# Nuclear Energy:
## Why We Need It Now More Than Ever

November 2023

Westinghouse

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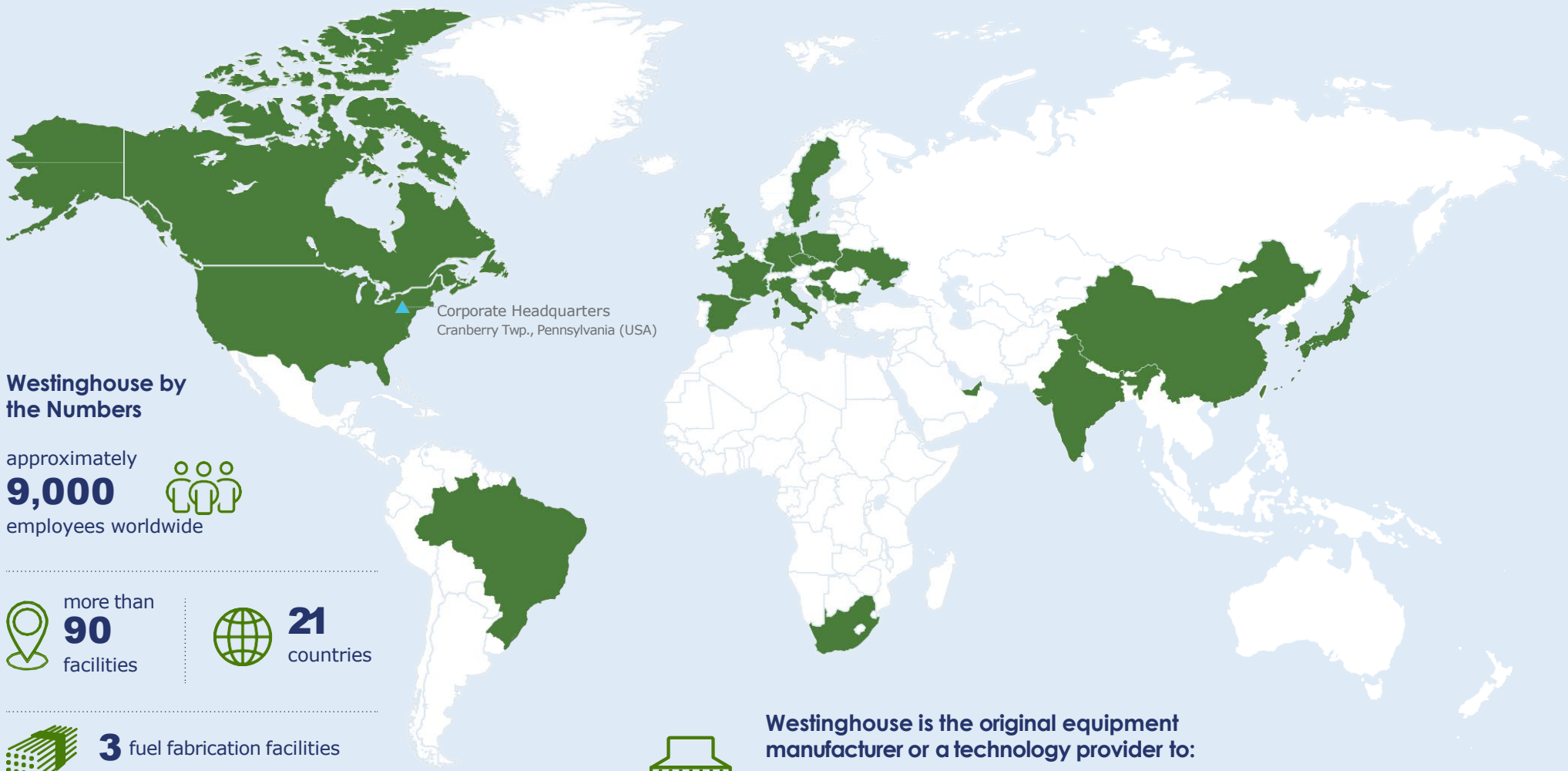
# global presence

**Legend**

- Corporate Headquarters
- Countries with Westinghouse Presence




## Westinghouse by the Numbers

approximately **9,000** employees worldwide

more than **90** facilities

**21** countries

**3** fuel fabrication facilities

**Westinghouse is the original equipment manufacturer or a technology provider to:**

**~50%** of the global nuclear reactor fleet, delivering capacity of ~190,000 carbon-free MWe

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# Today's Energy Landscape

The world is recognizing the need for nuclear & is seeking proven solutions

## CUSTOMER CHALLENGES

- Emission-free Energy
- Energy Security
- Energy Price Stability
- Grid Stability

