



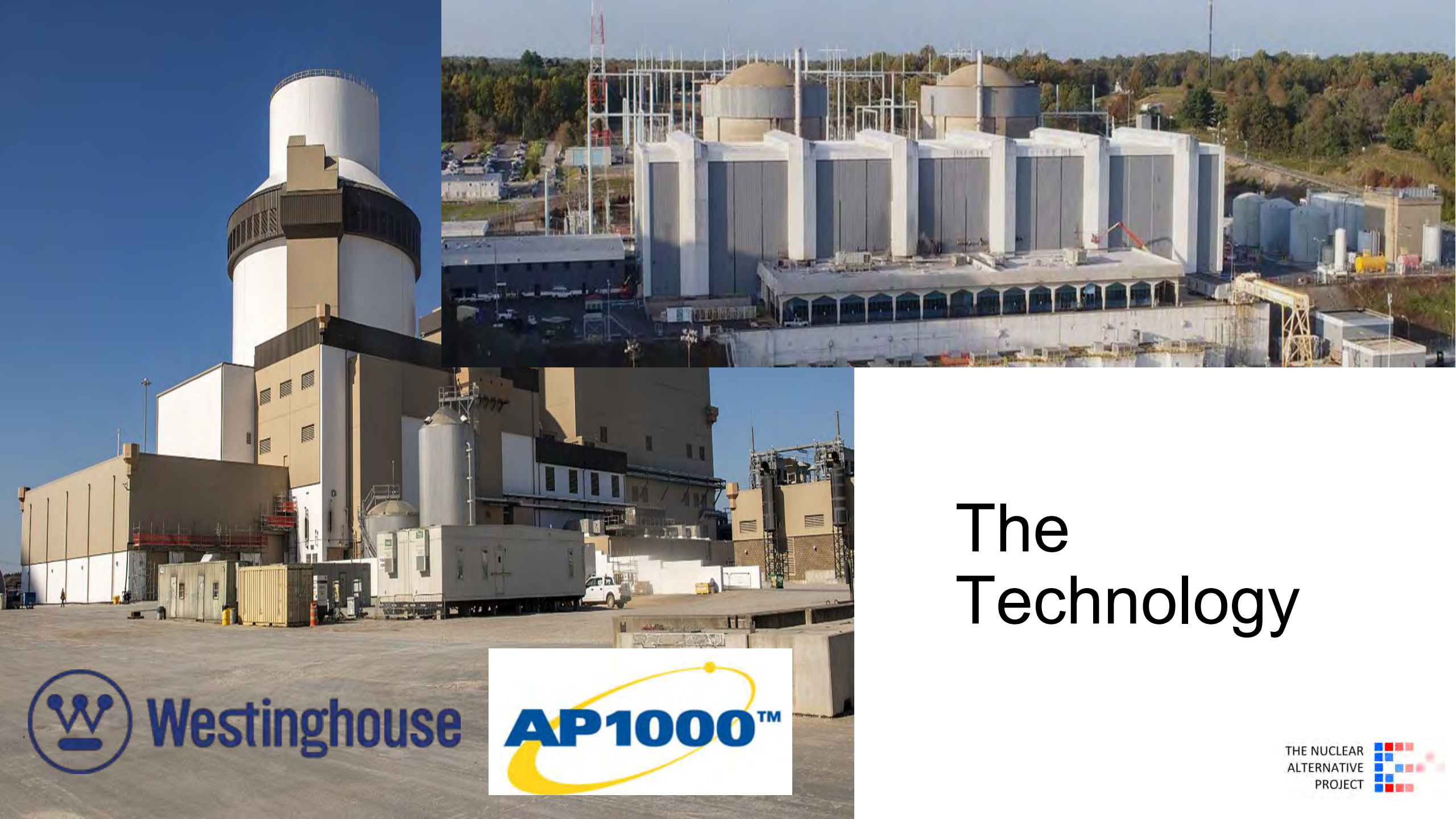
How Nuclear Power Could Set Puerto Rico for Global Competition

Presented by Jesus M Nunez, PE, CEO NAP
Camara de Comercio de Puerto Rico
September 2025

Full Disclosure Statement - Nuclear Alternative Project Representation

For the purposes of this presentation/discussion, I am speaking solely as a representative of the Nuclear Alternative Project (NAP). My views and statements reflect the position of NAP and should not be attributed to any other organization, including my current employer, Bechtel. While I am employed by Bechtel in my professional capacity, my involvement with the Nuclear Alternative Project is independent and separate. I am not presenting information or opinions on behalf of Bechtel, nor am I disclosing any confidential or proprietary information belonging to Bechtel. My participation with the Nuclear Alternative Project is driven by my personal commitment to advancing public understanding and support for nuclear energy as a safe, clean, and reliable power source. Therefore, please understand that any information, opinions, or recommendations I provide today pertain exclusively to the Nuclear Alternative Project and its mission. Thank you for your understanding and consideration.

Let's start with some fundamental aspects of nuclear as it applies to Puerto Rico...



The Technology

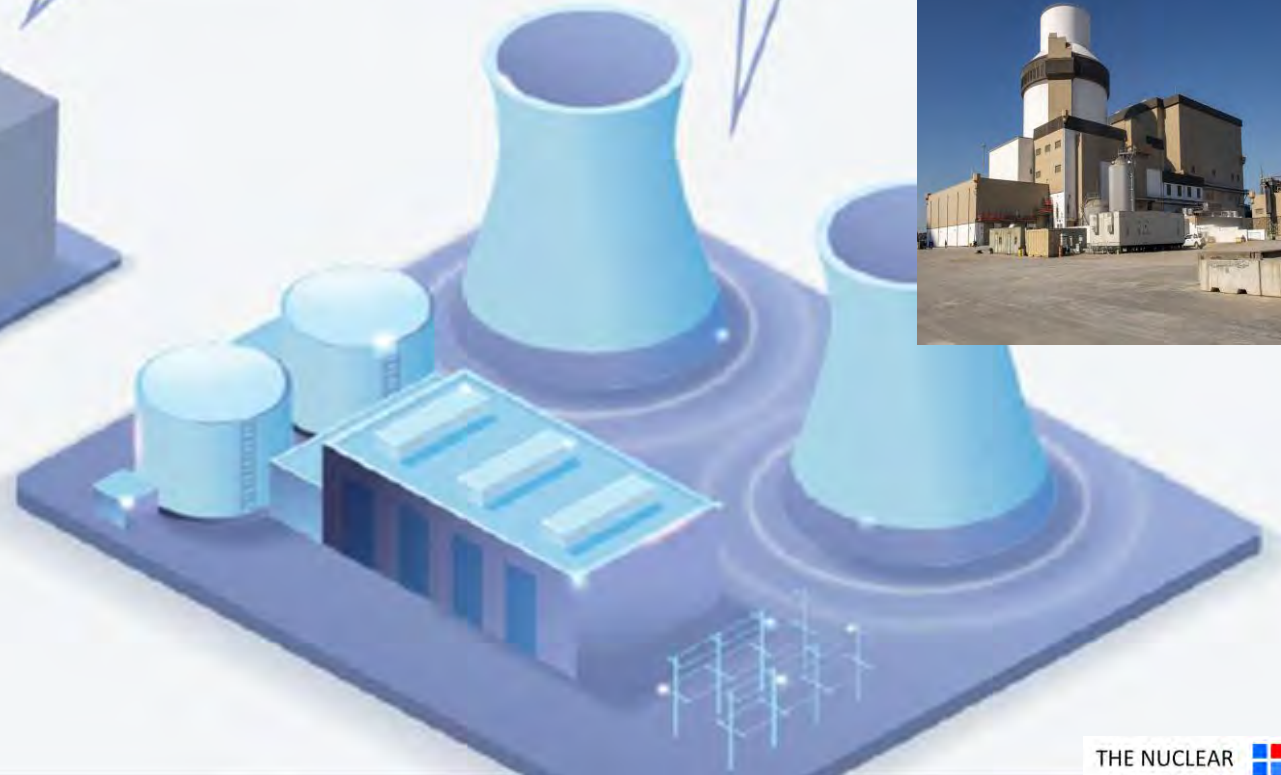
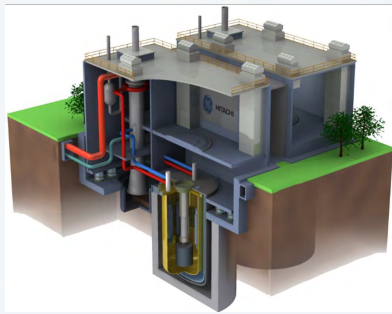


