

How Shell Lubricants solutions deliver value to wind turbine manufacturers and operators by reducing total cost of ownership and increasing equipment efficiency and reliability.



Boosting efficient and reliable wind power

SHELL LUBRICANTS
TOGETHER ANYTHING IS POSSIBLE

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About Us

About Shell in 2018

92,000

Average number of people
we employed

\$21 billion

Cash flow from operating
activities

30 million customers

Served every day through 43,000 Shell-branded retail stations

30.9 million tonnes per annum

Liquefied natural gas liquefaction volumes

2%

Our share of the world's
oil production

70+

Number of countries
in which we operated



50%

Share of our production that was
natural gas

1%

Our share of the global supply of
energy

3.7 million

Our production of crude oil
and natural gas in barrels
of oil equivalent a day



57.1 million

Tonnes of liquefied natural gas
we sold

\$1 billion

Spent on research and
development

\$102 million

Spent on voluntary social
investment worldwide

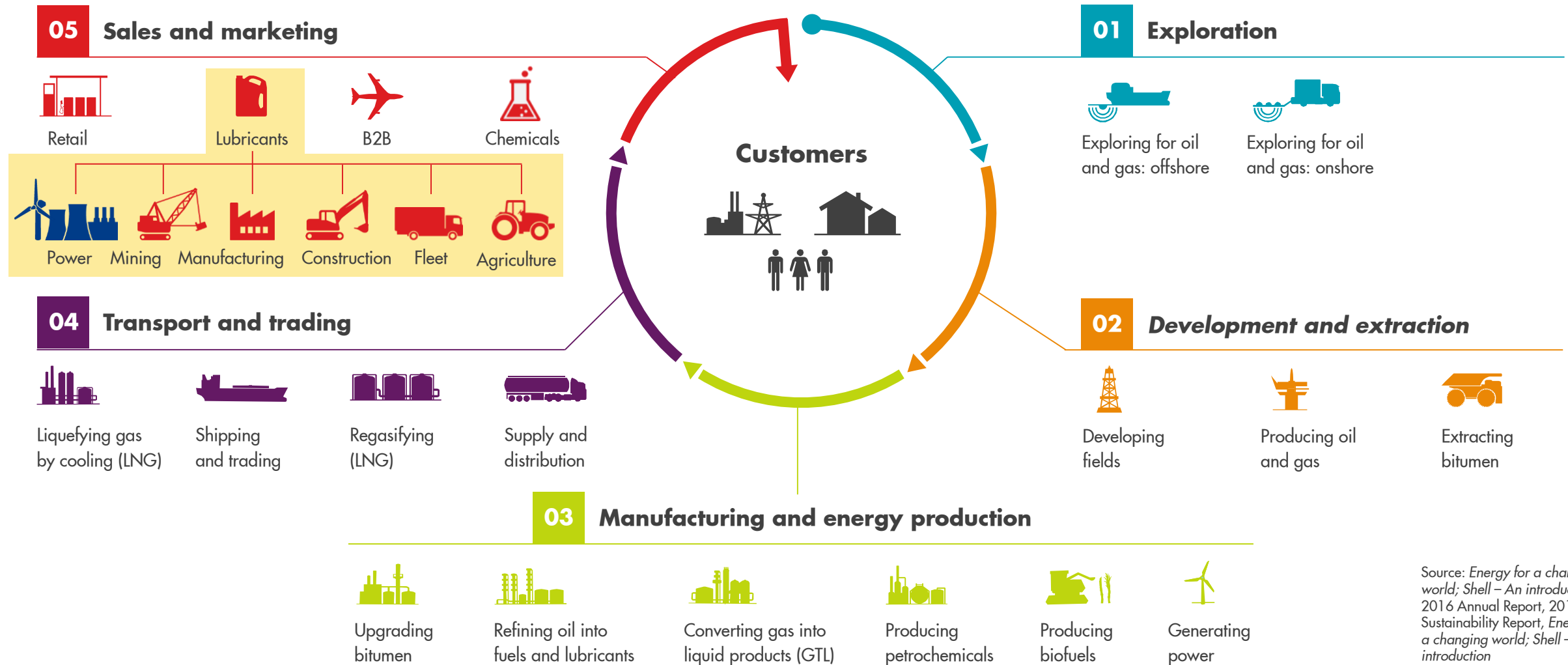
1 million tonnes

Amount of carbon dioxide
captured by the Quest CCS facility
in 2016

Sources: <http://reports.shell.com/annual-report/2016/>, 2016 Annual Report, 2016 Sustainability Report, Energy for a changing world; Shell – An introduction

Shell Lubricants

About lubricants within our business



Source: *Energy for a changing world*; Shell – An introduction/, 2016 Annual Report, 2016 Sustainability Report, *Energy for a changing world*; Shell – An introduction

About Shell Lubricants



105 years in Brazil

The global number-one lubricants supplier*

11 YEARS No. 1
GLOBAL LUBRICANTS SUPPLIER

Employs over 10,500 people



Research and development centres on four continents



Supports customers in more than 90 countries



More than 700 technical staff among Shell Lubricants and its distributors



Shell lubricants are recommended or approved by over 3,000 equipment manufacturers.



