

# AGENDA

- INTRODUCTION
- CELLS AND COMPONENTS
- PV PERFORMANCE
- PV APPLICATIONS
- CODES AND STANDARDS
- EMERGENCY RESPONSE



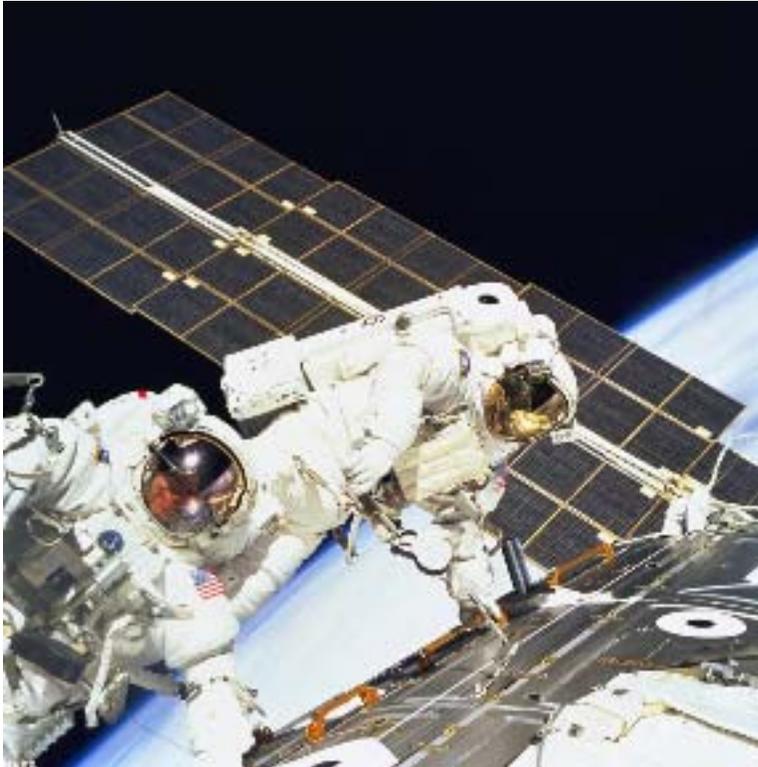
*“The world we live in is but thickened light.”*  
*Ralph Waldo Emerson, The Scholar, 1883*

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## **Objective**

To identify PV applications and  
the components associated  
with each application

# PV APPLICATIONS



In December of 1998  
Astronauts Jerry L. Ross (left)  
and James H. Newman work  
together on the final of three  
space walks of the STS-88  
mission. (Photo Credit: NASA)

Even if you don't use PV directly you are doing so indirectly.

Communication systems and satellites with integrated PV systems provide power that improves the efficiency of our everyday lives even though you may not be aware of it!

# PV APPLICATIONS

Day Use	Integrated with Battery Back-Up
Calculators	Watches
Toys	Radios
Fans	Flashlights
Blowers	Telecommunication
Pumps	Landscape lighting

These are some of the common applications  
of PV that you are already familiar with

# PV APPLICATIONS

## Direct Current (DC) Systems



Components in a direct current system include:

Photovoltaic module or array

Battery charge controller

Batteries and

Direct current appliances

# PV APPLICATIONS

## DC to AC Systems



This PV system includes:

Solar Modules or Array  
Battery Controller  
Batteries  
Plus an Inverter

In rural areas, people can power their homes by converting the direct current (DC) generated from the PV system to alternating current (AC)

# PV APPLICATIONS

## DC to AC Systems



This PV system includes:

Solar Modules or Array  
Battery Controller

Batteries

Plus an Inverter

This battery charge controller monitors the energy level in the battery as it charges and discharges

# PV APPLICATIONS

## DC to AC Systems



This PV system includes:

Solar Modules or Array  
Battery Controller  
Batteries  
Plus an Inverter

Battery backed-up PV systems provide electricity for a specific period of time without sunshine

