NexantThinking™

Special Reports

U.S. Ethane Utilization – Domestic Petrochemical Production Versus Exports

Brochure
January 2015

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Section 1 Introduction and Report Objectives

1.1 INTRODUCTION

One of the side benefits of the U.S. shale gas boom has been the production of large quantities of ethane. Today, U.S. ethane production at the wellhead exceeds demand. As a result, increasing amounts of ethane are being left in the natural gas to boost heating value, and reinjected where necessary.

Approximately 9 million metric tons per year (mtpy) of new U.S. ethane-based ethylene capacity listed in Table 1.1 is considered by Nexant to be firm. An additional 14 mtpy of capacity listed in Table 1.2 has been announced and is at various stages of development. Final approval of this additional capacity depends on obtaining the required permits, ethane supply commitments, ethylene derivative markets, final capital cost estimates, and corporate approval and financing.

Table 1.1 Firm U.S. Ethylene Capacity Additions

Company	Location	Ethylene Capacity (mm mtpy)	Startup
LyondellBasell	LaPorte, TX	0.4	2014
Westlake	Calvert City, KY	0.1	2014
Williams	Geismar, LA	0.27	2014
LyondellBasell	Channelview, TX	0.1	2015
	Corpus Christie, TX	0.4	2015
Westlake	Lake Charles, LA	0.27	2015
CP Chemical	Cedar Bayou, TX	1.5	2017
Dow Chemical	Freeport, TX	1.5	2017
ExxonMobil	Baytown, TX	1.5	2017
Formosa Plastics	Point Comfort, TX	1.0	2017
Ingleside Ethylene (JV Oxychem/Mexichem)	Ingleside, TX	0.54	2017
Sasol	Lake Charles, LA	1,5	2018
Total		**9.0**	

Table 1.2 Announced Speculative U.S. Ethylene Capacity Additions

Company	Location	Ethylene Capacity (mm mtpy)	Comments
Shell Chemical	Monaco, PA	1.5	Permits applied for Ethane contracts
Axiall, Lotte	Lake Charles, LA	1.2	
SABIC	NA	1.5	
Formosa Plastics	LA	1.0	Permits applied for
Williams	Geismar II	1.5	Looking for partners
Odebrecht	West Virginia	1.2	
Shintech	LA	0.5	Permits applied for
Others known to Nexant	NA	5.5+	
Total		**14.0**	

Uncertainty about capital costs, natural gas and ethane pricing, and resulting competitiveness of ethylene derivatives in needed export markets has been stretching the time required for decision-making on these speculative petrochemical plants. While there have been extensive discussions about combining some of these projects as joint ventures or "condo" crackers, it has been difficult to reach a consensus due to the uncertainties listed above.

At the same time, Nova has begun exporting ethane from the United States to Canada and INEOS has arranged to export ethane from the United States by 2015 to its European crackers at Rafnes, Norway and Grangemouth, UK. Recently, Enterprise Product Partners announced in April a final decision to build a 240,000 barrel per day ethane export terminal sited at its Morgan Point facility by the third quarter of 2016. It asserts that it has sufficient offshore ethane customers to proceed with the project.

What will be the future utilization pattern for U.S. ethane and will it be the optimum economic use for the ethane? Pipelines and export terminals can be built faster than multibillion dollar petrochemical plants, but there are uncertainties surrounding both domestic use and exports. Nexant's report considers the economics of both domestic use of ethane as a petrochemical feedstock with subsequent exports of petrochemical derivatives versus direct ethane exports. It also evaluates the amount of rationalization in older U.S. crackers to partially offset the new capacity and the competitiveness of U.S. petrochemical exports to overseas markets, essential to the dramatic expansion plans. In particular, the competitiveness of U.S.-based polyethylene exported to China versus Chinese polyethylene produced from ethane imported from the U.S. or via coal-based MTO or MTO based on methanol imported from the United States or other gas-rich country will be assessed.

1.2 REPORT OBJECTIVES

The findings and conclusions of the report provide guidance to buyers and sellers of ethane on the future market dynamics and pricing of U.S. ethane. As such, this report addresses key questions such as:

- What are the alternatives for U.S. ethane utilization?
- What is the structure of the ethane value chain for both domestic use and for exports, and how will the structure change going forward?
- What will be the future U.S. ethane availability and pricing?
- How cost competitive will ethane be for domestic use and exports?
- The overall impact of the shale gas ethane revolution in the United States on the United States and global petrochemical business?
- How will changes in U.S. ethane supply and pricing impact the comparative economics of the supply of chemical and petrochemical products from the U.S. to the main end-use markets of North America, Europe and Asia?

The report provides a valuable resource for natural gas, midstream, and both U.S. and non-U.S. petrochemical companies in considering future market developments and investment decisions.

Section 2 Report Scope and Coverage

2.1 REPORT OVERVIEW

The overall objective of this report is to provide a comprehensive coverage of U.S. ethane markets, now and in the future, both domestic and exports and how ethane is, and will be priced, in these markets.

The report reviews domestic and export use in Europe, South America, Asia, the pricing of ethane and the resulting economics for ethylene and polyethylene on a comparative basis. Long term scenarios, through to 2030, are considered, assessing the key risks and uncertainties.

2.2 REPORT STRUCTURE

2.2.1 Existing and Forecast U.S. Ethane Supply and Demand

Natural gas production is forecast as one key driver of ethane availability as will be the outlook for ethane content in U.S. natural gas. Forecast demand considers ethane left in natural gas, ethane use for domestic petrochemical production, and ethane exports.

2.2.2 Comparative Economics of Ethane as a Feedstock for Domestic Petrochemical Production Versus for Ethane Exports

The report compares the current and future economics of ethane as a domestic feedstock for ethylene and polyethylene production versus ethane export to Europe, South America, or Asia to be used as a petrochemical feedstock for Polyethylene production in crackers modified to use ethane. The competitiveness of U.S. polyethylene exports to these regions are compared with local production based on ethane imports from the United States.

2.2.3 Ethane Price Forecast

U.S. ethane price is forecast based on projected supply and demand, natural gas price trends, and the economics of use a domestic petrochemical feedstock and in exports.

2.2.4 Competitiveness with Alternative Downstream Product Technologies

The study assesses the competitiveness of ethane-based ethylene and polyethylene production either in the United States or in Asia with methanol to olefin (MTO) technology followed by polyethylene production. It compares coal-based methanol to MTO in China or MTO in China based on imported methanol from the United States or other advantaged natural gas location.

2.3 REPORT PRICE

This prospectus describes Nexant's multi-client study on U.S. Ethane Utilization: Domestic Consumption Versus Exports, the scope of the proposed report, the methodology to be used, and Nexant's qualifications to perform such a study.

The study was completed at the end of Q4 2014.

Appendix **Page**

4.1 GENERAL

Nexant utilizes its unique consulting skills and combination of global, regional and industry sector experience to bring readers real insight into the optimal utilization of U.S. ethane over the next 10 years. The basic approach consists of:

- Drawing on Nexant's in-house database on plans for domestic use and exports
- Utilizing its understanding of global petrochemical dynamics to assess the relative attractiveness of these two alternative uses
- Discussions with Nexant's key contacts in the domestic and target export countries to add further insight to each alternative use
- Additional research from the public domain
- Utilizing Nexant's technical, economic and financial models and expertise to consider the comparative economics of domestic versus exports

4.2 ETHANE SUPPLY, DEMAND AND PRICING

The market analysis for this report was prepared drawing on non-confidential material and insights gained from Nexant's recent studies, both multi-client and single client, and conclusions on the outlook for U.S. ethane supply and demand.

Ethane export potential is up to six million metric tons per year based on emerging pipeline and export terminal capacity summarized in Figure 4.1.

Figure 4.1 Recent Developments in U.S. Ethane Distribution and Pipeline Infrastructure

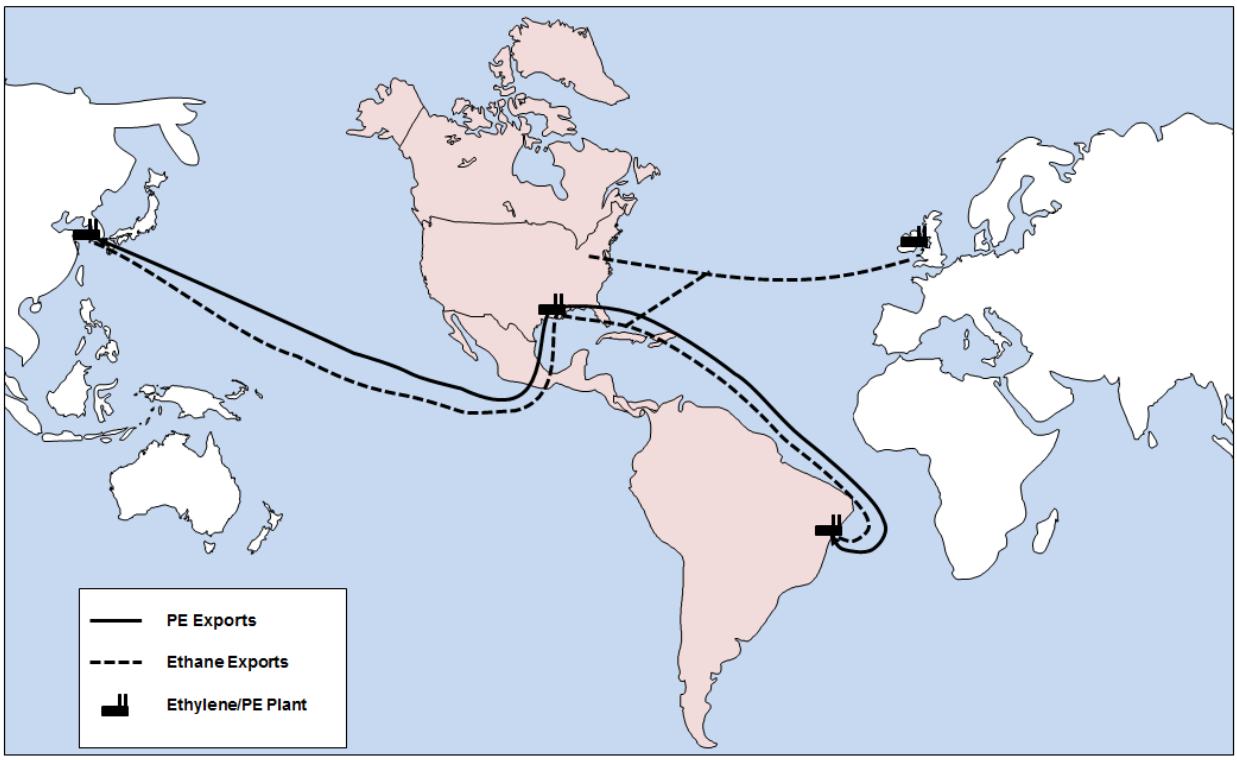
The ATEX (Appalachia to Texas Express) pipeline links fractionators in the Marcellus region to the Mont Belvieu storage and distribution hub. The planned Enterprise export terminal allows up to four million metric tons per year of ethane exports from Mont Belvieu. The Mariner East and West and the Vantage pipelines allows at least another two million metric tons per year of ethane exports and are expandable.