More than 150 patents for lubricants, base oils and greases



7 base oil plants, 15 grease plants and 44 blending plants

¹Source: Kline & Company, *Competitive Intelligence for the Global Lubricants Industry, 2008–2018*

About investment in lubricants technology

Shell delivers value by investing in new lubricants:

- We continually invest in research and development.
- We have pioneering research centres around the world.
- We have more than 150 lubricant, base oil and grease patent series.

We support customers with on-the-ground experts to help solve lubrication problems.



260 Shell Lubricants
technical specialists help
customers reduce the TCO
through effective lubrication



Hamburg



Amsterdam

■ Global technology hubs

■ Extended network of technical centres



Houston



Shanghai

Shell investing in New Energies

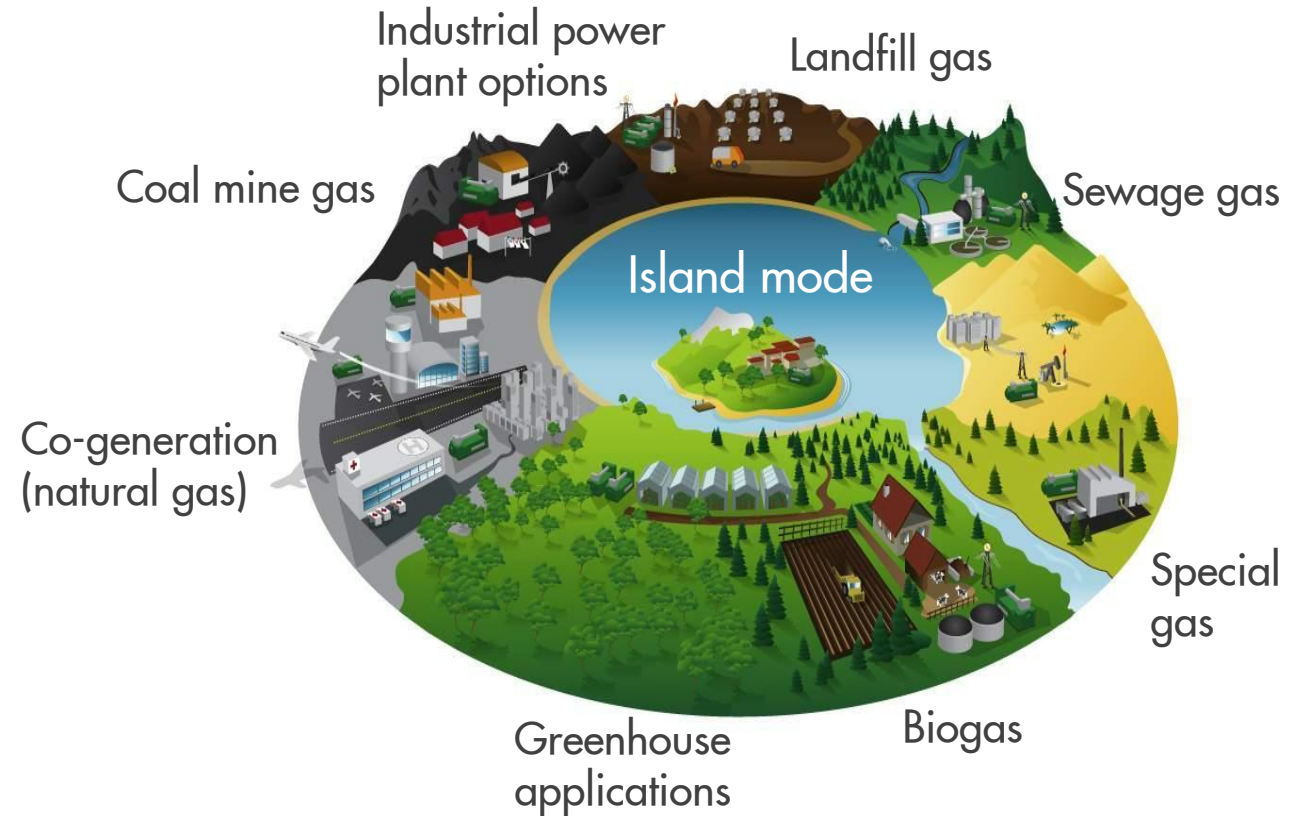
■ Focus areas:

