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REPORT

OF THE STUDY

ESTIMATING THE ECONOMIC BENEFITS OF KYOTO PROTOCOL ON THE NIGERIAN ECONOMY

SUBMITTED TO

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JANUARY 2004

TABLE OF CONTENTS

1. Background

Nigeria has shown active interest over the past decade in supporting global actions to reduce the foreseeable impacts of the increasing concentration of greenhouse gases (GHG) in the global environment. The country participated actively in each of the global negotiations that led to the most current agreement on what nations should do to achieve the desired future emission levels and the consequent reduction in global concentration of the culprit gases. Being a developing nation, Nigeria in line with global agreement on how to tackle the GHG issue, is classified as a non-annex 1 country. Annex 1 nations mostly developed and industrialized countries of the world are according to the Kyoto Protocol, expected to reduce the GHG emissions of their economic activities, which have been scientifically fingered as the prime cause of global warming. Non-Annex 1 nations of the world such as Nigeria do not have any emission limitations placed on them by the protocol, since the bulk of the emissions that are responsible for the current global negative impacts came from economic activities of the Annex 1 nations. Recent studies have shown that land use changes in the non-Annex 1 nations also contribute to GHG emissions. It is also widely believed now that countries like Nigeria among the non-Annex 1 group with large or potentially large economies are bound to have significantly huge jump in their fraction of global future GHG emission levels and if actions are not taken today and in the foreseeable future to reduce such emissions, current efforts to curtail global emissions may be an exercise in futility.

Ordinarily, given that Nigeria like all the other non-Annex 1 Nations does not have emission limitations placed on them, one will expect that the ratification and coming into force of the Kyoto Protocol will be an eagerly expected happening by all decision makers in the country. The contrary is however the case. A group of decision makers who are critical to the country's decision to ratify or not to ratify the Kyoto Protocol has been arguing that the eventual global ratification of the protocol will be harmful for the economy of Nigeria. The premise of their argument is that Nigeria, a country that is heavily dependent on foreign exchange earnings from crude oil exports, will be negatively impacted as Annex 1 nations implements domestic actions, which will shift their energy consumption away from the carbon intensive crude oil, in order to meet their emission limitations. The Nigerian opponents of the Kyoto Protocol argue that it is not in the best interest of Nigeria for the protocol to become an internationally binding legal agreement. They therefore conclude that the Nigerian government should not ratify the Protocol.

The other group however argues that it is in the best interest of Nigeria that the Protocol should come into force now. Not only will the Protocol promote the use of clean technology within the nations economy, the mechanisms of the Protocol they posit, will also provide the wherewithal for the availability of financial and technical support for the adoption of these technologies within such developing economies. Although they concur that the need for industrialized nations to shift away from carbon intensive fuels will lead to a weakening of the global demand for crude oil, they argue that the resulting loss to the economy will be more than offset in the short to medium term by a combination of increased utilization of Nigerian natural gas resources and the economic gains from increased productivity as a result of the adoption of clean energy within the productive sectors of the countries economy. In the long run they argue that increased productivity gains of the economy from cleaner production will be more than adequate to counter the loss from crude oil and gas exports, as nations of the world move to zero carbon energy such as hydrogen.

Towards the last quarter of the year 2003, UNIDO decided to put quantitative perspectives on this ideological perspectives as a means of fostering a better understanding of the issues involved as well as assisting the Nigerian Government to make informed decisions on its Kyoto Protocol objectives. In this respect, UNIDO engaged the services of Triple "E" Systems Associates Limited to quantitatively analyze the conjectures inherent in the views of the two groups elucidated above, within the context of the Nigerian economy. This is an Interim Report of the study. In this report, we present a concise elucidation of the study methods that the Consultant has put together. The report also provides some preliminary results of some of the database management activities, and some system modeling results that have so far been obtained.

2. Some Basic Considerations in the Choice of Study Method

The basic goal of the Kyoto Protocol is the stabilization of atmospheric concentrations of GHGs at a level that will prevent dangerous anthropogenic interference with the global climate system. As such, the first basic consideration in our choice of study methodology is the identification of the sources and mitigation of GHG emissions within the country's economy. A previous study (1) indicated that the most important sources of GHG in Nigeria, is the Country's energy system. The study discussed the components of the energy system and put gas flaring as the most important GHG source, followed by diesel and gasoline use in road transportation, fossil fuel consumption for electricity generation, energy consumption in the residential sector, and the use of oil products as a fuel for the production of process heat in industries (1). We therefore concluded that a comprehensive quantitative analysis of the demand for energy in the different end use sectors of the Nigerian economy, and its interaction with optimal supply of such energy forms to meet these demands would enable us to properly elucidate options available to reduce GHG emissions from the economy.

The second and equally important consideration for the selection of the methodology adopted for the study was the need to simulate the economic impacts of various issues to be analyzed. For example, the impact of a reduction in crude oil output, the adoption of energy efficient technologies in different sectors of the country's economy, to mention a few, are potential issues that must be analyzed. The implication of each issue that will be considered will depend on which actor in the economy will be affected and at what point of production and consumption. The third consideration is the availability of the data required for the simulation of energy demand, the optimization of the supply infrastructure as well as the simulation of the economy in the face of the energy economy envisaged.

Given these considerations and our previous experiences in the modeling of the country's energy system as well as the study of their interactions with the economy, we decided to link the simulation of the demand for future energy requirements in the Nigerian economy under various scenarios, at the useful energy level, to the optimization of the country's energy supply system, and to an energy-economy simulation model. In the next few sub-sections, we present brief elucidations of the methods, and the modeling techniques adopted.

3. The Modeling Framework

Apart from the consideration of data availability, the need to have consistent representation of the sectors of the economy in the energy demand, energy supply optimization and the macroeconomic simulation was one of the first critical issues that was resolved among the groups involved in this modeling effort. This was to ensure compatibility and usability for the different result of each of the modeling exercises. To achieve this, we set as a goal, compatibility between sectoral representation in the energy modeling exercises and the macroeconomic simulation. After extensive deliberations among the modeling groups, it was decided that a starting point would be the FOS-NISER social accounting matrix table, which contains 30 production sectors. However, for the purpose of this present study, this was reaggregated into 9 production sectors, viz:

(i) Agriculture
(ii) Crude Oil
(iii) Natural Gas
(iv) Manufacturing
(v) Petroleum Products
(vi) Electricity
(vii) Building and Construction
(viii) Transport Services

Utilizing these sectoral representations, Energy Balance Tables as well as the Reference Energy System (RES) has been developed for each of the years 1980-2002.

3.1 Study of the Demand for Energy

The main tool that will be used in the analysis of the optimal energy supply systems is MARKAL, a large-scale energy systems linear optimization software package. Since MARKAL is demand driven, the first step in the implementation of the software is the development of the useful energy demand profile, which must be provided as an exogenous input to MARKAL. Our initial plan was to use the simulation model MADE-II to estimate the exogenous useful energy demand requirements. Given time limitations and the paucity of data required for the implementation of MADE-II, it was decided that simple specifications, relating useful energy consumption in each sector to the GDP value addition for the sector would be utilized in this energy demand analysis. In each sector, the development of useful energy will be linked in the specifications to pertinent macroeconomic variables driving productivity in the sector. It was decided that a simple spreadsheet model using trend analysis on useful energy consumption and sector value addition to the gross domestic product as variables will suffice for this present energy demand analysis. The energy use sectors covered in this demand analysis include:

- Transportation
- Commercial
- Residential
- Agriculture
- Industrial

Energy balance tables for each of the historical years from the year 1990-2002 shown In Tables 1-13 in the Table Appendix were the final energy data for this energy demand estimation. The first step involves the conversion of the final energy in each end use sectors to useful energy using appropriate end use energy efficiency assumptions shown in

Table 14 in the Table Appendix. The resulting useful energy estimate is presented in Table 15. Next, energy intensities defined as the energy required to produce one unit of product in each of the end-use sectors is estimated. Historical real GDP values for each sector, which were used in the estimation of the historical energy intensity ratios, are presented in Table 16. The values of the resulting useful energy per GDP for each economic sector during each of the historical years are presented in Table 17. The trends of energy intensity for each of the sectors of the economy considered in this study are shown in Figs. 2 in the Figure Appendix. The following considerations went into the process of estimating future useful energy for each sector considered:

- Agriculture

  (i) Useful energy trend during the period 1990-2002 in the agricultural sector grew at an average rate of 2.2% per annum from about 5.7 PJ in 1990 to about 6.4 PJ in 2002.
  (ii) Energy use in this sector is historically low as most of agricultural production is from subsistence agriculture characterized by high labor intensity, little or no irrigation (rain fed agriculture) and little or no mechanization
  (iii) The trend of useful energy in this sector during the period 1990-2002 showed two troughs. The first occurred during the period 1993-1997—representing the period of downturn in agricultural productivity catalyzed by the political problems associated with the cancellation of the June 12 1993 Presidential elections.
  (iv) The intensity of energy use in the agricultural sector during the period 1990-2002 was constant at near zero value, indicating the very low energy use in the sector.
  (v) For the purpose of estimating future useful energy in this sector, we have assumed that the energy intensity trend in this sector during the future period 2003-2020 will not be markedly different from that of the historical trend. We have also assumed that the agricultural sector value addition will have an annual reference, low and high growth rates of 3.6%, 2.5% and 5.0% respectively.

- Industrial Sector

  (i) For this sector, useful energy grow from about 52.8 PJ in 1990 at an annual average of about 36.5% to about 285.3 PJ in 2002
  (ii) The trend curve for useful energy during this historical period showed two sharp declines and jumps. Useful energy declined sharply between 1997 and 1998 and rose sharply during the period 1998-1999. A similar trend occurred with a decline between 2000 and 2001 and the sharp rise during the period 2001-2003. Our investigations showed that the two declines marked period of near collapse of industrial capacity utilization in Nigeria caused by myriads of bad fiscal policies that promoted importation of goods at the expense of local production. The two sharp rises are postulated to be the result of fiscal measures introduced by government in reaction to declining productivity of the industrial sector.
  (iii) The intensity of useful energy in this sector was flat at around 0.003 PJ/ Million Naira during the period 1990-1998. An average annual growth of about 81.20% was recorded during the period 1998-2002.

(iv) In order to estimate industrial sector useful energy intensity during the future years, we have assumed that the Useful energy per Industrial sector GDP ratio achieved in the year 2002 will continue into the study period. We also assumed the following growth rate scenarios for the industrial value added: reference 2.27%; low 1.5%; and high 3.5%.

- Transport Sector

(i) Useful energy in the transportation sector of the Nigerian economy rose from a level of about 249.9 PJ in 1990 to about 373.4 PJ by the year 2002. This represented about 5.0% per annum growth rate. It is the most energy intensive sector within the Nigerian economy.
(ii) The useful energy trend curve for the period 1990-2002 is characterized by various fluctuations indicating stochastic nature of the development in this sector.
(iii) The sector however had the highest energy intensity, corroborating its leading posture in the Nigerian energy system.
(iv) The sector registered average energy intensity during the period 1999-2002 of about 0.131 PJ/ Million Naira.
(v) For the purpose of estimating future useful energy for the sector, we have assumed that the historical trend of 1.15% annual growth of the energy intensity will continue during the study period. We also assumed the following growth rate scenarios for the sector value addition: reference 3.0%; low growth2.0%; and high growth 4.0%.

- Commercial Sector

(i) This sector recorded a useful energy consumption of about 6.7 PJ in 1999 rising to about 7.7 PJ in 2002.
(ii) Even then, the trend curve showed a period of sharp increase and drop during the period 1991-1995 and a stabilization and flattening out during the period 1995-2000.
(iii) The energy intensity ratio was constant at an average value of about 0.00025 PJ/ Million Naira throughout the historical period 1999-2002
(iv) For the purpose of estimating future useful energy consumption in this sector, we have assumed that the constant historical energy intensity ratio will continue into the study period. We also assumed the following growth rate scenario for the sector's value addition: reference 4.66%; low growth 3.5%; and high growth 6.0%.

- Residential Sector

(i) The sector recorded a useful energy consumption of about 193.5 PJ in 1999, growing at an average annual rate of about 1.3% to reach about 210.8 PJ in 2002.
(ii) Apart from a decline in the useful energy consumption in this sector during the period 1990-1991, energy consumption in the sector has witnessed an average growth rate of about 3.8% during the period 1991-2002.
(iii) The useful energy intensity was flat at a constant averaging about 0.015 PJ/ Million Naira during the period 1991-2002.

(iv) In estimating future useful energy demand in this sector, we assumed that the average constant value of the sector's energy intensity from 1991-2002 would continue into the study period. We also assumed the following growth rate scenarios fore the future residential sector GDP: reference 5.45%; low growth 3.5%; and high growth 6.5%.

The resulting useful energy estimates for each of the five sectors considered in this study, using trend analysis are provided in the Appendix Tables and Figures: Tables 18-20 are the estimates for future useful energy demand for the five sectors for the reference, low growth and high growth scenarios respectively. Figs. 3-7 provides the resulting trend curves.

3.2 The Optimal Energy Path

The MARKAL Model is the main tool used in the analysis of the optimal path for energy supplies to the Nigerian economy. The sectors, sub-sectors and the level of dis-aggregation that has been considered in this system optimization are shown in Table 1 below:

Table 1 Sectors and Sub-sectors Considered in the MARKAL Study

Sectors	Sub-Sectors
1. **Agriculture**	1.1 Irrigation
	1.2 Motive Power
2. **Commercial**	2.1 Refrigeration
	2.2 Space Cooling
	2.3 Cooking & Hot Water
	2.4 Electrical Appliances
	2.5 Lighting
3. **Industry**	3.1 Feedstock
	3.2 Process Heat
	3.3 Non Substitutable Electricity
	3.4 Others
4. **Residential**	4.1 Urban Cooking
	4.2 Rural Cooking
	4.3 Urban Space Cooling
	4.4 Urban Electricity
	4.5 Rural Electricity
5. **Transport**	5.1 Road Freight
	5.2 Road Passenger Transport
	5.3 Air Transport
	5.4 Water Transport
	5.5 Rail Transport

3.2.1 The MARKAL Model

The primary modeling tool employed in this analysis is the MARKAL (acronym for **MARK**et **AL**location) model. MARKAL is a large-scale linear optimization model based on the concept of the reference energy system. By design, MARKAL is able to capture the complex interrelationships of an energy system, from primary energy resources to energy service demands. Being a dynamic model, MARKAL can also be used to explore mid - to long-term responses to different technological futures, emission constraints and policy scenarios. MARKAL is not a predictive model but, given a set of energy demand projections, technologies, emission and/or policy constraints, MARKAL is able to identify the least-cost path within the RES that best satisfies the overall objectives of the energy-environmental system. In other words then, MARKAL is best suited to answer "If ... then..." questions.

MARKAL is a demand-driven model, and useful energy demand projections must be estimated exogenously and made available to the model. Disaggregated useful energy demand projections are shown in Table 21 of Appendix A. In this report, MARKAL has been employed to provide answers to the following questions:

- What is the likely optimal structure of Nigeria's energy sector under Kyoto Protocol?

- What will be the effects of the Kyoto Protocol on key economic and environmental indicators? For example:
  - Capital costs (cost of investment on supply and demand technologies)
  - Expenditure on fuels
  - Primary energy intensity (primary energy consumed per GDP)
  - CO_2 intensity of primary energy consumption

- Oil export is the backbone of Nigeria's economy. If and when Kyoto protocol comes into effect, it is likely there will be a global reduction in the demand for oil, and consequently a reduction in the country's earnings from oil. What will be the effects, on the above indicators, of a reduction in global oil demand or a fall in oil prices, as a result of the implementation of Kyoto protocol?

- What will be the likely effects of CDM projects on Nigeria's energy system?

3.2.2 Model Assumptions

3.2.2.1 GDP and Discount Rate

The gross domestic product (GDP) of Nigeria was $41,107 million US$ in 2001, according to the OPEC Statistics[1]. At an average growth rate of 3% per annum, this gives a GDP of $42,340 for the base year, 2002. A social discount rate of 10%/a is also assumed, and is adjudged to be in line with the recommended rate for developing countries.

3.2.2.2 Crude Oil and Natural Gas Production

Crude oil export is the main stay of Nigeria's economy, and as a result, assumptions of future oil export will be of major importance in this analysis. For this report, derivation of

[1] *Opec Annual Statistical Bulletin 2001*, Organisation of Petroleum Exporting Countries, Vienna

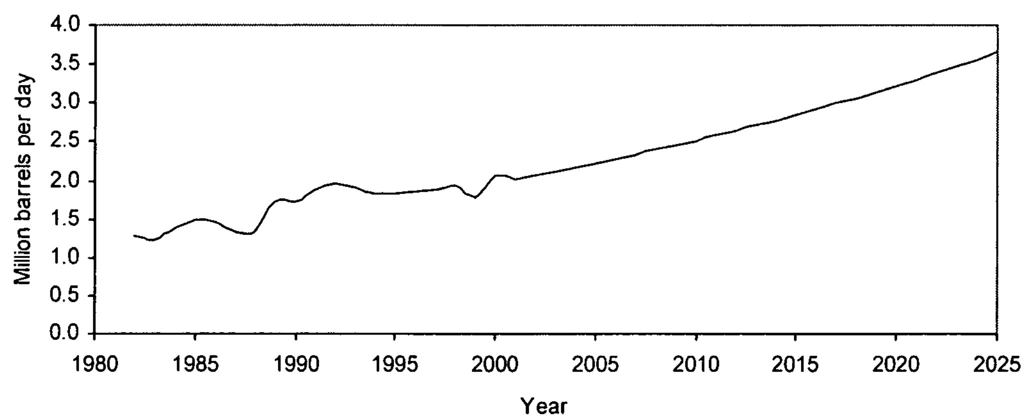
[2] *International Energy Outlook*, Energy Information Administration, Washington DC, May 2003.

[3] Ref. 1, Op cit.

projections of future oil production is based on the reference case projections of the Energy Information Administration (EIA) as published in International Energy Outlook (IEO) of 2003[2]. In its reference case, EIA projects that oil production in Nigeria will rise from 2.3 million barrels per day (mmbpd) in 2005 to reach 3.8 mmbpd by 2025, at an average rate of 2.5%/a. Figure 1 below shows historical[3] and projected estimates of crude oil production for Nigeria.

Projections for natural gas export was based on the fact that the available infrastructure for gas export in Nigeria is limited, and as such export projections were based on projected capacities of projects already on ground or proposed, and these include the LNG plant, the Oso Condensate plant, the Escravos NGL Plant, and the West African Gas Pipeline (WAGP). Projected gas production was then assumed as the total gas required to meet projected export as well as domestic needs.

Fig. 1: Historical and Projected Oil Production



3.2.2.3 Crude Oil Price Assumptions

Table 2 below shows world oil price projections from different market analysis groups. For the purposes of this report, the forecasted baseline oil price is taken as the average of the projections of the various analysts shown in the table. That is, we assume that the international oil price is will increase from an average of $21.57/bbl in 2005 to about $26.24/bbl in 2005. Base year prices of other energy carriers are also shown in Table 3. Apart from crude oil, the FOB prices of other energy carriers were assumed constant throughout the study period since projected prices are not available for these. Fuel import costs are derived by assuming a CIF/FOB ratio of 1.8.

Table 2: Comparison of World Oil Price Projections[4]

Forecast (2001 $/bbl)	2005	2010	2015	2020	2025

[4] *International Energy Outlook*, Energy Information Administration, Washington DC, May 2003.

[5] Ref. 1, Op cit.

