Inter-TSO Project on Data Management
Overview of existing legislation, standards and R&D projects

Elering AS

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Introduction

The purpose of this report is to give an overview of the existing documentation related to the topics closely connected to electricity consumption data exchange in the international energy grid. The focus of the report is specifically consumption data exchange with a broad audience of various participants in the energy market and not limited to national data hubs or metering data. The report covers existing and upcoming EU legislation, closely related standards and recently completed and ongoing R&D projects overviews.

The energy grid in Europe is intertwined and affected by each state and service provider. Data regarding electricity consumption has never before been as abundantly generated as it is now in the era of Big Data and therefore can be a valuable source of information to balance supply with demand. When the topic of metering data processing has been addressed and regulated, this is not the case with end user electricity consumption data. The position regarding collecting and processing consumption data varies across states in terms of regulation and across energy providers in terms of advancement in adoption information technology. A common understanding of governing energy consumption mass data would contribute to level and stabilise the energy grid on an international scale.

Using consumption information to display the trends and fluctuations would empower the customers to better understand opportunities of the competitive energy market and facilitate the producers to even further efficiency and consumer focus in short term as well as on the strategic level. Standardising the principles of gathering and processing consumption data covering both technology fundamentals and matters of privacy and security would create a baseline for developing a sustainable network of data hubs across Europe. The precedence of neutral exchange of market information has been made in the Nordic region and the interest in the initiative is spreading across Europe with a number of countries attempting to set the foundation to their own data sharing environment. An example of providing consumers with tools towards a more knowledgeable consumption has been made with the Estfeed[1] platform publishing aggregated data and applications to analyse the data. It is a challenge to develop a single homogenous model or a set of rules to fit all, and undetermined if such a model can at all be created, but initial steps towards different countries cooperating have been made by NordREG outlining the different maturity levels of information sharing environment in terms of data exchange operating models, rights of market participants, and regulation by law in their report of May 2015[2]. In the Nordic region NordREG offers support in developing individual countries data hubs in order to improve international cooperation in the Nordic region and to promote legal and institutional framework and cooperation necessary for development of energy markets.

Electricity consumers would benefit from analysis performed based on data in centralised data hubs by getting ad hoc information about their consumption for example via e-service as well as enabling reaction to market developments by choosing best value proposition available on market and endorse switching between providers. Service providers would benefit from a unified architecture and platform of consumption data identifying business opportunities and inducing innovation on a shared pan-European knowledge base. Insight drawn on the base of data hubs links flexibly energy wholesale and retail markets and supports interoperability for market participants. Exchange of such data will contribute the most in an environment of a selection of energy producers (e.g. internationally if there is a single producing entity

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[1] Estfeed project webpage http://estfeed.ee/en/
[2] Mapping TSO and DSO roles and responsibilities related to information exchange, NordREG, 2015, available at http://www.energimarknadsinspektionen.se/Documents/Publikationer/nordisk_slutkundsmarknad/THEMA%20Report%202015-02%20Mapping%20of%20TSO%20and%20DSO%20responsibilities%20related%20to%20information%20exchange.pdf

in-state), where a consumer can act as a stabilising factor on the demand side. Data hubs could be the source of an unbiased presentation of consumption data ensuring the privacy of consumption of individual consumers and security of data collected.

The challenges of establishing consumption information include agreeing on a common approach regarding data management and developing a universal protocol of processing the data. Due to existing monopolies in the energy sector in several states, the entity in charge of operating a data hub plays a crucial role preserving neutrality in presenting the information as the *independent source of truth*. To ensure the neutral interpretation of the obtained knowledge, some countries have established isolated organisations governing the data processing, but other models of data exchange and operators have also been created depending on the country specific roles and participants in the energy sectors. ENTSO-E data exchange platforms current status overview[3] describes the different models in operation and development.

