WHAT DO YOU THINK? PROS AND CONS OF CCS

THE ENOS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO 653718

ENOS

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CCS is a technology that allows for the storage of CO_2 in a safe way and for the long term. It is based on a strong scientific background and a large knowledge base, inherited from the oil and gas sector. Of course, like all technologies that can improve our quality of life, CCS can have downsides that should be recognized and, as much as possible, solved. In addition, the decision to implement it must take into account all the other technological options for reducing CO_2 emissions, to identify what are the best choices at a given point in time and in a given context. A correct evaluation of the technology and its possible role will thus rely on a balanced consideration of the advantages and disadvantages related to its implementation. Although making this analysis is not the objective of ENOS, it may be useful, for those who are not familiar with CCS, to summarise the public discussion of the technology's pros and cons. This is a complex issue and we realise that it will not be possible to give an exhaustive, complete, or totally impartial presentation. Within the limits of our researchers' perspective, we will only attempt to briefly illustrate what appear to be the most important highlights or topics regarding CO_2 storage. We will try as much as possible to give useful elements for discussion, "food for thought" so that even people who have never heard about CCS before can start to consider it. We hope that this can be a basis for exchange, during the ENOS activities, on all those aspects that are important for everyone: researchers, local residents, policy makers, environmental activists, industrial operators or other stakeholders. Of course for us, as researchers in the field of CCS, it will be particularly interesting to hear the point of view of non-professionals on CO_2 storage, such as members of the public and other social stakeholders, who will participate in the ENOS activities.

Returning carbon to the underground

Each day we consume considerable amounts of fossil fuels around the world. In many cases the massive burning of fossil fuels takes place at large power generating or industrial plants. If we take a moment to look at the substance that is being burned, we realise that the carbon, of which fossil fuels are made, is the same carbon that, once released to the atmosphere, forms the problematic CO_2 that is contributing to warming our climate. CO_2 geological storage has the significant advantage of allowing us to put this same carbon back underground, from where we extracted it. This can be a "bridging solution" which gives us the time needed for the transition to other low carbon technologies. Some people criticize this concept because they think we should, instead, stop extracting and burning fossil fuels altogether. In this way we would not need to store the CO_2 in the underground. This kind of reflection gives rise to many questions, on whether we can afford to stop using fossil fuels in the short term, how this could be done, how long it might take, where it could be started, and so on. In the meanwhile, fossil fuels continue to be used and account for about 80% of energy production globally. Until this situation changes, can we afford to keep burning oil and gas without storing CO_2 underground?

GROUP DIALOGUE
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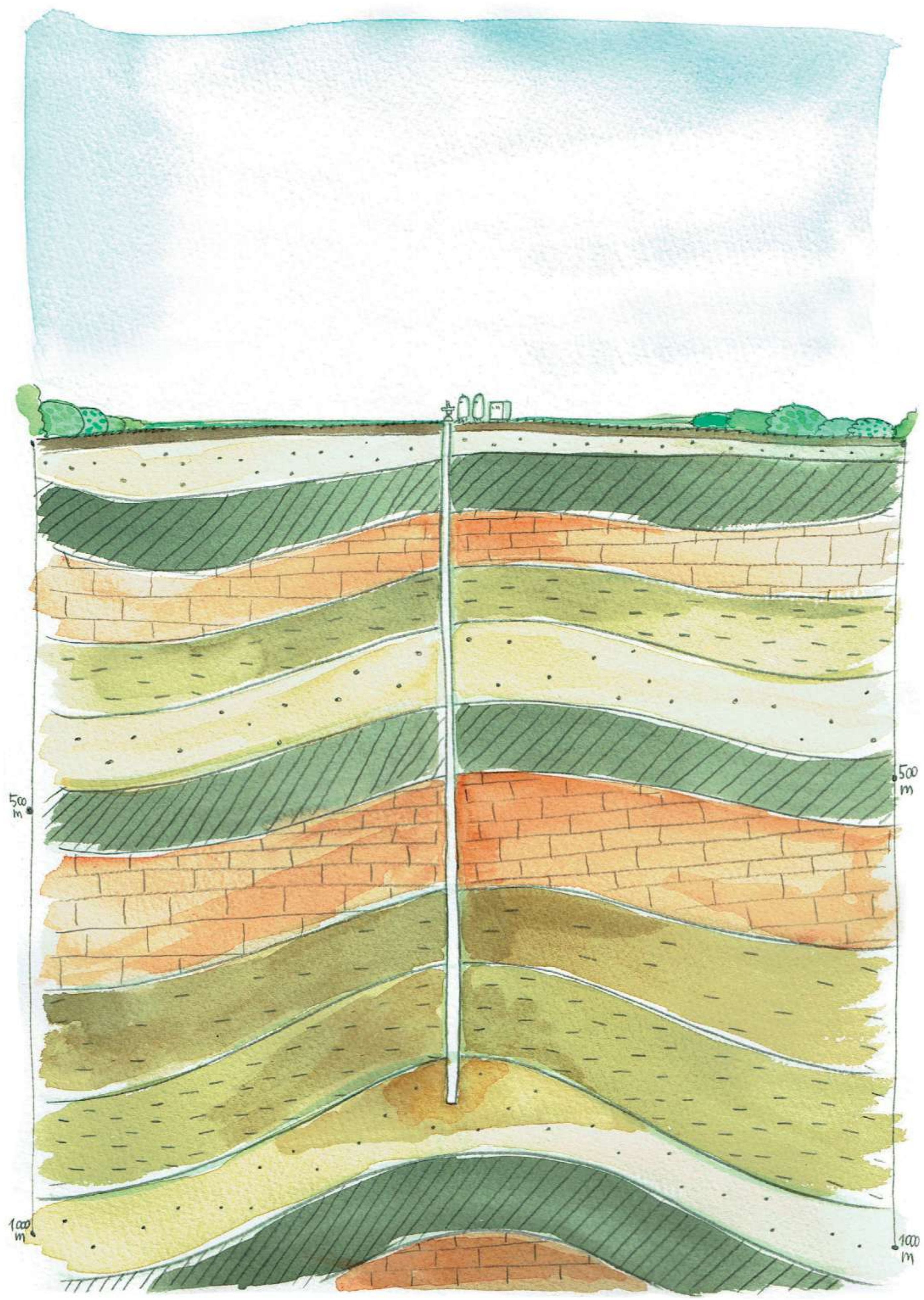

