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Solar Energy - Is It Possible To Achieve Grid Parity With Current Fossil Fuel Based Energy Systems?

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Thank you for coming to hear me speak regarding solar energy possibilities to reach Grid Parity with current fossil fuel based energy. Today lets' discuss what is the general problem.

Seriousness of the need and necessity for immediate action regarding climate change.

The world is grappling with serious energy issues in the first decade of the 21st century, from dependence on foreign oil and a finite supply of fossil fuels, to being a major contributor of greenhouse gas emissions. Currently, the US produces about 25% of global carbon dioxide in the world and our country meet 85% of our energy needs through burning fossil fuels, such as coal, natural gas and oil, primarily because our economy is the largest in the world. The majority of the world's electricity is produced by power plants that burn fossil fuels. Scientists estimate US business consumers alone utilize 415 million tons of coal per year releasing 864 million tons of CO2 greenhouse emissions into the earth's atmosphere[1]. We as humans have a responsibility to each other and every living thing on this planet to preserve and protect our environment better than what we are doing.

Two major negative consequences of our current fossil fuel usage are:1) Burning fossil fuels contributes too much of the negative CO2 emissions to our planet's atmosphere, and 2) there is a finite supply of fossil fuels, particularly oil, which have already begun a declining supply rate. These 2 facets have made it imperative to reduce our current energy consumption and develop more environmentally clean, renewable energy sources. Reducing fossil fuel energy consumption enables companies to save money and also reap environmental benefits by playing a part in addressing climate change.

Growing public and private demand for clean, more environmentally – friendly energy is motivating more renewable energy companies to seek to make a positive difference on our planet by providing clean, renewable solar energy. Solar Energy is one of the major choices for renewable energy. There are several reasons to promote solar energy use as a major energy source. The ability of utilizing solar energy to convert to electricity, for heating purposes, solar plants consume little or no fuel, saving billions of CO2 emissions and dollars per year as well as the fact that the earth receives more energy from the sun in just one hour than the entire world uses in a whole year are major factors in pushing this form of renewable energy use for present and future generations.

However, even though the variable cost of solar energy is very little, there are still tremendous costs and problems in the use of solar energy today.

The two major problems with a solar energy plant are 1) Solar energy cannot be generated easily at night or on overcast days and 2) the initial costs of generating solar electricity is very expensive compared to convention means of generating energy/electricity.

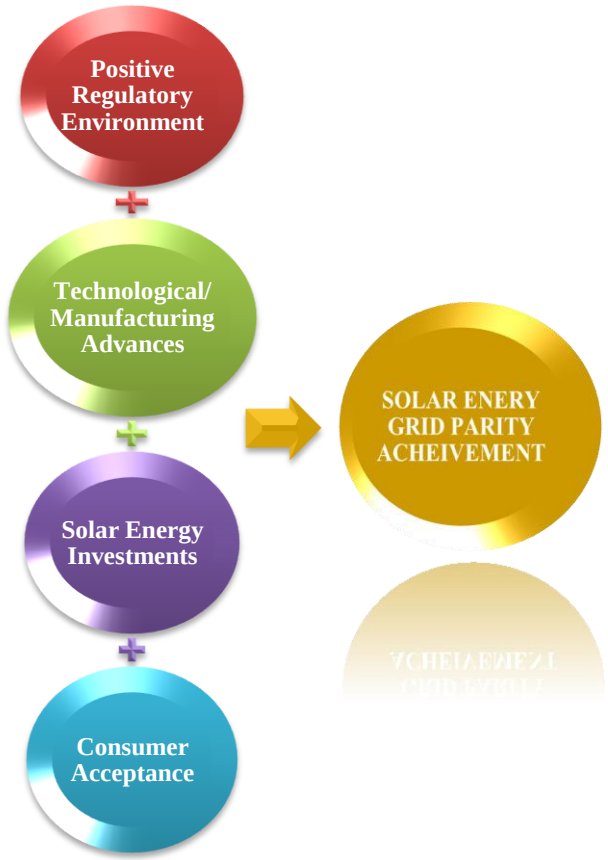
The first problem can be mitigated by the creation of a solar thermal plant. A solar thermal plant's process is to capture heat from the ground/roadway via a conduit (such as an underground pipe) and store heat directly generated from the sun into the roadways and in the ground. In a warm climate like Nevada, the ground is much warmer than in the air, particularly in the summer months where the ground temperature can reach above 150 degrees). This trapped heat (actual solar heat, not converted energy) then can be stored in large containers either above or underground. Molten salt can be used as a thermal storage medium to flow through the receiver, which will store the actual solar heat energy into well-insulated storage tanks. (Molten salt is considered the most efficient and lowest cost medium in which to store thermal energy, as it is liquid at atmospheric pressure, is readily available, relatively inexpensive, is non-flammable & non-toxic and it has current usages as a heat-transport fluid). Since the salt would be able to keep solar energy generated from the earth heated for quite some time, this results in direct solar energy heat will be used to generate renewable energy for electricity, thereby ensuring 24-hour continuous production of solar energy heat for conversion into electricity and removing a major advantage of conventional energy sources such as coal, which acts as its own heat storage medium.

