4. Solar Futures
Designing with the Sun
Solar Energy is currently being used to produce electricity for schools, business and homes as well as gadgets and lighting products. It can be used for stand alone devices, meters, gadgets, security, lighting products, mobility and scientific sensors.

- Solar Jobs
- Load Analysis
- Home Energy Efficiency
- Discussion Question
- Activities
- Links & Resources
Solar Jobs
Solar instructors train students in solar technology topics.

Some instructors conduct research on solar-related subjects.

Photo credit: Sol Design Lab at Stanford University
The **architect** designs, plans, and implements solar projects for individuals, governments, or businesses.

They work with solar installers to plan out solar-related equipment, such as photovoltaic modules and home roof racking systems.
The **solar designer** sources the equipment and designs the entire solar installation for residential or commercial projects.
The solar installation manager plans and subcontracts the installation and maintenance of solar energy systems, and finds the right location for solar installation and equipment.
Solar Installers mount solar systems onto building rooftops and make sure the solar system components are properly wired and secure.
Field inspector works with utility companies and city departments to permit and inspect solar installations for safety, PV shading issues and rebate qualifications.
Solar Sales Manager

The **solar sales manager** handles the contracts for clients seeking to install solar energy on their home or business and handle tax rebates and other incentives.
Solar Electrician

The **solar electrician** is responsible for the certification and electrical installation of the solar equipment.

Photo credit: mechanicalengineering.com

Photo credit: cfs.psu.edu
The **solar engineer** designs and develops different types of solar cells or batteries, maintaining technical specifications and uses computer design programs.
Solar technicians develop, manufacture and test solar PV technology in a factory clean room.
People invent new ways to use **solar products** to solve real world problems in their communities.

**We Care Solar** designs portable solar suitcases to power critical lighting and medical devices in low resources areas without reliable electricity.

-wecaresolar.org

Photo credit: We Care Solar
Challenges to the Solar Industry

- Pandemic related **business** disruption
- Availability of solar **financing** and **incentives** to support consumer demand
- Market demand for solar from **utilities**
- Upfront **expenses** of solar versus other forms of energy
- **Homeowners’ associations** may not allow solar installations
- Lack of basic **solar education**
- International **price competition** is constraining US solar manufacturing
- Fossil fuel subsidies and falling price of **oil**
- **Material depletion** and global shipping impact
- How will solar installations be affected by **climate disasters** (fire, storms)?
Load Analysis

The first step in designing a solar array system for a building is to do a **load analysis** to find out how much electricity your system will need to produce.

The **load** includes everything electrical in the home or building you are adding solar to.

**Example:**
- Dryer: 1000 watts
- Computer: 150 watts
- Teapot: 700 watts

It is very important to use **energy efficient appliances** when sizing a building for solar energy to minimize the energy need and cost of the system. Look for the energy star logo.
The **electric meter** measures the amount of energy consumed by a building.

The **watt** is a unit of power

The **kilowatt** \((kW)\) = 1000 watts

The **kilowatt hour** \((kWh)\) is most commonly used in electric bills by the utility company.
Calculate a load analysis for your house

**TYPICAL POWER USAGE**

- **Compact Fluorescent Lightbulb**: 11-16 watts
- **Incandescent Lightbulb**: 100 watts
- **Cell Phone**: 4-25 watts
- **Laptop Computer**: 120-140 watts
- **Electric Bike**: 100-300 watts
- **Coffee Maker**: 800 watts
- **Desktop Computer**: 80-450 watts
- **Microwave**: 750-1400 watts
- **Freezer**: 475-2500 watts
- **Clothes Dryer**: 4000 watts

