Designing Atmospheric Tools for Mobile Hybrid Microgrids

Gail Vaucher
U.S. Army Research Laboratory,
White Sands Missile Range, NM
gail.t.vaucher.civ@mail.mil

Background:

- Purpose for integrating a diversity of mobile power resources into a Hybrid Microgrid: To facilitate and improve uninterrupted electricity flow at isolated and remotely located sites, such as those serviced during disaster relief-and-recovery missions.
- Hybrid Microgrids: A power grid consisting of both traditional and non-traditional (renewable energy) power generation.
- The atmosphere has a significant impact on the successful operation of hybrid mobile microgrids.
- Impact examples range from customer power usage based on weather conditions, to the potential harvesting of energy from atmospheric resources, such as solar and wind, for the generation of electrical power. This research is investigating the latter, energy harvesting.

General Challenges:

- No 'standard' mobile hybrid microgrid.
- Solar power technology is quickly evolving, consequently:
  - End point applications are a moving target;
  - Historical research is informative, but not necessarily applicable to current technology.
- Most atmospheric renewable energy studies are oriented for utility-scale applications. Utility-grid requirements differ from isolated, hybrid microgrids.

Research:

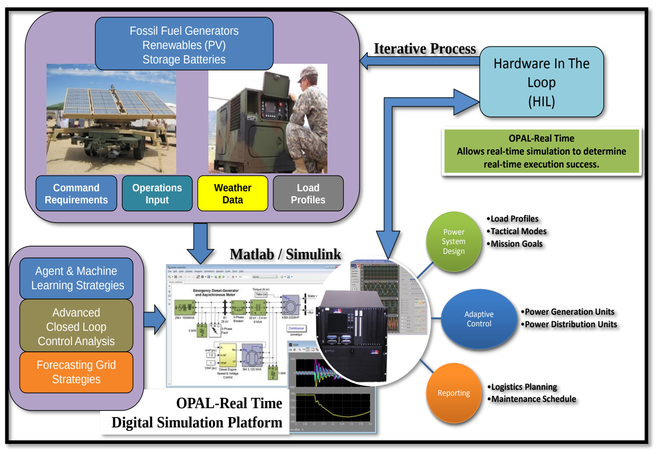
- Optimizing solar and non-solar resources, through current and future atmospheric awareness is the vision for this research.
- Ensuring transparent transitions (ramping) between multiple power generation resources is critical. For hybrids utilizing solar energy, the transitions are primarily a function of available solar radiation.
- Atmospheric variables being investigated include solar radiation, aerosols/dust, etc.

Method:

- Test scenarios through Microgrid Simulations.
- Develop in-situ atmospheric characterization schemes for hybrid microgrid applications.
- Collaborate with the evolving solar power forecasting researchers, to extract a compatible predictive model for the remotely located, hybrid power resource.

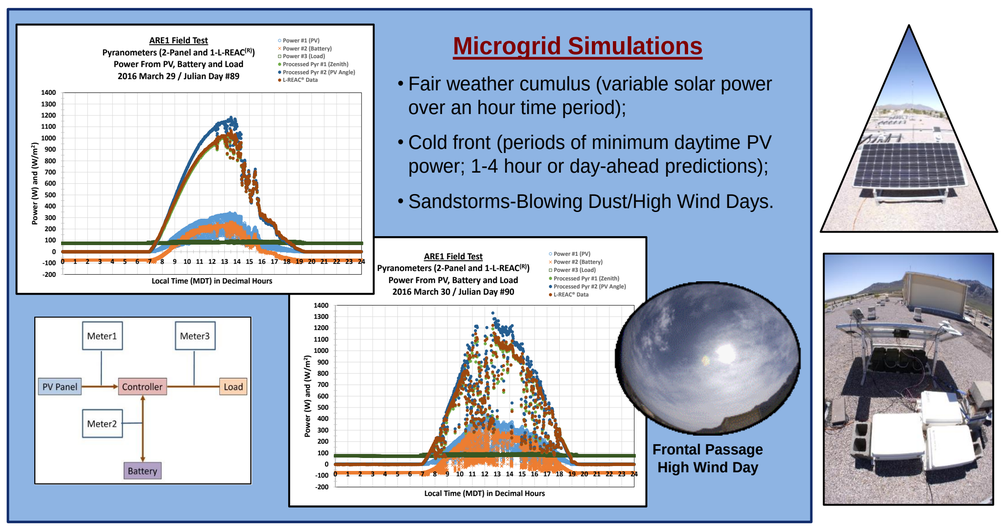
Discussion & Results: In progress.

- Microgrid simulations are being constructed.



Hardware in the Loop Real Time Digital Simulation

- Atmospheric Renewable Energy Field Test #1 (ARE1):
  - Coincident atmospheric and photovoltaic power generation were acquired and analyzed.
  - Developed informative atmospheric, power and photovoltaic panel characterization techniques.



- Subsequent atmospheric measurements were taken along side experimental photovoltaic materials.
- Strengths and challenges for future mobile hybrid microgrids were investigated, based on existing microgrids. Results revealed additional benefits for using such power resources, such as observing solar power as a 'quiet' power resource, an attribute welcomed by hospitals.

Path Forward:

- Develop atmospheric characterization schemes to optimize hybrid microgrid efficiency and power output.

Project Publications:

- Vaucher, G., Berman, M., Smith. J. *Atmospheric Renewable Energy Research, Volume 3: Solar-Power Microgrids and Atmospheric Influences*; ARL-TR-7797; USARL: WSMR, NM, Sep 2016.
- Vaucher, *Atmospheric Renewable Energy Research, Volume 2: Assessment Process for Solar-Powered Meteorological Applications*; ARL-TR-7762; USARL: WSMR, NM, Aug 2016.
- Vaucher, *Atmospheric Renewable Energy Research, Volume 1 ("To BE or not To BE")*; ARL-TR-7402; USARL: WSMR, NM, Sep 2015 (Technical Report/ Seminar).

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