Creating a Bold and Courageous 21st Century American Space Policy

Abstract

Today we are in the year 2017, the seventh year of the second decade of the 21st century, and yet our national space policy is still held hostage to a cold war declaration pronounced almost six decades ago, with a famous speech by a martyred president. That declaration created a big government space policy and program, fueled by transient cold war fears of the domination of the heavens and the earth by the former Soviet Union. The end result was flags and footsteps, but no enduring capability or presence despite arguably one of the greatest achievements in the history of humankind. It is time for a new 21st century policy, one that is based on a sound philosophical foundation and robust faith in the future that made our nation great, and one that will bring lasting benefits to the nation and the world. The underlying philosophy is that the economic development of the resources of the solar system will solve many of the problems facing our planetary civilization of over 9 billion humans living by the year 2050. The policy is to use the vigor, innovation, and growing abilities of the private sector as the centerpiece of our efforts.

The time is now to reach for the stars, beginning with new approach that leverages the full capacity of American ingenuity and free enterprise industrialism that quickly brings more of space into the world's economic sphere, including low Earth orbit, cis-lunar space, the Moon, and beyond. The centerpiece is a Lunar Industrial Facility that will enable the production of industrial quantities of metals, water for propulsion, and a ubiquitous transportation infrastructure between the Earth and the Moon to harness the potential of this approach. Evolving forward, this capability infrastructure could be leveraged to create a lunar shipyard where the Clipper ships of the 21st century will be built. These reusable cycling vehicles will carry mankind to Mars, enable the mining of the asteroids, and bring forth the future economic development of the solar system in a compelling and sustainable way.

This foundation places the competitive free enterprise system as the primary agent for implementation, with the government as a stimulator, enabler, investor, and regulator of conduct. Since the time of president Abraham Lincoln when he and the congress staunchly promoted the concept of "internal improvements" to build a national railroad to bind the nation together in commerce with the lead of the private sector, even in the midst of a national fight for survival, the nation and the people, have benefitted. It is this spirit of partnership that will finally enable the economic development of the solar system, bringing jobs, advancing technology, creating wealth, and inspiring a boldness in our national space policy missing since the Apollo era. Any new plan carries risk, and the challenges are immense, but most agree today that we have certainly not succeeded with the policies in place for over half a century and that the technical capabilities, economic opportunities, and social realities of today both enable and demand big, bold, and courageous action at this unique point in history.

For a generation we have added fear upon fear in our society. Beginning in the 1970's with books like the "Population Bomb", "Limits to Growth", and "Silent Spring", the Y2K computer

meltdown, as well as the anti-nuclear and anti-technology movements, we have been barraged with fear. This continues today with the fear of continuing war, climate apocalypse and the "sixth great extinction event". Curiously the solutions have all been the same, more government, more spending, and more control over the lives of our fellow citizens. In three hundred years, Western Civilization transformed the world, bringing more prosperity, more freedom, and better lives for billions; yet the fear based solutions are all to retreat back into the regimented societal forms that in the long climb of humanity from the swamps to the stars, failed the people just as spectacularly as the failure of the Soviet Union. It is said that the stock market is ruled by two emotions, fear and greed. In a larger sense, all civilization is in tension between fear and faith. Let us shake off the fear that drives so much today, marshal our courage, and boldly go forward in faith, bolstered by ingenuity, and executed with courage and vigor towards a brighter future.

How We Got Here

The fears of the 1950's were inflated and often unfounded, such as the famous "missile gap", a fiction born of those times. These fears were underpinned by a belief by some that temporary victories in state directed research and development in the regimented society of the Soviet Union would lead to overcoming the effort and progress of centuries by the free men and women of western civilization. These fears also led to the largest peacetime military buildup in American history and the largest civilian science and engineering project in all history, the Apollo program. Within a few years of Sputnik, we found that the missile gap did not exist but the consequences of having bought into that fear lives on today – mostly in the form of massive public debt and a loss of trust. Our state directed Apollo program reached its goal of demonstrating technological superiority and delivered the ultimate prestige with the placing of the American flag on the Moon before our rivals, and then, just as the science was beginning to bear fruit, the effort was abandoned as our government shifted its technocratic dreams to producing a "Great Society" and waging a "War on Poverty". National budgets and deficits dramatically increased with more than $22 trillion dollars spent in the "War on Poverty" to no avail – the percentage of Americans considered to be living in poverty has not gone down since 1970. All this while politicians proclaimed NASA's budget cuts as examples of fiscal responsibility.

