

**Tennessee Nuclear Energy Advisory Council**  
**Preliminary Report**  
*December 2023*

The State of Tennessee is well positioned to lead not only the nation but the world in developing the next generation of safe, clean, and reliable nuclear energy and deploying the ecosystem necessary to deliver it.

**Summary**

Under Gov. Bill Lee's Executive Order No. 101, the Tennessee Nuclear Energy Advisory Council convened to develop a strategy to capitalize on Tennessee's unique leadership position in the nuclear industry. The Council has prioritized deployment of safe, clean, and reliable nuclear energy, which is critical to the State continuing to lead the nation in economic growth, while balancing conservation and responsible stewardship of natural resources.

The Council established subcommittees to perform preliminary Strength, Weakness, Opportunity, and Threat (SWOT) analyses of four (4) critical areas identified in the Executive Order: 1) Education & Workforce; 2) Existing & Emerging Technologies; 3) Funding Opportunities; and 4) Regulatory Issues.

Upon considering the subcommittees' work, the Council respectfully reports to the Governor, the Speaker of the Senate, and the Speaker of the House, that the State of Tennessee should focus on two broad strategies to secure the benefits of nuclear energy:

- **Broad Strategy #1: Advance New Nuclear & the Clinch River Nuclear SMR project**

The State should partner with the Tennessee Valley Authority (TVA) and other states in the TVA service area to advance new nuclear generally and, specifically, to advance the Clinch River Nuclear Small Modular Reactor (CRN SMR) project and next-generation SMR configurations.

- **Broad Strategy #2: Build the Nuclear Workforce & Supply Chain Ecosystem**

The State should position itself as the obvious choice for companies that will comprise the new nuclear supply chain, regardless of where new nuclear power is ultimately deployed. A workforce trained to work in the nuclear sector can underpin growth in related nuclear industries, such as fusion energy and radiopharmaceuticals.

These strategies are more fully outlined below, including identification of key SWOT indicators as well as working recommendations that the Council would offer for continuing evaluation and development upon consultation and agreement of the Governor and the General Assembly.

A summary listing of the full SWOT analysis of each subcommittee is included as an appendix to this preliminary report.

## **I. Broad Strategy #1: Advance New Nuclear & the Clinch River Nuclear SMR project**

Several trends put considerable pressure on the U.S. utility sector to provide more power with lower carbon intensity. The utility sector is being forced to rethink capital investment plans due to advances in artificial intelligence driving construction of large computational datacenters, continued electrification of the transportation sector, and the retirement of coal plants coming to the end of their useful lives.

In addition to these macrorends, Tennessee's economy continues to grow, and clean and affordable electric power is one of the primary enablers. Ford's recent Blue Oval City investment in West Tennessee is an example of significant new load growth supported by Tennessee and TVA. There are also important national security missions and opportunities that could add to the power demands facing the region.

Opportunities for economic growth in Tennessee will be negatively impacted without the addition of substantial new clean, base load power generation. While renewables are and will remain an essential part of TVA's larger and longer-term plan, renewables alone cannot satisfy growing demand. Supply chain challenges impact the ability to deploy solar power quickly, the region's wind resources are insufficient with current turbine technology, and the lack of affordable grid-scale energy storage technology limits these energy sources' ability to meet the challenges ahead. Additionally, large-scale deployment of solar and wind consumes significant amounts of land compared to nuclear, and close attention to environmental impacts is required as renewable technology is manufactured. For these reasons, new nuclear power is needed to meet growing energy demands in a sustainable and environmentally friendly manner.

Nuclear power is the most promising resource that can be deployed at a scale sufficient to address emerging needs. Nuclear is safe, nuclear plants have a long asset life (some U.S. commercial plants are now licensed for 80 years), and the functionality of nuclear power as a base load resource enables a more stable grid that can accommodate renewable resources. Additionally, Tennessee is leading the nation in reuse of lands to support clean energy initiatives under the national cleanup-to-clean-energy strategy.

Deployment of new nuclear also has strategic value for the nation. It creates high-paying jobs, ensures U.S. standing in the international nuclear community, enhances energy independence, and advances strategic national security interests. Indeed, substantial advances in domestic nuclear energy production are required to insulate the U.S. from growing instability in energy markets across the globe. Unfortunately, nuclear power generation has suffered from the inability to deliver new generation plants timely and on budget, thus stifling the deployment of traditional nuclear. It is critical to lean in with additional investment to push advanced nuclear across the goal line.

With the help of the U.S. government and significant private sector capital, the promise of new nuclear now lies with Small Modular Reactors (SMRs). This approach to new nuclear offers the promise of traditional nuclear power plants, i.e., reliable performance and zero carbon emissions, but at a cost the ratepayer can afford. The U.S. Department of Energy (DOE) is investing

heavily in advanced reactor designs through an Advanced Reactor Demonstration Program (ARDP) that seeks to move SMR technology onto the grid. DOE is supporting two companies' SMR designs as demonstration projects (Terra Power and X-Energy), but neither has an NRC-licensed design. In addition to the ARDP, DOE has provided significant financial support to NuScale, which has an SMR design approved by the NRC. However, NuScale recently canceled plans for its first reactor (at Idaho National Laboratory) due to the inability to constrain costs, potentially creating an opportunity for TVA. On Dec. 10, NRC issued a construction permit to Kairos Power for a next-gen molten salt SMR test reactor in the Oak Ridge Heritage Industrial Park. Kairos, another ARDP-funded project, has a cooperative agreement with TVA, which has assisted the company with licensing and engineering services.

TVA is also considering SMR technology designed by GE-Hitachi that uses a traditional boiling water reactor design scaled down to take advantage of more efficient manufacturing and construction techniques. The design, which uses an existing fuel already licensed by the NRC, can be deployed on the CRN SMR site, which has already received a site license from the NRC. The CRN SMR site also has the advantage of being located near Oak Ridge, where there is a strong nuclear heritage and nuclear-trained workforce.

In addition to these advantages, TVA has partnered with two other organizations (Ontario Power Generation in Canada and Synthos in Poland) that are deploying GE-Hitachi SMRs, allowing the partners to share lessons learned, spread fiscal responsibility, and mitigate project execution risk. Ontario Power will be the first to deploy the GE-Hitachi BWRX-300 design around 2028. A construction license is under review by the Canadian regulator, and site ORand component fabrication are already underway.

TVA's plan is to deploy up to four SMRs at the Clinch River Site. If Tennessee desires to be a significant player in capturing the economic benefits of a resurgence in the nuclear industry, there are significant strategic advantages to being the first state to deploy commercial SMRs. Doing so will increase the chances of securing a role in the supply chain for production of not only these four reactors but those that will follow, irrespective of location.

A commitment to deploy new carbon-free generating sources will also attract traditional, non-nuclear industries and companies looking for a long-term supply of carbon-free, reliable power.

