

REC

External Verification of REC Modules

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 - REC Peak Energy Series
- Photon Module Test March 2010
- Fraunhofer Performance Ratio Test
- Öko Test
- Photon Product Warranty Test 2010
- Module energy payback time of 1 year
- Certifications
- ISO standards
- PV Cycle
- REC Silicon based modules

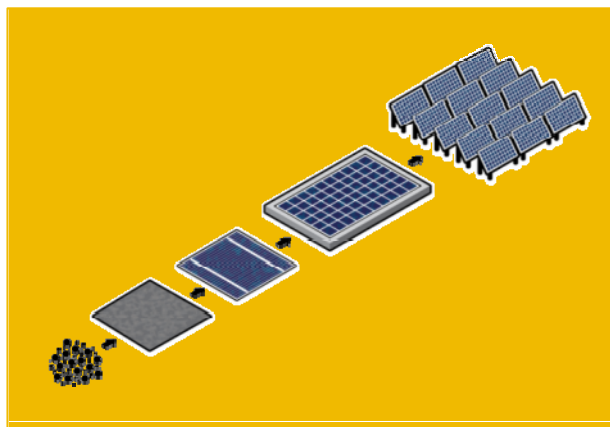
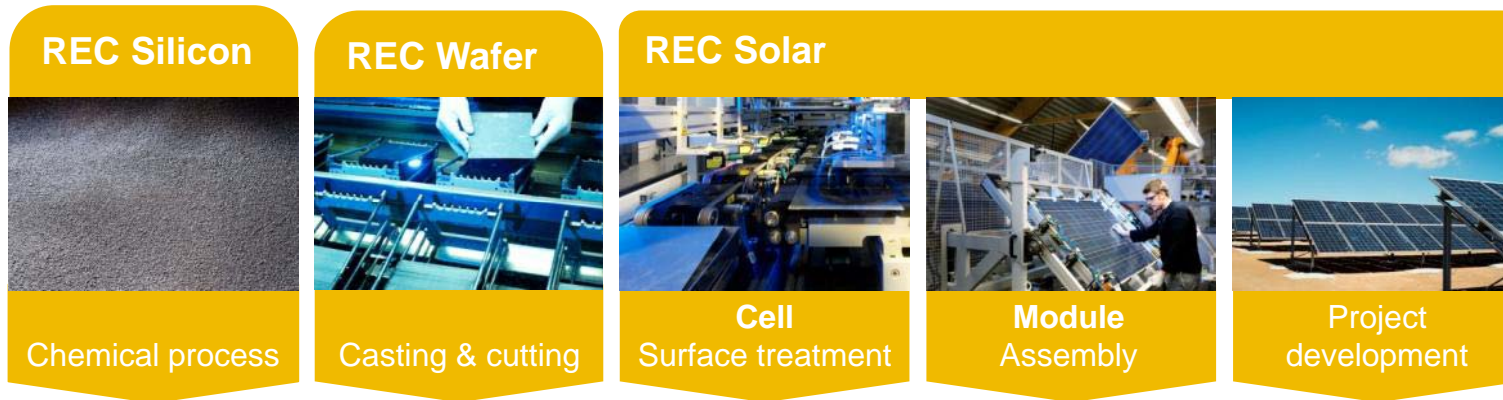


REC Group facts

- REC is a fast-growing, financially strong global company with customers worldwide
- Founded in Norway, REC is an international solar company, employing more than 3,000 people worldwide
- REC had revenues of approximately EUR 1 billion in 2009
- Established in 1996
- More than 200 patents granted or pending
- Listed on the Oslo Stock Exchange (ticker: REC)



