Lighting Global Quality Assurance "Crash Course"

Christopher Carlsen

LIGHTING GLOBAL
Catalyzing markets for modern off-grid energy

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Today's Objectives

Gain a general understanding of the role of off-grid solar products in energy access strategies and the importance of quality assurance

Become familiar with pico-PV products and SHS kits

Learn about off-grid solar technologies and how they are combined to provide useful energy services

Gain in-depth knowledge of the Quality Standards, test methods and how they are applied

Confidently explain components of the Lighting Global Quality Assurance Framework

Overview: Morning Session

- What are Pico-PV products and SHS kits, and how do they fit into energy access strategies?
- Hands on: Getting to know the products
- Following the “life” of a product and Lighting Global QA touch points
- Understanding off-grid solar technologies and trends
- Deep dive: Lighting Global Quality Standards and test methods
- Applying the QA framework: How do products receive and maintain quality verification?

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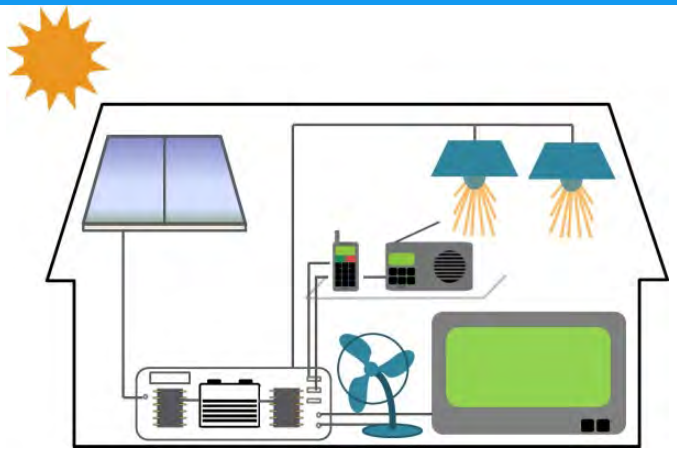
Pico-PV Product Definition

- Lighting is the primary function
- Stand alone – Able to function independently
  - Solar (PV) panel power ≤ 10-15 W_p
- Electric – No fuel
- Rechargeable – No disposable batteries
- Self-installed – No need for a technician
- May have additional features
  - Mobile phone charging
  - Radio
  - Others

Solar Home System (SHS) Kit Definition

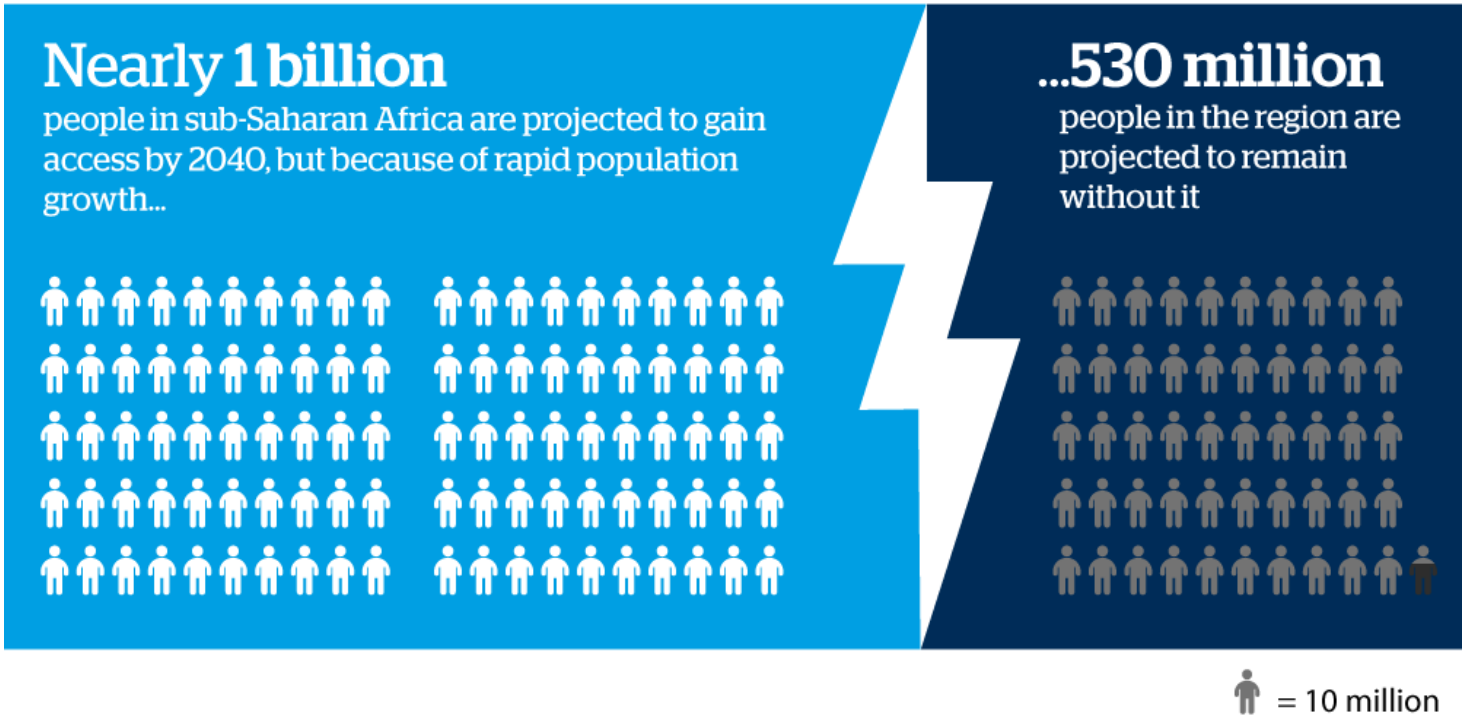


- All components sold as a kit
  - PV module
  - Charge control unit
  - Battery
  - Loads (e.g. lighting, TV, fan, radio)
  - Cables, switches, connectors, protective devices
- Plug-and-play
  - No design expertise required
  - No technicians
  - No tools for electrical connections
- DC only, including outputs and loads
- System voltage below 24 V nominal (35V operating voltage)
- PV module peak power rating 10 - 350 W

How do Pico-PV products and SHS kits fit into energy access strategies?

- **Underlying premise**: Access to clean, reliable and affordable energy is crucial for socio-economic development

- Future of grid electrification in sub-Saharan Africa:



Sub-Saharan Africa: Access to off-grid power
Source: International Energy Agency

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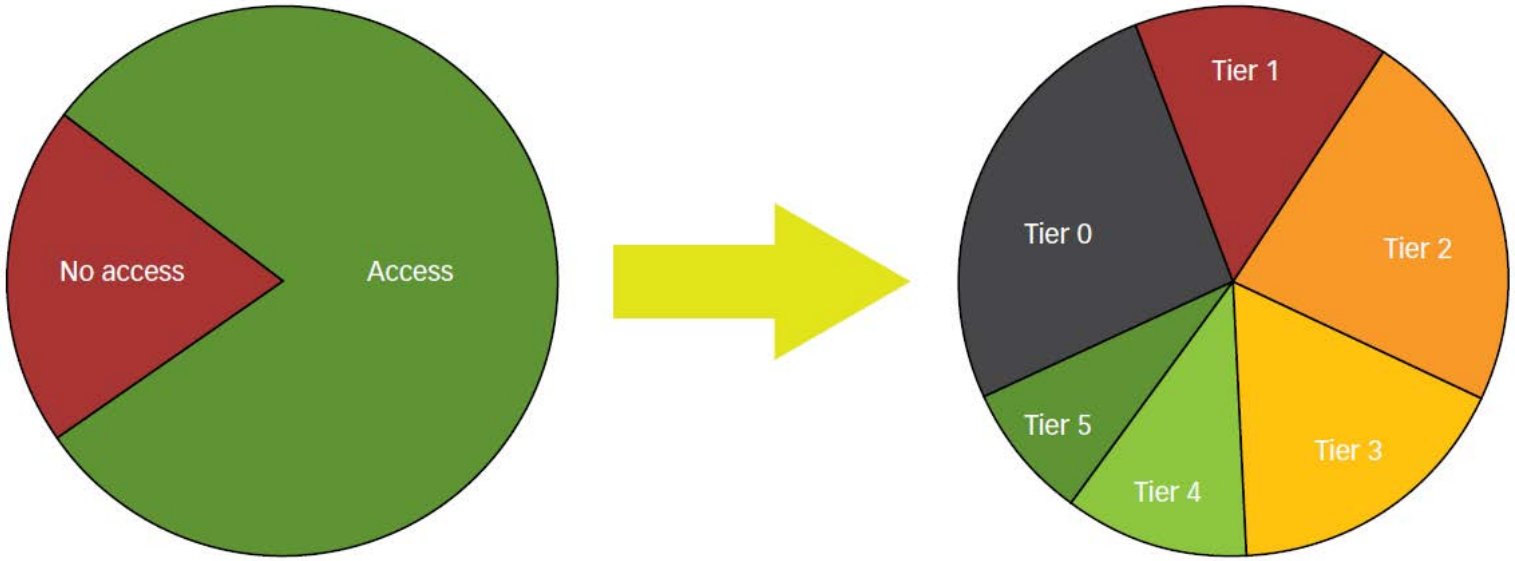
How do Pico-PV products and SHS kits fit into energy access strategies?

