Combating Global Warming by Aiding Zero-Carbon Energy Implementation

There is no debate that global temperatures have been rising ever since the industrial revolution. There is also no debate that burning fossil fuels to generate power emits lots of carbon dioxide. In the US, most of our carbon dioxide emissions come from burning fossil fuels to generate electricity in power plants. In order to slow the increasing greenhouse effect, we have been various implementing types of power plants (such as natural gas) that are lessening the amounts of CO_2 emitted. However, this is only slowing down the advance of global warming. In order to stop it and possibly even reverse it, a great first step would be to implement zero-carbon energy sources (such as wave, wind, and nuclear power). However, since zero-carbon energy sources are so young and under-funded, they cost much more to implement and operate than coal plants, and nobody wants to pay more for zero-carbon energy when they can get the same product for cheaper through coal. This is why,if we ever hope to significantly slow or stop global warming, the US government needs to begin implementing a grant, subsidy, or tax credit system to make zero-carbon energy a more economically feasible alternative to coal.

Today, coal power plants account for about ½ of all electricity production in the United States (the rest comes from a combination of hydroelectric dams, natural gas power plants, nuclear power, and a smattering of renewable energy sources). The reason for having so many coal power plants is because the United States has enough coal to last us for an estimated 240 years at current electricity consumption levels, and it is cheap to mine and burn to generate electricity ("Coal power plants:," 2010). However, it is a well known fact that coal power plants release large amounts of carbon dioxide – a major contributor to global warming. In fact, electricity generation is responsible for about one third of all the carbon dioxide produced in the United States, and over 70% of this is from fossil fuel based power plants ("Coal power plants:," 2010). Figure 1 demonstrates how the total amount of greenhouse gasses produced by commercial electricity production compares to other major economic sources of greenhouse gasses in the United States.

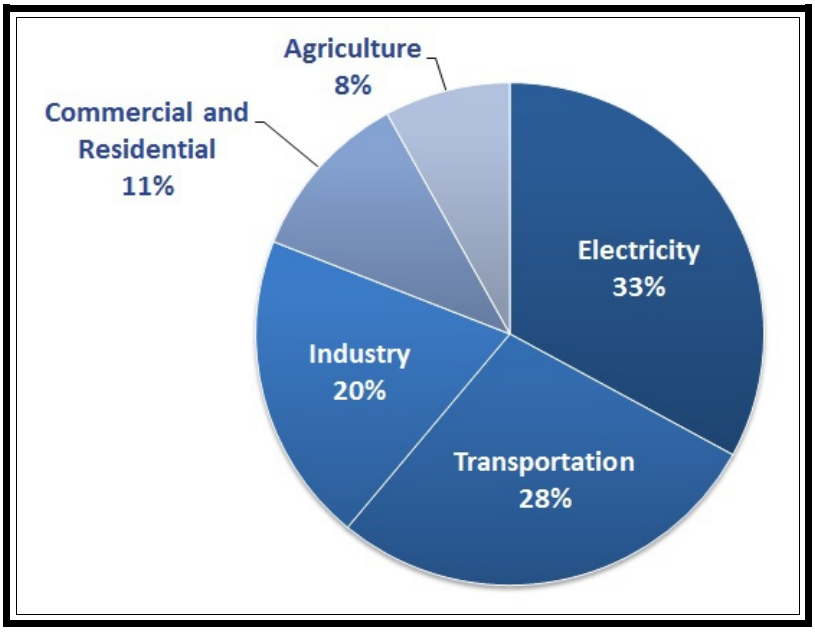

Figure 1: Total U.S. Greenhouse Emissions by Source
According to the EPA, in 2011, the commercial Electricity industry accounted for 33% of the total greenhouse gas emissions in the United States. ("Sources of greenhouse," 2011)

While carbon dioxide is the most prominent greenhouse gas created during fossil fuel combustion, it is by no means the only one. Most forms of fossil fuel combustion also create methane (CH_4) and Nitrous Oxide (N_20), which are also strong greenhouse gasses. However, much less of these gasses are emitted than carbon dioxide, as evidenced in Figure 2. This figure shows us how many million metric tons of CO_2 equivalent (the amount of CO_2 that it would take to have the same greenhouse effect as something else) were emitted by various economic sources of greenhouse gasses from 1990 to 2011. In most cases, it appears that methane and nitrous oxide account for about 2% or less of the greenhouse effect produced by most fossil fuel combustion.

