Federal Republic of Nigeria

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Assessment of Investment and Financial Flows to Mitigate Climate Change in the Industry Sector in Nigeria

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Investment and Financial Flows to Address Climate Change:

The Industry Sector

Climate Change poses significant challenges to development. Policy makers are faced with complex tasks to ensure sustainable development, particularly in the Least Developed Countries, where decision makers have to balance poverty alleviation, economic development as well as social and environmental justice issues, along with costs that occur with associated policies and measures which act as mechanism to implement solutions to rapidly changing states of climate and environment.

To better understand the importance of availability of funding in arresting current effects of climate change and long-term implications, specific countries have undertaken assessments of Investment and Financial Flows- I&FF, to address climate change for key sectors in the UNDP NDC Support Programme.

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ABBREVIATIONS

BAU	Business as Usual
BSL	Baseline
CBN	Central Bank of Nigeria
CDM	Clean Development Mechanism
CS	Climate Scenario
COP 21	Conference of Parties 21
DCC	Department of Climate Change
ECOWAS	Economic Community of West African States
EU	European Union
GDP	Gross Domestic Product
Gg	Gigagram
GHGs	Greenhouse Gases
HSH	Household
HST	Historical
FGN	Federal Government of Nigeria
IPPs	Independent Power Producers
IPPU	Industrial Processes and Product Use
LDCs	Least Developed Countries
SDGs	Sustainable Development Goals
NAPA	National Adaptation Programme of Action
NIAP-IS NDC	National Implementation Action Plan for the Industry Sector
ODA	Official Development Assistance
RETs	Renewable Energy Technologies
REA	Rural and Electrification Agency
SMEs	Small and Medium Enterprises
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

The Investment and Financial Flows (IFF) Assessment was a simultaneous exercise covering Nigeria's NDCs five (5) priority sectors -Agriculture, Power, Oil and Gas, Transport, and Industry. This report which covers the Industry sector, though stand-alone complements the other sector reports for a complete picture that provides the bases for policy options addressing climate change across different economic sectors with emission intensive manufacturing processes and supply chain activities.

For the Industry sub-sector, attention was given to the most GHGs emission intensive sub-categories which were the primary focus as captured by Nigeria's BUR1 that was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2018. These included the following:

- Mineral Industry - Cement
- Metal Industry – Steel

The mitigation scenario explored measures to mainstream energy efficient technologies and fuel switch in the Industry sector across the spectrum as mirrored by the scope of assessment (Mineral - Cement and Metal - steel) with specific focus on CO_2 emission reduction in Cement manufacturing. Historically, energy consumption in the production of cement and steel is known to be an energy intensive process requiring Coal and Biomass as fuel for firing the kilns as well as for operations in the various production units. Nonetheless, historical data could not be sourced for both investment types due to its unavailability. Again, one investment entity being corporation was focused on assessing both their old inefficient and upgraded efficient technologies, methods and processes used in their production as household activities are not involved in the production of cement and steel. On the other hand, government owned steel industries have been moribund for the past decades hence there is no record of such data.

The Business as Usual had an annual total IF, FF and O&M of 69.24, 0.00, and 1,154.02 for cement and 0.00, 0.00 and 668.09 for Steel. The discounted cost was 28.45, 0.00 and 474.38 for cement while that of steel was 0.00, 0.00 and 298.67. The Mitigation Scenario had an annual total IF, FF and O&M of 825.2, 0.00 and 8,318.80 for cement while steel had 550.00, 55.00 and 119.6 for IF, FF and O&M respectively. The discounted IF, FF and O&M cost for cement was 319.11, 0.00, and 2,573.94 while that of steel was 161.21, 16.12 and 32.66. The incremental annual total cost for cement was 756.33, 0.00 and 7164.73 while steel was 0.00, 0.00 and -548.48. The incremental discounted cost for cement was 290.66, 0.00 and 2099.56 while steel was 0.00. 0.00 and 266.01.

Several factors influence low-carbon innovation, via both energy efficiency and other CO_2 abatement measures, in the cement sector in Sub-Saharan Africa in general and Nigeria in particular. These include market liberalization, government support for industrial development, the activities of equipment suppliers, financiers and OECD-based multinationals are key factors that influence the rate of deployment of low-carbon technology. Poor resource availability (of alternative fuels and clinker substitutes for example), a lack of information and technical capacity, and access to international finance mechanisms are regarded as salient barriers[i].

CHAPTER ONE

1.0 INTRODUCTION

In 2015, Nigeria renewed its commitment to tackling climate change at the United Nations Framework Convention on Climate Change (UNFCCC) COP21 in Paris with the submission of the country's Nationally Determined Contribution (NDC) that sets out her intended contributions and strategies on bold climate action from 2015 to 2030. The subsequent signing and ratification of the Paris Agreement further reinforces the country's commitment towards the global quest towards GHG emission reduction that complements previous domestic efforts to address climate change.

In 2018, Nigeria received support from UNDP's NDC Support Programme to advance the implementation of her NDCs. As one of UNDP's flagship programmes, the NDCs Support Programme helps countries integrate climate and development solutions via the implementation of the Paris Climate Change Agreement. The NDCs-SP was launched in 2017 by UNDP, together with the European Union (EU) and Governments of Germany and Spain. The Programme is implemented as contribution to the NDC Partnership.

The NDC Support Programme in Nigeria focuses its intervention on four (4) axes:

1) developing a financial strategy for funding the country's NDCs Sectoral Action Plan
2) increasing private sector involvement in meeting the country's NDCs targets either by participating in mitigation and adaptation projects or by adopting climate-friendly measures in their current operations.
3) Establishing a registry of adaptation and mitigation actions that are contributing to the achievement of NDCs targets to start monitoring, reporting, and verifying progress.
4) increasing the visibility of the NDCs through an effective strategic communication and full integration of the NDCs in the SDGs and the next Economic Recovery Growth Plan (ERGP).

One key project activity in the first axis of intervention (First Intervention) is to conduct **Assessment of Investment and Financial Flows (IFF)** to understand the future financial needs of the five (5) NDCs priority sectors for implementing climate mitigation actions. Fundamentally, Nigeria's National IFF Assessment seeks to answer the question of what needs to be done to adapt to or mitigate climate change in the selected key sectors, from a developmental perspective; and what policy framework, investment environment and financial architecture will be required to achieve that purpose.

1.1. Rationale

More than ever before, there is need to understand the magnitude and intensity of efforts necessary to address climate change in key sectors at the national level. This understanding will facilitate integration of climate issues into national economic/environment planning, support diffusion of relevant information among policy makers to aid planning and contribute to the articulation of national positions for international negotiations.

To this end, and towards advancing national climate change strategies and encouraging an enabling environment for the private sector to leverage local and foreign investments, the Department of Climate Change of the Federal Ministry of Environment with the support of UNDP saw the need to

undertake assessment of Investment and Financial Flows (IFF) for Nigeria's five (5) NDCs Priority Sectors (Agriculture., Oil & Gas, Transport, Industry and Energy).
Such assessments of investment and financial flows are crucial tools to:

- help break down Nigeria's national climate change targets into actionable goals;
- determine how much is already being spent on activities related to climate change from public and private sector economic actors;
- identify the investment and financial flows to implement these climate change mitigation and adaptation measures, as well as the possible sources of finance, the implementing entities, and the timing of investments;
- structure national budgets and investments more efficiently to meet both climate change, economic growth, and development targets.

In addition, such IFF assessments not only put a "price" on climate change activities from the perspective of cost-benefit analyses, but provide comprehensive approaches on how to analyze, restructure and make national investments more efficient to support climate change adaptation and mitigation as well as provide a robust tool to implement national plans and measures.

It needs to be emphasized that the IFF assessment for the Industry Sector has become an urgent imperative due to increasing contributions of the Industry Sector to Nigeria's national GHG stockpile as demonstrated in Nigeria's First Biennial Update Report (BUR1) submitted to the UNFCCC in 2018 and the Draft Third National Communication awaiting official submission to the UNFCCC before the end of 2020.

1.2 Aims and Objectives

The overall aim of assessments of investments & financial flows is to strengthen the national capacity of developing countries to assess and develop policy options for addressing climate change across different sectors and economic activities.

The specific objectives include:

- Provide comprehensive approaches to analyse restructure and make national investments more efficient to support climate change adaptation and mitigation.
- Contribute to advancing national climate change strategies by engaging line ministries and encouraging an enabling environment for all economic actors.
- Provide comprehensive approaches to analysing, restructuring, and making national investments more efficient to supporting Climate Change Adaptation and Mitigation.
  Foster economic growth and development in alignment with Sustainable Development Goals (SDGs) and Low-Emission Development Strategy (LEDS).

1.3 Sector Background

Towards creating some context for the industry sector in Nigeria vis-a-vis climate action, NDC Implementation Action Plan for the Industry Sector (NIAP-IS) (pp.84-93) by Federal Ministry of Environment (2017) provided a basis for this assessment. The plan is part of a wider program to develop NDC implementation plans for the 5 main sectors of Nigeria's economy based on the signed Paris Agreement at the United Nations General Assembly in 2016.

According to the NIAP-IS, Nigeria's manufacturing sector currently contributes ten (10) per cent of the nation's Gross Domestic Product (GDP). The Nigerian economy still suffers from the collapse of the manufacturing sector from the mid-1980s following the economic crisis brought about by falling oil output and prices. The government is attempting to fast-track the renaissance of Nigerian manufacturing as a key source of growth, jobs, and food security. High consumer demand is the main force behind non-oil sector growth. However, inadequate power and infrastructure, quality issues and limited access to finance obstruct the path to industrialization. The cost of energy tops the list of barriers. Insufficient power generation capacity is driving companies to use natural gas and diesel to self-generate power. This makes local manufacturing about a third more expensive than foreign products on average.

