

How to reduce greenhouse gas emissions?

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Introduction (Dennis)

The Earth's surface absorbs about seventy percent of the sun's radiation and the remaining thirty percent of it is reflected into the atmosphere (World Meteorological Organization, n.d.). The percentage of ultraviolet rays absorbed by the Earth will then be radiated. Part of it will be absorbed by greenhouse gases and radiated into different directions and causes heat to be trapped by the atmosphere. According to the organization, if there was no greenhouse effect, the temperature of the Earth's surface will be negative 18°C but today, it is at 14°C. The increase in the greenhouse gases makes the Earth's atmosphere hotter which we are experiencing as global warming today. This effect is continuously experienced because of the human activities that increase the concentration of greenhouse gases in the atmosphere. These activities include burning of fossils, plastic production, deforestation, pharmaceuticals, aviation and more. Due to global warming we experience weather crises and more environmental problems so warming should be lessened if not reversed. To lessen the deterioration of the Earth due to global warming, there should be solutions that we should do to reduce the greenhouse gas emissions.

Objectives of the research (Bryant):

The objective of this research is to provide different methods that can be used to reduce greenhouse gas (GHG) emissions. More specifically, we will be discussing how less intensive farming, a carbon tax, a cap and trade program, and how solar and wind power can reduce GHG emissions. This research will also provide the main causes of GHG emissions and the impact it has on the environment with relations to global warming and climate change. According to the United States Environmental Protection Agency (EPA), heat, transportation and the burning of fossil fuels for power are the primary causes of greenhouse gas emissions from human activities in the US. The 4 main greenhouse gases include carbon dioxide, methane, nitrous oxide, and fluorinated gases. Human activities have been responsible for nearly all of the GHG emissions in the atmosphere over the last 150 years (EPA 2020). GHG emissions raise the temperature of the planet constantly, impacting the environment negatively. It directly affects the climate through irregular weather changes, forest fires and the melting of glaciers (Surampalli et al, 2013). These impacts on the environment also have an effect on human wellbeing, natural and agricultural environments, marine habitats and communities.

Method (Sheldon):

The kind of research that was done was searching for different varieties of terms that relates to reducing greenhouse emission within the City Tech library.

Searching for key terms such as climate change, transportation sector, understanding greenhouse gas emissions, and much more has allowed us to gain information that has solutions to reduce greenhouse gas emission. Another way of doing our research was by utilizing the active filter that gave us suggestions on topics that are relevant to greenhouse gas emission. The filters helped narrow down to specific sources that we found to be relating to reducing greenhouse gas emission or explains what can cause an increase of GHG emission.

Results:

Within our research, we have found sources that explain the causes and effects of greenhouse gases and different ways to reduce emissions.

(Bryant)

Some of the sources mentioned several methods such as having better management in soil nutrients, a carbon tax, and a cap & trade program. A carbon tax is essentially a fee on the burning of fossil fuels. The burning of these fossil fuels produces greenhouse gases. These greenhouse gases increase the heat of the atmosphere which leads to global warming. A carbon tax has many advantages to it. With the use of carbon taxes, it can encourage governments and businesses to use and grow more environment friendly industrial practices. This will open a window for the use of more clean technologies allowing them to compete more equally to other fossil fuel-based technologies. It is vital that industries start using cleaner technology for the sake of reducing emissions. This transition to clean energies and lower emissions prices will be sped up with the use of a carbon tax. A carbon tax can also potentially reduce other taxes and generate extra money that can be used as funds for programs that focus on initiatives to the climate. Implementation of a carbon tax has proved to be effective in reducing GHG emissions in several countries. Finland being one of the first countries to successfully implement carbon tax. Sweden implemented carbon taxes which successfully reduced carbon emissions by %11 (Andersson, 2019). British Columbia also found success in the use of carbon taxes reducing its emission of greenhouse gases by %5-%15 (Murray et al, 2017). Even though carbon taxes are seen as very controversial, overall, it is effective in reducing the emission of greenhouse gases. It is an option that can be further developed in countries if needed in order to reduce emissions.

