

Advanced Clean Energy

Innovation Cluster Strategic Roadmap



“ Washington VERTical, led by the Port of Benton— accelerating the transition to clean, renewable, and non-emitting energy production sources by 2025 through advanced nuclear power technologies. ”

— Washington State Department of Commerce
Innovation Cluster Accelerator Program Press Release

Message from the Chair



Generating clean energy is vital to protecting the environment for current and future generations. As we look to the future of carbon-free power in Washington state, the Northwest, and the country, the nexus of industry, academia, and community will play an indispensable role in our ability to achieve 100% clean electricity. The ongoing need for collaboration and innovation highlights the importance of organizations like the VERTical Advanced Clean Energy Innovation Cluster. This is an undertaking of paramount importance, and I was therefore honored to be named the inaugural Chair of VERTical's Board of Directors.

Another key reason I'm involved is VERTical's objective to enable the deployment of next-generation nuclear technologies, which is at the heart of my current role at Energy Northwest as its General Manager for Nuclear Development. In that position, I have worked side-by-side with organizations such as VERTical, the Clean Energy Supplier Alliance, and all of industry to bring the first next-generation nuclear project to Washington state—the X-energy Xe-100 small modular reactor project announced in July 2023. This project will be a landmark event in our journey toward zero-carbon power in keeping with national greenhouse gas reduction goals and Washington's Clean Energy Transformation Act (2019).

Nuclear energy is an essential part of a balanced, clean energy portfolio, able to provide baseload power on demand to complement and integrate with intermittent renewable resources. Nuclear energy facilities are designed to operate 24/7—during rain or shine, day or night, and on calm or windy days—to produce electricity more than 90% of the time. The newer, next-generation nuclear designs promise even higher capacity factors and offer great leaps forward in building on already strong safety margins. Nuclear power—together with innovations in hydroelectric, wind, solar, hydrogen, and renewable energy storage—is the all-of-the-above energy strategy needed to achieve greater energy security and address the climate challenge.

I am pleased to acknowledge VERTical's successes since its inception in 2022. I am excited about the future of clean energy and stand ready to support VERTical in achieving its objectives as outlined in this Strategic Roadmap. I look forward to working with all of you.

A handwritten signature in black ink, appearing to read 'Ken Langdon'.

Ken Langdon, Chair

"This region is a winner. It is the most likely place you will see a successful first-of-a-kind or near-first-of-a-kind nuclear technology launched on a big scale."

– Ken Langdon, General Manager, Nuclear Development, Energy Northwest and Board Chair for VERTical on the future of the X-energy small modular reactor project expected to be developed in Richland, WA.

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List of Acronyms

CEO	Chief Executive Officer
CGS	Columbia Generating Station
DOE	U.S. Department of Energy
EBW	Electron Beam Welding
ECA	Energy Communities Alliance
EPRI	Electric Power Research Institute
FCM[®]	Fully Ceramic Microencapsulated
FFRDC	Federally Funded Research and Development Center
FOAK	First-of-a-Kind
GAIN	Gateway for Accelerated Innovation in Nuclear
ICAP	Innovation Cluster Accelerator Program
INL	Idaho National Laboratory
KPI	Key Performance Indicator
kWh	Kilowatt Hour
LCOE	Levelized Cost of Electricity
MMR	Micro Modular Reactor
MW	Megawatt
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NOAK	Nth-of-a-Kind
NRC	Nuclear Regulatory Commission
PNNL	Pacific Northwest National Laboratory
PM-HIP	Powder Metallurgy Hot Isostatic Pressing
PMP[®]	Project Management Professional
PPQ[®]	Port Professional Executive
PPX[®]	Professional Port Executive
RFP	Request for Proposal
SMR	Small Modular Reactor
STEM	Science, Technology, Engineering, and Mathematics
Supplier Alliance	Clean Energy Supplier Alliance
SWOT	Strengths, Weaknesses, Opportunities, Threats
TRISO	TRi-structural ISOtropic Particle Fuel
U.S.	United States
USNIC	United States Nuclear Industry Council
WSU	Washington State University

Innovation Cluster Strategic Roadmap

Executive Summary

Launched in January 2022 with funding from the Washington State Department of Commerce, the VERTical Advanced Clean Energy Innovation Cluster (formerly Washington VERTical) has rapidly expanded into a cohort of more than 160 organizations, including the Clean Energy Supplier Alliance’s 40 members. VERTical has now established itself as a standalone 501(c)(6) nonprofit organization with an independent Board comprised of energy industry leaders. VERTical is poised to have a real impact on the clean energy future—first in the Northwest and then nationwide.



Figure 1. New SMR Project Planned Development.

In July 2023, Energy Northwest and X-energy announced the signing of a joint development agreement for up to 12 Xe-100 next-generation small modular reactors in Richland, Washington that are capable of generating a total of up to 960MW of

This Strategic Roadmap outlines VERTical’s mission, vision, priorities, and near-term focus and activities for the next three years (calendar years 2024-2026). Importantly, our focus and activities are informed by industry feedback and designed to enable and support the clean energy industry in deploying advanced technologies to help achieve local, regional, and national carbon-free objectives.

Among VERTical’s top priorities is enabling the accelerated deployment of next-generation nuclear reactor projects in the region, including the Energy Northwest and X-energy proposed development of a small modular reactor (SMR) project (Xe-100 technology) on a site adjacent to the Columbia Generating Station (CGS). CGS is the Northwest’s only operating commercial nuclear energy facility. Energy Northwest and X-energy target bringing the first Xe-100 module online by 2030.

VERTical's project focus for 2024-2026 include:

- Enabling and supporting deployment of the Energy Northwest and X-energy SMR project near the CGS to achieve operations by 2030
- Enabling and supporting the development and deployment of an advanced manufacturing facility to support domestic fabrication and component manufacturing needs for national deployment of next-generation nuclear technology, including the development and deployment of large-scale Powder Metallurgy Hot Isostatic Pressing (PM-HIP) as an advanced alternative to overseas forgings
- Enabling and supporting a second next-generation nuclear technology deployment (small modular reactor or micro modular reactor) at a second site also near the CGS
- Enabling and supporting a potential regional micro modular reactor (MMR) demonstration project
- Enabling and supporting the Framatome Fuel Facility project to provide advanced fuel for SMR and MMR technologies deployed globally, including TRi-structural ISOtropic (TRISO) particle and Fully Ceramic Microencapsulated (FCM®) fuel for the Ultra Safe Nuclear Corporation's MMR, with fuel fabrication/manufacturing beginning in 2025
- Enabling and supporting the development and deployment of Advanced Reactor Fuel Facility in Central Washington for global markets
- Enabling and supporting Zeno Power System's ocean-to-space Radioisotope Power Systems manufacturing facility beginning in 2026
- Enabling and supporting Atlas Agro's Pacific Green Fertilizer project, which will be powered by clean hydrogen and supporting additional projects in the Pacific Northwest Hydrogen Hub
- Positioning other advanced clean energy technologies for deployment (solar, hydrogen, hydroelectric, and advanced renewable energy battery storage systems) to prepare for future efforts

Peninsula Daily News Poll (Aug./Sept. 2023)

Should nuclear power be on the table for Washington state to meet the Clean Energy Transition Act, which aims for 100% renewable or non-emitting by 2045? **61% YES.**

VERTical supports industry in achieving the priorities listed above through our nine project areas:

- Facilitate next-generation reactor demonstration and deployment projects
- Accelerate advanced manufacturing to onshore and secure the supply chain
- Grow the advanced clean energy market
- Train skilled trades and professional workforces for next-generation nuclear jobs
- Attract capital for next-generation nuclear
- Establish a Northwest Nuclear Quality Management Center of Excellence
- Ready next-generation nuclear energy suppliers
- Coordinate grant partners to leverage state and federal funds
- Educate and advocate for next-generation nuclear energy

VERTical's concept for the Northwest Advanced Clean Energy Park includes SMR and MMR deployment, nuclear fuel fabrication, advanced manufacturing, solar, biofuels, and carbon-free commodities—all combined with a nuclear supply chain and regional nuclear and clean energy workforce.

“Increased capacity for nuclear energy production could be key to helping the United States and Canada meet national energy, economic, climate, environmental, and security goals.” – EPRI and NEI Advanced Reactor Roadmap Phase 1: North America (May 15, 2023)

1.0 Introduction to VERTical

VERTical was launched in January 2022 with a Washington State Department of Commerce investment of \$400,000 through its Innovation Cluster Accelerator Program (ICAP) with funding from the U.S. Department of Commerce’s Economic Development Administration to support VERTical’s formation and growth. In September 2023, VERTical registered as a 501(c)6 nonprofit organization with a fully independent Board of Directors comprised of nuclear and energy industry leaders from across the U.S. The organization changed its name from Washington VERTical to simply VERTical to acknowledge its broader regional and national impacts. VERTical is administered by Port of Benton, which is a publicly funded municipal corporation established in 1958 to drive economic development. Port of Benton was designated as a nuclear port in 1965 by the U.S. Coast Guard.



Figure 2. Port of Benton-Administered. VERTical is a nonprofit organization administered by the Port of Benton. The Port was designated as a nuclear port in 1965 by the U.S. Coast Guard and is one of only a handful of ports in the nation authorized to handle radioactive materials. The 2,756-acre Port District includes two airports, 16 miles of short-line railroads, 50 buildings, 1 barge slip, and 1 high dock. The Port, along with the city of Richland, offers more than 1,000 acres of industrial property available for siting commercial clean energy projects.

VERTical Geographic Origin with National Impact

- Washington state
- Northwest region
- Broader U.S.

