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Climate Change 2017 Information Request

Royal Dutch Shell

EXTRACT from 2017 submission

Module: Risks and Opportunities

Page: CC5. Climate Change Risks

CC5.1 **Have you identified any inherent climate change risks that have the potential to generate a substantive change in your business operations, revenue or expenditure? Tick all that apply**

Risks driven by changes in regulation
Risks driven by changes in physical climate parameters
Risks driven by changes in other climate-related development

CC5.1a **Please describe your inherent risks that are driven by changes in regulation**

Risk driver	Description	Potential impact	Time-frame	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
General environ-mental regulations, including planning	Rising climate change concerns could lead to additional regulatory measures, such as explicit and implicit GHG policies deployed globally. If we are unable to find economically viable, as well	Other: Project delays	>6 years	Direct	About as likely as not	High	As disclosed in Shell's Energy Transition and Portfolio Resilience report (page 33), on a 2015 basis, a $10/tonne CO2 movement in global CO2 price, will impact Shell earnings in the region of $400 million. There is continued and increased attention to climate change from all sectors of society. This attention has led, and we expect it to continue to lead, to additional	Shell has a rigorous approach to understanding, managing and mitigating climate risks in our assets and projects. We reflect future regulatory costs by typically applying a common $40/tonne project screening value (PSV) to the GHG emissions associated with investments. This incentivises investments in GHG abatement, highlights projects with the most exposure to rising carbon	Cost of management for a single topic may miss out on the complexity of shaping sustainable operations. Relevant teams are involved on working on wide and varied CO2 related activities, such as supporting the implementation of our policies within the business. Furthermore, our business strategy supports: supplying more natural gas, helping to

Risk driver	Description	Potential impact	Time-frame	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
	as publicly acceptable, solutions that reduce our GHG emissions and/or GHG intensity for new and existing projects or products, we could experience additional costs or financial penalties, delayed or cancelled projects.						regulations designed to reduce GHG emissions. Furthermore, we expect that a growing share of our GHG emissions will be subject to regulation. If our GHG emissions rise alongside our ambitions to increase the scale of our business, our regulatory burden will increase proportionally.	prices and helps screen early-stage opportunities. We have GHG and energy management plans at key sites to illustrate and identify potential ways to reduce GHG emissions. High-emitting projects undergo additional sensitivity testing. Projects in the most GHG-exposed asset classes have GHG intensity targets that reflect standards sufficient to allow them to compete and prosper in a more CO2 regulated future. This can lead to projects being stopped, designs being changed, and potential GHG mitigation investments being identified, in preparation for when regulations would make these investments commercially compelling. Such considerations, for example, influenced Shell's decision to invest in a gas-gathering system to reduce our flaring activities at the Majnoon field in Iraq. In 2016, Shell Iraq Petroleum Development (Shell interest 45%) safely delivered the second phase of a gas-capturing system at our Majnoon facilities. The system captured about 65% of the gas that would	develop CCS, improving energy efficiency in our operations and investing in new low carbon energies including biofuels and hydrogen, solar and wind. By way of example only: our CEO has explicitly talked about investing up to perhaps $1 billion a year by 2020 as long as viable, profitable projects are available.

Risk driver	Description	Potential impact	Time-frame	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
								otherwise be flared in 2016, which was around 90 million standard cubic feet per day.	
Cap and trade schemes	Several countries that are important operating areas for Shell are in the process of developing additional climate change legislation which may include the use of emissions trading systems and carbon taxes, which could potentially increase compliance costs for Shell. These include EU members, USA, Japan, and Canada.	Increased operational cost	1 to 3 years	Direct	Virtually certain	Low-medium	Phase III of the EU Emissions Trading System (ETS) will see facilities having to buy at auction an increasing percentage of allowances for compliance. In 2016, cost of compliance was €5-6/tonne of CO2. Several countries (e.g. USA) are developing climate change legislation which will introduce CO2 costs and impact financial performance.	Shell has a rigorous approach to understanding, managing and mitigating climate risks in our assets. We reflect future regulatory costs by typically applying a common $40/tonne project screening value (PSV) to the GHG emissions associated with investments. This incentivizes investments in GHG abatement, highlights projects with the most exposure to rising carbon prices and helps screen early-stage opportunities. We have greenhouse gas and energy management plans at key sites to illustrate and identify potential ways to reduce GHG emissions. Projects in the most GHG-exposed asset classes have GHG intensity targets that reflect standards sufficient to allow them to compete and prosper in a more CO2 regulated future. Across all our Upstream and Downstream operations, we strive for improved energy efficiency to help reduce Shell's overall GHG	It is not possible to come up with specific costs of management, as the relevant teams are also involved in many other CO2 related activities, such as supporting the implementation of our policies within the business. We consider a project screening value of CO2 emissions at $40/tonne. This is a guide that is used in all our investment decisions. Our business strategy supports: supplying more natural gas, helping to develop CCS; producing low-carbon energy including biofuels and improving energy efficiency in operations. One example of a cost of management is installing Cogeneration. The economics of cogeneration activities are variable and highly dependent on local electricity prices. As such, it can provide effectively negative abatement costs (where the installation is profitable), or high

