THE TIME FOR RENEWABLES IS NOW!!

Opportunities for Making a Rapid Transition to a Fully Renewable Energy Future

THE TIME FOR RENEWABLES IS NOW!!

Opportunities for Making a Rapid Transition to a Fully Renewable Energy Future

Rob Wheeler

May 2007

SYNOPSIS

Enough work has been done on energy conservation, efficiency, and renewable technologies that the world community could begin to make a rapid transition to a fully sustainable and renewable energy future within a period of perhaps 15 or 20 years. These technologies are so promising that there is no longer a need to invest in new coal or nuclear plants if we will only invest instead in research, development, capacity building, distribution, and marketing in such things as energy conservation, green building practices, sustainable agriculture, energy efficient vehicles, and renewable energy technologies, etc. All of which now have the potential to more than pay for themselves once they are instituted.

A WEALTH OF OPPORTUNITIES

Very few people actually realize the huge potential that already exists for humanity to make a rapid transition to a fully renewable energy future, probably within a relatively short period of years. As Clean Edge (energy investment consultants) states in it's 2006 Clean Energy Trends Report, "Clean-energy technologies are fast becoming cost-competitive with their 'dirtier' counterparts. While oil and natural gas prices remain stubbornly high and frustratingly volatile across the globe, and as nuclear and coal-based energy remain dogged by environmental and safety concerns, clean-energy prices continue their near-relentless downward march."

"Wind power is now one of the least expensive and most easily deployed sources of new generating capacity. Biodiesel's price is within striking distance of petroleum-based diesel. Even solar, still relatively expensive without subsidies, competes favorably in some places and is often the cheapest choice for power in remote regions. Global wind and solar markets reached $11.8 billion and $11.2 billion in 2005 — up 47% and 55%, respectively, from a year earlier. The market for biofuels hit $15.7 billion globally in 2005, up more than 15% from the previous year. Suddenly, so-called 'alternative' energy technologies are looking pretty mainstream."

However, as the saying goes, you haven't seen nothing yet. There are literally hundreds of new technologies and energy conservation and efficiency opportunities and practices that are coming on line now or that are already being instituted - both in small rural villages and in fast paced metropolitan cities, out in the middle of the wide open ocean or in the vast reaches of hot desert sands. And in addition, many more technologies and new energy opportunities are ready to be fully developed and marketed as soon as the money is made available for the last stages of research, development, distribution, and/or marketing.

In the US a New Energy Congress has been established by a group of renewable energy experts which reviews the most promising new technologies and has described and ranked the top one hundred according to their viability and perceived promise or worth. Among the top technologies that they list are a number of solar concentrators, thin film solar collectors, several technologies using magnetics, and a ceramic ultra capacitor which is essentially a super-fast-charging, environmentally-friendly, long-enduring, affordable battery technology. However they also include much more novel and exotic technologies that are on the leading edge of energy science as well. **See: www.newenergycongress.org.**

I have also found quite a few technologies that are already being developed or marketed that the New Energy Congress has missed and that are just as promising. If the Commission on Sustainable Development or national and regional agencies, partnerships, and financial institutions would put in place programs that would ensure that such technologies as these will receive the needed funding for research, development, distribution, and marketing, it would not be long before quite a number of these could be in common usage in countries around the world.

WAVE ENERGY CONVERTORS

Let's take a look at a few of these diverse opportunities, just to get an idea of what the possibilities are - beginning with wave power. In the past five years there has been a resurgence of activity in wave energy. A number of developers in different countries have either installed or are about to install full-scale prototypes with funding in excess of 70 million Euros.

For example, a £10 million wave farm is now being built off of Orkney in Scotland that will generate three megawatts of electricity - enough to power about 3,000 homes with its Pelamis Wave Converters. This is a proven technology that is just now being demonstrated in projects of increasing size but could soon dot the coast in countries around the world. The Pelamis Wave Converter looks like a giant red sea serpent swimming out through the waves to sea. As its back crests the offshore waves, rising and falling rhythmically, pistons and hydraulic pumps drive electrical generators that produce electricity endlessly. **See: www.oceanpd.com/Pelamis.**

The western seaboard of Europe offers an enormous number of potential sites where such technologies could be used. In the UK for example, the total wave resource is equivalent to 2-3 times current electricity demand. Just 5% of this resource could provide a similar generation capacity to that of the nuclear industry. However, it is not practical to recover all of this energy. Still, the economically recoverable resource for the UK alone has been estimated to be 87TWh per year, or ~25% of current UK demand. And the market for Wave Energy Converters has been estimated to be worth up to $500bn.

