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POST COP21 REFLECTION; "HOW CAN EMISSIONS FROM THE USE OF FOSSIL FUELS BE ADDRESSED TO MEET CLIMATE CHANGE OBLIGATIONS?''

ABSTRACT

Acknowledging Climate Change as a global issue, the United Nations has been in the lead to tackle this problem evidenced with the journey from Berlin in 1995 to Paris in 2015.Negotiations have formed the basis for mitigation however the difficulties of the game theory has been practical in this case. Moreover the issue of the use of Fossil fuels still remain an obstacle to this journey due to CO_2 emissions associated with it. This paper therefore looks at possible ways these emissions can be addressed to meet climate change obligations. It acknowledges that fossil fuels are 'addictive 'and for several reasons their use cannot be stooped completely: Yet their use impose negative externalities therefore a tax, trade permits, removal of fossil fuel subsidies, using CACs and use of alternative fuels can aid to reduce the use. This paper therefore concludes that it is possible to mitigate climate change impacts if governments embrace domestic policies that aim to reduce the use of fossil fuels

Presented to: Dr. Rafael MACATANGAY

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LIST OF ABBREVIATION

Carbon dioxide	CO_2
Cleaner Production Mechanism	CDM
Command and Control instruments	CACs
Conference of Parties	COP
Emission trading scheme	ETS
Environmental Kuznet Curve	EKC
greenhouse gases	GHGs
Growth Domestic Product	GDP
Intended Nationally Determined Contributions	INDCs
International Energy Agency	IEA
International Monetary Fund	IMF
Joint Implementation	JI
Kyoto Protocol	KP
Methane	CH_4
Nitrogen oxides	NO_xs
Paris Agreement	PA
Total primary Energy supply	TPES
United Kingdom	UK
United Nations Framework Convention on Climate Change	UNFCCC

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1.0 INTRODUCTION

Climate change has increasingly become an environmental concern in the world today. Many worry that it will impact on vulnerable people, while others are concerned about the ecosystems and climate instabilities (Tol, R.S., 2005).

In December 2015, the United Nations held a Conference of Parties (COP21) in Paris where world leaders from 195 nations convened to tackle climate change. It ended up with the Paris Agreement (PA) which placed exceptional importance on the needed actions- both at national and global levels- to combat climate change and mitigate its impacts, as well as to promote adaptation strategies. Participating countries affirmed their commitment to this cause.

This was not the first COP since several had taken place from the 1995 COP1 in Berlin, Germany to Paris COP21. In that regard different countries submitted their Intended Nationally Determined Contributions (INDCs) prior to the conference with the aim of holding warming below 2^0C goal (Climate Action Tracker, 2015). In fact Naomi Oreskes, 2015 called it "the 21st such attempt to forge an international agreement to curb greenhouse gas emissions.''

Whereas the Paris Agreement is a key step to climate change mitigation, it is key to understand that anthropogenic concentration of greenhouse gases (GHGs) that is to say Carbon dioxide (CO_2), Methane (CH_4) and Nitrogen oxides (NO_xs) in the atmosphere is one of the drivers of climate change problems. Of the total GHGs, CO_2 contributes the highest emissions of which 78% of it is from fossil fuels (Coal, Oil and Natural gas) and industrial processes (IPCC, 2014).

This percentage may not drop significantly since the pledges made at COP21 did not explicitly put into consideration the rising global energy demand which is set to grow by one-third by 2040 (IEA, 2015), in addition to the projected increase in the world GDP growth at a rate of 2.6 per cent by 2017(International Monetary Fund, 2016).

At the moment, over 80% of the total world energy mix is from fossil fuels and it is projected to reduce to only 78% in 2040. This clearly poses a threat in combating climate change since the biggest percentage of the CO_2 comes from energy related activities (Institute for Energy Research, 2015).

This paper therefore seeks answer the question of how emissions from the use of fossil fuels can be addressed to meet climate change obligations. Both qualitative and quantitative approaches were used. Data was collected from BP statistics to establish the emissions trend. Also scholarly publications, Government Websites and other stakeholder websites were reviewed and visited respectively. The rest of the paper is organised into; Chapter 2 provides literature on the game theory of climate change as well as the road to Paris; chapter 3 includes the reasons why fossil usage cannot stop; chapter 4 is the discussion providing possible solutions to harmonise fossil fuel usage and climate change and conclusion and recommendations are in 5

2.0 LITERATURE REVIEW

2.1 Climate change and game theory

In climate change mitigation two behaviours are expressed that is the non-cooperative and cooperative behaviour. The idea behind is the maximization of utility by each country where by utility means the utility a country derives after subtracting the domestic private and external costs due to emissions (Rogers et al., 2003).

