RENEWABLE ENERGY IN THE GREATER LOS ANGELES REGION (GLAR): EMERGING TRENDS, DYNAMICS AND PERSPECTIVES

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Background and Evolution of the Energy Sector

When people today think of energy, our minds jump from coal, to solar power, to nuclear power, and so on. Energy has powered living organisms for billions of years and is the ultimate source of life; thus, its study and advancement are both relevant and important for all living beings. While many energy problems have been solved, others (mainly those regarding nonrenewable energy sources) will affect our future global society in profound ways. Many major cities, including Los Angeles, have taken steps to combat our depleting resources by implementing and strengthening reliance on renewable energy. This report chronicles the history of the energy sector, highlights current trends and looks closely at efforts in Los Angeles – comparing its strengths and weaknesses to other major cities both domestically and abroad. Through this comparison, this report makes recommendations for Los Angeles and the global community as a whole while also conceptualizing emerging trends.

History of Energy

Before we take a look into the future and emerging renewable trends, we need to first gain an understanding of the evolution of energy and how we as a global environment got to where we are. Since the origin of archaic humans, wood and oil were burned to create fire. For thousands of years, humans lived and died by fire. Nearly 3000 years ago, humans discovered that energy could be harnessed from the wind through the use of windmills. These primitive technologies greatly improved the ability to mill grains and pump water. The world was forever changed when coal began to replace biomass and wind power as the main sources of energy. In 1769, James Watt created the steam engine, which not only changed the world of transportation, but also spurred the Industrial Revolution (EIA). Mass production and superior shipping became

commonplace, and with it came the mass consumption of coal. Its effects on humanity were not unrecognized. In the mid 1800s, Ralph Waldo Emerson, a famous poet, stated, “Every basket [of coal] is power and civilization” (Freese, pg. 10). Those who figured out how to harness the power of coal boosted their economy exponentially, but in doing so, created a reliance on one of the world's finite resources. Coal and oil have been major players in the energy realm by building wealth for companies as well as individuals, such as the Rockefellers who had a near monopoly of oil refineries. However, in a world that is becoming more clean energy conscious, it is these oil and coal companies that are to fear. Scientists have discovered ways to harness water, wind, sun, and nuclear power both greenly and increasingly efficiently. Noting the importance of finding alternative sources of energy, the 20th and 21st centuries brought with them solar panels and hydro power plants, which are just two of the future prospects for fulfilling our ever-growing energy needs. Nevertheless, there is still much work that needs to be done to decrease the world’s dependence on non-renewable sources.

Current Composition of the Energy Sector

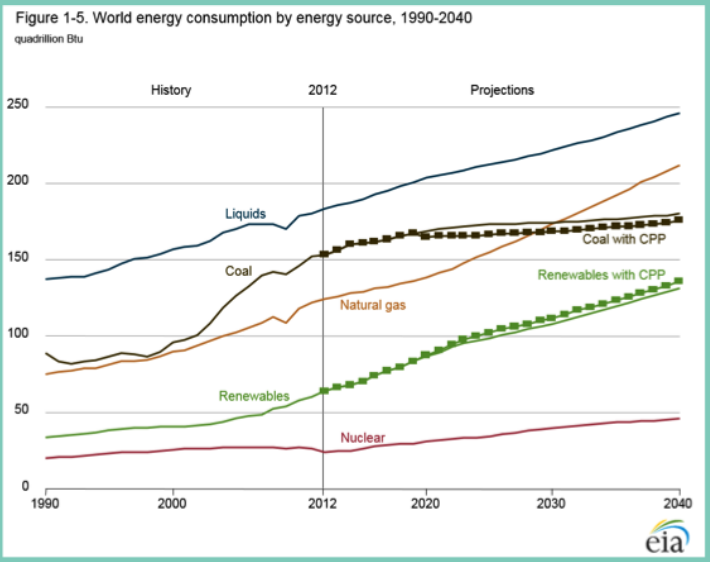
As mentioned, the production of energy has taken many different forms and is ever changing due to improving technology. These technologies and resources have opened up the doors for a restructuring of the energy sector. After centuries of dependence on coal, petroleum, and natural gas, the clean energy sphere has a large battle to fight to gain market share. That being said, these natural sources of energy provide 85.99% of the world's energy: 32.94% coming from oil, 29.20% coming from coal, and 23.85% produced by natural gas. The resulting production comes from renewable sources: mainly hydro (2.4%), biomass (10.3%), wind (1.44%), and solar power (0.45%) (IEA).

Energy Demand in the Future

The demand for energy and mass quantities of it are not going away, but the trends in the next 25 years differ slightly from our current consumption patterns. Let's look at the users of this energy. Today much of the world's energy consumption is concentrated in countries belonging to the OECD (Organization for Economic Co-operation and Development). These countries, 35 in total, work to stimulate economic progress and world trade. Fully developed countries use copious amounts of energy in their everyday lives and activities. From electricity in their homes, to large appliances, and automobiles, the OECD countries are large consumers of energy. However, the EIA (U.S. Energy Information Administration) predicts that by 2040, non-OECD nations' demand will far surpass that of the developed world, rising by 71%. "As countries develop and living standards improve, energy demand grows rapidly. For instance, in nations experiencing fast-paced economic growth, the share of the populace demanding improved housing, which requires more energy to construct and maintain often increases. Increased demand for appliances and transportation equipment, and growing capacity to produce goods and services for both domestic and foreign markets, also lead to higher energy consumption" (EIA.gov). These ever improving nations will restructure how we as a global entity think about energy and its usage as well as where we will get this energy in the future.