■ New Fuels

- Biofuels
- Hydrogen
- Electric Mobility
- Gas for Transport
- Shell GTL (Gas to Liquids) Technology

■ Power

- Wind
- Solar
- Energy Access
- Trading and Marketing



- Selective and opportunity driven investment
- Capital investment \$1-2 billion per annum average

Shell operations in Wind Power

- Wind is an increasingly prominent part of the evolving energy system
- Shell has more than 15 years' experience
- Onshore and offshore projects operational in the USA & Europe (50:50 Joint Ventures)
- Working to develop a diverse portfolio in offshore wind



Onshore US



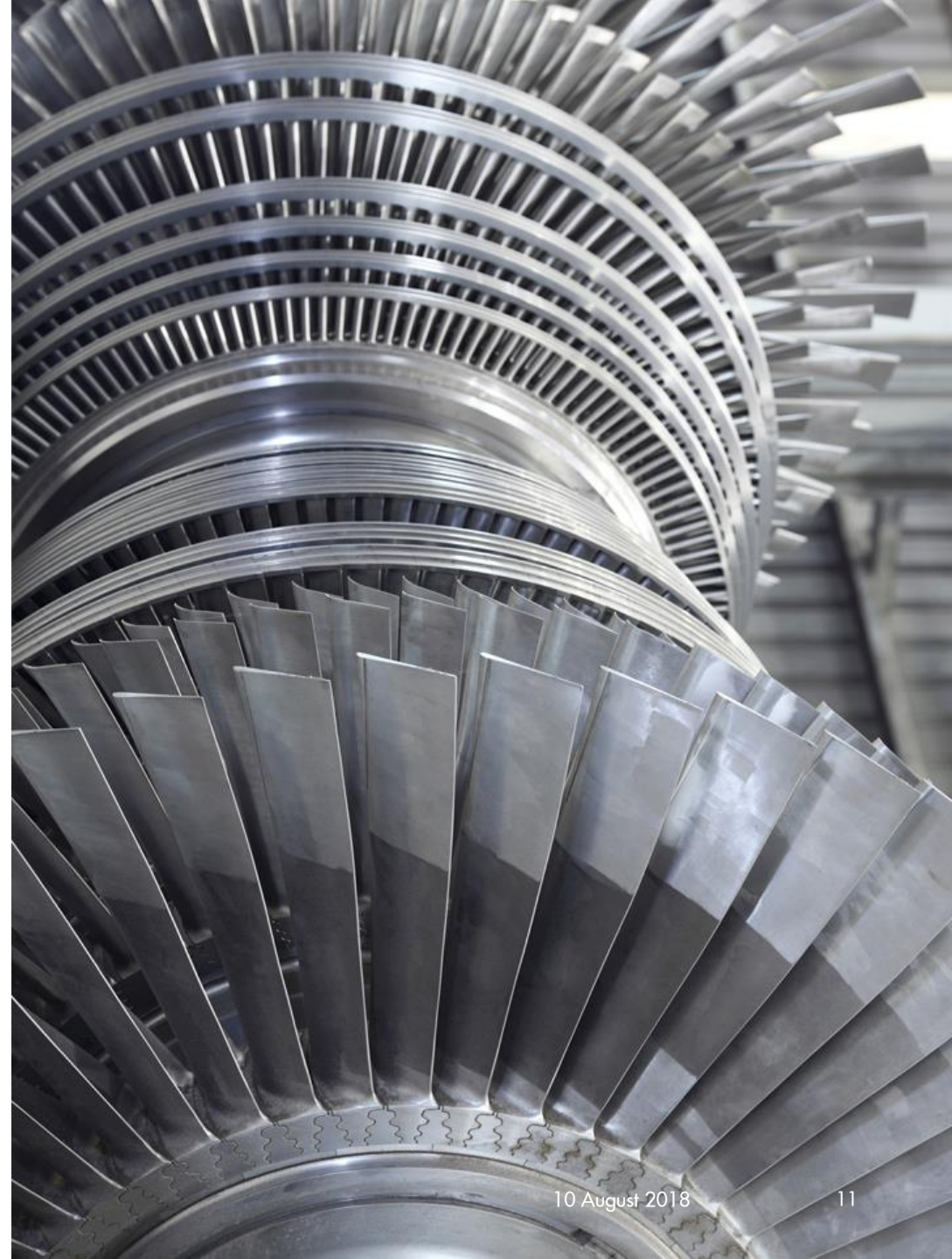
Offshore Europe

Challenges

The needs of wind power operators

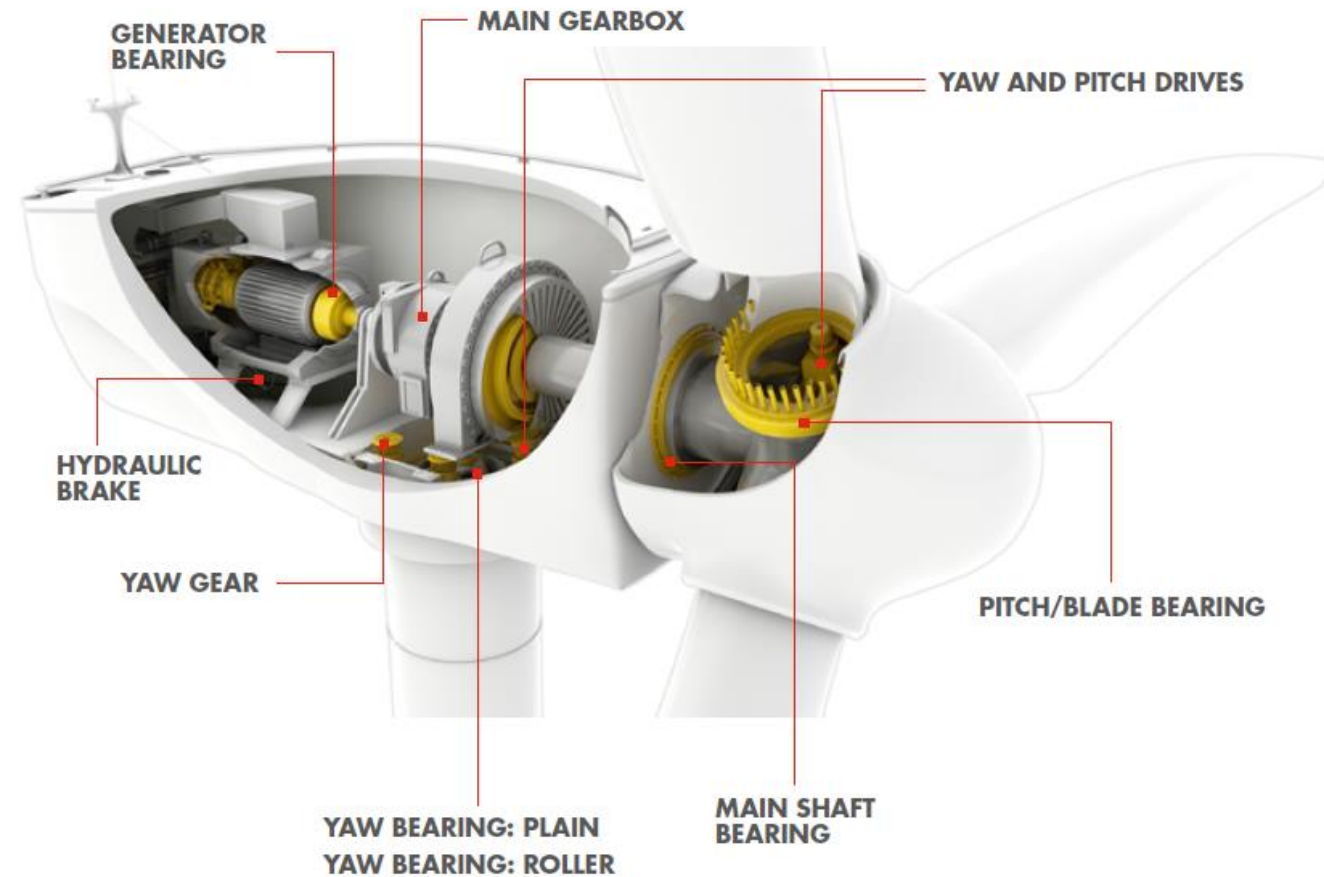
- Machine reliability
- High productivity
- Reliable supply
- Low total cost of ownership (TCO)
- On-site technical support
- Excellent safety and environmental conditions

We understand that enabling your equipment to work reliably for longer is essential to meeting your customers' demands. Our offer is designed to help you address the challenges facing your business.



Wind turbines technology evolution

- Turbines are becoming larger: the average output capacity has increased to 1.96 MW (3.6 MW offshore).
- Gearboxes are heavily loaded; in 2014, there were about 900 gearbox bearing failures that resulted in insurance claims.
- Wind turbines, especially for offshore environments, are moving towards direct drive (no gearbox) owing to reliability issues.



