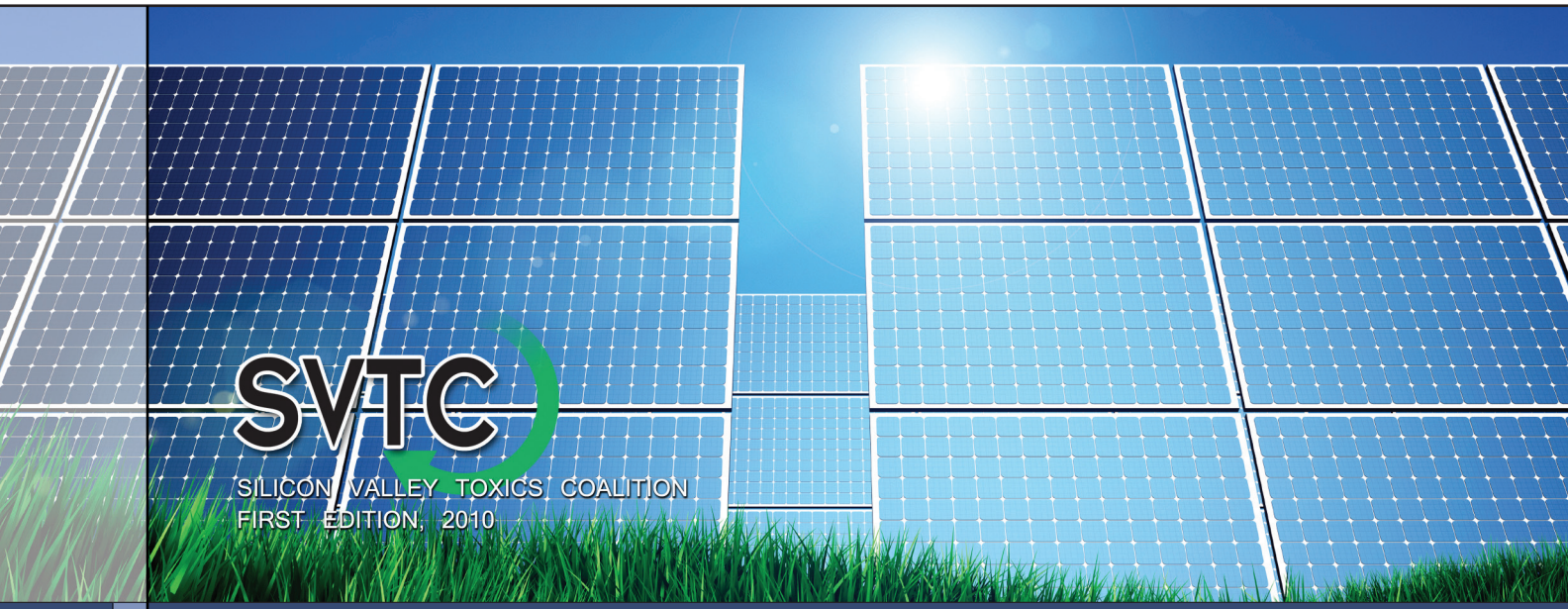


WWW

SOLARSCORECARD.COM

our vision

As the global economy transitions toward more renewable sources of energy, solar photovoltaics (PV) will play an increasingly prominent role. Because the generation of electricity from solar power produces no greenhouse gas emissions, it is widely considered to be "clean" energy.

However, the solar PV industry still faces serious issues that must be addressed if the industry is to be truly "clean and green" and socially just. These include potential environmental, health, and safety (EHS) hazards resulting from the manufacture and disposal of solar panels. In addition, the industry must ensure safe and equitable working conditions throughout solar supply chains.

In January 2009, the Silicon Valley Toxics Coalition (SVTC) launched a campaign to address these issues with the release of **Toward a Just and Sustainable Solar Energy Industry**. This report detailed the hazards related to the manufacturing and disposal of solar PV panels.

SVTC's 2010 **Solar PV Company Survey** and **Scorecard** builds on the recommendations of that report. In 2009, we surveyed over 200 solar PV companies to obtain a clearer picture of industry practices and standards related to environmental health and safety, sustainability, and social justice. Our research revealed that approximately 30 percent of the companies surveyed were in commercial production and the remainder were in pilot production or the research and development stage. The survey results are summarized here, and we have also compiled a scorecard that evaluates solar PV companies based on their responses.

This is the first solar PV scorecard, and it is an initial step in measuring companies' commitment to take responsibility for the impact of their products. We plan to update the scorecard annually to reflect the dynamic nature of the industry.

> "The industry is already dedicated to the goal of environmental sustainability - **we hope that it will be able to meet the high environmental standards it has set for itself.**

SVTC will continue to support and engage the solar PV industry on these issues. The industry is already dedicated to the goal of environmental sustainability—we hope that it will be able to meet the high environmental standards it has set for itself and develop a strong reputation for corporate responsibility.

