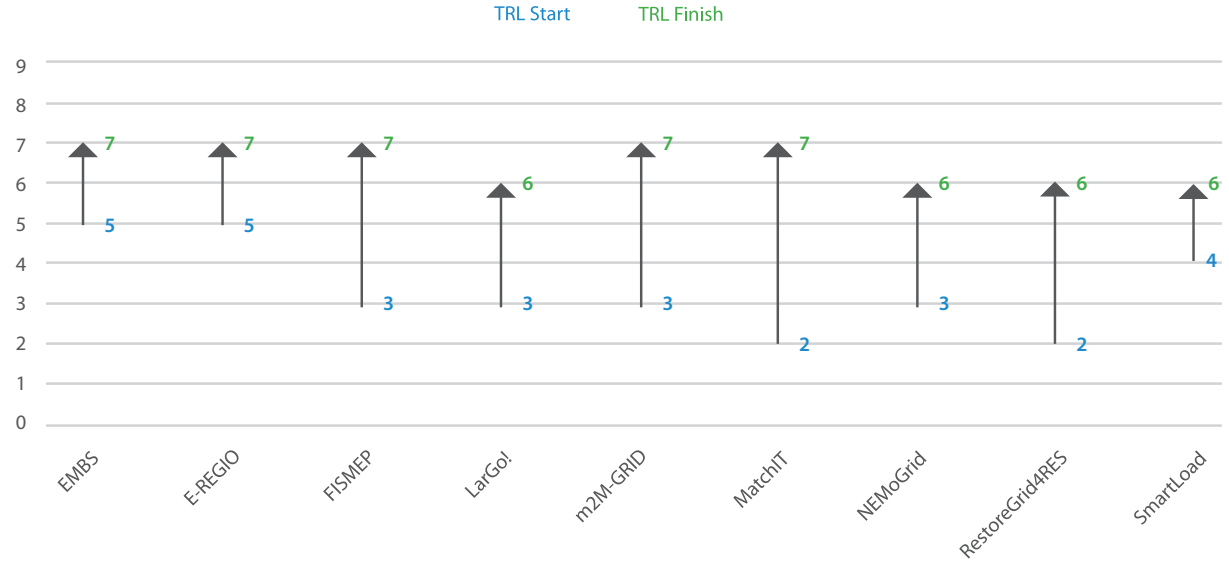
The average performance of the 20 Joint Call 2015 projects regarding each KPI is visualized in the bar diagram below.

Joint Call 2015 projects achieved good to remarkable results for most of the KPI. Limited efforts regarding the establishment of standards and critical masses (KPI 8) and the integration towards a holistic energy system (KPI 10) hint at persisting challenges in these areas.

TRL jump from start to finish (Joint Call 2015 projects)



TRL jump from start to finish (Joint Call 2016 projects)

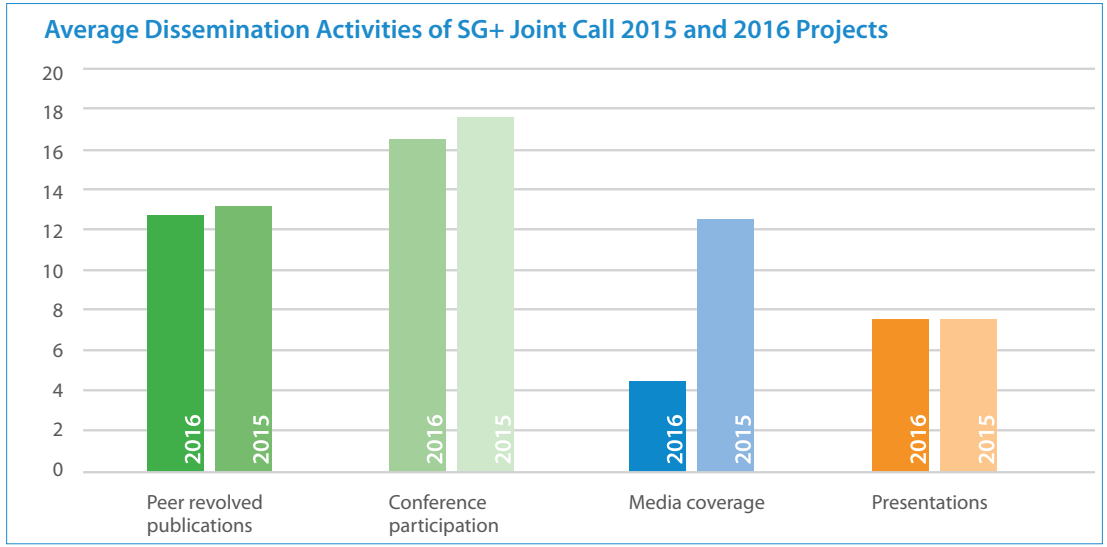


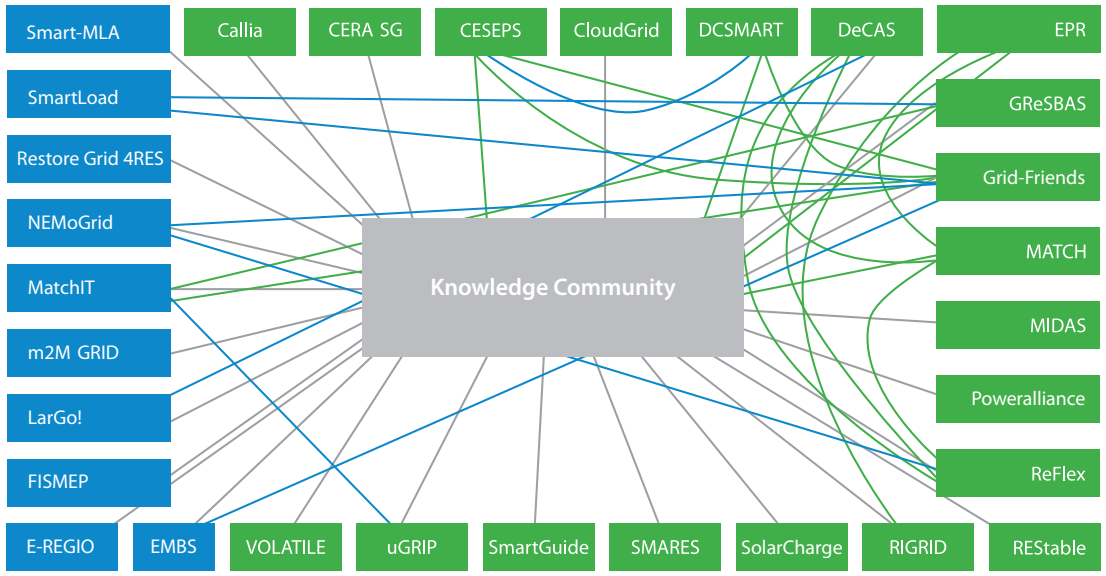
A closer look at the increases of the Technological Readiness Level (TRL) as displayed in the graphic beside reveals the significant advances by the projects.

The remarkably high TRL achieved by the majority of projects shows that solutions are far beyond first drafts and close to or even ready for market uptake.

Enabling Deep Knowledge Exchange and Promoting Learning (KPI 6 and 9)

Deep knowledge exchange and extensive learning (KPI 6 and 9) is driven by the significant amount of dissemination and cooperation activities pursued by many of the projects (see graphics below).





3.2 INTEGRATING PERSPECTIVES TO INFORM POLICY

In the JPP ERA-Net SES Working Groups, projects and further experts discuss crucial topics. One of their key outputs are the policy recommendations summarized in the ERA-Net SES Policy Briefs. On the basis of the profound expertise and deep exchange, the researchers develop an informed opinion of key aspects which, according to their perspective, should be considered by policy makers. The expert discussions regarding these **messages of the research community to the policy makers** are professionally facilitated. This bundled and digested knowledge in the form of synthesized, targeted messages is one of the ways how the JPP ERA-Net SES projects transforms knowledge and carries it into other spheres, boosting its impact.

The following recommendations represent the **condensed version** of the ERA-Net SES Policy Briefs, summarizing the recommendations developed between 2017 and 2020. Policy makers and regulators are invited to review the full text and share their perspective in the living documents on the **exchange platform expera**, so the recommendations can be discussed and evolve.

3.2.1 System Architecture & Implementation Modelling and Interoperability & Standardisation

- A clear terminology on the international level is necessary to constructively discuss integrated regional energy systems in relation to the overall energy system.
- As ICT architectures may differ from legacy systems, the discussion of developing cellular energy systems should come hand in hand with the discussion of establishing regional data hubs and broadband networks (e.g. 5G).
- To increase interoperability and standardisation, develop standards for more use cases (e.g. Smart Homes) and care for interoperability of testing methodologies and so-called Basic Application Profiles (BAPs).
- Complete and generalize the Smart Grid Architecture Model (SGAM) to include other domains (e.g. heat, gas); join domains „bulk generation“ and DER.
- Energy transition is part of regional development, hence local institutions for business and infrastructure need to be involved.

3.2.2 Storage & Cross Energy Carrier Synergies

- Flexible energy storages should be promoted to bridge the borders of multiple energy domains and help stabilizing the electricity grids.
- Processes of bidding, activation and billing flexibility in generation, storage and consumption should be standardized on a European level to ensure that liquid markets for providing local services can really be established.
- Cross-domain businesses are needed to enable co-operation between clean electricity generation, heating, gas and mobility – all sectors would benefit!
- Energy storage needs:
  - anEU regulatory framework that reduces both legislative and market barriers
  - technology neutrality.
- Facilitate cross-sector energy storage integration in order to increase the hosting capacity for renewables: develop innovative and fair commercial models including respective regulation.

3.2.3 Regulatory & Market Development

- Fair access for small-scale distribution-level resources: adjustment of ancillary services markets' framework with regard to activation period, minimum bid sizes, asymmetric bidding and frequency of contracting phase.
- Rules and monitoring practices enabling grid-oriented service provision: allow for sharing data between DSOs and market parties, lower barriers for small-scale actors to participate in flexibility trading and allow for flexibility service procurement between DSOs and TSOs.
- Establishment of local electricity and flexibility markets (e.g. by implementing the model of „Citizen Energy Community"): promote technological interoperability and define and regulate new actors and their relationship including concepts and features, different voltage levels and services, ancillary services and remuneration as well as responsibilities within the market.

3.2.4 Consumer & Citizen Involvement

- Deploy tested approaches and use social sciences for engaging professional or end-users starting with early development of a project (agile development). Apply and test prototype solutions in everyday life contexts. This requires innovation processes with many stakeholders (e.g. public-sector actors) and is crucial for enabling adoption.
- Smart and conscious integration of consumers: Exploiting the flexibility potential of active energy generation, storage and consumption must go hand in hand with user requirements for minimal bothering and maximum comfort. Yet, it must not compromise data privacy nor personal rights.
- One voice, one direction: Lack of information, contradicting messages or opposing actions from different policy levels create confusion. In order to motivate broad action, a common message and roadmap of actions are needed.
- Complexity of human behavior: Since economic incentives are not always first choice, broaden the portfolio of measures for fostering sustainable and system-friendly behaviour in the energy domain and investigate other instruments.
- Visibility of progress: Showcase good examples of consumers' and citizens' contributions to energy transition and the benefits for society and individuals.

4 KEY RESULTS OF THE JOINT CALL 2015 AND 2016 PROJECTS

The 20 projects funded by the SG+ Joint Call 2015 and 9 projects funded by the Joint Call 2016 of the JPP ERA-Net SES generated outstanding results. Each of the projects is presented in this chapter with a short profile, including key results.

According to common thematical focus areas, projects have been grouped in five clusters:

- Grid Design
- Grid Management
- TSO/DSO Interface
- Local Energy Communities and Microgrids
- Resilience
- Demand Response and Consumer Activation

Some projects have achieved especially remarkable results, standing out among their peers. These projects are showcased in more detail.

4.1 CLUSTER: GRID DESIGN

Projects in the cluster Grid Design developed solutions for designing efficient and smart electricity grids. The focus was on regional and residential grids with their technical, economic and social requirements and implications. This included aspects such as electric vehicle integration, user acceptance and network investments. Forecasting was integrated to enable an increased usage of re-newables, bringing regions closer to their local net zero objectives.

