

“Our scientists and researchers are committed to finding and applying technological advances to help confront the challenge of rising CO<sub>2</sub> emissions.”

Pat Brant, Chief Polymer Scientist



# Managing Climate Change Risks

Meeting growing demand, reducing greenhouse gas emissions

With increased global energy demand, energy-related carbon dioxide emissions are expected to rise by an average of 1 percent per year through the year 2030. As was recently summarized in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the risks to society and ecosystems from increasing greenhouse gas (GHG) emissions are significant. Meeting the enormous energy demand growth and managing the risk of GHG emissions are the twin challenges of our time.

We all must engage in the search for solutions if we are to succeed at mitigating these risks. Progress can be achieved through climate change policy frameworks that enable countries to pursue economic progress while promoting the development of technologies necessary to generate and use energy more efficiently. As the largest publicly traded international energy company, the energy ExxonMobil produces meets 2 percent of the world's needs. We share the responsibility to take action with scientists, citizens, and governments around the world and are doing so in several substantive ways. Over the years, we have supported major climate research projects, and we contribute to an array of public policy organizations that research and promote discussion on climate change and other domestic and international issues.

**Assessing risks associated with climate change policy.** We regularly consider risks to operations and investments from a wide variety of perspectives: technological, physical, political, and regulatory. A number of organizations have attempted to quantify the potential implications of climate-related policies for oil and gas industry shareholders. However, these efforts are based on regulatory assumptions that are only speculative given the current status of negotiations on climate-related policies.

## Reducing greenhouse gas emissions from our operations

In 2008, our direct GHG emissions from our equity operations were 131 million metric tons,\* which is a reduction of about 10 million metric tons from 2007. Over 2 million metric tons of this change were due to reduction actions taken in 2008, including reduced hydrocarbon flaring in Nigeria. The remainder was due to normal variations in our operations and improved GHG emissions measurement at some of our facilities.

**Energy efficiency improvements.** In 2008, our operations consumed approximately 1.5 billion gigajoules of energy. By applying new energy-efficient technologies, we use less energy to run our business, extend the life of the world's energy reserves, and reduce GHG emissions. Since 2004, we have invested more

than \$1.5 billion in activities to increase energy efficiency and reduce GHG emissions. In the next few years, we plan on spending at least \$500 million on additional energy efficiency initiatives.

In 2008, our energy efficiency performance in our refining and chemical operations was about even versus 2007, largely due to changes in plant operations. However, over the past several years, we have improved at a rate about two to three times faster than the industry. We remain on track to meet our target of improving energy efficiency across our worldwide refining and chemical operations by 10 percent between 2002 and 2012. This target is consistent with the American Petroleum Institute's *Voluntary Climate Challenge Program* in the United States.

**Cogeneration.** With cogeneration, we can produce electricity to power our operations while also capturing heat to make steam to transform raw materials into consumer products. This provides a more efficient power source than purchasing from a local utility, in some cases by up to 50 percent more efficient.

As an industry leader in cogeneration applications, we have interests in about 100 cogeneration facilities in more than 30 locations worldwide. We have invested in cogeneration projects for several decades.

\*Our calculations are based on the guidance provided in the Compendium of Greenhouse Gas Emission Estimation Methodologies for the Oil and Gas Industry (American Petroleum Institute) and the Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions (International Petroleum Industry Environmental Conservation Association).

## Priority issues



**Reducing Greenhouse Gas Emissions.** Improve energy efficiency and reduce greenhouse gas emissions from our own operations as well as from energy use by consumers.



**Policy Engagement.** Help shape energy policies that support long-range thinking, encourage long-term investment, and allow for an integrated set of solutions.



**Flare Reduction.** Employ a combination of technology, processes, and engagement with host governments to address operational and regional barriers to natural gas flaring reduction.

**\$1.5+**  
billion

invested to increase energy efficiency and reduce GHG emissions since 2004

**30%**  
reduction

in upstream hydrocarbon flaring since 2007

**~4**  
million

metric tons per year of CO<sub>2</sub> captured and transported from LaBarge Shute Creek facility

**10**  
million

metric ton reduction in GHG emissions from 2007

**~4.5**  
gigawatts

of electricity produced through cogeneration, enough to supply 2 million U.S. homes

These projects have the capacity to produce more than 4.5 gigawatts of electricity, enough to supply the needs of more than 2 million U.S. homes. In 2008, we expanded the use of cogeneration and added 125 megawatts of power capacity, with the start-up of new facilities at our refinery in Antwerp, Belgium. With new facilities under construction, we expect to increase our cogeneration capacity to more than 5 gigawatts by 2011.

We routinely evaluate cogeneration development opportunities when considering new investments that require both power and steam. For example, in Singapore, we are developing the nation-state's largest owned and operated petrochemical project, and cogeneration is expected to meet 100 percent of the project's electricity needs.

