ET3034TUx - 8.5 - Final thoughts

Dear Solar Energy students, we have arrived at the end of the course.

You have been introduced to a wide range of topics, which cover the various technologies, which try to harvest the energy in the light coming from the sun.

Let's look at a short overview of the important things you have learned.

In the first week, we have discussed that the current energy infrastructure heavily depends on fossil fuels.

Fossil fuels are mainly used for energy conversion into heat, mechanical energy or electricity.

Solar energy is an alternative sustainable route converting the energy in sunlight into heat, solar fuels or electricity.

The photovoltaic approach, which converts solar energy directly into electricity using semiconductor based devices has been an important part of this course.

I've discussed that the effective installed solar power is the fastest increasing power generation technology in the world.

If we extrapolate the trend of the last 5 years, the contribution of solar energy to the electricity generation, could be on the same level as nuclear and hydro energy before the end of this decade.

The forces behind this fast growth are the decentralized character of domestic PV systems combined with the grid parity achieved in many countries.

Soon, PV installations around the world will break through the magic level of a 1% contribution to the worldwide electricity production.

We started the theoretical part of this course by discussing the spectral shape and irradiance of sunlight.

The spectrum of the sunlight incident on the Earth's surface is determined by the temperature of the sun and the absorption, scattering and reflection losses in the Earth's atmosphere.

You now understand that this spectral shape basically determines the potentially achievable conversion efficiencies of the various semiconductor materials, when used in a single junction device.

In weeks 2 and 3 we have discussed the physical fundamentals of photovoltaic technology.

We have discussed various properties of semiconductor materials, such as the valence and conduction band, its band gap and the transport mechanism of the charge carriers like drift and diffusion.

We have discussed the working principle of p-n junctions.

These junctions separate the light-excited minority charge carriers.

In week 3 we saw that the behavior of the solar cells can be explained in terms of the external parameters: open-circuit voltage, the short-circuit current density, the fill factor, the maximum power point and the conversion efficiency.

In addition we have discussed the design rules of solar cells and categorized them in terms of spectral utilization, utilization of the band gap energy and light management.

These are handy tools to understand the differences between the various PV technologies.

In weeks 4 and 5, we have looked at the various PV technologies.

As example we have discussed the three c-Si wafer based solar cells with the highest achieved conversion efficiencies up to date, like the PERL solar cell, the interdigitated back contacted solar cell and the heterojunction based solar cells.

You have seen the various silicon processing methods to make electronic-grade silicon and multicrystalline and monocrystalline wafers.

We have quickly touched upon the various other PV technologies, like III-V semiconductor multi-junctions, the CdTe PV technology, the CIGS PV technology, the thin-film silicon technology, and the organic based PV technologies.

Every PV technology has its own advantages, such as the high conversion efficiencies, abundantly available source materials, low cost price per watt-peak, the possibility to process it on flexible substrates, etc.

In week 6 we have looked to alternative energy conversion approaches using solar energy.

We have looked to the welcome technology of using solar energy to heat water and concentrated power approaches using heat engines to make again electricity.

We addressed the challenge, for any sustainable energy technology in the future, which is the ability to store the generated energy.

In that light, we shortly talked about the combination of photoelectrochemical and photovoltaic approaches, to convert solar energy in fuels like hydrogen and methane.

In week 7 we looked at the crucial components, besides the PV module, that make a PV system, like inverters, charge controllers, maximum power point trackers and batteries.

In week 8 we have discussed the design rules of both a stand-alone PV system and a grid-connected PV system.

The economic and environmental aspects have been looked into in more detail.

Arriving at this final point in the course, you can be proud of yourself.

You have learned and mastered a broad range of topics related to solar energy technology.

Be aware that this course has the function of being an introduction.

If you are interested, fascinated and inspired by the various topics addressed, you can find many books and scientific literature that tackle the various topics in more depth.

Several universities around the world offer education focused on solar energy technologies.

For example, at Delft University of Technology, we have a PV profile in our Master's program, including courses like PV Basics, PV Technology, PV Systems and the PV Lab Course.

After this final lecture, you will find the final exam.

After you have finished your exam, I would like to ask you a last favor.

Could you make a short video, not longer than 2 minutes, in which you talk about your solar energy system.

If you don't have a system, make a short movie where you interview your neighbor, your friend or your relative, who has a PV system.

Upload your movie on YouTube and share the link with us in the dedicated discussion blog on the Solar Energy edX platform.

We can learn from other people's experiences and inspire each other.

As examples, I will upload some homemade movies myself, of people talking about their PV or solar thermal system.

Finally, we arrive at the end of my lecture.

I personally would like to thank everybody from the edX and DelftX team who helped us making this Massive Open Online Course.

This time I can't finish with saying "see you in the next block".

Therefore I would like to close with the words, "I hope to see you and your learned skills back in helping solar energy to become an important and sustainable contributor to human kind's energy need."