Grid-Forming Converters and Resources for 100 % Renewable Power Systems

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Abstract

In this presentation, a control scheme for power electronic grid-forming conversion is developed as an enabler for a system-wide integration of 100 % renewable energy sources (RESs) in power systems. The scheme culminates in the concept of the grid-forming resource (GFR) that brings together both the control technologies of the renewable power resource and the grid-forming converter. As part of a GFRs, the proposed grid-forming converter controller is shown to be practical in offering inertial response emulation and frequency control based on droop characteristics to maintain power balances rapidly and to control voltages. The integration with the control of wind energy conversion systems (WECSs) creates a grid-forming wind park as the prototype of the GFR. Feedforward signals exchanged between grid and resource-side controls enhance fast overall controllability. The principal claims are substantiated for a European scenario example with the Irish power transmission system in the focus. The model comprises more than 2000 individual WECSs grouped into wind parks, where ten wind parks function as GFRs. The transient behavior of this scenario comprising 100 % converter-interfaced generation is shown to be superior compared with a counterpart case comprising synchronous machinery. The results validate the fact that GFRs with their proposed controls are expected to be key elements in creating a renewable and secure electric power system.