# PV APPLICATIONS

## DC to AC Systems



This PV system includes:

- Solar Modules or Array
- Battery Controller
- Batteries
- Plus an Inverter

These inverters convert direct current from the PV array and battery bank to alternating current

# PV APPLICATIONS

## Grid-Tied System



**This PV system includes:  
Solar Array & Inverter**

This system allows the building owner to generate and use PV power during the day and deliver excess power directly to the utility grid

# PV APPLICATIONS

## Grid-Tied System

Line-in from the array →



In this system the utility grid provides the back-up power and eliminates the need for batteries in the system

To insure that the inverter is disconnected once the main electrical panel is locked out, fire personnel can also use the manual disconnect next to the inverter as an extra precaution

# PV APPLICATIONS

## Grid-Tied System



Loss of power from the grid will disconnect electricity in the building including the ability to use the electricity generated by the PV system

In this application where the inverter and main electrical panel is a distance from the meter another disconnect has been installed behind the meter on the utility pole

# PV APPLICATIONS

## Grid-Tied System

You may not be able to see a PV system on a flat roofed building from street level. The large inverters at the USPS processing and distribution center in Marina Del Rey, would be your first clue of the existence of a 127 kw monocrystalline PV system on the roof.



# PV APPLICATIONS

## BUILDING INTEGRATED DESIGN



The developing trend is to incorporate PV systems seamlessly into the building's exterior finish and landscape design

Laminated to the skylight glass are photovoltaic cells that produce electricity as well as serve as an element in the shading and day lighting design at the Thoreau Center for Sustainability, Presidio National Park, San Francisco, California.

# PV APPLICATIONS

## BUILDING INTEGRATED DESIGN (BID)



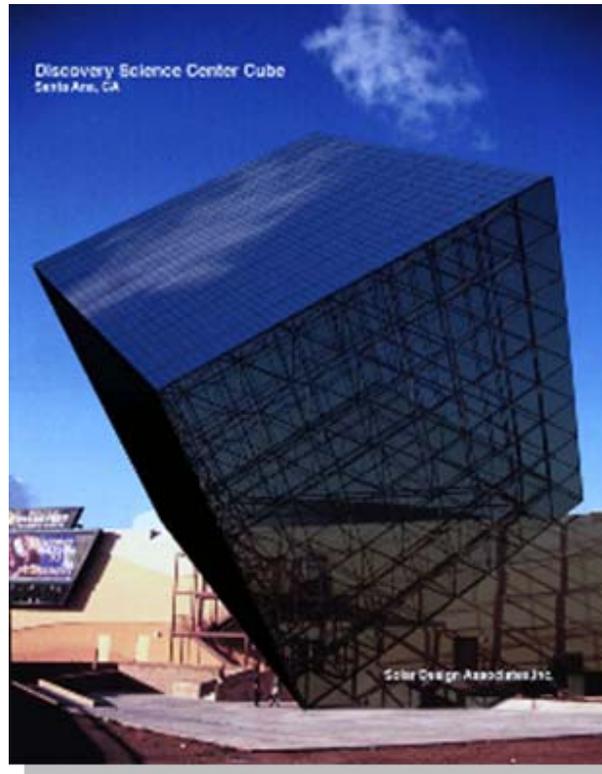
PV canopies at CAL EXPO in Sacramento provide shade to parked cars

BID systems appear as PV roofing systems, windows, skylights or patio covers



# PV APPLICATIONS

## BUILDING INTEGRATED DESIGN



Blending this technology into traditional building and landscape design is one of the many challenges designers are involved in and presents new challenges for emergency responders in identifying PV technology when sizing-up an emergency

The solar cube stands 135 feet tall on top of the Discovery Science Center in Santa Ana, CA



## SUMMARY

PV is used in a wide range of applications where electricity is needed; from simple and inexpensive appliances to high end satellites.

The future trend will be to integrate PV seamlessly and unobtrusively into buildings and building sites.

This trend will make PV system identification a little more challenging for emergency responders.