Projected Sources in the Future

In addition to the upheaval of the developing world's use of energy, we will also see a significant change in where the energy sources are coming from. As mentioned previously, natural resources provide the vast majority of the world's energy; however, the IEO report shows that renewable energy sources are the fastest growing sectors at 2.6% per year, with nuclear energy increasing by 2.3% per year. Conversely, we see coal use growing at a rate of 0.6% per



year, demonstrating the slow but important shift in energy sources. The EIA chart to the left shows the main energy sources and their projected growth pattern in the next 25 years.

Key Issues, Problems and Development Priorities

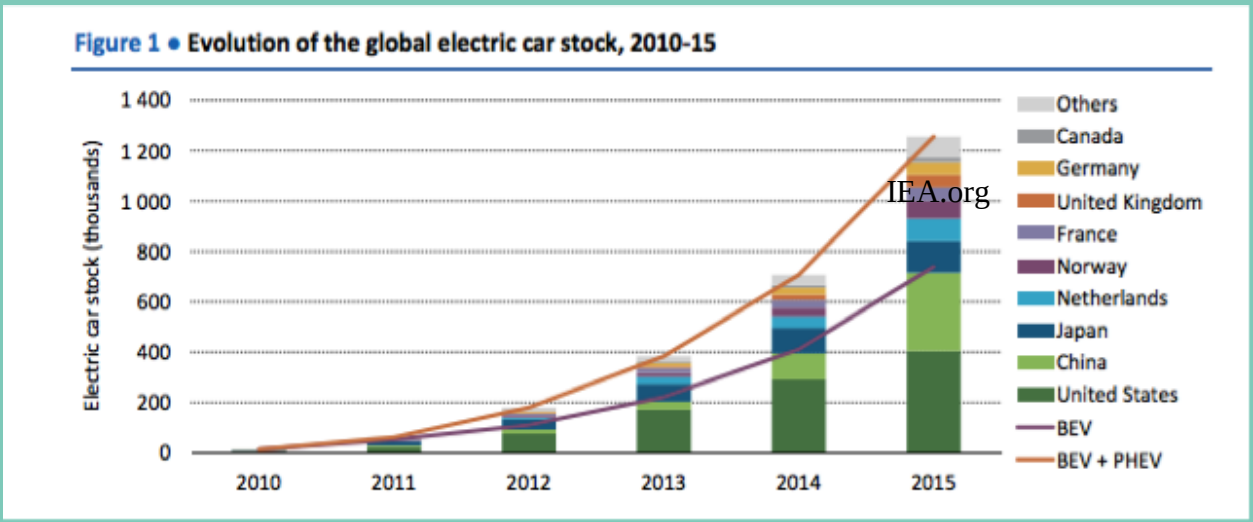
A recently published study by Navigant Research found that the energy sector is worth over 1.3 trillion dollars globally, but things are not necessarily sailing smoothly. As with every industry, there are problems that can cripple certain sections of the industry if they are unable to adapt to consumer preferences and develop sustainable practices. The three main issues that the industry needs to be responsive to are as follows: the need for sustainable energy in developing regions, rising oil prices, as well as the public's concern about climate change and its effects on consumer preferences.

Industrialization in developing countries has resulted in improved living conditions, but has also led to the degradation of the environment. Many of these countries are rapidly developing in order to maximize potential profits from new business ventures. “Rapidly urbanizing countries are likely to be under severe pressure from the international community to make the required trade-offs between economic growth and environmental quality” (Parikh, pg. 87). In order to get up to industrial speed, roads must be created, sewer systems need to be built, and transportation needs to be improved, all of which are great for the energy sector, but wreak havoc on the environment. Resources are used faster than they can be replenished and thus creates a need for sustainable energy.

The second issue is that oil prices are on the rise, which has affected micro and macro environments across the world. On the micro level, oil is a commodity that most individuals in developed countries rely on in their daily lives and thus in the short term, oil is a relatively inelastic good. However as prices continue to trend upward, the average consumer has become less willing to spend an inordinate amount of money at the pump and has begun to look for alternatives such as energy efficient automobiles, carpools, or proximity to his/her driving destinations. While these changes affect the economy, this impact is relatively small in comparison to the macro effects, which can be felt through a stagnated global economy. The increasing oil prices has resulted in more expensive transportation and has created pressure for companies to produce goods locally, without the need to pay exorbitant importing and exporting costs. Conversely, we also see a shift in the global economy in regard to research and development for new and innovative technologies to combat these oil prices. While they may be devastating to the current oil refining and drilling companies in the future, oil isn't going anywhere just yet; those willing and able to adapt to the changing economy will set themselves up for success in the future.

