Harnessing Virginia's Power Potential

VIN

Virginia Innovative Nuclear Hub

Virginia is Nuclear

> We have a great opportunity in Virginia to lead the nation in the development of small modular reactors and nuclear in order to provide base load power that's clean and reliable and affordable. This is why common sense has to come back into this equation, we can't evacuate one of our strengths, which is the fact that we innovate in America.
>
> Governor Glenn Youngkin – 2022 VA Energy Plan

Contents

ELECTRICAL GENERATION

2 commercial nuclear power stations

4 nuclear power reactors operated safely over 40 years

95%
of the Commonwealth's carbon-free electricity comes from nuclear

2000+
nuclear employees

ADVANCED MANUFACTURING & SERVICE CAPABILITIES

- Small modular or other advanced reactor
- Nuclear Fuel Fabrication
- Manufacturing
- Modeling & Simulation
- Services
- Equipment
- Engineering Design
- Cybersecurity
- Modular fabrication
- Visualization
- Welding & Robotics
- Thermal Propulsion

DEFENSE

- Home of the sole manufacturer of naval nuclear reactors for U.S. subs and aircraft carriers
- Norfolk Naval Shipyard is the oldest naval shipyard in the U.S.

28,000+
people employed by commercial defense industry

97
Navy-operated reactors safely commissioned in Newport News Shipyard

The Opportunity

Why a Virginia Hub, and Why Now?

Nuclear Energy plays an important role in the generation of clean, carbon-free electricity in the Commonwealth of Virginia. In fact, 32% of the electricity in Virginia is from nuclear power, of which 95% is carbon free. Conservative estimates are that 100,000 jobs in the Commonwealth are related to nuclear. Nationally, the Federal Government and private investors are making significant investments in advanced nuclear technologies, with the U.S. Department of Energy (DOE) awarding $3.2B in advanced nuclear technologies over the next 7 years. The question becomes how does Virginia coalesce the power and capitalize on its strong university, industry, and federal institutions to become the leader in nuclear innovation.

The answer is the creation of a Hub. The Hub's goal is to integrate highly collaborative research teams, spanning multiple scientific, engineering, and where appropriate, economics, and public policy disciplines. By bringing together top talent from across the full spectrum of R&D performers—including universities, private industry, non-profits, and National Laboratories—the Hub will serve as a world-leading nuclear research, engineering, and technology center, solving technical, business, and societal problems - all within Virgina's footprint, as seen in **Figure 1**.

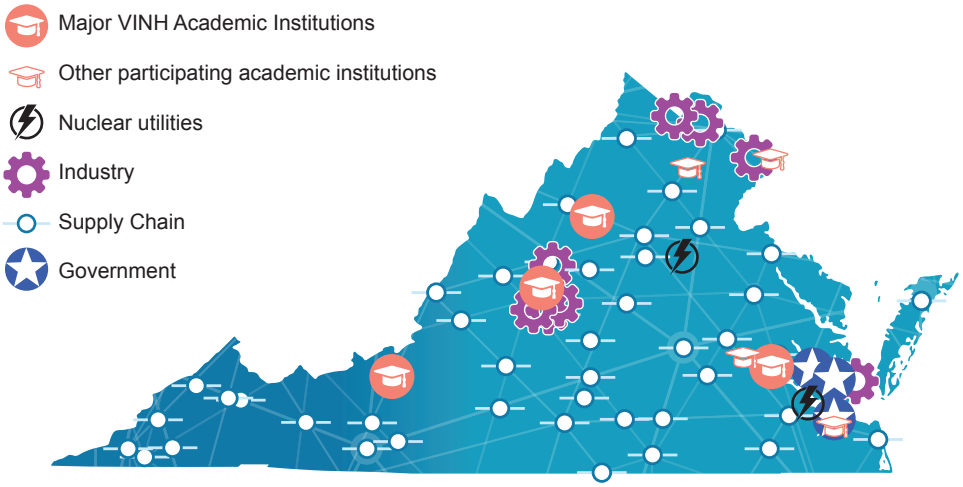


FIGURE 1: The projected growth of the nuclear industry, combined with its existing industry leadership, positions Virginia as a prime location for the first domestic advanced reactor value chain. The Hub makes advanced reactor development feasible, and construction and manufacturing of each reactor would support 7,000 jobs, generate $1.3 billion in spending and $627 million in value-add impact, according to data gathered by the Economic Modeling Specialists Intl.

The Virginia Innovative Nuclear Hub

Creating a World-Leading Nuclear Knowledge Center

The Virginia Innovative Nuclear (VIN) Hub is a collaboration between several leading academic institutions in Virginia: Virginia Polytechnic Institute (Virginia Tech), University of Virginia (UVA), Liberty University, and Virginia Commonwealth University (VCU), with the support of the Virginia Nuclear Energy Consortium Authority (VNECA) and the Virginia Nuclear Energy Consortium (VNEC). Combined, these institutions offer a pathway to promote innovation and collaboration for students, researchers, and industry, creating a broad and deep VA workforce of the future.

VIN
Virginia Innovative Nuclear Hub

ADVANCING NUCLEAR INNOVATION

$1B
IN RESEARCH FUNDING

5+ LEADING ACADEMIC INSTITUTIONS INCLUDING MSI

#1 EMPLOYER OF NUCLEAR ENGINEERS IN THE U.S.

95%
of the carbon-free power generated in Virginia
IS NUCLEAR

100,000
ESTIMATED NUMBER OF JOBS
across the Commonwealth tied directly to the nuclear sector

Vision

To be recognized internationally for cutting-edge research and education in nuclear science and engineering and fostering the growth and expansion of a highly qualified and diverse workforce in the Commonwealth of Virginia. The complete nuclear supply chain from OEMs to Tier 1, Tier 2, and Tier 3 companies will exist in Virginia arising from innovative designs and techniques, novel test facilities, and efficient, effective, and experimentally validated computational design and analysis tools.

Mission

The VIN Hub will develop and maintain the enabling technologies to support the generation of clean, sustainable, reliable, safe, and cost-effective electricity in the Commonwealth of Virginia focusing on a market pull mindset.

Values

For good stewardship of our environment and to contribute to society's grand challenges including sustainability, energy, safety, security, and medicine, the VIN Hub will proactively work with the people, industries, government officials, and educational parties. The VIN Hub will be fiscally responsible with the funding that we garner to synergize our efforts for overall success.

Our university partner leaders have worked closely with industry and analyzed the current nuclear landscape, identifying areas requiring new or transformed technologies. We will formailize this analysis through an in-depth roadmapping with Virginia-based OEMs, utilities, and nuclear technology companies, which includes an in-depth gap analysis of the current nuclear supply chain to determine the challenges of the nuclear ecosystem. Early interactions indicate that workforce development is a key contribution that needs to be addressed. Thus, the VIN Hub will, together with our industrial partners, close the gaps with Made-in-VA products, services, and employees.

