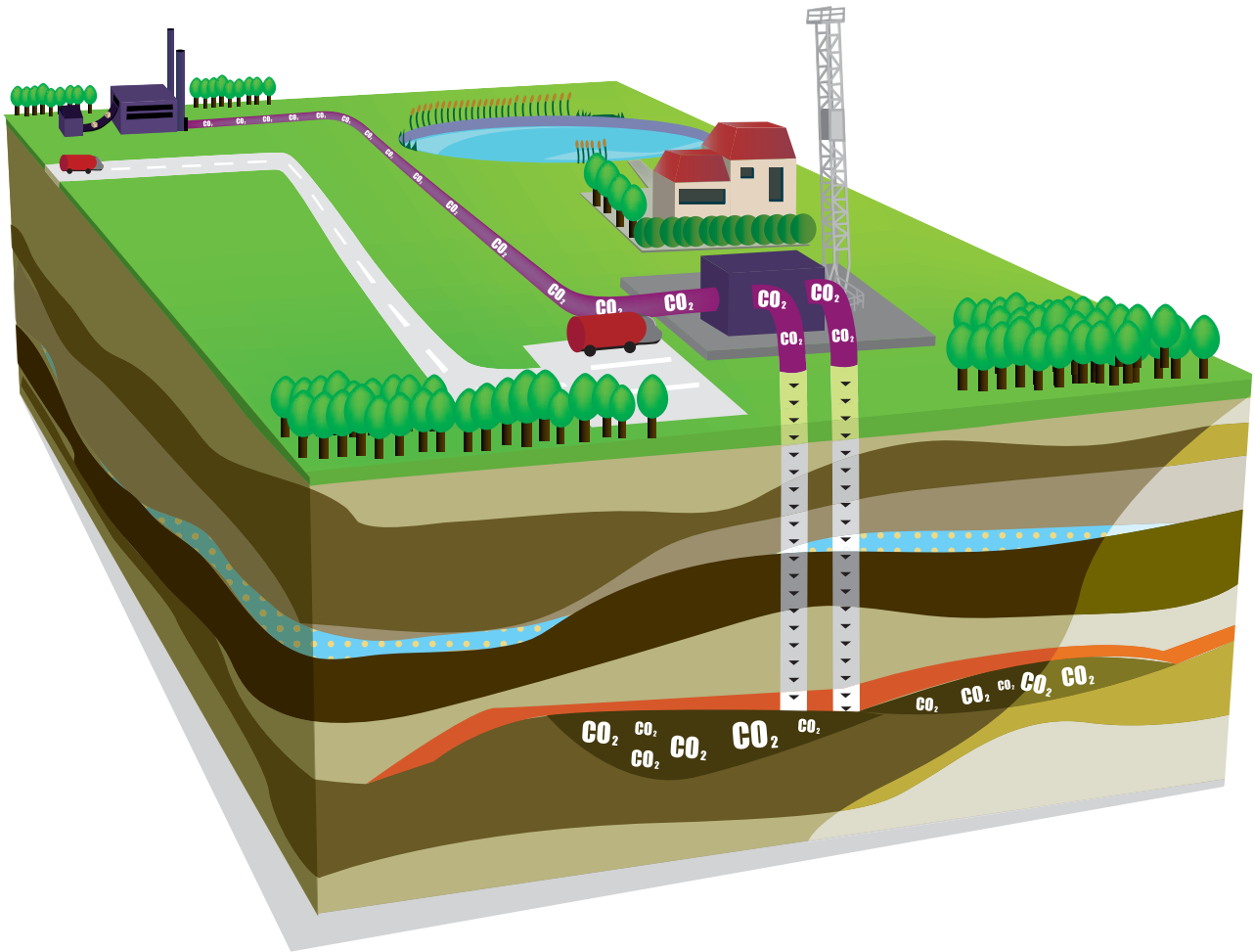




European
Commission



Ensuring safe use of **carbon
capture and
storage** in Europe

Climate Action

Carbon capture and storage (CCS) is a new technology with major potential to contribute to the fight against climate change. As with all new technologies, careful consideration of potential impacts on the environment and human health is important. In 2009, the European Union adopted legislation¹ to ensure that CCS is implemented safely and, as far as possible, to prevent and eliminate any risks to the environment and human health.

