

NUCLEAR 101

Indiana Office of Energy Development

A Guide to All Things Nuclear



NUCLEAR TERMINOLOGY DEFINED

[ACCESS FULL NUCLEAR GLOSSARY HERE](#)

Atom

An atom is a basic particle of matter with a nucleus of protons and neutrons, balanced by electrons orbiting around the nucleus.

Neutron

Neutrons are the uncharged particles within an atom that can trigger fission or be absorbed by nuclei depending on their speed.

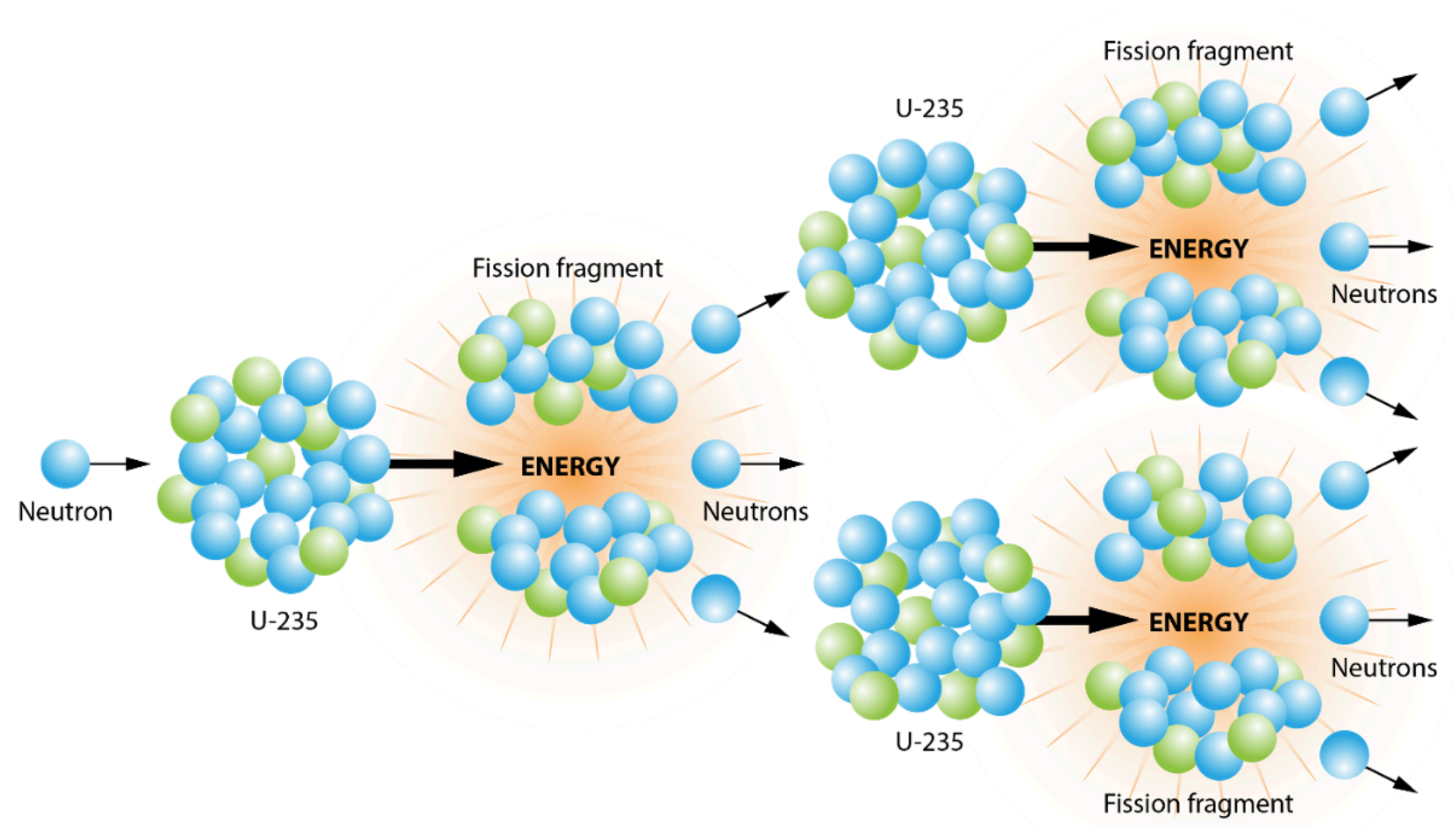
Fission

Fission releases energy because the nucleus splits into smaller fragments whose total mass is less than the original, and that missing mass is converted into energy.

FISSION IN ACTION

Nuclear energy begins with a natural process called fission.

In a nuclear reactor this process is carefully controlled to produce steady energy.



