ACHIEVING NET-ZERO EMISSIONS

Our Powering Progress strategy focuses on working with our customers and across sectors to accelerate the transition to net-zero emissions, in step with society. A net-zero world is one where society stops adding to the total amount of greenhouse gases in the atmosphere.

OUR CLIMATE TARGET

OUR APPROACH

Shell's target is to become a net-zero emissions energy business by 2050, in step with society's progress in achieving the goal of the UN Paris Agreement on climate change.

With this target, we will contribute to a net-zero world, where society stops adding to the total amount of greenhouse gases (GHGs) in the atmosphere. This supports the most ambitious goal to tackle climate change laid out in the Paris Agreement: to limit the rise in average global temperature to 1.5 degrees Celsius above pre-industrial levels.

Becoming a net-zero emissions energy business means that we are reducing emissions from our operations, and from the fuels and other energy products we sell to our customers. It also means capturing and storing any remaining emissions using technology or balancing them with offsets.

We are transforming our business to meet our target, providing more low-carbon energy such as charging for electric vehicles, hydrogen and electricity generated by solar and wind power.

We are also working with our customers as they make changes too, including in sectors that are difficult to decarbonise, such as aviation, shipping, road freight and industry.

We believe our emissions peaked in 2018 and we will continue to work to bring them down.

We will reduce emissions from our own operations, including the production of oil and gas, by increasing energy efficiency and capturing or offsetting any remaining emissions. Emissions from our own operations make up less than 10% of our total emissions.

Most of our emissions come from the use of the energy we sell, so we aim to help our customers cut their emissions when they use that energy. Importantly, our target includes emissions not only from the energy we produce and process ourselves, but also from all the energy products that others produce, such as oil, gas, biofuels and electricity, and that we sell to our customers.

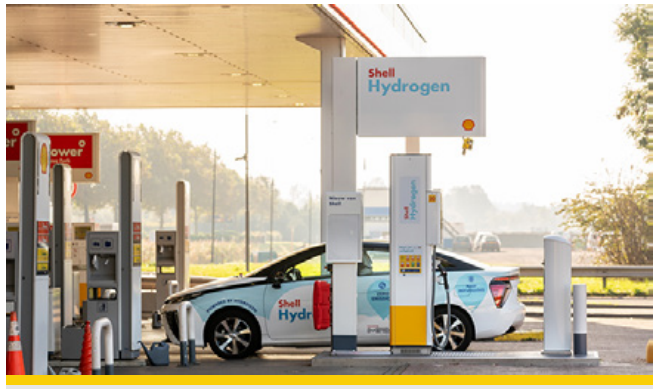
Becoming a net-zero emissions energy business means that we are reducing emissions from our operations, and from the fuels and other energy products we sell to our customers.

We play three roles

We are an energy provider. Becoming a net-zero emissions energy business means offering customers more low-carbon products, from renewable electricity to charging for electric vehicles and hydrogen. We aim to reduce the carbon intensity of the energy products we sell by 100% by 2050, in step with society. Carbon intensity is the total amount of GHG emissions associated with each unit of energy we sell, and which is used by our customers. This includes the emissions associated with the production, processing, transport and end use of our energy products. The calculation also subtracts emissions that are stored by using carbon capture and storage or are offset using natural carbon sinks, such as forests and wetlands. Read about how we measure this in Our carbon intensity.

We are an energy user. Our target is to achieve net-zero emissions from all our operations, as well as from the energy we need to power them. That means that any GHG emissions from making our products that cannot be avoided will be captured or offset using technology and nature.

We are a partner for change. Working with our customers, we are helping them to address the emissions created when they use products bought from us. We are also helping our customers to find ways to reduce their overall carbon footprints. Partnering with others includes supporting government policies to reduce carbon emissions, sector by sector.



We are transforming our business to meet our target of becoming a net-zero emissions energy business by 2050, in step with society, by providing more low-carbon energy such as hydrogen.

Business milestones

We are taking steps to cut emissions from our existing oil and gas operations, and to avoid generating more in the future. Here are some of Shell's business milestones:

- We believe our annual oil production peaked in 2019, and we expect our total oil production to decline by 1-2% a year until 2030.
- Natural gas emits 45-55% fewer GHG emissions than coal when used to generate electricity, according to IEA data. We expect the percentage of total gas production in our portfolio to gradually rise to 55% or more by 2030.
- By 2030, we will end routine flaring of gas from the assets we operate.
- By 2025, we expect to have kept the methane emissions intensity of Shell-operated assets to below 0.2%.

- We have linked the pay of more than 16,500 staff to our target to reduce the carbon intensity of our energy products by 6-8% by 2023, in comparison with 2016.
- We are the first energy company to offer shareholders an advisory vote on its energy transition strategy at its Annual General Meeting. We will do this every three years, starting in 2021.

EXTERNAL VOICE

PEDRO FARIA
CDP

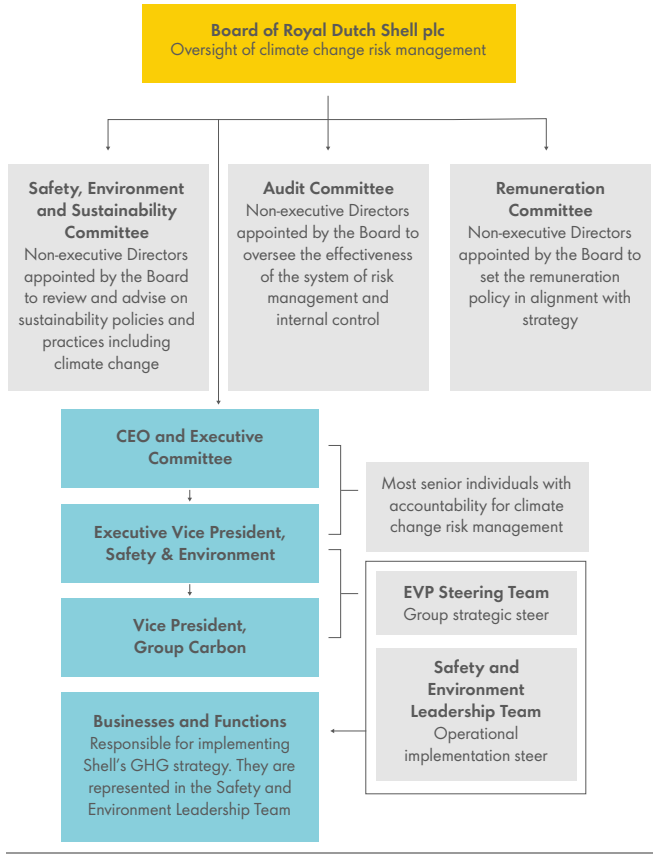
Pedro is a strategic adviser at CDP, a not-for-profit charity that runs a global disclosure system for investors, companies, cities, states and regions to manage their environmental impacts.

"We need help from everyone in achieving ambitious standards matched with the level of ambition we have as a society. Standards are essential for science-based targets, including a comprehensive look at emissions across the full value chain, both intensity and absolute targets, and including specific requirements for emissions from the consumption of energy products and also refining and production.

"We also need to assess the contribution of individual companies in achieving the Paris Agreement and net-zero goals by 2050 in a way that is dynamic and future-oriented. We need to account for the time lag between investments today, and emissions in five, 10 and 15 years. Because of this time lag challenge, we need extra scrutiny and I would say uber transparency.

"Continuing to evolve the reporting requirements for companies will be essential to building trust."

CLIMATE CHANGE MANAGEMENT ORGANOGRAM

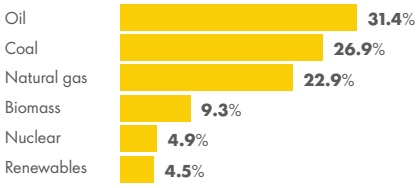


TODAY'S ENERGY USE

PRIMARY ENERGY DEMAND

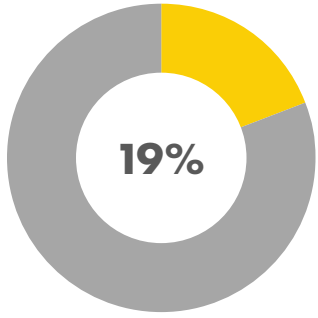
The global economy gets most of its energy from coal, oil and gas, with around a fifth of all energy being used to generate electricity. Energy sources differ across industry, transport and domestic use, which all need to transition to low-carbon options.

GLOBAL ENERGY DEMAND BY TYPE



ELECTRICITY

The power sector transforms primary energy, such as gas, coal or renewables, into the electricity used in other end-use sectors. Because electricity is emission-free at its point of use, decarbonisation of the power sector can enable decarbonisation elsewhere.

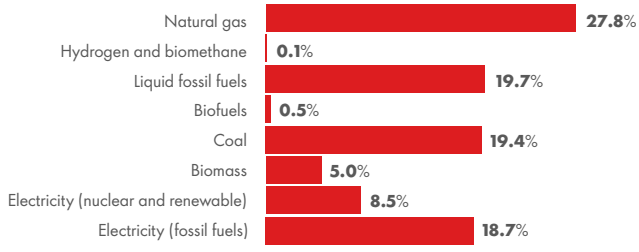


19% of total final consumption is electricity

ENERGY USE BY SECTOR

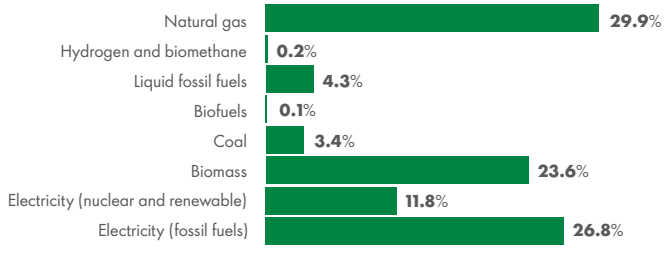
INDUSTRY

There are currently no easy replacements for hydrocarbons in energy-intensive industries, such as in petrochemicals or in iron and steel manufacturing where extremely high temperatures need carbon-intensive processes.



