African Refining Value Study
Presentation to the AGM
African Refiners Association
24th March 2014
• Soumendu is a Vice President in Wood Mackenzie’s Downstream consulting team.

• He has 18 years experience in the energy and natural resources sector, working on strategy, opportunity identification, market entry, transaction support, national policy development and operational assignments for private and public sector clients. Soumendu has worked on market entry plans for fuels depots in Africa, infrastructure studies in Africa as well as competitive assessments of mining and smelting/refining projects in Africa and the Middle East.

• Prior to joining Wood Mackenzie, Soumendu worked for CRA International in the UK and Middle East for 5 years, assisting host governments with retail service station privatization and national strategies on infrastructure development and industrial diversification.

• Previously, Soumendu worked for ExxonMobil for 10 years in a variety of operational and planning roles within the downstream sector in the UK, India and Singapore. This included market entry studies on LPG and Refining and retail fuels network planning responsibilities, retail site profitability analysis and implementing site acquisition and divestment programs across Asia Pacific.

• Soumendu graduated from the University of Cambridge with a Masters degree in Chemical Engineering.

• Chris is a member of Wood Mackenzie’s Downstream Consulting team based in London.

• Prior to this Chris gained 5 years experience within the downstream industry, working for BP and Petroplus at the Coryton Refinery in the UK. During this time Chris held roles in process engineering, providing technical support, operational optimisation and project development. Followed by a role in production planning, with responsibilities for setting and executing the refinery’s commercial plan, coordination between the refinery, trading, marketing, and shipping operations teams.

• Since joining Wood Mackenzie Chris has worked on a range of projects covering refining and storage industry valuation and opportunity screening, transaction support, fuels markets analysis, crude and feedstock valuation and business competitive assessments.

• Chris holds a First Class honours degree in Chemical Engineering from the University of Bath.
Our study demonstrates the impacts of African refineries on their host nations via a three-step process.

**Our overall 3 step approach**

1. **Characterise African Refining**
   - Confirm Subdivision of Africa
   - Develop Indicator Refineries

2. **Quantify the Value of Refining**
   - Refining Case
     - Analyse Economic Contribution
   - No-Refining (closure) case
     - Analyse Social Contribution

3. **Assess Policy Impacts**
   - Short-list Policy Levers Available
   - Assess Impact

What is the value contribution of the refining industry in Africa and what are the implications of the policy interventions available to host governments?
Value contribution from refineries is evaluated based on the host nation’s alternative

**Description of Approach**

- The contribution provided to various sources of value has been determined for African refineries.
- The difference between the existence and absence of an African refinery represents the incremental value contribution the refinery provides.
- Throughout this study, we compare the value from refineries with a corresponding ‘no-refinery’ case.

**Illustration of Approach**

\[
\text{Contribution of African Refinery} - \text{Contribution of Alternative Situation ("no-refinery case")} = \text{Incremental value of refining}
\]
We consider four indicative refining situations throughout to reflect the broad range of actual asset / country circumstances.

Quadrant approach to defining indicator refining situations:

- **HIGHER EARNINGS, LOWER HDI**
- **HIGHER EARNINGS, HIGHER HDI**
- **LOWER EARNINGS, LOWER HDI**
- **LOWER EARNINGS, HIGHER HDI**
We developed an xls model for members to estimate the socio-economic value contribution from their own assets

Overview of model available to members

- Refinery gate prices for crude and products
- Refinery capacity, yields
- Refinery staffing and salary levels
- Data on the local economy/society
- Type and level of any government support

- Refinery Net Cash Margin
- Total net job creation
- Refinery impact on local economy
- Net impact on local economy
- Net environmental benefits
Refining gives improved security of supply versus fuels imports

<table>
<thead>
<tr>
<th>Risk to supply</th>
<th>Refining</th>
<th>Importing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piracy</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Unfavourable marine conditions</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Trade embargos</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Competing markets</td>
<td>Lower</td>
<td>Higher</td>
</tr>
</tbody>
</table>
Refining can provide a springboard for broader industrial development via non-fuels production.

Potential integration opportunities downstream of refining:

- Domestic Goods
- Machinery/ Auto
- Construction
- Electronics
- Textiles & Sportswear

- Ethylene
- Propylene
- Butylenes
- Pygas

- Steam Cracker
- Aromatics Separation
- Lubes Unit
- Bitumen/ Asphalt Unit

- NGLs
- Light Naphtha
- Reformate
- VGO
- Residue

- PVC, EVA, VAM, Polyol, NBR, SBR, Butadien, Styrene, Aniline, Cumene, TDI, PET, PTA, PIA, p-X, o-X, m-X, Lubes, Wax, Bitumen
Refining can be environmentally beneficial by eliminating unnecessary tanker journeys and associated CO₂ emissions.