We envision a solar PV industry that:
1. Pursues innovative approaches to reducing the toxic chemicals used in panel manufacturing.
2. Implements and monitors equitable labor standards throughout its supply chains.
3. Takes responsibility for the environmental and health impacts of solar products throughout their lifecycles, including adherence to a mandatory policy for responsible recycling.

Responsible recycling is essential to the future of the solar PV industry—without it, improperly discarded panels will become a new wave of toxic electronic waste (e-waste), and many valuable materials will be lost. While a voluntary takeback program called PV Cycle exists in the European Union (E.U.), there are no laws in the E.U., the U.S., or anywhere else in the world, that require solar panel manufacturers to take back their panels and recycle them responsibly. In addition, no existing laws support companies that demonstrate good recycling practices.

For the solar PV industry to be truly sustainable, a regulatory framework must be put in place that supports sustainable practices, including reductions in the use of toxic materials and mandatory takeback and recycling by industry.

the purpose of the survey

The goal of SVTC's **Solar PV Company Survey** is to encourage a truly just and sustainable solar PV industry. We compiled a list of solar PV companies based on trade show literature, web searches, and industry association directories. We sent out the survey in October 2009, collecting results through January 2010. The survey addressed a range of critical issues, including extended producer responsibility, supply chain monitoring, green jobs, chemical use, and lifecycle analysis.

We asked companies to self-report on toxic chemical use and reduction and on how they address worker justice and environmental health. Based on the responses, we have rated companies using the **Solar PV Company Scorecard**. The scorecard serves as a resource for institutional purchasers, investors, and consumers—anyone who wants to be sure that the solar PV panels they purchase are produced by companies that are responsible stewards throughout product lifecycles. The survey also enables companies to see where they rank relative to their competitors and where they need improvement.

> "We see this as a first step in working together to share information to improve practices that **protect communities, workers, and the environment**.

We greatly appreciate the efforts of the companies that chose to respond fully to the survey. We see this as a first step in working together to share information, to improve practices, and to protect communities, workers, and the environment. This collaboration will help build a firm foundation for the long-term growth of the sector.

We want to ensure that the solar PV industry does not leave the same legacy of waste and injustice that has characterized the electronics industry. Most e-waste is sent to landfills, improperly recycled in prisons, or exported to developing nations such as India, Nigeria, Ghana, and China for dismantling. Many of the communities where such dangerous low-tech dismantling is done are experiencing serious health problems due to high levels of lead, indium, and other toxic compounds. While solar PV panels have much longer life spans than typical consumer e-waste, it is essential that we act now to ensure long-term sustainability.

overview of the solar PV industry

The solar PV industry is expected to grow significantly over the coming years. Supported by government tax incentives and the rapid introduction of new technologies, cumulative solar PV module installations grew by 42 percent in 2009, adding 6,370 MW[1] to bring total global installations to 21,500 MW by the end of 2009.[2]

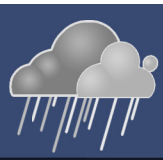
Conventional solar PV modules based on crystalline silicon remain the most commonly manufactured, but emerging thin film solar PV modules based on cadmium telluride (CdTe), copper indium gallium selenide (CIGS), and other newly developed materials are poised to gain market share as they become more cost effective. The development of thin film solar PV will be hastened further with the rise of building-integrated PV, which integrates solar panels into building design through conventional rooftop panels or by using new types of panels incorporated into facades and rooftop shingles and tiles. All of these technologies raise questions regarding the environmental and worker impact of the manufacturing and recycling processes. Thin films utilize novel chemical compounds and manufacturing processes (such as nanotechnology) for which there is little data about worker safety or community health impacts.

[1] Electric power industries like solar PV use watts, kilowatts (kW), and megawatts (MW) to measure the peak electric power production of their PV modules and systems, as well as to quantify factory production and capacity. Solar modules measure peak power output in watts. 1 kW equals 1,000 watts and is the unit used to denote the size of rooftop systems and arrays. 1 MW is equivalent to one million watts and is the typical unit used to measure solar PV power plants or factory output. 1 MW can provide power to 700 to 1,000 homes.

[2] http://www.solarbuzz.com/Marketbuzz2009-intro.htm
http://www.solarbuzz.com/News/NewsNACO1047.htm
http://www.researchandmarkets.com/reports/1071386/global_solar_photovoltaic_market_report_2009

the key

Scoring Criteria for Module Manufacturers: SVTC used a 0 to 100 point scale. Points were awarded in the following four areas.

