Energy from the Sun Workshop

Introduction to Photovoltaics

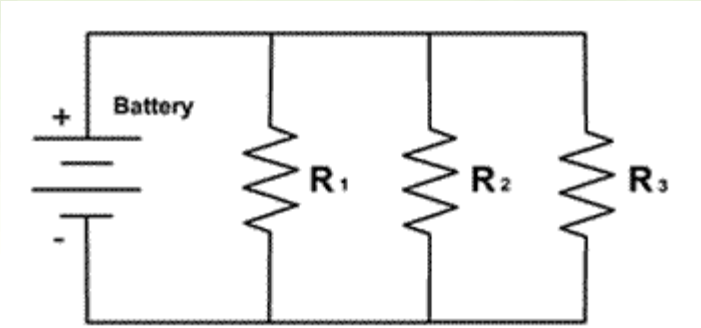
Electricity Basics

- Electrical Current – how many electrons
- Voltage – how hard they're pushed
- Power – what they can accomplish
- Circuit – where they can go
- Series Circuit – one pathway only
- Parallel Circuit – so many choices!

Parallel vs. Series Circuits

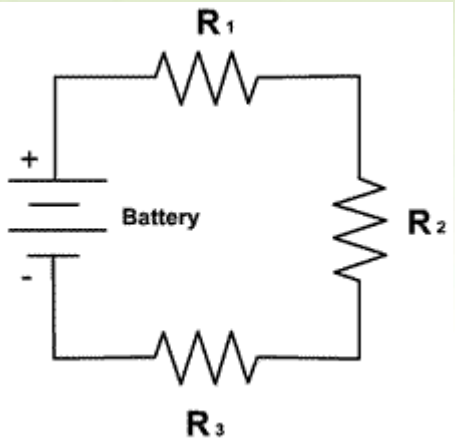
Parallel circuits

- maintain potential (voltage is constant)
- Current is divided among components
- If one light goes out, the others stay lit



Series circuits

- maintain electrical flow (current is constant)
- Voltage is divided among components
- Easy to open circuit quickly



DC vs. AC

Direct Current

- “Battery power”
- Electronics use
- Requires prohibitively high voltage to transmit over long distance

Alternating Current

- EASY to generate
- Can be transformed in voltage
- Can be limited while keeping voltage high
- Can be transmitted over long distance without super-high voltage

Photovoltaics

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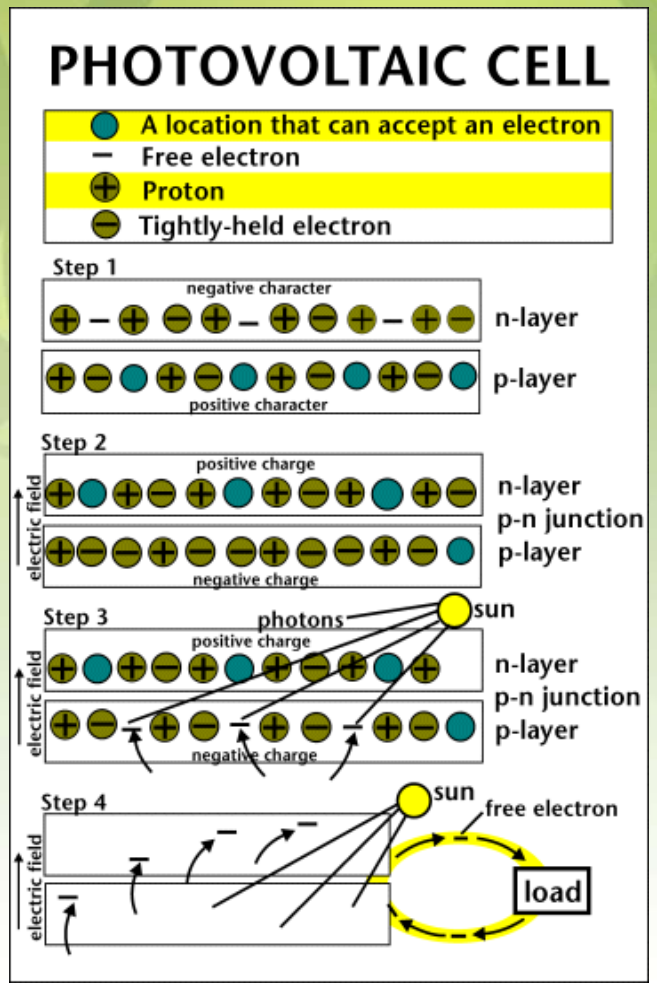
ases

