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

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Introduction

Small modular light-water reactors (SMRs) 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 mitigation of climate change.

From the December 2015 United Nations Paris Climate Agreement (COP21), to the June 2016 trilateral commitment by the heads of the United States, Canada and Mexico, to the Environmental Protection Agency's Clean Power Plan, there is growing recognition of the need to reduce carbon emissions. There is also growing recognition that nuclear energy is an essential zero-carbon technology in any electricity portfolio that seeks to make meaningful reductions in carbon emissions. In July 2016 the State of New York established a policy that values the carbon free benefits of nuclear energy in addition to renewables, and could be a model for other state policies. As existing generation capacity retires and the energy demands of the future evolve, the flexibility of SMRs and other advanced nuclear technologies will be absolutely critical to meeting national and international clean air goals.

SMRs are a strategic energy option for the future, and the U.S. needs this technology to be available to meet the huge need for new generation capacity in the mid-2020s and beyond. If SMRs are to be available in time to meet the demand and to support U.S. policy goals for carbon reduction, investments must be made today, and continuously over the next decade. 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 substantially demonstrated.

Today's energy markets, which are characterized by historically low natural gas prices, heavily subsidized 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. 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 strong U.S. industry interest in 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 stimulate the private investments required to ensure that the technology continues to advance and is capable of competing in overseas markets without additional direct support once the technology matures. Such partnerships are an appropriate policy due to the public benefits derived from SMRs that are not valued in the energy markets, such as carbon-free generation and improved electricity grid reliability.

Public-private partnerships are policy mechanisms that incentivize technology development by addressing temporary infrastructure and market risks. They can also help provide benefits to the public when market forces alone are inadequate. These partnerships can result in long-term economic benefits to taxpayers that far exceed the near term government costs, and provide societal benefits that would otherwise not be realized.

Public-private partnerships provide a means for new technology developers to share risk with the Federal government to accelerate deployment and achieve desired societal benefits. SMRs are an advanced nuclear technology based on proven light-water technology similar to the large reactors in operation and under construction, but still requiring infrastructure development to achieve improvements in standardization, shortened construction times, reduced financing costs and substantial global exports. The unique benefits and flexibility of SMRs will be highly valued in the future by the marketplace and society as a whole; as the trend in carbon reduction continues and as aging generation facilities need to be replaced. 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 60 percent 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 also is 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 a robust and resilient system.

Matching Demand Growth and Affordability – Modular facilities 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 facilities. 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 $6 billion to $7 billion up-front costs associated with a 1,000-megawatt reactor.

Diverse Applications and Siting Flexibility – SMRs can power retired fossil fuel sites 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. 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.

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 facilities 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.

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 four or more commercial SMR facilities domestically, and development of a strong domestic supply chain to support the domestic SMR market and export of U.S. SMRs.

The Energy Policy Act of 2005 provided limited incentives for new nuclear energy development. That legislation, and other legislation enacted before and since 2005, have provided large incentives for various energy technologies. Federal support for other energy sources dwarfs federal spending on nuclear energy. Since 1950 the U.S. government has provided $594 billion to oil, gas and coal, $171 billion to solar, wind and other renewables, and $73 billion to nuclear energy.[1] In order to achieve the nation's clean air goals, 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.

SMRs offer value beyond renewables based on their "always on" nature and the enhancement in electrical reliability offered. As more baseload generation sources retire, the value that baseload generation sources provide, such as electric transmission grid stability provided by the inertia of large rotating masses, will increase. Policies should be established that recognize these reliability and security benefits.

Large infrastructure projects of the scale and duration of SMRs may only be possible 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 to achieve design and licensing of two or more designs and deployment of four or more SMR facilities (approximately 3,000 megawatts-electric) 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:

[1] *60 Years of Energy Incentives: Analysis of Federal Expenditures for Energy Development*, Management Information Services, Inc., October 2011.

Design and Licensing Partnerships

Design and Licensing Cost-Share – The total cost to obtain regulatory approvals and perform first-of-a-kind final design engineering for two or more SMR designs and the initial SMR facilities is expected to be $2 billion to $2.5 billion. To date, four designers have invested a total of more than $1 billion dollars to develop their SMR designs. Potential owners of SMR facilities have also invested tens of millions of dollars in preparing their sites for possible deployment of SMRs. The U.S. Department of Energy's (DOE's) SMR Licensing Technical Support (LTS) program, envisioned to provide initial funding of $452 million on a cost share basis, is much appreciated but not sufficient in the current business environment to achieve large-scale SMR commercialization. The SMR LTS program is scheduled to end in fiscal year 2017, just as the first design and facility applications are being submitted for review by the NRC. DOE's LTS program should be expanded to cover design finalization in addition to licensing under the multiple available regulatory processes (10 CFR Part 50 and 10 CFR Part 52), with a commensurate increase in funding and extension through FY2025.

Commercial Deployment Partnerships

Construction of the first several SMR facilities 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 facilities 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), power purchase agreements (PPAs) and loan guarantees, sufficient for SMR deployment to be self-sustaining. Ideally, DOE and the industry partner would have the ability to select the appropriate partnership option for the project that accomplishes the objective at the lowest cost to the government. Criteria and conditions could be established to limit the total financial amounts made available by the U.S. government to any one project and in any one year. Incentives could be structured to promote industry's cost share, carbon emissions reductions, job growth, exports, use of government services and deployment timeliness.

