

**“THE NIGERIAN PETROLEUM
REFINING INDUSTRY:
HISTORY, PROBLEMS AND
POSSIBLE SOLUTIONS.”**

**A LECTURE DELIVERED AT THE
CENTRE FOR GAS, REFINING AND
PETROCHEMICAL ENGINEERING
INSTITUTE OF PETROLEUM
STUDIES,
UNIVERSITY OF PORT
HARCOURT.**

By

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OUTLINE.

- INTRODUCTION.
- Historical survey of the establishment of the Refining Industry
- A Review of the current state of the Nigerian refineries and the industry .
- To identify the current problems and the main reasons for the poor performance of the industry.
- To propose possible solutions



Photo: The New Port Harcourt Refinery at Alesa-Eleme, 1989.

THE PETROLEUM INDUSTRY

- UPSTREAM SECTOR-exploration, production,drilling,crude oil trunk pipelines and crude oil export terminals.
- MIDSTREAM SECTOR- refineries, petrochemical plants, crude oil supply pipelines, products' storage depots, products' pipelines from refineries.
- DOWNSTREAM SECTOR- products' marketing, sales & distribution; retail sales and marketing.

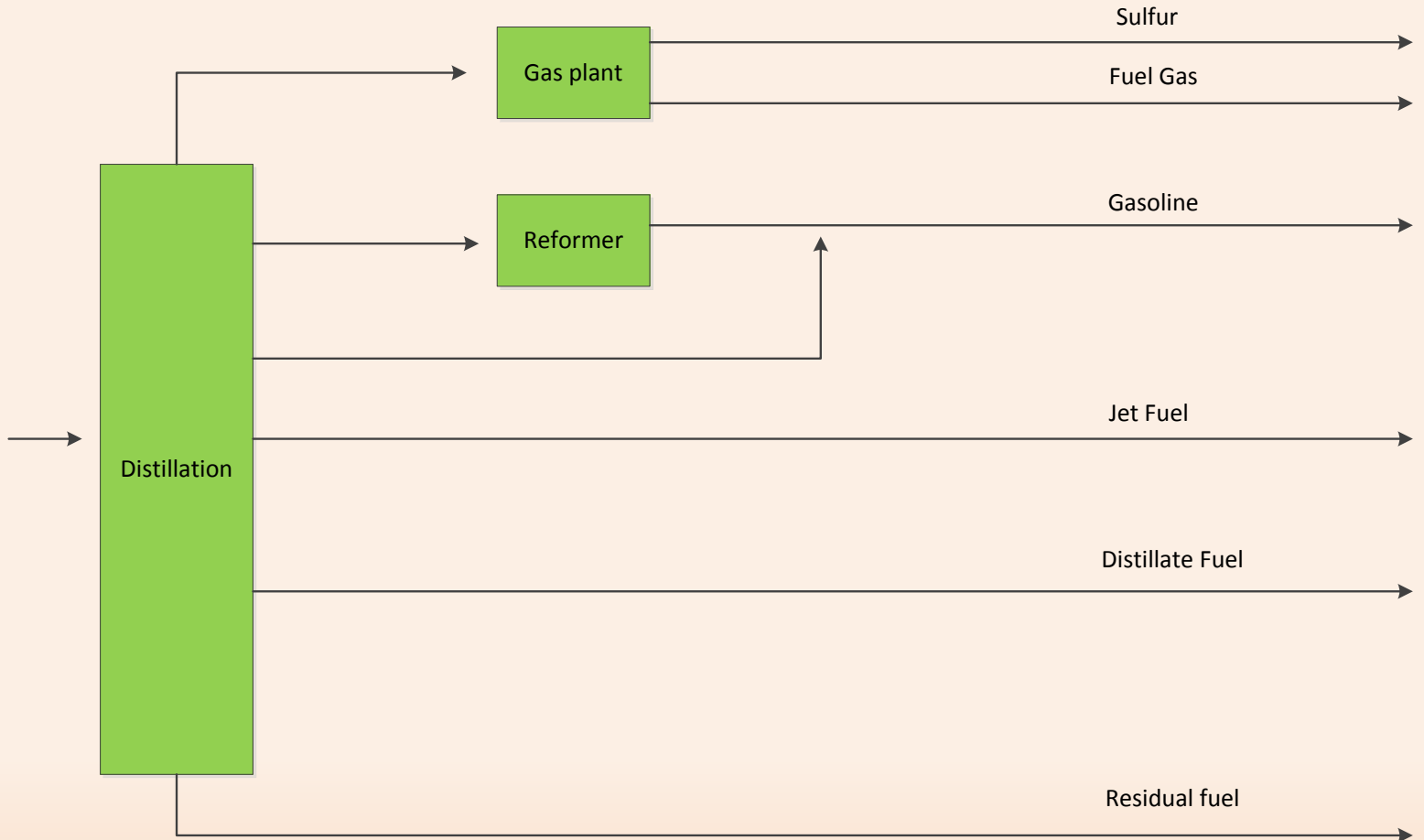
THE NIGERIAN REFINING INDUSTRY

- COMPRISES THE THREE NNPC REFINERIES AT PORT HARCOURT, WARRI, KADUNA, and 2 private refineries, NDPC Ogbale & DANGOTE refinery & petrochemical complex, (under construction), INCLUDING THE FACILITIES FOR TRANSFERRING THE PRODUCTS TO THE MARKETING COMPANIES.
- CRUDE OIL IS SUPPLIED TO THE REFINERIES BY PIPELINES FROM CRUDE OIL EXPORT TERMINALS AT BONNY, AND ESCRAVOS.
- PETROLEUM OIL PRODUCTS FROM REFINERIES CONSTITUTE THE DOMINANT COMPONENT OF NIGERIA'S PRIMARY ENERGY MIX AND ACCOUNT FOR 67% NIGERIA'S ENERGY CONSUMPTION.