[4] Extracted from Table 16, *International Energy Outlook*, Energy Information Administration, 2003. (www.eia.doe.gov)

IEO2003 Reference Case	23.27	23.99	24.72	25.48	26.57
Altos	22.64	23.40	25.58	27.90	31.61
GII	20.80	21.70	23.76	25.39	-
IEA	21.47	21.47	23.52	25.56	27.61
PEL	21.21	18.46	17.47	-	-
PIRA	22.43	23.33	26.32	-	-
NRCan	22.28	22.28	22.28	22.28	-
DBAB	19.04	18.94	19.34	19.07	19.18
EEA.	20.98	20.47	19.98	19.50	-
Average	**21.57**	**21.56**	**22.55**	**23.60**	**26.24**

Table 3: Year 2002 International Prices of Energy Carriers, $US\$_{2002}$

Energy Carrier	Unit Price, FOB
Crude Oil	$25.05/barrel [1]
Natural Gas, NGLs	$3.25/million BTU [2]
Coal	$40/tonne [2]
LPG	$347.5/tonne [3]
Gasoline	$28.47/barrel [4]
Diesel	$27.33/barrel [4]
Fuel Oil	$19.76/barrel [4]
Kerosene	$22.545/barrel [5]
Jet Kerosene	$0.697/USgallon [6]

[1] Forcados spot price, OPEC Annual Statistical Bulletin, 2002.
[2] Key World Energy Statistics, International Energy Agency, 2003
[3] Year 2000 international price, obtained from www.indiainfoline.com; 2002 price unavailable.
[4] Rotterdam spot price, OPEC Annual Statistical Bulletin, 2002.
[5] A distillate price ratio of 0.9 is assumed; international price not available
[6] Average of monthly averages of Rotterdam spot prices., from Weekly Petroleum Status, EIA, Jan. 2004.

3.2.3 Scenario Development

In this section we discuss the development of the baseline scenario and the Kyoto Policy scenario. Nigeria is rich in natural gas, with estimated reserves in the excess of 4.500 trillion standard cubic meters as at 2001[5]. However, most of the crude produced is in association with gas, because of the high gas-oil ratio of wells in the Niger-Delta region. Over the years, associated gas was mostly flared because of lack of adequate gas infrastructure to utilize the gas when collected. Recently the Federal Government gave a directive to downstream operators that natural gas flaring in Nigeria's oil sector should end by year 2008, and in compliance with this directive major oil companies in Nigeria have been making efforts towards the reduction of gas flaring. Although many infrastructures are now coming online to ensure utilization of the associated gas that is currently been flared, critics however believe that the target date is unrealistic under the current level of available infrastructure.

For the purposes of this study we assume for the baseline scenario that gas flaring in the oil fields indeed stops by 2008 as directed by the government. A second scenario, the Kyoto Protocol (KP) scenario is developed in which we try to simulate the effects of the Kyoto

[5] *Opec Annual Statistical Bulletin 2001*, Organization of Petroleum Exporting Countries, Vienna

protocol, mainly the effects on oil and gas production, the impact of CDM projects, and energy efficiency improvements.

3.2.3.1 The Business as Usual Scenario

The business as usual scenario (BAU) follows the *most-likely development* concept whereby all existing energy infrastructures are included in the scenario as well as on-going and firm projects. The scenario does not necessarily assume that present inefficiencies in the energy system are carried into the future; for example, in this scenario it is assumed that the present stock of oil refineries and electricity generating plants, which are currently producing well below capacity, will be refurbished and made functional. Also there is the provision for the introduction of newer technologies especially in electricity generation, oil refining and end-use sectors. Furthermore, it is assumed that, given the reforms currently going on in the electricity sector, transmission and distribution loses will be reduced to realistic limits, latest by 2020.

The baseline scenario further assumes that the oil companies comply with the Federal Government directive to eliminate gas flaring by 2008. Thus it is modeled such that gas flaring will decrease linearly from the base year down to about 5% of gross production in 2008. Appendix II gives a summary of the supply and demand technologies addressed in the reference scenario.

3.2.3.2 Kyoto Protocol (KP) Scenario

It is envisaged that implementation of the Kyoto Protocol (KP) will have three main impacts on Nigeria's energy system. Firstly, there will be inflow of investments under the framework of Clean Development Mechanism, CDM. Secondly, there is likely to be some impact on Nigeria's oil and gas exports as a result of decrease in global oil demand, and finally, KP is expected to forge the development of more energy-friendly devices worldwide, and the implication is some appreciable improvement in overall energy efficiency of energy technologies.

(a) CDM Activities

A number of possible CDM projects have already been identified in Nigeria through various studies. These include energy efficiency improvement options in the industrial sector (cogeneration, efficient motors, displacement of fuel-oil by natural gas), and increased use of renewable resources by way of decentralised electricity generation in the power sector (solar photovoltaic, micro- and mini-hydro systems), and micro turbines. In the KP scenario, each of these plants are modelled to grow from 10 Megawatts (MW) in 2005 (when we expect KP to likely come into effect), to a total of 100MW installed capacity in 2020. The choice of these CDM projects is based on ongoing discussions in the country in the past few years through various seminars and conferences. In addition, during the course of this analysis, the projects also turn out to be *win-win* options, which make them viable candidates for CDM.

(b) Developments in the Oil and Gas Industry

For Nigeria, the implication of the adoption of the KP is a decline in oil export as a result of reduced global demand for high-carbon fuels. Another implication is that increased global demand for natural gas may probably offset some revenue losses arising from decline in oil export under KP. Considering the amount of natural gas deposit available in Nigeria, the country's gas infrastructure is still underdeveloped. However, there have been substantive advances in recent years in the effort to export the most of the natural gas that is currently being flared in the oil industry. These include gas delivery to some ECOWAS (Economic Community of West African States) countries under the West African Gas Pipeline project, the Bonny liquefied natural gas (LNG) project, and a host of others. However, it is still important that Nigeria is able increase its access to the international gas market, and this can be achieved by expanding its LNG export capability through establishment of more processing plants.

In order to establish the likely trend of future oil and gas production under KP, four of the many scenarios reported by Working Group III of the IPCC were investigated[6]. Major characteristics of the scenario are as shown in Table 2, and these projections are plotted in Figures 2 and 3 for oil and gas, respectively. For this study we have adopted the worst-case scenario B1 in which world oil demand grows by an average of 0.9% per annum between 2005 and 2030, while natural gas demand increases correspondingly by an average of 3.29% per annum. Using these growth rates as our basis, crude oil and natural gas production in Nigeria under BAU and KP scenarios are as indicated in Figures 4 and 5 respectively.

Table 2: Characteristics of Oil and Gas Demand Projection Scenarios

Scenario	Characteristics
A1	• An affluent world, with rapid demographic transition and an increasing degree of international development equity • Very high productivity and economic growth in all regions, with a considerable catch-up of developing countries • Comparably high energy and materials demands, moderated by continuous structural change and diffusion of more energy efficient technologies.
A2	• Relatively slow demographic transition and relatively slow convergence in regional fertility patterns. • Relatively slow convergence in inter-regional GDP per capita differences. • Relatively slow end-use and supply side energy efficiency improvements. • Delayed development of renewable energy. • No barriers to the use of nuclear energy.
B1	• Rapid demographic transition driven by rapid social development including education. • High economic growth in all regions, with significant catch-up in the presently less-developed regions that leads to a substantial reduction in present economic disparities. • Comparatively small increase in energy demand because of dematerialisation of economic activities, saturation of material- and energy-intensive activities, and effective innovation and implementation of measures to improve energy efficiency. • Timely and effective development of non-fossil energy supply options in response to the desire for a clean local and regional environment and to the gradual depletion of conventional oil and gas supplies.
B2	• More gradual changes and less extreme developments in all respects, including

[6] *Special Report on Emission Scenarios*, Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, 2000.

geopolitics, demographics, productivity growth, technological dynamics, etc.

Fig. 2: Scenario Projections of Crude Oil Demand Under Kyoto Protocol

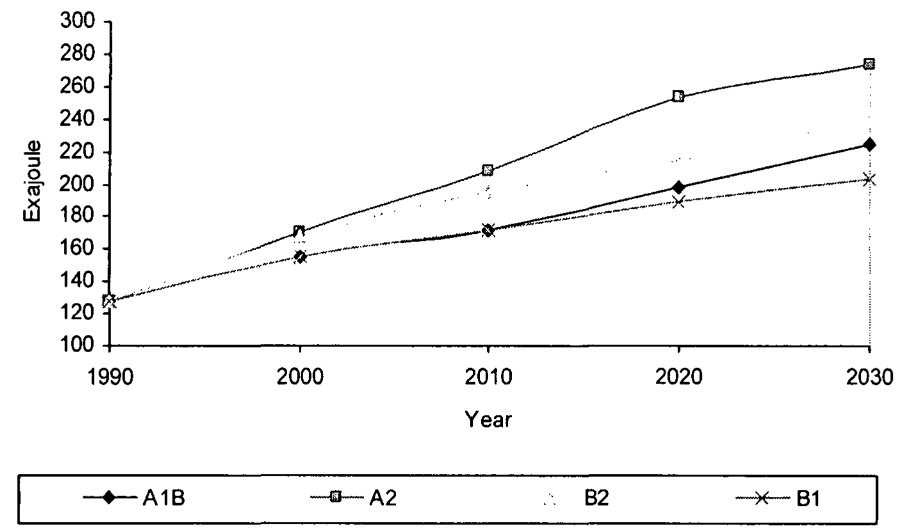


Fig. 3: Scenario Projections of Natural Gas Demand Under Kyoto Protocol

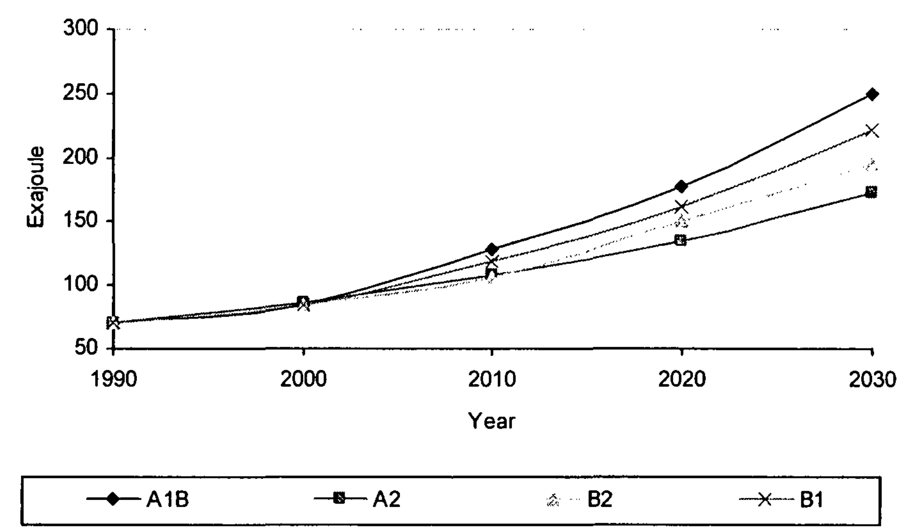


Fig. 4: Projected Crude Oil Production in Nigeria under BAU and KP Scenarios

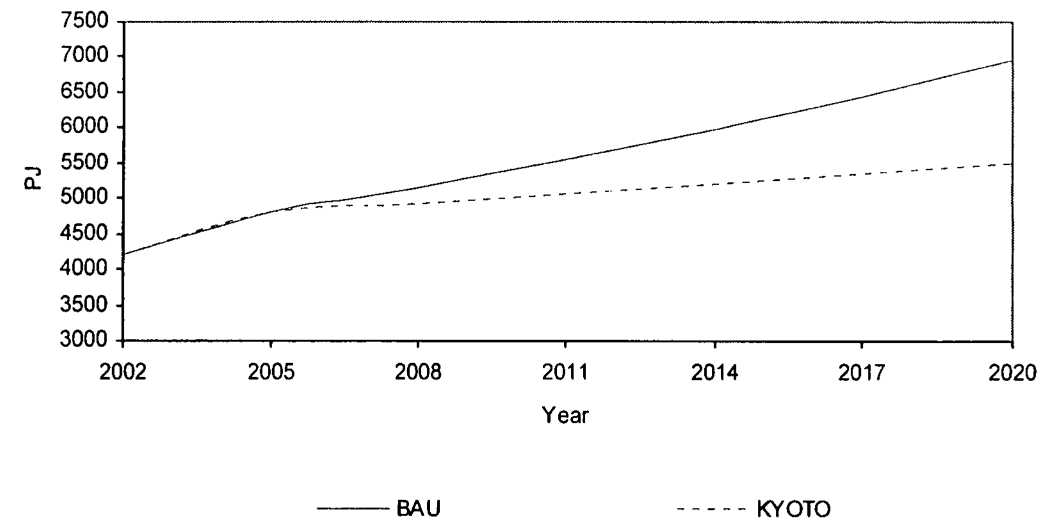
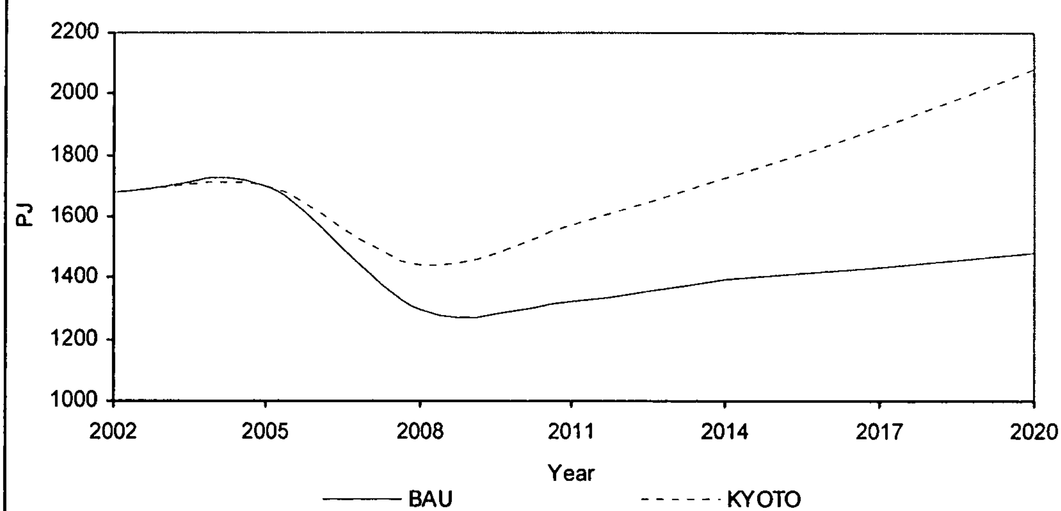


Fig. 5: Projected Natural Gas Production in Nigeria under BAU and KP Scenarios



(c) Energy Efficiency Improvement

We have assumed in this study that when KP comes into effect, there will be a general improvement in the efficiency of energy technologies utilized in several sectors of the country's economy. It is expected that such autonomous energy efficiency improvement (AEEI) could increase by 20% after 2005, by which time we estimate KP would have come into effect. Thus in this study we adopt an increase of AEEI from the baseline value of 1%/year to 1.2%/year across-board for all end-use technologies under KP.

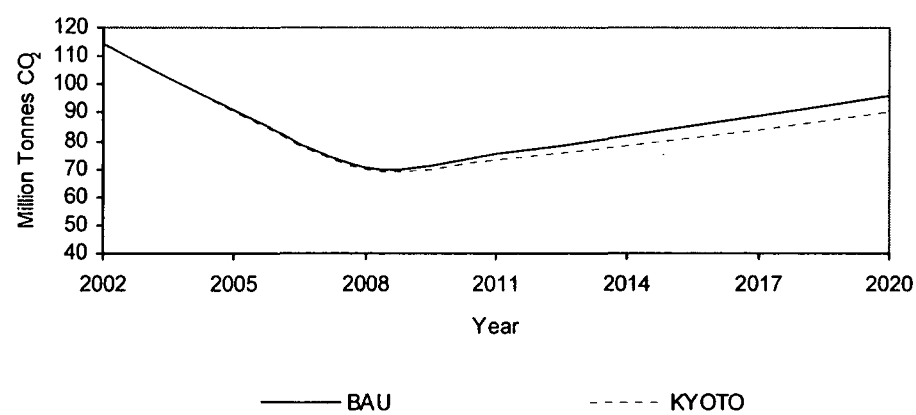
3.2.4 Results and Conclusions

In this section, we present the results of our analysis of the Nigerian energy sector. In the following sections, we present discussions of the outcome of the analysis especially the likely impacts of the Kyoto Protocol on major scenario indicators such as CO_2 emissions, primary energy consumption and its intensity, and some economic indicators.

3.2.4.1 CO_2 Emissions

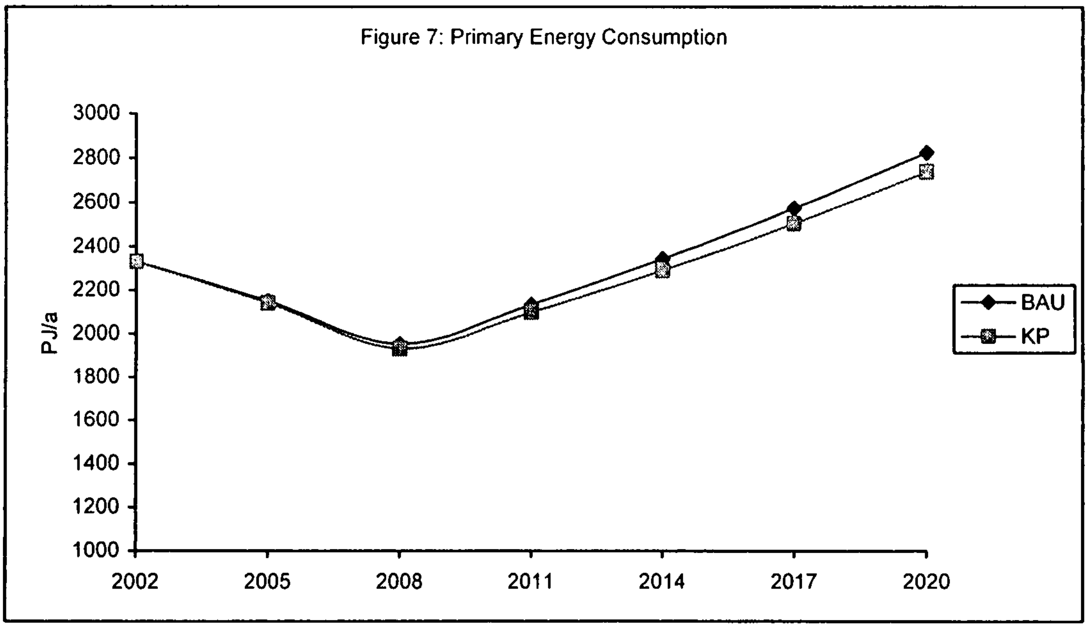
The trends of CO2 emissions are shown in Figure 6 for the period 2002 to 2020. Total CO_2 emissions from the energy sector amounted to 114 million tonnes in 2002. From the figure we observe an initial steep decline in CO_2 emission between 2002 and 2008. This is due to the Government directive that natural gas flaring in Nigeria's oil fields should end in 2008. Thereafter, the CO_2 trace increases at an average rate of 2.55%/a under the baseline scenario. We also observe a reduction from baseline emissions under the KP scenario. The reduction can be attributed mainly to the contributions of CDM Projects and energy efficiency improvements in end-use sector. The cumulative reduction from baseline is of the order of 55 million tonnes between 2005 and 2020.

Fig. 6: CO_2 Emission Profiles Under Baseline Kyoto Protocol Scenarios



3.2.4.2 Total Primary Energy Requirement

Total primary energy requirement (TPER) in Nigeria stood at 2332 PJ in 2002, and increases to 2825 PJ in 2020 under the BAU case (Figure 7). The estimated TPER is based on the total amount of natural gas, coal, fuel wood, crude oil, and renewable hydro consumed within the economy, but excludes all of the gas either exported as natural gas or natural gas liquids. In addition, TPER as estimated here includes the natural gas that will continue to be flared in reduced quantities up till 2008, and TPER increases thereafter at the rate of 3% per annum in the baseline scenario. We observe a noticeable decrease in TPER under the KP scenario, also due to the effects of energy efficiency improvements and CDM activities.



3.2.4.3 Primary Energy Intensity

The primary energy intensity measured in terms of primary energy consumption per GDP is usually interpreted as the energy required to sustain the projected economic and social development. In Figure 8 we observe that under both scenarios, the primary energy intensity decreases over time, an indication that the GDP will be growing faster than primary energy consumption.