Enabling **Carbon-Free Energy** to meet climate goals

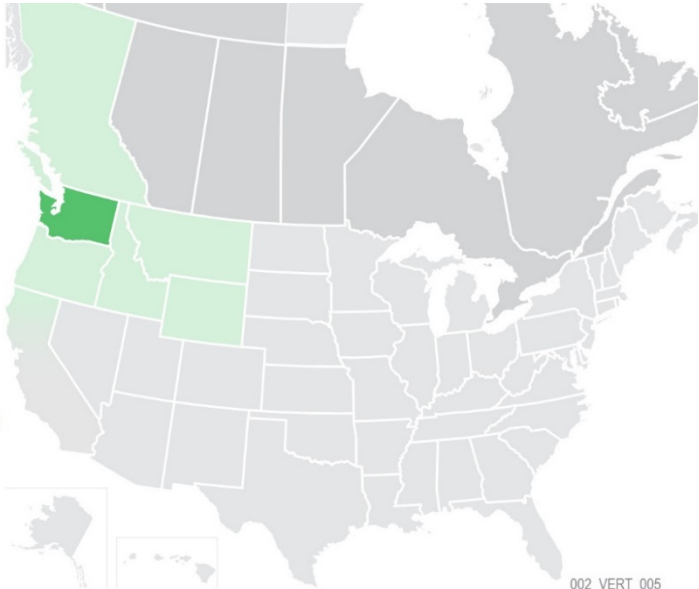


Figure 3. VERTical Geographic Origin with National Impact. With roots in the Tri-Cities, Washington area, VERTical’s focus on next-generation nuclear deployments will have an impact on Washington state, throughout the Northwest, and beyond.

With more than 160 participants, VERTical has grown into a broad-based coalition known as an “innovation cluster.” An innovation cluster is an industry-led consortium that works together to drive innovation, pursue market opportunities, and identify and solve challenges that limit growth. Clusters are comprised of industry leaders, entrepreneurs, government, academia, and investors.

VERTical is one of nine innovation clusters funded by the Washington State Department of Commerce. Others include BUILT (infrastructure decarbonization), CHARGE (hydrogen/e-fuels), EDGE (edge and 5G computing/digital transformation), Advanced Technology Cluster (quantum computing and distributed ledger), EVERGREEN (bioscience/life and health science), WAV-C (autonomous vehicle), and PNWAC (aerospace). Examples of our VERTical cluster makeup are illustrated in **Figure 4**. VERTical’s current actions are to support the early next-generation nuclear deployments originating in the Northwest (the most robust clean energy region in the U.S.) with collaboration between experienced developers, operators, and workers alongside researchers and industry trailblazers.

On May 7, 2019, Washington Governor Jay Inslee signed into law the Clean Energy Transformation Act (SB 5116, 2019), which commits Washington to an electricity supply free of greenhouse gas emissions by 2045. Clean electricity will enable Washington residents and businesses to power buildings, homes, vehicles, and appliances with carbon-free resources, such as wind, solar, hydroelectric, and nuclear.

Industry Leaders	Entrepreneurs	Government	Academia	Investors
Energy Northwest	X-energy	Port of Benton	Pacific Northwest National Laboratory	FUSE Fund
Fluor	NuScale Power	City of Richland	Idaho National Laboratory	Guggenheim Securities
Framatome	TerraPower	State of Washington	Washington State University	Capital 5
Day & Zimmermann	Ultra Safe Nuclear Corporation	Washington State Department of Commerce	Columbia Basin College	Cascade Financial Guarantees, Inc.
General Atomics	Zeno Power Systems	U.S. Department of Commerce’s Economic Development Administration	Center for Adult and Experiential Learning	United States Nuclear Industry Council (USNIC)
Orano	Longview Fusion Energy Systems	U.S. Department of Energy		Climate Capital
	Zap Energy	Nuclear Regulatory Commission		
	Avalanche Energy			
	Renuvi			
	First Mode			
	Atlas Agro			

Figure 4. Snapshot of VERTical Makeup.

VERTical is industry-led, with strategic partners spanning business and labor, entrepreneurs, government, academia (universities and national laboratories), and investors.

Reductions in fossil fuel use will improve the health of communities, grow the economy by creating new clean energy jobs at all wage and skill levels, and enable the state to achieve its long-term climate goals.

1.1 Mission and Vision

The VERTical mission is to support and enable the deployment of next-generation nuclear and other advanced clean energy technologies to accelerate the transition to clean, renewable, and carbon-free energy production sources, creating a sustainable energy future.

Our vision is to become the **leading innovation cluster in the Northwest** by providing meaningful support, collaboration, and **clean energy systems innovation** valued by the nuclear and energy industries within the region and beyond.

The Washington State Department of Commerce Innovation Cluster Accelerator Program (ICAP) goals include:

- Establish Washington as a global leader in key industry sectors (VERTical→ clean energy sector with an initial focus on next-generation nuclear)
 - Support technology transfer and commercialization (VERTical→ SMRs, MMRs, PM-HIP, and others)
 - Accelerate new start-ups and scale-ups (VERTical→ Zeno Power Systems, Ultra Safe Nuclear Corporation, and others)
 - Grow businesses (VERTical→ Framatome, Atlas Agro, and others)
 - Create high-value jobs throughout Washington (VERTical→ recruitments to date: \$480 million and 600-plus jobs secured with \$1 billion and 300-plus jobs pending)
 - Increase export opportunities (VERTical→ PM HIP, future MMRs, and others)
 - Increase and support diversity, equity, and inclusion in business ownership and workforce (VERTical→ 39% small business, 15% woman owned, 5% minority/Native American owned, and others)
-

Nuclear power plants had an 8% share of the total U.S. generation capacity in 2021, but produced 19% of the U.S. electricity, due to their higher capacity factor.

1.2 Purpose, Projects, and Initiatives

Since its foundation in January 2022, VERTical's purpose has centered on the following:

- Facilitate next-generation nuclear energy reactor demonstration and deployment projects
- Establish, maintain, and grow an industry-led, domestic Clean Energy Supplier Alliance to build a supply chain for next-generation nuclear and other advanced clean energy technologies
- Ensure the readiness of the industry's future clean energy skilled trades and professional workforce by creating a talent pipeline

With this in mind, VERTical developed the following nine initiatives, assigned leads and established working groups, and is making progress in all areas:



Facilitate Next-Generation Reactor Demonstration and Deployment.

VERTical collaborates with next-generation reactor companies to identify opportunities, conduct planning, and provide expertise and resources to support these opportunities. For example, VERTical is collaborating with Energy Northwest and X-energy to enable the success of a potential Xe-100

SMR project located adjacent to the Columbia Generating Station.

Accelerate Advanced Manufacturing to Onshore and Secure the Supply Chain. Through its partnership with the Clean Energy Supplier Alliance, VERTical is helping establish regional advanced manufacturing capabilities and facilities to provide domestic fabrication and manufacturing solutions in support of next-generation nuclear deployment.



Grow the Advanced Clean Energy Market. Through its partnership with the city of Richland and others, VERTical will help identify suitable properties for clean energy projects; eliminate encumbrances; help secure funding to enable infrastructure and improvements to create pre-packaged, certified sites for next-generation nuclear reactors and advanced clean energy

technology projects.

Train the Next-Generation Nuclear Skilled Trades and Professional Workforce. VERTical's workforce readiness initiative engages industry, labor, education, and training institutions from elementary to higher education, along with other partners to identify skills gaps and future industry requirements to prepare tomorrow's nuclear-skilled trades and professional workforce.





Attract Capital for Next-Generation Nuclear. This VERTical initiative is focused on helping form a central location for investors to learn about new nuclear industry players, make connections, and focus capital investments to accelerate the deployment of next-generation nuclear power projects.

Establish a Regional Nuclear Quality Management Center

of Excellence. Under the leadership of our Clean Energy Supplier Alliance, this project engages our Supplier Alliance members and VERTical industry partners to create a regional Nuclear Quality Management Center of Excellence. This effort will focus on providing resources and support to regional suppliers in developing required nuclear quality programs to support next-generation nuclear deployment.



Ready Next-Generation Nuclear Energy Suppliers. Under the guidance of our Supplier Alliance, this initiative area includes development and implementation of a program that companies can use to measure their operations against requirements for supplying the nuclear industry. This will enable suppliers to take the necessary steps to close any gaps, which

VERTical and the Supplier Alliance are already supporting with an initial gap analysis.

Coordinate Grant Partners to Leverage State and Federal Funds.

VERTical's grant initiative helps identify grants in the areas of workforce development, supply chain development, advanced manufacturing, and other enablers of the accelerated deployment of next-generation nuclear and other clean energy technologies. The VERTical grant working group brings partners, stakeholders, and industry together to submit collaborative, mutually beneficial applications to help implement successful projects and programs that advance new, clean energy technologies.



Educate and Advocate for Nuclear Energy. VERTical collaborates with local, state, and federal entities for ongoing nuclear energy education and advocacy efforts to build knowledgeable audiences, strengthen relationships, and disseminate factual information. This initiative includes participation in shaping regional, state, and local public policy to enable the accelerated deployment of new nuclear and clean energy.

1.3 VERTical Board of Directors and Leadership

The VERTical Board of Directors was formed in October 2023 with inaugural members hailing from coast to coast. These leaders will help shape and expand the Board to include additional representatives from industry-leading organizations and cutting-edge technology companies.

