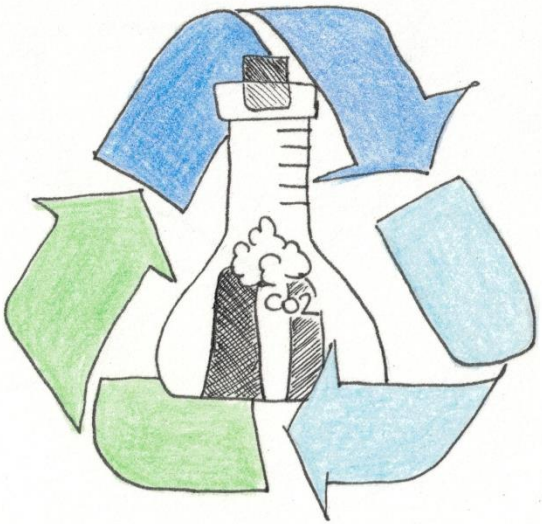
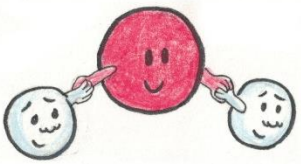
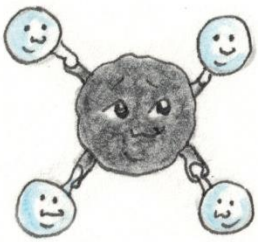
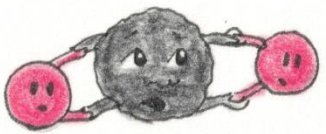
RECYCLING CARBON

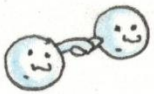
AN ILLUSTRATED STORY











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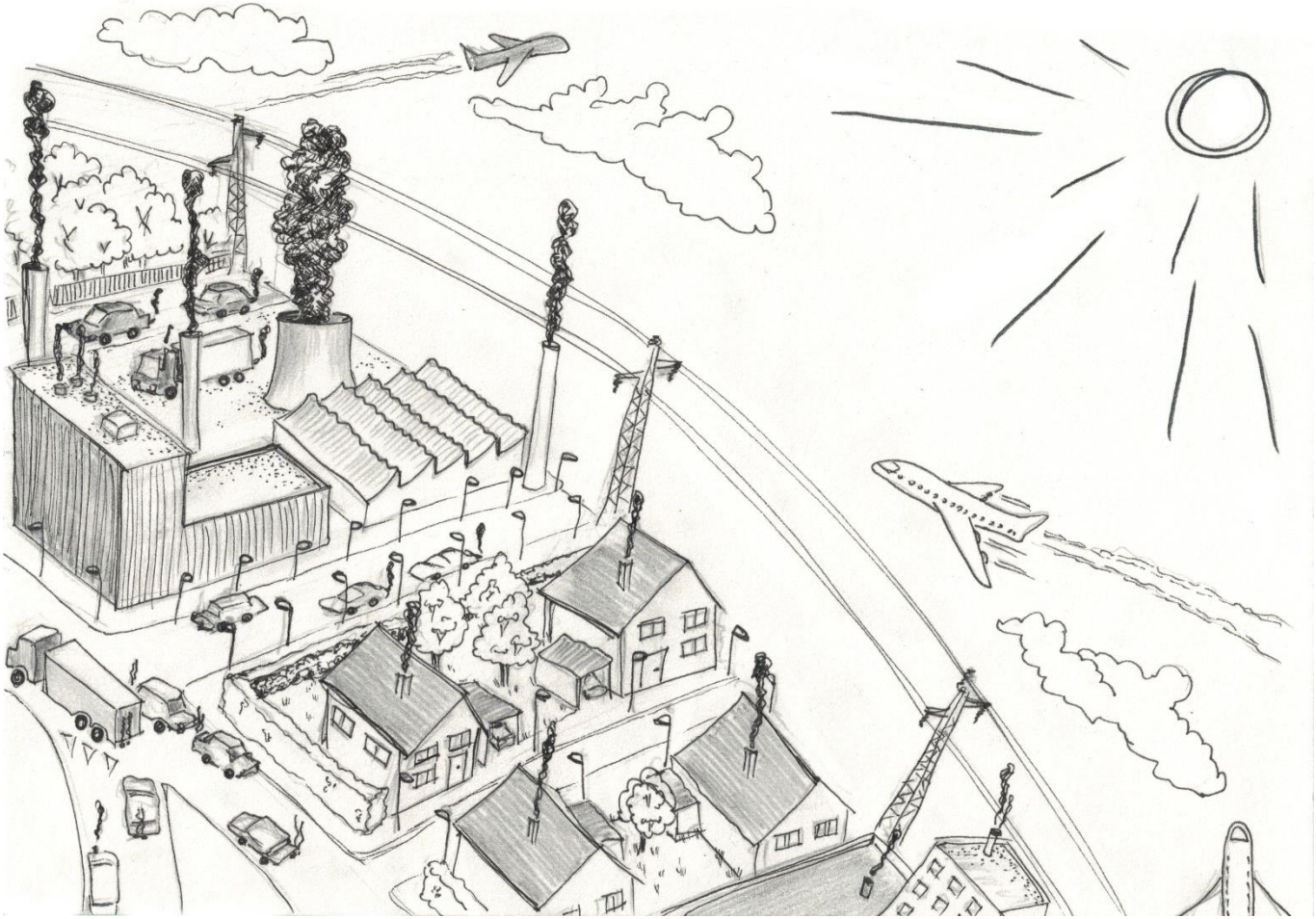
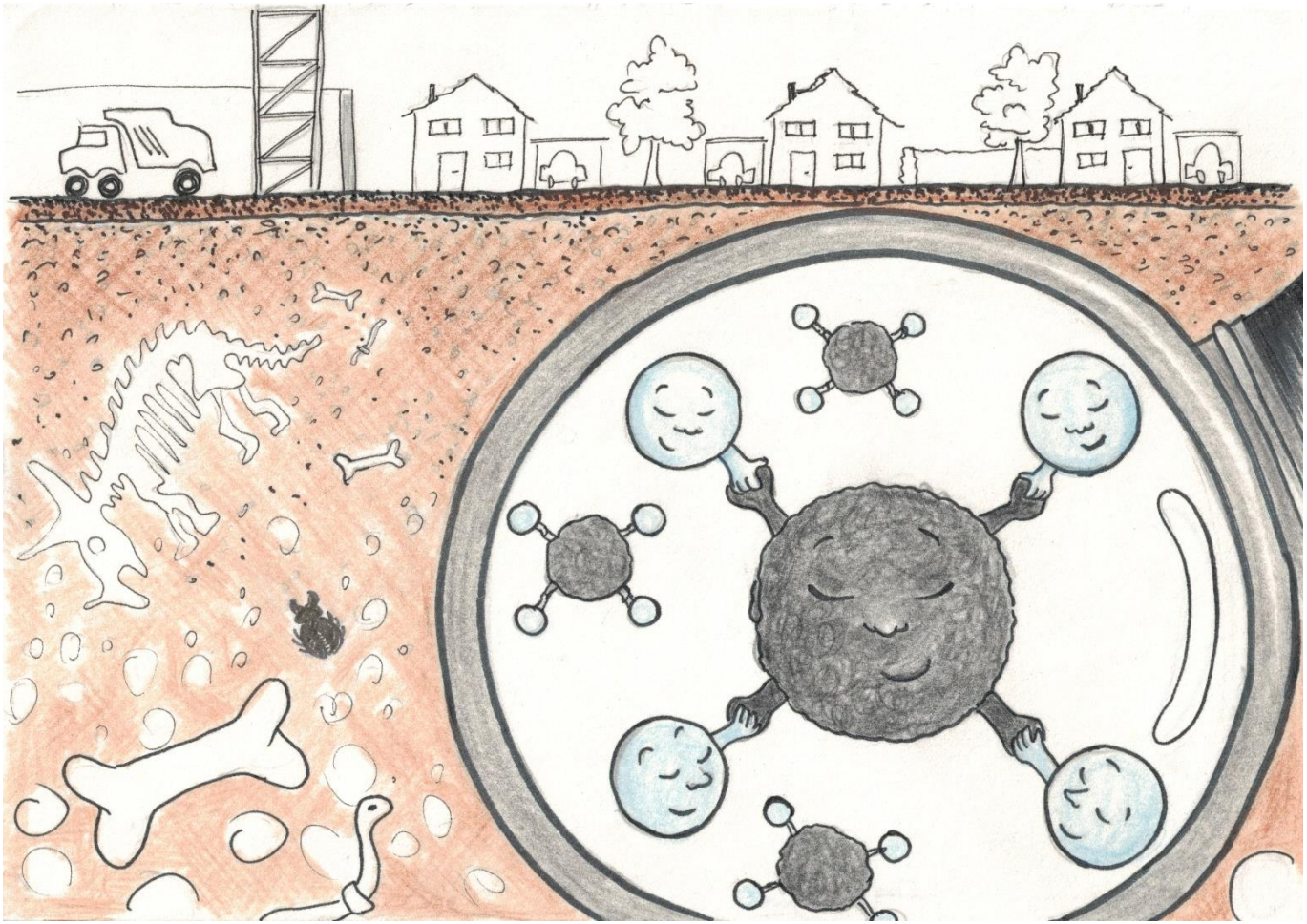


