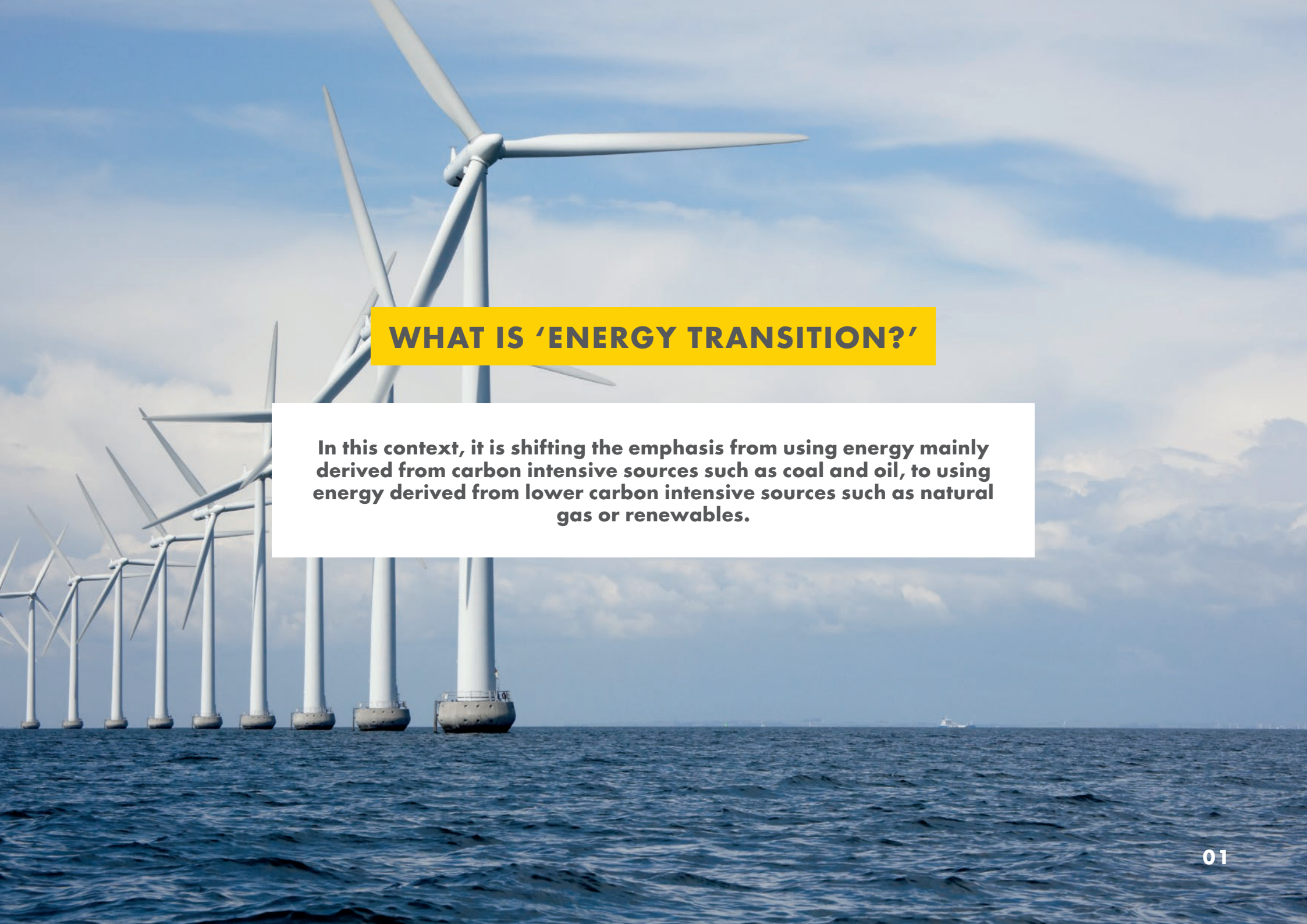
KNOWLEDGE EXPANDER

# ENERGY TRANSITION

Shell NXplorers



# WHAT IS ‘ENERGY TRANSITION?’

**In this context, it is shifting the emphasis from using energy mainly derived from carbon intensive sources such as coal and oil, to using energy derived from lower carbon intensive sources such as natural gas or renewables.**

