Grid vs Socket Parity

In the previous video, you were introduced to the term LCoE which stands for Levelized cost of electricity and the price trends of PV modules and PV systems.

We shall now look at the other important concepts that will help you further understand the factors involved in the financial aspects of PV when compared to other conventional sources of energy.

Now that you have been introduced to the concept of LCoE, we can use it to discuss how to finance PV and if it is competitive with other power generation technologies. We shall then look at Grid and socket parity and later look into how taxes can complicate parity.

In the previous lecture you learned that LCoE or Levelized cost of electricity can be defined as the price per kilowatt hour of a given energy source. We know that PV has no fuel costs making this calculation relatively simple. For PV to be competitive with conventional power, its LCOE must be lower than that of conventional power.

Reaching this point is known as reaching Grid Parity.

Grid parity is when the cost of producing grid power is greater than the cost of producing power through PV. Reaching grid parity is the point where investing in solar power becomes economically desirable as the investor will make money over the lifetime of the PV system.

Grid parity could be reached faster with the help of incentives and subsidies.

It is said however, that true grid parity occurs, when the price of unsubsidized PV power matches the grid price. Grid parity is hence a very important indicator of the financial viability of a renewable energy technology.

The closer a technology is to grid parity, the easier its integration in the local energy mix will be, economically.

So far, I have used the word "grid parity" You may hear the words grid parity and socket parity used interchangeably. However, they mean slightly different things and their distinction is important. Socket parity refers to the moment when LCOE of solar becomes lower than the retail price of electricity. This is the price you pay per killowatt hour on your electricity bill. Grid parity, on the other hand, refers to the moment when solar energy is cheaper than the amount that power plants spend on producing energy.

The energy production cost will always be less than the retail energy costs since energy producers have to make a profit. Furthermore, taxes will also increase the price of electricity for a consumer as well. Therefore, socket parity is reached before grid parity since the retail price for electricity is higher than what a producer pays.

When socket parity is reached, then it is economically desirable for an individual to invest in a solar home system since the cost of energy that the system produces is cheaper than what they would pay on the market. However, an investor looking to either build a coal fired power plant or a giant solar farm that would produce the same amount of energy will only prefer PV once grid parity is reached.

Here you can see the difference between grid and socket parity. On the x-axis we have volume of PV systems installed while on the y-axis we have the price of solar power.

Let's draw a dark blue curve that represents PV installed in average locations. You can see that as more PV is installed the price goes down due to upscaling and maturing markets.

We can also draw a light blue represents PV installed in ideal locations. Since ideal locations produce more power at the same cost, the cost of PV power is cheaper in the light blue curve. Now we can compare this to a red line that represents how much the same amount of energy would cost from a consumer, the retail cost. This line is simply linear as we can assume that the total retail price of energy simply scales with the amount of energy.

This is different than the grey line that represents wholesale energy costs. This is the energy cost that the producer pays.

So now you can see that parity can be reached in a best and worst case when our lines intersect. Intersections with the red line would be considered socket parity, while intersections with the grey line would be considered grid parity.

Another aspect that needs to be considered when it comes to PV economics is taxes. Some countries tax electricity and this is an important revenue stream for their government. When comparing prices of PV in discussions of parity, often untaxed PV is compared to taxed conventional sources. PV is generally not taxed in many countries even if there aren't real "subsidies" as many countries are trying to encourage investment in PV.

However, if PV were to penetrate in a big way, then the government would lose a large revenue stream in terms of electricity. Therefore it is always important to also compare PV to the untaxed production cost of conventional energy sources when trying to reach grid parity. Furthermore, if PV is not to be taxed, then governments need to find a way to increase their revenue by increasing taxes elsewhere and this may be an unforeseen cost of adopting PV before true grid parity is reached.

Let us now look at how taxes or specifically how state or federal tax credits impact the levelized cost of electricity. If we consider investment tax credit for U.S where new solar PV systems give a 30% investment tax credit on capital expenditures for generating facilities entering operation before 2019. It should be noted that tax credits are assumed to be phased out in the future based on current laws and regulations as we discussed.

From the previous lecture we know the total system LCOE, which is shown in orange, now if we consider levelized tax credit which is shown in yellow that is available for renewable energy technologies we get a negative levelized tax credit in $/MWh, the new total LCOE considering the Tax credit which is shown in green would hence now be lower than the previous total system LCOE calculated without including tax credits.

Taxation of PV is hence something which many countries have not figured out yet. Some countries believe that if PV is not taxed it is considered as giving subsidy to PV. There is therefore a dilemma if PV should be considered as an electronic appliance, a power generator or as a piece of property.

Since this stance varies from country to country you have to have a good understanding of tax laws regarding PV in your country when trying to fully understand the economics of PV. It should also be noted that at this point of time a lot of assessors ignore PV system when adding real estate costs.

However, if this changes in the future, house assessors may add the cost of a PV system to the housing cost which could increase the housing tax that a homeowner with a PV system would have to pay.

I have now covered the fundamental concepts behind the competitiveness of PV systems in terms of costs when compared to other conventional sources of energy. You now understand what grid parity means. You also know that comparing the LCOE of conventional energy and PV is not always straightforward. How PV is taxed and whether we are comparing the retail cost or the production cost are all very important aspects when assessing the viability of PV.