

Carbon Cards Challenge

Instructions

This game is played to the rules of "Happy Families" or "Quartet" a card game that is popular throughout Europe.

The game requires with a pack of 44 cards, grouped into 11 sets of four. These cards feature pictures and descriptions of issues and vocabulary to do with climate change and low-carbon technologies.

The aim of the game is to collect all four cards in a group, for example to complete the "Greenhouse Gases" group you will need to collect the following four cards: Water vapour, Carbon dioxide, Methane and Nitrous oxide.

- You will need** A3 colour printouts of the card sheets, scissors, backing card and glue (optional).
- To start** carefully cut-out all 44 cards (you can stick them onto cardboard to make them last longer) and shuffle them well. Deal the cards out as equally as possible to each player. Players can look at their cards but must not show them to others.
- To play** anybody who has been lucky enough to be dealt a complete set of four cards should put these cards face down in the centre before the game begins. The player on the dealer's left goes first. This player (player 1) can ask any other player for a card so long as they already hold at least one card in the set. If player 2 does not have the card asked for by player 1, then it is player 2's turn to ask any player for a card that they are looking for. If player 2 does have the card asked for by player 1, they have to pass it to player 1 and player 1 can then ask another player for a different card. Once a player forms a complete set of four cards, they place the set face down in the centre of the group.
- The winner** is the first player to get rid of all their cards.

S U P P O R T E D B Y



RENEWABLE ENERGY
Sources of energy that will not run out.

Solar energy
Thermal/electrical

Energy from the sun's rays (solar radiation) can be converted into heat (thermal energy) and electricity (using photovoltaic cells or solar thermal power plants).

RENEWABLE ENERGY
Sources of energy that will not run out.

Wind energy
Onshore/offshore wind farms

Energy from moving air (kinetic energy) can be used to turn the blades of a wind turbine, which turn a shaft connected to an electric generator that produces electricity.

RENEWABLE ENERGY
Sources of energy that will not run out.

Water energy
Hydro/tidal/wave power

Energy from rapidly falling water, strong tides or waves can be used to spin a turbine attached to an electric generator to create electricity.

RENEWABLE ENERGY
Sources of energy that will not run out.

Geothermal and biomass energy

Heat energy from the core of the Earth (geothermal energy) can be used as hot water or steam to heat buildings and operate thermal power plants.

The chemical energy in plants and tiny organisms are converted to thermal or electrical power. Biomass can be converted into gas and transportation fuels, like bio-diesel (biomass energy).

NON-RENEWABLE ENERGY
Sources of energy that will eventually run out.

Uranium (nuclear)

Uranium is a common metal found in rocks around the world. A special type can be split apart and used to create nuclear energy. Uranium is a non-renewable form of energy but not a fossil fuel.

NON-RENEWABLE ENERGY
Sources of energy that will eventually run out.

Coal

Coal is a brown or black rock mostly made up of carbon and hydrocarbon. It is a fossil fuel because it was formed from the remains of plants buried in layers of rock for millions of years. It is easily burnt to produce heat energy, which is often used to generate electricity.

NON-RENEWABLE ENERGY
Sources of energy that will eventually run out.

Oil

A liquid called crude oil can be refined into various products, such as diesel, petrol and propane. It is a fossil fuel because it was formed from the remains of plants and tiny animals buried under layers of rock millions of years ago. Oil is mainly burnt to produce energy, but it can also be used to make products like plastic.

NON-RENEWABLE ENERGY
Sources of energy that will eventually run out.

Gas (methane – CH₄)

Methane is a colourless, odourless and tasteless gas that can be burnt to produce heat energy and then used to generate electricity. It is a fossil fuel because it was formed from the remains of plants and tiny animals buried in layers of rock millions of years ago.

GREENHOUSE GASES (GHG)
Chemicals in the atmosphere that trap some of the heat from the sun.

Water vapour (H₂O)

Water vapour is the most abundant GHG. Water vapour is part of the water cycle - the Earth is about 72% water - but it is unclear how much this GHG is affected by human activity.

GREENHOUSE GASES (GHG)
Chemicals in the atmosphere that trap some of the heat from the sun.

