Economic Incentives and Tax Credits for Space Resource Development: Analogies and Ideas

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ABSTRACT

Space resource development, whether in the form of energy from Space-Based Solar Power (SBSP) or minerals from asteroid or lunar mining, is not only a major challenge from a technological prospective but also from an economic one. It is often dismissed out of hand as being too expensive to even consider. Yet these ideas keep being resurrected; like a phoenix, rising from the ashes of previous incarnations.

This paper looks at the types of economic incentives that could advance the development of space resources, especially SBSP and mining. Are there incentives available in other industries that could be applied to space resource development? What projects are currently or have been analogous? What types of incentives or tax credits have historically led to the successful completion of large capital intensive projects? In considering these factors, global incentives are looked at as well as domestic support measures.

Economic incentives and tax credits are established by top-down government policy aimed at creating desired results. It is therefore important to consider what policies are currently in place, and what new policies, if any, could/should be developed, to either encourage private enterprise to take the initiative in building space systems or result in government action in that direction. The benefits that a SBSP system could eventually provide encompass many government goals in areas ranging from energy policy, space policy, education and workforce issues, environmental and regulatory policies, innovation/technology and R&D policies. This paper looks at how SBSP fits within these policies, and how existing incentives in these areas can be used to advance SBSP.

It also considers incentives for other types of terrestrial resource (mining and oil/gas) exploration and investigates how tax credits, property rights and incentives in these sectors can be expanded beyond Earth into the space environment.

ECONOMIC INCENTIVES AND TAX CREDITS FOR SPACE RESOURCE DEVELOPMENT: ANALOGIES AND IDEAS

Assumption: This paper assumes that readers understand the general concept of Space-Based Solar Power (SBSP) and will not be reiterating that information. Should you not be familiar with the concept, please contact the author for recommended reading or go to http://en.wikipedia.org/wiki/Space-based_solar_power for a quick introduction.

INTRODUCTION

In Gerard O'Neill's *The High Frontier* [1], one of the key concepts was the development of space resources to benefit Earth. Supplying energy from space by means of Space-Based Solar Power (SBSP) satellites provided an important rationale for humanity to go to space to stay. These satellites were to be built by mining and processing the necessary minerals on the lunar surface (or asteroids) and manufacturing the satellites at a space station situated at one of the Earth-Moon Lagrange points, most likely L5. Written originally in 1976, these unrealized ideas continue to garner attention and interest today. This paper is written with these ideas in mind and discusses economic incentives in terms of how they could be used to advance progress towards these goals. When *The High Frontier* was written, the assumption was that the space shuttle would develop sufficient access to space for the rest of O'Neill's future to unfold. That has not happened. Could his vision still happen and what would it take? Both SBSP and space mining have excellent long term potential to provide economic and environmental benefits to Earth but the costs and obstacles involved in turning these ideas into viable and profitable endeavors are enormous.

Access to space has always been the key barrier to the development of commercial uses of space – whether those are for SBSP, space mining, space tourism, space manufacturing or the development of space cities/settlements, etc. Until there is cheap, reliable and frequent access to space, these ideas will remain in the realm of science fiction. Access has often been considered "a chicken or an egg" conundrum. Which decision comes first? Develop the launch capacity and access or build the system or application requiring the access [2]? The vehicle fleet necessary for a SBSP system to be placed into orbit does not exist today. Since launch cost is primarily a function of rate, the high demand created by a SBSP program, for example, would naturally drive down launch costs. It would lead to parallel investment in launch systems by launch providers, so they can maximize their capture of this lucrative future launch market. Increased demand (and the capital availability necessary to build these fleets) could be enough to tip launch economics into a virtuous cycle of cost improvement and scalability, and could lead to breakthroughs in propulsion techniques [3]. While this paper is primarily focused on space resource development, it is also important to discuss some of the economic incentives which have been developed to encourage commercial access to space.

