Proposal: Select Client Study

Commercial and Technical Advances in Octane Enhancement: Addressing the Octane Deficit

December 2018
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**Commercial and Technical Advances in Octane Enhancement: Addressing the Octane Deficit**

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**Background**

- TCGR will review the market data for octane barrels (size, value) from a range of sources, including IEA, EIA, OPEC and others to compare the global demand and supply of each octane unit and develop a proprietary EXCEL model to analyze the trends for future octane units, 2019-2024; including blending needs.

- We will examine the unique regional challenges to meet the octane needs, addressing each region’s market issues via our model, including NA, EUR, A-P, M-E and China.

- We will assess the assumptions that: 1) new refinery capacities will be mostly in the Asia-Pacific region through 2022; and 2) new octane units will be mostly in catalytic reforming.

- We will show how new refineries in each region will be affected and help refiners make impactful decisions on the best alternatives for future expansions and grassroots refineries.

- North America is the current leader in global demand for octane enhancements, but as the population increases, particularly in Asia-Pacific, the octane demand will continue to expand globally.

- There is a market imbalance of octane barrel supplies needed to meet the growing demand. TCGR will examine each type of octane unit and, with our proprietary model and assumptions, then make our recommendations.
The Need for the Study

- From 2017-2022 there is a need for 2 million octane barrels per day to meet the increased demand and new emissions standards. How will refineries and new refineries respond?
- In our 2017 technical report delivered to members of TCGR’s Catalytic Advances Program (CAP) entitled “Advances in Octane Enhancement,” we examined the technological approaches to addressing the octane deficit. In this proposed select-client study, we will go one step further to document the market size and commercial opportunities.
- There is a need to provide a forecast of octane barrels derived from multiple sources. TCGR will develop a consolidated assessment and then analyze global and regional market impacts to predict which units/approaches are a best fit for their region.
- Included in our assessment of octane barrels via both traditional/known and developmental refinery routes technologies, we will examine market impacts of:
  1. MTBE/ETBE and alcohols (EtOH, BuOH) in each region
  2. Benzene reduction effects on octane cost performance
  3. The impacts of EHVVs on octane
  4. The bio-revolution including demands from bio-chemicals (vs. biofuels)
Octane Forecast

• The report will provide a comprehensive short-term forecast of octane production and demand from 2019-2024:
  – Broken down by region for both production and consumption, highlighting North America, Europe, and China
  – Broken down by process, including catalytic reforming, alkylation, isomerization, and alcohol/ether production (with implications from other bio-derived fuels)

• The forecast will provide a concise view of the market with a clear delineation of the assumptions used to develop the forecast:
  – Demand by region based on forecasted gasoline consumption (including higher compression engines) and EV adoption
  – Raw material availability, including blending needs
  – Announced and anticipated octane unit developments (commercial, technical) over the forecast period

• This forecast will be compared against the many existing short-term forecasts from other sources (OPEC, IEA, EIA, etc.), with a discussion of the assumptions used to create TCGR’s projections. We will note why TCGR sees as different and why.
**Forecast Components**

- Historic octane production and demand by region and by type
- Key market drivers supporting octane production as well as factors limiting further product expansion
- Forecasted oil consumption by region and type
- Forecasted oil prices and analysis of potential crack spread
- Forecasted gasoline consumption in key countries and regions
- The use of ethanol as an octane enhancer in North America, Brazil, and Europe, and its growing use in Asia (e.g. China and Indonesia)
- The unique use of methanol as a gasoline additive for octane enhancement in China
- Tightening benzene limits in North America and Europe (and elsewhere)
- MTBE restrictions in North America and increased production in Asia
Potential Octane Market: Drivers and Headwinds

- **Drivers**
  - Current and upcoming regulations that increase octane requirements and the use of specific gasoline octane enhancers in different countries and regions
    - Gasoline specifications
    - Fuel efficiency standards
  - Renewable fuel standards (RFS) and RFS limitations to boost ethanol and other bio-derived fuel uses
  - Increasing premium gasoline price differential in the US
  - Expansion of premium car sales in China

- **Headwinds**
  - Declining gasoline use in Europe/North America
    - Advancing EV adoption
    - Changing paradigms of vehicle ownership
  - Benzene and MTBE regulation limits
  - The “ethanol wall” for blending
  - Limited octane production expansion in the US and Europe

