



Research and Global Warming: Economic Consequences on Business

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Abstract: Global warming is the most crucial problem threatening the earth. The Global warming occurs when carbon dioxide (CO₂) and other air pollutants collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. The aim of this article is to discuss the effect of global warming on business and effect on the global economy. Greenhouse gases, mainly carbon dioxide, and human activities emission increase global warming. The CO₂ results from burning fossil fuels, such as oil, natural gas and coal, to obtain energy for transportations, industry,...etc. Also, it results from burning trees for energy and burning forests to create pastures and plantations. All these activities produce huge amounts of CO₂ emission to the atmosphere. Therefore, the temperature of the earth increases. Any increase in the temperature will lead to catastrophic consequences for all living things on the earth. These consequences on living things have a direct relation to economy. There is an increase in the economic damages by approximately 0.9 percent of global output. The 0.9 percent of estimated 2014 U.S. Gross Domestic Product (GDP) is approximately \$150 billion. Accordingly, fast solution should be applied to solve the global warming crises. Renewable energy sources, such as, solar energy, wind energy, hydrogen energy, etc, are considered the most important solution for decreasing the CO₂ emission, consequently, the earth temperature will be controlled and economic damage will be reduced.

Keywords: Global warming, Greenhouse gases, Carbon dioxide, Business, Economy.

Introduction

There is a strong relation between global warming and global economy. This relation is because of the effect of the global warming on all living things on the earth, plants, animals and humans. Global warming is the increase of the earth temperature due to the effect of greenhouse gases emissions. The greenhouse gases include carbon dioxide 76%, chlorofluorocarbon 5% (CFC) or commonly named as Freon gas, which used as a cooling gas in refrigerators and air conditions, methane 13%, nitrous oxide 6% (Robison, 2016). The emission of these gases, especially CO₂, has increased the temperature of the earth. Warming of 3° Celsius above preindustrial levels, instead of 2° has a notable effect on economy. The increase of temperature leads to increase economic damages by approximately 0.9 percent of global output. The consequences of global warming are now well defined and particularly

alarming. In view of the stupendous economic advances of the larger Newly Industrialized Countries (NICs), with China in the first rank, no "business as usual" scenario in the matter of greenhouse gases (GHG) emissions can be acceptable (Hrechet and Maréchal, 2007). In fact, the consequences would change based on how high temperature of the earth might be raised. Under any circumstances, the raise of temperature affects sources of food, sources of water, ice cap melting and glaciers melting, and different ecosystems. The melting of ice caps and glaciers will increase the level of water in the oceans and seas, so the coastal areas and islands will be affected. Huge areas will be lost and the sources of food in these areas will be disappeared. The level of salt water will be increased in the fresh water (rivers) and the flooding will cover many cities. Also, the melting of the polar ice-cap will lead fast and general disturbances of the climate all over the world.



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"Scientists and economists are beginning to grapple with the serious economic and environmental consequences if we fail to reduce global carbon emissions quickly and deeply. The most expensive thing we can do is nothing" (UCS, 2011). The consequences of the global warming on the economy have different figures of damages. There is damage to property and infrastructure. The damage of the property and infrastructure includes forests fires, floods, increase in the sea-level, droughts, wildfires, and extreme storms require extensive repair of essential infrastructure such as houses, railways, long roads, bridges, dams, airport runways, power lines, and seawalls. The damage also includes loss of productivity. The loss of productivity has a direct effect on disruptions in daily life. This disruption can lead to work instability, trade problems, and change in energy production, transportation problems, agriculture problems, and even tourism problems. Severe rainfall events and snowstorms can delay planting and harvesting, cause power outages, snarl traffic, delay air travel, and otherwise make it difficult for people to go about their daily business. Climate change due to global warming can cause health problems and can reduce productivity, such as when extreme heat curtails construction, or when more potent allergies and more air pollution lead to lost work and school days (UCS, 2011). Also global warming has a great effect on migration of millions of people and security threats. The global warming is likely to increase the number of "climate refugees"—people who are forced to leave their homes because of drought, flooding, or other climate-related disasters (UCS, 2011). The consequences of migration of millions of people can make civil unrest and may even spur military intervention and other unintended consequences.