### ***Key SWOT Indicators***

<u>Strengths</u>	<u>Weaknesses</u>
<ul style="list-style-type: none"> <li>• Strong pro-nuclear support exists across the region. There is alignment among Tennessee's local, state, culture and federal officials supporting a nuclear ecosystem.</li> <li>• Federal assets such as TVA, ORNL, Y-12, and Erwin's Nuclear Fuel Services</li> </ul>	<ul style="list-style-type: none"> <li>• Nuclear facilities require large capital investments and long lead times to build, which is amplified for the CRN SMR because it is a "First-of-a-Kind" design and deployment.</li> <li>• Limited DOE investment to date in CRN SMR and/or Tennessee advanced nuclear.</li> </ul>

<p>position Tennessee as a key region for federal investment and national leadership in nuclear R&amp;D.</p> <ul style="list-style-type: none"> <li>• Every part of the nuclear value chain (research, fuel production, operations, and waste management) and lifecycle is already partially present in Tennessee.</li> <li>• The CRN SMR project is underway with a site permit from NRC, leveraging known technology with a much lower risk profile than other types of advanced reactor designs.</li> <li>• TVA’s preapplication engagements with the NRC have been productive, suggesting the opportunity for the review and permitting process to become more expedient.</li> <li>• TVA has a “lessons learned” approach for its licensing plan in developing the nation’s first SMR by drawing from its CRN SMR early site permit process and other related licensing actions through NRC. Holds potential for quicker licensing of the same kind of SMRs when TVA moves to deploy multiple SMRs throughout its service area.</li> </ul>	<ul style="list-style-type: none"> <li>• TVA service area is seven (7) states, but there is underdeveloped organized political support needed for large federal investment.</li> <li>• Relatively limited ability to attract private capital for nuclear industry and start-ups in Tennessee due to historic and regional risk/equity capital biases.</li> <li>• Regulatory review process time can experience delays, inaction, and redundancies.</li> <li>• Concerns over NRC review timelines.</li> </ul>
<p style="text-align: center;"><u>Opportunities</u></p> <ul style="list-style-type: none"> <li>• CRN SMR is the nation’s most likely new nuclear project to succeed in the near-term. Based on existing technology and with a site already licensed by the NRC, a successful first SMR project is critical to subsequent projects over the next five to 15 years and puts Tennessee in the strongest possible position to capture the benefits of deployment of SMRs.</li> <li>• Explore application of Inflation Reduction Act (IRA) provision 48E (Investment Tax Credit) for CRN SMR. <i>A statutory change</i></li> </ul>	<p style="text-align: center;"><u>Threats</u></p> <ul style="list-style-type: none"> <li>• Funding challenges, including lack of DOE/federal funding, to support the CRN SMR.</li> <li>• Competing technologies, designs, and prior federal funding commitments have diffused and diluted impact of federal resources.</li> <li>• Lack of NRC expediency could jeopardize TVA’s licensing schedule and ultimate success in large scale deployment of</li> </ul>

<p><i>or Treasury interpretation may be required for TVA to realize full eligibility of this provision: return 50 percent of the capital cost for a new nuclear plant back in tax credits.</i></p> <ul style="list-style-type: none"> <li>Align and motivate TVA’s multi-state political delegation to support strategic nuclear energy deployment that will ultimately benefit <u>all</u> states. Advocacy from a coalition of states may increase the possibility of federal funding. <i>CRN SMR is not just a “demonstration” project — it is a deployment project that will scale/impact clean energy production more than any other over the next 10-15 years.</i></li> <li>Tennessee is a business-friendly state.</li> </ul>	<p>multiple SMRs across its seven (7) state service area.</p> <ul style="list-style-type: none"> <li>Expanding nuclear energy sector may exacerbate a larger workforce shortage without an intentional strategy to address/mitigate workforce needs at the industry-sector level.</li> <li>Lack of U.S. leadership in nuclear energy is a threat to national security.</li> <li>Competition from other states and private entities with similar nuclear initiatives.</li> </ul>
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### **Broad Strategy #1: Advance New Nuclear & the Clinch River Nuclear SMR project**

(Proposed working recommendations)

#### **A. Boldly Push for TVA to Lead the New Nuclear Renaissance at Clinch River: Focus on Solving for “First-of-a-Kind” Costs**

TVA is working toward deployment of new nuclear power generation with innovative SMRs at the Clinch River Site in East Tennessee. As a potential first-of-its-kind effort to develop, license, and deploy new SMR design(s), TVA (and its ratepayers) would bear the brunt of stepping up as the “first mover” in the industry, i.e., TVA would incur substantial up-front, mostly one-time costs commonly called “first-of-a-kind” (FOAK) costs. Such costs will diminish to the point of elimination over time as later deployments reap the benefits of replicating the design(s) and regulatory and licensure pathways pioneered by the first mover.

These FOAK costs pose a substantial economic dilemma. They are a significant and understandable barrier for TVA and the Clinch River Project, particularly bearing in mind TVA’s statutory debt ceiling. However, time is of the essence regarding the need to expand new generation capacity sufficient to support continued economic growth in Tennessee. The Council and the State should evaluate ways to encourage and partner with TVA to address, eliminate, or diminish the impact of FOAK costs. This includes identifying and establishing concrete opportunities for state and federal policy advocacy and coalition-building in seeking direct financial support and investment from the federal government, as well as exploring creative financing strategies and options that might include, for example, leveraging private equity investment and/or partnerships with other utilities looking to benefit from the development of SMRs. Such financial strategies might also include exploring possible direct investment and/or tax credits offered by states in the TVA service area. Considering the cancelation of the NuScale

project in Idaho, Congress may provide federal grant funding for additional SMR deployment projects, and TVA would be eligible to compete for this federal funding. There are several actions the State can take to strengthen TVA's proposal for such a federal grant:

- Continue supporting State-funded grant money for nuclear deployment in Tennessee, e.g., \$50 million ECD Nuclear Fund in the FY23-24 budget;
- Evaluate State-funded grants to couple or “match” with federal grants for the initial reactor deployment at the Clinch River Nuclear site; and
- Partner with other State governments in the TVA service area (Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Virginia) to create a coalition that supports deployment across the region. This would give TVA and the region a louder voice in Washington, D.C., for continued federal funding, support for policies favorable to new nuclear, and a broader network of available resources.

## **B. Establish a Regulatory Facilitation Team**

Regulatory requirements are essential to protect the public, but processes for obtaining permits and other authorizations can lengthen efforts to establish new businesses or new operations for existing businesses, especially those in nuclear-related industries. Tennessee can utilize a regulatory approach and lessons learned from the success of a Regulatory Facilitation Team, which contributed to accelerated cleanup of DOE's legacy nuclear sites in Tennessee and enabled the Oak Ridge Nuclear Renaissance. A similar approach could be developed to assist businesses dependent on nuclear energy or radiological inventories. The team would facilitate stakeholder relationships related to NRC processes and engage intergovernmental relationships that support forward movement with nuclear energy and supply chain activities. This team would seek to reduce TVA's cost for NRC permitting, support future companies requiring NRC permitting, and assist with developing a Nuclear Innovation Site in Broad Strategy #2.

## **II. Broad Strategy #2: Build the Nuclear Workforce & Supply Chain**

Tennessee is well positioned to lead the development of nuclear energy, but the state must leverage its advantages and proactively address challenges within the nuclear industry ecosystem by imposing deliberate collaboration across departments, agencies, and the private sector.

Key challenges and opportunities exist in the following three areas:

- **Human Resources** — Ready workforce with skills, abilities, and competencies responsive to nuclear industry needs.
- **Financial Resources** — Funding opportunities and incentives at the federal and state government levels plus the private sector to support nuclear energy and supply chain companies at various stages of development and deployment.
- **Land Resources** – Available, accessible, developable sites proximal to the complementary supply chain, labor, education, research, and technology transfer assets and partners. This includes suitable sites for expanded, accelerated deployments of TVA SMRs, next-generation SMRs and other nuclear industry and supply chain facilities.