End-Use Sector	1990	2005	2007	2008	2009	2010	2011
Electricity Generation	**1,828.5**	**2,418.6**	**2,430.0**	**2,378.2**	**2,163.7**	**2,278.1**	**2,176.9**
CO_2	1,820.8	2,402.1	2,412.8	2,360.9	2,146.4	2,259.2	2,158.5
CH_4	0.3	0.5	0.5	0.5	0.4	0.5	0.4
N_2O	7.4	16.0	16.7	16.9	16.8	18.5	18.0
Transportation	**1,542.6**	**1,931.0**	**1,935.8**	**1,843.4**	**1,773.7**	**1,786.3**	**1,765.2**
CO_2	1,494.0	1,891.7	1,904.7	1,816.0	1,749.2	1,763.9	1,745.0
CH_4	4.6	2.4	2.1	1.9	1.8	1.8	1.7
N_2O	44.0	36.9	29.0	25.5	22.7	20.7	18.5
Industrial	**853.5**	**828.1**	**849.0**	**806.3**	**726.4**	**784.3**	**777.2**
CO_2	848.6	823.4	844.4	802.0	722.6	780.2	773.2
CH_4	1.6	1.5	1.5	1.4	1.2	1.3	1.3
N_2O	3.3	3.2	3.1	2.9	2.5	2.7	2.7
Residential	**344.1**	**362.5**	**346.0**	**351.6**	**341.5**	**339.0**	**333.2**
CO_2	338.3	357.9	341.6	347.0	337.0	334.6	328.8
CH_4	4.6	3.6	3.5	3.7	3.6	3.5	3.5
N_2O	1.1	1.0	0.9	0.9	0.9	0.9	0.9
Commercial	**220.2**	**224.8**	**220.1**	**225.0**	**224.6**	**221.9**	**223.4**
CO_2	219.0	223.5	218.9	223.8	223.4	220.6	222.1
CH_4	0.9	0.9	0.9	0.9	0.9	0.9	0.9
N_2O	0.4	0.4	0.3	0.3	0.3	0.3	0.3
U.S. Territories*	**28.0**	**50.2**	**45.4**	**41.1**	**44.0**	**49.8**	**49.9**
Total	**4,816.9**	**5,815.2**	**5,826.4**	**5,645.7**	**5,273.9**	**5,459.5**	**5,325.8**

Figure 2: Greenhouse Gasses By Source of Fossil Fuel Combustion
This figure shows how much more carbon dioxide is emitted specifically by fossil fuel combustion than any other greenhouse gasses. All units are in millions of metric tons of CO_2 equivalent. ("Inventory of u.s.," 2011)

Since carbon dioxide seems to account for the vast majority of the greenhouse effect from fossil fuel emissions, any efforts to reduce the global warming effects of power production should focus mainly on reducing carbon dioxide emissions. Though there has been much research done on zero-carbon energy, implementing large-scale power plants that can produce enough energy from these researched technologies still remains quite costly. Coal power is one of the cheapest forms of electricity we can offer, and few people are willing to create zero-carbon power plants, since their costs are not competitive with those of coal. It is this cost barrier that is keeping the United States from moving forward with these new technologies. Once we are able to overcome this barrier, costs will likely come down after we have gotten used to working with these new technologies. Therefore, it is the government's responsibility to the public to provide incentives, in the form of grants and subsidies, to make these technologies affordable.

Historically, energy incentives in the United States have been both plentiful and popular. In the year 2010, the United States Government Accountability Office counted 679 active federal energy initiatives – most of which promoted renewable and zero-energy technologies ("Renewable energy: Federal," 2012). It is worth mentioning that this value only includes federal incentives, and that there were countless more at state and city levels. This number of clean energy incentives was staggering compared to years before, reflecting society's increasing awareness of environmental issues.

Many of the energy incentives currently offered focus, understandably, on reducing costs for end consumers and small to medium sized businesses – the people purchasing and using most of the electricity the US produces. For example, in 2013, the state of Oregon offered a "Renewable Energy Development Grant Program," which issued grants of up to 35% of total installation costs (up to $250,000) to aid people in adding renewable energy sources to their home or business("Renewable energy development," 2013). This program received $3 million annually, which it then issued as grants ("Renewable energy development," 2013). However, three million dollars is not a lot of money to spread over an entire state, especially if you can only afford to pay out 12 grants of $250,000 each. Programs such as this have been very popular, but they only focus on reducing costs for small operations, and not for installing full-scale power plants, which can cost millions of dollars.

Though it is easy to say we need a widespread zero-carbon energy grant program, implementing one is a completely different story. While the inner workings of the United States government are quite complex, the fact that there were 679 active federal energy initiatives in the year 2010 shows that our government really does care about energy, and will likely pass most bills for energy incentives – as long as it is a sound and complete bill, there are limited repercussions (especially on the economy), and the effects of the bill are ultimately positive. Using this assumption, we can assume that if we could draft a bill for a national zero-carbon energy implementation incentive that would provide ample assistance to those needing it, the government would likely sign it into action. The largest problems in drafting such a bill are determining how the program will get the massive amount of funding it needs, and determining how to distribute those funds to applicants.