REC – an integrated PV company

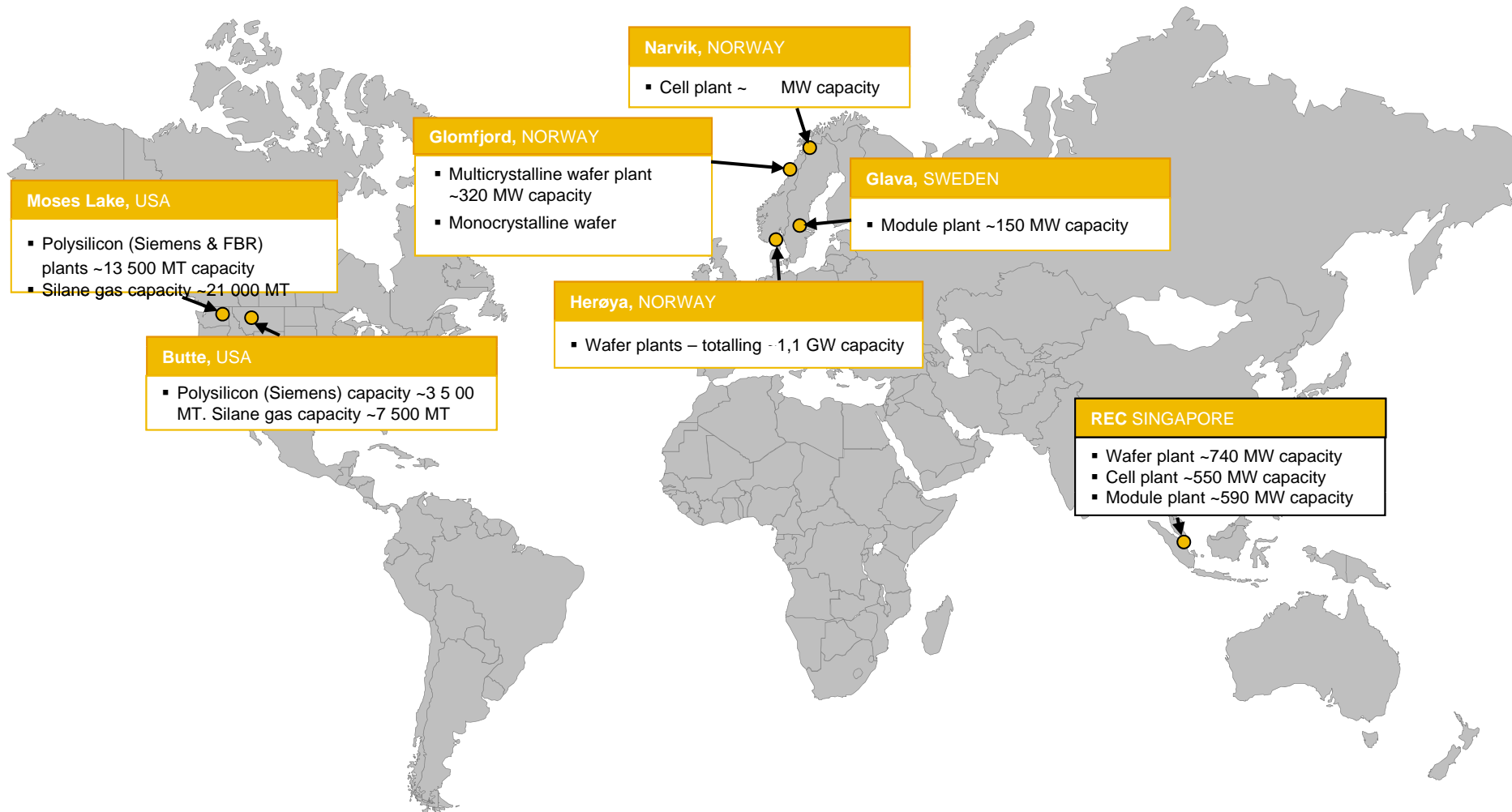


Presence across the solar value chain creates strategic opportunities

Competitive positions improved through:

- Transparent cost structure
- Technology development synergies
- Applying best practices

Manufacturing facilities and capacities



REC Modules

→ REC AE-Series

- 43 mm (1.7”) mm frame
- 4 mm glass
- 22 kg (48.5 lbs)
- REC AE Cells
- 30 modules per pallet
- MC3 Connector



→ REC Peak Energy Series

- 38 mm (1.5”) mm frame
- 3.2 mm glass
- 18 kg (40 lbs)
- REC Peak Energy Cells
- 40 modules per pallet
- H+S RADOX® Connector



REC Module Best in Photon Module test, March 2010

Photon

- Photon Laboratory announced that the REC AE-Series module ranked first in the independent, international module test for the month of March
 - 40 modules tested including the world's leading brands
- The test measures module performance which is the relationship between the output stated on the module labeling versus the amount of energy the module actually produces
- The independence and scientific methodology of the Photon test make it one of the key benchmarks in the PV industry

