Sustainable Space Exploration and Space Development ... A Unified Strategic Vision

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EXECUTIVE SUMMARY

1. Since the completion of the Apollo program nearly four decades ago, America has lacked a Unified Space Vision addressing our strategic goals, and our national and international needs and objectives in space exploration and space development endeavors.

2. The NASA-centric and exploration-centric national space enterprise has not successfully addressed the issues of affordability and sustainability in space exploration, and affordability and profitability in space commerce development. We therefore need a Unified Space Vision (USV) to guide both space exploration and space development efforts, one that integrates all aspects of commercial space, national security space, and NASA's exploration space endeavors.

3. Because of its own history and due to the extraordinary nature and challenges of the Apollo program, the Cold War, and the Space Race, NASA has developed an organizational culture that is not optimized for the development of space as an economic and commercial frontier

4. The commercial development of space promises to provide extraordinary opportunities to develop new economic capabilities that will most likely help overcome global challenges and crises in energy, climate change and resource shortages. Such efforts could also be transformative to all nations that participate. Human development and economic expansion into space could even help accelerate the evolution of human civilization, and also help inspire human collaborative and effective diplomacy, thus enhancing bonds between nations and fostering an enduring world peace.

5. We believe that the U.S. should be a leader in this effort, and consequently the authors propose that while NASA should remain charged with an aggressive space exploration portfolio, a new, cabinet level government entity such as a White House Council for Space or Department of Space, should be established to oversee and manage the overall American space effort, with a particular focus on commercial development and industrialization of space.

6. Working in close conjunction and collaboration with international partners, business organizations, and educators, the proposed new government organization should pursue an aggressive program to develop private, entrepreneurial space industries, and the associated Earth and space commerce development and infrastructure for the benefit of the US economy, the global economy, and all humans.

7. A primary program objective to enable space exploration and space economy should be the development, as quickly as possible, of a reliable, cost effective reusable launch vehicle (RLV) capable of getting crew, passengers and payloads to low Earth

Orbit. The RLV system will become core of the next space transportation infrastructure, a global space highway transportation system.

8. A joint international effort should be undertaken to return humans to the Moon and to establish permanent colonies there. The main focus should be on the cost-effective development of the trans-Earth and trans-lunar space infrastructure development, which buys down risks and therefore opens the door for private investment and commercial expansion into the entire LEO space, and beyond.

9. Being an R&D organization dedicated to space exploration and scientific discovery, NASA should take effective risks by pushing the envelope in science and engineering, undertaking continued exploration of other bodies in the solar system, as well as a program to land humans on NEOs and Mars.

10. Should the U.S. fail to establish a leadership position in the emerging field of space commerce, its leadership among the nations of the Earth would be progressively threatened. The actions necessary to sustain leadership are well within America's grasp, and we should move forward actively with a dynamic program of strategy development, policy planning, program and technology development, organization development, and action to assure that we make the most of this opportunity, which is likely to be one of the most significant undertakings of the 21st century.

Sustainable Space Exploration and Space Development

A Unified Strategic Vision

ABSTRACT

This paper recommends that a strategic Unified Space Vision (USV) for comprehensive human space exploration and space commerce endeavors in the 21st century be established through a collaborative process including extensive analysis of complex space policy issues by the new U.S. Administration, the NASA transition team, and the broad domestic and international community. The proposed Vision should constitute a new paradigm of space policy that is intended to replace the current Vision for Space Exploration (VSE), including its implementation plan, which has been pursued via the NASA Constellation program since its announcement by George Bush in early 2004. We believe that if adequately adopted, the USV would best serve the long-term economic, diplomatic and exploration interests of this nation and others around the globe.

1. Introduction

A wide range of critical issues relating to national and international policy and concerning human space exploration and space-based economic development have risen to the forefront among many in the aerospace community.

The topics and general views presented in this paper originated from a series of discussions between Dr. F. Hsu and Dr. Ken Cox. The purpose of the dialog was to delineate a comprehensive and strategic vision on key issues pertaining to human space endeavors for consideration by the new U.S. administration. The issues considered here include a view not only of the current status and future perspectives of the U.S. space enterprise, but also the organizational and political causes beneath the lessons drawn from the history of NASA across its 50 years of history.

Key issues addressed in this white paper include:

- Why the history and organizational approach used by the U.S. and NASA makes it so difficult to deliver the kind of profound success achieved in the Apollo era.

- Why there is an urgent need for realignment of America's space policy to accommodate the increasing importance of space commerce, as well as international participation in space development and space commerce.