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Nuclear Reactor

A reactor is a device where a controlled fission chain reaction produces usable heat or neutron beams, with commercial reactors using materials, such as light or heavy water or graphite, to slow neutrons.

Capacity Factor

A capacity factor is the percentage of a reactor's actual electricity output compared to what it would produce if running at full power continuously.

Megawatt (MW)

A megawatt (MW) is one million watts; MWe measures electric output, while MWt measures thermal output, which is typically about three times the electric output.

WHAT IS NUCLEAR ENERGY?

Nuclear energy comes from splitting atoms in a reactor to heat water into steam, turn a turbine, and generate electricity. There are 94 nuclear reactors in 28 states that generate nearly 20% of the nation's electricity, all without carbon emissions. These plants are always on. They are well-operated to avoid interruptions and built to withstand extreme weather, supporting the grid 24/7.

All that power and potential from a tiny atom!

THE NUCLEAR FUEL CYCLE

The nuclear fuel cycle is made up of two phases: the **front end** and the **back end**.

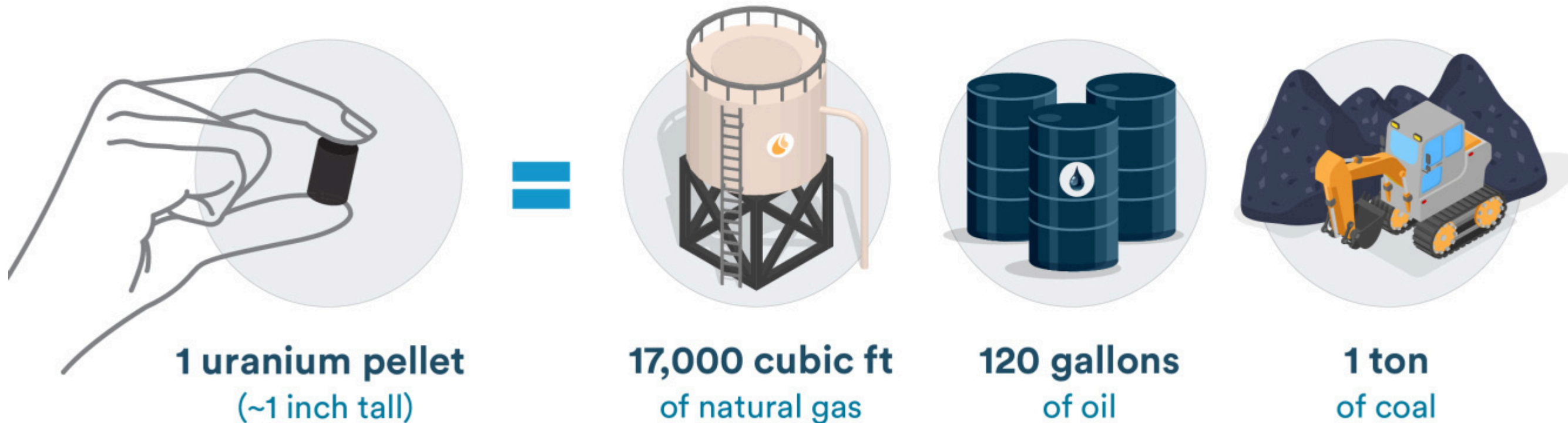
The **front end** prepares uranium for use in nuclear reactors. These steps include mining, milling, conversion, enrichment, and fuel fabrication.

The **back end** ensures that the used nuclear fuel is safely managed, recycled, or disposed. These steps include fuel storage, recycling, and waste disposal.



Fast Facts on **NUCLEAR ENERGY**

Nuclear fuel is **extremely energy dense**.



TYPES OF NUCLEAR REACTORS IN THE UNITED STATES

There are two types of nuclear reactors currently operating in the U.S.: boiling water reactors and pressurized water reactors. Both use steam to power a generator, but they differ in how they create steam.

