

# Master Plan For Responsible Advanced Nuclear Development in New York:

# Nuclear Microreactor Technologies Study

NEW YORK STATE

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# Notice

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# Summary

The Nuclear Microreactor Technologies Study examines microreactor technologies and their potential to supply electricity in New York State. It also considers various practical requirements for deployment. Microreactors may be relevant to smaller industrial, institutional, military, remote, or existing nuclear-site loads.

This study is a screening-level technical assessment based on a review of literature and public regulatory and industry information. The assessment identifies opportunities for further investigation; it does not establish project feasibility, cost-effectiveness, or a commitment to policy action or deployment.

This study supplements the Advanced Nuclear Policy Options Paper's discussion of large light-water reactors (LLWRs) and small modular reactors (SMRs).

# Findings

**Microreactor readiness**. In New York, microreactors may be most relevant to smaller, specialized industrial, institutional, military, remote, or existing nuclear-site loads, with lower-density locations offering more realistic early pathways. The market remains pre-commercial: there has been greater progress on funding, partnerships, and regulatory processes than on integrated demonstrations and fuel and manufacturing. Low-Enriched Uranium (LEU)-based designs generally have a fuel-supply advantage, while many advanced designs face High-Assay Low-Enriched Uranium (HALEU) and Tristructural Isotropic (TRISO) constraints. While the small size of these designs offers opportunities for these projects to be more fundable and faster, they currently remain at the first-of-a-kind (FOAK) development stage. Microreactors face similar deployment challenges as LLWRs and small modular reactors (SMRs) related to fuel supply, safety, spent fuel, siting, supply chain readiness, and permitting.

**Electricity supply configurations**. Microreactors may supply the wider grid, serve co-located industrial, institutional, or military electricity users, or form part of microgrids designed for islanded operation. These arrangements can overlap. Co-location may offer resilience, price stability, revenue certainty, and reduced transmission losses and grid-upgrade needs. However, deployment schedules may not align with host requirements, backup supply may still be needed, and reliance on one customer creates offtake and stranded-asset risks. Microgrids capable of operating independently of the wider grid require onsite balancing, controls, and

sufficient backup or redundancy. Batteries can help manage short-term differences between generation and demand, but additional backup arrangements are needed during extended reactor outages. The suitability of each arrangement depends on electricity demand, grid access, resilience requirements, and the associated cost and complexity.

**Further assessment of microreactor technologies.** Further work is needed to determine which microreactor technologies and applications, if any, offer sufficient value to New York State to warrant further action. That further work should be progressed in a staged manner to examine and identify the most compelling, high-value opportunities for New York State and, where further action is warranted, outline pathways and options to enable their development.

**Fort Drum.** Following the selection of Fort Drum as one of the awardees under the federal Janus microreactor program, the development of a nuclear micro-reactor project at this site will be the first such project in New York. Alongside the assessment in this study, cooperation with the Fort Drum project could provide opportunities to build State capabilities and draw on practical experience as the project progresses. Such engagement should identify where federal investments and emerging lessons could inform State initiatives, particularly in supply chain and workforce development.

# Conclusions

- **Examine and identify the most compelling, high-value nuclear microreactor technology opportunities for New York State and, where further action is warranted, outline pathways and options to enable their development.**

- **Establish an appropriate cooperation framework with the U.S. Army's Fort Drum leadership and Westinghouse Government Services to identify opportunities for the state to benefit from the available federal investments, and to leverage experience gained in respect of supply chain, workforce, and the project's development, construction and operation.**

# 1. Introduction

The Nuclear Microreactor Technologies Study is one of a collection of studies prepared by the New York State Energy Research and Development Authority (NYSERDA) and the New York State Department of Public Service (DPS) as part of the "Master Plan for Responsible Advanced Nuclear Development in New York" (Master Plan). Collectively, these studies examine the technical, economic, workforce, supply chain, regulatory, environmental, community, and infrastructure considerations associated with the potential deployment of advanced nuclear technologies in New York State. Each study addresses a distinct topic area and offers analysis, findings and conclusions to contribute to a comprehensive roadmap for advanced nuclear development in New York.

NYSERDA and DPS acknowledge the contributions of Sargent & Lundy, working as a subcontractor to The Brattle Group, in preparing this study.

This study examines microreactor technologies and their potential to supply electricity in New York State. It also considers various practical requirements for deployment. Microreactors may be relevant to smaller industrial, institutional, military, remote, or existing nuclear-site loads.

The Nuclear Microreactor Technologies Study includes the following sections:

- **Section 2, Microreactor Technologies** reviews reactor designs, developer progress, and the preliminary assessment of technology, fuel-supply, and execution readiness.
- **Section 3, Microreactor Deployment Considerations** notes issues such as fuel, transportation, local offtake and islanded operation relevant to microreactor deployment.

Advanced nuclear technologies may also support thermal applications, such as industrial heat and hydrogen production, and alternative siting or deployment arrangements, such as floating or underground nuclear designs. These are outside the scope of this study.

