Policy Statement on U.S. Public-Private Partnerships for Small Modular Reactors

October 10, 2019

Small modular light-water reactors (SMRs)[1] are one of the most promising new nuclear technologies to emerge in decades. Featuring numerous safety enhancements, the ability to better match new generation capacity with electric demand growth and to be deployed in diverse applications, the potential for SMRs is enormous. Together with large light-water and non-light-water reactors, SMRs are part of the all-of-the-above nuclear energy portfolio needed to meet national goals on energy security and carbon emissions.

There is broad recognition that nuclear energy is a critical part of a diverse source of electricity generation that is affordable, reliable and resilient. There is also growing recognition at the State, Federal and International levels that nuclear energy is an essential zero-carbon technology in any electricity portfolio that seeks to make meaningful reductions in carbon emissions. As the energy demands of the future evolve, the reliability and flexibility of SMRs and other advanced nuclear technologies will be absolutely critical to meeting national and international energy needs.

SMRs are a strategic energy option for the future, and the U.S. needs this technology to be available to meet the demand for new generation capacity in the 2020s and beyond. If SMRs are to be available in time to meet the demand and to support U.S. policy goals, investments must be made today, and continuously over the next several years. However, commercialization of new nuclear technologies requires large upfront first-of-a-kind costs and a relatively long timeframe to complete licensing and design activities. The ability of any company to invest the amounts required on their own over the timeframes required without contractual commitments presents a unique challenge for commercialization of new technologies. Further, some prospective customers are reluctant to sign contracts until the new nuclear technology has been sufficiently de-risked.

Today's energy markets, which are characterized by historically low natural gas prices, policies that favor renewable generation and low growth in electricity demand, presents further challenges to attracting the investments needed. U.S. vendors also compete in the international markets for the deployment of SMRs and other advanced nuclear reactor designs. Governments of other countries like Russia and China directly subsidize the export of their nation's nuclear technologies, significantly reducing their costs. Despite these challenges, there is a strong U.S. industry commitment to the development and commercialization of SMRs.

SMR Start advocates for public-private partnerships – similar to those that provide support for the introduction of other new energy technologies – to help ensure the successful commercialization of SMRs. Public-private partnerships are policy mechanisms that incentivize technology development by addressing temporary infrastructure and market risks and provide a means for new technology developers and customers to share risk with the Federal government to accelerate deployment and achieve desired societal benefits. These partnerships can result in long-term economic benefits to taxpayers that far exceed the near-term government investments, and provide societal benefits that would otherwise not be realized.

[1] SMRs are defined as reactors that produce less than 300 megawatts-electric with a plant containing one or more reactors.

SMRs are an advanced nuclear technology. They have evolved from the proven light-water technology used by large reactors in operation and under construction today by adding revolutionary features to achieve greater standardization, shortened construction times, and reduced financing costs. The unique benefits and flexibility of SMRs will be highly valued in the future by the marketplace and society as a whole; as the need for affordable, reliable and clean energy continues to grow. The following are a few of the most compelling benefits of SMRs:

Fuel Diversity and Carbon-Free Benefits – SMRs provide the same valued benefits of nuclear energy, that is, they produce large amounts of reliable, economic, carbon-free electricity. Nuclear energy currently generates more than half of the non-emitting electricity in the U.S. – preventing the equivalent of the carbon emissions produced annually by all U.S. motor vehicles. Nuclear is the only source of clean air energy that is neither intermittent nor dependent upon local weather conditions. Nuclear energy is also critical to maintaining fuel diversity in the U.S. If the U.S. becomes overly dependent on natural gas fueled electricity generation, it could expose consumers to punishing volatility and loss of reliability. A diverse portfolio – including nuclear energy as a significant fuel source – is an essential characteristic of an affordable, robust and resilient system.

Matching Demand Growth and Affordability – SMRs allow generating companies to better match construction of new capacity with electricity load growth – particularly important in parts of the country where load growth may have slowed for decades and in areas where the electricity grid is not developed enough to support larger nuclear energy plants. Capital investments also can be staged as modules are constructed. This could be particularly important for smaller companies – rural electric cooperatives or municipal agencies, for example – that cannot afford the more than $6 billion up-front costs associated with a 1,000-megawatt reactor.