The Technology

Microreactor
1 MW – 20 MW

Small Modular
Reactor
20 MW – 300 MW

Large-Scale
Reactor
300 MW – 1,000+ MW

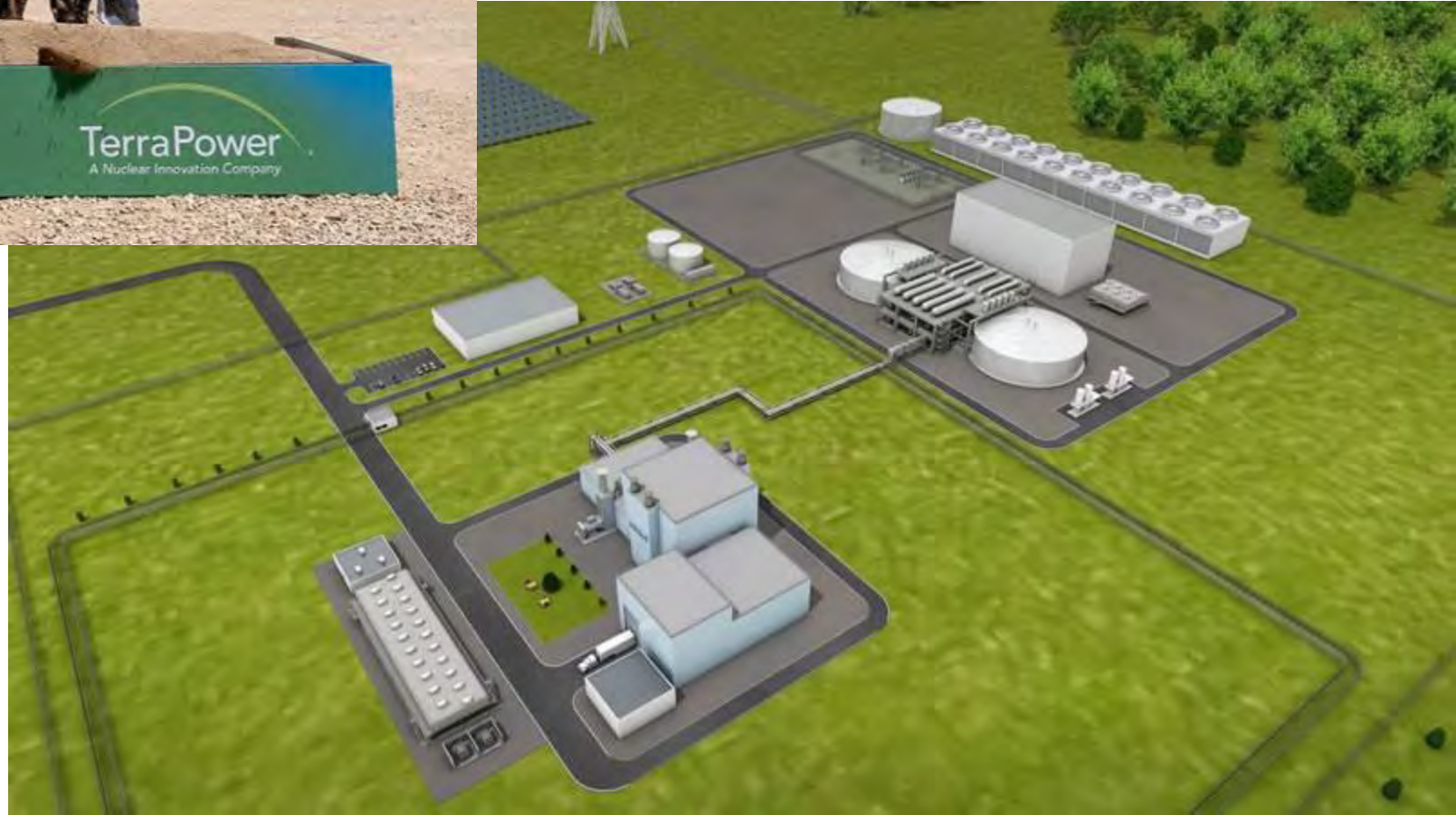


SMRs and Micro-reactors



The Sodium reactor and energy system architecture, recently [introduced](#) by TerraPower and GE Hitachi Nuclear Energy (GEH), offers baseload electricity output from a 345-MWe sodium fast reactor with the load-following flexibility of molten salt thermal storage.

Stored heat can be used to boost the system's output to 500 MWe for more than five and a half hours when needed, according to TerraPower. A company representative told *Nuclear News* that the company expects a commercial Sodium plant to cost \$1 billion or less.



NuScale – VOYGR-12

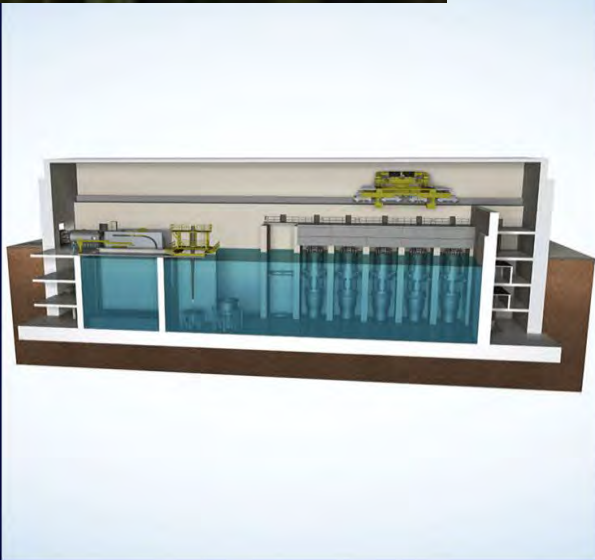


Generating Capacity	924 MWe (77 MWe per module)
Capacity Factor	>95 percent
Module Dimensions	76' x 15' cylindrical containment vessel with reactor and steam generator
Module Weight	~700 tons in total are shipped from the factory in three segments via truck, rail, or barge
Fuel	Standard LWR fuel in a 17 x 17 configuration, each assembly 2 meters (~ 6 ft.) in length
Refueling Cycle	Up to 21 months with fuel enriched at less than 5 percent

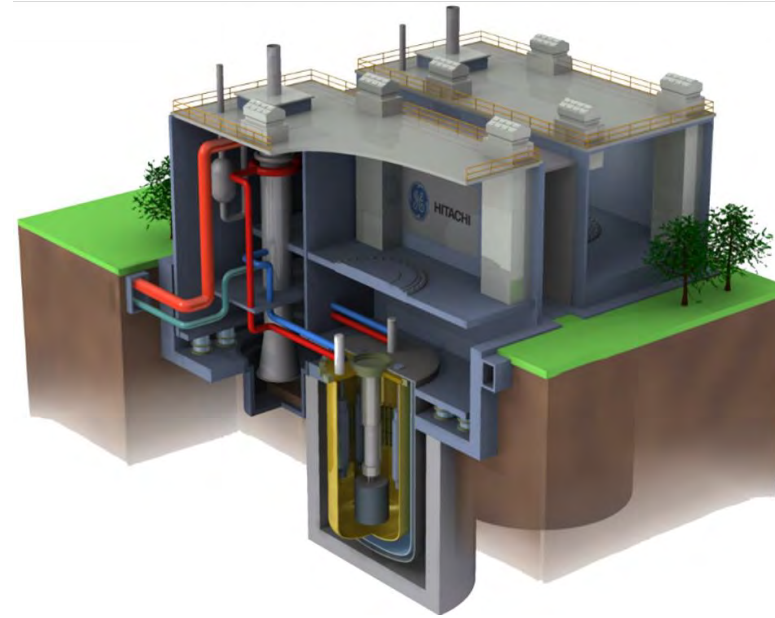
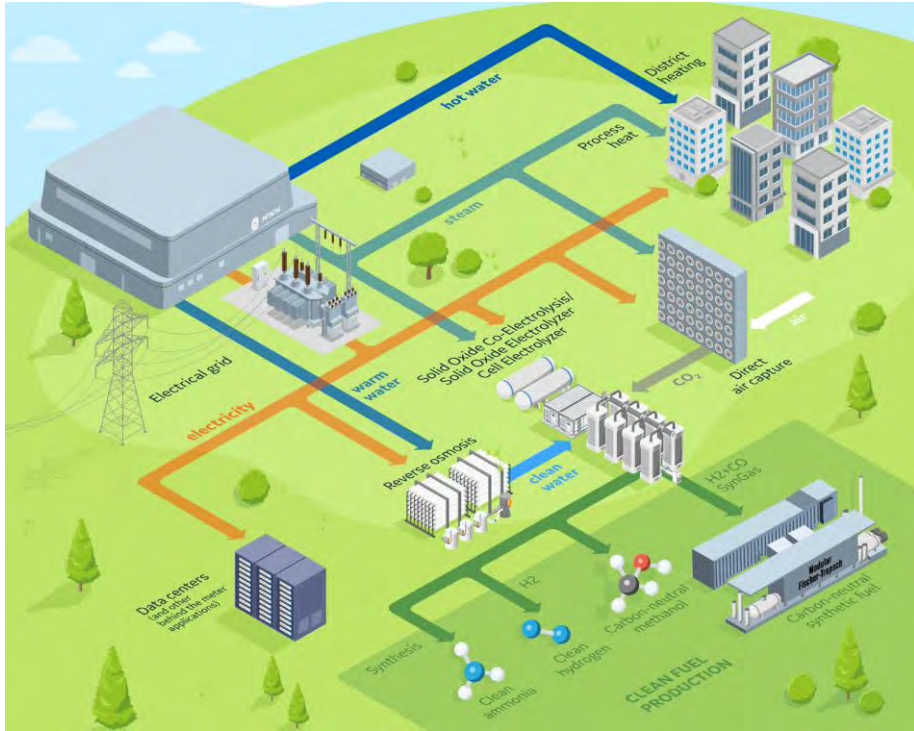
VOYGR-12

The VOYGR-12 SMR plant can generate 924 MWe on as little as 0.06 square miles*, compared to 94 square miles for wind and 17 square miles for solar. This makes it an ideal option for generating carbon-free power in locations with space constraints, such as retired coal plant sites. The VOYGR-12's always-on capabilities also make it an attractive solution as an emergency power source. Following a catastrophic loss of infrastructure, a VOYGR-12 can power a mission critical facility micro-grid at 154 MWe for 12 years without new fuel.

*Protected area only. Total plant size is dependent on individual site characteristics.



GE - BWRX-300 Small Modular Reactor



UK

GE Vernova's nuclear business accelerates UK Small Modular Reactor deployment with MoUs

Feb 4, 2025 - GE Vernova's nuclear business, GE Hitachi Nuclear Energy (GEH), has signed another series of Memorandum of Understanding (MoUs) with two major UK nuclear engineering firms—Boccard and Cavendish Nuclear.



Canada

GE Hitachi awards contract for BWRX-300 reactor pressure vessel to BWXT

Jan 27, 2025 - GE Vernova announced that it will manufacture BWX Technologies, Inc.'s (BWXT) reactor pressure valve for Ontario Power Generation's first BWRX-300 small modular reactor at its Darlington New Nuclear Project site.



United States

U.S. utilities team up to accelerate deployment of GE Vernova's BWRX-300 small modular reactor

Jan 17, 2025 - GE Vernova announced its part in a coalition of utility companies and supply chain partners collaborating to accelerate the BWRX-300 small modular reactor's deployment in the U.S.



