A world designed to last

Ethylene

A world leader in the design and construction of ethylene facilities



T.EN TECHNIP ENERGIES

A world leader in the ethylene industry for grassroots and expansions

Technip Energies has unique expertise in the design and construction of the largest ethylene plants and plant expansions.

Technip Energies is a world leader in the ethylene industry. We have unique expertise in the design and construction of the largest ethylene plants and plant expansions. We are also a leader in the modernization of existing units across the world, designed to add capacity or upgrade facilities. Our more than 50 years of experience includes a project portfolio of numerous grassroots plants and modernization projects, based on our proprietary technologies.

+50
years of expertise

150
glassroots plants

≈50
of the global licensing market share



MAXIMIZING ENERGY EFFICIENCY BY REDUCING CO_2 EMISSIONS

Technip Energies has worked continuously to improve the energy efficiency of ethylene plants, reducing total installation costs per ton of ethylene, and reducing hydrocarbon consumption per ton by 5-10%. Our innovations have also resulted in a 30% reduction in CO_2 emissions. Whether you need a new plant or are updating an existing unit, we can help you improve your energy efficiency and increase feed utilization and flexibility, while lowering emissions.

To meet increasingly strict environmental regulations, notably the need to reduce CO_2 emissions in ethylene plants, we are focusing our R&D efforts on ways to lower CO_2 emissions in our cracker designs, including by combining ethylene plants with carbon capture plants of our own design.

We offer our clients designs of plants that decrease steam generation and increase the use of electric motors as drivers for machinery. This electrification of plants works hand in hand with new furnaces design to minimize the fuel fired and CO_2 production. Today, we offer low-emission cracking furnace that brings a major decrease in CO_2 emissions.

“Enabling our clients to achieve their energy transition targets..”

Driving innovation for environmental and economic benefits

During the last 20 years, Technip Energies technological developments have improved the energy efficiency of ethylene plants, reducing CO_2 emissions by 30%.

Our technological developments have significantly improved energy efficiency of ethylene plants:

- Thermal efficiency of cracking furnaces has been improved by almost 10%
- Specific compression power per ton of ethylene has been reduced by more than 30%

Our technology complies with the most stringent environmental regulations:

- Gas emissions: limitation of greenhouse gases by reduction of NOx
- Liquid discharge: specific technology for treatment of spent caustic by wet oxidation to minimize chemical oxygen demand
- Solid emission: minimization of coke particles by routing the decoke effluents in the fire box to burn the remaining coke particles and achieve near zero emissions

Increasing plant efficiency

We offer our clients high efficiency plants:

- Increased plant capacity over 1,500 KTA
- Reduced specific energy consumption and CO_2 emissions
- Upgrading of safety facilities
- Reduced feed consumption
- Increased selectivity for better yields, reducing the specific energy consumption per ton of ethylene
- Increased flexibility for wider range of feed qualities and in operating severity / conversion
- Reduced maintenance cost with new state-of-the-art-technology

Reducing CO_2 emissions

Our plant design decreases steam generation and increases the use of electric motors as drivers for the machinery (“electrification”). This electrification of the plant works hand in hand with changing the design of the furnaces to minimize the fuel fired and therefore the CO_2 production.

Low carbon cracking furnaces design

Our latest design, a Low-Emission cracking furnace (patent granted) brings a major decrease in CO_2 emissions and is a substantial step towards meeting the future targets of the European Commission. By modifying the heat recovery scheme, fuel consumption and the associated CO_2 emissions can be reduced by 30%. This is a suitable solution for green field plants, furnace revamps or addition of furnace units in existing assets.

We have participated inthe European Improof project to improve the energy efficiency of steam cracking furnaces by at least 20%, while reducing emissions of greenhouse gases and NOx by at least 25%.
We have developed anew patented furnace design which exceeds these objectives.



A full scope of services from licensing and conceptual studies to EPC

Through our global network of experts, we provide our clients with a full range of services, from licensing and studies, to full lump sum, turnkey EPC projects. This includes the supply of proprietary technology and start-up services for the plant, its ancillary units and associated off-site and utilities areas. We design steam crackers from concept to construction and commissioning for both grassroots plants—including mega-crackers of over 2,000 KTA* of ethylene—and plant expansions.

Our project execution services include:

- Project management and consulting services
- Super licensor 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
- Safety studies

*KTA: Kilo tons per anum

As a market leader in licencing ethylene plants, we are committed to taking our leadership further by driving continuous innovation and pursuing project execution excellence.



Leading edge proprietary technologies

Our portfolio of proprietary technologies is designed to ensure our clients meet their production goals, while also reducing capital costs and improving operational efficiency.

- Mega ethylene plants (over 2,000 KTA) to ensure mechanical integrity, reliability and reduction of specific investment per ton of ethylene produced
- Low-emission cracking furnace to reduce the CO_2 emissions fuel efficiency. Our research showed that the heat recovery scheme of the conventional furnace configuration was limiting the extent to which the fuel efficiency can be improved. We have developed a new heat recovery scheme to overcome this limitation and has filed a patent for this new configuration.
- Proprietary equipment (Ripple trays, burners, Transfer Line Exchangers, enhanced heat exchanger surface)

Proprietary furnace technologies

Our furnace technologies include many design options for reliable, flexible and highly selective solutions to meet stringent environmental regulations and the operational needs of our customers. Standard design features include radiant coils, combustion systems, quench exchangers and multi-level shutdown features. We are able to design furnaces of over 300 KTA for inclusion in future projects.

