Saving Energy in the Oil and Gas Industry
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Hydrocarbons will remain essential to global economic development and prosperity for decades to come. Meeting rising energy demand needs to be reconciled with the goals of energy security and environmental protection. Energy efficiency and conservation can make a major contribution to moving the world onto a more sustainable energy path. Most of the potential for saving energy lies with end users, however the oil and gas industry continues to invest heavily in further improving the energy efficiency of its own operations, reducing waste and helping final consumers to use less fuel. Major challenges remain, notably in countering the increased use of energy to exploit less accessible crude oil resources and to meet tougher fuel-quality standards. The oil and gas industry, as a stakeholder in the energy debate, will play its part in further promoting rational energy use all along the supply chain for the good of everyone.

Enhancing energy efficiency is an important issue for IPIECA members, who can contribute by implementing changes in their operations, planning and investments. There are many positive drivers for industry as energy efficiency can help in lowering operating costs and reducing environmental impacts. Energy efficiency can also extend the life of finite natural resources and help keep energy affordable for consumers by lowering the investment costs and the effort required to meet rising demand. IPIECA aims to raise awareness of the benefits of energy efficiency and promote sharing of best practices.
Global demand for energy is growing, driven by rising population and economic growth. Over the past three decades, energy use has more than doubled. This increase, in turn, has enabled the world economy to expand, raising living standards and helping to meet the aspirations of millions of people around the world. It is impossible to operate a factory, run a shop, drive a car or deliver goods to consumers without using some form of energy. Oil and gas make a vital contribution to meeting the world’s energy needs. Today, they account for well over half of global total primary energy use. There are limited practical alternatives to oil-based fuels for transport—the fastest growing energy sector. In many cases, oil and natural gas are the lowest-cost fuels in industry, the residential and services sectors and power generation, and are essential feedstocks for a wide range of industrial and consumer goods.

Demand for oil and gas, as well as all other energy sources, will continue to rise. In its latest World Energy Outlook, the International Energy Agency projects global primary energy demand to grow by more than half between 2004 and 2030 in a Reference Scenario that assumes no change in government policies (Figure 1). Oil and gas continue to dominate the global energy mix, their share of total primary energy use falling slightly from 56 per cent to 55 per cent. The use of modern renewable technologies, including hydro, solar, geothermal and wind power, expands rapidly, but their combined share of global energy demand reaches only 5 per cent in 2030 because they start from a low base. More than 70 per cent of the projected increase in overall energy demand comes from developing countries, where economic activity and populations are growing fastest.

Rising demand for energy services reflects increasing prosperity, but it also raises concerns. The main net-importing regions—the United States, Europe and Asia—will have to...
is often the most cost-effective way of curbing the growth in demand for fossil fuels and cutting emissions of greenhouse gases and air pollutants (McKinsey, 2006; IEA, 2006b). There is considerable remaining potential for improving efficiency. This is demonstrated by the IEA’s Alternative Policy Scenario, which assumes that all the energy-security and climate policies that governments around the world are currently considering are fully implemented. Global CO₂ emissions are reduced by 16 per cent in 2030 vis-à-vis the Reference Scenario, with energy efficiency gains contributing almost 80 per cent of avoided emissions. Importantly, the economic cost of these policies is more than outweighed by the economic benefits of lower spending on fuel by consumers that come from using and producing energy more efficiently.

import increasing volumes of both oil and gas as their indigenous output fails to keep pace with consumption, with implications for the security of supply. And the future energy mix will put added strains on the environment. The IEA projects global energy-related emissions of carbon-dioxide (CO₂) from burning oil, gas and coal to grow by 55 per cent between 2004 and 2030 in its Reference Scenario. In addition, local air quality may also be affected by increased use of fossil fuels.

Saving energy through improved efficiency and conservation has a central role to play in reconciling the goals of economic development, energy security and environmental protection. A number of recent studies have shown that investment in more efficient energy technologies is often the most cost-effective way of curbing the growth in demand for fossil fuels and cutting emissions of greenhouse gases and air pollutants (McKinsey, 2006; IEA, 2006b). There is considerable remaining potential for improving efficiency. This is demonstrated by the IEA’s Alternative Policy Scenario, which assumes that all the energy-security and climate policies that governments around the world are currently considering are fully implemented. Global CO₂ emissions are reduced by 16 per cent in 2030 vis-à-vis the Reference Scenario, with energy efficiency gains contributing almost 80 per cent of avoided emissions. Importantly, the economic cost of these policies is more than outweighed by the economic benefits of lower spending on fuel by consumers that come from using and producing energy more efficiently.