CESEPS

Demand-oriented design of smart energy products and services for local energy grids and markets

CERA-SG

Cost-efficient data collection and analysis for smart grid and rev-enue assurance

ReFlex

Replicability concept for flexible smart grids considering technical, business and social design

RIGRID

Interactive applications for optimal planning and operation of energy infrastructure in rural areas

RIGRID

Interactive applications for optimal planning and operation of energy infrastructure in rural areas

RESULTS

TECHNOLOGY

Design and control tool for AC microgrids delivering:

- optimal corridors for MV/LV lines, positions and sizes for DGS, RES, BESS, MV/LV transformers
- estimation of RES and non-RES generation
- evaluation of power and heat grid parameters incl. loads and consumption
- optimization for minimized energy imports/power loss/energy generation mix/ operational costs or for maximized profits

MARKET

Financial analysis for power plant and BESS investments considering:

- energy costs (via Levelized Unit Energy Cost)
- economic benefits (incl. feed-in incentives & coupled storage)

ADOPTION

- 3D virtual reality tool for visualizing local system confi gurations, improving communication and enabling acceptance testing with stakeholders

Partners for further development

- (Net zero) microgrid operators and planners
- Planners of energy infrastructure
- Researcher community around multi-criterial planning and acceptance of energy infrastructure
- Software designers employing virtual reality
- Software providers for microgrid planning and operation (including Energy Management and Control Systems)
- Local energy communities with active participation of small electric producers, consumers and prosumers
- Experts for mechanisms and regulations for micro-grids off ering services to ESO/DSO

Project partners

RURAL INTELLIGENT RIgrid

Keywords:
rural regions, renewable energy sources, grid planning, infrastructure acceptance, net zero local grids, low voltage AC grids

Joint Call 2015

Total budget: € 1,033,542.-

Technological Readiness Level

Start 01.05.2016 End 30.04.2018

Project coordination

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www.rigrid.pl

The scientific, technical and socio-economic achievements have been practically implemented in regions from Poland and Germany. Through optimal planning and management concepts for more efficient operation of existing and future electric power infrastructures, RIGRID positively affects the reliability of power supply, decreases the carbon footprint and increases local authorities' visibility.

Key Result 1
Interactive Energy and Infrastructure Design Tool

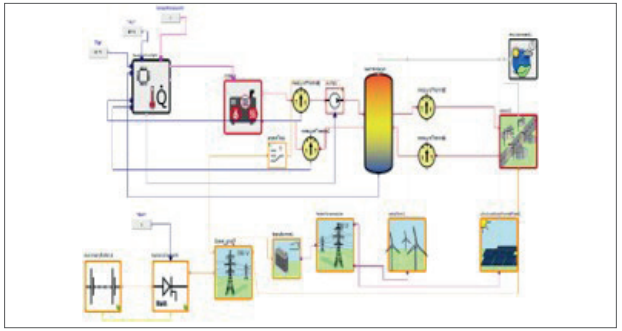
RIGRID's VR-tool is an interactive, modular application for technical and socio-economic planning and operation of energy infrastructure. It can visualize the visual and audible impact of planned infrastructure. Various scenarios can be compared together with affected citizens to find the optimal placement e.g. for PV, wind, storage elements and power lines. By enabling the participation of the population in the planning process, transparency and acceptance of new infrastructure elements are increased and investment is accelerated.

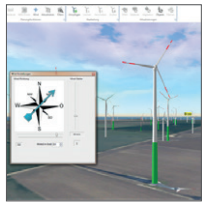
Key Result 2
Energy Management and Control System

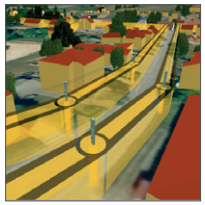
The developed Energy Management and Control System EMACS remotely monitors and controls system components such as RES, storage, controllable loads and protection devices to reliably operate the microgrid. Work status, measurements and control information are visualized in graphic tool of the EMACS' web server. Data is exchanged between PLC controllers and server router via a UMTS cellular network using communication protocols ModBus, IEC61850 GOOSE, OPC, DLMS, IEC60870-5-104, IEC61850 GOOSE and MMS.

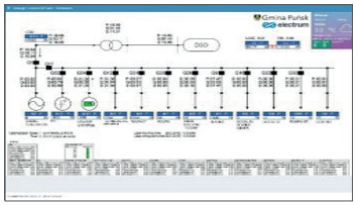
Key Result 3
Multi-criterial planning of Net Zero Energy System

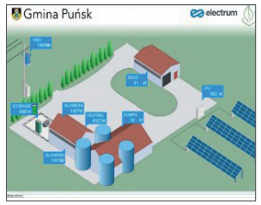
With the RIGRID tool, multi-energy systems (MES) can be planned as Net Zero Energy Systems (NZES). The district system (including electricity, thermal energy and transportation) is analyzed and modelled considering contextual variables such as building typologies and weather conditions. Accordingly, adequate RES based power plants, heat pumps and storage elements are selected and sized to optimally cover the energy demanded by the system. An economic tool evaluates the total investment (TI) required, net present value (NPV), internal rate of return (IRR) and levelized unit energy costs (LUEC) to select a suitable business model.

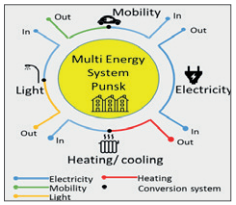


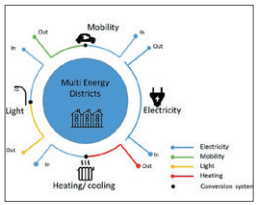












CESEPS

Demand-oriented design of smart energy products and services for local energy grids and markets

RESULTS

TECHNOLOGY

- Network modeling methodology for AC and DC with EV, demand side management, customer safety and storage
- Tools for sustainability and energy-efficiency rating of smart grid pilots
- Co-simulation framework combining real and simulated elements

MARKET

- Specifications and implementation guidelines for the development of products and services
- Medium and long term scenarios for local smart grids

ADOPTION

- Catalogue of user demands for smart energy products and services
- Overview on required changes in energy practices and related barriers

Partners for further development

- Planners and operators of local microgrids
- Research community around user needs and behaviour
- Research and development community around demand side management
- Developers of AC and DC network models
- Designers of products and services for local grids

Project partners

UNIVERSITY OF TWENTE. · WAGENINGEN UNIVERSITY & RESEARCH · TU Graz · DNV·GL · TU Delft · Universiteit Utrecht · AIT Austrian Institute of Technology · eseia european sustainable energy innovation alliance

CESEPS
Co-Evolution of Smart Energy Products and Services

Keywords:
residential grids, demand-oriented grid design, users' energy behavior, local energy generation and trading, demand side management, e-mobility, forecasting, renewables, co-evolution of products and services

Joint Call 2015

Total budget: € 1,963,305.-

Technological Readiness Level

Start 01.02.2016 End 31.03.2019

Project coordination

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CERA-SG

Cost-efficient data collection and analysis for smart grid and revenue assurance

RESULTS

TECHNOLOGY

Design and control tool for AC microgrids delivering:

- Software for efficient collection and analysis of energy and power fl ows in the distribution network
- ICT system with non-intrusive sensors, data concentrators and headend

MARKET

- Measures for cost savings in network installation
- Business case for complementary use of harvesting sensors for measuring capacity, technical and nontechnical losses
- Proposals for tariff s and further incentives rewarding loss reduction

ADOPTION

- Visualization of (prevented) losses in a neighbourhood

Partners for further development

- DSO with non technical power losses and capacity issues
- Developers of software for the management of distributed grids
- Research community around grid data processing
- Research community around incentives for loss reduction
- Producers of energy harvesting sensors

Project partners

Keywords:
data collection and analysis, distribution network planning, tariff incentives, consumer behaviour, power flows, prioritizing network investments, peak shaving, detection and reduction of non-technical losses

Joint Call 2015

Total budget: € 1,018,611.-

Technological Readiness Level

Start 01.04.2016 **End 31.03.2019**

Project coordination

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https://www.era-learn.eu/network-information/networks/era-net-smartgridplus/era-net-smart-grids-plus-joint-call-for-proposals/cost-efficient-data-collection-for-smart-grid-and-revenue-assurance

ReFlex

Replicability concept for flexible smart grids considering technical, business and social design

RESULTS

TECHNOLOGY

- Simulation tool for comparing grid topologies and scalability

MARKET

- Data sets of 10 demo sites and empirical studies including scenarios
- Collection of replicability tools and good practice examples
- Replicability framework including grid layout, regulations, (collaborative) business models, actors' relationships, mission, cognitive frames
- Guidebook for the deployment of flexible, user friendly smart grids with sound market models

ADOPTION

- Methodology for creating a community of practice
- Catalogue of demands of actors in local smart grids

Partners for further development

- Planners of smart grids with a high share of renewables
- Designers of business and interaction models for local grids
- Managers of communities of practie in smart energy
- Research community around processing smart grid data
- Research community around collaborative business models

Project partners

Keywords:
community of practice, renewables, replication, local production and consumption, voltage regulation, demand side management, technology, market actor relationships, social networks, user acceptance

Joint Call 2015

Total budget: € 1,998,687.-

Technological Readiness Level

Start 01.03.2016 **End** 27.02.2019

Project coordination

AIT Austrian Institute of Technology GmbH
Klaus Kubeczko

www.reflex-smartgrid.eu

4.2 CLUSTER: GRID MANAGEMENT

Projects in the cluster grid management developed solutions for optimising the technical operation of transmission and distribution grids. Important goals were load management and voltage regulation. The tools ranged from automated software for comprehensive monitoring and control to simulations for peak shaving and visualizations for plant management. The researchers also created guidelines for smart grid planning tailored to national regulations as well as tariffs reacting dynamically to market and grid signals.

MIDAS
Multi-input intelligent distribution automation system

SMARES
Configurable energy management system for renewable power plants and smart grids

SmartGuide
Planning and operation principles for cost-efficient distribution grid management

FISMEP
FIWARE for Smart Energy Platform

LarGo!
Large-Scale Smart Grid Application Roll-Out

Poweralliance

Flexibility market platform for regional load shaping

Poweralliance

Flexibility market platform for regional load shaping

RESULTS

TECHNOLOGY

- Hard- and software platform for efficient management of grid capacity based on market signals
- Catalogue of grid support options and simulation models for flexible loads
- Aggregation of peak shaving flexibility for grid-optimized regional load shaping

MARKET

- Pilot business model with defi ned processes and stakeholder incentives
- Pricing model sensitive to demanded security of supply

ADOPTION

- Simulation platform for visualizing complex systems
- Catalogue of stakeholder preferences for use and provision of flexible loads (incl. industry and commerce)

Partners for further development

- Distribution grid planners and operators
- Developers of market platforms for flexibility
- Designers of business models for flexibility
- Developers of software and solutions for peak shaving
- Providers of fl exibility
- Developers of solutions for complex systems
- Research and development community around grid capacity

Project partners

Keywords:
flexibility, market platform, tariff design, dynamic market & grid signals, stakeholder needs, grid capacity, simulation, peak shaving, load shaping

Joint Call 2015

Total budget: € 5,702,658.-

Technological Readiness Level

Start 01.02.2016 **End 31.03.2019**

Project coordination

Alpiq Digital AG
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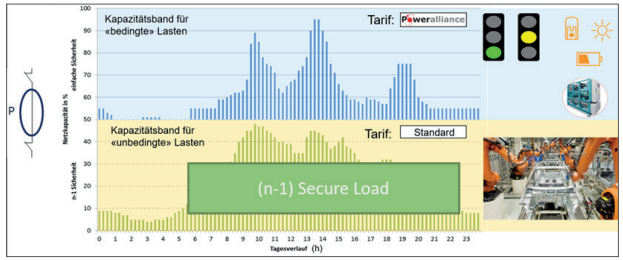
Yves.wymann@alpiq.com

www.zhaw.ch/no_cache/en/research/research-database/project-detailview/projektid/2465/

Through the Poweralliance tariff, the conditional use of the redundant grid capacity becomes attractive to the grid users. We developed metering and control devices, software and ensured data security and grid scheduling. Powealliance realized the Regional Load Shaping and verified the technical functionality in different scenarios of grid congestion. The curtailment mechanism of the traffic light system guarantees the respect of grid constraints. This secures the investments in the new assets.