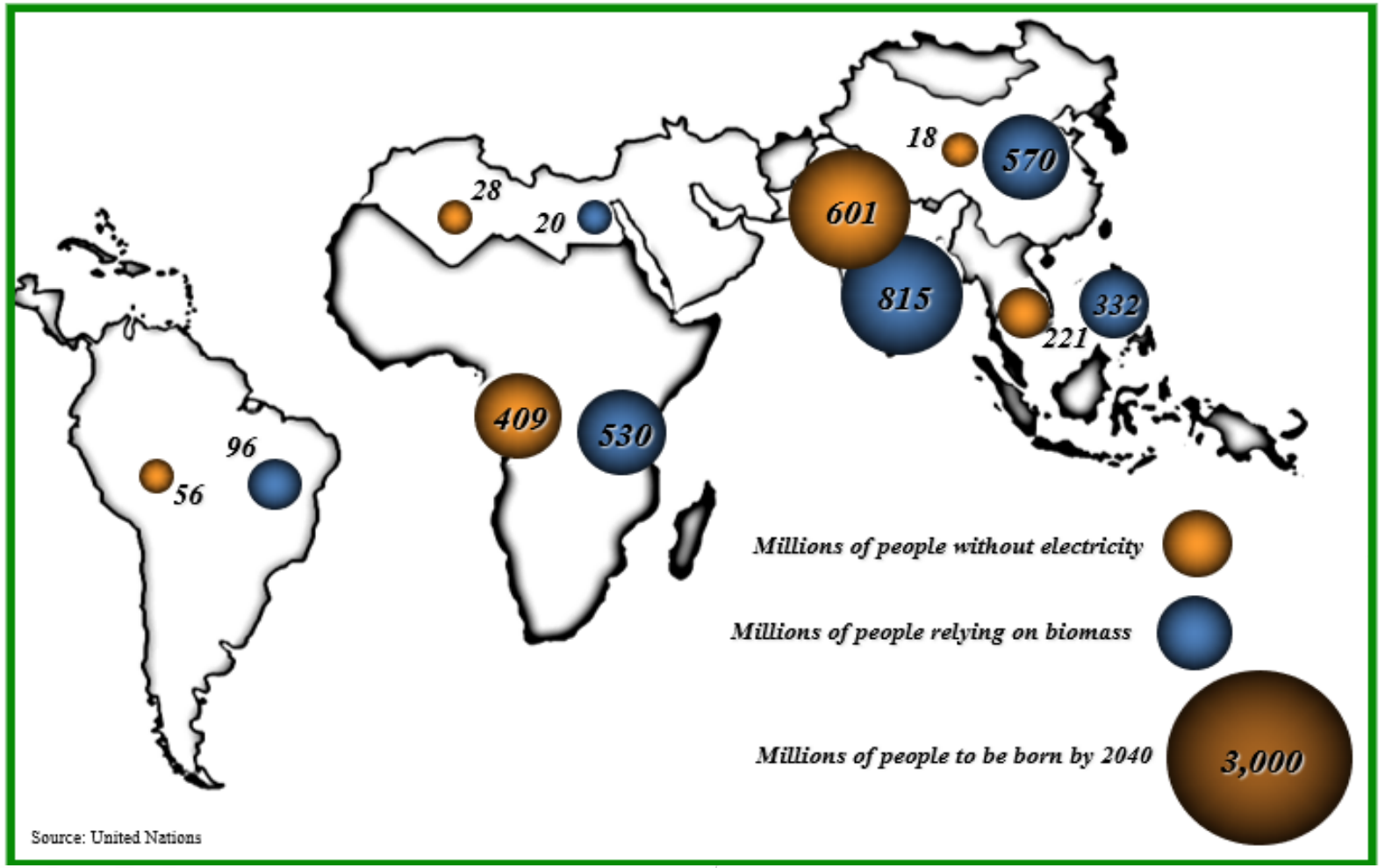
## THE SOLUTION

### CUSTOMERS CONTINUE TO SELECT WESTINGHOUSE

- China has 4 AP1000® reactors in operation & 6 units under construction
- Poland contracts for 3 AP1000 reactors
- Bulgaria selected 1-2 AP1000 reactors
- U.S. has 1 operating AP1000 and 1 in final commissioning
- Ukraine contracts for 9 AP1000 reactors
- India selects 6 AP1000 reactors

