



OIL AND GAS CLIMATE INITIATIVE

CATALYST FOR CHANGE

Collaborating to realize
the energy transition

A report from the Oil and Gas Climate Initiative
October 2017

Contents

Foreword	3
1. Delivering on our ambitions	5
OGCI Climate Investments – organized for action	7
OGCI in 2017	8
2. Scaling up CCUS	11
3. Realizing the potential of natural gas	15
Working towards near zero methane emissions	16
4. A step-change in transport efficiency	18
5. Concluding remarks	19



Foreword

We, the leaders of ten major oil and gas companies, are committed to the direction set out by the Paris Agreement on climate change. We support its agenda for global action and the need for urgency.

Through our collaboration in the Oil and Gas Climate Initiative (OGCI), we can be a catalyst for change in our industry and more widely. Our companies produce one-tenth of the world's energy. That makes us important players in ensuring the supply of reliable and affordable energy, and gives us the opportunity to advance the transition to a low emissions future.

OGCI aims to increase the ambition, speed and scale of the initiatives we undertake as individual companies to reduce the greenhouse gas footprint of our core oil and gas business – and to explore new business models and technologies.

In its first year, our billion-dollar investment arm, OGCI Climate Investments, has initiated discussions with dozens of potential partners and finalized the first three of many investments. We are focusing our efforts in high-impact areas where we believe we can make the big-

gest difference. Our investments in 2017 aim to help make carbon capture, utilization and storage a commercial reality and boost transport efficiency. We are also investigating significant investment opportunities for methane detection and reduction.

We have a unique opportunity to deploy technologies in our own respective operations – greatly amplifying the scale and impact of OGCI Climate Investments' initial investments. We work together to identify the most potent levers for achieving greenhouse gas emission reductions from the production, supply and use of oil and gas, and partner with other companies, scientists, policy-makers, and NGOs to take action.

One of our big commitments in 2017 was to provide financial and technical backing for the world's first global methane study, under the auspices of United Nations Environment. This project enables independent research teams to fill gaps in the identification and measurement of global methane emissions. As active participants and sponsors, we aim to reinforce our existing actions to manage methane emissions.

Separately, we are also working with Imperial College London on research that aims to provide a more accurate picture of greenhouse gas emissions across the natural gas value chain.

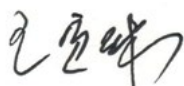
Our aim is to work towards near zero methane emissions from the gas value chain. We are also committed to ensure natural gas continues to deliver a clear climate and clean air benefit compared to coal.

The commercialization and scale up of new technologies – especially in energy infrastructure – takes time. It also depends on investment and policy choices made today. That is why we are reaching out and sharing our immediate and long-term plans with a broad range of stakeholders. We want to better understand their needs and concerns – and the potential for collaboration – as we move forward.

We believe that OGCI can be a catalyst for change. Accelerating our activities by working with others can help to make the world's energy systems fit for the future.



Bob Dudley
BP plc



Wang Yilin
CNPC



Claudio Descalzi
Eni S.p.A.



Jose Antonio Gonzalez Anaya
Petróleos Mexicanos



Sh. Mukesh D Ambani
Reliance Industries Limited



Josu Jon Imaz,
Repsol S.A.



Ben van Beurden
Royal Dutch Shell plc



Amin H. Nasser
Saudi Aramco



Eldar Saetre
Statoil ASA



Patrick Pouyanné
Total S.A.



1. Delivering on our ambitions

In just three years, the OGCI has become a driving force in our industry, delivering practical action in response to the growing challenge of climate change. Energized by the global commitment embodied in the Paris Agreement on climate change, we developed a strategy for how our members – ten major oil and gas companies from around the world – can collaborate to have a real impact on greenhouse gas emissions. Our work programme, now being implemented, has already resulted in a series of investments and partnership agreements that support OGCI's ambitions.

OGCI focuses its initiatives on areas where we believe we can make the most impact on greenhouse gas emissions now and remove obstacles to the development, deployment and scale-up of technologies needed to achieve long-term climate goals. We collaborate and invest with others to bring scale and greater speed to emissions reductions from the oil and gas value chain. Our focus is on carbon capture, utilization and storage (CCUS), methane detection and reduction, and energy efficiency in transport and in the oil and gas value chain.

Multiple solutions – including renewables, more efficient energy conversion

technologies and widespread deployment of CCUS – will be needed to power the world sustainably. The task is enormous and complex. A growing population and increased access to energy in emerging economies means there will be greater demand over the coming decades. At the same time, energy accounts for around two-thirds of manmade greenhouse gas emissions¹ – and for society to meet the Paris agenda, these need to be reduced rapidly and effectively. Our goal is to respond to this rising energy demand with sustainable solutions.