CO_2 STORAGE
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The geological concept: is CO_2 storage safe?

Many of the discussions around CCS, and storage in particular, revolve around the issue of safety, especially as information on this topic is scarcely disseminated. The concept of CO_2 geological storage was born from the observation of CO_2 and methane gas reservoirs that are present in nature, where the gas has been trapped in the deep subsurface for thousands or millions of years. Research has thus demonstrated the long term technical feasibility and safety of CO_2 storage. Today, from the point of view of professionals who work on CCS, the technology does not present any serious risk. However, it can be difficult for many people to imagine how a gas can remain trapped in the underground. Gas naturally flows upwards and the safety of CO_2 storage sites is thus often questioned. Will the CO_2 remain in the reservoir or will it escape one way or another? What risk could this pose for human health? Some people also observe that a natural geological trap, like oil and gas reservoirs which have not been drilled, is different from underground fields where there are wells that could act as pathways for gas leakage. Research that has addressed these concerns shows that these conditions represent limited risks that can be managed. More generally, when a site is properly chosen, the geological structures act as barriers, which make the possible escape of CO_2 from the reservoir a very low probability. Another aspect of strong interest, with regard to safety, relates to induced seismicity. People often ask: "Can we exclude the possibility that CO_2 storage might cause earthquakes?" During the injection phase small seismic activity cannot be excluded. When we extract fluids from the underground (water, oil or gas) or we inject them, underground rocks and fluids tend towards a new equilibrium and resultant small movements can lead to the release of energy. This is what researchers term "micro-seismicity", small earthquakes that are not perceived by humans and normally are only detectable using monitoring instruments. During the process of selection of a storage site, predictive modelling and other techniques are used to ensure that any ground movement that may be caused by storage operations will not constitute a risk. Similar to what happens for water extraction at very high flow rates and for oil and gas operations, safety will be ensured by proper management and operation of the storage site.

Lessening or increasing pollution through CCS?

