

**Coal Production and Consumption within the United States and China:**

The Implementation and Study of Renewable Energy Sources

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### **Executive Summary**

The world's consumption of fossil fuels is increasing at a colossal rate due to progressions in overall human populations. With an increase in population size, comes a greater demand for the amount of energy that is needed to supply this world's growing economy as a whole. This paper illustrates the burning and production of coal specifically within the United States and China. Unfortunately, the burning and production of coal have incredibly detrimental effects on global warming and increased amounts of greenhouse gas emissions, along with the health of its surrounding citizens. This fact has been recognized world-wide and now individual countries are doing their part to 'clean up' in hopes of continuing production with a limited affect on global warming and climate change. New technologies in the field of renewable energy sources are being sought as a band-aid approach to the issue concerning global warming. Wind turbines and photovoltaic solar panels in particular are being implemented at an increasing rate world-wide in efforts to meet a certain percentage of energy needs. The question becomes whether or not energy production without the power of coal can support the increased demand of this world's increasing production rates.

### **Literature Review**

The mining of coal is a great asset to our nation's economy and gives us a sense of comfort with our ever growing national debt. "According to the latest report from the International Energy Agency (IEA), coal will remain by 2035 the dominant source of electricity in the world's largest economies and comprise 30% of global energy demand" (Popovich, 2012). That's up from 25% in 2000. "Put another way, coal demand is forecasted to grow 600,000 tons every day over the next five years. And when the IEA looks at anticipated generating capacity coming online by then, it finds coal will account for more than a third—far more than any other competing fuel" (Popovich, 2012). What the world seems to want more than ever is what the

Unites has (as a country) in abundance. “With the world’s leading coal reserves pegged at 488 billion short tons, US producers are in an enviable position”(Popovich, 2012).

The Appalachian Mountains, where coal is mined in four states within the United States (West Virginia, Virginia, Kentucky, and Tennessee) has some of the best efficiency burning coal. The Powder River Basin located in Colorado, Montana, and South Dakota where coal is mined has a lot more coal in general, but the coal that is there is not as efficient in energy emissions. In the Powder River Basin (PRB), surface mining is a technique that is used to extract the coal from the land, where in Appalachia; strip mining is implemented to extract the coal. “First mined in the 19<sup>th</sup> century, Appalachian coal dominated the US market for 100 years. But the game changed in the 1970’s, when mining operations started in the PRB, where coal seams are far thicker- up to 200 feet- and closer to the surface than anything in the East” (McQuaid, 2009). In order to really understand why residents do not want to mine for coal in these communities that rely heavily on the coal industry for their growth and existence, residents’ family histories should be explored. “It’s no accident that many Appalachian family cemeteries are on tops of mountains or other high ground. People wanted to be buried high so that floodwaters couldn’t reach them, ideally in graves facing east to catch the morning sun. In the past, mountaintops represented safety. Today they represent easy access to coal” (McGlynn, 2012). The remains of these deceased humans are being ripped from the ground and pushed over the sides of the hills into the lower valleys. “So far, 2,000 miles of the region’s valleys have been filled in; by the end of the decade, it’s estimated, 1.4 million acres of land will be affected” (McGlynn, 2012). Making the land uninhabitable is only one consequence of destroying it to pick it clean of coal. Releasing particulates into the air and poisons into the water leads to a variety of illnesses. A 2011 West Virginia University study shows that communities near

mountaintop-removal (MTR) sites have a cancer rate double that of more distant towns. On top of all that, MTR mining is destroying the people of Appalachia's connection to their history.

“Most of the cemeteries here predate the arrival of the coal companies; some were established before the founding of the country” (McGlynn, 2012). It's not just the economic grasp it has on the place, but also the mental grasp it has on the people. That is one of the most horrible ways that the coal industry is ruining the beauty of Appalachia. Appalachia is also the second most bio-diverse area in the entire world, second to only the Amazon rainforest. There is no consideration for families who call these areas home and the coal companies are very unconcerned for the people's safety that reside below these mountain tops. One cannot blame the major corporations for not considering the health of its citizens, mostly due to the lack of effort that is input from the government.

