Centre for the Study of the Economies of Africa

Climate Policy and Finance:

Designing an Effective Carbon Pricing System for Nigeria's Oil and Gas Sector

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Abstract

Carbon pricing has been recognized not only as the most efficient economic policy instruments to internalize the social cost of emissions, but also as a major tool to generate public revenues that can be used to offset the potential adverse distributional effects of climate policy. However, in many developing countries, there is a widespread reluctance to commit to climate policy, largely due to financial constraints, a lack of public support, and concern over its regressive effects. The aim of this research is to make recommendations towards the design of an effective carbon pricing system that not only discourages air pollution but also encourages the gradual uptake of climate-friendly technologies by the private sector in Nigeria's oil and gas sector, while supporting public investment in sustainable infrastructures and projects that offset the distributional effect of the climate policy.

Key Words: Carbon Pricing, Carbon Tax, Climate Change, Climate Finance, Sustainable Development Goals.

1. BACKGROUND

A. Nigeria's Commitment to Climate Change Mitigation

The goal of climate policy is to mitigate anthropogenic climate change caused by greenhouse gases (GHG)[1] emitted by human activities, mainly industrial activities. Although developing African countries contribute minimally to climate change, there is a recognized need for these countries to embrace climate policy due to the potential adverse impact of climate change on the progress on food security, health, poverty reduction, inequality, as well as future economic growth and development. Particularly, Nigeria is exposed to dangerous climate impact –from desertification in the North to coastal flooding in the South. For instance, Lake Chad has shrunk by almost 90% in recent decades (Nigeria Infrastructure Advisory Facility, 2016), and the 2015 World's Climate Change Vulnerability Index classifies Nigeria as the third most vulnerable country in the world (Reliefweb, 2016).

Thus, during the Paris Agreement on climate Change in December 2015, over 190 countries submitted their GHG emissions reduction pledges –called the "Intended Nationally Determined Contribution" (INDC). The key focus of Nigeria's INDC is to pursue economic and social development that would minimize future GHG emissions by 20 percent unconditionally and 45 percent conditionally (i.e. dependent on international financial support) by 2030. Particularly, it aims to reduce carbon dioxide equivalent (CO_2e) per US$ real GDP – from 0.873 kg CO_2e in 2015 to 0.491 kg CO_2e by 2030 (FGN, 2015). The reduction in CO_2e is to be achieved by: ending gas flaring (by 2030), enforcing energy efficiency (2% improvement per year and 30% by 2030), adopting off-grid solar (PV[2] of 13 gigawatts), improving energy efficiency of the electricity grid, adopting climate smart agriculture and reforestation; as well as transport shift from cars to bus (FGN, 2015).

Pursing a sustainable (lower carbon) development pathway in Nigeria would offer not only the global benefits of reducing contributions to climate change (a global benefit of avoiding about 2.3 billion tons of CO_2e emissions over 25 years), but also domestic economic benefits of: more efficient operation of the oil and gas industry (with discounted net benefits of US$7.5 billion); improving air quality; promoting cheaper and more diversified electricity sources (with savings of about 7 percent or US$12 billion); better transport services resulting in fuel savings; more productive and climate-resilient agriculture; as well as reduced congestion (Cervigni, et al., 2013).

B. Challenges to Pursing a Lower-Carbon, Sustainable Development Path

The Nigerian government has shown interest in pursuing a (lower carbon) sustainable development pathway, through its INDC. However, since the Paris Agreement, the Nigerian government has

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[1]Greenhouse gases (GHG) are gaseous compounds in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat in the atmosphere. Burning fossil fuels like coal, natural gas and oil produces more GHG emissions than any human activity. GHG include: carbon dioxide, methane, nitrous oxide, and fluorinated gases (like Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride).

[2] Photovoltaics (PV) is a term which covers the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effect,

struggled to translate its INDC commitments into actions –largely due to financial constraints, a lack of public support, and concern over its regressive and distributional effects, among others.

First, it has been highlighted that achieving Nigeria's INDC goals will require a quantum leap in investment on sustainable infrastructure and projects, estimated at USD5.68 million per year for over 25 years (Cervigini, et al, 2013). However, like other developing countries, Nigeria's government revenues are often insufficient to provide for the basic needs and infrastructure, let alone fund climate change mitigations and adaptations. In fact, between first quarter of 2014 and second quarter of 2016, the Nigerian government lost 237 percent of its crude oil revenue (dropping to ₦537.19 billion approximately US$1.76 million in 2016Q2[3]) on account of the slump in crude oil price and production (CBN, 2016). Although the recent decline in the oil price has helped to promote some of the benefits from diversifying the Nigerian economy towards lower carbon activities and energy sources, it has also significantly reduced the government's fiscal capacity to take action. While the international community has made a commitment to provide US$ 100 billion per year to developing countries towards meeting their INDC, Nigeria is just one out of 114 developing countries that submitted their INDC proposals. Hence, the prospects of financing climate action in Nigeria is heavily constrained by poor access to sustainable external and domestic finance.

