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Solar cell guarantees: When recycling gets expensive

16 March 2012 | Thomas Guidon, PhD, SAA | Tore Ellingsen (inea)

While solar energy producers have a bright future ahead, how manufacturers handle guarantees for waste recycling and product reliability may determine who ultimately survives. The uncertainty around these guarantees highlights a critical exposure producers face: potentially large liabilities down the road. This also puts at risk those that finance solar energy manufacturers, including banks, equity investors, and debt investors.

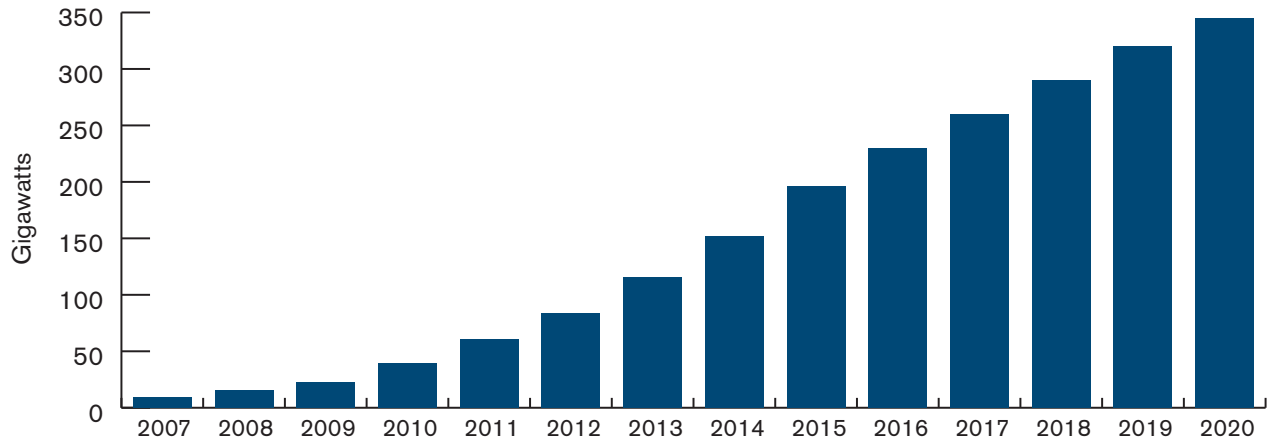
For solar producers, one big concern involves managing the recycling cost of the material when it reaches the end of its useful life. There are also product guarantees, the promises by producers that panels will perform above a certain level of efficiency over a long time period, generally 20 years or more.

Solar producers and stakeholders need to carefully consider the potential balance sheet and financial consequences of these risks, and set up a way to protect themselves from liabilities getting out of control.

Greater growth on the way

No doubt solar energy is here to stay. Despite the recent price wars among producers and cutbacks in European subsidies for purchasing solar panels, the long-term outlook is good. Worldwide photovoltaic (PV) module cumulative installations reached the equivalent of 40 gigawatts (40,000 megawatts) of capacity by 2010, up from about 23 gigawatts in 2009 and 5.4 gigawatts in 2005, according to data compiled by the Earth Policy Institute.[1] Cumulative solar output is expected to reach 196 gigawatts by 2015, growing at an annual rate between 20% and 30%. As global demand for fossil fuels rises, so will the need for solar energy.

FIGURE 1: WORLD SOLAR PHOTOVOLTAICS CUMULATIVE INSTALLATIONS, 2007-2020



Guarantees

While the greater growth of solar energy is a good thing, producers will be more exposed to higher costs from past promises in the years to come. Solar waste will be one of the main issues. Every form of energy comes with costs that must be borne by either the industry or society itself. For coal, oil, and gas, production of carbon dioxide has been blamed for global warming. Dams for hydropower have uprooted communities and caused ecological damage. With nuclear energy, there are costs for storing fuel rods and cleanup of fallout from radiation leaks. Even wind farms have been criticized for their detrimental effect on scenery and on the bird population.

