PV – 4

DEPARTMENT OF ENERGY
RENEWABLE ENERGY MANAGEMENT BUREAU

MANUAL

for

User Training

of

Solar PV System

June 2009

This manual was developed by the Department of Energy (DOE) through the technical assistance under the Project on "Sustainability Improvement of Renewable Energy Development for Village Electrification in the Philippines" which was provided by the Japan International Cooperation Agency (JICA).

For a better tomorrow for all.
Japan International Cooperation Agency

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LIST OF ANNEXES

1 OBJECTIVE

The objective of this manual is to guide the trainers who instruct PV system users under the Barangay Electrification Project (BEP) of the DOE. The training of PV custom users is one of the requirements for the sustainable operation of PV systems. Moreover, the trainers must acquire accurate knowledge for effective training of PV System users. Therefore, we edited this manual based on the experiences gained from many PV projects.

2 TARGETS

Targets of user training are Barangay Power Association (BAPA) technicians and individual users.

3 TRAINING METHOD

Even if users were trained, they usually forget what they have learned or have misunderstandings about what they were taught. Therefore, the user training should be held periodically not only during system installation, but also after installation. Likewise, hands-on training is necessary for practical and effective training. It is better to have interaction with the participants during training rather than just giving lecture. All users must be provided with a user's manual.

4 TRAINING MATERIALS

The training materials are listed below.

Training material	BAPA technician	Individual user
Training text	R (for technician)	R(for user)
Handout	R (for technician)	R(for user)
Volt-mater	R	R
Current-meter	R	R
Hydrometer	R	R
Distilled water	R	R
Pencil	R	A

R: Recommended, A: According to need

Separate training materials should be prepared for BAPA technician and user. Also the training text should be made in accordance with type of PV system such as Solar Home System (SHS) and Battery Charging System (BCS). A technician manual, a user manual and a user guide can be used in the training as handout. These materials should be simple by using pictures, photos, and quizzes. In addition, to translate to local dialect is helpful for understanding of users.

DOE and JICA developed the technician and user manuals for both SHS and BCS in 2008. Both manuals are provided in ANNEX 1 and ANNEX 2.

5 TRAINING COMPONENTS

Training components should cover 5 basic areas (1.Outline of PV system, 2.Role of main components, 3.Operation & management, 4.Periodic check & maintenance, 5.Troubleshooting). Points covered in the training are listed below.

Component	Training Points
Outline of PV system	a) PV module converts solar energy into Electricity (DC)
	b) Output power of PV module changes daily and instantly. (according to weather, season, and time etc.)
	c) Output power of PV module is affected by shadow and damage
Components of PV system	a) Explain specification of main components of PV system
	b) Explain configuration of PV system using picture
	c) Role of main components (charge controller and/or LVD) are: 1. Over charge protection, 2. Over discharge protection 3. Reverse polarity protection, 4. Over load protection
Operation & Management	a) How to operate PV system
	b) System voltage is 12VDC. Only appliances of 12VDC can be used.
	c) Major misconceptions regarding PV systems are: 1. Wrong connection, 2. Overuse of electricity 3. Inappropriate modification, 4. Inadequate replacement
	d) Explain how many hours they can use their appliances with example
	e) Explain affect of overuse
Periodic check & maintenance	a) Explain checkpoints for each components and maintenances
	b) Periodic checking is important for problem prevention.
	c) How to check and handle battery.
Troubleshooting	a) Troubleshooting is effective for the prevention of the further PV system damage.
	b) Explain usual problems and corresponding solutions
	c) Explain how to check PV system if trouble is found.
	d) Make clear communication system in case trouble is occurred.
Importance	Items which required special care should be explained repeatedly as importance.

6 AMENDMENT OF THE MANUAL

The DOE shall review this manual annually, and amend it, if necessary, according to the surrounding circumstances in rural electrification of the country. The amended manual shall be fully authorized among the DOE and approved by Director of Renewable Energy Management Bureau of the DOE.

ANNEX 1

User Manual

for

Battery Charging System (BCS)

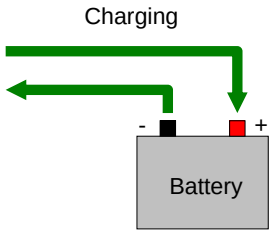
User Manual for Battery Charging System (BCS)

- What is solar PV system?
- Components of BCS
- Role of main component
- How to use user system
- Maintenance
- Troubleshooting
- Importance

What is Solar PV system?

Electricity from Solar Energy

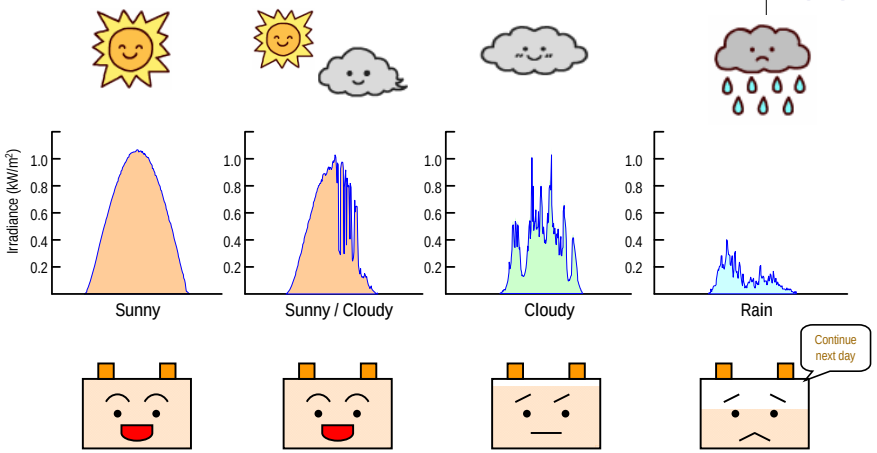
PV Module converts *Solar energy* into *Electricity(DC)*