Canada

GE Vernova selects Worley Chemetics for BWRX-300 SMR build

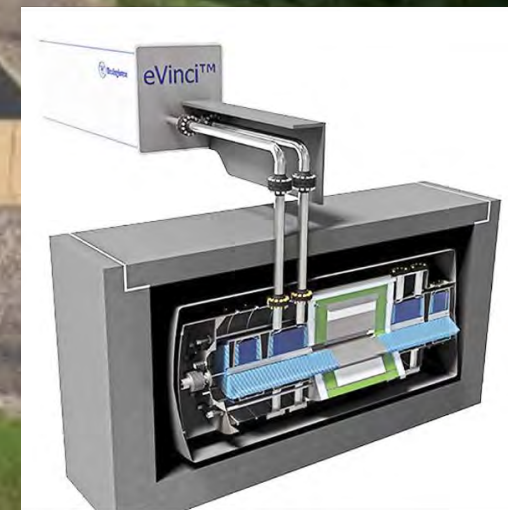
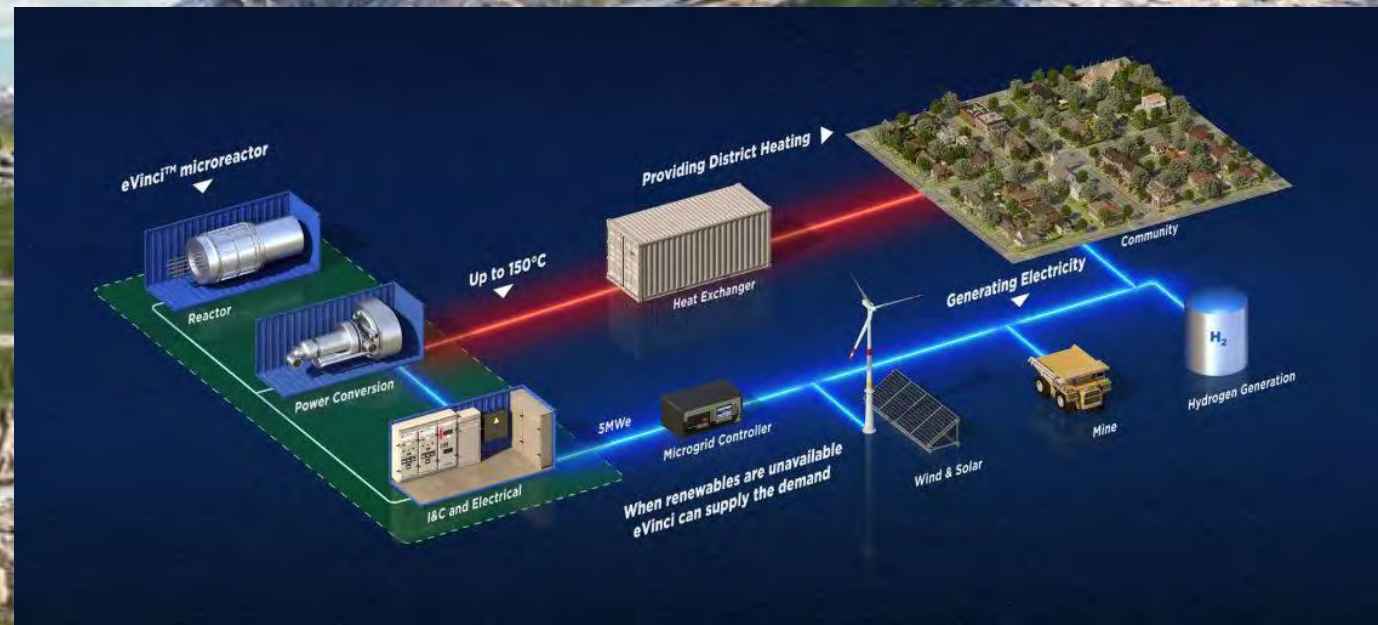
Oct 31, 2024 - GE Vernova taps Worley Chemetics to design a key safety system for North America's first BWRX-300 small modular reactor.

THE NUCLEAR
ALTERNATIVE
PROJECT



Westinghouse

eVinci™



X-Energy SMR and Microreactor

X-100

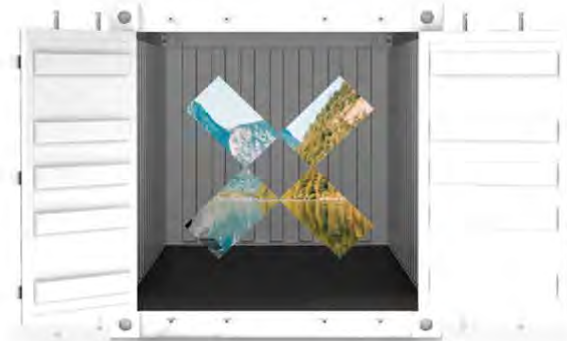


X-Mobile

Always on reliability with anywhere versatility

The ability to have a long-life, “almost instant on”, compact back-up power system will provide “peace of mind” and resilience to communities across the globe.

Xe-Mobile could support hundreds of critical infrastructure sites that, should power be lost for a long period, would greatly impact the quality of human life. Additionally, island nations and other remote, livable areas can benefit from a consistent, reliable, compact, any-weather power solution where the delivery of fossil fuel and/or replacement parts can be logistically difficult.



Our Reactor

In response to these multiple potential needs, X-energy has developed the “Xe-Mobile” – a power generation system that can be delivered to the point of electricity need and quickly begin generating power. Features of the Xe-Mobile include:

- Rail, truck, and sea transport compatibility
- Components housed cargo containers
- Can operate at full power for more than 3 years
- Utilizes TRISO fuel, due to high maturity & a strong safety case
- Produces 2-7 MWe of electrical power
- Multiple voltage outputs available

Key Design features for an Island

Smaller Footprint



Enhanced Safety Features

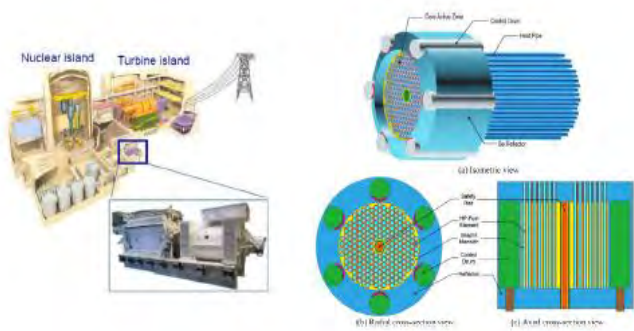


Greater flexibility with Grid, Reserves and Renewables



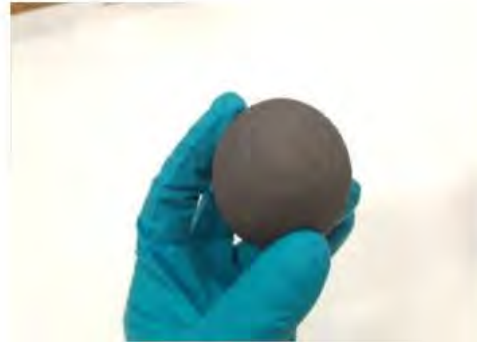
Safety and Reliability

In contrast with conventional large-scale reactors, advanced reactors possess increased safety features from more than 40 years of commercial operation and design experience in the U.S. The following are three(3) key safety features of advanced reactors.



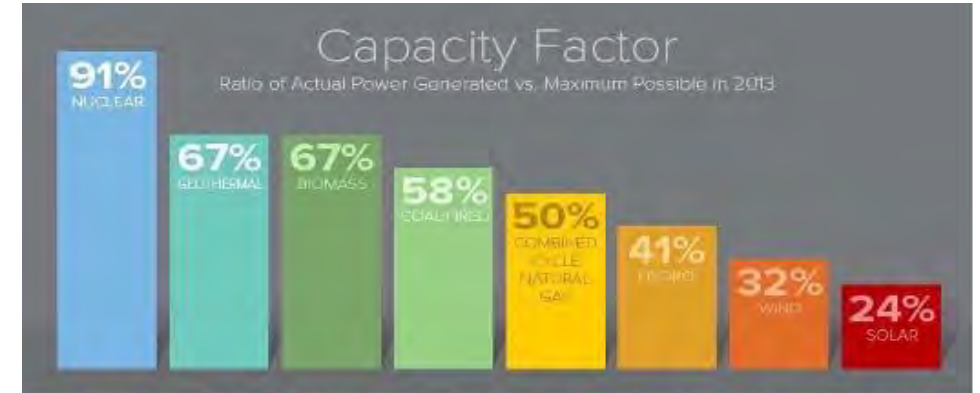
Passive Cooling

Conventional nuclear plants rely on external diesel generators to provide power for the emergency backup system. Microreactors do not require an external power source since the reactor core is cooled via "passive" cooling; which means that there's no need for pumps or moving parts.



Meltproof fuel

Microreactors will operate at lower temperatures when compared to conventional reactors, and possess fuel designs that are melt proof, including for example, ceramic covered fuel pellets.



Source: Nuclear Energy Institute. US Nuclear Power Plant Statistics. <http://www.nei.org/Knowledge-Center/Nuclear-Statistics>
US Nuclear Power Plants/US Capacity Factors by Fuel Type

Capacity Factor

Nuclear Fleets in the US operate almost at a 100% of the time.



History of Safe Management of Spent Fuel

Ashes in Peñuelas:

16 years of generation
1 coal plant
454 MW total capacity



Maine Yankee Nuclear Power Plant:

20 years of generation
1 nuclear plant
860 MW total capacity



1. Spent fuel is a solid and is typically made up of **ceramic pellets in metal rods**.
Spent fuel assemblies inside a dry storage cask. >>>

2. The U.S. has produced roughly **90,000 metric tons** of spent fuel. This could all fit on a football field at a **depth of less than 10 yards** if it could be stacked together.

