NexantThinking™

Strategic Business Analysis

Phosphate Rock Supplement

Brochure
January 2017

Nexant

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www.nexantthinking.com

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Section 1 Introduction and Report Objectives

1.1 INTRODUCTION

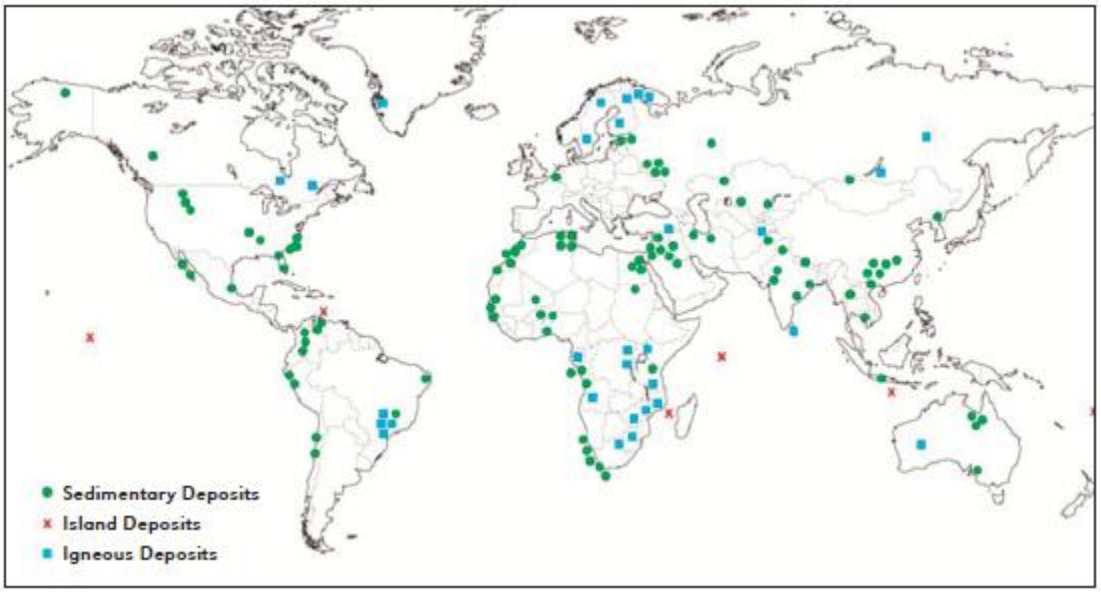
Phosphate rock is the only significant commercial source of the element phosphorus. It consists of the calcium phosphate mineral apatite together with quartz, calcite, dolomite, clay, and iron oxide as the so-called gangue constituents.

Phosphate rock (or phosphorite) refers to phosphate ores that have been commercially mined. There is a particular phosphate rock quality requirement for each process. For example, phosphate rocks used for commercial production of phosphoric acid by the wet process contain about 65 to 87 percent bone phosphate of lime (BPL), depending upon the origin. BPL is defined as the phosphate content, expressed as $Ca_3(PO_4)_2$, of phosphate materials. Commercial rocks contain varying amounts of other compounds, either physically mixed or substituted in the mineral itself.

Phosphate ores may be found in igneous or sedimentary rocks. Apatite is the name of phosphate based minerals in phosphate ore whether the ore is of an igneous or sedimentary origin. Apatites may be represented by the unit cell composition $Ca_{10}(PO4)_6(F,OH,Cl)_2$. The apatite lattice may be substituted by Mg, Sr, Ba, Cd, Zn, Pb, Fe, Mn, Cu, Li, Na, K, Y, and in small proportions, arsenate, silicate, aluminate, chromate, titanate, vanadate, sulfate, and borate. The most commonly encountered apatite minerals are fluorapatite $Ca_{10}(PO_4)_6F_2$ and francolite $Ca_{10}(PO_4,CO_3)_6(F,OH)_2$. Other variants include dahllite $Ca_{10}(PO_4,CO_3)_6(OH)_2$ and hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$. The majority of the phosphate rock resources are sedimentary, i.e. they originate from remains of marine life in regions that were once covered by seas, and got transformed into substantial phosphate deposits over the millennia. Other resources are igneous or volcanic in origin. The main phosphatic constituent of igneous basins is the fluorapatite, which usually occurs with alkaline intrusive rocks (i.e., carbonatites). Igneous deposits are mainly found in Africa, Scandinavia, and Brazil, as shown in Figure 1.1.

Figure 1.1 World Phosphate Deposits

(Source: International Fertilizer Development Corporation, 2013)



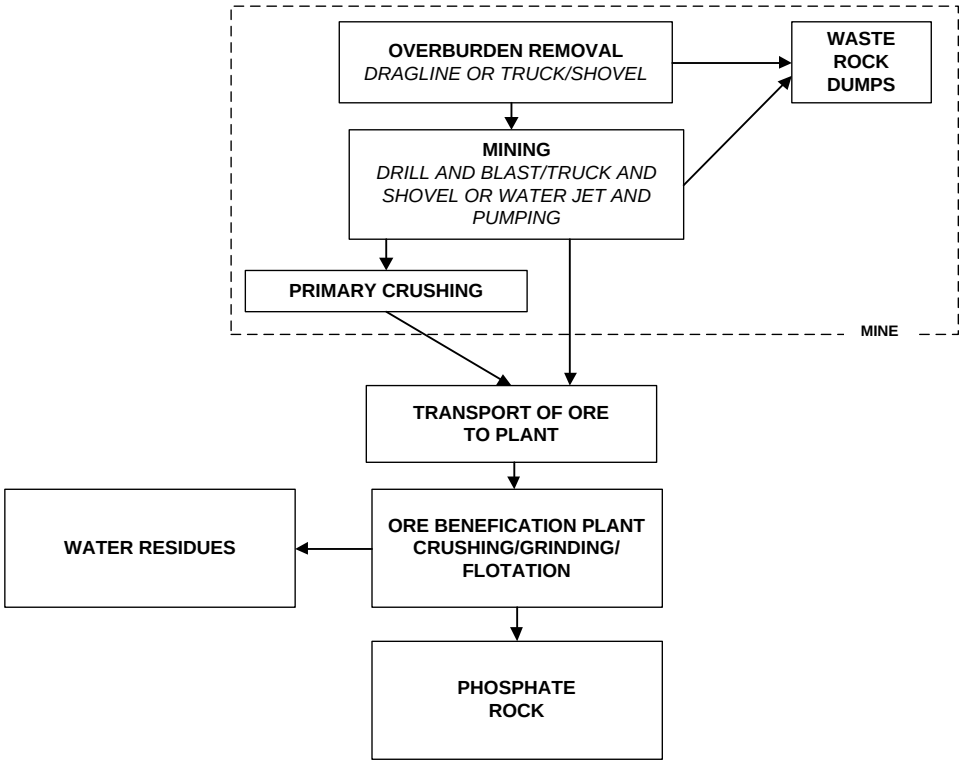
The impurities contained in the phosphate rock can have an effect (not always harmful) on downstream production processes and products. For example, impurities have the potential to influence the speed of corrosion-erosion, filtration rate, surface of filtration, as well as the density and viscosity of the phosphoric acid product. Impurities found in phosphate rock include carbon dioxide (increases foaming and therefore the use of antifoam reagents), magnesium oxide (high content decreases filterability), and aluminum and iron oxides (high content decreases the recovery of phosphorus pentoxide; but these oxides can reduce corrosion).

