

Polyolefin Catalysts and Process Licensing: Competitive Implications of Industry Consolidation

Select-Client Study Proposal

January 2018



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I. INTRODUCTION

Consolidation in the polyolefin catalyst and process licensing industries has increased in both pace and size over the past several years and the impacts have become material to the competitive landscape. Also important has been the nature of the restructurings as a result of these multiple deals/changes that will have a broader impact over the years to come on catalyst product lines, resin grades and margins given the various industry issues moving forward, e.g., US PE capacity increases, China supply/demand growth, etc. The most recent event – Grace’s proposed acquisition of Albemarle’s polymerization catalysts/components business (for a reported \$416 MIL) – raises the question as to how much farther this can go and what the industry will look like if/as it continues.

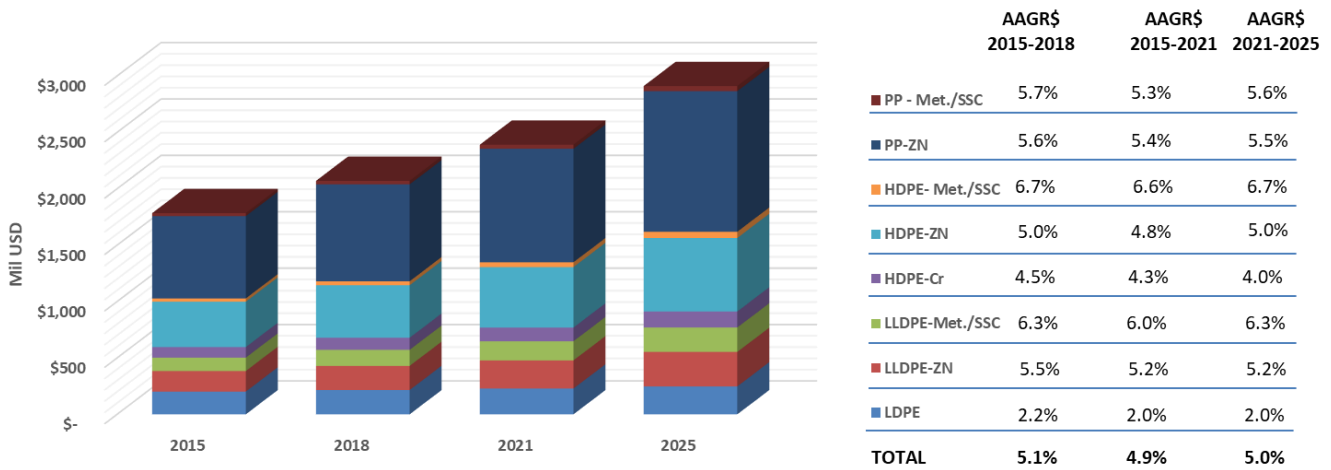
Whereas asset exchanges have, in the past, been as a result of strategic redirection or financial restructuring, the current situation reflects one wherein the results have yielded fewer competitors offering resin producers the required slate of options in order meet the evolving application and catalyst demands. As a result, two critical questions have arisen:

- At what point does the number and size of competitors reach its minimum, beyond which legitimate competition is affected and can no longer be meaningfully achieved? and;
- Is there now, or will there soon be, the need for additional suppliers, independent of ownership and/or affiliation, in order for 3rd party resin producers and/or those coming off license to obtain the materials (i.e., catalysts, supports, co-catalysts/activators, etc.) and/or process license in order to produce the resins demanded by end user applications?

In both cases, barriers to entry are known to be high; thus, these consolidations are significant.

In this “select-client” assessment, **TCGR proposes to document the recent changes in ownership - of production/supply capabilities and assets, process technology licensing, and intellectual property development (for future market needs) – in order to depict the current state of the competitive landscape and its strategic implications. The resultant study will allow current participants, as well as the industries/customers served by them, to make an independent judgement on the options going forward and what is needed in order to maintain long-term viability in these increasingly competitive times.** This will be a fast-paced/quick turn-around PowerPoint (PPT) study which captures product line/catalyst focused options (or not) to be delivered in March 2018, given the current high level of industry interest.