SKY SAILS

A more novel technology that is just now beginning to make waves in the shipping industry is the Sky Sail. Modeled after the sail of a ParaGlider, the 160 to 5,000 sq meter sail or towing kite is affixed to a freighter and pulls the ship through the water, thus saving approximately 20% of the fuel that would normally be used. The Sky Sail pays for itself within 3 to 5 years. Through the consistent global use of the SkySails technology worldwide, it would be possible to cut over 146 million tons of CO2, which equals approximately 15% of the CO2 emissions of Germany. An aggressive effort is needed, now that the practicality of the SkySail has been demonstrated, to support the usage of the SkySail on as many ships as possible. **See: www.skysails.de.**

DAYLIGHTING

Similarly, there is a new daylighting technology that could be installed around the world that would save an enormous amount of energy as it replaces artificial lighting – a most inefficient and expensive use of electricity. *Solartech* is based on a solar concentrator that provides direct light from the sun for warehouses and large retail stores. Each installation could save $50,000 to $100,000 a year in lighting costs for each building where it is used and pays for itself in less than 2 to 3 years. You can imagine the benefits in developing countries, particularly where electricity is already in short supply and especially on hot summer or cold winter days.

Use of *Solartech* in just 350 retail warehouses or large box stores would conserve the equivalent amount of electricity produced by the entire US 2002 manufacturing production of Photo Voltaic panels, 110 peak megawatts, and have an end user return on investment that is 10 times faster than with Photo Voltaics. Solar Tech's solar collector and transmitting system reduces CO_2 production quite dramatically as compared to Compact Fluorescent Bulbs. Once the technology is installed its produces none. **See: www.sunillumination.com.**

ULTRACAPACITOR "BATTERIES"

Meanwhile a Texas startup company developing what some are calling a "game changing" energy-storage technology recently announced that it has reached two production milestones and is on track to ship systems this year for use in electric vehicles. EEStor's goal is to "replace the electrochemical battery" in almost every application, from hybrid-electric and pure-electric vehicles to laptop computers to utility-scale electricity storage.

The company boldly claims that its system, a kind of battery-ultracapacitor hybrid based on barium-titanate powders, will dramatically outperform the best lithium-ion batteries on the market in terms of energy density, price, charge time, and safety. Pound for pound, it will also pack 10 times the punch of lead-acid batteries at half the cost and without the need for toxic materials or chemicals, according to the company.

The implications, if it is truly achievable, are enormous. Such a breakthrough has the potential to radically transform a transportation sector already flirting with an electric renaissance, improve the performance of intermittent energy sources such as wind and sun, and increase the efficiency and stability of power grids--all while fulfilling an oil-addicted America's quest for energy

security. In short this EESU ultracapacitor technology could replace the standard car battery and make plug-in electric vehicles the most common on the road in a limited number of years.

EEStor claims that, using an automated production line and existing power electronics, it will initially build a 15-kilowatt-hour energy-storage system for a small electric car weighing less than 100 pounds, and with a 200-mile driving range. The vehicle, the company says, will be able to recharge in less than 10 minutes. By some estimates, it would only require $9 worth of electricity for an EESU-powered vehicle to travel 500 miles, versus $60 worth of gasoline for a combustion-engine car. **See: www.peswiki.com/index.php/Directory:EEStore.**

The company announced this past week that this year it plans to begin shipping such a product to Toronto-based ZENN Motor, a maker of low-speed electric vehicles that has an exclusive license to use the EESU for small- and medium-size electric vehicles. **See: www.zenncars.com.**

PLUG IN ELECTRIC VEHICLES

ZENN Motor Company, is dedicated to producing zero-emission transportation solutions for global markets, including the revolutionary ZENN electric vehicle. The ZENN electric low speed vehicle is already sold throughout the US. It is the most innovative and feature-rich LSV including power windows, power locks, remote keyless entry, wipers, defrost, heater and panoramic sunroof, and retails starting at US $12,750. The ZENN Neighborhood Electric Vehicle recharges in as little as 4 hours, even without the UltraCapacitor technology, and has a range of up to 35 miles and gets the equivalent of about 245 miles per gallon – making ZENN one of most economical automobiles in the world.

The ZENN all-electric vehicle won the Challenge Bibendum gold medal in the Urban Vehicle category in 2006. The Challenge Bibendum (http://www.challengebibendum.com) is internationally recognized as the premier event in the promotion of sustainable road mobility. The ZENN performed exceptionally well in all categories including acceleration, braking, power consumption and noise level. Adding the UltraCapacitor to the ZENN electric vehicle increases the potential that electric vehicles could again become more popular than hybrid vehicles and would likely be much cheaper to produce.

A REVOLUTION IN RENEWABLE VEHICLES

Meanwhile a grassroots coalition of cities, businesses, electric utilities, and national policy organizations recently launched a nationwide campaign in the US to urge automakers to accelerate development of plug-in hybrid vehicles (PHEVs). PHEVs would combine today's new gas-electric hybrid technology with larger batteries that could provide an all-electric operating range of 25 to 35 miles or more. The result is an 80+ mile-per-gallon vehicle — with even greater fuel economy possible utilizing bio-fuels. **See: www.pluginpartners.org**

Plug-ins could be recharged by plugging into a standard wall socket, delivering "electric" gallons of gas for about 75 cents a gallon at prevailing electric rates. Such a vehicle could reduce gasoline consumption for the average American by 50 percent to 70 percent and reduce automobile emissions well in excess of emissions that might result from the additional use of power plants.

