
OUR ENERGY
FUTURE
INGAA
FOUNDATION

Alison Thompson

ABC Energy

Today we're going to learn more about:

SOURCES OF ENERGY

NATURAL GAS

PIPELINES

SAFETY

JOBS

A CLEANER ENERGY FUTURE

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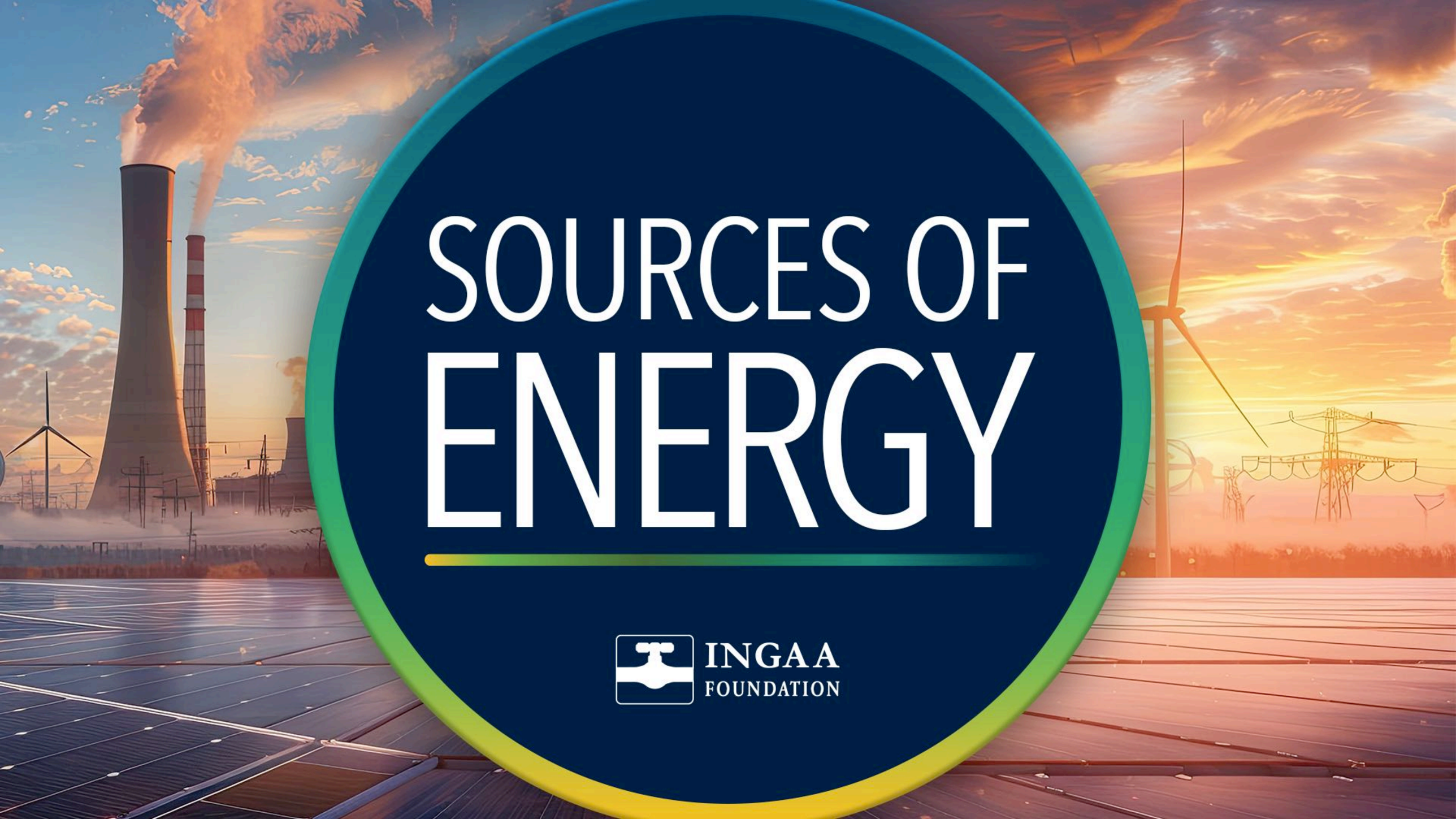
SOURCES OF
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José's morning

One example of how we use energy every day.

José woke up before sunrise because of the alarm clock. He turned on the lights in his closet, showered in warm water, put on clothes, poured cereal in a bowl and added milk from the refrigerator. He ate while watching YouTube videos, then placed the dishes in the dishwasher and turned it on. José used his electric toothbrush and fixed his hair with a hair dryer before putting on shoes and grabbing the backpack off the back of the chair. José got on the school bus for the 20-minute ride to school.

List all the ways José used energy this morning.

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Source: Switch Classroom

José's morning

One example of how we use energy every day.

DIRECT ENERGY USE

ALARM CLOCK


CLOSET LIGHT


HOT WATER


REFRIGERATOR


INTERNET


ELECTRIC TOOTHBRUSH


HAIR DRYER


SCHOOL BUS


SCHOOL

INDIRECT ENERGY USE


BED


HOUSE


CLOTHES & SHOES


CEREAL, MILK & BOWL


SCREEN & BATTERY


SINK, TOOTHPASTE & HAIR PRODUCT


BACKPACK


CHAIR

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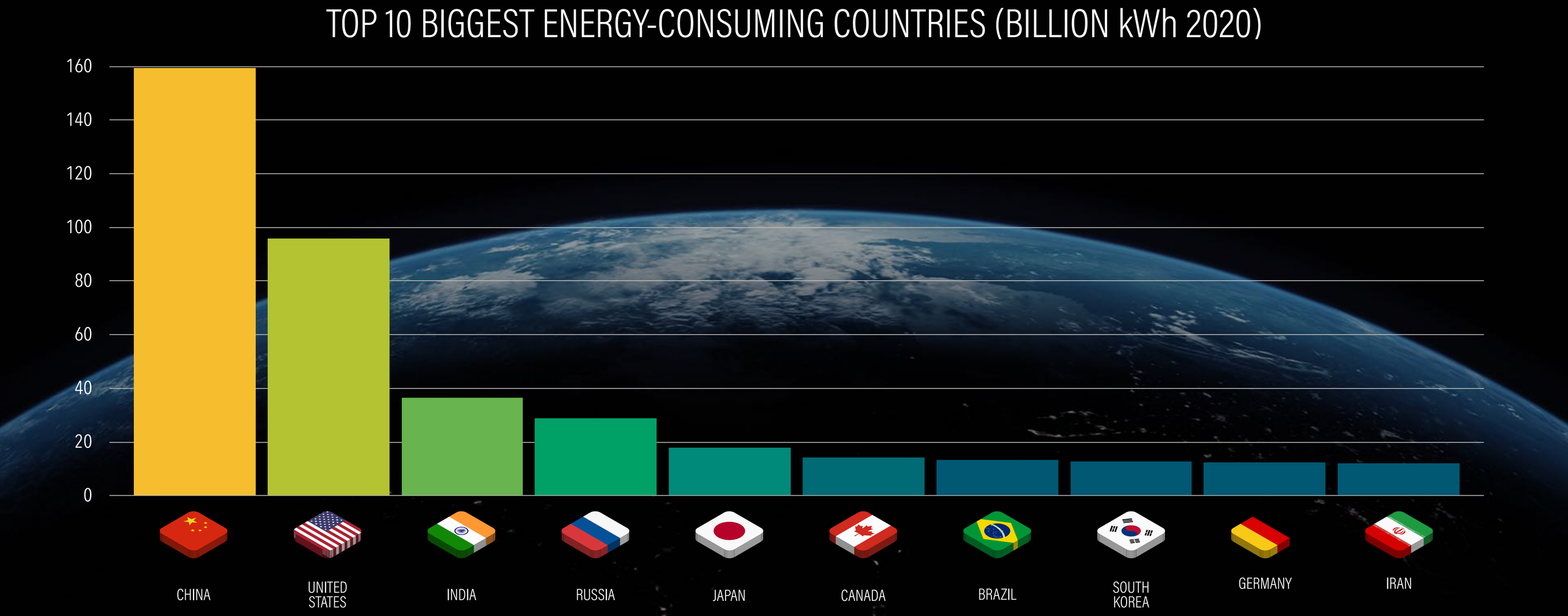
Source: Switch Classroom

Which country uses the most energy?



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Source: Energy Institute and the Institute for Energy Research

Some are living without access to energy

A lot of people in the world live in energy poverty.

Energy poverty is the lack of access to sustainable modern energy services and products and can be found in all conditions where there is a lack of adequate, affordable, reliable, quality, safe and environmentally sound energy services to support development.

1 billion people do not have access to electricity

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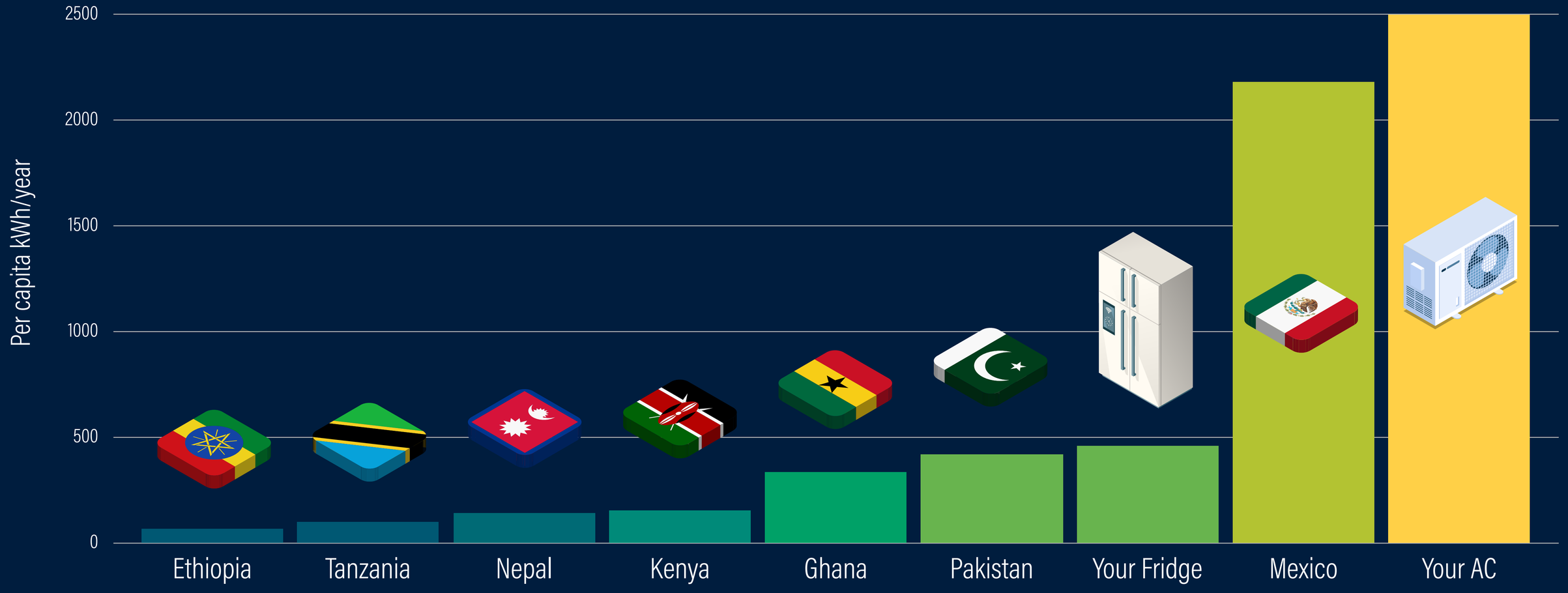
Energy poverty exists globally

Annual Electricity Consumption



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Source: data.worldbank.org

Renewable energy sources

These sources of energy are virtually unlimited, but not always constant.

SOLAR

WIND

HYDRO

BIOMASS

GEOTHERMAL

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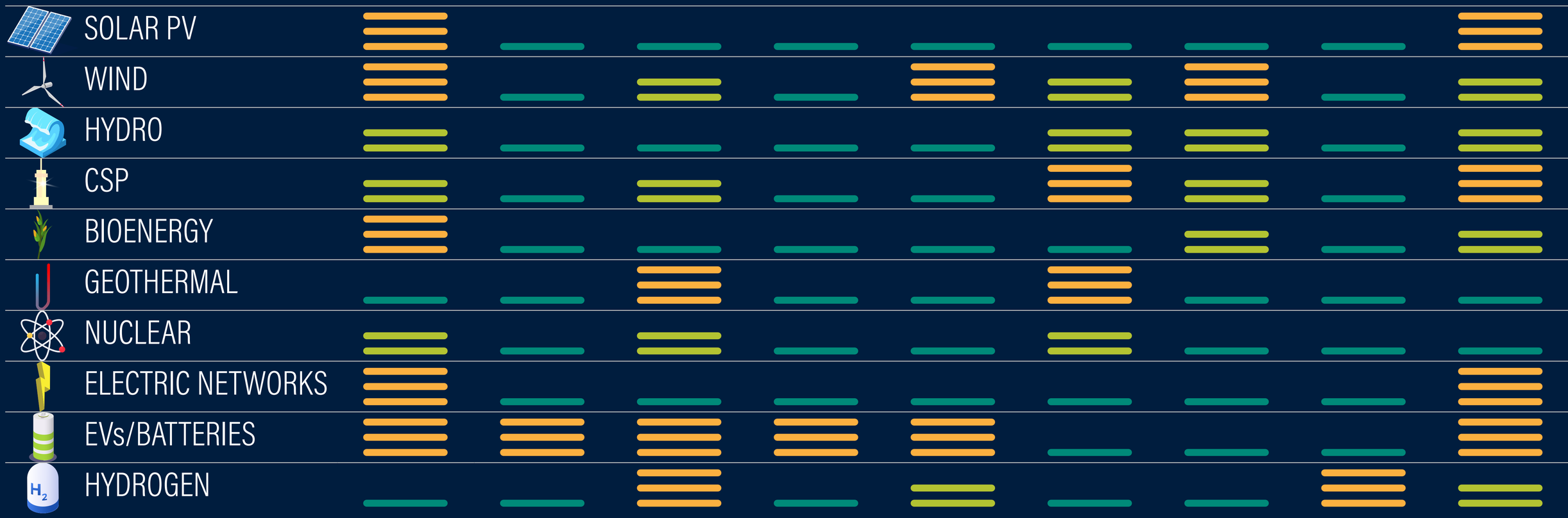
Manufacturing renewables

Critical minerals used in the manufacturing of renewable energy.



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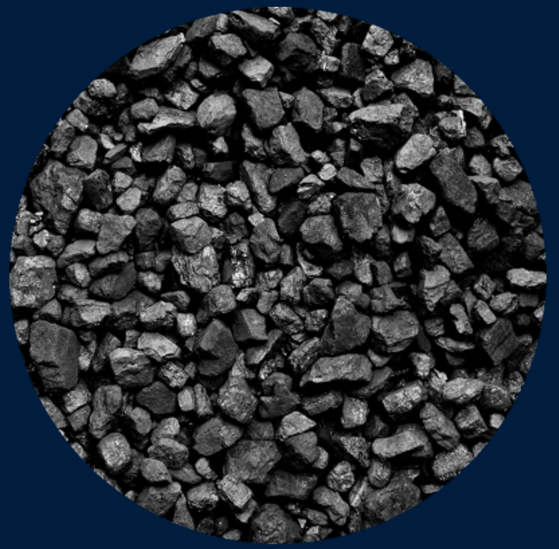
Source: International Energy Agency

Non-renewable energy sources

These sources of energy are constant, but limited resources.