The State is leading the nation in developing new, low-cost, and no-cost pathways for career and technical training; however, further work is needed to ensure development of policies and curricula designed and coordinated to the specific needs of the nuclear industry, including granular details such as developing estimates and targets for the number of workers required in specifically determined job descriptions to support development of a nuclear ecosystem. It is critical to identify and advance specific State policies that encourage nuclear energy and supply chain development.

Flexibility and creativity are essential due to the unique demands of nuclear projects. Meaningful public-private partnerships, for instance, are a crucial strategy to bridge existing gaps and alleviate the workforce, financial, and site challenges. These collaborative approaches are imperative in fortifying the State's standing as an appealing hub for nuclear-centric companies and positioning Tennessee as the nation's pioneering force in delivering secure, safe, and environmentally friendly power solutions bringing prosperity and energy equality to all. When achieved, Tennessee will create a favorable regulatory environment and provide a trained and skilled workforce specifically to support nuclear industry needs.

### ***Key SWOT Indicators***

<u>Strengths</u>	<u>Weaknesses</u>
<ul style="list-style-type: none"> <li>• Tennessee has a strong history and legacy in nuclear energy, with renowned institutions, laboratories, and organizations contributing to nuclear research, development, and innovation. Next-generation technology in Tennessee is a draw to the next generation of professionals.</li> <li>• Tennessee has a strong community of nuclear-related companies and employers. More than 230 nuclear-related companies exist in Tennessee.</li> <li>• Tennessee's established nuclear institutions and education programs produce a skilled workforce, creating personnel, including craftsmen and operators, capable of supporting nuclear initiatives.</li> </ul>	<ul style="list-style-type: none"> <li>• While there is suitable, cost-effective land available for development on the Oak Ridge Reservation, there is no consensus on use and timeline.</li> <li>• Multiple stakeholders in site readiness and preparation require a thoughtful, skilled approach. While there is a framework available, there is no formal consolidated plan for developing nuclear innovation district or supply chain.</li> <li>• Traditional outcome/success measures for economic development, including jobs created and capital expenditures, may not be applicable for some nuclear energy or nuclear industry investments.</li> <li>• Not enough people in workforce pipeline; need more qualified skilled trades.</li> </ul>
<u>Strengths</u>	<u>Weaknesses</u>
<ul style="list-style-type: none"> <li>• A review of the existing nuclear workforce and a preliminary plan to identify gaps and future needs has already been started by the East Tennessee</li> </ul>	<ul style="list-style-type: none"> <li>• Most people unaware of the benefits and sustainability of nuclear energy and availability of good-paying job opportunities and durable careers.</li> </ul>

<p>Economic Council (ETEC) and other entities in East Tennessee.</p> <ul style="list-style-type: none"> <li>• History of effective collaboration, partnership, and outcome orientation between regulators and regulated community; demonstrated framework and pathway to achieve desired goals.</li> <li>• Established incubators, innovation centers, and accelerators through universities, national labs, and industry leadership to sustain and support start-up and emerging companies in this space.</li> <li>• Demonstrated and proven approach for federal land reuse and reindustrialization of brownfield sites. The influx of new nuclear companies in the Oak Ridge area is located on the successfully remediated former K-25 site.</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of coordination or clearinghouse to provide “air traffic control” across the many stakeholders in higher education and the career pipeline to nuclear energy-related jobs.</li> </ul>
<p style="text-align: center;"><u>Opportunities</u></p> <ul style="list-style-type: none"> <li>• Growing demand from new businesses to start or relocate nuclear operations.</li> <li>• Oak Ridge Reservation’s proximity to existing nuclear companies, research, workforce pipelines, and supportive communities creates critical mass attractive to new and existing nuclear companies looking to move or grow.</li> <li>• Tennessee ECD can be a catalyst within federal-state-local relations to move forward with redevelopment on the Oak Ridge Reservation that will support a nuclear innovation district.</li> <li>• Current and projected nuclear industry workforce analysis, including supply and demand, initiated this year by ETEC, can be expanded to create a more detailed gap analysis.</li> <li>• Public-private partnerships have emerged in the past year that provide a roadmap for</li> </ul>	<p style="text-align: center;"><u>Threats</u></p> <ul style="list-style-type: none"> <li>• Range of local and federal issues to navigate for successful implementation of nuclear innovation district.</li> <li>• Unique and restrictive nuclear rules and regulations for workforce that are not present on other sites or for other industries.</li> <li>• Lack of qualified programs to support needs of nuclear industry at all levels.</li> <li>• Potentially not receiving funding to for skill, training, technical and career-based activities in Tennessee.</li> <li>• Other states are more effective in developing workforce strategies and workforce development incentives for attracting, recruiting nuclear industry.</li> <li>• Growth in nuclear industry will tax the workforce supply and increase</li> </ul>



<p>community colleges and TCATs looking to build out curriculum, skill building, and competencies to support workforce development feeding the nuclear industry (e.g., UT-Battelle \$100,000 grant to Roane State Community College (RSCC); RSCC leveraging \$1.44 million grant from U.S. Department of Labor to develop nuclear industry training).</p> <ul style="list-style-type: none"> <li>Gov. Lee and the General Assembly have been champions for vocational, career, and technical education. Enhanced public-private coordination and collaboration can expand community outreach, promote STEM education, and develop specialized nuclear-related training/education programs.</li> </ul>	<p>competition for skilled workforce talent at the local, regional, and national level. This could result in inflationary wage spikes that could negatively impact potential investments and hamper industry growth.</p> <ul style="list-style-type: none"> <li>Economic success in the region has led to constraints in several livability factors such as access to housing and childcare.</li> </ul>
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## **Broad Strategy #2: Build the Nuclear Workforce & Supply Chain**

(Proposed working recommendations)

### **A. Evaluate Economic Incentives and Tax Credits Administered by the Tennessee Department Economic & Community Development and the Department of Revenue, Respectively, Around Recruitment of Companies and Investment Necessary to Develop the Supply Chain for New Nuclear**

Existing incentives and tax credits are oriented around maximizing capital investment and job creation. This approach has served the State well, resulting in thousands of jobs and billions of dollars of capital investment. However, these standards may not be suitable for attracting and growing nuclear-related businesses. Careful study and attention should be given to developing criteria more suitable to attracting businesses with critical expertise and necessary ties to emerging technologies and industries. ECD may also coordinate a multidisciplinary team to serve as one point of contact to facilitate interaction between potential companies, local governments, community stakeholders, and educational institutions to help provide necessary resources for a successful startup.

### **B. Explore Development of a Nuclear Innovation Site**

TVA and the State of Tennessee have successfully utilized focused land development to promote business clusters and attract major industry through intentional site recognition, preparation, and execution. A similar approach, specifically focused on identification of a large parcel of land located in strategic proximity to the CRN project, would support recruitment of companies in emerging nuclear sectors and may accelerate the creation of a unique, innovative ecosystem attractive to companies critical to building the new nuclear supply chain.

Success of tier one nuclear generators, such as TVA, will rely heavily on a robust supply chain much like automotive OEMs in Tennessee rely on the large automotive supply industry in Tennessee. A similar model supported by comprehensive land-use planning and assistance from relevant state institutions could position the State to be a leader in not only new nuclear generation but supporting industries as well.