The study complements the Advanced Nuclear Policy Options Paper's (Options Paper) discussion of large light-water reactors (LLWRs) and small modular reactors (SMRs) by examining the characteristics and deployment considerations specific to microreactors. This screening-level technical assessment is based on literature and public-source review. It identifies potential New York relevance and comparative deployment considerations but does not establish the technical or economic feasibility of a specific project, select or endorse a vendor or technology.

# 2. Microreactor Technologies

This section reviews microreactor designs as to technical maturity, supply chain and fuel readiness, and developer and execution maturity.

## 2.1 Microreactor Developers and Preliminary Maturity Assessment

In recent years, SMRs and microreactors have gained traction as strategic ways to incorporate new nuclear reactor designs into the existing energy landscape. The idea behind using these smaller, more modular form factors is that with standardization of smaller systems and the use of more commercial parts, reactor construction may become faster and more economical than conventional gigawatt-scale reactors which have experienced cost and schedule overruns. Microreactors—also referred to in some sources as micro modular reactors (MMRs)—differ from SMRs in two key respects. Firstly, while SMRs are smaller than conventional large-scale reactors they typically still require significant onsite construction and assembly, while microreactors are megawatt- to tens-of-megawatt-scale designs that may be designed for factory assembly and delivery as compact modules. Secondly, while SMRs could be "behind the meter", they are typically (and especially when combined into "packs" of multiple reactors) still grid connected, whereas microreactors are often proposed for smaller, specialized grid-connected or alternative applications and configurations, such as remote or islanded heat and power.[1]

Microreactor technology variants include Light Water Reactors (LWRs), high-temperature gas reactors (HTGRs), liquid metal-cooled reactors (LMRs), and molten salt reactors (MSRs). The Blueprint for Consideration of Advanced Nuclear Energy Technologies discusses these technologies in detail. Microreactors also include Heat Pipe Reactors (HPRs), which are typically very small, often fast-spectrum reactors without neutron moderation, and tank-in-pool reactors which are commonly associated with research, test, and isotope-production reactors but are not typically considered advanced reactors.

MMRs are being developed to address several limitations of conventional large nuclear plants, including high upfront capital cost, long construction schedules, and limited flexibility for smaller grids or remote applications. Their modular designs are intended to enable factory fabrication, shorter installation timelines, improved repeatability, and deployment in locations where a traditional gigawatt-scale reactor would be oversized or impractical. They are also attractive for supporting decarbonization goals because they can offer decarbonization

opportunities where alternative options are limited, e.g. off-grid firm power needs or process heat needs for industrial facilities, campuses, military sites, or isolated communities. In terms of size, MMRs are a smaller subset of advanced reactors, typically producing only a few megawatts to a few tens of megawatts electric (definitions range from less than 20 megawatt-electric [MWe][2] to less than 50 MWe[3]).

Relevant microreactor developers and technologies have been compiled in this study to support consideration of their potential role in New York State. The technologies are evaluated through a preliminary qualitative screen applying the criteria described in Table 1. The outcome is described in Table 2. The screen provides a criterion-by-criterion comparison among concepts reviewed as of August 2026; it attempts to offer an inventory of the most mature designs under development and does not purport to be comprehensive. At the time of publication, all MMR technologies described in the table below are considered first-of-a-kind (FOAK), and the future technical and commercial success of any listed technology or company remains uncertain. The table should not be seen as providing market ranking or offering any endorsement, vendor selection or procurement evaluation. It should not be used to compare microreactor risk or feasibility with more mature conventional nuclear plants or SMRs. The assessment excludes Russian and Chinese MMR developments.

### Westinghouse's eVinci microreactor

Westinghouse is developing eVinci, a transportable microreactor designed to deliver 5 MWe and operate for at least eight years at full power before refueling. The design uses Tristructural Isotropic TRISO fuel and passive heat pipes to transfer heat from the reactor core, with no water required for cooling or operation. Factory assembly and transportation by truck, rail or barge are intended to simplify deployment, with an above-ground installation footprint of less than two acres. Potential applications include remote and edge-of-grid communities, mining operations, critical infrastructure, military installations and data centers. Westinghouse also describes grid-forming and grid-following capabilities to support integration with wind, solar and hydropower.

On August 26, 2026, the U.S. Army selected eVinci to be installed at Fort Drum in New York State as one of five initial installations under the Janus Program.

