Enabling the Advanced Reactor Future

Flexibility, Economics, and the Value of Innovation

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Transformative Nuclear Technologies

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Vision

To be a world leader in advancing science and technology solutions for a clean energy future

Mission

Advancing safe, reliable, affordable, and clean energy for society through global collaboration, science and technology innovation, and applied research.

Together…Shaping the Future of Energy®

COLLABORATION

EPRI's collaborative platform is unrivaled. Our R&D:

- Leverages your research dollars
- Connects you to a global network of peers
- Accelerates deployment of technology
- Mitigates the risk and uncertainty of going it alone
- Positions you as a leader in addressing industrywide challenges

CREDIBILITY

EPRI's independent research is guided by our mission to benefit the public. We offer:

- Objective solutions
- A proven track record
- Scientifically based research you can trust

EXPERTISE

For nearly 50 years, EPRI has been applying R&D to help solve real challenges. With EPRI, you can:

- Reduce expenses and increase productivity
- Be more resilient today and better prepared for tomorrow
- Access an industry repository of collective experiences, technical expertise, and training resources
- Extend your staff and make your teams more robust and more confident
- Benchmark, learn and share best practices
- Increase your awareness of challenges that others are facing and alternate solutions to challenges you might be facing
- Save time and money troubleshooting problems EPRI and its stakeholders have seen before

Who We Are

EPRI is a non-profit organization that performs research to advance safe, reliable, affordable, and clean energy for the public benefit.

Our Members

EPRI members represent 90% of the electricity generated and delivered in the United States, with international participation extending to 45 countries.

EPRI Research & Development

TECHNOLOGY INNOVATION

Driving thought leadership, advanced R&D, and technology scouting and incubation to sustain a full pipeline of solutions