Carbon dioxide (CO₂)

CO₂ is the GHG that people are most concerned about due to its huge increases in atmospheric concentration in the past 200 years, largely from increased burning of fossil fuels.

GREENHOUSE GASES (GHG)
Chemicals in the atmosphere that trap some of the heat from the sun.

Methane (CH₄)

CH₄ is a less abundant but more powerful GHG than CO₂. Human activities such as landfilling, coal mining, oil and natural gas processing and farming all add CH₄ to the atmosphere.

GREENHOUSE GASES (GHG)
Chemicals in the atmosphere that trap some of the heat from the sun.

Nitrous oxide (N₂O)

N₂O is a less abundant but more powerful GHG than CH₄ and CO₂. Human activities like burning fossil fuels, using nitrogen-based fertilisers and waste management processes add N₂O to the atmosphere.

CARBON CYCLE PRODUCERS

All living things are made of carbon, it is also in the air, oceans, and in the earth.

Humans & animals

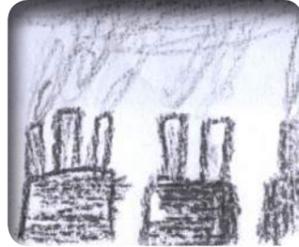
Humans & animals eat food that is full of carbon. Their bodies break this down using oxygen to produce energy and CO₂ in a process called respiration. Humans and animals then breathe the CO₂ back into the atmosphere.

**CARBON CYCLE PRODUCERS**

All living things are made of carbon, it is also in the air, oceans, and in the earth.

Power stations & industrial plants

Power stations and industrial plants burn fossil fuels for energy. The carbon from the plants and tiny organisms from which the fossil fuel was originally made is released as CO₂.

**CARBON CYCLE PRODUCERS**

All living things are made of carbon, it is also in the air, oceans, and in the earth.

Transport

Many methods of modern transport rely on burning fossil fuels for energy, which releases lots of CO₂ into the atmosphere.

**CARBON CYCLE PRODUCERS**

All living things are made of carbon, it is also in the air, oceans, and in the earth.

Deforestation

Deforestation produces CO₂ by reducing the number of CO₂-absorbing trees. Carbon contained within those trees as CO₂ when they are burnt or left to decompose.

**CARBON CYCLE ABSORBERS**

Human activity has upset the natural carbon cycle.

Trees & plants

Trees and plants are the main absorbers of CO₂. They use CO₂ and sunlight to make their own food and grow and produce oxygen, which humans and animals need to breathe. This process is called photosynthesis.

**CARBON CYCLE ABSORBERS**

Human activity has upset the natural carbon cycle.

Oceans

Oceans and other large stretches of cool water absorb vast quantities of carbon from the atmosphere, which algae use to grow.

**CO₂ CAPTURE**

Preventing release of CO₂ from power stations and industrial plants

Pre-combustion capture

CO₂ is removed from fossil fuels before burning, leaving hydrogen gas to be burnt for electricity and pure CO₂ to be stored or used.

**CO₂ CAPTURE**

Preventing release of CO₂ from power stations and industrial plants

Post-combustion capture

CO₂ is captured from the waste gases produced when fossil fuels are burnt for energy. This process is very common at a small scale in the chemical and food industries.

**CO₂ CAPTURE**

Preventing release of CO₂ from power stations and industrial plants

Oxyfuel

This is similar to post-combustion technology, but fossil fuels are burnt in extra oxygen rather than air. This makes it easier to separate the CO₂ from other gases without having to use expensive chemicals.

**CO₂ CAPTURE**

Preventing release of CO₂ from power stations and industrial plants

Natural gas processing

Some sources of natural gas contain lots of CO₂ that has to be removed before the gas is sold. Gas processors often release this CO₂ into the atmosphere, but more are starting to capture and permanently store the CO₂ in geological storage sites.

**CARBON CYCLE ABSORBERS**

Human activity has upset the natural carbon cycle.

Earth

When plants and animals die, their remains decay and decompose and the carbon in their remains is absorbed by the Earth. This is the process that created fossil fuels millions of years ago.

