



# Driving

# Excellence

3<sup>rd</sup> Quarter 2006

Helping Clients Achieve Operational and Capital Excellence



## KBC Consults on Possible Mesoamérican Refinery

by Sal Cubeta

The combined effect of the increase in the demand of oil derivatives in Central America (CA) and the Dominican Republic coupled with the sustained increase of international prices of crude oil and its derivatives has negatively impacted Central American countries. As a result, the Inter-American Development Bank (IADB) contracted KBC to define the location and configuration within Mesoamérica for a possible refinery. The study was divided into two phases.

### Phase I

In Phase I, KBC conducted a review of the Mesoamérican hydrocarbon markets, selected the refinery location, defined the basic refinery configuration, performed

the economic evaluation, and defined the business scheme for implementation of the refinery.

### Market Assessment

KBC's PEL (Petroleum Economics Limited) division reviewed the Mesoamérican hydrocarbon market product demand, and we concluded that this region's product demand for 2005 was approximately 378 MBPD, and it would grow to 470 MBPD. With the existing refineries' local production of less than 100 MBPD, a strong incentive exists to build a high conversion refinery in the region. KBC evaluated the critical factors in determining the feasibility for a major refining project in CA as shown in Figure 1.

based on two separate, but complimentary analyses. The first was a Site Assessment of the attributes for each potential site, and the second was a Transportation Cost Assessment of the oil logistics costs.

KBC site specialists visited the top eight sites. The Site Assessment included the key attributes of the potential sites such as the land availability, port capabilities, infrastructure, environment, and local business environment. On a parallel path, the Transportation Cost Assessment was conducted using an LP Model, "Central America Distribution Model" (CADM). This model evaluated the costs of transporting crude and products to the respective demand centers. This model included 23 key ports and demand centers, 3 transportation modes (ships – VLCC and Panamax, pipeline, truck), 5 existing refineries, and 7 product types. The model is illustrated in Figure 2.

The combined results of these assessments identified Puerto Quetzal in Guatemala and Puerto Armuelles in Panama as the two most attractive sites for a new refinery. After selection, these two sites were visited by KBC's environmental specialists to determine their suitability. Both sites were found feasible as part of a pre-

### Site Selection

The next major task was to determine the potential site location for the new refinery. KBC's approach was to develop a multi-variable evaluation process to determine which of 12 possible refinery sites proposed by the seven CA countries and the Dominican Republic was most feasible. This evaluation was

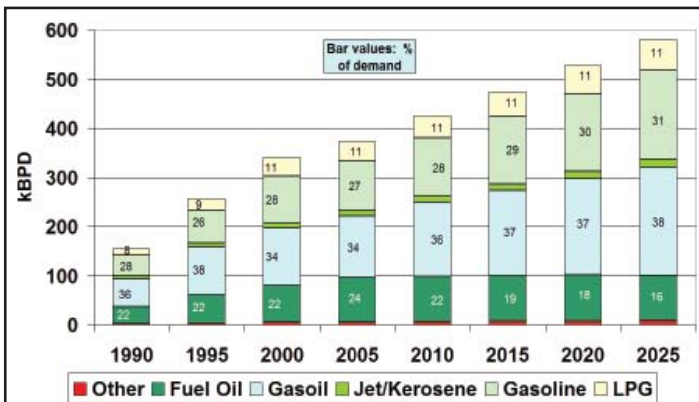


Figure 1 - Central American Demand Projection

KBC offers a comprehensive range of consulting, implementation, and training solutions to provide sustainable competitive advantage to our process industry clients worldwide.

### OUR SERVICES INCLUDE: CapX - Capital Excellence

- Market Analysis & Forecasting
- Process Strategy Review & Implementation
- Merger, Acquisition & Integration Studies
- Feasibility Studies
- Capital Project Support

### OpX - Operational Excellence

- Operational Planning
- Process Optimisation
- Energy
- HSE
- Reliability, Availability & Maintenance
- Human Performance Improvement

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## FEATURE STORY

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liminary environmental assessment regarding legal structure and proximity to populated areas.

### Refinery Definition and Economic Evaluation

KBC developed several models to define the basic configuration of the new refinery based on an economic evaluation of each model using KBC's tools. These included KBC's Petro-SIM process simulation package to provide the refinery process unit sub-models for the LP that assembled these process units, demand centers, and product specifications and prices. The product revenues were based on netback prices (market less transportation costs). These prices were based on the lowest cost supplier's delivered price to the CA markets. Crude cost was based on the refinery gate price for each crude (supply terminal plus transportation). The maximum product sales volume in each CA market equaled the full demand possible. The LP model permitted evaluation of alternative refinery configurations, unit severities, and export to alternative markets. This LP solution optimized the delivery of refinery products to the most profitable markets.