**Table 1. Illustrative Qualitative Screen Relative to the First-of-a-Kind Microreactor Market**

| Score | Technical maturity | Supply-chain and fuel readiness | Developer and Execution maturity |
|---|---|---|---|
|  **High** | Advanced integrated testing or strong validation of critical systems; remaining risk mainly integration or site-specific. | Credible fuel pathway; key suppliers identified; plausible manufacturing plan; concentration or HALEU exposure is bounded. | Durable funding; experienced nuclear team; meaningful regulatory engagement; credible partners; commercial deployment not required. |
|  **Medium/high** | Integrated prototype or demonstration is advanced; most critical systems tested; limited FOAK issues remain. | Fuel pathway is credible and progressing; key suppliers identified; pilot manufacturing or QA capability exists. | Credible funding and team; active regulator engagement; meaningful project, host, or offtake commitments. |
|  **Medium** | Critical subsystems tested; integrated-system demonstration pending; design or safety basis still evolving. | Fuel pathway is plausible but unsecured; limited suppliers or scale-up gaps remain. | Capable team; preliminary partnerships or project commitments; limited nuclear delivery track record. |
|  **Low/medium** | Laboratory or analytical validation; major components or integrated systems remain untested. | Fuel or enrichment route uncertain; critical components unqualified; manufacturing capacity unproven. | Early-stage developer; mostly nonbinding partnerships; licensing execution, site, or funding unresolved. |
|  **Low** | Concept or early proof-of-principle; core claims, safety basis, or performance remain unverified. | No credible fuel, supplier, manufacturing, or transport pathway. | Limited evidence of funding, nuclear capability, credible partners, or an executable project path. |

**Table 2. Microreactor Developer and Technology Screen**

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| Aalo Atomics/ Aalo-1 | Liquid Metal-Cooled Fast Reactor (LMFR) | LEU+ | 10/30 |  **Medium/high** Sodium-cooled Gen IV LMFR test reactor achieved first criticality at INL in July 2026 with Aalo-X (full scale sized demonstration unit of the Aalo-1 using LEU). |  **Medium/high** LEU+ UO2 fuel avoids constraints of HALEU/TRISO supply chains. |  **High** Over $100M raised (Series B led by Valor), active NRC pre-application engagement, and planned projects such as at Texas A&M RELLIS site. |
| Antares Nuclear/R1 | Heat-Pipe-Cooled Reactor (HPR) | HALEU - TRISO | 0.3/1 |  **Medium** Antares' Mark-0 achieved zero-power criticality at INL in June 2026, but integrated full-power operation and electricity generation remain to be demonstrated., Antares targets a Mark-1 electricity-producing demonstration in 2027, followed by initial customer deployments from 2028. |  **Medium/high** HALEU-TRISO carries inherent enrichment and fabrication risk, but Antares has a DOE HALEU allocation, a multi-year fuel supply agreement (FSA) with Standard Nuclear, and a multi-year HALEU supply contract with Centrus announced in September 2026, with deliveries scheduled to begin before the end of 2030. |  **Medium/high** Antares has raised over $600M (including a $470M Series C; $370M in equity and $100M in debt), is DOE React or Pilot Program participant, and was selected for proposed deployment at Joint Base San Antonio, though full NRC licensing is not yet engaged. In August, 2026, the Army paired Antares Nuclear with Fort Bragg under the Janus Program, and Antares was selected for the DOE Nuclear Energy Launch Pad Program led by the Office of Nuclear Energy and the National Reactor Innovation Center (NRIC) to move advanced nuclear technologies from concept to commercial deployment. |

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| BWXT<br>BANR | HTGR | HALEU - TRISO | 22/75 | <br>**Medium**<br>The commercial-scale Advanced Gen IV HTGR design has not been tested or licensed, but BWXT has institutional experience as it is involved in the design and construction of a 1.5 MWe gas-reactor prototype for the US Army (Pele project). | <br>**Medium/high**<br>HALEU-TRISO carries enrichment and fabrication risk. BWXT's subsidiary (Nuclear Fuel Services) operates a Category 1 Nuclear Fuel Facility licensed by the NRC which produces nuclear fuel for the US Navy as well as up to 2 tons of TRISO-HALEU fuel that is being reprocessed from scrap material provided via a 5-year contract (starting in 2023) by the National Nuclear Security Agency. BWXT has a vertically integrated and experienced fuel processing pipeline, but long-term availability of feedstock materials is uncertain. | <br>**High**<br>BWXT is an established nuclear technology and manufacturing company. The BANR microreactor was selected by the US Army's Janus program to provide nuclear power to Fort Campbell, Kentucky with a target operation date of 2030. |

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| Deep Fission/DFBR-1 | Light Water Reactor (LWR) | LEU | 15/50 |  **Medium** PWR-derived but first-of-a-kind mile-deep borehole deployment strategy, and active testing/validation of boring technology and wells. |  **High** Deep Fission's fuel is standard off-the-shelf LEU with an existing supply chain |  **High** Raised $80M (Feb 2026) backed by 8VC, Blue Owl Capital, and Goldman Sachs advisory, plus DOE Reactor Pilot Program selection, active NRC pre-application engagement, and an Endeavour Energy 2GW data-center partnership, as well as active construction of a demonstration reactor in Parsons, KS. |
| General Atomics Electromagnetic Systems (GA-EMS)/GA-TES | Liquid-metal-cooled reactor (lead); natural-circulation primary cooling | HALEU | 5/- |  **Low/medium** GA-TES draws on General Atomics' established UZrH fuel technology and TRIGA research-reactor experience. However, the integrated lead-cooled design remains under development; the cited company materials do not report a completed GA-TES prototype or integrated demonstration. The design incorporates natural-circulation primary cooling and passive decay-heat removal. |  **Medium/high** Uses HALEU–UZrH fuel, drawing on General Atomics' experience developing and supplying UZrH research-reactor fuel. The baseline core is designed for up to five years between refueling. The cited materials do not specify GA-TES fuel-supply commitments or production capacity |  **Medium/high** General Atomics is an established nuclear technology developer with experience deploying and supporting research reactors. On August 26, 2026, GA-EMS announced its selection for the Army's Janus Program at Fort Hood, Texas, with milestone-based funding supporting development, testing and site planning toward potential deployment. This strengthens evidence of execution progress but does not itself demonstrate GA-TES technical maturity. |