Cap & trade is defined as setting a limit, or a cap, on pollution and determining an emission-based market price. Cap and trade was first introduced and implemented by the European Union in 2005 which spread around and inspired other countries to develop their own emission trading systems. It has been used in several countries such as California's Cap-and-Trade program (launched in 2013) and Quebec's

Cap-and-Trade system (which was linked with California's program in 2014). According to the European Union, "In 2020, emissions from sectors covered by the system will be 21% lower than in 2005. The EU is on track to surpass this target." From this we can see the positive impact ETS has made in the EU. California's cap and trade program has also found great success in reducing its emissions while, additionally, flourishing its economy. According to the Environmental Defense Fund (EDF), California's GHG emissions have declined over 13% since 2006. "Per capita emissions have decreased by over 2 tonnes since 2006, and as of 2014 were over 5 tonnes less than national per capita emissions." (EDF n.d). Based on this, we can see just how much California benefited from a cap and trade program. Not only did they reduce their emissions, but they also economically gained from it. Now, about 500,000 residents currently work in the renewable energy, energy conservation and clean car industries, crushing the previously 18,000 workers that were employed by fossil fuel based industries (EDF, n.d). The State Legislative Assembly has introduced comprehensive regulations on air quality including the expansion of California's cap-and-trade policy to improve carbon monitoring, air quality planning and pollution reduction in nearby regions most affected by numerous sources of dangerous air pollution. (EDF, n.d) Since the launch of the cap-and-trade scheme, these investments have led to the addition or extension of 60,000 homes, more than 250,000 acres of reclaimed and restored property, and more than 330 transportation agencies (EDF, n.d).

(Sheldon)

From reading the article "Global warming potential and greenhouse gas emission under different soil nutrient management practices in soybean–wheat system of central India" says that "Agricultural land use is a potent contributor to GHG mitigation as it occupies about 40–50% of the Earth's land surface and accounts for 10–12% of the total anthropogenic GHG emissions (Smith et al. [2007](#)). " This quote tells us that agricultural land contributes to GHG & to consider a solution to manage the soil nutrients more cautiously. Agricultural land is land that is used for the purpose of farming. This kind of land produces crops, plants or animal products. With agriculture taking up 50% for the cause of GHG, it would be critical to make better adjustments to how the soil nutrients are handled and the nutrients the crops use up. Another thing the article points out is the excessive use of nitrogen to fertilize crops which results in the increase of GHG emission. Greenhouse gas is a compound gas that traps heat within the atmosphere. Nitrogen is one of the gases that traps heat within the atmosphere which makes the Earth become warmer. Overall, the excessive use of nitrogen in agricultural land released into the atmosphere results in an increase of GHG emission.

(Dennis)

In other words, The article by Smith, et. al. (2007) says that the use of agricultural land is a contributor to greenhouse gas mitigation because it uses forty to fifty percent of the Earth's surface and accounts for ten to twelve percent of GHG emission. This tells us that agricultural land contributes to GHG and to a possible solution is to manage the soil nutrients more cautiously. With agriculture taking up 50% for the cause of GHG, it would be critical to make better adjustments to how the soil nutrients are handled and the nutrients the crops use up.

On the other hand, Burney, N. (2010) wrote that one of the most challenging problems the Earth has to face is global warming which was a result of human activities producing greenhouse gases. He stated that the accumulation of these gases has costly and serious effects on the world's climate. He proposed a solution of cap control by limiting the quantity of emissions or carbon tax by increasing the price of fossil fuels to reduce greenhouse gas emissions. Strand, J (2013) also featured the same solutions and compared the two. It was found that carbon tax is preferable over cap control for reduction of emissions because prices are higher this way.