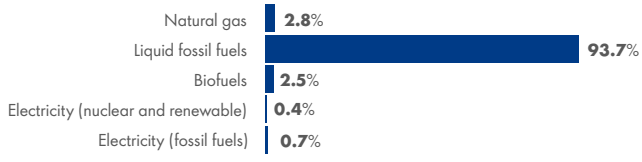
BUILDINGS

The buildings sector is responsible for around one-third of global final energy consumption and is also the source of a large proportion of electricity demand and therefore emissions in the power sector. The primary use of energy in buildings is for heating or cooling, lighting and cooking.



TRANSPORT

Oil currently powers more than 90% of transport, with aircraft, motor vehicles and ships in use for between 15 and 25 years.



Source: Shell analysis based on data from the IEA (2020) World Energy Balances, all rights reserved

OUR CARBON INTENSITY

Tackling climate change is an urgent challenge. We will contribute to a net-zero world, where society stops adding to the total amount of greenhouse gases (GHG) in the atmosphere. That is why we have set a target to become a net-zero emissions energy business by 2050, in step with society. This supports the most ambitious goal to tackle climate change laid out in the Paris Agreement: to limit the rise in average global warming to 1.5 degrees Celsius.

We have set short-, medium- and long-term targets to reduce the carbon intensity of the energy products we sell, in step with society. These targets are measured using the Net Carbon Footprint metric and methodology. Our Net Carbon Footprint is a carbon intensity measure that takes into account the life-cycle GHG emissions of the products we sell, including our customers' emissions when they use these products. For more on how we calculate our Net Carbon Footprint visit www.shell.com/ncf

We have set short-term reduction targets of 2-3% by 2021, 3-4% by 2022, and 6-8% by 2023 (compared with 2016). Our medium- and long-term reduction targets are 20% by 2030, 45% by 2035, and 100% by 2050 (compared with 2016). The updated 2035 and 2050 targets reflect the fact that we will start to include all actions taken to reduce emissions when we calculate our carbon intensity. This includes the actions we take ourselves as well as actions taken by the users of the energy products we sell.

We are taking steps to reduce emissions from our existing operations, including at our Moerdijk petrochemicals complex in the Netherlands, where we invested in new furnaces that reduce energy consumption and emissions.

We have linked the pay of more than 16,500 staff to our target to reduce the carbon intensity of our energy products by 6-8% by 2023, compared with 2016.

Achieving our target

We are already taking steps to cut GHG emissions from our existing oil and gas operations, and to avoid generating more in the future.

We are increasing the proportion of lower-carbon products such as natural gas, biofuels, electricity and hydrogen in the mix of products we sell. Customers' emissions from using our energy products account for over 90% of Shell's total emissions. That is why we are working with our customers to help them address the GHG emissions they produce when they use products sold by us.

We are working with our customers to help them address the GHG emissions they produce when they use products sold by us.

To reduce carbon emissions across sectors, we are partnering with our customers and others; this includes support for government policies.

We are also investing in ways to mitigate emissions through capturing and storing CO_2 safely underground, or by planting and protecting natural ecosystems.

Net Carbon Footprint performance

We express our Net Carbon Footprint as the grams of CO_2 equivalent per megajoule (gCO_2e/MJ) produced for each unit of energy delivered to, and used by, a consumer.

Shell's Net Carbon Footprint in 2020 was 75 gCO_2e/MJ, a 4% reduction from the previous year and a 5% reduction from the 2016 reference year. In 2020, one of the major causes of this reduction was lower demand for energy. Demand for oil products experienced the most significant reduction, followed by natural gas and LNG. Another important factor contributing to the reduction of the Net Carbon Footprint was the increase in our power sales in absolute terms as well as their share of the energy mix sold by Shell. The power we sold also had a lower average emissions intensity than in previous years, which further contributed to the overall reduction.

	2020	2019	2018	2017
Net Carbon Footprint (gCO_2e/MJ) [A]	75	78	79	79

[A] Retail sales volumes from markets where Shell operates under trademark licensing agreements are excluded from the scope of the Net Carbon Footprint.

Lloyd's Register Quality Assurance Ltd has provided limited assurance for our Net Carbon Footprint assertion for each year from 2016 to 2020. Limited assurance means nothing has come to the auditor's attention that would indicate that the Net Carbon Footprint data and information as presented in the Net Carbon Footprint assertions were not materially correct.

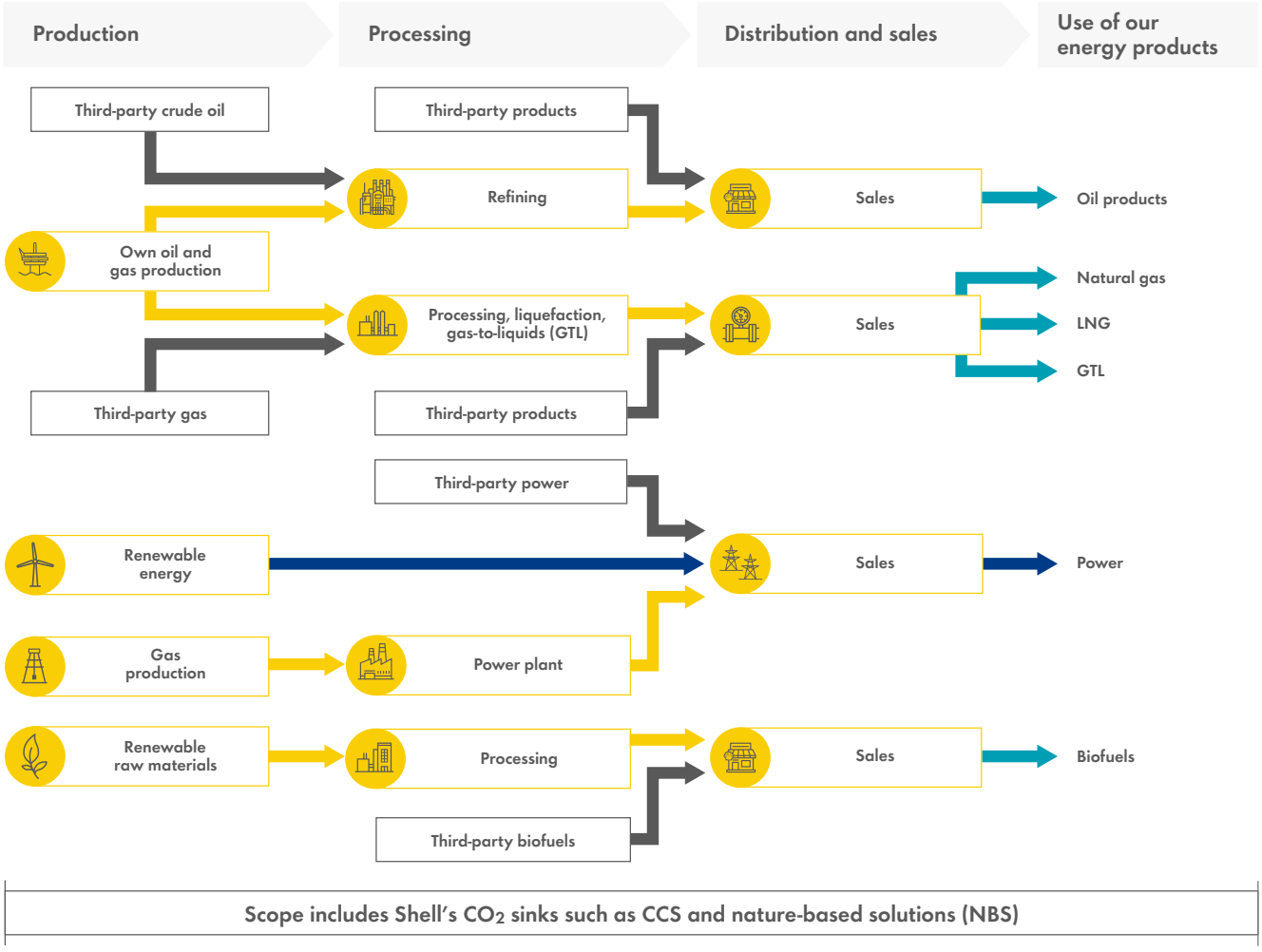
Data sources

The Net Carbon Footprint calculation uses production and product sales data taken from the Annual Report and Accounts. Any other product sales data used for the calculation but not disclosed in the Annual Report and Accounts are disclosed in this Sustainability Report.

For more on how we calculate our Net Carbon Footprint visit www.shell.com/ncf

SCOPE OF OUR NET CARBON FOOTPRINT

Emissions from energy products included within the Net Carbon Footprint framework



SECTORAL DECARBONISATION

Working with our customers, we are helping them to address the greenhouse gas (GHG) emissions they produce when they use products bought from us. We are also helping our customers to find ways to reduce their overall carbon footprints. Partnering with others involves supporting government policies to reduce carbon emissions, sector by sector. This includes sectors that are difficult to decarbonise, such as aviation, shipping, road freight and industry.

For example, we have agreed a deal with Amazon Air to supply up to six million gallons of sustainable aviation fuel. This biofuel, produced by the company World Energy using agricultural waste fats and oils, has significantly lower life-cycle carbon emissions than conventional jet fuel.

We also formed a strategic alliance with Microsoft in 2020. Shell will help supply Microsoft as the technology company works towards its goal of using 100% renewable energy by 2025. Both companies will develop digital tools to help Shell's customers decarbonise.

We are working on more of these strategic relationships, generating value while helping sectors to reduce their carbon emissions.

In shipping, we have also developed and deployed advanced energy-efficiency technologies, such as software that helps guide a vessel's position in the water to cut fuel consumption and lower emissions, as well as advanced engine lubricants that also boost efficiency. We outlined the actions we are taking to help accelerate progress towards net-zero emissions in the shipping sector in our report Setting Shell's Course.

In the road freight sector, we offer nature-based carbon credits to business customers operating heavy- and light-duty fleets in 10 countries across Europe and Asia (see Nature-based solutions). Together with Daimler Truck AG, IVECO, OMV, and the Volvo Group, we will also help create the conditions for the mass-market roll-out of hydrogen trucks in Europe (see Hydrogen).