Paradigm shift:

- Attaining universal energy access will be achieved through the use of multiple on- and off-grid technologies
- Energy access can no longer be understood in terms of grid electricity connections
  - Not binary
  - More accurately evaluated in a way that accounts for quantity, quality, affordability, and duration of supply

SE4All Multi-Tier Framework

Shift from binary to multi-tier measurement of energy access



Source: ESMAP 2014.

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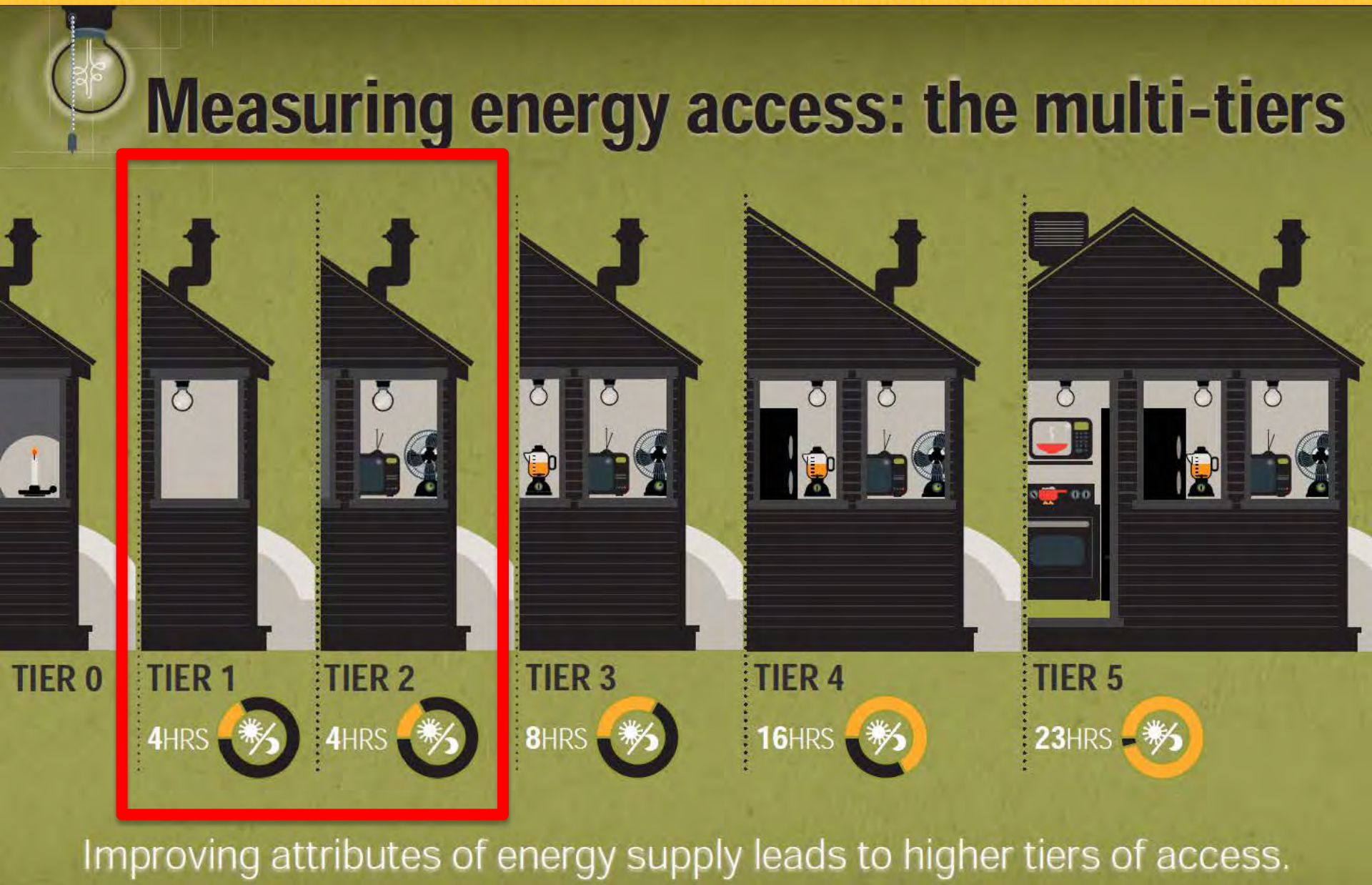
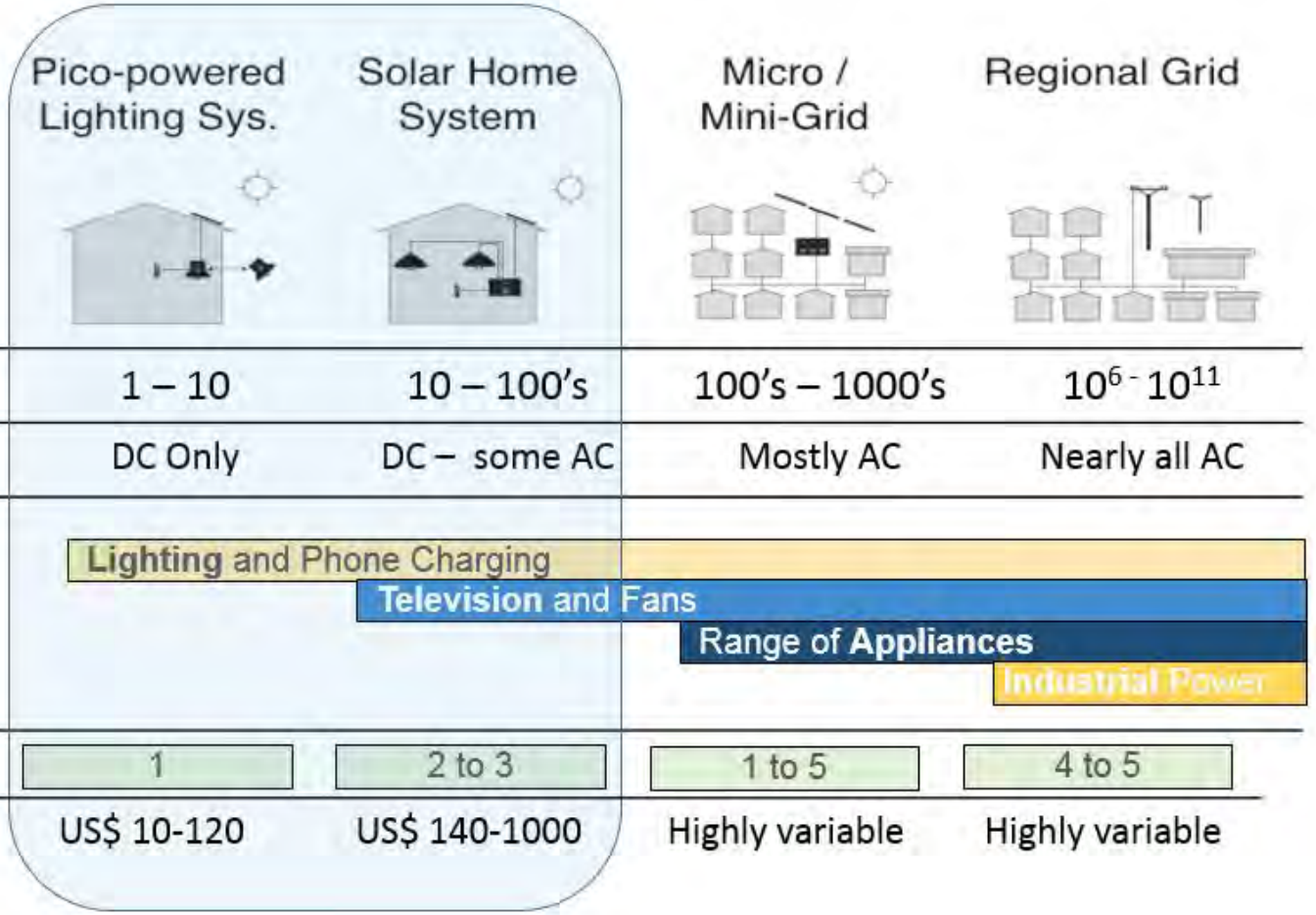
SE4All Multi-Tier Framework



Off grid solar enables BoP consumers
To climb the energy access ladder



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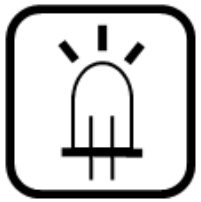
Incumbent Technologies

Fuel-based Lighting

- Expensive: Fuel-based lighting is a $US 20+ billion per year industry (UNEP, 2013)
- Unhealthy: Kerosene lighting causes health & environmental problems
- Inefficient and very low quality lighting

Modern lighting products can provide a better alternative



Brighter than kerosene

More services

Potential monetary savings

BUT...