Today it is self-evident that these massive public investments have been no more successful than Soviet era five year plans. In the Baltimore public school system in 2016 not one single student reached proficiency in English or Math while in the fifth largest economy in the world, the state of California, fully three quarters of minority students fail basic educational competency. Cities such as Baltimore, Detroit, and Camden New Jersey lie prostrate under the weight of socialist governments while entire states like Illinois, New Jersey, Connecticut, and more totter on the brink of insolvency. The Soviet Union is long since gone and Russia teeters on in economic decay, a victim of its five year plans, while China's vigorous embrace of Adam Smith over Mao Se-Tung has propelled them to become our greatest economic and national rival. Finally, our quest for a technocratic socialist utopia has resulted in a $20 trillion dollar debt, something that would have horrified any American of 1960.

The techno-politicocrats of today dream that their time has finally come, and that by ultimately controlling the economies of the world and by blunting and leveling the evils brought forth by capitalism and the industrial revolution, they can save us from ourselves. However, this misguided thinking with its recurring story and same fear-rooted approach that led our nation to all but abandon space in the 1970's is not the right path for a bold and courageous future. Thomas Jefferson addressed this mindset in his first inaugural address with these words:

Sometimes it is said that man cannot be trusted with the government of himself. Can he, then, be trusted with the government of others? Or have we found angels in the forms of kings to govern him? Let history answer this question.

Today, we must be smarter, more enlightened, and more courageous in action than the kings, courtiers and technocrats of old. We must not repeat what happened in the 1970's as our great leap into space was abandoned for the "Great Society" and other utopian dreams, for we abandoned the mighty Saturn V after its first production run and turned beyond Earth space exploration ships into museum pieces. We abandoned nuclear powered engines that would have drastically cut the travel time in space and thus cutting a trip to Mars by half or more, and worst of all, we abandoned the bold and compelling missions that generated 3 generations of scientists and engineers who underpinned our nation's economic and national security. We also misled a generation who were told that this was just the beginning of our future in space exploration. It is time to abandon fear and small scopes, it is time to look again to the stars in faith and boldly embark on a journey to expand and harness this infinite potential.

The apostle wrote almost 2,000 years ago that "faith is the substance of things hoped for, the evidence of things not seen". At the beginning of the space age, the economic development of the solar system was a faith statement. However, there were those who were discussing and advocating just such an economic focus, and that focus was based not on regimentation, but on the proposition of competitive free enterprise and freedom. This ideology, coupled with pragmatic and practical implementation, also underscores the very essence of our national values. In 1960 the Chairman of the Board of the General Electric Corporation, Ralph Cordiner, asked three questions regarding space policy and these questions are still relevant to the development of a new 21st century space policy.

***How** can we utilize our dynamic system of competitive private enterprise in space, as on earth, to make newly discovered resources useful to mankind?*
***How** can private enterprise and private capital make their maximum contribution? What projects will necessarily require government chairmanship and support for their execution?*
***What** must be done to preserve a free society while competing in the international race for space? How can we assure that when the space frontier is developed, it will be an area of freedom rather than regimentation?*

Cordiner did not see space policy as separate, or as an appendage to national policy, but a natural growth of the aspirations of a free people in a free market economy where space affords boundless opportunity.

Forty five years ago, while the Apollo missions were still flying, space as an arena for economic development and resource acquisition was dismissed by the academics who wrote books like the "Limits to Growth", who's forecasts of doom are still unfulfilled even as they grow louder today. They went further in this, to label anyone who posited positive futures as "technological optimists" who were "dangerous" and had to be overcome. Here is an excerpt from "Limits to Growth"

We have felt it necessary to dwell so long on an analysis of technology here because we have found that technological optimism is the most common and the most ***dangerous*** *reaction to our findings from the world model. Technology can relieve the symptoms of a problem without affecting the underlying causes.* ***Faith*** *in technology as the ultimate solution to all problems can thus divert our attention from the most fundamental problem-the problem of growth in a* ***finite system*** *and prevent us from taking effective action to solve it.*

The error in the thinking of those that wrote "Limits to Growth" is one of a common mindset of a limited perspective. Our understanding of off planet resources today are far beyond their limited vision in 1972. We clearly know today, over 45 years later, that resources from space exist and abound in inconceivably large quantities. Contextually, they are more readily accessible than at any time in all of human history with a compelling demand for these resources and markets equally unmatched in history. In 2022, NASA is sending a science mission to a metal asteroid (216 Psyche) that contains billions of times more metal than has ever been mined on the Earth and it is not the largest of its type! Today the issue is not existence proofs of such resources, but rather the technical and economic viability of harnessing them for the betterment of humanity. Simply put, science and technology have brought us to the point where we ***no longer*** have to live in a finite system. Given this fact, now is the time to harness this potential as "the future favors the bold".

