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آثار تغير المناخ العالمي على الاقتصاد والبيئة

د . رشدى أبراهيم رشدى

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Global climate change's implications on the economy and the environment

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ملخص

يعد إنتاج الطاقة واستهلاكها من المصادر الرئيسية لانبعاثات الغازات الدفيئة. واليوم، تشكل انبعاثات الغازات الدفيئة، وخاصة ثاني أكسيد الكربون، مصدرا رئيسيا للقلق. على الرغم من أن ثاني أكسيد الكربون يعد من أهم الغازات الدفيئة. نظرًا لاستخدام العديد من المواد الكيميائية والمواد المتفاعلة الضارة في مصفاة المنتجات البترولية، لا يمكن التغاضي عن خطر زيادة توليد نظائر ثاني أكسيد الكربون. إن مناقشة ظاهرة الاحتباس الحراري، إحدى الطرق لتقليل انبعاثات الكربون بسرعة مع تحسين كفاءة الطاقة، مما يؤدي إلى انخفاض في استهلاك الطاقة.

إن الاحتباس الحراري العالمي، والقوانين البيئية، والمناقشات المتعلقة بسياسة الطاقة، تبدأ جميعها بالاعتقاد السائد على نطاق واسع بأن نظام التدفئة والكهرباء الحالي مقبول اقتصاديا. ونتيجة لذلك، فإن أي خطوات لتغيير نظام الطاقة من أجل تحقيق أهداف أخرى، مثل الحد من الملوثات، ستؤدي إلى زيادة أسعار خدمات الطاقة والإضرار بالأسواق المالية. وبالتالي، فإن اختراع وتطوير تكنولوجيا جديدة هو الطريقة الوحيدة للحصول على طاقة نظيفة وبأسعار معقولة. هذه المفاهيم تحظى بشعبية كبيرة. وفي خطاب مهم بشأن تغير المناخ، أعلن الرئيس جورج دبليو بوش أن التكنولوجيا هي التذكرة (٢٠٠٥). ومع ذلك، فإن نظام الطاقة الحالي ليس مثاليًا، وبالتالي لا يحتاج المجتمع إلى مقايضة الوصول إلى الطاقة النظيفة مقابل دخل أعلى.

تغير المناخ هو أزمة. جميع السنوات العشر الأكثر حرارة، بما في ذلك عام ٢٠٠٧، حدثت منذ عام ١٩٩٧. وبما أن البيانات تم الاحتفاظ بها منذ عام ١٨٨٠، فقد حدثت سبع من السنوات الثماني الأكثر حرارة منذ ذلك العام. كان النصف الأول من عام ٢٠٠٦ هو النصف العام الأكثر دفئا على الإطلاق في الولايات المتحدة. وتذوب القمم الجليدية القطبية، وتتوسع المحيطات مع ارتفاع منسوبها، وتصبح الفيضانات

والعواصف أكثر شدة وتكرارا مع ارتفاع درجة حرارة الأرض. وتنجم موجات الحر والجفاف أيضًا عن ارتفاع درجات الحرارة، مما يعرض إمداداتنا الغذائية للخطر وتنتشر الأمراض. والخبر السار هنا هو أنه على الرغم من أن الأمور تتجه نحو الأسوأ تدريجياً، إلا أننا ندرك المتسببين الرئيسيين في ذلك: النفط، والغاز الطبيعي، والفحم، وإزالة الغابات.

تظهر أهمية الدراسة في القاء الضوء على تأثير التغيرات المناخية على قطاع الطاقة عالمياً، ودور انبعاثات غاز ثاني أكسيد الكربون في ارتفاع درجة حرارة الأرض، مع توضيح دور الحكومات العالمية في تخفيض حدة التغيرات المناخية من خلال وضع قوانين وتشريعات جديدة تدعم البيئة.

يهدف البحث الى تعزيز المعرفة بالآثار السلبية للتغيرات المناخية على الاقتصاد والبيئة، مع توضيح بعض المحاولات لتقليل خطر التغيرات المناخية مثل تقنية حبس الكربون وكذلك توضيح دور ديناميكية السوق وتحركاته من أجل تقليل الانبعاثات الكربونية.

كلمات مفتاحية (التغير المناخي – الاحتباس الحراري- غاز ثاني أكسيد الكربون – الانبعاثات الغازية – الوقود الحفري)

Global climate change's implications on the economy and the environment

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Abstract

The production and consumption of energy are key sources of greenhouse gas emissions. Today, greenhouse gas emissions, notably CO2, are a major source of concern. Despite the fact that CO2 is one of the most significant greenhouse gases. Because numerous harmful chemicals and reactants are employed in refinery of petroleum products, the risk of greater isotope C02 generation cannot be overlooked. Global warming debate, one way to reduce carbon emissions quickly and economically is to improve energy efficiency, which leads to a decrease in energy consumption.

Global warming, environmental laws, and energy policy debates all begin with the widely held belief that the current warm and electricity system is economically acceptable. As a result, any steps to alter the power system in order to attain other objectives, like reduction of pollutants, will increase in energy service prices and harm the financial market. Thus, it follows inventing and developing new technology is the only way to have affordable, clean energy. These conceptions are popular. In a significant speech on climate change, President George W. Bush declared that "technology is the ticket" (2005). However, the current energy system is not ideal, therefore society does not need to trade off access to cleaner energy for higher incomes.

Climate change is a crisis. All ten of the warmest years, including 2007, have happened since 1997. Since data have been kept since

1880, seven of the eight warmest years have happened since that year. The first half of 2006 was the warmest half-year on record in the United States. Polar ice caps melt, oceans enlarge and rise in elevation, and floods and storms become more intense and frequent as the world warms. Heat waves and droughts are also brought on by rising temperatures, endangering our food supply and spreading disease. The good news is that while things are gradually becoming worse, we are aware of the main offenders: oil, natural gas, coal, and deforestation.

The importance of the study appears in shedding light on the impact of climate changes on the energy sector globally, and the role of carbon dioxide emissions in increasing the Earth's temperature, while clarifying the role of global governments in reducing the severity of climate changes by establishing new laws and legislation that support the environment.

The research aims to enhance knowledge of the negative effects of climate change on the economy and the environment, while clarifying some attempts to reduce the risk of climate change, such as carbon capture technology, as well as clarifying the role of market dynamics and movements in order to reduce carbon emissions.

Keywords: (climate change, greenhouse, carbon emissions, fossil fuel, environment)

1. Introduction

Three segments typically make up the petroleum business. (1) Exploration and production (E&P) of crude oil and natural gas are considered upstream activities. (2) Petroleum must be stored and transported from oil producing areas to refineries and petrochemical facilities through pipelines, tankers, ships, trucks, or rail. (3) The processing of fossil fuels, crude oil, and petroleum products is done downstream., along with the promotion and distribution of liquid hydrocarbons (such as gasoline/petrol, diesel, kerosene, and jet fuel), Liquefied petroleum gas (LPG), solid hydrocarbons, and natural gas (lubricants, waxes, asphalt, etc.), and petrochemicals to consumers and customers. Midstream activities are occasionally incorporated into the downstream division.

In a comparative sense, the terms upstream and downstream can refer to operations and facilities that are located before and after a point of reference, respectively. Transportation is therefore upstream from oil production, and refining is upstream from transportation. In other words, oil refining comes after oil production, and transportation comes after oil refining. However, in the oil sector, upstream, midstream, and downstream are typically grouped into the three categories mentioned above. The workflow of the oil industry is compared in this scenario to a river or stream that originates in a mountain and flows down to the sea.

All aspects of the field life cycle, including technical and support functions, now place a high priority on security and the environment. The Piper Alpha catastrophe in the North Sea in 1988 led to a significant shift in the way the industry managed safety. Businesses understand that effective safety and environmental management are necessary to ensure long-term market presence and make sound financial sense.

Governments, non-governmental organizations (NGOs), and financial institutions are just a few of the stakeholders who regularly examine an operator's HSE (health, safety, and environment) performance.

The importance of this study stems from providing a full descriptive analysis of the impact of climate change on the economy and the environment.

1.1. methodology

The adopted methodology consists of a review of previous related literature and empirical studies concerned with Global climate change's implications on the economy and the environment. In addition, an in-depth analysis of how global warming affects the world Egyptian case study will be presented.

1.2. background

(Pascual & Elkind, 2010.) Every nation's economic growth is centered on energy. It moves us and fuels the establishments that house our offices, schools, hospitals, and government buildings. It retains chilly perishable items and heats dwellings. Its complexity is explained by its centrality. Energy is the foundation of prosperity and rivalry, political dispute and technical advancement, as well as the crux of an epochal environmental threat.

(M.M. Khan & Chhetri, 2012) At times of great crisis, such as the present, the disastrous cultural effects of highly fundamental beliefs begin to register very loudly and vividly. Environmental issues fall under this category, and this is even more true in the post-renaissance modern economy.

(A. Wiehe, 2008) While there is a dearth of light petroleum, there is a surplus of heavy petroleum that is rich in macromolecules, which has raised interest in methods that can transform heavy oils into light oils despite the lack of light petroleum.

(Sibyl Steuwer, 2013) In many IEA nations, awareness of the potential to reduce the growth in energy demand by enhancing end-use efficiency is rising. This interest is being stoked by growing worries about the prices, environmental effects, and other restrictions on additional generating capacity in some countries.

(Ersahin , Kapur, Akça, Namlı, & Emrah Erdoğan, 2017) Ecosystems and human livelihoods are seriously threatened by climate change. If they are left unmanaged or are managed properly, forest ecosystems can act as carbon sinks. If destroyed, they could also serve as sources of carbon. Because of their ability to lower atmospheric carbon dioxide and their contributions to biodiversity and sustainability, forest ecosystems are crucial to worldwide climate policy.

(Karimi, Shirzad, A. C. Silva, & E. Rodrigues, 2023) The principal issues facing humanity in the twenty-first century are the carbon dioxide emissions and global warming brought on by human activity, together with the universally rising rate of energy consumption, particularly fossil fuels. As a result, discovering renewable energy sources and creating new, more effective carbon capture technologies have been regarded as the primary initiatives to prevent an environmental catastrophe.

(I. Osman, Fawzy, & W. Rooney, 2023) Since the world became aware of the seriousness of the situation in the late 20th century, climate change has been a significant subject. Early in the 1990s, the United Nations Framework Convention on Climate Change (UNFCCC) was established. The Kyoto Protocol was then adopted in 1997, and finally, in 2015, the Paris Agreement. The Paris Agreement sought to keep the rise in global temperatures to 1.5 °C while limiting it to 2 °C by the end of the century.

(Hernández, 2021) It is vital to implement mitigation measures to lessen the effects of the temperature increase that has occurred over the past 50 years on the economy.

