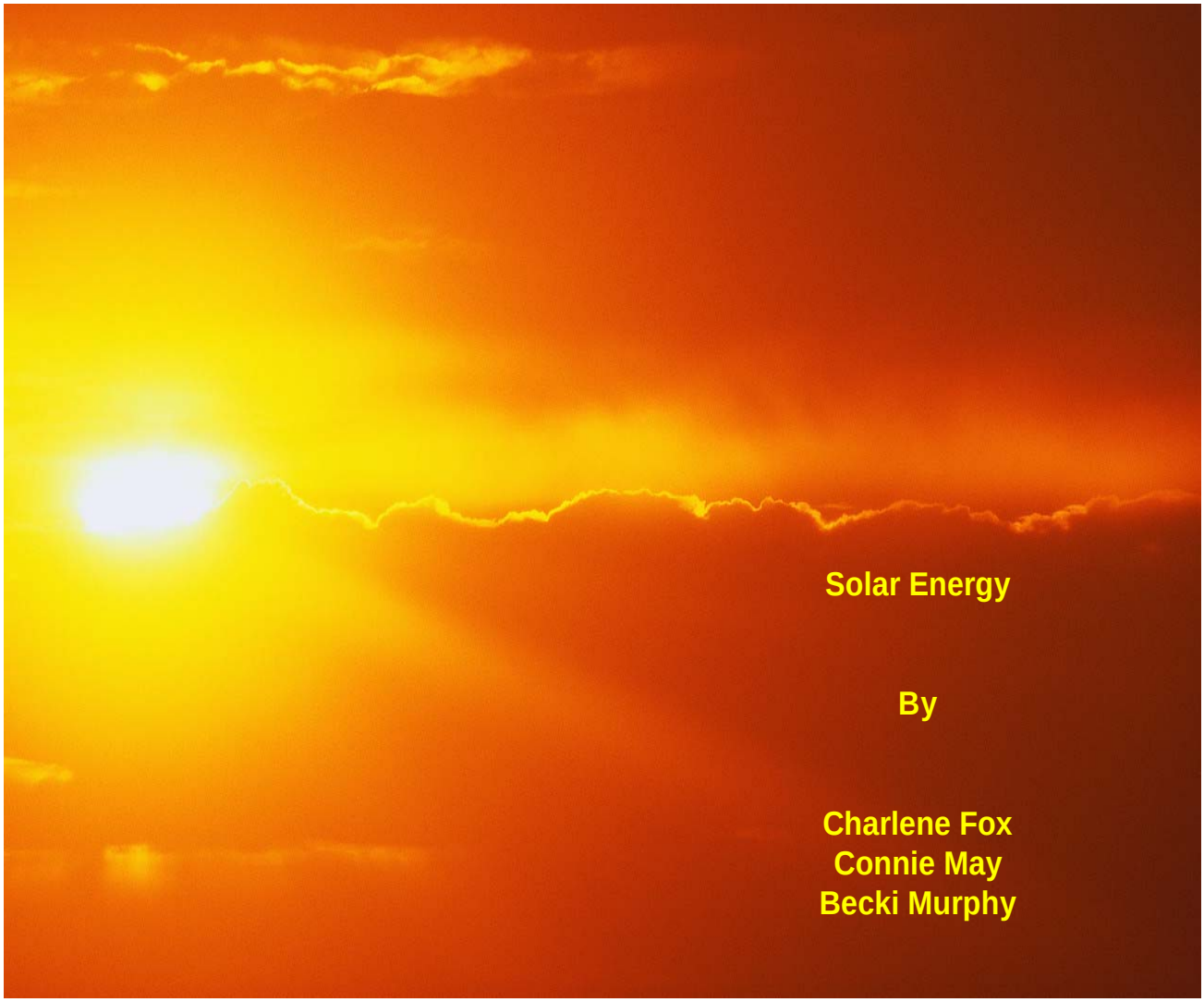
Solar Energy
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Introduction

Americans make up five percent of the world population, but consume twenty six percent of the world's energy. Now is the time to invest in solar energy. Solar energy can help reduce utility bills and operating costs. Investing is solar energy now can help everyone by protecting them from future rising electricity costs. Our current utility grids in the summer can not keep up with our current demand. The solar industry is experiencing shorter payback periods and obtaining higher returns for investors. Solar power produces zero emissions meaning environmentally friendly energy.

