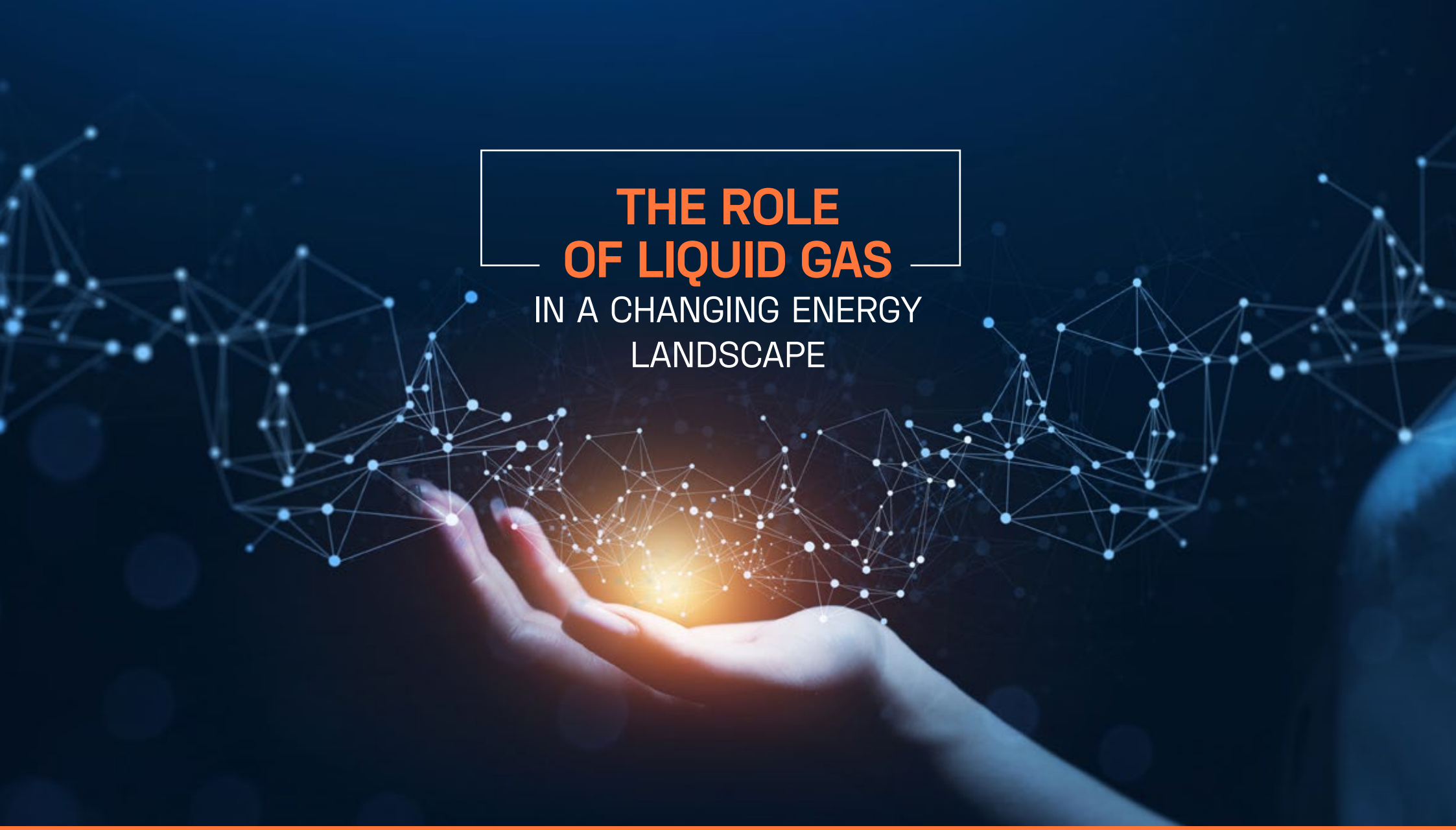


THE ROLE OF LIQUID GAS

IN A CHANGING ENERGY LANDSCAPE

LPG
EXCEPTIONAL ENERGY

WORLD LPG ASSOCIATION
www.wlpga.org

WLPGA

Table of Contents



What is Liquid Gas? 04



Why Liquid Gas? 06



Liquid Gas & the energy transition 08



Liquid Gas: a unique industry 12



Cooking
16



Transport
26



Heating
38



Power Generation
44



Maritime
48



Agriculture
54



Business & Industry
60

What is Liquid Gas?

The term “Liquid Gas” may seem a contradiction in terms since all things in nature are either a liquid, solid or a gas. Yet, liquidity is the unique character of Liquid Gas that makes it such a popular and widely-used fuel. At normal temperature and pressure, Liquid Gas is gaseous but it changes to a liquid when subjected to modest pressure or cooling.

Liquid Gas is a portable, clean and efficient energy source that is readily available to consumers around the world. Liquid Gas is primarily obtained from natural gas and oil production, but is also produced increasingly from renewable sources. Its unique properties make them a versatile energy source which can be used in more than 1,000 different applications.

LPG

LPG stands for liquefied petroleum gas and the term is used to describe two natural gas liquids: propane and butane, or a mix of the two. Propane and butane are chemically quite similar, but the small differences in their properties mean that they are particularly suited to specific uses. Often, propane and butane will be mixed to get the best energy yields and properties.

DME

DME (dimethyl ether) is a clean, colourless gas that is easy to liquefy and transport. It has remarkable potential for increased use as an automotive fuel, for power generation, and in industrial and domestic applications for heating and cooking.

DME has been used for decades in the personal care industry (as a benign aerosol propellant), and is now increasingly being exploited for use as an ultra-clean alternative fuel and energy carrier.

DME can be produced from a variety of abundant sources, including natural gas, coal, waste from pulp and paper mills, forest products, agricultural by-products, municipal waste and dedicated fuel crops such as switchgrass.

3 billion

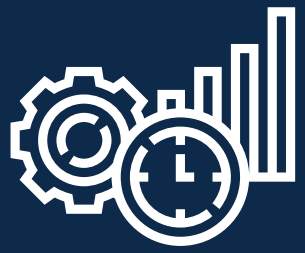
More than three billion people use Liquid Gas

300 Mt

Global Liquid Gas consumption exceeds 300 million tonnes

Liquid Gas is used on all six continents, from Asian megacities to remote bases on Antarctica

Why Liquid Gas?



Efficient

Liquid Gas is an energy-rich fuel source with a higher calorific value per unit than other commonly-used fuels, including coal, natural gas, diesel, petrol, fuel oils and biomass-derived alcohols. This means that a Liquid Gas flame burns hotter, an advantage that can translate into higher efficiency. In rural communities in developing countries, Liquid Gas can provide a first modern alternative to traditional cooking fuels (e.g. firewood, charcoal, dung). Liquid Gas is also very efficient at a macro scale: villages, towns, cities, regions and countries can reduce emissions, improve air quality and ensure energy security without large-scale capital expenditure.



Versatile

Liquid Gas has more than a thousand applications. It is used in transportation, in commercial business, industry, farming, domestic heating and cooking, and for recreational purposes.



Clean

Liquid Gas is a clean-burning fuel that is low-carbon, emits virtually no black carbon and does not spill. Its use improves air quality, reduces the emission of greenhouse gases and protects the environment. As a low-carbon, low-polluting fuel, Liquid Gas is recognised by governments around the world for the contribution they can make towards improved indoor and outdoor air quality and reduced greenhouse gas emissions.

Renewable Liquid Gas is becoming increasingly available. It is chemically identical to conventional Liquid Gas and can replace them, or be blended and used by existing appliances.



Portable

Liquid Gas is available in even the remotest of areas, improving the lives of millions of citizens worldwide and providing a further impetus to regional development. It can be transported using sea, rail or road transport. As relatively few rural or remote areas can benefit from piped natural gas, Liquid Gas is an ideal power source for these areas, either as a primary source or in combination with renewable fuels. It does not need a huge network of pipelines to support it. Often, it is the only fuel to reach islands or high-altitude communities and, in times of emergency or national disaster, it can be crucial to survival.

Liquid Gas can be carried away from a retail outlet in a cylinder by an individual, or delivered to an industrial plant in a bulk tanker. It is a truly multi-purpose energy source. It is easy to transport by tanker, or in cylinders. It has some special attributes for rural communities, which have earned it ready acceptance and a prominent position in rural energisation.



Accessible

Liquid Gas can be accessible to everyone everywhere today without major infrastructure investment. Nothing needs to be invented, and there are reserves sufficient to last many decades. It is extremely versatile and portable. It can be transported using sea, rail or road transport. Liquid Gas is available in a wide variety of packaging and storage options, ranging from refillable cylinders to underground tanks.

Liquid Gas is available in even the remotest of areas, improving the lives of millions of citizens worldwide and providing a further impetus to regional development. Liquid Gas does not need a huge network of pipelines to support the sector. Often, it is the only fuel to reach islands or high-altitude communities and, in times of emergency or national disaster, it can be crucial to survival.

Liquid Gas & the energy transition

As of 2023, more than 70 countries, covering over three-quarters of global emissions, have set net-zero targets[1]. At the same time, thousands of cities, businesses, financial institutions and educational bodies have independently pledged action to reduce carbon emissions. Most net-zero targets are aligned with the Paris Agreement, which calls for global emissions to fall to net-zero by 2050 in an effort to keep global warming to no more than 1.5°C above pre-industrial levels[2].

[1] The United Nations – For a Liveable Climate: Net-zero commitments must be backed by credible action.
[2] The United Nations – Paris Climate Agreement



With the energy system central to decarbonising the global economy, there is a requirement for a dramatic energy transition. Liquid Gas plays a role in this energy transition across a range of different sectors.

The unique properties of Liquid Gas (portability, long-term storage, energy density, flexible supply chain …) make it one of the easiest fuels to distribute cost-effectively. It is also among the most multi-faceted of energy sources, with versatile uses across numerous sectors including heating, cooking, transport, power generation, agriculture and broader industrial processes.

As a clean-burning fuel, Liquid Gas produces negligible air pollutant emissions compared with the combustion of oil, coal or biomass. It can therefore be used to help reduce levels of air pollution, an issue of concern given that 99% of the global population breathes air that exceeds WHO guideline limits[3].

Liquid Gas is also a less carbon-intensive energy source compared to oil and coal, meaning transition can result in immediate carbon savings.

Inevitably, the varying needs of countries - which depend on their geographies, natural resources, levels of economic development and governance - will mean that a variety of low-carbon technologies will be required to facilitate the energy transition.

A viable solution for one scenario could be an inappropriate solution somewhere else. Liquid Gas will not be the primary solution across all sectors in all regions. However, owing to its versatile nature and strong decarbonisation potential through renewable Liquid Gas will play an important role in the energy transition across multiple sectors in the years to come.

[3] The World Health Organization – Air Pollution

Renewable Liquid Gas (rLG)

rLG offers deeper decarbonisation across several applications and contexts, without necessitating disruptive changes in infrastructure or technology. rLG is a low-carbon alternative to conventional Liquid Gas, and can be derived from various renewable feedstocks, such as waste, residues and sustainably-sourced biomass.

The energy source can be produced from a range of innovative production technologies,using a broad range of feedstocks. Some of these feedstocks - such as municipal solid wastes and used cooking oil – are currently an environmental problem for countries. As such, the production of rLG can create a double benefit, helping to address waste management problems while also creating an energy source which can easily substitute high-carbon fossil fuels and therefore lower carbon emissions. rLG is also a by-product of the production processes of several other strategically important biofuels - such as sustainable aviation fuel and renewable diesel.

The clearest advantage of rLG is its potential as a drop-in solution, requiring minimal alterations to existing infrastructure and often lower upfront costs. This allows for a gradual, staggered transition away from conventional Liquid Gas, ensuring minimal disruption to energy systems and end-users, where applicable. rLG can also be blended with conventional Liquid Gas, facilitating immediate carbon savings that increase over time as the proportion of renewable fuel in the blend grows.



