Ethical desirability of carbon capture and storage in Barendrecht

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Summary

Carbon capture and storage (CCS) is a technique to filter out CO_2 from industrial processes and store it underground. This is done to prevent the CO_2 from being emitted into the atmosphere where it causes global warming. In the Netherlands, the government decided in November 2009 to start with a CCS project in Barendrecht.

The ethical desirability of this CCS project can be discussed with respect to the unknown effectiveness and the unknown risks. Because of the dubious effectiveness and the availability of alternatives, in my opinion the Dutch government should not go ahead with this project. The funds used are better spent on other technologies that actually make the world more sustainable instead of just mitigating negative effects, and that do not pose a (very low) risk to the Barendrecht people.

Introduction

In November 2009, just a few weeks before the Copenhagen Climate Conference where nations were hoped to decide on measures to prevent a global climate crisis, the Dutch government decided to fund a controversial new project in Barendrecht, near the port of Rotterdam. This so-called carbon capture and storage (CCS) project, meant to store CO_2 underground to prevent it from being emitted and warm the planet, meets heavy resistance from the local population. [The Wall Street Journal, 2009]

This decision raises some ethical questions. Because the technology is quite new and not used commercially yet, both risks and effectiveness are uncertain. Therefore this essay tries to answer the question:

Is it ethically desirable to invest in a CCS project in Barendrecht to reduce CO_2 emissions when the risks are uncertain and the effectiveness is unknown?

First, the technical background of CCS is discussed, including effectiveness, economics, safety and specifics for the Barendrecht project. Then, the ethical desirability with respect to the unknown effectiveness is discussed. Thereafter, the ethical desirability with respect to the unknown risks is discussed. Finally, some conclusions and recommendations are given.

How does carbon capture and storage work?

Carbon capture and storage is a technique meant to store CO_2 underground. CO_2 is captured from the source – usually a large user of fossil fuels like a power plant, steel factory or oil refinery – transported by pipeline to the storage site and injected into a suitable deep rock formation. [IPCC, 2005]

All this is done to prevent CO_2 from being emitted into the air, where it works as a greenhouse gas, warming the planet. Governments worldwide have agreed in the Copenhagen Climate Accord that the increase in global temperature should be below 2 degrees Celsius. To reach this, the emissions of CO_2 should be reduced enormously. [The New York Times, 2009]

Currently, there are several CCS plants operational around the world. However, almost all of these projects use the injected CO_2 to boost oil or gas extractions. No CCS facility currently exists purely to store CO_2 underground to mitigate global warming. [IPCC,

2005] In Germany a test power plant is operational, capturing the CO_2 but not storing it yet. [Vattenfall, 2009]

Effectiveness

The effectiveness of CCS facilities should be discussed in two ways: is CCS an effective way of capturing carbon dioxide; and is CCS an effective way to avert global warming?

The first question is a very technical one, and can quite definitively be answered with 'yes'. Capturing and storing CO_2 is technologically possible with proven techniques. When CO_2 is stored in suitable deep rock formations, depleted oil and gas reservoirs or saline formations, and when trapped by confining rock layers ('caprock') or by chemicals, the carbon dioxide will remain underground for centuries. [IPCC, 2005]

Whether CCS is an effective way to avert global warming is much harder to answer. Because CCS focuses on the 'waste product' CO_2, any investment in CCS facilities means that less is invested in completely carbon neutral technologies like wind or solar energy. Furthermore, the capture and storage of CO_2 costs a lot of energy, increasing the (fossil) fuel use of power plants equipped with CCS technology. Finally, because of leaking risks, part of the stored carbon dioxide may end up in the atmosphere after all. [The Economist, 2009]

Economics

The cost of CCS is not easily determined. Expected costs range from $40-90 per tonne CO_2, but are a lot higher for early demonstration projects: $60-90 per tonne CO_2. [IPCC, 2005] [McKinsey, 2008]

Because of the 'energy penalty' (capturing and storing CO_2 costs a lot of energy), power plants equipped with CCS technology use a lot more fuel.

