Solar Photovoltaic Training
For Architects and Engineers

Versailles, KY
January 31, 2018
This training program was made possible through Department of Energy, Office of Energy Efficiency and Renewable Energy’s Solar Training and Education for Professionals funding and prepared by the Building Codes Assistance Project and the Center for Sustainable Energy, in cooperation with the American Institute for Architects and the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

This is a good point to go over meeting logistics: phones off, location of restrooms, when to ask questions etc. Announce that AIA, ICC, and GBCI learning units are available for this training (and provide details on how to get those credits). Why AIA credits are eligible for HSW.
The SunShot Initiative's mission is to make solar energy fully cost-competitive with traditional energy sources before the end of this decade, making this clean renewable energy resource more affordable and accessible to Americans.

(Name refers to the seemingly-impossible "moonshot" project in the late 1960's to land a man on the moon)
The goal of this program training is to provide targeted training to design professionals, architects and engineers, to give design professionals the tools they need to promote solar PV into their earliest conversations with their clients, and to incorporate solar into their designs.

YOU have the power to be a significant leader in speeding up our transition from old fuels (which cause all sorts of problems, from dirty air and asthma, to political unrest as countries war over mineral rights), to new, clean, free energy from the sun.

SunShot 2020 Targets
In 2011, DOE set targets for solar energy to reach market competitiveness with conventional electricity sources by 2020:

$0.10 per kilowatt hour for residential solar
$0.08 per kilowatt hour for commercial solar
$0.06 per kilowatt hour for utility-scale solar

The 2020 residential and commercial targets were adjusted for inflation (to 2017 dollars), however the 2020 utility-scale target was not adjusted for inflation as wholesale electricity prices have been relatively flat from 2010-2017.

SunShot 2030 Targets: Photovoltaics
As the solar industry made rapid progress toward the 2020 targets, SETO committed to reaching new cost targets for the upcoming decade, which support greater energy affordability by cutting the cost of solar electricity an additional 50% between 2020 and 2030. The SunShot 2030 targets are:

$0.05 per kilowatt hour for residential PV
$0.04 per kilowatt hour for commercial PV
$0.03 per kilowatt hour for utility-scale PV
Michael E. Goldschmidt, AIA, LEED AP BD+C

Michael is a licensed architect and an Associate Teaching Professor in the Department of Architectural Studies at the University of Missouri. He coordinates and teaches many of the undergraduate classes in the department’s technology sequence, including coursework in sustainable building technologies and energy efficient buildings. Michael has over 30 years of professional architectural practice experience including sustainable designs for residential and commercial buildings.
Learning Objectives

Upon completion of this course, participants will be able to:

• Explain basic technical information and the economical, ecological and community benefits of solar photovoltaics (PV)
• Act in a leadership capacity to increase solar PV deployment in your community and in your practice
• Make an actionable connection between policy objectives for solar deployment and AIA sustainability and 2030 goals
• Increase services to clients with reliable information on solar costs, benefits and available incentives

Learning objectives: Course participants will learn:

• Understand basic technical information on solar photovoltaics (PV)
• Understand the economical, ecological and community benefits of solar PV
• Act in a leadership capacity to increase solar PV deployment in your community and in your practice
• Make an actionable connection between policy objectives for solar deployment and AIA sustainability and 2030 goals
• Increase services to clients with reliable information on solar costs, benefits and available incentives
Why are YOU here?

Learn to design a solar system

Sell solar to my clients

Sell solar to my boss/partner

Continuing education units

ANIMATION SLIDE

Why are you here today? What you are hoping to learn? (Question audience)

The tops reasons for attending the training:
• Design a solar system – what are the design considerations you need to take into account
• Sell solar to my clients – what is the value of solar?
• Sell solar to my boss/partner – you may not be the only decision maker
• Continuing education units – if you are here only for

(We should update this slide if we hear different reasons for attending)
Why is this training important?

Buildings use about 40% of primary energy

And 70% of the electricity

DEFINITION OF "PRIMARY ENERGY": Energy in the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy. For example, coal can be converted to synthetic gas, which can be converted to electricity; in this example, coal is primary energy, synthetic gas is secondary energy, and electricity is tertiary energy. Source: U.S. Energy Information Administration. https://www.eia.gov/tools/glossary/index.php


Energy efficiency is a low cost way to save money, support job growth, reduce pollution, and improve the competitiveness of our businesses. Our homes, offices, schools, hospitals, restaurants, and stores consume a lot of energy—and money. We spend more than $430 billion each year to power our homes and commercial buildings, consuming more than 70% of all electricity used in the United States, about 40% of our nation's total energy bill, and contributing to almost 40% of the nation's carbon dioxide emissions. And much of this energy and money is wasted—over 30% on average. If we cut the energy use of U.S. buildings by 20%, we could save approximately $80 billion annually on energy bills, reduce greenhouse gas emissions, and create jobs. Source: U.S. Department of Energy, Energy Efficiency and Renewable Energy
This is a magazine cover from Metropolis Magazine in October 2003. THIS is not the message we want to see, and not the view that people should have of people in our profession. Yet there's some truth to this – we should be leaders in new designs, and not designing buildings that require the mass burning of fossil fuels to operate.

