Prospectus

Technology Developments in Propylene and Propylene Derivatives
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Technology Developments in Propylene and Propylene Derivatives

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Nexant

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Chem Systems has a forty year history as an independent, industry-expert consulting firm providing technical, commercial and valuation consulting for the petroleum, refining and chemical industries. In 1998, Chem Systems was acquired by IBM, and subsequently in 2001, Chem Systems was acquired by Nexant, Inc. Nexant maintains Chem Systems’ intellectual capital and consultant continuity, and preserves Chem Systems’ business activity and brand name within Nexant’s Petroleum and Chemicals Division (“Nexant”, or “We”), in which we continue to perform the types of work that we have throughout Chem Systems’ history.

Propylene is one of the key building block petrochemicals used as feedstock for a variety of polymers and intermediates. Major propylene derivatives include polypropylene, acrylonitrile, propylene oxide, cumene/phenol, oxo alcohols, acrylic acid, isopropyl alcohol, oligomers and other miscellaneous intermediates used, in turn, in a wide range of end-use applications including automotive, construction, consumer durables and non-durables, packaging and electronics. As shown in Figure 1.1, global propylene demand grew from 16.4 million tons in 1980 to around 30 million tons in 1990, corresponding to an average annual growth of 6.2 percent. In the decade ending in 2000, demand grew at an average rate of 5.7 percent per year, reaching 52 million tons.

Demand for propylene will grow at an estimated 5.3 percent annually for the period 2001-2010, to 81 million by 2010. This increase will be driven by the demand for derivatives, especially
polypropylene, the demand for which is growing at the rate of 7.3 percent for the same time period. Propylene consumption by region is shown in Figure 1.2.

![Figure 1.2: Global Propylene Consumption Trends](chart.png)

Propylene demand is expected to grow faster than supply. Propylene supply/demand conditions and pricing are strongly dependent on refinery production and the supply/demand balance, operating rates and feedstock slates in the ethylene industry. Globally, more than 25 percent of the new crackers currently planned for start up in the 2003-2006 timeframe are based on ethane, and therefore will produce little propylene. Propylene is produced commercially on purpose by dehydrogenation of propane, but this is an expensive route that generally requires favorable feedstock pricing to be competitive. The amount of propylene produced by propane dehydrogenation is small compared to other sources.

Propylene is used in a number of major derivatives, as shown in Figure 1.3, with polypropylene by far the largest end-user.
Based on demand growth trends for the key propylene derivatives and limited supplies, the potentially higher prices of propylene that might result could restrict growth and impact on cross elasticity of demand in applications in which substitution is possible, e.g., polypropylene versus polyethylene, polystyrene and ABS.

Expanded or converted sources of propylene will have to be found, whether as an on-purpose supply or from redirection of existing capacity. Depending on the demand and alternative value for ethylene versus propylene, it may be economically advantageous to either produce more propylene at the expense of ethylene or produce propylene by alternative means.

The primary sources of propylene have been as a by-product of ethylene production in steam crackers and from refinery FCC streams. An alternative commercialized technology is propane dehydrogenation, which is only economical under certain conditions in certain areas of the world. As propylene demand continues to outpace ethylene demand, there is increasing interest and need in finding or developing alternative sources of propylene without adversely affecting ethylene availability. Conversion to higher activity FCC catalysts, a proven approach to increase propylene production, is not always the best solution due to competing economic and technical drivers to produce motor gasoline, FCC’s primary product. New technologies, using an expanding range of feedstocks, may change conventional propylene supply dynamics and economics, as well as the competitive regional supply balance.
Propylene demand will also be affected by new technology developments in propylene derivatives, as well. Although polypropylene will remain the principal propylene derivative and the driver of propylene demand, the following derivative technology developments may also influence propylene demand: potential for acrylonitrile production from propane; the non-coproduct route to propylene oxide; catalytic distillation for cumene/phenol production; the production and product characteristics of non-phosgene based polycarbonate and the effect on its principal raw material, bisphenol-A; and advances in oxo alcohol production technology.

