Technip is a world leader in Ethylene Technology for both grassroots plants and expansions.

Ethylene production

Engineering and technologies

Technip
Technip at a glance

Technip is a world leader in project management, engineering and construction for the oil and gas industry.

With a global footprint, our talents constantly offer the most innovative technologies and best solutions to our clients to optimize their investments and meet the world’s energy challenges.

Our mission is to deliver safe, sustainable and quality projects across the world.

We operate in three main businesses:

**Subsea**
In subsea hydrocarbon field development, Technip’s activities include the design, manufacture and installation of rigid and flexible subsea pipelines and umbilicals.
Thanks to our portfolio of technologies, industrial and operational assets on all continents and a state-of-the-art fleet, we offer a unique vertically integrated model in the industry.

**Offshore**
In the Offshore business, our activities include engineering, procurement, construction (EPC) and installation of fixed and floating platforms.
We use a complete range of technological solutions to answer the challenges faced by our clients.
We are leveraging our expertise in full-range of offshore facilities, as well as our strong know-how with added-value process skills and proprietary platform design.

**Onshore**
In the Onshore business, we deliver to our clients all the experience we have acquired for almost 60 years, combined with a large technology solutions portfolio. We are working on onshore facilities that the energy sector needs, in particular for oil and gas industry players.
Technip is one of the global leaders for the refining business and petrochemical units. We also reinforced our position on project management consultancy (PMC) activities, by leveraging our expertise in the management of complex projects.
Technip is a world leader in Ethylene technology for both grassroots plants (including mega-crackers) and plant expansions. Since the acquisition of Stone & Webster process technologies, Technip is able to propose legacy Stone & Webster ethylene technology and/or Technip ethylene technology. With respectively 70 years of expertise for Stone & Webster and 40 years for Technip, and a total of 150 grassroots plants, Technip is the leader in the field of ethylene. The global licensing market share since 2000 is about 50% of the world’s total added capacity.

Ethylene in our daily life

Ethylene, the simplest of olefins, is used as a base product for many syntheses in the petrochemical industry: plastics, solvents, cosmetics, pneumatics, paints, packaging, etc.

Today, the demand for ethylene is over 140 million tons per year with a growth rate of 3.5% per year. The average capacity of production plants, known as steam-crackers, has risen from 300 KTA in the 1980’s to over 1,000 KTA today.
**Mega-challenges for mega-crackers**

Since the late 1990’s, Technip has strengthened its leading position in the market for mega-crackers used for ethylene production.

Most recent achievements include:
- **Yansab, KSA**: the world’s largest steam cracker with an ultimate capacity of 1,700 KTA ethylene using ethane and propane feedstocks. Designed by Technip, the unit went into operation in 2008 with an initial capacity of 1,380 KTA.
- **Petro Rabigh, KSA**: the world’s largest olefins production plant with 1,500 KTA ethylene and 950 KTA propylene based on ethane feedstock, integrated with DCC process unit.
- **Sadara, KSA**: the world’s largest mixed feedstock cracker (ethane, LPG, naphtha), designed for 1,500 KTA ethylene and 500 KTA propylene.
- **Ras Laffan, Qatar**: large ethylene plant with a capacity of 1,300 KTA based on ethane feedstock.
- **SHARQ, KSA**: large plant with a capacity of 1,300 KTA ethylene based on ethane and propane cracking.
- **Jamnagar, India**: the world’s largest cracker based on refinery off-gases, under design to produce 1,400 KTA ethylene.
- **The world’s largest cracking furnaces**: 235 KTA ethylene based on ethane feedstock and 185 KTA ethylene based on liquid feedstocks, designed and built by Technip.

**Recent awards:**
- **Chevron Phillips Chemical Company, USA**: technology license and FEED for a 1,500 KTA grassroots ethane cracker based on feedstock derived from shale gas. Location is the Texas Gulf Coast.
- **Sasol Chemicals LLC, USA**: technology license and FEED for a 1,500 KTA grassroots ethane cracker based on feedstock derived from shale gas. Location is the Louisiana Gulf Coast.
- **Dow Chemical Co., LHC-9, USA**: technology license, FEED and cracking furnaces engineering and procurement for a 1,500 KTA ethane cracker. Location is the Texas Gulf Coast.

