ExxonMobil Catalysts and Technology Licensing
Creating a particle of difference
We’re committed to delivering industry-leading, innovative process technologies, specialty catalysts and expertise that exceeds customer expectations and provides differentiated value. Our main goal is to help customers increase production capacity, decrease operating costs and lower emissions, so they can achieve greater operational success. Most importantly, we collaborate with our customers as long-term partners — taking on challenges, finding solutions together and providing guidance on best practices that help achieve customer goals.

Building on more than 125 years of experience, ExxonMobil operates in three core businesses:

**Chemical**
Our decades of expertise in chemical production allow us to offer innovation and expertise to the chemical industry. Our high-quality catalysts and process technologies offer methods to upgrade low-value chemicals into high-value products in innovative and cost-effective ways. They can be used to manufacture chemicals and polymers used in creating polyethylene, nylon, styrene and other high-performance materials.

**Gas**
ExxonMobil Catalysts and Technology Licensing also bring our experience in innovation to offer cost-effective, low-risk solutions for H₂S cleanup and syngas production. Gas-treating technology can enable customers to meet stringent emissions standards. Our technologies can also assist in the production of high-quality synthetic fuels from methanol derived from natural gas.

**Refining**
Our high-performance catalysts and advanced process technologies can bring big benefits to refining companies. We can offer industry-leading advantages in fuel production, resid conversion and lubes production. Our technologies can offer higher product yields, convert low-value products to higher-value end products and enable the production of high-quality base stocks for engine oil production. They can also help to meet regulatory requirements for sulfur and benzene removal.
As a technology innovator and manufacturer with close relationships to its customers, ExxonMobil has developed fundamental insights that optimize and improve customers’ operations through technology development.

ExxonMobil catalysts are used in over 150 commercial facilities worldwide.

Solving shared challenges through our experience
ExxonMobil is committed to its customers’ operational success, focusing on increasing the value generated by our customers’ processes and plants. Used in over 150 commercial facilities around the world, ExxonMobil catalysts and technologies offer a number of potential advantages, over a range of technology categories.

Toluene alkylation with methanol (EMTAM℠ process technology)
ExxonMobil’s EMTAM process uses inexpensive methanol to upgrade toluene to paraxylene. It’s a breakthrough technology that maximizes production of valuable paraxylene product while lowering feed and energy costs. The highly paraxylene-selective process is built from commercially proven technologies. Unlike other toluene conversion processes, there is no benzene co-product and no hydrogen co-feed. It is the only process that can tune the methyl-to-ring ratio based on market conditions and allows unlimited benzene co-feeding to produce paraxylene.

Heavy aromatics transalkylation (TransPlus® 5 process technology)
ExxonMobil’s TransPlus 5 process is the low-cost, high-conversion solution to upgrade C9+ heavy aromatics and toluene into higher-value mixed xylenes and high-purity benzene products. The TransPlus 5 process — which is based on

Selective toluene disproportionation (PxMax℠ process technology)
ExxonMobil’s PxMax process technology is the industry benchmark for selective toluene disproportionation. Based on an ex-situ selectivated catalyst, the PxMax process offers unmatched paraxylene selectivity and product yields (superior xylenes-to-benzene ratio), which improve over an exceptionally long and stable catalyst cycle.

Xylene isomerization (XyMax℠ –2 process technology, LPI process technology)
ExxonMobil’s XyMax-2, and LPI processes isomerize para-depleted xylenes effluents from the paraxylene recovery section into equilibrium mixed xylenes, thereby upgrading lower-value isomers to

Shaping the future
higher-value paraxylene product. The XyMax℠-2 process provides unmatched performance, stable yields and catalyst cycles. The ultra-low xylenes losses, high ethylbenzene conversion, higher benzene purity and high WHSV allow customers to reduce capital costs, inexpensively debottleneck existing facilities and reliably increase profitability over the extremely long catalyst cycle.

The LPI process also isomerizes para-depleted xylenes effluents from the paraxylene recovery section into equilibrium mixed xylenes, but the reactions take place in the liquid phase — offering a number of unique benefits, including significant energy savings, low temperature operation and ultra-low xylenes losses. These unique benefits allow customers to reduce capital costs, inexpensively debottleneck existing facilities and reliably increase profitability over the long catalyst cycle.

**Aromatics treatment (Olgone℠ process technology)**

ExxonMobil Olgone process technology is designed to extend cycles of existing aromatic streams treaters to reduce or eliminate the amount of solid waste generated from an aromatics complex. At the heart of this high-performance technology is a highly stable and reusable catalyst. The outstanding performance of the Olgone process can lead to significant operating-cost savings, better protection of downstream units, fewer treater changeouts, as well as debottlenecking opportunities.

**Ethylbenzene alkylation (EBMax℠ process technology)**

The EBMax process was designed by Badger Licensing LLC to upgrade ethylene and benzene to ethylbenzene for use in the styrenics (polystyrene) value chain. It has been commercially deployed over 35 times and represents ~45% of all the ethylbenzene manufactured today. The process is built upon ExxonMobil’s proprietary zeolite catalyst that drives a very high selectivity to ethylbenzene and enables a low-capital, highly energy-efficient design that is applicable to grassroots, expansion and retrofit opportunities. The EBMax process produces ethylbenzene with exceptional product purity for the manufacture of styrene.