Ways of saving energy

Energy can be saved by using it more efficiently or by using less of it. Energy efficiency refers to the ratio between the input of energy—be it a primary source like fossil fuels or an energy carrier such as electricity or hydrogen—and the output of an energy service, such as light, heat or mobility. Improving energy efficiency, by reducing the quantity of energy consumed, can enhance energy security and mitigate the environmental harm caused by producing, transporting and consuming energy. It can also bring broader economic and social benefits, by lowering costs to businesses and households, increasing the competitiveness of the economy and creating jobs in supplying energy-efficient technologies and practices (‘energy services’). Energy efficiency can be enhanced through the application of new technology that yields a lower input/output ratio, using the same fuel or an alternative. For example, energy can be saved in power generation by replacing a conventional thermal station with a gas-fired combined-cycle gas-turbine station, which has much higher thermal efficiency.

Improving energy efficiency is not the same as energy conservation which, strictly speaking, refers to consuming less of a given energy service, and therefore consuming less of the energy that would be needed to provide it. Examples include switching off the light when leaving a room or walking short distances instead of driving. Where an energy service is wasted or is of little value to the person or business benefiting from it, conservation can bring real economic and social benefits. But forgoing an energy service that is critical to economic activity or to living standards can hold back economic development and reduce social welfare.
Energy use in the oil and gas industry

It is often overlooked that the oil and gas industry is, itself, a major consumer—as well as a producer—of energy. The industry is inherently very energy-intensive. That is, large amounts of energy are needed to extract resources from the ground and process, transform, transport and deliver those resources to final users, relative both to the economic value and to the volume of the oil and gas supplied. This does not mean that the oil and gas industry is inefficient compared with other industries: efficiency can only be compared for processes involving the same inputs and outputs. In fact, oil and gas companies have been investing and will continue to invest heavily in improving the efficiency of their operations.

Globally, the energy consumed by the oil and gas industry is estimated to amount to approximately 10 per cent of gross oil and gas production, or about 600 million tonnes of oil equivalent (Mtoe) a year, based on 2004 data. Around 90 per cent of the primary energy used by this industry takes the form of oil and gas, as supplies are available on site and are typically the cheapest source of energy. Natural gas makes up about half of the total (Figure 2). Some of the oil and gas used directly by the industry is transformed into electricity and heat, especially in the case of refineries and other large facilities. In total, about 10 per cent of the electricity and heat consumed by the industry is supplied from the grid, though its relative importance varies considerably by type of activity and country.

Figure 2: World energy consumption along the oil and gas supply chain, 2004
(Covers only those countries for which data are available)

1 Comprehensive data on energy consumption by oil and gas companies around the world is not available. The IEA compiles and publishes data, where available, on the own use of energy by country and fuel type in crude oil and natural gas production, oil refining, gas liquefaction/regasification, and pipeline transportation. In 2004, consumption for all these activities amounted to 513 Mtoe. However, this understates the total amount of energy used by the oil and gas industry worldwide, as data is not available for some countries, especially in the developing world. In addition, no breakdown of the use of transport fuels is to hand for any country, so it is not possible to estimate precisely how much of this energy consumption is used by the oil and gas industry for the distribution of oil products by tankers, barges, railcars and road trucks.
The oil and gas industry has a strong financial incentive to save energy, because of the large share of energy in the overall cost of operating its facilities. Efficient energy use reduces costs along the whole supply chain, improves supplier’s competitiveness and makes energy more affordable to consumers. The industry is also committed to acting in a socially responsible manner, notably with respect to the environmental impact of energy use, and has a strategic interest in extending the life of its large but finite resources. That is why oil and gas companies have invested heavily over the years in more efficient technologies all along the supply chain and plan to invest more in the future. However, those investments are not always reflected fully in trends in the energy intensity of oil and gas supply, measured by the amount of energy needed to supply a given quantity of oil or gas to consumers.

