ADRECS – Aerially Delivered Re-vegetation and Erosion Control System

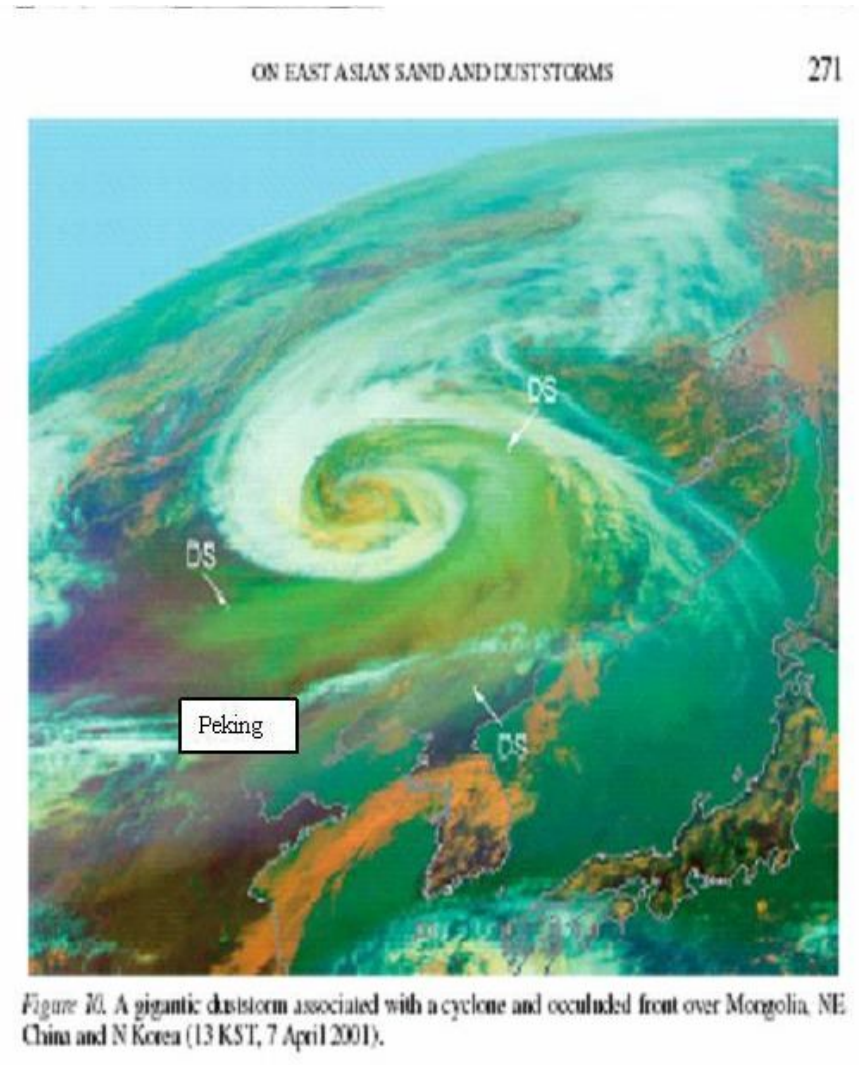


Figure 10. A gigantic duststorm associated with a cyclone and occluded front over Mongolia, NE China and N Korea (13 KST, 7 April 2001).

(Originally "Solutions to Desertification and Dust Storms in Northern China"– since starting this in -Jun-04, the problem seems to have got far worse –

"While these officials have experienced some measure of success in reclaiming land over the past few years — primarily through the imposition of strict grazing and planting regimes — this latest call to retreat is an implicit admission of defeat for an increasingly beleaguered Chinese government. According to researchers at the Chinese Academy of Sciences, China has had an average annual land loss of close to 950 sq. miles to desertification — which, in combination with the country's rapid residential and industrial development, has resulted in more than 10,500 residents having to relocate over the next 3 years. -http://www.treehugger.com/files/2007/08/china_losing_the_battle.php)

Introduction – the problem

(George Wallis has kindly edited this and made some cogent comments which I have counter commented on – grateful for any further advice and references where they are missing – DA. 22-May-08)

Gigantic dust storm, above. 1000 x 1500 km. Peking is only a few hundred miles from the storm. Korea (which experiences 7 extreme dust events each year) and Japan can be identified which gives an idea of the scale of the problem addressed in this article. Enormous sand dunes are now only 70 Km form Beijing, and are expected to overwhelm the city in the not too distant future.

The Basic Issue.
Deforestation and over-cropping in Northern China / Mongolia has created an enormous dustbowl 100 miles by 400 miles centred on the Gobi Desert, which creates raging sandstorms of vast extent. One dust storm (in actuality a dust storm is comprised of light soil particles and could therefore arguably be called a soil storm) in March 2004, was over 1000 km in extent.

In a vicious positive feedback loop, the dust bowl and associated storms are increasing in size and power, and threaten to engulf ever larger areas of hitherto productive Chinese lands, since the larger sand particles are dropped on the perimeter, clogging and killing what vegetation remains, whilst the lighter soil particles are blown elsewhere.

Wikipedia sums it up well –

[edit] Effects of the Gobi Desert

China has seen 3,600km^2 (1,390 miles^2) of grassland overtaken every year by the Gobi Desert. This loss of farmland has caused an estimated $50 billion in losses each year for China's economy.[2] Dust storms, which were once a rarity, are springing up all over China, and could cause even further damage to China's agriculture economy.

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

Local Chinese Effects
Large areas of China are threatened to become uninhabitable, forcing an already cramped population into ever-smaller areas, where the resultant

population and pressure on farmland, will tend to accelerate the desertification process.

Already vast areas of grassland and previously fertile valleys and rivers have been overwhelmed in days by shifting walls of sand or sand suddenly dumped from a storm.

There is no defence against a moving 70 m wall of sand — it will simply overwhelm any man made obstacles.

Desertification means that China's 1/7 of the world's population is living off crops grown on only 7% of its land area. Deserts are growing in China at the rate of 2.5% per year, or about 2,500 km2/yr.

The Historical Perspective
This desertification process has been going on for thousands of years since the development of early civilisations and the resulting population growth. The ruling dynasties of China and their peoples originally lived in the North, but they were forced to come south due to soil erosion following tree removal which made their original lands uninhabitable.

The famous Yellow Sea is yellow due to soil being eroded in storm runoff and causing soil out-wash into the rivers of Northern China, feeding muddy soil laden water into the Yellow Sea.

When the Yangtze River suddenly changed its southern course by some 200 miles, circa 1826(?) due to eroded northern soils clogging its lower reaches (the result of Northern deforestation and subsequent soil erosion), the then Tang? dynasty fell partly due to the widespread turmoil. (Any further references please DA)

There is so much silt clogging the lower reaches of many Chinese rivers that the rivers are in fact "perched" ie they are normally much higher than the surrounding lands, perched on a bed of silt. Hence when they flood they inundate the vast lower lying areas.

Health Effects:
The dust is composed in part of sub 2.5 micron (1/1000mm) of toxic, irritant alkali particles. These can penetrate lung tissue, causing damage, irritate eyes, and impede plant growth by blocking transpiration

International Effects - why should we care?
Apart from feeling sorry for the Chinese, it does affect surrounding countries including the West directly since these dust clouds can travel right around the world in a matter of days. The dust clouds regularly travel as far as USA where there are discernible falls in air quality. There have even been cases of cars being dirtied over large areas in England. These are reported blandly as being the result of "sandstorms in (distant) Asia", nothing for us to worry about. In Korea and Japan, regular storms make living unpleasant.

