Carbon Pricing System in Africa as a solution to climate change: A case study of Nigeria's Oil and Gas sector

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Abstract

This thesis covered the case of the best and most practical carbon pricing approach in Africa with focus on the oil and gas industry in Nigeria.

The Main tool used in this study was the MACBETH multicriteria decision tool, developed by Jean-Marie De Corte, Jean-Claude Vansnick and Prof Carlos A. Bana e Costa. Another tool used was the E3 Carbon Tax calculator developed by RFF Carbon Pricing Initiative which helped in comparing 4 selected carbon pricing policies with a projection from now till 2034.

The objective was to determine the best choice between 4 options of carbon policy, The Climate Action rebate, The Market choice policy, The Carbon Cut policy and a Custom design from this study. This was done using 3 different criteria of Initial Tax ($), Tax growth rate and Revenue recycling.

Since this is a Multicriteria decision, The MACBETH tool was also used in making qualitative judgements that are based are on the difference in attractiveness between two items at a time, in order to produce numerical scores for the options in-category and to weigh the criteria.

The problem was structured by creating a value tree for the 3 criteria, the performance of each criteria was done by inserting a qualitative judgement of ''good'' or ''neutral'' based on the Decision Maker judgements. An Overall performance of the options was developed to see which was the best choice and a sensitivity analysis was done to see the effect of a change in the weight. The Decision Maker for this study was Basumoh Nigeria ltd, An oil and gas company in Nigeria.

The result of this study shows that using the Carbon Pricing tool by the Carbon pricing initiative and considering previous carbon policy experience in South Africa, our custom design was the better choice for Nigeria based on the decision maker's judgement on if we were to develop a carbon price for the oil and gas sector that takes into account the Initial Tax rate and also Tax growth rate . The study also indicates that even though the Climate Rebate Act had the overall score for the options via qualitative judgment of the decision maker, our custom design was the better option when a sensitivity analysis was done by considering the intersection between the best and second best options for the Initial Tax rate and Tax growth rate.

1. Introduction

Developing countries in Africa are yet to fully subscribe to the idea of effective climate policies due to the large financial commitments it requires. Carbon Pricing is globally accepted as an effective and efficient economic tool to mitigate the social cost of emissions and also a tool to increase revenues to offset the distributional issues that come with Climate Policies. The thesis seeks to recommend effective carbon pricing policies that help to reduce Nigeria's massive air pollution due to activities of the oil and gas industry while also encouraging the use of climate friendly technologies in the sector. The study presents a multicriteria problem of making a choice between 4 different options of carbon pricing policies. The Decision Maker is considered to be an active company within the Oil and Gas industry in Nigeria. The four Policies are the Climate Rebate, Market choice, Cut Carbon and our custom design for the purpose of this study. These were based on 3 major criteria: Initial Tax, Growth Rate and Revenue Recycling

MACBETH software used in this multicriteria problem, The MACBETH tool was also used in making qualitative judgements that are based are on the difference in attractiveness between two items at a time, in order to produce numerical scores for the options in-category and to weigh the criteria.

The Carbon Pricing calculator developed by the Carbon pricing initiative was also used in analyzing the four different options based on the same 3 criteria listed above. This was done for a time period between 2020-2034.

The result from the two approaches to decision making seeks to highlight that the custom design presented in this study is the more feasible and practical option for imposing a carbon tax in the oil and gas sector in Nigeria.

1.2 Carbon Pricing

Carbon pricing is an environmental policy methodology that is used in a variety of countries and sub-national states and territories around the world. Carbon pricing operates by taxing issuers for the tonnes of carbon dioxide (CO2) emissions for which they are accountable (Marc 2019). CO2 is produced primarily through the burning of fossil fuels used in residential and commercial buildings for electricity generation, industrial production, transportation and energy usage.

