Free Life The Journal of the Libertarian Alliance
Vol. 5 : No.4 - *Article 4 of 6*

No Alternative

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Although the Club of Rome is talking a great deal of nonsense and the fossil fuels - gas, oil and coal will last a great deal longer than they would have us believe, it is of course a fact that they will not last for ever. What is more, they are indeed very dirty materials and they are polluting if used for energy production. Besides that we can make much better use of them in our chemical industries. So it is well worthwhile to look at alternatives for energy production and when I was told that there was an exhibition at Euston Station run by a pro-nuclear power lobby, I went there. All that was being exhibited was a short film, in which we were told that nuclear power is safe and should be used, but that only a small proportion of our energy needs could be covered by it, and that research into "Alterative Energies" had to continue. When I left the exhibition, I was convinced that it was high time that someone discussed all those "Alternatives" and made sense. That is what I am going to do now. I will use standard international units throughout this essay. (1)

The Sun

Solar energy reaches the earth at a rate of 1400W/m2 but much of that is reflected and absorbed in the atmosphere. Basically there would be two methods to receive it down here:

1) We could turn the energy into heat and run turbines with it. That would be a fairly robust method.

2) We could convert the energy into electricity directly. That would be a less robust method.

With the first method we would gather the radiation of the sun to achieve an increase in temperature. Now obviously we could either heat a large or a small surface. If we were to heat a large surface, we would bring the water nowhere near to boiling point, no matter how well we were able to prevent reflection. Water that is not boiling is no good for running a turbine. It might still he used as direct heating, but what good is heating that only works in hot weather anyway?

So what if we concentrate the radiation and heat a small surface instead? This would require a system of large mirrors. Power stations of this kind can indeed be run in tropical and subtropical regions; all that such systems need is a fair amount of cloudlessness, or else we will once again end up with power only when the weather is good. Even in the desert there would be many problems with the servicing needed by such mirrors. They would have to be covered up in the event of a sandstorm to prevent damage. In our region such power stations are not suitable at all. Our weather is not good enough; there is a lot of turbulence in our air and it contains too much dust; this would damage the mirrors, so would heavy rain and hail would totally destroy them. It wouldn't help us either to put the whole power station under a glass dome for then we would simply have to polish and service that instead of the mirrors.

The next problem would be that the mirrors would have to follow the sun. To achieve that we would need a system of sensors and motors for each mirror and a computer that works out how each mirror should he positioned at a given time. One of many nuclear power stations in France is the power station of *Kattenom*. Its power is 1300MW. To match that with mirrors we would need to have mirrors with a total surface area of 1 km^2. Just consider the cost of those mirrors and their short lifespan!

We might use solar cells instead of mirrors. But again these would have all the same problems as mirrors, they would have an equally short lifetime and they would be even more expensive.

Todays solar cells only have an electrical output of 15% of radiation received. Each cell gives a very small voltage, so a large number of cells would have to be connected (cabled up) to give a high voltage net.

For a reasonably high voltage at least 100,000 cells would have to be placed in series connections. The current itself would be small even then and should one cell fail, the current will be interrupted. The other possibility is to connect a number of cells in parallel connections and then a number of these in series connections. But whatever we do, there is a problem: The current will be a direct current and most of our electrical equipment runs on alternating current, so we would have to change the direct current to alternating current first. This would then give a conventional result, except that there would be many fluctuations.

The voltage amplitude must be constant if we want to use the energy, this would be accomplished as long as the current flows at all. What would not be accomplished is, that the current itself would be constant. It would change by the second and if a cloud would move in front of the sun, it would collapse altogether. With an efficiency of 15% we would need 7km^2 of solar cell arrays to replace a power station like *Kattenom*.

Whether we would use solar cells or mirrors: We are living far north, there are long shadows and no cell array or mirror could be placed in the shadow of another. Let us consider the case of winter solstice noon local time in the south of England: The sun will be 15º above the horizon, so to avoid the mirrors being in each other's shadow at that time, they would have to he placed in an area 3.86 times as large as the initial area. For mirrors that would he 3.86km^2; just before and after midday in winter they would still be in each other's shadow, i.e. in winter even a power station of such dimensions would reach the output of *Kattenom* only at midday and it would not be at full power on summer mornings and evenings either. Even if the efficiency of solar cells should increase, so will the need for energy and even if the development of solar cells could compete with our need for power for a while it would soon reach a limit, the use for electricity wouldn't. We would end up with power stations of several tens of kilometres in size and as the clouding of the sky in such an area varies considerably, so would the radiation received by different parts of the station.