Plug-In Partners is a national grass-roots initiative to demonstrate to automakers that a market for flexible-fuel Plug-in Hybrid Electric Vehicles (PHEV) exists today. Founding Partners include 4 BioFuel Organizations; 120 businesses from throughout Texas and the US; 75 Cities and County Governments; 175 utilities; 8 national utility associations; 3 national security associations; 100 environmental organizations, renewable energy associations, and institutes; and 17 state agencies and offices.

The Partnership was initiated by the City of Austin in Texas, where Mayor Will Wynn has pledged $1 million in city rebates to help citizens and businesses purchase the first wave of plug-ins to roll off assembly lines. "The technology exists today," Wynn says. "This campaign will demonstrate to automakers that the market is also there." All the technologies already exist to build PHEVs at competitive prices. Now all that is needed is for one of the leading auto manufacturers to agree to produce them.

Austin's plan calls for cities to initiate citizen petition drives and to encourage government and businesses to issue "soft" orders or expressions of interest in purchasing plug-ins. In Austin, 11,000 citizens have signed petitions calling on automakers to produce plug-ins, and soft orders for 600 plug-in vehicles have been received from government and businesses in just the first six months that the Partnership has been operating.

According to the Electric Power Research Institute (EPRI), half the cars in the U.S. are driven just 25 miles a day or less. "A plug-in vehicle with even a 20-mile range could reduce petroleum fuel consumption by about 60 percent," says Bob Graham, Manager of EPRI's Electric Transmission program. EPRI has teamed with DaimlerChrysler AG of Stuttgart, Germany, to design and build a plug-in prototype van that will be tested in a small number of American cities over the next year. The vans, which have a 20-mile all-electric range, will be outfitted with either nickel-metal hydride (NiMH) batteries or lithium ion (Li-Ion) batteries.

The cost, reliability and weight of batteries are often cited by automotive industry experts as one of the stumbling blocks to the mass production of plug-ins. However, a new generation of lithium-ion batteries is more powerful and lighter-weight and with reasonable volumes is expected to be able to sell for a price that would allow plug-in hybrid electric vehicles to be competitive.

This, though, is where the UltraCapacitor comes in. If it is able to come anywhere close to operating as suggested, then it could quickly replace the electric battery in PHEVs and bring both the price and practicability down to where PHEVs are in common usage both in the US and around the world. Plug-in vehicles have the potential to cut a vehicle's petroleum consumption by three-fourths or more, can operate at as little as one-fourth the fuel cost, and reduce greenhouse gases by two-thirds.

BREAKTHROUGHS IN SOLAR CONCENTRATORS

Now the next question that one has to deal with is how to produce the electricity in a sustainable fashion to power these vehicles. While biofuels are currently being touted as The Answer in the US for powering them, many energy experts think that wind and solar are even more promising solutions. Let's take a look now at a couple of solar technologies that are beginning to light up the sky in California and the SouthWest.

In contrast to the fact that no large scale Concentrating Solar Power systems have been built in the last 15 years, Stirling Energy Systems signed a 20-year purchase agreement with Southern California Edison(SCE) in 2005 to produce a 20,000+ solar dish array, covering 4,500 acres, and capable of generating 500 MW. This is enough power to run approximately half a million homes. The completed power station, located 70 miles northeast of Los Angeles, will be the world's largest solar facility, capable of producing more electricity than all other currently-operating U.S. solar projects combined. **See: www.stirlingenergy.com**

Stirling Energy Systems also signed a second contract with San Diego Gas & Electric (SDG&E) in September 2005 to provide between 300 and 900 megawatts (MW) of solar power, approximately 30 times more solar power than is now being generated in the San Diego, California region. Such systems offer some great advantages in that they produce peak power during the peak load part of the day.

Initially, Stirling is building a one-MW test facility; and then the full project will be constructed during a four-year period, starting in early 2008. Stirling Energy Systems already runs a dish array at Albuquerque, NM–based Sandia National Laboratories, which produces about 150 kW of AC power for the approximately 8,000 employees at Sandia who use the plant's power to light their buildings and pump their air conditioners.

Each unit operates automatically, with no assistance needed from any operators. The dishes generate electricity by focusing the sun's rays onto a receiver that transmits heat energy to an engine, a sealed system filled with hydrogen. As the gas heats and cools, its pressure rises and falls. The change in pressure drives the pistons inside the engine, which produces mechanical power. This drives a generator that makes the electricity.

According to SCE, "The contract requires no state subsidy and provides favorable pricing for ratepayers because tests have shown the Stirling dish technology to be twice as efficient as, and can produce electricity at significantly lower costs than, other solar technologies."