OIL

NATURAL GAS



COAL

NUCLEAR

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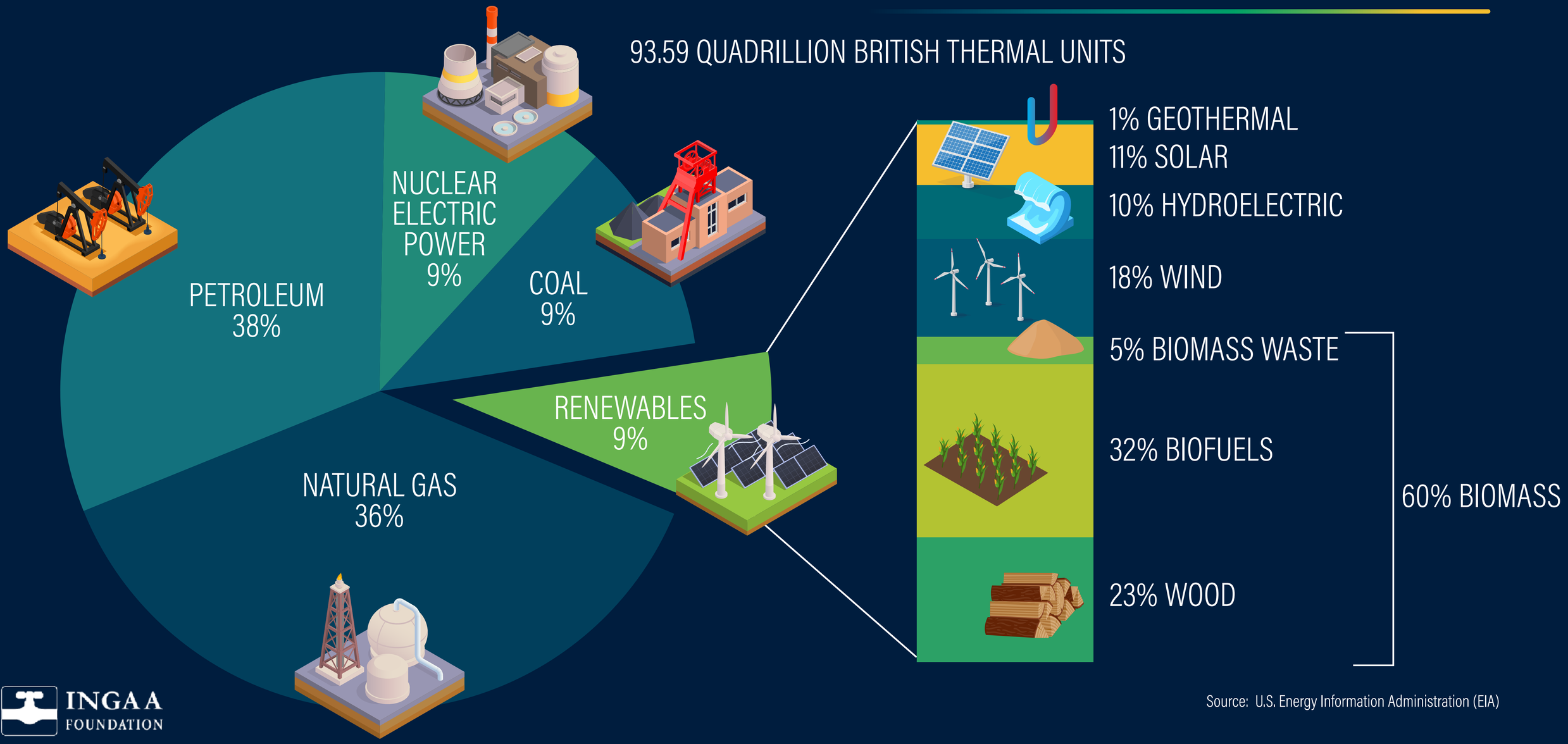
U.S. primary energy consumption by source

93.59 QUADRILLION BRITISH THERMAL UNITS



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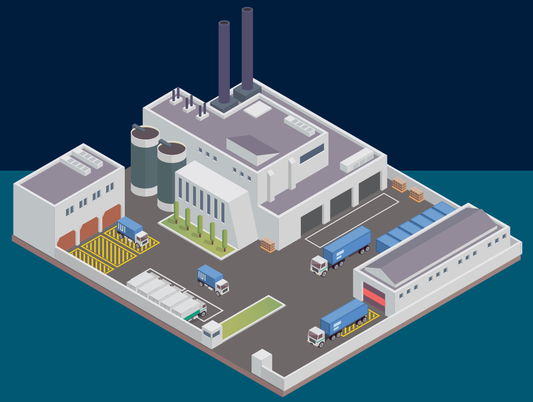
Source: U.S. Energy Information Administration (EIA)

Who uses the energy?

All of these rely on energy.

TRANSPORTATION
37%



INDUSTRY
35%

RESIDENTIAL
15%

COMMERCIAL
13%

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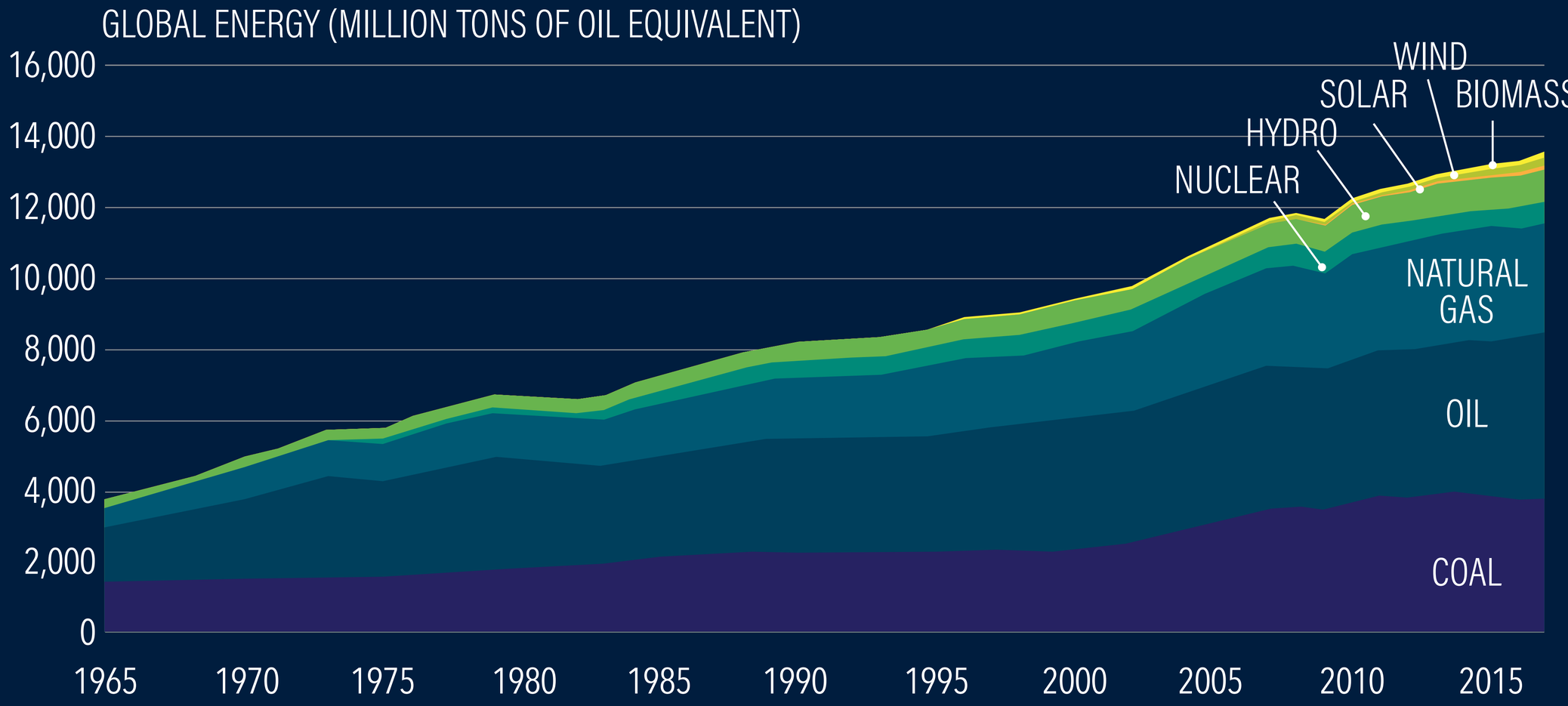
Source: U.S. Energy Information Administration (EIA)

Global energy consumption mix



Today, no source of primary energy is decreased globally.

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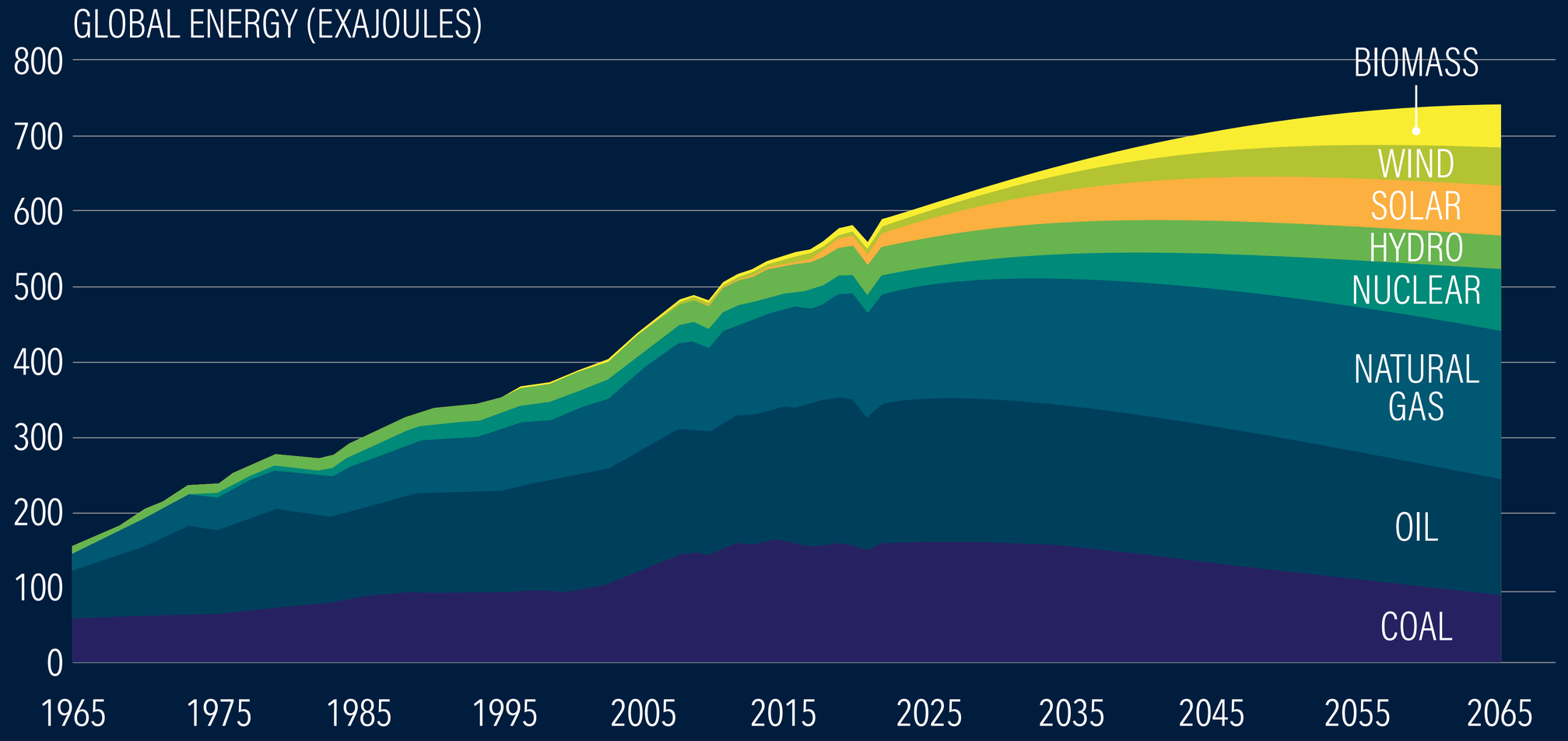
Source: BP Statistical View of World Energy (2018)

Future global energy consumption mix



A portfolio of energy sources is needed for affordable, reliable, secure energy.

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Source: BP Statistical View of World Energy (2018)

Energy in our homes

Electricity is created at power stations and delivered through power lines.

It takes all kinds of energy
to power our lives each day.

OF THE
TOTAL ENERGY
CONSUMED IN THE
UNITED STATES

40% IS USED TO
GENERATE ELECTRICITY

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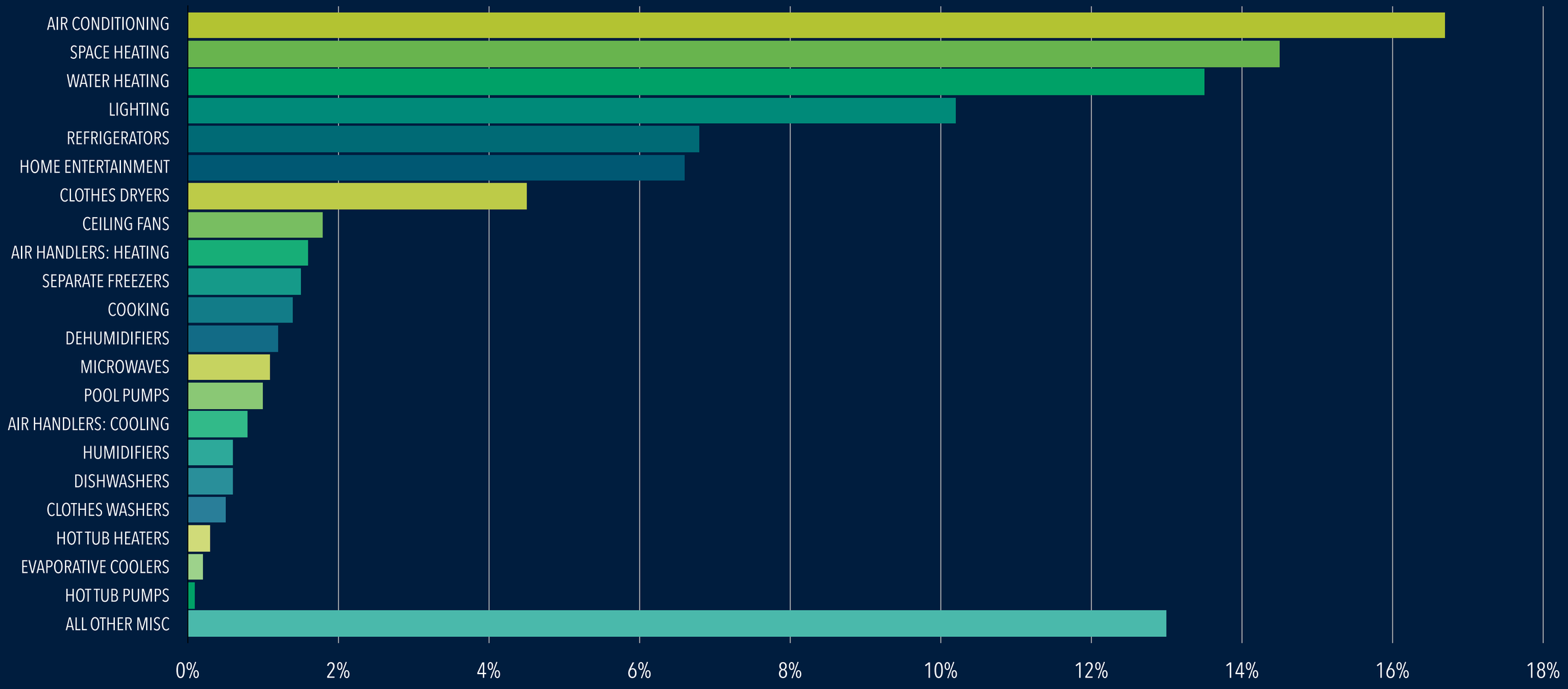
Source: eia.gov

What uses the most energy in our homes?



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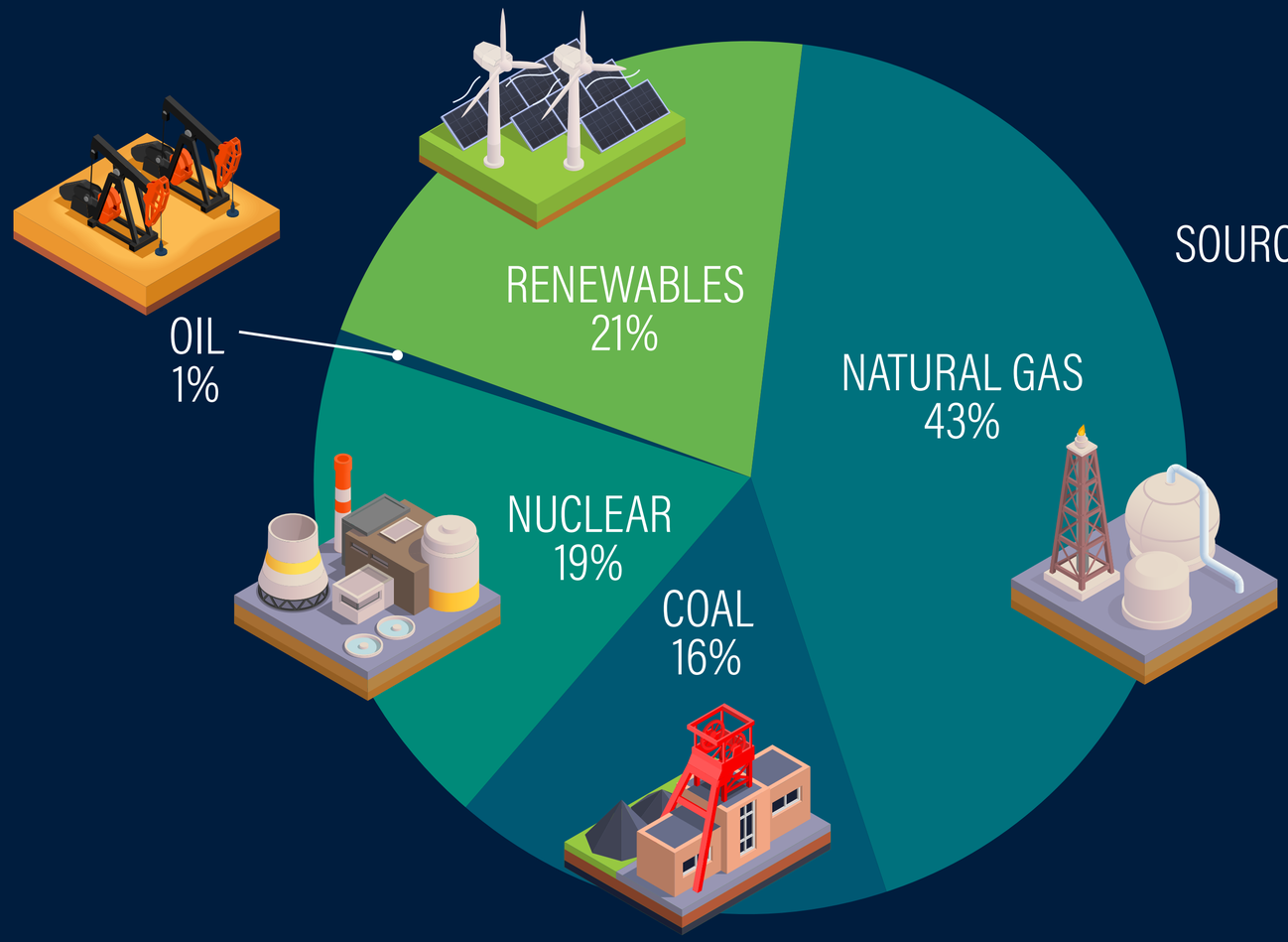
Source: U.S. Energy Information Administration (EIA)

America's top source for electricity generation

Natural gas generates about 43% of American electricity.