2. Defining the Problems of climate change

The problems of climate change, energy security, and energy affordability are each often defined in different ways, which exacerbates the difficulty of trying to develop policy responses and understand the interactions between policies. We, therefore, begin by defining the problems. At a high level, the problems of climate change and energy security are about negative externalities. The climate change, macroeconomic, and national security costs that result from fossil fuel consumption are not directly borne by consumers; they are social costs that economists call negative externalities, and government can help reduce them by making consumers bear them directly. On the other hand, energy affordability is an equity issue. (Pascual & Elkind, 2010., p. 210:211)

2.1. Global Warming and Carbon Dioxide

Energy production and consumption are key contributors to greenhouse gas emissions. Today, greenhouse gas emissions, notably CO2, are a major source of concern. Despite the fact that carbon dioxide is one of the major greenhouse gases, it is required for the survival of Earthly life. Consider that not all CO2 is created equal, and plants do not appear to all approve forms of CO2 for biosynthesis. (Islam, 2015, pp. 129-236) The old CO2 produced by fossil fuels and the new CO2 created by renewable biofuels are clearly distinguishable. The CO2 produced by fossil fuel combustion is old and polluted. The potential of increased isotope C02 creation cannot be disregarded because oil and natural gas refining utilizes a number of hazardous chemicals and catalysts. In light of this, it is clear that CO2 is not the source of global warming. Instead, industrial CO2, which is tainted with catalysts and chemicals, is more likely to grow heavier with higher isotopes that plants cannot absorb. Typically, plants absorb smaller amounts of CO2 from the atmosphere. In order to distinguish between natural and industrial CO2, it is necessary to know the source from which the gas is released, as well as the path the fuel that generates the gas takes from the source to the point of combustion. (Investopedia, 2023) After the industrial revolution, natural CO2 is declining even while the amount of CO2 in the atmosphere as a whole is rising. (M.M. Khan & Chhetri, 2012, p. 302)

Without reducing the use of fossil fuels, (budbromley, 2019) it is possible that the Earth would continue to warm and hurricanes will become more frequent and destructive. The most cost-effective method of carbon dioxide sequestration is carbon dioxide flooding in conjunction with enhanced petroleum production. Sadly, electricity plants are rarely found close to oil production facilities. The possibilities include piping carbon dioxide to locations where oil is produced or storing it as a supercritical gas in deep salt ponds (CCS, carbon capture, and sequestration). (epa)

Additionally, the volume of petroleum reservoirs in the US is insufficient to absorb all the carbon dioxide produced by the combustion of fossil fuels in power plants and refineries. There are no technical barriers preventing widespread CCS, (The Energy Chamber of Trinidad and Tobago, 2016) which is good news. Of course, the consumer will have to pay much more for energy, but if introduced gradually, the economy will not collapse. Utilizing the cutting-edge equipment used by petroleum engineers and geologists, technological advancements should even mitigate the economic impact. Canada is already implementing CCS to lessen the effect of tar sands extraction on greenhouse gas emissions. The United States is currently waiting for new legislation and public policy from a more educated government and populace. (A. Wiehe, 2008, p. 8:11)

Africa, and in line with the completion of shared projects. Such bilateral collaboration must not obstruct efforts to address the global issues affecting the energy and carbon markets, though. In such a multilateral setting, it is acceptable to consider the necessity of border tax adjustments for energy-intensive items in relation to nations that refuse to participate in international efforts to reduce greenhouse gas emissions.

Global warming is one of the most serious issues of our day, according to the Intergovernmental Panel on Climate Change (IPCC), and it affects both the present and future generations. The Paris Agreement, which went into effect in November 2016, intends to keep the average global temperature rise to 2°Cover pre-industrial levels, even if addressing climate change is one of the Sustainable Development Goals (SDGs). It is crucial to reduce these emissions through various regulations because it is widely believed that greenhouse gas (GHG) emissions from non-renewable energy sources are one of the main contributors to climate change. Although there are numerous factors that influence GHG emissions, empirical studies of the effects of economic variables have just recently been conducted. (Akbulut & Burçin Yereli, 2023, p. 32)

The most rational way to benefit both producing and consuming nations is through a multilateral economic system with global control. A component of the UNFCCC, the WTO, OPEC, the G8, and the International Energy Agency would need to be incorporated into such a global governance system. Right now, neither a huge bureaucracy nor harsh regulations are required. To discuss, monitor, and fully integrate energy and climate challenges, the world needs a permanent platform. The only international actor with the right to suggest such a new structure is Europe. The United States, China, Russia, and Saudi Arabia must work together to secure and enhance the global energy and climate trading system. However, in the absence of such a perfect solution, there are other leadership and platforms where Europe can continue to participate, putting its unique perspective on the energy and climate crisis into action on a global scale:

1. participation in international institutions such as the World Bank, the UNFCCC, the International Energy Agency, and the World Trade Organization on an ongoing basis (WTO). Energy and environmental concerns should be included as much as feasible in the WTO’s rule-based conflict resolution mechanisms. Attempts should be made by the Commission to encourage a global summit on the multilateral energy trading policy.

2. The European Union must continue to play a leading role in the Kyoto Protocol and the development of the European Emissions Trading Scheme, but it must also change. Its enormous potential to further decarbonize the EU economy and reduce reliance on imported hydrocarbons hasn’t always gotten enough attention in recent years. It is an essential component of EU energy policy and needs to be included in any energy-related foreign policy activities. As soon as possible, oil-based carbon emissions from the transportation sector (including land and air transport) must be included in the ETS for reasons of supply security as well as environmental concerns. Only with a comprehensive set of policies, most notably the expansion of the EU ETS outside of its boundaries, will Europe be able to maintain the worldwide leadership it has shown in this more and more policy-focused field.

3. Additionally, Europe must keep creating the framework for private investment in supplier nations. The term “supply country” will be used to refer to both emission reduction providers and hydrocarbon producers throughout the coming decades. Energy infrastructure projects like the Nabucco gas pipeline and the proposal to connect

sub-Saharan African nations to the Mediterranean are supported by the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD). However, building the technical and legal frameworks necessary for private investment to participate in energy production and greenhouse gas emission reductions in Third World nations would be more important.

4. Europe must continue to participate in the Energy Charter Treaty process. However, it needs to sharply alter its focus. First, the focus should move from stressing "third-party access" to establishing the regulations for foreign direct investment and technological change. Second, it needs to be made global energy investments a part of its extended purview. The Energy Charter Treaty (IISD) is a shining illustration of how bilateral or regional initiatives can get mired in unending rent-distribution disputes rather than creating the parameters that allow it to be maximized.

5. It is necessary for the EU to continue participating in multilateral technical projects like the Extractive Industries Transparency Initiative and the Global Gas Flaring Reduction Partnership of the World Bank, which both address environmental and supply security issues. These initiatives include backing the Financial Action Task Force's (FATF, 2012) fight against money laundering and expanding the adoption of the International Finance Corporation's (IFC) Equator Principles, which encourage environmentally and socially responsible investment, by EU businesses and banking institutions. The TACIS initiative, which logically results in joint implementation, should be used by the European Union to resume and broaden its technical support to Russia, East European, and Central Asian nations.

Accordingly, the main greenhouse gases that contribute to global warming are thought to be carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, hydrochlorofluorocarbons, and hydrofluorocarbons. It is important to note that the COVID-19 pandemic caused a fall in worldwide energy consumption of roughly 4% in 2020 compared to 2019, but by the end of 2021, the demand had increased by 0.5% from its pre-pandemic level.

After the industrial revolution, the earth's atmosphere's greenhouse gas concentration increased from zero to one, according to the Annual Greenhouse Gas Index (AGGI), while in the following 30 years, up until 2020, the AGGI grew more quickly and reached 1.47. In other words, the earth's atmosphere today absorbs around 3.18 W/m2 more energy than it did in the preindustrial era, which causes the global climate to change more quickly. Global warming, rising sea levels, severe natural disasters, forest fires, and melting snow are all effects of the rising rate of greenhouse gas emissions. (Karimi, Shirzad, A. C. Silva, & E. Rodrigues, 2023, p. 2042)

2.1.1. Climate change

Speaking about climate change, improving energy efficiency, and subsequently reducing energy consumption are seen as ways to quickly and economically reduce carbon emissions. Market-based policy instruments include tradable licenses, carbon taxes, and carbon offsets. These instruments have become well-known in the context of climate change discourse.

As a result, the three discourses on energy efficiency, built around the objectives of securing energy at reasonable rates, preserving competitiveness, and battling climate change, suggest several issues that need to be resolved. The ultimate objectives are translated into more specific, short-term objectives within each discourse, such as lowering CO2 emissions, lowering electricity and gas consumption, lowering peak loads, increasing market adoption of specific energy-efficiency standards, fostering cutting-edge technology, and so forth. Each viewpoint implies a different solution since it approaches energy efficiency from a somewhat different aspect. For instance, maintaining a comfortable standard of living in all families or safeguarding carbon reductions through energy efficiency are more important than energy savings in terms of preserving the environment and providing an affordable supply of energy. Therefore, the specific objectives that end-use energy efficiency seeks to address must be taken into consideration when selecting tools to promote end-use energy efficiency. And often, this objective can be found in one or several discourses on energy efficiency. (Sibyl Steuwer, 2013, p. 93:94)

As energy security and a healthy climate are both global public goods, there is an opportunity for windfalls and free riding. The global society benefits from these public goods, but markets need a proper regulatory and energy policy structure, including both social and

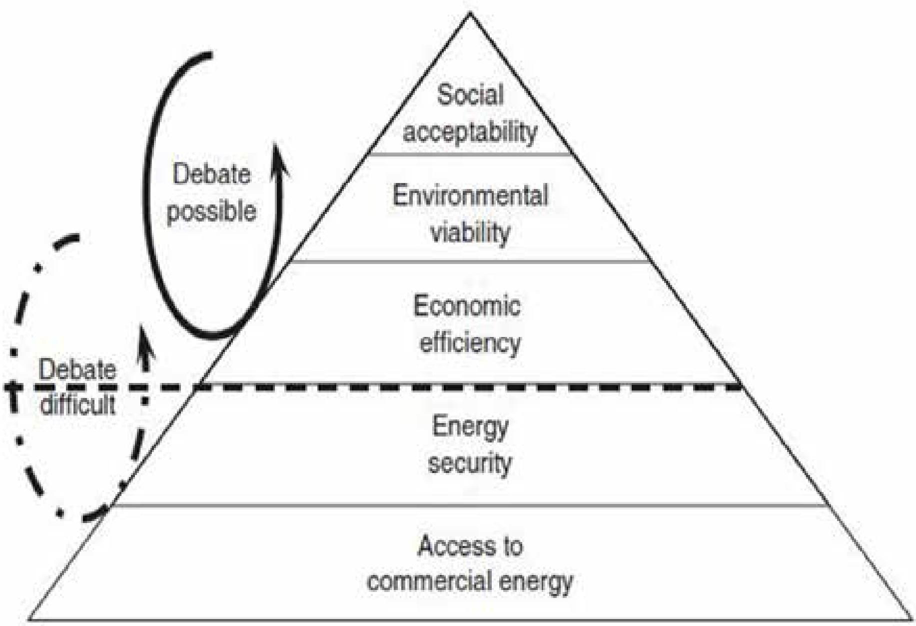

Fig. 1 (importance of energy security) (W.Freiab, 2008,)

An issue's linked position in the pyramid may shift over time. Climate change in Europe has shifted from being a concern for the environment (in the 1990s) to one for the economy, with carbon markets turning emissions into direct costs for businesses since 2005. Climate change is also a security concern, potentially leading to accelerated migration or more frequent environmental hazards. The precautionary principle has led most countries to invest large amounts in armies for the hypothetical case in which they have to defend themselves against aggression. The same principle should make us invest similar amounts in preventing climate change from happening.

2.1.2. climate crisis

Carbon dioxide (CO_2), the main greenhouse gas, is released into the atmosphere when fossil fuels—primarily oil, natural gas, and coal—are burned. More heat from the sun is trapped close to the surface of the earth the more greenhouse gases there are in the earth's atmosphere. The planet's temperature rises and the turbulence in our climate increases as more heat is trapped. The earth's natural system for removing greenhouse gas emissions from the atmosphere is forests. The planet's ability to mitigate the consequences of human emissions decreases as we clear more forests, particularly older, thicker forests.

By far the largest contributor to global warming per person is the United States, which in 2004 reported 30% of all energy-related CO_2 emissions worldwide (the most recent year for which certain data is available). The United States emits a staggering 70% of the world's CO_2 through just two sources: our power plants, which burn coal and natural gas, and our vehicles and trucks, which burn oil. America's roads alone use one of every seven barrels of oil produced worldwide. Another 5% of American greenhouse gas emissions come from the actual production of oil.

