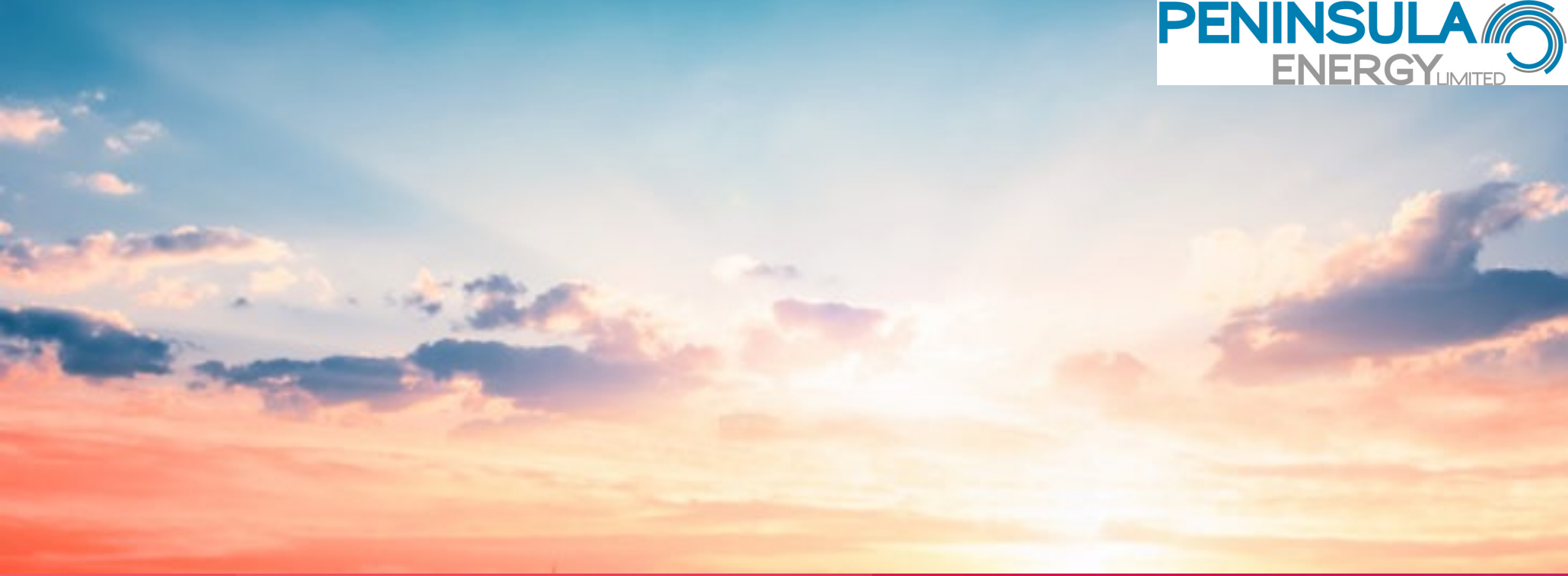


WYOMING'S NUCLEAR FUTURE: A NEXT-GENERATION NUCLEAR POWER PLANT AND OPPORTUNITIES FOR URANIUM MINING

PRESENTED BY WAYNE HEILI

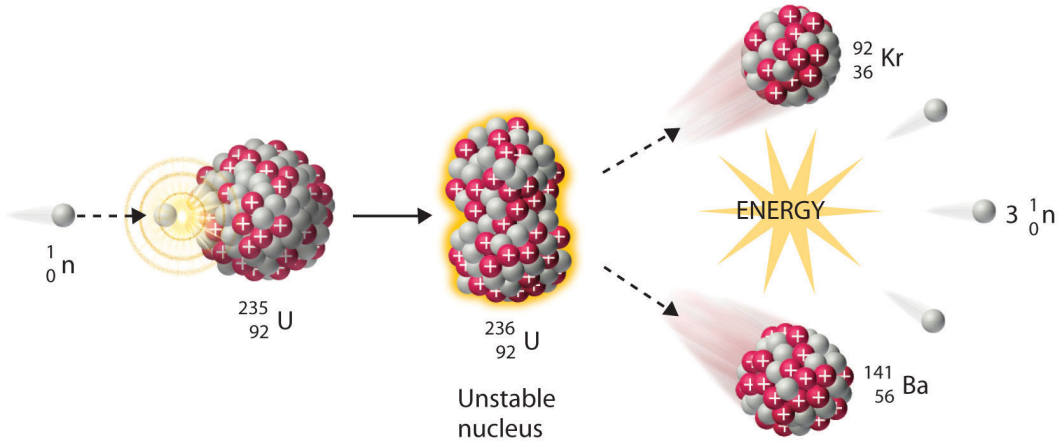
MD/CEO - PENINSULA ENERGY

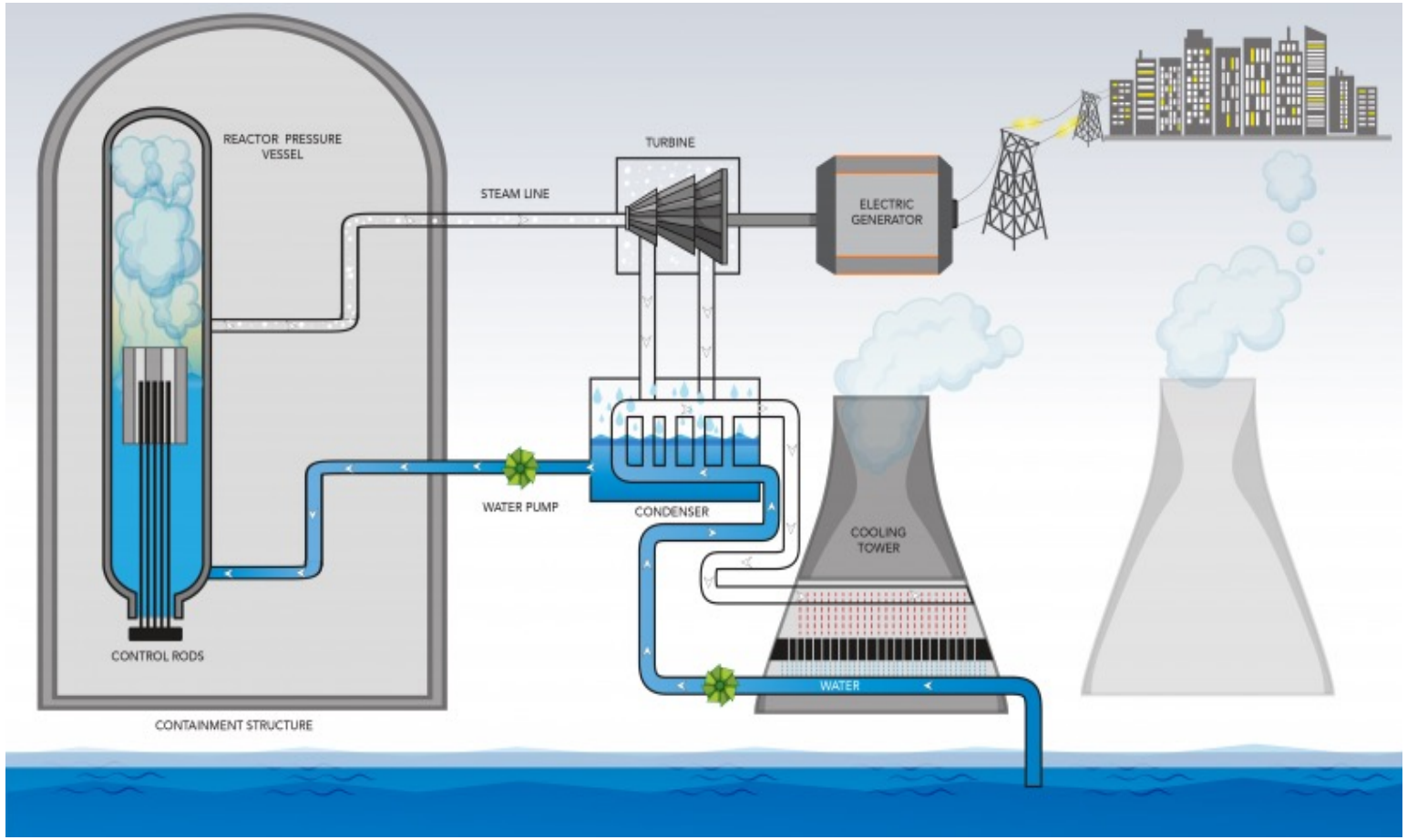
WYOMING'S NUCLEAR-POWERED FUTURE

- In June, TerraPower announced plans to locate it's Natrium Advanced Reactor Demonstration Program Plant at a retiring PacifiCorp coal fired power plant site in Wyoming
- Natrium will be the first commercial nuclear reactor ever in the State of Wyoming and one of the first advanced reactors to operate in the United States
- The US Dept. of Energy (DOE) is sharing the costs to support the licensing, construction and demonstration of this first-of-a-kind reactor by 2028