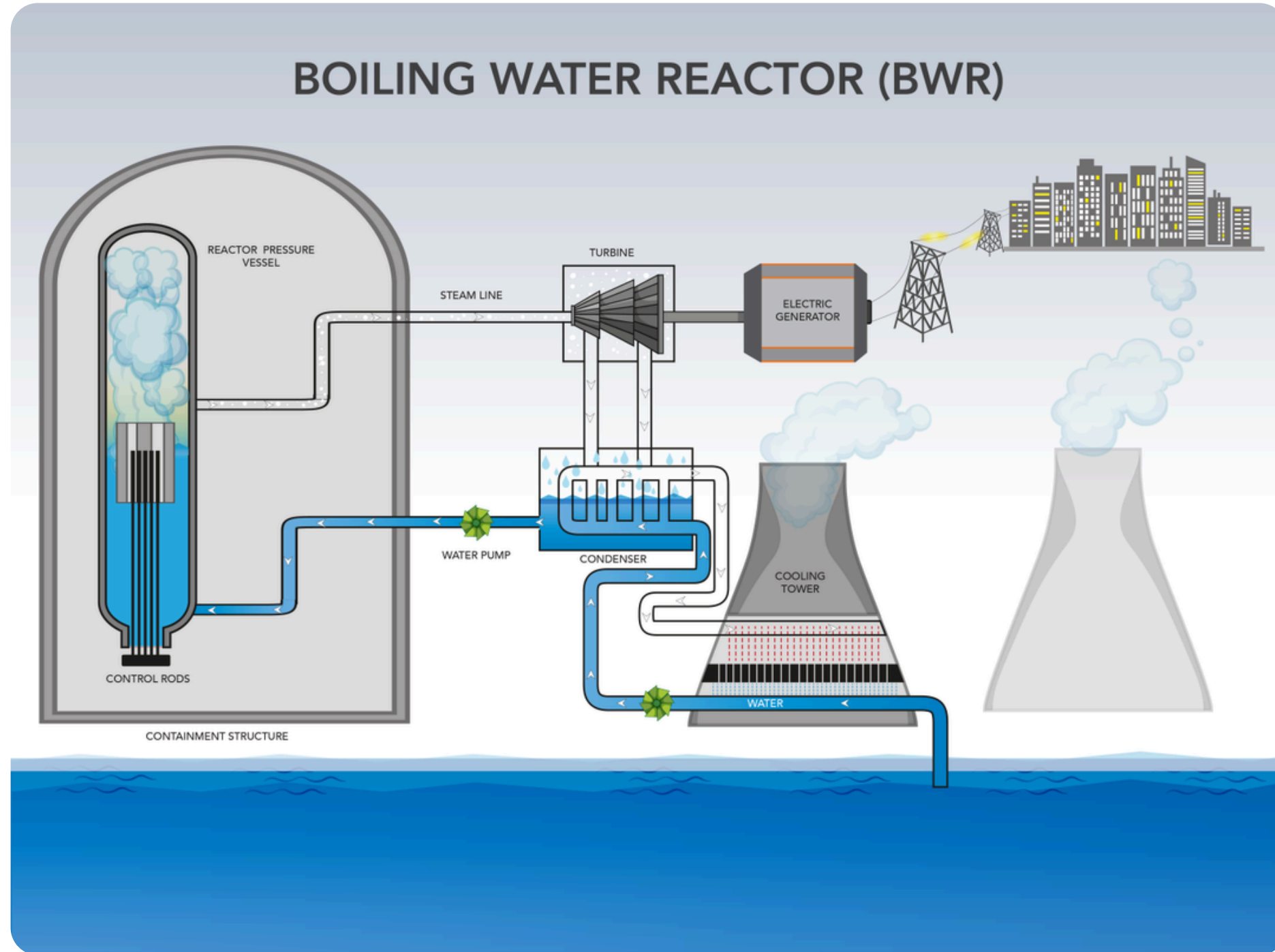
Boiling Water Reactor

Heats up water in the reactor until it boils into steam and spins the turbine

Pressurized Water Reactor

Heats up water in the reactor; however, the water is kept under pressure so it doesn't boil and is piped to another supply of water that becomes steam and spins the turbine

BOILING WATER REACTOR



Roughly a third of the reactors operating in the United States are boiling water reactors (BWRs).

