

## **A REVIEW ON AGGREGATION APPROACHES OF CONTROLLABLE DISTRIBUTED ENERGY UNITS IN ELECTRICAL POWER SYSTEMS**

*Martin Braun, Philipp Strauss*  
*Division Engineering and Power Electronics*  
*Institut fuer Solare Energieversorgungstechnik (ISET) e.V.*  
*Koenigstor 59, D-34119 Kassel, Germany*  
*Phone (49) 561/7294-118, Fax (49) 561/7294-400*  
*E-mail: mbraun@iset.uni-kassel.de*

*Keywords:* Active Customer Network (ACN), Active Distribution Network (ADN), Ancillary Services (AS), Controllable Distributed Energy (CDE) Units, Distributed Energy Resources (DER), Distributed Generation (DG), Microgrids, Virtual Power Plant (VPP).

### **ABSTRACT**

This paper reviews different aggregation approaches that can be applied for the integration of distributed energy resources and loads in electrical power systems. Based on this review we define a set of terms that allow a clear differentiation of aggregation approaches. These definitions provide a framework for electrical power systems analyses concerning also the interaction of different control approaches. In particular the integration of Controllable Distributed Energy (CDE) units - that comprise controllable distributed generators, controllable distributed storage units and controllable distributed loads - is analysed concerning their possibilities to provide ancillary services for network operation.