Risk driver	Description	Potential impact	Time-frame	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
								emissions, and compliance costs. For example, the combined heat and power plant at our Bukom refinery and chemical plant in Singapore had its first full year of operation in 2016. It is expected to reduce total energy consumption at Bukom by between 4% and 5%, saving more than 200,000 tonnes of CO2 a year.	abatement costs (where it represents a net cost); e.g. external analysis from McKinsey show cost of cogeneration for Downstream assets estimated around €10/ tCO2.
Product efficiency regulations and standards	Various national, regional and state based low carbon fuel directives and targets such as: Low Carbon Fuel Standards and Renewable Fuel mandates in the European Union and USA mean that new fuels must be developed and brought to market in order to comply with a variety of programmes. This may change the cost structure of Shell´s	Other: Adverse change the cost structure of the business against uncertainty in fuel prices.	1 to 3 years	Indirect (Supply chain)	Virtually certain	Low-medium	Several countries (e.g. USA) have developed (additional) climate legislation which includes product efficiency standards including the Low Carbon Fuel Standard in California. Such developments may introduce new CO2 costs to our businesses, e.g. the costs of LCFS* credit and average price for 2016 was $91 per credit; which therefore might impact our financial performance. *https://www.arb.ca.gov/fuels/lcfs/credit/20170101_wklycreditrept.pdf	To test the resilience of new projects, we assess potential costs associated with GHG emissions when evaluating all new investments. Our approach applies a uniform project screening value (PSV) of $40 (real terms) per tonne of carbon dioxide (CO2) equivalent to the total GHG emissions of each investment. This PSV is generally applied when evaluating our new projects around the world to test their resilience across a range of future scenarios. The project development process features a number of checks that may require development of detailed GHG and energy management plans. Projects in the most GHG-exposed asset classes	It is not possible to come up with specific costs of management, as the relevant teams are also involved in many other GHG related activities, such as supporting the implementation of our policies within the business. Our business strategy supports: supplying more natural gas, producing low-carbon energy including biofuels, implementing energy-efficiency measures in our operations where reasonably practical and helping to develop CCS. By way of example: costs of management includes the cost of Quest. At the time of the FID, Quest had an estimated cost of US$1.35 billion. The provincial government of

Risk driver	Description	Potential impact	Time-frame	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
	operations against uncertainty in fuel prices.							have GHG intensity targets that reflect standards sufficient to allow them to compete and prosper in a more CO2 regulated future. High-emitting projects undergo additional sensitivity testing, including the potential for future CCS projects. As another example, we evaluate options to integrate readiness for CCS into the design of our new projects. For example, this was the case at our Scotford Upgrader in Alberta, Canada, which is now the site of our Quest CCS facility. Quest has captured and safely stored more than 1 million tonnes of carbon dioxide (CO2) deep underground in 2016, its first full year of operation.	Alberta and federal government of Canada had provided C$865 million to support the development of Quest.
General environmental regulations, including planning	Carbon Capture and Storage technology needs to move rapidly from demonstration to deployment to play an important role in reducing global CO2 emissions, like the Quest	Other: Uncertainty for Shell about the CCS investment required in the future while policy	>6 years	Direct	Very likely	Medium	According to the IEA, CCS remains the only technology capable of delivering significant reductions in emissions from the use of hydrocarbons. CCS will be essential for meeting the goal of limiting global warming to well below 2°C. According to the IEA, reaching this goal will require 6,000 million tonnes of CO2 to be	Shell is playing a leading role in the demonstration of CCS technology at the Quest CCS project in Canada. We are working on CCS research programmes with partners around the world, and sharing knowledge with working groups and coalitions. In November 2015, we launched our Quest CCS project in Canada, which has	CCS projects require significant capital, technical and personnel resources. In 2012, Shell began construction of Quest CCS project in Canada. Quest started operating in 2015. At full capacity, it can capture and store more than 1 million tonnes of CO2 each year – equivalent to the emissions from about 250,000 cars. In 2016,

Risk driver	Description	Potential impact	Time-frame	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
	project in Canada in which Shell is involved. However, policy support for this mitigation technology has been limited, which could potentially increase future CCS project costs. Further support is needed to deploy the technology in a way that reduces its costs and builds public acceptance.	support is limited					stored by 2050, equivalent to about 100 times the global CCS capacity expected by the end of 2017. The IEA also estimates that without CCS, the transformation to a low-carbon power sector will cost at least $3.5 trillion more.	captured and safely stored more than 1 million tonnes of CO2 in 2016. We are also involved in a CCS test centre in Mongstad, Norway, the Gorgon CO2 injection project in Australia and the Qatar Carbonates and Carbon Storage Research Centre. We also have technology that can remove both CO2 and sulphur dioxide from industrial flue gases. It is being used at Boundary Dam, a third-party coal-fired power plant in Canada. Shell is sharing the knowledge and experience gained in CCS through various working groups. The Oil and Gas Climate Initiative's (OGCI) Climate Investments partnership – comprising 10 major oil and gas companies, including Shell – has made CCS one of its priority areas. It plans to invest in finding ways to make CCS commercially viable by reducing the cost of the technology and exploring ways to deploy CCS in a wide range of industrial sector.	Quest captured and stored more than 1 million tonnes. By way of example: costs of management includes the cost of Quest. At the time of the FID, Quest had an estimated cost of US$1.35 billion. The provincial government of Alberta and federal government of Canada had provided C$865 million to support the development of Quest. Gorgon LNG project (25% Shell share) is expected to store 3-4 million tonnes of CO2 per year. In 2016, Shell, along with other OGCI members have committed to investing $1 billion over 10 years in low-carbon technologies including CCS.

CC5.1b Please describe your inherent risks that are driven by changes in physical climate parameters

Risk driver	Description	Potential impact	Timeframe	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
Change in mean (average) temperature	Increased local air temperatures that could impact Shell's plants efficiency.	Increased operational cost	>6 years	Direct	More likely than not	Medium	Increase in air temperature could affect the efficiency of our plants. Financial implications include: increased operating costs and decreased revenue from loss of efficiency. For example, a detailed study was undertaken by Entergy (supported by Swiss Re, America´s Wetland Foundation and America´s Energy Coast) on the costs and benefits of adaptation in the energy sector on the US Gulf Coast. The annual average expected loss for O&G sector in 2030 under an 'average' climate scenario is $6.9 billion - due to wind/rain, surge/flood and business interruption. Entergy study: http://www.entergy.com/content/our_community/environment/GulfCoastAdaptation/report.pdf	Physical impacts of climate change, such as rising sea levels and changes in ambient operating temperatures, tend to be location and asset type specific. Within our Projects and Technology organisation we employ a Metocean team focused on the physical climate impacts and adaptation aspects. This team conducts assessments of future climate conditions such as the Regional Temperature Increase Review (2030-2050). Shell's project design standards are revised on an ongoing basis to take account of climate change influences. The most vulnerable existing assets, designed under previous standards, are identified and any adaptation plans will be integrated into Shell existing procedures and processes such as the asset reference plans that guide their ongoing maintenance schedules. Case study: to better understand temperature impacts on plant efficiency a case study was conducted to analyse the impacts of projected temperature increase	A more comprehensive physical impact of climate change risk review and integration together with an adaptation assessment is being carried out at a total cost of around US$1 million. We are undertaking screening of specific existing assets and new projects and then work with a sample of the affected asset managers to develop response plans. This work is expected to be completed over the next few years, at the end of which we will have a clearer, more robust understanding of the associated risks and costs.