- Bill Gates co-founded TerraPower in 2008 to advance the realization of the societal benefits of advanced nuclear
- How will this affect the Uranium Mining Industry in the State?

HOW DOES A NUCLEAR POWER PLANT WORK?

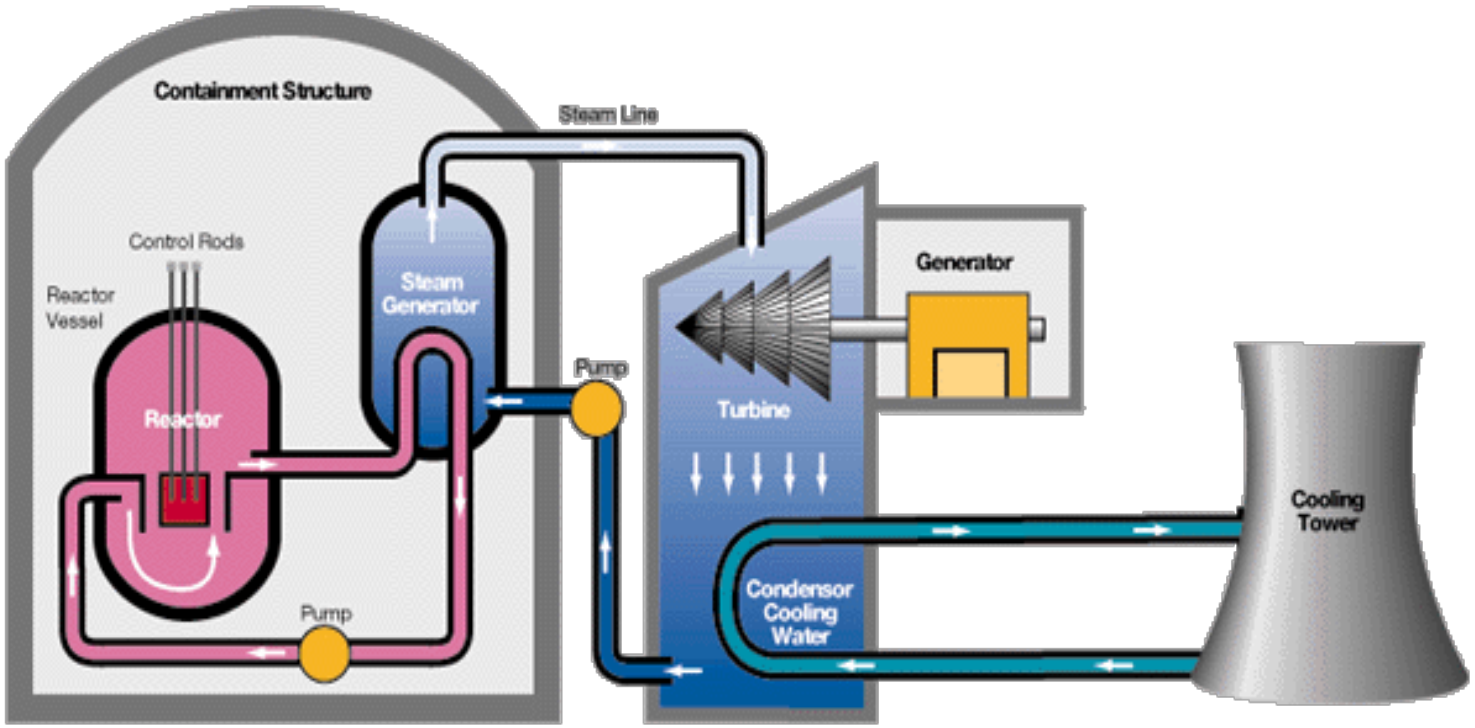
- The basis for generating electricity at a nuclear power plant is to utilize the heat energy generated by the controlled fission of uranium isotopes to produce steam which turns a standard turbine generator
- Steam turbine generators are also used in wood, coal, natural gas & diesel fired electric power plants
- There are several design variations of nuclear power plants (NPP's)