Unprecedented transformation

The pathway to a low emissions future will vary across different geographic regions, depending on available sources of energy, economic growth and land use patterns, government policies and affordability. Achieving it requires an unprecedented transformation of our economies in which all sectors will need to reduce their emissions substantially. For many industries, including our own, this will entail a broader change in strategy and business models. It requires bold action, innovative partnerships and a keen eye for the opportunities this transformation brings – not just the risks.



Erik Solheim
Executive Director
UN Environment

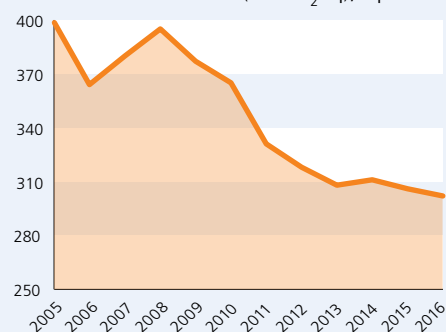
"Oil and gas industry leaders have a critical role to play in our efforts to take on climate change and limit the global temperature rise. We are counting on groups such as OGCI to support the needed shift in the way we produce and consume energy. Partnerships like this are extremely important. They're not about financial support, but concrete action – because this is how success will be measured."

GREENHOUSE GAS EMISSIONS

OGCI DATA

- Greenhouse gas emissions fell by 1% in 2016, according to data from seven OGCI members.
- Over the past decade, emissions have fallen by 17%, with a 9% drop in the past five years.

Direct GHG emissions (MtCO₂eq), operated



Source: OGCI

¹ International Energy Agency (IEA), *Energy, Climate Change and Environment*, 2016

We know that renewables will play an increasingly significant role in power generation. As this happens, electrification will become more important in reducing emissions in other industries too. But these essential elements of the energy transition cannot be deployed fast enough nor widely enough to curb global greenhouse gas emissions in the near future and sustain a rapid decline over the coming decades. Other solutions are needed too.²

As oil and gas producers, we have our own perspective, but we are also actively listening to other voices and views. In collaboration with the World Economic Forum, OGCI has held multi-stakeholder sessions around the world to under-

stand concerns and criticisms and share our own thoughts. For example, in June 2017, participants at one such stakeholder workshop in Dalian, China asked us to elaborate more on our strategic thinking around long-term emissions reductions from natural gas, more transparent reporting and future business models. While these issues largely relate to individual company strategies, OGCI ensures that the topics are discussed and responded to at the highest level.

Thinking long-term

To deepen our thinking around the challenges posed by climate change – and the ways we can best contribute to solving them – OGCI has this year analyzed exist-

ing climate scenarios out to 2100.³ The value of these scenarios is not so much to predict what the world will look like a century ahead, but to help identify possible drivers of change, as well as the technology and policy levers that are relevant to achieving different outcomes. They also prompt us to look at current progress from the perspective of future needs. Are critical technologies getting enough attention to scale up in time to meet future expectations? And how can we, as OGCI, address the obstacles to accelerating investment in these technologies and so deliver emissions reductions? OGCI aims to be a catalyst for change in this process, in our own industry and in the wider economy.

² IEA, *Energy Investment Trends*, 2017; IEA, *Energy Technology Perspectives 2017*

³ Over 100 scenarios from the IPCC AR5 Scenario database

Low emissions technologies

While OGCI focuses on reducing emissions from our core oil and gas businesses, OGCI member companies pursue their own opportunities across a much wider spectrum of renewable and low emissions technologies. Members are active in solar power, offshore and onshore wind, energy storage, biofuels and bioproducts, hydrogen, geothermal power and CCUS.

For the seven OGCI companies reporting data:

- More than \$19 billion was invested in renewables over the past five years
- More than \$3 billion was spent on research and development (R&D) in low emissions technologies in the past five years
- 21% of 2016 R&D budgets on average were focused on low emissions technologies



OGCI Climate Investments – organized for action

In November 2016, we launched a joint, billion-dollar investment vehicle, OGCI Climate Investments. Its aim is to help catalyze the development and deployment of technology and business models that will reduce greenhouse gas emissions across the oil and gas value chain on a significant scale. It invests in the growth of innovative young companies, sponsors projects designed to test specific technologies or unlock their commercial potential, and funds competitions that aim to solve specific technology challenges crucial to progress. OGCI Climate Investments focuses predominantly on CCUS, methane emissions, and energy and transport efficiency. It favours areas which are currently underserved by investors and which might benefit from the access and convening power of the ten OGCI member companies.

OGCI Climate Investments is run independently from its headquarters in London, drawing on the strategic support of board members from each of the member companies, and on the technical expertise of cross-company teams who work closely on specific topics in OGCI's areas of focus.

In June, Pratima Rangarajan was appointed as CEO, heading a team of experienced strategy, technology and venturing executives. Pratima brings an external perspective – and an eye for both technological innovation and commercial viability – stemming from over 20 years of experience across the energy and chemicals sectors.