Zullig (2009) performed a study that examined the health-related quality of life of residents in mountaintop mining counties of Appalachia. The study showed: “Residents of mountaintop mining (MTM) counties reported significantly more days of poor physical, mental, and activity limitation and poorer self-rated health compared with the other county groupings. MTM areas are also associated with the greatest reductions in health-related quality of life even when compared with counties with other forms of coal mining. Results were generally consistent in separate analyses by gender and age” (Zullig, 2009) Public health concerns are one important aspect of MTR, but environmental impacts on a large scale are quite possibly one of the leading causes of the unhealthy conditions.

Trees are clear-cut, and explosives and massive machines are used to remove earth and access coal seams from the top down. Mining waste, or “Spoil,” is dumped into valleys. The landscape changes produced by MTR mining and valley fills can increase the risk of flash

flooding. These valley fills are smoothed, terraced, and replanted. The native species which usually inhabit these areas are often slow to recolonize this disturbed land and planted trees may perform poorly in their growth rates. Holzman (2011) states that: “The practice of MTR coal mining has been carried out on at least 500 Appalachian peaks. MTR is controversial for its environmental impacts: “Spoil” which is the earth and rock dislodged by mining, is deposited in the valleys of this hilly and steep terrain, by some estimates, burying almost 2,000 miles of headwater streams that ultimately feed the Mississippi river. “Slurry”, the residue from cleaning the coal, is impounded in ponds or injected into abandoned underground mine shafts, where it can leach potentially toxic constituents such as arsenic, lead, manganese, iron, sodium, strontium, and sulfate that ultimately may end up in the ground water.” Holzman also explains that “Geology and the impact that mining has on that geology guarantee that contaminated water will move out of the mine voids.” He adds, “I don’t think that the industry is even saying that the slurry doesn’t migrate out of the underground mines in which it is placed—their just saying it doesn’t hurt anyone.” With this being said, Carl Werntz, an associate professor in the Department of Community Medicine at West Virginia University believes that “Coal slurry has impacted at least one, and probably two communities in West Virginia where it was injected in such a way that the drinking water was contaminated. People exposed to the water in their homes, both from consumption and showering, get what he calls ‘slurry syndrome,’ a mixture of diarrhea, rash, some changes in their teeth, and increasing frequency of kidney stones.”(Holzman, 2011) Fortunately, most of these symptoms went away after they got municipal water in the area. Another potential hazard from mining and processing the coal in Appalachia is coal dust. The coal is crushed or pulverized, and that releases particulate matter into the air. Residents from the town of Sylvester, West Virginia claim that when a large coal

processing plant was established in the town, the air quality sharply depleted. They claim also that they would have to wipe coal dust off their furniture every day. Impacts from coal dust exposure can lead to cardiovascular and lung disease, and possibly cancer.

The Clean Water Act specifies that streams must be suitable for designated uses which include recreation, consumption of fish by humans, and protection of the health of aquatic life. Health studies that have been conducted in Appalachia have revealed direct and indirect links to MTR mining. For starters, Gregory J. Pond, an environmental biologist with EPA Region 3 in Wheeling, showed that “More than 90% of 27 Appalachian streams below valley fill sites were impaired as per Clean Water Act standards, while none of 10 streams sampled in nonmined valleys were impaired.”(Holzman, 2011) “To determine whether the streams were healthy, Pond and colleagues monitored benthic macro invertebrates which are insects and other invertebrates that are visible to the naked eye and live on the bottom of streams. These organisms respond predictably to stressors, and they “are the best indicator of stream health,” says Pond, noting that they have been used as such for more than a century.” It turns out that in those places where the mining density is highest, the benthic communities are in the worst shape and this can be a direct warning for public health. This impairment of streams was also found to be directly correlated with human cancer mortality rates in surrounding areas. Holzman finally concludes that “Other studies are making a more direct case for human health effects attributable to MTR mining. In 2011, three new studies showed strong associations between MTR mining and increased cardiovascular disease, increased frequency of birth defects, and reduced quality of life” (Holzman, 2011).