1.1 Real Cases of Global Warming Effect

Researchers have extensive studies on the effect of global warming around the world. These studies lead to drawing hot map of the world (UCS, 2011). This map presents most areas around the world, which have directly affected by the global warming. There will be no change in the text of the cited examples because the texts are facts as shown in the hot

map around the world, therefore every fact will be cited with its reference.

First example: Mississippi Delta, LA, USA, Coastal wetlands in the Mississippi Delta are disappearing. Many factors contribute to the stress placed on wetlands, including the massive oil spill in the Gulf of Mexico in the summer of 2010. But natural forces are at work as well -- local sinking of the ground and accelerating rates of sea-level rise,(Karl et al., 2009; Janetos, et al., 2008) which scientists expect to further accelerate due to climate change(Karl et al., 2009; Rahmstorf, et al., 2007; Pfeffer, et al., 2008).

Over the past century, Louisiana has lost 1,900 square miles (4,920 square kilometers) of coastal wetlands -- more than one-third of its coastal plain.(Karl et al., 2009; Burkett, et al., 2005). Because coastal wetlands help protect the coastline from storm surge, Louisiana's capacity to absorb the surge from hurricanes such as Katrina in 2005 has been weakened.(Karl et al., 2009; Day, et al., 2007).

Increases in extreme weather in the Gulf Coast region -- home to the U.S. oil and gas industry -- are expected to disrupt the nation's energy production and supply (Karl et al., 2009).

Second example: Jakobshavn Glacier, Greenland, Located on the west coast of Greenland, Jakobshavn Isbræ is one of the most rapidly shrinking glaciers in the world.

Melting of Greenland's glaciers contributes to sea-level rise (Joughin, et al., 2004; , Alley, et al., 2005; Rignot and Kanagaratnam, 2006) and is expected to fuel global warming (Holland and Bitz. 2003; Lemke, et al., 2007).

The speed at which Jakobshavn Isbræ glacier is retreating doubled from 1996 to 2005 (Rignot and Kanagaratnam, 2006; Kerr, 2006). By 2003, this glacier -- already among the fastest-moving in the world -- reached retreat speeds of more than 7.8 miles (12.6 kilometers) per year (Joughin, et al., 2004).

Melting glaciers such as Jakobshavn Isbræ have begun to expose rock, soil, and ocean waters, which in turn causes further melting, as

those darker surfaces absorb more heat (Holland and Bitz, 2003; Lemke, et al., 2007).

Third example: Cape Floral Region, South Africa, the Cape Floral Region is a small area densely packed with an exceptionally high number of plant species (Hannah, et al., 2005).

This United Nations World Heritage Site (UNESCO, 2010) and biodiversity hotspot⁸ is at grave risk from climate change (BH, 2010).

Many of the region's 2,285 recorded plant species are endemic: they live only here (Simmons, and Cowling, 1996).

Proteas are the most common, best-recognized species of fynbos -- vegetation unique to the region. Scientists project that global warming could cause 21-40 percent of proteas to disappear (Hannah, et al., 2005; Fischlin, et al., 2007).

Unless we make deep and swift cuts in our heat-trapping emissions, the fynbos plant community could lose about two-thirds of its area (Thomas, et al., 2004; Fischlin, et al., 2007).

Forth example: Mekong River Delta, Vietnam, sea level rise threatens the viability of three-season rice farming in the Mekong River Delta in southern Vietnam. The delta has produced nearly half of the country's rice since 1997 (Bindoff, et al., 2007).