Global temperature has increased over the last 50 years, not only due to carbon dioxide (CO2) emissions, but also due to other types of greenhouse gases (GHG). According to the World Bank (2010), anthropogenic activities, in a baseline scenario, can increase global temperature by 5 °C more than what was raised in the pre-industrial period, but with appropriate actions and in the right time this can be restricted to 2 degrees Celsius. (Hernández, 2021, p. 524)

As a result, consumers are increasingly responsible for residential energy use and carbon emissions. Future increases in energy demand and carbon emissions are predicted to be mostly driven by residential, commercial, and vehicular construction. Between 2006 and 2030, total U.S. carbon emissions are expected to increase by 16 percent, making reductions even more necessary to prevent the worst effects of global warming. Carbon emissions are determined by four factors: population, economic production, economic energy intensity, and energy system carbon intensity.

2.1.3. Ozone-depleting elements

An international agreement called the "Montreal Protocol on Substances that Deplete the Ozone Layer" aims to protect the stratospheric ozone layer. It mandates the phase-out of the production and use of chemicals that destroy ozone in the stratosphere, including chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform. These compounds have the potential to deplete the stratospheric ozone layer, which shields the earth from UV radiation, if they are released into the atmosphere, in accordance with scientific theory and facts. Some of these parts are used in gas refrigeration and firefighting apparatus.

2.1.4. emissions from oil in water

When water and oil are generated together, some water is always left in the oil when the water and oil are separated. The typical limit for oil emissions into the sea is 40 ppm. On some drilling platforms, processing platforms, and oil terminals, oily water is disposed of. Since the ports are frequently close to local residential areas and vacation destinations, the quality of the water disposed of there is still under close examination. The surface handling issue is much diminished if the engineer can find a way to limit the produced water at the source (for example, by turning off the water supply or reinjecting produced water into reservoirs). Governments are increasingly forbidding oil-in-water emissions, which forces business owners to implement generated water re-injection systems (PWRI). (Jahn, Cook, & Graham, 2008, pp. 89-90)

2.1.5. Future Climate Change's Effects on Agriculture

The ramifications of any shift on agriculture will vary depending on the region, just as the effects of future climate change will. For instance, some farmers in the temperate mid-latitudes may gain from expected temperature increases, but those in the equatorial or tropical regions, where crops are already growing near the edge of their heat sensitivity, may not benefit as much. Indeed, the effects of any climate change on agriculture must take into account a number of variables, including the seasonality of temperature and precipitation variations, modifications to the hydrological cycle, and potential changes in soil fertility. (Wallace, 2016, p. 457:476)

However, from a global perspective, new simulations of the effects of climate change on the three main crop types (wheat, rice, and maize) show that only 10% of estimates for the years 2030–2049 show yield increases of 10% or more (compared to late twentieth century values). Ten percent of forecasts predict a simultaneous 25 percent decline in yields. Beyond this time period, the probabilities of serious agricultural consequences are scaled in accordance with the various levels of global warming expected by the various RCPs. A concise summary of the likely effects of climate change on agriculture in Europe and North America over the coming century is provided below. (Orszulik, 2016, p. 472:473)

3. Environmental effects of refining operations and products

The production, importation, storage, transportation, and use of petroleum are all subject to laws, making the oil and gas sector one of the most tightly regulated sectors in the US. Environmental and political legislation both have an impact on refining processes. Some of the air pollutants and other residuals produced by the methods used to refine petroleum are poisonous or dangerous substances. Numerous environmental rules and regulations have been created as a result of the effects that refining and using refined products have on the environment. Some of the most important laws concentrate on changing the way products are made to lessen the amount of air pollution they produce when they are used. (H. Gary, E. Handwerk, & J. Kaiser, 2007, p. 21)

4. Effects of power fuels on the environment

Impacts on the environment, human health, and safety can result from the production of electricity. These take place during mining, when using fuels, and when managing garbage. Pollution is also caused by the mining of power fuels, their transportation, and storage, as well as by the disposal of ash and other solid wastes that are byproducts of the combustion process. In terms of environmental considerations, coal stands out. Its consumption by-products are significantly more solid waste, higher carbon, SO_2, and NOx emissions, and more polluting than those of other fuels. The effects of coal mining and transportation on environmental health and other safety issues can be significant. Local, regional, and global effects of pollution are the three basic categories.

(i) Heavy hydrocarbons and particulate debris, which are deposited within hours and can move up to 100 kilometers from the source, are the main local repercussions.

(ii) Emissions and effluents have a regional influence; the most significant of them are SO_2 acid depositions, which have a few-day atmospheric residence time and can travel up to a few thousand kilometers, having cross-boundary consequences.

(iii) CO_2 emissions and other gases with long atmospheric residence durations, including methane, are the principal examples of global pollution. (Khatib, 2014, p. 109)

5. Environmental impact assessment (EIA)

A planned activity's potential physical, biological, social, and health impacts are intended to be documented by an EIA. Decision-makers will be able to assess whether an action is appropriate and, if not, identify potential alternatives as a result. EIAs will usually be carried out for seismic exploration and appraisal drilling, development drilling, facility installation, production operations, decommissioning, and abandonment.

EIAs are normally conducted out by independent specialists or organizations to ensure objectivity of the findings. It will require cooperation from government ministries of the environment, fisheries, food, agriculture, and local water in addition to scientific experts. Agreement with local NGOs may be critical in initiatives that may have an impact on the local people (terminals, refineries, access roads, land projects). The total schedule of the project will be significantly impacted by the EIA process and its results. Therefore, crucial success factors include early consultation, stakeholder involvement, and maximizing the utilization of local expertise.

Before any movement occurs, an EIA begins with a baseline study that characterizes and inventories the initial natural state of the flora, fauna, aquatic life, land, and seabed. The length of an EIA depends on the size, nature, and extent of the area being studied as well as the extent of the prior work, although it normally lasts at least six months. However, it could be necessary to monitor over numerous seasons to set a valid database (years).

The EIA should not be left off the planning schedule because it is frequently a "critical path item." An environmental impact statement (EIS), which covers the positive and negative effects thought to be a result of the activity, details the assessment's findings. One piece of information necessary for project approval is the report. A final choice can be taken while taking into account the potential effects of a given course of action, and where necessary, by implementing the requisite monitoring and mitigation procedures. (Jahn, Cook, & Graham, 2008)

6. Negotiations on climate change and sustainable development

In a number of international climate policy accords, the growing understandings of the socioeconomic, technical, and environmental risks of climate change have been expressed. The UN Foundation Convention on Climate Change (UNFCCC), which set a framework for continued international cooperation on climate policymaking, was the first of these agreements, and it was adopted at the UN Earth Summit in 1992. Since then, significant progress has been made in terms of establishing climate policy, including the 1997

Kyoto Protocol, the 2001 Marrakech Accords, and the 2010 Cancun Agreements. These texts have provided recommendations on how to prepare for and reduce climate change.

However, there were other issues on the 1992 Earth Summit's agenda in addition to climate change. The link between economic growth and environmental deterioration, including challenges to biodiversity, climate change, and forest degradation, was the main topic of discussion. In addition to the UNFCCC, the following documents were also adopted to address similar issues:

- Agenda 21 as a plan of action for sustainable development on a global scale;
- Rio's Framework Convention on Climate Change;
- The Convention on Biological Diversity; The Statement of Forest Principles.

Together, these publications conveyed the idea that the necessary changes wouldn't come about without a shift in our views and actions. The UN Conference on Sustainable Development (UNCSD), also known as "Rio+20," will be held in Rio de Janeiro, Brazil, June 4-6, 2012. It is timed to coincide with the 20th anniversary of the 1992 Earth Summit. A new policy agenda for a "green economy in the context of sustainable development and poverty eradication" and "building an institutional framework for sustainable development" should result from this. (van der Gaast & Begg, 2012, p. 6:7)

6.1. Managing the Interactions between Climate and Energy Policy

Not only is there stress between the goal of energy affordability and the goals of decreasing climate change and oil consumption, which may require higher rather than lower prices, but the issues of energy security and climate change themselves are often misleadingly conflated. Many pretend that addressing U.S. energy security needs will also promote progress on climate change, and vice versa. To be sure, in many ways, energy security and climate change do overlap. For example, petroleum accounts for 44 percent of U.S. carbon emissions, so reducing oil use would have significant climate benefits. But in at least four less appreciated respects, climate change and energy security are distinguished and, at times, even conflicting goals.

First, there is a temporary difference between the problems. Climate change is a long-term problem since carbon stays in the atmosphere for so long, while energy security is a much more immediate concern. Since reducing emissions in any given year has a low marginal benefit but a large potential cost, effective climate change programs can gradually reduce emissions while also incorporating cost-containment strategies. Contrarily, the risks connected with energy security already endanger the U.S. economy and constrain its options for foreign policy, necessitating more immediate cuts in oil use.

The effect of the oil price shock of 1973, for example, was an immediate decrease in the real GDP of the U.S. economy for the subsequent two years and an increase in the amount that households paid for gasoline. Similarly, the economy would not have been in recession from the last quarter of 2007 through the third quarter of 2008 had it not been for the oil price shock. Despite the immediacy of the problem, the solution to energy security, as we propose, may need to be regular to avoid unexpected changes to the tax policy or household budgets.

Second, there is geographic diversity. The United States can take single measures to promote its energy security by decreasing its oil consumption and thus the oil strength of its economy and its susceptibility to oil price shocks. Climate change, however, is a universal issue because emissions from everywhere over the world contribute equally to the issue. Therefore, without international cooperation, particularly from significant GHG emitters like China, any successful climate policy is challenging. To put in perspective, the importance of global action, consider that if Chinese CO_2 emissions continue to grow at the rate that they did from 2002 to 2007, then by 2036 China alone will consume the whole CO_2 emissions budget that would be allowed to reach a 450 parts-per-million global CO_2 stabilization goal.

Third, while cutting oil and gas usage might satisfy their respective concerns about energy security, doing so will not be sufficient to address the issue of climate change on its own. Current and past emissions will continue to warm the planet over the next century even if all future emissions are avoided. Even as governments endeavor to reduce the "flow" of new emissions into the atmosphere, the planet is already experiencing climate change from the "stock" of carbon emissions in the atmosphere. A general approach to addressing climate change, therefore, must include not only mitigation of future emissions but also adaptation to the consequences of past emissions.

Finally, while reducing oil and natural gas consumption is the primary way to alleviate energy security concerns as we have defined them (that is, energy problems with both macroeconomic and national security dimensions), reducing coal consumption is the primary way to alleviate climate change concerns. There are more affordable alternatives for coal used in the power sector than there are for oil used in the transportation and manufacturing sectors, which increases the likelihood that coal consumption will decline as a result of climate legislation. This is made worse by the fact that oil has comparatively less carbon per unit of energy compared to coal. Besides, the carbon component of coal power is a greater proportion of the final price than the carbon component of oil used in gasoline, where about $1 per gallon goes to taxes, marketing, refining, and distribution.

Therefore, pricing carbon emissions—the key component of a cost-effective climate change strategy—would lead to a far bigger increase in coal prices than in gasoline prices. For example, a CO_2 tax of $25 per ton would raise the price of oil, starting at a base price of $100 per barrel, by about 10 percent (a hike of roughly $0.24 per gallon at the pump), but it would approximately double the price of coal.

Given the cost of alternatives and entirely cutting back on consumption, carbon policies may therefore only have a limited impact on decreasing oil use. Additionally, they would not likely result in significant drops in oil demand on their own. Certainly, by sharply raising the price of coal relative to that of natural gas, a cap-and-trade system or carbon tax may increase energy security hazards by causing a substitution of natural gas for coal.