**Carbon capture and storage.** ExxonMobil is a leader in the development and use of component technologies essential for carbon capture and storage (CCS), which we have focused on in our oil and gas operations for many years. The ability to capture, transport, and store CO<sub>2</sub> safely and efficiently represents an important opportunity for reducing global GHG emissions. For example, at our LaBarge Shute Creek facility in Wyoming, we have been capturing, transporting, and selling CO<sub>2</sub> since 1987, at rates up to 4 million metric tons of CO<sub>2</sub> per year. We are currently expanding this capability by nearly 50 percent

## Policy options for curbing greenhouse gas emissions

Remarks by Rex W. Tillerson, Chairman and CEO



"With a new U.S. Congress and Administration, we have an opportunity to expand the dialogue about how America can best make an impact on this important global issue—reducing greenhouse gas emissions. As this dialogue goes forward, we must be mindful that sound public policy must not impede innovation, inhibit competition, or add market uncertainties by picking winners and losers. Good policy sets aspirational goals that represent the needs of the people and then provides the broad framework for entrepreneurs and innovative thinkers to achieve these goals.

One policy option that is intended to reduce emissions—and which has received much attention—is a cap-and-trade system. Before we rush to enact such a system, we must ask whether it can best achieve our shared goal of actually reducing greenhouse gas emissions. Cap-and-trade systems inevitably introduce unnecessary cost and complexity that undercut their effectiveness. It is important to remember that a cap-and-trade system requires a new market infrastructure for traders to trade emissions allowances. This new "Wall Street" of emissions brokers will take the emphasis away from the goal of reducing carbon emissions and focus on trading on price volatility instead.

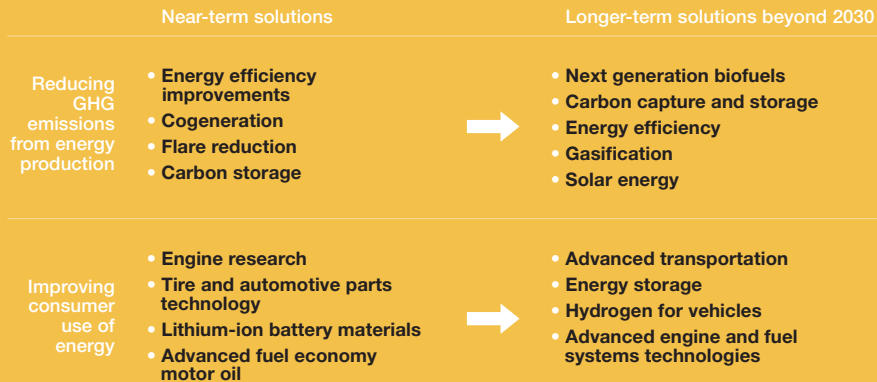
There is another policy option that should be considered, and that is a carbon tax. A carbon tax avoids the costs and complexity of having to build a new market for securities traders or the necessity of adding a new layer of regulators and administrators to police companies and consumers. And a carbon tax can be more easily implemented. It could be levied under the current tax code without requiring significant new infrastructure or enforcement bureaucracies. A carbon tax is also the most efficient means of reflecting the cost of carbon in all economic decisions—from investments made by companies to meet their fuel needs to the product choices made by consumers. In addition, such a tax should be made revenue neutral. There should be reductions or changes to other taxes—such as income or excise taxes—to offset the impacts of the carbon tax on the economy.

Finally, there is another potential advantage to the direct-tax, market-cost approach. A carbon tax may be better suited for setting a uniform standard to hold all nations accountable. Given the global nature of the challenge, and the fact that economic growth in developing economies will account for a significant portion of future greenhouse gas emissions increases, policy options must encourage and support global engagement."

## ExxonMobil's actions to reduce greenhouse gas emissions

Our strategy to achieve reductions in GHG emissions is focused on increasing our own energy efficiency in the short term; advancing current proven emissions-reducing technologies in the medium term; and developing breakthrough, game-changing technologies for the long term. These initiatives will reduce emissions generated both internally by our own operations and externally by consumers.

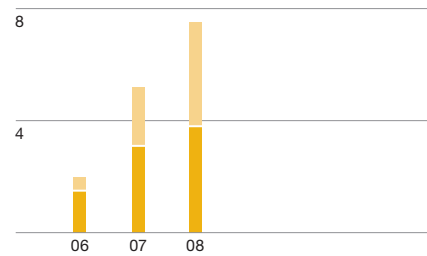
Internally, new energy efficiency technologies and day-to-day operational efficiency activities generate significant energy savings and reduce GHG emissions. Since the launch of our *Global Energy Management System* in 2000, we have identified opportunities to improve energy efficiency by 15 to 20 percent at our refineries and chemical plants and have already implemented about 60 percent of these.