The second problem unfortunately is not as simple to solve. At current market rates, solar energy electricity generation is still prohibitively costly as compared to conventional electricity sources such as coal and natural gas. Fossil-fuel based electricity currently cost between 5¢-8¢ per kilowatt, with solar generated electricity roughly double those rates. Without governmental involvement, subsidies, renewable energy sources such as solar energy would not be feasible for much of the world's population. It would appear that one of the few ways to solve this problem would be to bring the cost of generating electricity via solar energy down to the cost of conventional energy sources, thus achieving "GRID PARITY". Can this action be accomplished and in particular, can this action be done within the next decade?

Let's discuss how the achievement of solar energy grid parity can be possible in the next 10 years. The following questions call into focus some of the major issues in trying to accomplish to the goal of solar energy grid parity.

- What exactly must be done in order to achieve the desired outcome?
- What immediate and long-range results are expected?
- By what criteria will the success or failure of this project be measured?
- When should this project be implemented?

Factors to consider for Solar Energy Grid Parity Achievement



Desired Outcome – Achieving Grid Parity For Solar Generated Electricity Comparable With Current Fossil Fuel Based Energy Systems.

What do we mean by the phrase "Grid Parity"? Basically, the prevailing view is that grid parity is the point at which solar generated electricity is equal to or cheaper than fossil fuel based grid connected power (such as coal or oil). Grid parity is achievable earlier in areas with abundant sun and high costs for electricity such as in Nevada, California and Japan. Once the investments are made to buy, install and maintain solar panels, equipment, etc, the actual fuel (Sunshine) is free and ongoing. Compared to the costs related to fossil fuels (extraction, production, transport, pollution and related illnesses), clean, renewable energy seems cheap. While fossil fuels pollute the environment and contributes greatly to global warming/greenhouse gases effect, renewable energy is clean and based on the above factors regarding fossil fueled based energy, can most definitely achieve "Grid Parity".

However, even with the advent of reaching grid parity for solar generated electricity, there still remains the problem of transmission and the growing constraints on the US transmission lines as they are currently built. The nation's transmission grid was built to move electric power from large fossil fuel power plants to major population centers. However, the Obama administration is committed to redesigning and reconfiguring the infrastructure used with the national power grid to better utilize renewable energy sources as well as work with the conventional energy resources available today.

There are four major factors that contribute to a reduced unit cost of solar energy, thereby coming closer to reaching grid parity with fossil fuel based energy. These factors are 1) a supportive regulatory environment, 2) advances in technological and manufacturing fields, 3) the cost of financing for solar generated electricity and 4) consumer adoption modification and behavior. Let's discuss the impact of each major point, starting with a supportive regulatory environment.

Europe and other countries have long been supporters of governmental backing and incentives toward the use of renewable energy, in particular, solar energy. In the US, our country has lagged behind in supporting renewable energy to supplement and ultimately replace pollution causing fossil fueled based energy Renewable energy policy is set primarily at the state level, with the assumption of the Presidency of Barack Obama, a major supporter of solar energy and the support of many senators such as Senator Harry Reid of Nevada, the House Majority Leader, it appears that a national policy will be crafted and implemented for renewable and in particular, solar energy in the near future.