When it comes to the Powder River Basin (PRB) the region accounts for nearly 40% of all coal mined in the US, out producing Appalachia. Its Black Thunder Mine alone brings more

coal to market than all states except Wyoming, West Virginia, and Kentucky. “According to the US Geological Survey, the Gillette field, a single division within the PRB, has about 77 billion tons of recoverable coal. It would take the US almost a century to burn all that coal—but China could eat through it in 25 years or less” (Frick-Wright, 2011). The coal in the PRB is low grade, providing only two-thirds as much energy per pound as Appalachian fuel.

A small town by the name of Colstrip sits at the northern edge of the PRB and within this town; there is a coal burning factory. “When the coal is burned at Colstrip, one of two things happens to the sodium, thallium, mercury, boron, aluminum, and arsenic it contains: Either they are spread far and wide in the air, or they are trapped by scrubbers in the smokestacks and then dumped with coal ash into giant settling ponds—shallow artificial lakes of concentrated toxicity, which are prone to rupturing and leach positions into wells and aquifers. Colstrip’s toxic coal ash ponds are rated among the most hazardous in the nation.”(Bass, 2010)

China is currently the leading importer of US coal and has won international plaudits for its commitment to green goals. “It has pledged to reduce carbon emissions by at least 40% per economic unit by 2020 and is also adding alternative energy sources such as wind farms and nuclear power plants faster than any other country” (Biello, 2011). But the nation is also in the midst of extraordinary economic growth and an unparalleled surge in the use of energy, which for China means coal. “The country burns more coal than the US, Europe and Japan combined, the main reason why it is now the world’s largest emitter of greenhouse gasses” (Biello, 2011). China is seeing the impact which they burn coal by physical appearance to the atmosphere and the air in which their citizens breathe. Their main claim is that the US was allowed to develop for years to become a booming economy and has showed negative environmental effects and now China wants their chance to develop. The fact that they understand the negative effects of

burning coal is a good start to this negotiation, but China will not budge until they are developed. “In a bid to reduce the country’s reliance on coal, the National Development and Reform Commission (NDRC) has mandated that power companies generate at least 8% of their electricity from so-called new energy—such as nuclear power plants or wind turbines. But the wind is unreliable: in some provinces, it blows strongest in fall and winter, exactly when coal-fired power plants are most needed for their other output: heat.”(Biello, 2011)

China’s commitment to renewable energy is certainly real. “The current national five-year plan calls for wind, solar, biogas and water power to account for 10% of the country’s energy consumption by 2010 (up from 7.5% in 2005) and 15% by 2020”(Biello, 2011). According to Chinese Wind Energy Association, the country now has 158 wind farms. China has the largest wind resources in the world, and three quarters of them are offshore. Offshore wind farms are very dangerous to construct and maintain and even though wind is expanding, China is so power-hungry that turbines can meet only .6% of their energy demand. Despite all the wind turbines and solar panels, China is building new coal plants like there’s no tomorrow. China currently burns more than 3 billion tons of coal per year, which is half the total consumed world-wide.

