

Wentworth Institute of Technology

Energy in the 21<sup>st</sup> Century and Beyond:  
It's Effects on Globalization Now and in The Future

By: Eric Watson, Kyle St. George, Nicholas Torres and Gerard  
Walraven

International Relations POLS 450

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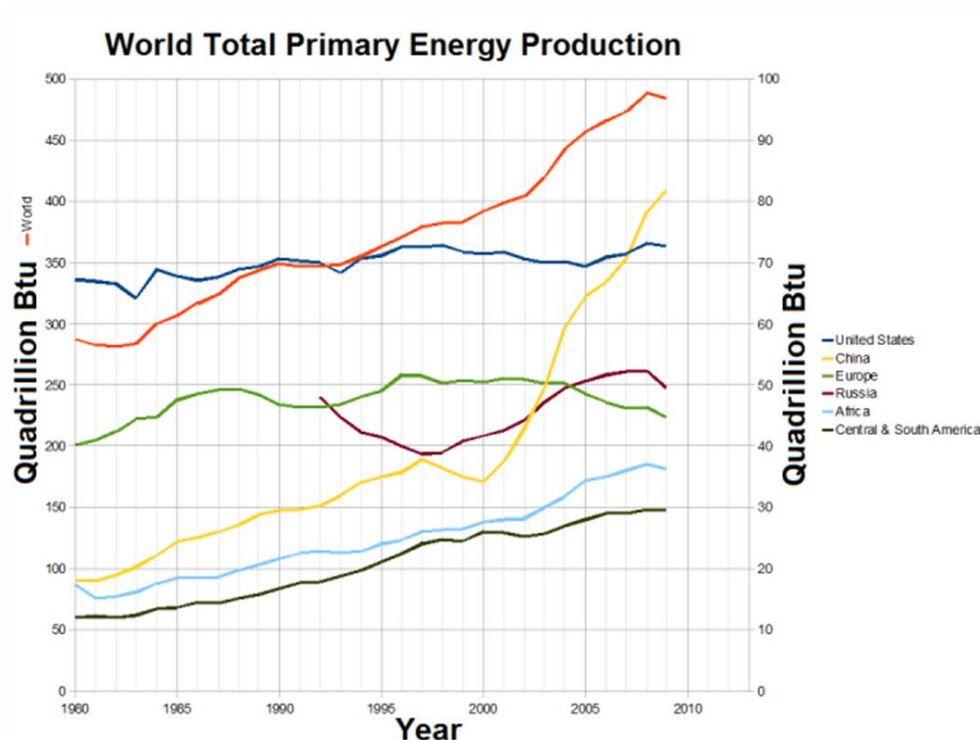
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## INTRODUCTION