The Environmental Protection Agency (EPA) is, at this time, aggressively pursuing the updating of the Clear Air Act to classify carbon dioxide as a pollutant. The effect of legislation on traditional fossil fueled energy intensive producers, such as coal fired plants, oil refineries and fertilizer users would be increased costs by the proposed cap and trade system that would require the approximately 13,0000 identified major facilities to purchase emission allowances. The passage of this act would require necessitating a solution to utilize renewable energy sources to help reduce and/or eliminate harmful greenhouse gases. In effect, more of a demand for renewable energy sources (solar energy being a major contender), would contribute to more support for solar energy, which would be included as one of the factors in the building of new paradigm of solar generated electricity on the same cost level as fossil fuel based energy. In addition, the support of other governmental organizations towards the development of the solar energy, in the form of subsidies (grants & loans towards the development of solar energy production, tax credits & carbon offsets can further reduce the unit cost of solar energy electricity production.

The second major point of focus would be technological advances and manufacturing economics of scale in the field of solar energy electricity production. With over 350 Megawatts of global incremental solar capacity installed in 2008, solar power plant

production (including modules, system components, and installation) is projected to grow from a $30 billion industry in 2008 to $80 billion by 2018. Annual installations reached more than 4 GW worldwide in 2008, four times the total set just four years earlier, when the solar energy market reached the 1 GW milestone for the first time in 2004. In spite of rapid growth solar energy is still a tiny fraction of the world primary energy market. However, its reduction in unit costs has yielded growth rates and market share gains that suggest solar energy has the potential to become a mainstream energy source in the foreseeable future, as part of a growing renewable energy sector.

While currently electricity generated from solar electricity cost 2 to 2 ½ more than fossil fuel powered plants, the price is expected to decline rapidly, particularly given the economics of scale of solar electricity (free, little to no variable costs). Nonetheless, continuing the solar cost decline remains the number one mission of the industry, driven mainly through manufacturing economies of scale and automation, solar cell technology enhancements and finally through enhanced procurement activities. Once installed (compared to the ongoing costs on fossil fuel based energy sources, such as coal, nuclear and oil), solar energy has close to zero variable costs as sunlight is free, constant & consistent.

As discussed earlier, a possible solution to the current high cost of solar energy would be to maximize a solar energy source that produces at the time of high demand (over a 24 hour period), is dispatchable (guaranteed & reliable) and has heat storage capability has greater value to the consumer. If the energy supply is "dispatchable", it means the energy supply is guaranteed or predictable. The more predictable it is, the higher its value.

An energy source that produces at the time of high demand (over a 24 hour period) has greater value to consumer. Solar energy is a good fit with daily load peaks where summer air conditioning is required and does not need to be "dispatchable" as it can pass surplus power back to the grid during the day, while drawing on the grid at night. This approach maximizes the value, while minimizing the cost of solar energy. Therefore it is highly likely, that solar power plants may be able to maximize more value from the potential power purchase agreement by incorporating a rate comparable to this daily load peak.

A concentrating solar plant can use several types of technology to capture the sun's rays in order to begin production of solar generated electricity. One of the types of technology, dish stirling, can collect the solar energy from the sun via solar collectors. Once collected, the solar energy heat can be converted to electricity by using a steam turbine or a stirring engine type of receiver to power a turbine to produce electricity. A solar thermal bank can be utilized to keep solar energy heated until nighttime/overcast usage is needed. This stored heat can be converted to steam for use with a turbine or a free piston engine.[2]

The use of both daytime solar collection methods (such as the Dish/Stirling method) and a solar thermal bank process can produce continuous solar generated electricity at any time, comparable to current fossil-fueled based electric systems. Because of the high utilization of the solar power plant, the unit & average costs are vastly reduced, bringing solar generated electricity costs in line closer to fossil fuel costs.

Moving on to the third point is the cost of financing factor. In such a difficult economic and financing environment, it can be difficult to justify investment in solar power plants, particularly given the lower price of oil, a major fossil fuel. However, all indicators point to the increasing interest in investing in solar energy. The following factors highlight the strong reasons for continued investment in solar energy.