U.S. ethane domestic demand for petrochemicals depends upon how many additional ethane crackers are built. Additional petrochemical production exceeds domestic demand. Hence, incremental production is exported. Ethane pricing depends upon the cost of ethane extraction from natural gas and its value as a petrochemical feed. The use of exported ethane as a fuel in Asia and South America is also considered. In order to assess future ethane exports and domestic use, the economics of each option are evaluated.

4.3 ECONOMICS OF DOMESTIC ETHANE USE FOR PETROCHEMICAL PRODUCTION VERSUS EXPORT

Figure 4.2 displays the overall approach to be used.

Figure 4.2 Alternatives for Ethane Utilization



Nexant evaluated the economics of domestic ethane use as follows:

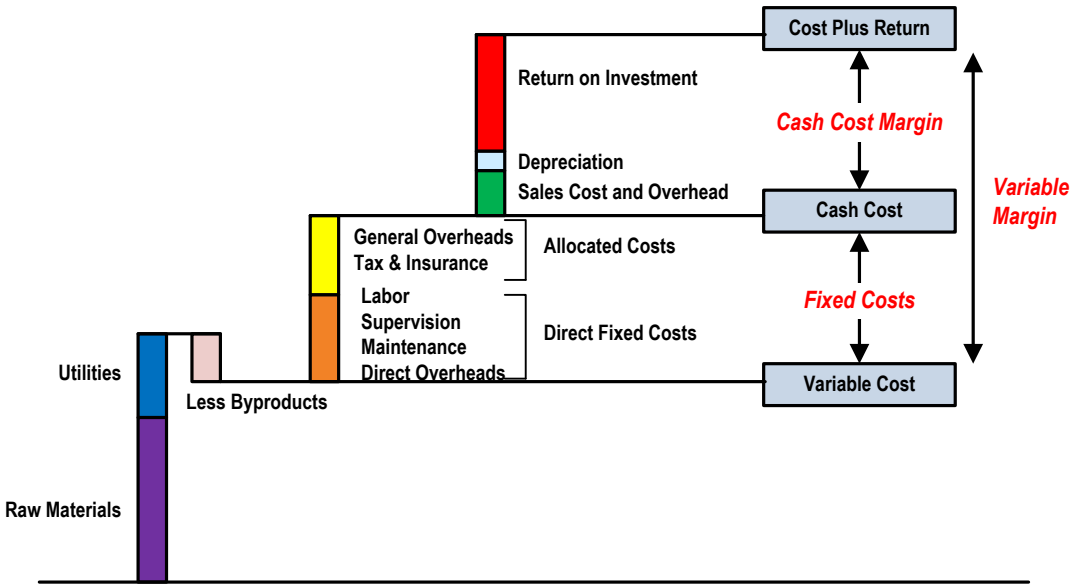
- Integrated production cost of ethylene and polyethylene followed by polyethylene export to three potential target markets: Asia, Western Europe, and South America
- As indicated in Figure 4.2, the variable cost of production includes the costs of raw materials – feedstocks plus catalysts and chemicals – and utilities at cash cost or purchase cost, with a credit for co-products:
  - The direct fixed costs shown in the figure below include salaries of operating staff plus associated on-costs such as holiday cover, social insurance, fringe benefits etc. Maintenance costs including materials and labor, with periodic maintenance costs such as two or three year shutdowns averaged over the period; maintenance costs are usually calculated as a percentage of process plant capital cost.

– The allocated fixed costs are the site charges, which are necessary for production, but which are not directly associated with the operation of the specified process plant. They include packing and warehousing, storage and workshops, site laboratories, safety and environment, security, site management, and on-site amenities for the workers. Insurance of the fixed assets is also counted under allocated fixed costs.

– In addition to the derived total cost of production, Nexant takes into account the freight and handling costs as well as tariffs involved in delivering the polyethylene to a particular target market to calculate the total delivered cost.

– Capital-related charges of depreciation plus a simple return on investment are added to characterize total costs associated with this option.

Figure 4.3 Components of Cost of Delivery to Market



The economics of U.S. ethane exports are evaluated as follows:

- Ethane export terminal fees
- Ethane transportation cost from U.S.G.C. to three target export markets: Western Europe, Asia, and Brazil
- Fixed investment and operating costs for ethane import terminal
- Investment for conversion of an existing cracker to utilize ethane feedstock in Western Europe, Asia, and Brazil
- Ethylene and polyethylene integrated production cost in the local market, including capital-related charges for depreciation and simple return on investment for all incremental investment

4.4 ECONOMICS OF ETHANE BASED U.S PETROCHEMICAL EXPORTS VERSUS MTO

Since China is a key potential export market for U.S. petrochemical exports, this study also compares the economics of U.S. ethane-based integrated ethylene/polyethylene production with MTO. The options compared include:

- U.S. ethane-based ethylene and polyethylene production and exports to China
- Coal-based MTO and polyethylene production in China
- U.S. methanol production and export to China followed by MTO and polyethylene in China

These comparisons provide a comparison of the relative attractiveness of ethane domestic use versus exports, and allow judgment on the relative quantities of each over the forecast period.

- **Marcos Nogueira Cesar – Project Executive.** Marcos is Global Vice President, Products in Nexant and will act as Project Executive. He has over 20 years of experience in market and economic evaluation, technology assessment and competitive analysis in both consulting and industrial environments. He currently manages the global multiclient and subscription products business of Nexant's consulting operation, which provides analytics, forecasts and insights for the chemical and energy industries. Prior to joining Nexant in 2013, he was Vice President of Chemical Industry Research and Senior Director, Global Product Management at IHS, where he led the integration of the entire IHS Chemical portfolio of multiclient products and services (legacy SRIC, CMAI, Harriman Chemsult and Chemical Week). He previously served as Global Director of Business Development and Vice President, Latin American Operations at SRI Consulting. Marcos was a Fulbright Scholar. He started his career at Rhodia S.A. and holds an M.B.A. from the University of California at Berkeley, an M.S. in Chemical Engineering at the University of Massachusetts at Amherst, and a B.S. in Chemical Engineering at the State University of Campinas (Brazil). He is fluent in English, Portuguese, Spanish and French.
- **William L. Tittle - Project Advisor.** Bill is a Principal in Nexant's Energy and Chemicals Advisory Group. He has over 35 years of experience in the U.S. and global petrochemical industry. He has conducted business strategies, feasibility studies, merger and acquisition assistance, competitor benchmarking studies, technology evaluations and business entry studies along the entire petrochemicals value chain.
- **Adam Chan - Project Manager.** Adam will have day to day management responsibility of this project. Adam is a Senior Consultant in Nexant's Energy and Chemicals Advisory. Adam brings a broad range of experience in petrochemicals, specialty chemicals, and gas processing with practical expertise in strategic planning, financial analysis/modeling, and product/market development. He has contributed as Project Manager for several technology evaluations and market analysis engagements with Nexant. Before joining Nexant, Adam held a number of technical and commercial positions at LyondellBasell and UOP. He holds a B.E. in Chemical Engineering from Stevens Institute of Technology and an MBA from Pace University.

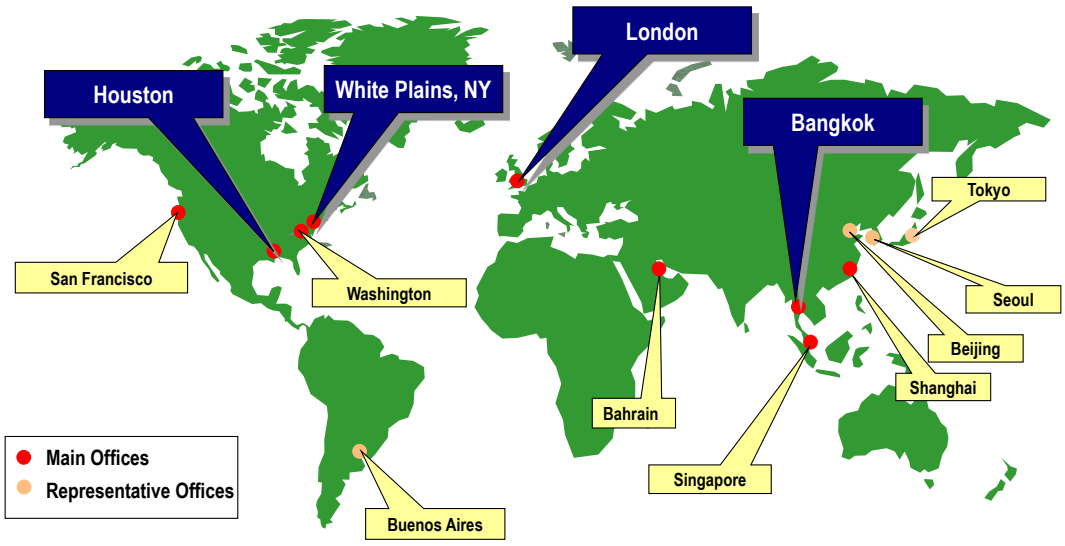
6.1 OVERVIEW

Nexant uses multidisciplinary project teams drawn from the ranks of our international staff of engineers, chemists, economists and financial professionals, and from other Nexant groups to respond to the requirements of each assignment. Most of the consulting staff possesses credentials in both scientific and commercial disciplines plus substantial industrial experience. The collective talents of our staff are strategically located and closely linked throughout the world, resulting in valuable insights gained through a variety of perspectives.

Nexant is an international consultancy and is dedicated to assisting businesses within the global energy, chemical, plastics, and process industries by providing incisive, objective, results-oriented management consulting. Over four decades of significant activity translates into an effective base of knowledge and resources for addressing the complex dynamics of specialized marketplaces. By assisting companies in developing and reviewing their business strategies, in planning and implementing new projects and products, diversification and divestiture endeavors and other management initiatives, Nexant helps clients increase the value of their businesses. Additionally, we advise financial firms, vendors, utilities, government agencies and others interested in issues and trends affecting industry segments and individual companies.

The Nexant Group was formed as an independent global consulting company in 2000, combining a number of companies that had a long history of providing consultancy services to the chemical and refining-related industries. Nexant's experience covers all aspects of project development relating to major refinery, petrochemical, and polymer investments, ranging from grassroots plants to revamps of existing process units. Nexant's key offices serving the petrochemical and downstream oil sectors are located in New York, Houston, London, Bangkok, and Bahrain, and locations for other offices are shown in Figure 6.1.

Figure 6.1 Nexant Office Locations



From major multinationals to locally based firms and governmental entities, our clients look to us for expert judgment in solving compelling business and technical problems and in making critical decisions.

