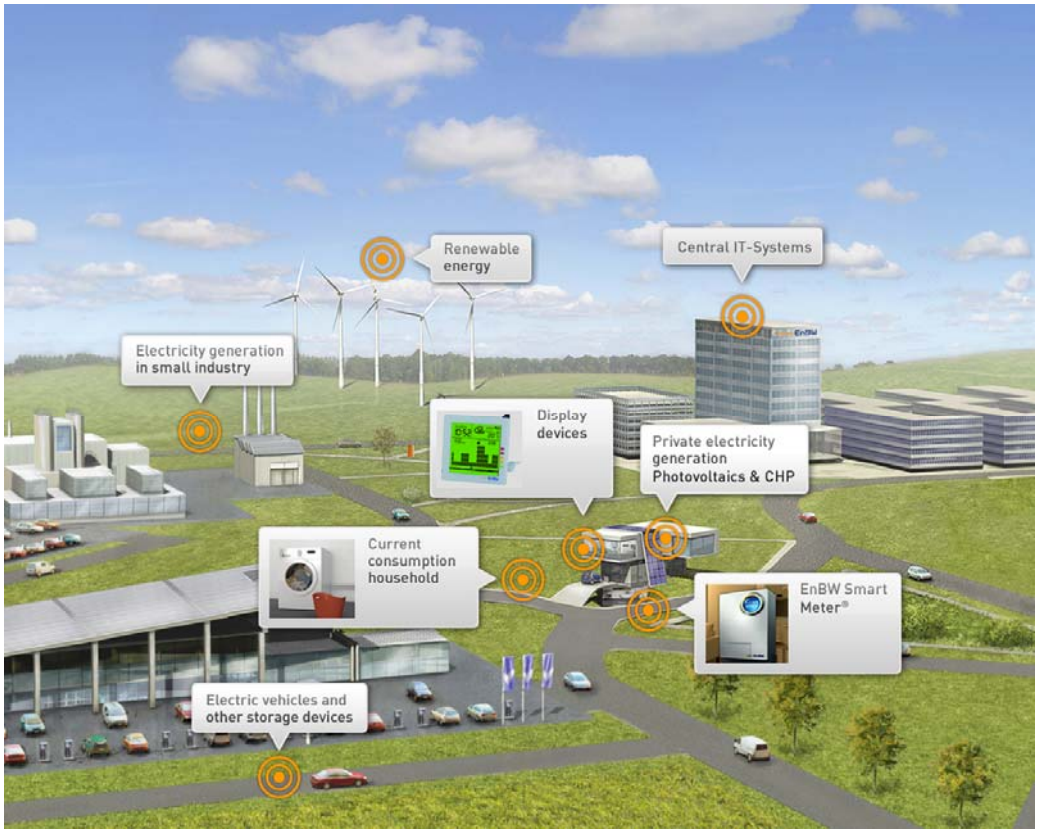
Project Summary
MEREGIO – Minimum Emission Region

Project Description:

In Germany many ideas and concepts have been proposed to achieve the goal of reducing CO_2 emissions by 2020 by 20 percent compared to 1990 levels. “MEREGIO – Minimum Emission Region” is one such scheme and applies a holistic concept. The objective is to develop regions with power supply systems that are optimized with respect to their greenhouse gas emissions. This is based on three specific components, namely

- E-Energy marketplaces (for energy products, system services, and other services) for producers of electricity, end customers, and intermediaries for coordinating the supply and demand of energy and complementary services;
- a sophisticated and innovative energy infrastructure; and
- a powerful information and communication infrastructure that links the physical infrastructure to the marketplace and controls it according to the specific market situation at hand.



The project focuses on developing technical and economic concepts, which implement the three components and put them to work in a pilot region with about 1000 participants at the towns of Göppingen and Freiamt (Baden Württemberg / Germany). Furthermore, the project plans to develop a minimum emission certification for regions where concrete specifications and standards are developed based on the experience gathered in the field test. The objective is to motivate regions to actively reduce their greenhouse gas emissions and promote specific measures to cut CO_2 production. Important part of the project is also the boost of awareness on energy efficiency topics in public and also specialized on different customer segments (households, middle sized industry and public sector).

