

**CHEMICAL/PETROCHEMICAL PRODUCTION AND
FEEDSTOCK CONVERSION IN CHINA: AN INDEPENDENT
ASSESSMENT OF MARKETS, PARTICIPANTS AND
EXPECTATIONS, 2017-2025**

UPDATED MULTI-CLIENT STUDY PROPOSAL

March 2017



CHEMICAL/PETROCHEMICAL PRODUCTION AND FEEDSTOCK CONVERSION IN CHINA: AN INDEPENDENT ASSESSMENT OF MARKETS, PARTICIPANTS AND EXPECTATIONS, 2017-2025

I. ABSTRACT

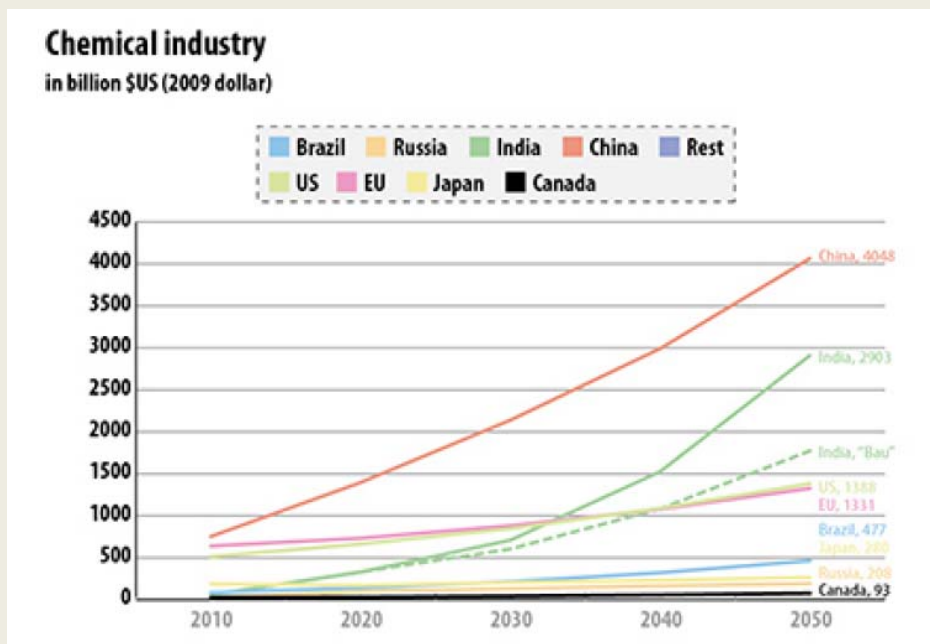
The current understanding of the marketplace in China for chemical/petrochemical production, feedstock conversion and related services is fragmented at best, with local knowledge of participants in China difficult to obtain and challenging to verify. The recent commercial slowdown in China, vs. the situation reported in publically available sources (including statistics), has prompted clients of The Catalyst Group Resources (TCGR) to begin questioning the real-world situation. Such local knowledge can be invaluable to current and prospective participants as they pursue market opportunities within China and consider commercial and/or technological partnerships, including product/market offtake expectations, toll manufacturing agreements and raw material supply relationships.

It is clear that a level of complexity has developed which has caused a reluctance to engage, or to slow the pace of engagement when undertaken. Coupled with the importance of the markets in China with regard to both size and growth for such products (and related technological advances with commercial implications), there is now a need for a more accurate and deeper understanding. The industry has progressed well-beyond initial forays and early relationships in China; we are currently in a time when a higher level of sophistication, and local knowledge, is required for success. In this proposed TCGR study, entitled ***“Chemical/Petrochemical Production and Feedstock Conversion in China: An Independent Assessment of Markets, Participants and Expectations, 2017-2025,”*** we will assess the real-world gaps which have developed and document how they can be overcome, based on local successes. The findings, if implemented appropriately, will result in more sophisticated participants and more robust, and rewarding, market involvement. This proposed study will provide current and prospective participants with the detailed and up-to-date information needed to further develop their activities in China and identify new, rapidly developing opportunities in areas where they might expand. It is both a timely and needed resource.

The past speed of development and pace of growth in selected chemical/petrochemical manufacturing and feedstock conversion (e.g., coal to olefins, oil to fuels/petrochemicals) has led to overcapacity in certain segments (e.g., methanol) which has resulted in increased uncertainties in where investments can or should be made. It is often difficult to comprehend the local Chinese drivers for, and factors in, decision-making with the implications having significant magnitude. Equally important is the need for a deeper understanding of the scientific leadership positions in Institutes, Universities and how they either follow or interact with government-directed policies, e.g., NRDC, NPCPI, and other national or provincial bodies. Documenting the implications of current and future cultural and commercial changes are very important to local success, along with adjustments already announced for the Five-Year Plan. TCGR’s

relationships with these influential organizations provides unique access to planning and permitting trends.

Figure 1. The Global Chemical Industry and China’s Increasing Role to 2050



Source: CHEManager, June 2013; “Future of the Chemical Industry by 2050.”