This is our planet, the Earth, as we are used to seeing it.

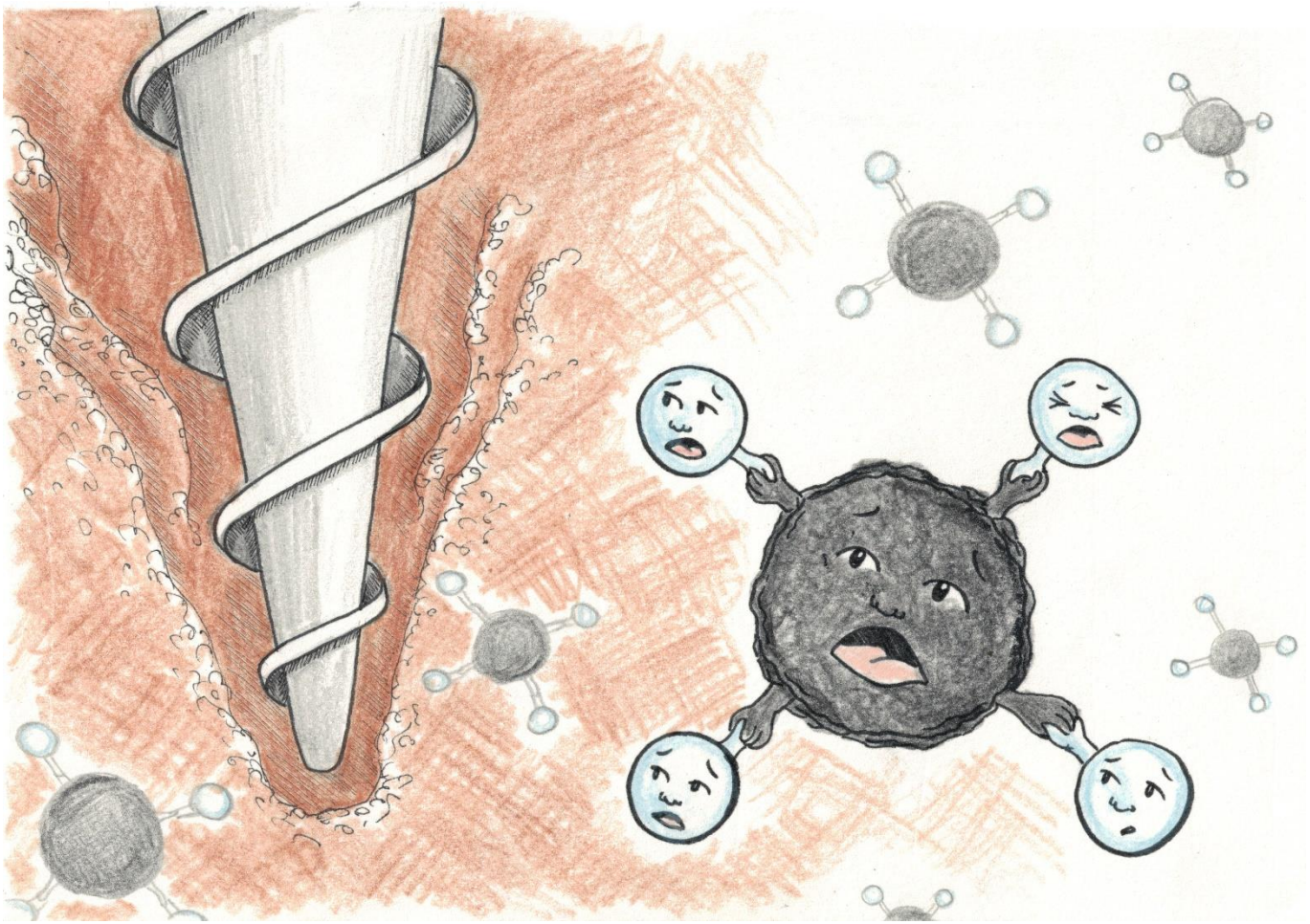
The progress of our society has left a deep footprint on the Earth: we live in warm homes, drive cars to school and work, travel around the world in aeroplanes and use many electronic devices.

