

TASK 12 - PV ENVIRONMENTAL HEALTH & SAFETY ACTIVITIES



Fig. 1 - Task 12 Experts Meeting in Valencia, Spain, 30th August 2008.

INTRODUCTION

The growth of the PV market is based on the promise of environmentally friendly energy generation, and is sustained by the support of the environmentally conscious public via market incentives, direct subsidies and R&D support. Without such support the industry can not grow to levels that would enable the reduction of direct (production and installation) costs to the levels of conventional energy generation. Furthermore, continuing diligence on EH&S issues is necessary to safeguard the environment, which is the promise of photovoltaics.

OVERALL OBJECTIVES

The goal of Task 12 is to facilitate a common understanding of EH&S issues among the various country members, and disseminate the Task group's knowledge and understanding to stakeholders and to energy and environmental policy decision makers.

Task 12 aims at fostering international collaboration in the areas of safety and sustainability which are crucial for allowing PV to grow and make major contributions to the energy needs of the member countries and the world. There are both technical and perception issues that need to be addressed.

The overall objectives of the Task are to:

- a) Quantify the environmental profile of PV in comparison to other energy technologies.
- b) Define and address EH&S and sustainability technical and perception issues that are important for the market growth.
- c) Disseminate the results of the EH&S analyses to stakeholders, policy makers and the general public.

The first objective can be served with life cycle analysis (LCA) that describes energy, material and emission flows in all stages of the life of PV. The second objective will be addressed by assisting the collective action of PV companies on defining material availability and product recycling issues and on communicating "lessons learned" from incidents, or preventing incidents in PV production facilities.

The third objective (dissemination) will be accomplished by presentations to broad audiences, producing simple fact sheets documented by comprehensive reports, and engaging industry associations and the media in the dissemination of the information.

APPROACH

The approach to meet Task 12 objectives is to subdivide the Task into four relevant subtasks and a number of detailed work activities on key aspects of PV Environmental Health and Safety activities.

SUBTASKS AND ACTIVITIES

The current subtasks and activities are as follows:

SUBTASK 1: Recycling of Manufacturing Waste and Spent Modules

The study carried out by Ökopol and co-funded by EPIA and BSW in the framework of PV CYCLE has been finalized during the spring 2008. The study "For the Development of a Recovery and Recycling System for Photovoltaic Products" is sponsored by BMU and it is available in both German and English at www.pvcycle.org. The study deals with PV market and technologies analysis, waste forecasts, political and legal parameters, recycling processes and techniques, eco-balance aspects (environmental impact of the different recycling options), benchmarks of a voluntary recovery systems of PV modules and logistic costs for such a system.

The Members of PV CYCLE (representing more than 70 % of the European PV market) have committed to collecting a minimum of 65 % of photovoltaic modules installed in Europe since 1990 and to recycling 85 % of the collected waste. PV CYCLE's declaration to that effect was made on 19 December 2008 and supported by French Energy Minister Jean-Louis Borloo, as well as Environment Commissioner Stavros Dimas.

The association is at the final stage of developing its recycling scheme that should be publicly presented by 1 April 2009.

TABLE 1 – TASK 12 PARTICIPANTS

COUNTRY	ORGANISATION	PARTICIPANT
The Netherlands	Utrecht University	Mr. Erik Alsema
		Mr. Nils Holger Reich
	ECN	Ms. Mariska de Wil-Scholten
Belgium	EPIA	Ms. Eleni Despotou Mr. Daniel Fraile
USA	Brookhaven National Laboratory	Mr. Vasilis Fthenakis
	Columbia University	Mr. Hyung Chul Kim
Germany	LBP Stuttgart University	Mr. Michael Held
	ZSW	Ms. Wiltraud Wischmann
	Deutsche Solar	Mr. Karsten Wambach
Switzerland	ESU-Services	Mr. Rolf Frischknecht
Austria	Umweltbundesamt GmbH	Mr. Werner Pölz
Norway	ELKEM Solar	Mr. Ronny Glockner
Spain	ESCI	Mr. Marco Raugei
Japan (Observer)	Nedo	Mr. Masanori Ishimura
	Mizuho Information & Research Institute Inc.	Mr. Keiichi Komoto
	Kyocera Corporation	Mr. Mitsutoshi Hino

Energy Pay-Back Time
(grid-connected, roof-top PV system;
irradiation 1700 kWh/m²/yr)