The following are considered relevant in understanding the overall background of the industry sector:

1.3.1 Policies and Plans

NIAP-IS confirms Nigeria's comprehensive industrial policy that is set out in the Nigeria Industrial Revolution Plan (2014) and the Strategic Implementation Plan for the 2016 Budget of Change. Specific industrial energy efficiency plans include the National Renewable Energy and Energy Efficiency Policy (2015), the National Energy Efficiency Action Plan (NEEAP) (2016) and the Sustainable Energy for All (SE4ALL) Action Agenda (2016). In particular, the NEEAP sets out a few measures that work towards achieving the SE4ALL proposed targets for industrial energy efficiency. These targets are to improve on 2015 energy consumption levels by 20% by 2020 and by 50% by 2030 through energy efficiency, as well as making energy audits compulsory to all energy-intensive sectors by 2016.

1.3.2 Mitigation

National Industrial Action Plan (NIAP) projections point to a tripling in the size of the industry sector by 2030, mainly in the substitution of basic and intermediate goods that are currently imported. The current industry sector's GHG emissions could increase from 4.2 Mt CO_2e in 2010 to 14.8 Mt CO_2e in 2030 if no measures to improve energy efficiency are implemented. Nigeria is well positioned to pursue an alternative and sustainable path to industrialization that takes advantage of new innovations, technologies, and business models. Nigerian industries could save up to 25% of the energy they currently consume through fuel switch and efficiency improvements by upgrading, replacing, and deploying best available technologies. Similarly, the NASPA-CCN (2011)[ii] recognized that Industry sector can suffer climate-induced problems from extreme temperature events, variable/more intense rainfall, extreme rainfall, windstorms, and sea-level rise. Anecdotal evidence suggests that some Nigerian industrial stakeholders recognize that some effects of climate change negatively affect their investments, but in general awareness is low.

1.3.3 Finance

There is need for high-impact funding through co-financing of industry energy audits and through the set-up of a body to channel energy efficiency capacity building for auditors and energy managers at a national level. The NESP/ UNIDO pilot programme on energy management systems covering two sectors is estimated at USD 4 million per year and expanding this to a further sector is estimated to cost extra USD 3 million/year.

1.3.4 Governance and Institutions

There is no single assigned governmental body for the promotion of industrial energy efficiency in Nigeria however the delivery of the sectoral plan is vested in the Federal Ministry of Industry, Trade, and Investment. NIAP-IS identifies key players at the federal level include the Federal Ministry of Industry, Trade & Investment, the Standards Organisation of Nigeria, the Small and Medium Enterprises Development Agency of Nigeria, the Federal Ministry of Power, Works and Housing, the Federal Ministry of Agriculture, and the Bank of Industry. The Nigerian Energy Support Programme (NESP), a partnership between the German Government and European Union (EU) implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), raises awareness in industry and government about the economic importance of energy efficiency.

1.4 Institutional Arrangements and Collaborations

The Nigeria IFF assessment project was financed by the UNDP-NDC Partnership and implemented by the Department of Climate Change (DCC), Federal Ministry of Environment (FMEnv) which serves as the National Focal Point (NFP) for climate change related projects and programmes in Nigeria. The DCC proactively provided strategic guidance to this project while maintaining administrative and technical oversight of the activities through the Project Lead working collaboratively with a 16-member Technical Working Group (TWG) drawn from relevant climate change impacted and impacting Ministries, Departments and Agencies (MDAs), private sector and non-State stakeholders. Five (5) Project Teams were constituted to conduct IFF assessments of the five (5) NDC Priority Sectors (NPS).

The industry sector was made of three Experts and a Team Coordinator supervising the assessment outputs of the Climate Expert, Data Analyst and Finance/Economist. The institutional support was provided by staff from the SDGs Office, National Bureau of Statistics (NBS), Federal Ministry of Industry Trade and Investment (FMITI), Federal Ministry of as well as the Ministry of Budget and National Planning (MBNP).

While the FMEnv. was the lead ministry for the study, a broader group of stakeholders were required for inputs: Federal Ministry of Agriculture, Ministry of Power, Ministry of Transport, Federal Ministry of Industry, Trade, and Investments took the lead in their sectors. Other ministries with cross-cutting or cross-thematic or inter-sectoral linkages such as the National Bureau of Statistics, Federal Ministry of Water Resources, and Federal Ministry of Finance, NNPC, DPR, etc., played key roles in the thematic area consultative groups together with relevant civil society, NGOs, academia and think tanks.

1.5 Major Documents & Work Plan

For the IFF assessment of Nigeria's Industry sector, various sources of data, statistics and information were consulted. Though there were data access challenges, the BUR1 with the sub-sector captured under Industrial Processes and Products Use (IPPU) provided some relevant information in categorization.

The following documents and literatures were relevant in the IFF assessment:

- NDC Implementation Action Plan for the Industry Sector (NIAP-IS) (pp.84-93), 2017.
- Nigeria's First Biennial Update Report (BUR1) submitted to the UNFCCC in 2018 and

- Draft Third National Communication

1.6 Basic Methodology and Key Terminology

The Methodology Guidebook for the IFF assessment prescribes an eight (8)-step approach as indicated below:

1. Establish the key parameters of the assessment.
   - Define the detailed scope of the sector.
   - Specify assessment period and base year.
   - Identify preliminary mitigation (or adaptation) measures.
   - Select analytical approach.
2. Compile historical IF, FF, and O&M cost data, subsidy cost data (if included explicitly), and other input data for scenarios
   - Compile Historical Annual IF and FF data, disaggregated by Investment Entity and source.
   - Compile Historical Annual O&M cost data, disaggregated by investment entity and source.
   - Compile historical annual subsidy cost data if subsidies are included explicitly in the assessment; and
   - Compile other input data for scenarios.
3. Define the Baseline scenario
   - Describe socio-economic trends, technological change, sectoral and national plans, and expected investments given current sectoral and national plans.
4. Estimate annual Investment Flow, Financial Flow, and Operation & Maintenance costs, and subsidy costs if included explicitly, for the baseline scenario:
   - Estimate annual IF and FF for each investment type, disaggregated by investment entity and funding source.
   - Estimate annual O&M costs for each IF, disaggregated by investment entity and funding source.
   - Estimate annual subsidy costs for each relevant investment type and for IF, FF, and O&M costs, if subsidies are included explicitly in the assessment.
5. Define Mitigation (or Adaptation) Scenario
   - Describe socioeconomic trends, technological change, mitigation (or adaptation) measures, and investments given implementation of mitigation (or adaptation) measures.
6. Estimate annual Investment Flow, Financial Flow, and Operation & Maintenance costs, and subsidy costs if included explicitly, for mitigation (or adaptation) scenario.
   - Estimate annual IF and FF for each investment type, disaggregated by investment entity and funding source.
   - Estimate annual O&M costs for each IF, disaggregated by investment entity and funding source.
   - Estimate annual subsidy costs for each relevant investment type and for IF, FF, and O&M costs, if subsidies are included explicitly in the assessment.
7. Calculate the changes in IF, FF, and O&M costs, and in subsidy costs if included explicitly, needed

to implement the mitigation (or adaptation) measures.

- Calculate changes in cumulative IF, FF, and O&M costs, by funding source, for individual investment types and for all investment types.
- Calculate changes in annual IF, FF, and O&M costs for individual investment types, for individual sources of funds, and for all investment types and funding sources.
- If subsidies are included explicitly, consider calculating changes in cumulative and/or in annual subsidies for IF, FF, and O&M for each investment type and all investment types.

8. Evaluate Policy Implications
   - Re-evaluate the initial priority mitigation (or adaptation) measures undertaken in step #5.
   - Analyse feasibility and compatibility with development and sector plans.
   - Determine policy measures to encourage changes in IFF.
   - Consider a variety of instruments, including incentives, economic instruments (e.g., taxes), regulatory instruments (e.g., fuel portfolio standards), voluntary agreements, education, information dissemination and other instruments (e.g., research, development, and demonstration (RD&D) programmes).

1.6.1 Key Terminology

Investment Flow
An "investment flow" (IF) is the capital cost of a new physical asset with a life of more than one year, such as the capital cost of a new power plant, new automobile, a new household appliance, or new agricultural irrigation system.

Financial Flow
A "financial flow" (FF) is an on-going expenditure of programmatic measures; financial flows encompass expenditures other than those for expansion or installation of new physical assets.

Investment Entity
An "investment entity" (IE) is an entity that is responsible for an investment -- decides to invest in.

Sources of Investment and Financial Flow Funds
These are the origins of the funds invested by the investment entities, e.g., domestic equity, foreign debt, domestic subsidies, and foreign aid.

Households
Households are individuals or groups of individuals (e.g., families or communities) who act as one unit financially. Households invest in assets, such as homes, farms, vehicles, and facilities for small unincorporated businesses.

Corporations
Corporations include both financial corporations and non-financial corporations and can be either for-profit or not-for-profit. Financial corporations are entities such as banks, credit unions, and insurance companies that provide financial services to non-financial corporations, households, and governments.

Governments
Governments are the national, provincial, state, and local governments of a country.

Operation and Maintenance (O&M) Costs of New Physical Assets
The physical assets purchased with investment flows will have operation and maintenance (O&M) costs associated with them (i.e., on-going fixed and variable costs such as salaries and raw materials).

Scenario

A Scenario is an internally consistent and plausible characterization of future conditions over some specified period.

Baseline Scenario

The baseline scenario in both cases reflects business-as-usual or non-policy case conditions, i.e., it is a description of what is likely to occur in the absence of new policies to address climate change.

Mitigation Scenario
The mitigation scenario incorporates measures to mitigate GHG emissions, i.e., the mitigation scenario should describe expected socioeconomic trends, technological change (if relevant), new measures to mitigate GHG emissions, and the expected investments in the sector given implementation of the mitigation measures. Similarly, the adaptation scenario incorporates new measures to respond to the potential impacts of climate change.

Assessment Period and Base Year
The assessment period is the time horizon for the assessment, i.e., the number of years spanned by the baseline and climate change scenarios and the associated stream of annual IF, FF, and O&M costs.

