A Winning Synergy

SINGAPORE REFINERY

SINGAPORE CHEMICAL PLANT
Introduction

Exxon Mobil Corporation and its affiliates have been operating for over a hundred years in Singapore, expanding from trading kerosene to a multi-billion dollar manufacturing and marketing business today. ExxonMobil Asia Pacific Pte Ltd ("ExxonMobil") is the single-largest foreign investor in Singapore with US$6.5 billion in assets.

In Singapore, ExxonMobil owns and operates a 605,000-barrel-per-day refinery in Jurong and on Jurong Island. The Singapore Refinery is ExxonMobil's largest refinery in the World. This operation is fully integrated with the Singapore Chemical Plant (SCP), a world-class petrochemical complex on Jurong Island. The Singapore Refinery and SCP, together, form ExxonMobil's largest integrated manufacturing site in Asia.

The Singapore Refinery and SCP have a committed workforce of about 1,300 employees. Several integrated departments support both facilities for Safety, Maintenance, Engineering and Optimisation & Coordination activities.

"Singapore Refinery is ExxonMobil’s largest refinery in the World"

Nobody Gets Hurt

At ExxonMobil, our belief is ‘Nobody Gets Hurt’. In order to live up to this motto, we have developed an intensive safety plan to look after all who pass through our gates. ExxonMobil is committed to conducting our business in a manner that is compatible with the environmental and economic needs of all communities in which we operate. These commitments are documented in our safety, health, environment, product safety and security policies. These policies are put into practice through a disciplined management framework called Operations Integrity Management System (OIMS).

OIMS establishes common worldwide expectations for controlling operations integrity risks inherent in our businesses. Operations integrity addresses all aspects of ExxonMobil's business, including security that can impact safety, health and environmental performance.
We make a positive contribution to our host countries and local communities. By building trust with each community, we believe we will earn the license to operate. Since 2002, we have worked with the South West Community Development Council to provide meals throughout the school year for students from needy families. ExxonMobil had our first blood drive in 1999. When we started the blood drive, it was only targeted at our own employees, contractors and the neighbouring companies. Year 2003 was the first time that we extended it to the public by having the blood drive at West Mall - a popular shopping mall in the suburbs.

Good Corporate Citizen

ExxonMobil strives to continuously improve our environmental performance. As part of this commitment, each of our facilities develops site-specific Environmental Business Plans (EBPs) to complement our corporate environmental plan. The EBPs are developed to provide a comprehensive, multi-year plan that supports ExxonMobil's commitment to safe operations and our goal of reducing emissions while continuing to provide quality products and services to our customers. The plans are consistent with each site's strategic needs and ExxonMobil's overarching objective of long term environmental improvement.

Environmental Performance

“Singapore Chemical Plant is a world-scale facility employing state-of-the-art technologies”

“"
ExxonMobil's Singapore Refinery has two operating sites - one on the mainland (referred to as Jurong) and another on Jurong Island (referred to as Pulau Ayer Chawan or PAC) - occupying 340 hectares of land. Since the Refinery was founded in 1966 for Jurong site and in 1970 for PAC site, it has grown steadily both in size and complexity. Enhancements over four decades include conventional Lubes Plant in 1973, Medium Pressure Hydrocracker in 1990, Jurong Aromatics Plant (JAR) in 1994 and Group II Lubes Plant in 1997.

The two sites are interconnected by a host of pipelines to ensure seamless operations and effective molecule management. The integrated refinery manufactures a wide range of fuels, lubes and specialty products that are marketed both within Singapore and exported to other countries in the Asia Pacific region. The Refinery also provides advantaged feedstock to the steam cracker and two aromatics plants that are located adjacent to the Refinery.

**CAPACITY**

- 605 KBD of pipestill throughput
- 300 KBD of hydrofining
- 115 KBD of visbreaking
- 80 KBD of reforming
- 33 KBD of hydrocracking
- 31 KBD of lubes
- 1330 KTA of aromatics
  - Paraxylene
  - Benzene
  - Toluene
  - Cyclohexane
  - Orthoxylene
- 380 KTA of solvents
- 17 Berths
Overview:

The refinery converts the raw material - either crude oil or condensate into:

a) Finished products that are marketed through the supply chain e.g. LPG, motor gasoline, jet fuel, diesel fuel, lubricating oils, bunker fuel and asphalt.

b) Intermediate / by-products that are consumed internally as chemical feedstock or fuel e.g. fuel gas, hydrogen, naphtha, reformate, distillates and fuel oil.

These raw materials are transformed into products through a number of unit operations e.g. fractionation, conversion, treating and blending.

• Fractionation (physical separation) is the separation of hydrocarbons in distillation towers into groups of hydrocarbon compounds of different boiling-point ranges called “fractions” or “cuts”.

• Conversion (chemical reaction) changes the size and/or structure of the hydrocarbon molecules. Conversion may result in a decomposition, unification or isomerisation of the feed molecules.

• Treating processes (physical separation and/or chemical reactions) prepare hydrocarbon streams for additional processing or finishing operations. It involves the removal or separation of impurities and other undesirable components.

