IEA SHC Task 53 2nd meeting

New Generation Solar Cooling & Heating systems (PV or solar thermally driven systems)

Updated state of the art on PV cooling

Daniel MUGNIER – Västeras, 07/10/2014

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www.tecsol.fr

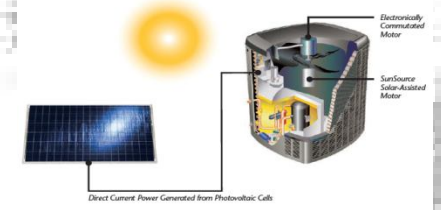
General state of the art

Main categories

Focus on 2 examples

R&D

General State of the art



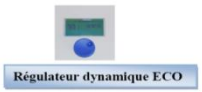
SUNSOURCE™
Solar by day. Electric by night. Savings all year.

LENNOX
Innovation never felt so good.™

Sud Concept
ACCELERATEUR D'INNOVATION

CENTROSOLAR
CENPAC plus

SOLAR LINE



CLIMATISATION SPLIT SOLAIRE DIRECTE

COSSECO

VIESSMANN
climate of innovation

HOTSPOT ENERGY

SOLAR AIR
COOLING HEATING

IEA Task 53 2nd meeting – Västeras 07-08/10/2014

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(no claim for completeness)

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Main categories

Solar air conditioners : Splits

PV+ HP coupling for Office/Commercial

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hotspot energy

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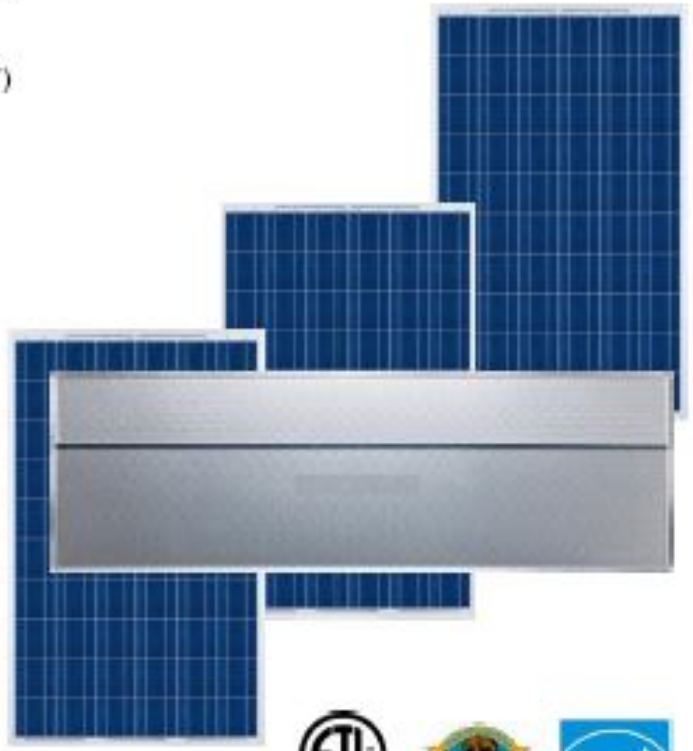
HotSpot Energy LLC
(757) 410-8640

Solar Air Conditioner

SEER 35 • Solar Hybrid Heat Pump

Model ACDC12

Connect Up To Three Panels (Max 840W)
Runs On Solar Power & AC Power
11,000 BTU Cooling/12,000 BTU Heat
Plug-And-Play Solar Connection
No Batteries Required



Home

Keep the inside cool all day for next to nothing in energy costs. Preventing daytime heat build-up also cuts evening cooling costs.

Office

Keep the work area comfortable during business hours for pennies per day. Cool or heat up to 750 Sq. Ft. (69m²).

International

Compatible with 50hz and 60hz power, use it anywhere in the world.

Intertek

Simple To Install

This unit installs exactly like a normal mini-split air conditioner. Standard MC4 solar connectors and cabling can be used to connect the solar panels directly to the AC unit.

