Re: forests on orbit

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- *From*: Willie.Mookie@xxxxxxxxx
- *Date*: Thu, 31 Jan 2008 10:30:58 −0800 (PST)

On Jan 31, 5:33 am, Ian Parker <ianpark...@xxxxxxxxx> wrote:

> On 31 Jan, 00:17, Willie.Moo...@xxxxxxxxx wrote:
>
> > http://www.fas.usda.gov/ffpd/Newsroom/2007%20Wood.pdf
> >
> > The US uses 1 cubic meter of softwood and 0.4 cubic meter of hardwood per person per year. If the entire world were to use paper and wood at this rate the world would need 6.6 billion cubic meters of softwood and 2.7 billion cubic meters of hardwood each year. This is 11x the annual production of these products in the world today.
> >
> > http://www.earth−policy.org/Books/Eco/EEch8_ss6.htm
> >
> > Forest plantations produce 4 cubic meters of wood product per hectare per year. That means 2.8 people may be supported per hectare. 280 people per square kilometer. Approximately 1/10th the number of people supported by an equivalent area of ag satellite.
> >
> > Clearly, forestry satellites will be built later than ag satellites since to take advantage of learning curve effects as well as existing capital in place following an ag build out − to reduce plantation costs.

I wrote earlier about a collection of 676,000 satellites in a sun synchronous polar orbit above Earth forming a band 1,000 km to 1,026 km above the Earth made from 1,000 select asteroidal fragments retrieved from the asteroid belt.

These satellites fly in an orbital plane that is constantly perpendicular to the sun. Thus the satellites are in constant sunlight. Each consists of cylinders 1 km in diameter intercepting 0.785 km2 of sunlight − and illuminating 3.140 km2 of cylinder area. Thus, the cylinder is 1 km tall.

Each of these satellites can support 879 persons in their wood needs.

The light falls on a shaped conical reflector that has two lobes. Each lobe reflects incident light across 90 degrees of cylinder circumference − with constant intensity along the height of the cylinder. There are two regions of highest intensity − which peaks at 1,000 w/m2 − separated by 180 degrees − so these are two lines on the cylinder on opposite sides. The intensity falls off along a cosine curve to zero intensity at plus and minus 45 degrees. from 45 degrees to 135 degrees and from −45 degrees to −135 degress − the cylinder is in darkness − simulating night.

To maintain 1 gee force the cylinder rotates once every 44.8342 seconds. The two lobed mirror described above rotates once every 44.8458 seconds. The slight difference in rotation rate means that the two bright lobes sweep across the cylinder every 24 hours − simulating the day night cycle of Earth.

With 6.6 billion people a total of 7,508,533 satellites are needed to supply them all with wood.

At an altitude of 1,026 km above Earth the ag satellite system ends. Capturing another 1,000 asteroids and operating at 1,186 km altitude in the same orbit above Earth as the agicultural cylinders − each asteroid is separated from the others by 47.5 km. These are equipped with productive capabilities that allow them to produce 7,520 satellites from each of the captured asteroids in a plane extending downward 160 km.− 47 km wide − 7520 cylinders in all each 1 km in diameter. A total area of 23.6 million sq km forestry plantations.

A total of 3.44 cubic meters of wood per day is produced by each satellite − an average weight of 1800 kg per day of wood. A very small flow rate reflecting the longer grow times of woods. Total flow for humanity is 13,536,000 metric tons per day for the whole plantation system.

This may be increased slightly due to the coproduction of consumable products in a forest setting. Products like mushrooms, nuts and various fruits may be produced in parallel.

Roughly speaking on a recurring basis, this system requires about 76% of the flow rate of the ag system described previously. A total of 200 years of production may be supported with this system. About four harvests of most woods.

Just as the food products may be processed on orbit with telerobotic labor, so too may the wood products be similarly processed. Furniture and building components may be produced on orbit and delivered to end users.

Other fibers include wool and cotton.

http://www.ers.usda.gov/briefing/cotton/pdf/totalfibercottonmilldeman...

Total fiber demand is about 15 kg and approximately 7 kg is cotton for the average American. Translating this to the entire Earth means 271,040 metric tons per day − which is but a slight adjustment, especially when given the short life cycle of cotton and the foodstuff of sheep.

The transition from ore processing to finished good processing to fabrication to high intensity agriculture to forestry is nearly a continuous transition in intensity per unit area

http://www.steeldynamics.com/investor_info/sec_filings/SDI%2010k−2001...

Modern steel producers require about 3 sq km of surface area to produce 1 million metric tons of steel per year from iron ore. Factories process 100,000 metric tons of products in the same area per year. Agricultural systems produce 10,000 metric tons of food products per year from the same area. Forestry systems produce 1,000 metric tons of wood and fiber products per year from the same area.

Raw materials	1,000,000 metric tons per year per satellite
Finished goods	100,000 metric tons per year per satellite
Agricultural goods	10,000 metric tons per year per satellite
Wood & Fiber	1,000 metric tons per year per satellite
Private Residences	100 metric tons per year per satellite

Number of Satellites

Raw materials	10,000
Finished goods	100,000
Agricultural goods	1,000,000
Wood and Fiber	10,000,000
Private Residences	2,000,000,000

Habitats with daily commutes to Earth and back process approximately 100 metric tons per year − given that each person masses approximately 80 kg with 3.5 people per satellite on average.

Again, as the volume of satellites increase and their use spreads, it is reasonable to conclude that residential use will expand.