SOURCES OF U.S. ELECTRICITY GENERATION

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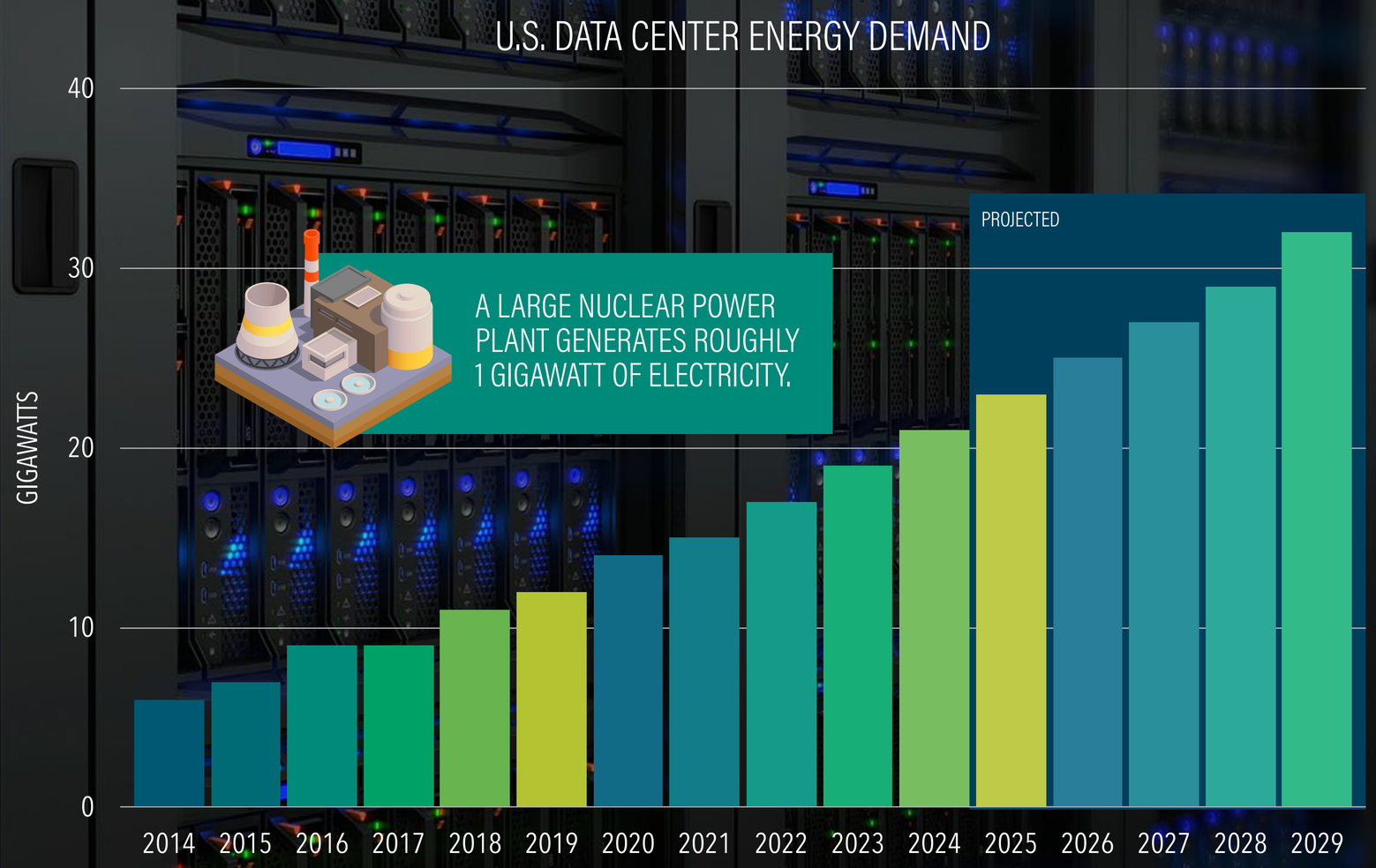
Source: U.S. Energy Information Administration (EIA)

Data centers tax the power grid

By 2026, data centers are projected to consume 6% of America's total electricity.



Source: McKinsey and Company, January 2023

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Workers in energy

How many people work to ensure you have the energy you need?

8.1 million
Americans are employed in the energy sector

300k
energy sector jobs added in 2022

150k
increase in women working in energy in 2022

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Source: usafacts.org

OUR FUTURE WITH NATURAL GAS

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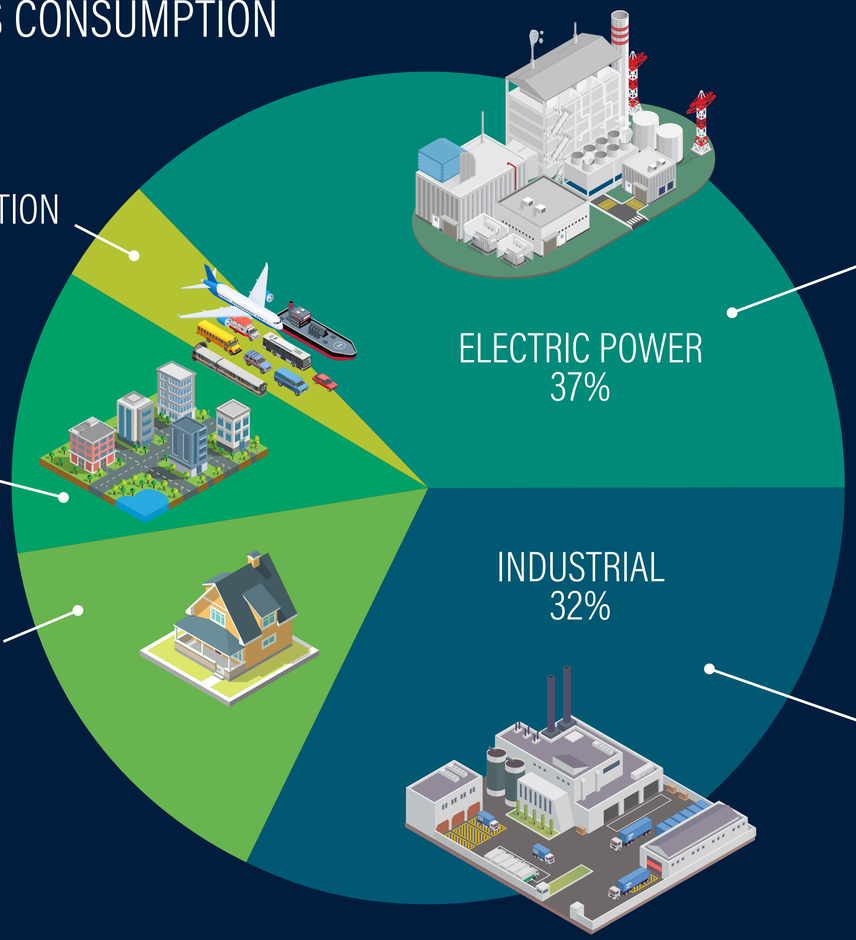
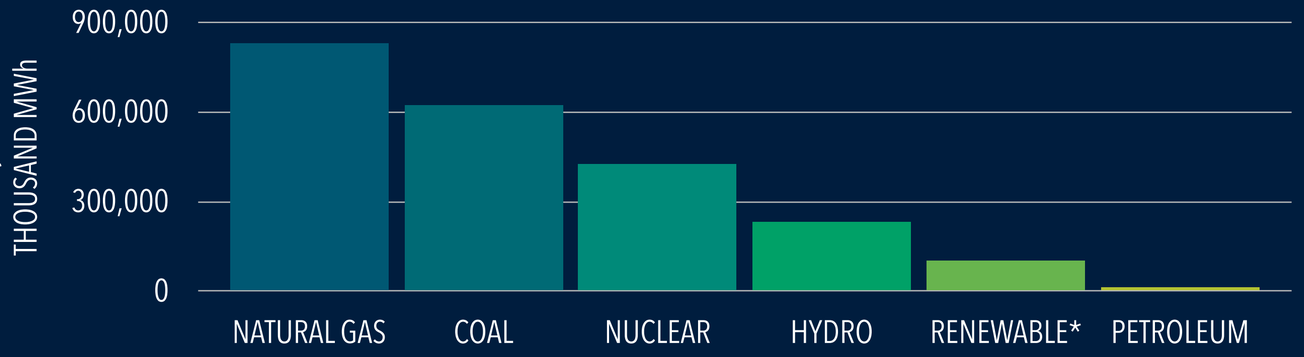
Natural gas plays a pivotal role in our energy mix

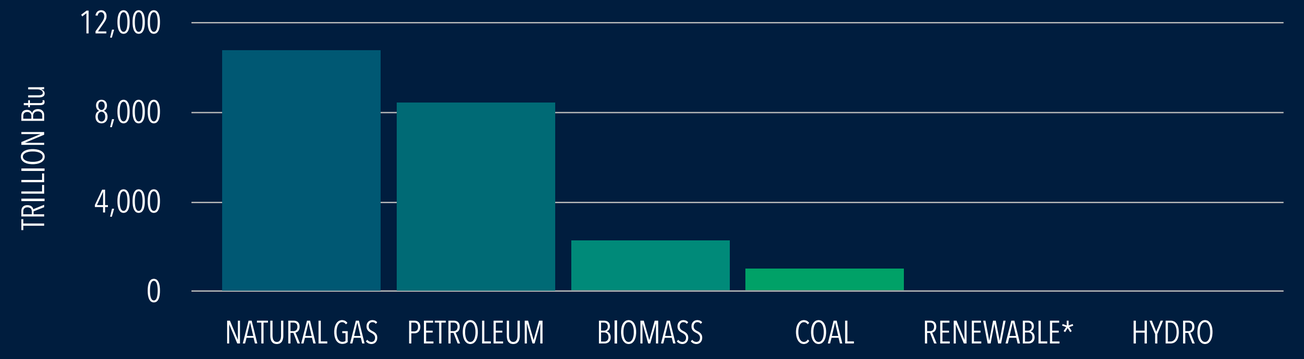
NATURAL GAS CONSUMPTION BY SECTOR



NET GENERATION BY ENERGY SOURCE



INDUSTRIAL SECTOR ENERGY CONSUMPTION



*Non-hydro, non-biomass renewables

Source: U.S. Energy Information Administration (EIA)

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How is natural gas formed?

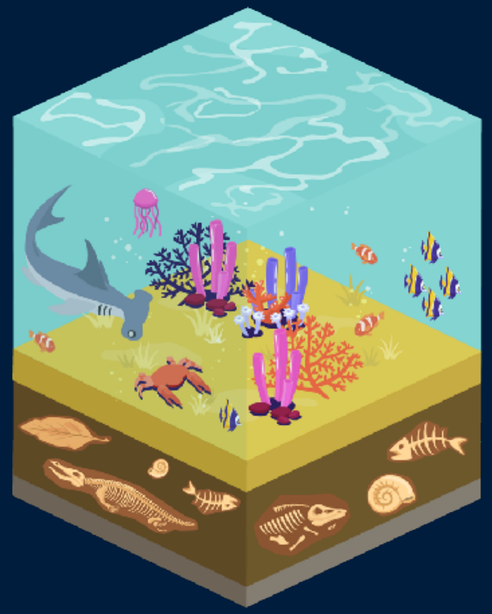
Natural gas is what we call a fossil fuel.

300-400 MILLION YEARS AGO

Ocean

Sand and Silt

50-100 MILLION YEARS AGO



Ocean

Sand and Silt

Plant and
Animal Remains

TODAY

Sand and Silt
Rock

Oil and Gas
Deposits

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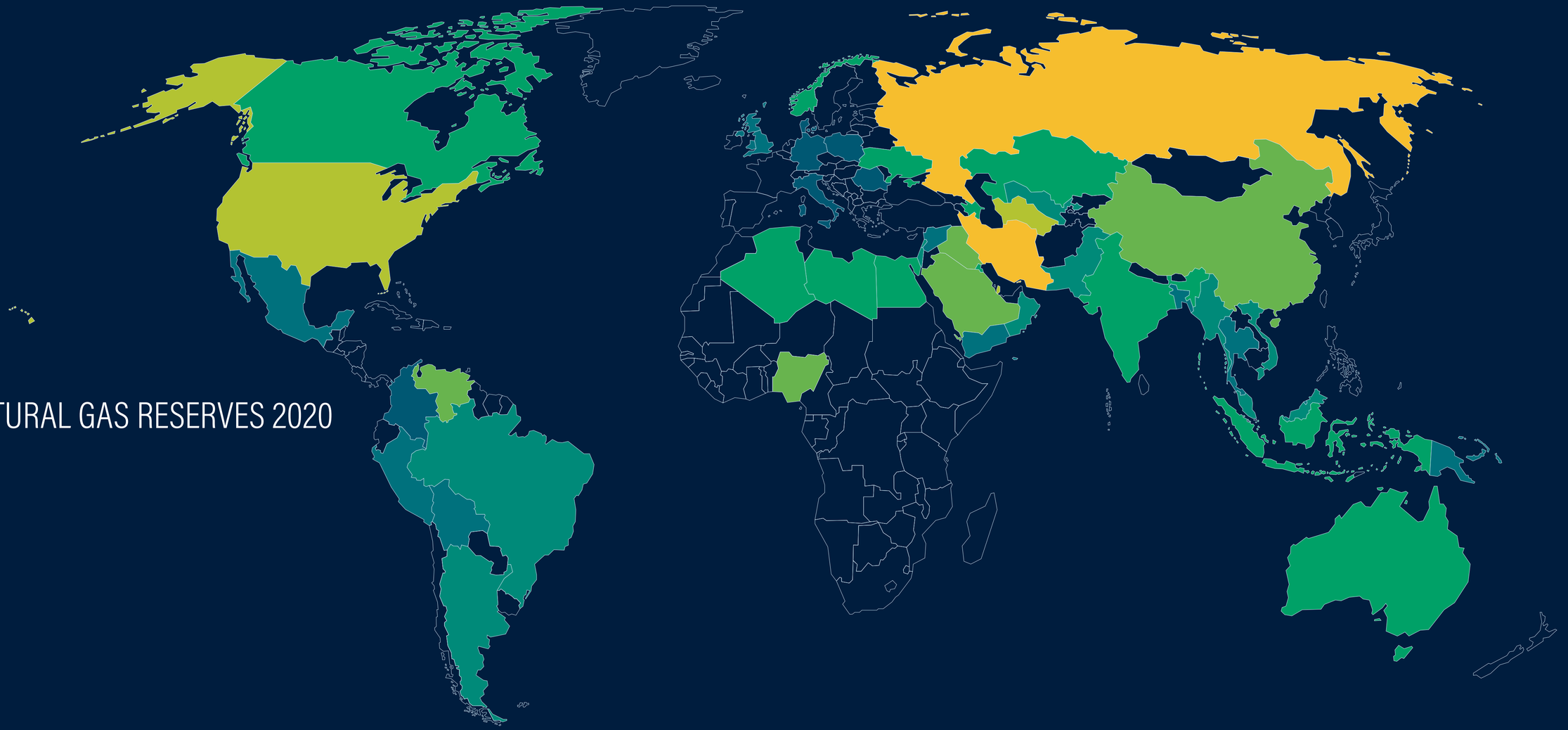
Where do we find natural gas today?