Second, the need and urgency for climate change mitigation and adaptation in Nigeria seems to be short of public interest and support; thus, presenting a major challenge to implementing the INDC. Historically, the importance of oil to the economy has led many to perceive climate issues as at best irrelevant or, at worst, a barrier to the development of the Nigerian economy (Nigeria Infrastructure Advisory Facility, 2016). Moreover, given that climate change policies can have a distributional effect on wealth via its impact on the prices of fossil fuel assets (depending on their carbon content), potentially affected asset owners are often ready to use their wealth to directly lobby and pressurize politicians or indirectly mobilize resistance through labour unions (Meishausen, et al., 2009; Rentschler & Bazilian, 2016). It is no surprise that over the past decades, successive government administrations have attempted to remove fuel subsidy in Nigeria with limited success, until recently when the shortage of government revenue (due to crude oil crises) forced the adoption of a partial and ambiguous fuel subsidy removal regime.

Third, another critical barrier to climate change action is the concern over the regressive effect of such policies. In most cases, the cost burden of such climate policies does not fall evenly on households: Low-income households stand to lose a higher share of their consumption than high-income households (Sterner, 2012; Klenert, et al., 2017). The regressive effect of climate policy is a serious concern given that the loss of any given percentage of income is weightier for poorer households, even if they pay less for climate policy in absolute terms (Klenert, et al., 2017). Although the cost burden of climate policy is less regressive in developed countries relative to their counterpart (Parry, et al., 2006; Sterner, 2012; Klenert, et al., 2017), the regressive effect of climate policy still create substantial concern about its potential to disproportionately affect the poor and exacerbate poverty, inequality, and other developmental challenges in the country –thus, a major barrier against taking substantial climate action in Nigeria.

[3] ₦ 305.05 per US$

C. What can be done?

Given the aforementioned major barriers to implementing an effective climate policy, there is the need to explore ways of strengthening climate finance from all sources; reorienting the public towards green and clean infrastructure development; and countering oppositions to climate action in Nigeria. Among other climate policies, carbon pricing is widely recognized as the most efficient economic policy instruments for addressing these issues. Placing a price on the carbon content of industrial activities particularly in the oil sector would be critical not only in reducing GHG emissions and addressing environmental/health concerns, but also in pooling climate finance that can be used to spur investments towards sustainable (lower-carbon) growth and address the distributional effects of climate policies on households. A carbon pricing policy that is well aligned with the broader policy context of a country will also help gain public acceptance. Likewise, where there are potentially strong oppositions from affected elites, a well-designed carbon pricing system can even provide a leeway for compensation. However, Nigeria is yet design a carbon pricing policy and program.

Thus, the aim of this study is to provide evidence-based analysis and recommendations for designing an effective carbon pricing system that discourages air pollution and encourages the gradual uptake of climate-friendly technologies by the oil and gas sector, while supporting public investment in sustainable infrastructures that can offset the regressive effect of the climate policy in Nigeria. The study focuses on the oil and gas sector because of the greater need for climate action especially in the oil and gas sector –on account of its importance to the productive capacity of Nigeria as well as its contribution to current and future GHG emissions. Substantial amounts of GHG are given off during oil and gas production via fuel combustion and gasification, leaking equipment, natural gas transmission, distribution lines, storage facilities, and gas flaring. For instance, in 2010, Nigeria's methane emissions from oil and natural gas were 25.8MMtCO_2e– more than those of India and Ukraine, and just below Mexico and Indonesia (Hogarth, et al., 2015). These emissions originate mostly from gas flaring: in 2012, Russia and Nigeria accounted for 40% of global gas flaring (Emam, 2015). Furthermore, the sector poses risks to technological, infrastructural and institutional lock-in to low-carbon development pathway (Hogarth, et al., 2015). Besides, the persistent incidences of oil spillage, gas flaring, destruction of farmlands and water bodies among other environmental hazards as well as the new incidence of black soot falling in the oil hub region of the country call for a commitment towards pursing an economically, socially, and environmentally sustainable growth. Particularly, the recent incidence of black soot falling in the oil hub region of the country due to some of the activities of firms in the extractive industry (Pulse International News Agency, 2017; Vanguard, 2017) presents a window of opportunity for evidence-based research and advocacy to push for climate policy.

While this research is country specific, the issues and challenges are similar across many developing countries; thus the outcome of the study will present lessons for other developing countries especially in Africa. The recommendation from this study can be applied in other African economies to promote the adoption of climate policies and mobilize resource for investment in climate-resilient projects, in line with the Sustainable Development Goals.

