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By Kris De Decker, originally published by Low-Tech Magazine

Picture: Jonathan Potts.

Solar photovoltaic (PV) systems generate "free" electricity from sunlight, but manufacturing them is an energy-intensive process.

It’s generally assumed that it only takes a few years before solar panels have generated as much energy as it took to make them, resulting in very low greenhouse gas emissions compared to conventional grid electricity.

However, the studies upon which this assumption is based are written by a handful of researchers who arguably have a positive bias towards solar PV. A more critical analysis shows that the cumulative energy and CO2 balance of the industry is negative, meaning that solar PV has actually increased energy use and greenhouse gas emissions instead of lowering them.

This doesn’t mean that the technology is useless. It’s just that our approach is wrong. By carefully selecting the location of the manufacturing and the installation of solar panels, the potential of solar power could be huge. We have to rethink the way we use and produce solar energy systems on a global scale.

There’s nothing but good news about solar energy these days. The average global price of PV panels has plummeted by more than 75% since 2008, and this trend is expected to continue in the coming years, though at a lower rate. [1-2] According to the 2015 solar outlook by investment bank Deutsche Bank, solar systems will be at grid parity in up to 80% of the global market by the end of 2017, meaning that PV electricity will be cost-effective compared to electricity from the grid. [3-4]

Lower costs have spurred an increase in solar PV installments. According to the Renewables 2014 Global Status Report, a record of more than 39 gigawatt (GW) of solar PV capacity was added in 2013, which brings total (peak) capacity worldwide to 139 GW at the end of 2013. While this is not even enough to generate 1% of global electricity demand, the growth is impressive. Almost half of all PV capacity in operation today was added in the past two years (2012-2013). [5] In 2014, an estimated 45 GW was added, bringing the total to 184 GW. [6] [4].

Solar PV total global capacity, 2004-2013. Source: Renewables 2014 Global Status Report.

Meanwhile, solar cells are becoming more energy efficient, and the same goes for the technology used to manufacture them. For example, the polysilicon content in solar cells — the most energy-intensive

component — has come down to 5.5-6.0 grams per watt peak (g/wp), a number that will further decrease to 4.5-5.0 g/wp in 2017. [2] Both trends have a positive effect on the sustainability of solar PV systems. According to the latest life cycle analyses, which measure the environmental impact of solar panels from production to decommission, greenhouse gas emissions have come down to around 30 grams of CO2-equivalents per kilwatt-hour of electricity generated (gCO2e/kWh), compared to 40-50 grams of CO2-equivalents ten years ago. [7-11] [12]

According to these numbers, electricity generated by photovoltaic systems is 15 times less carbon-intensive than electricity generated by a natural gas plant (450 gCO2e/kWh), and at least 30 times less carbon-intensive than electricity generated by a coal plant (+1,000 gCO2e/kWh). The most-cited energy payback times (EPBT) for solar PV systems are between one and two years. It seems that photovoltaic power, around since the 1970s, is finally ready to take over the role of fossil fuels.

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