Comment [G1]: Don't feel sorry for the Chinese, they don't like it!

Korea experiences 7 extreme dust events each year and the economic cost of washing dusty cars alone is estimated at $0.l billion, and the damage to health, fisheries, and agriculture is enormous.

Fundamentally, in a globalised world, loss of land affects all peoples everywhere, driving up food prices and placing more stress on remaining soils and water resources.

The Chinese government is now having to import food for its citizens as the available agriculture land shrinks, and this may be one of the unreported causes of high world food prices.

Finally it is a great opportunity for Western engineers and venture capitalists to come up with mutually beneficial and profitable solutions.

Comment [G2]: Doubt it; maybe an opportunity to nick your ideas though

The Cause of dust bowls and dust storms

Violent storms as large as a dust storm do not tend to occur spontaneously over vegetated regions. This is because the vegetation absorbs the solar energy, in the dark green foliage, and by the evaporation of water.

The dense moist air and clouds above the vegetation prevent the harsh solar energy from fully penetrating to the ground.

Because the air above the trees is cool and moist, it creates precipitation, which helps vegetation in a virtuous circle.

In contrast, a deforested region, denuded of vegetation, allows the full thermal input of the sun – 1 kW/m2 at peak, heating the ground during the day, which in turn heats the air in contact with it. This causes intense updrafts, which due to the earth's rotation become violently spinning storms as per the photograph. In a vegetated surface, the vegetation itself slows down any winds close to the surface, due to its roughness and resultant friction. This is clearly not the case in deserts.

Thus once started by the removal of vegetation, deserts become a self-perpetuating mechanism growing ever larger – by dumping sand particles on the still vegetated periphery, and more powerful – essentially fed by solar energy.

Fixing dust bowls — the Oklahoma experience

In the Oklahoma dustbowl of Woody Allen and "The Grapes of Wrath" fame, desertification was tamed by many simple methods, essentially manipulating the surface using vegetation - ploughing along contours and planting strips of tough vegetables — such simple measures worked by disrupting air and water flows over the surface, and trapping dust.

Solutions to dust bowl conditions:
Once vegetation has been lost, the climate above the land changes; in order to disrupt the major processes we must simultaneously be able to:

a) slow down the winds near the dust source
b) provide barriers to prevent soils being blown away
c) provide a means to allow plants to re-grow
d) provide a means to capture, and retain water.

For a full description of this see :
Countering desertification http://en.wikipedia.org/wiki/Desertification

Chinese Government solutions:

From Wikipedia -
Green Wall of China

From Wikipedia, the free encyclopedia

The **Green Wall of China**, also known as the **Green Great Wall** or **Great Green Wall** (Chinese: 绿色长城), will be a series of human-planted forest strips in the People's Republic of China, designed to hold back the Gobi Desert.[1] It is planned to be completed around 2074,[1] at which point it is planned to be 2,800 miles long.
http://en.wikipedia.org/wiki/Green_Wall_of_China

At the moment, the Chinese Government is using often conscripted manual labour, backed up by water trucks, which have to come hundreds of miles, to penetrate the desert and plant small saplings. This is a very slow, expensive and time consuming process. Many of the saplings don't survive since the water, and nutrients are soon lost or they are buried by sand. However film footage shows that even a small tree sapling a few inches high, can stabilise about a 20 foot zone behind it simply by interfering with the wind speed locally. But all too often, the sapling is quickly overwhelmed.

The Chinese government belatedly recognising that over grazing of marginal grass lands is causing the effect of soil loss, have now started giving grain to the peasants, and forcing them to stop grazing. They are instead employed in reforesting work. This is of course a good thing, but clearly the grain has to come from somewhere, meaning it is imported. This will affect world grain prices. Many recent articles on the internet

http://www.treehugger.com/files/2007/08/china_losing_the_battle.php

imply that the Chinese government is facing defeat in its attempts to halt the deserts spread.

Phase 1 – Stabilisation

The ADRECS Proposal
(ADRECS Aerially Delivered Re-vegetation and Erosion Control System)

Any solution must be capable of rapid implementation. Just as pouring bucket full's of water onto a large fire over a long period of time will have no discernible effect – the only solution being to drench the fire with massive and overwhelming quantities of water.

Similarly, due to the vast scale of the existing problem only massive and concerted effort can fix it.

There are already existing systems such as LAPES – Low Altitude Parachute Extraction System, whereby a fully laden Hercules transport aircraft, flying at tens of feet about the ground, can have a 37000 pound cargo extracted in a few seconds, pallet by pallet and deposited on the ground, in a long string, arriving on the ground with little forward motion, by means of a system of drogue parachutes which pull each pallet from the aircraft one by one and deposit them in line on the ground.

Comment [G3]: More likely to be the Chinese variant of the Antonov AN12DA – yes – I just used an example I was familiar with, but I am assuming the Chinese Government would do this.

http://www.parachutehistory.com/military/lapes.html

Even entire light tanks, the M551 **Sheridan** weighing 15 tonnes was delivered in this way.

http://en.wikipedia.org/wiki/M551_Sheridan

It is proposed that in a similar way a complete mini- environment, **ADME – Aerially Delivered Mini Environment** complete with nutrients, sand protection system, water, and a water generator, protected in a tough shell, be rapidly sewn from the air.

Whereas in the LAPES system, the load is removed and deposited pallet by pallet each weighing maybe 1000 lbs, we are proposing many more but lighter individual loads, perhaps 1500 units of 20 lbs each, each containing the total mini environment. And these do not need to be delivered at such a low and dangerous altitude as the LAPES.

Comment [G4]: PROBLEM – the fact that they are extracted on pallets is WHY they can be extracted. Any effort to have lots of lighter loads pulled out of an aircraft might be practicable, but would give a loadmaster nightmares.
DA Yes but I think with modifications you could find a way round it. Ie fit false lining to make interior of aircraft totally smooth for example.

The basis of the ADRECS proposal – the mini environment or ADME – Aerially Delivered Mini Environment

Each ADME comprises of:

- A discarded motor tyre
- A filling of wet sewage sludge contained in a sealed plastic bag
- A suitable tree sapling
- A pop- up plastic support pole, vertical in final position, but retained initially by folding around the tyre rim until deployment

- A means for automatically releasing the support pole soon after deployment
- A cord, about 10 meters in length connecting each tyre, capable of dragging successive ADME units from the plane, and to provide correct final spacing of 10 metres.
- A further cord, connecting the tops of the poles to provide support for the sand stabilisation netting
- A sand (or snow) barrier, which is essentially a piece of netting and provides a means to slow down surface winds causing them to drop entrained particles
- A series of saplings embedded in the base of the snow fence, also with sewage sludge package
- A drogue parachute to assist extraction from the plane, and to cause the ADME to land flat to the ground with the pole on the upper surface.

Comment [G5]: And this is why. What if one gets stuck with a dozen already deployed? Imagine a couple of hundred of these things flailing about inside a C130/AN12.
DA – well the cord simply breaks and you start again.

Comment [G6]: No chance, they'd tangle
DA only has to be small, handkerchief size – doesn't matter if a few fail as they will.

Functioning of each element of the ADME

Discarded motor tyres

These always have water in them – due to the useful ability to trap and retain moisture due to their shape and thermal properties – they in fact function as dew traps. In addition, due to their toroidal shape, it is in fact impossible to tip water out of a tyre.

