Prospectus

China Propane Dehydrogenation

Global Disruption on the Horizon?

A large wave of propane dehydrogenation (PDH) units is coming to China. One PDH plant is already in operation with many others under construction or in an advanced phase of planning. Propylene from PDH will grow from a current negligible amount to a significant part of the local supply source within the next five years. At the same time, many PDH projects are also planned outside of China.

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Premise

The on-purpose production of propylene is largely planned to reduce China's dependence on imports of propylene derivatives, and growing dependence on imports of crude oil which is the main feedstock for producing propylene domestically. PDH is one of the options to reduce dependence on imported oil. More importantly, it is a viable choice for medium and small propylene users to produce their own propylene. A majority of companies planning to build PDH units will integrate the propylene capacity with downstream propylene derivative capacities.

In contrast to the U.S. and Middle East, which have easy access to abundant propane supply, China has historically been a net propane importer and will remain so going forward. All China PDH projects will have to rely on imported propane from North America and the Middle East.

The large surge of PDH capacity in the near future will have a far-reaching impact on global propane, propylene and propylene derivative supply and demand dynamics.

The following key questions will be addressed:

- **Are all the announced projects going to happen? Which ones are more likely?**

  Each announced project will be examined by on-the-ground experts to assess its viability and likelihood to proceed. Our study team will conduct site visits and interviews to identify the actual progress of ongoing and planned PDH projects. We will assess the likelihood of announced projects advancing to the construction phase.

- **What is driving China's PDH development?**

  The study will address the rationale behind the current PDH rush. It will discuss the main incentives for companies to invest in PDH.

- **Where will all the propane come from? Will it create any global propane supply tightness?**

  Propane to feed the PDH units must come from imports. This report will study the source of propane supply and analyze the impact on regional and global propane supply/demand. The propane price outlook for China, and relevant propane supply logistics will be explored.

- **Is China PDH competitive?**

  This is the key issue impacting the viability of China PDH projects. This study will analyze the cost-competitiveness of China PDH based on actual cost inputs collected by the study team. The cost will be compared with naphtha cracking, Coal to Olefins (CTO), Methanol to Olefins (MTO), and PDH units in other countries including the U.S., Middle East and Korea.

- **What downstream derivative capacities are likely to be built and what impact will they have?**

  This report will analyze China propylene derivative capacity additions associated with PDH. Their impact on the existing market, particularly on propylene specialty derivatives (non-polypropylene), will be examined.

- **What are the hurdles and limits for PDH in China?**

  The study will look into the challenges and hurdles which PDH producers must overcome. We will also analyze the limit on how much PDH capacity China can build.

Contribution of IHS Expertise to the Study

Chemical Insight: IHS offers leading business research for the global chemical industry, with published reports and client-sponsored research. We are the preeminent source for in-depth business and process analysis in this space. Our olefin and propylene derivative experts in China and other regions will be the main resources conducting the study.

Energy Insight: As a leading advisor to international energy companies, governments, financial institutions, and technology providers, IHS Energy delivers critical knowledge and independent analysis on energy markets, geopolitics, industry trends, and strategy.

Country and Industry Forecasting: We provide the most comprehensive economic, financial, and political coverage available from any source to support planning and decision making. Using a unique combination of expertise, models, data, and software within a common analytical framework, IHS covers over 200 countries and more than 170 industries.

Scope of Work

This study is designed to be an executive level, interactive multiclient study, and will consider clients' specific interests and concerns regarding this topic.

- Feasibility analysis of each PDH project in China with assessments by local IHS experts
- Regional and world propane supply/demand balance with scenario analysis
- Relevant propane supply and logistics
- Comparative PDH economics in China, Korea, USA, and Middle East
- Competitive analysis of PDH economics in China with other olefins production processes
- Market impacts of propylene derivative capacity expansions associated with PDH projects
- Strategic issues and challenges to PDH

Deliverables

- PowerPoint presentation
- All supporting data in Excel
- A series of optional interactive roundtable workshops/webinars

Framework and Estimated Timeline

The China Propane Dehydrogenation special report will be conducted following a workshop study approach in which clients are able to provide input to the scope of the study. Several interactive workshops and webinars will be held to make sure charter participants' interests are incorporated into the scope of the study. The planned events are scheduled as follows:

Workshop 1 – Study Kick-off

The kick-off workshop will discuss methodology, deliverables, and study framework. This workshop will be conducted via conference call from Shanghai and will include a presentation of our initial assumptions, a review of our methodology and our study approach, and scheduled deliverables. A key component of the workshop process is an open discussion in which participant input is a key component of the scope finalization process.