# WHY DO WE NEED 'ENERGY TRANSITION?'

**SOCIETY FACES A DUAL CHALLENGE: HOW TO MAKE THE TRANSITION TO A LOW-CARBON ENERGY FUTURE TO MANAGE THE RISKS OF CLIMATE CHANGE, WHILE ALSO EXTENDING THE ECONOMIC AND SOCIAL BENEFITS OF ENERGY TO EVERYONE ON THE PLANET**

This transition will require a change in the way energy is produced, used and made accessible to more people while drastically cutting emissions.

A transformation of the global economy is needed, especially in power, transport, buildings and industry – four major sectors where energy is consumed and that produce significant energy-related $CO_2$ emissions.

To tackle climate change, the power sector, which only made up 18% of the energy for end use in 2016, must expand and evolve into a combination of more renewable sources of energy, as well as nuclear and natural gas – the cleanest-burning hydrocarbon. Carbon capture and storage (CCS) technology, which captures $CO_2$ emitted during power generation or industrial processing and stores it safely deep underground, will also be vital.

This transition is under way. It will move at different paces and produce different outcomes in different countries depending on local factors such as available natural resources and weather patterns, national policies that address climate change and local air quality, economic growth, and which technologies and products companies and consumers choose.

**“A transformation of the global economy is needed, especially in power, transport, buildings and industry – four major sectors where energy is consumed and that produce significant energy-related $CO_2$ emissions.”**

# WHY WILL THE WORLD NEED MORE ENERGY IN THE FUTURE?

**ENERGY IS EVER-PRESENT IN MOST PEOPLE'S LIVES. IT LIGHTS, HEATS AND COOLS HOMES AND BUSINESSES. IT TRANSPORTS AND CONNECTS PEOPLE AND GOODS**

It fuels water and sanitation systems. It is used in industrial processes that create building blocks such as steel and cement for the world's cities, the nerve centres of growing economies.

Energy use goes hand-in-hand with economic activity. Where infrastructure is poor or unemployment is very high, for example, average annual energy use per person is typically less than half that seen in stronger economies.

And little or no access to energy deprives much of the world's population the opportunity to better their lives. Around 1.1 billion people live without access to electricity, according to the World Bank. A billion more only have access to unreliable and unsafe power networks.

Global energy demand is expected to grow by 30% between 2015 and 2040, according to the International Energy Agency's (IEA) main scenario. This will be driven by a growing population looking to improve their living standards.

Future energy demand is likely to rise steeply in China, India, Africa, the Middle East and South-east Asia as growing populations improve living standards, and national economic development gathers pace.

Meeting future demand depends on global energy infrastructure, from transport to power plants, developed over 150 years. This infrastructure that uses hydrocarbons is worth around $55 trillion today, according to energy research firm IHS.