Nexant's clients include most of the world's leading oil and chemical companies, financial institutions, and many national and regional governments. Nexant, Inc. is active in most of the industrialized countries of the world, as well as in most of the developing areas including the Middle East, Africa, and East and Southeast Asia.

Major annual subscription programs are:

- Process Evaluation/Research Planning (PERP)
- Petroleum & Petrochemical Economics (PPE)
- Polyolefin Planning Service (POPS)

The PERP program covers technology, commercial trends, and economics applicable to the chemical industry. The program has more than 40 subscribers, including most of the major international chemical companies. Many of the processes to be analyzed in this multi-client study have been assessed in the PERP program.

The PPE program provides historic and forecast analysis of the profitability, competitive position, and supply/demand trends of the global petroleum and petrochemical industry. The program includes capacity listings and analysis, global supply, demand and trade balances, profitability, competitiveness, and price analysis and projections for all the major petrochemical value chains. The PPE program is supported by an internet-based planning and forecasting tool that provides online access to the database behind the reports of the PPE program.

The POPS program provides reports on the global polyethylene and polypropylene industry. It is recognized globally as the benchmark source for detailed information and analysis on current commercial, technical, and economic developments in the polyolefins industry. Coverage includes: capacity listing and analysis, detailed consumption, supply/demand, trade, operating rates, price forecasts, technological developments, new products, inter-material substitution, and regional competitiveness.

6.2 SPECIFIC EXPERIENCE RELATIVE TO ETHANE

6.2.1 Ethane

Nexant has prepared many studies relating to the production and use of North American NGLs. They have focused on a range of commercial/market, technical and strategic issues and often have considered the use of ethane, propane, butane and/or condensate as petrochemical feedstocks. Recent experience of particular relevance includes the following studies:

- **USGC Ethylene/Polyethylene Complex Feasibility Study** – Provided a foreign petrochemical company with an initial evaluation of the potential feasibility of an ethane based ethylene/polyethylene complex. Key issues addressed included the availability of ethane in North America under different investment scenarios, current and future ethane sourcing business and pricing models and the competitiveness of the complex
- **North American Shale Gas: Opportunity or Threat for Global Ethylene Producers?:** This multi-client study profiled and evaluated current and future North American shale gas production, and analyzed its future impact on global ethylene producers. The study forecasted North American shale gas output to determine the effect on natural gas pricing and NGL production. The report also analyzed future trends in the mix of North American steam cracker feedstocks, scenarios for the North American ethylene industry and the implications for the global industry
- **North American Shale Gas and Shale Oil Research:** Nexant provided JPEC with an overview of the Canadian and U.S. shale oil and shale gas businesses, including production forecasts and

broader and play-specific environmental and other developmental issues. Nexant also analyzed the possible future impact of shale oil and shale gas on U.S. and international energy markets

- **Petrochemical Market Dynamics: Feedstocks –** This multi-client report provides an analysis of the feedstock requirements for basic chemical production, and addresses which feedstocks will be important to the industry going forward. This report highlights emerging feedstocks, such as shale gas, as well as conventional materials including coal.

6.2.2 Experience in Competitiveness of North American Olefins Production

Nexant recently has prepared several studies that involved evaluating the competitiveness of North American olefins (ethylene and propylene) production, taking into account the impact of shale gas production on petrochemical feedstock pricing. Recent experience of particular relevance includes the following studies:

- **Competitiveness of USGC Polyethylene/Polypropylene Production** – Provided a Middle Eastern petrochemical company with an independent assessment of the relative competitiveness of olefins (e.g., propylene via PDH) and polyolefins production in the United States and Saudi Arabia, taking into account the impact of shale gas on USGC NGL pricing
- **North American Polyethylene Cost Structure - This multi-client** report provides an analysis of production costs by region, accompanied by an in-depth discussion on natural gas availability in North America and ethane availability and pricing. The impact of increased shale gas and associated NGL production on the North American feedstock slate used for olefins production is analyzed.
- **Feedstock Sourcing and Competitiveness** - This multi-client report provides an overview of the global and regional ethylene and propylene markets and examines and compares the process technologies and economics of the commercially available and developing technologies for the production of ethylene/propylene. The report also includes an analysis of regional competitiveness of both conventional and developing ethylene and propylene technologies.
- **Polyolefins Competitiveness Assessment** - Assessment of polyolefins markets, competitors' cost of production estimates for olefins and polyolefins, and profiled existing and potential polyolefin competitors for an Asian client

6.2.3 Petrochemicals

Nexant has an established international reputation as a leading consultant to the global petrochemical industry. Our experience covers all of the technical and commercial related aspects of the industry, including master plan development, strategic planning, technology assessment and selection, competitive benchmarking, engineering contractor/contract review, project monitoring role for lenders and sponsors, commercial advisory for joint venture agreements (JVA, supply/offtake, site services, etc.), oversight on project development and execution, market and pricing/margin analysis, research and forecasting, work on behalf of Lenders for financial transactions including project finance, IPOs, debt and equity restructuring, and M&A. The focus of this consulting work has been global.

MASTER PLAN DEVELOPMENT/FEASIBILITY STUDIES

- **Independent Master Plan Review and Enhancement - Confidential.** An independent commercial and technical review of client's internally developed master plan for upgrading their refinery in Thailand
- **Butane Master Plan - Confidential.** Nexant has examined fourteen complexes ranging from the production of synthetic alkylate for gasoline blending through to highly integrated C4 complexes
- **Methanol Feasibility Study - Confidential.** This feasibility study involved a methanol plant being built by a joint venture partnership at Pars Special Economic/Energy Zone in Assaluyeh, Iran. The study has been commissioned in order to: establish rigorously that the business fundamentals are in place; confirm basic recommendations on technology evaluation and selection; provide sufficient detail of the physical scope and define project execution and implementation to allow the client to plan the next steps in the development of the project. Nexant provided: energy and macro-economic assumptions, methanol market dynamics, including supply, demand and trade, profitability and pricing, delivered cost competitiveness, and marketing strategy, project execution and implementation definition, financial evaluation and contracting approach along with a SWOT analysis
- **Petrochemical Project: International Market Study** - Nexant was engaged to perform a market and pricing study, as part of a feasibility commissioned by Lukoil Neftekhim into the opportunity for investment in ethylene and derivatives based on the hydrocarbons of the North Caspian region. The report provides inputs to the whole feasibility study and includes: market analysis with a summary of global supply and demand prospects, and of interregional trade for each product, and price forecasting; methodology and key assumptions and notes on the development of netback prices for the North Caspian Petrochemical Project. The products reviewed include the main grades of polyethylene: LDPE, LLDPE, and HDPE
- **Gas Chemicals Complex Preliminary Feasibility Study – Confidential.** The client wishes to consider the construction of a gas chemicals complex based on feedstock from the Surgil field in Uzbekistan. This report is concerned with the construction of a gas chemical complex with production of natural gas, gas condensate, liquefied petroleum gas (LPG), polyethylene and other petrochemical products. Nexant provided a technology review, market analysis, financial analysis, pricing, and project cost estimate
- **Petrochemical Master Plan for Kazakhstan -** The Republic of Kazakhstan is rich in oil and gas resources and there is therefore the potential to develop a petrochemical industry based on these resources. This study was prepared in three phases to develop a petrochemical master plan for CMAR (Kazakhstan Commerce). Phase one of the study is to identify a list of 10-15 products which will be reviewed in further detail. The report is presented in four main parts. Background: general macroeconomic issues for Kazakhstan and whether developments in the non-oil industry might favor particular petrochemical projects. Petrochemical value chains: includes an overview of major petrochemical product chains, and methods of producing basic chemicals. Feedstocks: provides an initial overview of the types of feedstock that would be needed for the petrochemical industry, and comments on their availability. Screening analysis: a systematic review of 35 products, leading to a recommended list of 10-15 products for a detailed review. Phase two provided a detailed analysis and Phase three involved planning for the implementation of the master plan
- **Feasibility Study of Jubail Expansion, Saudi Arabia -** Nexant was retained by Royal Commission of Jubail and Yanbu, Directorate General for Jubail to evaluate the techno-economic feasibility of the expansion of the Jubail site. Factors considered included gas feedstock/fuel situation, market trend scenarios, competitiveness assessment, industry modeling, requirements for utilities, feedstocks, fuel, and infrastructure, and environmental considerations

- **Feasibility Study and Preliminary Conceptual Engineering for the New Industrial Park, Jubail, Saudi Arabia** - Nexant was commissioned to carry out a major planning exercise for the Royal Commission of Jubail and Yanbu, Directorate General for Jubail to evaluate the techno-economic feasibility of establishing a new world scale industrial park at the Jubail Industrial City and to draw up a conceptual plant for its development. The study identified the key prospective primary industries for development, based on the highest added value to the Saudi Arabian economy and the optimal location for the new development. All major infrastructure requirements for the park, and the impacts of import and export of material to the site from existing Jubail infrastructure were modeled. Using the infrastructure model a conceptual design for infrastructure and utility provision that optimized the use of existing facilities and minimized new capital spend was established
- **Jubail Economic Feasibility Study, Saudi Arabia -** Nexant was commissioned to carry out an economic feasibility study into the whole of the Jubail Industrial City development. In carrying out this study, Nexant determined the value of investment (including foreign direct investment) in Jubail and its contribution to investment in the Kingdom as a whole; evaluated the contribution of the industrial city to employment in the Kingdom, in particular in the manufacturing sector, and estimated the population whose livelihood is dependent on the industrial city; determined the value of the Kingdom's exports which originate in the industrial city and assessed the degree to which the industries have been able to substitute for imports; examined ways in which the contribution of Jubail can be maintained in the future; and assessed the most economic direction for future industrial development
- **Ruwais Area Master Plan, Abu Dhabi, United Arab Emirates -** With ADNOC embarking upon major projects in the Ruwais Industrial Complex and with other projects being planned by ADNOC or other third parties, Nexant was commissioned to review the 1976 Master Plan plans for the Ruwais area and identify the demand for new systems, infrastructure and community facilities and the need for upgrading existing facilities. Nexant provided an assessment of the potential synergies between various plants in order to optimize the provision of infrastructure and other facilities (and to minimize the costs of provision); and develop a Master Plan for the next 25 years. The Master Plan took into account the demands associated with existing processing plants, plants for which ADNOC has well developed plans and data, plants which were in an earlier and less defined stage of development and speculative projects which suggested might be developed after the year 2011
- **Egypt Petrochemical Infrastructure Master Plan -** Nexant was commissioned by the Egyptian Petrochemicals Holding Company (Echem) to conduct an infrastructure Master Plan to develop the country's petrochemicals industry. The Petrochemical Infrastructure Master Plan provided a high level road map of the infrastructure requirements to support the planned development of petrochemical complexes at three selected sites located in the coastal area. The Master Plan covers the period to 2020 and focused on the development of an infrastructure company and the identification of infrastructure required to provide feedstock supplies and utilities, and facilities to import/export products
- **Isobutylene Master Plan – Confidential.** To provide client with a master plan for developing an isobutylene-based chemicals complex at Al Jubail in Saudi Arabia, covering all aspects of market opportunity, technology, business performance and recommended options to develop the complex together with downstream industry development. The study includes market, production, supply and demand, capacity information on: butyl rubber, tyres (tires) and methyl methacrylate
- **Aromatics Complex Feasibility Study – Confidential.** The client is considering investing several billion U.S. dollars in the Saudi petrochemical industry to upgrade locally available feedstocks such as methane, ethane, propane/butane (LPGs) as well as naphtha into valuable

products for domestic consumption and exports. This report represents the conclusion of the third study in a series of four reports, regarding the development of an aromatics project