The course of R&D is directed by R&D plans, EU framework program funding, implementation plans and roadmaps. ENTSO-E monitors closely the progress of research and innovation concerning electricity in Europe and publishes the results in monitoring reports. ICT and Digitalisation of Power System is categorised as cluster 5 in ENTSO-E Research and Innovation Roadmap 2017-2026. In that cluster the topics of Big Data and Internet of Things are projected as the focal points for the years 2017-2021 followed by Standardisation & data exchange and Cybersecurity for the years 2022-2026. ENTSO-E also monitors coverage of Smart Grid related topics and assesses which topics have been sufficiently covered by research projects and achieved results, and which topics are in need of further attention in the foreseen future. This describes the background for the progress made so far in the specific topic of electricity consumption data exchange in Europe and lays out the endeavours for the coming years – electricity consumption data exchange is not the main focus in the imminent future but is expected to prevail in 5 years.

The European Commission Joint Research Centre mentions the need to define an open standard model to ensure interoperability in data exchange and enable the appearance in new business models and services in their Strategic Energy Technology (SET) Plan[4] Theme 6. Based on the funding decisions made by the European Commission, more emphasis at this point of time is on renewable energy and electric vehicles development projects. There are numerous projects in these areas and electricity consumption data exchange is a rather narrow field in the broader picture. European Commission plays an important role in leading the direction and pace being in charge of funding R&D projects. Among the organisations mentioned ENTSO-E stands out in including consumption data exchange in the development roadmap and keeping the topic in perspective in planning further development activities.

Beyond Europe the leading role in consumption data exchange is in the USA, where the Green Button initiative[5] demonstrates the maturity of energy grid in terms of energy markets participants, standardisation organisations and law maker's cooperation. The Green Button Alliance relies on the foundation laid by standards that have been developed along the years, and regulation to promote standard format of consumption data and making metering data available to customers. The initiative to form such form of cooperation was triggered by the state side to develop a rich industry ecosystem of operators, vendors, technology integrators, policy makers, regulatory agencies, actors involved in transmission and others.

Whereas in the USA regulation by standards has evolved to the extent to regulate electricity consumption data exchange between market participants, CENELEC in cooperation with IEC has not yet achieved that

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[3] Data Exchange Platforms for Electricity in Europe: State of Play, ENTSO-E, 2015
[4] Strategic Energy Technology (SET) Plan, available at
https://setis.ec.europa.eu/system/files/Towards%20an%20Integrated%20Roadmap_0.pdf
[5] Green Button Initiative website http://www.greenbuttondata.org/

level of maturity and the main focus of results presented by Technical Committee 8 System Aspects of Electrical Energy Supply is on the Smart Grid and metering data collection in general.

Glossary of Terms

CENELEC – European Committee for Electrotechnical Standardization

EC – European Commission

ENTSO-E – European Association of Transmission System Operators for Electricity

EU – European Union

I(C)T – Information (and Communication) Technology

IEC – International Electrotechnical Commission

JRC – Joint Research Centre of European Commission

NAESB – North American Energy Standards Board

R&D – Research and Development

TSO – Transmission System Operator

Existing and Upcoming EU Legislation

Below is the list of most important regulations and directives enacted by the European Parliament, European Council and/or European Commission. These legal acts relate to the operation of information exchange platform governing (personalised) electricity consumption data. The acts are divided whether they relate directly to the information exchange platform or indirectly if they govern aspects which are not core to platform's purpose.

REGULATIONS

Title	Status	Link to the platform's purpose and scope of application	Link to the regulation
Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)	In force, applicable from 25 May 2018.	Indirect link. Regulates processing and protection of personal data. As the data provided on the platform is about identifiable consumers then data protection regulation must be adhered.	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32016R0679
Regulation (EC) No 45/2001 of the European Parliament and of the Council of 18 December 2000, on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data.	In force.	Indirect link. Regulates processing and protection of personal data. As the data provided on the platform is about identifiable consumers then data protection regulation must be adhered.	http://eur-lex.europa.eu/legal-content/en/ALL/?uri=celex:32001R0045
Regulation (EU) No 526/2013 of the European Parliament and of the Council of 21 May 2013 concerning the European Union Agency for Network and Information Security (ENISA) and repealing Regulation (EC) No 460/2004 Text with EEA relevance	In force.	Indirect link. Regulates the establishment of European Union Agency for Network and Information Security, which will, *inter alia*, support Member States, at their request, in their efforts to develop and improve the prevention, detection and analysis of and the capability to respond to network and information security problems and incidents, and provide them with the necessary knowledge. The agency may assist in development of common framework of platforms.	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R0526
Regulation (EU) No 1227/2011 of the European Parliament and of the Council of 25 October 2011 on wholesale energy market integrity and transparency	In force.	Indirect link. Regulates market participants' obligation to provide a record of wholesale energy market transactions to the Agency for the Cooperation of Energy Regulators. Final customers with a consumption	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32011R1227