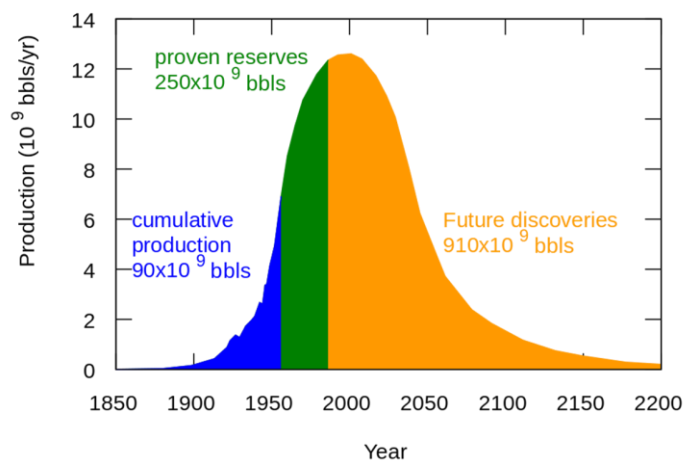
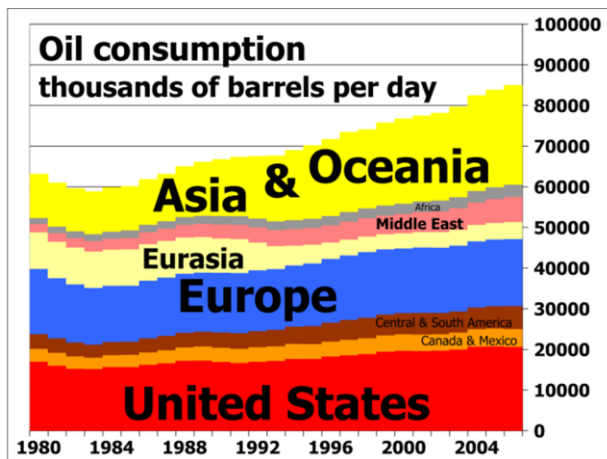
The state of the global energy situation could be the most precipitous situation our modern society has ever faced. So much of our global economic system depends on the production and trade of energy to keep the global system running. In just the past one hundred and fifty years since Edwin Drake constructed the first modern oil well in Titusville, Pennsylvania, we have exploited our means of un-renewable energy to the point where we are on the edge of going over the peak oil cliff. This insatiable need for more and more energy has been only exacerbated by the rapid development of countries during the Industrial Revolution towards the end of the nineteenth century, and the rise of automobility and suburbanization in the mid-twentieth century. Prior to this we were suppliant on the animal and plant complex and overall non-advanced solar generation. (Hubbert 5) It can be seen over the course of human history that we will often taken advantage of something for our own uses until it goes extinct due to our dominant, insatiable, needs. This has only grown in recent years do to development in the third world to promote first world standards of living in their own citizens in order to make their countries seem more “developed”. Just within the developing counties of China and Indian we have well over two and half billion people, bringing those citizens up to the current way first world citizens act would be disastrous to our planet. We must as a human species learn to progress beyond the use of non-renewable resources and work together to develop a clean and renewable energy trade that allows all humans to develop equally, while still maintaining the global economy without collapse.

## MAJOR SOURCES OF ENERGY AND WHO CONTROLS THEM

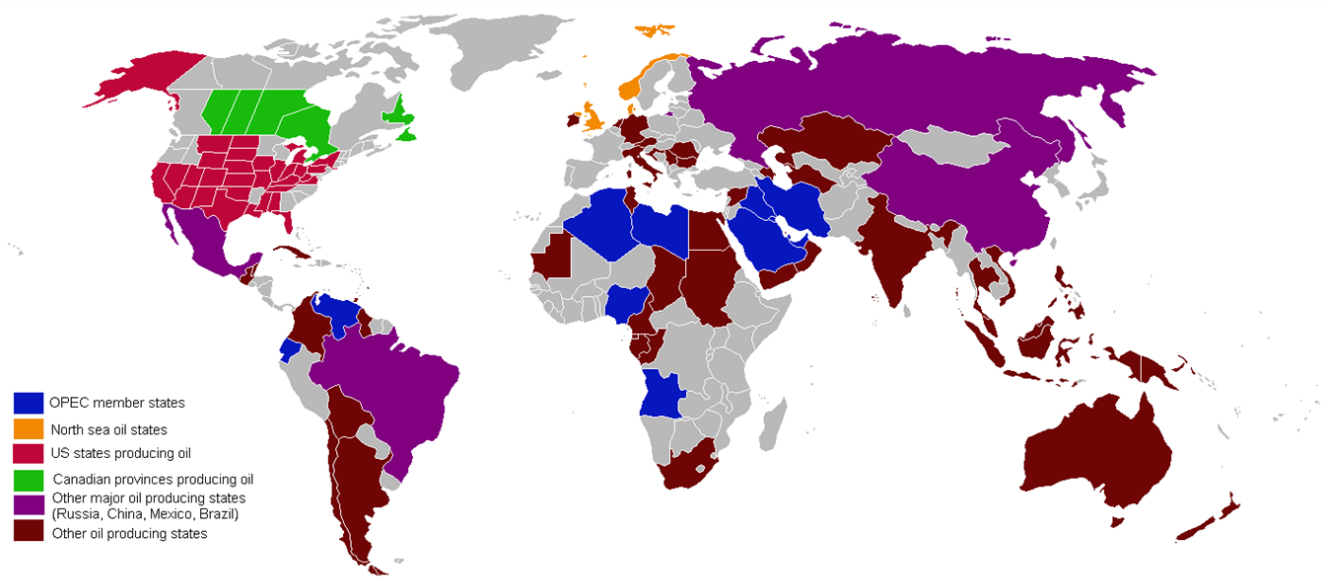
To be able to look towards the future, you must understand our present situation in the energy trade and how it affects the global power network. To look at this we must split our global leaders into renewable and non-renewable forms of energy. In terms of renewable these can be split into wind, hydroelectric, solar, biomass, geothermal, and tidal. Nuclear energy production can be considered renewable but there are many disastrous risks associated with this energy. Non-renewable sources are fossil fuels, coal, and natural gas. In 2008, the total energy consumption across the planet was 474 exajoules (Statistical). The potential of renewable energy lies with 1575 EJ for solar, 640 EJ for wind, 5000 EJ for geothermal, 276 EJ for biomass, 50 EJ for hydropower, and 1 EJ for tidal. (Johansson) Energy Use by power source is dominated by oil with 33.5%, followed by coal with 26.8%, Gas with 20.9%. Non-renewables make up a paltry 5.8% for nuclear, 2.2% Hydro, and 10.6% for other. (International Energy Agency)