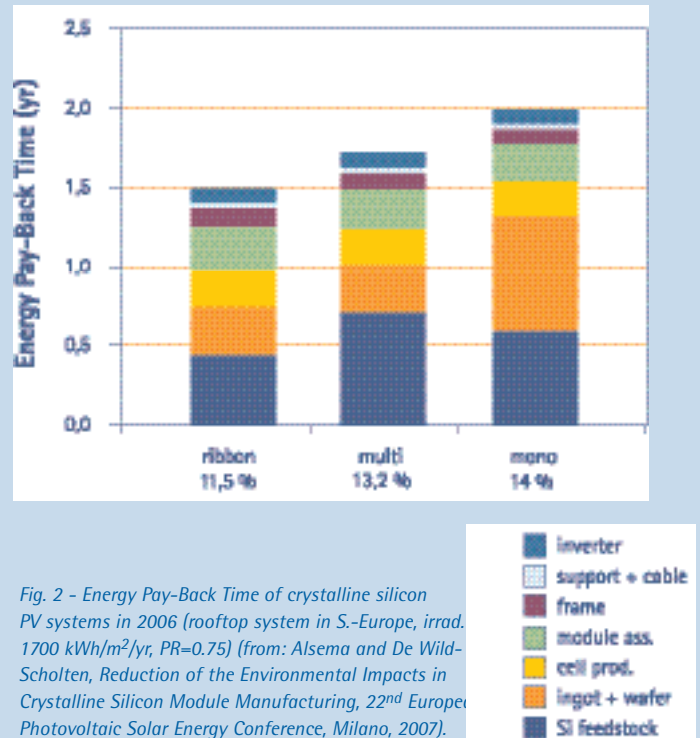


Fig. 2 - Energy Pay-Back Time of crystalline silicon PV systems in 2006 (rooftop system in S.-Europe, irradi. 1700 kWh/m²/yr, PR=0.75) (from: Alsema and De Wild-Scholten, Reduction of the Environmental Impacts in Crystalline Silicon Module Manufacturing, 22nd European Photovoltaic Solar Energy Conference, Milano, 2007).

SUBTASK 2: Life Cycle Assessment

Task 12 experts from Brookhaven National Laboratory (BNL), University of Utrecht, Energy Research Centre of the Netherlands (ECN), Stuttgart University and Elkem Solar are engaged on ongoing projects on LCA. These researchers presented papers at the 23rd EU PVSEC in Valencia, Spain, September 2008, and also submitted several articles to major journals.

Studies on LCA have been carried out for different Concentrated PV products and for the Solar grade silicon through a metallurgical route (Elkem Solar Silicon – ESS™) based in a low energy production process.

In 2008, a complete LCA model for estimating climate impact and energy consumption was finished. Results from this were disseminated at the "SCSI IX - Silicon for Chemical and Solar Industry" at Holmen Fjordhotel in Asker, Norway, June 2008. The models were upgraded with sensitivity analysis on the re-use of waste heat internally and externally in the production process. These results were presented at the 23rd EUPVSEC - European Photovoltaic Solar Energy Conference and Exhibition in Valencia, September 2008.

Update of the life cycle inventories of selected BOS components and of the GaAs modules embedded in the life cycle assessment databaseecoinvent.

A draft of the "Guidelines for a Common Approach in Photovoltaics Life Cycle Inventory and Life Cycle Assessment" was presented during the experts meeting in Valencia, September 2008 and afterward, several discussion have taken place to agree on the assumptions. The work in this area is now advancing quickly and the final version is expected to be ready by March 2009.

A number of papers related to life cycle assessments and other environmental aspects have been published during 2008 and can be found at:

- <http://www.ecn.nl/publicaties/default.aspx?au=44649>
- <http://www.clca.columbia.edu/publications.html>
- <http://www.pv.bnl.gov>

SUBTASK 3: Safety in Facilities

Eugene Ngai, Air Products, and Vasilis Fthenakis, Brookhaven, gave a seminar on Silane Safety in conjunction of the IEEE PVSC, San Diego, in April 2008, where they highlighted the risks involved with silane and presented an overview of proper silane safety procedures and practices.

Besides the cooperation with specific companies, negotiations among the Semiconductor Equipment and Materials International association (SEMI), the Semiconductor Safety Association Europe (SSA) and Task 12 members are taking place in order to bring the long experience on safety issues from the semiconductor industry to the photovoltaic industry. Presentations will take place during 2009 and some forms of collaboration are being discussed.



Fig. 3 - Life-cycle emissions from silicon and CdTe PV modules. BOS is the Balance of System (i.e., module supports, cabling and power conditioning). Ground-mounted systems, Southern European insolation, 1,700 kWh/m²/yr, performance ratio of 0.8, and lifetime of 30 years. Case 1- current electricity mixture in Si production-CrystalClear project and Ecoinvent database. Case 2- UCTE grid mixture and Ecoinvent database. Case 3- US grid mixture and Franklin database (from: Fthenakis, Kim and Alsema, Emissions from Photovoltaic Life Cycles, Environmental Science and Technology, 42(6): 2168-2174, 2008).