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| Hadron Energy, Inc./Halo | LWR | LEU+ | 10/35 |  **Medium/high** LWR/PWR-derived design, with no built prototype or integrated demonstration yet. |  **Medium/high** LEU+ UO2 fuel avoids constraints of HALEU/TRISO supply chains. |  **Medium/high** Hadron went public via a $1.2B deal, active NRC pre-application engagement. |
| Jimmy Energy/Jimmy | HTGR | HALEU - TRISO | -/20-60 |  **Low/medium** Gen IV HTGR still in detailed design with no demonstration unit built. Construction not planned until 2029, so critical systems remain analytically validated rather than integration tested. |  **Medium** HALEU-TRISO carries added risk from TRISO's limited fabricator base; Urenco contracted to supply LEU+ initially with transition to HALEU as it becomes available. Jimmy plans TRISO fabrication at Le Creusot facility but this capability is currently unproven. |  **Medium/high** CEA spin-off (founded 2020). It has raised over $175M since its founding, including over $105M in 2026, and a named industrial host/customer (Cristanol) to provide process heat using its first unit. |

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| Last Energy/PWR-20 | LWR | LEU | 20/80 |  **Medium/high** PWR-20 rests on mature LWR physics. The demonstration plant is targeting mid/late-2026 criticality, though the commercial PWR-20 itself remains unbuilt. |  **High** Last Energy's fuel is standard off-the-shelf LEU with an existing supply chain. |  **Medium/high** Last Energy has raised over $100M in Series C funding, participates in the DOE Reactor Pilot Program, has entered the NRC pre-application process (Docket 99902140), and has completed a UK ONR Preliminary Design Review. Its PWR-5 pilot at Texas A&M-RELLIS is under construction with a DOE-approved Preliminary Documented Safety Analysis. |
| NANO Nuclear Energy, Inc./KRONOS MMR | HTGR | HALEU | 15/45 |  **Medium** KRONOS is a Gen IV HTGR with a Construction Permit formally accepted for review (May 2026) targeting 2027 completion, but no integrated prototype exists yet and a non-nuclear demo unit is only now being built at Oak Brook. |  **Medium** HALEU fuel pathway is plausible but unsecured: Centrus MOU and LIST enrichment collaboration exist alongside an INL-licensed HALEU transport basket, yet no qualified in-house TRISO/HALEU fabrication capability is operational. |  **High** NASDAQ-listed (NNE) with active NRC construction-permit engagement, a real host site (University of Illinois), DOE HALEU Consortium founding membership, and multiple supplier/logistics partnerships support credible funding and regulatory traction. |

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| Natura Resources/MSR-1 | MSR | Flexible | 0.4/1 |  **Medium** As a Gen IV liquid-fueled MSR, Natura starts from a lower baseline but holds the NRC's first construction permit for a liquid-fueled reactor (Sept 2024) and logged 1,000 test-loop hours of their molten salt system; core reactor is not yet fueled/critical. |  **Low/medium** MSRs have flexible fuel inputs, but the MSR-1 design needs HALEU UF4 plus Li-7-enriched FLiBe salt; DOE has only conditionally committed HALEU, with INL synthesis and a new Quadrant Nuclear Industries HALEU agreement, while commercial HALEU, UF4, and FLiBe sources remain unavailable today. |  **Medium/high** Natura claims to have raised over $120M privately, is a DOE Reactor Pilot Program participant, and plans to develop a test reactor at Abilene Christian University. |
| NCBJ/HTGR-POLA | HTGR | HALEU - TRISO | 10/30 |  **Medium** The HTGR-POLA is an advanced Gen IV design, but no integrated HTGR-POLA prototype has been built, and licensing/construction remain pending. |  **Low/medium** HALEU supply is limited, and TRISO adds fabrication complexity. The manufacturer has no identified fuel fabricator or supply agreement, and Poland has no domestic HALEU/TRISO manufacturing base. |  **Medium/high** NCBJ is Poland's national nuclear research institute with a 50-year research reactor operating record (predominantly LWR). |