California has passed a Renewable Portfolio Standard that requires that 20% of retail electric sales must be supplied by renewable resources by 2018 and retail sellers must increase renewable supply by at least 1% per year until the 20% target is reached. **See: www.energy.ca.gov/ portfolio.**

Such programs and policies as this are clearly working in the state. SCE procured more than 13,000 gigawatt-hours of renewable energy in 2004, more than any other utility in the US and enough to power almost two million homes for an entire year. In 2004, more than 18% of the power SCE delivered to the 13 million Californians it serves came from renewable energy sources. SCE's current renewable portfolio can deliver 2,588 MW of electricity - including1,021 MW from wind, 892 MW from geothermal, 354 MW from solar, 226 MW from biomass, and 95 MW from small hydro.

A THIN-FILM SOLAR, BLADELESS TURBINE SYSTEM PAYS OFF

Meanwhile, International Automated Systems has developed a solar technology that they say will generate electricity at a cost comparable to conventional energy sources such as coal or natural

gas. Fresnel type lenses focus the sun's heat on a proprietary, bladeless turbine. IAUS has secured a site for its first 1 Megawatt solar power plant near Barstow California. The system generates electricity for 3 - 5 cents per kilowatt-hour. **See: http://iaus.com.**

There are two key factors in the IAUS technology that enable a cost-effective conversion of solar energy into usable power: their thin-film solar collectors, and their bladeless turbines. The solar collectors do not operate as photovoltaic cells. Rather, the sun's rays focus onto a heat exchanger which then transfers the heat to a highly efficient turbine, which in turn hooks directly to a regular AC electricity generator. Though the panels resemble a magnifying glass, they are in fact composed of thousands of microscopic refracting lenses on a thin substrate that is only about 1/8th of an inch thick, and held in place by a frame. The "thin film" manufacturing process is far less expensive than the photovoltaic cell manufacturing process.

The one-megawatt plant will be composed of four dishes with 25 hexagon-shaped lenses, each about 22 feet in diameter, arrayed in three rows of eight that are staggered to accommodate the hexagon shape. Each dish concentrates all the rays on a larger heat exchanger, which could get as hot as 4000 ºF, thus driving the turbine.

The turbine has several remarkable features. It has no blades but runs on the principle of a supersonic nozzle. This enables the turbines to be manufactured at one-tenth the cost of traditional turbines. As the steam exits the nozzles, it is immediately ionized, generating additional electricity, thus recovering up to 30-40 percent of what is typically lost energy in other systems. Having a wider range of operable speeds and driving temperatures, the turbine also has a wider range of applications, ranging from cogeneration to geothermal tapping, to harnessing energy from landfill methane burn-off. The turbine is completely scalable up or down in size; and its cost is proportionate to the scale -- in contrast to some systems that are only cost effective at a given scale or size.

IAUS has also achieved a solar energy storage breakthrough. First, in the IAUS system, the turbine generates directly to AC, eliminating the expensive DC inverter step and the expensive storage batteries. IAS's product operates on heat and produces heat as a byproduct. This energy can be stored using a chemical regeneration process based on a hydration-dehydration cycle. Thus when the sun is shining, excess energy can be dumped into the dehydration process. Then, when there is no sun, the hydration process gives off heat to operate the turbine; thus achieving a breakthrough to 24/7 solar power.

IAUS has acquired funding on the level of several million dollars, part of which was spent in research and development, part in ramping up for production, with another part going toward underwriting the installation of the panels through an innovative financing arrangement. International Automated Systems has been in business since 1987. They were responsible for the self-check-out system for stores; an automated fingerprint ID system for credit cards to prevent fraud; as well as a related technology for airport security. Thus they are a quite reputable company.

They are ready to go into full production and say that they can initially produce 200MW of electrical capacity a year. However they will need additional funding to be able to do so. This is where a governmental or intergovernmental program could really assist in rolling out and scaling up such new technologies in a rapid and cost effective manner.

SOLAR PHOTO VOLTAICS VERSUS COAL

In 2005 Co-op America's Solar Catalyst Program published a report showing how the price of solar PV can become cost competitive as soon as 2010. Now it appears that this could be achieved even sooner. Says Alisa Gravitz, Co-op America's Executive Director, "I'm seeing at least five companies that will be able to deliver solar PV at the price of coal in three to five years. Unfortunately, US power companies are shortsightedly planning to build more than 130 new coal-fired power plants in the next several years." Not a one of them should be built. The US should turn to energy conservation and renewables instead.

PROBLEMS WITH "CLEAN" COAL

Currently over half of the electricity used in the US is generated by coal-fired power plants. For every ton of coal they burn, they put over three tons of CO_2 into the atmosphere (The carbon emitted by burning coal bonds with oxygen in the air, creating the increase in mass.). Coal-fired power plants are the largest source of CO_2 emitted in the US. They're also major emitters of mercury, sulfur dioxide, and nitrogen oxide, which cause health problems ranging from learning disabilities to lung disease.

