



## RECOMMENDATIONS TO THE NEXT ADMINISTRATION REGARDING COMMERCIAL SPACE

Tremendous progress has been made in the commercial space arena since the last presidential transition in 2008. To ensure that the impact of these changes is adequately reflected in U.S. space policy the National Space Society (NSS) assembled a hand-picked group of experts to prepare recommendations for the incoming administration. This group met at the venture capital firm DFJ in Menlo Park California on Saturday Oct. 8th 2016. After a full day of discussion and deliberation, five major recommendations – focused on commercial space – were agreed upon.

### **Recommendation #1 - Reestablish the National Space Council**

In 2008 the Obama campaign stated “There is currently no organization in the Federal government with a sufficiently broad mandate to oversee a comprehensive and integrated strategy and policy dealing with all aspects of the government’s space-related programs, including those being managed by NASA, the Department of Defense, the Department of Energy, the National Reconnaissance Office, the Commerce Department, the Transportation Department and the other federal agencies.” **We recommend that the U.S. Government re-establish a National Space Council (NSC).** The chair of the National Space Council should be appointed by and report to the President, and advise the President on space policy topics including NASA Administrator candidates.

There are a number of space related challenges that the next Administration will have to address, including orbital debris, the militarization of space, space situational awareness and traffic management, international cooperation, and competition to name just a few. The goal of the re-established National Space Council will be to oversee and coordinate civilian, military, commercial, and national security space activities. The NSC should solicit public participation, work with commercial entities, engage the international community, and develop a 21st century vision of space that will continuously push the envelope on new technologies and new applications, as well as promote American space leadership and security.

### **Recommendation #2 – Enable and Support a Thriving Space Economy**

For the exploration, development and eventual settlement of space to be truly sustainable, there must be a viable space economy to support it. **We recommend that the U.S. Government establish that one of NASA’s goals should be to facilitate and promote a thriving space economy.** A recent (9/15) report by the Tauri Group for the Satellite Industries Association showed the worldwide market for all satellite services in 2014 to be \$203 billion, of which the U.S. portion was 43% (\$87.2 billion); however, the U.S. growth rate (2%) was significantly below the international growth rate (6%).<sup>i</sup> There are a number of other emerging space markets in Earth observation, low Earth orbit (LEO)

communications, and microgravity processing that have the potential to grow to be as large if not larger than the geostationary Earth orbit (GEO) communication satellite economy, with proper support from the federal government.

In 2015 United Launch Alliance (ULA) presented their “Cis-Lunar 1000” view of the potential for space development growth over the next 30 years. Their estimate was that the space economy could expand from its current \$330 billion to \$2.7 trillion by 2045.<sup>ii</sup> To make this projection a reality, the U.S. Government will need to play a vital but different role than it has traditionally fulfilled. The use of public/private partnerships as exemplified by the NASA Commercial Orbital Transportation Services (COTS) program and its use of funded Space Act Agreements (SAA) must become the norm instead of the exception. By aligning public and private strategic goals, dramatic financial leverage can be developed. A 2011 analysis of the development cost of the Space Exploration Technologies (SpaceX) Falcon 9 launch vehicle that was developed for the NASA COTS program was conducted by the office of the NASA Deputy Associate Administrator for Policy using the NASA/Air Force Costing Methodology (NAFCOM) computer modeling tool. This analysis showed an almost 10X cost reduction using the funded SAAs that were utilized by COTS as compared to the normal NASA cost plus contracts that are typically signed (\$400 million for actual SpaceX Falcon 9 development vs \$3.977 billion cost predicted by NAFCOM under a cost plus contract scenario).<sup>iii</sup>

Another key government initiative supporting commercialization of space was the Commercial Resupply Services (CRS) program. While COTS and the SAAs were utilized to demonstrate the capability to delivery cargo to the ISS, the CRS was a fixed price procurement contract for the actual delivery of payloads to the ISS over multiple years. The CRS contracts that were awarded to both COTS winners in an open competition allowed the two companies (SpaceX and Orbital/ATK) to raise the money required to pay for their significant share of the COTS development costs. This example of NASA acting as an anchor customer to help establish new commercial capabilities and new markets demonstrates the key role that the government can and must play to ensure U.S. space leadership.