Sixty percent of the delta is likely to become highly vulnerable to flooding if the sea level rises 17.7 inches (45 centimeters) above 1997 levels (Bindoff, et al., 2007).

Increases in salinity from encroaching seawater may also reduce rice production, potentially reducing the opportunities for rice growing from three seasons in a year to just one (Castillo, et al., 2003; Preston and Clayton, 2003).

By 2050, sea level rise in the delta could directly affect an estimated 1 million people or more (Ericson, et al., 2009).

2. Literature Review

The work attempts to assess the effects of global warming on the efficacy of current

greenhouse cooling methods following a methodology previously proved for other agricultural buildings. The cooling potential of four greenhouse cooling techniques (natural ventilation, forced ventilation, fogging and shading) were simulated by computer modelling for five European locations, calculating the greenhouse internal air temperature from measured external climate data. The results showed that, in locations in southern Europe, adding evaporative cooling methods to ventilation and/or shading will be indispensable. In some areas of northern Europe, natural ventilation will no longer be sufficient, and shading or fogging will also be necessary. The economic consequences will be important, over all in the southern locations where water consumption, investment and working costs will be higher and necessary to ensure the crop production (Valiño et al., 2014)

"A study recently carried out in Guangdong, China, (Huchet and Maréchal, 2007) reveals that many factories operating in the textile, paper and agro-alimentary sectors have elected to produce electricity themselves, building small coal-fired power plants on their own sites. Obviously, such decisions slow down the provincial government's efforts to control SO₂ and CO₂ emissions. More generally, the government's repeated attempts to rationalise industrial structures have been blocked by the strong political (and monetary) incentives for local officials to favour quantitative growth; this in turn is dictated by the concern, at all state levels, to avoid uncontrolled growth in unemployment, so as to maintain social stability and, in the last resort, the legitimacy of the Communist Party".

It was estimated by a study in Nature, 2015, that temperature change will leave the average income around the world 23% lower in 2100 than it would be without climate change (Bruke, et al., 2015; Worland, 2015).

As reported in the Independent newspaper (IN) (Johnston, 2016) "global warming will cost the world economy more than £1.5 trillion a year in lost productivity by 2030 as it becomes too hot to work in many jobs, according to a major new report". Also, reported in IN, "in just 14 years' time in India, where some jobs are



already shared by two people to allow regular breaks from the heat, the bill will be £340bn a year. China is predicted to experience similar losses, while other countries among the worst affected include Indonesia (£188bn), Malaysia (£188bn) and Thailand (£113bn)" (Johnston, 2016).

There is an interesting and surprising things occurs in the world of climate politics, "the climate change is now understood as a problem of 'decarburizing' the global economy" (Newell and Paterson, 2010). This means that we have to end our relying on the fossil fuels, which are called non renewable energy sources and rely on the renewable energy sources, such as solar energy, wind energy, hydrogen energy, etc.

As explained in the book of Mendelsohn, and Neumann, it is very important to understand the impact of climate change on the economy, this will give the chance to take policy actions to control its consequences (Mendelsohn, and Neumann, 2004). As concluded in the book that some climate change may produce economic gains in the agriculture and forestry sectors, whereas energy, coastal structures, and water sectors may be harmed (Mendelsohn, and Neumann, 2004).

It was mentioned in a research study that "the economic impacts of climate-change-induced change in human health, viz. cardiovascular and respiratory disorders, diarrhoea, malaria, dengue fever and schistosomiasis" (Bosello, et al., 2006). The study reveals that changes in morbidity and mortality are rationalized as changes in labor productivity and demand for health care, and used to shock the GTAP-E computable general equilibrium model, calibrated for the year 2050. Their remarkable prediction that make the remarkable prediction that one degree of global warming will save more than 800,000 lives annually by 2050 (Bosello, et al., 2006). Prices, production, and terms of trade show a mixed pattern. Direct cost estimates, common in climate change impact studies, underestimate the true welfare losses (Bosello, et al., 2006).