**LOAD ANALYSIS**

<table>
<thead>
<tr>
<th>Load Description</th>
<th>Qty</th>
<th>Power Rating (W)</th>
<th>Operating Time (hr/day)</th>
<th>Energy Consumption (Wh/day)</th>
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<tbody>
<tr>
<td>Refrigerator/Freezer</td>
<td>1</td>
<td>200</td>
<td>10</td>
<td>2000</td>
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<tr>
<td>Microwave</td>
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<td>1200</td>
<td>0.5</td>
<td>600</td>
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<tr>
<td>Toaster</td>
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<td>1000</td>
<td>0.05</td>
<td>50</td>
</tr>
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<td>0.25</td>
<td>150</td>
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<td>800</td>
<td>0.29</td>
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<td>Entertainment Center</td>
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<td>200</td>
<td>3</td>
<td>600</td>
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<tr>
<td>Computer System</td>
<td>1</td>
<td>100</td>
<td>2</td>
<td>200</td>
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<tr>
<td>Plug Loads</td>
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<td>1</td>
<td>200</td>
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<td>2400</td>
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<td>Fluorescent Lighting</td>
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<td>15</td>
<td>6</td>
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<tr>
<td>Fluorescent Lighting</td>
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<td>32</td>
<td>4</td>
<td>512</td>
</tr>
</tbody>
</table>

**AC LOADS**

- **Total AC Power**: 5388 W
- **Total DC Power**: 0 W
- **Total Daily AC Energy Consumption**: 7568 Wh/day
- **Total Daily DC Energy Consumption**: 0 Wh/day
- **Weighted Operating Time**: 11.2 hr/day
- **Inverter Efficiency**: 0.90

**Average Daily DC Energy Consumption**: 8409 Wh/day

Use an online calculator like [gensize](https://gensize.com)
Home Energy Efficiency

What can **you** do to save electricity at home?

**Tips:**

- Turn light off when not in the room.
- Use LED lights
- Hang clothes in the sun to dry
- Turn off vampire appliances
- Use window shades and fans to cool down a room without AC.
- Purchase energy efficient appliances when possible.

**TOP TEN “VAMPIRE” APPLIANCES**

**VAMPIRE APPLIANCES OR ELECTRONICS** use energy even when they are switched off, or are not performing their primary function.

1. **SET-TOP BOX** (Both Digital Cable or Satellite DVRs)
2. **COMPUTER** (Laptops use more energy than desktops)
3. **PRINTERS** (Inkjet and multi-use printers use the most)
4. **DVD/VCR** (Get rid of that VCR! It uses twice as much energy)
5. **CENTRAL HEATING FURNACE** (Even when “off,” a furnace can use a lot of electricity)
6. **ROUTERS & MODEM**
7. **PHONES** (Answering machines also use up electricity)
8. **GAMING CONSOLE** (Keeping multiple consoles plugged in can cost you)
9. **TELEVISION** (The larger the screen, the more energy used)
10. **MICROWAVES** (The clock on your microwave constantly uses energy!)

Photo credit: @Conductive Electric
What are some ways you can reduce electricity use at home?
Activity

Make a Sundial

Stump Block Sundial Activity
www.instructables.com/id/Stump-Block-Sundial/

Sundial by Noah Kirby
https://www.artsintransit.org/portfolio/sundial/
A **carbon footprint** is the total amount of greenhouse gas emissions that come from the production, use and end-of-life of a product or service. + Calculate your own footprint in regards to home energy, transportation, and waste.

www3.epa.gov/carbon-footprint-calculator/
Designing with the Sun

Links & Resources

Learn More

Database of State Incentives for Renewables [https://www.dsireusa.org/](https://www.dsireusa.org/)
NASA Climate Kids [https://climatekids.nasa.gov/greenhouse-effect/](https://climatekids.nasa.gov/greenhouse-effect/)
National Center for Appropriate Technology [www.ncat.org/](www.ncat.org/)
The Solutions Project [thesolutionsproject.org/](thesolutionsproject.org/)
PG&E Energenius Educational Program [https://www.energizeschools.org/](https://www.energizeschools.org/)
Designing with the Sun
Curriculum design by Prof. Beth Ferguson
Graphic design by Tracy Corado