These are an environmental problem around the world, and no one has a workable solution to get rid of them, apart from land filing. Current disposal costs are about $1 each. If they are burnt they can give off noxious gases containing powerful carcinogens, and mutagens.

In developing countries tyres are renowned for harbouring malaria mosquitoes due to their ability to always have water in them, and in the States it is recommended to drill a hole in a tyre before discarding it for this reason.

The wet sewage sludge filling of contained in a sealed plastic bag

Sewage sludge is not only a source of nutrients but also very hard to dewater, a fact well known to water companies who have trouble in processing it to less than 70% water, 30% dry solids by mechanical means (30% dry solids is similar say to elephant dung in handing properties). To dewater beyond 30% requires the sludge to be heated to over 100C to burst the cell membrane, or subjected to pressures in excess of 1000 bar. This is an enormously expensive.
This is due to the SAS (Surplus Activated Sludge) being essentially dead cell bodies – small spheres of gel covered in a tough cell membrane capable of withstanding enormous pressure, and even microbial attack in eg Anaerobic Digesters.
It is not only hard to dewater, but is in fact hydroscopic as well.

Comment [G7]: An aside – AD?
DA Surprisingly the cell bodies survive digestion – unless subject to very expensive homogeonisation

Tree sapling

Any suitable species capable of rapid grown in arid conditions, perhaps one bearing oils which may be used as fuel substitute such as Jatropha.

Comment [G8]: Jatropha?

A coiled plastic support, vertical in final position, but retained by folding around tyre until deployment

This is a flimsy pole about 0.5 to 1 meter high, able to support the snow fence when erect. It is initially restrained to curve around tyre periphery when ADME units are stacked in the plane's cargo hold, until released when it would spring into a vertical position

A means for automatically releasing support pole after deployment

This is achieved by restraining the pole by shrink wrapping it into position around the tyre rim with plastic film that would rapidly degrade in the harsh ultra violet conditions in the desert, allowing the pole to spring vertically upwards.

Comment [G9]: Might snap going out the cargo door.
DA ok we'll replace it with a shrink wrap.

Suitable cord, about 10 meters in length

This simply connects the tyres into a long string and is used, to drag successive ADME units from the plane, and to provide regular spacing of 10m for each ADME unit when on the ground. It is farily weak and will snap if the carog snags, whereup the load master will re-organise and re-direct the flight

Further cord, connecting the tops of the poles

to provide top level support for the sand stabilisation barrier when the pole is released

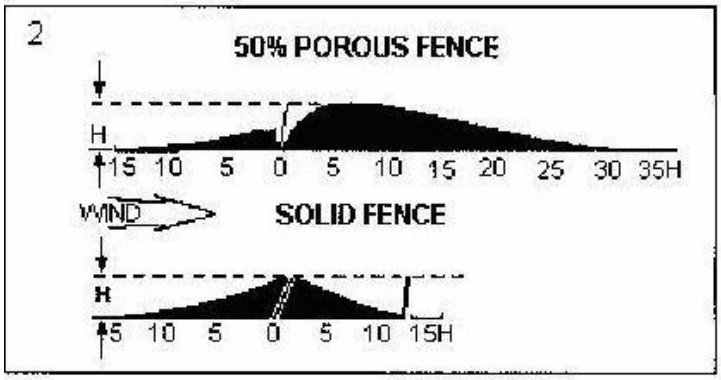
A sand (or snow) barrier type netting

This are widely already used to prevent snow drifting adjacent to highways, and sand drifting inland on beaches and to prevent or slow dune migration. They are commonly seen as red netting with large holes about 3 cm diameter and are used to screen excavations – the hole to surface ratio needs to be about 50:50. They are very cheap to manufacture. Such netting provides a means to slow down surface winds causing them to drop entrained particles.

How a snow fence works is to locally lower the wind velocity and cause the snow or in this case sand to fall out – crucially either downwind or upwind of the fence not at it.. The snow pile which begins to form downwind of the fence then creates a dead patch upwind which of which kills the forward movement of the wind-blown sand, causing it to drop its sand load BEFORE the snow fence. Thus the fence itself is never actually buried. After a short period of operation the two piles of sand then themselves act as snow fences, with sand being dropped in the lee of the artificially crated dunes.

The diagram below shows how a porous fence, whilst not only being cheaper since it does not need to be strong enough to actually stop the wind (merely slow it down a bit) is much more effective than a more expensive solid fence.

The porous fence has not been buried, and has trapped twice the volume of sand, and will continue to do so.

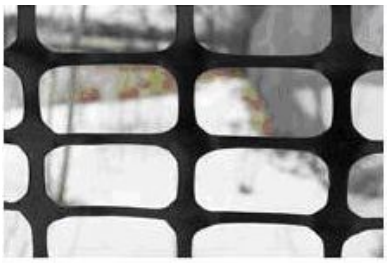


“Sand fencing has been an effective management strategy for both slowing the dune migration and forcing growth in dune elevation.” - Geospatial analysis of a coastal sand dune field evolution: Jockey's Ridge, North Carolina

Helena Mitasovaa, , , Margery Overtonb and Russell S. Harmonc

aDepartment of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, NC 27695, USA

This is what a snow or sand fence looks like.



Or this.

http://www.teksupply.com/farm/supplies/ProductImageView?catalogId=10053&storeId=10001&langId=-1&division=TekSupply&magnify=xr8285a.jpg&imglist=xr8285a.jpg%7cxr8285b.jpg%7c%7c%7c

From Tech Supplies

A series of saplings embedded in the base of the snow fence, also with sewage sludge package

These saplings will again be able to grow, into the sand, using the netting as support. The netting will also act as a dew trap, and will be slightly modified from standard netting, to channel such dew to the location of the plants. These will be provided at 1 m intervals.

Comment [G10]: How?

(modification will be a slight zig zagging of the horizontal strands so that water runs to the low point where the sapling is located. This is already done on sheep fencing to prevent rusting where the moisture is directed away from the vertical strands by kinking the horizontal strand)

A drogue parachute to assist extraction from the plane, and to cause the ADME to land flat to the ground with the pole on the upper surface.

The unloading process is initiated by ejecting an initial pilot drogue chute. This is attached to the first string of ADME units, by attachment to its drogue. This pulls the ADME drogue from its package which then pulls the first ADME unit from the plane. A three point attachment ensures the ADME drops vertically and ends up with the snow fence support pole on the upwards surface.

Once begun, all ADMEs will be deployed in a similar fashion.

Comment [G11]: A drogue for each unit??
DA
The first ADME unit will then pull out the 100m of cord which will then pull out the next unit and so on.

(in fact it may be more practical to dispense with the alignment drogue, and allow the ADME to fall randomly and have two poles one on either side , so that one always comes up vertically)

Note on dune movement:

It is important to understand how the movement of gigantic 70 m high dunes happens — they are not swept bodily along, in a solid mass. The underlying mass in solid at anyone time, but during a storm, the sand particles on the

surface of the crest is blown from the top, and falls along the downwind side. This exposes a new particle, and this too is blown off and so on, gradually the whole dune moves forward, grain by grain – typically 50 m / y. This is exactly the same as how snow drifts move, and a simple and flimsy fence can prevent their movement. A flimsy snow fence on the crest will also prevent a dune moving. Even if they are not on the crest, they will sooner or later end up there and then kill the forward movement.