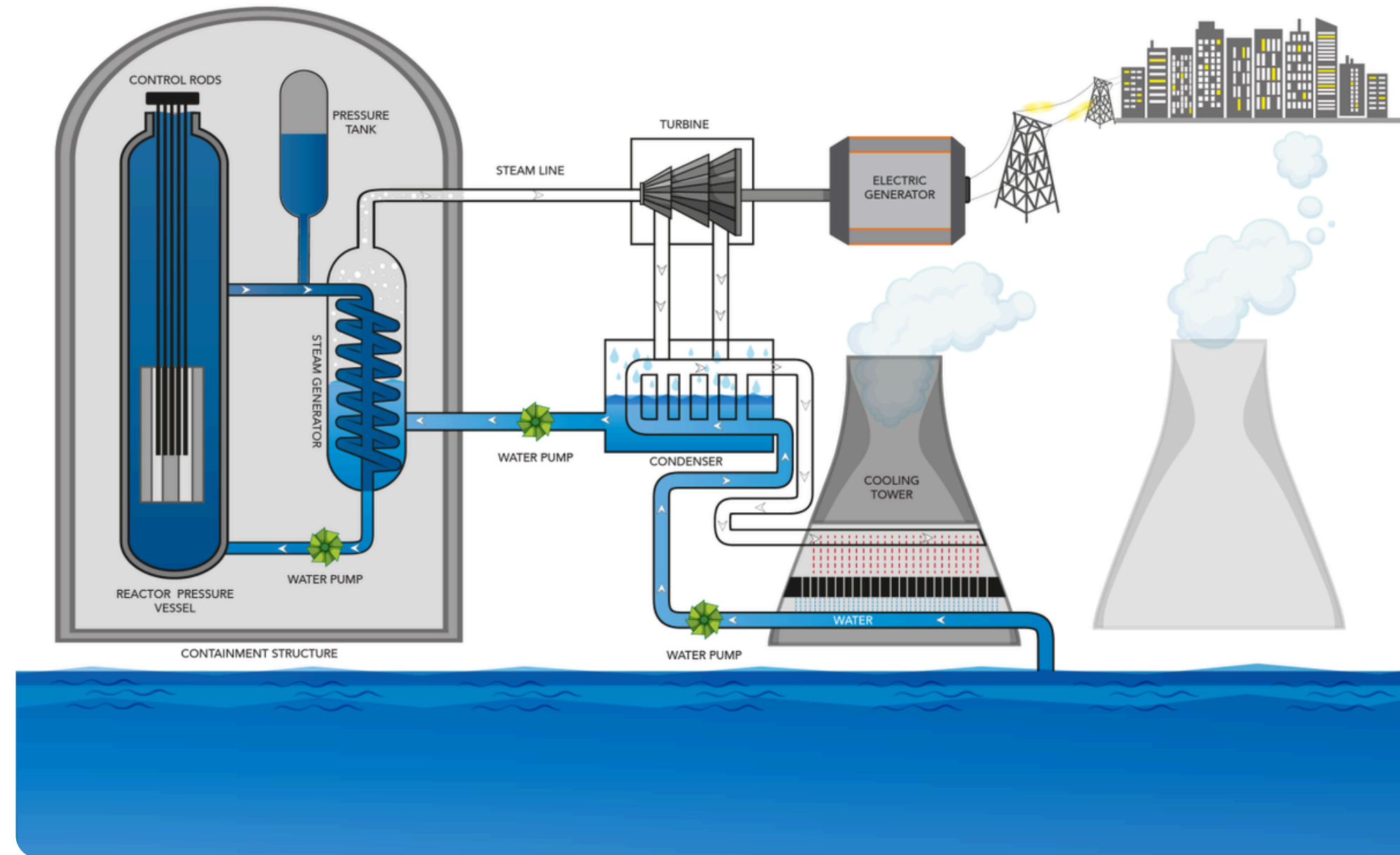
BWRs heat water and produce steam directly inside the reactor vessel. Water is pumped up through the reactor core and heated by fission. Pipes then feed the steam directly to a turbine to produce electricity.

The unused steam is then condensed back to water and reused in the heating process.

Source: U.S. Department of Energy

PRESSURIZED WATER REACTOR

PRESSURIZED WATER REACTOR (PWR)



More than 65% of the commercial reactors in the United States are pressurized-water reactors or PWRs. These reactors pump water into the reactor core under high pressure to prevent the water from boiling.

The water in the core is heated by nuclear fission and then pumped into tubes inside a heat exchanger. Those tubes heat a separate water source to create steam. The steam then turns an electric generator to produce electricity.

The core water cycles back to the reactor to be reheated and the process is repeated.

Source: U.S. Department of Energy

COOK POWER PLANT: pressurized water reactor



The Donald C. Cook Nuclear Plant is located on 650 acres along **Lake Michigan's eastern shoreline** in Berrien County, Michigan. The plant is owned and operated by American Electric Power. The two units can generate enough electricity for more than 1.5 million homes.

Cook Nuclear Plant has two Westinghouse **pressurized water reactors** that are licensed to operate until 2034 and 2037. Both reactors produce a combined 2360 megawatts (MWe) [Unit 1: 1120 MWe, Unit 2: 1240 MWe].

Unit 1 primarily services Southwest Michigan and **Unit 2 services Northwest/Central Indiana** (as far south as Fort Wayne, IN).