The world's main phosphate deposits, often very large resources, generally occur at shallow depth and are usually mined using established surface mining techniques, as illustrated in Figure 1.2. The principal mining methods lend themselves to the utilization of large mining machinery, giving benefits of scale that help to contain mining costs. Overburden lying above the ore is removed by either large draglines in a strip mining configuration, or with a fleet of large truck and shovel units, moving the waste to allocated dumping sites close by and exposing the phosphate ore for extraction.

Depending on the geological conditions, the ore can be mined using conventional drill, blast, load and haul techniques for harder materials or high pressure monitoring and pumping operations for softer material. The run of mine ore is sent to the beneficiation plant, often via a primary crusher to reduce particle size required by the plant.

The ore is then further crushed and milled in preparation for a flotation step, which separates the product from the gangue or waste material. The waste portion is often deposited in a specially prepared permanent waste management facility on site and the product is then ready for transport to a fertilizer plant for the next stage of the process.

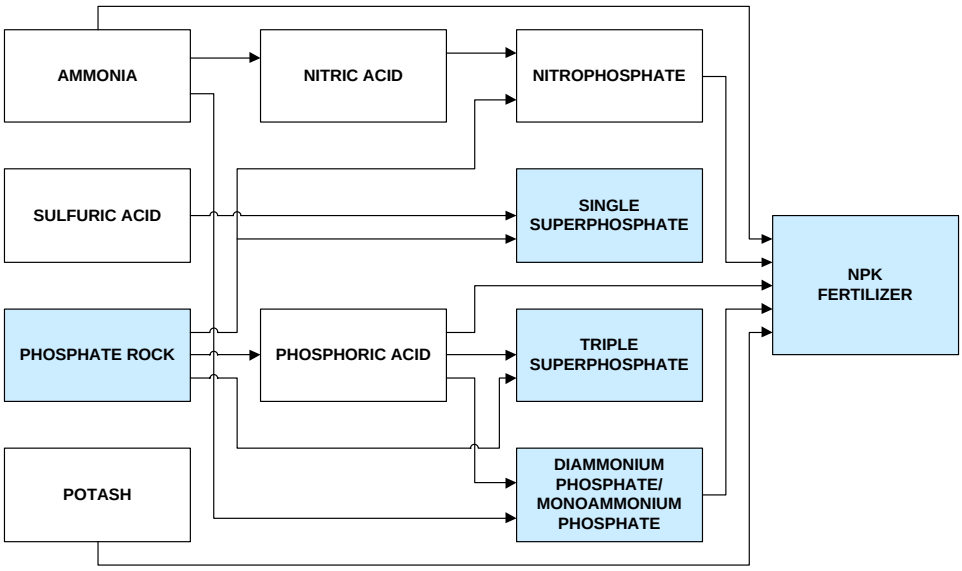
Figure 1.2 Typical Process Flow for a Surface Phosphate Mining Operation



Phosphate rock, through the production of phosphoric acid, is the main source of phosphorus in the production of phosphate fertilizers, as illustrated in Figure 1.3.

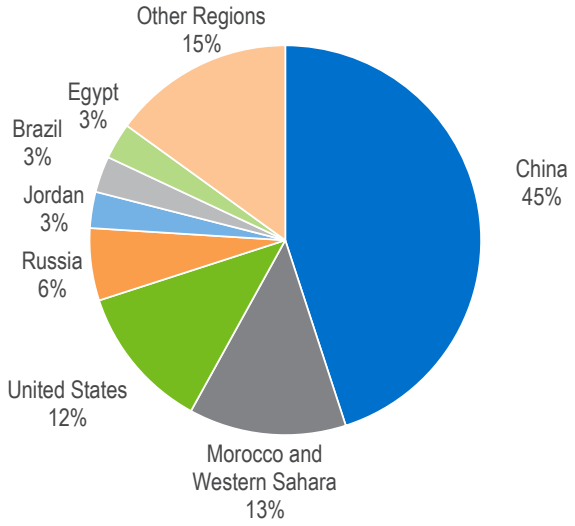
Phosphate fertilizers are those that contain phosphorus in a form that can be taken up by plants (mainly absorbed as $H_2PO_4^-$ and HPO_4^{2-}) to promote plant growth. This category includes ammonium phosphates (i.e. monoammonium phosphate and diammonium phosphate) and superphosphates (i.e. single and triple superphosphates, and nitrophosphates). Phosphate fertilizers also include more complex multinutrients known as NP and NPK fertilizers that, in addition to phosphorus, contain nitrogen and potassium. In countries with acidic soils, phosphate rock can in fact be applied directly to the soil in finely ground form, although this is not practiced very widely.

Figure 1.3 Phosphate Fertilizer Value Chain



Phosphate rock is a non-renewable natural resource. As such, there are concerns that phosphate rock reserves are being depleted around the world. According to the U.S. Geological Survey, world phosphate rock reserves were estimated to be around 67 million tons in 2014, representing more than trifold increase from 2005 levels. During the 2005-2014 timeframe, main producers such as China, Morocco (and Western Sahara), and the United States have seen their reserves declined. However, during the same period, new phosphate rock mines have been developed in counties such as Algeria, Jordan, and Peru. Phosphate rock developments in Peru include the Bayóvar mine in the Piura Province. The mine has the potential to produce close to 4 million of phosphate rock (29 percent P2O5) annually during an estimate lifetime of 27 years. Thus, while some reserves are being depleted there are new deposits that are currently being exploited. However, the availability to develop new mines or expand existing ones depends on E&P activity, water resources, and capital.