### **Case Study # 1**

## **China and their Efforts to Shy Away from Coal**

“As of 1990, global CO<sub>2</sub> emissions were approximately 5.7Gt Carbon or 21Gt CO<sub>2</sub>. As of 2010, the amount of global CO<sub>2</sub> emissions rose to approximately 8.4Gt Carbon or 31Gt CO<sub>2</sub>, which is a 43% increase over a 20 year period” (Biello, 2011) China has promised to curb their CO<sub>2</sub> emissions by 2020 and has also won international recognition for its commitments to green



goals. China has pledged to reduce carbon emissions by at least 40 percent per economic unit by 2020 and is also adding alternative energy sources such as wind farms and nuclear power plants faster than any other country. The nation is also in the midst of remarkable economic growth and along with growth, comes a larger demand for energy, which for China means coal. “China burns more coal than the U.S., Europe, and Japan combined, which is in large part the reason behind China being the world’s largest emitter of greenhouse gases” (Biello, 2011). China is currently continuing to build massive coal plants that will be pumping out greenhouse gasses decades from now, and the technology which is available to help capture carbon dioxide at coal-fired power plants is simply too expensive to add. “On average, China opens one coal-fired power plant every week to serve its 1.3 billion people and the massive industries that manufacture cheap goods, largely for the U.S. and Europe” (Biello, 2008) In China, growth is winning out over any push to go green and the question really becomes will China’s carbon dioxide emissions overwhelm the world?

China will always have the argument of only having developed their country for about three decades, whereas the U.S. has been able to develop for a much longer period of time. China is now starting to feel the pressure of having to clean up their emissions and practices but say that it’s unfair to not be able to develop like the U.S. once did. In 2008, China surpassed the U.S. as the world’s largest emitter of greenhouse gases, which is largely blamed on coal. “The dirty black rock is burned everywhere, from industrial boilers to home stoves, and generates 75% of the nation’s electricity.” (Biello, 2008) China plans to reduce pollutants to as much as 10 percent over the next five years, and part of the plan includes creating carbon neutral cities and expanding renewable energy sources. Much of China’s strategy is simply to shut down smaller, inefficient coal burning plants and replace them with larger plants that run more efficiently. This

seems to be a rather positive idea, but the amount of coal being burned will still be in massive quantities with little to no technological improvements on capturing carbon dioxide emissions. In order to capture these emissions, coal needs to be turned into a gas before it is burned and the cost of doing so is no cheaper than nuclear power.

More than 4,000 Chinese miners die every year in efforts to recover this fossil fuel from the ground within China's heartlands, and imports of coal continue to rise despite the extensive domestic mining. "China brings in about 150 million tons of coal a year but burns more than 3 billion, and demand for foreign coal is likely to grow (Biello, 2008). Nationally, healthcare associated with respiratory illnesses from coal cost China and estimated \$100 billion annually according to the World Bank. One consequence of China's reliance on coal is most visible in the air. "Smog cloaks cities, reducing the sky to little more than a blue patch amid a blanket of haze. As the pollution builds, it creates a brown cloud, visible from space, which in a week's time crosses the Pacific Ocean to the Western U.S., where it accounts for as much as 15 percent of the air pollution in the United States." (Biello, 2008) This foul air can literally stunt the growth of China's next generation along with many other health problems related with the burning of coal in the atmosphere. When considering the future of your country and generations to come, one would think the importance of air quality would be among the top of all lists to consider for future outcomes. One of the most immense contributors to reducing China's reliance on global carbon dioxide emissions is to reduce the burning of fossil fuels such as coal. In order for China and other countries to accomplish this goal, much research and technological improvement will need to be centered on renewable energies.

China's commitment to renewable energy is certainly real. "The current national five year plan calls for wind, solar, biogas and water power to account for ten percent of China's

