

Alternative Energy

- Wind Energy**
- Solar PV**
- Fuel Cells**
- Solar Hot Water**

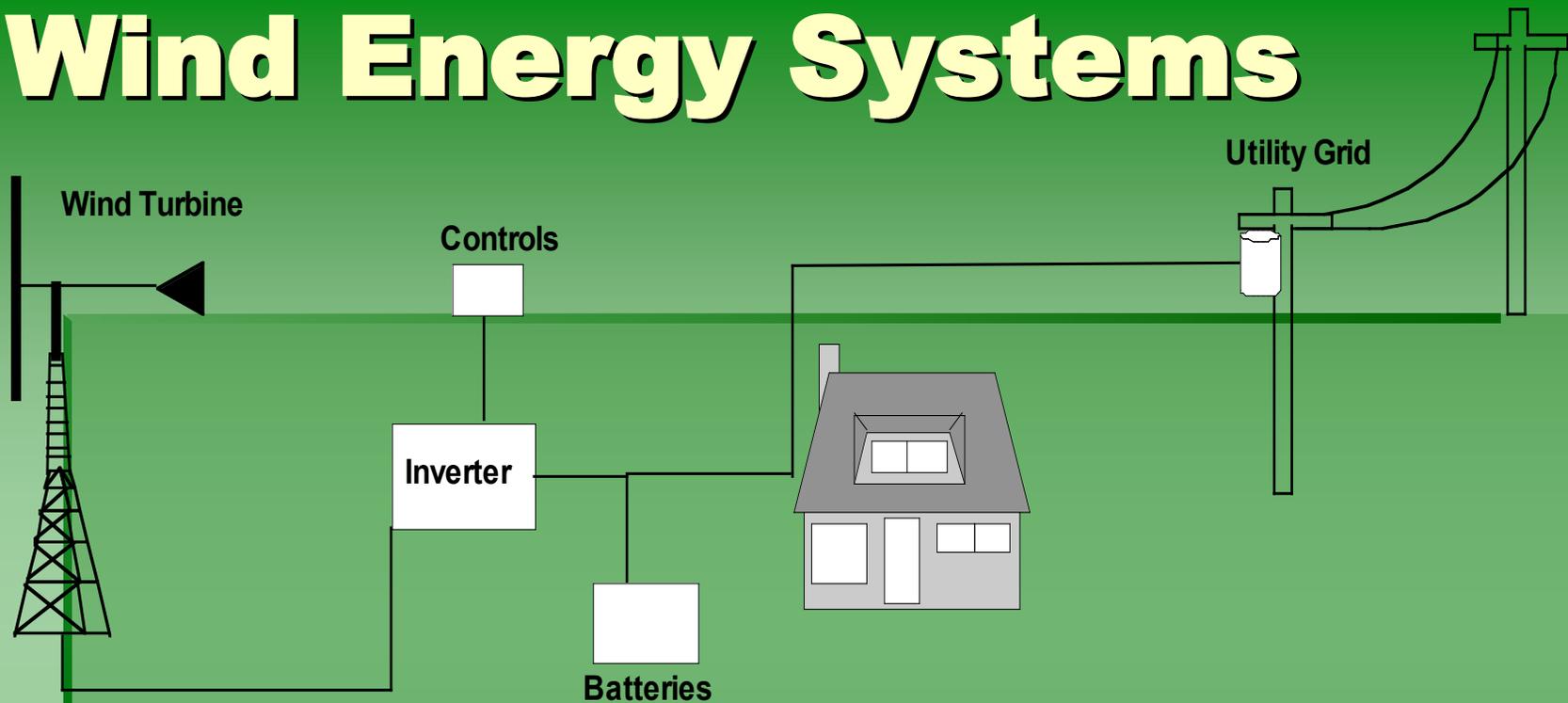
Wind Energy

System Overview

Wind Energy Systems

- A typical 10 kW home wind energy system costs \$20,000 - \$40,000 to install.
- Depending on the wind environment they will produce between 10,000 – 18,000 kWh per year - enough power for home or farm use.
- However, the height requirement of wind turbines to be taller than surrounding trees and buildings limits their feasibility to rural areas.