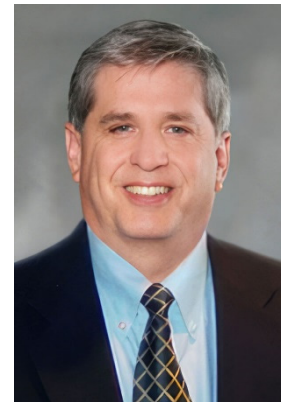
Ken Langdon, Chair

Ken is the Energy Northwest General Manager for Nuclear Development. He joined Energy Northwest in 2023 and has 35 years of nuclear experience. Ken served in the U.S. Navy for eight years and has an extensive background in management at various nuclear organizations, including as Site Vice President at Nine Mile Point for Constellation Energy, Director of Operations at Diablo Canyon Power Plant, Plant Manager at Sequoyah Nuclear Plant for Tennessee Valley Authority, Vice President of Operational Readiness for Westinghouse Electric Company, and Vice President of Operations and Plant Services for NuScale Power, LLC. Ken holds a Bachelor of Science in Workforce Education and Development and a Senior Reactor Operator Certification from LaSalle County Nuclear Station.



Fred Hughes, PMP, Member

Fred is a Fluor Vice President and is the Fluor Project Director working with Longview Fusion Energy Systems to design and engineer one of the first fusion power plants. Fred brings 48 years of nuclear industry experience, including leading construction activities for Westinghouse AP1000 plants and 5.5 years of experience leading the \$2.3 billion cleanup at Idaho National Laboratory, including the startup of operations at the Integrated Waste Treatment Unit. Fred brings more than 20 years in key leadership roles at DOE sites, including Idaho National Laboratory, Hanford, Portsmouth Enrichment Plant, Rocky Flats, and the Nevada Test Site. Fred has a Master of Business Administration in Operations Management, a Bachelor of Science in Operations Research from the U.S. Naval Academy, and is a Project Management Institute-certified Project Management Professional (PMP®).



Jeff Whitt, Member

Jeff is the President of Framatome U.S. Government Solutions LLC and Framatome Director of North America Advanced Reactors. He is responsible for the company’s North American focus on growing the advanced-reactor business and helping to build a strong future for the country’s nuclear industry. Jeff brings 40 years of nuclear industry experience, including fabrication, design, and technical management and holds patents related to the fabrication of nuclear fuel. He spent a period away from the nuclear industry working on the deployment of cellular technology and was the founder/president of a program management firm. Jeff serves various organizations, including the Virginia Nuclear Energy Consortium, the Texas A&M Nuclear Engineering Advisory Council, NEI and USNIC working groups, and the U.S. International Trade Association Working Group for SMRs.



Diahann Howard, PPM, PPX, VERTical Acting Director

Diahann serves as the acting director of the VERTical Advanced Clean Energy Innovation Cluster. Diahann is the Executive Director of the Port of Benton and has served in that role since 2019. Previously, Diahann served as Port of Benton’s Director of Economic Development and Governmental Affairs. Before joining the Port in 2006, she was the Economic Development Manager for city of Richland. Diahann earned a Professional Port Manager (PPM®) certification in 2019 and was named a Port Professional Executive (PPX®) by the American Association of Ports in 2023. Diahann currently serves on the boards of Visit Tri-Cities, Eastern Washington University Presidential Advisory Board, DOE Environmental Management Advisory Board, and others. She has a Bachelor of Science in International Affairs from Eastern Washington University.



VERTical will add additional Board members in 2024, with a focus on nuclear technology, nuclear industry/clean energy leaders, and diversity in membership. Also in 2024, VERTical plans to hire a full-time Director to serve the Board in leading and implementing VERTical initiatives.

1.4 VERTICAL Partners and Cohort

VERTical has grown to a cohort of 160 partners, stakeholders, and entities. VERTICAL is an open membership cohort with no required dues and corporate donations are welcomed and encouraged. VERTICAL holds quarterly meetings and participates in the meetings of its associated Supplier Alliance. The following is a representative sampling of the VERTICAL cohort.

Key Stakeholders & Partners

- Port of Benton (Administrator)
- American Bureau of Shipping
- Benton County
- Central Washington Building & Construction Trades Council
- City of Richland
- City of West Richland
- City of Everett
- Clean Energy Supplier Alliance
- CleanTech Alliance
- Columbia Basin College (academic partner)
- Energy Communities Alliance
- Energy Forward Alliance
- Energy Northwest (power utility partner)
- Fuse
- Idaho National Laboratory (FFRDC partner)
- Institute for Northwest Energy Futures
- International Union of Operating Engineers Local 302
- Maritime Blue
- Pacific Northwest Aerospace Alliance
- Pacific Northwest National Laboratory (FFRDC partner)
- Plumbers and Steamfitters Local Union 598
- Small Business Development Center
- Tri-Cities Research District
- Tri-City Development Council
- U.S. Department of Commerce's Economic Development Administration
- Washington State Department of Commerce
- Washington State University Tri-Cities (academic partner)
- Washington Technology Industry Association

Industry & Technology Partners

- ATI Materials
- Atlas Agro
- Avalanche Energy
- Avantech
- Bechtel
- Burns & McDonnell
- Christensen
- Curtiss-Wright
- Day & Zimmermann
- Energy Northwest
- First Mode
- Fluid Controls and Components, a division of Dupill Group
- Fluor
- Framatome
- General Atomics
- Hotrock Energy Research Organization
- Jacobs
- NuScale Power
- Orano
- NuScale Power
- Sargent & Lundy
- Schweitzer Engineering Laboratories
- STARS Technology Corporation
- TerraPower
- Tetra Tech
- Ultra Safe Nuclear Corporation
- Veolia North America
- X-energy
- Zap Energy
- Zeno Power Systems

Small Business Partners

- Advantek
- Arbaugh & Associates
- ARY Engineering
- Columbia Basin Consulting Group
- Columbia Energy
- Elite Construction
- Excelsior Design
- Green Grid Inc.

- Hadron Intrinsic Consulting, LLC
- HiLine Engineering & Fabrication
- Indian Eyes LLC
- Infinia Technology Corporation
- Iron Mountain Management
- Norton Strategic Consulting
- UFA Ventures

Other Suppliers & Partners

- Benton PUD
- Capital 5
- Cascade Financial Guarantees, Inc.
- Center for Adult and Experiential Learning
- Climate Capital
- FIRST Washington
- Franklin PUD
- FUSE Fund
- Guggenheim Securities
- Grant PUD
- Greater Spokane Incorporated
- Hanford Area Economic Investment Fund Advisory Committee
- Hanford Communities
- Inland Northwest Aerospace Consortium
- Johnston Engineering
- Meier Architecture • Engineering
- Raquel Crowley, Office of U.S. Sen. Patty Murray
- U.S. Congressman Newhouse
- Sen. Matt Boehnke
- Sen. Nicki Torres
- Rep. Stephanie Barnard
- Rep. April Connors
- Rep. Skyler Rude
- United States Nuclear Industry Council (USNIC)
- U.S. Department of Energy
- U.S. Nuclear Regulatory Commission
- Washington River Protection Solutions

1.5 Clean Energy Supplier Alliance (Supplier Alliance)



Clean Energy Supplier Alliance

The Supplier Alliance is a nonprofit, industry-led membership organization established to accelerate the development of **supply chain solutions for nuclear energy technologies** in support of next-generation nuclear and other advanced clean energy technologies. The Supplier Alliance meets monthly.

The Supplier Alliance was formally established as a nonprofit organization in December 2022 as one of the early initiatives of VERTical. The Supplier Alliance brings together business and labor members to address supply chain gaps, create competitive solutions, and foster

innovation and its members partner to pursue new market opportunities. Key areas of Supplier Alliance focus include: (1) nuclear supplier quality, (2) next-generation nuclear supply chain workforce, (3) nuclear supplier readiness, and (4) supply chain acceleration. The Supplier Alliance is led by CEO Dave McCormack (a 45-year veteran of the nuclear industry) and governed by its own eight-member Supplier Alliance Board of Directors:

- Steve Anderson, Supplier Alliance Board Chair—former President of Meier Architecture & Engineering (retired)
- Meghan Rose, Supplier Alliance Board Vice Chair—founder and CEO of Iron Mountain Management
- Dan Tyler, Supplier Alliance Board Secretary and Treasurer—founder and Chair at Freestone Environmental Services (retired)
- John Gonsky, Supplier Alliance Member—Vice President of DOE and Nuclear Programs for Tetra Tech, Inc.
- Patrice McEahern, Supplier Alliance Member—President of HukariAscendent
- Kathy Miller, Supplier Alliance Member—CEO of Polestar Technical Services, Inc.
- Michael Scrimsher, Supplier Alliance Member—Manager for Uranium, Uranium Recovery and Cylinders for Framatome
- Russ Watson, Supplier Alliance Member—Vice President of Fluid Controls and Components Inc. (a Division of the Dupill Group)

Supply Chain Advantages that the Supplier Alliance Delivers











































Figure 5. Supplier Alliance Advantages.

The Clean Energy Supplier Alliance is focused on readying the supply chain to enable the success of next-generation nuclear and advanced clean energy technologies.

As of October 2023, the Supplier Alliance has grown to 40 members.

Supplier Alliance Members

	ANR Group Inc		Hecate Software
	ATL Advanced Tech & Labs		HiLine Engineering & Fabrication Inc
	Armitage Engineering		HukariAscendent
	ARY Engineering		Iron Mountain Management
	Babcock Services Inc		ISMSolutions
	BID Designs		Johnston Engineering
	Burns & McDonnell		Lampson International
	Campbell Training Solutions		Lucas Engineering & Management Services, Inc
	Central Washington Building & Construction Trades Council		Meier Architecture – Engineering
	Day & Zimmermann		NV5/Dade Moeller
	Edgewater		NW Technical Resources, Inc.
	Elite Construction + Development		Orano Federal Services
	Energy Northwest		Perma-Fix Northwest – Richland, Inc.
	Environmental Assessment Services		Plumbers & Steamfitters
	Fluid Controls and Components Inc (FCCI), a division of the Dupill Group		Polestar Technical Services
	Fluor Federal Services		Sargent & Lundy
	Framatome		Schweitzer Engineering Laboratories
	Freestone Environmental Services, Inc.		Tetra Tech, Inc.
	Gravis Law		HiLine Engineering & Fabrication Inc
	Hadron Intrinsic Consulting, LLC		Veolia

“Through the Clean Energy Supplier Alliance, we connected with a green energy technology company and landed our largest job to date. We couldn’t have done it without the Supplier Alliance’s leadership, knowledge, and ability to attract and connect all the right players.” —*Andy Johnston, Johnston Engineering*

2.0 The VERTical Journey

This section outlines key accomplishments of VERTical and major events since 2019.