Furthermore, taking into account the great importance of renewable energy in reducing greenhouse gas emissions, the use of wind and solar energy would greatly reduce the use of fossil fuels, which provide the largest amount of energy in the U.S. and therefore cause a greater amount of carbon dioxide emissions. Then, by reducing the use of fossil fuels by wind and solar energy, the percentage of carbon dioxide emissions would significantly reduce and therefore there would be a great reduction in greenhouse gas emissions. All this is due to the fact that renewable energies such as wind and solar are clean energies which do not pollute the environment.

Discussion:

(Sheldon)

Our results consisted of data, tables, figures & facts that have shown what causes an increase in GHG emission. One of the results showed that the excessive use of the chemical nitrogen has increased the GHG emission due to nitrogen activating in high temperatures and being within the atmosphere. In the article "Global warming potential and greenhouse gas emission under different soil nutrient management practices in soybean–wheat system of central India", the authors mentioned the three types of nutrients management practices are fully organic (100% organic), integrated nutrient management (100% inorganic), and fully chemical (50% organic and 50% inorganic). Table 1 from the article showcases the types of chemicals that are used for fertilizing crops. Notice how it takes more doses of nitrogen to fertilize for both soybeans and wheat.

Figure 1: Details of crop cultivations and agronomic management.

Lenka, S., Lenka, N.K., Singh, A.B. *et al.* Global warming potential and greenhouse gas emission under different soil nutrient management practices in soybean–wheat system of central India. *Environ Sci Pollut Res* 24, p 4603–4612 (2017). <https://doi-org.citytech.ezproxy.cuny.edu/10.1007/s11356-016-8189-5>

Table 1 Details of crop cultivar and agronomic management adopted in the study

Crop	Cultivar	Duration (Days)	Date of Sowing	Date of harvest	Spacing (cm)	Recommended dose of chemical fertilizers (kg ha ⁻¹)		
						N	P ₂ O ₅	K ₂ O
Soybean (<i>Glycine max</i> L.)	JS-335	110	03/07/12	09/10/12	45 × 5	30	26.2	16.6
Durum wheat (<i>Triticum durum</i> L.)	HI-8498	130	06/11/12	14/03/13	22.5 × 5	80	17.5	33.2

The article also shows Table 2 three kinds of treatments used in the nutrient management which are 100% organic (ONM), 100% inorganic (NPK) & 50% organic & 50% inorganic integrated nutrient management (INM).

We see that the use of nitrogen chemical using the integrated nutrient management (INM) has a higher effect versus the NPK and ONM treatments. The author states “The soil N₂O flux during the soybean crop (Table 2) was significantly higher under INM, followed by ONM and NPK treatments. “ Table 2 showcases that N₂O had a higher emission occurrence during the time of producing the crops while under the use of INM treatment.

Figure 2: Effect of nutrient management treatment on soil organic carbon (SOC).

Lenka, S., Lenka, N.K., Singh, A.B. *et al.* Global warming potential and greenhouse gas emission under different soil nutrient management practices in soybean–wheat system of central India. *Environ Sci Pollut Res* 24, p 4603–4612 (2017). <https://doi-org.citytech.ezproxy.cuny.edu/10.1007/s11356-016-8189-5>

Table 2 Effect of nutrient management treatments on soil organic carbon (SOC) content, available N, SOC sequestration rate in the 0–15 cm soil depth, and seasonal emissions of carbon dioxide, methane, and nitrous oxide

Treatment	SOC (%) ^{*†}	Available N (kg ha ⁻¹)	ΔSoil carbon (kg ha ⁻¹ yr. ⁻¹)	Soybean [#]			Wheat ^{##}		
				CO ₂ -C	CH ₄ -C ^{**}	N ₂ O-N	CO ₂ -C	CH ₄ -C	N ₂ O-N
ONM	1.13a	283a	1250a	1303b	-0.071c*	1.20b	4158b	-0.092a	1.22b
NPK	0.62b	229c	198c	923c	-0.043a	1.02c	2957c	-0.167c	1.15b
INM	0.71b	241b	417b	1467a	-0.067b	1.36a	4486a	-0.116b	1.36a