OGCI Climate Investments has signed off on three investments in its first year and is building a strong pipeline, derived from opportunities within the member companies, as well as via investor, technology and value chain partners.



Dr Pratima Rangarajan
Chief Executive Officer
OGCI Climate Investments

"I have worked in renewables for the past ten years and believe in their future. But if we are to meet the energy needs of tomorrow *and* keep the global temperature rise below 2°C, we must lower the greenhouse gas impact of oil and gas. We need to focus the power of innovation here and now."



OGCI Climate Investments team

OGCI in 2017

Carbon capture & storage

We invested in a UK project that aims to develop a framework for the world's first commercial-scale gas power plant with integrated CCUS and additional carbon transport and storage capacity.

Potential impact: could remove 90% of carbon dioxide from the gas plant and store additional carbon dioxide from a range of other industries, if realized.

Carbon storage

We helped to create a standardized methodology to classify storage capacity for carbon dioxide.⁴

Potential impact: could help to accelerate investment in CCUS by providing confidence on availability of aquifers for storage.

Carbon utilization

We invested in Solidia Technologies, a company that is using carbon dioxide in a novel concrete manufacturing process.

Potential impact: could lower the carbon footprint of its concrete production by 70% and help nurture carbon dioxide recycling business models.

Methane emissions

We are providing financial and technical backing for two major global studies of methane emissions from the natural gas value chain, one with UN Environment and the other with Imperial College London.

Potential impact: could help identify new emission reduction initiatives and provide a scientific foundation to inform policy.

Transport efficiency

We invested in Achates Power, a company that is developing more efficient vehicle engines.

Potential impact: could help lower greenhouse gas emissions from road transport.

OGCI Member Companies



Pemex
Headquarters: Mexico
Output*: 3.3
Employees: 127,000
CEO: José Antonio González Anaya



Shell
Headquarters: The Netherlands
Output*: 3.0
Countries with operations: 70
Employees: 92,000
CEO: Ben van Beurden



Eni
Headquarters: Italy
Output*: 1.8
Countries with operations: 83
Employees: 34,000
CEO: Claudio Descalzi



⁴ <http://www.spe.org/industry/CO2-storage-resources-management-system>

All statistics are 2016
* Output is expressed as million barrels of oil equivalent per day





2. Scaling up CCUS

O GCI believes that CCUS is a crucial piece of the decarbonization puzzle. Studies show that it will be required on a major scale – and across a wide variety of sectors – to meet long-term climate change ambitions, and to do so at an affordable cost.⁵ A handful of dedicated policy-makers and companies have launched 17 large-scale facilities that demonstrate the technology's potential.⁶ But there has not been sufficient incentive to bring the replication and economies of scale that could create a functioning market for CCUS.

Indeed, there is a growing gap between short-term plans for CCUS and long-term expectations of what it will need to contribute. According to the IEA,⁷ CCUS is expected to account for 14% of carbon dioxide emissions reduction by 2060. To do that it would need to remove around a billion tonnes of carbon dioxide a year by 2030 and almost 7 billion tonnes by 2060. In contrast, today's CCUS projects capture just 30 million tonnes per year. The Energy Transitions Commis-

sion⁸ suggests that over 100 new CCUS plants are needed per year from 2020 to 2040 to realize ambitions from the Paris Agreement.

The value of CCUS

There is increasing recognition that CCUS is one of the very few ways of reducing emissions in energy-intensive industries. That includes those that produce steel, cement, aluminium, paper, chemicals and fertilizers, as well as refineries. Many of these industries rely on fossil fuels to generate the extremely high temperatures that are essential to their industrial processes. In some, carbon dioxide emissions are inherent to these processes.

CCUS could also support the low-emission production of hydrogen and its use as a fuel in power, heating and road transport. Longer term, a mature carbon dioxide transport and storage network could provide the backbone infrastructure for negative emissions energy technology, such as bioenergy with carbon capture

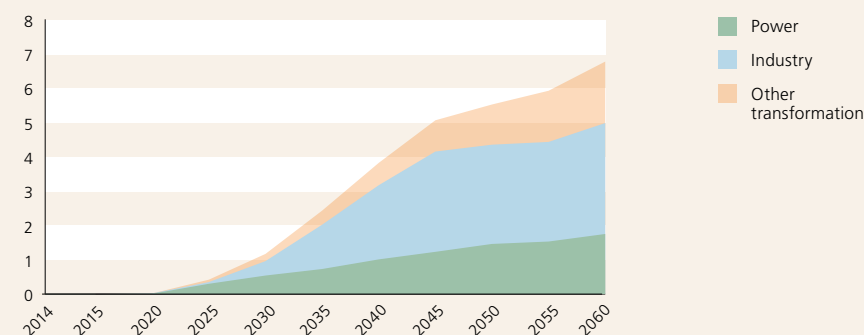


Dr Fatih Birol
*Executive Director
International Energy Agency*

"Harnessing the expertise, technical know-how and capital of major companies to help to address climate change is vital. At the IEA, we are pleased to collaborate closely with OGCI in the pursuit of a secure, low-emissions energy future."