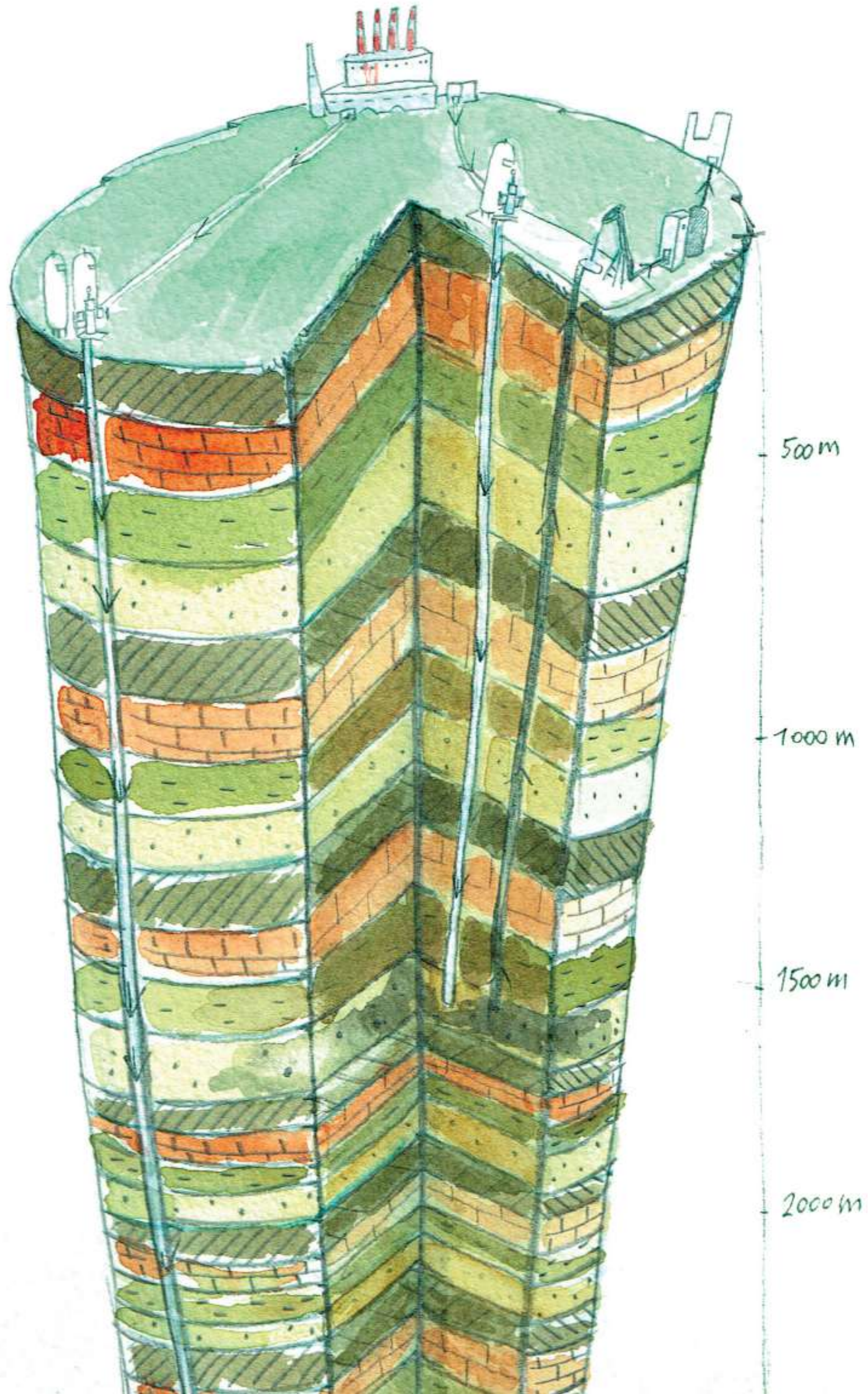
CCS can bring additional environmental side benefits. The sophisticated process for capturing and storing CO_2 can also reduce other pollutants, such as sulphur compounds or particulates. If we consider that CCS would require a complete upgrade of many power plants around the world that presently are very heavy polluters, the role of CCS for environmental protection could be much greater than just reducing CO_2. That said, the pollution related to the implementation of CCS needs to be taken into account, with the building of large-scale infrastructure and the risk of continuing to use fossil fuels beyond the period of time that is strictly necessary to switch to other forms of energy production. A specific aspect that needs consideration here is the so-called "energy penalty": the capture of CO_2 at large power and industrial plants requires a significant energy input (with the exception of some industrial processes which directly facilitate CO_2 separation and capture). The additional energy requirement implies a higher quantity of fuel must be burned, to produce the same amount of energy. This is a major downside of the technology, although it must be considered that the optimisation of the technology could considerably reduce the energy required for CCS.

Can CCS be implemented in Europe?

Being able to manage the complete carbon cycle, protecting the environment, ensuring a reliable energy supply and opening the way to new and more sustainable forms of energy production are key goals of European energy policy. Understanding if and how CCS can play a role is as urgent as ever. Europe in the past was at the forefront of CCS development. Norwegian researchers in the 1980's started to think about the possibility of putting the carbon, released through the combustion of fossil fuels, back underground. In 1996 this idea became a reality at Sleipner, in the North Sea, with the injection into a deep saline aquifer of CO_2 separated from the natural gas that was being extracted. After this promising start, pushed by a timely carbon tax, the pathway of CCS has been uneven. Plans at the European level for the demonstration of the technology have stalled. Some of the forerunner countries, like The Netherlands, Denmark or Germany, have encountered significant difficulties related to public opinion or opposition at the local community level. While funding issues together with the lack of public support have delayed the development of the technology, the use of fossil fuels has continued to produce emissions just as before. Additionally, considering CO_2 in a future perspective, not only as a greenhouse gas but also as a potential commodity (for instance associated with renewables to produce synthetic hydrocarbons), it may be even more important for Europe to advance research and demonstration of CCS.