Wind turbine lubrication challenges

Wind turbines are often remotely located, which makes accessing them for maintenance expensive. They are subjected to variable loads including gust loads.

- Longer turbine blades lead to more extreme loads and vibration on the bearings, which can accelerate wear.
- Lubricants must be able to perform efficiently despite extreme low or high ambient temperatures and sandstorms.
- The lubricant must resist the formation of deposits and retain its wear protection properties when contaminated with water.
- Gear oils need a low foaming tendency to cope with the high flow rates in wind turbine gearboxes, which give little time in the sump to release entrained air.

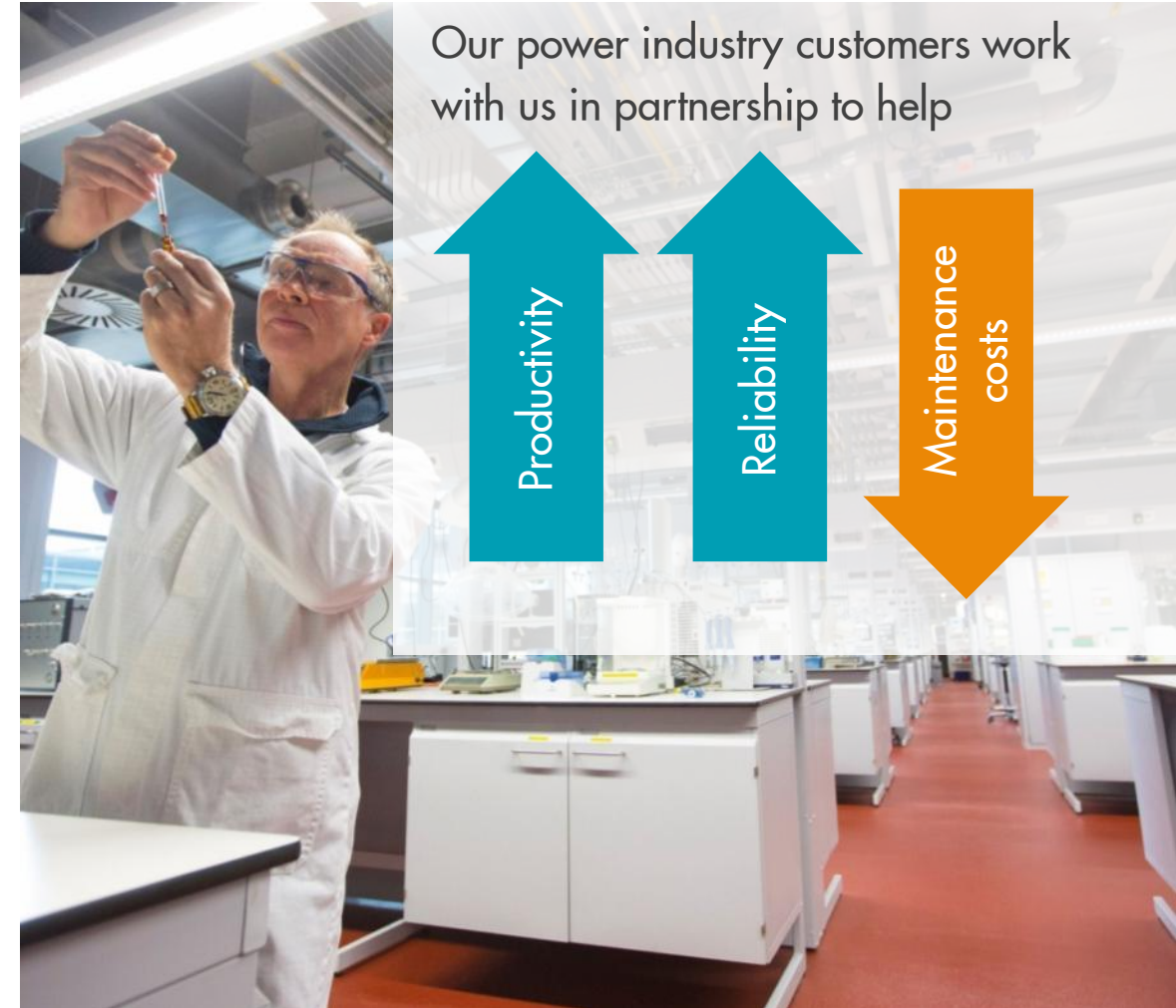


Lubricants can make a significant difference

Competitiveness is critical to power companies facing new competition from alternative and distributed energy providers. Cutting the costs of producing and delivering energy is a priority.