3.2.4.4 Cost structure

The total system cost in MARKAL comprises of three components. These are capital costs (i.e. costs of investment in supply and demand technologies), the net expenditure on fuel, and other expenditures, such as operating and maintenance costs, fuel delivery costs, etc. Capital investment is probably the most important contributor to the total energy cost, and as a result could be a major indicator of the effects of KP on the Nigerian energy sector. The effects of KP on capital investment on energy infrastructure, expenditure on fuel consumed within the economy, and other associated costs are shown in Table 4. From the table we notice that, over the study horizon, capital costs decrease by about 25% under the Kyoto Protocol, that is if we do not consider the costs of those energy infrastructures solely designed to service the export market (e.g the West African Gas Pipeline, LNG and other NGL plants, etc.) . As expected, there is a slight decrease of about 4.21% in fuel costs as a result of increased use of renewable technologies and improvements in energy efficiency under the Kyoto Protocol. Furthermore, analyses show that over the study period, earnings from oil exports could decline by 11.67% under KP, while on the other hand revenue from increased gas export could go up by 37.72%. In totality, however, the combined revenue earnings from oil and gas exports will only decrease marginally by about 7%.

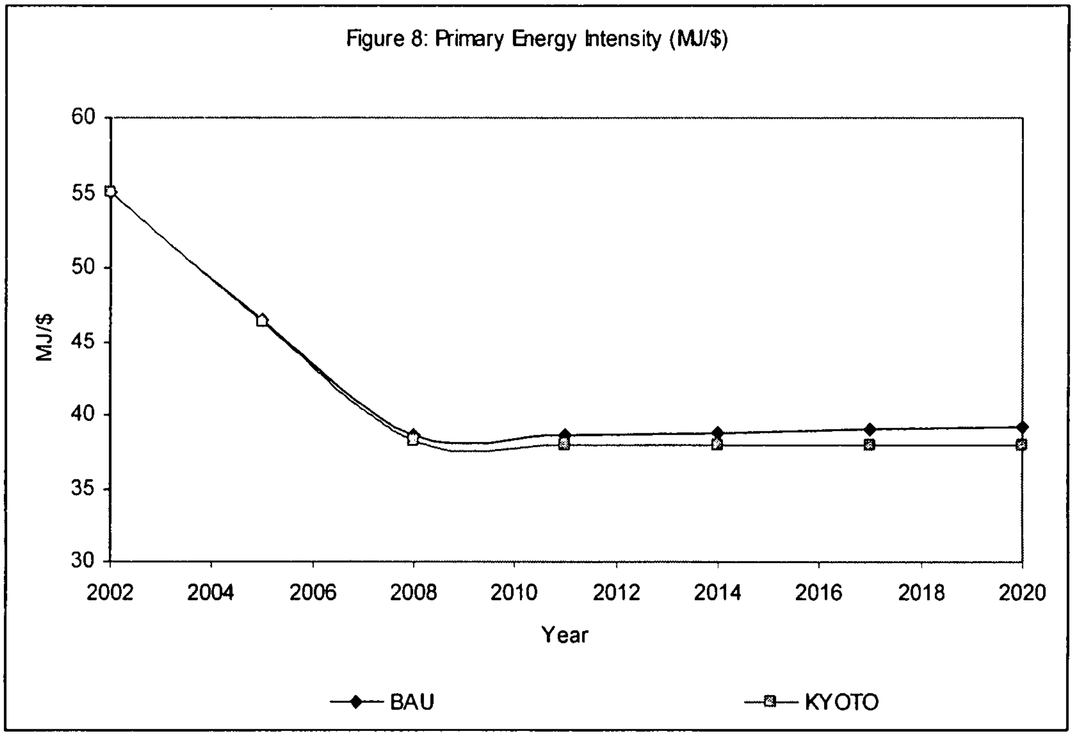


Table 4: Economic Indicators

Investment	KP Scenario (% Change from Baseline, 2002-2020)
Discounted Capital Cost, all energy infrastructures.	9.76%
Discounted Capital Cost, excluding cost of projects designed for energy export (e.g. West African Gas Pipeline, LNG and other NGL plants)	-24.63%
Discounted fuel cost	-4.21%
Discounted other expenditure	0.81%
Discounted total energy system cost	1.54%
Discounted energy system cost, excluding cost of projects designed for energy export (e.g. West African Gas Pipeline, LNG and other NGL plants)	-6.04%
Revenue from Oil Export	-11.67%
Revenue from Gas Export	37.72%
Combined revenue from Oil and Gas	-6.97%

3.2.4.5 Some Salient Conclusions

In this report we have investigated the effects of the Kyoto Protocol on Nigeria's energy sector. The effects on key parameters have been estimated. We have been able to show that if Kyoto Protocol comes into effect, a total of about 55 million tonnes of CO_2 emissions could be avoided between 1995 and 2020, mainly through CDM activities and energy efficiency improvements. During this same period we notice under the protocol that capital investments in the energy sector could go up by about 9.76% as a result of programs to boost natural gas export in response to the decline in crude oil revenues. On the overall, based on the assumed future trends in oil and gas production in Nigeria, revenue yield from the oil and gas sector could decrease by about 7% between 2005 and 2020 mainly fuelled by decreasing export of crude oil.

3.3 Macroeconomic Impact Analysis

3.3.1 Introduction

The implementation of the Kyoto Protocol agreement will have significant impact on the Nigerian economy. Such impacts will be both direct and indirect. The computable general equilibrium (CGE) model provides an appropriate framework for evaluating the overall macroeconomic impact of the agreement on the Nigerian economy.

CGE models represent attempts to provide numerical values to the Walrasian general equilibrium theory. It provides a holistic approach to the analysis of the economy. It sees the economy as an integrated process such that policy shocks in one market has implications for the rest of the markets in the economy. It is also best suited for a mixed-market economy like Nigeria. The features of CGE model include it allows for the endogeniety of price determination process, it captures both the efficiency and the income distributional effects of policy shocks, and it focuses on the real sectors of the economy and thus useful for resource allocation decisions. The CGE model serves as a laboratory for evaluating impact of alternative policy scenarios.

Thus, CGE model, which we have adopted to capture the macroeconomic impact of the Kyoto Protocol on the Nigerian economy, represents the most appropriate tool for such analysis.

3.3.2 Overview of the Model structure and Equation

The specification of a CGE model is based on the two fundamental principles of economics: optimization and equilibrium. Thus the system of equations forming the model describes the behavior of various economic agents, the constraints they face, and the equilibrium conditions in various markets. The equations for the CGE model follow closely the structure of the social accounting matrix (SAM). The system of equations of the model is typically divided into four blocks:

The price block essentially describes the structure of incentives facing the private sector. The government uses a combination of domestic and foreign taxes to form a wedge between domestic prices and international prices and between production costs and market prices.

In the supply block, sectoral production plans are guided by profit maximization. Sectoral production has a nested structure. At one level, output is a linear function of value added and intermediate inputs. Intermediate inputs are also a linear combination of domestic inputs and non-competitive imported inputs. At another level, value added is a CES function of capital and labor.

The demand block distinguishes intermediate demand from final demand. The final demand is composed of demand by the private sector, government, investment consumption and rest of the world (ROW). We also made a distinction between imported final goods and those that are domestically produced. Both types of goods are aggregated into composite goods using the Armington principle of imperfect substitution between locally produced goods and their imported counterparts. Similarly, exports and domestic goods supplied to the local markets are aggregated into total domestic output using the Armington principle of imperfect substitution between the two classes of goods. The implication of this is that the demand for a composite commodity depends on elasticity parameter and the relative prices.

The last block represents various equilibrium conditions and constraints. These include employment conditions in factor and goods markets. Capital is assumed to be sectorally immobile. Other material balances include the government budget and trade deficit constraints and also the savings-investment balance. The implicit excess demand functions are homogenous of degree zero in all prices. Therefore, only relative prices matter in the model.

3.3.3 Additional Features of the Model

In the model to capture the increasing importance of gas in both the domestic market and export market through the Nigerian Liquefied Natural Gas (NLNG) Company, we place a very important premium on the representation of the gas sector in the model.

Crude oil output is treated as exogenous to reflect Nigeria's OPEC membership. However, given the liberalization of the downstream sector, domestic crude oil price is treated as endogenous in the model.

Both comparative static and dynamic components of the model will be estimated. Although, the dynamic component of CGE models remain contentious, nevertheless, given the issues we are addressing in this study, we need to evaluate the time path of the adjustment process. The dynamic approach to be used in the model is based on the recursive process. This is based on periodic adjustment of both the capital stock and inventories and the labor supply. We also assume a periodic growth rate (2-3%) for crude oil supply.

3.3.4 Database for the CGE Model

At the center of a CGE model is the Social Accounting Matrix (SAM). The SAM provides a snapshot of an economy in a year. It captures the feedback relationship between production and income. A SAM is a square matrix divided into sub matrices or accounts. Although most SAMs have the same basic structure, the treatment of individual accounts, particularly in terms of level of aggregation, varies between studies. The structure of a SAM is however dependent on the nature of the study at hand. The SAM is a data intensive table, although the data is only needed for a single year, which is the base year chosen for the study. A balanced SAM is a necessity for a CGE model. The key accounts in the SAM include Production account, Income account, Factor account, Institutions account, and Savings – investment account

The social accounting matrix developed for this model is predicated on the year 2000 input-output table, jointly developed by the Federal Office of Statistics (FOS) and the Nigerian Institute of Social and Economic Research (NISER). The FOS-NISER table contains 30 production sectors. However, this was reaggregated into 9 production sectors, viz:

- Agriculture
- Crude Oil
- Natural Gas
- Manufacturing
- Petroleum Products
- Electricity
- Building and Construction
- Transport
- Services

Two primary factors of production made up of capital and labor are identified in the SAM. Four institutions are distinguished: households, firms, government and the foreign sector. The key linkage of the CGE modeling will be the updating of the existing Nigerian I-O Table with energy information on the base year extracted from the MARKAL runs and converted to monetary units using appropriate prices. For each of the policy scenario, the base I-O Table will be so updated before the CGE simulation is carried out.

Data from the input-output table would be supplemented by other sources such as energy table balance, national accounts, and other publications by the FOS, Central Bank of Nigeria (CBN), Nigerian National Petroleum Corporation (NNPC), etc.

Table 21 in the appendix provides an example of an aggregated SAM for Nigeria for 2000. This SAM with the underlying updated input-output table will provide the database for the CGE, which is being developed for the model.

3.3.5 Simulation

CGE model simulations involve changing the exogenous parameters corresponding to the policy being evaluated, and then comparing the results with the reference case to determine the changes. For the purpose of the present study, a number of policy scenarios were simulated to capture the impact of Kyoto protocol on the Nigerian economy. These scenarios, which have been developed for the optimization of the energy system, include:

- Business as Usual---the so called baseline scenario

- Kyoto Protocol Scenarios

The business as usual scenario represents the status quo situation. It can be correctly concluded that this scenario represents what will happen if the protocol comes into force and Nigeria fails to join the ratification train or what may happen, if the protocol fails to come into force. Although the argument can be presented that current knowledge of global changes suggest that we do things differently in the future, and that even if the Kyoto Protocol does not come into force, this need will translate to the introduction of more efficient energy systems. However, given the scarcity of capital that will be needed to implement energy efficiency improvement options in developing countries such as Nigeria, a change from the status quo may not be catalyzed if the Protocol is not legally in place.

The Kyoto Protocol scenario deals with what will happen when the Protocol becomes binding. When this happens, we have assumed that the following will occur: there will be a gradual improvement in the efficiency of end-use energy equipment across sectors; The global reduction in the use of high carbon fuels, will also impact the demand for crude oil and natural gas. At the one extreme is the fear of many OPEC members that the immediate consequence of the implementation of the Kyoto protocol will be a fall in demand for crude oil as energy importers shift to more environmentally friendly energy products. There is also the optimistic view that a reduction in crude oil demand will not happen within the next few decades. Furthermore, an increase in the utilization of natural gas, driven by the fact that its relatively lower carbon compared to the other fossil fuels will result in lower greenhouse gas (GHG) emissions, should be seen in these next decades.

Clean Development Mechanism (CDM) is one of the flexible mechanisms of the Kyoto Protocol that is expected to enable developing countries like Nigeria, to participate in the global efforts to reduce emissions of GHGs. Within the Kyoto Protocol scenario, we have also considered the impact that CDM will have on the Nigerian economy. Not only will CDM projects lead to the introduction of energy efficient facilities in the Nigerian energy system, it will also be a veritable source of the needed foreign direct investment for the modernization and capacity expansion of the system.

The impact of the considerations described above on varied macroeconomic and sectoral indicators such as real GDP, investment, exports, imports, private and public consumption, average price level, sectoral prices, output and employment, among others was the focus of the CGEM simulations carried out as part of this study. The CGE equations as utilized in this study are presented in Appendix C. The starting point was the development of a consistent database to run the CGEM for some of the policy scenarios for which the energy system has already been optimized. Our analysis in this section takes its input from the MARKAL output. The question we answer in this section is what are the macroeconomic and sectoral consequences of the simulations considered using the MARKAL under both the BAU and Kyoto. We present both the comparative static analysis for each of the simulations and also a dynamic simulation. The various simulations that we consider in this section are as follows:

Case 1: 1.54 per cent increase in Discounted Total Energy System Cost

Case 2: 11.67 per cent decline in Revenue from Crude oil Export

Case 3: 37.72 per cent increase in Revenue from Gas Export

Case 4: 6.97 per cent decline in Combined Revenue from Oil and Gas

Case 5: 20 per cent Energy Efficiency

Case 6: 9.76 per cent Increase in Foreign Direct Investment from Kyoto Activities.

The above scenarios are the outcome of the experiments performed using the MARKAL. Details on how these results were generated have been discussed in the previous sections. The computable general equilibrium (CGE) model was applied in order to derive the economy-wide economic impact of the MARKAL results. In the next section we discuss first the comparative static results and then later on we examine the results of the dynamic simulations.

3.3.5.1 Comparative Static Analysis

Each of the reported results should be interpreted as a change over the base case. It is obvious from Table 5, that the increase in energy system costs as a result of Kyoto has a contraction impact on real GDP. The economy-wide GDP contracted by about – 0.35 per cent. The contraction in GDP led to a decline in private income and private consumption expenditure. Other macroeconomic variables that declined include government revenue, government savings, national savings and imports of final goods. The aggregate price index also rose by 0.40 per cent leading to a fall in private consumption expenditures. Domestic investment however rose, financed mainly from increase in foreign savings that rose by over 1.38 per cent. Both cases 2 and 4 also led to a significant decline in real GDP. As we have demonstrated in the previous section, an outcome of the implementation of the Kyoto protocol is the expected decline in crude oil exports. Presently crude oil is the main source of government revenue and foreign exchange earner to the economy. As we have argued elsewhere, the oil sector defines the growth contour of the economy in the past three decades or so (Adenikinju, 2003). Thus, changes in the oil sector have important implications for the Nigerian economy. Case 2 shows the consequences of an 11.67 per cent decline in oil export earnings. Overall real GDP declined by –6.03 per cent. Private income, government revenue, and government savings also declined. The aggregate price level rose marginally by 0.67 per cent. Overall exports also fell by –9.07 per cent. Similarly, the decline in domestic capacity to imports led to a fall in total imports by –14.57 per cent. The negative consequences of a decline in oil export earnings were also felt on foreign and national savings

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In case 3, the shift to cleaner energy and the pressure to mitigate the loss in crude oil exports is expected to lead to increase in gas exports and revenue. The MARKAL results show that the Kyoto will lead to an increase of 37.72 per cent in revenue from gas exports. This increase in gas export revenues is expected to lead to an increase of 1.08 per cent in GDP. Overall exports revenue also rose by 0.89 per cent. Government revenue and government savings rose by 1.11 and 1.58 per cent. Overall price level however declined by 1.00 per cent.

Table 5: Percentage Change in Macroeconomic Variables

A. Tariffs and Trade Prices	**Case 1**	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**
Price Index	0.40	0.67	-1.00	-0.67	-4.11	-1.00
Direct Income Tax	-0.35	-6.09	1.06	-5.08	0.73	0.72
Duty on Imported Intermediate Input	-0.43	-4.05	1.13	-3.29	1.07	1.10
Indirect Business Tax	-0.37	-4.07	1.43	-3.33	1.60	1.71
B. Private Transactions						
Private Income	-0.35	-6.09	1.06	-5.08	0.73	0.72
Private Consumption Expenditure	-2.83	-9.10	1.26	-8.08	2.84	1.97

C. Government Transactions						
Government Revenue	-0.35	-5.65	1.11	-4.70	0.87	0.88
Government Savings	-0.50	-8.03	1.58	-6.67	1.23	1.25
D. Output and Trade Variables						
Exports	0.31	-9.07	0.89	-8.17	0.00	0.00
Total Imports	-1.49	-14.57	-6.19	-14.20	-6.26	-6.30
Foreign Savings	1.38	-0.20	-12.44	-1.93	-10.25	10.32
National Savings	-3.53	-18.91	-18.89	-18.91	-15.03	-15.18
Investments	0.31	0.00	0.00	0.00	4.78	4.59
Gross Domestic Product	-0.35	-6.03	1.08	-5.02	3.43	0.76

Source: Simulated

In addition, it has a positive impact on import duties, direct and indirect taxes. Case 4 shows that the net impact of the fall in crude oil export revenue and the rise in natural gas exports revenue consequent on the implementation of the Kyoto is expected to lead to a contraction in real GDP by about –5.02 per cent. This is because the fall in oil revenue is not fully compensated for by the rise in gas exports earnings. This can be seen from Table 5 which shows that total exports actually decline by –8.17 per cent. Total imports also decelerated by –14.20 per cent. In fact, nearly all the macroeconomic variables recorded negative growth from the base year under this scenario.

Case 5 involves an assumption of 20% increase in energy efficiency. What is obvious from Table 5 is that this particular scenario has the highest positive impact on the economy. The rise in energy efficiency leads to a 3.43 per cent rise in real GDP. Economy-wide price index also falls by -4.11per cent. Household incomes rose and government savings also improved significantly. In addition, the increase in national savings, which is largely from domestic sources caused domestic investment to rise by nearly 4.78 per cent. The final scenario takes on board the expectation that the implementation of the Kyoto protocol will result in additional inflow of foreign direct investment through the establishment of CDM projects and also through the possibility of emissions trading. The implied emission reduction from the implementation of the Kyoto vis-à-vis the BAU case was monetized under this simulation. This results in an increase of about 9.76 per cent in Foreign Direct Investment (FDI) inflow. The outcome of this is presented in the last column of Table 5. From the table, we observed that real GDP rose by 0.76 per cent. The rise in GDP was fuelled by the increase in aggregate domestic investment, and by increases in government revenue and private income.

Table 6 and 7 further show the sectoral impacts of the scenarios considered above. The fact is that the response of each sector to the different scenarios will depend on among other factors, the share of energy in each sector's input structure as well as the implied electricity of substitution. Table 6 shows sectoral changes in output from the different scenarios while Table 7 shows the changes in sectoral final demand. The results in Table 6 follow closely the trends observed for the macroeconomic variables. The rise in total energy system costs (Case 1) has a negative impact on the output of all the sectors. The petroleum refining, services, electricity and manufacturing sectors in that order, were the worst affected. Case 2 also shows that the crude oil, petroleum refining, services and transport sectors suffered the greatest reduction in their output due to the decline in crude oil export earnings. Under Case 3, all the sectors recorded positive growth in output, with LNG/Gas sector understandably having the highest output performance. In Case 4, all sectors with the exception of LNG/Gas experienced decline in output. This is because of the domineering impact of the fall in crude oil export earnings. Case 5 is however quite interesting. While nearly all the sectors have positive growths in their outputs, two sectors, viz., petroleum refining and electricity recorded negative output growth arising from more efficient energy utilization by consumers. Under Case 6, output rose in all the sectors with the exceptions of electricity and transport sector. The highest output growth was recorded in services, petroleum and manufacturing sectors.