		capacity exceeding set threshold may also be subject to regulation. As the platform includes information to be disclosed then the platform could be used for collection of information.	
Commission Regulation (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection	In force, applicable from 18 August 2019.	Indirect link. Establishes obligation to equip transmission-connected demand facilities to exchange information with TSO's with the specified time stamping according to the standards specified by the relevant TSO. The standards established by TSO are important to ensure proper collection of information from the customers.	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32016R1388

DIRECTIVES

Title	Status	Link to the platform's purpose and scope of application	Link to the directive
Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC	In force. Transposition period elapsed.	Directly link. Regulates the customers' right to receive consumption data and exchanging on consumption data between market participants. These rights correspond directly to the platforms' purpose.	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32009L0072
Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC	In force. Transposition period elapsed.	Direct link. Articles 9-11 regulate the use of smart meters, what information must be collected from the final customers and what information and how must be made available to the final customers and third parties. These rights correspond directly to the platforms' purpose.	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32012L0027
Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data	In force. Transposition period elapsed.	Indirect link. Regulates processing and protection of personal data. As the data provided on the platform is about identifiable consumers then data protection regulation must be adhered.	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31995L0046
Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications)	In force. Transposition period elapsed.	Indirect link. Regulates the processing of personal data in the electronic communication sector and free movement of such data. As the data provided on the platform is about identifiable consumers then data protection regulation must be adhered.	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32002L0058
Directive (EU) 2015/1535 of the European Parliament and of the Council of 9 September 2015 laying down a procedure for the	In force. Transposition period	Indirect link. Regulates drafting of technical regulations for information society services. If technical regulations are drafted for the	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32015L

provision of information in the field of technical regulations and of rules on Information Society services	elapsed.	services provided through platform, then such regulations must be processed according to the regulation.	1535
Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union	In force, transposition date 9 May 2018 and 10 May 2018.	Indirect link. Regulates security of networks and information systems. The platform operator must identify risks and take appropriate measures to manage the risks.	http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32016L1148

GUIDELINES

Title	Status	Link to the platform's purpose and scope of application	Link to the guideline
Framework Guidelines on Electricity Balancing	In force.	Indirect link. Gives guidelines on aggregated electricity data exchange, not specific only to consumption data exchange.	http://www.acer.europa.eu/en/Electricity/FG_and_network_codes/Electricity%20FG%20%20network%20codes/FG-2012-E-009.pdf
Interoperability Guidelines	In draft	Indirect link.	Unavailable publicly

Related Standards

Compared to data exchange from smart meters, which is well regulated by standards in the EU, consumption data exchange is not. Until the formulation of specific standards, general practices and requirements on data processing can be applied. For the future creating standards and protocols for consumption data exchange one can turn to existing technical standards documentation, but more relevant documentation is at place overseas in the USA.

CENELEC

CENELEC is the European Committee for Electrotechnical Standardization and is responsible for standardization in the electrotechnical engineering field. CENELEC prepares voluntary standards, which help facilitate trade between countries, create new markets, cut compliance costs and support the development of a Single European Market. CENELEC creates market access at European level but also at international level, adopting international standards wherever possible, through its close collaboration with the International Electrotechnical Commission (IEC). This close cooperation has resulted in some 75% of all European standards adopted by CENELEC being identical or based on IEC standards.[6]

Developing standards in CENELEC is divided into Technical Committees and Subcommittees. The topic of energy consumption data exchange is closest the Technical Committee of System aspects of electrical energy supply[7]. The committee aims to prepare the necessary standards framework and coordinate the development of CENELEC standards needed to facilitate the functioning of electricity supply systems in open markets.