Risk driver	Description	Potential impact	Timeframe	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
								impacts on Shell's Pernis refinery in 2030s and 2050s.	
Sea level rise	Global: rising sea levels could impact Shell's coastal facilities (e.g. refineries, ports, terminals etc.) and our offshore platforms.	Reduction/disruption in production capacity	>6 years	Direct	More likely than not	Medium	Rising sea levels could impact coastal facilities as events such as floods, related to storm surges, could become more frequent. In recent years, storm surges associated with hurricanes have resulted in refinery shutdowns in the US Gulf Coast for some companies including Shell. Financial implications include: increased capital cost from future design requirement, increased operating costs from loss of efficiency and decreased revenue from shutdowns and reduced production. A detailed energy study was undertaken on the costs and benefits of adaptation in the energy sector on the US Gulf Coast. The annual average expected loss for O&G sector in 2030 under an 'average' climate scenario is USD 6.9 billion - due to wind/rain, surge/flood and business interruption.	Physical impacts of climate change, such as rising sea levels and changes in ambient operating temperatures, tend to be location and asset type specific. Physical impacts of climate change, such as rising sea levels and changes in ambient operating temperatures, tend to be location and asset type specific. Within our Projects and Technology organisation we employ a Metocean team who focuses on the physical climate impacts and adaptation aspects. This team conducts assessments of future climate conditions. An example of a study is the Global Sea Level Rise Review (2030-2050). As this team influences ongoing engineering design standards, our new projects' resilience is always based on the latest climate science outlook. The ongoing challenge is retrofitting existing assets, already in production while climate views have altered or will alter Shell's project	A more comprehensive physical impact of climate change risk review and integration together with an adaptation assessment is being carried out at a total cost of around US$1 million. We are undertaking screening of specific existing assets and new projects and then work with a sample of the affected asset managers to develop response plans. This work is expected to be completed over the next few years, at the end of which we will have a clearer, more robust understanding of the associated risks and costs.

Risk driver	Description	Potential impact	Timeframe	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
								design standards are revised on an ongoing basis to take account of climate change influences. The most vulnerable existing assets, designed under previous standards, are identified and any adaptation plans will be integrated into Shell existing procedures and processes such as the asset reference plans that guide their ongoing maintenance schedules.	
Change in precipitation extremes and droughts	Global: Changes in the global hydrological cycle could impact Shell's assets, for example by causing flooding, or making access to suitable quantities of water to run a particular facility problematic.	Reduction/disruption in production capacity	>6 years	Direct	About as likely as not	Medium-high	Changes in the global hydrological cycle could cause flooding and make access to suitable quantities of water to run a particular facility problematic. Financial implications include: increased capital cost from future design requirement, increased operating costs and decreased revenue from shutdowns and reduced production. For example, a detailed energy study was undertaken by Entergy (supported by Swiss Re, America´s Wetland Foundation and America´s Energy Coast) on the costs and benefits of adaptation in the energy sector on the US Gulf Coast. The annual average expected loss for O&G sector	Within our Projects and Technology organisation we employ a Metocean team focused on the physical climate impacts and adaptation aspects. This team conducts assessments of future climate conditions such as Regional Increased Precipitations Review (2030-2050). We conduct water risk assessments. We have also responded to events and will continue to do so, thereby improving the overall integrity of our operations and addressing this risk.	A more comprehensive physical impact of climate change risk review and integration together with an adaptation assessment is being carried out at a total cost of around US$1 million. We are undertaking screening of specific existing assets and new projects and then work with a sample of the affected asset managers to develop response plans. This work is expected to be completed over the next few years, at the end of which we will have a clearer, more robust understanding of the associated risks and costs.

Risk driver	Description	Potential impact	Timeframe	Direct/ In-direct	Likeli-hood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
							in 2030 under an 'average' climate scenario is $6.9 billon - due to wind/rain, surge/flood and business interruption. Entergy study: http://www.entergy.com/content/our_community/environment/GulfCoastAdaptation/report.pdf		
Tropical cyclones (hurricanes and typhoons)	Tropics: changes in sea temperature could affect future tropical cyclones. Example: hurricane Katrina disrupted Shell's operations in the Gulf of Mexico, USA, and led to refitting of some platforms and changes in operations.	Reduction/disruption in production capacity	>6 years	Direct	More likely than not	Medium	Changes in sea temperature could affect the intensity and frequency of future tropical cyclones impacting assets. Financial implications include: increased capital cost from future design requirement, increased operating costs and decreased revenue from shutdowns and reduced production. For example, a detailed study was undertaken by Entergy (supported by Swiss Re, America´s Wetland Foundation and America´s Energy Coast) on the costs and benefits of adaptation in the energy sector on the US Gulf Coast. The annual average expected loss for O&G sector in 2030 under an 'average' climate scenario is $6.9 billion - due to wind/rain, surge/flood and business interruption. Entergy study: http://www.entergy.com/cont	Within our Projects and Technology organisation we employ a Metocean team focused on the physical climate impacts and adaptation aspects. This team conducts assessments of future climate conditions such as the South China Sea Review (2030-2050). We have also responded to events and will continue to do so, thereby improving the overall integrity of our operations and addressing this risk.	A more comprehensive physical impact of climate change risk review and integration together with an adaptation assessment is being carried out at a total cost of around US$1 million. We are undertaking screening of specific existing assets and new projects and then work with a sample of the affected asset managers to develop response plans. This work is expected to be completed over the next few years, at the end of which we will have a clearer, more robust understanding of the associated risks and costs.