- In particular, why there needs to be a cabinet-level government entity, such as a "White House Advisory Council on Space" to serve as the overall government space authority, which could then evolve into a formal "Department of Space" cabinet post.

We believe that a new paradigm of the strategic and unified space vision (USV) and related policies recommended herein, which have been drawn from candid and extensive discussions on above issues with members of ATWG and across the space community, will serve the long-term economic, diplomatic and exploration interests of this nation and others around the globe.

2. The Need for a New Vision to Transform America into a Spacefaring Nation

There have been extensive debates in the public as well as within the space science, industry, and technology communities regarding the wisdom of the current Vision for Space Exploration (VSE), and its proposed implementation, as set out by the Bush administration. More than 5 years have now passed since its announcement in early 2004, and it has become increasingly apparent that the rationale behind the formulation of the VSE as well as its implementation are problematic, and perhaps lacking in strategic merit.

In our view, there were several fundamental problems with the Vision and its implementation for Space Exploration inherited from the outset:

1. Because there was not a well-informed debate engaging a broad range of the space and science communities, policymakers, and the general public, the Bush VSE was crafted in isolation, and without the thorough reviews necessary to a strategic space policy statement. The proposed plan should have been scrutinized through hearings to engage the American public and politicians in the underlying thinking process.

2. The VSE plan constitutes an almost-Apollo-style, national program of long-lasting impacts on national resources and space policy, but it did not take into account the lessons of NASA's history, and therefore was certainly not optimized for success.

3. The VSE seems to lack strategic merit, which can be built only upon a sufficiently vetted decision-making process of logic and analytic rigor. The timing of the announcement, coming as it did in a period of chaos in conjunction with the war in Iraq, raises questions about possible political motives involved.

4. The budget needed to fulfill Bush's VSE far exceeds the resources currently available, as indicated by a recent GAO report. Consequently, budgets have been unfortunately reduced in other important NASA programs such as Earth monitoring, space science, and robotic exploration.

5. From a strategic perspective, the Bush VSE falls short of addressing the national and international needs, goals, and opportunities for space development. For example, although the Bush VSE calls for international participation, it did not include substantial strategies or mechanisms for international collaboration, a significant element that would be addressed in a comprehensive approach.

6. The current thrust of the plan to return humans to the Moon and to build a lunar outpost lacks political resonance. The American public and their representatives in Congress have shown little interest in supporting such a costly "Apollo-all-over-again national program." "Been there, done that" is the refrain we might expect.

On top of these shortcomings, the Bush VSE did not receive adequate funding, leaving the program crippled.

It is our view, then, that a new, Unified Vision is needed. It must fulfill the clear need to achieve sustainable space exploration development, it must be strategically well thought out, capable of generating strong public and political support, and at the same time it must be financially affordable. These are not modest requirements, but they are the real and meaningful requirements that it must nevertheless attain.

What follows are the outlines that we suggest for such a Vision and its accompanying Policy implementation.

3. A Unified Vision for Concurrent Space Exploration and Space Development

We propose a strategic unified vision for both space exploration (Vision for Space Exploration, VSE) and commercial space development (Vision for Space Development,

VSD). This unified space vision (USV) should be a comprehensive and balanced approach that addresses the long-term concurrent needs of space exploration, space science, and space-based economic development and commerce. This is a new paradigm of space vision that will benefit all of humanity while fostering world peace.

It has four critical strategic components:

1. A program of sustained, affordable space exploration activities directed at known and unknown planetary destinations beyond the Earth-Moon system.

2. A process of space exploration that enables the concurrent development of an affordable LEO space-transportation infrastructure to support sustained space science and exploration endeavors in and beyond low Earth orbit to also enable the rapid human economic and commercial expansion into the Earth-Moon system.

3. This vision must be achieved with the full participation of the private sector, together with broad international participation. Through this process, human collaborative endeavors in space will function as a strong catalyst for fostering world peace, thus contributing to the effective resolution of humanity's profound energy and climate change challenges.

4. Recognizing the distinctive strategic goals and objectives in both aspects of space exploration (VSE) and space development (VSD) activities, it becomes evident that restructuring and realigning NASA's role is necessary in order to maximize its contribution to technology R&D and space exploration, whereas a separate government entity is also needed to effectively promote the development of the economic infrastructure for LEO space and beyond.