IEC

International Electrotechnical Commission is a non-profit, non-governmental organization, founded in 1906, which develops International Standards and operates conformity assessment systems in the fields of electrotechnology.[8] The standards connected to technical data exchange are:

4. IEC 61970 Common Information Model (CIM) / Energy Management
5. IEC 61968 Common Information Model (CIM) / Distribution Management
6. IEC 62056 Data Exchange for Meter Reading, Tariff and Load Control
7. IEC 62325 Framework for Energy Market Communications

The principal task of the **IEC 61970** series of standards is to develop a set of guidelines and standards to facilitate 1) the integration of applications developed by different suppliers in the control center environment and 2) the exchange of information to systems external to the control center environment. The scope of these specifications includes other transmission systems as well as distribution and generation systems external to the control center that need to exchange real-time operational data with the control center. Therefore, another related goal of these standards is to enable the integration of existing legacy systems as well as new systems built to conform to these standards in these application domains.[9]

The **IEC 61968** series of standards is intended to facilitate inter-application integration as opposed to intra-application (same application system). IEC 61968 is intended to support the inter-application integration of a utility enterprise that needs to connect disparate applications that are already built or new, each supported by dissimilar runtime environments. This series of standards is intended to support applications that need to exchange data every few seconds, minutes, or hours rather than waiting for a nightly batch run. This series of

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[6] CENELEC website https://www.cenelec.eu/aboutcenelec/whoweare/index.html
[7] Technical Committee Description available at
https://www.cenelec.eu/dyn/www/f?p=104:7:246623051970001::::FSP_ORG_ID,FSP_LANG_ID:1258595,25
[8] International Electrotechnical Commission website http://www.iec.ch/about/profile/funding.htm
[9] Standard IEC 61970, available at https://webstore.iec.ch/preview/info_iec61970-1%7Bed1.0%7Db.pdf

standards, which are intended to be implemented with middleware services that exchange messages among applications, will complement, but not replace utility data warehouses, database gateways, and operational stores.[10]

The standards in the **IEC 62056 DLMS/COSEM** suite have been constantly improved and extended considering the growing requirements of the smart metering and smart grid applications. In particular, the object oriented COSEM data model has been extended with new interface classes supporting new smart metering and smart grid use cases. The application layer has been "fortified" with state-of-the art security features offering scalable security for the entire range of applications via a large range of communication channels. With the introduction of the concept of "communication profiles" the IEC 62056 DLMS/COSEM suite provides the means to link different communication channels standards with the consistent data model of DLMS/COSEM. The standards of the IEC 62056 DLMS/COSEM suite have been developed by IEC TC13 for the purposes of electricity metering. Some of the standards – in particular the COSEM data model – are also used by other Technical Committees responsible for non-electricity metering.[11]

The principal objective of the **IEC 62325** series of standards is to produce standards which facilitate the integration of market application software developed independently by different vendors into a market management system, between market management systems and market participant systems. This is accomplished by defining message exchanges to enable these applications or systems access to public data and exchange information independent of how such information is represented internally.[12]

MADES

The **Market Data Exchange Standard** (MADES) initiative specifies a standard for a communication platform which every Transmission System Operator (TSO) in Europe may use to reliably and securely exchange documents. Consequently a European market participant (trader, distribution utilities, etc.) could benefit from a single, common, harmonized and secure platform for message exchange with the different TSOs; thus reducing the cost of building different IT platforms to interface with all the parties involved. This also represents an important step in facilitating parties entering into markets other than their national ones. The MADES initiative has been adopted by the ENTSO-E Electronic Data Interchange Working Group to facilitate communication between TSOs and European electricity market participants.[13]

Beyond Europe

North American Energy Standards Board has issued various standards and best practices regarding Retail Electric Quadrant (REQ). A selection of relevant as follows:

1. NAESB REQ.18/WEQ19 Energy Usage Information
2. NAESB REQ.21 Energy Services Provider Interface
3. NAESB REQ.22 Third Party Access to Smart Meter-Based Information

NAESB REQ.18/WEQ.19 defines an information model of semantics for the definition and exchange of customer energy usage information. The actual exchange standards are anticipated to be derivative from this seed standard. Customers will benefit from energy usage information that enables them to make better decisions and take other actions. An understanding of energy usage informs better decisions about energy use and conservation, and is the basis for performance feedback on the operation of customer-owned energy management systems and understanding device energy usage and management.[14]