Solar was a $36 billion industry in 2008 with over 5GW of new solar capacity installed globally. In 2008, investment in expanding solar energy companies soared to over $10 billion dollars, almost a 40 fold growth increase within the last 5 years.[3]

The cost of finance is critical to renewable energy sources. Energy sources that utilize fossil fuels have both upfront costs and ongoing costs (i.e. the cost of purchasing oil, gas), which means that a substantial part of

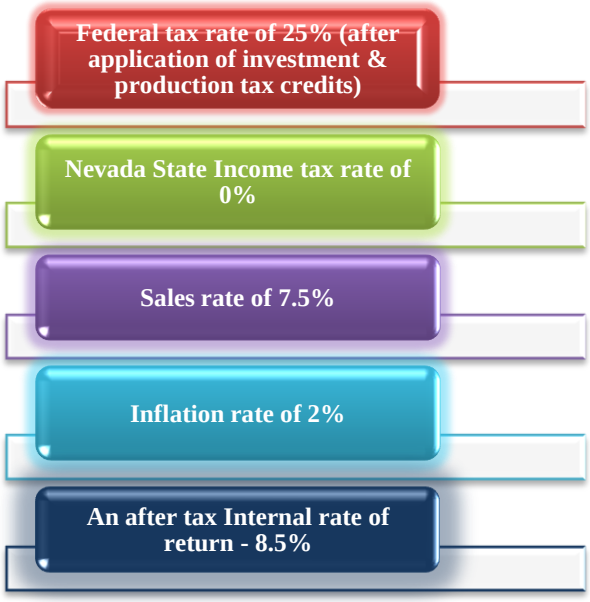
their total costs are spread over time. In contrast, renewable energy typically incurs a high initial upfront cost, but sees extremely low ongoing costs over the lifespan of a renewable energy plan. This means that a low cost of finance amortized over the life of the equipment/capital investment can vastly enhance the economics of renewable energy. Over the last two decades, the trend of solar energy prices has been consistently downwards, driven by continuous advances in PV technology, manufacturing economies of scale and governmental subsidies.

Solar energy is not exposed to price volatility as it is renewable and cost-free. This means that it avoids both commodity market price movements and carries no forward exchange rate risk during its life (unlike with other renewable energy sources). This element alone has value in a price volatility migration role in any utility portfolio. For non-sunlight times (night & overcast days) solar thermal banks will utilize the stored energy as steam to continue to power our turbines to create electricity, lowering our costs.

By incorporating a heat storage capability as a major component of a renewable energy solar production plan, our product will, in effect, become more dispatchable than a standard renewable energy power plant, therefore increasing the predictability of our power source and maximizing value for clients and shareholders.

There are major tax advantage incentives that come with investing in a solar energy plant. One of the most positive incentive is the The American Recovery and Reinvestment Act of 2009 act signed by President Obama grants a 30% credit for eligible solar energy generation systems placed in service before December 31, 2016. The credit is equal to 30% of expenditures, with no maximum credit limit stated. The passage of this act by President Obama has the net effect of as well as decreasing both the nominal and real levelized cost of energy, thereby increasing both the contribution margin, cash flow and the investor's net internal rate of return.

The energy investment payback time is the time required to produce an amount of energy as great as what was consumed during production. The energy payback time is determined from a life cycle analysis of energy. Using a levelized cost-of-energy financial analysis model with a solar power plant based in Nevada (estimates earnings, cash flows, and debt payment to calculate a project's levelized cost-of-electricity, after-tax nominal Internal Rate of Return, and annual Debt-Service-Coverage-Ratios) and the following calculation methodology, we assume the following:



Investment and Production Tax credits (reduces the Federal tax rate from 35% to approximately 25%; no limit on the Business energy investment tax credit deduction.

Life-cycle analysis show that the energy intensity & investment capital payback time of a typical solar thermal energy plant development is rapidly decreasing. In 2000 the energy payback time was estimated at 8 to 11 years but more recently (Year 2006) studies suggest that technological progress & governmental incentives has reduced this time to 3.5 to 6.5 years for solar power plants

Given the above statistics, the potential of high investment return maximization appears to be very strong, particularly when weighted against failed and/or flawed models such as financial derivatives or car production. In essence, a human can and probably should survive without either product but each and every human has use for sunlight Given the current economic and investment climate,

investors are naturally extremely cautious as to where they invest their funds, particularly given the extraordinary sequences of events pertaining to the stumble or indeed outright failure of some of the "Giants" of industry in the last twelve months. In the US alone, such corporate denizens have either fallen or are close to bankruptcy include Citibank, AIG and General Motors. After decades of growth and sales, it has emerged that their business models are flawed and/or are no longer applicable, causing investors to look for companies and industries with a more sustainable business model. Solar energy power plant firms will succeed with their business model where iconic giants have failed with their flawed business models (i.e., business models with a complex mix of goods and services that are not sellable in a recession/downturn).

