# \*\*\*SPENDING LINKS\*\*\*

## General Launch Cost

### Space lauches cost $10,000 per kilogram – we do not have technology to make space cost-efficient

Wall 11 Michael Wall, Ph.D, was a science writer for the Idaho National Laboratory and has been an intern at the SLAC National Accelerator Laboratory. January 13th, 2011, "Mining the Moon's Water: Q&A with Shackleton Energy's Bill Stone,"http://www.space.com/10619-mining-moon-water-bill-stone-110114.html

Bill Stone: It costs about $10,000/kg [$4,545 per lb] to launch most "business-class"payloads into low- Earth orbit (LEO), except for the space shuttle, which is tremendously more expensive. New breakthroughs in physics and/or economy must be realized to significantly reduce this high cost; however, none appear to be on the horizon. A major issue in making access to space cheaper is that every space mission must carry its own fuel for in-space operations, since in-space refueling does not currently exist. Even if it did, that fuel would have to be lifted and stored on orbit in fuel depots at even higher prices. To avoid this high-cost barrier to real progress, a means to provide cheaper propellants in space has to be developed. We have the answer: water-derived propellants from the moon.

## Asteroid Detection

### **Asteroid detection costs $20 billion dollars**

Matheny 7 Jason G. Matheny, Department of Health Policy and Management, BloombergSchool of Public Health, Johns Hopkins University, 2007, "Reducing the Risk of Human Extinction," Risk Analysis, Vol. 27, No. 5, 2007, <http://www.physics.harvard.edu/~wilson/pmpmta/Mahoney_extinction.pdf>

Although the usual justifications for discounting do not apply to extinction, we might accept discounting and still conclude that delaying human extinction is cost effective. In the tabular display below I estimate the cost effectiveness of asteroid defense under different discounting schemes. As above, these estimates assume asteroid defense will save an expected 8 billion life-years. However, now the value of future life-years is discounted, relative to the value of a lifeyear lived now. The cost of asteroid detection and deflection is still assumed to be $20 billion, paid in the present.

## Climate Satellites

### **Climate satellites would cost billons**

Associated Press 7 Associated Press, June 8thm 2007, "White House revisits climate, satellites issue," <http://www.msnbc.msn.com/id/19108871/ns/us_news-environment/t/white-house-revisits-climate-satellites-issue/#.TjnuqYLLfdk>

Congress's Government Accountability Office said the $12.5 billion price tag assumes only four satellites without the climate sensors will be launched. But it warned that price also is likely to rise if there are continued delays. "This executive-level footdragging is unacceptable," said David Powner, a GAO technology management specialist. The program is "far from being out of the woods," he said.

## Colonization

### **Colonizing the moon would literally cost trillions of dollars**

Brain No Date Marshall Brain is the founder of HowStuffWorks. He holds a bachelor's degree in electrical engineering from Rensselaer Polytechnic Institute and a master's degree in computer science from North Carolina State University, "What if we lived on the moon?" http://science.howstuffworks.com/what-if-moon-colony1.htm

Food is also a problem. One person eats about 450 pounds of dehydrated food per year. A whole colony of people would require tons of food. The first thought that anyone on Earth would have is, "Grow the food on the moon." We think that way because here on Earth, chemicals like carbon and nitrogen are freely available in the atmosphere, and minerals are freely available in the Earth’s soil. A ton of wheat is made up of a ton of carbon, nitrogen, oxygen, hydrogen, potassium, phosphorous, and so on. To grow a ton of wheat, you'll have to import all the chemicals not readily available on the moon. Once the first crop is in, and as long as the colony's population is stable, then the chemicals can be reused in a natural cycle. The plant grows, a person eats it, and the person excretes it as solid waste, liquid waste and carbon dioxide in the breath. These waste products then nourish the next batch of plants. But you still have to get tons of food or chemicals to the moon to start the cycle. American money Digital Vision/Getty Images It would cost $15 billion to ship supplies to start a colony on the moon -- and that's just for 100 people. In the shelter category, it's likely that the first shelters will be inflatable structures imported from Earth, but a lot of research has been done on the possibility of building structures from ceramics and metals created on the moon. Power on the moon is an interesting challenge. It would probably be possible to manufacture solar cells on the moon, but sunlight is available only part of the time. As mentioned previously, hydrogen and oxygen can react in a fuel cell to create electricity. Nuclear power is another possibility, using uranium mined on the moon. With all of this information, you can begin to see why there's not a colony on the moon right now -- it's complicated! But let's imagine that we wanted to create a 100-person self-sustaining colony on the moon. Let's further imagine that, to start the colony, the following was shipped to the moon per person: The person him/herself -- 200 pounds A starter pack of food (or chemicals to grow food) -- 500 pounds Initial shelter and equipment -- 1,000 pounds Manufacturing equipment -- 1,000 pounds That’s approximately 3,000 pounds per person and 300,000 pounds for the colony. When you realize that the space shuttle orbiter weighs 165,000 pounds without fuel, and you understand that the 100 people are going to live their entire lives on the moon off of the materials found in just two space shuttle orbiters, you realize how extremely optimistic this weight estimate is. At $50,000 per pound, that's $15 billion just for the shipping costs. By the time you factor in design, development, materials, training, people and administrative costs, as well as actual amounts of materials that have to be sent, not to mention the time and money that's been invested just to get the International Space Station into low-Earth orbit, you can see that even a small colony on the moon would cost hundreds of billions, if not trillions, of dollars.