nsition

					2 **He** Helium 4.002602 (2)	K
	5 **B** Boron 10.811 (2 3)	6 **C** Carbon 12.0107 (2 4)	7 **N** Nitrogen 14.0067 (2 5)	8 **O** Oxygen 15.9994 (2 6)	9 **F** Fluorine 18.9984032 (2 7)	10 **Ne** Neon 20.1797 (2 8)	K L
	13 **Al** Aluminium 26.9815386 (2 8 3)	14 **Si** Silicon 28.0855 (2 8 4)	15 **P** Phosphorus 30.973762 (2 8 5)	16 **S** Sulfur 32.065 (2 8 6)	17 **Cl** Chlorine 35.453 (2 8 7)	18 **Ar** Argon 39.948 (2 8 8)	K L M
30 **Zn** Zinc 65.38 (2 8 18 2)	31 **Ga** Gallium 69.723 (2 8 18 3)	32 **Ge** Germanium 72.63 (2 8 18 4)	33 **As** Arsenic 74.9216 (2 8 18 5)	34 **Se** Selenium 78.96 (2 8 18 6)	35 **Br** Bromine 79.904 (2 8 18 7)	36 **Kr** Krypton 83.798 (2 8 18 8)	K L M N
48 **Cd** Cadmium 112.411 (2 8 18 18 2)	49 **In** Indium 114.818 (2 8 18 18 3)	50 **Sn** Tin 118.71 (2 8 18 18 4)	51 **Sb** Antimony 121.76 (2 8 18 18 5)	52 **Te** Tellurium 127.6 (2 8 18 18 6)	53 **I** Iodine 126.90447 (2 8 18 18 7)	54 **Xe** Xenon 131.293 (2 8 18 18 8)	K L M N O

PV Cell


PHOTOVOLTAIC CELL
A location that can accept an electron
Free electron
Proton
Tightly-held electron
Step 1
negative character
n-layer
p-layer
positive character
Step 2
positive charge
n-layer
p-n junction
p-layer
negative charge
electric field
Step 3
photons
sun
positive charge
n-layer
p-n junction
p-layer
negative charge
electric field
Step 4
sun
free electron
load
electric field