All this is possible thanks to the use of the so-called "fossil fuels" to produce energy.



Fossil fuels, such as coal, natural gas and oil, are found deep underground and are the product of decomposition of dead plants and animals. This process has taken millions of years.

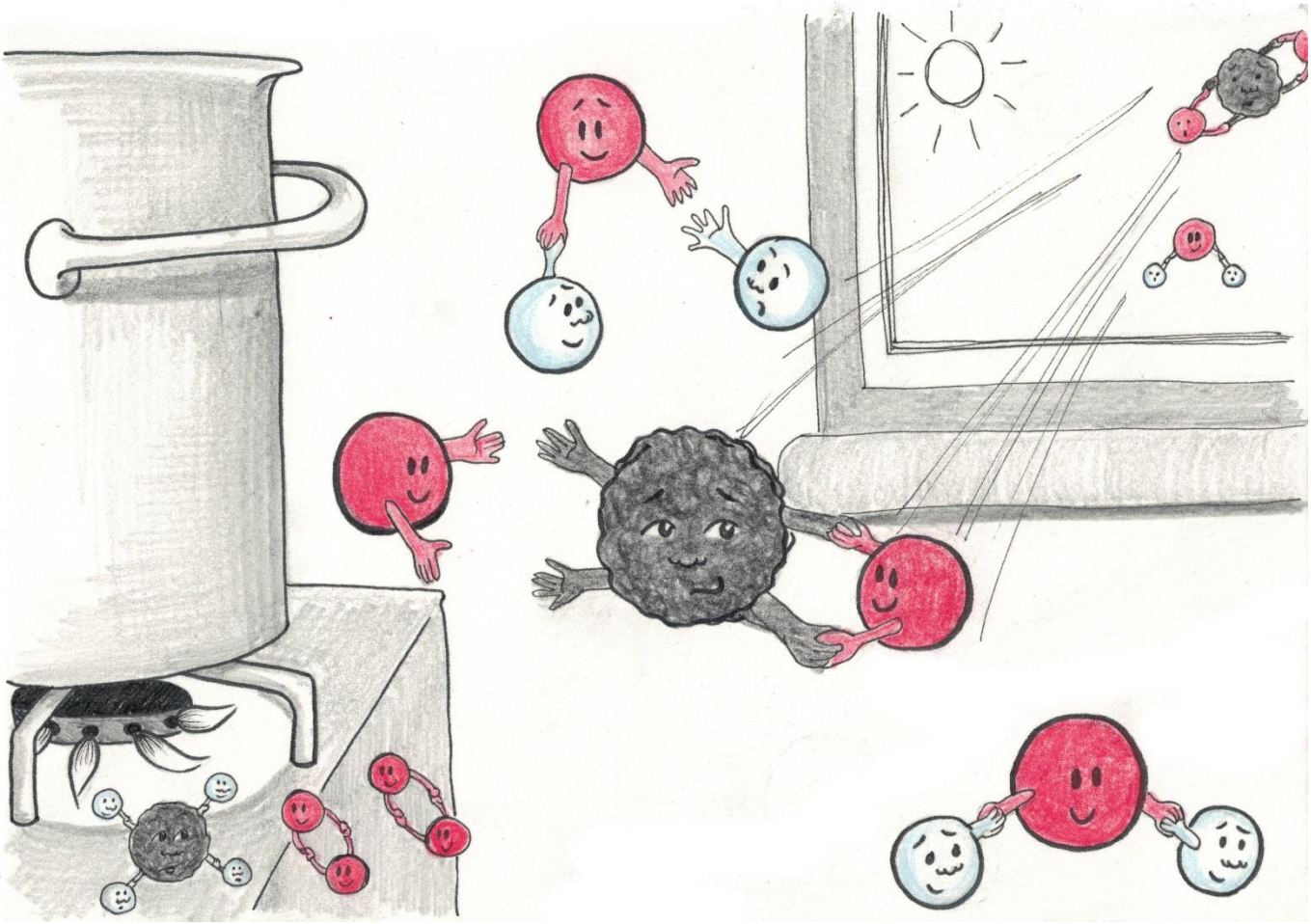
Fossil fuels are mainly composed of the chemical element carbon. Methane (CH_4), for example, is the main component of natural gas and is made of one carbon atom (black) and four hydrogen atoms (white).



About 150 years ago, humans discovered ways to use fossil fuels as a source of energy.

Soon, we also learned how to extract fossil fuels in large quantities from the ground.