The last key issue for the energy sector is the environmentally conscious consumer. In a report published by the University of Sheffield, "66% of consumers believe they can influence a company's environmental and ethical behavior" (Ponting, pg. 7). These consumers can have a large impact on what the market produces and what types of energy sources are used to create and run that product. For example, the electric car market has been growing exponentially, as shown in the chart below. Consumer preferences demonstrated that buying an energy efficient electric vehicle would be a product that they would be interested in. Car companies spent considerable time and resources making these desires a reality for customers and thus, there are more than 1.26 million electric vehicles on the road today. The auto industry is representative of

the impact consumers have on the market, on energy consumption, and on the trends in the future. Thus the energy sector needs to be cognizant of the issues being expressed today ─ as they point to the future of energy.



Renewable Energy Subsector

"Renewable Energy is energy obtained from natural repetitive and persistent flows of energy occurring in the local environment" (Twindle, pg. 3). The sources that fall within this category include the sun, water, wind, geothermal and biofuels. Despite the multitude of renewable resources, they only account for 13.2% of the world's energy production, largely due to cost and ease of acquisition. This section will go through each of the major renewable energy sources and explain the role they play in the current energy sector as well as future implications.

As mentioned previously, renewable energy only accounts for a small percentage of the world's energy production, though the possibility of these sources is quite large. This is particularly true for solar power, as it is the most abundant energy resource in the world. If just 0.1% of the sun's energy that reaches the earth were transformed at 10% efficiency, it would result in four times more electricity than all of our current sources provide (World Energy

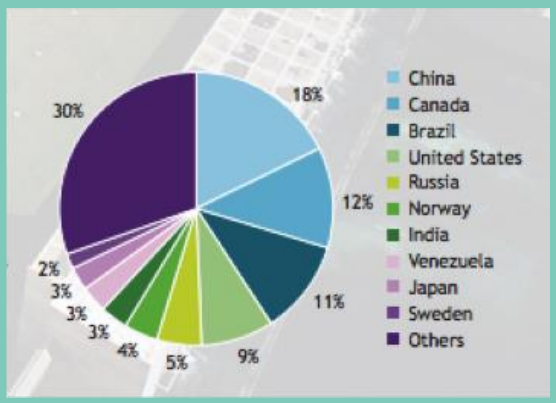
Council, pg.19). That being said solar power has yet to be harnessed to its full capacity. Some European countries such as Italy, Germany, and Greece have made leaps and bounds with the technology ─ as it supplies 7% of their nation's electricity ─ however, as a whole, solar power only provides 1% of the global electricity demand (Cleantechnica).

The potential of solar power leads to the question: why is solar energy not more prevalent in today's modern society? First of all, solar power is relatively expensive to install and relatively inefficient in energy capture, meaning that urban consumers are unable to garner substantial electricity from solar panel use. Secondly, solar panel technology has some limitations regarding the high cost of research and development as well as grid connectivity issues. However, the future of solar power is continually improving due to lowering costs, improved technology, and supportive public policy. Today we see companies such as Solar City, run by Elon Musk, creating innovative products, such as solar shingles that serve the function of roofing while collecting electricity that can be used by the household. These innovations and increasing alternative energy companies have spurred a surge in venture capitalist and private equity investments, increasing from $379 million dollars in 2013 to $1.2 billion in 2014 (Deloitte, 13). Additionally, there have been an increasing number of policies enacted that support the green energy sector and negatively impact carbon emissions, which along with the rising prices of electricity bodes well for the solar energy world and for the use of renewable energy. These factors considered, the EIA projects that electricity production from solar energy will jump up to 14% by 2040 (Deloitte).

The largest sector of renewable energy, biomass energy, produces 10% of the world's primary energy supply. Biomass is "the energy from plant-derived materials" (NREL). Much of this energy is used in developing countries that burn wood to produce heat and to cook. That being said, there are many ways to use biomass, including converting it into biofuels like ethanol

and biodiesel which can be used for transportation. Like all energy sources, biomasses have strengths and weaknesses. Biomass energy is plentiful in our current environment; there are significant trees and plants on our earth from which we can gain energy. However if we are not careful we could be depleting these resources faster than we are replenishing them. Biofuels are relatively inefficient in relation to the non-renewable resources like gasoline. They are also relatively expensive to obtain because of the land required to access this type of energy. The Department of Energy predicts that by 2040 the United States could increase its use of biomass resources from 400 million tons to 1.57 billion tons. Reliance on biofuels would decrease greenhouse gasses that are released in transportation as well as decrease dependence on imported oil (Energy.gov).

Next, we will discuss hydropower, which is a tremendous source of renewable energy that accounts for 10% of the global energy production. Hydropower is generated through the placement of dams, which force water through turbines, thus creating energy. Hydropower is currently being created by 100 countries; however the top 5, China, Brazil, the United States, Canada and Russia, generate nearly 50% of the world's production. In the United States alone, there are 34 hydroelectric power stations, which together create 6.1% of American electricity.