Wind Energy Systems

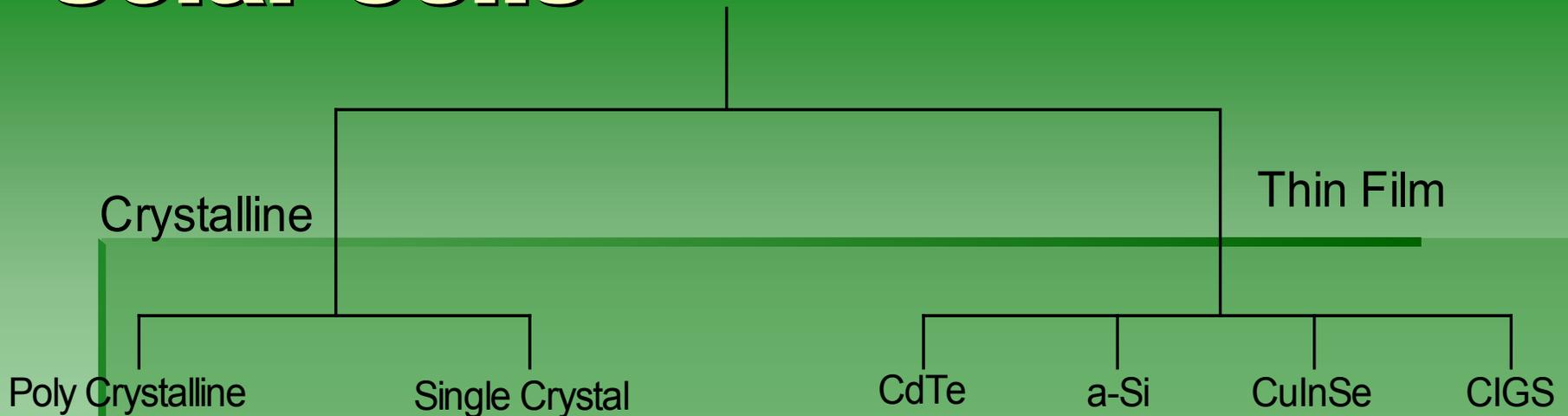


Wind provides the energy that enables the wind turbine to produce DC current that could be used to run a machine. Often an inverter is installed to convert the DC current to AC current that is used in homes. In addition, a battery system can be installed to provide back up power when is not adequate enough to generate power. Sometimes wind and solar energy systems are combined to provide electrical power.