Key Result 1
Forget security of supply (for decarbonization only)

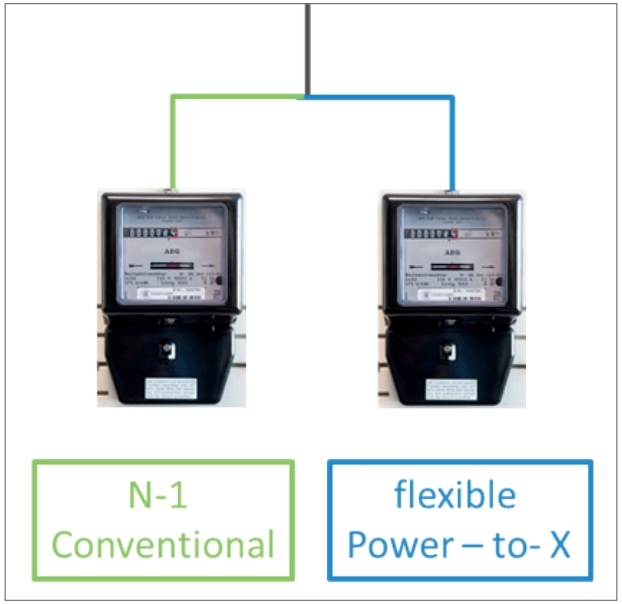
Sector coupling (Power to X) is:
– Purely price driven - not demand driven
– Grid capacity upgrades are needed
– PtX does not need security of supply

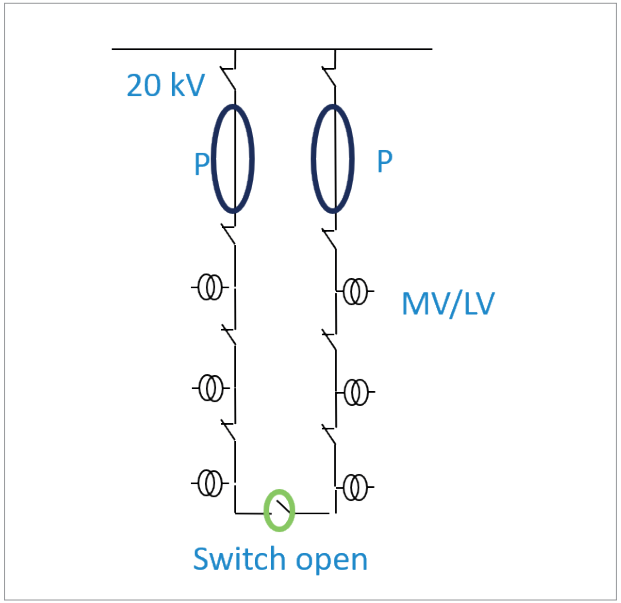


Key Result 2
Electricity is NOT electricity and diesel is NOT heating oil

Heat: Electricity not competitive against fossil fuels
Transport: PtL not competitive against fossil fuels

1. Special purpose electricity MUST be cheap (CO2 expensive)
2. Do not touch energy only price signal (use grid and levies and taxes instead)





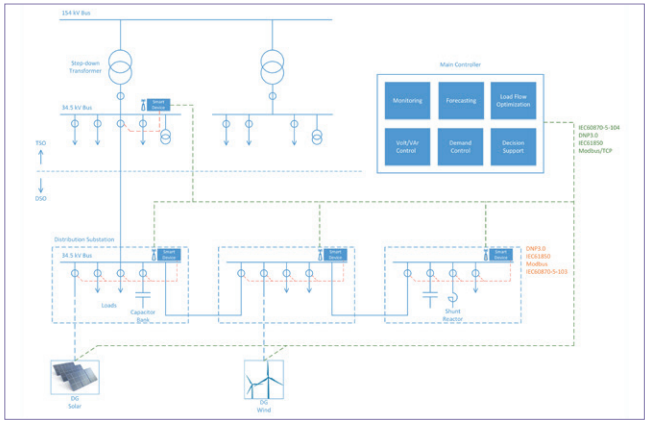
MIDAS

Multi-input intelligent distribution automation system

RESULTS

TECHNOLOGY

- Volt/VAR management system for generating maximum capacity
- Central automated control software for the distribution grid including monitoring, prediction and optimization
- Algorithms processing sensor and forecast data for load management and voltage regulation
- Designs for low-cost, smart devices and remote sensors with SCADA communication standards



Partners for further development

- Distribution grid planners and operators
- Research community around sensor data collection and processing (via algorithms)
- Developers of control software for distribution networks
- Developers of real-time monitoring and forecasting tools
- Developers of smart devices and remote sensors
- Research communities around interoperability of smart devices and remote sensing

Project partners

Keywords:
automated distribution grid management, remote sensing, forecasting

Joint Call 2015

Total budget: € 1,187,076.-

Technological Readiness Level

Start 01.02.2016 **End 30.06.2018**

Project coordination

T4E Energy
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alper.terciyanli@t4e.com.tr

www.eranet-smartenergysystems.eu/global/images/cms/Content/Fact%20Sheets/ERANetSmartGridsPlus_MIDAS_FactSheet.pdf

SMARES

Configurable energy management system for renewable power plants and smart grids

RESULTS

TECHNOLOGY

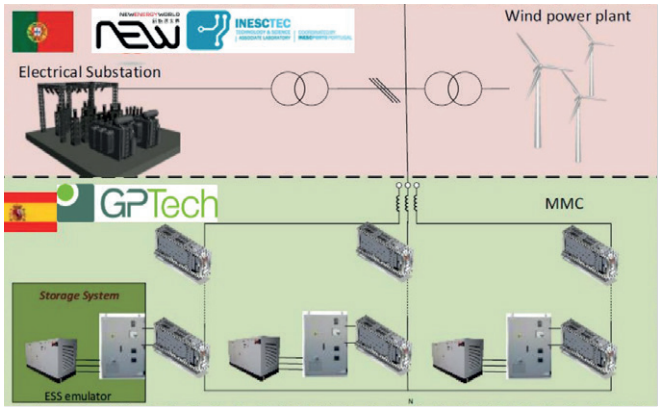
- Electronic equipment for real-time control of (re)active power for grid stability (HESS)
- High power density module requiring 35% less space
- Power plant management system for power balancing and peak shaving
- Hot-swapping feature for system reliability
- Modular multilevel converter incl. storage modules for integrating renewables in the high voltage grid

MARKET

- Catalogue of converter use cases and performance rating
- Power rate system for reduction of CAPEX by 50%

Partners for further development

- Grid code development community
- Transmission system operators
- Research community around (re)active power management
- Operators of power plants
- Research community around high voltage grid resilience
- Developers of energy management systems



Project partners

SMARES

Keywords:
storage, grid codes, monitoring and control, configurable ICT system, high voltage, grid stability, plant management

Joint Call 2015

Total budget: € 1,400,00.-

Technological Readiness Level

Start 01.04.2016 **End 01.04.2018**

Project coordination

GREEN POWER SYSTEMS s.r.l.
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https://www.eranet-smartenergysystems.eu/global/images/cms/Content/Fact%20Sheets/ERANetSmartGridsPlus_SMARES_FactSheet.pdf

SmartGuide

Planning and operation principles for cost-efficient distribution grid management

RESULTS

TECHNOLOGY

- Simulation tools for automated grid planning (low voltage) and curtailment prediction for distributed resources
- Method for network expansion planning
- Tools and methods for approximating the operational impact of flexibility (medium voltage grids)

MARKET

- Catalogue of country-specific conditions (incl. legal) for smart grid technology and market applications
- Estimates for network reinforcement savings by implementation of smart technology
- Characterisations of new market roles around mobility and flexibility

ADOPTION

- List of policy recommendations for reduced barriers
- Demand and generation profiles on household level with varied incorporated smart technology
- Best practice guidelines for smart grid planning and operation

Partners for further development

- Experts for flexibility in distribution networks
- Planners of (distributed) low voltage grids
- Developers and adopters of innovative technology for grid planning and operation
- Operators of low and medium voltage grids
- Designers of business models around flexibility
- Research community around demand and generation profiles
- Research community around differences in European regulation

Project partners

BERGISCHE UNIVERSITÄT WUPPERTAL

smarter grid solutions

INESCTEC

SINTEF

Skagerak Energi

SmartGuide

Keywords:
guidelines, grid planning, flexibility, distribution grid, smart technology, regulatory and market barriers

Joint Call 2015

Total budget: € 3,148,843.-

Technological Readiness Level

Start 01.04.2016 End 31.03.2019

Project coordination

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https://archivierte-website.uni-wuppertal.de/?www.smartguide.uni-wuppertal.de/en/era-net-smart-grids-plus.html

FISMEP

FIWARE for Smart Energy Platform

RESULTS

TECHNOLOGY

- Validated open source automation services for MVDC networks
- Platform with distributed architecture and semantics for energy efficiency, performance and user-based adaptation of energy systems
- District Heating Energy Management (CESO)
- ERO app for residents' energy usage

MARKET

- Innovative SOA platform as open source for rapid implementation of IoT solutions and newly built apps
- Test sites for complex testing of platforms

ADOPTION

- Use case evaluation with standards like SAREF and other ontologies
- Methods for engaging customers to test flexibility
- Supporting new business models for e.g. customer involvement

Partners for further development

- Open source technology providers
- Distribution system operators
- RDI projects
- Developer of energy management systems
- Energy providers
- Municipalities
- Housing associations

Project partners

Keywords:
smart grids, automation, smart energy, cloud platform

Joint Call 2016

Total budget: € 2,872,000.-

Technological Readiness Level

Start 01.12.2017 **End 30.11.2020**

Project coordination

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Flexible Electrical Networks (FEN) Research Campus
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www.fismep.de

LarGo!

Large-Scale Smart Grid Application Roll-Out

LarGo! Large-Scale Smart Grid Application Roll-Out

RESULTS

TECHNOLOGY

- Knowledge-based deployment process for smart grid applications
- Method for identification of security and safety critical issues
- Resilient optimal rollout-schedules through rollout analysis and validation
- Evidential networks for the identification of root causes of rollout failures

MARKET

- Software maintenance for field devices as a service

ADOPTION

- Guidelines and best practices for seamless, safe and secure application deployment for grid and customer
- Templates for communication and workshops with stakeholders

Partners for further development

- Utility operators
- Energy management operators
- System integrators
- Scientific community
- Communication/ICT operators

Project partners

Keywords:
resilience, smart grid applications, security, software deployment

Joint Call 2016

Total budget: € 2,473,534.-

Technological Readiness Level

Start 01.05.2017 End 30.04.2020

Project coordination

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Friederich Kupzog friederich.kupzog@ait.ac.at

https://www.offis.de/offis/projekt/largo.html

4.3 CLUSTER: TSO/DSO INTERFACE

In the cluster TSO/DSO interface, projects worked on the coordination between the transmission and distribution system operators. They developed diverse kinds of ancillary services to ensure system stability, such as frequency control, reactive power or voltage control. The researchers also built market models and trading options for virtual power plants.