2. CARBON PRICING OVERVIEW

A. Definition

Carbon pricing is basically a broad term that encompasses two climate policy approaches: carbon taxation and emissions trading. While carbon taxation sets a price for GHG emissions and allows the market to determine the aggregate level of emissions, emissions trading (or cap-and-trade) sets a ceiling for aggregate emissions level and allows the market to determine the price**.** Both are easily applicable to GHG emissions (not limited to carbon) coming from energy use, but can be extended to emissions arising from land use changes and other sources. Setting a price on carbon emissions, either through emissions trading or taxation, is considered an essential and the most effective policy tool for: minimizing $C0_2$ emissions, raising revenue, controlling air pollution, and mitigating anthropogenic climate change (Carbon Pricing Leadership Coalition, 2016; Parry, et al., 2016; Baranzini, et al., 2016).

B. The case for carbon pricing

Although ex ante studies analyzing carbon pricing programs are scarce, evidences from the few studies suggest several advantages of carbon pricing approach. First and from a theoretical perspective, market-based measures (such as carbon pricing programs) are more cost-effective relative to other regulatory measures based on source-specific limits (such as biofuel subsidies), because the former produces more emissions reduction per unit expenditure (Tietenberg, 2006; Kolstad & Wolak, 2008). However, while carbon pricing programs can be cost-effective in theory, they can often be distorted by manipulations by market participants in practice: e.g. emissions trading is uniquely susceptible to price manipulation arising from market power which could, in turn, reduce its cost-saving benefit (Tietenberg, 2013).

Second, the past empirical studies on non-carbon pollutions pricing programs also lend support to the theoretical expectation that carbon pricing programs would be more effective at reducing emissions (Tietenberg, 2013). For instance, a study shows that Sulphur allowance program (a cap and trade program) in the U.S led to a 36 percent reduction in SO2 emissions from the power sector, yet output from coal-fired power plants increased by 25 percent between 1990 and 2004 (Chan, et al., 2012). The study also found that the program resulted in a range of 15% - 90% savings relative to other alternative policies.

Third, the literature provides some empirical evidence to demonstrate that the implementation of carbon pricing will induce dynamic efficiency; as it offers financial/economic incentive for emitters to invest in emission-reducing innovation and adopt new emission-reducing technologies (Jaffe & Stavins, 1995; Acemoglu, et al., 2012; Baranzini, et al., 2016). Although the gains in innovation from carbon pricing programs have not always been as high as expected, most studies find a statistically significant response – often positive correlation between higher energy prices and the development of (green) innovative technologies (Das, 2011; Bellas & Lange, 2011; Ambec, et al., 2013). Furthermore, some evidences suggest that the channelling of proceeds from carbon pricing towards supporting low carbon investments has hastened technology diffusion (Dechezlepretre, et al., 2008; Sterner & Turnheim, 2009).

Fourth, relative to other climate change polices, carbon pricing is preferred because "it changes relative prices to reflect all direct and indirect CO_2 emissions of products and services so that firms and consumers will automatically internalize the costs of global warming" (Baranzini, et al., 2016, p. 10). Essentially, carbon pricing policies reflect the "polluter pays" principle and contribute to distributing costs and benefits equitably, avoiding disproportionate burdens on vulnerable groups (OECD and World Bank, 2015).

C. Global trends

Several countries are implementing one or more forms of carbon pricing policy: Sweden (a carbon tax, since 1991); European Union (a regional ETS, since 2005); Canada's British Columbia (a carbon tax, since 2008); and the US' Regional Greenhouse Gas Initiative (a regional ETS, since 2009) and others. Since the submission of INDCs to UNFCCC in December 2015, several other countries have begun designing and piloting their carbon pricing programs as an essential element for their proposed climate action. Brazil, Chile, China, Columbia, Coasta Rica, Indonesia, Morocco, Thailand, and Vietnam are expected to begin the implementation phase of their carbon pricing programs before 2019. There are about 42,000 carbon pricing programs being implemented or scheduled for implementation around the world, including Africa (World Bank, Ecofys, and Vivid Economics, 2016). In Africa, South Africa is at the forefront of carbon pricing implementation, while other African countries are also considering it. For instance, Egypt is considering a national market for carbon (an ETS); Morocco, Ethiopia and Cote d'Ivoire have joined the Carbon Pricing Leadership Coalition –an initiative of the World Bank to expand the use of carbon pricing; Senegal and Ethiopia have joined the Carbon Market Platform initiated by the G7.

3. DESIGNING AN EFFECTIVE CARBON PRICING SYSTEM IN NIGERIA

This section provides an evidence-based analysis of key elements and appropriate options to consider in the design of an effective carbon pricing system in Nigeria. Recommendations for designing an effective carbon pricing system in Nigeria's oil and gas sector draws key insight from the case studies of country experiences, as well as the FASTER Principle[4] for successful carbon pricing developed by OECD and the World Bank Group.

A. Choice of Carbon Pricing Instrument:

What is the appropriate carbon pricing instrument for Nigeria?