Figure 1.4 Phosphate Rock Production Globally
(Source: USGS, 2015)



World production of phosphate rock is estimated to have increased slightly in 2016 and 2015, with most of the increases taking place in the Middle East and South America. World production was estimated to be slightly more than 223 million tons, representing close to a 70 percent increase over the production level achieved in 2000. Three countries, the United States, China, and Morocco (including the Western Sahara) account for approximately 70 percent of world production. China is the dominant producer with 45 percent of the global output, followed by Morocco and Western Sahara then the United States. U.S. imports of phosphate rock have been lower because of the closure of a phosphoric acid plant in Mississippi that used phosphate rock from Morocco.

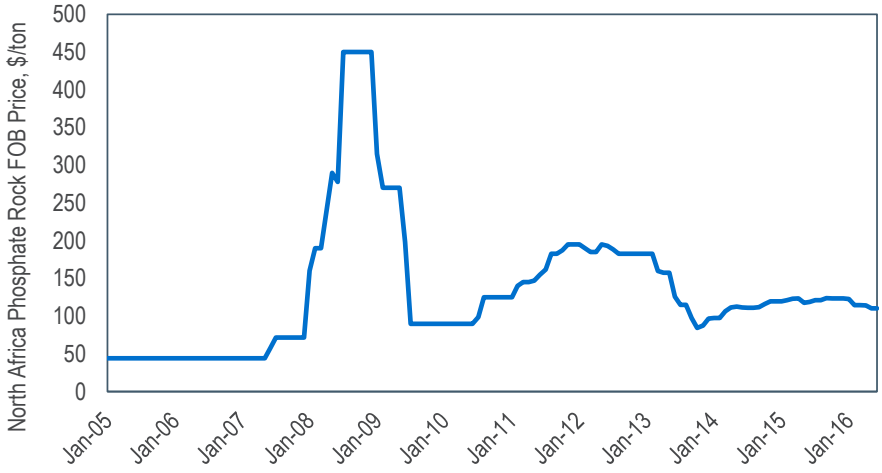
According to USGS Report 2015, world phosphate rock production is expected to increase from 223 million tons in 2015 to 255 million tons in 2019, driven by the growth in Africa and the Middle East. As a result of expansion of existing mines and development of new mines, Morocco's mine production capacity is expected to double in the next three to four years. Ma'aden's new 5.3 million tons phosphate mining and processing complex, is expected to commence production in 2017. The impact of these developments on the global phosphate rock trade and consumption dynamics remains to be seen.

Phosphate rock consumption and production is estimated to increase with growing population and food production needs driving phosphate fertilizer applications in the future. The demand for phosphorus is strongest in Asia Pacific, particularly China and India, and Latin America. Population growth is one of the main drivers of the consumption of phosphate rock in China. However, the government policy to attain zero percent fertilizer consumption growth may slow down the phosphate rock consumption in the region. India, which is a leading importer of phosphate rock globally, depends heavily on government subsidies for the consumption of fertilizers. Often, farmers prefer to use urea over phosphatic and potassic fertilizers due to the availability of highly subsidized urea. However, the Indian government is planning to promote the domestic growth of non-nitrogen fertilizers, which may bode well for the phosphate rock and fertilizer demand. Brazil's phosphate consumption is driven by the usage in the production of biofuel crops. More than 70 percent of the global phosphate rock is consumed in the production of phosphoric acid, which is mainly used in the production of MAP, DAP, TSP, while the remaining is used in production of TSP , SSP, and some industrial applications.

With regards to phosphate rock prices, the global industry uses Moroccan prices as a benchmark. Average contract price for 70 percent BPL (32 percent P_2O_5) Morocco phosphate rock was approximately $116 per

metric ton for the first half of 2016. As illustrated in Figure 1.5, North African prices have more doubled since 2005, reaching high levels during 2007-2008 as a result of high fertilizer demand that tightened supplies during that period. The biofuel industry has been in competition with agricultural sector as the production of biofuel crops requires phosphorus fertilizers. The spike in prices in 2008 was contributed by the rising phosphate rock demand and price due to increased ethanol production.

Figure 1.5 North African Phosphate Rock Prices[1]
(Source: Green Markets)



[1] Represents average mean prices

1.2 REPORT OBJECTIVES

This multi-client report will provide a valuable overview of the phosphate rock industry. The report will assess the impact of the regional socio-economic factors, environmental regulations, etc. on the mining activity and the subsequent effect on the phosphate rock supply and demand outlook. Further pricing forecasts will also be provided for the main global suppliers. Key uncertainties of the phosphate rock sector that will be addressed include:

- What have been the recent improvements in production processes? How will the improvements in production efficiency impact the supply outlook for phosphate rock?
- What quality of phosphate rock is expected for the new reserves?
- What will be the impact of India's New Urea Policy 2015 on the demand for phosphate fertilizers, and phosphate rock in India?
- Will China and India continue to be the major growth drivers for phosphate rock consumption?
- What will be the impact of the bleak economic outlook in Brazil on the mining and agricultural sector?
- Will China continue to be the main producer of phosphate rock?
- Given the discovery of new mines such as in Peru, what will be the effect on the regional trading pattern in the long term?
- Will supply issues cause a spike in phosphate rock prices?
- What is the impact of low oil prices on the phosphate rock prices?

These are just some of the business issues that will be addressed by this Supplement Report. Moreover, an understanding of the fundamental issues of the industry in the future will allow strategic planners to establish short, medium, and long term plans.

Nexant's Supplement Report will help phosphate rock producers and buyers to plan long term taking into account the supply and pricing issues. The report will provide an in-depth understanding of the phosphate rock consumption and help in evaluation of future export and import opportunities. The report will also be helpful to investors seeking to enhance their business by moving into phosphate mining, beneficiation or fertilizer business.

The study has a target completion date of end of the third quarter of 2017.

Section 2 Study Scope and Coverage

2.1 REPORT OVERVIEW

The main objective of this multi-client study is to assess the technical, commercial, and economic aspects of phosphate rock.

This report covers:

- Description of production processes
- Discussion of impurities found in phosphate rock
- Summary of phosphate rock grades
- Overview of major producers
- Market outlook for major global regions
- Analysis of regional trading
- Price projections

Cost competitiveness of phosphate fertilizer production

2.2 GEOGRAPHIC COVERAGE

This study will consider the market dynamics of phosphate rock within the following regions:

- North America
- South America
- Western Europe
- Central and Eastern Europe
- Middle East
- Africa
- Asia (excluding China)
- China

Section 3 Proposed Table of Contents

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Section 4 Methodology

4.1 GENERAL

Nexant has extensive experience performing analysis of this nature. The basic approach will consist of:

- Utilizing **experience** garnered from performing a number of similar recent assignments
- Utilizing global **in-house databases** on market dynamics, pricing/margins and technology
- Drawing on **industry data** from prior (non-confidential) commercial analyses
- Utilizing the expertize of Madinirisk which specializes in risk management in mining operations
- Building upon analysis for **multiclient studies** and **programs**

The report will be prepared drawing on Nexant recent studies, both multiclient and single client studies.