Ultra-High SEER
Solar Air Conditioner

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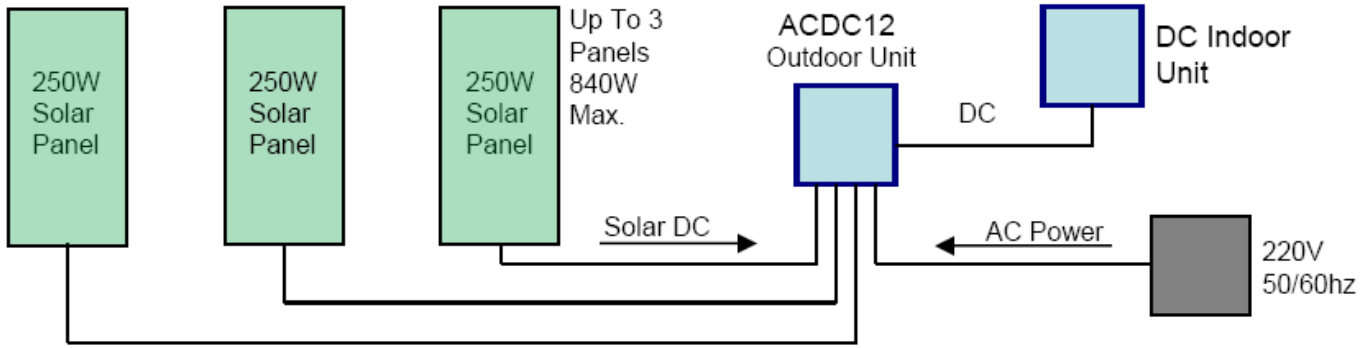
Your air conditioner needs the most power when the sun is shining, a coincidence you can take advantage of with our ACDC12 solar air conditioner. It can keep an indoor area cool during the day for pennies. Literally, pennies, operating above **SEER 35** with only two solar panels connected. Use this system to cool a small area or to augment a larger system.

The unit uses solar energy up to 720w, and adds in utility power, with no need for batteries. Even when the sun is not shining at all, this ultra high-efficiency (SEER >19 without solar) heat pump will keep you comfortable and save you money using far less electricity than a normal AC or heat pump unit of the same capacity.

Connects Directly To Solar Panels



Like all DC-Inverter air conditioners, the ACDC12 compressor runs on DC power converted from AC power. But this special solar air conditioner can also accept DC power directly from solar panels, without needing an inverter, controller, or batteries. The solar DC power directly replaces an equivalent amount of AC power from the power company and can cut daytime energy costs for air conditioning or heating by up to 80-90%.

During the day, the ACDC12 can get most of it's power from solar resulting in an efficiency above SEER 35 when using two 230W solar panels. The unit can be connected with up to three 280W panels up to 840 total Watts. The system is designed for hybrid operation with solar providing most of the energy needed during daylight hours. This air conditioner must be connected to a 220VAC power source and is not designed for off-grid operation.

ACDC12 Solar AC Specifications

Power AC	208/220V, 50/60Hz		Solar Power Input (Max.)	</=780W
Power DC	30-39 VDC		Solar Power Input (Max.)	</=20a
Cooling Capacity	11000 BTU/h		Operating Range (cooling/heating)	20F-122F/5F-90F
Power Input @ Full Cooling Operation	920W		Outdoor Noise Level	55 db
Avg. Power Consumption, Cooling	705W		Outdoor Fan Motor	Panasonic DC
Cooling COP	3.5		Outdoor Fan Input	35W DC
SEER	>19 / 35		Outdoor Air Flow	1295 CFM
Heating Capacity	12000 BTU/h		Outdoor Unit Dimension (W*D*H)	30" x 11.2" x 23.2"
Power Input @ Full Heating Operation	1025W		Compressor	BLDC DC Inverter (Rotary)
Avg. Power Consumption, Heating	836		Refrigerant	R410A / 46oz.
Heating COP	3.5		Max. Lineset Length /Elevation	65 ft. / 26 ft.
HSPF	10.1		Moisture Removal	.25 G/h
Indoor Fan Motor	Panasonic DC		Rated Current (RLA)	5.3A
Indoor Fan Input	20W DC		Locked Rotor Amp (LRA)	10A
Indoor Fan RPM (Hi/Med/Lo)	1250/900/700		Refrigerant Oil	VG74 / 17 oz.
Indoor Air Flow (Hi/Med/Lo)	412/295/235 CFM		Design Pressure	550/340 PSIG
Indoor Noise Level (Hi/Med/Lo)	39/29/26 dB		Liquid side/ Gas side	1/4" / 1/2"
Indoor Unit Dimensions (W*D*H)	35.5" x 6.5" x 11.2"		DC Connection / Wire	MC4 / AWG 10/12