### **C. Produce a Comprehensive Nuclear Education & Workforce Development Strategic Plan**

There is a need to identify and close critical workforce gaps facing the nuclear industry. Growing a nuclear workforce is a complex undertaking, requiring coordination among state, federal, and local agencies (education, labor & workforce, economic development, chambers of commerce, etc.), educational institutions, (K-12, TCAT, universities, community colleges, etc.), and industry. Different state, local, private, and nonprofit organizations are currently engaged in meaningful efforts, but stronger coordination and communication is needed to optimize effectiveness. There should be a designated person, group, or entity responsible for identifying/compiling the projected workforce skills that will be needed; merging those needs on a timeline; and partnering with education leaders to begin addressing specific gaps. This person/group/entity could serve as a clearinghouse to identify education funding needs to close those gaps; leverage existing programs; connect public-private partners; share information about successful models that can be replicated; import lessons learned from other states; and publicize grant, training, and apprenticeship programs and opportunities; etc.

A useful analog for study is the work and approach used by ETEC to identify specific gaps in the State's ability to prepare enough skilled and qualified workers to support the full spectrum of nuclear business opportunities. ETEC provided a holistic framework to evaluate the mechanisms in the State to train workers that can support the entire spectrum of needs. Based on this approach, a much more rigorous and structured analysis is required to inventory and project the needs of emerging companies, identify gaps in current workforce and training, and identify solutions to close those gaps.

A strategic plan in this area should focus on collaboration among various agencies, organizations, and companies to address effective recruitment and retention initiatives, STEM education, and leverage Tennessee's proven two-year community college and TCAT system, including the following initiatives to ensure success of the nuclear ecosystem:

- Partner with community colleges and TCATs to facilitate their understanding of nuclear technology and encourage them to integrate nuclear career paths into their curriculums. *Scale and amplify ORNL's partnership experiences with Roane State and Pellissippi State community colleges.*
- Explore additional two-year degrees, such as radiation-protection programs or related technical areas.
- Expand trades programs that support general construction and nuclear-related skills, taking advantage of apprentice programs like the East Tennessee Apprentice Readiness Program

- Develop upskilling programs that provide employees and underserved communities with training to transition into roles involving new technologies (potentially utilizing distance education).
- Promote development of nuclear engineering and related fields at Tennessee universities, including development of a nuclear minor in traditional engineering programs.
- Engage and leverage the coalition workforce planning partnership between TVA, ORNL, Y-12 and UCOR to develop labor supply that meets the demand and is adaptable with the skills, capabilities, tools, and technology needed to drive the future of the nuclear industry and support an ecosystem with a robust pipeline of talent from both established and untapped sources.

A plan should also include a crosscutting communication component to:

- Inform the public about the benefits of reliable, resilient, clean, carbon-free nuclear energy to increase understanding, improve perception, and proactively address concerns.
- Create greater awareness of high-paying, sustainable careers in the energy sector broadly and the nuclear sector specifically among young people (K-12, college-aged, trades).
- Promote the attributes of living, working, and doing business in Tennessee.

#### **D. Complete a Regulatory & Business Analysis for Sectors in the Nuclear Ecosystem**

Tennessee is an “Agreement State” with respect to the NRC and thus has regulatory oversight responsibility for all radiological activities not associated with nuclear fission for power generation. Where applicable, the State should identify opportunities to improve the time required to obtain necessary permits in each of these nuclear business sectors:

- Advanced Nuclear for Power Generation
- Front End of the Nuclear Fuel Cycle
- Back End of the Nuclear Fuel Cycle
- Medical Isotopes
- Fusion Power Generation
- Nuclear Security
- Nuclear Service Companies

These nuclear industry sectors represent the range of research, innovation, technology transfer, and business opportunities in Tennessee over the next 25 years. Regulatory analysis will feed into a time-sensitive business understanding (near-term/long-term) of how State policies and potential support could affect the growth, development, and expansion of these sectors. Launch and early experience from the \$50 million ECD Nuclear Fund will inform optimal steps for potential state action enabling key sectors, e.g., reactor component, fabrication, radioisotope production, and used

fuel reprocessing. Identified opportunities could also feed into the work of the forementioned Regulatory Facilitation Team.

### **Current Status & Looking Ahead to Final Report**

Tennessee will lead the way for the nation in the deployment of new nuclear energy by first succeeding in Oak Ridge, including deployment of the CRN SMR as first-in-the-nation advanced new nuclear generation, and then using that model to expand across the state, becoming the preferred destination in the United States for the nuclear industry.

*The comprehensive Tennessee Nuclear Education and Workforce Development Strategic Plan will be delivered in the Council's Final Report by Oct. 31, 2024.*

**Tennessee Nuclear Energy Advisory Committee  
Preliminary Report  
APPENDIX**

**Education & Workforce Work Group Analysis**

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## TNEAC Education & Workforce Work Group SWOT

### STRENGTHS

- 1) **Strong State and Government Support**
  - a) Financial Support to Students through “Drive to 55”, Tennessee Promise and Reconnect
  - b) Strong government leadership support for nuclear (Gov. Lee and Rep. Fleischmann)
  - c) Financial investment of \$50M could provide education and workforce resources
- 2) **University/Laboratory Research/Technology Partnerships with Industry**
  - a) Research and Development Leaders provide a robust foundation for nuclear R&D, fostering technological advancements.
  - b) Next generation technology in the valley is a draw to next generation professionals
- 3) **Rich Nuclear Heritage: Tennessee has a strong history and legacy in nuclear energy, with renowned institutions, laboratories, and organizations contributing to nuclear research, development, and innovation.**
  - a) Long history of skilled craft labor supporting nuclear infrastructure buildout (ORNL, Y12, TVA, CENTRUS...)
  - b) Pro nuclear community
- 4) **Skilled Workforce: Tennessee’s established nuclear institutions and education programs produce a pool of skilled professionals, creating a workforce capable of supporting nuclear initiatives.**
  - a) Strong partnership and engagement with Union Labor through programs at TVA, UCOR, and others.
  - b) A few industry internship and mentorship programs.
- 5) **Strong Community of Nuclear Related Companies/Employers:**
  - a) 229 nuclear related companies in TN
  - b) Cluster of globally recognized nuclear innovators in East TN (X-Energy/TRISO-X, Kairos Power, Ultra Safe Nuclear)
- 6) **Livability: Tennessee is a desirable location to live, work and play.**
  - a) Zero state income tax.
  - b) Moderate climate makes it attractive to our workforce.

### WEAKNESSES

- 1) **Supply of people:**
  - a) Current craft/skilled trades needs greatly outnumber available resources. Lack of educational opportunities.
  - b) Current needs for engineering and project management/controls specialists outnumber resources.
  - c) Regulatory (NRC) Workforce Challenges, not enough skilled employees
  - d) Security checks backlog/delays
- 2) **Communication:**
  - a) Public Perception: Individuals remain vocal in their negative views focused on misconceptions concerning safety protocols and waste disposal practices, potentially impeding the progression of nuclear initiatives (NIMBY).
  - b) Most of the state is unaware of the benefits and sustainability of nuclear energy and the availability high-paying job opportunities.
  - c) Competing clean energy focus (solar/wind lack of consistency)
  - d) Our future success is heavily reliant on one project to succeed (TVA SMR project)
  - e) Lack of “clearing house” to provide information to potential employees.
- 3) **Employment expectations not being met**
  - a) In some cases, salaries are not keeping up with inflation
  - b) Not meeting workplace expectations of the new generation of workers (slow career growth and professional development, flexibility, telework, workload expectations, transparency, support for social causes, training, etc.)
  - c) Aging Infrastructure: Some nuclear facilities and infrastructure may be outdated, requiring modernization and investment.
- 4) **Livability**
  - a) Lack of lifestyle benefits (pharmacy, eye care, childcare, etc.)
  - b) Lack of public transportation and/or housing
  - c) Remote location of many jobs in industry

# TNEAC Education & Workforce Work Group SWOT

## OPPORTUNITIES

## THREATS

### 1) Initiate and Expand Community Outreach:

- a) Inform public about benefits of nuclear energy to improve perception, generate career demand, overcome opposition.
- b) Increase awareness of high-paying and sustainable jobs.