Photon Module Testing – March 2010

SOLARMODULE: MONATSAUSWERTUNG DER PHOTON-ERTRAGSMESSUNGEN MÄRZ 2010

Hersteller	Modultyp	Zelltyp	Herkunftsland	Ertrag in kWh/kW*	Abstand zum Monatsbesten	Installationsjahr
REC Solar	REC230AE	poly	Schweden	99,09	Monatsbesten	2010
Bisol	BMU-215-2/221	poly	Slowenien	97,55	1,5 %	2010
Siliken	SLK60P6L 230Wp	poly	Spanien	97,43	1,7 %	2009
Trina Solar	TSM-PC05 (225)	poly	China	96,44	2,7 %	2010
S-Energy	SM-220PA8	poly	Südkorea	96,14	3,0 %	2009
Solarworld	Sunmodule Plus SW 225 mono	mono	USA	95,96	3,2 %	2010
Sunpeak	ALP235W	mono	Indien	95,80	3,3 %	2010
Winery Solar	Winaico WSP-230P6	poly	Taiwan	95,56	3,6 %	2009
Trina Solar	TSM-DC01 (180)	mono	China	95,42	3,7 %	2009
Mage Solar	225/6PJ	poly	China	95,33	3,8 %	2009
Frankfurt CS Solar	FS215W-Poly	poly	China	95,10	4,0 %	2009
Solarworld	Sunmodule Plus SW 210 poly ¹⁾	poly	Deutschland	95,08	4,0 %	2006
Photowatt	PW 1650-175W	poly	Frankreich	94,72	4,4 %	2006
Solarfun	SF160-24-1M175	mono	China	94,56	4,6 %	2010
Shell	SQ 150-C**	mono	Portugal	94,23	4,9 %	2006
PV Power Technologies	PVQ3220	poly	Indien	94,15	5,0 %	2009
Shell	Powermax Eclipse 80-C**	CIS	USA	94,14	5,0 %	2007
Evergreen	EC-120**	ribbon	USA	93,98	5,2 %	2006
Sunrise Solartech	SRM-180D-72	mono	China	93,44	5,7 %	2009
CNPV	CNPV-185M	mono	China	92,04	7,1 %	2010
Conergy	Conergy Powerplus 220P	poly	Deutschland	92,00	7,2 %	2010
First Solar	FS-265	CdTe	USA	91,99	7,2 %	2007
CSI	CS6A-170P	poly	China	91,80	7,4 %	2007
Emmvee Solar	ES-200-P60(230)	poly	Indien	91,76	7,4 %	2010
Evergreen	ES-180-RL**	ribbon	Deutschland	91,56	7,6 %	2007
Sonalis ²⁾	SL180CE-36M	mono	China	91,18	8,0 %	2010
Upsolar	UP-M180M	mono	China	90,75	8,4 %	2010
Solarfun	SF160 M5-24 (175 W)	mono	China	89,53	9,6 %	2007
Kyocera	KC170GT-2**	poly	Japan	89,24	9,9 %	2006
Isofoton	I-110/24**	mono	Spanien	89,04	10,1 %	2006
BP Solar	BP 7185 S**	mono	Spanien, Indien	88,83	10,4 %	2005
Isofoton	IS-170/24	mono	Spanien	88,25	10,9 %	2009

Fraunhofer Performance Ratio Test



- 3 module types tested in Glava, Sweden
 - REC: 8 x 215 Wp
 - Chinese Supplier: 9 x 210 Wp
 - European Supplier: 8 x 200 Wp
- Test supervised by Fraunhofer
- REC modules show excellent performance ratio after two years of operation