Nuclear Power

Energy Supply and Low-Carbon Resources

Electrification and Sustainable Energy Strategy

Transmission and Distribution Infrastructure

Integrated Grid and Energy Services

STRATEGIC RESEARCH

Low-Carbon Resources

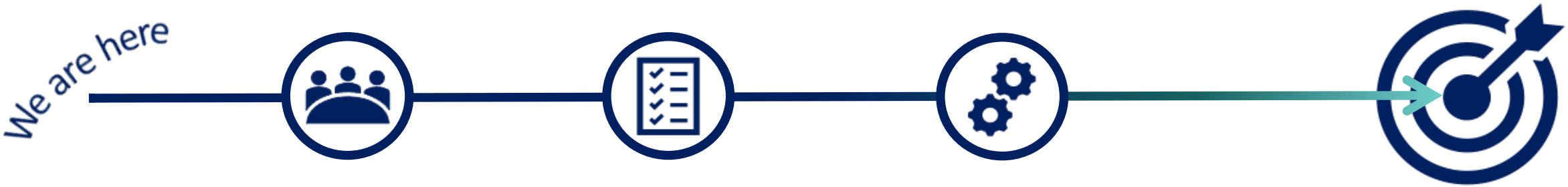
End-Use/ Economy-Wide Carbon Reduction

Electric System Reliability/Resilience

Electric System Flexibility

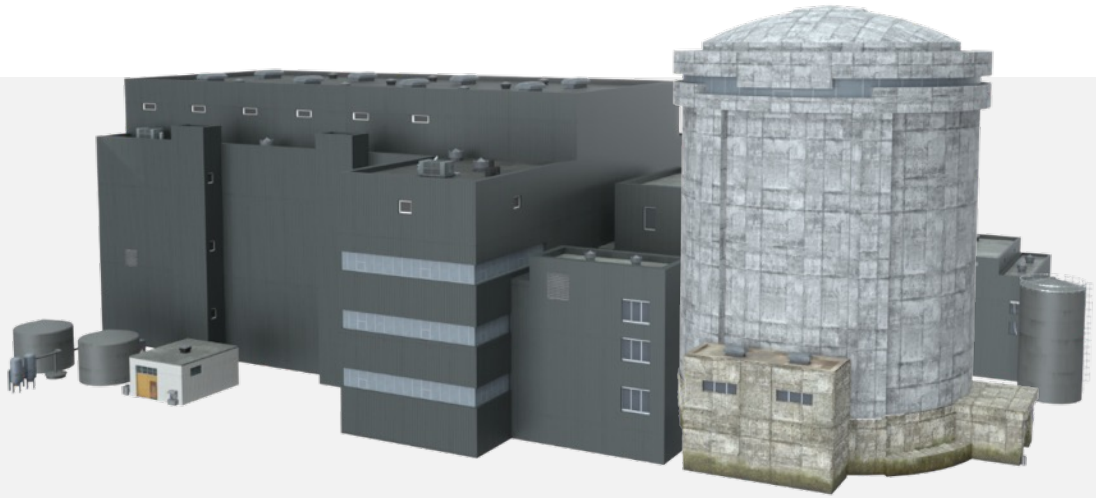
Market Transformation/ Policy/Regulatory Education

Our Path to the Future Fleet



In this decade...

- Design details will be finished
- Major components will be fabricated
- Ground will be broken at multiple sites



And advanced reactors will be deployed.

THE TIME TO ESTABLISH AN ADVANCED REACTOR FUTURE IS NOW

It Starts with Long-term Operations

Provides the **technical basis** for decision to operate plants through an **extended lifetime**

- ✓ Supports business case for life extension and refurbishments

Guidance and technology to manage plant assets through and **extended lifetime**

- ✓ Aging management, asset management, and risk management
- ✓ Address safety, performance and costs

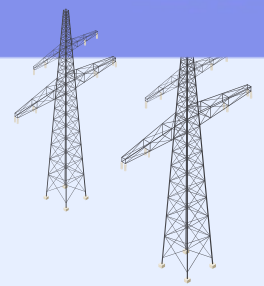
Where We've Been

EPRI's Nuclear Sector

SUPPORTS

98% of the World's Fleet

HIGH Capacity Factor



KEY GLOBAL RELATIONSHIPS

IAEA International Atomic Energy Agency · INPO · U.S.NRC · NEA Nuclear Energy Agency · NEI Nuclear Energy Institute · cea · CANDU Owners Group Inc. COG · CRIEPI Central Research Institute of Electric Power Industry · MIT Massachusetts Institute of Technology · National Nuclear Laboratory · WANO · EDF · KHNP Korea Hydro & Nuclear Power Co., Ltd · nnl materials ageing institute · UJV

DEFINED SPECS for **New Plant BUILDS**

Where We Are

>70 COMPANIES

Full ANT Supplemental Members

BECHTEL · FLUOR · GE · HITACHI · Kairos Power · NIPPON STEEL & SUMITOMO METAL CORPORATION · NUCLEAR AMRC · NUSCALE Power for all humankind · Rolls-Royce · Westinghouse · SKP · TerraPower · X energy

Advanced Reactor Initiative Members

Concrete Engineering Consultants, Inc. · DEEP ISOLATION · DOMINION ENGINEERING LLC · ENERCON ENERGIE FÜR DIE WELT · ENGIE · framatome · NEIL · Studsvik · TELEDYNE BROWN ENGINEERING Everywhereyoulook · ULTRA