If R denotes emissions and U denotes Utility and assuming no spill over case then the utility enjoyed by country M, U_m depends only on the amount of emissions generated by country M, R_x Similarly, the utility enjoyed by N, U_n depends on the emissions generated by N, R_y (ibid).The function will then be:

$U_m = U_m (R_x)$

$U_Y = U_n (R_y)$

In a non-cooperative game, decisions are made solely by a country disregarding the impacts it may cause on other countries (Wood, 2011). He further demonstrates the prisoner's dilemma in the context of climate change highlighting how hard it is to reach a level of cooperation. Given the prisoner's dilemma, a country would be better off continuing to pollute than to abate. Thus, where each country only looks at its interests, they will both continue to pursue strategies that do not reduce pollution (pollute, pollute), though the best social best optimal would be for both players to abate their pollution (abate, abate). To combat climate change, instead of decisions to pollute, countries make decisions to reduce their GHG emissions (ibid). This game was extended to a global emissions game with continuous strategy as explained by Finus (2003); that instead of making countries choose between polluting or not, countries are offered the option of gradual abatement, where players choose levels of pollution to emit. This is more practical, and is employed in climate change negotiations, where countries choose levels of GHG reduction.

On the other hand, a cooperative game involves collective efforts where groups of participants may enter into a coalition (Rogers et al., 2003). Here players are expected to behave cooperatively for a common cause (Wood, 2011). Because climate change is a public good and prone to free riding then this particular type of game best suites the situation moreover breaking individually the fossil addiction which forms the biggest part of GHG emissions is too expensive (Suranovic, 2013). Carraro, (1998)

and Asheim et al., (2006) voiced after analysing some climate change models that reaching one conclusive agreement will be hard to be signed if negotiations are restricted to emissions. This is further amplified by the lack of commitment as seen during negotiations when big emitters opt out because others have not committed (Suranovic, 2013).

2.2 The road to Paris

Basing on the above climate change concept, negotiations have been taking place from Berlin 1995 to Paris 2015. Much as several COPs have taken place as agreed during the 1992 United Nations Framework Convention on Climate Change (UNFCCC), there are those that are significant due to decisions adopted. COP3 of 1997 led to the adaptation of the Kyoto Protocol (KP) though it came into force in 2005 with a commitment period of 2008-2012. Countries were classified into Annex 1 (developed countries) and Non-Annex 1 which were developing countries (UNFCCC, 2016). Further, the KP relied on the flexible mechanisms to achieve emission reductions which included Joint Implementation (Article 6 of the protocol), Clean Development Mechanism (Article 12 of the protocol) and Emissions Trading (Article 17 of the protocol). The COP15- Copenhagen seemed to be the beginning of setting binding targets for the countries and also submission of mitigation measures; however, China was in the lead to wreck the deal since it was a Non Annex 1 and therefore the KP was not binding on them and neither did USA commit (Lynas, 2009). COP19 -Warsaw the green fund project was to be strengthened and countries agreed to submit their INDC before the COP21. COP20-Lima highlighted issues to be discussed in Paris while the COP-21 led to adaptation of the PA with procedural requirements of preparing Nationally Determined Contributions (NDCs) aiming at transforming the world to a low carbon one (UNFCCC, 2016).

However the PA has already been criticised by stakeholders right from the drafting of the agreement that leaves many legal uncertainties. It calls for collective actions and does not refer to Annexes as in the KP hence putting little emphasis on the UNFCCC principle of the ‘common but differentiated responsibilities and capabilities’ (Bodle et al., 2016). The same authors also observed that the statement ‘decarbonisation’ is not defined and further amplified by the absence of specific mitigation obligations like the KP; moreover energy related issues such as renewable energy, fossil fuel subsidies

and carbon pricing are not explicitly addressed in the PA. The implication is the need for transparency while drafting National Plans and NDCs (ibid).

Also prior to COP21 countries submitted their INDC and taking a sample from the six biggest emitters from the world, their assessment was not really promising.

