

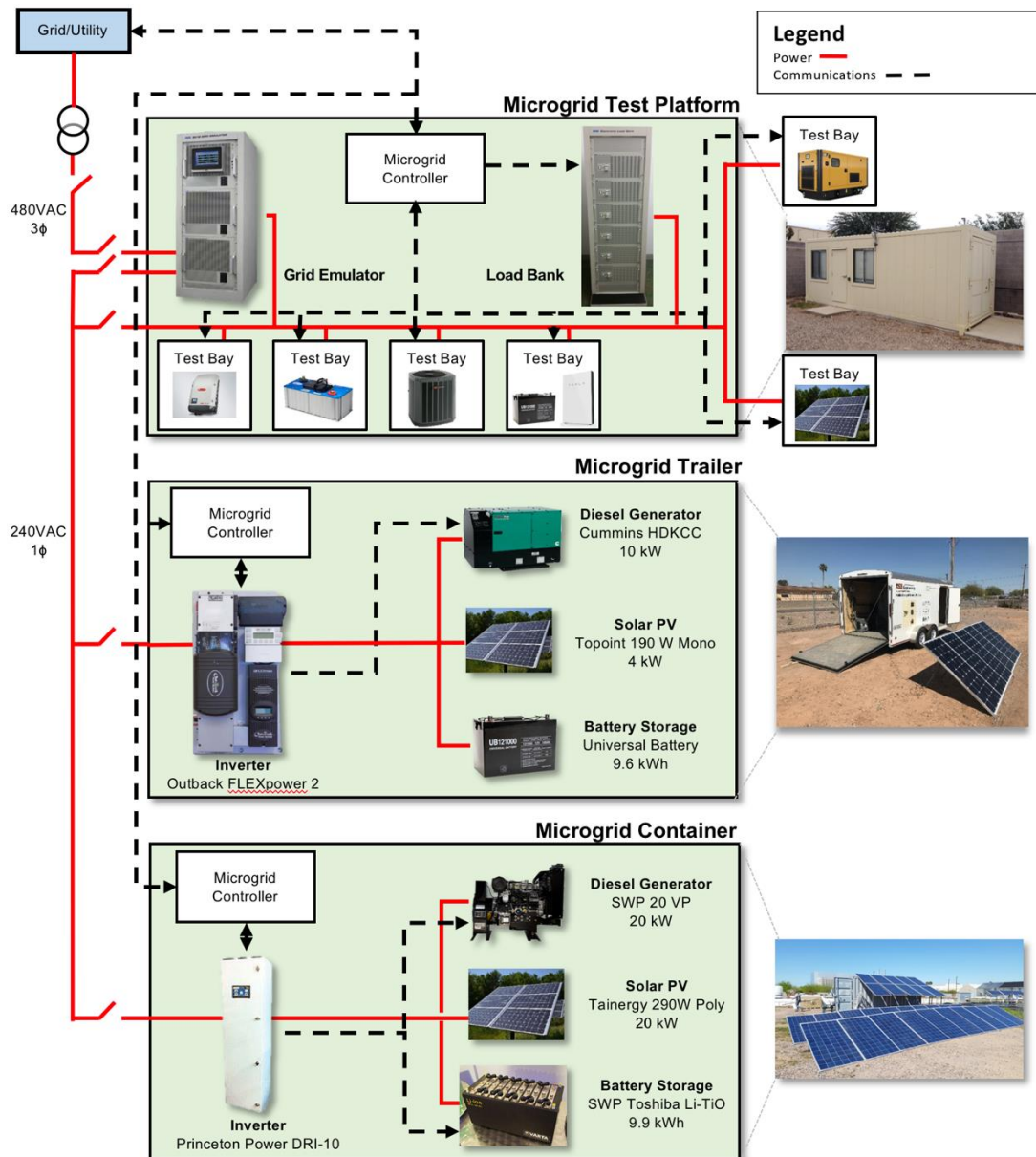
# Grid Modernization and Microgrid Test Bed at Arizona State University

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The Grid Modernization and Microgrid Test Bed shown below facilitates testing of components, single-node microgrids, and multi-node networked microgrid configurations consisting of:

- **Microgrid Test Platform** as a large “breadboard” for any asset configuration (2-25 kW)
- **Microgrid Trailer** used primarily for training and mobile demonstrations (7 kW)
- **Microgrid Container** disaster response or weak-grid applications (20 kW)

The test bed permits an extensive amount of data acquisition at the component, microgrid, and network level from (a) commissioning tests, (b) integration tests, (c) performance tests, (d) reliability tests, and (e) resiliency tests from physical and cyber threats.



Multi-node microgrid test bed layout

The Test Platform has a regenerative grid emulator (NH Research model 9410-24) with three independent channels that permits 1, 2, or 3-phase modes for AC and/or DC power for input/output simulation of grid, solar, wind, and storage. This can be programmed to mimic grid conditions for under/over frequency and under/over voltage up to 24 kW.

The Test Platform has a reactive load bank (NH Research model 4600-3), which can be programmed with actual load characteristics for single-phase and three-phase loads up to 18 kW.

The following assets are available for testing and integration:

- **Generator:** Cummins, SouthwestPower
- **Storage:** Tesla (Li-Ion), Toshiba (Li-TiO), AllCell (Li-Ion), Universal Battery (PbAcid)
- **Ultracap:** Maxwell
- **Solar Inverters:** ABB, SMA, Fronius, Outback
- **MG Controller:** Princeton Power, Outback, and an ASU controller