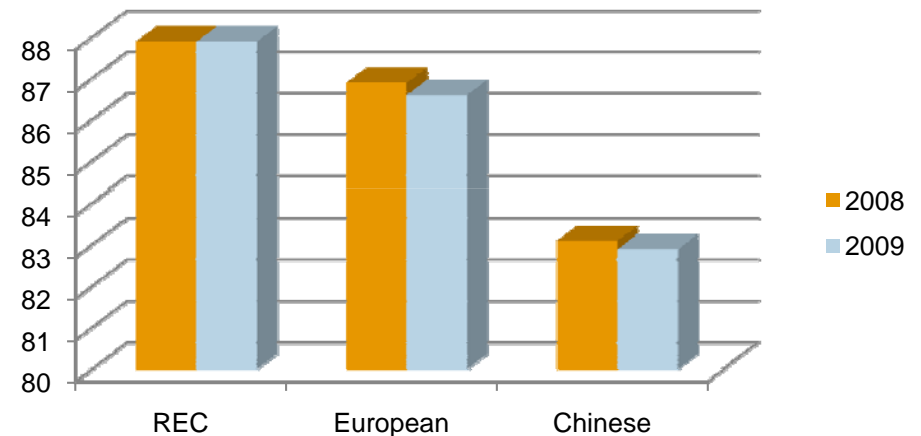
Test site in Glava, Sweden

Performance Ratio

- REC modules shows excellent performance ratio
- Leading European and leading Chinese manufacturer shows consistently lower performance ratio
- Measurement data
 - 2008-03 → 2008-12
 - 2009-01 → 2009-06



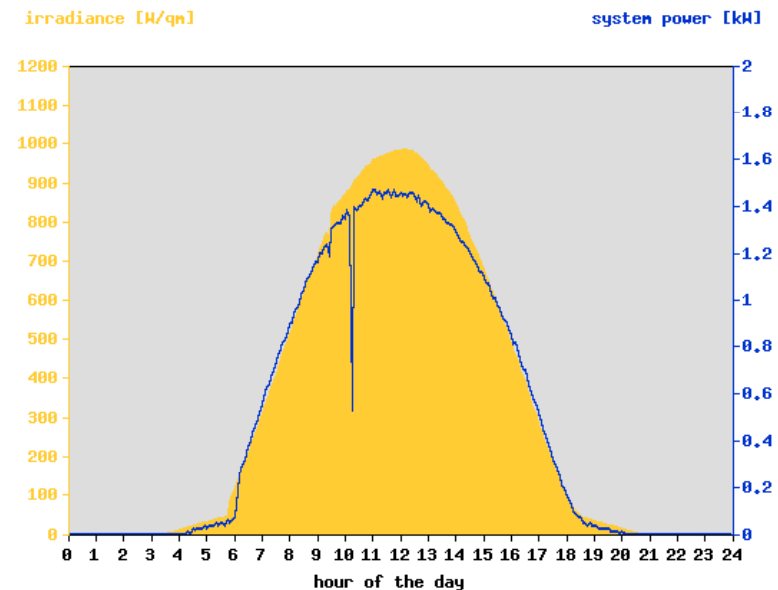
Performance Ratio



	2008	2009
REC	87,9	87,3
European brand	86,9	86,6
Chinese brand	83,1	82,9

How do we measure?

- Test day of this example, May 15th 2009
- Measuring solar irradiation per day
 - 7.897 kWh/m²
- System size
 - 1.72 kWp (8 x 215Wp)
- Measuring Solar Energy production per day
 - 12.288 kWh
- Yield = Solar Energy/System Size
(12.288/1.72 = 7.144 kWh/kWp)
- Ratio=Yield/Solar Irradiation (7.144/7.897 = 90.5%)



Performance Ratio Example

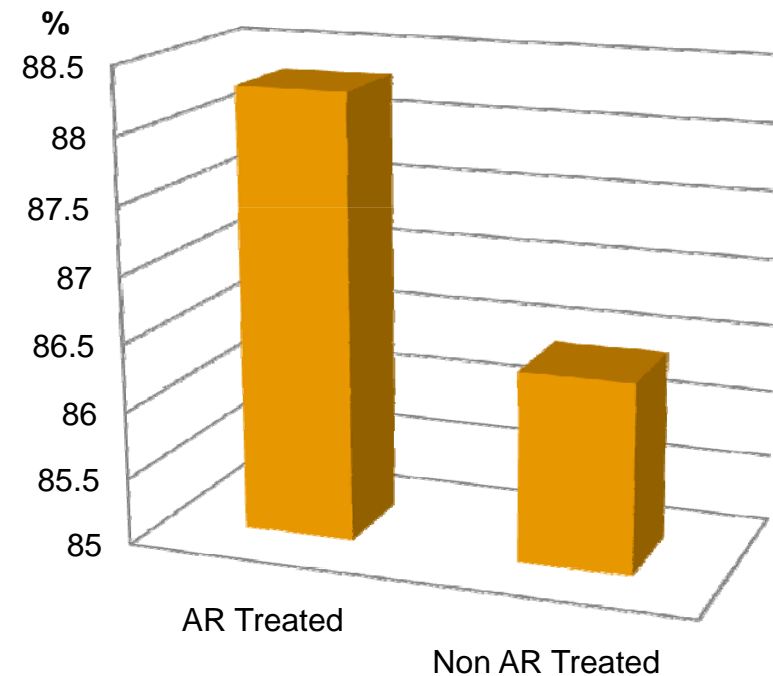
System Size	Yearly Sun Hours	Energy Pr. Year	Feed-in Tariff	Feed-In Income Per Year
4 kW REC	1500	5274 kWh	€0,44	€2321
4 kW European	1500	5214 kWh	€0.44	€2294
4 kW Chinese	1500	4986 kWh	€0.44	€2194