Diverse Applications and Siting Flexibility – SMRs can be deployed at retired fossil fuel sites (making use of the existing infrastructure and workforce) that are closer to population centers, can be deployed in remote areas where the grid is small, and can provide power for industrial process heat, desalination or water purification, and co-generation applications, such as for the petrochemical industry. Repurposing retired fossil fuel sites also retrains and utilizes the local workforce. Safety advances in SMRs are expected to provide public health and safety assurance without the need for large emergency planning zones. These flexibilities allow SMRs to bring the benefits of nuclear energy to more locations and customers. SMRs can quickly change output to follow changes in load demand or output from other generating sources. Renewable sources, such as solar and wind, are intermittent and the flexibility of SMRs makes them perfect partners with renewables to decarbonize electricity generation. When SMRs are not producing electricity, they can be designed to quickly switch to producing heat for industrial processes or hydrogen production. SMRs also offer the potential for high levels of resilience to power national security and mission critical activities, such as military bases and hospitals. They are protected against extreme weather and cyber threats and can be designed to resist electro-magnetic pulses and operate independent from the grid.

Economic Growth and Job Creation - SMRs can be manufactured in the U.S. to meet growing domestic and export demand, creating high-tech domestic manufacturing jobs and improving America's global competitiveness. The International Trade Administration noted that the development of SMRs for domestic use or export "could mean tremendous new commercial opportunities for U.S. firms and workers … and could result in the creation of many new jobs in manufacturing, engineering, transportation, construction … and craft labor, professional services, and ongoing plant operations." According to the UK National Nuclear Laboratory, there is a robust global market potential for SMRs, estimated at 65-85 gigawatts by 2035. Relative to other clean energy technologies, SMRs would create significantly more jobs with higher salaries providing more economic development benefits than the alternatives.

U.S. Leadership in International Markets – Maintaining U.S. leadership in nuclear energy technology is important to achieving U.S. economic and security goals. A vibrant U.S. supply chain of nuclear reactor designers and manufacturers would create tens of thousands of jobs. Large nuclear plants are constructed in the field and, as a result, field construction results in jobs at the plant site. In contrast, SMRs can mostly be built at offsite factories, and have a significantly larger market potential to export components for SMR plants built in other countries. The export of home-grown nuclear technologies increases U.S. influence over nuclear nonproliferation policy and practices, and ensures the highest possible levels of nuclear power plant safety and reliability around the world.

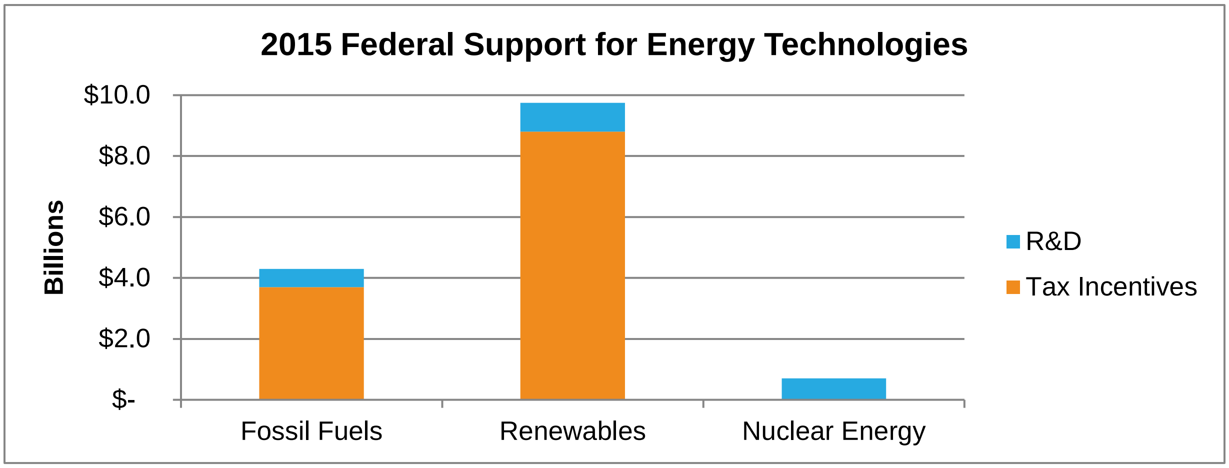
Public-private partnerships in the nuclear world stimulate the private investments required to ensure that the technology continues to advance and, once the technology matures, is capable of competing without additional direct support. Public-private partnerships provide a means for new technology developers and customers to share risk with the Federal government to accelerate deployment and achieve desired societal benefits. Such partnerships are an appropriate policy due to the public benefits derived from SMRs that are not valued in the energy markets, such as resilience, carbon-free generation, long-term price stability and improved electricity grid reliability