4. Spent fuel is safely transported across the U.S. with more than **2,500 cask shipments over the last 55 years**.

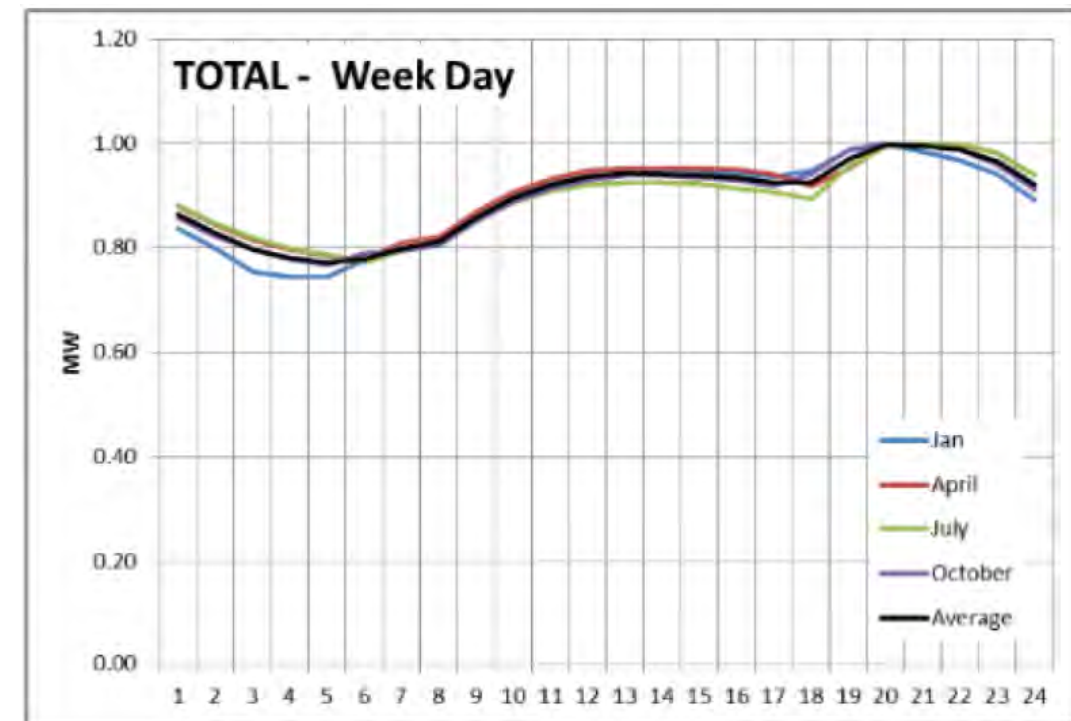
5. Spent fuel can be recycled. **More than 90% of its potential energy still remains in the fuel.**
Dry storage casks at Dresden Generating Station. >>>



A Look into the Current Energy Global Market

The Key for a local globally-competitive economy: Cost and Reliability

- Clean and resilient baseload power is the backbone for energy reliability in Puerto Rico
- Puerto Rico's energy consumption is typical of tropics – a flat, high average peak consumption daily and all year long
- This puts the need for base load power to be available to sustain the intermittency of renewable generation.



Analysis

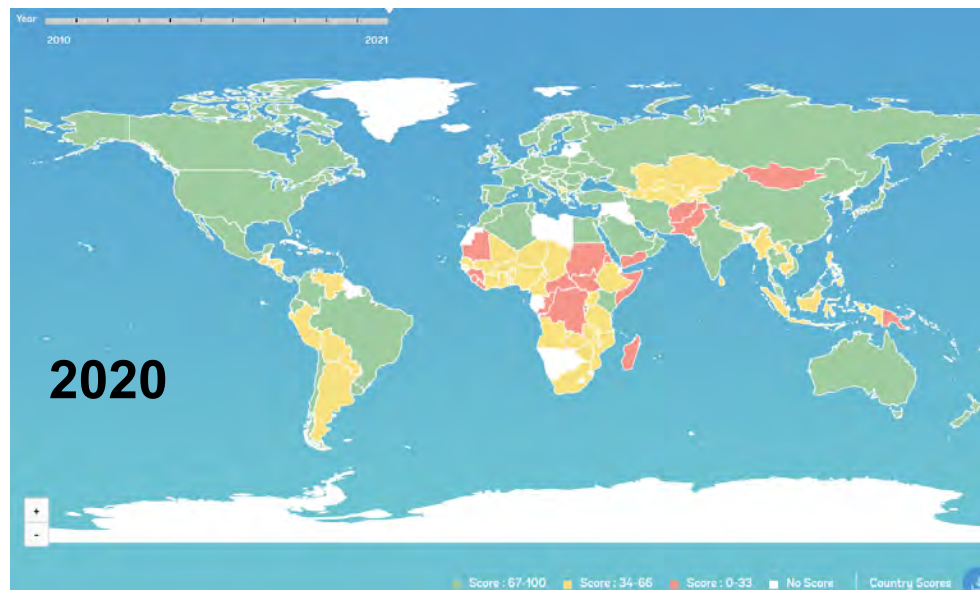
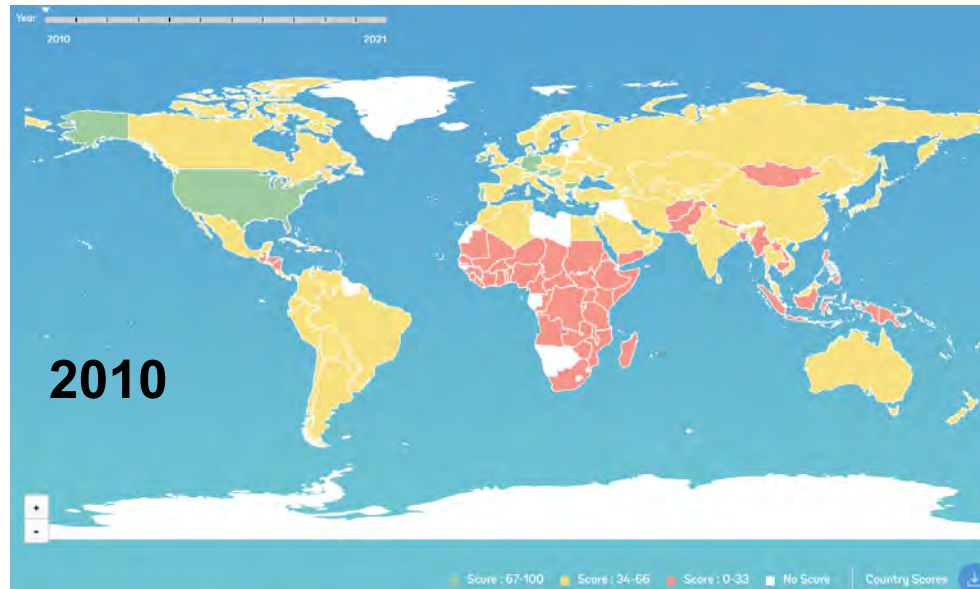
Last Updated: February 15, 2024

Overview

The Commonwealth of Puerto Rico consists of the easternmost islands of the Greater Antilles in the Caribbean Sea, southeast of Florida. Puerto Rico has no proved reserves or production of fossil fuels. The Commonwealth has some renewable resources in the form of solar, wind, hydropower, and biomass, but relies primarily on imported fossil fuels to meet its energy needs.^{1,2,3} Puerto Rico consumes almost 70 times more energy than it produces. In 2021, petroleum accounted for 58% of the Commonwealth's total energy use, while natural gas accounted for 28%, coal 12%, and renewables about 1%.⁴ Puerto Rico's energy consumption per capita is about one-fourth that of the 50 U.S. states.⁵

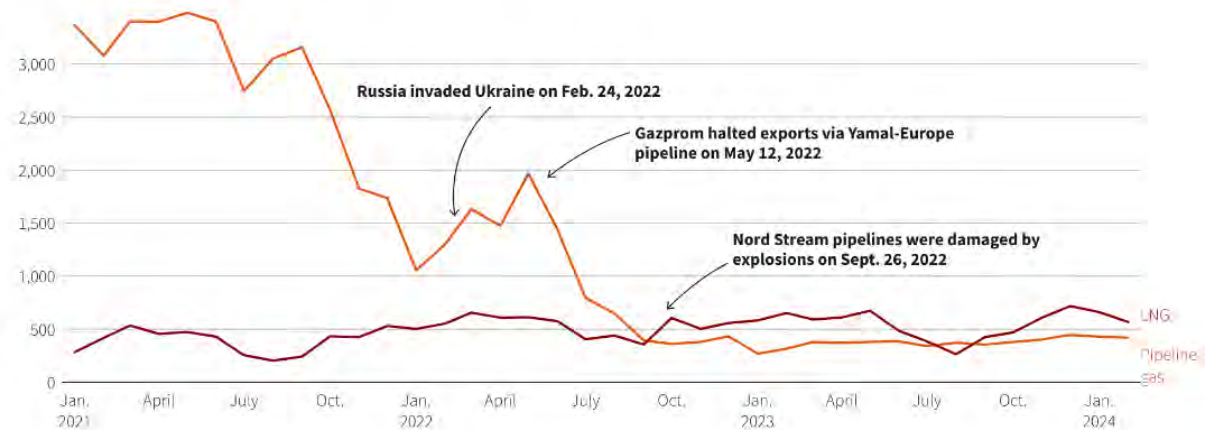
*Puerto Rico
consumes
almost 70 times
more energy
than it produces.*

The COVID pandemic and the war in Ukraine were key drivers for countries to increase energy sustainability and independence.



Russia gas exports to the European Union

in GWh/day



Note: Russian pipeline exports show accumulated flows via three main pipeline systems: Nord Stream, Yamal-Europe and Brotherhood. The graph excludes Russian gas exports via TurkStream pipeline. LNG flows are based on vessel tracking data.

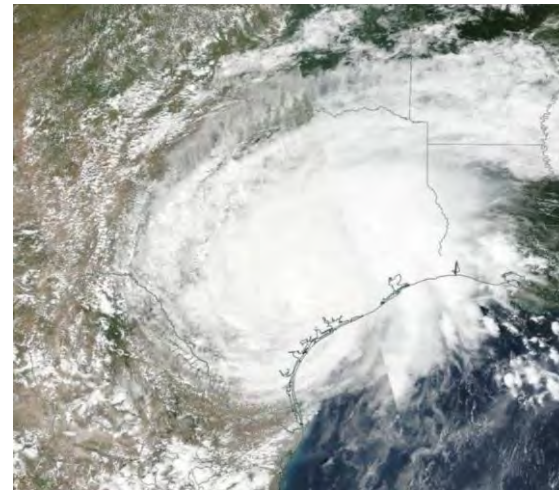
Source: LSEG, Kpler, Reuters estimates

Reuters Graphics

EU expected imports of Russian gas to drop to 40-45 billion cubic meters this year, compared with 155 bcm in 2021, the year before the Ukraine war.

The Key for a local globally-competitive economy: Cost and Reliability

- The U.S. Energy Information Administration (U.S. EIA) estimates that LNG fuel shipments to Puerto Rico averages two cargoes every month. During Maria, this was disrupted and only one cargo was received per month.
- REFUELING: In contrast, shipment for nuclear fuel for each SMR will be in the order of every 2 years and 10 to 15 years for Microreactors.
- No other technology has the capacity to sustain earthquakes and hurricanes characteristic of Puerto Rico.