Together, these elements constitute what we mean by a "grand strategic vision for concurrent or unified space exploration and space development." According to this vision, space exploration endeavors can be largely funded, embraced and sustained by tapping into the financial and international resources and skills present in human economic, technology, and commercial domains.

In fulfilling such a unified space vision, America will maintain its leadership in the implementation of a strategic space vision by sharing the responsibility for space development and infrastructure development, thereby fostering a culture of shared responsibility with international partners around the globe.

Humanity has achieved the "horizontal" exploration and economic expansion around our planet through thousands of years of human history, and now it is time, at the dawn of the 21st century, for humanity to embark on the outward expansion into space – not only to explore other planets, but just as importantly, to enable a wave of space-based economic and commercial development and space industrialization on the high frontier.

The U.S. should become a truly spacefaring nation, and all of humanity should become a space-faring civilization to prosper peacefully on this planet and beyond.

4. Space Development vs. Space Exploration

NASA achieved astonishing successes in the Apollo era of Moon landings, nearly four decades ago. Unfortunately, these were followed rather quickly by the frustrations of a series of compromised programs, cost overruns, and project cancellations.

We believe that the causes are rooted in the same reasons that led to the creation of NASA in the late 1950s. NASA was created primarily to respond to the challenges of the Space Race during the Cold War era, and it was a unique organization extremely capable of taking on the urgent national challenge of Apollo. In winning the space race, NASA did exactly what it was designed to achieve. But its lackluster performance since then is also a consequence of the same forces that made the agency so successful during Apollo, for at root, the agency was never set up to envision, create, manage a long-term development process such as what is needed today.

In addition, it should be noted that NASA's governing paradigm emerged from its military roots, for the agency was set originally in 1915 to serve the needs of the military in the development of combat aviation capabilities, and was converted to a space agency in 1958 for the purpose of winning the Space Race. Hence, NASA was created in a hurry to satisfy the nation's immediate need, but was never developed as a well-structured government institution created to address for America's long-term strategic goals beyond Apollo or the Cold War. Today NASA is characterized by fierce turf battles among the ten NASA field centers, and damaging competition for the funding that each needs to survive.

But today's strategic interests clearly lie in ensuring our national security by strengthening the U.S. economy and world economies, as well as enhancing our leadership in science exploration and technology development, and in promoting world peace for sustainable human development.

The Apollo program was launched without a strategic vision from the outset, so in hindsight it's not surprising that the agency lost its direction after the space race was won. Evidence of this shortsightedness includes the fact that many of Apollo's systems were not adequately documented, and NASA itself did not develop an effective "corporate memory" of its significant achievements and failures. The lack of memory has negatively impacted the current Constellation program because it has been difficult for today's designers, engineers, and managers to understand and benefit from some critical technical achievements of the Apollo era, such as the Saturn-V launch vehicle systems.

As a nation striving to prosper and build our financial and technological strength in today's post-Cold War economy, and in an increasingly globalized and mutually

dependent world economy, America certainly cannot afford to engage in another spending spree for space exploration, particularly one that might end up provoking an unwanted Space Race, and which could saddle the nation with excessive debt, or hurt America's long-term interests due pursuit of the wrong goals of little strategic and economic value.

We believe that a responsive vision for space exploration must be developed, but a program that is excessively steered according to external events, and which itself lacks strategic merit, can be detrimental not only to America's long-term interests, but the interests of all humanity as well.

For example, the selection of the Space Shuttle system design concept was heavily influenced by NASA's internal politics, and we fear that the current Constellation program is at high risk of repeating the post-Apollo "track record," and we urge the reform of NASA and recommend, as elaborated in the following two sections, that America's space enterprise should be guided by the proposed USV, to take on the concurrent challenges of fulfilling the strategic goals of space exploration and space commerce.

5. A Critical Path for Achieving the Unified Space Vision (USV)

NASA is the right government agency to conduct the nation's space exploration programs and projects, including Earth science, space science, and a planetary defense effort.

Although an efficient and functioning NASA is critical to the success of the nation's space exploration programs, NASA and its efforts in manned and robotic planetary science should represent only part of the larger picture of America's human activities in space. There is a much broader category of human space activity that cannot be handled or managed effectively or successfully by a government agency such as NASA.

Even with adequate reform in its governance model, NASA would not be the right institution to lead or manage the nation's business in Space Development projects. Human space development activities, such as creation of affordable launch vehicles, RLVs, space-based solar power, space tourism, communication satellites, and trans-Earth or trans-lunar space transportation infrastructure systems are primarily commercial development endeavors that are not only cost-benefit-sensitive in project management, but also subject to fundamental business principles related to profitability, sustainability, and market development.