2.1 2023 Key Progress and Accomplishments

Since its formation in 2022, VERTical has made significant progress on its Goals and Key Performance Indicators (KPI), as shown in **Figure 6**.

Goal/KPI	Key Accomplishments
<p>VERTical Framework (Establish VERTical, including charter, standards, and procedures – COMPLETE)</p>	<ul style="list-style-type: none"> ■ VERTical received initial funding from the Washington State Department of Commerce and began startup activities in January 2022; the VERTical Steering Committee was formed to participate in meetings with Commerce. ■ VERTical was formally established as an independent 501(c)(6) organization in June 2023. ■ VERTical's independent Board, comprised of industry leaders, held its first official Board meeting on October 17, 2023. ■ VERTical's Board approved the organization's official Bylaws and Articles of Incorporation in October 2023, which include the organization's purpose, charter, standards, and codes. ■ Administered by the Port of Benton, VERTical leverages and applies the Port policies, procedures, and programs for procurement, contracting, human resources, and other programmatic functions. ■ VERTical's website was launched in the third quarter of 2022.
<p>Vertical Diversity (Recruit small and diverse businesses, entrepreneurial ventures, and start-ups with a goal to increase diverse participation by 10% annually – ONGOING)</p>	<ul style="list-style-type: none"> ■ As of October 2023, the VERTical cohort included 160 entities, of which 39% were small businesses, including 15% women-owned, 5% minority and disadvantaged (including Native American-owned), and 3% entrepreneurial start-ups. ■ Supplier Alliance membership includes 39% small business, 15% women-owned, and 5% minority and disadvantaged (including Alaskan Native and Tribal-Owned). ■ 100% of VERTical's total subcontracted dollars have gone to small businesses since its inception in January 2022 and VERTical has subcontracted to the following diverse and/or small businesses – OnPoint Power, LLC (woman-owned); Sprout (woman-owned); Calyx Development Services (woman-owned); Prominence Public Relations (woman-owned); McCormack Consulting; and Gravis Law. ■ VERTical is sponsoring STEM education and entrepreneurship events targeted at historically underrepresented populations. ■ VERTical partner and cohort entity WSU-Tri-Cities won its second DOE diversity prize and plays a leadership role in diversity KPIs for VERTical. ■ VERTical follows the Port of Benton's procurement and DBE policy to seek to increase procurement by 3%.

<p>VERTical Membership</p> <p>(Achieve 50 members by Year 3 – COMPLETE)</p>	<ul style="list-style-type: none"> ■ VERTical has two membership elements: (1) a non-paid membership element defined as the VERTical cohort, which includes our partners, stakeholders, active participants, Supplier Alliance members, and other entities that are engaged through various VERTical communication mechanisms and (2) dues-paying members of VERTical’s partnership with the Clean Energy Supplier Alliance. ■ As of October 2023, the VERTical cohort had grown to 160 entities. ■ As of October 2023, the Supplier Alliance had 40 dues-paying members (members of the Supplier Alliance are also considered to be entities within the VERTical cohort).
<p>VERTical Funding</p> <p>(ONGOING)</p> <p>(Achieve self-funding within three years – ONGOING)</p>	<ul style="list-style-type: none"> ■ Since its establishment, VERTical’s funding sources have included the ICAP Grant (\$400,000), Evergreen Manufacturing Grant (\$200,000), and Port of Benton in-kind services (\$139,000). ■ VERTical-secured non-ICAP grants and Port of Benton in-kind services comprise nearly 46% of VERTical’s total funding with Port of Benton in-kind services accounting for 19% of VERTical’s funding. Beginning in 2024, 10% of Supplier Alliance dues will also contribute toward VERTical funding. <i>Note: The Supplier Alliance is currently self-funded.</i> ■ VERTical’s grant project initiative has identified several outside federal grant sources that VERTical has applied for and VERTical plans to collaborate with the city of Richland, Energy Forward Alliance, and others on potential funding sources outside of ICAP. ■ VERTical anticipates needing to secure the ICAP second phase funding to continue operations for 2024 and plans to achieve self-funding in 2025.
<p>Increase clean energy collaboration and advocacy in Central Washington</p> <p>(ONGOING)</p> <p>(Hire 1.5 full-time resources – COMPLETE)</p>	<ul style="list-style-type: none"> ■ VERTical is led by a combination of existing Port of Benton staff (e.g., Diahann Howard serves as the Acting Director and Lead Administrator of VERTical) and is supported by contract staff (e.g., McCormack Consulting leads the Supplier Alliance and coordinates several projects for VERTical; OnPoint Power, LLC provides strategic support and direction; Calyx Development Services provides grant research, strategy, and writing support; Prominence Public Relations provides communication support; and Gravis Law provides legal support). ■ Together, these roles equate to more than 1.5 full-time equivalent staff; Ms. Howard is further supported by Port of Benton commercial, finance, legal, contracts, and outreach support staff. ■ Collaboration and advocacy: Established VERTical Advocacy and Education Project Team to include Washington 8th, 9th, and 16th District legislators. ■ VERTical collaborates with other innovation clusters, stakeholders, partners, and community organizations.

<p>Formation of VERTical entity, recruiting of new industry, government, and academic partners</p> <p>(COMPLETE)</p>	<ul style="list-style-type: none"> ■ Formation documents for new VERTical 501(c)(6) nonprofit organization submitted to the Washington Secretary of State in June 2023. ■ VERTical independent industry-led Board held its first meeting in October 2023 in Richland, WA. ■ VERTical cohort has more than 160 entities, including industry, government, academic partners, stakeholders, entrepreneurs, and others.
<p>Formation of domestic clean energy supply chain alliance</p> <p>(COMPLETE)</p> <p>(Grow Supplier Alliance to achieve 50-100 members by Year 5 in 2026 – ONGOING)</p>	<ul style="list-style-type: none"> ■ Established Clean Energy Supplier Alliance in December 2022 under the leadership of Dave McCormack. ■ Supplier Alliance Board is fully established. ■ Current Supplier Alliance Membership consists of 40 paying members. ■ Strategic recruitment efforts continue targeting key local, regional, and national nuclear and clean energy supply chain. ■ The Supplier Alliance is on track to achieve more than 50 members well in advance of 2026. ■ Supplier Alliance participated in EPRI Supply Chain Workshop for Advanced Energy Systems on April 12-13, 2023.
<p>Identification of gaps within supply chain.</p> <p>(COMPLETE)</p>	<ul style="list-style-type: none"> ■ VERTical, through the Supplier Alliance, leveraged Clean Energy Supply Chain, Nuclear Energy Deep Dive reports, and Pathways to Commercial Liftoff: Advanced Nuclear (all efforts by DOE) and discussions at the Advanced Reactor Summit, as well as World Nuclear Association reports. ■ VERTical has obtained additional supply chain gap analyses through Gateway for Accelerated Innovation in Nuclear (GAIN) – Idaho National Laboratory. ■ VERTical and the Supplier Alliance are working in collaboration with GAIN and PNNL, including visits and industry days.
<p>Facilitation of collaboration among members</p> <p>(Regular meetings, industry events, identify gaps, and participate in cluster leadership program with Washington DOC – ONGOING)</p>	<ul style="list-style-type: none"> ■ VERTical participates in monthly meetings of its Supplier Alliance and hosts quarterly VERTical meetings. ■ VERTical sponsored and participated in April 4-7, 2023 Advanced Reactor Summit. ■ VERTical participates in regular Washington State Department of Commerce meetings on ICAP. ■ VERTical participated in Clean Energy Convening event in March 2023. ■ VERTical is collaborating with industry on 2024 conference in Tri-Cities area. ■ VERTical participated in I-90 Aerospace Corridor conference with Evergreen Cluster May 2023. ■ VERTical planning coordination and networking events with the CleanTech Alliance and the Washington Technology Industry Association. ■ VERTical and X-energy joined Washington Technology Industry Association on application for Tech Hub application as part of that cohort.

	<ul style="list-style-type: none"> ■ VERTical convened regional meetings in support of Framatome and Ultra Safe Nuclear Corporation opportunities that included Framatome’s CEO Bernard Fontana and Senior Executive Vice President Lionel Gaiffe.
<p>Advocacy for clean energy (Proposals for policy or incentives to support the sector statewide – ONGOING)</p>	<ul style="list-style-type: none"> ■ Nuclear energy advocacy and education is one of VERTical’s nine project initiative areas with an established working group and VERTical’s advocacy and education project team includes Washington’s 8th, 16th, and 9th district legislators, as well as coordination with other clusters. ■ Examples of VERTical advocacy include participation in Sen. Matt Boehnke’s Supply Chain Caucus; support for SB5901 for manufacturing incentives, HB1958 for shovel-ready sites, HB1864 for tax credits, and SB5600 for apprenticeships; and participation on the Board for the newly formed Clean Future Northwest (a state and national education and advocacy nonprofit). ■ VERTical holds Clean Energy Day in Olympia, January 2023. ■ VERTical supports increased investment in trades, apprenticeships, and education certifications to help develop a workforce pipeline for next-generation nuclear.
<p>Successful build out of Tri Energy Partnership along with related clean energy project (Inventory of certified suppliers, active members - ONGOING)</p>	<ul style="list-style-type: none"> ■ In July 2023, Energy Northwest and X-energy announced the signing of a joint development agreement for up to 12 Xe-100 next-generation small modular reactors in Central Washington capable of generating a total of up to 960 MWe of carbon-free electricity. ■ In March 2023, Atlas Agro signed a contract to purchase 150 acres of Port of Benton property at the North Horn Rapids Industrial Park as the site for Atlas Agro’s Pacific Green Fertilizer project, which will be powered by clean hydrogen and supports key VERTical priorities (pictured are Port Commissioner Lori Stevens, Atlas Agro Director of Policy and Government Relations Gina Zejdlik, Atlas Agro North America Executive Director Dan Holmes, Port Commissioner Christy Rassmussen, and Port Executive Director Diahann Howard). ■ VERTical, its partners, and stakeholders have been actively collaborating with the TRI Energy Partnership to ensure long-term project success. ■ Ken Langdon of Energy Northwest is VERTical’s newly elected Board chair, which will further strengthen collaboration among VERTical cohort partners and stakeholders.