**Oil refining**

Oil refining is the most energy-intensive part of the value chain, accounting for about half of all the energy consumed by the oil and gas industry as a whole. Refinery gas (a by-product of refining processes), heavy fuel oil and natural gas are the main fuels used in refineries. Several factors are contributing to higher energy intensity in refining, offsetting part of the efficiency gains from new investment. More stringent oil product standards, such as low-sulphur diesel, increasing demand for lighter products and heavier crude oil slates are forcing refiners to increase secondary processing and conversion of heavy residues. The introduction of carbon capture and storage at refineries while helping to offset increased emissions would significantly boost energy use too. According to IEA data, the energy intensity of oil refining has nonetheless fallen by 13 per cent since 1980 in OECD countries (for which reliable data are available) thanks to large efficiency improvements in processing.

**Oil and gas production**

Large amounts of energy are also needed to extract oil and gas from wells. Energy use covers a range of activities, including: driving...
pumps to extract hydrocarbons and to reinject water; heating the output stream to allow separation of the oil, gas and water; producing steam and reinjecting gas for enhanced oil recovery; powering compressors and pumps for transporting oil and gas through gathering pipelines to processing plants; and driving turbines to generate the electricity and heat needed for on-site operations and living quarters. Energy needs vary widely according to local circumstances and operational conditions. Locally produced gas is the main fuel used for upstream operations. The energy intensity of oil and gas extraction has been increasing—by approximately one-third since 1980 in OECD countries—despite heavy investments to improve efficiency. There are two main reasons:

- The growing maturity of oil and gas fields. Production declines as reservoirs become depleted of hydrocarbons, yet the amount of work and, therefore, energy required to produce those volumes stays about the same. Increased use of energy-intensive secondary and enhanced recovery techniques are also boosting energy needs.
- Increasing reliance on less accessible conventional fields, heavy crude oil and non-conventional resources, such as oil sands, which generally require more energy to produce.

Transportation

Sea-going oil tankers, fuelled by diesel oil and residual fuel, as well as pipelines, which mainly use natural gas to fuel pumps and compressors, account for much of the energy consumed in transporting and distributing crude oil, refined products and natural gas. Road tankers and rail cars, which distribute oil products in bulk to service stations and directly to end users, also consume significant amounts of diesel. Important advances have been achieved in improving the energy efficiency of transporting oil and gas. But the resulting energy savings are being offset by a shift in the geographic focus of production to regions that are further from centres of demand, boosting fuel use to deliver the output by pipeline or tanker.

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2 Survey data from the International Association of Oil and Gas Producers, covering one-third of world hydrocarbons output, shows that energy consumption per tonne of oil equivalent produced rose by about half between 2001 and 2005 to 1.4 gigajoules, though this partly reflects changes in the reporting system (OGP, 2006).
How the oil and gas industry is saving energy

Energy management

There is a strong consensus within the oil and gas industry on the importance of saving energy by improving the efficiency of its operations along the supply chain and eliminating unnecessary waste. Despite the large investments that have already been made, oil and gas companies continue to devote considerable resources in pursuit of further energy savings. Many companies have developed and implemented formal energy management systems, which seek to incorporate efficiency improvements and emissions reductions into the routine operations of every aspect of their businesses.

Case Study 1: Petrobras’ Energy Conservation Programme

Improving energy performance has been a major priority of Petrobras, the majority state-owned Brazilian oil company, since the first oil crisis in the early 1970s, when it first established the Energy Conservation Programme. It involves targets for energy use in each area of the company’s activities with the aim of lowering energy consumption and/or reducing spending on fuel. This is achieved by raising awareness of the importance of energy saving among employees, taking energy efficiency into account in preparing technical specifications for new projects, and analysing and reporting energy consumption levels. The programme consists of a wide variety of activities and projects, including:

- upgrading operating procedures in oil refining processes;
- optimizing the distribution and use of steam and power generated on site;
- preventing leaks and spills; and
- installing heat-recovery boilers and air pre-heating systems.

Although all projects are required to yield a financial return to the company, environmental aspects are always taken into consideration when selecting the projects to be implemented. Petrobras estimates that the programme has saved the company approximately 13 Mtoe of energy over the 32 years of its existence—equal to 11 per cent of all energy consumed by the company during that period. Investments under the Programme amount to $210 million (in year-2005 dollars). Savings in CO₂ emissions are estimated at about 42 million tonnes, while the average amount of CO₂ emitted per unit of energy consumed has fallen by around 20 per cent.