Figure 1. Polyolefin Catalysts – Market Size & Growth, 2015-2025



Growth drivers:

TCGR Intelligence Report 2016

- Improvements in “advanced” Z/N catalysts (e.g. 4th/5th generation) continue to fend off metallocene/SSC encroachment (more so in PP than PE)
- Metallocene/SSC for LLDPE as well as plastomeric and elastomeric LLDPEs highlight catalyst advances
- High pressure LDPE (autoclave, tubular) continues to grow, albeit slowly due to enhanced processing LLDPEs

Source: TCGR’s *“Polyolefin Catalysts and Processes: Technological and Commercial Impacts on PE and PP, 2015-2025”* select-client study (May 2017)

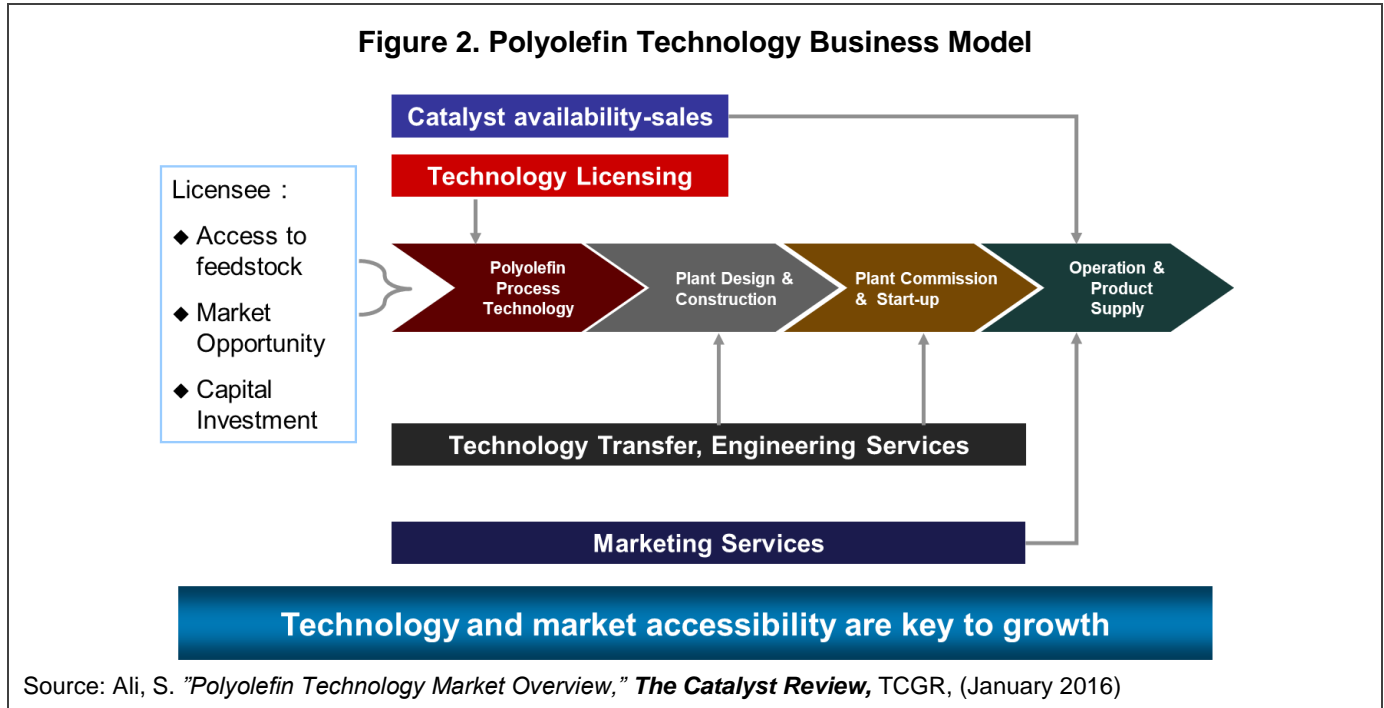
II. OBJECTIVE

In order to evaluate the impacts of industry consolidation and strategic re-direction in polyolefin catalysts and process licensing, TCGR will document the numerous recent acquisitions/divestitures (M&A) in businesses, as well as process licensing additions and/or discontinuations (including ownership changes). This will include the following:

- profiles of the deals, including products transferred, capacities, size and types of businesses down to product line implications; and
- SWOTs, with three (3) PPTs per profile and an envisioned eight (8) deals - going back in time to include Grace’s acquisition of Dow’s Unipol PP catalyst and licensing business to the present pending acquisition of the Albemarle catalyst business by Grace, the Akzo Nobel specialty chemicals business divestiture, and the SABIC acquisition of 24.99% of Clariant (in which the former Sud-Chemie catalyst business resides).

Analyses will be included on consolidation impacts by polyolefin type (i.e., polyethylene – PE and polypropylene – PP) product/catalyst types, e.g. C4 LLDPE, C6-LLDPE; via Ziegler-Natta or metallocene (with MAO or borate initiators), etc. as well as process technology licensing changes e.g., discontinuation of Innovene-S, and all licensing, by Ineos, etc.

TCGR's assessment will allow industry participants – from catalyst development and supply to resin production (including process licensing) – to make an independent judgement on the options going forward and what is needed in order to maintain long-term viability in these increasingly competitive times.



III. SCOPE

The scope will encompass the entirety of the polyolefin catalyst and process licensing value chains affected by the recent consolidation events, on a global basis, to include the following parts of the value chain:

- catalyst components (e.g., ligands, supports), co-catalysts/activators (e.g., metal alkyls, organometallics, MAO, organoborates, etc.)
- process licensing (technologies for license, in-house/exclusive processes) including relationships with partners/preferred contractors
- Polyethylene (PE) and Polypropylene (PP) production, including homo- and co-polymers (e.g., HDPEs, C4 LLDPEs, C6 LLDPEs, etc.) across density ranges and enduse applications

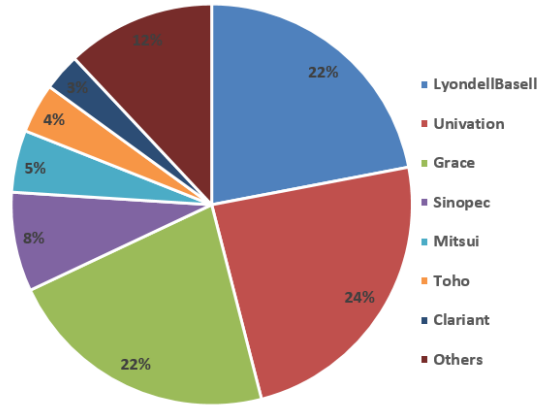
Attention will be paid to factors affecting access, costs, intellectual property/rights development and overall competition.

Figure 3. Current Environment – Catalyst Trends

Resin manufacturers naturally interested in producing highest margin resins

- **Polyethylene**
 - LLDPE
 - Expect the single-site/ metallocene catalysts area to expand as technology moves off license
 - HDPE
 - Movement away from Cr based Phillips catalyst due to regulatory concerns
 - Tailored Ziegler Natta solutions becoming more popular
 - Bimodal SSC for PE in single reactor scheme (Univation, CP Chem)
- **Polypropylene**
 - Phthalate free donors (REACH)
 - Movement towards post-reactor processing

PE/PP Catalyst 2015 - Global Market Share



Source: TCGR's **"Polyolefin Catalysts and Processes: Technological and Commercial Impacts on PE and PP, 2015-2025"** select-client study (May 2017)

Included in the scope are the recent events affecting ownership and offerings such as:

Catalysts and materials:

- Grace's acquisition of Dow's Unipol PP catalyst (and licensing) business
- Lanxess's acquisition of Chemtura
- Grace's acquisition of BASF's polyolefin catalyst business
- Akzo Nobel's proposed divestiture of its specialty chemicals business, including metal alkyls, organometallics, etc.
- Grace's proposed/pending acquisition of Albemarle's polyolefin catalyst business
- SABIC's acquisition of 24.99% of Clariant (in which the Sud-Chemie business resides)
- Sinopec's interest in expanding catalyst and component sales (via Shanghai Leader, etc.) beyond China