- Water is used as a heat exchange media
- Water is heated to steam inside the reactor vessel
- Steam exits the containment structure and turns a turbine to generate electricity
- Used steam is condensed with cooling water and returned to the reactor vessel to be reheated

BOILING WATER REACTOR (BWR)



- A Primary water loop circulates through the reactor vessel producing superheated water under high pressure
- The superheated water loop exchanges heat with a secondary water loop where steam is generated, all inside the containment structure
- Steam exits the containment structure and turns a turbine to generate electricity

PRESSURIZED WATER REACTOR (PWR)

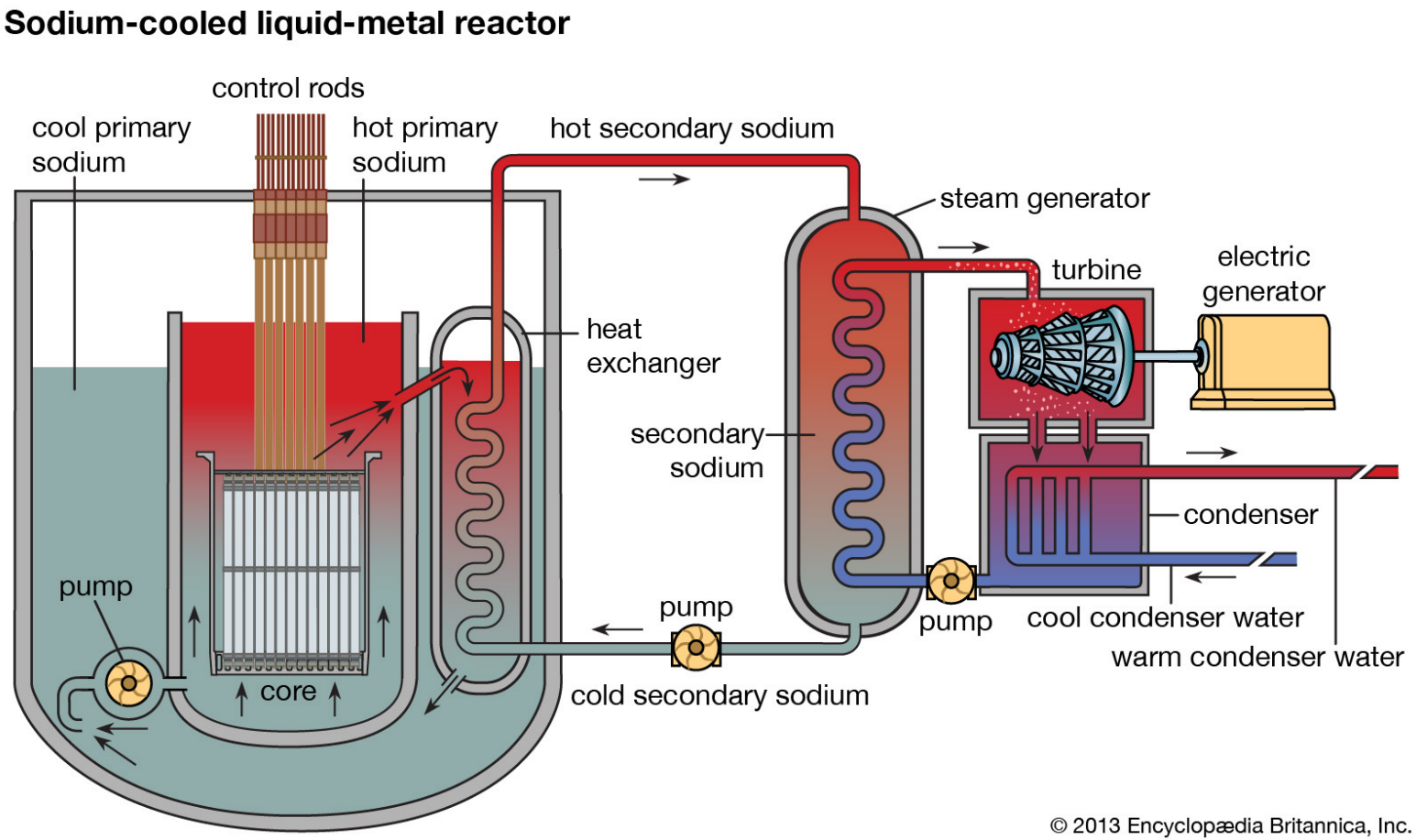
