SOLVING THE RENEWABLE ENERGY CONUNDRUM

A WHITE PAPER

What renewable energy sources, are feasible, logical, and realistic ?

Is there a solution?

The quick answer is, Yes.

The Earth provides us with multiple sources of renewable energy, mainly: Wind, Solar, Hydro, Waves, Tides, Core Earth Residual Heat and Bio fuels.

Where and how should our human resources be allocated to maximize future scientific breakthroughs and inventions incentivized through public policy.

A summary analysis follows.

By Kean W. Stimm

Second Edition

A SUMMARY ANALYSIS OF POTENTIAL RESOURCES

The world has been blessed with huge but finite supplies of fossil fuels. They have met and continue to meet all of civilization's requirements for abundant low cost energy. Perhaps 70% of this finite supply has been consumed and we are faced with rapidly diminishing reserves that are becoming increasingly more expensive to extract. An end to the fossil fuel era is on the horizon.

Civilization's needs for usable energy are enormous and continuous. Our standard of living is totally dependent on abundant low cost energy. This fact dramatically limits the potential sources as to amount of energy available, but also how continuous is the availability. The cost of transporting the energy to the ultimate user is a major consideration as it can be very expensive.

An analysis of which renewable energy sources are logical and feasible is the first step to resolving the energy conundrum. It must be recognized that a "Value Stack" analysis using various algorithms that factor in location, environment, tax abatements, subsidies, employment, affordability, resilience, reliability, and other factors, must be given proper consideration. Each energy source involves different technologies which, in turn, require adjustments to regulations.

BIOLOGICAL SOURCES (Bio-Fuels) This is realistic, as with ethanol, but require large amounts of agricultural land and water resources competing with production of food. Costs are high since production is intermittent requiring storage prior to processing. Land requirements would be huge. Transportation of the energy product requires a vast distribution network. The end product would probably be burned causing air pollution.

GEO THERMAL: The core of the earth, 2,000 miles in diameter, is a white hot molten metal mass that leaks heat into the earth's 3,000 mile thick crust resulting in hot springs and volcanic eruptions. Each mile down below the surface represents 1-1/2 million years as the earth receives space debris. The higher temperatures below the earth's surface represents an energy source that can be exploited but uses heat pumps that require another source of energy. The amount of available energy that is accessible is simply inadequate to satisfy the world's needs and the end product is only transferred heat and not directly usable except as heat.

WAVES AND TIDES: can be a viable source of continuous energy. The huge problem is the cost of harnessing this energy and maintaining the complex mechanisms required. The energy obtained is oscillatory and requires system smoothing. The coastlines of the world are hardly enough to supply world needs and this property is extraordinarily expensive and largely not available. Transportation costs of the energy to inland areas would be prohibitive.

CONTINUATION OF POTENTIAL RESOURCES

HYDRO POWER is highly feasible and practical, but is already almost fully exploited across much of the world. It provides a logical and significant contribution as renewable energy delivering about 2-1/2% of total energy consumption in the USA. It is more expensive than we are led to believe since it usually must be transported over long distances on transmission lines incurring significant expense and power loss. It is to be noted that the proper amortization of the huge investment when factored in, can show that the cost of delivered power may exceed that of fossil fuels. Amortization cost is usually written off by government using tax payer funds and seldom recognized by the public.

NUCLEAR FISSION is not a truly renewable energy since there is a limited supply of uranium, and these power plants are hugely expensive and worrisome. Utilization of the power requires expensive high voltage transmission lines and utility substations. The cost per kilowatt hour of electricity is so high as to currently require substantial government grants, subsidies, and tax abatements. Its early promise of a low cost universal source is now justified by assuaging the warnings of global warming. It currently represents about 8% of total electrical power usage in the USA. It best serves large metropolitan cities but its cost should be absorbed by users and not federal subsidies.

NUCLEAR FUSION continues as the dream of endless continuous power. Enormous efforts continue as a goal toward harnessing this infinite source of energy. We are a long way from the realization of Nuclear Fusion until such time as a scientific breakthrough occurs and then the necessary inventions to make it economically feasible.

FUEL CELLS: The hydrogen fuel cell has been used for three decades in Vancouver, Canada to power municipal busses, however, it is not a source of energy. It combines hydrogen (H_2) & oxygen (O_2) to form water (H_2O). In the process it releases an ion of oxygen that combines to enable a stream of electrons as an electrical current to power the busses. The end product is water which can then be "cracked" by a solar furnace, or by electrolysis, back to hydrogen and oxygen. The conversion adds the energy used to power the busses. It is effectively a storage battery system. Breakthrough engineering using *metallic fuel cells* will make the electric car practical by using plug in modules.