Implementation readiness

A number of issues must be considered to address the point of CCS readiness for implementation, such as the status of the technology, the existence of (or plans for) the necessary infrastructures, the costs, and governing national and European regulations. In terms of technology, it can be stated with confidence that the knowledge and material exists right now, as CCS (or CO_2-EOR) is already taking place at numerous sites throughout the world. Infrastructure, on the other hand, is at a much earlier stage. For example, pipeline networks that would transport the CO_2 from where it is produced to its final destination, are not yet in place in Europe and would have to be built. This also raises the point of costs, as, for example, construction of such infrastructure would be expensive. The capture of CO_2 is also, at present, very expensive, however investment in research and general support of deployment of the technology have great potential to reduce these costs, as has occurred for energy production via both solar and wind. For these latter two, governments established a long-term vision, regulations, and subsidies that created a favourable economic environment. Similarly, stable and predictable regulations for CCS would permit companies and local governments to have a long-range vision for the implementation of CCS, thus favouring investments in the technology which could make it less expensive.



CO_2 storage can allow for large scale CO_2 emissions' reduction

CCS can manage large amounts of CO_2 produced at industrial sources like power plants, cement factories, steel plants or oil refineries, and be combined with many other energy supply solutions like biomass or geothermal energy production. It can provide a much-needed answer for responsible fossil fuel use, and can be a major source of job creation. For example, the deployment of CCS could catalyse new jobs in the provision of services, the manufacture of components, and the construction of CCS plants. Several economic models have estimated the economic impacts of climate change, concluding that the benefits of strong and prompt action far outweigh the projected economic costs of inaction. CCS could be an important part of this effort.

Can CCS be implemented in Europe?

A common discussion about CCS regards its cost. It requires the building of very large infrastructures for capturing and transporting the CO_2 and consistent investments to identify good sites for storage. Due to the very low price of CO_2, at least at present, spending for CCS is not economical. On the other hand, supporters of CCS note that investing in CCS today can save us from much higher costs in the future, which would be triggered by climate change. When compared to other low carbon technologies, CCS can even be a cheaper solution for reducing CO_2 emissions, one which, however, requires large upfront investments. Who should pay for these investments? If it should be industry, then the cost might affect the whole economic system, impacting on profit and employment. What is commonly suggested is that public funds should be used now, to support the full development of the technology, bringing it to a cost level which facilitates its integration in the industrial system.