In contrast, space exploration involves human scientific research and development (R&D) activities that require exploring the unknown, "pushing the envelope" to reach

new frontiers, and taking higher risks with full government and public support, and these need to be invested in solely by taxpayer contributions.

Therefore, NASA should emulate the successful U.S. national research laboratories to focus on becoming an R&D organization dedicated to exploration, planetary research, scientific discovery, and technology development. NASA should not be too conservative in the exploration of new frontiers and unknowns, and should manage significant technical and programmatic risks. For example, if a space exploration project such as a Mars mission is managed without willingness to take even a moderate level of technical risk, then space exploration missions will be too expensive to afford, making it unlikely that successes comparable to the Apollo project could ever be achieved again. Therefore, we suggest that problematic management policies such as full-cost accounting, and most ITAR restrictions should be removed to enable NASA to reach its full potential in space and science exploration.

In parallel, we propose that a new cabinet-level department should take charge of and mange the government functions of supporting and incubating space-based industrial capability and transportation infrastructure development.

The programmatic principles and management culture appropriate for managing R&D projects in space exploration are fundamentally different from the principles and organizational culture that are needed to manage space development, so unlike NASA, the key role of the new agency should be to encourage strong government-business partnerships, much like the current NASA COTS program, but at orders of magnitude increased scale. It should work with the existing nascent space industry and with established private sector firms to promote space infrastructure development, which will directly benefit the US and world economies by bringing returns to taxpayers, not just by creating more high-tech jobs, but also by supporting NASA in its pursuit of more ambitious space exploration programs.

The new department should manage space development based on strict business, cost-benefit and market principles in order to develop high-reliability launch vehicles that are affordable for commercial space applications, thus contributing directly to economic human expansion into the Earth-Moon system.

The framework of the USV calls for key space exploration activities to be pursued through the following critical path for affordable and sustainable space endeavors:

1. The current NASA program to return to the moon should be part of human Space Development, managed by the new department.

2. An element key to all space endeavors is the development of a comprehensive transportation infrastructure to serve the needs of both NASA's exploration agenda

and the broader economic and commercial expansion into the Earth-Moon orbit systems.

3. The international community and industry should be fully engaged in the effort. An international presence for lunar science exploration should be established. Major investment on lunar transportation and surface systems development should be undertaken with international resources cooperating, and U.S. investment in lunar missions should be assessed by its necessity and technical relevance and risk reduction benefits pertinent to manned Mars explorations, or any other manned explorations beyond the Earth-Moon system. We must educate the public and our politicians to understand that human space exploration must be a global effort that is shared and supported by all nations. We must avoid even a hint of arrogance, and abandon the old way of U.S.-led international space collaborations in which the U.S. dictates all technical and programmatic outcomes.

4. Most importantly, we must use space as a strategic tool of U.S. diplomacy not only to strengthen relations, but also for enhancing mutual understanding, and diffusing and transforming confrontation with all other nations. We must avoid provoking a new space race, as it carries a high risk of getting everyone engaged in a loss-loss combative cycle.

5. The American space exploration goal should focus primarily on exploring new and unknown destinations by use of robotic exploration. The new vision must be of an interplanetary-exploration nature, with a manned missions utilizing the sun-Earth L2 libration point as a staging point for a mission to the Mars moon Phobos, followed eventually by manned missions to the surface of Mars.

6. To achieve these goals, the U.S. should develop a Deep Space Habitat, a deep space experiment module or station beyond low Earth orbit, complete with artificially produced gravity, for use in reaching destinations or to remain at libration points such as the moon-Earth L1 or sun-Earth L2 staging points, or to orbit various NEO destinations.

7. A one-way, manned mission to Mars should be considered, with sufficient Mars crew Hub capacity and in situ resource utilization capabilities delivered prior to the arrival of the first crew.

8. We recommend an R&D effort and demonstration projects on space-based solar power (SBSP), which offers great potential for electric propulsion and power resources that can be utilized for deep space exploration missions. More importantly, its key technology components can be shared or used by many other space applications, including future supply of baseload power from space for terrestrial electrical energy demands.

9. The above exploration goals, led by NASA and the international community, cannot be achieved unless a cost-effective heavy launch vehicle and affordable LEO transportation infrastructure is developed first. Such a low-cost crew launch vehicle and cargo HLV system development should be the task of highest U.S. short-term priority in space development, as they are not only crucial for supporting all strategic space exploration goals, but also imperative for space-based economic and commercial development, such as development and demonstration of SBSP and space tourist infrastructure system capabilities.

