

Reducing GHG emissions: an industry perspective

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Oil and gas account for about 33 per cent of anthropogenic greenhouse gas emissions, of which 85 per cent during their end use by consumers and industry. So greenhouse gases and possible ways to curb emission levels are a matter of concern to the oil and gas industry.

We will not get into the debate on climate change here. However, with industrial operations in 130 countries, we take this issue into account in everything we do and implement effective measures to curtail our emissions. However, targets have to be compatible with our primary responsibility, which is to supply the energy required for economic activity and human well-being and development, now and in the future.

In the context of post-Kyoto policies, as discussed in Copenhagen, Total would like to see a global, balanced agreement come out of the negotiations. As a leading operator in an industry that deals in long-term horizons, we need policies that provide visibility concerning the regulations that will apply over time and in the world's different regions, so that we can make the right medium- and long-term strategy and technology choices. Right now, without a realistic carbon cost model on which to base forecasts, the economic feasibility of certain options is unclear. The following article describes what we are doing to address these issues.

Total deploys a comprehensive strategy to manage and lessen the climate impacts of all our operations. Our approach focuses on reducing the flaring of associated gas produced with oil, optimising the energy efficiency of our facilities and products, capturing and storing carbon dioxide, and developing alternative energies to supplement oil and gas.

Managing our emissions more effectively: reducing flaring and improving energy efficiency

The first step in minimising our climate impact is to manage the emissions associated with our operations.

In 2009, our greenhouse gas emissions stood at 55 million metric tons of carbon dioxide equivalent. The flaring of unused gas associated with oil production accounted for close to a third of them. In 2000, we decided not to undertake any new projects involving continuous flaring. Since 2004, we have also been a member of the Global Gas Flaring Reduction (GGFR) private-public partnership initiated by the World Bank and have pledged to halve flaring in our operations from 2005 levels by 2014. We deploy a range of solutions tailored to local situations to achieve those goals, including process selection, reinjecting surplus gas into reservoirs, developing the gas as LNG, and reselling the gas to local industry. However, these solutions are not always easy to implement, due to technical complexity or complicated relationships with partners.

Total is also a major consumer of energy. Consequently,

using less energy is a priority focus of our greenhouse gas reduction strategy and requires making our facilities more energy efficient. In 2000, we set up an Energy Committee comprised of technical experts and representatives from our various units, to promote a culture of energy efficiency at Total and translate it into practical measures addressing the specific needs of each business.

We set clear targets for improving energy efficiency, ranging from 1 to 2 per cent a year depending on the type of activity involved. Their main objective is to decrease the energy used for industrial processes, by upgrading equipment, better managing installations, especially boilers and furnaces, improving operations monitoring and control systems, and investing in cogeneration¹ units.

We have achieved substantial energy savings. In the last few years, for example, the Carville facility in the United States has increased output 30 per cent while cutting its energy use. In Gonfreville, France, the construction of a new styrene plant boosted energy efficiency 30 per cent, while reducing associated carbon emissions by the same amount. Also in France, we launched the country's biggest cogeneration unit, at the Normandy refinery, in late 2004. The unit supplies the steam the refinery needs (450 metric tonnes per hour) while at the same time producing 250 MW of electricity that is resold to the power grid.

In addition, in October 2008 the French Environment and Energy Management Agency (ADEME) and Total signed a memorandum of understanding to lead and finance a joint R&D programme to improve the energy efficiency of industrial processes. The programme aims to support small and medium-sized businesses working on energy-saving technologies.

Helping customers shrink their environmental footprint

Most greenhouse gas emissions associated with oil and gas combustion are generated by their use as a fuel for transportation, buildings and industry. That's why offering our customers products and services that help reduce their consumption and/or greenhouse gas emissions is an integral part of our commitment.

We invest extensively in R&D to develop fuels and lubricants for today's new engine designs. Since 2005, for example, we have offered drivers automotive fuels formulated to optimise combustion and reduce engine friction loss, with our Total Excellium Diesel and Total Excellium 98 gasoline.

We are involved in biofuels. In 2008, we produced and blended almost 800,000 metric tons of ethyl tertiary butyl ether (ETBE) in gasoline and blended more than 1.4 million metric tons of fatty acid methyl ester (FAME) in diesel, strengthening our position as a leading biofuel operator in Europe.



Finally, for several years now our retail networks have offered our customers advice and services to lower their emissions. Choosing the right fuel and lubricant, checking tyre pressure and engine settings, and practising eco-driving are simple ways to make savings and avoid carbon dioxide emissions.

With our new Total Ecosolutions programme introduced in early 2009, we also aim to design more efficient products and services that will enable our customers to scale back their use of natural resources, such as energy, fossil fuel-sourced carbon and water, and reduce the environmental impacts of their utilisation, including the greenhouse effect and emissions.

After a rigorous evaluation process, 13 products and services have been selected to date, for the fields of transportation and buildings. Our fuel economy lubricants for cars improve fuel efficiency 2.5 per cent, while solutions combine heating oil and solar thermal heating, for example. We have also used innovative petrochemical technologies to develop eco-efficient products. Polyethylene Lumicène used to make transparent packaging film, for example, means that our customers who process it into finished products use fewer materials and less energy during manufacturing.

By using this first group of selected products and services, our estimation is that our customers can avoid 500,000 metric tons of carbon equivalent emissions annually, an amount equal to the emissions from 160,000 vehicles over the same period.