REstable

Virtual power plant for renewables-based ancillary services

DeCAS

Technology and market integration for coordinated ancillary services covering diff erent voltage levels

VOLATILE

Voltage control on the transmission grid using wind power at other voltage levels

CALLIA

Direct and automated cooperative market for grid operators on national and transnational level for integration of local flexibility

CALLIA

Direct and automated cooperative market for grid operators on national and transnational level for integration of local flexibility

RESULTS

TECHNOLOGY

- System architecture for using flexibility close to the origin (respecting grid requirements)
- Design for lean interface between DSO and TSO
- Hardware and software agents for automated local market clearing algorithms, flexibility clustering and load control
- PLC communication technology and cascade for automated grid operation from market to energy asset

MARKET

- Catalogue of roles of actors in local balancing and trading
- Proposal for a regulatory framework and market enabling congestion management and local balancing
- Multi-actor business models for flexibility and balancing incl. incentives and constraints of stakeholders
- Market framework for regional trading integrating flexibility providers and catering to stakeholder needs

ADOPTION

- Simulation tool for scenario evaluation
- Catalogue of recommended system management strategies

Partners for further development

- Operators and experts of local markets
- Research and development community around reactive power procurement scenarios
- Aggregators and grid planners and operators
- Designers and providers of energy market places
- Experts for flexibility in transmission grids
- Developers and adopters of innovative technology for grid planning and operation
- Research community around (automated) cascaded flexibility management and communication
- Research community around energy market stakeholders

Project partners

devolo, TRANSNET BW, ISC International Solar Energy Research Center Konstanz, IEH, stadtwerke heidelberg, BOĞAZİÇİ ELEKTRİK DAĞITIM, PAVOTEK, TU WIEN TECHNISCHE UNIVERSITÄT WIEN Vienna | Austria, salzburgresearch, REstore, vito

Keywords:
automated markets, inter-DSO, DSO/TSO, system architecture, grid management, flexibility, storage systems, business models, stakeholders

Joint Call 2015

Total budget: € 4,891,805.-

Technological Readiness Level

Start 01.07.2016 **End 31.03.2019**

Project coordination

International Solar Energy Research Center Konstanz
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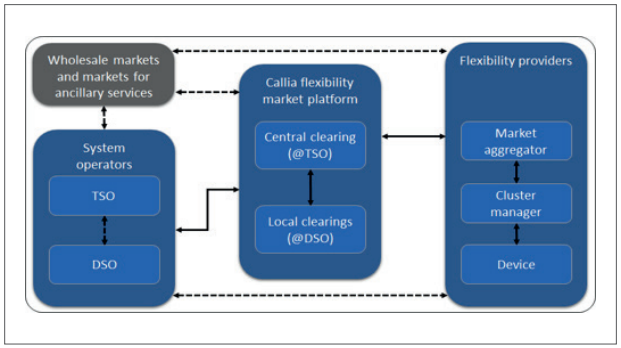
www.callia.info/en

The CALLIA cooperation scheme between grid operators and asset owners on the (trans)national level improves the integration of local flexibility. The collaboration between DSOs and TSOs is integrating markets with local clearing algorithms with TSO system-level markets by deploying flexibility at all voltage levels. Thereby it is guaranteeing stability of the European power system with increasing penetration of RES including use of electrical energy storage systems.

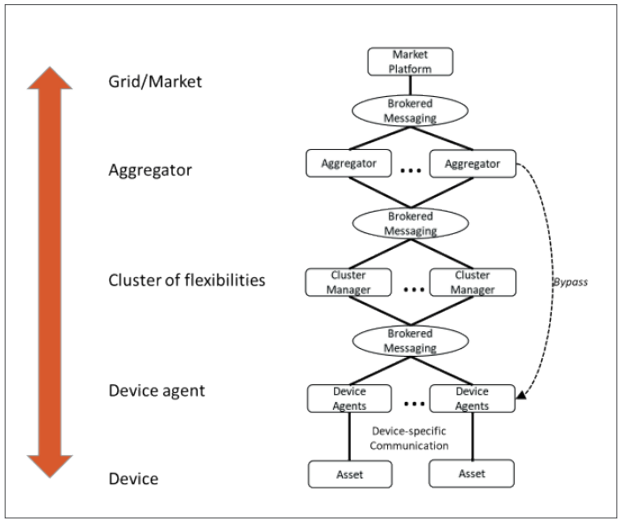
Key Result 1
The Market Framework

The CALLIA market framework is designed to address congestions at the DSO level in an integrated approach, taking also other DSOs, TSOs and asset operators into consideration. Callia uses a predictive decision making mechanism which optimizes over a receding horizon.



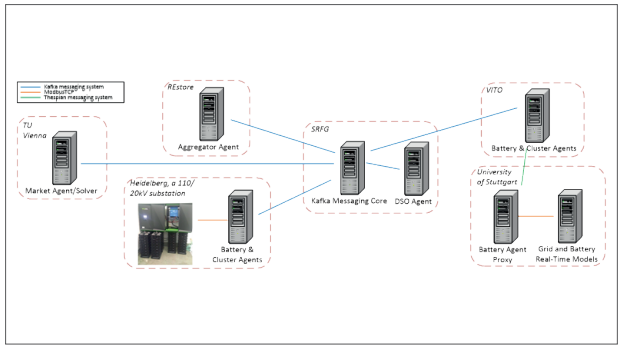
Key Result 2
The Communication Cascade

A fully automated and scalable communication cascade from market platform (top) down to the individual device level (bottom) was developed.
Reaction time for the entire cascade is below 100 ms on average and the framework allows integration of a broad range of assets.



Key Result 3
The Field Test

A hybrid approach was pursued for the field test in Heidelberg (DE) and Istanbul (TR). Real assets – P2H and battery storage – were combined with HiL (hardware-in-the-loop) simulations to both test the approach in a full working environment but also to assess the effectiveness on mitigating grid expansion in the future.



DeCAS

Technology and market integration for coordinated ancillary services covering different voltage levels

DeCAS
DEMONSTRATION OF COORDINATED ANCILLARY SERVICES

RESULTS

TECHNOLOGY

- Simulation platform for cross-voltage-level scenarios with varied distributed energy resources
- Control and monitoring system for the coordination of ancillary services (AS) across voltage levels
- Catalogue of requirements for AS at DSO/TSO level

MARKET

- Set of market mechanisms, business models and roles for AS by prosumers and responsive consumers
- Catalogue of trading options for topological and virtual power plants
- Evaluation sheet of grid codes and list of recommendations for improvements
- Assessment sheet of impact of European market frameworks on VPP participation

ADOPTION

- Catalogue of best practices for engaging prosumers

Partners for further development

- Developers and providers of ancillary services
- Providers of flexibility
- Experts in user-centered interface design
- Providers of short-term forecasts for active and reactive DER power
- Research and development community around grid codes, interfaces and interoperability
- Managers of grids (all voltage levels)
- Operators of virtual and topological power plants

Project partners

Keywords:
ancillary services, flexibility, reactive power, energy management, converter interoperability, cross-voltage levels, TSO/DSO, virtual and topological power plants

Joint Call 2015

Total budget: € 4,085,124.-

Technological Readiness Level

Start 01.02.2016 End 31.03.2019

Project coordination
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Energy Department
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Stefan Übermasser
stefan.uebermasser@ait.ac.at

https://www.era-learn.eu/network-information/networks/era-net-smartgridplus/era-net-smart-grids-plus-joint-call-for-proposals/demonstration-of-coordinated-ancillary-services-covering-different-voltage-levels-and-the-integration-in-future-markets

REstable

Virtual power plant for renewables-based ancillary services

RESTABLE PROJECT

RESULTS

TECHNOLOGY
- VPP control system aggregating distributed renewable energy resources for frequency containment and frequency restoration & replacement reserve as required by TSO
- VPP model incl. hardware, forecast tools for power generation and flexibility, reserve simulation and dispatch control algorithm considering plant & system inertia
- Evaluation methodology for renewables solutions based on forecast of weather events (EU-wide)

MARKET
- Estimates for revenue increase for renewables power plants and cost savings of reserve for grid operators

ADOPTION
- Stochastic and operational bidding tool for the VPP for bringing flexibilities to the market accounting for user behaviour

Partners for further development

- Research and development community around VPP and forecast tools
- Research and development community around inertia, frequency management and reserve simulation
- Operators and designers of renewables power plants
- Designers of market models integrating fl exibility
- Grid planners and operators
- Developers and actors of reserve markets

Project partners

Keywords:
ancillary services, renewables, stability, virtual power plant (VPP), frequency reserve, simulations, forecasting

Joint Call 2015

Total budget: € 2,984,563.-

Technological Readiness Level

Start 01.02.2016 End 31.03.2019

Project coordination
ARMINES
Center PERSEE
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www.restable-project.eu

VOLATILE

Voltage control on the transmission grid using wind power at other voltage levels

VOLATILE
TRANSMISSION GRID USING WIND POWER

RESULTS

TECHNOLOGY

- System for controlling voltage in the transmission grid by adapting voltage in wind turbines at lower voltage levels
- Voltage control strategies for medium voltage grids with distributed generation
- Voltage control algorithms, component and communication design for controllers in wind turbines, static VAR compensators and transformer tap-changers
- Analytical model for estimates of potential for reactive power provision by distribution grids

MARKET

- List of requirements for response to reactive power requests from superior grids
- Method for assessing the stability of distribution grids with distributed wind power with varied scenarios

Partners for further development

- Research and development community around interoperability, grid code implementation and TSO/DSO interfaces
- Designers of (remuneration models for) ancillary services and providers, especially reactive power support/voltage control
- Operators of medium voltage grids with distributed generation
- Operators of reactive power markets

Project partners

VATTENFALL

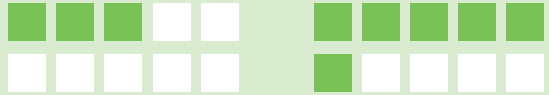
DTU Technical University of Denmark

Keywords:
wind, reactive power, DSO/TSO interface, voltage control, coordination

Joint Call 2015

Total budget: € 825,000.-

Technological Readiness Level



Start 01.02.2016 **End 30.06.2018**

Project coordination

KTH Royal Institute of Technology Sweden
Department of Electric Power and Energy Systems
Lennart Söder
lsod@kth.se

www.volatile-project.com

4.4 CLUSTER: LOCAL ENERGY COMMUNITIES AND MICROGRIDS

Projects in this cluster developed solutions for decentralized coordination in local energy communities and for the operation management of microgrids. This included for example smart grids with high production of renewables on the one hand and high consumption by electric vehicles on the other hand. They assisted municipalities with guidelines for investments into charging infrastructure and PV. To actively involve prosumers also into grid balancing, user roles were characterized and strategies also for non-economic incentives were created. Projects also developed mechanisms for guarantees of origin for renewable energy generation.

Solar Charge
Utilizing batteries in electric vehicles to store solar electricity

uGRIP
Distribution level microgrid concept integrating distributed generation sources and consumer participation

Grid-Friends
Energy management system with demand response for grid-friendly quasi-autarkic energy cooperatives

m2M-GRID
From micro to Mega-GRID: Interactions of micro-grids in active distribution networks

MATCH

Markets, actors, technologies:

A comparative study of smart grid solutions

MATCH

Markets, actors, technologies: A comparative study of smart grid solutions

RESULTS

TECHNOLOGY
- DC hardware, system-architecture and communication protocols for grid balancing with PV and storage, renewable powered company fleets and comprehensive energy concepts
- Test bed for emulating DC grids (configurable topology, grounding systems etc.)

MARKET
- Implementation guidelines for workable smart solutions considering technology, market and stakeholders requirements

ADOPTION
- Characterisation of user roles with requirements for microgrid solutions
- Catalogue of strategies and conditions for active involvement of small con-/prosumers in electricity generation and grid balancing incl. the potentials and limitations of economic incentives

Partners for further development

- Experts in long-term user involvement for smart energy
- Experts for social acceptance of smart technology
- Intermediaries between energy system planners and consumers
- Research and development community around business and market models relying on active user participation
- Designers of smart grid solutions
- Planners or smart energy systems

Project partners

Keywords:
stakeholder requirements, socio-technical networks, local anchoring, DC grids

Joint Call 2015

Total budget: € 1,353,019.-

Technological Readiness Level

Start 01.02.2016 **End** 31.07.2018

Project coordination

Aalborg University
Danish Building Research Institute
Toke Haunstrup Christensen
thc@sbi.aau.dk

www.era-learn.eu/network-information/networks/era-net-smartgridplus/era-net-smart-grids-plus-joint-call-for-proposals/markets-actors-technologies-a-comparative-study-of-smart-grid-solutions

A socio-technical analysis of smart energy solutions has been performed, considering the interplay of technologies with social matters, e.g. user aspects. The main result is that to implement a local solution, a sophisticated energy system assessment is needed. Examples from Austria, Denmark and Norway and others were studied to this question.