RINGHALS NPP, SWEDEN

R3 & R4: Twin 1,120 MWe PWR's
Vintage 1981/1983

R1 910 MWe BWR retired Dec-2020
R2 910 MWe BWR retired Dec-2019

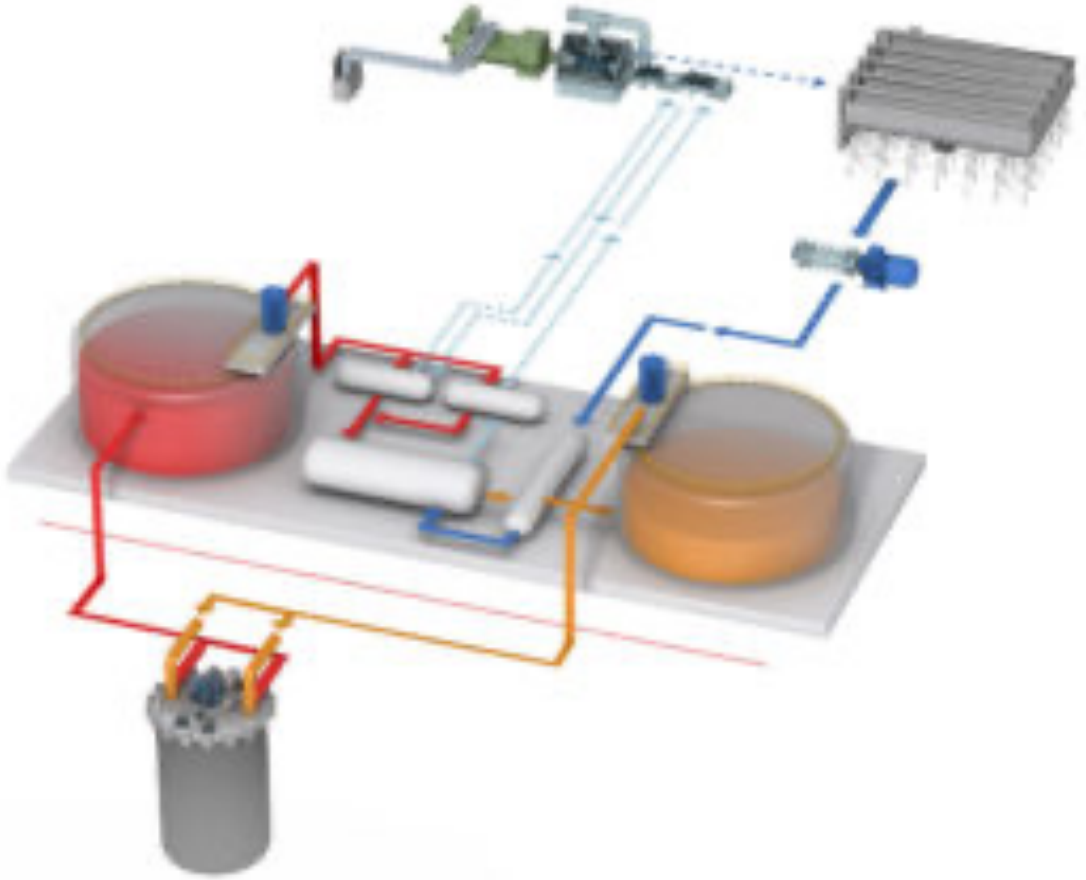
TAISHAN NPP, GUANGDONG PROVINCE CHINA

Twin 1,750 MWe EPR's (Advanced PWR Reactors) placed on-line in December-2018 and September-2019 respectively



- Molten sodium replaces water as the primary heat exchange media in the reactor vessel
- Hot primary sodium exchanges heat to a secondary sodium loop to produce hot secondary sodium
- Hot secondary sodium exits the containment structure and then exchanges heat to water in a steam generator located outside
- Steam turns the turbine to generate electricity

SODIUM-COOLED FAST REACTOR (SFR)