Table 1: INDCs for the largest Emitters

Emitter	Country	Targets submitted to lower emissions	Comment by Action Tracker
1	China	Reduce Carbon intensity by 60% to 65% by 2030 below 2005 levels	Medium but inadequate in Carbon intensity
2	USA	26%-28% below 2005 domestically	Medium
3	EU	Reduce GHGs at least 40% domestic below 1990 by 2030.	Medium
4	India	Lower GDP intensity between 33%-35% by 2030 below 2005 level	Medium
5	Russia	Reduction of 6–11% below 1990	Inadequate
6	Japan	26% below 2013 levels by 2030	Inadequate

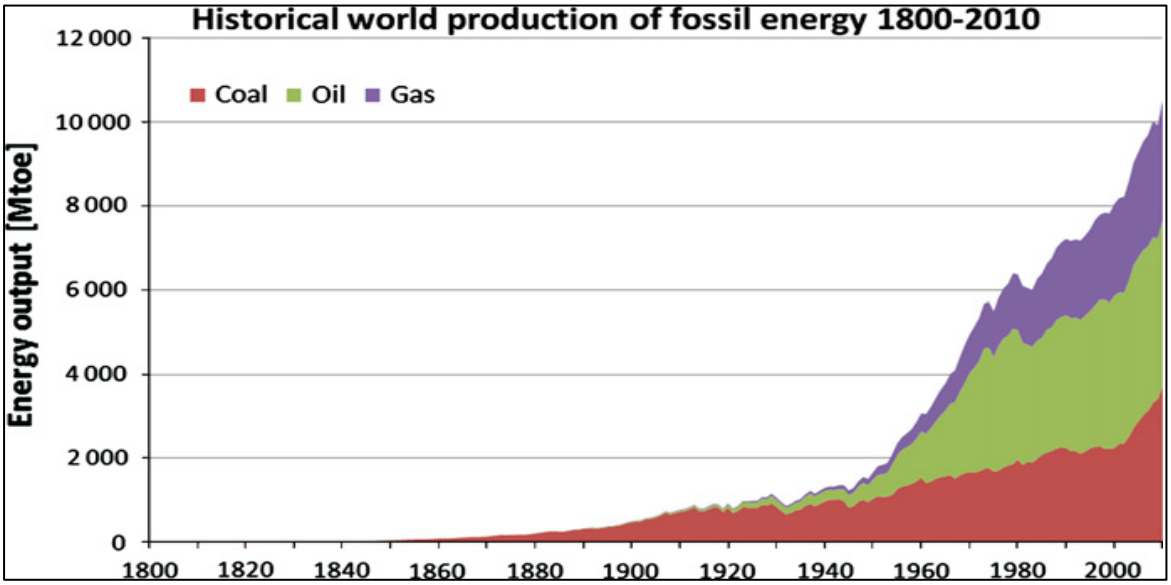
Source: Climate Action Tracker, 2015

Those same countries above are still the largest emitters of CO_2 from fossil fuels excluding EU but including Germany (Boden & Andres, 2013). Suranovic, (2013), drew an insight that this fossil fuel addiction may not really be addiction but the concern is the cost-benefit analysis of eliminating it yet it takes implementation behaviour and policy changes of fossil fuel usage to correct the impact it imposes on climate change.

2.3 Fossil fuels in the global energy system

Since the emergence of the industrial revolution, fossil fuels have been a key driver in the world development and its economic growth (Höök & Tang, 2013). The energy related to this has also gradually grown from zero in the year 1800 to almost 10,000 million tons of oil equivalents as illustrated in the figure 1 below.