Workshop 2 – Mid-Project

Gathering input from clients at various points in the research process is vital to ensuring that the research incorporates industry interests.

At the mid-project roundtable workshop we will present our findings and seek feedback from participants. At this stage of the process, client participation is critical in shaping the final report.

Workshop 3 – Final Presentation

The final report presentation will be held to review the conclusions and datasets. The final report will be released in October 2014.

Study Lead

Paul Pang, Senior Director – IHS Chemical, is the Service Leader in China, with more than 25 years of experience in the petrochemical industry.

Before joining IHS, he worked in various job functions and locations with ExxonMobil Chemical in Singapore and Houston, TX working in operation, technology, and business planning. Before moving overseas, Paul worked for SINOPEC as a Research and Technical Support Engineer in Beijing, China.

Paul received his B.S in chemical engineering from South China University of Technology in 1988 and M.S. in Chemical Engineering at National University of Singapore in 1995. He also received his Master of Business Administration from University of Houston in 2001.

Study Team

Sally Fu, Senior Analyst – IHS Chemical, covers the Chinese light olefin markets and supports the IHS China polyolefins research group. She has more than three years of experience in the olefin and polyolefin industry, and knowledge that extends throughout the entire product chain, including the economic model, technology, supply/demand analysis and trading activities.

Based in the Shanghai office, Sally joined Chemical Market Associates (CMAI, now IHS Chemical) in 2010. Before joining CMAI, she served in product research and analysis roles at Evonik from 2005 to 2010.

Sally graduated from the East China University of Science and Technology with a bachelor's degree in Materials Physics, and received her Master's degree in Chemical Engineering from Shanghai Jiaotong University.

Charles "Chuck" Carr, Senior Director – IHS Chemical Global Olefins

Chuck is currently Sr. Director Global Olefins and service leader for the North American Light Olefins Market Advisory Service. Chuck joined IHS Chemical (formerly CMAI) in 2006 as Director of Propylene Studies in the Olefins Group. His focus has primarily been in olefins and the analysis of the propylene and propylene derivative markets for hundreds of global clients.

Prior to joining IHS Chemical, Chuck had a 21 year career with Total Petrochemicals USA with experience in refinery engineering/operations, purchasing, plastics logistics, and olefins commercial activities. His most recent assignments from 2003 to 2006 were in the Base Chemicals division where he held Olefins Manager responsibilities concerning market intelligence and the commercial activities associated with ethylene and propylene. From 1998 to 2003, Chuck served in other corporate office roles including Business Development Coordinator handling research and economic evaluation for the Southwest Business Unit, Lead Buyer for catalyst, chemicals, and additives in the purchasing group, and Manager of Logistics & Distribution concerning all of Total Petrochemicals polymer transportation requirements. From 1985 to 1998, Chuck was at the Big Spring Refinery in various roles including Planning/Coordination Manager and Operations Manager.

Chuck received a Bachelor of Science in Chemical Engineering from the University of Oklahoma in 1985 and is a registered professional engineer in the state of Texas.

Study Team continued

Tom Manning Senior Research Director – IHS Energy Natural Gas Liquids

Based in the Houston office, Thomas J. (Tom) Manning is a senior research director at IHS. In that capacity, he is responsible for directing many of the company's long range studies covering natural gas liquids (NGLs), which investigate future trends in the industry. As a consultant he has directed a number of single client, as well as multi-client studies on supply, demand, pricing and marketing of petrochemicals, refined products, natural gas liquids, crude oil and natural gas.

Tom began his career at Monsanto in Texas City, Texas as a process engineer for five years. He then joined Pace Consulting where he worked for about 18 years before joining Purvin & Gertz (now IHS) where he has been for the past 32 years.

He holds a bachelor's of science degree in chemical engineering from Louisiana Tech University, and a MBA from the University of Houston.

Walt Hart, Senior Research Director – IHS Energy Natural Gas Liquids

Walt Hart, Senior Research Director in IHS' Houston office leads the Natural Gas Liquids Research & Consulting group. He joined Purvin & Gertz in 2006. IHS acquired Purvin & Gertz in 2011.

Walt's proprietary studies have involved business analysis and strategy, market studies, forecasting, valuations and legal support. He works primarily in the area of natural gas liquids and light naphtha, but also has significant experience in petrochemicals, alternative fuels and bio-fuels. He has authored portions of worldwide multi-client studies, taught workshops, given seminars and conducted training courses.

