Grid-forming Inverter-based resources

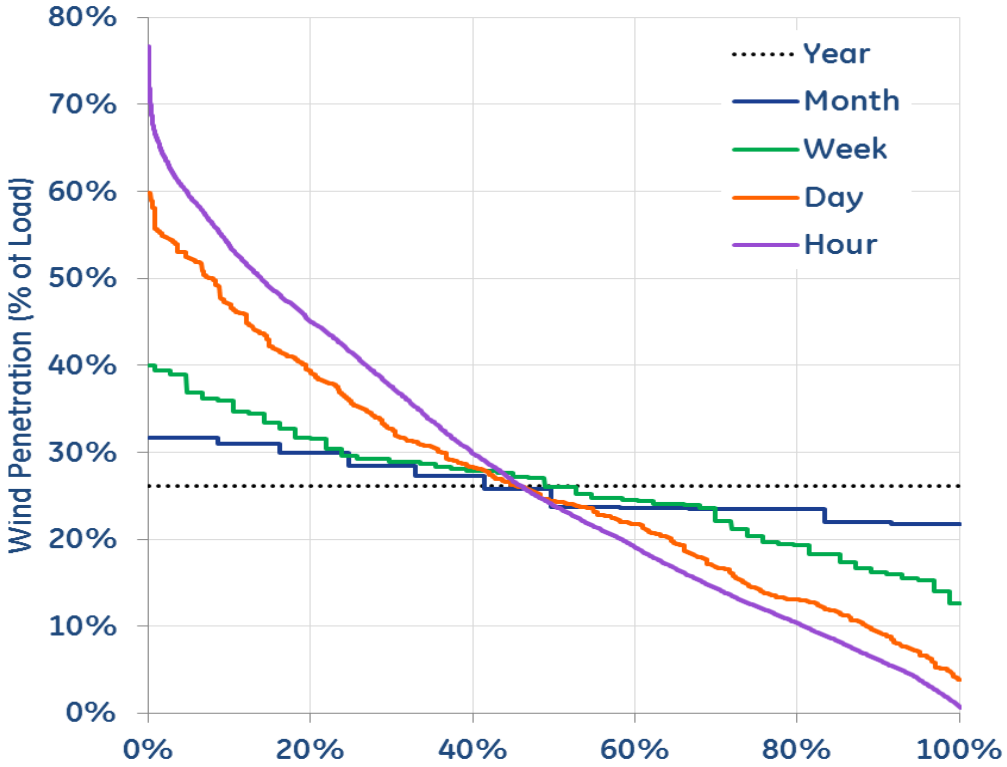
Dr. Debra Lew, Associate Director, ESIG
WECC Workshop on GFM IBRs
Oct 13, 2021

ESIG
ENERGY SYSTEMS INTEGRATION GROUP

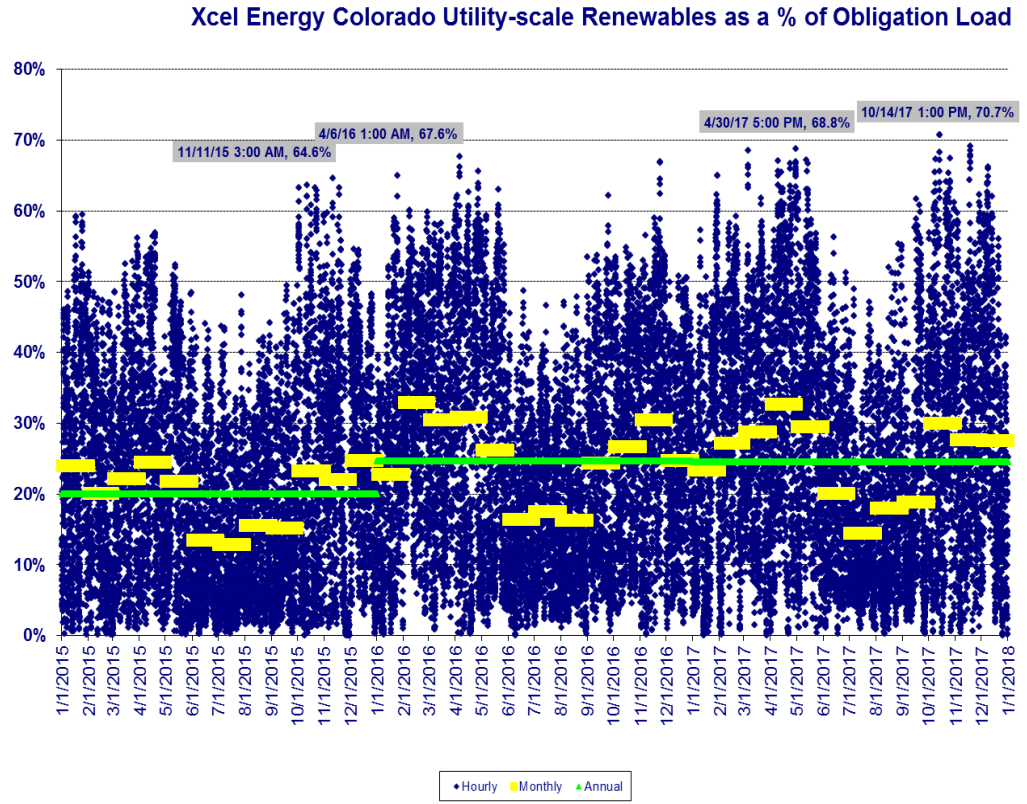
What is ESIG?