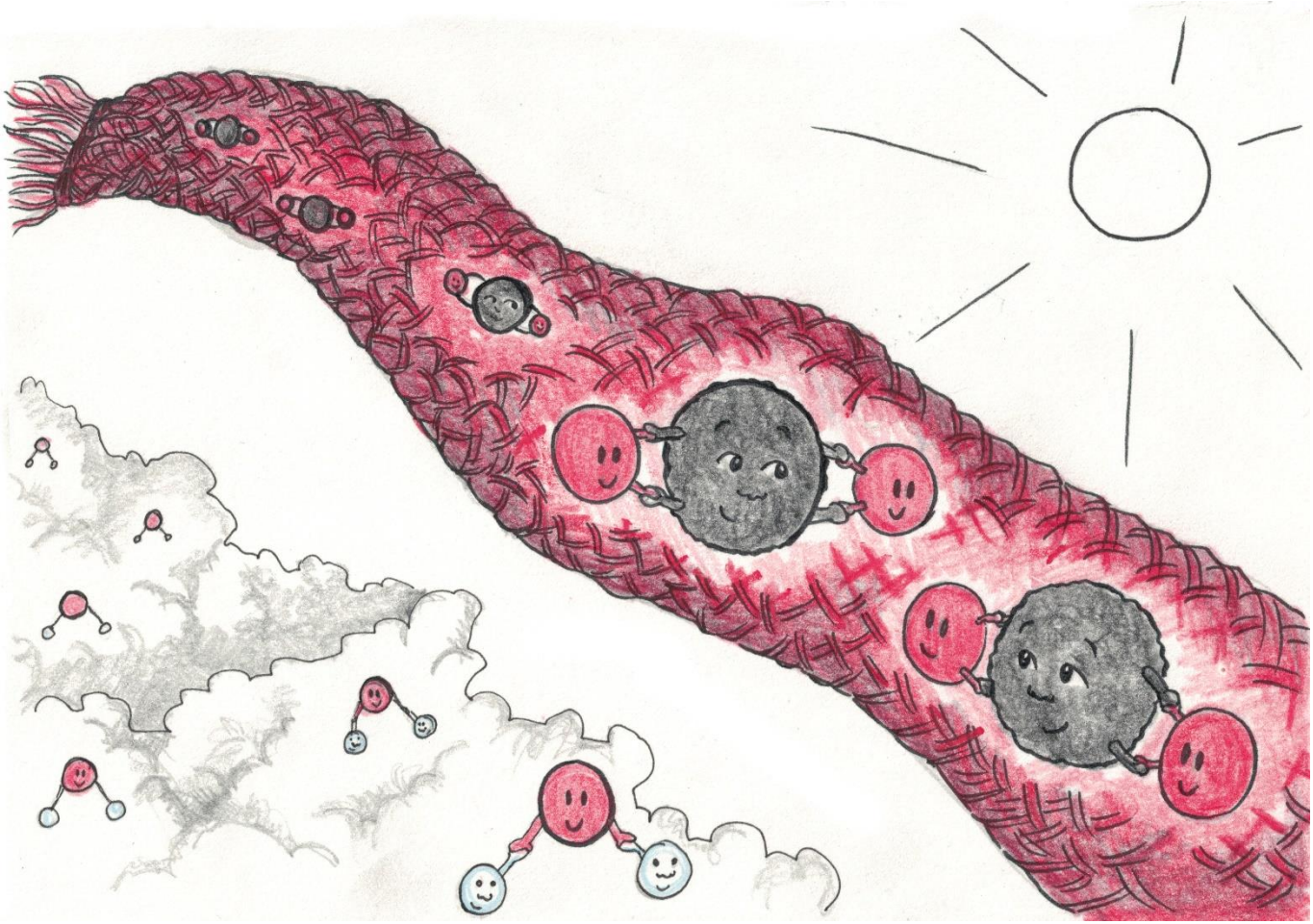
By extracting fossil fuels, we bring back to the surface carbon that had been sleeping underground for a long time.



Methane is used in our homes for heating and cooking. By burning methane, we produce energy. This process is known as "combustion".

Combustion is the chemical reaction between methane (CH_4) and oxygen (O_2, red). During the reaction, the bonds between carbon and hydrogen are broken and new bonds are formed between carbon and oxygen.

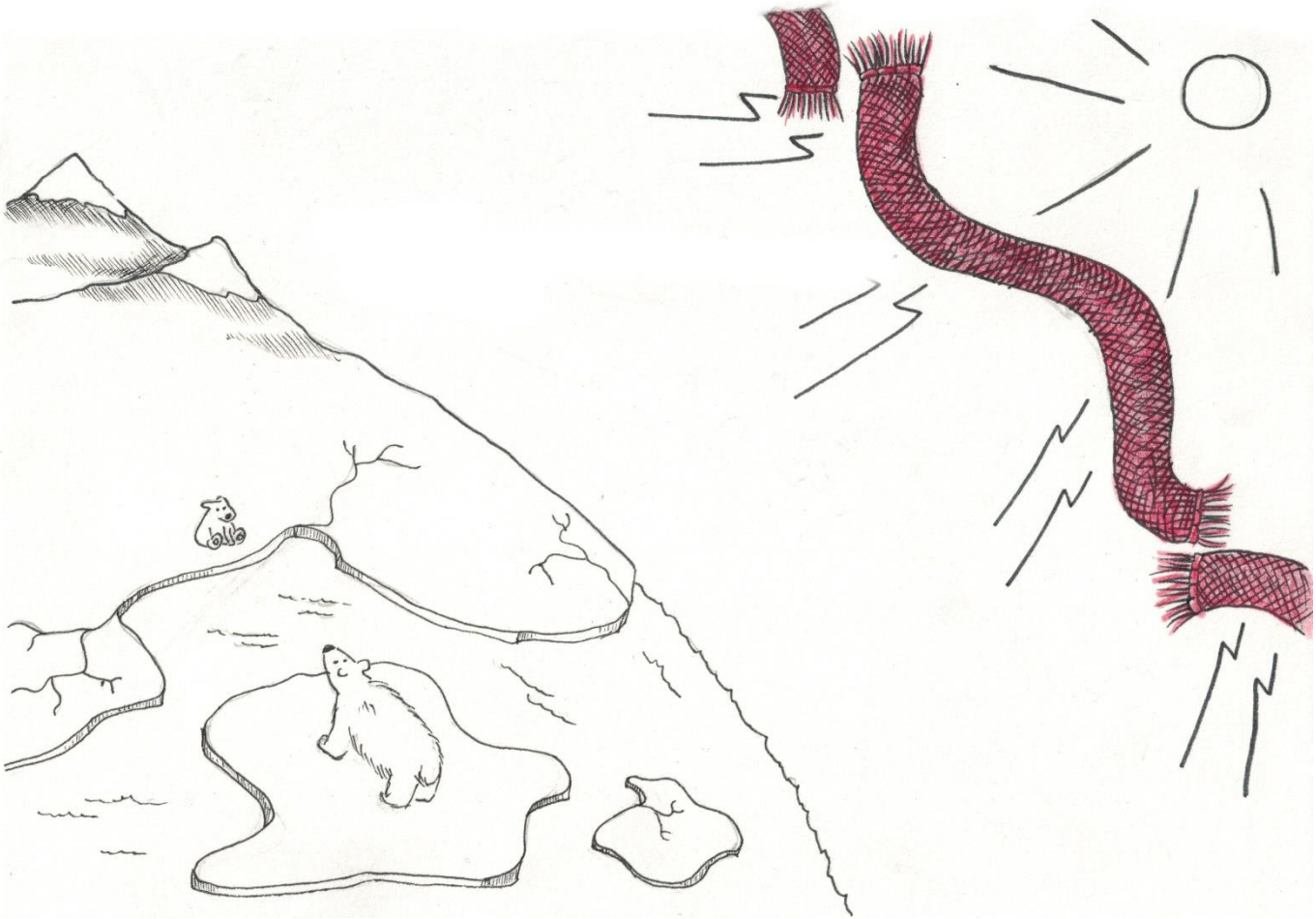
The products of the reaction are carbon dioxide (CO_2) and water (H_2O).