### 2) Promote STEM Education

- a) Collaborate with schools to promote STEM education with a focus on nuclear energy and the job opportunities available to create a workforce pipeline.
- b) Prioritize underserved communities.
- c) Utilize existing industry program(s) to engage K-12 students in STEM education and expose them to nuclear careers.
- d) Team with higher ed. and industry to develop teacher training programs.

### 3) Develop Specialized Nuclear Related Training/Education Programs

- a) Partner with community colleges to educate them on nuclear and encourage them to integrate nuclear into their curriculums.
- b) Develop nuclear minor in traditional engineering programs.
- c) Explore additional two-year degrees, such as radiation protection programs (Chattanooga State) or related domains.
- d) Expand trades programs that support nuclear-related skills.
- e) Develop upskilling programs that provide employees with training to transition into roles involving new technologies.

### 4) Support and Encourage Public-Private Partnerships:

- a) Foster dialogue among nuclear companies, the business community, and government stakeholders to explore synergies.
- b) Establish close ties between academia and industry to ensure education and training programs align with industry needs.

### 1) Community:

- a) Public distrust due to accidents, radiation concerns, and other misinformation can impede successful workforce recruitment.
- b) Lack of education related to the perception of clean energy and pros and cons of various renewables.
- c) Lack of awareness of new jobs.

### 2) Jobs:

- a) Not delivering on the promise of new jobs.
- b) Competition for construction, engineering jobs, etc. which could lead to workforce poaching among companies and/or higher wages, full employment related to inflationary wages.
- c) Competitive national job market.
- d) Construction worker lifestyle (no roots planted at job site).
- e) Unique and restrictive nuclear rules and regulations not present on other sites/industries (safety and security, drug testing, ability to obtain security clearance, etc.).
- f) Multi-generational workforce conflict.
- g) Changing workforce expectations:
  - i) Desire for remote employment that may not be available
  - ii) Training programs leading to rapid advancement
  - iii) Work life balance

### 3) Education/Workforce

- a) Lack of qualified workers with the required skills due to
  - i) Educational institutions not producing workforce
  - ii) Knowledge transfer constraints
  - iii) Aging workforce provides a drain
  - iv) Partnerships with Unions (independence)
- b) Lack of qualified programs to support the need at all levels

- c) Identify and utilize successful nuclear companies who designed retraining/training/apprentice programs and engage.
- d) Develop programs to support private sector involvement in training programs and offering internships or apprenticeships.

**5) Develop a TN Nuclear Recruiting Strategy (internal and external to the state)**

- a) Organize job fairs and recruitment events.
- b) Reimagine how industry networks recruit talent.
- c) Identify areas within Tennessee where workforce is or will decline and could retrain into the nuclear arena. (i.e. coal)
- d) Market industry careers to underserved communities.

**4) Funding/Investment**

- a) Potentially not receiving federal funding.
- b) State, communities, and/or educational institutions not investing in this area.

**5) Livability**

- a) Cost and availability of housing
- b) Remote locations



## TNEAC Existing & Emerging Technologies Work Group SWOT

### STRENGTHS

- 1) Pro-nuclear advocates at the state and federal levels (Gov. Lee and Rep. Fleischmann).
- 2) Long history of nuclear R&D at ORNL and UT.
- 3) Four operating nuclear power plants in Tennessee.
- 4) SMR companies are already located in Oak Ridge area.
- 5) Research reactor at HFIR and commercial isotope reactor may be built in Oak Ridge.
- 6) Largest DOE Isotope production.
- 7) 229 nuclear companies across the state.
- 8) Advanced manufacturing and advanced material capabilities in East Tennessee.
- 9) Rich Nuclear Heritage (nuclear weapons and nuclear energy).
- 10) Fusion Research at ORNL and fusion companies located in the area.
- 11) NRC approved sites are available for deployment.
- 12) Simulation capabilities for siting (for example, modeling of seismic activities for siting of new reactors).
- 13) Enrichment technologies capable of producing any elements in the periodic table from small quantity to large.
- 14) Network of higher ed, trade schools, and labor organizations.
- 15) Every part of the nuclear value chain, from research, fuel production, operations, and waste management are here in TN.

### WEAKNESSES

- 1) Flat land shortage and DOE land transfer challenges.
- 2) The people of Tennessee are not well aware of benefits of nuclear energy and its high-paying job opportunities.
- 3) Heavy reliance on success of TVA to deploy new nuclear.
- 4) Large capital investments needed (e.g., ~\$5B+) and long-time to build facilities.
- 5) Venture capital companies are not large enough to take advantage of TN incentives.
- 6) Nuclear-related economic benefits are concentrated in East Tennessee limiting statewide support.
- 7) Regulatory challenges and inadequate incentives to build new nuclear.
- 8) Lack of large component manufacturing and transportation capabilities.
- 9) Shortage of qualified skilled craft that can pass nuclear Fitness for Duty and background checks.
- 10) No major airports or airline hubs in East Tennessee. It is hard to find direct flights in and out of Knoxville, and air travel to and from Knoxville is expensive.
- 11) Lack of high-end luxury hotels in Tennessee except in Nashville. As a result, other parts of Tennessee are not a draw for big conferences.
- 12) Old and outdated college recruiting set ups. Only huge companies are able to hire our best talent.
- 13) Housing shortage and high rental rates.
- 14) Lack of good public transportation such as metro lines.

## TNEAC Existing & Emerging Technologies Work Group SWOT

### OPPORTUNITIES

- 1) **Near Term Fission Opportunity:** TVA's proposed Clinch River SMR project is the nation's most likely new nuclear project to succeed in the near term (5-7 years). Based on existing technology and with a site already licensed by the NRC, a successful first TVA SMR project is critical to subsequent projects (years 7-15) and thus sets Tennessee in the strongest possible position to capture the benefits of deployment of SMRs across the nation, and even the globe.
- 2) **Front End of Fuel Cycle:** The U.S. has no U.S. based enrichment capability. The federal government is making investments to re-establish an enrichment capability. The role of commercial vs uniquely federal is not clear, but in all likelihood, a centrifuge-based technology will be deployed at scale in the next 5-15 years. ORNL is DOE's steward of centrifuge technology. If Tennessee is selected by the DOE to re-establish an enrichment capability, it positions Tennessee to capture the benefits of a critical national capability.
- 3) **Longer Term Fission Opportunity:** Several companies are pursuing advanced fission reactor designs with private and/or federal funding. These companies face licensing challenges impacting design, siting, and fuel. The fuel supply chain for many of the proposed designs is non-existent. The supply chain to support these innovative designs is also nascent at best. Helping these companies with their technology development efforts, licensing efforts, and development of a fuel supply, presents opportunities to advance these designs to commercial applications.
- 4) **Fusion Opportunity:** Numerous companies have secured private and/or federal funding to pursue fusion energy technology. Many of these companies are looking to locate pilot/test facilities in the near term to mature their technology. ORNL is the nation's lead fusion energy laboratory. If Tennessee can attract one or more of these companies, it positions Tennessee to be a significant player in subsequent fusion energy technology development and/or commercialization efforts.
- 5) **Radiopharmaceutical Opportunity:** Tennessee has unique capabilities for the production of short-lived radioisotopes residing at ORNL. ORNL also fields world-class scientific capabilities in computing and materials science. These capabilities, combined with the medical research capabilities at ETSU, UT, and Vanderbilt University, position Tennessee to create a radiopharmaceutical ecosystem (research, production, and therapy) unmatched in the world.