Energy security and climate change affect distinct fuels to varying degrees, so attempts to advance one issue may be at the price of the other. Policymakers need to reduce such disputes. Coal use is one example of the tradeoff, since coal has fewer energy security risks than oil or gas but greater climate risks. If carbon capture and storage (CCS) proves feasible, then the United States may be able to remain consuming coal at current levels with minimal influence on the climate. But the viability and safety of CCS technology have yet to be proven on a large scale. Coal-to-liquid technology, which converts coal into a diesel fuel that may be used in place of conventional oil, is perhaps the best illustration of the trade-off between energy security and climate change.

Even though this technique might increase energy security by consuming less oil, it would intensify climate change by emitting more than twice the amount of GHGs as conventional oil production, in addition to requiring intense coal mining and large amounts of water.53 Similarly, subsidies for ethanol may reduce oil consumption, but recent data hints that corn-based ethanol may lead to more GHG emissions when land-use changes are taken into account. The recent run-up in oil prices also reveals how climate change and energy security can come into conflict due to unintended consequences.

From a climate change perspective, high oil prices were partly a welcome development because of the incentives created to reduce oil consumption. However, high oil prices have also made it profitable to extract hard-to-recover and dirtier fossil fuels like oil shale and to use coal-to-liquids technology. Similarly, since natural gas prices usually track crude oil prices, higher natural gas prices have led some European utilities to calculate that burning coal, even with the higher carbon charge in the EU's cap-and-trade system, is cheaper than burning cleaner natural gas. On the flip side, a high enough carbon price may exacerbate energy security concerns if it results in a switch from coal to natural gas, increasingly in the form of liquefied natural gas (LNG) from unstable regions. (Pascual & Elkind, 2010.)

7. Response of developing nations to climate change worries

Even though they frequently have other goals for their sustainable development as their motivations, developing countries are notably active in responding to concerns about climate change, even though they have not agreed to target levels of GHG emission reductions (like some developed countries, including the United States). They are sometimes world leaders in describing excellent renewable energy options and taking adaptation into account as part of a comprehensive response to future climate changes. (J. Wilbanks, 2007, pp. 341–350)

Brazil is the most prominent example, which is a sizable emerging nation: the only nation in the world with a sizable industrial sector that gets most of its electricity from renewable sources. This is mostly due to the nation's significant hydroelectric energy production potential as well as decisions made in the 1970s and 1980s to embark on very big hydropower projects like the Itaipu and Tucurui dams. At the moment, more than 80% of Brazil's electricity comes from hydroelectric power. It also displays choices that go above the accepted limits for producing liquid fuel from biomass; in this example, ethanol from their sugar sector. National fuel supply had 25% ethanol as of June 2003, and by 2006 the whole fleet of highway vehicles was expected to be able to run on both gasoline and ethanol (EIA, 2003a). Brazil barely contributes 1.5 percent of the total worldwide energy-related carbon emissions, but consuming 2.2 percent of the world's total energy. No industrialized nation can duplicate this feat, despite the fact that Brazil's extensive growth of biomass and hydropower has had negative environmental effects in addition to reductions in carbon emissions. There are too many different types of leadership to list them all. Important instances include:

• China's achievements in increasing industrial energy efficiency. China's national energy usage decreased by more than 9% between 1997 and 2000, although the country's overall GDP increased. Reduced energy usage in the sector while industrial production increased was largely responsible for this trend. Despite the fact that global energy consumption has increased after 2000, China's achievement in the late 1990s to reduce emissions during economic growth was particularly remarkable given the country's stage of development.

• India's success in switching to alternate fuels for high-volume petroleum-based car fuels. The most exciting change in the use of highway fuel in any global city occurred in 1998 when the Indian Supreme Court ordered that the public vehicle fleet in the nation's capital, New Delhi, be converted to compressed natural gas (CNG) in response to a lawsuit filed by environmental protection advocates. The transition was fully finished by 2002, and the quality of the urban air had significantly improved. This great experiment continues to be a one-of-a-kind illustration of how quickly the use of alternative fuels with lower emissions has replaced conventional highway fuels. India has also been a global pioneer in the renovation of electric power plants to increase efficiencies and lower pollution.

• Barbados' solar water heating accomplishments. Barbados, which ranks alongside Israel and Cyprus as a manufacturer and user of solar water heaters, may be the only developing nation (outside of Brazil's large-scale uses) to be an international leader in clean energy technology. Nearly 32,000 solar water heaters are used in homes, businesses, and hotels in this small nation, accounting for about one-third of all households. This is undoubtedly the largest use of solar water heaters in the Western Hemisphere. The only significant global provider of solar water heaters to come from the Western Hemisphere, three modest production and service companies are expanding into regional and, in some cases, global markets. This is a wonderful example of how local leadership from three decades ago has paid off.

• proactive participation of Central American nations in accords aimed at reducing emissions in developing nations or improving carbon sinks in industrialized nations. Such agreements were promoted by a UNFCCC initiative known as Activities Implemented Jointly (AIJ), which was renamed Joint Implementation (JI) under the Kyoto Protocol. Though there were few results overall, Central American nations were among the most eager to pursue options for emission reduction. One example of this is a partnership between American power providers and Costa Rican afforestation initiatives.

Each time, national, regional, or local economic and/or environmental co-benefits were used as the foundation for a developing country's achievements in researching global greenhouse emissions as well as delivering quantifiable reductions in such emissions. Cost-cutting measures (as in China's industrial sector or India's power plants), local and regional air quality improvements (as in India's use of CNG), or opportunities for sustainable development (as in Barbados's solar water heating and Central America's JI cooperation) have all contributed to decreases in greenhouse gas emissions. Benefits from climate change were observed and proudly recounted, but other benefits - more immediate and short-term - were the drivers of action.

Meanwhile, emerging nations have taken the lead in another crucial relationship on the global stage. In New Delhi in 2002, at the UNFCCC Conference of Parties' Eighth meeting (COP-8), poor nations successfully pushed for the inclusion of adaptation and mitigation measures in the international response to climate change. They sparked the creation of the Delhi Ministerial Declaration on Climate Change and Sustainable Development (commonly referred to as "The Delhi Declaration"), which called for immediate action to advance adaptation measures. This declaration was anchored once more in their development concerns, in this case about their vulnerabilities to the effects of climate change. Since then, the UNFCCC has emphasized the need of integrating national adaptation programs of action in national communications, particularly from the least developed nations, and several developing nations (including China and India) have ratified the Kyoto Protocol. The yearly COP meetings continue to discuss how to include commitments to assisting adaptation in upcoming climate change laws and agreements.

The outcomes of cost-benefit comparisons are scale-dependent, according to new data, which has significant strategic consequences. The net benefits of avoidance are greater on a global scale than the net benefits of adaptation, which are greater locally.

Of course, this record does not represent a significant overall reaction by developing countries to their concern for climate change. Some of the developing nations that export oil are among the most outspoken deniers of the dangers posed by climate change. However, poor nations do seem to be contributing to what is still a varied, dispersed, partial global reaction at a time when affluent countries themselves have shown little desire for meaningful efforts to decrease carbon emissions, with portions of Europe as the exception. In the grand scheme of things, neither their contributions nor those from industrialized nations have been transformative. To date, this preliminary research appears to support a number of broad conclusions:

• Instead of a strong commitment to mitigation per se, developing countries are more interested in reducing greenhouse gas emissions because of the potential economic or environmental benefits or because they are worried about potential vulnerabilities to climate change influences in their regions.

• Because the co-benefits are so important so often, developing countries are sometimes not only responding but leading the global response, typically through bottom-up dispersed initiatives rather than national legislation or action.

• Although many observers think that adaptation is more likely to be able to address many of the risks and costs associated with climate change in developed regions than in developing regions, developing countries are ahead of most developed countries in considering this aspect of an integrated portfolio of responses to climate change. (K. Sovacool & A. Brown, 2007, pp. 227-228)

Determining what their role should be in maintaining greenhouse gas (GHG) concentrations in the earth's atmosphere will play a significant role in whether or not emerging countries are doing their part. One component is that people responsible for the issue should resolve it. In other words, since activities in the industrialized world, particularly in Europe and North America, were largely responsible for increases in GHG concentrations in the earth's atmosphere due to the use of fossil fuels and because these activities produced wealth in those regions, the areas that benefited should bear the burden of dealing with the environmental consequences.

Another viewpoint is that, regardless of the past, everyone who poses a threat to future issues must be part in resolving them. To put it another way, future contributions to preserving GHG emissions must take into account future emissions, where the part of the global total from developing countries is already starting to surpass the share from the traditional industrialized countries.

This perspective gap is mostly due to the emphasis on equity and justice vs the emphasis on reality and pragmatism. Advocates of one emphasis frequently fail to appreciate the value in the other, and system studies must design methods that take into account both imperatives.

Think about the equity perspective first. There is no doubt in the world whose emissions since the beginning of the Industrial Revolution, and particularly whose emissions since the middle of the 20th Century, are the cause of climate change to the extent that human activities that convert fossil carbon fuels into greenhouse gas emissions are the primary cause (IPCC, 2001). The consumption of fossil fuels in what are typically referred to as developed or industrialized countries—specifically the United States, Western Europe, and other advanced economies like Japan—has contributed to the issue. The high incomes and lifestyles supported by this consumption and the energy services it has made possible have often widened the divide between the "North," or the developed countries, and the "South," or the developing nations. The main exception are the oil and gas producing nations in what was formerly referred to as the South, whose standards of life have frequently profited from a "natural resource lottery" that makes them suppliers of fossil fuels to satisfy the demands of developed nations.

Since 1751, the usage of fossil fuels has released a little more than 300 billion tonnes of carbon into the earth's atmosphere (along with cement production). Since the mid-1970s, half of these emissions have occurred.

The United States, Europe, Japan, Canada, and Australia—the roughly wealthy, relatively large developed countries of the world—produced a very large part of the emissions up until the 1990s. The United States continued to account for more than 22% of the world's total carbon dioxide emissions in 2003, measured in tons of carbon. Greater differences between developed and less developed countries can be seen in data on per capita CO2 emission rates. For instance, the United States had a carbon emission rate per person of 5.43 metric tons in 2003, compared to 0.86 for China, 0.33 for India, and 0.1 for Ghana. Although correlations are stronger between high and low values than in the middle ranges, per capita carbon emissions tend to be closely correlated with per capita national incomes. Consequently, developing countries typically argue that per capita emissions rather than national total emissions should be the equitable metric for emission reduction responsibilities.

Additionally, they contend that by pursuing economic development and progress, which require considerable increases in the use of energy services, they have a claim to reduce the gap between industrialized and developing nations. If fossil fuels are the most cost-effective energy sources, then limiting their greenhouse gas emissions means limiting their economic growth. To put it another way, developing countries' contributions to reducing global trends in greenhouse gas emissions should take into account both the fact that they did not cause the issue and the fact that their development aspirations come first.

Despite equity and justice, many observers and decision-makers contend that the world's population must come together to address the issue of climate change because no one person or group can resolve it on their own. China is now the second-largest nation in terms of total national carbon emissions, followed by India, Korea, and Mexico. Additionally, emissions from developed economies with large, expanding economies are increasing more slowly than those from developing economies; according to current forecasts, carbon emissions from developing countries will overtake those from industrialized countries before 2020. Because of this, stabilizing greenhouse gas concentrations in the earth's atmosphere very probably won't be possible with significant emission reductions from industrialized countries alone. Instead, stabilizing the global carbon cycle will require significant contributions from emerging countries.