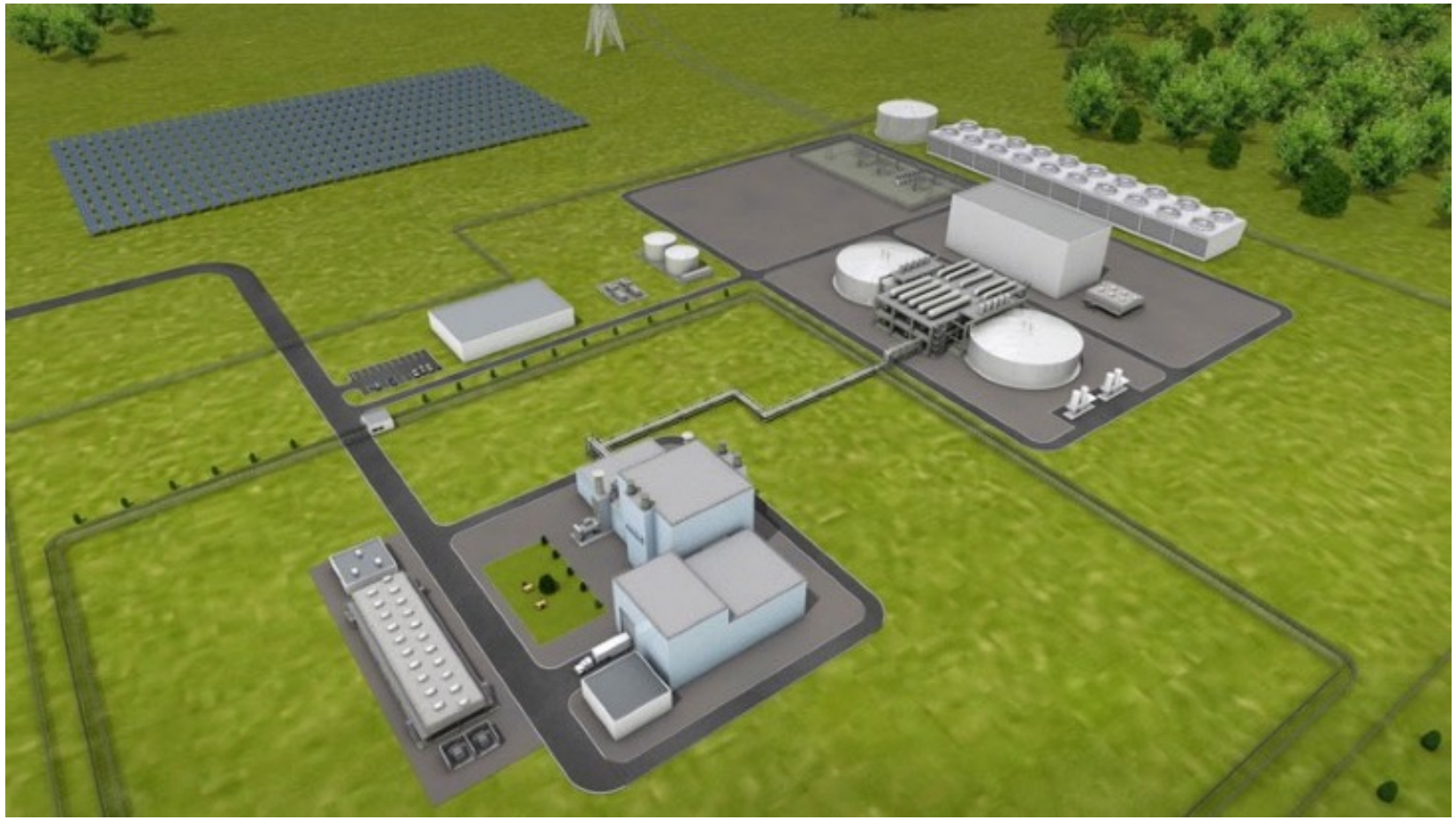


TERRAPOWER'S NATRIUM SFR SMALL MODULAR REACTOR (SMR)

Natrium means "sodium" in latin

345 MWe SFR

ARTIST RENDERING OF THE NATRIUM SMR NUCLEAR POWER PLANT



THE NATRIUM REACTOR ADVANTAGE

- The innovative combination of an **advanced sodium fast reactor** with **Gigawatt-hour scale energy storage** allows the reactor to operate at a high efficiency while simultaneously providing more electricity to the grid when needed, supporting the increased use of renewables.

TIMEOUT FOR STEM EDUCATION

"THE NATRIUM PLANT CAN STORE GIGAWATT-HOUR SCALE ENERGY" … CONTEXT PLEASE!

- A watt is a measure of power
  - 1,000 watts equals 1 kilowatt (kW).
  - 1,000 kW equals 1 megawatt (MW)
  - 1,000 MW equals 1 gigawatt (GW) **= 1 billion watts**
- Gigawatt-hours and kilowatt-hours (kWh) are measures of energy
  - 1kWh equals the amount of energy you would use by keeping a 1,000 watt appliance running for 1 hour – think of a small microwave oven
- 1 Gigawatt-hour can power all of Casper for over 3 hours at peak demand

ADVANTAGE #1
ENERGY STORAGE – LIKE A BATTERY

- The Natrium design includes the capacity to store heat in tanks of molten salt for use when the grid demands more power
- It's the first nuclear concept to integrate large-scale storage capabilities
- The storage capability can quickly increase the power plant's output from about 345 MWe to 500 MWe for five+ hours

… LIKE A REALLY BIG BATTERY!

ADVANTAGE #2
ADVANCED SAFETY FEATURES

DESPITE THE COMMON IMPULSE AVERSION TO NUCLEAR POWER, IT IS ACTUALLY THE SAFEST FORM OF POWER GENERATION WHEN ANALYSED BY DEATHS PER UNIT OF ELECTRICITY GENERATED

- Designed with passive cooling systems
  - Can prevent accidents like what happened at Fukushima Daiichi Plant
- Liquid sodium cooling agent
  - BWR's and PWR's use water to absorb heat, water turns to steam, creating pressure
  - Natrium uses liquid sodium that has a far higher boiling point and can absorb/remove a lot more heat than water at low pressures
  - High pressure does not build up inside the Natrium reactor containment structure

ADVANTAGE #3
LOWER CONSTRUCTION COSTS

IN AMERICA, THE CAPITAL COST OF BUILDING CONVENTIONAL NUCLEAR POWER PLANTS PRESENTS THE BIGGEST HURDLE FOR A UTILITY COMPANY

- Two new units being built at Plant Vogtle in Georgia are expected to cost more than $25 billion.
- The target cost for a commercial Natrium plant is $1 billion
  - The lower cost is due to Natrium operating at lower pressure
  - The Natrium plant does not require the same heavy duty construction materials
  - The Natrium plant is also a smaller scale plant than conventional ones

Plant Vogtle – under construction

ADVANTAGE #4
LESS NUCLEAR WASTE

WITH NO PERMANENT STORAGE SOLUTION IN USE IN THE US, NUCLEAR WASTE IS CURRENTLY STORED IN CONCRETE AND STEEL CASKS AT THE FACILITY WHERE IT WAS GENERATED

