

Small Wind – An Important Part of the Solution to Global Warming and Perhaps a Catalyst for World Peace.

Abstract:

This white paper presents data regarding future demand and supply constraints on traditional energy sources in an effort to explain the seriousness of the ramifications of our continued reliance on oil and gasoline. We present evidence that individuals and their policy makers understand the seriousness of global warming and are taking action. We propose Small Wind as a vehicle for supporting individuals and businesses in reducing, if not eliminating, their reliance on the existing energy supply structures while contributing to the long-term protection of the environment.

The Challenge:

The best predictor of future behavior is past behavior according to many authorities on human nature. Not a very positive thought if we are referring to our approach to global energy policy. The CO₂ levels keep rising and the ice packs are melting. What do we need to do to avert continuation of this trend towards floods, fierce storms and famine?

It means slashing emissions of CO₂ by a mind-boggling number – up to 80% within 40 years.^[1]

Over the past two decades several expert groups have sought to define levels of climate change that could be characterized by different levels of risk. Based on the available knowledge in 1990, a 2°C increase was determined to be ‘an upper limit beyond which the risks of grave damage to ecosystems are expected to increase rapidly’. More recently, others in the scientific community have reached conclusions that point in a similar direction ‘that global warming of more than 1°C, relative to 2000, will constitute “dangerous” climate change as judged from likely effects on sea level and extermination of species. The Stern Review (Stern, 2006) argues that any delay in reducing emissions would be ‘would be costly and dangerous’.^[2]

In 1997, the Kyoto Protocol was proposed under the Convention on Climate Change and was ratified with the objective of achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."^[3] By December 2007, 174 nations had ratified the Protocol.

Below is a list of the change in greenhouse gas emissions from 1990 to 2004 for some countries that are part of the Climate Change Convention as reported by the United Nations:

Country	Change in greenhouse gas Emissions (1990-2004)	EU Assigned Objective for 2012	Treaty Obligation 2008-2012
Australia	25%	N/A	+8%
Canada	27%	N/A	-6%
France	-0.80%	0%	-8%
Germany	-17%	-21%	-8%
Ireland	23%	13%	-8%
Norway	10%	N/A	1%
Portugal	41%	27%	-8%
Spain	49%	15%	-8%
United Kingdom	-14%	-12.50%	-8%
United States	16%	N/A	-7%*

(Source: United Nations – Climate Control Convention Report)

Since the US did not ratify the treaty, the emissions targets are not a treaty obligation. On average the EU has reduced its GHG emissions from 1990 to 2004 by 0.8% however as can be seen in the table above, this has been achieved by a number of large star performers namely Germany and France with a large number of nations with significant increases over the same period. The challenge is that these increases will have come about through installation of emission generating power generation assets which are expected to continue to be a part of each country’s energy supply structure for many years to come. These kinds of investment decisions make the achievement of net reductions in emissions, a very challenging goal. Add to this the reality of our major developing economies, who are not required to meet any particular goals under the treaty:

Country	Change in greenhouse gas Emissions (1990-2004)
China	47%
India	55%

(Source: United Nations – Climate Control Convention Report)

Continuation of historical trends of greenhouse gas emissions will result in additional warming over the 21st century, with current projections of a global increase of 2.5°F to 10.4°F by 2100, with warming in the U.S. expected to be even higher.^[4] So it seems that without a significant change in our choice of energy sources we can expect significant earth changes within a relatively short time.

As Nobel Laureate Steven Chu said in 2005 :

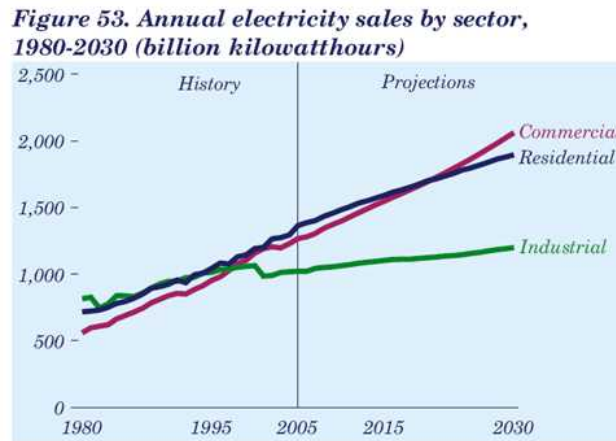
“Everything you’ve heard about climate change is wrong. It is much worse than people know – and every engineer should be working on it.”^[5]

Global Energy Demand

According to the International Energy Association’s Outlook 2007, worldwide energy demand will increase by a staggering 50% by 2030 with most of this growth being driven by the rapid economic expansion of emerging economies particularly China and India.