### THREATS

- 1) Current global politics and lack of U.S. leadership in nuclear energy is a threat to national security.
- 2) Competing technologies dilute resources: renewables vs. biofuels vs. nuclear and SMRs vs. Gen. 4 reactors.
- 3) Lack of adequate federal funding to support first of a kind reactor development and deployment.
- 4) Lack of domestic HALEU for new reactors.
- 5) Expanding nuclear sector will exacerbate workforce shortages.
- 6) Proliferation Concerns.
- 7) Funding Challenges.
- 8) Relying on design without design certification.
- 9) Low technical readiness level for deployment.
- 10) Focus on technologies without consideration of realistic time to deploy can waste resources in the near term.
- 11) DOE focus has not been on TN projects, and there is little appetite to call into question previous decisions on project allocation.

- 6) **Nuclear Security Opportunity:** Global trends toward cleaner energy are driving national energy policies toward the utilization of nuclear. Expanded use of nuclear power increases the need for strong nonproliferation capabilities to preserve national security. Existing and new technologies will be in greater demand as more and more nuclear material is produced for defense and non-defense purposes.
- 7) **Nuclear Service Companies:** Global trends toward cleaner energy are driving domestic and foreign policy makers toward the utilization of nuclear. Supply chain opportunities are emerging in support of fission and fusion technology advancements. Servicing new nuclear and life extension of existing nuclear, both foreign and domestic, will create increased demand for nuclear service and supply chain companies. Tennessee's existing concentration of nuclear capabilities positions the state to support the expansion/creation of these companies.

## TNEAC Funding/Finance Work Group SWOT

### STRENGTHS

- 1) Strong local support (community, region, state/local government, delegation)
- 2) Over \$5B annual investment in TN by DOE
- 3) Strong foundation/Leadership by ORNL/UCOR/CNS/UT/Vandy/TTech/ORAU/TVA/etc
- 4) Several nuclear companies have already located to TN (driven in part by politics)
- 5) Leadership by State/Gov. Lee /\$50M approved.
- 6) Low cost of living, nice place to live, business friendly.
- 7) Available workforce
- 8) Pro-nuclear East TN community with advocates at the state and federal levels
- 9) State investment of \$50M to provide incentives for new and existing nuclear companies.
- 10) Access to R&D support from ORNL, UT, etc.
- 11) TVA has the only early site permit issued by the Nuclear Regulatory Commission (NRC) for small modular reactors in the U.S.
- 12) Strong existing nuclear workforce and plan to define future needs and identify gaps.
- 13) Network of higher ed, trade schools, and labor organizations
- 14) Supply Chain: 229 companies working in the nuclear industry across the state.
- 15) Cluster of globally recognized nuclear innovators in East TN (X-Energy/TRISO-X, Kairos Power, Ultra Safe Nuclear)
- 16) Leadership in nuclear R&D and education (ORNL nuclear science, UT nuclear engineering, TN Tech nuclear eng. education, VU nuclear waste mgmt.)

### WEAKNESSES

- 1) Vision/Outcomes not fully defined.
- 2) Measures of success unclear
- 3) TN generally not supportive of federal funding
- 4) Overly optimistic or unrealistic expectations
- 5) Lack of focus
- 6) Not much federal funding for nuclear projects in TN
- 7) We're late—federal funding programs are already in motion.
- 8) No clear process for maximizing impact of \$50M in ECD Fund
- 9) TVA service area is broad, but we aren't capitalizing on the potentially broad political support we'll need for large federal investment.
- 10) Little developable land available in East Tennessee; DOE land transfer process takes minimum 18 months.
- 11) Not enough people for workforce pipeline; need more qualified skilled trades.
- 12) Most of the state is unaware of the benefits of nuclear energy and the high-paying job opportunities available in the industry.
- 13) Our future success is heavily reliant on one project to succeed (TVA SMR project)
- 14) Large capital investments needed (e.g., ~\$5B+) and long-time horizon to build facilities.

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| <p>17) Long history of nuclear energy and other clean/renewable energy generation (TVA)</p> <p>18) Private sector leadership in nuclear energy technology development</p> <p>19) Independent, DOE-supported consortium for risk and stakeholder assessments and mgmt. (VU-CRESP)</p> <p>20) Federal assets such as Oak Ridge National Laboratory, the Y-12 National Security Complex, TVA and Erwin's Nuclear Fuel Services have cemented our State 's standing as a nuclear center of excellence.</p> <p>21) The residents of Oak Ridge, Roane and Anderson County, TN and the surrounding region are comfortable with nuclear related industries and adapted the education of our youth to prepare a future workforce quicker than other locations.</p> <p>22) Successful recruitment of nuclear companies such as X Energy/Triso-X, Kairos, and Ultra Safe Nuclear have helped create a nuclear business cluster.</p> <p>23) Engineering programs from the University of Tennessee system and now Tennessee Tech working closely with nuclear industry.</p> <p>24) Gov Lee and Tennessee General Assembly are genuinely interested in the advancement of nuclear energy and have put \$50M towards the recruitment/retainment of nuclear companies.</p> <p>25) Alignment among Tennessee's local, state, and federal officials on support of nuclear ecosystem</p> <p>26) High concentration of existing nuclear entities covering the complete nuclear life cycle (except waste storage).</p> <p>27) ORNL is lead fusion energy lab in U.S.</p> <p>28) No other location in U.S. has the foundation for breakthrough advances in radiopharmaceuticals similar to TN.</p> <p>29) Already starting to get organized to address workforce shortages . . . this de-risks projects from an investor perspective.</p> | <p>15) Lack of waste management pathway. Waste management needs to be addressed up front, incl. plans for long-term safe storage for the foreseeable future.</p> <p>16) Nuclear-related economic benefits are currently concentrated in East Tennessee potentially limiting statewide support.</p> <p>17) State government tends to be risk-adverse towards emerging technologies, including nuclear, particularly when associated with new companies.</p> <p>18) TNECD needs to respond more quickly to companies deploying new technologies to keep pace with other States.</p> <p>19) Communication between Communities, State and TVA needs to be improved.</p> <p>20) Lack of specialized nuclear supply chain – there are gaps that can't be filled in the US.</p> <p>21) Lack of industrial property in East TN close to existing nuclear business cluster where topography often presents challenges.</p> <p>22) Full scope of what level of funding is needed.</p> <p>23) Hard to secure federal investment in TVA SMR</p> <p>24) Ability to align and motivate TVA 7 state delegation to support nuclear in TN</p> <p>25) Ability to attract private capital investment into startups; TN is a "fly-over" state.</p> <p>26) DOE Oak Ridge is reluctant to support siting of private sector fusion pilot/demo projects on the federal reservation</p> |
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## TNEAC Funding/Finance Work Group SWOT