The interdisciplinary project team combines the expertise of five chairs of the Karlsruhe Institute of Technology (KIT) with the industrial partners EnBW (having the project lead), ABB, IBM, SAP, and systemplan (an engineering

Project Summary
MEREGIO – Minimum Emission Region

consulting company on the field of energy efficiency measures in industry). While the industrial partners focus on the business context and an ICT based implementation to be applicable in the field trials, the KIT is mainly involved in the analysis, simulation, and development of concepts for each area.

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Project Participants:
EnBW (Hellmuth Frey – project manager); ABB (Klaus von Sengbusch); SAP (Harald Vogt); IBM (Achim Becker) –; systemplan (Michael Hager); KIT (Hartmut Schmeck)

CE1 – Integration of multiple distributed resource types

Description:
The project integrates conventional power plants, distributed combined heat and power plants (CHP), distributed energy storage systems, as well as renewable energy sources like wind turbines and photovoltaic systems at both the system and customer levels. In order to integrate these devices at system level and to provide various system services, such as idle load or balancing power, innovative control strategies will be developed. At the customer level, demand response will be achieved via different regional energy marketplaces for the allocation of energy and ancillary services resulting in dynamic rates, control signals for home appliances, and an overall power management. An awareness of the need for energy-efficient acting will be created in both the population and the (local) politics and economy. Further, industrial and public (B2B) customers will be consulted on energy efficiency topics and special measures to boost their efficiency and awareness for saving energy and reducing CO2 Emissions.

Key Deliverables:
- integration of distributed and renewable energy sources
- market-based coordination mechanisms
- legal framework
- privacy-preserving architecture

CE2 – Incorporation of dynamic rates or other approaches for connecting retail customers with wholesale conditions

Description:
In the project MeRegio a market-based approach for the efficient coordination of energy supply and demand will be developed and tested in a real pilot region. Therefore, various marketplaces will be implemented in order to trade energy products and system services. These marketplaces employ different types of tariffs, for example with different pricing rules, or dynamic rates aiming at an efficient coordination approach for energy allocation.

Key Deliverables:
- different types of marketplaces
- price and other control signals
- dynamic tariffs

CE3 – Integration into system planning and operations

Description:
Within the project, simulation components will be developed and applied to analyze many different design features of the MeRegio concepts. There will be simulations that are directly coupled to the pilot region (online simulations) and simulations that do not influence real participants (offline simulations). These simulations comprise different

market mechanisms, network management concepts and business models as well as tests that cannot be implemented in a real environment, such as power outages or extreme weather events. Long-term effects of decentralization on the development of the power plant mix will be investigated within an energy system model. Additionally, short-time aspects and their influence on the generation mix will be considered. Power grid simulation tools will be used to analyze the influence of new network control strategies and to identify how many additional decentralized capacities can be linked at a grid node.

Key Deliverables:
- distributed sources providing system services
- integrated simulations with real participants
- fully integrated prototype
- power grid simulation

CE4 – Application of critical integration technologies and standards

Description:
Existing and emerging technologies for DER integration will be applied including a broad range of DER types and communication platforms for smart metering (at B2B and B2C level) and distribution automation. The MeRegio consortium is heavily engaged in a number of standardization boards in the area of smart metering, smart grids, and the adaptation of the legal framework.

Key Deliverables:
- preparation of new industry standards in the area of smart metering and home automation
- plans are to build (and extend) the solution upon existing standards like CIM and IEC 61850 structures, together with references to business layers and behaviors (i.e. like OpenSmartGrid); using open XML and WebServices based technology wherever possible
- plans are to deliver a solution with security "build-in", but which is nevertheless granting a non-discriminatory, easy-to-handle access to all (existing and new) market roles and players.
  In analogy to the CO_2 emission certification, the ICT based solution is planned to target an "audit ready" state for its architectural concept.
- the ICT implementations currently planned, will try to focus on scalability and interoperability of the architecture for future advancements in technology as well as business lifecycles.