PV
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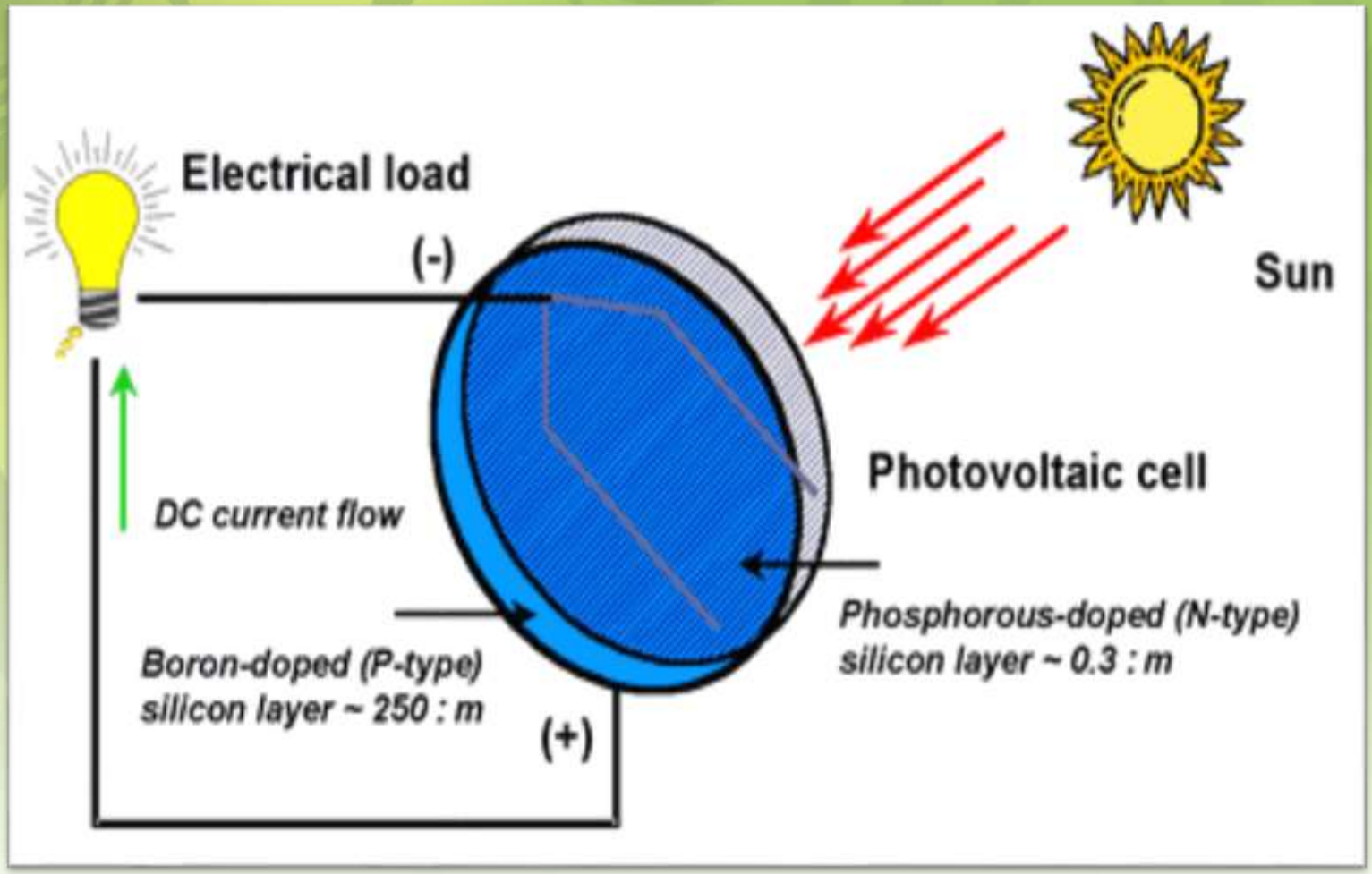