Comment [G12]: Why? Wouldn't it get overwhelmed and buried?
DA I don't think so – the snow fence prevents sand build up at the fence, so an upwind sand dune, would end up stationary in two parts with the fence in the middle.

Indicative Deployment Timescales and logistics

The Lockheed Martin C-130J Hercules

The C-130 has been in continuous production since 1954 and over 2,300 Hercules have been built for 67 countries, entered production in 1997.

The C-130J Hercules can auto extract 42,000 lb / 19,000 kgs at 10 ft altitude.

Assume each tire, plus its sludge, sapling, support pole, and 10 m of snow fence and cords weighs 20lbs/ 10 kg,

So Hercules can carry 19,000/10 = 1,900 units.
At 10 m tyre spacing, this would mean each aircraft could lay a sand fence 1,900 x 10 m = 19,000 meters, or 19 km per sortie.

Assume each aircraft could load, fly, drop, return to base, every 8 hours – so 3 sorties per 24 hours

500 cargo aircraft were deployed on this project then that is 1500 sorties per day, each sortie laying 19km of line.

So 500 aircraft could lay 28500 km of ADME line per day.

Assume the required transverse spacing of the ADME lines is 100m or 0.1km and the extent of the areas to be treated is 1500 km x 1500 km.

Then the number of transverse lines would be 1500km / 0.1 = 15000km

These would each be of length 1500 km.

Hence total length of ADME lines will be 15000km x 1500 km =22500000 km

So 500 craft would take 22500000 km / 28500 km = 700 days = say 2 years in total.

Comment [G13]: PROBLEM. IN FACT A FAIR FEW OF THEM. OK this is an academic exercise, but you strike me as being very practical. ONE – would the Chinese allow other air forces into their territory?
DA – I'm assuming the Chinese Government will do this with their air force and planes.
TWO – how many air crews would be available for deployment?
DA
I think the Chinese are building up a vast air force anyway – good for training.
THREE – what's the weather like?
DA we do it during the non dust periods and not during storms. Since FOUR – turboprops don't like deserts at all, it kills their engines.
DA Ok high maintenance costs
FIVE – how many aircrews and aircraft would constitute an acceptable loss? You WILL lose crews on an operation like this
DA – ok but a lot of people are dying from starvation / will die otherwise.

Indicative Costs

Aircraft:
From the internet, each Hercules sortie costs $10,000.

Comment [G14]: Not in the desert – replacement engines needed more often
OK needs adjust by an expert

Total number of sorties is 500 x 3 x 700 = 1,050,000

At $10,000.per sortie, that is a total cost of $10 Billion

Hardware:

Assume the following costs:

Tyre - $1
Pole – $0.1
Cord – $0.5
Cord – $0.5
Netting –$ 0.5
Saplings, 11 per ADME - $1
Sludge –$ 0.1
Drogue – $1
Preparation labour – $1
Handling and transport - $1
Admin - $.25

Total costs per ADME – say $10

Total number of ADMIN units -

Costs:
Aeroplane sortie costs, - $10,000 (from internet)
tyre $2 + sludge $1 + pole $1 + sapling $1 $5,
l200units per plane x $ 5 = $6000
then total costs are . $16000
Cost per mile of fence = $ 16000/6 = $2600
Given that the Gobi is roughly 1000 by 400 miles, and that the wall would need to be every 100 m, then this is a total length of wall of
400 miles x 1000 miles x 2000/100 = 8,000,000 miles
Cost = 8,000,000 x $2600 = $21 billion – 1/10 of the cost of the Vietnam war.
The Iraq war is reckoned to have cost between $2 and $13 trillion dollars

Quantities of tyres:
There are 800m vehicles world wide, then this will yield say 800m scrap tires per year. Over a 10 year period, this will yield, say 8 billion scrap tires.
To build the 8,000,000 miles wall, with a tyre every 10 meters, would need 8,000,000 miles x 2000/10 = 1.6,000,000,000 tires, only 25% of tires arising during that period, so clearly this is feasible.

Variations on the basic theme
The above scheme is one way of implementing this – strings of connected by sand fencing.

It would be equally possible to simply randomly drop the ADMEs with a pre arranged spacing using a sort of carpet bombing technique separately from

the sand fence. In this variation, each ADME might only have its own diameter's length of sand fencing and two self erecting supports.

Comment [G15]: Own drogue for each system? Might work better

The sand fencing could be delivered from a continuous length, carefully stored in the aircraft so that it could be deployed in a continuous length by the use of a single drogue at one end to pull the lengths out. The fence would be loaded and stored in a suitable way such as some form of layered concertina with lengths folded back and forth across the width of the aircraft fuselage in the vertical plane, so that the length could be continuously withdrawn again using a drogue parachute to initiate the deployment.

Comment [G16]: No – either ripped fencing or crashed aircraft
DA – yes probably impractialy

This would typically comprise pallet sized sections of fence, stored vertically but packed in a concertina fashion. Each pallet would be connected by links once the aircraft was fully loaded by specially trained air crews.

More traditionally, pallets for fencing could be simply air dropped and erected by waiting ground crews.

China is not short of labour, and these could be deployed on the ground to receive and erect the fencing once dropped and laid out into position.

Comment [G17]: How deployed and supplied?
DA see latetr

Fencing stakes could either be again dropped from the air along the line of a fence at the appropriate spacing in a manner similar to precision bombing or simply incorporated into the sand fencing – one manufacturer already offers just such a product, which could be finally erected by ground crews.

Such roving crews could be deployed for lengthy tours of duty – say one month on and one month off, fed and watered by air drop.

Comment [G18]: What happens in bad weather? How do they RTB?
DA Survival tents – KISU Helicopters?

There are many variations on the basic theme of mass drop of components and only detailed logistical study and discussion with desert control experts can determine the optimum method.

Phase 2 – Sea Water Green House and the Gobi Forest

The basic problem with the central Chinese deserts is that there is not enough water. This has been largely man made, due to over-cropping and deforestation, and subsequent over pumping of fossil water (but is possibly also due to climate change limiting melting or snowing on Tibetan glaciers) . There is now as previously noted a catastrophic increase in soil loss, which in turn feeds back into further vegetation and soil loss and aridification.

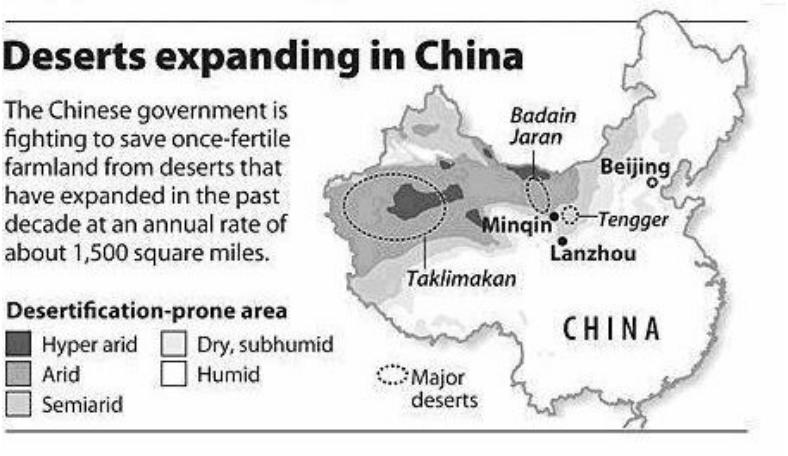
How can we get more water to this area? Desalination of sea water by conventional means is not a solution, since for every litre of fresh water produced, about one litre of oil is needed and this is prohibitively expensive.