History of Solar Energy

The idea of solar energy as an alternative energy source is something that most people think of as a newer technology developed only in the past 30 plus years. However, the idea of turning the sun's rays into mechanical power was developed more than a century ago by inventors whose dreams failed due to a lack of public interest.

According to the author of the article "Rivisiting Solar Power's Past," Charles Smith, "Many of us assume that the nation's first serious push to develop renewable fuels was spawned while angry Americans waited in gas lines during the 'energy crisis' of the 1970s. Held hostage by the OPEC oil embargo, the country suddenly seemed receptive to warnings from scientists, environmentalists, and even a few politicians to end its over-reliance on finite coal and oil reserves or face severe economic distress and political upheaval."[1] While this is the assumption of most people, the truth is that the technological development of harnessing solar energy began at the height of the Industrial Revolution, which, as luck would have it was founded on the thought that there would always be an ample supply of fossil fuels. "Contrary to the prevailing opinion of the day, a number of engineers questioned the practice of an industrial economy based

on nonrenewable energy and worried about what the world's nations would do after exhausting the fuel supply."[2]

According to Smith, scientists did not just talk about the future depletion of fossil fuels; they were proactively exploring renewable energy options. "In the end, most decided to focus on solar power, reasoning that the potential rewards outweighed the technical barriers. In less than 50 years, these pioneers developed an impressive array of innovative techniques for capturing solar radiation and using it to produce steam that powered the machines of that era. In fact, just before World War I, they had outlined all of the solar thermal conversion methods now being considered."[3]

History is doomed to repeat itself. Today, following much of the same path as early engineers, contemporary solar engineers have determined that "solar power is not only possible but eminently practical, not to mention more environmentally friendly." Unlike fossil fuels that produce significant amounts of pollution and enormous amounts of greenhouse gases, "the sun's energy is clean and its supply is virtually limitless. In just one hour the earth receives more energy from the sun than human beings consume during an entire year."[4] Companies such as Microsoft, Google, and Wal-Mart are seeing the obvious benefits of using solar systems. *The Economist's* research for the article "Bright Prospects, found that the U.S. Department of Energy has said that, "solar panels could, if placed on about .5 percent of the country's mainland landmass, provide for all of its current electricity needs."[5]

What must be remembered is that solar renewable energy is not in its infant stages as most would like to believe. "Such misconceptions lead many to assert that before solar power can become a viable alternative, the industry must first pay its dues with a fair share of technological evolution. Solar technology already boasts a century of (research and

development), requires no toxic fuel and relatively little maintenance, is inexhaustible, and with adequate financial support, is capable of becoming directly competitive with conventional technologies in many locations."[6]

Types of Solar Energy

Solar Process Heat

Solar process heating systems are designed to provide large quantities of hot water or space heating for non-residential buildings. A typical system includes solar collectors that work

along with a pump, a heat exchanger, and/or one or more large storage tanks. The two main types of solar collectors used—an *evacuated-tube collector* and a *parabolic-trough collector*—can operate at high temperatures with high efficiency. An evacuated-tube collector is a shallow box full of many glass, double-walled tubes and reflectors to heat the fluid inside the tubes. A vacuum between the two walls insulates the inner tube, holding in the heat. Parabolic troughs are long, rectangular, curved (U-shaped) mirrors tilted to focus sunlight on a tube, which runs down the center of the trough. This heats the fluid within the tube[7].

