



## eTelligence: GERMAN LIGHTHOUSE PROJECT WITHIN THE E-ENERGY PROGRAM

### Advanced System Technology AST

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### The challenge

Today and future most important issues are the sustainable and sufficient supply of consumers with electrical energy based on an eco-friendly generation. Due to the need of CO<sub>2</sub> reduction and the limitation of fossil sources of energy the share of renewable energy sources in generation is going to take a remarkable part in the future energy mix.

However, the growing share of renewable generation is the major challenge for grid operation. Today's grid infrastructure is adjusted to a centralized power generation at large power plants with power flows from higher voltage levels to lower voltage levels with predictable consumption.

In contrast, renewable generation is generally distributed and most of all it has a fluctuating character e.g. wind power or photo-voltaic power.

The danger of temporary imbalances between generation and consumption is reinforced by the affected predictability of generation. In order to compensate these effects additional balancing power has to be in standby offered by conventional power plants.

In addition, renewable generation occurs to a significant percentage at the distribution grid level. This may cause a reversal of the power flows from the distribution grid level towards the transmission grid level. The actual design of the electrical transmission and distribution system does not consider these states of operation and reaches its operational limits.



## Tasks and results

Within the project “eTelligence” the optimization of electrical energy supply by the utilization of information and communication technology (ICT) in combination with the existing transmission and distribution infrastructure is demonstrated. Furthermore the project has to concern about ecological issues and issues of efficiency as well as the sustainable energy supply.

In a nutshell, basics are established and components are developed to create a sustainable regional energy supply system. Therefore a regional energy marketplace, new tariffs and economic incentive programs, algorithm of control for distributed generation units and virtual power plants as well as innovative concepts for the operation of distribution grid are developed and tested. A standardized infrastructure for both business and operational processes is needed to realize these objectives. “eTelligence” takes place at the city of Cuxhaven where the operability and effectiveness of the approach is demonstrated. The region of Cuxhaven offers a suitable grid topology and a multitude of distributed generation and large-scale consumers. In addition the city gives the opportunity to present the E-Energy program and the project “eTelligence” itself because Cuxhaven records as a health resort and center of tourism over three million overnight stop-overs a year. The Fraunhofer AST is responsible for the project management of the subproject “Smart distribution grid” which contains amongst others the capture and modeling of the distribution grid of the city

Cuxhaven. The optimal integration of distributed generation and the creation of accepted ancillary services and grid products e.g. reactive power compensation within the framework of the liberalization and the discrimination free market admission of all participants are the major challenges of grid operation. Optimization objects are an ecological and economical operation of the entire energy system. Therefore existing degrees of freedom in control of distributed generation using a general load management for an active operation under consideration of an optimal distribution grid access are realized.

Additional results in the field of grid operation are:

- ┃ Approaches to optimize and manage distribution grids based on marketable ancillary services.
- ┃ Technical solutions to optimize voltage profiles by reactive power of virtual and conventional power plants.
- ┃ Technical solutions to optimize load flows by reactive power of virtual and conventional power plants.
- ┃ Algorithms as well as solutions for an adaptive grid protection.
- ┃ New methods for the calculation and determination of grid access fees.

## Initiator and partners

- ┃ BMWi and BMU
- ┃ EWE AG
- ┃ Fraunhofer Energy Alliance
- ┃ BTC AG
- ┃ OFFIS e.V.
- ┃ Öko-Institut
- ┃ energy & meteo systems GmbH

