



Propylene and Polypropylene:

Introduction, Applications, Value Chain, Review of Iran's Production Status and Global Market Analysis

Author: Mehdi Dizani
Senior Expert
Development of International Relations
National Petrochemical Industries Company
Tehran - Islamic Republic of Iran

1. Introduction

Propylene (C_3H_6), also referred to as propene, is an unsaturated hydrocarbon from the olefin (alkene) family and serves as one of the most essential feedstocks in the petrochemical industry. This compound is a colorless and flammable gas with a mild petroleum-like odor under standard temperature and pressure conditions.

Physically, propylene exists as a gas at ambient temperature, with a boiling point of approximately $-47.6^{\circ}C$ and a melting point of $-185.2^{\circ}C$. Its vapor density of 1.45 g/L is higher than that of air, causing it to settle in low-lying areas, which can pose risks related to inhalation and combustion. The material's flammability range (2.4–10.3% by volume in air) and low autoignition temperature ($455^{\circ}C$) require strict safety measures during handling, storage, and transport.

The properties of propylene make it indispensable for petrochemical manufacturing. However, the associated safety considerations emphasize the need for meticulous oversight and careful infrastructure to minimize risks and ensure operational reliability.



Polypropylene (C_3H_6)_n, commonly abbreviated as PP, is a thermoplastic polymer belonging to the polyolefin family. It is one of the most versatile and widely produced plastics in the world. This material is a rigid, semi-crystalline solid that typically appears white or translucent and is odorless under standard conditions.

Polypropylene is known for its excellent chemical resistance and durability. It has a melting point ranging from 160 to 170°C and a density between 0.855 and 0.946 g/cm³, making it notably lighter than many other polymers. Its low moisture absorption and resistance to fatigue contribute to its extensive range of applications.

While polypropylene is non-flammable at room temperature, it becomes combustible when exposed to high heat. It has a flammability range that enables sustained burning in air and an autoignition temperature of approximately 570°C. These thermal characteristics emphasize the need for precautions against degradation and the release of fumes during processing or combustion.

Thanks to these properties, polypropylene is invaluable across industries, finding use in packaging, automotive components, textiles, and consumer goods.

2. Production Methods

Propylene Production

Propylene is primarily produced through four main methods:

- **Cracking:** Heavy hydrocarbons, such as naphtha or ethane, are thermally decomposed at high temperatures (800–1200°C), producing propylene as a byproduct.
- **Fluid Catalytic Cracking (FCC):** In refineries, propylene is generated as a byproduct during the conversion of heavy hydrocarbons into gasoline, using zeolite-based catalysts.
- **Propane Dehydrogenation (PDH):** Propane is catalytically converted into propylene using platinum-based catalysts, offering high selectivity and efficiency.
- **Metathesis Process:** Butene and ethylene are rearranged into propylene via metal catalysts, providing a flexible approach to production.



Polypropylene Production

Polypropylene is predominantly produced through two key methods:

- **Ziegler-Natta Catalysis:** This is the most widely used industrial method, employing titanium chloride (TiCl_4) and organoaluminum co-catalysts to polymerize propylene in slurry or gas-phase reactors. It produces isotactic polypropylene with high crystallinity, exceptional strength, and suitability for applications such as rigid packaging, automotive components, and textiles.
- **Metallocene Catalysis:** A modern technique using single-site metallocene catalysts (e.g., zirconium-based) that allows precise control over polymer structure. This method enables tailored properties such as narrow molecular weight distribution, enhanced transparency, and improved impact resistance, making it ideal for specialty films, medical devices, and high-performance applications.

• **3. Propylene Derivatives and Industrial Applications**

- **Polypropylene (PP):** Widely utilized in packaging, textiles, automotive components, reusable containers, laboratory equipment, and medical devices due to its exceptional versatility, durability, and chemical resistance.
- **Acrylonitrile (AN):** Essential for the production of carbon fiber and ABS resin, offering high strength and rigidity for advanced applications.
- **Propylene Oxide (PO):** A critical precursor for polyurethanes and propylene glycol, commonly used in antifreeze solutions and flexible foam production.
- **Cumene:** Serves as feedstock for producing phenol and acetone, which are integral to manufacturing epoxy resins, PMMA, and polycarbonate resins.
- **Oxo-Alcohols:** Utilized in the production of plasticizers that enhance the flexibility and durability of plastics.
- **Methionine:** An essential amino acid used as a supplement in organic poultry feed to promote growth and health.