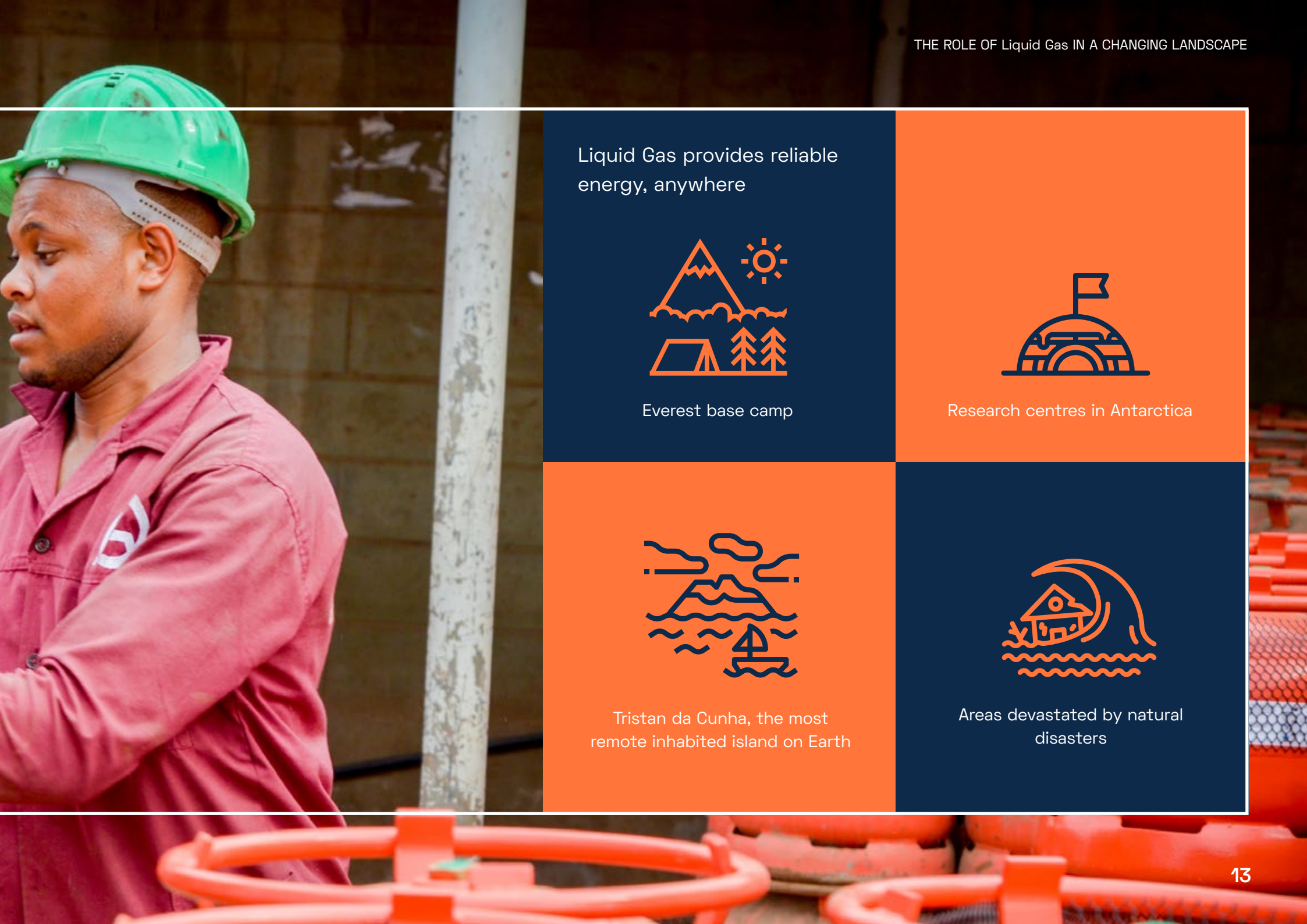
The production of rLG can create a double benefit, helping to address waste management problems while also creating an energy source which can easily substitute high-carbon fossil fuels and therefore lower carbon emissions.



Liquid Gas: a unique industry

Liquid Gas, especially LPG, is used in every country and territory. It is used for a broad range of applications. Over four million people and thousands of companies from global actors to self-employed distributors work around the clock to make sure Liquid Gas reach customers in time.

Liquid Gas is available in even the remotest of areas, improving the lives of millions of citizens worldwide and providing an impetus to regional development. As relatively few rural or remote areas can benefit from piped natural gas, Liquid Gas is an ideal power source for these areas, either as a primary source or in combination with renewable energy.



Liquid Gas provides reliable energy, anywhere

Everest base camp

Research centres in Antarctica

Tristan da Cunha, the most remote inhabited island on Earth

Areas devastated by natural disasters

A diverse collection of companies
The Liquid Gas industry is not dominated by a few global companies but includes a wide range of companies, including producers, distributors and retailers.

The decentralised distribution model is fundamentally different from all other energy sources and has allowed people from all walks of life to build successful businesses.

In the US, the LPG industry employs

57,000

American workers and generates

46 billion

in direct economic impact annually[4]

[4] https://www.npga.org/impact/economic/#_ftn2





Why Liquid Gas?

Diversified and competitive

Devoted to the highest safety standards

Committed to meeting the world's energy challenges

Equipped to immediately contribute to a sustainable energy mix

The role of the Liquid Gas industry in the energy transition

The Liquid Gas industry delivers reliable energy, everywhere. No mountain is too high, island too remote or desert too vast. The Liquid Gas industry has already helped several hundreds million families switch from polluting solid or liquid fuels to cleaner gaseous solutions and enabled millions of farms and companies to reduce their emissions.

However, billions of people still cook using biomass, charcoal or kerosene. The Liquid Gas industry is committed to finding solutions to help make the switch to reduce emissions and household air pollution.

The Liquid Gas industry is also perfectly placed to enable a transition to lower- or zero-carbon fuels. With minimal adaptations, our unique distribution model and logistics can be adapted to distribute these new fuels to our customers across all continents.

In several countries, renewable Liquid Gas that will substantially reduce emissions are already available for homes and businesses, and the available volumes are steadily increasing.



Cooking is the oldest form of energy use, and stovetop cooking is one of the world's most energy-consuming activities. Cooking accounts for less than 10% of energy use in developed countries but represents the lion's share of domestic energy use in developing countries.

People in industrialised countries can choose from numerous stovetops and ovens using energy sources such as Liquid Gas, natural gas and electricity. However, in many parts of the world, the choice of cooking fuel is dictated by availability and cost, which means that more than 2.5 billion people, especially in Asia and Africa, still lack access to clean cooking fuels.

For three billion people[5] living in low-income and middle-income countries, the simple act of cooking is a major health and safety risk. They routinely cook with fuels such as wood, animal dung, coal and kerosene. Burning these types of fuels in open fires or traditional stoves causes harmful household air pollution, resulting in an estimated 3.8 million deaths annually according to the World Health Organization (WHO), and contributes to various health, socio-economic, and environmental problems.

Health effects are concentrated among women, who are more likely to be responsible for cooking, and young children. The work of gathering fuel exposes women and children to safety risks and often consumes 15 or more hours per week, constraining their time available for education, rest and paid work.

[5] https://www.nature.com/articles/s41467-021-26036-x



Cooking

The key to reducing emissions and household air pollution

Every year, the indoor air pollution caused by smoke from open fires and traditional stoves kills about 4.3 million people. Every eight seconds, someone (mostly women and children) dies as a consequence of inefficient use of biomass fuel.

Decarbonising cooking in industrialised countries and guaranteeing access to clean cooking fuels are achievable objectives that will have an immediate positive impact on mitigating climate change, improving air quality, preserving biodiversity and protecting vulnerable populations.

90%

Cooking energy accounts for about 90% of all household energy consumption in developing countries.

95%

of staple foods need cooking before they can be eaten.

6%

In the EU, the energy used for domestic cooking represents 6% of total energy use[6].

23 M

Food is prepared at home and at 23 million food outlets across the world.

13.2 H

India ranked highest on the list for home cooking, with an average of 13.2 hours spent in the kitchen every week.

6.7

Today, we cook an average of 6.7 meals per day at home, although this number varies considerably from country to country.



[6] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_consumption_in_households



Challenges and solutions

In the industrialised world, many meals are cooked using fossil fuels or electricity generated by thermal power plants. Greenhouse gas emissions can be reduced or avoided by switching to renewable gases or electricity from renewable sources. Furthermore, polluting forms of outdoor cooking, such as coal barbecues, can be replaced with clean-burning gases.

However, the main issues related to cooking are concentrated in the developing world. Cooking with biomass or polluting liquid fuels in developing regions is a major cause of non-communicable diseases, air pollution and deforestation as well as a barrier to social progress. Some 2.4 billion people are without access to clean cooking, costing the world more than US$2.4 trillion in damage to the climate and local economies and contributing to 3.2 million premature deaths each year. Fuel collection is often tasked to women and children, perpetuating the negative socioeconomic and gender inequities of energy poverty by taking away time that could be spent on other activities such as schooling, income generation and socialising[7].

[7] World Health Organization. Burning Opportunity: Clean Household Energy for Health, Sustainable Development, and Wellbeing of Women and Children (WHO, 2016).



Household air pollution
Many people cook on open fires, filling their homes with smoke.

Household air pollution was responsible for an estimated 3.2 million deaths per year in 2020, including over 237,000 deaths of children under the age of five[8].

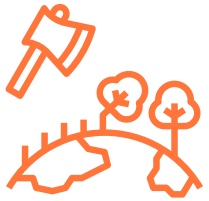
Household air pollution increases the risk of noncommunicable diseases including stroke, ischaemic heart disease, chronic obstructive pulmonary disease and lung cancer.



Outdoor air pollution
Household air pollution eventually finds its way outside, and many meals are cooked outdoors on open fires. Outdoor air pollution in both cities and rural areas was estimated to cause 4.2 million premature deaths worldwide per year in 2019. This mortality is due to exposure to fine particulate matter, which causes cardiovascular and respiratory disease and cancers[9].

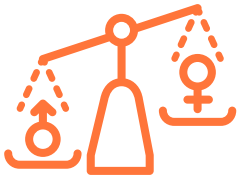


Greenhouse gas emissions
Black carbon (sooty particles) and methane emitted by inefficient stove combustion are powerful climate pollutants. Emissions from non-renewable biomass for cooking amount to 1 Gt/CO_2 per year — about 2% of global emissions and up to 4.3% of total emissions in pan-tropical regions, and roughly on a par with emissions from aviation[10].



Deforestation
Approximately 30% of global greenhouse gas (GHG) emissions from forest degradation are caused by harvesting fuel for cooking.

Up to 34% of wood harvested is unsustainable, contributing to forest degradation and climate change.



Barrier to social progress
Women and children can spend up to ten hours each week gathering fuel, walking ever-greater distances and carrying heavy loads due to forest degradation. In many countries, women spend 1.5 hours each day collecting firewood and four hours are spent cooking.

Women and girls must often walk long distances to obtain cooking fuel, and, as a result, face increased risk of physical and sexual violence. Many children, especially girls, may skip school to help with firewood collection and food preparation.

[8] https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health
[9] https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health
[10] Clean Cooking Alliance (2021). Clean Cooking Critical to Achieving COP26 Climate Goals.

The role of Liquid Gas

The UN has established access to “affordable and clean energy” as one of the Sustainable Development Goals (SDGs), with ambitions to achieve universal access to clean cooking methods by 2030. Liquid Gas, such as LPG, plays a key role in achieving this goal. Several countries have launched successful programmes to provide access to liquid fuels, and their impact has been profound and immediate.

There are a range of options to reduce cooking emissions and provide access to clean cooking fuels. These include electric stoves, clean biomass stoves or connections to the natural gas grid.

The International Energy Agency set out in 2022 what it calls the Sustainable Africa (energy) Scenario. This envisages that by 2030, one third of homes would be using LPG, 10% electricity, 10% biogas and 6% alcohol fuels. This leaves 41% still using solid biomass, but on more efficient, cleaner stoves. However, the acceleration required to reach even these projections is staggering. Clean cooking access in sub-Saharan Africa needs to improve around 15 times faster over the 2022-2030 period than it has before. LPG is the only cleaner fuel that ticks all the boxes. It is popular, meets household needs, is easy to store and transport and – crucially – is available now in the quantities needed.