### Greenhouse Gas Reductions From ExxonMobil Actions From 2006 to 2008

Direct equity, CO<sub>2</sub>-equivalent emissions (millions of metric tons)

■ Energy Efficiency and Cogeneration ■ Flare Reduction



and significantly reducing overall emissions. Most of the CO<sub>2</sub> marketed at Shute Creek is used for enhanced oil recovery. ExxonMobil is also a partner in the Sleipner Field in the North Sea, which has injected over 10 million tons of CO<sub>2</sub> (for storage) over the past decade.

ExxonMobil supports a robust research program on CCS through a variety of partnerships—*Global Climate and Energy Project* (GCEP) at Stanford University, CO<sub>2</sub>ReMoVe, U.S. Department of Energy's *Regional Carbon Sequestration Partnership Program*, the International Energy Agency's *Greenhouse Gas R&D Programme*, and the Gulf Coast Carbon Center as well as research at the Georgia Institute of Technology, the University of Texas, and the Massachusetts Institute of Technology.

### Improving consumer use of energy

Ongoing advances in vehicle and fuel technology offer significant potential for efficiency gains and reductions in GHG emissions. However, solutions must be affordable to consumers in the developed and developing world and they must allow for continued economic growth and improvement in global living standards.

ExxonMobil conducts and supports research aimed at developing innovative, efficient, low-emissions technologies to improve how the world uses and produces energy. We focus on steps that can be deployed in the short term as well as options for the longer term, beyond 2030. Longer-term research is aimed at creating low-carbon or no-carbon options for energy supply and use, which could become part of our future business. We conduct research through our in-house staff, in partnership with academic and private groups, and through programs such as GCEP. GCEP's 2008 research portfolio included promising research activities in biomass and solar energy.

#### Conventional fuel-saving technologies.

Together with automobile manufacturers and other partners, ExxonMobil is using its expertise in chemicals and fuels to improve the efficiency of current vehicle technologies.

- **Automotive parts and tires.** ExxonMobil has developed advanced plastics for use in car parts such as bumpers and fuel tanks, which make vehicles lighter. For every 10-percent drop in vehicle weight, fuel economy improves by about 7 percent. ExxonMobil has also worked with tire manufacturers to develop a new tire-lining technology that uses up to 80 percent less material in the manufacturing

process, making tires lighter while reducing air permeability. Cars with under-inflated tires burn more gasoline.

- **Motor oil.** ExxonMobil introduced *Mobil 1 Advanced Fuel Economy*, a lower-viscosity synthetic motor oil that can improve fuel economy by up to 2\* percent versus motor oils most commonly used. Because less energy is required to circulate oil in the engine, more energy is available for driving the car.

If one-third of U.S. vehicles used technologies such as these, it would save about 5 billion gallons of gasoline and prevent GHG emissions equivalent to taking about 8 million cars off the road each year.

**Advanced vehicle technologies.** ExxonMobil is collaborating with vehicle and engine manufacturers and others to develop breakthrough engine technologies that could produce step-changes in fuel efficiency and hold the potential to diversify energy sources for transportation.

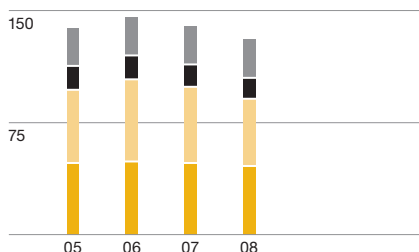
- **Lithium-ion battery materials.** ExxonMobil Chemical and our affiliate in Japan, TonenGeneral, have developed a new generation of separator films for the lithium-ion batteries used in hybrid vehicles. Lighter, smaller, and more durable batteries are expected to help improve the reliability, energy efficiency, and affordability of hybrid vehicles. To meet growing demand for new and existing

\*Actual savings are dependent upon vehicle/engine type, outside temperature, driving conditions, and current engine oil viscosity.

### Greenhouse Gas Emissions (Absolute)

Direct equity, CO<sub>2</sub>-equivalent emissions (millions of metric tons)

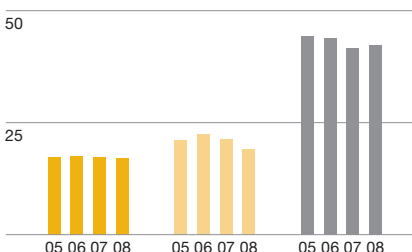
■ Downstream ■ Upstream ■ Chemical  
■ Cogeneration and Hong Kong power



