Negative Emissions in Energy Transition – The case of Geological Carbon Storage

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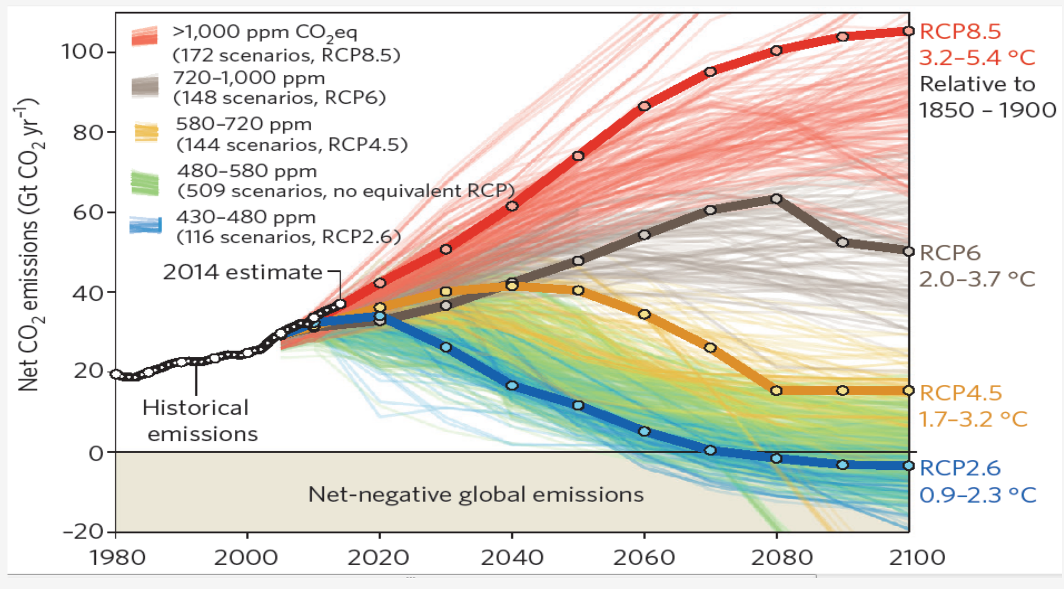
Negative Emissions, Energy transition and BECCS

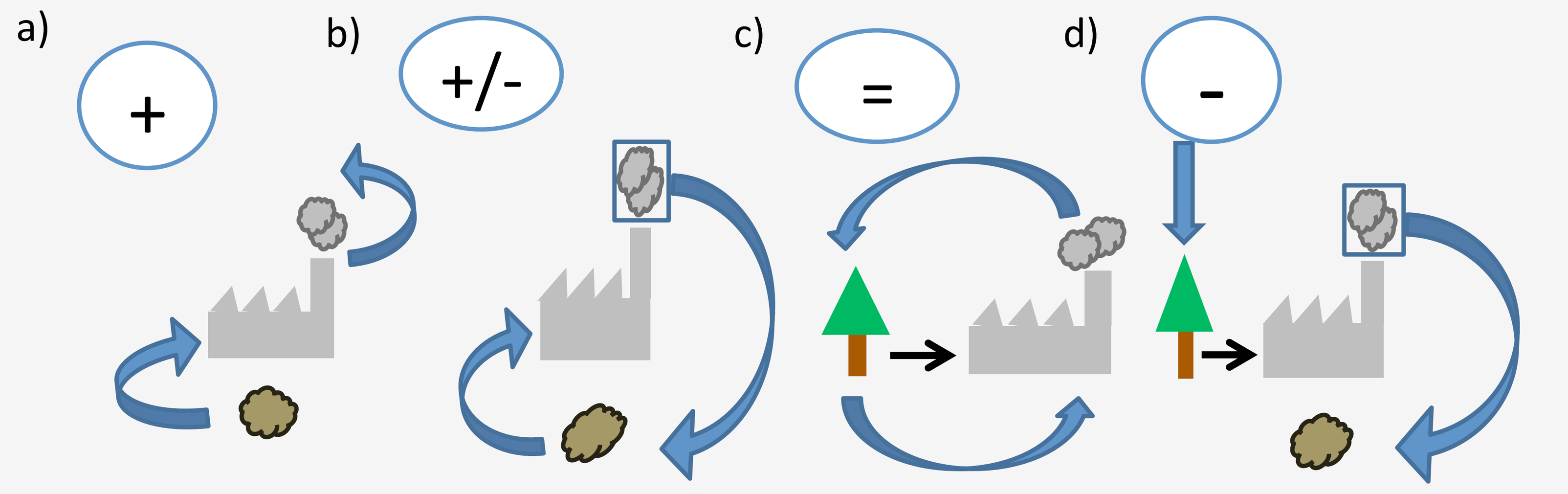
Negative emissions role for bending CO_2 world emissions curve

