Presidential Policy Directive
National Strategy for Space Solar Power

Memorandum for:

The Vice President
The Secretary of State
The Administrator of the National Aeronautics and Space Administration
The Secretary of Energy
The Secretary of Defense
The Secretary of Commerce
The Secretary of Transportation
The Director of the Office of Management and Budget
The Assistant to the President for National Security Affairs
The Director of the Office of Science and Technology Policy

Section 1. Policy. The ability to develop, deploy and use government and commercial space solar power (SSP) and wireless power transmission (WPT) systems safely, securely, and sustainably is vital to combating the global threats posed by climate change, to maintaining and advancing United States strategic leadership in developing new, scalable net zero carbon dispatchable baseload energy sources for US and global electricity markets, and to US leadership in space. SSP systems may include solar power generation (SPG) systems (including optics such as concentrators, photovoltaics (PV) and power management and distribution (PMAD)); wireless power transmission (WPT) systems (including microwave and laser power transmission); large in-space low-mass structural systems (assembled and deployable); critical robotic and mechanical systems supporting assembly, deployment and repair; solar electric propulsion; and, other systems (e.g., for transportation, attitude control and station-keeping, etc.). SSP systems have the flexibility to deliver power for commercial or government purposes on Earth, as well as for spacecraft, lunar and other surface systems, and other applications in which large, scalable power is required, thereby enabling adaptable and affordable power and operations. Cooperation with commercial and international partners is critical to achieving America's strategic objectives for space solar power.

This memorandum establishes a national strategy to ensure the development and use of SSP systems to enable and achieve the climate, national security, commercial, space exploration and space science objectives of the United States. In the context of this strategy, the term ''development'' includes the full process from supporting research and development to design, testing and production, and the term ''use'' includes launch, operation, and disposition.

This memorandum outlines high-level policy goals and a supporting roadmap that will advance the ability of the United States to use government, commercial and international SSP systems safely, securely, and sustainably. The execution of this strategy will be subject to relevant budgetary and regulatory processes and to the availability of appropriations.

Section 2. Goals. The United States will pursue goals for SSP development and use that are ambitious in their substance and their timeline, and which enable SSP to become a viable mid-term net zero carbon terrestrial energy option in the campaign to counter climate change by the

late 2020s, with nearly continuous dispatchable power at scales of gigawatts and greater. These goals will also enable a range of future space missions and applications, with the aim of accelerating achievement of key milestones such as the in-space demonstration and use of new SSP capabilities. This memorandum establishes the following such goals for the Nation:

(a) Develop capabilities that enable production of SSP systems to deliver almost continuously dispatchable, baseload-scale net-zero carbon power to markets on Earth. To maximize international adoption, private-sector adoption and low-cost, these capabilities should be developed through public-private partnerships and with international partners to the greatest degree possible;

(b) Develop capabilities that enable production of SSP systems suitable to lunar and planetary surface and in-space power, as needed. To maximize private-sector engagement and cost savings, these capabilities should be developed to enable a range of terrestrial as well as space applications, including future commercial applications;

(c) Establish the technical foundations and capabilities—including through identification and resolution of the key technical challenges—that will enable options for SSP to meet future terrestrial commercial needs, as well as commercial space, National Aeronautics and Space Administration (NASA) and Department of Defense (DoD) mission requirements;

(d) Demonstrate a space solar power system (including wireless power transmission) on the surface of the Moon that is scalable to a power range of 1 megawatt-electric (MWe) and higher to support a sustained lunar presence and in situ resource utilization (ISRU) in the permanently shadowed regions (PSRs). To the extent feasible, this power system should align with mission needs for, and potential future government and commercial applications of, in-space SSP and space solar power for terrestrial power;

(e) Demonstrate a space solar power pilot plant system in Earth orbit that can deliver power of not less that 100 megawatt-electric (MWe) to one or more terrestrial markets, scalable to a power range of 1 gigawatt-electric (GWe) and higher. To the extent feasible, this SSP system should align with needs of potential future government and commercial mission applications; and,

(f) Develop advanced SSP capabilities that provide for future improvements in various efficiencies (PV arrays, WPT, etc.), higher specific energy, improvements in operations (e.g., repair and maintenance) and longer operational lifetime than existing SSP capabilities, thus enabling commercially-competitive space solar power to be delivered broadly and at large scale into terrestrial markets.

Section. 3. Principles. The United States will adhere to principles of safety, security, and sustainability in its development and use of SSP systems (including WPT), in accordance with all applicable Federal laws and consistent with international obligations and commitments.

