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THE MECHANICS OF HOME BUILDING

BY DEBRA JUDGE SILBER

Grid-tied PV systems

If it seems like more and more roofs in your neighborhood are sprouting shiny black photovoltaic (PV) arrays, you're not alone: In 2013, the number of home PV installations in the United States grew 60%.

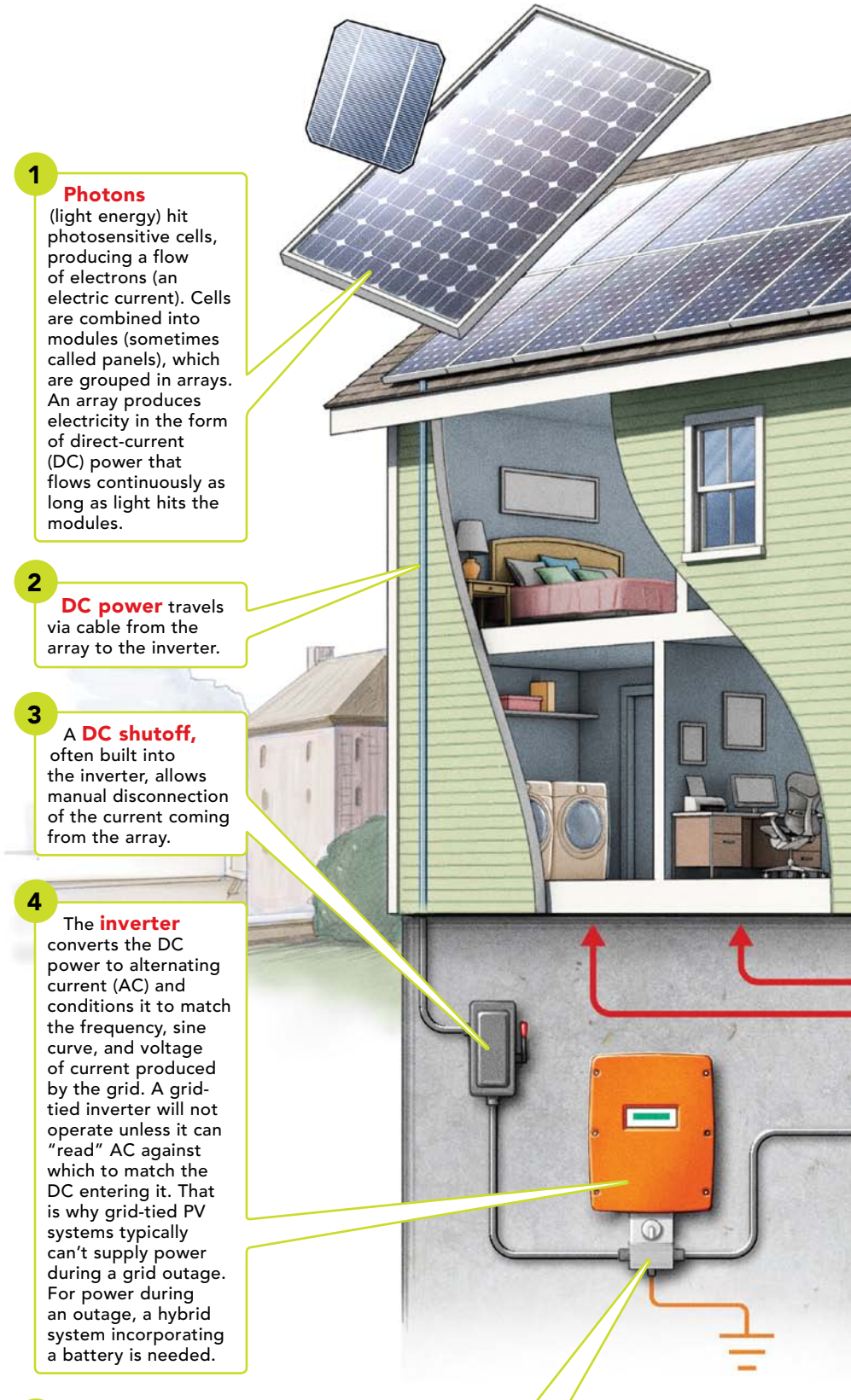
While some home PV systems operate independent of the electrical grid, grid-tied systems are far more common. Electricity produced by these systems is used first to satisfy the home's load; any surplus is fed into the utility-maintained grid. When the system is not producing electricity (at night, for example) the house draws power from the grid like any other home.

Distributed generation (DG) is the feeding of electricity into the power grid from multiple locations. DG is a hot topic right now, as the popularity of PV has generated fierce debate between home-power advocates, utilities, and regulators over pricing, regulations, and connection requirements.

The conversion of light to electricity occurs in a solar cell the size of a CD case, but the process doesn't end there. It is the "balance of system" equipment that conditions, monitors, and distributes that power so it can be used to run your TV, computer, and refrigerator (as well as your neighbors'). These components are what make PV power practical.

Here's how it works.

Debra Judge Silber is managing editor.
Sources: Technicians for Sustainability; Jim Rogers, IAEI.



1 **Photons** (light energy) hit photosensitive cells, producing a flow of electrons (an electric current). Cells are combined into modules (sometimes called panels), which are grouped in arrays. An array produces electricity in the form of direct-current (DC) power that flows continuously as long as light hits the modules.