- «Negative emissions» means that *more* GHG emissions are avoided than emitted during a production process.
- It results in a *net* storage of CO_2, not only a reduction.
- Negative emissions could help reducing GHG already emitted in the atmosphere.
- It could be a solution to rectify the GHG emissions path, regarding different emissions scenarios.



Adjacent figure coming from : Fuss et al. (2014). Betting on negative emissions. Nature Climate Change, vol 4.

Negative emissions could be achieved with BECCS (BioEnergy and Carbon Capture & Storage)

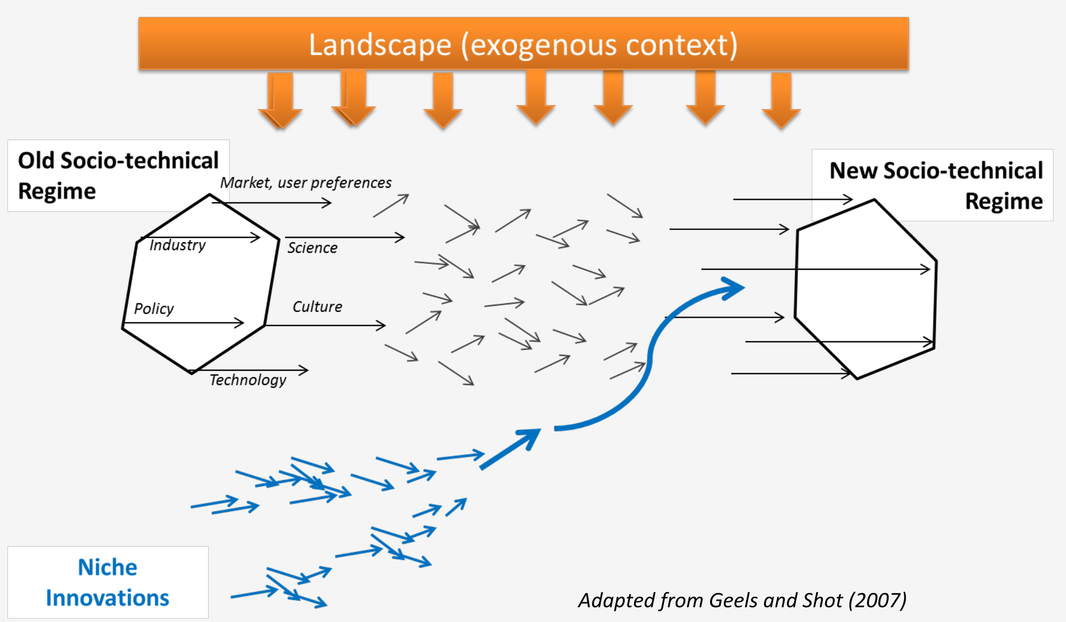


Schematic design of the carbon flows associated to the production of energy from fossil fuels (a), fossil fuel with carbon storage (CCS) (b), bioenergy (c) et Bioenergy coupled with carbon storage, BECCS (d).

CCS synergy with renewables : Which role in energy transition?