Solar Energy ➡ *PV Module* ➡ *Electricity (DC)*

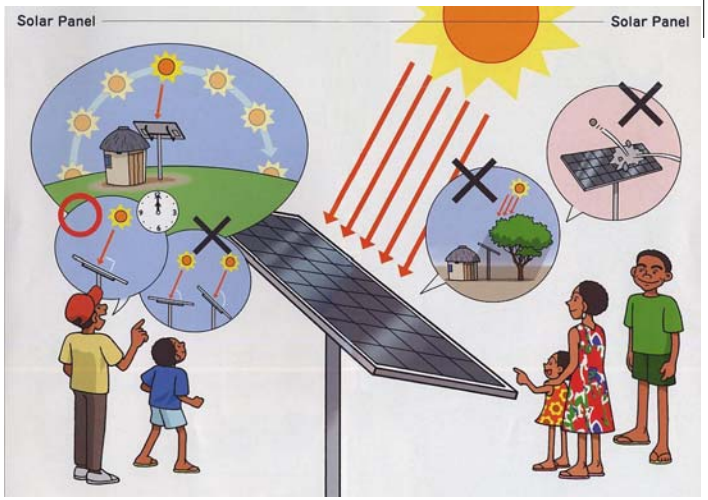
Input *Conversion* *Output*

What is Solar PV system?



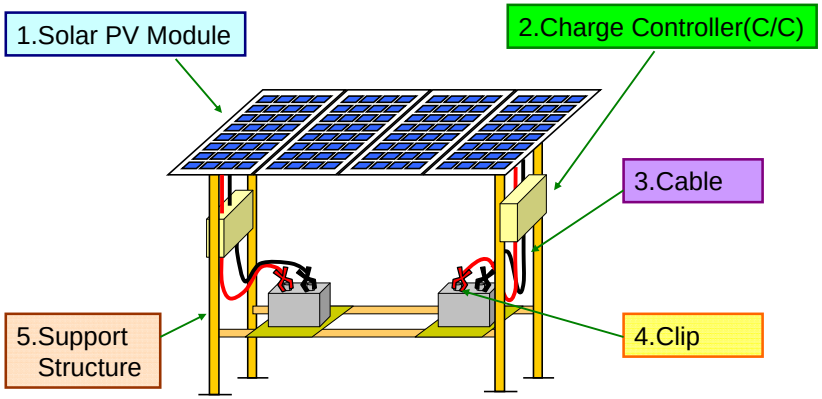
Generation power changes daily ➡ *Chargeable power* *also* changes

Which is correct?



Components of BCS

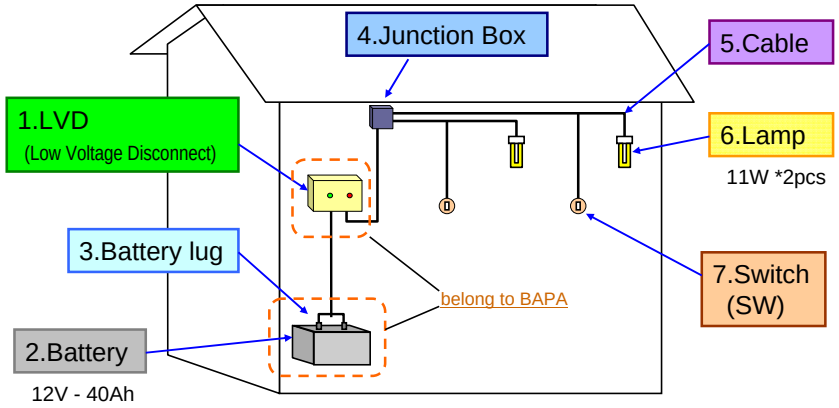
Battery Charging Station



Battery Charging Station belongs to BAPA.
BAPA has responsibility for managing it.

Components of BCS

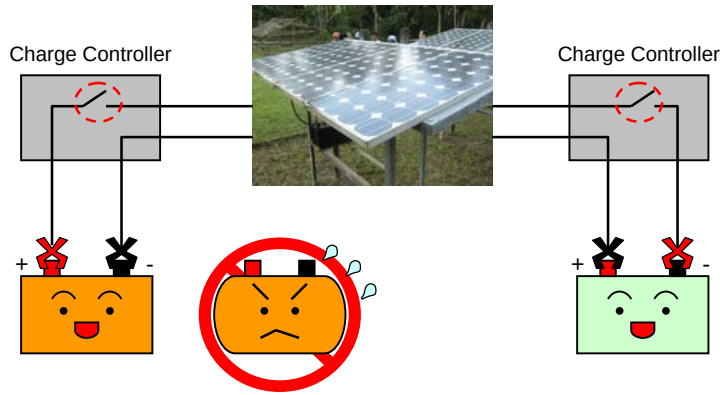
User System



User has responsibility for taking care of user system.
Battery and LVD belong to BAPA. BAPA has responsibility for managing them.

Role of main component

Charge Controller of BCS

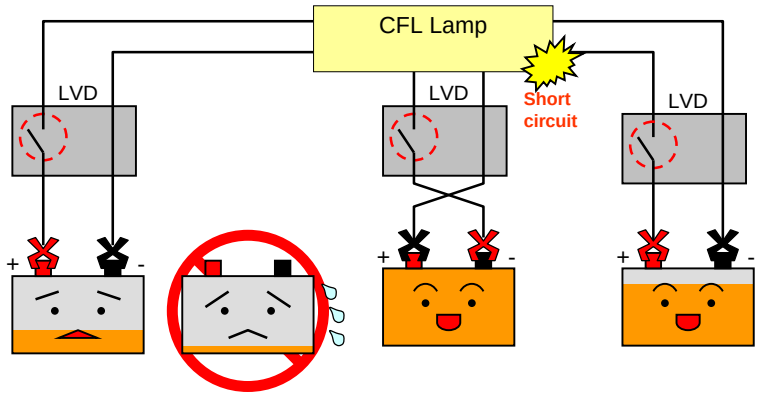


1. Overcharge Protection
2. Reverse Polarity Protection

For those protections, SW of C/C will be turned OFF automatically

Role of main component

Low voltage disconnect (LVD)