CHAPTER TWO

2.0 SCOPE, DATA INPUTS, AND SCENARIOS

2.1 Scope of the IFF for the Industry Sector

The IFF is a simultaneous exercise covering Nigeria's NDCs five (5) priority sectors. This means that the Agriculture, Power, Transport as well as Oil and Gas sectors were undergoing IFF assessments simultaneously. Thus, this industry sector report, though standalone, complements the other sector reports for a complete picture that provides the basis for policy options for addressing climate change across different economic sectors with energy intensive activities.

For the Industry sub-sector, the project team identified the most energy intensive sub-categories which were the primary focus of Nigeria's BUR1 submitted to the UNFCCC in 2018. These include the following:

- Mineral Industry- Cement
- Chemical Industry- Ammonia-Fertilizer
- Metal Industry- Steel

However, Fertilizer was dropped from the assessment based on the negligible contribution to Nigeria's GHGs emission stock as captured by the BUR1 report (Table 1). The contribution of the Ammonia sub-category was marginal. Fertilizer was also dropped due to the need to avoid "double counting" as it overlapped with activities under the purview of the Agriculture Sector.

Only the Cement sub-category said to be responsible for more than half of the emissions at 53.4% of the aggregated (total) emissions followed by Steel industry with 46.6% were used in this assessment.

Table 1: Aggregate CO_2 and CH_4 (Gg CO_2-eq) Emissions for the IPPU sector (2000 to 2015)

Years	CO_2	CH_4	Total
2000	2324.75	3.19	2327.94
2001	1552.32	1.66	1553.98
2002	2658.50	3.91	2662.41
2003	7131.79	12.83	7144.62
2004	3079.83	4.57	3084.40
2005	4768.72	7.59	4776.31
2006	6575.41	10.93	6586.34
2007	6907.29	10.65	6917.94
2008	3112.47	1.97	3114.44
2009	6515.03	3.21	6518.24
2010	8234.40	9.72	8244.12
2011	9113.59	10.22	9123.81
2012	10820.76	10.72	10831.48
2013	12278.73	11.22	12289.95
2014	12452.77	11.72	12464.49
2015	13254.92	12.22	13267.14

Source: Nigeria BUR1[iii]

Table 2: Sub-Category Disaggregated GHG Emissions of CO2 and CH4 (Gg CO2-eq) for IPPU sector (2000 to 2015)

Year	Cement (CO_2)	Ammonia (CO_2)	Iron and Steel (CH_4)	Iron and steel (CO_2)	Total
2000	713.60	2.82	3.19	1608.33	2327.94
2001	714.46	1.20	1.66	836.66	1553.98
2002	682.50	2.27	3.91	1973.73	2662.41
2003	652.84	1.66	12.83	6477.29	7144.62
2004	770.16	1.80	4.57	2307.87	3084.40
2005	938.89	1.62	7.59	3828.21	4776.31
2006	1057.53	1.63	10.93	5516.25	6586.34
2007	1529.77	1.63	10.65	5375.89	6917.94
2008	2117.36	1.64	1.97	993.47	3114.44
2009	2621.57	1.65	3.21	3891.81	6518.24
2010	3328.46	1.66	9.72	4904.28	8244.12
2011	3954.53	1.67	10.22	5157.39	9123.81
2012	5408.57	1.68	10.72	5410.51	10831.48
2013	6613.41	1.69	11.22	5663.63	12289.95
2014	6534.32	1.70	11.72	5916.75	12464.49
2015	7083.35	1.71	12.22	6169.86	13267.14

Source: Nigeria BUR1

2.2. Data Inputs and Scenarios

In terms of timeline for establishing the energy intensive production processes for the two main products (Cement and Steel) the following scenarios were used:

- Baseline period - (2015)
- Projection period covering 2016 – 2030 (15years)

The origins of the funds invested by the investment entities such as domestic equity, foreign debt, domestic subsidies, and foreign aid were identified based on the entities responsible for the investment decisions, and the sources of the funds that are invested. For easy of application, the Investment Types (ITs) were disaggregated into three, namely:

- Grant,
- Equity and
- Loan

2.3 Data Requirements and Inputs

For the subsector, the data type needed for the historical and scenario building included the followings: Energy Consumption, Production Output, Investment, Sectoral GDP Contribution: Population Growth Rate/National Demand**,** Inflation Rate and Exchange Rate with Interest Rate**,** Technology and Plant Lifespan. The specific data arising from these for calculations included the followings:

- Summary of the production process/units for Cement, and Steel
- Type of energy utilized in the production process by the respective industry.
- Annual rate of energy consumption (past, current, and anticipated)
- Statistics on CO2 emission by respective production units
- International Best Practices in the production process by similar industries
- Current investment flows in new physical assets, and energy related investments-Domestic, FDI, Debts etc.

- FFs relevant to CC mitigation/adaptation (energy utility, especially fossil fuels & Energy mix in production processes)
- Technological improvements on energy efficiency and emission reduction.
- Policies and Regulations on industry-related energy efficiency and emissions regulation (subsidies, pricing, and taxation).
- Requirements on capacity-building.

2.4 Assessment Period and Cost Accounting Parameters

2.4.1. Assessment Period

The Baseline year and then a 15-year projection Scenario period from 2016- 2030.

The year, 2030, was used as the last year of the assessment period since this year aligns with strategic national and international climate change mitigation frameworks like the NDCs as building blocks of the Paris Agreement and other climate agenda related agenda. This period also provided latitude for robust results flowing from a reasonable assessment period.

All the investment data in Nigerian Naira were converted to United States Dollars (USD) using 2015 exchange rates[iv]. The Central Bank of Nigeria's Minimum Rate of Return (MRR) value of 12.5% was used as our Discount Rate (DR) which was mainstreamed in the computation of the Net Present Value.

2.4.2 Cost Accounting Parameters

Actual Data Collected from Entities - Individual, Government, Private sector

The data collection challenges were encountered with no historical data beyond 2015 coming from individuals, government agencies or the private sector. However, the team improvised with a range of data from corporations focused reports. For instance, the Nigerian cement industry grew rapidly from about N26 billion in 2004 to an estimated valued of N134 billion in 2008 and the estimated total consumption grew by 8% to 14.8 million tons in 2009, and approximately 10.5% annually over the six years between 2007-2013 with potential aggregate demand for cement more than supply, estimated at 18 million tons. Although Nigerian's Cement consumption continues to rise, per capita usage, consumption per head is low by global standards, and as evidenced by the housing deficiency of about 12 million units and relatively poor infrastructure within the country with a population of about 140,431,790 million (NPopC 2006)v. Nigeria's per capita consumption is at about c.180kg as of 2011, a far cry when compared to UAE's 4,198Kg, China 1,055kg and Saudi Arabia 1294 kg (Ugochukwu, S.C; et al 2014)vi.

2.5 Calculation of Greenhouse Gas Emissions

Financial services and climate action or inaction are closely related. This IFF assessment of the Industry sector seeks to understand the emission reductions achievable as the industry transitions from business as usual to a climate action scenario. The carbon footprint for capital investments is a tool that showcases the financed GHGs emissions of capital investment products to be mapped and compared under different economic activity scenarios.

In want of data which were not readily available, across the spectrum of this assessment, our calculation of the GHGs reduction relied on the outcome of the study by Adelphi Tool used on behalf of Germany's Federal Ministry of Environment, Nature Conservation and Nuclear Safety to assess a broad range of capital investment products. One of the main goals of the assessment was to set out the correlation between climate protection and capital investment by comparing the GHG intensity of conventional and climate-friendly capital investments. The outcome of the assessment showed that every 10,000 Euros invested currently finances five tonnes of greenhouse gas emissions a year and that private investors can substantially reduce their carbon footprint by choosing climate-friendly and sustainable financial investments. The use of the tool further demonstrated that the average potential for reduction across the investment portfolio is 42% and that carbon foot printing as a tool helps to enthrone greater transparency in determining the climate-friendliness of capital investments while providing strategic guidance to private investors as well as financial services providers.

Therefore, the calculation converted the Euro to USD using 2015 exchange rate and arrived at Euro 1: USD 1.11. This leaves us with each USD 11, 100 financing five (5) tonnes of GHGs which gives (11, 100/5) USD 2, 220 causing 1 tonne of GHG emission under BAU GHGs intensive investment scenario. For the climate-friendly invested, the same USD 11, 100 will cause 42% less GHG emission. From our calculations, we arrived at a total GHG emission reduction of 77, 826, 900 tCO_2eq for a total discounted investment flow for cement and Iron & Steel of USD 17, 277, 580, 000 in the 15-year period from 2016 to 2030.

Capital Expenditure (CAPEX) for Cement and Steel includes:

- Total cement and Steel production, exports, and imports,
- Penalties for breach of environmental regulations,
- Total number of plants and depots,
- Total consumption of volume by households, corporations, and government, etc.
- Proposed investments (USD estimates) in new plants, improved technologies, and facilities
- Investments in activities to reduce carbon emissions and mitigate climate change.

Operation & Maintenance (OPEX) costs include the following categories of costs:

- Advertising
- Insurance
- Raw materials,
- Office supplies/consumables,
- Salaries or wages of personnel
- Fuel costs such as power and/or fuel for operations, fuel for production
- Utilities costs such as telephone service, Internet connectivity
- Maintenance and/or leasing of equipment.
- License or equivalent fees such as annual business registration fees.
- Rent or lease payments for office space, furniture/equipment, property taxes, etc.
- Operational costs such as permits, and parking fees charged by local governments.
- Damages due to uninsured losses, accident, sabotage, negligence, or terrorism.

2.6 Benefits and Non-Investment Costs of Mitigation Measures

One of the main purposes of an IFF assessment is to determine the incremental, direct monetary costs of climate change mitigation measures, and the likely sources of the anticipated investment funds. Given the reality of the methodology not being a cost-benefit kind of assessment, quantitative estimates of the direct benefits of investments were not included. Direct benefits of climate change measures include net GHG reductions and climate impacts avoided.

During data disaggregation evaluation, the project team assessed the relative magnitude of revenues from those investments that will generate return on investment and incomes over the lifetime of the assets (relative to lifetime O&M costs), and the likely sources of the revenues.