Although both emissions trading systems (ETS) and carbon taxation share generally favourable properties *(see section 2)*, each has its unique pros and cons. While ETS (which entails setting an emission cap) can guarantee the achievement of a given environmental objective (e.g. reduction in $C0_2$ emission), the price of carbon is left uncertain. The inherent price volatility in ETS is argued to hamper long-term investments (Baranzini, et al., 2016). However, volatility in ETS can be minimized with the incorporation of price floors and ceilings (i.e. safety valves) into policy design, or a combination of a permanent carbon tax and an emission trading market (Wood & Jotzo, 2011).

On the other hand, carbon taxation guarantees the price of carbon but leaves the level of emission or environmental impact uncertain. While the maximum level of emissions reduction is not guaranteed, carbon tax can be more cost-effective and easier to implement (Baranzini & Carattini, 2014; Parry, et al., 2016). It is often preferred for startups in order to prevent instability in the pricing of carbon that comes with ETS (World Bank, Ecofys, and Vivid Economics, 2016). Many countries begun their carbon pricing policy with a tax before moving to an ETS. For instance, Mexico implemented a carbon tax in 2014 –which generated about US$1 billion – in order to prepare the path for an ETS (its preferred option) in 2018. South Africa's proposed carbon pricing program entails a carbon tax that covers CO_2e emissions from fuel combustion, coal gasification, and non-energy industrial processes (that is Scope 1 emissions).

Furthermore, based on an assessment of carbon tax initiatives around the globe, carbon tax may also be easier to implement for sector- and activity-specific carbon pricing relative to its counterpart. For example, Finland runs a carbon tax for light and heavy fuel oil, coal and natural gas in order to encourage the use of biomass and low emissions heating fuels, as well as improve the competitive position of peat and natural gas compared to coal (World Bank, Ecofys, and Vivid Economics, 2016). France has also placed a carbon tax on the use of fossil fuels by sectors not covered by the EU ETS.

Given that Nigeria implementing a carbon pricing system in Nigeria would be a test drive, a carbon tax is deemed preferable. Once some maturity is gained, an ETS (preferably with other African countries) can be considered.

[4] The FASTER Principle: fairness, alignment with existing policies, stability, transparency, efficiency, and reliability

B. Structure of Carbon Pricing Policy:

What should the price be, should it be static or change overtime?

Generally, carbon prices (for both ETS and tax) vary significantly –from less than US$1 to US$130 per tonne of CO_2e, with about 85% of emissions set at a price less than US$10/t$CO_2$e (Rydge, 2015). South Africa's proposed carbon pricing initiative (to be launched in 2018) is set at a tax rate equivalent of US$8/t$CO_2$e[5], scheduled to increase by 10 percent (US$1) annually until 2019 in order to account for inflation and give business time to adjust (Machingambi, Memory, 2017). Likewise, in 2008, the Canadian Province of British Columbia launched a carbon tax initiative set at an equivalent rate of US$7.3/t$CO_2$e, increasing by US$3.7/tCO_2e annually for four years until it settled at a predetermined rate of US$22.1 in July 2012 (World Bank, Ecofys, and Vivid Economics, 2016). An initial low tax rate allowed to increase gradually helped to minimize political controversy since adjustment were clear and anticipated, and provided incentive for investments in cleaner technology. British Columbia was able to move from a low to a more stringent price with less opposition than might have been the case if a US$22.1 rate/t was implemented upfront (OECD and World Bank, 2015). Similarly, carbon tax rate in France –at US$24/t as at January 2016– is scheduled to continue to increase by US$9/t$CO_2$e each year until it reaches US$62/tCO2e in 2020 (OECD and World Bank, 2015).

In a similar vein, Nigeria appears to be best suited for a carbon tax initiative that begins with a low rate and increases by a given percentage each year. While a low starting rate would yield lesser climate and fiscal benefits, it is needed to allow companies adjust to new climate policy and spur private investment in lower-carbon infrastructures. It will also help minimize potential political opposition that is likely to arise during the legislative processes. Conversely, while a high initial rate could reduce emissions, raise in government revenues (or otherwise – an implication of the Laffer curve[6]), and spur technological deployments more quickly (by increasing the return to low-carbon investments), but it would rouse stronger oppositions that could lead to the non-passage of the policy. This is because an ambitious start would cause fossil fuel prices to shoot up and make exiting capital become economically inefficient; thus arousing more agitations (Morris, 2016).