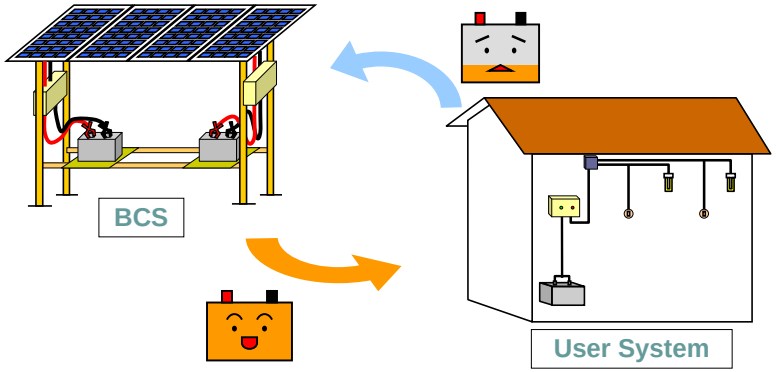


1. Over-discharge Protection
2. Reverse Polarity Protection
3. Over Load Protection

For those protections, SW of LVD will be turned OFF automatically

How to use user system

Charging of battery



Battery shall be charged periodically

Charging interval : 5 ～7 days, depending on weather

How to use user system

Connection of battery

1.Confirmation of SW position

SW of lamps should be turned off

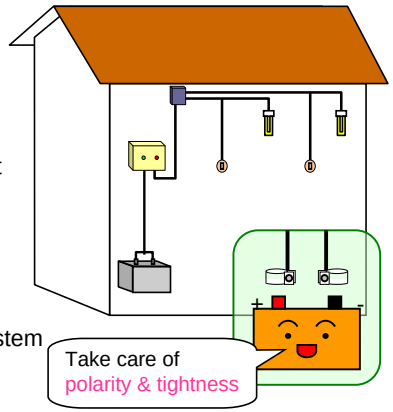
2.Connection of battery

Battery should be connected at correct polarity and tightly by battery lugs

3.Check of LED on LVD

If no LED turns on, check connection

If green LED turns on, you can use system



How to use user system

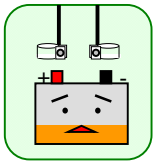
Disconnection of battery

1.Confirmation of SW position

SW of lamps should be turned off

2.Disconnection of battery

Battery is disconnected from battery lugs



<Timing of disconnection of battery>

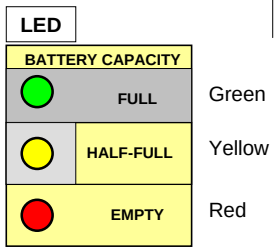
1.When it's user's turn to charge

2.When protective function of LVD operates

(Over-discharge protection: ●, Other cause: ○○○)

How to use user system

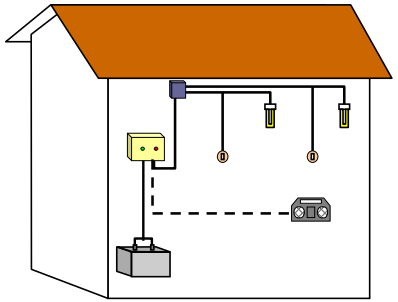
Display on LVD



Condition	LED	Operation of LED
1. After connecting battery	● ○	Red LED will stay ON for 3 seconds If no LED is ON, press the RESET button
2. Battery level is full	●	Green LED will turn on
3. Battery level is middle	●	Yellow LED will turn on
4. Battery level is low	●	Red LED will turn on Need to recharge
5. Reverse connection etc.	○ ○ ○	All LED will not turn on

How to use user system

Usable appliances and hour



Charging interval: 5 days

Using			6W
	3.5 hr	3.5 hr	-
	7.0 hr	-	-
	3.0 hr	3.0 hr	1.5 hr
	6.0 hr	-	1.5 hr

Charging interval: 7 days

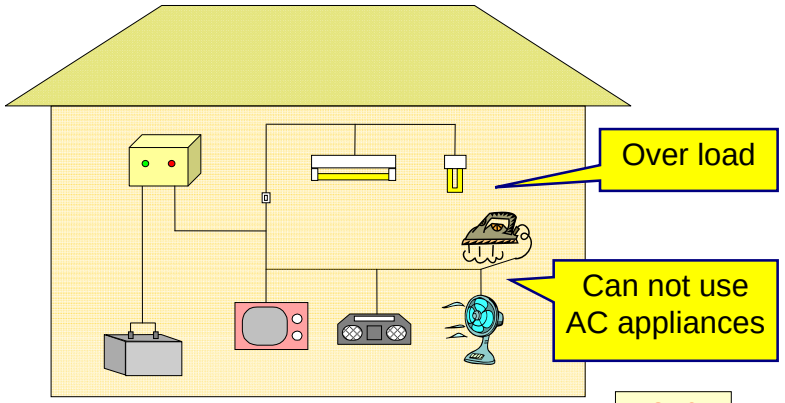
Using			6W
	2.5 hr	2.5 hr	-
	5.0 hr	-	-
	2.0 hr	2.0 hr	1.5 hr
	4.0 hr	-	1.5 hr

Common : 11W Lamp * 2
Extra : Radio * 1

In rainy season, you should reduce your power usage

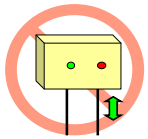
How to use user system

What is wrong?

