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# GOVERNMENT AND INDUSTRY ISSUES FOR EXPANDING COMMERCIAL MARKETS INTO SPACE

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## Abstract

In 2002, the Foresight and Governance Project at the Woodrow Wilson Center in Washington, D.C, organized a "Global Foresight Workshop"[1] in partnership with NASA and in cooperation with other Federal Agencies to provide integrated consideration of broad challenges for the 21st century. Many long-range goals for the nation were discussed and selected, among them were space related goals of interest to NASA. During much of the Agency's history, NASA advanced studies have focused consistently on the challenges of science-driven space exploration and operations. However, workshop findings indicate little interest in these goals unless they can also solve national and global issues. Many technologies and space development studies indicate great potential to enable new, important commercial markets in space that could address the many global challenges facing America in this century. But communication of these ideas are lacking. In conclusion, it appears that the commercial development of space could have broad implications on many impending problems, including energy resources, environmental impact, and climate changes. The challenge will be to develop a consistent coordinated effort among the many industries and Agencies that should be involved in opening this new frontier for these new commercial markets.



## Long-term Commitment

The Honorable Lee H. Hamilton, Director of the Woodrow Wilson Center provided this insight into the problem of coming to grips with the setting of major goals that require long-term commitments.

> *A few years ago, I was in the office of the National Security Advisor, Tony Lake. I asked about the large stack of files on his desk. He said to me, "Lee, those files all deserve immediate attention. They cannot wait." Then, I noticed another large stack, twice as high, behind him. "Those," he said, "are extremely urgent."*
>
> *That anecdote pretty well sums up the problem that has become known in Washington as the tyranny of the inbox. The day-to-day problems are so many, and so pressing, that policymakers cannot free themselves from them to think long-term. Space development requires both major goals and long-term commitment as evidenced by the tremendous effort, cost, and time over which NASA's major programs have developed.*[1]

Finding the time for policy makers to even think about long-term goals is a major challenge.

### Goal Setting

Prior to the Global Foresight Workshop, organizers solicited goals from key agencies and organizations across the country, and internationally through solicitations from the United Nations University, via the "Millennium Project."[2] Over one hundred goals were submitted, which were then combined and condensed to 46 for consideration at the workshop. The top five goals based on high ranking for overall global importance were as follows.

1. Provide clean water and food
2. Provide clean and abundant energy

3. Eliminate all major diseases
4. End slavery globally
5. Provide universal health care

In contrast, it is interesting to note that the five least favored goals included space.

- Improve human intelligence 50 points in 50 years
- Create permanent ocean habitats
- Establish several habitats throughout the solar system
- Move much of the industrial economy into space
- Develop means for allowing individuals to triple their life span

This finding is consistent with a follow-up to a Brookings Institute survey that asked a group of academics to forecast the most important achievements for the next 50 years. Space exploration was not on that list, but instead was ranked among the least important accomplishments for the near future.[3] Clearly, space is not on the American agenda.

## Can space resolve major issues for human kind?

So how can space exploration and development demonstrate its importance to society? A first approach might be to consider addressing the 2nd cited goal above, "provide clean and abundant energy." Forecasts cited at the workshop indicated that by 2050 an additional 3 billion people will be added to the world's population and 5-7 billion of the 9 billion will live in high urban concentrations. At present, the increasing use of fossil fuels will continue until signs of depletion, or more severe environmental impacts occur. An excerpt from the Millennium Project materials lends this interesting graphic on the consumption of fossil fuels over time; see Figure 1.[4]

At our current pace of consumption, it appears possible that we will do exactly as this chart implies. Use every drop of oil, grain of coal, and litre of gas we can squeeze out of the earth until it is gone, and we are forced to do something else. An alternative approach might be to look at space as a vast source of clean and abundant energy.

Two other global problems, population growth and its impact on the environment are additional areas that space development could address in the very long term. It is conceivable that in the distant future we could build environments in space and on other planets to accommodate infinite growth that would alleviate the crowded conditions on earth. Such a long-term goal is as yet unimaginable by most policy makers because of our meagre progress in space development thus far.

