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MAY 2017

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**Integrating**  
**Climate**  
**Into Our Strategy**



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# Total at a Glance

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**98,109**

employees

at January 31, 2017  
after the sale of Atotech



More than

**4 million**

customers served in our  
service stations each day

## A Global Energy Leader

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**No. 4**

oil and gas  
company worldwide

2.5 Mboe/d produced in 2016,  
of which approximately 48% gas



**Refining & Chemicals:**  
a global top 10  
integrated manufacturer



**A leader**  
in solar energy



**European leader**  
in biofuel marketing

2.3 Mt of biofuels blended  
into gasoline and diesel in 2016

## Responsible Growth

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**23%**

decrease  
in greenhouse gas  
emissions since 2010  
in our operated scope



**USD 6.7 billion**  
forecasted spending  
on R&D between  
2016 and 2020



**“This report is an opportunity to take stock of our actions, our investments to secure the future and the indicators we use to track our performance.”**

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## FOREWORD

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### **PATRICK POUYANNÉ**

Chairman and Chief Executive Officer, Total

#### **The Time for Action Is Now**

This is Total's second report on what we are doing to tackle climate challenges as an integral part of our corporate strategy. This publication has three major objectives. First, to share our ambition for Total in 2035, as we reshape the company using the International Energy Agency's (IEA) 2°C scenario as a baseline. Second, to describe how we are addressing the impact of that scenario on our decision-making. It has prompted us to acknowledge that oil is a mature market facing long-term decline. Thus, our policy of selective investment is an increasingly important contributor to sustainable performance and warrants further clarification. And third, this report is an opportunity to take stock of the actions we have already implemented, the initiatives we are currently undertaking, our investments to secure the future and the indicators we use to track our performance.

## “Our goal is to have low-carbon businesses account for close to 20% of our portfolio in 2035.”

Our policy has evolved out of a desire for transparency and dialogue with our stakeholders, to ensure they fully understand the challenges and opportunities that climate change presents for Total.

This year’s report comes at a time of major developments. The COP21 Paris Climate Conference in 2015 generated renewed awareness, formally outlined in goals and voluntary commitments by numerous stakeholders. Those goals and commitments remain valid today. The 2016 ratification of the Paris Agreement by 94 parties was a further milestone. So 2017 represents a time for action by governments and the private sector alike. The business world has mobilized to an impressive degree and here at Total, we are actively backing international initiatives that will compel industry action. The Oil & Gas Climate Initiative’s launch of Climate Investments (OGCI CI), including its pledge of no less than \$1 billion for projects and technology that could significantly reduce emissions, is the best example of this. The initial focus areas will be developing carbon capture, utilization and storage, reducing methane emissions and improving energy efficiency. The multiplier effect of all of these companies investing together serves as an engine to attract other funding.

Total’s strategy — to become the responsible energy major, providing affordable, reliable and clean energy to as many people as possible — is consistent with this proactive commitment. At Total, today’s climate concerns are integral to our strategic decisions. With that in mind, we have taken the critical step of creating a combined

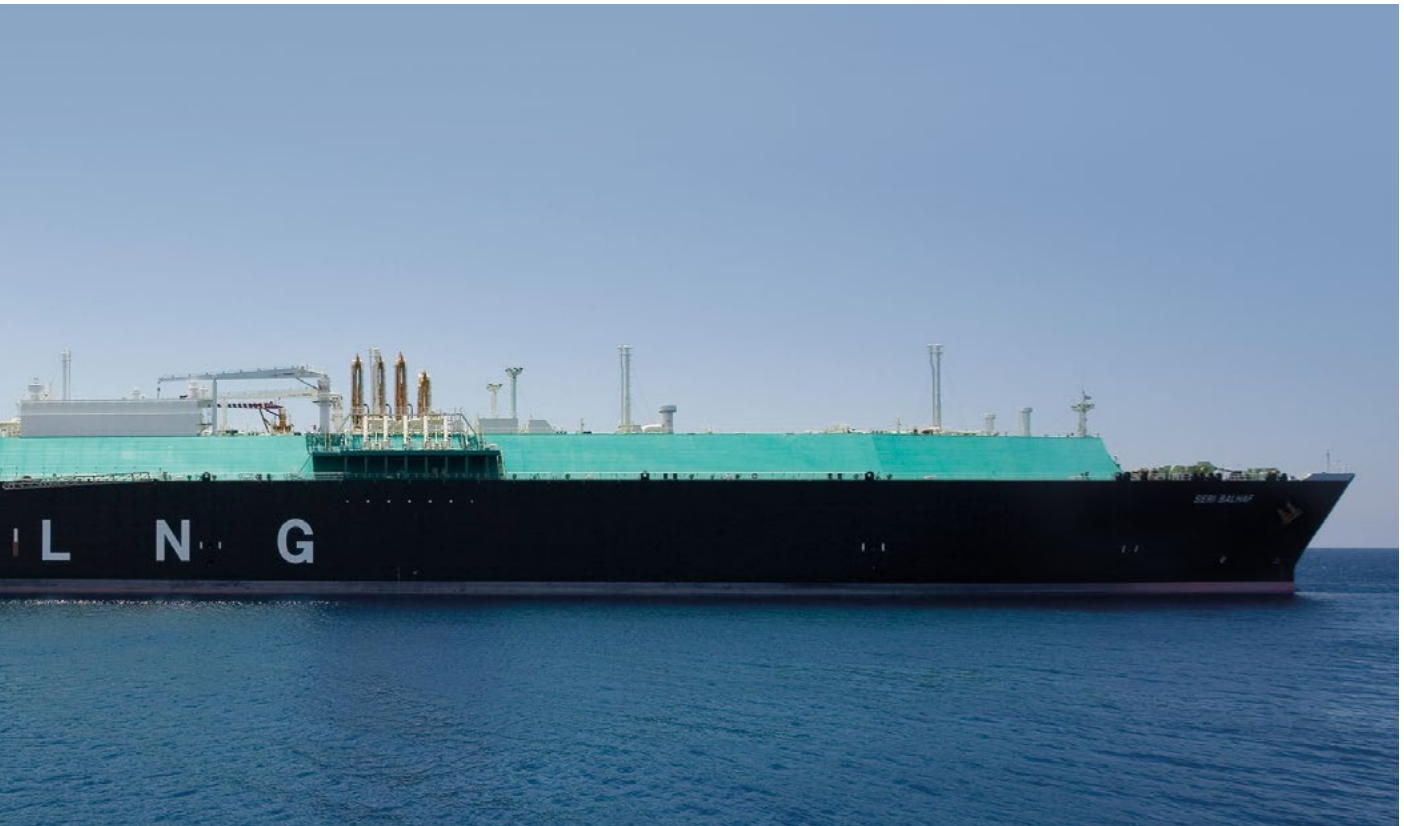


Strategy & Climate Division and a new business segments, Gas, Renewables & Power (GRP), which is spearheading Total’s ambitions in the field of low-carbon energy.

### Significant Ongoing Investment in R&D

As the IEA’s 2°C scenario indicates, changes in the energy mix play an instrumental role in any effort to limit climate change.

Demand for energy remains intense and will only grow more so in the coming years. There are now 7 billion people in the world, of whom 1.3 billion lack access to energy. By 2040, the world’s population is likely to top 9 billion, including 2 billion people in Africa. Global demographic growth will require energy that is not only affordable, to support the planet’s economic and social development, but friendlier to the environment as well. That calls for significant progress, and while some avenues of opportunity are at hand, others must be improved or even built from scratch. That is why Total’s R&D budget, which already exceeded \$1 billion in 2016, will continue to rise. That campaign for innovation — marked by determination, commitment but also pragmatism, and in many cases involving partner organizations — is already leading us toward a lower-carbon energy mix.



In particular, we intend to earmark 10% of our R&D budget (excluding specialty chemicals R&D) for carbon capture, utilization and storage technologies. Reaching carbon neutrality during the latter half of the century is a climate imperative. But oil and gas will still dominate the energy mix at that time. Those two factors can only be reconciled if carbon storage and utilization technology is in place and operational.

#### More Natural Gas to Meet Demand for Electricity

Oil and natural gas are not going away. They are essential to continued growth, and will continue to play an important role in the decades to come: under the IEA's 2°C scenario, they will still comprise more than 40% of the primary energy mix in 2035. So we must not embrace the unrealistic idea of an abrupt transition; instead, we need to look at these energies from a fresh perspective. We are moving toward a model in which natural gas — which emits half as much carbon as coal for power generation — increasingly replaces coal in the energy mix. Here too, climate concerns generate opportunities for growth. Demand for electricity will outpace energy demand over the next two decades, and natural gas offers a reliable solution in the face of that reality. Gas will make up the biggest share of our portfolio by 2035.

But in order for natural gas to gradually take the place of coal — an inexpensive, abundant energy source — we must tackle a critical challenge: cost. That's a priority. Total has a role to play in meeting that challenge. First, by maintaining a high level of investment, as we have done in recent years and will continue to do, despite the volatility of energy prices. Second, by ensuring that the cost of our gas liquefaction projects is lowered by introducing new technologies. And third, by encouraging the growth of gas demand, as with our recent regasification terminal projects in Côte d'Ivoire and Pakistan.

Energy efficiency is likewise a key component of our activities, whether at our own facilities, where we aim for a 1% improvement each year, or those of our customers, thanks to products and services that encourage responsible energy use.

Beyond our own initiatives, one crucial factor for success remains the introduction of carbon pricing that aligns energy prices more closely with carbon content, to ensure a more balanced mix that favors sources with lower emissions. Putting a price on carbon is the most efficient financial mechanism to change the rules of the game quickly. The main priority is to reduce the use of coal by switching to natural gas and renewables for power

generation. Some countries, such as the United Kingdom, have begun moving in that direction by establishing a price support (£18 per ton) to maintain the E.U. Emissions Trading System (ETS) market price. This has quickly led to a reduction in carbon emissions without curbing the supply of energy. We support any such initiative that would immediately institute a carbon floor price in the European Union, for example €20/ton, and otherwise allow the market to determine price through schemes such as the ETS.

### More Renewables to Meet Demand for Electricity

We are getting ready for the trend toward greater electricity demand by looking outside the company with acquisitions such as Lampiris, a supplier of natural gas and green power to the residential sector; Saft, a battery manufacturer; and PitPoint, a leading European provider of natural gas vehicle fuel.

Like natural gas, renewable energy offers a further resource for meeting rising power demand. Our ambition is to consolidate a market-leading position in solar energy by leveraging SunPower's cutting-edge technology for distributed generation applications and through the growth of our affiliate Total Solar in utility-scale solar power plant projects. We aim to continue expanding our operations — especially in Africa, which could, in fact, leapfrog to distributed generation based on renewable energies. Already deployed in over 30 countries, our Total Access to Solar program provides us with valuable experience in understanding the challenges ahead.



**“The main priority is to reduce the use of coal by switching to natural gas and renewables for power generation.”**

Our goal is to have low-carbon energy account for close to 20% of our businesses in 2035, while also growing this portfolio profitably.

### Tackling the Challenges Raised by Transportation

The face of transportation will be transformed in the coming decades. For instance, electric vehicles will be extensively used in large urban areas within 20 years.

The changes will also impact the trucking sector and maritime transportation. In both cases, natural gas will be called on to play a role, and Total aims to be a front-ranking provider to industry players.

In aviation and road transportation alike, biofuel use will have to expand if climate objectives are to be met. In response, we are investing to cement our position as Europe's leading biofuel marketer.

### An Organization That Reflects Our Strategy

To address this array of challenges, Total's organization needed to be adapted. So in 2016 we created a new business segment: Gas, Renewables & Power (GRP). The very name reflects our perspective on the market. GRP has a very clear task: propose a growth strategy with regard to midstream and downstream gas, renewable energies, the electricity value chain and energy efficiency. It is founded on the integrated business model that has served us so well: we explore for, produce, refine, process, market and distribute energy to fulfill our customers' expectations as closely as possible. Our approach is rooted in a highly disciplined investment policy, with a focus on low-cost energies to meet our customers' primary requirement: affordable, even cheap, energy. There too, corporate strategy and climate responsibility go hand in hand.

Optimizing the mix of fossil fuels, developing low-carbon businesses, promoting energy efficiency, exploring new options for carbon utilization — Total is building a comprehensive array of diversified, growth-enhancing solutions, commensurate with the scope of the challenges we face.



### THREE QUESTIONS FOR

## PATRICIA BARBIZET

Lead Independent Director of Total

**You were appointed lead independent director of Total on December 19, 2015. What does your role involve?**

The lead independent director helps to ensure efficient governance of the company in accordance with current practice. This role is considered to be useful by many investors and proxy advisory firms when the positions of Chairman and Chief Executive Officer are combined, as is again the case at Total since the management transition led by Patrick Pouyanné. My responsibility is to ensure that the Board of Directors runs smoothly and follows its rules of procedure. As Chairwoman of the Governance & Ethics Committee, I'm also in charge of leading the review of the Board's work and preventing conflicts of interest. And, along with the Chairman and Chief Executive Officer, I'm a primary contact for shareholders.

**You have been a Total director since 2008. How has the Board of Directors' approach to climate issues changed over time?**

The Board has always taken climate issues seriously. But what has changed over time is the role that they play in Total's strategy.