Table 6: Percentage in Sectoral Output

Sector	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Agriculture	-0.39	-3.68	0.71	-3.06	2.96	0.53
Crude Oil	-0.24	-10.01	0.15	-9.60	3.47	0.01
LNG/Gas	-0.43	-4.03	8.54	4.48	4.37	0.48
Petroleum	-0.71	-5.72	0.95	-4.77	-13.90	0.71
Manufacturing	-0.46	-4.16	0.99	-3.41	6.23	0.84
Electricity	-0.93	-7.65	-1.21	-6.84	-30.18	-1.21
Building and Construction	-0.34	-2.54	0.49	-2.15	6.53	0.62
Transport	-2.35	-14.08	-9.09	-13.48	0.17	-8.01
Services	0.01	-2.06	3.49	-1.29	3.93	4.61
All	-0.35	-6.02	1.08	-5.02	3.43	0.76

Source: Simulated

Table 7 reports on the changes in sectoral final demand as a result of the various scenarios above. What is obvious from the table is that expectedly there is a very close semblance between the changes observed in Table 6 and Table 7. Perhaps, the only exception is Case 5 where the increase in imports dominated domestic absorption leading to a decline in final demand for some sectors in particular agriculture, crude oil, manufacturing, services and transport sectors. In respect of case 6 changes in final demand also follow the same trend as observed under sectoral output (Table 6).

Table 7: Percentage in Sectoral Final Demand

Sector	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Agriculture	-0.54	-3.67	0.64	-3.06	-0.38	0.44
Crude Oil	13.53	-10.25	0.25	-10.01	-0.12	0.17
LNG/Gas	3.83	-4.04	8.54	4.48	0.01	0.48
Petroleum	19.43	-7.18	1.23	-5.99	-0.61	0.84
Manufacturing	12.87	-4.26	0.75	-3.55	-1.13	0.48
Electricity	3.82	-10.54	-4.19	-9.77	-19.38	-4.50
Building and Construction	-7.64	-0.72	0.10	-0.58	5.98	0.07
Transport	-4.06	-21.67	-17.65	-21.10	-0.78	-15.97
Services	2.08	-1.47	4.12	-0.68	-0.68	5.46
All	5.73	-6.88	0.87	-6.01	-0.34	0.60

Source: **Simulated**

3.3.5.2 Dynamic Simulation

The dynamic approach used in the model is based on the recursive process. This is based on periodic adjustment of both the capital stock and inventories and the labor supply. The purpose of the dynamic simulations is to examine the inter-temporal implications of the various scenarios on key macroeconomic variables in the economy. The simulations are the net effect of each scenario on the BAU (reference case). Tables 8, 9 and 10 provide indications about the average sectoral output, final demand and macroeconomic performance for the period 2005 – 2020. Focusing on the performance of real GDP, case 1 recorded the greatest decline in economic performance followed by case 2 and 4. The highest positive impact however comes from increase in efficiency (Case 5) with 4.79 per cent. This is followed by FDI inflow (Case 6) and increase in revenue from gas export (Case 3) with 0.38 and 3.58 per cent respectively (Tables 8 and 10).

Table 8: Dynamic Simulations: Average Sectoral Output [Percentage change over the reference scenario – 2000 – 2020]

Sector	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Agriculture	-0.19	-1.11	0.25	-0.97	1.69	0.92
Crude Oil	-0.39	-4.03	-0.15	-3.94	4.74	0.36
LNG/Gas	-0.26	-1.13	2.35	1.20	5.14	30.40
Petroleum	-0.53	-1.89	0.24	-1.65	-9.07	1.31
Manufacturing	-0.10	-1.20	0.45	-1.02	7.63	8.42
Electricity	-2.28	-3.86	-1.71	-3.69	-30.85	0.07
Building & Construction	1.35	1.09	1.67	1.14	6.00	4.95
Transport	-9.89	-10.89	-9.47	-10.78	8.53	-2.19
Services	2.35	1.33	2.90	1.49	9.20	6.13
All	-2.15	-2.04	0.36	-1.80	4.79	3.58

Sectoral analysis as presented in Table 8 shows that energy efficiency (case 5) has the highest impact on the service sector with 9.20 per cent, followed by transport sector with 8.53 per cent. Others with positive and significant impacts are manufacturing, building and construction, LNG/Gas, crude oil and agriculture. In terms of positive and significant impacts of FDI (Case 6) and increase in revenue from gas export (Case 3), the LNG/gas and services are leading with 30.40 and 2.90 per cent respectively.

Table 9: Dynamic Simulations: Average Sectoral Final Demand [Percentage change over the reference scenario – 2000 – 2020]

Sector	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Agriculture	-0.24	-1.14	0.19	-1.01	1.92	0.72
Crude Oil	-0.09	-3.99	0.08	-3.95	0.11	0.30
LNG/Gas	-0.26	-1.13	2.34	1.20	1.92	0.10
Petroleum	-0.63	-2.31	0.36	-2.03	-0.98	1.45
Manufacturing	-0.34	-1.40	0.23	-1.23	-0.59	0.90
Electricity	-5.58	-7.05	-4.86	-6.85	2.64	-3.98
Building & Construction	2.77	3.34	2.92	3.30	6.22	2.41
Transport	-18.49	-19.05	-18.10	-18.95	1.48	-6.07
Services	2.95	1.97	3.51	2.13	3.43	6.27
All	-2.56	-2.47	0.25	-2.26	1.15	1.13

Source: Simulated.

Also, Table 5 shows that energy efficiency (case 5) has the highest positive impacts on final demand with 1.15 per cent, followed by FDI and increase in revenue from gas exports (case 3) with 1.13 and 0.25 per cent respectively. Sectoral break down shows that the energy efficiency (case5) has the highest positive impacts on building and construction with 6.22 per cent, followed by (in order of their magnitudes) services, electricity, LNG/Gas, agriculture and transport sectors. However, negative impacts of increase in energy system cost (case 1), decline in revenue from crude oil export (case 2) and increase in combine revenue from oil and gas (case 4) are recorded in sectoral final out with –2.56, -2.47 and –2.26 per cent respectively. The greatest negative impacts of these cases are felt on transport sector, followed by electricity, crude oil and agriculture.

Table 10: Dynamic Simulations: Average Macroeconomic Performance [Percentage change over the reference scenario – 2000 – 2020]

A. Tariffs and Trade Prices	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Price Index	2.70	2.50	-0.67	2.56	-2.30	-0.94
Direct Income Tax	-0.17	-2.08	0.34	-1.84	0.85	1.35
Indirect Business Tax	0.35	-0.82	0.90	-0.65	-0.52	2.42
B. Private Transactions						
Private Income	-0.17	-2.08	0.34	-1.84	0.85	1.35
Private Consumption Expenditure	-9.88	-11.54	-9.39	-11.32	-8.94	-8.54
C. Government Transactions						
Government Revenue	-0.08	-1.83	0.43	-1.60	0.71	1.51
Government Savings	-0.12	-2.60	5.58	-2.28	1.01	2.14
D. Output and Trade Variables						

Exports	0.29	-3.63	0.25	-3.39	3.91	0.00
Total Imports	-19.61	-9.64	-6.46	-9.56	6.20	-5.99
Foreign Savings	-10.08	-6.30	-11.19	-6.79	1.02	-9.77
National Savings	42.92	42.50	42.64	42.64	72.14	50.93
Investments	36.28	36.02	36.02	36.02	64.23	43.94
Gross Domestic Product	-2.15	-2.04	0.36	-1.80	4.79	3.58

Source: Simulated

Trends in selected macroeconomic variables over the simulated years are shown in Figures 9 – 12. Figure 9 shows the trends in GDP in the various scenarios over the reference case. In line with the result obtained under the comparative static analysis, the decline in real GDP was highest under the increase in energy cost (case 1).

3.3.5.3 Summary Conclusions on the Macroeconomic Simulations

There is evidence from the CGE simulations that various consequences of the implementation of the Kyoto Protocol would have significant macroeconomic implications in Nigeria. In order to allow for proper integration across the models some of our critical inputs were taken from the output of MARKAL based on the various simulations in respect of Kyoto Protocol. Hence the CGE results brought out the economic implications of the MARKAL output.

Expectedly there is a close link in both the static and dynamic simulations. What is obvious from the table is that the Kyoto protocol has an admixture of positive and negative impacts on the growth process of the Nigerian economy. On the positive side are the expected rise in gas export earnings, energy efficiency and rise in FDI inflows. However, on the negative side are the possible rise in energy system costs and the fall in crude oil export earnings. It therefore implies that the country will need a well thought out policy framework to: (i) to mitigate the negative effects of the protocol, and (ii) to be able to fully harness the benefits from the positive impact. The ability to do this would influence to a great extent the net impact of these changes on the Nigerian economy in the near future.

Figure 9: Dynamic Simulation: Trend in GDP

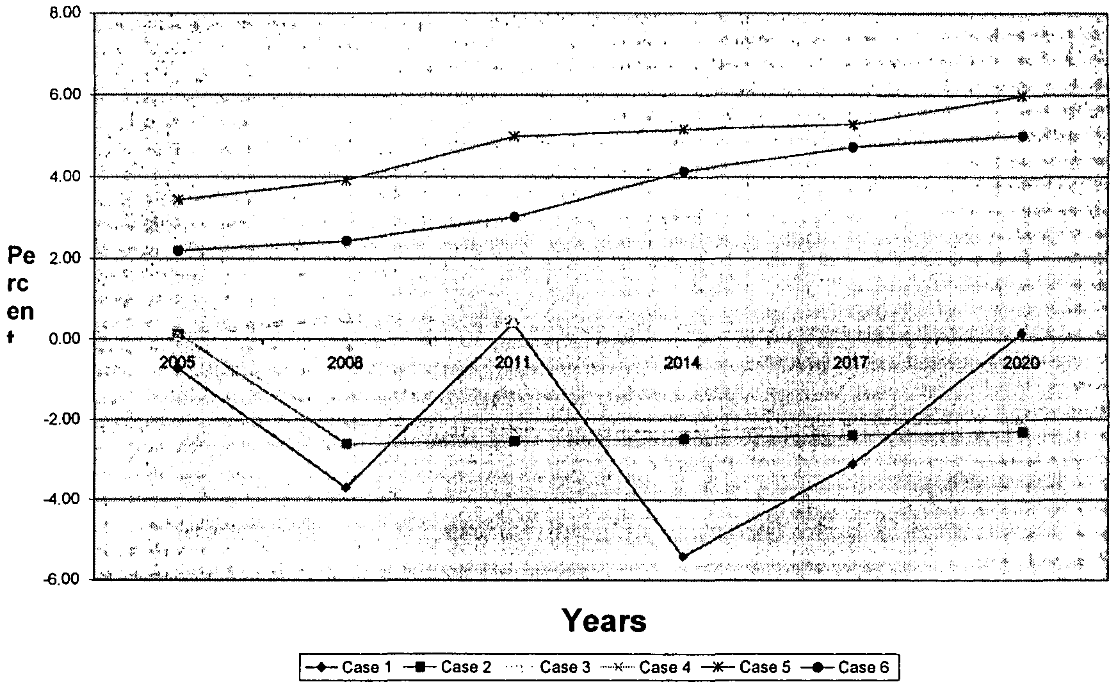


Figure 10: Dynamic Simulation: Trend in National Savings

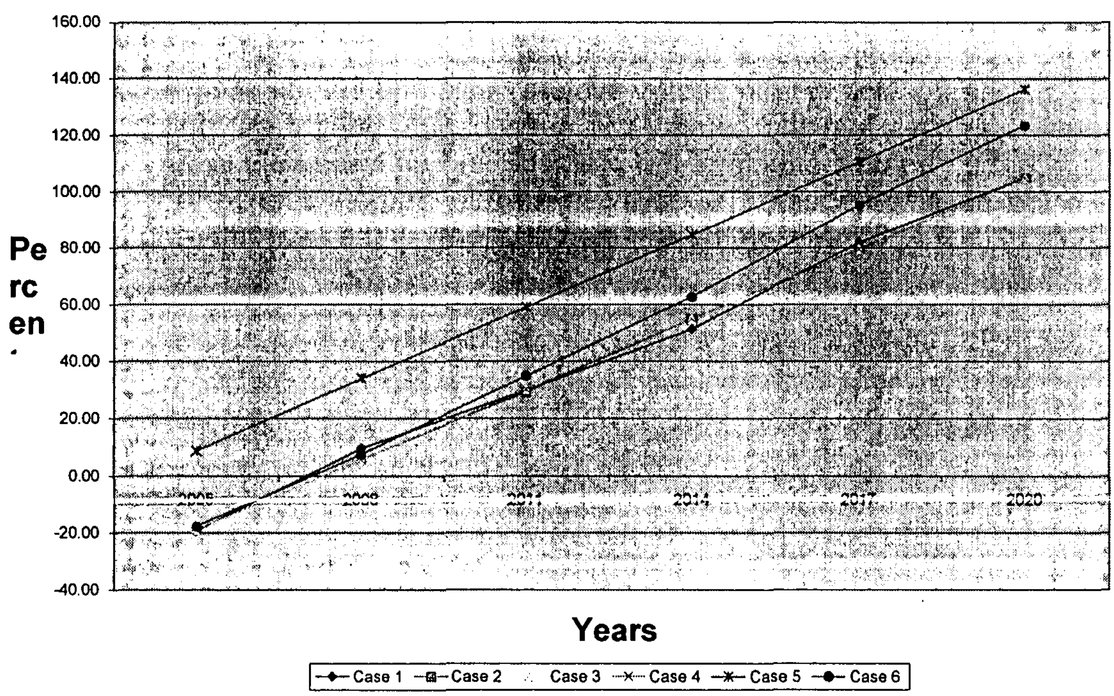


Figure 11: Dynamic Simulation:Trend in

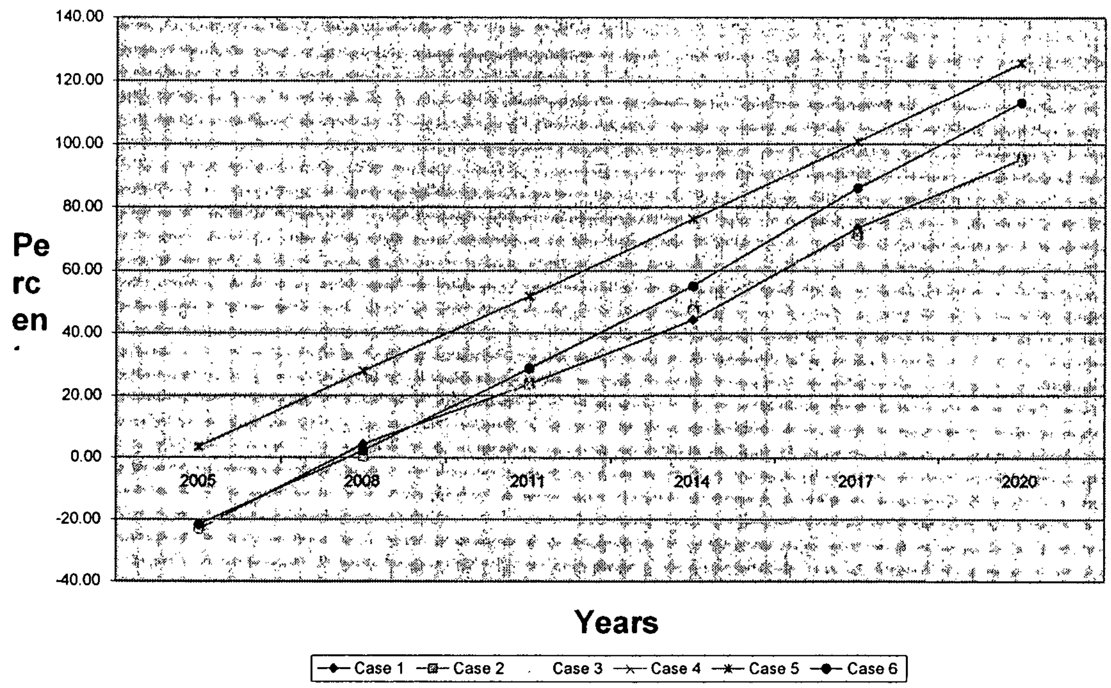
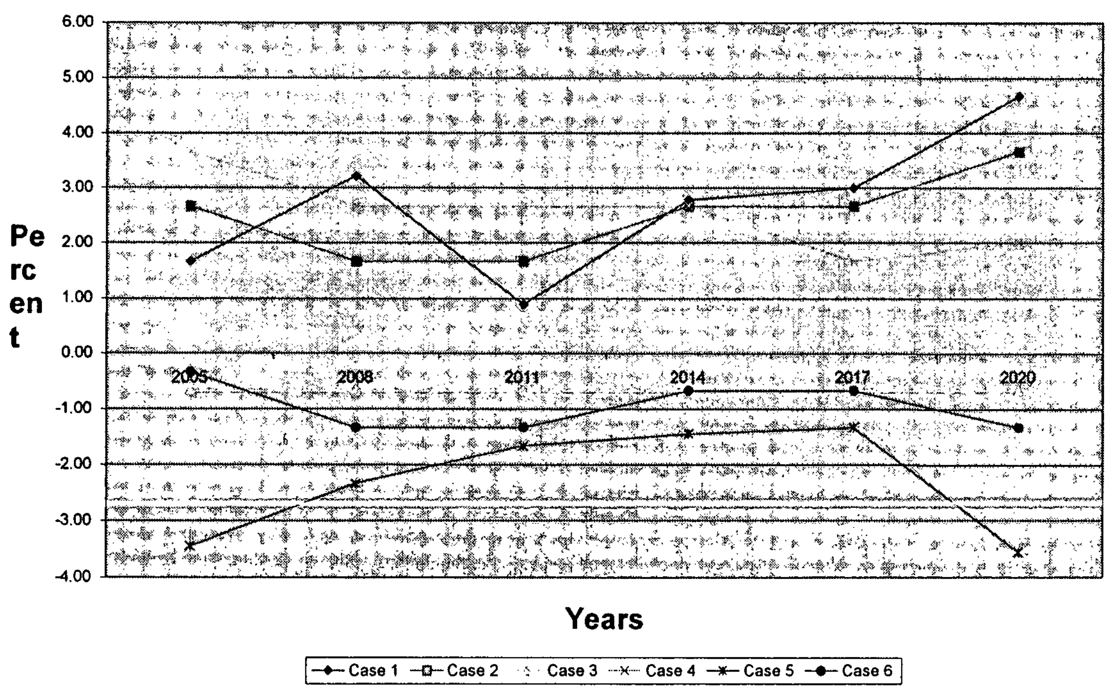


Figure 12: Dynamic Simulation: Trend in Price



4. Conclusions and Recommendations

The first conclusion that can be derived from the result of this study is that the Kyoto Protocol when it comes into force will lead to a reduction in emission of greenhouse gases from the Nigerian economy. This will come from the implementation of clean development mechanism projects that are expected to be catalyzed by the Protocol, and by the increasing trend in the use of energy efficient technologies in almost all sectors of the country's economy. The later trend will also be catalyzed by the coming into force of the Protocol, which will engender the global shift to more efficient use of energy. In this study, a conservative estimate of GHG emission reduction in Nigeria between the period 1995 – 2020 from CDM and energy efficiency has been put at 55 million tones of CO_2.

Secondly, we have established that the coming into force of the Kyoto Protocol will lead to a significant reduction in revenues that Nigeria can earn from the export of crude oil to the international markets during the study period. This is because a significant number of importers, who have emission reduction mandates, will shift away from the use of crude oil derived fuels to cleaner fuels. It has been estimated that this will translate for Nigeria to a significant decrease of about 12% in revenue from crude oil. When this is combined with the fact that revenue from crude oil is the current mainstay of the Nigerian economy, this is not a good picture for the future.

Thirdly, results from the study however showed that the decrease in crude oil revenue could be mitigated by a significant increase in revenue that will be earned from natural gas exports from Nigeria. This will come from the fact that the country is well endowed with natural gas resources, and the fact that natural gas, as a result of its relatively lower carbon content is likely to serve as a global transition fuel in a future likely to be constrained by GHG emissions reduction. This will open a policy path and opportunity for ameliorating the negative impacts of the significant reduction in crude oil revenues on the Nigerian economy. It has been estimated that revenue from gas export will increase by about 38%. As a matter of fact, if Kyoto Protocol comes into force, combined revenue from oil and gas in Nigeria between 2000-2020 will decline by about 7%. According to the result of the macroeconomic simulation, this decline will translate to a decline of about 1.8% decline in GDP in the same period. This decline in GDP is marginal and could even be offset within the same time period if the relative price of gas compared to oil shifts in favor of gas.