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[10] Standard IEC 61968-3, available at https://webstore.iec.ch/preview/info_iec61968-3%7Bed1.0%7Den.pdf
[11] Standard IEC 62056-1-0, available at https://webstore.iec.ch/preview/info_iec62056-1-0%7Bed1.0%7Db.pdf
[12] Standard IEC 62325-301, available at ftp://preview.iec.ch/preview/info_iec62325-301%7Bed1.0%7Db.pdf
[13] MADES Communication Standard, available at
https://www.entsoe.eu/fileadmin/user_upload/edi/library/mades/mades-v1r1.pdf
[14] NAESB REQ.18/WE.19, available at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPCosSIFNAESBREQ18WEQ19

NAESB REQ.21 Energy Services Provider Interface (ESPI) builds on the NAESB Energy Usage Information Model and, subject to the Governing Documents and any requirements of the Applicable Regulatory Authority, will help enable Retail Customers to share Energy Usage Information with Third Parties who have acquired the right to act in this role. This ESPI will provide a consistent method for Retail Customers to authorize a Third Party to gain access to Energy Usage Information. Doing so will help enable Retail Customers to choose Third Party products to assist them to better understand their energy usage and to make more economical decisions about their usage. ESPI will contribute to the development of an open and interoperable method for Third Party authorization and machine-to-machine exchange of Retail Customer Energy Usage Information.[15]

The **NAESB REQ.22** document establishes voluntary Model Business Practices for Third Party access to Smart Meter-based information. These business practices are intended only to serve as flexible guidelines rather than requirements, with the onus on regulatory authorities or similar bodies to establish the actual requirements. These Model Business Practices are expected to help adopters of these guidelines to make informed decisions that appropriately balance beneficial uses of the Smart Meter-based information with privacy concerns. They are also not intended for any billing or collection activities.[16]

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[15] NAESB REQ.21, available at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPCosSIFNAESBREQ21
[16] NAESB REQ.22, available at http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/SGIPCosSIFNAESBREQ22

R&D Projects

Projects listed below is a selection from the 211 Smart Grid research and development projects list of the Joint Research Centre of European Commission (JRC) Smart Electricity Systems and Interoperability section. ENTSO-E R&D Monitoring Report 2015[17] also lists and describes European TSO-related R&D projects in order to assess progress in the activities described in R&D Roadmap 2013-2022. The projects listed in both sources overlap greatly. The selection as follows is composed on the abstracts of the projects in JRC and is selected based on whether they encapsulate any of the aspects of consumption data exchange. The details describing each project originate from JRC website (http://ses.jrc.ec.europa.eu) unless indicated otherwise. Projects connected to this paper topic focus not listed by JRC and mentioned by ENTSO-E Monitoring Report, are also incorporated in this following selection.

i-EM

Start and end dates:	January, 2012 to December, 2014
Countries involved:	Italy
Project description:	i-EM offers complete ICT solutions for managing of dispersed generation and of energy storage process and for the control and optimization of energy consumption. The solutions which the start-up offers to the market are built on their own innovative software. In comparison to the other technologies available on the market, this system includes some innovation facilities which give the providers and consumers the possibility of a bidirectional exchange of data with external players in total safety. This makes the system suitable for processing of data provided by third parties.
Link type:	Direct
Website:	http://www.en.i-em.eu/

ESTFEED[18]

Start and end dates:	2012 to 2017
Countries involved:	Estonia
Project description:	Designing, implementing, and testing an open software platform for energy consumption monitoring and management from the customer perspective that is able to interact with grids and provide data feeds to service providers for an efficient use of energy.
Link type:	Direct
Website:	http://estfeed.ee/en/

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[17] R&D Monitoring Report 2015, ENTSO-E, available at http://rdmonitoring.entsoe.eu/wp-content/uploads/2016/03/entsoe_RD_Monitoring_Report_2015.pdf
[18] ESTFEED Project details originate from R&D Monitoring Report 2015, ENTSO-E, available at http://rdmonitoring.entsoe.eu/wp-content/uploads/2016/03/entsoe_RD_Monitoring_Report_2015.pdf