Safer, no open combustion

Environmental benefits

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Benefits are only received if products provide reliable service for a long duration

- **Low cost / low quality products** dominate many markets
- **End-users are deeply disappointed** with the performance and quality.
- Despite the quality issues, people use them because they beat the incumbent technology.
- Low quality products form peoples' **first impression** with the technology, resulting in market spoilage for high quality products.

The Need for Quality Assurance

Quality assurance is necessary for:

- Avoiding market spoilage
- Protecting consumers
- Developing sustainable markets
- Achieving energy access goals

Technology Trends

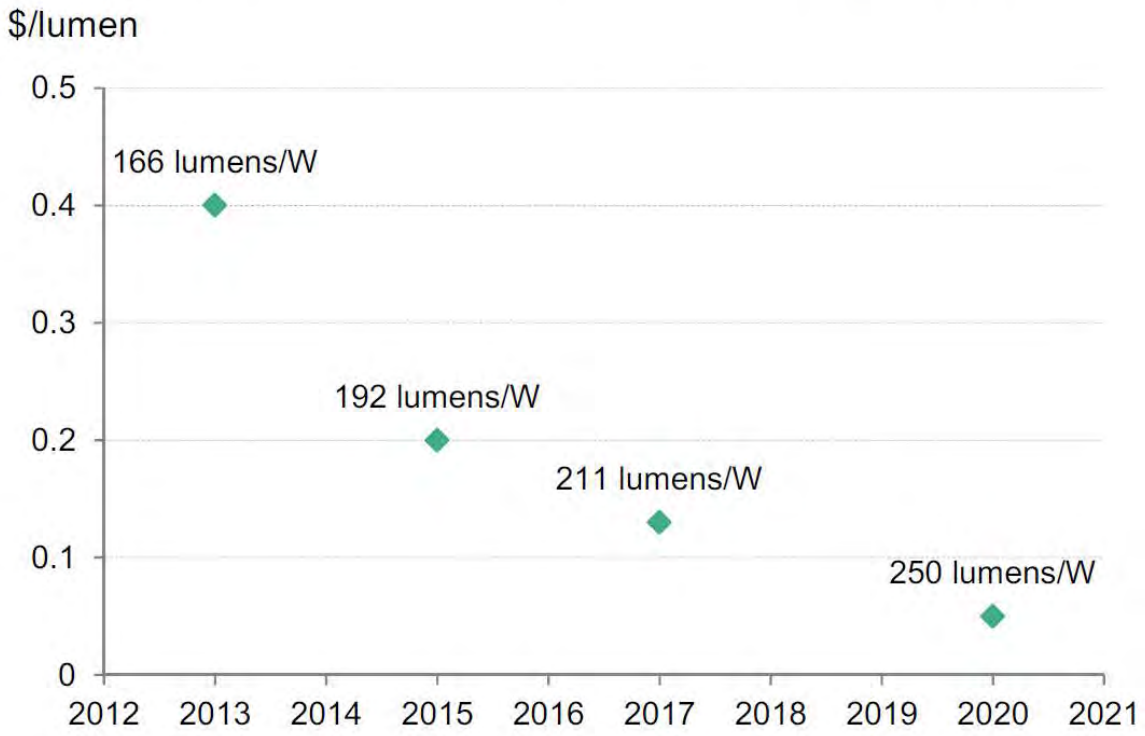
The same pico-solar user experience that cost US$20 in 2010 can now be manufactured for around US$4

Why is this?

- Cost of components is decreasing
- Increased energy efficiency
- Economies of scale
- Innovation

LEDs: Less Expensive & Higher Efficacy

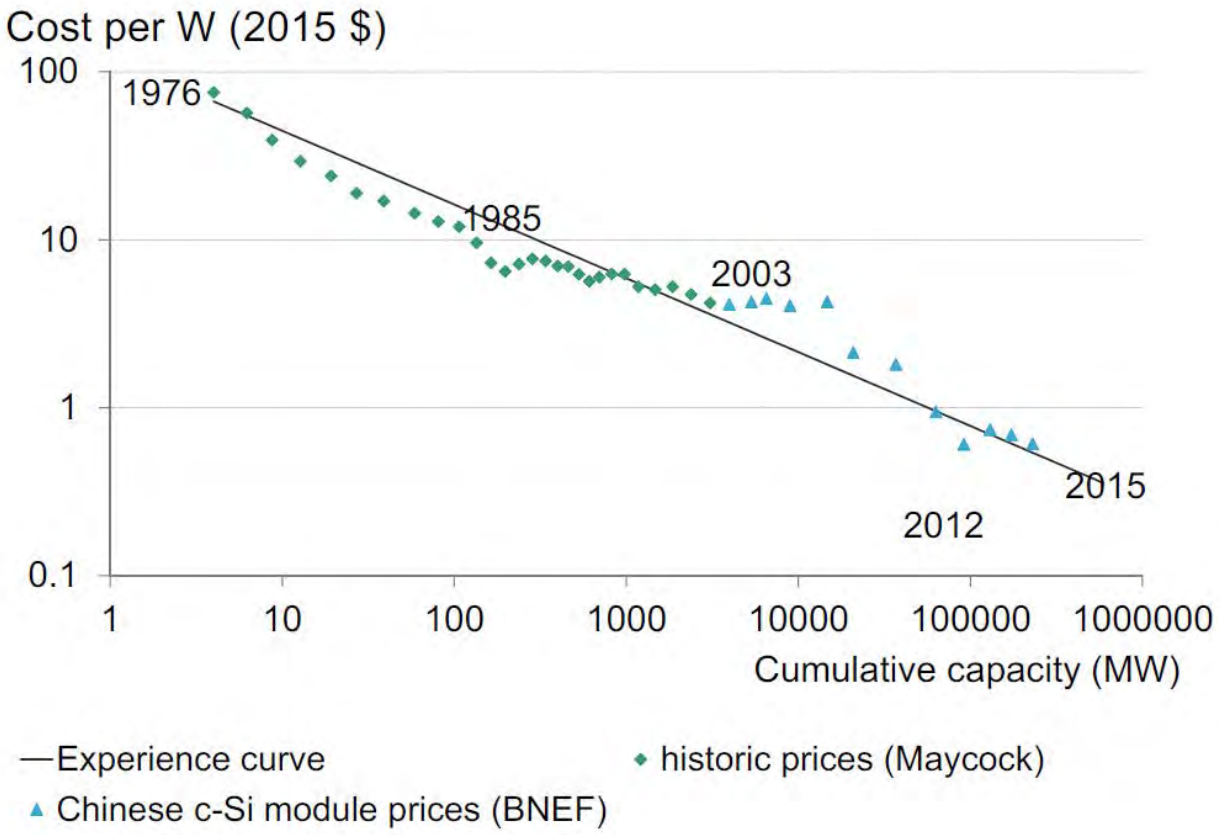
Figure 76: LED package price and efficacy developments, 2013 and forecast



Source: EERE Solid-State Lighting Research and Development Multi-Year Program Plan; Bloomberg New Energy Finance. Note: based on cool white LEDs.