Fourthly, our analysis showed that the coming into force of the Kyoto Protocol would also impact the Nigerian economy in other positive ways. Apart from increased earnings from export of natural gas from Nigeria, increased energy efficiency within the various sector of the economy, increased inflows of foreign direct investment (FDIs) due to CDM activities are the other positive impacts. Our study concludes that over the period 2000-2020, GDP will increase by about 4.8% and the price index will decline by about 2.3% in the increased energy efficiency scenario. The same trend of growth inn GDP of about 3.8% and decline in Price Index of about 0.9% will be recorded in the case of increased FDI as a result of CDM activities in the country. A global conclusion that can be reached is that these positive impacts if properly harnessed are likely to offset the negative impact of the significant reduction in the revenue from combined oil and gas revenue on the economy. Given this insight, we strongly recommend that Government should:

- Continue to promote the aggressive promotion of natural gas export since this will ameliorate the likely decrease in cruse oil export earnings that is bound to come from the coming into force of the Kyoto Protocol;

- Government should streamline the enabling environment for the CDM activities in Nigeria so as to remove barriers that may hamper the inflow of FDI for CDM projects into Nigeria;

- Since increased energy efficiency in all the sectors of the Nigerian economy is expected to result from the coming into force of the Kyoto Protocol, Government must also put in place policies that will assist in removing barriers to energy efficiency in the various sectors of the Nigerian economy..

APPENDIX A

Table 1: 1990 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1072.06	2.27	3835.76	0	0	0	0	0	10.09	0	419.54	0	20.06
Import	0	0	0	0	20.98	6.46	0	12.89	0	0	0	0	0
Export	0	0	3248.74	0	-21.34	0	-26.06	-0.05	0	-0.06	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	1072.06	2.27	587.02	0	-0.36	6.46	-26.06	12.84	10.09	-0.06	419.54	0	20.06
Flaring	-850.57	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-1.48	0	-587.02	5.19	169.96	100.62	91.59	85.14	0	0	0	0	0
Other Conversion	-1.06	0	0	0	0	0	0	0	0	0	-34.14	6.83	0
Electricity													
Central Generation	-101.01	-0.13	0	0	0	-0.23	-0.63	0	-10.09	48.47	0	0	0
Self Generation	0	0	0	0	-2.55	-5.1	0	0	0	2.3	0	0	0
Own Use	-105.22	0	0	-0.41	0	0	-22.18	0	0	-0.97	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-14.54	0	0	0
Balancing Item	0	0	0	0	0	0	0	0	0	-6.87	0	0	0
Final Energy	12.72	2.14	0	4.78	167.05	101.75	42.72	97.98	0	28.33	385.4	6.83	20.06
Domestic Consumption													
Residential	0.51	0.15	0	4.59	0	0	0	74.46	0	13.03	384	4.79	20.6
Agriculture	0	0	0	0	0	7.12	0	0	0	0	0	0	0
Commercial	0	0	0	0.19	0	0	0	0	0	6.8	1.4	0	0
Industry	12.2	1.99	0	0	0	0	40.58	0	0	8.5		2.04	0
Transport	0	0	0	0	167.05	94.63	2.14	23.52	0	0	0	0	0

Table1a: FINAL ENERGY 1990 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	7.130	0.000	0.000	0.000	0.000	0.000	0.000
Industry	12.200	1.990	0.000	0.000	0.000	40.580	0.000	8.500	0.000	2.040	0.000
Transport	0.000	0.000	0.000	167.050	94.630	2.140	23.520	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.190	0.000	0.000	0.000	0.000	6.800	1.400	0.000	0.000
Residential	0.510	0.150	4.590	0.000	0.000	0.000	74.460	13.030	384.000	4.790	20.060

Table 2: 1991 ENERGY BALANCE TABLE FOR NIGERIA (PJ)													
Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1096.34	4.03	4001.13	0	0	0	0	0	21.35	0		0	
Import	0	0	0	1.08	0.28	0	0	0.06	0	0	0	0	0
Export	0	0	-3397.86	0	-9.72	-22.28	-156.82	0	0	-0.06	0	0	0
Stockchange	0	0	0	0	0	0	0	-25.65	0	0	0	0	0
Net Supply	1096.34	4.03	603.27	1.08	-9.44	-22.28	-156.82	-25.59	21.35	-0.06	0	0	0
Flaring	-843.56	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-1.52	0	-603.27	7.52	159.53	131.6	221.86	82.13	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity													
Central Generation	-94.08	0	0	0	0	-0.17	-1.89	0	-21.35	51	0	0	0
Self Generation	0	0	0	0	-2.39	-6.58	0	0	0	2.69	0	0	0
Own Use	-141.01	0	0	-0.29	0	0	-22.92	0	0	-1.02	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-15.3	0	0	0
Balancing Item	0	0	0	-5.49	0	0	0	0	0	-8.83	0	0	0
Final Energy	16.17	4.03	0	2.82	147.7	102.57	40.23	56.54	0	28.48	0	0	0
Domestic Consumption													
Residential	0.64	0.28	0	207	0	0	0	36.75	0	13.67	395.92	0	0
Agriculture	0	0	0	0	0	7.18	0	0	0	0	0	0	0
Commercial	0	0	0	0.11	0	0	0	0.1	0	6.27	0	0	0
Industry	15.53	3.75	0	0	0	0	38.22	0	0	8.54	0	0	0
Transport	0	0.06	0	0	147.7	95.39	2.01	14.91	0	0	0	0	0

Table 2a: FINAL ENERGY 1991 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	7.180	0.000	0.000	0.000	0.000	0.000	0.000
Industry	15.530	3.750	0.000	0.000	0.000	38.220	0.000	8.540	0.000	0.000	0.000
Transport	0.000	0.060	0.000	147.700	95.390	2.010	14.910	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.110	0.000	0.000	0.000	0.100	6.270	0.000	0.000	0.000
Residential	0.640	0.280	2.720	0.000	0.000	0.000	36.750	13.670	395.520	0.000	0.000

Table 3: 1992 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1165.75	2.31	4125.77	0	0	0	0	0	21.81	0	439.49	0	21.825
Import	0	0	0	0	66.79	1.72	0	25.52	0	0	0	0	0
Export	0	0	-3504.94	0	0	-9.22	-41.32	0	0	-0.06	0	0	0
Stockchange	0	0	0	0	0	0	0	-14.11	0	0	0	0	0
Net Supply	1165.75	2.31	620.83	0	66.79	-7.5	-41.32	11.41	21.81	-0.06	439.49	0	21.825
Flaring	-811.44	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-1.56	0	-620.83	10.57	168.16	121.93	99.81	64.91	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	-43.649	5.238	0
Electricity													
Central Generation	-195.48	0	0	0	0	-0.28	-0.85	0	21.81	53.4	0	0	0
Self Generation	0	0	0	0	-2.52	-6.1	0	0	0	2.59	0	0	0
Own Use	-141.51	0	0	-0.33	0	0	-23.56	0	0	-1.07	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-16.02	0	0	0
Balancing Item	0	0	0	-6.32	9.11	0	0	0	0	-7.46	0	0	0
Final Energy	15.76	2.31	0	3.92	241.54	108.05	34.08	76.32	0	31.38	392.84	5.24	21.83
Domestic Consumption													
Residential	0.62	0.16	0	3.76	0	0	0	65.64	0	15.73	373.199	4.19	21.825
Agriculture	0	0	0	0	0	7.56	0	0	0	0	0	0	0
Commercial	0	0	0	0.16	0	0	0	0	0	6.24	19.642	0.524	0
Industry	15.14	2.15	0	0	0	0	32.38	0	0	9.41	0	0.524	0
Transport	0	0	0	0	241.54	100.49	1.7	10.68	0	0	0	0	0

Table 3a:FINAL ENERGY 1992 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	7.560	0.000	0.000	0.000	0.000	0.000	0.000
Industry	15.140	2.150	0.000	0.000	0.000	32.380	0.000	9.410	0.000	0.524	0.000
Transport	0.000	0.000	0.000	241.540	100.490	1.700	10.680	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.160	0.000	0.000	0.000	0.000	6.240	19.642	0.524	0.000
Residential	0.620	0.160	3.760	0.000	0.000	0.000	65.640	15.730	373.199	4.190	21.825

Table 4: 1993 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1175.12	0.83	4010.12	0	0	0	0	0	18.89	0	445.22	0	22.261
Import	0	0	0	0	79	31.72	0	28.51	0	0	0	0	0
Export	0	0	-3268.96	0	-2.02	-31.32	-17.56	-15.76	0	-0.06	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	**1175.12**	**0.83**	**741.16**	**0**	**76.98**	**0.4**	**-17.56**	**12.75**	**18.89**	**-0.06**	**445.22**	**0**	**22.261**
Flaring	-912.84	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-1.87	0	-741.16	6.89	145.93	114.08	87.14	68.05	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	-44.522	5.343	0
Electricity													
Central Generation	-116.75	0	0	0	0	-0.16	-0.74	0	-18.89	51.39	0	0	0
Self Generation	0	0	0	0	-2.19	-5.7	0	0	0	2.37	0	0	0
Own Use	-128.31	0	0	-0.19	0	-0.26	-28.33	0	0	-1.03	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-15.42	0	0	0
Balancing Item	0	0	0	-3.5	0	0	0	0	0	-0.66	0	0	0
Final Energy	**15.35**	**0.83**	**0**	**3.2**	**220.72**	**108.36**	**40.51**	**80.8**	**0**	**36.59**	**400.698**	**5.343**	**22.261**
Domestic Consumption													
Residential	0.62	0.06	0	3.07	0	0	0	62.22	0	18.78	380.663	4.274	22.261
Agriculture	0	0	0	0	0	7.6	0	0	0	0	0	0	0
Commercial	0	0	0	0.13	0	0	0	0	0	6.83	20.035	0.534	0
Industry	14.73	0.77	0	0	0	0	38.48	0	0	10.98	0	0.534	0
Transport	0	0	0	0	220.72	101.02	2.03	18.58	0	0	0	0	0

Table 4a:FINAL ENERGY 1993 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	7.600	0.000	0.000	0.000	0.000	0.000	0.000
Industry	14.730	0.770	0.000	0.000	0.000	38.480	0.000	10.980	0.000	0.534	0.000
Transport	0.000	0.000	0.000	220.720	101.020	2.030	18.580	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.130	0.000	0.000	0.000	0.000	6.830	20.035	0.534	0.000
Residential	0.620	0.060	3.070	0.000	0.000	0.000	62.220	18.780	380.663	4.274	22.261

Table 5: 1994ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1153.62	0.38	4041.38	0	0	0	0	0	23.72	0	454.124	0	22.706
Import	0	0	0	0.42	88.37	11.52	0	21.76	0	0	0	0	0
Export	0	0	-3352.66	0	-36.12	-1.14	-0.14	0	0	-0.06	0	0	0
Stockchange	0	0	0	0	0	0	0	30.55	0	0	0	0	0
Net Supply	**1153.62**	**0.38**	**688.72**	**0.42**	**52.25**	**10.38**	**-0.14**	**52.31**	**23.72**	**-0.06**	**454.124**	**0**	**22.706**
Flaring	-992.94	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-1.73	0	-688.72	3.07	94.42	72.42	62.38	41.73	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	-45.412	5.449	0
Electricity													
Central Generation	-99.68	0	0	0	0	-0.06	-0.53	0	-23.72	52.76	0	0	0
Self Generation	0	0	0	0	-1.42	-3.62	0	0	0	1.51	0	0	0
Own Use	-41.58	0	0	-0.1	0	0	-26.41	0	0	-1.06	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-15.83	0	0	0
Balancing Item	0	0	0	-1.86	0	0	0	0	0	-4.67	0	0	0
Final Energy	**17.69**	**0.38**	**0**	**1.53**	**145.25**	**79.12**	**35.3**	**94.04**	**0**	**32.65**	**408.712**	**5.449**	**22.706**
Domestic Consumption													
Residential	0.68	0.03	0	1.47	0	0	0	68.48	0	18.28	388.276	4.359	22.706
Agriculture	0	0	0	0	0	5.54	0	0	0	0	0	0	0
Commercial	0	0	0	0.06	0	0	0	0.12	0	4.57	20.436	0.545	0
Industry	16.39	0.35	0	0	0	0	33.54	0	0	9.8	0	0.545	0
Transport	0	0	0	0	145.25	73.58	1.76	25.56	0	0	0	0	0

Table 5a:FINAL ENERGY 1994 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	5.540	0.000	0.000	0.000	0.000	0.000	0.000
Industry	16.390	0.350	0.000	0.000	0.000	33.540	0.000	9.800	0.000	0.545	0.000
Transport	0.000	0.000	0.000	145.420	73.580	1.760	25.560	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.060	0.000	0.000	0.000	0.000	4.570	20.436	0.545	0.000
Residential	0.680	0.030	1.470	0.000	0.000		68.480	18.280	388.276	4.359	22.706

Table 6: 1995ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1147.7	0.57	4149.32	0	0	0	0	0	26.35	0	472.94	0	22.706
Import	0	0	0	0	65.42	0	0	0.88	0	0	0	0	0
Export	0	0	-3578.02	0	0	-15.67	-49.39	0	0	-0.06	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	**1147.7**	**0.57**	**571.3**	**0**	**65.42**	**-15.67**	**-49.39**	**0.88**	**26.35**	**-0.06**	**472.94**	**0**	**22.706**
Flaring	-977.3	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-1.44	0	-571.3	5.71	118.8	97.37	83	61.94	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	-37.95	7.59	0
Electricity													
Central Generation	-105.88	0	0	0	0	-0.02	-0.65	0	-26.35	57.04	0	0	0
Self Generation	0	0	0	0	-1.78	-4.87	0	0	0	2	0	0	0
Own Use	-50.62	0	0	-0.45	0	0	0	0	0	-1.14	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-17.11	0	0	0
Balancing Item	0	0	0	-4.34	0	0	0	0	0	-5.38	0	0	0
Final Energy	**12.46**	**0.57**	**0**	**0.92**	**182.44**	**76.81**	**32.96**	**62.82**	**0**	**35.35**	**434.99**	**7.59**	**22.706**
Domestic Consumption													
Residential	0.36	0.04	0	0.88	0	0	0	39.58	0	17.78	433.39	5.88	22.706
Agriculture	0	0	0	0	0	5.38	0	0	0	0	0	0	0
Commercial	0	0	0	0.04	0	0	0	0	0	6.96	1.6	0	0
Industry	11.7	0.53	0	0	0	0	31.31	0	0	10.61	0	1.71	0
Transport	0	0	0	0	182.44	71.43	1.65	23.24	0	0	0	0	0

Table 6a: FINAL ENERGY 1995 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	5.380	0.000	0.000	0.000	0.000	0.000	0.000
Industry	11.700	0.530	0.000	0.000	0.000	31.310	0.000	10.610	0.000	1.710	0.000
Transport	0.000	0.000	0.000	182.440	71.430	1.650	23.240	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.040	0.000	0.000	0.000	0.000	6.960	1.600	0.000	0.000
Residential	0.360	0.040	0.880	0.000	0.000	0.000	39.580	17.780	433.390	5.880	22.270

Table 7: 1996 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1233.66	0.45	3954.99	0	0	0	0	0	21.49	0	446.39	0	0
Import	0	0	0	0.43	91.03	11.87	0	0.00	0	0	0	0	0
Export	0	0	-3596.78	0	-37.20	-1.17	-0.14	22.40	0	-0.58	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	1233.66	0.45	358.21	0.43	53.83	10.7	-0.14	22.40	21.49		446.39	0	0
Flaring	-925.33	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-6.17	0	358.21	3.16	97.43	74.60	64.25	42.98	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity													
Central Generation	-108.21	0	0	0	0	-0.06	-0.54	0	-21.49	58.03	0	0	0
Self Generation	0	0	0	0	-1.46	-3.72	0	0	0	1.74	0	0	0
Own Use	-172.71	0	0	0	0	0	-27.2	0	0	-1.19	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-21.17	0	0	0
Balancing Item	0	0	0	0	0	0	0	0	0		0	0	0
Final Energy	21.24	0.45	0	3.59	149.80	81.52	36.37	65.38	0	36.83	446.39	0	0
Domestic Consumption													
Residential	0.85	0.03	0	3.46	0	0	0	50.9	0	19.06	446.39	0	0
Agriculture	0	0	0	0	0	5.71	0	0	0	0	0	0	0
Commercial	0	0	0	0.13	0	0	0	0	0	7.88	0	0	0
Industry	20.39	0.42	0	0	0	0	35.1		0	9.89	0	0	0
Transport	0	0	0	0	149.80	75.81	1.27	14.48	0	0	0	0	0

Table 7a: FINAL ENERGY 1996 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	5.710	0.000	0.000	0.000	0.000	0.000	0.000
Industry	20.390	0.420	0.000	0.000	0.000	35.100	0.000	9.890	0.000	0.000	0.000
Transport	0.000	0.000	0.000	149.800	75.810	1.270	14.480	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.130	0.000	0.000	0.000	0.000	7.880	0.000	0.000	0.000
Residential	0.850	0.030	3.460	0.000	0.000	0.000	50.900	19.060	446.392	0.000	0.000

Table 8: 1997 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1292.82	0.61	4963.27	0	0	0	0	0	21.49	0	459.78	0	0
Import	0	0	0	0	46.72	7.91	0	0.00	0	0	0	0	0
Export	0	0	-4454.10	0	-0.05	-0.87	-74.91	-0.05	0	-0.56	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	1292.82	0.61	509.16	0	46.67	7.04	-74.91	-0.05	21.49	-0.56	459.78	0	0
Flaring	-843.34	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-6.46	0	-509.16	4.43	117.79	100.48	107.00	63.22	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity													
Central Generation	-91.69	0	0	0	0	-0.06	-0.86	0	-21.49	55.78	0	0	0
Self Generation	0	0	0	0	-1.77	-5.02	0	0	0	1.67	0	0	0
Own Use	-297.35	0	0	0	0	0	-10.7	0	0	-1.52	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-18.41	0	0	0
Balancing Item	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Energy	53.98	0.61	0	4.43	162.69	102.44	20.53	63.17	0	36.96	459.78	0	0
Domestic Consumption													
Residential	2.16	0.04	0	4.27	0	0	0	49.27	0	19.88	459.78	0	0
Agriculture	0	0	0	0	0	7.17	0	0	0	0	0	0	0
Commercial	0	0	0	0.16	0	0	0	0	0	7.58	0	0	0
Industry	51.82	0.57	0	0	0	0	19.81	0	0	9.50	0	0	0
Transport	0	0	0	0	162.69	95.27	0.72	13.9	0	0	0	0	0

Table 8a: FINAL ENERGY 1997 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	7.170	0.000	0.000	0.000	0.000	0.000	0.000
Industry	51.820	0.570	0.000	0.000	0.000	19.810	0.000	9.500	0.000	0.000	0.000
Transport	0.000	0.000	0.000	162.690	95.270	0.720	13.900	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.160	0.000	0.000	0.000	0.000	7.580	0.000	0.000	0.000
Residential	2.160	0.040	4.270	0.000	0.000	0.000	49.270	19.880	459.783	0.000	0.000

Table 9: 1998 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1288.96	0.54	4677.31	0	0	0	0	0	25.44	0	473.57	0	0
Import	0	0	0	0.79	110.31	22.03	0	28.26	0	0	0	0	0
Export	0	0	-4096.34	0	-0.06	-0.06	-44.36	-0.08	0	-0.59	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	1288.96	0.54	580.97	0.79	110.25	21.97	-44.36	28.18	25.44		473.57	0	0
Flaring	-822.39	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-7.21	0	-580.97	3.17	63.83	68.78	91.37	48.80	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity													
Central Generation	-102.06	0	0	0	0	-0.29	-0.73	0	-25.44	58.98	0	0	0
Self Generation	0	0	0	0	-0.96	-3.44	0	0	0	1.77	0	0	0
Own Use	-296.96	0	0		0	0	-7.80	0	0	-2.35	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-19.46	0	0	0
Balancing Item	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Energy	60.34	0.54	0	4.16	173.12	87.02	38.48	76.98	0	38.35	473.57	0	0
Domestic Consumption													
Residential	2.41	0.03	0	4.01	0	0	0	60.04	0	-20.29	473.57	0	0
Agriculture	0	0	0	0	0	6.09	0	0	0	0	0	0	0
Commercial	0	0	0	0.15	0	0	0	0	0	8.01	0	0	0
Industry	57.93	0.51	0	0	0	0	37.13	0	0	10.05	0	0	0
Transport	0	0	0	0	173.12	80.93	1.35	16.94	0	0	0	0	0