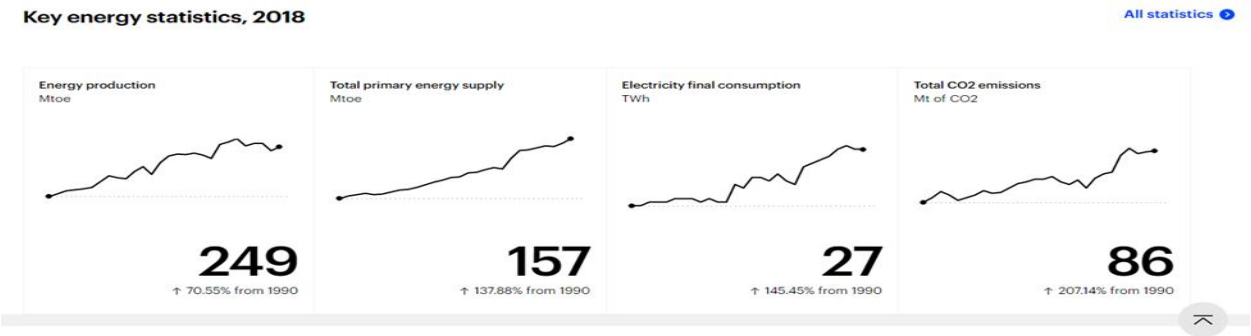

Figure 1: Nigeria Key Energy Statistics (International Energy Agency)

1.2.1 Carbon Pricing Programs

Typically, Carbon Pricing programs take two forms: Carbon taxes, and Cap-and-Trade schemes.
A carbon tax is a price per tonne of carbon or, more often than not, per tonne of CO2 emitted. Because the CO2 emissions from fossil fuel combustion are commensurate to the carbon content of the fuel, the carbon tax is really a CO2 levy. A Cap and Trade policy restricts the total amount of CO2 that some facilities will produce.. (Akinwande 2014)

1.4 Environmental Tax Implementation: Lessons from Nigeria

Environmental taxation has been an integral part of Nigeria's gas flaring legal framework from the start, and is now one of the leading initiatives of their government in trying to reduce flaring. (Akinwande 2014)
In practice, Section 3 of the Associated Gas Reinjection Act prohibits gas flaring, but allows polluters to continue to flare at a fine's fee. The situation in Nigeria is relevant to the case in South Africa because the tax introduced in Nigeria followed the "soft ramp up" strategy, which is what South Africa's National Treasury intends to use. In a "soft ramp up" method, the tax is gradually introduced over time, beginning with a low initial rate or a small initial base and Then increase the rate or base to the pre announced timetable to reach the right system. The Petroleum Resources Ministry, which was tasked with the responsibility of implementing the flare rule, failed to apply the penalty to oil companies. The estimated damage / penalty for gas flares by local and international oil companies between August 2011 and November 2012 is $3.9 billion. (Akinwande 2014).

1.6 Carbon Pricing Policy and Sector

The activities of oil and gas companies both directly and indirectly contribute to the emission of greenhouse gases in Nigeria. The emissions come from the mining activities of coal, oil and gas. Several processes in the oil and gas industry lead to the emission of high amount of Nitrous oxide and also methane, processes like gasification, fuel combustion, storage and most importantly gas flaring.

2.Methodology

2.1. Carbon Pricing Calculator

The tool was developed by the RFF carbon pricing initiative. The essence of using this tool was estimate the actual effect of different carbon pricing initiatives and help inform better decision making regarding the cost and benefit of this initiatives to the environment and economy. (RFF 2019). The Impact is measured across emissions per year, the revenue per year, the actual carbon price, change in percentage of the consumer price and the cumulative emissions which relates to carbon dioxide emitted specifically by the energy industry.

2.2 Carbon Pricing Policies

2.2.1 Climate Action Rebate

The 2019 Climate Action Rebate Act seeks to level the energy landscape by ensuring that businesses utilizing emission-intensive technology and fuels internalize the social and environmental impacts of those activities. Rectifying the market distortions already induced by the negative externality of pollutants would reduce greenhouse gas emissions effectively and create sustainable technologies. The bill is aimed at reducing carbon emissions by 55 percent by 2030 and by 100 percent by 2050. (Panetta 2019). Key Components include a) Carbon Fee: A gradually rising tax on fossil fuels and fluorinated gases, adjusted for their potential greenhouse gases.