PV Modules: Decreasing Cost

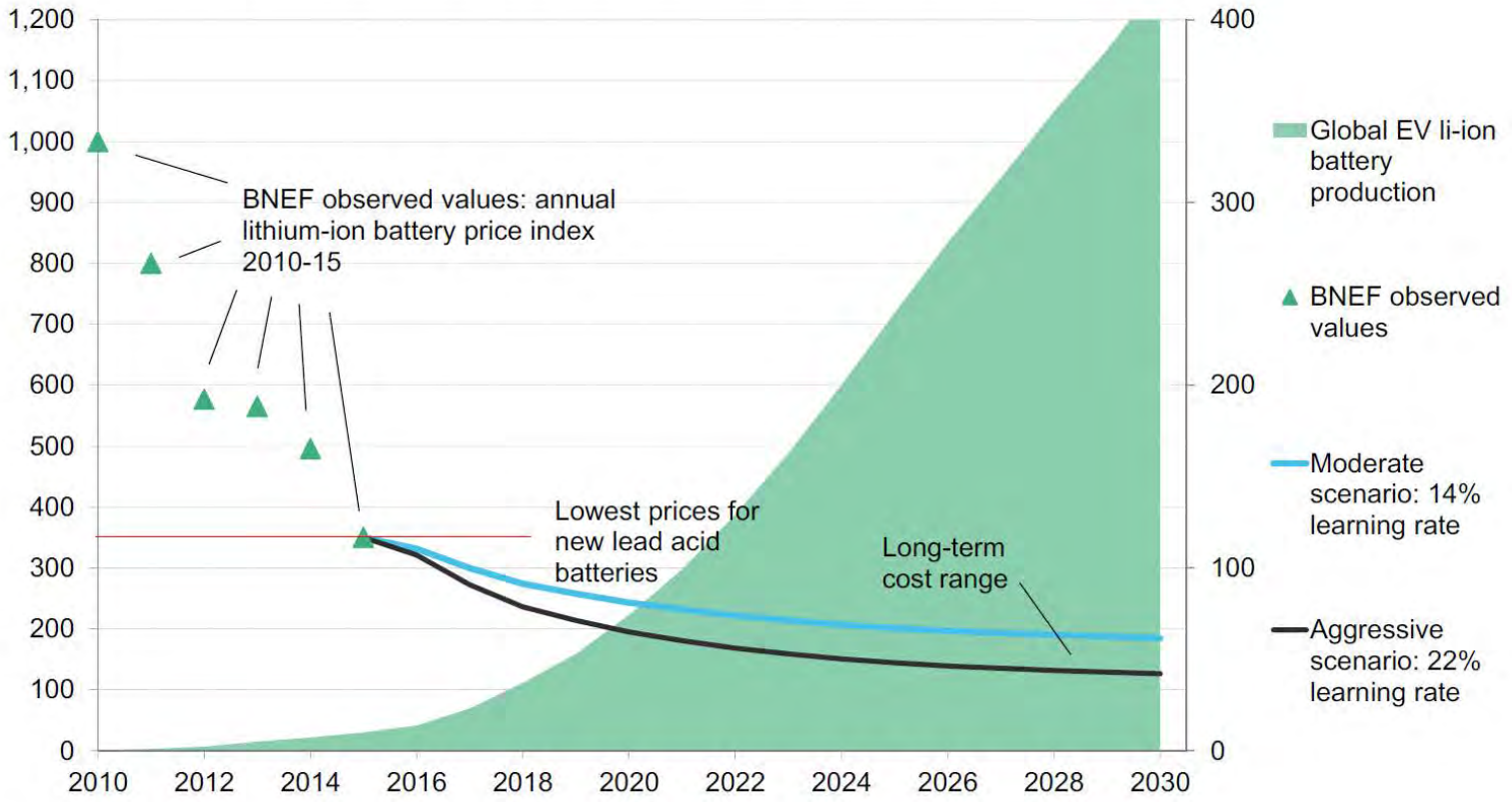
Figure 73: Experience curve for PV modules



Source: Maycock, Bloomberg New Energy Finance

Lithium Batteries: Higher Performance & Decreasing Cost

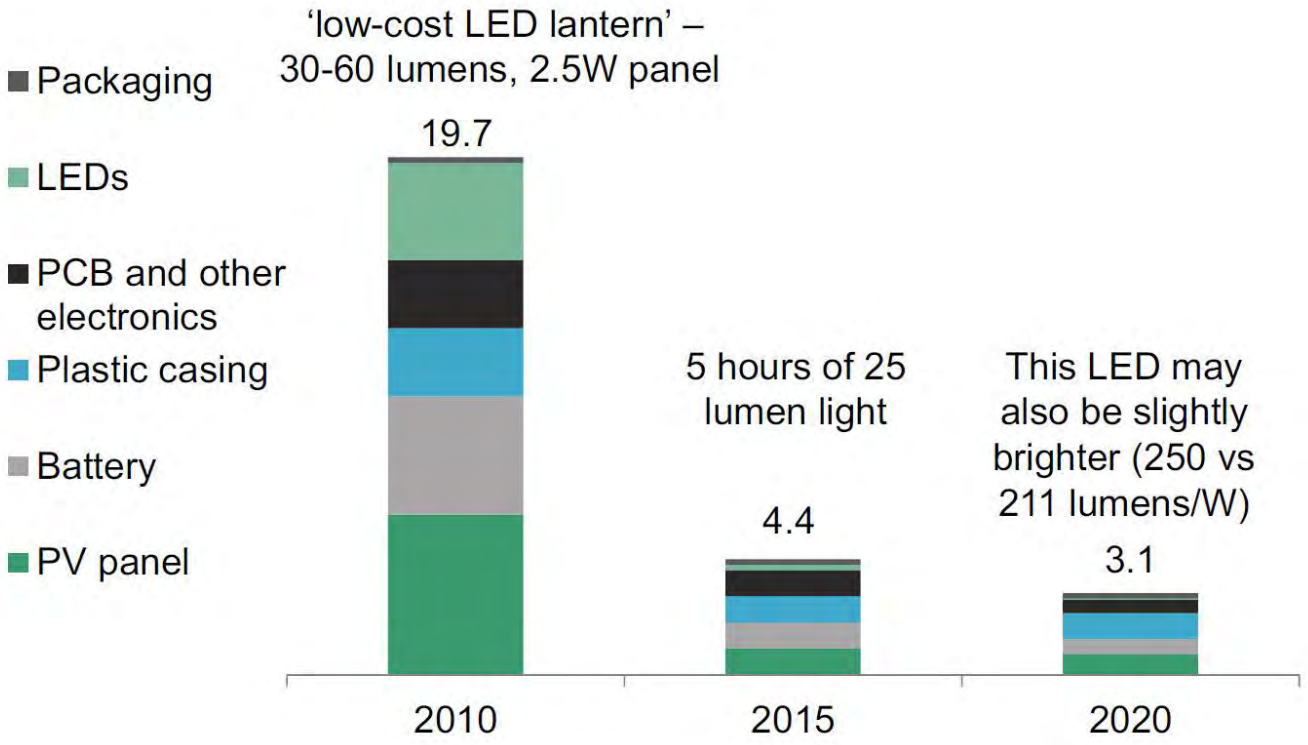
Figure 75: Lithium-ion battery prices, historic and forecast ($/kWh)



Source: Bloomberg New Energy Finance

Pico-PV Product Cost Reduction

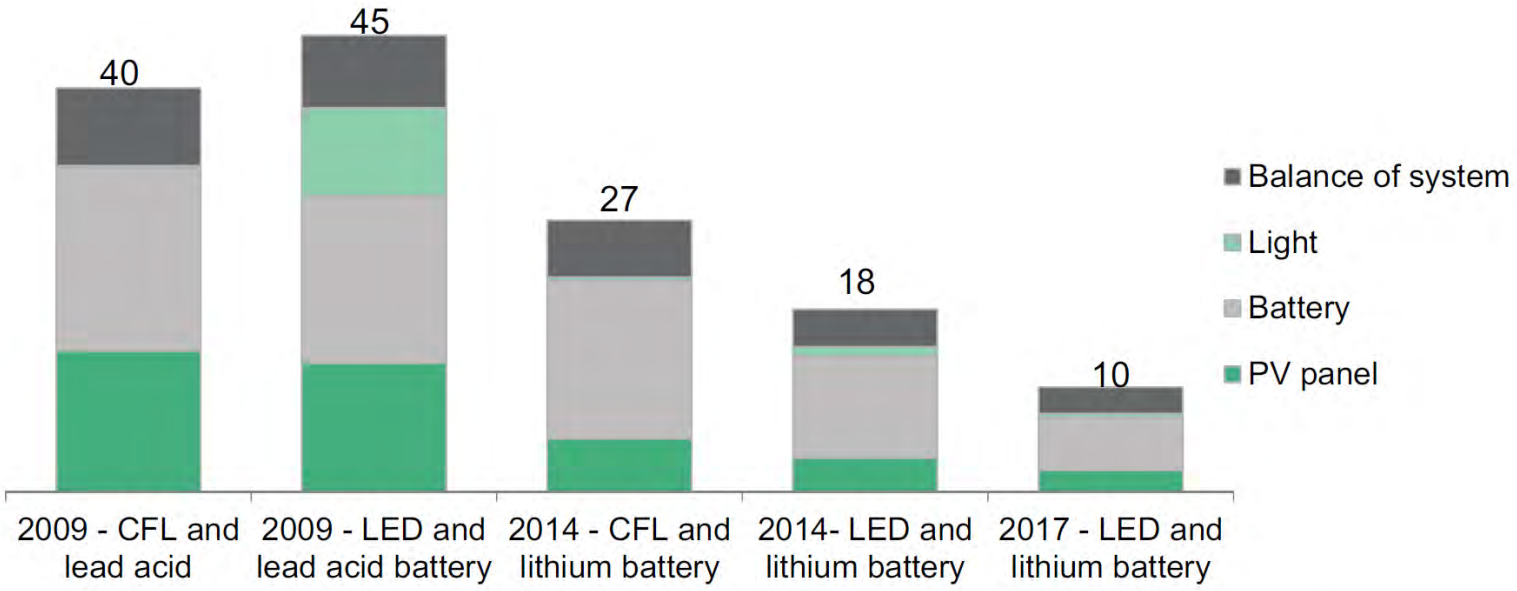
Figure 68: Pico-solar lantern cost development ($/unit)