Industry has indicated that interests will center on specific challenging or costly safety-related nuclear systems, structures, and components (SSCs), and non-safety-related support systems, and their functions that have bearing on the safe, reliable, and economic operation of nuclear facilities. Based on this feedback, we will engage all science, engineering, and business disciplines in design, validation, and licensing of such SSCs for these purposes. The Hub will have a clearly identified role in applied research for innovations and validation of key aspects of advanced reactor technologies, with the the goals of safety, reliability, and improved economics.

THE VIN HUB WILL:

- Promote advanced manufacturing and 3-D printing technology
- Develop and use novel experimental facilities for validation and verification
- Evaluate economics of innovative systems
- Conduct life cycle Modeling & Simulation
- Develop advanced modeling and simulation techniques using machine-learning and virtual reality for reactor monitoring and human-machine collaboration.
- Provide support to Virginia in developing effective policies by addressing socio-technical system design

THE VIN HUB WILL ALSO ENGAGE IN A K-PHD PROGRAM TO:

1. Engage minority serving high schools and colleges
2. Train undergraduate and graduate students in relevant engineering, science and policy matters
3. Engage in training of specialized technicians and vocational workers to create a growing and highly qualified nuclear workforce within the Commonwealth

MORE THAN THE POWER OF ONE

Virginia Tech brings a decades-long leadership role in the nuclear industry. From 1962-1981, Virginia Tech operated a research reactor to provide students the opportunity to learn about reactor theory and nuclear physics. The VT Nuclear Engineering Program (VT-NEP) is the only program in the State of Virginia that offers graduate degrees and an undergraduate minor in Nuclear Engineering. VT's NEP faculty are making important contributions to the nuclear engineering community by establishing internationally recognized research groups and laboratories in particle transport methods with application to reactors, nuclear security, and medicine; nuclear materials and fuel cycle technologies; two-phase-flow experimentation and modeling; advanced reactor design and safety; and advanced multi-modal antineutrino and neutron detector designs.

UVA has active nuclear research programs in the departments of Materials Science and Engineering and Mechanical and Aerospace. Engineering related to the uranium enrichment and non-proliferation policy; spent fuel storage; materials degradation in aqueous, molten salt, and high-temperature environments; actinide, metallurgy, and mechanical behavior; neutron scattering; and effects of radiation damage on mechanisms of heat transfer.

Liberty University offers 6 undergraduate engineering degrees and graduates an average of 100 engineers annually. Many of the students obtain positions with Virginia-based companies including Framatome, NNS, and BWXT. Liberty's School of Engineering offers a unique approach to simulation-based design by focusing on the creation of new technology and processes, following a design, analysis, and sustainability cycle, enabled by high-performance computing. These steps also relate to the fundamental features of a successful business. Liberty calls this creationeering – where these two domains meet and society benefits from the results.

VCU is ranked a Top 100 Research University, providing more than 200 undergraduate degree programs. VCU offers the nation's only combined doctorate in Mechanical and Nuclear Engineering. It's location is at the hub of the heaviest concentration of nuclear engineering enterprises in the nation. VCU offers a full range of ABET accredited undergraduate nuclear engineering courses, and is a key source of new nuclear engineers for the region's many nuclear engineering enterprises.

1960	1962	1996	2010
UVA begins operating its first research reactor	Virginia Tech begins operating its first research reactor	VCU offers Mechanical and Nuclear Engineering Program	Liberty establishes 25,000 distance learning programs

Leadership Team

Laying the Groundwork for Future Generations

ACCOMPLISHMENTS OF OUR KEY PERSONNEL

1000+
PAPERS
published by our team of 4 leaders

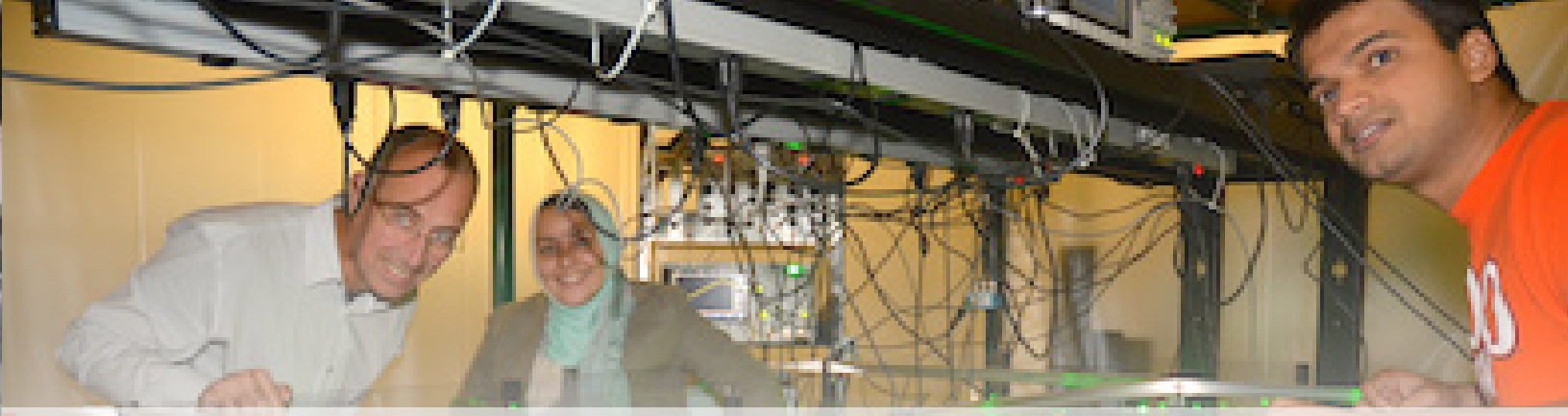
25
AVERAGE YEARS
of teaching and research experience

$70M
SPONSORED RESEARCH FUNDING
acquired by our core team

VIN Hub's leadership team brings the optimal blend of academic and business insight and expertise needed for success. They are known leaders in the nuclear industry, and have excelled on other directly relevant, large-scale Research, Development, Demonstration, and Deployment (RDD&D) enterprises—building partnerships between the Government, research universities, and industry to deliver technology with far-reaching market impact.