While a low starting rate is preferred, the tax rate should rise gradually. A carbon price that stays constant will reduce emissions for a while, but owing to economic growth and other factors, emissions will eventually start going up again. Most economists advocate a carbon price trajectory that goes up over time at a pace that encourages continued abatement even as the economy grows (Morris, 2016). However, there is a limit to how high the price can go and still encourage additional emissions abatement, this is because carbon prices that are controversially high can raise the risk that the parliament will amend or repeal the policy. This is because as prices go up beyond optimal price, it also becomes economically inefficient for firms to produce and would lead to other adverse economic implications such as declining productivity and rising unemployment – which would make a strong case for the abolishment of the climate policy. For example, Australia's carbon tax initiated in July 2012 at US$23.8/t$CO_2$e rising at 2.5 percent in real terms every year, was repealed in July

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[5]tCO_2e – metric tonne of carbon dioxide equivalent

[6] The Laffer Curve is a theory developed by supply-side economist Arthur Laffer to show the relationship between tax rates and the amount of tax revenue collected by governments

2014 due to pressure from the business community, among others (Australian Government, 2015). Critically, if investors believe that future price might be reduced, they may not initiate investment in cleaner technologies –and this defeats one the main objectives of a carbon pricing policy.

Given that the starting rate and trajectory of the carbon price are central to the outcomes of the climate policy, there is the need to carefully determine the rate and trajectory of a carbon tax. There are a few approaches to setting a carbon price path. First, the government could set the carbon price equal to the present value of the environmental and social damages produced by each additional ton of CO_2e emissions, i.e. the social cost of carbon (SCC)[7]. This quantifies present and future economic damages/costs of carbon emissions. In effect, setting the carbon tax at the SCC would equate marginal damages to marginal cost –thus justifying the abatement costs by its benefits. The set of values provided by either a Marginal SCC[8] or Average SCC[9] could then be used to set the trajectory of the tax. However, the estimated value of SCC is heavily dependent on a highly sensitive discount rate which is quite controversial as it can be easily manipulated to obtain desired value (Pindyck, 2016; Morris, 2016; Nordhaus, 2017). Estimating the SCC also involves large uncertainties that are dependent on critical judgements such as: whether to include benefits to the sector/cities in which the policy is implemented, Nigeria as a whole, or global benefits. Nevertheless, these problems are more pronounced for Marginal SCC relative to Average SCC. Thus, estimating Average SCC is deemed preferable for carbon tax because it is much less sensitive to discount rate and lends itself to expert elicitation (Pindyck, 2016). The SCC has long been adopted in many developed countries for: setting long-term sustainability objectives/targets, especially climate policy; setting values for economic instruments (such as taxes, charges, taxes); project appraisal (project cost-benefit analysis); and Regulatory Impact Assessment (policy cost-benefit analysis). For example, the UK's Department for Environment, Food and Rural Affairs, as well as the US White House in estimating cost and benefits of it carbon pricing policies and other regulations (Gayer, 2017).

Another popular approach for estimating the initial price and trajectory of carbon tax is to establish a formula for increments in the tax rate based on a key economic indicator. For instance, tying increments in tax rate to percentage increase in inflation, as proposed in South Africa. This could help provide businesses and households with clear information to guide long-term capital investments in new technology. It also relatively easier to estimate and administer (Morris, 2016). A major drawback is that this approach would not guarantee a particular emissions outcome without complementary policy measures or adjustments. This is because the formula would omit other important developments such as evolving climate pledges; thus would need periodic review/revision of the price trajectory which creates unfavourable uncertainties for businesses and households.

A third approach is to tie carbon price to other tax changes. It is often an attractive option for stakeholders worried that a carbon tax policy would cause the government to enlarge uncontrollably. While this would help ensure that the carbon tax shift is revenue neutral, it could leads to fluctuations in the carbon price or rates of other taxes; thus complicating the administration of the program and raising uncertainty for private sector investment decisions (Morris, 2016).

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[7] The Social Cost of Carbon is usually estimated as the net present value of climate change impacts over the next 100 years (or longer) of an increase in carbon emitted to the atmosphere today.
[8] Marginal SCC is present value of flow of benefits from one-ton reduction in today's emissions.
[9] Average SCC is present value of flow of benefits from large reduction in emissions now and throughout the future, relative to total size of reduction.