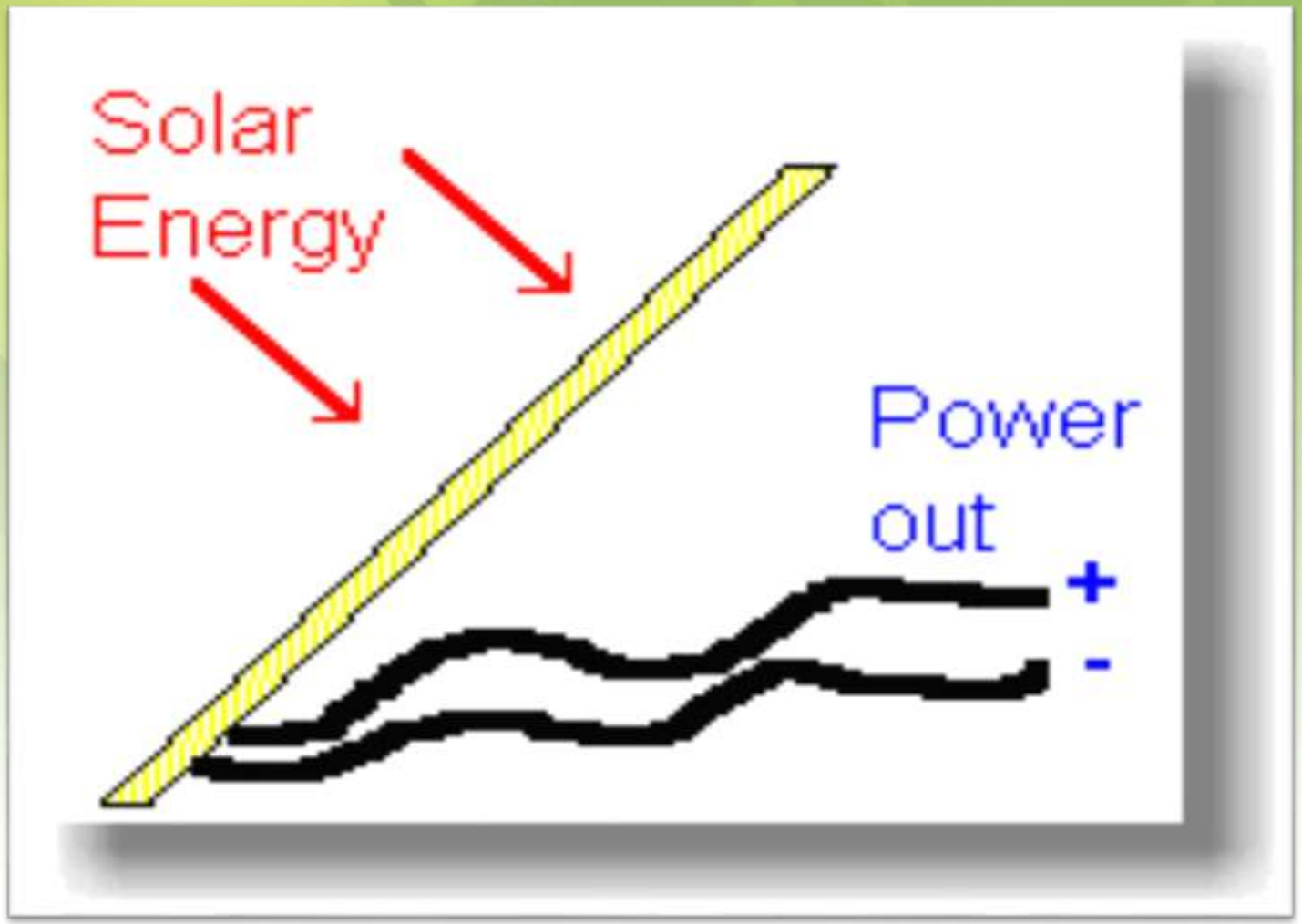
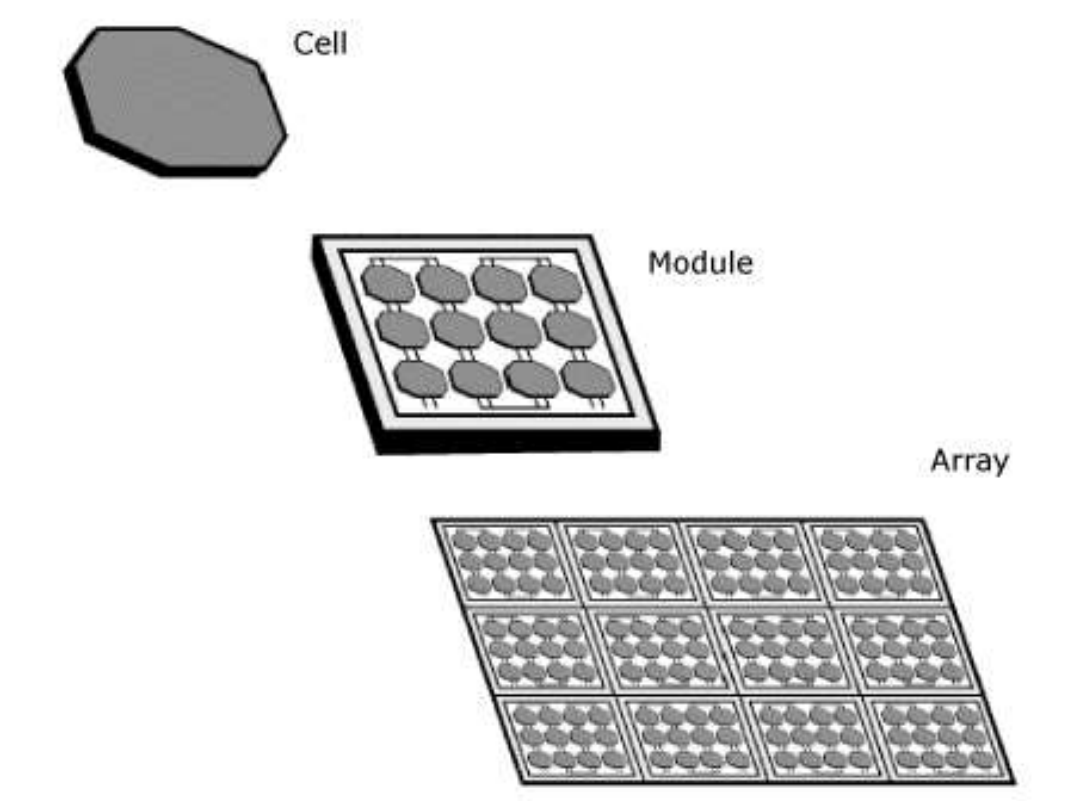

