Lousy Design Decisions
Now let’s talk about a few solar installation failures.

A common mistake is designing the system where a portion of the panels are shaded. This can be from the surrounding landscape or buildings, equipment on the rooftop where the system is installed, or other panels in the system. Keep in mind landscape will grow and if the property owner has permission, trees may need to be trimmed every few years. Also, neighboring new construction should be considered as well.

“After a solar system is installed it is important to properly commission the solar system. This means taking a volt meter through the system to verify you have the correct voltage inputs to the equipment being used.” http://pveducation.com/solar-installation-failures/inverter-commissioning/

For more examples of ‘what not to do’: http://pveducation.com/solar-installation-failures/

OR Aurora Solar: http://blog.aurorasolar.com/shading-losses-for-pv-systems-and-techniques-to-mitigate-them/
Lousy design decisions

- Damaged roofing
- Potential snow dam
- Poor design/installation

Powered by SunShot
U.S. Department of Energy
Lousy design decisions

Orientation

North facing system
Lousy design decisions

String inverters

Different azimuths or inclinations in the same string

Modules of different power ratings in the same string
Lousy design decisions

Cables

- No bending support
- Too loose

Source: First Green

More information on planning cable layouts: http://www.firstgreen.co/2013/05/dc-cable-layout-planning-in-solar-power-projects/
There are many ways you can incorporate solar PV into buildings. There are conventional applications like rooftop and carports, but also many ways the solar can be integrated into the building structure with awnings, shade structures, roofs, window glazing and other architectural features.

We will now go through examples of each of these applications.
Here is an example of rooftop solar on a small business. The system is tilted rack mounted.
Here are two examples of flush mounted rooftop solar installations.
Example of a peel-and-stick roof panel system
Solar panels can also be mounted as shade structures where the solar panels can provide shade instead of standard carports or patio covers.
The support structure for the shading systems can be normal systems as the weight of a standard PV array is between 3 and 5 pounds/ft$^2$. 
Snow falling into lanes of travel should also be considered where snow loads are expected.
Many Carport PV structures utilize the PV power to facilitate electric vehicle charging stations located beneath the carport array.
In addition to carports, PV can be installed on other shade structures. Here the PV provides shade for outdoor picnic areas.
Just like any other PV system, it is best to orient the panels south and avoid shading when possible, but because windows are typically vertical they will likely not have the optimal tilt. This will affect the generation output.
Creative use of standard panels

Photo credit: Eileen Blass, USA TODAY
Creative use of standard panels
Creative use of standard panels

Because they face south, it is nice when they provide architectural shade features as well as PV power.
Standard modules can also be used to create sunshades to improve the comfort of the building occupants.
BIPV prices are variable by market and by application, but are typically a higher cost than the traditional PV system. There are additional labor costs for specialized architectural design, engineering design, and installation and maintenance.

They may require additional materials like adhesives and flashing materials, but they will not require the racking and mounting systems.

Like all PV systems, it’s important to clean and maintain BIPV installations.

Today, BIPV only accounts for 1 percent of the total solar installations worldwide.
BIPV shingles are typically used in residential applications. PV shingles can be aesthetically pleasing for homeowners than rack mounted systems, and do not require holes to be drilled into the roof. PV shingles have a higher cost than crystalline panels and a lower efficiency.
Examples of semi-transparent and translucent panels. It’s a BIPV panel (Georgia Tech natatorium). These bi-facial panels are beautiful but the panels cost much more. Performance is similar or better than traditional panels. If you want covered walkways, or parking areas, etc to look pretty.

Semi-transparent and translucent PV modules present the design with a wide range of possibilities to combine the production of the electricity with natural light and interesting light effects.
For more information on the BIPV market, refer to the Inside the BIPV Market white paper.

Visit: [http://www.pointenergyinnovations.com/profiting-from-the-sun/](http://www.pointenergyinnovations.com/profiting-from-the-sun/) to download the white paper. Note: you will need to provide your contact information to have access to copy to download.
What is “Solar Ready”? 