ECONOMIC INCENTIVES

What are Economic Incentives? In the context of space resource development, economic incentives are valuable policy tools created to support nascent industries and help them to develop and mature. In terms of national competitiveness, they are intended to generate leadership in innovative industries. Incentives are designed to motivate or stimulate consumers, businesses or other participants in the economy such as investors or lenders to make a decision or to take action. Most incentives are explicitly produced through government policy to achieve a desired end but they can also be created in the private sector through pricing mechanisms (such as price reduction sales, coupons and/or rebates), patronage or prizes. Within government; policy, policymakers and politics are so intricately intertwined that one must examine these relationships and determine how they interact. Policies which are straightforward with stated, measurable goals can easily be assessed as to how successfully they accomplish their purposes without significant undesirable side effects. Many policies however are qualitative with goals that are fuzzy and cannot easily be measured to determine success or impact. Often appropriateness (and success) depends on the

political viewpoint of the policy maker. Political will can be fleeting and fickle, changing with the minds (and inhabitants) of Congress, Senates or Parliaments. Politicians tend to be short sighted, focused on their election cycle and thus can be incapable of making decisions on policies with long ranging implications. It can also be difficult to distinguish policy goals from political ones or to see the perhaps hidden, political agendas behind policies that may initially appear apolitical e.g. jobs in certain districts/ridings [4], etc.

Government incentives come in a variety of different forms including policy tools such as:

- Grants
- Subsidies [5]
- Low interest loans
- Loan guarantees
- Carbon credits/offsets
- Other incentives
- Tax holidays
- Reduced tax rates
- Investment Tax Credits
- Investment Grants
- Treasury Grants
- New Business Grants and Loans
- Production Tax Credits
- Performance-Based Tax Credits
- Transferrable tax credits
- Prizes
- Pre-Purchase Agreements
- Preferential procurement policies
- Depletion allowances vs Depreciation and applicable rates
- Tariffs, Duties and applicable rates
- Guaranteed annual revenues, etc
- Funding for selective infrastructure development
- Payroll rebates
- R&D Tax Credits.

SBSP in particular relates to multiple areas of government policy. When developed, it will provide energy, employment, R&D opportunities and technological innovations. It also involves space and regulatory issues. Most advocates focus on space policy and try to encourage space-related incentives but their efforts might be better directed toward influencing energy policy.

ENERGY INCENTIVES

There are numerous forms of government policy directed towards encouraging and incentivizing the development of clean, safe, renewable alternative energy forms but none specifically oriented at the development of SBSP. Advocates of SBSP need to work diligently to have energy produced in space and beamed to Earth be given at least the same benefits as other renewable sources. In February 2009, President Obama "extended the production tax credits (PTC) and investment tax credits (ITC), which have been critical to the growth of the renewable energy sector, and added a new incentive, Treasury grants taken in lieu of tax credits" [6] by signing The American Recovery and Reinvestment Act of 2009 (H.R. 1), into law. Designed to promote the growth of renewables despite the economic downturn, these include Production Tax Credits (PTC) of 2.1¢ or 1.0¢ per kWh depending on the source of generation. These credits are very important to the solar and wind power industries. A survey by Navigant Consulting suggests that over 100,000 jobs and $19 billion of investment hinges on these credits [7]. The Investment Tax Credit of 30% of the cost of a solar energy system is especially attractive where uncertainty about the value of a PTC exists. The Treasury's "renewable energy cash grants" [8] would be in lieu of tax credits to new renewable energy power plant construction. As these facilities would not be taxable in early years, a cash grant would be far more valuable to them than a tax credit.

Carbon credits or carbon offsets are another form of incentive that is available as a subsidy to qualified renewable energy producers that reduce greenhouse gas (GHG) emissions below a predetermined level [9]. Unlike straight subsidies, these credits can be traded like a financial instrument such as a stock or bond on an open market. SBSP producers will find it to their benefit to become "qualified" by the relevant criteria.

For biofuels, there are at least 25 different incentive programs offered by five U.S. federal government departments or agencies. [10] Whether these are effective in obtaining the most efficient and valuable results has been questioned [11] and some recommend that many of these be changed to performance-based biofuels tax credits. Standards, such as the Renewable Fuel Standards (RFS) [12] are another type of incentive that benefits the biofuels industry. While SBSP would not qualify for any of these as it would provide energy to the electricity grid rather than for transportation fuels, an awareness of what is available in similar industries is important. Standards for the use of renewables in power generation, called Renewable Portfolio Standards (RPS) [13] exist in over 24 states [14] and the District of Columbia, in many European countries, [15] China [16] and many other countries worldwide. These standards provide no direct incentives but ensure a viable market exists for renewable energy sources.