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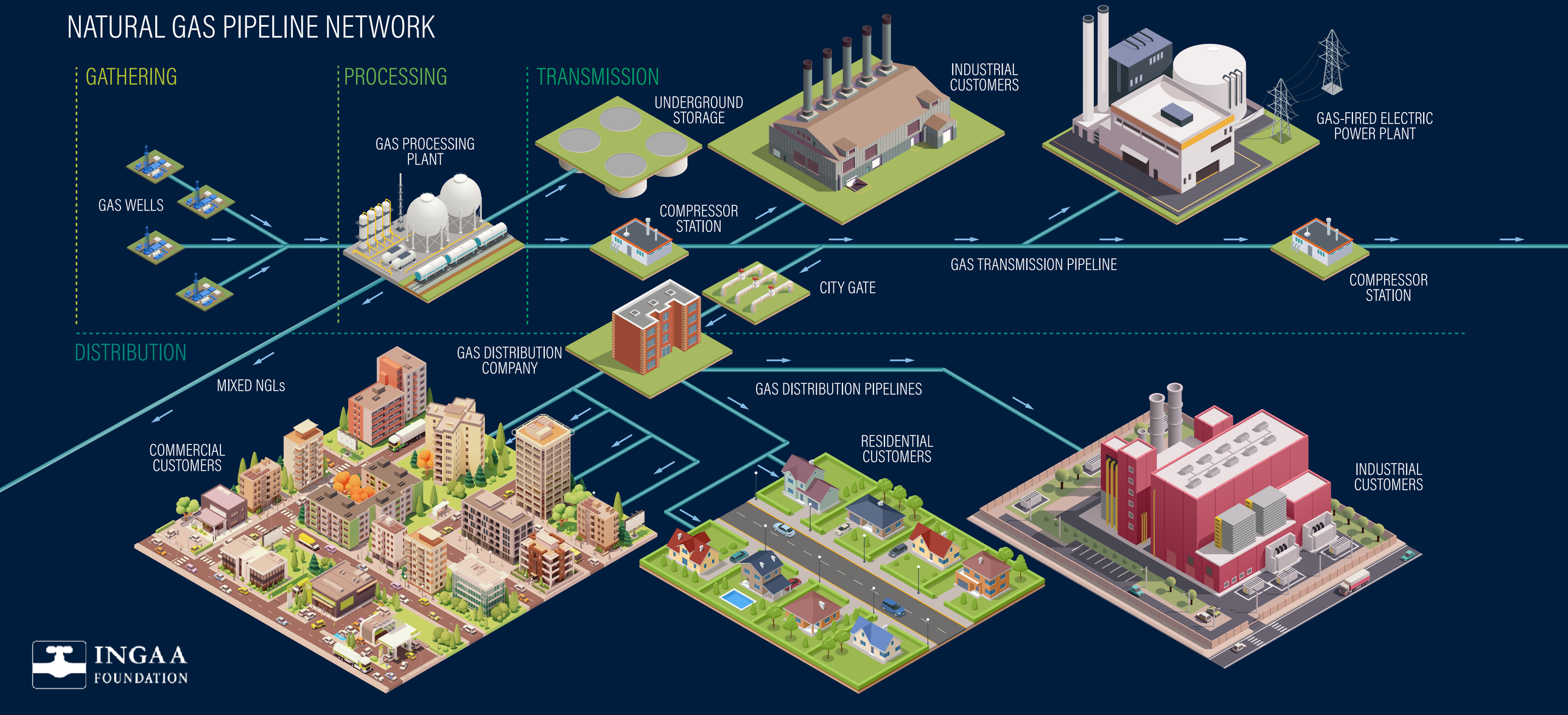
No data | 0 m^3 | 100 billion m^3 | 300 billion m^3 | 1 trillion m^3 | 3 trillion m^3 | 10 trillion m^3 | 30 trillion m^3 | 100 trillion m^3

The journey of natural gas



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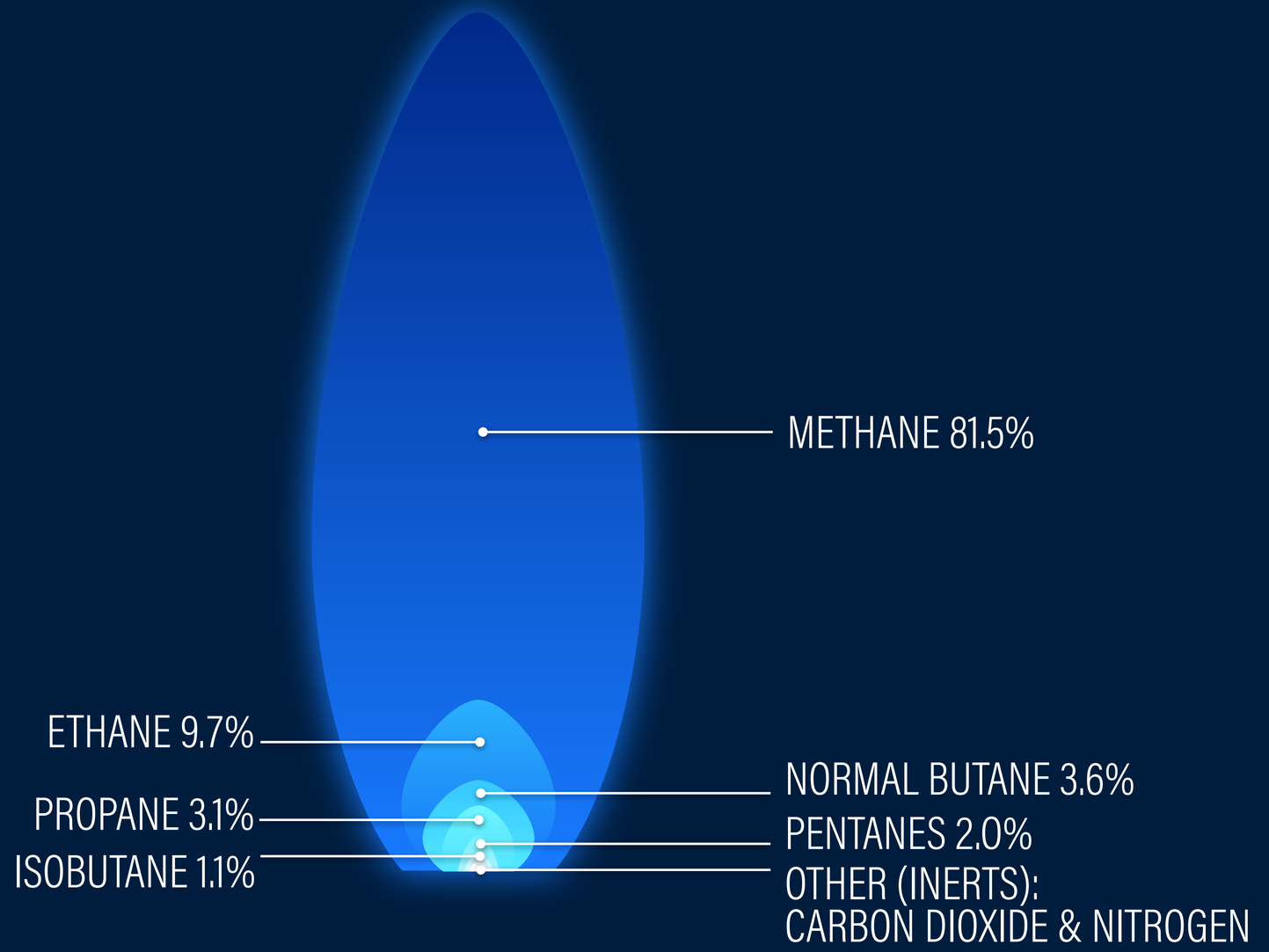
What exactly is natural gas?

Pipeline quality gas is natural gas that has been processed to remove impurities and contaminants, ensuring it meets specific standards for transportation through pipelines.



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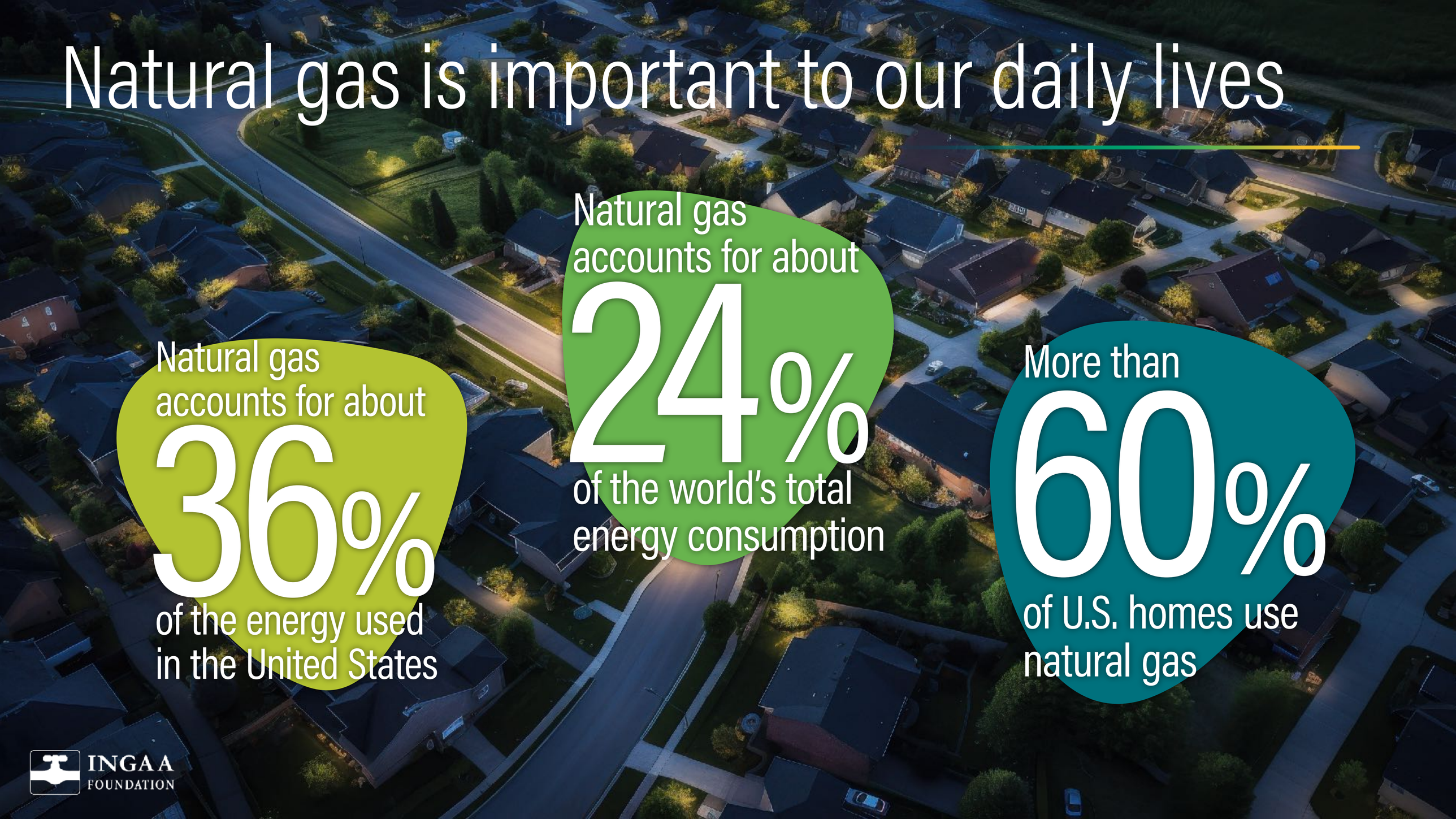
Natural gas is important to our daily lives



Natural gas accounts for about **36%** of the energy used in the United States

Natural gas accounts for about **24%** of the world's total energy consumption

More than **60%** of U.S. homes use natural gas

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Products made with natural gas

Some examples of the products we use every day.

FERTILIZER

GOLF BALLS

MOBILE PHONES

PAINTBRUSHES

PHARMACEUTICALS

TIRES

TOOTHPASTE

WATER BOTTLES

RENEWABLES COMPONENTS

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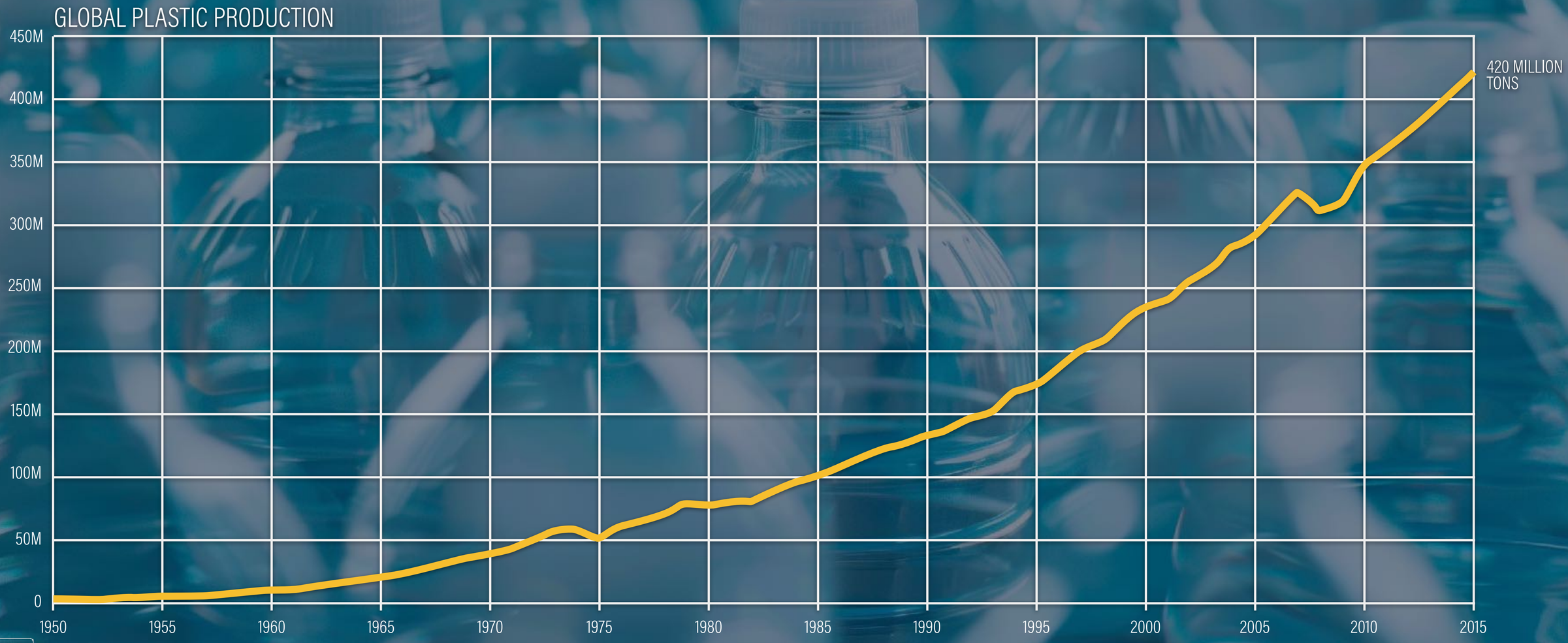
Natural gas is used to produce plastics

This helps provide some of the materials needed for solar and wind energy.



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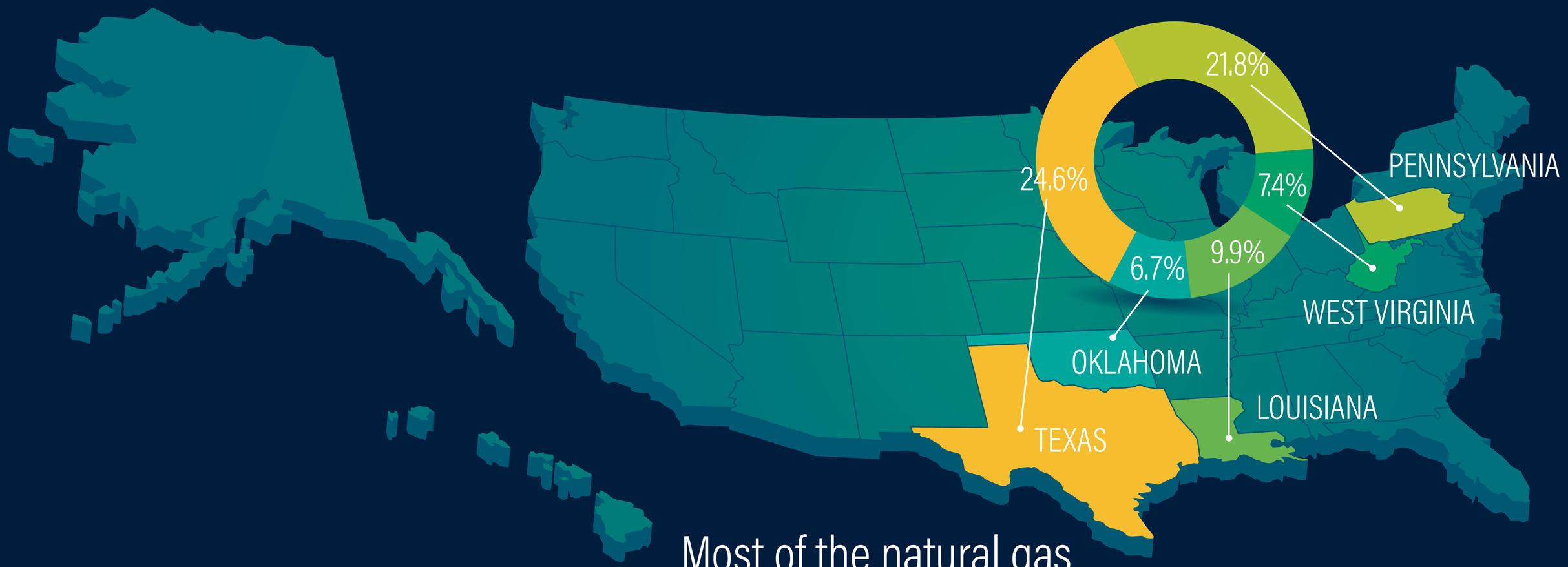
Source: Geyer, Jambeck and Law (2017)

The world's largest producer of natural gas



Most of the natural gas
used in the U.S. is produced in the U.S.