The refinery configuration includes a hydrocracker, coker, VGO hydrotreater, FCC, alkylation, naphtha reforming, hydrogen plant, and associated product hydrotreating. All refined products will be capable of complying with international product standards to permit export considerations.

The study results are based on a 2015 project start-up as follows:

- A large investment will be required to build the CA refinery (USD\$7-8B)
- Project economics do not support an attractive rate of return for investors if all products are sold in CA at alternative product import prices
- Exporting to product-short USWC and Mexico and including a power plant option provides an attractive project for investors seeking a presence in the USWC and unable to build in that market (13.7-14.5% IRR)
  - Almost half (46%) of the refinery products will economically go to

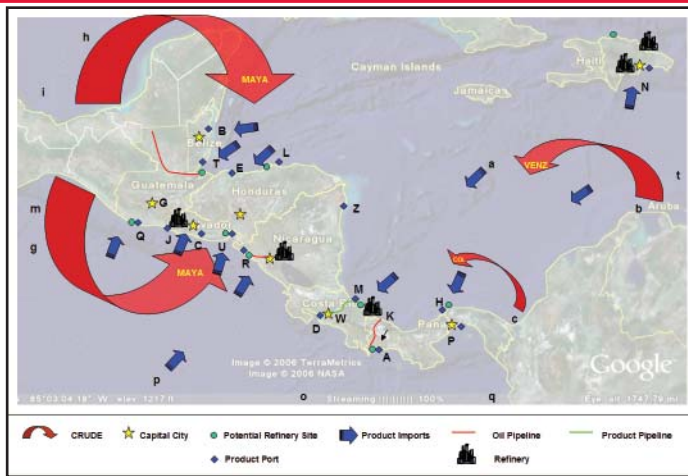


Figure 2

- CA/Mexico (31/15%)
  - The refinery will supply 39% of the CA demand in 2015
- Debit financing improves the IRR to 17-24% depending on leveraging option (30-70%).
- This IRR range provides a respective cushion for economic downside risks associated with investment and margin

KBC presented its conclusions in May and June to the Technical Committee representing the Mesoamerica nations and the Hydrocarbons Group responsible for the study. Additionally, the results were presented to the Secretaries of Energy of the nations and in June to the Summit of the Presidents of the Mesoamerica countries in the Dominican Republic.

The conclusion of Phase I suggests that there were enough positive elements to continue exploring the potential interest of private investors for a refinery with the described configuration.

### Phase II

The second phase of the work (currently ongoing) involves promoting the project, obtaining investor feedback, and preparing bid bases and regulatory framework for the development of the project. Feedback was collected at a Houston briefing in July, and presented to the CA nations in August. This information helped shape the framework for developing the bid mechanism, with the issuance of an Expression of Interest (EOI) document published in mid-September through the PMI (Comercio Internacional S.A. de C.V.) website for interested parties to respond. If your company would like to express interest in the project, please visit PMI's website at [www.pmi.com.mx](http://www.pmi.com.mx), and see the links on the right side of the page under "Request for Expression of Interest."

## EVENTS

### NPRA Q&A and Technology Forum

8-11 Oct – Phoenix, AZ, USA

This conference addresses real problems and challenges facing refiners today with Q&A, plant automation, safety, and principles and practices sessions. An English from the Parsippany, New Jersey office will represent KBC on the FCC Panel. KBC will also co-sponsor the opening reception.

### ERTC Petrochemicals

9-11 Oct – Dusseldorf, Germany

KBC's Peter Hallas will present "Optimise the Total Site Energy Performance – Simultaneous Process and Utility System Integration." The paper presents the methodology used and the results of a Total Site energy study for Samsung Total Petrochemical Co. Ltd (STC) at its Daesan complex.

### CEE 9<sup>th</sup> Annual Roundtable

17-19 Oct – Budapest, Hungary

Mr. Silvian Potlogea for Rompetrol and Mr. Jim Sheldon of KBC will present, "Capital Project Optimisation for Maximum Diesel Production." This paper describes an analysis of the Petromidia refinery investment project and how KBC's Petro-SIM™ refinery-wide optimisation software was used for evaluating the integration considerations and opportunities.

### Rotating Equipment 2006

7-8 Nov – Kuala Lumpur, Malaysia

Mr Greg Gustafson of KBC will present, "Focusing on Rotating Machinery Case Study: Compressor Dry Gas Seal Improvements." This presentation details the insights on practical Defect Elimination and RCFA techniques for a recent KBC project for a fertilizer plant in Malaysia.