INCENTIVES IN THE SPACE INDUSTRY

Economic incentives have not been used extensively in the space industry to date. For the most part this is because most space companies have operated primarily as government contractors rather than as true commercial enterprises. As government contractors they operate on a cost-plus basis. They take no real financial risks as all their expenses are covered by a space agency or defense department. While this could be considered an economic incentive in itself, it is not a productive way to build an innovative and prospering industry.

There are many regional economic incentives aimed at luring businesses to relocate to a new jurisdiction. This is true for space companies, as well as the more traditional targets of automobile manufacturing plants, research (biotechnology, telecommunications, and technology) companies, call centers, and many others. At least 16 states have programs in place relating to the space industry [17]. These range from standard incentives to targeted incentives for the aerospace and suborbital industries.

Oklahoma is one state that has actively tried to lure suborbital Reusable Launch Vehicle (RLV) manufacturers to locate there. In 2004, Rocketplane Ltd. qualified for a set of incentives developed in the late 1990s when Oklahoma was trying to become the launch site for the proposed Lockheed Martin VentureStar vehicle (that never went into production) [18] These incentives provided a transferrable tax credit of 60% of up to $10 million of investors' capital in the company. The transferability feature of Bill SB55 is very important as it allows these tax credits to be sold to others whose primary motivation may be tax savings as opposed to investment in the emerging suborbital industry.

Virginia is another state with space-specific incentives. Their Zero-G, Zero Tax Act of 2008 provides for tax exemptions on income earned from the sale of training for spaceflight participants, launch services to them or from delivering payloads for NASA Commercial Orbital Transportation Services (COTS) resupply services contracts. The Virginia Commercial Space Flight Authority and the operations of the Mid Atlantic Regional Spaceport (MARS) and Wallops Island can also exempt equipment imported for the purposes of launch from import/export duties and launch consumables from sales tax. It has

the authority to issue bonds for infrastructure development and provides liability protection for space transportation companies and their contractors. These incentives led to Orbital Sciences Corporation's decision to launch its Taurus II vehicle (partially funded by NASA COTS) out of MARS.

NASA has become more focused on creating incentives through its Innovative Partnerships Program (IPP) office [19]. These include programs such as Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) [20], and Centennial Challenges. SBIRs and STTRs provide funding directly to small businesses to conduct research for NASA. The Centennial Challenges Program provides no direct funding but instead endows the winners (and in some cases runners-up) with a cash prize for successfully completing a challenge designed to produce innovative solutions to a particular problem. If no one is successful before the challenge's deadline, then no funds are expended.

These prizes were introduced after the highly successful privately funded $10 million Ansari X Prize for the "first private team to build and launch a spacecraft capable of carrying three people to 100 kilometers above the earth's surface, twice within two weeks" [21]. Since then, the X Prize Foundation [22] has continued to offer an ongoing series of prize competitions including the $30 million Google Lunar X Prize. NASA has offered their own prizes and there have been a number of combined public/private competitions such as the Northrop Grumman Lunar Lander Challenge.

COTS, administered by NASA's Commercial Crew and Cargo Program Office (C3PO), is "investing financial and technical resources to stimulate efforts within the private sector to develop and demonstrate safe, reliable, and cost-effective space transportation capabilities" [23]. NASA is providing, through partnership agreements with U.S. industry, $500 million for commercial cargo demonstrations and $50 million toward commercial crew initiatives. The two current industry partners, Orbital Sciences Corporation (Orbital) [24] and Space Exploration Technologies Corp. (SpaceX) [25] must also raise substantial private investment before receiving milestone payments as they accomplish the concrete objectives set forth by NASA. This program recognizes that creating a successful industry requires multiple suppliers and competition to eventually achieve price reduction and innovation. The economic incentives provided by COTS appear to be leading to the successful creation of a small commercial orbital spaceflight industry.