The United States is the single biggest energy consumer in the world, even before accounting for the energy used in producing U.S. imports. One of the main reasons behind high U.S. energy consumption is that the country has the lowest energy productivity—or the level of output that the United States achieves from the energy it consumes—of any developed economy. Each person in the United States today consumes the equivalent of almost seven gallons of oil—80 percent more energy than Northwestern Europe, 94 percent more than Japan, and seven times the level of China. As a result, the United States is also the most CO₂-intensive country, producing 19 tons of CO₂ per capita annually—more than twice the level of Northwestern Europe and Japan.^[6]

In the USA, the split of application of this energy is as follows: The residential and commercial sectors use 40% of all energy. These two sectors include all types of buildings such as houses, offices, stores restaurants and places of worship. Energy used for transportation accounts for more than 25% of all energy. The growth rates of each sector are illustrated below:



(Source: Energy Information Administration, Annual Energy Review 2006)

Population Growth will also play an important part in the energy demand for the future. The tables below indicate the pace of growth expected with an extra 1.5 billion potential energy customers on the earth by 2030.^[7]

Year	2020	2030	2040	2050
Population (in billions)	7.6	8.3	8.9	9.4

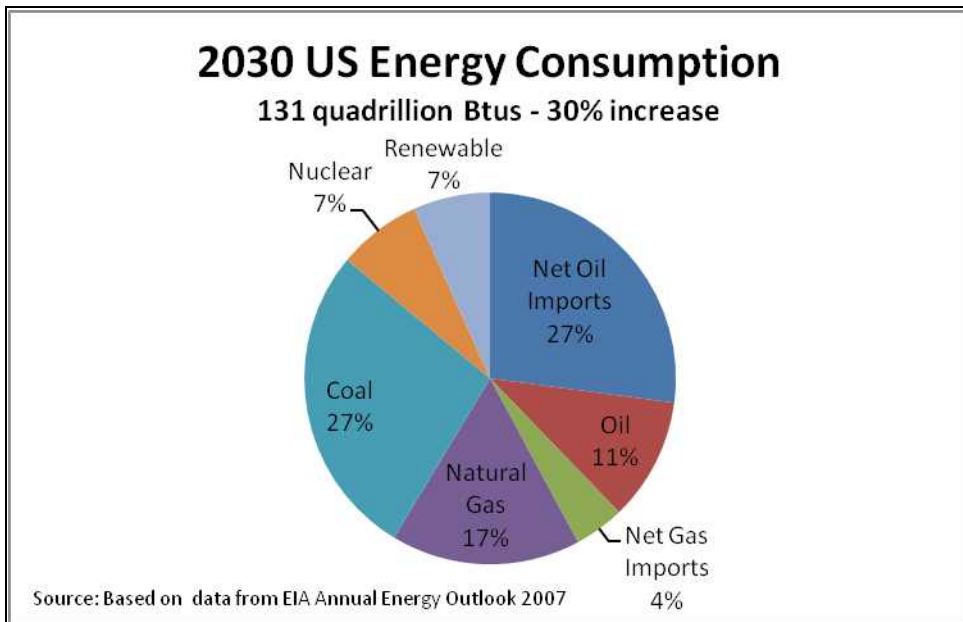
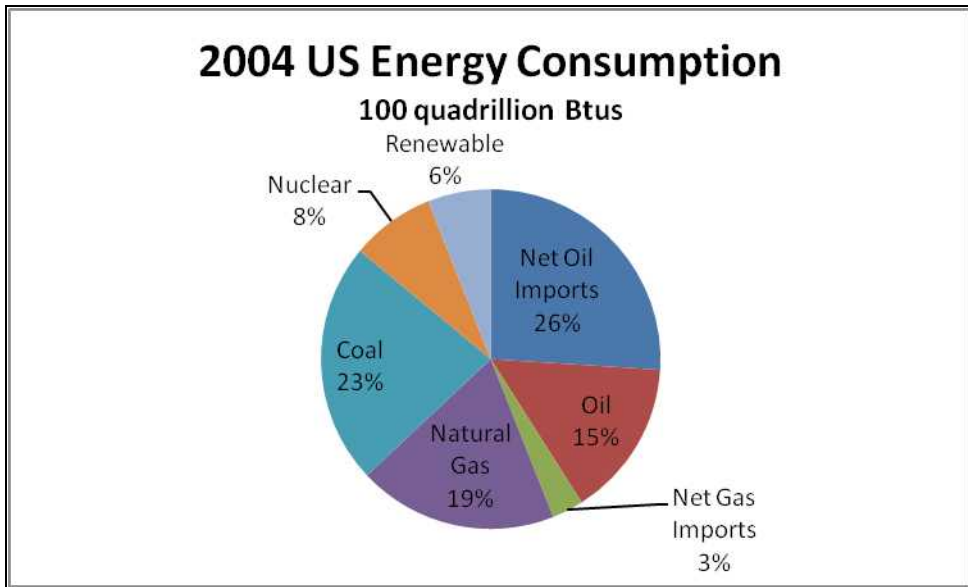
China and India together account for 45% of the increase in global primary energy demand in this scenario. Both countries’ energy use is set to more than double between 2005 and 2030.^[8]