RANKING					
	SUNNY	CLOUDY	RAINY	ECLIPSE	GOLD STAR
	85-100 POINTS	60-84 POINTS	1 - 59 POINTS	NO RESPONSE	
	This company is an industry leader and is on the right track.	This company has taken some big steps toward creating a clean solar PV industry. A few more commitments to the environment and workers will help the sun come out.	This company responded to the survey but has not taken any significant steps toward creating a clean solar PV industry (or did not completely fill out the survey).	This company did not respond to our invitation to participate in the survey.	This company currently has a takeback program and has policies against exporting waste and using prison labor to dismantle end-of-life panels.

the standards

Extended Producer Responsibility (EPR) and Takeback

EPR requires that manufacturers be responsible for the impacts of their products on the environment and on communities throughout product lifecycles.

Requirements for a 'Sunny' Score

Company has a takeback and recycling program that is adequately financed and free to the consumer. Company adheres to at least minimum EHS and labor standards for panel recycling; does not use prison labor for dismantling; and has a policy against exporting end-of-life panels to developing countries.

Range of Points
0 – 33

Supply Chain Monitoring and Green Jobs

Green jobs protect workers from exposure to toxic chemicals and ensure a living wage. There is no guarantee that companies are providing green jobs if they do not monitor their supply chains.

Requirements for a 'Sunny' Score

Company requires suppliers and sub-suppliers to follow a code of conduct; has systems to verify supplier performance, handle EHS violations, and enforce agreements; and does not use prison labor.

Range of Points
0 – 29

Chemical Use and Life-Cycle Analysis

Solar PV manufacturing currently relies on a number of hazardous or toxic chemicals. By using lifecycle analysis, risk assessment, and other tools, the solar PV industry can move away from the most toxic and hazardous inputs. In the E.U., using a risk assessment framework, the Restriction on Hazardous Substances (ROHS) directive lists maximum concentrations of several toxic chemicals (including cadmium and lead) used by the solar PV industry.

Requirements for a 'Sunny' Score

Company avoids lead and cadmium throughout product lifecycles and has phased out potent greenhouse gases; uses tools such as lifecycle analysis and risk assessment to characterize environmental and worker impacts.

Range of Points
0 – 28

Disclosure

Corporate claims about being "green" are increasingly common—but there are few ways for the public to confirm those claims. Transparency is important to verify whether companies are implementing EHS standards, takeback programs, and responsible recycling. By providing information on their practices, companies can demonstrate their performance and be held accountable to the communities where they manufacture and market their products.

Requirements for a 'Sunny' Score

Company is willing to share all company information related to labor standards, manufacturing hazards, and sustainability.

Range of Points
0 - 10

> **This is the first solar PV scorecard,** and is an initial step in measuring companies' commitment to take responsibility for the impact of their products.

scores for 25 solar panel (module) manufacturers

The list of 25 companies scored below in this report includes survey respondents, top PV manufacturers, and emerging solar PV manufacturers.

MODULE MANUFACTURER	SCORE
Abound Solar	63
Best Solar	0
Calyxo	90
Canadian Solar	0
DayStar Technology	0
First Solar	67
Global Solar	0
JA Solar	16
Konarka	0
Miasole	0
Nanosolar	0
Sharp	0
Solar Cells Hellas	32
SolarFun	0
SolarWorld	88
Solon	50
Solopower	0
Solaire Direct	43
Solyndra	0
Sovello	73
SunPower	0
Suntech	0
Trina	0
Uni-Solar	0
Yingli	69

Thank you to **Solar Technologies**, **Solibro**, **PV Crystalox**, **the European Photovoltaic Industry Association**, and **the Solar Energy Industries Association** for also responding to our survey. These companies and industry associations were not scored because they do not manufacture solar modules or cells.

Scores for Solar Cell Manufacturers

In addition to PV module manufacturers listed above (some who also manufacture solar cells), we received survey information from Q-Cells, which only produces crystalline PV cells. Thus, Q-Cells' score represents only those survey questions that apply to PV cell manufacturers.

Q-Cells	96

Go to the following link for more information on how crystalline silicon PV modules are made.

SolarScorecard.com/diagram

survey analysis

The 14 responding companies represented about 24 percent of the 2008 module market share (based on an industry total of 5,950 MW) and 31 percent of the cumulative market share (based on an industry total of 15,200 MW). The Silicon Valley Toxics Coalition survey questions focused on four categories: product takeback and recycling; supply chain and "green jobs;" chemical use and lifecycle analysis; and disclosure.

Although product takeback and recycling is not a service regularly offered by solar PV companies, among these respondents, product takeback is fairly common, and there is strong support for extended producer responsibility. However, the survey revealed some issues of concern regarding supply chain management; only half of the responding companies have worker codes of conduct in place with their suppliers and have implemented systems to verify performance.