6. Humanity's Outward Expansion into Space-based Economic Frontiers

The history of human economic development shows that the development of new frontiers has almost always triggered significant economic growth. For example, the opening of commercial air transportation sheds light on the possibilities for the next giant leap forward in humanity's economic and commercial expansion into low Earth orbit. Commercial aircraft transportation systems and operations have advanced in all areas, and have contributed tremendously to the world economy and modern civilization.

Despite this opportunity, the capability of humans to access space at LEO has not advanced significantly in nearly half a century, and the current plans under the existing program paradigm offer little hope of making substantial improvements in safety, affordability, or commercial operations in LEO for perhaps even another generation. We must not allow this to happen.

So while some might argue that RLV or SBSP are too expensive or too difficult to realize, we must not forget that what makes a nation and its people thrive and prosper are not what they do for easy or short-term gain, but what they accomplish that others dare *not* do or *cannot* do. How many of history's great endeavors have brought profound benefits to humanity across the economic, scientific and social fronts? It is precisely such an opportunity that lies before us today.

Hence, we recommend the new paradigm of a strategic vision for space development (VSD) be considered by the new administration, consisting of the following key strategic elements, as a roadmap for propelling America and humanity's outward expansion into space-based economic and commercial frontiers:

1. Set the goal of a low-cost, reliable space transportation infrastructure development within the Earth-moon system as the highest priority to be implemented by the proposed new Department of Space. The U.S. should build strong support and invite global participation from the entire international community.

2. In this effort to achieve the proposed VSD, the U.S. and its international partners should focus heavily on the development of RLVs, such as crew & cargo transport and launch vehicle systems with top-level requirements of low-cost, low system complexity, and aircraft-like reliability, maintainability and operability.

3. We should develop and establish an international Fuel-Depot and Orbital Staging or Service point (station) in the LEO environment to support and service commercial space-transportation traffic, including space tourism, Lunar and Earth orbital transfers, and commercial satellite services.

4. We should also promote and support the establishment and construction of spaceport infrastructure in several strategic locations within the U.S. and around the globe, which will meet the emerging demand for increased commercial launch and space-transport economic activities.

5. We must develop enabling space infrastructure observation and tracking capabilities for planetary defense. In particular, develop ground and orbital systems, in close collaboration with international partners, for monitoring, tracking and deflecting asteroids, comets, and other cosmic objects in near-Earth orbit, which threaten the safety of our home planet.

6. And we must invest in projects with multiple benefits such as space-based solar power (SBSP) research and development, which would be developed by first funding a series of space-to-space or space-to-Earth SBSP demonstration projects. Technology demonstrations, such as wireless power transmission (WPT), high-efficiency microwave beam generation and control, system safety and reliability, on-orbit robotic assembly technology, and deployment of large-scale orbital solar structures would also be advisable to help reduce risks, thus triggering large-scale investments by private industries. The upside potential, if successful, would ultimately lead to the capacity to harness solar energy from space to alleviate Earth's dependence on fossil fuels, thereby addressing global climate-change concerns.

7. A New Space Economy with Transformed Global Collaborative Paradigm

History has brought humanity to the brink of an unprecedented era of crises, challenges, and opportunities. The current situation facing the world economy, energy resources, and global climate change certainly constitute dire threats, yet they also present enormous opportunities for humans to apply science, technology, and thoughtful economic development in the pursuit of solutions to these very problems. Having evolved on Earth through millions of years, we see that today we have the opportunity to

address many of our most pressing problems by expanding our vision beyond that of an Earth-bound civilization to a space-fairing civilization.

Much like when our ancestors learned to use fire, developed tool-making skills, evolved from primitive tribal-based societies into a collaborative agricultural civilizations, and changed from isolated regions to a globalized world economy, now is the time for humanity to develop space and to industrialize the Earth-Moon system for the benefit of all humans, and to make this industrialization a key part of a global economic revitalization toward a new sustainable human civilization.

While some believe that humanity must solve our crises on Earth before we can expand into space in a successful and peaceful manner, we suggest the opposite. We believe that humanity is not going to solve all its problems here on Earth, that we cannot create a utopia here, or anywhere, for this does not seem to be in our nature or in our destiny.