While "clean" coal burning technologies do remove nitrogen oxide, sulfur dioxide, mercury, and other particulates from the process, they do not significantly reduce CO_2 emissions – and therefore do not reduce coal's global warming impact enough. Carbon Capture and Sequestration is still being researched and is unlikely to be ready for widespread development for another ten years, if then – and ten years is the window in which we have to act if we're going to meaningfully reduce our emissions worldwide. We already have much better options in terms of energy efficiency and renewables. And that is where our research and investment monies should be spent.

Even if Carbon Capture and Sequestration proves effective, the mining and transportation of coal would still be energy-intensive and environmentally damaging, to say nothing of the safety and mining hazards. Mining is also a water-intensive process that has been blamed for depleting aquifers, including in Indigenous regions. Mining companies store their waste, a thick liquid containing toxic chemicals in slurry impoundments that sometimes burst and contaminate entire towns.

The Bush Administration talks about "clean coal" as if it is the answer to our energy future or as if there actually is such a thing. However, it doesn't exist, at least not with how coal is mined and processed in the US. It is anything but clean in terms of health, safety, and environmental pollution and degradation.

We ought to make it illegal to invest in and build any new coal or nuclear power plants because of the capital expense and long time period during which they must operate to pay back the investment and the desire to ensure that the stockholders do not have to eat their bad investments. In the 70s and 80s it was widely suspected that a good number of utilities in the US would have gladly replaced their plans and construction projects for nuclear power plants if they could have written them off or if the ratepayers would have picked up the tab to pay for them –

even if they were not built and never operated. In other words many were built just to cover the costs that accrued in the initial stages of design, siting, and pre-construction.

The same situation exists with coal power plants today. The technologies already exist for us to be able to make a rapid transition to a renewable energy future. Now we just need to invest adequately in it. If we invest in coal plants instead, we will just be locking ourselves into an unsustainable and polluting energy system for decades to come.

BIOFUELS COMING OF AGE

In 2005, biofuels represented just 1% of world road-fuel use; however this is projected to increase to between 4% and 7% by 2030, an annual rate of growth of between 7 and 9%, according to the International Energy Agency. However, according to recent studies, advanced biofuels could actually replace over a third of US transport fuel, up to a quarter in Europe, and more if combined with greater fuel efficiency. Many small developing countries could potentially meet all their fuel needs. **See: www.worldwatch.org/node/4078.**

According to the IUCN's paper for CSD15, entitled *Biofuels: A Tool for Conservation?,* "The most important potential, from an ecological perspective, is a transition from annual to perennial crops for biofuel production, which could help stabilize ecosystems by reducing disturbance levels resulting from tilling and planting. Natural vegetation may also be re-introduced into landscapes."

"For example, intensively-farmed grain production areas could be converted to mixed native grasses, providing a sustainable feedstock for biofuels which require less water and fertilizer and also sequester carbon in the roots and surrounding soil."

The latest research indicates that different crops are appropriate for different regions of the world and that biodiesel production makes much more sense than ethanol in most situations. One new opportunity that is emerging is the use of various oilseed crops, particularly those that could grow in dry land crop areas. For example, there is a growing interest in the mustard plant, which has many performance advantages over soybeans.

Pound for pound, the oil content of mustard seed is 40 percent, compared to the 18 percent content of soybeans. Mustard seed has a higher cetane rating, the measurement of fuel's ignition quality, and it retains flow properties in freezing temperatures better than soy-derived oil. In addition, the drought-tolerant and heat -resistant crop requires little irrigation, a factor that improves the fuel's energy balance. Soybeans produce 3.2 units of energy for every unit of energy used to process the oil into fuel. Growing the low-moisture feedstock close to the manufacturer helps to boost mustard seed's energy balance to more than four units of energy per unit spent in processing.

In fact a farmer's cooperative has been formed in the US to fund the construction of a 2.8-million-gallon biodiesel production facility in northeastern Colorado. Members must invest a minimum of $5,000 and plant up to 200 acres with seed provided by the cooperative. More than 50 farmers have already joined and USDA Rural Development has provided two matching grants for $450,000 each to help with setting up the growers' co-ops.

What is essential in any case is that appropriate sources of biofuels be determined based on local circumstances and environmental conditions. However, it is clear that some crops have significant potential to contribute to a sustainable future, while others do not.

INDOOR AIR POLLUTION CAUSES 1.5 MILLION DEATHS A YEAR

(The information in this section comes from the World Health Organization's 2006 Report, *Fuel for Life, Household Energy and Health*. **See:www.who.int/indoorair/publications/ fuelforlife.pdf.)**

More than three billion people still burn wood, dung, coal and other traditional fuels inside their homes. The resulting indoor air pollution is responsible for more than 1.5 million deaths a year, - mostly of young children and their mothers. Millions more suffer every day with difficulty in breathing, stinging eyes and chronic respiratory disease. Moreover indoor air pollution and inefficient household energy practices are a significant obstacle to the achievement of the Millennium Development Goals – which we could fairly easily do something about.