### IOCC Conference

30 Nov-1 Dec – London, UK

Mr. Simon Rogers of KBC will present, "Using Simulation to Improve Refinery Profits." This paper examines profit improvement opportunities through a series of case studies using a rigorous and complex Petro-SIM model of major refineries and petrochemical complexes.

### FPSO Summit 2006

5-6 Dec – Singapore

Mr. David Turner of KBC will present, "Achieving Operational Excellence (OpX) for FPSO Based Oil & Gas Production." This paper will present a global best practice OpX model that has been applied worldwide by a global integrated oil company on all of its major oil & gas producing assets, including some of the most complex FPSOs in the world.

### Texas Technology Showcase: The Engineer's Energy Toolbox - Practices, Technologies and Management

6-7 Dec – Galveston, TX, USA

KBC's Joe Davis, will present, "A Better Approach to Energy Performance Benchmarking," and "A Case Study in Developing Process Unit Energy Metrics." KBC will also exhibit at the conference.



# REFINING MARGINS

by Richard Warner

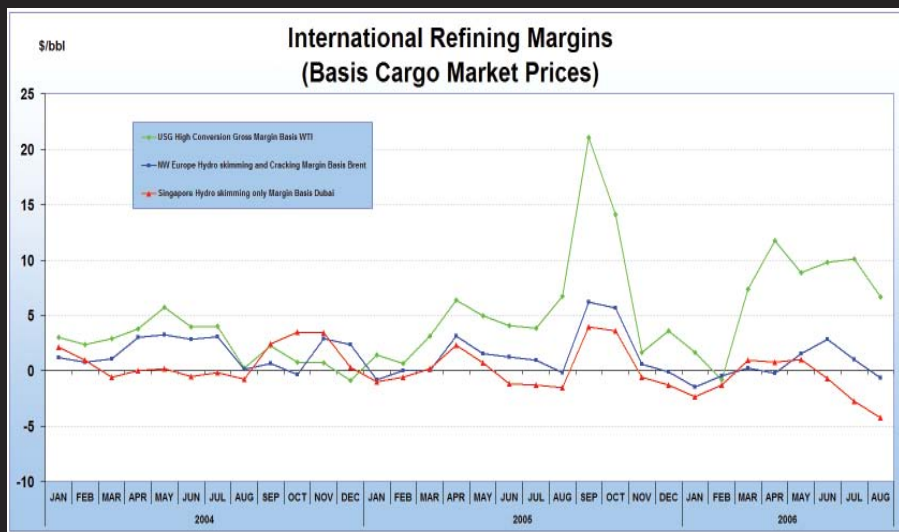
Despite record high crude oil prices, high conversion refinery margins in the US Gulf remained well above the marginal break-even level in the third quarter of 2006 whilst margins in NW Europe and Singapore

declined. With the onset of the driving season in the US, refinery utilisation levels approached their theoretical limits. Gasoline and diesel refinery margins held in the Gulf notwithstanding the significant changes in specifications for both. The replacement of MTBE in gasoline with ethanol and the lowering of the sulphur limit on diesel from 500 ppm to 15 ppm created considerable uncertainty in the market ensuring that the two driving fuels crack spreads remained robust until the end of driving season.

On a hydroskimming and cracking basis, European refinery margins fell below marginal cost break even in August as crude prices rallied and gasoline and gas oil prices followed US prices lower. The sustained weakness in residual fuel oil prices placed a ceiling on returns.

Singapore margins (hydroskimming only basis) also declined over the quarter to their lowest level in the last five years. The strong gasoline crack spreads, which had held up margins under strong pressure

from heavily negative fuel oil crack spreads, declined due to large Indian and Taiwanese gasoline exports and reduced Japanese demand led to lower prices. Furthermore, the relative decline of USWC prices limited opportunities for arbitrage from Singapore, and left the region with more than ample supply. Moreover, fuel oil crack spreads weakened further after massive inflows of material from Europe created a glut in the Asian market, which was already weighed-down by a lack of demand from traditional consumers such as China's power producers and tea kettle refineries.



## COMPLETED PROJECTS

### Strategic Investment Option Study

Romania

The client had committed to an upgrade project including a new mild hydrocracker and a new hydrogen plant to allow the refinery to operate at full capacity and meet new clean fuels specifications for diesel and gasoline. The site required assistance in integrating new units, by defining, as appropriate, required revamps/upgrades of existing units and utility systems. In addition, the impact and economics of optional new units (alkylation and TAME) were evaluated. Finally, the client requested help in identifying profit improvement opportunities both with the existing and the future refinery.