Risk driver	Description	Potential impact	Timeframe	Direct/ Indirect	Likelihood	Magnitude of impact	Estimated financial implications	Management method	Cost of management
							ent/our_community/environment/GulfCoastAdaptation/report.pdf		

CC5.1c Please describe your inherent risks that are driven by changes in other climate-related developments

Risk driver	Description	Potential impact	Time-frame	Direct / Indirect	Likelihood	Magnitude of impact	Estimated financial implications	Management method	Cost of management
Other drivers	The significant investment and changes that will be required to move to a low carbon energy world means that governments, businesses and society all have a significant part to play. Changes	Other: Falling sales revenue and earnings	>6 years	Direct	Very likely	Medium-high	Shell has provided earnings sensitivities on potential impacts of changing CO2 prices in the Shell Energy Transition and Portfolio Resilience report, on page 33. On a 2015 basis, $10/tonne CO2 movement in global CO2 price, $400 million earnings impact. In 2016, the International Energy Agency (IEA) has updated its 450 Scenario	Shell has been working to reduce overall GHG emissions from its own operations for well over a decade and has helped to develop technology that can reduce emissions from a range of industries. For example, our Quest project in Canada captured and safely stored more than 1 million tonnes of carbon dioxide (CO2) deep underground in 2016, its	We are positioning for the energy transition and a lower carbon future in a number of ways. Managing our own emissions, investing in more gas, the cleanest out of the fossil fuels which has a major role to play in the power sector, and in the longer term investing in low carbon energy solutions which we call new energies. By way of example only: our CEO has explicitly talked about investing up to perhaps $1 billion a year by

Risk driver	Description	Potential impact	Time-frame	Direct / Indirect	Like-lihood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
	brought about by the energy transition (e.g. Oil, Gas and CO2 prices) will require energy suppliers like Shell, needing to adapt their business models or face lower demand for products and potential impairments to some less energy efficient assets. This could have material impact on Shell's operational performance, earnings, cash flows and financial condition.						that describes an energy pathway consistent with the goal of limiting the average global temperature increase to 2°C. Our preliminary view, looking through 2040, is that the CO2 costs and oil and gas prices forecast under the IEA's 450 Scenario would have a slightly negative impact on planned portfolio cash flow.	first full year of operation. Cleaner and lower-carbon fuels, such as natural gas and biofuels, combined with more widespread use of technologies such as CCS, are needed for limiting CO2 emissions across the global economy. We created a New Energies business in 2016 to further explore opportunities in alternative transport fuels, such as biofuels and hydrogen, along with new ways to connect energy producers and consumers, including through increased use of digital technology.	2020 as long as viable, profitable projects are available. Shell, along with other OGCI members have committed to investing $1 billion over 10 years in low-carbon technologies including CCS.
Reputation	In the future, in order to help meet the world's energy demand, we will produce more oil from unconventional sources. Therefore, it is	Wider social disadvantages	>6 years	Direct	About as likely as not	Medium-high	The management of GHG emissions will become increasingly important as concerns over climate change lead to tighter environmental regulations. Policies and regulations designed to limit the increase in global temperatures to well	Shell is working towards reducing its carbon intensity and shaping our portfolio and business strategy. Since 2016, our New Energies business is overseeing investments in renewables, such as wind, solar and biofuels but also goes beyond	a) We have a CO2 and energy management programme that includes monitoring the energy efficiency of equipment. b) We have secured final investment decisions for CCS projects, including Mongstad and the Gorgon LNG project. By way of example: at the

Risk driver	Description	Potential impact	Time-frame	Direct / Indirect	Like-lihood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
	expected that the CO2 intensity of our production will increase. If we are unable to find CO2 solutions for new and existing projects, challenges from society could lead to project delays, additional costs and operational risks.						below 2°C could have a material adverse effect on us. If we are unable to find economically viable, as well as publicly acceptable, solutions that reduce our GHG emissions and/or GHG intensity for new and existing projects or products, we could experience additional costs or financial penalties, delayed or cancelled projects, and/or reduced production and reduced demand for hydrocarbons, which could have a material adverse effect on our operational performance, earnings, cash flows and financial condition.	traditional renewables spanning digital revolution, more electrification in transport, more energy mix choices for customers. Shell seeks cost-effective ways to manage GHG emissions and explores potential business opportunities in developing such solutions. Our 4 main contributions are supplying more natural gas to replace coal for power generation; progressing CCS technologies; developing lower carbon energies; and implementing energy-efficiency measures in our operations. We continue to advocate the introduction of effective government-led carbon pricing mechanisms and to work with governments, industry, and NGOs to support effective climate policies; we are a member of various industry initiatives/trade associations, incl. IPIECA and OGCI, dedicated to help the oil and gas industry improve its performance. In 2015, we	time of the FID, Quest had an estimated cost of US$1.35 billion. c) In 2016, we invested $1,014 million in R&D. By way of example only: our CEO has explicitly talked about investing up to perhaps $1 billion a year by 2020 as long as viable, profitable projects are available. We support the development and implementation of new energy technologies by investing in companies and technologies that are complementary to Shell's existing business. It is also important that we work with coalitions, both within industry and more broadly, to help meet the challenge of climate change. In late 2016, for example, we were one of 10 oil and gas companies that jointly pledged to invest $1 billion in technologies with the potential to reduce GHG emissions.

