
**The case for renewable energy technology and projects as the New Industrial Revolution.**

## Introduction

For 200 years industrial civilization has relied on the combustion of abundant and cheap carbon fuels, but continued reliance has had perilous consequences. On the one hand, there is the insecurity of relying on the world's most unstable region - the Middle East - compounded by the imminence of peak oil, its growing scarcity and mounting fuel prices. On the other, the potentially cataclysmic consequences of continually burning fossil fuels, as evidence of accelerating climate change shows. Yet there is a sustainable solution: to make the transition to renewable sources of energy and distributed, decentralized energy generation. It is a model that has been proven technologically, commercially and politically viable. The alternative being widely advocated - of a return to nuclear power - shows to be compromised and illusory. The advantages of renewable energy are so overwhelmingly clear that resistance to them needs diagnosis. This report will reveal the ways and means, through the collective effort of Green Air Energy of Texas, Inc. and other private and public organizations, of why the transition to renewable energy is vital.

In the two decades since the Earth Summit in Rio de Janeiro, the response of the world's government leaders to the threats of the global environment has been to enforce the reduction of energy consumption and harmful emissions. Yet the solutions put forth have primarily been based around conventional energy resources and conventional thinking. The question is whether this strategy is radical enough to address the key challenges now facing the environment, and whether it can be effective in avoiding catastrophe on a global scale. Climate change, pollution, deforestation, overconsumption, destruction of the ozone layer, poverty, and the population explosion are all problems created or exacerbated by the use of conventional energy. What Green Air Energy of Texas, Inc. proposes in this report is that this switch, from conventional energy production and job creation, can only happen through a refocused domestic energy policy in political and economic strategies, paving the way towards a global renewable energy economy sustained by new social principles.

We will use as an example, the recent push by Canadian and American government and private corporate authorities to get a 17,000 mile pipeline built – from Alberta, Canada to the Gulf of Mexico – as the traditional way of looking at job creation and energy production. We will counter that idea with information and projects exemplifying how an equally strong drive to invest in the manufacturing and installation of renewable energy technologies that will create just as many (estimated 2,500 to 4,700 temporary jobs), if not more jobs and produce more energy for longer than the estimated 30 to 50 years from the extraction of crude in the tar sands region of Alberta, Canada, without the environmental risks created once the toxic products are flowing through the pipeline.

Consequently, this pipeline will have another lasting effect. It will tie us for another generation to fossil fuel, postponing the green switch to renewables. The green switch is just beginning; for example, there are more Americans employed in the solar industry than in coal mining. When we as a society decide to decisively break our addiction to fossil fuel, job creation will bloom and thrive. More laborers are needed to engineer, inspect, manufacture, assemble, sell, market, advertise, and install solar panels on America’s roofs

than to build a single pipe. Cornell Global Labor Institute looked carefully at all the project specifications and concluded: yes, the Keystone XL project will create jobs. Somewhere between 2500 and 4650 people will be needed to build the pipeline. However, those jobs will be temporary (once a pipeline is built it doesn't take many people to run). But then construction jobs are by definition temporary. Cornell looked, too, at the jobs the new pipeline would kill. At the moment, the fairly small amount of oil from tar sands that make it into this country heads to a few refineries in the Midwest, and that's helped lower the cost of gasoline in the region. With new markets for the crude overseas (most of Keystone XL's oil will be exported), the Gulf of Mexico extension will raise the price of gas in the Midwest—and that will be enough to ruin as many jobs as it creates.

## Conventional Thought

The perceived importance and the actual role of oil and nuclear energy in the global energy scene have changed several times over the past 50 years due to various factors. The oil price shocks in the 1970s and 1980s, and the incidents at Three Mile Island and Chernobyl are some marked examples. Currently, there are several concerns associated with both energy sources and their related technologies. For oil, the list includes supply security, geopolitical sensitivity, price volatility, water pollution from off-shore installations and tanker accidents, soil contamination in processing plants, emissions of substances contributing to acid deposition and to global climate change, and the specter of depletion. (See Holdren and Smith, 2000 for a discussion of energy–environment relationships.) The list of worries related to nuclear energy comprises economic performance, proliferation of dangerous material, the peril of terrorism, operation safety, radioactive waste disposal, and as a result of all of these, public acceptance.