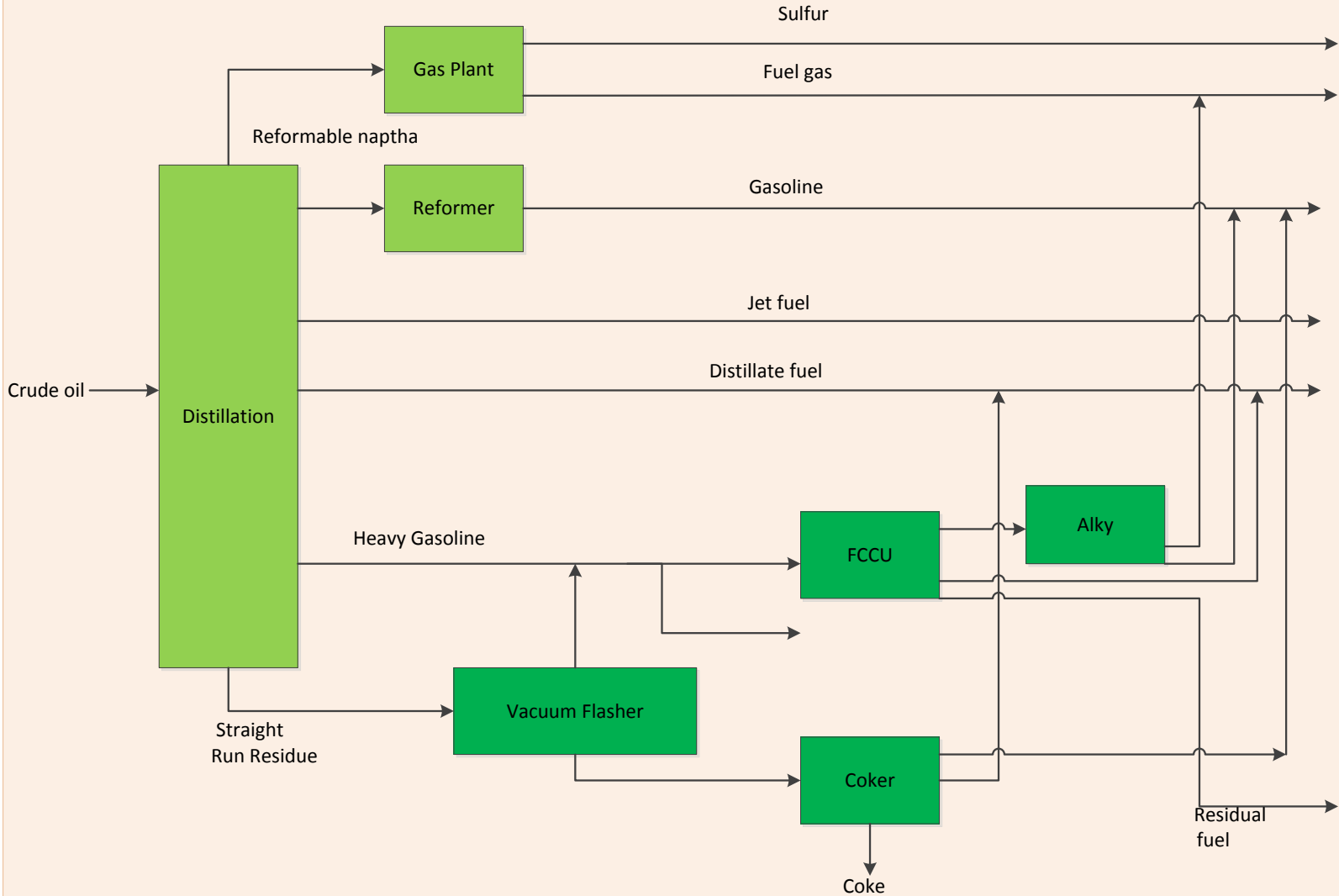
DEFINITION OF BASIC CONCEPTS

- REFINERIES ARE CHARACTERISED BY:
 - TYPE OF PRODUCTS, i.e. fuels, lubes or naphtha for cracking in a petrochemical plant.
 - COMPLEXITY, configuration, i.e. type of secondary conversion units are used.
 - SIZE, i.e. how much crude is processed.
 - MARKET FOCUS, i.e. what type of crude and products slate.
 - TURNAROUND MAINTENANCE OR TAM.

Simple refinery



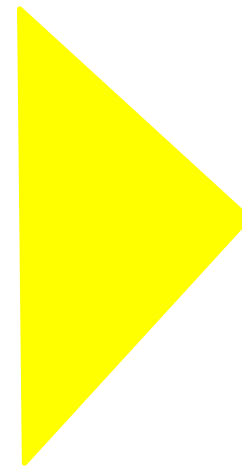
Complex refinery (Typical North America coking/FCC/Alky refinery)