**Cumene alkylation (Cumene process technology)**

The Badger cumene process was designed by Badger Licensing LLC to upgrade propylene and benzene to cumene for use in the phenolics/bisphenol-A value chain. It has been commercially deployed over 29 times and represents ~55% of all the cumene manufactured today. The process is built upon ExxonMobil’s proprietary zeolite catalyst that drives a very high selectivity to cumene and enables a low-capital, highly energy-efficient design that is applicable to grassroots, expansion and retrofit opportunities. The Badger cumene process produces cumene with exception product purity for the manufacture of phenol, acetone and subsequently bisphenol-A.

**Gas treating (FLEXSORB™ technology)**

ExxonMobil’s FLEXSORB technology enables customers to process increasingly sour gas streams while helping to meet stringent emission regulations and sulfur recovery objectives. The highly selective H₂S removal process has also been used in tail gas treating (TGT), acid gas enrichment (AGE) and high-pressure acid gas removal (AGR) units. The technology provides a cost-effective way to meet low H₂S specifications while minimizing CO₂ co-absorption.

**Synthetic fuels (Methanol to gasoline technology)**

ExxonMobil’s methanol-to-gasoline technology converts methanol to gasoline that minimizes offsite and logistic complexity. MTG creates a single, fungible liquid product with virtually no sulfur and low benzene, which can be sold as-is or blended with ethanol, methanol, conventional gasoline or gasoline components.

**Lube dewaxing (MSDW™ technology, MWI™ technology, MAXSAT™ technology)**

ExxonMobil’s MSDW, MWI and MAXSAT catalyst technologies are ideal solutions for producing base stocks for high-quality engine oils. These high-performance catalytic technologies offer premier lube catalytic dewaxing and hydrofinishing benefits capable of processing a very wide range of feedstocks — from hydrotreated VGOs and DAOs to hydrotreated raffinates and slack waxes.

**Diesel dewaxing (MIDW™ technology)**

ExxonMobil’s MIDW catalyst technology enables higher yields of low cloud-point diesel. Through isomerizing paraffins instead of cracking them, this diesel dewaxing technology may also enhance cetane and volume swell compared to other technologies that rely only on cracking.
**Mogas production (BenzOUT® technology)**

ExxonMobil’s BenzOUT technology is a commercially proven process technology for the reduction of benzene in gasoline. Developed by ExxonMobil and licensed by Badger Licensing LLC, BenzOUT can operate as a grassroots unit or can be retrofitted into existing equipment, such as polygas units. This unique process advantage helps refiners meet benzene regulations, while maximizing their return on investment.

**Hydroprocessing (SCANfining™ technology)**

ExxonMobil’s SCANfining technology is a cost-effective solution for meeting the low-sulfur requirements of gasoline. Jointly developed by ExxonMobil and Albemarle, this hydroprocessing technology removes sulfur, lowers hydrogen consumption and minimizes octane loss.

**Sulfuric acid alkylation**

ExxonMobil’s proven sulfuric acid alkylation technology helps refiners increase their crude barrel value. By reacting isobutene with propylene, butylene and pentylene, this process forms alkylate — a superior gasoline blendstock that offers high octane and low vapor pressure.

**Resid conversion (FLEXICOKING™ technology)**

ExxonMobil’s FLEXICOKING technology converts a range of heavy, low-value feeds to higher-value products in a competitive, cost-effective, flexible and environmentally friendly solution with virtually no coke. ExxonMobil’s operations experience, low-cost design and continuous innovation enable significant long-term economic value.

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* All EM technologies use a catalyst except for FLEXICOKING and FLEXSORB

Celestia is a second-generation bulk-metal catalyst. It has the highest activity of any catalyst in the hydroprocessing industry. Through unprecedented hydrodesulfurization, hydrodenitrogenation and aromatic saturation activity, Celestia℠ catalyst can provide step-out performance and operational flexibility.

The higher activity of the Celestia catalyst allows refiners to simultaneously benefit from opportunities such as increased feed rate, cycle length and improved product quality.

The Nebula and Celestia catalysts are often deployed together in stacked configurations, which can lead to significant performance improvement over other supported catalysts.
Technology leadership in catalyst discovery and commercialization

ExxonMobil has a long history of innovation in catalyst development and process technologies, and proven track record for converting its inventions into commercial reality. From its early pioneering work on fluid catalyst cracking units and zeolite technology through numerous advanced technologies, ExxonMobil continues to demonstrate its leadership in innovation and commercialization.

1958 Sulfuric Acid Alkylation
Process that primarily reacts butylene with isobutane to form high octane alkylate for gasoline blending.

1962 Zeolite catalytic cracking
Selectively cracking of gas oils greatly improves the octane value of gasoline.

1967 Zeolite beta discovery
The second zeolite catalyst in the ZSM series of catalysts with a three-dimensional structure of 12-ring pores.