ALIREZA HAGHIGHAT CHIEF SCIENCE OFFICER

Dr. Haghighat is the Director of the Nuclear Engineering Program at Virginia Tech, formerly Department Head at the University of Florida, Director of the UF Training Reactor (UFTR), Florida Power & Light Endowed Chair Professor, and Professor at Penn State. Dr. Haghighat is an internationally known educator and leader in the field of nuclear science and engineering. He was named a Fellow of American Nuclear Society in 2002 for pioneering contributions to the development of accurate and efficient deterministic, stochastic, and hybrid particle transport theory methods and their application to different complex nuclear systems. He is the recipient of the 2021 College of Engineering Dean's Award for Excellence in Service, the 2011 RPSD Professional Excellence Award for his outstanding contributions to deterministic, Monte Carlo, and hybrid particle transport methods and codes, and the 2009 DOE recognition award for his leadership & contributions to design and analysis for the UFTR HEU to LEU fuel conversion. In his academic career spanning 34 years and three institutions, Dr. Haghighat has mentored 53 graduate students who have become professors at peer institutions, research scientists and leaders at national labs, and fellow engineers at private nuclear organizations. Dr. Haghighat has given 114 invited talks, short course and workshops at national and international meetings and organizations. He has served as Chair of the ANS Mathematics and Computation and Reactor Physics Divisions, and the Computational Medical Physics Working Group. He has led or contributed to the development of four ANS technical standards and filed for patents on different computational methods and reactor designs. Dr. Haghighat has authored two textbooks on the Monte Carlo methods which are widely used at national and international nuclear engineering programs. He has published 280+ refereed papers, and his work is widely cited by the nuclear engineering community.



BUILDING THE NEXT GENERATION EMPLOYEE BASE

A significant outcome of the VIN Hub will be the creation of the nuclear workforce of the future. The Hub's leaders will mentor and train students in areas of expertise critical to deploying advanced nuclear technologies - modeling and simulation, multiple engineering disciplines, materials science, and chemical separations / reprocessing to name a few. The university partners of the Hub will augment their course offerings with nuclear-related classes and degrees. In addition to degreed programs, the Hub will establish workforce training programs and partnerships to create opportunities for both skilled and unskilled workers in the nuclear sector. Currently, there are noticeable gaps in the supply of nuclear engineers in the state (less than half of openings are filled by local graduates).

MARK HORSTEMEYER
CHIEF TECHNOLOGY OFFICER

Dr Horstemeyer is the Dean of Engineering at Liberty University. He brings expertise in Integrated Computational Materials Engineering (ICME). He brings a unique combination of experience from his scientific leadership position at Sandia National Laboratory performing thermonuclear design, from industry as founder of two startups, and in the academic research community as a professor at Mississippi State. He is a Fellow for several associations including the American Society of Metals (ASM), American Society of Mechanical Engineers (ASME), the Society of Automotive Engineers, and the American Association for the Advancement of Science. He has received $44M in funding for research related to modeling and simulation. Dr. Horstemeyer has authored more than 500 documents, was invited 166 times as a guest lecturer, is a member of 12 professional societies, and was the recipient of multiple awards.

SUPATHORN PHONGIKAROON
CHIEF WFDW OFFICER

Dr. Phongikaroon is a professor at VCU, where his research focuses on pedagogy and experimental studies in used nuclear fuel reprocessing. Prior to joining VCU in January 2014, he held academic and research positions at University of Idaho, Idaho National Laboratory, and Naval Research Laboratory, Washington, D.C. During his research career, Dr. Phongikaroon has established chemical and electrochemical separation of used nuclear fuel through pyroprocessing technology and extended his expertise toward molten salt reactor physics and material detection and accountability for safeguarding applications. These developments include kinetics in ion exchange process, advanced chemical separation routines via cold fingers and zone freezing, electrochemical methods, laser induced breakdown spectroscopy, and computational modeling for electrorefiner. This effort led to a strong establishment of Radiochemistry and Laser Spectroscopy Laboratories at VCU.

SEAN AGNEW
CHIEF INTEGRATION & SUSTAINABILITY OFFICER

Dr. Agnew is the William G. Reynolds Professor of Materials Science at the University of Virginia School of Engineering and Applied Science, is a leading mechanical metallurgist whose research focuses on lightweight alloys as well as metallic nuclear fuel. Dr. Agnew specializes in the characterization and computational modeling of metals relevant to particle accelerators, transportation, aerospace, energy, and defense applications. He was a Eugene P. Wigner Postdoctoral Fellow at the Oak Ridge National Laboratory before joining UVA in 2001. He earned the Helmholtz-Zentrum Geesthacht Magnesium Research Award in 2008 and was elected Fellow of ASM International 2015. He has published over 200 scientific articles, and he serves as associate editor of the International Journal of Plasticity. Agnew was a Rosen Scholar (visiting scientist) at the Los Alamos Neutron Science Center (LANSCE) in 2022.

VIN
Virginia Innovative Nuclear Hub

VIN HUB ANNUAL WORKSHOP

The VIN Hub will host an in-person quarterly meeting to provide our team with an opportunity to review major achievements and Hub operations through an overview by the Director, oral and poster presentations highlighting the Hub's progress, and interaction with the personnel and students. The Governance and Advisory Committee members are an instrumental part of this workshop. The Governance Board will meet with the Director at the conclusion of the meeting to provide initial feedback, including progress, impact, potential changes in direction, and Hub management.

The Advisory Committee will meet with the ExCom during the 2-day workshop to identify opportunities for new research, recommendations on changes in direction, or new funding opportunities. Their findings will be presented by the Director to the Governance Board.

Organization & Governance

Organized for Success

The VIN Hub's innovative management approach and organizational structure enable a multi-disciplinary team to communicate, collaborate, and share resources to advance the frontier of nuclear energy in Virginia. The organization builds on the successes achieved by its leadership team, applying committed resources from the founding institutions. Accomplishing the Hub's goal requires a management structure that simultaneously fosters outcome-driven research while managing strategic domain areas, all backed by a talented group of rising young researchers and engineers. Our centralized management approach promotes teamwork, synergy, and program-wide collaboration through a lively and vibrant Executive Committee.

VIN Management Structure

Figure 2 shows our organization structure for the VIN Hub, which focuses team effort and resources on the 4 organizational areas. Our approach to establish Virginia as the nation's leading center of nuclear activity focuses on creating a Nuclear Test Center that attracts advanced reactor developers to test their technologies while simultaneously analyzing the nuclear supply chain to identify gaps. This requires strong interaction among the leadership team, frequent sharing of ideas and results, and periodic refinement of a shared strategy.

The CEO is an independent position that will be filled after a search is performed, candidates down-selected, and chosen by the Governance Board. The CEO, as an independent third party, will be solely dedicated to managing the organization, coordinating project proposals, and developing new opportunities. Moreover, this function will guide and direct research and technology activities throughout the Roadmapping process, with the direct reports who as a group we call the Leadership Team. The Leadership Team will oversee the research, ensure integration of researchers from the different entities, and guarantee the meeting of milestones and deliverables.

The Leadership Team (CSO, CTO, CWTO, and CISO) in Year 1 begin with strategic roadmapping of their domains. Each oversees specific projects identified during roadmapping as they related to industry pull (CTO domain) or R&D push (CSO). Our Leadership Team domains are intimately linked—progress in any one requires working with other areas to achieve the Hub goals. With this in mind, a management structure that examines the whole Hub in its entirety, while ensuring each part pushes the boundaries, is crucial for success. To ensure this integration, we have created the CISO function. This position looks for interconnectivity between the R&D and industry needs, while identifying opportunities for integration of technologies into the supply chain, research projects to fulfill supply chain gaps, and translation to market as technologies

mature. We recognize the importance of building the next generation workforce and involving other members into the Hub. As such, we have created the CWTO position to build the next generation workforce through education activities and onboard new members through Annual Workshops and other projects.