So to know the power that the station would deliver within the next second, we would not only have to know when there is a cloud in the sky but also where. We will have to know the shape and size and speed of all the clouds between the station and the sun and then we will have to predict which parts of the station will be in light and which in shadow within the next second. There is no software that can accomplish such a task, nor is it possible to develop such software at present or in the near future.

But let us believe in miracles for a moment: We would need some central office to obtain from all power stations nationwide data on how much power they will produce the next second. The central office would then have to work out the total power of the national grid and to keep the output constant somehow. Two situations would he imaginable:

Much of the total power is produced with non-solar power stations. Then the central office will have to tell these stations - second by second - what extra power they will have to cover and they will have to react immediately. Turbines in conventional power stations will have to be on and off in seconds to counteract the fluctuations.

If most of the power were produced by solar power stations, we would have no power at all at nights. We would also need a large surplus of power stations. The central office then works out the total power at the grid as above and turns off those stations that are not needed. Should there be a nationwide period of bad weather the supply will have to be rationed. The most harmless method is that which the German Federal Government proposed in 1979: All machines that use a lot of power - such as washing machines and cookers - would be fitted with a remote control and when the supply became scarce the government would turn them off. (2)

For the purposes of the methods of production considered above, energy storage devices should he considered as a form of power station that might be put into operation as required. Storage of large amounts of energy is technically difficult and expensive and doesn't make this form of generating energy any cheaper We will also have to consider that this would leave us

with very little energy in winter when it is needed most.

There is one other idea about solar energy though: A power station in orbit. This would have none of the above problems. One of the proponents of this idea is Isaac Asimov. Let him speak for the method as he did in one of his short stories: "... the two earthmen knew the value of naked-eye appearances. Deviations in arc of a hundredth of a milli-second - invisible to the eye - were enough to send the beam wildly out of focus - enough to blast hundreds of square miles of Earth into incandescent ruin." (3)

I don't know about you, but I'd much prefer to live in a giant microwave oven. No computer can direct a beam that well, let alone a human being. But some people have come up with the grand idea to use a laser beam for this purpose, which would of course be much more concentrated and do a lot more damage. Could those with a taste for disaster please stick to the movies?

The Wind

Unlike clouds, you cannot see the wind coming and it is therefore much more difficult to predict where it will be next. However a turning propeller doesn't stop immediately when the wind stops and the change of power would be continuous. A large plant would need to be able to predict wind speed, but that could be achieved by simply placing a small propeller in front of every large one to measure the wind. The force of the wind is proportional to the square of the wind speed, the power it can generate is there-fore proportional to the cube of the wind speed which means that the capacity of the propeller would he very much dependent on the wind speed. The conversion of the rotational energy to electricity would be no problem. Either we could create a direct current which could then be converted to alternating current for use in our grid, or we could create an alternating current, which is technically easier but less useful as the frequency would vary with the wind speed. The conversion into electricity would be possible with high efficiency. Therefore the main aim would be to convert as much wind energy as possible into the rotational energy of a propeller. If this conversion were to take place with much loss we would need many propellers and that would result in high cost. If the conversion could take place without much loss, we would have relative calm behind the first propeller. Any large-scale application of wind energy would result in a substantial lowering of the wind speed countrywide.

The claim that this form of energy would not change the climate is therefore wrong. But let us see just how much wind energy such a propeller could deliver. Assuming a wind speed of 10m/s, which is extremely bigh, and the air having a density of about 1.3kg/ml we arrive at a pressure of 65Pa. So to arrive once again at a power output equal to that of *Kattenom*, which was 1300MW we will have to use the wind of a certain vertical area.

To work that out, we will have to divide the required power ($1.3x10^9$W) by the product of pressure and wind speed (65Pa x 10m/s). We then arrive at the result, that the area would have to be about $2kM^2$.