Just imagine for a moment that you are a mother living in a third world country living in utmost poverty. The one thing that you have and care about is your children. How could you possibly watch one of them die, slowly and agonizingly, knowing that there is nothing that you can do about it while it could all have been avoided if the right programs had only been put in place. So what are we, in the world community, waiting for? Why don't we establish programs that ensure that every village community in the world is able to use improved cook stoves, biogas, and other remedial technologies.

In its 2000 Report, WHO reported that cooking was a dangerous undertaking and that indoor air pollution was one of the top ten global health risks. In poor developing countries, only malnutrition, unsafe sex, and lack of clean water and adequate sanitation were greater threats than indoor air pollution. How is it that with the wealth and prosperity of the 21st century we allow any of these things to continue to be a problem for billions of people around the globe?

Progress in access to modern cooking fuels since 1990 has been negligible, as the small gains made are lagging behind population growth. In order to halve the number of people without access to such fuels by 2015, 485,000 people will need to gain access to modern energy services every day for the next ten years. Innovative policy approaches and a rigorous acceleration of investments is needed now to save lives and enable development. Programs, policies and initiatives must be funded and put in place at the national and international levels.

According to the WHO report, investing only $13 billion per year to halve, by 2015, the number of people worldwide cooking with solid fuels by providing them with access to liquefied petroleum gas would show a payback of $91 billion per year. Making improved stoves available to half of those still burning biomass fuels and coal on traditional stoves would save $34 billion a year (as fuel cost savings due to greater stove efficiency exceed investment costs) and generate an economic return of $105 billion a year over a ten year period. Health and productivity gains make household energy solutions potentially good value for money spent.

Inefficient household energy practices may be of particular significance to the health of pregnant women: carrying heavy loads during fuel collection may bring about prolapse during pregnancy,

and exposure of the developing embryo to harmful pollutants may lead to low birth weight as well as stillbirth.

Switching to cleaner fuels and increasing fuel efficiency through better stoves reduces health risks for all family members. Beyond curbing respiratory problems, a more secure household energy situation enables water to be boiled and thus helps reduce the incidence of water-borne diseases. It can also increase the number of hot meals consumed per day and thus improve food safety and nutrition. A closed, raised stove prevents infants and toddlers from falling into the fire or knocking over pots of hot liquid and being burned or scalded. Closing the household energy gap can thus be a springboard for achieving the health-related MDGs.

BIOGAS AND WATER MILLS

There have been many efforts to support the development and use of fuel efficient stoves in various parts of the world. The Chinese produced 200 million of such stoves during the 1980s and 90s. A commercialization strategy helped to set up rural energy enterprises; while national-level stove challenges generated healthy competition. Meanwhile the Indian national programme distributed more than 33 million stoves between 1983 and 2000. In Africa more than 5 million improved stoves are now in use.

The Centre for Rural Technology, Nepal has implemented a program in Nepal that has had great success. CRT/N has served as the Technical Service Provider and supported implementation through 67 Local Partner Organizations in 18 mid-hill districts through its 5 Regional Renewable Energy Service Centers. Between June 2000 and June 2006, 126,085 Improved Cook Stoves were installed. **See: www.inforse.org/asia.**

The stoves that are produced fit local conditions, situations, and desires. The materials for the ICS construction are locally available and include stones/bricks, mud/earth, straw/rice husks, iron plates/rebar/sheet, and animal dung. The type of ICS promoted in Nepal is made up of 3 parts mud/earth, 2 parts straw/husk, and 1 part animal dung. The whole structure is plastered smooth with the same mud mortar. ICSS has two fire openings for cooking pots, one behind the other. The users only have to pay for iron rod and installation charges. The cost varies upon the place but in general it is only 300 – 400 Nepali rupees. In addition to domestic uses, the stoves are also being used in hotels, teashops, schools, hostels, barracks, etc.

In Nepal, they have also focused on Biogas systems, which convert cattle dung and other animal or human wastes into methane. This flammable gas is a simple-to-use fuel for lighting and cooking: it burns cleanly and efficiently on a conventional low-pressure gas burner. In Nepal the Biogas Support Programme has installed more than 120,000 biogas plants over the last 13 years. About 3% of Nepalese homes now benefit from much lower levels of indoor air ppollution. Moreover, 72% of the biogas plants are connected to latrines, leading to improved cleanliness and reduced health risks in the vicinity of the home. The residual slurry provides a valuable organic fertilizer.

This biogas programme was the first to be recognized under the Clean Development Mechanism. It trades certified emission reductions; each operational biogas plant is worth 4.6 tonnes of CO_2 per year. This type of program should certainly be replicated in other countries around the world.

THE TIME FOR ACTION IS NOW

More than 1.6 billion people lack access to electricity and considerably more than half of humanity to modern forms of energy for heating and cooking; but this could also be changed in a short period of time. There is no reason that everyone could not have access to sufficient energy to meet their basic human needs. It will however take a major commitment on all of our parts to achieve this; but it is certainly doable and the results would be a greatly improved quality of life for all peoples.