The crude oil trade is often thought as the most common of these energy trades, as it often dominates the news headlines, controls most of our modern amenities, and we will even go into warfare to secure its supply. The United States is often considered, fluctuating with the growing China. The U.S. consumes almost 20 million barrels of petroleum per day, with nine million of that used for motor gasoline. With just five percent of the world's population, the U.S. is responsible for more than a quarter of annual global oil consumption (United States 1). However since petroleum is finite, since it is extracted from the decay of long dead animals, the idea of peak oil, or the point where we can no longer be able to produce the amount of oil needed to continue civilization will be reached. This idea was founded by M. King Hubbert in the mid 1950's as he used the idea of a bell curve to describe how finite resources react to human consumption, that everything eventually levels off and starts to fall in production, likened to the depletion of the ocean fisheries of cod in the North Sea. If current trends continue, Hubbert believed global oil production would be in the late 1990s. This trend was backed up by the National Academy of Sciences and high petroleum prices, saving Hubbert from criticism.



The largest producers of crude oil are Saudi Arabia with 333 Mt, Russia with 246 Mt, Nigeria with 129 Mt, Iran with 126 Mt, and the United Arab Emirates with 105 Mt. Saudi Arabia, Russia, and Nigeria accounts for 36% of oil exportation in 2011. Two of these countries are in the Middle East and you can see why the United States constantly tries to maintain a military presence there and continue a “peaceful” relationship with Saudi Arabia, since not only are the largest oil exporter, but they maintain influence over the politics of other Arabian Peninsula countries. You can clearly see the wealth involved in the oil trade with the rapid rise of Arabic economies such as the U.A.E. which over the past fifteen years has been able to fund massive land reclamation, massive skyscrapers, and the world’s largest shopping malls, all funded with state supported oil trade money. This is the most commonly traded energy source not only because it powers so much of our modern economy but also because it is only found in very certain pockets of the planet. Other Arabic countries also get wealthy off the transportation and refinement of oil since it passes through the Persian Gulf. Coal production, compared to the oil trade, is more domestic, used internally with countries.



The top coal producers are China with 3,576 Mt, the United States with 1,004 Mt, India with 586 Mt, Australia with 414 Mt, and Indonesia with 376 Mt. However in terms of coal exportations, Indonesia and Australia lead the pack with 29.7% and 27.4% of the global share respectively. Natural Gas, also a major export for countries is produced by Russia with 677 bcm, the U.S. with 651bcm, Canada with 160bcm, Qatar with 151bcm, and Iran with 149bcm.

Nonrenewable energy is the cheap and easy way to operate. It has been the world's driving power source for a long time. Clearly the world is too reliant on fossil fuels. If we continue our current rate of consumption we will be left to deal with the environmental implications, and possibly face a day in the not too distant future where supplies of fossil fuels have run out. For these reasons it is imperative that the world invest in renewable energy. The next section of this report will take an in-depth look at different sources of renewable energy, which states are using them and what how they will be used in the future.