Key Result 1
Smart energy solutions are socio-technical

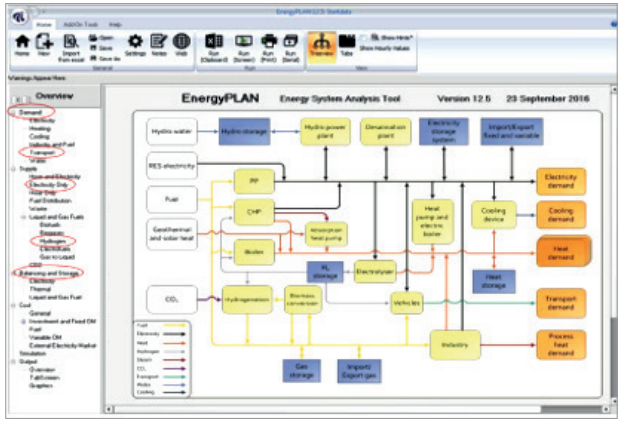
Smart energy solutions work when they are designed as socio-technical systems from early on.
The successful implementation of new solutions largely depends on a well-designed interplay of social and technical elements.
Smart grid projects must closely involve participants in order to achieve good local integration of the solutions.

Key Result 2
Users matter

Technology users play a multifaceted and decisive role in R&D projects. It is important to ensure diversity of different roles of utilisation and their associated perspectives, interests and requirements from early on.
We were able to identify six different user roles: Research partners, traditional or ordinary users, prosumers, energy citizens, affiliated users, and user-innovators.

Key Result 3
Local solutions need an energy system assessment

Solutions that work well locally do not necessarily have a significant (positive) impact from the point of view of the entire energy system. Hence, it is important to examine the various systemic effects locally successful solutions have on existing energy systems (regional, national) before replicating or up-scaling them.



Solar Charge

SOLAR CHARGE 2020

Utilizing batteries in electric vehicles to store solar electricity

RESULTS

TECHNOLOGY

- Supervisory control and data software for production and consumption in a distribution grid with high EV and PV load
- Strategies for efficient power storage and consumption reducing grid strain based on smart meter data, e.g. by adapting power consumption at EV charging stations to production

MARKET

- Scalable business model for a virtual network for realtime p2p trading of solar power
- Mechanism for issuing and trading guarantees of origin

ADOPTION

- Toolkit for municipalities and companies investing in EV charging infrastructure and PV

Partners for further development

- Municipalities and companies planning/operating PV and/or EV installations
- Designers and operators of distribution grids seeking to integrate RES and/or small producers
- Researcher community investigating EV storage solutions
- Developers of virtual networks
- Providers of software for load balancing and marketplaces for p2p trading

Project partners

UiT / THE ARCTIC UNIVERSITY OF NORWAY

TROMS fylkeskommune
ROMSSA fylkkasuohkan

Solelia GREENTECH

UPPSALA PARKERINGS AB

Uppsala kommun

Keywords:
photovoltaic power production, renewable energy sources, batteries, electric vehicles, charging stations, CO2 emissions, virtual networks, big data, low voltage, peer-to-peer (p2p)

Joint Call 2015

Total budget: € 1,414,458.-

Technological Readiness Level

Start 01.04.2016 End 31.12.2018

Project coordination

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www.era-learn.eu/network-information/networks/era-net-smartgridplus/era-net-smart-grids-plus-joint-call-for-proposals/increased-self-consumption-of-photovoltaic-power-for-electric-vehicle-charging-in-virtual-networks

uGRIP

Distribution level microgrid concept integrating distributed generation sources and consumer participation

RESULTS

TECHNOLOGY

- Framework for microgrid scheduling incl. uncertainty management
- Communication protocols for operation of microgrid components and interface to local energy markets

MARKET

- Decision support tool for DSOs and aggregators guiding daily, real-time allocation of resources and interaction at wholesale & ancillary service markets
- Operation mechanism and structure of local market for microgrid management
- Economic assessment for microgrid business cases

Partners for further development

- Planners and operators of microgrids and aggregators
- Operators of distribution grids connected to microgrids
- Developers of communication protocols for grids
- Providers of solutions for interfaces between microgrids and distribution grids
- Providers of energy management systems for microgrids
- Research community around uncertainty in grid operation
- Designers of energy market models

Project partners

DTU Technical University of Denmark

FER University of Zagreb Faculty of Electrical Engineering and Computing

OFFIS Institute for Information Technology

uGRIP microGRId Positioning

Keywords:
flexibility, microgrids, hierarchical control, simulation scenarios, optimized control, energy management systems, distribution level

Joint Call 2015

Total budget: € 1,116,73.-

Technological Readiness Level

Start 01.04.2016 **End 31.03.2019**

Project coordination

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Faculty of Electrical Engineering and Computing
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www.ugrip.eu

Grid-Friends

Energy management system with demand response for grid-friendly quasi-autarkic energy cooperatives

Grid-Friends

RESULTS

TECHNOLOGY

- Control algorithms for energy services with distributed storage units (batteries, heat buff er, EV)
- Licensable software for distributed sector-coupled energy management system and community management system
- Forecasting algorithms for PV generation, load and heat demand

MARKET

- Cooperative business models for microgrids
- Characterisation of the market actor "microgrid manager"

ADOPTION

- Decision model for eliciting user preferences

Partners for further development

- Research and development community around forecasting algorithms; multi-sector, multi-vendor energy management systems; distributed fl exibility aggregation and exchange; user preferences for energy products
- Providers of solutions for microgrids eager to test interoperability
- Developers of energy management systems
- Distribution and micro-grid operators
- Energy community pilots
- Established and emerging energy cooperatives

Project partners

Keywords:
demand response, forecasting algorithms, cooperative models, decentralized coordination, energy management system, renewables, user preferences

Joint Call 2015

Total budget: € 2,416,723.-

Technological Readiness Level

Start 01.05.2016 **End 30.04.2019**

Project coordination

Centrum Wiskunde & Informatica
Intelligent and Autonomous Systems
Michael Kaisers
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www.grid-friends.com

m2M-GRID

From micro to Mega-GRID: Interactions of micro-grids in active distribution networks

RESULTS

TECHNOLOGY

- Optimization tool for energy scheduling of multiple grid-connected micro-grids
- ICT interfaces for physical and commercial micro-grids
- Algorithms to control and exchange information to enable load sharing among micro-grids

MARKET

- Demonstration of coordinated optimal operation of two battery energy storage-based MG-EMS
- Methodologies have been developed for local markets and clustering of users
- Procurement strategies and quantification tools for flexibility for network issues
- Assessment of the impact of market design aspects on the overall market efficiency

Partners for further development

- DSOs facing capacity issues
- Developers of software for the management (of DSOs and EMS) of micro-grids
- Testbeds for local energy communities
- Designers of products and services for local grids
- Research community around incentives for loss reduction and optimal operation
- Aggregators and planners and operators of local micro-grids

Project partners

m2M-GRID

Keywords:
micro-grids, interface, storage, demand response, distribution system operators, aggregators, renewable energy sources

Joint Call 2016

Total budget: € 2,957,057.-

Technological Readiness Level

Start 01.02.2017 End 31.03.2020

Project coordination

RISE Research Institutes of Sweden
Future Energy Systems
Magnus Brolin
magnus.brolin@ri.se

https://m2m-grid.eu/

4.5 CLUSTER: RESILIENCE

The projects of this cluster developed solutions for a resilient grid infrastruc-ture, especially for distribution grids with a high share of renewables or congestion issues. They evaluated risks and benefits for prosumers to provide ancillary services contributing to grid stability. With artificial intelligence, patterns could be detected in user charging behavior to better forecast power use. With these approaches, grid maintenance was improved and the risk of failures or outages of the grid was minimized.This improves energy planning and maintenance for grid operarators.

DC Smart
Integrating smart DC distribution grid technologies

CloudGrid
Transnational cloud for interconnection of demonstration facilities for smart grid lab research & development

GReSBAS
Gamification for energy management in buidlings

RestoreGrid4RES
Supply Security, Restoration Strategies, Control Center Tools, RES Utilisation, Smart Ancillary Service

EPR
Pattern recognition for optimized grid parameter management

EPR

Pattern recognition for optimized grid parameter management

European Pattern Recognition project

RESULTS

TECHNOLOGY

- Control software for automatic asset management enabling streamlined preventive maintenance
- Monitoring and forecasting tool for power, power quality and energy for planning and operating transmission and distribution systems
- DC microgrid concept with PV, batteries and flexible power conversion for ancillary services to the grid
- Tools for detecting EV charging patterns and multicriteria evaluation of capacity for hosting renewables
- Catalogue of potentials and risks for curtailing power use by voltage reduction
- Database of grid parameters, e.g. power quality

ADOPTION

- Approach for user-friendly visualization of grid capacity, consumption and flexibility potentials
- Characterisation of consumer segments based on consumption and generation patterns

Partners for further development

- Grid operators and providers of grid maintenance services
- Research and development community around AI for forecasting energy data
- Research and development community around DC grids and components
- Operators of renewable energy sources
- Developers of innovative, data-driven solutions for grid management
- Ancillary service providers
- Planners of highly independent microgrids

Project partners

Keywords:
AI, pattern recognition, smart meters, grid parameters, grid maintenance & operation, inertia, utilities, renewables, EV, distributed generation, web-based tools

Joint Call 2015

Total budget: € 1,600,000.-

Technological Readiness Level

Start 01.03.2016 **End 28.02.2018**

Project coordination
Metrum Sweden AB
info@metrum.se

www.europeanpatternrecognition.eu

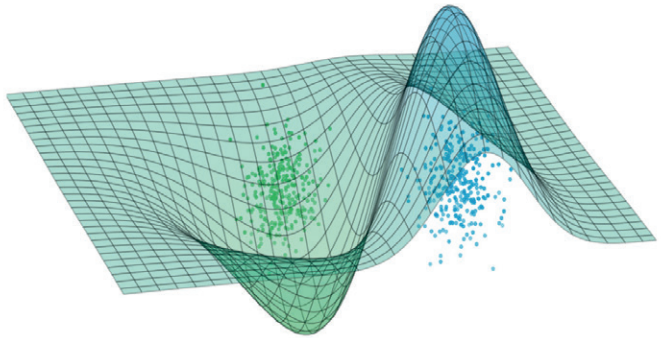
Combining AI with simple calculations is optimal. "Big data" are already available from several sources, e.g. smart meters & PQ metering. EPR developed visualisation tools, enabling clients to realise the value: savings potential. Regulators should set incentives towards solutions that avoid future problems, enabling increased share of renewables and set standards for metering based on requirements for analysis, not only billing.

European Pattern Recognition project

Key Result 1
Forecasting

PROACT.
A pro-active system solution using PQ data and AI for trend forecasts that can be used to avoid severe disturbances.

Multi-tool.
A web-based prototype multi-tool based on PR technology that visualizes and forecasts electrical grid capacities and identifies potential flexibility.



Key Result 2
Micro-grid concept, solar power plant monitoring

Micro-grid concept.
A modular, scalable and flexible micro grid system was developed and demonstrated, where batteries and a smart controller were used to maximise the use of solar energy.

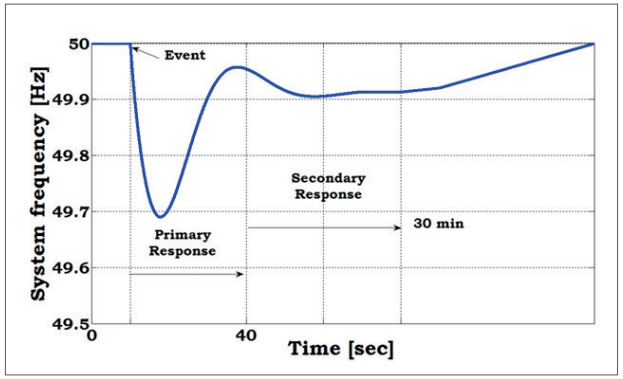
Solar power plant monitoring.
EPR compared 2 systems for fault detection and diagnosis of large-scale grid-connected PV systems.