Figure 1: Historical world production of Fosil

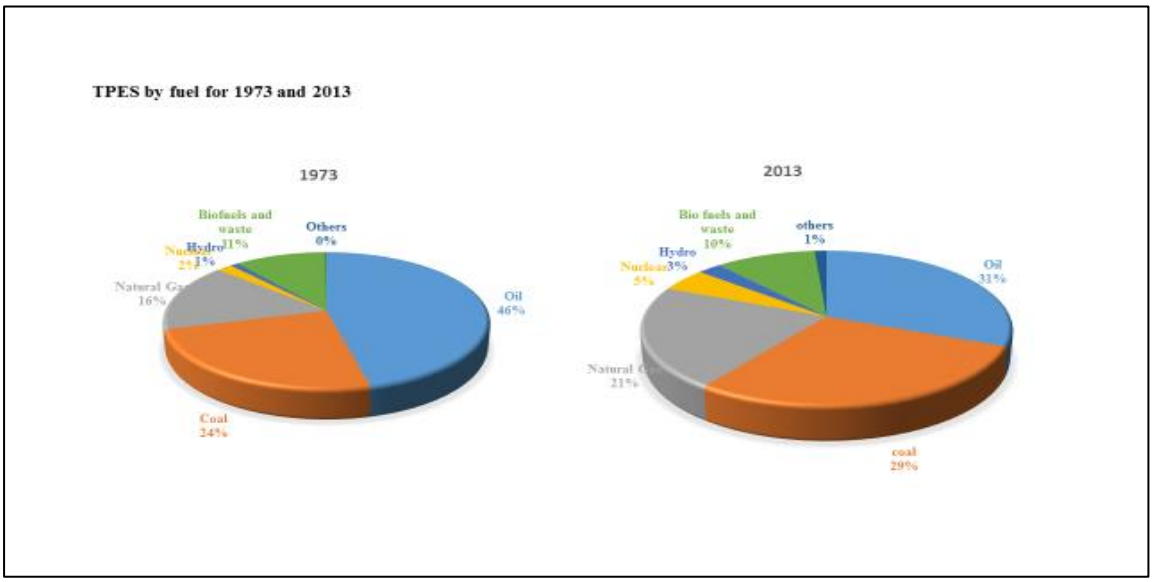


Source: Global production of fossil energyfrom1800 to 2010.Adapted from Höök & Tang (2013)

Furtherstill, Fossil fuels formed about 81% of the world's Total primary Energy supply (TPES), as of 2013 as shown in figure 2 below.

A comparison of 1973, when climate change had not become a major world concern, and 2013, after several COPs; indicates that the use of fossil fuels has reduced from 86% to 81% of the TPES. However, it should be noted that the specific reduction is in use of oil while natural gas and coal have increased. On the other hand, non fossil fuels have increased besides bio fuels and waste.

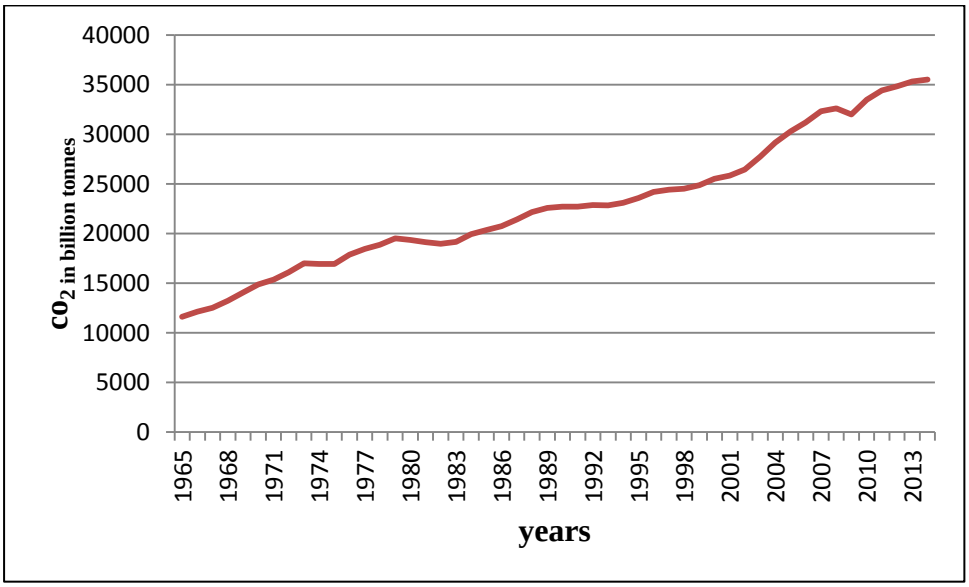
Figure 2: TPES by fuel for 1973 and 2013



Source :(IEA, 2015) *Figures estimated to whole numbers after Author's computation

By and large, fossil fuels-related energy is expected to remain the main energy source and could makeup over 84% of world's energy demand by 2030 (Shafiee & Topal, 2009)., The concern then is the GHGs specifically CO_2 that is produced during energy production and utilization (Höök & Tang, 2013).CO_2 emissions related to global energy have continuously increased over the years (International Energy Agency (IEA), 2015). As shown in the graph below.