Solar Hot Water

Most solar water heating systems for buildings have two main parts: a solar collector and a storage tank. The most common collector is called a *flat-plate collector*. Mounted on the roof, it consists of a thin, flat, rectangular box with a transparent cover that faces the sun. Small tubes

run through the box and carry the fluid — either water or other fluid, such as an antifreeze solution — to be heated. The tubes are attached to an absorber plate, which is painted black to absorb the heat. As heat builds up in the collector, it heats the fluid passing through the tubes. The storage tank then holds the hot liquid. It can be just a

modified water heater, but it is usually larger and very well-insulated. Systems that use fluids other than water usually heat the water by passing it through a coil of tubing in the tank, which is full of hot fluid. Solar water heating systems can be either active or passive, but the most common are active systems. Active systems rely on pumps to move the liquid between the collector and the storage tank, while passive systems rely on gravity and the tendency for water to naturally circulate as it is heated[8].

Photovoltaic

Solar cells, also called photovoltaics (PV) by solar cell scientists, convert sunlight directly into electricity. Solar cells are often used to power calculators and watches. They are made of semi-conducting materials similar to those used in computer chips. When sunlight is absorbed by these materials, the solar energy knocks electrons loose from their atoms, allowing

the electrons to flow through the material to produce electricity. This process of converting light (photons) to electricity (voltage) is called the *photovoltaic (PV) effect.* Solar cells are typically combined into modules that hold about 40 cells; about 10 of these modules are mounted in PV *arrays* that can measure up to several meters on a side. These *flat-plate* PV arrays can be mounted at a fixed angle facing south, or they can be mounted on a tracking device that follows the sun, allowing them to capture the most sunlight over the course of a day. About 10 to 20 PV arrays can provide enough power for a household; for large electric utility or industrial applications, hundreds of arrays can be interconnected to form a single, large PV system[9].

Passive Solar

Many buildings are designed to take advantage of a natural resource through the use of passive solar heating and day lighting. The south side of a building always receives the most sunlight. Therefore, buildings designed for passive solar heating usually have large, south-facing windows. Materials that absorb and store the sun's heat can be built into the sunlit floors and walls. The floors and walls will then heat up during the day and slowly release heat at night, when the heat is needed most. This passive solar design feature is called direct gain. Other passive solar heating design features include sunspaces and trombe walls. A sunspace (which is much like a greenhouse) is built on the south side of a building. As sunlight passes through glass or other glazing, it warms the sunspace. Proper ventilation allows the heat to circulate into the building. On the other hand, a trombe wall is a very thick, south-facing wall, which is painted black and made of a material that absorbs a lot of heat. A pane of glass or plastic glazing, installed a few inches in front of the wall, helps hold in the heat. The wall heats up slowly during the day. Then as it cools gradually during the night, it gives off its heat inside the building. The Anasazi Indians of Colorado used passive solar design in their cliff dwellings[10].

Concentrating Solar Power

Concentrating Solar Power consists of three types of systems. The three systems are troughs, dish/engines, and power towers. A trough system uses the sun's energy by collecting it

into trough-shaped reflectors which has a receiver pipe that is positioned inside the curved area

of the reflector. The energy that is gathered heats oil in the pipe and the heat energy produced powers a conventional steam generator. The dish/engine type system uses the sun's energy by collecting solar energy in the dish part by using mirrors to concentrate the energy as much as possible and it must track the sun continuously. A thermal receiver then interfaces with the dish and the engine generator. The engine generator uses the heat from the thermal receiver to create electricity. A power tower system has many mirrors at the top of the tower to follow the suns rays. The receiver on the top of the tower uses the energy to heat fluid to generate steam. A commercial type plant using a power tower system has been estimated to be able to generate between 50 to 200 MW of electricity.

The amount of energy one barrel of oil varies, but approximately it will produce 1.7 thousand kilowatt-hours according to the U.S. Energy Information Administration. [11] So 1,700 kilowatts times 4 cents per kilowatt hour to produce would equal approximately $68. So, when oil is at $68 dollars per barrel and solar can be produced at 4 cents per kilowatt hour the two forms of energy would be on equal operating leverage playing fields.