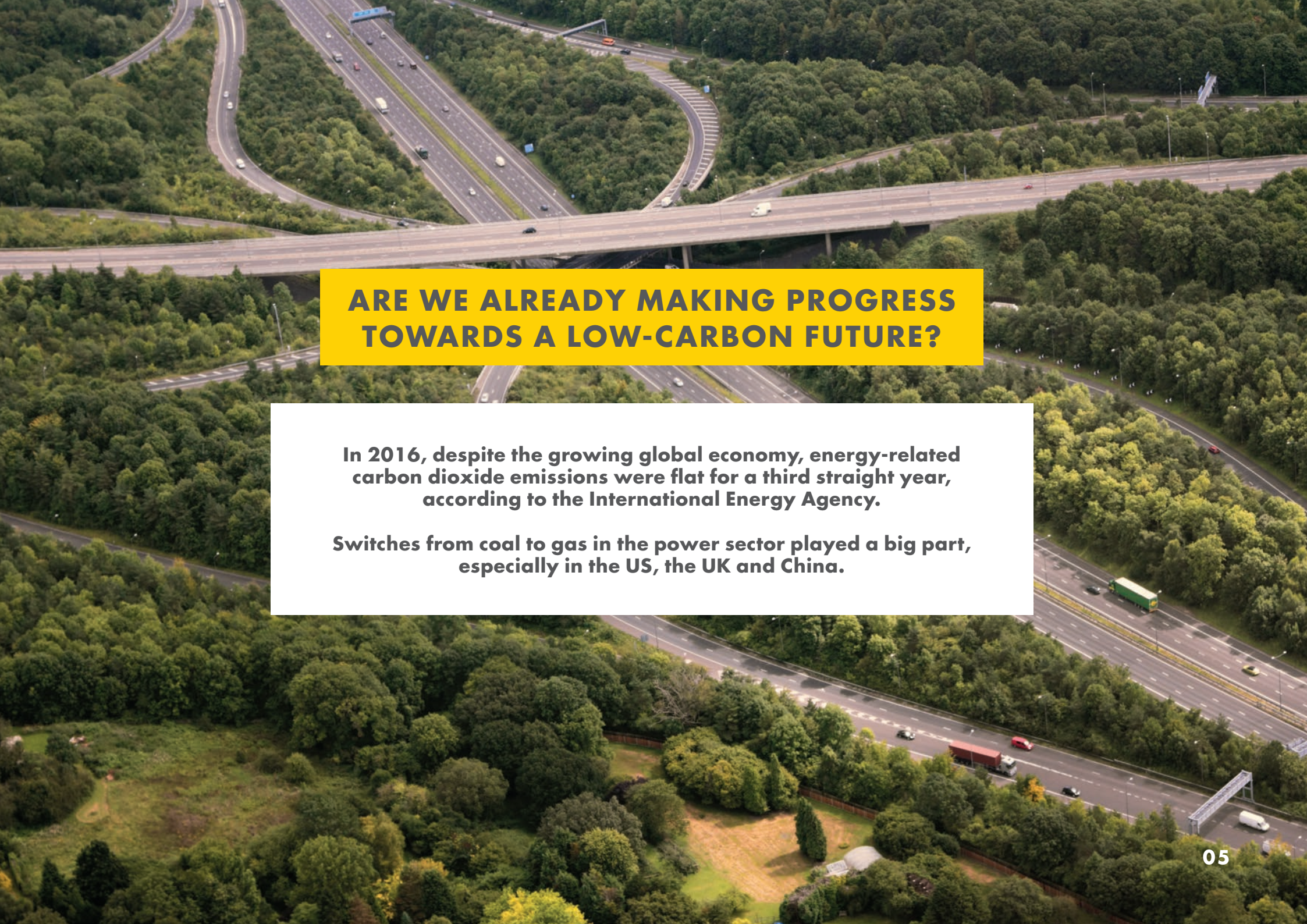
This is equivalent to 70% of the world's annual gross domestic product.

To meet demand, yet stay below a 2°C temperature rise, the IEA estimates energy-related emissions need to be no more than 19 gigatonnes of $CO_2$ equivalent a year by 2040 – current energy policies would result in 44 gigatonnes a year by then.

# WHERE DO WE GET MOST OF OUR ENERGY FROM TODAY?

**Today, oil, gas and coal make up around 80% of the world's energy mix. The remaining fifth comes from biomass (wood, peat, dung and waste), nuclear, hydro, geothermal and renewables such as solar and wind.**

**More energy from this current energy mix means more carbon dioxide ($CO_2$), which in turn leads to climate change. It also means more air pollutants, such as nitrous oxide and sulphur oxide, which harm people's health.**