These scenarios and trends are unprecedented in human history.

Global Energy Supply:

According to the experts, in order to meet this demand, the world will continue to require much of the same sources of energy. The Energy Information Agency of the United States clearly sees little grounds for significant change in the supply mix over the next 20 years.

The most striking and worrying indicator from the graphs below is how similar they look between 2004 and 2030. With a 30% increase in consumption, the share supported by coal has increased from 23% to 27%. The US reliance on imported oil has worsened and the renewable sources are expected to just about keep up with this 30% growth.



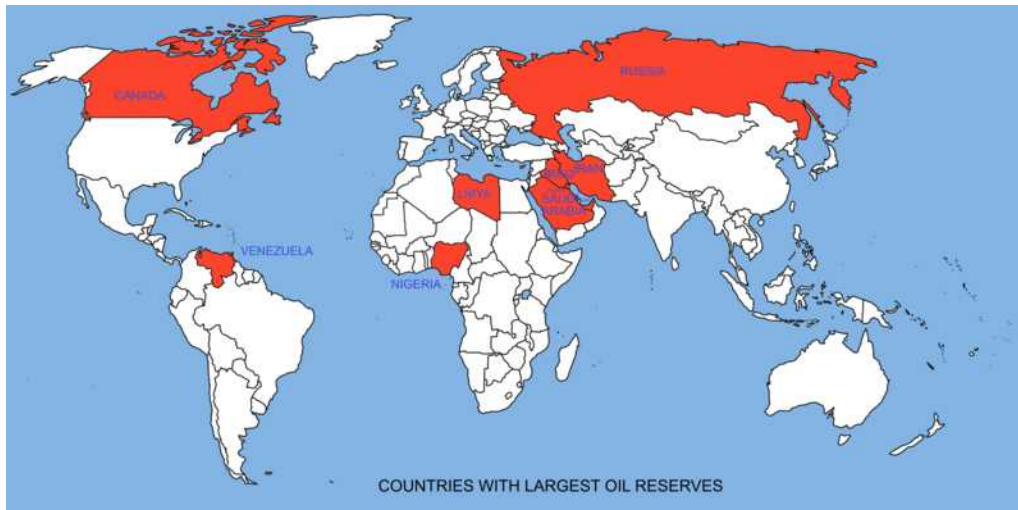
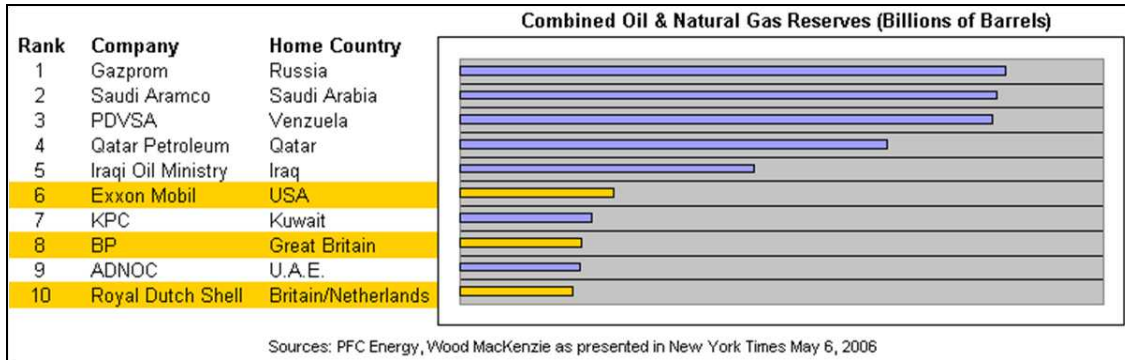
These trends lead to continued growth in global energy-related emissions of carbon-dioxide (CO₂), from 27 Giga-tons in 2005 to 42 Giga-tons in 2030 – a rise of 57%. China has overtaken the United States to become the world's biggest emitter. Based on present day government policies, these trends will lead to continued growth in energy-related emissions of carbon dioxide as well as continued reliance on imports of oil and gas from the Middle East and Russia. Fossil fuels would remain the dominant source of primary energy accounting for 84% of the overall increase. Coal is set to jump by 73% between 2005 levels through to 2030.^[8]