Many governments have already prioritised the rapid scale-up of Liquid Gas to secure cleaner cooking and forest protection, alongside active investment in renewables.





Why Liquid Gas?

Locally stored energy
Unique distribution model
Liquid Gas can be, and is, transported everywhere, from remote deserts areas or islands to mountaintops. It can be transported by a bulk truck or in convenient cylinders of varying sizes. Liquid Gas is distributed by a private sector-driven industry with significant potential for job creation and entrepreneurship, especially in the local setting through engagement in the downstream part of the value chain.

Convenience
Cooking with gas is universally popular because of its convenience, speed and controllable heat. Chefs in rural areas or cooks in food trucks all use Liquid Gas. People switching from biomass to Liquid Gas universally appreciate the convenience and time savings, as well as the lack of smoke

Limited infrastructure
Unlike natural gas grids that are better suited for densely populated areas, Liquid Gas does not require capital-intensive infrastructure. Using Liquid Gas for cooking also reduces the strain on power grids.

Available
Liquid Gas is available in sufficient quantities to provide access to clean cooking fuels for everyone. Furthermore, the stoves or other applications are low-tech and cost-effective. New ‘Pay as you Go’ can help further reduce the barrier to adoption.

Seamless transition to a renewable future
Existing stoves, ovens and barbecues can switch to renewable Liquid Gas without any modifications

Reliability
Liquid Gas can be stored locally for a long time, which means the cooking fuel is always available, even in the most remote areas.



A proven track record

53%

In 1990, 53% of the global population relied on polluting cooking fuels. This percentage dropped to 36% by 2020[11]. This change was mainly driven by the large-scale adoption of LPG.

776 M

776 million people secured access to clean cooking fuels since 2010, with China and India accounting for 570 million people, thanks to LPG programmes and clean air policies.

87 M

In India, national data show the share of population relying on biomass and kerosene declining 30 percentage points between 2010 and 2020, with most now using LPG instead. Since 2015, government figures indicate that an additional 87 million free LPG connections were provided to poor households via the high-profile Pradhan Mantri Ujjwala Yojana (PMUY scheme).

XX

Africa case study

Liquid Gas and the energy transition

Liquid Gas, especially LPG, helps billions move away from polluting solid and liquid fuels.

According to the International Energy Agency, between 800 million and two billion people will switch from traditional cooking with wood to other fuels (such as LPG) over the 2015-30 period.

Liquid Gas is far more energy-concentrated than wood: annual per capita cooking requires 43 kg instead of 400 kg of wood.

LPG transfers 50% of its energy content to the pot, compared to wood's 10-20%.

Unlike wood, an LPG fire can easily be turned on and off. Instead of emitting choking smoke, its exhaust is problem-free for indoor use. These advantages lead to improved wealth and health.

Switching from wood to Liquid Gas can reduce cooking's carbon emissions significantly. In the tropics, where much traditional cooking happens, switching cuts net CO_2 output to the atmosphere by 60%.

A typical 13 kg cylinder of LPG would avert deforestation of a 6 m2 forest area.

If, as the International Energy Agency projects, the 800 million to two billion people switching from wood instead used LPG , this would create a net annual atmospheric reduction of 170-415 million tonnes of carbon dioxide. That lower figure is about equal to the annual emissions of Pakistan or the Netherlands; the larger is about that of South Africa or the United Kingdom.





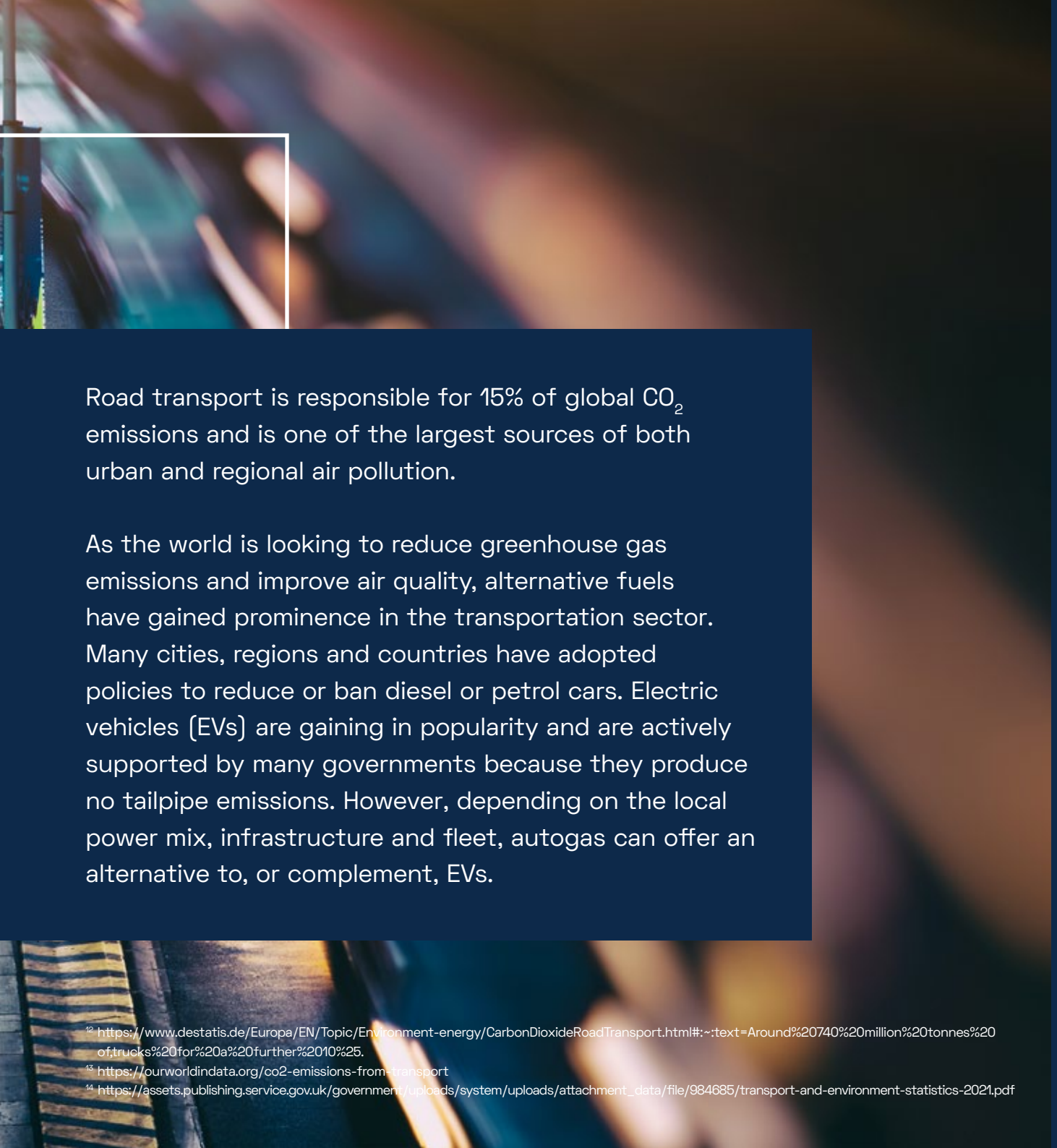
Liquid Gas represents a substantial positive impact on several important sustainability factors such as creating jobs and reducing deforestation, GHG emissions and the number of deaths caused each year by indoor pollution. It has a proven track record in substituting charcoal and biomass for a substantial part of household energy, and could contribute positively towards several of the SDGs, including Access to Energy, Climate Change, Health, and Gender/Equality.

The cost of achieving access to clean fuels by 2030 is estimated to be US$4.5 billion per year. The World Bank estimates that the cost of inaction on clean cooking is in the region of US$2.4 trillion per year, more than 500 times the cost of positive action.
In the industrialised world, Liquid Gas is the cooking fuel of choice in rural areas and for outdoor cooking. Gas cooking is efficient, fast and reliable. For recreational applications, Liquid Gas can also be transported in convenient, compact cylinders. To further reduce CO_2 emissions, traditional Liquid Gas can be seamlessly replaced by renewable gases.



Transport

A proven solution to reduce transport emissions, today



Road transport is responsible for 15% of global CO_2 emissions and is one of the largest sources of both urban and regional air pollution.

As the world is looking to reduce greenhouse gas emissions and improve air quality, alternative fuels have gained prominence in the transportation sector. Many cities, regions and countries have adopted policies to reduce or ban diesel or petrol cars. Electric vehicles (EVs) are gaining in popularity and are actively supported by many governments because they produce no tailpipe emissions. However, depending on the local power mix, infrastructure and fleet, autogas can offer an alternative to, or complement, EVs.

740 M

Around 740 million tonnes of CO_2 were emitted in the EU in 2021 from the road transport fuel combustion.[12]

3/4

Road transport accounts for three-quarters of transport emissions.[13]

34%

In the UK, 34% of nitrous oxide (NOx) emissions and 13% of particulate matter (PM) emissions come from transport.[14]

[12] https://www.destatis.de/Europa/EN/Topic/Environment-energy/CarbonDioxideRoadTransport.html#:~:text=Around%20740%20million%20tonnes%20of,trucks%20for%20a%20further%2010%25.
[13] https://ourworldindata.org/co2-emissions-from-transport
[14] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984685/transport-and-environment-statistics-2021.pdf

Challenges and solutions

Across the world, measures are being taken to reduce emissions from road transport.

Promotion of EVs	Governments around the world are encouraging the adoption of electric vehicles by offering incentives such as tax rebates, subsidies and access to carpool lanes. The development of charging infrastructure is also a priority to support the widespread adoption of EVs.
Fuel efficiency standards	Many countries are implementing stricter fuel efficiency standards for new vehicles. These standards incentivise car manufacturers to produce vehicles that consume less fuel and emit fewer greenhouse gases.
Hybrid vehicles	Hybrid vehicles, which combine internal combustion engines with electric propulsion systems, are being promoted as an intermediate step toward full electrification. They offer improved fuel efficiency and reduced emissions compared to traditional vehicles.
Public transportation and active mobility	Investments in public transportation systems, such as buses, trams and trains, help reduce the number of individual vehicles on the road. Additionally, promoting active transportation modes like walking and cycling can help reduce emissions and improve urban air quality.
Low-emission zones	Some cities are implementing low-emission zones into which only vehicles meeting certain emissions standards are allowed to enter. This helps reduce pollution in densely-populated areas.
Biofuels	Biofuels, such as ethanol and biodiesel are promoted as alternatives to conventional fossil fuels. These fuels are derived from renewable sources and can help lower carbon emissions.
Emission standards and regulations	Governments are continuing to implement and tighten emissions standards for vehicles, which encourage the development and adoption of cleaner technologies.
Internal combustion engine bans	Several countries have decided to ban the sale of cars with internal combustion engines in the future.
Gaseous fuels	Several countries and regions offer incentives for the use of Compressed Natural Gas (CNG) or autogas by offering lower taxes on the fuel or allowing access to low-emission zones.

Sales of EVs have increased exponentially. However, EVs are not the ideal solution for all countries and regions. The switch to EVs requires substantial investments in charging infrastructure, and EVs are only as clean as the electricity they use. Questions have also been raised about the availability of raw materials to scale up EV production.



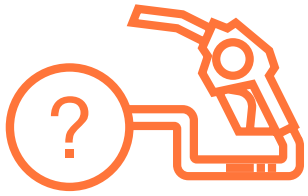
The role of Liquid Gas

Liquid fuels, better known as autogas as a transport fuel, already play a key role in reducing emissions and improving air quality. Their unique qualities make them an available and viable alternative to electrification for a part of the vehicle fleet.

What is autogas?

Autogas is LPG used as a fuel in internal combustion engines in vehicles. It is usually a mixture of propane and butane, but other gases such as DME can be blended in.

In the United States, autogas is more commonly known under the name of its primary constituent, propane. In the UK, LPG and autogas are used interchangeably. In Australia, the common terms are LPG and gas. In Italy and France, GPL is used, and in Spain autogas is referred to as GLP. In many Asian countries the term autogas is not commonly recognised as a generic term, and the use of the terms LPG or autoLPG is more common.