Prior to joining Purvin & Gertz, Walt spent 14 years at Union Carbide Corp. and Dow Chemical Co., as well as two years at Owens Corning Fiberglas. He has held positions in process engineering, technical sales, research and development, finance and strategic planning. He has also taught at the undergraduate level.

Hart received his Bachelor of Science in Chemical Engineering in 1986 from Notre Dame, an MBA from the University of Charleston and a Ph.D. in Chemical Engineering from West Virginia University. He is a registered Professional Engineer and a member of the Gas Processors Association and the American Institute of Chemical Engineers.

Keefer Douglas, Senior Research Analyst – IHS Energy Natural Gas Liquids

Keefer Douglas joined the Global Gas group at PFC Energy in 2007, and since IHS acquired PFC in June 2013 has been a member of the IHS Natural Gas Liquids Research and Consulting group. On the NGL team, Keefer has taken the lead in developing NGL supply, demand and pricing studies for Asia, and has also contributed to several consulting projects and the IHS long term NGL supply and demand study.

At PFC Keefer managed the Gas Competition Service (GCS), which focused on company performance and strategy in global gas. As an analyst his research primarily focused on natural gas markets across North Asia and Southeast Asia, and on competitive strategy, with a particular emphasis on the Chinese NOCs. Keefer was also involved in natural gas and NGL supply and demand forecasting.

Prior to joining PFC Energy, Keefer spent four years in Beijing, and worked for Sinosphere Corp., a consulting firm specialized in helping multinational clients in the energy, electronics manufacturing and other sectors navigate Chinese policy and regulations related to Health, Safety and Environment (HSE) and labor standards, as well as implement best practices in these areas in their Chinese operations.

Keefer holds a BA in East Asian Studies from Brown University, and an MALD from the Fletcher School at Tufts University. His Masters coursework and thesis focused on economics and energy, with a particular focus on economic and geopolitical impacts of Chinese energy demand growth.

Study Team continued

Dewey Johnson, Senior Director, Market Research – IHS Chemical

Dewey Johnson is the senior director of Market Research at IHS Chemical, where he is responsible for the company's market research services, which provide global insight and research covering five primary value chains consisting of aromatics and fibers, olefins and derivatives, inorganics (chlor-alkali, vinyls, and soda ash), plastics and polymers , and syn-gas chemicals (acetyls and methanol).

Based in Houston, Johnson joined CMAI (now IHS Chemical), in 2009. His experience in the petrochemical industry covers all aspects of the business — financial, commercial, operations, research, design and business planning, as well as consultancy.

Prior to CMAI/IHS, he worked for Eastman Chemical Company, where he spent more than 29 years in experience in strategic and commercial roles in capital intensive industries, holding various management positions in commercial development, global procurement for commodity chemicals, business management, market development, and market analysis of complex chemical value chains.

Dewey served in various functions within the Eastman Chemical Company including chemicals from coal, polymers, and global supply chain and procurement. In addition, he covered corporate quality, corporate strategy and business analysis, corporate system dynamics, and global engineering and construction. Johnson has led multi-functional teams in strategy development and execution, global sourcing, business gaming and dynamic modeling, sales/ marketing, and complex program management for business development.

After completing a bachelor's degree in civil engineering from Tennessee Technological University in 1979, Johnson began his career with Eastman Chemical Company. He earned his master's of business administration degree from East Tennessee State University in 1985, and he received a master's of science degree in environmental engineering from the Virginia Polytechnic Institute University in 1994.

Xizhou Zhou, Director – IHS Energy China

Xizhou Zhou leads IHS Energy 's China Energy practice and specializes in gas and power market fundamentals and policy analysis. Based in Beijing, Zhou is a core member of the IHS energy research and consulting team in Asia. He is the author of numerous IHS Energy reports and has managed a variety of consulting engagements.

Zhou's latest research includes contributing to the IHS Energy multiclient study Unconventional Frontier, which explores the future of shale gas and coalbed methane outside North America; as well as leading the analysis on the causes and likelihood of future power shortages in China and the implications for the wider energy markets.

He's also a project director of the IHS Energy multi-client study Coal Rush: The Future of China's Coal Markets. Prior to joining IHS Energy , Zhou was a consultant engaged in regulatory and energy economics projects at Industrial Economics Inc. in Boston. Earlier in his career he was a research analyst at the World Resources Institute in Washington, D.C., where he focused on energy and transportation in developing Asia and Latin America.

Fluent in Mandarin Chinese and proficient in Spanish, Zhou holds bachelor and master's degrees in environmental management from Yale University.

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