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| Radiant/Kaleidos | HTGR | HALEU-TRISO | 1/1.9 | <br>**Medium/high**<br>Radiant's Kaleidos is an advanced Gen IV design. Passive cooldown demo completed, with a planned full-power/full-temperature endurance test at INL's DOME, targeting criticality mid/late-2026. | <br>**Medium/high**<br>Radiant uses HALEU TRISO fuel via a Centrus Energy supply agreement and DOE HALEU allocation; custom TRISO fuel already fabricated and delivered to INL, though TRISO fabrication remains limited industry-wide. | <br>**High**<br>Over $300M raised through Series D and now has a $1.8B valuation. NRC 10 CFR Part 70 license application accepted with accelerated review, DOE Reactor Pilot Program selection, and firm commitments including a USAF agreement and a 20-unit Equinix deal with deposits.<br>IN August 2026 Radiant Won a $750M contract to deliver up to 15 Microreactors to US Military Bases under Janus Program for Fort Benning. |
| Steady Energy/LDR-50 | LWR | LEU | -/50 | <br>**Medium**<br>LWR-based design gives a mature LWR baseline. Only a non-nuclear electrically-heated pilot is under construction, with integrated nuclear demonstration still pending. | <br>**High**<br>Steady Energy's fuel is standard off-the-shelf LEU with an existing supply chain. | <br>**Medium/high**<br>VTT Technical Research Centre of Finland spin-off with seed VC funding, with a collaboration with Finnish utility Fortum, signaling credible partners, and traction. |

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| Terra Innovatum/SOLO | HTGR | LEU | 1/4 |  **Low/medium** The HTGR has a Gen IV baseline; design was completed in October 2024 and multiple NRC topical reports are under review, but no prototype or integrated demonstration unit has been completed, and no construction-permit application has yet been filed (submission planned for 2026). |  **High** Terra Innovatum's fuel is standard off-the-shelf LEU with an existing supply chain but is designed to be capable of transitioning to HALEU fuels when supply chain is more available. |  **Medium/high** Nasdaq-listed (NKLR) after raising approximately $130M, with veteran nuclear leadership and active NRC pre-application engagement (but no construction permit has yet been issued). Company claims it will be commercially available in 2028. |
| Westinghouse/e-Vinci | Heat-Pipe-Cooled Reactor (HPR) | HALEU-TRISO | 5/15 |  **Medium/high** The eVinci heat pipe design is a Gen IV non-LWR. DOE approved its Preliminary Safety Design Report with a 1/5-scale test reactor advancing toward INL DOME construction. |  **Medium** Uses HALEU TRISO fuel (19.75% U-235), adding both HALEU scarcity and TRISO fabrication risk versus LEU designs, but Westinghouse signed a long-term HALEU enrichment agreement with Urenco and holds a DOE HALEU deconversion IDIQ contract plus TRISO-X/Springfields fabrication ties. |  **High** Westinghouse is an established, well-capitalized nuclear industrial company with deep engineering talent, active NRC/CNSC pre-application engagement, and named commitments including Penn State hosting arrangements. Separately, on August 26, 2026, the Army paired Westinghouse Government Services with Fort Drum under the Janus Program. The selection strengthens evidence of host and execution progress but does not by itself change the eVinci technical-maturity assessment. |

| Company Name/Reactor | Nuclear Reactor Technology | Fuel Type | MWe/ MWth | Technical Maturity | Supply-Chain and Fuel Readiness | Developer and Execution Maturity |
|---|---|---|---|---|---|---|
| X-Energy/Xenith | HTGR | HALEU - TRISO | 5/20 |  **Medium** Xenith builds on X-energy's Gen-IV HTGR platform but is in a preliminary design/engineering phase with NRC pre-application docketing only; no integrated prototype has been built or tested yet. |  **Medium/high** HALEU-TRISO carries inherent fuel-cycle risk, but X-energy's TRISO-X subsidiary has an NRC-approved 40-year fuel license, an operating pilot facility since 2016, and TX-1 under construction, giving Xenith a mature TRISO supply chain compared to many of its peers. |  **Medium/high** X-energy has DOE Advanced Reactor Development Program support for its SMR platform, an Air Force/DIU ANPI agreement, active NRC pre-licensing engagement, Dow and Amazon partnerships for its broader platform, and a publicly traded, well-funded structure, although Xenith itself lacks a named commercial host site. |

# 3. Microreactor Deployment Considerations

Because many proposed microreactor designs rely on less-established fuels and supply chains, factory fabrication or fueling, and transport of compact reactor modules, some considerations are particularly material for microreactors and discussed here. The issues are nevertheless design- and project-specific and should not be attributed uniformly to every microreactor concept.

Relevant considerations for microreactors are also discussed in other Master Plan studies—see also the studies on Regulatory Issues and Safety, Waste, Siting, and Environmental and Climate Justice.