energy consumption by 2010 (up from 7.5 percent in 2005) and 15 percent by 2020” (Biello, 2011). In 2009, China’s main source of power was from coal at an astonishing 70 percent, oil made up 20 percent and natural gas used only three percent. Hydroelectric power accounted for about six percent and the rest of their energy of less than one percent was from other forms of renewable energy (Institute for Energy Research, 2009). “The most optimistic projections have wind accounting for less than three percent of China’s total energy production by the year 2020.”(Biello, 2008) Foreign companies usually see to the construction and establishments of these wind farms in China, but almost 70 percent of the components of wind mills are manufactured within China currently (Institute for Energy Research, 2009). According to the Chinese Wind Energy Association (CWEA) China now has 158 wind farms which are the most in any country within the globe currently. One major issue of concern is that all of the good wind farm locations have already been secured by the major energy companies within China, which makes other prospects begin to develop their search for wind on offshore sites. Off shore sites become dangerous and unstable when they are constructed too cheap and in a short period of time. China is said to have the largest wind resources in the world, but unfortunately three quarters of them are located offshore. There is no doubt that China is taking the proper actions to becoming a more renewable energy based society, but the fact of the matter is there is still too immense of a reliance on coal as an energy source.

China is also the number one producer of solar photovoltaic panels. “More than 200 manufacturers constructed 1,700 megawatts of panels in 2007 according to the Chinese Renewable Energy Industries Association” (Institute for Energy Research, 2009). Manufacturing these panels is a positive impact for the entire world to endure, but China seems to have one of the largest problems with Carbon emissions currently, and nearly all of these

panels were made for export. The reasoning for this is due to the fact that photovoltaic technologies are too expensive to establish and run. Solar and wind energy sources are significantly more expensive than simply burning coal. Cleaning photovoltaic panels from dust in China's desert is very difficult and expensive as well because water is used to free them from dust that builds up on their flat surfaces which in turn makes them less efficient when covered in dust. As we all know, water in any desert can be difficult to find, and can cause more problems when water needs to be pumped from underground storage. One of the main reasons for constructing solar panels in China is to help single homes with their hot water heaters, which is less than a drop in the bucket when considering China's energy uses. "China also erected the world's largest dam in 2006 which provides enough power to be compared to 20 large coal fired power plants without the emissions of greenhouse gasses. The dam also raised water levels in the Yangtze River by approximately 60 feet, which also helped to improve commercial shipping in the area" (Biello, 2011). Even with the considerable efforts taken to develop wind and solar power in China, hydroelectric dams are the cleanest, cheapest forms of energy in China accounting for 16 percent of total electricity generation in 2009 (Institute for Energy Research, 2009). As history shows, with the damming of these vast and scenic gorges comes controversy and despair to many individuals who call these places home. These human and environmental costs cause many headaches for citizens and governmental officials within China, but also take the place of health issues when concerning the air that is consumed by humans.

China invested \$45.5 billion in wind power and solar energy in 2011 alone (Biello, 2011) and the falling prices of solar power and wind energy technologies in 2011 allowed for more products while spending the same amount of money. "In 2011, the Chinese government spent \$1.6 billion on research and clean energy development. China has the capacity to generate 133

gigawatts of clean energy, accounting for 26 percent of the world's total. China also intends to stay among the world leaders in installing 160Gw of wind power and 50Gw of solar power by 2020" (Biello, 2011). All of these factors make China look like they are really taking positive steps toward the right direction in decreasing their ecological footprint when considering carbon and greenhouse gas emissions. China's efforts to do so will pave the way for other countries to develop more renewable energy practices as well through their research and experimentation. Coal is still being burned and used as 70 percent of China's energy resources and will continue to be for decades to come due to the tardy establishment of China's major factories. China will eventually run out of coal on their homeland and will look toward the U.S. for exports in order to continue to run their new facilities. The question will soon become when the U.S. cuts off the supply which is causing the global atmosphere to deteriorate at an ever growing rate. Then the answer we should really be looking for is how to save the energy that is produced, because what the world doesn't use goes to waste every single day, and new energy must be created to power the world's selfish lifestyles.