Source: Indiana Michigan Power, an AEP company

THE BENEFITS OF NUCLEAR

Source: Nuclear Energy Institute



CLEAN ENERGY:

One of the cleanest energy sources, producing reliable power with minimal emissions and a small land footprint



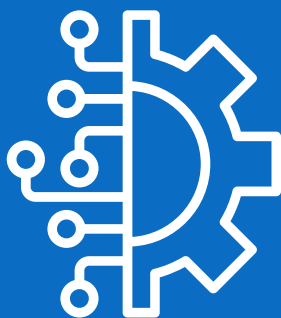
ENERGY SECURITY:

Strengthens energy independence, grid reliability, and national security



JOB:

Creates thousands of high-paying jobs and supports long-term economic growth



TECH LEADERSHIP:

Keeps America competitive in advanced technology and energy innovation



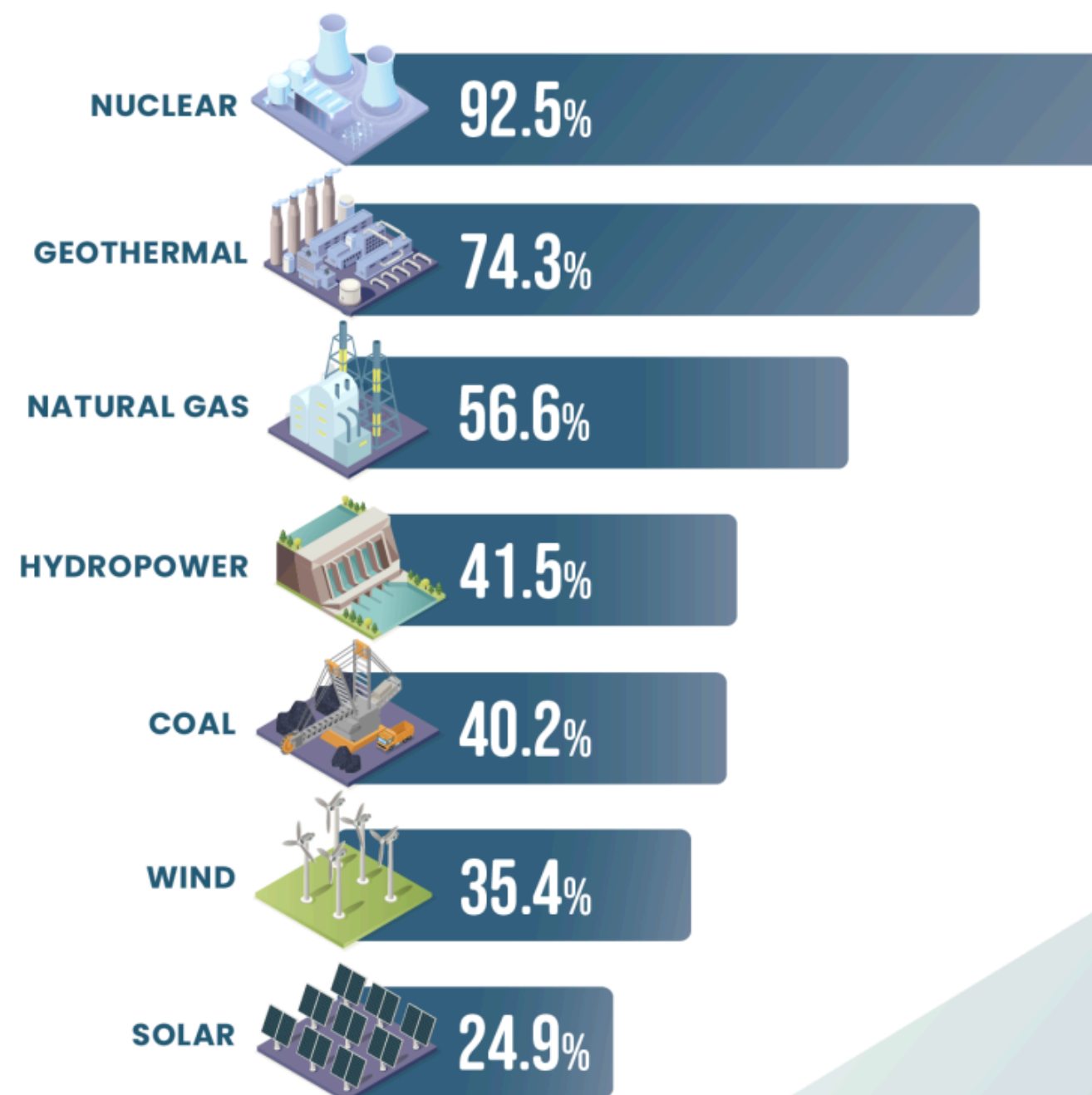
INFRASTRUCTURE:

Provides dependable, around-the-clock power to support growing industries and modern infrastructure

NUCLEAR POWER IS THE MOST RELIABLE ENERGY SOURCE

Capacity Factor by Energy Source in 2020

Source: U.S. Energy Information Administration



Nuclear energy has by far the highest capacity factor of any other energy source. This means nuclear power plants are producing maximum power more than **92%** of the time during the year.