Are autogas and CNG the same fuel?

CNG and autogas are both gaseous fuels, but they are not the same. CNG is high-pressure compressed natural gas and autogas is composed of propane or a propane/butane mix.
The pressure in a CNG tank is 200 bar, compared to 7.5 bar for LPG. A car equipped with autogas cannot be powered by CNG, and vice versa.



What vehicles can run on autogas?

Eight of the ten largest car manufacturers in the world produce autogas vehicles. Petrol cars can also be retro-fitted with an autogas system.





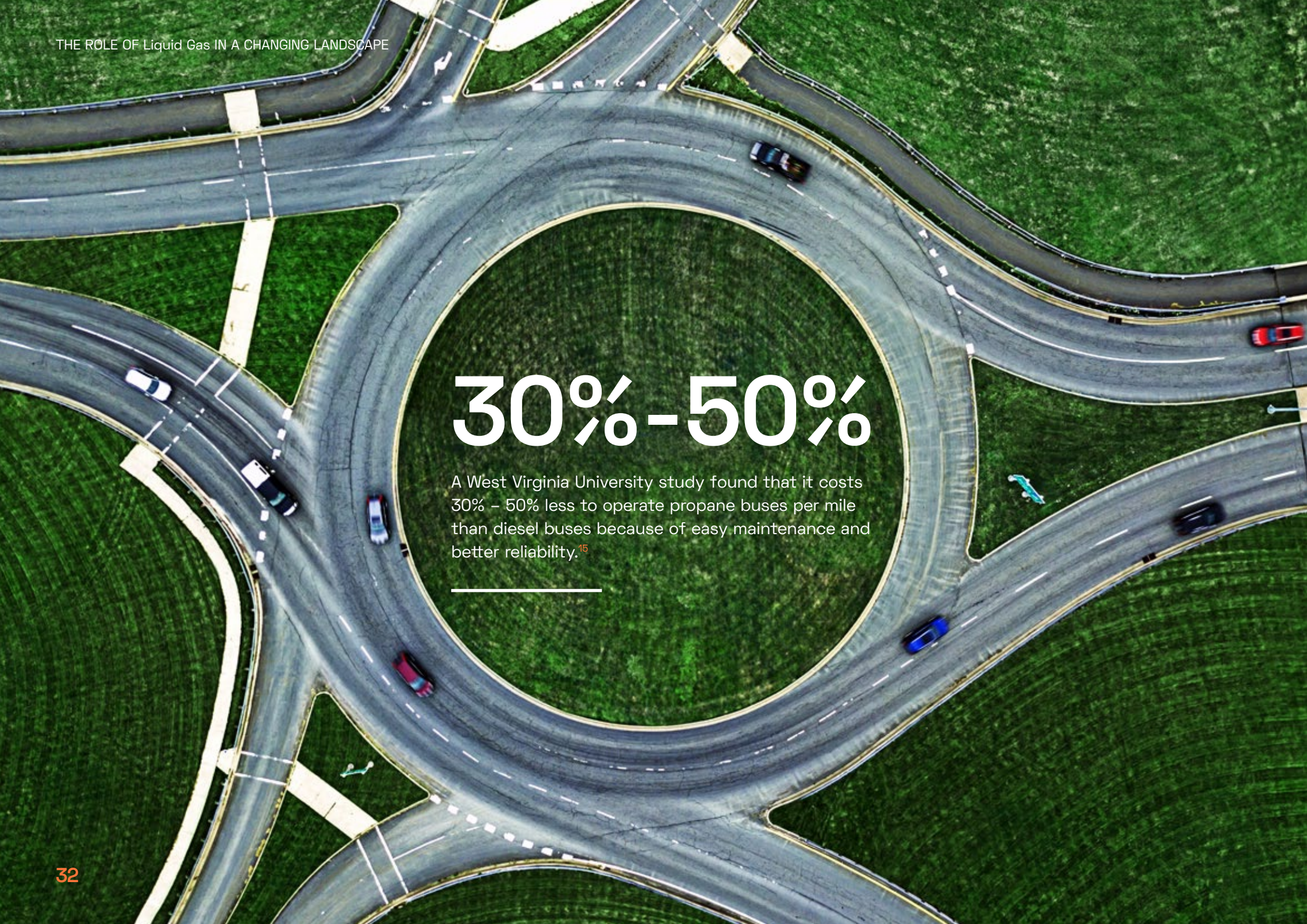
Where is autogas used?

Globally, the autogas fleet continues to grow. There are now 28.3 million autogas vehicles in use around the world and close to 82,000 refuelling stations selling the fuel.

Autogas use is still concentrated in a small number of markets. The five largest – Russia, Turkey, Korea, Poland and Ukraine – together account for almost half of world consumption in 2021, while the top 25 countries account for 80%. The share of autogas in total automotive fuel consumption varies widely, ranging from a mere 0.04% in the United States to almost 28% in Ukraine. The enormous disparity in the success of autogas in competing against the conventional automotive fuels of gasoline and diesel is explained mainly by differences in government incentive policies.

The market penetration of autogas is strongly correlated with the competitiveness of autogas vis-à-vis gasoline and diesel, as well as the availability of models and refuelling infrastructure.

[15] https://www.npga.org/news-resources/reports-studies/perc-wv-study/



30%-50%

A West Virginia University study found that it costs 30% – 50% less to operate propane buses per mile than diesel buses because of easy maintenance and better reliability.[15]

Why autogas?

Infrastructure
Autogas infrastructure can leverage existing gasoline distribution networks, making it relatively easier to implement without significant additional infrastructure investment. Autogas can also be transported anywhere in the world by sea, road or rail.

Conversion and compatibility
Many internal combustion engine vehicles can be converted to run on autogas with relatively straightforward modifications, allowing for a more gradual transition away from traditional gasoline vehicles. Driving an autogas vehicle is very similar to a petrol car, refuelling is fast and safe and the range is similar to petrol cars

Affordability
Autogas is often more cost-effective than gasoline or diesel, which can make it an attractive option for consumers looking to save money on fuel. In many cases, the upfront cost of converting an internal combustion engine vehicle to run on autogas is lower than purchasing a new electric vehicle. This can make autogas a more accessible option for consumers in regions where the cost of electric vehicles is still relatively high.

Dual-fuel option
Many vehicles can be converted to run on both autogas and gasoline, offering flexibility and reducing dependence on a single fuel source.

Autogas-electric hybrids
New autogas-electric hybrids and engine technology ensure that autogas is ready for the future.

Air quality
Autogas combustion generally produces lower levels of PM and NOx, which are harmful pollutants that contribute to smog, respiratory issues, and environmental damage. They emit 98% less NOx than diesel cars and 90% less PM than gasoline cars in real driving condition[16].

Climate
Autogas produces fewer CO_2 emissions per unit of energy compared to gasoline or diesel. It burns more efficiently, which can lead to a reduction in overall greenhouse gas emissions. Autogas well-to-wheel carbon intensity as outlined in the Fuel Quality Directive is also significantly lower than diesel (-23%) and petrol (-21%). As larger columns of renewable Liquid Gas become available, CO_2 emissions by up to 80%.

Availability
Autogas is readily available due to its production as a byproduct of natural gas processing and crude oil refining. This inherent availability makes autogas a feasible option for ensuring energy security and reducing dependence on crude oil imports. With the exponential growth production of renewable Liquid Gas, renewable autogas will also become more readily available.

[16] Liquid Gas Europe

Safety

Autogas is a safe alternative fuel that is non-toxic, non-corrosive and insoluble in water. Fuelling with autogas is as safe and simple as filling up with gasoline or diesel. Around the world, vehicles of all types, from cars to tuktuks, school buses to police cars, run safely on autogas.

- Autogas requires a much higher temperature to ignite compared to gasoline and diesel.
- Autogas has the lowest flammability range of any fossil fuel.
- Unlike gasoline and diesel, if autogas leaks it does not pool or puddle, but instead vaporises and dissipates into the air.
- Since autogas is released as a vapour, it can't be ingested like gasoline, diesel or alcohol fuels.

Factory fitted or conversion

Factory-fitted LPG vehicles
Many vehicle manufacturers offer models that feature factory-fitted LPG systems. These vehicles come with LPG tanks and components installed by the manufacturer, ensuring that the vehicle is designed to run efficiently on both gasoline and LPG.

Conversions
Many vehicles can be retrofitted with aftermarket LPG conversion kits. These kits include components like LPG tanks, fuel lines, regulators and injectors, which are added to the vehicle's existing engine system.

Autogas by the numbers

28 M
autogas vehicles

40%
Global autogas consumption has risen by 40% in the past 10 years

82,000
autogas filling stations

1/5
LPG models sales made up one in every five cars sold by Dacia in 2020

8%
Autogas accounts for 8% of global LPG consumption

40%
More than 40% of cars in Ukraine run on autogas



Liquid Gas and the energy transition

Autogas or EVs?

If we want to reduce emissions from road transport on a global scale, this is the wrong question. Only by combining all available technologies including EVs, hydrogen, renewable fuels and autogas will we be able to substantially reduce emissions, fast.

Depending on the local context, a bespoke mix of technologies needs to be selected to meet the emissions reduction goal.

In certain regions, electrification of the passenger car fleet could be the best option. However, we have to keep in mind that the emissions story might end with tailpipe emissions but does not start in the powertrain. Electric vehicles are only as clean as the local power mix. If the majority of the power mix is generated by thermal power plants, electric vehicles could actually emit more than autogas-powered cars on a wheel-to wheel basis.

We also need to take geography, infrastructure and the affordability of electric vehicles into account. Building charging infrastructure for electric vehicles requires significant investment and time. In contrast, autogas refuelling infrastructure can often be integrated into existing gasoline or diesel stations with relatively lower costs and quicker implementation. This is particularly advantageous for regions with limited resources or remote areas where setting up a comprehensive EV charging network could be challenging.

Ultimately, the choice of solutions depends on the specific goals of emissions reduction, energy efficiency, and sustainability, as well as the feasibility of transitioning to each technology in a given region.

Furthermore, in most cases several technologies can be promoted simultaneously to decrease emissions faster and offer a range of affordable options.



Autogas goes renewable

As increased volumes of renewable Liquid Gas become available, renewable autogas will help further reduce emissions from transport.

Why do governments support autogas?

The primary reason why governments in many countries actively encourage the use of autogas and other alternative fuels is for environmental reasons. In the majority of studies comparing environmental performance that have been conducted around the world, autogas outperforms gasoline and, especially, diesel, as well as some other alternative fuels . Autogas emissions are especially low with respect to noxious pollutants. With regard to greenhouse gas emissions, autogas performs better than gasoline and, according to some studies, outperforms diesel when emissions are measured on a full fuel-cycle basis and when the LPG is sourced mainly from natural gas processing plants.