<p>Outreach and collaboration to raise awareness</p> <p>(Outreach events, speakers, webinars, networking events, TC trade show by year three, survey/polling, financial resources/capital – ONGOING)</p>	<ul style="list-style-type: none"> ■ The VERTical website launched in the third quarter of 2022. ■ Presentations and participation at the April 4-7, 2022 Advanced Reactor Summit; State of Energy event in Tri-Cities November 2022; ABS in September 2023; new nuclear presentations with WSU-Tri-Cities and Energy Northwest at Richland Library. ■ Nine companies hosted as part of PNNL GAIN event in April 2023. ■ Preparations for POWERS and POWERGEN conferences in January 2024. ■ Flyers, talking points, questions and answers, fact sheets, banners, and tours developed for public awareness and education. ■ Washington Fast Facts on Nuclear flyer created and posted to website. ■ Animated video about the Northwest Advanced Clean Energy Park created and posted to VERTical website. ■ Conducting survey on Advanced Reactor Technologies (ongoing November 2023). ■ Conducted a total of 21 site visits to Richland, WA, during 2022-2023.
<p>Workforce – develop pipeline for clean energy</p> <p>(Training, education, job opportunities at all levels – ONGOING)</p>	<ul style="list-style-type: none"> ■ Collaborated with VERTical partners, including local unions, WSU, Columbia Basin College, TRIDEC, Tri-Cities Research District, and Worksource on workforce development. ■ Meetings with PNNL, Idaho National Laboratory, State of Idaho Department of Commerce and Economic Development on further workforce development collaboration opportunities. ■ Established focused initiative/project and working group for workforce development. ■ VERTical is moving forward, working with local labor on the Apprenticeship Readiness Program to be launched in 2024.
<p>Growth of VERTical</p> <p>(Website, database, number of recruitment proposal packages and site visits – ONGOING)</p>	<ul style="list-style-type: none"> ■ VERTical website is fully established and is receiving increased interest, with the engagement rate reaching nearly 85% in November 2023. ■ Our database of cohort entities has reached more than 160 as of October 2023 and continues to grow. ■ VERTical has submitted four grant applications and proposal packages since January 2022. ■ VERTical has conducted 12 site visits in 2023, including visits by Stack Metallurgical Group, Ultra Safe Nuclear Corporation, Zeno Power Systems, Atlas Agro, GAIN, confidential technology companies and several developers (OKLO, Lightbridge, TerraPower, Moltex, and Materion). ■ In April 2023, VERTical, in collaboration with TRIDEC, received a \$200,000 Evergreen Manufacturing Grant award for an Advanced Manufacturing Center focused on attracting technology companies critical to the Small Modular Nuclear Reactor supply chain, including large-scale Powder Metallurgy, Hot Isostatic Pressing, and Electron Beam Welding. The grant supports conducting a readiness assessment and business and market analysis, with total job creation estimated to be 50-100 jobs.

- The Supplier Alliance formed teams and submitted responses to multiple funding opportunities involving PM-HIP, including the Advanced Technology Large Scale (ATLAS) PM-HIP Project Expression of Interest, the Office of Energy Efficiency and Renewable Energy Domestic Near Net Shape Manufacturing, and an expression of interest to the U.S. Navy.

Figure 6. Key Performance Indicators.

Of its original 12 KPIs, VERTical has completed four and is on track toward achieving the remaining eight.

2.2 The VERTical Timeline

VERTical’s timeline, shown in **Figure 8**, depicts many relevant events in VERTical’s history, from the signing of the Washington Clean Energy Transformation Act in May of 2019 to the award of federal and state grant funds in January 2022 that catalyzed the creation of VERTical, to announcements in 2023 regarding the development agreement between Energy Northwest and X-energy for the first-ever next-generation small modular reactor project in Washington.

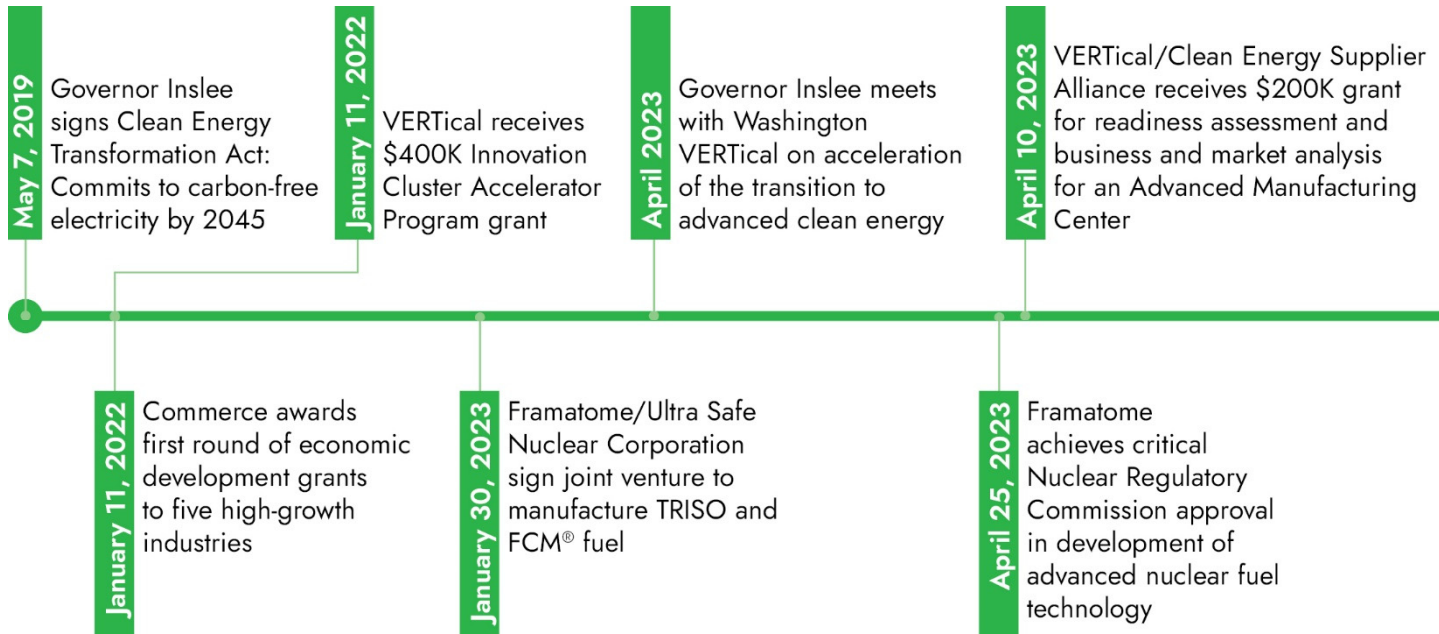


Figure 7. The VERTical Timeline.

The VERTical journey has at its inception the state and national focus on transformation to clean and carbon-free electricity, including the Washington Clean Energy Transformation Act signed in 2019 with a carbon-free goal by 2045.

Multiple Xe-100 SMRs planned for Washington State

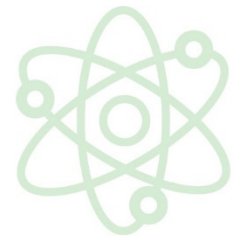
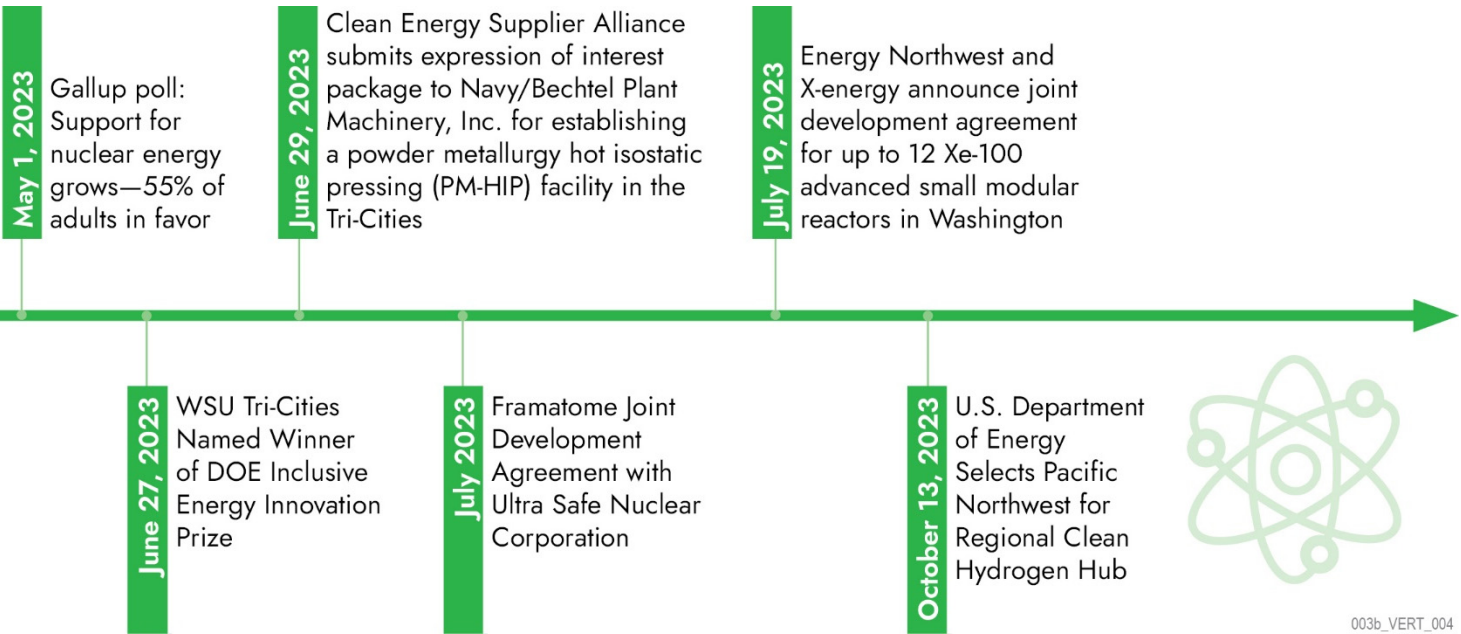
19 July 2023