(a) Safety. All executive departments and agencies (agencies) involved in the development and use of SSP systems shall take appropriate measures to ensure, within their respective roles and responsibilities, the safe development, testing, launch, operation, and disposition of SSP systems. For United States Government SSP programs, the sponsoring agency holds primary responsibility for safety. For programs involving multiple agencies,

the terms of cooperation shall designate a lead agency with primary responsibility for safety in each stage of development and use.

(i) Ground development. Activities associated with ground development, including ground testing, of SSP systems shall be conducted in accordance with applicable Federal, State, and local laws and existing authorities of regulatory agencies.

(ii) Launch. Established safety guidelines and safety analysis and review processes for Federal Government launches of spacecraft, including SSP systems, and for launches for which the Department of Transportation has statutory authority to license as commercial space launch activities (commercial launches). These guidelines and processes address launch and any subsequent stages during which accidents may result in any effects on the public or the environment. Launch activities shall be conducted in accordance with these guidelines and processes.

(iii) Wireless Power Transmission. The safety, security and non-interference due to wireless power transmission (WPT) from an SSP system in space to a ground receiver shall be conducted in accordance with applicable Federal, State, and local laws and existing authorities of regulatory agencies. Key issues associated with spectrum allocation and management will be resolved by the Federal Communications Commission of the DOC and through the International Telecommunications Union (ITU).

(iv) Operations and disposition. The operation and disposition of SSP systems shall be planned and conducted in a manner that protect human and environmental safety and national security assets. SSP systems may be operated on interplanetary missions, in sufficiently high orbits, and in low-Earth orbits. These systems should be stored in sufficiently high orbits or safely reenter Earth's atmosphere for destruction after the operational part of their mission.

(b) Sustainability. All agencies involved in the development and use of SSP systems shall take appropriate measures to conduct these activities in a manner that is suitable for the long- term sustainment of United States space capabilities and leadership in SSP.

(i) Coordination and Collaboration. To maximize efficiency and return on taxpayer investment, the heads of relevant agencies shall seek and pursue opportunities to coordinate among existing and future SSP development and use programs. Connecting current efforts with likely future applications will help ensure that such programs can contribute to long-term United States SSP capabilities and leadership. Agencies also shall seek opportunities to partner with international agencies, the private sector, including academic institutions, in order to facilitate contributions to United States SSP capabilities and leadership. To help identify opportunities for collaboration, the heads of relevant agencies should conduct regular technical exchanges among SSP programs, to the extent that such exchanges are consistent with the principle of security and comply with applicable Federal, State, and local laws. Agencies shall coordinate with the Department of State when seeking opportunities for international partnerships.

(ii) Commonality. The heads of relevant agencies shall seek to identify and use opportunities for commonality among SSP systems, and between SSP and terrestrial

power systems, whenever doing so could advance program and policy objectives without unduly inhibiting innovation or market development, or hampering system suitability to specific mission applications. For example, opportunities for commonality may exist in goals (e.g., demonstration timeline), design, development, supplementary systems, methods, and infrastructure (e.g., testing facilities, launch facilities, and workforce).

(iii) Cost-effectiveness. The heads of relevant agencies should pursue SSP development and use solutions that are cost-effective while also consistent with the principles of safety and security. For any program or system, the head of the sponsoring agency(ies) should seek to identify the combination of ground-based and in-space testing and certification that will best qualify the system for a given mission.

(iv) Operational Security. The heads of relevant agencies shall pursue operational security for SSP deployment, operations and disposition, working with international and commercial partners. For any systems, these considerations will include cyber-security.

(v) Protection of the Space Environment. The heads of relevant agencies should pursue SSP development and use solutions that, to the extent practicable, minimize impacts from SSP systems on orbital debris, light pollution and other factors as may arise.

(c) Technology Transfer. All agencies involved in the development and use of SSP systems shall take appropriate measures to protect sensitive information, consistent with sound technology transfer principles. To facilitate timely cooperation and collaboration, where it is in the interest of the US Government, Agencies shall establish appropriate technology transfer and sharing agreements with international partners vis-à-vis SSP technologies and systems, and facilitate such agreements among private sector organizations and international counterparts. For United States Government SSP programs, the sponsoring agency holds primary responsibility for security.

Section. 4. Roles and Responsibilities.

(a) The Vice President, on behalf of the President and acting through the National Space Council, shall coordinate United States policy related to the development, demonstration, and use of SSP systems.