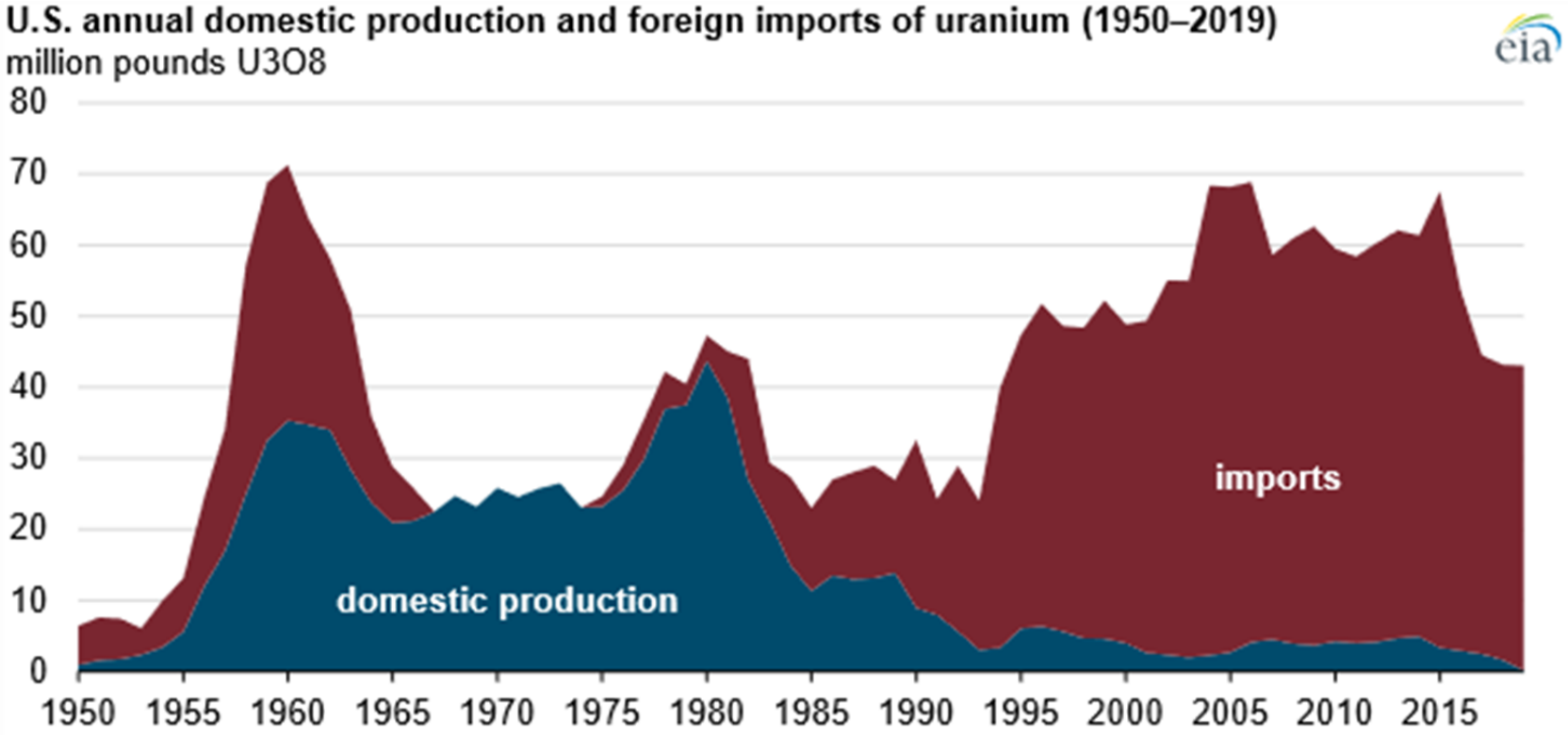
- Advanced reactors produce less waste by using the fuel more efficiently and more completely
  - Natrium will utilize only 1/3 the volume of fuel that today's reactors use, per unit of power generated
  - This is enabled by a precise reactor design process that takes advantage of today's high-performance computing and advanced materials.

BENEFIT TO WYOMING: EMPLOYMENT OPPORTUNITIES

- 2,000 – 3,000 construction jobs
- 300-400 permanent jobs
- Wyoming is projected to lose around 1,600 jobs over the next decade due to PacifiCorp reducing its coal fleet
- What is the prospect of gaining some Wyoming uranium mining jobs?

DOMESTIC URANIUM INDUSTRIAL BASE IN DECLINE

The U.S. uranium industry once employed more than 21,000 Americans – Today employment is down to 255 ~ 75 percent less than 10 years ago. Mine production is almost nonexistent. It is just a small fraction of the material needed to power even one of America's 94 commercial nuclear reactors.



URANIUM IMPORTS HAVE TAKEN OVER THE US MARKET

- WYOMING'S URANIUM MINING INDUSTRY FACES AN EXISTENTIAL THREAT FROM STATE-OWNED ENTITIES IN COUNTRIES LIKE RUSSIA AND CHINA

- Russian is outpacing the U.S. nuclear fuel cycle from mining to enrichment and the development of the advanced fuels needed for the reactors of the future.
- A renewed federal commitment to uranium production is needed to level the global playing field, create high paying jobs in uranium states like Wyoming, and ensure a domestic fuel supply for conventional and advanced nuclear reactors.

STATE-OWNED ENTITIES ARE UNDERCUTTING THE URANIUM MARKET

WHILE SOME U.S. URANIUM IMPORTS ARE FROM ENTITIES OPERATING IN ALLIED COUNTRIES, AN INCREASING SHARE IS PRICE INSENSITIVE MATERIAL COMING FROM STATE-OWNED ENTITIES (SOES).

- Imports from Russia, Kazakhstan, and Uzbekistan have averaged 40 percent of U.S. reactor demand since 2010 and climbed to 47 percent in 2020.
- The Department of Commerce determined in June 2020 that Russian imports to U.S. utilities were contributing to the suppression and undercutting of domestic price levels.
    - In response to adverse market conditions, U.S. mine production dropped more than 95 percent between 2010 and 2019.
    - In the same time period, SOEs ignored the market signals and increased their total supply, thus further suppressing prices.
- Now, Chinese SOEs are working to increase their share of the global uranium market, acquiring and subsidizing uranium mines and importing $200 million in enriched uranium to U.S. utilities since 2015.

THE LOSS OF OUR DOMESTIC URANIUM MINING CAPACITY WOULD LEAVE OUR COUNTRY AT RISK

- Uranium is a federally-recognized critical mineral.
- Nuclear energy powers 1 in 5 American homes and businesses and provides over half of our carbon free power.
- U.S. origin uranium is required for the nuclear Navy and for nuclear deterrence.
- Stockpiles of U.S. origin uranium for defense use are finite and diminishing.
- Defense demand alone is not enough to support an industrial base, which has historically relied on commercial uranium sales.