The effect of climate change on the human health has been noticed, even if there is a little evidence but there are some symptoms.

The research has focused on thermal stress, extreme whether events, and infectious diseases (McMichael, et al., 2006). Also, the attention has paid to estimate the food production and hunger prevalence. It is stated that "An emerging broader approach addresses a wider spectrum of health risks due to the social, demographic, and economic disruptions of climate change. Evidence and anticipation of adverse health effects will strengthen the case for pre-emptive policies, and will also guide priorities for planned adaptive strategies" (McMichael, et al., 2006).

A research has studied the effect of global warming and climate change of the sea level. The study reveals that the rise of the sea level exerting unprecedeted pressure on coastal areas through activated coastal flooding and saltwater intrusion (Fua et al., 2016). There is a global attention towards this issue. It should be an adaption between cost-efficiency and decision making to accurately estimate the economic cost of rise of sea level. Based on the study using specific approaches and theories, in 2050, it is estimated that the inundation of 3-foot sea level rise could cost Hillsborough and Pinellas County over 300 and 900 million dollars respectively for the real estate market alone. The researchers stressed the importance of such studies to support local decision making and enhance adaptation planning for the climate change and sea level rise in the coastal communities (Fua et al., 2016).

The attention has been paid towards understanding of present climatic conditions, observed climate trends and regional climate vulnerability of the Bhutan Himalayas (Hoy, et al., 2016). Bhutan's complex, often high-altitude terrain and the severe impact of the Indian summer monsoon leads to a strong exposure of the countries' key economic sectors, especially, agriculture, forestry, hydropower generation and tourism, to changes in the climate of the region. In fact, Bhutan's vast biodiversity has threatened by the climate change and increases the likelihood of natural hazards (e.g. glacier lake outburst floods, flash floods, droughts and forest fires) (Hoy, et al., 2016). This study is important to understand the effect of climate change on different sectors and



will help in improving the handling of regional social, economic and ecologic challenges not limited to the Himalayas. A few numbers of studies on Himalaya mainly focus on adaptation to immediate threats by glacier lake outbursts. In contrast, this research “(1) investigates the average spatial and inner-annual diversity of the air temperature regime of Bhutan, based on local meteorological observations, (2) discusses past temperature variability, based on global datasets, and (3) relates effects of observed warming to water availability, hydropower development, natural hazards, forests, biodiversity, agriculture, human health and tourism in the Bhutan Himalayas”. Results show a large variability in the temperature, especially, increasing temperatures over recent decades (Hoy, et al., 2016).

3. Discussion on Previous Studies

As presented in the introduction and literature review, the world economy will be heavily affected by global warming in the next decades. As estimated, the global warming will cost the world economy £1.5 trillion by 2030 ((Johnston, 2016)). Such great amount of money is enough to develop many countries and can save good living standards for millions of people all over the world. Who can save the aforementioned amount of money? Of course the answer on this question is not difficult because the high developed countries are the main reason for the global warming. Huge amounts of GHGs are emitted from these countries every year. If they carry their responsibilities towards the environment they can save such huge amount of money. As mentioned, in Vietnam, by 2050, sea level rise in the delta could directly affect an estimated 1 million people or more (Ericson, et al., 2009). As shown, there is a notable effect of global warming and climate on human health. The variation in the temperature leads to presence of different types of virus, which can adapt themselves to affect human. It is discussed that “the economic impacts of climate-change-induced change in human health, viz. cardiovascular and respiratory disorders, diarrhoea, malaria, dengue fever and schistosomiasis” (Bosello, et al., 2006). The study reveals that changes in morbidity and mortality are rationalized as changes in labor