SOLAR POWER has enormous apparent potential. Consider that our sun is truly nuclear fusion radiating energy to the earth and delivered nine minutes later at a rate of about 100 watts per square foot. This is approximately equivalent to 3,000 megawatts per square mile. If we allow that the sun shines high enough in the sky about 20% of the time, because of clouds, nights, and low sun angles, that square mile is actually receiving power at an average rate of about 600 megawatt hours per hour or an accumulated amount of about 5,000,000 megawatt hours per year. Since the best solar panels are able to convert about 20% of the energy to electricity, the useful yearly output would be about 1,000,000 megawatt hours per square mile of the earth's surface.

The total consumption of electricity in the USA in the year 2016 was 28.6 billion megawatt hours. (includes 11.1 billion MWH natural gas equivalent for electric heating). Hence, it would take 28,600 square miles of solar panels to furnish the electrical power needs of the USA (if we convert to electric heat). This is equivalent to about the total land area of Massachusetts, New Jersey, Vermont, and Connecticut, combined. It is logical to place the panels in desert areas, but there would be great expense for the transmission lines, and losses therein, as needed to distribute the power across the USA. Because of the on and off nature of sunlight, enormous storage systems would be required.

The concept of covering roof tops with solar panels is expensive and forces the building owner to finance the cost and amortize the investment over 20 years. Each installation becomes a micro grid with maintenance by the building owner. To provide the average home enough power for heat, cooling and electricity requires a panel of at least 1,000 square feet (2-1/2 stories high and 40 feet long) It is a very expensive process that has resulted, so far, in contributing less than 0.7% of the total USA electrical needs. The cost is high enough to require government grants, subsidies, and tax abatements; a cost the user should pay.

It is important to recognize that the concept of "Net Metering" imposes a high expense burden on the utility which raises the cost of power to other customers. The electric utility is mandated by government regulations to furnish power instantly when the sun does not shine and to buy the solar generated power when there is excess power. At the end of the year, the "net" bill could be zero. The utility receives no revenue but somehow must recover the expense. It reduces power being bought from high quality suppliers, thus increasing their costs.

To make solar power economically feasible, it is logical that the Investor Owned Electric Utilities be able to purchase and own the solar panels "distributing the energy resource" (DER) strategically across their grid on their distribution side of the meter. Panels installed on flat roofs of commercial buildings and in open areas avoid the amortization cost (since the investment is owned by the shareholders) and the exorbitant cost of selling to home and business owners. (Utilities can offer Building owners a discount). This concept dramatically reduces the cost of solar power while complimenting wind power during summers when winds are less.

CONTINUATION OF POTENTIAL RESOURCES

WIND POWER is a primary source for renewable energy because of the enormous energy in wind. It is estimated that there is enough power flowing just over our heads (as a river of energy) to supply all of civilization's needs 100 times over. We just require an efficient method of extracting this energy. The three blade windmill is not the answer because of its incredible inefficiency.

To understand the energy in wind, consider a hoop 100 feet in diameter placed just above the trees in an average wind of 12 miles an hour. In one year, the amount of wind energy that flows through that hoop is 600 megawatt hours (90 horsepower continuously). An average home requires about 25 megawatt hours for all heating, cooling, and electricity. Double the wind speed to 24 MPH, the speed of the trade winds; the power flowing through that hoop increases exponentially by the third power to 4,800 megawatt hours (730 HP continuously) enough to power a sub division of 200 homes. The weight of air passing through that hoop in <u>one second</u> at 12 MPH is an incredible 10,400 pounds (5 tons). Air has weight ! The three blade windmills, proliferating across the world, missed this important fact. It is the mass weight of the air, and its velocity that produces "foot pounds per second" that equals horse power that converts to megawatts of electrical power. A large three blade windmill allows 96% of the mass weight of the wind to pass uselessly between the three slender blades converting less than 1% of the energy in the wind (they use) to useful electrical energy.

New recently developed wind turbines (completely different than three blade windmills and noiseless) utilize Sir Isaac Newton's principles of linear motion and are called Newtonian wind turbines. They can be 1/10th the size and 1/20th (5%) the cost of a three blade windmill for the same output. For example, an 8 meter Newtonian turbine rated at 100 KW (134 HP) that utilizes 100% of the wind air mass can match a 2,500 KW windmill whose rating is also based on using 100% of the air mass. Because the windmill's three slender blades only occupy 4% of the span area, 96% of the wind energy passes between the blades and is lost. The proper rating is 4% of 2,500 = 100 KW. The new turbines convert wind energy more efficiently to electric power and use twice as much of the wind speed spectrum.

Newtonian wind turbines, used as a "Distributed Energy Resource" (DER) produce three phase 60 cycle power direct from an alternator (without an inverter) that connects directly to an electric utility grid on the utility side of the meter. They are sized to not overload the grid wiring. This reduces the need for sub stations, transmission lines, and wind farms. Various sized turbines would be available to produce from 25 to 1000 MW hours per year with the size varying from 4 to 25 meters in diameter. Heights range from 60 feet to about 130 feet. Most trees rise about 45 feet but some taller trees rise over 130 feet. Hence larger Newtonian turbines can be relatively inconspicuous if placed with consideration.