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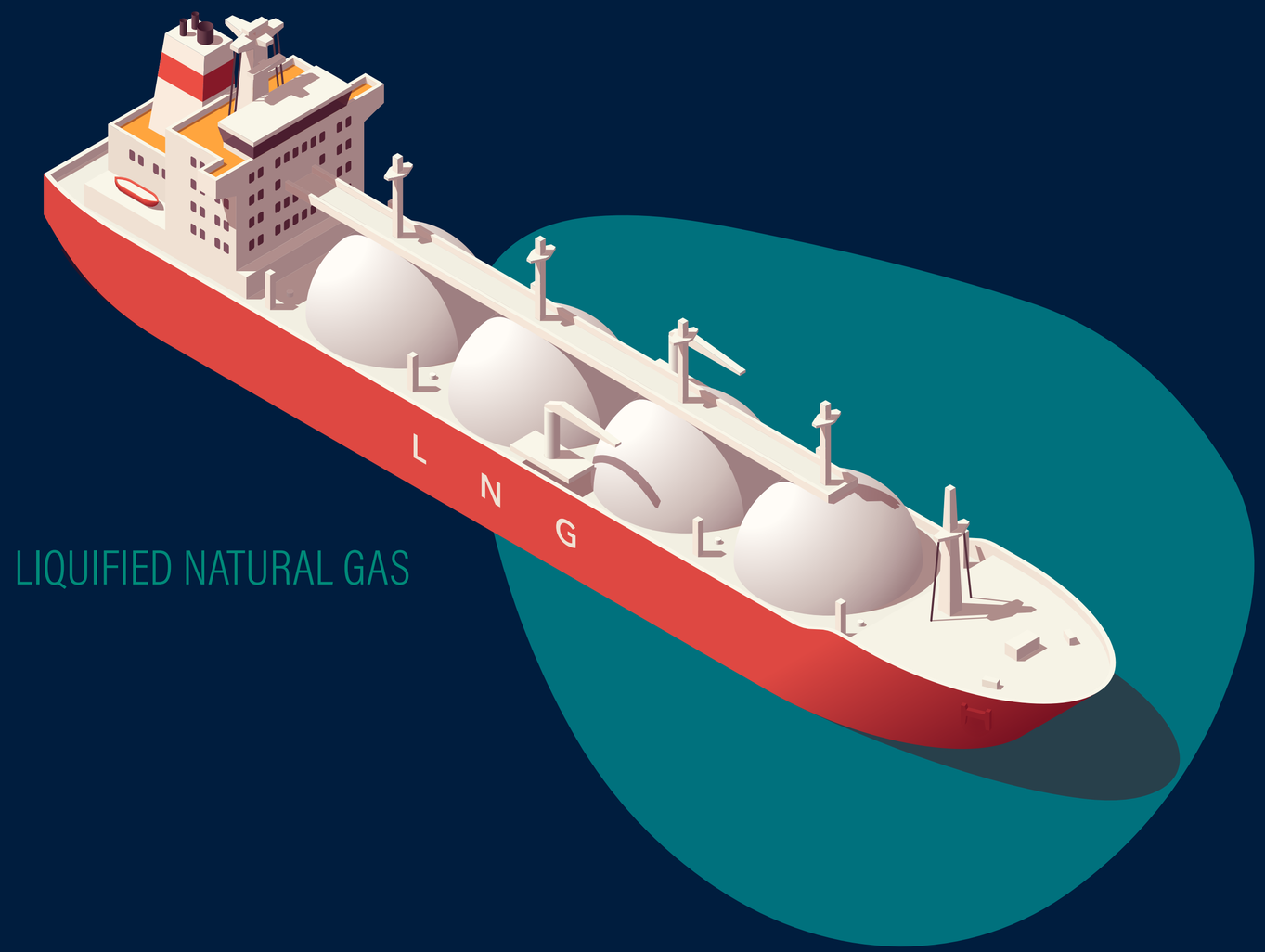
What's America's role with natural gas?

The United States is one of the top exporters of LNG in the world.



LIQUIFIED NATURAL GAS

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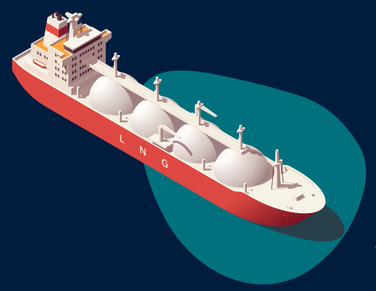
LNG export capacity has continued to grow



LNG exports have exceeded pipeline exports since 2021.

U.S. NATURAL GAS PRODUCTION, CONSUMPTION AND NET EXPORTS

TRILLION CUBIC FEET

35
30
25
20
15
10
5
0
-5

1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020

PRODUCTION
36.35 TRILLION CUBIC FEET

CONSUMPTION
32.26 TRILLION CUBIC FEET

NET EXPORTS
3.88 TRILLION CUBIC FEET

Source: U.S. Energy Information Administration (EIA)

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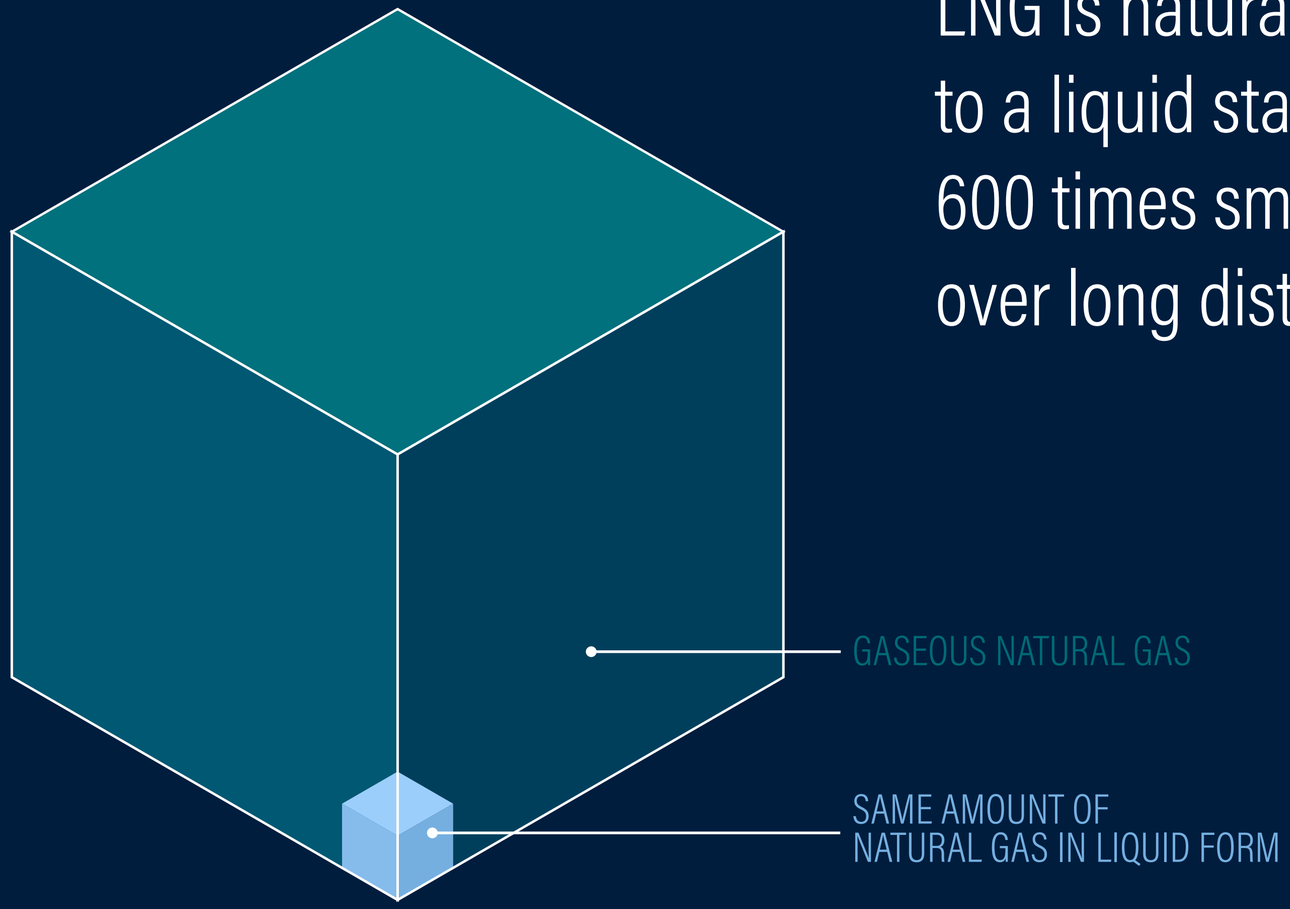
Why liquify natural gas?



LNG is natural gas that has been cooled to a liquid state, making its volume about 600 times smaller and easier to transport over long distances.

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Key benefits of natural gas

AFFORDABLE

ECONOMIC DRIVER

RELIABLE

NATIONAL SECURITY

VERSATILE

CLEANER-BURNING

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Natural gas complements renewable energy

The importance of natural gas is expected to grow as countries transition to lower-carbon energy.


HOW
PIPELINES
CONNECT US
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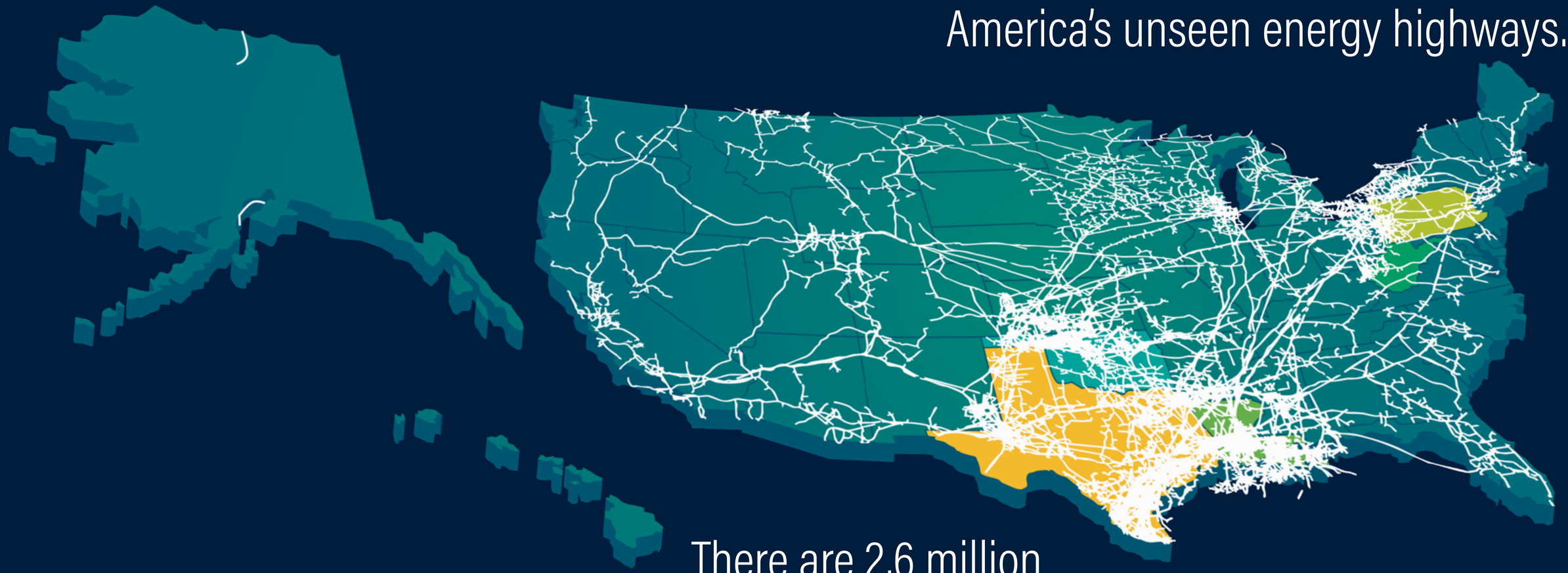
Natural gas pipelines in the U.S.

America's unseen energy highways.



There are 2.6 million
miles of natural gas pipelines in the U.S.

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Pipelines move energy more efficiently

Safely delivering trillions of cubic feet of natural gas.

It would take a constant line of tanker trucks, about 750 per day, loading up and moving out every two minutes, 24 hours a day, seven days a week, to move the volume of even a modest pipeline.

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Quick history of pipelines

An innovation that has been part of our energy system for centuries.

2,500 YEARS AGO
Ancient Chinese use bamboo pipes to transport natural gas.

1792
Scottish inventor William Murdoch created the first gas distribution network in Europe to light his home.

1817
Baltimore becomes the first American city to install gas street lighting using a pipeline network along the city's streets.

1848
There was an effort to light the U.S. Capitol with natural gas, including a six-foot-wide natural gas lantern on the dome.

1930s
Technological advancements make it possible to extract natural gas and to transport it through large pipes, bringing natural gas to more areas.

TODAY
Technology improves pipes with better steel, better ways to install pipelines and the ability to continually analyze pipelines in the ground.

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Deciding where a pipeline goes

Many factors determine the route of a pipeline.

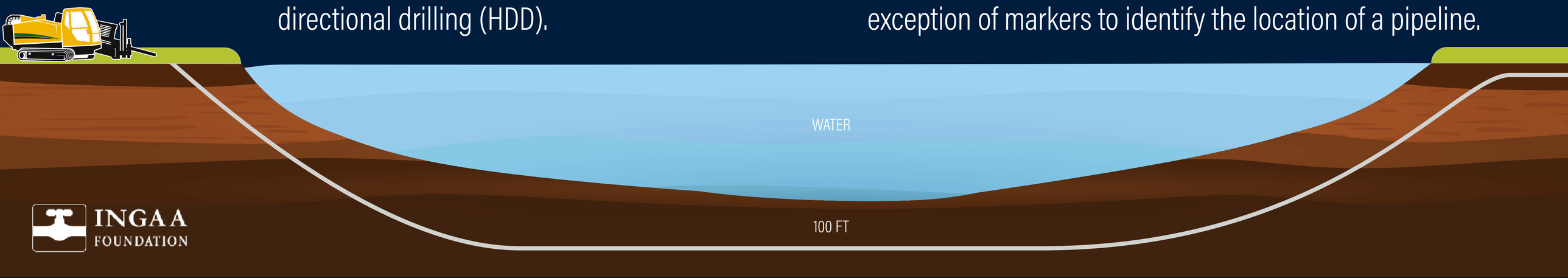
Engaging with and listening to community members.

Finding routes to avoid highly populated, environmentally sensitive or culturally significant areas.

Following existing routes when possible to minimize environmental or community impacts.

Pipeline planners avoid impacting rivers or lakes by tunneling deep beneath them with horizontal directional drilling (HDD).

Land disturbance for pipeline construction is temporary. Crews work to restore land to its previous state with the exception of markers to identify the location of a pipeline.



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Pipelines are the safest way to deliver energy

Regulators and operators work together to keep pipelines safe.

Pipelines make up less than

.01%

of all transportation accidents in the U.S.

The steel used for pipelines must be certified and meet industry and federal government quality standards for toughness and strength.

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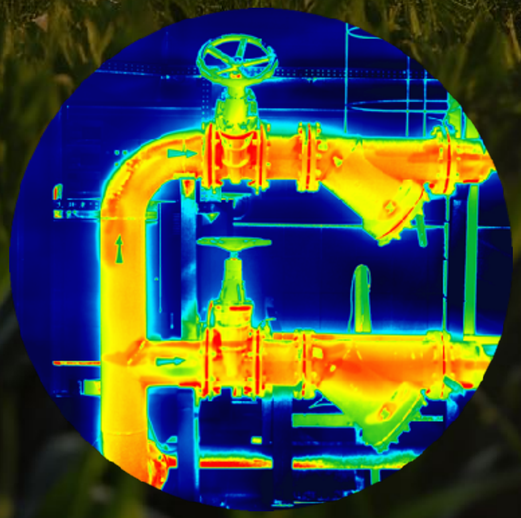
The technology that keeps pipelines safe

PIPELINE MONITORING TECHNOLOGIES

Real-time sensors, AI-powered diagnostics and drones ensure early detection of leaks, corrosion or other pipeline issues, long before they would become dangerous.



Technologies like infrared cameras and laser-based systems help detect leaks before they become hazardous.

In emergencies, smart technology can automatically and instantly stop gas flow to prevent accidents.

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Pipelines benefit communities

Providing affordable fuel, jobs and millions in tax revenue.

