



Virtual Power Plants across Energy-Autonomous Regions

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Across Europe, national as well as enterprise strategies for energy supply are currently being re-adjusted to meet a set of objectives: emphasizing renewable sources of energy, minimizing dependence on imports, meeting emission reduction targets and limiting long-distance transmission. Distributed generation, an 'intelligent' mix of energy sources and sophisticated control strategies are required to move towards autonomous regions with minimal dependence from outside energy supplies and long-range transmission.

The concept of a 'virtual power plant' covering a region's energy needs starts from a fully distributed GIS-based demand and load forecasting model. Due to disparities and high temporal variability of energy demand, the flexible energy provision is a challenging task. Most renewable sources like wind or solar provide highly variable outputs and are difficult to forecast. Biomass and hydropower as well as (a minimum of) fossil thermal are the only currently available technologies to balance variable generation and to meet current demand.

GIS-based models are an indispensable method for surveying and developing the renewable energy potential of regions, and subsequently the foundation for short term generation forecasts. Combined with demand forecasts, grid control strategies can only be implemented with balancing capabilities from e.g. hydropower with pumping capability into reservoirs. The traditional inter-regional balancing relies heavily on centralized generation and requires high transmission capacities, which are expensive and increasingly difficult to build, e.g. as high voltage corridors face strong public opposition.

The concept of autonomous energy regions with a maximum of renewable sources

is aiming at meeting objectives of sustainability, climate protection and security as well as stability. While this sounds like an uncontested strategy, implementation requires highly sophisticated spatialised modelling as well as revised approaches to risk management and quality of service. Temporally dynamic maps of demand, generation potential and balancing needs are the foundation of intra-regional planning, forecast and control strategies leading towards new paradigms in sustainable and largely autonomous regions.