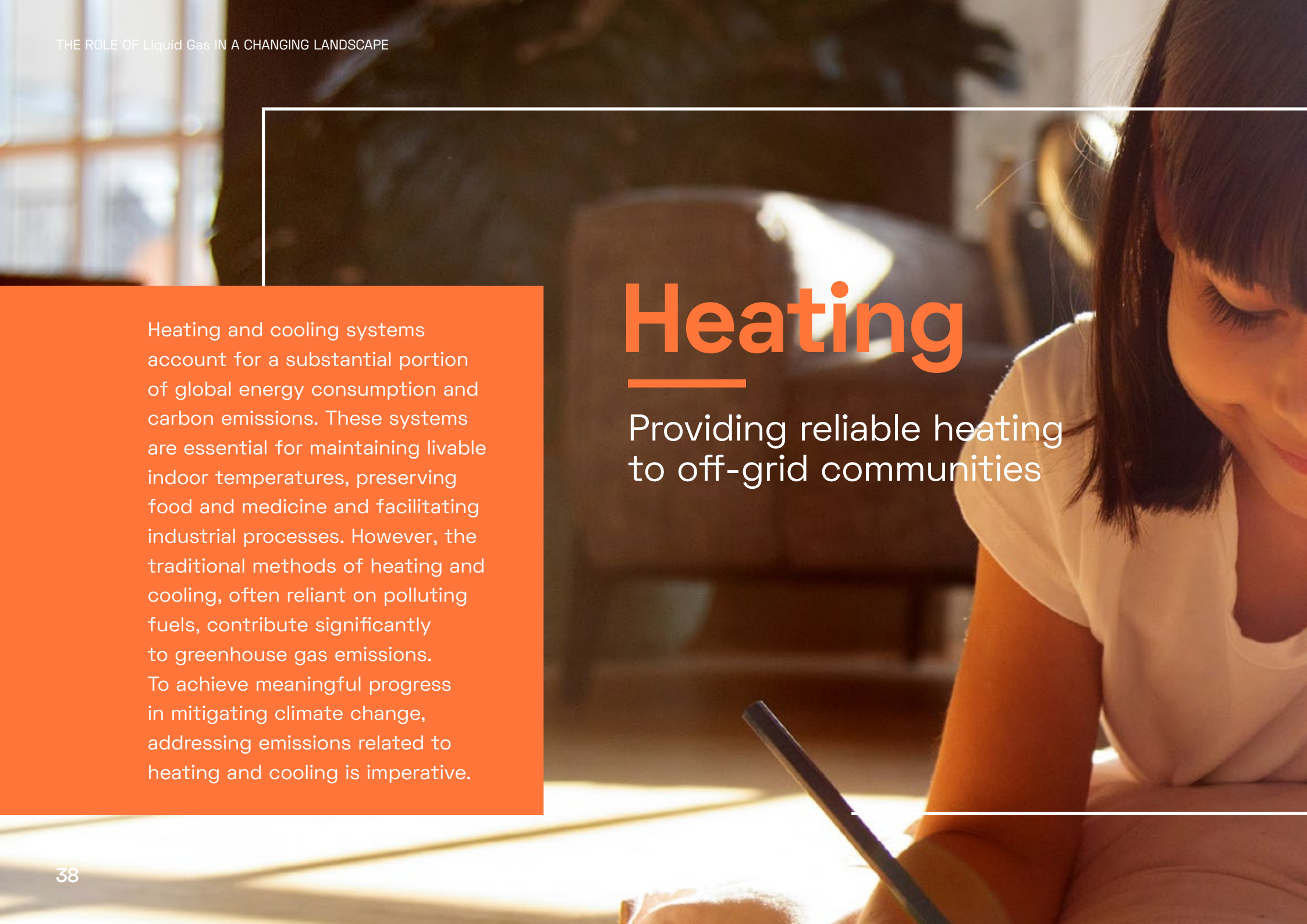
Transitioning to autogas can be seen as a gradual step towards reducing emissions. In regions where the power mix is predominantly powered by thermal power plants, where a sudden shift to EVs might strain the energy grid or where the infrastructure for EVs is not ready, a transition to autogas could be a solution to reduce emissions and air pollution.

Autogas can also play a key role in a just transition, allowing citizens who cannot afford an EV to reduce emissions from their vehicles.

The conversion of internal combustion engine vehicles to autogas provides a fast approach to addressing air pollution concerns before the EV market matures or in markets where recharging infrastructure remains limited. Although EVs are considered the most viable alternative for high-income countries, autogas may provide the most economically feasible substitute for conventional fuels in countries with more carbon-intensive electricity networks.

Investing in autogas is a sustainable solution that does not overburden the electricity network in countries that do not have adequate infrastructure to support the electrification of the transport system. Autogas also presents a solution for decarbonising the second-hand vehicle market, with the cost of converting a car to autogas being significantly lower than the upfront cost of a new electric vehicle.





Heating

Providing reliable heating to off-grid communities

Heating and cooling systems account for a substantial portion of global energy consumption and carbon emissions. These systems are essential for maintaining livable indoor temperatures, preserving food and medicine and facilitating industrial processes. However, the traditional methods of heating and cooling, often reliant on polluting fuels, contribute significantly to greenhouse gas emissions. To achieve meaningful progress in mitigating climate change, addressing emissions related to heating and cooling is imperative.



1/2

Heating and cooling constitutes around half of energy consumption in the EU.[17]

10%

Cooling represents 10% of total energy consumption.[18]

25%

Heating, ventilation, air conditioning and refrigeration equipment uses around 25% of all electricity produced in Australia.[19]

1/2

Space and water heating accounts for almost half of global energy use in buildings.[20]

[17] https://energy.ec.europa.eu/topics/energy-efficiency/heating-and-cooling_en
[18] https://www.eia.gov/tools/faqs/faq.php?id=1174&t=1
[19] https://www.energy.gov.au/households/heating-and-cooling
[20] https://www.iea.org/energy-system/buildings/heating

Why Liquid Gas?

Several types of heating and cooling require energy

Residential and commercial space heating

Residential and commercial space cooling

Water heating

To achieve meaningful progress in mitigating climate change, addressing emissions related to heating and cooling is imperative.



Available systems and fuel types

There are several technologies aimed at reducing emissions from the shipping industry.

	Energy source	Opportunities	Challenges
Furnaces Furnaces heat air, which is then distributed through ducts to various rooms in the house.	■ Electricity ■ Natural gas ■ Liquid Gas ■ Heating oil ■ Coal	■ Proven technology ■ New generation offer high level of efficiency ■ Can seamlessly switch to renewable fuels	■ Emissions is fossil fuels are used ■ Particulate emissions if heating oil or coal are used
Boiler Boilers heat water, which is then circulated through radiators or underfloor heating systems or used to heat water.	■ Electricity ■ Natural gas ■ Liquid Gas ■ Heating oil ■ Coal	■ Proven technology ■ New generation offer high level of efficiency ■ Can seamlessly switch to renewable fuels	■ Emissions is fossil fuels are used ■ Particulate emissions if heating oil or coal are used
Heat pumps Heat pumps extract heat from the air, ground, or water sources and transfer it indoors.	■ Electricity	■ More energy-efficient than fuel-based or electric resistance systems ■ No emissions if powered by renewable electricity ■ Depending on the cost of electricity, thye can generate savings ■ Can provide cooling as well as heating	■ Limited pool of installers ■ Only as clean as the electricity used ■ Requires reliable green electricity supply
Solar thermal heaters Solar thermal heaters use solar collectors on the roof to produce hot water.	■ Solar	■ Only use sunlight and this produce no emissions ■ Inexpensive and low tech ■ Can be combined with boiler as a back up	■ Water volume is limited to the size of the tank
Stoves Stoves are the oldest form of heating and involve burning biomass	■ Coal ■ Wood ■ Wood pellets	■ If sustainable sourced wood is used, the carbon balance is neutral	■ Inefficient combustion ■ High particulate matter emissions ■ If coal is used the CO_2 emissions are high
Air conditioning The process of absorbing heat from indoor air and releasing it outdoors results in the cooling of the indoor space.	■ Electricity	■ Can provide heating and cooling	■ Requires large amounts of electricity
Space heaters These are standalone units that generate heat and are often used to supplement central heating systems.	■ Electricity ■ Liquid Gas	■ Inexpensive	■ Low efficiency ■ Emissions
Electric radiators	■ Electricity	■ No emission is green electricity is used ■ Efficiency	■ Expensive if electricity costs are high ■ Not suitable for all areas
District heating Heat networks, available in some areas, are centralised systems distributing heat through underground pipes	■ Coal ■ Electricity ■ Natural gas ■ Recovered heat	■ Energy efficiency and possible use of recovered heat ■ Reduces space use and maintenance ■ Possible emissions saving	■ Mostly fossil fuel-powered ■ Losses in distribution ■ Initial cost

The role of Liquid Gas

Liquid Gas is a valuable solution for heating, particularly in rural areas. Remote and off-grid communities often lack access to centralised energy sources, making Liquid Gas an efficient alternative. Liquid Gas is a clean-burning fuel, emitting fewer pollutants and CO_2 emissions compared to coal or heating oil. Its portability and ease of use make it well-suited for regions where infrastructure challenges limit the reach of other energy sources.

Why Liquid Gas?

Locally stored energy
Locally stored energy Liquid Gas is stored in a tank on the property, ensuring energy is available even in the most adverse weather conditions.

Soil protection
Liquid Gas does not leak and therefore does not pollute the soil.

Efficient
A heating system using renewable gas is very efficient.

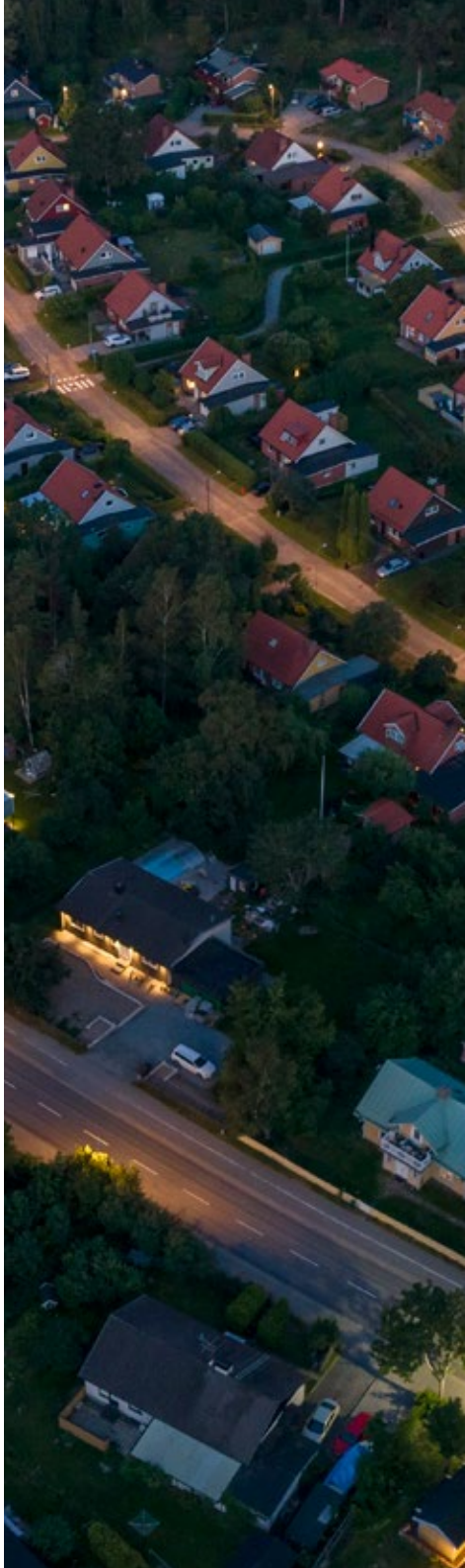
Low emissions
Liquid Gas emits less CO_2 and pollutants compared to coal or heating oil.