In this global economic meltdown, people will stop buying designer goods, cars, clothes and reduce consumption of such items like gas for their car. For example, AIG, whose complex and illiquid investments were not a necessity for clients cannot utilize these assets, thus threatening AIG's survival as a company. In good times and bad, consumers will always pay for the basic necessities in life such as food and electricity, these products are necessary for survival. Solar energy firms provide such a product that is a necessity - solar generated electricity. The business paradigm for solar energy is strong (the product, sunlight, it is consistent, almost always available, renewable and extremely competitively priced, free). In a nutshell, solar power plants provide such a product that is a necessity - solar generated electricity.

Once the capital costs are expensed over time and solar generated electricity cost per kilowatt is on parity with a fossil-fueled based kilowatt, the rate of return for an investor will be very advantageous and significant for the solar energy investor.

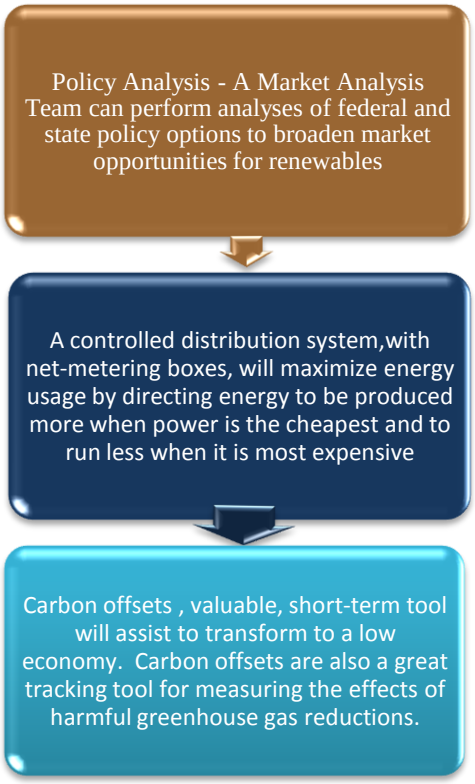
The fourth and last point I would like to emphasize is consumer adoption modification and behavior toward the use of solar energy. With the above stated facts in mind and amid growing public and private demand for clean, more environmentally–friendly energy widespread consumer interest, both among residential, commercial and governmental clients for sustainable, renewable energy and for patronizing companies that adhere to high environmental responsible standards (i.e. "green" practices which increases the marketability of these services). As the global society recognizes the harmful and dangerous results from our over-reliance on fossil fuel based energy and technology and becomes more comfortable with the emergence of renewable energy. The growth of sustainable and responsible investing has marched in lock-step with increasing public interest in natural and organic food, renewable energy, green building, and alternative health care, providing new inspiration and expanded investment opportunities.

As a sidebar to the financial costs factor contributing to the solar electricity business paradigm is the prevailing view of socially responsible investing. As consumers and investors have become increasingly aware of both the dangers and business opportunities embodied in the climate crisis, more and more are looking to using business and capitalism as an alley to assist with investing in solutions5. Socially conscious investors, no matter how large or small, are more satisfied with investments that reach beyond purely financial goals to address ethical concerns. An impressive body of academic evidence plus real-world results effectively refutes the contention that social screening will automatically result in underperformance. Investors are realizing that responsibility can walk hand-in-hand with prosperity and the profit potential of solar energy can match or even surpass that of fossil fuel energy, given the right set of circumstances (national legislation backing, increasing consumer desire to utilize energy that doesn't harm the environment, etc).

As the renowned economists based in Princeton University, Robert Scolow and his colleague, Stephen Pacal concluded in a respected policy study that humanity already possesses the fundamental scientific, technical and industrial knowhow to solve the carbon and climate problems for the next 50 years, the current problems are the political will and the change in the minds and hearts of the American public.[4]

Immediate and long-range results & objectives

Project success/failure measurement criteria



CONCLUSION

Greenhouse gas emissions has become harmful to our planet and we need to drastically reduce the greenhouse gas emissions level immediately. There are solutions for this problem. The technology is available and there will be great economic & environmental opportunities by substituting clean domestic sources of energy and beginning a transition away from fossil fuels that contributes to the spreading of CO2 emissions. Renewable energy is the solution to this momentous problem of harmful greenhouse gas emission.