New For 2022 - Nuclear Sector Base Members

22 US Members

24 Global Members

>360 Reactors Worldwide

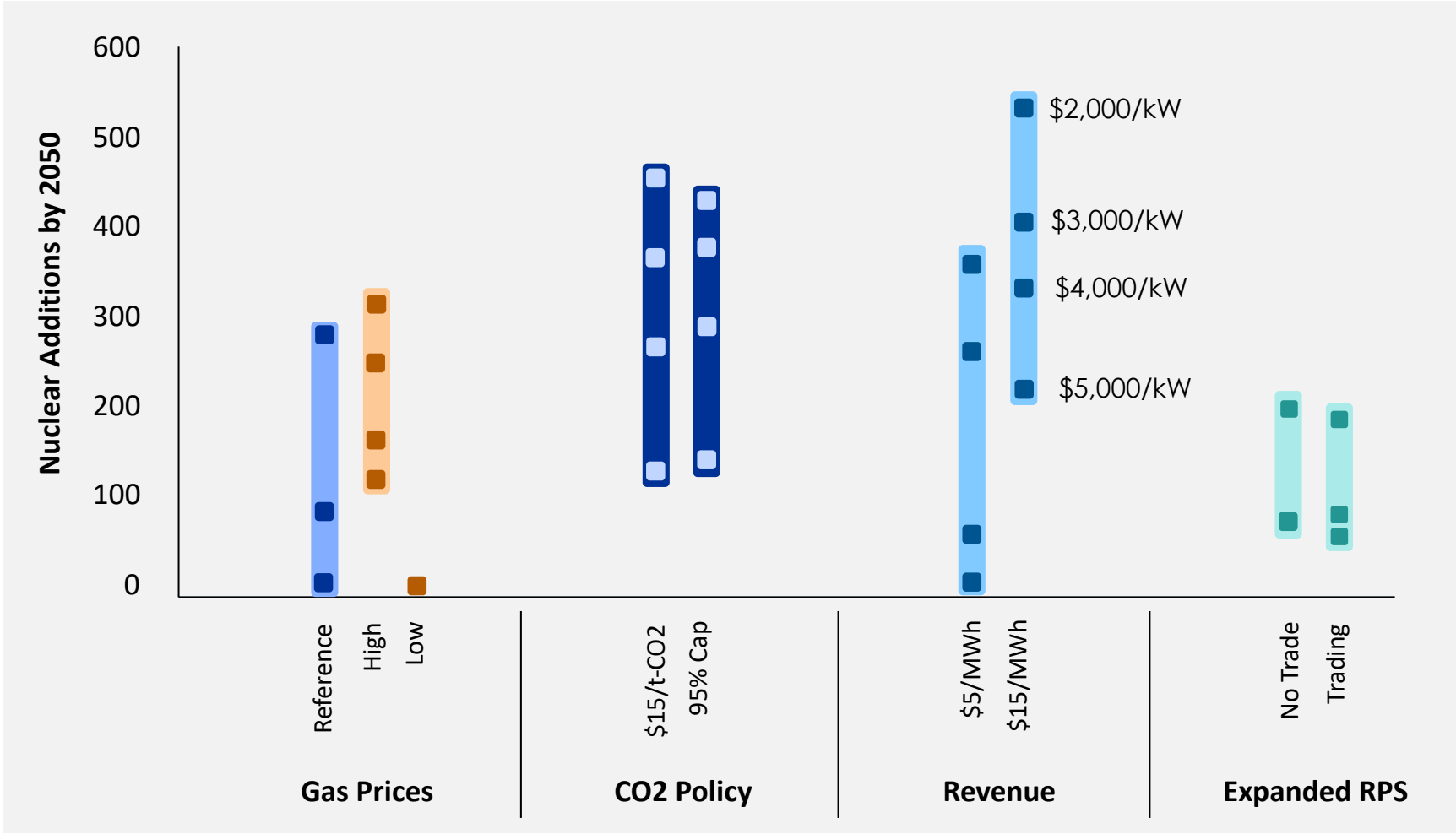
Economics of Advanced Nuclear

Exploring the Role of Advanced Nuclear in Future Energy Markets. March 2018, Report 3002011803

Cumulative nuclear additions through 2050 (GW) across a range of sensitivities (horizontal axis) and nuclear capital costs (dots)

KEY DRIVERS INFLUENCING DEPLOYMENT:

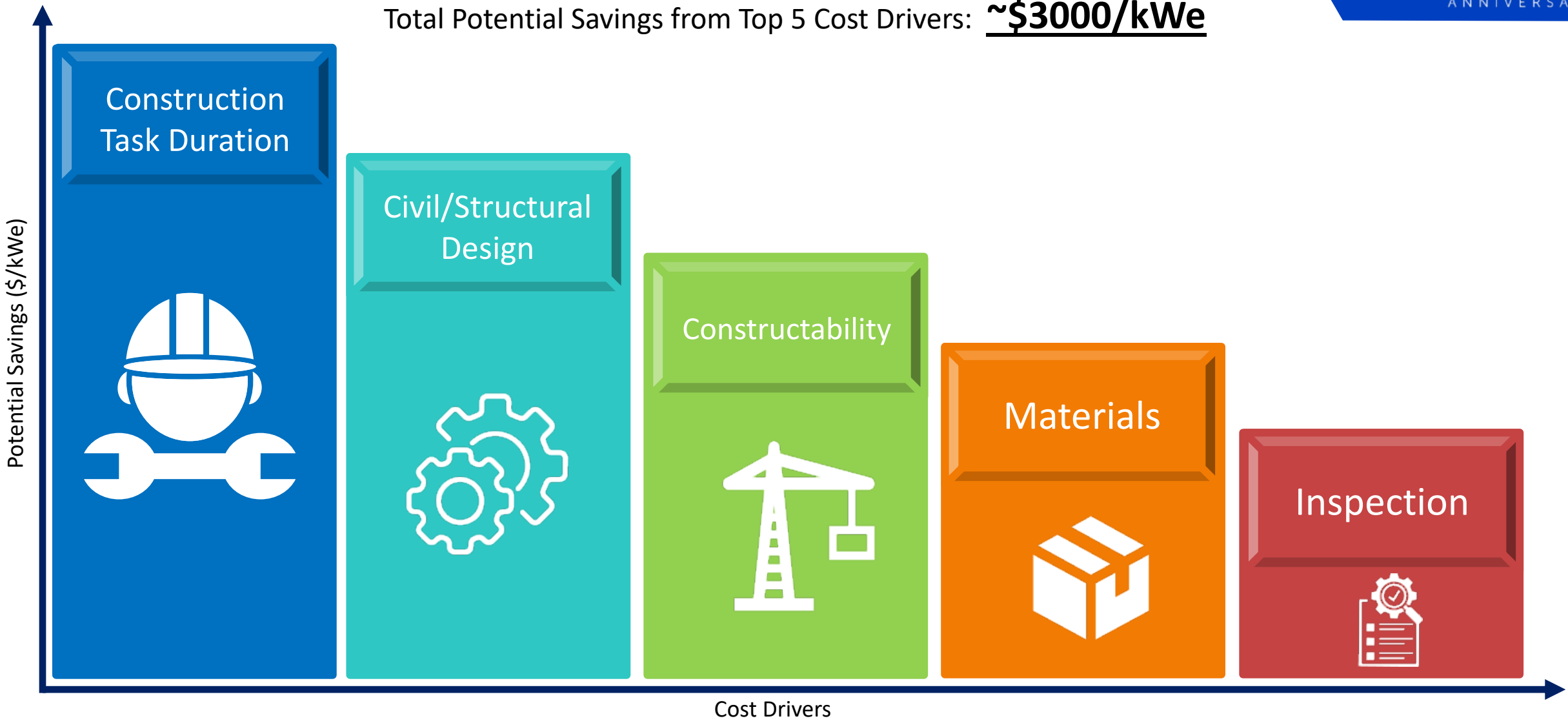
- Competition (technology)
- Capital costs
- Revenue
- Regional factors
- Energy and environmental policies



We've done the modeling to understand what nuclear needs to cost

What Drives Nuclear Costs

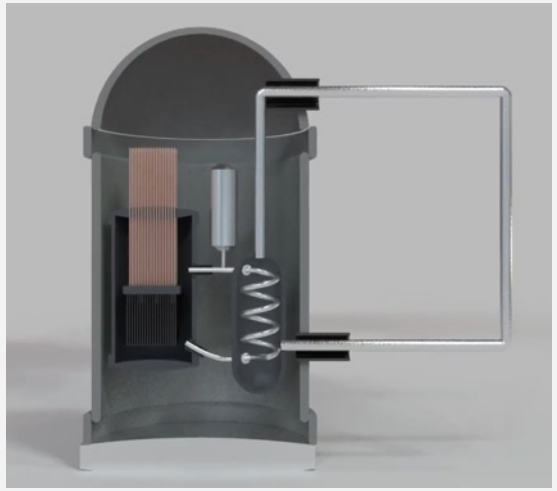
Total Potential Savings from Top 5 Cost Drivers: **~$3000/kWe**