Governance Board

The Governance Board provides executive guidance to ensure the program is meeting its overall objectives. This committee is a key decision-making body, with authority to approve an Annual Plan, assign new partners, monitor performance (and act if not satisfactory), and resolve conflicts. The Committee rotates chairmanship every two years with Vice President for Research from the founding institutions. The Committee members have decision authority for their respective home institutions and have committed their organizations to provide oversight, staff, and resources, such as research facilities, to enable Hub work. Governance Board Members will meet twice annually, once remotely, and once in person. Additionally, the Governance Board holds monthly status calls with the Hub Director.

Advisory Committee

To ensure that the Hub Director and his leadership team have access to advice and counsel on a regular basis on all aspects of work, we have established the Advisory Committee. This Committee is composed of distinguished members from industry and academia who are experts in the scientific, technical, and management aspects of the mission. The AC advises the Director and his team on all elements from a wide range of perspectives.

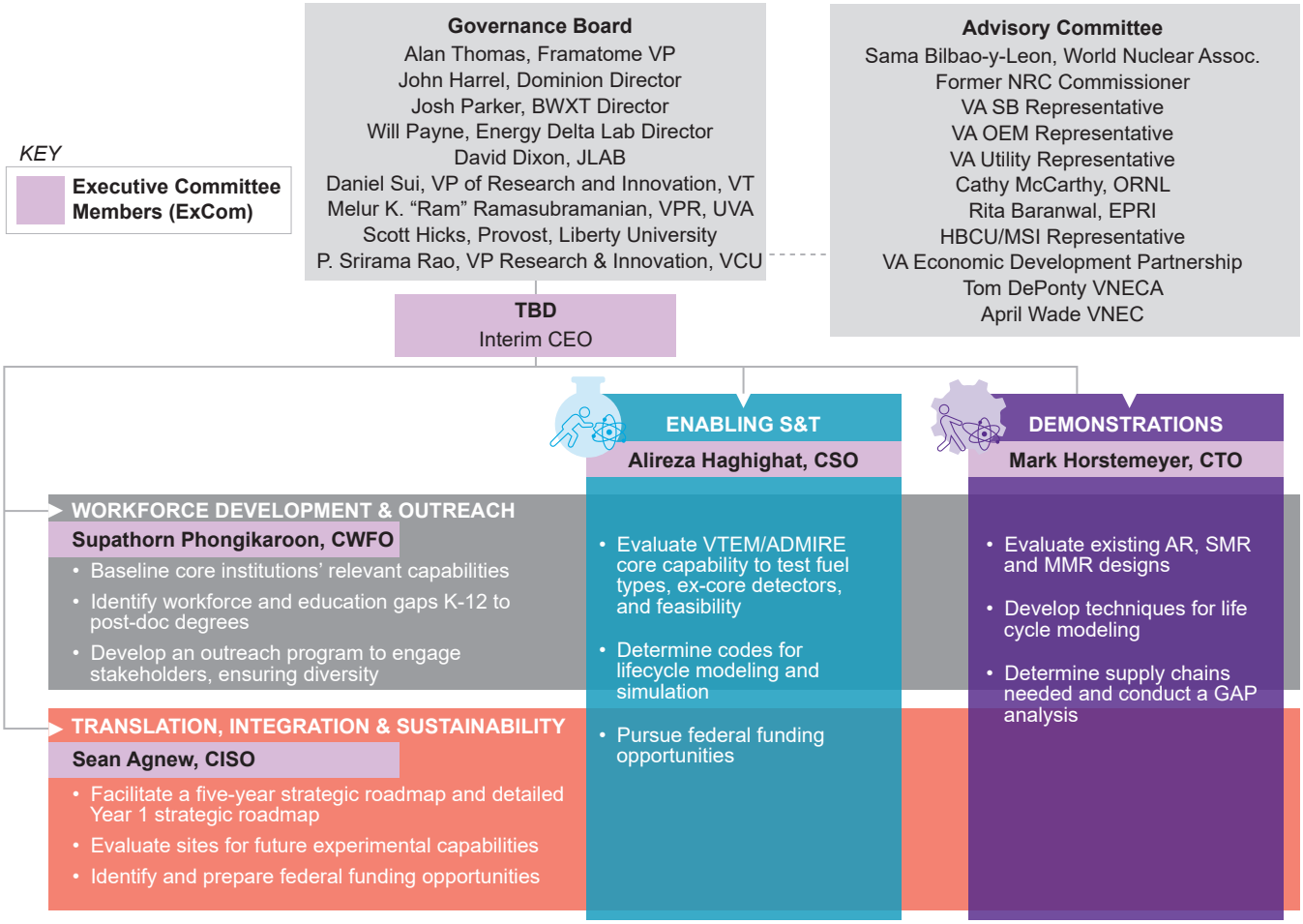


Figure 2: Management Structure of the VIN Hub.

Proposed Approach

Roadmap to Success

The Hub leadership realizes the urgent need for achieving net zero emission, and believes this goal is not only achievable, by combining nuclear energy together with renewable energy sources, it will provide both economic and education engines for development within the Commonwealth.

INITIAL MAPPING

Initial industry outreach indicated performance of technical/regulatory research, design, or design reviews; validations of designs, manufacturing, monitoring, maintenance, and operations for simplicity and cost-effectiveness. Specific projects may include:

High Fidelity Modeling & Visualization & Codes

- Multiphysics methodologies and code development
- Multi-scale materials computing methods and codes development
- Neutronics and reactor kinetics computing methods

Verification & Validation for Modeling Methodologies & Codes

- Uncertainty Quantification (UQ)
- Test & research reactors
- Specialized facilities design and use
- Computational benchmarks

Artificial Intelligence (AI)/ Machine Learning (ML)

- Reactor physics parameter interface
- Fuel burnup and isotopic interference / optimization
- Reactor maintenance, safety and control
- Human-machine collaboration

Workforce Development & Outreach

- Public education
- K-12 Programs
- Workshops
- Graduate certificates
- Nuclear Engineering degrees

The U.S. Federal government endorses this belief and has initiated major public-private funding opportunities in support of advanced nuclear technologies over the past decade. The VIN Hub will promote innovation while engaging in research projects enabling short-term deployment of Advanced Reactors, Small Modular Reactors (SMRs), and Micro Modular Reactors (MMRs) for both terrestrial and space applications, such as Nuclear thermal propulsion (NTP) systems. Every project and action we take in this Hub is to support both the federal Government and the Commonwealth.