The price forecast analysis will be developed using Nexant's proprietary Simulator which provides an econometric model of the global fertilizer industry, allowing an unprecedented level of analysis. The key principles of the price forecasting methodology are outlined below.

4.2 MARKET DYNAMICS FORECASTING METHODOLOGY

Nexant has developed a proprietary simulation model of the global chemical and fertilizer industry, the Petrochemical Industry Simulator. The simulation model is used to forecast consumption, production, and trade for all global countries or trading blocks forward to 2035. The integrated simulation model includes both the market dynamics of product flows and the economics of production costs, logistics, prices, and profitability.

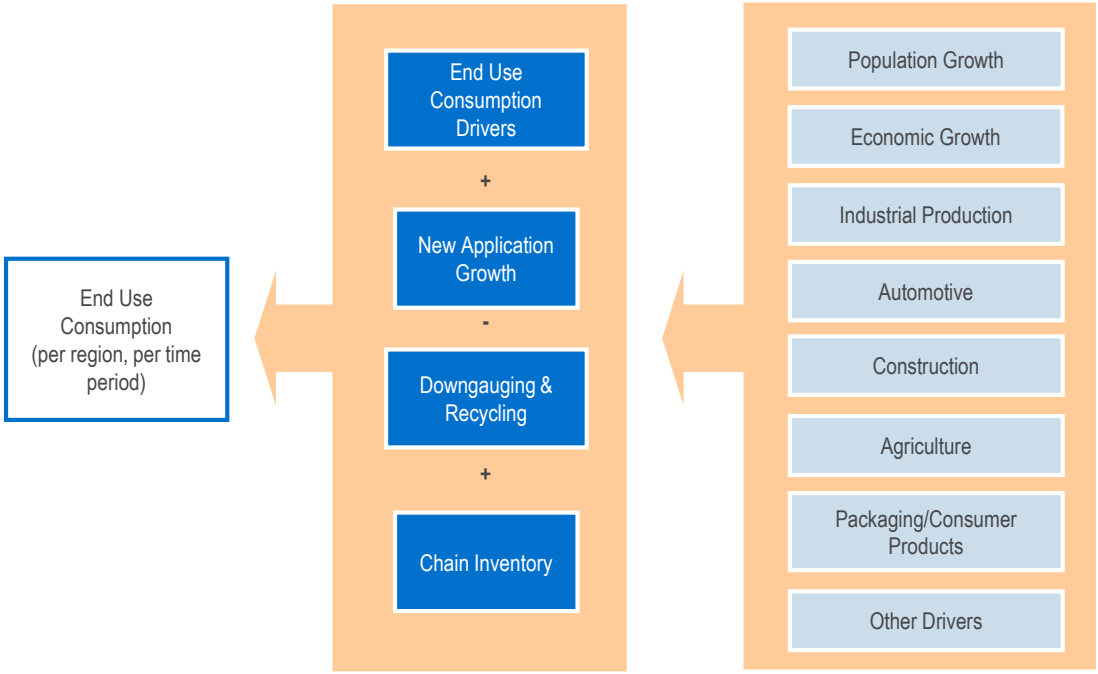
4.2.1 Capacity Availability and Forecasting

The model includes a full capacity database for every fertilizer producing plant in all global regions to generate the full potential to supply. The capacity listings include the production process, the current capacity to produce and changes to the capacity due to, amongst others, expansions and new builds. The capacity to produce fertilizer for existing and planned projects is continuously researched and verified with industry participants. Announced new production plants and projects in the planning phase provide a guide on the likely capacity available in each region for the next five to eight years. Thereafter, new capacity is forecast based on likely investment strategies for the given macro-economic scenario being considered. Speculative capacity development is typically considered in regions with strategic advantages such as proximity to a growing end-user market or availability of cheap feedstock. Changes and advances in technology can also lead to a change in the feedstock composition of the global fertilizer capacity. China is arguably one of the most important influencing markets of the global fertilizer business. The country is increasing its fertilizer capacity mainly based on coal as a feedstock for the production of syngas based ammonia and urea, as compared to the previously more common feedstock natural gas.

4.2.2 End-Use Consumption Forecasting

Consumption growth for fertilizers is related to economic activity, population growth and government policies in the consuming region. Consumption of non-fertilizer end-use materials into the major economies is researched to determine the link between sectors of the economy and consumption. Demand can be linked to the sum of the demand into each of the end-use sectors.

Figure 4.1 End-Use Consumption Drivers (Major Economies)



4.2.2.1 End-Use Sector Growth

The demand due to growth in the end-use sector assumes that the existing application for each derivative grows at the same rate as the end-use sector. Thus, the end-use sector growth forecasts developed in the "Base Case" Scenario are applied to the individual consumption figures for each derivative and each end-use sector. In the case of phosphate rock, most of the consumption is for phosphoric acid production.

4.2.2.2 Penetration (New Application Growth)

Analysis of historic demand for each sector by means of curve fitting allows a curve of overall penetration to be developed. This reflects the maturity of a product.

Penetration growth rates can be negative and are added to the growth of the end-use market. A negative penetration does not automatically mean that the growth of demand itself would be negative, as the end use sector growth plus inventory growth may produce a positive overall rate.