The truth is that both of these viewpoints are legitimate. In conclusion, individuals who contributed significantly to the problem's development and who have benefitted from its causes bear a specific responsibility for taking the initiative to find solutions. It is irresponsible to take less action. However, the industrialized nations, whose GHG emissions over the past century have contributed to rising GHG concentrations in the earth's atmosphere, cannot resolve the issue by cutting their emissions. Regardless of what industrialized countries do, emission trends in relatively big, fast expanding emerging countries will dominate global totals over the next half-century or more; hence, actions by developing countries are an inescapable key to the global response. Finding a policy course that strikes a balance between the two viewpoints that is both politically feasible and environmentally responsible is a challenge. (K. Sovacool & A. Brown, 2007, pp. 342-348)

8. Economic Policies for Carbon dioxide reduction

8.1. Global Carbon Market

The international Kyoto Protocol commitments were spurred by the need to reduce greenhouse gas emissions in 1998. Most global efforts to reduce emissions have concentrated on creating an economic framework that uses financial incentives to prohibit excessive carbon emissions and encourage the development of clean energy. Two of the most prevalent forms of these economic incentives are a carbon tax ("carbon tax") and various emissions trading schemes ("ETS"), which enable businesses to purchase and sell permits for certain amounts of emissions on the open market.

In Finland, initiatives to reduce emissions through the use of a carbon price scheme date back to 1990. Soon after Finland implemented its national carbon price, other European nations followed suit. A large number of Scandinavian and Eastern European nations were among the first to implement this strategy. However, the European Union Gases Trading Scheme didn't go into operation until 2005, which is when the considerable coverage of greenhouse emissions began. Currently, 4% of the world's carbon emissions are subject to carbon taxes and emissions trading.

By integrating national or regional carbon prices with ETS, non-EU countries have started taking part in emissions control systems. There are a number of regional initiatives in the United States

(California), Canada (Alberta, British Columbia, and Quebec), and China, despite the fact that the majority of nations have established national strategies to reduce emissions (regional pilot programs in large metropolitan areas). A little under 12% of all worldwide greenhouse emissions were covered by carbon pricing in 2015 as a result of the establishment of carbon pricing schemes in numerous important nations (Japan and California in 2012, China in 2013, and Korea in 2015). The EU ETS was by far the biggest contributor to global efforts to reduce emissions. (Veld-Merkoulova & Viteva, 2016, p. 7:9)

8.1.1. Theory and restrictions of carbon pricing

Climate mitigation policies would be simple in an ideal world. By increasing the cost of high-emitting technologies relative to low-emitting technologies, a single global carbon price might be established (either through a tax or a cap-and-trade system), which would encourage emission reductions. In theory, these extra expenses would be taken into account by businesses when making operating and investment decisions, providing an incentive to move from one existing technology to another or to advance new low-carbon technologies. The cheapest sources would reduce emissions initially, with prices rising over time until emissions were nearly zero and could be absorbed by the natural sinks. The strategy would need to include almost all of the sources of anthropogenic greenhouse gas emissions on the world in order to prevent emissions from “leaking” from this restriction. (Ebrahim, 2019, p. 113:114)

Martin Weitzman debated the benefits and drawbacks of taxes vs tradable permits in 1974, coming to the conclusion that there is a justification for favoring taxes in the case of climate change. However, raising taxes politically is challenging, particularly in a global setting. Because free permits can be given away as a solution to the issue of stranded assets of current emitters, the idea of paying for emissions has gained significant popularity. Although many of the conclusions also apply to efforts to create a unified international taxation system, the majority of the discussion of carbon markets assumes that trading schemes will continue to be the best option for carbon pricing schemes.

The efficiency of carbon price is nevertheless constrained by practical issues. The difficulties of developing a stable enough regulatory administration to for emission reductions to be used as bankable assets by businesses to finance the necessary investments is perhaps the most fundamental. Due to the potential for significant wealth transfers between companies and between nations as well as the associated challenges of agreeing on how such taxes or trading scheme revenues should be allocated and spent, there are significant political challenges associated with reaching an international agreement on standardized rules for taxes or trading schemes.

Another significant drawback of carbon pricing is that it will result in underinvestment in research and development of technologies that are still far from commercial viability, even if these regulatory challenges could be resolved. This is due to the fact that businesses cannot guarantee they will be able to retain exclusive access to all of the knowledge developed through research and development (R & D). Contrary to the prevailing premise of environmental economics, Knut Rosendahl demonstrates that ideal tax rates should be diversified to disclose the learning capacity; as a result, they will not necessarily be the same across all sources.

Additionally, the issue of time inconsistency makes it challenging for policymakers to convincingly guarantee high future prices to justify current expenditure on R & D in new technologies, and there is evidence that multiple policy measures may perform better than single policy measures in the presence of multiple market externalities.

However, carbon pricing is a crucial part of the policy mix that complements technology-specific assistance measures. Technology policy can be seen of as placing solutions on the market, and carbon pricing is necessary to remove solutions from the market. For instance, the Stern Review suggests combining communication campaigns, technology-specific policy support (such R & D), and carbon pricing. To make sure that such policy packages are adequately coordinated, policymakers must take care. A cap-and-trade system's investment signals will be less successful if you move too quickly down a technology-specific path and undercut carbon prices.

Because of the ambiguity around the necessary rate of abatement and the irreversibility of significant expenditures in energy infrastructure, decision-making under uncertainty is a challenge with mitigation policy. Due to these concerns, the price signal generated by carbon trading schemes may not be as effective as intended as a foundation for investment decision making. (goldthau & martin witte, 2010, pp. 138-139)

8.1.2. The Principal Policy Instrument to Reduce Emissions: Carbon Pricing

The concept that excessive carbon dioxide emissions are the result of a market failure underlies a large portion of the discussion concerning climate change. Because the long-term costs of climate change are not factored into the pricing of fossil fuels, internalizing the costs of carbon is the suggested solution. Carbon pricing is, in reality, the favored policy of neoclassical economists (e.g., Garnaut and Stern) in international policy circles, and it dominates policy debates.

A carbon price will reduce carbon relative to other economic indicators, all other things being equal, according to the principle of a price on greenhouse emissions. Since the 1990s, carbon taxes in Europe have reduced emissions relative to what they otherwise would have been, and largely without a material loss in economic competitiveness. There is a case to be made that moving the tax burden from income taxes to consumption taxes will promote saving and investment, even if the issue of climate change is ignored.

However, in contrast to the price of social evils or pollutants, the goal here is not merely to marginally reduce the number of emissions, but to fundamentally alter the energy systems that support advanced countries, along with the health, education, industry, and culture that defines modernity.

There is little to argue against renewable energy playing a mitigating role in an economy that relies on fossil fuels; in fact, carbon price is probably an effective marginal mitigation measure in the advanced economies. However, it is less certain that it can be a successful global energy strategy in a time when energy returns on investment are declining and there is a need to provide affordable energy to a large portion of the global population. The chance to highlight some of the difficulties in transitioning to a high-penetration renewables scenario in a global setting arises from a discussion of the significance of carbon pricing. (Palmer, 2014, p. 71:73)

8.1.3. The carbon pricing model

Regular carbon pricing involves a low initial price that steadily increases over time. Most people assume ipso facto that as the price of carbon rises, lower-emission energy sources will also rise and fall in a virtual dance until the energy supply reaches low or near-zero emission levels.

Neoclassical economics is concerned with finding the best course of action to accomplish the best pace of decarbonization under the current climate uncertainty without unduly impeding economic growth. In the absence of low-emission choices, it is also assumed that, by default, carbon reduction can be imposed through economic contraction (i.e. a recession).

It is assumed that, holding other factors constant, a price on CO2 will reduce the quantity of CO2 relative to other economic indicators while avoiding rebound factors. This is the advantage of an explicit carbon price over alternative policy instruments because it targets emissions directly while remaining technology-neutral. An explicit carbon price would be expected to achieve better abatement at a cheaper cost since technology-specific system instruments are rarely the most effective reduction tools.

A thorough analysis of Australian greenhouse policies shows that market mechanisms have been significantly more effective at decreasing emissions than subsidies and other policy.

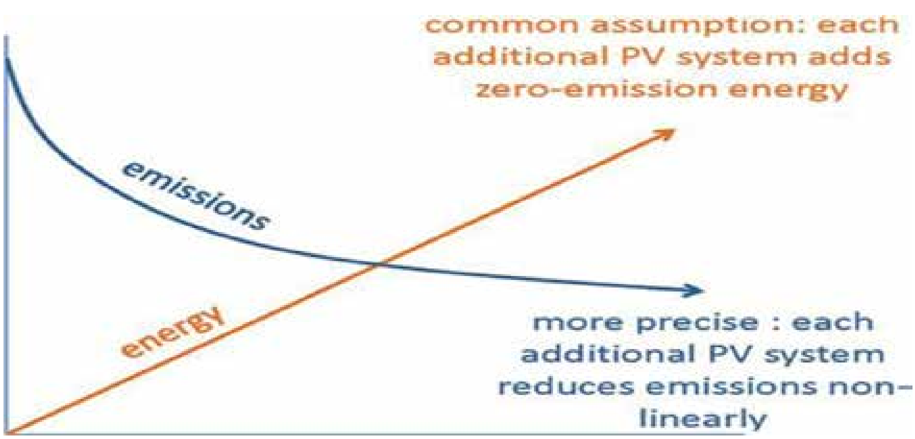

Fig. 2 (market mechanisms about greenhouse policies chart) (Palmer, 2014)

Similar to this, the Australian Productivity Commission (2011) observed that an explicit carbon price would be financially advantageous at a low carbon price since it catches a sizable proportion of low-cost demand-side abatement (i.e. energy efficiency and conservation). Given that Australia's per-capita energy consumption is rather high, there is a lot of room for low-cost abatement if the right incentives are in place. (Palmer, 2014)

8.2. Smart Climate Policy

According to forecasts from the U.S. Census Bureau, the country's population will continue to grow, surpassing 300 million today and reaching 420 million in 2050, in contrast to Europe, Japan, and many other developed economies. The United States must lessen the energy intensity of its economic system and the carbon intensity of its energy usage as its population expands. Since these changes require money, they are frequently only economical when capital assets are first constructed or when significant improvements, renovations, or system replacements are made. If improved technology is not used at these periods, the current, carbon-intensive state of affairs may be maintained for decades.

The current economic slump in the United States provides time for thought and an opportunity to get ready for upcoming needs. The American Recovery and Reinvestment Act of 2009, sometimes known as the "Stimulus Bill," authorized $787 billion in spending, of which over $40 billion is available for climate-smart infrastructure and plants. This includes, for instance, $3.2 billion for a new Energy Efficiency and Conservation Block Grant (EECBG) program to be used by state, local, and tribal governments for energy efficiency and conservation projects. Such funds must be allocated to high-yield projects that will accelerate the nation's shift to a low-carbon economy.

According to our analysis, investing in the country's modern areas, which provide prospects for more energy- and carbon-efficient lives, is expected to result in substantial returns. This type of investment makes sense because urban regions account for a significant portion of the country's projected growth and practically all of the nation's-built environment and energy infrastructure.

Even while there are affordable ways to build climate-friendly urban environments, this does not guarantee that customers and decision-makers will choose low-carbon choices. There are many issues that prevent the market from working effectively to address the climate challenge. Major economic-wide public policies as well as regional and local initiatives are needed to address those problems.

The absence of a price on carbon emissions is the primary cause of market collapse across the whole economy. As a result, internalizing the climatic costs of burning fossil fuels through carbon taxes or a cap-and-trade system is a critical cure. Although carbon pricing is arguably the most effective policy tool to promote cost-effective and low-carbon energy options, it can only be implemented at the national or international level. More municipal regulations may reduce carbon emissions, spillovers, and free riding. Additionally, the federal government must expand existing initiatives and implement new ones to promote decision-making that reduces the nation's carbon impact. These include raising the amount spent on energy research, development, and demonstration (RD&D), creating a national standard for renewable electricity, and giving states and localities better information and technical support.