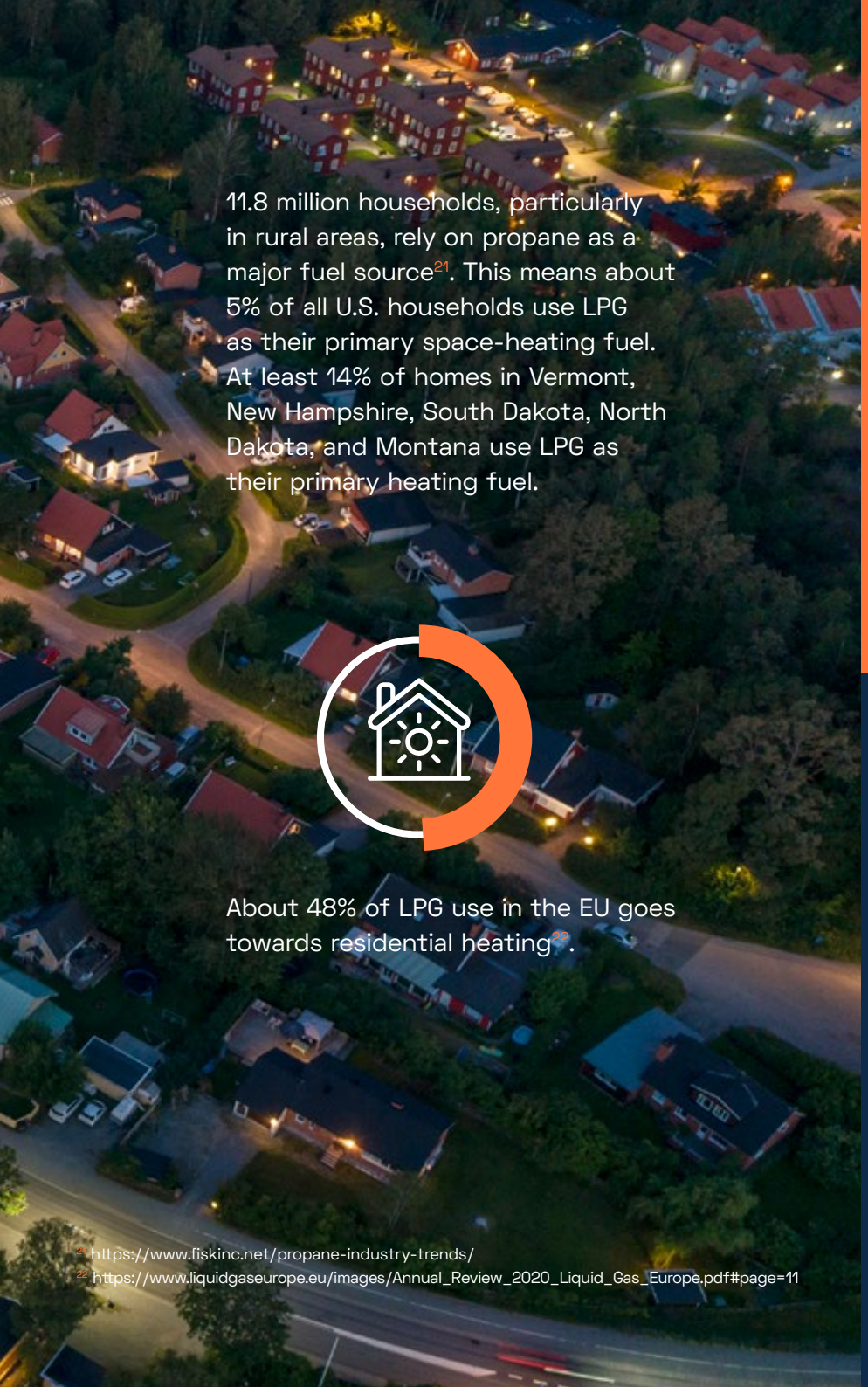
Hybrid systems
Liquid Gas finance can be combined with heat pumps to complement or act as back-up.

A partner for renewable energy
Liquid Gas systems can complement solar water heaters, only being used when called upon.

Integration with micro-CHP system
With a micro-CHP unit, you can cover up to 100% of your heating needs and up to 80% of your electricity needs, making you independent from third-party suppliers.

Switch to renewable Liquid Gas
Heating systems can seamlessly switch to a range of renewable Liquid Gas, thereby further reducing emissions.





11.8 million households, particularly in rural areas, rely on propane as a major fuel source[21]. This means about 5% of all U.S. households use LPG as their primary space-heating fuel. At least 14% of homes in Vermont, New Hampshire, South Dakota, North Dakota, and Montana use LPG as their primary heating fuel.

About 48% of LPG use in the EU goes towards residential heating[22].

[21] https://www.fiskinc.net/propane-industry-trends/
[22] https://www.liquidgaseurope.eu/images/Annual_Review_2020_Liquid_Gas_Europe.pdf#page=11

Liquid Gas and the energy transition

Space heating is a major source of emissions. Energy-efficiency measures can substantially reduce emissions, and heat pumps running on renewable power will play an important role. However, the climate clock is ticking and we will need a broad range of solutions to reduce emissions. Switching from coal or heating oil to Liquid Gas will help reduce emissions, and these emissions will be further when switching to renewable Liquid Gas.

77%

Replacing the average heating-oil system with a new LPG or bioLPG heating installation will reduce CO_2 emissions by 39% and 77%, respectively.

52%

NOx emissions are 31% and 52% lower when currently installed average heating oil and wood/pellets-fired biomass boilers are switched to a new LPG boiler, respectively.

100%

Sulphur oxide (SOx) emissions are 100% lower when compared to currently installed average heating oil and wood/pellets-fired biomass boilers.

Power Generation

Reliable power generation, anywhere



The world's electricity consumption has continuously grown over the past half-century, reaching approximately 25,300 terawatt hours in 2021. Between 1980 and 2021, electricity consumption more than tripled, while the global population increased by roughly 75 percent.[23]



In 2019, almost two thirds (63.3%) of global electricity came from fossil fuels. Of the 36.7% that came from low-carbon sources, renewables accounted for 26.3% and nuclear energy for 10.4%.[27]

The share of renewable power generation is steadily growing but the energy mix can differ fundamentally from region to region.

1/5

Electricity generation accounted for one fifth of final energy consumption in 2022.[24]

38.6%

Oil, coal and natural gas fuelled 38.6% of EU electricity generation in 2022.[25]

2/3

In 2022, LPG generated about two thirds of the US Virgin Islands' electricity.[26]

[23] Statistica
[24] https://yearbook.enerdata.net/electricity/share-electricity-final-consumption.html
[25] https://www.consilium.europa.eu/en/infographics/how-is-eu-electricity-produced-and-sold/
[26] https://www.eia.gov/state/analysis.php?sid=VQ
[27] https://ourworldindata.org/electricity-mix

The role of Liquid Gas

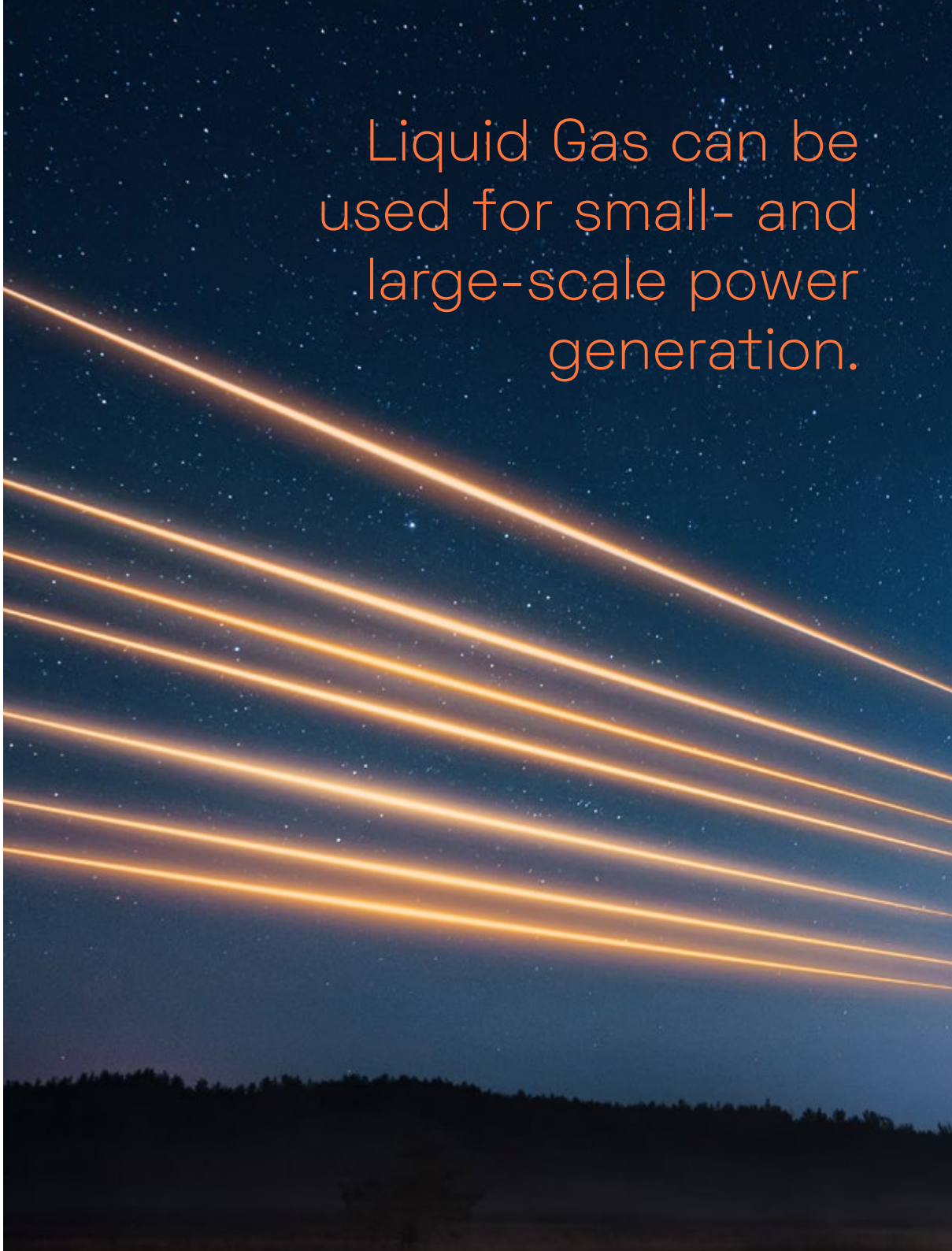
Liquid Gas is the ideal fuel for a wide range of power generation applications, from small back-up generators to large-scale power plants. Liquid Gas is increasingly used in homes, businesses, hospitals and for mobile generators to provide efficient, reliable and clean power. With governments and power companies looking to replace polluting coal, diesel or heavy oil plants, Liquid Gas offers a cost-efficient and low-emissions alternative for areas that are not connected to the natural gas grid.

Generators

Liquid Gas offers clean, reliable and proven solutions mobile generators that are used at events, on construction sites or to provide back-up power.

Power plants

Liquid Gas is increasingly being used in large-scale power generation, especially on islands, in remote areas and in developing regions that are not connected to the natural gas grid.



Why Liquid Gas?

Reliability
Liquid Gas can be stored on-site, thus increasing up-time. Since Liquid Gas does not degrade, it can be stored. for an extended amount of time.

Remote areas
For islands or other remote areas, Liquid Gas is the ideal solution since it does not require a connection to the natural gas network.

Local energy
Smaller power plants can be set up close to where energy is needed, thus avoiding energy loss over power lines and ensuring that virtually every kw/h is used.

Partner for renewable energy
Liquid Gas is the ideal partner for solar, wind and other forms of renewable power. It can complement renewable power production or act as a back-up.

Easy transport
Liquid Gas is easier to transport that liquid natural gas (LNG).

Infrastructure
Many areas around the world already have LPG terminals at ports.

Emissions
Switching from coal, diesel or heavy fuel oil will substantially reduce both CO_2 and particulate emissions.

