Solar without Subsidies

This article introduces a creative approach to solar energy as one of the 100 innovations that shape “The Blue Economy”. This article is part of a broad effort to stimulate entrepreneurship, competitiveness and employment.

The Market

The photovoltaic (PV) industry generated in 2010 $82 billion dollars in revenues, more than doubling in monetary value over a period of only one year. The new PV installations in 2010 reached a record high of 18.2 Gigawatts (GW) which represents a growth of nearly 140% over the past twelve months. The European market represented with 14.7 GW 81 percent of world demand for PV. Germany, Italy and the Czech Republic are the three European leaders, while Japan and the US follow. Such rapid growth requires capital. Companies part of the supply chain of PV successfully raised $10 billion in equity and debt. As a result, the production capacity expanded from 9.9 GW in 2009 to 20.5 GW in 2010, with thin film production already representing 13.5 percent of total output. China and Taiwan account for just under 60 percent of global production. Suntech Power based in Wuxi (China) is the largest manufacturer in the world.

The German government, the largest market for photovoltaics, added 7 GW in a record breaking year 2010 to 17 GW, equivalent to 17 large power stations generating a total of 130,000 jobs at a total subsidy costs of 9 billion dollars, nearly 1.3 billion dollars for each giga and €70,000 for each job. The incentives agreed in the year 2000 by the German Renewable Energy Act guarantee above market feed-in tariffs for solar installations for 20 years from the point of installation. This generous support has helped drive down the cost of PV systems. The silicon module prices dropped 38 percent in 2009, and 14 percent in 2010 over the previous year. As demand in Asia and North America expands, factory prices are expected over the next five years to drop 50 percent below the 2010 level.

The fossil fuel industry - according to Greenpeace - received last year an estimated $100 billion in government hand-outs in the G-20 member states. Fossil fuel and nuclear have received generous government support for decades. Coal has been receiving subsidies in Germany since 1965, and solar only started to obtain a strong fiscal support a decade ago. However the annual subsidy for coal in Germany was limited in 2010 to €2 billion ($2.8 billion) and the government has passed a law phasing out all subsidies by 2018. The German subsidies for renewables (wind, solar, biogas, etc.) equalled $17.9 billion - meaning that renewables are getting a major share of government support.
The Innovation
The complex wiring system makes the price of PV panels uncompetitive, whereas the cost and supply of silicon is not an issue. While Leonardo da Vinci already predicted the use of solar energy in 1447, its penetration on the market has relied on fiscal measures which in the end are paid by the consumer, either through increased taxes to cover government debt, or through higher tariffs for green energy. The fact that solar energy only generates direct current (DC) while the electric grid functions with alternate current (AC) implies that all electricity from PV requires inverters. Since the sun only shines at best 5 hours a day all year around, PV needs batteries as a back up. The combination of batteries, inverters and the discontinuous supply of sunshine implies that the present technologies of solar energy will rely on government support be at par with non-renewables.

Stefan Larsson accomplished research projects related to maximum reflection concentrators. One of his objectives was to render solar energy viable in the arctic and antarctic. He and his team concentrated sunlight 3.5 times using reflectors that also follow the movement of the sun throughout the year without the need for expensive heliostats. The geometry of the reflector is designed in such a way that all light hits the heat absorbing tube. His designs permit to generate heat and electricity in the coldest corners of the world. He went on to adjust the reflector so that it gives the highest efficiency when the sun is the lowest in the sky. This innovative approach provides consistent energy output efficiency across a wide range of temperatures which together with its modular approach makes it suitable for hot water, district heating, solar cooling, water sanitation, desalination and ... the generation of electricity, all at the same time.

Mr. Larsson went on to create Solarus AB, and while he and his team perfected the technology of combining multiple functions into one panel, he also spent considerable time securing a supply chain of core materials recycling carbon fiber from the aerospace industry and accessing silicon ribbon manufacturing technologies. It is the combination of the multifunctional solar cells and the use of recycled carbon fibers that allows Solarus to offer solar energy to the market cheaper than fossil fuel based energy supply without requiring subsidies. On top of that, Solarus has developed a business model that foresees dozens - and over time - hundreds of local manufacturing plants generating local jobs. The combination of ingenious geometrical designs, the recycling of discarded high tech materials, a decentralized production model, that competes on the market without the need for subsidies (while still welcoming any assistance) makes this a prototype of The Blue Economy.

The First Cash Flow
Sweden is a world leader in district heating, where water is centrally heated and distributed through pipe networks. This system is less capital intensive and more energy efficient than the individual water heating systems that today consume 30 percent of all electricity for home use. Solarus undertook to power a district heating system with 2,400 square meters of solar and thermal collectors reaching a cost price of only $0.025/kWh, based on a 10 year
payback time with government subsidies. Without the subsidies, the district heating would still only cost $0.07/KWhr, and if the full lifespan of the solar and thermal collectors were considered, then the price of energy without subsidies is as low as $0.02/KWhr, at par or even lower that subsidized nuclear, coal or diesel fuels.

The Opportunity
The market potential for Stefan Larsson and his team at Solarus AB is tremendous. Each panel generates 300W of power and 880W of heat which converts in a sun deprived nation like Sweden into 264 KWh of electricity and 660KWhr of heat for each panel. This multifunctional system provides electricity, hot water, heating and cooling through a heat exchange system, relying on one uniform facility on building rooftops with a minimum of 200 square meters. This turns buildings energy neutral. A home would become energy independent (in Sweden) with 8 to 12 panels covering hot water, electricity and room heating. The low weight, easy installation, weather proof and ability to operate under diffuse sunlight combined with the use of recycled composite materials have reduced the traditional payback from the usual 3 to 5 years to solely 6 months.

The low cost of the Solarus system, its high efficiency and low heat loss opens the opportunity to utilize the solar humidification-dehumidification (HDH) process. While this was the standard desalination and water purification system decades ago, it was very energy intensive and was replaced by reverse osmosis. Now it seems that HDH based on solar technologies described can provide a constant heat in excess of 100°C required to speed up the evaporation and condensation. Whereas the construction cost would equal any existing facility, the operating and maintenance costs are cut down by factor ten, proving that innovations in solar will permit to outcompete fossil and nuclear even in the absence of subsidies. Fortunately, subsidies will still be the rule of the game, tipping the benefits even faster in favor of Solarus-like solutions. Now, knowing that it can be manufactured locally from recycled materials should have the entrepreneurs in the world sitting on the edge of their chairs, while governments on the edge of bankruptcy could still provide some support without having to go all the way the German authorities did.

GUNTER PAULI

… Further information on the 100 innovations at www.theblueeconomy.org

Publication and dissemination of this article, including translations, require prior written consent. Please contact info@zeri.org

The Blue Economy | All rights reserved. © 2010, Pauli