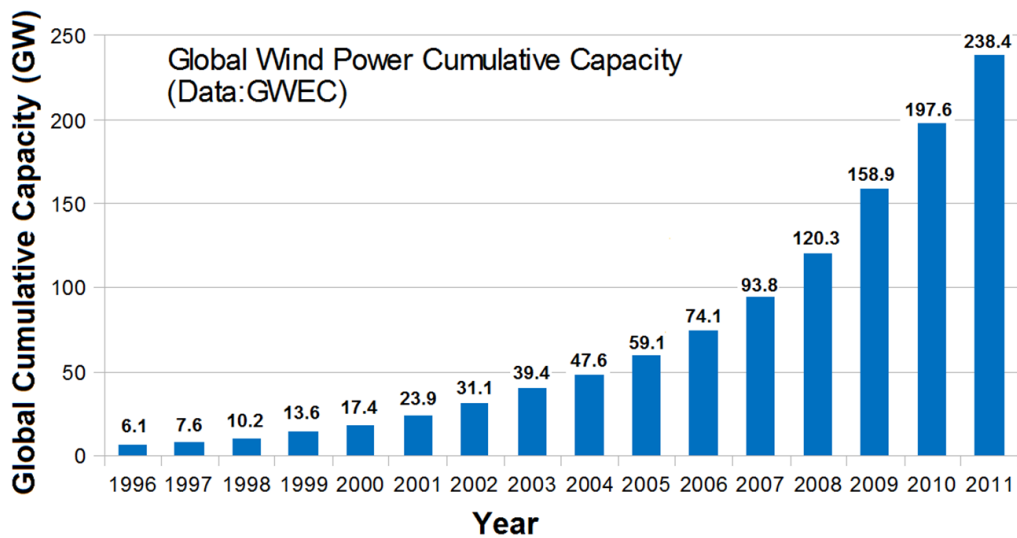
## RENEWABLE ENERGY AND ITS AFFECTS OF GLOBALIZATION

The ultimate goal of countries should be energy independence, which can be done through renewable energy common to that countries climate and topography. The most common types of renewable energy are nuclear energy, wind powered energy, hydroelectric power and solar energy. Renewable energy is a great thing but not always easily achievable. A country must have natural resources for the energy to be created, renewable energy generally has high initial cost and some types of renewable energy can be very destructive to the biomes that built on. This part of the report this look at what countries are major producers of renewable energy, the possible effects on globalization and international trade.

Wind power is when wind energy is converted in a useful form of energy such as electrical power. This is possible through large wind farms consisting of many wind turbines. Wind power is a great form of a renewable power because it is plentiful, can be put on land or in water and generally does not affect the ecosystem it's built in too poorly. Economically, wind farms have a somewhat high initial cost but generally only take a short while to break even. In the US it is estimated the wind industry generates thousands of jobs and billions of dollars in economic activity. [6] It can be assumed similar results occur in other countries who are investing in wind power.

Leading the world in wind power are the United States with 95.2TWh, China with 55.5TWh, Spain with 43.7, Germany with 36.5TWh, and India with 20.6TWh. [5] The United States produces about twenty eight percent of the global output of wind energy. Wind turbine energy production has made large inroads in Denmark where it picks up 21% of the country's energy. [7] It is also common in Portugal, Spain, Ireland, and Germany.



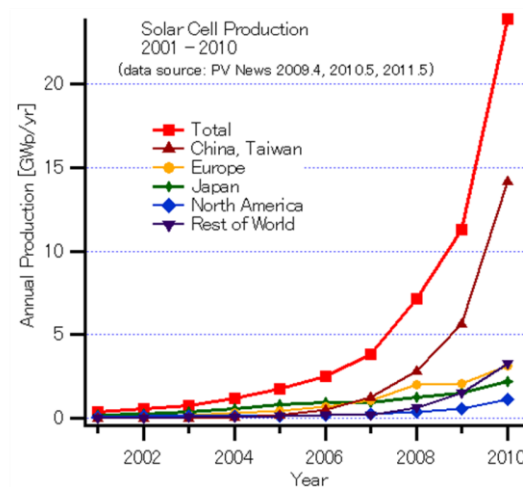


Hydroelectric power is the most widely used form of renewable energy. This is because the cost is quite low for the amount of power you get. Unlike wind farms, hydroelectric dams are much more difficult to have a large amount of because it takes a very specific water source in order to work properly. Many of these major hydroelectric dams are engineering feats as well, like the Hoover Dam, the Three Gorges Dam in China and the Itaipu Dam that expands across the Brazil and Paraguay border. The downside of hydropower is that the ecosystems where these stations are set up are greatly affected. China leads countries with hydroelectric energy with 625Twh, followed by Canada, Brazil, the United States, and Russia.