Fluid catalytic cracker unit, also called an FCC or fluid catalytic cracker

IMPACT OF COMPLEXITY ON YIELD

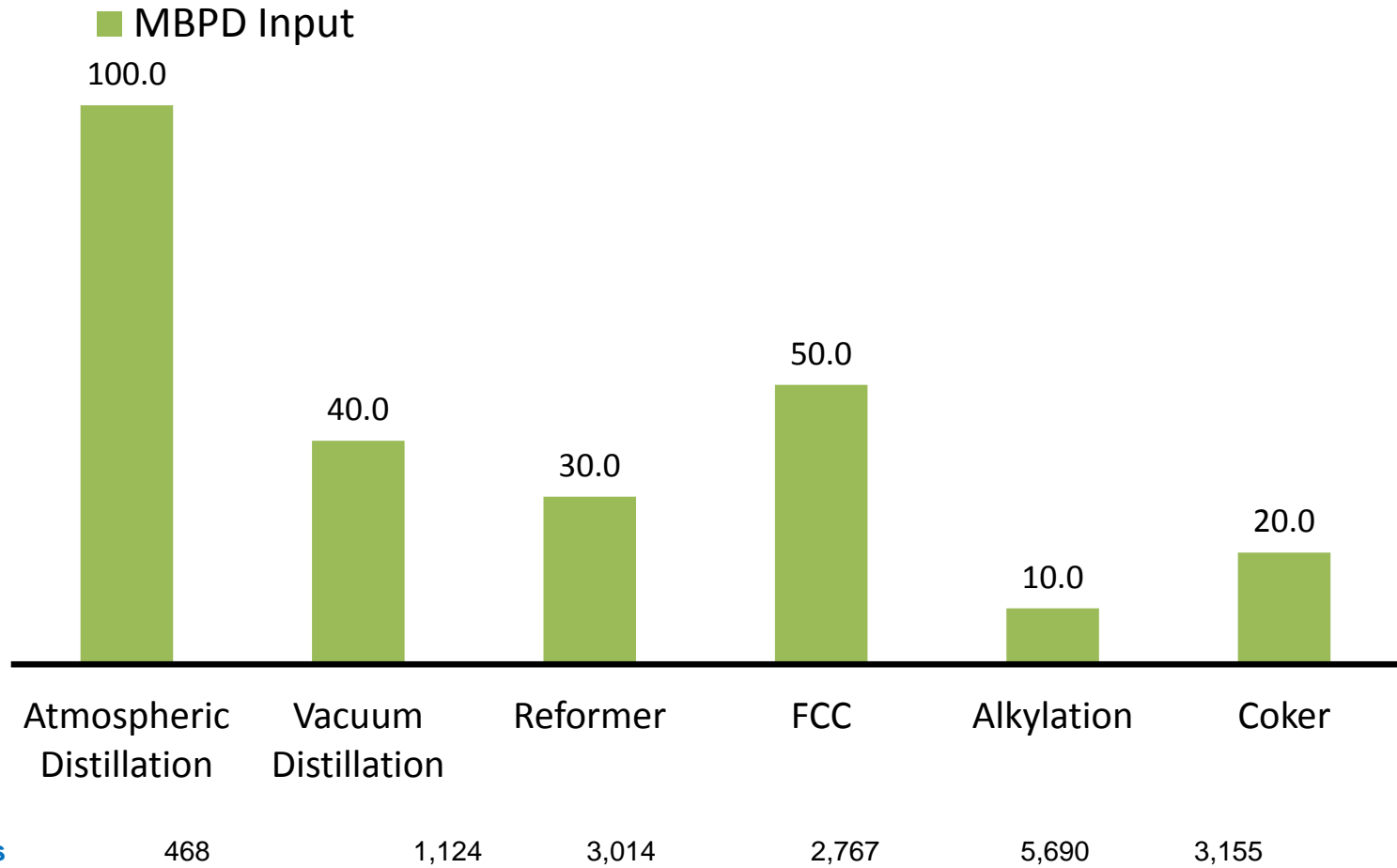
Refinery configuration type	Refinery process unit present					Typical light product yield ¹ %volume
Topping	■					30
Hydro skimming	■	■				50
FCC	■	■	■			70
FCC/alky	■	■	■	■		75
Coking	■	■	■	■	■	85
	Distillation	Reformer	FCC	Alky	Coker	



- More complex refineries produce more high-value light product
- This topic will be covered in more detail in the refinery economics presentation

¹ Actual yield is also dependent on the crude type/quality
SOURCE: McKinsey team analysis

Typical Refinery Unit sizes



(in 2000 \$/BPD)

BASIC CONCEPTS CONTD: CRUDE OIL SUPPLY.

- CRUDE OIL IS PRIMARY FEEDSTOCK,
SUPPLIED BY:
 - PIPELINE,
 - OCEAN TANKERS, OR
 - LARGE RIVER BARGES.

PRODUCTS EVACUATION STRATEGY.

ENSURES REFINERY OPERATES CONTINUOUSLY OVER A PLANNED PERIOD, BY

- EVACUATING PRODUCTS PROMPTLY FROM STORAGE TANKS THROUGH PIPELINES, ROAD TANKERS, OCEAN TANKERS AND RAIL TANKERS TO MARKETERS.
- TO AVOID EMERGENCY SHUT DOWNS.

HISTORICAL SURVEY OF THE NIGERIAN REFINING INDUSTRY.

- 1908: Preliminary Exploration started by Shell.
- 1935: Shell Darcy Petroleum Company commenced continuous activities.
- 1958: Oil discovered in commercial quantities in Oloibiri by Shell
- 1960: Two major marketing companies Shell and BP established NPRC (Nigerian Petroleum Refining Company) as a 50/50 Joint venture.
- 1965: NPRC completed the first refinery in Nigeria at 38,000b/d at a cost of £12million
- Crude oil processed in the refinery came from the Shell –BP crude oil pipeline (TNP) to Bonny Terminal.

HISTORICAL SURVEY OF THE NIGERIAN REFINING INDUSTRY.

- 5 marketers owned the crude oil and products processed by NPRC
- 1970: Federal Government Compulsorily acquired 60% equity in all International Oil Companies operating in Nigeria, including NPRC .
- No change in NPRC operations, policies and strategies until 100% equity acquisition in 1978.
- 1973: NPRC Refinery Debottlenecked from 38,000b/d to 60,000b /d

NNPC REFINERIES DIVISION

- 1977, New Decree 77 was promulgated to establishing NNPC.
- Refineries Division, one of 5 divisions of the new NNPC was created & headed by a General Manager.
- Refineries Division was responsible for policy, projects implementation and coordination of all petroleum refining functions and activities.
- General Manger Division was also the Chairman of NPRC Board.

NNPC REFINERY PORT HARCOURT,

- In 1978, Federal Government acquired the remaining 40% equity of Shell and BP in NPRC & its name changed to NNPC Refinery Port Harcourt.
- New Organizational structure was established by NNPC . NPRC Chief Executive Officer 's title changed to Managing Director and reported to General Manager Refineries, NNPC Corporate Headquarters, Lagos.
- Major policy and operational strategy changes occurred to bring the Refinery Management under NNPC Corporate Supervision.
- Bureaucratic style of Management gradually replaced the commercial business type– Refinery became a cost centre for NNPC Operations, supplying all its products to PPMS for sales, marketing and distribution.

THE REFINERY PROJECTS AT WARRI, KADUNA AND PORTHARCOURT

- 1973 – 1974: First appearance of vehicle queues nationwide, showing the shortage of petroleum products, especially petrol
- Shortages resulted from sharp increases in demand due to:
 - a) Increase in economic activities after the end of the Nigerian Civil war,
 - b) 1975 Udoji Commission's salaries arrears awards, and 40-50% increases for all workers in public and private companies, including ministries and parastatals spurred a boom in ownership of cars and motor cycles.
- Beginning of the “Oil Boom “ - Federal Government began to earn large sums of foreign currency from oil
 - (a) result of higher oil prices
 - (b) increased production of oil. Government earnings came through payments of Royalties and Petroleum Profit Tax (PPF).

Federal Government commissioned BEICIP to carry out feasibility studies to:

- (a) determine national demand for petroleum products,
- (b) consumption pattern across the country and
- (c) number, size and type of new refineries needed to meet the national demand.