The cost of a photovoltaic is a little harder to project because it depends on what rebates and grants that may be available, is it a stand alone system or part of the building structure, and if the unit will be used for heating water or space. So, beside the fixed cost of the system an individual would have to consider the cost of fuel in their area and if the utility company will pay for any excess energy produced.

Profitability of Solar Energy

The profit margins and volumes of the solar energy market are taking turns for the better. The solar power industry has been on a tear, growing at more than 30 percent per year for last six years.[12] According to an article by Joshua Lipton that appeared in Forbes Magazine, solar installations ballooned nearly 40 percent in the U.S. in 2005. "The increase in demand is likely to continue, driven by high fossil fuel prices and a 30 percent federal investment tax credit."[13]

Companies such as First Solar, a Phoenix-based solar cell maker, reported earnings in the quarter ending Dec. 30, 2006, that completely exceeded Wall Street expectations. First Solar told investors, "it raked in $8 million, or 12 cents per share, versus a loss of $7.2 million, or 14 cents per share, for the similar quarter in 2005. Revenue rose $52.7 million, up from $13.6 million."[14]

There is money to be made in renewable energy. Even at modest margins it can add up to big dollars and investors are realizing it. "Wall Street isn't banking on a radically different future, though. It's merely betting that wind, solar, biofuels, and the rest will make up some bigger portion of the nation's $1.6 trillion energy market – enough to give clean-energy investing credit as part of a diversified portfolio. The federal and state clean-energy quotas that have appeared virtually overnight bolster their confidence. Already 22 states have ordered utilities to obtain as much as 33% of their electricity from renewable resources in the next 10 years."[15] Solar power in one of the fastest-growing areas: investments have risen from $59m in 2004 to $308m in 2006, according to Nicholas Parker, chairman of the Cleantech Venture Network.[16]

Cambridge Energy expects demand for renewable energies including that of solar energy to "rise from 2.5% of the nation's electricity to 3.4%. That translates to as much as $10 million in new revenues for clean power producers by 2010. And these are baseline assumptions over the short run."[17]

The thing that has held back the wide spread use of solar panels as an alternative energy source is their price. The sun is free but converting it into electricity is costly. “At present, solar power is at least two to three times as expensive as the typical electricity generated in America for retail customers. (Because homeowners and businesses generally use solar power in place of electricity bought from utilities, the relevant comparison is with the price of retail electricity, not the lower wholesale price from power plants.)”[18]

While this is the case, the prospects for solar energy have never looked brighter. “Decades of research have improved the efficiency of silicon-based solar cells from 6% to an average of 15% today, whereas improvements in manufacturing have reduced the price of modules from about $200 per watt in the 1950s to $2.70 in 2004. Within three to eight years, many in the industry expect the price of solar power to be cost-competitive with electricity from the grid.”[19]

The solar industry has been able to continuously reduce the cost of the silicon-based solar panels, which has been one of the largest cost factors in being able to use solar energy. The silicon used to make the panels is expensive and limited.[20] However, “for every doubling in cumulative production volume, the cost of modules has declined by 20%. That translates to an annual reduction in manufacturing costs of about 5%.” (“Bright Prospects”) Factors contributing to the decline in production costs are contributed to “making the wafers thinner, increasing the efficiency of the cells, and taking advantage of economies of scale by building bigger and more automated factories.”[21]

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oil is at $68 dollars per barrel and solar can be produced at 4 cents per kilowatt hour the two forms of energy would be on equal operating leverage playing fields.

Price increases and cost reductions are stronger than expected by most in the solar energy industry. “In 2005, the sector achieved 44 % volume, 50% revenue and 149% profit growth. In the next five years, we expect rising residential grid prices, robust policy support and new sales channels will drive six-fold production growth,” according to Michael Rogol of Photon Consulting.[23]

The initial thoughts are that the 40-50 percent annual expansion of production might reduce prices and margins. Concerns of negative impacts on demand if interest rates increase, hydrocarbon prices fall or pro-solar policies are reversed also have surfaced. However, “400+ solar power executives and policymakers in 10 geographic markets have fortified the conviction that demand will significantly exceed supply through the end of the decade, that prices are likely to remain high and that margins are likely to continue expanding for at least 3 more years.”[24] Overall, it appears that many analysts are drastically underestimating the solar industry’s strong forecast for volume, price and earnings now through 2010.[25]

Business Model

The business we propose is a Photovoltaic solar panel plant consisting of 25,000 panels that will generate the equivalent of enough kilowatts of electricity to power 4,000 homes. We will sell the electricity directly to TXU, our only customer.