ACDC12-Hybrid

Retail/List-$1695ea FOB Factory

Dealer Price: 4-49 units $1290ea FOB Factory

Distributor Price: 50+ units $891ea FOB China

*****Unit includes 3m lineset***

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DC4812VRF

Solar/DC Air Conditioner

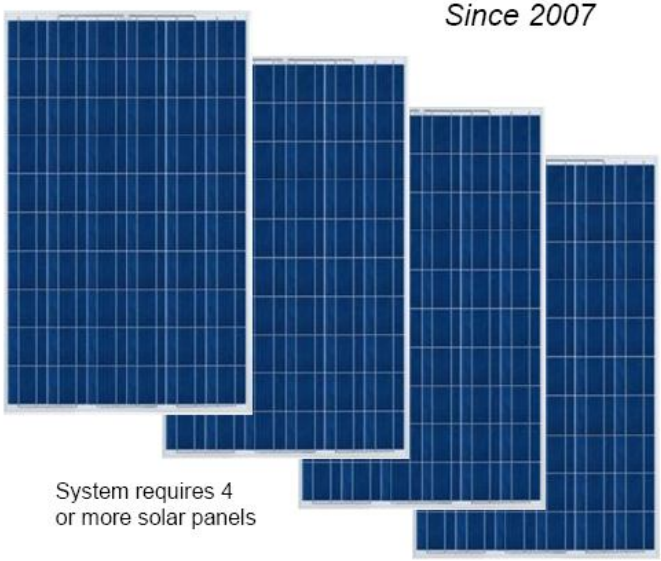
hotspot energy

Specialty HVAC Manufacturing Since 2007

12,000 BTU 48V DC Heat Pump
VRF Dynamic Capacity Compressor
100% DC - No Inverter

Wall Mount Indoor Unit (IDU)

The DC4812VRF is designed from the ground up to operate on DC power. There is no AC power used inside or needed externally to operate the unit. DC power is connected to the outdoor unit. The indoor unit receives DC power from the outdoor unit.



System requires 4 or more solar panels

- **48v Solar/Battery Power**
- **12,000 BTU Heat Pump**
- **Cool or Heat up to 700 ft^2**
- **Eligible For US Tax Credits**
- **Variable Capacity**
- **Anti-Corrosion Technology**
- **Eco-Friendly R410a Refrigerant**
- **Washable Filters**
- **Digital Wireless Remote**
- **Quiet Indoor Unit**
  (As Low As 26dB)

User Friendly Remote w/ sleep mode, timer, & follow-me (C or F)

Complete Kits

48v DC Air Conditioner
4, 6 or 8 x 250w PV Panels
PV Mounting Hardware
Charge Controller
Deep Cycle Batteries
Refrigerant Line-set
*Customer Supplied Wiring

Starting at $3995

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PV Solar Panels & Batteries Needed For System Operation @ Typical Conditions*						
Hours Per Day Solar Operation		10	15	20	24	*Assumes 5 Hours of Sun (Solar Insolation)
PV Solar Panels	250w	4	6	8	10	and normal AC duty cycle. Battery discharge levels
6v Golf Cart Batteries	AH 225	0	8	16	16	have been reduced to extend battery life.
12v Deep Cycle	AH 130	4	0	0	0	

ODU (Outdoor Unit)