4.2.2.3 Short-Term Influences

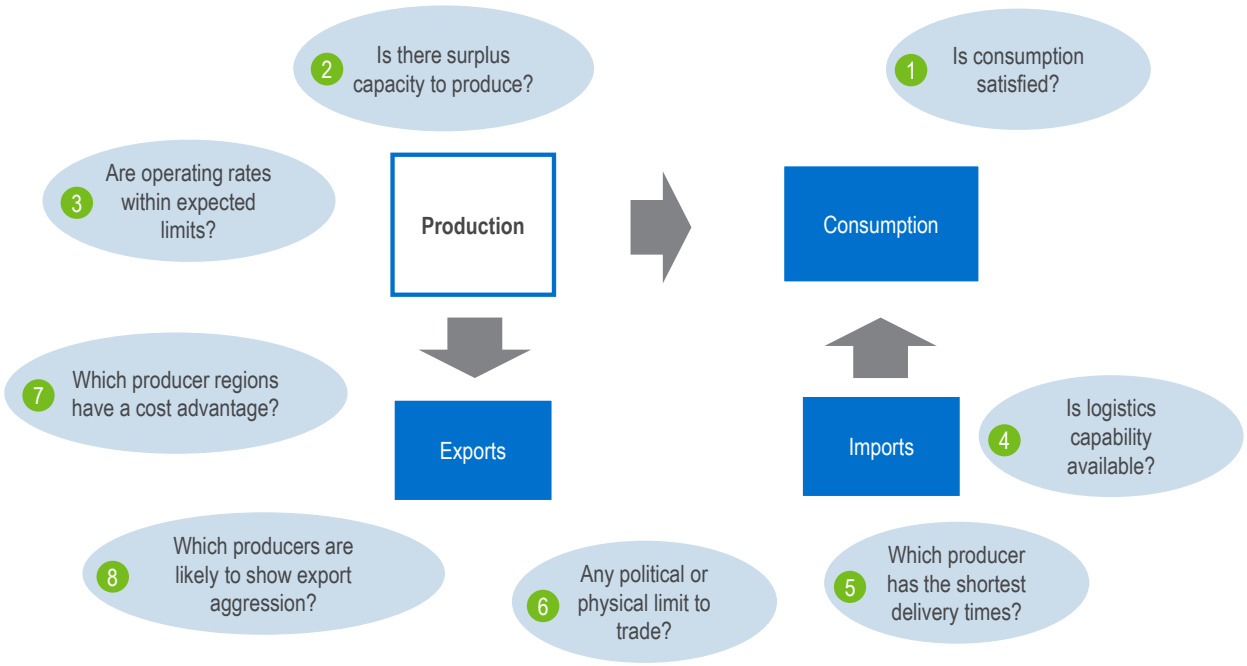
An influence on fertilizer demand during the economic cycle is a transient demand swing caused by short-term pricing volatility. As demand starts to pick up, buyers and sellers perceive the tightness coming, which in turn leads to price increases. The buyer then responds to expected price increases by increasing demand above expected consumption levels in the knowledge that any purchases made above immediate consumption will be at a lower price than that required for the subsequent purchase. The reverse occurs when price falls are expected.

These transient demand swings usually occur over a few months and so do not influence annualized demand estimates. They are driven by market perception and although predictable in a short-term forecast, they cannot be realistically forecast on a long-term basis such as that used in this analysis. Consequently, the Nexant model does not consider short-term demand swings due to price fluctuations.

4.2.3 Production and Trade Forecasting

The simulation model incorporates a detailed logistics and trade model to allow integrated forecasts of global trade balances. The trade balances use demand forecasting, capacity availability and trade drivers to forecast global supply, demand, and trade.

Figure 4.2 Trade Considerations



The integrated NexantThinking Simulator simultaneously develops forecasts of regional consumption, production, imports, exports and inventory changes for fertilizers in all countries/regions forward to 2035.

The forecasts developed and presented in this report use the Nexant "medium crude oil, business as usual" scenario. Details of which will be covered in the section "Macro-economic Assumptions" of the report.

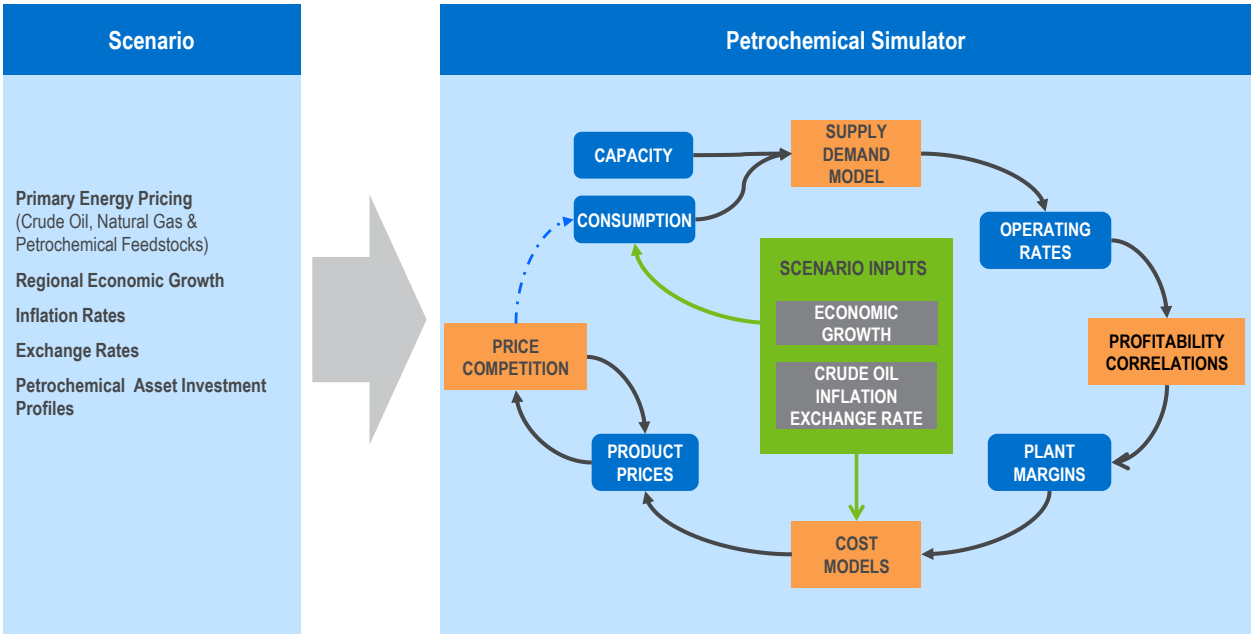
4.2.4 Price Forecasting Methodology

4.2.4.1 Introduction

NexantThinking™ profitability forecasts are prepared using a proprietary simulation model of the global petrochemicals and fertilizer industry. The advanced simulator is a fully integrated model of the global business dynamics (material flows and cash flows) using sophisticated software. The industry outlooks draw on more than 40 years of knowledge and experience of the global industry to develop algorithms to simulate petrochemical and fertilizer business dynamics. The NexantThinking™ simulator is a unique offering, marking a major advance in supply/demand and profitability forecasting technology.

The NexantThinking™ simulator is used to generate the data content of all SBA and PPE reports and the output to the www.nexantthinking.com website.

Figure 4.3 NexantThinking™ Simulator Forecast Methodology



The NexantThinking™ forecast methodology relates market demand drivers for fertilizers to factors such as population, regional economic activity, etc. From a database of petrochemical and fertilizer processes and plant capacity the regional consumption is compared to the ability to produce. Global trade algorithms complete a full supply, demand and trade model of the industry. Basic commodity theory dictates that market tightness, measured by average operating rates, is the primary driver of profitability. Production costs are built up from a detailed database of archetype plant techno-economic models, heavily influenced by the assumptions of crude oil prices. Petrochemical and fertilizer product prices are determined by adding projected production costs to the margin outlook. Inter-regional competition and inter-material competition add further constraints and complexity to shape the pricing dynamics.