Figure 3: World $C0_2$ emissions from fossil fuels



Source: BP Statistics data (2015)

The graph indicates a gradual increase in the CO_2 emissions from 1965 to 2013.

3.0 WHY THE USE OF FOSSIL FUELS CAN NEVER STOP

Literature on the use of fossil fuels and its impact on climate change has been evolving over time and all conclude that fossil fuels impact on climate change and yet their use cannot be stopped immediately; it is simply an 'impossible divorce' hence the need for concrete policies to harmonise the situation. As highlighted in 2.3, one of the key drivers is economic growth as explained below in details and also other factors follow.

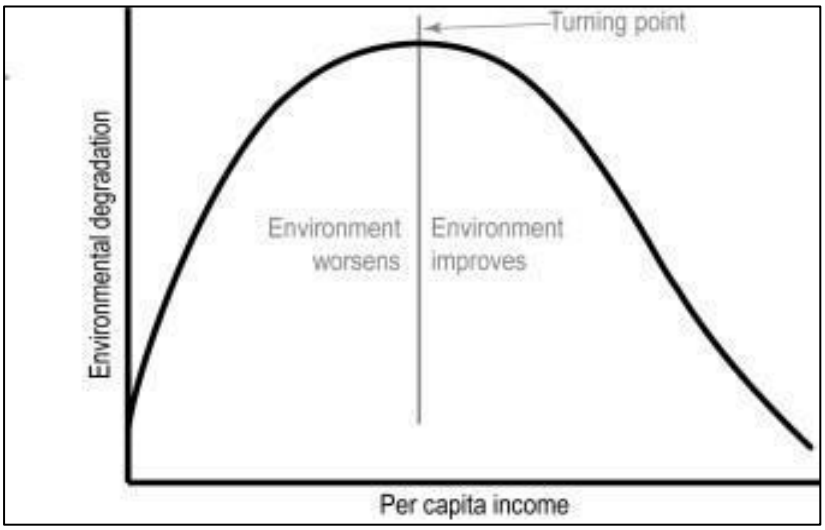
3.1 Economic growth and CO_2 emissions (Environmental Kuznet Curve (EKC) Hypothesis)

In the fifth paragraph of chapter one, this paper confirms that the world's growth rate is increasing and the industry sector accounts for the biggest growth. A relationship between economic growth and CO2 emissions has been established by several scholars.

In the early 1990s when fears about climate change as result of environmental quality increased, the nexus of pollution–economic growth gained acceptance (Narayan & Narayan, 2010). To understand the genesis of CO_2 emissions, it is vital to appreciate the relationship between economic growth (GDP) and CO_2 emissions given that majority comes from energy related activities which are the drivers of the economy. Hoffert, (2010) expressed a dilemma of continued world economic growth while keeping CO_2 concentrations below 450 parts per million (ppm), despite continuing improvements in energy intensity. The relationship is explained by the EKC.

Stern, 2003 defined EKC as a hypothesized relationship between various indicators of environmental degradation and income per capita. He added that initially as economic growth increases, pollution increases until a certain level after which increase in economic growth leads to environmental improvement. This creates an inverted U-shaped graph. Figure 3 refers

Figure 4: Environmental Kuznet Curve



This relationship has been tested in energy literature. Narayan & Narayan (2010) in testing the EKC for 43 developing countries using an econometric approach concluded that as economies grow, CO_2 emissions reduce. Also as economies move to the right hand of the curve (as they become richer), they are able to give support to poorer economies in pursuit of enhancing their adaptive capacity through technological support and other initiatives (Goklany, 2005). Holtz-Eakin & Selden, 2005 used global panel data using an intermediate approach to examine the relationship between CO_2 emissions. There was evidence of diminishing marginal propensity to emit (MPE) CO_2 as the economy develops and they established the need for international cooperation as a way of tackling global warming an argument similar to Goklay, 2005. Whereas Stern et al, 1996 cautioned about the econometric problems identified in estimating the EKC in some earlier studies, the EKC concept will still form the basis for solutions to climate change in chapters 4.