2.2.2 Cut Carbon Act

As of 2020, the Increase Wages, cut carbon Act imposes a premium of $40 per metric ton of carbon dioxide. The tax is levied "upstream," or at the point of extraction / production of coal, petroleum, natural gas, and fluorinated greenhouse gases. (Rooney 2019). Revenue goes to a number of ends. Eighty-four per cent of the revenue is used to cover payroll taxes. The bill imposes taxes on (1) the producer or importer of coal (including lignite and peat), petroleum and petroleum products, and natural gas (not met $40 per ton in 2020, with an annual 2.5 percent increase in emission reduction targets); (2) any taxable imported product sold or used by its importer; and (3) fluorinated greenhouse gasses. (Lipinski 2019)

2.2.3 Market Choice Policy

The aims of the Market Choice Act are a) to fund infrastructure projects by regulating and taxing GHG emissions b) Spur major GHG emission reductions b) Provide a business solution to increasing GHG regulations (FNCL 2018). The Market Choice Act (MCA) is simply an act that seeks to impose a greenhouse gas (GHG) tax on emissions from fossil fuels, some large industrial facilities and certain industrial process goods. The GHG tax would launch at $35 per metric ton of CO2-equivalent emissions and rise at an average real pace of 5 per cent.

2.2.4 Custom Design

A custom carbon tax path was designed for this thesis based on three criteria which are the a) Initial Tax per Ton, b) The growth for tax based on the inflation and c) How the revenue will be recycled. The initial Tax was pegged at $10 in accordance to concept of using a low rate at the beginning with a potential of gradual increase mitigated the adverse risk of political tension and served as an initiative for cleaner energy investments. (OECD 2015). It was chosen basing on the experience and lesson learnt South African Carbon tax path and also the minimum carbon price constraint by the Carbon price calculator. (Akanonu 2017).

2.3Macbeth Analysis

2.3.1 Introduction

Multi-Criteria Decision Analysis (MCDA) is a general method to help dynamic decision-making scenarios with various and sometimes contradictory priorities that are viewed differently by stakeholder group and/or decision maker. (G´omez-Baggethun 2014). MCDA is a "definition concept to define a set of systematic strategies that aim to specifically take various factors into consideration when helping individuals or groups discuss specific decisions.

2.3.3Decision Maker

The Decision being analyzed is the choice regarding the best carbon pricing approach for the Oil and gas industry in Nigeria and Nigeria as a whole. The Decision Maker is Basumoh Nigeria limited, a Trading, Storage, Marketing and Distribution of petroleum products such as Petroleum Motor Spirit (PMS), Automotive Gas Oil (AGO), Dual Purpose Kerosene (DPK), Liquefied Petroleum Gas (LPG) Storage and distribution and also Bitumen Products and also engages in upstream oil and gas activities. For the purpose of this thesis and vying on their industry experience, they have the responsibility to choose between 4 Carbon Pricing Policies or approaches. Market choice act 2019, Carbon act of 2019, Climate action rebate act, Custom design.

Table 1: Criteria and options of the projects

Policy	Initial Tax (Per metric Ton)	Tax Growth Rate (%)	Revenue Recycling (%)
Custom Design	10	3	23
Climate Action Rebate	15	2.25	40
Cut Carbon Act	40	2.5	84
Market Choice Act	35	5	70

3 Result and Discussion

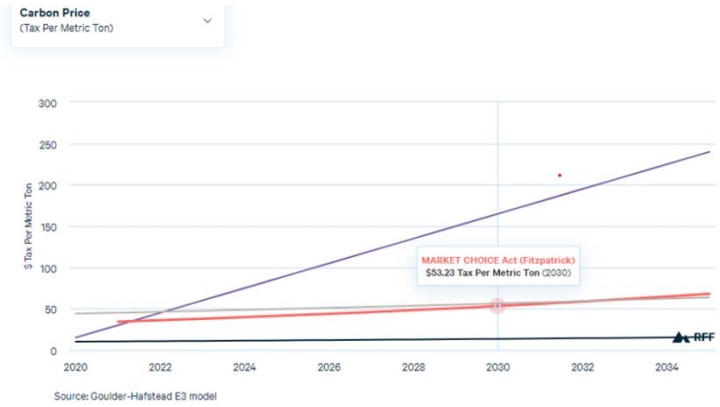

Figure 13: Comparison of all policies

3.1 Structuring the problem and model

Problem structuring involves specifying the potential alternative (means) for achieving the end result within the limits of each constraints that each option can pose and how its consequences on the desired outcome are. The fundamental principle is to promote and solve complex problems by decomposing them in multiple sections.