Table 9a: FINAL ENERGY 1998 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	6.090	0.000	0.000	0.000	0.000	0.000	0.000
Industry	57.930	0.510	0.000	0.000	0.000	37.130		10.050	0.000	0.000	0.000
Transport	0.000	0.000	0.000	173.120	80.930	1.350	16.940	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.150	0.000	0.000	0.000	0.000	8.010	0.000	0.000	0.000
Residential	2.410	0.030	4.010	0.000	0.000	0.000	60.040	20.290	473.577	0.000	0.000

Table 10: 1999 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1518.53	0.48	4493.28	0	0	0	0	0	26.27	0	487.78	0	0
Import	0	0	0	0.68	87.45	19.87	0	7.39	0	0	0	0	0
Export	0	0	-3933.04	0	0	0	-76.15	0	0	-0.58	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	1518.53	0.48	560.23	0.68	87.45	19.87	-76.15	7.39	26.27		487.78	0	0
Flaring	-778.20	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-45.96	0	-560.23	2.45	73.17	77.46	115.57	55.11	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity													
Central Generation	-108.43	0	0	0	0	-0.58	-0.92	0	-26.27	57.84	0	0	0
Self Generation	0	0	0	0	-1.10	-2.92	0	0	0	1.74	0	0	0
Own Use	-392.22	0	0	0	0	0	-10.86	0	0	-0.98	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-19.09	0	0	0
Balancing Item	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Energy	193.72	0.48	0	3.13	159.52	93.83	27.64	62.5	0	38.93	487.78	0	0
Domestic Consumption													
Residential	7.75	0.03	0	3.02	0	0	0	48.75	0	21.22	487.78	0	0
Agriculture	0	0	0	0	0	6.57	0	0	0	0	0	0	0
Commercial	0	0	0	0.11	0	0	0	0	0	7.86	0	0	0
Industry	185.97	0.45	0	0	0	0	26.67	0	0	9.85	0	0	0
Transport	0	0	0	0	159	87.26	0.97	13.75	0	0	0	0	0

Table 10a: FINAL ENERGY 1999 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	6.570	0.000	0.000	0.000	0.000	0.000	0.000
Industry	185.970	0.450	0.000	0.000		26.670	0.000	9.850	0.000	0.000	0.000
Transport	0.000	0.000	0.000	159.000	87.260	0.970	13.750	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.110	0.000	0.000	0.000	0.000	7.860	0.000	0.000	0.000
Residential	7.750	0.030	3.020	0.000	0.000	0.000	48.750	21.220	487.784	0.000	0.000

Table 11: 2000 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1487.07	0.34	4773.58	0	0	0	0	0	23.19	0	502.42	0	0
Import	0	0	0	0.39	182.35	83.38	0	49.80	0	0	0	0	0
Export	0	0	-4143.26	0	0	0	-46.98	0	0	-0.53	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	1487.07	0.34	630.32	0.39	182.35	83.38	-46.98	49.80	23.19		502.42	0	0
Flaring	-844.07	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-22.73	0	-630.32	0	42.75	44.75	56.72	28.52	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity													
Central Generation	-83.06	0	0	0	0	-0.77	-0.45	0	-23.19	52.87	0	0	0
Self Generation	0	0	0	0	-0.64	-3.84	0	0	0	1.59	0	0	0
Own Use	-368.32	0	0		0	0	-8.93	0	0	-5.25	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-17.45	0	0	0
Balancing Item	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Energy	168.89	0.34	0	0.39	224.46	123.52	0.36	78.32	0	31.23	502.42	0	0
Domestic Consumption													
Residential	6.76	0.02	0	0.38	0	0	0	61.09	0	15.04	502.42	0	0
Agriculture	0	0	0	0	0	8.65	0	0	0	0	0	0	0
Commercial	0	0	0	0.01	0	0	0	0	0	7.18	0	0	0
Industry	162.13	0.32	0	0	0	0	0.35	0	0	9.01	0	0	0
Transport	0	0	0	0	225.10	114.87	0.01	17.23	0	0	0	0	0

Table 11a: FINAL ENERGY 2000 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	8.650	0.000	0.000	0.000	0.000	0.000	0.000
Industry	162.130	0.320	0.000	0.000	0.000	0.350	0.000	9.010	0.000	0.000	0.000
Transport	0.000	0.000	0.000	225.100	114.870	0.010	17.230	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.010	0.000	0.000	0.000	0.000	7.180	0.000	0.000	0.000
Residential	6.760	0.020	0.380	0.000	0.000	0.000	61.090	15.040	502.418	0.000	0.000

Table 12: 2001 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1825.36	0.34	5009.72	0	0	0	0	0	23.19	0	517.49	0	0
Import	0	0	0	0.00	169.71	6.36		19.86	0	0	0	0	0
Export	0	0	-4524.54	-0.44	0	-1.81	-91.00	0	0	-0.56	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	1825.36	0.34	485.18	-0.44	169.71	4.55	-91.00	19.86	23.19	-0.56	517.49	0	0
Flaring	-931.21	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-46.16	0	-485.18	4.01	114.22	107.71	111.36	70.14	0	0	0	0	0
Other Conversion	0	0	0	0	0	0		0	0	0	0.00	0	0
Electricity													
Central Generation	142.07	0	0	0	0	-0.67	-0.89	0	-23.19	55.67	0	0	0
Self Generation	0	0	0	0	1.71	-3.37	0	0	0	2.00	0	0	0
Own Use	-417.74	0	0		0	0	-14.35	0	0	-6.22	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-18.37	0	0	0
Balancing Item	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Energy	288.18	0.34	0	3.57	282.22	108.22	5.12	90	0	32.52	517.49	0	0
Domestic Consumption													
Residential	11.53	0.02	0	3.44	0	0	0	70.2	0	16.59	517.49	0	0
Agriculture	0	0	0	0	0	7.58	0	0	0	0	0	0	0
Commercial	0	0	0	0.13	0	0	0	0	0	8.78	0	0	0
Industry	276.65	0.32	0	0	0	0	4.94	0	0	7.15	0	0	0
Transport	0	0	0	0	283.93	100.64	0.18	19.8	0	0	0	0	0

Table 12a: FINAL ENERGY 2001 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	7.580	0.000	0.000	0.000	0.000	0.000	0.000
Industry	276.650	0.320	0.000	0.000	0.000	4.940	0.000	7.150	0.000	0.000	0.000
Transport	0.000	0.000	0.000	283.930	100.640	0.180	19.800	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.130	0.000	0.000	0.000	0.000	8.780	0.000	0.000	0.000
Residential	11.530	0.020	3.440	0.000	0.000	0.000	70.200	16.590	517.490	0.000	0.000

Table 13: 2002 ENERGY BALANCE TABLE FOR NIGERIA (PJ)

Energy Source/Product	PRIMARY ENERGY			SECONDARY AND FINAL ENERGY									
Production & Utilisation	Natural Gas	Coal	Crude Oil	LPG	Gasoline Av. Spirit	Diesel	Fuel Oil	Kerosine	Hydro	Electricity	Fuelwood	Charcoal	Other Biomass
Production	1677.08	0.34	4209.98	0	0	0	0	0	23.19	0	533.02	0	0
Import	0	0	0	0	177.61	4.03	0	17.45	0	0	0	0	0
Export	0	0	-3847.29	-0.80	-0.69	-0.60	-91.86	-0.64	0	-0.56	0	0	0
Stockchange	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Supply	1677.08	0.34	362.69	-0.80	176.92	3.43	-91.86	16.81	23.19	-0.56	533.02	0	0
Flaring	-864.29	0	0	0	0	0	0	0	0	0	0	0	0
Refinery	-263.37	0	-362.69	5.09	114.55	107.43	111	66.05	0	0	0	0	0
Other Conversion	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity													
Central Generation	-141.90	0	0	0	0	-0.67	-0.85	0	-23.19	57.92	0	0	0
Self Generation	0	0	0	0	-1.72	-3.33	0	0	0	2.09	0	0	0
Own Use	-70.03	0	0		0	0	-13.78	0	0	1.53	0	0	0
Transmission/Distribution Losses	0	0	0	0	0	0	0	0	0	-25.90	0	0	0
Balancing Item	0	0	0	0	0	0	0	0	0	0	0	0	0
Final Energy	337.41	0.34	0	4.29	289.75	114.85	4.51	82.85	0	32.02	533.02	0	0
Domestic Consumption													
Residential	13.5	0.02	0	4.14	0	0	0	64.63	0	16.65	533.02	0	0
Agriculture	0	0	0	0	0	8.04	0	0	0	0.00	0	0	0
Commercial	0	0	0	0.15	0	0	0	0	0	8.39	0	0	0
Industry	323.91	0.32	0	0	0	0	4.35	0	0	6.98	0	0	0
Transport	0	0	0	0	289.75	106.81	0.16	18.23	0	0	0	0	0

Table 13a : FINAL ENERGY 2002 (PJ)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture	0.000	0.000	0.000	0.000	8.040	0.000	0.000		0.000	0.000	0.000
Industry	323.910	0.320	0.000	0.000	0.000	4.350	0.000	6.980	0.000	0.000	0.000
Transport	0.000	0.000	0.000	289.750	106.810	0.160	18.230	0.000	0.000	0.000	0.000
Commercial	0.000	0.000	0.150	0.000	0.000	0.000	0.000	8.390	0.000	0.000	0.000
Residential	13.500	0.020	4.140	0.000	0.000	0.000	64.630	16.650	533.015	0.000	0.000

Table 14: ENERGY EFFCIENCY ASSUMPTIONS (%)

	Natural Gas	Coal	LPG	Gasoline AV. Spirit	Diesel	Fuel Oil	Kerosene	Electricity	Fuel wood	Charcoal	Biomass
SECTORS											
Agriculture					0.800						
Industry	0.850	0.750				0.800		0.900		0.400	
Transport	0.800	0.700		0.900	0.900	0.800	0.900	0.900			
Commercial	0.800	0.700	0.900				0.200	0.900	0.300		
Residential	0.800	0.700	0.800				0.750	0.900	0.250	0.400	0.100

Table 15: USEFUL ENERGY (PJ) ....Historical

SECTORS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Agriculture	5.704	5.744	6.048	6.080	4.432	4.304	4.568	5.736	4.872	5.256	6.920	6.064	6.432
Industry	52.793	54.275	49.064	53.978	50.064	45.624	54.628	68.873	38.749	188.613	146.440	245.780	285.326
Transport	249.932	233.850	318.799	307.912	221.512	250.719	217.097	245.250	244.971	234.785	321.488	364.077	373.439
Commercial	6.711	5.762	11.653	12.275	10.298	6.780	7.209	6.966	7.344	7.173	6.471	8.019	7.686
Residential	193.489	141.630	164.161	165.662	170.636	159.634	170.396	174.962	186.842	186.244	190.684	208.944	210.837

Table 16: REAL GDP BY ENERGY DEMAND SECTORS (N' Million) .... Historical

SECTORS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Agriculture	35277.25	34755.62	37273.04	37780.75	38692.35	40107.42	41743.37	43495.23	45254.01	47595.59	48981.52	50861.50	53630.63
Industry	23396.48	22964.96	23011.42	22852.88	22556.58	22507.04	23520.03	23896.82	24058.32	23356.01	25178.95	26630.94	26207.94
Transport	2853.63	2950.47	3083.74	3215.84	3217.78	3256.12	3323.85	3420.64	3535.53	3638.92	3751.43	3909.15	4101.10
Commercial	21034.29	21720.98	22503.08	23291.73	23680.31	24233.95	24907.38	25734.24	26961.78	28063.31	28949.50	30139.86	32247.62
Residential	8263.88	8590.68	9624.25	10916.12	11280.76	11533.68	11794.81	12133.15	12521.73	13048.72	13435.74	13932.96	14465.75

Table 17: $U.E_{(sector)}/GDP_{(sector)}$ .... Historical

SECTORS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Agriculture	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industry	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.002	0.008	0.006	0.009	0.011
Transport	0.088	0.079	0.103	0.096	0.069	0.077	0.065	0.072	0.069	0.065	0.086	0.093	0.091
Commercial	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Residential	0.023	0.016	0.017	0.015	0.015	0.014	0.014	0.014	0.015	0.014	0.014	0.015	0.015

Table 18: REFERENCE TREND USEFUL ENERGY (PJ) ....Projection

SECTORS	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture	6.665	6.906	7.156	7.415	7.684	7.962	8.250	8.549	8.858	9.179	9.511	9.855	10.212
Industry	291.802	298.426	305.201	312.129	319.214	326.460	333.871	341.450	349.201	357.127	365.234	373.525	382.004
Transport	389.066	405.346	422.308	439.979	458.390	477.571	497.555	518.376	540.067	562.666	586.211	610.741	636.297
Commercial	8.044	8.419	8.811	9.222	9.652	10.101	10.572	11.065	11.580	12.120	12.685	13.276	13.895
Residential	222.328	234.445	247.222	260.696	274.904	289.886	305.685	322.344	339.912	358.437	377.972	398.572	420.294

REFERENCE TREND (Contd.)

REFERENCE TREND USEFUL ENERGY (PJ) ......Projection

SECTORS	2016	2017	2018	2019	2020
Agriculture	10.582	10.965	11.362	11.773	12.199
Industry	390.675	399.544	408.613	417.889	427.375
Transport	662.923	690.663	719.564	749.674	781.044
Commercial	14.542	15.220	15.929	16.671	17.448
Residential	443.200	467.354	492.825	519.684	548.007

Table 19: LOW TREND USEFUL ENERGY (PJ) ....Projection

SECTORS	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture	6.593	6.758	6.927	7.100	7.277	7.459	7.646	7.837	8.033	8.234	8.439	8.650	8.867
Industry	289.605	293.949	298.359	302.834	307.377	311.987	316.667	321.417	326.238	331.132	336.099	341.140	346.257
Transport	385.288	397.513	410.127	423.140	436.566	450.418	464.710	479.455	494.668	510.364	526.558	543.266	560.504
Commercial	7.955	8.233	8.522	8.820	9.129	9.448	9.779	10.121	10.475	10.842	11.221	11.614	12.021
Residential	218.217	225.854	233.759	241.941	250.409	259.173	268.244	277.632	287.350	297.407	307.816	318.590	329.740

LOW TREND (Contd.)

LOW TREND USEFUL ENERGY (PJ) ......Projection

SECTORS	2016	2017	2018	2019	2020
Agriculture	9.088	9.315	9.548	9.787	10.032
Industry	351.451	356.723	362.074	367.505	373.018
Transport	578.288	596.638	615.569	635.101	655.253
Commercial	12.441	12.877	13.327	13.794	14.277
Residential	341.281	353.226	365.589	378.384	391.628

Table 20: HIGH TREND USEFUL ENERGY (PJ) ....Projection

SECTORS	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture	6.754	7.091	7.446	7.818	8.209	8.619	9.050	9.503	9.978	10.477	11.001	11.551	12.128
Industry	295.312	305.648	316.345	327.418	338.877	350.738	363.014	375.719	388.869	402.480	416.567	431.146	446.237
Transport	392.843	413.255	434.728	457.316	481.078	506.075	532.371	560.033	589.132	619.743	651.945	685.820	721.456
Commercial	8.147	8.636	9.154	9.703	10.286	10.903	11.557	12.250	12.985	13.764	14.590	15.466	16.394
Residential	224.542	239.137	254.681	271.235	288.865	307.642	327.638	348.935	371.616	395.771	421.496	448.893	478.071

HIGH TREND (Contd.)

HIGH TREND USEFUL ENERGY (PJ) ......Projection

SECTORS	2016	2017	2018	2019	2020
Agriculture	12.735	13.372	14.040	14.742	15.479
Industry	461.855	478.020	494.750	512.067	529.989
Transport	758.942	798.377	839.861	883.500	929.407
Commercial	17.377	18.420	19.525	20.697	21.938
Residential	509.145	542.240	577.486	615.022	654.998

TABLE 21: DISAGGREGATED USEFUL ENERGY DEMAND PROJECTIONS UTILIZED IN THE MARKAL ANALYSIS

RESIDENTIAL SECTOR

Demand Category	Demand Device		2002	2005	2008	2011	2014	2017	2020
Urban Cooking	URBAN COOKING (KEROSINE STOVE)	0.75	17.45	20.46	23.99	28.13	32.99	38.68	45.36
	URBAN COOKING (LPG GAS COOKER)	0.8	3.31	3.88	4.55	5.34	6.26	7.34	8.61
	URBAN COOKING (ELECTRIC COOKER)	0.9	0.22	0.26	0.31	0.36	0.42	0.50	0.58
	URBAN COOKING (FWD STOVE)	0.25	9.75	11.44	13.41	15.73	18.44	21.62	25.35
	URBAN COOKING (NATURAL GAS COOKER)	0.8	10.80	12.66	14.85	17.41	20.42	23.94	28.07
Rural Cooking	RURAL COOKING (KEROSINE STOVE)	0.75	12.84	15.05	17.65	20.69	24.26	28.45	33.36
	RURAL COOKING (FWD STOVE)	0.25	123.50	144.81	169.80	199.11	233.47	273.76	321.00
Urban Lighting	URBAN LIGHTING (ELEC))	0.9	10.95	12.84	15.06	17.66	20.70	24.27	28.46
	URBAN LIGHTING (Kerosine)	0.75	3.20	3.75	4.40	5.16	6.05	7.09	8.32
Rural Lighting	RURAL LIGHTING (elec)	0.9	0.88	1.03	1.20	1.41	1.65	1.94	2.27
	RURAL LIGHTING (Kerosine)	0.75	14.99	17.57	20.61	24.16	28.33	33.22	38.96
Misc. Elec. Appliances	Misc Elec Appliances	0.9	2.93	3.44	4.03	4.73	5.55	6.50	7.63
	TOTAL		210.82	247.21	289.87	339.89	398.55	467.32	547.97

INDUSTRIAL SECTOR

Demand Category	Demand Device		2002	2005	2008	2011	2014	2017	2020
Feedstock	Chemical and Petrochemical	0.85	15.14	16.19	17.32	18.53	19.82	21.20	22.68
Process Heat	Gas Furnace	0.85	260.18	278.31	297.69	318.43	340.61	364.34	389.72
	Coal Oven	0.75	0.24	0.26	0.27	0.29	0.31	0.34	0.36
	Fuel-oil Oven	0.8	3.48	3.72	3.98	4.26	4.56	4.87	5.21
Electricity	Electrical Appliances	0.9	6.28	6.72	7.19	7.69	8.22	8.80	9.41
	TOTAL		285.33	305.20	326.46	349.20	373.52	399.54	427.37

TRANSPORT SECTOR

Demand Category	Demand Device		2002	2005	2008	2011	2014	2017	2020
Road Passenger Transport	Gasoline Motor Vehicle	0.9	239.91	271.31	306.81	346.96	392.37	443.71	501.78
	Diesel Motor Vehicle	0.9	71.14	80.44	90.97	102.88	116.34	131.56	148.78
Road Freight	Gasoline Freight Vehicle	0.9	20.86	23.59	26.68	30.17	34.12	38.58	43.63
	Diesel Freight Vehicle	0.9	23.07	26.09	29.50	33.37	37.73	42.67	48.25
Rail Transport	Diesel Train	0.9	1.92	2.17	2.46	2.78	3.14	3.56	4.02
Air Transport	Aircraft	0.9	16.41	18.55	20.98	23.73	26.83	30.34	34.32
Water Transport	Ferries	0.8	0.13	0.14	0.16	0.19	0.21	0.24	0.27
	TOTAL		**373.44**	**422.31**	**477.57**	**540.07**	**610.74**	**690.66**	**781.04**

