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THE REALITY OF GEO-ENGINEERING

A lesser-known technology to the public, **Negative Emission Technology (NET)** became a central pillar to politicians. This intriguing oxymoron describes technologies in which the main goal is to remove CO^2 (**Carbon Dioxide Removal – CDR**). They are the basis for most «climate models», and supposedly could fix the amount of CO^2 in the air around 2030.
Nonetheless, we currently don't have enough evidence that that technology will be available in such a short amount of time nor that they will be as efficient as they say they will be – **will they be good enough to lower the bar to +2°C at most** - without leading to massive risks?
Therefore, is it reasonable to put our trust in purely hypothetical technologies?

CARBON BUDGETS AND CLIMATE MODELS

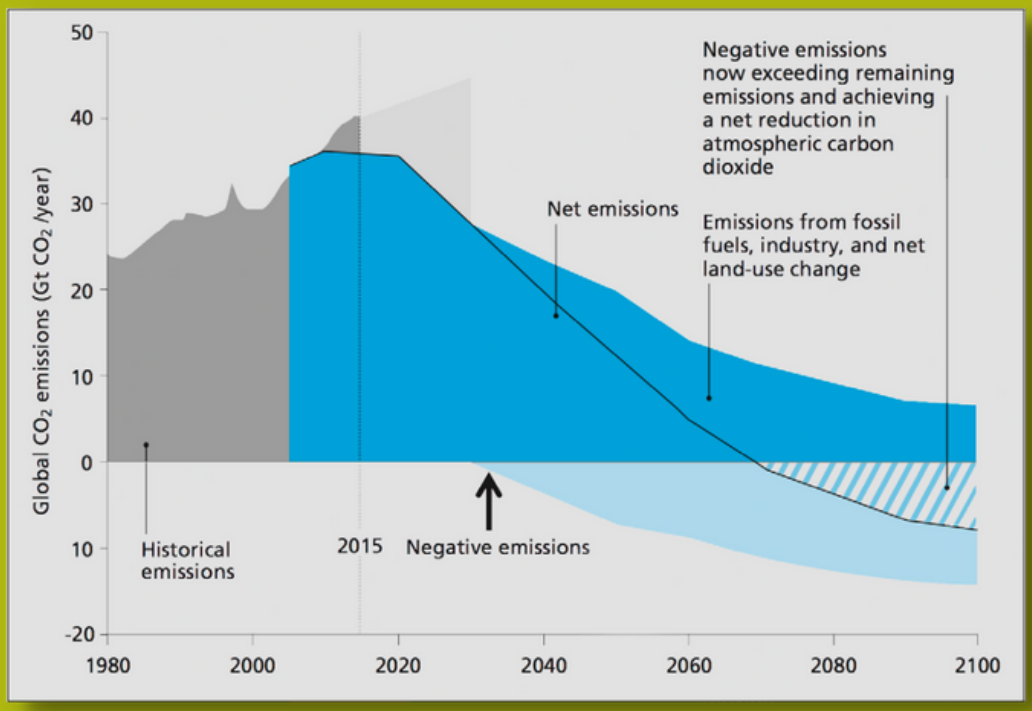
Passed in 2015 during the COP21, the texts of the « Accord de Paris » aim to contain global warming to a **maximum of +2°C** and if possible, to **limit it to +1.5°C**. Those engagements have not been respected – CO^2 emissions will increase until the second part of the 21st century – which means « inevitable » emissions such as air travel will have to be compensated with NET to obtain zero emissions.

The current climate models for carbon neutrality are based on the works of the GIEC. Those models show that we can estimate the amount of CO^2 we are allowed to release to have respectable chances of **maintaining global warming to +2°C.**
In their special report published in October of 2018, the GIEC estimated the amount of CO^2 to be around **570 billions of tons of CO^2 to emit to stay under the bar of 1.5°C**. This represents **less than 15 years of emissions**.

The national agreements in term of climate at the Paris agreements are insufficient to lessen the damage. They would cause an increase in the emissions of CO^2, from 52 to 58 megatons per year in 2030. T**hat would cause in increase in temperature by 3°C**. Almost all climate previsions under 1.5°C require that CO^2 emissions are reduce under 35 GT per year.

For its 5th report published In 2014, the GIEC evaluated **400 different scenarios** that'd obtain acceptable result (under 2°C). 344 of which used the rapid deployment of CO^2 catchment on a large scale. On its 2018 report, the GEC emphasized the negative impact of NET technology. However, the majority of those scenarios **evolved in a way to include NETs from 2030**, with a catchment that'd exceed the emissions from 2050 to 2070.

To better understand the consequences of those climatic models, it is important to understand the principals , potential and risks associated with NETs.



Average CO^2 emissions modeled by the GIEC and compatible with a 2°C increase
Source : Rapport EASAC 2018 adapted from d'Anderson et Peters, 2016.

WHAT ARE TENS

The acronym **TEN** gathers all the different technics supposed to **catch CO^2 to stock it in compartments** (mostly geological or oceanic) where they won't increase the greenhouse gas effect. Those techniques go further than supposedly neutral technologies (like catchment of CO^2 in coal burning factories' chimneys). **They theoretically present negative CO^2 results**. TENs are regrouped in six different categories :

ALTERATION OF OCEANS

ENSEMENCEMENT OF OCEANS

AFFORESTATION AND REFORESTATION

MANAGEMENT OF LAND AND AFOLU

BECCS

DACCS

OCEAN-BASED TECHNIQUES

ALTERATION OF OCEANS

The alteration of oceans **accelerates geochemical processes that occur naturally in the wild,** allowing them to capture CO^2. For example, basic minerals (like olivine or lime) in soil and oceans. One of the main limitations of this technique is the necessity to **crush rocks and heat it up to very high temperatures** to obtain required materials. Both processes require an **important amount of energy**. It is estimated that to catch **1 ton of CO^2, it'd require to extract and transport 1 to 3 tons of silicates** on long distances.