# The world needs energy…

# Map of Global Energy Poverty

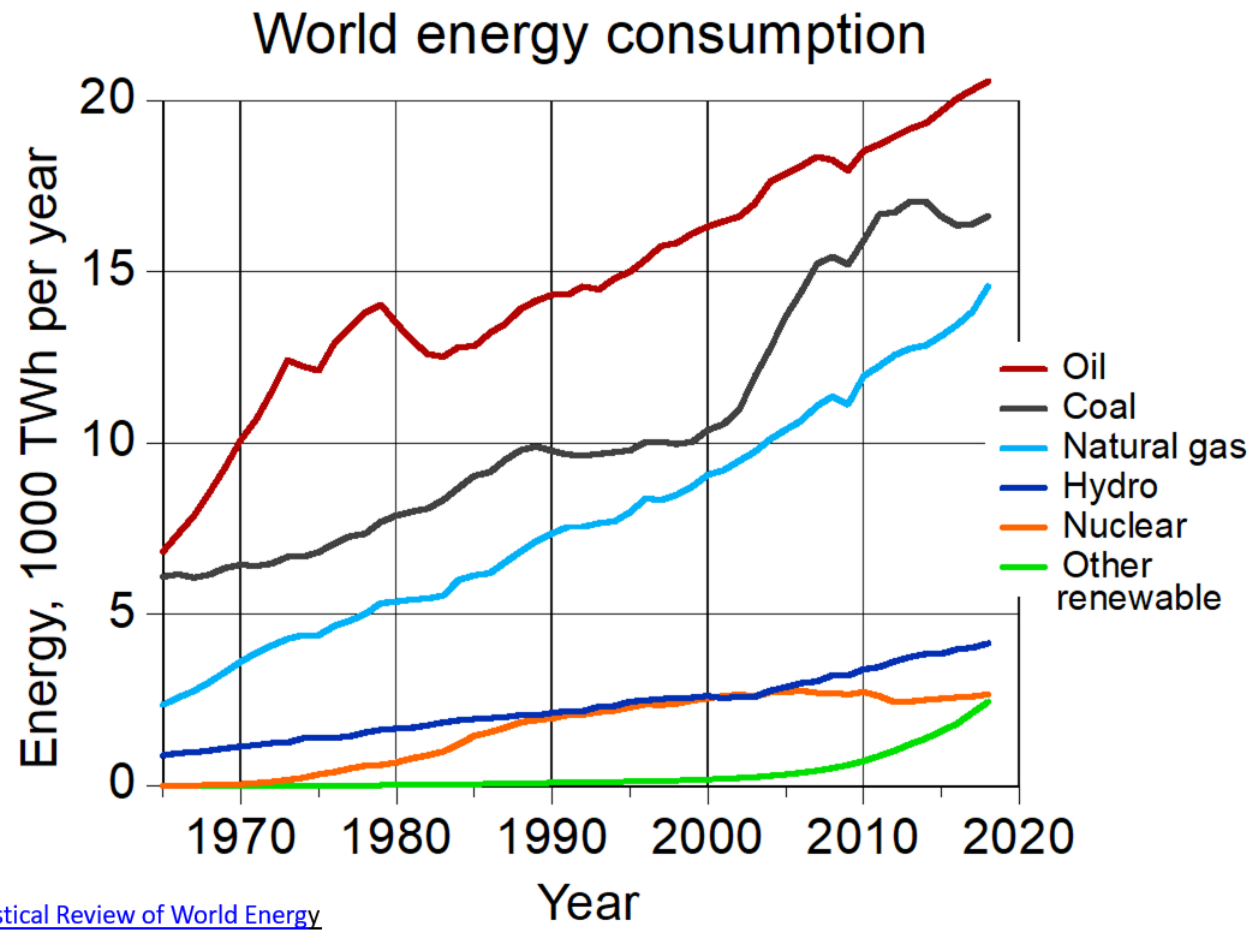



It takes 3,000 kWh per person per year to lift someone out of poverty.

Source: Kay Chernush for the U.S. Department of State

# Our Current Energy Sources

What are the fastest growing energy sources in the world?




