10

Global Warming

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1. Introduction

The first person to write a paper on the possibility of Global Warming by a mechanism he outlined was Svante Arrhenius (1859-1927) {National Research Council, 2004} [1], a renowned Swedish physical chemist who was known particularly by his early ideas on electrolytes and their conductivity.

His idea about Global Warming depended upon the reflected light from the sun that he deduced would be likely to be absorbed by CO_2.

The date that this paper was first written indicates that it hardly caused a flutter on future ideas about the methods of obtaining energy.[1]

1.1 Global warming due to CO_2

The stress upon our dealing with Global Warming, predicted by Arrhenius has been thrust upon the CO_2 in the atmosphere that clearly depends on the amount of fossil fuels burned per unit time and therefore reflects the degree by which we use carbon-containing fuels to run our civilization.

Now, one has to understand first of all, the radiation from the sun comes into the earth's atmosphere at wavelengths which correspond to the temperature of the surface of the sun, the emitter, 6 million degrees and the wavelength of the irradiated light from a body of that temperature would be far from that which would get absorbed by the earth's atmosphere. After it has struck the earth, the earth itself absorbs about half of it whilst about half of it is reradiated into space, (Figure 1 {Robert A. Rohde, 1997}) from published data and is part of the Global Warming Art project) and is that part of the solar radiation that is partly absorbed by the CO_2.

However, this second half of the reradiated light comes at wavelengths that correspond to the temperature of the radiating body, i.e. our earth, so that the reflected light is in a wavelength corresponding to light coming from a body with at temperature of around 300^o K.

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[1] **Friedrich Wilhelm Ostwald** (September 1853 – 4 April 1932) [2], a renowned German chemist of the early part of the 20th century, wrote a paper which can be looked at, as parallel to that of Arrhenius. Ostwald was a savvy physical chemist and he saw something else which was parallel to the observations Arrhenius had made somewhat earlier. Ostwald spoke before the German society of scientists pointing out that if we went on burning the fossil fuels we would gradually evolve so much heat that the atmosphere itself would warm.

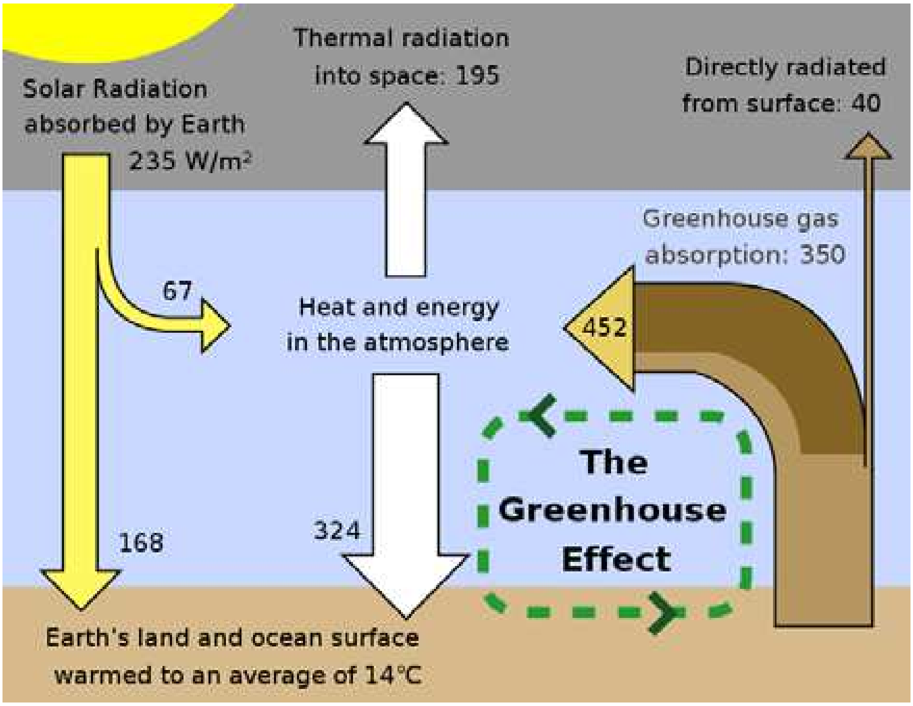


Fig. 1. This figure is a simplified, schematic representation of the flows of energy between space, the atmosphere, and the Earth's surface, and shows how these flows combine to trap heat near the surface and create the greenhouse effect. Energy exchanges are expressed in watts per square meter (W/m2) and derived from Kiehl & Trenberth (1997).The sun is ultimately responsible for virtually all energy that reaches the Earth's surface. Direct overhead sunlight at the top of the atmosphere provides 1366 W/m2; however, geometric effects and reflective surfaces limit the light which is absorbed at the typical location to an annual average of ~235 W/m2. If this were the total heat received at the surface, then, neglecting changes in albedo, the Earth's surface would be expected to have an average temperature of -18 °C (Lashof 1989). Instead, the Earth's atmosphere recycles heat coming from the surface and delivers an additional 324 W/m2, which results in an average surface temperature of roughly +14 °C.Of the surface heat captured by the atmosphere, more than 75% can be attributed to the action of greenhouse gases that absorb thermal radiation emitted by the Earth's surface. The atmosphere in turn transfers the energy it receives both into space (38%) and back to the Earth's surface (62%), where the amount transferred in each direction depends on the thermal and density structure of the atmosphere.This process by which energy is recycled in the atmosphere to warm the Earth's surface is known as the greenhouse effect and is an essential piece of Earth's climate. Under stable conditions, the total amount of energy entering the system from solar radiation will exactly balance the amount being radiated into space, thus allowing the Earth to maintain a constant average temperature over time. However, recent measurements indicate that the Earth is presently absorbing 0.85 ± 0.15 W/m2 more than it emits into space (Hansen et al. 2005). An overwhelming majority of climate scientists believe that this asymmetry in the flow of energy has been significantly increased by human emissions of greenhouse gases.

Now, the shape of the solar spectrum (see Figure 1) i.e. the plot of intensity against wavelength depends sharply upon the temperature of the emitter. The solar light incoming, as we have said, does not overlap the absorption bands of the CO_2 in the atmosphere. Conversely however, the radiation coming from the 300-degree emitter, our earth does indeed contain bands that correspond to those in which CO_2 absorbs. (Figure 2 {Robert A. Rohde, 2008}); Figure 3 {Tapan Bose & Pierre Malbrunot, 2006}).