**A strategic acquisition**

Technip acquired Stone & Webster process technologies and the associated oil and gas engineering capabilities in 2012. This leading technology-driven engineering, procurement and construction contractor complements and widens Technip’s technology and alliances in ethylene. Technip formed a new business unit, Technip Stone & Webster Process Technology, to oversee both ethylene technology offerings. The unit is fully integrated with Technip’s Onshore segment and acts as a transversal key player in licensing this process technology.

**Centers of excellence**

Thanks to its highly qualified process engineers and experts, Technip has acquired sound technological expertise and has the ability to design and develop proprietary technologies.

Its centers of Ethylene expertise based in the U.S. (California and Texas), the Netherlands, Italy, England and France, supported by a global engineering, procurement and construction network, contribute to Technip’s leadership in terms of experience and resources, making it the partner of choice for any ethylene project.
Proprietary furnace technologies

Thanks to a variety of associated proprietary technologies, Technip Stone & Webster Process Technology offers ethylene producers the ability to meet the toughest production-related challenges, reduce capital costs of new furnaces and improve operational efficiency of existing furnaces.

The furnace technologies contain a wide range of design options for reliable, flexible and highly selective solutions best suited to the operational needs of our clients and the most stringent environmental regulations. Standard design features include radiant coils, combustion systems, quench exchangers and multi-level shutdown features.

Today, the largest gas cracking furnace is more than 235 KTA, and the largest liquids cracking furnace is 185 KTA.
Gas cracking:
SMK™ and Ultra Selective Conversion (USC®) M-coils are preferred for high-capacity, low-cost for gas cracking.

Liquids cracking:
GK6® and USC® U-coils are designed for short-residence-time for liquids cracking.

Recent developments:
- **SMK™ and USC® M-coil technology for gas feed**: these technologies, designed to achieve very large capacities, enable selectivity optimization. The largest capacity furnace in the world uses Technip gas cracking technology and has a capacity of more than 235 KTA ethylene. During the last 10 years, more than 160 furnaces have been installed based on either the SMK™ or USC® M-coil technology.

- **GK6® and USC® U-coil technologies for liquid feeds** are applied in new furnaces and used to modernize existing furnaces. These technologies have been applied in nearly 200 furnaces in the last 10 years.

- **A unique linear quench exchanger** arrangement eliminates the need for offline cleaning and reduces waste. This arrangement can be applied for all coil types.

- **SFT® (Swirl Flow Tube) technology**, which uses helical tubes that enable improved thermal exchange coefficients, can be used in all furnaces to further improve performance (selectivity, capacity and run-length).
SPYRO® is Technip’s proprietary model for steam-cracking yield prediction and complete furnace simulation of either gas or liquid feedstocks. Since its introduction in 1978, SPYRO® has been adopted by 80% of ethylene producers worldwide. Today Technip uses SPYRO® in the design of all cracking furnaces, including those designed in Technip Stone & Webster Process Technology centers.

**SPYRO® furnace design and optimization software**

SPYRO® simulates the pyrolysis reactions of the cracking process inside the radiant coil of an ethylene furnace together with the complete furnace model. It is applied for feedstock selection, process scheduling and production optimization. SPYRO® allows accurate prediction of yield patterns for feedstocks ranging from gases to heavy (or treated) gas oils at all current operating conditions. Many ethylene plants run on-line control and optimization systems with Technip’s SPYRO® program embedded in their system software. SPYRO® can also be applied for stand-alone simulation.

**A determining factor in plant configuration and revamp scenarios**

SPYRO® provides detailed information on yields and furnace availability which can also be used to set up revamp scenarios for the furnace and downstream sections of a plant. For optimum design of large capacity GK® and SMK™ furnaces, Technip applies SPYRO® linked with CFD (Computational Fluid Dynamics), enabling the best design of burner arrangement, cracking coil layout and flue gas ducting.

**Technology developments**

Technip continues to develop a range of olefin-related technologies. Recent developments include cracking furnace intensification, improved cryogenic schemes with associated equipment advances, anti-fouling quench systems, and a spent caustic pre-treatment/oxidation process for plant optimization, investment cost, HSE, energy efficiency and emission reduction. Ongoing flow scheme evolution/simplification and significant alternative approaches to cracking technology are under development.
Proprietary equipment

U-coil/SLE combination
Technip has exclusive design and patents with BORSIG allowing direct combination of two pass coils (LP coil or GK6®) with SLE (double pipe quench exchanger) which minimize the adiabatic volume.

Ripple Tray™ technology
Technip's high-capacity Ripple Trays are used in fouling services and/or increase production capacity. The trays have been applied for 50 years in 470 applications worldwide.