Process technologies:

- Grace's acquisition of Dow's Unipol PP licensing (and catalyst) business
- Dow's acquisition of the 50% of Univation previously owned by ExxonMobil
- Ineos's discontinuation of licensing (e.g., Innovene-S, etc.)
- ExxonMobil's consideration/potential of expanding licensing and 3rd party sales
- SABIC's intentions in licensing and 3rd party sales

The above events give rise to the following questions:

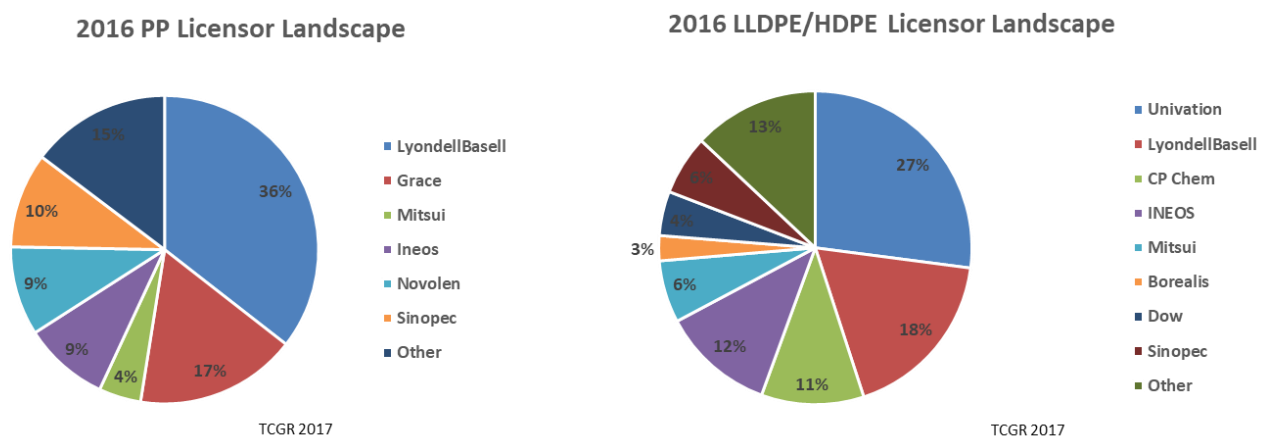
- What are Ineos' intentions in process licensing (beyond Ineos-S)? With its investment in PQ, will it transfer this or sell it outright?

- What does ExxonMobil plan to do in polyolefin catalysts and licensing, beyond its internal needs?
- What options for catalyst supply do independent/3rd party resin producers have beyond process licensors (e.g., LyondellBasell, Univation, etc.) and the “major” catalyst suppliers (e.g., Grace)?
- What are Japan’s interests/plans – e.g., Japan Polychem, Mitsui, etc. in sub-licensing catalyst/toll manufacture and process licensing?

The metrics to be included in order to quantify the competitive intensification and comment on the implications are:

- Catalyst production capacity – competitive density (and alternative suppliers), by product line/type, e.g., C4 LLDPE, C6 LLDPE, HDPE, PP, etc.
- Relationships between catalyst supplies and licensed process technologies, i.e., who is tolling for whom?
- The role of 3rd party capabilities – current and future
- The start-ups or alternative companies that might be in a position for market entry and/or capability to produce commercial volumes, e.g., SACHEM, Strem, Boulder Scientific, Designed Chemistry, etc.

Figure 4. PE & PP Licensor Market Share 2016



- **2016 Announcement by Ineos that they will no longer be licensing Innovene S double loop slurry technology**
 - Strategic response to reduce competition for Ineos Olefins & Polymers business
- **Sinopec licensing major wins in China and Asia Pacific**
 - Erosion primarily into Grace Unipol and Univation’s market shares
- **Industry trend toward JV relationships between feedstock provider, technology licensor, and resin producer**
 - Reduces technology options for independent resin producers
- **Univation acquisition by Dow**
 - Exxon a possible “free agent”
 - Significant player if they choose to show interest in licensing or 3rd party catalyst

Source: TCGR’s *“Polyolefin Catalysts and Processes: Technological and Commercial Impacts on PE and PP, 2015-2025”* select-client study (May 2017)

IV. METHODOLOGY

TCGR will deliver this report in its “select-client” study format – PowerPoint (PPT) slides - in order to effectively and efficiently capture the most important business, market, competitive and strategic developments for use by decision-makers. It will be a fast-paced project with delivery over 4-5 weeks and 50 +/- slides with the focus on detail.