3.2 Other key factors

One of the interesting literature are the works of Covert,et al.,(2016) which assess if the use of fossil fuels would ever stop. They point out that given the current availability of technology that has enabled exploration and drilling in higher- risk prospect areas, the proven reserves especially for oil and natural gas have gone up hence a justifying the prediction that more fossil fuels will be used in the future. Also McGlade and Ekins (2015) suggest keeping half of the oil reserves from 2010 to 2050 so as to maintain the global temperatures at 2^oC; however, the urge to develop fossil fuel territories is too high to be in line with temperature commitments. Besides, built

up economies are locked into the use of energy systems related to fossil fuels or what may be called carbon lock driven by path-dependent increasing returns to scale. This has been an obstacle to policies geared to low carbon-saving technologies despite their environmental benefits (Unruh, 2 000)

On the other hand, considering levelized cost for electricity technology in comparison, solar turns out to be less costly in the future however factors such as reliability and intermittent nature of supply come to play and so is wind (Covert, et al., 2016).

Bhattacharyya, (2011) further brings the concern of energy security that has led non resource rich countries to heavily involve in importation of fossils so as to meet their fuel mix demand.

4.0 DISCUSSION

Generally speaking, the Kyoto Protocol's (KP) flexible mechanisms designed to help Annex 1 countries to attempt to reduce their emissions have had their own shortcomings; for instance under the Cleaner Production Mechanism (CDM) project implementation, domestic actions geared towards emission reductions in developed countries have been undermined in hope of recovering the credits from developing countries. There has also been an increase in the transaction costs as a result of the complicated international regulatory system; and inadequate institutional capacity in developing countries, which hinders the freedom to choose which project to develop and also limits the negotiation capacity of developing countries (Begg, et al., 1999). The same issues were brought to light by Karakosta and Psarras (2013) while analysing the CDM potential in the Mediterranean basin.

Also the Joint Implementation (JI) projects have suffered transparency issues; inadequate information which frustrates project implementation; inadequate human and financial resources among others (Karousakis, 2006).

Further, the emission trading scheme (ETS) has also had their issues notably low carbon prices that do not encourage polluting industries to change their behaviour; and delayed auctioning of permits. There is excess supply compared to demand due to other government initiatives; policy uncertainty that discourages investors; laxity to adopt to environmentally friendly technologies in a bid to offset credits (Fairley, 2012). A good example of ETS gone bad is the European ETC. In fact the UK government regarded it ineffective since 2013 as it attempted to boost low-carbon energy sources (Robinson, 2013)

As discussed in chapter 3, the use of fossil fuels which are the key drivers of CO_2 emissions may not end soon yet there are few policy responses to limit their usage especially in developing countries that have increased their consumption by 7.5%, 24%, and 20% in oil, coal and natur al gas respectively (Covert, et al., 2016). Appreciating that CO_2 emissions reduction is a public good yet actual emissions are a negative externality then there is need for government intervention to clear these market failures (Bhattacharyya,2011). These externalities from fossil fuels have triggered litigation to the extent of property rights conflicts and even if the Coase theorem is used as a solution, the transaction costs are high (Rogers, 2008)

The recently concluded Paris Agreement (PA) advocates for concrete domestic policies and actions and there therefore the following can be explored.