The large 20 fold increase in the number of residences when compared to the growth in number of satellites needed for other uses suggest some sort of disconnect. This can easily be remedied by observing that we have assumed the per capita income of the average American, as a global standard of consumption. While this represents a massive increase in the standard of living world wide (11x) it would be naive to believe this to be an end point in human development. In fact, we can look at the amount of wood, fibers, metal and so forth, used by different income groups throughout the world, compared to the surface area projected for the private residences, and we see that by increasing per capita income from $45,000 per year (US average) to $1,000,000 per year − the disconnect disappears as the number of satellites grow to meet this need.

Raw materials	200,000
Finished goods	2,000,000
Agricultural goods	20,000,000
Wood and Fiber	200,000,000
Private Residences	2,000,000,000

So we build for a 220x increase in consumption, from the global average today, not the 11x to meet today's US per capita consumption.

We could of course increase the number of people aboard each satellite increasing them to 75 people per satellite. This is about 20 hectares per household. But to maintain a lower mass flow rate requires visiting the Earth once every 3 weeks or so − which makes the orbiting community pretty isolated from the Earth.

Of course every satellite will be operated for a profit − so the numbers will continue to grow until the marginal profits decline below the returns available from other investment vehicles. In short there are no arbitrary limits as to when people will use residences, or how dense they will be an so forth. The only thing this calculation is intended for here is to determine when MOST people will use MOST of the off−world assets, what the largest use rate will be, and plan systems around that.

It seems most reasonable to me, notwithstanding early developments in the field − i.e. a space hotel, or a lunar golf community, etc., that when most people leave Earth they will have per capita incomes in the $1 million range and each family will inhabit space stations comprising of 314 hectares −

> As rocketry costs decrease and sophisticated robotic and automation and AI systems are added to each station − along with sophisticated medical treatments − propulsion systems will be added to individual satellites and families will have the option of moving beyond the intense industrial belts of Earth − for regions beyond Earth orbit − and even with the development of very powerful lasers near the solar surface − regions beyond the solar system.

I think it would be far better to grow a forest in the Sahara. Energy for the desalination of sea water to be provoded by solar power, possibly SSP. If we assume SSP (terresrial SP merely adds to the force of the argument) we need far less material in space doing it this way.

− Ian Parker− Hide quoted text −

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http://en.wikipedia.org/wiki/Sahara

The Sahara is 9 million sq km and its environment is uncontrollable.

The 7.5 million satellites total over 23 million sq km and their environment is very controllable.

Soil conditions are no suitable for forests in the Sahara. Soil conditions are whatever we make them on orbit.

How much water is needed? How much infrastructure? Greenhouses for forests have not been built yet. Its not clear using terrestrial supply chains, that the same economies of scale are possible on Earth as on orbit. There are economies of scale for very large space stations that are produced in zero gee − that can reduce their costs dramatically. Similar physical processes do not exist for terrestrial greenhouses.

I have looked at the Sahara and you might be able to develop advanced low cost green hourses from molded PET combined with large desalination plants − powered from space − covering 9 million sq km − enough to provide the world's food supply − at the US per capita rate.

But the productive capacity of forests is such that it is beyond the limits of terrestrial construction to make money at that.

Besides anything on Earth is necessarily limited.

There already exists a large forest stretching from Norway to Siberia throughout Russia − with sufficient standing mass on 23 million sq km of land − to provide for all the world's need for wood for about 200 years at the rate I am projecting. It cannot be extended in size or time however − and is best left in its natural state. .

http://www.unep−wcmc.org/forest/I/glob_fullclass3.gif

The ultimate cost of harvesiting forests in place is that they turn the bulk of this biomass into a desert eventually. Notice that the forest comes right down to Mongolia − and stops at the Great Wall of China.

Humans did that. 'developing' this biomass will turn the forested region from Norway to Siberia into a desert in about 200 years − and demand growth beyond present US per capita rate − cannot be supported.

We'd like to establish a direct from off−world marketing system that bypasses ancient terrestrial means of distribution.

We'd like to avoid turning the Earth into a desert and leaving it to future generations to figure out what to do with the mess.

Of course, this terrestrial resource can be developed and exploited as the satellite network grows its first crop − say in about 30 years − and the forests can be used as seed stock for the satellite network and then restored as the satellite system grows.

So they're not mutually exclusive.

Surveying the world's forests from orbit, and creating a system of heavy lift balloons to harvest wood from the air − a flying automated sawmill − sort of like the Predator aircraft on steroids − but with its sights on wood. would supply wood and manage this large area quite handily .

http://www.worldskycat.com/markets/skyfreight.html

cruising down from the skies, picking up wood out of the forests without any access roads or logging roads − and wafting it at high speed while processing it on board − transporting the wood to automated centers that process it further into a wide range of product for distribution to markets.

Humanity consuming 5 billion metric tons of wood per year − and these balloons processing 1,000 metric tons of wood per day − means that 13,400 balloons operating out of 268 aerodromes spread across this landscape, with terrestrial road and rail to retrieve the wood products and bring them to market.

Delivery from orbit would not be possible, and a new distribution network would have to be established and integrated with existing supply chains, and new supply chains would have to be established.

We could certainly develop wood products that way − but it is just as costly and provides limited opportunities for establihing efficient global markets for goods delivered from space and has no opoortunity for growth beyond the confines outlined here. So, it leaves to those in 25 years to still solve the problems of long term growth we could just as easily solve today..

As a seed stock and training grounds and basis for national growth supporting the orbital system − it makes sense. Also as a production source until the orbiting forests are ready to harvest from their off−world plantations makes sense too..

75,000 balloons with a 1,500 metric ton cargo capacity operating throughout the world at 400 kph − could deliver all the food and wood around the world in four days or less. They would be floated by hydogen gas, and use fuel cells to convert the hydrogen to drive the vehicle − and refuel at aerodromes equipped to produce hydrogen from water using sunlight and laser power from space.. .

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