Risk driver	Description	Potential impact	Time-frame	Direct / Indirect	Like-lihood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
								signed up to the World Bank´s Zero Routine Flaring by 2030 initiative. E.g., Shell Iraq Petroleum Development (Shell interest 45%) safely installed a gas-capturing system at our Majnoon facilities which captured about 65% of gas that would otherwise be flared in 2016 - around 90 mln scf/day. This marks a significant milestone in our efforts to reduce gas flaring at Majnoon and deliver natural gas for power generation in Iraq.	
Other drivers	Long term changes in product demand due to climate change regulation. Impact of direct and indirect regulation on demand for oil products, especially road transport fuels. Policies that raise fuel costs, improve vehicle efficiency or reduce	Other: Falling sales revenue and earnings	>6 years	Direct	Very likely	Medium-high	GHG regulations are likely to focus more on suppressing demand for fossil fuels. By 2030, IEA's 450 Scenario describes significant renewables penetration, marked improvement in vehicle/process efficiency and widespread replacement of coal with natural gas; CCS is storing around 40x the CO2 volume it does now; O&G price assumptions in 2030 are ~$97/b and $9/MMbtu, respectively (real terms), global CO2 equivalent costs $100/t (real terms). Related	Long term trends in product demand and their causes are an integral part of Shell's energy scenarios. The business plans tend to work on shorter time periods and may overlook such trends. The Shell strategic plan, which bridges the plan and scenario time scale is the point of such guidance.	In the short term, ahead of the risk occurring, management costs are restricted to monitoring such trends and formulating viable strategic responses.

Risk driver	Description	Potential impact	Time-frame	Direct / Indirect	Like-lihood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
	average distances driven will reduce fuel demand.						impact on expected production (2015-2030) is decreasing global demand for oil by 17%; growing demand for natural gas by 8%. Reducing demand for transport fuels could lead to reduced revenue/net profits. Annual financial impact of those trends could be in the $100mlns category. Those impacts could be intensified by lack of refinery competitiveness as industry capacity surplus is generated. A shift, even if not a net reduction, in global demand, such as reduction in OECD sales and growth in non-OECD sales, could threaten net global earnings too.		

Further Information

CC5.1a, line "Cap and Trade Schemes" http://www.mckinsey.com/industries/oil-and-gas/our-insights/co2-abatement-exploring-options-for-oil-and-natural-gas-companies

Page: CC6. Climate Change Opportunities

CC6.1 **Have you identified any inherent climate change opportunities that have the potential to generate a substantive change in your business operations, revenue or expenditure? Tick all that apply**

Opportunities driven by changes in regulation
Opportunities driven by changes in physical climate parameters
Opportunities driven by changes in other climate-related developments

CC6.1a Please describe your inherent opportunities that are driven by changes in regulation

Opportunity driver	Description	Potential impact	Time-frame	Direct /In-direct	Likelihood	Magnitude of impact	Estimated financial implications	Management method	Cost of management
Fuel/energy taxes and regulations	Instruments aimed at reducing emissions from the use of fuels/energy provide incentives to develop alternative lower carbon fuels e.g. Shell investment in biofuels (Joint Venture Raízen), hydrogen and wind.	New products/business services	1 to 3 years	Direct	Very likely	Medium-high	Regulatory action on climate change focuses on policy frameworks development introducing a CO2 cost into economy, incl. fuel standards (e.g. Low Carbon Fuel Standard, California). International market for biofuels is growing, driven largely by introduction of new energy policies in Europe/USA calling for more renewable, lower-carbon fuels for transport. Acc. to IEA, biofuels can provide up to 27% of world transportation fuel by 2050. Shell is one of the largest blenders and distributers of biofuels worldwide. In 2016, we used around 9.5 bln litres of biofuel in our gasoline and diesel blends wordwide. Our JV Raízen reached an EBITDA of BRL 6.3 billion, which was 28.8% higher than the previous year, its net operating revenue increased 13.9%, to BRL 74.1 billion. Raízen ended the crop year	Shell invests in low carbon energy solutions, which we call new energies. Shell's new energies business actively explores opportunities where the commercial value is clear. We have invested in the past, and we intend to continue to invest in new opportunities at scale in the future. Shell´s New Energies business covers a number of important themes including new fuels for mobility, such as advanced biofuels and hydrogen. In 2016, our joint venture Raízen (Shell interest 50%) produced more than 2 billion litres of low-carbon ethanol from Brazilian sugar cane. This JV will allow us to supply low-CO2 fuels to regulated markets like California. We continue to invest in new ways of producing biofuels from sustainable	We believe that low-carbon biofuels are one of the most viable ways to reduce CO2 from transport fuels in the coming years. Our New Energies strategy includes to grow our investment in this area up to $1 bln by 2020. Our Raízen joint venture (not part of New Energies) (Shell interest 50%) in Brazil produces low-carbon biofuel from sugar cane. We are also investing in research to help develop and commercialise advanced biofuels. Investments in the 2015/2016 crop year amounted to BRL 2.5 billion, between Raízen Energy (Raízen Energia) - which invested approx. BRL 1.8 billion - and Raízen Fuels (Raízen Combustíveis), responsible for BRL 0.7 billion.

Opportunity driver	Description	Potential impact	Time-frame	Direct /In-direct	Likeli hood	Magnit ude of impact	Estimated financial implications	Management method	Cost of management
							with net debt of BRL 7.1 billion, resulting in leverage of 1.1x EBITDA. (see Raízen Annual Report 2015//2016).	feedstock's, such as biofuels made from waste products or cellulosic biomass. These advanced biofuels could potentially emit less CO2 in the production process than the biofuels available today. In 2015, Raízen opened its first cellulosic ethanol plant at its Costa Pinto mill in Brazil. Production in 2016 was almost 6.9 million litres, over time the mill is expected to produce around 40 million litres a year of advanced biofuels from sugar-cane residues. Shell has also two pilot plants in the USA, which convert cellulosic biomass into a range of products, including petrol, aviation fuel and ethanol. Another pilot plant is being installed in Bangalore, India, that will demonstrate a technology called IH2 that turns waste into fuel using a two-stage catalytic reaction.	In Shell, in our New Energies business that we established in 2016, we aim to grow investment to perhaps $1 billion a year by the end of the decade.
Cap and trade schemes	Regulatory action on climate change is focused on the development	Other: Potential to provide new products, business services;	1 to 3 years	Direct	Very likely	Medium -high	Some EU - ETS allowances will be distributed on the basis of benchmarks. A higher performance against the benchmark offers the opportunity to secure additional allowances. Shell	We continue to work on improving energy efficiency at our oil and gas production facilities, refineries and chemical plants. Measures include our GHG and energy	Energy typically accounts for around half of all costs at refineries and chemical plants. We continue to research and develop technologies that increase efficiency