Industry collaborations

We are a founding member of the Energy Transitions Commission. The commission brings together leaders from a wide range of sectors and interests to accelerate the energy transition while enabling robust economic development and limiting the rise in global average temperature.

In 2020, we agreed to apply six Energy Transition Principles that we jointly developed with BP, Eni, Equinor, Galp, Occidental, Repsol and Total. The principles aim to support collective industry acceleration to contribute to the Paris Agreement goals by delivering progress on reducing GHG emissions, the role of carbon sinks, and transparency and alignment on climate change with trade associations.

The joint approach was welcomed by Climate Action 100+, an initiative led by investors with around $52 trillion in assets under management. Read more about the principles at www.shell.com/leading-energy-companies-announce-transition-principles

We are helping our customers to find ways to reduce their overall carbon footprints, including in sectors that are difficult to decarbonise such as shipping.

We have helped to develop a range of sector-specific programmes under the Mission Possible Platform, an initiative by the World Economic Forum together with the Energy Transitions Commission. The platform focuses on developing partnerships for enabling the heavy-industry and heavy-duty transport sectors to achieve net-zero carbon emissions.

We also work with the Oil and Gas Climate Initiative (OGCI), a voluntary CEO-led group that focuses on carbon capture, utilisation and storage, methane detection and reduction, and energy efficiency. In 2020, the OGCI announced a new target to reduce the collective average carbon intensity of member companies' aggregated upstream oil and gas operations to between 20 kilograms and 21 kilograms of carbon dioxide equivalent per barrel of oil equivalent by 2025. This is consistent with the reduction needed across the industry by 2025 to support the Paris Agreement goals.

Read more about Shell's work with others to help address GHG emissions across different sectors at www.shell.com/energy-and-innovation/the-energy-future/cutting-carbon-together-sector-by-sector

MANAGING GREENHOUSE GAS EMISSIONS

OUR APPROACH

We have set a target to be net zero on greenhouse gas (GHG) emissions generated by all our operations by 2050, in step with society, as well as on emissions associated with the energy we need to power them.

Improving the energy efficiency of our facilities is one of the ways to help us reduce GHG emissions from our operations. We achieve this by replacing old machinery with more energy-efficient equipment, among other things.

We will work to ensure that any GHG emissions from making our products that cannot be avoided will be captured or offset using technology and nature.

We aim to eliminate the GHG emissions that are generated from the electricity we buy to power our operations. We are taking a number of steps to achieve this, including buying renewable energy certificates and increasing our use of electricity from renewable sources (see Wind and Solar).

The Gangarri Solar Project in Australia will help power our QGC natural gas project in Queensland and has the potential to reduce QGC's carbon dioxide emissions by around 300,000 tonnes a year.

We require projects and facilities that produce more than 50,000 tonnes of GHG emissions a year to have a GHG emissions and energy management plan in place.

These plans encourage site managers to take steps such as using more energy-efficient equipment, installing power from renewable sources and evaluating readiness for carbon capture, utilisation and storage in the design of our new and largest projects, with the aim of reducing our emissions. Plans must include the sources of GHG emissions, as well as a forecast of expected emissions at the site for at least 10 years.

Projects under development that are expected to have a material emissions footprint must meet our carbon performance standards or industry benchmarks. During development, projects are expected to evaluate relevant low-carbon technologies and options to remove these emissions.

To assess the resilience of proposed projects, we consider factors such as potential costs associated with operational GHG emissions. We use short-, medium- and long-term estimates of future carbon costs that are specific to each country. These estimates are reviewed and updated on an annual basis. This is an important part of our efforts to stay in step with society's progress toward the goals of the Paris Agreement.

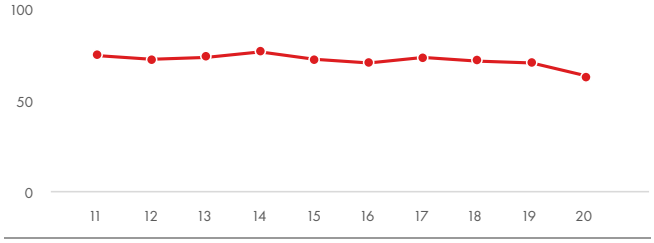
The process for developing these estimates uses short-term policy outlooks and long-term scenario forecasts, both of which reflect the current nationally determined contributions (NDCs) submitted by countries as part of the Paris Agreement and evolving national policy developments. By 2050, our estimates for all countries increase to at least $100 a tonne of GHG emissions. The United Nations estimate that the current NDCs are consistent with limiting the rise in global average temperature to around three degrees Celsius above pre-industrial levels. They are the first NDCs under the Paris Agreement and are scheduled to be revised every five years. In the coming decades, we expect countries to tighten their NDCs to meet the goals of the Paris Agreement. We expect to update our estimates as countries update their NDCs and climate policies. Accordingly, we believe our estimates appropriately reflect society's current implementation of the Paris Agreement.

Greenhouse gas emissions performance

Our direct GHG emissions decreased from 70 million tonnes of CO_2 equivalent in 2019 to 63 million tonnes of CO_2 equivalent in 2020.

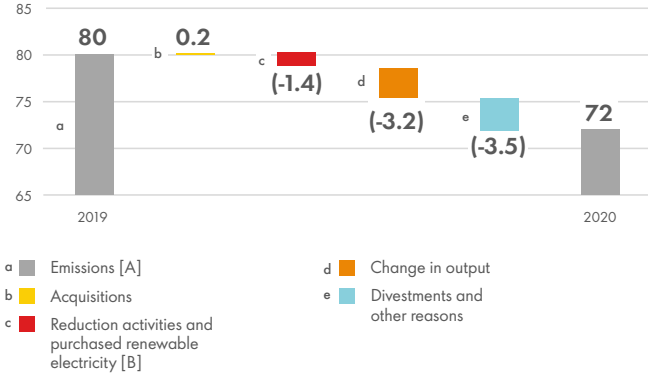
DIRECT GREENHOUSE GAS EMISSIONS

million tonnes CO_2e



SCOPE 1 AND SCOPE 2 GHG EMISSIONS CHANGES FROM 2019 TO 2020

million tonnes CO_2e



[A] Total greenhouse gas emissions are rounded to the closest million tonnes
[B] Does not include ~0.94 million tonnes of CO_2 captured and sequestered by our Quest CCS project in Canada in 2020

The main reasons for this decrease were divestments (for example, in Canada and the USA) and the number of our facilities operating at reduced capacity due to lower demand driven by the COVID-19 pandemic. In addition, our Prelude floating liquefied natural gas installation in Australia did not run at full capacity in 2020.

ENERGY EFFICIENCY IN OUR OPERATIONS

We aim to be net zero on emissions generated by all our operations by 2050 or sooner, as well as on emissions associated with the energy we need to power them. To help us achieve this, our production sites are increasingly using lower-carbon energy sources. Shell's Renewables and Energy Solutions business (formerly New Energies) is playing a key role in developing these.

Greenhouse gas emissions (GHG) from making our products that cannot be avoided – through energy efficiency or using lower-carbon fuel – will be balanced using technology or carbon offsets that avoid emissions or remove them from the atmosphere.

Boosting efficiency and cutting emissions

Our chemical plants continue to work on improving energy efficiency and reducing GHG emissions. In 2020, we announced that we will install eight new cracker furnaces at our Moerdijk petrochemicals complex, replacing 16 older units. This is expected to reduce the site's energy consumption, and lower GHG emissions by around 10% compared with 2019.

We are building a power plant at our Rheinland refinery in Germany that is expected to lead to a reduction of around 100,000 tonnes of GHG emissions a year.

In the USA, we are building a 250 MW co-generation power plant at our Pennsylvania chemicals facility that will also supply electricity to local homes. The chemicals plant has been designed with an energy-efficient gas cracker that will use hydrogen as a fuel source.

At our Rheinland refinery in Germany, we are building a power plant that is expected to lead to a reduction of around 100,000 tonnes of GHG emissions a year. We are also working with ITM Power to build an electrolyser at the site that produces hydrogen using renewable energy. The new hydrogen electrolysis plant is expected to be completed in 2021. It is designed to have a capacity of 10 MW and produce 1,300 tonnes of hydrogen a year. The hydrogen produced will initially be used by the refinery.

Reducing our shipping emissions

Shipping is critical to the global economy and accounts for around 2.7% of global GHG emissions. It is also a sector that is hard to decarbonise quickly, partly because currently it cannot be easily electrified.

We are investing in our fleet and researching and implementing efficiency technologies in order to lower emissions. In 2020, we signed a further 10 long-term charter contracts for carriers that can use either liquefied natural gas or conventional liquid marine fuel. This is expected to deliver a 60% reduction in carbon emissions compared with 2004 models of steam turbine LNG carriers.

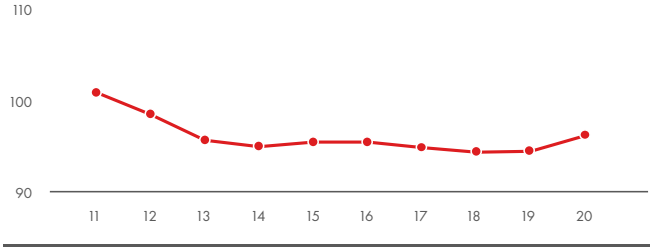
To reduce energy consumption in our LNG ships, we are deploying air lubrication technology. The first vessel equipped with this technology set sail in October 2020. Air lubrication uses air bubbles to reduce resistance between a ship's hull and the seawater, in the same way a penguin's feathers do. Less resistance results in less fuel consumption. The technology can reduce fuel consumption by 5–8% and will be included on all eight of Shell's LNG vessels currently under construction.

Energy intensity performance

The main metric we use to measure our performance is energy intensity: the amount of energy consumed for every unit of output.

ENERGY INTENSITY – REFINING

Refinery Energy Index [A]

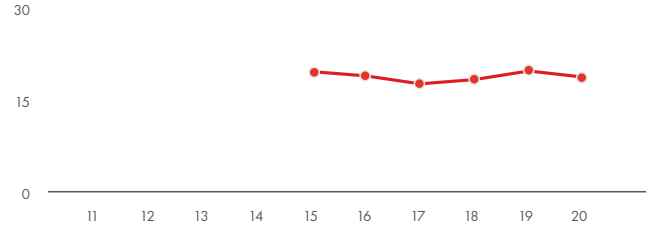


[A] Data are indexed to 2002, based on Solomon Associates Energy Intensity Index methodology.

