ET3034TUx - 7.1 - Introduction to PV Systems

I would like to welcome back all of you to the last two weeks of the Solar Energy course.

So far, you have seen the basic principles of semiconductor based solar cells, the operation and design of solar cells, the various PV technologies, solar thermal concepts and even novel, state-of-the-art concepts like solar fuels.

In this video I will briefly explain what to expect from the last two weeks of this course.

In these last two weeks, we shall focus on the more commonly known field in photovoltaics, PV systems.

First let us look at a typical PV system.

Here I show a grid-connected PV system.

The grid-connected topology is especially very common in countries that have supporting solar policies, where excess power generated by the consumer can be fed back to the electric grid.

In this case, a set of PV panels are responsible for power generation.

The PV generated power is not only able to meet the load requirements, but is also able to feed the excess power generated to the electric grid when the supply exceeds the load demand.

Let's look at such a system in action in the following 3D illustration.

On a normal day with the sun out, the PV modules on top of this rooftop are busy converting the incoming irradiance into photogenerated power.

The grid-connected solar inverters used in the system are also constantly converting the DC output of the solar modules into usable AC power.

The PV system is able to meet the load demand of the household.

On a different day, if it's a very sunny day, the PV system is providing much higher power than what the load needs.

Under such a condition, the excess power is fed to the grid.

In most countries, the consumer can offset his electric bills in this manner.

This facility is called net metering.

Even after a solar cell has been designed perfectly using the concepts you learned in the first 6 weeks, there are still many other factors that contribute to the working of a good PV system.

In week 7, we shall look at the various system components and their properties.

In week 8, we shall look at how these components come together and function as systems that are widely in use today.

What do we mean by PV system components?

Let's look at this figure for instance.

Here, a typical off-grid or stand-alone PV system is shown.

Different components that constitute this PV system can be seen.

The PV system uses a PV module or a bunch of modules interconnected to form an array.

PV modules, although just an interconnection of solar cells, have a different set of design and operational constraints when being used in a PV system.

Is it just enough that we place the PV modules randomly on the rooftop?

Do harsh summer and winter conditions have any impact on the PV output?

We shall learn more about all these in the next block.

You can also see a battery that is responsible for storing the excess energy.

The stored energy can be used when the PV generated power is not enough to meet the load demand.

In order to ensure the electrical specifications of the battery are being respected by the rest of the circuit, a charge controller is used.

An inverter is used to convert the DC power into usable AC power for the required application.

All these PV system components, and important concepts like maximum power point tracking, will be discussed this week.

By putting together these components we can get different topologies for PV systems.

The main features of designing such systems shall be discussed in week 8, the last week of this course.

What makes a stand-alone PV system different from a grid-connected one?

Which system topology is a better choice for a particular application?

And how do we go about designing a PV system for a specific application?

These are some of the main questions that I will answer in the last week of the course.

I would also cover in the final week the economics and the environmental aspects of the PV system.

A lot of people complain that 'going solar' is not cheap enough, or that rooftop PV doesn't pay back in its lifetime the money invested in the system.

We shall examine these claims on the economics of PV systems with an unbiased, objective approach.

I shall introduce you to basic terms like the payback period and the levelized cost of electricity.

At the end of the final week you would hopefully be in a position to perform basic calculations and see for yourselves as to which factors would make the economics of a PV system more favorable.

Lastly, I would also include in brief an interesting topic in week 8 - that of the energy payback time.

A lot of people believe in the myth that solar panels consume more power in their manufacture process than they would ever produce in their lifetime.

Is this really true?

If it were, I would not be standing here advocating solar power.

But how do the numbers actually compare?

That is something we will see in the final week of this course.

So, are you ready for the last and the most interesting 2 weeks of this course?

Then, see you back in the next block!