Hurricane Harvey, 2017
Plant



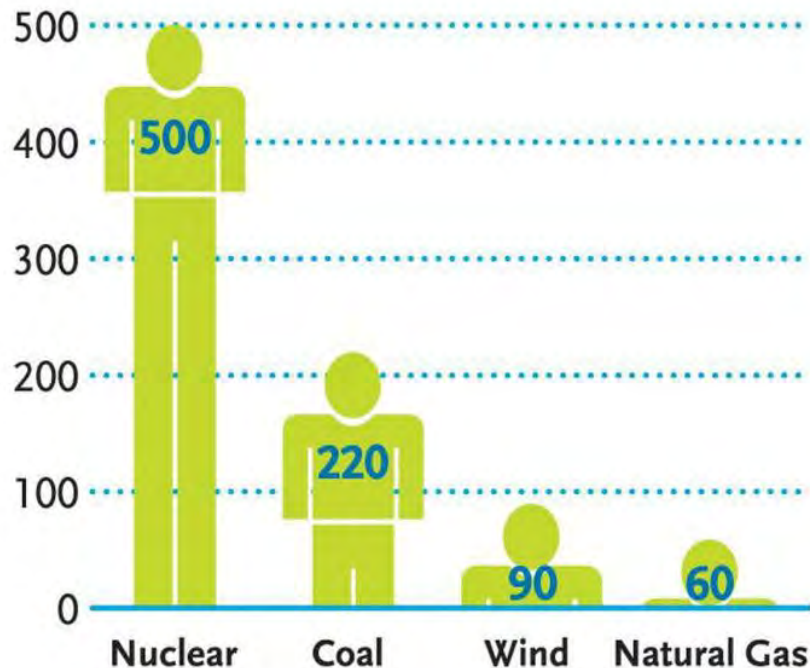
South Texas Project Nuclear



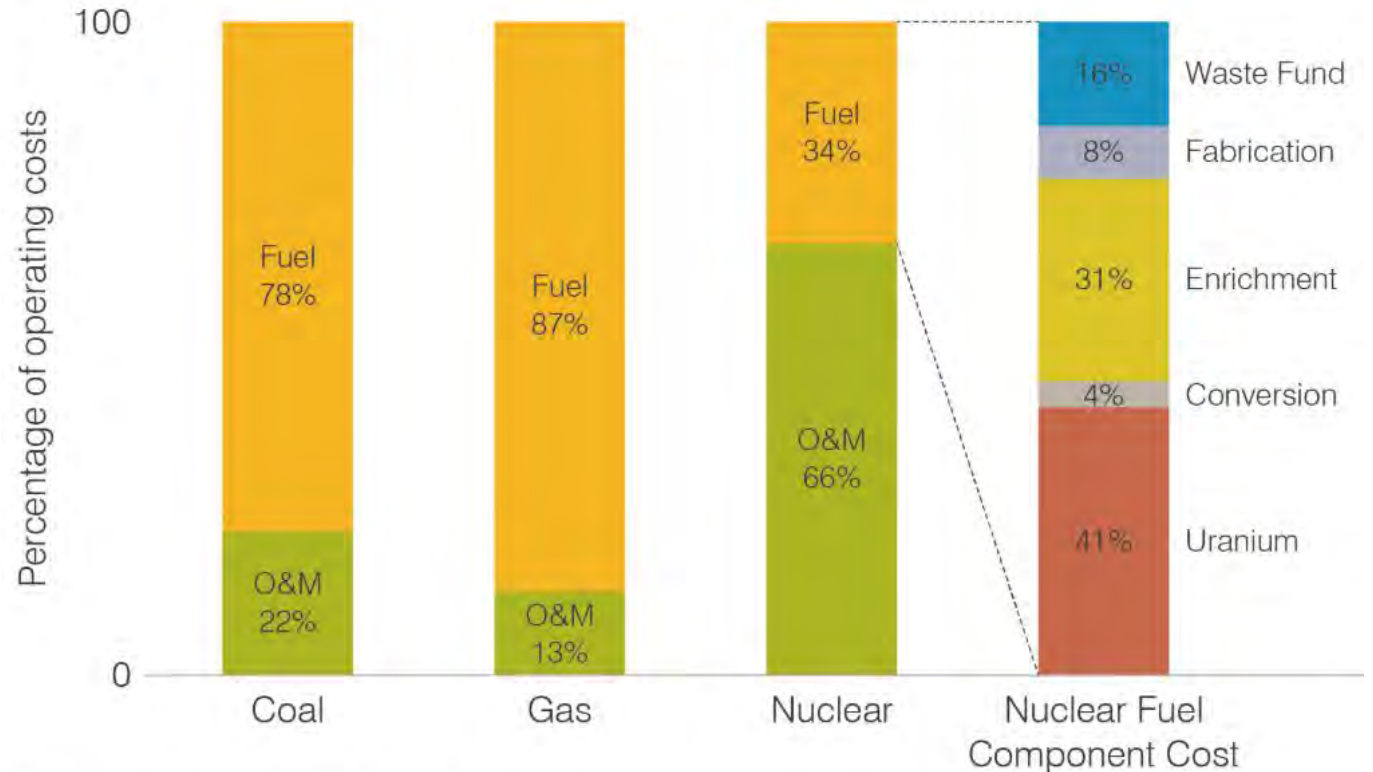
Job creation and percentage spent in operating costs

Jobs Created for Operating Energy Plants

Jobs per 1,000-megawatts of capacity



Sources: Ventyx and U.S. Department of Energy



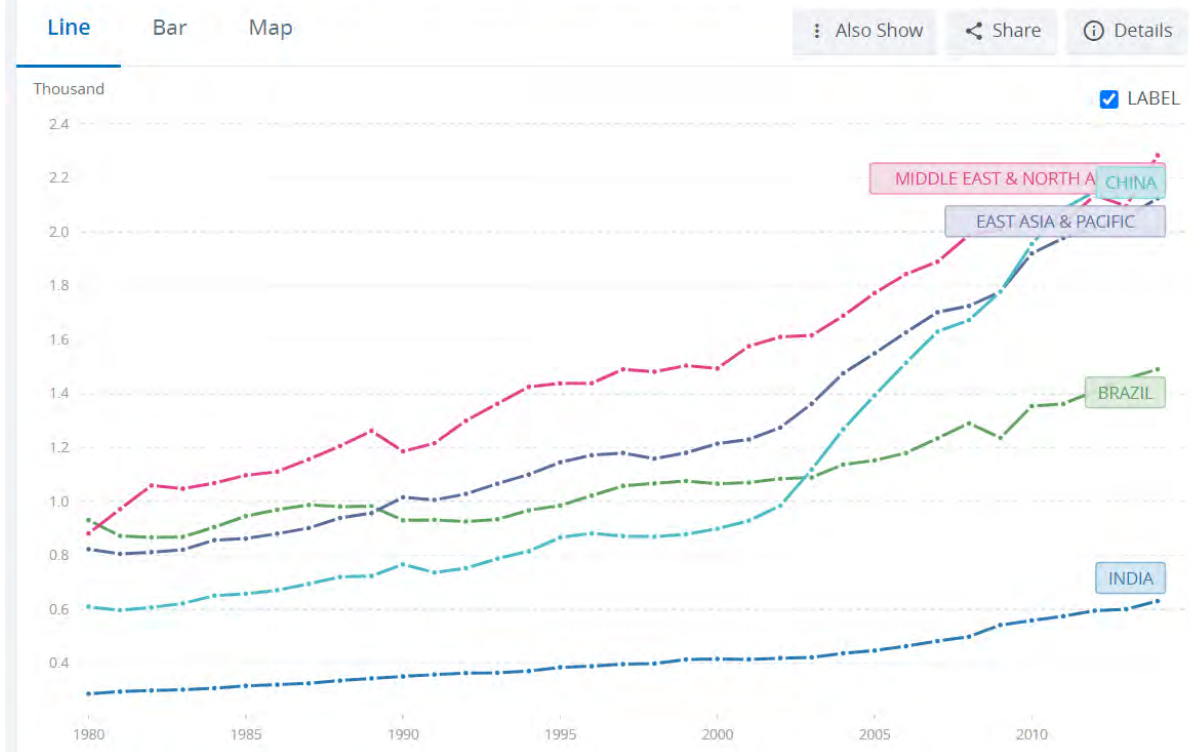
Source: Nuclear Energy Institute



Growth in Energy Demand: lift of middle class in developing countries and A.I./digitalization/manufacturing in developed countries.

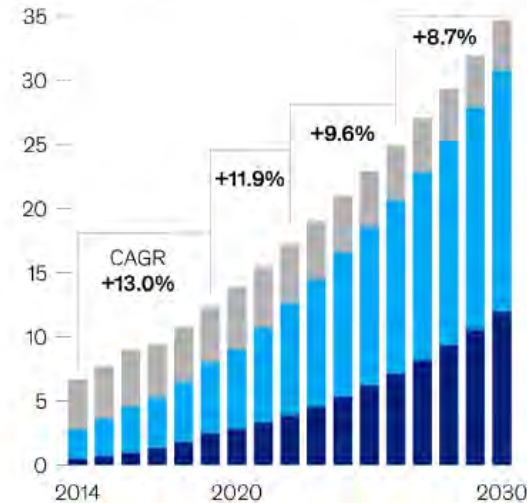
Energy use (kg of oil equivalent per capita) - India, Brazil, East Asia & Pacific, Middle East & North Africa, China

IEA Statistics © OECD/IEA 2014 ([iea.org/data-and-statistics](https://www.iea.org/data-and-statistics)), subject to [iea.org/terms](https://www.iea.org/terms)



US data center demand is forecast to grow by some 10 percent a year until 2030.

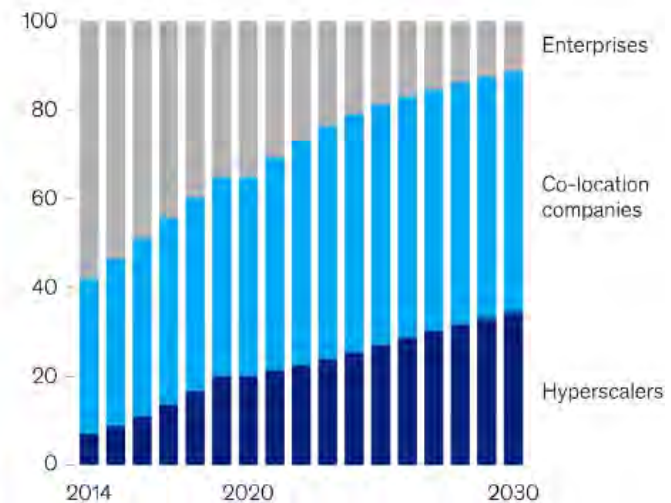
Data center power consumption, by providers/enterprises,¹ gigawatts



¹Demand is measured by power consumption to reflect the number of servers a data center can house. Demand includes megawatts for storage, servers, and networks.

