Everything You Need To Know About Energy

Scientists describe energy as the power enabling a body or system (machine) to work.

Energy is all around us. When you cook over a campfire you’re taking the stored energy in the wood you’re burning and transferring it to the food you’re about to eat in order to warm up that meal.

There is energy in that food, too, which ultimately comes from the energy absorbed by plants from the sun (even if an animal had to eat that plant first and use the energy themselves. You can feel the energy of the sun when you feel the warmth of the sun on your back.

For 2019-20, Australian electricity was generated from (Source):

- 55 percent coal sources
- 21 percent gas sources
- 23 percent renewable sources, specifically;
  - 8 percent from solar
  - 8 per cent from wind
  - 6.4 per cent from hydro (water)
WHAT IS ELECTRICITY?

Electricity is a form of energy. We use this energy in almost every aspect of our lives, such as generating heat and light for our homes, and powering our computers.

All the matter of the universe is made up of microscopic particles called atoms. The nucleus (centre) of an atom is surrounded by particles called electrons. When these electrons move from one place to another (a current), this is what we know as electricity.

A circuit is a loop that directs the flow of electrons through something. For example, electrons are fed into a lightbulb, and the lightbulb converts that electrical energy into light.

HOW DO WE GENERATE (CREATE) ELECTRICITY?

There are a number of different ways to generate electrical energy. Most methods involved turning a turbine to power a generator.

Some forces (water, wind) flow and turn a turbine. The spinning turbine causes large magnets to turn within coils of copper wire; this is called the generator. The magnets cause electrons in the wires to move from one place to another. This creates an electrical current, and this is what we know as electricity.
FOSSIL FUELS are so-called because they are formed from the fossilised remains of ancient forests and animal remains. Many of these forests built up deep layers of peat (wet, rotten plant matter) at their base over time. Animals died and their remains lay in the peat as well.

During the millions of years of the Carboniferous period 300-360 million years ago, all of this material was squashed by sediment that built up on top of it. A combination of all of that pressure, as well as the heat of the earth, caused those remains to turn into solid coal, liquid crude oil, and natural gas. These remained trapped beneath the surface of the earth in pockets, reservoirs (pools) and coal beds until humans began to extract them.

At a power station, fossil fuels are combusted (burned). The heat this generates turns water into steam. The pressure from the steam causes a turbine to spin.

Interestingly, coal power plants are not very energy efficient and on average only 30-40% of the chemical energy in coal is converted to useful energy. The rest is lost as heat in the conversion process.

Another problem is that the process of burning fossil fuels also releases a large amount of the greenhouse gas carbon dioxide which is stored within the fuel, because all of the things that made the fossil fuels in the first place contained high amounts of the chemical element carbon, which is an important building block of all living things. Carbon dioxide is a contributor to climate change as it remains in the atmosphere heating our planet.

Currently, 24 gigatonnes of the world’s total annual carbon emissions are emissions from electricity and heating generation.

The alternative is renewable energy sources. These produce energy using natural resources that are constantly replaced and never run out.
METHODS OF GENERATING
ELECTRICITY

SOLAR POWER

Solar is the Latin word for ‘sun’, so when we talk about solar energy, we are talking about energy that comes from the sun. We already use the energy from the sun for light and warmth: without the sun the earth would be completely dark, freezing and lifeless.

But we can use solar panels to capture the sun’s energy and convert it into electricity. This is a bit different to the way other sources of energy use turbines and generators to create electricity.

Each solar panel is made up of photovoltaic (PV) cells made from silicon. The sun shines photon (light) particles onto the solar panel with enough energy to ‘knock loose’ microscopic electrical particles known as electrons held within the cell. These electrons are drawn into a conduit on the outside of the cell, where they flow into an external circuit such as a lightbulb and provide power to it. Any power that is ‘left over’ gets directed into the mains power grid for others to use.

The best part about solar energy is that it creates almost no pollution (some pollution may be generated in building and transporting the solar panels). And because the sun’s energy is totally renewable it will never run out (well, it will in around 4 billion years but that means we’ve got a bit of time to prepare).

The amount of energy received from the sun in one hour could power the entire world for a year.

However, only 8 per cent of Australia’s electricity generation in 2019-20 came from solar power.
WIND POWER

The wind turbines that we now use for generating electricity work in much the same way as the windmills of the past: when the wind turns the blades of the windmill, which is known as kinetic or movement energy, it spins a turbine inside a small generator to produce electricity.