Not all companies are aware that the choice of lubricant can make a significant difference to the TCO of generation, transmission and distribution equipment.

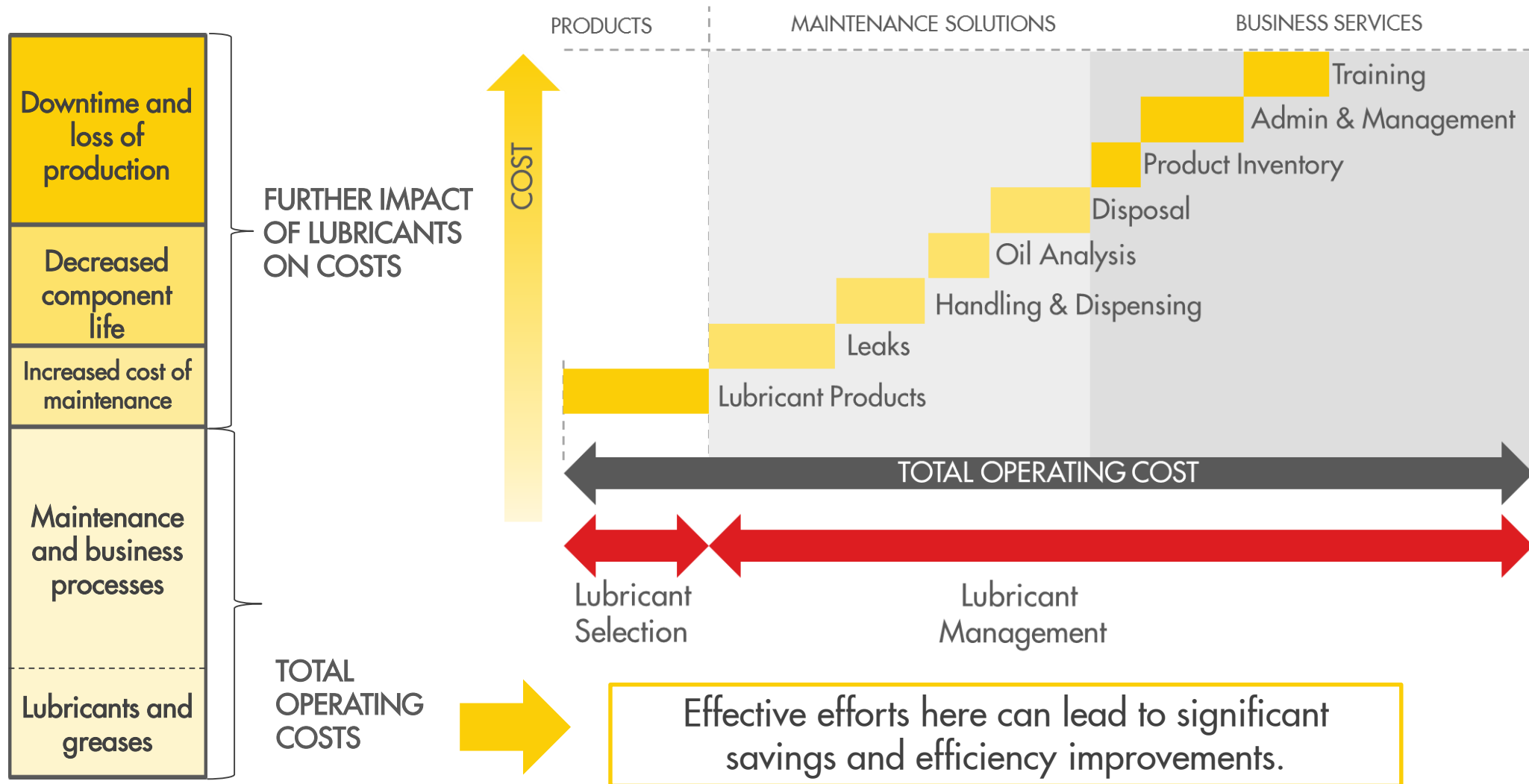
Whether you operate gas or combined-cycle turbines, stationary engines, wind turbines or transformers, **lubricants can make a significant difference to your equipment's TCO.**





Tico

TCO: Understanding lubricants' impact on business costs



Unlocking savings and productivity in the power industry

COMPANIES RECOGNIZE, BUT UNDERVALUE, POTENTIAL COST SAVINGS FROM EFFECTIVE LUBRICATION

56%

of companies believe they can **reduce costs by >5%** through lubricant selection and/or management