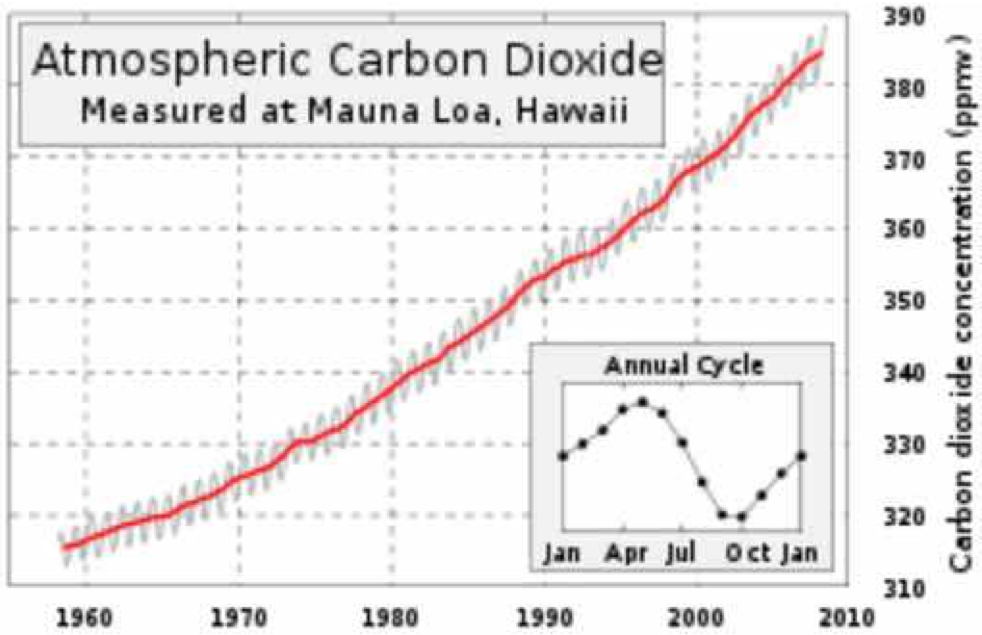


Fig. 2. The Keeling Curve of atmospheric CO_2 concentrations measured at Mauna Loa Observatory.This figure shows the history of atmospheric carbon dioxide concentrations as directly measured at Mauna Loa, Hawaii. This curve is known as the Keeling curve, and is an essential piece of evidence of the man-made increases in greenhouse gases that are believed to be the cause of global warming. The longest such record exists at Mauna Loa, but these measurements have been independently confirmed at many other sites around the world. The annual fluctuation in carbon dioxide is caused by seasonal variations in carbon dioxide uptake by land plants. Since many more forests are concentrated in the Northern Hemisphere, more carbon dioxide is removed from the atmosphere during Northern Hemisphere summer than Southern Hemisphere summer. This annual cycle is shown in the inset figure by taking the average concentration for each month across all measured years. Own work, from Image:Mauna Loa Carbon Dioxide.png, uploaded in Commons by Nils Simon under licence GFDL & CC-NC-SA ; itself created by Robert A. Rohde (2008) from NOAA published data and is incorporated into the Global Warming Art project. *Permission is granted to copy, distribute and/or modify this document under the terms of the* ***GNU Free Documentation License****, Version 1.2 or any later version published by the Free software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation license"*

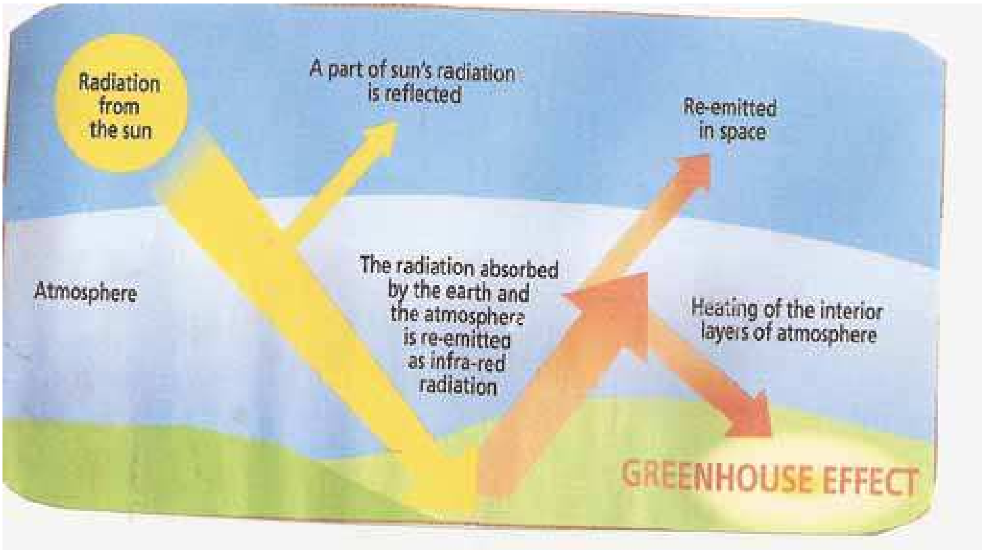


Fig. 3. From Tapan Bose and Pierre Malbrunot, et al, Hydrogen: Facing the Energy Challenge of the 21st Century, John Libby Eurotext, UK, December 2006, page 17.

It is possible to look at Global Warming in a mathematical way and that is exactly what the Turkish-American scientist, Veziroglu {Veziroglu, Gurkin, and Padki, 1989} with colleagues did in a paper to which we shall refer later on when considering contributions which could be made for the earth's temperature by other gases, e.g. methane [3].

Figure 2 shows the temperature rise in the atmosphere and it can be seen that the increase of the CO_2 with time has been of an exponential character.

The anxiety that has been produced in some citizens, who conclude that the earth will become too hot to sustain human life, can now be looked at with the facts. The first reaction is perhaps a sigh of relief. It's not going to happen at once but there are societies that would be sensitive in respect to the maintenance of life, and even due to a further rise of, say, 5 ^{o}C. (See section on methane.)

Such a country is Saudi Arabia, and also the surrounding countries in the Middle East. The government of Saudi Arabia has made a law there that should the surrounding temperature increase got to more than 50 ^{o}C (122 ^{o} F), then as far as is possible: no traffic, no machines operating, which produce significant heat. Heat bursts at 40 ^{o}C were experienced in France in 2007 and more than 1000 did not survive, but these people were above 75 years in age.

Looking then at Figure 4 {Jones, P.D. and Moberg, A., 2003}, it is seen that we have, at 2010, that the increase has already exceeded 1.4 ^{o} F.[2]

[2] The actual mechanism of the heat rise of the atmosphere comes through an intermediate stage when the excited CO2 molecules, absorbing the reflected light, collide with very many surrounding nitrogen and oxygen molecules of the air and transfer some of the excited energy in the vibrational bands to the translational energy of the air molecules. This means that they in turn travel faster, i.e. their molecular energy is increased and that in turn is the essence of Global Warming.