Opportunity driver	Description	Potential impact	Time-frame	Direct /In-direct	Likeli hood	Magnit ude of impact	Estimated financial implications	Management method	Cost of management
	of carbon pricing, such as the EU-ETS or the upcoming carbon tax in South Africa. Shell is operating in these areas and thus it will affect the company. Such schemes give rise to a cost for emitting CO2, which in turn incentivises solutions and provides opportunity for business development.	wider social benefits.					has implemented an energy efficiency programme in its assets and thus has an opportunity to increase income by selling allowances.	management programme that focuses on the efficient operation of existing equipment by using monitoring systems which give us instant information that we can use to make energy-saving changes. This gives Shell a competitive advantage in emissions trading schemes. Greater efficiency of operations reduces Shell's GHG emissions in a given market, reducing the level of equivalent GHG emissions allowances that a given asset is required to purchase. Shell produces GHG and energy management plans with annual updates for Shell-operated facilities that account for more than 50,000 tonnes of GHG emissions per year, and for each proposed project that will account for more than 500,000 tonnes of GHG emissions per year. In 2016, chemical plants and refineries continued to focus on operational improvements. For example, the combined heat and power plant at our Bukom refinery and chemical plant in Singapore	and reduce emissions in hydrocarbon production. Shell continues to invest in research and development (R&D) to improve the efficiency of our products, processes and operations, and to develop new technology solutions for the energy transition. In 2016, we invested $1,014 million in R&D.

Opportunity driver	Description	Potential impact	Time-frame	Direct /In-direct	Likeli hood	Magnit ude of impact	Estimated financial implications	Management method	Cost of management
								had its first full year of operation in 2016. It is expected to reduce total energy consumption at Bukom by between 4% and 5%, saving more than 200,000 tonnes of CO2 a year.	
Other regulatory drivers	Coal to gas fuel switching could result in growth in natural gas demand and increased gas production and sales opportunities.	Increased demand for existing products/services	Up to 1 year	Direct	Virtually certain	High	Increases in revenue from increased demand for gas: acc. to IEA, over 40% of global emissions in 2013 came from electricity/heat generation. For many countries, using more gas in power generation instead of coal can make the largest contribution, at lowest cost, to meet GHG reduction objectives. Today, new global LNG supply is mainly coming from Australia, North America, East Africa. We expect the global LNG market to grow to around 460mtpa by 2030. The addition of BG`s competitive natural gas positions makes strategic sense, ahead of the long-term growth in demand we see for this cleaner-burning fuel. Q1-2017: Shell is the IOC leader in LNG; the largest independent producer and marketer of LNG; with 42mtpa of liquefaction capacity; 61 mt LNG sales	Shell is the leading IOC today in the global LNG industry. We were a pioneer of the LNG industry five decades ago and, today, one of the largest LNG suppliers. LNG links gas in remote locations to power markets world-wide, and particularly in Asia Pacific. Even after liquefying, transporting and turning it back into natural gas, LNG emits around half the CO2 compared to coal when burnt to generate electricity. Shell is developing our first FLNG facility, Prelude FLNG (Shell interest 67.5%), which will be located 475 km off the coast of Western Australia. And enables us to produce, liquefy, store and transport LNG at sea. As a result of the BG acquisition, we have a majority interest in the QGC Project in Queensland,	Shell is one of the world's leading suppliers of LNG, with a growing portfolio. In January 2014, Shell completed the acquisition of Repsol S.A.'s LNG portfolio outside of North America for a net cash purchase price of $3.8 billion, subject to post-closing adjustments. Capital investment of $3.4 billion was reported in 2013. During Q1/2016, Shell completed the acquisition of BG for a purchase consideration of $54,034 mln. This includes cash of $19,036 mln, and the fair value ($34,050 mln) of 1,523,804,425 shares issued in exchange for all BG shares. This should add significant scale and profitability, particularly in LNG worldwide.

Opportunity driver	Description	Potential impact	Time-frame	Direct /In-direct	Likeli hood	Magnit ude of impact	Estimated financial implications	Management method	Cost of management
							volumes 4Q rolling (Q1/16: 12.29mtpa and Q1/17: 15.84mtpa); 6.3mtpa liquefaction capacity under construction incl. capacity rights from 3rd party plants.	Australia. The Shell-operated project consists of onshore production areas piping natural gas to a two-train LNG facility. Shell holds a 50% interest in train one and a 97.5% interest in train two, and a 100% interest in the common facilities on the LNG plant.	
Cap and trade schemes	Proliferation of emissions trading systems present opportunities for the expansion of our carbon trading business.	Increased demand for existing products/services	1 to 3 years	Direct	More likely than not	Low-medium	Shell offers access to almost every environmental trading market in the world. We are able to assist our customers in several markets including: the EU ETS, Clean Development Mechanism, emerging carbon markets such as New Zealand ETS and North American markets, renewable energy markets for both voluntary needs and compliance programs. Point Carbon estimates the value of global carbon markets at €70 bln in 2015.	In the EU ETS and CDM /JI markets, the main products we buy and sell are EU Allowances (EUAs), Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs). We also trade UK Allowances (UKAs), RECs, ROCs and EU Aviation Allowances, Californian Allowances, New Zealand Units and others.	Shell has almost a decade of experience and proven risk management capabilities in the environmental trading marketplace in Europe. We are active in Asia and the USA. Shell was the first company to execute a trade in European Union Allowances (EUAs) and more recently, the first company to trade US federal CO2 compliance futures contracts on the Chicago Climate Futures Exchange.