Additionally, five government programs are required to advance climate-smart development and guarantee achievement in metropolitan America. First, federal transportation policy should equalize funding decisions for highways and public transportation, which would promote new transit-oriented construction and urban redevelopment. Through increased usage of public transportation and non-motorized transportation, this would enhance opportunities for the country's transportation footprint to be reduced.

The establishment of more effective regional freight planning that takes into account both intra- and inter-metropolitan freight operations is the first step toward the federal government facilitating more energy-efficient freight operations, which are concentrated in the country's largest metropolitan areas. The usage and maintenance of more energy-efficient vehicles, the introduction of more energy-efficient intra-urban trucking operations, and the creation and operation of more energy-efficient freight intermodal facilities are all opportunities to reduce the carbon footprint of the freight industry. More fuel-efficient operations have the potential to be profitable for freight carriers and their clients, but they will need to be persuaded of both the financial and environmental advantages of implementing the necessary modifications. The federal government can not only promote but also support (through creative financing mechanisms) the adoption of greener transportation options in urban areas through initiatives like the EPA's Smart Way transport program, which educates trucking companies on how they can lower their fuel bills and the associated carbon emissions.

Third, the federal government could take steps to improve housing decisions, such as demanding more disclosure of home energy costs and "on-bill" financing options, which would support the building stock of the country's energy integrity. With these disclosures, purchasers may estimate energy expenditures and how the building's current attributes may affect those expenses. Austin, Texas, passed an ordinance in 2008 that combines a requirement to conduct an energy audit before a home is sold with a voluntary program for carrying out cost-effective upgrades. Additionally, it sets goals for multifamily audits. One of the first instances in the United States is this. In on-bill financing, a utility company (or a state or federal agency) lends money to consumers for the purchase of energy-efficient equipment, and the consumers pay back the loans with monthly utility bill payments that are no more than the monthly energy savings. Long-term financial savings are possible for homeowners thanks to this financing arrangement. Partnering with utilities considerably increases the success of this kind of program because they already have a structured billing connection with their customers and have access to data on that customers' patterns of energy use and payment history.

Fourth, incentives for energy- and location-efficient dwelling choices should be created utilizing federal housing subsidies. The federal government has a chance to create market-catalyzing financial products, such as mortgages that are location- and energy-efficient (EEMs and LEMs). The mortgage interest reduction, which encourages people to purchase more and larger homes on larger lots in less populated areas, should also be taken into consideration. By looking for more "affordable" properties outside of the metropolitan center, current mortgage lending processes encourage purchasers to "drive until they qualify. Homes on the periphery of cities become more expensive as energy costs rise, as seen in 2008 when gas prices accelerated. Climate-smart housing plans would promote urban redevelopment and curb sprawl while lowering energy use.

Last but not least, the federal government ought to offer a metropolitan challenge award to incentivize metropolitan areas to reduce their carbon footprints through the integration of housing, transportation, and economic development program. Metro actors will struggle to create the place-based transformative policies required to address climate and energy concerns without such comprehensive methods. (Pascual & Elkind, 2010.)

8.2.1. Sequestration of CO2

Although permanent storage is susceptible to perturbations from both natural and human causes, carbon storage in forests can be a highly effective way to lower greenhouse gas emissions. Indeed, human-induced deforestation operations, which can jeopardize the integrity of carbon storage, as well as natural calamities like fires, droughts, and disease pose hazards to forests. Because biogenic storage has a substantially shorter lifespan than storage in geological formations, it's critical to save forests and manage them responsibly. Additionally, forestation operations call for a sizable amount of land, which could conflict with other land uses. (I. Osman, Fawzy, & W. Rooney, 2023)

New, large-scale gas projects, like the Sleipner field in Norway and the Gorgon development on the Australian North West Shelf, have specific CO2 sequestration plans in which carbon dioxide is separated from natural gas or flue gases from combustion are injected into suitable formations in the ground. The advantages include improved oil recovery and sequestration, or the long-term capture of CO2. Pressure readings and seismic surveys are used to keep track on the storage system's integrity. (Jahn, Cook, & Graham, 2008, p. 92)

8.2.2. Market Mechanisms and the Reduction of Emissions

Reduced greenhouse gas emissions can be attained in a number of ways. First is a regulatory mechanism (the so-called "command-and-control" approach), in which a government authority may impose strict limits on the amount of carbon emissions that every company or plant operating within a nation or a region may emit.

This approach requires exact estimates of the trade-offs between societal benefits of emissions reductions vs the costs of such reduction by a specific firm, as well as extensive knowledge of the technologies utilized by each firm, their potentialities for carbon reduction, and their application. Such in-depth knowledge is practically unachievable, and attempting to control each company's emissions independently would result in market distortions.

Due to these factors, most nations have implemented two types of emissions control that focus on giving businesses financial incentives to cut their greenhouse gas emissions. These two options are carbon tax and emissions trading, which are, respectively, utilized by various European nations, Japan, and British Columbia (most notably, employed by the EU, California, and China). Some of these governments implement both emissions trading program and carbon taxes (for example, Norway, France, UK, Sweden, and Finland) (The World Bank, 2015).

Each significant emitter in a nation, like a power plant or facility, is given a particular number of permits under the more widely used market method of emissions trading, allowing it to emit a specific amount of CO2. Typically, this amount is chosen based on the previous emissions data for each plant or installation. Participants in the emissions trading scheme can exchange emission permits on a free market. A corporation's cost of production goes up if its greenhouse emissions rise (for instance, as a result of expanding its output). To cover these extra emissions, the company must get more permits. However, a business that is successful in reducing its emissions will have extra licenses to offer for sale. A system like this establishes a market mechanism where businesses in sectors where reducing emissions is reasonably affordable will end up being net sellers of permits and businesses in sectors where reducing emissions has significant marginal costs will be net purchasers. Emission trading programs are anticipated to lower the overall costs of emissions control to the economy (provided that the total amount of allocated emissions permits firmly declines to meet emissions reduction targets).

Prior to now, leaded gasoline, Sulphur dioxide (SO_2) emissions, and nitrogen oxides (NO_x) emissions were among the sources of pollution that were reduced through the use of permit trading procedures. An empirical investigation of the efficacy and financial burdens of adopting market-based pollution reduction systems is now possible thanks to the earlier implementation of these mechanisms. Higher costs of heavy pollution (applied through regulatory mechanisms) were successful in pressuring manufacturers to use cleaner lead-reducing technologies in the case of the US gasoline lead phasedown plan. Moreover, by encouraging businesses to use more efficient technologies, the tradable permit system decreased the overall economic costs of pollution management.

Concerning the US Acid Rain Program and its follow-up scheme Clean Air Interstate Rule, another long-running cap and trade program for reducing pollution According to EPA (2013), SO_2 emissions have decreased by 79 percent between 1990 and 2012, while NO_x emissions have declined by 73 percent. Both reductions were achieved without a discernible drop in energy generation, indicating that improved technologies rather than decreased economic output were primarily responsible for the pollution reduction.

In general, empirical research on the efficacy of cap-and-trade regimes aimed to reduce pollution shows that trading in pollution permits is quite effective at doing so by utilizing market processes. However, for such systems to be sufficiently efficient in decreasing emissions, they should appropriately communicate regulatory signals to the market players. (Veld-Merkoulova & Viteva, 2016, p. 11:13)

8.2.3. Subsidies for energy are typical

Any product subsidies distort price signals and result in poor investment decisions. But the global energy business honors this undeniable economic fact in the breach. Politicians around the world have subsidized various aspects of the energy system in response to residents' demands for cheaper electricity. These tax-funded subsidies lower power rates for customers, encouraging them to use more energy and make fewer investments in energy efficiency and conservation.

Example: In contrast to other manufacturing businesses, state and municipally owned power systems are permitted to issue tax-exempt and/or taxpayer-backed loans at interest rates that are far lower than those charged by comparable companies. Renewable energy sources including wind, solar, geothermal, and biomass are supported financially through tax incentives. These subsidies increase waste by covering the actual cost of electricity. Because governments are forced to tax other activities to make up for lost revenue, consumers collectively pay for all the subsidies. But because of the subsidies, a lot of poor choices are made, raising the price of heat and electricity. Energy subsidies are almost always used, despite the fact that they are a real "lose/lose" strategy.

Second Example: Oil and gas corporations that rented blocks of drilling rights in American territorial waters in the Gulf of Mexico had a windfall thanks to the 2005 U.S. Energy Policy Act (EPACT). Despite the fact that such payments are necessary for oil generated on any other federal property, a legislative provision waived royalty payments for oil produced on federal assets in the Gulf of Mexico. In other words, EPACT told the oil firms that they could extract the oil without having to pay the federal government anything. The New

York Times estimated that over the next five years, this subsidy will cost taxpayers between $7 and $28 billion. Very little is done by the subsidies to assist American consumers.

The lease-free oil either boosts oil company profits or affects the price of oil globally, dispersing the subsidies across the world's oil customers. However, all of the lost revenue must be made up by American taxpayers. Investments in energy efficiency are less appealing than their genuine economic benefit because this subsidy of oil firms obscures the true cost of utilizing oil and gas to the extent that it lowers oil prices. (K. Sovacool & A. Brown, 2007)

8.2.4. Higher than anticipated GHG Allowance Prices Are Needed for Emission Reductions

The majority of industries are subject to strict GHG emission reduction requirements. Therefore, substantially higher prices are needed to induce the change than what planners anticipate. Given that prices frequently move by $0.25 in a week and most definitely by $0.50 over the course of a year, the impact of GHG pricing of $25–50/ton (which seems like a plausible range) on gasoline prices only amounts to a $0.25-0.50/gal rise. When gas prices were less than $1/gal in 2002, it was widely believed that everyone would substantially cut back on driving if the price doubled to $2/gal. (S. Amlin, 2013, p. 107:122)

As of right now, we are merely witnessing average decreases in gasoline demand (a 6% decline from their 2007 peak) (EIA 2012). At this stage, it should not be anticipated that a $0.25 increase in petrol prices will result in a noticeably lower level of demand for gasoline.

The explanation is that most Americans only have one choice for getting to work: driving their cars. The majority of options increase travel time, which lessens the impact of rising petrol prices. For instance, given a vehicle that uses 20 miles per gallon of fuel, a commute of 20 miles (30 minutes), and a free bus that requires 75 minutes to get there, taking the bus results in a savings of $4.67 per hour. This is below minimum wage, so it would be preferable for the individual to drive and work more hours. Even after accounting for an absurd $200/ton (USD $2.00/gal) GHG allowance cost, the bus savings only amount to about $7.33/hour, or minimum wage. The decision to drive vs take the bus depends on a variety of additional circumstances, but the application of a high GHG allowance fee has a negligible effect. (Qudrat-Ullah, 2013, p. 119:120)

8.2.5. Cleaner Technologies for Fossil Fuels

It is crucial to address electricity generation if significant reductions in global CO_2 emissions are to be achieved. 35 percent of the world's total fossil fuel use and close to 41 percent of all energy-related CO_2 emissions are attributed to the production of electricity. Fossil fuels account for around 70% of electricity production, and this percentage has steadily climbed since 1990. In 2008, 41% of the world's electricity was generated by coal, making it the most significant energy source. While gas's contribution, which was at 21 percent in 2008, has increased significantly over the past 20 years, oil's part was only 5 percent. There are currently no signs that the usage of coal as a fuel source for electricity generation will decrease. Coal is powering the vast bulk of new power generation capacity in the quickly developing economies of China and India, for instance. (L. Toth, Energy for Development, 2012, p. 188:192)

But there are a number of difficulties that come with increased coal use. Along with CO_2 emissions, so-called conventional pollutants like SO_2, NO_x, and particulates from coal combustion also need to be addressed because they have a big impact on human health and the environment. From the 1960s to the present, they have mostly been addressed, and solutions have been created that can bring the concentrations of these pollutants in power plant flue gas to very low levels. Reduced heavy metal emissions from coal burning have been the subject of an effort in more recent years, and this effort is still going strong today.