We do impactful research in each of these areas to drive down cost

Shifting Paradigms for the Future Fleet

Through **advanced manufacturing** *innovations* 5-year lead times can be reduced to **<12 months**



By **decoupling** the nuclear island, you could save **$1 Billion** on your Balance of Plant

By supporting **remote** and **autonomous** operation we're optimizing staff to less than **100 people**

We do transformative research to revolutionize the future of nuclear

Demonstrations: *Advanced Manufacturing for SMRs*

- Powder Metallurgy - Hot Isostatic Processing
  - Produces near-net shaped components
  - Eliminates 1000's of hour of machining
  - No welds to inspect
  - Forging: 2-5yr lead time; PM-HIP component produced in 6-12 months
- Electron Beam Welding
  - 10x reduction in typical weld times
  - Demonstrate EBW by fabricating reactor sections
- Diode Laser Cladding
  - Reduces cladding material by > 50%
  - No machining required after application
- **40% Cost Reduction Potential**

EPRI ELECTRIC POWER RESEARCH INSTITUTE

U.S. DEPARTMENT OF ENERGY

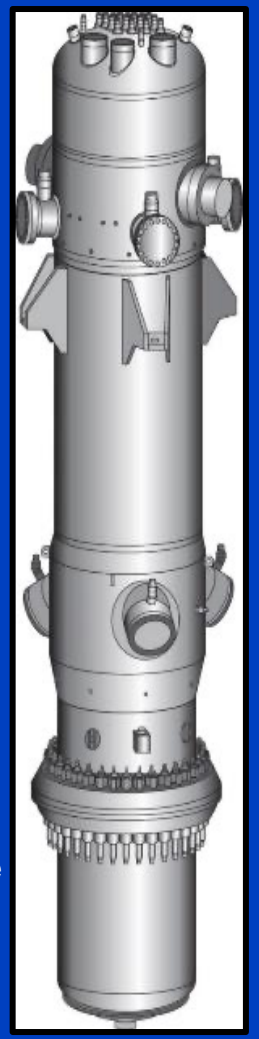
NUCLEAR AMRC

NUSCALE Power for all humankind

PM-HIP: No Welds!

1.8m Flange & Head Welds: 47 minutes!