- **Egyptian Petrochemical Master Plan** – Nexant was retained by Astra Horizons to provide a Petrochemical Master Plan for Egypt to detail how the industry should develop to exploit Egypt's increasing hydrocarbon reserves. The study was prepared in two volumes that include the Egyptian market and feedstock review, and a master plan for the Egyptian petrochemical industry. Included in the study was a market analysis, supply/demand and pricing, financial analysis, economics and cost of production, project feasibility, gas and aromatic feedstocks, government policy implications, technology selection, site selection, capital cost and operating cost estimates
- **Shuangdao Bay Petrochemical Feasibility Study – Confidential.** For the USTDA, Nexant preformed a feasibility study on a large-scale joint venture refinery and petrochemical complex in the Shuangdao Bay area in the northeastern region of China. This five volume study included: the executive summary; refinery market research and pricing, petrochemical market research and pricing; technical analysis; economic, financial, environmental, and country benefits analysis; regulatory issues, equipment and services, and implementation plan
- **Feasibility Study for Polyethylene and EPS in Tatarstan – Confidential.** A feasibility study into the development of polyethylene and expandable polystyrene plants at Nizhnekamsk. The feasibility study includes: a market outlook, technology review, indicative project cost estimate, an assessment of competitiveness, economic feasibility analysis, and a preliminary HSE assessment
- **Phased Angarsk Petrochemical Feasibility Study – Confidential.** A feasibility study into the proposed modernization project at Angarsk Polymer Plant. The objectives are to identify sources of feedstock and markets from the Angarsk petrochemical complex (including potential volume limitations and projected pricing bases); assess the potential competitiveness of the upgraded facility in comparison with international competitors; product an indicative project cost estimate to carry out an economic analysis for the project; identify potential equity partners for the project; provide a review of polymer technologies and to undertake a preliminary HSE review of the project. The study included a market study, project cost estimates, an economic analysis and competitive assessment; potential equity partners; a technology review and HSE review
- **Vietnam Petrochemical Master Plan -** Nexant was retained by PETRONAS to perform a market study on the outlook for petrochemicals in Vietnam, the types and sizes of projects that will be required in Vietnam over time, global trade in these products, and regional pricing. The study was prepared in multiple volumes to include market and price analysis, technical and infrastructure study and economic analysis
- **Turkmenistan Petrochemical Project: Prefeasibility Study** - LG International and Industrial Projects Management of Iran have signed a memorandum of understanding with the Government of Turkmenistan (acting through Turkmenneftgaz) to develop a potential gas-based petrochemical project at Gazachak. The project will produce ethylene from ethane extracted from the natural gas, to be the feedstock for the production of polyethylene for export. This pre-feasibility study covers: an assessment of market opportunities and an evaluation of the financial attractiveness of the project and the price of feedstock gas required to achieve attractiveness. The study covered market projections; logistics, product prices and competitive position; ethane extraction; petrochemical plants; offsites and infrastructure; safety, health and environmental issues; capital costs estimates and financial analysis
- **Philippines Project Development** - Nexant had several engagements over an extended period related to the Philippines petrochemical master plan and cracker project development. For the Philippines National Oil Company (PNOC), a feasibility study and aspects of commercial development for the planned cracker project. Nexant, in collaboration with Flour Daniel, provided PNOC and the investor companies with direction in engineering and commercial decisions.

Engineering tasks included: project definition and preparation of the invitation to bid; preparation of the bidders list; selection of short-listed ethylene technology licensors; final licensor, EPC selection and contract negotiations; and construction management. Commercial activities included: JV naphtha cracker owner partnership agreement; feedstock agreement; product offtake agreement; site service agreement; information memorandum preparation and support of the financial advisor. Nexant updated the feasibility study, including assessment of a number of technical options for the project; provided support to PNOC Petrochemicals (PPDC) on presenting the project to the government for support on tariffs and investment incentives, and led discussions on key issues negotiated in the Letter of Intent among the sponsor consortium leading to the initial equity injections for the project

- **Thailand Petrochemical Master Plan Development and Update** - Nexant was engaged by the Petroleum Authority of Thailand to develop an overall petrochemical Master Plan, which included all of the major feedstocks, intermediates and first order derivatives. The screening began with about 80 products in total and was narrowed down to 15 products for detailed evaluation. The screening was based on projected growth in downstream derivatives based on economic sector growth, product growth rate, simple return and utilization of indigenous hydrocarbon feedstocks. The investment program followed the Master Plan and many of the recommendations were followed. An update and extension of the Master Plan was also developed which focused on derivative applications to utilize olefins and aromatics based on the complexes which were constructed
- **Petrochemical Master Plan** - Petroliam Nasional Berhad (PETRONAS) engaged Nexant to assist them to determine the optimal composition of the Malaysian petrochemical industry. As building a strong position requires Malaysia to focus on areas where PETRONAS can best leverage its feedstock cost advantage and sustain a competitive position, Nexant's assistance identified and ranked products/processes across a wide range products: olefins, aromatics, inorganics and their derivatives, and assessed the financial and commercial attractiveness of projects proposed by others. Phase I encompassed commercial and technical analyses of feedstocks and markets; financial modeling of investment cost, financing, feedstocks and products and timing; project ranking and recommendations. Phase II developed a strategy for industry development, identification of strategic focus using competitive advantages, low cost feedstocks, growing domestic markets and technology access; plan to implement each of the projects, method of entry, share of ownership and project timing. PETRONAS staff worked closely with Nexant throughout the project to insure that requisite technical, market and analytical skills were transferred
- **Polypropylene Feasibility Study** - Philippines National Oil Company commissioned Nexant to perform a detailed analysis of the polypropylene industry, including compounding, process exports and forward integration. The scope of this feasibility study included an Asian market analysis; evaluation of technology and potential licensors; evaluation of competitive Asian projects; feedstock analysis and general feedstock economics. Nexant was also involved in meeting with government personnel on tax incentives and tariff protection and in final negotiations with licensors. The PNOC staff participated in activities such as market analysis and visits to potential licensors
- **Polyolefin Feasibility Study** - A Philippine company requested studies on supply, demand, grades, fabricators pricing and trade in order to develop the status and structure of the polyolefins business in the Philippines. Nexant developed a ten-year forecast taking into account global conditions, government incentive/protection requirements, competitive economics and likely resin selling prices. Nexant also identified potential technology and licensors and determined the number and type of viable polyolefins

- **The Second Petrochemical Complex in Thailand -** Nexant was engaged by the Petroleum Authority of Thailand, with Bechtel, to complete feasibility studies for planned petrochemical complexes. This study evaluated the production of olefins and aromatics (the upstream plants), and all of their derivatives (the downstream plants) including polyethylene, polypropylene, ethylene oxide/glycol, styrene/ polystyrene, caustic-chlorine/EDC/VCM/PVC). The assignment included the full range of technical, market, commercial, and financial analyses, and also interactions with government authorities to coordinate decisions on plant licenses/sizes, project development incentives, etc. The study recommended the development of the integrated Second Petrochemical Complexes and resulted in the creation of Thai Olefins Company, Aromatics (Thailand) Company, and all of the olefins and aromatics derivative companies. With the formation of Thai Olefins Company (TOC), Nexant was retained as the commercial advisor to TOC. As TOC's commercial advisor, Nexant advised leading TOC's contract negotiations for sales of olefins; advised and worked with TOC's financial advisor on project financing; assisted in preparation of project strategy and economic forecasts, etc. Nexant has participated in the selection of licensor/contractor bidders, bid invitation preparation, evaluation and selection of bidders and contract negotiations
- **Aromatics Feasibility Study** - A Singapore company requested a feasibility study for an aromatics project producing benzene and p-xylene for prospective equity partners and lending institutions. Nexant reviewed material provided by outside sources, developed a global/regional overview of the condensate feedstock supply, provided a market analysis with pricing, developed projected project cash flow and economics, and reviewed environmental considerations and the project implementation
- **Petrochemical Industry Development** - Nexant performed extensive work on the development of an olefins-based petrochemical industry in the Philippines; and was retained jointly by an international oil company and a domestic Philippine company to act as consultant in the planning of a large olefins-based chemical and petrochemical project. Feedstocks were from an existing domestic petroleum refinery and products were primarily for the domestic markets, with export markets considered in developing plants of adequate economic scale of production. The process plants involved in these studies were chlorine, caustic soda, ethylene, and propylene, HDPE, LDPE, PVC and VCM. Nexant's supplied raw material supply and price assessments and analyzed the interaction of the petrochemical complex with the adjacent refinery. The study also included: product pricing and markets (both domestic and export factors); cost of production (COP) estimates that established the plant size needed to be competitive with future world-scale plants; discussions with potential joint venture partners, analyses of project financing plans, reviews of managing contractors, and establishment of project definition documents. The second phase of work involved Nexant efforts on behalf of the Philippine National Oil Company (PNOC), to encourage and develop the project. This work involved: further analysis and recommendations on plants to be included; evaluations of government strategy, national benefits, public sector participation, and the policies and support that are necessary and appropriate to develop this project. Nexant had a resident consultant in Manila working as part of the petrochemical task force
- **Aromatics Industry Advisory Assistance** - The government of Indonesia through P.T. Pupuk Kaltim contracted Nexant to evaluate the development of an aromatics-based complex to produce primary petrochemicals and their derivatives. The products from these facilities were slated to meet demands for these materials primarily in Indonesia and other ASEAN countries. The major areas addressed by this study were forecasts of markets for potential products in Indonesia and other ASEAN countries, and an overview of the world situation; analysis of possible sites and selection of a site and feedstock for the evaluation of the project; determination of overall project logic, units to be included in the complex, and representative technology to be employed; analysis of incentives offered by other governments to develop comparable industries and

recommendations for this project, and evaluation of project economics and analysis potential for successful implementation