A much better solution is the cheap and simple Sea Water Green House.

http://www.seawatergreenhouse.com/

The Sea Water Green House uses solar energy to evaporate sea water sea water and achieves two things:

1. The evaporation causes cooling sufficient for plants to be grown within the green house.
2. Water vapour can be condensed to create sufficient water to grow food crops within the green house and to provide drinking water and clean water for other purposes. They are relatively cheap (being essentially a poly tunnel type green house, with plastic tubing used as heat exchangers), easy to erect and have low running costs. The major operational cost would be the pumping of seawater over quite large distances from the sea to the deserts. However pumping costs are not as high as commonly supposed.



…….some stats to come – now supplied.

Comment [G19]: LIBYA is doing this, could the proposal be trialled there?

From the above, the centre of the Taklimakan deserts can be seen to be about 3500 km from the coast.

To pump the entire output of a small regional water company – say Wessex Water, 353 Ml per day 300 miles / 483 km with a 100 m lift via a 3m dia. pipe would require 7.3 MW continuous running pumps,.

To pump this same amount of water 3500 kM, with the same head, static lift and same pipe would require continuous pumping of 17.5 MW. (static head clearly dominates)

To pump the entire water demand for the UK, 13,234 Ml/Day, 3500 kM, (http://www.water.org.uk/home/policy/reports/sustainability/indicators-2005-06/towards-sustainability-2005-2006.pdf) would require a 13234 / 353 = a 37 fold increase in power and pipe sizing.

Thus 37 x 3 m pipes would be needed, with a continuous power of 656 MW.

656 MW is the output of one steam turbine set of which China presently has an signalled capacity of about 300,000 MW.

This may seem a colossal undertaking, but for example, by eye from the above http://en.wikipedia.org/wiki/Image:Canals_USA_1825.png there are about 60 x 300 mile = 18,000 miles of fairly large width canals in the US largely constructed over a 50 year period with manual labour.

This is not beyond the wit of china to perform this task in say a 20 year period. Another example is the Great Wall of China constructed over a mere 30 years when the population of China was much smaller.

Not only could this scheme could allow the deserts' growth to be ended, and brought back into food production, but would also allow the area to be reforested and re populated.

The phasing of the various components would have to be carefully worked out and scheduled since the green houses could be destroyed unless there is

sufficient abatement of storms, and or the production of shelter belts from trees; the two clearly go hand in hand.

Once established, there is also the possibility of using the plant-growing possibilities of the solar green house, for oil producing plants such as Jatropha being converted to biofuels.

Other biofuels can produce food for human consumption ie starches, and the woody stems converted to fuels.

Phase 3 – Energy Generation.

The area presents excellent opportunities for power generation.

There are two main contenders all proven technologies:

Wind power

Comment [G20]: OK, but how would the resource be affected as wind speed drops and 'wind-broken' dunes start to form behind and ahead of the turbines?

Wind power is one of the fastest growing and cheapest forms of renewable energy. Present world capacity is about 94 GW and growing at the rate shown below with is up to 32% compound and accelerating.

Year, end	2003	2004	2005	2006	2007
Total Wind Capacity, GW	43	51	62	83	100 +
Increase, GW		8	11	21	
% increase		19	22	32	

Because wind only produces on average at about 1/3 of its installed capacity, this represent an average rate of world production of about 33 GW.

For comparison, total world installed generating capacity of all types in 2004 was 3,741 GW with a total world consumption of 16,790,000 GWh /year.

http://www.eia.doe.gov/oiaf/ieo/excel/ieoecgtab_1.xls

To get a meaningful comparison, therefore we need to divide 16,790,000 GWh / year by the number of hours in a year, 8760, and we get the average rate of world production of 1917 GW, so presently world wind average output is 33 / 1917 x 100 =1.72 % of world demand but rising fast.

Wind speed maps for the Chinese desert areas

Inspection of the wind speed maps for the Chinese desert areas indicates that there are numerous areas with sufficiently high average speed to justify the installation of wind turbines.

Indeed, one author goes so far as to say:

“The high plains of Nei Mongol, in particular, which have very little vegetation and hence a low surface roughness, have an especially attractive wind resource, with mean speeds exceeding 9 to 10 m/s in some areas.
The proximity of windy land to Beijing and other population centers bodes well for the useful application of wind energy in China. It appears likely that China has greater potential for the use of wind energy than most other countries in the world.”

New High-Resolution Wind Resource Maps of China

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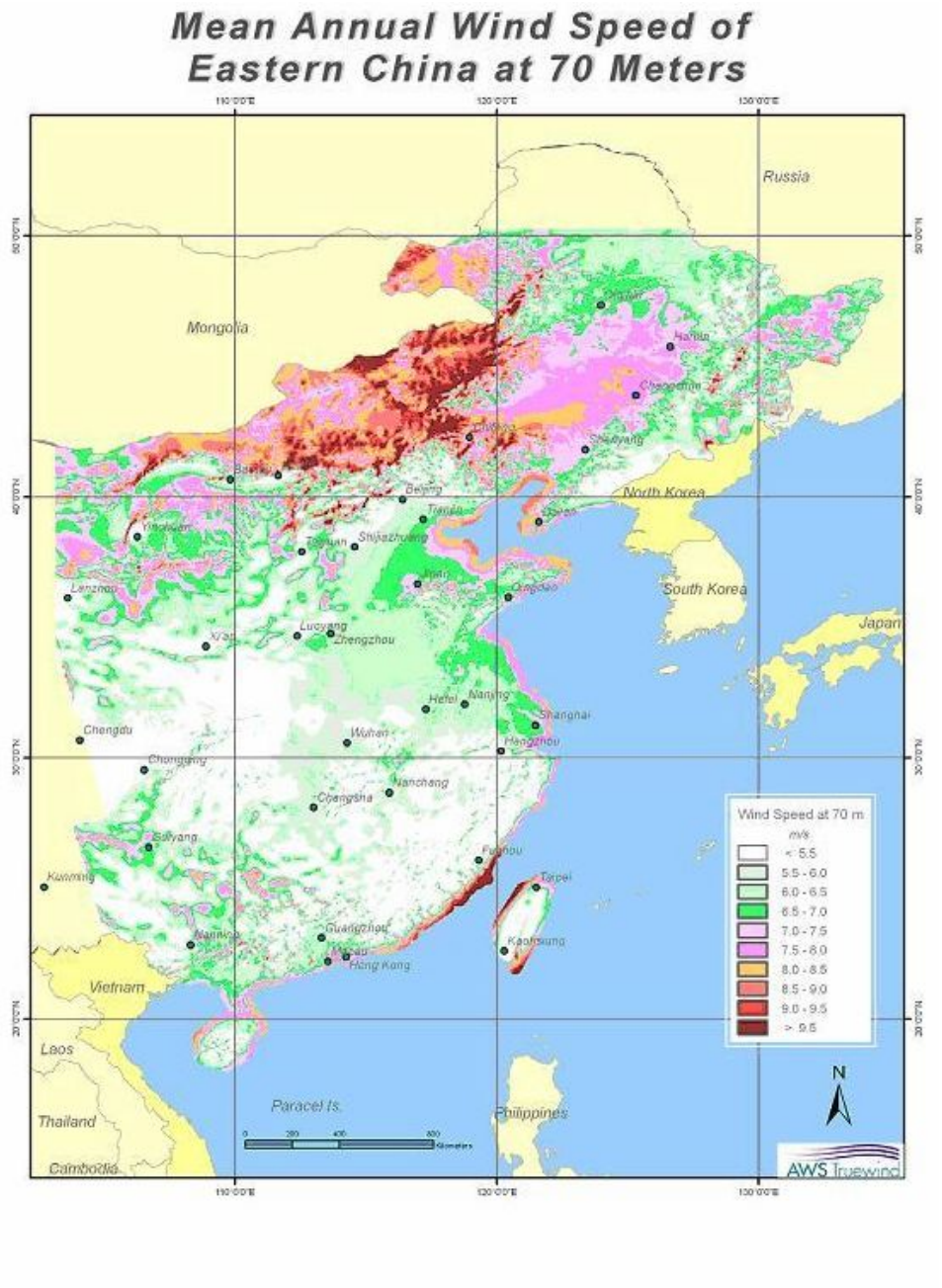