**Comparison of Shipping Distances in Crude and Refined Product Imports**

**Shipping Saving in Refinery Case =**

- **Crude Export +**
- **Refined Product Import –**
- **Crude Import Flow**

*Roundtrips mean that twice the number of shipping day savings are realised for each delivery*

- **Crude (Erha) Imports**
- **Refined Product Imports**
- **Crude Export Alternative**

Shipping Days at 14.4 Knots:
- 7.5 days from Rotterdam to Senegal
- 5.4 days from Senegal to Nigeria
- 12.9 days from Rotterdam to Nigeria
Direct job creation at refineries filters across society through indirect and induced multiplier effects

- An oil refinery supports job creation through three channels:
  - Firstly, the refinery employs people directly to run the refinery.
  - The operation of the refinery requires inputs from other industries, which also creates employment. This is called indirect employment.
  - Finally, both the direct and indirect employees spend their wages, supporting other businesses. This is called induced employment.
Refineries provide 500-1000 more graduate/highly skilled jobs than a similar capacity fuels import terminal

Source: Wood Mackenzie
We estimate the total job creation generated by a refining presence may reach up 10,000 in some countries.
Our analysis shows that social benefits from refining are evident for most nations, especially those with lower HDI.

<table>
<thead>
<tr>
<th>Value of refining?</th>
<th>Results of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides skilled employment opportunities</td>
<td>weak/less</td>
</tr>
<tr>
<td></td>
<td>strong/less</td>
</tr>
<tr>
<td></td>
<td>weak/more</td>
</tr>
<tr>
<td></td>
<td>strong/more</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
</tr>
<tr>
<td>Increases transparency</td>
<td>weak/less</td>
</tr>
<tr>
<td></td>
<td>strong/less</td>
</tr>
<tr>
<td></td>
<td>weak/more</td>
</tr>
<tr>
<td></td>
<td>strong/more</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
</tr>
<tr>
<td>Contributes to social stability</td>
<td>weak/less</td>
</tr>
<tr>
<td></td>
<td>strong/less</td>
</tr>
<tr>
<td></td>
<td>weak/more</td>
</tr>
<tr>
<td></td>
<td>strong/more</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
</tr>
<tr>
<td>Provides security of fuels supply</td>
<td>weak/less</td>
</tr>
<tr>
<td></td>
<td>strong/less</td>
</tr>
<tr>
<td></td>
<td>weak/more</td>
</tr>
<tr>
<td></td>
<td>strong/more</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
</tr>
<tr>
<td>Reduces environmental emissions</td>
<td>weak/less</td>
</tr>
<tr>
<td></td>
<td>strong/less</td>
</tr>
<tr>
<td></td>
<td>weak/more</td>
</tr>
<tr>
<td></td>
<td>strong/more</td>
</tr>
<tr>
<td></td>
<td>Summary</td>
</tr>
</tbody>
</table>

Summary:
- Strong
- Moderately strong
- Moderate
- Moderately weak
- Weak
We extended our analysis to assess the economic impact of refining via the GVA approach

<table>
<thead>
<tr>
<th>Approach to measuring direct GVA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net Cash Margin (NCM $/bbl)</strong> – Estimated based on the NCM of the 4 indicator refineries. It is worth noting that the NCM we used is net of any Government subsidies.</td>
</tr>
<tr>
<td><strong>Indicator Refinery Capacities (bbl/d)</strong> – Estimated based on the capacities of the indicator refineries in each refinery case</td>
</tr>
<tr>
<td><strong>Indicator Refineries Utilisation Rates (%)</strong> – Estimated based on the utilisation rates of the indicator refineries plotted in refinery case</td>
</tr>
<tr>
<td><strong>Indicator Refinery Salaries (p.a.)</strong> – Estimated based on the salary benchmarks of the indicator refineries in each refinery case.</td>
</tr>
<tr>
<td><strong>Number of Refinery Employees per Indicator Refinery</strong> – Estimated based on refinery employees numbers of the indicator refineries in each refinery case</td>
</tr>
</tbody>
</table>
We find that even weaker refineries can provide a positive contribution to local economies.

Even cash negative refineries can add value to their economy via the indirect and induced effects.
Although only those refineries with a history of investment give higher economic benefit than importing fuels.