The mix of sources allows for at least a 30% increase in installed renewable energy sources however this does nothing to stem growth in the use of fossil fuels in meeting the demand. The truly shocking truth about this scenario is that the rise in CO₂ levels continues while moving further and further away from the goal of actually reducing the emissions.

If the sources are going to remain the same, it is important to recognize that there are a number of factors taking place which when put all together are suggesting that control over the supply of our traditional sources of energy will become more politically charged than ever before. Competition for these resources is leading to higher prices. We can only hope that a price war is the only way that competing nations will respond to their supply being at the behest of another nation.

Oil and Gas – Future Source of Political Tensions:

The increasing influence of national oil companies and, consequently the governments of those countries who hold these reserves, suggests an increasingly charged political situation. Seven out of the top ten reserves of oil and gas are under the control of national companies. ExxonMobil and the other majors are dwarfed in size by the resources under the control of these state-run institutions.



Source: Wikipedia

In 1960s, the major independent oil and gas companies such as ExxonMobil, Chevron and Royal Dutch Shell, had open access to countries with 86% of the reserves. Today that number stands at less than 16%.^[9] For small economies with large reserves such as the UAE and Kuwait there is little impetus to look abroad as their energy needs are easily satisfied. For larger, rapidly growing economies however it is a different story. China has comparatively little oil reserves and as such must look abroad for sources of energy to fuel its economy. Evidence of what these countries’ governments are willing to do to ensure access to reserves was seen in bidding for two offshore blocks in Angola during 2006. China’s Sinopec formed a consortium with Angola’s Sonangal and together they bid \$2.2billion for the two Angolan offshore blocks. In contrast, ExxonMobil bid \$120million while BP bid \$15m.^[10] The majors were pushed out in the name of national interests of China and Angola. It seems inevitable that the majors will continue to struggle to gain access.

As Brazil's Petrobras has developed its world-class ability to extract oil and gas from extreme depths,^[11] it seems certain that the national oil companies will continue to work together at the expense of the independents. Petrobras has already been consulting to Mexico's Pemex whose future lies in the deepwater off its West coast as the reserves in their giant Cantarell field depletes by 15% annually.^[11] Cooperation amongst the nationals will undoubtedly increase. We have seen evidence of Nigeria and Kazakhstan showing preferential treatment to NOCs. CNPC from China and ONGC from India put a joint bid together for a Syrian oil field to avoid a bidding war.^[8] The alignment of their goals of securing access to supplies for their burgeoning economies seems to be their main driver to work together. The traditional economic model of the price of oil vs. the cost to produce has been eclipsed by a calculation based on the value gained from transforming that barrel of oil into an hour of production in a factory in China or India which provides countless jobs and drives economic growth in the area, thus increasing the quality of life and taxable income to the government. The types of goals any government around the world is tasked with achieving in looking after its citizens.

Nationals Oil Companies Take Back Control:

The development of national oil companies came about when countries like Mexico, Venezuela, Saudi Arabia and Algeria decided they needed to exert more control over their own natural resources. Historically the majors controlled access to the markets and so the focus of the nationals was to invest in refineries in their preferred markets. Today, the NOCs have gained control over the access to supplies. The three (3) largest reserves in the world are with Russia, Saudi Arabia and Venezuela. In Russia we have seen the break up of Yukos^[12] and the appropriation of its assets by the government. Gazprom, Russia's national gas company was granted half of Shell's 50% share of the Sakhalin Island project.^[13] Saudi Arabia limits any foreign interest it allows to remote areas. Venezuela announced a renegotiation of terms: royalties were increased from 1% to 17%, taxes went from 34% to 50% and PDVSA's ownership in projects increased from 40% to 60%. When Total and Eni declined to accept the new terms their assets were "expropriated".^[14] We have seen the changes towards populist politics in Latin America. Venezuela's Chavez has taken an overtly anti-US stance. The Venezuelan government owned CITGO Petroleum Corp is the 4th largest supplier of crude to the US however in 2006, exports fell 18% and CITGO began a campaign of selling US based assets. Meanwhile, China's oil shipments from Venezuela have doubled in the same period.^[15] Putin has begun flexing his governments muscles as demonstrated by an incident in the Arctic, described later.