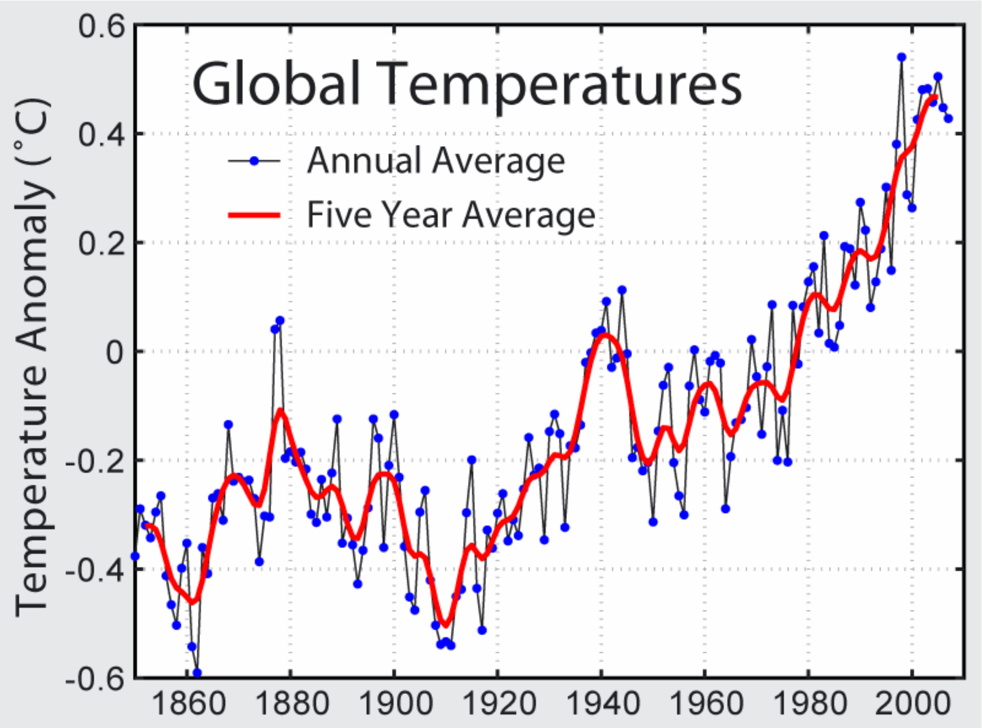


Fig. 4. This figure shows the instrumental record of global average temperatures as compiled by the Climatic Research Unit of the University of East Anglia and the Hadley Centre of the0 UK Meteorological Office. Data set TaveGL2v was used. The most recent documentation for this data set is Jones, P.D. and Moberg, A. (2003) "Hemispheric and large-scale surface air temperature variations: An extensive revision and an update to 2001". Journal of Climate, 16, 206-223.

Many interested in this area of Global Warming would like to know how many years do we have before an unattended problem becomes too much for us [3]? Now, the answer to such a question depends upon how citizens react to very high atmospheric temperatures. 50°C, the Saudi limit, is 123 ° F and that is not an unknown temperature in the United States, in such places as Death Valley in California. However, the prospect of living under such temperatures seems to be out of the question.

Now, to answer the question, when will it get too hot, is difficult for two reasons. First of all (and this is easily understood) the answer can only be given for a given region of earth, or at least a section of a large country such as the USA. Indeed, if one moves a thousand miles north into arctic Canada, one can see some years of happiness there, occurring during the later stages of Global Warming because Canada, too, would be a gigantic country were it not for the fact that most of it is at present frozen.[3]

[3] It is possible to treat the degree of curvature in Figure 2 and we would do better with an equation for a relation which has curvature in it were we to have a few more points.

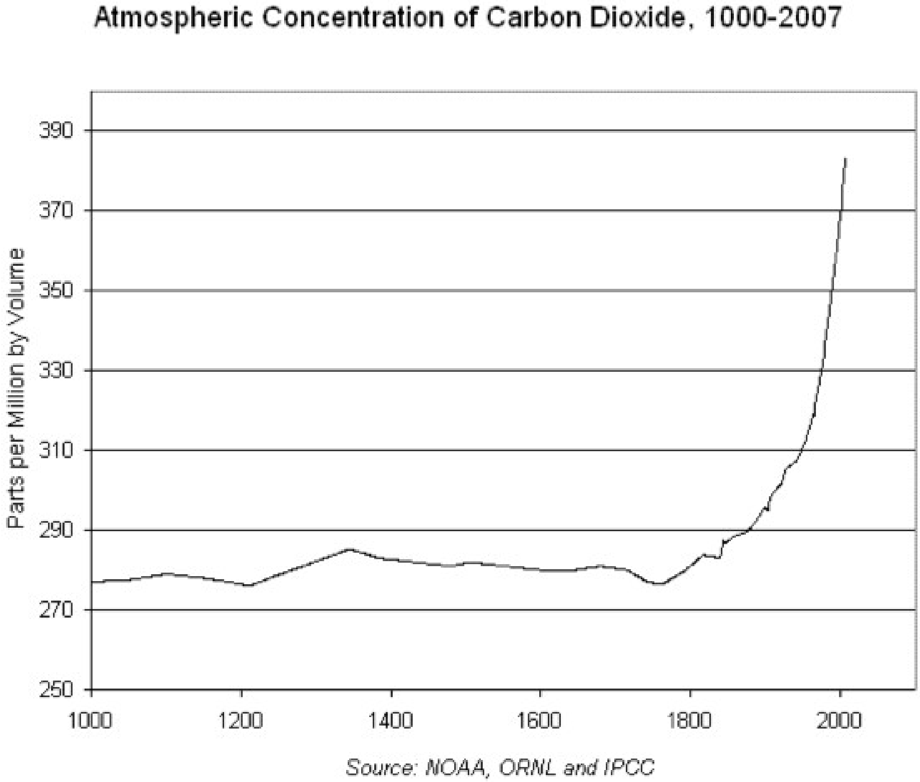


Fig. 5. CO_2 over 1000 years. The Hydrogen Economy. Opportunities, Costs, Barriers and R&D Needs. National Research Council and National Academy of Engineering, National Academies Press, Washington DC, 2004 [4].

1.2 Global warming due to the presence of methane in the atmosphere?

In most articles on Global Warming, the entire problem is put on CO_2, but this may be too optimistic because there is another gas that is gradually increasing in our atmosphere and it is the simple molecule methane, CH_4.

Now, at present, 2010, there is a contribution of methane to the temperature of the atmosphere, which at first seems quite low, 8%.

However, in considering this figure, one has to understand something after which methane can be looked at differently {H. Blake, 2010} [5]. Thus, the individual methane molecule absorbs 23 times more of the reflected energy from the sun than the CO_2 molecule when both, in our atmosphere, get reflected light upon our surface.