That's about 2 times more than natural gas and coal units, and almost 3 times more reliable than wind and solar plants.

Source: U.S. Energy Information Administration & U.S. Department of Energy

WHAT HAPPENS TO NUCLEAR FUEL AFTER IT'S BEEN IN A REACTOR?

A single fuel assembly spends about five years in a reactor on average, powering the system that generates electricity.

Nuclear plants shut down every 18–24 months to replace fuel, which then cools in a spent fuel pool.

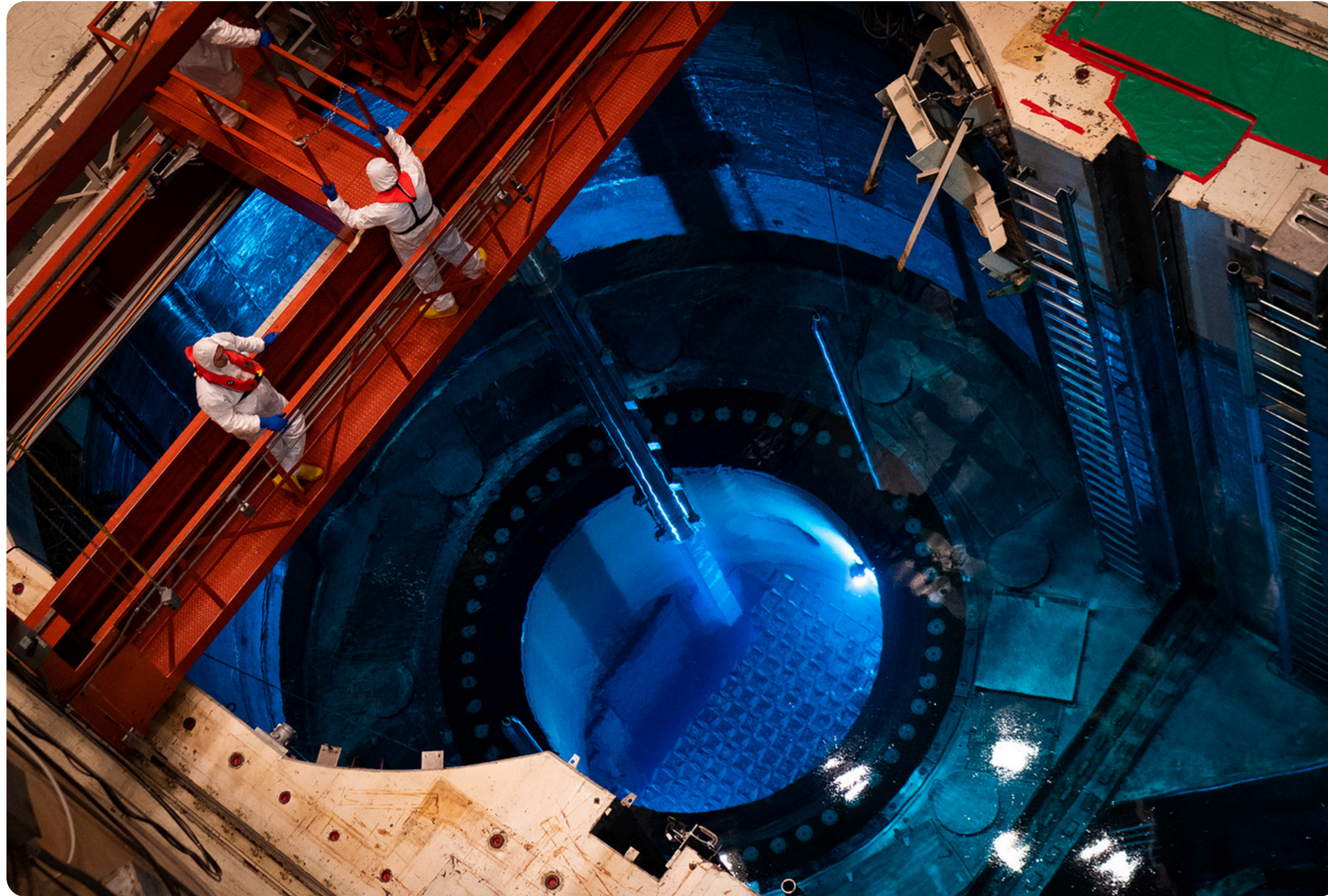
The radioactive byproducts remain contained in the used fuel assemblies.

Once cooled, used fuel is moved to secure storage in steel-reinforced concrete containers.

Every nuclear plant stores its used fuel on-site as the industry awaits federal interim or permanent disposal facilities.