GAS CRACKING

SMK™ and Ultra Selective Conversion (USC®) M-coils are the preferred option for high-capacity, low-cost, and reliable operations. Enabling selective optimization, these technologies have been installed in more than 180 furnaces.

LIQUIDS CRACKING

GK6® and USC® U-coils are designed for short-residence time. These technologies, which can be used in new furnaces or to modernize existing furnaces, have been applied in over 100 furnaces over the past 10 years.

SFT® (SWIRL FLOW TUBE) TECHNOLOGY

This technology, which uses helical tubes that enables improved thermal exchange coefficients, can be used in all furnaces to further improve performance (selectivity, capacity and run-length).

TRIPLE-LANE RADIANT COIL DESIGNS

This patented technology has been developed by Technip Energies. Radiant coils are arranged in three lanes, with one outlet lane and two inlet lanes. This design is applicable to both gas and liquid furnaces, and allows for greater capacity and/or run-length in a given firebox size.

Separation technologies

We offer a sophisticated sequence of processes that separate and purify high value products in the steam cracker, with minimum energy consumption and ease of start-up and operation:

- Quench oil tower equipped with reliable/fouling resistant Ripple Tray™ technology
- Packed quench water tower to minimize ΔP
- Four or five stage cracked gas compressor at low suction pressure to optimise furnace yields
- Caustic tower with Ripple Tray™ technology for fouling minimisation
- Dual depropanisers for efficient/reliable fractionation
- Cold section with proprietary Heat Recovery System (HRS) and dual demethaniser columns for high energy efficiency
- Heat pumped low pressure two feed C2 splitter integrated with ethylene refrigerant
- Heat pumped or conventionally reboiled C3 splitter
- Cascade single component refrigeration (ethylene and propylene or propane) – easier start-up than combined refrigeration systems and preferred for energy optimization

Two proven acetylene conversion technologies are available to obtain up to 2,000 KTA of ethylene:

Front-end hydrogenation, coupled with either a front-end de-ethanizer or a front-end de-propanizer, is available for gas or liquids crackers. We have strong industry references for this widely used technology such as the Petro Rabigh and Sadara projects in the Saudi Arabia.

Back-end hydrogenation, coupled with a front-end de-methanizer, can be used in either gas or liquids crackers. This technology is currently in use in many operating plants, including the Yansab plant in the Kingdom of Saudi Arabia.



Other olefin technologies

Hummingbird® next generation ethanol-to-ethylene dehydration technology is owned by Technip Energies. It uses an ultra-high selectivity catalyst to produce a green ethylene product.

Refinery Off-Gas technology allows valuable olefins to be recovered from refinery fuel gases, both saturated and unsaturated gases. Technip Energies has considerable experience applying refinery off-gas technology as an add-on to the main cracker. However, in the case of a cracker for Reliance, the plant is designed to crack refinery off-gas as the main feed, making it unique in the market.

Acetylene extraction is a technology we offer. It is used in 4 plants based on dimethylformamide (DMF) absorption technology licensed by Technip Energies.

Technip Energies' **CRYOMAX®** technology, for the recovery of ethane or LPG and C5 plus streams from LNG, can be integrated into steam crackers. It reduces overall CAPEX and specific energy consumption, and to integrate and simplify utilities.

Our **Wet Air Oxidation technology** helps reduce the environmental impact of spent caustic effluent from steam crackers and other sources.

Methanol-to-Propylene technology combines methanol-to-propylene technology with Technip Energies's steam cracking technology, to provide an integrated solution. Compared to stand alone plants, this technology increases ethylene and propylene production by 5-10% and reduces the CAPEX spend per ton of olefins.

Proprietary equipment

TRANSFER LINE EXCHANGER (TLE)

This exchanger safely recovers heat from furnace outlets without fouling to produce very high-pressure steam. Equipment can be manufactured in our own workshops according to our designs, ensuring better integration and a shorter delivery schedule.

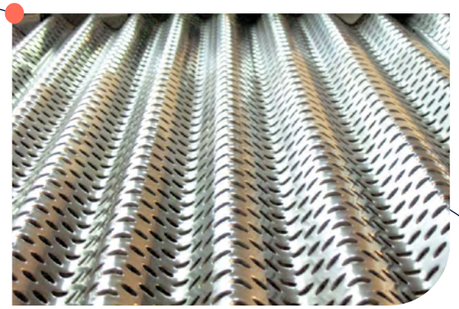
BURNERS

Our burner designs for low NOx emission, developed in-house, are also manufactured in our workshop:

- Large Scale Vortex (LSV®) burners for bottom burners
- Side wall burners

RIPPLE TRAY™ TECHNOLOGY

- Our high-capacity trays are used in fouling services and/or to increase production capacity. Over the past 50 years, the technology has been used in almost 500 applications worldwide.