Meanwhile despite the publicity, the major growth in market capitalization value has been driven by stock buybacks and despite decreased production. ExxonMobil spent most of its profits in 2006 on stock buybacks – \$20bn v.s. \$15bn on exploration and production in order to bolster its share price as it struggles to find quality projects in politically stable zones. In May 2006, the Chairman of ExxonMobil, Rex Tillerson was quoted: "The biggest challenge for us.. is simply being granted access".^[16] As the mature, politically stable oil and gas fields of the Gulf of Mexico and the UK's North Sea deplete, the seriousness of this issue becomes apparent.

Who will keep up with the Demand? Those who control the Supply!

Despite being cash rich, the majors are clearly struggling to replace what they use year on year with proven reserves. Reserve Replacement is a key measure for oil and gas companies and many of the majors quote these results in their annual reports and it is noticeable that many are struggling. As an example, in its annual report for 2006, BP suggested it has a measure of “100%+” of Reserve Replacement. A somewhat inexact statement and troubling when compared to the performance of PetroChina. As well as leapfrogging ExxonMobil – whose \$48bn market capitalization had previously made it the world's biggest company – PetroChina is worth nearly twice as much as the combined value of Royal Dutch Shell and BP. Management has announced that PetroChina's reserve-replacement ratio will be over 100% in oil and over 300% in natural gas over 2006-2009. ^[17] This contrasts with ExxonMobil whose performance from 2005 to 2010 is expected to drop to an average of 90% reserve replacement. This is eclipsed however by Shell who is expected to drop as low as 75%.^[9]

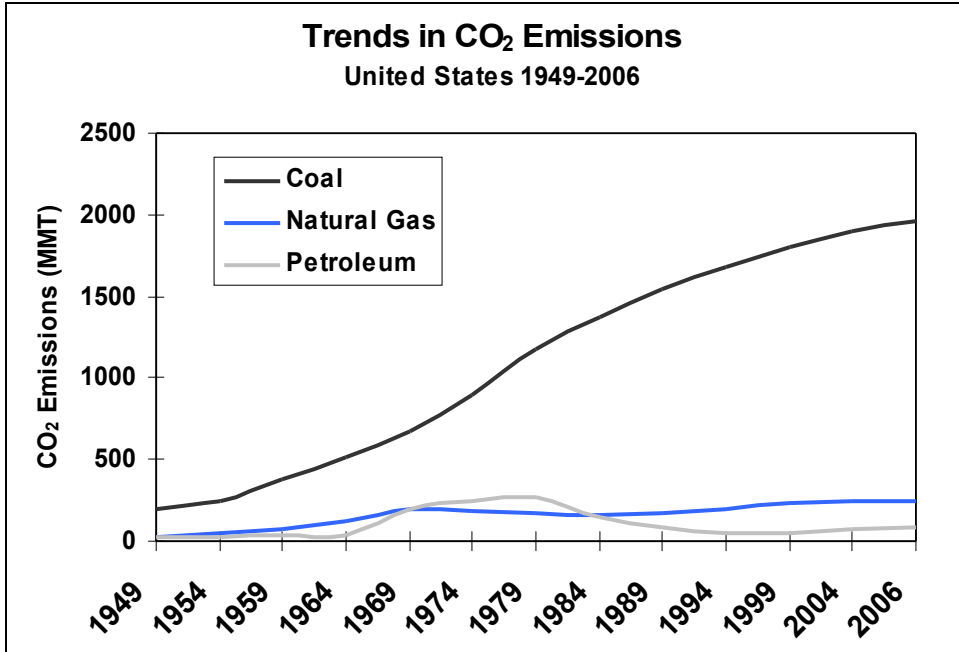
Peak Oil or no Peak Oil, a continued worldwide reliance on, and competition for, limited oil and gas reserves will lead to conflicts between nations over resources without which, the fabric of the very civilizations they serve would begin to crack and perhaps crumble. Political tension may be the very best outcome – there may be much worse unless something changes....

Natural Gas as a Global Commodity:

With the technology of liquification now being installed all over the world, natural gas is set to become a worldwide commodity with transportation possible by tanker, beyond just through a pipeline. This means that the once stranded reserves of Russia and countries in the Middle East such as Qatar can now find ready and willing customers in the East and West coast of the US as well as China and India. As pipeline networks are built on the back of this development, economies such as China and India are seeing the growth in distributed power based on natural gas. This is very positive news for those people in remote areas who are finally enjoying the comfort and warmth of a ready supply of natural gas. Unfortunately it entrenches fossil fuels as a source of electricity and economic prosperity just when what we need is less use of these fuels. The one bit of good news though is that natural gas is the cleanest of any form of fossil fuel and even the most passionate environmentalists accept that it is likely that it will play an important role in weaning the world off the more harmful fossil fuels.