2.7 Approach to Data Gathering

We sent out letters to the operators with the expectation to receive raw primary data. The sources of funding for projects in the two sub-categories under review could not be easily referenced due to paucity of data occasioned by the non-responsiveness of the stakeholders despite the many questionnaires we sent to them. This made it impossible to get the exact ratios for the disaggregation of the investments into various types and sources which left us with no option than to make assumptions. Based on the foregoing, we assumed that Corporation had 60% domestic funding sources while foreign sources of fund was 40% for both IF and O&M. This application was based on expert judgment with discretion on the various ratios deployed as appropriate for the costs within the investment entities.

2.8 Analytical Approach

To ensure a transparent and comparable result for the sector, the established approaches for compiling data on the costs of Investment Flow (IF), Financial Flow (FF) and Operation and Maintenance (O&M) Costs were used. These included a combination of the following:

- Sectoral Model of the Industry Sector,
- Sectoral Plan of the Industry Sector,
- Projection of Sectoral Trends vis-à-vis the Current Situation in Industry sector (assuming no change).

These analytical approaches are in tandem with previous analytical work related to green economy, climate mitigation, adaptation and sustainable development that incorporated demand/supply forecasting and econometric assessments such as Nigeria's first biennial Update Report (BUR1, 2018), NDC Implementation Action Plan for Industry Sector (NIAP-IS 2017), Draft Third National Communication.

The projection mainstreamed anticipated changes in the industry sector over the selected assessment period in ways that allowed the identification of preliminary mitigation measures as well as the scale and timing of their implementation. The projection was based on sectoral demand forecasts for Cement and Steel deploying quantitative methods like extrapolation of historical sales data, per capita demand, and population growth rate up to 2030. Excel application was especially useful for elaboration of the outcomes.

Specifically,

a. Costs were compiled in real terms, with inflation adjusted. It is as well recommended investment costs for assets (IF) be reported in the year in which they are expected to be incurred, rather than spreading the costs over the lifetime of the asset.
b. Financial flows and O&M costs were reported as annual costs in the year in which they occur.
c. Appropriate discounting of future costs (IF, FF, and O&M costs for the baseline and climate change scenarios) were used to account properly for varying opportunity costs and time preferences of investment entities.
d. The discount rates chosen reflected Nigeria-specific economic conditions with two discount rates for public discount and private discount rate or use the public discount rate for all sectors.
e. The IFF method does not consider explicitly the contribution of government subsidies in financing private sector (household and corporation) investments (IF and FF) and O&M costs because computing or discriminating subsidies for private investments is not always possible. Since the USD is considered a legal tender in Nigeria, all monetary figures were deflated to 2015 USD.
   CBN Discount Rate of 12.5% which reflected return on present consumption foregone or sacrificed to secure future consumption was applied.
f. The ration of domestic to foreign sources of fund was 60:40 being same with the operational and maintenance cost.

The after-tax real interest rate or return on capital investment was used as the discount rate, knowing that one USD as at today is worth much more than one USD in the future so the DR is necessary to enable us capture inflationary trends. The CBN's subsisting 12.5% discount rate for economic analysis of critical investment projections was used for this assessment.

2.9 Approach to Modelling

The model for the Industry sector IFF assessment was developed based on the mitigation activities highlighted in the NDC implementation action plan for the Industry sector. The cost of implementing projects in Nigeria are usually far higher than what is obtainable elsewhere mainly due to high costs of self-generation of electricity due to erratic supply from the grid, multiple taxation, and general insecurity which entities make provisions for the protection of their staff, equipment, and facilities. All these contribute to remarkably to high costs for engagement of expatriates as well as mobilization and deployment of equipment and resources.

For mitigation projects which could extend up to one year of the project implementation, it is expected that higher percentage of investments on assets occur at early stage of the project execution. However, it is worthy of note that it was difficult obtaining financial data on mitigation activities due to the operators and stakeholders not responding in good time before the outbreak of the COVID-19 pandemic.

To this assessment, these data lacuna has been handled using the most relevant and/or reliable data available in the public domain.

2.10 Historical IF, FF, and O&M Data, and Subsidies (Million USD 2005)

Historical IFF, FF, O&M and Subsidies entail the interrogation of investment flows disaggregated by FF, O&M and subsidies. There are no subsidies for Cement and Steel for the HST assessment period as these product types are hardly subsidized in Nigeria compared to electricity (Energy), Fertilizers (Agriculture) and Premium Motor Spirit PMS as well as Dual Purpose Kerosene DPK (Oil & Gas) products costs.

Data availability was a major challenge during the assessment. So, no historical data sets were recorded.

2.11 Baseline Scenario IF, FF, O&M and Subsidy Costs (Million 2015 USD)

Baseline IF, FF and O&M represent investment flows with projections within the 16-year Baseline BAU period spanning 2015-2030. There are no subsidies for Cement and Steel for the BSL assessment period as these product types are hardly subsidized in Nigeria compared to products in the Energy, Agriculture and Oil & Gas) sectors.

The major energy consumption in cement production is at the kilns. Usually, dedicated supply of energy is expected for the kilns. The business as usual assumes that industry continues to use fossil fuels (Coal & Diesel with gas) in their kilns and for power generation. The assessment showed sensitivity to the 2016 recession in the Nigerian economy as well as the 2020 economic shock occasioned by the COVID-19 pandemic. Data availability was a major challenge during the assessment which showed in the accompanying graph for this assessment.

Table 3: BAU IF, FF, and O&M Cost by Investment Type/ Entities in million 2015 USD

Annual Total IF, FF, O&M costs by Investment types/entity							
		Cement			Steel		
Investment Category	**Investment Entity**	**IF**	**FF**	**O&M**	**IF**	**FF**	**O&M**
Household		0.00	0.00	0.00	0.00	0.00	0.00
Corporations	Domestic						
	Domestic equity	62.32	0.00	484.69	0.00	0.00	400.86
	Domestic borrowing	6.92	0.00	323.13	0.00	0.00	267.24
	Total Domestic funds	69.24	0.00	807.82	0.00	0.00	668.09
	Foreign						
	FDI		0.00	17.31	0.00	0.00	0.00
	Foreign borrowing		0.00	259.66	0.00	0.00	0.00
	ODA		0.00	69.24	0.00	0.00	0.00
	Total foreign sources		0.00	346.21	0.00	0.00	0.00
	Total Corporation Funds	69.24	0.00	1,154.02	0.00	0.00	668.09
Government		0.00	0.00	0.00	0.00	0.00	0.00
Total Funds		**69.24**	**0.00**	**1,154.02**	**0.00**	**0.00**	**668.09**

Figure 1: BAU IF, FF, and O&M Cost by Investment Type/ Entities in million 2015 USD

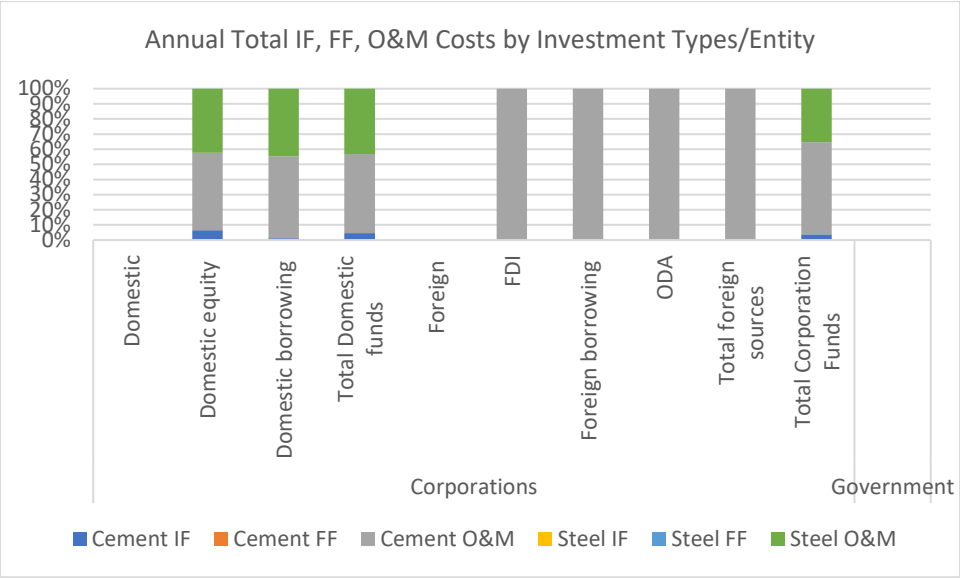


Table 4: BAU Annual IF, FF, and O&M Cost by Investment Types in million 2015 USD

Annual total IF, FF, O&M costs by investment types in million 2015 (USD)						
Year	**Cement**			**Steel**		
	IF	**FF**	**O&M**	**IF**	**FF**	**O&M**
2015	3.38	0.00	56.36	0.00	0.00	50.16
2016	3.74	0.00	62.30	0.00	0.00	50.16
2017	4.14	0.00	69.05	0.00	0.00	48.25
2018	4.36	0.00	72.62	0.00	0.00	48.25
2019	4.44	0.00	74.01	0.00	0.00	44.14
2020	4.44	0.00	74.01	0.00	0.00	39.72
2021	4.47	0.00	74.57	0.00	0.00	39.72
2022	4.47	0.00	74.57	0.00	0.00	39.72
2023	4.47	0.00	74.57	0.00	0.00	39.12
2024	4.47	0.00	74.57	0.00	0.00	39.12
2025	4.47	0.00	74.57	0.00	0.00	39.12
2026	4.47	0.00	74.57	0.00	0.00	38.12
2027	4.47	0.00	74.57	0.00	0.00	38.12
2028	4.47	0.00	74.57	0.00	0.00	38.12
2029	4.47	0.00	74.57	0.00	0.00	38.12
2030	4.47	0.00	74.57	0.00	0.00	38.12
Total	**69.2**	**0**	**1154.05**	**0**	**0**	**668.08**

Figure 2: BAU Annual Total IF, FF, and O&M Cost by Investment Types in million 2015 USD