Mean Annual Wind Speed of
Eastern China at 70 Meters
Russia
Mongolia
North Korea
South Korea
Japan
Vietnam
Laos
Thailand
Cambodia
Philippines
Paracel Is.
Harbin
Changchun
Shenyang
Beijing
Tianjin
Shijiazhuang
Taiyuan
Jinan
Qingdao
Lanzhou
Xi'an
Lucyang
Zhengzhou
Hefei
Nanjing
Shanghai
Chengdu
Wuhan
Hangzhou
Chongqing
Nanchang
Changsha
Kunming
Fuzhou
Taipei
Nanning
Guangzhou
Macau
Hong Kong
Kaohsiung
Wind Speed at 70 m
m/s
< 5.5
5.5 - 6.0
6.0 - 6.5
6.5 - 7.0
7.0 - 7.5
7.5 - 8.0
8.0 - 8.5
8.5 - 9.0
9.0 - 9.5
> 9.5
N
AWS Truewind

Rapid installation techniques

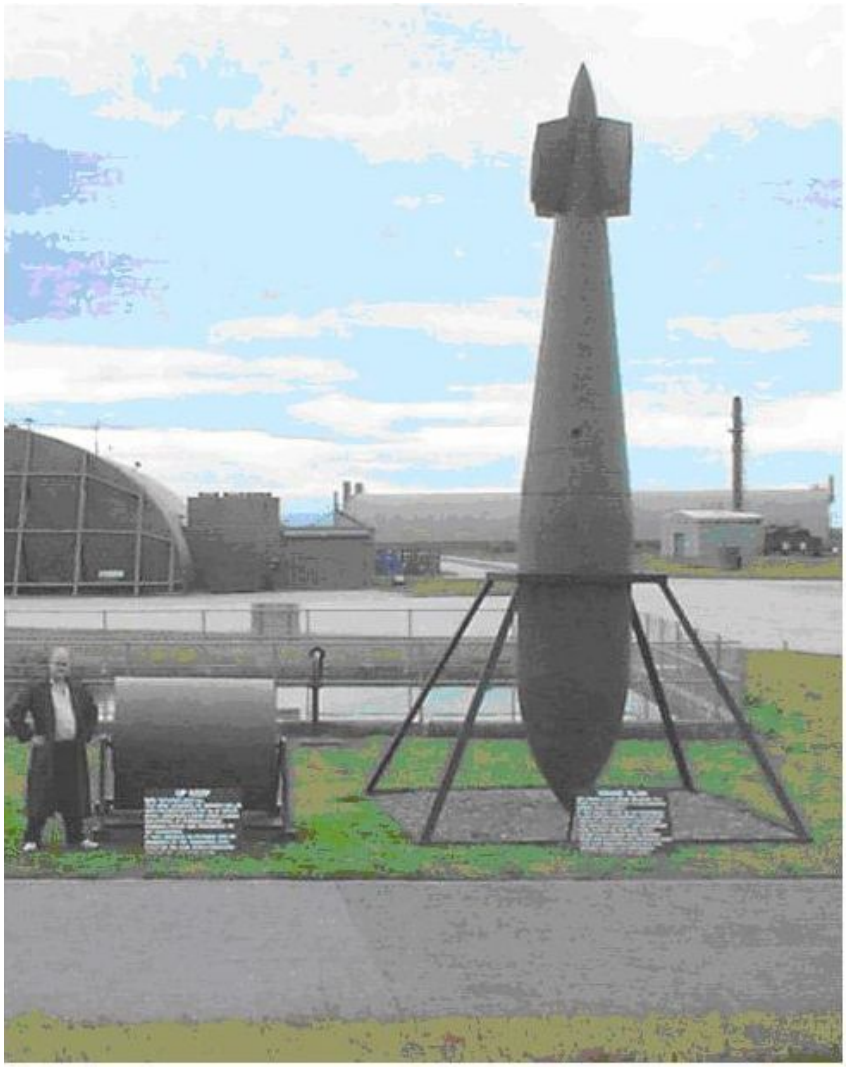
The more than 40 Chinese turbine manufacturers now operating supply 56 per cent of the Chinese market, up from 41 per cent in 2006, could be capable of building these turbines a the required rate – to achieve the required rate of building up is simply a question of building more turbine factories.

Rapid turbine installation methods

Traditionally wind farms on shore have had fairly large access roads built to transport the very heavy items of plant – towers, blades, gear boxes and so on, plus the very large cranes to install these items on the towers. This clearly would be a huge undertaking in a remote desert environment of Northern China.

Whilst this may in fact be the best method, an innovative approach may be to use advanced air based techniques, as used in eg precision guided bombs, and heavy lift helicopters.

Tower installation using smart bomb techniques



The gentleman in the picture is unknown but gives an idea of the scale of Barnes Wallis Grand Slam.

Various nations around the world have developed bunker busting bombs which have enormous penetrating power BEFORE they explode, and can penetrate 100 of feet into the ground before exploding and these can be guided with great accuracy as they fall.

Comment [G21]: Need to use the Chinese TU-16 variant to get anywhere near a decent payload

Even in World War 2 Barnes Wallis' 10 tonne Grand Slam could penetrate 15 ft feet of reinforced concrete BEFORE detonation, simply due to the kinetic energy picked up during descent from 20,000 feet during which terminal velocities were supersonic – nowadays these device could be heavier - some Russian planes can lift 180 Tonnes.

http://en.wikipedia.org/wiki/Bunker_buster#cite_note

The type of soils and rocks in the deserts in question are much much weaker than reinforced concrete and it should therefore be possible to devise a method to drop either a pilot dart, or even the first part of the 60 m high pre-fabricated steel towers, directly to self embed into the desert floor.

Comment [G22]: Exactly the problem. Grand Slam relied on the propagating shockwave of its hit destroying the concrete UNDERSIDE of a boat pen roof as much as its own explosives. Softer and less dense material will lead to a great big crater, but less penetration
DA – ok fair point.

Drop parameters – eg height, type of hardened nose cone, weight of tower, would need to be individually adjusted to suit the depth of sand, hardness of soils and rocks etc based, based on prior aerial geophysics surveys, to ensure optimum penetration, and of course feed back from the previous drops in the locality.

Comment [G23]: It would be cheaper to build roads
DA ok quie possibly - but huge areas….?

Depending on hardness actual explosive bombs may need to be used initially, with the actually tower base following later, again all laser guided, simply a dumb penetrator.