### Greenhouse Gas Emissions (Normalized)

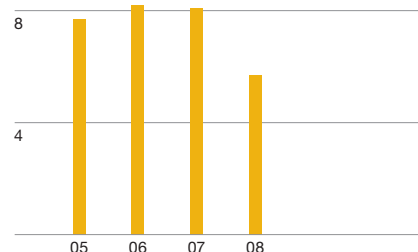
Direct equity, CO<sub>2</sub>-equivalent emissions (excluding cogeneration and Hong Kong power) (metric tons per 100 metric tons of throughput)

■ Downstream ■ Upstream ■ Chemical



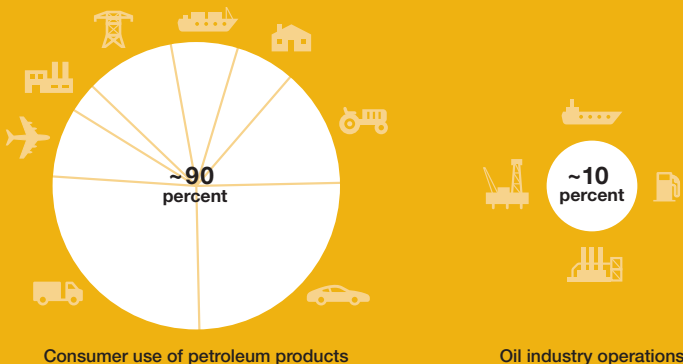
### Hydrocarbon Flaring From Upstream Oil and Gas Production

(millions of metric tons)



### Distribution of GHG emissions from use of petroleum

The International Energy Agency estimates that, on average, about 10 percent of petroleum-related GHG emissions are from industry operations while 90 percent are from consumer use. This being the case, we recognize the importance of developing technologies that help consumers reduce their environmental impacts.



applications, we began construction of a new separator film plant in Gumi, South Korea, which is expected to start up in 2009.

- **Advanced engine and fuel systems technologies.** ExxonMobil is contributing to the development of advanced internal combustion engine and fuel systems technologies with a long-term goal of achieving significant improvement in fuel economy and lower GHG emissions.

- **Hydrogen fuel cells.** Together with partners in industry and the research community, ExxonMobil is developing an innovative on-board hydrogen-powered fuel cell system. Measured on a “well-to-wheels” basis, this system could be up to 80 percent more fuel-efficient and emit 45 percent less CO<sub>2</sub> than today’s internal combustion engine. We are focusing on industrial applications in the near term, with the long-term research goal being application in passenger vehicles.

#### on the Web:

Research contributions  
[exxonmobil.com/climate/research](http://exxonmobil.com/climate/research)

Our actions to reduce GHG emissions  
[exxonmobil.com/emissions](http://exxonmobil.com/emissions)

Flaring  
[exxonmobil.com/flaring](http://exxonmobil.com/flaring)

Global Climate and Energy Project  
[gcep.stanford.edu](http://gcep.stanford.edu)

#### up close:

### Nigerian flare reduction

Flaring—burning gas under controlled conditions—serves as a safety device to protect people, equipment, and facilities during operation disruptions or maintenance. It also enables oil and gas production when gas injection or gas utilization pipeline infrastructure is not available, as has been the case in Nigeria. ExxonMobil is committed to increasing gas utilization in Nigeria and is actively progressing projects that will end routine gas flaring from our operations.

ExxonMobil has focused on improving gas utilization as oil and gas production have increased. Even as gas production has increased six-fold, we have successfully increased gas utilization from 25 to 80 percent. In 2008, several gas utilization projects were commissioned, helping to reduce flaring in Nigeria by nearly half versus 2006 to 2007 levels.

Our approach to gas utilization and flare reduction in Nigeria has been to extract natural gas liquids (NGL) for sale and inject produced gas, which maximizes oil recovery by maintaining reservoir pressure. We have invested over \$5 billion to increase gas utilization, with each project requiring years of engineering design, construction, and installation. We have made significant progress over the last decade, with the installation of six gas re-injection facilities, two

offshore NGL extraction plants, and higher efficiency flare stacks. The most recent of these projects is the East Area Project, which includes a gas compression platform that injects gas to maintain reservoir pressure and an extraction platform that recovers NGL from the gas stream. The project’s gas utilization capacity will continue to increase through 2011 as additional gas gathering facilities are installed. In 2008, three flare reduction projects were commissioned, which reduced flaring by approximately 120 million cubic feet per day (mcf/d).

By the end of 2008, we reduced our flaring in Nigeria to less than 300 mcf/d. We aim to reduce flaring even further through future projects and operational efforts, which include existing flaring protocols and improving equipment reliability. Our ability to commission these projects in a timely manner and to realize flare reductions relies on a cooperative approach with our partners in Nigeria to maintain funding, enhance security, and improve the overall infrastructure for gas utilization.

#### Gas Utilization in Nigeria