ONM 100% organic, NPK 100% inorganic, INM 50% organic + 50% inorganic

*In a column, values followed by the same letter are not significantly different at $p < 0.05$ by Duncan's multiple range test

**Negative sign indicates CH₄ oxidation by methanotrophs

[#] Soybean includes the fallow period after soybean harvest and before wheat sowing

^{##} Wheat includes the fallow period after wheat harvest and before soybean sowing

[†]0–15 cm soil depth

In Figure 5, we can see the effect of N₂O used in the crop season under the three treatments which are ONM, INM and NPK. Similar to Table 2, INM once again has a higher occurrence and even a peak of high soil moisture content activity. N₂O is the highest at sowing in the graph. The author states that “N₂O emissions are substrate availability, soil moisture and air temperature.” This points out that nitrogen can affect the air temperature to increase since nitrogen emits during higher temperatures of the atmosphere.

Figure 3: Effect of 9 years of nutrient management on N₂O emission in a soybean and B wheat.

Lenka, S., Lenka, N.K., Singh, A.B. *et al.* Global warming potential and greenhouse gas emission under different soil nutrient management practices in soybean–wheat system of central India. *Environ Sci Pollut Res* 24, p 4603–4612 (2017). <https://doi-org.citytech.ezproxy.cuny.edu/10.1007/s11356-016-8189-5>