- **Sources of Information**
  - Government organizations (US EIA, IEA, OPEC, etc.); price services (Platts, Argus, IHS Markit, etc.); key refiners (BP, Marathon, Shell, ExxonMobil, Saudi Aramco, etc.); journals and publications
**Project Scope & Methodology**

**SCOPE:**
- TCGR will develop an analysis of the octane barrels needed for each region, globally, documenting the size and value of the “octane deficit” and how the deficit can/will be addressed, by octane refinery process and forecasted by the major regions of the world (including blending needs). This is a commercial analysis comparing the existing processes and the impacts of the technical advances including traditional refining approaches as well as bio-derived sources.
- We will include the following commercial refining octane processes for analysis: 1) Catalytic reforming; 2) Isomerization; 3) Alkylation; and 4) Oxygenates, e.g., Bio fuels, Ethers and Alcohols.
- TCGR will provide forecasts of octane barrels for each process and, based on our analysis, make recommendations for future plant expansions and new refineries.

**METHODOLOGY:**
- We will document and assess the claimed advantages of each commercial and developmental process and share recent notices of refinery configurations and the rationale of the selector for choosing it.
- We will interview key stakeholders and share their perspective for the future of octane enhancements.

The proprietary EXCEL model will be available for license, as a subscription deliverable, so that subscribers can run their own “scenarios” based on internal inputs/assumptions.
Proposed Study Outline

I. Background

II. Executive Summary

III. The Octane Deficit and Production Enhancements (via proprietary EXCEL model)
   A. Market Size by Region (2010-2018; NA, EUR, A-P, M-E, China)
   B. Market Forecast by Region and Source (2019-2024; NA, EUR, A-P, M-E, China)
   C. Octane Blending Needs in Each Region

IV. Octane Enhancement Process Advancements and Trends
   A. Refining (e.g., reforming, isomerization, alkylation, etc.)
   B. Oxygenate (e.g., EtOH, MTBE/ETBE, etc.)
   C. Bio-/other

V. Commercial Implementations: How the Industry is Responding

VI. Analysis for Future Refining Needs to Address the Octane Deficit
TCGR Experience and Qualifications

- TCGR will leverage its access to refining and fuels/bio-fuels experts that have >35 years’ industry experience via its Dialog Group® (a mixture of commercial and technical) in completing this study.

- TCGR will utilize publicly available and in-house information to complete the deliverables as well as patent searches, technical literature reviews, in-field interviews and its proprietary model.

- TCGR Dialog Group® experts have deep experience in the required technology from a process technology, catalyst technology and market size/growth application perspective.

The Catalyst Group Resources has covered related technical process advancements in similar reports; those can be seen here on our website. Other advancements are also tracked as part of our Catalytic Advances Program and CO₂ Capture and Conversion Program.

The Dialog Group® is a renowned group of industry-leading experts that provide key intelligence and analysis of the fuels and chemicals industries.
Order Form & Secrecy Agreement

The Catalyst Group Resources, Inc.  
Tel: +1.215.628.4447  •  Fax:+1.215.628.2267  
e-mail: tcgr@catalystgrp.com  •  website: www.catalystgrp.com

Please enter our order for **Commercial and Technical Advances in Octane Enhancement: Addressing the Octane Deficit** to be completed in March/April 2019, as follows:

- ________ Commercial and Technical Advances in Octane Enhancement: Addressing the Octane Deficit, as a “charter” subscriber (i.e., prior to January 25, 2019) for US$17,500 (US$19,500 after study launch) to be delivered as a PDF file containing PowerPoint slides, which includes use across locations (i.e. site license).

- ________ We are interested in the proprietary EXCEL model, available for license, for an additional US$3,000.

- ________ We are members of TCGR’s **Catalytic Advances Program (CAP)** and received the 2017 technical report entitled “**Advances in Octane Enhancement**” and are therefore entitled to the $1,000 discount off the subscription price.

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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Additional Information and TCGR Contact Details…

The Catalyst Group Consulting (TCG)
For more information, contact:

Clyde F. Payn
Chief Executive Officer, TCG
CPayn@catalystgrp.com
+1.215.628.4447

The Catalyst Group Resources (TCGR)
For more information, contact:

John J. Murphy
President, TCGR
John.J.Murphy@catalystgrp.com
+1.215.628.4447

P.O. Box 680
Spring House, PA 19477  U.S.A
ph: +1.215.628.4447
fax: +1.215.628.2267
www.catalystgrp.com