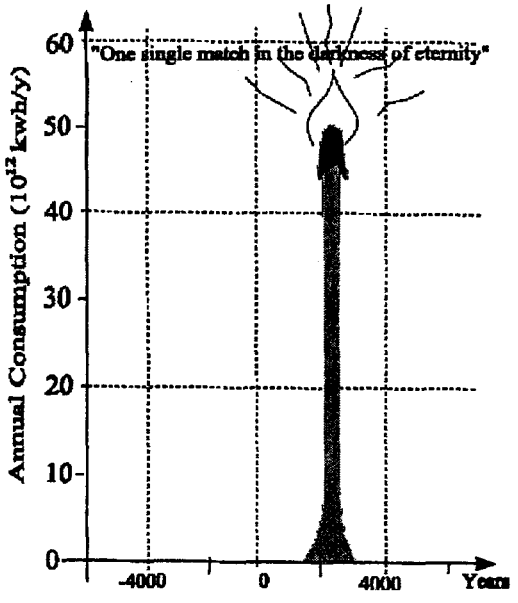



Figure 1. Consumption of fossil fuels over time.

If we can resolve the many problems that have inhibited the development of the space frontier, then perhaps space will be on America's agenda as a means to resolving energy and the many other global problems. Recognizing that there are many other issues that space technology, exploration and development cannot yet address, what are the specific space issues that must be addressed first before major development can occur?

## Launch Cost

In 1994, NASA released a study on commercial space transportation that indicated many new market possibilities if the cost of access to space were brought down. Today's cost in the $1,000's per pound was found to be a major barrier to those new markets. Somewhere in the $100's per pound would be required to see significant improvement in the development of new markets; see Figure 2.[5]

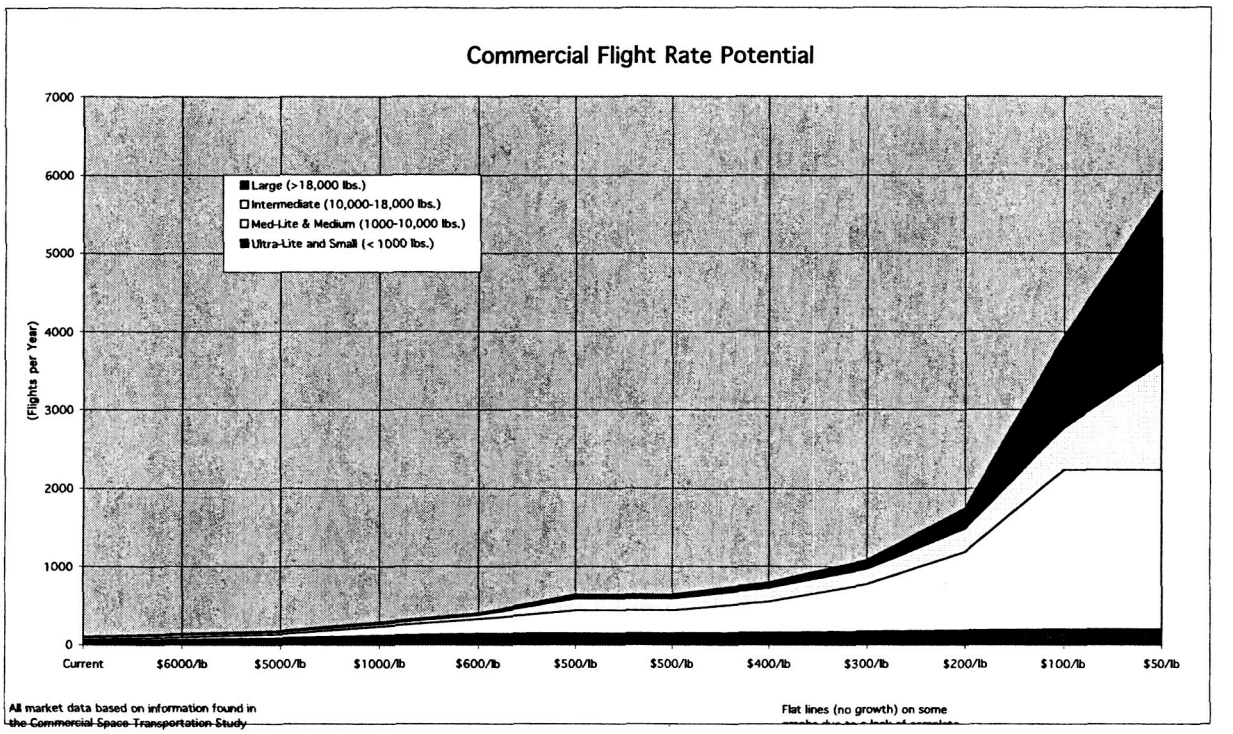



Figure 2. Commercial flight rate potential vs. cost

Part of the problem with getting launch costs down is the flight rate. Unlike airlines with 100's of flights per day at major airports, the launch industry as a whole has a flight rate of perhaps 1 per month per major launch facility. The resulting overhead cost is tremendous. This situation leads to what is commonly referred to as a "chicken-and-egg" scenario. Which comes first, lower launch cost to stimulate the market, or increased launch rates with resulting efficiencies and lower cost; see Figure 3.