Today we have mega-entrepreneurs like Elon Musk candidly and seriously planning for the colonization of Mars and Jeff Bezos investing in reusability to enable access to space for significant numbers of people so that they may truly unleash the economic and scientific potential of this domain. Others entrepreneurs and capitalists are putting serious financial resources into commercial space stations and lunar development. The Luxembourg government has passed a new legal framework for extraterrestrial resource ownership and is providing funding for resource acquisition projects from the asteroids. NASA, despite extensive work, mission designs, and billions spent on approved programs, has never been able to, through an appeal to the scientific value, reach the critical mass necessary to move beyond low earth orbit. It is time, to broaden our scope, and in partnership with American competitive free enterprise, we can finally reach the goal of sustainably returning to the Moon (for good) and boldly continuing beyond on a pace that matches our potential. We know, thanks to NASA and international science missions, far more about the resources of the Moon, asteroids, and Mars

than we did 40, 20, and even 5 years ago. Things that were impossible dreams are now being reduced to the financial calculations of visionary capitalists and the aspirations of bold entrepreneurs. In the recent past, America may have lost its way in abandoning our competitive free enterprise system to compete with the communist Soviet Union on their terms, with disastrous results. However, today we have the opportunity to be bold and courageous, to embrace the core value that have and will continue to make us great, and to bring about the next golden age of space development – led and sustained by America.

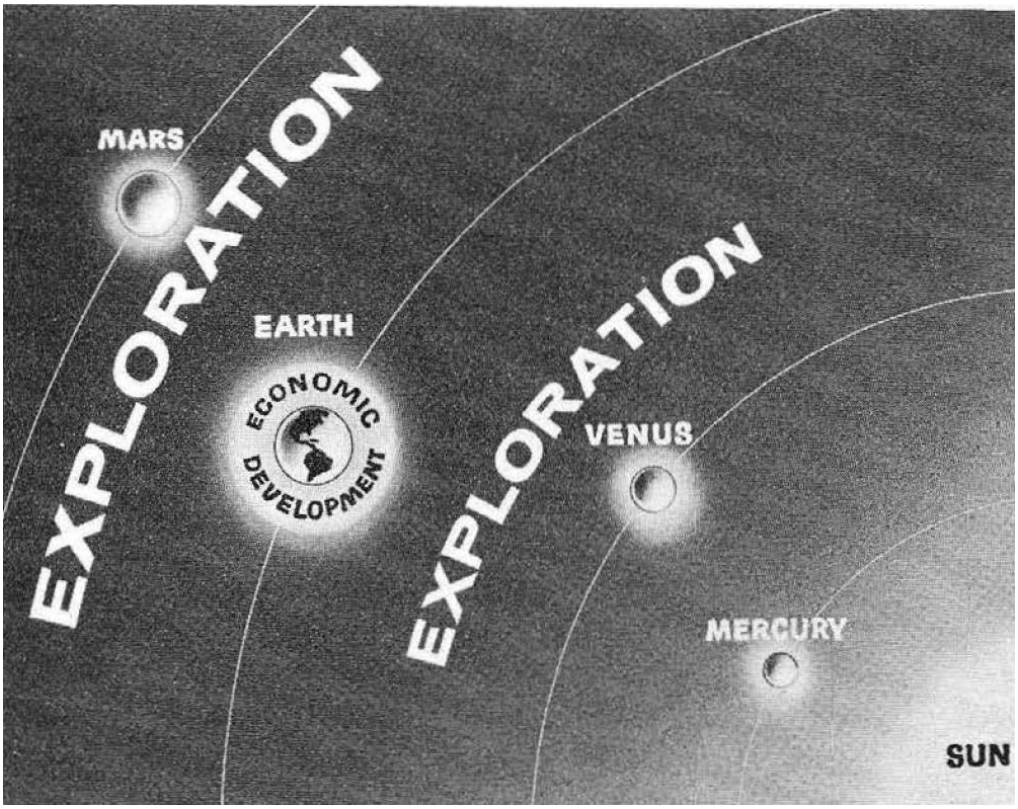
Where and How to Begin the "Economic Development of the Solar System"?

Our national goal must be the economic development of our solar system, beginning with a return to the Moon and cislunar space (the Earth/Moon system), then expanding outward to Mars and the rest of the solar system. This goal is viable and achievable in the near term and this era has already begun with the commercial crew and cargo partnerships and contracts for the International Space Station. These partnerships, based upon every objective measure, have worked, with the end result being vital transportation to and from space that is more competitive, affordable, sustainable, and responsive. Expanding on these partnerships and leveraging these principles through the leadership of the reconstituted National Space Council, bi-partisan legislative support in the Congress, and smart NASA and other Agency oversight and collaborative partnership for implementation, propelled by the vision of our American entrepreneurs and bold political leaders, this goal can and will be reached.