If this does not occur however and if it is not achieved, then it is quite likely that the price and cost of energy will rise fairly dramatically and the strife and competition over the available energy resources will effect all, or at least a very large number, of us quite dramatically. But it will only be our own short-sightedness that would allow this to occur. The technologies, capital, and expertise already exist to make a rapid transition to a sustainable and renewable energy future that meets most people's needs and averts climate change. Now all that is needed is the political will to develop and fund the needed programs and strategy development plans or global framework needed to do it.

In fact, CSD15 could provide our first and perhaps best opportunity for initiating and establishing the strategy development plans and programs needed to do this. The Secretary-General's Report included one recommendation which could help substantially to provide a means by which such programs and planning could be funded and implemented. This is the recommendation that the World Solar Programme be replaced with a World Renewable Energy Programme. The basic commitments that are agreed to during CSD15 could thus be funded and implemented as a part of such a World Renewable Energy Programme which would carry out and implement the CSD15 outcome document or framework agreement.

However, even if such a Programme is not established, if the governments will take seriously their commitments and take specific action to fulfill them, then we will still be able to do the things that are needed. There are plenty of energy partnership initiatives that need more funding and resources, the Johannesburg Plan of Implementation already calls for a global network of research and development centers to be linked up and established, and UNDP's Thematic Trust Fund for Energy could serve as a good means to fund Capacity Building projects.

FINANCING RENEWABLE ENERGY TECHNOLOGIES

Similarly, the European Commission's Global Energy Efficiency and Renewable Energy Fund (GEEREF) is coming on line this year. GEEREF is a new global risk capital fund to mobilize private investment in energy efficiency and renewable energy projects in developing countries and economies in transition. It will accelerate the transfer, development and deployment of environmentally sound technologies and thereby help to bring secure energy supplies to the people in poorer regions of the world, while combating climate change and air pollution.

GEEREF expects to provide financing for around 30 projects with its initial capital funding of 112 million Euros and is looking for more partners that want to invest in this most worthwhile program that will again pay for itself. **See: http://ec.europa.eu/environment/jrec/energy_fund_en.htm.**

INVESTING IN R&D TO AVERT CLIMATE CHANGE

In March, an international panel of scientists presented the United Nations with a sweeping, detailed plan to combat climate change - a challenge, it said, "to which civilization must rise." Failure would produce a turbulent 21st century of weather extremes, spreading drought and disease, expanding oceans and displaced coastal populations. "The increasing numbers of environmental refugees as sea levels rise and storm surges increase will be in the tens of millions," the panel co-chair told reporters. **See: www.turkishdailynews.com.tr/article.php?enewsid=67239.**

The experts panel said global carbon dioxide emissions should be leveled off by 2015-2020, and then cut back to less than one-third that level by 2100, via a vast transformation of global energy systems - toward greater efficiency, away from fossil fuels, and toward biofuels, solar, wind and other renewable energy sources.

The US says it spends almost US$3 billion a year on energy-technology research and development as its major contribution to combating climate change. But others put the spending at less than $2 billion and suggest that it's "far from proportionate to either the size of the challenge or the size of the opportunities." Tuesday's report said such research budgets worldwide are badly underfunded, and require a tripling or quadrupling of from $45 billion to $60 billion a year. The GEEREF and other programs like it will have to be significantly scaled up if the research and development monies that are needed are going to be forthcoming.

MUNICIPAL PROGRAMS GIVE RESULTS

Even the matter of political will is, however, changing. In the US, where the Congress refused to ratify the Kyoto Protocol under both the Clinton and Bush Administrations, 22 States have now adopted Renewable Portfolio Standards; and more than 435 municipalities have joined a Climate Protection Agreement. These cities have thus committed to meet or beat the Kyoto Protocol targets in their own communities and to urge their state and the federal government to adopt policies and programs that would meet or beat the Kyoto Protocol. In fact most of these communities are well on their way and it is quite likely that most of them will achieve this.

Oakland, California already gets 17% of its electricity from renewables followed by San Francisco, San Jose, and Sacramento at 12%. Portland Oregon gets 10% of its electricity from renewables and a number of other big cities in the US are also above 5%. It is clearly possible to make fairly rapid shifts to renewables when the right government policies and incentives are put in place. It's no accident that six of the top cities are in California. The Golden State has set aggressive renewable energy portfolio standards for its three big investor-owned utilities - PG&E (PCG), Southern California Edison (EIX) and San Diego Gas & Electric (SRE). And city-owned utilities like the Sacramento Municipal Utility District have been green-energy pioneers.