The key element in meeting the client's objectives was the development of a Petro-SIM model of the existing and future refinery. This enabled KBC to identify opportunities worth over 65 c/bbl in two lead cases and evaluate the impact of optional new units. The study confirmed that no additional new units were essential for meeting the new gasoline specifications. Investment could be delayed or cancelled, thus assisting cash flow. Additional off-line studies defined cost-effective upgrade requirements for the amine system and the hydrogen network. An additional study determined that replacing reactors when converting the existing VGO hydrotreater (replaced by the new mild hydrocracker) to diesel service was not necessary and could not

be justified, which saved significant investment cost.

### Strategic Energy Review

South Korea

SamsungTotal Petrochemicals Co., Ltd. (STC) had already executed a number of energy saving projects on various process units. The steam system was quite constrained by boiler production limits and the presence of critical steam turbines used as process drivers. Consequently, STC were concerned that the success of future plant expansions and further energy improvement measures would be limited by the utility system constraints.

KBC's Total Site and utility system modelling techniques were proposed to analyse the process units and the utility systems simultaneously so that the realistic scope for energy improvement could be quantified. The methodologies used were:

1. BT benchmarking and Gap Analysis
2. Pinch Analysis of the process units
3. Total Site Analysis of the process/utility system interface
4. Utility system modelling using Pro-Steam

KBC identified a total of 71 energy saving project ideas, and we recommended 50 of these for more detailed evaluation. STC accepted that 13 projects were likely to be feasible within current practi-

cal and economic constraints and would save \$5.6M per year. The improvements would be located in Aromatics, BTX, ethylene plant, ethylene oxide/glycol, HDPE, and in the utility system.

### Optimising Refinery/Aromatics Operations

Malaysia

The client had envisioned that process optimisation and energy usage review should yield savings of more than \$6M per year, and set a target of capturing 50% of these possible opportunities.

KBC utilised its Petro-SIM and Pro-Steam models to develop comprehensive process and energy models of this petrochemical plant. After this initial evaluation, KBC applied Best Practice methodologies to identify all possible opportunities related to Process and Energy.

Based on the results, KBC consultants identified several "no cost" and "low cost" opportunities in the Operations, Energy, and Maintenance areas of the petrochemical plant. The value of these opportunities exceeded \$25M per year. With a six month implementation program, KBC consultants were able to implement more than \$13M per year of these opportunities. As part of the program implementation, KBC provided on-the-job training so that the client's staff could carry out the remaining opportunities.

## Petro-SIM Version 3 Released

KBC is pleased to announce that the new version of Petro-SIM and the KBC SIM models is now available!

Petro-SIM Version 3 contains innovative ways to integrate process simulation with key systems in the plant, including plant data information systems, LPs, relational databases, and Microsoft Excel® - all methods are included in the basic simulation package. Version 3 also contains two new reactor models to improve petrochemical-refinery integration profitability.

### *Improved Collaboration*

New features in Version 3 help improve collaboration within the facility. Case-linking mechanisms simplify deployment across teams and throughout the refinery. The new Meter operation allows simulations to

become more operations-centric with direct access to process and lab measurements.

In addition, a new LP utility provides built-in intelligence for selecting and generating stream properties for tracking in LPs. Swing cuts are easily built and vectors generated by regression, perturbing properties, or both.

### *Unique Results Management*

Version 3 extends the features of the internal spreadsheet and adds a host of new capabilities to form a unique results management solution. Results analysis and data preparation are simplified through a new direct, two-way interaction with Excel. This two-way data flow is seamless and fast - no coding required!

With this release, KBC introduces a unique Knowledge Base with built-in intelligence

to automatically select key results based on "Best Practices." For instance, the Knowledge Base can be used to manage refinery stream properties. The data you need is right at your fingertips.

Change tracking features, a first on this simulation platform, enhance case management and usability. These features include: an Undo feature, a Journal to automatically record changes, and case comparison tools.

### *Enhanced Reactor Models*

KBC continues to enhance and update the existing SIM models along with Petro-SIM for a consistent interface. New reactor models include AROM-SIM for toluene disproportionation reactors and xylene isomerisation units and ISOM-SIM for C5/C6 isomerisation. These reactors are available as fully-integrated components of Petro-SIM.

## UPCOMING HUMAN PERFORMANCE TRAINING SEMINARS

### Improving and Sustaining Process Plant Operator Performance

• 18-20 Oct **SOLD OUT** Houston, TX, USA

### Supervising for Operational Effectiveness

• 1-3 Nov – Houston, TX, USA

To register, visit us online at: [http://www.ttsp performancesystems.com/Seminars\\_toc.php](http://www.ttsp performancesystems.com/Seminars_toc.php).

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