Source: BNEF, company interviews, Lighting Africa 2010 report, EERE Solid-State Lighting Program

Decreasing Cost of Lighting Service

Figure 71: Development of the cost of a medium solar lantern ($ per unit) – lighting service of 120 lumens for four hours per day

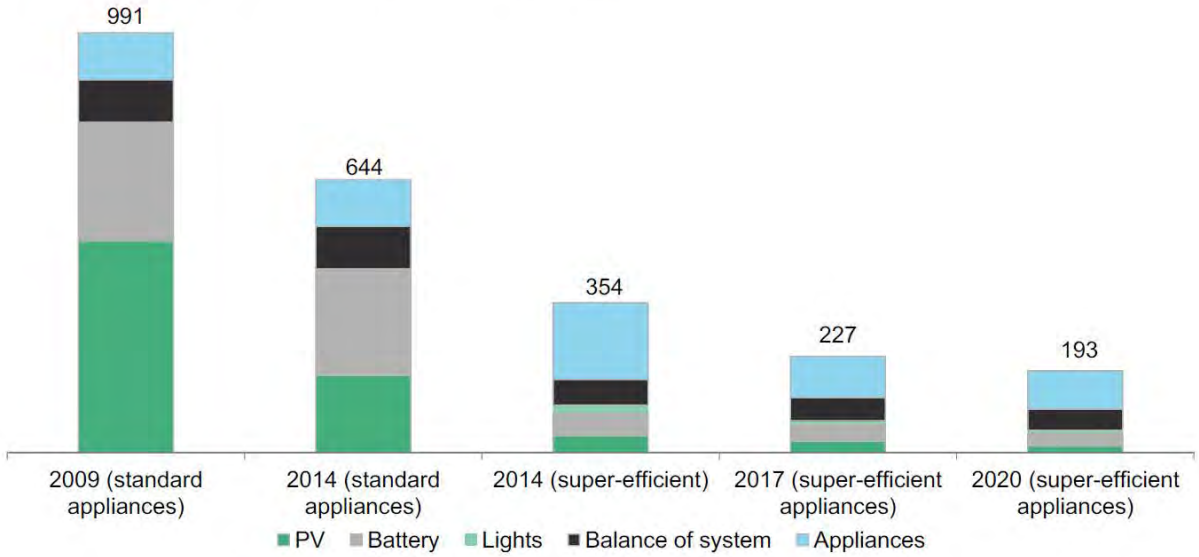


Source: Lawrence Berkeley National Laboratory, Bloomberg New Energy Finance. Note: Costs are indicative only, since few systems are precisely comparable.

SHS Kits: Improvements via Efficient Appliances

Major cost reductions and performance increase will likely come from highly efficient DC appliances that will enable the use of smaller PV panels and batteries.

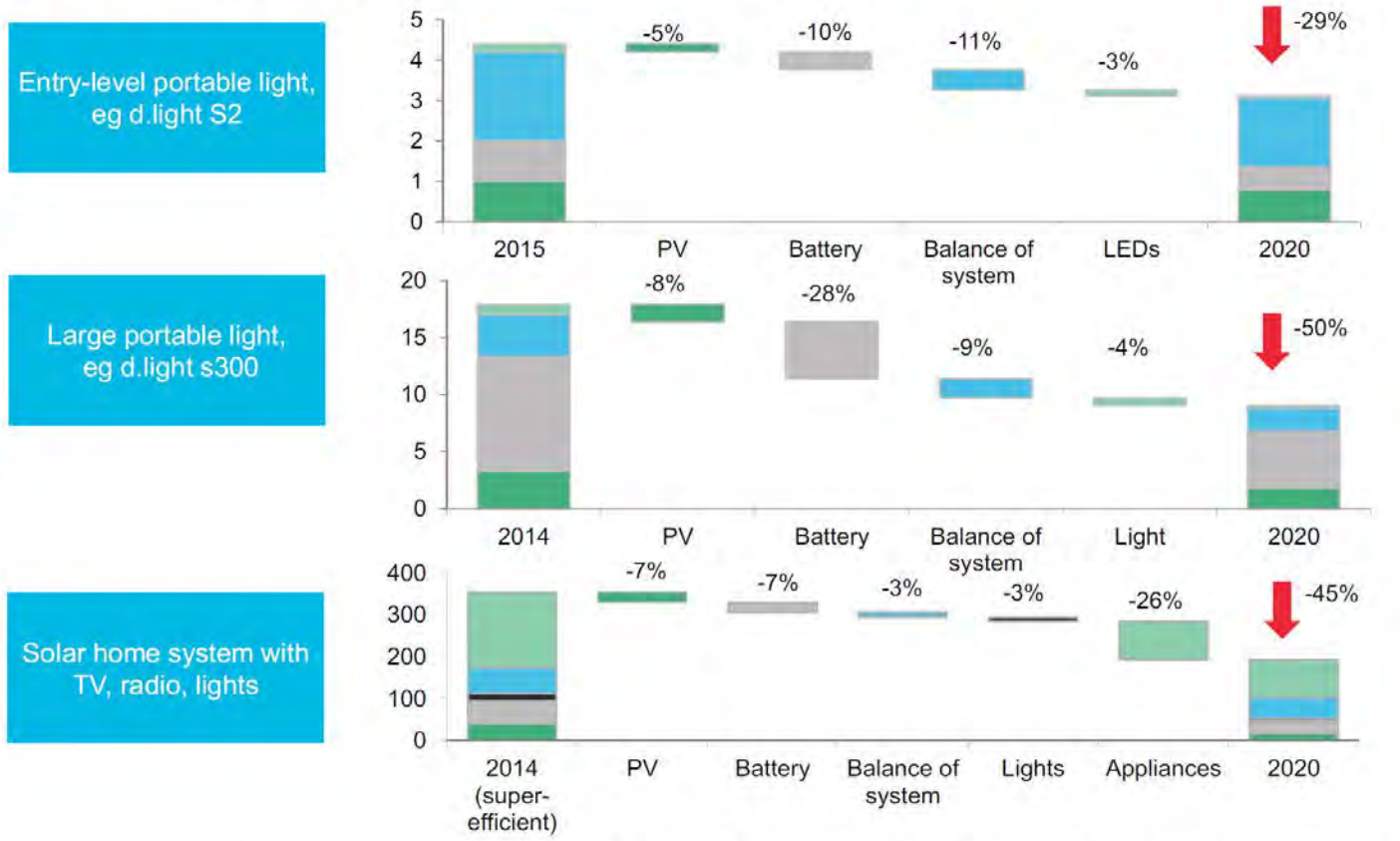
Figure 72: Solar home system with 19" TV, radio, lights ($/unit)



Source: Lawrence Berkeley National Laboratory, EERE Solid-State Lighting Programme, Bloomberg New Energy Finance, Dalberg Global LEAP Off-Grid Appliance Market Research.