The refinery energy intensity index increased from 94.4 in 2019 to 96.1 in 2020, mainly because many sites were running below capacity.

ENERGY INTENSITY – CHEMICAL PLANTS

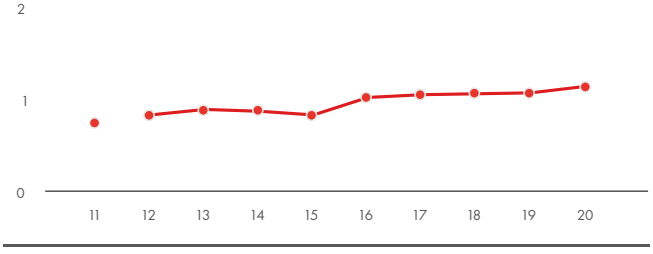
Chemicals Energy Intensity – GJ/tonne production



Chemical steam cracker energy intensity in 2020 was 18.7 gigajoules per tonne (GJ/tonne) of high-value chemical (HVC) production, down from 19.7 GJ/tonne HVC in 2019, mainly as a result of facilities running at higher capacity after turnaround at three of our sites in 2019.

ENERGY INTENSITY – UPSTREAM

(excl. LNG and GTL) GJ/tonne production [A]



[A] Methodology was updated in 2012. Data for 2011 are not directly comparable.

In 2020, the overall energy intensity for the production of oil and gas in our Upstream and Integrated Gas businesses (excluding liquefied natural gas and gas-to-liquids) increased to 1.14 compared with 1.07 in 2019. This was partly because of reduced production from the Groningen gas field (lower energy intensity asset) operated by the NAM joint venture (Shell interest 50%) in the Netherlands and inclusion of energy consumption from contractor transport in our data.

We expect it will be difficult to maintain the energy intensity levels of recent years, as existing fields age and new production comes from

more energy-intensive sources. This may increase our upstream energy intensity over time.

METHANE EMISSIONS

Methane is a potent greenhouse gas (GHG) and when it is released into the atmosphere it has a much higher immediate global warming impact than carbon dioxide.

We use a range of methods and technologies to limit leaks of methane from our oil and gas operations, including implementing leak detection and repair programmes. We use the best available technologies such as drones and other aircraft equipped with optical gas imaging cameras, and satellites to detect leaks.

We are expanding our use of drones for methane leak detection at our sites in the Permian Basin, USA.

In 2020, in the Permian Basin, USA, where we have more than 400 sites, we deployed drones with specialised cameras and laser detection technology to detect methane emissions. This enables us to repair leaks and reduce emissions faster and more efficiently by reducing the time inspection teams need to spend at sites. Read more about this project at www.shell.us/media/2020-media-releases/expanding-use-of-drones-for-methane-detection

At our Shell ONEGas facilities in the North Sea, we have reduced methane emissions by 55% (around 2,000 tonnes) since 2017 through a series of improvements to reduce gas venting, including minimising valve leakage.

Methane initiatives and collaborations

We encourage industry-wide action on methane emissions reduction by participating in voluntary initiatives. In 2020 we:

- were a founding signatory to the Oil and Gas Methane Partnership 2.0, which is designed to enhance methane emissions reporting and transparency and encourage greater participation across the industry;
- proposed recommendations to the European Commission on reducing methane emissions in the oil and gas industry, alongside BP, the Environmental Defense Fund, Eni, Equinor, the Florence School of Regulation, Repsol, the Rocky Mountain Institute, Total and Wintershall Dea; and
- advocated a return to the direct regulation of methane under the Clean Air Act in the USA.

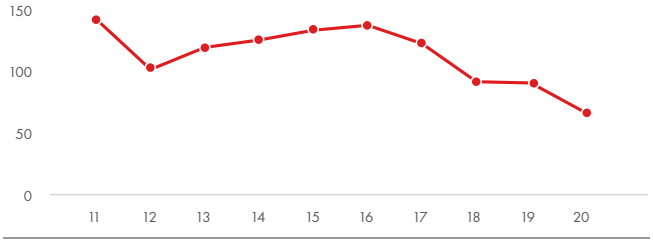
We also participate in the Methane Guiding Principles coalition, which we initiated in 2017. The partnership's growing membership includes major international and national oil companies and associate signatories such as the International Energy Agency and the UN Environment Programme.

Methane emissions performance

Our target is to maintain methane emissions intensity below 0.2% by 2025. This target covers all Upstream and Integrated Gas oil and gas assets for which Shell is the operator. In 2020, our methane intensity averaged 0.06% for assets with marketed gas and 0.01% for assets without marketed gas. Shell's methane emissions intensity in 2020 ranged from below 0.01% to 0.6%.

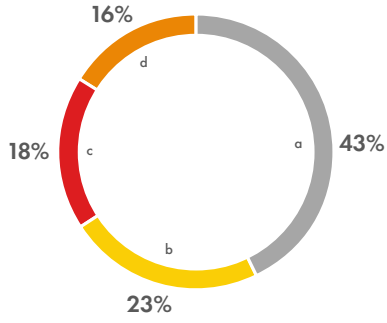
METHANE (CH_4) EMISSIONS

thousand tonnes



METHANE EMISSIONS BY SOURCE IN 2020

percentage



In 2020, our total methane emissions were 67 thousand tonnes compared with 91 thousand tonnes in 2019, in part driven by divestments (for example, in Canada and the USA) and decreased flaring. Methane emissions were less than 5% of Shell's GHG emissions on a CO_2-equivalent basis. More than 60% of our reported methane emissions in 2020 came from flaring and venting in our upstream and midstream (for example, storage and processing) operations.

FLARING

We are working to reduce flaring, which contributes to climate change and wastes valuable resources.

Flaring is the controlled burning of natural gas and is a common practice in oil and gas exploration, production and processing operations. Flaring is used to safely dispose of hydrocarbons that could pose a hazard to workers, nearby residents and facility equipment if there is a lack of equipment to gather the gas. Flaring can occur during start-ups, maintenance turnarounds and power failures, where production system pressure must be safely relieved.

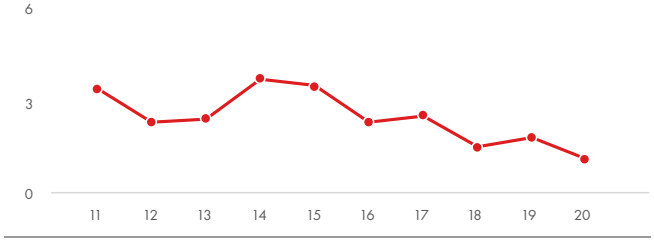
We may use flaring at facilities, such as our Pernis refinery in the Netherlands, if required to safely relieve production system pressure.

Gas routinely produced with oil, known as associated gas, may also be flared. As a signatory to the World Bank's Zero Routine Flaring by 2030 initiative, we continue to pursue our 2015 commitment to eliminate associated gas flaring at our facilities.

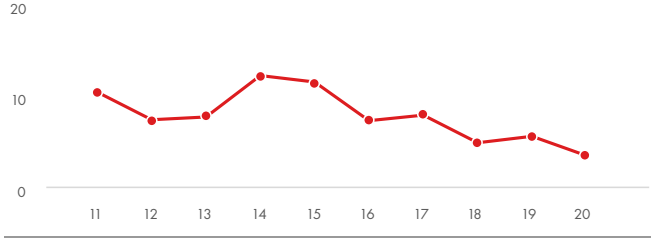
Flaring performance

Flaring of gas in our Upstream and Integrated Gas businesses contributed around 6% to our overall direct greenhouse gas (GHG) emissions in 2020. Around 35% of this flaring occurred at facilities where there was no infrastructure to capture the gas produced with oil, known as associated gas. Overall flaring decreased to 3.8 million tonnes of carbon dioxide equivalent in 2020 from 5.9 million tonnes of carbon dioxide equivalent in 2019.

FLARING – UPSTREAM HYDROCARBONS FLARED
million tonnes



FLARING – UPSTREAM CO_2 EQUIVALENT
million tonnes CO_2e



The most significant reduction for upstream flaring emissions in 2020 was due to the extended shutdown of the Prelude floating liquefied natural gas facility in Australia, a significant contributor to Shell flaring in 2019.

Also in Australia, Shell affiliate QGC Pty Limited's upstream coal-seam gas facilities reduced flaring by about 65% in 2020 compared with 2019. In the USA, flare reduction continued at our Permian unconventional oil facilities, while in Qatar our Pearl gas-to-liquids plant reduced its GHG emissions from flaring by more than 15% in 2020 compared with 2019.

In Nigeria, the Southern Swamp Associated Gas Solutions project captures gas produced alongside oil in the Niger Delta to help reduce flaring. The Shell Petroleum Development Company of Nigeria Ltd (SPDC) Joint Venture reported a 17% decrease in routine flaring in 2020.

Further associated gas flaring reductions by SPDC are anticipated with the completion of commissioning of the Forcados Yokri gas-gathering project in 2021. This was delayed from 2020, in part due to COVID-19-related procurement and construction activity suspensions.

REALISING THE ROLE OF NATURE

We are increasing our investment in protecting or developing natural ecosystems, such as forests, grasslands and wetlands, to capture carbon and help our customers offset their emissions using carbon credits.

We recognise that nature-based solutions are a tool that can only ever complement, and not replace, other solutions we are deploying to help society move to a low-carbon future.

Investing directly in natural ecosystems

In 2020, Shell invested around $90 million in nature-based projects that reduce or avoid emissions and can also benefit ecosystems by improving biodiversity, water quality and flood protection.

In 2020, we acquired Select Carbon, a specialist company that partners with farmers, pastoralists and other landowners in Australia to develop carbon farming projects, where plants are grown and soil managed to absorb carbon dioxide from the atmosphere. Select Carbon runs more than 70 carbon farming projects that span an area of more than 10 million hectares. The carbon credits generated by the farms are sold through the Australian government's Emissions Reduction Fund and other markets, creating additional revenues for farmers and landowners. Select Carbon is our first acquisition in nature-based solutions.