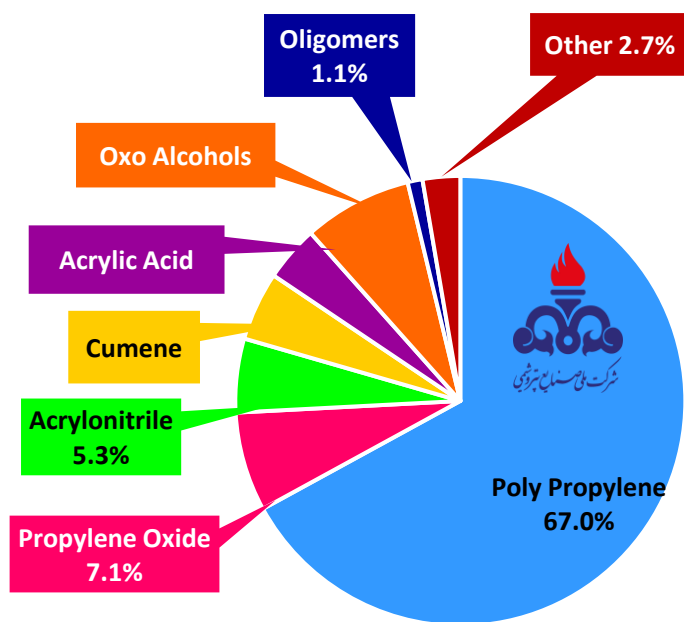


National Iranian Petrochemical Company
International Affairs



- **Superabsorbent Polymers (SAP):** Materials capable of absorbing significant amounts of water relative to their mass, primarily used in sanitary products like diapers and hygiene items.
- **Acrylate Esters:** Widely applied in paints, coatings, adhesives, textiles, and plastics due to their excellent durability, flexibility, and adhesive properties.

propylene Applications in 2020





4. Global Market Analysis and Industry Economics

4.1. Status of Global Propylene Capacity and Production

In 2020, the global nominal production capacity for propylene reached approximately 140 million metric tons, with over 110 million metric tons produced. This represents a 78% utilization rate of production facilities, underscoring high demand, profitability, and the vitality of the market. However, only about 4% of the total production is traded internationally, primarily due to logistical challenges associated with transporting propylene. This indicates that most propylene is consumed domestically within the producing regions or countries, where it undergoes further processing into derivative products.

China stands as the largest producer and consumer of propylene globally, accounting for nearly 30% of worldwide production and consumption. Following China, East Asia, North America, and Western Europe dominate the market, with the Middle East ranking fourth. The Middle East contributes approximately 8% to global production and consumption, maintaining a significant position within the industry while showcasing potential for further growth.

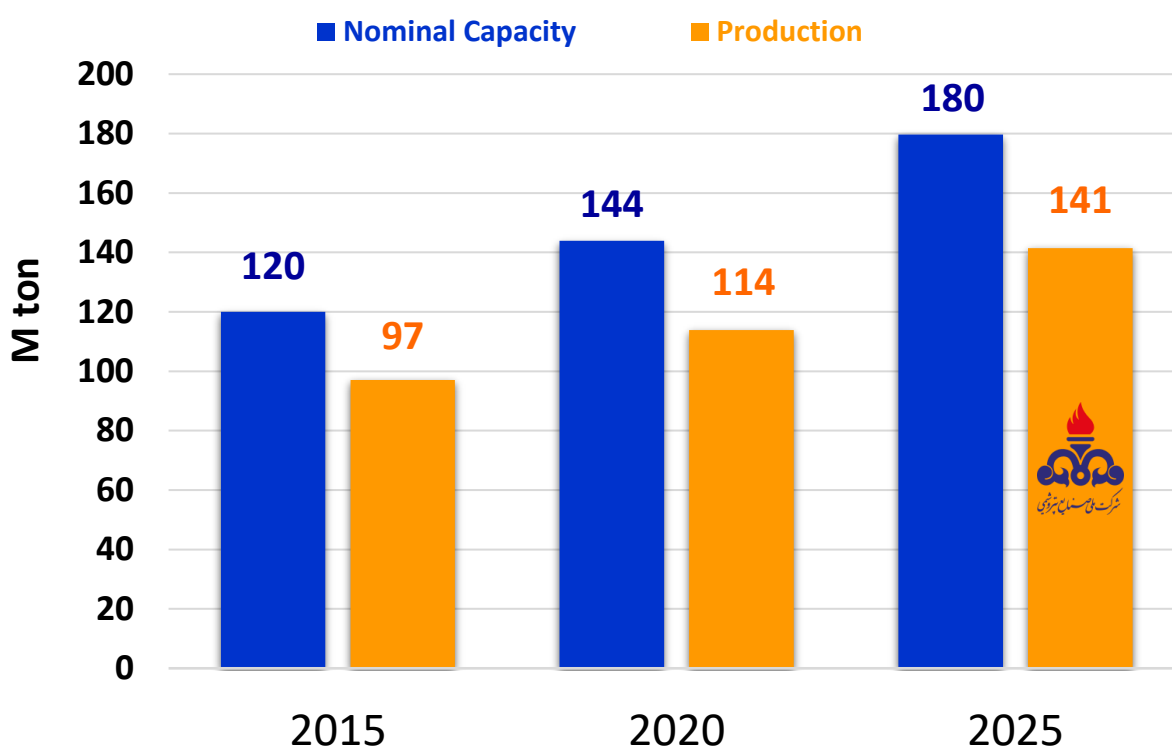
4.2. Future Outlook for the Global Propylene Market