Due to the large investments needed for CCS projects, government support is often needed to make the facility feasible. For instance, the Dutch government participates in the Barendrecht project for €30 million. [VROM, 2009]

Safety

Safety aspects are a major point of interest with respect to CCS projects. Tonnes of CO_2 are injected into rock formations several kilometres deep, while knowledge of what happens with these earth layers remains sparse. The CO_2 may have an effect on ground water supplies, on soils, minerals and plants, and it may pose a serious risk for humans living nearby the storage site in case of a leak. [IPCC, 2005] Because CO_2 is heavier than air, it may pose suffocation risks for people. [The Economist, 2009]

Specifics of Barendrecht project

In Barendrecht, Shell wants to divert captured CO_2 from its oil refinery in nearby Pernis to two depleted gas fields near Barendrecht. These fields have a capacity of 0.8 and 9.5 megatonnes CO_2. Per year 300 to 400 kilotonnes CO_2 is to be stored. [Shell, 2009] [The Wall Street Journal, 2009]

In November 2009, the Dutch government decided to go ahead with the Barendrecht project and to give a €30 million subsidy. CCS is a very important element in the climate plans of the current cabinet. The local population and government are heavily against the project, mainly because of perceived safety risks. [VROM, 2009] [The Wall Street Journal, 2009]

Is it ethically desirable to invest in CCS when the effectiveness is unknown?

To answer the main question, the ethical discussion is split in two parts. The first part is about the unknown effectiveness. As explained before, the effectiveness of CCS can be measured in two ways: technological feasibility and effectiveness against global warming. As the technological feasibility is not really up for discussion, the ethical

deliberations should be about the effectiveness of CCS as a means to avert a global climate crisis.

Often, discussions on global warming focus on the future of next generations: will our children's children and their children still be able to live on this planet? This basis for all kinds of investments and studies into sustainable new technologies can be classified as care ethics. Care ethics is about caring, for people you are related to but also for the planet in a broader sense. Therefore it makes sense, based on care ethics, to make sure that the world does not overheat and therefore to reduce emissions.

If it is clear that the planet should be saved and that emissions should be reduced, it is wise to do so in the most effective way. This is wise from an ethical perspective – it can be classified as a virtue – but also from the view that tax money should not be wasted (as often large public investments and subsidies are linked to the development of new green technologies).

As for the specific effectiveness of the CCS project, some say it is a waste of energy and money, money that could much better be spent on completely carbon neutral technologies like wind or solar energy. [Greenpeace, 2007] Because when using CCS the dependence still is on fossil fuels, CCS does little to make life really more sustainable.

Also, opponents of CCS worry that because of this technology, more coal powered power plants may be built. These power plants may then, thanks to CCS, be relatively 'green', but in essence these plants are still very heavy emitters of CO_2. For oil refineries, the same argument goes up: the refinery might become more sustainable, but the use of fossil fuels is not reduced at all. Therefore, when these kinds of developments are taken into account, the real effectiveness of CCS becomes uncertain.

Proponents of CCS, including the Dutch government, say that while it is true that CCS is a technology that prolongs the use of fossil fuel burning facilities, it is definitely necessary to meet climate goals. [NRC Handelsblad, 2008] Because CCS can be operational quite fast, it should be used, because the world cannot afford to wait until wind and solar energy are ready to provide the complete energy demand of the world. It may be too late then to turn back the effects of global warming.

Basically, the proponents of the CCS thus take a very utilitarian point of view. Their reasoning is that because the negative effects of global warming are so bad, all actions necessary to prevent that should be taken. CCS may not be the prettiest solution, but it probably works and it can be used now. Therefore, CCS is worth investing in.