4.2.4.2 Price Influences

Petrochemical and fertilizer prices refer to specific agreements to transfer material between producers and consumers. The producer pledges to make available material at a specified unit cost. The consumer commits to take delivery of the material at the same unit rate. The commonly agreed unit cost is more typically referred to as the price. Prices for most commodity petrochemicals and fertilizers are set by direct negotiation between the principle producers and consumers, settling at a balance between their respective needs.

Producer's primary focus in pricing negotiations is their expected production cost, ensuring they capture the total expense incurred in making the material available. In the short term, prices must cover variable costs to provide incentive to process incremental volumes. Longer term, prices must settle above the full cash cost of production, providing sufficient profitability to cover investments in petrochemical and fertilizer assets where necessary.

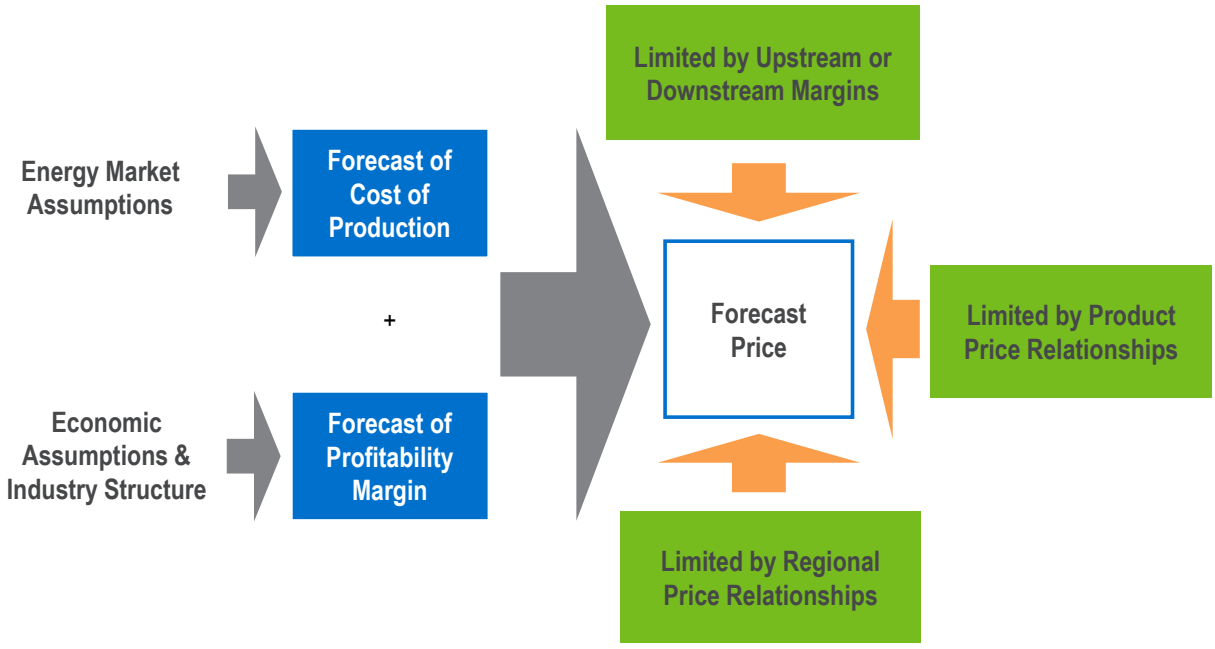
Prices may be viewed as built of a distinct cost and margin component, with both parts frequently the focus of pricing negotiations. Freely negotiated prices are heavily influenced by production costs. Basic economic theory suggests prices should drop towards a floor price, near the cost of the marginal Laggard producer in weak markets. Consumers hold the balance of power in pricing negotiations in weak markets, with many options for sourcing material, typically turning to the lowest cost source. The balance of power in pricing negotiations progressively moves towards producers as markets tighten. With few sourcing

options, consumers must bid up prices sharply to guarantee securing incremental volumes. Margins may rise sharply as prices open a premium over production costs. The distribution of margin between producers and consumers is frequently at the center of pricing negotiations.

The cost and margin components of the price have very different drivers, and have moved independently in the past. Production costs are heavily driven by the underlying energy environment. Most petrochemicals are derived from hydrocarbon streams that are highly valued as fuels within the energy sector. In the case of nitrogen fertilizer the main feedstock is natural gas. The industry has little opportunity to influence feedstock costs, competing with the vastly bigger energy sector. Energy prices are relatively transparent and costs quickly pass down the petrochemical value chain. Margins are principally shaped by the market structure, with basic commodity theory suggesting margins will rise as markets tighten. The petrochemical and fertilizer industry has little opportunity to vary demand, but directly influence supply through investment decisions.

Cost and margin forecasts are prepared independently. These two distinct components of price are subsequently combined to derive a preliminary price projection via the fundamental relationship of cost plus margin. The variable cost of production is determined from raw material costs and the cost of utilities less credit for co-products (all heavily influenced by the assumed energy complex). Fixed costs, consisting of operating labor, maintenance, overheads and tax and insurance yields cash cost of production. Projections of fixed costs are largely shaped by underlying inflation assumptions and assumptions about the reduction of costs over time due to experience curve effects and capacity creep. The margin is determined from the return on investment (ROI) forecast that, in turn, is derived from an analysis of the historical relationship of profitability with average industry operating rate. This ensures pricing projections are entirely consistent with the underlying market projections.

Figure 4.4 Price Influences



Secondary influences on the price may place a ceiling or floor on the preliminary cost and margin driven price projection:

- **Forecast prices in other regions.** Inter-regional price spreads are assessed to ensure that they are consistent with projected trade flows. Over the long term, opportunities for interregional trade generally constrain regional price differences to be lower than the logistical cost of freight between the two regions. Products such as urea, which are easy to ship in bulk, and are widely traded show little variance in regional pricing. Other products which may be hazardous or costly to ship, such as ammonium nitrate or ammonia are less widely traded as well as fertilizers with low nutrient value, potentially supporting larger inter regional price spreads.
- **Relationship to other fertilizers**. Where two or more products with similar properties compete in an end-use application, inter-product competition imposes price relationships between the products. Consumers have opportunity to switch product, choosing the one that offers best value. Over the long term, prices of each product must remain in balance with the demand for each.
- **Profitability of upstream and downstream processes.** For the chemical and fertilizer industry to be sustainable in the long term, margins must be distributed in a balanced manner between different parts of the value chain. Many contracts are based on formal margin sharing agreements. Where prices are based on free negotiation, profitability of upstream and downstream processes is frequently at the center of discussions.