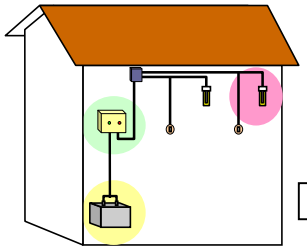


How to use user system

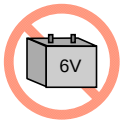
Prohibited matter



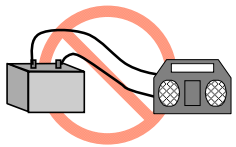
Remove or reconnection of cable



Large power consumption



Usage of different battery



Direct connection

These matters cause reduction of battery life and trouble of LVD.

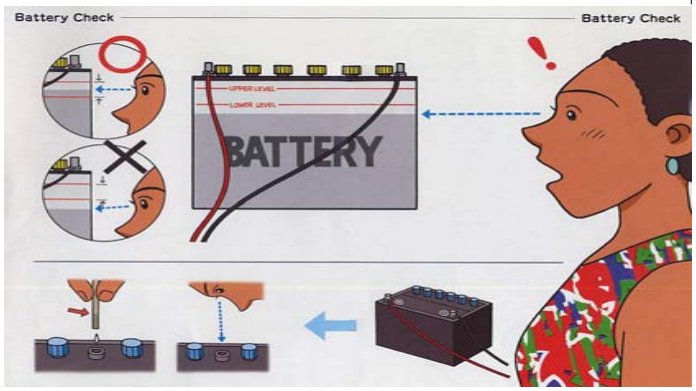
Check Points and Maintenance

Objects	Check Points	Maintenance
Battery	-Electrolyte level	-Contact Technician
	-Dust and moisture	-Cleaning (with dry cloth)
	-Loose connection	-Retightening
	-Rust of terminals	-Contact Technician
	-Damage	-Contact Technician
LVD	-Loose connection	-Contact Technician
	-Damage, malfunction	-Contact Technician
Cables	-Damage	-Repair or Replacement
Battery lug	-Rust	-Cleaning (with sandpaper)
	-Damage	-Repair or replacement
Lamp	-Blown light bulb	-Replacement of the bulb
	-Damage	-Repair or Replacement

General maintenance is cleaning

Battery Electrolyte level

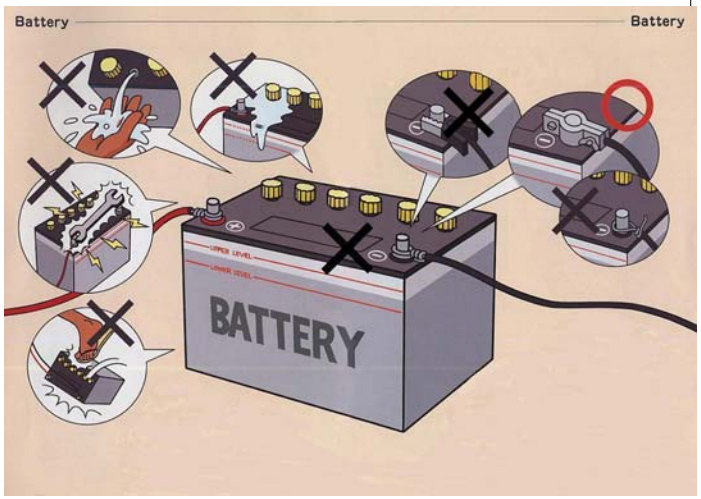
Which is acceptable?



Keep electrolyte within the proper level (open the cap to check)

Battery Handling & Connection

Which is correct?



User system

In these instances, contact technician

LVD

Abnormal noise

Damage & Deformation

Battery Load

Heat

Loose connection

Battery

Damage & Deformation

Liquid spill

Indoor wiring

<Cable>
*Damage
*Disconnection
*Short circuit
*Loose connection

<Switch>
*Damage
*Malfunction

<Junction box>
*Damage

<Lamp>
*Damage

Moving house, Change of layout

Troubleshooting (1)

The usage hour of appliances is getting shorter than ever!

Possible Reason	Check point	Solution
Usage of appliance which is large consumption	Specification of appliance	Reduce power usage
Loose connection	Connector, terminal	Retightening
Rust of battery lug	Condition of battery lug	Cleaning (with sandpaper)
Battery is weakening	Performance of battery	Contact technician
Malfunction of LVD	Operation of LVD	Contact technician

LVD can not operate properly!

Possible ReasonContact	Check point	Solution
Loose connection	Battery lug, terminal	Retightening
Misconnection of cable	Connection of cable	Reconnection
Damage of cable	Condition of cable	Contact technician
Malfunction of LVD	Operation of LVD	Contact technician

Troubleshooting (2)

Appliances can not use even with correct connection of battery!

Possible Reason	Check point	Solution
Failure of appliance	Condition of appliance	Repair/Replacement
Loose connection	Battery lug, terminal	Retightening
Battery can not charge fully	Condition of battery, C/C	Contact technician
Damage of cable, SW	Condition of cable, SW	Contact technician
Malfunction of LVD	Operation of LVD	Contact technician
Battery is weakening	Performance of battery	Contact technician

The interval of water refilling is getting shorter than ever!