This being said, hydropower is a relatively expensive endeavor requiring a large amount of capital. Additionally, in order to effectively generate significant energy, the ecosystem of the body of water is disrupted which is oftentimes met by resistance by environmentalist groups. However, if these obstacles can be overcome, the technology is relatively simple and has been

proven with low operating costs. The largest area for growth is in the non-OECD countries, largely because the OECD has already developed its capabilities, taking advantage of its large bodies of water. Non-OECD countries' hydropower generation jumps to 71% of renewable electricity generation by 2040. Thus the future of hydropower lays in the hands of non-OECD countries (EIA.org).

Lastly, wind power provides the world with 2.5% of its electricity. Wind power is generated by turbines that spin when their blades are struck by gusts of wind. Large-scale commercial wind turbines were created in the 1980s, and as time has passed, they have become one of the cheapest forms of energy around. The drawbacks, however, are the large amount of land in which to place the wind turbines and the intermittency of wind. By 2050, wind power is projected to account for 35% of all electricity in the United States. European countries have begun to experiment with offshore wind turbines opening a whole new sector for wind power. Today, the energy sector is only minimally affected by renewable energy, but as the implications of climate change and concern about longevity of non-renewable resources increases, new technologies will be created and solar, hydro, biomass and wind power will become major players in the world of energy.

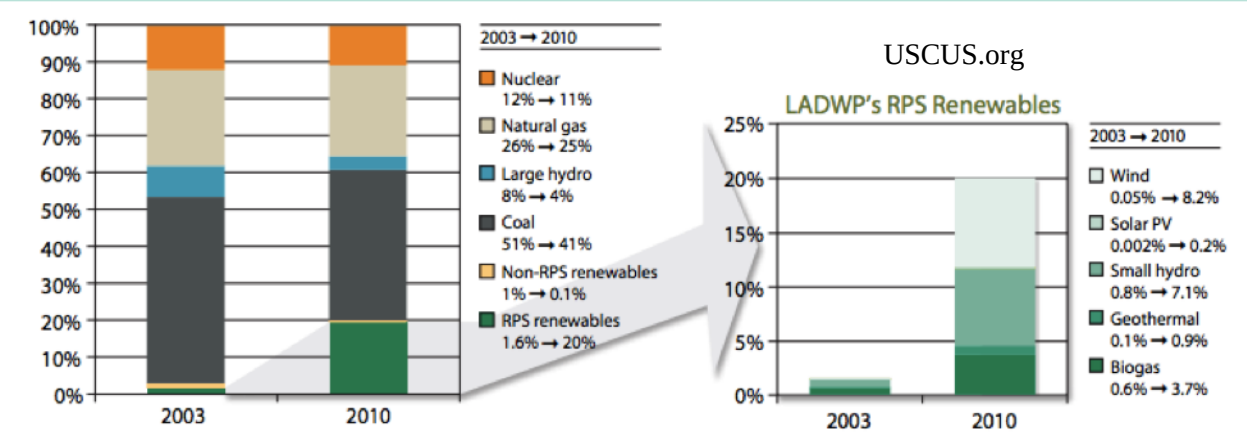
Current Profile, Trends, and Dynamics in the GLAR

With a population of 10 million people, Los Angeles County is the largest county in the United States and one of the largest urban agglomerations in the world. Home to constant warm weather and sun, there has been constant growth in the City of Angels. Last year, as reported by LA Weekly, the population grew by 1.3%. However, all these newcomers consume a tremendous amount of energy, to the tune of 454.42 Trillion BTU, which is 4.7% of the United States total consumption (UCLA).

Los Angeles County is large in area and thus very diverse in its population and income. UCLA did a study on the largest users of energy and looked at both residence and income. First, we see that the vast majority of energy used in Los Angeles is in fact used by the residential sector, with commercial buildings using only 19.55% of all the energy supplied to Los Angeles. Second, the research looked at how income plays a role in the consumption of energy. They found that households with a median income over $86,622 consumed three times more energy than households with a median household income of less than $36,474 (UCLA).

Sources of Energy in the GLAR

While California and LA specifically are known for their green energy efforts, much of the energy supplied to the LA region is still dependent on non-renewable sources.
As shown below, as of 2010, coal, natural gas, and nuclear energy still power 77% of LA. As



this chart shows, there has been significant increases in the efforts displayed by the LADWP to boost renewable energy. Additionally, California passed a law in 2011 stating that by 2030, all utilities have to obtain 50% from renewables (UCS). The policies enacted by the California state government have made it a leader in regard to energy efficiency. For example, the residential sector in California, although quite big, uses less energy per person than every state except for

Hawaii. The general attitude of being environmentally conscious has had a tremendous impact on both businesses and individuals who have worked to promote green living. That being said, California and Los Angeles have a tremendous amount of natural resources at their disposal and are some of the largest producers of oil in the nation. Despite the wealth of non-renewable resources, LA has been on a mission to be 100% renewable and hopes that in the near future this will be an option.

GLAR: Renewable Energy Sector in a Comparative Perspective

A Global Comparison of GLAR

The world has developed at a different pace overall, with some countries paving the way with new technologies while others are just beginning to adapt to the modern world. Thus, each country is in a different place regarding its use of energy and, more specifically, renewable energy. In this section, we will look at three countries in different parts of the world: Iceland, Brazil and Saudi Arabia, and analyze their consumption of renewable vs. nonrenewable energy.