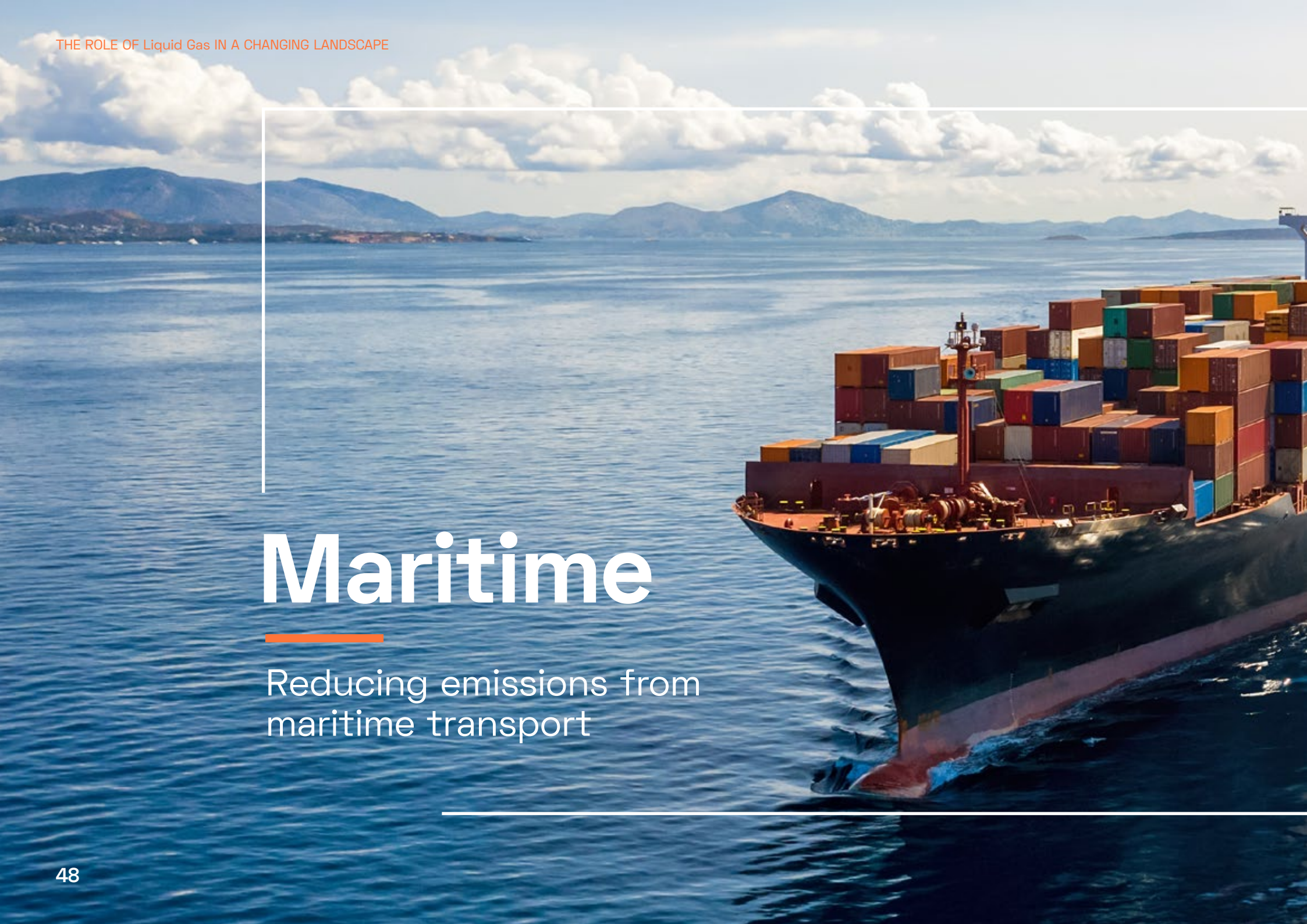
Transition
Liquid Gas for power generation can act as a 'bridge' until natural gas infrastructure is built.

[24] https://www.consilium.europa.eu/en/infographics/how-is-eu-electricity-produced-and-sold/
[25] https://yearbook.enerdata.net/electricity/share-electricity-final-consumption.html
[26] https://www.eia.gov/state/analysis.php?sid=VQ

Liquid Gas and the energy transition

The International Energy Agency (IEA) anticipates a 50% growth in the demand for natural gas in the period 2016 to 2040 – with much of this growth associated with electricity generation, amid an acceleration of the trend away from using coal-fired power plants. Where pipeline infrastructure exists in close proximity to the demand, natural gas is clearly the gaseous fuel of choice. However, many countries do not have an established network of natural gas pipelines. In countries where these do exist, infrastructure is often reserved for areas of high population density and/or centres of industrial activity, leaving more remote areas with little or no access to natural gas. In such cases, there is a clear opportunity for Liquid Gas to provide a solution for power generation – especially when new power plants are necessary to meet increasing electricity demand.

In the future, there is also likely to be an emerging opportunity associated with the use of LPG power generation in combination with renewables such as solar photovoltaics and wind power. These 'hybrid' (or microgrid) projects are likely to be particularly well-suited to remote, or island, locations which currently rely on expensive diesel to meet their power needs.



Maritime

Reducing emissions from maritime transport



Shipping, particularly maritime transportation, plays a significant role in the global economy, facilitating the movement of goods across long distances. However, it also has a notable impact on the environment, primarily due to emissions of greenhouse gases and other pollutants.

Ships primarily burn heavy fuel oil, which produces substantial amounts of CO_2. Ships also emit black carbon, a particulate matter that absorbs sunlight and contributes to the melting of ice and snow, accelerating climate change in sensitive regions. Shipping emissions include NOx and SOx, which contribute to air pollution and acid rain, leading to adverse health effects and ecosystem damage.

Decarbonising the capital-intensive marine industry is complex and expensive due to its large, long-life assets, thin margins and high dependence on energy-dense fuel.

While electric vessels present a potential solution for short-haul shipping, there is currently no affordable low-carbon energy source for deep-sea shipping, which accounts for 85% of greenhouse gas emissions from the maritime industry.



99%

Historically, oil-based fuels have met over 99% of the total energy demand for international shipping.[28]

2%

In 2022, international shipping accounted for about 2% of global energy-related CO_2 emissions.[29]

x2

Without major interventions, emissions are expected to double by 2050.

85%

Deep-sea shipping accounts for 85% of greenhouse gas emissions from the maritime industry.

5-10%

Ships generate approximately 5-10% of all Sulphur Dioxide anthropogenic emissions at a global level.[30]

[28] https://www.iea.org/energy-system/transport/international-shipping
[29] https://www.iea.org/energy-system/transport/international-shipping
[30] https://www.itf-oecd.org/sites/default/files/docs/sulphur-emissions-shipping.pdf

Challenges and solutions

There are several technologies aimed at reducing emissions from the shipping industry.

Technology	Opportunities	Challenges
LNG	LNG is a cleaner-burning fossil fuel compared to traditional marine fuels, resulting in lower emissions of SOx and PM. It also produces fewer NOx and CO_2 emissions.	Most LNG is fossil natural gas Complexity and cost Limited bunkering and port infrastructure
Biofuels	Biofuels derived from renewable sources like vegetable oils and waste products can be used as an alternative to conventional fuels, reducing carbon emissions.	Availability because of demand from road transport and aviation Limited production capacity Cost
Hydrogen	Hydrogen can be used as a fuel source for ships when produced through renewable methods, emitting only water vapour as a byproduct.	Non-mature technology Low energy density Infrastructure and storage Limited supply and cost of green hydrogen
Ammonia	Ammonia is another potential carbon-free fuel option for ships when produced using green hydrogen. It emits only nitrogen and water when burned.	Limited supply and cost of green ammonia Low energy density compared to bunker oil Safety and toxicity needs to be addressed
Wind-assisted propulsion	Installing sails or other wind-assist technologies can harness wind power to supplement engine propulsion.	Can only support other propulsion technologies
Liquid Gas	Using liquid fuels, such as LPG, produces fewer harmful emissions compared to traditional fossil fuels like diesel or heavy fuel oil. It emits lower levels of sulphur dioxide (SO2), PM and NOx.	Most liquid fuels are still made from fossil sources Cost of retrofit
Electricity	Small engines can be electrified	Only suitable for small leisure craft

Zero-emissions technologies such as green hydrogen and green ammonia are still in the early stages of development and will require an exponential scale-up in production, substantial infrastructure as well as adoption by the global shipping industry.

The role of Liquid Gas

With a well-developed infrastructure and proven technology, Liquid Gas provides a convenient solution to expedite the energy transition in the maritime industry. It presents a viable alternative energy source to traditional fuels such as heavy fuel oil, marine diesel fuel and marine gas oil.

Lower CO_2 emissions
Compared to heavy fuel oil, Liquid Gas combustion emits fewer CO_2 emissions per unit of energy produced. Although not a zero-emission fuel, LPG has a lower carbon footprint, making it a transitional option towards more sustainable energy sources.

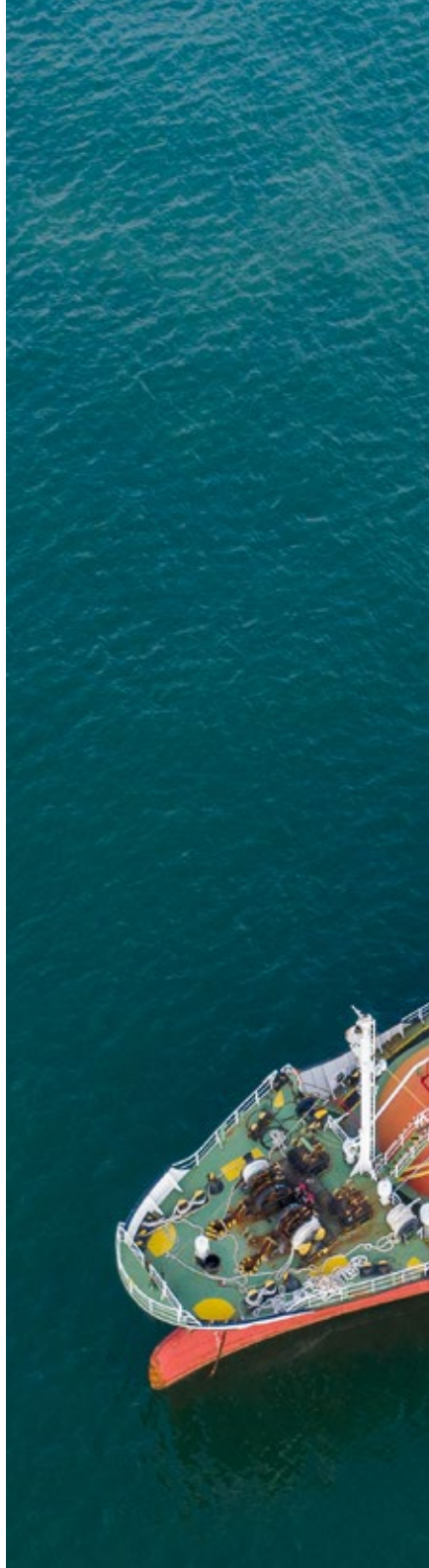
Reduced air pollutants
Liquid Gas produces significantly lower levels of SOx and NOx compared to conventional maritime fuels. This would lead to improvements in air quality and reduced acid rain formation.

A step towards ammonia-powered ships
LPG engines have the potential to be adapted to use green ammonia as a fuel or as a carbon-free combustion promoter, which would eliminate CO_2 emissions entirely and significantly reduce other emissions.

Compliance with regulations
As international regulations such as the International Maritime Organization's (IMO) sulphur cap and stricter emissions standards come into play, Liquid Gas could provide a compliant alternative without the need for exhaust gas cleaning systems ("scrubbers").

Existing infrastructure
With more than 1,000 existing storage facilities and terminals, LPG infrastructure is well-developed globally.

No risk of spillage
Liquid Gas is non-toxic





Currently, LPG is already a preferred marine fuel solution for LPG carriers.

Liquid Gas and the energy transition

Liquid Gas can play a key role in reducing emissions from global shipping

- Compared to heavy fuel oils, LPG emits approximately 97% less SOx, 20% less NOx and 90% less PM while cutting carbon emissions by roughly 20%. Therefore, LPG is compliant with existing emission standards including the IMO's sulphur cap of 0.5% and requirements regarding operating in emission control areas (ECA).
- Liquid fuels also have economic advantages that allow for a cost-competitive transition to lower-carbon fuels. Studies based on data from over 70,000 ships in South Korea show that LPG in ships could reduce annual fuel costs by up to 25.9%.
- LPG is also easier to handle than LNG, as cryogenic materials are not required for the fuel tanks. This also results in lower investment costs for such a system.
- Liquid fuels are a viable alternative gaseous fuel for all sizes and types of boats and ships.
- With more than 1,000 existing storage facilities and terminals, the LPG infrastructure is well-developed globally. This implies that LPG can be effectively supplied using existing facilities while new terminals can be built faster and at lower cost.
- LPG-powered propulsion installations could be made ammonia-ready with a relatively small investment, making LPG vessels compatible with ammonia pathways. LPG can therefore act as a bridging energy until the ammonia technology is ready for commercialisation.

Agriculture

Supporting sustainable food production



Modern agriculture requires an energy input at all stages of agricultural production such as direct use of energy in farm machinery, water management, irrigation, cultivation and harvesting. Post-harvest energy use includes energy for food processing, storage and in transport to market.