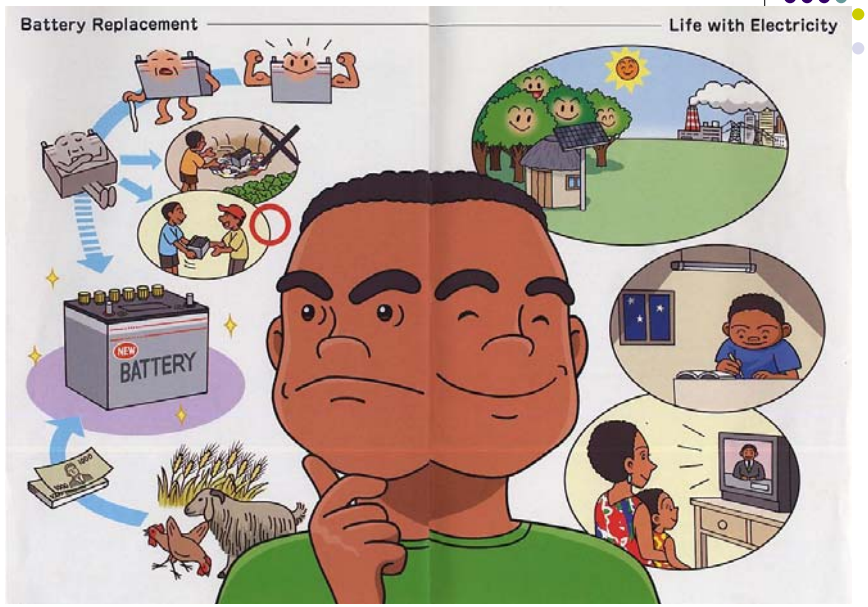
Possible Reason	Check point	Solution
Leave battery at hot place	Ambient condition	Change in place
Over charge	Function of charge controller	Contact technician
Leakage of electrolyte	Damage of battery case	Contact technician
Battery is weakening	Performance of battery	Contact technician

Importance

- BCS, Battery and LVD belong to BAPA. BAPA has responsibility for management of those equipment.
- User has responsibility to take care of user system Including Battery and LVD.
- Battery should be charged periodically according to technician's instruction.
- Useable hour of appliances changes by the charging interval.
- General maintenance is cleaning.
- If you find a problem, please let technician know.

Last

- Solar power systems are the precious resources for you and your country.
- You have big responsibility to prolong the life of system.
- It cannot be success without your proper knowledge.
- Please keep proper knowledge in your mind and teach them to everybody.



ANNEX 2

User Manual

for

Solar Home System (SHS)

User Manual for Solar Home System (SHS)

- What is solar PV system?
- Components of SHS
- Role of main component
- How to use user system
- Maintenance
- Troubleshooting
- Importance

What is Solar PV system?

Electricity from Solar Energy

PV Module converts *Solar energy* into *Electricity(DC)*

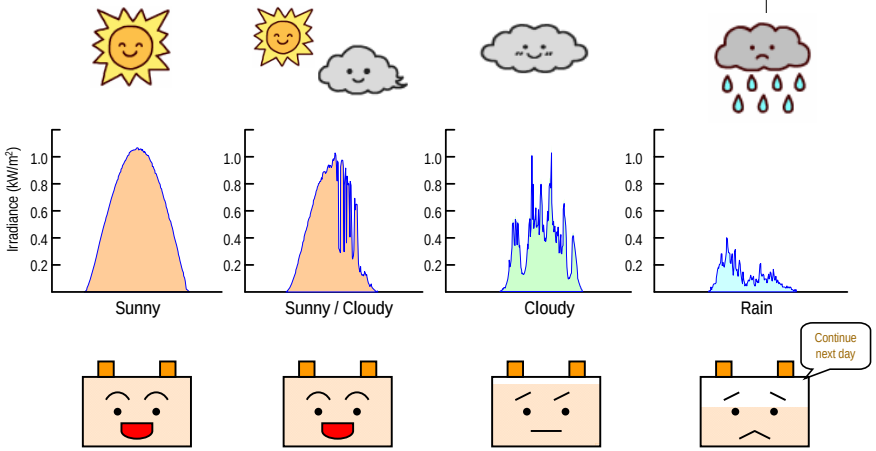
- Less *Solar Energy* Less *Electricity*
- More *Solar Energy* More *Electricity*

Power generation changes daily

Solar Energy → *PV Module* → *Electricity* (DC)

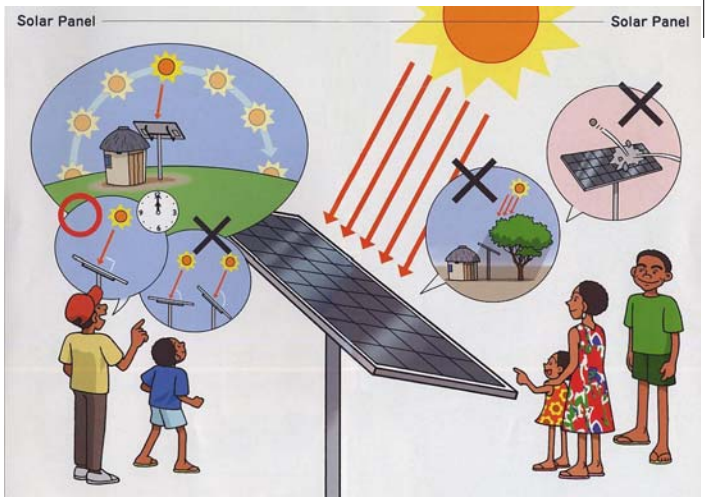
Input — *Conversion* — *Output*

What is Solar PV system?



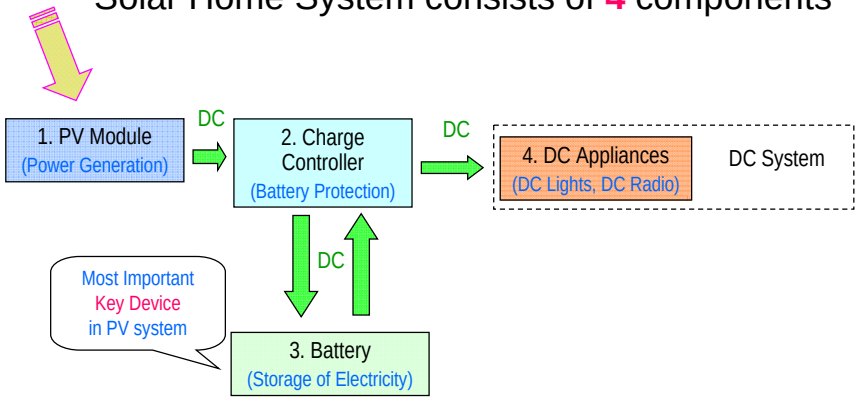
Generation power changes daily → *Chargeable power* *also* changes

Which is correct?