In other words, methane, CH_4, is a more dangerous molecule than CO_2 and the only reason why there has been so much discussion of CO_2 and almost no public discussion about methane is that hitherto the concentration of methane in the atmosphere has been small.

Now, there is a reason why we might have to be more concerned with methane for not only its absorptive power, 23 times greater than that of CO_2, but also there is a reason whereby methane could significantly increase its concentration in our atmosphere.
Estimates have been made of the total amount of methane that may be in fact hidden from us at the moment because it is largely in the tundra in the northern climes of the world {National Oceanic and Atmospheric Administration, 2007; and H. Blake, 2010} [4,5].
This tundra is dark-colored vegetation that is met in the far north and it is inside this that the methane at present is largely hidden. This area of the world is still frozen and the methane is in the frozen tundra {University of Toronto, Chemistry Department, 2008} [6].
Predictions have been made (but I must caution they are not reliable) about the total amount of methane that may be hidden in the tundra {BBC News, 2006; N. Shakhova & I. Semiletov, 2007; University of Cambridge Press, 2001; and Walter et al., 2006} [7, 8, 9, 10, 11]. The figure I have obtained is 380 billion tons and were this huge amount of methane to be released, the question is what would happen to it?
One way of looking at this is to observe that methane is lighter per molecule than oxygen, nitrogen or CO_2 and therefore, according to the Archimedean principle, it should rise and eventually escape our atmosphere into space {http://globalwarmingcycles.info/, 2010} [12].
This is comforting but then we come across a disagreeable fact. CO_2 is heavier than the other molecules in the atmosphere and if Archimedean principles were the only thing to consider, CO_2 would sink among the other constituents in the atmosphere until it blanketed the earth down low on us. This would not be good at all. Luckily, our measurements show that CO_2 is evenly distributed for at least 10 miles up.
Thus, we cannot complacently expect the methane to escape upwards. What is it that makes the CO_2 be uniformly distributed?
The answer the climatologists give us is that as one goes upwards from the earth, there is increasing turbulence. The temperature gets colder and the winds greater, so the CO_2, jostled around in its collisions with the other molecules until the affect of the Archimedean drop becomes negligible. Indeed the CO_2 has been there for much of the earth's life, because the green plants and their growth depend directly upon it.
The principal thing that I tried to draw out of DOE was the rate of the movement of the ice line towards the north. It's clear that it's retreating, but what is the rate of that retreat for it will eventually melt the frozen tundra?
Some discussions I had with a senior expert from the Washington DOE {Private communications, 2009} [14], who warned me that I should be cautious in stirring anxiety. I decided that the only thing I could do was to assume that eventually, be it in one year or ten, that the tundra were going to melt and I wanted to know what would happen then {Private communications, 2009} [13].
Thus, to assume the entire 380 billion tons would all go to the atmosphere was an extreme but unlikely assumption. The tundra is not growing on the surface of the earth but deep inside it as well.
Further, to get the 380 billion tons estimated was to assume that the whole tundra was inundated with methane now whereas the creation of methane is a biological reaction going on at a speed of which we know little.
It is not that the 380 billion tons that may be there right now might hit us immediately. The question is how much methane is being created inside the tundra and what will be the rate of that growth compared with the time at which the tundra will melt.

The truth is the methane in the tundra is a possible threat {D. Roberts et al., 2007} [15]. We should be aware of it and look at calculations with certain assumptions. Certainly the maximum likely effect is dire, but its severity is unlikely to be realized.

1.3 Attempted calculation of the maximum effect of methane on the world's temperature

I made a number of positive assumptions in order to get the worst that the assumptions predict. The first assumption is that the 380 billion tons of methane is a number that may become reality in our time.

A second assumption is: will the distribution of methane, were it to mix with air, be uniform and how long would it take to become so? At first I assumed that the methane would spread along the near earth surface and then diffuse upwards. The figure I got was four years, for the methane to diffuse up 10 miles that is around about the extent of 90% of our atmosphere. (Some information on the albedo can help in estimating a uniformity of the mixture of gases (Figure 6) {Dar A. Roberts a, Eliza S. Bradley a, Ross Cheung b, Ira Leifer c, Philip E. Dennison d, Jack S. Margolis, 2006}.)

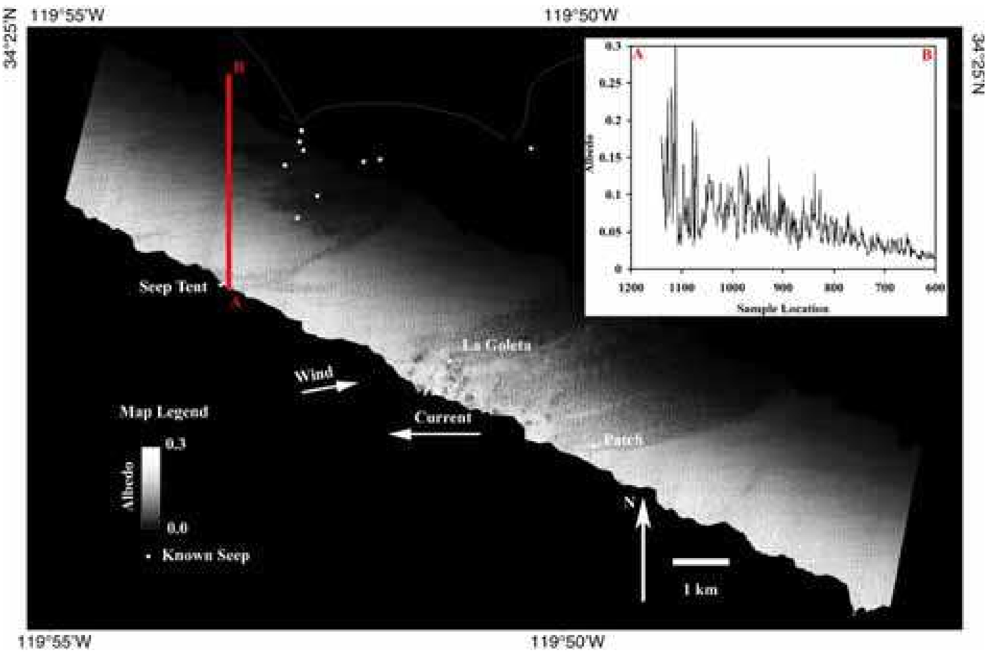


Fig. 6. Estimated albedo for 6 August 2007 Run R04. The location of the coast is marked in very faint green. Wind direction, from a coastal weather station (www.geog.ucsb.edu/ideas) and codar-derived currents, measured by the Interdisciplinary Oceanography Group (http://www.icess.ucsb.edu/iog/archive/25) are marked. Inset shows north–south albedo transect (red line) that includes the Seep Tent area. Some named seeps are marked by white squares [15]