# ARE WE ALREADY MAKING PROGRESS TOWARDS A LOW-CARBON FUTURE?

**In 2016, despite the growing global economy, energy-related carbon dioxide emissions were flat for a third straight year, according to the International Energy Agency.**

**Switches from coal to gas in the power sector played a big part, especially in the US, the UK and China.**

# WHY IS AN ENERGY MIX ESSENTIAL FOR A LOW-CARBON FUTURE?

**TO TACKLE CLIMATE CHANGE, THE POWER SECTOR, WHICH ONLY MADE UP 18% OF THE ENERGY FOR END USE IN 2016, MUST EXPAND AND EVOLVE INTO A COMBINATION OF MORE RENEWABLE SOURCES OF ENERGY, AS WELL AS NUCLEAR AND NATURAL GAS – THE CLEANEST-BURNING HYDROCARBON**

Carbon capture and storage (CCS) technology, which captures $CO_2$ emitted during power generation or industrial processing and stores it safely deep underground, will also be vital.

Natural gas is a reliable and flexible partner for variable wind and solar. It is a readily available source of energy for countries throughout the world. The global network of gas pipelines continues to expand.

And when pipelines cannot reach consumers, gas can be cooled to make a liquid, shrinking its volume for easier, safer storage and shipping overseas.

Modern gas-fired power plants can also quickly respond to an increase in demand for electricity or when the sun does not shine and there is limited wind.

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# WHY WILL WE STILL NEED FOSSIL FUELS IN THE FUTURE LOW-CARBON ENERGY MIX?

**THE MOVE TO USING MORE ELECTRICITY POWERED BY LOW-CARBON OR RENEWABLE ENERGY SOURCES WILL BE RELATIVELY STRAIGHTFORWARD FOR SOME PARTS OF THE ECONOMY SUCH AS THE MANUFACTURE OF CLOTHES AND FOOD**

These require low-temperature processes and mechanical activities, which electricity is well suited to deliver.

Other parts of the economy, such as industries that produce iron, steel, cement, plastic, chemicals and long distance heavy goods transportation – the foundations of economic development – currently rely on hydrocarbons to provide extremely high temperatures, chemical reactions or dense energy storage. As of today, many of these cannot be electrified at all, or only at a prohibitively high cost at the moment.

In sectors which will continue to rely on hydrocarbons, solutions are needed including switching from coal to cleaner-burning gas.

Technologies like Carbon Capture and Storage (CCS) will be needed to manage emissions in sectors that will continue to rely on hydrocarbons for decades to come.

Natural solutions, such as forestry and sustainable land use, can also be used to capture and store carbon. Today, transport accounts for more than a quarter of the world's total energy use and one fifth of global energy-related $CO_2$ emissions.

Passenger road travel increasingly needs to be electrified or rely on hydrogen. For the foreseeable future, longer-distance freight shipping and aviation will continue to rely on energy dense liquid fuels, including oil, biofuels and LNG.

Further breakthroughs on battery storage are needed. Container ships and large passenger aircraft cannot operate on battery power because of challenges over storage and weight, for example.

Oil and gas will also continue to be needed for everyday products. Components of gas are used to make fertiliser, which helps feed billions of people, for example. In addition, oil products such as lubricants and plastics have many uses, including in wind turbines, home insulation and medicines.

# HOW DOES ENERGY CONTRIBUTE TO CLIMATE CHANGE?

## THE PRODUCTION AND USE OF ENERGY ACCOUNTS FOR TWO-THIRDS OF THE WORLD'S INDUSTRIAL GREENHOUSE GAS EMISSIONS

World leaders have recognised the need to meet rising energy demand while acting urgently and effectively against climate change.

At the landmark UN climate conference in Paris in December 2015, they agreed to work towards keeping the global rise in temperature from pre-industrial times to well below 2°C in order to avoid the more serious likely effects of climate change. They include floods, droughts and sea-level rise according to the UN Intergovernmental Panel on Climate Change.

The Paris Agreement, which formally took effect in November 2016, signalled a step-change in the global drive to tackle climate change.