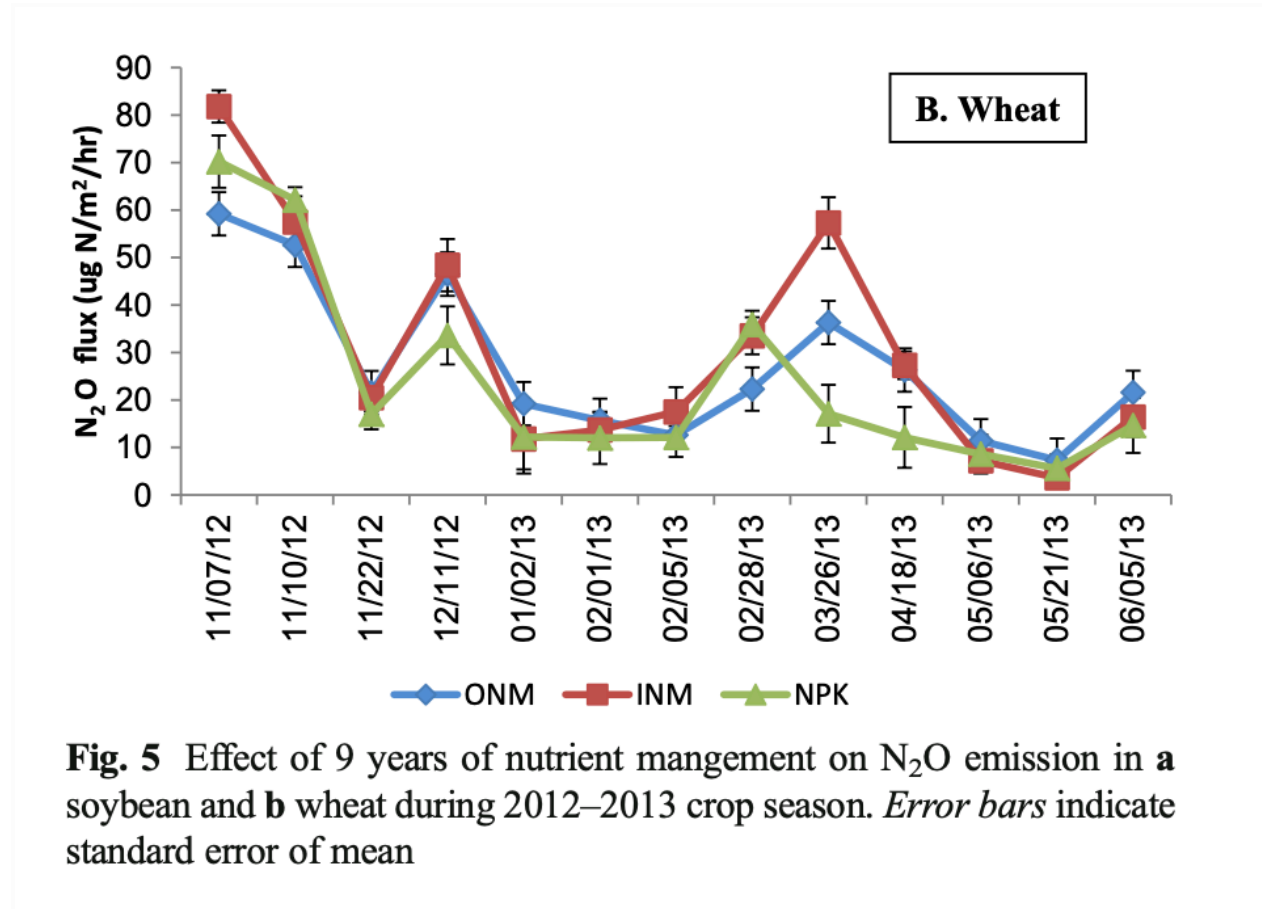


Table 1, 2 and Figure 5 essentially showcases that nitrogen chemical (N₂O) emits during human activities (agricultural soil management). With the excessive amount of nitrogen chemical it requires to fertilize the soybeans and wheat, the nitrogen gets released into the atmosphere which would raise the Earth temperature.

In the book *Paths to a sustainable agricultural system: Pathways to a Nordic agricultural and food system with reduced emissions of greenhouse gases and air pollutants* the author mentions one way to reduce GHG would be to have less intensive farming. The authors mention “A reduced dependency on external inputs and the ability to use local resources flows will lead to lower emissions.” Limiting big farmers with a lot of animal densities and animal production would . If less land is used for agricultural production (intensive farming), then the agricultural soil would decrease &

the size of farm lands would decrease as well. Figure 1 shows that in some parts of the world agricultural soils are used intensively for farming.

Figure 4: N₂O emission in 2012

Pira, M. (2016). Paths to a sustainable agricultural system: Pathways to a Nordic agricultural and food system with reduced emissions of greenhouse gases and air pollutants. In *Paths to a sustainable agricultural system*. Nordic Council of Ministers. <https://ebookcentral.proquest.com/lib/citytech-ebooks/reader.action?docID=4518453>