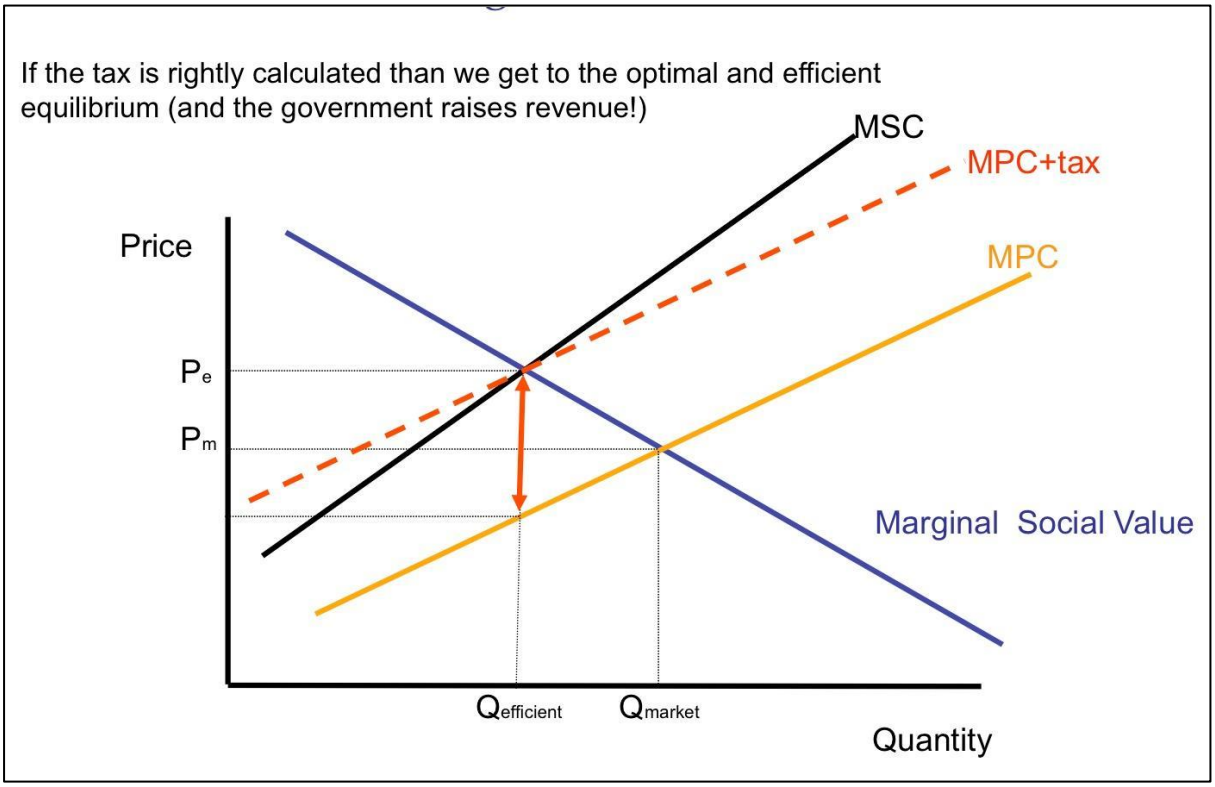
Command and Control instruments (CACs)

'Rogers et al (2003) broke down these instruments into regulations, quantitative and qualitative controls. Controls referring to the quantities of output and input produced, technology used and the location of the polluting activities. Usually an environmental state agency is given the powers to set the acceptable behaviour and most times standards are considered (Bhattacharyya, 2011). For instance in regulating permissible quantities of emission, direct regulations on quantity of pollution emitted can be applied or even specific technology needed Rogers et la., (2003). However, information problems still pose as challenge to the regulators while implementing this mechanism. Besides, there is room for negotiation with the regulators which gives room to compromise on the standards: Also standards discourage the potential to outperform. (Goulder and Parry, 2008: Bhattacharyya, 2011). By and large this may be the best option for dealing with harmful emissions (Ibid).

Taxes or charges

The underlying idea behind a tax is to bring the social costs in equilibrium with the private costs .This kind of tax is referred to as a Pigouvian tax. Imposing a tax helps internalise an externality in an economically efficient way. However, the problem is to identify the right optimal level where the tax is equal to the marginal social cost (Bhattacharyya, 2011). The concern of inadequate pricing of GHG emissions was still emphasised by Covert, et al (2016). In that regard taxes can be imposed either on the level of a specific input (for example coal or oil) or on the level of emissions (Rogers et al., 2003.The figure below shows the concept of a Pigouvian tax.

Figure 5: Concept of a Pigouvian tax



In a normal competitive market without any intervention, output will be at Q_m where MPC =MSV at Price P_m. However if the externality is considered by imposing a tax, the quantity reduces to Q_e and the prices increase at P_e .

Indeed Carbon taxes have been implemented in various countries such as Ireland, Sweden, Australia and many more countries, but no government is prepared to solely bank on it due the massive information needed for it to be successful (Robinson, 2013). Besides, some of the biggest emitters such as China, USA and Japan have not yet accepted the implementation of this tax (Komanoff, 2015). Taxes on fossil fuels on the basis of the carbon content would greatly tackle climate change problems and besides the revenue from it can be redistributed to lower –income households (ibid).