Nexant’s new report, *Technology Developments in Propylene and Propylene Derivatives*, examines and compares the process technologies and economics of the commercially available and developing technologies for the production of propylene alone or as a coproduct. The report focuses on the economics of alternate routes to propylene, how they compare to conventional routes, and how competitive they are. These routes include the conventional processes and feedstocks practiced today:

- Conventional steam cracking
- Production and recovery from refinery streams
- Propane dehydrogenation

These conventional propylene technologies are compared to the new and developing technologies for propylene production. Nexant examines and analyzes newer developments in alternate technology and feedstock sources, and those technologies that are designed to either produce propylene exclusively or increase propylene yields from conventional sources:

- Olefin Metathesis
- Catalytic Pyrolysis
- Natural Gas based processes
  - Methanol to Olefins (MTO)
  - Methanol to Propylene (MTP)
- Olefin Interconversion

In addition to propylene production technology, Nexant analyzes technology developments and cost of production implications in the major propylene derivatives:

- Direct conversion of propylene to propylene oxide
- Non-phosgene routes to polycarbonate
- Propane ammomoxidation to acrylonitrile
- Catalytic distillation to cumene/phenol
- Developments in acrylic acid technology
- Developments in oxo alcohol technology
For both the propylene and derivative technologies, Nexant compares the estimated costs of production to those of conventional technology. Economics are developed for worldscale capacities in the major production regions, the U.S., Western Europe, Southeast Asia, Northeast Asia, and the Middle East.
Nexant’s overall objective for the *Technology Developments in Propylene and Propylene Derivatives* study is to assess and evaluate the important technology issues that will affect the future availability and supply of propylene and its derivatives. The study provides an in-depth quantitative and qualitative analysis of the various new and developing technologies for the production of propylene and propylene product derivatives, from both conventional and non-conventional feedstocks. An important part of this assessment and evaluation is a discussion of the commercial issues including projected impact of these technologies on regional propylene demand, supply, and trade.

The report analyzes the major commercial and developing propylene technologies, including:

- **Conventional Propylene Technology**
  - *Steam Cracking*
    Propylene is the primary ethylene coproduct from a steam cracker. Two variables affect the distribution of coproducts: choice of feedstock and severity of operation. Under a market-limited ethylene production scenario, operators could choose the feedstock that minimizes the production of ethylene by resorting to more naphthenic naphtha and gas oil feedstocks.
  - *Recovery from Refinery Streams*
    Propylene is produced as a dilute stream in propane from the three main refinery processes, fluid catalytic cracking (FCC), visbreaking/thermal cracking, and coking. The propane/propylene proportions vary considerably depending on the process, feedstock, operating conditions and catalyst.

Refineries in developing regions such as East Asia and Latin America have varying degrees of complexity but on average produce much less FCC propylene. Economic development in these regions and trends towards use of gasoline fuels in the automotive industry will justify refinery expansions and greater refinery conversion, producing offgas propylene. Additionally, in both developing and developed regions, including North America, there are a number of refineries that do not currently recover propylene from FCC offgas. In this case, higher propylene prices might support investment in new propylene concentration facilities. The increase in FCC-sourced propylene is viewed as a major likely source of increased propylene demand.
Commercial On-Purpose Propylene Technology

- **Propane Dehydrogenation**
  - OLEFLEX ®
  - CATOFIN ®
  - Phillips STAR ® (technology now Krupp Uhde)
  - Linde
  - Yarsintez/Snamprogetti

Propane dehydrogenation technology is readily available from a number of licensors and is used commercially, especially where propylene is in short supply, e.g., in the Middle East and East Asia. The economics for this route are highly dependent on feedstock availability and cost. Nexant estimates and compares the cost of production economics for the various licensors and in the various regions where feedstock availability makes this technology a viable alternative. Nexant also analyzes and comments on the major challenges and limitations of the technology and prospects for improvements.

- **Olefin Metathesis**
  - META-4 ® (Axens – IFP Group Technologies)
  - OCT ® (ABB Lummus)

Metathesis involves the conversion of ethylene to propylene and, as such, the major commercial issue is the use of ethylene as the feedstock. Olefins metathesis can be added to steam crackers in order to boost propylene production via the cracking exchange reaction of ethylene and by-product mixed butylenes. This is available from various licensors, is being operated at the Lyondell plant in Channelview, TX, has been selected by Mitsui Chemicals to increase propylene capacity at its unit in Osaka, Japan, and is under construction at the new BASF/Total Fina Elf cracker in Port Arthur, TX.