The resolution of these concerns will be a complex social process involving relatively clear-cut technical, technological, and economic factors as well as particularly contentious social and political choices. The outcome of this process will determine the roles oil and nuclear might play in the world energy balance in the long-term future. Diesel generation is often the only dependable electricity supply route in remote, non-grid connected areas—hence out of reach for nuclear power (at least for present nuclear technology). Remote markets in industrialized countries, however, are often associated with pristine natural environments where the current tendency is to deploy renewable forms of electricity supply. Remote electricity markets are unlikely to grow in the OECD (The Organization for Economic Co-operation and Development) countries as grid-connected electrification has already reached more than 95% area coverage.

## Keystone XL Pipeline

The US and Canada have a special economic partnership and engage $1.6 billion in two-way trade daily. In Utah, Canada is the third largest trading partner with a combined $2.6 billion in 2010. The supply chains are deeply integrated. It's no surprise then, that the US is Canada's largest market. More than 8 million US jobs are dependent on trade with Canada.

Secondly, Canada is the largest supplier of crude oil and petroleum products to our country and the largest supplier of energy to the US overall. Mexico is second in imports of crude oil and petroleum products followed by Saudi Arabia, Nigeria and Venezuela. Excluding Canada, the governments of these countries can be unstable as we know. Add to the problems of Iran's threats to block the Strait of Hormuz where one-fifth of the world's oil supply flows, and it becomes clear why oil prices are highly volatile.

Given these facts and the fact that Canada has abundant resources, (the third-largest oil reserves in the world after Saudi Arabia and Venezuela) growing production, political stability, and high environmental standards, everything is being done to ensure that the US receives an uninterrupted and increased flow of crude oil and petroleum products.

***Details of Keystone XL project***

- Keystone XL is an export pipeline. According to presentations to investors, Gulf Coast refiners plan to refine the cheap Canadian crude supplied by the pipeline into diesel and other products for export to Europe and Latin America. Proceeds from these exports are earned tax-free.
- TransCanada's 2008 Permit Application states "Existing markets for Canadian heavy crude, principally PADD II [US Midwest], are currently oversupplied, resulting in price discounting for Canadian heavy crude oil. Access to the USGC [US Gulf Coast] via the Keystone XL Pipeline is expected to strengthen Canadian crude oil pricing in [the Midwest] by removing this oversupply. This is expected to increase the price of heavy crude to the equivalent cost of imported crude. The resultant increase in the price of heavy crude is estimated to provide an increase in annual revenue to the Canadian producing industry in 2013 of US $2 billion to US $3.9 billion."
- In 2008, TransCanada's Presidential Permit application for Keystone XL to the State Department indicated "a peak workforce of approximately 3,500 to 4,200 construction personnel" to build the pipeline.
- The State Department Environmental Impact Statement fails to adequately analyze lifecycle greenhouse gas (GHG) emissions caused by the pipeline. Extraction and refinement of oil sands are more GHG-intensive compared to conventional oil. The EIS estimates that the additional annual GHG emissions from the proposed pipeline could range from an additional "12-23 million metric tons of CO2 equivalent… (roughly the equivalent of annual emissions from 2 to 4 coal-fired power plants)" over conventional crude oil from the Middle East.
- The original Keystone Pipeline cost is US $5.2 billion with the Keystone XL expansion slated to cost approximately US $7 billion. The Keystone XL is expected to be completed by 2012–2013.
- Due to an exemption the US gave TransCanada, the local authorities would lose $50 million public revenue from property taxes for a decade.