CONTINUATION OF WIND RESOURCE

To properly use the Newtonian wind turbine, hundreds of turbines are strategically connected across a large grid averaging perhaps 16 small turbines per square mile. This provides a smoothing of the power from all the turbines as the individual power outputs can fluctuate significantly. The larger the grid, the greater the smoothing effect. When the turbines are installed across the USA to the interconnected grids, areas with temporary higher winds easily push power to other areas with lower winds. The end result is a continuous smooth flow of power to the national total grid at all times, winter and summer, nights and days.

Turbines can be grouped or clustered with grid loading and the smoothing effect the only considerations. Larger turbines reduce the number of turbines required. All turbines collectively enable heating of buildings and recharging of vehicles. The total US consumption of electric power including natural gas equivalent for heating, was 28.6 billion megawatt hours in 2016. Wind power is capable of doing this.

Power costs less when utilities are able to purchase and own their own small wind turbines and solar panels. Utilities who are investor owned do not amortize the turbine or solar panel cost as the investment is owned by the shareholders. They can, however, deduct depreciation over 20 to 30 years thus offsetting the operating and maintenance cost (O & M). An eight meter turbine, producing 100 megawatt hours per year is estimated to have a total O & M at less than 1/2 cent per kilowatt hour. With a tax deduction for depreciation, the power is virtually free.

It is important to recognize that if third party suppliers of energy are involved, the cost that the utility will pay for this power can go up to perhaps ten times as much per kilowatt hour. This is because third parties must amortize the cost of the turbine, and pay a higher cost for the turbines or solar panels due to greater selling expense to independents. Net metering may require a "power availability charge" and, of course, a third party supplier needs to add a profit.

There is a critical urgency to begin the transition to renewable energy as it will take 10 to 20 years to complete even part of the work. Before then a crises will have developed due to diminishing fossil fuels and rising costs. In fact, if government subsidies stop, the crises will begin now. The fastest way to accomplish the transition will be to incentivize the utilities to get the job done. As with any well run business, an effort that lowers costs should improve profitability and shareholder equity. If a fixed profit percentage is mandated, lowering costs only reduces profit and incentive is lost. Certainly, a serious consideration must be given to this very fundamental and essential aspect of the regulations which govern electric utilities.

It is now obvious that far lower costs from smooth continuous sources of free renewable energy are possible, thus enabling the saving of our fossil fuels to make synthetic leather, clothing, medicines, plastics, solvents, etc. as imperative.

TRANSITIONING TO RENEWABLE ENERGY

The continued burning of these precious fossil fuels is grossly irresponsible. Current subsidies destroy initiative to transition to the renewable energies. If we wait too long, we will have an energy crises born out of costs being too high and an inability to respond quickly enough. Now is the time to begin the transition.

We must also conserve energy. Two huge opportunities exist: The metallic fuel cell makes the electric car practical as a "plug in" energy source. Since electric cars are 10 times more energy efficient than internal combustion engines, the savings of fossil fuel can be enormous. Likewise, high speed electric trains (240 MPH) running silently on overhead rails can connect our cities and villages at a travel cost that is far below aircraft and private automobiles or busses. Running continuously with stops every 25 miles, the savings of energy costs, and time would be spectacular.

Our national electric grid must be reliable, resilient, of high integrity, designed to provide low cost abundant energy. This becomes a vital requirement as we gradually consume the last of our fossil fuels. This will be a slow gradual process and needs to be governed by a national policy that is especially designed for the benefit of the entire country without subsidies, grants and special tax favors. Utilities need to purchase an agreed cost determined percentage of renewable energies available in their area. It is logical that solar power be available in sunny areas and tidal power in coastal areas, as we do with hydro power. Stored fuels such as coal and bio mass add resilience. Where geo thermal sources exist, it is certainly logical to use this source in those areas. A balanced usage of all our appropriate resources across the country provides a continuous opportunity and incentive to reduce costs, improve reliability, and make improvements. The elimination of all forms of subsidy support provides accurate comparisons of energy costs. By requiring the utility to utilize allotments of the available energy resources, it encourages suppliers, and promotes innovation and constant progress.

Prosperity is driven by abundant low cost energy

Kean W. Stimm is a scientist engineer, Purdue University graduate, and C.E.O. of Kean Wind Turbines, Inc. The company is a "C" corporation registered in New York State and has undertaken the development of the Newtonian Wind Turbine. An engineering "Proof of Concept" model was tested outdoors and in a wind tunnel at Calspan, Inc.; a renown aeronautical testing laboratory. The original model extracted over 50% of the wind energy. Patents were filed in 52 foreign countries and most have issued. Manufacturing rights will be licensed to small manufacturers throughout the world to provide turbines to electric utilities serving their community. This starts the gradual transition from fossil fuels. There is no licensing fee, but royalties from all over the world return to the USA. Kean's next projects will be to set specifications for the High Speed railway system and the Metallic Fuel Cell.

keanstimm@gmail.com