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A joint development agreement (JDA) has been signed between US utility Energy Northwest and X-Energy Reactor Company for the deployment of up to 12 Xe-100 small modular reactors (SMRs) in central Washington State. Energy Northwest expects to bring the first Xe-100 module online by 2030.



The Columbia Generating Station (Image: Energy Northwest)



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3.0 Solutions Shaped by Industry

3.1 Summary of Next-Generation Reactor Technology Survey Results

In Q4 FY2023, VERTical, working in collaboration with the Supplier Alliance and OnPoint Power, LLC, conducted a next-generation reactor technology survey and individual interviews of next-generation nuclear technology vendors and supply chain members. Conducted anonymously, respondents included SMR and MMR technology providers and nuclear supply chain members.

Next-Generation Nuclear Deployment Forecasts. While the majority of the respondents declined to provide their out-year forecasts, several respondents provided some level of detail, including plans to have between 11 to 20 units operational by 2040 and some predicting booking 10 projects per year beginning in 2028, with others predicting as many as three orders per month starting in 2029. The earliest respondents anticipated having their first units online and operational in the 2028-2030 timeframe.

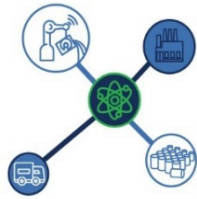
Most and Least Likely States for Next-Generation Nuclear. Respondents indicated they saw the most likely states for successful next-generation nuclear reactor deployments as Texas, Tennessee, Virginia, Idaho, Wyoming, and Georgia. States also noted as likely deployment targets included Alaska, Washington, Montana, Arizona, and Ohio. For comparison, the current top nuclear power producing states (from existing nuclear power plants) include Illinois, Pennsylvania, South Carolina, North Carolina, Alabama, Texas, Tennessee, Georgia, Arizona, and Florida.

The states noted as least likely for successful advanced reactor deployment included California and New York, with all respondents indicating these as unlikely targets. Others designated as least likely included Oregon, Maine, Massachusetts, Vermont, Connecticut, Rhode Island, and Illinois. These results are consistent with historical data regarding states recognized as being anti-nuclear (California, New York, Oregon, and Maine).

WESTERN U.S. NEXT-GENERATION NUCLEAR

- TerraPower Sodium Reactor Demonstration Project in Kemmerer, Wyoming with an expected operations date by 2030.
- X-energy's small modular reactor project for Dow in Seadrift, Texas under the DOE Advanced Reactor Demonstration Program with construction start in 2026 and operations by 2030.
- X-energy's Xe-100 small modular reactor project planned for Energy Northwest located in Richland, Washington adjacent to the existing Columbia Generating Station with SMR operations by 2030.

TARGETING OPERATIONS BY 2030.



Top Challenges in Deploying Advanced Reactor Technologies.

Respondents indicated that the top five challenges impacting successful deployment of advanced reactor technologies in the U.S. include: (1) increasing costs and timeframes to build, (2) timeframes for NRC licensing and NRC licensing risk, (3) availability of a supply chain for nuclear components (domestic and international), (4) availability of a nuclear-skilled operations workforce, and (5) lack of domestic U.S. services and manufacturing companies with acceptable/needed nuclear quality programs. Additional challenges flagged by industry include local politics, local permitting process timeframes and uncertainties, and availability of a skilled construction workforce. The areas identified by industry through the VERTical survey and interviews align with the EPRI and NEI enablers and key issues identified in their May 2023 Advanced Reactor Roadmap Phase 1: North America report (e.g., regulatory efficiencies, siting and permitting, public acceptance, supply chain, and workforce).



With respect to skilled trades and professional workforce availability, respondents listed the following potential resource shortages impacting successful deployment: nuclear engineers, licensing engineers, instrumentation and control technicians, nuclear operators/reactor operators, and nuclear-qualified project managers, as well as specialists in core physics and quantitative modeling. When asked about interest in a system-wide workforce modeling tool that enabled workforce forecasting over time tied to both deployment schedule and talent pipelines (universities, trade schools, and training programs) on a regional and national level, all respondents indicated “yes” or “maybe” and ranked it between 6 and 8 (on a scale of 1-10 with 10 being most important).

Regarding major supply chain gaps, the top gap identified was availability of advanced reactor fuel, followed by large forgings and fabrication needs, domestic manufacturing capabilities, and availability of advanced components and specialty alloys. In addition, nuclear supply chain respondents cited engineering, electrical products, safety services, transportation services, piping, and structural steel in their top five lists.



With respect to factors impacting NRC licensing, respondents cited: (1) NRC regulatory requirements that are out-of-date or misaligned with future advanced reactor needs, (2) a lengthy NEPA review process, (3) NEPA and NRC licensing aspects that do not account for SMR and MMR safety factors, (4) extended timing and high cost of NRC licensing, (5) lack of NRC staff for timely review, and (6) inexperienced technology licensing staff resulting in poor submittal quality.



For factors impacting local siting and permitting, challenges identified included citizen/public support, resources and staff availability for state and local permitting entities, the unique nature of SMR and MMR, lack of state and local regulations specific to unique siting aspects, and lengthy state and local permitting process with uncertain results.

Advanced Reactor Survey Results

Respondents' opinions on states' stances regarding advanced nuclear technology.

- Most likely for advanced nuclear
- Additional deployment targets
- Least likely for advanced nuclear
- Less likely for advanced nuclear
- Traditionally anti-nuclear
- Current top nuclear power producers

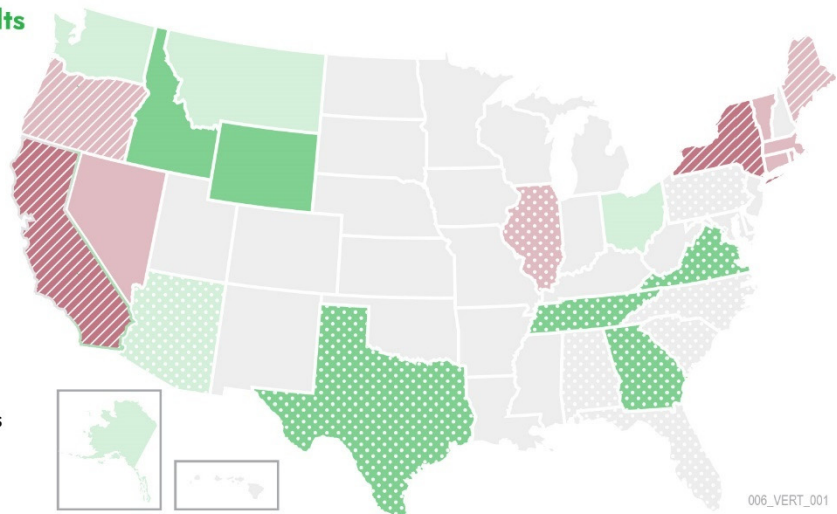


Figure 8. Targeted States for Next-Generation Nuclear.

Industry respondents identified 10 states (varying shades of green) as most likely for next-generation nuclear deployments and nine states (varying shades of red) as least likely for next-generation nuclear deployment.

State and Local Incentives to Recruit and Enable Next-Generation Nuclear. Respondents cited the following incentives that would positively impact their decision to site an advanced reactor project in a particular state or community:

- Property tax exemptions, credits, and abatements
- Investment and corporate income tax credits
- Business tax incentives, exemptions, abatements, and credits (i.e., Wyoming)
- Jobs tax credits
- State grants, loans, and loan guarantee programs for clean energy, including nuclear
- State and/or local funding for infrastructure improvements
- Low/no carbon emission credits
- Nuclear production tax credit (per kWh)
- State-funded Power Project fund (i.e., Alaska)
- Free or discounted land
- Permit and impact fee waivers
- Payroll tax credit (Michigan)
- Allowing utilities to collect for construction prior to construction completion
- Tax exemptions on facility, equipment, and construction costs
- Clean Energy Investment Tax Credit and property tax abatement for manufacturing facilities supporting clean energy (Montana)

Top Considerations When Siting a Next-Generation Nuclear Project. Key considerations listed by respondents included (1) energy need/business/use case, (2) state/local public and government support, (3) workforce availability, and (4) financial incentives.