Projected Cost Trends

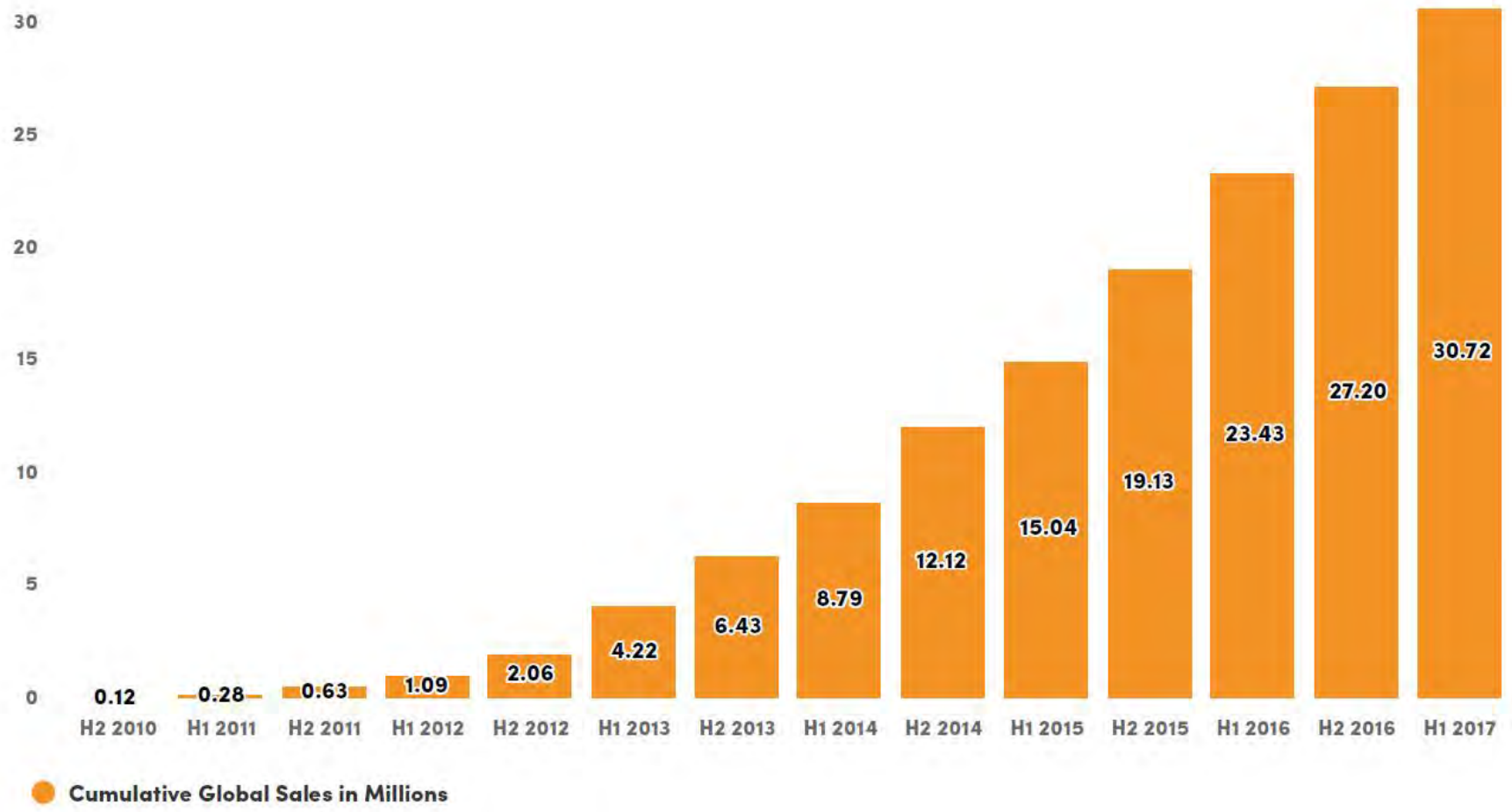
Figure 66: Production cost developments (nominal $ per-unit)



Source: Powering a Home with Just 25 Watts of Solar PV: Super-Efficient Appliances Can Enable Expanded Off-Grid Energy Service Using Small Solar Power Systems Dalberg, EERE Solid-State Lighting Programme, Bloomberg New Energy Finance. Note: Example products mentioned are indicative of the service provided by the category.

Increased selection, availability and affordability

Figure 4: Cumulative Global Sales: Volume of Products Sold

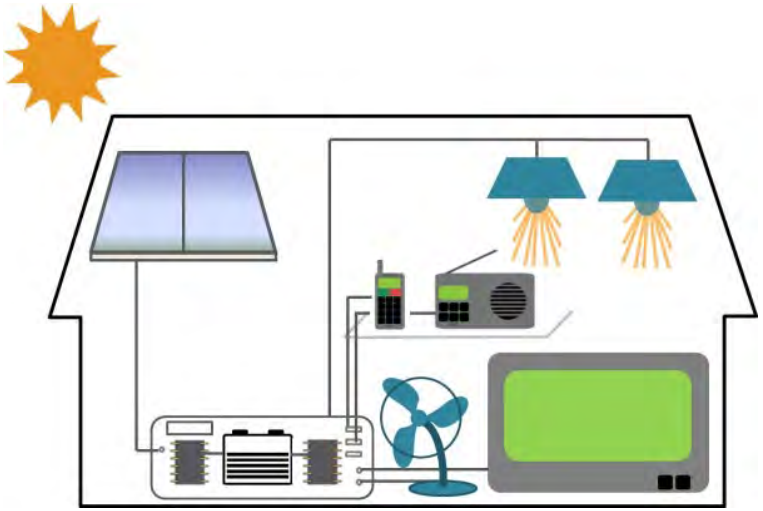


Key Take-aways: Off-Grid Energy Systems & LED Lighting

- By redefining the way we think about energy access, Pico-PV products and SHS kits are becoming mainstream elements of energy access strategies
- Off-grid systems with LED lights can be a cost-effective substitute for fuel-based lighting, and provide many more energy services
- Quality assurance is needed to protect buyer interests, avoid market spoilage, and achieve energy access goals
- Improving technologies, innovations and market growth give consumers increasingly greater access to a diverse range of high-quality, affordable off-grid energy systems

Introduction to pico-PV & SHS kits

- What kind of products are available?
- How are the products used?
- What technologies are in the products?
- Becoming familiar with the products



Pico PV Products: Wide range available
Many shapes, sizes and features


Fosera


Lagazel


Shamba Technologies


d.light


Zhejiang Holley


All Weather Solar Tech


Barefoot Power


Greenlight Planet


Schneider Electric

Nokero


Speedtech Energy


Nadji Bi.


Omnivoltaic Power


EcoZoom

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Information on all quality verified products available at
https://www.lightingglobal.org/products/

SHS Kits: Increasing availability & demand

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How are the products used?

Task lighting: Portable torches and desk lamps

How are the products used?

Ambient lighting: Lanterns and multi-point systems

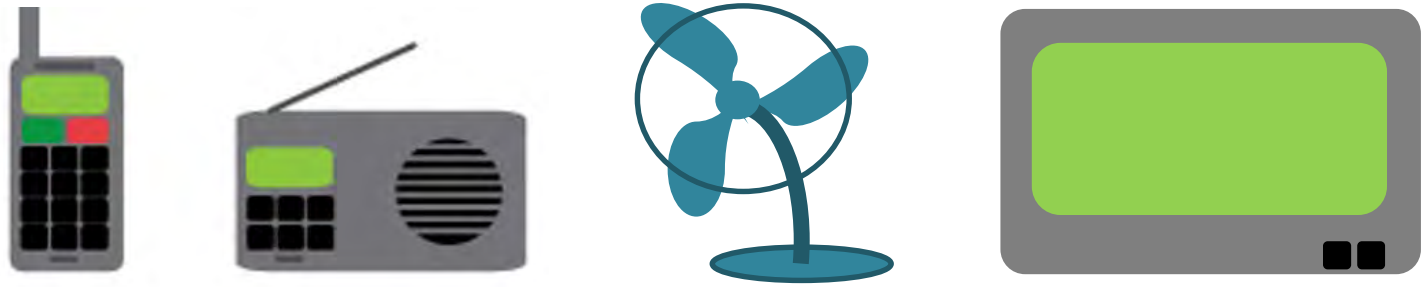
How are the products used?

Hybrid: Used for both task and ambient lighting

How are the products used?

Appliances: Some Pico-PV products also power phones, radios and other accessories.

SHS kits often include, or are designed to support mobile phone charging, radios, and larger appliances like TVs & fans.