**"The climate has been fully integrated into Total's business and strategic vision, as well as its organizational structure."**

In 2008, climate issues were treated as a completely separate environmental risk requiring measures to reduce the footprint of Total's activities. More recently, these issues have been fully integrated into the company's business and strategic vision, as well as its organizational structure, which was revamped in September 2016, a process that included the creation of a combined Strategy & Climate Division. By the same token, the creation of the Gas, Renewables & Power segment provides the opportunity for industrial and commercial synergies in Total's low-carbon solutions. That's a good indicator of how Total's long-term strategy is built on addressing climate-related challenges.

**Does the Board's commitment include considering climate issues in setting the Chairman and Chief Executive Officer's compensation?**

Absolutely. Last year, the Compensation Committee changed the criteria for the Chairman and Chief Executive Officer's variable compensation to put more emphasis on achieving HSE and CSR objectives. Together those goals now account for 30% of that compensation. In 2016 the safety objective, established largely by benchmarking with the other leading oil companies, was met. At Total, safety is not just a priority, but also a core value, and the Board's members fully support that perspective. The Group's CSR

performance likewise was deemed fully satisfactory, notably with the deployment of the "One Total, One Ambition" project, which uses the IEA's 2°C scenario as its baseline. The acquisitions of Saft, a leading supplier of electricity storage solutions, and Lampiris, a natural gas and power provider, will also contribute to fulfilling those objectives. Total has improved its position in the rankings published by non-financial (ESG) rating agencies, and at the request of the directors, has published a report on the role of climate concerns in its strategy. In its assessment of 2017, the Board of Directors will uphold an equally strict standard regarding these issues.

### CLIMATE GIVEN GREATER WEIGHT IN THE CHAIRMAN AND CEO'S COMPENSATION

In 2015, the portion relating to the HSE/CSR performance criteria used to calculate Patrick Pouyanné's variable compensation was set at a maximum of 16% of his base salary.

For 2016, in a bid to give greater weight to HSE/CSR criteria, the Board of Directors increased this portion to 30%, with 20% tied to safety performance and 10% to CSR performance.

This breakdown is being maintained for 2017, and CSR performance will be assessed on the basis of Total's attention to climate issues in its strategy as well as its reputation in the area of corporate social responsibility.



# Shaping Tomorrow's Energy

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Energy is at the heart of the challenges we face to keep the global average temperature rise below 2°C. What mechanisms can be put in place and what conditions favor success?

We are helping to effect this transformation and are actively involved, both within our industry and in the broader international community, in shaping tomorrow's energy.



## INTERVIEW

### FATIH BIROL

Executive Director of the International Energy Agency (IEA), which publishes the flagship *World Energy Outlook* (WEO) report, Dr. Birol shares his insights on energy perspectives and related climate challenges.

#### 450 MILLION EVs IN 2035

The expected number of electric vehicles has substantially progressed in the WEO 2016 versus the 2015 edition, reaching 450 million in 2035 versus in 2040 previously.

## “Natural gas performs best of all the fossil fuels in our WEO scenarios.”

### What are the latest trends in terms of GHG emissions worldwide?

Our data shows that while the global economy grew by over 3% in 2016, energy-related emissions of carbon dioxide were flat. This was mainly the result of markets, with generators switching from coal to gas in the U.S., U.K. and other countries, and a continued push on renewables and energy efficiency.

### What changed in 2016 for the IEA's 2°C scenario?

In our latest edition of the *World Energy Outlook* (WEO), the role of carbon capture and storage has been revised downward to reflect the current slow progress, despite the key role this technology could play as an asset protection strategy in a decarbonized world. On the other hand, we have revised upward the role of electric vehicles and variable renewables, solar in particular, due to the recent strong progress that has been driven by cost reductions and strong government support.

### What is the role of efficiency measures in IEA projections?

Energy efficiency is and will remain a key instrument to achieve multiple goals, and the policy attention

it receives is reflected in our projections. While tighter standards have been important in improving energy efficiency, another key policy development has been the increased use of market-based instruments, such as utility obligation programs and auction mechanisms. We are currently also investigating the role that digitalization will have in future energy demand trends, including energy efficiency in transportation, buildings and industry.

### What place do you expect natural gas to hold in time?

Natural gas performs best of all the fossil fuels in our WEO scenarios. But it will not be plain sailing for gas, which faces strong competition from coal in some markets and is being squeezed by the rise of renewables in others. Over the next five years another 130 billion cubic meters of liquefaction capacity will come on line — mostly in the United States and Australia — creating new options and greater flexibility for buyers of gas. But as we expect the current overcapacity in LNG to be absorbed by the mid-2020s, new investment decisions will be needed well before this point to avoid a new round of market tightening.

A CLOSER LOOK

# The 2°C Objective: Challenges Ahead for Every Form of Energy

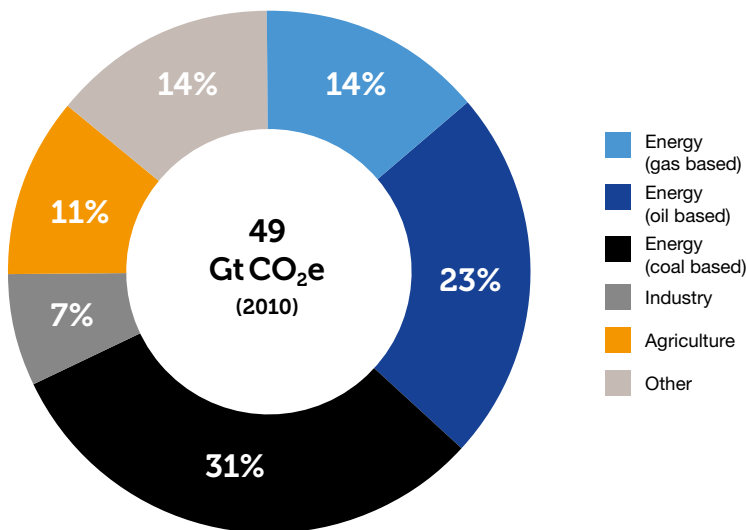
The world economy must be profoundly reshaped to keep the average global temperature rise to below 2°C above pre-industrial levels by 2100. Energy consumption, which represents nearly 70% of global greenhouse gas emissions — with the rest due primarily to agriculture and industry — is a key factor in the balancing act required.

## The Facts

Global greenhouse gas emissions amounted to 49 Gt CO<sub>2</sub>-eq in 2010. According to the IPCC Fifth Assessment Report, if current trends continue, global emissions will total approximately 75 Gt CO<sub>2</sub>-eq in 2035, whereas scenarios compatible with a 2°C increase assume emissions of no more than about 35 Gt CO<sub>2</sub>-eq in 2035.

The 2°C trajectory outlined by the International Energy Agency (IEA) scenarios<sup>1</sup> incorporates this emissions reduction, which entails sharply decreasing the carbon content (“carbon intensity”) of GDP by an estimated 3 to 4% annually between now and 2035.

### Greenhouse Gas Emissions Related to Human Activity in 2010

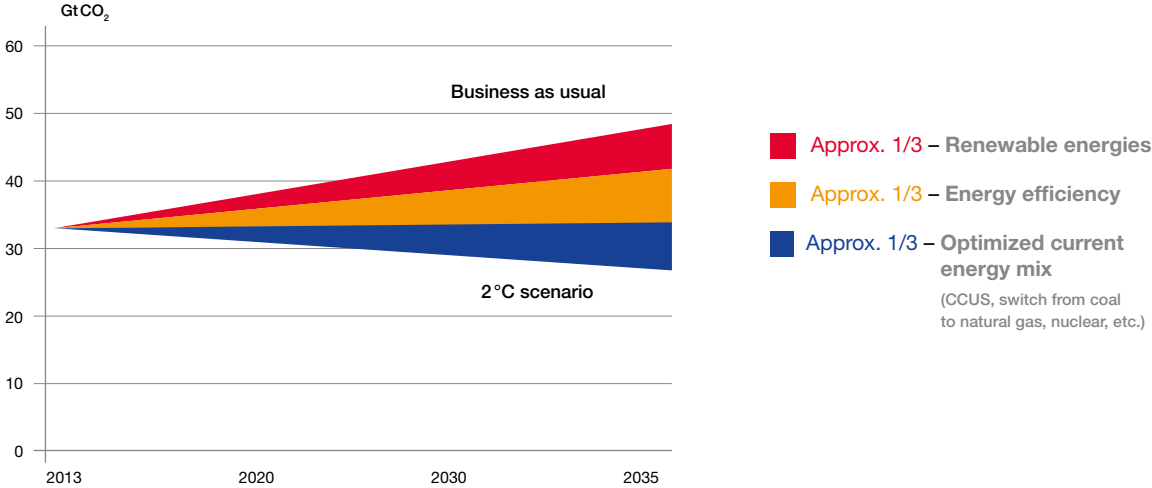


Oil and gas account for 37% of greenhouse gas emissions related to human activity. Roughly 85% of emissions related to oil and gas are generated during product end-use; the remaining 15%, during production and refining.

Source: Adapted from the IEA report CO<sub>2</sub> Emissions from Fuel Combustion, 2016 edition.

<sup>1</sup> For the purposes of this report, “2°C scenario” refers to the pathways outlined in the 450 and 2°C scenarios published by the IEA in the *World Energy Outlook and Energy Technology Perspectives*, respectively. These scenarios aim to limit the average global temperature rise above pre-industrial levels to 2°C by 2100.

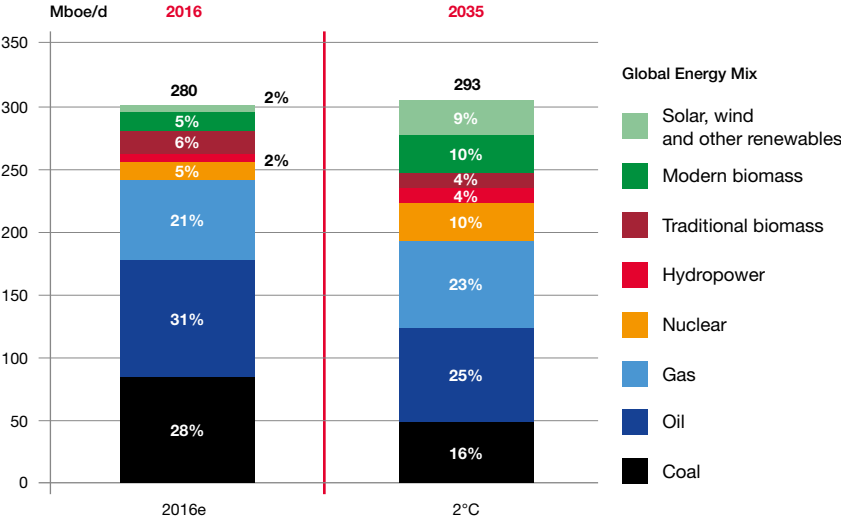
In its 2°C scenario, the IEA outlines three areas of focus to alter the trajectory of energy-related CO<sub>2</sub> emissions:



**An Energy Mix That Is Up to the Task**

The first challenge is to reduce the share of coal. Under the IEA’s 2°C scenario, it will shrink from 28% to 16% between 2016 and 2035. Oil and gas will account for 48% of the “target” 2°C mix for 2035, versus 52% today. All fossil fuels are not equal. For an equivalent energy content, gas emits around half as much CO<sub>2</sub> as coal on average when used for power generation. Consequently, the share of gas should continue to grow — by around 15% over the period — to 23% of the 2035 energy mix.

But that will require reducing gas production and transportation costs, so that consumers gain access to affordable energy that is competitively priced compared with coal. Oil’s share of the mix will begin to decline gradually, to 25% in 2035 from 31% today, because it will be reserved primarily for transportation and petrochemicals. The share of renewables, excluding traditional biomass, will soar over the same period, to 23% from 9%.



**A DYNAMIC CLIMATE OF INVESTMENT**

According to the IEA, some \$5.7 trillion and \$6.9 trillion need to be invested in the natural gas and oil sectors respectively over the next 20 years. Although this represents a slowdown in investment for oil, it amounts to a 13% increase over the average annual investment in natural gas in the period from 2000 to 2013.

# Carbon Pricing, the Key to Achieving the 2°C Scenario

**Putting a price on carbon is an essential step in the transition to a low-carbon economy. Carbon pricing would help to push power generation from coal to natural gas, which has half the carbon intensity of its rival. We have been working since 2015 to convey our values and propose solutions through dialogue with governments, organizations and industry peers.**

A price of between \$30 and \$40 per ton would be enough to:

- Encourage a switch from coal to gas; gas has half the carbon intensity of coal in power generation.
- Steer investment toward the technologies required to reduce emissions.

In particular, carbon capture, utilization and storage (CCUS) — which the IEA considers a prerequisite for halving global greenhouse gas emissions by 2050 — requires the introduction of a carbon pricing mechanism if it is to become feasible on a large scale.

We are calling for the rapid adoption of pricing mechanisms that are tailored to specific circumstances, such as geographical region or economic sector, and can be gradually linked. Currently, the most pressing issue is simply to promote the idea of carbon pricing in any form.

We have been campaigning on behalf of that goal since 2015, notably through international initiatives, such as the World Bank's Carbon Pricing Leadership Coalition<sup>1</sup>, that give our message a wider reach.

For example, we support the immediate adoption of a floor price of approximately €20 per ton of CO<sub>2</sub>-eq. This would strengthen the European Union emissions market and accelerate the switch to natural gas from coal for power generation.