New tax incentives have recently been proposed by U.S. Senator Bill Nelson (D. Fla) [26] to provide tax breaks to investors and companies working to provide commercial spacecraft to transport astronauts to orbit [27]. Entitled "The Commercial Space Jobs and Investment Act", this is currently at the proposal stage and focuses primarily on creating five regional business enterprise zones, as described in the Presidential Task Force on Space Industry Workforce and Economic Development, [28] to offset the job losses from the closure of the space shuttle program

INCENTIVES IN THE MINING INDUSTRY

One of the most pertinent analogies for space resource development may lie within the Canadian resource exploration sector. Mining, whether terrestrial, lunar, or on an asteroid or other planetary body is a very high-risk proposition. Prospectors may start with the best geological inferences and still end up with nothing. Like space development and transportation, it is a very capital-intensive industry, in both the exploration and the development stages. It is crucial to ensure that title is secured for exploration and

extraction to the property being explored before beginning. (In Canada, these "claims" are filed with the territorial governments. It is not always necessary to own the land itself as long as you have secured the mineral rights.) The higher the price of a commodity, be it a mineral or oil or gas, the more exploration that begins to occur and the more development projects that become feasible. It will take VERY high prices for space resource development to become viable for Earth use but given resource scarcity and concern over the environmental impact of many types of mining on Earth, that possibility exists. For resource utilization in space, the economics will differ. Resource extraction prices that are lower than launch costs could create a new and separate market as suggested in *The High Frontier*.

In Canada, federal and provincial tax incentives are often available to encourage mineral and oil/gas exploration. There are major benefits to society for these activities, particularly to the infrastructure development of rural and remote communities and employment opportunities for their residents. Mining has been responsible for the founding and continued existence of many Northern communities. It could easily form the basis for communities on other worlds as well.

To encourage investment in exploration and mining in Canada, the federal and some provincial and territorial governments offer tax incentives. In October 2000, the federal government introduced a 15% non-refundable tax credit known as the Investment Tax Credit for Exploration (ITCE). This is in addition to the existing 100% deduction of eligible exploration expenditures (CEE). These "super" flow-through shares, as investors know them, have been used successfully in the past to help finance discoveries. Between October 2000 and December 31, 2003, over $750 million in flow-through financing was raised for exploration in Canada. Approximately $1.7 billion [29] was raised in 2006. The program has stalled and been reinstated several times and is currently set to expire in 2011 though pressure continues to be exerted to make these credits permanent. This financial incentive encourages exploration within the country, with the intention of replenishing mineral reserves that have been depleted by mining.

These tax credits are especially valuable to small exploration companies without current earnings who would otherwise have substantial challenges raising capital. Without earnings to offset the tax credits, those credits would be worthless to them but by issuing "flow-through" shares to investors they can raise capital and their investors can then use the tax deduction against their own personal income. Because the investment is 115% deductible against other income, it attracts many investors and perhaps encourages them to take risks they might otherwise not consider [30].

PROPERTY RIGHTS and REGULATORY ISSUES

While private property rights and a capitalist approach may not be technically considered an economic incentive, they are crucial to attracting investors in any endeavor. Ownership leads to better care, attention and development than renting or communal property. "No one ever returned a rental car waxed." Owners invest in what they own both to maintain and make improvements. Land grants and property rights spurred the settlement and growth of the United States and Canada. Patent rights are a crucial element in the development of most technologies. Without these rights and protections, most inventors would not have spent the time, energy and perseverance needed for many of the noted breakthroughs throughout the years. Space resource development needs that perseverance, innovation and strong commitment of time and energy for progress to be realized.

Hernando de Soto, author of *The Mystery of Capital: Why Capitalism Triumphs in the West but Fails Everywhere Else* [31] and President of the Institute of Liberty and Democracy in Peru (regarded by *The Economist* as the second most important think-tank in the world), discusses the impact and importance of formal property systems – including property rights, records and titles with legal rules governing the process. The effects of a formal property system allow for an asset to become its economic concept or value and to be used for its productive potential ie to be borrowed against, used as collateral etc.