Despite these achievements, Petrobras has identified significant potential for further energy savings. Several major projects are currently under way, including a range of measures to reduce gas flaring. The company is also planning to install four turbo-expanders at different refineries, with a total capacity of 68 MW. Turbo-expanders use the energy contained in the flue gas emitted by catalytic cracking units, which are found at most Petrobras refineries, to generate electricity.

Below: an air preheater incorporated into distillation unit U-32 at the Landulpho Alves Refinery in Brazil, which improves the thermal efficiency of the crude oil heating furnace of the unit.
Integration of operations often makes a big contribution to improving efficiency. For example, cogeneration of electricity and steam using natural gas is nearly twice as efficient as traditional methods of producing them separately. A growing share of power and heat needs at upstream production sites, refineries and petrochemical plants around the world is being met by cogeneration plants, yielding big improvements in energy efficiency.

Oil and gas production

The growing energy intensity of oil and gas production in many parts of the world—as well as rising energy prices—is giving new impetus to industry efforts to improve the efficiency of the different operations involved in the production process, combat waste and reduce emissions. Recent initiatives, as mentioned earlier have largely focused on better

In 2000, ExxonMobil launched the Global Energy Management System (GEMS), which was developed to drive energy efficiency improvements at the company’s refineries and chemical plants. The system utilizes a common methodology to identify opportunities, develop plans to exploit them and continuously improve performance. GEMS is based on a three-step approach: the first step is to improve base performance by operating existing facilities optimally and efficiently through application of best practices; the second is to identify economic investment opportunities above an optimized base; and the third is to implement strong management systems to provide the rigour and discipline necessary to drive continuous improvement.

Since the launch of GEMS, the company has identified opportunities to improve energy efficiency by 15 per cent to 20 per cent. To date, more than half of these opportunities have been captured. In 2006 alone, the reduction in ExxonMobil’s energy costs was about $750 million, with an associated reduction in CO₂ emissions of around 8 million tonnes—an amount equivalent to taking about 1.5 million cars off the road in the United States. Most of these savings have come from the company’s refining and chemical operations. From 2000 to 2005, ExxonMobil’s refineries and steam cracking operations have improved their energy efficiency at a rate of about twice that of the historical industry average. ExxonMobil is on track to meet its commitment to improving energy efficiency by 10 per cent between 2002 and 2012 across the company’s US refining operations as part of the API Climate Action Challenge programme (see ‘Oil refining’ on page 12).

In addition to the GEMS initiatives, cogeneration is a significant factor in improving energy efficiency at ExxonMobil facilities around the world. ExxonMobil is an industry leader in cogeneration, investing more than $1 billion in such projects during 2004–05 alone. The company now has interests in about 100 cogeneration facilities in more than 30 locations worldwide, with a capacity to provide about 4,300 MW of power—enough electricity to meet the needs of close to seven million households in Europe. ExxonMobil’s current cogeneration capacity reduces global CO₂ emissions by more than 10.5 million metric tons annually. The company is continually considering new cogeneration investments. Projects currently under construction or development in Kazakhstan, Belgium, China and Singapore have a combined capacity of 875 MW of power, which will bring the company’s total cogeneration capacity to over 5,000 MW by 2010.

Case Study 2: ExxonMobil’s Global Energy Management System (GEMS)
integration of operations, including the increased use of cogeneration of power and steam. The introduction of more efficient pumps and compressors has also helped save energy. The most advanced high-efficiency motors that are increasingly being used in the upstream industry are about 85 per cent to 95 per cent efficient, compared with 60 per cent to 70 per cent for many of the oldest motors still in use (IEA, 2006b). In addition, energy use associated with oil and gas exploration has been reduced as a result of big improvements in drilling success rates, mainly due to advances in seismic surveying and analysis, and drilling techniques.