The proposed location of the plant will be along the I-20 corridor in the area of Loop 250 and I-20 in Midland, Texas. The location was chosen because the twenty two year average sunshine time for the area is 74%. We plan to negotiate a 30 year lease on 500 acres of undeveloped land in the area with an option to buy. The initial 25,000 solar panels will only take up approximately 100 acres of the land, but we will need additional space to build office space, storage buildings, and eventually a visitor's center. We feel securing the remaining land for future placement of an additional 25,000 panels will be extremely cost effective to do at this time.

Since our only customer will be TXU, there will be no need to market our services anywhere else. Looking down the road, there is a strong potential to supply power to the truck stop planned near the location of our plant. The truck stop will be the largest of its kind between El Paso and Ft. Worth. Commercial rates for electricity are approximately fifty percent higher than residential rates, so the revenue potential generated from our plant supplying the truck stop with electricity could be tremendous. We could also supply electricity to any housing developments that might spring up in the area.

We hope to be very active in the community of Midland. We understand the importance of setting a positive environmental example and want to seize the opportunity to serve as an educational resource for the community. We will also seek additional avenues to become an active partner with the community.

Our management team consists of three well qualified individuals who have proven abilities to make decisions and manage employees and finances. We believe our management team, staff, plant, and equipment is our most valuable resource.

Job creation will allow our company to get some financial assistance from the Economic Development Corporation in Midland, Texas therefore reducing our payroll costs for the next 3 years. The Economic Development Corporation provided three $70,000 payments to our solar business over the next three years in the form of forgivable loans. Forgivable loans require that our firm comply with the specified requirements and if we meet those criteria then the loan is forgiven. Our part will be to certify that we have ten full time positions with an annual payroll of ½ million dollars per year. The Economic Development Corporation will also provide a one time forgivable loan for a capital investment over 5 million dollars in the amount of $200,000.00.

The initial capital investment for this company is tremendous. The investment will include the following:

- 25,000 panels @ $650 = $16,250,000
- Office and Storage Buildings = $150,000
- Grounds Equipment = $50,000
- Security System = $300,000
- Fencing = $70,000
- Electrical Connections = $100,000
- Start Up Operating Cash = $400,000
- Total Capital Investment = $17,320,000

The capital funding resources for the project are made up of the following:

- Management each invest $1,000,000 for a total of $3,000,000
- Economic Development $410,000
- Rebates & Grants $1,000,000
- Total resources $4,410,000
- Amount needed from Investors: $12,910,000

The Bottom Line

The 25,000 panels will produce 3,913 mega watts, or 3,913,461 kilowatts, of electricity per month based on seventy four percent average sunshine rate in the Permian Basin. The cost of producing this electricity will be approximately .045 cents per kilowatt and the selling price of the electricity will be .075 cents per kilowatt. The anticipated potential profit for the plant will be $1,408,846 pre-tax per year. Since there will be tax credits available for ten years from the government, our income tax will be extremely low. The estimated time of return on investment for the project is 12.29 years leaving an additional 17.71 years of debt free operations.

Conclusion

This is only the beginning though and technology will soon evolve to enable mass production to become more and more cost effective. Nanotechnology will soon be combined with solar technology to decrease the size of current solar panels. Less size and better efficiency will only compute to greater returns. For example, “a carbon nanotube is perhaps the most conductive material ever discovered. Some estimates suggest properly configured carbon nanotubes might be 1,000 times more conductive than copper. When carbon atoms are arranged in this cylindrical structure, they become the strongest materials ever made.”[26] The possibilities are endless.

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