POWERING
OUR LIVES

MANUFACTURING OUR PRODUCTS

SUPPORTING
OUR FARMS

GETTING US WHERE WE WANT TO GO

PROVIDING
ENERGY SECURITY

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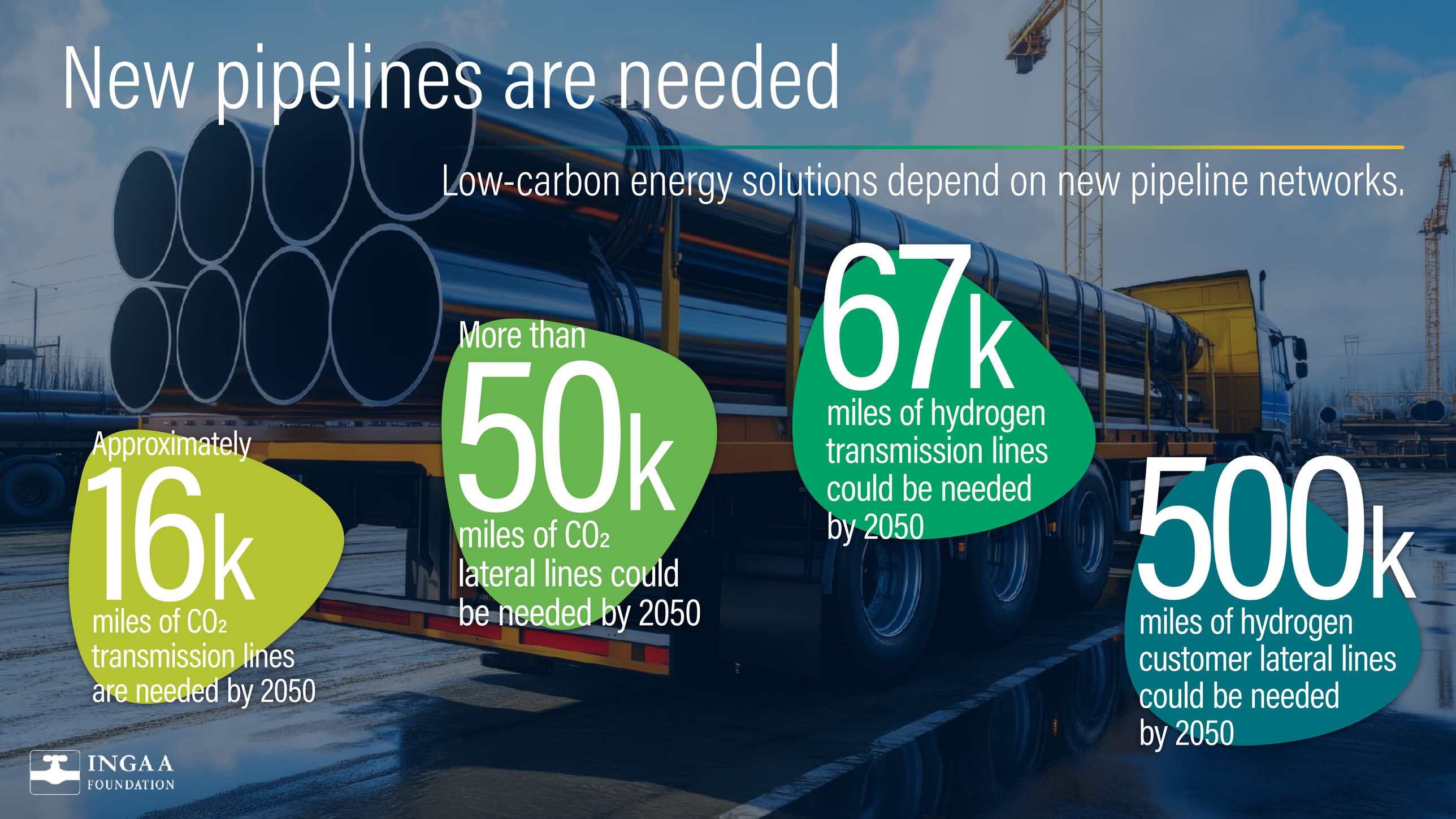
New pipelines are needed

Low-carbon energy solutions depend on new pipeline networks.



Approximately

16k

miles of CO_2 transmission lines are needed by 2050

More than

50k

miles of CO_2 lateral lines could be needed by 2050

67k

miles of hydrogen transmission lines could be needed by 2050

500k

miles of hydrogen customer lateral lines could be needed by 2050

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New pipelines create new jobs

Pipelines create hundreds of thousands of good-paying jobs across the U.S.

A single major pipeline project can create:

42,000
jobs paying more than

$2 billion
in salaries for workers and their families

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SAFETY
IS OUR TOP
PRIORITY
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Industry safeguards help prevent accidents

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Commitment to keeping workers safe

Wearable technology like smart helmets or vests can help fulfill a variety of safety functions:

TRACK WORKER LOCATIONS

MONITOR VITAL SIGNS IN HAZARDOUS OR REMOTE LOCATIONS

ALERT WORKERS TO POSSIBLE DANGERS

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ENERGY
CAREERS
FOR THE FUTURE
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Energy careers in natural gas

The natural gas industry offers a unique, rewarding pathway.

4 million
U.S. jobs are supported by this industry

1.9 million
projected job opportunities to be available by 2035

$50k
higher average pay than the national average

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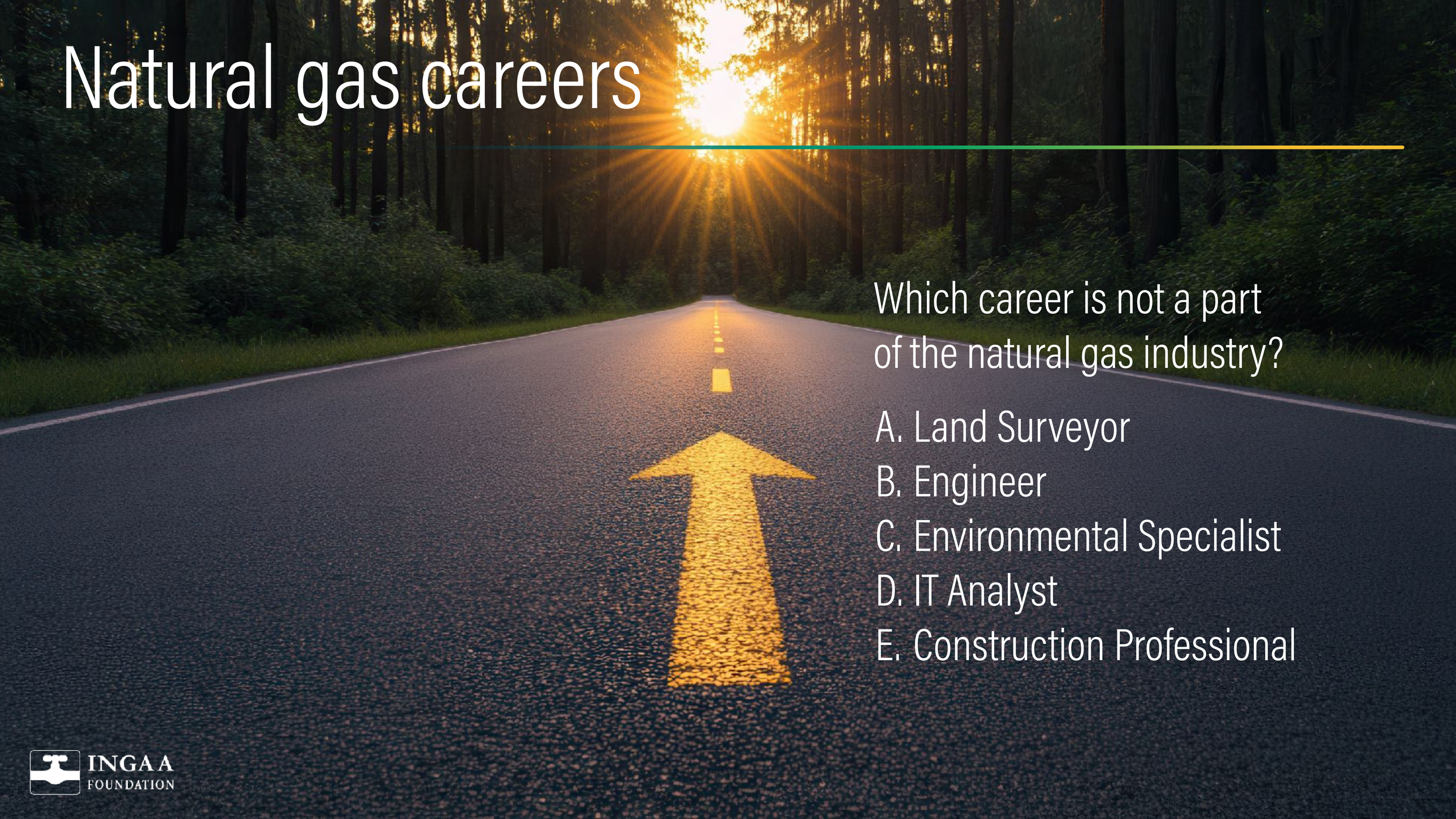
Sources: empoweringamerica.org and api.org

Natural gas careers



Which career is not a part of the natural gas industry?

A. Land Surveyor
B. Engineer
C. Environmental Specialist
D. IT Analyst
E. Construction Professional

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STEM careers in natural gas

For those interested in pursuing a college degree in STEM-related fields.

ENGINEER

Salary range:
$78K-$130K*

ENVIRONMENTAL SPECIALIST

Salary range:
$79K-$133K

CAD (COMPUTER-AIDED DESIGN) TECHNICIAN

Salary range:
$63K-$98K

GIS (GEOGRAPHIC INFORMATION SYSTEMS) ANALYST

Salary range:
$66K-$83K

PROJECT MANAGER

Salary range:
$89K-$172K

IT ANALYST / INFORMATION SECURITY ANALYST

Salary range:
$120K-$182K

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*These salaries reflect a range of median salaries for various types of engineers within this industry.

Career opportunities with no prior experience

For those interested in heading directly into the workforce after high school.

PIPELINE CONTROLLER

Salary range:
$42-$57 per hour

LAND SURVEYOR

Salary range:
Field Surveyor
$22 -$45 per hour

Salary range:
Office Surveyor
$30-$50 per hour

NATURAL GAS TECHNICIAN

Salary range:
$24-$50 per hour

INSPECTOR

Salary range:
$22-$35 per hour

CONSTRUCTION PROFESSIONAL

Salary range:
$16-$43 per hour*

WELDER

Salary range:
$24-$35 per hour

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*These salaries reflect a range of median salaries for various types of construction professionals within this industry.

Career opportunities you might not expect

They play crucial roles in supplying reliable energy and shaping our clean-energy future.

ACCOUNTANT

ATTORNEY

HR PROFESSIONAL

TRUCK DRIVER

OFFICE MANAGER

DATA ANALYST

COMMUNICATIONS MANAGER

REAL ESTATE AGENT

GOVERNMENT AFFAIRS SPECIALIST

PUBLIC RELATIONS SPECIALIST

HEALTH & SAFETY SPECIALIST

SALES REPRESENTATIVE

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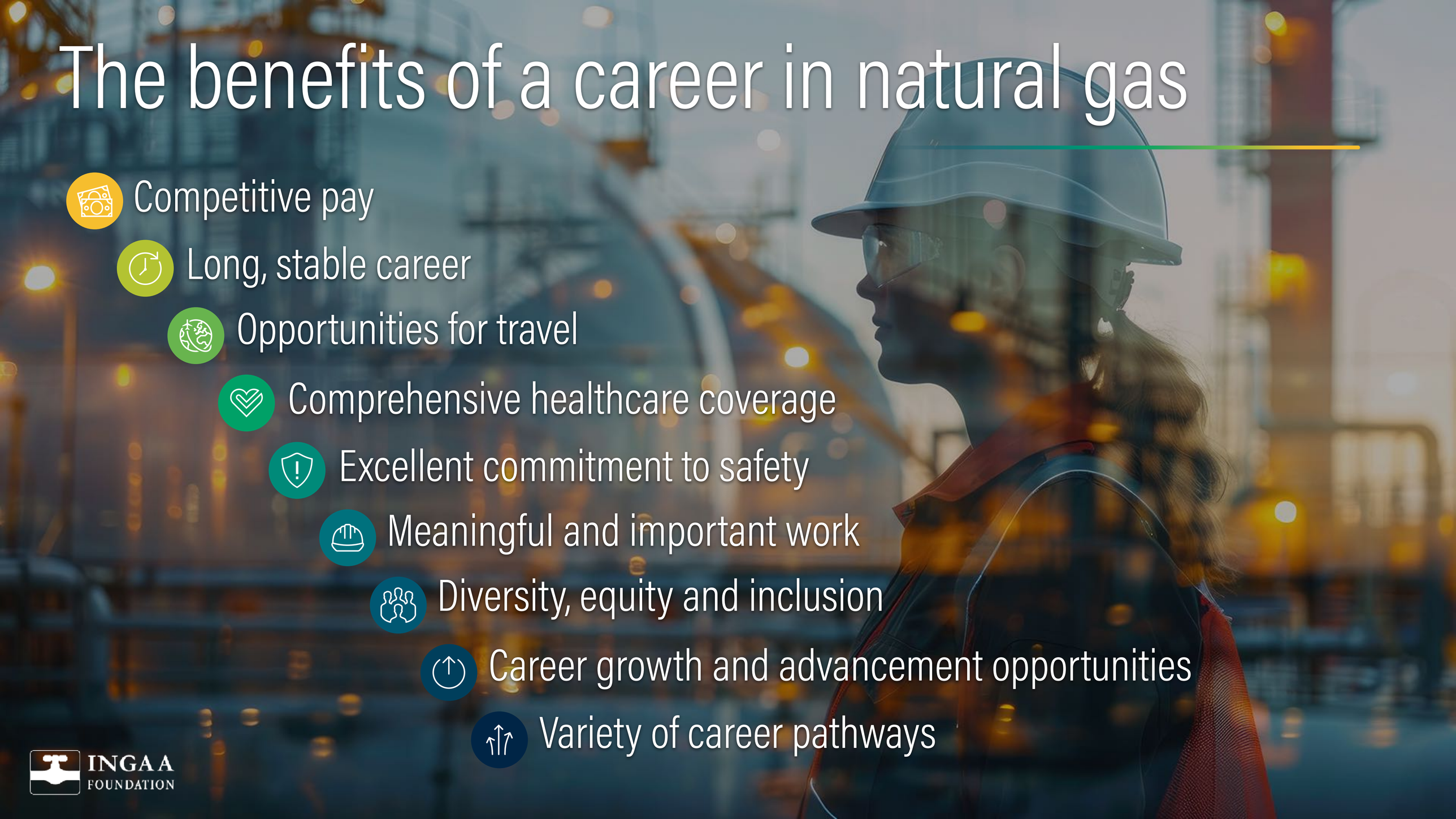
The benefits of a career in natural gas

- Competitive pay
- Long, stable career
- Opportunities for travel
- Comprehensive healthcare coverage
- Excellent commitment to safety
- Meaningful and important work
- Diversity, equity and inclusion
- Career growth and advancement opportunities
- Variety of career pathways



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The natural gas industry is evolving

Energy demands, environmental concerns and new technology are creating change.

ARTIFICIAL INTELLIGENCE

AI helps optimize systems, predict maintenance needs and enhance safety.

RENEWABLE NATURAL GAS

Focuses on converting waste from sources like landfills, dairy farms and poultry farms into "BioGas." This BioGas can be used for transportation, electricity and even hydrogen production.

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THE PATH TO A
CLEANER
ENERGY
FUTURE
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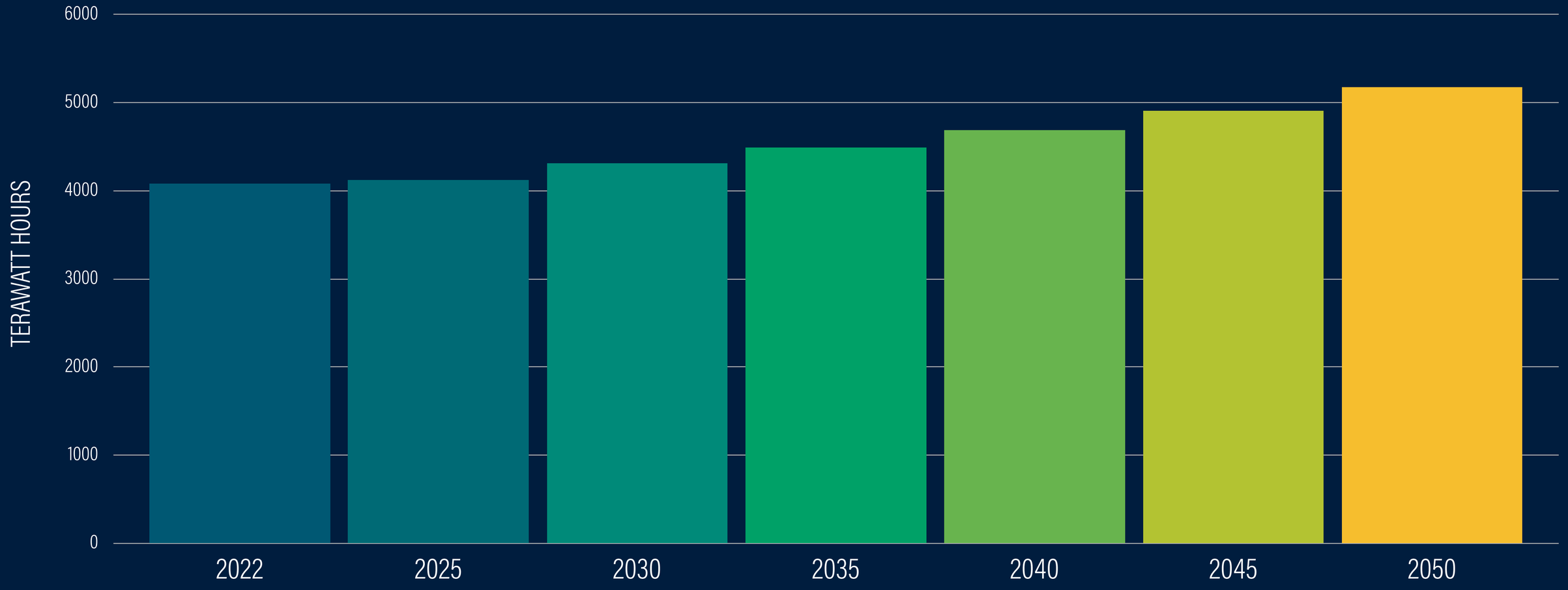
The demand for energy keeps rising

Projected electricity use in the United States.