Carbon dioxide (CO_2) and water (H_2O) are released into the atmosphere.

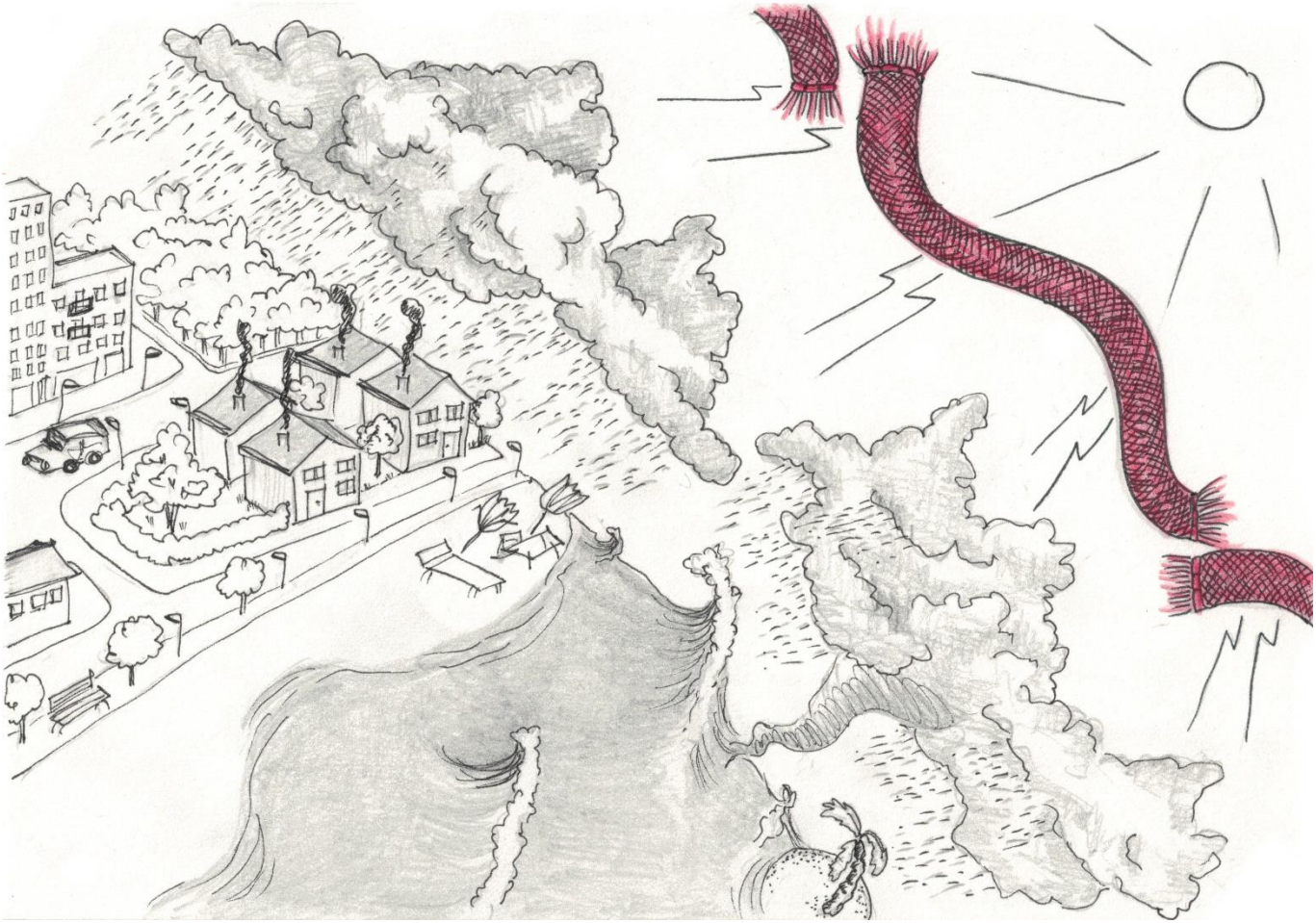
Water forms clouds and eventually comes back to the ground as rain.

Carbon dioxide, instead, stays in the atmosphere and forms a "scarf" around the Earth. Because we burn a lot of fossil fuels to produce energy, this scarf is growing, causing global warming and climate change.



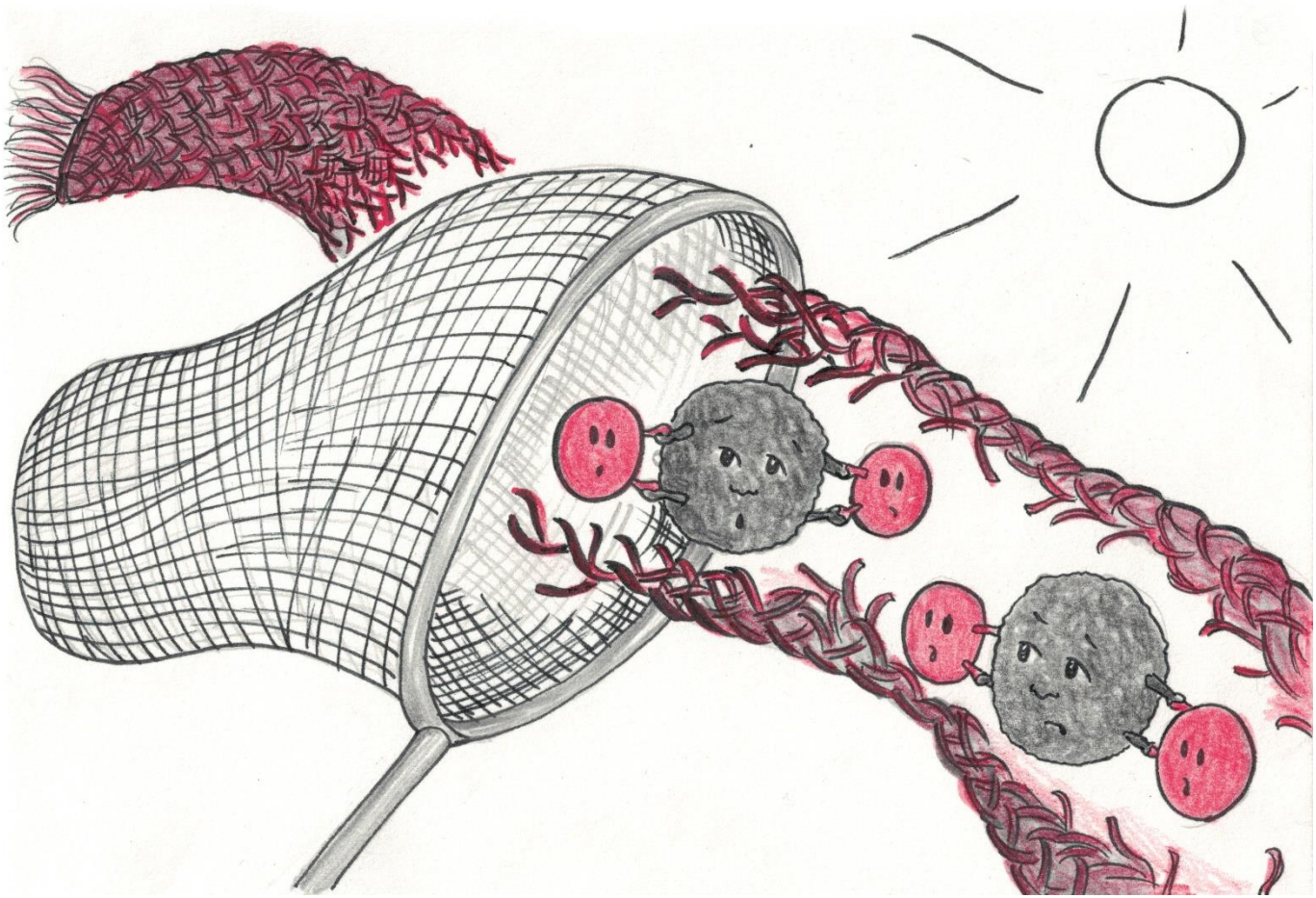
The effects of climate change are serious and already visible today.