- **Industry Advisory Assistance** - Nexant has advised Petrochemical Industries Company (PIC), Kuwait on general petrochemical planning matters for numerous years, during which Nexant performed a feasibility and project definition of an ethylene complex. The ethylene complex was to be based on natural gas-derived ethane and was to produce the following products for the export markets. Low density polyethylene (LDPE), ethylene oxide/glycol, ethylbenzene/styrene. Nexant provided market research surveys on a worldwide basis for the listed products and identified specific markets, and in the case of LDPE, provided identification of required grades or products for these markets. Nexant assessed the qualifications of process licensors and contractors and made technical evaluations of their offerings. Nexant prepared a master project definition that included required infrastructure, utilities, and process plants. This included estimates and schedules for all facilities
- **Natural Gas Master Plan** - Nexant was retained by PETRONAS (Petroliam Nasional Berhad), Malaysia, on several related assignments over several years to determine the optimum usage of natural gas and how a natural gas industry should be developed in Malaysia. It involved studies related to the extraction of ethane for petrochemicals, and liquefied petroleum gases (LPG) for domestic fuel use and export. The lean gas after extraction was then evaluated for use in the industrial fuel markets, and as feedstock for nitrogen fertilizers (ammonia, urea, nitrates) and methanol. The work involved: global chemical and energy market evaluations; field work in Malaysia and elsewhere in the world to identify chemical and product use patterns, and global trade in various energy products; competitive supplier economics and growth forecasts for domestic and global demand provided the basis for the determination of domestic plant capacities; analyses and recommendations on pricing policies of natural gas and natural gas liquids versus petroleum products and coal; assessment of reserves and production data to establish reasonable forecasts of quality and quantity of future natural gas production; secondary benefits to existing and new users of the products resulting from lower prices or increased availability; additional benefits resulting from the improvement of Malaysia's balance of payments, either as a result of exporting the products or as a result of import substitution
- **Strategic Assessment of Petrochemical Options** - The government of a South American country with both refinery and petrochemical capabilities requested an assessment of petrochemicals opportunities: what could/should be produced; possible markets and assessment of their competitive position. Nexant produced a series of scenarios describing different business positions for their review and consideration
- **Regional Petrochemical Industry Advisory Assistance** - Nexant was retained by the Industrial Development Center of Arab States (IDCAS) in Egypt to carry out independent feasibility studies to determine the potential for establishing olefins and aromatics industries within the Arab States. These studies would assist decision-makers in the respective states to implement oil and gas utilization programs giving maximum, long-term benefits to the Arab economies. Nexant prepared a master plan involving global market analyses for ethylene, ethylene oxide/glycol, polyethylene, polypropylene, xylenes, styrene, VCM, DMT, terephathalic acid, etc. The master plan developed the economic implications associated with the region's low-cost raw materials and established the likely production, transportation, and sales costs in competition with the domestic producers in Europe, Japan, and the United States. The economic analysis included appropriate technologies, location of facilities, infrastructure requirements
- **Petrochemical Industry Advisory Assistance**-- Nexant was retained by the Ministry of Industries, Nigeria, to assist in the development of a new petrochemical industry in Nigeria for the following chemicals and petrochemicals: ethylene; VCM, LDPE, chlorine, HDPE, caustic soda, PVC. Consulting services included: market research in Nigeria and West Africa to identify

product use patterns and growth forecasts and to determine plant production capabilities; project definition, including infrastructure requirements, utilities, and the preparation of accurate cost estimates and schedules associated with alternative site candidates; qualifications, selection of joint venture partners, and negotiating of agreements with these partners; development of financial plans and participated in discussions with merchant banks, credit guarantee authorities, and similar organizations essential to the financing of the project(s); project planning including project organization, manpower requirements, job description and specifications, training programs; qualifications and selection of the managing contractor; bid specifications for each of the plants and evaluated the proposals of the candidate process contractors. Nexant continued planning responsibilities during design and engineering and also at the plant site training Nigerian personnel

- **Master Plan for Natural Gas Utilization in the Ivory Coast** -The Ivory Coast, a net importer of petroleum to supply its energy needs, has substantial offshore natural gas reserves that could be of benefit to the Ivory coast economy if developed. Nexant evaluated the potential for the development of the natural gas markets and provided a plan to implement it. The assessment evaluated fuel substitution options including the use of natural gas and natural gas liquids for motor transport. A detailed assessment of the local market was carried out. This involved an evaluation of the necessary infrastructure changes required to yield a substantial use of natural gas in these applications. A program for achieving objectives was developed and presented to the government

STRATEGY DEVELOPMENT

- **Petrochemical Investments Prefeasibility Study -** EBRAM Investments is interested in developing a petrochemical complex in the Kingdom of Saudi Arabia. Nexant has been engaged to: provide an insight into the potential projects that could be developed, identify an optimum project configuration and perform a pre-feasibility analysis on the chosen complex. The project development and pre-feasibility analysis is the subject of this report. Products of interest included n-butanol, hexanol, polyethylene, and MEG and 2-ethyl hexanol
- **Strategic Master Plan** - This study was made to identify, analyze and recommend projects for investment to a ten-year time horizon incorporating: review of domestic market and growth potential; review of existing facilities and achievable capacities; screening of products as candidates for expansion; definition of projects and related capital investment and operating budget estimates; development of price projections for domestic and export scales; evaluation of projects; planning recommendations
- **Business Strategy** - A major U.S. chemical producer engaged Nexant to assist in developing a strategy to substantially expand the company's business in Southeast Asia, including China and India. Nexant's study, carried out in close cooperation with the client's strategy development team, provided an outside viewpoint relative to expansion in Asia. Nexant sought to match the client's capabilities with opportunities to participate in Asia. The issues discussed included: country preferences; site integration; financial attractiveness; value added products; flexibility of strategy
- **Strategy Development** - Nexant closely collaborated with a client considering back integrating into ethylene production as a hedge against high feedstock costs for the core businesses or as an opportunity to develop another profitable business. The project comprised: analyzing current/expected market conditions; reviewing ethylene capital requirements, operating costs and profitability; evaluating the client's options; developing the preferred course of action
- **Natural Gas Strategy** - A large diversified energy company, undergoing a complete reorganization, required a clear direction for its natural gas business, especially a resource and

supply management framework to supply natural gas and related products in an efficient and safe manner, and manage the development of its gas resource base in an economical manner. Nexant participated in the development of an overall strategy to establish and sustain a viable and self- supporting natural gas company. The recommended strategy took into consideration specific marketing and pricing policies, key operational programs, the appropriate infrastructure needed to support the strategy and the role of natural gas within its energy system portfolio

- **Strategic Opportunities** - Nexant suggested that this client could add value and increase profits in its refining business by upgrading streams and producing higher value products. Nexant identified suitable projects; such as recovering propylene or aromatics and manufacturing cumene or other derivative, recovering ethylene or upgrading saturated C4 streams; and suggested various approaches that would contribute to the success of this strategy
- **Latin American Strategy** - A Brazilian polymer company, concerned about the short and long term impact of recent and planned events in Brazil and other South American companies, approached Nexant for assistance with a strategic plan. Nexant's role was to: define the future Brazilian/MERCOSUL/Latin American markets for polyethylene; assess competitors in areas, such as evaluating areas such as capacity plans, technology used, market share, product slate, pricing philosophy, R&D/technical position, etc.; audit the client's operations in order to develop a complete understanding of current/historic strategy; identify a number of strategic options
- **Value Creation** - The largest division of a major chemical company had not been meeting its corporate earnings objectives and was concerned regarding its long-term contribution to the company's share value. Nexant was retained to review the client's existing strategy, to help develop a new approach which might improve its competitive position, earnings and its contribution to company share value. An alternate strategy was developed with clearly set targets and milestones and was presented and agreed to by both senior divisional management as well as the overall company CEO
- **Business Repositioning** - A U.S. chemical company, trying to reposition itself within its business areas, engaged Nexant to review strategies to increase shareholder value and to develop a strategic vision for the firm. Nexant primarily used two analytical tools in developing a strategy for the firm in each of its businesses. The initial step evaluated the long-term attractiveness of each business which encompassed the analysis of the historical supply and demand curves to identify price setting mechanisms and industry profitability, qualitative analysis of industry discipline and rivalry within the industry, and determination of barriers to entry and other cost advantages. The second analytical tool used was a determination of the firm's cost of capital, which was used as one of several screening mechanisms. Based on this analysis, Nexant was able to recommend which businesses to divest and which to diversify into
- **Technology Strategy Development -** For a major U.S. chemical company, Nexant participated on a task force that was formed for the purpose of developing a technology strategy. Specific roles and assignments evolved over the course of several months as the members of the group formulated their technology platform pertaining to plastics
- **Ethylene Oxide/Glycol Strategy** - An important producer of ethylene oxide and glycol requested assistance in developing an EO/EG strategy. Their position as a major antifreeze producer and merchant EO supplier to the ethoxylate market was under threat. Nexant evaluated the markets they were in, their competitive cost position, the strengths, weaknesses and strategies of their competitors and recommended strategies, consistent with their corporate mission and business objectives. These recommendations included downstream integration into new business areas, an acquisition and customer targeting strategies

- **Industry Restructuring** - The response of the European petrochemical industry to overcapacity was cautious until the end of the decade, when optimism again fired up unwarranted new capacity. Nexant again analyzed the role the industry could best serve in the next decade and defined strategic objectives for the industry
- **Planning Strategy -** A regional division of an international chemical producer, concerned about limited future export and growth opportunities, requested Nexant's assistance in assessing the business environment. Nexant's approach included: a situation analysis that reviewed current competencies/positions and future plans; development of scenarios that included macroeconomic factors and business specific issues; characterized the dynamics of the Asian chemical industry; identified major issues, trends and options
- **Upstream Integration** - A major petrochemical producer questioned whether it was necessary to back integrate into natural gas and gas liquids production to support its downstream petrochemical activities. Back integration represented a major step involving significant investments, commitment of management resources and assumption of a new set of business risks and uncertainty. Nexant analyzed the structure of the natural gas and gas liquids business (exploration and production, marketing and transportation, gas processing and transportation of raw NGLs and finished products), identify key performance drivers, provide historical profitability analysis and identify preliminary business entry options
- **Divestment Strategy** - A U.S. producer of coatings resins with a portfolio of poorly performing businesses was considering downstream integration in an effort to improve its business posture. Nexant analyzed each business separately, and as a group. It was determined that in most cases, downstream integration would prove difficult relative to other options. Development of cost curves revealed that the firm was poorly positioned and would have to improve its manufacturing plant in order to survive. Relatedness maps were used to determine which businesses could be divested without hurting the core business
- **Business Development/Diversification -** This assignment for a major multinational chemical company created a business development program for a business recently acquired, but stalled in a mid-level business position. Nexant worked with the client to: convert a technology and marketing capability into a business; identify new businesses for entry and determine the best means of entry; develop a strategy geared to a long term leadership position. This study helped establish business objectives consistent with the corporate vision; performed the necessary market, competitor and profitability analysis; developed marketing programs; targeted companies for acquisition; developed strategic options and recommendations for management to follow
- **Petrochemical Growth Strategy -** For a government agency concerned with international developments and the competitiveness of Thailand in the chemical industry, Nexant discussed the outlook for supply/demand in Thailand; domestic production versus imports; competition from other ASEAN producers; role of the government in the petrochemical industry; profitability and product opportunities
- **Aromatics Implementation Planning -** For a Thai chemical producer involved in the implementation phase of an aromatics project, Nexant assessed the future availability and price of the feedstock supply (reformate streams and hydrogen) over a ten year period and evaluated an upstream naphtha-based catalytic reforming unit considering three potential naphtha feedstocks
- **U.S. Ethylene Expansion Strategy -** Following the privatization of the Brazilian chemical industry, a small ethylene producer, confronted with larger producers benefiting from the scale of their operations and opportunities for consolidation/restructuring, Nexant assessed current and

future positions and to develop a strategy for the future. In order to identify the possible option, Nexant audited (cost position, feedstock position, sales, logistics, site dynamics, competition) the facility and performed a situation analysis (outlook on products and derivatives, customer base, logistics and pricing) the location in order to understand the current position. As part of the situation analysis, Nexant developed the costs for capital and operations of a new cracker using various feedstocks. Strategic options considered included expansion, joint venture, forward integration, restructuring, etc.