II. BACKGROUND

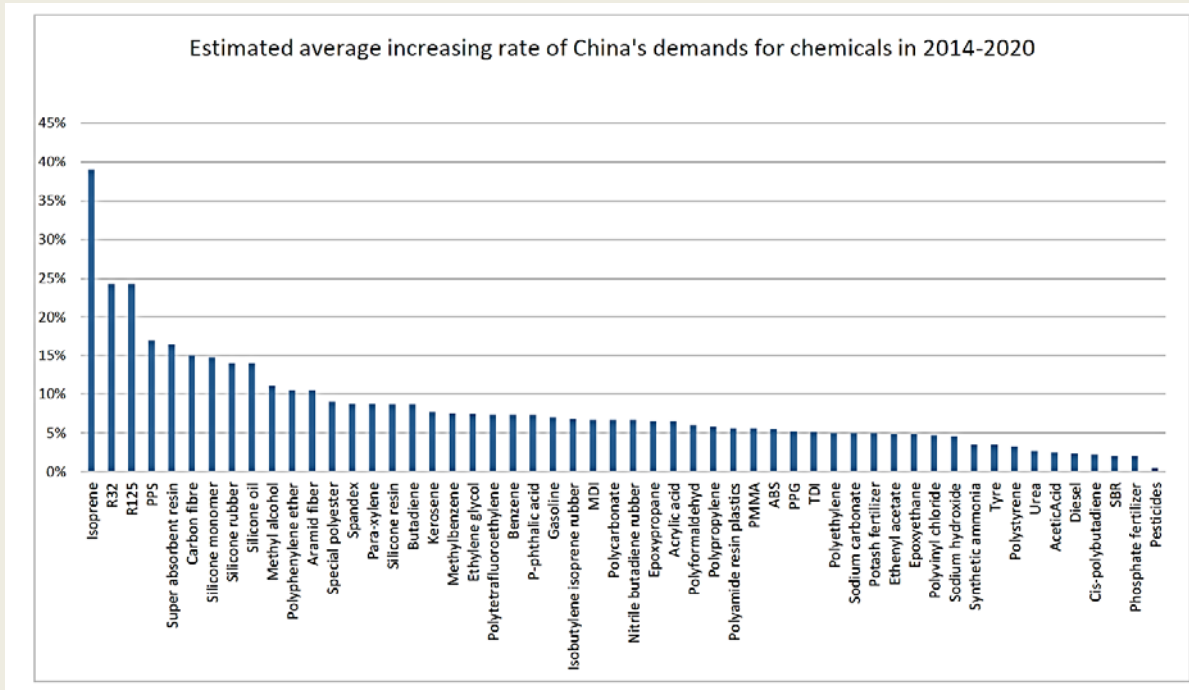
There is a great deal of information on the importance of the markets for, and advancements in, chemical/petrochemical production, feedstock conversion and related services in China. In addressing those needs in the past, TCGR has produced a series of multi-client studies capturing market size/growth and participant (companies, institutions) profiles in order to enable opportunity identification and provide strategic guidance. These study series’ were as follows, both completed with our partner the China National Chemical Information Center (CNCIC):

- **“The Catalytic Process Industries in China: Markets, Technologies & Strategic Implications – Update 2013”** (completed as a series of four segment reports in 2013); see: <http://www.catalystgrp.com/php/articledetail.php?China-Catalytic-Process-Industries---Update-2013-77>
- **“The Catalytic Process Industries in China: Markets, Technologies & Strategic Implications”** (completed as a series of four segment reports in 2005)

These assessments, however, were predominantly data-driven and relied on governmental statistics (cross-checked and verified via “on the ground,” independent resources). Although useful in their time, such assessments are no longer sufficient for companies pursuing more narrowly-defined and strategically important markets and relationships in China. Today, it is a more complicated situation, with a higher level of sophistication and understanding required in order to succeed.