CCUS DEPLOYMENT NEEDED TO ACHIEVE 2°C SCENARIO

GtCO₂ captured and stored, 2DS



Source: IEA, Energy Technology Perspectives 2017

⁵ Intergovernmental Panel on Climate Change (IPCC), *Fifth Assessment Report*, 2013; International Energy Agency, *Energy Technology Perspectives 2017*, 2017; Energy Transitions Commission, *Better Energy, Greater Prosperity*, 2017

⁶ 17 large-scale facilities are in operation, four are in construction and a further five are in advanced development, see Global Carbon Capture and Storage Institute <http://www.globalccsinstitute.com/projects/large-scale-ccs-projects>

⁷ International Energy Agency (IEA), *Energy Technology Perspectives*

⁸ Energy Transitions Commission, *Better Energy, Greater Prosperity*, 2017

and storage technologies. Most long-term 2°C pathways rely on such technologies to remove carbon dioxide from the atmosphere in the second half of the century, compensating for emissions from sectors like freight transport and air travel that are likely to remain net emitters. This technology cannot emerge on the scale required without a mature CCUS industry in place.

OGCI is focused on overcoming the obstacles to CCUS deployment on such a large scale. We have helped to develop a consistent methodology to classify available storage capacity for carbon dioxide that has been adopted by the Society for Petroleum Engineers. We are targeting a large portion of OGCI Climate

Investments' funds to act as a catalyst for CCUS. And we are also starting to engage with policy-makers, the public and other industries to both advance the technology and encourage its commercial deployment.

Getting to commercial viability

Our first investment has been to acquire a UK project concept that aims to design the world's first commercial gas power plant using CCUS. OGCI Climate Investments' goal is to work with the project team on a commercially viable concept and basic engineering design that also has government support. We aim to develop a project that would attract private sector investors.

Another aim of the project is to enable neighbouring energy-intensive industries to leverage the carbon dioxide transport and storage network that would be developed. This way, they too would be able to eliminate a large share of carbon dioxide from their operations. The project could be a way to help the UK reach its ambitious commitment to reduce greenhouse gas emissions by 80% on 1990 levels by 2050, while also helping to keep UK energy supplies secure, attract new sustainable growth and employment, and assist local industries as they face their own decarbonizing challenge.

Many governments are trying to balance similar goals. We are exploring the potential to replicate the concept



in regions that are willing to promote deployment of CCUS as a means to advance its commercial viability through price mechanisms, capital investments, or other policies that establish a strong investment signal.

Carbon utilization

Carbon utilization – the conversion of captured carbon dioxide into useable products – can help reduce greenhouse gas emissions in specific sectors. As more companies invest in utilization they may play an important role in the evolution of future business models, where carbon recycling becomes business-as-usual for energy-intensive industries. That's why OGCI Climate Investments is

looking to invest in a range of companies that have developed innovative and commercially viable carbon utilization technologies.

Our investment in Solidia Technologies, a US-based pioneer in the heavy-emitting cement and concrete industry, demonstrates the type of approach we are looking for. Solidia has patented a technology that has a two-fold impact on greenhouse gas emissions. It produces cement in a way that generates fewer emissions and then adds carbon dioxide during the final production process to harden the concrete. Together, these two innovations could reduce the carbon footprint of Solidia's concrete by as much as 70% and water

consumption by up to 80%.

Collaboration with the oil and gas industry opens the option to use carbon dioxide captured from oil and gas facilities for sequestration in concrete. Companies like Solidia demonstrate how carbon dioxide could be re-used successfully – from both an environmental and a commercial perspective.

OGCI will continue to invest in CCUS solutions across industries – including in our own – seeking cost reduction through innovative technologies and economies of scale. We intend to be a catalyst for the technology's commercialization and look forward to engaging with policy-makers, commercial partners and the public to realize its value.





3. Realizing the potential of natural gas

It is hard to imagine a pathway to a lower emissions future that does not include natural gas. That is because the electrification of the global economy – and the share of renewables in generating that electricity – cannot grow fast enough to replace fossil fuels in time to reach climate goals.