In my opinion, the reasoning by, among others, the Dutch government and Shell is too defeatist: it sounds as if they are saying "CCS may or may not be effective, but it is one of a few technologies ready now, so let's use it and then hope it works and the climate crisis is averted." This pure utilitarian point of view neglects the choice that policy makers and energy corporations have: the choice to invest heavily in alternatives to a fossil fuel based economy.

Because CCS is a technology focused on mitigating negative effects (emitting CO_2) instead of finding new ways to prevent these negative effects, this technology basically postpones the solution of today's problems to the future. Next to huge reservoirs with CO_2, which present unknown risks to future generations (see next section), also the unknown effectiveness may damage future generations if negative climate effects are not averted.

Therefore, I think that from an ethical point of view, considering our responsibility to Earth and to future generations, it is unwise to invest in CCS. The funds used to develop these

projects can be better spent on technologies, such as wind energy and solar energy, that are known to be effective in reducing emissions.

Is it ethically desirable to invest in CCS when the risks are uncertain?

The second ethically debatable subject about CCS is the risks involved, and the uncertainty of these risks. A couple of risks can be distinguished.

First of all, there are risks for the people of Barendrecht, living very nearby the empty gas fields that will be used to store CO_2. As described before, there are risks associated with the transportation and injection processes, but also with the CO_2 when it is stored underground. The professional estimates for CO_2 storage underground state that with the right monitoring and mitigation procedures, the risks for humans can be kept very small. [IPCC, 2005] Furthermore, all professional safety assessments for the Barendrecht project show that the risks involved with storing CO_2 are very small and do not exceed official limits. [DCMR, 2009]

However, the people of Barendrecht themselves are heavily against the CCS project, mainly because of the risks.

These complaints can be said to be a NIMBY (Not In My Back Yard) reaction. It is not a strange response for people to complain about a big new project going on in (or underneath) your home city, even if all safety assessments say that it is perfectly safe. A lot of citizens demand "guarantees" from the government that nothing will go wrong, and see the absence of such guarantees as proof that the technology is in fact dangerous. Of course this line of argument ignores the fact that nothing in life is certain, and that risks can never be reduced to zero. Therefore it can be justified for the government to overrule the local council's barriers, when independent research shows that risks are low.

But even when risks are low, they are present. The government, in deciding whether to overrule the local city council, must then determine if the risk is acceptable. There are some ethical considerations regarding acceptability of risks.

Both from a utilitarian as from a Kantian perspective, the principle of "do no harm" can be derived. This leads to several aspects in deciding when a risk is acceptable.

Acceptability of risk depends on the *benefits* of the risky technology. The beneficial goal of CCS is clear. However, as discussed before the effectiveness of CCS in averting a climate crisis is debatable and in my opinion too uncertain. Therefore, the people of Barendrecht have a good point if they would point to the dubious benefits of the technology that would pose a risk to them.

Closely linked to the availability of benefits is the *availability of alternatives*. From a very narrow perspective, looking at alternatives for CO_2 storage sites, there are several alternatives. The government for instance considered a seaborne location as an alternative to the Barendrecht site. However, it was deemed not realistic because of costs, delays in the start of the project and, interestingly, because already more is known about storing CO_2 at sea than at land. And one of the goals of the €30 million state subsidy for the CCS project is to gain knowledge about CCS. [VROM, 2009]

There are also a lot of alternatives in a broader sense. As said before, in averting a potential climate crisis, also investments in wind or solar energy can be done.

In my opinion, there is a wide range of available alternatives, all of which can benefit from the state subsidies given to CCS. It is therefore unnecessary to let the Barendrecht people be exposed to extra risks, however small.

Furthermore, risks generally become more acceptable if they are accepted *voluntarily*. As explained before, the people of Barendrecht most certainly do not accept the risks that are imposed on them by the CCS project. However, as I have argued before the government is allowed to overrule such NIMBY reactions if the benefits to the entire country outweigh the risks.