productivity and demand for health care, and used to shock the GTAP-E computable general equilibrium model, calibrated for the year 2050. Their remarkable prediction that make the remarkable prediction that one degree of global warming will save more than 800,000 lives annually by 2050 (Bosello, et al., 2006). How can we save one degree of global warming? This can be done by the effort of all communities in the world, United Nations, highly developed countries, non-governmental organizations, and big companies all over the world. Reducing the emission of the greenhouse gases is crucial to control the global warming. As we have seen all sectors are affected by the global warming, food production, agriculture, industry, transportation, health, and all materials on the earth. Materials degradation occurs due to global warming, which increase the level of temperature and acid rains. All types of materials, metals and nonmetals, are affected by global warming. Monuments are affected by global warming. The following section focuses on the effect of global warming of materials degradation and corrosion, and the economic consequences of such effect.

3.1 Economic consequences of Materials' Degradation

Global warming has not only consequences on living things but also on materials, such as metals and alloys. In presence of greenhouse gases, there will be direct effect of the degradation of materials. The presence of pollutants gases in the atmosphere lead acid rain formation. The acid is formed due to presence of CO₂ and SO₂ in the atmosphere, these gases react with water during rain and acids will be formed, hydrochloric acid and sulphuric acid. Both acids have a corrosive effect on metals and alloys. Therefore, corrosion will occurs to metals and alloys and like other natural forces, such as earthquakes, corrosion can cause dangerous and expensive damage to everything from cars, home appliances, bridges...etc. (US Report, 2002). Therefore, corrosion causes a heavy burden to economy all over the world. The corrosion costs should be drawn between the direct and indirect costs. The Direct costs of corrosion are:

- Capital: replacement of buildings, installations and machinery.
- Design and control: materials selection, corrosion allowances, special treatments (e.g. acid cleaning), control agents, maintenance and repair. The indirect corrosion costs are:
- Depreciation and interest losses; -product and production loss, technical support; and -additional reserves, insurance.

British and American surveys have shown that the overall- direct plus indirect costs caused by corrosion amount to approximately 4.5 % of Gross National Products (GNP) (During, 1997). That represents about \$ 500 per annum per capita of the population of the industrialized countries. The corrosion costs by the five major industry categories in USA. The cost of Infrastructure, utilities, transportation, production and manufacturing, and government were \$137.9 billion per annum (Ross and Lott, 1981-2001). Also, it is estimated that about 10 % of the world's steel output that is nearly 5 x 107 ton per year, is made for the purpose of replacing corroded steel. In the UK, it has been calculated that one ton of steel is converted completely into rust every 90 seconds. Apart from the waste of metals, the energy required to produce one tonne of steel from iron ore is sufficient to provide an average family home with energy for 3 months (Trethewey and Chamberlain, 1995). As well, corrosion will lead to additional consumption of energy, loss of health due to toxic materials, and even loss of life caused by explosions or by transport (aircraft) due to corrosion degradation. The case history 01.11.06.06 presented in Corrosion Atlas (During, 1997). showed a catastrophic action due to distillation pipe failures, which caused a fire and lead to total destruction of the refinery plant. Accordingly, effective corrosion prevention and control may contribute towards the limitation of economic, social and personnel loss. All these consequences increased the pressure of society to control the corrosion attack and to save the environment.

4. Conclusion

- Global warming has a great effect on the world economy.
- Continuous emission of greenhouse gases will lead to increase the earth temperature.
- By 2030, the global warming will cost the world economy £150 trillion.
- warming of 3° Celsius above preindustrial levels, instead of 2. The increase in the temperature will increase economic damages by approximately 0.9 percent of global output.
- 0.9 percent of estimated 2014 U.S. Gross Domestic Product (GDP) is approximately \$150 billion.
- The damage of the global warming will include everything on the earth, ice-caps melting, increase sea level and increase the salinity in the rivers, mass migration for millions of people all over the world, disappearing of many islands and coastal areas of the world, and loss of food sources.
- Renewable energy sources can be a solution to control the global warming by cutting off the high level of greenhouse gases in the atmosphere.

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