

## SCIENTIFIC CONTENT

**Title:** Unleashing Network Flexibility through Managed Storage and Demand Diversity – UNIFLEX

**Abstract:**

European Parliament and Council endorsed an integrated approach to combat climate change and increase the EU's energy security by setting climate and energy targets to be met by the year 2020 ("20-20-20 scenario"). In order to answer these challenges, new solutions are required for existing energy networks, infrastructures and resources. There is a general consensus that these solutions should use advanced and secure communication, sensing and metering/monitoring technologies for a more flexible, efficient and reliable management of energy supply and demand (so called "Smart Grids"). The proposed UNIFLEX Project aims to coordinate ongoing and planned research efforts of its partners related to a greater control and flexibility of bi-directional energy flows and better regulation of generation, storage and demand-responsive resources of future Smart Grids, and to further explore how their benefits can be maximised, ultimately resulting in enhanced quality of supply and system security.

**Key Words:** energy management, **information and communication technologies**, network security and trust, distributed energy generation and storage, demand response, smart grids, renewable resources, power quality, security and reliability, decarbonisation.

**Preferred COST Domain:** Information and Communication Technologies (ICT)

**Text of proposal:**

### BACKGROUND, PROBLEMS

A lot of effort is recently directed towards "Smart Grid Solutions", with a number of large research projects, trials and demonstrations initiated all over the world. Some examples of projects on Smart Grid implementation of ICT in EU FP7 are: DLC-VIT4IP, E-PRICE, HiPerDNO, INTEGRIS, MIRACLE, NOBEL, OpenNode, SmartHouse/SmartGrid, ICT4SMARTDG, SEESGEN-ICT; COST has approved the ICT Action IC0804: "Energy efficiency in large scale distributed systems", while in the US EPRI has launched IntelliGridSM and CRIEPI in Japan has established a project TIPS, or Triple I. Most of the UNIFLEX partners are or have been already deeply involved with this important area of research, at the level of either national or international projects. There are, however, several key issues that require immediate attention and further coordinated development and research:

#### **1. Successful network integration of multiple distributed generation/storage resources**

There are no validated models of aggregate distributed resources (generation and electrical/thermal energy storage) and aggregate models of demand-responsive loads. There are currently no transparent procedures and methodologies for their coordinated control, required for maximizing their effects, impacts and benefits. The true nature of non-dispatchable stochastic storage/generation resources and demand can only be determined and fully explored on a large scale by applying sophisticated probabilistic modelling tools together with appropriate incentives and market solutions (prices, tariffs, rewards/penalties, etc.).

#### **2. Implementation of new ICT infrastructures**

Although it is clear that the efficient operation and control of non-dispatchable storage/generation requires advanced ICT solutions, it is still matter of discussion what communications standards and protocols should be used, or how they should be unified and interfaced in cases when different proprietary solutions are implemented by different stakeholders. Furthermore, there is still uncertainty regarding what information is required at different levels and locations in the network, about different network components, and how this information should be stored and secured, and how quickly processed, etc.

#### **3. Realization of responsive demand capabilities through the involvement of consumers**

Although the overall concept is relatively clear there is an ongoing debate as to what incentives and rewards should be applied for different consumers, how they should be implemented in different end-

use applications, how the feedback to consumers should be provided and how motivation and willingness to respond to different DSM/DR interventions can be enhanced.

#### **4. Development of tools and systems for improved control and management**

Different and even conflicting requirements (and interests) of all involved parties pose questions about hierarchical implementation and prioritization of different signals and interventions, as well as their actual values for different parties. Additionally, development, validation and implementation of accurate multi-scale models are still a target to aim for.

#### **BENEFITS**

The main purpose of this multidisciplinary proposal is to investigate the opportunities and challenges of managing dispersed storage and responsive-demand resources in power systems through the full integration with ICT systems. It will strongly promote the interdomain cooperation of ICT and power system experts in establishment of a Forum focused on:

- identification of the current status of deployment of energy storage technologies across European grids,
- the drivers and opportunities for further development and implementation of ICT-enabled electricity networks,
- the flexibility required for new services accessible by Smart Grids,
- exchanging information and avoiding duplication of efforts in international cooperation in R&D,
- contributing towards full social and technological cohesion across Europe.