This brochure explains how this legislation seeks to ensure the safety of CCS in Europe.

What is carbon capture and storage?

CCS involves capturing the carbon dioxide (CO₂) from power plants or industrial installations, transporting it to designated sites, and injecting it into geological formations from which it cannot escape. Suitable geological formations can be offshore or onshore, for example in exhausted oil or gas fields or saline aquifers, and several kilometres below sea or ground level.

Europe is recognised as one of the global leaders in the development of CCS technologies. The processes themselves (capture, transport and storage) are not new. Since 1996, CO₂ capture and storage has been demonstrated in Norway at the Sleipner gas field. Thousands of kilometres of CO₂ pipelines exist in the US and Canada. Integrating the capture, transport and storage into a single chain on a commercial scale at power plants or industrial installations is the

main challenge. This is addressed in commercial-scale demonstration programmes co-funded by the EU.

The EU adopted its CCS Directive as part of a package of climate and energy measures aimed at cutting the greenhouse gas emissions that contribute to climate change, increasing energy security, and moving towards a low-carbon economy. The EU wants to see CCS become commercially viable and so start to realise its potential as an important technology to reduce carbon emissions in the EU and globally.

For economic reasons, CCS is likely to be deployed first in the power sector. The European Commission expects it to be among a number of low-carbon technologies and energy efficiency measures contributing to the process of decarbonising the power sector by 2050.² The large-scale commercial application of CCS to emissions from industrial installations, such as steel or cement works, is expected to follow from 2030 onwards.

1 Directive 2009/31/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006

2 COM (2011) 112: A Roadmap for moving to a competitive low carbon economy in 2050 (08 Mar 2011)



The international community has acknowledged that global warming needs to be kept below 2°C (3.6°F) compared with the pre-industrial temperature in order to prevent dangerous climate change. This will require significant reductions in the world's emissions of CO₂ and other greenhouse gases (GHG) over the coming decades. CCS is one of the technologies that can help to achieve this.

The EU, which is responsible for around 11% of global GHG emissions today, has put in place binding legislation to reduce its emissions to 20% below 1990 levels by 2020. Europe is also offering to scale up this reduction to 30% if other major economies in the developed and developing worlds agree to undertake their fair share of a global reduction effort.

For the longer term, the EU has committed to cut its emissions to 80-95% below 1990 levels by 2050, as part of the action that will be required from the developed world. In March 2011, the European Commission published a roadmap that charts a cost-effective pathway for making the transition to the competitive, low carbon European economy that this significant reduction will require. Research and development into CCS and demonstration and early deployment are of paramount importance to ensure its safe, cost-effective and large-scale application.



Courtesy of the Zero Emissions Platform

The CCS Directive

The Directive establishes a robust legal framework for the safe geological storage of CO₂, putting in place high standards designed both to ensure safety and also to help Europe meet its targets in the fight against climate change. It gives priority to the protection of the environment and human health, aiming to minimise risks and eliminate any negative effects. The focus of the Directive is on the storage component of the CCS chain; capture and transport are covered through other EU legislation.³

Selecting safe storage sites

EU Member States are free to choose whether or not to allow geological storage of CO₂ to be carried out in their territories. If a country chooses to allow the activity in its territory, it must comply with the Directive. It has to assess the storage capacity available in specific regions or across the whole of its territory, including by allowing exploration. No exploration can take place without a permit, and permits must be granted according to transparent, objective criteria. They must cover a limited area and last no longer than the time needed to carry out the exploration, although they can be extended, if necessary, for the completion of the exploration concerned.