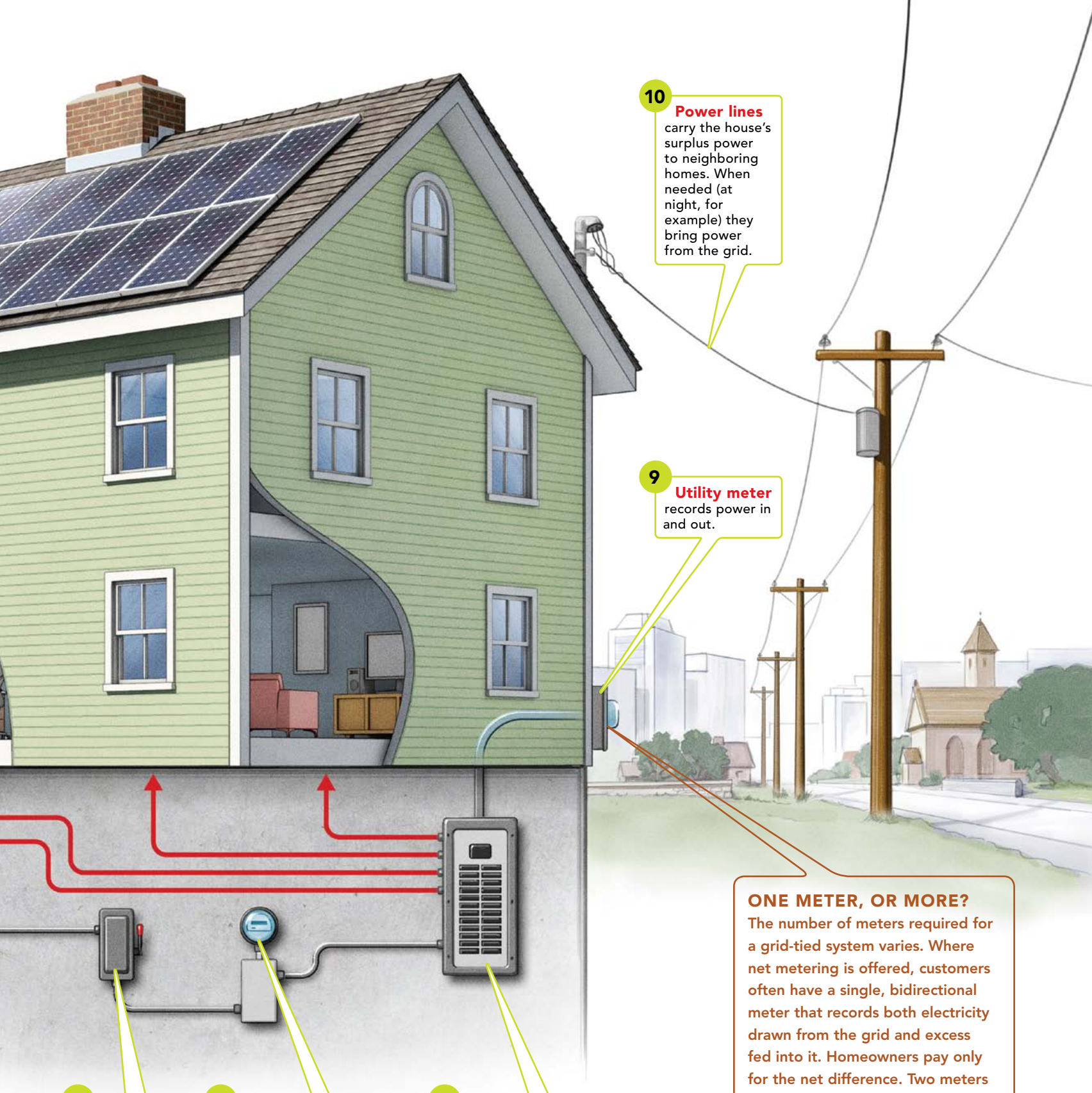
2 **DC power** travels via cable from the array to the inverter.

3 A **DC shutoff,** often built into the inverter, allows manual disconnection of the current coming from the array.

4 The **inverter** converts the DC power to alternating current (AC) and conditions it to match the frequency, sine curve, and voltage of current produced by the grid. A grid-tied inverter will not operate unless it can "read" AC against which to match the DC entering it. That is why grid-tied PV systems typically can't supply power during a grid outage. For power during an outage, a hybrid system incorporating a battery is needed.

5 **Safety features,** including grounding equipment, surge protection, and disconnection switches, are also part of the system. Grounding equipment provides protection against shocks in the event of a short circuit. Both the array and balance-of-system components should be grounded. The National Electric Code NFPA 70 provides more information on grounding and other safety components.

Drawing: John Hartman



10 **Power lines** carry the house's surplus power to neighboring homes. When needed (at night, for example) they bring power from the grid.

9 **Utility meter** records power in and out.

6 Many utilities require a manual **safety shutoff** to cut AC power between the inverter and the service panel.

7 A dedicated **solar meter or monitor** records power produced by the PV system. These may be required in areas where solar credits are offered. Many new units allow monitoring of the system from a phone or computer.

8 AC power enters the **service panel** that supplies the house. A slightly higher voltage on the current coming from the PV system ensures it is used first; if PV production does not meet the home's load, additional power is drawn from the grid. When there's a surplus, extra power flows to the utility meter and to the grid.

ONE METER, OR MORE?

The number of meters required for a grid-tied system varies. Where net metering is offered, customers often have a single, bidirectional meter that records both electricity drawn from the grid and excess fed into it. Homeowners pay only for the net difference. Two meters are required in areas using "value of solar" tariffs. Under this new (and hotly contested) pricing system, customers sell all the energy they produce to the utility at a specific "solar" rate and then buy back what they need.