Coal – the fuel of the future – please NO!

In an effort to look for alternatives to oil and gas, the world is revisiting an energy source thought not long ago to be of a bygone age and no longer viable. In 2006, China installed more than 114,000 megawatts of fossil-fuel-based power generation facilities – that is 50% more than the entire United Kingdom’s power grid, which was installed over decades. The majority of this was coal.^[18] The graph below indicates the seriousness of this decision to the fight to reduce GHG emissions.



Source: DOE/EIA – 0573(2006), Annual Energy Review & State Energy Data Report

In the US, reserves of almost 270 billion tons, a 200 year supply, has encouraged utilities to put together plans to build 150 additional plants.

Much of the developed world has already imposed restrictions on GHG emissions, and the U.S. is likely to follow suit. The European experience suggests that the cost of emitting a ton of CO₂ is about \$20 -\$25. Since coal fired power plants emit more than twice as much CO₂ for the same amount of electricity as natural-gas-fired plants, the curbs may hit coal hardest. The effective price of coal could leap as much as six-fold, raising the cost of electricity by 50%.^[19]

Other Not So Bright Ideas:

As awareness has grown of the reality outlined, new and old ideas are being considered. “Unconventional Oil” is the name given to those sources, which have been uneconomical in the past but with almost \$100 per barrel of oil, are now being revisited. The most advanced today is the Canadian Oil sands. They are a mixture of sand or clay with water and crude oil. The sands are strip-mined and crude is extracted from the sand using a steam-based process. It has become a source of almost 1 million barrels of oil per day. ^[20]

A more unlikely source being looked at seriously now is Oil Shale. Shell’s single biggest R&D investment is aimed at discovering the long hidden key to extracting this oil source economically. If successful, a reserve of 800 billion barrels of oil – triple the size of the reserves of Saudi Arabia - lie under 17,000 square miles across Colorado, Utah and Wyoming. ^[21]

Probably the most ominous sign of the world’s obsession with fossil fuels took place on 2nd August 2007, when it was announced that the Russian navy had placed a Russian flag two miles under the ice cap, on the seabed of the Arctic Ocean. Thus laying claim to any oil and gas reserves found. Eight countries — Canada, Denmark, Norway, Russia, Sweden, Iceland and Finland and the United States — have Arctic Ocean coastlines and, under international convention, have rights to economic zones within 200 miles of their shores. Denmark has sent its own scientific expeditions to study the opposite end of the ocean-spanning ridge and to seek proof that it is torn from the continental shelf north of Greenland, which is a Danish territory. ^[22]



Map of the Disputed Region (Source: www.telegraph.co.uk)

Let the games begin!

The Range of Renewable Solutions:

The Pew Center for Global Climate Change says the following regarding temperature rise: “Continuation of historical trends of greenhouse gas emissions will result in additional warming over the 21st century, with current projections of a global increase of 2.5°F to 10.4°F by 2100, with warming in the U.S. expected to be even higher.”

On the other hand, The European Renewable Energy Council and Greenpeace have published a scenario of their own with the target of reducing carbon dioxide emissions such that the average world temperature rise can be kept below 2degrees C.^[23]

It involves a combination of many renewable technologies:

Biofuels:

Probably the most controversial so-called green alternative energy source, biofuels has been criticized due to the deforestation activities, particularly in Indonesia, necessary in order to clear land for biodiesel producing palm crops.^[24] Clearly a renewable source, biofuels do reduce emissions, however not completely. For instance, corn ethanol, on average, produces about 13 percent less greenhouse gas emissions than gasoline. But when ethanol refineries burn coal to provide heat for fermentation, emissions are up to 20 percent worse for the environment than gasoline. In the United States, state and federal biofuel subsidies cost about \$500 per metric ton of GHG emissions they avoid, according to a study by the Global Subsidies Initiative. In Europe the same ton would cost about \$28 via the European carbon emissions market.^[25]

Solar:

Solar power will be critical to a sustainable future and works well in hybrid schemes, which take advantage of windy and sunny conditions. Unfortunately it is still an expensive prospect for an individual household or business. In order to get customers past the hurdle of the high initial cost some companies are resorting to selling the power to the owners of the equipment requiring them to sign up to long term agreements. The agreements are generally priced a fraction below utility prices, just enough to say it is cheaper. Not a very exciting prospect for a customer seeking power independence. As quoted in an article entitled “Solar’s Newest Resource” in Businessweek December 3 2007: The “(Customer) would have had to pony up \$4 million to install solar panels on one of its factories, an investment that would have taken up to 10 years to earn back. Instead the company signed a 25-year contract ...to build solar panels and provide energy. (Customer) now pays (Company Name) for the electricity the system generates. (Company Name) charges it about 13.6cents per kilowatt hour, less than the utility’s 13.9cents.”