In general, it is agreed that both will have to be pursued simultaneously. New technologies must be developed and incorporated into new vehicles to lower cost, and new vehicles must be designed to accommodate new markets.

Here in lies part of the real problem. We have yet to recognize the real future market potential for space. New launch vehicles designed to carry payloads, and not people, will miss out on the high flight rates that could help drive down launch cost.

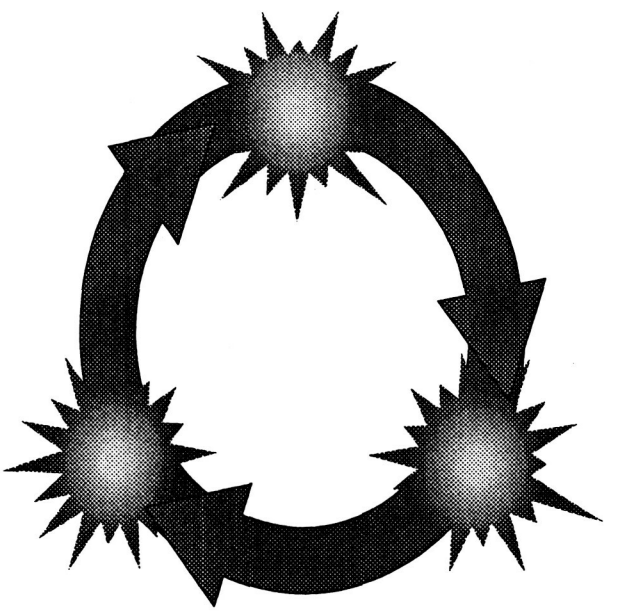


Figure 3. Launch cost vs. flight rate

## Tourism

As controversial as space tourism has been, it is about time we considered it if we want to succeed in bringing down the cost of space transportation. Consider, for example, what package delivery services might cost by air if aircraft were not designed to accommodate people. The point here is that any spacecraft designed to carry people can also carry cargo, but the reverse is not necessarily true.

In 1997 a survey was conducted of 1500 families, representative of the 130 million travelers in the United States, and found that 1/3 would like to take a 2-week vacation flight on the Space Shuttle. That is a potential market demand from 42,900,000 people. Those interested in space flight indicated a willingness to pay substantial fares for this travel; see Figure 4.[6]

Although the average price was about $10,000 per ticket, it is interesting to note that there are a substantial number of people willing to pay $100,000 or more. A 7% market share at that rate yields 9,100,000 people, potentially paying $100,000 for perhaps a once in a lifetime flight, totals a $910 billion industry potential. Even at $5,000 per ticket, and 26% market potential, results in a potential $169 billion industry. These staggering numbers are even further substantiated by the willingness of a few to pay $20 million for a 1-week stay in space today.

## Space Transfer Services

At present, every satellite launched from earth uses an expendable upper stage to transfer it to its proper orbit. In 1997, a study was conducted that found a substantial market for reusable upper stages that could deliver satellites from low-earth-orbit (LEO) to geo synchronous-earth-orbit (GEO). In addition, it could move satellites from point to point, recover failed satellites, collect space junk, etc. The value of this service was determined to range between $10–40 million per mission; see Figure 5.[7]