For example, SMRs and MMRs have attractive features such as increased safety and security by design, low cost, reduced exclusion zone, reduced construction span, high thermal efficiency, and flexibility to generate hydrogen, industrial process heat, and to load follow with renewables. A recent study by the IAEA indicates that there are 75 SMR designs being investigated worldwide. Eighteen designs have been developed and investigated by different companies in the US, while Russia, China and Japan are working on 17, 9 and 8 other designs, respectively. Unfortunately, there is a limited supply chain, declining nuclear expertise in the workforce, licensing requirements, and inevitable construction issues that face any new technology with limited or no existing prototypes. The Hub leadership recognizes these challenges and opportunities and has identified four areas to address them:

- Investigating innovative designs and collaborating with industry to identify the “best” designs
- Developing multi-physics tools for simulating these novel designs
- Identifying technological and educational gaps, workforce and supply chain

needs, and licensing and deployment requirements
- Developing a test reactor to generate data in support of advanced reactor designs

In support of the 4th area, a notional Virginia Test and Education Microreactor (VTEM) design has been patented, which provides a novel experimental environment and robust instrumentation for testing of different fuel types (e.g., molten salt, pebble bed, High Assay Low Enriched Uranium (HALEU), etc.), high-fidelity validation of physics-based modeling and simulation tools and estimation of uncertainties, development and validation of Machine Learning (ML) algorithm for determination of reactor physics and kinetics parameters.

To educate and develop a diverse workforce, it is necessary that we reach out to a diverse population throughout the State and identify regional resources and needs. To do so, the Hub partitions the State of Virginia into four regions (shown in **Figure 3**) including Northern (VT/GMU), Central (UVA/Liberty), Southeast (VCU/Hampton) and Southwest (VT).

To accomplish the Hub's research and educational goals, the universities have identified six Research Themes (RTs) and four cross cutting (CC) areas presented in **Figure 4**.