COMMERCIAL SECTOR

Demand Category	Demand Device		2002	2005	2008	2011	2014	2017	2020
Lighting	Lighting	0.9	1.59	1.82	2.08	2.39	2.74	3.14	3.60
Space Cooling	Air Conditioning	0.9	3.82	4.38	5.03	5.76	6.61	7.57	8.68
Refridgeration	Refrigeration	0.9	0.96	1.10	1.26	1.44	1.65	1.89	2.17
Misc. Elec. Apllicances	Electrical Appliances	0.9	1.20	1.37	1.57	1.80	2.06	2.37	2.71
Cooking	Gas Cooker	0.9	0.14	0.15	0.18	0.20	0.23	0.27	0.31
	TOTAL		**7.70**	**8.82**	**10.12**	**11.60**	**13.29**	**15.24**	**17.47**

AGRICULTURAL SECTOR

Demand Category	Demand Device		2002	2005	2008	2011	2014	2017	2020
Motive Power	Irrigation and Motive Power	0.8	**6.43**	**7.16**	**7.96**	**8.86**	**9.86**	**10.97**	**12.20**
	TOTAL	**0.8**	**6.43**	**7.16**	**7.96**	**8.86**	**9.86**	**10.97**	**12.20**

TABLE 22: LIST OF DEMAND AND SUPPLY TECHNOLOGIES REPRESENTED IN MARKAL

1. Demand Technologies

Sector	Technology
Agriculture	IRRIGATION & MOTIVE POWER
Commercial	COMMERCIAL LIGHTING
	AIR CONDITIONERS
	REFRIDGERATION
	MISC. ELECTRICAL APPLIANCES
	LPG GAS COOKER
Industrial	CHEMICAL & PETROCHEMICAL FEEDSTOCK
	GAS FURNACE
	COAL FURNACE
	FUEL-OIL FURNACE
	INDUSTRIAL HT FROM COGENERATION
	MISC. ELECTRICAL APPLIANCES
Residential	URBAN COOKING (KEROSINE STOVE)
	URBAN COOKING (LPG GAS COOKER)
	URBAN COOKING (ELECTRIC COOKER)
	URBAN COOKING (FWD STOVE)
	URBAN COOKING (NATURAL GAS COOKER)
	RURAL COOKING (KEROSINE STOVE)
	RURAL COOKING (FWD STOVE)
	URBAN ELECTRIC LIGHTING
	URBAN KEROSINE LIGHTING
	RURAL ELECTRIC LIGHTING
	RURAL KEROSINE LIGHTING
	MISC. ELECTRICAL APPLIANCES

Transport	GASOLINE MOTOR VEHICLE
	DIESEL MOTOR VEHICLE
	GASOLINE TRUCK
	DIESEL TRUCK
	RAIL TRANSPORT (DIESEL TRAIN)
	AIR TRANSPORT
	WATER TRANSPORT

2. Supply Technologies

CONVERSION TECHNOLOGIES	
	INDUSTRIAL COGENERATION - GAS TURBINE
	INDUSTRIAL COGENERATION - BIOMAS
	MICRO GAS TURBINE
	CENTRAL SOLAR VOLTAIC
	SOLAR PHOTOELECTRIC-RESIDENTIAL
	EXISTING GT ELECTRIC PLANTS
	EXISTING HYDRO ELECTRIC PLANTS
	OIL PLANTS
	SMALL-HYDRO PLANTS 30MW
	MINI-HYDRO PLANTS 10MW
	MICRO-HYDRO PLANTS 50kW
	ZUNGERU HYDRO PLANT
	MAMBILA HYDRO PLANT
	OKITIPUPA GT PLANT
	PAPALANTO GT PLANT
	AJAOKUTA GT PLANT
	AUTOGENERATION
	12x650MW COMBINED CYCLE PLANTS
	17x450MW GAS TURBINE PLANTS

PROCESS TECHNOLGIES	
	PETROLEUM PRODUCT REFINERY
	MEDIUM CONVERSION REFINERY
	CNG PLANT
	LNG PLANT
	LPG RECOVERY FROM NATURAL GAS
	ADDITIONAL LNG PLANTS
	CRUDE OIL PIPELINE DISTRIBUTION
	NAT. GAS PIPELINE DISTRIBUTION (RESIDENTIAL)
	NAT.GAS DISTRIB. BY PIPELINE (INDUSTRIAL)
	WEST AFRICAN GAS PIPELINE
	GASOLINE TRANSPORT
	KEROSENE TRANSPORT
	DIESEL TRANSPORT
	FUEL OIL TRANSPORT
	LPG TRANSPORT
	ESCRAVOS FLARED GAS REDUCTION PROJECT
	OSO CONDENSATE PLANT
	ASSOCIATED GAS REINJECTION
	ASSOCIATED GAS OWN-USE
	ASSOCIATED GAS RECOVERY PLANT
	ASSOCIATED GAS PIPELINE
	ASSOC. GAS BURNERS (GAS FLARING)
	NATURAL GAS TRANSMISSION BY PIPELINE

TABLE 23: AN AGGREGATED SOCIAL ACCOUNTING MATRIX (SAM) FOR 2000

	Receipts	Expenditures								
		Activities	Commodities	Labor	Capital	Households	Government	Capital A/C	ROW	Total Receipts
1	Activities		3992805						2203375	6196180
2	Commodities	2350152				2379682	260335.7	303171.7		5293342
3	Labor	319958.4								319958.4
4	Capital	3393619								3393619
5	Households			319958.4	3393619					3713577
6	Government	132450.8								132450.8
7	Capital A/C					1333895	-1030723			303171.7
8	ROW		1300537				902838.5			2203375
9	Total Expenditure	6196180	5293342	319958.4	3393619	3713577	132450.8	303171.7	2203375	

APPENDIX B: FIGURE APPENDIX

Figure 1: Calibration and Simulation Procedures with CGE Models

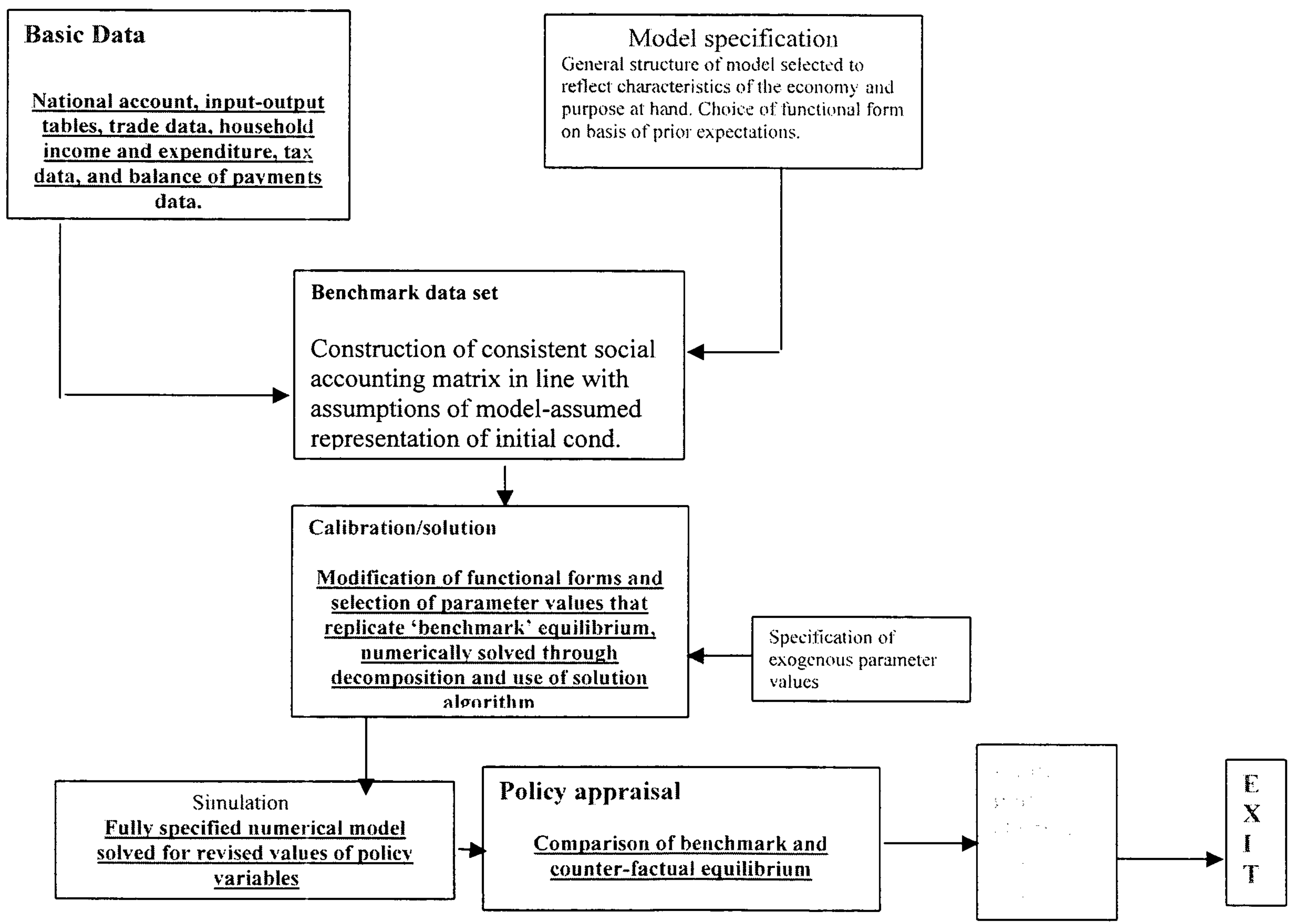


Fig. 2

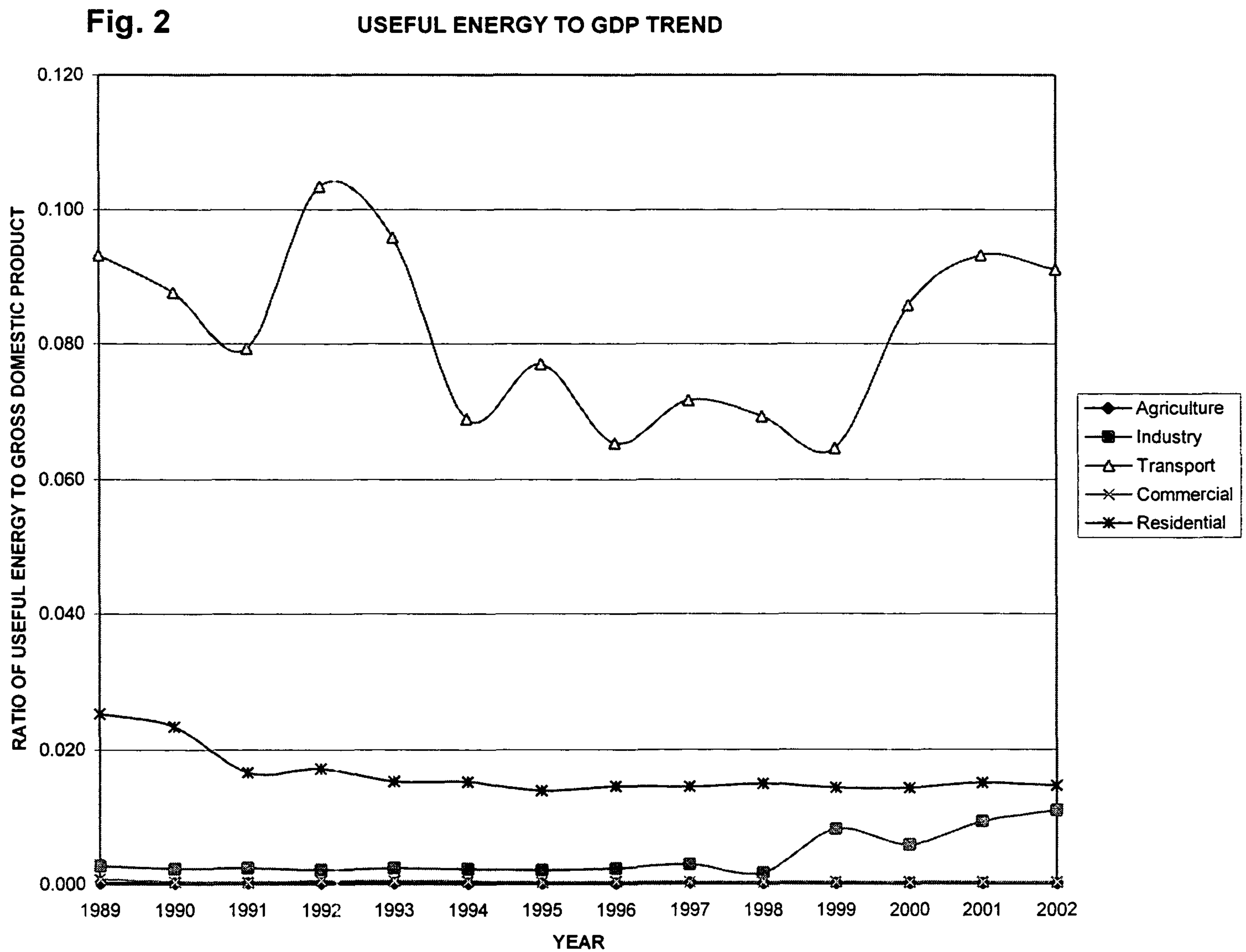

USEFUL ENERGY TO GDP TREND
RATIO OF USEFUL ENERGY TO GROSS DOMESTIC PRODUCT
0.120
0.100
0.080
0.060
0.040
0.020
0.000
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
YEAR
Agriculture
Industry
Transport
Commercial
Residential