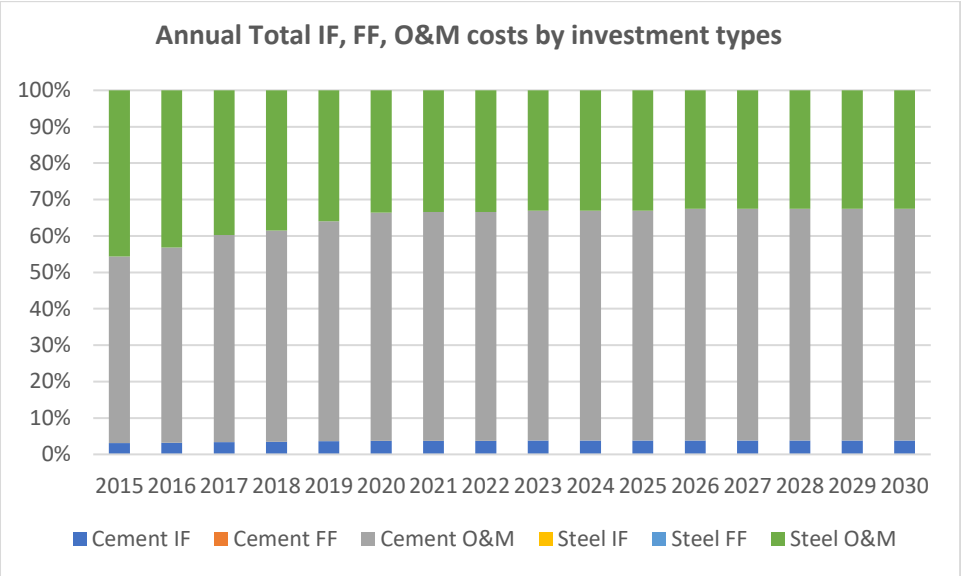
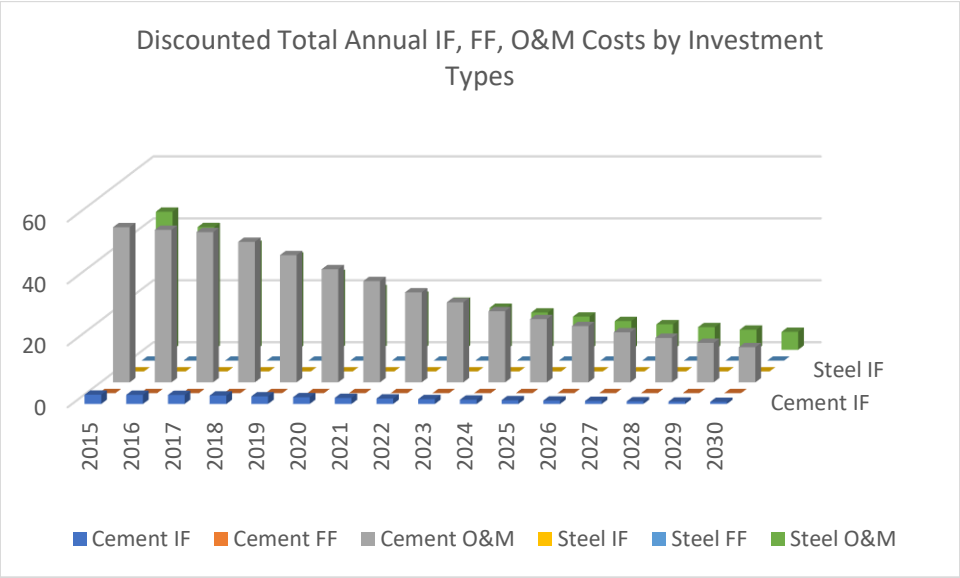


Figure 3: BAU Discounted Annual IF, FF, and O&M Cost by Investment Types in million 2015 USD

Discounted Annual total IF, FF, O&M costs by investment types in million 2015 (USD)						
Year	**Cement**			**Steel**		
	IF	**FF**	**O&M**	**IF**	**FF**	**O&M**
2015	3.00	0.00	50.10	0.00	0.00	44.59
2016	2.96	0.00	49.22	0.00	0.00	39.63
2017	2.91	0.00	48.50	0.00	0.00	33.89
2018	2.72	0.00	45.34	0.00	0.00	30.12
2019	2.46	0.00	41.07	0.00	0.00	24.49
2020	2.19	0.00	36.51	0.00	0.00	19.59
2021	1.96	0.00	32.70	0.00	0.00	17.42
2022	1.74	0.00	29.06	0.00	0.00	15.48
2023	1.55	0.00	25.83	0.00	0.00	13.55
2024	1.38	0.00	22.96	0.00	0.00	12.05
2025	1.22	0.00	20.41	0.00	0.00	10.71
2026	1.09	0.00	18.14	0.00	0.00	9.28
2027	0.97	0.00	16.13	0.00	0.00	8.24
2028	0.86	0.00	14.34	0.00	0.00	7.33
2029	0.76	0.00	12.74	0.00	0.00	6.51
2030	0.68	0.00	11.33	0.00	0.00	5.79
Total	**28.45**	**0**	**474.38**	**0**	**0**	**298.67**

Figure 4: BAU Discounted Annual IF, FF, and O&M Cost by Investment Types in million 2015 USD



2.12 Climate Change or Mitigation Scenario

The mitigation scenario explored measures to mainstream energy efficient technologies in the sub-categories of Cement and Steel with specific focus on CO_2 emission reduction. In this, the primary sources of GHG emissions were identified to include primarily the production processes for cement and steel.

Cement manufacturing from the business-as-usual scenario is known as an energy intensive process requiring Coal, Gas and Biomass as fuel for firing the kilns as well as for operations in the various production units.

The Project Scenario (Climate action) assumes that all kilns in all the Cement Industry will all partially substitute their fuel consumption with biomass to about 40% of the energy mix in the kilns and optimize the efficiency of production through process adjustments.

For the steel industries, the business-as-usual scenario is known to be supplied energy need from grid electricity which is available for about 40% of the time and the captive generators run on diesel fuel fired for 60% of the time.

The Project scenario (Climate action) assumes that this process is reversed; and natural gas will be utilized for at least 60% of the time and that the gas could be served either by pipeline or trucked LNG with each facility equipping itself with LNG kits.

2.12.1 Cement Production Process Summary

Lime is produced by thermal decomposition of limestone, which is mainly calcium carbonate ($CaCO_3$). This process also known as calcination (equation below), produces lime (CaO) and CO_2 as by-product:

$CaCO_3$ + Heat ⍰⟵==⟶ CaO + CO_2

The CaO then reacts with Silica (SiO_2), Alumina ($Al2O_3$) and Iron Oxide (Fe_2O_3) as other raw materials to make the clinker minerals (chiefly calcium silicates). This product is finely ground, along with a small proportion of Calcium Sulphate (Gypsum ($CaSO_4 \cdot 2H_2O$) or Anhydrite ($CaSO_4$)), into hydraulic (typically Portland) cement. CO_2 is the main GHG emitted in cement production during Calcination:

- Primary & Secondary Crushing
- Clinkering
- Grinding

2.12.2 Steel Sub-Category

The steel industry is not really working as it should. Most of the industries considered under this study are mostly those recycling existing steel into different shapes. These are mostly owned by the Indians and Chinese. Some of these Industries use electric kilns mostly running with a backup generator fuelled by diesel. In most places where highly intensive energy is required for such processes, they are usually powered by hydro power which is a cheap source of power. The cost of production has made most of these Industries to become moribund or running sub-optimally as the cheap steel floods the market supplied from China hence, they are not competitive. A good choice of energy source for steel industries in Nigeria has been identified to be natural gas which is much cleaner compared to the Diesel and Heavy oil that is currently used. While lack of gas infrastructure remains a barrier, the option of using trucked LNG is gradually being embraced especially places with unserved natural gas could take advantage of trucked LNG.

Table 5: Mitigation Scenario Total IF, FF, and O&M Cost by Investment Types and Entities in million 2015 USD

Total IF, FF, O&M costs by Investment types/entity							
		Cement			Steel		
Investment Category	**Investment Entity**	**IF**	**FF**	**O&M**	**IF**	**FF**	**O&M**
Household		0.00	0.00	0.00	0.00	0.00	0.00
Corporations	Domestic						
	Domestic equity	99.06	0.00	998.26	88.00	0.00	47.83
	Domestic borrowing	396.25	0.00	3,993.02	132.00	0.00	71.74
	Total Domestic funds	495.31	0.00	4,991.28	220.00	0.00	119.57
	Foreign						
	FDI	33.02	0.00	332.75	16.50	0.00	0.00
	Foreign borrowing	257.56	0.00	2,595.47	264.00	0.00	0.00
	ODA	39.62	0.00	399.30	49.50	0.00	0.00
	Total foreign sources	330.21	0.00	3,327.52	330.00	0.00	0.00
	Total Corporation Funds	825.52	0.00	8,318.80	550.00	55.00	119.57
Government		0.00	0.00	0.00	0.00	0.00	0.00
Total Funds		**825.2**	**0.00**	**8,318.80**	**550.00**	**55.00**	**119.57**

Figure 5: Mitigation Scenario Total IF, FF, and O&M Cost by Investment Types and Entities in million 2015 USD