Upon consulting with the Decision Maker, we settled on a Bottom-Up strategy on which the opinions were described as seen below. Then, the 3 criterion nodes were aggregated into 1 parent node with significant non-criteria.

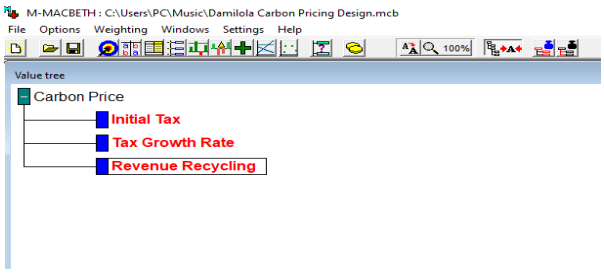

Figure 14: Value Tree

3.2. Descriptors of performance

3.2.1 Initial Tax (Per Metric Ton): Tax is charged on all fossil resources (coal, petroleum, and natural gas) combusted in Nigeria. The tax is focused on such fuel's carbon content. The tax is levied at $X per ton of CO2 generated by combustion. The decision maker was questioned about his comparative framework and he decided that we are going to use a Quantitative one with comparisons named" good and" neutral" where Good = $10 Neutral = $45.

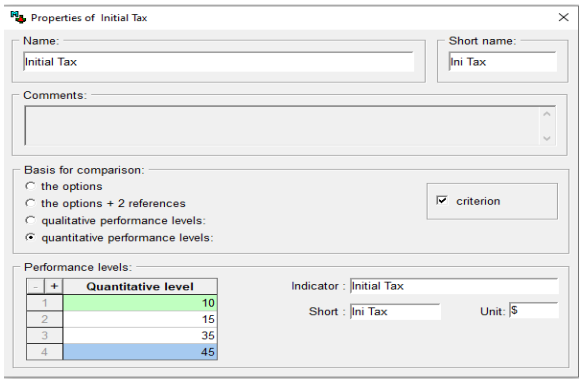

Figure 15: Properties of Initial Tax

3.2.2 Tax Growth Rate (%):

Refers to the percentage increase in the tax levied per year. The decision maker was questioned about his comparative framework and he decided that we are going to use a Quantitative one with comparisons named" good and" neutral" where Good = 2.25% Neutral = 5%

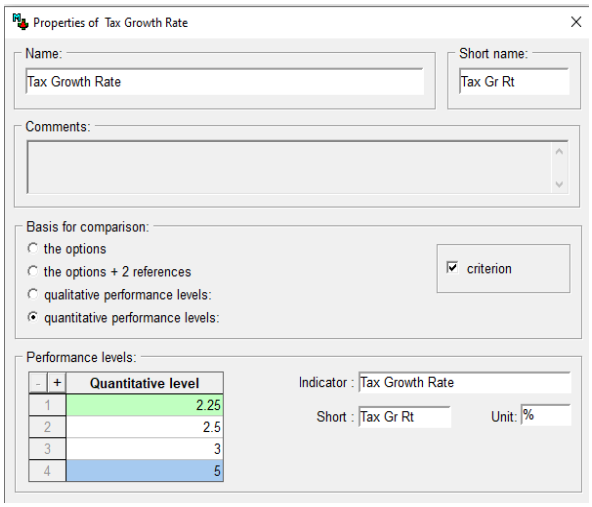

Figure 16: Properties of Tax Growth Rate

3.2.3 Revenue Recycling (%):

It refers to the percentage of revenue gotten from the Carbon Tax proceeds to be utilized in enhancing the economy and developing infrastructure and clean energy initiatives and technology. The decision maker was questioned about his comparative framework and he decided that we are going to use a Quantitative one with comparisons named" good and" neutral" where Good = 84% Neutral = 23%

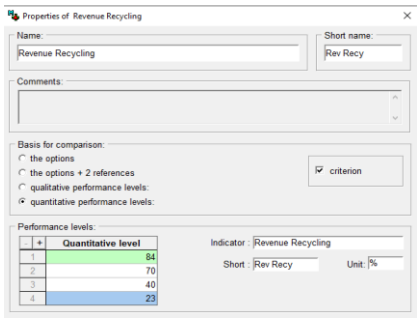

Figure 17: Properties of Revenue Recycling

3.3 Additive value model

3.3.1 Attractiveness Judgements

To translate performance into value function M-MACBETH sets 2 reference point i.e. upper reference labeled good and lower reference designated neutral. Our DM was asked to define good and neutral reference level to the performances in each criterion. The process to get the value function for Performances on each criterion required that Our DM makes qualitative judgments in quality judgment matrix in order to account or measure the difference of attractiveness between

options. This is indicated in the pictures below.

