

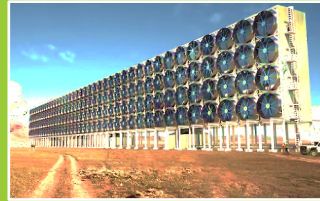
GREEN AIR CONDITIONER

Introduction

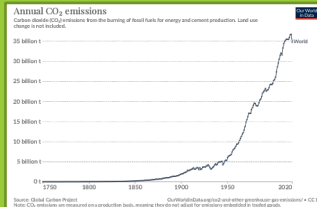
Direct Air Capture is a technology that can extract CO₂ directly from the atmosphere. There are currently 19 direct air capture plants operating in places like Iceland and Switzerland, capturing more than 0.01 mega tonnes of CO₂ per year. Though it is a considerable amount, with the worldwide emission reaching a record high of CO₂ emission (36.7 billion metric tonnes) in 2019, it is far from enough to have a significant effect. To utilize this technology fully, we must expand it to a public scale.

Integrating Direct air capture into a public scale

The answer is air conditioners! With about 94.3 million Units of air conditioners in 2020, it is the perfect model for integrating the technology of direct air capture.



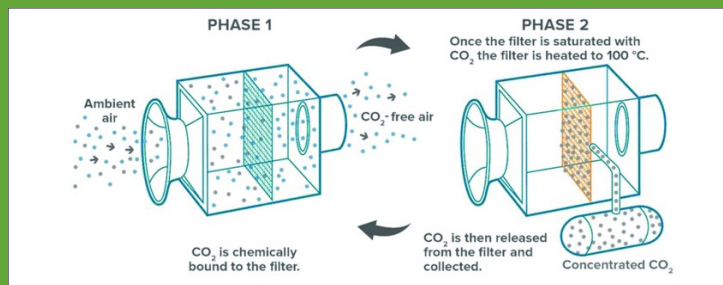
Link: <https://journeytozero.com/?p=543>



Brief introduction of Green Air Conditioner scheme:

Technology of Direct Air Capture

Direct Air capture involves two major steps. The first step involves absorption of carbon dioxide using a solid sorbent while a fan sucks in the air. The second step involves heating the fully absorbed solid sorbent up to 100 °C in order to release the CO₂ in a concentrated form.



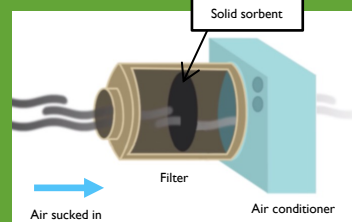
Source: https://www.researchgate.net/figure/Schematic-illustration-of-Climeworks-direct-air-capture-process_fig2_337429357

How air conditioners can be used?

A filter can be added outside the air conditioner. While the air conditioner is turned on, the air will be sucked into the filter and the solid sorbent would be able to absorb the CO₂ in the air.

The scheme

The scheme first involves a company that sells these filters to the public, the consumers can assemble the filters onto their own air conditioners. Hence, CO₂ can be absorbed when the air conditioner is used. Afterwards, when the solid sorbent is fully absorbed, the user could remove the sorbent and sell it back to the company. The company can collect the sorbent filter and heat them up in a factory to collect the concentrated CO₂. Then, the company can use the concentrated CO₂ to produce liquid fuels, which can be sold for profit. This interdependent relationship between the consumers and the company creates a sustainable cycle.



Source: How Your AC Could Help Instead of Hurt The Environment - Cheddar Explores

Detailed explanation for each step

- 1) The company would sell filters and the sorbents to individual users. Users would set up the filter on their air conditioners. CO₂ would be absorbed when the air conditioner are turned on.

Inside the filter:

- Amine is used as the solid sorbent. The reaction that occur between the CO₂ and the sorbent can happen at lower temperatures.



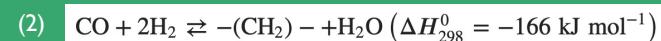
- 2) The fully absorbed solid sorbent can be sold to the company for a cheap price and can be transferred to a factory for further processing.