The largest project of this kind was initiated by the German Ministry for Research and Technology under the name of *Growian* in 1979. It consisted of a tower which carried a propeller that was 100m in diameter; when that huge propeller turned once it moved through an area of $7850m^2$. What we need is an area of 2 million m^2 however. So if each windmill could convert all the wind energy we would need 255 windmills the size of *Growian* to replace one station such as *Kattenom*. And those are the people who are against tower blocks! Nor could we place those windmills behind each other, for those behind would he becalmed. We would have to place them one next to the other and leave enough space between them so that the propellers will not collide. So for more than 25km we would have to place one such tower at about every 100m. Should we decide to use small towers instead, with propellers of, let us say, only 5m diameter then the propellers would have only 1/20 the height of *Growian* and we would have to place them 20 times as wide to make up for that, that means towers for over 500km (along the whole west coast of England as far as the Scottish border one tower every 5m, in all 100,000 towers to replace one station like *Kattenom*.) All that assuming

100% efficiency. *Growian's* actual power was 3MW. In an advertisement for this project the Federal Secretary for Research said: "*During recent years there was no project in non-nuclear energy research, that we didn't farther if it looked only half promising. We are presently spending 5 times as much for non-nuclear energy devices, including coal, as for nuclear power."*

As I said, Growian had a capacity of 3MW. The Germans assumed a wind speed of 6m/s rather than 10m/s which is realistic. And so the Secretary of State continues: "*... but it would take 500 to 1000 wind power stations like "Growian" to produce as much energy as a large nuclear power station, while an evenly strong wind is blowing.*" So much for that fantasy. Incidentally: If we had a network of such stations in the country we could be absolutely certain that within a few days virtually every bird would find its end in the propellers. Shouldn't that bother the proponents of such energy, people who are pretending to be oh so worried about nature?

The Earth

There is still geothermal energy to consider. It is done like this: You drill a few holes several km deep, two always next to each other; then you use high pressure to pump water into one, you let it trickle to the next hole deep down and take it back up from there. The water will have been heated in the earth so that hot water will come from the hole. When the pressure is released the water will turn into steam and the steam will turn a turbine. In 1961 the US army was drilling such deep holes in Colorado. They then used them to pump water into them (but only occasionally). Three years later geologist David M. Evans of the University of Colorado had measured 710 minor earthquakes with their epicentres underneath the hole. (4) That is how advisable this method is. We are lucky to live in a geologically fairly passive area and I suggest we should leave it at that. Physicists calculated in 1977 that even if the transport of this energy to the surface could be done 1 million times faster than it arrives by itself, we would have to cover 1/1,000,000 of the earth's surface - including the oceans - with such holes to cover the energy needs of 1977. These have of course increased since. (5) Even that would have been 650,000,000 holes! To replace Kattenom we would need 8450 pairs of such holes.

What all those projects have in common is this: They may be suitable for the Academy of Laputa or the German Ministry for Research. They are definitely not suitable for anyone who is still in his right mind. As we have seen, it is dead easy to prove on a piece of paper that these "alternatives" do not exist So if the state insists on doing research into them it would be better if they just burned the money. That money is tax money.

It has been forcibly taken from us to be, wasted on idiocies. I don't like it and neither should you. It is not only feasible to cover our basic energy needs through nuclear power, it is the sensible thing to do and it is being done right now, in France.

Nuclear power is energy at so low a price, that production using other forms of energy can not compete. The only worthwhile research we ought to be doing is that into nuclear fusion. As long as that is not developed, nuclear fission is the only source of energy that can support an economy with a future. If we don't use it, others will and we will be standing in the ruins of our economy looking like the idiots we would be.
Free Life

1) m=metre: km=kilometre (1000m): m^2=square metre: m^3=cubic metre

s=second: m/s= metre/second

Pa=Pascal (unit of pressure derived from the equation:

pressure=force/area defined as 1 Newton/$m^{2;}$ examples: normal atmospheric pressure is 101,325 Pa, the pressure in a car tyre is about 200,000 Pa.

W=Watt: MW=megawatt (1,000,000W)

2) As the *Westdeutsche Allgemeine Zeitung* reported on 7.02.1980. This was not reported as a scandal but as a good idea. We were assured, that we wouldn't have to expect "*more than 2.3 such turn-offs for 1 to 2*

hours a year per household" and that the Federal Ministry for Research and Technology was spending 2.3 Million Mark to make it possible. So this is how it will all start ....

3) I. Asimov: *I, Robot* 3rd chapter entitled *Reason*, Grenada Publishing 1979

4) Walter Sullivan: *Continents in Motion*, McGraw Hill, New York retranslated from its German translation: *Warum die Erde bebt*, Umschau Verlag 1977, page 299

5) Source: Gerthsen, Kneser, Yogel; *Physik*, 13th edition, Springer Verlag 1977 pages 28/29