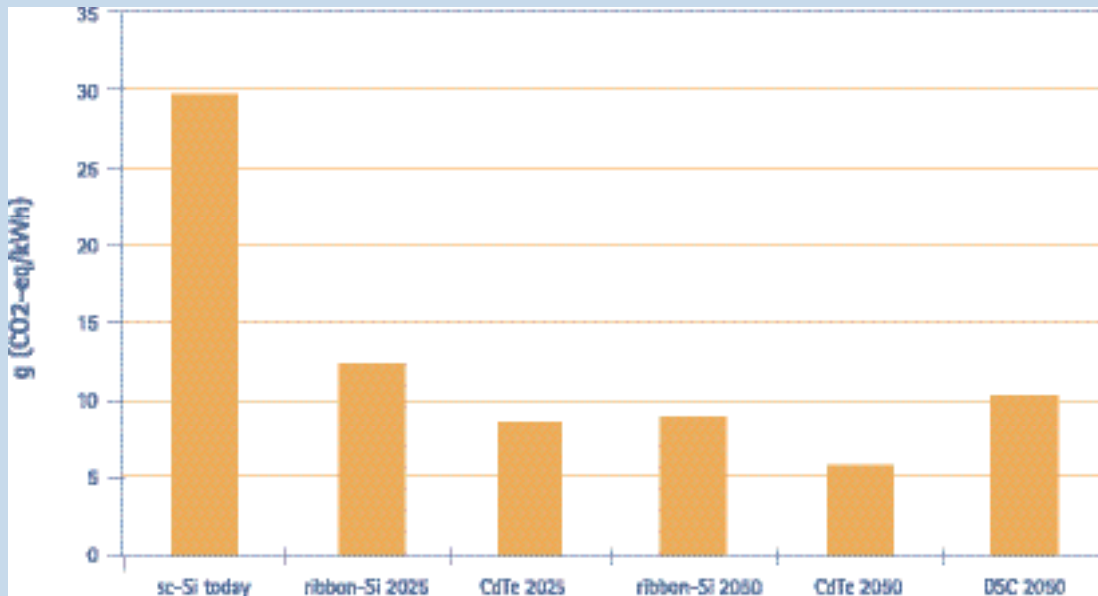


Fig. 4 - GWP results for future PV systems, based on an update of the scenario analysis performed within the NEEDS^[1] project (from: Rauegi and Frankl, *Life cycle impacts and costs of photovoltaic systems: current state of the art and future outlooks*, Energy, in press).

SUBTASK 4: EH&S Information Dissemination

The Task 12 website www.iea-pvps-task12.org was created in 2008 and is currently being developed.

The website will host the Task 12 documentation, announcements, products and will provide links to other IEA and PV Technology and EH&S and LCA research websites (e.g., Brookhaven National Laboratory, Columbia University, University of Utrecht, ECN, University of Stuttgart, National Renewable Energy Laboratory, PVCYCLE, ESU-services Ltd).

Literature related to life cycle assessment of photovoltaic systems, as well as literature related to recycling of photovoltaic components will be posted on the website.

Nevertheless, the main objective of this website is not only to offer EH&S technical information such as scientific papers and studies (as the one of PVCYCLE), but also to provide general information about the environmental benefits of PV. It should be a reference of point for journalists when searching for this kind of information.

PLANS FOR 2009

The "Guidelines for a Common Approach in Photovoltaics Life Cycle Inventory and Life Cycle Assessment" are being finalized and are expected to be ready by March 2009. Once they are approved by the ExCo, they will be printed and disseminated.

A study has been initiated at the Brookhaven National Laboratories, U.S.A, to define the cost of collecting and recycling thin-film PV modules and the cost of setting up a collection infrastructure in the U.S.

A workshop on Recycling for the US industry is proposed in conjunction with the IEEE PVSC, Philadelphia, June, 2009, Philadelphia, PA, USA, June 6-11 June, 2009.

A workshop on Recycling may be organized in Europe by PV Cycle with the Support of EPIA in the second half of 2009.

A Task 12 technical and administrative meeting will be held in conjunction with the 24th EU PVSEC, Germany, in September 2009, and perhaps the IEEE PVSC, US, 6-11 June 2009.

The Next version of ecoinvent data v2.1 will be ready incorporating updates of thin-film GaAs modules and updated figures on BOS components. It will also include Metallurgical grade silicon production:

- include microsilica as by-product
- refine CO₂ emissions
- include emissions of PAHs and dioxin

By spring 2009, PV Cycle expects to have completed the design of the recycling model in detail and to have documented this model through the voluntary agreement signed lately in 2008 with the commitment of the PV industry producers. Having done so, the association will introduce the Phase II of the project.

PUBLICATIONS AND DELIVERABLES

In 2009, articles and papers will be presented in the press and during international conferences like 24th EUPVSEC; some of which include:

- Life Cycle Impacts and Costs of Photovoltaic Systems: Current State of the Art and Future Outlooks, Energy, (Marco Rauegi and Paolo Frankl)
- Life Cycle Assessment of CdTe PV modules (it will present and discuss the results of the whole life cycle of CdTe modules and will present results from a scenario analysis concerning possible future environmental profiles of CdTe modules). Michael Held, LBP University of Stuttgart
- Control of Emissions from Crystalline Silicon Solar Cell Manufacturing (M.J. de Wild-Scholten, M. Schottler)
- Meeting the NEEDS of European Environmental Sustainability Assessment, (Frischknecht R., Krewitt W)

Footnotes

- 1 <http://www.needs-project.org>