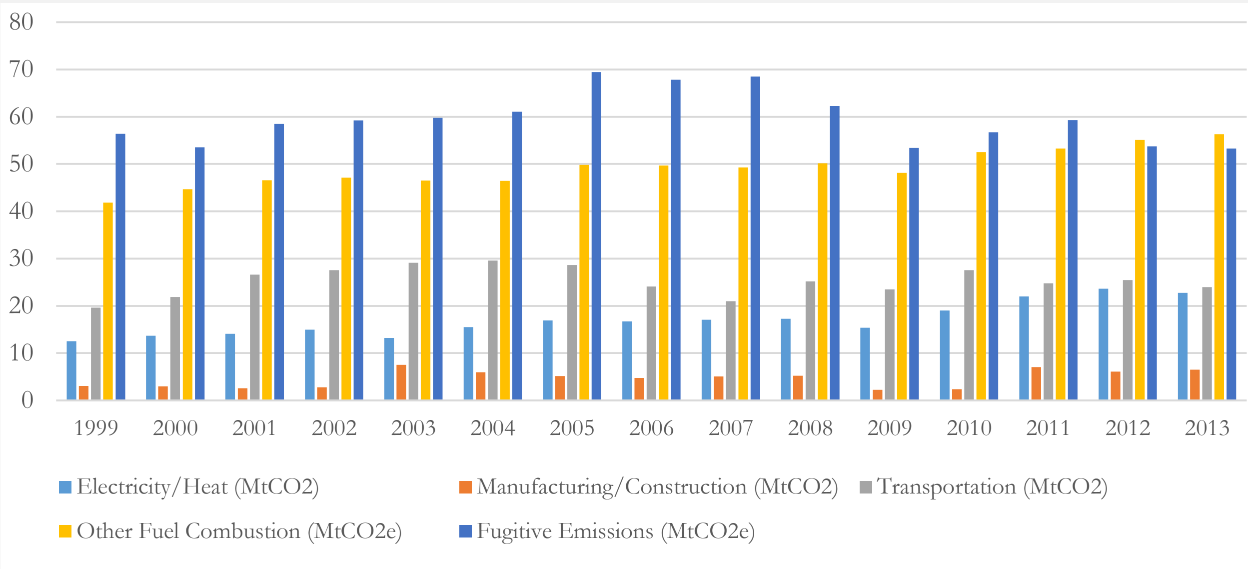
Preferably, the initial price and trajectory of carbon pricing in Nigeria should be estimated based on inflation rates, as in South Africa. While an average SCC would provide better estimates, it is not well-suited for developing countries due to data limitations and lack of technical capacity. While a gradual adjustment of carbon price in line with inflation may not be gradual adjustment of carbon pricing with a key economic indicator would be more convenient, cost-effective, and less subject to dispute. Furthermore, based on lessons from country case studies, the initial tax rate should fall be below US$8/t$CO_2$e and increase by a given percentage each year, as an ambitious start would have adverse implications. A low but increasing carbon tax rate starting rate would signal to the oil and gas sector, and even other sectors, to increase investment and innovation in low-carbon solutions for the future; thus eroding the advantage of incumbent fossil fuel technologies. Importantly, the SCC value must be carefully estimated by a group of scientific and economic experts, and with carefully collected data and inputs from key stakeholders.

C. Coverage of the Carbon Pricing Policy:

What sector and activities should the carbon pricing policy cover?

Many of the GHG emissions associated with the oil and gas sector originate from direct and indirect activities of oil and gas companies, mostly from fugitive emissions and other combustion *(Figure 1)*. Fugitive emissions result from the liberation of GHGs during mining of oil, gas and coal. Particularly, significant amounts of methane (CH_4) and nitrous oxide (N_2O) are emitted during oil and gas production via fuel combustion and gasification, leaking equipment, natural gas transmission, distribution lines, storage facilities, and especially gas flaring. In 2010, Nigeria's methane emissions from oil and natural gas were 25.8MMtCO2e –more than those of India and Ukraine, and just below Mexico and Indonesia (Hogarth, et al., 2015). In 2012, Russia and Nigeria accounted for 40 percent of global gas flaring (Emam, 2015).

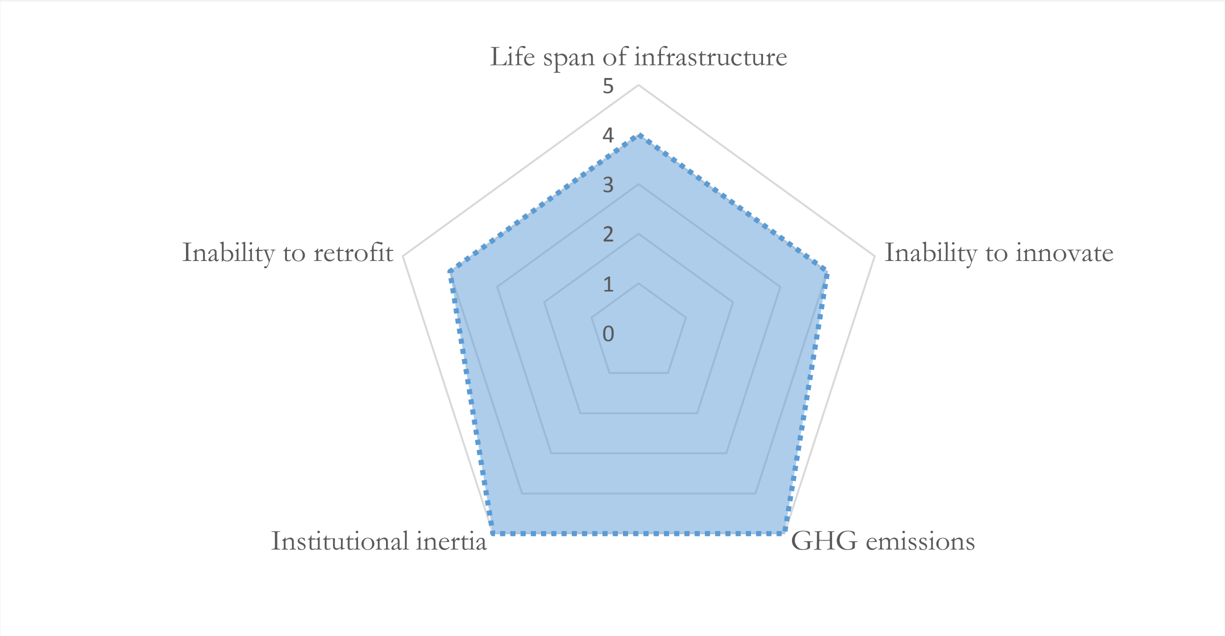
Figure 1: Total GHG Emissions in Nigeria Energy Sub-Sectors