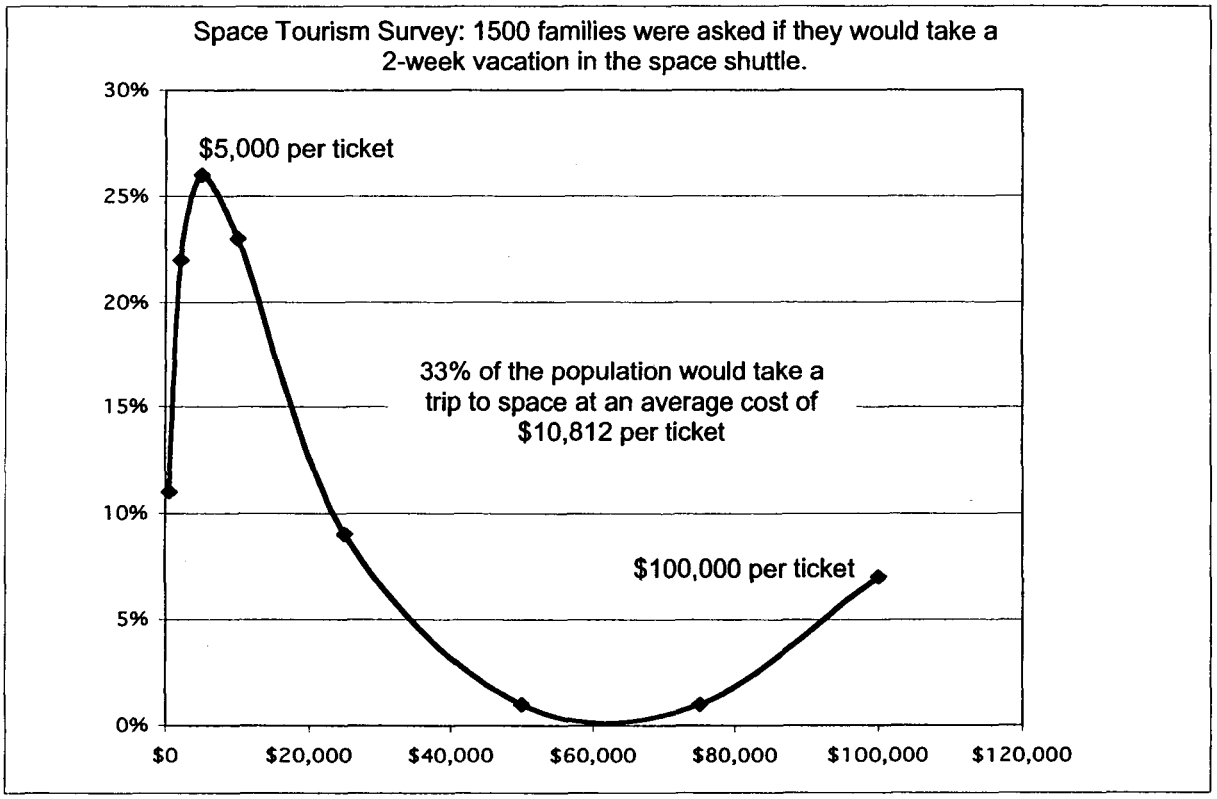



Figure 4. Ticket prices for tourist space flights

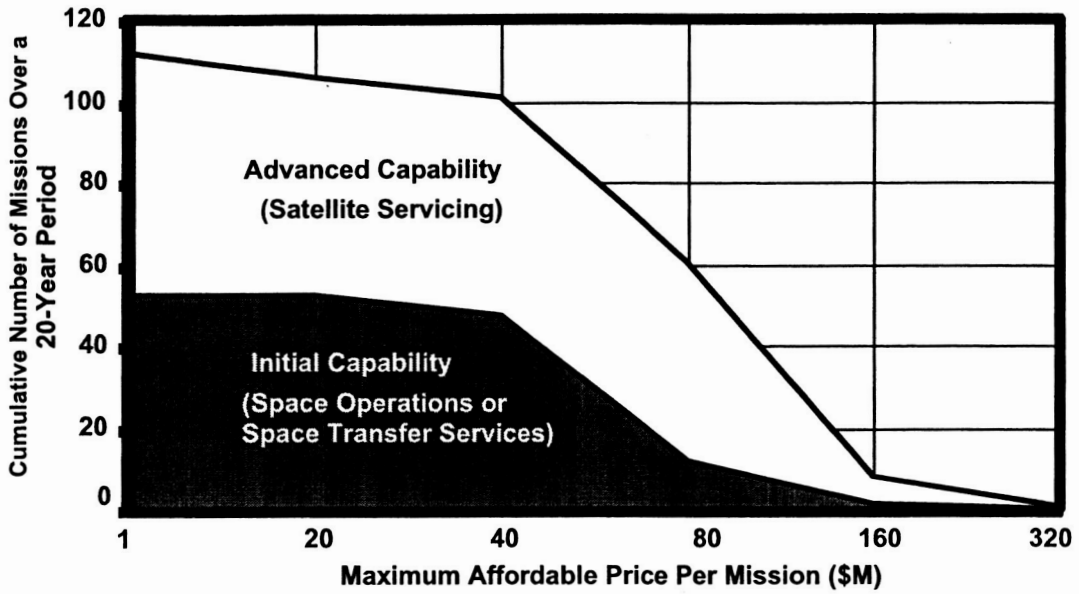
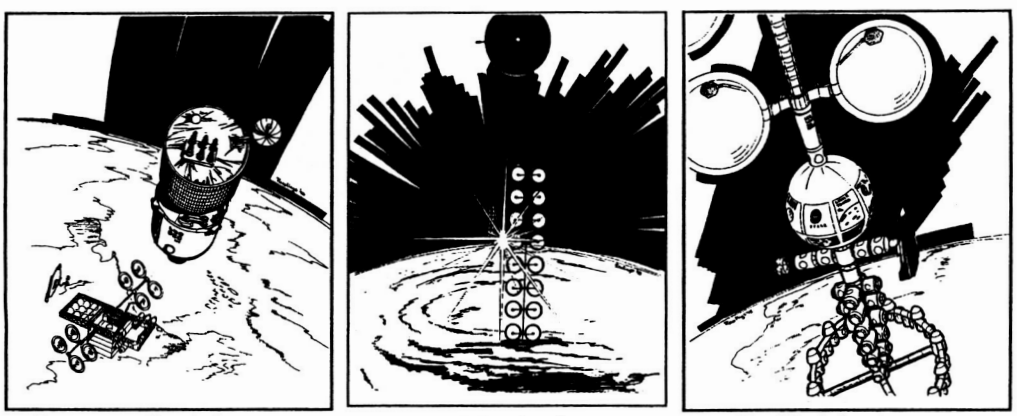



Figure 5. Satellite services market analysis

## Space Infrastructure

Profit from this market is not as important as the new markets it could open up. In particular, a year later in 1998, a New Space Industries workshop[8] was held, and the resulting study documentation identified numerous business opportunities in space for reusable launch vehicles with reusable upper stages supported by propellant depots. These are the beginnings of space infrastructures that could greatly expand our human presence in space driven by economic factors rather than simply a quest for new knowledge. These infrastructures included: 1) transportation, in particular reusable earth to orbit transport and reusable in-space transfer services; 2) utilities, like propellant depots to support the reusable vehicles, and space solar power satellites; and 3) facilities, space stations and lunar bases for the conduct or research, exploration, and business; see Figure 6.



Transportation Infrastructure (Earth to Orbit & In-space Vehicles, and Depots)

Utility Infrastructure (Space Solar Power Satellites)

Facility Infrastructure (Space Hotels & Space Business Parks)

Figure 6. Space infrastructures

What is needed is a plan to develop these infrastructures within the earth-moon system, providing access for government and industry endeavors that will eventually expand our earth-based economy into space. Conceptually, such a plan might include coordinated access to earth orbit; systems to facilitate access between all earth orbits, the moon, and some asteroids; and access to the lunar surface; see Figure 7.

## Policy

Key to many of these initiatives is not technology development or large spending bills. In many cases it is a simple matter of good policy. Industry and policy makers have proposed many ideas for expanding markets into space.[9] But any initiative stated by the government must be backed up with appropriate regulations and incentives. This is the only way to simultaneously open new markets and spur industry to develop the required infrastructures. Key policy issues found repeatedly in the previous workshops and studies are the following.

- Promote proactive space industry initiatives such as government anchor tenancy in private developments, tax credits, consortiums, trade promotion, education, and endorsement to promote private investments in space development.
- Promote planning to build space infrastructure similar to the way government and industry has been involved in the highway system, air traffic control system, railroads, power, water, port authorities, etc.
- Promote the creation of innovative financing opportunities, such as a space development bank, limited liability insurance, and government guaranteed loans to reduce risk and cost of new space investments.