- **Deep Catalytic Cracking (DCC)**
  - Stone and Webster

DCC utilizes fluid catalytic cracking principles combined with a proprietary catalyst, different operating conditions, and other enhancements to achieve its objective of producing light olefins from vacuum gas oil.

Developing Propylene Technology

- **Catalytic Pyrolysis**
  - Asahi
  - Vniios

The current method of producing olefins via steam cracking has several drawbacks such as the high temperature required for the cracking reactions, the deposition of coke in the tubes (and the subsequent decoking process), and the
relatively low selectivities. Catalytic pyrolysis has been researched extensively for the past 20 years in an attempt to improve steam cracking.

- **Natural Gas Based Processes**
  - Methanol to Olefins (MTO)
    - UOP Hydro MTO Process ®
    - ExxonMobil
  - Methanol to Propylene (MTP)
    - Lurgi MTP ®

MTO and MTP plants are in the planning stages in China and Nigeria. With relatively high capital costs, the economics of the plants will depend and rely upon low cost natural gas, such as might be available from remote, stranded gas reserves. However, these processes might be most attractive as an approach to add value to stranded gas reserves as part of an overall complex.

- **Olefin Interconversion**
  - MOI ® (ExxonMobil)
  - SUPERFLEX ® (Lyondell/Kellogg)
  - Propylur ® (Lurgi)

Olefin Interconversion is based on the catalytic cracking of C4s and C5s in a fixed or fluidized bed reactor. The process is compatible with crackers and FCCs and, unlike metathesis, does not consume ethylene.

The report includes a critical assessment of the main alternative on-purpose technologies, comprising a review of the technologies and licensors, commercial experience, and analysis of the competitive costs of production versus propylene at market price and from conventional production.

There have been important developments in the technologies for the production of the key propylene derivatives. These developments will have an impact on the production cost and competitiveness of the products and on the overall demand for propylene. Propylene derivative technology evaluations include:

- **Propylene Oxide**
  - POSM
  - POTBA
  - Chlorohydrin
  - Sumitomo Coproduct Free Cumene Process
  - Dow/BASF Hydrogen Peroxide Process
  - Direct Oxidation

The chlorohydrin process, using chlorine as a raw material, involves environmental concerns regarding waste disposal and potential permitting for new
plants and expansions. In addition, plants not integrated with chlor-alkali production are at the economic disadvantage of having to treat and dispose of the brine waste. The economic success of the two co-product processes, producing styrene or tertiary butyl alcohol, is highly dependent upon the value attributed to the large volume of co-product. These disadvantages have spurred the development of alternate, direct processes that do not produce large volumes of co-products and can be competitive with the conventional technology on a cost basis. The new processes detailed here hold early promise of success and will, if advanced, change the dynamics of PO production.

- **Acrylonitrile**
  - Propylene ammoxidation
    - Sensitivity for catalyst advances
  - Propane ammoxidation

Acrylonitrile is produced commercially by the ammoxidation of propylene. To date, efforts to commercialize a competitive route via propane have been unsuccessful, though new developments offer the promise that the process may soon be competitive, though largely dependent upon the relative pricing and availability of propane and propylene. The commercialization of propane ammoxidation would have an immediate impact on propylene demand.

- **Cumene/Phenol**
  - Propylene and benzene alkylation
    - Catalytic distillation
  - Phenol from toluene via benzoic acid
  - Solutia nitrous oxide process
  - Direct benzene oxidation to phenol

Cumene/phenol production via the alkylation of benzene with propylene is a mature technology. Zeolite catalysts offer an alternate to the conventional phosphoric acid and aluminum chloride alkylation catalysts and eliminate the corrosion and waste disposal considerations of those catalysts. Phenol from toluene/benzoic acid is a commercial process that is practiced on a limited basis. The more promising developing technology is the direct oxidation of phenol with no co-product production.