Optimized for all Sunlight Conditions



REC Module
Presentation

- A 2-year performance test has been conducted together with Fraunhofer ISE
- The in-house glass etching process increased the performance ratio by 2%
- REC uses a special Anti-Reflective (AR) Coating (with Sunarc Technology) that improves the performance ratio of the modules
- Graph shows difference with AR coating and without AR coating



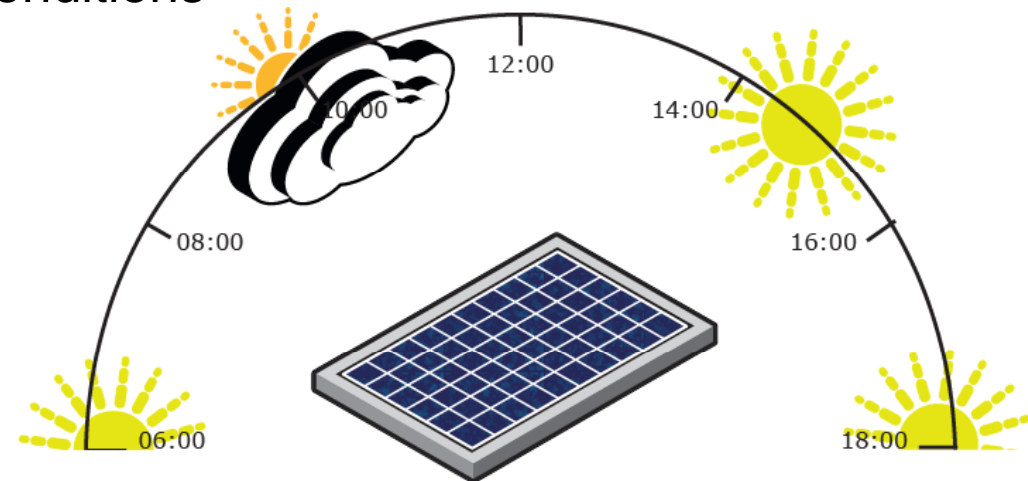
Optimized for all Sunlight Conditions



REC Module
Presentation

→ Special glass etching, anti-reflective coating - improves the power output of the module in all sunlight conditions

- Direct light
- Sunrise/Sunset
- Diffuse light



REC Module Rated Good by Öko-test

- The modules were evaluated in an extensive series of performance tests
- The test ranked modules according to the content of their warranty, watt class tolerance and power output
- A total of 17 solar modules were tested
- Results were published in the May issue of Öko-Test, German publication



REC Premium 210 was renamed
REC AE-Series in 2009

Module Energy Payback Time of One Year



REC Module
Presentation

→ Energy payback time is the length of time it takes a solar panel to generate the same amount of energy that was used to create it, is an important factor for the environmental attractiveness of solar