But only **1 in 4** think savings could **exceed 10%**



In reality lubricants can impact up to

20% to 30%

of total maintenance expenditure¹



¹Potential effect calculated based on Shell Lubricants site surveys with customers

Unlocking savings and productivity in the power industry

LACK OF LUBRICANTS EXPERTISE AND PROCESS ARE BARRIERS TO TOTAL COST OF OWNERSHIP¹ SAVINGS

The benefits of higher quality lubricants are not fully understood

60%

do not expect it will help
reduce unplanned downtime



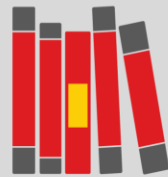
49%

do not expect it will help
reduce maintenance costs



59%

think they do not conduct
staff training on lubricants
as regularly as they should



Only **48%**

think **lubricant product performance** should be an
important purchase consideration



Only **43%**

have all the **correct lubrication management procedures** in place²



¹TCO is defined by Shell Lubricants as the total amount spent on industrial equipment, including cost of acquisition and operation over its entire working life, including costs of lost production during equipment downtime.

²Shell recommended procedures are delivery and storage, oil change, oil dispensing systems, efficiency of grease lubrication systems, oil analysis and training employees in lubricant selection or management.

Unlocking savings and productivity in the power industry

THIS IS HAVING A FINANCIAL IMPACT

62%

admit their incorrect
lubricant selection has
caused unplanned downtime



1 in 4

companies believe costs
exceeded \$500,000*



and **1 in 5**

companies state costs
exceeded \$1 million*



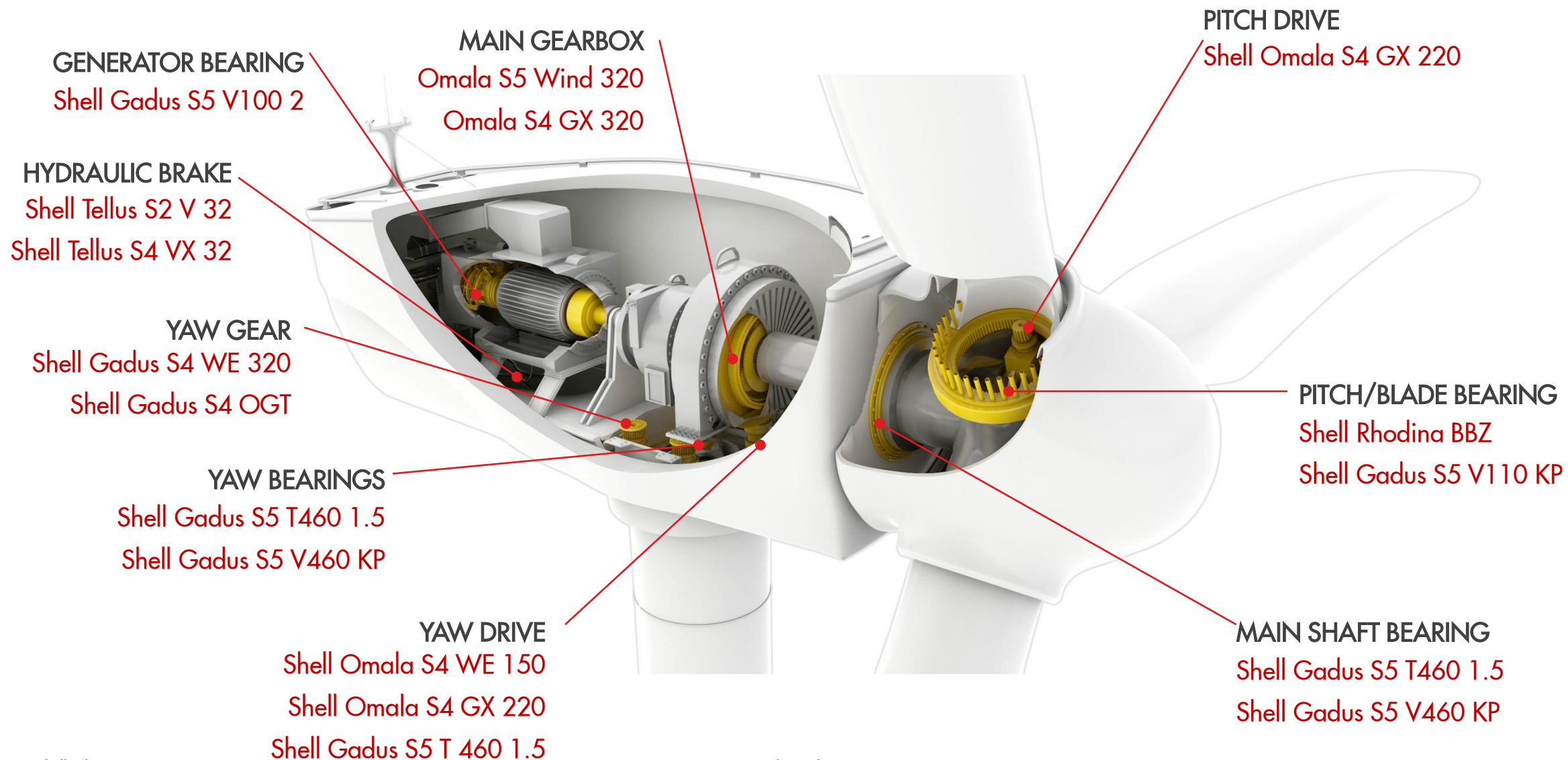
EFFECTIVE LUBRICANT SELECTION AND MANAGEMENT CAN HELP COMPANIES LOWER **TOTAL COST OF OWNERSHIP (TCO)**
THROUGH **REDUCED UNPLANNED DOWNTIME AND LOWER MAINTENANCE COSTS**