- **BPA/Polycarbonate**
  - Phosgene-based
  - Non-phosgene based

Recent developments in bisphenol A (BPA) technology have not been significant and are not expected to have a major effect on propylene demand. Advances in polycarbonate technology, however, have been significant and may have a large impact on polycarbonate and BPA consumption. The non-phosgene route to polycarbonate offers a
competitive process without the environmental considerations of the conventional phosgene-based route, though the ability of the technology to produce equivalent resin properties remains a question.

- **Acrylic acid**
  - Propylene oxidation
  - Reppe
  - Latest developments

Refinement of the conventional propylene oxidation process continues to be largely centered on incremental catalyst improvements and its effect on propylene consumption.

- **Oxo Alcohols**
  - Conventional hydroformylation
  - Advanced high selectivity catalyst
  - Speculative butadiene based process

Oxo alcohols are conventionally produced via the addition of carbon monoxide and hydrogen simultaneously to a double bond to form an aldehyde. This process is called hydroformylation. The aldehyde is then reduced to an alcohol. Advances in catalyst systems benefit both economics and product selectivity. The speculative butadiene based process may prove to be a viable alternate route to oxo alcohols, lowering the dependence on propylene as feedstock.

Economics are developed for each of the developing propylene and propylene derivative technologies, based on information provided by the various technology holders, supplemented by publicly available information and Nexant’s own engineering experience and expertise. These costs of production are compared to conventional Leader technology. The Leader is designated as the typical low cost producer in any region, that plant expected to be in the top quartile of low cost producers.

Nexant also evaluates the potential for operating and capital cost improvement possibly attainable from the developmental work in progress, such as those disclosed in patents. We estimate the effect of the potential improvements, such as catalyst selectivity, catalyst life, raw material yields, reactor productivity, etc., on production costs and how the improvements may impact upon the competitiveness of the technologies against conventional processes, feedstocks and products.

The study includes detailed technology, economic, and commercial evaluations:

**Technology Evaluation** – A detailed review and status of the various process routes including: patent review and analysis, technology holders and offerers, licensor package analysis and cost of production development for what would be considered representative of each technology, identification of the stage of process package commercial development with a listing of actual and announced projects.
**Economic Evaluation** – Cost of production estimates for typical estimated 2003 and 2012 conditions are developed for each of the developing technologies for comparison to conventional technology and to other developing technologies for propylene and for the derivatives. Costs are developed for the major producing regions, such as the U.S., Western Europe, Middle East, Southeast Asia, and China, as well as for other locations more suited to the technology and/or feedstock, where applicable, such as for MTO and MTP (i.e., stranded gas location). The economic comparisons are used to help develop regional production and competitive dynamics, which will ultimately affect the regional propylene demand, especially in the case of alternate feedstocks. As a measure of regional competitiveness, delivered costs to the major import region of Northern Asia are estimated from each production region. A typical cost of production worksheet is attached as Table 2.1.

Sensitivities are performed for important process variables, and estimates are made as to potential improvements and their implications. Nexant estimates the production costs and potential improvements to these costs in order to speculate on the potential for the developing technologies to displace their conventional counterparts.

**Commercial Evaluation** – Nexant developed a forecast of propylene demand, production and trade, globally and by region to 2020. In these forecasts, the projected impact of the technology developments is incorporated into the balances.
### Table 2.1

COP Estimate for Propylene

**Process: Metathesis**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant start-up</td>
<td>2000</td>
</tr>
<tr>
<td>Analysis date</td>
<td>1Q2000</td>
</tr>
<tr>
<td>Location</td>
<td>USGC</td>
</tr>
<tr>
<td>Capacity</td>
<td>881.8 Million Pounds/yr</td>
</tr>
<tr>
<td>Operating rate</td>
<td>100 percent</td>
</tr>
<tr>
<td>Throughput</td>
<td>881.8 Million Pounds/yr</td>
</tr>
</tbody>
</table>