No companies report using prison labor in any aspect of production, and only one company is unwilling to commit to not using prison labor in the future. Highlights of the survey results include:

▶ The combined manufacturing capacity for all responding companies (as of 10/1/2009) is approximately 5 GW[3]. However, this varies significantly by company, from a low of zero, to a high of 1.2 GW reported for First Solar.

▶ Six companies are setting aside money to finance the collection and disposal of end-of-life panels, and seven companies said that they provide recycling services free of charge. All of those in the latter group provide such services to both residential and commercial customers.

▶ Six of the responding companies have a policy setting minimum EHS and/or labor standards for panel recycling. Among the four companies that responded "no" to this question, three stated that they would commit to developing such a policy.

▶ Nine companies said that they would commit to not using prison labor to dismantle end-of-life products. Two companies did not respond to this question, and only Abound Solar would not commit to this. Two companies do not manufacture solar panels.

▶ Eight companies said that they would support mandatory extended producer responsibility in the markets where they sell solar panels. No respondents declined to support this, but four companies failed to respond to this question. Two companies do not manufacture solar panels.

▶ Half of the responding companies (seven) have undertaken analysis of their supply chain to document the social and environmental impacts associated with different production phases. Most other respondents say they have not done so (one company left this question blank).

▶ Six companies require their direct suppliers to follow a worker code of conduct or other set of publicly available standards. All six also have a system in place to verify supplier performance, although the auditing systems are almost exclusively internal. However, SolarWorld includes an external audit and two other companies require International Standards Organization or Occupational Health and Safety Assessment Series certification.

▶ Six companies report that their products contain lead, the most commonly used toxic element/chemical of those reviewed. All of these companies have plans to phase out lead eventually, though most say that the timeline is undetermined. Two companies will begin phasing out lead in 2010. Six companies report that they have employees doing manual lead soldering.

▶ Three companies (Abound Solar, First Solar, and Calyxo) have products that contain cadmium compounds, and that they do not have plans to phase them out. No responding companies use mercury, hexavalent chromium (Cr6+), polybrominated biphenyls (PBB), or polybrominated diphenyl ether (PBDE).

> **Only half of responding companies** have worker codes of conduct in place with their suppliers and the systems to verify performance.

▶ None of the companies use any of the potent greenhouse gases listed in the survey, except for one instance: Solar Cells Hellas uses nitrogen trifluoride (NF3), and they do not have plans to phase it out.

▶ Five companies say that they conduct lifecycle analyses or risk assessments on new chemicals, including nanomaterials.

3. GW is the abbreviation for gigawatts which equal one billion watts, or 1,000 MW.

"Early action to develop recycling capacity is essential if the solar PV industry is to avoid the experience of electronics manufacturers."
Sheila Davis, Executive Director SVTC

recommendations for action

If you are a commercial, governmental, or residential purchaser of solar PV panels, you are making a long-term financial and environmental commitment. Be sure that the panel manufacturer is making the same long-term commitment to purchasers and to the environment.

How to Use the Solar Scorecard

- **If you have not yet purchased solar PV panels -** please use the scorecard to help ensure that you buy from a company that is working toward a more just and sustainable future.

- **If you already own solar PV panels -** find the company that manufactured your panels and see if they have a plan in place to take back and responsibly recycle panels and also determine whether they support mandatory programs. If they don't support such programs, encourage them to do so. It will help you and the environment!

- **If you own solar panels made by a company that got an "eclipse" score -** contact them to ask if they plan to implement a takeback program, and encourage them to answer our survey next year.

FOR FULL ANALYSIS VISIT:

WWW SOLARSCORECARD.COM

survey sponsors

Silicon Valley Toxics Coalition (SVTC) is a U.S.-based non-profit organization engaged in research, advocacy and grassroots organizing to promote human health and environmental justice in response to the rapid growth of the high-tech industry.

SVTC was founded in 1982 as a response to the discovery of groundwater contamination caused by leaking underground chemical storage tanks belonging to the high-tech industry. Since then, SVTC has worked to reduce the burden that the electronics and high-tech industries place on workers, communities, and our environment.

Henderson Global Investors and **Boston Common Asset Management** are investment companies committed to the long-term sustainability of the solar industry. We believe strongly that solar (PV) technologies offer a critical set of solutions to the challenge of developing cleaner energy sources that don't contribute to climate change or wider environmental issues. While SVTC has undertaken this work independently, and we take no credit for it, we have nonetheless supported the project because we believe it is essential that the industry develops systems and processes to manage environmental, health, safety, and labor issues effectively. We see this scorecard as an important first step in this development.

www.Henderson.com www.BostonCommonAsset.com

Silicon Valley Toxics Coalition
760 N. First Street | San Jose, CA 95112 | P: 408-287-6707 | F: 408-287-6771
svtc@svtc.org | www.SVTC.org | www.SolarScorecard.com