The Vapor Flute™
Technip's proprietary Vapor Flute™, an important component of many Quench Oil and/or Quench Water tower grassroots and revamp projects, increases operational efficiency by improving distribution and acting as a first line of defense against liquids and coke that enters the tower(s).

Quench Fitting technology
Technip's Quench Fitting technology is a unique device that provides high-efficiency, direct-contact quenching of furnace effluent gas with a process hydrocarbon liquid stream to obtain the desired mix, quickly and completely.

Anti-Coking Heavy Feed Mixer™
Technip’s Anti-Coking Heavy Feed Mixer™ completely vaporizes heavy hydrocarbon feedstocks using a unique patented anti-coking design. This design greatly minimizes the coking tendency and required length of mixing chamber, thus reducing the upfront capital costs and periodic maintenance of the furnace convection section.

High performance exchangers
The Technip and Wieland agreement to jointly market innovative enhanced heat exchangers for ethylene plants allows further reduction of energy consumption as well as CO₂ emissions. These exchangers can be used either for boiling or condensing applications.
Ethylene production

Technip's progressive separation technology reduces energy consumption thereby lowering CO₂ emissions. This technology is available for all types of acetylene separation processes.

Acetylene elimination

Ethylene plant operators aim at a very pure output from steam crackers: 99.95% ethylene, with a very low content (below 1 ppm) of extremely reactive molecules such as acetylene.

To achieve this, Technip has developed a sophisticated sequence of processes to separate and purify the high value products in the steam cracker.

Three methods of acetylene elimination are currently implemented:

- **Front-end hydrogenation**, coupled with either front-end deethanizer or front-end depropanizer, is available for gas or liquids crackers. The technology is applied in many plants in operation such as Petro Rabigh and Sadara projects in the Kingdom of Saudi Arabia.

- **Back-end hydrogenation** coupled with front-end demethanizer is applied for either gas or liquids crackers. The technology is applied in many plants in operation such as Yansab in the Kingdom of Saudi Arabia.

- **Acetylene extraction** can also be provided. Technip has installed acetylene extraction in four plants based on DMF absorption technology.

For all of these technologies, current equipment limits the maximum capacity of each unit to approximately 2,000 KTA of ethylene.
Lowering CO₂ emissions by maximizing energy efficiency. During the last 20 years, CO₂ emissions/ton of ethylene have been reduced by 30%.

**Continuous improvement**

Reduction of energy consumption and CO₂ emissions has been obtained through:
- a better thermal efficiency of the furnaces, above 95%
- a reduction of the steam demand by reducing compression power required per ton of ethylene

![Graph showing decrease in specific compression power kWh/th Ethylene from 1978 to 2014](image)
With its own proprietary technologies and the acquisition of Stone & Webster process technologies, Technip is one of the few world-class companies capable of providing integrated solutions for ethylene plants, from conceptual design to turnkey design and construction.

There are several challenges inherent in the execution of ethylene complexes. The ever-increasing scale of equipment, piping and structures makes it necessary to develop new concepts and work closely with suppliers.

**The Technip offer**

Through its network of process experts in centers around the world, Technip provides the full scope of services, from licensing to EPC and full lump sum turnkey project responsibility. This also includes the supply of proprietary technology and start-up services for the plant, its ancillary units and associated off-sites and utility sections.

**Project services rendered:**
- Financing
- Project management and consulting services
- Feasibility studies
- Conceptual design
- Licensing
- Front-End Engineering and Design (FEED)
- Detailed engineering of equipment, piping, civil, instrumentation, electrical and automation
- Cost estimating
- Project planning and scheduling
- Procurement including purchasing, expediting and inspection
- Construction
- Start-up and plant operation supporting services
- Environmental permitting and assistance in Authority Approval and Permit procedures
- HAZOP and HASAN
- Safety studies
Ethylene plant modernization

Technip is the world leader in furnace modernization. For complete modernization of existing plants, including revamp of the cracking section, compression and separation sections, Technip offers a unique proven approach, applied successfully in several recent revamp projects.

Ethylene plant modernization, capacity expansion and revamp projects

Ethylene plant modernization projects vary in scope and size. Existing cracking furnaces, even if they originate from a recent generation, may be redesigned to increase the original ethylene capacity by 20% to more than double. At the same time, specific feed consumption is drastically reduced, thereby contributing to an attractive low cost of production per ton of incremental ethylene.