Our push to develop more advanced solutions is an ongoing process. We will gradually expand our line of Total Ecosolutions products and services.

Carbon capture and storage (CCS)

According to the International Energy Agency, carbon capture and geological storage could deliver 20 per cent of the required reduction in carbon dioxide emissions worldwide by 2050. The CCS process is well suited to industrial facilities emitting large quantities of carbon, such as thermal power plants, cement plants, refineries, petrochemical plants and steel plants. It supplements efforts to reduce emissions at source, through energy efficiency and renewable or carbon-neutral energies. Total is directly concerned by carbon capture and storage at some of our industrial facilities.

CCS technology is still in its infancy and, compared with the targets that must be met before it can have a real impact on emission reduction, the quantities actually captured and stored today are tiny. Although theoretically there is nothing to prevent its application, several major problems remain unsolved. One of the biggest is its extremely high cost; a combination of technological advances and economies of scale will be required to bring it down to acceptable levels. Regulations will also need



Night view of the distillate hydrocracker at Total's Normandy refinery

to be clarified and the method will have to be explained to the public to make it more acceptable.

We are applying all our knowledge and skills to help improve CCS technologies and facilitate their commercial application. In 2007, for example, we decided to invest in the world's first end-to-end demonstration project for carbon capture and storage near Lacq, in southwestern France. The project covers the entire industrial carbon capture, transportation and storage chain, from the extraction, treatment and combustion of natural gas, carbon capture via the oxy-fuel combustion process, transportation of the captured carbon and finally its injection and storage in a depleted gas field. Oxy-fuel combustion is a technique that burns fuel using pure oxygen instead of air, to produce waste gas with a carbon concentration of 90 to 95 per cent.

The pilot began operating in early 2010 and will capture and store 120,000 metric tons of carbon over a period of two years.

The primary objectives are to improve our control of the oxy-fuel combustion process, significantly lower the costs and boost the energy efficiency of capture, and gain proficiency in an end-to-end carbon capture, transportation and storage system. This first-ever European storage trial in a depleted reservoir is also expected to validate methods and monitoring tools, for future, larger-scale operations.



It has attracted the interest of the international scientific and technology research community, and in October 2009 was endorsed by the Carbon Sequestration Leadership Forum, a ministerial-level international climate change initiative focused on the development of improved cost-effective technologies for the separation and capture of carbon for its transportation and long-term safe storage.

Also in France, as part of the €100-million Carbon Demonstrator Fund, Total is coordinating an initiative of interest to the energy, refining, petrochemicals, cement and other industries that emit carbon. The project consists of a two-year (2010 and 2011) evaluation of the feasibility of shared commercial-scale transportation and storage infrastructure for carbon-emitting sources north of the Loire River. It would include a demonstration unit to inject 100,000 tons of carbon, the threshold in the relevant EU directive.

This work is part of an international network of operational and R&D projects in which we are participating, in order to pool expertise and share findings for the benefit of all stakeholders.

Helping to create a more sustainable energy mix

As an energy producer and provider, we are developing low carbon energy sources to supplement our core oil and gas business. Solar energy, nuclear power and biomass are our priority focuses.

Total has been active for more than 25 years in photovoltaic solar energy, which is fast becoming more efficient and cost-competitive. We are positioned across much of the photovoltaic chain through our subsidiaries Photovolttech, which makes first-generation, crystalline silicon wafer-based photovoltaic cells, and Tenesol, which designs, produces and installs solar panels.

Technological advances are very important in the solar energy field, which is why we acquired a stake in Konarka, a US startup specialised in third-generation photovoltaic organic cells, in December 2008. We also formed several R&D partnerships in the fall of 2009 with world-class organisations, covering first-generation cells, second-generation thin films, and solar batteries.

Total believes that photovoltaic solar energy is essential to the success of the fledgling energy transition, though it still has a way to go before it really takes off.

By our estimate, nuclear power will grow 30 per cent between now and 2020. Our strategy is to partner with major nuclear industry operators, to combine our knowledge and expertise and our experience in major projects, especially international projects, with the skills needed for nuclear projects. We want to build up our nuclear operations gradually. Total currently has an 8.33 per cent interest in the European Pressurised Reactor (EPR)

project being considered for Penly, in northwestern France.

Finally, one R&D avenue we are studying is biomass-to-energy and biomass-to-chemical conversion, reducing competition with food crops. Options under study include biofuels, bio-DME, and the production of bioplastics from sugar through the Futerro joint venture. In 2008, we joined France's Futurool project to research and develop cellulosic bioethanol and are also participating in the BioTfuel project to develop a biofuel production process based on lignocellulosic biomass. In April 2009, Total also announced the acquisition of an interest in US-based Gevo, which is using innovative technologies to develop a portfolio of bioproducts for the automotive fuel and chemical markets.

As you can see, managing and curtailing greenhouse gas emissions has to be approached from a number of different, strategically interrelated angles that can be combined, with a strong determination to succeed. Total has committed to this path and announced clear objectives. So far, our combined efforts have paid off: from 1990 to 2008, our Refining business cut its specific emissions by 17 per cent and Exploration & Production slashed its specific emissions by 40 per cent. Looking ahead, internal estimates project that by 2015 our initiatives will reduce our total emissions by about 15 per cent from 2008 levels, for a constant reporting scope. □

¹ Cogeneration is a process improving unit's energy efficiency, by producing steam and power at the same time.

Maintenance and modernisation work at Total's Feyzin refinery