Indirect taxes can also be used, and these are typical in the energy sector- such as taxes on oil products. However they are not as efficient as the direct taxes (Bhattacharyya, 2011). Goulder and Parry (2008) added that the indirect taxes do not focus directly on the externality hence do not absorb all the pollution channels rendering the cost ineffective; they further provide an example of a tax on electricity

that however much it reduces the demand and output, it does not guarantee that there is clean fuel substitution in the power generation.

Reduce fossil fuel related subsidies

Governments have been spending a lot of money on fossil fuel subsidies for political and equitable reasons (Victor, 2009) yet they are a hindrance to the revolution of clean technologies (European Commission, 2016). In fact EIA, (2015) puts the value of these subsidies at 493 billion dollars by 2014. This has not only distorted the true pricing of energy but also induced the consumption of fossil related fuels imposing a threat of pollution (Victor, 2009). Peace (2003) analysed and noted there is potential of decrease of CO_2 from the Kyoto Protocol expectations if subsidies on fossil fuels are removed. Koplow & Dernbach (2001) were in agreement with Peace, and added that the removal of the subsidies can actually reduce government costs while at the same time enabling it in its climate change obligations.

Trade permits (cap and trade)

Tk2he Kyoto Protocol took a step to promote cap and trade in form of emission trading and so is the Paris Agreement, though the latter does not give details; however it obligates developed and developing countries to take part. As noted in this chapter paragraph 3 this system has had its challenges, but it can be strengthened since it changes polluting behaviour.

Bhattacharyya, (2011) put it as a system that involves an overall cap set based on historical emissions; permit distributions done either through auctioning or free of charge; trading mechanism where an actual market is formed and the transaction of permits can take place at a given clearing price; monitoring and recording of all transactions, emissions and penalties.

Increase the use of alternative low carbon energies

Alternative fuels include may include both renewables and non-renewables; however, in this context emphasis is drawn on modern renewables such as solar, wind, and biomass and non-renewable such as nuclear energy.

Much as renewable electricity energy has been promoted for price stability concern and energy security, the un-priced externality from burning fossil fuels has contributed to the advocating of renewables (Borenstein, 2012). Even if the Paris Agreement says little about renewables and how they should be promoted, renewables are vital in climate change mitigations (Bold et al., 2016). The life cycle emissions of renewables and nuclear in electricity generation are low compared to fossil fuels (World Nuclear Association,).

Though renewables are good, they have shortcomings such as their intermittent nature which require improvement in grid management and network upgrading, they are costly, and they pose storage and back up capacity problems. Moreover, emissions associated with them may not be quantified (Weisser,2007). By and large, support mechanisms such as feed in tariffs, renewable quotas, financial incentives and public financing can be applied to support renewables (Bhattacharyya, 2011; Green and Yatch, 2012).The UK government has, in this area, embarked on promotion of non-fossil fuel (Robin, 2013).

On the other hand, while nuclear energy has also been used a base load by countries like France and Japan, its support has gone down since the Fukushima accident in Japan due to environmental concerns (World Nuclear Association, 2015). Covert, et al still poses a question if really these alternative policies are better than pricing the negative eternality from the generation of fossil fuels.

5.0 CONCLUSION AND RECOMMENDATIONS

Scientists have established all evidence that climate change is a threat and energy related emissions contribute the most to the cause. The UNFCCC has also tried to address the cause however the reality of fossil fuels is being neglected right away from national level yet the addiction is real as noted by away Suranovic, (2013).Further, the KP mechanisms have had their own challenges while The PA that seemed to be the hope has also been criticised before the actual implementation; moreover Coase's efficient bargaining cannot work perfectly in this condition due to the large number of participants and the high transaction costs involved (Rogers et al., 2003).

This paper therefore concludes that it is possible to mitigate climate change impacts if governments embrace domestic policies that aim to reduce the use of fossil fuels. Fossils and climate change are two intertwined challenges that require a holistic solution. As seen in chapter 4, there is no single approach to the reduction of CO2 from Fossil fuels though many scholars propose the use of taxes/charges and cap and trade. For instance Knittel, 2012 advanced that putting a price on externality influences behaviour though he put a disclaimer of political interference. Moreover the taxes work in the context of polluter pay principle which is effective at national level but not in global problems. Also renewables have failed to pick up while countries like Middle East can never do away with energy subsidies.

Therefore policies geared to energy demand management and supply can also be explored as supplementary to the views in chapter 4.Further developed countries need to invest more in research and development in developing countries.

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