Smart Grid Test Facility: Mockup

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This mockup of the Smart Grid Test Facility illustrates the overall anticipated structure and layout of the test bench. The objective of this project is to create an educational tool for engineering students; the test bench can be used in classroom demonstrations, power electronics labs, or grid network courses. This test bench will also provide the infrastructure for future integration of smart grid components, such as communication and feedback systems.

As indicated, the test bench will be constructed on a mobile cart. On the bottom level will be the 12DC power supply, which is powered by a typical wall outlet. This is the prime source of power to the overall system. The lower level is also an ideal place to store parts such as wires, resistors, and other elements that may be needed throughout the test bench's use.

The upper level of the cart will hold the majority of the grid elements. The 12DC power supply will directly power the motor as shown in the mockup. The motor's outputted mechanical energy will power the alternator (as shown) which will generate the 3 phase AC power for the grid network. The motor and alternator will be housed in a transparent or semi-transparent casing for safety purposes.

Transmission lines will connect the alternator's AC output to the loads. Since this test bench aims to model the real power grid, the transmission lines will have resistive, capacitive, and inductive characteristics that are proportional to those on the real electrical grid. Thus, as visible on this mockup, the transmission network will include RLC elements. The binary load boxes will allow for variable load using a collection of switches. Additionally, clean energy input ports will exist for integration of simulated or small-scale green systems such as solar, wind, or hydroelectric power.

The data acquisition system, as shown, will collect information about power flow at various points along the test bench. Students will connect the bench to a computer in order to observe information such as power factor, voltage, current, and phase via a GUI.

Ultimately, we aspire to create this grid test bench as a learning tool for engineering students, who will be able to test their designed circuits with the behavior of a small-scale power grid.