EXAMPLES OF SHELL'S DIRECT INVESTMENTS IN NATURAL ECOSYSTEMS [A]

1 CANADA

840,000 trees

to be planted on 700 hectares of wildfire-devastated land, together with the Tŝilhqot'in National Government

2 SPAIN

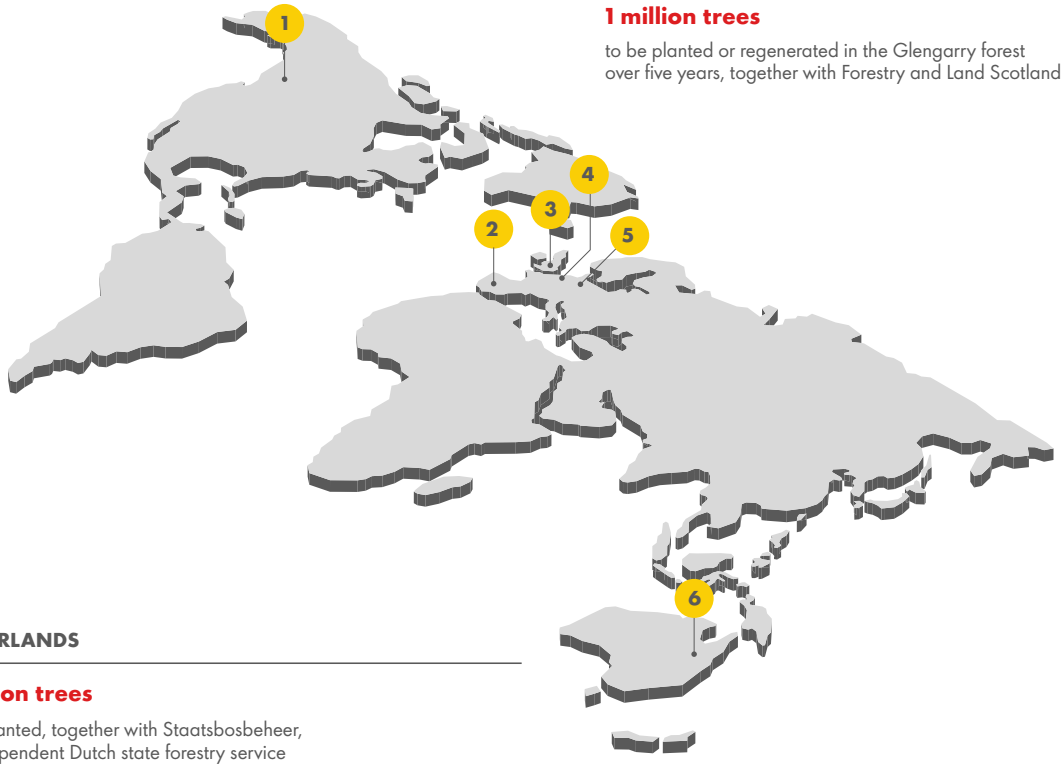
300-hectare

reforestation project in the Castilla y León region, together with Land Life Company

3 UK

1 million trees

to be planted or regenerated in the Glengarry forest over five years, together with Forestry and Land Scotland



4 NETHERLANDS

5 million trees

to be planted, together with Staatsbosbeheer, the independent Dutch state forestry service

5 GERMANY

20 hectares

of former agricultural land to be utilised for a reforestation project, together with Schleswig-Holsteinische Landesforsten AöR

6 AUSTRALIA

800-hectare

project focused on endangered native forest regeneration in Queensland developed by Shell's QGC

[A] Selection of nature-based solutions projects announced between 2019 and 2020

Expanding carbon-neutral choices

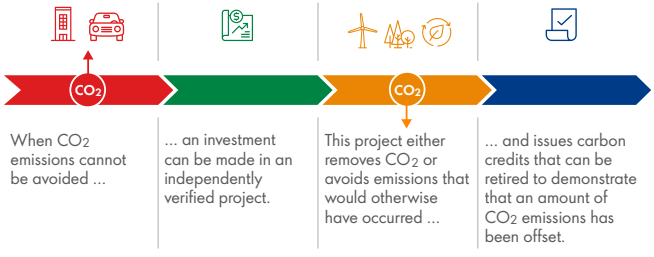
In 2020, we increased the number of drivers and business customers who use our nature-based carbon credits to offset the life-cycle CO_2-equivalent emissions generated by their use of the Shell fuel they buy.

We are increasing our investment in protecting or developing natural ecosystems, including in the Netherlands where we are working with the state forestry service to plant 5 million trees.

We have made carbon-neutral driving available to our fleet customers in 12 countries and to retail customers at more than 4,600 service stations in Austria, Canada, Denmark, Germany, the Netherlands, Switzerland and the UK.

We also offer a range of products with nature-based carbon credits, including home energy in the UK, liquefied natural gas in Asia (see Natural gas), bitumen in Europe and selected lubricants.

HOW CARBON OFFSETS WORK



Emissions trading

We are one of the world's most established traders of carbon credits and have been operating in compliance and voluntary emissions markets since 2003.

We have a global portfolio of nature-based projects, for example, the Katingan Peatland Restoration and Conservation Project in Indonesia, through which we can help our customers to offset their CO_2 emitted from their use of fuels they buy from us. We also provide customers with tailor-made solutions for environmental compliance markets globally. Compliance markets are a mechanism through which companies can comply with environmental regulations and manage their emissions by trading carbon credits.

Screening our investments

In 2020, we strengthened our screening approach aimed at ensuring that nature-based credits used by Shell meet accepted standards of quality. All projects we invest in or buy from are certified under independent carbon credit standards. Each project must deliver broader environmental and social benefits and the organisations that develop the projects must maintain appropriate health, safety, security and social governance standards. Our project screening processes are audited by an independent third party.

Learn more about our work in nature-based solutions at www.shell.com/energy-and-innovation/new-energies/nature-based-solutions

CAPTURING CARBON EMISSIONS

We invest in projects to capture and store carbon dioxide (CO_2) and we are exploring new ways of using CO_2 once it has been captured. Carbon capture and storage (CCS) technology is necessary to achieve the goals of the Paris Agreement, according to the majority of climate change scenarios produced by the IEA, IPCC and Shell.

Shell is involved in seven of the 51 large-scale CCS projects globally, listed in 2019 by the Global CCS Institute. Accelerating the pace of CCS deployment requires continued collaboration between governments, industry and investors, among others, to help unlock financing capacity, accelerate technology development and encourage public support. We recognise the scale of the challenge in developing CCS globally as quickly and as widely as needed.

In 2020, Shell invested around $70 million in CCS. This included progressing opportunities and operating costs for CCS assets in which Shell has an interest. We seek to have access to an additional 25 million tonnes a year of CCS capacity by 2035 – equal to 25 CCS facilities the size of our Quest CCS project in Canada (Shell interest 10%).

EXAMPLES OF CCS JOINT VENTURES WITH SHELL INVOLVEMENT

		Northern Lights	TCM CO_2 capture test and research facility	Gorgon	Quest
		Post final investment decision	Operating	Operating	Operating
Location		Norway	Norway	Australia	Canada
CO_2 source	Gas power		■		
	Refining/ chemical		■		
	Hydrogen				■
	Gas			■	
	Industrial (third party)	■			

We are a member of the Oil and Gas Climate Initiative (OGCI), which is taking steps to unlock large-scale investment in carbon capture, utilisation and storage with a focus on decarbonising industrial hubs around the world, including in Canada, China, Norway, the Netherlands, the UK and the USA.

In Norway, we are working with Equinor, Total and the Norwegian government to create a market across Europe for industry to capture and safely store CO_2. In 2020, the government approved the final investment decision for the Northern Lights CCS project, which will transport CO_2 from industrial sites by ship to a plant on Norway's west coast. CO_2 will then be piped to a reservoir around 3,000 metres below the seabed to be safely and permanently stored.

Using ships to transport the captured CO_2 enables more sectors to take advantage of CCS technology, for example, industrial companies based far from a pipeline or suitable CO_2 reservoir.

We are also part of an industry partnership with BP, Eni, Equinor and Total that in 2020 took ownership of the Net Zero Teesside project, which was launched by the OGCI to build the UK's first zero-carbon industrial cluster. The BP-operated project will build a transportation and storage system to gather industrial CO_2, compress it and store it safely in a reservoir under the seabed.

By the end of 2020, our Quest CCS project had captured and safely stored more than 5.5 million tonnes of CO_2 since it began operating in 2015. In Australia, the Chevron-operated Gorgon CCS project (Shell interest 25%), which started operating in August 2019, had stored more than 4 million tonnes of CO_2 by the end of 2020. Gorgon is the largest CCS operation in the world.

HOW CARBON CAPTURE AND STORAGE WORKS

See what is involved in the process of capturing and storing carbon dioxide deep underground

1 Capture

CO_2 capture separates CO_2 from gas before it is emitted using a chemical solvent. The captured CO_2 is separated from the solvent and compressed into a liquid form for transport.

2 Transport

CO_2 is generally pumped through a pipeline, taking the CO_2 from the industrial site where it has been produced to its storage site, which may be onshore or offshore.