Data Hub

Start and end dates:	January, 2009 to December, 2012
Countries involved:	Denmark
Project description:	A more free competition in the Danish electricity market, easier access to information, and more transparency for consumers who choose to switch supplier. A desire for more standardized communication between players on the Danish electricity market
Link type:	Direct
Website:	http://www.energinet.dk/EN/Sider/default.aspx

CHPCOM

Start and end dates:	January, 2013 to December, 2016
Countries involved:	Denmark
Project description:	The goal for CHPCOM is, in cooperation with Danish CHP owners, power market stakeholders, plant suppliers and grid utilities, to develop a standardized data communication platform, by using the international standards IEC 61850 for data information exchange and IEC 62351 for data and communication security. A key goal of the CHPCOM project is also to develop new business cases, reduce business uncertainty and reduce the transaction cost for all stakeholders. This practical demonstration will bring Danish CHPs to the next step towards the future Smart Grid.
Link type:	Direct
Website:	http://www.chpcom.dk/en/

Smart Web Grid

Start and end dates:	January, 2011 to December, 2013
Countries involved:	Austria
Project description:	Smart Web Grid analyzes user interaction, technology, cost effectiveness and data security of data exchange by means of three concrete examples in the Smart Grid Model Region Salzburg. The goal is the conceptual design of a comprehensive information model for web-service-based access to smart grids data sources, providing a more efficient integration of different applications as well as additional benefits through information aggregation. At the same time, it will be made sure on a conceptual level that privacy and security are guaranteed. Furthermore, business models and business model options for smart grid customer portals will be investigated and evaluated. Finally, proof of concept implementations of selected smart grid applications will be developed and tested.
Link type:	Direct
Website:	http://ses.jrc.ec.europa.eu/smart-web-grid

FutureFlow[19]

Start and end dates:	January, 2016 to December, 2019
Countries involved:	Austria, Slovenia, Serbia, Romania, Hungary, Germany, Belgium, France
Project description:	Four European TSOs of Central-Eastern Europe (Austria, Hungary, Romania, Slovenia), associated with power system experts, electricity retailers, IT providers and renewable electricity providers, propose to design a unique regional cooperation scheme: it aims at opening Balancing and Redispatching markets to new sources of flexibility and supporting such sources to act on such markets competitively. Thanks to a prototype aggregation solution and renewable generation forecasting techniques, flexibility providers – distributed generators (DG) and Commercial and Industrial (C&I) consumers providing demand response (DR) – are enabled, through retailers acting as flexibility aggregators, to provide competitive offers for Frequency Restoration Reserve (including secondary control activated with a response time between 30 seconds and 15 minutes). A comprehensive techno-economic model for the cross-border integration of such services involves a common activation function (CAF) tailored to congested borders and optimized to overcome critical intra-regional barriers. The resulting CAF is implemented into a prototype Regional Balancing and Redispatching Platform, securely integrated within the four TSOs' IT systems: this makes research activities about cross-border integration flexible while linking with the aggregation solution. Use cases of growing complexity are pilot tested, going from the involvement of DR and DG into national balancing markets to cross-border competition between flexibility aggregators. Impact analyses of the pilot tests together with dissemination activities towards all the stakeholders of the electricity value chain will recommend business models and deployment roadmaps for the most promising use cases, which, in turn, contribute to the practical implementation of the European Balancing Target Model by 2020.
Link type:	Direct
Website:	http://www.futureflow.eu/

Data Exchange

Start and end dates:	January, 2010 to December, 2011
Countries involved:	United Kingdom
Project description:	The Data Exchange was established to identify an enduring solution to the interaction between the STC and Grid Code regarding the exchange of User data.
Link type:	Direct
Website:	http://ses.jrc.ec.europa.eu/data-exchange

AMADEOS

Start and end dates:	January, 2013 to December, 2016
Countries involved:	Austria, France, Italy, Netherlands
Project description:	The objective of this research proposal is to bring time awareness and evolution into the design of System-of-Systems (SoS), to establish a sound conceptual model, a generic architectural framework and a design methodology, supported by some prototype tools, for the modeling, development and evolution of time-sensitive SoSes with possible

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[19] Project description and details originate from project website www.futureflow.eu

emergent behaviours. Special emphasis is placed on evolution, emergence, dependability (e.g. safety, availability) and security, considering embedded devices and the cloud as the execution platform.

