CHPB-26-2018: The DC Micro-Grid House:
Converting an existing home to DC power to improve energy efficiency

Objective:
- To improve the energy efficiency of an existing home by converting it from AC to DC power.

Problem:
- Many systems and devices in the modern home already use DC power at the point of use. Converting the delivered AC power from the grid to DC power at each point of use incurs system inefficiencies. Other alternative energy systems also use DC energy and therefore suffer efficiency losses when coupled with AC systems.

Expected Results / Impact:
- Reduction in primary energy consumption
- Increased efficiency of appliances, lighting, and HVAC systems
- Increased efficiency of alternative energy systems such as solar PV and battery storage
- Development of new direct DC appliances, technologies, and control strategies.
- Reduction in the complexity and cost of electrical systems.
- First demonstration of an occupied fully DC powered house.

Approach:
- Instrument a baseline AC powered home that will serve as a living lab.
- Develop and install new DC technologies, appliances, and power delivery systems through collaboration with corporate partners.
  - Current partners include: Whirlpool Corp., Regal Beloit, Duke Energy, Rheem Manufacturing, and United Technologies Carrier
- Retrofit the AC powered home to supply DC power
- Outfit the house with direct DC powered appliances and systems
- Compare the performance of the AC powered house to the retrofitted DC power house

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Schedule:
Year 1
- Initial AC retrofit to modernize the house (Completed)
- Selection and installation of instrumentation and data acquisition system; development of data reduction and monitoring software (Fall 2017)
- Baseline data collection with AC-powered appliances & HVAC system (Fall 2017 to Fall 2018)
- Development of DC-powered appliances and HVAC system in collaboration with corporate partners (Fall 2017 to Fall 2018)
- Design and implementation of the DC micro-grid infrastructure in collaboration with corporate partners (Fall 2017 to Fall 2018)

Year 2
- DC retrofit and installation of new DC appliances and HVAC system (Fall 2018)
- Data collection with DC-powered appliances & HVAC system, including comparison to baseline data (Fall 2018 to Fall 2019)

Year 3
- Further Evaluation of and Optimization of DC Micro-Grid House (Spring 2019 to Fall 2019)

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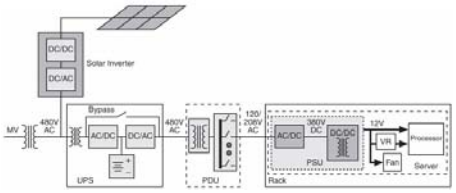

Figure 1. Solar Integration in a Conventional AC Data Center

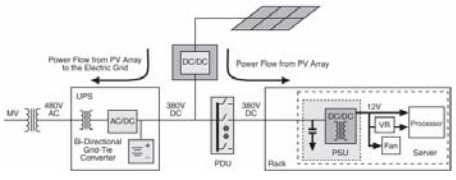

Figure 2. Solar Integration in an DC Data Center

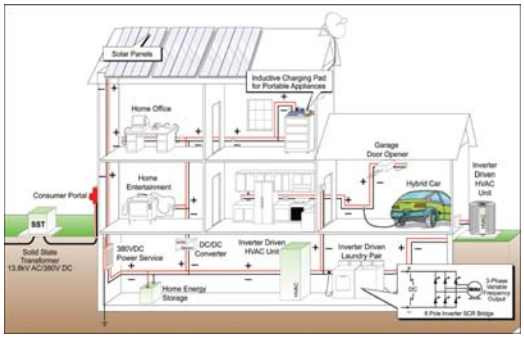

Figure 3: Example of a Proposed Residential DC Micro-Grid Infrastructure

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