It is unlikely to be possible to entirely embed the tower from the air in this way with sufficient rigidity to resist over turning moment so concrete grout will needed to be added at a later date to consolidate fractured and fissured soil around the drop site. Again this could be shipped in by heavy lift Antonov aircraft which can carry 120 T and air dropped.

Comment [G24]: MUCH cheaper

Pouring concrete to consolidate ground fissures or craters, is likely to use far less concrete and excavating machinery than the traditional method of digging a large hole and then entirely filling this with concrete.

Comment [G25]: Not ground fissures, craters

Additional tower lengths would be added later to build up to the correct height, lowered from heavy lift helicopters, or possibly sections could again be air dropped using a variant of the LAPES technique.

Comment [G26]: Helicopters maybe, depending on weather. Air dropped sections may be more trouble than they're worth, in that they'll likely be at least slightly damaged and therefore more difficult to install.
DA fair point but worth looking at.

The rotors and blades could then be installed onto the towers using for example the Russian heavy lift Helicopter the MI — 26T can lift 20 tonnes — far more than the weight of a blade but not the rotor.

http://www.rostvertolplc.ru/ENG/type26.htm

Rotors may need to be shipped in using rough terrain vehicles such as bulldozers towing trailers or even roads may have to be built.

Airship derivatives

Airships have been coming back for years and never quite got here, nevertheless, CargoLifter AG, based in Berlin, is claimed to be developing a 260-meter-long and 65-meter-wide airship for the transport of oversized and heavy goods weighing up to 160 metric tons - the CargoLifter CL 160. This "flying crane" will ot os claimed, be able to carry out expensive heavy transports faster, more simply and more cost efficiently - without ever touching the ground and almost entirely independent from the local infrastructure. Already, before the CL 160 is completed, it is claimed the logistics company's second product line will go on the market: the CL 75 AC transportation balloon, which has a diameter of 61 meters and is able to transport up to 75 tons.

Potential power from wind

In Europe turbines can be sited at the rate of 10 per mile, and generate a maximum of 3 MW of power at peak.
Typically on average they only generate at about 1/3 of their maximum output.
So if the entire Gobi (say 400 miles x 1000 miles) were covered in wind turbines at European spacing, this would imply:

400m x 10 x l000m x 10 = 16,000,000 turbines.

They would generate at an average rate of:

16,000,000 x 3MW x 1/3 = 48,000 giga watts or GW

To put this number into perspective, the average output of Drax, the largest power station in Europe is 4 GW, and the average output of the entire UK national grid is 30 GW and the entire world power demand is 1917 GW

Thus the Gobi wind farm project, could generate 25 times the power requirement for the entire world

How to get the power to where it is needed

Power would be shipped to the parts of China where it is needed, in the South, by a network of overhead power cables. Modern High Voltage Direct Current – HVDC is much cheaper than the old AC and the losses are considerably lower – about 3% per 100 km. The world’s longest HVDC link is currently the Inga-Shaba 1700 km 600 MW link connecting the Inga Dam to the Shaba copper mine, in the Democratic Republic of Congo

China is already building some fairly large HVDC systems

Three Gorges link - China

China installed two 975 km long distance HVDC links from the Three Gorges

power plant to the major load centres in Shanghai and Guangdong. This involves two 3000 MW HVDC transmission systems.

The HVDC link from Three Gorges to Guangdong has been built in record time – 32 months.

See: http://en.wikipedia.org/wiki/HVDC

Effect on climate and wind regime

The presence of all these wind turbines would itself stabilise the climate by again slowing down the wind, near the ground, quite literally, which will assist in taming the deleterious effects of the high winds.

It is quite possible that steel cables could be connected form tower to tower supporting quite large and heavy duty nets again to promote sand settlement – albeit this would to some extent limit the output of the turbines by lowering surface wind speeds, however this would mainly be a near surface effect and the majority of a turbines' power is generated from the winds much higher from the ground.

Concentrating solar power – CSP

Concentrating solar power may be another alternative or addition to wind power. This could easily be installed on the ground below and between wind turbines.

Comment [G27]: CSP would disturb airflow

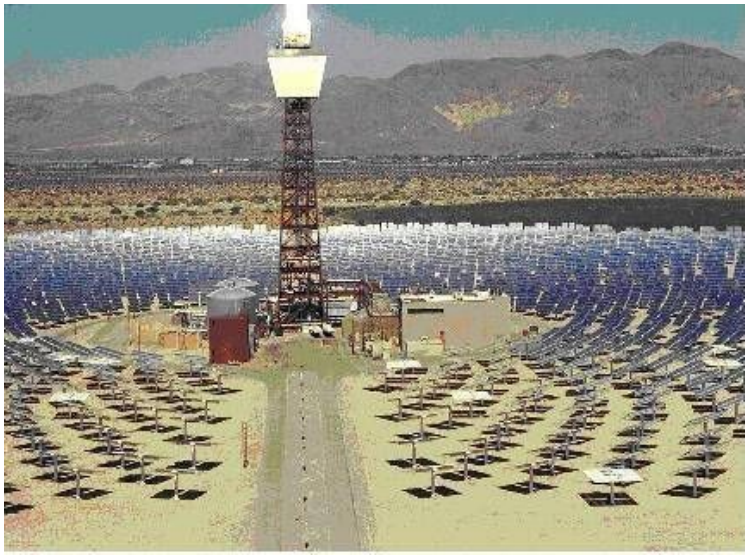
CSP has now been around for 20 years and simply involves using computer controlled mirrors to in effect direct heat onto a power station boiler, where the resultant high pressure steam is used to drive a standard steam turbine power station.

See http://www1.eere.energy.gov/solar/csp.html

This solar thermal power plant located in the Mojave Desert in Kramer Junction, California, is one of nine such plants built in the 1980s. During operation, oil in the receiver tubes collects the concentrated solar energy as heat and is pumped to a power block (in background) for generating electricity.

This solar dish-engine system is an electric generator that "burns" sunlight instead of gas or coal to produce electricity. The dish, a concentrator, is the primary solar component of the system, collecting the energy coming directly from the sun and concentrating it on a small area. A thermal receiver absorbs the concentrated beam of solar energy, converts it to heat, and transfers the heat to the engine/generator. (Credit: Sandia National Laboratories)

http://www.trec-uk.org.uk/csp.htm



Time scale.
Total Chinese generating capacity is forecast to grow as follows by the IEA, the Energy Information Administration of the USA.

http://www.eia.doe.gov/oiaf/ieo/ieoecg.html

2004	2010
391 GW	510 GW
Build rate	19.8 GW/y

Clearly if the Chinese government were to direct its manufacturers efforts into producing wind turbines, it could rapidly switch away from fossil fuels.

Appendix 1 – Seawater Green House

Hi Dave

A well managed greenhouse will produce 50kg of tomato / m2 / year. Tomato is the most common greenhouse crop, so lets stick with that as a reference.

That equates to 500,000kg / hectare / year.

In somewhere hot and sunny, a 1 hectare Seawater Greenhouse will evaporate between 50-100 tons of seawater water / day. About 10% of that is converted to fresh water and used to irrigate the crop, but then the crop transpires it anyway, so it all ends up as humid air.

If we take Almeria and Murcia in the South of Spain as a reference, they have 44,000 hectares of greenhouse, so if they were magically converted to the SG process, we would be taking somewhere between 2-4 million tons of water out of the sea every day and evaporating it. Not enough to halt sea level rise, but a start. What goes up must come down, but I don't know enough about the climate or wind patterns there to suggest an answer.