The World Bank produces a report that outlines how much of a specific country's energy comes from renewable sources. The countries that top that list are non-developed countries located in Africa, which is largely because they don't have access to the efficient nonrenewable energy sources that are needed to power heavy duty appliances and automobiles that most developed countries have. These African countries are largely getting energy from biomasses (such as burning wood), which they use to cook. The U.N.'s list of least developed countries get 74.85% of their energy from renewable sources, whereas members of the OECD get only 10.79% of their energy from renewable sources (World Bank).

Second to the African countries that use biomass energy and power over 90% of their country's energy needs using these renewable sources, Iceland leads the list. Based on data from

2012, 78.14% of the energy used by Iceland was renewable; however, today it is nearly 100%. Iceland, being the cold place it is, spends a great deal of its energy on heating. However, Iceland has figured out how to effectively harness its abundant geothermal energy, so 9 out of 10 homes use geothermal energy for their heating needs. Geothermal energy powers 66% percent of all energy consumption in Iceland, whereas hydropower accounts for the majority of the rest. The hydropower comes from glaciers which cover 11% of Iceland's land mass. When these glaciers melt into the rivers and streams during the summer months, they can be used to power water turbines. Iceland's government-ran energy website states that they have only accessed 17% of the renewable resource potential, which means that in the future they may be able to supply other countries with their renewable energy sources (NEI.is.org). Most impressively, this change has been rather rapid as Iceland began their conquest toward renewable energy in 1950. Within 70 years, Iceland has become entirely renewable, a feat in which many other countries are looking to follow (UN Chronicle).

After Iceland, we looked at Brazil, whose renewable energy consumption equals 43.63%. While being the largest renewable energy market in Latin America, in comparison to the rest of the world, Brazil falls right in the middle. Most of Brazil's energy is produced via hydropower, which accounts for 80% of its domestic electricity production ─ effectively making them one of the world's leaders in hydropower. The second renewable source that Brazil has made a great impact with is biofuels. Due to the 1970's oil crisis, Brazil started using sugarcane ethanol to fuel their cars and is now the world leader in biofuels. However, Brazil has been unable to harness solar and wind power effectively and thus, they are dependent on hydropower and biofuels. This strategy and dependency has resulted in renewable energy growth stagnation due to the drought Brazil has been experiencing. Thus, the once leader of the renewable energy sector has been on the decline and is looking to make a name for itself once again.

Lastly, as the world's largest provider of crude oil, Saudi Arabia has virtually no renewable resources. In addition to producing the most oil in the world, they also consume the most in the Middle East because they have so much readily available (EIA). Despite this, in January of 2017, Saudi Arabia committed between $30-$50 billion USD to renewable energy, to aid the 8% increase in energy demand. While this energy will be used to pull more oil out of the earth, their forays into renewable energy are a step in the right direction.

While Los Angeles is on a mission to become 100% renewable energy reliant, as of 2010 it was only at 20%, which puts it far below Iceland and even Brazil. However, the U.S. only consumes 10% renewable energy, so in reference to the nation, Los Angeles is on the cutting edge of renewable energy consumption. Additionally, in comparison to Iceland, Brazil and Saudi Arabia, the GLAR is much more focused on wind power, as it provides 8.1% of their energy. While Los Angeles and the United States as a whole have a lot of room to grow in terms of renewable energy sourcing, they are making good efforts. In the future, they hope to be on the level of Iceland and until then, they must keep current with technology and adapt to new methods of green energy.

A National Comparison of GLAR

The Greater Los Angeles Region is becoming a largely green area in the United States. However, there are many other regions in certain states that outperform the GLAR when it comes to renewable energy production and consumption. In this section, certain areas in the US will be compared to the GLAR in terms of renewable energy production and consumption. In essence, the GLAR will be compared to a leader (Burlington, Vermont), an average performer (Wyoming), and a laggard (Ohio) when it comes to being green in the US.

The first area to be analyzed is Burlington, Vermont, which is the first city in the US to run completely on renewable energy. Back in the 1980s, Burlington was already making decisions to produce and run on more renewable energy than other conventional forms of electricity. Now it runs completely on renewable energy in the forms of biomass, wind, solar, hydro, and a few other sources (Peters). In order to run completely on renewable energy, the city has to buy and sell renewable energy credits to other cities (Peters). This allows the renewable energy consumed in Burlington to have a cheaper cost than it otherwise would ─ effectively getting rid of the problem of renewable energy's normally excessive cost. Burlington's city government has also helped its residents cut back on energy use so that the city doesn't have to utilize as much renewable energy ─ another effective way of combatting the cost of renewable energy (Peters). As a whole, Vermont is the greenest state in the US. Considering it has the second smallest population and the lowest overall GDP, it doesn't produce much pollution at all and has the smallest carbon footprint in the US (24/7 Wall St.).