In conclusion, even America's unions are split on the Keystone XL project. The Laborers, understandably, see pipeline construction as right up their alley and have fought hard in

support of the project. But the Transport Workers Union and the Amalgamated Transit Union, which have huge numbers of people, have been outspoken in their opposition. Here's how they put it in a joint statement last summer:

*"We need jobs, but not ones based on increasing our reliance on Tar Sands oil. There is no shortage of water and sewage pipelines that need to be fixed or replaced, bridges and tunnels that are in need of emergency repair, transportation infrastructure that needs to be renewed and developed. Many jobs could also be created in energy conservation, upgrading the grid, maintaining and expanding public transportation—jobs that can help us reduce air pollution, greenhouse gas emissions, and improve energy efficiency."*

## The Case for Renewable Energy

We need a comprehensive industrial policy to rebuild manufacturing — and by extension, "Main Street" — across the United States. A critical component of a new industrial policy will be a program to make the US the world's leading manufacturer of new, green technologies and components. This is not a pie-in-the-sky goal. It makes good economic sense and we have the capacity to do it. Renewable energy technologies provide three to six times as many jobs as equivalent investments in fossil fuels, when manufacturing, installation, operation and maintenance jobs are taken into account. US demand for renewable energy technologies currently exceeds domestic manufacturing capacity, which can lead to critical component supply bottlenecks or temporary price increases for clean power.

Our central findings show that a strong national renewable energy policy that can increase the US electric generation share to 25 percent renewable content by 2025, would stimulate enough demand for the component parts needed to make wind turbines, solar panels and other clean energy technologies to create 850,000 (Fig. 1) jobs in existing US manufacturing firms across the country. A national policy with strong interim goals should be adopted as part of comprehensive climate change legislation. This national policy will help create complementary green manufacturing assembly line jobs making super-efficient appliances, windows and other energy-saving equipment.

Government Research and Development (R&D) investments fuel the innovation cycle. A key goal of such a strategy is to invest in early-stage basic and applied research that complements existing private-sector efforts. Over the next generation and beyond, the US — and the world — will need and demand more clean energy. By developing a robust green manufacturing sector, America can revive its economy by becoming a leading exporter of clean energy parts and technology.

Fig. 1

| Top Ten Potential Renewable Manufacturing Job States | |
|---|---|
| California | 95,616 |
| Texas | 60,100 |
| Illinois | 56,579 |
| Ohio | 51,269 |
| New York | 47,930 |
| Pennsylvania | 42,668 |
| Indiana | 39,221 |
| Wisconsin | 35,133 |
| Michigan | 34,777 |
| North Carolina | 28,544 |

***Solar***

Solar energy creates and retains jobs, including those in the manufacturing industry. One of the great advantages of solar plants is the large number of components that are involved in installing solar power systems. Manufacturing and installing these devices requires significant job creation. In addition, jobs to maintain solar plants cannot be transferred overseas, therefore guaranteeing that jobs will remain in this country. Solar energy can be a significant source of job creation. A recent study estimates that 20 manufacturing job-years and 13 installation job-years are created for each Mega-Watt power (MWp) of solar panels installed. The majority of jobs created are white-collar or highly-skilled craft labor, including engineers, assemblers, sales representatives and installers. Our research validates these findings by examining Japan and the European Union solar energy job creation records. By 2002, 360 MWp of PV power were installed in Japan, which created an estimated 9,800 cumulative jobs or 27.2 job-years/MWp installed. European PV employment data estimates a job creation of 56,000 job-years/2000MWp or 28 job-years per MWp. Although the precise estimates of employment impact may vary, most agree that the impacts could be significant. The workforce implications of renewable energy will vary by job function and technology area (Fig. 2). Solar energy industry will require personnel in:

- Research and Development
- Product Design
- Product Manufacturing
- Sales (retail and wholesale)
- Installation
- Operations and Maintenance

According to the US Department of Energy there are two main reasons why renewable energy technologies offer an economic advantage: (1) they are labor-intensive, so they generally create more jobs per dollar invested than conventional electricity generation technologies, and (2) they use primarily indigenous resources, so most of the energy dollars can be kept at home.