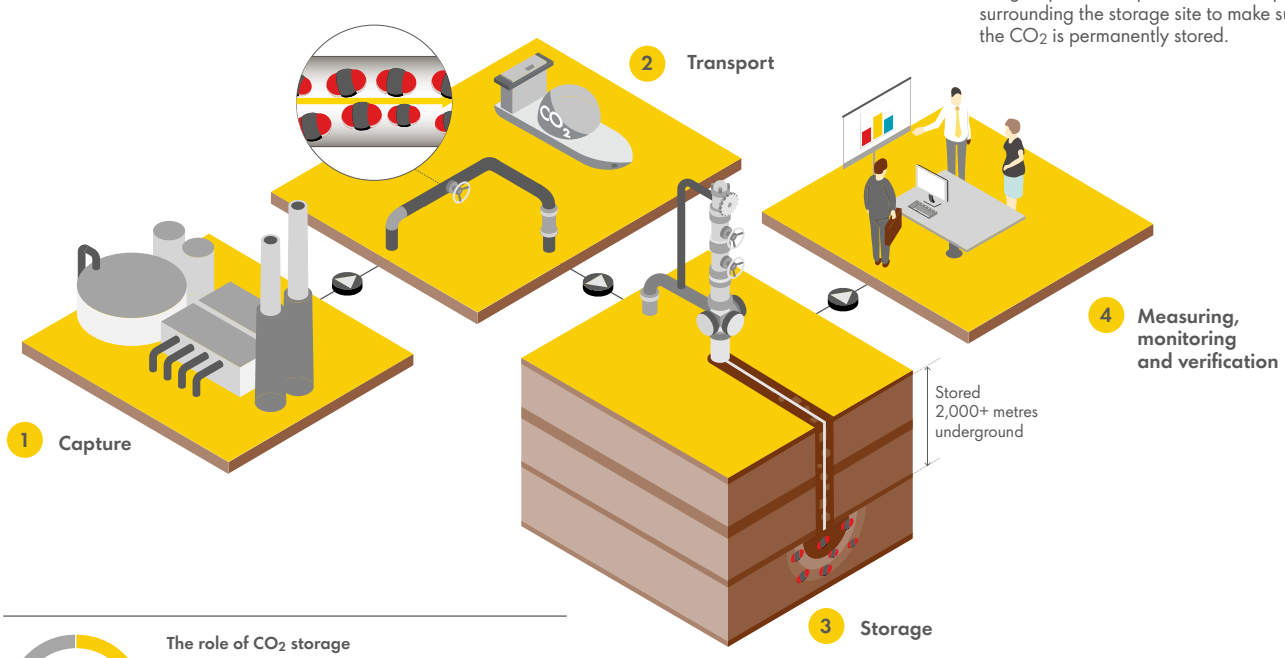
3 Storage

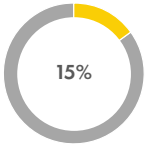
CO_2 is injected deep underground into the microscopic spaces in porous rocks. A layer of impermeable rock, called a cap rock, lies directly above the porous rocks ensuring that the CO_2 remains there permanently.

4 Measuring, monitoring and verification

Monitoring of storage sites takes place within the storage reservoir, as well as at the injection well, where sensors can detect small changes in pressure or CO_2 levels.

In addition, a number of monitoring technologies can be incorporated within the geosphere, biosphere and atmosphere surrounding the storage site to make sure the CO_2 is permanently stored.





The role of CO_2 storage

In the IEA's sustainable development scenario, carbon capture, utilisation and storage accounts for nearly 15% of the cumulative reduction in emissions.

Source: International Energy Agency 2020 report: CCUS in Clean Energy Transitions 2020

PRODUCING NATURAL GAS RESPONSIBLY

NATURAL GAS

Natural gas emits 45-55% fewer greenhouse gas emissions than coal when used to generate electricity, according to IEA data. Increasing the role that gas plays in the energy mix is one way countries can take action as the world moves to a low-carbon future.

Gas will help us achieve our target, in step with society's progress towards meeting the Paris Agreement goal, to become a net-zero emissions energy business by 2050.

NATURAL GAS

SUPPLY

We provide around 2.5% of the world's natural gas

LNG SHIPPING

We manage one of the world's largest fleets of LNG carriers

Carbon-neutral LNG

We are delivering liquefied natural gas (LNG) to business customers in Asia that has had the carbon dioxide-equivalent emissions associated with its production, delivery and usage offset with carbon credits originating from projects that protect or develop natural ecosystems. We made the world's first deliveries of carbon-neutral LNG in 2019 to Tokyo Gas in Japan and GS Energy in South Korea. In 2020, we secured new customers such as China National Offshore Oil Corporation (CNOOC) and CPC Corporation Taiwan. Since 2019, we have delivered seven cargoes, providing enough carbon-neutral LNG to power nearly 1 million homes for a year.

Carbon-neutral LNG allows our customers in these countries to offer, in turn, carbon-neutral gas to companies that want to decarbonise their energy use. In Japan, Tokyo Gas sells carbon-neutral gas to offices and utilities. It also makes hydrogen from carbon-neutral LNG at its Toyosu hydrogen station in Tokyo. CNOOC has auctioned the cargoes received from Shell on the Shanghai Petroleum and Gas Exchange, offering gas buyers the chance to reduce their net carbon footprint.

Gas production

In 2020, we took final investment decisions to sustain our production of natural gas in Australia and to expand our LNG production in Nigeria.

In Queensland, Australia, phase one of Arrow Energy's Surat Gas Project (Shell interest 50%) is being developed to meet local and overseas demand. The gas produced from Surat will use pipelines and treatment facilities at our QGC gas plant to reduce the need to build new infrastructure, which could have an impact on safety and the environment.

Our Nigeria LNG joint venture aims to boost LNG production capacity, create more jobs and stimulate local industries.

In Nigeria, our Nigeria LNG joint venture (Shell interest 25.6%) will increase production capacity at the Bonny Island liquefied natural gas (LNG) facility by around a third. The expansion is expected to create about 12,000 direct jobs during construction and stimulate the growth of local industries that provide ancillary services. Construction is expected to take a number of years.

Visit www.shell.com/energy-and-innovation/natural-gas and www.shell.com/providing-more-and-cleaner-energy for more on how natural gas contributes to a lower-carbon world.

SPECIAL REPORT

WORKING FOR THE FUTURE OF GRONINGEN

The NAM joint venture with ExxonMobil (Shell interest 50%) in partnership with the Dutch government operates the Groningen gas field in the Netherlands. NAM continues to help people living in Groningen who regrettably have been affected by earthquakes linked to gas production.

NAM continued to decommission its gas production facilities in Groningen in 2020.

The Dutch government is currently instructing NAM on production levels. Production from the Groningen field is expected to stop by 2022 or shortly thereafter. NAM is working with the government on plans to close down production as quickly and safely as possible while considering the energy security of the Netherlands. NAM is safely decommissioning its facilities and consulting with local communities to plan for the future of these production sites.

Supporting local communities

Since 2014, NAM has taken steps to help improve the situation in Groningen, such as investing in the NAM Liveability and Sustainability programme, which provided financial support for around 300 local initiatives to strengthen structures affected by earthquakes. This included support for houses and improving the running costs of sports facilities by installing solar panels.

In June 2020, the Dutch government took over the management of these investments through its Nationaal Programma Groningen, which receives around half its funding from NAM.

Handling damage claims

In 2020, NAM settled all outstanding damage claims for affected residents. All new claims are now handled by independent public organisations set up by the Dutch government.

NAM was, and will remain, responsible for all earthquake-related costs. Shell has provided a guarantee that it will fund its share of these costs if NAM is not able to pay them.

Decommissioning and restoration

In 2020, NAM continued to decommission its gas production facilities in Groningen with eight locations plugged and work started to safely remove surface infrastructure. In 2020, this included decommissioning gas facilities in Uiterburen, a small village in south-east Groningen, where production stopped in 2008. NAM plans for all wells at Uiterburen to be safely closed down by 2021.

At the same time, NAM continues to discuss plans with neighbours of production locations, local municipalities and the Economic Board Groningen to reuse locations for renewable energy facilities.

Investing for the future

Shell and NAM continue to look for ways to play a part in building a low-carbon energy future for Groningen.

In 2020, for example, Shell announced plans to work with partners Gasunie and Groningen Seaports on a project to use renewable energy to electrolyse water to produce green hydrogen. The NortH2 project includes an ambition to build an offshore wind farm in Groningen capable of producing up to 4 gigawatts by 2030 and up to 10 gigawatts by 2040.

PRODUCING SHALE OIL AND GAS RESPONSIBLY

Shales – also known as tight gas and oil – will continue to play a role in meeting global energy demand. We work to unlock shale resources safely and responsibly, using advances in technology and by following our onshore operating principles.

Our shales activity in the USA is focused on the Permian Basin.

Tackling emissions

We have a range of technologies and practices in place in our shales operations to help find and reduce greenhouse gas emissions (GHG), such as methane which may be emitted during the extraction and processing of shales.

Our approach includes methane leak detection and repair programmes, primarily using handheld optical gas imaging cameras. In the Permian Basin, USA, we deploy drones equipped with multiple cameras and sensors to detect methane emissions more effectively and repair them more quickly. In 2020, we expanded the programme to cover our 400 sites in the Permian Basin.

We have taken steps to reduce flaring, or burning off, of gas from shales. Flaring contributes to climate change and wastes valuable resources. In 2018, we upgraded Permian Basin older facilities with equipment to automatically shut down production, instead of flaring gas, to relieve high pressure from certain high-demand pipelines. In 2020, we started replacing flare stacks, the devices used to burn off gas, with improved gas processing infrastructure in the Permian Basin.

In 2020, we also completed the installation of around 130 more energy-efficient control devices, which regulate the flow of gas, to potentially reduce GHG emissions from Permian facilities by up to 3%.

Since 2017, these efforts and others have reduced GHG emissions by 34%, including methane emissions by 50% and flaring by more than 80%, across our Permian facilities.

We have long supported the direct regulation of methane emissions when regulation is efficient, effective and encourages innovation. For example, in 2020 in the USA, we advocated a return to the direct regulation of methane emissions by the United States Environmental Protection Agency under the Clean Air Act. Shell believes more robust measurement, transparency and management are needed to successfully reduce methane emissions globally (see Methane emissions).

Local communities

Engagement with communities is an important part of our approach to shales. This includes our extensive engagement in Argentina with indigenous people, as well as local farmers and nearby communities, in the Vaca Muerta shales basin in Neuquén (see Indigenous people). These efforts help us understand community concerns so they can be proactively addressed in our operations.

Earth tremors

We believe there is a relatively low likelihood of hydraulic fracturing technologies or produced water disposal well operations inducing earth tremors that are felt on the surface. We take precautionary measures to prevent tremors and proactively manage the risk in accordance with regulatory requirements.