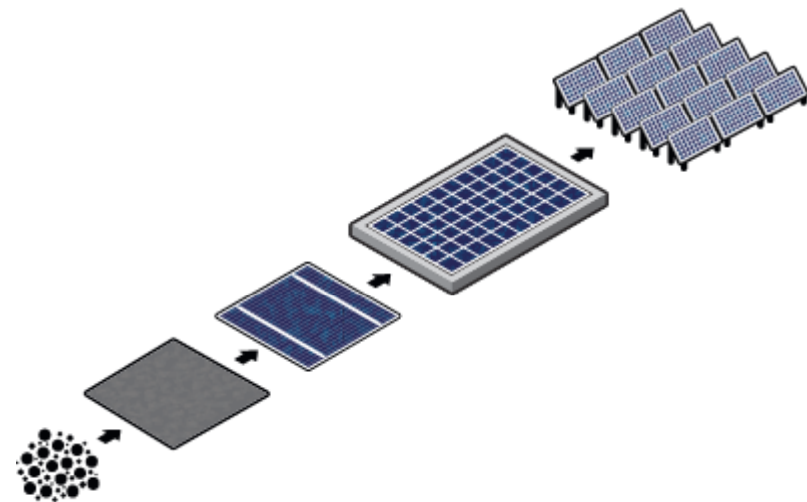
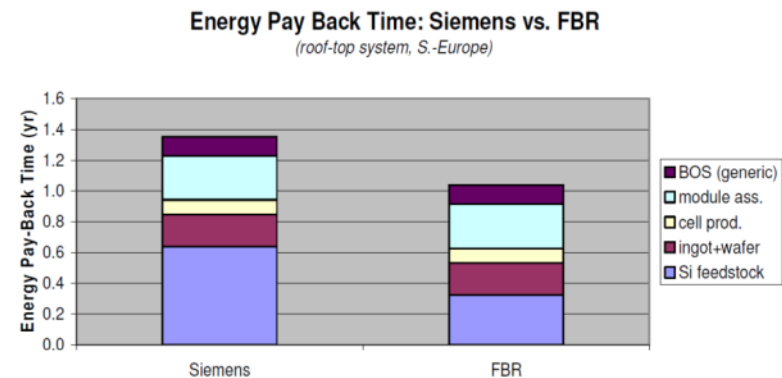
→ REC modules have an energy payback time of 1 year due to the new FBR silicon process

- Including transport and BOS
- For the energy payback time we assume the following
 - 1700 kWh/m² per year
 - System performance of 75%

→ Automation

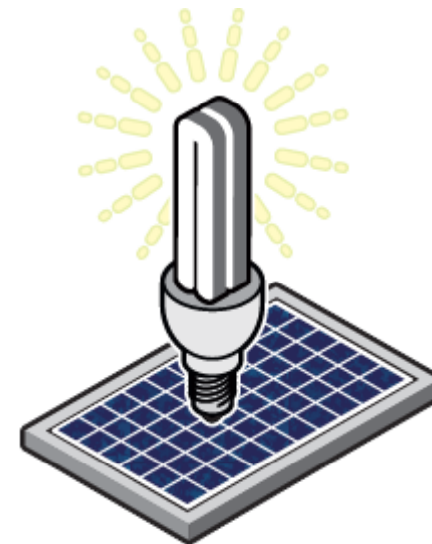
- All parts of the REC value chain are highly automated

→ Life Cycle analysis performed by Utrecht University



Product Warranty

- Module warranty conditions:
 - 10 years warranty for 90% power output
 - 25 years warranty for 80% power output
 - 63 months limited product warranty
- REC has a proven track record of respecting warranty



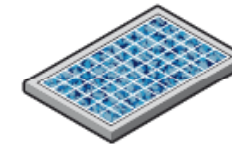
REC Module Rated Best in Photon Warranty Test

Photon

→ REC AE Series Best in Photon Warranty Test

The REC AE 210 Module was recognized for having the most comprehensive warranty in a Photon Laboratory Test published in the March 2010 edition of Photon Germany. REC's warranty was compared to forty other leading brands and was considered closest to best practice recommended by the European Union

Standards



REC Module
Presentation

→ IEC61215

- Crystalline silicon terrestrial photovoltaic (PV) modules – design qualification and type approval

→ IEC61646

- Thin-film terrestrial photovoltaic (PV) modules – design qualification and type approval

→ IEC61730

- Photovoltaic (PV) module safety qualification - Part 2: requirements for testing