So while solar energy is viewed as a clean energy, it still has its side effects. Governments are looking into mandating recycling of solar panels, because they contain rare earth metals and glass, materials that can be recycled. To be sure, more regulation seems to be on the way for Europe: Italy has already passed a law requiring that companies issue waste-recycling guarantees, starting in 2012.

To attract customers, solar producers in the European Union and Switzerland have taken the challenge on themselves, with plans to set up a voluntary take-back and recycling system for PV modules, to be paid for by fees or contributions by its members. Yet who will ultimately bear the cost of recycling? Theoretically, the solar producers, through recycling guarantees–but only if they can afford to pay for the recycling in future years. If a company goes bankrupt, then taxpayers end up paying for the cost.

Performance guarantees are another hazard of sorts for solar producers. In order to encourage investment, solar producers issue guarantees, typically five years for parts, and 20 years for performance, where the warranty states that the product will produce 90% of an industry-set capacity standard for 10 years, and 80% for 25 years. Governments are also writing product guarantees into legislation. For example, in the same Italian law that takes effect next year, producers will need to provide a 10-year product warranty.

Photovoltaic is a blend of the two words "photo," or light, and "voltaic," meaning electricity. Photovoltaic (PV) cells use semiconductor materials made of silicon–an element most typically found in sand. PV cells have at least two layers of semi-conductors, one negatively charged and one positively charged. When light hits the solar panel, the electrical field between the two layers generates a current, forming electricity. Cells are grouped to form a module; inverters convert the electricity into a form ready for consumption.

PV cells are typically made from crystalline silicon. Wafers, which are very thin slices of silicon, form the building blocks of the solar cells. Thinner wafers translate to less silicon needed per solar cell, meaning lower costs. The industry is constantly working to decrease the thickness of the wafers to improve efficiency.

Source: European Photovoltaic Industry Association and Greenpeace[2]

Hedging against future costs

Issuing guarantees leaves producers–and the stakeholders that finance them–liable for big losses if they don't take care of the issue now. The guarantees are all the more risky because they are highly correlated: an increase in bad solar panels leads to a higher volume of recycling. There are also other major causes of non-performance, such as degradation of the panel, sealing, glass, and foils–which will also boost recycling totals.

At this point, producers have not set aside funds to handle recycling costs for PV modules produced between 1990 and 2009, meaning they currently do not hold reserves on the balance sheets. While the European Union Commission has requested bankruptcy-proven reserve settings, legislation has yet to be passed. When legislation is completed, it seems likely that the industry will recycle modules from throughout this period, though the details and exact financial implications are currently unclear.

Still relatively new, the industry hasn't made it a priority to set up reserves for potential liabilities. There are few reasons for this. For one, there's limited long-term performance experience in relation to the long-term guarantees. Also, it's still unresolved how the guarantees will be treated under International Financial Reporting Standards. Along with pricing changes, these issues could develop into major near-term challenges for the industry, and potentially be one of the drivers for a market consolidation.

Meanwhile, the ongoing turbulence in the financial markets, the pricing volatility of the PV modules, and the decrease of subsidies by various governments have put more pressure on the industry.

To get to a point of adequately setting aside reserves, let's take a closer look at recycling. The structure of a funding mechanism to pay such future cost can be calculated in the following ways:

- The contribution fee paid during a calendar year is used to cover the cost of the PV modules to be recycled during that year.
- The contribution fee paid during a calendar year will be used to recycle the modules produced and sold during the same year, with reserves set aside. This is also called the "cost-by-cause" method.