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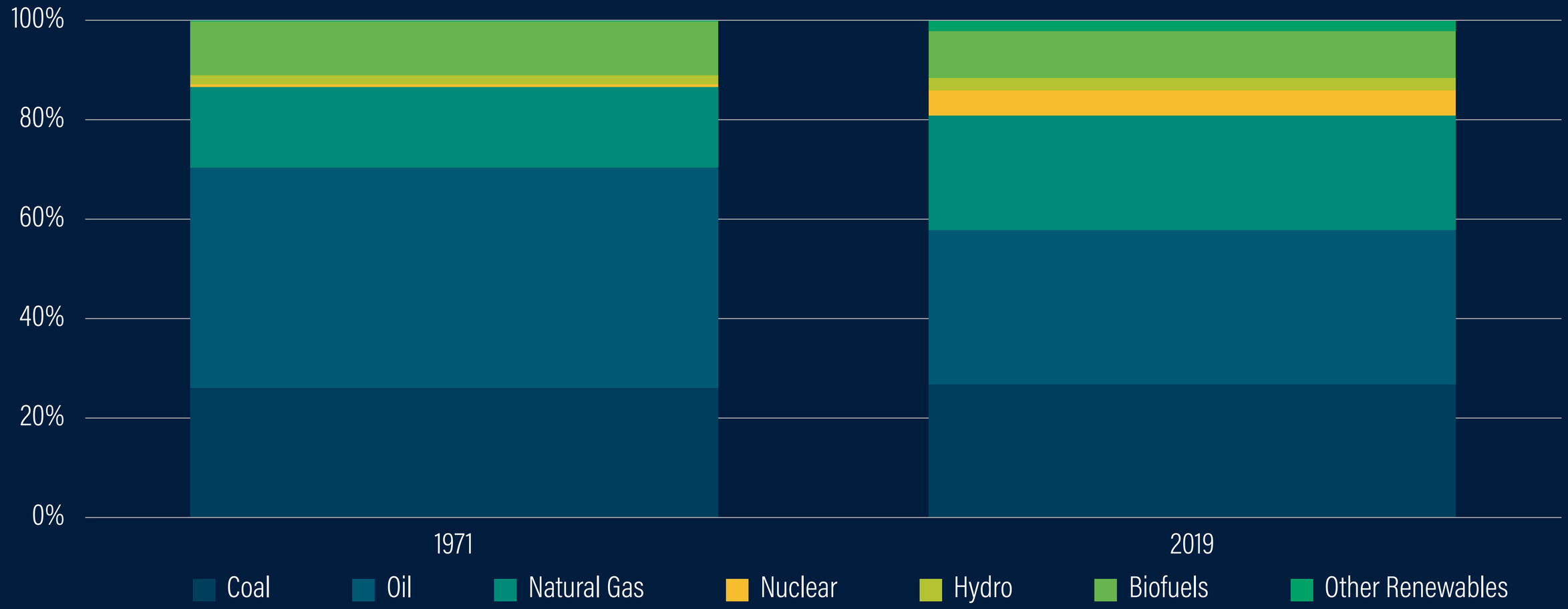
Source: Statista

Non-renewable sources still dominate global energy

Renewable sources are growing, but non-renewables still make up 80% of global energy use.



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Source: International Energy Agency

Natural gas complements renewables

Natural gas-fired power plants can be turned on and off quickly to meet peak electricity demand, balancing intermittent renewable sources.

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Current emissions challenges

These gases lead to what is called the ‘greenhouse effect’ which is the phenomenon whereby the presence of these gases in Earth’s atmosphere traps more heat from solar radiation.

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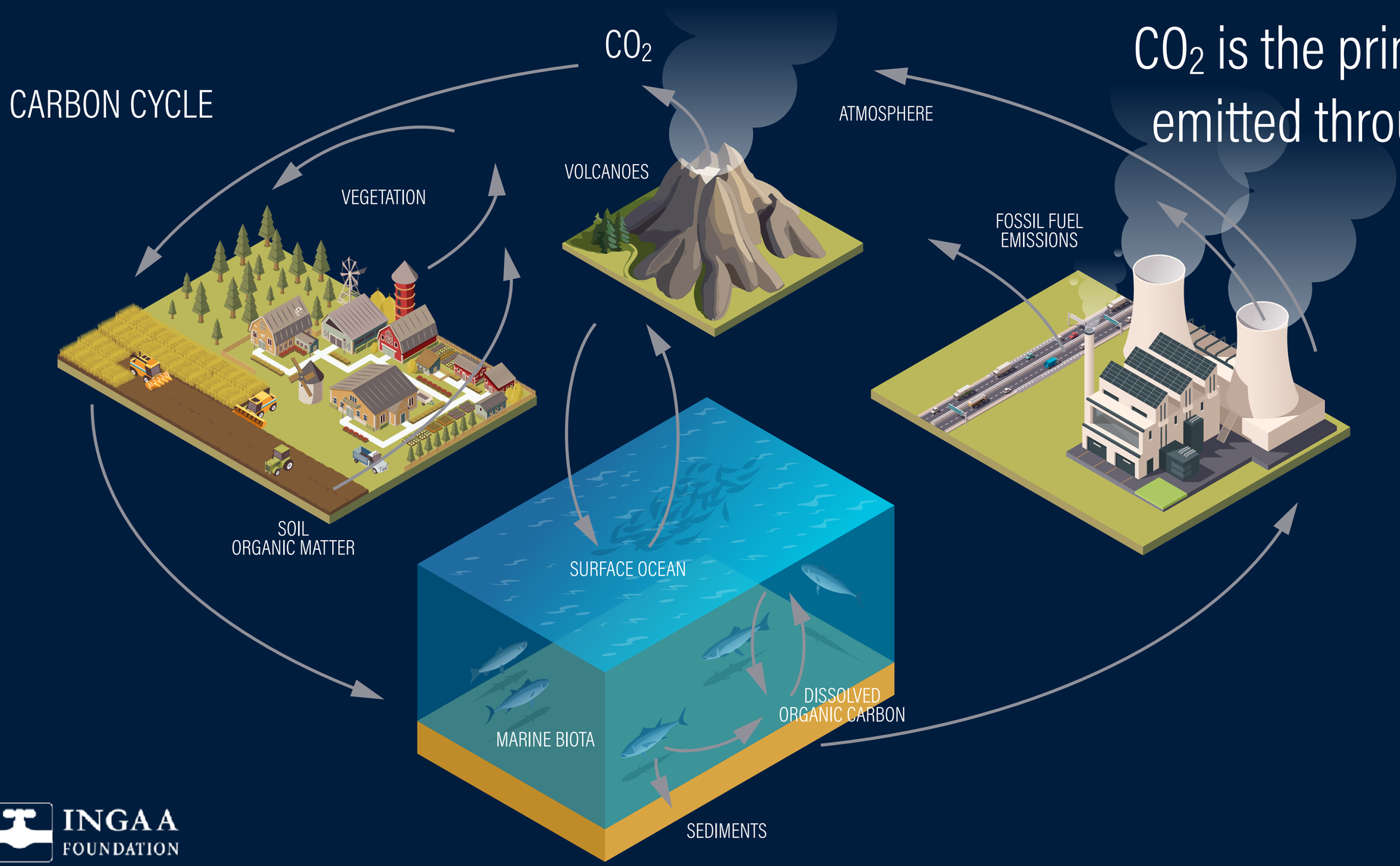
Source: World Resource Institute

What exactly is CO_2?

CO_2 is the primary greenhouse gas emitted through human activities.



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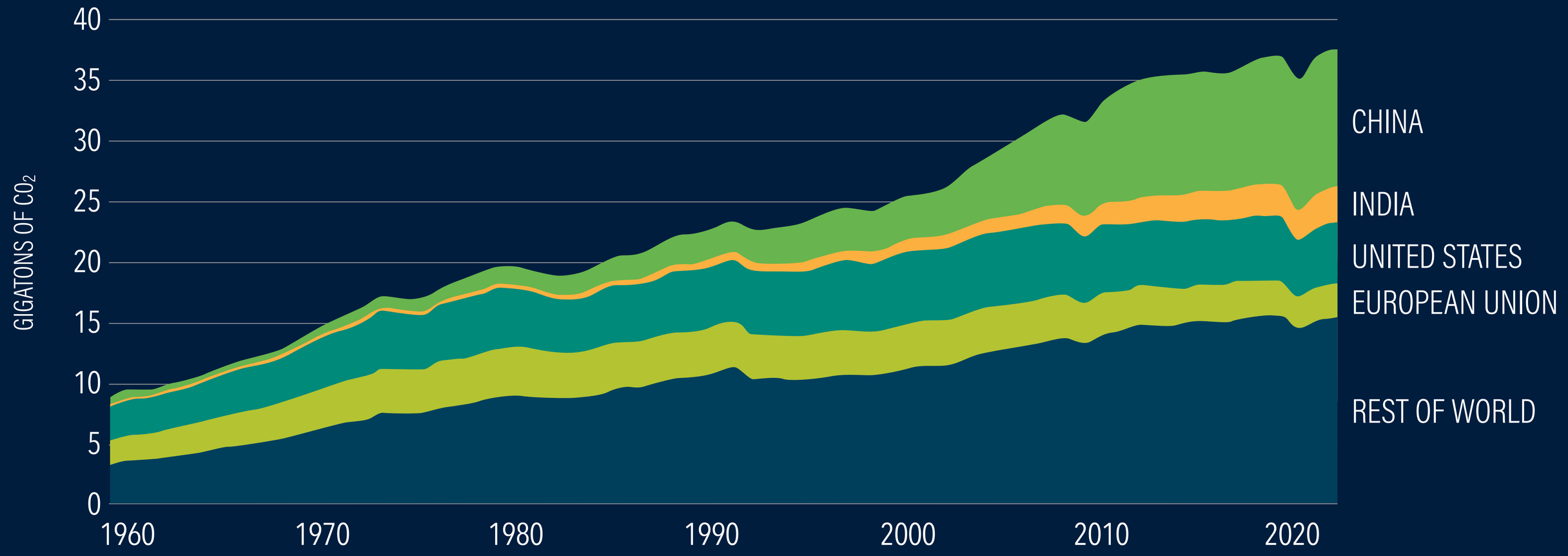
Global increase in CO_2 emissions

The rate of increase of CO_2 emissions has slowed over the past decade.



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Source: Global Carbon Project

Industry solutions to reduce CO_2 emissions

Innovations align with the global push for decarbonization.

CARBON CAPTURE,
UTILIZATION AND STORAGE

RENEWABLE NATURAL GAS

HYDROGEN

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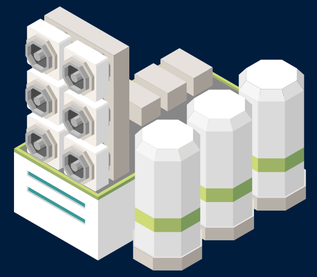
Carbon capture, utilization and storage

Technology can reduce the carbon footprint of natural gas.

Capture

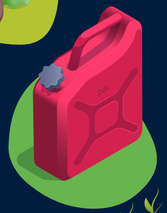
POINT SOURCE CAPTURE



DIRECT AIR CAPTURE

Repurposing

FIZZY BEVERAGES



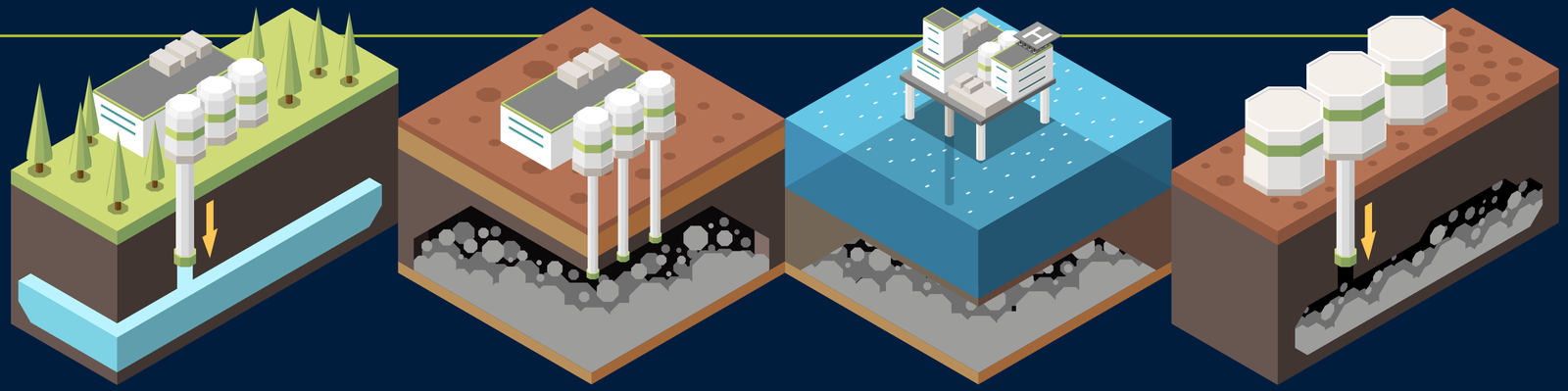
FUELS

FOODS

MEDICINE

BUILDING

Storage



SALINE FORMATIONS

UNMINEABLE COAL SEAMS

ENHANCED OIL RECOVERY

DEPLETED OIL & GAS RESERVES

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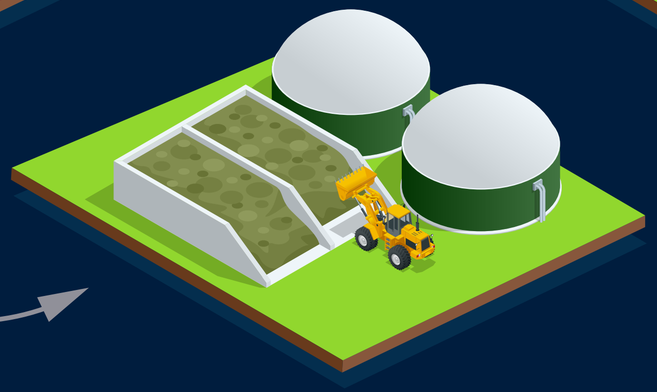
Source: Center for Climate and Energy Solutions

What is Renewable Natural Gas (RNG)?

RNG is chemically identical to natural gas but has a much lower carbon footprint.

1. Collect organic waste from various sources

2. Capture greenhouse gases from organic waste



3. Clean and condition biogas for use in existing infrastructure and appliances

4. Consume in homes, businesses and transportation

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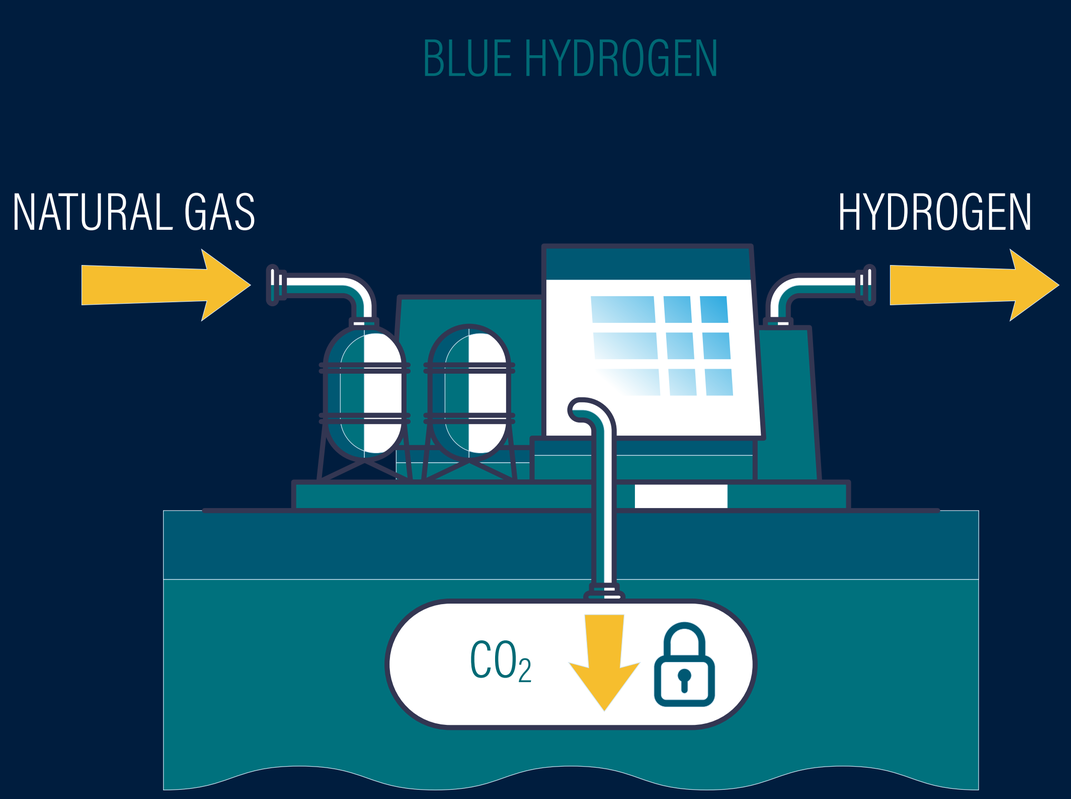
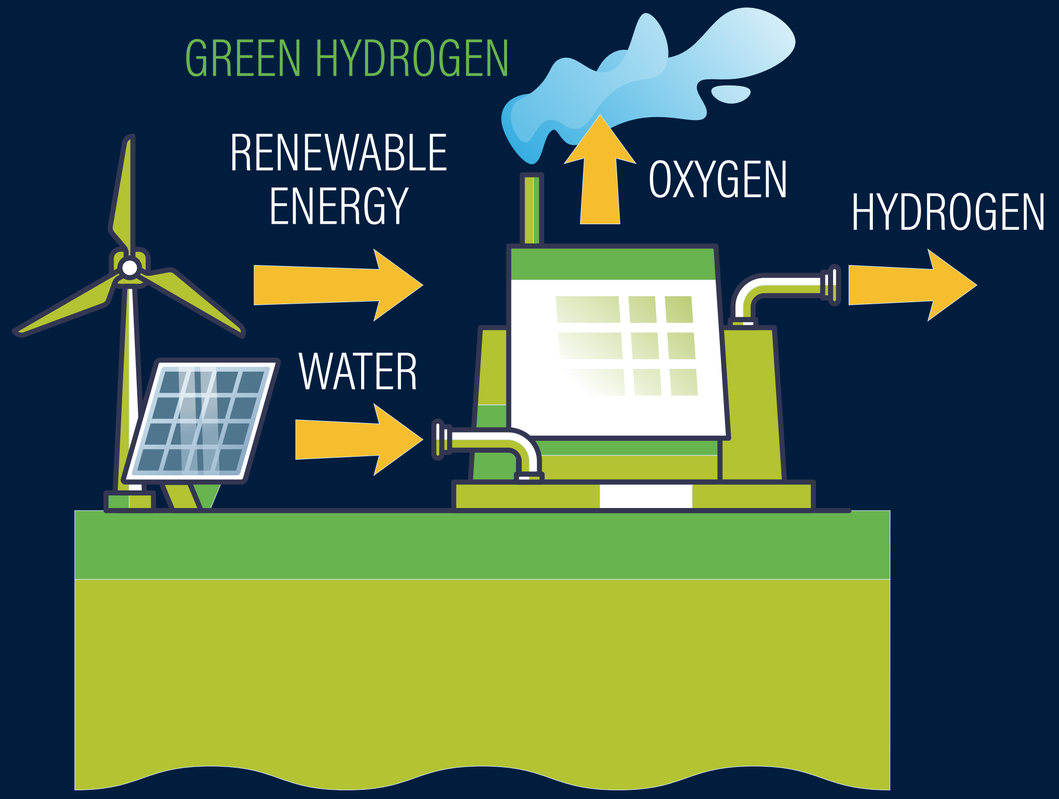
Source: The Coalition For Renewable Natural Gas

Hydrogen is a promising new fuel

When produced using natural gas, it's known as "blue hydrogen".