SMRs enjoy strong bipartisan support, but federal and state policies have not yet been broadly enacted that recognize or properly value the unique attributes and strategic value of SMRs for domestic deployment and international export. In order to assure that SMRs are a viable strategic energy option in the future, the U.S. government should establish the following objectives:

1. U.S. policies and programs support the successful commercialization of SMRs in order to enhance the societal and economic benefits of nuclear energy.

2. U.S. public-private partnerships support development of two or more U.S. SMR designs, deployment of six or more commercial SMR plants domestically for each design, and development of a strong domestic supply chain to support the domestic SMR market and export of U.S. SMRs.

Federal support highly favors other energy sources and disadvantages the development of new nuclear energy technologies. From 1950 to 2010 the U.S. government provided $594 billion to fossil fuels, $171 billion to renewables, and $73 billion to nuclear energy.[2] The Energy Policy Act of 2005, and other legislation enacted before and since 2005, have provided large incentives for various energy technologies; however, the majority of Federal support has gone to renewables, while relatively little has gone to nuclear. For example, in 2015 renewables received $9.8 billion, fossil fuels received $4.3 billion and nuclear energy received $0.7 billion.[3]



[2] 60 Years of Energy Incentives: Analysis of Federal Expenditures for Energy Development, Management Information Services, Inc., October 2011.
[3] Federal Support for the Development, Production and Use of Fuels and Energy Technologies, Congressional Budget Office, November 2015. This is not an annual report and is the most recently published data.

In order to ensure the affordability, reliability and sustainability of the nation's clean energy supply, federal programs for renewable energy sources should be modified to encompass all credible carbon-free energy alternatives and become available to support SMRs. Modification of these programs to focus on carbon-free energy sources will better align with the goals of addressing climate change, spur more innovation in new technologies and increase competition that benefits consumers. Programs related to production tax credits, investment tax credits and portfolio standards that currently are available only to renewable energy should be modified to equally benefit all technologies that provide carbon-free benefits. Similarly, Federal procurement targets for renewable energy should be modified to include nuclear energy.

SMRs are flexible baseload generation that is "always on", dispatchable and able to adjust output to respond to the needs of the grid; offering value that other sources can't. As more baseload generation sources retire, the always-on value that nuclear energy provides, such as electric transmission grid stability provided by the inertia of large rotating masses, will increase. Similarly, as more intermittent wind and solar generation is connected to the grid, the value that flexible SMRs provide will increase. Policies should be established that recognize these reliability and flexibility benefits.

Infrastructure projects like SMRs may be best supported when built on a foundation of stable federal government and industry partnerships. The degree of partnership needed will vary based on many factors, such as market conditions and supply alternatives. The amount of private investment will be significantly more than the public contribution. After the initial demonstration of the technology through such a partnership, further SMR deployment is expected to be self-sustaining.

In order to ensure sufficient investment for SMR commercialization, SMR Start envisions the establishment of the following public-private partnerships and will work with interested stakeholders toward their formation and implementation:

Design and Licensing Partnerships

Design and Licensing Support – High costs and long timelines for regulatory approval are a unique barrier for new nuclear technologies. The total cost to obtain regulatory approvals and perform first-of-a-kind final design engineering for an SMR design is expected to be $1 billion or more. To date, four designers have invested a total of more than $1 billion dollars to develop their SMR designs. Potential owners of SMR plants have also invested tens of millions of dollars in preparing their sites for possible deployment of SMRs. DOE support is needed to reduce the economic, technical and regulatory barriers to efficient, timely and cost-effective deployment of new technology for two or more designs and the initial SMR plants.