The development of the conceptual model, the architectural framework, the design methodology and some extensions to UML-based tools will form the core of the project work.

Link type:	Indirect
Website:	http://amadeos-project.eu/consortium/

evolvDSO[20]

Start and end dates:	September, 2013 to Januar, 2017
Countries involved:	Austria, Portugal, Belgium, France, Ireland, Italy, Germany
Project description:	With the growing relevance of distributed renewable energy sources (DRES) in the generation mix and the increasingly pro-active demand for electricity, power systems and their mode of operation need to evolve. evolvDSO will define future roles of distribution system operators (DSOs) and develop tools required for these new roles on the basis of scenarios which will be driven by different DRES penetration levels, various degrees of technological progress, and differing customer acceptance patterns.
Link type:	Indirect
Website:	http://www.evolvdso.eu/Home/About

HiperDNO

Start and end dates:	January, 2010 to December, 2013
Countries involved:	Germany, Spain, France, Israel, Slovenia, United Kingdom
Project description:	The aim of this research project is to develop a new generation of distribution network management systems that exploits novel near to real-time High Performance Computing (HPC) solutions with inherent security and intelligent communications for smart distribution network operation and management. Cost effective scalable HPC solutions will be developed and initially demonstrated for realistic distribution network data traffic and management scenarios via off-line field trials involving several distribution network owners and operators.
Link type:	Indirect
Website:	http://ses.jrc.ec.europa.eu/hiperdno

INSTINCT

Start and end dates:	January, 2012 to December, 2014
Countries involved:	Belgium, France, Sweden
Project description:	The objective of the project is optimal design of robust, secure, interoperable and scalable ICT solutions that enable active distribution networks and facilitate new

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[20] Project description and details originate from project website http://www.evolvdso.eu/Home/About

models for customer involvement. Development of the program has the following objectives:

- efficient methods for design of robust and interoperable ICT systems;
- development of new business models involving partners from several industries;
- cost-efficient communication systems for integration of partners across industrial boundaries;
- information models for semantic interoperability across power system domains (production, distribution, end-use);
- new communication models for high-speed communication among several peers over lossy media;
- methods for assessment of reliability and robustness of ICT infrastructures;
- establishment of experimental platforms and research arenas for cross-disciplinary work involving power, ICT and markets.

Link type:	Indirect
Website:	http://ses.jrc.ec.europa.eu/instinct

SecMobil – Secure eMobility

Start and end dates:	January, 2012 to December, 2014
Countries involved:	Germany
Project description:	This project not only opens up the possibility of critical security technologies to pilot, but also to develop new business models, which are stabilized sustained by the underlying IT security. The market potential of sustainably supported by IT security electric mobility opened up by the following in the project to be developed technologies: – technologies for trusted-cost electricity measurement (in the electromobility sector, but also in domestic and industrial applications); – security-based technologies in the vehicle to enable additional services such as function enabling, application store, identification with the new ID card and software updates to ensure new business models; – security-based technology for the infrastructure and services (PKI, ID management, etc.) to e.g. identity management and billing processes between the different domains (Smart Car, Smart Grid, Smart Traffic) to pilot. Characteristic of SecMobil is the holistic approach of the subject in two dimensions. From matters of content ago IT security is handled at all system levels, are handled by the current detection up to the network via the 'cloud', where both technical and legal aspects.
Link type:	Indirect
Website:	http://ses.jrc.ec.europa.eu/secmobil-secure-emobility

SGIH – Smart Grid Innovation Hub

Start and end dates:	January, 2012 to December, 2020
Countries involved:	Ireland
Project description:	The Smart Grid Innovation Hub is a collaborative initiative between EirGrid, SONI and the National Digital Research Centre to promote the development of innovative Smart Grid ideas on the island of Ireland. It has been established to create a facility to enable

innovation in the Smart Grid arena in Ireland or Northern Ireland, with access to the people, systems and data necessary to test ideas and concepts and enable them to develop from ideas to reality. The Smart Grid Innovation Hub offers the following supports to companies, academics and entrepreneurs:

– a facility - 'the Sandbox' to enable prototyping, test, integration and demonstration of Smart Grid systems and applications built on digital technologies;
– commercialisation support structures - people, funding, customers, know – how;
– access to data and systems with ability to test / trial products and applications;
– project spaces: temporary / short term office facilities (desks) at the sponsor companies;
– access to a network of experts across the sponsor companies encompassing technical and engineering domain expertise in electrical engineering, system operation and ICT;
– access to a wider network within the Smart Grid community, energy industry and supporting industries.