■ Feasibility Studies' Findings;

- a) Petroleum Products Demand was growing between 6 – 12% p/a for all products (petrol was the highest. LPG was the lowest at 6%).
- b) Two new grassroots refineries were needed as soon as feasible to meet the demand.
- c) It would always be cheaper to refine crude oil locally than import products.
- d) Consumption pattern was as follows: 45% in the West, 28% in the East and 27% in the North.

The following actions by the FGN resulting from the Feasibility report

- Warri Refinery project was awarded to Snamprogetti SPA of Milan in Nov. 1975 after an international bidding exercise. The capacity was 100,000b/d, cost was US\$478million for a 30 month project duration. The refinery was completed and successfully commissioned in September 1978.
- The Kaduna refinery Project was the second of the two new refineries the Federal Government decided to build. The choice of location was a strategic decision, since it was far inland from the source of crude oil supply. The refinery consists of two types of refining streams:
 - a) 50,000b/d for lubricating oils, waxes, asphalt and elemental sulfur production, and
 - b) 50,000b/d for fuels, LPG, PMS, DPK, Diesel & Fuel oil.

- The engineering, procurement and construction contract was awarded to Chiyoda Engineering and Construction Company of Japan in 1976 at a cost of US\$525million. The duration of Project was 36 months. The refinery was completed in September 1979 and commissioned soon thereafter.
- By 1980. the old PHR, Warri & Kaduna refineries were fully operational , and products' shortages persisted.
 - The 1974 BEICIP feasibility studies report was updated for demand and consumption pattern:
 - a) Consumption pattern remained virtually unchanged.
 - b) But additional refining capacity for fuel products, more the 200,000b/d was estimated.

- Federal Government decided to meet the new demand increases by
 - a) Debottlenecking the existing refineries at Warri and Kaduna. This option would be quicker, but the increase in capacity would be moderate, and
 - b) Constructing a new grassroots refinery at Port Harcourt, adjacent to the old refinery.
- The Debottlenecking projects were completed in 1985 for Warri Refinery from 100,000b/d - 125,000b/d and Kaduna Refinery fuels Plant from 50,000b/d – 60,000b/d.
- The new Port Harcourt Refinery with 150,000b/d was designed to include facilities for export of products in excess of domestic demand.

- Contract for design and construction was awarded to a consortium of JGC Corporation, Marubeni Corporation both of Japan and Spibatignolles of France in October 1985 at a total cost equivalent of US\$850million.
- Project was completed and refinery commissioned March 1989.
- In 1990 and 1991, the new Port Harcourt was able to export all types of Petroleum products in excess of domestic demand.
- The value of the exports were US\$124m in 1990 and US \$156m million in 1991.
- By the end of 1991, normal increases in domestic demand coupled with the decreasing production from Warri and Kaduna Refineries had stopped the exports from the new PH Refinery.

THE DECISIONS BY THE FEDERAL GOVERNMENT TO CONSTRUCT THREE NEW REFINERIES, 1975-1989.

- I believe the Federal Government took the correct decisions at the time, to undertake the projects because;
 - a) The investment and operating costs of any refinery project were too high for any local private company to undertake, regardless of the profitability of the enterprise. Moreover, none of the international oil companies operating in Nigeria was interested in establishing any new refineries in Nigeria at that time.
 - b) The economic stability of the country was seriously threatened by the acute shortage of the crucial fuel products. There were additional benefits realizable from that decision, such as
 - the importation of new technologies and skills,
 - creation of new jobs and
 - potential cost savings for the country's economy.

c) The feasibility studies for the new Port Harcourt refinery project had clearly demonstrated that it would always be cheaper overall, to refine the abundantly available local crude oils in Nigerian refineries located in the coastal areas than the importation of products for domestic consumption.

ANALYSIS OF THE PERFORMANCE OF THE NIGERIAN REFINERIES

There are standard criteria used in industry for measuring the performance of petroleum refineries. These include:

- The percentage capacity utilisation. This is the most common parameter used and it essentially measures the overall efficiency of utilization of the refinery.
- The actual products yield vis-à-vis design yields. This measures the efficiency of the processing units of the refinery.
- Historical safety records. Such records include the number, frequency and severity of different causes of accidents
- The refinery on-stream factors , measured for individual process units, as well as the entire refinery. These factors measure the continuity and reliability of the operations.

	Port Harcourt	Warri	Kaduna	Total
Capacity MTA	10.5	6.0	5.5	22
Age	1988	1978	1980	
Configuration	FCC/Ref	FCC/Ref	FCC/Ref	
Other Process	Dimersol/Alky	Carbon Black (18)/PP(13)	Lubes (450)/asphalt(300)/LAB (30)/Benzene(15)	
Crude Supply	P/L from Bonny	P/L from Escravos	P/L from Escravos thru Warri	
Design PMS	3.0	2.1	1.3	6.4
Design DPK	1.4	0.5	0.6	2.5
Design AGO	2.4	1.7	1.0	5.1

Table 1

Actual PMS or Petrol Consumption of Petroleum Products (Million Metric tons)

(Local Refineries Production + Imported Products)

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
PMS	3.7	5.1	6.4	6.6	6.4	6.2	7.2	6.4	6.1	5.6
AGO	2.3	3.0	2.6	2.9	2.6	N/A	N/A	N/A	N/A	N/A
KERO	1.5	1.8	2.1	1.5	1.5	1.1	1.3+ N/A	0.8+ N/A	0.4+ N/A	0.7+ N/A