However, I abandoned this approach because, of disturbances which interfere grossly with the condition diffusion requires. It's going to spread further and faster than that, egged on by the Archimedean thrust to rise but mixed up with wind and temperature changes it will meet.
I therefore assumed uniformity and of course it's a simple calculation to find out the concentration per liter of methane if the whole 380 billions tons were uniformly distributed in the 10 miles (upward in our atmosphere).
With these limiting assumptions then, I turned to the mathematics which Veziroglu {Veziroglu et al., 1989} and his associates produced and fitted my assumptions into his calculations [3]. What the Veziroglu paper actually calculates is the temperature change in the atmosphere and so far as the CO_2 changes its concentration, climbing slowly as we show in Figures 2 and 4. So I assumed one could equate a single methane molecule to 23 CO_2 molecules. Of course this simplifying assumption made it easy to get results from the Veziroglu theoretical formulations on CO_2 and the result I got, with all the positive assumptions I had made, was 6 ^{o}C in ten years {Veziroglu, Gurkin, and Padki, 1989} [16].
I asked myself then when it would begin a decline in our atmosphere and was there any end to it, and here I took to a Professor in Meteorology at the University of Florida, who seemed knowledgeable in discussions of methane and the dynamics of its presence in the atmosphere.
Qualitatively, his view was that there was a conflict between the Archimedean rise idea and the wind and temperature disturbance idea. He brushed aside the CO_2 and the fact it has remained stable and uniform for millennia. He said he had made a calculation which suggested that the best model would be to assume a quick distribution of the methane after the tundra had melted and then he thought that ten years would be about the time at which the tendency of the light methane molecule would escape into space.
For a moment, let us consider that my 6-degree calculation from Veziroglu's theory has value.
One can see at once there were some places on earth that would be stricken. Imagine what it would be like in Saudi Arabia at 123 ^{o}F. Now, add to that, 6 ^{o}C or c. 12^{o} F, and you will see that the inhabitants of Saudi Arabia could be really threatened if the temperature rose as I think is possible.
Of course it wouldn't be only Saudi Arabia but their surrounding countries, too. This is something that they have to confront (and they have the money to launch a more accurate investigation than the rough one I did in using what DOE would give, together with the calculations of Veziroglu et al {Veziroglu, Gurkin, and Padki, 1989} [17].

1.4 Disagreement as to the cause of global warming

Among those who have studied the CO_2 theory of Global Warming, may be somewhat surprised to know that there is a group of people (are they scientists?) in our community who disagree that CO_2 is the main cause {Edward Townes, 2007} [18].
This has always been the case from the beginning of concern about Global Warming way back in the 1970's.
The argument of the anti- CO_2 group begins by pointing out that ice cores taken deep into the earth show that the temperature of the earth has varied greatly over thousands of years. The opponents of this theory point to much greater variations in the earth's temperature

than we see at the moment. Some anti-reactions will occur on earth that will compensate the temperature rise we are now seeing and it's better to find out the true cause of the present rise before we put too much money into fighting it {B. Pelham, 2009} [19].
Another part of the strength of the anti- CO_2 group is largely from the public itself. The distressing truth is that the majority does not believe in Global Warming and that naturally this affects the vote in congress when it comes to research and money spent in that direction. The answer is that the change is very slow but indeed it is faster than the changes in the past (the really big changes) to which people refer. The idea that there is "no change really"

2. Sources unencumbered by CO_2

The general presentation of this treatment of Global Warming is to point out that there are a total of six different sources of energy, some of which we could develop and rely upon. They're inexhaustible and clean, and it's easy to profit from them, compared to gasoline that comes from oil buried in the earth and has to be processed, but also damages the environment. The first thing then is to present clean sources of energy. They are mainly wind {J. Usaola, E. Castronuovo, 2009; C. Osphey, 2009; H. Green, 2008} [20, 21, 22], solar, and enhanced geothermal.
Then having given the stated main sources on each of them, I go on to treat several others {J. Bockris, 2009} [23], for example, the enhanced geothermal energy ("Hot Rock Geothermal"), which could be a major source of energy, together with the less realized ones, the massive development of tidal energies and et cetera {C. Osphey, 2009; H. Green, 2008} [21, 22].
Later on in the article you will find there is a discussion of the mediums because each of these main energy sources {J. Bockris, 2009} [23] must have a partner which is in a form of energy which can be spread and be introduced into households and factories {J. Bockris, 2009} [23].
Among the discussion of these mediums there is an introduction to a concept, the power relay satellite. German inventions of World War II but never developed. It's development concerns diurnal difficulties of solar light and it would be possible, if we had a sufficient collection of solar energy, - and the Australian Continent is such {B. Roberts et al, 2007}[24], - to spread this solar energy and operate not only within a few tens of miles of the original source, but to anywhere in the world and therefore as the times of darkness are different in different parts of the world, but varying the opposite direction to the periods of light, it should be possible in principle to bring solar energy {J. Bockris, 2009} [25] to anywhere in the earth and thus counteract its principal hazard {J. Bockris, 1975} [26].

2.1 General philosophy of dealing with global warming

The general philosophy in this article in dealing with Global Warming is to take the attitude that the principal cause of Global Warming; the influx of CO_2 into the atmosphere, must be reduced towards zero. This therefore is only a scientific matter in respect to what comes after {N. Muradov, N. Veziroglu, 2009} [27]; because of course there is no point in shutting off the gasoline unless we replace it. The task is large so that is seems reasonable that there should be a central authority for the development of replacement energy systems for the fossil fuels.
As to the fossil fuels, - coal, oil, and natural gas, - I believe that what has to be done with them, - a very political matter, - is arranged between the government and their very wealthy owners, for the government has the right to tax their products.

Thus, in the following pages we are going to review our energy future in two ways {J. Bockris, 2009} [28]. Firstly, we are going to think that discretion is the better part of valor in respect to dealing with the oil companies. It is a matter that the government has to do and the president of our country has to be careful to be sure that special interests do not have any part in the decision as to when and how the fossil fuels will be made too expensive.

It will be necessary to allow time to build across the country the replacement energy systems of wind, solar, and hot rock geothermal.

There are various estimates on how quickly the change can be made. The Chinese government has made public their plan to change their transportation system in eleven years.

Let us adopt a pathway that is a little less demanding and decide that we are going to change over in twenty years with the extension to thirty years being acceptable, but not joyfully.

We will begin then by illuminating here first wind energy because it is the lowest cost. Then after we have the best source for our part of the world, other matters such as the transfer of energy over long distances, - will come in.