Concerns Relative to Cost and Schedule. Respondents expressed the following key concerns relative to speeding up and economizing for *N*th-of-a-kind (NOAK) deployment: technology maturity-design changes (e.g., do not start construction while still designing); workforce availability; supply chain availability; regulatory uncertainty; realism in cost for first units; levelized cost of electricity (LCOE) based on NOAK, not first-of-a-kind (FOAK) (e.g., Can next-generation nuclear survive the sticker shock of the first units through enhanced certainty of cost and schedule by NOAK?); and need for transparency on cost and schedule reality—lessons learned from AP1000 projects.

What can VERTical and its Supplier Alliance Do to Help? When asked what organizations such as VERTical and its Supplier Alliance can do to support and enable deployment of next-generation technologies, the following were the top repeated responses: (1) generate public and state/local government support through education and engagement (i.e., enduring cross-party line support); (2) support and facilitate development of state/local financial incentives; (3) support development of energy need/business/use cases for projects, (4) offer solutions to NRC licensing challenges (e.g., resources, timing) and serve as watchdog to track NRC performance

(golden standard versus golden handcuffs to the industry); (5) ensure availability of technicians/operators through certificate and trade programs across U.S.; and (6) enable/develop domestic forging/casting and advanced manufacturing capabilities.

4.0 VERTical Tomorrow—the Future is VERTical

This Strategic Roadmap focuses on the next three years of VERTical. While Phase 1 (2022-2023) included organizational establishment, definition, framework, and growth. Phase 2 (2024-2026) will focus on meaningful development of next-generation nuclear projects in Central Washington and Phase 3 (2026-2030) will see VERTical fully self-funded with nuclear projects through to operations, while adding projects and initiatives focused on the development and deployment of other advanced clean energy technology projects in the areas of solar, hydrogen, hydroelectric, and advanced renewable energy storage systems.

4.1 Phase 2 Objectives (2024-2026)

Our top objectives for 2024-2026 include:

- Submit a follow-on Innovation Cluster Accelerator Program grant application and receive award for additional funding from the Washington State Department of Commerce
- Support and enable achievement of investment decisions for two next-generation nuclear energy projects, one or more advanced manufacturing projects, and one or more advanced nuclear fuel fabrication projects in Central Washington
- Continue organizational growth: grow the Supplier Alliance to achieve 50-plus members and VERTical cohort to 200-plus entities, providing opportunities for engagement
- Work with the Washington State Department of Commerce to develop and enhance incentives for new nuclear and other clean energy-related projects in the state
- Participate on EPRI and NEI working groups on federal NRC regulatory and federal siting aspects to enable accelerated licensing, siting, and deployment of new nuclear
- Site two to three additional advanced reactor projects in region
- Continue workforce development efforts with labor to develop the Central Washington Building Pathways Apprenticeship Readiness program
- Continue to host annual Clean Energy Convenings/supplier events for industry connections
- Provide a central location for start-up companies in collaboration with WSU-Tri-Cities, Fuse, and Small Business Development Center

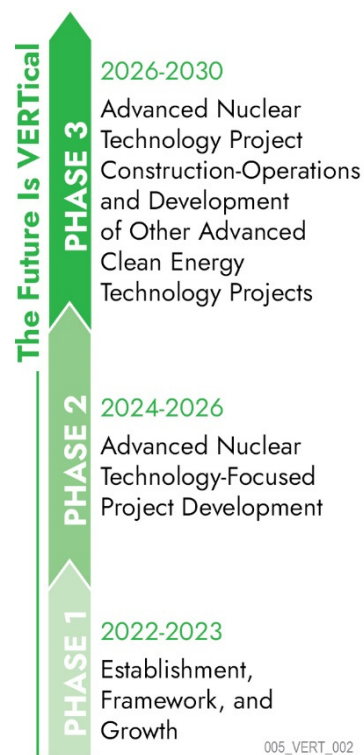


Figure 9. VERTical Launch Phases.

VERTical is completing Phase 1 and has applied for grant funding for Phase 2.

- Submit a follow-on Supplier Alliance proposal in response to anticipated RFP for the Naval Nuclear Propulsion Program ATLAS PM-HIP Project
- Establish Commercial Advanced Reactor, SMR, and MMR End-User Consortium for Supplier Alliance ATLAS PM-HIP Project
- Pursue collaborative projects with TerraPower, Westinghouse eVinci (MMR), Holtec International and Stack Metallurgical Group for Atlas PM-HIP.
- Hold webinar and networking events in partnership with the BUILT Cluster, Pacific Northwest Aerospace Alliance, and Advanced Energy Technology clusters.
- Attend the U.S. Nuclear Industry Council’s Conference for Advanced Reactors Summit.
- Identify companies seeking to establish themselves in Washington state.
 - Collaborate with cohort members to highlight VERTical’s work along with opportunities for their company’s growth as part of our “business attraction” strategy.

4.2 Top Captures

VERTical has identified its top projects for focus in the 2024-2026 timeframe. These projects are prioritized based on: (1) being defined as “Central Washington” investment; (2) having local, state, and regional nuclear supply chain needs; (3) having local, state, and regional workforce needs; and (4) contributing toward the achievement of carbon-free electricity goals.

Targeted projects for VERTical focus include:

- Energy Northwest and X-energy SMR near CGS to achieve operations by 2030
- An advanced manufacturing facility (two potential sites identified in Tri-Cities, Washington area) to support domestic fabrication and component manufacturing needs for next-generation nuclear technology deployment, including development and deployment of PM-HIP as an advanced alternative to overseas forgings
- Second next-generation nuclear technology deployment (SMR or MMR) at a second site also near the CGS
- Potential regional MMR demonstration project
- Framatome Fuel Facility project to provide fresh fuel for SMR and MMR technologies, including TRISO particle and FCM fuel for the Ultra Safe Nuclear Corporation's MMR, with fuel fabrication/manufacturing to begin in 2025

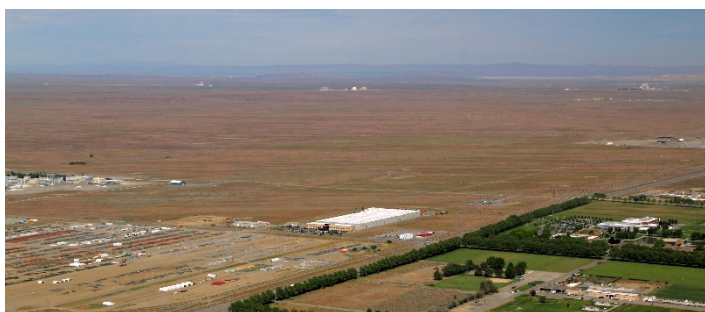


Figure 10. North Horn Rapids Future Site Locations. An aerial of the Port of Benton-owned North Horn Rapids Industrial Park location, which is the future home of the Northwest Advanced Clean Energy Park, including sites being considered for a renewable energy-powered fertilizer plant.

■ Potential Advanced Reactor Fuel Facility in Central Washington

VERTical has conducted a preliminary analysis of strengths, weaknesses, opportunities, and threats (SWOT) for the ability to site and deliver these targeted projects in Central Washington, as shown below. This analysis (shown in **Figure 11**) will be refined during the upcoming months as project development continues.



Figure 11. Preliminary SWOT Analysis.

During the first quarter of 2024, VERTical will engage industry for inputs to refine this preliminary SWOT analysis.

4.3 VERTical Three-Year Strategic Plan

The section defines key actions for the VERTical team over the next three years. By design, these actions are more detailed for 2024. With each year's update to the VERTical Strategic Roadmap, we will further refine the out-year actions, report on the prior year's progress and accomplishments, and plan for the rolling third year.

2024

- Identify, nominate, and appoint two or three additional industry Board members to the VERTical Board of Directors, including at least one reactor technology vendor representative with a focus on diversity in membership **by June 30, 2024**
- Onboard Cluster Director **by June 30, 2024**
- Recruit additional Supplier Alliance and VERTical cohort members to achieve Supplier Alliance membership of 50 members and cohort size of 200 **by December 31, 2024**
- Host VERTical Annual Clean Energy Day and Supplier Forum **by December 31, 2024**
- Sponsor Energy Community Alliance New Nuclear event in Tri-Cities **by May 2024**
- Launch VERTical-led Apprenticeship Readiness Program **by August 31, 2024**
- Launch WSU Tri-Cities, Columbia Basin College, and Tri-Tech clean energy sector-focused certification programs **by December 31, 2024**
- Support positive initial investment decision for Energy Northwest and X-energy Xe-100 project near the Columbia Generating Station **by December 31, 2024**
- Support positive investment decision for Atlas Agro Carbon-Free Fertilizer Plant at North Horn Rapids **by December 31, 2024**
- Support positive investment decision for Framatome Fuel Facility Project **by December 31, 2024**
- Support and enable positive investment decision for the Advanced Manufacturing Facility (PM-HIP) project to be located in Richland, Washington **by December 31, 2024**
- Help attract 2-3 additional advanced reactors or related clean energy technology companies **by December 31, 2024**
- Develop VERTical Self-Sustainment Plan **by June 30, 2024** to generate independent funding sources, such that VERTical is self-funded (through industry dues, donations, or other sources of non-grant income) **by the end of 2026**
- Participate in EPRI/NEI efforts regarding NRC regulatory streamlining and tailoring to meet SMR/MMR timeline demands **throughout the year**
- Participate in EPRI/NEI efforts regarding streamlining of federal siting process and requirements for SMR/MMRs to meet timeline demands **throughout the year**