A Multi-Level Transition Perspective (MLP)

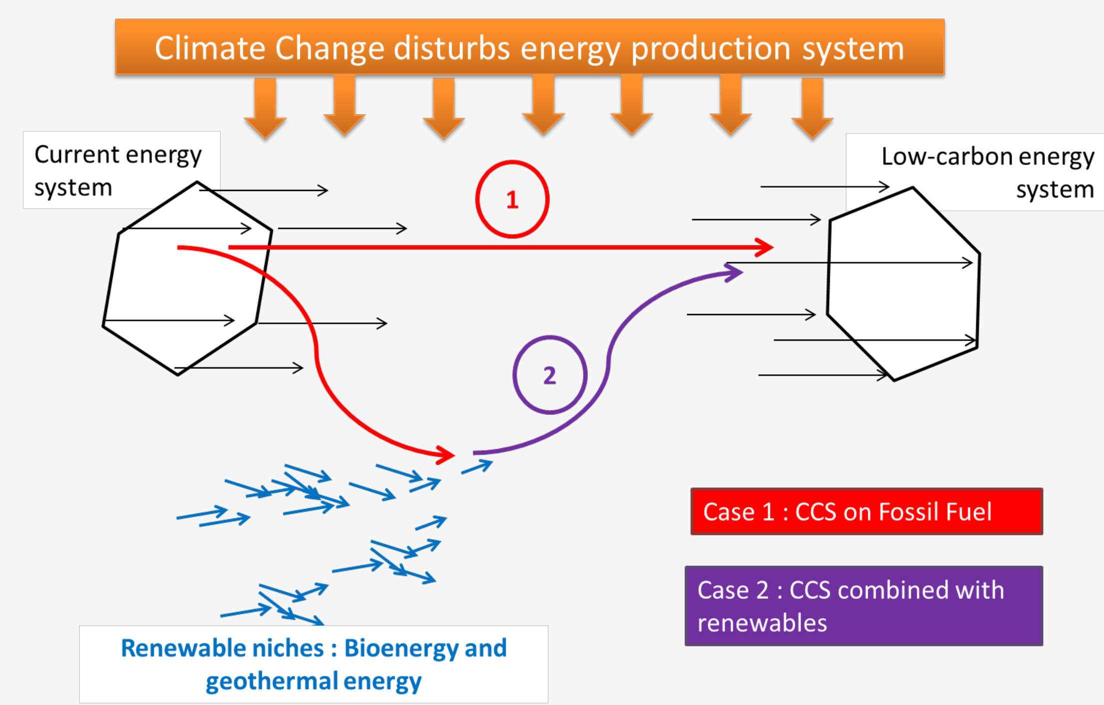
General modeling of MLP .



MLP analyses transition as a mutation process :

- from one sociotechnical regime to another,
- under the pressure of macro-level forces (the landscape),
- and the emergence of market niches / innovations that could provide the basis of the new regime .

CCS in MLP



- Here « Landscape » is climate change, but economic crisis or world energy demand increase also contribute to it.
- The socio-technical régime is the current energy system, based on centralized energy production, using fossil fuels and nuclear energy.
- The innovations are renewable energies that could compete or be used in synergy with CCS

Case 1 : CCS on fossil fuels

CCS is perceived as a niche coming from the current regime (Geels, 2014)

- It helps to pursue fossil fuel use
- It could be an example of *resistance to change* of inner actors
- Risk of actors understatement of CCS uncertainties (Arranz, 2015)

CCS on fossil fuels could slow down the energy transition in :

1 – Reinforcing carbon lock-in :

- CCS is costly as it generates high capital costs *in equipment* and *infrastructure* (e.g. Pipelines Networks), mostly sunk.
- Higher Operating Costs through a rise of *Demand for electricity* required by the process (energy penalty).
- So Neither firms nor governments cannot go back easily to their decision to implement CCS