In preparation for these international conditions, we measure the robustness of our future long-term investments with an internal carbon price of between \$30 and \$40 per ton, depending on the price of oil.

## OIL AND GAS COMPANIES CALL FOR CARBON PRICING

In May 2015, six global oil and gas companies — BG Group plc, BP plc, Eni S.p.A, Royal Dutch Shell plc, Statoil ASA and Total S.A. — sent an open letter to the United Nations Framework Convention on Climate Change (UNFCCC) and the Presidency of COP21 calling for the introduction of carbon pricing mechanisms. Their goal was to reduce uncertainty and promote more economically efficient methods for reducing carbon emissions worldwide.

**1,200** More than 1,200 companies (a threefold increase since 2014) say they are using a baseline carbon price internally or expect to do so within two years.

**40** Forty countries and 20 provinces and cities are currently using or expect to institute carbon pricing.

**13%** The proportion of global emissions covered by an explicit pricing mechanism.

**25%** The percentage of GHG emissions that will be covered by a carbon pricing system when China introduces a national cap and trade market, expected in 2017.

Source: *State and Trends of Carbon Pricing 2016*, World Bank Group, and *Key Figures on Climate, France and Worldwide*, 2017 edition, French Ministry of the Environment, Energy and Marine Affairs.

### Milestones

**2008**

We begin factoring a carbon price of €25 per ton into our investment decisions.

**2015**

Paying for Carbon: Total and five other leading oil and gas companies call on the international community to implement carbon pricing mechanisms.

**2016**

We help to deploy the World Bank's Carbon Pricing Leadership Coalition.

**2016**

We review our internal carbon price, setting it at between \$30 and \$40 per ton, depending on the price of oil.

<sup>1</sup> Established in 2015, the Carbon Pricing Leadership Coalition (CPLC) is a platform for collective action by more than 24 countries and 90 global businesses and strategic partners. Its goal is to encourage action on carbon pricing by expanding the evidence base and mobilizing support in the business community.

Source: World Bank

<http://www.worldbank.org/en/news/feature/2016/04/15/carbon-pricing-building-on-the-momentum-of-the-paris-agreement>




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**INTERVIEW**


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**ERIK SOLHEIM**

Executive Director of UN Environment, Mr. Solheim is a former Norwegian Minister of Environment and International Development.

**“What is crucial is a change in mindset.”**

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**Climate change is a global issue. How do we coordinate public regulation and private partnerships?**

Public regulation is essential to establish clear boundaries, but it cannot achieve climate change on its own. The private sector is where innovation and technological solutions will come from. It needs to be given the space necessary for driving change. I often say that the regulator’s relationship with the private sector should not be limited to naming and shaming. We also need to name and fame.

**Is there enough leadership today in the fight against climate change?**

There is always space for more leadership. But what is crucial is a change in mindset. Previously, action on climate change was presented as a cost, with negotiations focusing on who should pay. Now more countries, like India and China, are embracing the idea that a low-carbon economy is a great business opportunity.

**Is closer monitoring of methane emissions necessary?**

Methane is a major driver of climate change as a powerful greenhouse gas.

As such, methane emissions need to be an integral part of our wider monitoring efforts.

**Which areas would benefit most from more environmental collaboration and cooperation?**

We clearly need to see more progress on carbon capture, utilization and storage (CCUS), moving toward stable long-term storage solutions that are effective, cost competitive, and environmentally safe. This can be done by ensuring adequate investment in science and providing adequate space for the right solutions to emerge. Urgent action in urban areas would also deliver critical results: cities produce over 70% of global CO<sub>2</sub> emissions.

**+2.9° TO 3.4° CELSIUS**

Despite the Paris Agreement, we are still heading for a temperature rise of 2.9° to 3.4°C this century, says Erik Solheim. Without stronger commitments, CO<sub>2</sub> emissions in 2030 will be 12 to 14 gigatons above the levels needed to limit global warming to 2°C.

# Oil and Gas Companies Join Forces



**Launched in 2014 by Total and nine other companies<sup>1</sup>, the Oil & Gas Climate Initiative (OGCI) has set itself the objective of driving practical action to mitigate the industry's greenhouse gas emissions.**

The creation of the OGCI was announced on September 23, 2014 during the United Nations Climate Summit held in New York. The industry-driven initiative currently has 10 members, all major international companies, that together represent around 20% of global oil and gas production. The CEO-led OGCI aims to catalyze collective action by those most committed to addressing climate change and to advance technological solutions through collaborative programs. The organization has expressed its collective support for the Paris Agreement and welcomed its entry into force in November 2016.

As a founding member, we engaged fully in the initiative's launch and development. The OGCI is currently focusing its efforts on four issues.

The first is accelerated deployment of CCUS, and specifically a study of mechanisms that will foster the emergence of a market and technology for carbon capture and storage.

The second is managing methane emissions in the natural gas value chain. Natural gas can play a pivotal role in the fight against climate change, notably as a replacement for coal in power generation.

The third relates to improving energy efficiency in the industrial sector. Each member company is conducting initiatives in this area, but the OGCI's role is to identify technology that could be introduced on a larger scale through a collaborative effort.

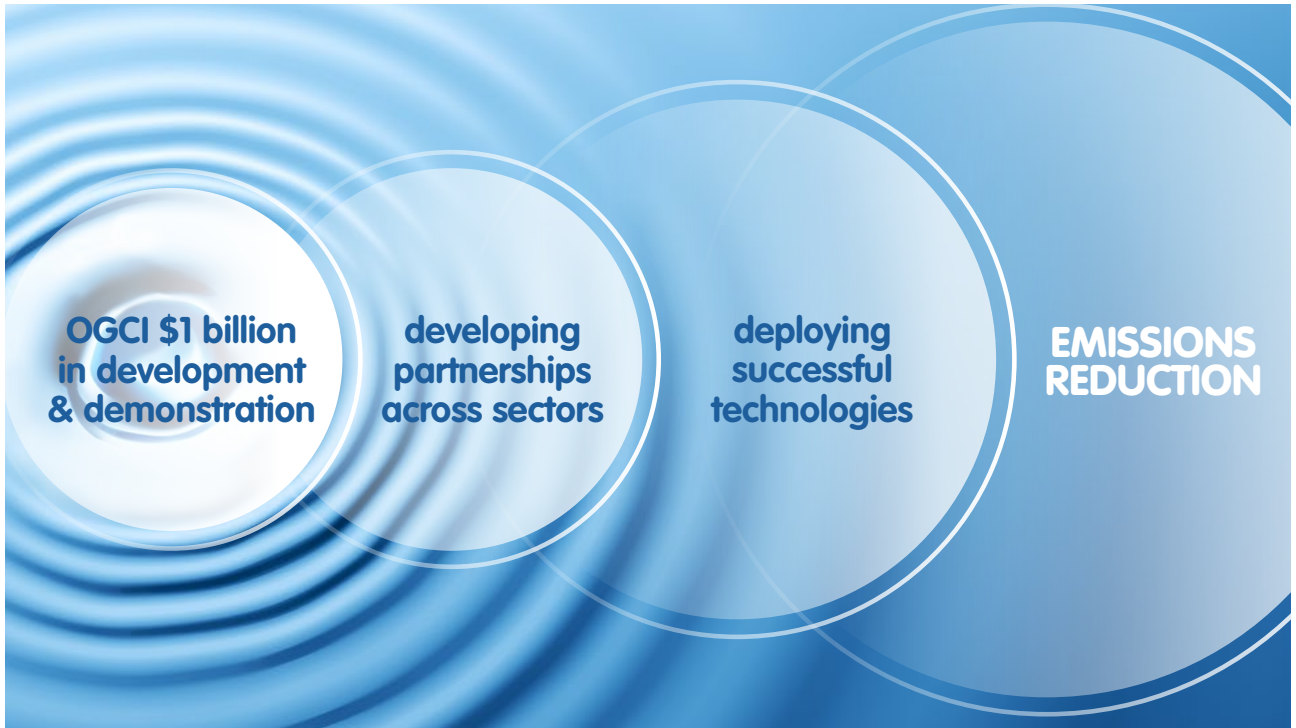
The fourth is energy efficiency in transportation.

In 2017 the OGCI will also be examining potentially compatible options and technology for the longer term, with an eye toward carbon neutrality in the second half of the century.

<sup>1</sup> BP plc, CNPC, ENI S.p.A., Petróleos Mexicanos, Reliance Industries Limited, Repsol SA, Royal Dutch Shell plc, Saudi Aramco, Statoil ASA.



## The Multiplier Effect



## \$1 billion

The guaranteed minimum investment pledged for the next decade.

## 20%

The share of the world's oil and gas produced by OGCI members.

### Creation of OGCI Climate Investments in 2016

In November 2016, the OGCI announced the creation of a \$1 billion partnership to finance technology that substantially reduces emissions from energy production and consumption. As of 2017 and for the next decade, OGCI Climate Investments will be supporting start-ups and projects that have the potential to reduce GHG emissions significantly. The investments will back projects for large-scale carbon capture, utilization and storage (CCUS), reductions in methane emissions across the natural gas value chain and energy efficiency in transportation and industry. This funding is on top of each company's own programs on low-emissions technology and will capitalize on the collective resources and expertise of the OGCI's member businesses. OGCI Climate Investments expects to have a multiplier effect by spurring investment from other sources and encouraging members to adopt technology made possible by the fund.






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**INTERVIEW**


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**BILL GATES**

Breakthrough Energy Ventures

**“Industry partners like Total understand the energy business better than anyone else.”**

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**At a time when reducing greenhouse gas emissions is a global priority, Bill Gates has launched Breakthrough Energy Ventures (BEV), a billion-dollar investment fund. It will finance cleaner technology to produce low-carbon energy. We will be mobilizing our expertise in support of this new initiative, and have been recognized as a technological and strategic partner to BEV.**

**What makes BEV special and why could it become a key enabler for the future of energy?**

It’s hard to get any new technology from the lab to the market. It’s especially hard with energy, because energy systems are so slow to change and the incentives aren’t always there. It takes a combination of scientific vision and practical experience building companies. BEV is unique because it has both the vision and the experience. It’s assembling a team of multidisciplinary scientists and entrepreneurs to identify the ideas that are most promising, technically and commercially. BEV is also bringing together a unique mix of risk-tolerant and patient investors who are committed to accelerating the commercialization of new energy technologies. Our investors are knowledgeable and experienced, and they bring extensive contacts in energy and related fields. BEV is eager to partner with research institutions and companies — like Total — that are delivering reliable and affordable energy so it can uncover the most promising technologies.

**What do you expect from Total as a strategic partner to your initiative?**

Industry partners like Total understand the energy business better than anyone else. They know how to deliver energy solutions reliably and affordably at scale, and they have the infrastructure to do so. In many cases I expect that industry partners will help scale and deliver the new technologies that BEV companies discover and develop. And I hope they will provide insight into which new technologies are most likely to succeed in the market.

**What could private companies, in particular in the energy world, do better to support the fight against climate change?**

By 2050, the world will be using 50% more energy than it does today, and it will need to meet that demand with sources that don’t contribute to climate change. That’s a big challenge, but we can do it if the world gets some big breakthroughs. Governments, research institutions, businesses, and private investors all have a role to play. For the private sector, that means taking great research, turning it into a great product, and creating a great company to bring a transformative technology to market. That’s a vital piece of the solution that no other part of our society can provide. I encourage government leaders to raise R&D budgets, but the issue always needs more advocates making the case. So in addition to being partners in the work itself, energy companies can be great champions for governments investing in energy R&D.

# Taking Action Today

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Mindful of the part we play, we take action across our value chain to reduce our impact on the climate and promote the responsible use of energy.

What actions have we already implemented?

Where do we stand in relation to our objectives?

How are we taking into account the implications of the 2°C scenario for the oil and gas market?

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2°C ROADMAP

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# Integrating Climate Into Our Strategy

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## Improving the Carbon Intensity of Our Current Production Mix

- PP. 24-28 Deploying an assertive strategy in gas, while strictly limiting methane emissions
- P. 30 Selecting and developing safe, environmentally responsible, competitive oil and gas projects
- P. 29 Innovating and expanding in carbon capture, utilization and storage technologies
- P. 14 Publicly supporting the implementation of carbon pricing mechanisms
- P. 30 Exiting the coal business
- PP. 16-17 Encouraging sector initiatives and collectively engaging to address climate issues



## Developing Renewable Energies

P. 34 Growing as a leading solar player by expanding our activities along the photovoltaic chain, including distribution

P. 36 Adding energy storage to our businesses

P. 37 Developing bioenergies

P. 35 Promoting access to energy



## Improving Energy Efficiency

PP. 23 and 38 Continuing our efforts to reduce greenhouse gas emissions at our facilities

P. 38 Providing solutions (products and services) to encourage responsible energy use by our customers

### FOCUS ON TRANSPORTATION

Global warming, coupled with changing technology and usage, is irrevocably altering every form of transportation. From cars and trucks to maritime and air transportation, we have demonstrated a long-term commitment to finding concrete solutions.

PP. 39-44



OUR PRODUCTION MIX FOR 2035

# An Ambition Consistent with the 2°C Scenario

Integrating climate issues into our strategy goes beyond reducing emissions at our facilities. It also involves gradually decreasing the carbon intensity of our production mix. We take the 2°C scenario into account in our strategy.

To do this, we compare the change in the carbon intensity of our projected growth profile for primary energy production to the change under the 2°C scenario.