The second area to be analyzed is the average performer of Wyoming. Considering how the population of the GLAR is larger than all of Wyoming, the whole state will be analyzed rather than a particular region. Wyoming was ranked 25th overall in the US in terms of renewable energy capacity and generation in 2010 ("Wyoming - State Energy Profile Overview."). The state draws the bulk of its renewable energy production from wind sources and also utilizes hydropower ("Wyoming - State Energy Profile Overview."). Compared to the GLAR, most of Wyoming's energy consumption is by the industrial sector, with the lowest portion being consumed by the residential sector ("Wyoming - State Energy Profile Overview."). It still derives a large portion of its energy from nonrenewable sources, with the largest portion, 88%, coming from coal. In fact, in 2015 Wyoming produced 42% of all coal mined in the US ("Wyoming - State Energy Profile Overview."). Only 11% of Wyoming's energy comes from

renewable sources. All of the above facts place Wyoming in the middle of the pack when it comes to being green. The GLAR is largely greener than Wyoming as a whole.

The final area that will be analyzed is Ohio. Ohio's population is comparable in size to the GLAR, and as such, the state as a whole is worthy of comparison. Ohio is one of the least green states in the US. An analysis by 24/7 Wall St. put it best:

> Ohio ranks fifth in energy consumption, and very little of this demand is met by alternative energy. Only 0.7% of the state's energy comes from renewable sources, the worst rate in the country. Most of the state's energy comes from coal. Along with this tendency comes a long and poor record of pollution. The state ranks 47th for CO2 emissions from fossil fuel combustion, 46th for toxic exposure, 47th for developmental toxins released, and 47th for reproductive toxins released. Additionally, the state ranks second worst, just behind Florida, for hazardous waste violations since 2000, as reported by the nonprofit group OMB Watch.

This quote shows how bad Ohio's track record is when it comes to being green. Considering how it is a largely industrial state, these statistics make sense. However, the state has great potential to become greener over time. It has the largest amount of installed solar energy capacity in the Midwest and has significant renewable energy resources from wind power and bioenergy ("Renewable Energy in Ohio."). The state is also in the process of creating multifaceted renewable energy policies that will play out in the near future. As a whole, Ohio doesn't hold a candle to the GLAR in terms of being green. However, it has the potential to be a contender in the renewable energy market in the future.

In conclusion, the GLAR is unique in its commitment to being green in the US. It isn't at the point of running completely on renewable energy like Burlington, Vermont, but it has already made commitments to achieving such a goal in the future. It surpasses the average performers like Wyoming, and completely dwarfs the laggards like Ohio. Due to its huge population and influence, the GLAR is able to take action on its liberal agenda for being a largely green area. In

the near future when it inevitably accomplishes the goal of running on 100% renewable energy, the GLAR will be a role model for other areas throughout the US to follow.

Renewable Energy in the GLAR: Growth, Development and Future Outlook

Future Vision of the Renewable Energy Sector in GLAR

The renewable energy sector in California has been growing steadily over the last few decades due to the government of California's dedication to protecting the climate and natural resources of the state under Jerry Brown's leadership. As a result, the Greater Los Angeles Region (GLAR) has also utilized renewable energy sources more in the recent past. In 2009, the mayor of LA declared that by 2020, LA will no longer use coal as an energy source and will opt for alternative energy sources like renewables from the wind and sun (Ramon, "Los Angeles to Stop Using Coal by 2020"). The mayor stated that "LADWP [LA Department of Water and Power] will deliver 40 percent renewable power, with the remainder coming from natural gas, nuclear, and large hydroelectric" (Ramon, "Los Angeles to Stop Using Coal by 2020"). The city also planned to reduce the use of power by 1% yearly over the next 10 years by utilizing its current energy more efficiently. This presents a huge opportunity for renewable energy providers to target the GLAR market from 2020 and onward.

In mid-September of 2016, the LA City Council directed the LADWP to meet with academics and other LA stakeholders to brainstorm ideas on how to make LA receive 100% of its energy from renewable energy sources (Kinman). Michelle Kinman, an advocate for clean energy, stated that "Today's decision sends a strong signal to cities everywhere that it's no longer a question of whether we'll get to 100% renewable power, but how fast?" This motion in the City Council was spurred by Councilmembers Paul Krekorian and Mike Bonin, who were

largely disappointed that LA, for the third year in a row, was ranked as having the worst air pollution in the U.S. In the same year, the state created policy to commit California to use 50% renewable energy by 2030 (Kinman). Such an initiative has served to complement LA in its determination to run completely on clean energy.

On December 13, 2016, the LA County Board of Supervisors adopted the Renewable Energy Ordinance (REO), which would "help California meet its goals for renewable energy generation and greenhouse gas reduction, while minimizing environmental and community impacts" ("Renewable Energy", LACDRP). The REO creates planning and zoning code for the creation of solar and wind energy projects in LA. It also establishes a simple, streamlined process for obtaining permits in order to encourage more small-scale solar and wind projects. This minimization of bureaucratic red tape opens the door for more companies to enter the GLAR solar and wind energy markets.