## 3.1 Fuel Types and Availability

SMR and MMR designs often utilize more enriched fuels such as low-enriched uranium plus (LEU+, 5-10% enriched) or high-assay low-enriched uranium (HALEU, 5-20% enriched). HALEU fuels, in particular, are also designed to incorporate new form factors to include more passive safety features. Tristructural Isotropic (TRISO) fuel is composed of small spherical fuel pebbles that are coated in layers of pyrolytic carbon and silicon carbide, enabling them to withstand extreme heat to prevent fuel release under nuclear reactor conditions.[4] Because of the inherent safety and fuel containment that TRISO fuels can potentially offer, many MMR designs utilize TRISO form factors as a means to reduce the size, cost, and time required to build reactors, as systems with this fuel type attempt to reduce the number of additional components and containment barriers in the reactor itself.[5] The U.S. has a much more robust low-enriched uranium (LEU) supply chain than it does for either LEU+ or HALEU fuels, and individual companies are currently relying on solidifying their own supply chains to ensure they have adequate fuel supplies. Fuel availability is therefore a material determinant of reactor-design choice and potential operational timing.

Some Generation IV (Gen IV) designs may use alternate fuels to uranium, such as thorium. Thorium is considered in some reactor designs because it is more abundant in Earth's crust than uranium. Th-232 is 3-4 times as abundant as U-238 which makes up over 99% of all uranium found in nature, while the fissile isotope of uranium required for nuclear power, U-235 makes up approximately 0.7% of natural uranium. In addition to its relative abundance, thorium has potential safety advantages during operation.[6] Because thorium cannot undergo fission on its own, it must first be transmuted into U-233 and only then can the U-233 undergo fission. As a

result, the fission reaction in some of these types of reactors is subcritical, leading to quicker shutdowns and eliminating the threat of runaway chain reactions, unlike reactor designs that utilize fissile fuels like U-235. Despite these potential design advantages, byproducts of the U-233 fission in thorium reactors can be difficult to handle (e.g. U-232, which emits gamma rays) and thorium supply chains are much less developed than LEU or even HALEU fuel lines. These factors along with additional research and development (R&D) to advance the technology lead thorium fuel to struggle to achieve market penetration.[7]

## 3.2 Transportation and Factory-Fueled Reactors

Transportation is a topic that is specifically relevant to MMRs compared to SMRs or conventional nuclear power plants that are assembled and fueled at the project site. Historically 10 CFR Part 71 is a regulation that applies to the packaging and transportation of nuclear fuels, but since many MMR designs include loading fuel into the reactor at the factory, the entire MMR reactor acts as the package and is subject to the rules of this regulation. Additionally, for reactors that may be using HALEU, there are currently no fuel transportation casks in the United States designed specifically for HALEU. Fully encapsulated MMRs may introduce additional requirements for route planning to ensure appropriate emergency services are available for potential spills and cleanup and that there is appropriate security to prevent sabotage or theft of nuclear materials between the factory and the project site.

Some MMR manufacturers are seeking to overcome these challenges by developing specialized transport shielding or vertically integrating their companies.[8] One recent example of vertical integration is the acquisition of Secured Transport Services, LLC (a global nuclear logistics and transportation company specializing in the transport of nuclear materials) by NANO Nuclear Energy in 2026 to facilitate their ability to deploy their reactors.[9] Ultimately the ability of a manufacturer to deliver the product to the site while complying with regulations is a challenge unique to the MMR class of reactors and requires manufacturers and regulators to continue to work together to streamline the process while ensuring safety and security.

## 3.3 Co-Located Supply

Co-location can provide firm, reliable electricity, long-term price stability, resilience, and reduced transmission costs. Grid support can reduce the amount of onsite generating redundancy required. Conversely, configurations without grid backup may require additional reactor modules, storage, or other onsite generation, increasing project cost. Regardless of the external supply arrangement, the customer may still require redundant circuits, and backup generation

to meet its reliability requirements.[10] Co-location also creates schedule and offtake risks: nuclear development may not match the host's timeline, loss of the host load requires export capability, storage, steam diversion, or another heat sink, and dependence on one customer can create stranded-asset risk.

## 3.4 Microgrids and Islanded Operation

For remote sites without a reliable grid connection, or facilities that must be capable of islanded operation, the need for continuous firm power and local management of generation and load variability may motivate the co-location of nuclear, renewable, and storage assets to form a self-sufficient energy island. A good example for microgrids are military bases because mission-critical operations must continue during disruptions to the wider grid. Microgrids designed for islanded operation can coordinate onsite generation, storage, and loads to maintain electricity supply to essential facilities, strengthening energy security and operational resilience.

An islanded microgrid must continuously balance local generation and demand and maintain voltage and frequency without support from the wider grid. Storage can offer balancing and reliability functions across different timescales.

### Fort Drum Janus Program Microreactor

On August 26, 2026, the U.S. Army selected Fort Drum as one of five initial installations under the Janus Program and paired the installation with Westinghouse Government Services, for the planned deployment its eVinci microreactor, a heat-pipe design using TRISO fuel.[a] The planned microreactors are intended to generate less than 20 MWe, occupy less than five acres, and provide localized resilience for critical mission infrastructure while integrating with the existing commercial grid.[a] The announced model is contractor-owned, constructed, and operated, with Army and federal oversight. Permanent onsite storage of spent fuel is not planned.[a] The Army's target of September 30, 2028, applies program-wide to at least one microreactor producing usable electricity at an Army installation.