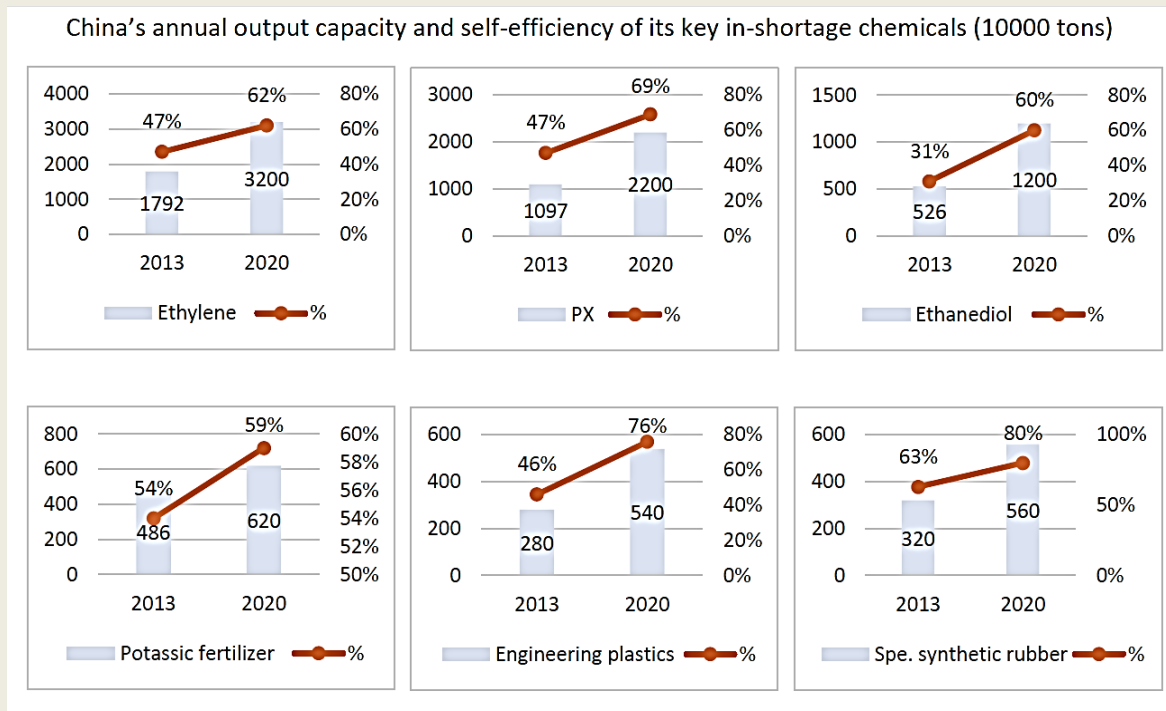
As a result, this proposed TCGR study is envisioned as being significantly different based on our subscriber’s evolving interests and needs. That is, **industrial participants have become more familiar with business in China and have expressed the need for information which goes beyond that available from established/governmental sources. In addition, they have expressed interest in sharing particular questions/concerns about local market conditions, the capabilities of government-owned/-sponsored institutes and universities, and prospects for continued vs. changed behaviors/expectations in China.** There is a distinct opportunity for TCGR to provide this information and analyses, unique to the marketplace, based on our detailed knowledge, strong resources (on-the-ground, in China) and breadth/depth of contacts via our DIALOG GROUP® including a consulting/cultural presence in China for over 15 years.

Figure 2. Estimated Average Increasing Rate of China’s Demands for Chemicals



Source: Flanders Investment & Trade Guangzhou, 2015; “China’s Petrochemical and Chemical Industry.”

Figure 3. China's Annual Output Capacity and Self-Sufficiency of Its Key in-Shortage Chemicals (10000 tons)



Source: Flanders Investment & Trade Guangzhou, 2015; "China's Petrochemical and Chemical Industry."

As an indication of some earlier findings (from 2013) and more current insights and/or questions (from the present, 2016/17), there is a clear indication of a higher level of sophistication required for informed decision-making in China, as follows:

Overview on Technology (Licensing, Catalysts)

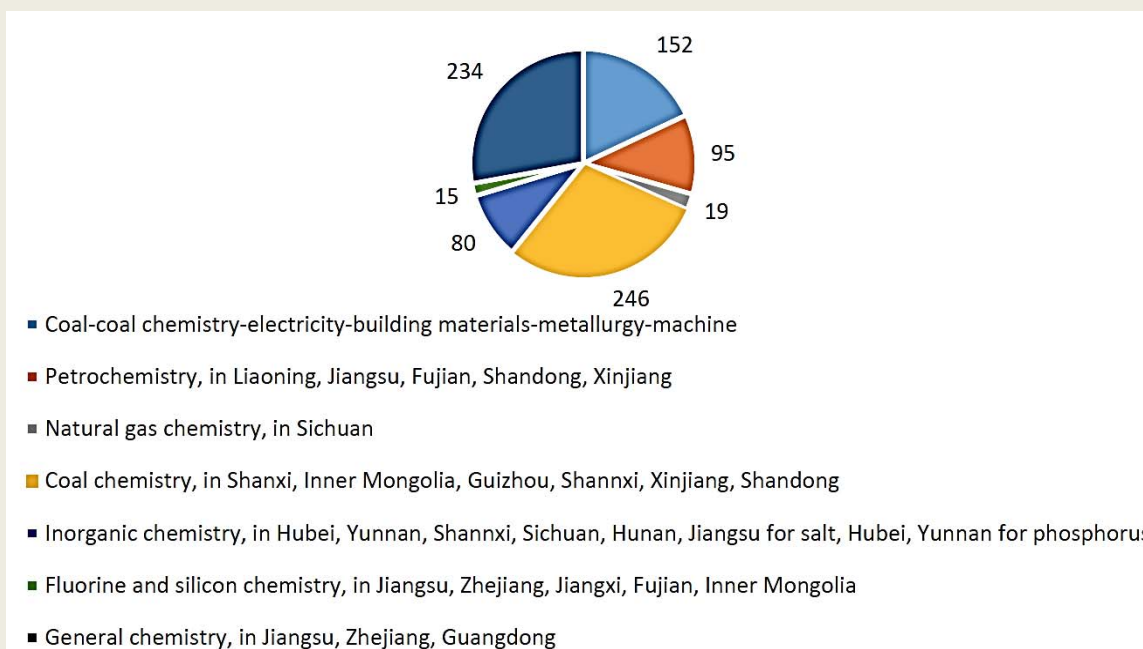
2013 findings:

Technology (Licensing, Catalysts): China continues to emphasize self-sufficiency in certain industrial sectors. Among them is technology, where competitive advantage can be gained from knowing detailed customer requirements as well as meeting the rapid turn-around times to supply them. Major Chinese production and feedstock conversion companies have been increasing their technical development capabilities, expanding their production capacities and marketing their improved products towards higher value-added applications. All major sectors have demonstrated significant technical and commercial development.

2016/17 comments/questions:

- To what degree are major Chinese chemical/petrochemical producers, feedstock converters (i.e., to chemicals/fuels) and EPC companies, both State-owned and private, able to meet current end-user requirements?
- Which organizations are back integrated into raw materials and/or have the capabilities to do toll/custom manufacturing?
- What are the company's/organization's current capacities, and plans for expansion, in each of the major segments served?
- What are the resultant impacts on capacity utilization, profitability and need for "new" business development (locally and internationally)?
- How will supply channels (raw materials, fabrication, activation, process incorporation) be organized for domestic vs. international participants?
- What activities are being studied, or planned, at the state-owned/-directed institutes and universities (e.g., Dalian Institute of Chemical Physics, Chinese Academy of Sciences, etc.) and how will this affect the ability of others to participate?

Figure 4. China's 841 Chemical Industrial Parks and Their Main Locations (Provinces/Regions)



Source: Flanders Investment & Trade Guangzhou, 2015; "China's Petrochemical and Chemical Industry."

Petrochemical/Chemical and Feedstock Conversion (e.g. Refining)

2013 findings:

Petrochemical/Chemical Production: China's petrochemical/chemical industry has made considerable progress over the past several years. However, it is not self-sufficient and has numerous unique characteristics, such as its "coal to chemicals" sector, e.g. acetylene based carbide chemistry, coal to methanol, coal to MTO/DME and to SNG. While China's chemical industry has focused on the domestic production and supply of chemicals required for agriculture, e.g. fertilizers to food, or those to support its manufacturing exports e.g. textiles/clothing, thus p-xylene to PET or polyolefin plastics, it has also increased its diversification and value-added complexity in specialty/fine chemicals. These segments are more fragmented and less State run, bearing in mind the largest petrochemical producers SINOPEC, PetroChina and CNOOC are still integrated government companies.

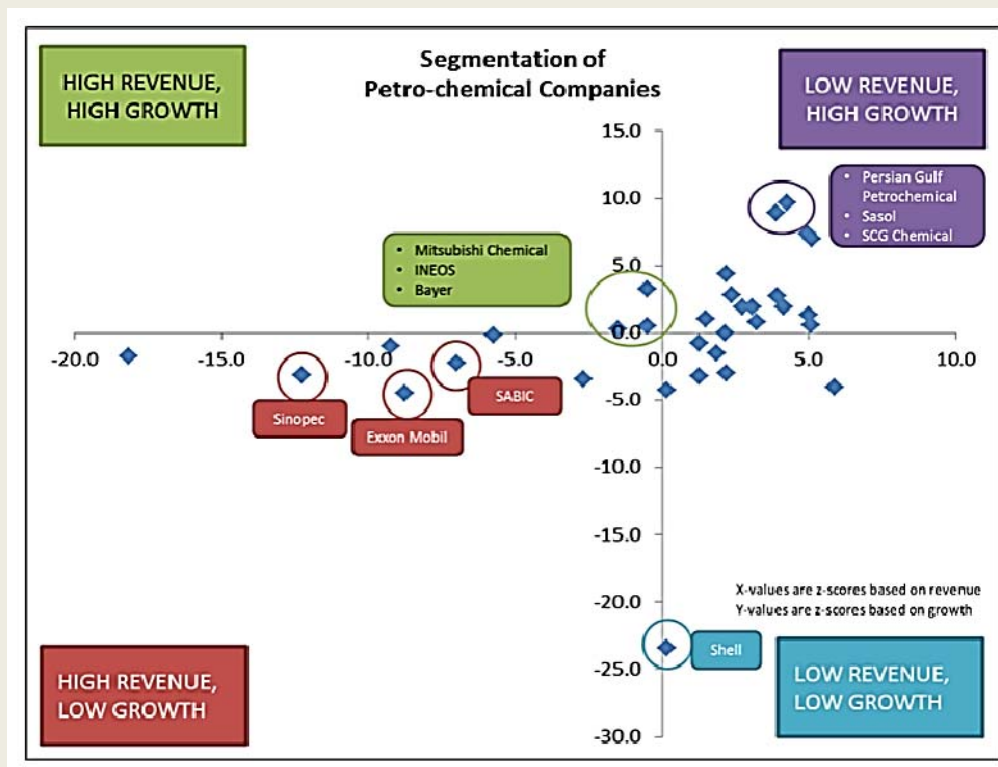
Feedstock Conversion/Refining: China's refining industry is maturing and becoming more sophisticated from within and internationally. Key examples include increased IOC domestic investment – e.g., the formation of the SINOPEC Catalyst Company which is now selling internationally. There are increased hydrotreating, hydrocracking and octane processes as the country's international fuel standards are raised in order to meet transport emission standards and export fuel requirements. There is a drive toward diversification, particularly at the Provincial level (i.e., consolidation and/or reconfiguration of independent "tea pot" refineries to improve industry size and profitability per refinery site).