- 3) Production of liquid fuel from CO₂

There are two steps in the production of fuels by the reaction between carbon dioxide and hydrogen. Firstly, reaction (1) between carbon dioxide and hydrogen forms water and carbon monoxide. Mostly, an iron-based catalyst is used for the reaction.



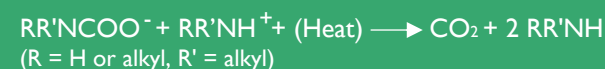
Secondly, the reaction (2) between carbon monoxide and hydrogen which will form water and liquid hydrocarbon (fuel).



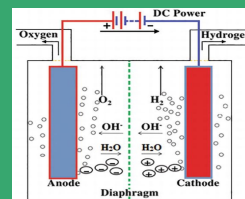
Inside the factory:

- A) Source of CO₂ - Regeneration of the absorbed CO₂ from sorbents

The solid sorbents will need to be heated up to 100 °C to release the CO₂ to produce a concentrated form of CO₂.

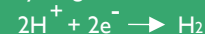


- B) Production of hydrogen – Electrolysis of water

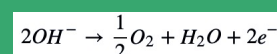


- Solution such as sodium hydroxide and sulfuric acid could be used as electrolyte during the electrolysis of water

The positively charged hydrogen ions would be attracted by the negatively charged cathode. The hydrogen ions will then gain electron to form H₂.



Near the positively charged anode, hydroxide ions will be oxidized and lose electrons to form water and oxygen. Overall, water is electrolyzed to produce oxygen and hydrogen.



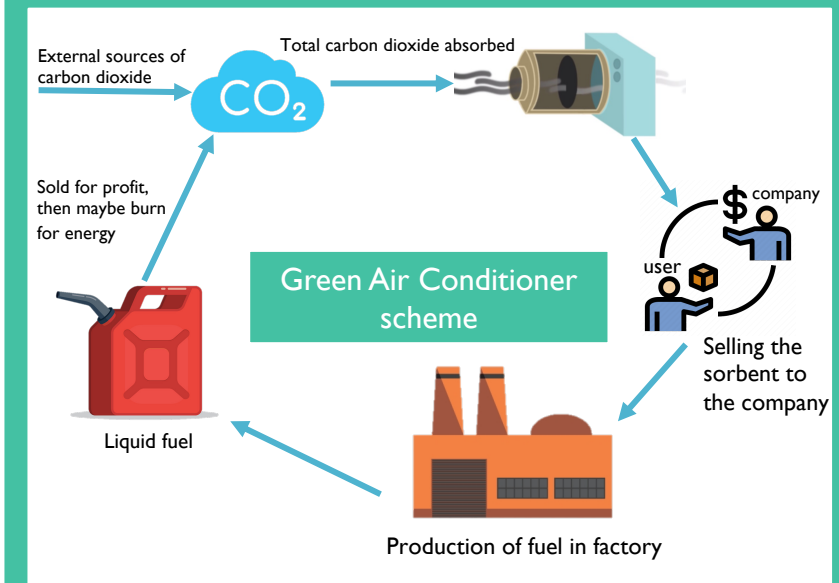
The company can sell the liquid fuel for profit.

Why will this scheme be effective?

- 1) Public demand: In developed countries, almost everyone would own an air conditioner. By adopting this scheme, in the short term, users will experience some loss in investments due to the purchase of the filter. However, if the selling price of the fully absorbed sorbent is more than the cost of sorbent, the users will have a gain in investment in the long term.
- 2) A solution for the current problems – Renewable energy development has been growing exponentially, but it takes a lot of time and money for a complete replacement. For others, renewable energy development like solar panels and wind turbines might be hard to implement due to problems like space restriction. This scheme serves an alternative solution for a sustainable development

Problems that may arise / Areas of improvement

- Electricity in the production of the liquid fuel could come from renewable energy to be more environmentally-friendly.
- Safety problems - when the users set up the filter, when the users take out the sorbents. (Can be solved by having a good design and clear instruction, supported with technical help if needed)



Reference

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