For New York, the project may provide lessons on utility integration, localized resilience and grid integration, contractor ownership and risk allocation, safety and emergency planning, community engagement, workforce, and fuel, transport, and waste arrangements.

[a] Mike Strasser, "Army Selects Fort Drum for Janus Program Microreactor," U.S. Army, August 26, 2026, https://www.army.mil/article/294897/army_selects_fort_drum_for_janus_program_microreactor.

## 3.5 Licensing and Regulatory Pathways

As discussed in the Master Plan Regulatory Issues and Safety Study, advanced reactors may be licensed under 10 Code of Federal Regulations (CFR) Parts 50 or 52 or under the optional, technology-inclusive Part 53 framework, which became effective on April 29, 2026. These general licensing pathways are discussed in the Policy Options Paper and are not repeated here. For microreactors, Part 53 is particularly relevant because it accommodates any reactor size and end use and includes provisions addressing factory fuel loading, remote operation, and standardized designs.[11]

The NRC has also proposed Part 57 specifically for rapid licensing and high-volume deployment of microreactors and other reactors with comparable risk profiles. Proposed features include licensing standardized reactors across multiple sites, manufacturing and factory fueling, remote or autonomous operation, transportation of fueled reactors, and centralized decommissioning or refurbishment. The proposed rule states that this process should enable the NRC to issue an operating license within 6–12 months after accepting an application, assuming the application is complete, construction proceeds on schedule, and any hearing issues are resolved expeditiously. Part 57 remains proposed as of publication of this document.[12]

## 3.6 Waste Management and Decommissioning

Waste management remains an important consideration for MMR and SMR deployment because some designs may produce more radioactive and hazardous waste per unit of energy generated than larger reactors, in part due to smaller core size, higher neutron leakage, and potentially shorter fuel cycles depending on the technology. This does not necessarily make such systems infeasible, but it may complicate backend fuel management, storage requirements, and lifecycle economics, particularly for FOAK deployments. For New York, this suggests that any MMR pathway should be evaluated not only on its operational benefits, but also on the practical implications for spent fuel handling, interim storage, transportation, and long-term waste management and disposal.

## 3.7 Findings and Conclusions

**Microreactor readiness.** In New York, microreactors may be most relevant to smaller, specialized industrial, institutional, military, remote, or existing nuclear-site loads, with lower-density locations offering more realistic early pathways. The market remains pre-commercial: there has been greater progress on funding, partnerships, and regulatory processes than on

integrated demonstrations and fuel and manufacturing. LEU-based designs generally have a fuel-supply advantage, while many advanced designs face HALEU and TRISO constraints. While the small size of these designs offers opportunities for these projects to be more fundable and faster, they currently remain at the FOAK development stage. Microreactors face similar deployment challenges as LLWRs and SMRs related to fuel supply, safety, spent fuel, siting, supply chain readiness, and permitting.

**Electricity supply configurations**. Microreactors may supply the wider grid, serve co-located industrial, institutional, or military electricity users, or form part of microgrids designed for islanded operation. These arrangements can overlap. Co-location may offer resilience, price stability, revenue certainty, and reduced transmission losses and grid-upgrade needs. However, deployment schedules may not align with host requirements, backup supply may still be needed, and reliance on one customer creates offtake and stranded-asset risks. Microgrids capable of operating independently of the wider grid require onsite balancing, controls, and sufficient backup or redundancy. Batteries can help manage short-term differences between generation and demand, but additional backup arrangements are needed during extended reactor outages. The suitability of each arrangement depends on electricity demand, grid access, resilience requirements, and the associated cost and complexity.

**Further assessment of microreactor technologies.** Further work is needed to determine which microreactor technologies and applications, if any, offer sufficient value to New York State to warrant further action. That further work should be progressed in a staged manner to examine and identify the most compelling, high-value opportunities for New York State and, where further action is warranted, outline pathways and options to enable their development.

**Fort Drum.** Following the selection of Fort Drum as one of the awardees under the federal Janus microreactor program, the development of a nuclear micro-reactor project at this site will be the first such project in New York. Alongside the assessment in this study, cooperation with the Fort Drum project could provide opportunities to build State capabilities and draw on practical experience as the project progresses. Such engagement should identify where federal investments and emerging lessons could inform State initiatives, particularly in supply chain and workforce development.