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Understanding the source of emissions

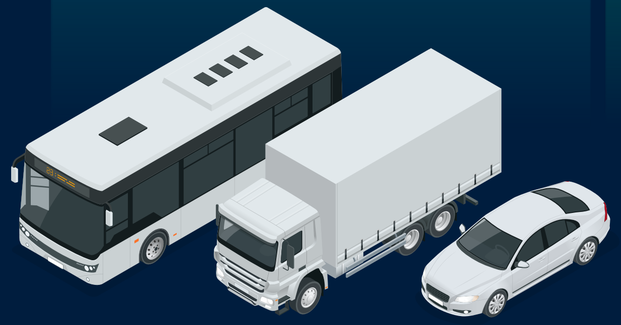
The three scopes are a way of categorizing the different kinds of emissions.

Scope 1

Direct emissions

Emissions from sources a company owns or controls directly.

Burning fuel in a company's non-electric vehicle fleet is an example of scope 1 direct emissions.

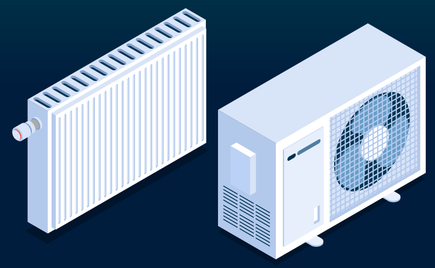


Scope 2

Indirect emissions

Emissions that are a consequence of a company's activities but occur from sources not owned or controlled by the company.

Emissions created by producing the energy used by a company, like electricity, is an example of scope 2 indirect emissions.



Scope 3

Indirect emissions

Emissions created by a company's activities that are not covered by scope 1 or 2, like buying, using and disposing of goods from suppliers, are an example of scope 3 indirect emissions.

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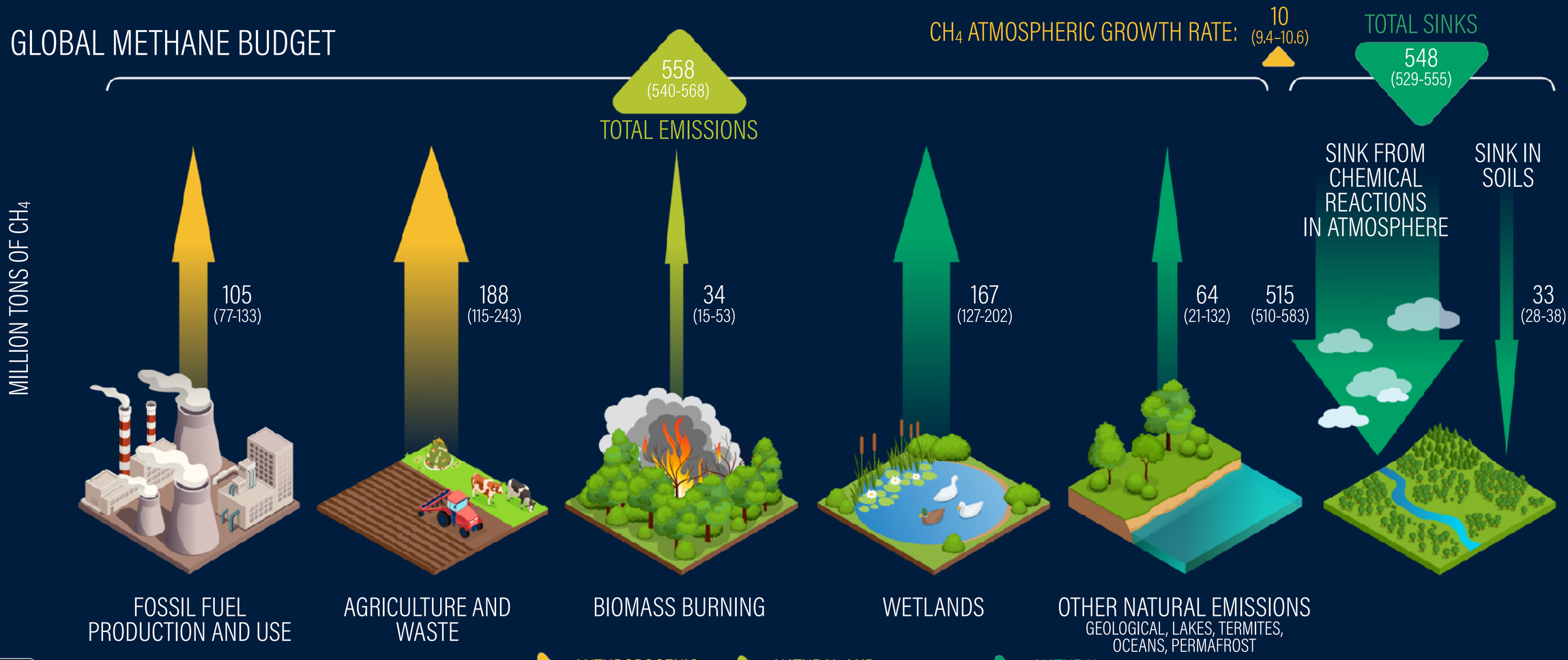
Source: National Grid

What exactly is methane?

CH_4 is a primary component of natural gas and is emitted from a variety of sources.



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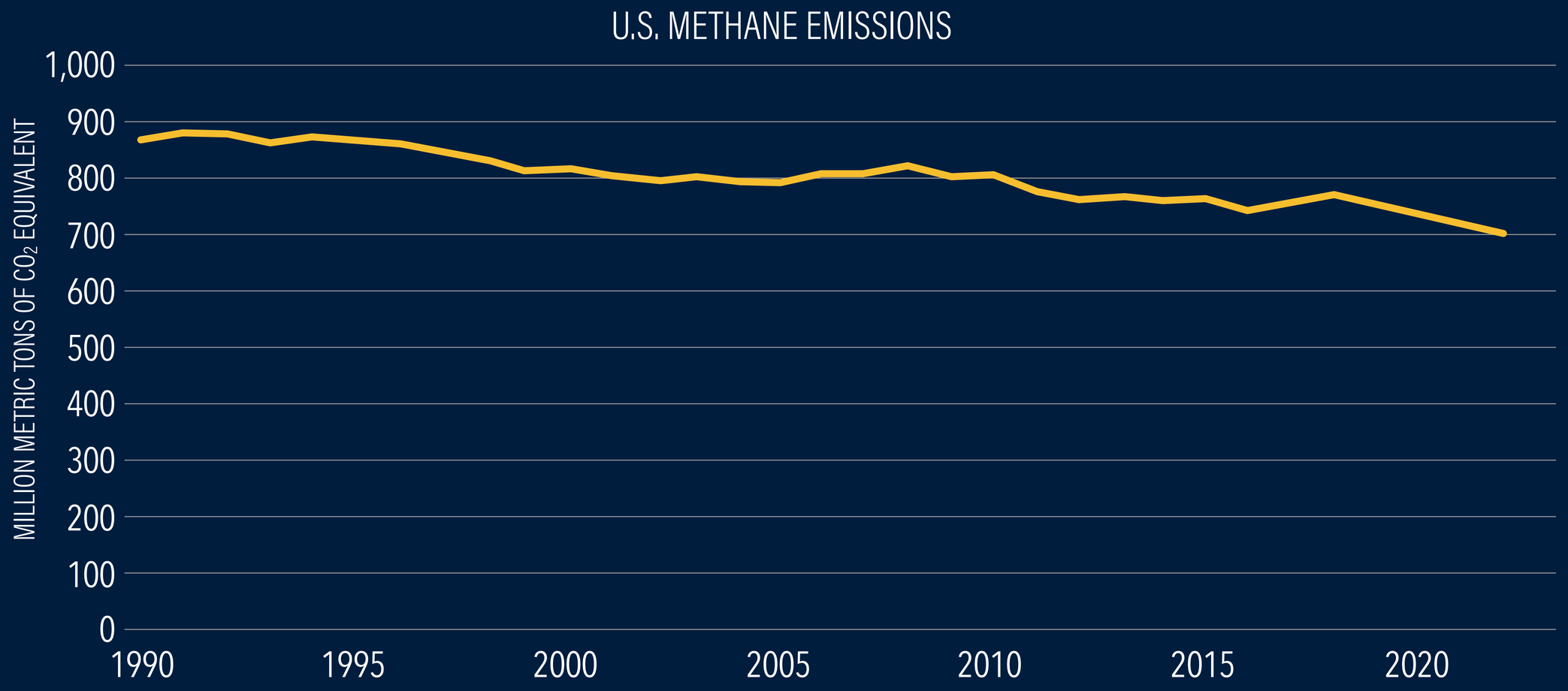
Source: Global Carbon Project & Fondation BNP Paribas

Controlling methane emissions

Methane emissions in the U.S. decreased by 19% between 1990 and 2022.



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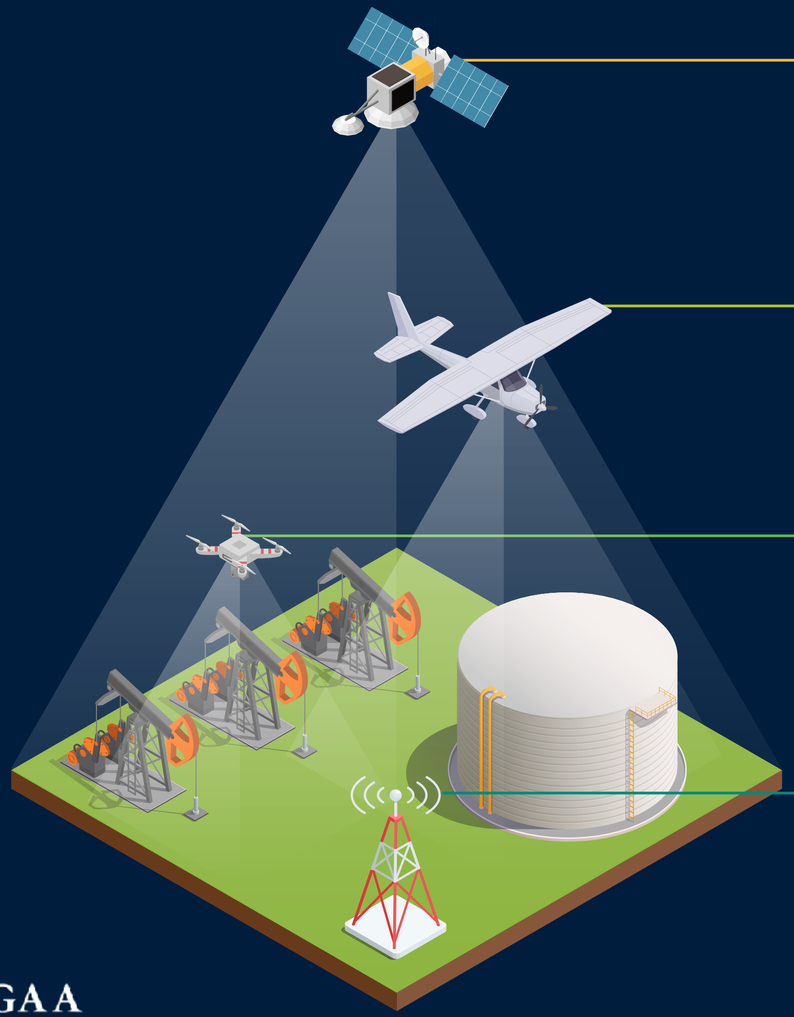
Source: United States Environmental Protection Agency

Helping to reduce methane emissions

The natural gas industry is focused on reducing emissions.



LEVEL 3: SATELLITES
Long-term monitoring
of industrial assets

LEVEL 2: AERIAL
Fast, repeat measurement
surveys to quantify site emissions

LEVEL 1: DRONE
Equipment-level quantification
surveys: verify inventory estimates

LEVEL 0: CMS
Continuous monitoring to flag emission
events and direct follow-up action

MULTI-SCALE MEASUREMENTS
TO ASSESS EMISSIONS

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Source: Wang et al. (2023), Daniels et al. (2023), Brown et al. (2023)

What does net zero mean?

It's balancing the amount of greenhouse gases added and removed from the atmosphere.

Action taken to limit emissions in the next decade will be critical to the future.

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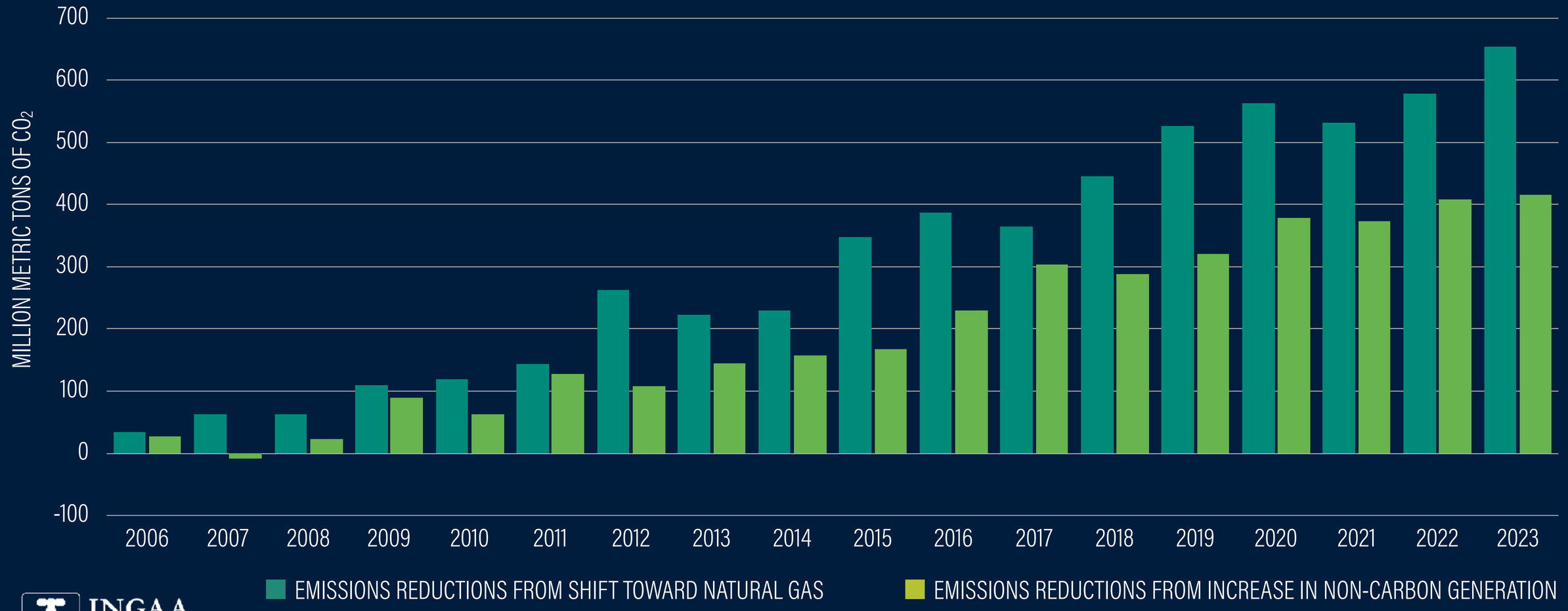
U.S. natural gas is helping reduce emissions

Natural gas will be essential to achieve a net-zero emissions future.



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Source: U.S. Energy Information Administration (EIA)

A partner in building a cleaner future

Natural gas will play a vital role in meeting energy demands, reducing emissions and supporting renewables.

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