Ice in the North and South Poles is melting, leaving many animal species, such as polar bears, homeless and contributing to raise the level of seas around the world.



Extreme weather events, such as hurricanes, heat waves and floods,
are becoming more frequent and more violent,
leaving many people homeless.

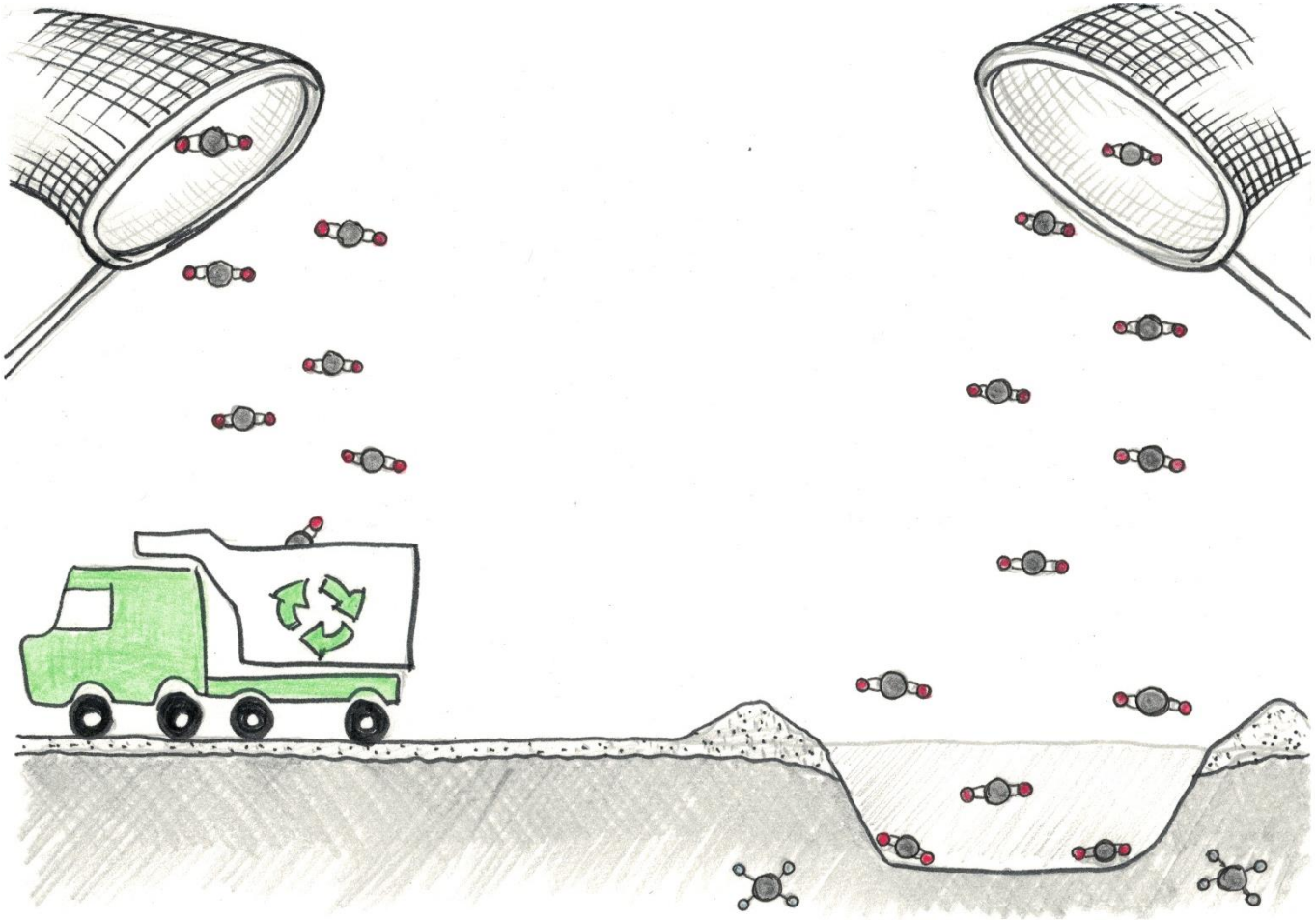
We need to find solutions as soon as possible to reduce our emissions
of carbon dioxide and stop climate change.



One of these solutions is to capture carbon dioxide from the atmosphere. This is not a simple thing, because there is a very tiny amount of carbon dioxide in the air (only 4 molecules out of 10000).

We can do this by using materials that function as butterfly nets, whose mesh is the right size to filter carbon dioxide.