Various forms of energy are currently used on farms including

- Human or animal energy to work the land
- Renewable energy (either direct or to produce heat or electricity)
- Diesel and petrol for machinery as well as other operations such as heating, drying, pumping
- Liquid Gas for heating, drying, pumping and other operations
- Electricity for lighting, heating and operating machinery
- Biomass and coal for heat generation

The type of energy and energy intensity of each farm will depend on the type of farm and level of mechanisation.

3-5%

In OECD countries, for example, around 3-5% of total final energy consumption is used directly in the agriculture sector.[31]

3.7%

In the EU, open-field agriculture accounts for 3.7% of total EU annual energy consumption.[32]

30%

The food production and supply chain accounts for about 30% of total global energy consumption.[33]

[31] https://www.fao.org/3/x8054e/x8054e05.htm#:~:text=In%200ECD%20countries%2C%20for%20example,total%20final%20commercial%20energy%20use.
[32] https://www.sciencedirect.com/science/article/pii/S1364032122000284
[33] https://www.fao.org/3/i2454e/i2454e00.pdf

Challenges and solutions

While almost 800 million people are currently afflicted by chronic hunger, by 2050 global food production would need to increase by 50% to feed the more than nine billion people projected to live on our planet.[34] This increase in food production will inevitably lead to an increase in energy use.

The energy use on farms differs from industry or domestic use which limits the number of available solutions.

Off-grid
Most farms do not have access to the natural gas grid and many do not have reliable access to electricity supply.

Mobile
Many energy-intensive applications require mobile energy.

Peak use
Several applications require a lot of energy for a short amount of time. For example, grain is only dried during a specific time period.

Reliability
Farms need a reliable energy source without which livestock could perish or crops could become unfit for consumption.

Several parallel solutions including energy efficiency and precision agriculture will help reduce the environmental impact of farming. Liquid Gas already plays a key role, and its adoption in regions where its use is still scarce will further mitigate the impact.

[34] https://www.fao.org/3/I7695e/I7695e.pdf

The role of Liquid Gas

Liquid Gas already plays a key role on millions of farms. For example, over 800,000 farms in the US use Liquid Gas for at least one application.

- Irrigation pumps
- Crop drying
- Storage or livestock rearing heating
- Greenhouse heating
- Flame weeding
- Machinery and equipment
- Agricultural building heat
- CO_2 generation (for plant growth enhancement in greenhouses)
- Flame sanitation (for indoor livestock spaces)
- Pest control
- Forklifts
- Generators
- Grain dryers
- Water heating



Liquid Gas to go renewable

As the volume of renewable Liquid Gas increases, more farmers could start using renewable energy, further reducing their carbon footprint. Waste and residues from farms as well as cover crops can also further expand the renewable feedstock base for renewable Liquid Gas, thereby closing the carbon cycle.

Why Liquid Gas?

Using Liquid Gas in agriculture offers a range of benefits

Storage
Liquid Gas can be stored on-site, providing energy when it is needed.

Portable
Liquid Gas can be transported in cylinders or in tanks mounted on top of farm equipment.

Lower emissions
When compared to liquid or solid fuels, using Liquid Gas helps reduce particulate and greenhouse gas emissions.

Soil protection
Liquid Gas does not spill, eliminating the risk of ground pollution.

Efficient
Liquid Gas can store a lot of energy, ready for use.

Fewer chemicals
Applications such as flame weeding can help reduce the amount of chemicals used, and can be used in organic farming.

Cost-effectiveness
In many regions, Liquid Gas offers a cost-effective solution.

Secure supply
Liquid Gas can supply energy when and where it is needed.

Versatility
The same fuel can be used for a variety of applications



Liquid Gas is a crucial energy source for millions for farmers and is key to producing safe food, lowering emission and reducing air pollution. Because of the rural settings of farms and the type of applications, liquid fuels are the most efficient and most environmentally-friendly option.



Liquid Gas and the energy transition

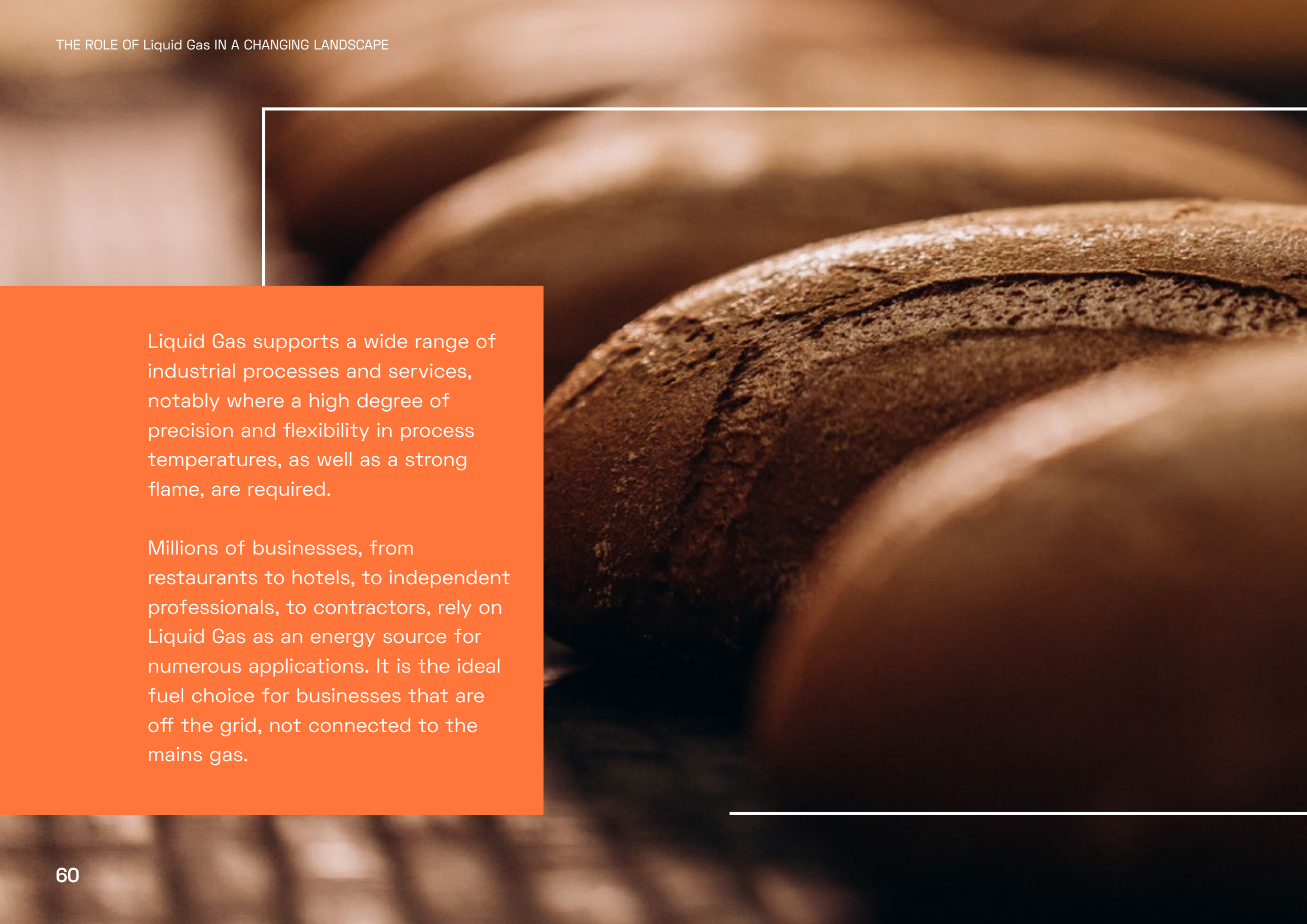
Liquid Gas can help reduce emissions on farms in several ways due to its cleaner burning properties compared to traditional fossil fuels.

- **Far lower particulate emissions**
  Switching to Liquid Gas can help reduce particulate emissions compared to diesel or gasoline. Particulate matter can contribute to air pollution and can have negative effects on human health and the environment.

- **Lower NOx emissions**
  Liquid Gas emits lower levels of NOx compared to diesel and gasoline combustion. NOx emissions can contribute to smog formation and have adverse effects on air quality and respiratory health.

- **Lower carbon emissions**
  While most Liquid Gases are hydrocarbons, they typically emit fewer CO_2 emissions per unit of energy compared to conventional fuels like diesel. This can help mitigate the farm's carbon footprint.

- **Flexible applications**
  Liquid Gas can be used in a variety of farm equipment, from tractors and trucks to heaters and water heaters. This flexibility allows farms to transition to Liquid Gas across different operations, further reducing emissions.



Liquid Gas supports a wide range of industrial processes and services, notably where a high degree of precision and flexibility in process temperatures, as well as a strong flame, are required.

Millions of businesses, from restaurants to hotels, to independent professionals, to contractors, rely on Liquid Gas as an energy source for numerous applications. It is the ideal fuel choice for businesses that are off the grid, not connected to the mains gas.

Business and industry

Locally-stored energy for business and industry

Millions of businesses, from restaurants to hotels, to independent professionals, to contractors, rely on Liquid Gas as an energy source for numerous applications.

[24] https://www.consilium.europa.eu/en/infographics/how-is-eu-electricity-produced-and-sold/
[25] https://yearbook.enerdata.net/electricity/share-electricity-final-consumption.html
[26] https://www.eia.gov/state/analysis.php?sid=VQ

The role of Liquid Gas

Liquid Gas has a higher calorific value and offers portability, highly controllable temperatures, homogeneous content, low emissions as well as availability.

Where is Liquid Gas used?

Forklifts	Mobile energy	Construction
Ovens in small-scale and industrial bakeries	Trucks	Power generation or providing back-up power
Commercial cooking	Outdoor cooking	Industrial drying
Ceramic production	Glass production	Agro-food industry
Cremation services	Street & graffiti cleaning	Land and garden care
Soldering, welding, flame cutting	Roofing	Concrete buffering
Laundry services	Paint & concrete drying	Steam generation
Waste incineration	Industrial water heating & pumping	Asphalt production
Brick manufacturing	Hotels & campsites	Pest control





In the US,

185,000

industrial companies use Liquid Gas.

Reliability

Liquid Gas is used as a feedstock in the production of various chemicals and petrochemicals, including propylene and butadiene, which are essential components in the plastics and rubber industries.

Refrigerants

LPG is increasingly being used as a refrigerant because it is not a greenhouse gas.

Propellant

Liquid Gas is used as a propellant by manufacturers of air fresheners, perfumes, cosmetics, spray paint and food-grade packaging material.

Why Liquid Gas?

Storage
Liquid Gas can be stored on-site, providing energy when it is needed.

Portable
Liquid Gas can be transported in cylinders and used for application where the energy source needs to be moved such as street cooking and roofing.

Lower emissions
When compared to liquid or solid fuels, using Liquid Gas helps reduce particulate and greenhouse gas emissions.

Soil protection
Liquid Gas does not spill, eliminating the risk of ground pollution.

Calorific value
Liquid Gas has a high calorific value and can generate high, controllable heat.

No soot
Many industrial applications, such as food processing and glass manufacturing, need a clean burning fuel source.

Cost-effectiveness
In many regions, Liquid Gas offers a cost-effective solution.

Secure supply
Liquid Gas can supply energy when and where it is needed.

Versatility
The same fuel can be used for a variety of applications .

Liquid Gas and the energy transition

Liquid Gas has enabled thousands of businesses to move away from polluting solid and liquid fuels and reduce their emissions as well as improve local air quality. Because of the type of energy needed or the type of operations, electrification is often not an option and only liquid fuels can provide the type of energy required. With the increasing availability of renewable liquid fuels, businesses can seamlessly switch and further reduce their emissions.

Energising rural economies

Many rural areas across the world do not have access to the natural gas grid, but businesses operating in these areas need reliable energy. Liquid Gas provides efficient, locally-stored energy that enables these companies to operate and grow rural economies.





LPG
EXCEPTIONAL
ENERGY

WORLD LPG ASSOCIATION
www.wlpga.org

WLPGA