There are three ways that SAAs and public-private partnerships can be used to advance the commercialization of space:

- NASA should produce a plan to transition the ISS National Laboratory from the ISS to leased space in commercial LEO stations, and to assist new space businesses that use the ISS in a similar transition. As part of this transition plan, a goal should be to increase the quality, quantity, and variability of gravity levels available in which to conduct research and manufacturing activities. This policy will support the emerging LEO commercial sector.
- NASA should purchase rocket fuel and oxygen/water to use at any location in space (LEO, GEO, BEO) from commercial entities if such commodities are commercially available. This policy will encourage the nascent asteroid and lunar mining industries, as well as lower the cost of an eventual journey to Mars.

- NASA bases/gateways/stations in any location in space, including the lunar surface, lunar orbit, and others, should contract with commercial services to provide cargo and crew to such stations. This policy will enable the development of economic and reusable cislunar transportation, and will support goals such as #3 below and an ultimate journey to Mars.

### **Recommendation #3 – Establish a Public/Private Lunar Base**

There are a number of scientific and commercial reasons for returning to the Moon. Scientifically the Moon offers a treasure trove of information about the early formation of the solar system and its evolution. We now know that there are huge quantities of water ice in the permanently shadowed craters at the lunar poles, and this water has great interest not only to the scientific community who want to understand how it got there, but also to the space resources companies who want to explore the feasibility of harvesting water as a resource and offering it for sale to help facilitate the exploration, development and eventual settlement of the solar system. This water can be used for growing crops as well as drinking and for a number of industrial purposes. The water can also be separated into hydrogen and oxygen for use as rocket propellant and the oxygen can be used for life support.

The International Space Exploration Coordination Group (ISECG) is a collaboration of 14 space agencies working cooperatively to coordinate the activities of the member countries to facilitate the exploration of the solar system. Almost all of the members of the ISECG except for the U.S. have set their sights on human and robotic exploration of the Moon first and then expanding outwards to Mars. Earlier this year ESA Director General Johann-Dietrich proposed that the world should collaborate to create a permanent lunar base that he is calling the “Moon Village” which could support science, business, tourism and even mining.<sup>iv</sup>

**We recommend that the U.S. Government take a leadership role in establishing a lunar base focused on the extraction of lunar resources.** This should be undertaken as a public/private partnership with commercial companies who have already set their sights on the Moon such as Astrobotic, Moon Express and Masten Space Systems, all of which are currently participating in the NASA Lunar Catalyst program. ULA’s previously mentioned CisLunar 1000 concept lays out their plan for developing their ACES/XEUS space tug and lunar lander such that both vehicles can be refueled from resources mined from Lunar ice deposits. By partnering with these companies (and others) that already want to develop the Moon, as well as our international partners, the cost of a lunar base could be dramatically reduced. Key components of such a base might be owned and operated by NASA or international partners, but other elements would be owned and operated by commercial enterprises.<sup>v</sup>

### **Recommendation #4 – Create a Space Commodities Futures Trading Exchange**

In order to create and sustain a thriving space economy it will be necessary to be able to buy and sell commodities that are assembled, produced or mined in space. To facilitate this process, **we recommend that the U.S. Government establish a Space Commodities Futures Trading Commission (SCFTC) for the space industry.** The Commission, with input from industry, academia and government, would establish the

guidelines to enable a board of trade or designated market-maker to establish and operate an exchange or alternative exchange mechanism (collectively, the Exchange). The Exchange would design, standardize and trade in the future commitments to deliver goods, services or other units constituting the various commodities necessary to get to, operate within, and return from space (e.g. launch, water, energy, insurance and currency). The Exchange would be a private or public-private entity with primary responsibility for operating all aspects of the market operations. The SCFTC would be responsible for oversight, space commodities forecasting, futures contract enforcement, clearing and risk, and mediation.