Solar panels are prone to dirt, which reduces their efficiency, which requires continuous maintenance of a clean surface. They also have the limitation of requiring a large uni-directional flat area, which limits the hours during which they are productive.

Others include hydro, geothermal, Solar thermal, biomass, wave and tidal power not to mention Big Wind.

Why Small Wind?

Energy efficiency is seen to be a massive potential source for savings in emissions. The reality is proving much harder as the barriers, particularly financial, for individual homeowners and business leaders are causing slow progress. The proposition of this paper is that Small Wind is an effective option for individuals and businesses to reduce their carbon footprint while securing their own source of energy, into the future, independent of the developments in turbulent worldwide energy markets.

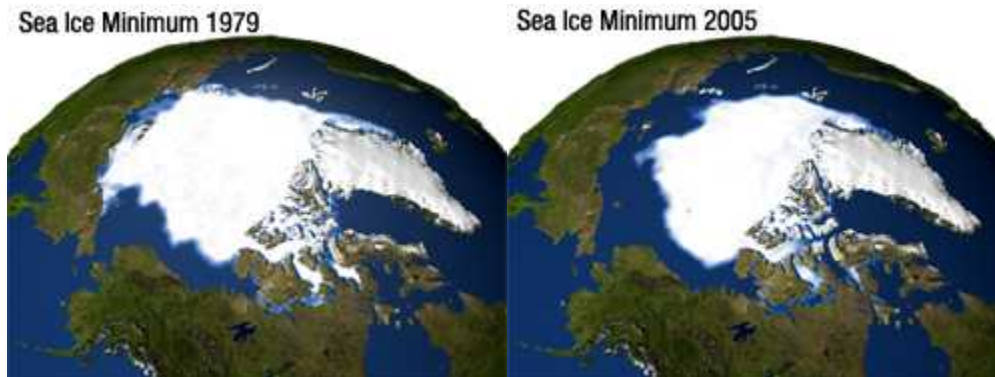
10 Reasons why Small Wind is here to stay:

- 1) **Energy Security = Rising Cost of Energy:** Business owners and private individuals have seen the dramatic rise in recent years in fuel prices. With the circumstances outlined earlier, it is clear that the competition for energy resources will continue and this will be mirrored in rising energy costs. In May 2006, Goldman Sachs raised eyebrows on Wall Street by releasing a report warning that crude oil could see a "super spike," with prices reaching as high as \$105 per barrel.^[26] Not so unlikely now. Homeowners and businesses who are seeing these cost increases month on month are seeking alternatives, which limit their exposure and offer them peace of mind in the long term.
- 2) **Climate Change Agreements = Financial Assistance Availability:** The 37 countries (plus the [E.U.](#) as a party in its own right) who signed the Kyoto Protocol are required to reduce greenhouse gas emissions to the levels below those in 1990. These countries represent over 61.6% of worldwide emissions.^[26] Signatory countries understand the cost of a ton of carbon to their economy. If their target reductions in the GHG emissions are not attained by 2012, they will be required to purchase carbon credits to offset their excess. In order to reach those targets, each country has set up schemes offering financial assistance for individuals and business owners to offset the installation cost of small wind systems. The rebates are so attractive that in some areas, payback periods are between 1-3 years, which means that any energy produced after this point will be completely free to the consumer.
- 3) **Net metering – Send your Meter Backwards:** The advent of net-metering means that a HelixWind turbine owner not only gets to use free energy from the wind to supplement their utility supply, but at night when the load is low and the wind is still blowing, the meter on the home or business owner's wall can be sent backwards, cancelling out the cost that would have appeared in the next monthly bill. In some areas, if the power produced exceeds the power consumed, the utility will pay the owner for this power. Owners of Small Wind systems are basically investing in a revenue generating, 100% clean energy power plant of their own. Thirty five (35) US states support net metering and under most state rules, residential, commercial, and industrial customers are eligible for net metering.^[27] Federal legislation is pending that would establish a comprehensive Net Metering rule for all states.
- 4) **Future Reliance on Electricity:** Household primary energy consumption is projected to increase by 25 percent between 2002 and 2025. Electricity use is projected to account for about 76 percent of the growth in household energy use.^[28] The broad launch of Plug-In technology for automobiles in 2009 will be the most profound step in an on-going trend of growing reliance on electricity as the primary source of energy for our lives.
- 5) **Awareness of Criticality of Climate Change:** Under the Kyoto Protocol, all signatory nations have agreed to be responsible for the development and implementation of educational and public awareness programs on climate change and its effects at the National Level / Regional Level.^[29]