The systematic approach to modernization

Technip’s Systematic Approach to Modernization enables an in-depth evaluation of technology options and project implementation scenarios, leading to the most economical capacity expansion of an existing ethylene plant. The application of this approach ensures that bottlenecks in an existing plant are identified and prioritized to ensure a maximum return on investment is achieved.

Main steps involved in the systematic approach to modernization

- **Capacity**: Equipment technology
- **Energy**: Process technology, key Energy users
- **Investment**: Key equipment cost & schedule

client's objective

Equipment technology

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Iterations

FINAL REPORT
The increased availability of ethane from shale-derived natural gas is driving numerous chemical producers to expand their ethylene capacity, particularly on the US Gulf Coast. Many of these producers, who are looking for reliable, efficient, low-cost gas-cracking facilities, are turning to Technip for their solutions.

This is demonstrated by recent awards such as Chevron Phillips' 1,500 KTA ethane cracker located in Baytown, TX, Dow Chemical's 1,500 KTA plant in Freeport, TX, and Sasol's 1,500 KTA unit in Lake Charles, Louisiana. All three mega-cracker awards are based on Technip's gas cracking furnace technology and efficient recovery flow scheme.
**SHARQ - KSA**

Stone & Webster process technologies provided its proprietary ethylene technology and engineering, procurement and construction management for this 1,300 KTA grassroots ethylene plant located in Al-Jubail, Saudi Arabia.

The project includes eight proprietary Ultra Selective Conversion (USC©) cracking furnaces.

The plant reached full commercial operation in 2010.

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**RAS LAFFAN - QATAR**

In 2005, Qatar Petroleum, Chevron Phillips Chemical Company LLC, Qatar Petrochemical Company and Total Petrochemicals awarded Technip a contract to provide its technology and EPC of a stand-alone ethane cracker at Ras Laffan in Qatar.

With a capacity of 1,300 KTA, the plant is based on nine proprietary SMK™ gas cracking furnaces and progressive separation technology.

The unit started production in 2010.

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**YANSAB - KINGDOM OF SAUDIA ARABIA**

In 2005, Technip signed a contract with Saudi Basic Industries Corporation (SABIC) for the construction of a large-scale ethylene and propylene production plant at the Yansab Complex in Yanbu Industrial City, on the Red Sea coast of Saudi Arabia. The plant is based on eight proprietary SMK™ gas cracking furnaces and progressive separation technology, handling both ethane and propane feedstocks. With a capacity of 220 KTA each, these furnaces are the world’s largest. With a production capacity of 1,380 KTA of ethylene and 400 KTA of propylene, the plant plays a key role in SABIC’s ambitious plan to significantly increase production of basic petrochemicals, intermediates and polymers.

The plant is already designed for a future capacity of 1,700 KTA. This facility has been in production since mid-2009.
PETRO RABIGH - KINGDOM OF SAUDIA ARABIA

In 2004, the Aramco-Sumitomo joint venture, Petro Rabigh, awarded JGC the EPC based on technology provided by Technip Stone & Webster Process Technology for an ethane cracker designed to produce 1,500 KTA of ethylene. The cracker is integrated with the world’s largest DCC unit feeding 92,000 BPSD of hydrotreated VGO and producing 950 KTA of propylene. The complex is located on the Red Sea Coast of Saudi Arabia. The design of the ethane cracker features eleven USC® M-coil furnaces (nine installed for phase I), a front-end acetylene hydrogenation system and a low pressure heat pump C2 splitter. The integrated complex has been in operation since 2009.

OL2K - KUWAIT

In 2005, Technip signed a contract for the construction of an ethylene plant at The Kuwait Olefins Company’s (TKOC) new Olefins-2 Petrochemical Complex in Shuaiba, Kuwait. The plant is based on eight Technip SMK™ gas cracking furnaces and progressive separation technologies. The facility, with a production capacity of 850 KTA, plays an important role in Kuwait’s program to significantly increase the country’s ethylene derivatives production. The plant has been in production since 2008.

MAP TA PHUT - THAILAND

In 2006, Technip was awarded a contract by Map Ta Phut Olefins for the construction of the furnace section of a steam-cracker located in Map Ta Phut, Thailand. The plant, which is based on seven Technip’s proprietary GK6® naphtha cracking furnaces and one SMK™ gas cracking furnace, started in 2010. At the time of implementation, the GK6® furnaces were the largest in operation with an ethylene capacity of 175 KTA each.