2.2 Wind:

Many who are told that wind may be part of our future energy supply find it hard to believe because wind is sporadic, and cannot be relied upon at any particular time or place.

Hence, it is important to understand the concept of averages when applied to wind energy. The usual thing is to look at the average or the cubes of the reported wind velocity taken daily. This gives the effective wind speed for the year, and the cube of this is the usual quoted figure. It's important not to take the cube of the average of the wind energies, but rather the average of the cubes. (See Equation 1 below.)

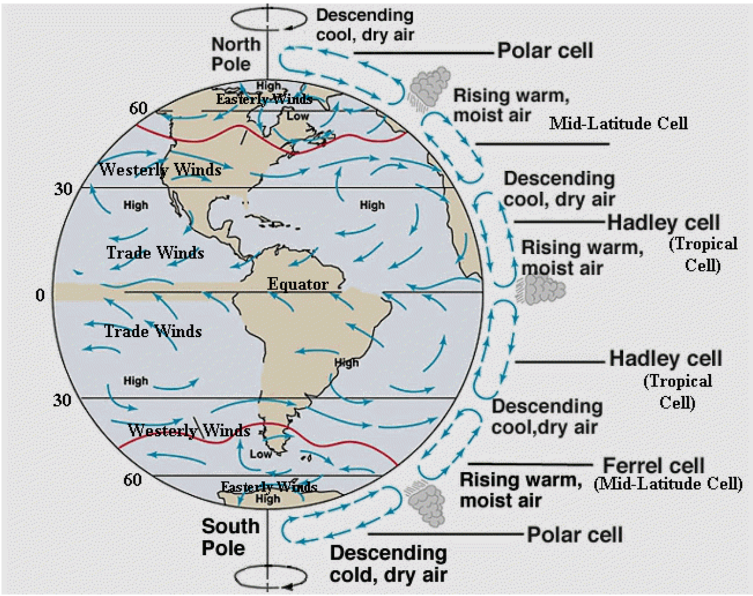
Another important preliminary to discussion of wind energy is wind belts. Of course, there are minor variations from year to year of the wind velocities in a given location, but on the whole if the average of the cubes is taken every year for a number of years, and the average of this figure is used in planning, such results will be effective.

In the USA, the part of the country for wind belt location is in Middle USA., north to south. The Wind Energy Association publishes maps of wind belts (DOE does the same). To show the sensitivity of a wind generator to values of v, the wind speed, one can take the example of going from 15mph to 18mph (apparently a small difference), but when one takes the cubes, it turns out that 18 mph is some 75 percent over 15 mph as the rates at which energy can be gathered.

2.3 Wind to electricity

The transfer of wind energy to electricity is carried out by using the combination of the energy of a rotating series of blades in the path of the wind, coupled with an electricity generator built into the apparatus. The axle of a rotor may weigh many tons {J. Usaola, E. Castronuovo, 2009} [20].

If untreated the supply of electrical energy from a wind generator would vary with the cube of the speed of the wind, and the occasional wind gusts. In order to avoid irregularity of supply, most wind generators are fitted with electronic devices that smooth out the supply in terms of volts. Powerful wind gusts, however, are a different matter and there is research to be done on how to capture the considerable energy that does come in gusts where the v may go to six to ten times the average velocity {J. Usaola, E. Castronuovo, 2009; C. Osphey, 2009} [20,21].



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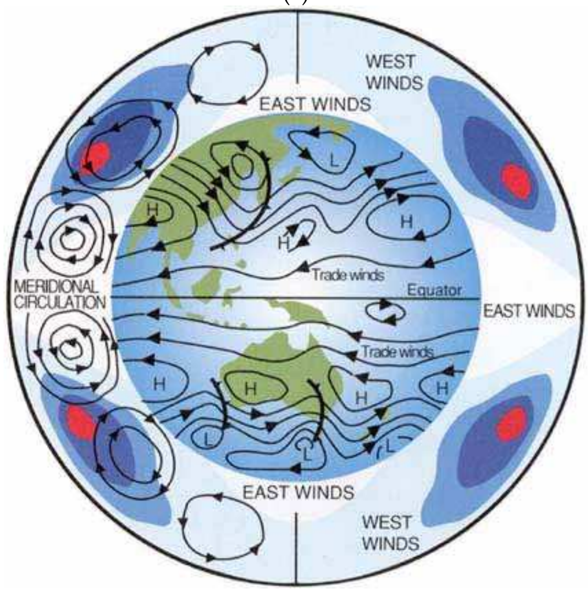

(b)

Fig. 7. a. Wind map of the USA
http://www.cnsm.csulb.edu/departments/geology/people/bperry/geology303/_derived/geol303text.html_txt_atmoscell_big.gif
b. Wind maps of northern regions.
http://mabryonline.org/blogs/woolsey/images/global%20winds%202-1.jpg

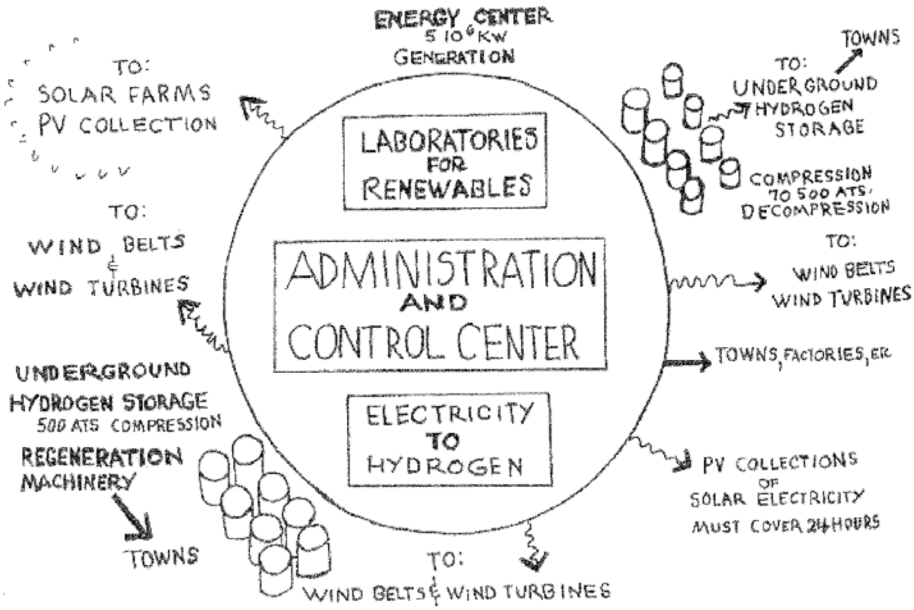

Fig. 8. Energy Center, J. O'M. Bockris Original, 2009

Many of the earlier wind generators often broke down in gusts, having been built to sustain only the average wind energy in a given location.