Sunlight is the world's largest potential source of renewable energy and has a unique potential to generate vast amounts of clean energy that doesn't contribute to global warming. A worldwide market for solar energy is increasing but without an inexpensive means to store this energy and decreasing the cost of solar energy compared to current fossil-fueled based energy, solar power can't replace fossil fuels on a large scale.

One solution to the current high cost of solar energy would be to maximize a solar energy source, such as a concentrating solar plant that produces at the time of high demand (over a 24 hour period), is dispatchable (guaranteed & reliable) and has heat storage capability such as a solar thermal bank. Periods of peak load are the most expensive time because the utility has to have that capacity available, yet that same capacity needs to remain idle during other parts of the day.

The use of both the day solar collector method and a solar thermal bank process can produce continuous solar generated electricity at any time, comparable to current fossil-fueled based electric systems. Because of the high utilization of the solar power plant, the unit & average costs are vastly reduced, bringing solar generated electricity costs in line closer to fossil fuel costs.

A second solution would be a confluence of factors that include governmental support in the form of federal and state government incentives such as tax credits, grants, subsidiaries and carbon offsets, technological advances and manufacturing economics of scale that reduce the per unit cost of generating solar powered electricity and also greater consume and corporate awareness of the both the tangible and intangible benefits of using solar generated electricity in the course of their daily lives. The socially conscious consumer will appreciate being a part of the solution of helping to improve the environmental quality of their planet by reducing harmful greenhouse gas emissions that affect all living things on our planet and at a cost slightly above or even below what they are paying currently; also consumer support will increase "green" jobs, increasing their contribution to society even further.

Once solar energy electricity unit cost methodology is established, project implementation procedures should follow an established set of rules in establishing of a solar power plant generating electricity.

Project success/failure measurement criteria should be calculated and analyzed by governmental units, corporate valuation schedules and renewable energy credit tracking mechanisms.

With the continuous production of a solar power plant generating solar electricity day and night, a higher utilization is available, thereby lowering the cost of the solar plant significantly to near or at cost parity level with current fossil-fuel based electric power plants. In the United States, the average cost of fossil-fuel based electricity averages 5¢ - 9¢ per kilowatt. Given the above factors, the efficient market hypothesis would positively conclude that the possibility of solar energy costs reaching "Grid Parity" with current fossil-fuel based energy costs is highly achievable before the end of the next decade of the 21st century.

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[2] J. Hasci (2008). "Modified Stirling Engine With Greater Power Density". Create the Future Design Contest. NASA & SolidWorks.
[3] I Solar Energy Industries Association (SEIA) 2008 U.S. Solar Industry Year in Review report
[4] C. Billy (2006) "Global Warming" Opposing Viewpoints Series.
[5] A. Gore (2006) "An Inconvenient Truth

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A. Professional Preparation.

Montclair State University, Montclair, NJ	Accounting	B.S – Accounting, 1986

B. Appointments.

A list, in reverse chronological order, of all the individual's academic/professional appointments beginning with the current appointment.

- CEO & President, Virgo Star Corp dba VirgoStar Solar 09/2008 - Current
- President, Analytics Business Inc 04/2007 - Current
- Database Analyst Consultant – AT&T, MetLife & State of South Dakota, Wyeth, Goldman Sachs 08/1998 – 04/2007
- Business Analyst Developer, Vencor Hospitals, 6/1990 – 07/1998

C. Publications.

SOLAR ENERGY - IS IT POSSIBLE TO ACHIEVE GRID PARITY WITH CONVENTIONAL ENERGY SYSTEMS

- Proposed Lecture Date – April 21, 2009 white paper lecture at the EVER Monaco Renewable energy forum.

- Proposed Lecture Date – April 21, 2009 white paper presentation at the Dow Jones Alternative Energy Innovations conference – Redwood City, California USA.

D. Synergistic Activities

- Extensive research regarding solar energy, the solar thermal process and free piston engine (in particular, the closed cycle regenerative operation and thermodynamic principles
- Built a Derivatives Credit-Spread Based Probability Model Excel application utilizing Visual Basic 6 for calculating maximum/minimum levels/percentages for the periodic fixed or floating rate payment, spread and percentage basis of LIBOR.
- Responsible with development of functional specifications, system design and analysis and system documentation of many financial & production models (What IF analysis, Capital Budgeting analysis, IT infrastructure model analysis, Business Valuation models). This list in not inclusive of the models used in development of business