4.2.4.3 Crude Oil Price in Scenarios

The majority of commodity chemicals are derived from refined products, whose prices are intimately linked to the crude oil price. It is important to understand the interrelationship between the various feedstocks and their price drivers.

Nexant has prepared three distinct scenarios for 2016, spanning a broad range of crude oil prices that is reasonably expected to capture the range of future pricing in most years. The crude oil prices selected for Nexant's 2016 scenarios (Brent FOB basis) are:

- **High oil scenario:** set at $100 per barrel (2016 constant dollars)
- **Medium oil scenario:** set at $70 per barrel (2016 constant dollars)
- **Low oil scenario:** set at $40 per barrel (2016 constant dollars)

Section 5 Staffing and Qualifications

5.1 STAFFING

Nexant will staff this engagement with members of its global team of consultants and engineers who have extensive prior industry experience to address all the technical, commercial, and strategic issues associated with this study.

The core staff for this report will be:

Alistair Forbes – Alistair, a collaborator with Nexant, is a qualified mining engineer with over 44 years' experience in the mining industry and extensive operational and managerial experience in underground and open pit mines. In his most recent role he has conducted numerous risk engineering surveys for a large insurance broker for mining clients and consulted on technical, business and risk management issues on mining operations across the globe. Alistair has over five years management experience on large open pit copper and associated phosphate operations at Phalaborwa in South Africa and conducted business and technical risk analysis for a solution mining potash project in Argentina for Rio Tinto. Throughout his career, Alistair has worked with all the major mining companies including Rio Tinto, De Beers, Anglo American Collieries, Rand Mines, BHP Billiton, and Xstrata.

Priyanka Khemka – Priyanka is a Consultant in Nexant's Energy and Chemicals Advisory group based in White Plains, New York. She has been a key contributor to Nexant's Polyolefin Planning Service program for the past three years and recently to the Strategic Business Analysis (SBA) Ammonia & Urea program. She has performed a series of market research activities investigating various aspects of the petrochemicals and fertilizers industry, including nitrogen and phosphatic fertilizers business. She has managed several multi-client and single-client studies, and recently started to manage the Strategic Business Analysis Ammonia and Urea program. Priyanka received her Bachelors and Masters in Chemical Engineering from University of California, Berkeley.

Marisabel Dolan – Marisabel is a Senior Consultant in Nexant's Energy & Chemicals Advisory Division. Based in Nexant's White Plains office, she has participated in several world-wide studies, with particular focus on Latin America, involving market research, cost of production evaluations, technology assessment, and strategic plans for multiple petrochemical products such as fertilizers, polyolefins, MEG, and PET. Marisabel has directly managed several of Nexant's fertilizer market studies in Latin America including a major assessment of fertilizer markets, prices, and logistics for a planned new grassroots fertilizer plant currently being built in South America. She has also been the primary author for several reports that analyze technological and commercial trends and developments (including new processes that employ renewable feedstocks) in areas of interest to the chemical and allied industries, including fertilizers. Topics of some of her reports include Phosphoric Acid, NPK and Phosphates, Ammonia, Urea, Nitric Acid, and Methanol. A Honduran native, Marisabel received a B.S. and M.S. in Chemical Engineering from Manhattan College.

5.2 QUALIFICATIONS

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 fertilizer investments, ranging from grassroots plants to revamps of existing process units. Nexant's key offices serving the petrochemical and fertilizer sectors are located in New York, Houston, London, Bangkok, and Bahrain, and locations for other offices are shown in Figure 5.1.

Figure 5.1 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:

- Methanol Strategic Business Analysis (SBA)
- Ammonia and Urea Strategic Business Analysis (SBA)
- Process Evaluation/Research Planning (PERP)
- Petroleum & Petrochemical Economics (PPE) – United States, Western Europe, Middle East, and Asia
- Polyolefin Planning Service (POPS)

NexantThinking Methanol Strategic Business Analysis (SBA) program provides a valuable aid for strategic planning at a time of both opportunity and challenge for existing players and prospective new entrants. It identifies the strategic trends and issues that will shape the industry based upon a review of the fundamental business drivers and their dynamics with respect to markets, pricing, technology and delivered cost competitiveness. This program is unique in offering the industry a high quality, in-depth analysis based upon Nexant's knowledge built on its strategic consulting activities, its chemicals team (for chemical methanol and derivative applications), its downstream oil team (for fuel applications including biofuels) and its global gas team (for feedstock availability and pricing).

NexantThinking Ammonia and Urea Strategic Business Analysis (SBA) program provides a valuable aid for strategic planning purposes, at a time of both opportunity and challenge for players and prospective entrants into the nitrogenous fertilizer business. It combines a review of the fundamental business drivers and their dynamics, as well as analysis of the wider trends in ammonia and urea to understand what these entail for the short, medium and long-term outlook for the business.

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.

5.3 SPECIFIC EXPERIENCE RELEVANT TO PHOSPHATE ROCK AND ITS DERIVATIVES

- **Fertilizer Benchmarking Study –** Nexant performed a study for a major fertilizer company, benchmarking the value chains for major nitrogen and phosphate fertilizer companies. The study involved in-depth key performance indicator and key success factor analysis for a number of companies for functions of sales, marketing, operations, strategy, technology and supply chain
- **NPK Market –** To assist a Middle Eastern oil and gas producer in evaluating the viability of a granular NPK fertilizer plant to be constructed in the Middle East. This report has been commissioned examined the global granulated NPK market, identified possible target markets, developed profitability and price forecasts for feedstocks and products, evaluated the delivered cost competitiveness of the project, and suggested a realistic sales volume and split for the proposed target markets
- **DAP Business: Techno-Commercial Due Diligence –** A technical due diligence that included plant condition, raw materials requirements, production capacity, capital requirements, environmental review and major equipment replacement plan. The commercial diligence included a competitive analysis, a review of the client's financial model as well as market analysis and price forecasts for raw materials (ammonia, phosphate rock, sulfur, phosphoric acid) and diammonium phosphate (DAP), potash, NPK fertilizer, phosphoric acid, monobasic potassium phosphate (MKP), calcium chloride, sodium chloride; also a discussion of urea, muriate of potassium (KCl) and potassium sulfate (K_2SO_4), limestone
- **Technical Due Diligence Assistance in Evaluation of a Russian Fertilizer Complex** – The report focusses on the following for phosphoric acid and MAP production: technology review, plant operations review, asset condition assessment, cash cost competitiveness, future capex requirements, and identification of any major risks
- **Syrian Phosphates Feasibility Study –** A feasibility study for the development of a TSP fertilizer and DCP facility in Central Syria, from phosphate rock feedstock from the Eastern Phosphate mines (Homs and Palmyra). The scope of the project was extended to include an assessment of the feasibility of also producing DAP
- **Strategic Review –** An independent audit of the design, operation and management of the client's planned project site in Jordan. The project was intended to produce the specialty products horticultural grade NOP (nitrate of potash or potassium nitrate) and animal feed grade DCP (di-calcium phosphate). The report covered a technology review, review of raw materials, plant operations and cost performances, and alternatives to continued operation in existing configuration.
- **Technical and Market Due Diligence Assistance –** Nexant has performed technical and market due diligence assistance for a phosphate based fertilizer facility in South Africa. The complex included a sulfuric acid, phosphoric acid, and mono-ammonium phosphate plant. The study included a technical review of the plants as well as a market overview for the respective products
- **Opportunity for a Fertilizer Plant in Kazakhstan –** Nexant has provided its client with diligence support in evaluating an opportunity to build a fertilizer production plant in Kazakhstan. The study included the main products urea as well as phosphates and consisted inter-alia of a market and pricing analysis and addressed regulatory issues for developing a project in the respective region
- **Sulfur Disposition Study: Phase II –** Nexant has undertaken a two-phase approach to providing a major Middle Eastern oil producer with future opportunities to exploit domestic and international sulfur disposition opportunities, building on its existing feedstock platform, generally available technology and market opportunities. In Phase Two, Nexant focused on three products for an in-depth study: sulfuric acid, phosphoric acid, and phosphate-containing fertilizers (DAP, MAP, NPK, TSP)