Key Result 3
Improved hosting capacity, conservation voltage reduction, inertia support

Improved hosting capacity.
Creating higher accuracy than regular theoretical calculations used today, EPR improved the tool for grid operators to assess the capacity for hosting renewable energy.

Conservation Voltage Reduction (CVR).
A study on possibilities to curtail the power use in a grid by reducing voltage levels. The need of predictable load patterns and detailed information about load composition is crucial.

Inertia support by wind turbines.
ENERJISA's BARES wind farm has been modelled to provide part of its kinetic energy for inertial support.



DCSmart

Integrating smart DC distribution grid technologies

DC Smart
www.dcsmart.eu

RESULTS

TECHNOLOGY
- Modular DC/DC power converter design
- Protection strategies and design topologies for meshed DC grids
- Models and algorithms for congestion management
- Algorithms for increased system reliability with automatic islanding and reconnection

MARKET
- Decentralised real-time market models connected to the physical grid allowing for prosumer participation

ADOPTION
- Proof of concept for selected prosumer integration solutions

Partners for further development

- Planners and operators of distributed grids with high share of renewables and/or congestion issues
- Developers of (DC) grid component
- Research and development community around grid design and resilience
- Developers of algorithms for grid operation
- Developers of models for flexibility markets

Project partners

Fraunhofer IISB
csem
TU Delft
TU/e
DIRECT CURRENT BV

Keywords:
DC grids, volatile distributed resources, market clearing algorithms, modular scalable smart grid components, grid operator cooperation

Joint Call 2015

Total budget: € 2,063,286.-

Technological Readiness Level

Start 01.02.2016 **End 31.03.2019**

Project coordination

Delft University of Technology
Prof. Dr. Pavol Bauer
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www.dcsmart.eu/

CloudGrid

Transnational cloud for interconnection of demonstration facilities for smart grid lab research & development

RESULTS

TECHNOLOGY

- Transnational cloud platform for smart grid labs with data, methodologies, test results and catalogue of resources
- List of parameters and requirements fo converter interoperability
- Comprehensive map of ancillary services including technical evaluation

MARKET

- Method for evaluation of risks and benefits of providing ancillary services by prosumers
- Market design for many participants on supply and demand side and renewables integration

ADOPTION

- Catalogue of recommended actions for safeguarding grid stability
- Catalogue of recommended system management strategies

Partners for further development

- Operators and users of grid labs
- Research and development community of ancillary services
- (Potential) providers of ancillary services
- Experts in regulatory issues relevant for ancillary services
- Experts in payment schemes and incentives for ancillary services
- Developers of converters
- Grid operators
- Developers and planners of market models

Project partners

Keywords:
smart sockets, grid resilience, ancillary services, risk and benefit analysis, converter interoperability, energy management, validation of grid lab results, grid lab cooperation, renewables, distributed energy resources, AC/DC hybrid grids

Joint Call 2015

Total budget: € 2,300,000.-

Technological Readiness Level

Start 01.03.2016 **End 31.03.2019**

Project coordination

ABB Asea Brown Boveri Ltd
ABB Power Consulting
Michael Calder
michael.calder@no.abb.com

https://www.aramis.admin.ch/Kategorien/?ProjectID=37233

GReSBAS

Gamification for energy management in buidlings

GRESBAS

RESULTS

TECHNOLOGY

- ICT system for meter data collection, storage and analysis
- Energy monitoring and management application for residential and commercial buildings including algorithms for automated grid services
- Game-like mechanisms for active participation in demand response

ADOPTION

- Catalogue of incentives for energy efficient behaviour
- User interface displaying individual performance and ranking, energy education and personalized suggestions

Partners for further development

- Research community around meter data collection and processing
- Developers of building automation and energy management systems
- Research communities around demand response, active participation and end-user education
- Experts for long term user engagement (collaborative and competitive approaches)
- Experts for energy management performance evaluation based on smart meter data
- Developers of energy applications for end-users

Project partners

ITU MAKEL INESCTEC

Keywords:
gamification, smart buildings, energy management, demand response, distribution grid support, automated response, end-user activation, energy data processing

Joint Call 2015

Total budget: € 665,058.-

Technological Readiness Level

Start 01.04.2016 **End 31.03.2019**

Project coordination

Istanbul Technical University
Prof. Dr. Aydogan Ozdemir
ozdemiraydo@itu.edu.tr

https://gresbas.eu/en/

RestoreGrid4RES

Strategies and operator tools for grid restoration with massive renewable energy sources

RESULTS

TECHNOLOGY

- Modelling strategy for artificial LV- and MV-grids
- Residual load models for restoration process studies
- Supporting tools for the restoration of grids with a high share of RES

MARKET

- Specification and implementation guidelines for restoration tools
- Strategies for future grid restoration

ADOPTION

- Overview on grid restoration challenges considering high shares of renewables

Partners for further development

- Transmission System Operators
- Distribution System Operators
- Control center manufacturers

Project partners

Keywords:
Supply Security, Restoration Strategies, Control Center Tools, RES Utilisation, Smart Ancillary Service

Joint Call 2016

Total budget: € 977,859.-

Technological Readiness Level

Start 01.05.2017 **End** 30.04.2020

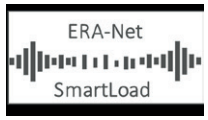
Project coordination

University of Kaiserslautern
Chair for Energy Systems and Energy Management
Prof. Dr.-Ing. Wolfram Wellßow
wellssow@eit.uni-kl.de

https://www.eit.uni-kl.de/en/esem/research-development/transmission-systems/restoregrid4res/

4.6 CLUSTER: DEMAND RESPONSE AND CONSUMER ACTIVATION

In this cluster, the projects optimized the matching of demand and supply of energy in different contexts. In the market layer, this included contracts for smart markets and business models for energy cooperatives. Local applications demonstrate what models for decentralized energy markets could look like. With user-centered approaches, the projects were able to improve social acceptance and user collaboration. Technical solutions ranged from a flexible simulation environment, monitoring and control algorithms to automation for local optimization.



SmartLoad
Smart Meter Data Analytics for Enhanced Energy Efficiency in the Residential Sector

NEMoGrid
New Energy Business Models in the Distribution Grid

E-REGIO
Smart Community Markets

EMBS
Energy Management Building Set

MatchIT

Efficient demand and supply matching by incentivizing end-users in buildings

MatchIT

Efficient demand and supply matching by incentivizing end-users in buildings

RESULTS

TECHNOLOGY

- User-proof building energy management systems
- Scalable, automated ICT platform for supply-demand matching
- Automated control designs based on algorithms for innovative, integrated futur demand-supply management

MARKET

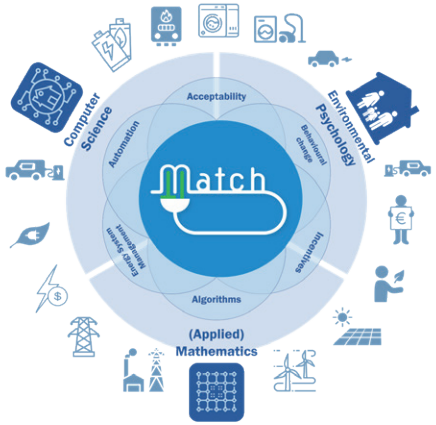
- Models for local energy markets
- Management schemes for energy savings
- Analysis of key incentives for promoting demand-supply matching

ADOPTION

- Integration of social aspects in models
- User control preferences
- Motive-based incentives and interventions

Partners for further development

- Network operators
- Distribution and micro-grid operators
- Developers of energy management systems
- Energy service companies
- Energy companies aiming to provide energy feedback and automated control solutions
- Owners and managers of buildings
- (Local) governments and policy makers



Project partners

university of groningen

KUNGL TEKNISKA HÖGSKOLAN

ELLEVIO

METRY

Keywords:
smart grids, flexible demand-response, user acceptability, control systems, intelligent buildings, living labs

Joint Call 2016

Total budget: € 1,424,704.-

Technological Readiness Level

Start 01.04.17 **End 31.03.20**

Project coordination

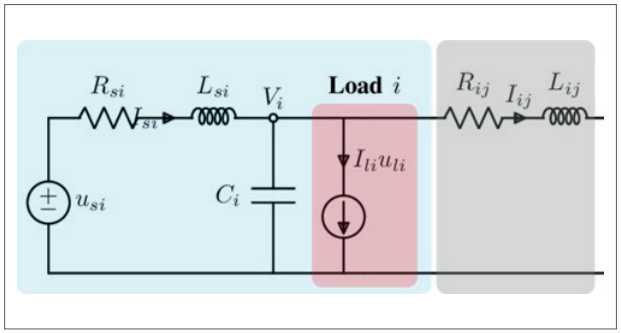
University of Groningen Environmental Psychology
info@matchit.info

www.matchit.info

Key findings regarding demand-supply management:
Firstly, control algorithms and ICT-solutions should consider technical, physical and social aspects of energy grids.
Secondly, social aspects can – and should – be incorporated in technology-oriented energy system models.
Third, social and environmental motives can be more important than financial motives.
Last but not least, giving end-users some (feeling of) control can enhance engagement, but too much control may backfire.

Key Result 1
Social Control Algorithms

MatchIT developed control algorithms to optimize demand-supply matching by building users, while accounting for social aspects (e.g., their motives, preferences, goals).



Key Result 2
ICT platform for demand-supply matching

MatchIT designed an ICT platform coupled with automation to optimize demand-supply matching by building users, while accounting for social aspects

Key Result 3
Identification of key motives and incentives

Identification of key motives, incentives and other user aspects that need to be considered when developing and designing energy solutions.

SmartLoad

Smart Meter Data Analytics for Enhanced Energy Efficiency in the Residential Sector

RESULTS

TECHNOLOGY
- Machine learning prediction methods for household efficiency characteristics and consumer behaviour
- Algorithms to identify electricity base load of households

MARKET
- Targeting tool to identify customers likely to switch to an eco-tariff
- Prospecting tool to identify customers willing to invest in sustainable energy systems for generation and storage

ADOPTION
- Customer segments with interest to adopt sustainable energy products
- Design principles for prediction systems to individualize offers and consultancies for end-customers

Partners for further development

- Energy utilities
- Electricity retailers
- Vendors of renewable Energy systems like heat pumps or photovoltaic installation
- Research communities interested in Energy feedback and dissemination of sustainable products
- Data analytics / artificial intelligence Vendors

Project partners

CKW. BEN Energy

ERA-Net SmartLoad

Keywords:
data analytics, smart meter, machine learning, forecasting

Joint Call 2016

Total budget: € 802,378.-

Technological Readiness Level

Start 01.06.16 **End 31.03.20**

Project coordination

University of Bamberg
Energy Efficient Systems Group
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https://www.uni-bamberg.de/eesys/forschung/forschungsprojekte/abgeschlossene-projekte/

NEMoGrid

New Energy Business Models in the Distribution Grid

RESULTS

TECHNOLOGY
- Python package for short-term forecasting tool
- Simulation environment with grid simulation tools for agent-based modelling of interaction between end-users and grid
- Ethereum smart contracts for energy markets

MARKET
- Mechanisms for the right definition of the electricity market price
- Criteria for the evaluation of the economic profitability of energy communities
- Design for a mutual win-win market, with a benefit and cost pooling system

ADOPTION
- Consumer/prosumer requirements for different business models and market designs
- User-centered approaches enhancing social acceptance and user collaboration

Partners for further development

- Local municipalities in cooperation with their citizen
- Communities of pro- and consumers
- Distribution grid operators and related business administrators interested in business models for DERs integration
- Researchers interested in user-centered design of self-consumption communities
- User researchers interested in acceptance and gamification concepts for distributed energy resource (DER) management

Project partners

NEMoGrid

Keywords:
business models, participation, prosumer, consumer, peer-to-peer market, blockchain