A brief reflection on the near-term advancement of our knowledge, understanding, and capabilities is quite illustrative. In 1960 these ideas were faith-based approaches with significant challenges and limitations. For example, Dr. Gerard Kupier's 1963 book on asteroids lurking in the vicinity of the earth listed only 14 objects. We now know of tens of thousands, and a percentage of those hold valuable resources and now private companies of the "New Space" variety, backed by venture capital as well as European governments seek to prospect them. In 1960 we knew nothing of the resources of the Moon, it might as well have been green cheese. However, the most valuable tangible return on investment of the Apollo lunar landing missions was 842 pounds of lunar material. From that material and from remote sensing missions since then we know that the Moon has metals, in the form of metal oxides. We know that the rain of meteoric materials over billions of years has implanted even more metals. We also have verified water and hydrocarbons on the moon from the NASA LCROSS mission, and probably in tens of billion of tons quantities, locked in the cold dark polar regions. Together, these precious resources afford tremendous potential – if we can affordably access them, unlock them, and harness them.

The basic concept is unbelievably compelling: water is essential to life and along with methane can serve as constituents for vital propellant, and metals for the feedstock of industries yet unborn – all of which is ready to be unleashed. We know from the American, Indian, European, and Chinese orbiters and landers that there are far more resources on the Moon than was conceived of during the Apollo era. The question now is what will we do about it? GE CEO Cordiner in a 1960 Speech, supported as a series of lectures on the subject of space by Simon

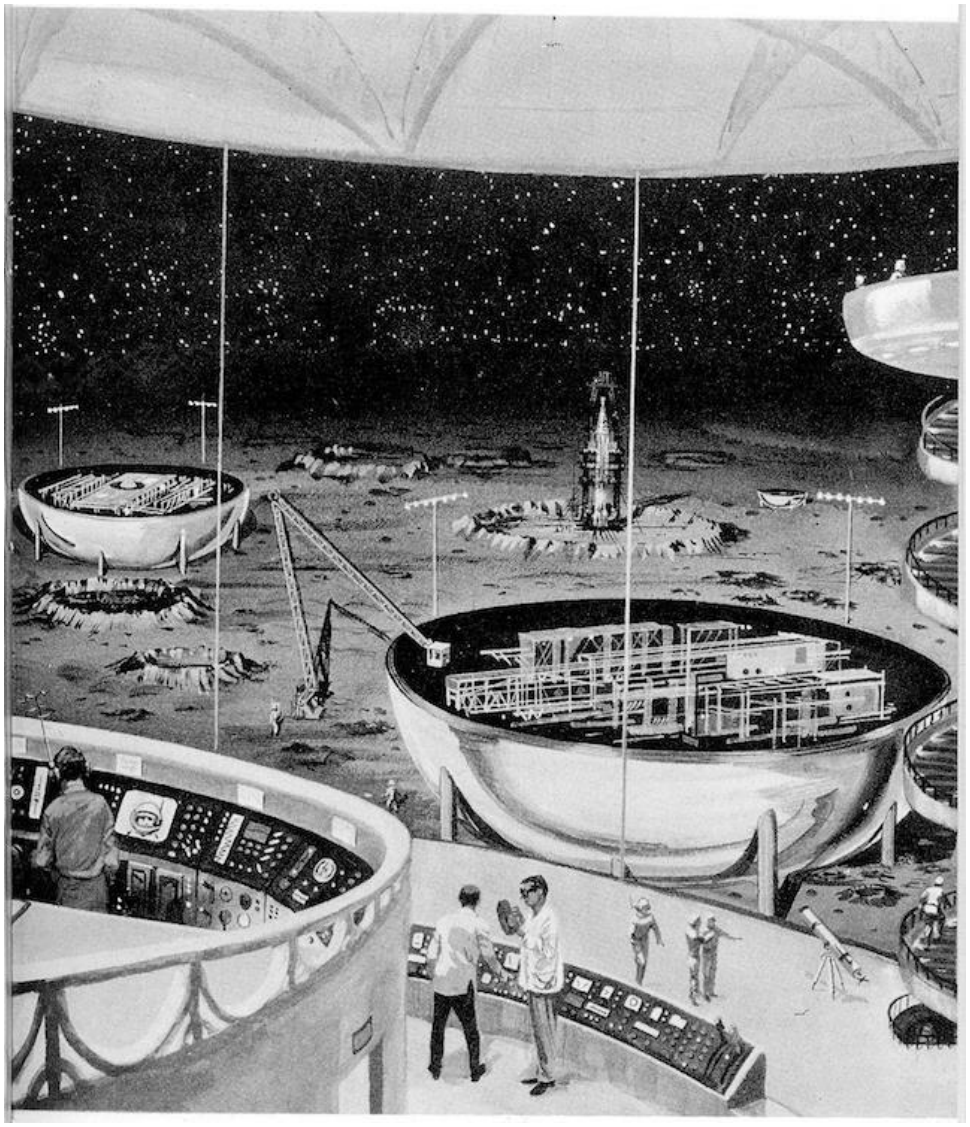
Ramo, (the "R" in the TRW corporation) exposited on this development. This is within the framework and as an answer to the questions that he posited in the speech quoted above. Cordiner's vision of solar system economic development is illustrated here.