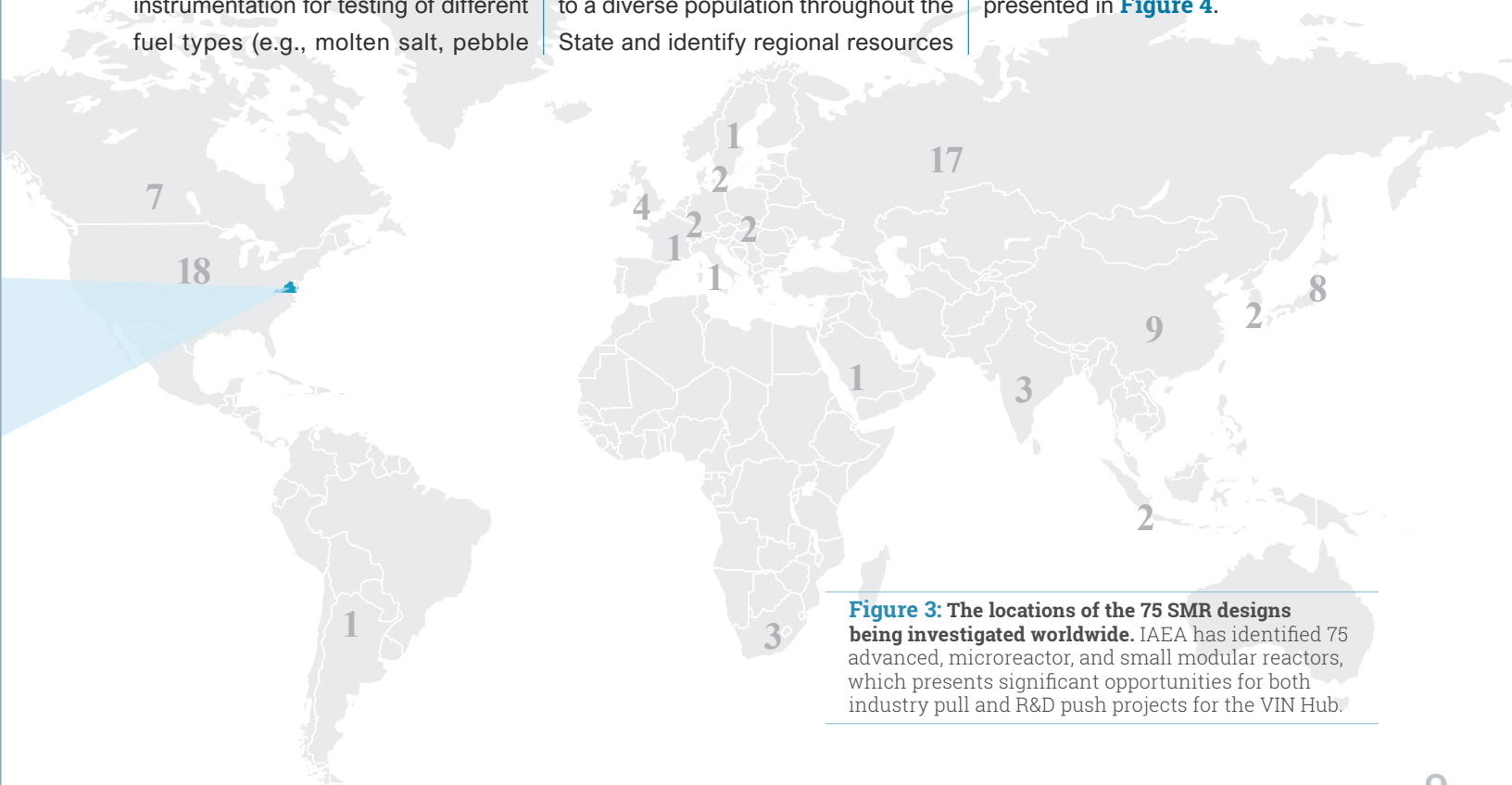
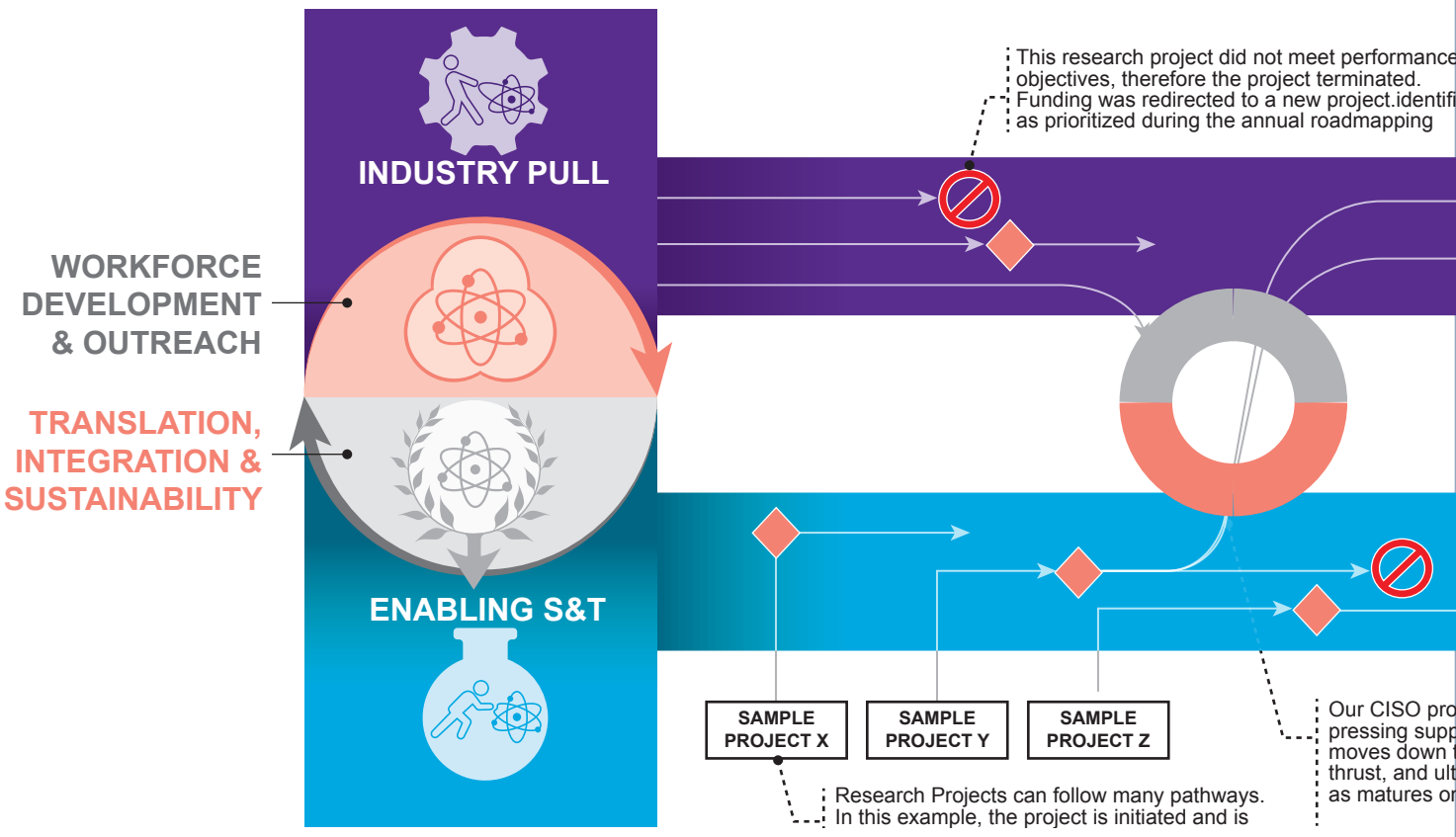
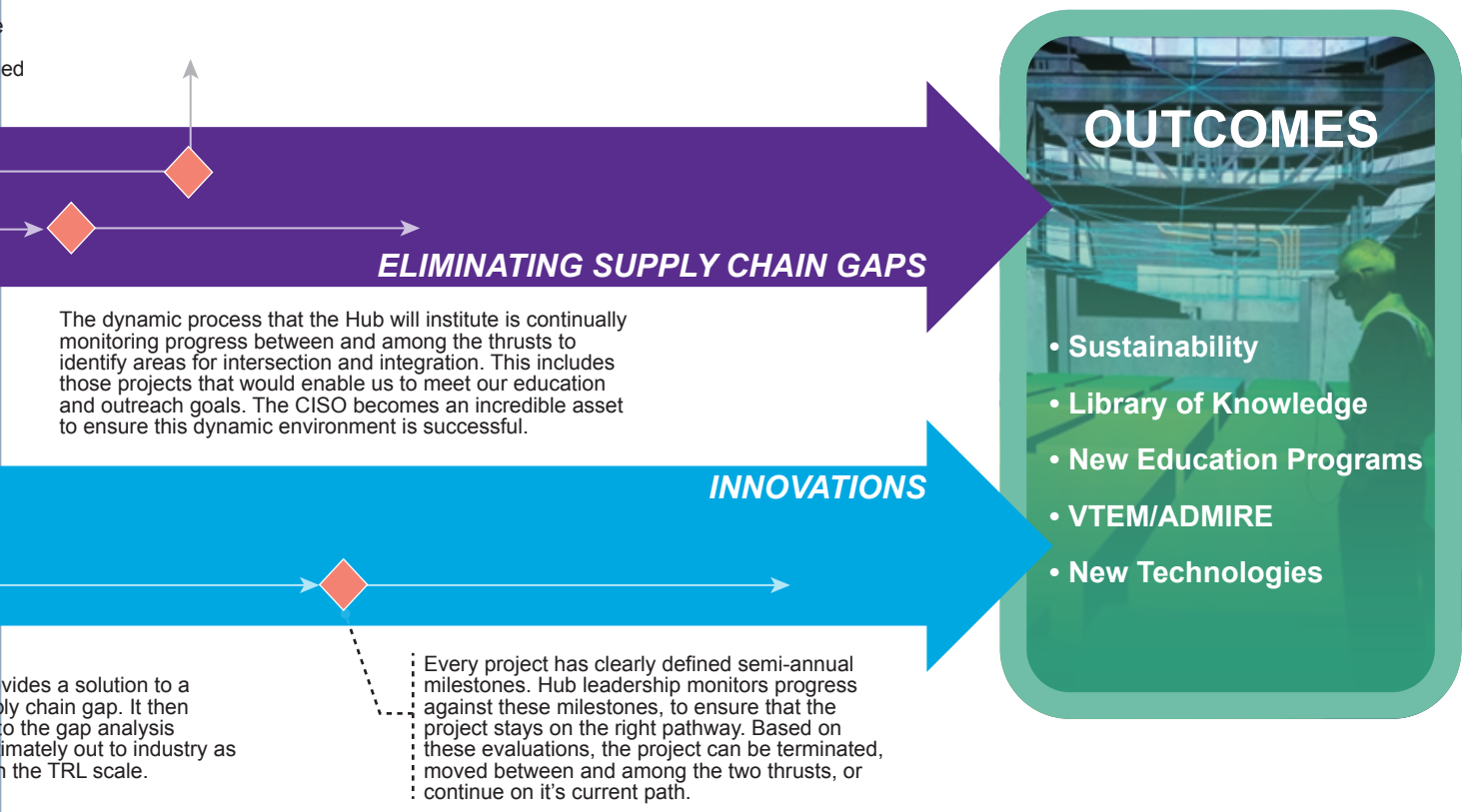


Figure 3: The locations of the 75 SMR designs being investigated worldwide. IAEA has identified 75 advanced, microreactor, and small modular reactors, which presents significant opportunities for both industry pull and R&D push projects for the VIN Hub.