(b) The Secretary of State shall, under the direction of the President, coordinate United States activities related to international obligations and commitments and international cooperation involving SSP.

(c) The Administrator of NASA shall conduct and support activities associated with development and use of SSP systems to enable and achieve United States climate, energy, exploration and space science objectives. The Administrator of NASA shall establish the performance requirements for SSP capabilities necessary to achieve those objectives. When appropriate, the Administrator of NASA shall facilitate private-sector engagement in NASA SSP activities, and shall coordinate with the Secretary of State to facilitate international activities, with the Secretary of Commerce to help facilitate private-sector SSP activities, with the Secretary of Energy on relevant technology

developments, and with the Secretary of Defense concerning relevant applications of SSP technology and systems.

(d) The Secretary of Energy shall, in coordination with sponsoring agencies and other agencies, as appropriate, support development and use of SSP systems to enable and achieve United States climate, energy exploration, scientific, and national security objectives. When appropriate, the Secretary of Energy shall work with sponsoring agencies and DOC to facilitate United States private-sector engagement in Department of Energy (DOE) SSP activities.

(e) The Secretary of Defense, working with other Agencies shall conduct and support activities associated with development and use of SSP systems to enable and achieve United States national security objectives. When appropriate, the Secretary of Defense shall facilitate private-sector engagement in DoD SSP activities.

(f) The Secretary of Commerce shall promote responsible United States commercial SSP investment, innovation, and use, and shall, when consistent with the authorities of the Secretary, ensure the publication of clear, flexible, performance-based rules that are applicable to use of SSP and are easily navigated. Under the direction of the Secretary of Commerce, the Department of Commerce (DOC) shall ascertain and communicate the views of private-sector partners and potential private-sector partners to relevant agency partners in order to facilitate public-private collaboration in SSP development and use. These considerations shall include the resolution of spectrum allocation and management under the auspices of FCC responsibilities.

(g) The Secretary of Transportation shall, when appropriate, facilitate private-sector engagement in the launch or reentry aspects of SSP development and use activities, in support of United States science, exploration, national security, and commercial objectives. To help ensure the launch safety of an SSP payload, a payload review may be conducted as part of a license application review or may be requested by a payload owner or operator in advance of or apart from a license application.

(h) The Director of the Office and Science and Technology Policy shall coordinate United States policy related to research and development of SSP systems.

Section. 5. Roadmap. The United States will pursue a coordinated roadmap for federally-supported SSP activities to achieve the goals and uphold the principles established in this memorandum. This roadmap comprises the following elements, which the relevant agencies should pursue consistent with the following objective timeline, subject to relevant budgetary and regulatory processes and to the availability of appropriations:

(a) By the mid-2020s, establish the technical foundations and capabilities – including through identification and resolution of the key technical challenges – that will enable SSP options to meet sustainable terrestrial commercial needs, as well as commercial space, NASA and DoD mission needs.

(i) Conduct requirements assessment. NASA and DOE, in cooperation with DoD, and with other agencies and private-sector partners and international partners, as appropriate, should assess the ability of SSP capabilities to enable and advance

existing and potential future terrestrial commercial needs, as well as NASA, DoD and commercial space mission requirements.

(ii) Conduct technology assessment. NASA, in cooperation with DOE and DoD, and with other agencies, private-sector partners and international partners, as appropriate, should evaluate technology options and associated key technical challenges for an SSP system. NASA, DOE and DoD should work with their partners – including the private sector, other agencies and international partners – to evaluate and use opportunities for commonality with other SSP needs, terrestrial power needs, and demonstrations planned by agencies and the private sector.

(iii) Conduct technology development. NASA, DOE and DoD should work with their partners – including the private sector, other agencies and international partners – to develop SSP system technologies that will resolve the key technical challenges.

(b) By the mid-2020s, develop capabilities that enable production of SSP systems that are suitable for sustainable delivery of net zero carbon energy to markets on Earth at commercially competitive prices, using technologies that are consistent with safe, commercially-competitive lunar and planetary surface and in-space power applications as needed. Begin development of advanced SSP capabilities that provide for future improvements in various efficiencies (PV arrays, WPT, etc.), higher specific energy, improvements in operations (e.g., repair and maintenance) and longer operational lifetime than then-current SSP capabilities.

(c) By the mid- to late- 2020s, resolve spectrum management and other regulatory issues, working through appropriate US and international organizations that will enable SSP options to meet future terrestrial commercial needs, as well as commercial space, NASA and DoD mission needs.