The carbon intensity of our primary energy production mix, expressed in tCO<sub>2</sub>/toe, is the ratio between:

- Carbon emissions attributed to the energies in that production mix.
- Production of those energies in response to global energy demand.

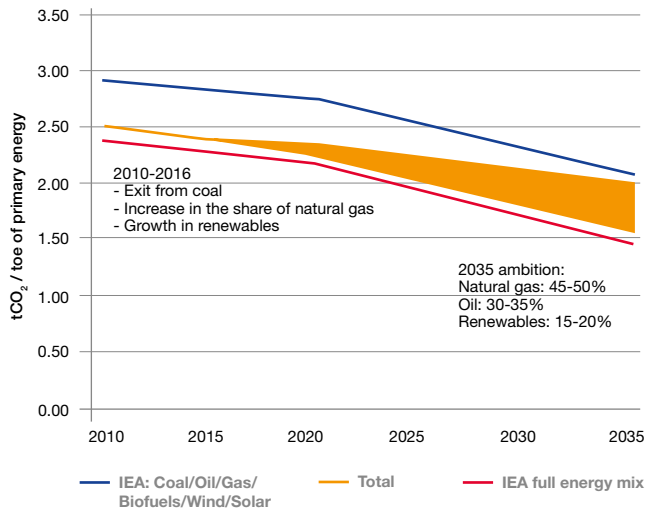
According to the IEA in its *World Energy Outlook 2016*, all CO<sub>2</sub> emissions are attributable to fossil fuels.

To calculate the carbon intensity of Total's energy production mix, we use an emissions factor specific to each type of primary energy, calculated on the basis of IEA data. That emissions factor represents the ratio of CO<sub>2</sub> emissions to production of the type of energy in question.

## Promoting Low-Carbon Businesses

Our objective is to encourage the production of natural gas over oil and to grow our share of low-carbon businesses: midstream and downstream gas, renewable energies and energy storage, energy efficiency, clean fuels and carbon capture, utilization and storage (CCUS)

**Carbon Intensity of Total's Energy Mix Compared With That of the IEA's 2°C Scenario**



The bottom curve shows the trajectory of the global energy mix as a whole.

The top curve shows the trajectory for energies that are comparable to our business (coal<sup>1</sup>, oil, natural gas, solar, wind and biofuels).

Our 20-year ambition is to gradually reduce the carbon intensity of the energy we produce and deliver to customers, through continued growth in natural gas and renewables.

<sup>1</sup> Coal was removed from Total's energy mix in 2015, but is often compared to natural gas.

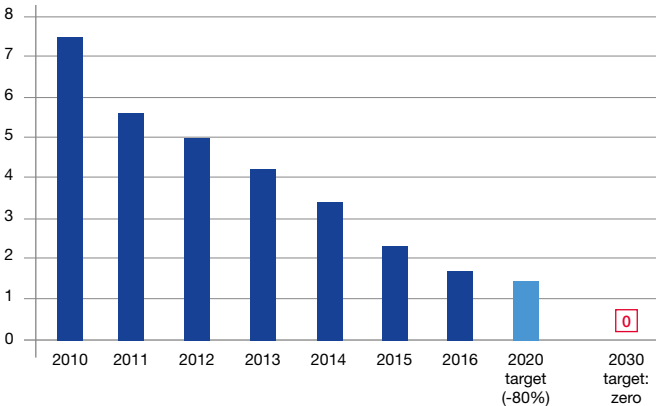
OUR OPERATED SCOPE

# Greenhouse Gas Emissions Down 23% Since 2010

For more than a decade, we have published our improvement objectives and accomplishments. This transparent reporting, backed by multiple assessment tools, includes information on the results obtained, any difficulties encountered and our future actions.

In 2016, our direct greenhouse gas emissions amounted to 39 MtCO<sub>2</sub>-eq in our operated scope, down 23% from 2010. Of that total, 48% came from our Exploration & Production segment and 51% from our Refining & Chemicals segment. Our Marketing & Services segment accounted for around 1%.

### Routine Flaring (Mcu. m/d)

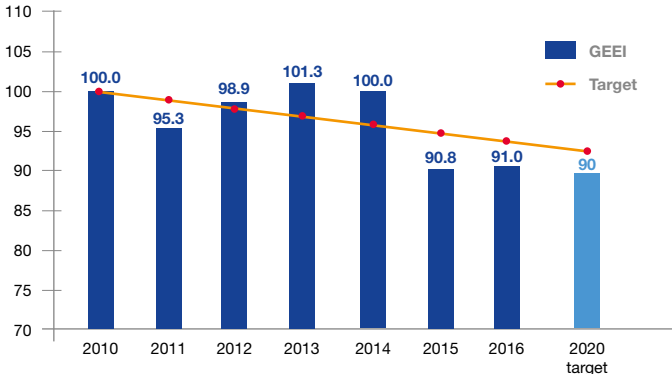


We continue to cut greenhouse gas emissions in our operated scope by focusing on two main areas.

First, we are reducing routine flaring in our production activities. In 2000, we pledged that this practice would be eliminated in new developments.

A member since 2002 of the Global Gas Flaring Reduction (GGFR) Partnership, we worked with the World Bank to create and launch the Zero Routine Flaring by 2030 initiative bringing together oil and gas companies, producing countries and international institutions to support flaring reduction. We were the first company to adhere to the initiative, in 2014. The interim objective is to reduce routine flaring by 80% from the 2010 baseline over the period 2010-2020.

### Group Energy Efficiency Indicator (GEEI)



Improvements in energy efficiency represent a further source of emissions reduction.

In early 2016, we set a new target of an average 1% per year improvement in the energy efficiency of our facilities from 2010 to 2020, despite the increasingly complex operating environment.



# Natural Gas, the Key Energy Resource for Fast Climate Action

**Natural gas — an abundant energy source — is the best option currently available for combating climate change while ensuring the world has access to the energy it needs. Already accounting for nearly 50% of our energy mix, natural gas is at the heart of our ambition to be the responsible energy major.**

## A Solution for Today

Natural gas plays an important role in the optimal energy mix envisaged in the IEA's 2°C scenario. While the share of oil and especially coal in the global energy mix is expected to diminish between now and 2035<sup>1</sup>, natural gas will boost its share of the total to 23%, driven by an approximately 15% increase in volume.

The reason is that natural gas emits fewer greenhouse gases (GHG) than any other fossil fuel. According to a CIRAIG<sup>2</sup> study, life cycle GHG emissions from gas during power generation are less than half those of coal.

Moreover, given its abundance and availability — the current reserve life is estimated at more than 200 years — natural gas is a vital adjunct to growth in renewable energies, inherently intermittent resources.

But while natural gas is the backbone of the 2°C scenario, it cannot be used to its full potential unless certain environmental risks — such as the methane emissions connected with its production and transportation — are mitigated. We are wholly committed to addressing this major environmental challenge, and are sharing our expertise through our role in the Climate & Clean Air Coalition, promoted by UN Environment.

## Milestones

**2005-2015**

Natural gas rises from 35% to nearly 50% of our production mix.

**2015**

We cease all coal production operations, following the August sale of our affiliate Total Coal South Africa.

**2016**

We discontinue our coal marketing operations.

**2016**

We acquire Lampiris, Belgium's third-largest natural gas and power supplier.

<sup>1</sup> Oil is forecast to decline from 31% to 25%; coal, from 28% to 16%. Source: IEA, *World Energy Outlook 2016*.

<sup>2</sup> "Life Cycle Assessment of Greenhouse Gas Emissions Associated with Natural Gas and Coal in Different Geographical Contexts," October 2016.

Published by the International Reference Centre for the Life Cycle of Products, Processes and Services (CIRAIG), Polytechnique Montréal engineering school.

### Supplying Affordable, Clean Energy

To supply the clean energy the world needs, we are continuing to expand our gas production and liquefaction capacity, which has doubled over the past decade to position Total as a global leader in liquefied natural gas (LNG). We are making a substantial, ongoing investment in projects designed to further boost our production of natural gas. By 2035, gas could comprise as much as 60% of our overall output.

Concomitant with our investment in production and liquefaction capacity, we are taking steps to expand reliance on this clean, reliable energy source by making it increasingly affordable worldwide. That includes, striving to reduce technical and logistical costs to make natural gas a more competitive option.

We are also investing downstream in the gas value chain so as to keep pace with growing demand. In keeping with our strategy of fully integrating all our activities, we are developing new midstream and downstream businesses that carry gas all the way to residential end users. With our 2016 acquisition of Lampiris, we now market gas and power to 1 million European consumers; through our 2017 acquisition of PitPoint, we are the leading provider of natural gas vehicle fuel in Europe. In emerging marketplaces that have substantial electricity needs but still face sizable challenges in reducing their carbon emissions, we are expanding access to increasingly competitive natural gas through our newly deployed floating storage and regasification units (FSRUs).

**Three major projects in operation in 2017:**

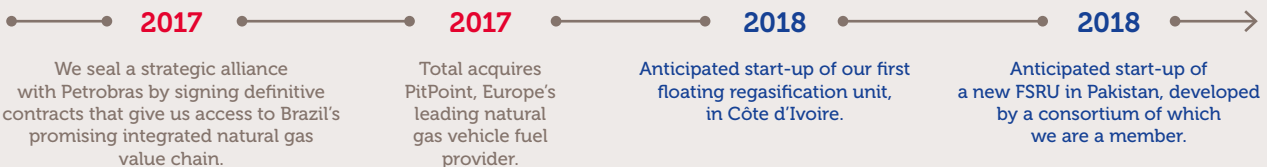
**Ichthys LNG, Australia  
9 Mt/year**

**Gladstone LNG, Australia  
7.2 Mt/year**

**Yamal LNG, Russia  
16.5 Mt/year**

**An LNG pioneer, we are now the world's second-largest private LNG operator.** We expect to increase production from 11 million tons in 2016<sup>1</sup> to 20 million tons in 2020. Integrated across the value chain, from production through marketing, we have interests in 11 liquefaction plants and reserved regasification capacity in five terminals worldwide.

<sup>1</sup> Total's equity production.







# Switching to Natural Gas from Coal for Power Generation

**A CIRAIG<sup>1</sup> study has confirmed that natural gas produces fewer carbon emissions than coal during power generation, and that gas-fired power plants offer superior efficiency as well. Coupled with added operational flexibility, that makes gas a more competitive option for producing electricity.**

When burned to produce electricity, natural gas emits 50 to 60% less carbon dioxide on average than coal. That's a marked advantage in the fight against climate change, but one that has often been downplayed when weighed against the related methane emissions or energy used for liquefaction, transportation and regasification.

So in 2015, we asked CIRAIG — an independent research organization with special expertise in this issue — to perform a comparative life cycle assessment of the various gas and coal supply chains used in power generation.

CIRAIG's final report, based on its analysis of emissions at each step in the chain from extraction to consumption, was published in October 2016. It found that greenhouse gas emissions from the use of natural gas were, on average, half those of coal, even in the case of unconventional gas. Thus, replacing coal with natural gas in power production worldwide would prevent 5 Gt of CO<sub>2</sub>-equivalent worldwide, or 10% of anthropogenic global emissions.

In addition, gas-fired power plants on average have a much faster restart time and can build up to full capacity twice as quickly as coal-fired plants. These advantages make natural gas an obvious partner for renewable energy, until the latter's variability can be offset by power storage capacity.

## THE CIRAIG LIFE CYCLE ASSESSMENT, A CERTIFIED STUDY

The CIRAIG Life Cycle Assessment is ISO 14040 and 14044-certified. In other words, it was critically reviewed by independent, third-party examiners (experts and manufacturers) before being published.

Method: CIRAIG estimated life cycle emissions of CO<sub>2</sub>-equivalent for several production processes covering a large portion of our gas business (conventional and unconventional, onshore and offshore, LNG, etc.) and compared them with life cycle emissions for eight of the most common coal processes. It also conducted sensitivity analyses, notably on methane's global warming potential, that confirmed the results indicated here.

<sup>1</sup> "Life cycle assessment of greenhouse gas emissions associated with natural gas and coal in different geographical contexts," October 2016. Published by the International Reference Centre for the Life Cycle of Products, Processes and Services. <http://www.ciraig.org/en/v.php?id=450&locale=en&year=2016&type=2>

# Investigating and Strictly Limiting Methane Emissions

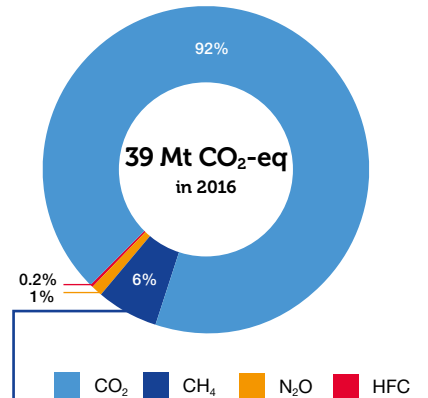
**Methane is a greenhouse gas with a higher global warming potential (GWP) than carbon dioxide. As a major player in the gas industry, we at Total are taking steps to measure and mitigate methane emissions more effectively.**

Unlike CO<sub>2</sub> emissions, which originate from a variety of combustion processes, methane is released into the atmosphere primarily when energy is lost or discharged for safety reasons. As a result, methane emissions are easier to mitigate, provided those losses can be identified, measured and addressed.