Despite record growth in wind and solar energy in 2016, for example, investment in overall renewables capacity is not keeping up with the growing demand for electricity. These sources account for less than 5% of power generation, compared to coal which still covers more than 40%; electricity represents just 18% of total world energy use.⁹

A critical question, then, is how best to leverage the climate benefits that natural gas brings, while minimizing its downsides. There are powerful examples of how natural gas can reduce carbon dioxide emissions. The UK cut its emissions by a third from 1990 to 2015, early on due to the switch from coal to North Sea gas, and later with renewables also playing a part.¹⁰ The shale gas growth in the USA in the last decade has set a strong example,

too. The carbon intensity of power generation in the US decreased by 5% in both 2015 and 2016, as gas replaced coal to become the largest fuel source for power generation and renewables expanded rapidly alongside. US carbon dioxide emissions from energy were down 14% over the decade, almost reaching the level of 1990.¹¹

Economics and policy

The switch to gas in both the UK and the USA was a result of economics, as well as policy. However, in countries with a domestic coal industry and insufficient local gas production, regulations designed to achieve rigorous climate and air quality standards may be required. China, for example, has introduced policies to support a shift from coal to gas as part of a comprehensive plan to cut carbon intensity by 18% from 2016 to 2020,¹² while tackling the high levels of air pollution.

In many ways, natural gas is the ideal partner for renewable energy, making electricity supplies more secure by providing reliable base-load power and



He Jiakun
Vice Chairman
National Expert Committee on
Climate Change of China

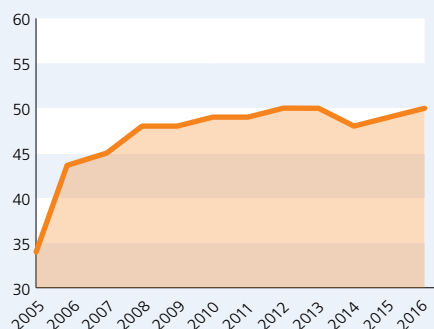
"OGCI is a pioneer of international cooperation and pragmatic action to reduce carbon emissions within the oil and gas industry. This approach will help promote the new concept of climate governance for win-win cooperation – embodied in the Paris Agreement on the basis of Nationally Determined Contributions (NDCs) – to other industries and the whole of society. "

SHARE OF GAS

OGCI DATA

- Gas represents half (50%) of the operated output of the OGCI members reporting data, compared to just 44% a decade ago and 47% five years ago.
- One additional company is now providing operated data from 2014; our chart shows the gas share of seven companies to 2013 and eight companies from 2014.

Gas as a share of total operated production (%)



Source: OGCI

⁹ IEA, *Energy Investment Trends*, 2017; IEA, *World Energy Outlook 2016*; IEA, *Key World Energy Statistics*, 2017

¹⁰ Department for Business, Energy and Industrial Strategy, *2015 UK Greenhouse Gas Emissions, Final Figures*, February 2017

¹¹ US Energy Information Administration (EIA), April 2017 <https://www.eia.gov/todayinenergy/detail.php?id=30712>

¹² The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China (2016-2020)

flexibility to match the intermittency of renewable energy sources. But concerns around the scale of methane emissions along the gas value chain can weaken the climate case for gas.

Measuring methane emissions

As long as its greenhouse gas footprint is significantly lower than that of coal, shifting from coal to natural gas is an immediate way to reduce the long-term build-up of carbon dioxide emissions. Confirming this positive effect has been made more difficult by widely different estimates of the scale of the fugitive methane emissions problem. It is not just a question of uncertainty about the data – the real challenge is that methane emissions from natural gas vary widely between types of facilities, regional conditions and company performance in monitoring and reduction.

Recent measurements at selected onshore oil and gas facilities in the US, for example, showed that overall levels were higher than previously estimated, due mainly to a few large emitters in specific regions.¹³ A third party assessment of gas delivered to customers in Europe, however, showed an average leakage rate of 0.6% of the gas sold to market.¹⁴

Over the past year, OGCI has partnered with others under the umbrella of United Nations Environment's Climate and Clean Air Coalition to understand the gaps in international methane data. Together, we have now launched a comprehensive independent study to measure and compare methane emissions across global gas value chains – from production, to supply and distribution.

The findings will help identify actions that would have the biggest impact on reducing methane emissions. They can

also provide a foundation for policy-makers to understand the environmental and climate implications of a more extensive use of natural gas.

To help ensure transparency and credibility, the project supports groups of scientists who publish their findings independently. In addition to providing financial support through United Nations Environment, some OGCI members will grant access to their facilities and technical experts. The researchers use a combination of top-down and bottom-up measurements to validate their results.

The gas footprint

We are also working with Imperial College London, using their expertise in life-cycle analysis modelling, to provide a more accurate picture of the total greenhouse gas emissions of natural gas, from well to distribution. This work will identify hotspots within the life-cycle where focused intervention could bring the greatest benefits.

Imperial College's model takes the opposite approach to the United Nations Environment study, analyzing in detail multiple engineering designs from OGCI member companies to estimate expected greenhouse emissions. This data is then matched with the companies' own operating and emissions monitoring data, and their reporting to local and international regulators, to develop a credible independent view of the main sources of emissions.