DLC: no machining

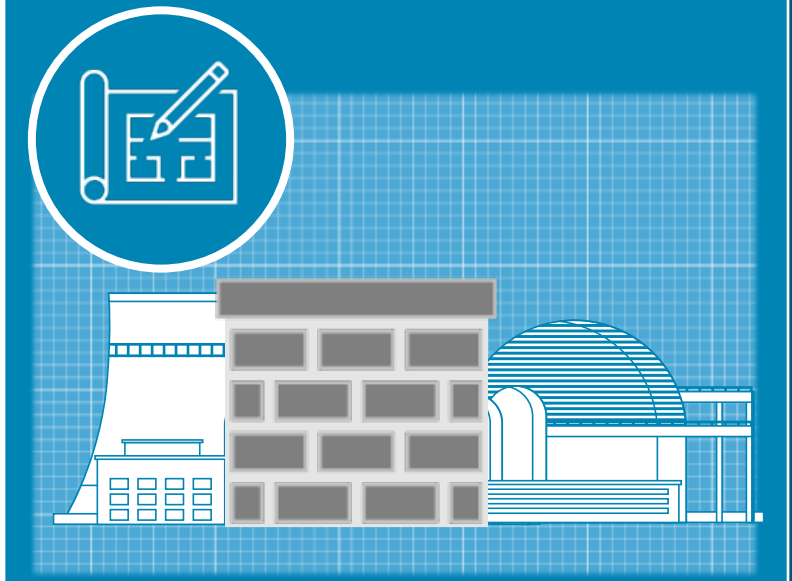


Representative Model of NuScale Power RV

DOE Project DE-NE0008629

Decoupling the Nuclear Island

Technical Basis



- ✓ Functional Separation
- ✓ Physical Separation

Project Execution

- ✓ Division of responsibility
- ✓ Contracting
- ✓ Site layout

Operation & Maintenance

- ✓ Organization
- ✓ Tools
- ✓ Processes

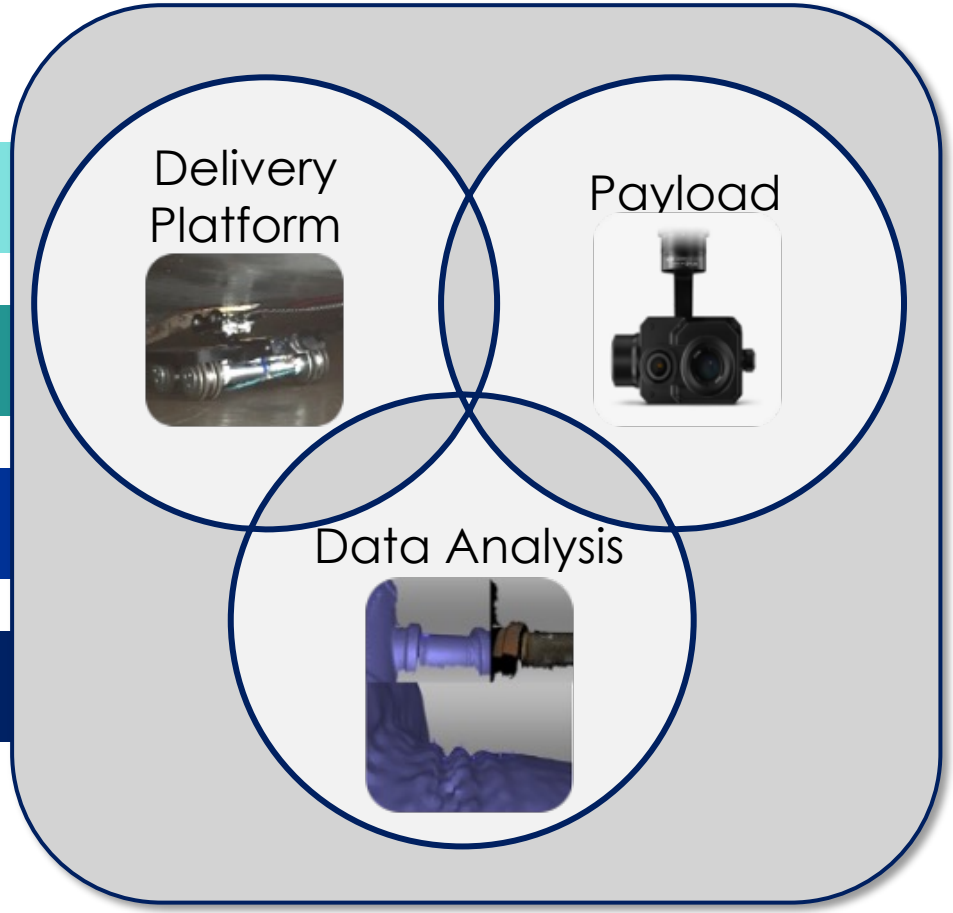
In Progress

Robotics and Automation

Automation Principles

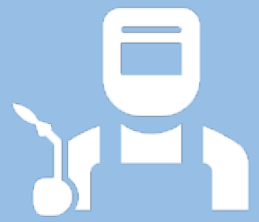
- Safe → Embrace Safety-First Principles
- Reliable → More Efficient & Thorough
- Affordable → Optimize Human Staff
- Valuable → Enhanced Archival Data