CE5 – Compatibility with EPRI Smart Grid initiative goals and approach

Description:
An integral part of this project is to create a certificate for minimum emission regions. Additionally, a catalog of options to improve the energy efficiency of regions is designed (and to increase the number of DERs). With the certificate an awareness of the need for energy-efficient acting is to be created. In addition, the certification will enable the comparability of regions.

Key Deliverables:
- minimum emission certification
- public awareness
- full integration of DER
- preparation of new industry standards

CE6 – Leverage of additional funding sources

Description:
This project will leverage the significant existing energy-infrastructure and experience of the industrial partners

Project Summary
MEREGIO – Minimum Emission Region

EnBW, ABB, IBM, SAP, and systemplan and the competence of the Karlsruhe Institute of Technology which is an internationally leading research center on energy systems and on ICT.. The project is co-funded to a significant extend by the Federal Ministry of Economics and Technology (BMWi). All project partners are simultaneously involved in complementary projects funded by public sources.
Progress Summary (Conclusions, Recommendations):

Preferred Criteria		**Description of Project Element (if applicable)**
1) Does the project integrate multiple distributed resource types?		PV, wind turbines, CHP plants, energy storages
a	Demand Response	☒ Direct Load Control Program ☒ Demand Response Program ☐ Electric Vehicle Charging ☐ Thermal Storage for Electric Peak Shifting & DR Other:
b	Electric Energy Storage	☐ Behind the meter Battery Storage ☒ Utility System Battery Storage <= 100kWh ☐ Utility System Battery Storage > 100kWh ☐ Flywheel Other:
c	Renewable Generation	☒ Solar PV (Customer Owned) ☐ Solar PV (Utility Owned) ☐ Concentrated Solar ☒ Wind Generation ☒ Biogas Other: Water (run of river)
d	Distributed Generation	☐ Diesel Generator ☐ Microturbine ☐ Fuel Cell ☒ Combined Heat & Power ☒ Compressed Air Energy Storage Other:

Project Summary
MEREGIO – Minimum Emission Region

e	Other	
2) Does the project apply critical integration technologies and standards?		yes; plans are to build the solution upon standards like CIM and IEC 61850 structures, together with OpenSmartGrid layouts; using open XML and WebServices based technology wherever possible
a	Customer System Interfaces	☐ 6LowPAN ☐ ANSI C.12.xx ☐ BACnet ☐ DNP3 ☐ HomePlug ☒ IEC 61850 Family ☒ Internet Based (wired or wireless – IP, TCP, HTTP) ☐ MODBUS or MODBUS/TCP ☐ oBix ☐ OpenADR / OASIS Energy Interop ☐ Smart Energy Profile (SEP) 1.0 or 2.0 ☐ ZigBee (802.15.4) Other:
b	Distribution System Interfaces	☐ DNP3 ☐ IEC 60870 (ICCP) ☒ IEC 61850 Family ☐ IEC 61968 Family ☐ IEC 61970 Family ☒ Internet Based (wired or wireless – IP, TCP, HTTP) ☐ MODBUS or MODBUS/TCP ☐ Multispeak Other:

Project Summary
MEREGIO – Minimum Emission Region

c	Transmission System Interfaces	☐ DNP3 ☐ IEC 60870 (ICCP) ☐ IEC 61850 Family ☐ IEC 61968 Family ☐ IEC 61970 Family ☐ Internet Based (wired or wireless – IP, TCP, HTTP) ☐ MODBUS or MODBUS/TCP ☐ Multispeak Other:
d	Aggregator/Service Provider System Interfaces	☐ ANSI C.12.xx ☐ Cellular Based (1xRTT, GPRS, EVDO, CDMA, etc.) ☐ DNP3 ☐ FixML ☐ IEC 60870 (ICCP) ☒ IEC 61850 Family ☐ IEC 61968 Family ☐ IEC 61970 Family ☒ Internet Based (wired or wireless – IP, TCP, HTTP) ☐ Multispeak ☐ OpenADR / OASIS Energy Interop Other: under consideration: WSDL, based on OpenSmartGrid layouts