An energy center (See Figure 8 above) has to be made if wind is to be used on a massive scale for the supply of towns. The idea here is to place the wind generators in a circle surrounding the energy center with no greater distance than 50 miles between generator and center.

A possible energy center is shown in the Figure 8 above.

The Center contains apparatus for mixing various incoming electrical energies from the wind generators. These are then divided into supply lines that go out from the wind (or solar) center to surrounding towns. Details of arrangements will depend upon the population density of the area, however, the center may supply only large towns of say 1 million in population or larger.

Then, these supply towns would act as sub centers for other smaller towns. So, a one million people town may branch out to supply, say, ten smaller towns, down to the supply of villages from nearby larger house groups.

In large cities such as New York, several centers would have to be used.

After much research the optimal shape of wind generators has been reduced to two, {H. Green, 2008} [22] (see 9A and B). The main one is that well known one, horizontal propeller and such wind generators are found to last about fifty to 100 years. However, there is another type of wind generator as shown in the Figure 9B which is called a vertical axis generator, and it can be seen that the wind is gathered in the cusp type shape of half the blades, and these then rotate around the vertical shaft, bringing in to face the wind, a sloping area of the other half type cusps so that when this swings around to face the wind, the pull on it is much less than when the wind is being collected in the cusp type part of the generator.

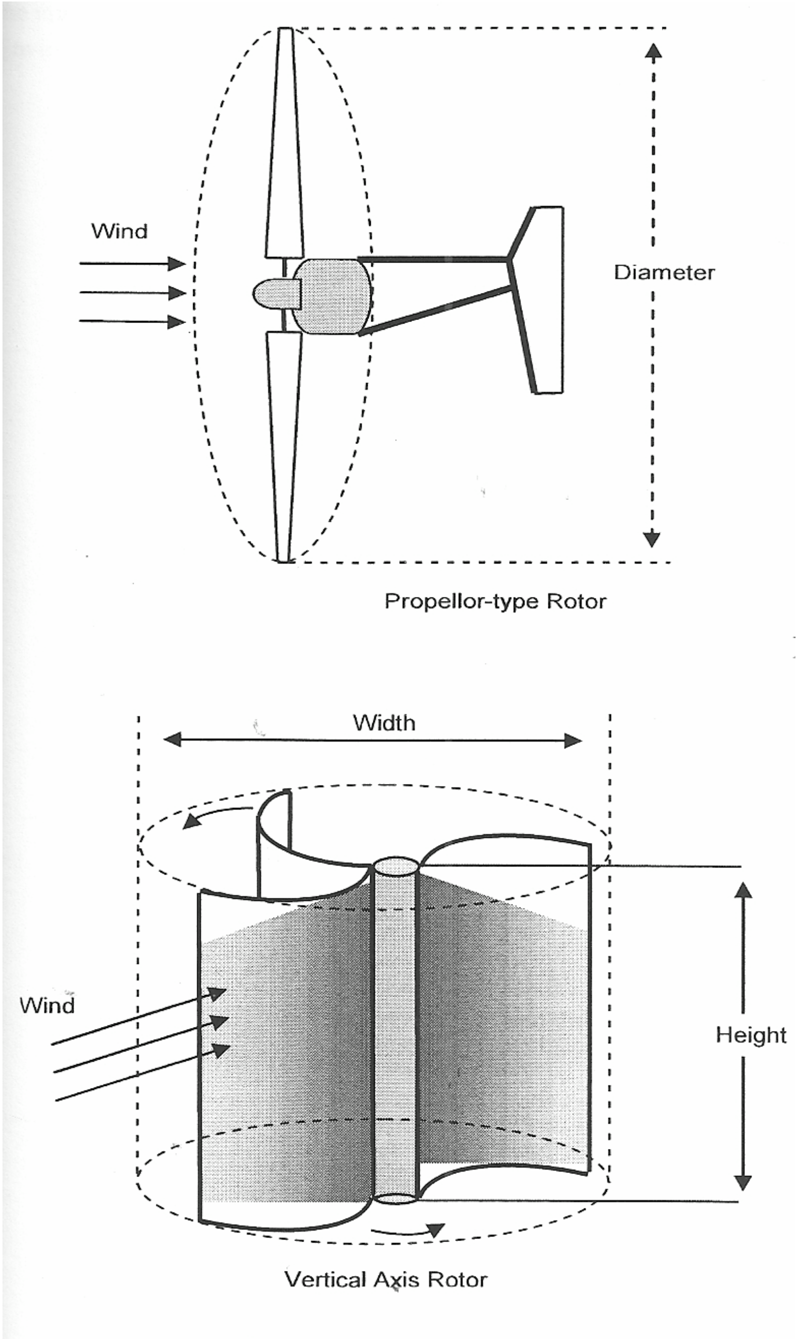

Fig. 9. A & B: {Iowa Energy Center, 2006}

It might be thought that four blades would increase the use of a single shaft but the manufacturers tell us that the material and machinery for accommodating multi-blade generators do not pay.

Wind generators can also be set up to work at sea. At first sight, there is much advantage in this because winds at sea tend to be greater and even up to twice times the winds on land. The reason is the lack of obstructions to the wind that occur on the ground.

However, there are compensating factors that make the positioning of the generators at sea, a questionable matter. Firstly, the construction of the actual generator has to be strengthened because of the higher intensity of the winds. This strengthening must include balancing weights underwater as shown in Figures 10 and 11.

Another negative feature of the wind borne generator is the cost of delivering the energy back to land. This can be done by cable but in extreme cases, ships collect the product.