Concept of Operations



OFFICE	YEAR 1	YEAR 2	
Enabling S&T	• Baseline codes for lifecycle modeling and simulation • Evaluate VTEM/ADMIRE core capability to test fuel types, ex-core detectors, and feasibility • Pursue federal funding opportunities	• Design and optimize VTEM/ADMIRE capabilities • Implement codes for lifecycle modeling and simulation • Submit proposals for funding	• Initiate expe • Use Year 2 tion for a co
Industry Pull Demos	• Evaluate existing AR, SMR and MMR designs • Develop techniques for life cycle modeling • Determine supply chains needed and conduct a GAP analysis	• Determine the research related to the gap analysis needs, and the associated teams • Start the research	• Continue th analysis
Translation, Integration, & Sustainability	• Facilitate a five-year strategic roadmap and detailed Year 1 strategic roadmap • Evaluate sites for future experimental capabilities • Identify and prepare federal funding opportunities	• Facilitate Year 2 strategic roadmap • Identify potential IP and patent-filing process for the VIN Hub • Evaluate opportunities to integrate science and technology inside the VIN Hub • Identify outside science and technology to integrate into the hub	• Facilitate Ye • Identify pot experiment tion codes • Evaluate po businesses • Identify are
Workforce Development & Outreach	• Baseline core institutions' relevant capabilities • Identify workforce and education gaps K-12 to post-doc degrees • Develop an outreach program to engage stakeholders, ensuring diversity	• Develop materials and organize nuclear energy workshops for K-12 teachers • Onboard new university partners to fill gaps within core team capabilities • Launch the first VIN Hub Annual Workshop showcasing Year 1 achievements	• Establish a for sharing • Formalize th • Define proc in VA corpo • Hold VIN Hu



YEAR 3	YEAR 4	YEAR 5
erimental studies for VTEM/ADMIRE codes for lifecycle modeling and simula- omponent	• Evaluate the fuel lifecycle using VTEM/ADMIRE • Verify, validate, and apply the codes for lifecycle modeling and simulation for a subsystem • Model VTEM/ADMIRE accident scenarios and transient analysis	• Perform siting, licensing, and permitting for VTEM/ADMIRE • Use the codes for lifecycle modeling and simulation for the whole system, including uncertainty
e research from the supply chain gap	• Create the technologies from the research from the supply chain gap analysis	• Create the businesses from the technologies from the research from the supply chain gap analysis
ear 3 strategic roadmap ential customers for VTEM/ADMIRE al capabilities and modeling and simula- tential to spin off startups or diverse as to enhance sustainability	• Facilitate Year 4 strategic roadmap • Application of multi-modal detection system for current reactor fleet • Fund raising for VTEM and CHANDLER • Survey employers on the use of ex-core multi-modal detectors	• Facilitate Year 5 strategic roadmap • Create VTEM/ADMIRE user facility with associated policies and procedures • Assist startups and spin-offs to achieve sustainability
cooperative program among universities courses he use of reactor facilities for training cess and relationships to place students rations ub Annual Workshop	• Work with member universities and develop curriculum to enhance current programmatic offerings • Identify initial set of projects specific to VTEM/ADMIRE • Invite international attendees to the VIN Hub Annual Workshop	• Initiate educational programs at colleges and universities • Continue recruitment of highly diverse population • Address shortcomings and needs of educational and workforce development programs • Hold VIN Hub Annual Workshop with international participation

Figure 4: The VIN Hub will fill knowledge gaps in basic and applied research, as well as in the U.S. supply chain, creating a world-wide center of nuclear excellence.

Phased Implementation Approach

Phase 1: Establish the Hub and Phase 2: Execute Projects

We have organized our activities into 3 major phases. During Phase 1 we will perform all of the activities to establish the Hub. During Phase 2, we will execute projects identified during Phase 1.

Phase 1 equates to Year 1 of funding. Upon award, the Hub leadership Team will finalize the strategic plan within the first 3 months. Once approved by the Governance Board, each Domain Lead will execute their initial tasks. The CTO will secure his team to perform Task 1: supply chain analysis, a 6-month process. In the 4th quarter, they will identify significant gaps that will lead to projects aligned to Hub capabilities. The CSO will gather his team and begin coalescing core member capabilities and define the process, including the site, to house the Nuclear Test Facility. The CISO will develop and implement a road map for the entire Hub, working closely with the other leads. Within the first year, the Education and Outreach will develop a 5-year plan to communicate Hub successes, identify potential users, and work with university partners to develop curriculum to help mentor and train the next generation nuclear workforce in Virginia.

Phase 2 will occur in years 2-5 and is when we will begin to execute our domain-specific projects. During Phase 2, projects that are not fruitful may be terminated and replaced with more promising ones. Technologies may be pushed to meet a supply chain gap, capabilities may be added to the Nuclear Test Facility, members may be added to augment Hub capabilities. We will continually update our road map and 5-year plan to accommodate the dynamic nature of the work.