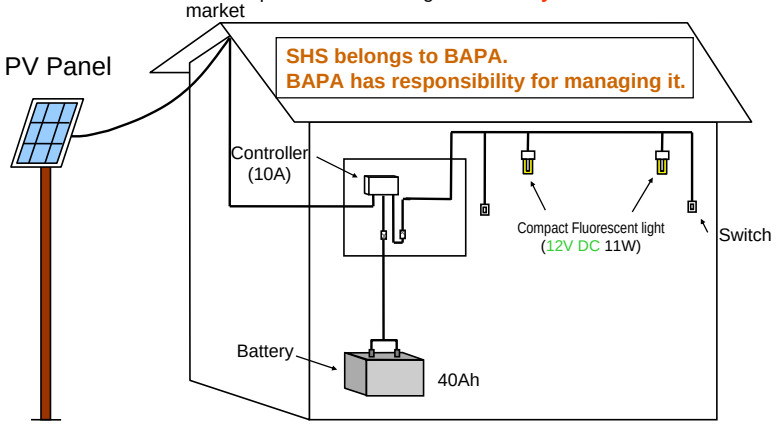
SHS Components

Solar Home System consists of **4** components

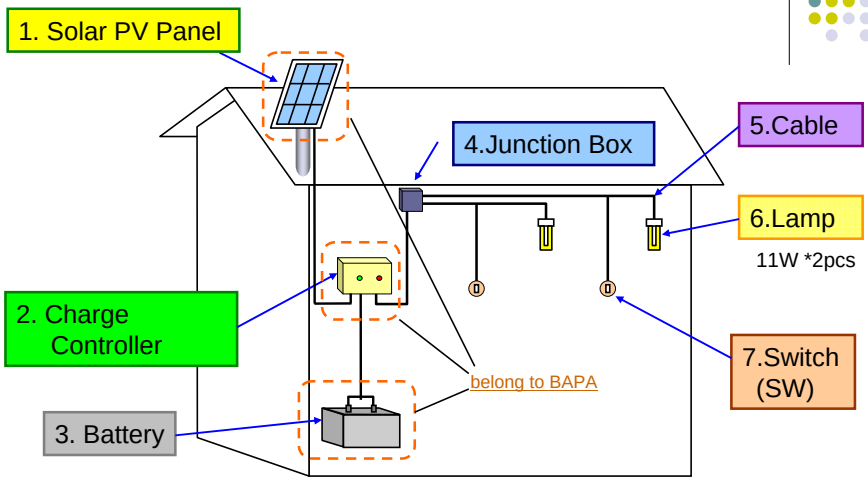


SHS Components

- SHS is Small, independent DC system
- **Most efficient and economical** system
- DC Compact Fluorescent Lights are **easily available** in local market



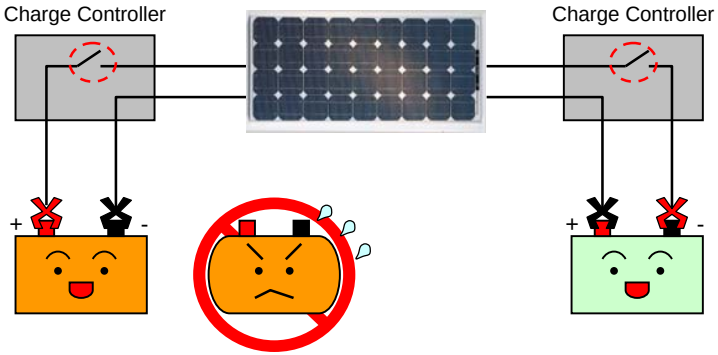
SHS Components



User has responsibility for taking care of user system.
Solar PV Panel, Battery and Charge Controller belong to BAPA. BAPA has responsibility for managing them.

Role of main component

Charge Controller (C/C) of SHS

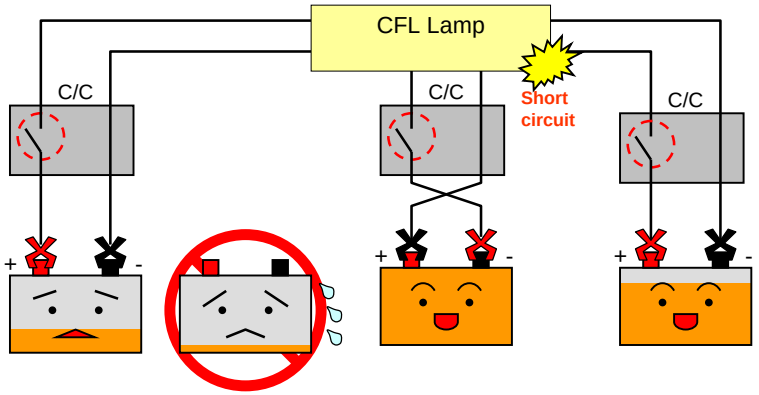


1. Overcharge Protection **2. Reverse Polarity Protection**

For those protections, SW of C/C will be turned OFF automatically

Role of main component

Charge Controller (C/C)