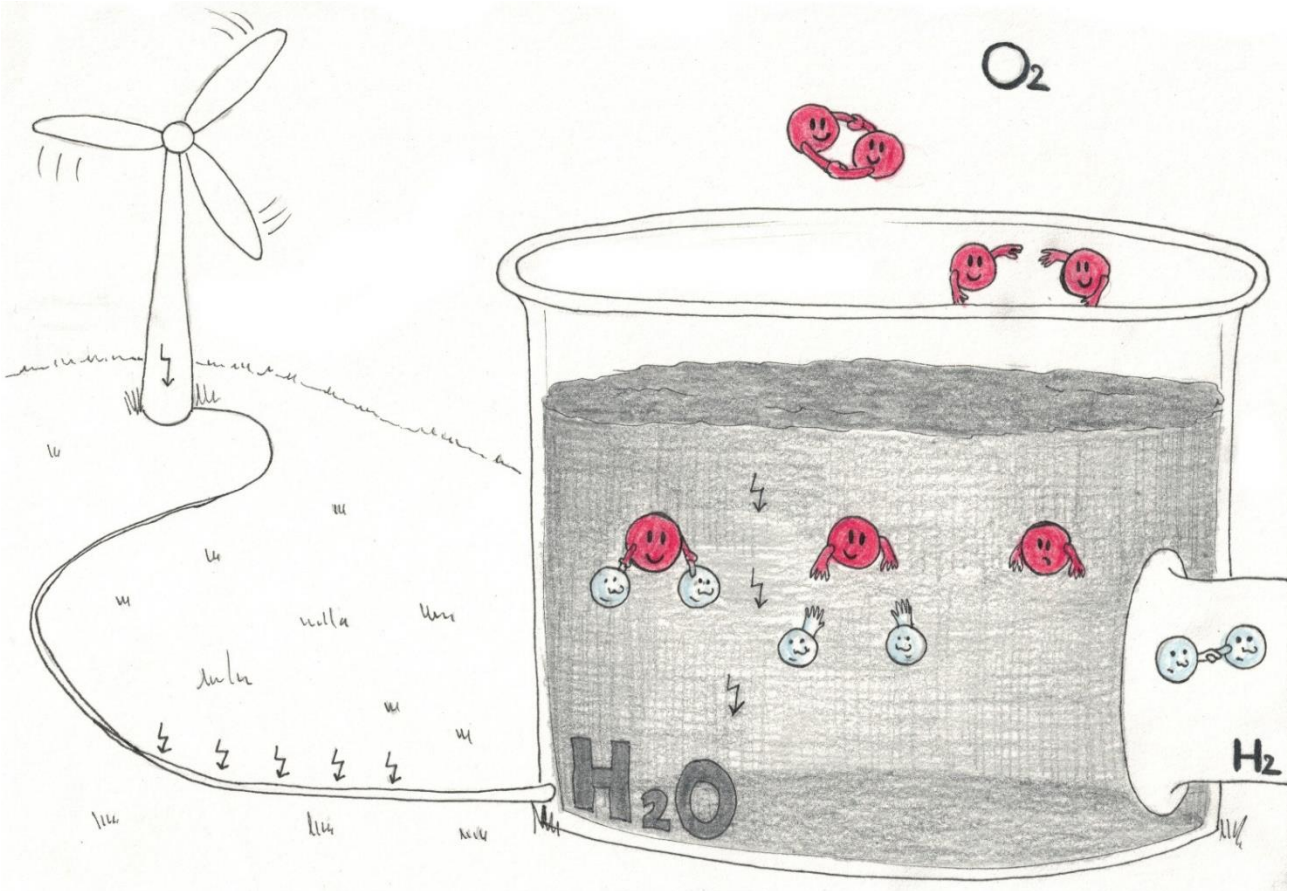
Alternatively, we can think of these materials as sponges that can soak up carbon dioxide.



After we have captured carbon dioxide, we need to think of what to do with it.

One option is to bury it deep underground, which is like sending rubbish to landfill.

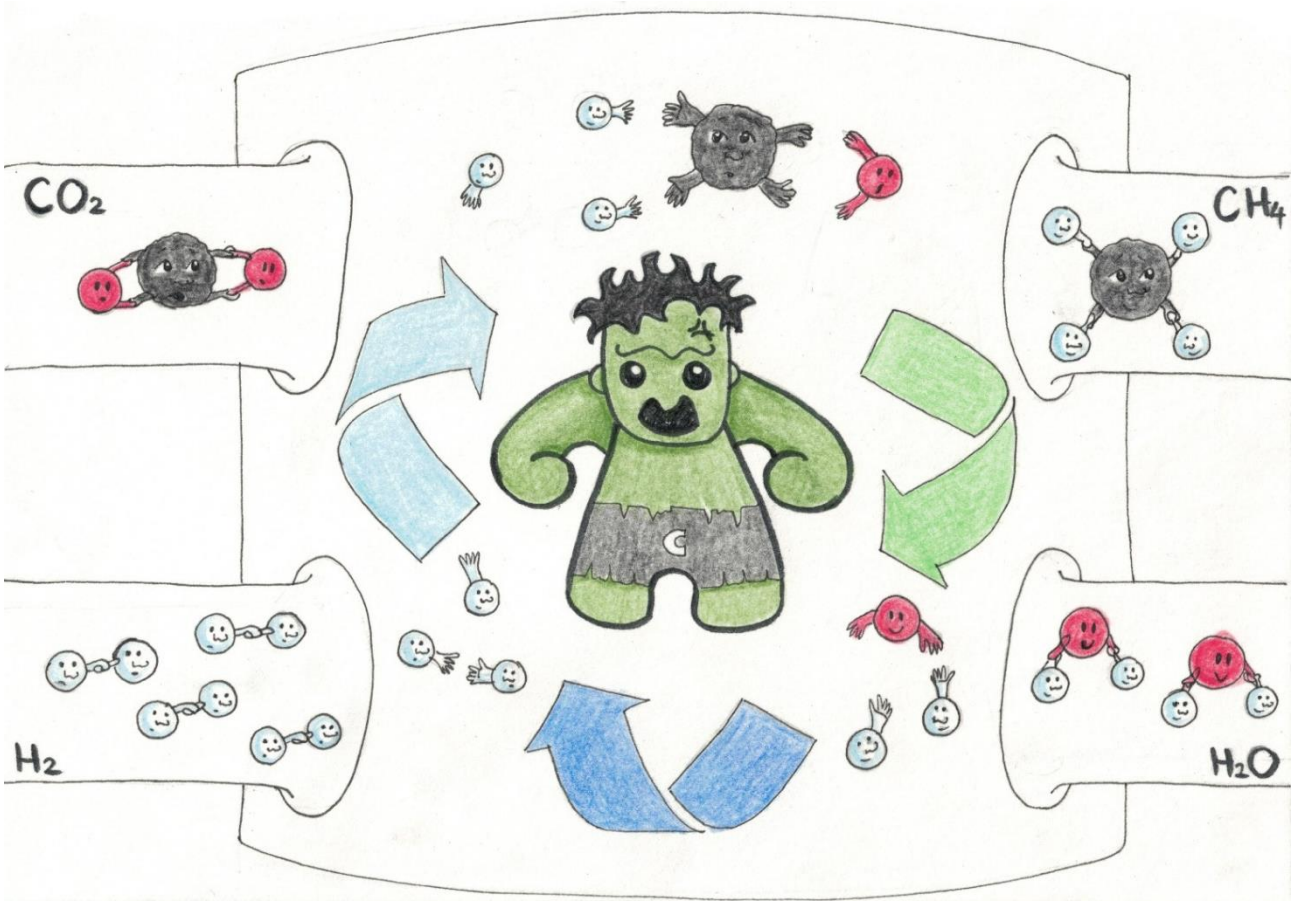
The other option is to recycle carbon dioxide into something useful (like, for example, methane), in the same way we do with paper, glass, plastic and cans.