- **Phosphate and NPK Fertilizers –** This PERP report reviews the chemistry, production processes, applications and markets for monoammonium phosphate (MAP), diammonium phosphate (DAP) and triple superphosphate (TSP). Examines commercial technologies of INCRO, Espindesa, Jacobs Engineering, Casale, and Yara
- **Nitrophosphate Project: Competitiveness Assessment –** Comparison of nitrophosphate with slurry granulation, flowsheet, capital costs, delivered costs analysis, shipping costs, urea delivered costs, DAP costs, potash costs, AN and CN netback values. The study also included cost of production estimates for nitrophosphate NPK, ammonia, dilute nitric acid, phosphoric acid, and ammonium nitrate
- **Phosphorous and Phosphates Technical Due Diligence –** Nexant was hired to provide technical due diligence of the client's phosphorous and phosphorous based chemicals complexes in central Asia. The scope of work included a technology review and assessment of key plants and a comparative with industry norms, review of the plant operations, future capex requirements and planned investments, and identification of any major risks
- **Elemental Phosphorus (P4) and Phosphorus Trichloride Production Economics in China –** The report provide information about elemental phosphorus and PCl3, the precursors for DMP, and TMP in China, and an update on the economics of production
- **Inventory Valuation –** The objective of the study was to develop a history of market prices for phosphate rock, sulfur, sulfuric acid, ammonia, MAP, DAP and ATS and value the client's inventory of these materials
- **Acquisition Study –** In preparation for the acquisition of a producer of specialty mining and metal working chemicals, Nexant was asked by the acquiring company to perform an analysis of the primary markets served by the target company. The markets surveyed included: phosphate mining and fertilizer production; potash mining and fertilizer production; asphalt anti-strip additives and sulfated fatty oils. For each, major end users were identified; current demand; industry trends and growth outlook determined competing producers identified and profiled and business threats discussed
- **Competitiveness of the West European Fertilizer Industry –**This study is an audit of the core operations of all of the West European fertilizer producers. Contents of the report include: competitive analysis, economics, cash cost analysis, cash cost curve, nitrogen supply/demand, ammonia capacity, phosphates supply/demand/capacity utilization and costs of natural gas, ammonia, urea, phosphate rock/sulfur, phosphoric acid, and diammonium phosphate
- **An Evaluation of a Phosphate Deposit in Vietnam –** Nexant provided an objective and independent review of the technical and economic status a phosphate deposit; the mine; the associated processing plants; the phosphate fertilizer plants, and the transport infrastructure required for the commercial exploitation of the deposit by international interests. Provided an indicative estimate of likely capital costs of the investment required to increase production to a level that would allow exports of rock and provide raw materials for the local production of phosphatic fertilizers to satisfy Vietnam's requirements for these
- **Phosphate Mining & Fertilizer Integrated Project –** Nexant provided market and economic analysis for phosphate mining project planned in Hubei Province, China
- **Togo Phosphate Project: Preliminary Macro-Economic Evaluations –** The objective of the study was to assessed the attractiveness of the planned project from the standpoint of the country's economy by developing marketing and price projections, an economic/financial return analysis, and the impact on balance of payments, and on public sector financial position

- **Phosphoric Acid –** This techno-economic report offers a review on conventional routes to phosphoric acid and process descriptions for several licensors of phosphoric acid technologies. The report also provides economics developed for several different global locations (USGC, China, and the Middle East) for the dihydrate, hemihydrate, purified wet phosphoric acid, and thermal phosphoric acid
- **Phosphoric Acid Plant Closure: Conceptual Plan** – In order to satisfy the requirements of the financiers of the phosphoric acid and sulfuric acid plant currently under construction in Jordan, the client required a conceptual plan in the event of the closure of the plant. The closure plan is also required to cover the project's import and export facilities and the logistics between the port and the site

6.1 CONTACT DETAILS

AMERICAS
Nexant, Inc.
44 South Broadway, 4th Floor
White Plains, NY 10601-4425
U.S.A.

Attn: Marisabel Dolan
Senior Consultant
Tel: + 1-914-609-0342
Fax: + 1-914-609-0399
Email: mdolan@nexant.com

Or
Attn: Sonia Ouertani
Client Services Coordinator, E&CA-Products
Tel: + 44 (0) 20 7950-1587
Fax: + 44 (0) 20 7950-1550
e-mail: souertani@nexant.com

EUROPE
Nexant Limited
1 King's Arms Yard, 1st Floor
London EC2R 7AF
United Kingdom
Attn: Anna Ibbotson
Global Director, Petrochemical Markets & Profitability, NexantThinking
Email: aibbotson@nexant.com

ASIA
Nexant (Asia) Ltd
22nd Floor, Rasa Tower 1
555 Phahonyothin Road
Kwaeng Chatuchak, Khet Chatuchak
Bangkok 10900
Thailand
Attn: Tiankanok Sirichayaporn
Managing Consultant, E&CA, NexantThinking
Email: Tiankanoks@nexant.com

Nexant, Inc.

San Francisco
New York
Houston
Washington D.C.
London
Frankfurt
Bahrain
Singapore
Bangkok
Shanghai
Kuala Lumpur

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