Cordiner Speech Figure 2; Phase II of Solar System Economic Development

This illustrates where we would like to be in the very near future, bringing the cislunar space regions boldly and briskly into Earth's economic sphere, maturing this region first, then moving outward to encompass the entire inner solar system. Today we have over 500 spacecraft orbiting 22,700 miles above the Earth, worth billions of dollars. What is not appreciated is how heavily many other economic segments are leveraged by space systems. We have the Global Positioning System in a medium Earth orbit, from which trillions of dollars of terrestrial commerce is enabled, including our ubiquitous smart phone traffic maps. Total global satellite manufacturing and launch revenue in 2016 was $19.4 billion dollars. Total global satellite and associated ground systems revenue in 2016 was $261 billion dollars. These are validated numbers from the Satellite Industries Association yearly report. We have the nascent beginnings of a period of tremendous growth in commerce in low Earth orbit in which the International Space Station plays a vital role. Only 3 days away and visible to every human being on Earth, the Moon holds both tremendous human appeal as well as economic potential well within our reach – if we stretch. Moreover, the Moon presents the next logical step in expanding beyond the "finite resources and markets" of the Earth and its near-space environs. What we do there and how we do it is the next phase in our discussion.

History provides a guide for this consideration, updated of course with modern technology and processes. In 1965 the president of the American Chemical Society, Mr. Neil P. Ruzic wrote a book called “The Case for Going to the Moon”. An illustration from that book follows here:



A Factory on the Moon Using Cryostats for Precision Temperature Control

Ruzic did not envision the Apollo flags and footprints missions to the Moon. He envisioned, as Wernher Von Braun did (Von Braun wrote the forward to the book), a full-fledged series of missions that would end up with the industrialization of the Moon. Ruzic’s musings on the subject led him to invent and patent a device called a cryostat, which is used in high tech industry today all over the world for precise temperature control in a vacuum environment. This is used for making aerospace alloys and are used in many medical applications for tissue preservation. A simple search of “industrial cryostats” turns up billions of dollars worth of applications. On the Moon Ruzic envisioned exceptionally large cryostats as are shown for precise temperature control for materials manufacturing. The mindset of utilizing the Moon

and its resources in a practical manner was central to the 1950s and 60s generation. The race to the Moon for prestige in a cold war with the former Soviet Union, which underpinned Apollo, diverted all attention from this direction. This is what we want to recapture, this is the lesson of Cordiner, Ruzic, Von Braun, and many others that we want to bring back as a central element of our path forward. This brings us to specific recommendation for what to do on the Moon.

The Lunar Industrial Facility

A Lunar Industrial Facility (LIF), situated in one of the polar regions of the Moon, will be a stepping stone for space exploration and a jumping off point to the solar system. The polar regions of the Moon are highlands terrain, meaning that the areas are rich in aluminum, silicon, as well as the all-important water resources in the permanently shadowed regions. The Lunar Industrial Facility would be anchored by NASA as a paying user for the science community, lowering costs, and providing technical mentorship to companies that want to use the lunar surface as a proving ground for industrial activity. This is not unlike the role of the military development of turbine jet aircraft in the late 1940s and 50s. Once the foundations for engineering and the infrastructure needed to produce and distribute kerosene were in place, the commercial jet age blossomed. That has evolved into one of the most robust and important sectors of our economy – one in which we are the leader in the world.

So, what can be done to incubate a robust commercial space segment for our economy? First, Congress should incentivize private investment by passing legislation removing taxation from activities on the lunar surface, along with a structure similar to the one used in the oil and gas industry (26 U.S.C. § 263(c)), that would allow companies doing business in cislunar space and the Moon to expense intangible and capital costs in the year incurred. This would extend to investment tax breaks as well to help to defray risk involved in such ventures and to encourage more entrants than just well financed existing entities. Additionally, legislation currently under consideration in congress (American Space Commerce Free Enterprise Act of 2017), must be clarified in regards to the ownership of goods manufactured from materials [or propellants] obtained from the Moon, asteroids, and Mars.