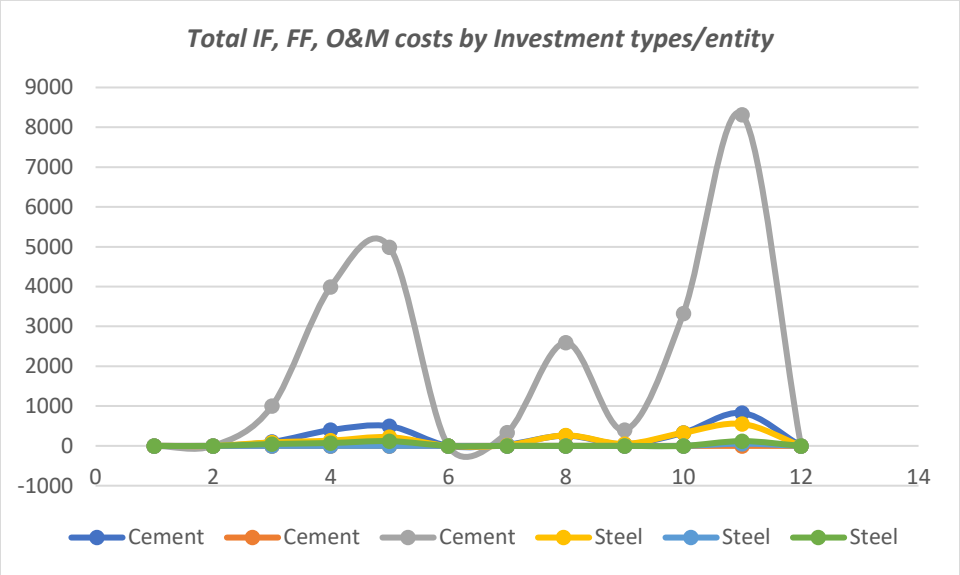


Table 6: Mitigation Scenario Total IF, FF, and O&M Cost by Investment Types in million 2015 USD

Annual total IF, FF, O&M costs by investment types in million 2015 (USD)						
Year	**Cement**			**Steel**		
	IF	**FF**	**O&M**	**IF**	**FF**	**O&M**
2015	7.25	0.00	15.24	0.00	0.00	0.00
2016	42.89	0.00	107.55	0.00	0.00	0.00
2017	49.19	0.00	219.87	0.00	0.00	0.00
2018	53.56	0.00	273.09	0.00	0.00	0.00
2019	56.07	0.00	303.21	0.00	0.00	0.00
2020	56.07	0.00	433.16	50.00	5.00	0.00
2021	56.29	0.00	436.51	50.00	5.00	11.96
2022	56.84	0.00	528.89	50.00	5.00	11.96
2023	51.69	0.00	613.44	50.00	5.00	11.96
2024	54.68	0.00	648.83	50.00	5.00	11.96
2025	54.68	0.00	648.83	50.00	5.00	11.96
2026	54.68	0.00	648.83	50.00	5.00	11.96
2027	54.68	0.00	741.52	50.00	5.00	11.96
2028	57.66	0.00	879.71	50.00	5.00	11.96
2029	59.65	0.00	910.05	50.00	5.00	11.96
2030	59.65	0.00	910.05	50.00	5.00	11.96
Total	**825.53**	**0.00**	**8318.78**	**550.00**	**55.00**	**119.6**

Figure 6: Climate Change/Mitigation Scenario Total IF, FF, and O&M Cost by Investment Types in million 2015 USD

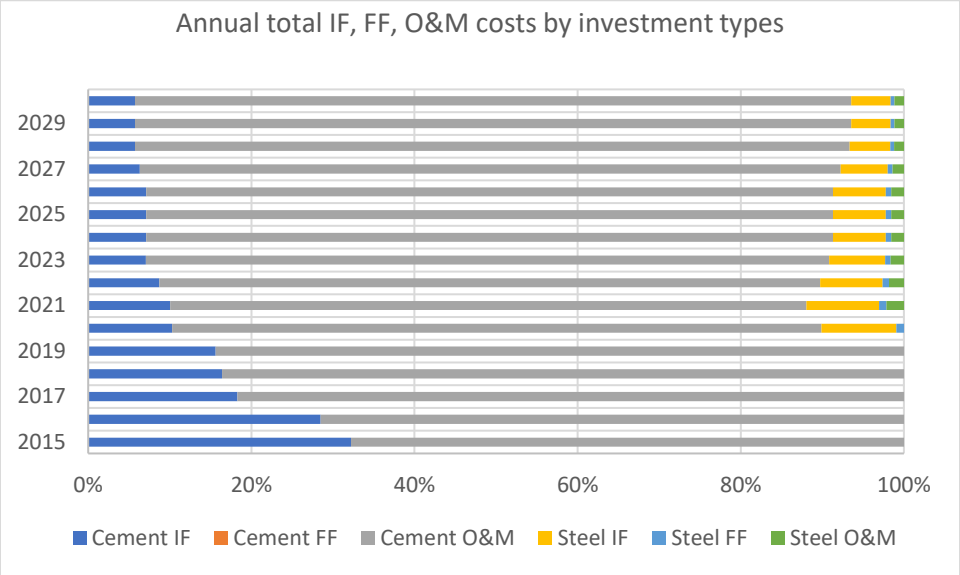
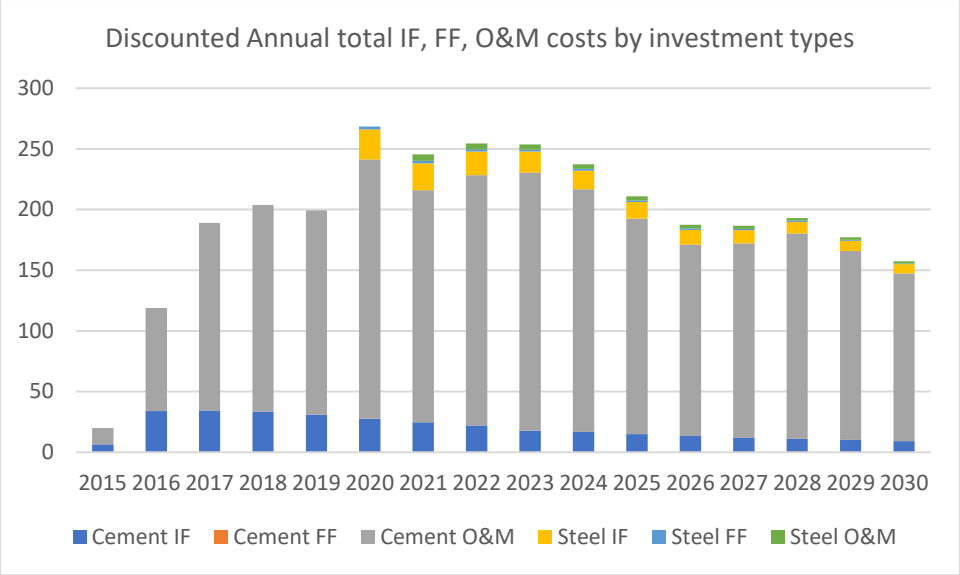


Table 7: Mitigation Scenario Total IF, FF, and O&M Cost by Investment Types and Entities in million 2015 USD

Discounted Annual total IF, FF, O&M costs by investment types in million 2015 (USD)						
Year	**Cement**			**Steel**		
	IF	**FF**	**O&M**	**IF**	**FF**	**O&M**
2015	6.44	0.00	13.55	0.00	0.00	0.00
2016	33.89	0.00	84.98	0.00	0.00	0.00
2017	34.55	0.00	154.42	0.00	0.00	0.00
2018	33.44	0.00	170.49	0.00	0.00	0.00
2019	31.11	0.00	168.26	0.00	0.00	0.00
2020	27.66	0.00	213.66	24.66	2.47	0.00
2021	24.68	0.00	191.39	21.92	2.19	5.24
2022	22.15	0.00	206.13	19.49	1.95	4.66
2023	17.91	0.00	212.52	17.32	1.73	4.14
2024	16.84	0.00	199.80	15.40	1.54	3.68
2025	14.97	0.00	177.60	13.69	1.37	3.27
2026	13.30	0.00	157.87	12.17	1.22	2.91
2027	11.83	0.00	160.38	10.81	1.08	2.59
2028	11.09	0.00	169.12	9.61	0.96	2.30
2029	10.19	0.00	155.52	8.54	0.85	2.04
2030	9.06	0.00	138.24	7.60	0.76	1.82
Total	**319.11**	**0.00**	**2573.94**	**161.21**	**16.12**	**32.66**

Figure 7: Mitigation Scenario - Discounted Total IF, FF, and O&M Cost by Investment Types in million 2015 USD



The mitigation scenario explored measures to mainstream energy efficient technologies, climate change mitigation processes and activities with specific focus on CO_2 emission reduction. In cement manufacturing where historically, production of cement is an energy intensive process requiring Coal, Gas and Biomass as fuel. To reduce GHGs emissions in the Cement and Steel sub-categories, eight (8)- short, medium, and long term, mitigation options were recommended during the IFF assessment of the Industry sector in Nigeria. Two of which were considered and captured in the Climate Scenario projections, the two were: Alternative Fuels for Cement and Investment in Energy Efficiency for Steel. Others include:

i. Alternative fuels/biomass/fuel shifting from coal to gas (Short-term; Cement and Steel)
ii. Investment in Energy Efficiency (Short Term – Cement and Steel)
iii. Substitution of Clinker with Other Materials (Medium Term - Cement Only)
iv. Efficient Cement Use and Substitute Building Materials (Short-term – Cement only)
v. Developments of Alternatives to Cement (Medium term - Cement)
vi. Deployment of Carbon Capture and Storage (CCS) technology (Long term - Cement and Steel).
vii. Innovative steels and efficient steel use to deliver same service at lower weight/ carbon emissions (Short term – Steel only).
viii. Increasing steel end of life recovery and re-use rates (Short-term – Steel only).

From the IFF assessment, opportunities to reduce both fuel and process emissions in the production and use of Cement and Steel include investment in modernization of production and processing plants to reduce the GHGs emissions.

