PHOTON Lab's outdoor module tests – February results

The overview tables document the current status of solar module yield measurements conducted by PHOTON Laboratory. Since 2005, the lab has been measuring solar module yields under real-world conditions: three modules of each model are installed on an open field, facing south, at a 30° incline. PHOTON Lab's proprietary measurement devices take second-by-second measurements of the IV curve for each module. The test also captures other important values such as global irradiation, as well as module and air temperature.

For testing purposes, it's important that modules actually feed in their electricity, as they would heat up in open-circuit mode. It's also important to measure yield before it hits the inverter. One common mistake made in yield comparisons, apart from using generally imprecise measurements, is capturing data at the electricity meter – after the output has passed through the inverter. Inverter efficiency impacts yield measurements. Moreover, different combinations of modules and inverters result in better or worse performances, which makes it impossible to compare results.

Another factor that poses challenges for module yield comparisons is standardization according to the manufacturer's specified nominal power. These specifications can deviate considerably from actual power – power under standard test conditions (STC). For instance, if a manufacturer with a 105 W module specifies that the module's nominal power is 100 W and the module produces an annual yield of 100,000 Wh, then standardizing to nominal power would result in a value of 1,000 Wh per W. Another 105 W module with a specified nominal power of 110 W, producing 100,000 Wh annually, would have a value of 909 Wh per W. But in both cases, the actual yield is 952 Wh per W. That's why PHOTON Lab's yield tests always standardize to STC power.

The table regarding annual yield measurements from 2010 presents results for all modules installed on the test field for the entire year (see table, p. 154). The table on monthly yield (see table below) shows results for 1 month, February 2011. The module types in the two tables are not identical, since PHOTON Lab receives new modules constantly. Hence there are several modules that have monthly yield measurements, but no annual values yet. But there are other reasons why the values in the tables are not directly comparable: the results from just a single month say relatively little about how the modules function over the course of a full year. For instance, modules that perform well under direct solar irradiation, delivering high yield in the summer months, have considerable reductions in performance during fall and winter – when the share of diffuse irradiation is higher. The opposite scenario is also possible. Naturally, the summer months play a disproportionately large role for annual yield calculations.

Winter can also impact results, albeit differently: modules on the test field are not cleaned during the year and PHOTON Lab does not remove snow. Frameless modules therefore have an advantage, as snow tends to slide off these models faster. This explains the disproportionate yield advantages enjoyed by First Solar thin-film modules in the winter – although these modules also performed well during the rest of the year.

The age of the modules should also be taken into account when analyzing yield information: a module installed in 2005 cannot be compared directly with a module just recently installed on the test field.

Further information

To get details about PHOTON Lab's module tests, please go to: www.photon-laboratory.com.

PHOTON Lab's outdoor module tests: Results for February 2011

Manufacturer	Model	Cell type	Origin	STC power in W	Yield in kWh/kW		Deviation from test winner (%)	Installed in
					February	January - February		
REC	REC 230 AE	Multi	Sweden	228.6	48.0	**79.6**	-	2010
Bisol	BMU-215-2/221	Multi	Slovenia	229.1	47.1	**78.4**	1.5	2010
Solarworld	Sunmodule Plus SW 225 mono	Mono	USA	233.4	47.1	**78.4**	1.5	2010
Silliken	SLK60P6L 230Wp	Multi	Spain	229.7	47.3	**78.1**	1.9	2009
Win Win Precision	Winaico WSP-235P6	Multi	Taiwan	240.1	47.1	**78.0**	2.0	2010
CSG PVTech	CSG180S1-35/1589x807	Mono	China	184.1	46.7	**77.1**	3.1	2010
Trina Solar	TSM-PC05 (225)	Multi	China	233.0	46.4	**77.1**	3.2	2010
Conergy	Conergy Powerplus 220P	Multi	Germany	224.2	46.5	**77.1**	3.2	2010
CH Solar	CH Solar 180 mono	Mono	China	184.4	46.7	**77.0**	3.2	2010
Sun Peak	ALP235W	Mono	India	233.0	46.4	**77.0**	3.3	2010
CSG PVTech	CSG230M2-30/1640x992	Multi	China	228.3	46.7	**77.0**	3.3	2010
Kioto Photovoltaics	KPV 210 PE*1	Multi	Austria	206.6	46.5	**76.9**	3.4	2009
CNPV Solar	CNPV-185M	Mono	China	193.8	46.5	**76.9**	3.4	2010
Aleo Solar	Aleo S_18 225	Multi	Germany, Spain	230.5	46.3	**76.6**	3.7	2010
Upsolar	UP-M180M	Mono	China	181.5	46.1	**76.3**	4.1	2010
Trina Solar	TSM-180DC01	Mono	China	176.2	46.1	**76.3**	4.2	2009
Emmvee Solar	ES-200-P60(230)	Multi	India	234.0	46.0	**76.2**	4.2	2010
Mage Solar	Mage Powertec Plus 225/6PJ	Multi	China	232.0	45.9	**75.9**	4.6	2009
S-Energy	SM-220PA8	Multi	South Korea	224.4	46.1	**75.8**	4.8	2009
Evergreen	EC-120*1	Ribbon	USA	121.0	45.8	**75.7**	4.9	2006
Win Win Precision	Winaico WSP-230P6	Multi	Taiwan	234.4	45.9	**75.3**	5.4	2009

