**DC Power Distribution in Commercial Buildings**

**Why DC?**

- DC-based distributed generation such as photovoltaic and wind
- On-site DC electrical storage
- The most efficient types of loads are natively-DC (LEDs, electronics, EV charging, induction stoves, and variable speed motors in HVAC and water heating)
- Power electronics
- DC Power Standards: USB, Ethernet, Communications

**Technology and Market Trends**

- Energy Savings in Zero Net Energy (ZNE) Buildings with large solar and storage capacity
- Simpler power electronics: better cost and reliability
- Reliable microgrid islanding through power electronics allows for low-cost disaster resiliency
- Improved power quality
- Combined data and power allows for communications

**Energy Simulation**

- Develop Modelica models of AC and DC medium office building in Los Angeles
- Zero net energy building with all electric loads internally DC
- Solar profiles from PV Watts, and load profiles from EnergyPlus, and converter efficiency curves from product data
- Use parametric simulations to determine when DC is beneficial and by how much

**Techno-Economic Analysis**

- Results determined from market cost data, grid tariffs, and Monte-Carlo analysis
- First cost is higher for DC
- Given the enormous efficiency savings, the payback period is less than a year
- End-use costs, installation costs, and other soft costs not considered

**Experimental Load Modification**

- Modified AC loads to take a DC input
- Demonstrated savings with DC input
- Determine how each type of load should be modified to benefit most from DC

**Potential Benefits**

- Zero net energy building with all electric loads internally DC
- Solar profiles from PV Watts, and load profiles from EnergyPlus, and converter efficiency curves from product data
- Use parametric simulations to determine when DC is beneficial and by how much

**Analysis Approach**

- **Energy Simulation**
  - Develop Modelica models of AC and DC medium office building in Los Angeles
  - Zero net energy building with all electric loads internally DC
  - Solar profiles from PV Watts, and load profiles from EnergyPlus, and converter efficiency curves from product data
  - Use parametric simulations to determine when DC is beneficial and by how much

- **Techno-Economic Analysis**
  - Results determined from market cost data, grid tariffs, and Monte-Carlo analysis
  - First cost is higher for DC
  - Given the enormous efficiency savings, the payback period is less than a year
  - End-use costs, installation costs, and other soft costs not considered

- **Experimental Load Modification**
  - Modified AC loads to take a DC input
  - Demonstrated savings with DC input
  - Determine how each type of load should be modified to benefit most from DC

**Future Research**

- Develop detailed converter loss models to help compare AC and DC
- Develop a DC Design Tool to help building designers compare
- Field test upcoming and developed DC building systems

**Industry Need:**

- Quantify the benefit of DC Distribution

**DC Design Tool Provides:**

- Fair and Accurate Cost/Benefit Analysis

**Contact:**

- dgerb@lbl.gov
- Website: dc.lbl.gov

We thank U.S. DOE and CEC for supporting this work!