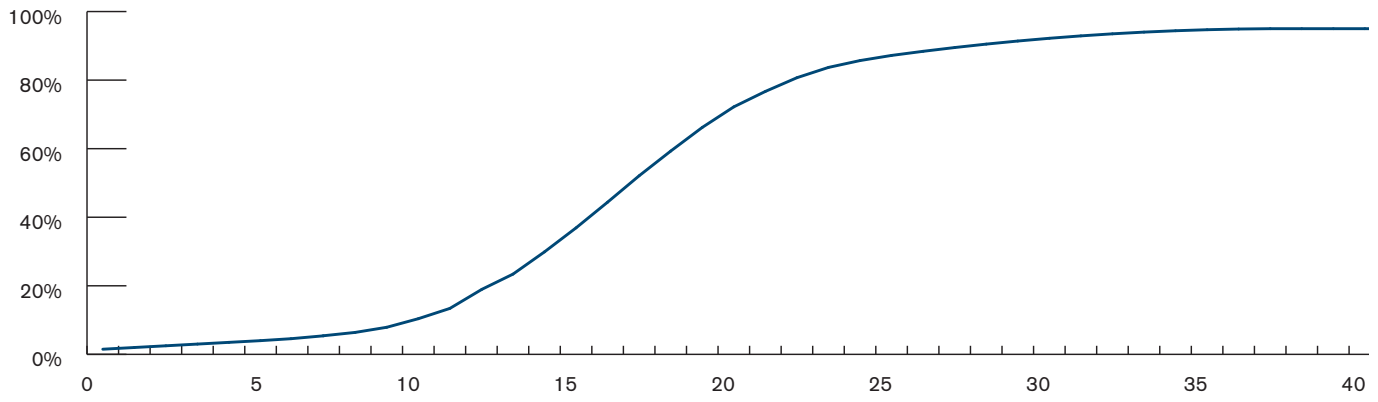
The first way has the advantage of being able to estimate the expected cost reasonably accurately for a short time horizon of two to five years. Yet any mechanism that finances the cost of recycling PV modules with current revenues is not sustainable. This method raises the possibility of bankruptcy down the road by shifting today's greater burden of "caused" costs into the future. When growth levels off, then PV producers would face rapidly increasing recycling costs as a percentage of revenues. Also, in the event of company bankruptcies, PV module producers would no longer contribute to the recycling cost of their products, leaving governments to decide how to deal with cleanup.

A simple recycling cost calculation

While estimating future liabilities can get complicated quickly, we have taken a basic approach to estimating the overall amount for companies to set aside. One critical consideration includes the return rate, as not all installed PV modules will be recycled.

The ability to determine the most realistic shape of this curve will be crucial in early years; monitoring experienced recycling will then allow for correct recycling projections as time passes and also will allow for adjustments that account for over- or underfunding of past installation year contributions. To start, we assume that 95% of all PV modules will be recycled. The assumed time span from installation to recycling for each installed PV module is illustrated in Figure 2.

FIGURE 2: EXPECTED PV END-OF-LIFE CYCLE



This return rate allows us to determine the actual weight of materials that will come back for recycling, based on sales of the PV modules. Expressed in terms of the power, the PV modules that generate the equivalent of a gigawatt would roughly lead to 99,000 metric tons for recycling for installation year 2010, and an estimated 66,000 metric tons for 2020. Industry predictions call for a declining weight per year as power usage increases, which is due to more efficient panels coming to market.

Expected nominal costs would be €379 million for installation year 2010, assuming EPI's industry counts, a 95% return rate, and a constant recycling cost of €0.24 per kilogram[3] (these values and those in the following tables are based on calculations and trending assumptions made by Milliman and Inea Consulting, derived from data from the Earth Policy Institute and other sources). Taking into account inflation of 3.5%, discounted recycling costs would amount to €212 million when assuming a recycling pattern for the panels, as illustrated in Figure 3. By installation year 2015, the amount required to set aside for recycling would increase to a nominal cost of €836 million, and fall to €380 million by 2020, as the annual installation is expected to drop off after peaking in 2015.

FIGURE 3: EXPECTED RECYCLING COSTS BY VINTAGE YEAR

AMOUNTS IN € (000)

	RECYCLING COST	
VINTAGE YEAR	NOMINAL	DISCOUNTED
2009	124,095	69,468
2010	284,356	159,183
2011	363,751	203,628
2012	395,010	221,127
2013	536,940	300,579
2014	627,570	351,314
2015	752,400	421,194
2016	581,400	325,468
2017	513,000	287,178
2018	513,000	287,178
2019	513,000	287,178
2020	427,500	239,315
2021	432,372	242,042
2022	437,300	244,801
2023	442,284	247,591
2024	447,325	250,413
2025	452,423	253,267
2026	457,580	256,154
2027	462,795	259,073
2028	468,070	262,026
2029	473,404	265,012
2030	478,800	268,033

A possible solution: An industry mutual

A structured way to address the matter may be merely to set up a nonprofit mutual company to manage an account, with amounts pledged each year based on product sales. Contributions would include the sum of the recycling cost for PV modules produced between 1990 and 2009, to account for insuring past production. They would also cover the expected recycling cost of a PV module in any given year going forward. The concept is similar to one used in nuclear waste management, where, in several countries, funds for future costs are collected annually from the power plants and managed in centralized funds.