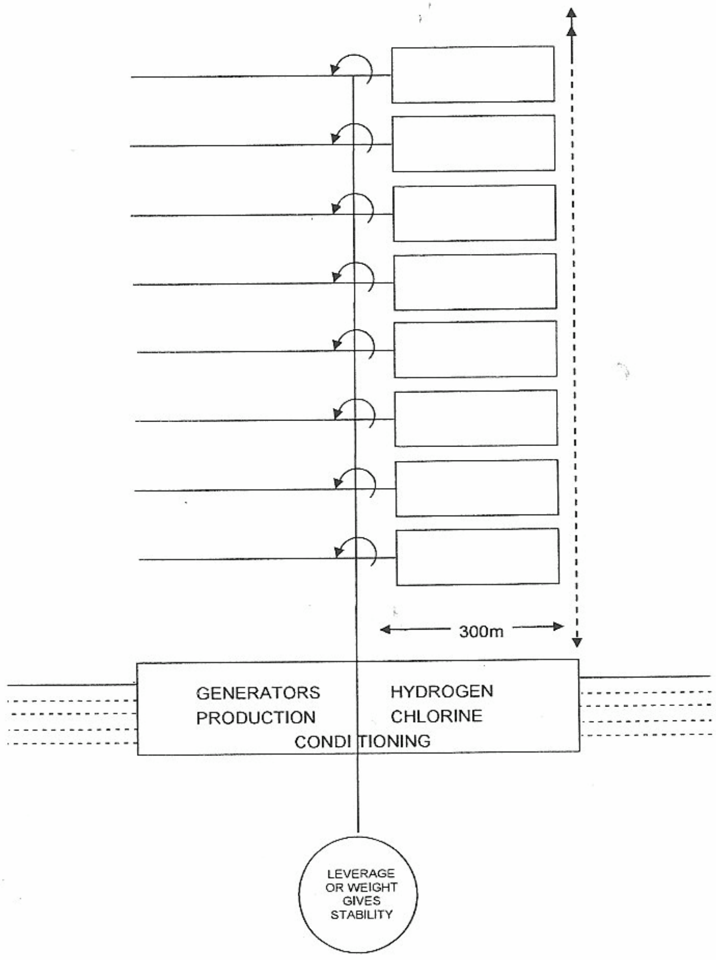

Fig. 10. A possible arrangement for a sea-borne generator. {J.Bockris, 1975}

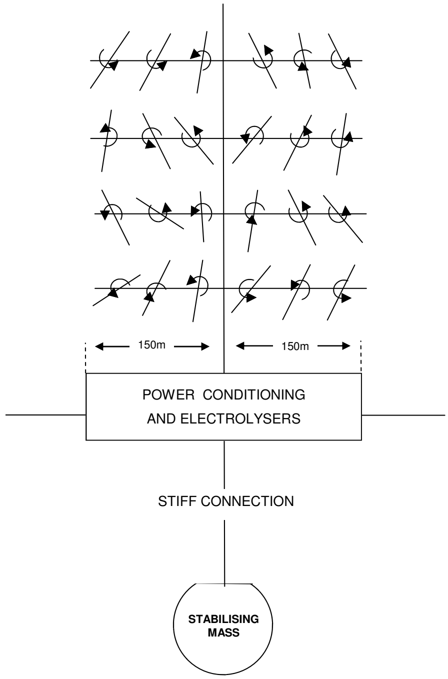

Fig. 11. An alternative arrangement for a sea-borne generator. {J.Bockris, 1975}

One of the newer concepts that have been introduced into wind generator construction is the magna lev concept, i.e. the shaft of the generator that of course normally is fitted into a socket that causes friction but is lifted from the socket contact by electro-magnetism. This concept is not commercial, but the designers say the lessening of the cost of the wind is up to 10x, and if this can be verified in practice, it is obvious that it will be introduced into newer generators which make wind even lower cost.

One may be forced to go to sea, where there is always plenty of room, - and more wind.[4]

2.4 A theory of wind generation of energy at speeds of up to 20 mph

Wind generators have not been considered on a massive scale such as that which will be needed for the supply of towns. However the economic attraction of the wind generator is great on an economic basis because the owner who receives his generator can start using it to produce a profit within weeks of delivery.

With several renewable energies, there may be preliminary building to be made that could delay the receipt of profit by the owner for years.

Of course, a study has to be made firstly about the detailed conditions of wind in the place considered, and this must include not only the minimal economic velocity of the wind

[4] It may be important to lower the cost of wind generators, which at the moment on land, produce energy as low as $.03c/kWh. Wind as a main source of energy in the future must face the hot rock geothermal situation and therefore lowering it would be needed.

average, about 12mph, but also the question of wind gusts and whether they would be a threat to the stability of the wind generators {H. Green, 2008; J. Bockris, 2009} [22, 23].

A primary engineering objective therefore is the mechanical engineering one of producing wind generators, should always take into account the question of whether the generator can withstand gusts {B. Roberts et al, 2007} [24].

Now, a simple theory of the energy obtained from a wind generator starts by recalling that the kinetic energy of a moving mass is given by ½ mv ^{2}. The hydrodynamics of the actual transfer of the wind energy due to the rotational action of the blades is the kinetic energy multiplied by the factor 16/27 {J. Bockris, 2009} [28].

Thus, the energy of the generator, taken in this ideal picture is $\frac{1}{2}\rho v^3 \frac{16}{27}$ where Δ is the density of the air and v the average energy of the wind (over one year).

This is the simplest basic expression possible for a wind generator. However, it is still insufficient and has to be aided by an experimentally added factor, which for most generators is about ½ the ideal value {AWEA, 2009} [30].

It's important to realize that even this simple equation only applies in the lower regions of wind speeds. The important information that the energy of a wind generator depends on the 3rd power of v, the average wind speed for the year, makes it important to ascertain when the equation begins to break down as the average speed is increased past 20 mph.

Thus, does it apply where much higher average wind speeds than that typical of North America (15-20mph) are available {J. Bockris, 2009} [25]? In Patagonia at the tip of South America, there are regions where the average wind speed for nine months of the year, is 40mph.

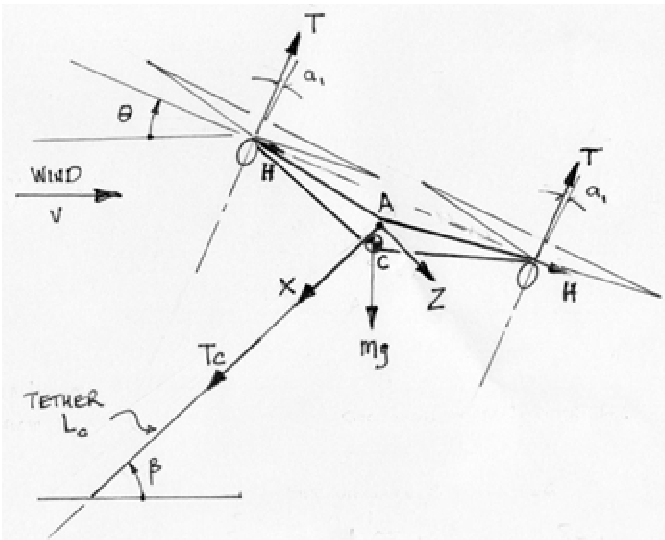

Fig. 12. Diagram of the FEG in flight, showing the craft's nose-up angle which is identical to the control axis, as no cyclic pitch use is planned. The rotor's fore and aft flapping angle, a1, is shown as the angle between the normal to the tip-path plane and the control axis. The total rotor thrust component along the control axis is T, and normal to this axis is the component force H. If T and H forces are combined vectorally the total rotor force is almost normal to the tip-path plane {B. Roberts et al., 2007: [29].