**Ten of the largest hydroelectric producers as at 2009.**<sup>[34][36]</sup>

Country	Annual hydroelectric production (TWh)	Installed capacity (GW)	Capacity factor	% of total capacity
China	652.05	196.79	0.37	22.25
Canada	369.5	88.974	0.59	61.12
Brazil	363.8	69.080	0.56	85.56
United States	250.6	79.511	0.42	5.74
Russia	167.0	45.000	0.42	17.64
Norway	140.5	27.528	0.49	98.25
India	115.6	33.600	0.43	15.80
Venezuela	85.96	14.622	0.67	69.20
Japan	69.2	27.229	0.37	7.21
Sweden	65.5	16.209	0.46	44.34

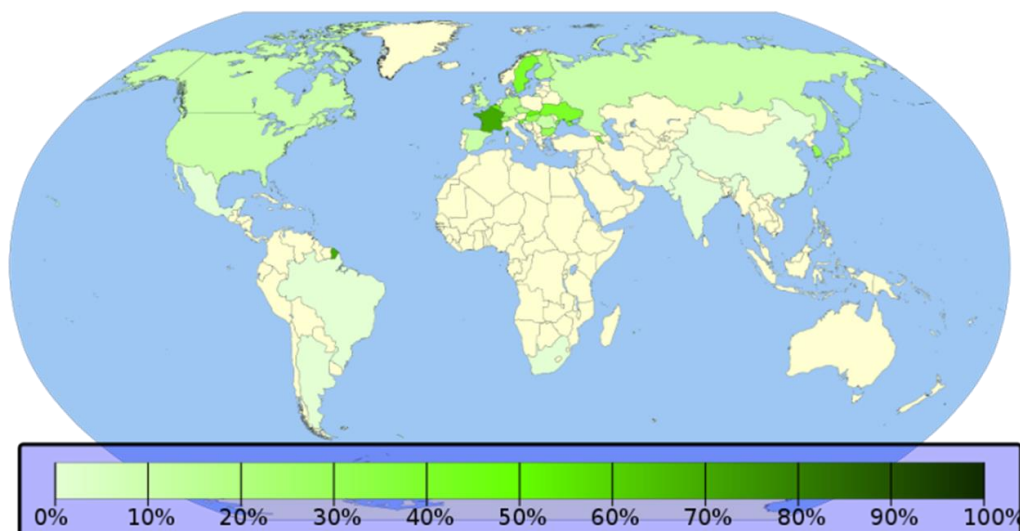
Solar power is when sunlight is converted into electricity. This done by using the sun's energy to boil water which is what is then used to provide power. Solar power has is tremendously available but due to the high installation cost not a large amount have been put into use. Although they are starting to become more popular as installation costs have been consistently declining. Solar panels have a pretty low effect on the environment they are placed in and produce a very small amount of greenhouse gases. As the costs continue to decline it is very likely that solar power will become much more popular and produce a large amount of renewable energy for states.



The most controversial of renewable energies is nuclear energy. There is still an ongoing debate whether nuclear energy can even be classified as renewable energy but for the purpose of this paper we will consider it so. Nuclear power plants produce energy through a process called nuclear fission which generates heat and electricity. Nuclear power plants produce a sizeable portion of the world's electricity, about 13%. [9] Nuclear power does not produce any greenhouse gases and although the economics are highly debated topic, many studies show that they are a financially solid investment. These plants due come with issues though. Their waste is

highly radioactive and takes thousands of years to fully decay. Also as we have seen very recently with the Fukushima disaster in Japan, nuclear accidents are a very real possibility. There are hundreds of operational nuclear power plants around the globe. France gets the vast majority of its power from nuclear power plants. Although nuclear power has strong advocates there uses will be less and less as years pass.