Design professionals play a crucial role in solar deployment since they are in the unique position of educating building owners, appraisers, and code officials as part of every project. When design professionals and engineers better understand how solar impacts their day-to-day work, they can support solar growth and eliminate barriers.

You are the leaders in this new technology. We are in the 21st century and we need 21st century buildings and retrofits. This trend is not just for new buildings! Solar PV can be added to retrofits / remodel projects as well.

Demand for solar is growing – and those that are selling it are the modern-day leaders that are making money because they are educated and equipped to do so. Architects and engineers in states where solar is booming have a market advantage that others don’t. As demand for solar expands into other states, this market opportunity is up for grabs. There will be those designers that let it pass by them, and clients that know of and want solar, will go to them. OR you can take advantage of this opportunity and BE one of the leaders that clients go to for advice. You can be the one with experience, and the one that knows the newest technology and how it will lower energy bills for clients, and make them feel good about using you as their designer. This is a huge opportunity – don’t miss out! Attending this training is the first step... so you’re already on your way to becoming a solar PV market leader, and you’re on your way to differentiating yourself from your competition. And you’re on your way to making more money by incorporating more solar PV into your designs, and effectively communicating the benefits in terms of utility bill savings, if not healthier air quality, to your clients.
Why is this training important?

Putting the power source on the building

With solar, you are putting a power source on the building. That doesn’t exist anywhere else unless you’re sitting on an oil well. Power losses occur during the generation and transmission of traditional power. But if you can build your own power right on your building, the loss will be minimalized.

For more than the past 100 years society has relied on traditional fuels for electricity... charcoal, then coal, natural gas, some hydro and nuclear energy. But solar photovoltaic technology has come a long way in just the past few years, the cost is falling rapidly, and it is now a viable alternative. It is one of today's technologies that will transform the human race. It's free, it's cool, and it's booming - it IS THE FUTURE of clean electricity generation, and it's coming. As designers, YOU are the leaders that will help determine how fast we transfer to this new technology. YOU have the power to be a significant leader in speeding up our transition from old fuels (which cause all sorts of problems, from dirty air and asthma, to political unrest as countries war over mineral rights), to new, clean, free energy from the sun.
The AIA's current portfolio of Public Policies includes a commitment to achieving a carbon-neutral built environment by the year 2030. This is based on the Architecture 2030 Challenge, which calls for new buildings and major renovations built this year to use 70% less fossil fuel than typical projects built in 2003.

As a point of reference, the most current model energy code – the 2015 IECC - represents only a 40% (+/-) improvement in energy efficiency, and it is not yet widely adopted and compliance is thought to be considerably less than 100%.

*Does everyone know about the AIA 2030 Challenge?* In 2006, Architecture 2030 issued the 2030 Challenge, a breakthrough vision that calls for all new buildings, developments, and major renovations to be carbon-neutral by 2030. To support this call to action, we created the AIA 2030 Commitment—a national framework with simple metrics and a standardized reporting format—to provide a structure for tracking progress and help you meet the challenge.

Firms from all over the country have been tracking and reporting projects since 2010, with over 2.6 billion sq ft of project work reported in 2015 alone.
Architecture 2030 is a non-profit organization organized to rapidly transform the global built environment from the major contributor of greenhouse gas (GHG) emissions to a central part of the solution to the climate crisis. Established in 2002 by Ed Mazria, FAIA.

The 2030 Challenge was issued as a means of slowing the growth rate of GHG emissions and keeping the rise in average global temperature below 2°C, which is the tipping point for irreversible climate change. The graph shows the goals of the challenge:

- All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% below the regional (or country) average/median for that building type. (THIS IS WHAT WE SHOULD BE DESIGNING AND BUILDING RIGHT NOW)
- At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% of the regional (or country) average/median for that building type.
- The fossil fuel reduction standard for all new buildings and major renovations shall be increased to:
  - 80% in 2020
  - 90% in 2025
  - Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).
The red line indicates the approximate level of stringency of the most current model energy codes, the 2012/2015 IECC or ASHRAE 90.1-2013. Using the energy code as a design guide only gets us to about halfway to where we SHOULD be in order to avert serious climate change.
And the blue line is an estimate of actual energy savings/GHG reductions from new construction and major renovations taking into account:

- The most current model energy codes are not uniformly adopted across the U.S. and
- Compliance with the energy codes is less than 100%, according to numerous studies evaluating rates of compliance
In March 2017, and again in April 2017, U.S. monthly electricity generation from utility-scale renewable sources exceeded nuclear generation for the first time since July 1984. This outcome reflects both seasonal and trend growth in renewable generation, as well as maintenance and refueling schedules for nuclear plants.