Unlike the sun, wind is not constant and doesn’t blow in the same place all the time (although there will always be wind somewhere and it will never run out, making it a truly renewable source of energy). If the wind turbines are spread far enough they can be always capturing the wind energy and putting it into the grid.

Every 24 hours, wind generates enough energy to produce roughly 35x more electricity than humanity uses each day. However, only 8 per cent of Australia’s electricity generation in 2019-20 came from wind power.

The trouble with wind energy has nothing to do with energy creation itself, but everything to do with the look of wind turbines. Some people have a problem with them, and this has prevented a number of wind farms being constructed in Australia and other parts of the world.

There is a very low chance that wind turbines can harm birds or bats flying through them.

However, only 8 per cent of Australia’s electricity generation in 2019-20 came from wind farms.
HYDROPOWER

If you’ve ever been dumped by a big wave while out swimming at the beach, you’ll understand the power of water.

Humans have known about the power of water for a long time. Ancient civilisations used the running water of a river to turn a big paddle and power a grinding stone to grind grain.

More recently, humans have been using the power of water to make electricity.

The Snowy Mountains Scheme (NSW) is a hydroelectric scheme that’s been going for more than 35 years and has been operating as the largest renewable energy generator in Australia, providing up to 3.5% of the mainland grid’s power.

A dam is built across a river to stop its natural flow. The damn forces the water through a large pipe which contains a turbine. Hydroelectricity does not actually consume any water, as all the water is returned to the river after use, making it quite renewable. However, while hydro plants can have very large capacities, the amount of electricity they generate can be very different from year to year depending on how much rainfalls.

Also, constructing the dams and diverting the rivers to get the most amount of water possible to produce the electricity can lead to environmental damage, both through the construction of the dam and also through reduced water flows to the natural environment.
NUCLEAR POWER

Uranium is a silvery-grey metal that occurs naturally in rocks and soil. Uranium is radioactive. This means that the nucleus (the collection of particles at the centre of an atom) is unstable - it spontaneously releases little bursts of energy. This is commonly known as radiation, and this energy isn’t good for humans, as it can mutate or even kill the cells in our bodies.

The main use humans have found for uranium is as a non-renewable fuel source in nuclear power plants, and the power output from nuclear power plants is unbelievably efficient. However, unlike other fossil fuels like coal, the production of power from uranium is pollution-free - at least, in terms of carbon emissions.

A nuclear reactor work by bombarding uranium particle with neutrons, splitting them in half. The force of this split releases lots of energy, which is captured by control rods which channels them into our power grids.

However, nuclear power comes with many challenges.

The construction of nuclear plants is very energy-intensive, expensive, and takes a long time. There have been several large accidents at nuclear power plants, such as Chernobyl and Three Mile Island, that led to mass evacuations and uninhabitable areas due to radiation poisoning of the surrounding land and air.

The nuclear waste produced by nuclear power plants remains radioactive for thousands of years, making it difficult to store in a safe way. Furthermore, this waste (plutonium) can be used to make nuclear bombs.

This makes nuclear power a difficult prospect despite its benefits, and the risk it poses and harmful waste it produces means many people are opposed to adopting it.
USEFUL VIDEOS

ENERGY

- Can 100% renewable energy power the world? - Federico Rosei and Renzo Rosei (https://www.youtube.com/watch?v=RnvCbquYeIM)

ELECTRICITY

- What is electricity? | STEM kids (https://www.youtube.com/watch?v=oB1v-wh7EGU)
- Energy 101: Electricity Generation (https://www.youtube.com/watch?v=20Vb6hLQ5Sg)
- How much electricity does it take to power the world? (https://www.youtube.com/watch?v=tjwrG4Debc4)

COAL

- Coal 101 (https://www.youtube.com/watch?v=iN6LvH_4Q3g)

SOLAR POWER

- How do solar panels work? - Richard Komp (https://www.youtube.com/watch?v=xKxrkht7CyY)
- Why aren't we only using solar power? - Alexandros George Charalambides (https://www.youtube.com/watch?v=k8d5Pf7VliU)

WIND POWER


HYDROPOWER

- How Does Hydroelectricity Work (https://www.youtube.com/watch?v=W0axSL4tQYA)
NUCLEAR POWER

- How do nuclear power plants work? - M. V. Ramana and Sajan Saini
  (https://www.youtube.com/watch?v=R7WPEYGr1Vs)
- Is radiation dangerous? - Matt Anticole
  (https://www.youtube.com/watch?v=zl2vRwFKnHQ)