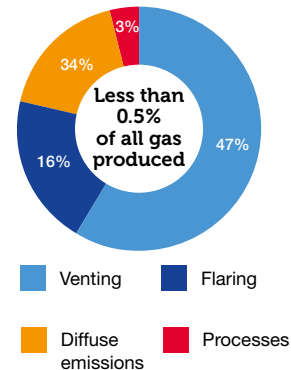
So we're taking action, first by mobilizing in the field to educate employees and to detect and reduce methane emissions in our operated scope. In this way, we kept them below 0.5% of the natural gas produced in 2016. We've also joined campaigns beyond our walls: for several years we have been an active participant in international initiatives designed to improve methods of measuring and mitigating methane emissions.

For example, Total is acting to eliminate routine flaring by 2030 as part of the World Bank's Global Gas Flaring Reduction (GGFR) Partnership. As a member of the Climate & Clean Air Coalition (CCAC), we are also participating in the Oil & Gas Methane Partnership<sup>1</sup> to promote more effective measurement, mitigation and reporting of methane emissions. Through our founding membership in the OGCI, we are lending financial support for studies on emissions measurement systems as well as for new technology — backed by the organization's new Climate Investments fund — for moving from indirect to more accurate direct measurements of methane emissions.

**Total's GHG emissions (operated scope)**



**Direct methane (CH<sub>4</sub>) emissions associated with Total's gas production (operated scope)**



## 420,000 tCO<sub>2</sub>-eq

The total reduction in methane emissions in 2015 thanks to measures adopted by the members of the Oil & Gas Methane Partnership.

### Milestones



<sup>1</sup> Alongside BP, ENGIE E&P, Eni, Pemex, PTT, Repsol, Southwestern Energy and Statoil.



# Providing Affordable Natural Gas

**As a plentiful resource with low emissions, natural gas can meet the growing demand for electricity while helping numerous countries respond to climate concerns. To bring natural gas to the widest possible market at an affordable price, we are now developing several floating storage and regasification units (FSRUs) for LNG, which reduce costs substantially and help bypass logistical constraints.**

Once extracted, natural gas must be transported to consumer markets that are often far removed from the production site. In recent years, liquefied natural gas (LNG) — a sector in which we have long been a leader — has offered a solution to these logistical constraints. By cooling the gas to  $-163^{\circ}\text{C}$ , it can be liquefied and then shipped by LNG carrier to regasification terminals connected to local distribution networks, anywhere in the world.

For countries that lack a domestic supply of natural gas and cannot invest heavily in land-based terminals, we are currently developing floating storage and regasification units, known as FSRUs. These units, moored to a docking facility or out at sea, can be built new or by converting former ships, such as LNG carriers.

The cost and environmental footprint of such a unit, not to mention its time-to-deployment, are significantly reduced by comparison with an onshore terminal. It takes one to three years to implement a floating solution, versus four to six to build a land-based facility.

In Côte d'Ivoire, we will be helping to deploy an FRSU that, for the first time, Total itself will operate. Once the unit starts up, currently set for mid-2018, we can address the country's skyrocketing energy demand<sup>1</sup> while helping it meet its environmental commitments and become West Africa's first regional LNG import hub.

## A STRATEGY BUILT ON PARTNERSHIP

In Côte d'Ivoire, we will be a member of the CI-GNL consortium alongside national companies PetroCI and CI-Energies as well as SOCAR, Shell, Endeavor Energy and Golar.

For a separate FSRU project in Pakistan, we have joined forces with Høegh LNG, Qatar Petroleum, Mitsubishi and ExxonMobil to import LNG.

## A FAST-CHANGING LNG MARKET

More than 20 units are already in operation and nearly 70 projects are currently under consideration worldwide, with a third of those considered highly likely. FSRUs are experiencing a boom and shaking up the LNG market by enabling countries to move quickly and set up new import channels precisely where energy demand is most acute.

<sup>1</sup> Demand for electricity in Côte d'Ivoire is growing by 10% annually, and power generation will double between now and 2020.

# CCUS, Critical to Carbon Neutrality

**Technology for carbon capture, utilization and storage (CCUS) plays a vital role in the International Energy Agency's 2°C scenario. We share that view and are preparing a strategy to encourage advances in CCUS technology, both on our own and through partnerships.**

In its 2°C scenario, the IEA assumes that 6 billion tons of carbon will be captured and stored each year by 2050. CCUS technology will be critical for meeting that goal and indeed for achieving carbon neutrality during the second half of the century. In the wake of COP21, 10 countries to date have integrated CCUS into their climate regulations, including four countries in the Middle East: the United Arab Emirates, Saudi Arabia, Iran and Bahrain; several other major energy producers: Norway, Canada and South Africa; and the world's biggest emitter of CO<sub>2</sub>, China. There is widespread awareness of the issue, but technological progress is essential if CCUS is to fulfill its critical role in the IEA's 2°C scenario.

We have been actively involved in this field for many years and routinely examine any opportunity for storing or reusing our CO<sub>2</sub> emissions. Conducted between 2010 and 2013, the Lacq pilot project involved oxy-fuel combustion capture followed by storage in a converted reservoir. It helped us gain relevant expertise, notably in designing a formal approval process for carbon storage. Today, we are stepping up our efforts to treat our own emissions while we also develop solutions that can be applied in other sectors, such as power generation, cement manufacturing and steelmaking. Accordingly, our R&D budget for CCUS has tripled in just two years and is expected to eventually account for 10% of our overall R&D budget, excluding specialty chemicals R&D.

Our CCUS R&D strategy is two-pronged. One goal is to improve existing technology in order to take quick, concrete action; the second is to pursue upstream research that could ultimately yield innovative new solutions that are significantly more cost-effective and less energy-intensive.

To cultivate these innovations, we have forged multiple partnerships with universities and industry, and will continue to open up our CCUS R&D. That commitment includes participation in the Oil & Gas Climate Initiative, which brings together 10 of the world's largest oil and gas companies. OGCI Climate Investments will earmark approximately half of its funding for CCUS technology. In 2017, we signed a Memorandum of Understanding (MOU) with Norway's Ministry of Petroleum & Energy, Shell and Statoil to join that country's Technology Centre Mongstad. Operated by state-owned Gassnova, the center has a capacity of 100,000 tons of carbon a year. It also has industrial-scale facilities to improve carbon capture processes and make them more reliable, while cutting their costs and environmental impacts to ensure the technology can be brought to market quickly.

In addition to developing more advanced, cost-effective technology, we need to create the conditions in which CCUS can thrive. In other words, we must convincingly demonstrate the value of CCUS and propose support mechanisms to ensure further progress. For that purpose, collaboration — both between the public and private sectors and across industries — is essential, and our participation in the OGCI is consistent with that agenda.

## Milestones

1996

Norway's Sleipner project, in which Total is a partner, represents the natural gas industry's first major advancement in carbon capture.

2010-2013

We conduct the Lacq pilot project, which involves oxy-fuel combustion capture followed by storage in a depleted reservoir.

2014

The OGCI is established and expects to allocate roughly half of its Climate Investments (created in 2016) funding to CCUS technology.

2017

We are preparing to conduct carbon storage engineering after a call for tenders for an industrial-scale project in Norway.



# A Resilient Portfolio

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**Oil and gas — expected to meet over 40% of the world’s primary energy needs in 2035 — remain a cornerstone of the IEA’s 2°C scenario. While always mindful of that prospect, we maintain a resilient business portfolio.**

We prioritize our projects as part of our growth strategy, focusing on competitively priced production and processing assets that meet the highest safety and environmental standards. This outlook is simultaneously strategic and responsible, rooted in an agile organization committed to providing energy that is cost-effective (in terms of production, marketing, etc.), reliable and clean.

On that basis, in 2015 we decided to reduce our exposure in Canada’s oil sands, which are costly to develop and operate. In addition, we exited coal production in 2015 following the sale of our affiliate Total Coal South Africa and discontinued all coal marketing activities in 2016. We also chose to withdraw from China’s coal-to-olefins (CTO) project for producing plastics from coal, since it was no longer consistent with our ambition. As well, given the high costs involved, Total has ruled out any future oil exploration operations in the Arctic ice pack.

Furthermore, to ensure the viability of our projects and our long-term strategy with regard to climate change issues, we apply an internal, long-term carbon price of \$30 to \$40, depending on the oil price scenario or the actual price if it is higher in a given country, when evaluating our investments. This is consistent with our support for initiatives to replace coal with natural gas in power generation and our investment in R&D on low-carbon technologies.

## GREATER SELECTIVITY IN OIL PROJECTS

“The Stone Age came to an end, not because we had a lack of stones, and the oil age will come to an end not because we have a lack of oil.”

**Sheikh Ahmed Zaki Yamani,**  
former Saudi Oil Minister, in an  
interview with the *Daily Telegraph*  
published on June 25, 2000

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## \$30 to \$40 per ton

This long-term carbon price, applied worldwide, would have an impact of around 5% on the discounted present value of Total’s upstream and downstream assets<sup>1</sup>.

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<sup>1</sup> Sensitivity calculated for a crude oil price of \$60 to \$80, compared to a reference scenario based on a carbon price in regions already covered by a carbon pricing scheme and, effective from 2021, worldwide.

## Facilities That Can Withstand Natural Disasters

The models produced by the Intergovernmental Panel on Climate Change (IPCC) anticipate increasingly significant natural impacts over the coming decades as the global temperature gradually increases. We assess the vulnerability of our facilities to these events, which include rising sea levels, hurricanes, flooding and droughts.

In accordance with generally accepted practices, we take the risk of natural disasters into account when designing industrial facilities. These risks can be climate-related; they can also include seismic, tsunami, soil strength and other risks. Meteorological and, where applicable, oceanographic measurements taken on site are supplemented by satellite data and climate models. These data are used to develop statistics describing normal operating conditions and extrapolate extreme, centennial and over 10,000-year conditions. Facilities are designed to withstand both normal and extreme conditions, by building in appropriate safety margins.

In addition, our internal procedures specifically call for the systematic assessment of the possible repercussions of climate change on our future projects. In-depth studies are carried out when the potential risk is significant relative to the existing safety margin. Our analyses include a review by type of risk — sea level, storms, temperature change and melting permafrost, among others. They also take into account the life span of our projects and their capacity to gradually adapt. To date, these studies have not identified any facilities that cannot withstand the consequences of climate change.



With our partners, we also conduct studies focusing on a given region or topic. For example, through the CASE<sup>1</sup> consortium, we took part in a study led by RPSEA<sup>2</sup> on how climate change affects hurricanes in the Gulf of Mexico. We are also involved in the European Union CLIM4ENERGY project to investigate the potential effects of climate change on our North Sea platforms.

Additionally, we lead an IPIECA<sup>3</sup> task force focused on best practices and adapting oil and gas facilities to climate risk. In April 2017, the task force hosted a roundtable discussion among experts from a range of industries. Their aim was to examine various aspects of the issue, from climate change to water resources, biodiversity and civil liability. This strategy of wider dialogue helps us identify best practices and enhance our internal policies.

1 Climatology and Simulation of Eddies Joint Industry Project.

2 Research Partnership to Secure Energy for America.

3 The global oil and gas industry association for environmental and social issues.



# Low-Carbon Businesses to Become the Responsible Energy Major

**We are taking steps to gradually reduce the carbon intensity of our energy production mix, and our ambition is to have low-carbon businesses make up close to 20% of our portfolio in 20 years' time.**

## Sharply Rising Demand for Electricity

In light of demographic growth and the determination to develop new solutions and practices in response to climate change, demand for electricity will outpace overall energy demand in the two decades to come. We have several low-carbon options available for meeting that need and at the same time reducing reliance on coal — the most carbon-intensive fossil fuel — and complying with the IEA's 2°C scenario. Those options include natural gas, improving energy efficiency and developing renewable energies.

By 2035, renewable energies are expected to make up a much greater share of the energy mix: more than 20%, compared to 9% currently. That trend will be led by a surge in solar and wind power, which could easily help replace coal in power generation, especially with the emergence of high-performance energy storage technology and other solutions for overcoming the intermittent nature of those energy sources.

## Gas, Renewables & Power, the Organization Leading Our Low-Carbon Businesses

We have already recognized these inevitable trends, as our new organizational structure proves. The new Gas, Renewables & Power (GRP) segment

is spearheading our ambitions in low-carbon energy through growth in the natural gas midstream and downstream and in renewable energies, as well as the field of energy efficiency.

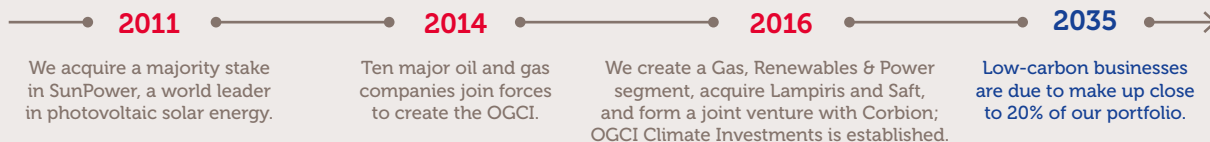
With SunPower and Total Solar (see page 34), we are active across the entire photovoltaic solar value chain, from manufacturing photovoltaic cells to developing utility-scale plants and installing solar home systems. Moreover, in 2016 we acquired Saft, a leading provider of energy storage solutions, and Lampiris, reflecting our strategic expansion in gas and power marketing activities.