Often, the initial cost of PV and solar thermal systems prevents them from being included in new construction. However, with better incentives, technological improvements, and rising conventional power prices, energy from solar sources will become more cost competitive. New construction that is solar ready will be in a position to take advantage of an environment more favorable to renewable energy.
What is Solar Ready?

Planning for the eventual installation of a solar system when designing a building can significantly improve the economics of the investment.

Without the forethought to make buildings solar ready, solar installation may not be technically possible or the added costs of making infrastructure changes may make solar applications economically prohibitive.

Planning for the eventual installation of a solar system when designing a building can significantly improve the economics of the investment.

NOTE: On May 16, 2017, the state of Massachusetts (MA Board of Building Regulations and Standards (BBRS)) finalized the next (9th) edition of the forthcoming MA building code. It is based on the 20015 I-codes, but the energy portion includes Solar ready roof requirements for residential new construction and new commercial buildings and additions of 3 stories or less.

Citigroup Center, formerly Citicorp Building, NYC. Was designed to accommodate solar array, but the technology at the time (1977) was not advanced enough and the plan was scrapped. Could it still accommodate solar? (It does face due south!)
Installation efficiency can be maximized and costs minimized by understanding these systems’ requirements and accounting for them during the design and construction of the building.

It’s a good idea to design “solar ready” and in the future it may be required.
The National Renewable Energy Laboratory produced a solar ready guide which is available at: http://www.nrel.gov/docs/fy10osti/46078.pdf

Included in the report, is a checklist with each of the measures needed to be taken to make a building solar ready.

(Much more comprehensive than requirements in the IECC, which we will cover later.)
Avoid shading from trees, buildings, etc.
Check the zoning laws for the proposed site to ensure that future neighboring construction will not cast shadow on the array.
Solar Ready Checklist

✓ Determine where a future solar array might be placed

Determine where a future solar array might be placed
If the roof is sloped, the south-facing section will optimize the system performance
Minimize area dedicated to rooftop equipment to maximize available open area for solar panel placement
The type of roof installed can greatly affect the cost of later solar PV installation.
The roof must be capable of carrying the load of the solar equipment
The wind loads on rooftop solar must be analyzed to ensure that the roof structure is sufficient.
Add additional safety equipment for solar equipment access and installation, such as personal safety lanyard attachment points and access pathways.
Decide whether the solar panels will be mounted, and consider the different mounting strategies available
If the panels will be placed on the roof, consider how installation might affect the roofing warranty.

If the panels will be placed on the roof, check if the roof carries a warranty.
Solar Ready Checklist

☑ Make sure all equipment is in compliance with the current version of the National Electrical Code.

Make sure all equipment is in compliance with the current version of the National Electrical Code. International Fire Code requirements should also be considered.
Solar Ready Checklist

✓ Provide conduit or duct for access to electrical service

Provide conduit or duct for access to electrical service.
Quiz & Discussion
Solar PV is most cost-effective when partnered with:

a) Building integrated PV technology 
b) Passive design and energy efficiency 
c) Unimproved existing buildings 
d) Solar thermal systems
Question 1

Solar PV is most cost-effective when partnered with:

a) Building integrated PV technology
b) **Passive design and energy efficiency**
c) Unimproved existing buildings
d) Solar thermal systems
Shade on just a corner of one module can significantly reduce production of an entire array.

a) True
b) False
Question 2

Shade on just a corner of one module can significantly reduce production of an entire array.

a) True
b) False
Question 3

A standard PV module can be used for which of the following applications?

a) Sun screen or awning
b) Rooftop system
c) South-facing vertical surfaces
d) All of the above
A standard PV module can be used for which of the following applications?

a) Sun screen or awning
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d) All of the above
Question 4

Solar-ready design would NOT need to consider:

a) Locations of chimneys, vents and rooftop equipment
b) Type of inverter required
c) Capacity of main electrical panel
d) Future neighboring development
Solar-ready design would NOT need to consider:

a) Locations of chimneys, vents and rooftop equipment
b) **Type of inverter required**
c) Capacity of main electrical panel
d) Future neighboring development