Data Source: CAIT Climate Data Explorer

Mitigating these emission in the oil and gas sector via a carbon pricing policy is therefore critical to reducing GHG emissions. More so, capturing the costs of damage caused by emissions via a carbon tax has the advantage of levelling the playing field between emission-intensive and low-carbon economic activities –this is necessary in fostering a shift in Nigeria's economic structure from sole dependence on fossil fuel revenue. Importantly, the extractive industry (particularly the oil and gas sector), in Nigeria and Africa as a whole, is highly susceptible to lock-in to high-carbon pathways *(Figure 2)*. The risk of lock-in to high carbon pathways is a particularly important concern because once polluting-intensive infrastructure is built, green retrofits[10] can often be costly or technically impossible to implement and it becomes more challenging to phase out such infrastructure before the end of its productive life cycle; thus, creating a hard lock-in of polluting development pathways (Hogarth, et al., 2015).

Figure 2: Risk of lock-in to high carbon pathways in the extractive industry



Data Source: (Hogarth, et al., 2015)

Thus, the carbon tax could cover stationary and mobile combustion as well as fugitive emissions in the oil and gas sector. However, the tax should not be applied to proportion of fuels (particularly gas) used for electricity production given the deplorable state of electricity supply in Nigeria. This would help minimize gas flaring and encourage the conservation of gas fuels for supply to domestic power generating companies –bearing in mind that inadequate gas supply is one the major problems in the electricity industry. The oil and gas sector could serve as pilot carbon pricing policy in Nigeria, in preparation for a broader carbon tax policy in the future.

[10] Green retrofits are any kind of upgrade at an existing infrastructure/capital that is wholly or partially in use in order to improve energy and environmental performance in a way that it is financially beneficial to the owner.

D. Strategy for Utilizing Carbon Dividends/Proceeds/Revenues

How should the carbon dividend be invested? What infrastructures, projects or social programmes should be invested in to offset the regressive effect of the climate policy? What infrastructures, projects or social programmes should be invested in to offset other distributional effects of the climate policy? How would potential oppositions be averted?

Total GHG emissions in the energy sector amounts to 162.73 tCO_2e (CAIT Climate Data Explorer, 2017). With Nigeria's carbon tax pricing starting modestly at $8/tCO2e (see section 3.D), Nigeria can generate carbon revenue of about $1.30 million per year from oil and gas sector[11]. This can provide nearly 23 percent of total investment finance needed to achieve Nigeria's INDC goals.

Thus, the distribution of huge potential revenue from the carbon tax policy is a critical decision: it presents implications for its political appeal, distributional outcomes, carbon abatement outcomes, and the overall net benefits of the policy. Countries have made diverse choices on how to recycle revenues from their carbon pricing policies. The most popular channels for redistributing carbon dividends include: tax reductions, social programmes, and investments in infrastructure, as well as supporting lower-carbon projects and technologies. For example, Finland and Sweden adopts income tax cuts; the U.K and Denmark lowers employee's social security contributions; Switzerland pays carbon dividend directly to households. Canada's British Columbia runs a Low Income Climate Action Tax Credit program that provides tax cuts on personal, corporate, and small business income taxes of low-income households (Andersen, 2009; Tietenberg, 2013).

Some carbon pricing programs also use carbon dividend to promote additional emissions reductions, lower the cost of carbon abatement, and minimize the program's impact on the domestic economy (Tietenberg, 2013). For instance, in Denmark, while about 60 percent of the revenue is returned to industry, 40 percent of carbon tax revenue is used for environmental subsidies. Canada's Quebec deposits its carbon tax revenue into a "green fund" that supports projects that offers the lowest GHG reduction benefit. (Sumner et al. 2011). The US RGGI also directs most of its carbon dividends toward promoting energy efficiency, renewable energy alongside other consumer benefit programs –to support low-carbon inventions and minimize the regressive effect of the program (RGGI, 2017). For South Africa's proposed carbon tax program, generated revenue would be recycled into providing: energy-efficiency savings tax incentive; enhanced free basic electricity/energy for low income households; support for installation of solar water geyser; credit against Eskrom's carbon tax liability for renewable energy premium built into electricity tariffs; Credit for electricity levy; and improved public passenger transport and support for shift of freight from road to rail (Machingambi, Memory, 2017)