Additional input from OGCI member companies helps Imperial College researchers analyze the cost implications of intervention. By bringing these two elements together, their research will identify prioritized interventions with the biggest impact at the lowest cost – creating a clear course of action that the oil and gas industry can adopt. We will have the final results by the end of 2018.

The long-term role of natural gas

Some argue that gas can only play a role

Working towards near zero methane emissions

Prevention of methane leaks is a top priority for OGCI. Our aim is to work towards near zero methane emissions from the gas value chain. We are also committed to ensure natural gas continues to deliver a clear climate and clean air benefit compared with coal.

Our next steps towards this aim are:

1. Following a pathway to reduce methane emissions from the upstream gas value chain (from wellhead to point of sale) where OGCI member companies have operational control by:
 - Establishing a methodology to improve the collection, verification and reporting of methane emission data in 2018
 - Developing a baseline of methane emissions by the end of 2018
 - Announcing a target by end 2018
 - Reporting progress through our annual report
2. Working with operators of downstream gas value chains (from point of sale to power plant or domestic supplies) to develop specific actions to improve quantification and mitigation actions along the gas value chain.

¹³ Proceedings of the National Academy of Science, *Reconciling divergent estimates of oil and gas methane emissions*, David Zavala-Araiza et al, December 2015 www.pnas.org/content/112/51/15597.full.pdf

¹⁴ Thinkstep, *Greenhouse Gas Intensity of Natural Gas*, NGVA Europe, May 2017, <http://ngvemissionsstudy.eu/>

in the first stages of the energy transition, but would leave widespread gas infrastructure and supply sources, which could be an obstacle to deeper emission reductions in later decades. In other words, the benefit brought by gas to the early peaking of carbon dioxide emissions might be offset by slowing the momentum of zero-emission technologies.

Based on our analysis of long-term scenarios, we believe natural gas has a role to play not just in the coming decades, but in a low emissions future too. Gas is an excellent partner to com-

plement renewables. Gas technology and infrastructure are scalable and flexible – key features of a future-oriented energy system. It can accommodate both centralized and decentralized energy generation. Technologies like power-to-gas that connect the electricity grid to the gas grid can store excess electricity and accelerate emissions reduction needed in home heating. In combination with CCUS, gas can become a very low emission fuel for electricity production and industrial use, and be used to produce zero-emission hydrogen for a broad range of uses.



Dr Alice Gast
*President
Imperial College London*

"We are very pleased to welcome OGCI Climate Investments to our collaborative research and innovation ecosystem on our White City Campus. Here and across Imperial College's campuses, our leading academics are working with partners to develop innovative technologies to tackle climate change, reduce greenhouse gas emissions and use natural resources sustainably. We look forward to shaping further collaborations with OGCI and their partners."

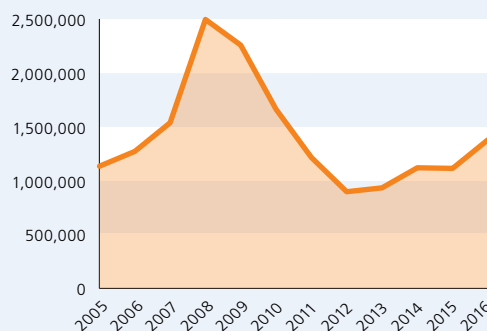
METHANE EMISSIONS

OGCI DATA

- Methane emissions from the seven companies reporting data rose 24% in 2016
- This rise was due to the consolidation of a major acquisition by one company and maintenance issues in compression facilities in another.
- Over the past decade, methane emissions have risen 9%, with a 13% increase over the past five years.

Source: OGCI

Direct CH₄ emissions (tCH₄)
– all sectors, operated



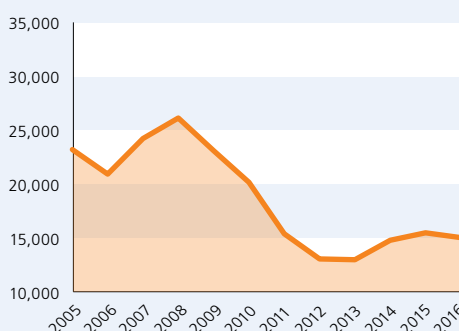
VOLUME OF GAS FLARED

OGCI DATA

- The overall volume of natural gas flaring fell by 2% in 2016, based on data from seven OGCI members reporting data.
- Over the past decade, flaring has fallen by 28%, with a 2% drop over the past five years.
- This reduction comes as companies built infrastructure to capture associated gas in facilities they had acquired in recent years.

Source: OGCI

Hydrocarbon gas flared (Mm³),
without inerts, upstream sector, operated



4. A step-change in transport efficiency

The energy transition is picking up pace in the transport sector. Electrification of passenger cars is expanding quickly as mainstream auto-makers introduce mass market models, and battery-powered cars become more affordable. Although electric vehicles account for just 0.2% of passenger cars on the road today,¹⁵ sales are growing fast – and will likely grow even faster as governments put in place incentives and regulations to improve urban air quality and achieve climate commitments.