(This map shows what countries use nuclear power and what percentage of that power is nuclear.)



With these rapidly changing ideas in the renewable energy sector is it difficult to determine exactly what kind of affect it will have on globalization. One thing that is for certain is that there will be some change. For example if wind and solar power really begin to grow in usage in the U.S., there will be a solid gain in the employment rate and overall economic activity. This could also become a new export for the U.S. increasing its GDP. The same

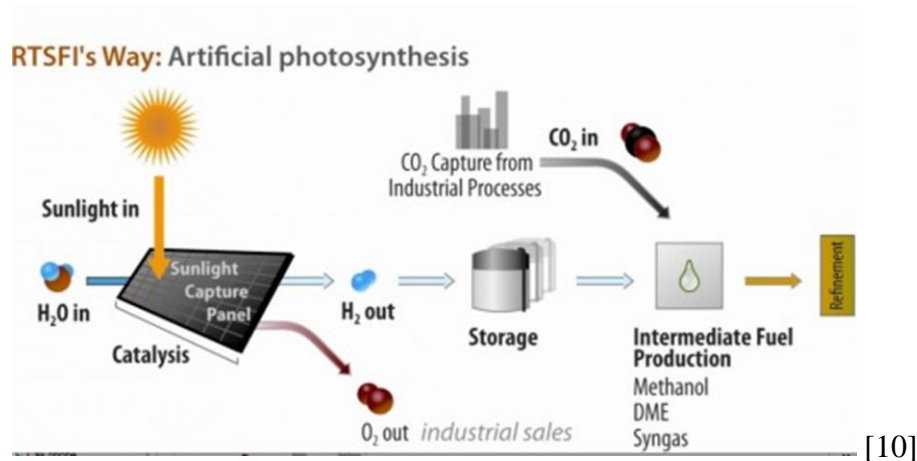
phenomenon could occur in just about any country that has the capability for strong renewable energy growth. Countries that will be hurt by gains in renewable energy will be the OPEC countries. For most of them almost all of their GDP is based off the oil they sell. Many of these countries are already quite poor and could be left behind because the leading economic countries would no longer need them.

Governments need to be involved in the process of renewable energy but it cannot solely fall on the government's shoulders. Kevin P. Kane, is an Oil & Gas analyst and cleantech business consultant living in South Korea. He argues that it will be up to large corporations to lead the charge in the push for renewable energy on a global scale. Kane believes that because companies can operate free of international borders, that joint ventures in fields involving renewable energy such as solar, wind, geothermal and hydroelectric power will lead to advances in renewable energy. Kane also argues that no country has all the resources to integrate fully to renewable energy, and that it will be up to companies that conduct business worldwide to work together to achieve these goals.