Robotic Research



Collaborative Projects

Electron Beam Welding for SMRs

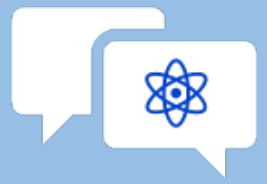


U.S. DOE
NuScale Power

Molten Salt Chemistry and NDE Guidance

Kairos Power

Fusion Forum



Fusion Industry Association

Fast-Spectrum Molten Salt Reactor

Southern Company

Advanced Construction Technologies

GE Hitachi

Rethinking Nuclear Deployment

Coal Plant Redevelopment Series

50% of coal set to retire by 2050, **AMOUNTING TO…**

~2,400
Individual Sites

79 Countries

>2.5 M
Skilled Workers

1,000 GW

Part 1: Solar

(Complete 2021)

Part 2: Advanced Reactors

(2022)

Part 3: Bulk Energy Storage

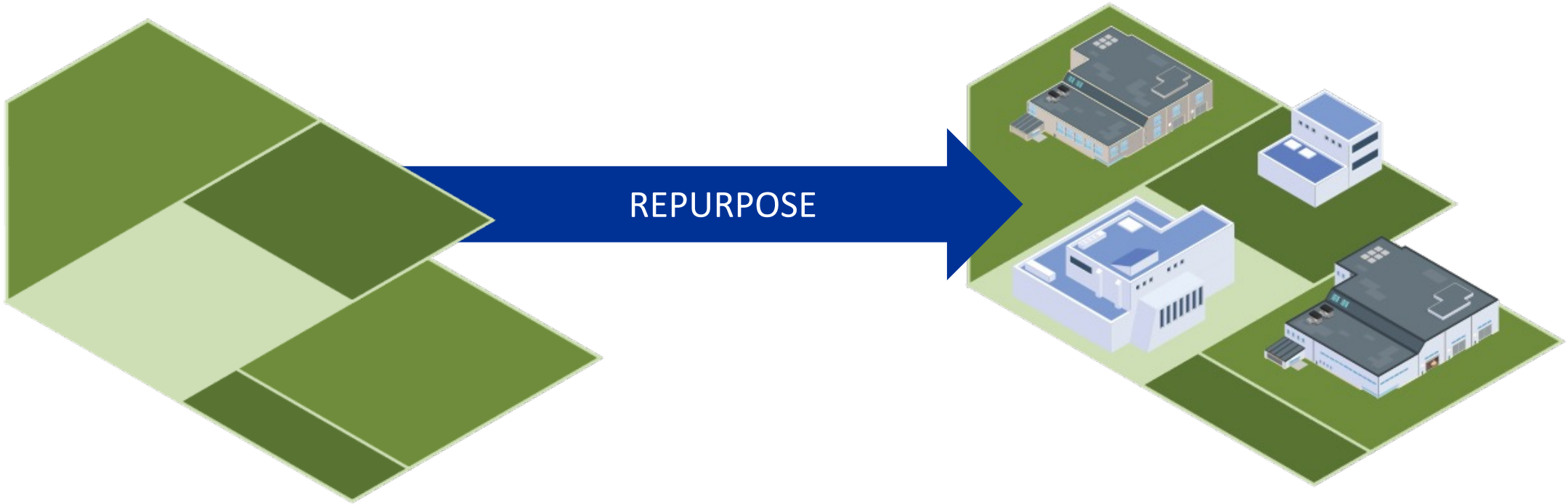
(Planning)

Part 4: Low Carbon Resources

(Future)

Decarbonizing equitably by supporting communities in need

EPRI's Nuclear Siting Guide Updates



Expands siting-related technology considerations for **advanced reactors**

Expands considerations for reuse, including **repowering of coal plants** and reindustrialization of former nuclear fuel cycle facilities

Reviews and expands treatment of social, economic, and **environmental justice** considerations in site selection

North American Advanced Reactor Roadmap

Strategy

A shared (industry-wide) strategy to ensure the success of advanced reactors

Align organizations and foster collaboration in implementing the strategy

Serving government, academic, industrial, and public stakeholders

Timeline