BP Statistical Review of World Energy

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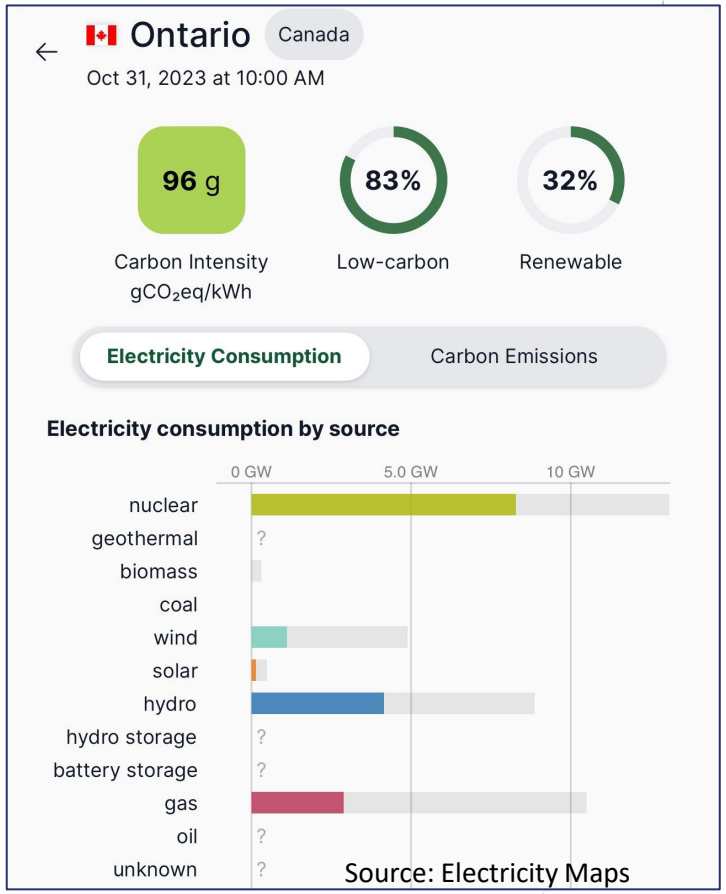
# Life Cycle Greenhouse Gas Emissions

(g CO2e/kWh)

| | |
|---|---|
| • Ocean | 8 |
| • Wind (on-and offshore) | 13 |
| • **Nuclear** | **13** |
| • Hydro | 21 |
| • Solar (PV) | 43 |
| • Natural Gas | 486 |
| • Coal | 1001 |

Source: NREL, Sept. 2021

# The Ontario Experience




## How Nuclear Helped Ontario Abandon Coal

Ontario was the first jurisdiction in North America to end coal power, representing the single largest GHG emissions reduction action in North America.[4] Existing and new-build nuclear played a critical role in facilitating this phaseout.

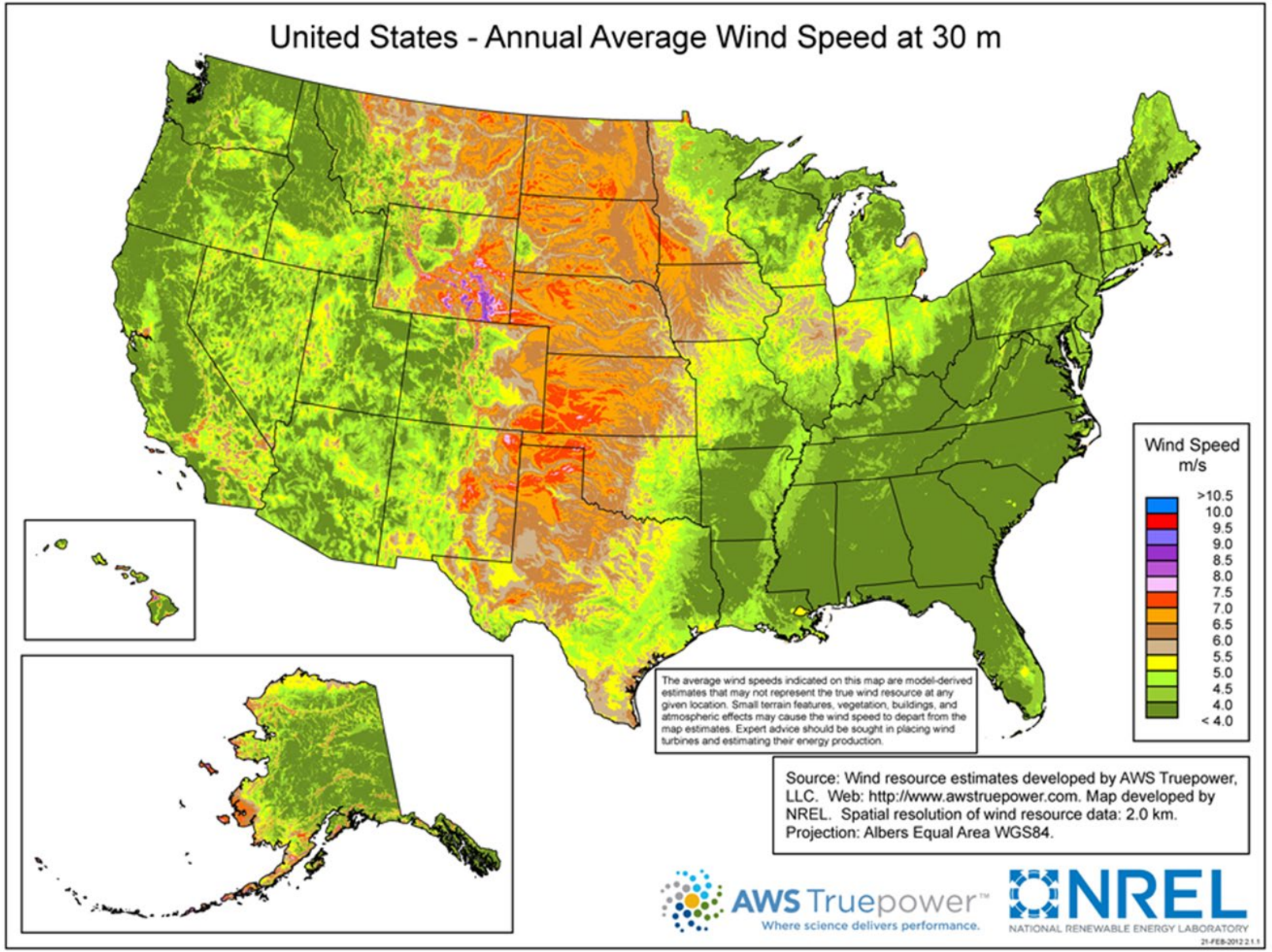
Coal-fired electricity was replaced by a mix of baseload, intermittent and peaking capacity and a strong conservation and demand management approach. In the end, Ontario added a total of 1,500 MW of nuclear, 5,500 MW of natural gas and 5,500 MW of non-hydro renewables.