#### **OBJECTIVES, DELIVERABLES AND EXPECTED SCIENTIFIC IMPACT**

The idea behind establishing UNIFLEX Research Network within COST Action is to allow efficient coordination and exchange of research expertise in several distinctive areas currently scattered across various institutions in Europe and to facilitate common platform for further advancement and cross-fertilization of knowledge. The UNIFLEX network has several clearly defined aims:

- to coordinate and integrate ongoing and future research activities aimed at decarbonising and improving efficiency of energy supply systems,
- to allow knowledge transfer between European research centres,
- to establish long-term multidisciplinary research network fully capable of successfully bidding for major EU research grants and projects,
- to educate and inform policymakers, utilities, network operators, regulators, consumers and other stakeholders about cost-effective solutions for full network flexibility, and
- to disseminate robust solutions for flexible and intelligent use of distributed generation, storage and demand-responsive resources in future electricity network.

The main objectives of UNIFLEX are:

1. Identify key generation/storage technologies and associated knowledge extraction techniques to fulfil the requirements for flexible electricity generation and delivery, with the ability to react in real-time for trading, demand management (including electrification of transport) and value added services insuring full voltage and power quality control.
2. Contribute to identifying appropriate communication infrastructure and data management tools based on smart sensors, actuators and data acquisition devices, together with enhanced processing/control software.

The following activities and deliverables are envisaged:

- assessment of scientific technological prospects and exploitation concept, recommendations for policy and sustainable development,
- organization of meetings and events: presentations, workshops and seminars,
- training and study programme (distant learning, certification scheme, Webinars, summer schools, exchange visits of young researchers, etc),
- dissemination activities: newsletters, leaflets, web portal, blogs, international meetings and conferences, white papers, guidelines/brochures, workshop proceedings, etc.,
- reports: on scientific technological prospects and exploitation concepts, periodical progress reports, final reports with key project results and policy recommendations.

Expected scientific impact:

- identification of the required level and consequent impact of full integration and reliance on ICT for delivery of flexible networks of the future,
- adopting common advanced scientific methods, tools, models and technologies to facilitate smooth transition to Smart Grids,
- extending the level of scientific knowledge and expertise of involved researchers and other stakeholder throughout the Europe and within participating countries in particular.

### **SCIENTIFIC PROGRAMME AND INNOVATION**

This Action will establish a dialogue platform for researchers, policy and decision-makers with relation to network flexibility through managed storage and demand diversity, that are required for the following applications:

- forecasting and balancing,
- full network integration of energy (electrical and thermal) storage,
- wide-scale deployment of plug-in (hybrid) electric vehicles,
- extension of conventional micro-grid and Virtual Power Plants with energy storage,
- observability, monitoring and stability of active electricity networks with energy storage,
- reliable data acquisition, processing and knowledge extraction,
- delivery of improved quality of supply and energy efficiency,
- novel control procedures for distributed storage in distribution networks,
- optimal sizing of storage system (based on the involved charging/discharging technologies, which is currently unsolved problem) to cost-effectively maximize impact (e.g. reduce network losses, improve efficiency and overall quality of supply),
- Demand Side Management/Demand Response,
- agent technology,
- distributed and wireless sensors and other communication technologies in online power quality monitoring,
- distributed computing and data security,
- communication methods and technologies.

### **ORGANISATION**

The UNIFLEX will establish an open and flexible framework, enabling participating researchers to develop common specifications and requirements for implementation of flexible and controllable energy storage systems in power networks. It will further initiate pre-normative cooperation in the countries concerned with these issues and strongly encourage and facilitate involvement of any other country/research centre willing to join the Action. This action is one of the possibilities for Western Balkan countries to participate in EU research activities.

This becomes acute in the framework of Smart Grids integrating electric mobility and distributed energy storage. Not only one sees the interest in a merge of perspectives but also the industry needs guidelines – utilities, equipment manufacturers and service providers. The ambition of UNIFLEX is, therefore, to help in building the atmosphere of multidisciplinary cooperation and knowledge, experience and expertise exchange across Europe. The research advances achieved in different projects, by different researchers and in separate areas of knowledge, will be integrated within the UNIFLEX framework to promote cooperation and data exchange, and opens opportunity for synthesis over a diversity of uncoordinated actions that are taking place in Europe. Action UNIFLEX also provides a science network across EU to boost research potential by bringing together scientists to cooperate on Smart Energy Grids to meet the challenges of smart infrastructures, whilst contributing to the needs of society and to EU policies in terms of innovation, sustainable growth, energy and environmental targets.

### **Participants interested in network:**