Fig. 2

| Top Five Solar PV Potential Manufacturing States | |
|---|---|
| California | 48,896 |
| Texas | 23,221 |
| Illinois | 19,298 |
| Pennsylvania | 15,767 |
| New York | 14,617 |

***Wind***

A modern wind turbine is composed of some 8,000 parts, from massive steel towers and blades to high precision gearboxes to state-of-the-art software control systems. While much attention is paid to the company that assembles and puts its name on the wind turbine — high-profile names like GE and Siemens — most of the supply chain is composed of small specialty manufacturers. One firm will roll large plates of steel into the towers that support the turbine. Another firm will make the huge turbine blades from special carbon fiber materials. Still another will make the electronic computerized control systems allowing wind turbines to adjust to changes in wind speed and direction.

For every megawatt of new wind power capacity — enough potential clean electricity to power up to 300 homes — REPP estimates 4.85 Full Time Equivalent (FTE) jobs are created to manufacture, install and then operate and maintain the wind farm. About 70-75 percent of the total labor required for a typical wind turbine or solar panel is in manufacturing the various component parts that could be supplied by existing US businesses.

> For example, wind energy has come of age, while more Europeans are attracted by the jobs created in the industry. Over the past five years (2004-2009), the EU wind energy industry has created more than 60,000 new jobs. On average, the wind energy sector in Europe has employed 33 new people every day, seven days a week over the past five years.

Given this amount of demand, research identified specific current US companies in each of those NAICS categories, on the assumption that they would be the most likely firms to supply components to a growing renewables industry. This methodology was able to identify where the supply chain could be located, the amount of new revenues for these firms and new employees needed to meet demand. The studies did not model multiplier effects, such as indirect and induced employment, nor did it quantify jobs in other parts of the supply chain, such as construction, transportation and logistics, or operations and maintenance. (Fig. 3)

Fig. 3

| Top Five Potential Wind Manufacturing States | |
|---|---|
| California | 32,046 |
| Illinois | 30,010 |
| Ohio | 29,820 |
| Indiana | 25,180 |
| Wisconsin | 25,179 |

***Biofuels***

The emergence of a new advanced biofuels production industry over the next two decades foreshadows significant economic value creation and jobs growth. Although it is early to predict the exact character and dimensions of these impacts, detailed studies of advanced biofuels production processes conducted in recent years provide a foundation for predicting the potential size of economic impacts on the US economy resulting from the growth of this revolutionary new industry. Forecasts show that 190,000 new direct industry jobs will be created, with $37 billion dollars in direct economic growth, by 2022. The impact throughout the economy could be as much as $148.7 billion, creating 807,000 jobs within the same 2010-2022 period. The US Renewable Fuel Standard (RFS) for transportation fuels sets minimum levels of renewable fuels that must be blended into gasoline and other transportation fuels from 2006 to 2022. Specific requirements for blending advanced biofuels, including cellulosic biofuels and biomass-based biodiesel, begin at 0.6 billion gallons per year in 2009 and rise to 21 billion gallons in 2022. The RFS levels for advanced biofuels production will drive the creation of a major new industry, creating a foundation for future technology development and commercial growth.

Biofuels, especially ethanol distilled mainly from corn (maize) in the United States, have been blamed for driving up food prices, but further research has shown that biofuels' role in price spikes is small and the fuels boost farm income and spark rural growth. This year's US ethanol production is forecasted at 13.5 billion gallons, or 51 billion liters, 7 percent more than required. High oil prices make ethanol an attractive alternative fuel. The United States is the No. 1 ethanol maker and Brazil is No. 2.

To meet the RFS requirements, we estimate that advanced biofuels production capacity will need to rise to more than 23 billion gallons by 2022, requiring a cumulative capital investment in processing capacity of more than $95 billion. Annual capital investments in advanced biofuels processing plants would rise from $2.0 billion in 2011 to $8.5 billion in 2016 and $12.2 billion in 2022. We assume a capacity utilization factor of 90 percent for advanced biofuel plants. This is comparable to the capacity utilization for petroleum refineries, which averaged 89.5 percent from 1985 to 2007, and that for corn-based ethanol plants, which typically operate at average utilization rates of 90–95 percent.