Determining where a national zero-carbon energy grant and subsidy program would get its funding is the easy part of drafting the bill. There are various options for this, including the following:

- A small, lump sum charge on every american's monthly electricity bill (on the order of a few cents to a dollar each)
- Taxing electricity usage (probably not a popular idea among voters)
- Private donations (angel investors)
- Tax credit auctions

Of these suggested methods of generating funding, tax credit auctions are probably the least understood. A tax credit auction is where various tax credit certificates are put up for public auction, and the funds generated are used for funding something (zero-carbon energy grants, in this case). The certificates usually have a face value in dollar amounts, and people bid on them like any other auction. These certificates than can be used as deductions on taxes. The state of Oregon is able to raise all its annual funding ($3 million) for its Renewable Energy Development Grant Program using this method ("Renewable energy development," 2013). While it may not be feasible to raise the entirety of the funding needed for a national zero-carbon energy grant program through tax credit auctions, it is definitely an attractive option. One strong suggestion is to utilize a mixture of small charges on electricity bills, private donations, and tax credit auctions to come up with the necessary funding.

Once enough funding is secured, it will then be time to determine how to distribute the grants and subsidies. Obviously, it will not be sufficient to distribute equal-sized payments to everyone who applies. Some forms of zero-carbon energy cost more than others (wave and tidal are much more expensive than wind, for example), and densely populated areas will have greater power needs than rural farming communities. There are multiple options for distributing funds, which include, but are not limited to the following:

- Distribute grants on a dollar per watt of capacity basis for new plants
- Issue various sized grants for implementing different types of zero-carbon energy
- Issue grants on the construction of zero-carbon energy plants that will be enough to make the capital costs comparable to that of coal (the energy form we are trying to eventually get rid of)
- Subsidize zero-carbon energy production so that its production cost is comparable to coal

Since it is possible to have different methods of energy production within one zero-carbon energy family, each with their own widely varying costs, it would be unfair to issue grants using the first two methods. The most attractive idea seems to be issuing grants for construction of zero-carbon energy plants, and then subsidizing their power production after construction, so that their capital and production costs will be lower than coal – this would provide market pressure toward zero-carbon energy, and away from coal. Eventually, it would be ideal to move completely away from coal power, or only use it as a backup system.

According to the Energy Information Administration's *Annual Energy Outlook 2013*, it costs an average of 8.5¢ per kWh to generate electricity from coal, and about 6.5¢ per kWh to construct the necessary plants ("Annual energy outlook 2013," 2013). We need to provide enough grants and subsidies to make costs for zero-carbon energies at least this low. The amount of grants and subsidies we need to provide will greatly vary on a case-to-case basis, so we need to institute an application process that requires applicants to to submit estimated costs of construction and production. Then, we must compare those submitted numbers with the target values (those of coal), and the subsidies will need to make up for most of the difference in order to be effective.

Once the government begins issuing grants and subsidies for zero-carbon energy and companies begin installing new infrastructure, there are likely to be some limited side effects – mostly on the economy. The effects on the economy will stem from a modest increase in electricity rates, which will only rise by an almost negligible amount per kWh. The reason for this small rise in rates would be to help build a contingency fund to help offset any unexpected costs from the zero-carbon energy sources. As we become more comfortable with these new zero-carbon technologies, the rates for electricity will likely come back down to where they were before. In addition, stock prices for publicly traded power companies will likely fluctuate suddenly depending on the relative successes and failures of new zero-carbon energy sources.

Overall, it is imperative in the fight against global warming that the United States government sets an example for other countries by instituting an assistance program to promote zero-carbon energy sources, thus creating market pressure against CO_2-belching coal power. This program could get its funding in a variety of ways, from tax credit auctions to private donations. Assistance for the construction and operation of zero-carbon power plants should cover enough of the construction and operation costs to make costs to the companies and rates to the consumer comparable to coal power, the largest source of carbon dioxide in the US. Instituting such an assistance program would help steer ourselves away from out-dated coal power and into a brighter, more sustainable future.

Works Cited

Renewable energy development grant program . (2013, March 29). Retrieved from http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OR147F

United States Energy Information Administration, Office of Integrated and International Energy Analysis. (2013). *Annual energy outlook 2013*. Retrieved from website: http://www.eia.gov/forecasts/aeo/pdf/0383(2013).pdf

United States Environmental Protection Agency, (2011). *Inventory of u.s. greenhouse gas emissions and sinks.* Retrieved from website: http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Chapter-3-Energy.pdf

United States Environmental Protection Agency, (2011). *Sources of greenhouse gas emissions.* Retrieved from website: http://www.epa.gov/climatechange/ghgemissions/sources.html

United States Government Accountability Office, (2010). *Coal power plants: Opportunities exist for doe to provide better information on the maturity of key technologies to reduce carbon dioxide emissions* (GAO-10-675). Retrieved from website:http://www.gao.gov/assets/590/588876.pdf http://www.gao.gov/assets/310/305573.pdf

United States Government Accountability Office, (2012). *Renewable energy: Federal agencies implement hundreds of initiatives* (GAO-12-260). Retrieved from website: http://www.gao.gov/assets/590/588876.pdf