### ELIMINATING COAL-FIRED ELECTRICITY IN ONTARIO[5]

- **2001:** Ontario has five coal-fired generating stations, comprising 19 units totaling ~8,800 MW
- **2003:** Coal represents approximately 25%, or 7,560 MW, of Ontario's supply mix
- **2003:** Ontario commits to phase out coal-fired electricity entirely
- **2012:** Two nuclear power units are refurbished and returned to service
- **2014:** Coal's share of Ontario's power supply reaches 0%
- **Today:** Nuclear power now generates 60% of Ontario's power

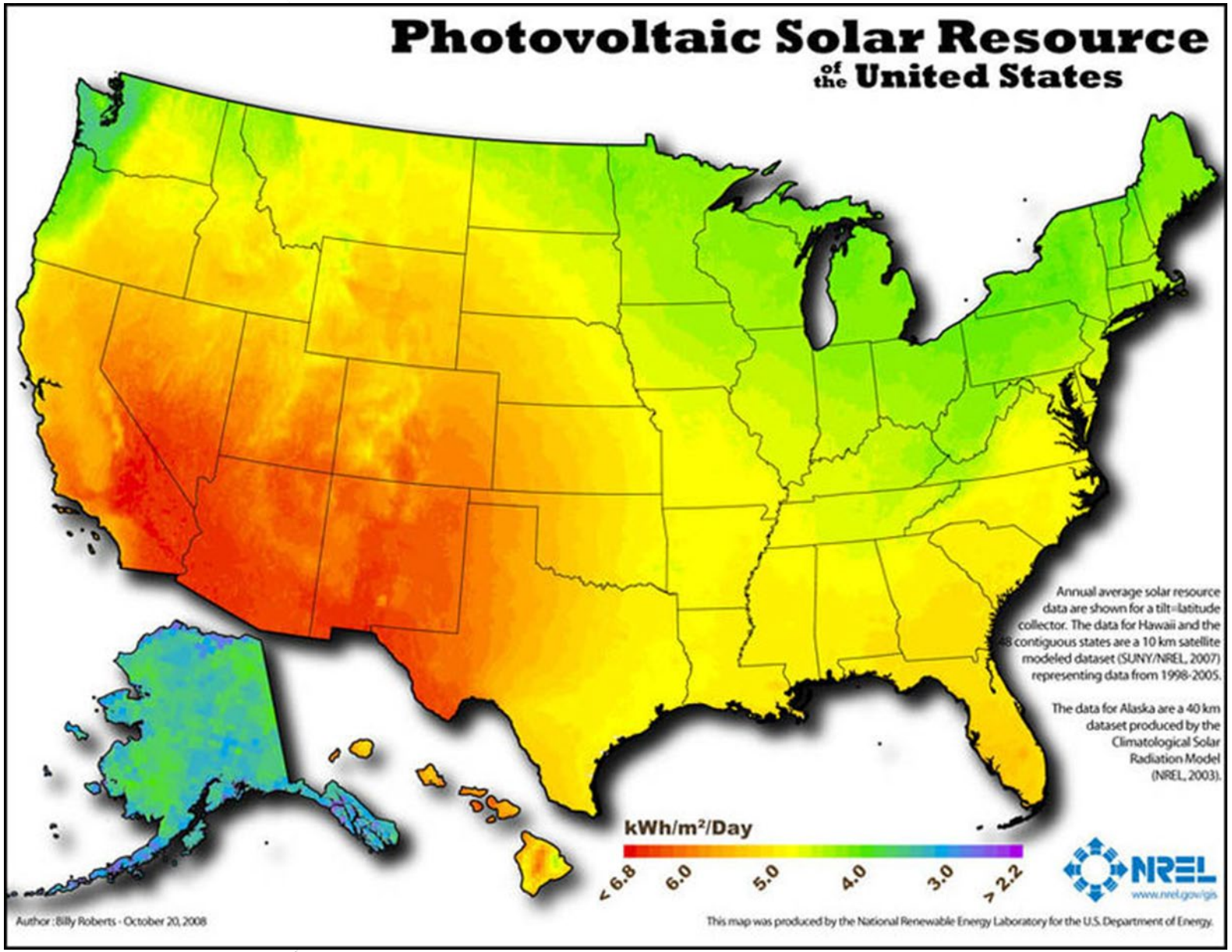
# Why We Need a Mix

**Where the wind blows matters…**

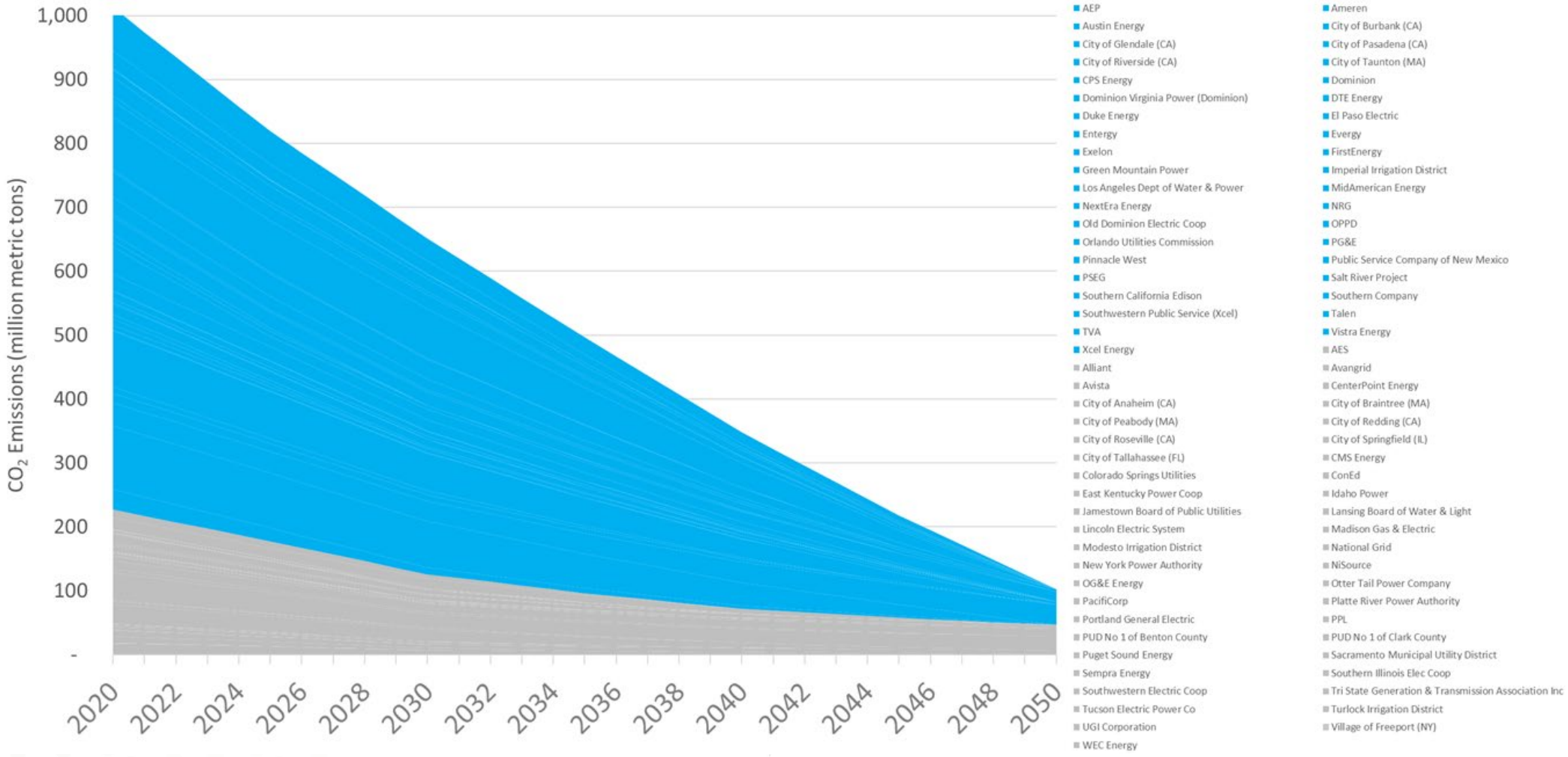