#### PRODUCTION COST SUMMARY

<table>
<thead>
<tr>
<th>RAW MATERIALS</th>
<th>PRICE</th>
<th>ANNUAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethylene (market price), Lb</td>
<td>0.3629</td>
<td>0.102 U.S. $</td>
</tr>
<tr>
<td>Raffinate-2, Gal</td>
<td>0.1451</td>
<td>0.097 U.S. $</td>
</tr>
<tr>
<td>Catalyst &amp; Chemicals</td>
<td>0.0020</td>
<td>0.002 U.S. $</td>
</tr>
<tr>
<td><strong>TOTAL RAW MATERIALS</strong></td>
<td>0.201</td>
<td>0.177 U.S. $</td>
</tr>
</tbody>
</table>

#### BY-PRODUCT CREDITS

<table>
<thead>
<tr>
<th>BY-PRODUCT CREDITS</th>
<th>PRICE</th>
<th>ANNUAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel, MM BTU</td>
<td>0.0014</td>
<td>(0.004)</td>
</tr>
<tr>
<td><strong>TOTAL BY-PRODUCT CREDITS</strong></td>
<td>0.017</td>
<td>0.197 U.S. $</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UTILITIES</th>
<th>PRICE</th>
<th>ANNUAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power, kWh</td>
<td>0.0422</td>
<td>0.002 U.S. $</td>
</tr>
<tr>
<td>Natural Gas, MM Btu</td>
<td>0.0004</td>
<td>0.001 U.S. $</td>
</tr>
<tr>
<td>Cooling Water, M Gal</td>
<td>0.0058</td>
<td>0.000 U.S. $</td>
</tr>
<tr>
<td>Steam, LP, M Lb</td>
<td>0.0008</td>
<td>0.004 U.S. $</td>
</tr>
<tr>
<td>Inert Gas, M SCF</td>
<td>0.0025</td>
<td>0.003 U.S. $</td>
</tr>
<tr>
<td><strong>TOTAL UTILITIES</strong></td>
<td>0.011</td>
<td>0.111 U.S. $</td>
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<table>
<thead>
<tr>
<th>NET RAW MATERIALS &amp; UTILITIES</th>
<th>PRICE</th>
<th>ANNUAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<table>
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<tr>
<th>DIRECT FIXED COSTS</th>
<th>PRICE</th>
<th>ANNUAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor, 11 Men</td>
<td>38.10 Thousand</td>
<td>0.000 U.S. $</td>
</tr>
<tr>
<td>Foremen, 5 Men</td>
<td>43.20 Thousand</td>
<td>0.000 U.S. $</td>
</tr>
<tr>
<td>Super., 1 Men</td>
<td>52.20 Thousand</td>
<td>0.000 U.S. $</td>
</tr>
<tr>
<td>Maint., Material &amp; Labor, 3.00 % of ISBL</td>
<td>0.002</td>
<td>0.002 U.S. $</td>
</tr>
<tr>
<td>Direct Overhead</td>
<td>45 % Labor &amp; Supervision</td>
<td>0.000 U.S. $</td>
</tr>
<tr>
<td><strong>TOTAL DIRECT FIXED COSTS</strong></td>
<td>0.003</td>
<td>0.003 U.S. $</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>ALLOCATED FIXED COSTS</th>
<th>PRICE</th>
<th>ANNUAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Plant Overhead</td>
<td>60 % Direct Fixed Costs</td>
<td>0.002 U.S. $</td>
</tr>
<tr>
<td>Insurance, Property Tax</td>
<td>1.0 % Total Plant Capital</td>
<td>0.001 U.S. $</td>
</tr>
<tr>
<td>Environmental</td>
<td>0.5 % Total Plant Capital</td>
<td>0.000 U.S. $</td>
</tr>
<tr>
<td><strong>TOTAL ALLOCATED FIXED COSTS</strong></td>
<td>0.003</td>
<td>0.003 U.S. $</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOTAL CASH COST</th>
<th>PRICE</th>
<th>ANNUAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depreciation @ 10 % for ISBL &amp; OPC</td>
<td>0.009</td>
<td>7.70 U.S. $</td>
</tr>
<tr>
<td><strong>COST OF PRODUCTION</strong></td>
<td><strong>0.222</strong></td>
<td><strong>195.93</strong> U.S. $</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RETURN ON CAPITAL EMPLOYED, ROCE (Incl. WC) @ 10 Percent</th>
<th>PRICE</th>
<th>ANNUAL COST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.013</td>
<td>11.16 U.S. $</td>
</tr>
<tr>
<td><strong>COST OF PRODUCTION + RETURN</strong></td>
<td><strong>0.235</strong></td>
<td><strong>207.09</strong> U.S. $</td>
</tr>
</tbody>
</table>
Section 3 Approach

The evaluations of conventional technology are based on Nexant’s in-house and published information regarding process technology, augmented by contacts with licensors, engineering contractors and other experts in the industry. Propylene and propylene derivative technology evaluations are “built up” from a review of patents, public domain information, and discussions with the technology developing companies and engineering contractors.