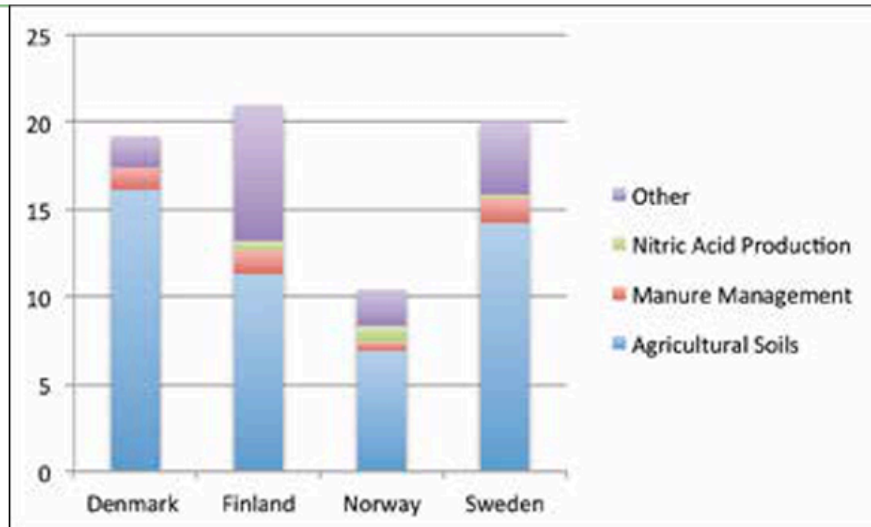


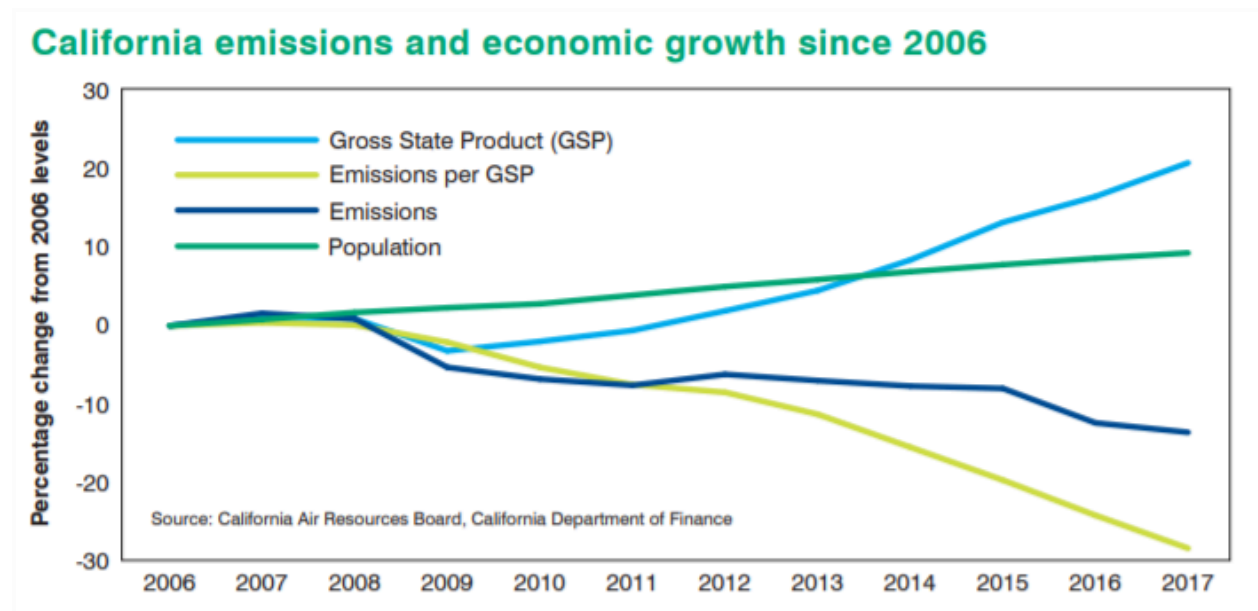
Figure 1: Nitrous oxide emissions (thousand tonnes) in 2012 (EEA tech report No 09/2014).

From Figure 1, most of those countries used agricultural soil management to fertilize their crops in farm land. Intensive farming involves a high level of animal & crop production, the use of land for farming & using a lot of chemicals (such as nitrogen).

(Bryant)

The Environmental Defense Fund (EDF) shared a PDF detailing the successes of California's cap and trade program. According to the EDF "carbon emissions are in decline, the economy is robust, and residents across the state are reaping the benefits." This is all because the cap and trade program that California implemented back in 2006. Below is a graph from the EDF files depicting the emission levels (blue line) of California from 2006 up to 2017. As you can see, emissions have drastically reduced due to the success of the cap and trade program. California's emissions have declined by over 13% since 2006 and their GSP has also increased by more than 20% since 2006 (EDF, n.d).

Table 1: Sources: California Air Resources Board, California Department of Finance



(Dennis)

