

CPET 581 Smart Grid & Energy Management  
Friday 6:00-8:45PM  
2013/11/8

Lecture 14

Topics of Discussion

(1) Solar Power Systems and System Integration

- Solar Research, Major Research Laboratories
- Solar System Engineering, Design, Integration
- Solar Energy Storage
- PV Testing Equipment
- Solar Energy Estimation, Performance Estimation Software Tools

(2) Energy Efficiency Management & Smart Building

- Cutting Energy Cost with Hierarchical Control, Vol. 1, No. 1, IEEE Electrification Magazine, Sept. 2013, [www.ieee-pes.org](http://www.ieee-pes.org)
- Energy Management, Building Automation Systems, U of I
- Building Automation for Enhanced Energy and Operational Efficiency, <http://www.ti.com/lit/wp/spry247/spry247.pdf>
- Occupancy-Driven Energy Management for Smart Building, [http://synergy.ucsd.edu/yuvraj/docs/Agarwal\\_BuildSys10\\_Occupancy.pdf](http://synergy.ucsd.edu/yuvraj/docs/Agarwal_BuildSys10_Occupancy.pdf)
- Building Automation & Energy Management & Control
- Energy Management Services, <http://us.sunpowercorp.com/power-plant/products-services/services/>
- Eaton Energy, <http://www.eaton.com/Eaton/ProductsbyMarket/Energy/index.htm>

(3) Solar Energy Links, U.S. Bureau of Land Management,

[http://www.blm.gov/wo/st/en/prog/energy/solar\\_energy.html](http://www.blm.gov/wo/st/en/prog/energy/solar_energy.html)

(4) Other References

- Solar PV On Campus Database, The Association for the Advancement of Sustainability in Higher Education, <http://www.aashe.org/resources/campus-solar-photovoltaic-installations/>
  - 322 campuses in 45 states, total capacity 183,747 kW (183 MW), and the average capacity is 344 kW.
  - 3 MW Solar PV, 2010, William Paterson University, NJ
  - Arizona State University, Solar Initiatives, <http://www.asu.edu/tour/sustainability/solar.html>
    - TUV Rheinland Photovoltaic Testing Laboratory, <http://www.asu.edu/tour/sustainability/tuv-ptl.html>

- Solar College Initiatives, <http://www.solarcampusinitiative.org/>
- Solar PV Laboratories
- NREL Solar Research, <http://www.nrel.gov/solar/>
  - Solar Radiation Research
  - Solar Thermal Research
  - Solar Heating
  - Solar Systems Integration
    - Distributed Grid Integration, <http://www.nrel.gov/electricity/distribution/>
    - Transmission Grid Integration, <http://www.nrel.gov/electricity/transmission/>
    - System Advisor Model (SAM), <https://sam.nrel.gov/>
    - PV Engineering, <http://www.nrel.gov/pv/engineering.html>
    - PV performance reliability and safety, [http://www.nrel.gov/pv/performance\\_reliability/](http://www.nrel.gov/pv/performance_reliability/)
    - Solar source assessment, [http://www.nrel.gov/solar\\_radiation/](http://www.nrel.gov/solar_radiation/)
    - Technology system analysis, [http://www.nrel.gov/analysis/tech\\_analysis.html](http://www.nrel.gov/analysis/tech_analysis.html)
- Sandia National Laboratories - Photovoltaics, [http://energy.sandia.gov/?page\\_id=2727](http://energy.sandia.gov/?page_id=2727)
- MIT PV Research Lab, <http://pv.mit.edu/>
- Renewable Energy & Smart Grid, FSI Stanford, [http://pesd.stanford.edu/research/low\\_carbon\\_electricity/](http://pesd.stanford.edu/research/low_carbon_electricity/)
- The Open PV Project, <https://openpv.nrel.gov/>
  - The real-time status of solar PV market in U.S.: Total # of installs: 235, 919, Cost \$/W (2013) 4.47, Capacity (MW) 5463.67
  - Search for State
- Solar Estimator, <http://www.solar-estimate.org/?page=rightforme>
- Clean Power Estimator, [http://www.gosolarcalifornia.org/tools/clean\\_power\\_estimator.php](http://www.gosolarcalifornia.org/tools/clean_power_estimator.php)
- Solar PV
- U.S. DOE Solar Decathlon, <http://www.solardecathlon.gov/>
- PV Testing Equipment
  - [http://www.seaward-groupusa.com/userfiles/pv150.php?utm\\_source=google&utm\\_medium=cpc&utm\\_campaign=solar](http://www.seaward-groupusa.com/userfiles/pv150.php?utm_source=google&utm_medium=cpc&utm_campaign=solar)
    - Ground continuity
    - Insulation resistance
    - Polarity
    - Open circuit voltage
    - DC operating power
    - Ground test lead null
    - Short circuit current