Finally, the acceptability of risks depends on the *distribution* of the risks. The people of Barendrecht argue that they are exposed to a lot of risks, not just the CCS risks. Also the large port of Rotterdam nearby, with a lot of chemical industry, poses some risks on Barendrecht. And also national highways and high-speed rail links pass through or near the city, adding to the cumulative risks for the citizens of Barendrecht. Because all these risks are linked to vastly different sources (from a port to a refinery to a highway), and because all these risks are small and stay below official limits, I do not think the concentration of risks in Barendrecht is a reason not to go ahead with CCS.

Next to the direct risks of CO_2 storage and injection for the people living nearby, there is also a second category of risks. Due to CCS, future generations will end up with huge reservoirs of CO_2 in the earth, with unknown effects. Because these uncertain effects may have negative consequences, this also presents risks.

As mentioned before, stored CO_2 at deep earth layers may contaminate ground water and minerals. And although there is little evidence that CO_2 stored underground does great harm, at the same time there is no certainty for any long-term projects. [IPCC, 2005]

Thus, while implementing CCS may be done from an ethical conviction to take care of future generations by protecting them of a climate crisis, at the same time this presents risks to those future generations.

Of course, these objections hold for a lot of new technologies. And if new and (by definition) unproven technologies can never be used because of potential unknown risks, then new technologies can never be used.

This dilemma is rooted in ethical theories, where foreseeability is very important in determining the active responsibility someone has. Foreseeability with respect to new technologies can be expressed in the precautionary principle: “When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm.” [UNESCO, 2005] So when there are uncertain risks involved with new technologies, actions must be taken to prevent them from leading to serious harm.

In the case of CCS, this means primarily that there should be a good monitoring system that gives information on the status of the CO_2 storage sites and possible leaks or other adverse effects. Because these monitoring and verification technologies are available from the oil and gas extraction industry, and mankind is well aware of the possible risks associated with CCS, I think CCS can comply with the precautionary principle and there should be no objections of this category to the implementation of CCS technology.

One of the risks associated with the very long-term periods associated with CO_2 storage, is that people, in the future, may not know the risks associated with drilling into the storage sites. Because of comparable issues with radioactive and other toxic waste storage, research has been conducted into what is the best way to communicate to future generations that they should not excavate these storage sites. [Sebeok, 1984] [Trauth, 1993] In my opinion, these kind of precautionary measures

should also be considered when very long-term CO_2 storage sites are selected.

Conclusions and recommendations

Carbon capture and storage is a technique to filter out CO_2 from industrial processes and store it underground. This is done to prevent the CO_2 from being emitted into the atmosphere where it causes global warming. In the Netherlands, the government decided in November 2009 to start with a CCS project in Barendrecht.

Ethical questions rise when it is considered that the effectiveness of this technique is unknown. In my opinion, considering the responsibility of current generations to the future of the Earth and coming generations, it is unwise to invest in CCS. The funds used are better spent on other technologies that actually make the world more sustainable instead of just mitigating negative effects.

Other ethical considerations play a role in assessing the risks associated with CCS. The Barendrecht people are heavily against the project near their homes, but in my opinion the government has the right to overrule local NIMBY objections. However, this is only allowed when risks are acceptable.

In my opinion, the risks of the CCS project are not acceptable due to the lack of benefits as the effectiveness of CCS is dubious. Moreover, due to available alternatives it is not necessary to put the people of Barendrecht at risk.

Risks associated with CCS for future generations can be dealt with by using monitoring and verification techniques already used by the oil and gas industry. These risks should pose no ethical problems in implementing CCS technology.

Overall, I think, from an ethical point of view, that the government should revise its decision and not invest in the CCS project at Barendrecht.

I would recommend that the acceptability of risks in case of overruling of local objections is made very explicit to local people. Furthermore, in case the CCS project is continued, I would recommend that serious monitoring, verification and marking techniques are used to prevent risks for future generations.

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