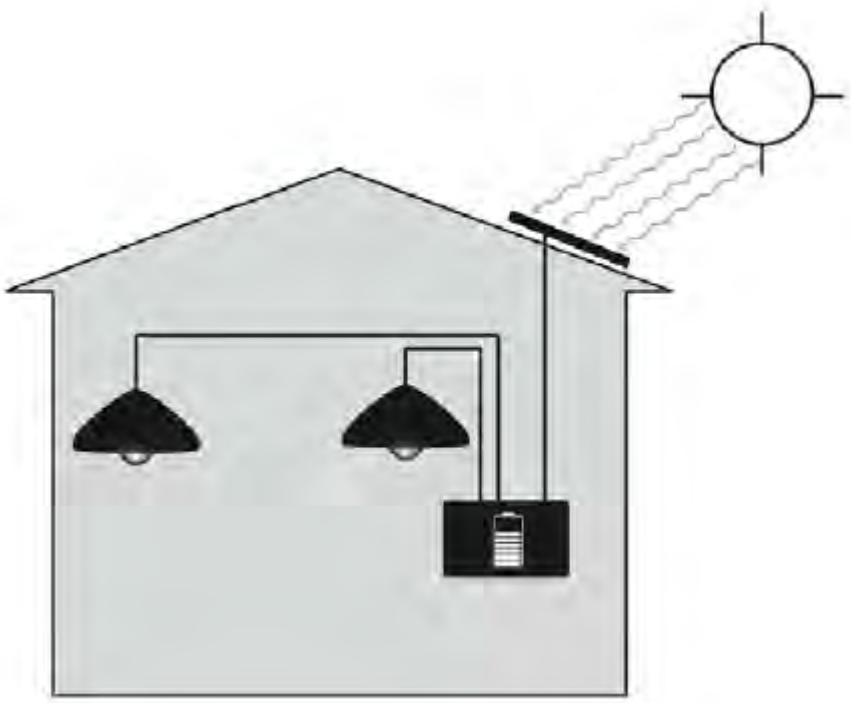
System Description: Component Categories

- **Fixed** – designed for permanent or semi-permanent mounting and use in one place

- **Portable** – intended for portable use and generally contain an internal battery

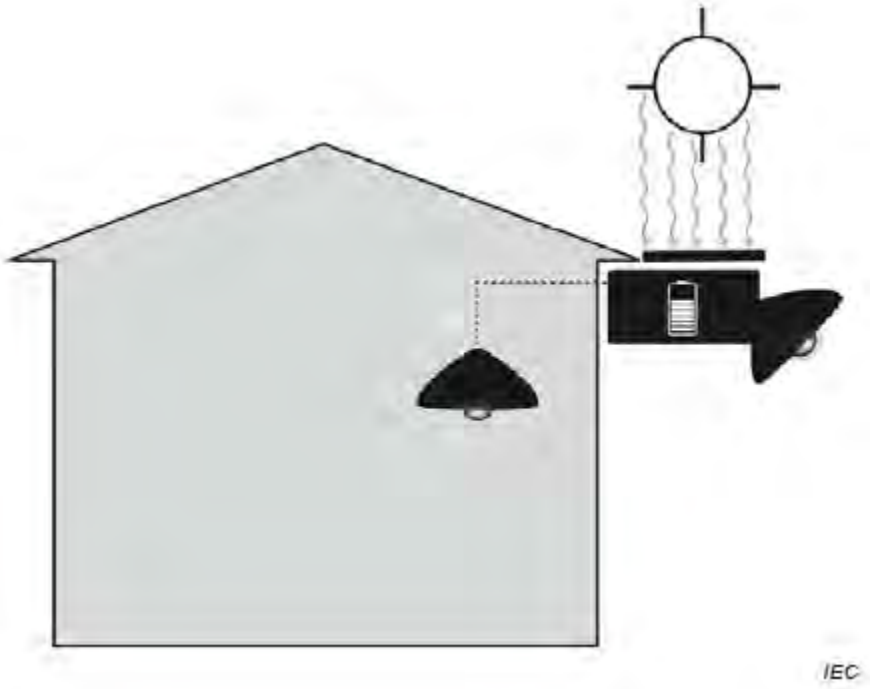
System Description: Component Categories

- **Fixed Indoor** – not inherently portable and solely used inside



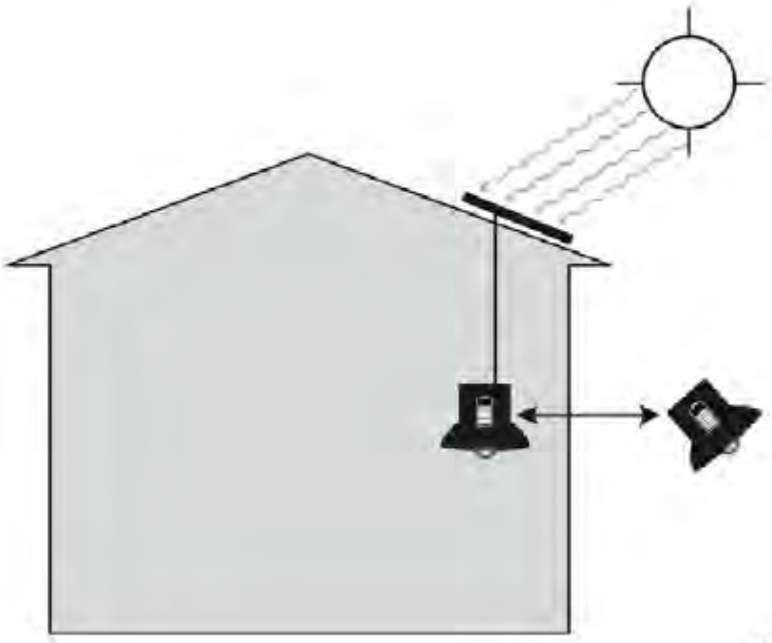
System Description: Component Categories

- **Fixed Outdoor** – not inherently portable and intended to be permanently installed outside



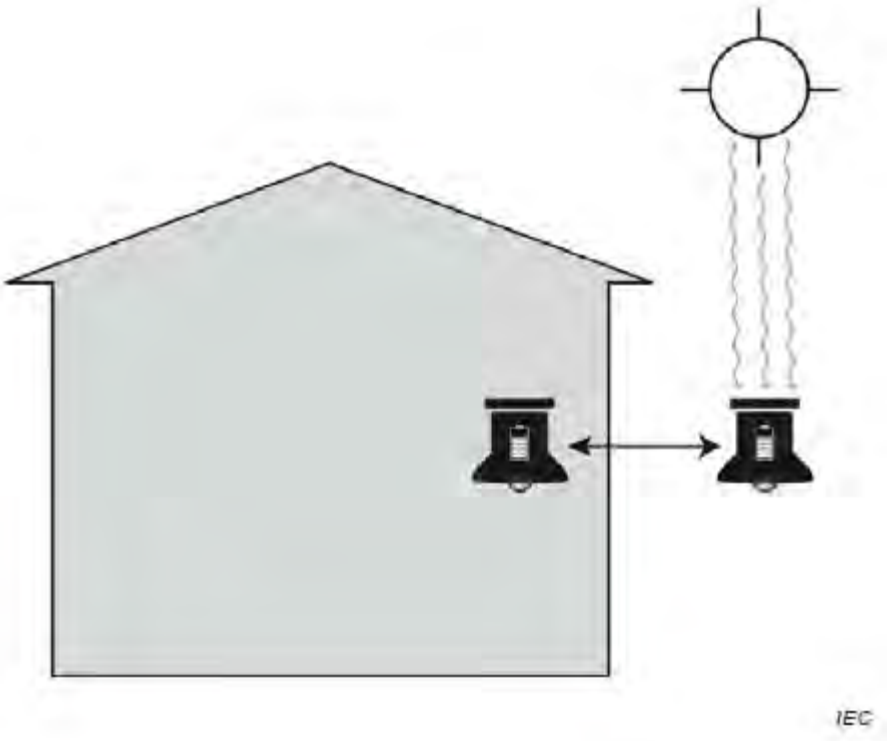
System Description: Component Categories

- **Portable Separate** – intended to be carried, with the battery and load permanently joined; the PV module is connected via a long cable that allows the product to be charged indoors



System Description: Component Categories

- **Portable Integrated** – intended to be carried and charged by a solar module that is integrated in the casing



System Description – Main Components

- Energy source – typically solar photovoltaic (PV) module
- Battery (or multiple batteries)
- One or more light sources – typically LED
- Additional loads

System Description: Enclosure and Components

- **Casing** – protecting sensitive electronics, optics
- **Circuits** – battery charge/discharge controller, regulated voltage and current sources
- **Wiring** – connecting circuits and main components
- **Fasteners** – secure components in casings
- **Switches** – control operation
- **Cables and connectors**
- **Status indicators**

System Description: Additional Elements

- Packaging with information about the product

- User's manual(s)

- Advertising for the product across media: print, radio, TV, internet, etc.