How Will the Lunar Industrial Facility (LIF) Develop?

The development of the LIF is not a quick, easy, nor singularly-focused effort. Nevertheless, it is an essential enabler that must be stimulated by governments and executed by industry, working in collaborative synergy enabled by policy, incentives, and capabilities. The international community, particularly NASA, has massive amounts of remote sensing data for the moon, but our ground truth is largely limited to the Apollo samples and that must change. This is something that NASA can lead, or support, in close collaboration with the rest of the international and industrial community that is already engaged in these pursuits. A low cost and immediate starting point is a robust research and analysis effort to exploit the Apollo lunar samples, including expending some of this precious national asset in testing lunar materials and manufacturing process development. Additionally, affordable and prolific robotic rovers and explorers are needed soon to further characterize and inform forward planning to expand upon

the Apollo samples ground truth. These systems must have communications capability, rovers, and a means to accurately determine enhanced volatile concentrations in the non-permanently shadowed regions. Furthermore, there should be multiple rovers and each should have a high range-rate, i.e. speed, in order to cover considerable terrain in the area that is near permanently lit. Whatever systems are landed, some should land as close as possible to the peak of greatest light in order to verify and validate the orbital remote sensing of the terrain.

The most important aspect of the LIF is energy, and thus NASA either as a primary driver or in support, should help install a minimum of 1000 kilowatts of solar power systems to support operations. NASA would also lead in providing funding or other support for habitation, logistics, and robotic operations. An explosion of technical progress is transforming earthly manufacturing, transportation, and logistics. From additive manufacturing, swarm robotics, and autonomous systems, what was once far off dreams in NASA's earlier plans are now common everyday industrial activities, requiring only implementation in an environment no more challenging than the Arctic or a deep water oil well. Space is hard, but it is no harder than many earthly industrial environments. Transportation logistical systems is something that NASA can lead and or work with the emerging private community to execute, leveraging the Space Launch System, the International Space Station, and other NASA assets in concert with the emerging capabilities of the private sector. What is fundamental is helping to remove the remaining technical barriers and creating an environment wherein private capital can make a profit. With that in place, all we need to do is stand back and watch it grow.

Today technology is not the greatest barrier to success, but rather will and financing. The right policy and financial incentives can create a fertile environment for investment that will inject a flood of capital into the market while not burdening the American taxpayer and rapidly break down the barriers between real and perceived risk. A simple example of large private capital outlays is the $37 billion dollars being spent on a single natural gas terminal offshore of western Australia. A typical large scale industrial project today ranges from the single billions to tens of billions of dollars. The problem is not availability, it is the direction of capital flow.

Fundamentally, resources from space and the economic development of the solar system are instrumental to bursting through the myth of the earth as a finite system. Large capital flows are routine today – especially when there is significant potential for large returns on investment. For example, in the realm of climate change mitigation, the Paris Accords would direct $100 billion per year of US government funding into this effort, with no clear understanding regarding the investment return. On the global scale, the United Nations has estimated that over the next 30 years over $30 trillion dollars needs to be spent for global infrastructure improvements. Without a pathway that conclusively takes our global civilization beyond our finite system, these expenditures are not sustainable. However….

By incentivizing large private capital flows into space efforts, supported by strong government policy, the economic development of the solar system will rapidly occur and many of the problems that drive our economic and environmental fears, including climate change, will be solved. What the government support does more than anything else is to reduce the difference

between real and perceived risk in new realms of commerce. In the example of the first transcontinental railroad, the reduced capital risk and government support enabled private enterprise to execute on an otherwise unaffordable capital infrastructure project, it also as a byproduct helped to bind the wounds of the civil war and re-unite the United States.

What Will the Lunar Industrial Facility Do?