Table 2a

NNPC Refineries Design Capacity for PMS/AGO/KERO

	PMS	AGO	KERO
Million Metric Tons/Annum	6.4	5.1	2.5

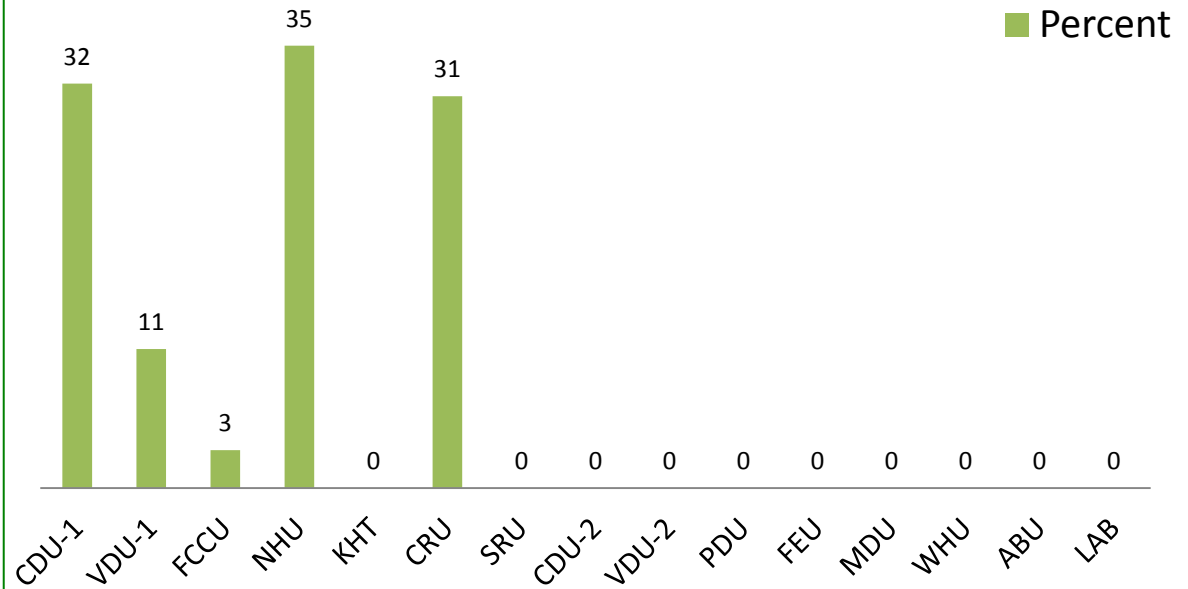
Table 2b

Kaduna Refining and Petrochemical Company

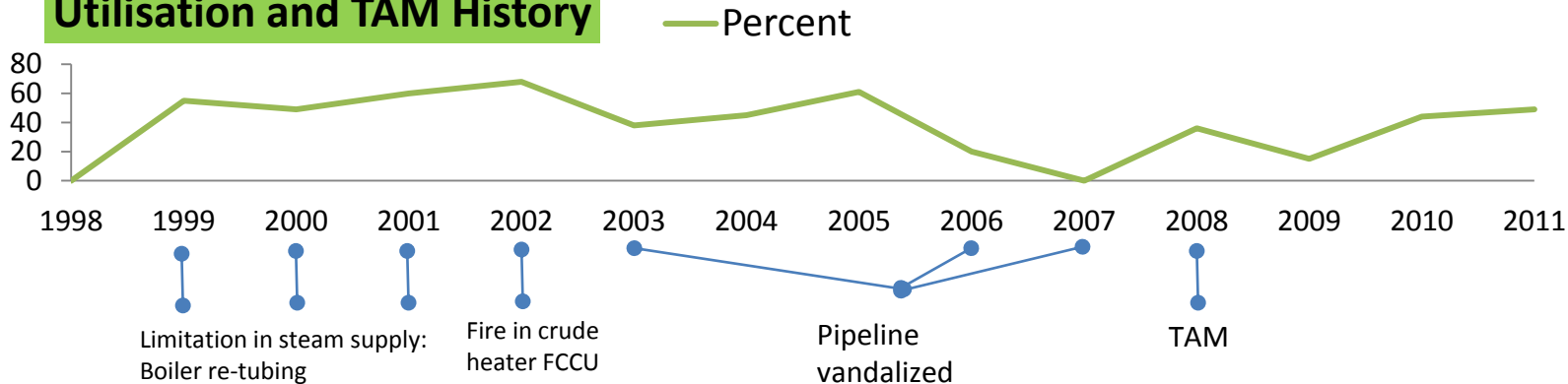
Overview

- Kaduna refinery started operations in 1980
- In 1985, Fuels was debottlenecked from 50 kbpd to 60 kbpd. This increased nameplate capacity to 110 kbpd
- Petrochemical plant established in 1988