To ensure the successful adoption of technologies created to reduce pollution emissions, legislation and its effective enforcement are required.

But now that anthropogenic emissions' impact on global warming has been acknowledged, emissions of greenhouse gases are a matter of concern for everyone. In addition to being the main fuel used to produce electricity, coal also produces the most carbon dioxide. Because of this, it receives the most consideration when developing plans to reduce greenhouse gas emissions. In 2008, CO2 emissions reached 29 gigatons (Gt), with the production of electricity accounting for 41% of those emissions (IEA, 2010 b). The IEA predicts that emissions might increase to 57 Gt by 2050 in the absence of additional CO2 reduction measures, with power generation accounting for 40% of those emissions (IEA, 2010 a).

Increases in emissions of this size, according to the Intergovernmental Panel on Climate Change (IPCC) of the United Nations, would cause catastrophic climate change, including a rise in the global average surface temperature of more than 6°C (IPCC, 2007). The amount of CO2 that is emitted into the atmosphere must be decreased to prevent such serious climate change. In order to significantly lower the atmospheric CO2 concentration and prevent the worst effects of climate change, it will be necessary to keep temperature increases to 2-3°C. The IEA's BLUE Map scenario is based on this principle. According to this scenario, emissions in 2050 are estimated to be 14 Gt, which is 43 Gt less than what was predicted in the Baseline scenario and roughly half the amount emitted in 2005. It will take the creation and implementation of a variety of strategies to improve energy efficiency and advance low-carbon technology in order to achieve these CO2 emission reductions.

In the BLUE Map scenario, improvements in energy efficiency, renewable energy, nuclear power, and CCS will all help to reduce CO2 emissions. generation, which is largely decarbonized, and the remainder of the construction, transport, and industry sectors.

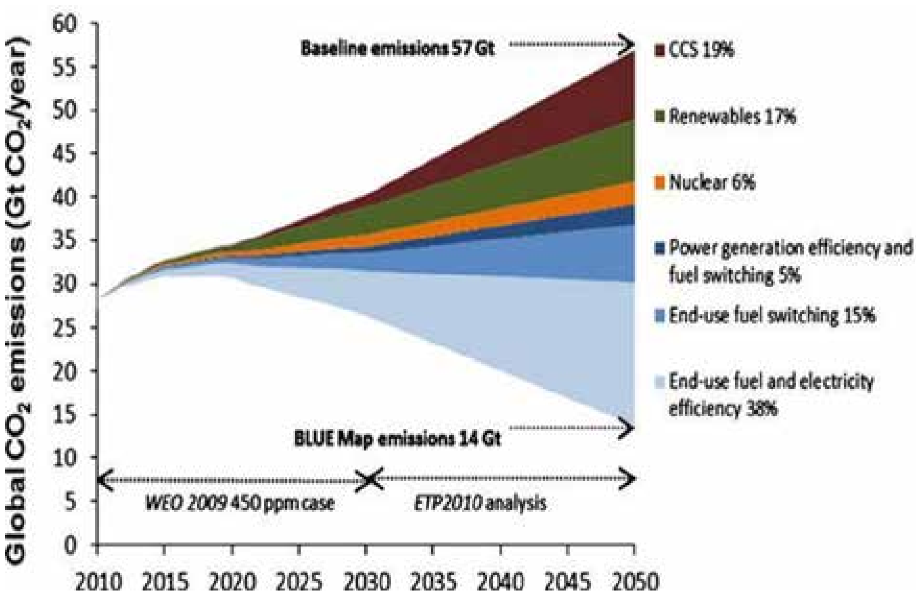

Fig. 3 (global co_2 emissions chart) (L. Toth, 2012)

The difficulties facing each of these sectors cannot be understated; enormous efforts will be needed in each. There are various ways to reduce CO2 emissions from the burning of fossil fuels for power generation. The basic choices, other from simply using less fuel, are to:

• the use of low-carbon fuels, • create more efficient conversion methods, or

• use CCS in power production facilities.

In the BLUE Map scenario, improvements in power generating efficiency and fuel switching will make a sizable contribution to the reductions in CO2 emissions necessary (5 percent, or 2 Gt CO2, in 2050). The longer it takes for CCS to be widely deployed commercially, the more crucial it is to increase the efficiency of power plants. In addition to emitting less CO2 and other waste, higher-efficiency plants also use less fuel and cooling water per unit of power produced. All other factors being equal, they are likewise more appealing for retrofitting acquisition technologies. Currently, the global fleet of coal-fired power plants has an average efficiency of about 32%. (LHV 1). The majority of the current fleet consists of pulverized coal (PC) combustion units. Ultra-supercritical (USC) pulverized coal plants that follow best practices operate at an efficiency of about 45%. (LHV).

Technologies have advanced considerably over time, especially when advancements in materials allowed for operation under supercritical (SC) and ultra-supercritical (USC) steam conditions, i.e. at temperatures much beyond 375°C and pressures above 22 megapascals (MPa). The following graph displays the share of coal-fired power generation capacity in various nations using SC technology, which is more efficient.

The relatively high efficiency of the plants in Korea and Japan is seen from this figure. Additionally, it is evident that China has made significant advancements in the application of supercritical technology. The efficiency of coal-fired power facilities in China is expected to reach the OECD average soon.

What then can be done to increase coal-fired power plants' efficiency from its current low global average of roughly 32 percent (LHV)? Average efficiency inside the European Union (EU) is greater, at around 38% (LHV), and cutting-edge plants are over 45%. (LHV). Advanced research and development is creating materials that can function in increasingly higher steam settings. Steam conditions of 30 MPa and 700°C could lead to efficiencies of 50% or more using the new superalloys that are being developed. Even so, CO_2 emissions from modern natural gas combined cycle power plants, which typically produce about 350 g CO_2 per kWh, are still much greater.

Deep decreases in CO_2 emissions will be necessary for the effective decarbonization of electricity generation, far bigger than those that can be made by improving generation efficiency or converting to natural gas. However, it is anticipated that fossil fuels, and coal in particular, would continue to be significant fuels, particularly in emerging economies. For countries like China, India, and Indonesia, coal is currently and will continue to be the "fuel of choice" due to its low cost and energy security. CCS is thus a crucial element of an efficient, affordable, and low-carbon future. This is shown by the IEA analysis, which demonstrates that the additional investment costs in the power sector to reduce CO_2 emissions from 2005 levels by 2050 would be much greater without CCS in the technological mix. (L. Toth, 2012, p. 1:24)

8.3. Indigenous Egyptian Nubians and Climate Change Mitigation

One of the most populous nations in both Africa and the Middle East is Egypt, with the majority of the country's projected 101.230 million people (as of November 2020) living in an area of around 40,000 km^2 (15,000 $mile^2$) near the Nile River's banks, the country's only arable territory (World Bank 2013). However, large sections of the Sahara Desert are scarcely populated. About half of Egypt's population lives in cities, especially in the heavily populated districts of greater Cairo, Alexandria, and other major Nile delta cities.

Sudan, a nation in North Africa that is also geographically part of the Middle East, is surrounded by Egypt to the north, the Red Sea to the northeast, Eritrea, Ethiopia, South Sudan, the Central African Republic, Chad, and Libya to the east, west, and south, respectively. The majority of Sudan's population, estimated at 38.5 million as of July 2015, is Muslim and consists of both native Saharan Africans and migrants' offspring from the Arabian Peninsula. East and west of the nation are separated by the Nile. The Nile River is widely recognized as the longest river in the world and the main north-flowing river in North Africa (6,650 km). It played a significant role in ancient Egyptian spirituality and served as a crucial link between Sudan and Egypt. Before finally flowing through Sudan and Egypt to the sea, the Nile passes through 10 nations: Burundi, Rwanda, the Democratic Republic of the Congo, Tanzania, Kenya, Ethiopia, Uganda, and South Sudan. Egypt was a gift from the Nile, the Greek historian Herodotus penned. The Nile, a never-ending source of food, was essential to the advancement of Egyptian civilization. The leftover silt deposits have made the surrounding area productive for thousands of years when the river overflows each year. (ErSahin , Kapur, Akça, Namlı, & Emrah Erdoğan, 2017, p. 62:70)

8.3.1. setting of the environment

The second-largest artificial lake in the world, Lake Nasser, was made possible by the building of the Aswan High Dam. A little less than a million metric tons of water were available in the new lake following the completion of the Dam. The lake has the name of President Nasser, who presided over Egypt from 1954 to 1970 and served as president during the construction of the High Dam, which forced the Nubians to abandon their ancestral homeland in southern Egypt due to the altered geography it created. The Nubians have since looked for their ancestors in their native countries. (Hassan Mohamed Ahmed, 2016, p. 61:72)

Behind the Aswan High Dam, Lake Nasser expands; it is 480 km long and has a surface area of 5,250 km^2. More than 100,000 people were evacuated as a result of the dam and the building of Lake Nasser, which had substantial environmental and societal effects, many of which were unanticipated. Since then, many measures have been taken to reduce these effects.

The relocation of the Nubian population from places submerged by reservoir construction, preservation of historical sites, loss of soil productivity, health effects, and coastal erosion were some of the projected effects. Other effects, such as the waterlogging and salinization of the soil, however, took time to become apparent, and expensive mitigation measures were only implemented after lengthy delays. However, it was not possible to offset other projected effects such reservoir evaporation and rising sedimentation. However, some expected effects, like seepage from the reservoir, did not materialize, and others, like river-bed erosion, were less severe than anticipated.

South Egypt's Nubian region has a continental climate with distinct changes between summer and winter temperatures as well as daytime and nocturnal temperatures. The hottest months are July and August, with average highs of 24 to 39.7 °C. Temperatures drop to between 10 and 21.7 °C in the two coldest months of December and January. From 13 percent in the summer to 34 percent in the winter, the average humidity varies. Rainfall is uncommon, though it occasionally causes flash flooding in the lowlands on the eastern banks of Lake Nasser and the Nile River when it falls in the eastern desert.

8.3.2. Resettlement of Nubians

For a very long time, southern Egypt served as the motherland of the Egyptian Nubian people. After leaving their homes and agricultural fields, the Nubians were dispersed to the north and relocated at several Governorates as a result of the construction of the Aswan High Dam. Egyptian Nubians lived in a stunningly beautiful landscape with desert sands on both sides of their lands, punctuated by rocky hills that sloped down to the water's edge.

In this region, there were 3 notable ethnic groups represented by 553 sparsely inhabited settlements, of which two spoke Nubian languages. All date palms were destroyed after the reservoir was built, and for the most of the year, all arable land was submerged. When the reservoir water was drawn down, just a few months of the year could be used for cultivation.

Due to this, Nubians were relocated between Egypt and Sudan in a southerly direction, with the majority of people who had lived in Egypt being relocated 3–10 km from the Nile in Kom-Ombo, 45 km downstream from Aswan. In order to create a New Nubba in a crescent that was 60 km long and, on average, 3 km broad, population planners developed 47 village units, each of which included homes and amenities that were similar to those in Old Nubba.