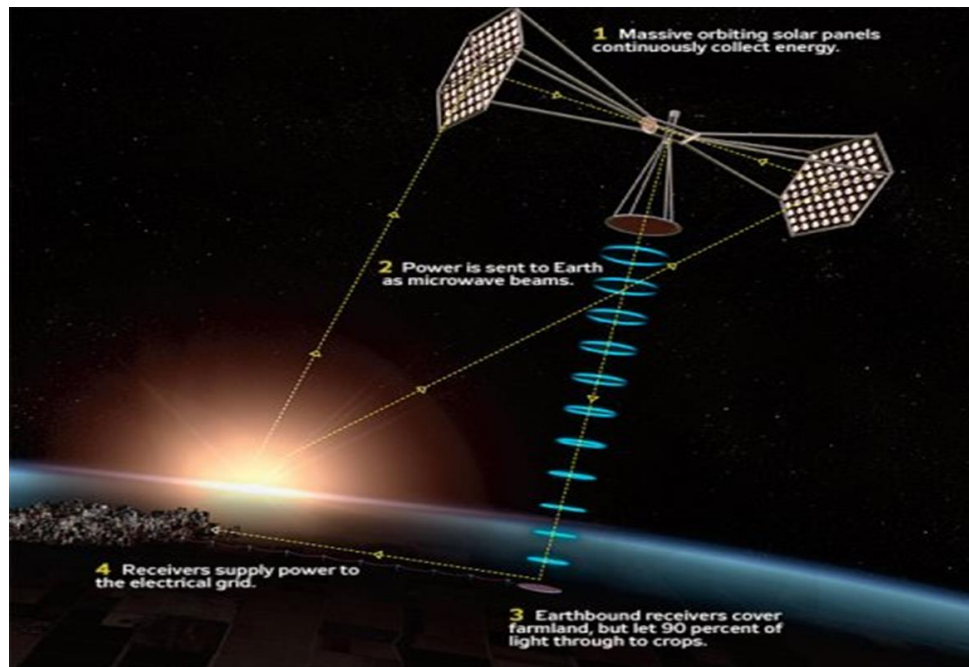
## FUTURE TECHNOLOGY

The way we get our renewable energy seems like common sense, especially because some of the practices have been around since the 1860's and even way before that. Truly harnessing that energy has been quite difficult. It takes a lot of science and engineering. In today's world we know how quickly technology can improve and evolve. Well there is no difference in the renewable energy sector. Companies have spent billions are trying to create the optimal way to harness renewable energy. The two future technologies that will be highlighted are still some years away from being possible but when they are completed they will change the world drastically.

The first of technology is called solar fuel. It is created with sunlight through artificial photosynthesis. It is very interesting that a process plants have been using for millions and millions of years could be our key to never needing fossil fuels again. That is the main objective for solar fuel, to be an alternative to fossil fuel. The most sought after solar fuel is hydrogen because it can be stored, transported and used later. This technology is still a few years away but there are several companies making huge strides in this technology. Solar fuel would not just relieve us from our dependence of fossil fuels but struggling countries with an abundant amount of sunlight would have a new trade.



The second future technology further expands on solar power. It is called space-based solar power. The goal of space-based solar power in laymen's terms is to have a solar panel field in space. There are two major reason why having solar panels in space is optimal. The first is that the panels would constantly be in sunlight, so they could always be creating energy. Secondly, solar panels on earth cannot harness all the possible power sunlight produces. This is because of how our atmosphere protects us from its power rays. But when located in space the solar panels would be able to yield a much higher percentage of this power. This technology is further away than solar fuel. This is because the technology to transport the energy from space back to earth is still being perfected.



Both of these technologies could have extremely positive outcomes for all of mankind. With solar fuel the earth would become less polluted, energy would be much less expensive and

more readily available to the world's population. Although the technologies are some time away from being operational it is something to be very excited about. With energy more readily available it is possible global conflicts between large nations would become something of the past. The root of many conflicts is over energy and dominance but with possibly an unlimited amount of energy countries would be able to run themselves much more effectively.

## THE STATE OF ENERGY IN THE NEAR FUTURE

It is very cool to look ahead into the future and see what it possibly holds. But to close out the report we will focus on technology already created and how it will shape the state of energy in the near future. We look take a look at wind, solar and nuclear power. A change in the way we produce and consume energy is not just the right thing to do. It is imperative for future global economic health, environmental health and positive relations between states.

As stated earlier wind energy is very eco-friendly and a solid financial investment. As prices of energy continue to rise, we will begin to see a large nationwide investment into wind energy. I believe that the people who are against wind energy because they think the turbines are ugly will drop that complaint when they see how much energy they can produce leading to lower costs for consumers. As for solar power initial costs have been consistently declining. Solar power can easily become the leader in renewable energy and may be soon with its increasing efficiency and lower costs. Nuclear power is going to steadily decline over the coming years. With major worries about nuclear accidents and nuclear waste citizens of states want their governments to move away from it. With the increasing efficiency and cost benefit seen in wind power and solar power states won't have a problem doing so.

In our near future we will see a great increase in renewable energy. It may only be because we have depleted resources so much we have to but in the long run renewable energy has the potential to go many great things. Many jobs will be created, economies will grow and some states that had little to grow their GDP will have news way to do that. Large implementation of renewable energy sources will not be easy or cheap but is necessary. If it is not done fossil fuels will become scarce and tension between states will tighten and tighten. Let's hope our political and business leaders make the correct investment.



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