McKinsey & Company

Data center power consumption, by providers/enterprises,¹ % share



- In 2025, the projected revenue in the Pharmaceuticals market in Puerto Rico is expected to reach US\$376.06m.
- The largest market within this industry is Oncology Drugs, with a projected market volume of US\$68.32m in the same year.
- Looking ahead, the industry is anticipated to exhibit an annual growth rate of 4.76% (CAGR 2025-2029), leading to a market volume of US\$452.91m by 2029.
- When compared globally, United States is expected to generate the highest revenue, reaching US\$660.04bn in 2025.
- Puerto Rico's pharmaceutical industry is thriving, attracting multinational companies with its skilled workforce and generous tax incentives.

Commitment and actions from private and government sectors to **reduce carbon emissions**, and a strong **shift towards nuclear power**.

Penn State University and the E-Vinci

Partners: Penn State University and Westinghouse

Project: The partners are discussing siting an e-Vinci microreactor at the University Park campus

Status: Penn State and Westinghouse have signed an MOU

Learn More:

<https://www.psu.edu/news/engineering/story/westinghouse-and-penn-state-explore-advancing-sustainable-micro-reactors/>



Development and Demonstration of a Concept for an Economically Optimized Integrated Energy services

- **Partners:** Shell Global Solutions, NuScale
- **Project:** The partners will develop and assess a concept for a cost-effective Integrated Energy System for hydrogen production using a NuScale SMR
- **Status:** According to May 2024 NuScale Investor report, the project is ongoing
- **Learn More:**
<https://www.datacenterdynamics.com/en/news/shell-and-nuscale-to-use-nuclear-power-to-make-hydrogen/>



Micro-reactor Pilot Program at Eielson AFB

- **Partners:** Eielson Air Force Base (AFB), Department of the Airforce, Defense Logistics Agency (DLA) Energy Office
- **Project:** The department of the Airforce is partnering with the Defense Logistics Agency (DLA) Energy Office to execute a power purchase agreement with a third-party developer.
- **Status:** The procurement process is currently paused to allow for additional proposal review. Review is anticipated to conclude by the end of Summer 2024.
- **Learn More:**
<https://www.eielson.af.mil/microreactor/>



EIELSON AIR FORCE BASE



THE NUCLEAR
ALTERNATIVE
PROJECT



Google, Microsoft, Nucor Advanced Clean Electricity

- **Partners:** Google LLC, Microsoft Corporation, and Nucor Corporation
- **Project:** The companies are collaborating to accelerate the development of first-of-a-kind (FOAK) and early commercial projects, including advanced nuclear. They recently released an RFI to solicit industry participation.
- **Status:** First round of power purchase agreements expected to be completed during the first quarter of 2025
- **Learn More:**
<https://www.ans.org/news/article-5911/google-microsoft-nucor-partner-on-clean-power-initiative/>



Microsoft and Constellation Energy

- **Partners:** Microsoft Corporation and Constellation Energy
- **Project:** Constellation signs its largest-ever power purchase agreement with Microsoft, a deal that will restore TMI Unit 1 to service and keep it online for decades; add approximately 835MW of carbon-free energy to the grid; create 3,400 direct and indirect jobs and deliver more than \$3 billion in state and federal taxes
- **Status:** Constellation will pursue license renewal that will extend plant operations to at least 2054. The CCEC is expected to be online in 2028.



Microsoft



Constellation.



Advanced Nuclear Reactor Project in Seadrift, Texas

- **Partners:** Dow and X-energy
- **Project:** Power the Seadrift Site with a small modular reactor. Manufacturing medical and pharmaceutical products
- **Status:** Construction expected to begin in 2026 and complete by 2030
- **Learn More:** <https://x-energy.com/seadrift>





COP²⁸
UAE

مضاعفة إنتاج الطاقة النووية ثلاث مرات بحلول عام 2050
الإمارات العربية المتحدة، ديسمبر 2023