- **Competitive Positioning Of Downstream Business -** A U.S. oil company interested in entering a petroleum derivative business dominated by a major Japanese competitor retained Nexant to competitively position them within the industry, determine the resources necessary to achieve this position, and estimate the value of business. The study included: a commercial analysis of the business (including market segmentation); demand forecasts; price sensitivities based on a value-in-use (demand) curve; evaluation of competing technologies for production costs and likely minimum efficient scales. A business strategy was developed that addressed positioning, competitor analysis, entry by other firms, and value chain economics. A financial valuation of the business was produced

- **Ethylene Derivatives Strategy** - Nexant was engaged by a leading Brazilian producer serving international markets to develop and evaluate corporate strategy for its ethylene derivatives business. As part of the evaluation of the complex market environment, Nexant analyzed current operations with an emphasis on manufacturing economics, including pricing and price setting mechanisms. Financial models were used to project cash flows for the next ten years, to run sensitivities on cases and assumptions regarding products, competitors and sales, and to identify the optimal strategic options

- **Restructuring and Diversification -** In an effort to reposition itself within its business area, a U.S. chemical company requested that Nexant review strategies developed to increase shareholder value and to develop a strategic vision for the firm. Nexant based the analysis on two analytical tools. S-C-P (structure, conduct, performance) model identified the long-term attractiveness of each business. This encompassed the analysis of the historical supply and demand curves to identify price setting mechanisms and industry profitability, qualitative analysis of industry discipline and rivalry within the industry, and determination of barriers to entry and other cost advantages. The other analytical tool was determination of the firm's cost of capital, used as a screening mechanism. Based on this analysis, Nexant was able to recommend businesses to divest, and business to diversify into

- **Maintaining Competitive Advantage** - A U.S. company was attempting to extend its competitive advantage in an ethylene derivative business. Nexant performed a market segmentation study to determine a value-in-use curve in the derivative markets to determine how the firm should direct its sales effort. It also developed supply curves for ethylene and its derivatives to determine price setting mechanisms and degree of competitive advantage that was possible. An historic analysis of the price setting mechanisms that covered the complete business cycle revealed the advantages back integration provides. Finally, a relatedness map was used to illustrate resource and market overlaps that would result in synergies

- **Strategy Development for a Canadian Province -** The government of a Canadian province requested that Nexant develop a long-range strategy for its chemical industry. Nexant first developed regional and global economic scenarios for the future. Then feedstock, energy costs, and other basic advantages were identified and quantified by development of global cost curves for the various commodity chemicals being produced in the province. Product and market life cycles for each product were examined to determine the long-term attractiveness of the

province's business portfolio. Nexant then helped the province define the best role for the government and state-owned enterprises to foster growth in the private sector. The impact of the proposed Free Trade Agreement between the United States and Canada was reviewed in terms of its implications of the long-term competitiveness of the chemical companies in the province

- **Strategy Assessment -** Nexant assisted a division of a major chemical producer assess its current strategy and develop and evaluate several alternative options that would expand operations beyond dependence of a single commodity chemical. A variety of strategic options were identified via extensive consultant/client interaction. Strategies defined as leadership, low cost, differentiation or divestiture were tested and ranked based on several factors: competitive advantage, flexibility, resource requirement
- **Global Petrochemical Strategy -** For this four part study commissioned by the national oil company of to identify and leverage strategic resources, Nexant analyzed the international petrochemical industry and the competitor position; analyzed international economic and institutional framework designed to support competitiveness; assessed the clients existing product structure; assessed the petrochemical sectors product groups/markets; developed strategies options and evaluated the options based on predetermined criteria and selection of recommended strategies
- **Corporate Strategies** - The Gas and Basic Petrochemical group of the national oil company required the development of a strategy with national, corporate and unit level for natural gas resources. The national objectives involved resources and supply management; policy setting and a regulatory framework. At the corporate level were issues of energy efficiency technological developments and the interface between the new units; the operating concerns were profitability, extraction, exports, growth objectives and safety targets. Nexant provided a solution assessment, options in natural gas/NGL petrochemical feedstock, implementation program and organizational structure
- **Petrochemical Strategy -** Developed a petrochemical strategy for PEMEX by providing competitive costs, detailed cost analyses, pricing, transportation costs and market analyses. Also, examined the development and growth of other regional petrochemical industries to provide a frame of reference for PEMEX
- **Gas Strategy –** Assisted PEMEX's gas unit in the formulation and implementation of an overall corporate strategy. Assignment entails structuring all key aspects of operating a gas company and establishing a viable Mexican gas industry with emphasis on developing marketing and pricing strategies
- **Diversification -** A U.S. chemical company wanted to grow its business by diversification into a business area that was largely unrelated to its core businesses. Nexant developed a methodology for identifying new business areas to be considered, and a screening mechanism to ensure that diversification would be successful. The screening tool was based primarily on a relatedness map in which the client's current skills, technologies, manufacturing, and marketing strengths were identified and compared with the new businesses. Two new business opportunities were identified, and entry strategy is now proceeding
- **Building A European Manufacturing Base -** A major U.S. petrochemical producer wanted to expand its market position in certain ethylene derivatives in Europe by investment in production capacity there. Nexant determined that the best entry strategy was by joint venture with an incumbent European chemical producer. The initial analysis identified the likely candidates by their current market and cost position, location to local markets, and other factors. The final

candidates were analyzed to determine the value of the proposed joint venture, its value to each partner, and the competitive position of the joint venture business within the European industry

- **Petrochemical Strategy -** Comprehensive analysis of the existing business of an African petrochemical producer, to identify competitive pressures and formulate a strategy for future development
- **Aromatics Strategy -** Nexant was retained to perform a business analysis and strategy development for a large European aromatics producer. Competitiveness, market development, investment needs and other key issues are all under intensive review
- **Ethylene Oxide/Glycol Strategy -** An important U.S. producer of ethylene oxide and glycol requested assistance in developing an EO/EG strategy. Their position as a major antifreeze producer and merchant EO supplier to the ethoxylate market was under threat. Nexant evaluated the markets they were in, their competitive cost position, the strengths, weaknesses and strategies of their competitors and recommended strategies, consistent with their corporate mission and business objectives. These recommendations included downstream integration into new business areas, an acquisition, and customer targeting strategies
- **Investment Strategy -** For the privatization of a leading Czech refining and petrochemical company, Nexant assisted a leading merchant bank in evaluating the potential value of the company before and after various investment options and assisted in the privatization process

FINANCIAL RELATED

- **Advisory Role for Defining Petrochemical Investments -** To identify potential petrochemical opportunities in the Kingdom of Saudi Arabia and, potentially, the GCC region. This screening study covers four intermediates products and sixteen derivative products including LDPE, LLDPE, HDPE, PTA and MEG
- **Polypropylene Due Diligence -** A Japanese bank considering the revision of financing for an Indonesian polypropylene project engaged Nexant as advisors who understood the interaction between olefin operations, petroleum refineries, polypropylene technologies and markets and the relationship of polypropylene to other polymers. Nexant provided: a market forecast for propylene and polypropylene with an outlook for Indonesia and Southeast Asia; price forecasts for propylene and polypropylene in Asia; and a review of operations, costs and price/margin projections of the financed plant
- **Petrochemical Complex Market Assessment -** For two financial institutions interested in financing the development of the Chandra Asri complex in Indonesia, Nexant assessed the outlook for the complex with regard to markets, feedstock availability, operating costs, product sales and prices and overall project economics/cash flow. The study encompassed the key global regions of U.S., Western Europe and Japan, reviewing ten years of history and developing estimates for ten years in the future
- **Petrochemical Feedstocks and Markets -** An update following a feasibility study intended to provide the current outlook and provide documentation for an initial public offering (IPO) in Thailand. Nexant provided information on feedstock supplies; outlook for products; pricing for feedstocks and basic chemicals; project economics
- **Portfolio Analysis -** Review of U.S. client's portfolio of businesses to determine how competitive advantage could be achieved. Determination of the appropriate position on the value chain for each strategic business unit was done through S-C-P (structure, conduct, and performance) modeling. Each strategy option was reviewed via financial analysis of the earnings profile,

competitive matrix, and cost curve analysis. Game theory was used in the analysis of mature business to determine the appropriate strategy options