# Why We Need a Mix

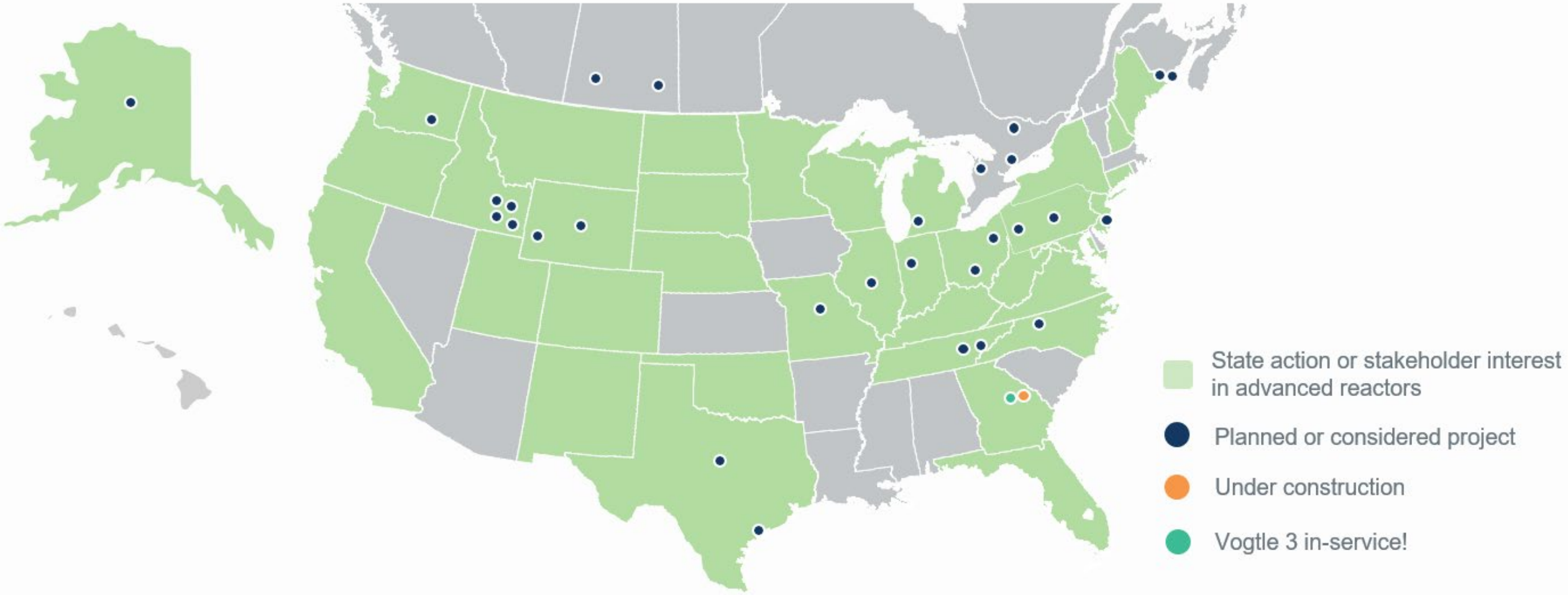
**as does where the sun shines.**



# Utility carbon emission projections based on pledges



# More Nuclear Planned in the U.S.




Updated 10/9/2023

# Nuclear Offers Versatility

## Spectrum of Sizes and Options

Micro (Few MW)

Mini (10s of MW)

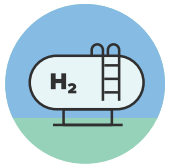
Small (100s of MW)



Large (1,000+ MW)

## Variety of Outputs

Electricity




$H_2$ Hydrogen

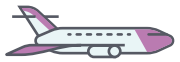
Process Heat

## Multitude of Uses

Homes

Vehicles

Businesses



Aviation

Rail

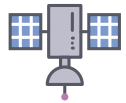
Shipping

Concrete

Steel

Factories

Water



Space

# District Heating

Haiyang Nuclear Power Plant

- Largest heat project in China
- Provides winter heat to 200,000 people in 5 million sq meter area
- Avoids 330,000 tons of $CO_2$ and 1,243 tons of smoke dust

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***Energy Systems***

*A portfolio of innovative solutions*

# AP1000® PWR

## 1100+ $MW_e$

**Most advanced nuclear technology operating in the world today with record-setting performance**

**TECHNICAL CAPABILITIES**

- Passive Safety Systems
- Simplified Active Systems
- Proven NSSS Components; Canned Motor Pumps
- Compact Footprint
- Modular Construction
- Digital I&C and Advanced Control Room
- Load Follow Capability
- Global Licensing Pedigree