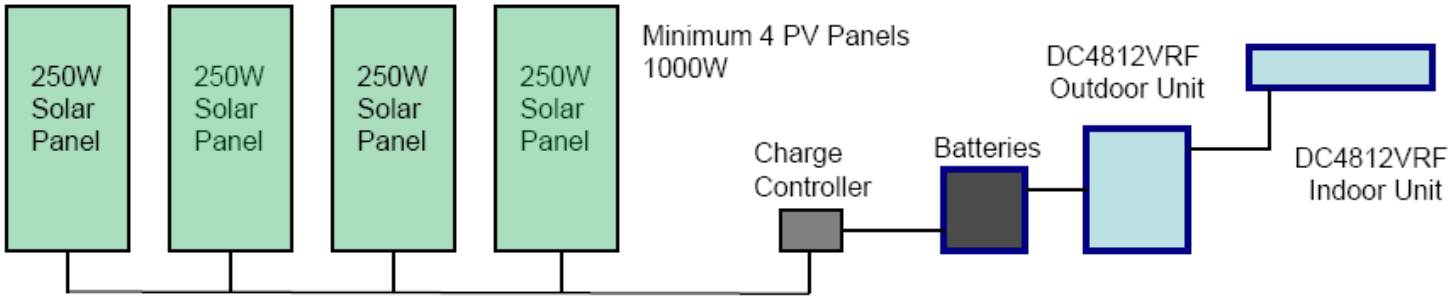
Variable Refrigerant Flow & Capacity means that the air conditioner is always the right size for the conditions and is never wasting power.

This unit uses utilizes SeaSpray™ anti-corrosion technology including hermetically sealed compressor, sealed circuit boards, and silica-nanotech condenser and evaporator protection.

A product of HotSpot Energy, a trusted name in specialty air conditioning manufacturing and renewable energy.

HotSpot Energy LLC • 732E Eden Way North 255 • Chesapeake VA 23320 • 757-410-8640

Powered By Batteries & Solar Panels



Using technology similar to SEER 27 air conditioners, the DC2418VRF compressor runs on DC power at various frequencies and refrigerant flow depending on cooling load. The all-DC solar air conditioner uses DC power directly without needing an inverter or other AC power source. Due to solar voltage fluctuations the unit cannot connect directly to solar panels and must have a stable source of power such as batteries.

Depending on conditions, the entry-level setup can operate up to 10 hours per day using 4 x 250w panels. A configuration of 6 panels can provide up to 15 hours of daily operation, with 8 panels yielding up to 20 hours. A 10 panel configuration can handle up to 24 hours per day operation. Batteries and charge controller must be sized appropriately. See our website for calculation information at www.hotspotenergy.com/DC-air-conditioner/ or call us for pre-sales technical support.

DC4812VRF DC Solar AC Specifications

Power DC	48 VDC		DC Power Input (Max.)	22 Amps
Power DC Range	46-58 VDC		Low Voltage Disconnect	46V
Max Cooling Capacity	13098 Btu/h		Operating Range (cooling/heating)	20F-122F/5F-90F
Max Power Input, Cooling	960W		Outdoor Noise Level	55 db
Normal Power Consumption, Cooling	< 500W		Outdoor Fan Motor	Panasonic BLDC
Cooling COP	5.45		Outdoor Fan Input	35W DC
Cooling EER	18.61		Outdoor Air Flow	1295 CFM
Max Heating Capacity	13632 Btu/h		Outdoor Unit Dimension (W*D*H)	30" x 11.2" x 23.2"
Max Power Input, Heating	1081W		Compressor	BLDC Rotary
Normal Power Consumption, Heating	866		Refrigerant	R410A / 56.5 oz.
Heating COP	3.69		Pre-charged For Line Set L	23 Ft.
HSPF	9.6		Max. Lineset Length /Elevation	66 ft. / 26 ft.
Indoor Fan Motor	Panasonic BLDC		Moisture Removal	.25 G/h
Indoor Fan Input	30W DC		Digital Display	F or C
Indoor Fan RPM (Hi/Med/Lo)	1250/900/700		Refrigerant Oil	VG74 / 17 oz.
Indoor Air Flow (Hi/Med/Lo)	412/295/235 CFM		Design Pressure	550/340 PSIG
Indoor Noise Level (Hi/Med/Lo)	39/29/26 dB		Liquid side/ Gas side	1/4" / 1/2"
Indoor Unit Dimensions (W*D*H)	36.3" x 8.8" x 11.5"		* Cooling COP & EER Rated at AHRI 210/240 EV	