Capacity Utilisation of Process Units, Q4 2011



Utilisation and TAM History



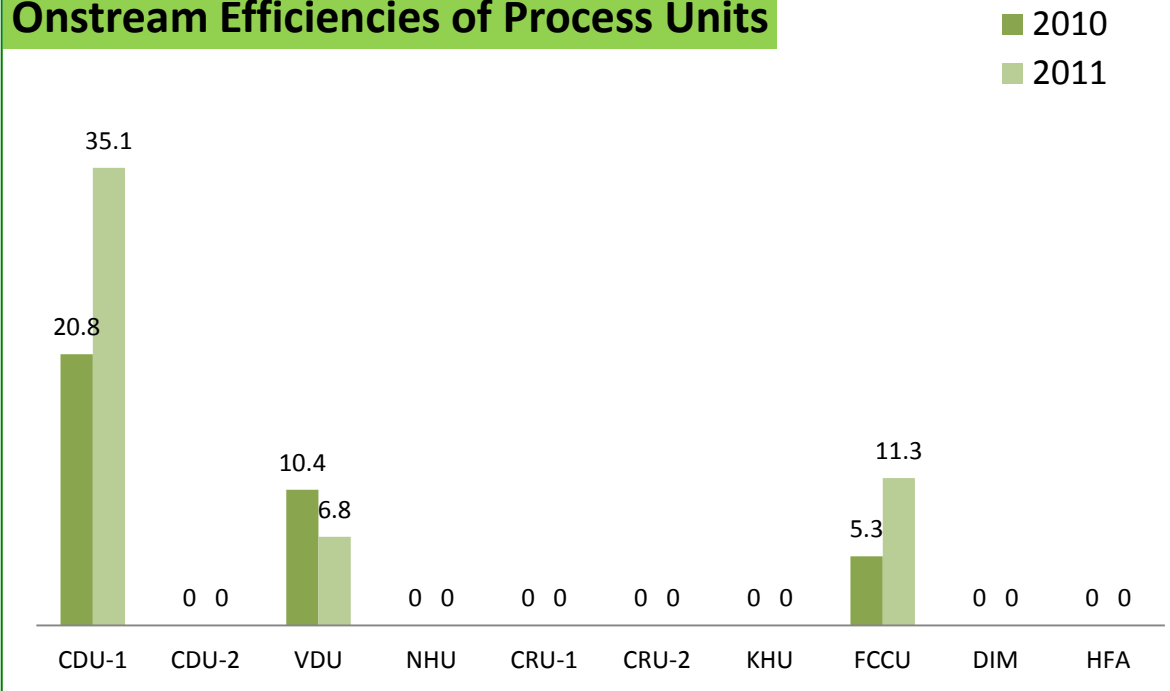
1 TAM in the period 1998 - 2011

Port Harcourt Refining Company

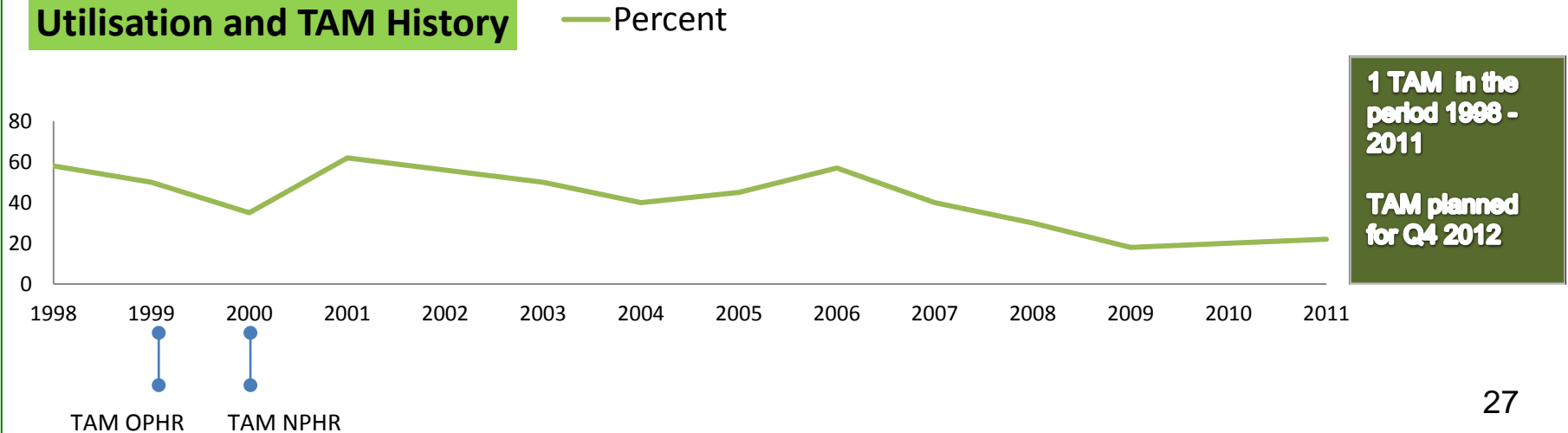
Overview

- PHRC operates two refineries
- The first refinery was acquired by NNPC in 1983 and the second was built in 1988
- The combined capacity of the refineries is 210 kbpd