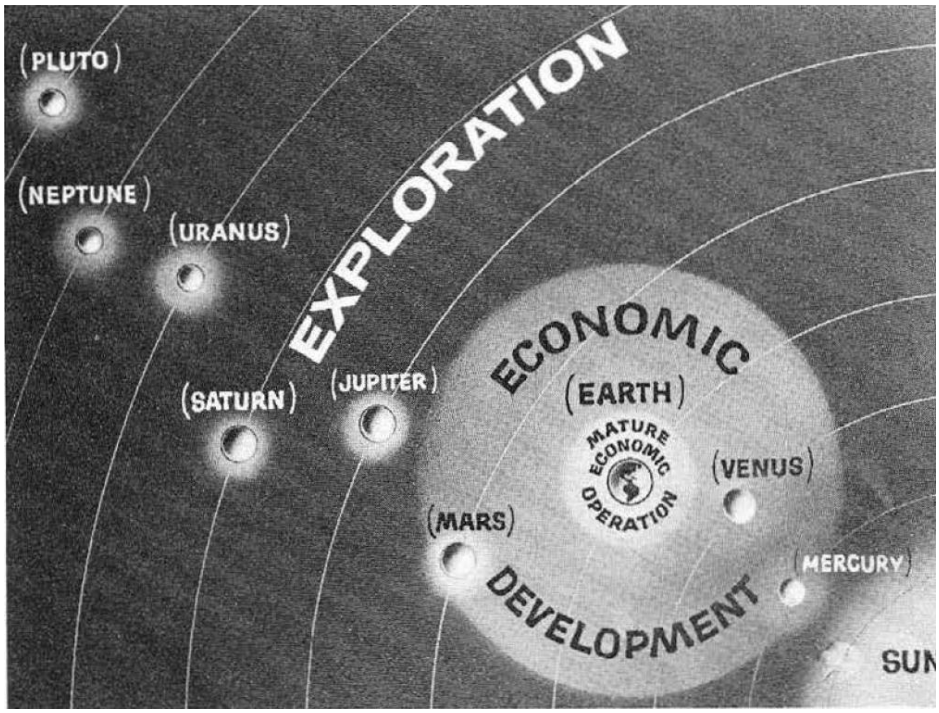
At maturity, the LIF will leverage lunar resources and harness the industrial potential of the Moon. Further, an ultimate goal of the LIF is to enable the creation, in lunar orbit, of a shipyard for the construction of interplanetary spacecraft and large platforms in Earth orbit. It is well known by anyone who has examined the budget and financing projections of the current NASA design reference missions to Mars in detail, that each one will cost a minimum of $20 billion dollars, just to again plant flags, and leave footprints. This is simply unaffordable. Moreover, when overlaid with the coming world of 2050, when we will have to support over 9 billion people relying only on the resources of a single planet for sustenance and address the economic and resource challenges that this future holds, flags and footprints missions are morally indefensible. Thus we must seek a portfolio of new and breakthrough capabilities… both from Earth and from space as we must learn to live off of and leverage the resources of "the land" much like what has been done throughout history. To address the question, what would the shipyard build? The answer is: Affordable access to the rest of the solar system using local resources outside of Earth's deep gravity well. A LIF shipyard is the key to reaching beyond our planet. Here is an illustrative example, interestingly enough from the movie "The Martian".

The Mars Cycling Vehicle as Imagined in the Movie "The Martian"

The vehicle shown above is an imagination of Hollywood, but it comes from an idea first seriously proposed by German rocket scientist Dr. Ernst Stuhlinger in the 1950's with the navigation system worked out by astronaut Buzz Aldrin as the "Aldrin Cycler". Today the two principal problems with humans to Mars are 1) radiation environment and 2) the zero gravity environment on the trip and the corresponding impact on crew health and safety. Nether

NASA nor Elon Musk currently address these challenges, but that does not mean they are insurmountable. By utilizing bulk resources from the moon in the form of aluminum for structure as well as water for radiation shielding and propellant, a large rotating vehicle could be constructed in orbit, thus solving the current Mars transportation barriers. Not only will the Mars problem be solved, this will create a logistical system that will enable the construction of ships for asteroid mining, human exploration beyond Mars to the main asteroid belt and Jupiter, and allow the beginning of the true development of a solar system wide economic system.

The specific goals of the LIF would be to produce 100 tons per year of raw aluminum and 1000 tons of water. Each of these is doable within the proposed 1000 kilowatts of solar power. The facility would be minimally staffed, but with the vast majority of the operations executed with robotic systems. The maturity of robotic systems is such now that the principal effort will be to optimize these systems for the lunar environment. With the widespread use of additive manufacturing (3D printing of metals), not only will the production of raw metals be possible, the further finishing of those metals into forms suitable for assembly at the lunar shipyards into the structure of interplanetary vehicles becomes part of the facility. The United States proved single stage to orbit technology on the Moon in 1969 through 1972 with the Apollo missions. Since the Moon or cis-lunar space has no atmosphere, reusable vehicles can be built and shaped in any non-aerodynamic form desired in order to loft parts into lunar orbit (or potentially Earth orbit or cis-lunar space including LaGrange points). These parts would be supplemented through the cis-lunar logistics system with solar arrays, avionics, and other systems not obtainable from the lunar surface. With this infrastructure Cordiner's final vision, shown here, is brought into being.