Overall, the future outlook for renewable energy in GLAR is bright. The city is paving the way to become wholly reliant on renewable energy sources, which would allow renewable energy companies to enter the GLAR market and build relationships with the city government. Solar and wind energy sources have been receiving a lot of attention and special focus by the city government with the creation of the REO and the city's commitment to become 100% renewable energy reliant. Now is the best time to invest in renewable energy products in the GLAR.

Future Outlook of Solar and Wind Industries in GLAR

As discussed in the previous section, solar and wind energy has received special attention from the LA city government. As such, these industries would make for attractive investments in the current LA business climate. This section will touch on the future outlook of the solar and wind energy industries in GLAR.

Considering how LA uses an abundance of energy due to its massive population and that the region gets a lot of sunlight, one has to wonder why LA doesn't primarily use solar energy systems to provide energy to its millions of consumers. As it turns out, LA is planning to do something similar in the not-so-distant future. In 2008, LA took up the largest solar power project to date out of any city in the world with a project called Solar LA (Ramon, "World's Most Ambitious Solar Plan in LA"). Mayor Antonio Villaraigosa wanted to make LA a greener city and increase its reliance on clean energy as part of his legacy. The plan sought to replace fossil fuel energy required during peak demand with solar energy instead. It laid out a course of action for creating solar systems in residential, commercial, and municipal areas in LA (Ramon, "World's Most Ambitious Solar Plan in LA"). As part of the plan, LADWP would receive $313 million in state funds to be used for future solar projects and rebate programs to incentivize customers to install solar panels on their homes. This project provides a huge opportunity for solar energy companies in LA.

In 2013, LADWP adopted a Feed-In Tariff (FIT) program. This program would allow more LA residents to invest in solar power for their own homes and receive money back for doing so. LADWP planned to procure 150 megawatts of solar power from rooftops in LA through the FIT program (Lauth). Along with previous projects LADWP approved, the city planned to provide enough energy every year for approximately 331,000 LA households beginning in 2012 (Lauth). The FIT program is a huge step in the right direction for creating a long-term environment for solar power to thrive in LA.

According to the *LA Times*, the growth rate of the solar industry slowed in 2016 (Penn). In 2016, "U.S. rooftop solar installations increased 19% compared with an average growth of 63% year-over-year from 2012 to 2015" (Penn). However, this decrease in growth is likely due to other reasons than the industry experiencing any sort of decline. Instead, industry experts

stated that the decrease in growth was probably due to policies that have raised consumer costs along with moves by the utility sector to attempt to stifle homeowners and businesses from installing their own solar panels to generate their own electricity (Penn). As such, consumers will be dependent on city government policy to combat the power of utility companies and lower the cost of households going green on their own.

Wind energy plays a significant role in California's energy production. Even back in 1991, the wind energy industry in California garnered a whopping $3.2 billion in private investment ("Overview of Wind Energy in California."). The wind energy industry also creates many jobs in California as it continues to grow. Over time, the cost of wind energy has significantly decreased, which opens the door for future investment opportunities in California.

Due to California officials setting ambitious renewable energy usage and production goals, energy companies have been scrambling to meet the demands of the state and its populous cities like LA. One company that has stepped up to answer the call is a Philip Anschutz-owned energy firm that got the go-ahead to start a $5 billion project to build the largest wind farm in the U.S. (Groom). However, this project has a catch ─ the wind farm will be built in Wyoming and the energy will be delivered to California via transmission lines. As a result, much of the economic benefits of this project will be reaped by Wyoming and not California. The reason why this wind farm is being built in Wyoming and not California has a lot to do with the perspectives of the public and officials in California. They both believe that wind farms are an eyesore to an otherwise pristine desert landscape, and as such, they would prefer that large wind farms be built elsewhere.

In 2015, the LA County Board of Supervisors took steps to ban utility-scale wind turbines in "unincorporated areas of the county" (Favot). This decision was largely spurned by the pleas of Antelope Valley residents who have already had to deal with the negative side

effects of solar energy farms. This represents a hurdle for wind energy companies, but they can still adapt to the situation and find other ways of producing wind energy ─ like offshore wind farms.

Offshore wind farms represent a huge opportunity in California and LA. However, the seabed off the coast drops off rather quickly and therefore creates a hurdle that wind companies will have to overcome. Some innovative minds have already come up with the idea of using floating wind turbines instead of fixing them to the sea floor. In 2016, a wind energy company, Trident Winds LLC, applied for a lease to build an offshore wind farm in California (Nikolewski). The company will begin building in 2025. This project has already inspired other companies to start up similar projects in other areas across the U.S. If it is successful, it will pave the way for other wind companies in California to follow.

Although they have their hurdles, the solar and wind energy industries in LA and California as a whole look rather attractive in the future. Wind seemingly has significantly more hurdles to overcome than solar, and as such, solar would make for a better future investment. In the next section, the major drivers and constraints affecting the solar and wind industries will be analyzed in depth.

Drivers and Constraints of Solar and Wind Industries

Overall, the two primary drivers of demand in the energy industry are economic activity and population growth. People spend more on energy when the economy is good. As the population grows, there is an increase in demand for energy over time and also due to the energy required by hospitals and households as babies are nurtured through their initial months with the help of various appliances. However, when it comes to the solar and wind industries themselves, the drivers and constraints become more complex.