Recycling costs should be loaded onto the annual selling price, according to the cost-by-cause method. This approach, therefore, considers the recycling costs for each and every specific "installation year" separately, with a calculation to determine how much should fund the mutual company.

The mutual company's purpose and responsibility would be to determine the expected future recycling cost per kilogram of potential waste, purchase in future the necessary recycling services at competitive prices, collect the proceeds, and manage the investment. The mutual company could even subcontract recycling services to the members, with some more than capable of arranging for, or actually conducting, the recycling.

Creating a separate structure also helps companies remove the asset from the balance sheet, possibly reducing the need for extensive and complex tax analysis. But it also ensures that the reserve funds wouldn't be liquidated in case of a bankruptcy, because the monies would reside elsewhere. It would also mean that the financial well-being of the members ought not to affect the fund as a whole.

Exiting the structure would be easy, by a producer simply stopping payments to the mutual company. The exiting member would be able to decide whether it wanted to continue to receive services for the years in which it had contributed or leave the mutual entirely. It could sell its shareholding at a pre-agreed price.

Using the discounted amount for funding for each year of sold PV modules, less the cost of recycling, and adding investment income, a recycling fund could grow from €96 million in 2009 to €3.9 billion in 2020, based on the recycling cost calculation in Figure 4. A methodology for investing contributions for product guarantees could also be established.

Insurance or capital market solution

The insurance industry has been able to adapt to the growing demand for transfer of risks within the renewable energy sector. This has resulted in several market solutions for the areas of manufacturing, construction, and performance. The development of a market for these partially very innovative products has underlined the need for risk transfer. The risk transfer has been triggered by the different stakeholders in the products, such as PV manufacturers, project developers, financing banks, and investors. Guarantees could potentially also be hedged, off the balance sheet. These risks also do not necessarily correlate with other risks being transferred and could therefore be attractive for the insurers and potential capital markets.

One such method of safeguarding the ability to pay the guarantees would be through insurance-linked securities, financial instruments such as bonds that are triggered by loss events. The bonds would help pay the guarantees in the event of a bankruptcy, with investors losing their principal. But because of low correlation, investors would also treat this as an attractive risk to finance. A combination of an industry mutual and the insurance/capital market solution could also be the solution to the current issues with PV guarantees.

Over time, new methodologies and financial instruments will come to the market out of necessity in order to treat the related costs. In essence, setting up structures to deal with guarantees is a form of self-insurance. Actuaries are well equipped to help determine the necessary funds to cover guarantees for the solar industry, helping structure bankruptcy-proof concepts to secure funds covering guarantees. Such concepts could contain development of indices that help measure risk and allow for estimating of future liabilities. The instruments in essence are structured financial solutions designed to mitigate risk.

While solar energy will play a large part in how we produce energy in the future, how manufacturers handle guarantees for waste recycling and product reliability will separate the strong from the weak. Removing uncertainty from guarantees will help solar manufacturers avoid being saddled with potentially large liabilities down the road, and help them assure banks that they are indeed underwriting an industry that has taken the right steps to safeguard itself from financial collapse.

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1 Roney, J.M. (October 27, 2011). Solar PV breaks records in 2010. Earth Policy Institute. Retrieved February 3, 2012, from http://www.earth-policy.org/indicators/C47M.

2 European Photovoltaic Industry Association and Greenpeace. Report: Solar Generation: Solar Electricity for Over 1 Billion People and 2 Million Jobs By 2020.

3 PV Cycle (February 1, 2010). Update on the current status of the collection and recycling programme of end-of-life photovoltaic (PV) modules. Information Note: Progress Report PV Cycle and timeline 2010.