Reclamation started on 21,000 feddans (equal to 8,820 ha or 21,798 acres) to support the population, and eventually 18,000 feddans were reclaimed. Three major canals through which water would be pumped from the Nile were to be used to cultivate this land. Sugar cane was grown on 60% of the area, and it was anticipated that the crop would increase the capacity of the adjoining sugar mill by double. In contrast to the circumstance in Egypt, 50,000–70,000 Sudanese Nubians were relocated roughly 700 km south to a region close to the town of Khashm el-Gibran, several hundred kilometers up the Atbara River from its confluence with the Nile. In contrast to their former desert environment, where there was almost no rain, the relocated had to adapt to a climate with a regular wet season there.

In addition, they had to contend with a host population devoid of Nubians and novel diseases like endemic malaria. The government created an even larger irrigation project dubbed the New Half Agricultural Development Scheme that would draw water from a dam erected on the Atbara River, similar to the action taken for the Egyptian Nubians. (ErSahin , Kapur, Akça, Namlı, & Emrah Erdoğan, 2017, p. 62:70)

8.3.4. Effects of Climate Change in Upper Egypt

All climate models predict that Egypt's temperatures will rise steadily, with little variation, and more warming in the summer than the winter. For June, July, and August or in terms of annual totals, the variations in precipitation are not anticipated to be statistically significant. However, considerable precipitation drops are anticipated for the months of December, January, and February.

Precipitation over Egypt itself doesn't really matter because the majority of the nation is a desert and mostly depends on irrigated agriculture. The Nile's water sources' precipitation fluctuations, however, are more significant and increase susceptibility.

Although the patterns generally indicate more precipitation, there is uncertainty on whether the yearly average precipitation will rise or decrease due to the high inter-model heterogeneity. Although there is limited confidence in these seasonal estimates, the models predict that precipitation will be higher in the winter and slightly lower in the summer.

Scenarios for temperature changes of 0, +2, and +4 °C as well as reductions in rainfall of 10 and 20 percent were explored in a study on the effects of climate change on Egypt. Due to an induced sea level rise that would result in high biophysical exposure and have a substantial impact on nearby communities, it was determined that the possible impact of climate change on coastal resources was the most worrisome. Further, as the Nile provides nearly all of the country's water for drinking, farming, and hydroelectric production, a significant decrease in the Nile's flow might have a very serious impact on Egypt's well-being.

While there are numerous unknowns regarding how changes in rainfall patterns may affect the Nile flow itself, there is far greater confidence regarding how temperature increases would increase evaporative losses, concurrently raising irrigation and other water needs.

Climate change is expected to have a significant influence on the Nile's water supply for agriculture, which accounts for approximately 30% of all employment. The loss or salinization of prime agricultural land in the coastal zone and/or diminished Nile irrigation supplies would have the biggest indirect effects on agriculture, interfering with crop production.

8.3.5. indigenous People and Climate Change

Evaluations on a regional and worldwide scale show that the climate of the Earth is changing. Some environments and cultures are more vulnerable to the long-term effects of climate change than others, according to current and future levels of exposure to climate-related sensitivities as well as limits and restrictions on adaptive ability.

Indigenous peoples usually live in a variety of precarious habitats and depend on natural resources for their survival. On the other hand, indigenous peoples are some of the most marginalized, poor, and vulnerable people in the world. As a result, even while indigenous peoples bear the brunt of the effects of climate change, they are less equipped to handle them.

For indigenous peoples all across the world, climate change presents a variety of risks and opportunities, putting their cultural survival and human rights at risk. Animals, fisheries, and forests are affected by ecosystem changes, which have an effect on how traditionally used species and resources that are significant for culture and the economy are used.

International experts frequently disregard indigenous people's rights and the potentially priceless contributions their traditional knowledge, innovation, and practices can make to the global search for climate change solutions, despite the effects of climate change on indigenous people and their traditional knowledge.

Indigenous people are faced with the possibility of climate change, further challenging their capacity to adapt to and cope with environmental and social changes. As the global discourse on climate change focuses on understanding how we can scientifically and technologically adapt to, as well as mitigate, climate change. Indigenous territory and coping mechanisms are frequently put at risk by national and international climate change mitigation measures.

The adaptation and social implications are the most important factors to take into account while analyzing the effects of climate change on settlements. These two elements are crucial for the native population, particularly for Nubians. Numerous regional, national, and international organizations have started raising awareness of the effects of climate change on indigenous people. This is done by strengthening the ability of indigenous societies to communicate and participate by supporting and encouraging their initiatives.

Despite these admirable initiatives, the adaptations pertaining to indigenous communities are still insufficiently taken into account in the global organizations' long-term development plans, particularly in the UNCCD, IPCC, and UNFCCC climate change programs. (Ergahin , Kapur, Akça, Namlı, & Emrah ErdoSan, 2017, p. 62:70)

8.3.6. Indigenous Peoples and Forests

About 10% of the net global carbon emissions are collectively caused by the degradation and destruction of tropical forests. Therefore, the core of any organized campaign to mitigate climate change is addressing the degradation of tropical forests. Unfortunately, traditional methods to stop the loss of tropical forests have failed, as evidenced by the fact that deforestation and forest degradation continue unabatedly.

REDD (Reducing Emissions from Deforestation and Forest Degradation) encourages a shift away from long-term trends of rising deforestation and greenhouse gas emissions (UN-REDD, 2012). The REDD (Reducing Emissions from Deforestation and Forest Degradation) paradigm rewards poor nations financially for any carbon savings associated with a decrease in the conversion of forests to other land uses. It supports a change away from long-term trends of escalating deforestation. A nation will get financial compensation in proportion to the extent of its achieved emissions reductions if it takes corrective action to significantly lower current and/or projected rates of deforestation and forest degradation. A once-in-a-lifetime chance to achieve significant cost-effective carbon reductions is provided by (REDD, 2009). Intact forests may face competition from historically more valuable alternative land uses, which could result in their extinction because forest ecosystems are valued commercially for their function in carbon capture and storage.

To reduce emissions brought on by deforestation and forest degradation, REDD (2009) was established. However, a comprehensive strategy for mitigating climate change should include policy approaches and supportive incentives on issues related to reducing emissions from deforestation and forest degradation in developing countries, according to the Bali Action Plan, which was adopted at the United Nations Framework Convention on Climate Change (UNFCCC) thirteenth session in 2007. In addition to the improvement of forest carbon reserves, this initiative also focused on the role of forest conservation and sustainable management in developing countries. (IUCN, 2009).

A year later, the emphasis was changed to include avoided emissions from deforestation and forest degradation as well as conservation, sustainable forest management, and the establishment of forest carbon reserves. At the COP-16 in 2010, REDD was finally called REDD-plus (REDD+) in compliance with the Cancun Agreements. The scope of REDD+ has been increased to:

(a) lowering deforestation-related emissions; (b) Reducing emissions from forest degradation;

(c) preservation of the carbon stores in forests; (d) sustainable forest management;

(e) improved forest carbon stocks.

REDD+ has the ability to both reduce poverty and combat climate change within its purview, while also preserving biodiversity and preserving essential ecosystem services (IUCN 2010). With so many advantages possible, it is critical to consider whether or not including development and conservation goals will improve or hurt talks for a future REDD+ framework (explicitly for climate change mitigation). However, the earlier query may be unimportant given how fast anticipated co-benefits can change into prospective co-detriments. Without regard to whether or not taking such issues into account will help or hinder the negotiations and success of a REDD+ framework, they are clearly crucial for the development of a sustainable and fair REDD+ process.

The UNFCCC is still debating the specifics of a REDD+ framework, and the substantial funding requirements for full implementation have not yet been satisfied. Therefore, a complete mechanism is not yet established and functioning at a large scale. The UNFCC should keep in mind that indigenous civilizations continue to contribute some of the least to global carbon emissions in this regard. The REDD+ program, which has adopted a rights-based approach and modified its mission to better line with the goals of the UN Declaration on the Rights of the Indigenous Peoples, acknowledged this in the context of deforestation and made a call to action.

In order to demonstrate the potential of community schools as tools for environmental conservation through their promotion of indigenous knowledge systems, an afforestation/reforestation carbon sequestration model has been created. The approach illustrates the value of including community schools and kids as active participants in forest carbon projects to promote successful implementation of afforestation and reforestation initiatives and lower leakage of carbon emissions in REDD+ (IUCN, 2010).

The Nubian sandstone is rich in water resources, and the motherland of the Nubians is situated in southern Egypt on fertile agricultural territory. The dispersed clay in the water from the river Nile also helps to reclaim and improve the quality of the best soils. As a result, it may be possible to execute the REDD and REDD+ programs on these sites, which will be helpful in lowering CO2 emissions. Unfortunately, the Egyptian government hasn't launched any REDD-related initiatives in this region to help the people. The enormous orchards some communities have built, nevertheless, have increased money generation from fruit yields and, in turn, fight erosion by preventing sand movement. These actions have indirect effects on climate change mitigation despite the undirected and individual efforts. (Ergahin , Kapur, Akça, Namlı, & Emrah ErdoSan, 2017, p.

62:70)

8.3.7. Actions for Mitigation in the Indigenous Communities of Egypt

Native to the region around Lake Nasser, the Nubians have their own language, traditions, culture, and customs. In order to lessen the effects of summertime high temperatures in the Lake Nasser region, which can reach 50 °C, and to use less electricity to run air conditioning, the Nubians have created specific models and architectural settlement models. Domes have been incorporated into the construction of homes to take advantage of air currents and lower indoor temperatures, eliminating the need for air conditioning and lowering power use and greenhouse gas emissions. Additionally, numerous trees of all sizes have been planted alongside the lake to improve breathing and lower local temperatures.

Despite these efforts to counteract the climate, the Nubians near Lake Nasser are still experiencing the negative effects of high temperatures and humidity, much like the Egyptians in other regions. The drought, a lack of potable water, rising water temperatures, and the effects of these problems are challenges for the Nubian society. The Nubians continue to experience the effects of climate change on their crops and a decline in the quality of their general health, despite the fact that pollution does not have an impact on the local environment because there is no industrial production close to Lake Nasser. For preventing deforestation and forest degradation, REDD offers financial incentives. In doing so, it also gives those who live in and around forested areas an incentive to manage trees sustainably and fairly.

By burning fewer trees, destroying fewer forests, and releasing less carbon dioxide into the atmosphere, carbon emissions might be decreased. However, there is another, equally significant component of REDD that improves forest preservation and, as a result, the absorption of carbon dioxide from the atmosphere, storage of the gas in plants and trees, and soil sequestration. Ultimately, GHG emissions are decreased and CO2 is sequestered by maintaining healthy, intact forests. (Ergahin , Kapur, Akça, Namlı, & Emrah ErdoSan, 2017, p. 62:70)

Conclusion

Carbon dioxide (CO2), the main greenhouse gas, is released into the atmosphere when fossil fuels, chiefly coal, natural gas, and oil, are burned. More heat from the sun is trapped close to the surface of the earth the more greenhouse gases there are in the earth's atmosphere.

More heat is trapped, which causes the planet's temperature to rise and further destabilizes our climate. The earth's natural system for removing greenhouse gas emissions from the air is forests. The more mature, thicker woods we clear-cut, especially, the less the planet can do to mitigate the consequences of our emissions.

We cannot ignore the likelihood that unless we lessen our reliance on fossil fuels, the Earth will continue to warm and hurricanes will become more severe and frequent. The most cost-effective method of carbon dioxide sequestration is carbon dioxide flooding in conjunction with enhanced petroleum production. Sadly, electricity plants are rarely found close to oil production facilities.

There are two more options: piping carbon dioxide to petroleum producing locations or storing it as a supercritical gas in deep saltwater reservoirs via carbon capture and sequestration.

Even though they frequently have other goals for their sustainable development as their motivations, developing countries are notably active in responding to concerns about climate change, even though

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