**CARBON CYCLE ABSORBERS**

Human activity has upset the natural carbon cycle.

Atmosphere

CO₂ in the atmosphere is an essential greenhouse gas that keeps the Earth warm. But because there are now so many more CO₂ producers than absorbers, the atmosphere contains too much CO₂. This is causing climate change.

**CO₂ TRANSPORT**

Once captured, CO₂ is transported to a storage site.

Pipeline

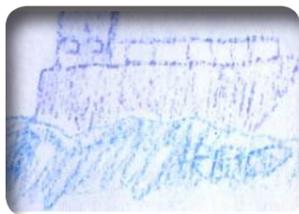
The most common method of transporting large quantities of CO₂ is through pipelines. There are already millions of kilometres of pipelines around the world that transport various gases, including CO₂.

**CO₂ TRANSPORT**

Once captured, CO₂ is transported to a storage site.

Ship

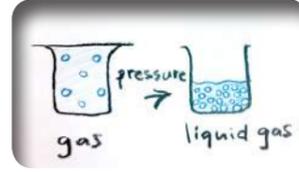
Shipping CO₂ is an option for moving it over long distances or in areas where pipelines are not available. Small-scale shipping of CO₂ already takes place in Europe. Softdrink producers are some of the biggest shippers of CO₂!

**CO₂ TRANSPORT**

Once captured, CO₂ is transported to a storage site.

Compression

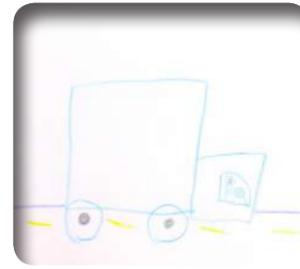
In its natural state, CO₂ is a gas. Gases take up lots of space and are not easy to transport. CO₂ is put under great pressure to turn large volumes of gas into much smaller volumes of a kind of liquid gas for transportation. This process is called compression.

**CO₂ TRANSPORT**

Once captured, CO₂ is transported to a storage site.

Truck & rail

It is possible to transport small amounts of CO₂ by truck and rail. This is often the form of transport used for small test project sites.



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S U P P O R T E D B Y

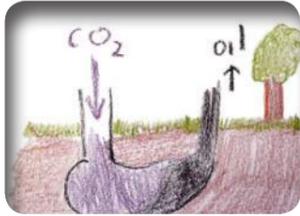


CO₂ STORAGE

CO₂ can be injected into rock for permanent storage.

Enhanced oil recovery

CO₂ has been injected into rock formations for more than 30 years to suck the last drops of oil from old reservoirs. By using waste CO₂ to do this job, CO₂ can be usefully recycled and eventually stored in the rock formation.

**CO₂ STORAGE**

CO₂ can be injected into rock for permanent storage.

Caprock

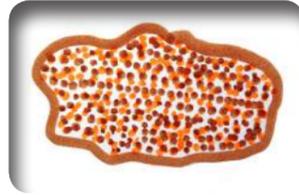
Effective CO₂ storage sites have layers of non-permeable rock, like shale, that act as a physical barrier to injected CO₂ moving back to the surface. This rock is called caprock.

**CO₂ STORAGE**

CO₂ can be injected into rock for permanent storage.

Porous & permeable

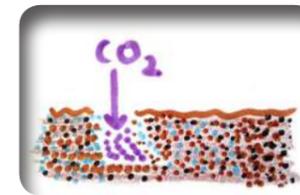
Effective CO₂ storage sites are made of rock that is porous (full of tiny holes) and permeable (the holes are connected enough to allow movement through the rock). This is the same kind of rock where oil and gas has been stored for millions of years.

**CO₂ STORAGE**

CO₂ can be injected into rock for permanent storage.

Oil and gas or saline reservoir

Porous rocks are required to permanently store CO₂. The pores might contain some oil or gas or, more likely very salty water. Injected CO₂ will push these fluids aside and may even react with them to form stable minerals to permanently store the CO₂.

**CCS RESEARCH**

More research is needed to make CCS a commercially viable, sustainable low-carbon technology.