- The Exchange would create a standardized set of agreements for the exchange of commodities, such that the tenure of ownership of the commodities could be readily ascertained.
- The federal government would refer to the Exchange for the acquisition of commodities it regulates through the SCFTC, and would prototype futures contracts for acquisition of commodities it would like to stimulate supply of, and that could be offered through the Exchange.
- The federal government shall recognize the commercial viability of any commodity listed on the Exchange as *prima facie* evidence in satisfying federal acquisition requirements for the proof of commercial viability in order to develop the science, technology and production that would supply the commodity. In order to benefit from and coordinate with terrestrial experience, history and financial practices in trading commodities futures, consideration would be given to having the SCFTC operate as part of, or via strategic partnership with, the Commodities Futures Trading Commission codified at 7 U.S.C. Chapter 1, as amended.

#### **Recommendation #5 - Establish a Major Breakthrough Space R&D Program**

Throughout its history NASA has always been associated with major technological advancements, from the Saturn 5 that took American astronauts to the Moon, to the remarkably versatile, reusable but complex space shuttle, to the International Space Station that has been permanently occupied for 16 years. No technological challenge seemed to be too great during this period. But recently, NASA's technological reach has been significantly reduced, and very few breakthrough technologies and/or capabilities now emerge from the agency's far more conservative and fiscally constrained endeavors

**We recommend that the U.S. Government enable NASA to return to its cutting edge technology roots by establishing a significant (\$1 billion/year) Breakthrough Technology R&D program** focused on providing the new capabilities and dramatic cost reductions to the aerospace industry that have been achieved in almost all other industries. Commercial companies, often backed by significant venture capital investments, are increasingly leading in the development of the cutting edge technologies required by our 21st century space program. NASA needs to team with these companies to encourage and mature selected technologies that can best enable ambitious future NASA missions. The establishment of an innovative and long term Breakthrough Technology R&D program, one that focuses on high risk but high payoff technology

development and demonstration, would help not only NASA, but commercial space suppliers and users as well. This is similar to the role that the National Advisory Committee for Aeronautics (NACA) played in the last century to ensure U.S. leadership in aviation.

This program should be “DARPA-like” in that it takes on true game-changing challenges with specific objectives and a requirement for measurable progress to receive phased funding. Examples of the types of breakthrough capabilities that might be targeted include self-sustaining habitats in space, propellant production and storage (at the Moon, at small bodies, and at Mars), *in situ* manufacturing (Moon, small bodies, Mars), reusable large-scale solar electric or nuclear propulsion systems, space solar power (SSP), and others. These technologies must be matured to the point where system and/or flight proven technology (TRL 6/7 or higher) can be incorporated into future NASA and/or U.S. commercial ventures.

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<sup>i</sup> [2015 State of the Satellite Industry Report prepared by The Tauri Group, Sept. 2015](#)

<sup>ii</sup> [http://www.ulalaunch.com/uploads/docs/Published\\_Papers/Commercial\\_Space/2016\\_Cislunar.pdf](http://www.ulalaunch.com/uploads/docs/Published_Papers/Commercial_Space/2016_Cislunar.pdf)

<sup>iii</sup> [https://www.nasa.gov/pdf/586023main\\_8-3-11\\_NAFCOM.pdf](https://www.nasa.gov/pdf/586023main_8-3-11_NAFCOM.pdf)

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[http://www.esa.int/About\\_Us/DG\\_s\\_news\\_and\\_views/Moon\\_Village\\_humans\\_and\\_robots\\_together\\_on\\_the\\_Moon](http://www.esa.int/About_Us/DG_s_news_and_views/Moon_Village_humans_and_robots_together_on_the_Moon)

<sup>v</sup> [http://science.ksc.nasa.gov/shuttle/nexgen/Nexgen\\_Downloads/NexGen\\_ELA\\_Report\\_FINAL.pdf](http://science.ksc.nasa.gov/shuttle/nexgen/Nexgen_Downloads/NexGen_ELA_Report_FINAL.pdf)