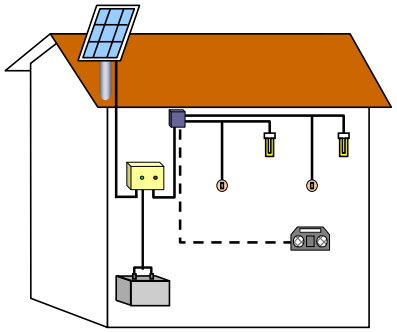


1. Over-discharge Protection
2. Reverse Polarity Protection
3. Over Load Protection

For those protections, SW of C/C will be turned OFF automatically

How to use user system

Usable appliances and hour



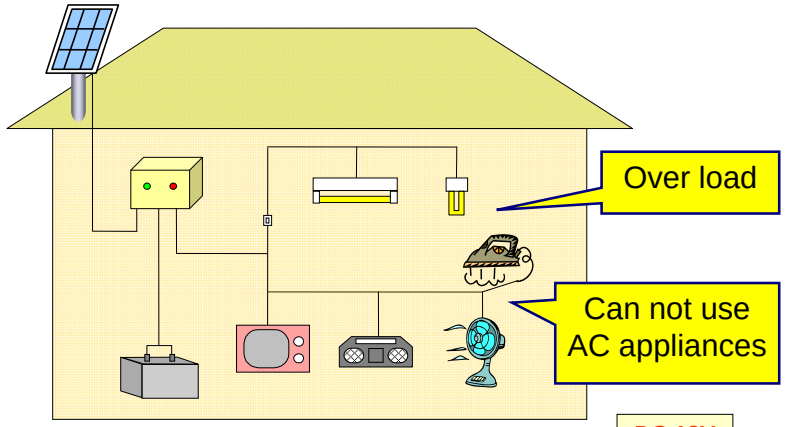
Using			6W
	3.5 hr	3.5 hr	-
	7.0 hr	-	-
	3.0 hr	3.0 hr	1.5 hr
	6.0 hr	-	1.5 hr

Common : 11W Lamp * 2
Extra : Radio * 1

In rainy season, you should reduce your power usage

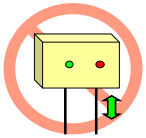
How to use user system

What is wrong?

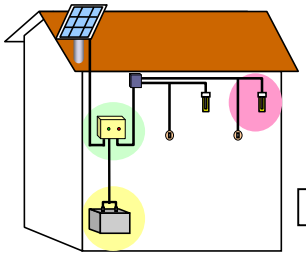


How to use user system

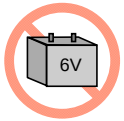
Prohibited matter



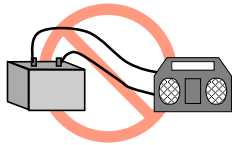
Remove or reconnection of cable



Large power consumption



Usage of different battery



Direct connection

These matters cause reduction of battery life and trouble of CC.

Check Points and Maintenance

Objects	Check Points	Maintenance
PV Panel	-Dirt or Obstacles on the surface	-Cleaning (with water and soft cloth) and Removal
	-Shadow during daytime	-Removal of the source
	-Damage	-Contact Technician
	-Direction	-Contact Technician
	-Tilt angle	-Contact Technician
	-Rust of the frame	-Painting after removal of the rust

General maintenance is cleaning

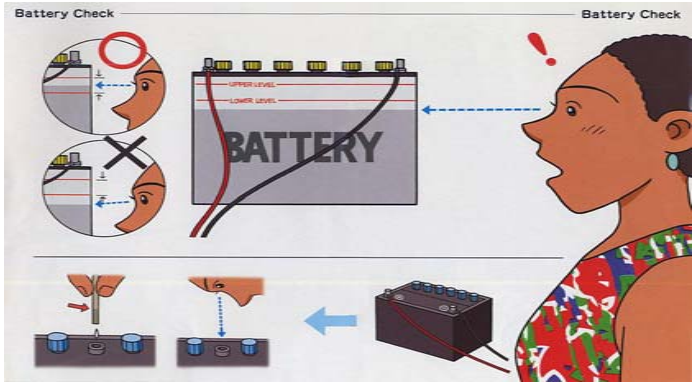
Check Points and Maintenance

Objects	Check Points	Maintenance
Battery	-Electrolyte level	-Contact Technician
	-Dust and moisture	-Cleaning (with dry cloth)
	-Loose connection	-Retightening
	-Rust of terminals	-Contact Technician
	-Damage	-Contact Technician
Charge Controller	-Loose connection	-Contact Technician
	-Damage, malfunction	-Contact Technician
Cables	-Damage	-Repair or Replacement
Battery lug	-Rust	-Cleaning (with sandpaper)
	-Damage	-Repair or replacement
Lamp	-Blown light bulb	-Replacement of the bulb
	-Damage	-Repair or Replacement

General maintenance is cleaning

Battery — Electrolyte level

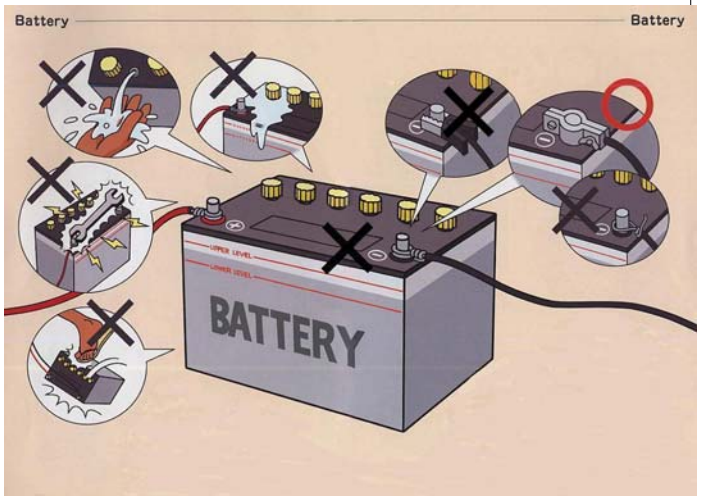
Which is acceptable?