## Case Study #2

### **The Future of Coal Mining in the United States**

Beginning in the 1990's, there has been a new advancement in which the coal industry of the United States has harvested this black rock from mountains. Coal companies have pulverized Appalachian mountaintops in West Virginia, Kentucky, Virginia and Tennessee. These peaks that formed some hundreds of millions of years ago are demolished in just a few months time. Forests that survived the last ice age are being chopped down and burned. "The Environmental Protection Agency estimates that by 2012, two decades of mountaintop removal

will have destroyed or degraded 11.5 percent of the forests in those four states, an area larger than Delaware. Rubble and waste will have buried more than 1,000 miles of streams. More than 500 mountains and 1.2 million acres of hardwood forests have been destroyed in the United States by mountaintop removal” (McQuaid, 2009). The demand for coal has been rising quickly due to high oil prices, and the increase of energy consuming lifestyles within the United States, China and India. “The price of Appalachian coal nearly tripled in 2006 and United States coal exports increased by 19 percent in 2007 and increased by 43 percent again in 2008” (McQuaid, 2009). There are more kinds of organisms living in the southern Appalachians than any other forest ecosystem in the world. Appalachia is the second most bio-diverse area in the entire world, second only to the Amazon Rainforest. To think that this entire ecosystem has been destroyed to mine coal is considerably appalling.

First mined in the 19<sup>th</sup> century, Appalachian coal dominated the United States’ market for 100 years. Coal mining changed in the 1970s, when mining operations started in Wyoming’s Powder River Basin where coal seams are far thicker (up to 200 feet) and closer to the surface than the Appalachian Mountains. Instead of tapping into the sides of mountains, the world’s largest movable industrial equipment is used to scrape the surface of the earth in efforts to recover the coal. “In 2006 the United States produced 1.16 billion tons of coal, 70 percent of which came from surface mining” (Kramer, 2010). The coal located in the Powder River Basin is of lower grade than that of Appalachia, providing only two-thirds as much energy per pound as Appalachian fuel. “The Powder River Basin region accounts for nearly 40 percent of all coal mined in the United States, out producing Appalachia. The Black Thunder Mine (largest single surface coal mine in the world located in Wyoming) alone brings more coal to market than all states except Wyoming, West Virginia and Kentucky” (McGlynn, 2012). The biggest difference

between Appalachian and Powder River basin mining techniques is the affect it has on the environment. Wyoming's open pit coal mines are not visibly pleasing much like the destruction of mountain tops, but their remote locations in arid regions have less of an impact on people and wildlife.

With a higher concentration of people and wildlife surrounding the hills of Appalachia, one would think more is being done to consider the health and responsiveness of these individuals. Mountaintop mining waste contains chemical compounds that otherwise would remain sealed up in coal and rock. "Rainwater falling on a valley fill becomes enriched with heavy metals such as lead, aluminum, chromium, manganese and selenium" (McQuaid, 2009). Research is finding that only approximately 35 percent of reclaimed mine land can support fish and wildlife. For the most part, coal companies construct filtration holding ponds to capture sediments and valley fill runoff. Unfortunately the water that sometimes flows out of these ponds isn't healthy and some metals inevitably end up flowing downstream and contaminate the water resources. Scientists and community groups are concerned about the possible effects of coal removal waste. "Ben Stout, the biologist, says he has found barium and arsenic in slurry from mining sites in West Virginia at concentrations that nearly qualify as hazardous waste" (Kramer, 2010). These high levels of metals and arsenic are obviously not going to affect the natural environment and wildlife in positive ways, but what about the people who reside close to these areas? Research studies have found that significant increases in deaths for chronic lung, heart and kidney disease as well as lung and digestive system cancers are all elevated in areas close to mining sites. "A 2011 West Virginia University study shows that communities near mountaintop removal sites have a cancer rate double that of more distant towns"(McGlynn, 2012). Residents in mountaintop mining communities endure more days of poor physical,

mental, and activity limitation than any other surrounding regions. Mountaintop mining areas are associated with the greatest reductions in health-related quality of life even when compared to regions with other forms of coal mining. One way to stray away from these environmental devastations toward wildlife and humans is to obviously reduce the reliance on fossil fuels and become more dependent on renewable energies within the United States.