To recycle carbon dioxide (CO_2) into methane (CH_4), we must substitute two oxygen atoms with four hydrogen atoms, using hydrogen gas (H_2).

To produce hydrogen gas, we can use electricity to power a process called "water splitting", where the bonds between the hydrogens and the oxygen of water (H_2O) are broken.

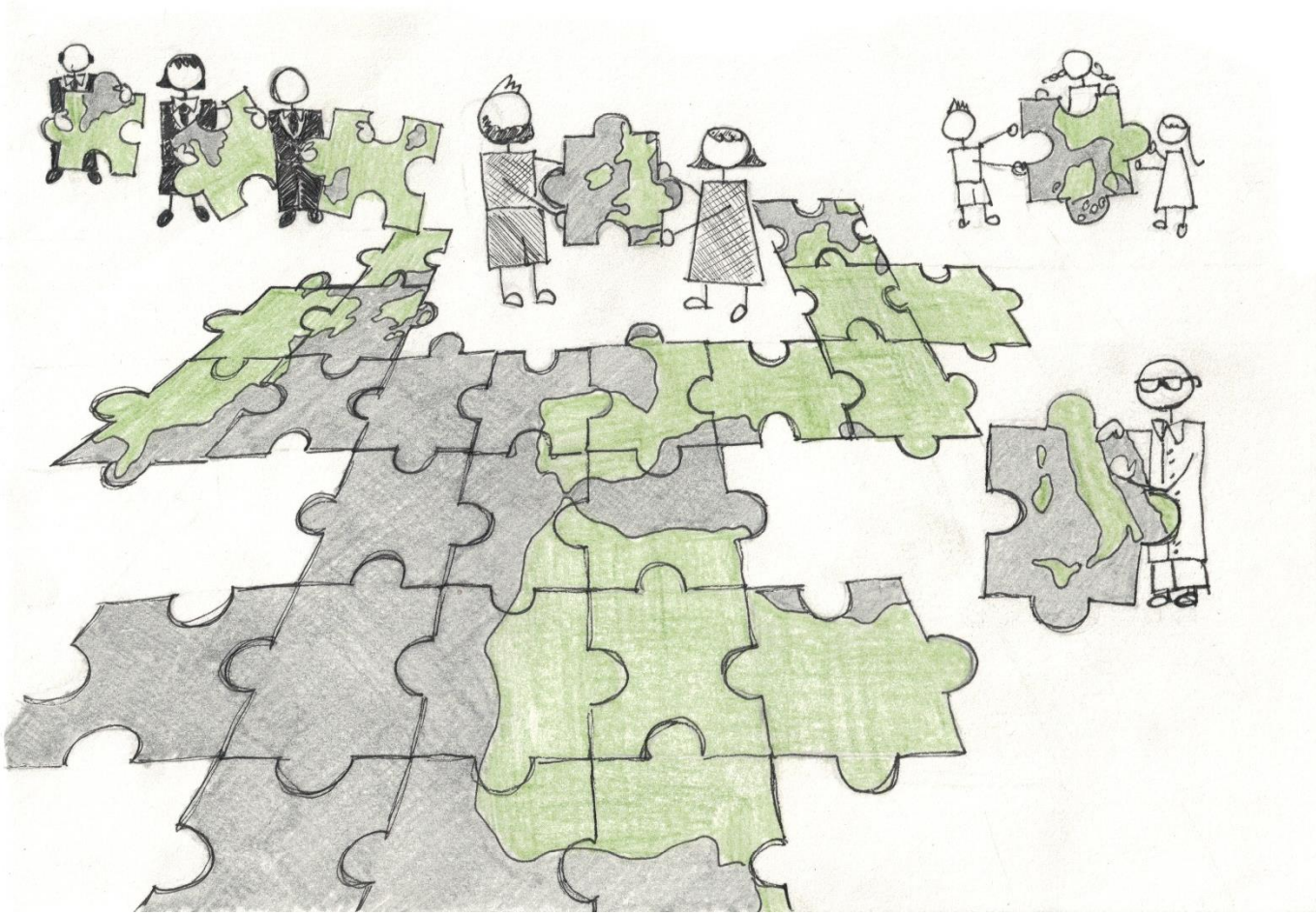
The best way of producing electricity is from clean sources of energy, such as wind or sunlight.



Recycling of carbon dioxide (CO_2) to methane (CH_4) is difficult, because it requires the breaking of the tight bonds between carbon and oxygen.

To make this easier, we can use a catalyst. The catalyst is like a superhero that can take carbon and oxygen apart and combine them with hydrogen, producing methane and water.

Methane can then be sent back to our homes, where we can use it again for heating and cooking.



While recycling carbon is an important piece of the puzzle to solve climate change, the ultimate solution can only be found if we all work together.

Scientists must find technological solutions for our problems.

Political leaders must make decisions to put these solutions into practice.

People must adapt their lifestyle to make it more sustainable.

"Recycling Carbon" is an outreach project co-created by Marco Taddei, Russell Wakeham and Michael Warwick, based at the Energy Safety Research Institute (Swansea University).
Website: https://recyclingcarbon.wordpress.com/
Twitter: https://twitter.com/RecyclingCarbon

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