The decision on whether a geological formation is suitable for use as a storage site must be based on thorough characterisation and assessment of the potential storage complex and surrounding area. Criteria specified in the Directive must be applied. They include the development of computer models and simulations of CO₂ injection, risk assessment, and identification of all potential hazards, especially leakage of CO₂. Potential developers will have to take account of people living in the surrounding area and the interests of local species and habitats, and draw up an analysis of potential environmental and health impacts.

³ For example, the 2008 Directive on Integrated Pollution Prevention and Control (IPPC) regulates the impact of CO₂ capture, from the installations it covers, on environmental and human health. Any injection of CO₂ into saline aquifers must conform to EU legislation on the protection of groundwater from pollution and deterioration.

Storage permits

The storage permit is the key tool in ensuring that CCS takes place in an environmentally safe way. Sites may not operate without one.

Potential operators need to supply information that proves their technical competence to operate a storage site safely. They have to provide detailed data on the storage site and complex to ensure that a geological formation will be selected only if there is no significant risk of CO₂ leakage or other environmental or health damage. The applicant also needs to outline what measures he/she will take to prevent significant irregularities; propose plans for monitoring, corrective measures if necessary, and post-closure arrangements; and provide proof of financial security to be valid and effective prior to injection of CO₂, to ensure that all legal obligations can be fulfilled at all times.

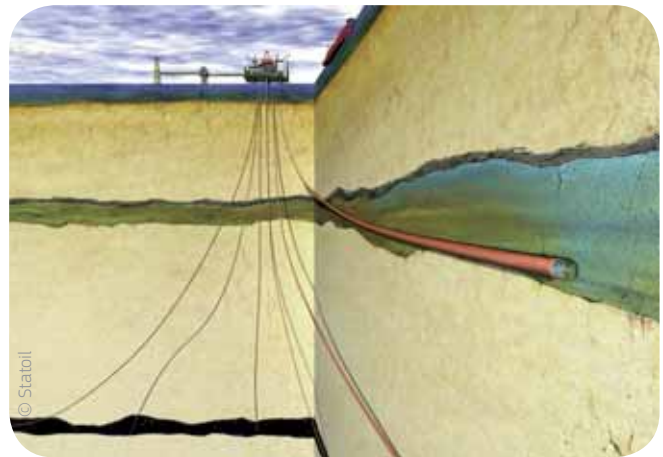
A storage permit can be granted only if all the requirements of the CCS Directive and of other relevant EU legislation are met. The permit itself must indicate – amongst other things – the precise location of the storage area, the maximum quantity of CO₂ to be injected, an approved monitoring plan and the corrective measures envisaged in the event of problems.

Member States have responsibility for issuing permits, but must forward the permit applications they receive, as well as the draft permits they intend to issue, to the European Commission for review. The Commission may issue an opinion and national authorities must give reasons for not following this. This procedure is designed to ensure coherent implementation of the Directive, and so boost public confidence in safety.

National authorities⁴ must be informed about any changes to storage sites, and if necessary the permit should be updated. In the event of CO₂ leakages, or failure to meet other conditions, the authorities can withdraw the permit and take over management of the site, recovering costs from the former operator. All storage permits shall be reviewed five years after they are issued, and then every 10 years.

Monitoring

Monitoring of the storage site is vital to check that the CO₂ stored is conforming to modelled behaviour. Operators are therefore obliged to carry out comprehensive monitoring of specific parameters, such as pressure, temperature and seismic activity – both of the storage complex and, where appropriate, the area around it – to detect



any significant irregularities or leakages, particularly affecting drinking water, local communities and the surrounding environment. Operators have to draw up a monitoring plan, updated every five years to reflect the latest technologies and scientific knowledge, and report their findings to the national authorities at least once a year.