Moreover, Solar and wind power can be an alternative energy that is effective in reducing greenhouse emissions. The U.S. Energy Information Administration reports that there is a significant increase in the production of renewable energy. In 2017, renewable energy, including solar and wind power, provided 11 percent of total US energy consumption (EIA, 2018). Turbines produce wind power as the blades of the turbines accumulate kinetic power. The modern turbines are silent, produce more energy, and cost-effective. Both small scales' residential users can conveniently use these turbines, and mass production industrial organizations as the earth produce wind abundantly. Industrial size turbines can be installed in so many diverse locations. In contrast, the smaller ones require quite specific sites as it requires the wind speed of at least 12 miles per hour with smooth airflow (Well, Pg. 246, 2012). Meanwhile, the sun is the oldest, most potent, and ultimate energy source, for every energy that we use today has been enabled by the sun. Solar panels collect radiation from the sun and transform it into heat, which can be used for heating space and water, and electricity. Solar panels can absorb radiation, even on cloudy days. The panels can be incorporated into windows or roofs, thus they do not provide aesthetic disturbances. Furthermore, the panels' benefit is the low maintenance cost as the panels only require cleaning every few months. On the other hand, as argued by Lakatos, Hevessy, and Kovacs (2011), "the most serious problem of solar energy supply is that at night there is no available energy and in winter only a relatively low quantity of solar energy is available", thus solar power is not always readily available, especially for countries with long winters.

Conclusion:

(Sheldon)

Based on the results from the research “Global warming potential and greenhouse gas emission under different soil nutrient management practices in the soybean–wheat system of central India”, one thing that was discovered is that the use of excessive nitrogen in the atmosphere & in sowing crops increases GHG emission. Another discovery is that intensive farming & agricultural soil management results in farmers using chemicals to produce as much as possible which also results in the increase of GHG emission. Due to the increase of agricultural land usage, there's the risk of more nitrogen being used which would get exposed into the atmosphere. The less farms use nitrogen chemical, the better chances to reduce GHG emission since nitrogen wouldn't be in the atmosphere to emit. If agricultural land usage decreases & less intensive farming occurs, less nitrogen would be released into the atmosphere which would slow down the chances of the temperature rising.

(Bryant)

We also discovered that implementation of a carbon tax or a cap and trade program can be effective in reducing GHG emissions according to Burney (2010). By placing a tax on the amount of carbon emissions produced, it will make it more expensive to use products that contribute to these emissions. Thus, companies will seek for cheaper alternatives allowing cleaner solutions to compete with fossil fuel based products resulting in overall reduction of GHG emissions. The money gained from this tax can also be used for funding renewable energy products, helping low-income families, and even reducing other taxes. With a cap and trade program, Policy makers will set emission limits and allow businesses to buy and sell CO₂ emission rights (Burney 2010, p.68). Companies that are able to reduce their emissions rapidly can sell allowances to other companies with high emission rates. This gives an incentive for companies to reduce emissions faster and cheaper.

(Dennis)

The release of greenhouse gases from different sources obviously became one of the biggest problems threatening the existence of the world today. These greenhouse gases are the sum of the concentration of toxic gases that accumulated from several sources: agricultural, residential, industrial, transportation and electrical. All sources point to human activities in different sectors of the community. In short, human activities are the primary cause of greenhouse gas emission and accumulation in the atmosphere. As a result, humans, and other living organisms experience changes in the environment because of the GHG.

Initially, these greenhouse gases like methane, carbon dioxide, fluorinated gases and nitrous oxide are a very big help to living organisms. It is because they trap heat from the ultraviolet rays of the sun and makes the climate bearable for humans and other living microorganisms. If not for the greenhouse gases, the Earth will be very cold and habituating it may not be possible. But today, greenhouse gases do not only provide help and assistance for us. These gases are out of balance causing several problems that threaten life. Too much greenhouse gas emissions resulted in the sudden shifts in our weather and extreme climatic conditions. Then these resulted in wildfires, floods, and storms. Health problems like respiratory diseases and infections also arise.

The data that were gathered and discussed have key importance in the preservation of the world. It is very important to know the effects of greenhouse gas emissions for us to realize that the world should be taken care of. There should be lesser concentrations of greenhouse gases that will be emitted if the emissions cannot be stopped. Stopping the accumulation of greenhouse gases may be too late but lessening it is still possible. To do this, it is very vital to know the causes of greenhouse gas emissions which are also contained in the data presented. The information gathered is important in taking care of the planet that holds us.