CCS and the use of local energy sources

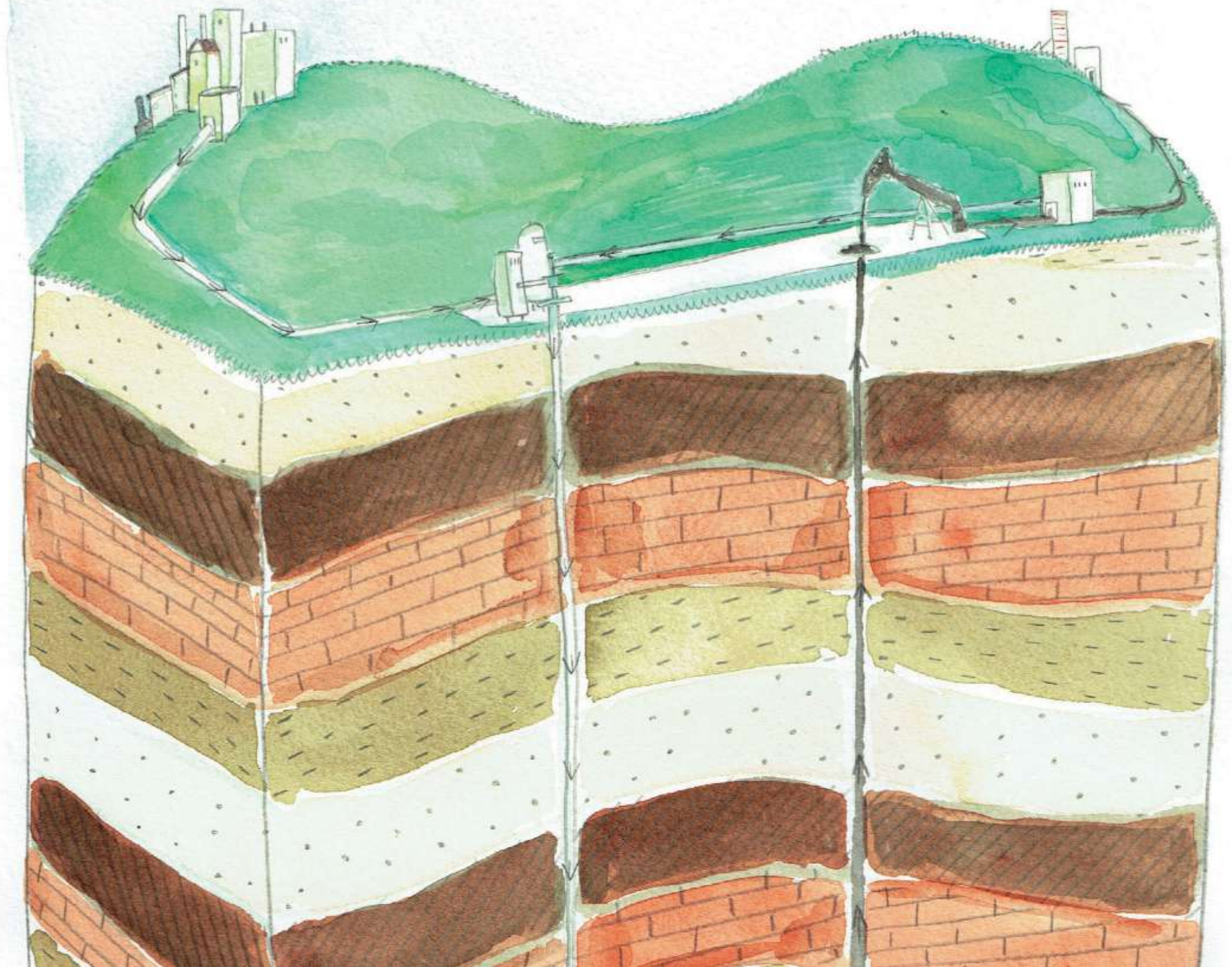
A major problem for all countries is finding resources to produce energy, one of the main commodities that allows us to live comfortably. Making use of resources that are locally available is therefore the first option that is considered, even if local energy sources may not be ideal in terms of the environment and climate. In this context, the use of fossil fuels which are still very abundant in many places of the world, appears to some countries as the only way to produce sufficient energy to allow for development at an affordable cost. CCS, together with other technologies that limit the impacts of coal and natural gas use, could make them more sustainable. This would, over the long term, reduce the overall costs that would have been associated with a "business as usual" approach (such as the health costs of pollution).

CCS can reduce emissions from energy intensive industry

When discussing CCS applied to coal or gas power plants, a common objection is that we should not aim to make fossil fuel use more sustainable, but rather stop it altogether, as soon as possible, by using alternative forms of energy production, like renewables or nuclear, which do not carry the problem of CO_2 emissions. This kind of alternative does not yet exist for some energy intensive industries, such as steel or cement factories, chemical or paper production. These industries account for a considerable proportion of CO_2 emissions, due both to the use of fossil fuels and to CO_2 emissions related to the industrial processes themselves. CCS can play an important role to prevent these industries from releasing large amounts of CO_2 into the atmosphere.

Different perspectives on CCS: advantages and disadvantages

Arguments regarding benefits and downsides of CCS often coincide, as the same characteristics of the technology can be seen as advantageous or disadvantageous depending on the different perspectives. For instance, CCS can help abate CO_2 emissions of coal power plants. This is seen positively by those who think that we will not be able to do without coal for many years, or that in some countries of the world development cannot happen without coal. It is instead seen negatively by those who think that coal use should be given up as soon as possible, because of its environmental impact. Similarly, those who oppose the use of fossil fuels fear that CCS could extend and increase their consumption, while others think that as long as fossil fuels are used, all the possible ways to reduce their emissions should also be used, making their consumption more "responsible". Another focus is on large scale industrial activities, which at present could not take place without fossil fuels, because of the intensive energy supply they require. CCS could make them more sustainable, and less likely to migrate to other countries to escape the carbon issue. But this is seen negatively by those who think that we should move towards a different economic model, in which large scale industrial activities are reduced. It is clear that the real characteristics of the technology play a very limited role in these discussions, which relate to much wider technological challenges. However, improvements of the CCS technology, and reduction of its implementation costs, could probably make it easier to find the best way forward.



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