One city to watch is Austin. The Texas capital's government has committed itself to going carbon neutral by 2020, and its municipal owned utility - Austin Energy, a leader in renewable energy - has been given a mandate to generate 100 megawatts of solar power and make all new plants zero emission. There is no reason that something similar couldn't be done by all big cities around the world, if they had the capital and expertise to do it. In fact, San Francisco challenged them to

move rapidly in this direction when it hosted World Environment Day in June of 2005 and put forward the Urban Accords.

ICLEI has also served as an excellent support network through which communities could move towards sustainability and create their Local Agenda 21 Plans as agreed to by the governments at the Rio Earth Summit Conference fifteen years ago now in 1992. Unfortunately, ICLEI has not had the funds needed to assist most municipalities in the developing world to complete nor to implement their plans. This is thus one area in which global support is needed to assist such communities both in completing and implementing their sustainability plans and in adopting energy efficiency and making a rapid transition to renewable energy.

PROVIDING ACCESS TO BASIC SERVICES

(The following information is from the World Energy Council's 2000 Report - *Energy for Tomorrow's World – Acting Now!* ***See:*** **www.worldenergy.org**.)

One of the biggest challenges we face is that of supplying basic services to those in the developing world. In 1993 there were1.8 billion people in the world without access to commercial energy. Despite the effort to connect roughly 300 million people to electricity grids or to provide them with modern biomass or other forms of affordable energy since then, there are still about 1.6 billion people in this situation. Another 400 million will join them between now and 2020 (25-30% of the additional 1.4 billion people expected to be born between 2000 and 2020).

In 2000, 1.2 billion people (20% of the world population) in the industrialized part of the world consumed 60% of the total energy supply, while 4.8 billion people (80% of the world population) in the developing countries consumed 40% of the total energy supply. However, the two billion poorest people with an average income of less than $1000 consumed only 0.2 toe per capita, mostly biomass, whereas the industrialized countries use an average of 5 toe per year, nearly exclusively modern energy.

In terms of electricity, at the start of the 21st century 800 million people in the developed market economies used 9000 Twh of electricity, while the developing market economies (excluding China) used 3000 Twh of electricity for 3.5 billion people. Is it any wonder then that the developing countries are complaining about unfair treatment and are insisting that access to energy is essential? However, we can easily see that it cannot be done unless we make a rapid transition to new renewable forms of energy – as fossil fuels are rapidly running out and even nuclear energy would have a limited life span.

In order to quantify the challenge before us, let us assume that there will be 7.4 billion people in the world by 2020. Even that should appear shocking, however it is where we are headed. Already 1.6 billion people do not have access to modern energy and 30% of an additional 1.1 billion people will need it. This is thus almost 2 billion people that will lack access to modern energy by 2020. In order to provide energy access to all people we would have to provide it to 150 million people a year or close to 450,000 a day.

This contrasts with our ability to provide modern forms of energy to only 40 million people a year during the period of 1970 to 1990 when fossil fuels were still relatively cheap or the 30

million people a year who have gained access since then. Clearly we would have to quadruple or quintuple our effort in order to provide access to energy for all by 2020; and it will have to be done by making a rapid transition to sustainable and renewable energy sources. There is surely no way around it. It is the only thing that will be at all affordable.

The WEC reported in 2000 that the annual per capita consumption of electricity in industrialized countries was about 9000 kWh per year while it is about 900 kWh per year for those in developing countries. The WEC suggested that while the immediate objective could be set at providing the world's poor with about 300 kWh per capita per annum (because of their inability to afford more sophisticated end uses), they believe that a minimum target of 500 kWh should be reached.

While a large number of people living in rural areas have indeed been connected to electricity in recent years – over 400 million in China and 150 million in India during 1970 – 2000, there remains a large and substantial difference among countries in the scale and quality of service offered. Such statistics often mask the realities. In India, where electricity may be provided in many villages with some lighting facility (over 80% of Indian villages are so covered), only one third of village homes actually had access to it in 2000.

In 2000 GEF was donating $10 million to support renewable energy development. These funds were to subsidize investment in equipment, technical assistance and studies focused on the analysis of technological and diffusion problems. However when compared with the amount of money that the IFIs have spent on large industrial energy projects or the subsidies that have been given to the fossil fuel and nuclear industries this amount of money is pitiful.

According to the World Energy Council's 2000 report, "Half of the world's population still live in rural areas, nearly 90% of them – some 2.8 billion in 2000 – in the developing countries. It is calculated that an amount of energy roughly equivalent to 7% of the world's electricity production today could cover basic human needs. In an age of apparently advanced technological and management skills, we have and are continuing to fail miserably in this modest challenge."

There is no reason that the world community could not move rapidly towards a renewable energy future and provide for all people's basic human needs. It is only a matter of political will, human imagination, and a belief that it is possible. Let us make a commitment to carry out our promise to build a better future for all of the people in the world. The Time for Renewables is Now!!

Rob Wheeler
US Citizens Network for Sustainable Development: www.citnet.org
Global Ecovillage Network: www.ecovillage.org

robwheeler22@gmail.com
Skype: robineagle333