Reducing cost

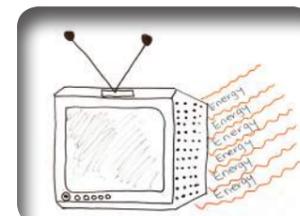
CCS requires a lot of up-front funding, and parts of the technology need to be more efficient and less expensive. The more testing and demonstration of the technology, the more costs are likely to reduce.

**CCS RESEARCH**

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Reducing energy requirements

CCS technology, especially CO₂ capture, requires large amounts of energy. Lots of testing is being done to reduce the energy required for CCS to make the technology sustainable.

**ACTIONS**

We all have a role to play in reducing CO₂ emissions!

Energy efficiency at home and school

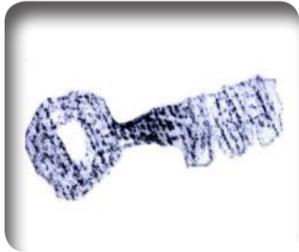
Lots of small actions can make a huge difference. We should all be recycling, using energy saving light bulbs, improving building insulation, switching off appliances and trying not to waste food.

**ACTIONS**

We all have a role to play in reducing CO₂ emissions!

Improving energy efficiency in industry

Improving the energy efficiency of industrial processes and in power generation is essential to reduce CO₂ emissions and create more sustainable, environmentally conscious industries.

**ACTIONS**

We all have a role to play in reducing CO₂ emissions!

Using renewable sources of energy

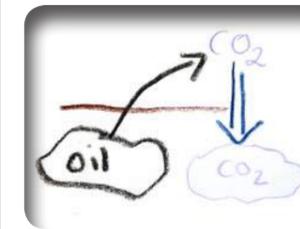
Governments and organisations must work hard to improve renewable energy technologies and energy infrastructure to increase the renewable sources we can use to meet world energy demands.

**ACTIONS**

We all have a role to play in reducing CO₂ emissions!

Developing low carbon technologies

Fossil fuels will be part of our future energy mix, so it is really important to develop technologies - like CCS - that will allow us to deal responsibly with the CO₂ emissions they produce.

**CCS RESEARCH**

More research is needed to make CCS a commercially viable, sustainable low-carbon technology.

Finding good storage sites

Safely storing CO₂ relies on detailed studies of potential storage sites. Lots of work is being done globally to identify suitable storage sites and share learning about identifying and monitoring CO₂ stores.

**CCS RESEARCH**

More research is needed to make CCS a commercially viable, sustainable low-carbon technology.

Making the technology bigger

CCS is not a 'new' technology. All the different parts of CCS have been used separately in other industries for many years. CCS developers are working hard to take familiar technologies and make them work together on a larger scale.

**CO₂ STORAGE**

Extension cards for advanced students.

Structural trapping

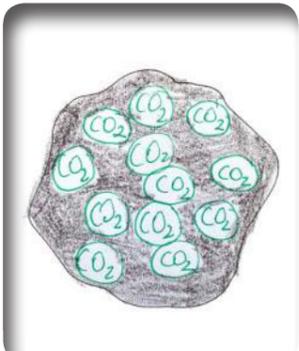
Injected CO₂ will first move to the top of the rock formation where it will be trapped underneath the caprock, which acts as a seal. In most sites there will be multiple layers of caprock.

**CO₂ STORAGE**

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Residual trapping

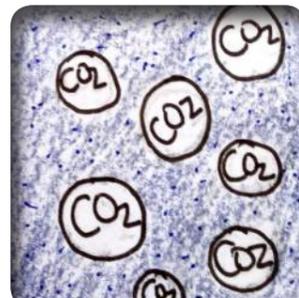
Some injected CO₂ will get stuck in the tiny pore spaces in the rock.

**CO₂ STORAGE**

Extension cards for advanced students.

Dissolution trapping

Over time, some of the injected CO₂ will dissolve slowly into the salty water in the rock pores and become trapped.

**CO₂ STORAGE**

Extension cards for advanced students.

Mineral trapping

The ultimate form of CO₂ trapping occurs when dissolved CO₂ reacts with the rock around it to form a mineral such as calcium carbonate.

**Carbon Cards Challenge****Extension cards for advanced students**