Read more about our approach at www.shell.com/energy-and-innovation/shale-oil-and-gas

PROVIDING LOWER-CARBON ELECTRICITY

LOWER-CARBON AND RENEWABLE POWER

We believe more renewable energy, such as solar and wind, is critical for a cleaner energy future, and that how people live, work and play is increasingly going to need to be powered by lower-carbon electricity.

In 2020, we stepped up our activities in generating and trading lower-carbon and renewable electricity, as well as providing it directly to customers.

WIND

We are expanding our wind power activities to make more renewable electricity available to our customers. At the end of 2020, the Shell share of total installed capacity combined from onshore and offshore wind was 290 megawatts (MW), with a further Shell share of 2,861 MW in development. We have wind power interests in several countries, including off the coasts of the Netherlands and the USA, as well as onshore USA.

In 2020, the CrossWind consortium, a joint venture between Shell and Eneco, won the tender to build and operate the Hollandse Kust (noord) offshore wind farm (Shell interest 79.9%). The project is expected to start operating in 2023 and will supply 759 MW, equivalent to powering more than 1 million Dutch homes with renewable energy. It is intended to help meet the objectives of the Dutch government's National Climate Agreement, which contains agreements with sectors on what they will do to help achieve the Netherlands' climate goals, and the European Green Deal, the plan to make the European Union's economy sustainable.

Shell is a 20% shareholder in the Blauwwind Consortium, which is developing the Borssele III and IV wind farm off the Dutch coast. In 2020, Blauwwind started generating power and delivering renewable electricity into the Dutch grid. The site has the capacity to generate 731.5 MW. Shell has an agreement to buy and trade half the electricity produced.

The Silicon Ranch project in the USA, where solar electricity generation is combined with rural revitalisation.

We continue to invest in floating wind technologies. We have acquired EOLFI, a French renewable energy developer specialising in floating wind power. Shell is a major shareholder in TetraSpar (Shell interest 46.2%), which is developing an innovative floating wind demonstration project off the coast of Norway. We are also developing a project with floating wind specialist CoensHexicon that could bring 800 MW of floating wind power to South Korea in the first phase of development.

Visit www.shell.com/wind to find out more about our work in wind power.

SOLAR

We are expanding our solar power generation capability by investing in the development and operation of long-term commercial and industrial solar projects, including at our own sites.

At the end of 2020, our share of installed solar power capacity was 674 megawatts (MW), with 1,053 MW in development.

In the USA, Silicon Ranch, a company in which we increased our stake in 2020 and now have a 46.47% interest, continued to expand its Regenerative Energy programme across some of the 142 projects it owns and operates in 14 states. The programme combines solar electricity generation with carbon sequestration and ecosystem restoration. Silicon Ranch projects operating in 2020 had a total capacity of 1,130 MW.

In 2020, we announced plans to build our first industrial-scale solar power plant. The Gangarri Solar Project in Australia is expected to produce up to 120 MW of renewable energy. The project will help power our QGC natural gas project in Queensland and has the potential to reduce QGC's carbon dioxide emissions by around 300,000 tonnes a year.

Oman Shell launched the Qabas solar project in Oman to help power a smelting company. The project comprises 88,000 solar panels and generates 25 MW, displacing the equivalent gas-fired power generation taken from the grid and avoiding more than 25,000 tonnes of CO_2 emissions each year.

Read more about our operations and investments in solar power at www.shell.com/solar

Read more about Silicon Ranch and Regenerative Energy at: www.shell.com/inside-energy/power-of-sun-and-soil

REDUCING EMISSIONS AT WORK AND HOME

As well as supplying industrial power, Shell also provides low-carbon electricity to workplaces and homes in several countries, including Australia, Germany, the UK, and the USA.

Carbon-neutral homes

We supply 100% certified renewable electricity to more than 900,000 homes in Great Britain through Shell Energy Retail. There we recently launched a range of carbon-neutral energy tariffs to meet growing interest from households for energy with a lower-carbon footprint. The Go Further tariffs offset the life-cycle CO_2-equivalent emissions associated with the production, distribution and use of renewable electricity and gas in the home. This is managed by buying equivalent certified carbon credits from projects that protect or enhance forests.

Customers receive 100% renewable electricity with the tariffs. Our renewable electricity is certified by Renewable Energy Guarantees of Origin, which means that all the electricity customers use is matched with the equivalent amount of electricity generated from 100% renewable sources.

Lower-carbon businesses

We are working with industrial and commercial customers to help them make the transition to lower-carbon and renewable energy. In 2020, in the USA, through our partner company MP2 and Shell Energy, we agreed long-term contracts to supply 100% certified renewable energy to 1,200 Wells Fargo sites in Washington DC and seven US states.

Read more about Shell and lower-carbon electricity at www.shell.com/energy-and-innovation/new-energies

RENEWABLES AND ENERGY SOLUTIONS

a selection of investments, acquisitions and ventures

KEY

- Energy solutions
- Energy access
- Wind
- Solar
- Mobility
- Nature-based solutions
- Trading
- Hydrogen
- * Minority investments

YEAR	BUSINESS FOUNDED		
2016	■ Blauwwind*, NL		
2017	■ Acquired NewMotion, NL ■ Connected Freight*, Philippines	■ Shell Energy Retail, UK (acquired as First Utility) ■ Innowatts*, USA	■ SolarNow*, Uganda ■ SteamaCo*, Kenya ■ Sunseap*, Singapore
	■ Acquired MP2 Energy, USA	■ Opened hydrogen stations in the UK and USA	
2018	■ Silicon Ranch*, USA ■ Cleantech Solar*, Asia ■ Opened Moerdijk solar farm, NL	■ Atlantic Shores Offshore Wind*, USA ■ Mayflower Wind Energy*, USA ■ TetraSpar*, Norway	■ Shell Energy Inside, USA
	■ Opened hydrogen stations in California, USA ■ HyET Hydrogen*, NL	■ Husk Power*, India ■ SunFunder*, Kenya	■ Ample*, USA
2019	■ Acquired Greenlots, USA ■ Ravin.ai*, UK ■ Revel*, USA ■ Aurora*, USA ■ Nordsol*, NL	■ Acquired EOLFI, France ■ CoensHexicon*, South Korea	■ Acquired sonnen, Germany ■ Acquired Hudson Energy UK (rebranded to Shell Energy Retail in 2020) ■ LO3 Energy*, USA ■ Corvus Energy*, Norway
	■ Nature-based solutions projects under way in Australia, Malaysia, Netherlands, Spain and UK	■ Orb Energy*, India ■ PowerGen*, Kenya ■ d.light*, Kenya	■ Acquired ERM Power (rebranded to Shell Energy in 2020), Australia ■ Acquired Limejump, UK
	■ ESCO Pacific*, Australia	■ Announced plans to build Rheinland Hydrogen Electrolyser, Germany	
2020	■ Final Investment Decision to build Gangarri solar farm, Australia	■ Masabi*, UK ■ InstaFreight*, Germany ■ Spiffy*, USA	■ Shell and Eneco awarded tender tobuild 759 MW Hollandse Kust (Noord) offshore wind farm, NL
	■ Select Carbon, Australia ■ Climate Bridge*, China	■ Announced plans to build 20 MW green hydrogen electrolyser and refuelling stations, China ■ ZeroAvia*, USA	■ Palmetto*, USA ■ GreenCom*, Germany

FUELLING MOBILITY

REDUCING EMISSIONS FROM TRANSPORT

Transport accounts for almost 30% of the world's energy use and around 25% of global carbon dioxide (CO_2) emissions. To help people and companies switch to cleaner modes of transport, we are investing in lower-carbon options – from electric-vehicle charging points and e-Mobility products to fuels like hydrogen and biofuels.

BIOFUELS

Biofuels are a renewable energy source, made from organic matter or waste, which can significantly reduce CO_2 emissions from transport.

Biofuels are blended with other fuels such as petrol and diesel. They can help decarbonise the aviation, marine and heavy-duty road transport sectors.

Our Raízen joint venture in Brazil produces one of the lowest-CO_2 biofuels available.

The Raízen joint venture (Shell interest 50%, not Shell-operated) in Brazil is one of the world's largest biofuel producers, with one of the lowest-CO_2 biofuels available today. In 2020, Raízen produced around 2.5 billion litres of ethanol and around 4.4 million tonnes of sugar from sugar cane. In 2015, Raízen opened its first cellulosic ethanol plant at its Costa Pinto mill in Brazil. This produced almost 25 million litres in 2020.

In 2020, around 9.5 billion litres of biofuels went into Shell's petrol and diesel worldwide, which includes Raízen sales.

Turning waste into fuel

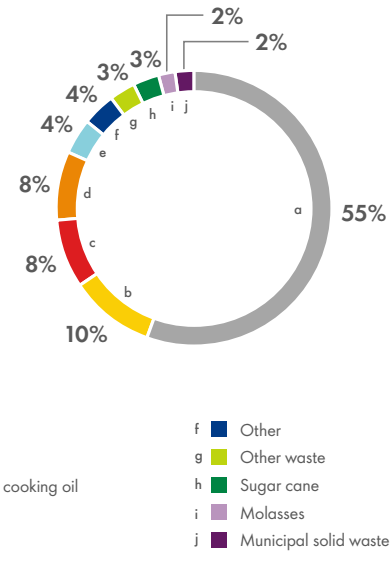
Most biofuels are produced from agricultural crops, such as corn, sugar cane, or vegetable oil. We are exploring ways to use agricultural or animal waste, inedible crops, and waste wood to produce biofuels.

For example, we produce renewable natural gas, also known as biogas, from food waste, agricultural residues or manure. It can be used instead of natural gas in vehicles and shipping to reduce CO_2 emissions by between 50% and 100% compared with fossil fuels.

We also have agreements with companies in Europe and North America to supply sustainable aviation fuel. In 2020, we extended our operations into air cargo by agreeing to supply online retailer Amazon with blended sustainable aviation fuel for its air cargo fleet.

We continue to invest in new ways to produce advanced biofuels from sustainable raw materials. These include waste and cellulosic biomass from non-food plants at our demonstration plant in India and investments in biofuel start-ups, such as FORGE Hydrocarbons, Canada.