Production Tax Credits – PTCs can offset first-of-a-kind risk for new SMR generating facilities. The Energy Policy Act of 2005 established a nuclear production tax credit (PTC) for new nuclear generating capacity built after 2005; however, it was limited in both availability (new nuclear plants must be placed in service by the end of 2020) and capacity (the first 6,000 megawatts of new nuclear generation). PTCs should be available to stimulate SMR deployment beyond 2020, the current expiration date of the existing program. The PTC should be transferable from public entities to non-public participants.

Power Purchase Agreements – Future business risk can be reduced, enabling larger investments in new facilities, 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 facility, benefits that current markets do not value.

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 (e.g., six 9's – 99.9999% – of reliability with zero carbon emissions).

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 heat, fuel irradiation, or a source of neutrons for R&D. Congress should specifically authorize the duration of PPAs to be up to 30 years to spread the investment over more of the SMR facility'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.

Loan Guarantee Program – The existing loan guarantee program and authority should remain available through the design and construction of SMR facilities 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.

<u>Technology Development Partnerships</u>

Grid Security and Reliability Programs – Government development and demonstration are needed to enhance the reliability of electricity supply to federal facilities with large electricity requirements and missions that are important to national security. Some SMR design features make them more resilient than other types of facilities to withstand natural phenomena (e.g., earthquakes, floods, tornados) and intentional destructive acts (e.g., aircraft impacts, snipers). Additional capabilities, such as underground transmission, can be coupled with SMRs to improve resiliency of the transmission and distribution system and further improve reliability. DOE and DOD programs should be funded to develop the requirements and specifications for SMR-Powered Secure and Reliable microgrids, capable of operating independent of the main electrical grid, to improve reliability and resiliency for selected federal facilities to make them less vulnerable to natural phenomena and intentional destructive acts. Microgrid demonstration and deployment could be included in a PPA pursuant to enhance reliability for large DOE or DOD facilities.

National Laboratory Support – SMR development can be accelerated with access to and support from the U.S. national laboratories (Labs). Research and development into SMR technologies can help accelerate the commercialization of SMRs and facilitates regulatory acceptance of new concepts (e.g., passive safety features, fuel designs and testing, digital I&C, nuclear safety codes, dose calculations and modeling & simulation). A key focus of lab efforts should be to support development of SMR technologies for use in traditional and innovative applications, such as the production of hydrogen, isotope and process heat, flexible operations, and microgrid installation. The DOE Gateway for Accelerated Innovation in Nuclear (GAIN) initiative is one such way of organizing lab resources. DOE should provide SMR designers and other developers of SMR technologies, including manufacturing capabilities important to the U.S. supply chain, with direct and in-kind support (i.e., use of lab resources, people, codes, facilities).

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 investment tax credit (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.

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 in the mid-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 facilities that would otherwise not exist without the U.S. government's investment.

SMR facilities could range from a few dozen to over 1,000 megawatts-electric depending on the actual number of units deployed, with the majority of facilities expected to produce between 300 to 600 megawatts-electric.[2] Construction and operation of a 600 megawatt SMR facility with multiple reactors is estimated to employ about 800 to 900 manufacturing and construction workers for about 4 years and about 300 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. Payroll taxes alone from the direct and indirect employees associated with one nuclear plant over 60 years total over $400 million.[3]

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 facilities 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.

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

[3] 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.

In order to supplement the considerable private investment and achieve the benefits of SMR technology, Congress should authorize in FY2018, and appropriate sufficient funds in FY2018 and beyond to implement, the following public-private partnerships and other federal government actions that are instrumental in facilitating the successful domestic commercialization and export of U.S. SMRs.

1. SMR Licensing Technical Support (LTS) program continuation and expansion to include the design and engineering, through design finalization, and regulatory review and approval of SMR technologies and facilities. The SMR LTS program should be increased to continue providing 50-50 cost share for two or more SMR designs and several initial facilities, and be available through 2025. This program funding should be structured to accommodate participants that are following diverse regulatory approaches and pathways to market development.

2. An SMR commercial deployment program to stimulate new SMR generation sufficient for self-sustaining deployment. The program should be available through a combination of the following investment mechanisms:

    i. Production Tax Credits (PTCs) – that stimulate SMR deployment beyond the current 2020 expiration date of the existing program. The PTC should be transferable from Public owners to non-public project participants.

    ii. Power Purchase Agreements (PPAs) – that provide DOE and DOD the ability to enter into long-term PPAs to compensate SMR projects that supply carbon-free and highly reliable electricity to facilities that support critical national security missions or other federal goals and priorities. PPAs should be "scored" such that the federal budgets are impacted annually instead of the entire PPA value being "scored" in the year the PPA is entered.

    iii. Loan Guarantees – that support financing, through continuation of the existing loan guarantee program and authority, for design and construction of SMR facilities and SMR component manufacturing facilities.

3. An SMR investment tax credit (ITC) for manufacturing capabilities that form a robust U.S. supply chain for domestic SMR facilities and export of U.S. SMR components and equipment.

4. DOE research, development, and demonstration of innovative SMR capabilities, such as load-following, providing power for industrial process heat, desalination or water purification, co-generation applications.

5. DOE and DOD programs to develop the requirements and specifications for SMR-Powered Secure and Reliable microgrids, capable of operating independent of the main electrical grid, to improve reliability and resiliency for selected federal facilities to make them less vulnerable to natural phenomena and intentional destructive acts.