ENSEMENCEMENT OF OCEANS

The ensemencement of oceans involves the spillage of nutrients, notably iron, in oceans in order to **stimulate the growth of phytoplankton** that'd catch **large quantities of CO^2.** The first calculations were **extremely optimistic**, and suggested that a few thousand tons of iron were enough to balance CO^2 emissions.
Experiments in confined spaces led to **disappointing results** that show that plankton's growth would inhibit nearby spaces. Therefore, **the results are null.** Furthermore, this technique would considerably modify the tropical chain and would have **repercussions on all oceanic ecosystems.**

TREE-BASED TECHNIQUES

AFFORESTATION AND REFORESTATION

Techniques based on trees aim to **reduce the quantities of CO^2 stocked in the vegetal biomass**. Estimates show that those techniques **are well available and mastered, and could stock 1 to 3 GT of CO^2 per year (out of 40).** However, using arable trees might have **consequences on the exploited land and on agricultural productions**. They would have a **negative impact on local biodiversity and be susceptible to forest fires.** That'd cause to release all the CO^2 they captured.

MANAGEMENT OF LAND AND AFOLU

The management of land aims to increase the quantity of CO^2 present in soil. Those techniques are based on the acronym **AFOLU** (Agriculture forestry and other land use). The intensive agricultural practices led to the **loss of 50 to 70% of the CO^2** originally contained in the land. The AFOLU practices would restore part of the land's capacity to store CO2. Those practices are encourages by the 4 pour 1000 (4 for 1000) initiative. (4P1000.org). The management of non arable land could c**ontribute in stocking a large amount of CO^2.** Nevertheless, those techniques can only contribute to the catchment of CO2 to an extent, until the lands are saturated with CO^2. **It'd be a modest quantity (<1GT) for 30 to 40 years.**

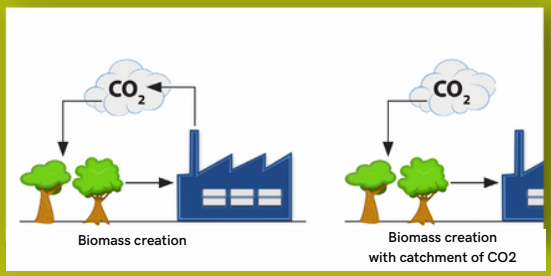
MORE INFORMATION ON MANAGEMENT OF LAND ON THE 4POUR1000 WEBSITE :

4P1000.ORG

AIR-BASED TECHNIQUES

BECCS

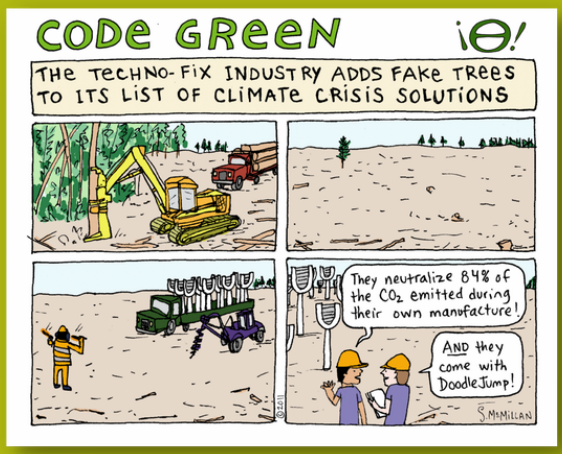
The bioenergy associated with the captation and stockage of CO^2 is well known as BECCS. (Bioenergy with carbone capture and sequestration). It represents, in most cases, the most important source of negative emissions. **It's based on growing plants and burning them to produce energy while capturing CO^2 issued from the combustion.** The captured carbon during the plant's growth is displaced in geological compartments. **BECCS represents the double advantage of producing energy while capturing carbon.** However, this technique is still **very costly energy wise.**



As a matter of fact, the captation of CO^2 at the end of chimneys is a process with **very mixed results with combustibles like fossil energies.** The difficulties associated with the usage of vegetal combustibles with heterogenous properties add up to the processes which seem economically fragile. Questions linked to the usage of land are the same as the one concerning afforestation. **BECCS would allow global warming to be under 1.5°C.** After the climatic models evaluated by the GIEC in its last report. It'd imply using 20% of arable lands for the growth of biomass. **Using natural lands like forest or prairies would increase the temperature by 3°C.** Finally, doubts are expressed on stockage of CO^2, experiments have shown risks of leakage as well as reactivation of seismic faults linked to CO^2 storage.

DACCS

Direct air carbon dioxide capture and storage or **DACCS consist of capturing CO^2 in the air directly to stock in geological compartments.** The necessary dispositions requires the air to be selected selectively and concentrated. The low concentration of $C0^2$ in the ambient air makes it a **very energy dependent process**. It costs **more than 4 times the amount of other TENs. It also uses large quantities of water and dangerous substances like sodium hydroxide.** There's also **many doubts expressed about the security of the CO^2 stocked in those containers.**



WHAT TO EXCEPT FROM TEN

In conclusion, even though they are an important component of most climatic models, **they are used as a negotiation for climatic negotiations.** The real potential of TEN **is far from being able to compensate the current levels of emissions.** The european academies science advisory council states that "**basing ourselves on TEN to compensate the lack of carbon emission reduction would have serious implications for future generations**". Though they have a role in fighting climate change, **it'd be an illusion to think they could be enough to maintain the current emissions. Moreover, those techniques aren't risk free when it comes to food safety and biodiversity.**

LEARN MORE ABOUT CLIMATE CHANGE

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