Joint Call 2016

Total budget: € 1,322,000.-

Technological Readiness Level

Start 01.04.17 **End** 31.03.20

Project coordination

University of Applied Sciences and Arts of Southern Switzerland (SUPSI)
Vasco Medici
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www.nemogrid.eu

E-REGIO

Smart Community Markets

RESULTS

TECHNOLOGY
- ICT platform for a decentralized, local energy market with neighbourhood battery as market center supported by software agents
- System for providing flexibility to TSOs based on aggregating residential offers and smart charging
- Monitoring, forecast and optimization tools for the provision of flexibility

MARKET
- Validated business model for stacked flexibility services for the frequency market
- Flexibility services for households

ADOPTION
- Approaches for negotiating with local authorities
- Guidelines for local market designs including best practice for implementation

Partners for further development

- Technology suppliers for battery storage, ICT and hybrid technologies
- DSOs and TSOs of distributed grids with high renewables share and frequency market
- Building owners aiming to improve the building environment
- Research and development community of flexibility market, smart energy and EVs
- Experts with AI technology in energy fields

Project partners




E-REGIO

Keywords:
local markets, end-user engagement, digitalization, business models

Joint Call 2016

Total budget: € 2,933,326.-

Technological Readiness Level

Start 01.02.17 **End** 31.08.20

Project coordination

Smart Innovation Norway
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www.eregioproject.com

EMBS

Energy Management Building Set

RESULTS

TECHNOLOGY

- ICT architecture for a heterogeneous multi-vendor system
- Energy monitoring and controlling architecture
- Forecast tool to optimize the provision of thermal and electric energy
- Automated control application for local optimization based on comprehensive data sets (price, weather, consumption)

MARKET

- Strategies for optimizing KWKG benefits
- Sensitivity analysis for CO2 pricing, e.g.: Energy Sources Act

ADOPTION

- Feedback from EMBS prototype installation at partner side
- Feedback from EMBS backend installation (security, firewall, backup)

Partners for further development

- Model Developers
- Modelers of Design Tools
- Integration architects
- Energy communities
- Energy contractors
- Housing associations
- Power System integrators
- Local Energy communities

Project partners

Keywords:
demand response, aggregator, energy cooperatives

Joint Call 2016

Total budget: € 1,367,492.-

Technological Readiness Level

Start 01.08.17 **End** 31.03.20

Project coordination

Salzburg Research Forschungsgesellschaft
Thomas Pfeiffenberger
thomas.pfeiffenberger@salzburgresearch.at

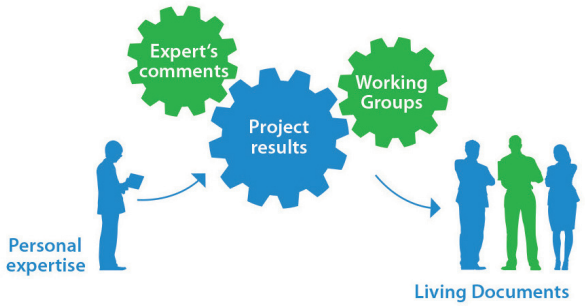
www.srfg.at/embs

5 STAY IN TOUCH WITH ERA-NET SES

Researchers and Practitioners in Smart Energy and Related Fields

Join expera, the knowledge exchange and cooperation platform for smart energy on **www.smartgridsplus.eu** to gain access and contribute to Working Groups and their Living Documents on

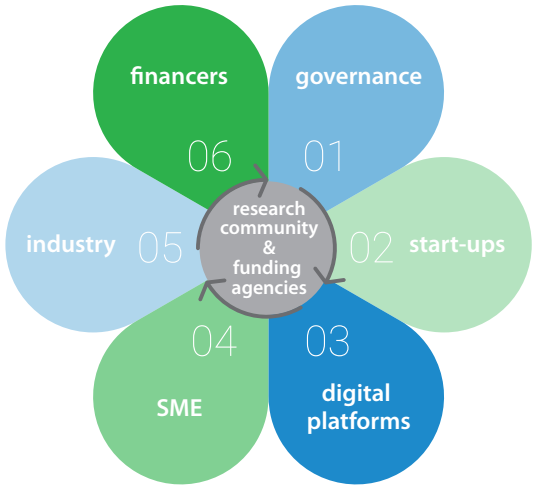
- Regulatory and Market Development
- Consumer and Citizen Involvement
- Storage and Cross Energy Carrier Synergies
- Standards and Interoperability
- Regional Matters and Energy Communities



Owners of Resources and Representatives of Stakeholders for Smart Energy Solutions

Join the Joint Programming Platform as ERA-Net SES Associated Partner and build bridges to …

- exploit innovative technological and business solutions
- exchange with policy and decision makers to create business opportunities
- scope the next call and generate funding for the topics relevant to your target group



Current associated partners and further information:
www.eranet-ses.eu/ASP

National and Regional Agencies Aspiring to Funding Clean Energy Research

Join the Joint Programming Platform ERA-Net SES and:

- shape our upcoming call,
- exchange with fellow decision makers and
- support smart energy research, development and demonstration in your region or country!

Current funding partners and further information:
https://www.eranet-smartenergysystems.eu/About/Funding_Partners

Contact us to become part of the smart energy innovation ecosystem:
office@eranet-smartenergysystems.eu

6 PROJECT OUTPUTS: EXPLOITABLE RESULTS ON TECHNOLOGY, MARKET AND ADOPTION LAYERS

The following subchapters provide an overview on the outputs of projects of the Joint Programming Platform ERA-Net SES Joint Calls 2015 and 2016. It reveals how projects cover the topics of Smart Grids broadly and deeply, generating results which provide valuable contributions to theory and practice. This is how projects create broad impact, leveraged by the initiative's dissemination support.
The Key Exploitable Results (KER) are especially highlighted. These outputs are solutions developed by the projects which are ready for market uptake.

6.1 Technology Layer

This layer includes results focusing on cross energy carrier solutions, grid automation, telecommunications, machine learning, technological research etc.

PROJECT	OUTPUT	CATEGORY	KER
CALLIA	System architecture for using flexibility close to the origin (respecting grid requirements)	ICT design	x
CALLIA	Design for lean interface between DSO and TSO	Interface design	
CALLIA	Hardware and software agents for automated local market clearing algorithms, flexibility clustering and load control	Hardware and software for automated market agents	x
CALLIA	PLC communication technology and cascade for automated grid operation from market to energy asset	Communication hardware and architecture	
CESEPS	Network modelling methodology for AC and DC with EV, demand side management, customer safety and storage	Grid modelling method	x
CESEPS	Tools for sustainability and energy-efficiency rating of smart grid pilots	Evaluation software	x
CESEPS	Co-simulation framework combining real and simulated elements	Simulation framework	
CloudGrid	Transnational cloud platform for smart grid labs with data, methodologies, test results and catalogue of resources	ICT platform	x
CloudGrid	List of parameters and requirements for converter interoperability	Catalogue	
CloudGrid	Comprehensive map of ancillary services including technical evaluation	Map	x
DeCAS	Simulation platform for cross-voltage-level scenarios with varied distributed energy resources	Simulation software	x
DeCAS	Control and monitoring system for the coordination of ancillary services (AS) across voltage levels	Management software	x
DeCAS	Catalogue of requirements for AS at DSO/TSO level	Catalogue	

PROJECT	OUTPUT	CATEGORY	KER
EMBS	ICT architecture for a heterogeneous multi-vendor system	ICT system	
EMBS	Energy monitoring and controlling architecture	Management software	x
EMBS	Forecasting tool to optimize the provision of thermal and electric energy	Forecasting tool	x
EMBS	Automated control application for local optimization based on comprehensive data sets (price, weather, consumption)	Application	x
EPR	Control software for automatic asset management enabling streamlined preventive maintenance	Management software	x
EPR	Monitoring and forecasting tool for power, power quality and energy for planning and operating transmission and distribution systems	Management software	x
EPR	DC microgrid concept with PV, batteries and flexible power conversion for ancillary services to the grid	Grid design	
EPR	Tools for detecting EV charging patterns and multicriteria evaluation of ca-pacity for hosting renewables	Management software	x
EPR	Catalogue of potentials and risks for curtailing power use by voltage reduction	Catalogue	
EPR	Database of grid parameters, e.g. power quality	Database	
E-REGIO	ICT platform for a decentralized, local energy market with neighbourhood battery as market center supported by software agents	ICT platform	x
E-REGIO	System for providing flexibility to TSOs based on aggregating residential offers and smart charging	ICT platform	x
E-REGIO	Monitoring, forecast and optimization tools for the provision of flexibility	Management tools	

PROJECT	OUTPUT	CATEGORY	KER
FISMEP	Design and implementation of open source automation services for MVDC networks	ICT system	x
FISMEP	Platform with distributed architecture and semantics for energy efficiency, performance and user-based adaptation of energy systems	ICT system	
FISMEP	District Heating Energy Management (CESO)	Management software	x
FISMEP	ERO app for residents' energy usage	Application	x
GReSBAS	ICT system for meter data collection, storage and analysis	ICT System	x
GReSBAS	Energy monitoring and management application for residential and commer-cial buildings including algorithms for automated grid services	Management software	x
GReSBAS	Game-like mechanisms for active participation in demand response	Gamification software	x
Grid-Friends	Control algorithms for energy services with distributed storage units (batter-ies, heat buffer, EV)	Algorithm	x
Grid-Friends	Licensable software for distributed sector-coupled energy management sys-tem and community management system	Management software	x
Grid-Friends	Forecasting algorithms for PV generation, load and heat demand (Grid-Friends)	Forecasting model	x
LarGo!	Knowledge-based deployment process for smart grid applications	Process	
LarGo!	Method for identification of security and safety critical issues	Method	x
LarGo!	Resilient optimal rollout schedules through rollout analysis and validation	Rollout process	
LarGo!	Evidential networks for the identification of root causes of rollout failures	Strategy	x
m2M-Grid	Optimization tool for energy scheduling of multiple grid-connected micro-grids	Forecasting software	
m2M-Grid	ICT interfaces for physical and commercial microgrids validated	Interface design	x
m2M-Grid	Algorithms to control and exchange information to enable load sharing among micro-grids	Algorithm	
MATCH	Concepts for DC hardware, system architecture and communication protocols for grid balancing with PV and storage, renewable powered company fleets and comprehensive energy concepts	ICT design	x
MATCH	Test bed for emulating DC grids (configurable topology, grounding systems etc.)	Simulation software	
MatchIT	User-proof building energy management systems	Management software	x
MatchIT	Scalable, automated ICT platform for supply-demand matching	ICT system	x

PROJECT	OUTPUT	CATEGORY	KER
MatchIT	Automated control designs based on algorithms for innovative, integrated future demand-supply management	Algorithm	x
MIDAS	Volt/VAR management system for generating maximum capacity	ICT system	x
MIDAS	Central automated control software for the distribution grid including moni-toring, prediction and optimization	Management software	x
MIDAS	Algorithms processing sensor and forecast data for load management and voltage regulation	Algorithm	x
MIDAS	Designs for low-cost, smart devices and remote sensors with SCADA com-munication standards	Hardware design	
NEMoGrid	Python package for short-term forecasting tool	Forecasting software	x
NEMoGrid	Simulation environment with grid simulation tools for agent-based modelling of interaction between end-users and grid	Simulation software	x
NEMoGrid	Ethereum smart contracts for energy markets	Blockchain contract design	x
Poweralliance	Hard- and software platform for efficient management of grid capacity based on market signals	ICT platform	x
Poweralliance	Aggregation of peak-shaving flexibility for grid-optimized regional load shaping	Method	
Poweralliance	Catalogue of grid support options	Catalogue	
Poweralliance	Simulation models for flexible loads	Simulation models	
ReFlex	Simulation tool for comparing grid topologies and scalability	Simulation software	x
REStable	Virtual power plant (VPP) control system aggregating distributed renewable energy resources for frequency containment and frequency restoration and replacement reserve as required by TSO	Software	x
REStable	VPP model incl. hardware, forecast tools for power generation and flexibility, reserve simulation and dispatch control algorithm considering plant and system inertia	ICT system	x
REStable	Evaluation methodology for renewables solutions based on forecast of weather events (EU-wide)	Method	x
RestoreGrid4RES	Modelling strategy for artificial LV- and MV-grids	Modelling software	x
RestoreGrid4RES	Residual load models for restoration process studies	Models	x
RestoreGrid4RES	Supporting tools for system operators for grid restoration in grids with a high share of RES	ICT system	x