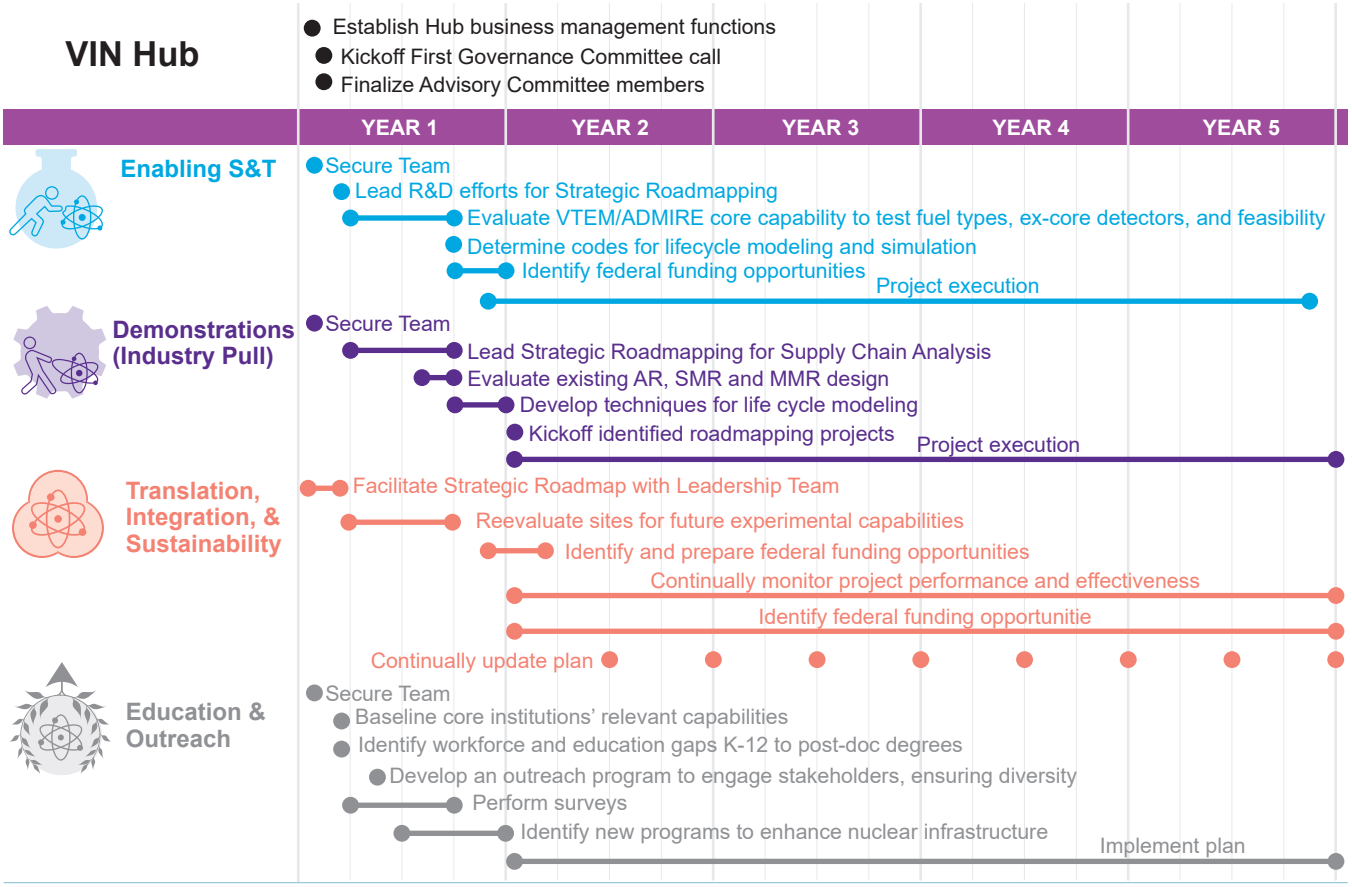


Figure 5: High Level Hub Milestones. Our strategic roadmap enables us to fill the supply chain gaps, build the VTEM/ADMIRE research facility, achieve sustainability, and build the next generation workforce.

Measure of Success

Phase 3: Achieving Sustainability

The VIN Hub is well positioned to achieve sustainability at the end of 5 years by integrating academia with industry from the outset, assigning leaders with a proven history of attracting outside funding, and providing researchers with a centralized facility to perform testing on critical nuclear technologies using an as-a-service model.

There are three important components for creating sustainability of the Hub:

- Community sustainability
- Financial sustainability
- Organizational sustainability

Community sustainability requires engagement of all the stakeholders in the nuclear science, engineering and technology community to promote ownership for the Hub. We encourage them to share their preferences and ideas to promote their engagement in all Hub activities. This includes integration of the existing methodology and extends to political support.

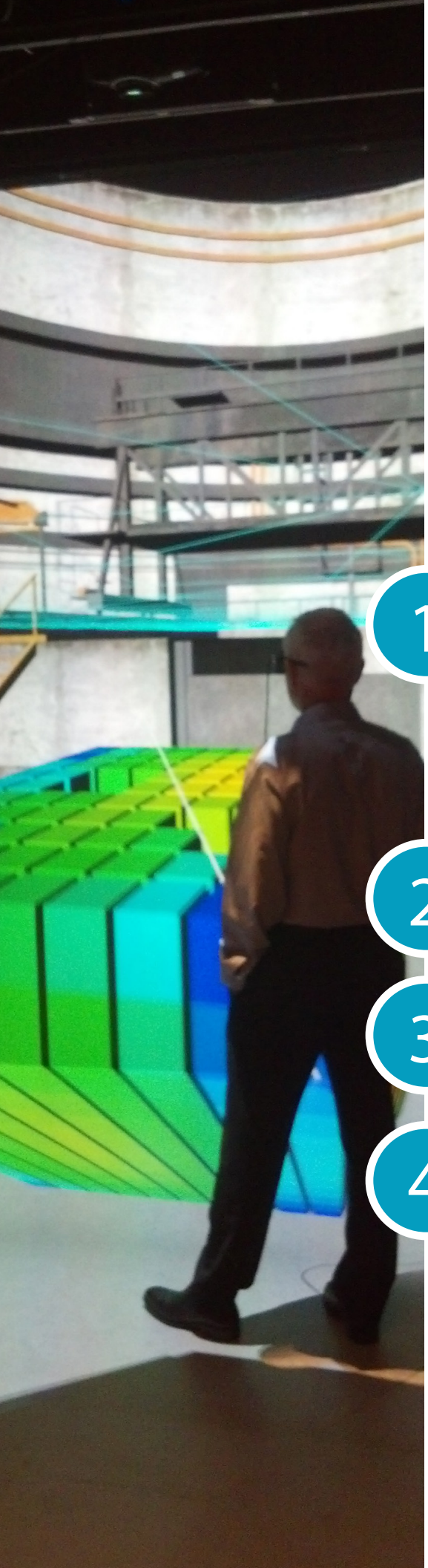
- Utility preferences
- Industry preferences may include advanced reactor component testing, HALEU testing
- Non-profits may include preferences like economic growth, workforce development, and specialized certifications
- University preferences might include such examples as creating new degree programs including Master's and PhD studies, cutting edge research opportunities, and others.

Financial sustainability will be a priority from the Hub's inception. We will continually scan for federal funding opportunities so that we are not reliant on State funding. We are already strengthening both the external and internal sources to support sustainability. We will leverage the Biden Administration's increased nuclear funding opportunities as an immediate avenue for consideration. DOE agencies like ARPA-E, IRP and NE currently have a plethora of funding opportunities in the works. The Hub's capabilities are ideally suited for many of these opportunities. Financial Sustainability might also come from endowments from outside institutions. The Hub will create its own funding stream through business ventures, patents, and/or membership fees.

Organizational sustainability stems from a Hub with a well-defined mission and populated by leaders who are results-driven to achieve the stated measures of success. Our thought leaders will mentor and train the next generation workforce and continually adapt to this ever-changing dynamic environment.

The Hub will become sustainable in five years by seeking federal government and industry funding, conduct consulting, offer special educational programs, and benefit from invention royalties.

Figure 6: Achieving Sustainability. Our three-pronged approach achieves sustainability by Year 5..



Compelling Reasons to Fund the Virginia Innovative Nuclear Hub

Establishing the Commonwealth of Virginia as the Leader for All Things Nuclear in the U.S.

1. Coalescing Virginia's nuclear resources into a highly-collaborative research team, spanning multiple scientific, engineering, economic, and public policy disciplines. Bringing this top talent from across the full spectrum of Commonwealth resources, the Hub will serve as a world-leading nuclear research, engineering, and technology center. all within Virginia's footprint.

2. Creating and training the next generation workforce through mentorship opportunities with team leadership.

3. Achieving financial, community, and organizational sustainability for the Hub by leveraging outside funding, integrating team preferences, and assigning proven leaders.

4. The potential for patents and spin-offs with this Hub model is significant. This creates a steady revenue stream as well as promoting the thought leadership contained within the Hub.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