## Lunar Base

### **A single lunar base would cost at least $300 billion dollars**

Easterbrook 6 Gregg Easterbrook, fellow at the Brookings Institution, graduate from NORTHWESTERN UNIVERSITY, author and journalist, December 8th, 2006, "Moon Baseless," Slate, <http://www.slate.com/id/2155164/>

How much will it cost? NASA said Monday it can build a moon base for about the $10 billion per year it now spends on the (soon-to-be-retired) space shuttle and the space station. (The agency also says that the international community will soon begin funding the space station, but no nation has agreed to this.) Considering that the space station and shuttle cost about $10 billion per year, a moon base might cost much more. The space station is 200 miles away and only goes up, never comes down. The equipment for a moon base would need to be accelerated to a significantly higher speed than was required for the space station, and that means a lot more fuel and a lot more expense. Moon-base ships will also need lots of fuel to descend to the lunar surface, and some will need still more fuel to blast off again. Remember, launching the fuel is a major expense. The Apollo program spent about $135 billion, in 2006 dollars, to place about 50 usable tons on the lunar surface. Even an austere moon base would need 300 or 400 tons of structure, equipment, fuel, vehicles, and life support—and probably more. Suppose today's technology allows for lunar-rated materiel to be built and placed on the moon at half the cost of the Apollo project. This quickly gets you to a program cost of at least $300 billion to build the moon base.

## Lunar Mining

### **The start-up for lunar mining would cost at least $25 billion**

Popular Mechanics 4 Popular Mechanics, December 7th, 2004, "Mining The Moon," <http://www.popularmechanics.com/science/space/moon-mars/1283056>

The total estimated cost for fusion development, rocket development and starting lunar operations would be about $15 billion. The International Thermonuclear Reactor Project, with a current estimated cost of $10 billion for a proof-of-concept reactor, is just a small part of the necessary development of tritium-based fusion and does not include the problems of commercialization and waste disposal.

## SETI

### **SETI would cost millions of dollars**

Sagan and Drake 97 CARL SAGAN and FRANK DRAKE are professors of astronomy at Cornell University, where Sagan is director of the Laboratory for Planetary Studies and Drake is director of the National Astronomy and Ionospheric Center., 1997, "The Search for Extraterrestrial Intelligence" [http://www.is.wayne.edu/mnissani/a&s/et.htm](http://www.is.wayne.edu/mnissani/a%26s/et.htm)

A search of hundreds of thousands of stars in the hope of detecting one message would require remarkable dedication and would probably take several decades. It seems unlikely that any existing major radio telescope would be given over to such an intensive program to the exclusion of its usual work. The construction of one radio telescope or more that would be devoted perhaps half-time to the search seems to be the only practical method of seeking out extraterrestrial intelligence in a serious way. The cost would be some tens of millions of dollars.

## SMD

### **SMD would cost $78 billion**

Institute for Foreign Policy Analysis 9Independent Working Group, the Institute for Foreign Policy Analysis, 2009, "Missile Defense, the Space Relationship, & the Twenty-First Century," http://www.ifpa.org/pdf/IWG2009.pdf

For example, a July 2004 Congressional Budget Office (CBO) report, called “Alternatives for Boost-phase Missile Defense,” estimates that costs could reach upwards of $78 billion for the most effective option (out of five options stud­ied) for a 20-year space-based operating system – very ex­pensive because of the weight of the components assumed in the study, that is, the heavier the kill vehicle (KV), the big­ger the booster required to deliver the KV into space and the greater the cost. This compares with $19.1 billion (in 2008 dollars) for the *Brilliant Pebbles* system discussed extensive­ly in section 2.8

## SSP

### **SSP is extremely expensive**

Space Daily 3 Space Daily, August 11, 2003, "The Case For Space Based Solar Power Development," <http://www.spacedaily.com/news/ssp-03b.html>

The other cost of concern is delivery to orbit. Typical communications satellite solar panels have a mass per kW of about 20 kg, so with current launch costs of $10,000/kg that comes to $200/Watt, or a hundred times too large to be competitive at the utility level. Bringing that number down requires both improvements in mass per kW, and cheaper access to space.