*Potential effect calculated based on Shell Lubricants site surveys with customers



Our Solutions

Shell Lubricants for Wind Turbines



Shell lubricants with OEM in wind power

Shell Lubricants has long-standing relationships with many of the sector's leading equipment manufacturers. It has more than 3,000 equipment manufacturers' recommendations or approvals across its product range, including approvals from

- Gamesa
- Siemens
- Dongfang
- Suzlon
- NGC
- General Electric
- Nordex-Acciona
- Windey
- Moventas
- Winergy
- Envision
- Suzlon
- Bosch Rexroth
- Vestas



Shell Omala S5 Wind 320: Key features and benefits

Superior oxidation and thermal degradation resistance promotes extended oil-drain intervals.



Robust wear and corrosion protection can help to extend equipment life.



Advanced foam control and superior filterability contribute to less gear and bearing failure.



Enhanced low-temperature flow can lead to improved speed to grid and improve system efficiency in cold climates.



Over **one million cumulative run-hours** have been accrued in turbines located in Spain, China, United States, India and Denmark.

Oil changing without flushing.



Shell Omala S5 Wind 320: **10 years warranty**

TRUST

Purchasing the most advanced technology in the market through a trusted partner with technical expertise



FINANCIAL

Removes one oil change in the lifetime of the wind turbine, thereby saving costs for oil and for maintenance for an oil change



SAFETY

Reduced risk exposure with less up-tower work



Offshore, this can amount to a **US\$30,000 saving per asset.**

Shell Lubricants Services

Shell
Lube**Advisor**

Shell
Lube**Analyst**

Shell
Lube**Coach**

Shell
Lube**Match**



Shell HSSE Culture & Commitment



12 Live Saving Rules



Road Safety Campaign



Industrial Safety Program





DVR

Unlocking savings and productivity in the power industry

**SHELL LUBRICANTS HAS
UNLOCKED OVER US\$139
MILLION IN SAVINGS FOR
POWER SECTOR CUSTOMERS.***

*Based on documented savings delivered to Shell Lubricants customers from 2011 to 2016



Chinese wind farm enhances turbine performance with Shell Omala S5 Wind 320

Background

The Guohua wind farm in Dailiji, Inner Mongolia, China, operates 33 1.5-MW turbines from Dongfang Electric New Energy Equipment that began productive operation in late 2009. The wind farm is in an area that experiences a yearly temperature range of -30.5 to $+38.9^{\circ}\text{C}$.

Outcome

The management team enlisted the help of the Shell technical team and the equipment manufacturer, who recommended that the wind farm should trial Shell Omala S5 Wind 320, Shell's next-generation gear oil for wind applications, in two of its turbines.

Challenge

The wind farm operator, Guohua (Tongliao) Wind Power Co., Ltd, wanted to ensure maximum uptime and availability for the turbines by using a high-performance lubricant. Although the turbines' gearboxes are not prone to frequent faults, a failure would result in a long period of downtime for the affected turbine.

Benefits

Guohua wind farm tracked the operation of the two turbines and the properties of the oil during the two-year trial and found that

- The runtime of the turbines was significantly longer
- A foaming problem in the gearboxes had been alleviated
- The cold start-up time of the turbines was shorter
- The additive content of the oil remained stable
- The amount of wear metals in the oil was much lower than the industry standard limit.

SHELL LUBRICANTS

From extending oil life to powering cities

Shell Lubricants
From extending oil life to powering cities

Questions and answers

Q&A