1970 FCC Fluid Catalyst Cracking
Upgrades heavy gas oils to lighter oils substantially increasing production of gasoline and diesel from crude oil.

1973 Xylene isomerization
Advanced catalysts for converting C8-rich feedstocks to orthoxylene and paraxylene.

1975 Allyl aromatics synthesis
Nickel-containing zeolite catalysts enable production of alkylaromatic compounds.

1976 FLEXICOOKING®
Combines fluid cracking with air blown fluid bed coke gasification to produce high value liquids and clean burning fuel gas.

1979 Vapor phase ethylbenzene
ZSM-5 catalyst enables the alkylation of benzene to ethylbenzene, and allows the production of styrene and styrene derivatives.

1980 Methanol-to-gasoline
MCM-41 invention
An advanced molecular sieve with tunable mesopore diameters.

1983 FLEXSORB®
Gas treating technology utilizing proprietary hindered amine processes for selective removal of H2S in the presence of CO2.

1985 Methanol-to-gasoline
ZSM-5 catalyst material can play a key role in methanol-to-gasoline processes, which allow the use of natural gas from remote areas to be utilized to make liquid fuels.

1986 MCM-22 invention
Discovery of the zeolite MCM-22, with a 3-D structure featuring 12-ring surface pockets, enables highly shape-selective chemistry with minimal coking for aromatic processes.

1995 Liquid phase alkylation
Advanced catalysts for ethylbenzene and cumene production serve over 50 applications.

1997 Selective toluene disproportionation
Catalysts allow higher overall xylenes yields without the need for in-situ regeneration.

1998 Transalkylation to xylenes
Catalyst enables upgrading of C9 aromatics to xylenes and benzene.

1999 MIDW®
Hydroisomerization of light distillates to produce low temperature diesel.

2000 Olefins™
Advanced catalyst that accomplishes the selective removal of xilenes and dialkylbenzenes from aromatic streams.

2001 Nebula catalyst
Extremely high activity shape selective base metal catalyst representing a significant step forward since the beginning of hydrosprocessing catalyst development in the 1950’s.

2007 CCAF™
Advanced catalyst technology jointly developed with Albemarle.

2009 OligoSM™
Reduced octane loss and significantly improving benzene yields.

2011 Nebula OUT®
New catalyst offerings allow selective upgrading of benzene in gasoline blend components, thus reducing benzene in gasoline.

2015 Liquid Phase Isomerization (LPI)
Xylenes isomerization process that operates at low temperature with less xylene losses than vapor phase technology. Significant energy savings from low temperature operation and elimination of boiling and condensation operations.

CELESTA™
A breakthrough technology which maximizes production of valuable paraxylene product while lowering feed and energy costs.

EMTAM™
An ultra-high activity hydrotreating catalyst, developed in partnership with Albemarle, for increased flexibility and profitability, providing step-out performance, feed flexibility and reduced energy costs.

MSCW™
An ultra-high activity hydroisomerization catalyst, developed in partnership with Albemarle, which minimizes production of valuable paraxylene product while lowering feed and energy costs.

2011 CELESTA™
A breakthrough technology which maximizes production of valuable paraxylene product while lowering feed and energy costs.
Realizing the benefits of continuous innovation

ExxonMobil invests more than $1 billion annually into research and development. Innovation begins at ExxonMobil’s Corporate Strategic Research Center, where new catalysts and technologies are discovered and their development accelerated.

**Continuous innovation and investment**
ExxonMobil’s research and development efforts support a program of continuous improvement in performance and process optimization. Innovation begins at ExxonMobil’s Corporate Strategic Research Center, where new catalysts and processes are discovered, developed and tested. ExxonMobil was one of the first companies to pioneer the use of high throughput experimentation to accelerate catalyst development. The extensive experience built by ExxonMobil researchers over many years has resulted in an efficient and effective innovation process.

**Field-tested, insight-driven**
ExxonMobil occupies a unique position as both a developer of technology and a commercial user. Catalysts and technologies developed within ExxonMobil research laboratories are field-tested at the company’s refining and chemical production facilities. Insights gained inside ExxonMobil plants regarding use and performance enable further optimization of the products and processes. ExxonMobil can then bring these catalysts and technologies to their customers.

**Successful customer relationships**
ExxonMobil highly values relationships with customers. ExxonMobil routinely meets with customers throughout the process to identify opportunities to improve operation and to discuss future expansions and needs, including the latest catalyst products and technologies. Customers can benefit from the insights that have been developed from many years of global technical experiences, as customized to meet their specific needs. In addition, ExxonMobil and its technology licensing partners can provide combined technical and commercial solutions that assist in meeting customers’ production and efficiency goals, such as process modification, expansions and new production facilities.

**Worldwide logistics**
For many years, ExxonMobil has coordinated with its customers to reliably supply catalysts and process technologies all over the world. Using a responsive global supply chain, ExxonMobil continues to achieve operational excellence. Along with our technology licensing partners, we can provide engineering and logistics support at every step of the way.
Where common challenges meet shared solutions. Contact us to see how our experience can work for you.