Fine-particle pollution from coal-fired power plants causes multitudes of premature deaths every year in the United States. “The most recent estimation on the number of coal burning power plants is 580, which has fallen from 594 plants in 2009 and an astonishing 645 plants in 2001. 40 percent of the United States’ energy comes from coal, 37 percent comes from petroleum, 25 percent is used from natural gas, 9 percent nuclear, which leaves only 8 percent of the power used from renewable energies” (Truths and Fiction, 2011). “The United States currently produces 23.3 percent of the world’s coal consumption for electricity” (Kramer, 2010). Coal’s share in power production has fallen due to major increases in production from natural gas and smaller increases from nuclear and renewable. “In 2011, \$48.1 billion went into clean energy in the United States, a 44 percent increase from 2010, making it the country where the most money was put toward renewable energy in 2011” (McGlynn, 2012). When you take a look at the 8 percent of renewable energies the United States produces, it can be broken down into five different categories. “The use of biomass fuels in the United States accounts for 53 percent of the renewable energy sources nationally” (Truths and Fiction, 2011). There are many different forms of biomass which can be converted into energy, but of the most common are plant materials, vegetable oils, and treated municipal and industrial wastes. Hydroelectric, which is the conversion of energy from running water (dams) accounts for 31 percent (Truths and Fiction, 2011) of the United States’ renewable energies. Wind powered turbines create 12



percent (Truths and Fiction, 2011) of the nation's renewable energy resources, followed by solar at one percent. Geothermal energy derived from the heat at the interior of the earth also makes up three percent of the United States' renewable energies. "In all, hydroelectricity accounts for seven percent of the nation's energy, followed by wind power at .9 percent and solar power is even less of a percentage than wind" (Truths and Fiction, 2011). "In 2010, the United States' wind capacity grew by ten percent and areas with good wind resources have the potential to supply 20 percent of the nation's electricity consumption by 2030" (Kramer, 2010). Solar powered systems would only have to cover less than a percent of the United States total land mass and could supply the entire country with their energy needs. The biggest issue at this point in time is the cost of the components of these solar energy systems and the nation just doesn't have the funding to support this idea.

With the multi-million dollar investments made for research and implementations of renewable energy resources in the United States every year, one would think the world's carbon and greenhouse gas emission crisis would be nearing an end. In fact, the world's dependency on coal and fossil fuels is still increasing due to the higher demand for electricity and elevated human populations in general. Keep in mind the United States is not alone in the burning of coal to create energy, but with the amount of technological advancements and funding they have in comparison to other countries, one would think the United States should be paving the way for a greener future. As a nation, the United States has been developing for a much longer period of time than just about any other country in the entire world. Which means, the mark in which the United States has left on this world already has been far greater than the rest of its competition when considering greenhouse gas emissions. For the United States to claim they have done more

than any other country to turn this mess around is certainly unfair when considering past footprints that have been left behind for the rest of the world to suffer through.

## Critique

### **United States and China Renewable Energies Critique**

The World Bank shows that in 2011, China spent \$45.5 billion on renewable energy construction, a close second to the United States who spent \$48.1 billion. To say this is a close to equal comparison in some manner is relatively correct when considering China spent another \$1.6 billion on researching renewable energies alone in 2011 (Popovich, 2012). With regards to increased expenditures in renewable energy construction, the United States increased their spending from 2010 by 44 percent, where China spent the exact same on renewable energy construction in 2011 as in 2010. (Frick-Wright, 2011) The amount of money which is spent on continuing to progress as an individual country is definitely a positive outlook on renewable energy and the dependency from fossil fuels. One negative aspect where China falls short of the United States is the continuation of constructing more coal fired power plants. “In 2001, the United States had a powerful 645 coal fired power plants, but by 2009, that number decreased to 594 and is currently standing in the neighborhood of 580” (Frick-Wright, 2011). China is currently, on average, opening one coal fired power plant in their country every single week. For the rest of the world this is a scary sense of comfort considering the fact that China also currently burns more coal than the United States, Europe and Japan combined. China is currently at the top of the leader board when considering coal consumption with 28.7 percent (Kramer, 2010) of the world’s coal being burned and is continuing to rise at an increasing rate to try and keep pace with their growing economy. The United States is in a close second with 23.3 (Kramer, 2010) percent of the world’s consumption of coal, but is on a downfall with burning less coal every