Electrical load
(-)
Sun
Photovoltaic cell
DC current flow
Phosphorous-doped (N-type)
silicon layer ~ 0.3 : m
Boron-doped (P-type)
silicon layer ~ 250 : m
(+)

Conversion Efficiency

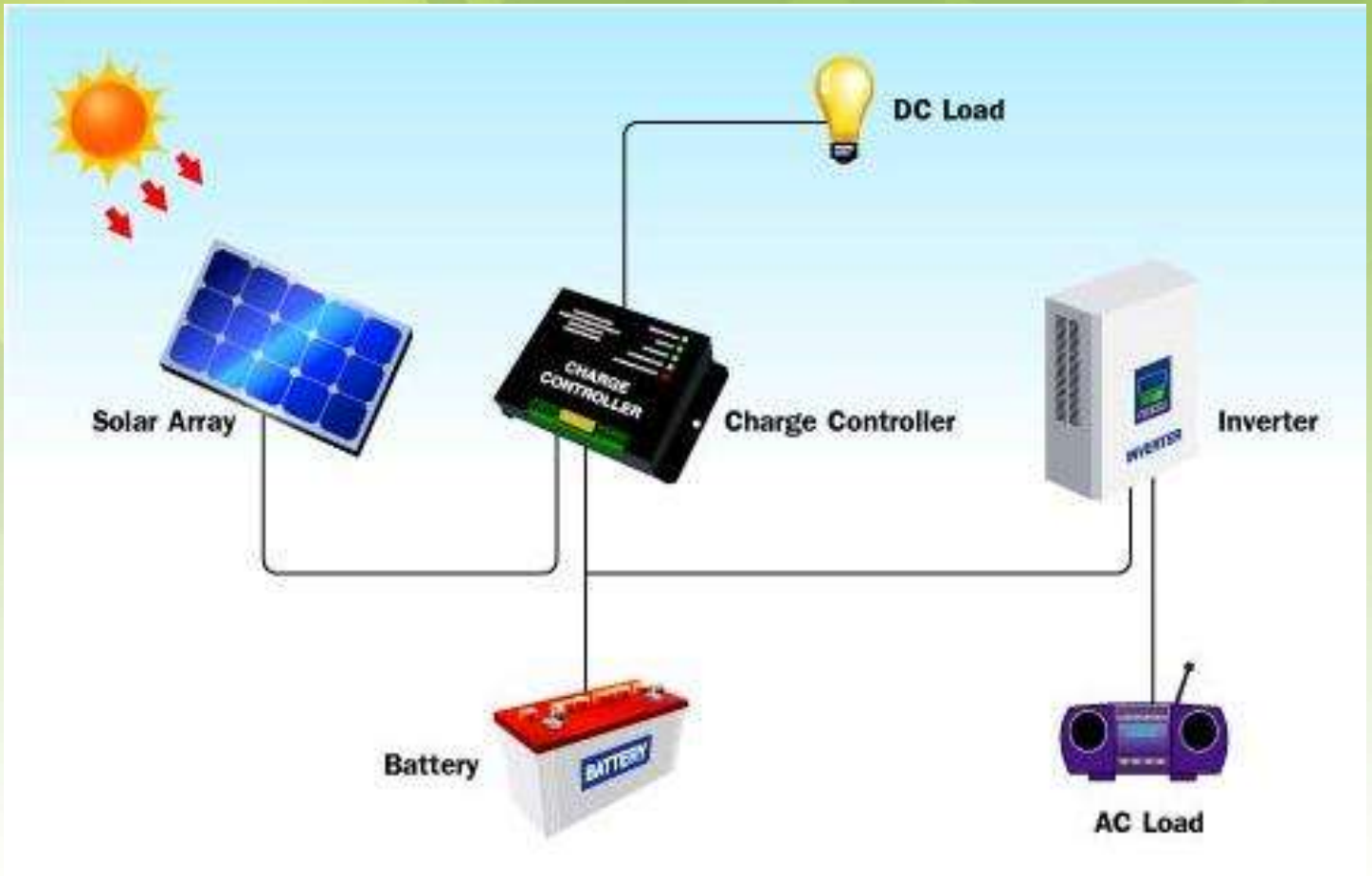


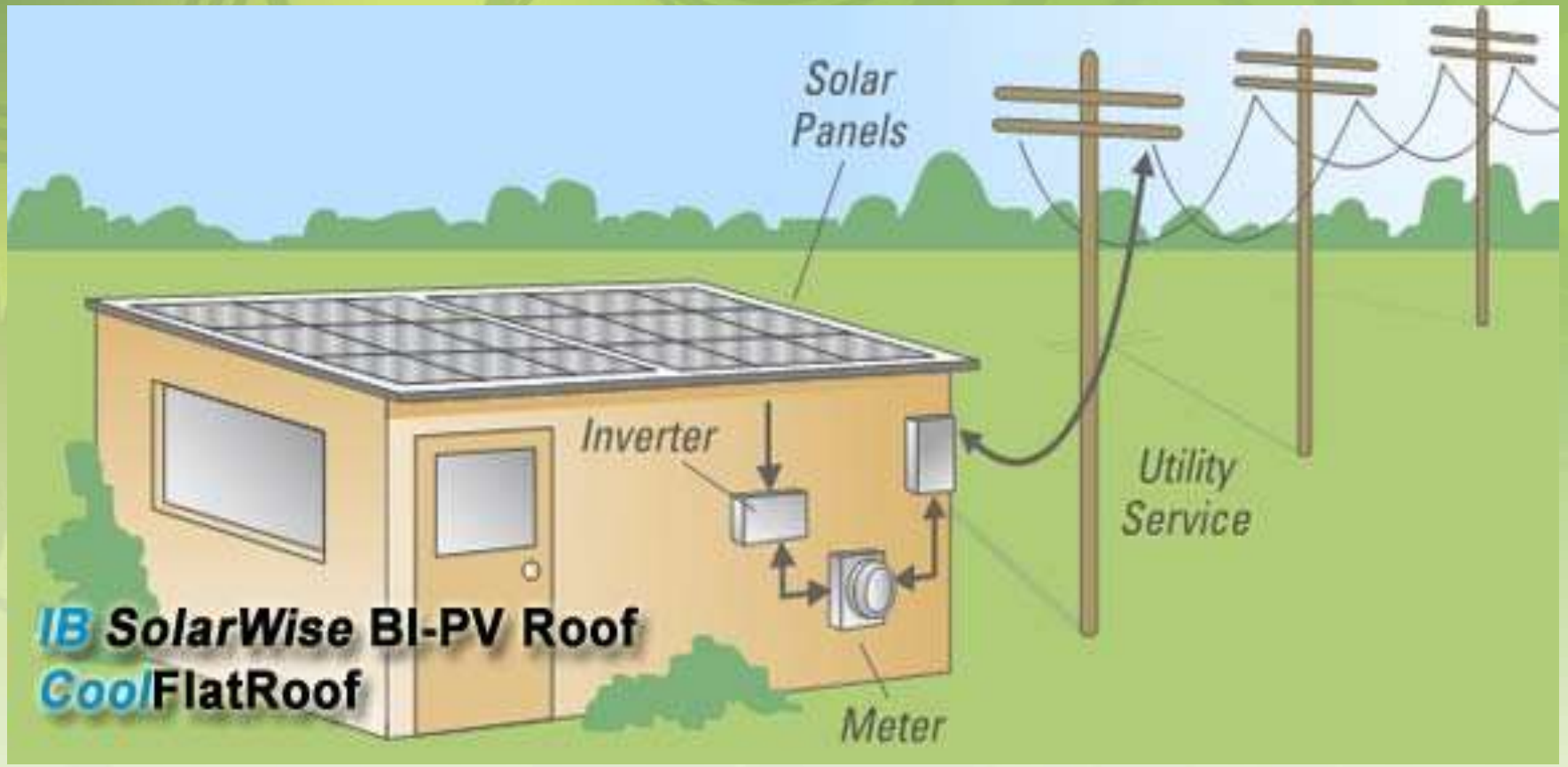
PV Array Components