2016/17 comments/questions:

- In the large/important chemical/petrochemical applications (e.g., aromatics/BTX, EO/EG and other oxo-chemicals, PTA, syngas/ammonia/methanol, olefins, etc.), what are realistic measurements for market size and how can expectations for growth be justified?
- What are the influences that governmental actions (i.e., Five Year Plans, Provincial objectives) have on growth, competition and opportunities?
- How will institutes, universities and research industrial centers (domestic and international) affect new technology development and commercial introduction?
- Which channels to end-market, or within the supply chain (raw materials, synthesis/fabrication, incorporation into process license, etc.), be successful and why?
- To what degree are the specifications for refined products for fuels (e.g., octane number, sulfur level, etc.) being regulated and/or enforced and what are the implications on technologies licensed/practiced in refineries across China?

At this time, TCGR is in a unique position to re-visit the topics/questions of greatest interest to current and prospective participants in Chinese chemical/petrochemical production, feedstock conversion and related services in order to provide an updated, real-world depiction of the situation.

Figure 5. Segmentation of Global Petrochemical Companies by Growth and Revenue



Source: Data used are from ICIS Top 100 Chemical Companies in 2015

III. THE NEED FOR THE STUDY

The current understanding of the marketplace in China for chemical/petrochemical production, feedstock conversion and related services is fragmented at best, with local knowledge of participants in China difficult to obtain and challenging to verify. Such local knowledge can be invaluable to current and prospective participants as they pursue market opportunities and consider commercial and/or technological partnerships, including toll manufacturing and raw material or finished product supply relationships. The resulting level of complexity which has developed has caused a reluctance to engage, or to slow the pace of engagement when undertaken. Coupled with the importance of the markets in China with regard to both size and growth for such products (and related technological advances with commercial implications), there is now a need for a more accurate and deeper understanding. The industry is now well-beyond initial forays and early relationships in China; we are currently in a time when a higher level of sophistication, and local knowledge, is required for success.

In updating our 2013 insights and broadening the scope to address the issues/questions for 2016/17 as cited above, TCGR envisions a single volume study (as opposed to a series of four reports addressing each the major segments). We will address the issues common to all four segments, as well as each segment's topics/issues independently, going well-beyond governmental statistics/agencies in order to yield real-world, on-the-ground perspectives and insights directly from those in the Chinese industry. We will both gather the primary (i.e., original) market research as well as analyze it for the benefit of subscribers. **Note that included among the methodology will be the development of specific survey questions to be posed to 20-25 key business operations and development executives in China, with the depiction of the results in both qualitative and quantitative ways, as follows:**