Solar Energy

Technology Primer

Solar Cells Photovoltaic

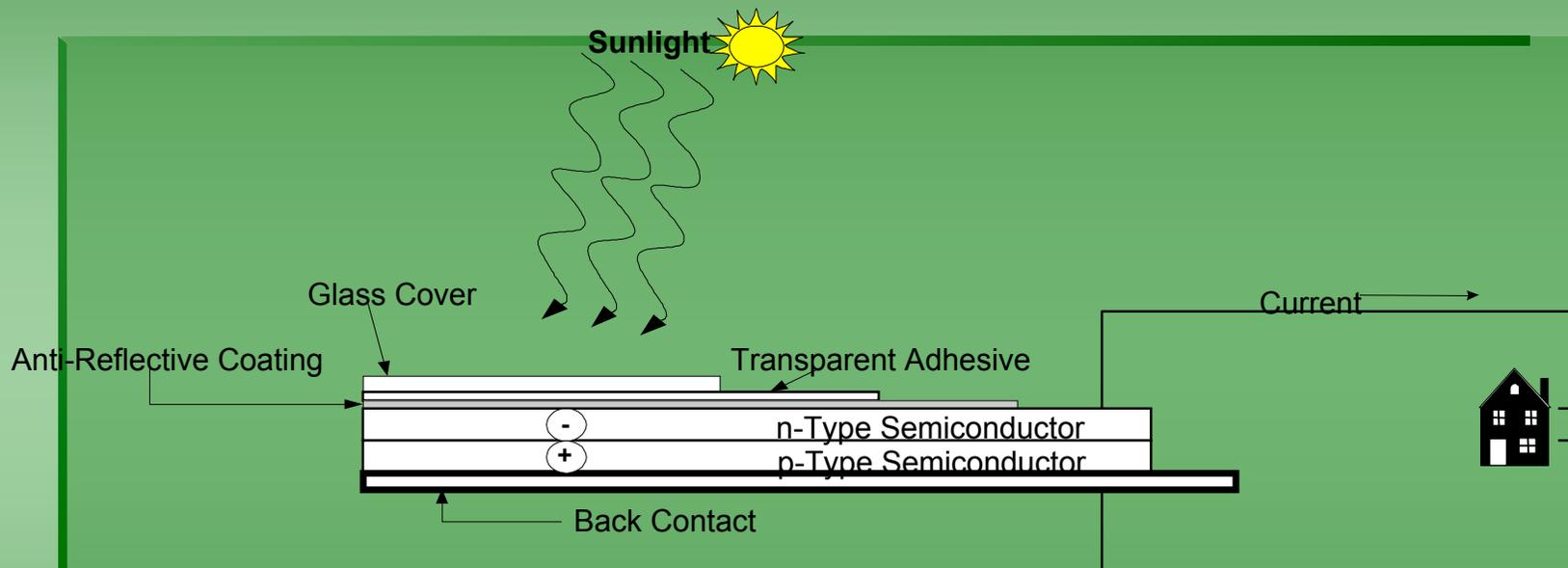


CdTe - Cadmium Telluride
a-Si - Amorphous Silicon
CuInSe - Copper Indium Selenium
CIGS - (Cu(In,Ga)Se₂) - Copper, Indium, Gallium and Selenium

Crystalline is most common for homes because it offers higher efficiencies requiring a smaller footprint in comparison to Thin Film solar cells. However, advances with new materials such as CIGS and CdTe solar cells offer a number of advantages over crystalline silicon solar cells.: CIGS is less expensive per watt in comparison to crystalline, more efficient in low-angle and low-light conditions, and is lightweight and flexible.

Thin Film has a cost advantage over Crystalline. Thin Film is a direct band-gap semiconductor and Crystalline silicon is an indirect band-gap semiconductor. The direct band-gap properties of Thin Film enables the material to generate significantly more electricity per unit of material. A 1 micron thick film of CIGS film can generate a photoelectric field equal to a crystalline silicon wafer 200-300 microns thick. In essence, CIGS has a dramatic cost advantage because it uses less than 1% of the semiconductor material.