Onstream Efficiencies of Process Units



Utilisation and TAM History

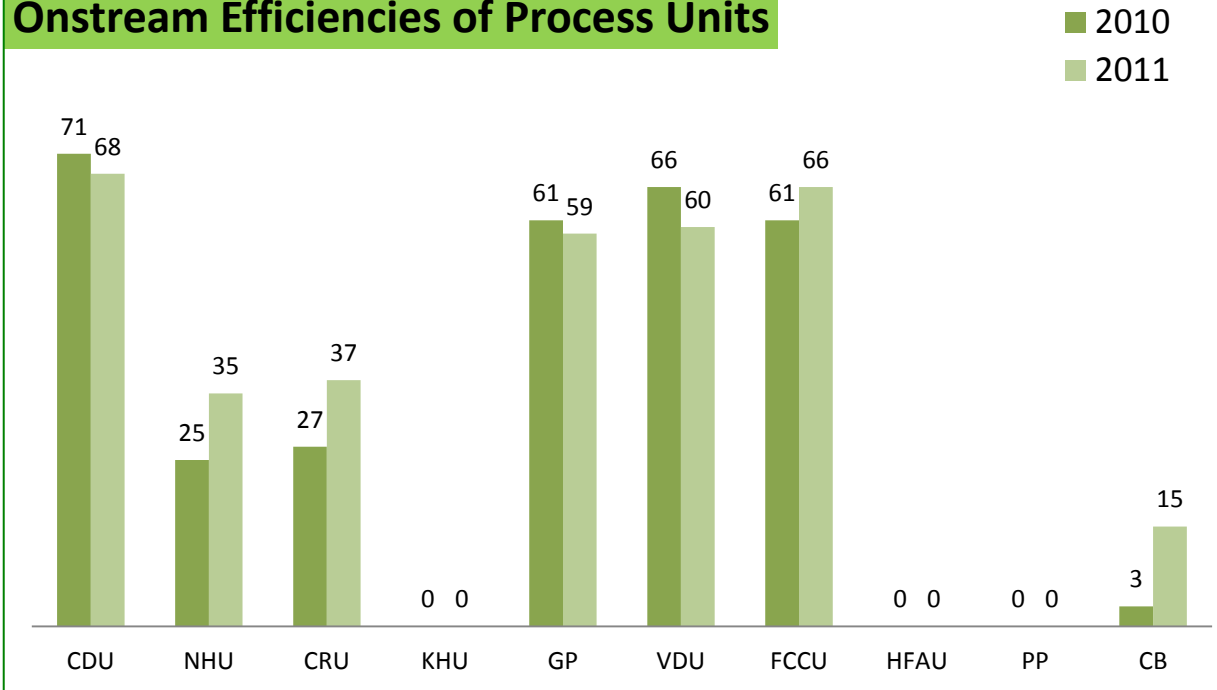


Warri Refining and Petrochemical Company

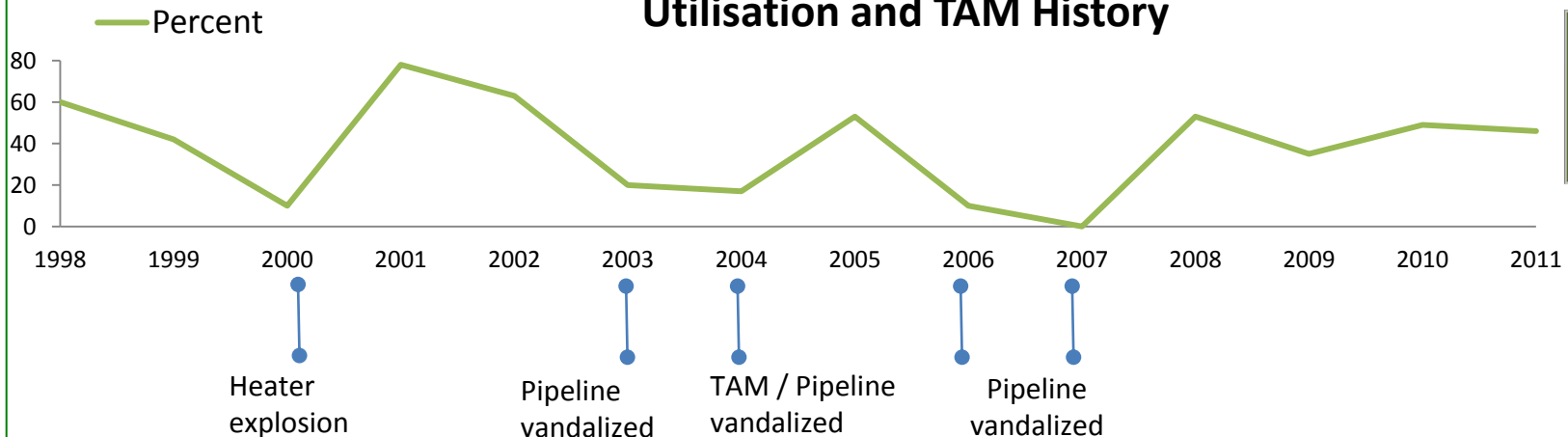
Overview

- Warri refinery started operations in 1978
- Initial capacity was 100 kbpd was debottlenecked to 125 kbpd in 1987

Onstream Efficiencies of Process Units



Utilisation and TAM History

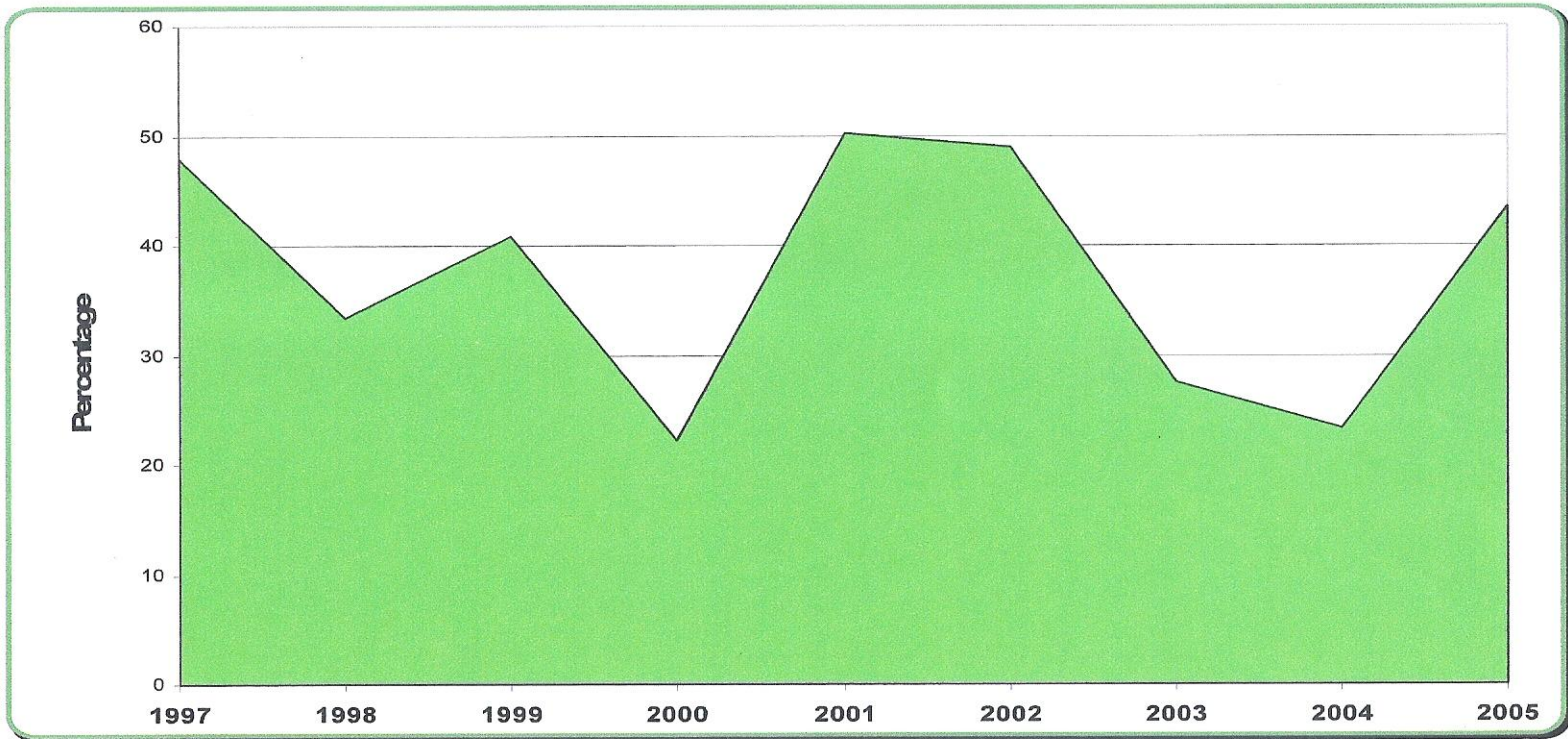


1 TAM in the period 1998 - 2011

The most comprehensive of these criteria, the percentage capacity utilization factor has been used to illustrate my findings in the Graphs and Tables below;

Figure 6

Refinery Capacity Utilization: 1997 - 2005



The situation of Nigerian downstream sector as compared with the rest of the world is shown in the table below

	NIGERIA	REST OF THE WORLD
Refineries Utilization	25 – 92%	92%
Product Supply	Product shortages, adulteration and leaded fuel	Mostly unleaded fuel by 2000. No product shortages & adulteration
Operating Cost	NNPC pays \$3/bbl including bridging & product distribution	\$1.7 - \$3/bbl
Productivity per man	10 Mmbbl/year	110 Mmbbl/year
Manpower	1,000 +	480 exclusive contract staff
Upgrading units	2	7
Petroleum products prices	Fixed by Government	Determined by market forces
Input losses	15%	0.4%
Chemical inputs	5.6%	3.9%
Salaries & Overdrafts	22%	15%
Repairs & Maintenance	15.5%	6.4%