Source: Nuclear Energy Institute

COOK POWER PLANT: REFUELING



Source: Indiana Michigan Power, an AEP company

COOK POWER PLANT: USED FUEL STORAGE



Source: Indiana Michigan Power, an AEP company

NUCLEAR ENERGY

MYTH

vs.

FACT

"Nuclear isn't safe."

**"Nuclear energy is bad for
the environment."**

**"Nuclear uses too
much water."**

**Western nuclear plants use layered,
"defense-in-depth" safety systems.**

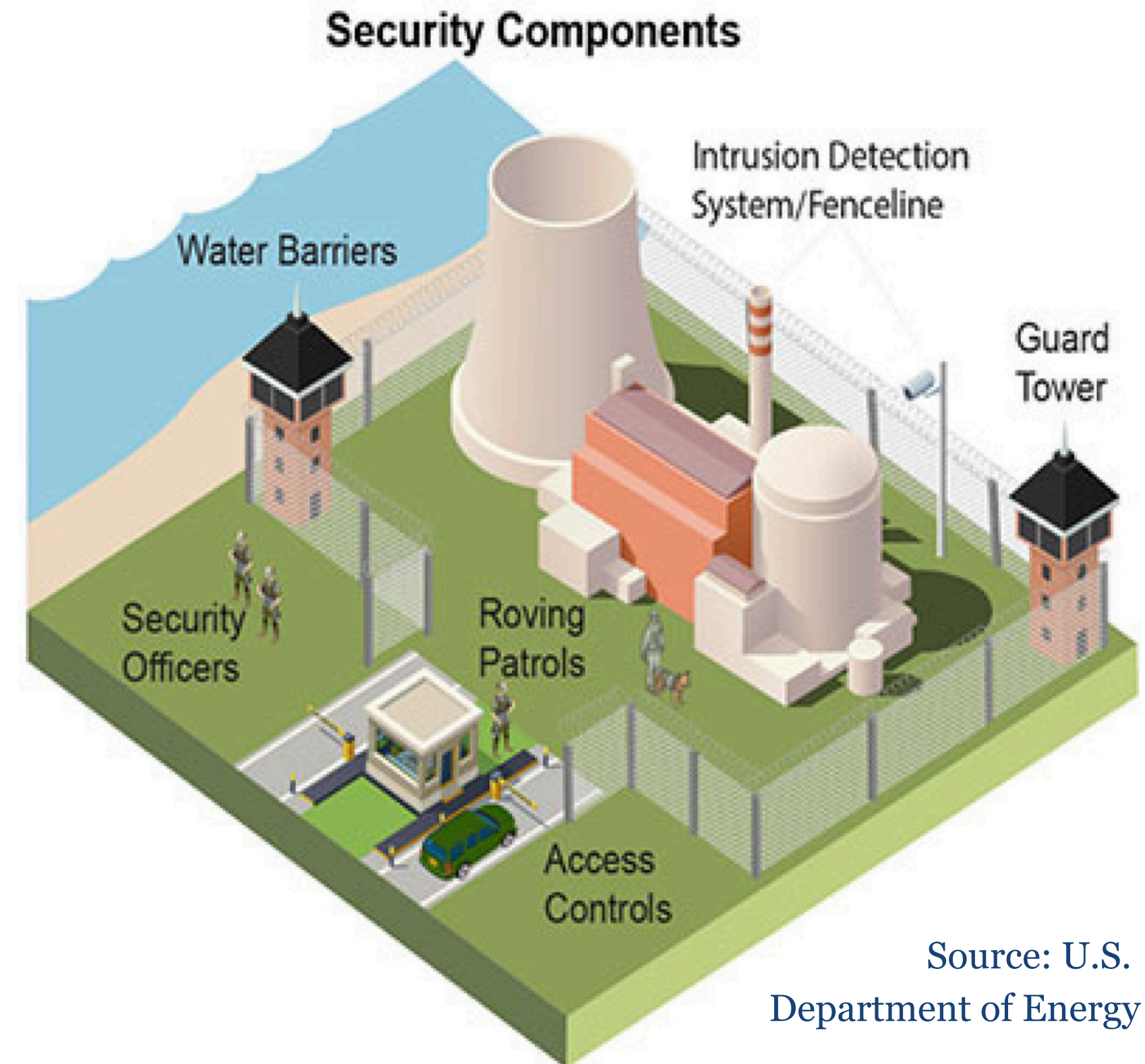
**Nuclear reactors emit no greenhouse
gases during operation.**