**Added Value to Local Economies – Refineries Net of Import Terminal**

- **Weak Refinery, less developed**
- **Strong Refinery, less developed**
- **Weak Refinery, more developed**
- **Strong Refinery, more developed**

**But netting off GVA contribution from import terminal shows weak refineries can be a net burden.**
Our analysis shows that economic benefits from refining are evident for all nations

<table>
<thead>
<tr>
<th>Value of refining?</th>
<th>Results of Analysis</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>weak/less</td>
<td>strong/less</td>
</tr>
<tr>
<td>Creates employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adds value to local economies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increases tax revenues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports value chain integration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>De-risks economies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary

Our analysis shows that economic benefits from refining are evident for all nations.
Tightening environmental legislation would bring considerable benefits, but mandated investment could risk refinery closures

Extract from “Refinery and Health Study for Sub-Saharan Africa (SSA)”, World Bank, 2009

$6bn of investment in African refineries to improve environmental performance would result in $43bn of health savings to African nations over a 10 year period
Government support may represent an attractive solution for host nations

Potential Symbiotic Relationship Between Refiners and Host Governments

- Margin support
- Human capital investment
- Financial/loan support for investments

Gov’t Support

Sustainable Domestic Refining

Ongoing socio-economic benefits

- Greater job creation
- Greater wealth creation
- Improved public health
Strengthening the cash-generating position of African refineries would yield considerable benefits for all.

Government Support to Kick-Start Refinery and Economic Development

- Support from governments
- Ability to invest in clean fuels
- Ability to invest in stronger margins
- More job creation
- More wealth creation
- Stronger economy enhances multiplier effects

More job creation

More wealth creation

Stronger economy enhances multiplier effects

Ability to invest in stronger margins

Ability to invest in clean fuels

Support from governments
Thank you for your attention

Any questions?
Contacts

Soumendu Nath
**Vice President, Downstream Consulting**
T +44 203 060 0525
E soumendu.nath@woodmac.com

Chris Barry
**Downstream Consultant**
T +44 203 060 0575
E christopher.barry@woodmac.com

Peter Bajowa
**Vice President, Sales and Account Management**
T +234 816 356 6084
E peter.bajowa@woodmac.com
Strictly Private & Confidential

This presentation has been prepared for ARA ("Client") by Wood Mackenzie Limited ("Wood Mackenzie") in accordance with the Consulting Agreement between Wood Mackenzie and the Client dated 10th June 2013. The report is intended solely for the benefit of the Client and its Affiliates and its contents and conclusions are confidential and must not be published, quoted or disseminated to any other persons or companies unless otherwise permitted by the Agreement or with Wood Mackenzie’s prior written permission.

The information upon which this report is comes from our own experience, knowledge and databases. The opinions expressed in this report are those of Wood Mackenzie. They have been arrived at following careful consideration and enquiry but Wood Mackenzie does not guarantee their fairness, completeness or accuracy. The opinions, as of March 2014, are subject to change. This presentation may only be relied on by the Client or its Affiliates for the purposes described in the Agreement.
Wood Mackenzie* is a global leader in commercial intelligence for the energy, metals and mining industries. We provide objective analysis and advice on assets, companies and markets, giving clients the insight they need to make better strategic decisions. For more information visit: www.woodmac.com

*WOOD MACKENZIE is a Registered Trade Mark of Wood Mackenzie Limited
Wood Mackenzie works with clients throughout the downstream value chain in five main offering areas

**Illustrative hydrocarbon value chain**

- **Resource Monetization & Trading**
- **Infrastructure**
- **Refining**
- **Product Trading & Distribution**
- **Fuel, Products & Feedstocks Marketing**

**Business Environment**
- What’s happening?

**Project Development**
- How do we move from concept to completion?

**Transactions Support**
- What or how can we buy or sell?

**Business Improvement**
- How good are we – how can we get better?

**Commercial & Market Strategy**
- What should we do?
Further details of our core offerings:

**Activities Undertaken by Wood Mackenzie’s Consultants in each Offering**

<table>
<thead>
<tr>
<th>Business Environment</th>
<th>Project Development</th>
<th>Transactions Support</th>
<th>Business Improvement</th>
<th>Commercial &amp; Market Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pricing &amp; Margin Forecasting</td>
<td>Establishing Goals and Objectives</td>
<td>Buy / Sell Industry Adviser (CDD)</td>
<td>Performance Benchmarking</td>
<td>Competitive Positioning</td>
</tr>
<tr>
<td>Energy Policy Advisory</td>
<td>Partner Identification &amp; Selection</td>
<td>Valuation Modelling Inputs</td>
<td>Capability Development</td>
<td>Opportunity Screening</td>
</tr>
<tr>
<td>Risk Management</td>
<td>Offtake Agreements &amp; Contracting</td>
<td>Transaction Synergy Analysis &amp; Planning</td>
<td>Knowledge Transfer</td>
<td>“What If” Analysis &amp; Business Planning</td>
</tr>
<tr>
<td>Dispute Resolution &amp; Expert Witness</td>
<td>Project Finance Advice</td>
<td>Mandate Winning &amp; IM Support</td>
<td>Workshops &amp; Training</td>
<td>Project Development &amp; Contracting</td>
</tr>
</tbody>
</table>