- Operational current
  - Irradiance
  - Temperature
- <http://www.solar-pv-tester.com/>
- Solar Power System + Substation Integration,
  - AETI (American Electric Technologies), Solar Inversion System  
<http://www.aeti.com/solarsolutions>
    - 1000V 1.0 & 1.5 MW 15kV
    - UL 1741 Integrated Solar Inversion Stations (ISI);
    - 1000V 15 or 38kV collection grid or substation utility interconnection system,
- Solar power systems & Integration
  - System Integration, <http://www1.eere.energy.gov/solar/pdfs/46663.pdf>
  - Solar Energy Technologies Program,  
<http://www1.eere.energy.gov/solar/pdfs/47282.pdf>
  - Solar Energy Grid Integration Systems (SEGIS), Oct. 2007,  
[http://www1.eere.energy.gov/solar/pdfs/segis\\_concept\\_paper.pdf](http://www1.eere.energy.gov/solar/pdfs/segis_concept_paper.pdf)
- Integrated Substation Automation System Design, 2001,  
<http://tdworld.com/archive/integrated-substation-automation-system-design>
- NREL Distributed Grid Integration, <http://www.nrel.gov/electricity/distribution/>
  - Codes & Standards,  
[http://www.nrel.gov/electricity/distribution/projects\\_codes\\_standards.html](http://www.nrel.gov/electricity/distribution/projects_codes_standards.html)
    - IEEE 1547 Family of standards
    - IEEE 2030 Family of standards
  - Data Collection & Visualization,  
[http://www.nrel.gov/electricity/distribution/projects\\_data\\_collection.html](http://www.nrel.gov/electricity/distribution/projects_data_collection.html)
  - Hawaii Clean Energy Initiative,  
[http://www.nrel.gov/electricity/distribution/projects\\_hcei.html](http://www.nrel.gov/electricity/distribution/projects_hcei.html)
  - Microgrids,  
[http://www.nrel.gov/electricity/distribution/projects\\_microgrid.html](http://www.nrel.gov/electricity/distribution/projects_microgrid.html)
  - Power System Modeling,  
[http://www.nrel.gov/electricity/distribution/projects\\_power\\_systems.html](http://www.nrel.gov/electricity/distribution/projects_power_systems.html)
  - Solar Distributed Grid Integration,  
[http://www.nrel.gov/electricity/distribution/projects\\_solar.html](http://www.nrel.gov/electricity/distribution/projects_solar.html)
  - Technology Development,  
[http://www.nrel.gov/electricity/distribution/projects\\_technology\\_development.html](http://www.nrel.gov/electricity/distribution/projects_technology_development.html)
    - High Penetration Photovoltaics,  
[http://www.nrel.gov/electricity/distribution/projects\\_high\\_pen.html](http://www.nrel.gov/electricity/distribution/projects_high_pen.html)
    - Hydrogen System Research,  
[http://www.nrel.gov/electricity/distribution/projects\\_hydrogen.html](http://www.nrel.gov/electricity/distribution/projects_hydrogen.html)
    - Metering Solutions,  
[http://www.nrel.gov/electricity/distribution/projects\\_metering.html](http://www.nrel.gov/electricity/distribution/projects_metering.html)