### OPPORTUNITIES

- 1) TVA Clinch River site could be first US grid scale SMR.
- 2) A lot of funding opportunities/tax credits for investments in nuclear/manufacturing/coal to nuclear/hydrogen; may be able to pair/match federal and state funding.
- 3) Need to ensure we maximize investment tax credit opportunities for TN.
- 4) Collaboration across states to build a regional network for nuclear deployments (may help with R/B)
- 5) Can leverage manufacturing expertise at ORNL and Y12 to support new businesses.
- 6) Strong community college and trade schools that can help generate workforce needed to deploy new nuclear.
- 7) \$50m can be used to attract new businesses that can support existing and new nuclear and create US supply and export opportunities.
- 8) TVA's project will bring significant industry to expand growth from an industry cluster to a National Nuclear Hub, creating economic growth via more jobs, industry investments, tax revenues, etc.
- 9) Restore U.S. global leadership in nuclear energy and assure the nation's security by deploying the first of many SMRs in the U.S.
- 10) Leverage EDA Tech Hub grant to (1) establish TN as the Nuclear Workforce Center of Excellence (using existing partners like UT, ORAU, TCAT and Community Colleges); and/or (2) to launch a "Nuclear Grade Supplier Development Program"; and/or (3) Create nuclear-specific accelerator for entrepreneurs (like Innovation Crossroads), etc.
- 11) Expand K-12 education about nuclear energy and the job opportunities available.
- 12) Increase public awareness of the benefits of clean nuclear energy and high-paying job opportunities within the industry.

### THREATS

- 1) Administration may not be supportive of new deployment project in TN (Red/Blue), and there are already other existing demonstration projects.
- 2) Red/Blue issues may limit opportunities, and it may get worse with upcoming election.
- 3) Many states are trying to do this too.
- 4) Considering the current state of global politics, lack of U.S. leadership in nuclear energy is a threat to national security.
- 5) Competing technologies dilute resources: renewables vs. biofuels vs. nuclear and SMRs vs. Gen. 4 reactors, etc.
- 6) Tennessee's success is heavily dependent on TVA's decision to proceed with SMRs at Clinch River Site (most of our eggs are in this basket)
- 7) Lack of federal funding to support first of a kind reactor.
- 8) Potential for repeal of federal tax credits supporting new nuclear plant construction.
- 9) No U.S. production of High Assay Low Enriched Uranium (HALEU) for fuel for advanced nuclear reactors
- 10) Other states have enacted demand-inducing policies for new nuclear that may incentivize utilities in those states to build first.
- 11) Anti-nuclear activism and insufficient/erosion of public trust makes nuclear power a politically charged topic where support can shift quickly.

- 13) Secure economic growth across the state via energy-sector-jobs, new industries attracted (incl. EVs and AI/data centers in the state), lower energy costs, and long-term utility rate stability.
  - 14) Shape national policy and strategy with science-based approaches, economic/cost-benefit analysis and independent review boards to enable U.S. energy independence for the safe, secure, and environmentally responsible development of nuclear energy generation.
  - 15) Gain long term public support in the state by establishing programs for multi-tiered education, stakeholder engagement, and independent oversight/assessment (e.g., for monitoring of environmental quality).
  - 16) Secure federal funding for a “hub” that is multifaceted including R&D, technology innovation, waste management and environmental monitoring, workforce development and small and medium business expansion.
  - 17) Tennessee is a business-friendly state. Deployment of advanced green energies such as nuclear draw additional interest particularly with energy intensive industrial sectors such as big data and AI.
  - 18) Tennessee’s recruitment of EV’s gives Tennessee the opportunity to “complete the cycle” of future transportation technologies from manufacturing to fuel source.
  - 19) Becoming more comfortable with nuclear energy technology allows State of TN to become more comfortable with all emerging technologies.
  - 20) Developing incentives for nuclear ecosystem investment
  - 21) TVA’s Clinch River SMR project is underway and leveraging known technology (much lower risk profile vs advanced reactors)
  - 22) Advances in AI will drive significant increases in power demand; TVA is well positioned to support these demands with clean nuclear . . . if we can get the SMR project going!
  - 23) Connect UT’s Health Science Center with ETSU’s medical research with ORNL’s radioisotope capabilities to set the foundation for radiopharma ecosystem that can secure “big pharma” investment.
- 12) Even small safety violations can upend community support, draw adverse national attention, and significantly delay/stop what is already a 7 to 10-year long process of SMR facility build-out.
  - 13) Commitment to safety (worker, public) and environmental protection must be paramount and clearly communicated to gain and maintain long-term public trust.
  - 14) An expanding nuclear sector caused by the clean energy transition will further exacerbate workforce shortages.
  - 15) Shortage of skilled trade labor.
  - 16) Unknown risks associated with TVA SMR deployment at the Clinch River Site.
  - 17) Unknown risks associated with X-Energy (Triso-X) deployment of XE100 at Dow facility in Texas.
  - 18) Migration of population to Tennessee potentially puts too much pressure on available power grid.
  - 19) International political climate and associated policy disrupting dependence on foreign nuclear supply chains.
  - 20) Other states that have programs that support nuclear investment /development.
  - 21) Advanced reactor supporters not vested in TVA’s success.
  - 22) If TVA SMR project fails, how will we be able to claim we are the hub of nuclear?
  - 23) Traditional ECD paradigm on “incentives” may not be competitive in this sector.

## TNEAC Regulatory Work Group SWOT

### STRENGTHS

- 1) Oak Ridge and West End Innovation District**
  - a) Nuclear-friendly community/workforce
  - b) Available, cost effective, and suitable land
  - c) Proximity to ORNL and UT
  - d) Site infrastructure and location (two major interstates, railroad, barge system, electricity, water, sewer, gas, Watts Bar, TVA Clinch River)
  - e) History/legacy is a story to build upon
  - f) First site to successfully close the nuclear life cycle
  
- 2) Regulator Partnerships**
  - a) Partnership model and history of collaboration
  - b) Supportive State and local regulators
  - c) TVA's Preapplication Engagements with the Nuclear Regulatory Commission (NRC) have been productive, suggesting opportunity for review and permitting process to become more timely and expedient
  - d) NRC Readiness Assessment part of establishing predictable licensing pathway.
  - e) Topical reports are developed and submitted to de-risk licensing process.
  - f) TVA has a lessons-learned approach for its licensing plan in developing the nation's first small modular reactor (SMR) by drawing from Clinch River Early Site permit process and other recent licensing actions through NRC
  - g) NRC National Environmental Policy Act (NEPA) review process has been enhanced to address efficiency in review and issuance of Environmental Impact Statement
  
- 3) Additional Strengths**
  - a) Vision casting and land use management expertise
  - b) Pathways to End States framework
  - c) Communication and facilitation are driving outcomes.
  - d) Federal and state initiatives backed by funding.
  - e) Significant momentum with current companies
  - f) TVA partnership
  - g) Trained workforce; education opportunities
  - h) Ability to reuse land/brownfield is tied to federal sustainability missions

### WEAKNESSES

- 1) Oak Ridge and West End Innovation District**
  - a) Challenging geologic and hydrogeologic conditions (karst and difficult to predict groundwater flow)
  - b) Land development concerns from potentially difficult geotechnical conditions resulting from karst geology.
  - c) Historic contamination/ongoing remediation
  - d) Potential land use restrictions from contamination impacting site development
  - e) Land topography in some areas may hinder development.
  - f) No consolidated approach/plan
  - g) Reservation Management owned by Office of Science results in lack of a consolidated land use plan.
  