Nexant used proprietary and commercial state-of-the-art software tools to develop the technology and economic estimates. These are well established; state-of-the-art engineering tools in the process chemical industry and they are used by major engineering contractors.

Nexant has extensive knowledge, experience and technology databases maintained under the Process Evaluation/Research Planning (PERP) program. The major propylene derivative, polypropylene, is one of the key products covered under the PolyOlefins Planning Service (POPS) multiclient subscription program, which covers market outlooks and key commercial and technology developments in the global polyolefins industry. These technology databases are used extensively in both multiclient reports and single client engagements for new technology evaluation, cost benchmarking, price forecasting and techno-economic evaluation. Nexant has done extensive work in evaluating alternative on-purpose propylene technologies and the latest developments in steam cracking in its PERP program, which will be the basis for the technology assessments to be covered in this study.

In addition to using existing knowledge and database information, Nexant supplemented its technology database with selected contacts with licensors and other technology holders as needed in completing work for the study.

This project was managed and most of the work will be carried out at Nexant’s White Plains, NY office. Information and data for other regions was gathered as needed by consulting staff in Nexant’s regional and representative offices in Bangkok, Beijing, Buenos Aires, Houston, London, Singapore, Seoul and Tokyo.
Section 4  Contact Information

Please visit [www.nexant.com](http://www.nexant.com) to authorize engagement of the study or return the following authorization form to one of Nexant’s offices.

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Section 5

Authorization Form

1. The undersigned (hereafter "Client") hereby subscribes to purchase from Nexant, Inc./Chem Systems ("Nexant"), Nexant’s study, *Technology Developments in Propylene and Propylene Derivatives*, in accordance with the following terms and conditions.

Nexant will provide to Client the following information and services:

(a) Three (3) bound copies of the report
(b) Access to electronic downloads of the report via a password-protected area from www.nexant.com

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5. Client shall not republish any of the report except within its own organization or that of its 51 percent or greater owned affiliates. Client further agrees to refrain from any general publication of the reports, either directly or through its affiliates, so as to constitute passage of title into the public domain or otherwise jeopardize common law or statutory copyright in said report.

6. Each party agrees that it will not, without the prior written consent of the other party in each instance use in advertising, publicity, or otherwise the name of the other party, or any affiliate, partner, employee or agent of the other party, or any trade name, trademark, trade device, service mark, symbol or any abbreviation, contraction, or simulation thereof owned by the other party or its affiliates, provided, however, that either Party may disclose the existence of a contractual relationship between the Parties for promotional purposes.

7. Client will be billed by and shall pay Nexant a total of US$15,000. Client shall have the option of being invoiced the total amount upon authorization or in two equal installments, one upon authorization and the second six months later. Amounts are due upon receipt of invoice and payable within thirty (30) days. Late payments shall accrue interest at the rate of 1.5% per month. Fees quoted do not include any applicable sales tax, or use or value added tax, all of which are for the account of Client.

8. Additional copies of the report are available at US$500 each. The complete report will also be available electronically on CD-ROM at a cost of US$1,000.

9. The obligations of paragraphs 3 and 4 shall terminate five (5) years from receipt of reports.

10. A person who is not a party to this Agreement shall have no right to enforce any of its terms.

11. Unless specified otherwise, there are no warranties of any kind for reports and consulting services provided under this Agreement. Nexant’s total liability under this Agreement is limited to the total amount paid to Nexant for the reports. Under no circumstances shall Nexant be liable to Client for any consequential or incidental damages, including but not limited to loss of use or loss of profit.

12. This Agreement will be governed by the laws of the State of New York.