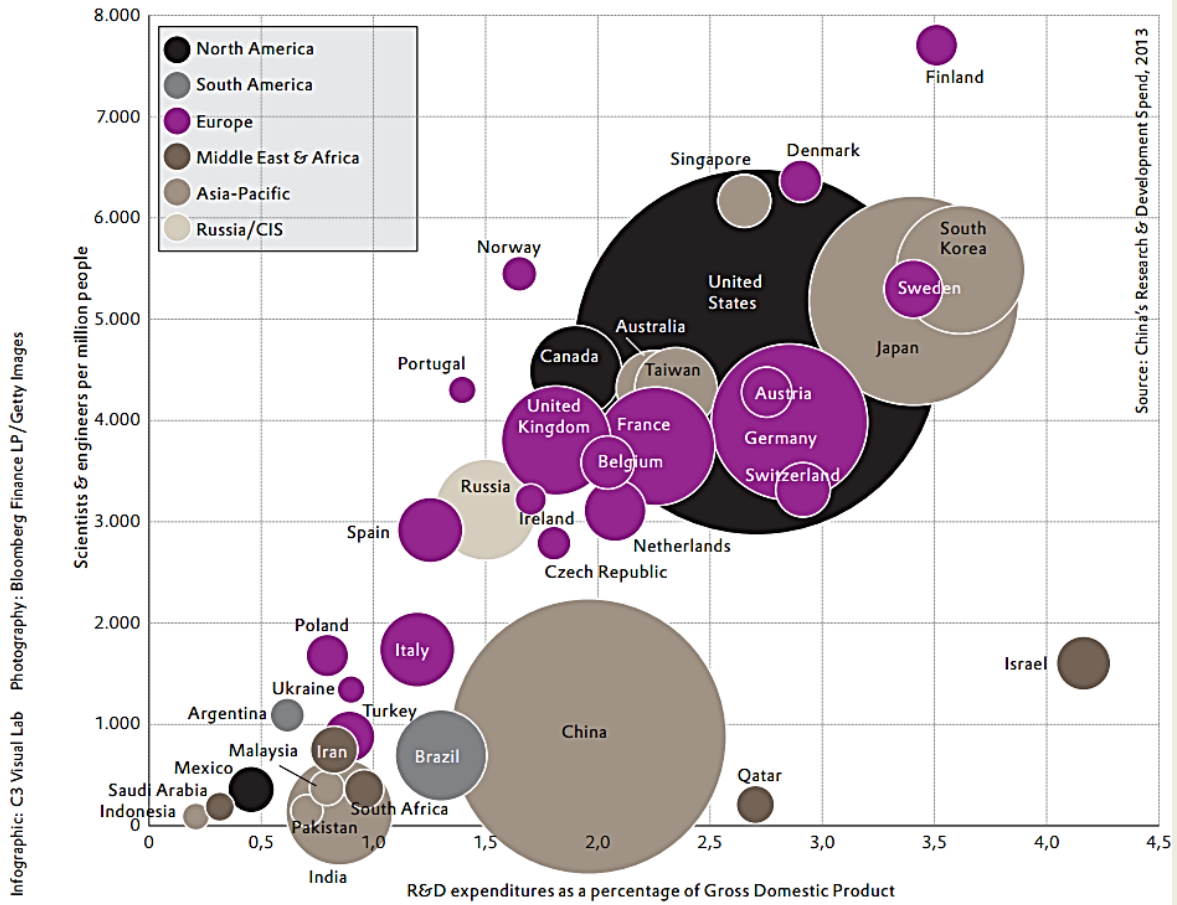
- First and foremost among needs (i.e., where an increased level of complexity is required) is in the area of the true or real economic and industry environment, notably market size and growth. Market participants require actual/real industry segment level size and growth data, beyond official governmental sources via direct industry surveys. Also important for decision-making is a clear depiction of the political environment, including Five-Year Plans and priorities for the country. Completing this depiction is characterizing the evolving position of Chinese companies/organizations among "peer" countries, in general as well as specific to the chemical/petrochemical production, feedstock conversion and related services industries.
- Supplementing the documentation of the government and other situational factors are industry-specific perspectives and experiences. Direct, primary feedback from both Chinese companies in China and Western owned, operated or joint ventures in China are instrumental for decision-making. It is important to have detailed, accurate and up-to-date company/organizational profiles, SWOTs, capability descriptions (i.e., definitions of production capacities, technology development areas, partnerships/JVs, market channels, etc.). This includes research institutes and universities as well as their relationships with industry (in and outside of China).

Due to the challenge involved as well as the importance of these descriptions, **TCGR envisions a survey/interview approach, conducted on-the-ground via local experts with 20-25 key business operations and development executives, to include direct/attributable quotations. TCGR anticipates that "charter" subscribers (i.e., those companies that sign-up for the study prior to its launch) will contribute segment- and organization-specific contents for inclusion in the surveys.**

Figure 6. Research and Development in 2013 (Scientists/Engineers and R&D Expenditures per Million People)

Research and development in 2013

Scientists and engineers per million people, as well as R&D expenditures as a percentage of the gross domestic product; the size of the circles shows the level of R&D expenditures in each country.



Source: Elements #54 - The Evonik Innovation Magazine, April 2016; "Research: Full Speed Ahead."

There is then the need for the gathered data to be supplemented via detailed analyses in order to distinguish between what is "real" vs. what is "perceived" in the industry, by segment. This can lead to noteworthy opportunity (and threat) identification – valuable results from a deeper understanding. An indication of the lessons learned from recent industry events is also justified, so that past mistakes are not repeated. An indication of what to expect in the next 5-10 years will provide guidance on next steps.

Based on the findings and insights from above, TCGR will provide recommendations on how to proceed from here, in China, noting what to look for in the competitive landscape, potential partners, etc. The study will deliver actionable advice with explanations indicating rationales.

This parallels two other recent TCGR multi-client studies which capture region-specific data, analysis and recommendations:

- ***The Middle East Catalyst Market: Technologies, Applications and Opportunities*** (March 2016); see: <http://www.catalystgrp.com/php/articledetail.php?MiddleEastCatalystMarket-89>
- ***The Asia Pacific Catalyst Industry: Markets, Technologies and Manufacturers*** (September 2015); see: <http://www.catalystgrp.com/php/articledetail.php?Asia-PacificCatalyst-87>.