Solar and wind energy both heavily rely on the driver and constraint of city government policy. When permits are made easier to obtain, it opens the door for solar and wind companies to move into new markets. Also, the city government has to create planning and zoning code for solar and wind companies. This means that these companies can be blocked from entering certain market areas if the city government won't allow it (like with the ban on wind turbines in unincorporated areas of LA). As such, city government policy is both a driver and a constraint for the solar and wind industries.

A driver for the solar industry in LA is economic growth. Solar is unique from wind energy in that it can be harnessed by individuals themselves in their own households via solar panels. People in LA would have a rough time trying to install a wind turbine in their backyard to supply their energy, but solar panels are relatively easy to install. The only obstacle between most consumers and solar panels is that solar panels are generally on the expensive side. As such, until solar panels become cheaper to manufacture, they won't be widely adopted by consumers. However, certain municipalities within LA have recently begun installing solar panels in their schools to supply energy. This city government involvement will open a new market for solar companies to leverage.

When it comes to the wind industry, one of the largest constraints is land. Wind energy requires lots of land to host numerous wind turbines. As such, it may be difficult for wind energy companies to bargain with city governments in order to acquire plots of land. However, recent innovations have allowed wind turbines to be hosted offshore in local waters. This bypasses the need for large amounts of land, although it does come with new problems to tackle (maintenance being the largest one). LA's location near the ocean provides wind companies the opportunity to leverage offshore wind turbine farms.

Both the solar and wind industries face different drivers and constraints. The constraints that affect the solar industry are seemingly less of an obstacle than the wind industry. Land is a relatively scarce resource, and wind energy requires lots of it, whereas solar companies can bypass this constraint by building on commercial and residential rooftops. As such, the solar industry appears to be a more attractive investment.

Future Development Scenarios for Solar and Wind Industries

The solar and wind industries are constantly evolving and adapting to the current business and political climate. As such, there are many future development scenarios and opportunities for solar and wind companies. As discussed in the previous section, both of these industries are heavily reliant on city governments in order to infiltrate new markets. They also must heavily rely on innovation if they want to keep up with the ever-evolving competition. Cost is the name of the game in the solar and wind industries, so whoever can provide the services and products for the cheapest price will often be able to acquire the largest share of the market.

A recent development for the wind industry is President Donald Trump's embracement of wind farms. In the past, Trump spoke down about wind farms, but as of April 10, 2017, he has now expressed a desire to host offshore wind farms on the East Coast of the U.S. (Reilly). The Department of the Interior also has recently been putting up large portions of land on the U.S.'s Eastern Seaboard up for lease (Reilly). This will allow wind companies to take advantage of the available offshore space and profit in the future. As stated in an *MIT Technology Review* article written by Michael Reilly and Rick Perry, Trump's secretary of energy, presents an opportunity for wind companies as he spearheaded many wind projects as governor of Texas and turned the state into a leader of wind energy. The wind energy sector represents an opportunity to create

thousands of jobs, and as such, Trump may be incentivized to keep his campaign promises by creating many wind energy projects off the East Coast.

The solar industry also has its own future development opportunities. One of the opportunities that can be seen in many Southern California cities is when solar companies partner with schools to provide solar panel facilities in school parking lots. This benefits the schools as well as the solar companies. Solar companies have also developed solar panels for electric vehicles. For instance, many Tesla Model S cars can be seen sporting a solar panel on top. This presents the opportunity for solar companies to partner with car manufacturers in order to provide solar panels on their electric vehicles. Storage innovation is another future opportunity for solar companies. Currently, solar technology isn't that great at storing the energy it acquires during the day. As such, solar companies that invest in more efficient battery storage technology will reap the benefits in the future.

Green states also present the opportunity for future development for solar and wind companies. States like California that focus on clean energy provide an incredibly attractive opportunity for solar and wind companies as these states are more likely to provide permits to clean energy companies. California is largely the greenest state in the country, and as such, solar and wind companies would do well to befriend city and state government officials in California and find their way into new markets.

Conclusion

Renewable energy is a relatively new industry in the energy sector that has been taking the U.S. and other countries by storm. Its ability to meet the demands of a growing populace while subsequently protecting the environment makes it an attractive industry for many future-minded investors. In this paper, the renewable energy industry in the GLAR was dissected into

many parts and analyzed in different ways in order to determine its attractiveness as a whole. The renewable energy industry in the GLAR was compared to some countries as well as some cities and states within the U.S., and was deemed to be an attractive market. The solar and wind industries were paid special attention in their own individual analyses. Overall, the solar industry in the GLAR was deemed to be the most attractive industry for investment. It has the least amount of hurdles to overcome and can flourish in the GLAR due to the region's tendency to have sunny weather for most of the year. Also, the city government has already accepted many future solar projects (which shows how city officials are favorable to solar power) due to its commitment to green energy. With the goodwill of the politicians, the solar industry will thrive in the GLAR in the future. The best time to invest in solar power in the GLAR is now.

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