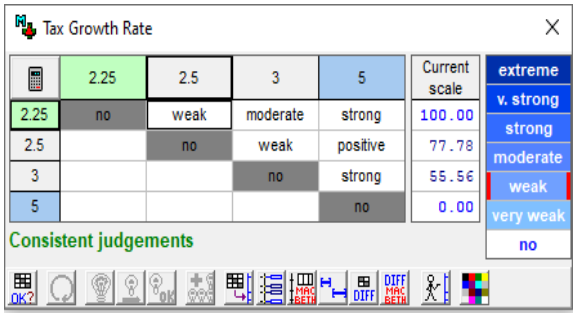

Figure 19: Judgement on Tax Growth Rate

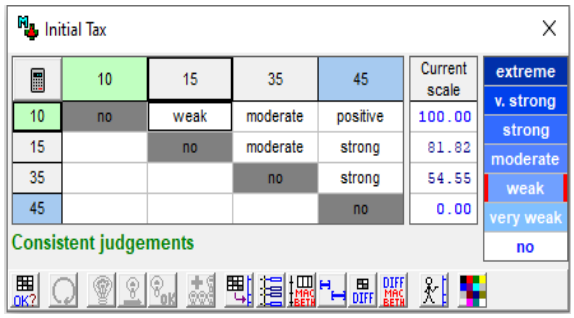

Figure 20: Judgement on Initial Tax

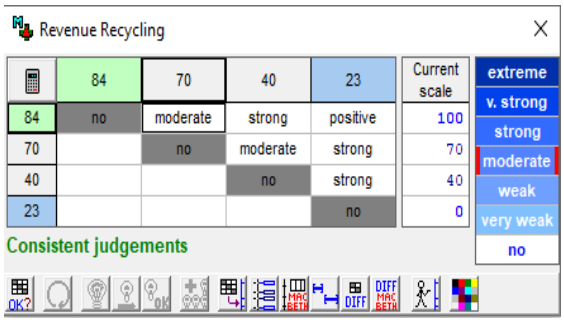

Figure 21: Judgement on Revenue Recycling

3.5 Weighting coefficient

The DM ordered his points of view in terms of a descending importance of swing from lower reference level to high reference level and then made qualitative judgement of attractiveness. MACBETH determined the weights of the criteria while the DM made a qualitative judgment input so as to measure the difference of attractive between each pair of criteria. Once the quality judgments matrix is done, the consistent weight of criteria is done by MACBETH and Cross checked with the decision maker. It is of importance that the calculation based on the representation sum of all criteria weight should sum up to 100.The judgment matrix and the weights calculated are indicated below

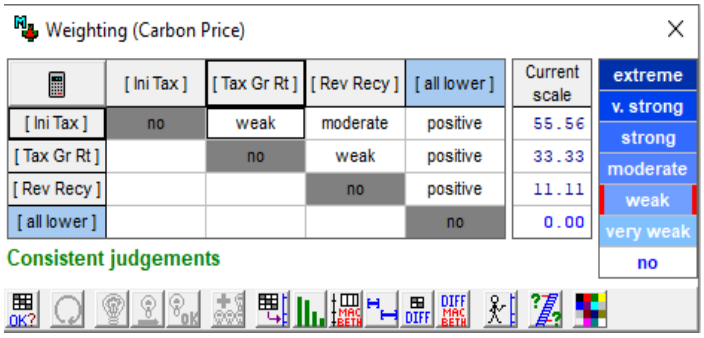

Figure 25: Weighting of Options

3.6 Overall Performance of Options

The figure indicated below highlights the overall value score of the model. M-MACBETH calculates the overall score of the options via an additive model i.e. overall summation of the multiplication of partial value scores of options on each criteria and weight of the criteria