CC6.1b Please describe your inherent opportunities that are driven by changes in physical climate parameters

Opportunity driver	Description	Potential impact	Timeframe	Direct / Indirect	Likelihood	Magnitude of impact	Estimated financial implications	Management method	Cost of management
Other physical climate opportunities	Natural gas can also act as a partner for intermittent renewable energy, such as solar and wind, to maintain a steady supply of electricity, because gas-fired plants can start and stop relatively quickly. A warmer climate may result in reduced thermal efficiency and reduced load - including shutdowns - in thermal power plants.	Increased demand for existing products/ services	>6 years	Direct	About as likely as not	Low	Increased revenue from increased demand for gas and LNG. The Fukushima nuclear disaster in Japan is an example of how natural gas/LNG can act as a partner to help meet immediate demand in the absence of renewables. According to an external energy research group, the disaster resulted in an increase in unplanned LNG consumption by ~27% compared to prior to the accident. It is noted that Qatar in particular contributed greatly to meeting this demand due to its expanded LNG production capacity. It is difficult to estimate Shell's LNG sales contribution to the increased LNG demand, however, as reported in the 2012 investors handbook (page 20), our total LNG sales volume in 2012 was 20.2 million tonnes – up 7% from 2011. This increase mainly reflected the increase in sales volumes from Qatargas 4 and Pluto LNG Project (Source: http://web.mit.edu/12.000/	Natural gas today is around half of Shell's production. Today, new global LNG supply is mainly coming from Australia, North America and East Africa. At the same time, we expect LNG demand to rise by 5% each year over the next two decades. Shell is currently involved in several LNG projects around the world We are constructing our first FLNG facility, Prelude FLNG (Shell interest 67.5%), which will be located 475 km off the coast of Western Australia. In 2016, the project began the transition from construction to commissioning and start-up activities at the shipyard in Geoje, South Korea. The undersea infrastructure has also been completed in preparation for the arrival of Prelude. Once completed, Prelude FLNG will be the largest floating offshore facility in the world. Also, LNG can be utilized as transport fuel (trucks / vessels). For example, Carnival Cruisers will order up to 13 cruise ships on LNG and Shell was received exclusive rights for their supply with LNG.	Shell is one of the world's leading suppliers of LNG, with a growing portfolio. In January 2014, Shell completed the acquisition of Repsol S.A.'s LNG portfolio outside of North America for a net cash purchase price of $3.8 billion, subject to post-closing adjustments. Capital investment of $3.4 billion was reported in 2013. During Q1/2016, Shell completed the acquisition of BG for a purchase consideration of $54,034 mln. This includes cash of $19,036 mln, and the fair value ($34,050 mln) of 1,523.804,425 shares issued in exchange for all BG shares. This brings in a world-wide addition to our LNG business, and a growth position, for example, in new LNG in Queensland, Australia.

Opportunity driver	Description	Potential impact	Timeframe	Direct / Indirect	Likelihood	Magnitude of impact	Estimated financial implications	Management method	Cost of management
							www/m2018/pdfs/japan/policy.pdf). Furthermore, Shell's global presence in LNG provides the flexibility to support global markets.		
Change in temperature extremes	Growth in demand for products that improve insulation efficiency like styrene monomers and rigid polyols, which Shell is already producing.	New products/ business services	>6 years	Direct	About as likely as not	Low	As physical changes in climate result in increases in mean and extreme temperatures, improving efficiency of cooling will become increasingly more critical. This can potentially lead to greater demand for high quality insulation materials and related chemical feedstock.	We are reviewing the market developments and this opportunity and associated costs / revenues and plans for managing the opportunity are currently under development. For example, the chemicals sector, one of our growth priorities, is the fastest growing hydrocarbon demand sector with annual global demand growth of 3.7% over the last 10 years. We see key drivers for global growth in demand for chemicals – increased population, rising standards of living and urbanisation – continuing. Chemical products are essential to peoples' everyday lives, from health and hygiene to transport, construction and computing. According to a study conducted by the International Council of Chemical Associations, the biggest opportunities to reduce carbon dioxide (CO_2) emissions over the lifetime of a product are in areas such as insulation, packaging materials, synthetic textiles, automotive plastics and	We are monitoring the market developments and this opportunity and associated costs / revenues and plans for managing the opportunity are currently under development.

Opportunity driver	Description	Potential impact	Timeframe	Direct / Indirect	Likelihood	Magnitude of impact	Estimated financial implications	Management method	Cost of management
								low-temperature detergents. Many petrochemical products will play a role in a low carbon future. The large majority of Shell's petrochemical output comprises ethylene-based products such as styrene and higher olefins. Products made from these chemicals can enable CO2 savings over their lifetime. Besides this, we also work to improve energy efficiency performance and reduce Shell's greenhouse gas emissions across our chemical plants and we are making good progress there.	