In addition, we have made an active commitment to partnerships that will accelerate the emergence of solutions. Our participation in the OGCI together with nine other major oil and gas companies, along with our support for Breakthrough Energy Ventures, launched by Bill Gates, are a testament to that commitment.

### WHAT IS A "LOW-CARBON" BUSINESS?

Total's low-carbon businesses include midstream and downstream gas, renewable energies and energy storage, energy efficiency, clean fuels and carbon capture, utilization and storage (CCUS) technology. We aim to have low-carbon businesses account for close to 20% of our portfolio in 20 years' time.

## Milestones



# Acquisitions That Exemplify Our Low-Carbon Strategy

**Our decision to integrate climate into our strategy is reflected in our recent acquisitions. After an initial major acquisition involving an interest in solar specialist SunPower in 2011, we have announced four transactions since 2016 that reflect our determination to tackle the challenge of climate change from multiple directions.**

The battle against climate change must not only be fought collectively, but also simultaneously on multiple fronts. During 2016 we made several business acquisitions with that objective in mind.

In June 2016, we acquired Lampiris, Belgium's third-largest supplier of natural gas, green power and energy services such as insulation, furnace maintenance, wood and pellets for heating, and smart thermostats. As a result, we are now marketing natural gas and power to consumers (B2C) as well as industrial customers (B2B).

In July we acquired Saft, the world leader in high-tech batteries for industry. The deal complements our presence in solar power and also offers a springboard for our expansion into electricity storage — a prerequisite for growth in renewable energies.

Following these two acquisitions, both indicative of our desire to provide broader access to clean, efficient energy, we announced a joint venture with Corbion in November. That transaction makes us the world's second-ranked supplier of polylactic acid (or PLA, a 100% biobased polymer), and reaffirms our commitment to bioplastics alongside our conventional hydrocarbon-based products.

And in May 2017, we acquired PitPoint B.V., a Dutch company that is Europe's third-ranked provider of natural gas vehicle fuel (see page 43).

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## 1 million+

The number of Lampiris customers.

## 9%

The share of its revenue that Saft allocates to R&D.

## 75,000 tons

The annual production capacity of the PLA polymerization plant operated by the Total-Corbion joint venture in Thailand.

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### TOTAL ENERGY VENTURES, A SCOUT FOR TOTAL

Total Energy Ventures (TEV) identifies opportunities to collaborate with energy start-ups and support their initiatives through equity investment. It's opening the door to innovations that could help us fulfill our top ambition: to supply the world with affordable, reliable and clean energy. Since TEV was established in 2008, it has evaluated some 2,500 companies and invested €150 million in more than 20 start-ups. In January 2017, that record led to our being named Corporate Investor of the Year by the Global Cleantech 100 Program, which recognizes the top 100 most innovative and promising cleantech start-ups.





# Accelerating the Solar Energy Transition

**Abundant, renewable, clean solar energy will be instrumental in the success of the IEA's 2°C scenario. Since our acquisition of SunPower in 2011 and the recent creation of Total Solar, we have been channeling investment toward the deployment of new production capacity and the development of even more efficient technology.**

The ability to meet rising demand for electricity over the coming decades will hinge on the use of renewables to generate power. Solar energy in particular is expected to emerge as the primary source of electricity by 2050, according to the IEA.

Solar has already shown exceptionally strong growth. Installation of new capacity hit a record high in 2016 at 75 to 80 GW, surpassing the record of 58 GW set the previous year. Alongside that rapid surge in capacity, solar power is now more competitively priced: in some regions the tariff can rival that of the most inexpensive sources of power generation.

Governments need to preserve policies that encourage renewables and spark the development of technology to make them more reliable and competitive. At Total we firmly believe in renewable energy, and despite occasional market headwinds we have continued to invest in developing new photovoltaic power generation capacity. That includes SunPower with its utility-scale projects in the United States and Mexico, as well as Total Solar, which is focused on developing and operating solar power production capacity and is already active in South Africa, Japan and Chile.

With our 2016 acquisition of Saft, we are also investing in energy storage technology, essential for integrating renewables into the grid and developing solutions for

distributed generation. That's because photovoltaic solar energy is unique: it offers the prospect of distributed power generation at the point of consumption, without the need for a transmission or distribution grid. We're helping to usher in that paradigm shift with high-efficiency cells for use in new solar home systems connected to smart mini-grids that not only supply cleaner energy, but also help consumers use that energy more wisely.

## EXPANDING THE USE OF SOLAR POWER AT OUR OWN SITES

In the belief that distributed solar energy is the future of power generation, we are investing heavily at our own sites. We have begun installing solar solutions at several dozen industrial sites and 5,000 of our service stations worldwide, a project that will take five years. That's an ambitious objective, encompassing more than 30% of our 16,000 service stations around the world and representing an investment of about \$300 million. For the service stations alone, installed capacity will near 200 MW and carbon emissions will be reduced by 100,000 tons annually. In France, 800 of our retail network's 2,200 service stations will be equipped with solar systems.

## 1.6 GWp

Total has interests in operating renewables-based power plants with a combined capacity of 1.6 GWp.

### Milestones

2011

We acquire SunPower, a global leader in photovoltaic solar energy.

2011

We launch Awango by Total, the first program to market distributed solar PV solutions.

2015

Solar Star, the world's largest photovoltaic power plant with 1.6 million panels and a capacity of 750 MW — enough to supply 255,000 homes — comes on line in California.

2016

We begin installing solar solutions at 5,000 service stations.

# Affordable, Reliable and Clean Energy

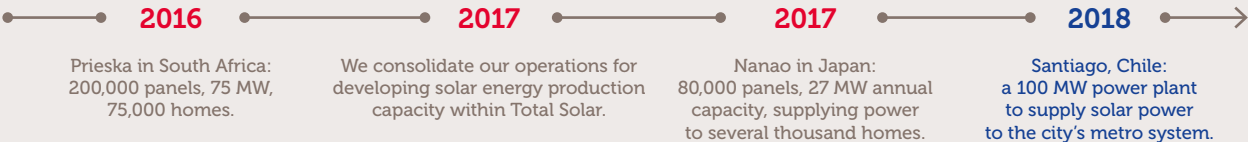
Providing the widest possible access to affordable, reliable and clean energy offers a powerful tool in the battle against climate change. Since 2011 we have been marketing distributed solar solutions that have transformed the day-to-day lives of more than 9 million people in some 30 growth countries, primarily in Africa.

In some parts of the world<sup>1</sup>, access to energy is still an uphill battle. Even when grids exist, they may not extend throughout the region, and the energy they supply is sometimes unreliable.

Addressing that need is part of our climate strategy. Most energy demand will come from countries whose current energy mix is carbon-intensive, because of widespread reliance on biomass and diesel generators.

To meet that challenge, we are helping to create an investment fund that will finance start-ups and innovative initiatives to expand energy access, particularly in Africa. It plans to begin with an initial tranche of \$50 million, which could subsequently be increased to \$100 million. Additional investment is expected from qualified investors such as development banks and other major institutions that share our ambition and standards in terms of offering wider access to affordable, reliable and clean energy.

By 2020,  
those solutions are expected to reach  
**25 million**  
people.



<sup>1</sup> In Africa, 600 million people lack access to energy; worldwide, the number stands at more than 1.3 billion, according to the World Bank (<http://data.worldbank.org/products/wdi>).



# Saft, Offering Industrial Solutions to the Climate Change Challenge

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Saft offers long-term solutions for reducing fossil fuel consumption and carbon emissions. Its Li-ion<sup>1</sup> batteries, for example, are an essential component in smart grids: they help improve power grid management and reduce the energy lost during transmission and distribution — losses that can total between 8 and 15% of the overall power generated.

In addition to being more energy-efficient, smart grids help operators manage production peaks and troughs, a process known as demand response, so that renewable energies — which are variable by nature — can be integrated into the grid more smoothly.

Saft's high-efficiency batteries will also play a critical role in reducing transportation-related carbon emissions by 40% by 2030. Lightweight, space-saving Li-ion batteries can meet the technical challenges posed by hybrid and electric propulsion, not only in urban environments, but also at ports, airports and industrial sites and in shipping. For example, hybrid ships use Seanergy<sup>®</sup> battery systems to handle peak power demand in critical situations and save 25% on fuel at the same time. Saft is also one of the foremost suppliers of batteries for rail projects in Asia, especially China. Through its contract with Chinese rolling stock manufacturer CRRC, Saft supplied the batteries for China's first driverless subway line, in Beijing. Saft currently commands 40% of the battery market for subway systems in Southeast Asia and China, and nearly 20% of the market for high-speed rail networks. It also supplies batteries for electric buses in Gothenburg, Sweden, and Hamburg, Germany (plug-in hybrid vehicles).



<sup>1</sup> Li-ion batteries generate 40% fewer carbon emissions over their life cycle than lead acid batteries, and are designed to meet recycling requirements without compromising performance.

# The La Mède Biorefinery, a Responsible Transformation



## NEW TECHNOLOGY AND A NEW SUPPLY CHAIN

Axens markets the technology developed by IFP Énergies Nouvelles<sup>3</sup> that will be used to produce the HVO; the new site is the first time that the technology is being used on an industrial scale.

Suez will collect up to 20,000 tons of used cooking oil each year from the biggest names in France's food industry for delivery to the La Mède site.

The partnership will increase the amount of used oil collected in France by more than 20%.

**After solar energy, biofuels represent our most important avenue of growth in renewables. Now, after producing biofuels for more than 20 years and becoming Europe's leading biofuels marketer, we are transforming our La Mède crude oil refinery into a biorefinery. Set to debut in 2018, the site will be France's first world-class facility of its kind, with the capacity to produce 500,000 tons of high-quality biodiesel known as HVO.**

The hydrotreated vegetable oil (HVO) produced at La Mède will be derived from used oil<sup>1</sup> and vegetable oil<sup>2</sup>. Its high quality stems from the fact that it contains no oxygen and there are no limitations on its incorporation — unlike fatty acid methyl ether (FAME), which cannot exceed 7% in diesel.

Once its transformation is complete, the site will also produce 25,000 tons of bionaphtha per year, up to 60,000 tons of aviation fuel (avgas) and 50,000 cubic meters of AdBlue<sup>®</sup> additive for trucks, which cuts nitrogen oxide emissions. The complex will be powered by an 8 MW solar farm that uses SunPower technology.

<sup>1</sup> Used oil or waste oil: frying oil, residue from palm oil refining, animal fats, residue from pulp and paper manufacturing.

<sup>2</sup> Vegetable oil: rapeseed, palm, soybean, sunflower.

<sup>3</sup> IFP Énergies Nouvelles: A French public center for R&D, innovation and education in the fields of energy, transportation and the environment.



# Energy Efficiency: Optimizing Energy Consumption

**The ongoing search for gains in energy efficiency will play a decisive role in making the IEA's 2°C scenario a reality. Both at our own sites and through the services we offer our customers, we are developing products and tools for using energy responsibly.**

In early 2016, we set a new target of an average 1% per year improvement in our energy efficiency from 2010 to 2020. Since 2010, our energy efficiency has improved by nearly 9%.

We are also pursuing ISO 50001 energy management certification as a mark of our energy cost control. In 2015, our Leuna refinery in Germany obtained certification, as did several Marketing & Services sites: the Brunsbüttel bitumen plant in Germany and, in France, the Solaize research center, the Saint-Martin-d'Hères site, and seven depots and 193 service stations. In the Exploration & Production segment, Total ABK in Abu Dhabi was certified in early 2016. And at each exploration and production site we are stepping up our efforts by reducing routine flaring in our production activities.

## Innovation on Behalf of Our Customers

We have developed a comprehensive array of services to help our customers manage their energy use more effectively. These offerings draw on the expertise of our affiliates that specialize in energy efficiency: BHC Energy in France and TENAG in Germany. As a result, we can offer services and solutions that include energy audits, leading energy efficiency investment projects, installing smart energy systems to manage and reduce consumption, and leveraging demand response capacity. Our recent purchase of a stake in AutoGrid (see sidebar) will further expand our range of services.

We capitalize on innovative tools for monitoring power consumption and consolidating energy performance. At our Normandy site, for example, we have introduced CBE, software designed by ProSim as part of the

ADEME<sup>1</sup>-Total Program. We are also assisting with obtaining ISO 50001 certification. Similarly, our offerings now include DIESTA, a compact compressed air-cooling technology developed by a consortium made up of Kelvion, Wieland and Technip. Its use reduces installation costs and enhances energy efficiency.

In addition, energy management demands quality products. Total Excellium fuels keep engines cleaner, reducing air pollutant and carbon emissions. The entire lineup has been awarded the Total Ecosolutions label. Our Fuel Economy lubricant range improves fuel efficiency by decreasing friction between engine parts.

Advances in energy efficiency come in a variety of forms, from products and services to digital solutions.

## DIGITAL SOLUTIONS FROM AUTOGRID

Total Energy Ventures, our venture capital arm for investing in start-ups, acquired a stake in AutoGrid in 2016. The California-based company has developed a suite of energy internet applications that can balance connected distributed energy resources, identify and prevent problems, and optimize consumption by meters, water heaters, electric vehicle (EV) chargers and other equipment.

# 7%

The reduction in our net primary energy consumption between 2010 and 2016.

# Focus on Transportation

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Global warming, coupled with changing technology and usage, is irrevocably altering every form of transportation.