Inspections

National authorities are also responsible for carrying out routine and non-routine inspections of the storage complex. Routine checks must take place at least once a year until three years after closure of the site and every five years until transfer of responsibility to the competent authority has occurred. Non-routine inspections will be carried out particularly if authorities receive serious complaints about harm to the environment or human health, or reports of leakages. A report on the results of the inspection will be publicly available within two months of the inspection.

Corrective measures

If CO₂ leakages or any other problems occur, the Directive requires operators to take the necessary corrective measures at once, including measures to protect human health. Operators must also draw up and get approval for a corrective measures plan. If a site operator fails to take these measures, the authorities have to step in. They recover the cost of action needed from the operator, including by drawing on the financial security. Liability for environmental damage – such as to natural habitats, water and land – is covered under the Environmental Liability Directive.⁵ In the case of any CO₂ leaks to the atmosphere, the operator of a CO₂ storage site has to surrender carbon emission allowances under the EU Emissions Trading System.

⁴ All Member States have to designate an authority to carry out the obligations set down in the Directive.

⁵ Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage, OJ L 143, 30.4.2004, p. 56

Long-term safety

When a storage site has been closed, the operator remains responsible for monitoring, reporting and any corrective measures. Those obligations are to be met based on a post-closure plan originally approved as part of the storage permit and updated as necessary before the closure of the site.

Eventually, normally at least 20 years after a site has been closed, the operator can pass responsibility to the competent authority. Specific conditions have to be met. Most notably, the site must be in a long-term stable condition and all available evidence needs to indicate that the stored CO₂ will be completely and permanently contained. The operator has to prepare a report demonstrating that this is the case. The site also has to be sealed, and the injection facilities have to be removed, before the transfer can happen. When all relevant conditions have been met, the authority approves the transfer of responsibility. Draft transfer decisions have to be submitted to the European Commission, which issues an opinion before a final decision is made.

After the transfer of responsibility, routine inspections stop and monitoring may be reduced to a level which allows for detection of CO₂ leakages or significant irregularities. In case of CO₂ leakages or significant irregularities, monitoring must be intensified to assess the scale of the problem and the effectiveness of corrective

measures. If the authority finds the operator has concealed information or been at fault, however, it can recover the costs incurred after the transfer of responsibility from the former operator.

Financial security and financial contribution

It is crucial that operators have the financial resources they need to meet all these obligations, especially after the site has been closed and until the transfer of responsibility. This is why operators must establish proof of adequate financial security provisions as part of the storage application. The financial security needs to be valid and effective before injection starts and will be adjusted to take account of changes such as risks of leakage during operation.

When a site is closed and handed over to the competent authority, the operator must also make a financial contribution to cover, at least, the cost of monitoring the site for 30 years.

The European Commission's role in promoting safe use of CCS

As with all EU legislation, the Commission is responsible for ensuring Member States correctly transpose the CCS Directive into their national law and enforce it on the ground.

The Commission is assisting and supporting Member States in practical ways to implement the CCS Directive. It has set up an Information Exchange Group to facilitate the exchange of information and best practice between Member States' authorities. This aims to promote coherent implementation of the law throughout the EU.

The Commission has also issued four documents providing technical guidance to Member States and operators on specific issues, including safety.⁶ These are the result of discussions and consultation with national authorities, industry, NGOs, researchers and other stakeholders.⁷

The Directive requires that the Commission, by 31 March 2015, carries out a wide-ranging review of the CCS Directive and proposes amending it if necessary. The review shall take into account experience with CCS to date, technical progress and the most recent scientific knowledge.



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6 The documents issued cover: a) CO₂ storage life-cycle risk management framework; b) Characterisation of the storage complex, CO₂ stream composition, monitoring and corrective measures; c) Criteria for transfer of responsibility to the competent authority; d) Financial security and financial mechanism

7 See http://ec.europa.eu/clima/policies/lowcarbon/ccs_implementation_en.htm



Further information

DG Climate Action:
http://ec.europa.eu/clima/policies/lowcarbon/ccs_directive_en.htm