DC4812VRF-100% DC
Retail: $1795ea FOB Factory
Dealer Price: 4-49 units $1490ea FOB Factory
Distributor Price: 50+ units $1185ea FOB China
*****NO LINESET***

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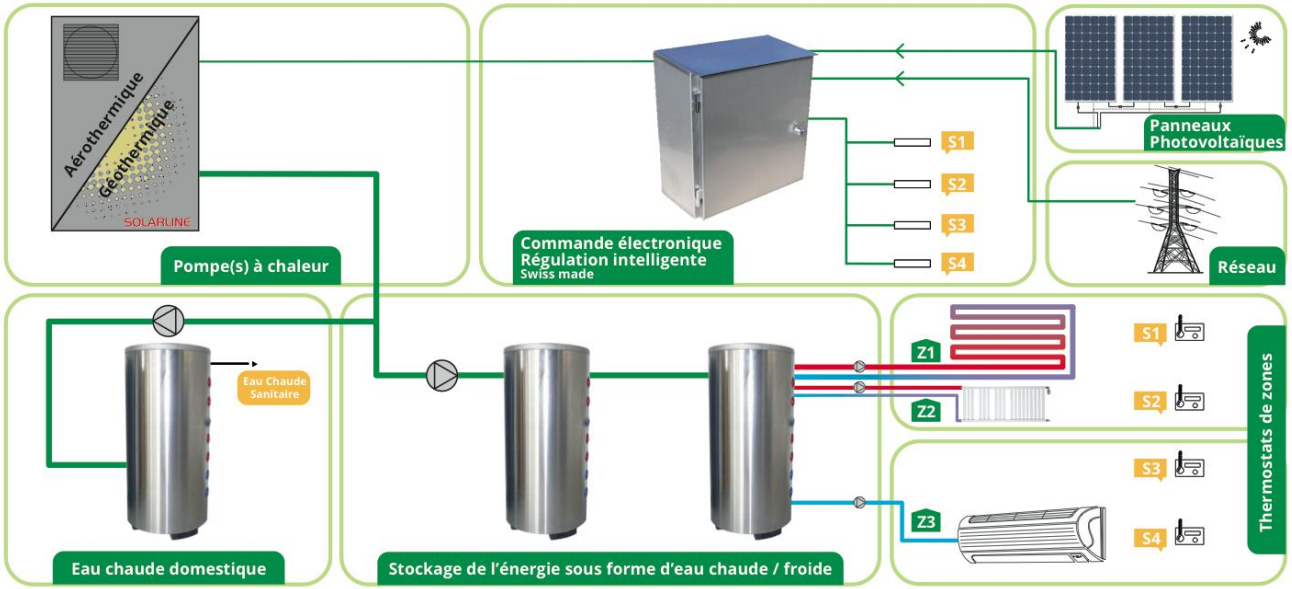
Typical **ALREADY** EU market available solution

Efficient Geothermal Heat Pump : COP of 5,3
Field test since 2011 in Switzerland



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PV booster => **overall yearly COP of 6,9**

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New R&D discovered during EUROSUN

EuroSun 2014, International Conference on Solar Energy and Buildings.
September 16-19, 2014 . Aix-les-Bains, France

Solar PV-driven Air Conditioner

Bin-Juine Huang, Tse-Han Lin, Yan-Tze Chen, Po-Chien Hsu, Kang Li

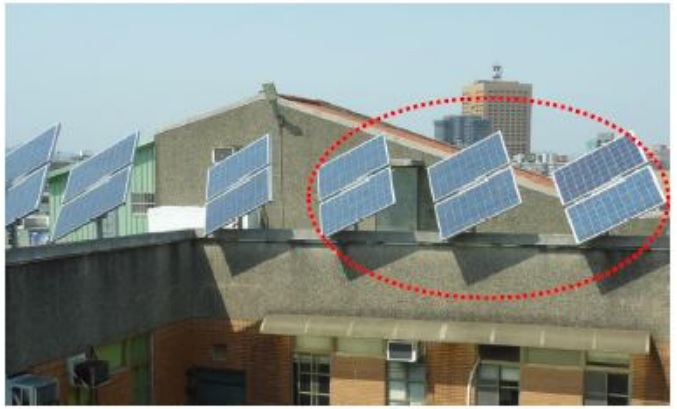
New Energy Center, Department of Mechanical Engineering,
National Taiwan University, Taipei, Taiwan