- **Divestiture -** A U.S. producer of coatings resins had a portfolio of businesses which were performing poorly from a financial standpoint, and believed that downstream integration would improve its business posture. Nexant analyzed each business separately, and as a group. It was determined that in most cases, downstream integration would prove difficult relative to other options. Development of cost curves revealed that the firm was poorly positioned, and would have to improve its manufacturing plant in order to survive. Relatedness maps were used to determine which businesses could be divested without hurting the core business
- **Asset Valuation -** Nexant performed an asset valuation of a U.S. petrochemical producer for a client who was considering acquiring the firm. Nexant analyzed the technological and commercial position of the firm, and developed a financial model that closely replicated the reported historical financial performance of the firm. This model was then used to estimate the present value of the firm based on its future income potential
- **Recapitalization -** Nexant provided a financial model and market demand forecast for the major businesses of a U.S. petrochemical producer. This detailed analysis was used to determine the form and extent of financial recapitalization the firm could execute
- **Downstream Integration -** A U.S. ethylene producer asked Nexant to assess the viability of entering into a particular ethylene derivative business. Nexant first evaluated the business by performing an S-C-P analysis, and determining price-setting mechanisms based on cost curves. Based on the positioning of the incumbent producers in the industry, and their cost position, and lack of commercially available technology, it was determined that the entry barriers made entry economically unattractive
- **Acquisition -** Nexant performed a commercial analysis and asset valuation of a division of a U.S. petrochemical company for a client who was bidding for the division. The commercial analysis included developing supply and demand balances, product price forecasts, and competitor analysis
- **Leveraged Buyout -** Nexant performed a complete commercial, technical, and financial due diligence, including the development of a financial business model, to assist a U.S. investment bank to structure the leverage buyout of a U.S. petrochemical company
- **Privatization Support -** Nexant provided a broad range of support to an integrated refiner/petrochemical producer in the Czech Republic. The assignment involved: assessment of competitive position in all product areas, a valuation of the company and its product areas as they exist today, a broad review of strengths and weaknesses in all businesses, and definition of an overall strategic plan; a privatization strategy (including company restructuring); partner selection, negotiation support and finalization of all agreements
- **Acquisition -** Nexant performed an asset valuation of a major oil company for the U.S. firm that was acquiring it. This valuation involved both a technical and commercial audit of the subject facilities
- **Acquisition -** A French petrochemical producer retained Nexant to identify specialty chemical companies it could acquire. Nexant first worked with the client to develop a list of criteria that crystallized what the company was looking for. Each candidate for acquisition was analyzed in terms of the criteria, its relatedness with the client's businesses, and its position within the industry it served. This positioning analysis was performed by evaluating industry attractiveness

versus the position of the acquisition target within the business, as well as by quantitative analysis of the companies' position on the industry cost curve

- **Acquisition -** Nexant was hired by a French petrochemical producer to perform a due diligence and business analysis of a U.S. chemical company for use in bidding. Nexant developed a financial model to forecast cash flows, which was used as the basis of preliminary and final bidding
- **Valuation of Romanian Refining and Petrochemical Sites -** For the Western partners evaluating Romanian facilities, Nexant provided assessments of the commercial and technical environment
- **Comprehensive Review and Diligence Valuation of Romanian Complex -** Nexant undertook a full assessment of the commercial, technical and economic aspects of the operations of a refining and petrochemicals complex for a joint venture with a U.S. oil company. Proposals for technical, commercial and logistical improvements were made
- **Industry Advisory Assistance -** The Energy Ministry was planning/considering the privatization of the chemical industry. This meant their withdrawal from equity participation as well as control of feedstock pricing. Nexant consulted with the Ministry with regard to the long-term health of their industry. The implications/impact their withdrawal from the market would have, and how feedstock pricing in the country should be structured so that a privately owned monopoly (now taking over from the government owned monopoly) does not due harm to the downstream industry and consumers was then assessed
- **U.S. Acquisition Analysis -** An Italian firm active in the acrylic sheet business was interested in entering the U.S. market via acquisition. Nexant evaluated the U.S. market, pricing, profitability, competition, importance of upstream and downstream positioning and product quality technology relationships. Acquisition targets were then identified based upon agreed criteria. Bid prices defined via P/E and cash flow analyses and recommendations were made

TECHNO-ECONOMIC EVALUATION

- **Petrochemical Opportunity Study – Confidential.** The objectives of this study are to define the basic configuration of a petrochemical project based on feedstock, market, and technology availability considerations. In addition, the competitive landscape will be described and a high level implementation plan developed to reflect the lengthy process between project definition, government approval and plant construction
- **Petrochemical Market and Technology Review – Confidential.** Nexant was retained to perform a techno-economic evaluation for selected petrochemical products, covering the supply, demand and pricing in Russia, including export pricing, together with details of the production processes and an HSE review of waste streams. The selected products included: alpha olefins, ethylene oxide/ethylene glycol, propylene oxide/propylene glycol, polypropylene, polystyrene, ethyl benzene, styrene monomer, MMPA and PMMA
- **Due Diligence** – Nexant carried out a technical due diligence on an Asian polypropylene complex for merger purposes. The work scope included environmental due diligence covering emissions history and compliance, permits, and excursions
- **Chinese Polyolefins Benchmarking -** For a Chinese firm, Nexant completed a comprehensive benchmarking of suppliers of LLDPE, LDPE, HDPE and PP to the Chinese markets covering key local Chinese suppliers and international suppliers of imports into China

- **Petrochemical Project Pre-Feasibility Study – Confidential.** An in-depth market analysis and technical review on the ethylene, propylene, nylon and acetic acid derivatives for a petrochemical project in Saudi Arabia
- **Feasibility Study for Modernizations of Refinery Petrochemical Unit – Confidential.** Nexant was retained to examine the technical, economic, environmental and commercial aspects of the client's refinery petrochemical unit and to decide the most economically feasible way to proceed with capacity expansions and modernizations. Products covered in the study include: ethylene, polypropylene, HDPE, LDPE, DMT, ethylene oxide/ethylene glycol, PET and EDC
- **Japanese Ethylene Strategy -** A Japanese company involved in merger's assimilation activity required an independent evaluation of strategies for future ethylene production. Nexant assisted the client to optimize the product slate and resulting balance of products available from the new or existing plants based on ethylene production. Nexant also assisted the company determining optimum and most beneficial (long-term) plant capacities
- **Asian Ethylene Benchmarking -** Nexant completed a cash cost of production benchmarking analysis of Asian and Middle East ethylene producers for a Thai firm which was used in an IM for bond listing in order to update its overall business performance and competitive positioning versus key competitors in the Asian industry. The benchmarking study included representative key competitors in the region including Middle East, South Korea, Japanese, Taiwanese, Chinese and Southeast Asian producers (the specific producers were not identified in the study), and identified significant differences reflecting: producing location, hydrocarbon feedstocks, economies of scale
- **Canadian Petrochemical Assessment -** For a U.S. client interested in an assessment of the economics of recent petrochemical developments in Canada, Nexant provided: cost of ethane feedstock for cracker; cost of production, including depreciation and ROI, of ethylene produced in a state-of-the-art cracker and via a combination process; cost of production of LLDPE produced in a gas phase process unit; cost of transporting LLDPE to major U.S. markets. Nexant also included comments on and an evaluation of strategic and commercial issues driving other companies to invest in Canada
- **Competitive Analysis of Regional and Global Olefins Producers -** For a client considering a new olefins plant, Nexant provided a comprehensive comparative analysis of potentially competitive projects in the nearby region and relevant world exporting countries. The scope included: current status and costs of competitive olefins projects; comparative project economics over an extended period; structural issues/comparisons in competing countries; outlook for ethylene demand, operating rates and margins/prices. The results of this study formed an important element in the review/decision to proceed with the project, which was implemented
- **Petrochemicals Planning and Implementation -** Nexant provided assistance over several years to SABIC on all aspects of project planning, joint venture partner negotiations and project implementation
- **Styrene Production Economics -** This report provided production economics for styrene process technologies that are available from several licensors, including Lummus, Badger, CDF-Technip, and UOP
- **Petrochemical Industry Manufacturing Costs -** This study provided a comparison of production economics for major global petrochemical producers. The report served as a benchmark for Nexant client operations and provided a framework for monitoring petrochemical costs, prices, and margins on an ongoing basis

- **Technoeconomics of Ethylbenzene and Styrene -** Nexant provided an analysis of the market for ethylbenzene in Europe. An assessment of the available ethylbenzene and styrene production technologies was also included in the report

MARKET/BUSINESS ANALYSIS

- **Petrochemical Growth Strategy – Confidential.** Market fundamentals and competitive analysis around benzene, para-xylene, olefins, HDPE, LDPE, LLDPE, polypropylene by region and within Asia. This study examines feedstocks, supply and demand, net trade, ethylene growth shares, pricing, margins, cost curves and profitability
- **Market Analysis – Confidential.** The objectives of this analysis are to prepare independent market outlooks for a selected number of products of interest to the client; to assess the competitiveness of their LDPE, HDPE and polypropylene units in relation to selected competitors and benchmarks; and to develop West European price forecasts for a number of materials (plus an estimate of any additional premiums or discounts the client enjoy in the Romanian and Turkish markets for these products). The products covered are: polypropylene, HDPE, LDPE, LLDPE, PVC, PET, polypropylene copolymers (impact / block, and random) and polypropylene compounds. Primary countries covered by the study are Romania and Turkey, plus secondary markets, the Former Yugoslavia, Russia, Ukraine and Bulgaria. The report also includes West European price forecasts for the products listed above, plus ethylene and propylene (polymer and chemical grade)
- **Opportunity Evaluation -** Nexant updated the findings of an earlier evaluation on the potential for the propylene recovery followed by conversion into polypropylene to include additional products, potential customer sales and strategic alliances. In addition, Nexant analyzed the potential for a new ethylene plant in the USGC adjacent to an existing refinery. The plant profile consisted of: plant size, feedstocks and products; land and investment requirements; technology and project economics; supply/demand; and potential partners
- **Market Evaluation -** A Thai olefins producer requested an updated market and price outlook for olefins, derivatives and feedstocks. Nexant provided historical and forecast supply/demand/net trade outlooks for major petrochemicals. Naphtha through ethylene and propylene to the polyolefins and other derivatives were included. Price forecasts were prepared using the low-oil and base-oil scenarios
- **Business Assessment –** The financial institution leading the financing of a joint venture between two major U.S. companies engaged Nexant to provide advice and assistance via reports containing market analysis, forecasts, competitive positions and industry drivers, as well as meeting participation, on the polyurethane, propylene oxide/MTBE and overall petrochemical businesses. Nexant was also available to other banks contacted by the lead bank as it attempted to syndicate the debt and equity
- **Technoeconomic Evaluation -** For an U.S. energy company, Nexant evaluated the economics and market opportunities for alternative that could be produced at a methanol facility in Africa. The products considered included: natural gas alternatives, such as ammonia, liquid fuels, LNG or dimethyl ether, and methanol derivatives, such as olefins (MTO), gasoline and distillates (MOGD), formaldehyde and acetic acid. Cost of production for each, as well as demand outlook, was provided
- **Technical/Commercial Audit -** A U.S. investment company needing to make a decision on exercising an option to finance a new project required a technical and commercial assessment of a new process route to metadichlorobenzene. Nexant evaluated whether the product could be made successfully at the required high purity, the uniqueness and attractiveness of the

technology, the cost to design and construct a facility for the new route. The commercial assessment covered current producers in the U.S., Japan and Europe, as well as uses and prices for it