China has led the way, introducing more battery-only electric vehicles annually than the rest of the world combined. Now China, India and several European countries are planning to ban the sale of new passenger cars that have solely petroleum and diesel engines within the next few decades, accelerating the uptake of electric vehicles and plug-in hybrids.

Driving change

That signals a major shift for light passenger vehicles – and has the potential to improve urban air quality and reduce greenhouse gases as the emissions profile of electricity generation is lowered. But electrification is not sufficient to help the

transport sector reach climate goals, for three reasons.

First, even if half of all light passenger vehicles were electric in 2040 – far beyond most scenarios – the car market is growing so fast that hundreds of millions of cars on the road will still have internal combustion engines. Secondly, the expected reduction in global carbon dioxide levels brought by electrification will be limited if large amounts of electricity continue to be generated from coal. Finally, light vehicles are responsible for just under half of the greenhouse gas emissions that come from the transport sector. The rest comes from long-distance freight vehicles, aviation and shipping, where electrification is far more challenging. As a result, dramatically improving the efficiency of internal combustion engines must remain a high priority.

In our view, reducing greenhouse gas emissions in transport will require:

- Highly efficient engine-fuel systems that economically reduce carbon emissions and are easy to implement
- A move toward hybrid vehicles, which reduce oil consumption, and still overcome the issues of driving range and battery charging times

- A combination of low emissions fuels – electrification, advanced biofuels, hydrogen and natural gas
- A change in vehicle usage through car sharing and other modal shifts
- The development of new opportunities brought by the digitally connected vehicle

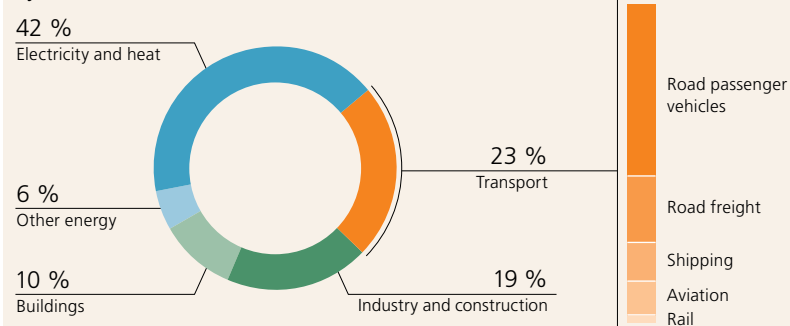
OGCI sees its role as facilitating a step-change in efficient fuel engines and ensuring that these opportunities are not lost as the focus turns to electrification. As part of this effort, we have begun to screen innovative engine and vehicle technologies, filtering them for their ability to reduce energy use and greenhouse gas emissions at an affordable cost, while meeting required standards on other pollutants.

Investing in innovation

In 2017, we invested in Achates Power, a US-based company that is developing high-efficiency opposed piston engines that could have a substantial impact on greenhouse gas emissions. With our investment, as part of a broader consortium alongside engine makers, Achates aims to accelerate deployment in fast-growing countries.

CARBON DIOXIDE EMISSIONS FROM FUEL COMBUSTION

by sector, 2014 (million tonnes)



Sources: IEA, IPCC AR5, EIA

15 International Energy Agency, *Global EV Outlook 2017*

5. Concluding remarks

OGCI member companies understand the urgency of climate change and support the aims of the Paris Agreement. We recognize that the oil and gas industry has a key role to play in reducing greenhouse gas emissions. Working together, and in our own operations, we are committed to helping eliminate routine flaring, reduce methane emissions and invest in low emissions technologies.