• Blending is the process of mixing and combining hydrocarbon fractions, additives and other components to produce finished products with specific performance properties.

These processes are supported by other activities like oil movement, utility generation / distribution and effluent treatment.
Products and their end uses:

**LPG**
- Used as a clean domestic / commercial fuel for heating and cooking as well as fuel for motor vehicles.

**Naphtha**
- Feedstock destined for motor gasoline and petrochemicals industry (e.g. ethylene manufacture or aromatics production).

**Motor Gasoline**
- Commonly used as a fuel in motor vehicles.
- Additives are often used to enhance performance and provide protection against oxidation and rust formation.

**Kerosene / Jet Fuel**
- A refined middle-distillate product that is used as a jet fuel, domestic heating and to manufacture solvents.

**Gas Oil / Diesel**
- Used as motor fuel for compression ignition (buses, trucks, marine) and light heating oil for industrial and commercial application.

**Heavy Fuel Oil Residual**
- Many power plants, commercial buildings and industrial facilities use fuel oil for heating and processing.
- Fuel oil is also used to power marine vessels.

**Technology characteristics**
- The Singapore Refinery is a world-scale refining complex. Together with the Singapore Chemical Plant, it forms the largest integrated ExxonMobil manufacturing complex in Asia. As a worldwide supplier of refined products, such interconnectivity allows us to be flexible and respond quickly to the market.
Singapore Refinery: Lubes & Specialties

Products and their end uses:

Lube Basestocks (Group I & II)
- Hydrocarbons produced from heavy distillate; used mainly as lubricants.
- Group I basestocks are conventional basestocks manufactured via solvent refining techniques while Group II basestocks are made through hydrocracking / hydroisomerisation technology.
- Additives such as demulsifiers, antioxidants and viscosity improvers are added to enhance the performance of motor oils, industrial greases, industrial oils and lubricants.

Asphalt
- Solid, semi-solid or viscous hydrocarbon, obtained through the distillation of crude oil.
- Asphalt is primarily used for surfacing of roads and for roofing material as it is resistant to most chemicals and weather conditions.

Paraffin Waxes
- Waxes are residues extracted from Group I Lubes and they have a crystalline structure, are pale yellow to white (or colourless).
- Wide uses in food packaging, water proofing for paper and textile, candle making and cosmetics, after additional processing.

Solvents
- Used as a cleaning agent and in the manufacture of a variety of paints, glues and enamels.

Technology characteristics
- Group II Lubes plant was built using state-of-the-art ExxonMobil technology and ExxonMobil proprietary catalyst. This produces lubes base stock with improved thermal and oxidation stability, low temperature properties and volatility resulting in higher fuel economy, better engine protection, lower oil consumption, extended lubricant life and sustained emissions performance.
Production
• 400 KTA Paraxylene
• 300 KTA Benzene
• 250 KTA Cyclohexane
• 200 KTA Orthoxylene
• 180 KTA Toluene

Products and their end uses:
Paraxylene and Benzene same as Singapore Aromatics Plant (SAR).

Cyclohexane
• Used in making nylon, to manufacture end products such as textile, carpets and auto parts.

Orthoxylene
• Orthoxylene is a raw material for making alkaline resins and plasticisers.

Toluene
• Used in motor gasoline, feed to generate more xylenes and benzene molecules and making chemical derivatives.

Technology Characteristics
• JAR is one of ExxonMobil's biggest aromatics plants in Asia. Its key strength is the flexibility to optimise product slates according to market conditions. It is also highly integrated with Singapore Aromatics Plant and Singapore Refinery.
Singapore Chemical Plant (SCP) is ExxonMobil Chemical’s largest investment (US$2 billion) in the Asia Pacific. This world-scale facility employs state-of-the-art chemical processing technologies for high-performance manufacturing in today’s competitive global chemicals market. Comprising five integrated units, this highly synergised plant serves as a strategic supply pillar for the region.

Consistent with ExxonMobil’s worldwide operational standards, SCP is committed to protecting the safety and health of our employees, the communities in which we operate, and the environment. In addition, we are committed to maintaining the highest level of customer focus through world-class performance in operational and supply reliability. SCP is owned by ExxonMobil Asia Pacific Pte Ltd. Ground breaking took place in 1998 and the plant was commissioned in 2001. SCP is located on 90 hectares of mostly reclaimed land on Jurong Island.

### FACILITY

### CAPACITY

- 900 KTA of ethylene
- 435 KTA of propylene
- 270 KTA of n-butylene
- 80 KTA of MTBE
- 480 KTA of polyethylene
- 315 KTA of polypropylene
- 35 KBD of reforming
- 420 KTA of paraxylene
- 190 KTA of benzene
- 220 KTA of oxo alcohol
- 35 KTA of isopar
The Singapore Chemical Plant (SCP) consists of five plants namely: Oxo alcohol, Olefins, Aromatics, Polypropylene and Polyethylene Plants.

It is fully integrated with our Singapore Refinery. The heart of the facility is a world-scale steam cracker producing mainly ethylene and propylene. The majority of feedstocks are consumed by our four derivative plants. The site also has facilities for importing and exporting these monomers. The steam cracker receives feed from ExxonMobil refineries and other sources in Asia Pacific.