- **Business Analysis -** For a company considering a plan to recover propylene from its refinery and upgrade its value by producing polypropylene as a new business venture, Nexant provided a technical and commercial evaluation that included a competitive analysis with each producer's cost structure by site, their market position, and propylene position. Industry structural issues, including transportation logistics, geographic sales distribution, operating rates and their impact on pricing, were also considered. Nexant also reviewed the client's financial model that covered commercial and economic inputs such as licensing fees, production costs, pricing, and volume
- **Business Analysis -** As part of the in-house review of strategic options with a major U.S. petrochemical producer, Nexant was called upon to provide background information on olefins and aromatics and a financial model for the client's use. The specific information included: technology barriers that would keep the client from participating in any of the value chain for the following: ethylene, propylene, benzene and xylene and all derivatives; For selected countries throughout the world, Nexant also provided: an outlook for supply/demand, including trade of derivatives; supply demand outlook for naphtha feedstock; driving forces impacting profitability; political/governmental factors (taxes, incentives, tariffs) that affect profitability; opportunities for petrochemicals with emphasis on refinery integration and the options open to the client
- **Business Assessment -** A company considering a new aromatics trading company for benzene, toluene, mixed xylenes, and para-xylene retained Nexant to assess the potential by analyzing the benefit and risk of product trading and describing the activities of other trading organizations. The study covered transaction types such as: back-to-back trading, regional arbitrage trading, short and long positions and location and time swaps; and issues, such as measurement, cash flow management/control, profitability, and risk exposure and credit availability
- **Opportunity Analysis -** An Argentine petrochemical producer came to Nexant for an independent evaluation of the future supply and demand of natural gas and petroleum-based feedstocks for the Argentine industry. Nexant profiled key petroleum and natural gas producing sites and proven reserves: ownership, annual production, reserve level, planned expansions, etc.; profiled existing and planned pipelines and distribution systems; profiled the locations, capacities, production, planned expansion of the refineries; provided quality characteristics of hydrocarbon resources; provided historical and forecast supply and demand for crude oil and condensate, natural gas, ethane, LPG, naphtha; identified sites that could support world scale olefin or aromatics operations; etc. Using the information available in the above work, Nexant identified potential investment opportunities for the client in Argentina
- **Global Competitive Petrochemical Analysis -** In this study for a major Japanese ethylene and ethylene derivatives producer, Nexant assess the impact of feedstock price changes on the economics of ethylene and derivatives to determine the competitive position of the client among the international producers. Nexant covered: feedstock valuation; plant economics; cost curve analysis; product valuations and competitive analyses for the Middle East, United States, Western Europe, Japan and South Korea
- **Petrochemical Market Survey -** A Brazilian chemical producer approached Nexant to develop a ten year supply/demand and pricing scenarios for feedstocks, basic petrochemicals and selected thermoplastics and elastomers for use in a competitive analysis of selected international producers in order to determine Brazil's ability to participate internationally. Nexant's conducted field studies and interacted with the client to develop detailed information on the chemical

business in Brazil to use in the comparison. The information for Brazil was then compared with Nexant's information base on the other regions involved

- **Business Entry -** A Canadian company considering a major investment in Western Canada requested Nexant to assist it in determining whether it should enter the aromatics and styrene business and how it should best maintain its position long term. Nexant determined the long-term profitability of this business, evaluated the competition, identified markets for entry and developed both penetration and long-term maintenance strategies
- **Styrenics Business Entry Strategy -** A South Korean company developing a styrene position requested assistance in developing a downstream domestic strategy. Nexant evaluated the South Korean market, the clients competitive cost position, the strengths/weaknesses of the client and competition and the elements of success in derivative products. A downstream product strategy was then developed based on a combination of downstream joint ventures and the targeting of specific customers
- **Industry Advisory Assistance -** The Ministry of Industry was interested in developing an industrial zone driven by the petrochemical production base in the country. Nexant identified appropriate projects to be considered for funding and its impact on the economy
- **Olefins and Derivatives Markets -** This study was prepared for a company considering the construction of a new steam cracker that would use ethane, LPGs, and/or other feedstocks. Nexant was asked to provide data, analysis and opinions on the economics of alternative feedstocks and the future global markets for ethylene, propylene, and major derivatives. Potential target markets were also identified. As part of the analysis, Nexant evaluated several potential crude scenarios and the impact each scenario would have on feedstock (e.g. naphtha, ethane, butane, etc.) costs and subsequent olefins manufacturing costs. Pricing mechanisms and forecasts were developed for ethylene and propylene, as were global supply/demand forecasts for all major derivatives
- **Producer Competitor Analysis -** Nexant was asked to provide a detailed analysis of the feedstock supply, pricing, and logistics options for the major MTBE producers in the U.S. Gulf Coast region. Its client was an international MTBE producer wanting to further penetrate rapidly growing MTBE markets in the United States and Western Europe. The report provided information, by company, on the following: hardware, feedstock, production costs, and marketing strategy
- **Mexican Export Opportunities -** The Mexican government has opened its petrochemical industry to the private sector. Our client, a financial institution, is in a position to help finance export related projects developed by the private sector. The global outlook for 29 products was evaluated in order to provide an assessment of export opportunities. The study also provided an analysis of competitive world economics, prices, and margins, which global exporters realize, and the prices and margins a Mexican exporter could anticipate
- **Business Perspective -** The primary use for butene-1 is as a comonomer for LLDPE production. The study provided an overview of the global butene-1 business including supply/demand analysis, the outlook for polyethylene comonomers, historical and projected butene-1 pricing, supply/demand analysis for hexane and octene, alpha-olefin process information, and global LLDPE capacities
- **Market Assessment -** Methyl chloroform is under environmental scrutiny as an ozone-depleting chemical. This study provided a perspective on the use and outlook for methyl chloroform in selected developing regions and an assessment of the impact that any methyl chloroform phase-

out would have on these markets. This report was part of a larger effort to characterize the use of methyl chloroform in major regions of the world and the potential impact of proposed regulations

- **Market Outlook -** This study contained an analysis of the structure of global propylene oxide and derivatives demand. Future supply/demand balances were determined on a regional basis for propylene oxide, polyether polyols, and propylene glycol
- **Petrochemical Developments -** Nexant reviewed emerging trends in the global petrochemical industry and the potential impact on Japanese petrochemical producers. Recommendations on how Japanese companies should position themselves in response to these developments were part of the study
- **Availability Analysis -** Nexant determined the availability of ethane and other steam cracker feedstocks in Saudi Arabia, with emphasis on the relationship between crude oil production and ethane availability. The study also contained a description of the facilities in Saudi Arabia that collect and process the associated gas
- **Positioning For The Future -** The study projected the future structure of the chemical industry. Among the issues analyzed were profitability, supply, environmental issues, and the competitive environment. This report was the starting point for a major strategy development effort
- **Phthalic Anhydride Business Analysis -** This study provided market and strategic analyses of the phthalic anhydride business in Western Europe. Derivative markets, producer companies, capacity addition, and the effects of technological improvements on production costs were analyzed
- **Analysis Of Olefins Business -** A study for a North European olefin producer to assist in an investment decision on a new cracker. Market analysis, competitive review and strategic issues were covered in depth
- **Olefins Pricing -** An analysis of the basis for pricing of deep sea ethylene and propylene with recommendations for a purchaser's future contract policy. The study established bases for pricing in all major regions and, using netback analysis, identified most likely future supply patterns
- **Steam Cracker Construction -** Analysis of the West European olefins scene for a major olefin producer. The need for a new cracker was identified and the location suggested on the basis of future company balances

MULTI-CLIENT STUDIES

Multi-client studies prepared by Nexant cover virtually all areas concerning the petrochemical industry. Specific reports, used worldwide by most of the major companies in the industry, include basic petrochemical topics such as ethylene technology and economics, nonconventional ethylene technology, and markets for ethylene, propylene, benzene, toluene, para-xylene, etc. Annual multi-client programs cover the continuing changes in the energy and petrochemical industries in North America, Europe and Asia. Key petrochemical derivatives are also the focus of multi-client studies.

- **Coal to MEG - Strategic Impact and Technology Evaluation –** This study provides a valuable aid for strategic planning purposes, at a time of both opportunity and challenge for players and prospective entrants into the global MEG business. It combines a review of the new coal-derived process and future configurations with natural gas, etc., as well as analysis of future market dynamics for MEG for the short, medium and long-term outlook for the business. The study provides key insight to the reader as to whether the coal to MEG development poses a threat or provides a new opportunity
- **New Technology Valuations: The Values of Technologies Under Development -** This study evaluates the intangible assets represented by chemical and energy process technologies that are in the research and development (R&D) phase. These technologies are not yet commercialized but appear to have significant economic value. The study surveys twenty promising technologies and explains Nexant's assessment of their value
- **Propylene Technology: The Next Generation -** This study provides an in-depth quantitative and qualitative analysis of various new and developing technologies for the production of propylene via conventional and emerging process routes and conventional and non-conventional feedstocks, including biomass
- **An In-Depth Analysis of the Polyethylene and Polypropylene Industry in China -** This study details polyethylene and polypropylene supply/demand and trade in China, including: imports of recycled/scrap polyethylene and polypropylene, impact of domestic recycling on demand growth, detailed demand analysis, and competitive supply costs from key exporting regions
- **Chemicals from Acetylene: Back to the Future? -** This study analyzes the technologies and economics of producing acetylene and commercially proven, technically attractive acetylene derivatives
- **Strategic Assessment of Middle East Impact on the Asian Petrochemical Industry -**This study provides a strategic evaluation of Middle East industry structure, competitiveness, and future direction of the Asian Industry with a view towards identifying opportunities and threats for Asian producers and potential entrants to the industry
- **Adding Value to Methane - Strategic Opportunities for the Middle East –** This multi-client study provides a valuable aid for strategic planning at a time of opportunity and challenge for methane exploitation. Study includes: regional market dynamics, impact on global trade, technology, capex/opex, and cost competitiveness
- **Squeezing Profitability from the PTA/PET Value Chain: Impact of the Latest Technology Advances –** This **s**tudy provides an in-depth analysis of new and developing technologies for production of terephthalic acid, EG, and polyester resin and fiber, and surveys/qualifies differences in medium quality terephthalic acid versus conventional PTA
- **An In-Depth Analysis of the Polyolefins Industry in China -** This study is designed to help companies selling polyolefins into China to better understand the market dynamics and position

themselves for the future. Study includes: demand by end-use, province, process; supply/demand, distribution and price history

- **Strategic Directions for the Middle Eastern Petrochemical Industry: Outlook for Development** – Nexant, in conjunction with the Gulf Organization for Industrial Consulting, prepared in-depth study of the Middle Eastern Petrochemical Industry. This study examines both regional "on the ground" issues, and their impact on the overall global industry
- **Asian Competitive Cost Issues** - An in-depth, quantitative, qualitative, strategic analysis of the global styrene business. The study covered: demand by region/country and application; current supply and future capacity by company and location; regional balances and world trade; current and developing technologies; regional economics; margin and price forecasts; business and strategic analyses
- **Technology Developments in Propylene and Propylene Derivatives –** This report examines and compares the process technologies and economics of the commercially available and developing technologies for the production of propylene alone or as a co-product. The report focuses on the economics of alternate routes to propylene, their comparison and competitiveness to conventional routes

Section 7 Contact Details

For more information and to place an order, contact as follows:

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