- PV Cells
- Modules
- Arrays



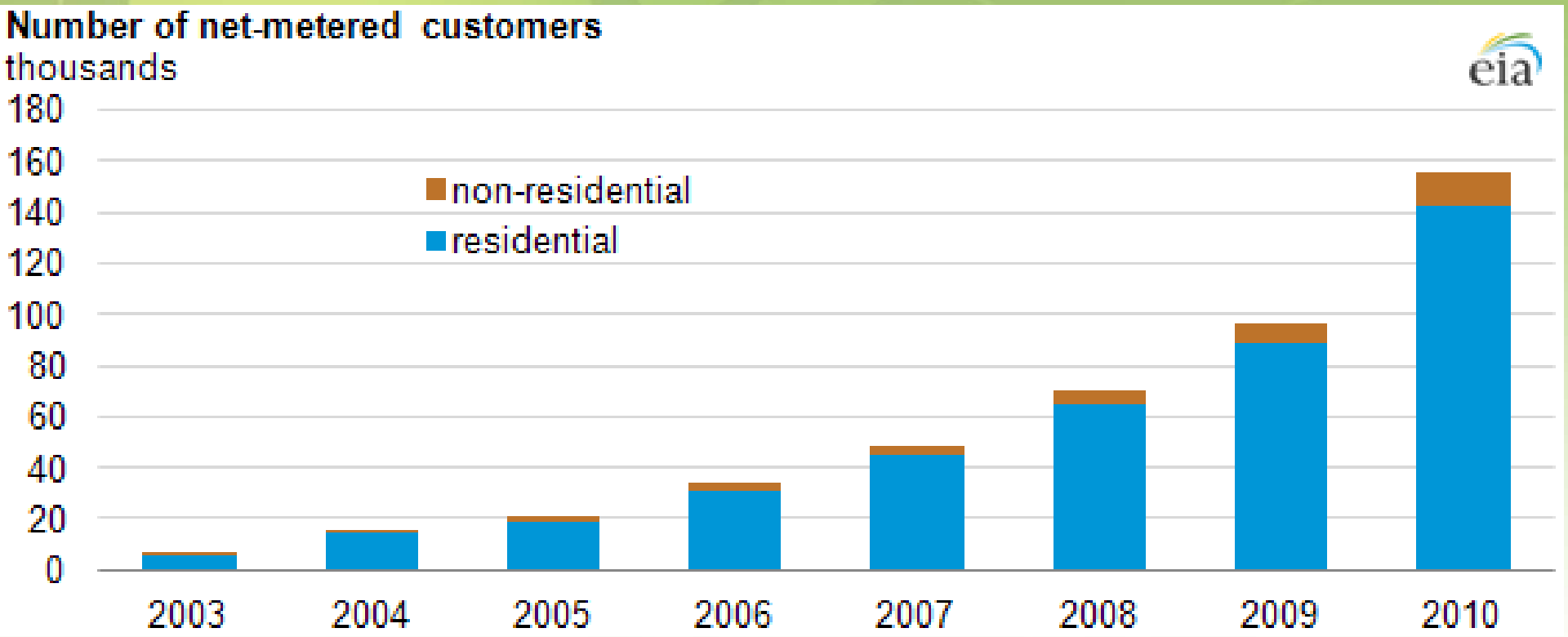
PV System Components





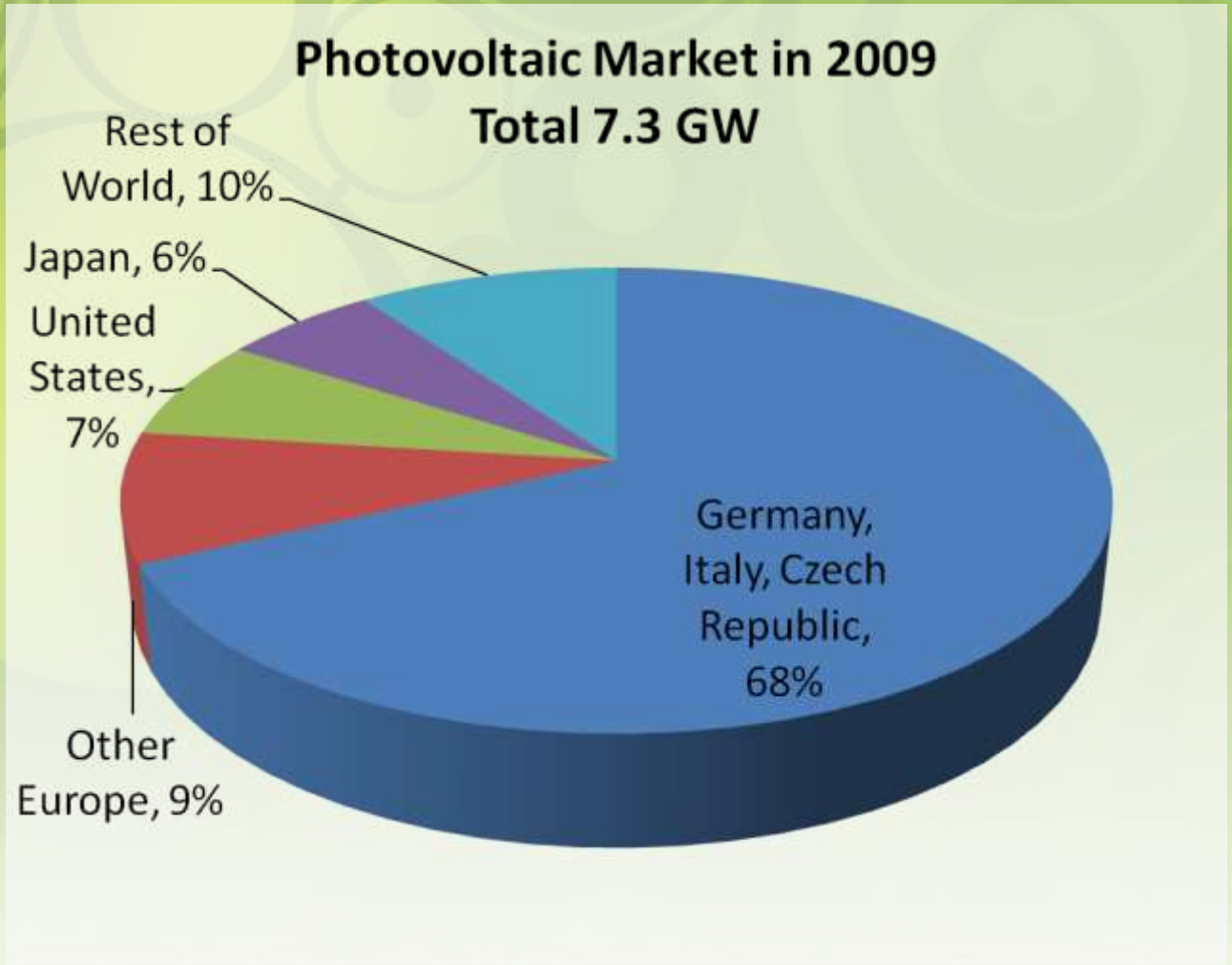
Net Metering

Net Metering Participation



PV Array Fields


BRIDGE
CLOSED
AHEAD



Source: Solarbuzz, a part of The NPD Group

- Clean
- Sustainable
- Free
- Provide electricity to remote places

Advantages of Solar Energy

Disadvantages of Solar Energy

- Less efficient and costly equipment
- Part Time
- Reliability Depends On Location
- Environmental Impact of PV Cell Production

Classroom Photovoltaics

- Experiments help students understand the conditions needed for optimal power production
- Focus of secondary-level solar curriculum
- Use digital multimeters

Using a Digital Multimeter

DC Voltage Scale

Indicates voltage from alternating current. Do not use.

Resistance Scale. Do not use.

DC Current Scale