Processing plants will likely span a wide range of sizes, with most facilities between 20 and 200 million gallons of annual capacity. Smaller plants will have the advantage of shorter haul distances for feed stocks, at least where energy crops are being grown to supply biomass to the plant. On the other hand, economies of scale in engineering, construction, and permitting may make the capital costs per unit of capacity lower for larger plants.

The total number of jobs directly created reaches 29,000 by 2012 and 190,000 by 2022. Taking into consideration indirect job creation as a result of the economic stimulus created by biofuels development brings total job creation to 123,000 by 2012 and 807,000 by 2022. These estimates assume that only half of new jobs created in biofuels transportation and distribution represent net job creation in the US economy, since some offsetting jobs losses

in the petroleum industry will occur as a result of biofuels' displacement of petroleum product volumes. (Fig. 4) These are the potential “green jobs” that are key to revitalizing the US and global economy. Without new policies promoting domestic manufacturing, an unnecessarily large portion of these jobs will remain overseas.

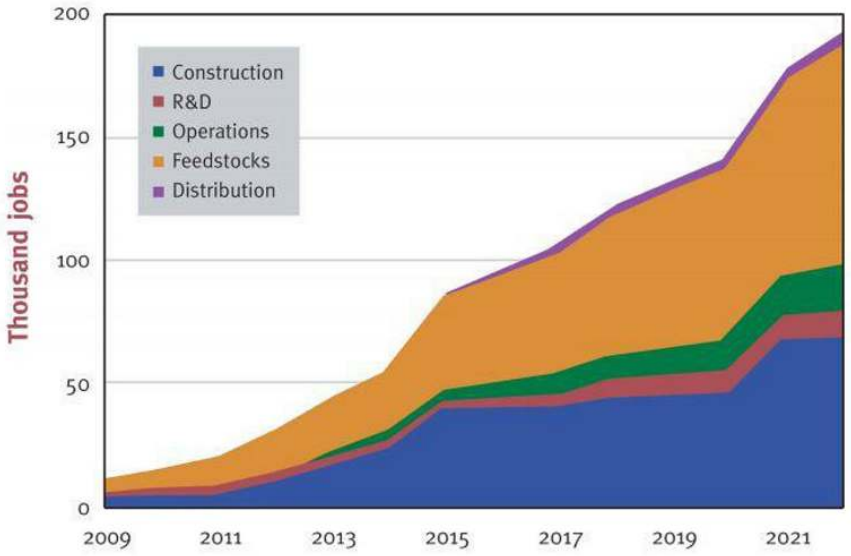


Fig. 4

**Renewable Energy Technology and Projects as the New Industrial Revolution.**

The great pivotal economic changes in world history have occurred when new energy regimes converge with new communication regimes. Today, the same design principles and smart technologies that made the internet possible, and vast “distributed” global communication networks, are just beginning to be used to reconfigure the world’s power grids so that people can produce renewable energy and share it peer-to-grid, just like they now produce and share information, creating a new, decentralized form of energy use. We need to envision a future in which millions of individuals can collect and produce locally generated renewable energy in their homes, offices, factories, and vehicles, store that energy and share their power generation with each other across a continent-wide intelligent inter-grid.

Renewable forms of energy—solar, wind, hydro, geothermal, ocean waves, and biomass—make up the bulk of the New Renewable Energy Revolution. We believe that by becoming the first superpower to establish a mandatory target of 20 percent renewable energy by 2020, the US can set in motion the process of vastly enlarging the renewable energy portion of its energy mix. While renewable energy is found everywhere and new technologies are allowing us to harness it more cheaply and efficiently, we need infrastructure to load it. Over the next 40 years, millions of buildings – homes, offices, shopping malls, and industrial/technology parks – will be renovated or constructed to serve as both “power plants” and habitats. These buildings will collect and generate energy locally from the sun, wind, garbage, agricultural and forestry waste, ocean waves and tides, hydro and geothermal– enough energy to provide for their own power needs as well as surplus energy that can be shared.