One important way in which the oil and gas industry has been conserving energy is by efficient hydroconversion at the Scotford Upgrader. The upgrader was sited and designed to maximize integration with the existing refinery and cogeneration units. Energy-efficient cogeneration and hydro-conversion technology, as well as combined hydroconversion/hydrotreating process integration to avoid pressure drop, were adopted to minimize energy use. In addition, a hydrogen-rich waste stream is purchased from a nearby Dow Chemical plant to reduce the need to produce hydrogen on site. As a result of these factors, AOSP currently produces refined products emitting 27 per cent less CO₂ on a well-to-wheels basis than would have been the case with the original project design. Emissions are nonetheless approximately 50 per cent higher than for imported crude oil. AOSP is exploring ways of achieving a voluntary commitment to cut greenhouse-gas emissions from current levels by 50 per cent by 2010, including through new projects to improve energy efficiency and to capture the CO₂ produced at the upgrader and reinject it into oil fields to enhance oil recovery or into saline aquifers. The remaining reductions will be achieved though domestic and international renewable energy and emission-offset projects.

Case Study 3: Athabasca Oil Sands Project, Canada

The Athabasca Oil Sands Project (AOSP) in Alberta, Canada—a joint venture of Shell, Chevron Canada and Western Oil Sands—is the first fully integrated oil sands project. The project, which began operation in 2003, consists of two main components:

● The Muskeg River Mine, located north of Fort McMurray, Alberta. A mix of heavy crude oil (bitumen) and sand is removed from just below the surface using trucks and mechanical shovels and is then mixed with warm water and solvents to separate the oil from the sand. The mine currently produces 155,000 barrels per day.

● The Scotford Upgrader (see photograph), located next to Shell’s Scotford Refinery in Fort Saskatchewan. The bitumen is mixed with diluent at the Muskeg River Mine to reduce viscosity and enable it to be transported south through a 493-kilometre pipeline to the upgrader. Once the bitumen is separated out, hydrogen-addition technology is used to process it into low sulphur synthetic crude oils. The diluent is recycled and piped back to the mine.

Integrated oil-sands projects are very energy intensive, so the AOSP was designed to minimize the energy requirements for financial and environmental reasons. Energy savings were made at the mine by using low-temperature extraction techniques, integration of heat streams and the installation of gas-fired cogeneration facilities. The bitumen-separation process was designed to remove clays and asphaltenes so as to achieve higher purity, thus enabling more
reducing the flaring or venting of natural gas produced in association with crude oil. Flaring is sometimes carried out where barriers to the development of gas markets and gas infrastructure prevent the gas from being used. The industry is committed to eliminating unnecessary flaring by developing processing and distribution infrastructure in order to monetize the gas. The Global Gas Flaring Reduction partnership—a World Bank-led initiative that brings together representatives of governments of oil-producing countries, and state-owned and major international oil companies—facilitates and supports national efforts to use currently flared gas by promoting effective regulatory frameworks and tackling the constraints on gas utilization, particularly in developing countries. For example, Nigeria’s Shell Petroleum Development Company—a joint venture between the Nigerian National Petroleum Company, Shell, Total and Agip—invested more than $2.3 billion between 2000 and 2005 in building pipelines and compressor stations to gather associated gas and use it in local power plants or for making liquefied natural gas (LNG). As a result, the amount of gas flared has been cut by 30 per cent since 2001 (www.shell.com).

**Oil refining**

As large energy consumers, oil refiners have long recognized the importance of improving energy efficiency. The amount of secondary processing of crude oil and other feedstocks carried out by refineries as a proportion of throughput has increased sharply over recent decades, resulting from the need to handle heavier crude oils with higher sulphur content and to meet increasing demand for lighter and better quality products. Yet the amount of energy used per barrel of output has actually fallen, due to massive investments in more energy-efficient processes, the adoption of efficient practices and the reconfiguration of refining and associated operations such as petrochemicals.

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**Case Study 4: Heat exchanger at Hydro’s Sture Oil Terminal, Norway**

The Hydro-operated Sture oil terminal on the west coast of Norway receives oil through two pipeline systems:

- **The Oseberg Transportation System**, which began operating in 1989. It comprises a 115-km pipeline that brings crude and condensate from the Oseberg, Brage and Veslefrikk offshore fields. The oil contains some associated gas, which is separated out. The naphtha and liquefied petroleum gases contained in the oil are also removed in a processing plant before the oil is shipped from the terminal. Close to 26 million cubic metres of crude oil and condensate were shipped from the terminal in 2006.