GLOBAL BIO-COMPONENT PURCHASE [A]
by feedstock



a Corn
b Palm oil
c Waste used cooking oil
d Rapeseed
e Soy bean
f Other
g Other waste
h Sugar cane
i Molasses
j Municipal solid waste

[A] Does not include purchases by Raízen.

Sustainable production

The production of some biofuel feedstocks is considered higher risk for human rights, biodiversity or the release of carbon into the atmosphere. To help mitigate these risks, all the palm oil, sugar cane and South American soy feedstock we purchase is certified as sustainable by credible sustainability standards like the Round Table on Responsible Soy, the Roundtable for Sustainable Palm Oil and Bonsucro.

Visit www.shell.com/biofuels for more on our activities in biofuels.

E-MOBILITY

Shell is exploring how best to meet the needs of electric-vehicle drivers – at home, at work or on the road. We are expanding our charging network worldwide and our range of specialised fluids for electric vehicles.

We operate more than 60,000 electric-vehicle charging points and aim to increase this to around 500,000 by 2025. This includes more than 1,000 charging points at Shell forecourts and new locations as well as operated charge points that are owned by individual consumers and business customers.

Shell-owned NewMotion is helping Alphabet, the world's fourth-largest fleet operator, move to e-vehicles by using the same Shell fleet cards to buy fuel and recharge their vehicles in the UK. Drivers can plan their next charging stop in real-time at more than 3,000 charging points and track their fuel and electricity use in a single invoice.

We are developing charging networks for electric-vehicle drivers through our NewMotion subsidiary.

Electric-vehicle fluids

Electric vehicles require specially developed fluids and lubricants. The Shell e-fluids range covers the specialised needs of battery-electric and fuel-cell electric passenger and commercial vehicles.

We develop these fluids and greases, in collaboration with our customers, which include leading automotive manufacturers and Formula E racing teams. In 2020, we developed a specialised transmission fluid for Mahindra Racing's Formula E car to enhance transmission efficiency and the car's performance on the racetrack.

In 2020, we also formed a strategic alliance with Kreisel Electric, an Austrian technology company, to offer a combined battery and thermal management fluid solution for electric vehicles. The solution controls the temperature of each battery cell individually. This stabilises the cells and improves battery performance and safety when fast charging.

Learn more about e-mobility at www.shell.com/electric-vehicle-charging

HYDROGEN

Hydrogen is a versatile energy carrier that can play a significant role in the transition to a low-carbon world.

It has great potential to help meet growing demand for cleaner transport. When driven, hydrogen vehicles do not emit carbon dioxide, only water vapour. If the hydrogen is produced by electrolysis using renewable energy to split water into pure hydrogen and oxygen, the fuel is virtually emission-free. This is known as green hydrogen.

Shell is helping to build the infrastructure that will be needed if hydrogen is to fulfil its potential.

Making hydrogen from renewable energy

Nearly all hydrogen today is produced through fossil-fuel reforming, a process that creates a reaction between natural gas and steam. Shell is also assessing the feasibility of using hydrogen produced by electrolysis on a large scale for our own facilities as a starting point, then rolling it out with our customers. We are working with ITM Power to build a 10-megawatt electrolyser at our Rheinland refinery in Germany. The electrolyser, expected to be completed in 2021, is designed to produce up to 1,300 tonnes of green hydrogen a year.

We are also exploring several integrated hydrogen projects including electrolysers for industrial and mobility demand in China, Germany and the Netherlands, to help demonstrate that it is possible to produce large-scale green hydrogen using renewable energy.

In 2020, we announced one of the largest green hydrogen projects in Europe, NortH2, in a consortium with Gasunie, Groningen Seaports, Equinor and RWE. The project aims to build large wind farms in the North Sea to generate sufficient renewable energy for green hydrogen production for a range of industrial customers.

Green hydrogen is an important part of the Dutch government's National Climate Agreement, which contains agreements with sectors on what they will do to help achieve the Netherlands' climate goals, and the European Green Deal, the plan to make the European Union's economy sustainable.

Building our refuelling network

We are helping to build networks of hydrogen refuelling stations in Europe and North America. We are part of several initiatives to encourage the use of hydrogen vehicles to reduce greenhouse gas (GHG) emissions in transport.

In Germany, through our participation in the H2 Mobility Germany joint venture, we are working with the government and partners to develop a national network of 100 hydrogen refuelling stations by 2021. At the end of 2020, 87 stations were open, 37 at Shell retail sites.

The H2 Mobility Germany joint venture is developing a network of 100 hydrogen refuelling stations.

In the UK, we are working with ITM Power, a company specialising in electrolysers, to produce hydrogen fuel from renewable energy at Shell retail sites in England. Three of the sites began producing and selling green hydrogen in 2020.

In the USA in 2020, the California Energy Commission awarded Shell a $40.8 million grant to install hydrogen refuelling equipment at 48 Shell retail stations and to upgrade three existing Shell hydrogen stations. At the end of 2020, we operated nine hydrogen refuelling stations in California.

We also opened two hydrogen refuelling stations in Canada and the first of three planned stations in the Netherlands.

In 2020, we announced a collaboration with Daimler Truck AG, IVECO, OMV and the Volvo Group to support the roll-out of hydrogen trucks in Europe, which will be needed to meet the EU's ambition of net-zero emissions by 2050. Read more about the H2Accelerate collaboration at www.shell.com/h2-accelerate-new-collaboration-for-zero-emission-hydrogen-trucking

Learn more about how we are developing and using hydrogen to reduce GHG emissions at www.shell.com/hydrogen

ENERGY-EFFICIENT PRODUCTS

Shell V-Power petrol and diesel and Shell Helix engine oil increase efficiency by helping to keep engines running smoothly and reducing friction and wear. These products are used in millions of vehicle engines worldwide every day.

Shell PurePlus Technology converts natural gas into a pure base oil – which can form up to 90% of a finished motor oil – to improve and protect an engine's performance. For example, the technology is used in the Shell Helix 0W range of lubricants and can help to reduce car carbon dioxide emissions by up to 4% compared with traditional lubricants.

For heavy-duty vehicles, Shell Rimula engine lubricants help heavy-duty diesel engines reduce friction to improve fuel economy and therefore reduce CO_2 emissions.

Read more about our fuels and lubricants at www.shell.com/motorist

Reducing fuel consumption in shipping

We have developed a software tool for our marine customers that determines the best position for a ship's hull in the water, at any speed and in any weather conditions, to minimise fuel use and emissions.

In 2020, we deployed the software on 62 Shell-operated vessels, potentially reducing each ship's fuel use and associated emissions by up to 7%. We have now licensed the software, making it available to the wider industry.

Discover more about our marine solutions at www.shell.com/marine

Reducing data centre energy use

We have worked with technology firm Asperitas to develop an innovative approach which could boost energy efficiency in data centres by up to 45%. This involves immersing data servers in a specialised Shell cooling fluid made from natural gas, reducing the need for air cooling equipment. Data centres use large amounts of electricity to power equipment that cools the air around the servers that process the data.

DRIVING INNOVATION

In 2020, we spent $907 million on research and development (R&D), compared with $962 million in 2019.

Our R&D projects often involve collaborations with public or private entities, including universities, government laboratories, technology start-ups and incubators. This collaborative approach to innovation with partners inside and beyond the energy sector helps spark new ideas and accelerates their development and deployment.

In 2020, we started work on 124 R&D projects with universities, which is less than half that of last year due to the disruptions caused by COVID-19. Many of these projects focus on areas that are crucial for low-carbon energy systems, such as energy storage, fuel cells and greenhouse gas emissions.

LOWER-CARBON AVIATION FUEL

In 2020, our scientists demonstrated how to produce 500 litres of synthetic kerosene aviation fuel from carbon dioxide, water and renewable energy to replace conventional hydrocarbon feedstocks. In a world first, the synthetic kerosene was blended with conventional jet fuel to power a KLM airlines passenger flight from Amsterdam to Madrid in early 2021.

The method can use carbon dioxide from any source, such as waste carbon dioxide from a refinery or biogas facility. We already supply airlines with sustainable aviation fuel refined from waste fats and oils.

We are now planning to test the technology at larger scale and use the same process to make chemical feedstocks.

HIGH-PERFORMANCE FLUIDS FOR ELECTRIC VEHICLES

In 2020, we developed a range of e-fluids specially for battery-electric and fuel-cell electric vans and goods vehicles to help reduce emissions in the commercial road transport sector.

We are developing fluids and lubricants for electric vehicles in collaboration with customers such as Formula E racing teams.

Electric and hybrid vehicles require special transmission fluids to lubricate the gearbox, thermal fluids to cool the battery and electric motor, and greases to lubricate electric motor components working at much higher revolutions than internal combustion engines.

We develop the fluids and greases, in collaboration with our customers, at our Shell Technology Centres worldwide. Read more in e-mobility.

We are also using technology to help reduce energy use at data centres (see Energy-efficient products).

BLOCKCHAIN FOR A LOWER-CARBON WORLD

We are investing in blockchain, a system in which a record of transactions is stored across a network of computers, as a way of proving the credentials of low-carbon technologies and products. Blockchain provides a secure, transparent and tamper-proof record as no single party controls the computing system supporting it. Changes to the data in one computer must be validated by all computers in the network.

Blockchain can make it possible to track low-carbon energy and certificates from their origin through every stage and transaction.

We are exploring blockchain as a way of verifying if hydrogen is produced using renewable power and whether carbon credits actually represent the removal of carbon from the atmosphere.

For example, by tracking the progress and effectiveness of nature-based solutions for carbon capture or avoided emissions, blockchain could identify and avoid double counting of carbon credits and help to maintain the quality of forestry or conservation projects.

We have started using this approach in a pilot project that creates digital passports for equipment, so it can be tracked throughout its life cycle. This approach is more efficient and significantly reduces paperwork associated with conventional audit trails.

Shell believes blockchain could transform the way companies collaborate and interact to accelerate development of lower-carbon energy.

Read more about innovation and collaboration at Shell at www.shell.com/innovation-through-research-and-development