Keep electrolyte within the proper level (open the cap to check)

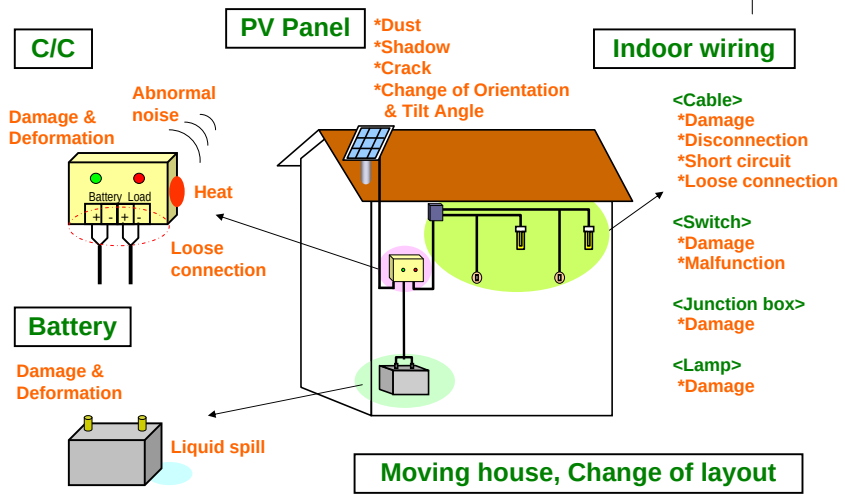
Battery — Handling & Connection

Which is correct?



Troubles

In these instances, contact technician



Troubleshooting (1)

Battery can not charge fully in spite of fine day!

Possible Reason	Check point	Solution
Battery level is too low	Weather condition/Overuse	User retraining
Overuse of load	Usage condition of load	User retraining
Loose connection, Rust	Connector, terminal	Retightening /Cleaning
Dirt on PV module	Surface of PV module	Cleaning
Shadow on PV module	Surrounding condition	Removal of the source
Damage of cable	Condition of cable	Repair /Replacement
Damage of PV module	Condition of PV module	If bad, Contact engineer
Malfunction of C/C	Operation of C/C	If bad, Contact engineer
Battery is weakening	Performance of battery	If bad, replace it

Troubleshooting (2)

Charge Controller can not operate properly!

Possible Reason	Check point	Solution
Loose connection	Terminal	Reconnection /Retightening
Set voltage is shifted	HVD and LVD setting	Rectify setting
Malfunction of C/C	Operation of C/C	If bad, Contact supplier
Damage of PV module	Condition of PV module	If bad, Replace it
Damage of cable	Condition of cable	Repair /Replacement
Direct connection between battery and additional load	Connection of additional load	Remove User retraining
Effect of noise	Terminal voltage	De-noising/Grounding
Battery is weakening	Performance of battery	If bad, replace it
Type/voltage of battery is not matched with C/C	Specification of battery and C/C	Replacement of Battery or C/C

Troubleshooting (3)

The usage hour of appliances is getting shorter than ever!

Possible Reason	Check point	Solution
Usage of appliance which is large consumption	Specification of appliances	Reduce power usage
Loose connection	Connector, terminal	Retightening
Shade on PV module	Surrounding condition	Removal of the source
Damage of PV module	Condition of PV module	If bad, Contact engineer
Rust of connector	Condition of connector	Cleaning (with sandpaper)
Battery is weakening	Performance of battery	If bad, Replace it
Malfunction of C/C	Operation of C/C	If bad, Replace it

Troubleshooting (4)

Appliances can not use even with correct connection of battery!

Possible Reason	Check point	Solution
Failure of appliance	Condition of appliance	Repair/Replacement
Loose connection	Connector, terminal	Retightening
Battery can not charge fully	Condition of battery, C/C	If bad, Contact supplier
Damage of cable, SW	Condition of cable, SW	Repair/Replacement
Malfunction of C/C	Operation of C/C	If bad, Contact engineer

The interval of water refilling is getting shorter than ever!

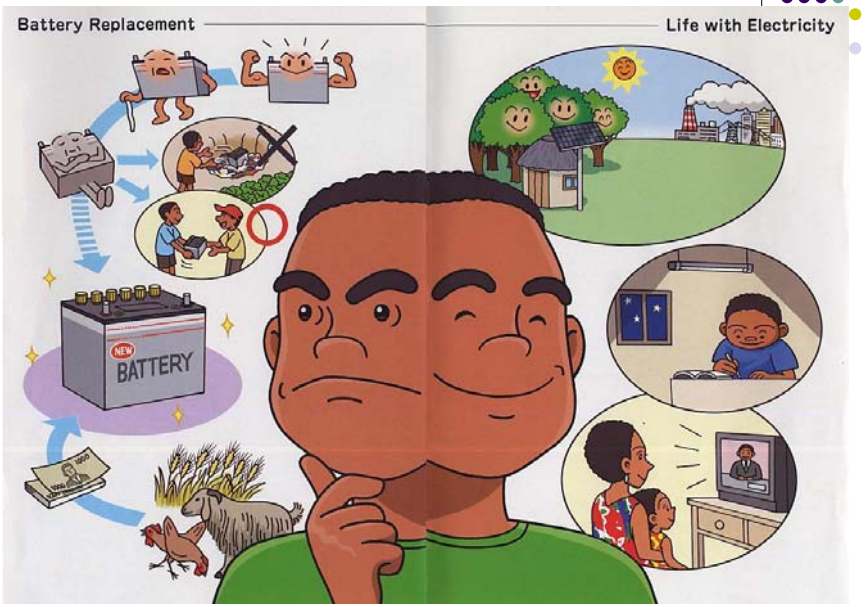
Possible Reason	Check point	Solution
Overcharge	Function of charge controller	If bad, Contact supplier
Leave battery at hot place	Ambient condition	Change in place
Leakage of electrolyte	Damage of battery case	If bad, Replace it
Battery is weakening	Performance of battery	If bad, Replace it

Importance

- Solar PV Panel, Battery and CC belong to BAPA. BAPA has responsibility for management of those equipment.
- User has responsibility to take care of user system including Solar PV Panel, Battery and CC.
- General maintenance is cleaning.
- If you find a problem, call your technician.

Last

- Solar power systems are the precious resources for you and your country.
- You have big responsibility to prolong the life of system.
- It cannot be success without your proper knowledge.
- Please keep proper knowledge in your mind and teach them to everybody.



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