- 6) **Growth of Green Build Movement:** The Green Build Expo in San Francisco in October 2007, had planned for 10,000 attendees. Instead they were shocked to find 18,000 attendees all cramming into lecture rooms scrambling for handouts.^[30] Green developments are no longer purely the topic on the front of a newspaper supplement and out of reach of most consumers and businesses. The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria.^[31] The number of LEED-registered and LEED-certified green building projects are increasing at rates approaching 70% to 80% year-over-year.^[32]
- 7) **Energy Efficiency a tough sell to Existing Property:** Although the data supports huge savings in GHG emissions from increased efficiency, there remain many barriers to such activity. The conversion of 30-year-old properties is prohibitive for most homeowners to consider. In the UK, 6.1 million homes lack an adequate thickness of loft insulation, 8.5 million homes have cavity walls without insulation, and that there is a potential to insulate 7.5 million homes that have solid external walls. These three measures alone have the potential to save 8.5 million tons of carbon emissions each year. Despite this, 95% of home owners think that the heating of their own home is currently effective.^[33] A much more realistic solution is to install a small-wind system which nullifies their role in using electricity derived from fossil fuel burning, in addition to energy conservation activities.
- 8) **Growth of Investment in Green Energy Technology:** European Commission President Jose Manuel Barroso said that countries should invest more in renewable energy to mitigate the impact of expensive fossil fuels such as crude oil. "It's quite obvious that the prices of oil and gas and fossil energies are indeed creating new scenarios. This is one of the reasons why we should not be so dependent on fossil energies. We should invest more on renewable energies and we should also try to accelerate (a) transition to a low carbon economy because this is crucial to understand what is going to happen in the global economy in the future. Renewable energy investment is so big that it's here to stay. Having more than doubled in the last two years, worldwide investment is forecasted to reach USD 85bn in 2007, driven by high oil prices, and energy security and climate change concerns."^[34]
- 9) **Nature of Wind – everywhere! Unlike the Sun!:** Due to the sun unevenly heating the air around the globe, the air surrounding us is always on the move. Unlike sunshine, which is a much sought after phenomenon in some dark, wet places around the world, the wind is everywhere. Germany has a potential on-land capacity of 100GW of wind power while North Dakota alone, the no. 1 ranked US state has the potential to generate 400 GW of wind energy.^[35]

10) **People want to do the right thing and Policy makers are listening!** There is growing evidence that individuals are making a personal decision to do what they can to avoid being a burden to the environment. Whether changing from incandescent light bulbs to the new high efficiency versions or remembering to turn the lights off, people's consciousness of the role they play in the problem and the solution is rising and the politicians agree. In September 2007, Governor of California, Arnold Schwarzenegger signed a law demanding a 25% cut in CO2 emissions from power plants, refineries and other large polluters by 2020.^[36] Over 500 US cities have signed the US Mayors Climate Protection Agreement pledging to drop emissions 7% below 1990 levels^[37] – close to the challenging target set by the Kyoto Protocol. Al Gore's Inconvenient Truth movie brought a data driven message to a wide audience who otherwise would not have been expected to appreciate it or get to see it. It was launched in more than 560 movies theatres across the US and has become the 4th highest grossing documentary of all time.^[38] The million owners^[39] of a Toyota Prius – the original mass production hybrid car-- have led the way in taking positive action on a private basis. A vehicle with conservative styling and a hefty price tag with a not so attractive payback period based on fuel cost savings, has been a major success. From 2008, there will be no less than 18 new hybrid models from 12 different car manufacturers available to the general public. And then comes PLUG-IN.....

A picture is the equivalent of a thousand words:



Since 1979, 20% of the Polar Ice Cap has melted away.^[40]

The seriousness of the situation outlined in this white paper describes a stark reality that many individuals understand and are concerned about. In fact so concerned that when facilitated in making a contribution many are hearing the call and taking action.

HelixWind is dedicated to facilitating those actions.

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