

**2016 FEEDER Summer Institute
National Renewable Energy Laboratory
May 30-June 3**

Monday, May 30

Visit Golden Colorado - This day we will visit many local locations in the Golden, Colorado area. Please wear comfortable hiking shoes. We will travel to several local parks to see the natural wonders of Colorado. The visit will include: Red Rocks Park sandstone formations, dinosaur bones and footprints, and other unique sites. Bring hats, sunglasses, and sunscreen.

8:00 – 9:00 Breakfast (on your own)

9:00 – 12:00 Start from CSM Dorms – Visit Red Rocks Park and Dinosaur Ridge

12:00 – 1:30 Lunch (Woody's Pizza – Downtown Golden)

1:30 – 4:00 Mt. Evans Road trip (weather dependent)

Tuesday, May 31 (Day 1)

Distributed Energy Resources

8:00 – 8:30 *Continental Breakfast – NREL Golden Campus*

8:30 – 8:35 Welcome to NREL– [Ben Kroposki \(benjamin.kroposki@nrel.gov\)](mailto:benjamin.kroposki@nrel.gov)

8:30 – 8:35 Welcome to Course – [Larry Holloway \(UK\)](#) and [Zhihua Qu \(UCF\)](#)

8:45 – 10:30 DER and Inverter Technologies – cover all classes of DER. Focus on inverter based technologies (PV, wind, energy storage, fuel cells). Describe types of DER. Describe types of inverters. Power electronics basics.

- [Fahimi Babak \(UT- Dallas\)](#)

10:30 – 11:00 *Break*

11:00 – 12:00 Power grids and the need for advanced grid functionality from inverters – Discuss basics of power system operations (power/frequency and reactive power/ voltage). Cover new classes of advanced inverter functionality including, fault ride-through, Volt-VAR control, frequency-watt control.

- [Roy McCann \(UArkansas\)](#)

12:00 -1:00 *Lunch - Provided*

1:00 – 2:30 Testing and Evaluation of Inverters – overview of recent testing results from inverter evaluations at NREL

- [Sudipta Chakraborty \(NREL\)](#)

2:30 – 3:00 *Break*

3:30 – 5:00 Tour of ESIF – Tour the NREL Energy Systems Integration Facility – see inverters and other technologies under test

- [Lab Project Testing - Andy Hoke \(NREL\)](#)
- [ADMS Test Bed Tour and 3D Visualizations – Murali Baggu \(NREL\)](#)

5:00 – 5:15 Discuss class project – Class will split into groups of 4 students each. They will be given a specific region or state in the USA to evaluate renewable

potential and discuss issues and solutions to reaching high levels of renewable integration and meeting RPS goals. Groups will develop presentation and deliver on Friday.

Wednesday, June 1 (Day 2)

Distribution Planning and Analysis

8:00 – 8:30 Continental Breakfast – NREL Golden Campus

8:30 – 10:30 Planning Distribution Systems with high levels of PV

- Omar Faruque (FSU), Tom McDermott (Pitt), and Andrea Benigni (USC)

10:30 – 11:00 Break

11:00 – 12:00 Introduction to Modeling and Simulation of Distribution Systems

- Bryan Palmintier (NREL)

12:00 – 1:00 Lunch

1:00 – 2:30 Introduction to Distribution System Modeling with GridLab-D

- Bryan Palmintier (NREL)

2:30 – 3:00 Break

3:00 – 5:00 Get full simulation up and running using test distribution circuit. Discuss larger project circuits.

- Bryan Palmintier (NREL)

Thursday, June 2 (Day 3)

Distribution System Operations and Control

8:00 – 8:30 Drive to NREL National Wind Technology Center

8:30 – 9:00 Continental Breakfast (NREL NWTC)

9:00 – 10:30 Tour NREL Wind Site

10:30 – 11:00 Drive back to NREL - Golden

11:00 – 12:00 Distribution Sensing and Measurement

- Yuan Liao (UK) and Yingchen Zhang (NREL)

12:00 – 1:00 Lunch

1:00 – 2:00 Distributed Controls and Optimization

- Zhihua Qu (UCF)

2:00 – 3:00 Advanced Distribution Management System

- Wei Sun (UCF) and Murali Baggu (NREL)

3:00 – 5:00 Time to work on Class Projects

Friday, June 3 (Day 4)

Student Project Reports

8:00 – 8:30 Continental Breakfast – NREL Golden Campus

8:30 – 12:00 Students report out on projects

12:00 – 1:00 Lunch

1:00 Adjourn