Other recently completed multi-client studies and limited-client reports from TCGR include:

- ***Membranes in Separations: Commercial Advances In Refinery, Petrochemical/Chemical and Industrial Gases Applications*** (November 2016)
- ***The Intelligence Report: Business Shifts in the Global Catalytic Process Industries, 2015-2021*** (May 2016)
- ***Specialty Zeolites in Catalysis, 2002-2020: International, Commercial and Technical Progress – A New Era!*** (March 2014)
- ***The Catalytic Process Industries in China: Markets, Technologies & Strategic Implications*** (4 part Series – 2013)
- ***The Industrial Adsorbents Business: Commercial Strategy, Technical and R&D Assessment in Refining, Chemicals/Syngas, Natural Gas and Industrial Gases*** (July 2013)
- ***FCC Additives: Meeting Refiners' Environmental, Performance & Product Slate Flexibility Requirements 2013-2018*** (June 2013)
- ***Unconventional Catalytic Olefins Production: Commercial Vision and Breakout?*** (January 2013)

IV. SCOPE AND METHODOLOGY

In this proposed TCGR study, entitled ***“Chemical/Petrochemical Production and Feedstock Conversion in China: An Independent Assessment of Markets, Participants and Expectations, 2017-2025,”*** TCGR will assess the gaps between information in currently available sources (e.g., governmental and institutional) and the “real world” via market participants in order to document how they can be overcome, based on successes from the marketplace.

TCGR will both update our 2013 insights and address the issues/questions of greatest interest to (and importance for) current and prospective market participants. This single-volume study will go well-beyond governmental statistics/agencies in order to yield real-world, on-the-ground perspectives and insights directly from those in the Chinese industry. We will both gather the primary (i.e., original) market research as well as analyze/interpret it for the benefit of our subscribers. **Included as part of the methodology will be the development of specific survey questions to be posed to 20-25 key business operations and development executives, with the depiction of the replies in both qualitative and quantitative ways.**

Among the topics included are:

- Industry (economic, political) environment and China among “peer” countries
- Industry perspectives (Chinese and Western owned, operated or JVs, by segment)
- Company/organization profiles, SWOTs, capabilities (production, technology development, relationships/channels, etc.); to include interview results: direct/attributable quotations, based on questions provided by TCGR (including “charter” subscriber inputs)
- Strategic analysis and insights (“real” vs. “perceived” situation; notable opportunities and threats)
- Conclusions and recommendations (how to proceed from here; what to look for, in competitive landscape, potential partner, etc.)

A depiction of the study’s envisioned scope is presented in the preliminary Table of Contents as shown on the following page.

All TCGR studies are characterized by competitive and strategic insights for industrial and financial investment companies to evaluate. These include key trends, concerns, and conclusions on the best return on investment (ROI) actions, competitive expectations and strategic SWOT’s on the players. TCGR is noted for its sound strategic advice in over 30 years of experience.

TCGR’s unique background and established global Dialog Group® ensures expert capability and skill level in this study area. TCGR will utilize numerous deeply experienced experts on China’s chemical/petrochemical and feedstock conversion industries to assist us to provide insights beyond what other sources that do not have the reach and industrial experience can provide.

As it does in each of its industrially-focused multi-client studies, TCGR will seek input from “charter” subscribers to help shape the report’s final scope/ToC so that it covers and emphasizes the most pertinent content due to the breadth of potential topics of interest, including nominations for interview questions and company/institution coverage (as represented in Section IV of the study’s Preliminary Table of Contents).

Preliminary Table of Contents
CHEMICAL/PETROCHEMICAL PRODUCTION AND FEEDSTOCK CONVERSION IN
CHINA: AN INDEPENDENT ASSESSMENT OF MARKETS, PARTICIPANTS
AND EXPECTATIONS, 2017-2025

I. BACKGROUND/INTRODUCTION

- A. Scope and Objectives
- B. Methodology
- C. Report Contributors

II. EXECUTIVE SUMMARY

III. INDUSTRY ENVIRONMENT

- A. Economic environment (government vs. actual/real industry segment level growth forecasts)
- B. Political environment (5-year plans and priorities)
- C. The evolving position of China among “peer” countries, in general as well as specific to chemical/petrochemical production, feedstock conversion and related services industries

IV. INDUSTRY PERSPECTIVES (including survey/interview results)

- A. Chinese companies in China, by segment
- B. Western owned, operated or joint ventures in China, by segment
- C. Profiles, SWOTs, capabilities (production, technology development, relationships/ channels, etc.)
- D. Research institutes/universities and relationships with industry (in and outside of China)
- E. Interview results: direct/attributionable quotations, based on questions provided by TCGR and “charter” subscribers

V. STRATEGIC ANALYSIS AND INSIGHTS

- A. Real vs. perceived state of the industry
- B. Noteworthy opportunities and threats
- C. Lessons learned
- D. What to expect in the next 5-10 years

VI. CONCLUSIONS AND RECOMMENDATIONS

- A. How to proceed from here, in China
- B. What to look for, in competitive landscape, potential partners, etc.