Table of scores

Options	Overall	Ini Tax	Tax Gr Rt	Rev Recy
Mar choice	38.08	54.55	0.00	70.00
Rev Wages	52.19	27.28	77.78	100.00
Clim Reb	83.23	81.82	100.00	40.00
Cus Des	74.08	100.00	55.56	0.00
[all upper]	100.00	100.00	100.00	100.00
[all lower]	0.00	0.00	0.00	0.00
Weights :		0.5556	0.3333	0.1111

Figure 27: Table of Scores

M-MACBETH indicated weights for criteria, the decision-maker cross-checked and final weights is shown below and also the overall performance of options

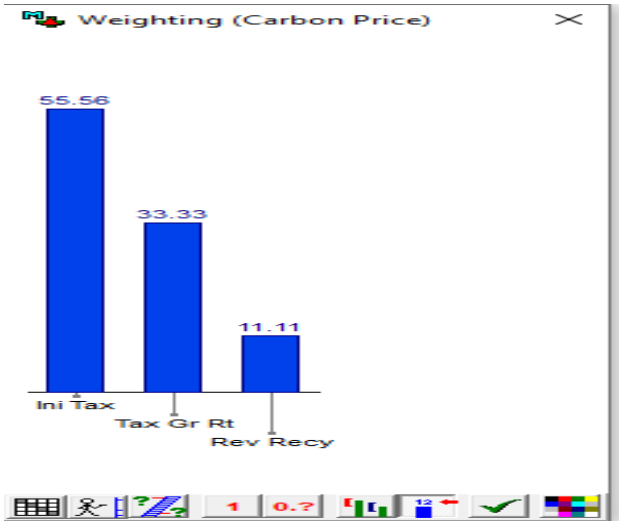

Figure 26: Validation of Weights

3.7 Sensitivity analysis

A sensitivity analysis is done in order to see if there Is a difference in the ranking order of the overall performance of the options when there is a change in the weight. The analysis takes into consideration moments where the maker of the decision has some form of reservation or uncertainty regarding the judgment verdict given on the criteria. Hence, sensitivity is done on the best and second-best options. The Figure below indicates the sensitivity analysis on Initial Tax We can see a slight imprecision will not ultimately affect the best option as the current weight indicated is 55.56. However, when the weight is 70.4, there occurs a change and at this point the best option will the custom design.

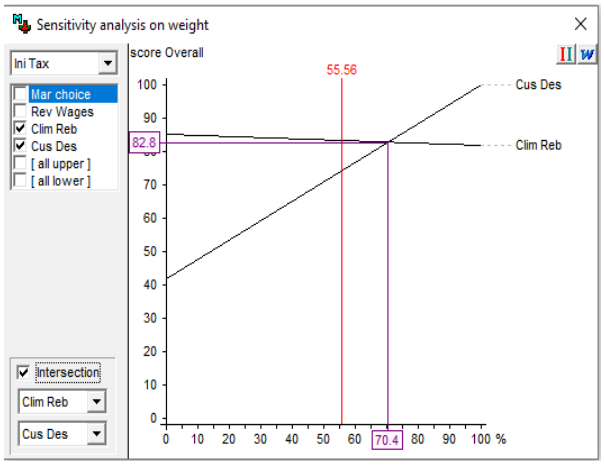

Figure 28: Sensitivity Analysis on Initial Tax

The sensitivity analysis on the Tax Growth Rate, we can see a slight imprecision will not ultimately affect the best option as the current weight indicated is 33.33. However, when the weight is 16.0, there occurs a change and at this point the

best option will the Custom Design.

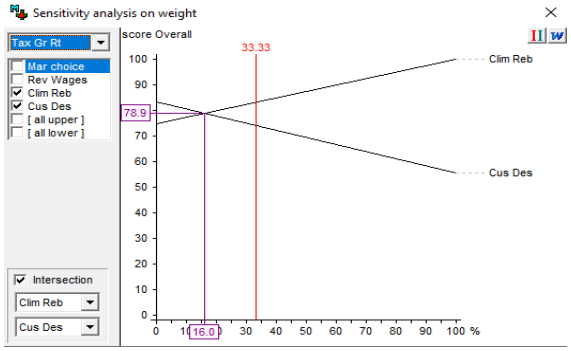

Figure 29: Sensitivity Analysis on Tax Growth Rate

The sensitivity analysis on the Revenue recycling, we can notice that option Climate Rebate does not intersect with the Custom design no matter the weight of the criterion which is indicated in the figure below. It can then be said, that the option Climate Rebate dominates the Custom design.