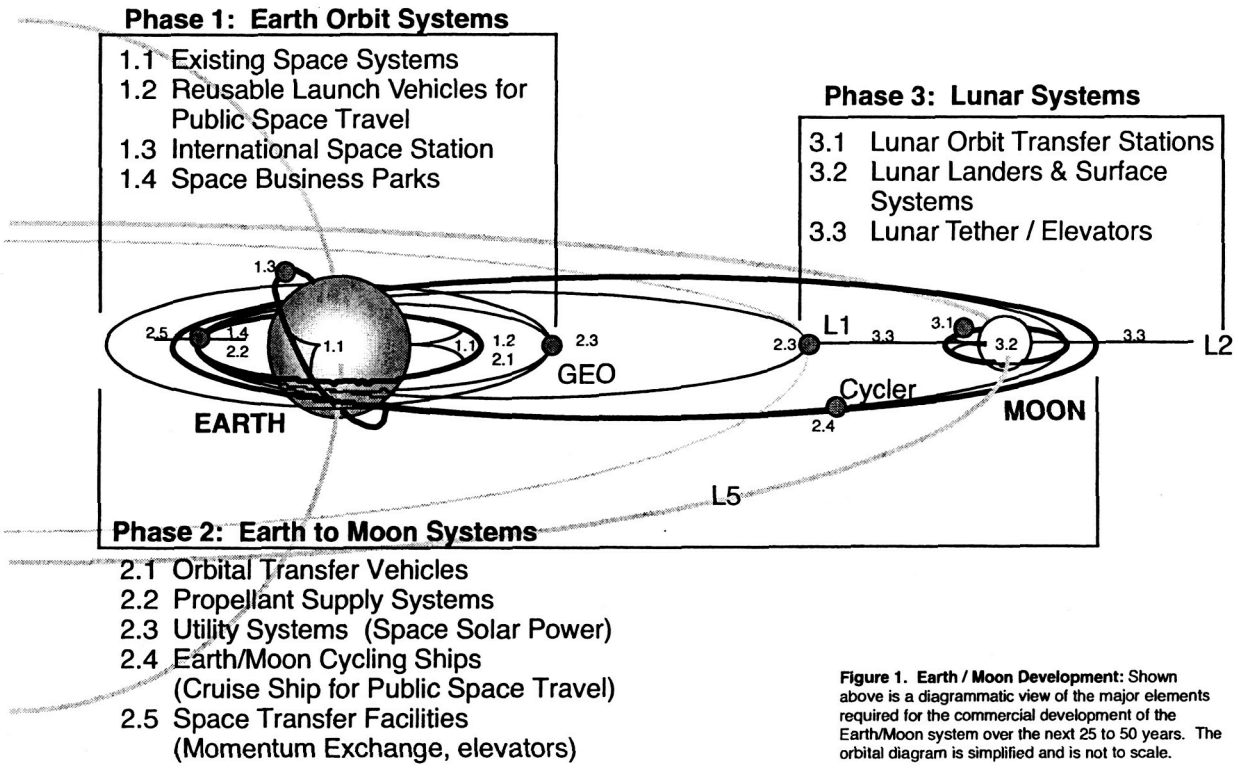



**Figure 1. Earth / Moon Development:** Shown above is a diagrammatic view of the major elements required for the commercial development of the Earth/Moon system over the next 25 to 50 years. The orbital diagram is simplified and is not to scale.

Figure 7. An earth-moon development concept

- Extend patent rights on space technology to encourage the long-term investment strategies required for space industry developments.
- Encourage FAA certification of parabolic flights that simulate micro-gravity for U.S. based adventure tourism businesses.
- Consider promoting tax policy that will leverage tax revenues from mature and profitable space commerce to fund space infrastructure development initiatives.
- Promote technology development and demonstration of new x-vehicles that will lower the cost of space transportation and enable public space travel.

## Conclusions

In conclusion, it is important to utilize our existing space systems to build on the next step. The Space Shuttle represents a huge technology advancement that should not be lost. It can be upgraded and improved, and other vehicles can be built to compliment its capabilities. The Space Station is a similar great achievement whose technology can be utilized to build many other capabilities in space. Transfer of these technologies and systems into the private sector, and continued use and expansion of these capabilities is important or we will loose them completely. Also, it appears that the commercial development of space could have broad implications on many impending problems, including energy resources, environmental impact, climate changes, and eventual population expansion rather than control. The challenge will be to develop a consistent coordinated effort among the many industries and Agencies that should be involved in opening this new frontier for these new commercial markets.

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