Photovoltaic Device

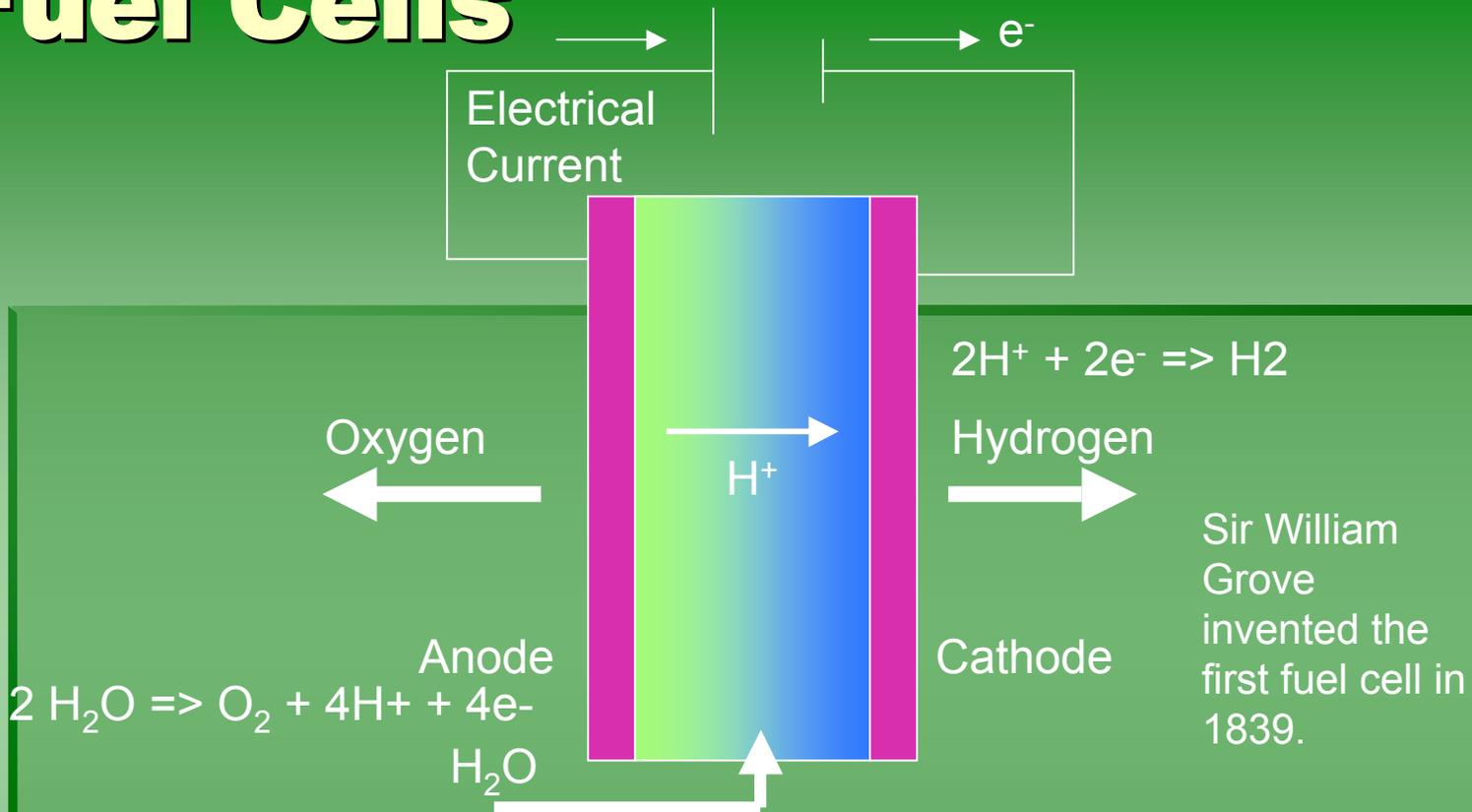


Certain Thin Film materials such as CdTe offer efficiencies almost as high as poly crystalline, but lends itself to more efficient manufacturing processes such as an integrated continuous process system, lower material costs, and significantly larger substrates (2' x 4' sheet versus a 6" wafer)

Fuel Cells

Technology Primer

Fuel Cells



Source: Dept of Energy <http://www.sc.doe.gov/bes/hydrogen.pdf>

Sir William Grove invented the first fuel cell in 1839.

Fuel cells are devices that convert chemical to electrical energy - in essence, it is an electrochemical energy conversion device. The chemical process of a fuel cell hydrogen and oxygen are combined into water, and in the process the conversion produces electricity. Passing a electrical current through water - water electrolysis is just the reverse of the electricity-generating process occurring in a fuel cell.

Fuel Cells

There are several types of fuel cells base on their chemical process. Some fuel cells are applicable for vehicles and others for generating electricity for homes or businesses.

Polymer Exchange Membrane Fuel Cell (PEMFC)

The Department of Energy (DOE) believes PEMFC could be used for vehicle applications because it offers high power density and a relatively low operating temperature. The low operating temperature means that it doesn't take very long for the fuel cell to warm up and begin generating electricity.

The PEMFC uses an electrolyte as the proton exchange membrane similar to water used in the electrolysis process. The membrane is a treated material that collects electrons. One of the issues with PEMFC, is that the membrane must be hydrated in order to function and remain stable so cold environments may pose a problem.

Solid oxide fuel cell (SOFC)

SCFC fuel cells appear most feasible for generating electricity for factories or towns. SOFC fuel cells operate at very high temperatures which makes them less desirable for vehicle applications.