Recommendations:

(Sheldon)

From reading the article “Global warming potential and greenhouse gas emission under different soil nutrient management practices in soybean–wheat system of central India”, our recommendation to reduce GHG would be to reduce the amount of nitrogen that is fertilized into sowing the crops or to use other chemicals such as P_2O_5 and K_2O . This source explains that it takes more nitrogen chemicals to fertilize the crops unlike chemicals P_2O_5 and K_2O . If there is more nitrogen used to fertilize crops, the atmosphere and air quality can be polluted with bacteria which increases the GHG emission. The higher the temperatures, the more nitrogen will activate to pollute the air and water quality while trapping the heat. To reduce the amount of nitrogen used, farmers can use more chemicals P_2O_5 and K_2O when fertilizing crops. Another recommendation would be to have less agricultural land used so that nitrogen chemical isn't used as much when fertilizing crops. In the book *Paths to a sustainable agricultural system: Pathways to a Nordic agricultural and food system with reduced emissions of greenhouse gases and air pollutants*, the authors mentions “Decreasing the surface area where emission can take place.” This is a great recommendation so that there is less land usage for agriculture activities to take place.

(Bryant)

As for whether to implement a carbon tax or a cap and trade program, we recommend opting for a carbon tax. Burney (2010) suggests that “a tax provides greater flexibility over time, allowing firms to achieve reductions when they are least expensive. In particular, a tax encourages firms to make greater reductions in emissions at times when the cost of doing so is low and allows them leeway to lessen their efforts when the cost is high.” (p.65). In simpler terms, a carbon tax offers a consistent market whereas cap and trade would not promote reductions above the target of emissions. Strand(2013) also recommends a carbon tax over a cap and trade policy since fuel exporters charge a lower carbon tax fuel price than a cap and trade.

A carbon tax is essentially a fee on the burning of fossil fuels. The burning of these fossil fuels produces greenhouse gases. These greenhouse gases increase the heat of the atmosphere which leads to global warming. With the use of carbon taxes, it can encourage governments and businesses to use and grow more environment friendly industrial practices. This will open a window for the use of more clean technologies allowing them to compete more equally to other fossil fuel-based technologies. It is vital that industries start using cleaner technology for the sake of reducing emissions. This transition to clean energies and lower emissions prices will be sped up with the use of a carbon tax. A carbon tax can also potentially reduce other taxes and generate extra money that can be used as funds for programs that focus on initiatives to the climate.

Cap & trade is defined as setting a limit, or a cap, on pollution and determining an emission-based market price. The government issues allowances to companies for every ton of greenhouse gases they emit. Companies that are able to reduce their emissions rapidly can sell allowances to other companies with high emission rates. This gives an incentive for companies to reduce emissions faster and cheaper.

(Dennis)

Moreover, the effects of greenhouse gas emissions are very disturbing as it does not only end the lives of living organisms but may also end the life of the world we live in. The problem may no longer be solved because greenhouse gases that have accumulated may not be reversed. However, there are still some things we can do to lessen its accumulation if it will not be stopped. The use of fossil fuels in agricultural sectors, transportation users, and industrial productions must be avoided or lessened. Fossil fuels may be replaced with renewable energy sources. Energy efficiency may also be boosted. Putting cap control or higher prices on fossil fuels are also proposed solutions to lessen their consumption and sale. More than just avoiding the use of fuels that may emit greenhouse gases, there are ways on how people can possibly help reduce these GHG. We may plant trees that can suck carbon dioxide from the atmosphere. We must also preserve the greens that are still present like grass lands

and forests. Carbon dioxide capturing from factories and power plants is also possible. There is also a recommendation containing simple steps that will help reduce GHG emissions. Practicing these at home will be very helpful for the planet. We can reduce, recycle, and reuse. We can also use less air conditioning, drive less, turn off our appliances when not in use, conserve and have a plant-plenty diet. Our very little efforts by doing these, when combined all together will make a very big change. There are very many ways in how we can reduce greenhouse gas emissions. All there is left to do is for us to start.

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