Commercial Deployment Partnerships Construction of the first several SMR plants represents a unique set of risks to the "first movers" that will build them. The policy tools to stimulate investment will vary based on the unique needs of the plant owners. Flexibility is needed in the establishment of public-private partnerships for deployment of SMR plants in the U.S. to account for varied differences in the electricity rate regulatory structure and generation asset ownership (public or investor owned).

An SMR commercial deployment program that stimulates new SMR generation should be established and made available through a combination of production tax credits (PTCs), investment tax credits (ITCs), power purchase agreements (PPAs) and loan guarantees. The total size of the program should be sufficient to achieve design and licensing of two or more designs and deployment of six or more SMR plants for each design (approximately 5,000 megawatts-electric).[4] Such a program would encourage the formation of customer groups to deploy these designs in sufficient volumes to achieve SMR costs that would be competitive in the market without further government support.

Tax Credits – PTCs and ITCs can offset first-of-a-kind risk for new SMR generating plants. A nuclear production tax credit (PTC) was established by the Energy Policy Act of 2005, and amended in 2018, for new nuclear generating capacity. However, the nuclear production tax credit requires additional changes to bring it on par with production tax credits for other generating sources, such as renewables. The value of the nuclear production tax credit should be commensurate with the need to incentivize new nuclear deployment, escalated with inflation and the lifetime capacity should be increased beyond the current limit of 6,000 megawatts to account for the development of SMRs and other advanced reactors. Although there is not currently a nuclear investment tax credit, ITCs are available for other energy sources. An ITC should be made available as an option for SMRs and other nuclear plants that would either not qualify for a PTC, or whose project structure would be more conducive to utilizing an ITC.

Power Purchase Agreements – Future business risk can be reduced, enabling larger investments in new plants, if there is a contractual commitment by entities to purchase the power from the plant once completed. Longer-term power purchase agreements (PPAs) are one such way this could be achieved, provided the purchaser makes the commitment early enough. One possible approach could be for the federal government to be the buyer, willing to enter into a longer-term agreement for the value of the clean and reliable energy to be supplied from the SMR plant, benefits that current markets do not value. Congress should specifically authorize the duration of PPAs to be up to 40 years to spread the investment over more of the SMR plant's useful life and to lower annual cost allocations. Congress should also ensure that PPAs are "scored" by the Office of Management and Budget no differently than a multi-year building lease, each year impacting the federal budget for that year only, not the duration of the PPA being "scored" in the year the PPA is entered.

Congress should create a program directing DOE and U.S. Department of Defense (DOD) to pursue projects that meet stringent reliability requirements in a carbon-free manner at select facilities with large electrical requirements and programs important to national security. The program should be flexible to allow the PPA to be established based on the requirements of the federal purchaser (DOE or DOD) and the power provider. One option could be for the PPA to compensate the SMR owner for a commitment to provide highly reliable power from the SMR facility, the value of which is negotiated based on the requirements of the buyer. Authorization should permit similar compensation arrangements to be available to allow PPAs that purchase other energy products from SMRs deemed valuable to DOE or DOD like tritium, isotopes for use in medical treatment, purified water, process

[4] *The Economics of Small Modular Reactors,* SMR Start, September 2017 concludes that the deployment of six or more SMRs of a particular design would achieve cost reductions that are sufficient for future SMRs to be cost competitive in the market without further government support.

heat, fuel irradiation, or a source of neutrons for R&D. The DOE Joint Use Modular Program (JUMP) is one such way that the Labs could benefit from partnering on the deployment of SMRs.