3.0 Results, Analysis and Findings

Table 8: Incremental Annual Total IF, FF, and O&M Cost by Investment Types in million 2015 USD

Year	Investment Types					
	Cement			Steel		
	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M
2015	3.87	0.00	-41.12	0.00	0.00	-50.16
2016	39.15	0.00	45.25	0.00	0.00	-50.16
2017	45.05	0.00	150.82	0.00	0.00	-48.25
2018	49.2	0.00	200.47	0.00	0.00	-48.25
2019	51.63	0.00	229.2	0.00	0.00	-44.14
2020	51.63	0.00	359.15	0.00	0.00	-39.72
2021	51.82	0.00	361.94	0.00	0.00	-27.76
2022	52.37	0.00	454.32	0.00	0.00	-27.76
2023	47.22	0.00	538.87	0.00	0.00	-27.16
2024	50.21	0.00	574.26	0.00	0.00	-27.16
2025	50.21	0.00	574.26	0.00	0.00	-27.16
2026	50.21	0.00	574.26	0.00	0.00	-26.16
2027	50.21	0.00	666.95	0.00	0.00	-26.16
2028	53.19	0.00	805.14	0.00	0.00	-26.16
2029	55.18	0.00	835.48	0.00	0.00	-26.16
2030	55.18	0.00	835.48	0.00	0.00	-26.16
TOTAL	**756.33**	**0.00**	**7164.73**	**0.00**	**0.00**	**-548.48**

Figure 8: Incremental Annual Total IF, FF, and O&M Cost by Investment Types in million 2015 USD

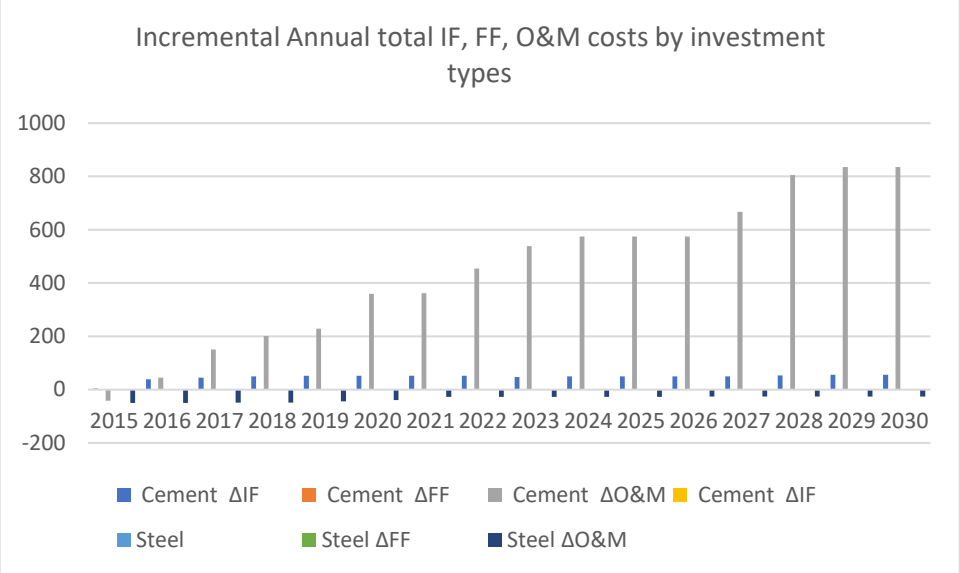


Table 9: Incremental Discounted Annual Total IF, FF, and O&M Cost by Investment Types in million 2015 USD

Year	Investment Type					
	Cement			Steel		
	ΔIF	ΔFF	ΔO&M	ΔIF	ΔFF	ΔO&M
2015	3.44	0.00	-36.55	0.00	0.00	-44.59
2016	30.93	0.00	35.75	0.00	0.00	-39.63
2017	31.64	0.00	105.93	0.00	0.00	-33.89
2018	30.72	0.00	125.15	0.00	0.00	-30.12
2019	28.65	0.00	127.19	0.00	0.00	-24.49
2020	25.47	0.00	177.16	0.00	0.00	-19.59
2021	22.72	0.00	158.70	0.00	0.00	-12.17
2022	20.41	0.00	177.07	0.00	0.00	-10.82
2023	16.36	0.00	186.69	0.00	0.00	-9.41
2024	15.46	0.00	176.84	0.00	0.00	-8.36
2025	13.74	0.00	157.19	0.00	0.00	-7.43
2026	12.22	0.00	139.73	0.00	0.00	-6.37
2027	10.86	0.00	144.25	0.00	0.00	-5.66
2028	10.23	0.00	154.79	0.00	0.00	-5.03
2029	9.43	0.00	142.77	0.00	0.00	-4.47
2030	8.38	0.00	126.91	0.00	0.00	-3.97
TOTAL	**290.66**	**0.00**	**2099.56**	**0.00**	**0.00**	**-266.01**

Figure 9: Incremental Discounted Annual Total IF, FF, and O&M Cost by Investment Types in million 2015 USD

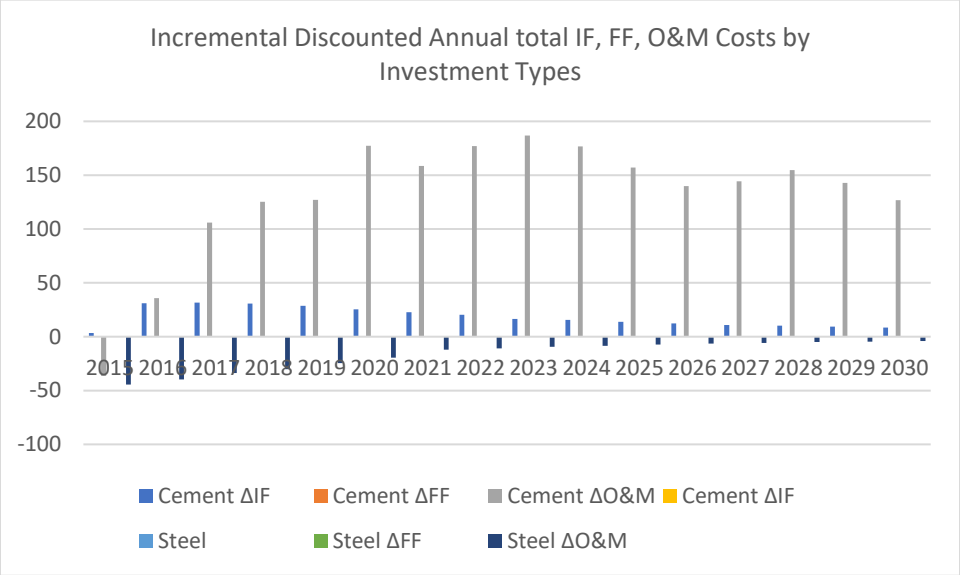


Table 10: Incremental Annual Total IF, FF, and O&M Cost by Investment Types/Entities in million 2015 USD

Incremental Annual Total IF, FF, O&M costs by Investment types/entity							
		Cement			**Steel**		
Investment Category	**Investment Entity**	**IF**	**FF**	**O&M**	**IF**	**FF**	**O&M**
Household		0.00	0.00	0.00	0.00	0.00	0.00
Corporations	Domestic						
	Domestic equity	36.74		513.57	88.00	0	-353.03
	Domestic borrowing	389.33		3669.89	132.00		-195.5
	Total Domestic funds	426.07		4183.46	220.00		-548.52
	Foreign	0		0	0.00		0
	FDI	33.02		315.44	16.50		0
	Foreign borrowing	257.56		2335.81	264.00		0
	ODA	39.62		330.06	49.50		0
	Total foreign sources	330.21		2981.31	330.00		0
	Total Corporation Funds	756.28		7164.78	550.00	55.00	-548.52
Government		0	0.00	0	0.00	0.00	0
Total Funds		**756.28**	**0.00**	**7164.78**	**550.00**	**55.00**	**-548.52**

Figure 10: Incremental Annual Total IF, FF, and O&M Cost by Investment Types/Entities in million 2015 USD

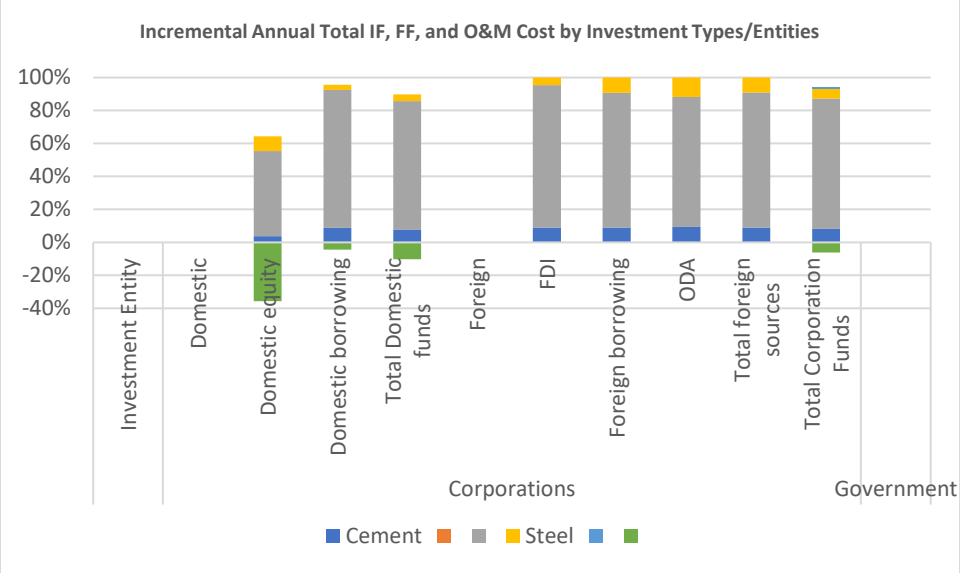
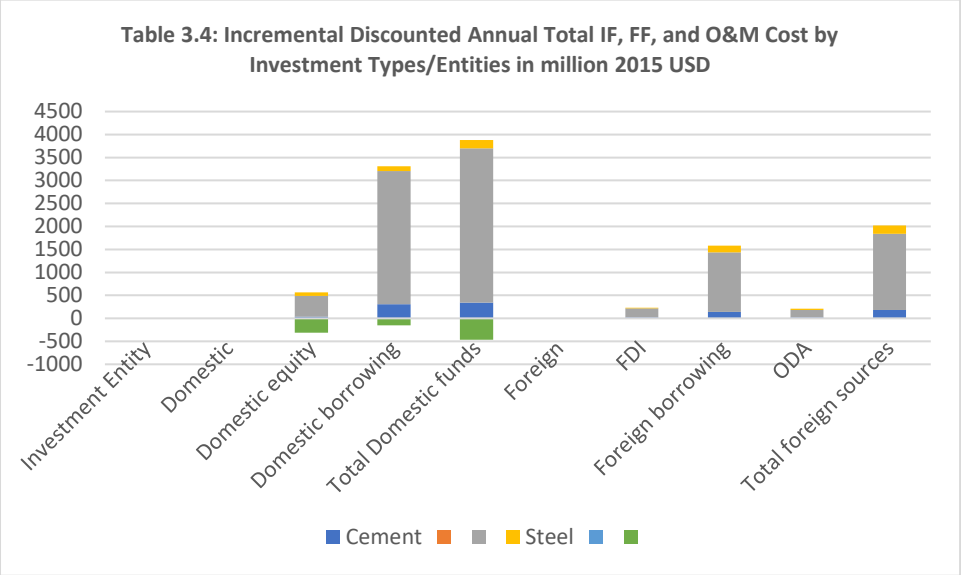