TCGR will leverage its recently completed “select-client” study entitled ***“Polyolefin Catalysts and Processes: Technological and Commercial Impacts on PE and PP, 2015-2025”*** (May 2017) in which the progress in technology and product/resin developments were captured. This will allow TCGR to **develop and deliver these results in a quick turn-around (4-5 week) timeframe so that it is available for immediate internal use and implementation.**

Beyond the resources used therein, TCGR will utilize additional polyolefin experts that have >30 years’ industry experience (a mixture of commercial & technical) in completing this study. TCGR also utilizes publicly available and in-house information to complete the deliverables as well as patent searches, technical literature reviews, and in-field interviews with catalyst manufacturers and process licensors.

V. TCGR’S UNIQUE EXPERTISE!

In addition to its in-house expertise, TCGR will utilize a combination of Dialog Group® experts to assist with completing this report. These industry experts have deep experience in the PE and PP industries, from both commercial and technical perspectives, with expertise in catalyst development and production as well as process technology licensing and resin production. Presented below are examples of contributors who TCGR intends to utilize, among others, for this report:

Dialog Group® Expert 1:

This expert recently retired from a large chemical company as Global Director of New Business Development. In this role, his main responsibilities were to identify and manage the new business development portfolio for their Performance plastics division, as well as identifying key partners for new platforms & technologies. Prior to this role, he held the position of R&D Director. Within this role he defined the key technology strategy for new market participation in consumer goods, building and construction and others. A main responsibility was to partner with other business directors to ensure alignment of R&D direction to business strategies.

Dialog Group® Expert 2:

This expert has a PhD in Chemical Engineering and Physics of Polymers, as well as a Masters in Chemical Engineering. This consultant’s career spans 40 years and he has held previous positions as R&D VP at a major Oil Company and R&D Director at an innovative chemical company. The expert’s experience in polyolefins includes: 15 years’ experience as a technology manager. His role included product development, catalyst development, technical service and plant assistance. Numerous products were developed more specifically for plastic modification, adhesive, roofing, mechanical rubber compound. Also responsible for process technology enhancements; and led R&D efforts focusing on metallocene catalysts.

VI. DELIVERABLES AND PRICING

The report will be delivered in PowerPoint format and consist of 45-55 slides structured according to the proposed/preliminary outline (see page 8). Contents will consist of the following: (1) profiles of the deals, including products transferred, capacities, size and types of businesses; (2) SWOTs, with three (3) PPTs per profile and an envisioned eight (8) deals.

This report is timely and strategically important to those industry participants and observers both monitoring and investing in polyolefin (PE and PP) catalysts and process technologies. TCGR's report, based on industry statistics, competitor profiles, technology evaluations, and interviews with key players will go beyond public domain information. As a result, subscribers are requested to complete and sign the "Order Form and Secrecy Agreement" on page 9.

The study, "**Polyolefin Catalysts and Processes: Competitive Implications of Industry Consolidation**" is expected to be available within 4-5 weeks of study initiation (or by March 31, 2018).