From cars and trucks to maritime and air transportation, we have demonstrated a long-term commitment to finding concrete solutions to reduce the environmental and health consequences of today's transportation options.

# Transportation: Offering a Balanced Response to New Challenges

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**Climate change, the rise of new consumer habits and services, growth in electric vehicles — mobility is evolving in far-reaching ways that make it a key component of the 2°C scenario outlined by the IEA.**

The realm of transportation is evolving almost beyond recognition, driven by three underlying trends. The first is **climate change** and the need to combat global warming by reducing carbon emissions. Closely intertwined with that concern is the challenge to health posed by worsening air quality in a growing number of regions worldwide. In response, governments have imposed quantified targets on the auto industry to improve engine fuel efficiency and reduce pollutant emissions. Those measures, applicable to every new vehicle in the market, have yielded sharp reductions in average fuel consumption as well as new powertrain technology (electric, natural gas, hydrogen) designed to minimize the impact on the environment.

Moreover, governments are promoting ecofriendly policies by adopting stringent local standards, such as California's zero-emission vehicle program, or by implementing travel demand management, especially in large cities, with measures that include congestion pricing, road space rationing and bans on older cars. Major urban centers, which suffer acutely from congestion as well as industrial and automotive pollution, are in the forefront of efforts to find more sustainable forms of transportation. While such policies are especially visible in the area of road transportation, they have counterparts in maritime and air transportation as well (see following pages).

Another critical factor is the **emergence of new forms of transportation**, driven by the large-scale embrace of information technology. More than just passing trends, these new options are revolutionizing consumer practices, as the traditional model of car ownership is supplanted by an array of transportation services. They include ride sharing (BlaBlaCar) and ride hailing (Uber) — services that reduce the number of cars on the road but not necessarily the number of miles driven.

Meanwhile, **new technology and the explosion in big data** herald the arrival of connected cars, which are radically changing conventional wisdom about automobiles. They include a host of services that mine driving data to analyze user needs; for example, drivers can be offered lower insurance premiums based on their driving statistics. Other features include geolocation services and the use of digital technology to aid drivers. The culmination of this trend is self-driving cars, an idea whose time has come. They won't be adopted on a large scale until we see major regulatory changes and broader consumer acceptance. But the technology is mature, and a market is taking shape.

**We at Total are playing a key role in this fast-changing environment**, by providing automakers with extremely energy-efficient products, quality services and innovative materials, by developing alternative fuels, and by supporting the wider use of electric vehicles (see following pages).

## Electricity and Oil: Partners in Energy

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Although they still represent just 0.1% of all cars on the road today, these are boom times for electric vehicles. Their success can be attributed to the steadily dropping price of batteries coupled with an increased driving range, not to mention regulatory requirements that mandate lower emissions for new vehicles.

Under the IEA's 2°C scenario, there could be as many as 450 million electric cars<sup>1</sup> in use worldwide by 2035, representing 25% of cars on the road and 39% of sales. Over the same time period, the number of cars in the world is expected to increase to 1.8 billion vehicles, compared to 1 billion in 2016.

Based on figures from the IEA, we estimate that in 2016 transportation consumed approximately 55 million barrels of oil per day. Under the 2°C scenario, the shift to electric vehicles would reduce demand for oil by some 4 million barrels per day by 2035. That's a significant decline, but on its own it will not offset rising demand for petroleum products led by more cars on the road, especially in emerging marketplaces; the higher number of trucks and buses; and expanded air and sea traffic. So efforts must continue to improve engine energy efficiency and increase the use of alternative fuels, including natural gas. With help from our quality products and R&D, we intend to play a prominent role in this transition to more sustainable transportation.



<sup>1</sup> Battery Electric Vehicles (BEVs) and Plug-In Hybrid Electric Vehicles (PHEVs).



# Our Initiatives

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**From passenger cars to buses, trucks and maritime transportation, how are we demonstrating our commitment to reducing the environmental and health consequences of today's transportation options? Here's a round-up of recent progress and areas of R&D.**

## Passenger Cars: The Synergies Between Internal Combustion Engines and Electric Motors

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### Improving Energy Efficiency in Existing Cars

There are currently more than 1 billion internal combustion vehicles on the road worldwide. It's unrealistic to assume those engines could be replaced with other energy sources overnight. Therefore, improving internal combustion engine performance is shaping up as a major challenge.

Total Excellium fuels, which have earned the Total Ecosolutions<sup>1</sup> label, are helping to improve the existing fleet of these vehicles. Enhanced with our specially engineered additives, Total Excellium products offer average energy savings of 1.1 to 2.7%, depending on the vehicle, and corresponding reductions in carbon emissions. These fuels are currently available in 57% of our service stations around the world — that's more than 9,000 of our 16,000 retail outlets.

Total also develops and markets lubricants for the manufacturing and automotive sectors. Products with the Total Ecosolutions label can reduce consumption by anywhere from 1 to 2.2% and thereby passenger car carbon emissions as well.

In addition, biofuels represent an essential tool for quickly cutting carbon emissions from transportation. We have been producing biofuels for more than 20 years and are the top marketer in Europe today.

Elastomers are another available resource. Hutchinson, a wholly owned Total affiliate, has been building expertise in elastomers for 160 years. Its know-how has made

it a world leader in vibration control, sealing and fluid management systems and insulation. That expertise translates to numerous sectors, including the auto industry, a ready market for Hutchinson's proven advancements in weight reduction for aerospace.

Hutchinson also designs innovative materials that collect data or energy, offering the potential for integrated solutions that improve connected car performance and make transportation safer, more comfortable and more energy efficient.

We also encourage ride sharing programs and have signed a partnership with BlaBlaCar in France, offering drivers discounts on car washes or fuel after their first ride share.

### Electric Cars: Constructing a Network

In 2017, electric vehicles will account for more than 0.1% of cars on the road. To encourage that trend, the major sticking point to be addressed is charging stations. Most owners slow charge their electric cars at a private location (home, office, etc.) during a lengthy period of time when they are otherwise occupied. But for occasional long-distance travel that requires an extended driving range, owners will need a much faster charge. As part of our power distribution business, we're aiming to play a visible role in meeting both of these charging needs. In the latter case, we are focusing on building a regional network of 300 outlets across Europe, dotted along major roads and highways: more than 1,000 charging stations in all, located about 150 kilometers apart so as to cover all of France, Germany and the Benelux countries. Electric vehicles will primarily be used for short distances; motorists who typically make longer journeys will continue to choose vehicles with internal combustion engines. So both forms of energy should coexist or work in tandem in plug-in hybrid vehicles.

## Trucks: Natural Gas, a Viable and Accessible Alternative to Diesel

Today's market for trucks and commercial vehicles is dominated by diesel fuel. But new alternatives are already in use, the best of which is natural gas vehicle fuel, recognized as one of the most responsible fossil fuels. Powertrain technologies using this fuel are 50% quieter than diesel engines and compliant with the Euro 6 emission standards for trucks. Natural gas vehicle fuel therefore offers an alternative to diesel for a wide variety of applications in the trucking industry.

Natural gas vehicle fuel comes in two forms:

- Compressed natural gas (CNG), which can be used in any vehicle from passenger cars to trucks; it is especially suited to city buses and garbage trucks, and gives trucks a range of 300 to 550 kilometers.
- Liquefied natural gas (LNG), which is particularly suited to long-haul trucks.

As one of the world's biggest natural gas operators, we have positioned ourselves in this sector and now operate roughly 450 natural gas vehicle fueling stations in Asia, Africa and Europe.

Our first natural gas vehicle fueling station in France opened in July 2017. We expect to open another 15 this year and approximately 10 a year thereafter, under the Total and AS 24 brands (the latter is a Total affiliate that markets fuel to transporters). In May 2017, to expedite our move into this sector, we acquired Dutch firm PitPoint B.V., Europe's third-largest provider of natural gas vehicle fuel with a network of 100 stations. The company is also involved in biogas, hydrogen and electric vehicle charging points for road and maritime transportation. Our goal is to operate 350 outlets by 2022, which will make us the leader in the European natural gas vehicle fuel market.

## POLYMERS FOR CLEANER, LIGHTER-WEIGHT VEHICLES

Polymers are taking on a larger role in the automotive industry, notably as a replacement for other materials. They have the virtue of being both recyclable and lighter in weight. Polypropylene body parts trim 100 kilograms off the weight of a standard vehicle, reducing fuel consumption by 0.4 liters per 100 kilometers and carbon emissions by 10 grams per kilometer. Our products include polymers derived from catalysts, processes and formulations developed in-house. They provide superior performance for both the car's interior and exterior, with cutting-edge properties for creating lighter, slimmer components.

**We have partnered with PSA Group to achieve several breakthroughs that draw on Total fuel and lubricants as well as lighter vehicle bodies designed to cut fuel consumption. One result: a demonstrator that can travel 100 kilometers on just 2 liters of fuel.**

## 3%

The increase in the number of passenger cars worldwide by 2035, according to the IEA. While rates of car ownership have plateaued in the OECD countries, demographics combined with rising aspirations to mobility in Asia and Africa will boost sales.

## Maritime Transportation: Natural Gas to Ensure Regulatory Compliance

International regulations, specifically those of the International Maritime Organization, impose tight restrictions on pollutant emissions in maritime shipping. Our specialized marketing affiliate, Total Marine Fuels Global Solutions, offers a variety of solutions for complying with those restrictions. They include liquefied natural gas (LNG), which offers numerous advantages from an environmental standpoint, including significantly reduced carbon emissions, negligible sulfur oxide (SOx) emissions and substantially decreased nitrogen oxide (NOx) and fine particulate matter emissions.

We aim to build a competitive international LNG bunkering network, and we're securing access to major ports as part of that strategy. Under a memorandum of understanding signed in April 2017, Pavilion Energy will provide Total Marine Fuels Global Solutions with LNG that it can supply to its marine fuel clients in the port of Singapore. We have also concluded an agreement with Brittany Ferries to provide its newbuild LNG ferry with LNG bunker. In addition, we have signed a memorandum of understanding with CMA CGM, the world's third-largest shipping company, to broaden its current fuel supply to include a complete line of multifuel solutions, including fuel oil with a sulfur content of 0.5%, fuel oil with a sulfur content of 3.5% for ships equipped with exhaust gas cleaning systems, or scrubbers, to reduce polluting emissions before they are released to the atmosphere, and LNG.

**Incorporating 1% biojet for flights worldwide would require 2.5 million tons of biojet fuel per year, or five facilities on the scale of La Mède.**

## Air Transportation: Biojet Fuel for Scheduled Flights

Between now and 2030, the number of air passengers is likely to double from 3 billion to 6 billion per year<sup>1</sup>. To combat climate change, the air transportation sector has set a goal of halving its net greenhouse gas emissions from the 2005 baseline by 2050. Biojet fuel will ultimately be critical for meeting that goal, along with other drivers including load factor and engine efficiency.

We have ambitious research programs under way in this area, with Amyris and BioTfuel, among others. We have also taken part in a number of demonstration programs, including Air France's Lab'line for the Future flights between Paris and Toulouse and flights to deliver Airbus A350s to Cathay Pacific. By 2018 we expect to be able to produce biojet from hydrotreated vegetable oil (HVO) at our La Mède biorefinery, which will have a capacity of 500,000 tons a year.

### HYDROGEN COUNCIL: JOINING FORCES TO PROMOTE HYDROGEN

Hydrogen offers vast potential as an energy carrier: it can be used to produce storable energy and emits zero carbon emissions when used as a fuel. We have been actively studying hydrogen for more than a decade. In January 2017, we were one of 13 leading companies from the energy, transportation and manufacturing sectors to form the Hydrogen Council. The goal of the initiative is to place hydrogen at the forefront of the future energy mix. The members of the Hydrogen Council confirmed their ambition to accelerate their investment in developing and commercializing the hydrogen and fuel cell sectors from its current level of €1.4 billion.

<sup>1</sup> International Civil Aviation Organization (ICAO), *Air Navigation Report 2015*.

# Our Figures

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As part of our continuous improvement process, we report our results publicly.

We rely on best reporting practices that make it easier for stakeholders to assess our performance.