PROJECT	OUTPUT	CATEGORY	KER
RIGRID	Design and control tool for AC microgrids delivering: – optimal corridors for MV/LV lines, positions and sizes for DGS, RES, BESS, MV/LV transformers – estimation of RES and non-RES generation – evaluation of power and heat grid parameters incl. loads and consumption – optimization for minimized energy imports/ power loss/ energy generation mix/ operational costs or for maximized profits	Management software	x
SMARES	Electronic equipment for real-time control of (re) active power for grid stabil-ity (HESS)	Hardware	x
SMARES	Power plant management system for power balancing and peak shaving	ICT system	x
SMARES	Hot-swapping feature for system reliability	Software	x
SMARES	Modular multilevel converter incl. storage modules for integrating renewa-bles in the high voltage grid	Hardware	x
SMARES	High power density module requiring 35% less space	Hardware	x
SmartGuide	Simulation tools for automated grid planning (low voltage) and curtailment prediction for distributed resources	Simulation software	x
SmartGuide	Method for network expansion planning	Method	x
SmartGuide	Tools and methods for approximating the operational impact of flexibility in medium voltage grids	Software and method	x
SmartLoad	Machine learning prediction methods for household efficiency characteris-tics and consumer behaviour	Forecasting model	x
SmartLoad	Algorithms to identify electricity base load of households	Algorithm	x
SolarCharge	Supervisory control and data software for production and consumption in a distribution grid with high EV and PV load	Management software	x
SolarCharge	Strategies for efficient power storage and consumption reducing grid strain based on smart meter data, e.g. by adapting power consumption at EV charging stations to production	Strategy	
uGRIP	Framework for microgrid scheduling incl. uncertainty management	Scheduling framework	
uGRIP	Communication protocols for operation of microgrid components and inter-face to local energy markets	Communication protocol	
VOLATILE	System for controlling voltage in the transmission grid by adapting voltage in wind turbines at lower voltage levels	Software	x
VOLATILE	Voltage control strategies for medium voltage grids with distributed genera-tion	Method	
VOLATILE	Voltage control algorithms, component and communication design for con-trollers in wind turbines, static VAR compensators and transformer tap-changers	Algorithm, hardware design and communication design	
VOLATILE	Analytical model for estimates of potential for reactive power provision by distribution grids	Algorithm	x

6.2 Market Layer

Results regarding market design with news goods and services, business models, regulatory framework, economic research, etc are in-cluded in this layer.

PROJECT	OUTPUT	CATEGORY	KER
CALLIA	Catalogue of roles of actors in local balancing and trading	Catalogue	
CALLIA	Proposal for a regulatory framework and market enabling congestion management and local balancing	Framework	
CALLIA	Multi-actor business models for flexibility and balancing incl. incentives and constraints of stakeholders	Model	x
CALLIA	Market framework for regional trading integrating flexibility providers and catering to stakeholder needs	Framework	
CESEPS	Specifications and implementation guidelines for the development of products and services	Data set	
CESEPS	Medium- and long-term scenarios for local smart grids	Framework	x
CloudGrid	Method for evaluation of risks and benefits of providing ancillary services by prosumers	Catalogue	x
CloudGrid	Market design for many participants on supply and demand side and renewables integration	Software tool	
DeCAS	Set of market mechanisms, business models and roles for AS by prosumers and responsive consumers	Evaluation tool	
DeCAS	Catalogue of trading options for topological and virtual power plants	Evaluation tool	
DeCAS	Evaluation sheet of grid codes and list of recommendations for improvements	Business model	x
DeCAS	Assessment sheet of impact of European market frameworks on VPP participation	Mechanism	x
EMBS	Strategies for optimizing KWKG benefits		

PROJECT	OUTPUT	CATEGORY	KER
EMBS	Sensitivity analysis for CO2 pricing, e.g.: Energy Sources Act		x
E-REGIO	Validated business model for stacked flexibility services for the frequency market	Business model	x
E-REGIO	Flexibility services for households	Service	
FISMEP	Innovative SOA platform as open source for rapid implementation of IoT solutions and newly built apps	Coordination mechanisms	x
FISMEP	Test sites for complex testing of platforms	Impact assessment	
Grid-Friends	Cooperative business models for microgrids	Software	x
Grid-Friends	Characterisation of the market actor "microgrid manager"	Software	
LarGo!	Software maintenance for field devices as a service	Set of criteria	x
m2M-Grid	Demonstrated, coordinated optimal operation of two battery energy storage-based MG-EMS	Strategies and software tools	
m2M-Grid	Assessment of the impact of market design aspects on the overall market efficiency	Service design	
m2M-Grid	Procurement strategies and quantification tools for flexibility for network issues	Pricing method	
MATCH	Implementation guidelines for workable smart solutions considering technology, market and stakeholders' requirements	Guidelines	
MatchIT	Models for local energy markets	Method	x
MatchIT	Management schemes for energy savings	Guideline	x
MatchIT	Analysis of key incentives for promoting demand-supply matching	Operation strategies	
NEMoGrid	Mechanisms for the right definition of the electricity market price	Market design	x
NEMoGrid	Criteria for the evaluation of the economic profitability of energy communities	Market design	x
NEMoGrid	Design for a mutual win-win market, with a benefit and cost pooling system	Management scheme	
Poweralliance	Pilot business model with defined processes and stakeholder incentives	Model	x
Poweralliance	Pricing model sensitive to demanded security of supply	Model	x
ReFlex	Data sets of 10 demo sites and empirical studies including scenarios	Guidebook	x
ReFlex	Replicability framework including grid layout, regulations, (collaborative) business models, actors' relationships, mission, cognitive frames	Method	

PROJECT	OUTPUT	CATEGORY	KER
ReFlex	Guidebook for the deployment of flexible, user friendly smart grids with sound market models with a collection of replicability tools and good practice examples	Market design	x
REStable	Estimates for revenue increase for renewables power plants and cost savings of reserve for grid operators	Method	
RestoreGrid4RES	Specification and implementation guidelines for restoration tools	Business strategies	x
RestoreGrid4RES	Strategies for future grid restoration	Pricing method	
RIGRID	Financial analysis for power plant and BESS investments considering: – energy costs (via Levelized Unit Energy Cost) – economic benefits (incl. feed-in incentives & coupled storage)	Evaluation tool	x
SMARES	Catalogue of converter use cases and performance rating	Catalogue	
SMARES	Power rate system for reduction of CAPEX by 50%	Estimates	x
SmartGuide	Catalogue of country-specific conditions (incl. legal) for smart grid technology and market applications	Definitions	
SmartGuide	Estimates for network reinforcement savings by implementation of smart technology	Estimates	
SmartGuide	Characterisations of new market roles around mobility and flexibility	Requirements catalogue	
SmartLoad	Targeting tool to identify customers likely to switch to an eco-tariff	Platform	
SmartLoad	Prospecting tool to identify customers willing to invest in sustainable energy systems for generation and storage	Test site	x
SolarCharge	Scalable business model for a virtual network for real-time p2p trading of solar power	Management tool	x
SolarCharge	Mechanism for issuing and trading guarantees of origin	Mechanism	
uGRIP	Decision support tool for DSOs and aggregators guiding daily, real-time allocation of resources and interaction at whole-sale & ancillary service markets	Evaluation tool	x
uGRIP	Operation mechanism and structure of local market for microgrid management	Model	
uGRIP	Economic assessment for microgrid business cases	Definition	x
VOLATILE	List of requirements for response to reactive power requests from superior grids	Framework	
VOLATILE	Method for assessing the stability of distribution grids with distributed wind power with varied scenarios	Catalogue	x

6.3 Adoption Layer

Results in this layer include innovation and transition processes with stakeholders, consumer acceptance, education, policy, retail, community and society, social research and adjacent areas.

PROJECT	OUTPUT	CATEGORY	KER
CALLIA	Simulation tool for scenario evaluation	Simulation tool	x
CESEPS	Catalogue of user demands for smart energy products and services	Catalogue	
CESEPS	Overview on required changes in energy practices and related barriers	Catalogue	
CESEPS	A new design for a HEMS developed by industrial designers and tested and improved by end-users	HEMS Design	
CESEPS	20 new product concepts for SEPS	Product design	
CESEPS	Three individual design concepts for energy Apps and a solar home charging kit for e-bikes	App and product designs	
CESEPS	Design for a solar charging station for e-bikes (installed at UT)	Product design	
CloudGrid	Catalogue of recommended actions for safeguarding grid stability	Catalogue	
CloudGrid	Catalogue of recommended system management strategies	Catalogue	
DeCAS	Catalogue of best practices for engaging prosumers	Catalogue	
EMBS	Feedback from EMBS prototype installation at partner side	Catalogue	x
EMBS	Feedback from EMBS backend installation (security, firewall, backup)	Catalogue	
EPR	User-friendly visualization of grid capacity, consumption and flexibility potentials	Design	
EPR	Characterisation of consumer segments based on consumption and generation patterns	Definition	
E-REGIO	Approaches for negotiating with local authorities	Strategy	
E-REGIO	Guidelines for local market designs including best practice for implementation	Strategy	x
FISMEP	Use case evaluation with standards like SAREF and other ontologies	Evaluation	
FISMEP	Methods for engaging customers to test flexibility	Customer engagement process	
FISMEP	Supporting new business models for e.g. customer involvement	Framework	x
GReSBAS	Catalogue of incentives for energy efficient behaviour	Catalogue	
GReSBAS	User interface displaying individual performance and ranking, energy education and personalized suggestions	Software tool	x
Grid-Friends	Decision model for eliciting user preferences	Model	x
LarGo!	Guidelines and best practices for seamless, safe and secure application deployment for grid and customer	Guideline	x
LarGo!	Templates for communication and workshops with stakeholders	Method	
m2M-Grid	Methodologies for clustering users	Method	
MATCH	Characterisation of user roles with requirements for microgrid solution	Definition	
MATCH	Catalogue of strategies and conditions for active involvement of small con-/prosumers in electricity generation and grid balancing incl. the potentials and limitations of eco-nomic incentives	Catalogue	
MatchIT	Integration of social aspects in models	Modelling approach	
MatchIT	User control preferences	Catalogue	
MatchIT	Motive-based incentives and interventions	Method	
NEMoGrid	Consumer / prosumer requirements for different business models and market designs	Catalogue	x
NEMoGrid	User-centred approaches enhancing social acceptance and user collaboration	Method	x
Poweralliance	Simulation platform for visualizing complex systems	Simulation tool	x
Poweralliance	Catalogue of stakeholder preferences for use and provision of flexible loads (incl. industry and commerce)	Catalogue	
ReFlex	Methodology for creating a community of practice	Method	x
ReFlex	Catalogue of demands of actors in local smart grids	Catalogue	
REStable	Stochastic and operational bidding tool for the VPP for bringing flexibilities to the market accounting for user behaviour	Bidding tool	x
RestoreGrid4RES	Overview on grid restoration challenges considering high shares of renewables	Catalogue	x
RIGRID	3D virtual reality tool for visualizing local system configurations, improving communication and enabling acceptance testing with stakeholders	Software tool	x

PROJECT	OUTPUT	CATEGORY	KER
SmartGuide	List of policy recommendations for reduced barriers	Policy recommen-dations	
SmartGuide	Demand and generation profiles on household level with varied incorporated smart technology	Data set	x
SmartGuide	Best practice guidelines for smart grid planning and operation	Guidelines	
SmartLoad	Customer segments with interest to adopt sustainable energy products	Catalogue	
SmartLoad	Design principles for prediction systems to individualize offers and consultancies for end-customers	Guidelines	x
SolarCharge	Toolkit for municipalities and companies investing in EV charging infrastructure and PV	Toolkit	x

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