2- Diverting resources from renewable energies

- Subsidizing CCS could *reduce financial incentives* to renewables energy
- CCS could be a signal that fossil fuels use will go on, reducing investment in renewables

Case 2 : CCS and bioenergy (BECCS)

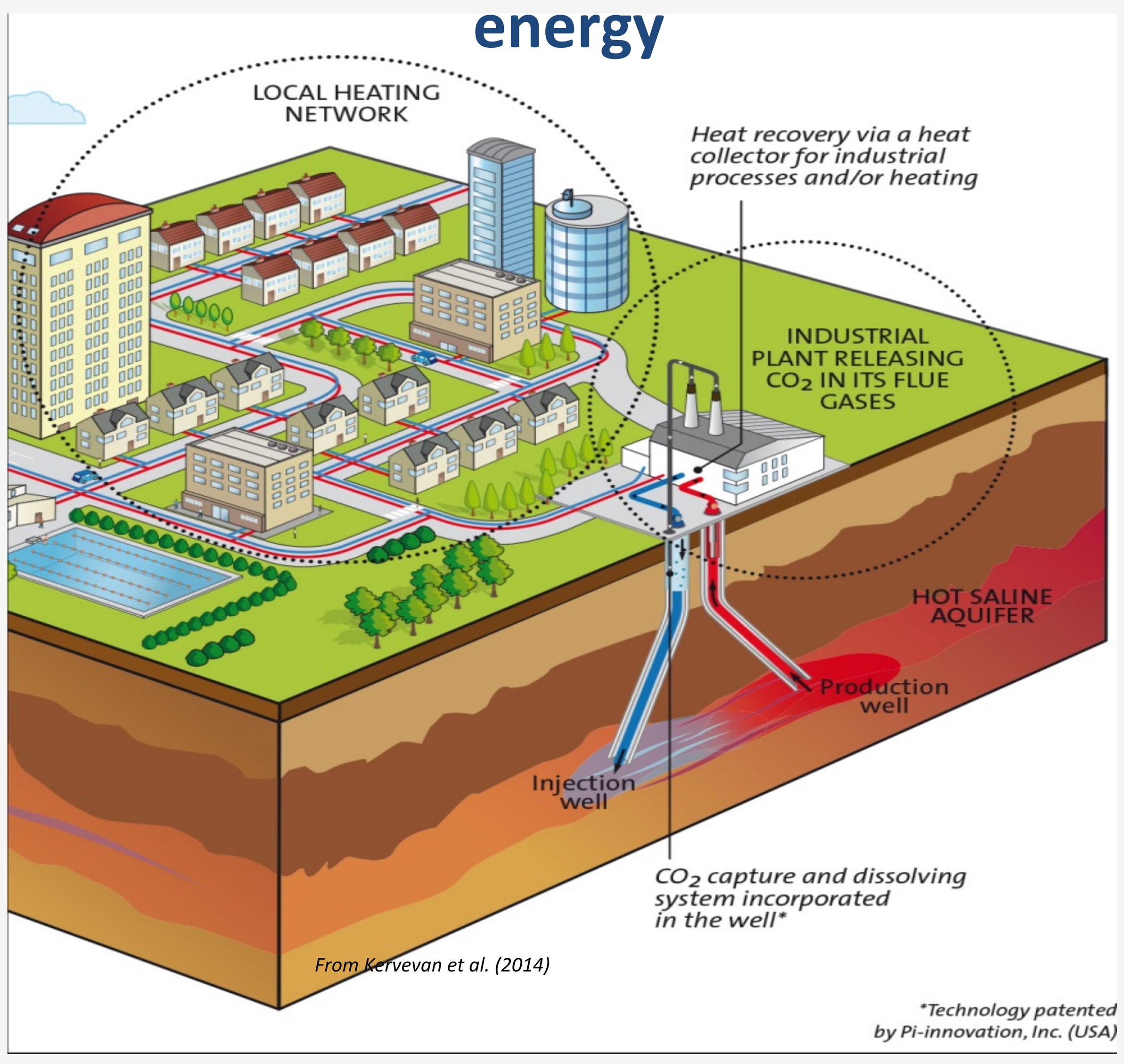
- **BECCS reduces the risk of carbon lock-in** (*Vergragt et al, 2011*)
- **Thanks to negative emissions, BECCS could reduce GHG already emitted**

