Basics of Electricity

This paper sets out three fundamental concepts of electricity:

1. The difference between **energy** and **power**;
2. Basic **electrical units**; and
3. How electricity relates to **other sources of energy**.

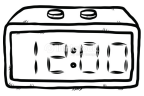
Energy and Power

Energy is the ability to do work. **Power** is how fast energy can be used or transmitted.

Consider a truck: it needs **energy** to carry cargo from point A to point B. The heavier the cargo is, and the further A is from B, the more **energy** the truck will use. The truck's **power** is the maximum amount of **energy** it has available, often described as horsepower. The more powerful the truck, the faster it can go from A to B, and the more cargo it can carry. **Power** is there even if the truck is not turned on, whereas **energy** is only consumed while operating.

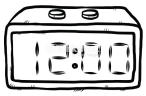
Electrical Units

The power needed to run an appliance is referred to as the **load**, and the amount of power a generator can provide is referred to as its power generation **capacity**. In both cases it is expressed in **watts** (**W**). Electrical energy is measured as the amount of power used multiplied by its duration, and its units are **watt-hours** (**Wh**). The prefixes **kilo**-, **mega**-, **giga**- and **tera**- describe progressively larger amounts of energy or power.



A clock radio needs **2 W** (watts) of **power** (**load**) to work.

1 clock radio draws **1 Wh** (watt-hour) of **energy** every half hour



A kilowatt, **1 kW = 1,000 W**
An electric bike's motor produces around half a **kW** of **power** (**capacity**).

A kilowatt-hour, **1 kWh = 1,000 Wh**
With 1 **kWh** of **energy** storage a 0.5 kW electric bike will run for 2 hours

A megawatt, **1 MW = 1,000,000 W**, or 1,000 kW
A wind turbine can generate **3 MW** of **power** (**capacity**)

A megawatt-hour, **1 MWh = 1,000,000 Wh**, or 1,000 kWh
The average US household consumes **1 MWh** of **energy** in a month

A gigawatt, **1 GW = 1,000,000,000 W**, or a million kW
The Hoover Dam can generate **4 GW** of **power** (**capacity**)

A gigawatt-hour, **1 GWh = 1,000,000,000 Wh**, or 1,000,000 kWh
A 3 MW turbine would generate 1 **GWh** of **energy** in 14 days at full power

A terawatt, **1 TW = 1,000,000,000,000 W**, or 1,000,000,000 kW
The United States has **1 TW** of **power** generation **capacity**

A terawatt-hour, **1 TWh = 1,000,000,000,000 Wh**, or 1,000,000,000 kWh
The Hoover Dam generates **4 TWh** of **energy** every year

Other Sources of Energy

Electricity only supplies about a third of US energy uses. Many applications, including heating, cooking, and transportation, still depend on other sources of energy. **Primary energy** comes directly from natural

resources (such as wind, crude oil, or hydropower) and has to be transformed into an **energy currency** (such as electricity), or a **secondary fuel** (such as gasoline) for use.

The table below shows the distribution of primary energy use between sectors in the United States. Electric power generation makes up 37% of energy consumption, but only 27% of greenhouse gas (GHG) emissions, making it the least GHG-intensive energy use. Increasing the proportion of renewable energy (RE) generation on the grid will only improve electricity's GHG intensity. If the increased RE generation is used to power other energy uses, such as heating and transportation, humanity's contribution to climate change can be reduced even further.

U.S. Energy Use and GHG Emissions by Sector

Sector	Primary Energy Consumption	GHG Emissions
Transportation	28%	28%
Industrial	23%	22%
Residential & Commercial	12%	12%
Electric Power	37%	27%
Agriculture	—	10%

References and Further Reading

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Where this White Paper Fits In