Loan Guarantee Program – The existing loan guarantee program and authority should remain available through the design and construction of SMR plants and SMR component manufacturing facilities. Loan guarantees that facilitate borrowing of up to 80 percent or more of the total project cost can dramatically improve the scale of SMR commercialization. Unlike renewable projects, the loan guarantee program office charges the borrower for nuclear projects to cover costs associated with providing the loan guarantee. The existing loan guarantee program should remain available with no additional cost or authorization required in addition to tax credits and PPAs.

Manufacturing and Supply Chain Partnerships

Investment tax credits can incentivize investments in SMR designs, the construction of SMR facilities and kick-start a robust U.S. SMR supply chain and the manufacturing of SMR components for both domestic and international markets. One SMR designer has invested in excess of $300 million in a state-of-the-art purpose-built SMR manufacturing facility in the United States. An SMR ITC should be established to incentivize investments in U.S. SMR manufacturing facilities. This is similar in amount to the ITC for renewable energy sources.

Innovative Supply Chain Manufacturing – DOE support to innovate the SMR supply chain is needed to reduce manufacturing risks for SMRs and other advanced reactors. This effort would support the manufacturing of innovative first-of-a-kind components during the licensing phase to demonstrate advanced manufacturing techniques and allow fabrication of commercial units to occur at lower costs and in a compressed delivery schedule by incorporating lessons learned. This includes the demonstration of closing Inspections and Tests at the factory. This would also support the incorporation of advanced manufacturing methods in the SMR supply chain, including acceptance by the Nuclear Regulatory Commission and Codes and Standards organizations.

Private companies and DOE have invested over $1 billion in the development of SMRs. However, more investment, through public-private partnerships is needed in order to assure that SMRs are a viable option to generate electricity beginning in the 2020s. In addition to accomplishing the public benefit from SMR deployment, the federal government would receive a return on investment through taxes associated with investment, job creation and economic output over the lifetime of the SMR plants that would otherwise not exist without the U.S. government's investment.

SMR plants could range from a few dozen to over 1,000 megawatts-electric depending on the actual number of units deployed, with the majority of plants expected to produce between 300 to 600 megawatts-electric. Construction and operation of a 400 megawatt SMR[5] site with multiple reactors is estimated to employ about 600 manufacturing and construction workers for about 4 years and about 200 permanent positions for the 60+ years the SMR operates. The data shows that each permanent position creates a multiplier effect resulting in 1.66 additional jobs in the local community and 2.36 additional jobs in the rest of the state. Nuclear jobs pay 36 percent more than average salaries in the local area.[6]

The U.S. Energy Information Administration forecasts a need for 196 gigawatts of new electric capacity by 2040. In addition, the U.S. has about 300 gigawatts of coal-fired capacity, with a consensus estimate that as much as 126 gigawatts of generating capacity will be permanently retired by 2030. Using a conservative assumption of SMRs capturing an additional 5 percent of the electricity generation market share between 2025 and 2040, the demand for SMR plants in the U.S. would exceed 15 gigawatts. The total economic output anticipated for that level of SMR generation capacity over a 40 year lifetime is $215 billion in direct output and nearly $400 billion of direct and indirect output.

World Energy Outlook 2014 projects nuclear generation capacity to grow internationally by 624 gigawatts (including the U.S. share of 16 percent) by 2040. Most of this growth is concentrated in China (46 percent) and India, Korea and Russia (30 percent). The global market for nuclear technologies is estimated at $500 billion to $750 billion over the next 10 years. According to the U.S. Department of Commerce, every $1 billion of exports by U.S. companies represents 5,000 to 10,000 jobs. If U.S. exporters of SMR technologies were able to capture 10 percent of the global market this would create (or sustain) tens of thousands of high-paying American jobs in addition to billions of dollars in tax revenues.

[5] A 400 MWe SMR was modeled in the SMR Start report, The Economics of Small Modular Reactors

[6] The average 1,000 megawatt nuclear plant generates approximately $943 million in direct and indirect economic output or value. This includes over $453 million in the plant's annual electricity sales and indirect and induced spending at the local, state and national levels of $17 million, $80 million, and $393 million, respectively. The average nuclear plant pays about $16 million in state and local taxes and $67 million in federal taxes annually. Nuclear jobs pay 36 percent more than average salaries in the local area.