But :

- Bioenergies could generate deep land-use changes and a loss of biodiversity
- Matching between bioenergies, demand location and CCS storage could reduce the technological potential
- And : **CCS needs large scale effects** and is **not well-adapted for small or medium emitters, as bioenergy emitters are often.**

CO_2-DISSOLVED technology: Improving CCS and BECCS with Geothermal Energy

A Synergy between CCS and geothermal energy

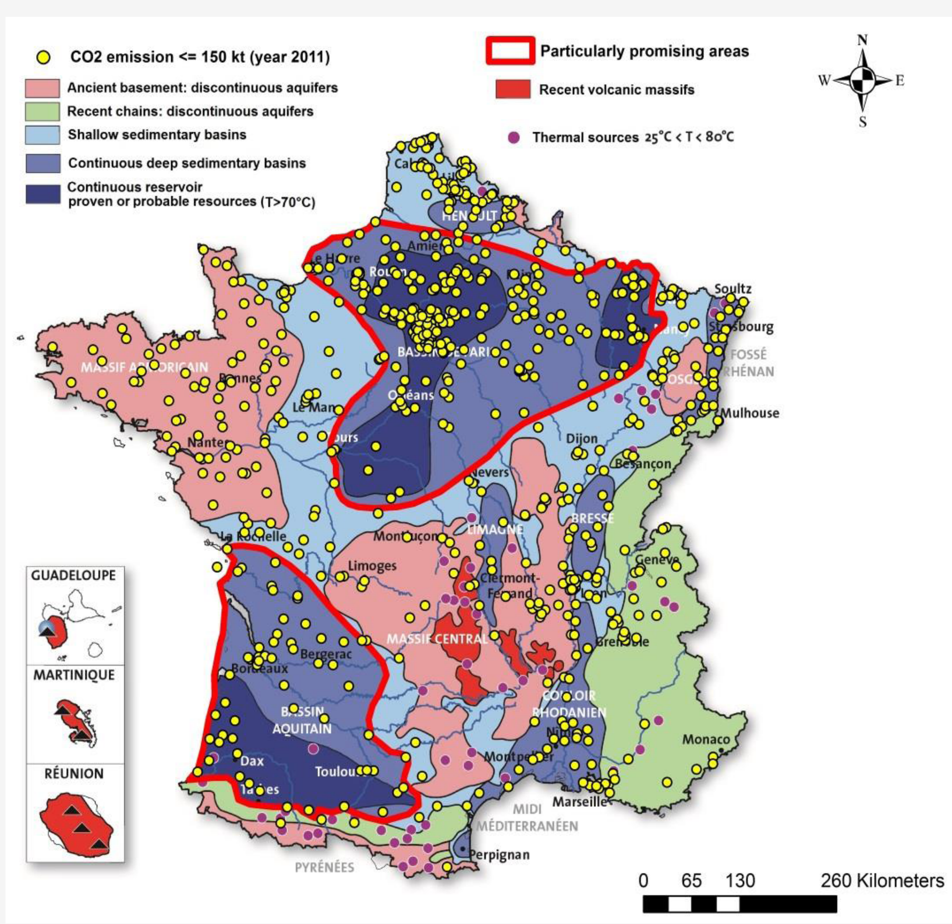


The industrial plant emits CO_2 that is compressed with cold brine (moderately/highly salted water) into the "injection well" where it is entirely dissolved into brine before reaching the targeted underground storing reservoir (aquifer).

The injected brine was first pumped out from the same aquifer via the "production well" so that water circulates in a closed loop between the two wells. Before being reinjected, the thermal energy contained in the extracted brine is recovered at the surface trough a heat exchanger system. This thermal energy is then used to feed a local heat network and/or to partly supply the own energy needs of the industrial emitter.