(i) Spectrum Management. NASA, in coordination with the Department of Commerce, DOE, DOD, other Agencies, the private sector and international collaborators, as appropriate should develop recommendations for, and approval of spectrum allocation choices for SSP wireless power transmission, focusing on the requirements of an SSP pilot plant (see below).

(d) By the mid-to late-2020s, demonstrate a space solar power system delivering power from low Earth orbit (LEO) to the surface of the Earth, delivering not less than 1 kW of power to the receiver on Earth.

(i) Initiate a LEO SSP demonstration project. NASA should initiate development of an SSP system producing not less than 100s of kilowatts (kW) power in LEO by means that are scalable to a large-scale, all-weather dispatchable SSP system and delivering not less than 1 kW to Earth for demonstration by 2026. NASA should consult with other agencies, and with the private sector, as appropriate, when developing project requirements.

(ii) System development. NASA should work with DOE, and with other agencies and private-sector partners to develop the LEO SSP power demonstration project.

(iii) Conduct demonstration mission. NASA, in coordination with other agencies and with private-sector partners, as appropriate, should launch and conduct the LEO SSP demonstration project.

(e) By the late-2020s, demonstrate a space solar power system delivering power to the surface of the Moon that is scalable to a higher power to support sustained lunar presence and resource development and utilization at the lunar polar regions and elsewhere.

(i) Initiate a surface power project. NASA should initiate development of an SSP system delivering not less than 100 kilowatt-electric (kWe) power for lunar surface demonstration by c. 2028, with scalability to power levels at or above 1 megawatt-electric (MWe). NASA should consult with other agencies, and with the private sector, as appropriate, when developing project requirements.

(ii) Engage the private sector. NASA, working with DOE and other Agencies should determine mechanisms for engaging with the private sector to meet NASA's lunar surface power needs in an effective manner consistent with the guiding principles set forth in this memorandum. In evaluating mechanisms, NASA, DOE and others should consider the possibility of NASA issuing a request for proposal for the development and construction of the surface power system or demonstration.

(iii) System development. NASA should work with DOE, and with other agencies and private-sector partners, as appropriate, to develop the lunar surface power demonstration project.

(iv) Conduct demonstration mission. NASA, in coordination with other agencies and with private-sector partners, as appropriate, should launch and conduct the lunar surface power demonstration project.

(f) By the late-2020s, develop, deploy and operate a space solar power pilot plant system delivering net zero carbon power to one or more markets on Earth at 100 MW or greater, and scalable to 1 gigawatt (GW) and higher to support competitive commercial operations in a wide range of terrestrial markets.

(i) Initiate an SSP pilot plant project. NASA, working with DOE and the Department of State should initiate an SSP pilot plant project for terrestrial markets by c. 2028, with initial delivered power of at least 100 MWe with a system scalable to 1 GWe or above. NASA should consult with other agencies, and with the private sector, as appropriate, when developing project requirements.

(ii) Engage the private sector. NASA, working with DOE and other Agencies should engage with the private sector through public-private partnerships to meet this milestone in a timely and cost-effective manner consistent with the guiding principles set forth in this memorandum.

(iii) System development. NASA should work with DOE, other agencies and private-sector partners, and with international partners as appropriate, to develop the SSP pilot plant project.

(iv) Conduct pilot plant deployment and operations. NASA, in coordination with other agencies, private-sector partners, and international partners, as appropriate, should

launch and operate the SSP pilot plant, with operations to last for a period of not less than five (5) years before transitioning to private sector ownership and operations.

(v) During pilot plant operations, NASA, in coordination with other agencies, private-sector partners, and international partners, as appropriate, should use the SSP pilot plant for purposes of testing new SSP technologies and systems elements.

Section. 6. Implementation. The Vice President, through the National Space Council, shall coordinate implementation of this memorandum.

Section. 7. General Provisions.

(a) Nothing in this memorandum shall be construed to impair or otherwise affect:

(i) the authority granted by law to an executive department or agency, or the head thereof; or

(ii) the functions of the Director of the Office of Management and Budget relating to budgetary, administrative, or legislative proposals.

(b) This memorandum shall be implemented consistent with applicable law and subject to the availability of appropriations.

(c) This memorandum is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

(d) The Administrator of NASA is authorized and directed to publish this memorandum in the Federal Register.

Dated: TBD.

Signing Authority