PHOTON Lab's outdoor module tests: Results for February 2011 (continued)

Manufacturer	Model	Cell type	Origin	STC power in W	Yield in kWh/kW		Deviation from test winner (%)	Installed in
Sonalis*1	SL 180 CE-36M	Mono	China	185.1	45.4	**75.2**	5.5	2010
Frankfurt CS Solar	FS215W-Poly	Multi	China	221.3	45.4	**74.9**	6.0	2009
Shell Solar (now SolarWorld)	SQ 150-C*1	Mono	Portugal	155.8	45.2	**74.7**	6.1	2006
Solarfun	SF160-24-1M175	Mono	China	183.0	45.1	**74.5**	6.4	2010
SolarWorld	Sunmodule Plus SW 210 poly*2	Multi	Germany	212.2	45.0	**74.4**	6.6	2006
Perfectenergy	PEM-180/185-72M-SSC	Mono	China	191.3	44.9	**74.0**	7.1	2010
Photowatt	PW 1650-175W	Multi	France	171.4	44.6	**73.7**	7.4	2006
Sunrise Solartech	SRM-180D-72	Mono	China	181.5	44.6	**73.6**	7.6	2009
Sovello	Pure Power SV-X-200 (LV)	Ribbon	Germany	205.0	44.9	**73.6**	7.6	2011
PV Power Technologies	PVQ3 220	Multi	India	223.6	44.7	**73.6**	7.6	2009
First Solar	FS-265	CdTe	USA	65.4	43.7	**71.9**	9.7	2007
NexPower	NT-125AX	µc-Si/a-Si	Taiwan	125.4	43.9	**71.5**	10.2	2010
Canadian Solar	CS6A-170P	Multi	China	174.4	43.3	**70.8**	11.0	2007
Shell Solar (now SolarWorld)	Powermax Eclipse 80-C*1	CIS	USA	90.8	43.5	**70.8**	11.1	2007
Solarfun	SF160 M5-24 (175 W)	Mono	China	174.6	42.7	**70.4**	11.5	2007
Evergreen	ES-180-RL*1	Ribbon	Germany	185.4	42.7	**70.4**	11.5	2007
Kyocera	KC170GT-2*1	Multi	Japan	178.4	42.5	**70.0**	12.0	2006
BP Solar	BP 7185 S*1	Mono	Spain, India	185.1	41.8	**69.1**	13.2	2005
Isofoton	IS-170/24*1	Mono	Spain	172.8	41.7	**68.3**	14.2	2009
Schott Solar	ASE-300-DG-FT (300 W)*1	Ribbon	USA	308.1	41.5	**68.2**	14.4	2007
Solar-Fabrik	SF 130/4-130	Mono	Germany	130.7	41.8	**68.1**	14.5	2010
Isofoton	I-110/24*1	Mono	Spain	102.5	41.5	**67.7**	15.0	2006
Sharp	NT-R5E3E*1	Mono	Japan	187.9	40.9	**67.5**	15.2	2005
Sunways	MHH plus 190 (190 Wp)*1	Multi	Germany	199.5	40.9	**67.2**	15.6	2005
Solar-Fabrik	SF 145A*1	Ribbon	Germany	145.8	40.3	**66.0**	17.1	2005

Please note: yield data can only be fully assessed once a year of testing has been completed; the data provided here only allows for preliminary assessments; all yield data is standardized to STC; the average values displayed by each module model are listed

*1 not manufactured anymore, *2 former model name: SW 210 poly, *3 for manufacturer Ningbo Qixin Solar Electrical Appliance Co. Ltd.