State of the art of the future new **Market**

Ongoing R&D in Taïwan

Design of a stand-alone solar PV air conditioner

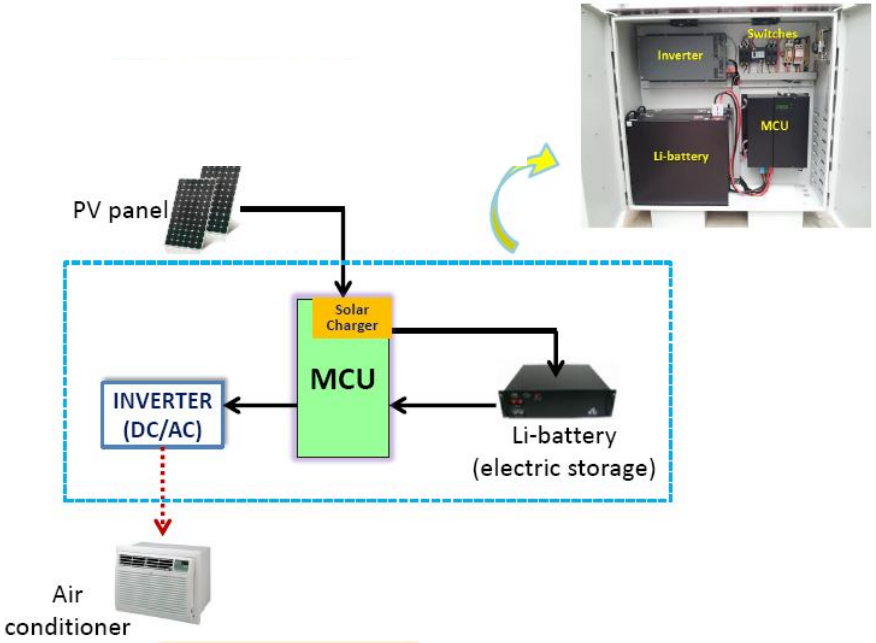
- Solar PV panel installed: 1.38 kWp
- Li-battery capacity: 720 Wh (DOD 80%)
- Power consumption of air conditioner: 200~800W (average 500W)
- Cooling capacity of air conditioner: 2.2 kW



Source: EUROSUN conference, Prof Huang, National Taiwan University, Taipei, Taiwan

State of the art of the future new **Market**

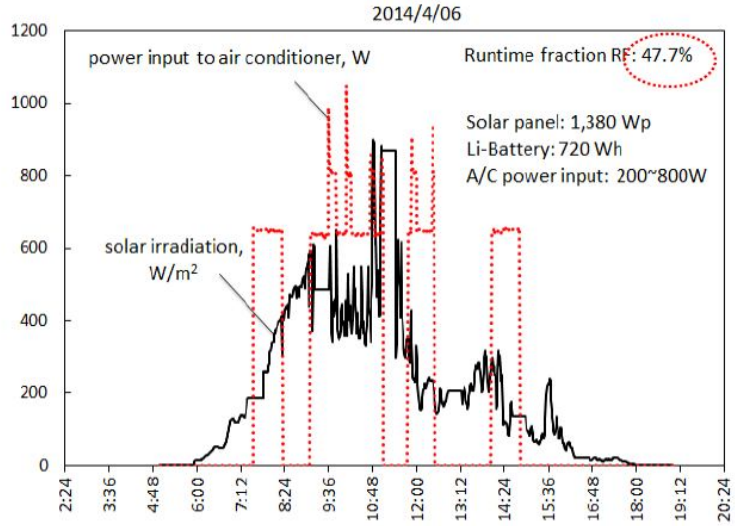
Ongoing R&D in Taïwan



Operation probability (*OPB*)

- 100% at solar irradiation >550W/m2 (full solar cooling)
- around 80% at solar irradiation 400W/m2 (partly solar cooling) at cloudy condition

Battery use to run a AC on/off air conditioner



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