As renewable generation has increased, net generation from nuclear power has remained relatively flat since the late 1990s. Retirements of a number of nuclear plants have resulted in a slightly lower level of overall nuclear generation capacity, and in turn, a lower level of generation.

Source: https://www.eia.gov/todayinenergy/detail.php?id=31932
Our primary goal is to give you the tools to become a knowledgeable resource in your firm and in your community on the importance of increased solar PV deployment on new and existing buildings.

There are many myths and barriers we have seen that prevent design professionals to incorporate solar into their designs.

This program will help you answer or rebut these questions.
“Solar is ugly.”

“It’s ugly”: Some of the first systems that went in the 1970s – were clunky and that old technology was ugly to some people. The technology has come a long way since then and today’s options are much greater than back then. Today we’ll show you some strikingly beautiful ways to incorporate solar into buildings.
“If I wait 10 years...”: This is true for everything isn’t it? Computers, iPhones, etc. The technology is market ready NOW, and most solar PV technology has a 30 years life span. Some historical info (for speaker’s reference; from the “SunShot Vision Study – Feb 2012): “In the 1980s, the U.S. and global PV demand was dominated by off-grid applications, typically very small systems with installed capacities measured in hundreds of watts. During the late 1990s, grid-connected systems—with installed capacities measured initially in kilowatts and later in megawatts—began dominating global demand. As this transition occurred, system cost declined significantly owing to a combination of research and development (R&D) advances as well as economies of scale on the production and installation sides. In the United States, the transition to a market dominated by grid-connected systems occurred slightly later, driven by state and federal incentives. “
In 42 of America’s 50 largest cities, financing a residential solar energy system actually costs less than purchasing electricity from a customer’s local utility. Studies show the cost of going solar has dropped every year since 2009. If you’d like to purchase your solar energy system, you don’t have to buy it in cash -- there are a number of different financing options.
Source: DOE EERE

Solar brings great potential to save money on your monthly utility bill. The amount you save depends upon how much electricity you consume, the size of your solar energy system, and how much power it is able to generate. The monthly amount owed on a solar loan is typically less than an average utility bill.
Source: DOE EERE
“You need to own a building to install solar”: Do you rent your house? Or do you live in a high-rise condo building? Not a problem. Community solar programs allow multiple people to benefit from a single, shared solar array. These arrays can be installed on your building or offsite in a different location. Purchasing costs and the installation of the solar energy system are then divided among all of the participants. Source: DOE EERE
“Solar will lower the value of my building.”

Although, there have not been any studies released for the value solar adds to commercial buildings, it has been proven that solar will add value to homes if the system is purchased. With solar, the utility costs can be minimal which is attractive to buyers.
“Solar doesn’t work in certain climates.”

Solar panels only need one thing to generate electricity -- sunshine! Even in the winter when there are fewer hours of daylight, there is still a sufficient amount to power the average American home. That makes solar viable even in Alaska with longer, colder winters. Source DOE EERE
1. **Basic Technical Information on Solar PV**
   - How does solar PV work
   - Main components of a solar PV system
   - Mounting options – solar PV should be aesthetically pleasing

2. **State of the Market & Current Policy**
   - State of the market – the cost of solar PV has dropped considerably over the last 10 years, the solar resource maps of the US & Germany will show solar can (and has been) installed in colder climates
   - Current policy – you do not need to

3. **Utility Connections & Code Considerations**
   - Grid connection and relationship to the utility
   - Codes and standards
   - What is solar ready?

4. **Architectural Integration of Solar PV**
   - Benefits of adding solar in new construction
   - Zero net energy buildings and energy ratings
   - Design considerations to maximize solar potential
   - Lousy design decisions
   - Examples of architectural integration

5. **Benefits, Financing Options & Cost Analysis**
   - Financing and incentives
   - Cost-benefit analysis of adding solar to projects;
   - Case studies

6. **Putting it all together / Basic design principles of basic PV systems**

7. **Emerging Technologies & Wrap-up**
   - Emerging technologies
   - Individual and community benefits (as wrap up)
   - Charging message to incorporate and advocate