- 2) Regulator Challenges**
  - a) Regulatory review process time can experience delays, inaction and redundancies
  - b) NRC seems inadequately resourced based on pace of review timelines and likely increasing requests
  - c) Historical license application reviews have been a lengthy process that results in increased cost and schedule to implement critical licensing actions
  - d) NRC's Advisory Committee on Reactor Safeguards (ACRS) reviews are excessive for established technologies and add burden to cost and time for application approvals
  - e) Regulatory burden associated with legacy light-water reactors designs challenge conformance with new nuclear technologies
  - f) NRC NEPA process is duplicative for applications from Federal Agencies
  - g) North American Electric Reliability Corporation (NERC) and Federal Energy Regulatory Commission (FERC) existing regulations undervalue nuclear
  
- 3) Additional Weaknesses**
  - a) Competing priorities and multiple organizations with similar goals



## TNEAC Regulatory Work Group SWOT

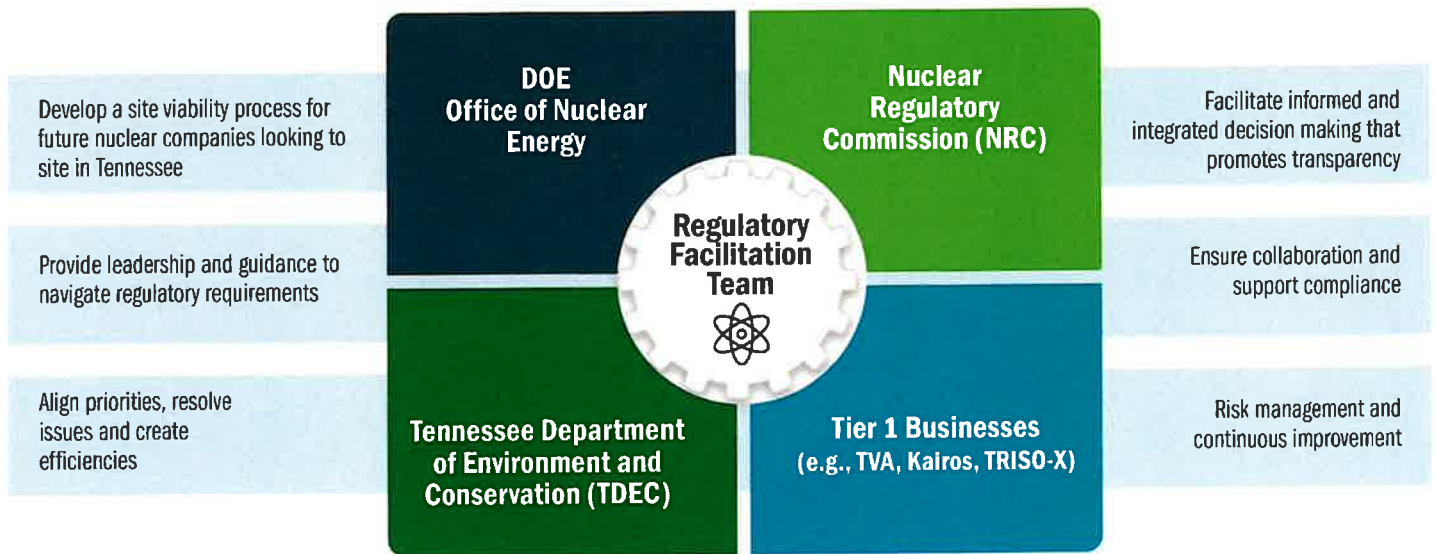
### OPPORTUNITIES

- 1) **Oak Ridge and West End Innovation District**
  - a) Growing demand from new businesses to start or relocate operations.
  - b) New City of Oak Ridge Manager may provide new perspective/energy around City's involvement.
  - c) Coqui Pharma has 200 acres at Heritage Center that could be used by other company(s).
  - d) Transportation of HEU out-of-commerce
  - e) Potential for state park at Clark Center Park as workforce attractant
  - f) Natural Resources both in the immediate and great area could be a workforce attractant to increase livability of area.
  - g) Willingness of ECD to facilitate land transfers and redevelopment.
  
- 2) **Regulatory Opportunities**
  - a) TDEC ability to act as a facilitator/enabler in interactions w/ federal regulators.
  - b) Canadian Nuclear Safety Commission (CNSC) and the United States Nuclear Regulatory Commission (NRC) collaboration on the technical reviews of advanced reactor and small modular reactor technologies
  - c) Performance-based Emergency Planning Rule approved for use.
  - d) Security by Design Rulemaking in review
  - e) Industry/TVA participation in Advanced Reactor Construction Oversight Program Implementation Team
  - f) NRC committed to a reduction in overall licensing application approval.
  - g) NRC could take immediate actions to increase staffing to support existing and increasing requests and make timelines more expedient.
  
- 3) **Additional Opportunities**
  - a) Expand public involvement efforts
  - b) Ability to potentially leverage TN Clean
  - c) Public/Private Partnerships
  - d) TDOT/State investment in infrastructure
  - e) Leveraging AI work at ORNL
  - f) Innovative Nuclear Fuels and Recycling

### THREATS

- 1) **Oak Ridge and West End Innovation District**
  - a) Airport at Heritage Center takes large piece of developable/prime land and may impact nuclear mission safety basis.
  - b) Airport could remove corridor to barge facility.
  - c) Airport would remove railroad access to barge facility and Clinch River nuclear site.
  - d) CROET sunseting creates void.
  - e) Lack of planning could increase costs, affect budgets, create redundancies, or compromise safety.
  - f) Competing for new businesses
  - g) Traffic/transportation challenges at Solway bridge and Edgemoor Road that impact safety and ingress/egress to and from Oak Ridge
  - h) Lack of infrastructure (water, sewer, schools) to support growing workforce.
  - i) Not enough land available when needed.
  - j) No public transportation
  - k) Lack of restaurants, hotels, entertainment, cultural and support services
  - l) Infrastructure/power supply not robust
  - m) Multiple concurrent major construction projects
  - n) Not enough workforce available
  - o) Lack of affordable housing to attract new workforce.
  
- 2) **Regulatory Threats**
  - a) Lack of expediency at NRC due to combination of workload backlog, insufficient resources, increasing number of incoming requests.
  - b) Lack of NRC expediency could jeopardize TVA's licensing schedule and ultimate success in development of first small modular reactor.
  - c) If TVA is unsuccessful in successful deployment of first small modular reactor, it threatens energy security for the Tennessee Valley as well as the success of other SMR projects in the United States.
  - d) Waste disposition of spent fuels.
  - e) Lack of clearer NERC/FERC regulations in appreciating need for adequate and long-term baseload generation threatens the reliability and resiliency of the nation's power grids.
  
- 3) **Additional Threats**
  - a) Competition from other states with similar initiatives

# Establish Regulatory Facilitation Team



## Outcomes

- Streamline nuclear builds in Tennessee through regulatory stakeholder partnership
- Single POC/entity in Tennessee for potential new companies
- Use as model to expand clean/nuclear energy hubs across Tennessee

# How an Innovation District May Fit