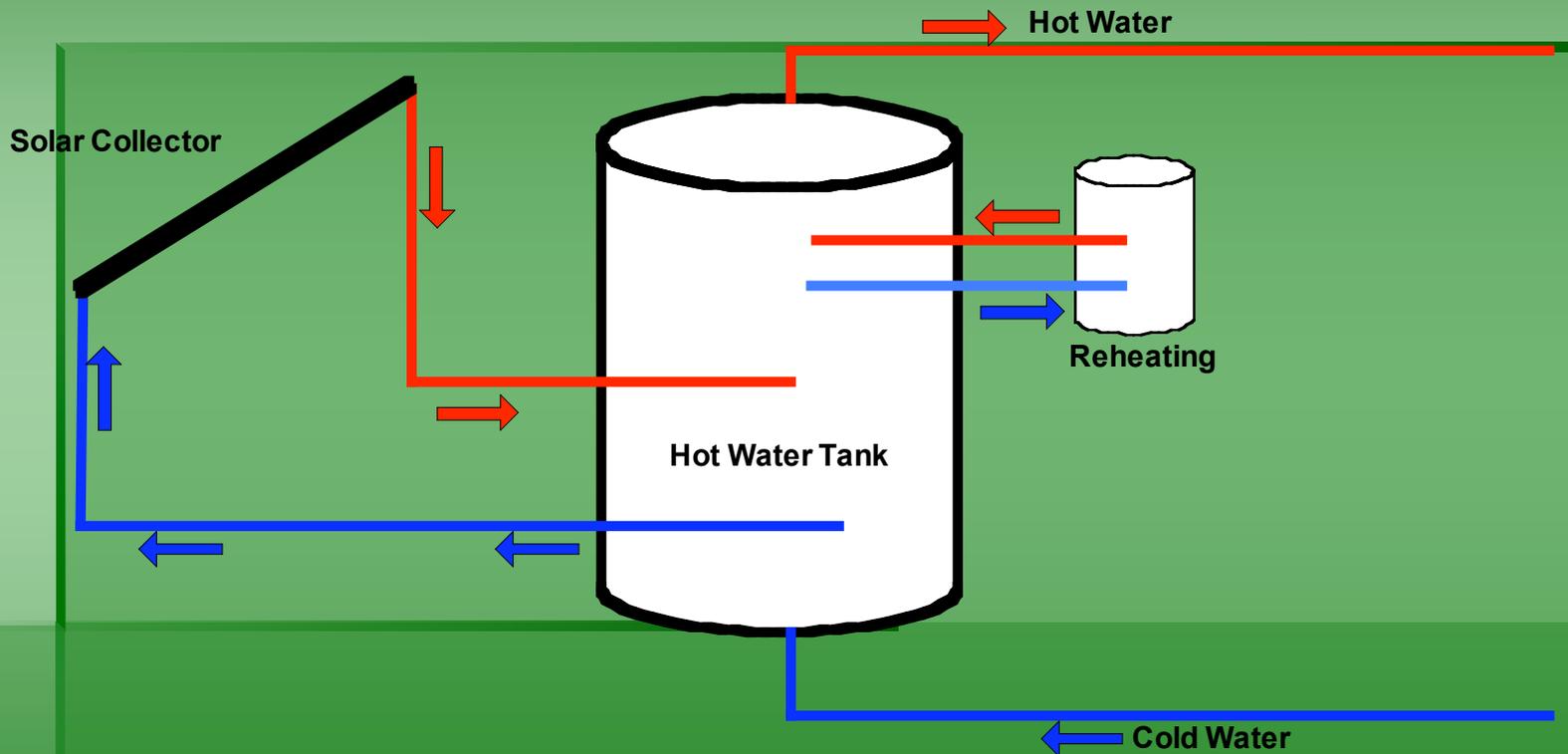
Source: <http://www.fuelcells.org/>

Green Econometrics –
Wanasa Holdings Company LLC

Solar Hot Water

System Basics

Solar Hot Water System



In a solar hot water system the sun's rays provide heat transfer to the solar collector which in turn raises the water temperature to minimize the energy consumption for hot water use. A reheating system heats the water in the hot water storage tank for home usage.