The new smart grids or inter-grids will revolutionize the way electricity is produced and delivered. Millions of existing and new buildings—homes, offices, factories—will be converted or built to serve as "positive power plants" that can capture local renewable energy—solar, wind, geothermal, biomass, hydro, and ocean waves—to create electricity to power the buildings, while sharing the surplus power with others across smart inter-grids, just like we now produce our own information and share it with each other across the Internet. The shift to a Renewable Energy Industrial Revolution, infrastructure will require a massive public-private financial commitment. We will need to retool the automotive industry, reconfigure the power grid, and convert millions of commercial and residential buildings into positive power plants. Laying out the new infrastructure will cost hundreds of billions of dollars. Some argue that we can't afford it. But, then, they will need to explain to us how they expect to regrow a debt-ridden American economy dependent on a failing energy regime.

## In Conclusion

With demand for environmentally savvy technicians skyrocketing, community colleges are establishing flexible training programs to meet the needs of the emerging clean-energy economy. Less than two years after California launched a $3.3 billion program to install solar power on a million roofs across the state, Sierra College, a community college near Sacramento, received a $468,000 state grant to train students in photovoltaic technology. With 36 solar companies in the region employing nearly 400 people, the college will fill a gap in training for the estimated 130 jobs that will be added to the field each year. While green jobs are being created in a variety of fields, the largest number of new positions in sustainable development likely will relate to the area of energy efficiency, which includes retrofitting and auditing buildings and installing energy-saving appliances, according to Susan Christopherson, the J. Thomas Clark Professor of City and Regional Planning at Cornell University. *"The reason that energy efficiency is potentially going to produce more jobs is that we're all going to have to be engaged in retrofitting our houses and our commercial and public buildings to make them more energy efficient,"* she says.

Efficiency and whole-system design can help industry accelerate these growing advantages. Analysis from Reinventing Fire, RMI's blueprint to running a 158% bigger FY2050 US economy powered by efficiency and renewables, reveals that the industrial sector can achieve 84 percent greater production using 9 to 13 percent less energy, and save $0.5 trillion net.

Manufacturing serves as the bedrock of our economy. It is the engine that has driven our dramatic economic growth and lifestyle gains since World War II. It has the largest multiplier of any other sector by far—for every $1 in manufacturing value added, $1.40 of value is created in other areas of the economy. It is worth our attention and persistent investment in ensuring its success. Alan Mulally, CEO of Ford Motor Co., after leading a resurgence at Boeing, underscores the point: *"We have to make manufacturing a priority. It's the foundation of everything associated with the economy."*

In the last three years we've seen events that signal the beginning of the endgame for the Industrial Revolution based on fossil fuels. One of them was July 2008 when oil hit $147 a barrel and the costs of all the goods and services across the global supply chain went through the roof, purchasing power plummeted, and the entire global economy ground to a halt. That was the great economic earthquake that signaled the beginning of the endgame for an Industrial Revolution based on fossil fuels. That is why we are likely looking at four-year cycles of growth and collapse. Each time we try to restart the engine by replenishing inventories, oil prices will climb back up, all the other prices for goods and services will spike along with the price of oil, and at around $150 a barrel, purchasing power will plunge and the economy will shut down.

We need to bring the best entrepreneurial talent and scientific and technological know-how together, and work with local, regional, and national governments and their respective business communities and civil society organizations to transform the infrastructure of the global economy and prepare the world for the next great economic era.

It's time to unlock the next industrial revolution through renewable energy.

**Resources**

1. George Ban-Weiss et al., "Solar Energy Job Creation in California", University of
2. California at Berkeley
3. Randy Gee, "Solar Electric Division Annual Report 2006".
4. Solarbuzz.com
5. Environment Texas - Lone Star Power: How Texas Businesses Can Supply the World With Solar Energy
6. Tree Hugger - New Bill Could Create 10 Million Solar Roofs Across US
7. Progressive States Network - Promoting Municipal Financing for Solar Power Investments
8. The Baltimore Sun - Maryland Aims for 100,000 Solar Rooftops in 10 years
9. Reuters - Los Angeles Eyes Owens Lake for Huge Solar Project
10. Blue Green Alliance - Building the Clean Energy Assembly Line: How Renewable Energy can Revitalize US Manufacturing and the American Middle Class