I believe, but am not sure, that there are over 2 million hectares of greenhouses in China which have all sprung up recently. I have looked at China and can' t think of an answer, as the Gobi Desert is so far inland and the wrong side of the Himalayas. Much of China is temperate / tropical, with cold winters, so not an ideal candidate for the SG.

North Africa and the Sahara looks much more interesting to me as there is agriculture and tree growth all around it, and a coast that wraps around 2/3rds of it. Egypt, Tunisia, Libya and Morocco all have inland depressions that are below sea level, which solves the pumping problem. Some of them have a mountain range downwind which would help to enhance precipitation from the water we evaporate.

There have been great strides with tree planting in Mali and Niger, see the attached article, and there is a lot more about it here www.frameweb.org/nigerregeneration

It is amazing how effective it has been, and rather illustrates what can be done with a push and a shove! Its just a question of tipping a very delicate balance.

By the way, do you know why Thames Water are so keen to build a desalination plant on the Thames? Seems barmy to me?

Cheers
Charlie Paton

----- Original Message -----
From: Dave EU Andrews
To: 'Charlie Paton'
Sent: Thursday, May 22, 2008 4:47 PM

Subject: RE: Pipe Head loss & Power calculator - pumping all of Wessex Waters output 300 miles with a 100 m rise

Charlie - can you give me a specific, if highly estimated, idea of how much sea water you would need for a Greenhouse for a given area, and how much food and water you could produce, all very approximately?

I have calculated the power and number of pipes I need to pipe the entire UK water usage to the deserts in Central China - but what I need you to tell me, is what area that would de desertify and how much food you could grow.

Cheers

David Andrews

Claverton Energy Group

01225 837978

07942 750022

3 Victoria Place, Combe Down, Bath BA2 5EY

To see the new forum go to:

http://www.energyresearchgroup.eu

click on "Main Page" under Forum Links on the Left side

Then "Register* - supply a user name and password, then you are away.

Apendix2
LINKING ADAPTATION TO CLIMATE CHANGE, POVERTY REDUCTION AND SUSTAINABLE DEVELOPMENT IN DRYLANDS:

How to move from research to action in the post-Bali era?

International Institute for Environment and Development
VU University Amsterdam

IED Afrique
IUCN Senegal
Réseau MARP Burkina Faso
CRESA, Université de Niamey
Australia
Drylands Coordination Group, Norway

ICCO
Both Ends

SOS Sahel UK
Tree Aid
Near East Foundation
World Vision

CARE Denmark
and other partners

January 2008

Introduction:

The purpose of this paper is to i) highlight the unprecedented reforestation gains made in Niger Republic over the last twenty years ii) outline some of the beneficial impacts of this phenomena, iii) offer a way forward for publicizing and replicating the Niger success story in other Sahelian countries.

Niger: re- greening at a spectacular scale

This note describes some of the impacts of the recently uncovered and surprisingly large-scale management and protection of on-farm vegetation by farmers in densely populated regions of Niger and how these findings have inspired the development of a substantive new initiative for the re-greening of parts of the Sahel.

In some regions of Niger farmers began protecting and managing on-farm trees in the middle of the 1980s. Remote sensing images and field visits show that this farmer-managed re-greening in Niger now concerns at least 5 million ha. This means an average increase in on-farm protection of trees of *250,000 ha/year over a period of 20 years*. This has never been achieved by any tree planting project in Africa.

Five million hectares x an average 40 trees/ha means 200 million new trees. If each tree produces an average annual value of 1 Euro/tree (firewood, fodder, fruits, medicinal products, etc.) *this means an annual production value of 200 million Euro*. This does not yet include the value of the standing tree stock (asset building).

In some places projects have played a key role in stimulating farmers to protect and manage on-farm trees, but it subsequently spread spontaneously.

What has triggered farmers to protect and manage on-farm natural regeneration in Niger? [1]

1. The environmental crisis of the 1970s and 1980s (the need to fight dust and sand storms, land degradation, declining crop yields, etc.)
2. The perceived shift in rights to trees from State-owned to private ownership.
3. The need to intensify production systems in reaction to strong demographic growth.

Which are some of the measured or perceived impacts of this farmer-managed re-greening?

1. *Higher crop yields and improved household food security*. Before the farmers had to sow 2 – 4 times before the crops succeeded as the strong winds covered the crops with sand or wind-blown sand razed the young plants. Now they only sow once, which increases the length of the growing season.

2. *The local climate has changed* as wind and sun do not scorch the soil. Rainfall studies have shown that large-scale re-greening also leads to locally higher rainfall (+ about 30%). (Nicholson et al.

3. *The farming systems become more complex, more productive, which leads to a reduction in rural poverty and increases in household food security*. Trees produce fodder, which allows farmers to keep more livestock. More livestock means more manure, which is no longer used as a source of household

[1] The impacts mentioned are based on an exploratory study by Larwanou, M., M.Abdoulaye and C.Reij (2006), Etude de la Régénération Naturelle Assistée dans la Région de Zinder (Niger): une première exploration d'un phénomène spectaculaire. This report as well as other information about the re-greening can be downloaded from: www.frameweb.org/nigerregeneration

energy, but is all used to fertilize the fields and subsequently increase productivity.

4. *The time women spent on the collection of firewood has gone down from about 2.5 hours/day to 0.5 hours/day*.

5. *The re-greening has reduced vulnerability to drought*. During the 2005 famine, child mortality in villages which had protected natural regeneration was much lower than in villages without.

6. In some regions farmer-managed natural regeneration is dominated by *Acacia albida* , but elsewhere *tree biodiversity is increasing*.

7. The economic benefits to farmers of investing in the protection and management of on-farm natural regeneration are high. A study by economists, which is based on a review of some of the benefits, shows *an internal rate of return of 31%.*

The challenge is now to move from research to substantive action.
How to promote re-greening of the Sahel based on farmer-managed natural regeneration?

1. It is vital that national legislation supports investments by farmers in trees and *a vital policy measure is that farmers are granted exclusive rights to the trees on their fields.*

2. It is important to *identify and analyze existing grass-root success stories* in farmer-managed re-greening in the Sahel and use these success stories as a basis for organizing farmer study visits which are a proven tool for spreading good practices. There are numerous cases of farmer-managed natural regeneration in the other Sahel countries.

3. *Use mass media* to inform the farmers and the widest possible audience about success stories, the impacts of farmer study visits as well as about forestry legislation.

How to organize substantive on the ground action?

1. In each participating Sahel country (at present Niger, Burkina Faso, Mali and Senegal) *a national alliance of NGOs and other partners* is created. All partners in the national alliances will jointly promote the protection and management of on-farm natural regeneration by farmers.

2. *An international alliance of NGOs and research institutions* has been created to support the national alliances.

Conclusion

Promoting farmer-managed natural regeneration in the Sahel is complex, but it contributes to realizing some of the MDGs as well as the international environmental conventions on climate change, desertification and biodiversity. It also offers a cheap, rapid and sustainable means of fulfilling the African Heads of state desire to combat desertification through the Green Wall initiative, without repeating the mistakes and failings of previous similar movements. This is an opportunity for developing *substantive civil society action on the ground, which builds on existing grass-root success stories*.

To become involved or for further information about the initiative you can contact:

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