**Charter subscribers (those who sign up for the study before April 21, 2017) will have the opportunity to work with TCGR to further refine the scope of the report by delineating areas of particular interest, including nominations for interview questions and company/institution coverage depicted in Section IV of the study's Preliminary ToC).*

V. QUALIFICATIONS

The Catalyst Group Resources (TCGR), a member of The Catalyst Group, works with clients to develop sustainable competitive advantage in technology-driven industries such as chemicals, refining, petrochemicals, polymers, specialty/fine chemicals, biotechnology, pharmaceuticals, and environmental protection. We provide concrete proven solutions based on our understanding of how technology impacts business.

Using our in-depth knowledge of molecular structures, process systems, and commercial applications, we offer a unique combination of business solutions and technology skills through a range of client-focused services. Often working as a member of our clients' planning teams, we combine our knowledge of cutting-edge technology with commercial expertise to:

- Define the business and commercial impacts of leading-edge technologies
- Develop technology strategies that support business objectives.
- Assess technology options through strategy development, including:
 - Independent appraisals and valuations of technology/potential
 - Acquisition consulting, planning and due diligence
- Provide leading-edge financial methodology for shareholder value creation
- Lead and/or manage client-sponsored R&D programs targeted through our opportunity identification process.
- Provide leading information and knowledge through:
 - World-class seminars, conferences and courses
 - Timely technical publications

The client-confidential assignments conducted by The Catalyst Group Consulting (TCGC) include projects in:

- Reinventing R&D pipelines
- Technology alliances
- Technology acquisition
- Market strategy

We have built our consulting practice on long-term client relationships, dedication, and integrity. Our philosophy is clear and focused:

We Provide the "Catalysts" for Business Growth by Linking Technology and Leading-Edge Business Practices to Market Opportunities

VI. DELIVERABLES AND PRICING

This report is timely and strategically important to those industry participants and observers both monitoring and investing in China, whether it is via production/supply, process licensing or EPC. TCGR’s report, based on technology evaluations, commercial/market assessments and interviews with key players goes beyond public domain information. As a result, subscribers are requested to complete and sign the “Order Form and Secrecy Agreement” on the following page.

The study, ***“Chemical/Petrochemical Production and Feedstock Conversion in China: An Independent Assessment of Markets, Participants and Expectations, 2017-2025,”*** is expected to be available in August/September 2017.

<u>Participation</u>	<u>Deadline</u>	<u>Price</u>
<u>“Charter” Subscribers*</u> <i>“Chemical/Petrochemical Production and Feedstock Conversion in China: An Independent Assessment of Markets, Participants and Expectations, 2017-2025.”</i>	<u>before April 21, 2017</u>	\$17,500
<u>Post-launch Subscribers</u> <i>“Chemical/Petrochemical Production and Feedstock Conversion in China: An Independent Assessment of Markets, Participants and Expectations, 2017-2025.”</i>	<u>after April 21, 2017</u>	\$20,500
Report in PDF format, in addition to subscription price		\$1,000

**Charter subscribers (those who sign up for the study before April 21, 2017) will have the opportunity to work with TCGR to refine the scope of the report by delineating areas of particular interest for inclusion in the assessment, including nominations for interview questions and company/institution coverage represented in Section IV of the study’s Preliminary Table of Contents.*

* * * * *

ORDER FORM AND SECRECY AGREEMENT

The Catalyst Group Resources, Inc. Tel: +1.215.628.4447
Gwynedd Office Park Fax: +1.215.628.2267
P.O. Box 680 e-mail: tcgr@catalystgrp.com
Spring House, PA 19477 - USA - website: www.catalystgrp.com

Please enter our order for ***“Chemical/Petrochemical Production and Feedstock Conversion in China: An Independent Assessment of Markets, Participants and Expectations, 2017-2025,”*** to be completed in August/September 2017, as follows:

_____ ***“Chemical/Petrochemical Production and Feedstock Conversion in China: An Independent Assessment of Markets, Participants and Expectations, 2017-2025,”*** as a “charter” subscriber (i.e., prior to April 21, 2017) for \$17,500 (\$20,500 after study launch)

_____ Please enter our order for the study to be delivered in PDF (Adobe Acrobat) format for use across our sites/locations (i.e., site license) for an additional \$1,000.

_____ Please send us _____ additional printed copies @ \$250 each.

In signing this order form, our company agrees to hold this report confidential and not make it available to subsidiaries unless a controlling interest (>50%) exists.

Signature: _____ Date: _____

Name: _____ Title: _____

Company: _____

Billing Address: _____

Shipping Address (no P.O. Boxes): _____

Express delivery services will not deliver to P.O. Boxes

City: _____ State/Country: _____

Zip/Postal Code: _____ Phone: _____

E-mail: _____ Fax: _____

This report and our study findings are sold for the exclusive use of the client companies and their employees only. No other use, duplication, or publication of this report or any part contained herein is permitted without the expressed written consent of The Catalyst Group Resources.