- **The Grane Transportation System**, a 212-km pipeline bringing crude oil from the Grane field. The system came onstream in 2005. Grane crude is heavy and must be heated to facilitate loading operations at Sture. Heat requirements amount to 9 MW.

The processing of the Oseberg oil involves heating it to approximately 100°C. A heat exchanger was constructed in 2006 to transfer excess heat from the Oseberg crude after processing to the cold and heavy Grane crude. The heat exchanging process saves approximately 8,000 toe of energy each year, reducing CO₂ emissions by about 25,000 tonnes.
and power production. Improved integration of operations, including increased reliance on cogeneration of heat and power and the installation of heat recovery systems on processing units, has contributed much of these gains. Refiners have become far more systematic in reviewing the efficiency of their processes, improving maintenance practices and running on-site assessments or audits of energy performance. The refining industry has

Case Study 5: Mongstad refinery energy project, Norway

A combined heat and power plant at Mongstad is being built to supply Statoil’s adjacent refinery with electricity and heat, and to supply power to the Troll A platform in the North Sea and the gas-processing facilities at Kollsnes. The project involves the construction of a new gas pipeline from Kollsnes to Mongstad, as well as tie-ins and modifications to the Mongstad refinery (Figure 3). The plant is expected to be ready for operation in 2010. Total investment is estimated at about 4 billion krone ($650 million). DONG Energy, a Danish company, will participate as an owner of the plant and will be responsible for building and operating it.

The facility will have a power-generation capacity of approximately 280 megawatts (MW) and heat-production capacity of about 350 MW. All of the heat will be supplied to the refinery. Electricity production of 2.3 terawatt-hours (TWh) per year will be shared by the refinery, the Kollsnes processing plant and the Troll A platform. The plant will comprise two gas turbines. Each of these will be connected to a generator for electricity production, and have its own waste heat recovery unit. A steam turbine and generator will also be installed. The high-temperature energy from the heat-recovery unit will be used to pre-heat the crude oil before it is distilled at the refinery. It will also be used to produce high-pressure steam to be used in crude distillation and secondary processing of intermediate refined products.

The project will significantly improve the efficiency of energy supply and use at the refinery. At start-up, thermal efficiency—the output of usable energy as a percentage of the energy content of the natural gas feed—is expected to be around 70 per cent and may exceed 80 per cent in the future as more units in the refinery are connected. Emissions of CO₂ per unit of output will be reduced sharply and the reliability of the electric power supply to Kollsnes and Troll A improved.

Figure 3: Technical configuration of the Mongstad Refinery Energy Project, Norway

- Gas to Mongolia
- Power grid
- Energy efficiency CHP station at 70–80%
developed tools to benchmark performance to provide a robust basis for taking decisions about energy use and efficiency.³

Refiners in several countries have made voluntary commitments to improve their energy efficiency and cut emissions. In the United States, for example, member refiners of the American Petroleum Institute (API) have undertaken to reduce their greenhouse-gas emissions by using less energy as part of the Institute’s voluntary Climate Action Challenge programme. They have set a target of increasing energy efficiency by at least 10 per cent between 2002 and 2012. These improvements are being tracked using the Solomon Energy Intensity Index which compares the overall energy efficiency of a given plant against the industry standard taking account of each type of processing unit in the plant and the type of crude oil processed. Refiners from the National Petrochemical and Refiners Association (NPRA) recently joined the API effort. The first progress report on meeting this goal shows that API and NPRA member refineries improved their overall energy efficiency by about 2 per cent in the two years to 2004. The energy saved over that period is enough to meet the total energy needs of more than half a million American households.

Transportation

The energy requirements of long-distance oil and gas pipelines and local gas networks have been reduced significantly in recent years, mainly through the development of more efficient pumps and compressors, and high-pressure (HP) gas transmission pipeline technology. High-efficiency turbines used to compress natural gas can now achieve thermal efficiency of up to 40 per cent. Higher pressure permits a corresponding increase in throughput capacity for a given diameter. Energy consumption per cubic metre of gas transported is between 20 per cent and 35 per cent lower for a 15 to 30 billion cubic metre/year line, because of the need for fewer stations, higher throughput levels and reduced friction losses.

