

# **Design and Installation of a Hybrid Photovoltaic-Fuel Cell Direct Current Generation and Distribution System at the ASU Polytechnic Campus**

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One of the challenges of using solar and wind energy to generate power is their intermittent nature, thus storage systems are used to provide electricity during nighttime hours, when the sun is obscured by clouds or the wind isn't blowing. We have designed and installed a hybrid electricity generating system that combines a photovoltaic array as the primary source of power, with batteries and a hydrogen fuel cell for storage and backup power, to provide electricity for a work-study room at San Tan Hall on the ASU Polytechnic campus. A key element of the system's design was to provide both AC and DC feeds to the work-study room and to compare the overall energy efficiency attained by using AC- and DC-supplied office equipment.

## Purposes

The primary purpose of the project is to demonstrate the implementation of a hybrid electricity generation/storage system. We will use a data acquisition system to monitor voltage levels and current flows at various points in the system in order to compare the efficiency of the AC- and DC-supplied circuits to the work-study room. We will also perform a cost-benefit analysis between AC and DC office equipment. Finally, the system provides a visible example of renewable energy for students, faculty members and visitors to the ASU Polytechnic campus.

## System Components

12, 320W BIPV modules  
Plug Power Gencore 5kW, 48Vdc UPS fuel cell  
Agilent A61646 Programmable Power Supply  
80Ah lead-acid battery bank for PV system  
Excell 1100W pure sine wave inverter  
Zahn DC/DC voltage converter  
Campbell Scientific CF1000 data logger

## Implementation Challenges

The biggest obstacle to implementing the system was the high cost of its components and their installation, which result in an impossibly long payback period. Fortunately, many of the key components were donated by their manufacturers, who were motivated in part by an interest in seeing a demonstration of this type of hybrid generation and distribution system. We also faced siting problems with the hydrogen storage system and conversion/battery equipment. Other challenges included a lack of experience with DC systems by installers and rigid thinking by

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inspectors. These challenges have led to unexpected setbacks in the project, but we anticipate reaching our goals, albeit with a slower timeline.