WE HAVE THE CAPACITY!

LICENSED URANIUM PRODUCTION CAPACITY IN THE US & WYOMING

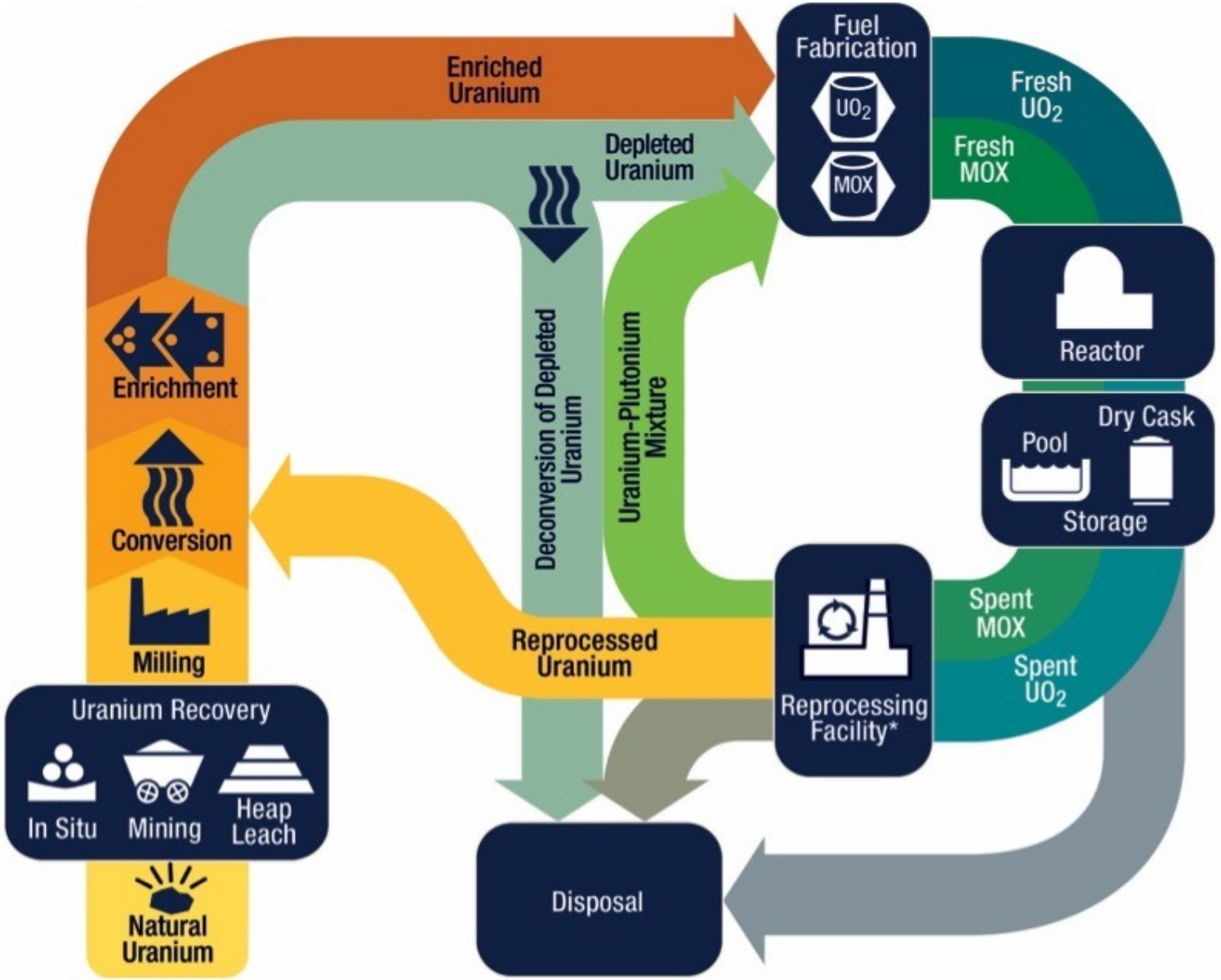
In-situ-leach plant owner	In-situ-leach plant name	County, state (existing and *planned* locations)	Production capacity (pounds U_3O_8 per year)
Uranium Energy Corp	Reno Creek	*Campbell, Wyoming*	2,000,000
Azarga Uranium Corp	Dewey Burdock Project	*Fall River and Custer, South Dakota*	1,000,000
Cameco	Crow Butte Operation	Dawes, Nebraska	1,000,000
Encore Energy	Church Rock	*McKinley, New Mexico*	1,000,000
Encore Energy	Crownpoint	*McKinley, New Mexico*	1,000,000
Ur-Energy	Lost Creek Project	Sweetwater, Wyoming	2,000,000
Energy Fuels	Alta Mesa Project	Brooks, Texas	1,500,000
Cameco Resources	Smith Ranch-Highland Operation	Converse, Wyoming	5,500,000
Uranium Energy Corp – STMV	Hobson ISR Plant	Karnes, Texas	1,000,000
Uranium Energy Corp - STMV	La Palangana	Duval, Texas	1,000,000
Peninsula/Strata Energy	Lance Project	Crook, Wyoming	3,000,000
Energy Fuels/Uranerz	Nichols Ranch ISR Project	Johnson and Campbell, Wyoming	2,000,000
Uranium Energy Corp.	Goliad ISR Uranium Project	*Goliad, Texas*	1,000,000
Uranium One Americas, Inc.	Jab and Antelope	*Sweetwater, Wyoming*	2,000,000
Uranium One Americas, Inc.	Moore Ranch	*Campbell, Wyoming*	500,000
Uranium One USA, Inc.	Willow Creek Project (Christensen Ranch and Irigaray)	Campbell and Johnson, Wyoming	1,300,000
Total Production Capacity:			**25,800,000**

WYOMING MINING ASSOCIATION

Source: U.S. Energy Information Administration: Form EIA-851A and Form EIA-851Q, "Domestic Uranium Production Report."