³ See, for example, a 2004 study by CIEEDAC, which reports harmonized data on energy and CO₂ emissions intensities for the Canadian refining industry. Both intensities have fallen significantly since 1990.
The fuel efficiency of oil tankers, which carry the bulk of crude oil and refined products traded internationally, has improved greatly over the years, with the replacement of steam-boiler propulsion systems with more efficient and less polluting diesel engines. LNG carriers, which account for a growing share of trade in natural gas, are among the few large ships still using steam boilers, fuelled with gas that has to be ‘boiled off’ during the voyage to maintain pressure and temperature inside the vessels to within operating limits. But a number of carriers now being built feature modified diesel engines, including dual-fuel systems that can burn both diesel oil and gas.

The loss of oil, natural gas and refined products through leaks and spills in transportation and storage has been dramatically reduced through the introduction of a wide range of technologies, including improved valves, vapour-recovery units, double-hulled tankers, improved underground storage tanks at gasoline stations and improved corrosion-prevention technologies. When spills do occur, a substantial portion is now recovered and reused. For example, well over half of the crude oil associated with pipeline spills is now recovered and reused (www.api.org).

**Liquefied natural gas**

The last decade or so has seen major improvements in fuel efficiency in liquefaction and regasification, mainly through the deployment of high-efficiency gas turbines in on-site cogeneration facilities and in compressors. Some of these gains have been achieved through the development of larger turbines, which are now able to achieve electrical conversion efficiencies of 60 per cent when used in combined-cycle configuration (integrated with a steam turbine and a heat recovery steam generator) and overall thermal efficiencies of up to 80 per cent (when the heat output is fully utilized). Optimization of design parameters, improved reliability, closed-loop cooling systems, exploitation of cold-recovery and new heat exchanger designs are also contributing to higher efficiency.
Future challenges: the way forward

The oil and gas industry is facing major challenges in meeting the world’s rising hydrocarbon needs in an environmentally sound and socially acceptable way while curbing its own energy consumption. Many new sources of hydrocarbons, including oil sands, gas-to-liquids and biofuels, are inherently more energy-intensive. Tougher standards for refined products and the growing shift towards lighter products are pushing up the energy intensity of refining. The greater distances over which oil and gas must be transported will boost fuel needs, as would the introduction of carbon capture and storage. These challenges make it all the more important to unleash the potential that still exists for the industry to save energy through efficiency gains and conservation. Energy efficiency is often the cheapest, fastest and most environmentally friendly way of meeting the challenges of reducing industry’s own energy needs.

All stakeholders in the hydrocarbon sector—from producers to consumers—have a role to play, working together, to ensure energy is used efficiently and cleanly. The hydrocarbon industry is committed to stepping up efforts to seek out every opportunity for saving energy where it is economic to do so, and to helping policymakers formulate strategies and measures aimed at saving energy and reducing emissions. Policymakers, for their part, are responsible for establishing a stable and predictable policy framework that promotes planning and investment in more efficient energy options, and enhances market drivers to improve efficiency all along the supply chain.

Case Study 6: Total’s high-mileage diesel programme

Total has developed a new diesel fuel that achieves higher mileage while reducing engine noise and lowering emissions of toxic gases. The fuel is marketed at most service stations in France and is widely available in several other countries, notably Belgium, Germany, The Netherlands, Portugal, the United Kingdom and Turkey.

Total launched a project in late 2005, in partnership with Bouygues Construction and the water sanitation company, SAUR, to test the fuel, as part of a broader programme aimed at reducing emissions of CO$_2$ and pollutants, partly through changes in driving behaviour. In the first phase of the project, during which 8 million kilometres were driven in real driving conditions by the 750 vehicles involved testing the fuel, average fuel consumption per kilometre was reduced by 3.7 per cent. In the second phase, which is still under way, drivers are being encouraged to change their behaviour. The objective is to cut fuel use by a further 1.3 per cent, giving an overall fuel saving of 5 per cent and avoiding an estimated 12,500 tonnes of CO$_2$ emissions.
Oil and gas companies will continue to invest heavily in research and development of more efficient technologies; many companies are augmenting their efforts substantially. Government-funded research will remain vital, especially for promising technologies that are not yet ready to be commercialized. Yet public budgets for oil and gas research remain well below the levels reached after the oil shocks of the 1970s and have fallen in many cases over the past decade. There is a pressing need for the public and private sectors to work together to develop more efficient oil and gas technologies.