Importantly, since government revenues in developing countries are often insufficient to provide essential infrastructure, one of the most efficient ways of utilizing carbon dividends in developing countries is to invest in infrastructures that cater to low-income households and reduce inequality (Klenert, et al., 2017). Given that carbon taxes are harder to evade than other taxes (such as income tax), carbon taxes are found to increase economic efficiency of tax systems in countries with large informal sectors like Nigeria (Liu, 2013). Carbon dividends can make significant contributions to the

[11] Based on author's estimation

achievement of universal access to clean water, electricity, sanitation, transport system etc. in line with the SDGs. Since low-income households have the least access to infrastructures, they would benefit the most from additional infrastructure provision (Dorband, 2016).

Asides its regressive effect on income, a carbon pricing policy can also have a distributional effect on wealth. Given that climate policies gradually make fossil fuel reserves become "stranded assets", the wealth of owners of fossil fuel assets are often affected (Jakob & Hilaire, 2015). This also explains the difficulty with implementing climate policy as owners of fossil fuel assets are often affluent and politically influential individuals. They can use their wealth to mobilize resistance through workers, or lobby politicians directly. Klener, et al (2017) suggests that the government could make lump-sum transfers to relevant stakeholders (such as capital investors) to acquiesce their political opposition to climate policies, or mobilize public opinion to affirm the prevalence of public interests over private interests. However, there are better approaches.

Given the aforementioned, Nigeria's choice of carbon revenue allocation should inculcate the following. First, to encourage the efficient use of energy and the adoption of lower-carbon technologies, a large proportion of the carbon dividend (say, 55-60%) should be pumped back into the industry. The aim is to help remove barriers, provide support that enables the industry respond to the price signal, and increase the rate at which abatement opportunities are adopted. Particularly, facilitating access to long-term financing of upfront capital costs for lower-carbon technologies would be essential. A portion of the upfront capital cost for cleaner technologies can be provided to domestic companies in the oil and gas sector through long-term loans. This would address arguments regarding the impact of the carbon tax on competitiveness of the industry, thus most importantly addressing concerns around the distributional effect on wealth and minimizing potential political resistance.

Second, to address the potential regressive effect of a carbon tax in Nigeria's oil and gas sector, about a proportion of the carbon dividend should be used to: improve access to clean water (e.g, digging boreholes), upgrade electricity/energy infrastructure (e.g. erecting solar plants/panels for low-income households), and improve soil conditions to support agriculture in the Niger Delta– the oil hub region of the country. This would improve the deplorable living conditions in the region, and placate the anger of Niger Delta militants that are responsible for attacks on Nigeria's oil facilities – its major source of revenue.

Third, there may be a need to further minimize the potential distributional effect of a carbon tax policy on the wealth of affected individuals, and avert strong opposition from this group. A small percentage of the carbon revenue should be channelled towards mobilizing climate change action advocacy on media outlets to drive public interest and desire for the program. The campaign should emphasize its present and future benefits on the Nigerian economy, fiscal capacity, competiveness environment, as well as health of citizens. Preferably, the media campaign should be initiated one or two years before legislative deliberations on a carbon tax bill begins at the parliament.

4. CONCLUSION AND RECOMMENDATIONS

Although most of its crude oil products are exported, Nigeria is one of the world's major producer and user of fossil fuels. Indeed, inaction on climate change would be detrimental not only to the Nigerian economy and its citizens, but would also have counteractive effects on the relentless efforts at meeting the global Sustainable Development Goals, among others.

Nigeria can be a pioneer of climate change policy in West Africa, and another major pioneer in Sub-Saharan Africa. However, the stakes are high in deviating from 'businesses as usual' as finance, public interest as well as concerns about distributional effect presents enormous difficulty. While a well-designed national carbon pricing policy can help resolve these issues, international and regional cooperation would be also be very helpful in overcoming these barriers, especially when implementing a nation-wide climate policy.

While a sector-specific climate tax program may be easier to implement, a nation-wide program would present more challenges and oppositions in the absence of international and regional cooperation. Going forward, international collaboration is needed to support regional cooperation for climate policy in West Africa, and Sub-Saharan Africa at large. A regional carbon price covering all sectors and countries would clear concerns about competitiveness of domestic products in international markets, as well as concerns about externalities and leakages including –indirect production, consumption, investment, innovation and diffusion effects that increase carbon emissions elsewhere. The multilateral institutions can support the introduction and harmonization of carbon prices among trading partners and neighbouring countries in the region. This would not only help overcome leakages and competitiveness concerns, but would also allow participating countries benefit from knowledge-sharing on best practices and promote transparency and opportunity for regional integration. As an incentive, the G20 can also establish some sort of preferential trade agreements for participating countries with or without trade sanctions for non-participants in the region.