# eVinci Microreactor™

## 5 $MW_e$

**Microreactor designed for safe and reliable electricity and heat generation**

**TECHNICAL CAPABILITIES**

- 5 MWe + ~8MWth @ 200C cogeneration
- Minimum 8 year refueling cycle
- Transportable for ease of installation and elimination of spent fuel storage on site
- Cost-competitive plant lifecycle
- Minimal onsite personnel
- Mature technology, manufacturing, and regulatory readiness
- High speed load following capability

# AP300™

## 300 $MW_e$

**Only SMR based on deployed, operating & advanced reactor technology**

**TECHNICAL CAPABILITIES**

- 300MWe (900MWth) 1-loop PWR with demonstrated reliability
- Based on the fully licensed & operating AP1000 technology
- Utilizes identical passive safety systems used in the AP1000 reactor to maintain safe shutdown condition
- Ultra-compact, simplified design reduces construction timeframes
- Maximizes use of established supply chain
- Less than 0.4 acres needed for safety related buildings

# Pumped thermal energy storage

**Innovative design coupled with tested technology**

**TECHNICAL CAPABILITIES**

- Advanced Supercritical Carbon Dioxide (sCO2) Technology
- Efficient heat pump and heat engine cycle
- Unique, Patented Thermal Storage Solution
- Engineered concrete thermal batteries
- Low-cost materials; Printed Circuit Heat Exchangers (PCHE)
- Power turbine and low-temperature compressor are derivatives of existing designs
- Heat exchangers, piping, valves, controls are of similar design to existing SCO2 systems

# The Big Myth about Nuclear Power

Myth

Nuclear power is bad for the environment

Reality

Nuclear energy generates **ZERO greenhouse gas** emissions during operations

Water cooling tower emissions are just **pure steam**.

Nuclear power and heat is one of our best tools for de-carbonizing energy

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# Fighting Climate Change for Over a Half Century

Fact 1

The International Energy Agency estimates that over the last

**50 yrs**

nuclear power has avoided

**70 Giga Tons**

of $CO_2$ emissions globally by avoiding the emissions from equivalent Coal, Natural Gas and Oil burning power plants

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# Emissions-Free Power

Approximate emissions reduction equivalents*

| | Approximate Emissions Avoided | Equivalent Vehicles Off the Road | Homes Powered Annually |
|---|---|---|---|
| **AP1000 Power Plant**<br>1100+ MWe | **7 million**<br>metric tons of $CO_2$ | **1.5 million**<br>cars off the road | **750,000**<br>homes powered |
| **AP300 SMR**<br>300 MWe | **1.85 million**<br>metric tons of $CO_2$ | **400,000**<br>cars off the road | **195,000**<br>homes powered |
| **eVinci Microreactor**<br>5 MWe | **55,000**<br>metric tons of $CO_2$ | **10,000**<br>cars off the road | **5,000**<br>homes powered |

Source: data calculated using Westinghouse research and epa.gov emissions comparatives

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# Did you know?

Fact 2

If you had

**100%**

of your electricity needs
over **your entire lifetime**
come from nuclear power
the used nuclear fuel
could fit in a soda can


Nuclear is the **most regulated industry** from cradle to grave.

The nuclear waste from every nuclear plant is meticulously tracked and safely managed.

New safe storage facilities and spent fuel recycling technologies are actively being developed.

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# Did you know?

Fact 3

**1**

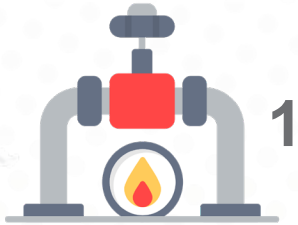
**uranium fuel pellet**

the size of a gummy bear

produces the same power as…

**1 ton** of coal

**149 gallons** of oil



**17,000$^{3}$FT** of natural gas

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# Did you know?

Fact 4

Thanks to the density of uranium fuel and high nuclear reactor efficiency, just

**93 reactors**

in the USA generate an incredible

**20%**

of the country's electricity

There are 440 reactors in 33 countries across the globe accounting for

10% of global electricity

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# What about renewables?

Fact 5

Nuclear Power requires a fraction of the land for equivalent Wind and Solar electricity production

Solar requires

**75x**

more land than nuclear

Wind requires

**360x**

more land than nuclear

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“**Energy** is central to nearly every major challenge and opportunity the world faces today.”

—The United Nations

Over the next 20 years, the world population is expected to grow 25% and, by 2030, demand for electricity will **nearly double**.

Finding solutions to our increased energy needs while confronting the realities of a **changing climate might be the most pressing issue of our time.**

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# Thank You

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