SCP also generates all its own electricity and steam through cogeneration.

SCP Process Overview

Overview:

- The Singapore Chemical Plant (SCP) consists of five plants namely: Oxo alcohol, Olefins, Aromatics, Polypropylene and Polyethylene Plants.
- It is fully integrated with our Singapore Refinery.
- The heart of the facility is a world-scale steam cracker producing mainly ethylene and propylene. The majority of feedstocks are consumed by our four derivative plants. The site also has facilities for importing and exporting these monomers.
- The steam cracker receives feed from ExxonMobil refineries and other sources in Asia Pacific.
- SCP also generates all its own electricity and steam through cogeneration.

- The Oxo alcohol Plant produces Isononyl Alcohol, or INA in short, which is used to make plasticisers that are used to make PVC plastic flexible.
- The Polypropylene and Polyethylene produce thermoplastics which are used by our customers to produce a wide variety of finished products.
- Our Aromatics Plant produces paraxylene and recovers benzene from the feed streams it receives from the Olefins Plant and refineries. Paraxylene and benzene are intermediate chemicals used by our customers to produce polyester and a wide variety of other products.
- Units within the SCP also produce components of motor gasoline. These components are used in our refineries.
Production
- 900 KTA ethylene, 435 KTA propylene
- 270 KTA n-butylene, 80 KTA MTBE

Products and their end uses:
**Ethylene**
- Basic building-block for making a wide variety of chemical and polymer products, including polyethylene.
- Used in plastic packaging, containers, films, detergents, cosmetics and paints.

**Propylene**
- Basic building-block for making polypropylene, polymers and other chemicals.
- Used in carpeting, upholstery, pleasure boats and automotive parts.

**Normal Butylene**
- Basic building-block for making butyl rubber, polymers and other chemicals.
- Used in tyre liners and vinyl intermediates.

**MTBE**
- Used as an octane enhancer / anti-knock agent for petrol.

Technology characteristics
- The steam cracker is the core of the integrated site. Built using advanced ExxonMobil technology, the highly-efficient furnaces ‘crack’ both light and heavy feed to produce basic molecules like ethylene, propylene and butylene. These are then transformed into other products such as polyolefins. The residues from this process are used to produce syngas that is used as feed for the oxo alcohol plant, and to power the cogeneration unit for the production of steam and electricity for the site.
Production
• 480 KTA polyethylene
• 315 KTA polypropylene

Products and their end uses:
Polyethylene
• Basic plastic, in the form of resin pellets, derived from ethylene.
• Used in packaging material, bread wrappers, garbage bags and electrical insulation. Also used in the agricultural film market to facilitate early crop yield.

Polypropylene
• Basic plastic, in the form of resin pellets, derived from propylene.
• Used in carpeting, upholstery, film, car seats, battery cases and automotive parts.

Technology characteristics
• SPO [comprising both the Singapore Polyethylene Plant (SPE) and the Singapore Polypropylene Plant (SPP)] has the largest single-line Unipol plant - the world’s largest extruder and pelletiser. SPE utilises the cutting-edge "Univation super condensed mode" technology to increase throughput beyond that which is available to all other Unipol plants.
SPA: Singapore Oxo alcohol Plant

Production
- 220 KTA Oxo alcohol
- 35 KTA Isopar

Products and their end uses:

Isononyl Alcohol
- Feedstock for the manufacture of plasticisers which provide flexibility/elasticity to many products.
- Plasticised PVC is used in floor and wall coverings, wire and cable insulation, synthetic leathers, automotive applications and medical products.

Isopar
- Carrier fluids for household products like degreasers and detergents.
- Used in aerosol insecticides, printing inks and reaction diluents.

Technology characteristics
- SPA utilises ExxonMobil cobalt flash technology and feeds on the butylene stream produced by the steam cracker. It supplies to customers across Asia, including ExxonMobil’s own plasticiser plants in the region. SPA’s high-tech laboratory features the latest testing equipment. It employs advanced on-line and off-line analytics facilities to ensure reliable and consistently on-specification production.
Production
• 35 KBD Reforming
• 420 KTA Paraxylene
• 190 KTA Benzene

Products and their end uses:
Paraxylene
• Used to make polyesters [including polyethylene terephthalate (PET)] which are commonly applied in clothings, packaging, car tyre rods and plastic bottles.
• Used in x-ray, video and audio tapes films.

Benzene
• Key basic chemical for manufacture of a wide range intermediate products, including cyclohexane that makes nylon. Nylon is used in everyday items such as stockings, rope and plastic toys.
• Makes styrene which is used to manufacture polystyrene and rubber products.
• Makes cumene and phenol which are used in health care products such as aspirin and penicillin, as well as epoxy resins.

Technology characteristics
• SAR is designed as one of the largest paraxylene trains. It uses the UOP Parex technology to produce paraxylene and the UOP sulfolane technology to make benzene. These cutting edge technologies allow efficient production of high-purity products to meet the demands of customers.