Link type:	Indirect
Website:	http://www.eirgridgroup.com/

Smart-Immo

Start and end dates:	January, 2009 to December, 2011
Countries involved:	Germany, France
Project description:	The Smart Immo Project issue is a Smart box for data collection and analysis coming from different tools and for a better building management monitoring
Link type:	Indirect
Website:	https://francesingaporeinnovationdays.files.wordpress.com/2011/10/secured-communicating-solution-cluster-f-s-i-d-v6.pdf

STRONgrid

Start and end dates:	January, 2011 to December, 2015
Countries involved:	Denmark, Finland, Norway, Sweden
Project description:	This project seeks to develop better tools for addressing the increasing need to move electricity across national borders. More interconnected electricity grids in both the Nordic region and Europe are seen as an important facilitator of more sustainable energy systems, and international cooperation is critical in achieving this vision.
Link type:	Indirect
Website:	http://www.nordicenergy.org/project/smart-transmission-grid-operation-and-control/

C-DAX – Cyber-Secure Data and Control Cloud for Power Grids

Start and end dates:	January, 2012 to December, 2015
Countries involved:	Belgium, Switzerland, Germany, France, Netherlands, Sweden, United Kingdom

Project description:	The progressive penetration of conventional and renewable distributed generation is driving major changes in the whole power systems infrastructure justifying the introduction of more intelligence, in particular, in power distribution networks. The information infrastructure will play a central role as future power systems cannot be supported by centralized information infrastructures on which today's power systems rely.
	Within this context, the C-DAX project proposes a Cyber-secure data and Control Cloud for future power distribution networks as an integrated communication and information infrastructure. C-DAX exploits the properties of novel, information-centric networking architectures that are by design more secure, resilient, scalable, and flexible than conventional information systems.
	C-DAX will be tailored to the specific needs of smart grids for efficient support of massive integration of renewables and a heterogeneous set of co-existing smart grid applications. Realistic and pertinent use cases from different domains (low-voltage, medium-voltage, and trading) will be used to guide the design and provide validation criteria.
	Further, C-DAX will provide added value to current protocols and data models used within the power systems domain for monitoring and control purposes (e.g. IEC 61850, IEEE C37.118, etc.). C-DAX concepts will be proposed for standardisation (i.e. M490, IEC TC57, ETSI M2M, Cigre, IETF) and industry interest groups. The C-DAX architecture aims at providing for smart grids:

	– the flexibility to integrate renewable energy resources of different sizes to support communication with individual consumers to facilitate the growing number of active subjects connected to electrical grids;
	   – the secure, synchronized and timely delivery of measurement and control data to ensure stable and reliable supply;
	   – the security and reliability required by distributed control systems and (iv) add a resilient cyber-secure layer to currently used protocols in the electrical grids infrastructure.

	C-DAX will be implemented as a software prototype that will be extensively tested and optimized. C-DAX software will be validated in multiple phases:

	– through modelling, simulation and mathematical analysis;
	   – functional tests in a laboratory IT environment;
	   – integrated in field equipment, deployed into real-time hardware in the loop emulation test bed, and
	   – in the Alliander's MS LiveLab.

	This last validation will represent the main proof of the C-DAX applicability in a live electricity network with real world monitoring and control requirements.
Link type:	Indirect
Website:	http://www.cdax.eu/

FlexCom

Start and end dates:	January, 2008 to December, 2010
Countries involved:	Denmark
Project description:	The project aims at producing a conceptual framework for the unified and extensible representation and exchange of power system information and data. The aim is not to produce a new communication standard; it will instead focus on concept design and proof-of-concept testing to provide input to the existing standardisation effort.
Link type:	Indirect
Website:	http://ses.jrc.ec.europa.eu/flexcom

www.pwc.ee