Project Summary
MEREGIO – Minimum Emission Region

e	Operations System Interfaces	☐ DRBizNet ☐ FixML ☐ IEC 60870 (ICCP) ☐ IEC 61850 Family ☐ IEC 61968 Family ☐ IEC 61970 Family ☐ Internet Based (wired or wireless – IP, TCP, HTTP) ☐ Multispeak ☐ OpenADR / OASIS Energy Interop Other:
f	Energy Markets System Interfaces	☐ ANSI C.12.xx ☐ DNP3 ☐ DRBizNet ☐ FixML ☐ IEC 60870 (ICCP) ☒ IEC 61850 Family ☐ IEC 61968 Family ☐ IEC 61970 Family ☒ Internet Based (wired or wireless – IP, TCP, HTTP) ☐ Multispeak ☐ OpenADR / OASIS Energy Interop Other: under consideration: WSDL, based on OpenSmartGrid layouts

Project Summary
MEREGIO – Minimum Emission Region

g	WAN Communication Architecture	☐ AMI Infrastructure (Two-Way) ☐ RF Tower ☐ RF Mesh ☒ Public Internet ☐ Cellular Based (1xRTT, GPRS, EVDO, CDMA, etc.) ☐ Powerline Based ☐ WiMAX Other:
h	Cyber Security	☐ Audit trails ☒ Authentication ☒ Certificates ☐ Encryption ☐ Intrusion Detection Other: privacy; under concideration: Security Event Processing patterns
i	Other	
3) Does the project incorporate dynamic rates or other approaches for connecting retail customers with wholesale conditions?		yes
a	Customer Diversity	☒ Residential Customers ☒ Commercial Customers ☒ Industrial Customers
b	Price Based	☒ Real-Time Pricing (RTP) ☒ Day Ahead Pricing ☒ Critical / Variable Peak Pricing ☐ Time of Use Rates ☐ Block (or Reverse Block) Rate

Project Summary
MEREGIO – Minimum Emission Region

c	Incentive Based	☒ Emergency Demand Response ☐ Demand Bidding/Buyback ☒ Capacity Market ☐ Ancillary/Regulation Services ☒ Interuptible/Curtailable ☒ Direct Load Control Other:
d	Other	
4) Does the project integrate with system planning and operations?		
a	Integration with System Operations	☐ Visibility of DER with Real-Time Sys Ops ☐ Integration with Distribution Management System Other:
b	Integration with System Planning	☐ Visibility of DER for future planning ☐ DER treated on equal footing as Generation Other:
c	Tools for Integration	☒ Modeling and/or Simulation Tools Other:
d	Other	
5) Is the project compatible with EPRI's initiative and approach?		
a	Business case development	Creation of new business models in liberalized energy markets
b	Use cases as documentation of important applications and requirements	The project partners are jointly using an UML based modelling approach, modelling Goals, Requirements, Features and UseCases
c	Use of Standards in Utility Domains	☐ Customer Domain ☐ Distribution Domain ☐ Transmission Domain ☒ Aggregator/Service Provider Domain ☐ Operations Domain ☒ Energy Markets Domain

Project Summary
MEREGIO – Minimum Emission Region

d	Enables Widespread integration of DER	☐ Public Sharing of Business Cases ☐ Public Sharing of Use Cases ☐ Public Sharing of Cost Benefit Analysis ☒ Public Sharing of Lessons Learned ☒ Working Directly with Standards Bodies ☐ Leveraging or Advancing Open Source Software
e	Other	
6) Does the project leverage additional funding sources?		
a	Leverage Additional Funding Sources	☒ Government (Local, State, Federal) ☐ Research Organizations besides EPRI ☐ Universities, Consortiums ☐ Vendors Other:
b	Other	