The oil and gas industry is responsible for ensuring efficient energy use and conservation in its own activities, or ‘inside the fence’. But it also has an interest—and, in some cases, a legal obligation—to promote energy-efficient use of its products ‘outside the fence’ too, particularly since the potential for saving energy there is considerably higher in absolute terms. For example, a 10 per cent improvement in the efficiency of oil use in transport and other end uses would save the equivalent of one-half of all the energy used by the oil and gas industry worldwide. The oil and gas industry is already helping final consumers of its products to save energy and will continue to do so. Another way in which the industry is seeking to reduce energy needs is through improvements in the quality of its products, such as advanced road fuels that improve mileage.

Several European countries have implemented or plan to introduce white certificate schemes, involving obligations or voluntary commitments on the part of producers, suppliers and distributors of oil, gas and electricity to undertake energy-efficiency measures that ensure that their final users save an amount of energy equal to a pre-defined percentage of their annual energy deliveries. White certificates are documents certifying that a certain reduction of energy consumption has been attained. Great Britain was the first EU country to introduce such a scheme, combining its obligations on suppliers to save energy with the possibility of trading those obligations and the certificates. Italy started a scheme in January 2005 and France a year later, while Denmark and The Netherlands are considering introducing them in the near future.

The oil and gas industry, as a stakeholder in the energy debate, is playing, and will continue to play, its part in promoting rational energy use all along the entire supply chain. IPIECA, representing international oil and gas companies as well as national oil companies and numerous industry associations from around the globe, strongly supports energy efficiency and conservation. IPIECA will continue to raise awareness and share best practices among its members in identifying and implementing projects to save energy, in line with IPIECA/API Voluntary Sustainability Reporting Guidance. It will also encourage networking and partnerships with other key stakeholders in the industry. IPIECA members stand ready to broaden their dialogue with energy end users on how we can all best save energy for the good of everyone.
References and information sources

Reports/books


Websites

Alliance to save Energy: www.ase.org

American Council for an Energy-Efficient Economy: www.aceee.org

American Petroleum Institute: www.api.org

CONCAWE: www.concawe.be


International Association of Oil and Gas Producers (OGP): www.ogp.org.uk

International Energy Agency: www.iea.org

International Petroleum Industry Environmental Conservation Association (IPIECA): www.ipieca.org


The World Energy Council: www.worldenergy.org
## IPIECA membership

### Company Members
- BG Group
- BHP Billiton
- BP
- Chevron
- CNOOC
- ConocoPhillips
- ENI
- ExxonMobil
- Hess
- Hunt Oil
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- Kuwait Petroleum Corporation
- Mærsk Olie og Gas
- Marathon Oil
- National Hydrocarbon Corporation of the Republic of Cameroon
- Nexen
- NOC Libya
- Petrobras
- Petroleum Development of Oman
- Petronas
- Petrotrin
- PTTEP
- Repsol
- Saudi Aramco
- Shell
- Statoil
- TNK-BP
- Total
- Woodside Energy

### Association Members
- American Petroleum Institute (API)
- Australian Institute of Petroleum (AIP)
- Canadian Association of Petroleum Producers (CAPP)
- Canadian Petroleum Products Institute (CPPI)
- CONCAWE
- European Petroleum Industry Association (EUROPIA)
- Institut Français du Pétrole (IFP)
- International Association of Oil & Gas Producers (OGP)
- Petroleum Association of Japan (PAJ)
- Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean (ARPEL)
- South African Petroleum Industry Association (SAPIA)
- World Petroleum Council (WPC)
IPIECA

IPIECA is the single global association representing both the upstream and downstream oil and gas industry on key environmental and social issues, including: oil spill response; global climate change; fuels; biodiversity; social responsibility and sustainability reporting.

Founded in 1974 following the establishment of the United Nations Environment Programme (UNEP), IPIECA provides a principal channel of communication with the United Nations. IPIECA Members are drawn from private and state-owned companies as well as national, regional and international associations. Membership covers Africa, Latin America, Asia, Europe, the Middle East and North America.

Through a Strategic Issues Assessment Forum, IPIECA also helps its members identify emerging global issues and evaluates their potential impact on the oil industry. IPIECA’s programme takes full account of international developments in these issues, serving as a forum for discussion and cooperation, involving industry and international organizations.