# Reporting Frameworks

## Cross-Reference Table<sup>1</sup>

IPIECA Climate Change Reporting Framework	CDP Climate Change Questionnaire (2017 version)	Integrating Climate Into Our Strategy - May 2017, Total	Page
<b>TOPIC 1</b> CLIMATE CHANGE POSITIONS, POLICIES OR PRINCIPLES	CC2.2. - CC2.2a-c	Foreword by Patrick Pouyanné	05
		The 2°C Objective: Challenges Ahead for Every Form of Energy	12
		Oil and Gas Companies Join Forces	16
		An Ambition Consistent with the 2°C Scenario	22
		Natural Gas, the Key Energy Resource for Fast Climate Action	24
		Low-Carbon Businesses to Become the Responsible Energy Major	32
		Transportation: Offering a Balanced Response to New Challenges	40
<b>TOPIC 2</b> RESPONSIBILITIES AND ACCOUNTABILITIES	CC1.1 - CC1.1a - CC1.2 - CC1.2a	Foreword by Patrick Pouyanné	05
		Three Questions for Patricia Barbizet	09
		Integrating Climate Into Our Strategy	20
<b>TOPIC 3</b> STAKEHOLDER ENGAGEMENT APPROACHES	CC2.3 - CC2.3a-f - CC4.1	Carbon Pricing, the Key to Achieving the 2°C Scenario	14
		Oil and Gas Companies Join Forces	16
		Bill Gates Interview	18
<b>TOPIC 4</b> IMPLICATIONS OF SHIFTING ENERGY SUPPLY/DEMAND AND CLIMATE POLICY	CC2.2 - CC2.2a - CC2.2b OG1.7 - OG1.7a	Switching to Natural Gas from Coal for Power Generation	26
		A Resilient Portfolio	30
		Acquisitions That Exemplify Our Low-Carbon Strategy	33
		Accelerating the Solar Energy Transition	34
		Affordable, Reliable and Clean Energy	35
		Safe, Offering Industrial Solutions to the Climate Change Challenge	36
		The La Mède Biorefinery	37
<b>TOPIC 5</b> CORPORATE RISK MANAGEMENT APPROACHES	CC2.1 - CC2.1a-c - CC3.3c CC5.1 - CC5.1a c - CC6.1 CC6.1a-c - OG1.7 - OG1.7a	Focus on Transportation	40
		A Resilient Portfolio	30

<sup>1</sup> The cross-reference table above is based on (a) the Climate Change Reporting Framework of IPIECA (the global oil and gas industry association for environmental and social issues), the pilot version of which was published in December 2015, with the final version to be published during 2017 following the public comment period; and (b) the CDP's Climate Change questionnaire (Total's full response to the questionnaire for 2016 will be published on our website, www.total.com, in early July 2017).

IPIECA Climate Change Reporting Framework	CDP Climate Change Questionnaire (2017 version)	Integrating Climate Into Our Strategy - May 2017, Total	Page
<b>TOPIC 6</b> EMISSIONS MITIGATION STRATEGIES, PROGRAMS, INITIATIVES AND ACTIVITIES	CC3.1 - CC3.1a-e - CC3.2 CC3.2a - CC3.3 - CC3.3a-c CC12.1 - CC12.1a - CC12.2 CC12.3 - CC14.3 - CC14.3a CC14.4 - CC14.4a-b - OG4.1-4.8 OG5.1-5.2 - OG6.1-6.3 - OG7.3 OG7.3a - OG7.6 - OG7.6a OG7.7 - OG7.7a-b	An Ambition Consistent with the 2°C Scenario	22
		Greenhouse Gas Emissions Down 23% Since 2010	23
		Investigating and Strictly Limiting Methane Emissions	27
		Providing Affordable Natural Gas	28
		CCUS, Critical to Carbon Neutrality	29
		Energy Efficiency: Optimizing Energy Consumption	38
<b>TOPIC 7</b> ADDRESSING GHG REGULATION	CC13.1 - CC13.1a-b - CC13.2 CC13.2a	Carbon Pricing, the Key to Achieving the 2°C Scenario	14
<b>TOPIC 8</b> RESEARCH AND DEVELOPMENT	CC3.3c - OG6.3	CCUS, Critical to Carbon Neutrality	29
		Energy Efficiency: Optimizing Energy Consumption	38
<b>TOPIC 9</b> HISTORICAL PERFORMANCE DATA	CC7.1-7.4 - CC8.1-8.5 - CC9.1 CC9.1a - CC9.2 - CC9.2a-c CC10.1 - CC10.1a - CC10.2 CC10.2a - CC11.3 - CC12.1 CC14.1 - OG2.1-2.4 - OG3.1-3.3	Indicators	45
<b>TOPIC 10</b> ASSURANCE	CC8.6 - CC8.6a - CC8.7 - CC8.7a CC8.8 - CC14.2 - CC14.2a	Assurance	Total's Registration Document p. 175

# Indicators

	Unit	2010	2011	2012	2013	2014	2015	2016
<b>SCOPE 1</b> Absolute direct greenhouse gas emissions (operated scope)	Mt CO <sub>2</sub> -eq	51.6	46.3	47.0	46.0	44.3	41.8	39.4
<b>BREAKDOWN BY SEGMENT</b>								
Upstream (E1-C3) <sup>1</sup>	Mt CO <sub>2</sub> -eq	26.0	22.1	23.4	23.5	22.1	19.3	19
Refining & Chemicals (E1-C3)	Mt CO <sub>2</sub> -eq	25.4	24.0	23.4	22.3	22.0	22.3	20.2
Marketing & Services (E1-C3)	Mt CO <sub>2</sub> -eq	0.2	0.2	0.2	0.2	0.2	0.2	0.2
<b>BREAKDOWN BY REGION</b>								
Europe (E1-C3)	Mt CO <sub>2</sub> -eq	25.6	23.8	22.8	22.1	21.2	22.3	19.9
Africa (E1-C3)	Mt CO <sub>2</sub> -eq	16.0	11.9	14.2	14.7	14.2	11.6	12.0
Americas (E1-C3)	Mt CO <sub>2</sub> -eq	3.7	3.9	3.7	3.7	3.8	3.8	3.8
CIS and Asia (E1-C3)	Mt CO <sub>2</sub> -eq	3.7	3.4	3.5	3.6	3.8	3.3	3.7
Middle East (E1-C3)	Mt CO <sub>2</sub> -eq	2.4	3.3	2.8	1.9	1.3	0.8	0
<b>BREAKDOWN BY TYPE OF GREENHOUSE GAS (EXCLUDING HFCs)</b>								
CO <sub>2</sub> (E1-C1)	Mt CO <sub>2</sub> -eq	47.6	43.1	43.5	43.5	41.3	38.9	36.4
Methane – CH <sub>4</sub> (E1-C1)	Mt CO <sub>2</sub> -eq	2.8	2.6	2.8	2.0	2.5	2.3	2.4
N <sub>2</sub> O (E1-C1)	Mt CO <sub>2</sub> -eq	1.2	0.6	0.7	0.5	0.5	0.5	0.4
<b>SCOPE 1</b> Direct greenhouse gas emissions based on equity share	Mt CO <sub>2</sub> -eq	59	53	53	51	54	50	51
<b>SCOPE 2</b> Indirect emissions (E1-S1)	Mt CO <sub>2</sub> -eq	5.4	5.5	4.4	4.3	4.1	4.0	4.0
<b>SCOPE 3<sup>2</sup></b> Other indirect emissions – Use by customers of products sold for end use (E1-S2)	Mt CO <sub>2</sub> -eq	440	430	430	430	430	410	420
Net primary energy consumption (operated scope) (E2-C1)	TWh	157	158	159	157	153	153	146
Group Energy Efficiency Indicator	Base 100 in 2010	100.0	95.3	98.9	101.3	100	90.8	91.0
Total daily volume of flaring (operated scope) (E4-C1) (includes routine, start-up, operational and safety flaring)	Mcu.m/d	14.5	10.0	10.8	10.8	9.8	7.2	7.1
Of which routine flaring	Mcu.m/d	7.5	5.6	5	4.2	3.4	2.3	1.7

<sup>1</sup> The references provided in parentheses refer to the 2015 edition of the Oil and Gas Industry Guidance on Voluntary Sustainability Reporting published by IPIECA, API and IOGP. E(x) refers to an environmental indicator. C(x) refers to a common reporting element. S(x) refers to a supplemental reporting element.

<sup>2</sup> We comply with the petroleum industry value chain methodologies published by IPIECA, which are consistent with those in the GHG Protocol. In this document, only Category 11 of Scope 3 (Use of sold products), which is the most significant, is reported. Emissions for this category are calculated based on sales of finished products for subsequent end use, i.e., combustion of the products to obtain energy. A stoichiometric emissions factor (oxidation of molecules into carbon dioxide) is applied to those sales to obtain a volume of emissions.

# Glossary

## Units of Measurement

<b>b</b>	barrel
<b>B or G</b>	billion
<b>boe</b>	barrel of oil equivalent
<b>CO<sub>2</sub>-eq</b>	CO <sub>2</sub> equivalent
<b>eq</b>	equivalent
<b>Gt</b>	billion tons
<b>GW</b>	gigawatt
<b>k</b>	thousand
<b>M</b>	million
<b>Mboe/d</b>	million barrels of oil equivalent per day
<b>Mcu. m</b>	million cubic meters
<b>t</b>	metric ton
<b>TWh</b>	terawatt-hour

## Definitions

### Greenhouse Gases (GHG)

The six gases named in the Kyoto Protocol: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF<sub>6</sub>), with their respective Global Warming Potential (GWP), as described in the 2007 IPCC report.

### Life Cycle Assessment (LCA)

A standardized method for assessing and quantifying the environmental impact of a product or service. A life cycle assessment is used to identify and quantify the physical flows of matter and energy associated with human activity at every stage of the product's life, evaluating the potential impact of those flows and interpreting the results. In particular, it can be used to compare two products for an identical service.

### Operated Scope

The activities, sites and assets operated by Total S.A. or a company it controls, i.e. those that Total or a Total-controlled company operates or is contractually responsible for managing operations: 808 sites at December 31, 2016.

## Acronyms

<b>CCUS</b>	Carbon Capture, Utilization and Storage
<b>CNG</b>	Compressed Natural Gas
<b>CSR</b>	Corporate Social Responsibility
<b>FSRU</b>	Floating and Storage Regasification Unit
<b>IOGP</b>	International Association of Oil & Gas Producers
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IEA</b>	International Energy Agency
<b>LNG</b>	Liquefied Natural Gas
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>OGCI</b>	Oil & Gas Climate Initiative
<b>R&amp;D</b>	Research and Development
<b>USD</b>	Official abbreviation of the United States dollar

### Operational/Non-Continuous Production Flaring

All flaring other than continuous or safety flaring. It is usually sporadic and carried out at high intensity for a short duration. It may occur on a planned or unplanned basis. It includes flaring carried out during temporary (or partial) failures of equipment used to process gas during normal operations and lasts until the equipment has been repaired or replaced.

### Routine Flaring

Flaring during normal oil production operations in the absence of sufficient facilities or amenable geology to reinject the produced gas, utilize it onsite, or dispatch it to a market. Routine flaring does not include safety flaring, even when the latter is continuous.

### Safety Flaring

Flaring carried out to ensure safe operations on facilities.

### Start-up Flaring

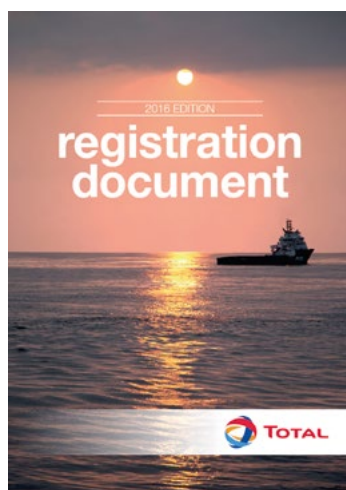
Commissioning new oil or gas production facilities generally takes several weeks. Flaring during this phase can take the form of each of the types of flaring mentioned above, until normal production starts.



# More

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**Total offers a sustainability reporting and information process outlining our corporate social responsibility. In addition to the Registration Document, all reporting information on this topic is now available on our Sustainable Performance website. All of our publications and the latest news and reports can still be found on our corporate website, total.com.**

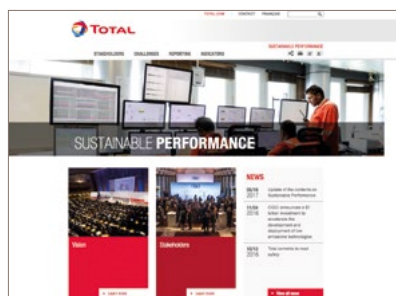


## Registration Document

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The Registration Document presents our activities and the financial statements for the year just ended. In application of France's Grenelle II Act, social, environmental and societal information is reported in Section 7. This information is audited by an independent third party.

[www.total.com/en/media/publications](http://www.total.com/en/media/publications)



## Sustainable Performance

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In May 2016, Total created a dedicated website for CSR reporting that we regularly update and enhance. The website focuses on all of the CSR and sustainability issues we deal with, including safety, climate change, environmental protection, ethics, human rights and community engagement, and includes our policies, information on our initiatives and performance indicators for each issue. It also makes our response to environmental, social and governance (ESG) reporting standards available to the public.

[www.sustainable-performance.total.com](http://www.sustainable-performance.total.com)

## Printing

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This document was printed with vegetable ink on 100% recycled uncoated, natural white Cyclus Offset paper, produced from recycled FSC-certified pulp, reducing pressure on the world's forests. The E.U. Ecolabel-certified paper was produced in an ISO 14001- and FSC-certified paper mill. The printer is certified as complying with Imprim'Vert®, the French printing industry's environmental initiative.



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[www.ecofolio.fr](http://www.ecofolio.fr)

## Illustrations

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OGCI, Siemens, Thierry Gonzalez, François Lacour.

## Design and Production

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TERRE DE SIENNE / Chaikana EXPRESSION

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## Disclaimer

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**total.com**



Total is a major energy company committed to supplying affordable energy to a growing population, addressing climate change and meeting new customer expectations.

These commitments guide what we do. With operations in more than 130 countries, we are a global integrated energy producer and provider, a leading international oil and gas company, and a major player in solar energy with Total Solar and our affiliate SunPower. We explore for, produce, transform, market and distribute energy in a variety of forms, to serve the end customer.

Our 98,000 employees are committed to better energy that is safer, cleaner, more efficient, more innovative and accessible to as many people as possible. As a responsible corporate citizen, we focus on ensuring that our operations consistently deliver economic, social and environmental benefits.

Our ambition is to become the responsible energy major.



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