

MINERALS IN A SOLAR PANEL

Sunlight, or **solar power**, is a form of **renewable energy**. This means it can be used again and again without running out. Renewable energy resources are an alternative to **non-renewable** energy resources like coal, natural gas, and oil (also known as fossil fuels). We've been burning fossil fuels for our energy for a long time and because of this we've been emitting **greenhouse gases** into the Earth's atmosphere. These greenhouse gases, one of which is called carbon dioxide, are contributing to **climate change**. Therefore, it's crucial that we replace fossil fuels with renewable energy resources, like solar power, to be able to meet our future energy needs and help reduce the effects of climate change.

HOW DO THEY WORK?

Solar panels can harness the sun's energy and convert this into either electricity or heat. Solar **photovoltaic cells** are the solar panels that we use to generate electricity and **solar thermal panels** are used to generate heat.

Solar photovoltaic cells are made from materials that are **semi-conductors**. These are materials that conduct electricity better than an insulator but not as well as a metal. When sunlight hits the semi-conductor material it gives its energy to negatively charged particles called electrons. This causes the electrons to flow through the semi-conductor material and produces an electrical current.

DID YOU KNOW?

Solar power can be used in space! Spacecraft that orbit the Earth, known as **satellites**, are installed with solar panels which generate electricity from the sunlight. This electricity is used to power instruments that help the satellites take pictures and collect information in space. The first satellite to use solar power was the Vanguard 1 satellite, which was launched back in 1958.

SPHALERITE : ZINC

Chemical formula: $(\text{Zn},\text{Fe})\text{S}$

Zinc is a silvery metal which is often used to galvanise, or coat, other metals like iron to prevent rusting. The mineral sphalerite is the most important ore for zinc.

Zinc oxide can be used to coat solar panels, protecting them from weather, preventing rust and increasing their lifespans. Zinc oxide can also be used as a coating to minimise light reflection of the solar panel and increase its efficiency.

Compounds containing zinc are important components in lots of different things we use including batteries, paints, medicines, cosmetics, fluorescent lights and X-ray screens. Zinc is also important in our body as it helps support our immune system as well as our sense of smell and taste.

QUARTZ : SILICON

Chemical formula: SiO_2

Silicon is a 'metalloid' which means it shares some characteristics of metals and some characteristic of non-metals. Silicon comes from the rock quartzite (made from the mineral quartz) or from quartz rich sand.

Silicon is the most important element in a solar panel as its used to make the thin films in the photovoltaic cells. Each photovoltaic cell is made from two layers of silicon crystal, a positive 'p-type' layer and a negative 'n-type' layer. To create the p-type layer atoms such as boron or gallium are added to the silicon to give it a positive charge (a lack of electrons) and to create the n-type layer atoms such as phosphorous are added to give it a negative charge (an excess of electrons). On top of a solar panel there is also usually a thin layer of glass which protects the photovoltaic cells and can also help regulate heat and humidity within the panel. Silica (silicon oxide, SiO_2) is the main component of glass.

Silicon is one of the most common elements in the Earth's crust it's beaten only by oxygen.

MOLYBDENITE: MOLYBDENUM

Chemical formula: MoS_2

Molybdenum is a silvery-grey metal. It is a good electrical conductor and is stable over a wide temperature range. Most of the molybdenum we use comes from the mineral molybdenite, however we can also get molybdenum as a by-product from tungsten and copper production.

Molybdenum is used in solar panels as an electrode to gather electricity from the rear surface of the thin film of silicon, which is what converts solar energy to electricity in the panels. A thin layer of molybdenum, only a few billionths of a meter thick, is bonded to the glass or plastic which sits behind the silicon film. Compared to other metals, its ability to bond well, resist corrosion and pick up charged particles, helps panels run reliably, cooler and more efficiently.

CHALCOPYRITE: COPPER

Chemical formula: CuFeS_2

Copper is a brownish-red, shiny metal that is very good at conducting heat and electricity. Most of the copper we use comes from the mineral chalcopyrite. However we can also find copper in its 'elemental form', which means finding the copper as a lump of metal rather than within another mineral.

Because it is so good at conducting electricity and also very bendy, copper is used in the wires and cables of a solar panel.

The Statue of Liberty is green because of copper! That's because when copper is exposed to water it turns into copper oxide which is a bluey-green colour. Believe it or not when the statue was first put up in 1886 it was actually a dull brown colour because of its copper coating.

HEMATITE : IRON

Chemical formula: Fe_3O_4

Iron is a shiny grey metal which comes from iron ore - a combination of minerals or a material that contains a lot of metallic iron. Common types of iron minerals are hematite, magnetite and goethite.

Iron is used to make steel which is used in frames of solar panels. Because steel is very strong, steel frames can often support larger solar panels than those made from just aluminium.

Iron is used to make steel which is used in bridges, buildings, cars, ships, railways, aeroplanes and many other things. Because of this iron is the most widely used metal on Earth.

LIMONITE : NICKEL

Chemical formula: $\text{FeO}(\text{OH}) \cdot n\text{H}_2\text{O}$

Nickel is a silvery-white metal which is very ductile (stretchable) and has a high melting point. Nickel comes from two main sources. It can be found in sulfide minerals like pentlandite and chalcopyrite (an important mineral for copper), or it can be found in deposits known as laterites. Laterites are soft clay-like minerals. Limonite is an example of a laterite mineral that is rich in nickel and iron.

Nickel can be combined with steel and used in the frames that support the solar panels and direct them towards the sunlight. Nickel can also be used to coat the solar panels to make them more resistant to weathering and corrosion.

The inner core of the Earth is made from an alloy (mix) of iron and nickel metals. Nickel can also be found in meteorites and asteroids out in space!

CASSITERITE: TIN

Chemical formula: SnO_2

Tin is a soft silvery-white metal it can be used to make lots of important alloys including steel, solder and pewter. The mineral cassiterite is the most important source of tin.

Tin solder is a very important component solar panels. Thin ribbons of metal that connect the individual photovoltaic cells, are made from copper wires with a tin solder coating. The electrical systems in the solar panels also require tin solder for connection points.

Bronze is an alloy (mix) of copper and tin which is very strong but also easy to melt and shape. The 'Bronze Age', was a period in human history lasting from around 3300 - 1200 BCE. It was a time when humans started using bronze instead of stone to make tools, weapons, armour and other items, and is considered to be a key developmental period in our human history.