Research from industrial and energy institutions projects that the global propylene market will grow by 4–5% annually. A significant portion of this growth is driven by increasing demand for polypropylene, the most critical derivative of propylene, which is expected to expand at a slightly higher rate of over 5% per year.

In East Asia and Western Europe, production units for ethylene and propylene predominantly rely on imported liquid feedstocks, making them more susceptible to price volatility. In contrast, gas-based feedstocks are more readily available in North America and the Middle East, where ethylene and propylene production benefit from greater stability in feedstock supply. This regional disparity highlights heightened risk exposure for Asia and Europe compared to the relatively stable conditions in North America and the Middle East.



Global Nominal Capacity and Production of Propylene in 2015, 2020 and 2025



5. Overview of Propylene Production in Iran

Introduction to Iranian Petrochemical Units in Propylene Production

Iran's nominal production capacity for both propylene and polypropylene stands at approximately 1.2 million tons annually for each product. In practice, these industrial units collectively produce around 800,000 tons of propylene and polypropylene per year.

The majority of these products are manufactured using traditional methods such as Cracking and Fluid Catalytic Cracking (FCC). However, newer techniques like Propane Dehydrogenation (PDH), which offer higher efficiency, currently account for a smaller share of production. That said, multiple ongoing projects across the country are set to adopt PDH technology in the near future.



National Iranian Petrochemical Company
International Affairs



Iran's strategic goal is to first fully satisfy its domestic market demand, thereby eliminating reliance on imports. Following this, the country plans to focus on expanding its presence in foreign markets by developing polypropylene and other propylene-derived products.

No.	Logo	Petrochemical Complex	Propylene Production Capacity (KTons/Year)	Poly Propylene Production Capacity (KTons/Year)	License	Year of Operation	Web site
1		Bandar Imam Petrochemical Complex	64	-		1971	https://bipc.ir
2		Amir Kabir Petrochemical Co.	154	-	Linde	2005	https://www.akpc.ir/
3		Ilam Petrochemical Co.	124.5	-		2013	https://ilampetro.com/
4		Jam Polypropylene Co.	-	300	Basell	2008	https://www.jpcc.ir/
		Poly Nar Co.	80	30	Himont	2000	http://www.polynar.ir
5		Jam Petrochemical Co.	305	-	Technip	2007	https://jpccomplex.ir/



National Iranian Petrochemical Company
International Affairs



6		Rejal Petrochemical Co.	-	180	A.B.B	2006 & 2012	https://regalpetro.com/
7		Tabriz Petrochemical Co.	56	-	TPL (Italy) KTI (Netherlands)	1997	https://www.tpc.ir/
8		Shazand (Arak) Petrochemical Co.	127.5	75	TPL (Italy) KTI (Netherlands)	1993	https://www.arpc.ir/
9		Di Aria Polymer (Khomein)	175	-	Basell	2023	-----
10		Marun Petrochemical Co.	200	300	Linde	2006	https://www.mpc.ir/
11		Navid Zar Shimi Co.	-	160	Basell	2004	http://navidzarchimi.co. ir