- ESIG addresses the technical challenges for transforming energy systems through collaboration, education and knowledge sharing. Workshops, webinars, reports available freely at energy.esig.
- 175 members worldwide broadly focused on decarbonization and integration of energy systems
- ESIG is part of the Global Power System Transformation Consortium and leads their System Operator Research and Peer Learning pillar.

Moderate annual averages of wind/PV can cause high instantaneous penetrations



Source: GE, NSPI Renewable Integration Study
http://www.nspower.ca/site-nsp/media/nspower/CA%20DR-14%20SUPPLEMENTAL%20REIS%20Final%20Report%20REDACTED.pdf



Source: Drake Bartlett, Xcel 2018

Inverter-based resources (IBRs) interact with the grid differently from synchronous generators

IBRs: Wind, PV, and batteries (and others)

- Highly controllable and configurable power electronics
- Can provide very fast responses, or ride through long transmission faults that would trip a synchronous generator
- Today's grid-following IBRs don't provide inertia or system strength

Synchronous generators: steam, gas, hydro

- Grid was designed around this behavior
- Provides inertia and system strength
- Dynamics and capabilities based on their physics

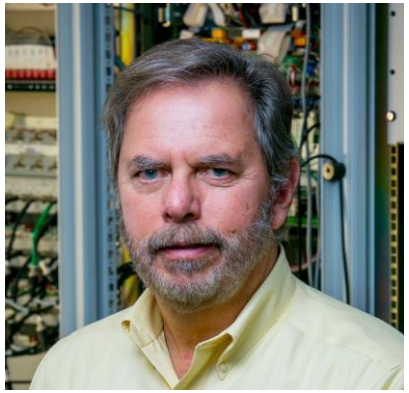
Jason MacDowell, GE

Jason MacDowell is Senior Director of Technology, Strategy & Policy at GE Energy Consulting in Schenectady, NY. He has 20 years of energy industry experience on power system planning, operation and engineering analysis, grid integration of multiple technologies, grid stability and economic modeling as well as development of regulatory policy, grid codes and technical standards.

Julia Matevosyan, ERCOT

Julia Matevosyan is Lead Planning Engineer at the Electric Reliability Council of Texas (ERCOT), Resource Adequacy Group, primarily working on adequacy of system inertial response, system flexibility, frequency control and performance issues related to high penetration levels of inverter-based generation. Her other interests are integration of storage and distributed generation. Julia is a member of CIGRE Working Group C2/C4.41 “Impact of High Penetration of Inverter-based Generation on System Inertia of Networks” and serves on a number of the technical advisory committees for projects related to high penetration of inverter-based generation carried out by NREL, EPRI, NERC, Hawaiian Electric, Xcel Energy and the EU-SysFlex project consortium. Julia received her BSc from Riga Technical University in Latvia, and her MSc and PhD from the Royal Institute of Technology (KTH) in Sweden. Prior to joining ERCOT she was with the consulting firms Parsons Brinkerhoff (now WSP) and Sinclair Knight Merz (now Jacobs), working primarily on system planning studies, grid interconnection and grid code compliance studies for wind power plants around the world.

Nick Miller, HickoryLedge



Nick Miller recently retired from GE after 3/8 century of experience and research on bulk power systems. He has lectured on Wind and Solar Power integration to governments and institutions in more than three dozen countries. He currently provides consulting expertise to a variety of private and public institutions on topics of grid integration of renewable resources. He holds twenty US patents for wind, solar, and grid technologies, is a Fellow of IEEE, a NY PE, active in CIGRE and IEC, has authored over 150 technical papers and articles, and is the recipient of several power industry awards.

Deepak Ramasubramanian, EPRI

Deepak Ramasubramanian is a Technical Leader at the Electric Power Research Institute (EPRI). His research is in the area of modeling, control, and stability of future power systems focusing on both transmission and distribution connected generation sources. He joined EPRI in 2017.

Sebastian Achilles, GE

Sebastian Achilles is Managing Director, Power Systems Operation and Planning at GE Energy Consulting. His responsibilities include integration and interconnection of onshore wind, offshore wind, PV solar, battery and FACTS technologies globally. His team provides support to product design related to grid behavior of these IBRs. Team also provides consulting support to developers and transmission entities related to same area of expertise.

Agenda

- Advantages and challenges of high penetrations of IBRs and introduction to grid-forming IBRs – Jason MacDowell, GE
- Applications of Grid-forming IBRs – Julia Matevosyan, ERCOT
- Break
- Weak Grid Experiences in ERCOT – Julia Matevosyan, ERCOT
- Export Stability study comparing grid-following IBR, grid-forming IBR and synchronous machines – Nick Miller, HickoryLedge
- Break
- Modeling of grid-forming IBR and frequency response in a 100% IBR grid – Deepak Ramasubramanian, EPRI
- Grid-forming IBR in wind, solar and battery plants – Sebastian Achilles, GE

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