So we will venture into space not in pursuit of utopia, but rather for exactly the same reasons that our distant ancestors migrated from one valley to the next, and later from one continent to the next: for adventure into the unknown, for resources, for freedom, and for better lives for ourselves and our descendants.

Recent events have taught us a harsh lesson, that merely manipulating financial capital and producing services have failed to bring humanity a sustainable global economy, and so instead of arguing over the factors that limit and restrict human development on this planet, we must now expand our horizons, look upward and outward for resources, and embark on economic and commercial development of space.

Bold strategic visions supported by strong government and accompanied by leadership in technology and infrastructure development have brought incalculable benefits to humanity. Examples include transcontinental railway systems, and then later transcontinental highway infrastructures, and still later the creation of a global aviation industry, all of which stimulated progressive economic and cultural development in every nation; the global energy and power infrastructures that fueled the development of industrialization worldwide; the global communications infrastructures of wired, and then wireless, fiber optic, and satellite enabled voice and data that are now essential to the functioning of human society and the global economy.

Now is the time, more than ever, for a bold vision with strategic leadership to help bring humanity out of its crisis by promoting and investing heavily in the next frontier of human development: space. At this crucial crossroad, the world can choose to make space industrialization an integral part of our strategy and a key component of stimulus for shifting our economy towards recovery.

In addition to the economic and resource dimensions inherent in the space effort, there is also an important psychological dimension to consider. It seems to be a universal

experience among astronauts that when they look back at our blue home planet from the depths of space that they feel what has been called the "overview effect," a profound natural bond for humanity accompanied by a desire to cherish one another. While humans, currently limited to a single-planet civilization, often feel threatened or compelled to fight for resources and living space on the surface of the Earth, we may anticipate that our psychological attitude may change as more people experience the overview effect as a result of expanding the human horizon outward into space. Hence, we should not underestimate the benefit to be achieved by expanding human habitats outside the Earth as a contributing factor to the acceleration of human conscious evolution, leading perhaps to sustainable and peaceful human development on Earth.

8. Strategic Action Plan

To achieve a bold, strategic vision it is almost always necessary to think beyond the conventional paradigm. Unlike investment in short-term stimulus projects, the jobs and opportunities that will the U.S. and the world will receive from space development can be enormous, and could even dwarf anything we have seen in the past. Therefore, we urge the administration and Congress to consider the strategic policies outlined below to support the development of a transformative space-based global economy:

1. Allocate a significant portion of economic stimulus investment to space development projects, particularly those that encourage entrepreneurial partnerships for space projects, such as commercial orbital transportation, and those that support and incubate development of new technologies.

2. Support the development of space tourism and other space commerce. Help establish and enable commercial and tourist markets in zero-G, suborbital, orbital, and trans-planetary environments.

3. Support renewable energy research and development, including affordable solar, wind, and geothermal energy systems and products, and cost-effective energy storage technologies, etc.

4. Support Earth and space science research and development projects that enhance Earth and environment monitoring capabilities from space. Utilize resultant strategies and technologies to help mitigate and avert risks of natural disasters, catastrophic climate changes, and protect our natural environment.

5. Invest in space based solar power research and demonstration projects, wireless power transmission, electric propulsion technologies, including those related cost-effective and efficient electric engine systems that can be applied to ground

transportation vehicles, and commercial aircraft and as well as use as space propulsion systems.

We urge the president and Congress to demonstrate American leadership in both space development and space exploration endeavors, to engage international partners broadly, and to promote human commercial and economic expansion into space following the unified strategic space policy as elaborated here.

If this were to happen, we envision with confidence that by the turn of the next century, year 2101, having implemented the bold Unified Space Vision of Space Exploration and Space Development, humanity would experience profound impacts and benefits. We would witness business executives, tourists, and government and NGO leaders booking space flights on Travelocity and departing from Shanghai, Tokyo, Jakarta, New York, Mexico, Cairo, Paris, London, Mumbai, or any other major city in the early morning hours (local time), and returning home for dinner with their families after a few hours of meetings in any other city in the world, or in orbit, floating serenely about the blue miracle of Earth.

By 2101 we could see vast economic activity spread across the near solar system, human habitats on many worlds, vast expansion of human knowledge, expertise, economic activity, and culture, and in hindsight we would see the transformation of the current economic crisis into the seeds of global opportunity that benefitted each and every living human, and all of our descendants.

Economic development and the conquest of unknown geographic and technological frontiers have provided countless benefits throughout human history, and what better strategic vision can there be for our future than the peaceful space exploration and development for the benefit of all humans, alive and yet to be born.

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