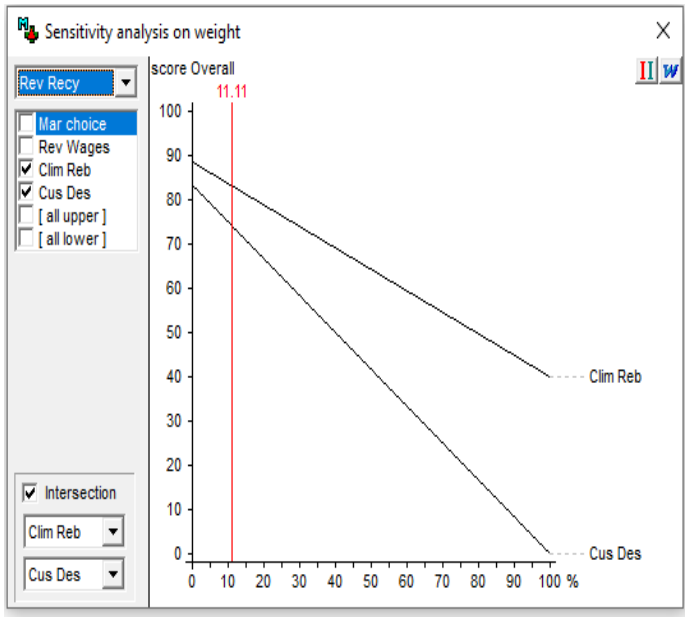

Figure 30: Sensitivity Analysis on Revenue Recycling

4.Recommendation and Conclusion

To summarize this study, 4 Carbon pricing policies were studied, The cut carbon, Market choice, Climate Rebate and Custom design approach. The main objective was to study which policy works best for the oil and gas industry in Nigeria considering no prior carbon pricing policy has been fully developed in Nigeria. The tools used were the Carbon pricing calculator developed by the Carbon Pricing initiative, which enabled us compare the projection of each policy in terms of Initial Tax, Tax growth rate and revenue recycling for a period of 2020 to 2034. The other tool used was the Multicriteria decision analysis tool MACBETH developed by Professor Carlos Antonio Bana e Costa in collaboration with Professor Jean-Claude Vansnick and Dr. Jean- Marie De Corte, from the Universit´e de Mons. The used helped the decision maker (Basumoh Nig Ltd, and oil and gas company in Nigeria) to make qualitative and quantitative judgement about the 4 different policy options based on the same criteria used in results for the carbon pricing calculator projections initially developed.

From the result using the Carbon Pricing calculator, we observed that the long term projection of the custom design is better considering especially as it relates to the initial tax required for the beginning of the process and also to encourage players in the industry to develop more carbon efficient technologies and innovate within that space. Achieving the goal of climate and financial advantages will require that Nigeria follows the trend of starting with a low carbon tax and increasing it by a certain percentage per year. It gives room for companies especially in the oil and gas industry to adjust to the new tax and also helps motivates them to support and implement cleaner technologies. (Morris 2016) argues that starting with a higher carbon price will lead to a drastic increase in the price of fossil fuel and stretch the limit of the existing capital which will lead to reluctance both politically and industry wide.

Using the MACBETH approach, even though the climate rebate policy had the best overall score in terms of options , we observe that by doing a sensitivity analysis on the best two options with the overall score(Climate Rebate and Custom design) we observe that a slight change in the weight shows that the custom design is also a better choice.
It is therefore recommended that in order for Nigeria to play a leading role in enforcing carbon efficiency and investing in carbon efficient technologies, it is necessary to enforce and adopt the right energy prices as the prices of the conventional energy used today is not a correct reflection of the production cost and also does not take into consideration the cost on the environment. It is also important to ensure that revenue gotten from the energy carbon pricing adopted should be used in investing in renewable energy technologies such as increase in use of solar energy technology as also helping to reduce tariffs on such renewable technologies.

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