Property rights as they relate to space often appear confusing. The Outer Space Treaty [32] talks on one hand of the "common heritage of mankind" and "for the benefit of all peoples" while affirming that "non-governmental entities, including private individuals, companies, and organizations, have the right to conduct activities in space in accordance with international space law, and subject to the authorization and continuing supervision of the appropriate State Party". The term "common heritage" remains undefined and "for the benefits of all peoples" suggests a communist rather than capitalist economic model leading to the apparent contradictions. This lack of clarity makes it very confusing to potential investors. Providing economic certainty in the form of clearly defined and assured property rights would be an incentive to those entrepreneurs and investors.

Almost all activities, especially commerce, are subject to regulations of one kind or another. It is important for regulators to act in as least restrictive a manner possible while ensuring safety is maintained. For commercial space transportation, the FAA's Office of Commercial Space Transportation (AST) has in their mission statement "encourage, facilitate and promote" while ensuring "protection of the public, property, and the national security and foreign policy interests of the United States during commercial launch or reentry activities". An open and enabling approach to regulation like this acts if not as an incentive at least not as a disincentive to commercial activity.

Another type of regulation essential to space resource development, particularly SBSP, is allocation of transmission frequencies and orbital slots. These come under the International Telecommunications Union's (ITU) jurisdiction. Availability of both is crucial to SBSP development and success. Again an enabling and non-bureaucratic approach is needed.

CONCLUSIONS

The creation of a vibrant emerging growth industry often suffers and languishes for lack of needed economic incentives. The nascent commercial space sector is no exception and commercial space resource development lags even farther behind. Ideally an incentive is there to develop an industry until it can survive and thrive on its own. While the entrepreneurial space industry is not yet at that point, there is some progress. Programs like COTS which have been introduced in the past five years are providing some incentives for the development of commercial launch capability, though COTS remains narrowly focused on only two companies. Increased numbers and types of incentives are highly desirable.

Investors expect the early stage companies they invest in to be aware of and apply for all relevant incentives and to encourage (in what small amount of time the entrepreneurs might have available for lobbying) the creation of more. Initial high capital requirements are the major challenge in this industry and anything that will help make raising that capital easier (or providing it) is the type of incentive that would be most valuable for space resource development.

The most attractive types of incentives are often tax credits, like the CEE and ITCE that can flow through directly to the investor offsetting his or her personal income tax payable while creating direct investment capital for the company. Also attractive are grants, loan guarantees and pre-purchase agreements that can be used as collateral for bank loans. Of less importance to many of these emerging companies are incentives to reduce taxes payable as most do not yet have revenues in excess of their expenses.
Once cheap reliable and frequent access to space is established and no longer the major stumbling block, economic incentives could give space resource development the boost it needs to become viable.

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Eva-Jane Lark is a Vice-President and Investment Advisor with BMO Nesbitt Burns, one of Canada's largest full-service investment firms. For over 20 years, she has provided expert advice on a wide variety of investment and wealth management issues. In 2003, she revived her childhood passion for seeing humanity live and thrive beyond Earth. Researching the state of the space industry, she began to consider how to contribute to such a future by taking a more active role. She has presented papers at space conferences, starting with the Investment Financing of Exploration. In that effort, she took a probing look at how historical journeys of exploration had been funded, discovering a number of parallels facing the space exploration community today. She has been invited as a speaker, panelist and judge (Heinlein Business Plan Competition) to discuss topics including: financing for new space companies and markets; business accelerators; business case issues facing Space-Based Solar Power as a future energy source; and for her insights as a keen observer of the emerging new space industries. She was among the contributors to the National Security Space Office's (NSSO) Space-Based Solar Power Architecture Study in 2007, with her work featured as the study's central business case analysis. She has been both a guest and a guest host on The Space Show and is the creator, author and host of "EVA Interviews: The Business of the new Space Age™". Eva-Jane Lark is a Fellow of the Canadian Securities Institute and holds an Honours Bachelors Degree in Commerce. She is a member of the Management Advisory Board for the Center for Space Power at Texas A&M University (now called SERC - Space Engineering Research Center) and SPACE Canada.

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