**Closed-loop cooling recirculates
water and limits use.**

NUCLEAR SAFETY

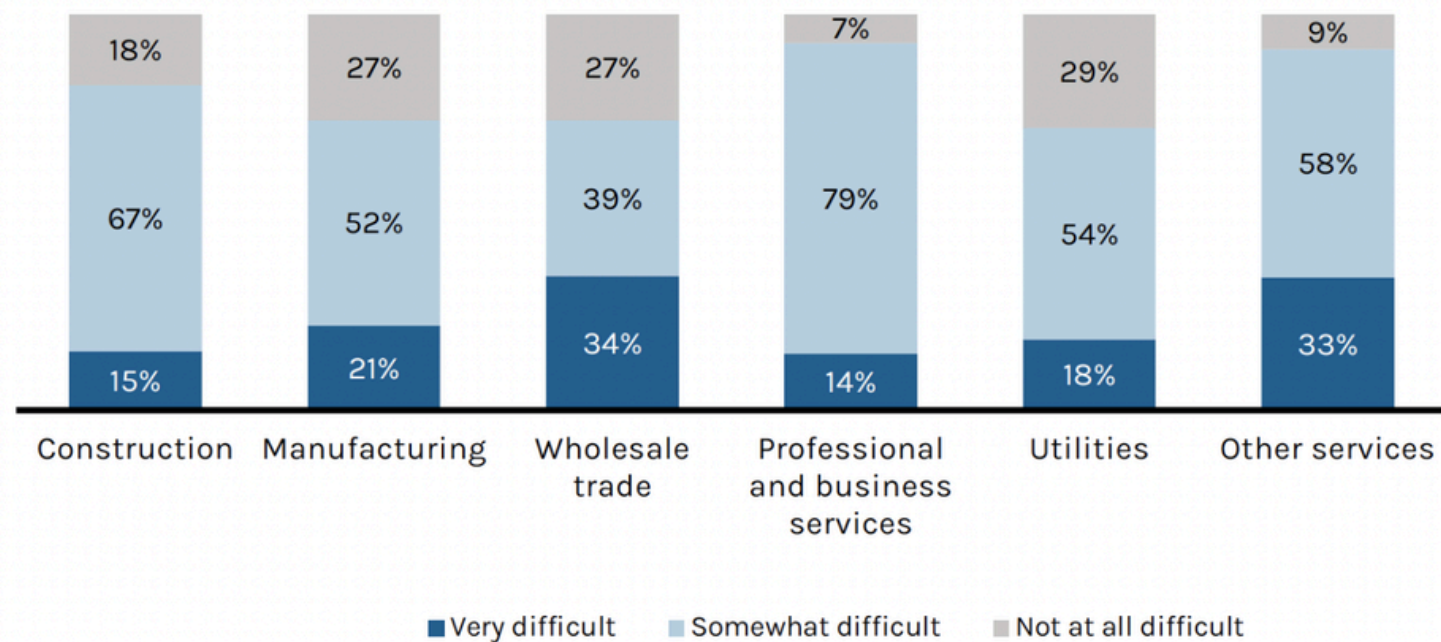
U.S. nuclear power plants are among the **safest** and **most secure** industrial facilities due to comprehensive safety procedures, robust training, and strict federal regulation.

Nuclear plants use a “**defense-in-depth**” design, meaning multiple independent and redundant layers of protection ensure safe operation even if something goes wrong.



Source: U.S.
Department of Energy

Figure 25. Nuclear Electric Power Generation Employers' Perceived Hiring Difficulty by Industry



NUCLEAR & THE ECONOMY

High-paying jobs: Nuclear energy offers some of the strongest wages in the energy sector

Local tax revenue: Stable, long-term nuclear jobs support local economies

Manufacturing opportunities: Growth in nuclear drives demand for domestic manufacturing and skilled trades

Workforce development: Employers need more qualified workers, creating strong opportunities for training and career entry



INDIANA: AMERICA'S ENERGY POWERHOUSE

"Strengthening energy affordability for all Hoosiers is a cornerstone of our all-of-the-above approach. Affordability is why advanced nuclear energy is a top priority. We are working now to ensure our energy resources remain robust and resilient."

– Governor Braun via press release

Advanced nuclear helps Indiana prepare for the future by providing reliable, around-the-clock power for growing industries like manufacturing and data centers, while keeping energy **affordable** for Hoosiers.

As electricity demand grows, grid reliability is crucial. Nuclear energy **works alongside** natural gas, solar, wind, and battery storage to help ensure Indiana has the power needed for future growth.



Interested in Introducing Nuclear to Your Community?

**CONTACT THE INDIANA OFFICE OF
ENERGY DEVELOPMENT!**

Scan to visit our Nuclear
Communities Webpage!



Contact:
Nuclear@oed.IN.gov



SOURCES & RESOURCES

<https://world-nuclear.org/information-library/facts-and-figures/nuclear-glossary>

<https://inl.gov/nuclear-energy/nuclear-energy-101/>

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