Table 11: Incremental Discounted Annual Total IF, FF, and O&M Cost by Investment Types/Entities in million 2015 USD

Incremental Discounted Annual Total IF, FF, O&M costs by Investment types/entity							
		Cement			**Steel**		
Investment Category	**Investment Entity**	**IF**	**FF**	**O&M**	**IF**	**FF**	**O&M**
Household		0.00	0.00	0.00	0.00	0.00	0.00
Corporations	Domestic						
	Domestic equity	32.66	0.00	456.51	78.22	0.00	-313.804
	Domestic borrowing	307.62	0.00	2899.67	104.30	0.00	-154.469
	Total Domestic funds	340.28	0.00	3356.18	182.52	0.00	-468.274
	Foreign						
	FDI	20.61	0.00	196.93	10.30	0.00	0.00
	Foreign borrowing	142.93	0.00	1296.21	146.50	0.00	0.00
	ODA	19.54	0.00	162.81	24.42	0.00	0.00
	Total foreign sources	183.08	0.00	1655.95	181.22	0.00	0.00
	Total Corporation Funds	523.36	0.00	5012.13	363.74	48.89	-468.274
Government		0	0.00			0.00	0.00
Total Funds		**523.36**	**0.00**	**5012.13**	**363.74**	**48.89**	**-468.274**

Figure 11: Incremental Discounted Annual Total IF, FF, and O&M Cost by Investment Types/Entities in million 2015 USD



3.1 Policy Objectives

The Policy Objectives are to:

1. Promote energy efficiency measures; and,
2. Build capacity of the cement and steel companies to mainstream climate risks into their business models as well as leverage climate and carbon finance opportunities to lower the carbon footprints of their operations.
3. Enshrine global best practice in the operations and production processes of the cement and iron and steel companies.

3.1.1 General Policy Implications

The following will have implications on climate mitigation in the Industry sector when prioritized:

1. Provision of dedicated funds to co-finance cement and iron and steel manufacturers who are eager to invest in the construction of energy-efficient plants and facilities.
2. Introduction of incentives and tax reliefs to cement manufacturers who meet a certain threshold of GHGs emissions reduction.
3. Enforcing industrial end-use energy efficiency regulatory interventions integrated into national industrial development policy and planning strategy documents.
4. The Federal Government of Nigeria (FGN), through the Department of Climate Change of the Federal Ministry of Environment (FMEnv) should put in place an incentives-based mechanism for rewarding cement and Iron and Steel companies that have mainstreamed the global best low carbon manufacturing standards and practices in their facilities.
5. There should also be effective public-private interface at the inter-ministerial level with civil society/NGO coordination regarding the coordination regarding climate change mitigation issues and challenges.

3.2 Recommendation for GHG Emission Mitigation

To reduce GHGs emissions, Nigeria should look at the use of alternative fuels (Instead of coal) to fire the energy intensive clinkers in cement manufacturing at the cost of $11,249,366,713.00 and use of more energy efficient "Electric Arc Furnaces" in Iron & Steel at the cost of $3,797,840,305.00. The investments in the Cement sub-category, six (6) mitigation options were recommended during the IFF assessment of the Industry sector in Nigeria, three of which (Alternative Fuels, Investment in Energy Efficiency for example change from wet rotary kilns to the dry kilns and Substitution of Clinker with other Materials) were considered and captured in the Climate Scenario projections.

- **Substitution of Clinker with Other Materials**
  Since it is the production of clinker that causes CO_2 emissions, the substitution of it by other hydraulic minerals is the most effective way to reduce CO_2 emissions in cement. The European cement norm19 allows six clinker substituting minerals, from which the most important are ground granulated blast furnace slag from the steel industry, fly ash from coal fired power stations, limestone and burnt oil shale. Reducing the clinker content in cement is currently the most effective mitigation option because it not only prevents fuel CO_2 but also the process CO_2 emissions from the chemical transformation of limestone in clinker.[vii]
- **Efficient Cement Use and Substitute Building Materials**
  From a civil engineering technical point of view, bridges are one example where the volume of concrete can be reduced by using wood-concrete-composite materials. In this way, concrete can support compression loads and wood can be used to take over tension forces. In interviews with engineers, it was reported that wood-concrete composites can save 50% of concrete and 20% of steel required for the construction of bigger heavy traffic bridges or long deck constructions.[viii]
- **Developments of Alternatives to Cement**
  Low-carbon cement options include "new" cements based on "old" ideas, such as Calcium Sulfo-Aluminate cement, clinker mineralization and alkali-activated cement, as well as new processes and products such as Celitement (Schwenk) and Novacem. The biggest barrier for product innovation is absence of market demand for low carbon cement alternatives, especially when/where carbon prices are low and not reflected in cement prices.

- **Deployment of Carbon Capture and Storage (CCS) technology**
  CO_2 capture and storage (CCS) is a mitigation option that captures CO_2 from the flue gases of stationary installations, compresses the purified CO_2 and transports it to a geological storage location, injecting it deep underground for permanent isolation from the atmosphere.

3.3 Key Uncertainties and Methodological Limitations / Challenges

Data access and/or paucity were major limitation to the assessment. No access could be gained to records of investment as the private sector participants were not willing to provide this information that are classed to be confidential. On the parts of government, no access could be gained readily to records of monitoring of investment flows and GHGs emission reduction in Nigeria's Industry sector. Granted that some industry players had assured the release of some of the data available to them, the onset of COVID-19 made that impossible with the attendant lockdown of the economy.

To this end, this led to projections made over the assessment period with the few data obtained from some industry literature, especially for cement investment which covers 2004 and 2008 only. Annual projections made for the assessment period were based on these sector-specific investment data which was disaggregated based using GHGs emissions implicated in the sub-categories which were indexed to the macro-economic parameters of the country.

Due to limited data, this IFF assessment did not include calculations and estimates of projections in respect of annual GHGs emissions, energy conserved, produced, and consumed over the assessment period for the various scenarios.

3.3.1 Overcoming the Challenges of Key Uncertainties and Methodological Limitations

To overcome the data access challenges, some assumptions were made upon which this IFF assessment was carried out. These assumptions are listed below and in Annex 1:

1. A flat rate of 12.5% to discount projected investment flows up to 2030.
2. Primary Data Reference (Climate Scenario): **2015 USD: NGN Exchange Rate (**"Investment in industrial energy efficiency has to date only been possible through the support of the EU and other donors, particularly through NESP which will receive **24.5 Million EUR funding between 2013 and 2018**. There is potential for high-impact funding through support for co-financing of industry energy audits, and through the set-up of a body to channel energy efficiency capacity building for auditors and energy managers at a national level. The NESP/ UNIDO pilot programme on energy management systems covering two sectors is estimated at US$ 4 million per year. Expanding this to a further sector is estimated at **US$ 3 million per year**").

END NOTES

[i] Ionita, et al, 2013: Climate Technology & Development: Energy Efficiency and GHG Reduction in the Cement Industry -Case Study of Sub-Sahara Africa. CDKN, ECN accessed via https://climatestrategies.org/wp-content/uploads/2014/10/Climate-Technology-and-Development-Case-study-Cement-Ionita-et-al-final.pdf May 25, 2020

[ii] Federal Ministry of Environment, 2011: National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN)

[iii] Nigeria's BUR1 (Table 2.1) reported CO_2 constitute about 99.99% of all GHGs emissions, increasing 600% and CH_4 constituted 0.01% and increased 400% in the 15-year period between 2000-2015.

[iv] Average FOREX Exchange Rates accessed via https://ng.investing.com/currencies/usd-ngn-historical-data May, 25, 2020.

[v] National Population Commission (NPopC) 2006: Nigeria National Official 2006 Census Result extracted from National Bureau of Statistics (BNS) Annual Abstract of Statistics 2001 pg. 18.

[vi] Ugochukwu, S. C, et al 2014: AN Appraisal of the Sources, Quantities and Prices of Imported Building Materials in Nigeria; International Journal of Advanced Research (2014), Volume 2, Issue 9, 871-889

[vii] Neuhoff, K; et al, 2014: "Carbon Control and Competitiveness Post 2020: The Cement Report" Climate Strategies: pg 18-19

[viii] Neuhoff, K; et al, 2014: "Carbon Control and Competitiveness Post 2020: The Cement Report" Climate Strategies: pg 20.

[viiii] Federal Ministry of Environment, 2017: Nigeria NDCs Sectoral Implementation Action Plan for the Industry Sector (NSIAP-IS)

[viiiii] Ionita, et al, 2013: Climate Technology & Development: Energy Efficiency and GHG Reduction in the Cement Industry -Case Study of Sub-Sahara Africa. CDKN, ECN accessed via https://climatestrategies.org/wp-content/uploads/2014/10/Climate-Technology-and-Development-Case-study-Cement-Ionita-et-al-final.pdf May 25, 2020

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- **Ionita, et al, 2013**: Climate Technology & Development: Energy Efficiency and GHG Reduction in the Cement Industry -Case Study of Sub-Sahara Africa. CDKN, ECN accessed via https://climatestrategies.org/wp-content/uploads/2014/10/Climate-Technology-and-Development-Case-study-Cement-Ionita-et-al-final.pdf May 25, 2020

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- **Cement Sustainability Initiative CSI** "Getting the Numbers Right", GNR Indicator 3211a.

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