TRIPLING NUCLEAR ENERGY BY 2050

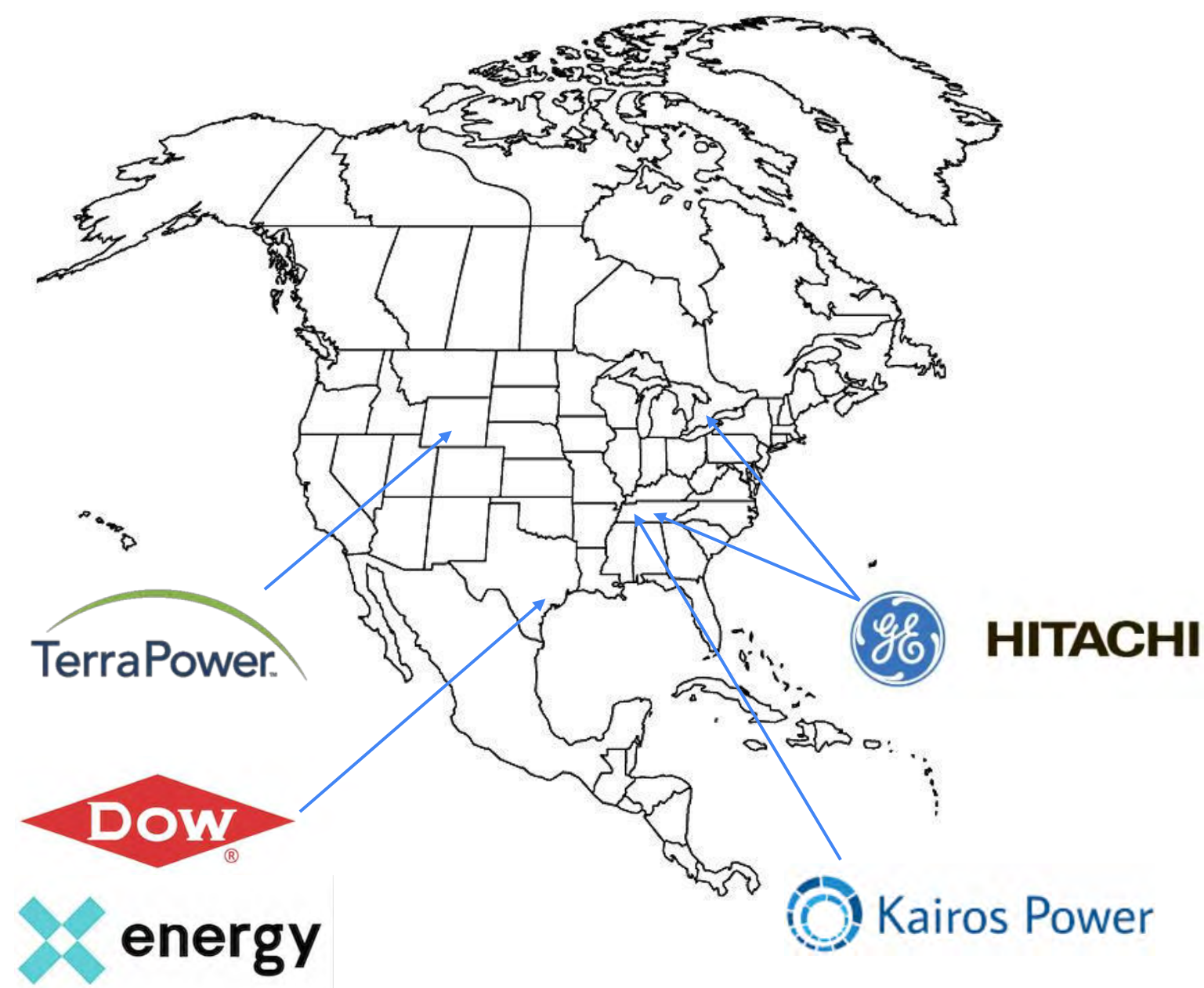
United Arab Emirates, December 2023



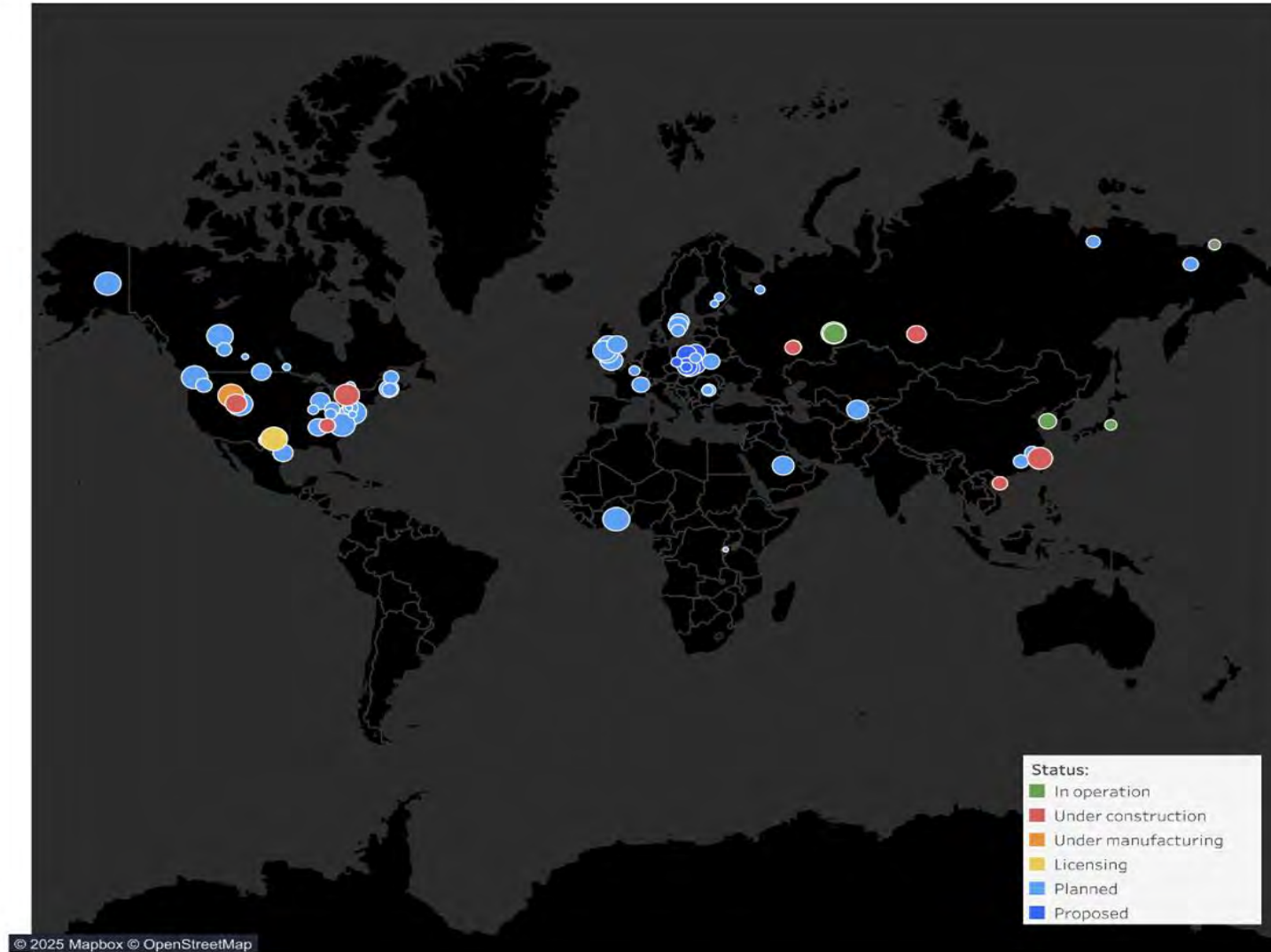
THE NUCLEAR
ALTERNATIVE
PROJECT



Ongoing site preparations and construction for SMRs in North America



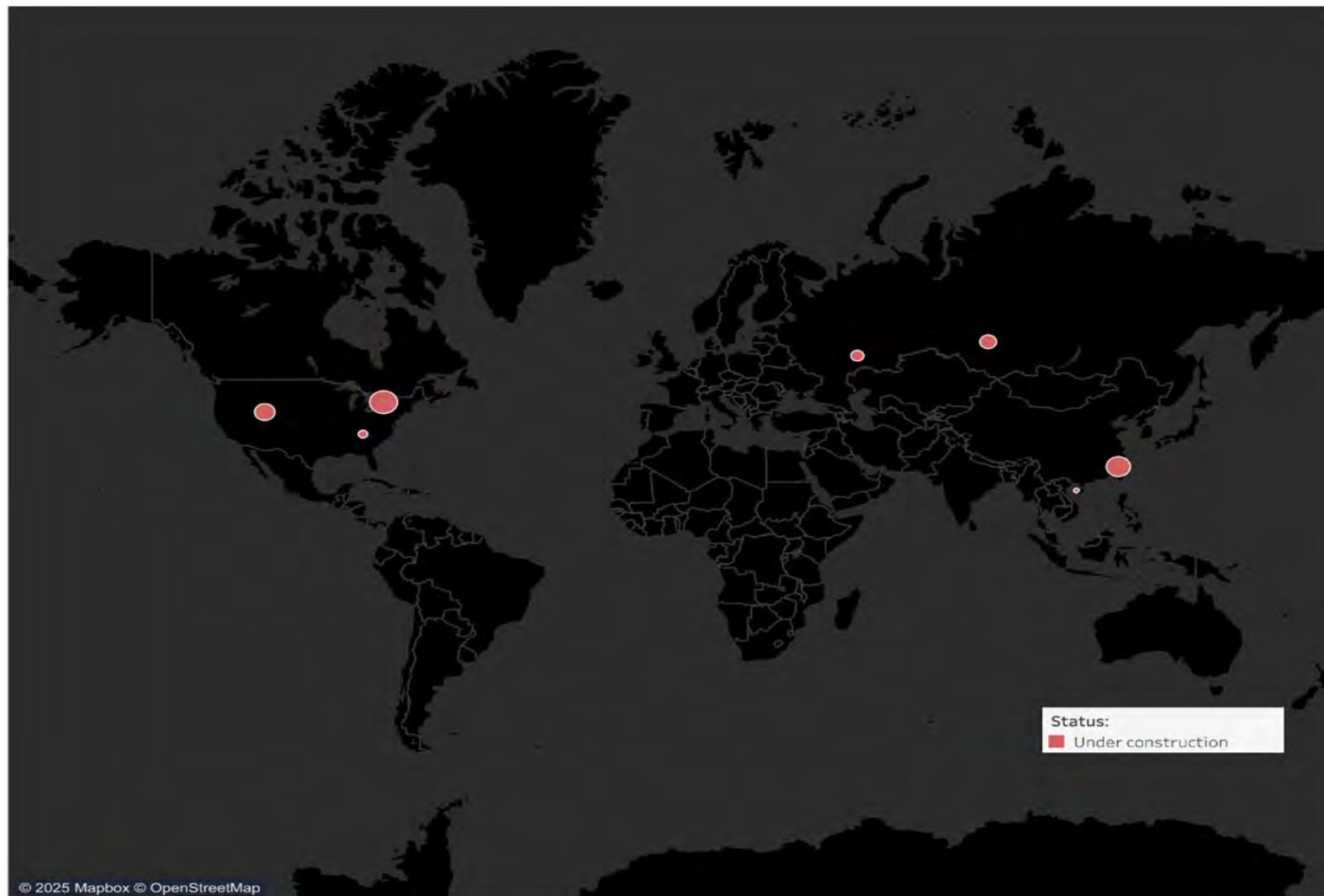
Advanced Nuclear Global Status



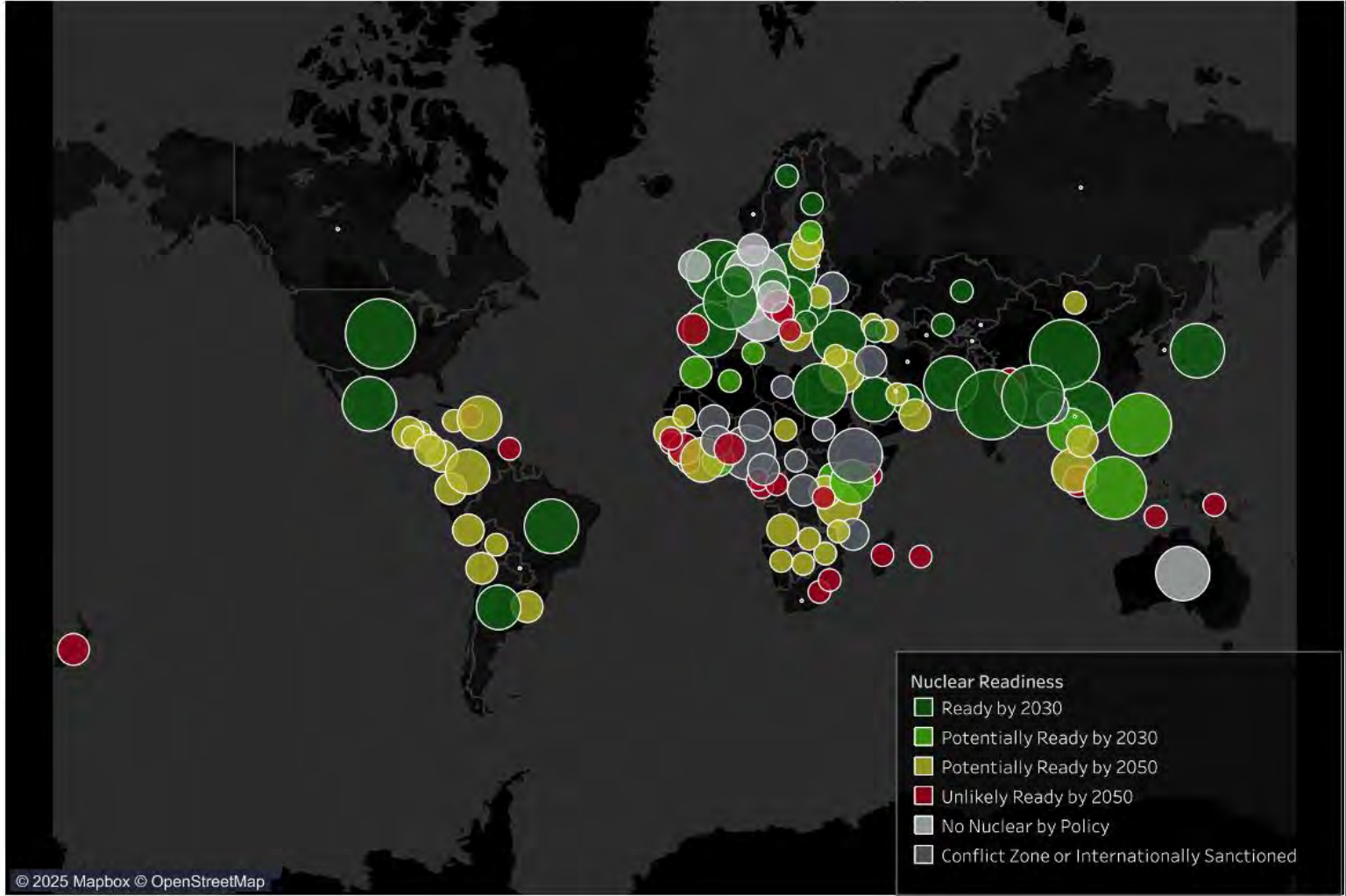
Status:

- In operation
- Under construction
- Under manufacturing
- Licensing
- Planned
- Proposed

Advanced Nuclear under Construction



Advanced Nuclear Global Market



Nuclear Readiness

- Ready by 2030
- Potentially Ready by 2030
- Potentially Ready by 2050
- Unlikely Ready by 2050
- No Nuclear by Policy
- Conflict Zone or Internationally Sanctioned

Readiness for Advanced Nuclear by 2030-2050



Potential Readiness by 2030:

- USA
- Mexico
- Brazil (Already Operate Conventional Plant)
- Argentina

Potential Readiness by 2030 by 2050

- Colombia
- Argentina (3 operational plants)
- Mexico (Already Operate Conventional Plant)
- Peru
- **JAMAICA**
- **DOMINICAN REPUBLIC***



Government in process of selecting winning technology for construction at Borselle site

Technology selected for site at Dukovany NPP for new reactor



1st site being developed, SMR sites being evaluated



Advanced Canadian reactors units 3 and 4 to start construction in 2025



Technology selected for a 2nd advanced reactor in Kozloduy site

With electricity demand expected to more than triple by 2040, energy security is a stated priority for the government.