MORE STEM EDUCATION

THE NUCLEAR FUEL CYCLE



DYK - THE ENITRE US NUCLEAR FUEL CYCLE INDUSTRY IS IN JEOPARDY!

- **BAD NEWS** – The U.S. is ceding the nuclear fuel cycle to Russia and China – *domestic uranium mining and conversion industries are at the most urgent risk.*

- **US uranium producers have idled all their mines and laid off workers**
- **The sole US conversion facility has been idled, 2023 restart**
- **There is no commercial US owned enrichment capacity**
- **The lead US supplier of reactor technologies recently went through bankruptcy**

RESTORING U.S. NUCLEAR LEADERSHIP

THE FEDERAL NUCLEAR FUEL WORKING GROUP'S (NFWG) APRIL 2020 REPORT CHARTED A "STRATEGY TO RESTORE AMERICAN NUCLEAR ENERGY LEADERSHIP"

- **GOOD NEWS** – Pro-nuclear federal policies can counter SOE influence and help level the global playing field.
  - NFWG recommends a strategic uranium reserve to purchase U.S. uranium, guarding against foreign supply disruptions
  - Congress provided an initial $75 million in FY21. The NFWG recommended a 10-year program totaling $1.5 billion depending on market conditions.
  - U.S. miners have ample licensed and permitted capacity to begin filling the reserve, creating mining jobs and strengthening the industrial base.

WHERE WILL TERRAPOWER BUILD IT'S FIRST NATRIUM PLANT?

TerraPower and PacifiCorp identified four possible Wyoming sites for the Natrium Demonstration plant.

1. Dave Johnston Plant, Glenrock
2. Jim Bridger Plant, Rock Springs
3. Naughton Plant, Kemmerer
4. WyoDak Plant, Gillette

Siting factors include

1. Access to infrastructure
2. Regional electricity demands
3. Business opportunities

A final location is expected to be selected by the end of 2021

"IF I WAS TO PLACE A BET…"

DAVE JOHNSTON GLENROCK

- DJ is scheduled to retire in 2027 – same timeframe as aspirational date to start Natrium
- DJ has sufficient infrastructure for two modular Natrium SMR's
  - 922 MWe connection to grid
- DJ 's retirement will leave unmet regional electric demand
  - DJ supplies Casper's demand of ~330 MW's
- Casper provides nice amenities for workers and visiting dignitaries

RUNNER UP…JIM BRIDGER PLANT

CHALLENGES

Licensing

- A first of a kind reactor
- A tight schedule
  - TerraPower plans to apply for a construction permit in 2023
  - TerraPower plans to apply for a NPP operating license in 2026
  - TerraPower hopes to be operating in 2028

CHALLENGES

Cost Control

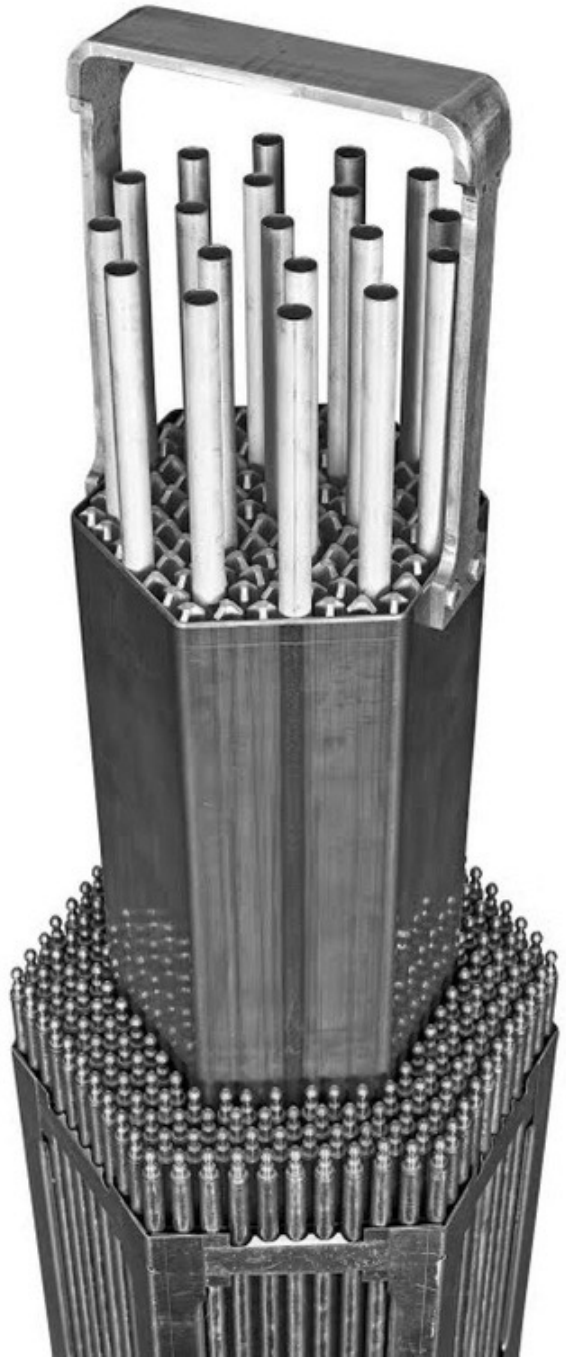
- A first of a kind reactor
- Construction cost control
  - Will be ***"THE KEY"*** to future opportunities for SMR's in free market economies

CHALLENGES

Fuel Procurement

- Requires High Assay Low Enriched Uranium (HALEU) Fuel
  - Only Russia's State-Owned Company (TENEX) has commercial HALEU production capabilities now
  - US-Based CENTRUS recently gained its license to demonstrate limited HALEU production

- Wyoming uranium miners would like to be a part of a revived US nuclear fuel cycle



WHAT DO YOU THINK?