Ralph Cordiner's 1960 Vision of the Economic Development of the Solar System

Those who might dismiss Cordiner's vision, must consider his impactful role in American history. Beyond being the CEO of General Electric, one of the largest industrial corporations of mid 20th century America, he was also the number two man during World War II on the war production board. It was the war production board that transformed America's industrial might from civilian products to producing fleets of thousands of navy ships, tens of thousands of airplanes, tanks, and millions of military vehicles and victory in a global war. He, as few others, understood the power of government directed industry, yet he rejected that path for the American move into space and had the vision to tie that to a time where the productive abilities of our competitive free enterprise system could take us across the solar system.

There will of course be those who question whether this is possible. There will be those who exclaim with absolute certainty that it is impossible. However, for the most part those are the same ones who are throwing up their hands exclaiming that climate change and resource depletion are both past the point of no return and that we are all doomed to the collapse of civilization. These who believe so have already given up and taken themselves out of the game. We as a society do not need to follow them. A recent article in New York Magazine has made exactly this point as their title graphic shows here.

Our Future in Space Renders this Quaint Alternative History

We must reject this doom and gloom as it comes from the same well of fear that brought us the missile gap, the population bomb, limits to growth, Y2K, and the invalid concept of a finite world. We must also reject the anti-intellectual position that technology, genius, and cooperation is incapable of finding solutions to our material problems here on the Earth.

Scientists no less than Stephen Hawking have been advocating for this type of bold solution that goes beyond of the geocentric mindset (the mindset that does not look beyond the resources of the Earth for a solution to our problems). Instead, we stand at the dawn of a perfect inflection point in history where humankind has the ability across the technical, political, programmatic, and industrial landscapes to expand Earth's economic sphere, access the near infinite resources in our solar system, and solve many of our nation's and world's most challenging material issues. We have the technological prowess, we have the catalytic energy of American ingenuity and industrial capacity, and the economic potential is imminently alluring. The call to action here is to return to the value and core capabilities that have underpinned and fueled the success of the United States: bold, courageous innovation and action in a free enterprise system driven by the belief that we can indeed improve life, liberty, and security through discovery, exploration, and pioneering that leads to great achievements and a better life for all through progress.

NASA can provide leadership and stewardship of the new era in exploration to stimulate and drive this worthy goal. In a 2006 speech at the Robert Goddard Memorial Symposium Dr. John Marburger, then the head of the Office of Science and Technology policy, stated that American space policy boiled down to its essence was about *"whether we want to incorporate the solar system into our economic sphere, or not."* This philosophy and the implementing policy answers that question and expands on the importance of space to the nation and the world in much the same way that civil aviation was birthed in our free economy. Space policy can no longer be an appendage of national policy to be summoned like a genie when needed. It can and must be a central element of national policy regarding future economic development. NASA cannot do this alone. It should be part of a broader national policy, coordinated by the National Space Council recently brought back to life by the President and Vice President. The National Space Council, working with the various stake holders and with Congress, could bring this about, and in a rapid manner while harnessing and channeling a broader "whole of government" approach that will ensure that the essential elements are strategically aligned. But to do so, it must be visionary and forward leaning and it must have deep top cover from the politicos who would take it apart to finance their own empires. If those who claim that our time is limited to solve the problems of the world are correct, there is no time to lose. We have the technology, what we need is the vision and entrepreneurial leadership in the United States to make this happen.

No longer will we not fully embrace the greatest elements of our national character by not trusting our system of competitive free enterprise and no longer will be retreat from our greatest accomplishments of exploration and discovery. Instead, we will make the bold and courageous and forward-thinking moves to truly embrace the values and attributes that make the United States the greatest country in the history of the world. Moreover, we will choose to make the 21st Century, the American renaissance century, but finally and fully opening the infinite potential of space through a serious of realistically achievable, but truly big, bold, and courageous moves, starting with the Moon. The past decade of successes and results, coupled with the emergence of many new and successful commercial and international space ventures signals that Ralph J. Cordiner's vision from 1960 is the right one. It is time for us to shake off the shackles of a government space policy dominated by a dysfunctional relationship between

government and the free enterprise system, and bring a courageous 21st century policy into being. A bold policy of exploration and economic development will indeed bring back the leadership in space. This is a policy and philosophy worthy of a new generation, and worthy of America's role in the 21st century. As the poet once said; "We live in the 21st century, time to act like it!"

A fitting conclusion is a quote from Lawrence of Arabia, T.E. Lawrence:

All men dream; but not equally. Those who dream by night in the dusty recesses of their minds wake in the day to find that it was vanity; but the dreamers of the day are dangerous men, for they may act their dream with open eyes, to make it possible. T.E. Lawrence—The Seven Pillars of Wisdom…..