Site evaluations on going for construction of 2nd NPP at KRSKO site



Italy's government last Friday adopted a law paving the way for a return to nuclear energy almost 40 years after it was banned



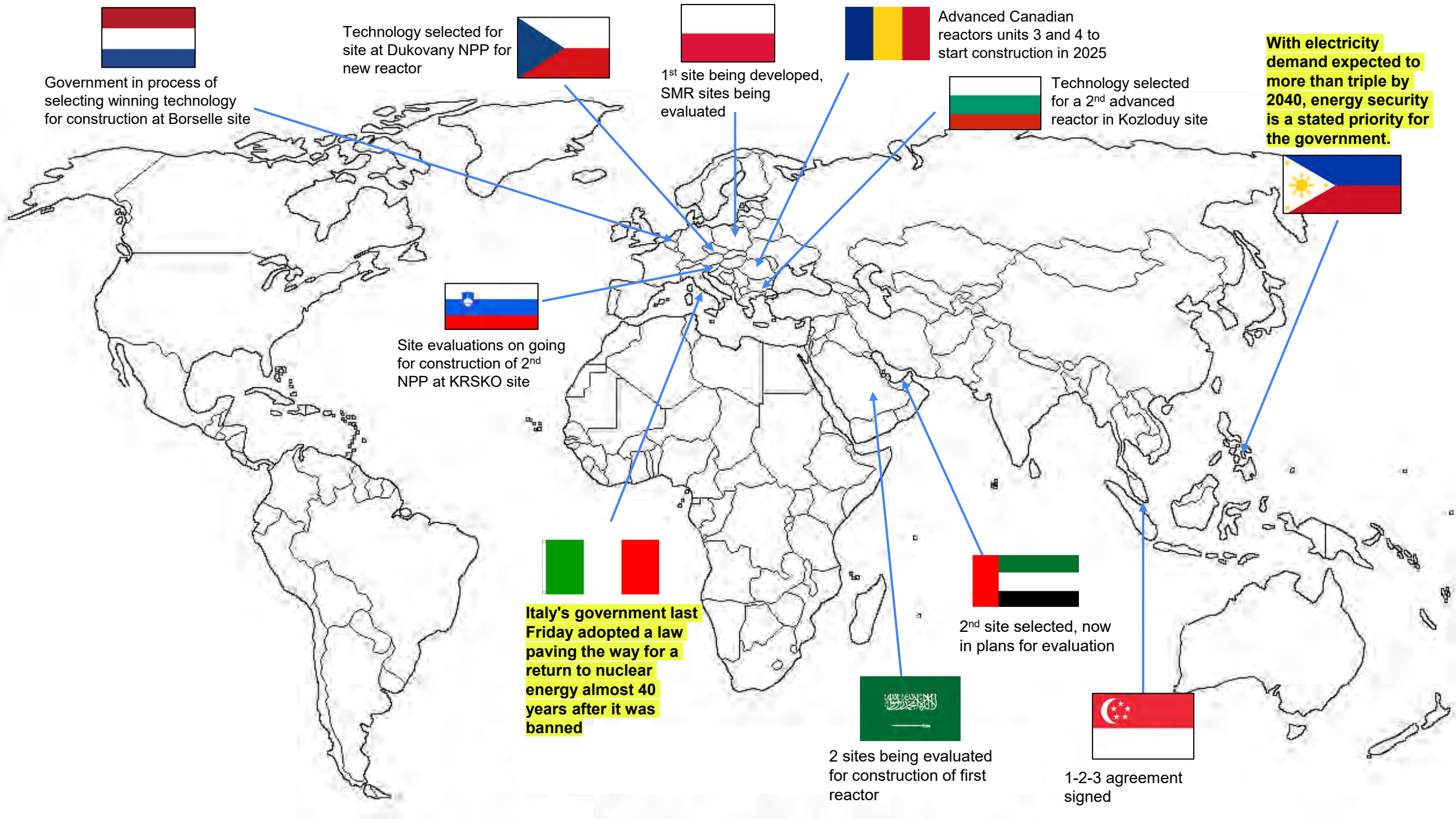
2nd site selected, now in plans for evaluation



2 sites being evaluated for construction of first reactor



1-2-3 agreement signed



Recent Developments in Advanced Nuclear: USA-Canada

- **WEST VIRGINIA LIFTS BANS ON NUCLEAR POWER PLANTS** <https://www.ans.org/news/article-3656/west-virginia-lifts-ban-on-nuclear-power-plants/>
- TerraPower selects Wyoming as the preferred site for the Natrium™ reactor demonstration project, which is a TerraPower and GE-Hitachi technology. <https://www.terrapower.com/natrium-demo-kemmerer-wyoming/>
- The U.S. Department of Energy (DOE) requests for information on the implementation of the Bipartisan Infrastructure Law's \$6 billion Civil Nuclear Credit Program. <https://www.energy.gov/articles/doe-establishes-6-billion-program-preserve-americas-clean-nuclear-energy-infrastructure>
- GEH Canada SMR <https://www.nucnet.org/news/opg-chooses-geh-as-technology-partner-for-first-smr-at-darlington-12-4-2021>
- DOD Microreactor Alaska <https://www.ans.org/news/article-3367/microreactor-planned-for-us-air-force-base-in-alaska/>
- **Hawaii: PROPOSING AN AMENDMENT TO THE HAWAII CONSTITUTION TO ALLOW CONSTRUCTION OF A NUCLEAR POWER PLANT OR DISPOSAL OF RADIOACTIVE MATERIAL IN THE STATE WITHOUT PRIOR LEGISLATIVE APPROVAL.** <https://fastdemocracy.com/bill-search/hi/2024/bills/HIB00054983/>

Recent Developments in Advanced Nuclear: USA

- **Georgia:** The completion of Vogtle Units 3 and 4 is a landmark achievement. This project demonstrates the ability to build new large-scale nuclear reactors in the U.S., providing a crucial source of baseload clean energy.
- **Wyoming:** TerraPower's Natrium reactor project in Kemmerer, Wyoming, is a significant development. This project, supported by the Department of Energy's Advanced Reactor Demonstration Program, is a prime example of advanced reactor technology being deployed.
- **Texas:** Texas is actively pursuing advanced nuclear energy.
 - X-energy is constructing four Xe-100 reactors at a Dow Chemical plant in Seadrift, Texas.
 - Texas A&M's RELLIS project is involved in advanced reactor testing.
 - Texas released a landmark report in response to Governor Greg Abbott's 2023 directive, to push Texas to be a leader in advanced nuclear energy.
- **Indiana:** Indiana has established a \$50 million Nuclear Energy Fund to support nuclear development and manufacturing within the state.
- **Utah:** Utah is taking proactive steps to prepare for nuclear energy expansion.
 - Governor Cox has included funding for nuclear infrastructure in the state budget.
 - Utah is collaborating with Idaho National Lab on nuclear development frameworks.
 - Utah has released a strategic nuclear energy pathway.
- **Virginia:** Virginia is preparing for a large increase in electricity demand, and nuclear energy is a large part of the plan.
 - The Virginia Nuclear Energy Consortium was created.
 - State bills have been passed to create a strategic nuclear energy plan, and to allow electric utilities to recover new reactor development costs.

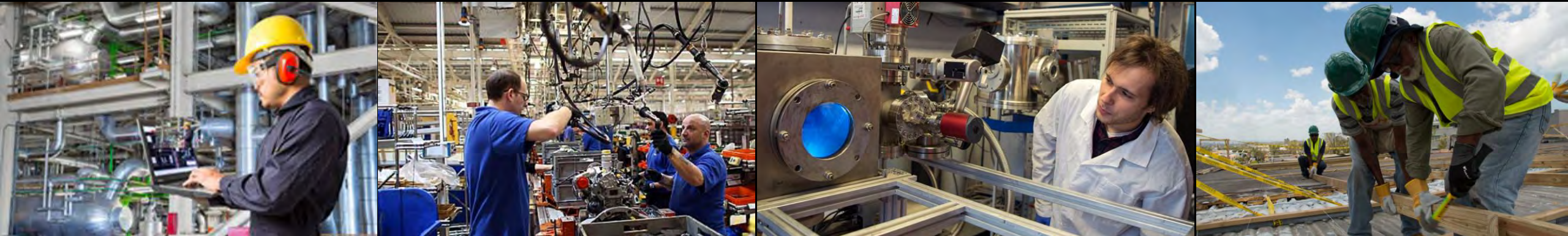
The trend is clear: developed and industrialized countries are adopting nuclear power to decarbonize the energy generation footprint, energize their industries, ensure economic growth and compete in a global economy.

Puerto Rico can follow such example, specifically with SMRs and Microreactors, to energize its industry, provide safe and reliable energy to critical infrastructure, and grow a globally-competitive economy.

In Closing...

My question to you, Boricua, today is:

Do we want Puerto Rico to be an industrial,
manufacturing and pharmaceutical powerhouse
that competes around the world?



If the answer is yes, I have shared with you how I see countries around the world moving to energize their economy for the 21st century...

...with a diverse energy portfolio, with nuclear at its core.

So, where do we go from here?



The United States government is under pressure to compete with Russia and China for global commercial nuclear leadership.

The United States government has recently established foundational programs to kickstart SMR and Microreactor programs all around the world.

The government of Puerto Rico could tap into this.

The Nuclear Alternative Project, together with Puerto Rico's energy stakeholders, we could tap into the FIRST program for educational programs and site feasibility.

The need for energy reliability in Puerto Rico is evident.

We all share the vision to build a globally competitive Puerto Rico.

The opportunity to include nuclear power in Puerto Rico is now.





"Sometimes, the most revolutionary ideas are the ones that seem the most absurd at first."

"If you have an opportunity to accomplish something that will make things better for someone coming behind you, and you don't do that, you are wasting your time on this earth" - Roberto Clemente 1971



Our Future Nuclear Workforce?



Thank You!



THE NUCLEAR
ALTERNATIVE
PROJECT