(Reference: The complete Nigerian Petroleum Industry Report of E & A, 1998/99 edition)

ALL 3 NNPC REFINERIES CAPACITY UTILIZATION 1997 – 2008

YEAR	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CAPACITY UTILIZATION %	48.0	33.4	40.9	22.3	50.2	49.0	27.6	23.4	43.5	20.2	14.8	24.11

Table 2a

NEW PORT HARCOURT REFINERY ONLY

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
CAPACITY UTILIZATION %	66	93	90	76	85	58	76	58.4	69	54.3
YEAR	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CAPACITY UTILIZATION %	55.7	31.1	60.7	51.4	50.5	30.7	38.1	45.7	23.8	48.5

Table 2b

THE PROBLEMS OF NIGERIAN REFINERIES

The problems are presented as follows:

■ **Inadequate Funding and Autonomy**

1. Managing Directors' inability to secure adequate working capital from the NNPC Corporate Headquarters.
2. Managing Directors' inability to exercise full autonomy to commit the required funds, as necessary to procure chemicals, and catalysts, equipment spare parts, other plant consumables and contract out services from suppliers and experts. This is due to very low limits of financial authority from the NNPC Corporate Headquarters.
3. The bureaucratic process of approvals, which in some instances required a many as 27 signatures to get critical maintenance spend signed off.

- These problems originated from the centralisation of powers at the NNPC Corporate Headquarters in Lagos and later in Abuja , away from the refineries' operations.
- These problems affect all activities of the refineries directly or indirectly in varying degree of severity.
- The approval processes do not have time limits. They may take a long (up to 6months) or relatively short time (within a few weeks).

- **Lack of proactive governance**

As cost centers instead of profit centers,

- The driving force to be efficient and profitable disappeared with the full acquisition of NPRC.
- Due to NNPC bureaucratic system, sustaining high level of staff morale continuously had become a serious and perennial challenge to management

- **Poor Maintenance of the Refineries**

- Shortage of spare parts as required
- Lack of systematic maintenance activities
- Ineffective supervision of activities due to depletion of experienced staff through compulsory mass retrenchment.

- **Serious Political Interference by the Federal Government**

- This could take any form from staff matters (appointments, recruitments, promotions and compulsory mass retirements), procurement issues, award of contracts etc.
- These undue influences which constitute a heavy burden and distraction to the business would not exist, if the refineries were privately owned. Corrupt practices were easily perpetuated under such circumstances.

- **Absence of Competition due to Uniform Pricing of PMS**
 - The Federal Government's mandated uniform pricing of petrol and the making the refineries a cost centre instead of a profit centre have effectively eliminated all competition among the refining companies.
 - These two policies are also responsible for the overall reduction of efficiency and for eliminating any staff incentive for innovation in the refineries.
- **Serious Political Interference by the Federal Government**
 - This could take any form from staff matters (appointments, recruitments, promotions and compulsory mass retirements), procurement issues, award of contracts etc.
 - These undue influences which constitute a heavy burden and distraction to the business would not exist, if the refineries were privately owned. Corrupt practices were easily perpetuated under such circumstances

■ **Ineffective Technical services Departments**

Depletion of experienced staff through arbitrary transfer or mass retrenchment, without proper and timely replacement.

- Inadequate training for newly recruited staff.
- Failure to monitor and timely correct minor operational deficiencies in equipment and systems , to ensure continuous satisfactory performance
- Inability to make necessary improvements or innovate as necessary.

■ **Frequent Emergency Shutdowns of Units or entire refineries.**

- Caused thermal shocks to equipment, especially those operated at high temperatures
- Metallurgical stress failures were common causes of equipment failures.
- Loss of production

SUMMARY OF THE ROOT CAUSES OF POOR REFINERIES' PERFORMANCE.

- POOR OPERATIONAL PERFORMANCE.
- MAINTENANCE NEGLECT.
- INADEQUATE FUNDING.
- ORGANIZATION & GOVERNMENT INTERFERENCE.
- REFINERIES BUSINESS MODEL- COST BASED RATHER THAN PROFIT-BASED.
- VANDALISATION OF CRUDE OIL & PRODUCTS PIPELINES.

Conclusion

NNPC Refineries historically performed satisfactorily, as designed only for about 5 years after initial commencement, for each new refinery. Thereafter performance gradually declined for the reasons stated above, especially when compared to international standards.

DANGOTE REFINERY & PETROCHEMICAL COMPLEX

- Currently under construction.
- 650,000 barrels per day, integrated grassroots refinery and petrochemical complex, located in the Lekki Free Trade Zone LAGOS.
- Will use UOP licensed technology for Crude distillation unit, Resid fluid cracker, RFCC; Continuous catalytic reformer, CCR; Unicracker and Penex.

NRSTF Recommendations & Way forward-I

- **Nigerian Refineries:** Existing NNPC owned refineries should be Privatized within 18 months since the current ownership and business model led to the sub-optimal performance of the refineries.
- **Pricing:** Fully deregulate prices in the Downstream Sector prior to privatization. (Palliatives needed to ameliorate the socio-economic burden on the populace.)
- **Supply & Distribution Network:** A new commercial company of NNPC should be established to take over the assets of PPMC. The company will concession aspects of the terminal, depot and operations to franchisees, while protecting national interests.

NRSTF Recommendations & Way forward-II

- **Offshore Refining Scheme:** The balance of the unrefined 445,000 barrels per day crude oil allocation should be refined by a new independent arrangement to meet the national demand of PMS and DPK. Therefore NNPC refineries should be supplied only crude oil that they can refine.
- **Security:** Government is urged to deal decisively with the security issues impacting so negatively the industry within the period of the reform.
- **Implementation Plan:** The implementation plan should be driven by a focused team sponsored at the highest level of government.

Implementation Plan

- **Implementation Strategy:**
- Self-sufficiency in petroleum products.
- Transform Nigeria into an Export Hub for petroleum products in West Africa.
- **Implementation Timelines** categorized into Short, Medium & Long-Term Implementation Milestones.
- **Set up a dedicated Implementation Team** to assist the Honorable Minister implement the reforms on a timely basis.
- **Integrate Risk and Mitigation plan** to get Stake-holder Buy-in.

THANK YOU FOR LISTENING !