<u>Participation</u>	<u>Deadline</u>	<u>Price</u>
"Charter" subscribers*	before February 9, 2018	\$15,500
Post-launch subscribers	after "launch"	\$18,000

** Charter subscribers (those who sign up for the study before February 9, 2018) will have the opportunity to work with TCGR to further refine the scope of the report by nominating specific industry events/transactions as well as delineating areas of particular interest for inclusion in the assessment.*

* * * * *

Notice to Subscribers of TCGR's Past Select-Client Study in this Area:

*Due to the complementary nature of this study to TCGR's select-client report entitled "**Polyolefin (PO) Catalysts & Processes: Technological and Commercial Impacts on PE and PP, 2015-2025**" (completed May 2017), TCGR is offering a discount of \$1,000 off the subscription price to subscribers of that study. When completing the order form, please make sure to indicate your company's subscription to that earlier report. Subscribers are requested to contact John J. Murphy at +1.215.628.4447 or John.J.Murphy@catalystgrp.com if you are unsure of your company's past subscriptions from TCGR.*

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and Leading-Edge Business Practices to Market Opportunities**

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Proposed/Preliminary Table of Contents*

- does not include feedback from “charter” subscribers (i.e., those who sign-up by Feb. 9, 2018) -

- I. Background/Introduction**
 - A. Background and Study Need
 - B. Scope and Methodology
 - C. Contributors

- II. Executive Summary**

- III. Polyolefin Industry Consolidation: Catalysts**

(to include merger/acquisition description, with: (1) profiles of the deals, including products transferred, capacities, size and types of businesses; (2) SWOTs, with three (3) PPTs per profile and an envisioned 4-5 deals; analyses of consolidation impacts by PO (PE and PP) product/catalyst types, e.g. C4-LLDPE; C6-LLDPE; via MCN and MAO or borate initiators, etc.)

 - A. Grace’s Acquisition of Dow’s Unipol PP Catalysts (and Licensing)
 - B. Lanxess’s Acquisition of Chemtura
 - C. Grace’s BASF Polyolefins Catalysts
 - D. Akzo Nobel’s Proposed Divestiture of Specialty Chemicals (organometallics, etc.)
 - E. Grace’s Proposed Acquisition of Albemarle’s Polymer Catalysts
 - F. SABIC’s Acquisition of 24.99% of Clariant (Sud-Chemie)
 - G. Other* – to be determined by “charter” subscribers

- IV. Polyolefin Industry Consolidation: Process Licensing**

(to include merger/acquisition description, with: (1) profiles of the deals, including products transferred, capacities, size and types of businesses; (2) SWOTs, with three (3) PPTs per profile and an envisioned 3-4 deals; analyses of consolidation impacts by PO (PE and PP) license, e.g., gas phase, slurry, etc.)

 - A. Grace’s Acquisition of Dow’s Unipol PP Licensing (and Catalysts)
 - B. Dow’s Acquisition of ExxonMobil’s 50% Stake in Univation
 - C. Ineos’s Discontinuation of Licensing (Innovene-S, etc.)
 - D. ExxonMobil’s Consideration in Licensing (and Catalysts)
 - E. Other* – to be determined by “charter” subscribers

- V. Strategic Assessment and Competitive Implications**

(to include analyses of competitive density, alternative supply options, implications on catalyst sourcing, licensing developments, implications, etc.)

 - A. Impacts on Competitive Density (# of Participants) in Each Segment and Access/Supply
 - B. Implications on Licensing Options
 - C. Assessment of Relationships with Suppliers, EPCs, etc.

- VI. Conclusions and Recommendations**

**Charter subscribers (those who sign up for the study before February 9, 2018) will have the opportunity to work with TCGR to further refine the scope of the report by nominating specific industry events/transactions as well as delineating areas of particular interest for inclusion in the assessment.*

ORDER FORM AND SECRECY AGREEMENT

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Please enter our order for **“Polyolefin Catalysts and Processes: Competitive Implications of Industry Consolidation”** to be completed within 4-5 weeks of launch (i.e., by March 31, 2018) as follows:

_____ **“Polyolefin Catalysts and Processes: Competitive Implications of Industry Consolidation,”** as a “charter” subscriber (i.e., prior to February 9, 2018) for \$15,500 (\$18,000 after study launch); to be delivered in PowerPoint (PPT) format, which includes use across locations (i.e. site license).

_____ * * We are subscribers to TCGR’s earlier select-client study entitled **“Polyolefin (PO) Catalysts & Processes: Technological and Commercial Impacts on PE and PP, 2015-2025”** (May 2017) and are therefore entitled to the \$1,000 discount off the subscription rate. * *

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.

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