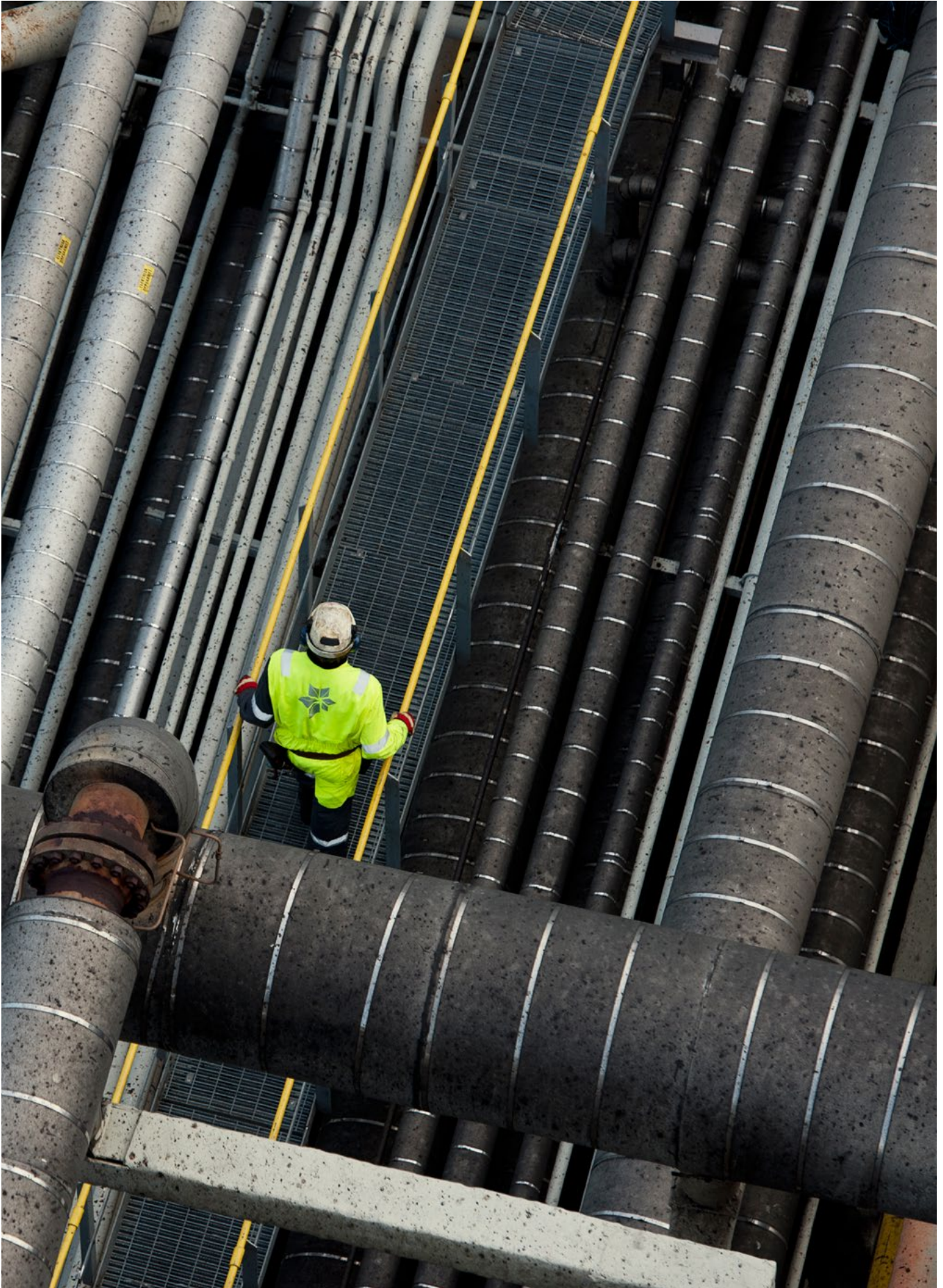
Creating a low emissions economy is

incredibly challenging. It requires multiple solutions and the cooperation of all sectors. It needs investment and innovative policy decisions to accelerate the creation of new low emissions markets. The commercialization and scale-up of new technologies takes time – especially for energy infrastructure where lead times are long. Every year that passes without material action increases the cost of delivering on the Paris ambitions and the risk of not meeting them at all.

Tackling the challenge

OGCI is keen to work with our partners, customers and policy-makers, acting as a catalyst for wider investment. Working together and through OGCI Climate Investments, we aim to combine the scale, depth of expertise and reach of ten oil and gas producers, with an ecosystem of potentially path-breaking start-ups. We are confident that collectively, we can help tackle the climate change challenge.





Photographs



Cover:
Andrew Platform, North Sea



Page 10:
Solidia Technologies ®



Page 2:
Operators at LNG plant, Indonesia



Page 12–13:
Researcher at Technology Centre, India



Page 4:
Cogeneration plant, Italy



Page 14:
Testing for methane leaks, China



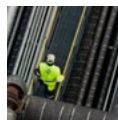
Page 6:
Sheringham Shoal Wind Farm, UK



Page 19:
Carbon capture and storage, Saudi Arabia



Page 7:
OGCI Climate Investments team



Page 20:
Processing plant, Norway

All photographs courtesy of OGCI member companies.

Legal disclaimer

While all OGCI member companies have contributed to the development of this report, the views or positions it contains may not fully reflect the views of a particular OGCI member company. Similarly, this report does not cover all relevant activities of OGCI member companies; nor do all member companies participate in all of the activities described.

©2017 OGCI
All Rights Reserved

What is OGCI?

The Oil and Gas Climate Initiative is a voluntary, CEO-led initiative which aims to lead the industry response to climate change. Launched in 2014, OGCI is currently made up of ten oil and gas companies that pool expert knowledge and collaborate on action to reduce greenhouse gas emissions. Our billion-dollar investment arm, OGCI Climate Investments, supports the development, deployment and scale-up of low emissions technology.



oilandgasclimateinitiative.com