- Provide Washington State Clean Energy Incentive Program white paper and recommendations to the Washington State Department of Commerce and collaborate with state and local elected officials for initial support for incentives **by December 31, 2024**
- Attract at least one start-up or scaleup annually to Washington **by December 31, 2024**
- Identify and apply for 2-4 grant opportunities throughout the year and secure \$600,000 in grant funding for VERTICAL and/or joint or collaborative grant projects aligned to VERTICAL priorities **by December 31, 2024**
- Develop and publish the Northwest Nuclear Quality Management Center of Excellence Program Description and Operations Plan **by June 30, 2024**
- Develop and report VERTICAL cluster-related, high-value job creation metrics, economic impact metrics, and diverse business inclusion metrics to the Washington State Department of Commerce annually **by December 31, 2024**
- Submit Supplier Alliance proposal in response to anticipated RFP for the Naval Nuclear Propulsion Program ATLAS PM-HIP Project **during first quarter 2024**
- Establish Commercial Advanced Reactor, SMR, and MMR End-User Consortium for Supplier Alliance ATLAS PM-HIP Project **by June 30, 2024**
- VERTICAL Executive Director to form capture team to pursue key opportunities in collaboration with cities, Port, and TRIDEC/ Energy Forward Alliance **by December 31, 2024**

2025

- Onboard second direct hire full-time VERTICAL cluster resource in one of the following areas: Communication Manager (outreach, advocacy, education and engagement), Business/Project Developer, or Project Manager **by June 30, 2025**
- Host VERTICAL Annual Clean Energy Day and Supplier Forum **by December 31, 2025**
- Sponsor/host USNIC Ready for Nuclear advanced reactor conference in Tri-Cities, Washington area **in 2025**
- Support and enable positive investment decision for second SMR project near the Columbia Generating Station **by December 31, 2025**
- Support and enable positive investment decision for a potential MMR demonstration or development project in Central Washington **by June 30, 2025**
- Attract at least one start-up or scaleup per year to Washington **by December 31, 2025**
- Conduct Biennial Advanced Reactor Technology Survey **by September 30, 2025**
- Identify and apply for four grant opportunities throughout the year and secure \$800,000 in grant funding for VERTICAL and/or joint or collaborative grant projects aligned to VERTICAL priorities **by December 31, 2025**
- Report VERTICAL cluster-related, high-value job creation metrics, economic impact metrics, and diverse business inclusion metrics to the Washington State Department of Commerce annually **by December 31, 2025**

- Initiate operations under the Northwest Nuclear Quality Management Center of Excellence as a commercial enterprise providing nuclear quality services to businesses beyond the Supplier Alliance **by June 30, 2025**
- Announce graduation of first Supplier Alliance member cohort from Supplier Alliance Readiness Program **by December 31, 2025**

2026

- Onboard third direct hire full-time VERTical cluster resource in one of the following areas: Communication Manager (outreach, advocacy, education and engagement), Business/Project Developer; or Project Manager **by June 30, 2026**
- Identify and position for 3-5 new clean energy project targets in the following clean energy technology areas: solar, hydroelectric, hydrogen, and advanced renewable energy battery storage for Washington **by June 30, 2026**
- Achieve VERTical self-funded status **by December 31, 2026**
- Achieve “Growth Cluster” level as defined by the Washington State Department of Commerce **by December 31, 2026**
- Achieve cumulative cluster-related high-quality job creation goals of 1,737 clean energy construction jobs and 577 clean energy enduring operations jobs **by December 31, 2026**
- Attract at least one start-up or scaleup per year to Washington **by December 31, 2026**
- Host VERTical Annual Clean Energy Day and Supplier Forum **by December 31, 2026**
- Identify and apply for 6-10 grant opportunities throughout the year and secure \$1,000,000 in grant funding for VERTical and/or joint or collaborative grant projects aligned to VERTical priorities **by December 31, 2026**
- Develop VERTical Export Opportunity Plan to identify VERTical cluster-related export potential and implementation strategy **by December 31, 2026**
- Report VERTical cluster-related high-value job creation metrics, economic impact metrics, and diverse business inclusion metrics to the Washington State Department of Commerce annually **by December 31, 2026**
- Support and enable positive investment decision for second advanced nuclear fuel project near the Columbia Generating Station **by December 31, 2026**
- Announce graduation of second Supplier Alliance member cohort from Supplier Alliance Readiness Program **by December 31, 2026**

4.4 VERTical’s Vision for the Future

VERTical’s vision for the future includes bringing together industry with research and educational institutions to create a Northwest regional center focused on advanced clean carbon-free energy deployment, including establishing the Northwest Advanced Clean Energy Park in Tri-Cities, Washington. VERTical’s conceptual vision for the Northwest Advanced Clean Energy Park (as depicted in **Figure 12**) includes SMR and MMR deployment, nuclear fuel fabrication, advanced manufacturing, solar, biofuels, and carbon-free commodities—all

combined with a nuclear supply chain and regional nuclear and clean energy workforce. This vision leverages the DOE Hanford Site and Energy Northwest's Columbia Generating Station in creating a regional nuclear-skilled workforce and supply chain in the Tri-Cities area, as well as the research capabilities of Pacific Northwest National Laboratory and education and training capabilities of our educational partners WSU-Tri-Cities and Columbia Basin College and economic development partners Benton County, city of Richland and TRIDEC.

The map on page 31 (**Figure 12**) shows key elements of the VERTical strategy and regional ties for further next-generation nuclear and advanced clean energy collaboration.



Figure 12. Map of VERTICAL Key Partners and Projects.

VERTICAL's partners span Washington state and reach beyond to collaborations across the U.S.

5.0 Conclusion

VERTical has made notable progress since its inception in January 2022. Through its newly established, industry-led Board and growing cohort and Supplier Alliance, the future holds great opportunities for deploying next-generation nuclear and clean energy supported and enabled by VERTICAL. **Figure 13** summarizes how VERTICAL stacks up against the seven core elements of cluster success.

We will continue our growth trajectory and track our progress in enabling and supporting the success of our top-priority projects in next-generation nuclear, as well as metrics of progress for supply chain and workforce readiness, and our actions defined in **Section 4.3**.

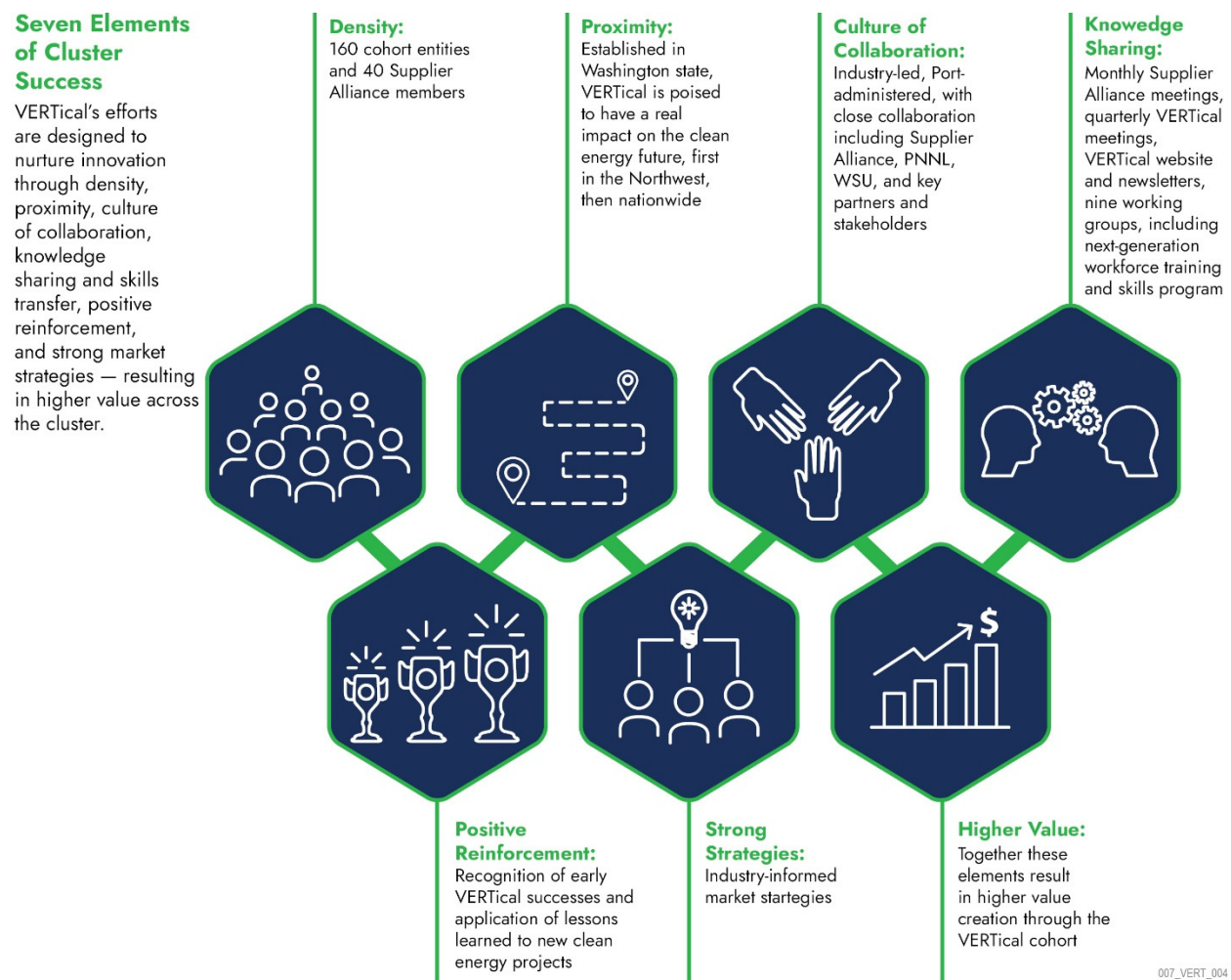


Figure 13. Building Blocks for Innovation Cluster Success.

In line with the definition of Harvard Business School's Michael Porter, VERTICAL's "innovation cluster" is a geographic concentration of competing and cooperating companies, suppliers, service providers, and associated institutions.