→ TÜV Safety Class II

→ IEC60904

- Measurement of photovoltaic current-voltage characteristics

→ EN 50380

- Data sheet and name plate information for photovoltaic modules

→ UL 1703

- Flat-Plate Photovoltaic Modules and Panels

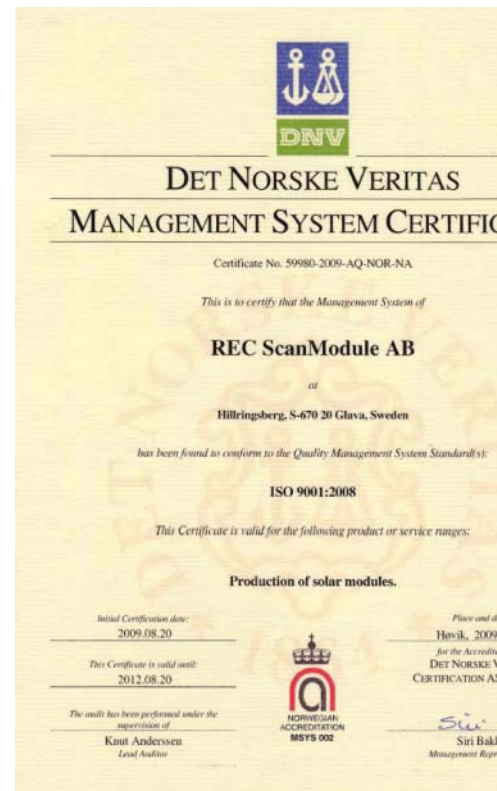
→ NEC 2008

- National Electric Code (US), governs all electrical installations in the US

		82/376/FDIS			
FINAL DRAFT INTERNATIONAL STANDARD PROJET FINAL DE NORME INTERNATIONALE					
Project number Nombre de projet		IEC 61215 Ed.2			
IEC/TC or SC / CEI/CC ou SC		Secretariat / Secretariat			
TC 82		United States of America			
Submitted for parallel voting in CENELEC Soumis au vote parallèle au CENELEC		Dissemination on / Diffusé le			
2005-02-04		2005-04-08			
Submitted for parallel voting in CENELEC Soumis au vote parallèle au CENELEC		Voting terminates on / Vote clos le			
2005-02-04		2005-04-08			
Supersedes document Remplace le document		82/310/CDV - 82/328/RVC			
<input type="checkbox"/> EMC CEM		<input type="checkbox"/> Environment Environnement		<input type="checkbox"/> Quality assurance Assurance de la qualité	
COMMISSION ELECTROTECHNIQUE INTERNATIONALE					
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TEXT OR DISCUSSION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS					
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TECHNIQUES, LES PROJETS FINAUX DE NORMES INTERNATIONALES DOIVENT PARFOIS ETRE EXAMINES EN					
VUE DES NORMES EXISTANTES POUR SERVIR DE REFERENCE DANS LES REGULATIONS NATIONALES.					
crystalline silicon terrestrial photovoltaic (PV) modules - Design approval					
modules photovoltaïques (PV) au silicium cristallin pour application de la conception et homologation					
ATTENTION PARALLELE VOTING			ATTENTION IEC - CENELEC PARALLELE VOTING		
The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this final Draft International Standard (DIS) is submitted for parallel voting. A separate form for CENELEC voting will be sent to them by the CENELEC Central Secretariat.			The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this final Draft International Standard (DIS) is submitted for parallel voting. A separate form for CENELEC voting will be sent to them by the CENELEC Central Secretariat.		
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UL 1703					
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REC is focusing on Environmental and Quality Standards

- ➔ REC ScanCell (Norway)
 - ISO 9001
 - ISO 14001
- ➔ REC ScanModule (Sweden)
 - ISO 9001
 - ISO 14001 Pending
- ➔ REC Cells Pty Ltd (Singapore)
 - ISO 9001 and ISO 14001 pending ramp-up completion
- ➔ REC Modules Pty Ltd (Singapore)
 - ISO 9001 and ISO 14001 pending ramp-up completion



REC PV Cycle Membership



REC Module Presentation

→ History and purpose

- PV CYCLE was founded in July 2007 to implement the photovoltaic industry's commitment to set up a voluntary take back and recycling program for end-of-life-modules in Europe and to take responsibility for PV modules throughout their entire value chain.



→ Members

- PV Cycle represents about 75 % of the European PV Industry
 - 44 members and 5 associated members as of September 2009
- REC joined PV Cycle in September 2008 and is one of the most active companies in PV Cycle



REC Modules are Based on Silicon Material

- 85 % of PV modules in the industry are based on silicon material
 - Proven technology
- REC does not have the toxic material Cadmium-Telluride (CdTe) in our modules
- REC has a strategy to remove Lead (Pb) from the modules to increase our commitment to providing environment friendly products
 - Today the modules have a minimal content of lead in cross connectors, bus bars and solder

REC

Thank you!