…..which needs to match geothermal resources with small CO_2 emitters

Potential Matching in France

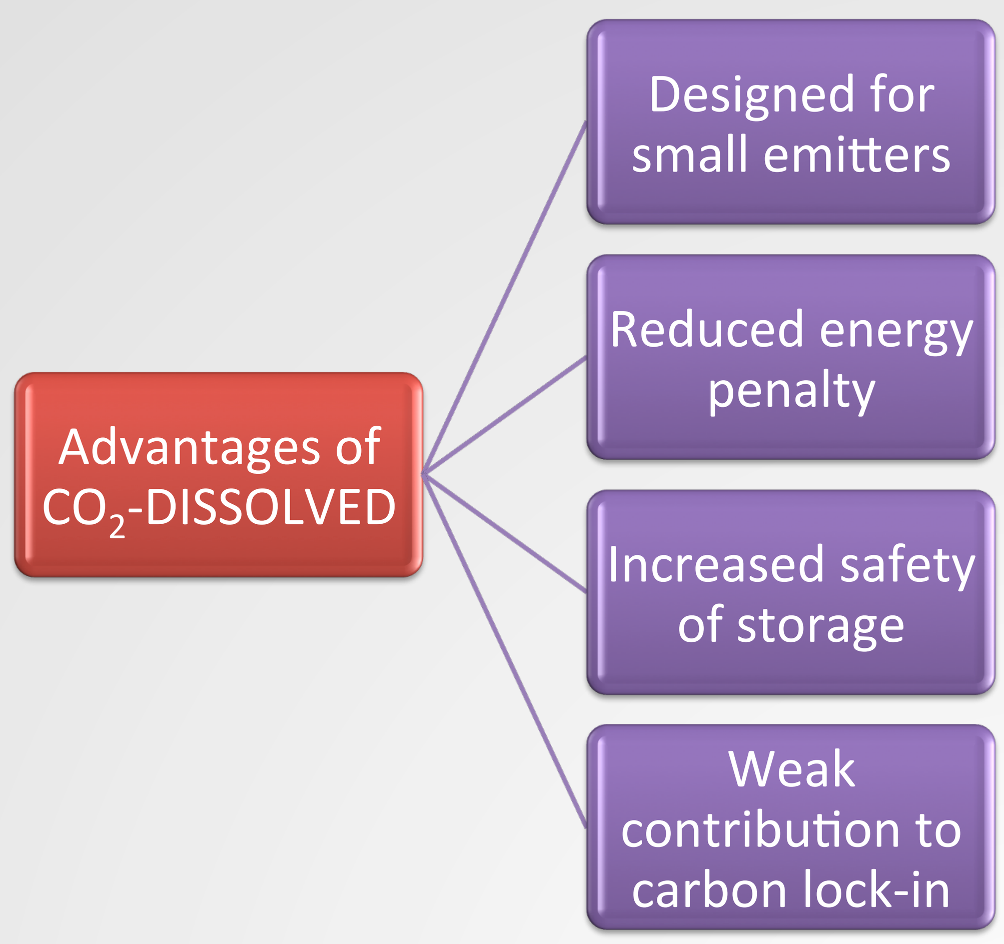


Implementing CO2 DISSOLVED Technology on a large scale will require to match small CO2 sources and geothermal sources.

Two promising areas have been identified in France.

Key messages

- Negative emissions could be provided by BECCS (Bioenergy and CCS)
- But, Bioenergy emitters are often smaller than fossil fuels emitters, as coal-fired plant, while CCS needs big scale effects.
- CO_2-DISSOLVED is a solution for small and medium emitters (CA< 150000T/yr)
- Despite additional constraints on geological characteristic of the storage site, CO_2-DISSOLVED could help the deployment of BECCS, and – hopefully- negative emissions



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Web site: http://co2-dissolved.brgm.fr