- Warranty support from the manufacturer

- Hardware for mounting PV module or other components

System Component Technologies

Light Source

– Typically LED (Light Emitting Diode)

System Component Technologies

Energy Source

- Typically solar powered
- Photovoltaic (PV) modules
- Several types available

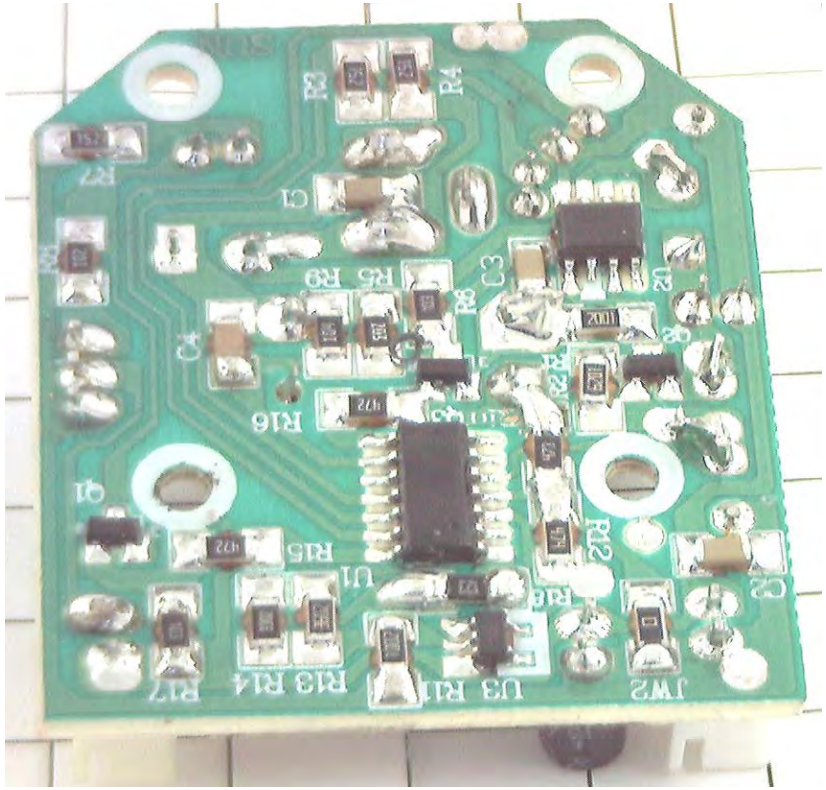
System Component Technologies

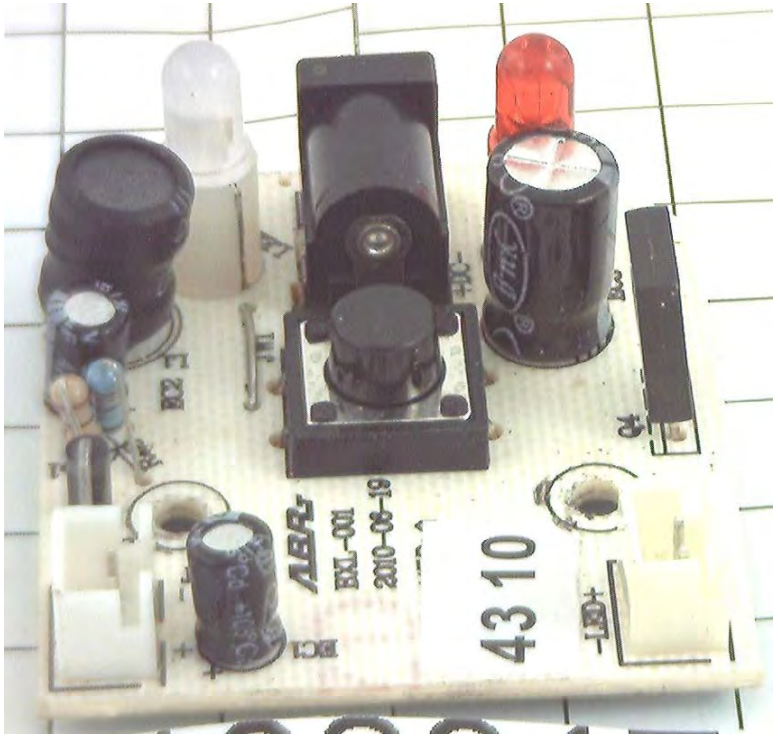
Energy Storage

- Rechargeable batteries
- Several types available
- Lithium batteries have become dominant

System Component Technologies

Electronic control circuits



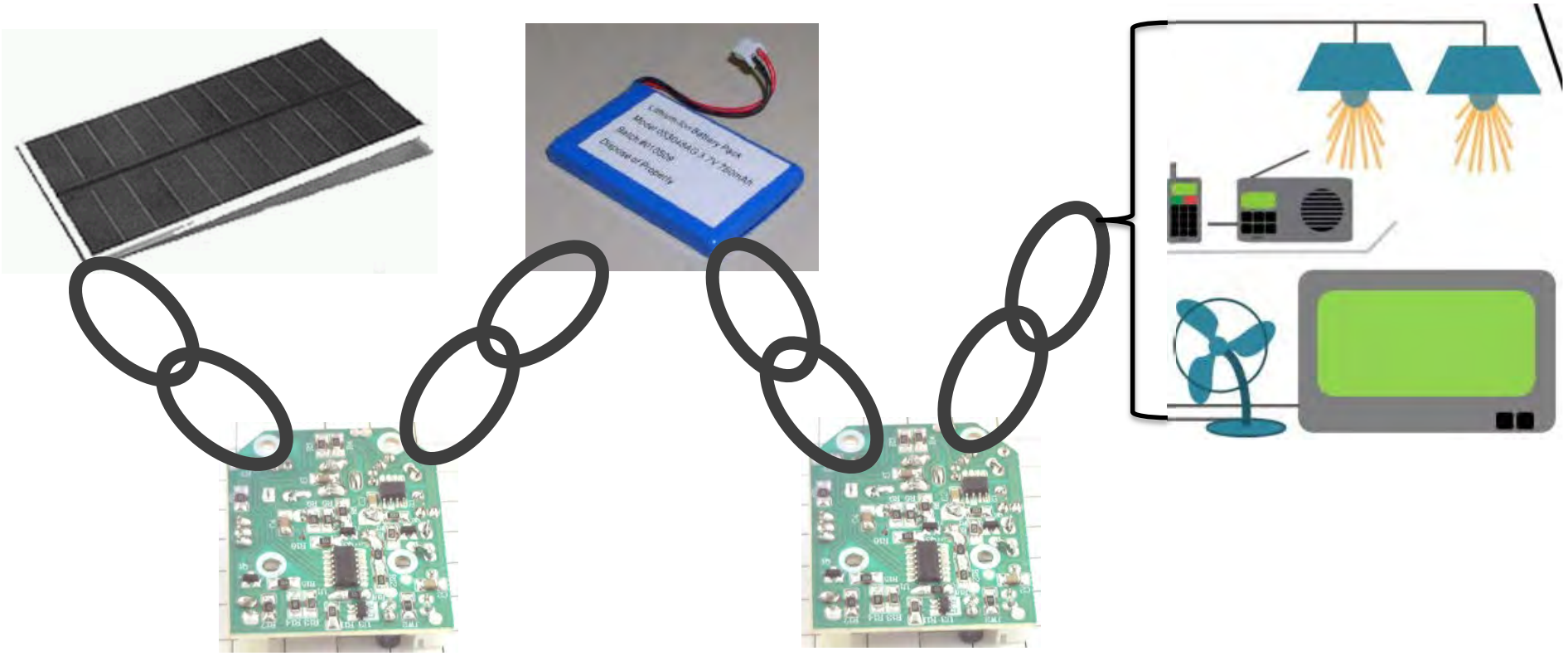


System Component Technologies

- **Plastic and/or metal body**
  - House and protect sensitive electronics
- **Optics (usually plastic)**
  - Focus or distribute light, protect LEDs

Technologies work together

System parts are like links in a chain



Becoming familiar with the products

- Packaging – What information is advertised?
- Documentation – What information is included inside the packaging?
  - Performance
  - Usage
  - Warranty
- How do you use the product?
  - Turn on/off
  - Charge
  - Additional features & appliances