# Conclusions:

- **Examine and identify the most compelling, high-value nuclear microreactor technology opportunities for New York State and, where further action is warranted, outline pathways and options to enable their development.**

- **Establish an appropriate cooperation framework with the U.S. Army's Fort Drum leadership and Westinghouse Government Services to identify appropriate opportunities where the State can benefit from federal investments and learnings, particularly around supply chain and workforce development, and to leverage experience gained through the project's development, construction and operation.**

# Acronyms and Abbreviations

| | |
|---|---|
| BANR | BWXT Advanced Nuclear Reactor |
| DOE | U.S. Department of Energy |
| DPS | New York State Department of Public Service |
| FOAK | first-of-a-kind |
| GA-EMS | General Atomics Electromagnetic Systems |
| GA-TES | General Atomics Tactical Energy System |
| Gen IV | Generation IV reactor |
| HALEU | high-assay low-enriched uranium |
| HPR | heat pipe reactors |
| HTGR | high-temperature gas reactors |
| LEU | low-enriched uranium |
| LLWR | large light-water reactors |
| LWR | light-water reactor |
| Master Plan | Master Plan for Responsible Advanced Nuclear Development in New York |
| MMR | micro modular reactor |
| NRC | U.S. Nuclear Regulatory Commission |
| NYSERDA | New York State Energy Research and Development Authority New York State Energy Research and Development Authority |
| PWR | pressurized water reactor |
| SMR | small modular reactor |
| TRISO | tristructural isotropic |
| U | uranium |
| UZrH | uranium-zirconium hydride |

# Endnotes

[1] Solestiss, *Landscape of U.S. Domestic Advanced Nuclear Energy Supply Chain: An Overview Analysis of Bottlenecks, Opportunities, and Recommendations*, prepared for the Nuclear Scaling Initiative, March 2026, https://www.nuclearscaling.org/wp-content/uploads/2026/03/2026-Landscape-of-U.S.-Domestic-Advanced-Nuclear-Energy-Supply-Chain.pdf.

[2] U.S. Department of Energy, Office of Nuclear Energy, "The BIG Potential for Nuclear Microreactors," August 7, 2019, https://www.energy.gov/ne/articles/big-potential-nuclear-microreactors.

[3] U.S. Government Accountability Office (GAO), Science & Tech Spotlight: Nuclear Microreactors, GAO-20-380SP (February 2020), https://www.gao.gov/assets/gao-20-380sp.pdf.

[4] B. E. Wells, N. R. Phillips, and K. J. Geelhood, *TRISO Fuel: Properties and Failure Modes*, PNNL-31427 (Pacific Northwest National Laboratory, June 2021), https://www.nrc.gov/docs/ML2117/ML21175A152.pdf; ANS, "Blue Energy, GE Vernova Plan Gas-Plus-Nuclear Power Plant in Texas."

[5] Solestiss, *Landscape of U.S. Domestic Advanced Nuclear Energy Supply Chain: An Overview Analysis of Bottlenecks, Opportunities, and Recommendations*.

[6] World Nuclear News, "Australian Thorium to Fuel Ampera Energy System," June 9, 2026, https://www.world-nuclear-news.org/articles/australian-thorium-to-fuel-ampera-energy-system; Isabelle Dumé, "Can Thorium Compete with Uranium as a Nuclear Fuel?," Polytechnique Insights, March 31, 2022, https://www.polytechnique-insights.com/en/braincamps/energy/the-latest-technological-advances-in-nuclear-energy/can-thorium-compete-with-uranium-as-a-nuclear-fuel/.

[7] Isabelle Dumé, "Can Thorium Compete with Uranium as a Nuclear Fuel?"; Arun Kumar, "Why Is Thorium Not Yet Explored for Energy Generation?," Fuld & Company, n.d., accessed October 20, 2026, https://www.fuld.com/why-is-thorium-not-yet-explored-for-energy-generation/.

[8] Solestiss, *Landscape of U.S. Domestic Advanced Nuclear Energy Supply Chain: An Overview Analysis of Bottlenecks, Opportunities, and Recommendations*; NANO Nuclear Energy Inc., "NANO Nuclear Acquires Secured Transportation Services LLC, Establishing a Fully Integrated Nuclear Fuel Logistics and Transportation Platform and Joining a Select Group of Revenue-Generating Microreactor Developers," *GlobeNewswire*, May 26, 2026, https://www.fidelity.com/news/article/mergers-and-acquisitions/202605260800PRIMZONEFULLFEED9726349.

[9] NANO Nuclear Energy Inc., "NANO Nuclear Acquires Secured Transportation Services LLC, Establishing a Fully Integrated Nuclear Fuel Logistics and Transportation Platform and Joining a Select Group of Revenue-Generating Microreactor Developers."

[10] Idaho National Laboratory, *Nuclear Power for Data Centers Playbook*, INL/MIS-26-91487 (Idaho: Idaho National Laboratory, April 2026), https://inl.gov/flipbook/nuclear-power-for-data-centers-playbook/.

[11] Adam Stein and Spencer Toohill, "Part 53: A Viable Licensing Pathway for New Reactors," *The Breakthrough Institute*, April 9, 2026, https://thebreakthrough.org/issues/nuclear-energy-innovation/part-53-a-viable-licensing-pathway-for-new-reactors.

[12] American Nuclear Society (ANS), "NRC Introduces Microreactor Regulatory Framework," *Nuclear Newswire*, April 27, 2026, https://www.ans.org/news/2026-04-27/article-7981/nrc-introduces-microreactor-regulatory-framework/.




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