CC6.1c Please describe your inherent opportunities that are driven by changes in other climate-related developments

Opportunity driver	Description	Potential impact	Time-frame	Direct / In-direct	Like-lihood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
Changing consumer behavior	Growth in demand for goods and services that can lower customers' energy consumption and/or reduce	New products/ business services		Direct	Very likely	High	Shell invests in a portfolio of lower-carbon energy opportunities, incl. technologies and fuels. We supply fuels to millions of drivers, and for more than a century, our scientists have worked on improving products. E.g.,	We created a New Energies business in 2016 to further explore opportunities in alternative transport fuels, such as biofuels and hydrogen, along with new ways to connect energy producers and consumers, including through increased use of digital	Innovation and advanced technologies play a crucial role in the energy transition Our research and development (R&D) activities aim to address the need for more energy while reducing

Opportunity driver	Description	Potential impact	Time-frame	Direct / In-direct	Like-lihood	Magni-tude of impact	Estimated financial implications	Management method	Cost of management
	their CO2 emissions, for example demand for advanced fuels and lubricants, hydrogen and biofuels – areas in which Shell is currently investing in because this is an opportunity for growth.						Shell FuelSave Diesel contains ingredients designed to improve fuel-efficiency. In 2016, Shell introduced a new range of heavy-duty engine oils in the USA, under the Shell Rotella brand. These were developed to meet the requirements of new American Petroleum Institute specifications for lubricants, which include reducing engine emissions. Over the past 6-7 years, Shell has invested over $1.1 billion in low-carbon R&D, incl. hydrogen. Hydrogen has the potential to be an important low-carbon transport fuel. Acc. to the World Energy Technology Outlook, by 2050, hydrogen is estimated to provide 13% of final energy consumption. Currently, around 90% of hydrogen is used in transport. (Source: http://europa.eu/rapid/press-release_MEMO-07-2_en.htm?locale=en.)	technology. Shell is part of several initiatives to encourage the adoption of hydrogen electric energy e.g. In Germany, the government is supporting the development of a national network of hydrogen electric fuel stations across the country by 2023. We are working on this project with our joint-venture partners in H2 Mobility Germany. In 2016, the first two stations in the H2 Mobility network opened in Germany. Our joint venture, Raízen (Shell interest 50%), in Brazil is the world's largest producer of sugar-cane ethanol - that can reduce CO2 emissions by around 70% compared with conventional petrol, across its lifecycle. In 2016, Raízen produced more than 2 billion litres of low-carbon ethanol from Brazilian sugar cane.	the environmental impact. We look at research and development across three time horizons, and over the last 6-7 years we have spent over $1.1 billion in low-carbon R+D. In Shell, in our New Energies business that we established in 2016, we aim to grow investment to perhaps $1 billion a year by the end of the decade.

Further Information

NEW LENS SCENARIOS
This publication contains data from Shell's New Lens Scenarios. The New Lens Scenarios are a part of an ongoing process used in Shell for 40 years to challenge executives' perspectives on the future business environment. We base them on plausible assumptions and quantifications, and they are designed to stretch management to consider even events that may only be remotely possible. Scenarios, therefore, are not intended to be predictions of likely future events or outcomes and investors should not rely on them when making an investment decision with regard to Royal Dutch Shell plc securities.
CAUTIONARY NOTE
The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate legal entities. In this report, "Shell", "Shell group" and "Royal Dutch Shell" are sometimes used for convenience where references are made to Royal Dutch Shell plc and its subsidiaries in general. Likewise, the words "we", "us" and "our" are also used to refer to subsidiaries in general or to those who work for them. These expressions are also used where no useful purpose is served by identifying the particular company or companies. "Subsidiaries", "Shell subsidiaries" and "Shell companies" as used in this publication refer to companies over which Royal Dutch Shell plc either directly or indirectly has control. Entities and unincorporated arrangements over which Shell has joint control are generally referred to as "joint ventures" and "joint operations" respectively. Entities over which Shell has significant influence but neither control nor joint control are referred to as "associates". The term "Shell interest" is used for convenience to indicate the direct and/or indirect (for example, through our 23% shareholding in Woodside Petroleum Ltd.) ownership interest held by Shell in a venture, partnership or company, after exclusion of all third-party interest. This report contains forward-looking statements concerning the financial condition, results of operations and businesses of Royal Dutch Shell. All statements other than statements of historical fact are, or may be deemed to be, forward-looking statements. Forward-looking statements are statements of future expectations that are based on management's current expectations and assumptions and involve known and unknown risks and uncertainties that could cause actual results, performance or events to differ materially from those expressed or implied in these statements. Forward-looking statements include, among other things, statements concerning the potential exposure of Royal Dutch Shell to market risks and statements expressing management's expectations, beliefs, estimates, forecasts, projections and assumptions. These forward-looking statements are identified by their use of terms and phrases such as "anticipate", "believe", "could", "estimate", "expect", "goals", "intend", "may", "objectives", "outlook", "plan", "probably", "project", "risks", "schedule", "seek", "should", "target", "will" and similar terms and phrases. There are a number of factors that could affect the future operations of Royal Dutch Shell and could cause those results to differ materially from those expressed in the forward-looking statements included in this report, including (without limitation): (a) price fluctuations in crude oil and natural gas; (b) changes in demand for Shell's products; (c) currency fluctuations; (d) drilling and production results; (e) reserves estimates; (f) loss of market share and industry competition; (g) environmental and physical risks; (h) risks associated with the identification of suitable potential acquisition properties and targets, and successful negotiation and completion of such transactions; (i) the risk of doing business in developing countries and countries subject to international sanctions; (j) legislative, fiscal and regulatory developments including regulatory measures addressing climate change; (k) economic and financial market conditions in various countries and regions; (l) political risks, including the risks of expropriation and renegotiation of the terms of contracts with governmental entities, delays or advancements in the approval of projects and delays in the reimbursement for shared costs; and (m) changes in trading conditions. All forward-looking statements contained in this report are expressly qualified in their entirety by the cautionary statements contained or referred to in this section. Readers should not place undue reliance on forward-looking statements. Additional risk factors that may affect future results are contained in Royal Dutch Shell's 20-F for the year ended December 31, 2016 (available at www.shell.com/investor and www.sec.gov). These risk factors also expressly qualify all forward-looking statements contained in this report and should be considered by the reader. Each forward-looking statement speaks only as of the date of this report, submitted 29 June 2017. Neither Royal Dutch Shell plc nor any of its subsidiaries undertake any obligation to publicly update or revise any forward-looking statement as a result of new information, future events or other information. In light of these risks, results could differ materially from those stated, implied or inferred from the forward-looking statements contained in this report. We may have used certain terms, such as resources, in this report that the United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. US investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website www.sec.gov.