Fig. 3 USEFUL ENERGY FOR AGRICULTURAL SECTOR

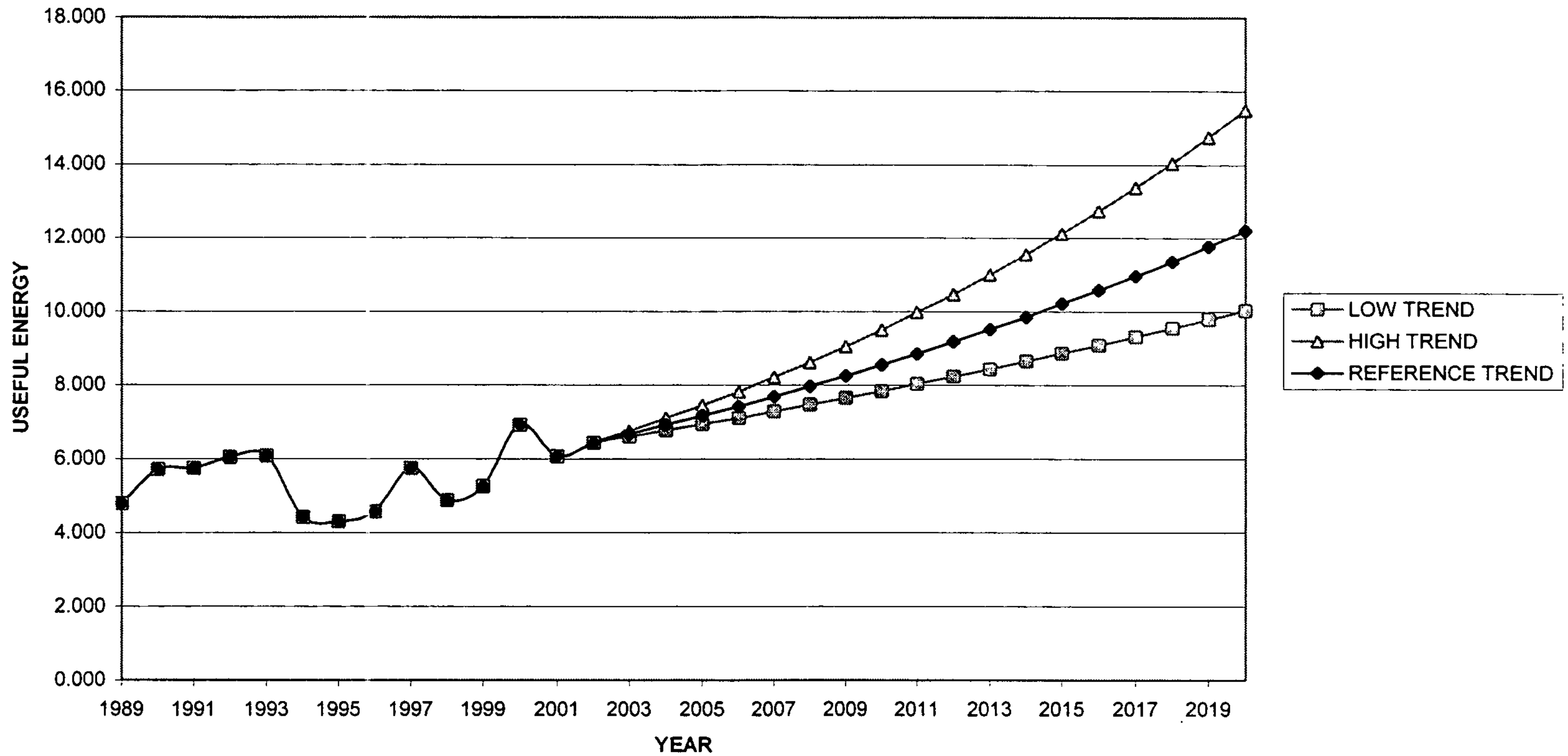


Fig. 4 USEFUL ENERGY FOR INDUSTRY

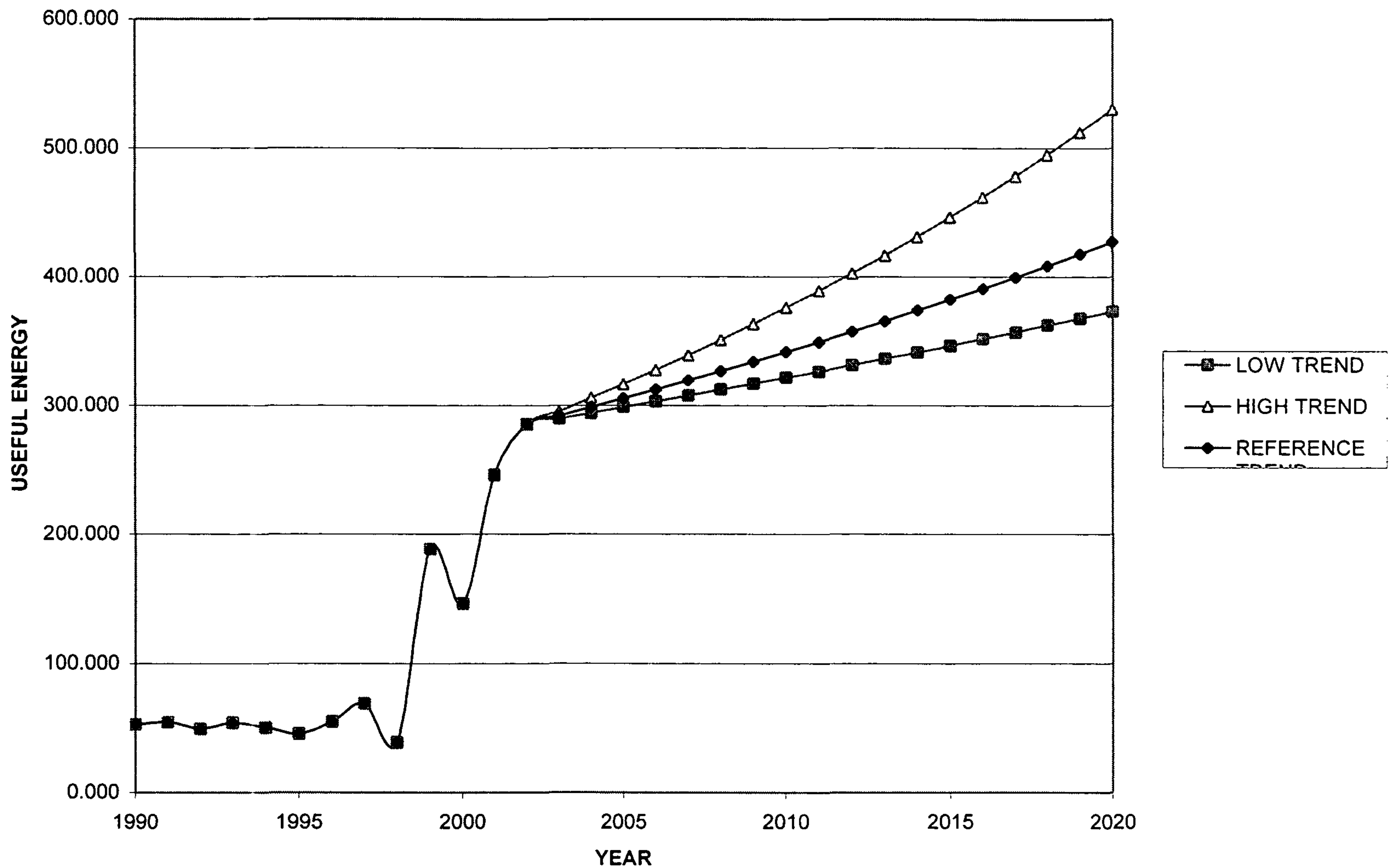


Fig. 5 USEFUL ENERGY FOR TRANSPORT

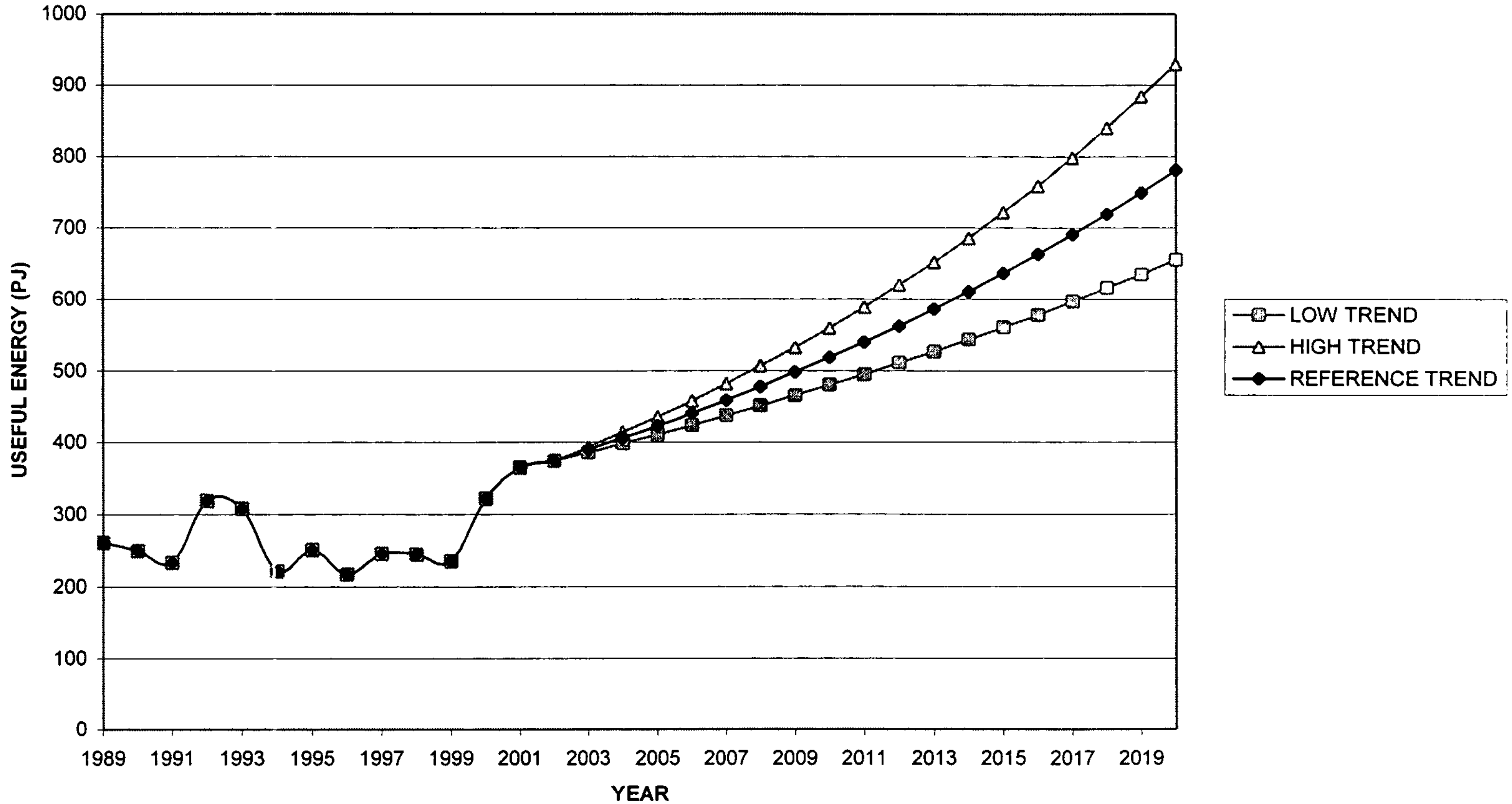


Fig. 6 USEFUL ENERGY FOR COMMERCIAL SECTOR

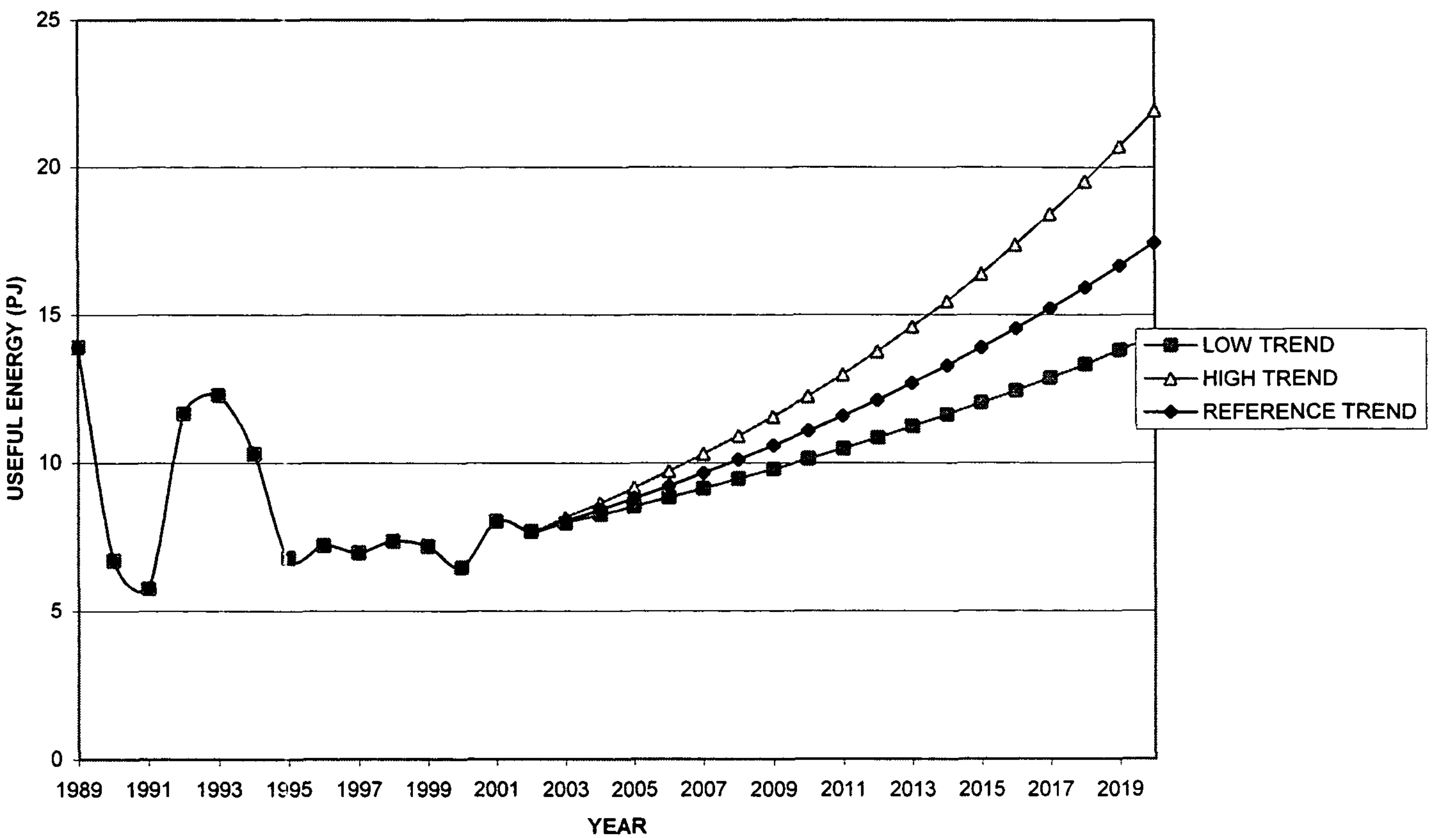
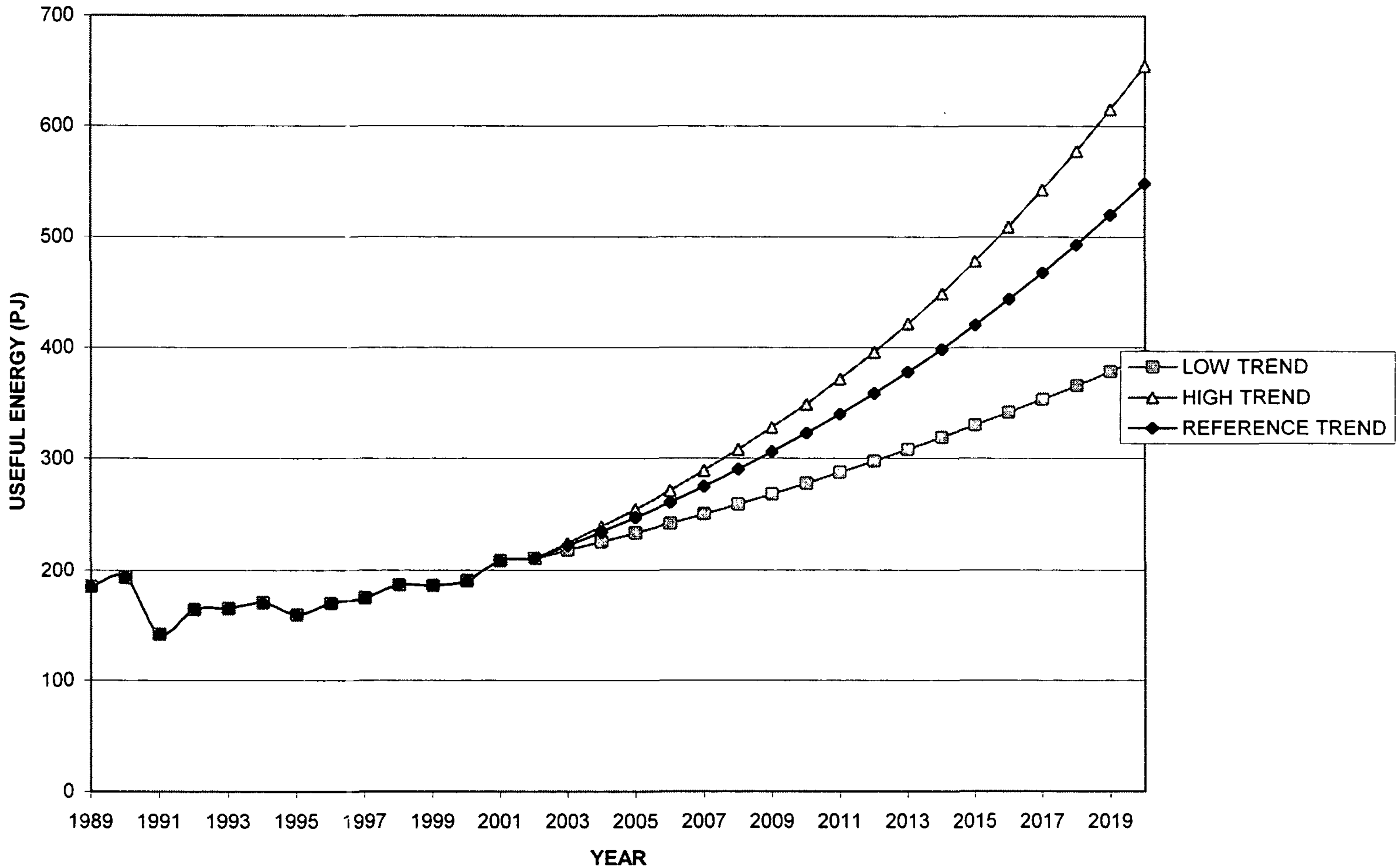


Fig. 7 USEFUL ENERGY FOR RESIDENTIAL SECTOR



APPENDIX C: THE NIGERIAN CGE MODEL

THE NIGERIAN MODEL

I. Price Determination Block

(1) $Pm_i = Pw_i\,(1 + tm_i + td_i + vat_i)er$; $(i = 1,....8)$

(2) $P_i = CES\,(Pd_i(1 + td_i + vat_i), Pm_i)$; $(i = 1,....8)$

(3) $Pe_i = Pwe_i\,(1 + te_i + td_i - se_i)er$; $(i = 1,....8)$

(4) $Pe_i = Pd_i;\ E_i\ ?0$; $(i = 1,....8)$

(5) $Pwe_i = [Pd_i/(1 + te_i + td_i - se_i)er]$; $(i = 1,....8)$

(6) $Px_i = CET(Pd_i, Pe_i)$; $(i = 1,....8)$

(7) $Pn_i = PX_i - ?_j a_{ji}P_j - td_iP_i)$; $(i = 1,....8)$

(8) $PINDEX = ?\,u_iP_i$; $(i = 1,....8)$

II. Production and Factor Demand Block

(9) $X^s_i = A_i\,CES(K^d_i, L^d_i)$; $(i = 1,....8)$

(10) $N_{ji} = a_{ji}X^s_i$; $(i,j = 1,..8)$

(11) $L^d_i = L^d_i(Pn_i, w_i)$; $(i = 1,....8)$

(12) $w_i = Pn_i(X^s_i/L_i)$; $(i = 1,....8)$

(13) $K^d_i = K_i(Pn_i, r_i)$; $(i = 1,....8)$

(14) $r_i = Pn_i(X^s_i/K_i)$; $(i = 1,....8)$

III. Foreign Trade Block

(15) $E_i = E_i[Wp_i/Pwe_i]^{ni}$; $(i = 1,....8)$

(16) $M_i = [[?\,i/(1-?\,i)]^{?\,i}Pd_i/Pm_i]^{?\,i}]D_i$; $(i = 1,....8)$

(17) $?_iPm_iM_i - ?_iPe_iE_i - F\^{} = 0$; $(i = 1,....8)$

(18) $Fs = (?_iPw_iM_i - ?_iPwe_iE_i + DC)er$; $(i = 1,....8)$

IV. Income and Absorption Block

(19) $py = ?_iw_iL^d_i + ?\,r_iK^d_i$; $(i = 1,....8)$

(20) $py^d = (1-ty)py$

(21) $ps = psrpy$

(22) $prcon_i = P_i^{-1} b(py^d - ps)$; $(i = 1,....8)$

(23) $Gr = typy + ?_i td_i P_i X^s_i + ?_i (tm_i Pw_i M_i) er +$
$?_i (vat_i Pw_i M_i) er + ?_i (te_i Pwe_i E_i) er$; $(i = 1,....8)$

(24) $Ge = ?_i P_i G_i + P_i Gvat + w_g L^d_g +$
$?_i sb_i P_i X^s_i + ?_i (se_i Pwe_i E_i) er$; $(i = 1,....8)$

(25) $Gvat = ?\, Rvat$

(26) $Gs = Gr - Ge$

(27) $I^t = ?_i P_i Inv_i$; $(i = 1,....8)$

(28) $Ts = S_p + Gs + Fs$

(29) $I^t - Tsav = 0$

(30) $C_i = prcon_i + G_i$; $(i = 1,....8)$

(31) $V_i = ?_j a_{ij} X_j$; $(i,j = 1,....8)$

(32) $?_i D_i = ?_i u_i [(Inv_i + C_i + V_i - Mc_i) P_i]$; $(i = 1,....8)$

(33) $u_i = 1/f_i(M_i/D_i, 1)$; $(i = 1,....8)$

(34) $X^d_i = D_i + E_i$; $(i = 1,....8)$

V. Model Closure and dynamics

(35) $X^d_i - X^s_i = 0$; $(i = 1,....8)$

(36) $L^d_i ?L^s_i$; ; $(i = 1,....8)$

(37) $K^d_i ?K^s_i$; $(i = 1,....8)$

(38) $w_i = w_i^\wedge$; ; $(i = 1,....8)$

(39) $r_i = r_i^\wedge$; ; $(i = 1,....8)$

(40) $Trin_{t+1} = Tsav_t / P_t$

(41) $Srin_{t+1} = Trin_{t+1} V_t$

B. Equations for Import Restrictions

(42) $Mv = ?_i Pw_i M_i$; $(i = 1,....8)$

(43) $Rm = Tfex/Mv$; $(i = 1,....8)$

(44) $Ma_i = Rm.M_i$; $(i = 1,....8)$

Definition of Variables and Parameters

Pm_i = domestic price of imported commodities (competitive and non competitive);

Pw_i = world price of imports in dollars;
Pxi = average producer price;
tm_i = tariff rate on imports;
se_i = export subsidy;
er = exchange rate;
vat = value added tax rate;
P_i = price of composite commodities;
Pd_i = domestic good price;
td_i = sectoral indirect tax rate;
Pe_i = domestic currency receipts of exporters per unit of exports from sector I;
Pwe_i = world "dollar" supply price of domestic exports;
te_i = export taxes;
E_i = sectoral exports;
M_i = sectoral imports (Competitive and non-competitive);
Pn_i = sectoral net or value added price;
a_{ij} = technological coefficients;
PINDEX = aggregate price index;
X^s_i = sectoral gross output supplied;
X^d_i = sectoral gross output demand;
CES = constant elasticity of substitution;
CET = constant elasticity of transformation
A_i = sectoral productivity parameter;
K^d_i = sectoral capital stock demand;
K^s_i = sectoral capital stock supply;
L^d_i = sectoral labour demand;
L^s_i = sectoral labour supply;
N_{ji} = intermediate inputs;
w_i = per unit sectoral wage cost;
r_i = per unit sectoral rental price of capital;
Wp_i = average world price for export goods;
^{P}= price elasticity of export demand;
? i = share parameter in the CES trade aggregation function;
? i = the trade substitution elasticity;

D_i = sectoral domestically produced commodities;
py = nominal private income;
ty = direct taxes;
py^d = nominal private disposable income;
ps = private savings;
psr = savings rate;
$prcon_i$ = private real sectoral consumption expenditures;
Gr = government revenue;
Ge = government expenditure;
G_i = real sectoral government consumption expenditure;
Gvat = sectoral real Vat induced increase in government consumption expenditure;
Rvat = real value added revenue;
? = government consumption expenditure shares;
w_g = per unit government wage cost;
L^d_g = government labour demand;
Gs = government savings;
Fs = foreign savings;
sb_i = sectoral subsidies;
Dc = total (domestic and foreign) debt charges;
I^t = total nominal investments;
Inv_i = vector of real investment demand;
Ts = total savings;
C_i = sectoral real consumption demand;
V_i = sectoral demand for composite intermediate inputs;
u_i = sectoral domestic use ratio;
Mc_i = sectoral competitive imports;
f_i = CES trade aggregation function;
LES = linear expenditure system;
F^ = exogeneous value of net foreign capital inflow;
$Trin_{t+1}$ = total real investible funds in time t+1;
$Tsav_t/P_t$ = real total savings in time t;
P_t = weighted sum of sectoral prices in time t;
$Srin_{t+1}$ = sectoral allocation of real investible funds in time t+1;

V_t = sectoral investment coefficients in time t;
Mv = total value of desired imports;
Rm = ratio of total foreign exchange available for imports to desired imports (overall excess import demand parameters);
Tfex = total foreign exchange available for imports;
Ma_i = sectoral actual realized imports