year. “According to the U.S. Geological Survey, the Gillette field, a single division within the Powder River Basin, has about 77 billion tons of recoverable coal. It would take the United States almost a century to burn through all that coal, but China could eat through it in 25 years or less.” (Frick-Wright, 2011)

On the part of the United States, the Chinese point to a major double standard of sorts in the fact that they have only been able to develop their country for about three decades, where the United States has been developing for much longer. This is truly unfair for the Chinese, and they really feel the pressure for having to clean the air quality from their emitting of coal and the particles which are released into the atmosphere. This is in large part the reason for China becoming the world’s largest renewable energy emitter, but to be quite honest, China is in no hurry to slow down their energy created by the burning of coal. “According to the latest report from the International Energy Agency (IEA), coal will remain by 2035 the dominant source of electricity in the world’s largest economies and comprise 30 percent of global energy demand. That’s up from 25 percent in 2000. Put another way, coal demand is forecasted to grow by 600,000 tons every day over the next five years.” (Popovich, 2012) The future of this world will need to depend on coal as a major source of energy in order for every country to be pleased with their amount of international progress. The only question will be is how long this world can withstand the beating these power plants are emitting into the atmosphere which is deteriorating the ozone later at increasing rates. With the increase in human populations, more jobs will be needed in order for economies to maintain stability and with increasing work demand comes increasing facilities to work within. The power that generates these massive facilities will undoubtedly need to come from coal in the near future, even with the increasing amount of renewable energies which will continue to be constructed.

China is already running into dead ends with most of their good wind farm locations being owned by the largest energy companies. China is now beginning to look offshore for sites to construct more turbines, which has proven to be unsafe in past experiences. Placing turbines in deep water has proved to be treacherous in the past due to China's typhoon season, but the damage was blamed on poorly designed structures. In order to build stable structures to adhere to high winds offshore, the cost of materials alone would hardly be worth the effort of placing these turbines in the ocean. This is of major concern due to the fact that China is home to the largest wind resources in the world. Once the realization of lack of space to place turbines hit home, other renewable resources will be sought after. Hydroelectric power is the leader in renewable energy currently in the United States and China. The amount of effort and headaches created from gaining compliance to dam these gorges is a battle all of its own and is incredibly time consuming. A major renewable technology to look into is the solar voltaic systems that are often used to power facilities. If the United States was to cover a measly .4 percent (Popovich, 2012) of their land mass with these photovoltaic structures, the amount of energy would be enough to satisfy the entire United States with their energy needs. Solar photovoltaic structures are also incredibly expensive to produce and even more expensive to maintain. In China there is a major solar facility which is currently being researched and every day needs to be cleaned from dust that sticks to the flat panels which make up its surface. This site has been strategically placed in the desert where the sun is more intense and most likely to shine on a regular basis. The only way to clean these panels is by spraying water on them which is pumped from underground. As we all know, water is already extremely limited in the desert, and to pump from underground aquifers to clean solar panels is diminishing a more important resource than energy, water.

The race between China and the United States for sole ownership of amounts of renewable energies is rather pointless when considering the amount of coal which is burned. The United States has had much more time to develop renewable resources and yet China is the world's leading producer of most components of renewable energy facilities. These two energy powerhouses should be more concerned with cleaning up their coal emissions and less concerned with creating more renewable energies. In order for any of this to work, many policies must be changed and that is not likely to take affect for many years either.

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