QUENCH FITTING

This unique device provides high efficiency, direct-contact quenching of furnace effluent gas with a process hydrocarbon liquid stream to obtain the desired mix, rapidly and completely.

VAPOR FLUTE™

This proprietary device is an important component of many quench oil and/or quench water tower grassroots and revamp projects. The device increases operational efficiency by improving distribution and acting as a first line of defense against liquids and coke that enter the tower.

ANTI-COKING HEAVY FEED MIXER™

The mixer vaporizes heavy hydrocarbon feedstocks. It uses a unique patented anti-coking design that minimizes the coking tendency and required length of the mixing chamber. In turn, this reduces capital costs and maintenance of the furnace convection section.

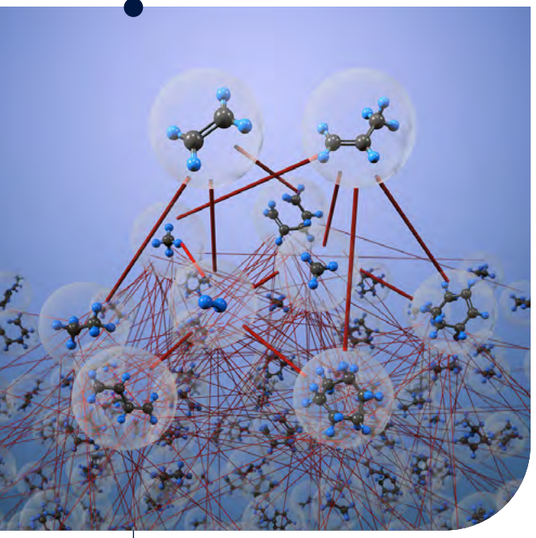
HIGH PERFORMANCE EXCHANGERS

Our agreement with Wieland to jointly market innovative enhanced heat exchangers for ethylene plants has led to a further reduction in energy consumption and CO_2 emissions. These exchangers can be used either for boiling or condensing applications.





Proven experience in ethylene plant modernization



Innovative software tool

SPYRO® is Technip Energies' proprietary model for steam cracking yield prediction and complete furnace simulation of either gas or liquid feedstocks. Since its introduction in 1978, the tool has been adopted by 80% of ethylene producers worldwide.
The tool 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: "via on-line systems".

SPYRO® for Asset Management is a cloud-based product that allows the ethylene plant operators to enhance its day-to-day production, availability and reliability. This is achieved by analyzing historical plant data combined with the know-how of ethylene technology.

Determining factor in plant configuration and revamp scenarios

The data on yields and furnace availability provided by SPYRO® 8 can also be used to set up revamp scenarios for the furnace and downstream sections of a plant. For optimum design of larger capacity gas or liquid furnaces, we apply SPYRO® linked with CFD (Computational Fluid Dynamics), enabling the best design of burner arrangement, cracking coil layout and flue gas ducting.

Typical revamping work we undertake

- Energy efficiency improvements
- Reduction of CO_2 and other emissions
- Design safety improvement
- Cracking furnace intensification and modernization
- Improved cryogenic schemes with associated equipment advances
- Anti-fouling quench systems
- Ongoing flow scheme evolution/simplification and significant alternative approaches to cracking technology are under development
- Spent caustic pre-treatment/oxidation process for plant optimization, investment costs

We have a long-standing expertise and experience in the modernization of existing ethylene plants, including the revamp of cracking sections, as well as compression and separation sections. Our proven approach has been successfully applied in a number of recent revamp projects.

Each modernization project is specifically designed to meet our clients' requirements including safety upgrades, energy and CO_2 reduction, capacity increase, change of feed type, or reduction of maintenance and operating costs.

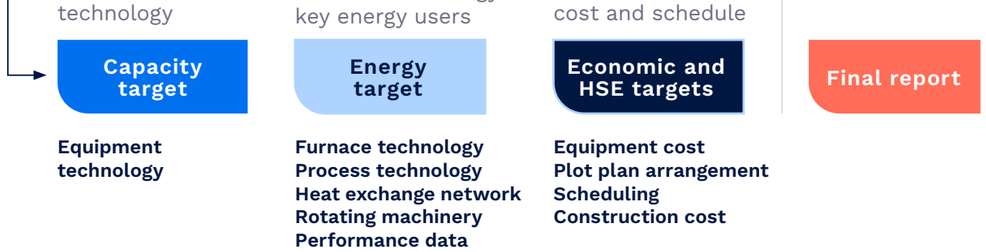
CAPACITY EXPANSION AND REVAMP PROJECTS

Existing cracking furnaces can be redesigned to increase their original capacity by 20% to 200%. At the same time, specific feed consumption is dramatically reduced, contributing to an attractive low cost of production per ton of incremental ethylene.

SYSTEMATIC APPROACH TO OPTIMIZING INVESTMENT

In determining the most economical way to expand a plant, we evaluate technology options and review project implementation scenarios. This approach ensures that bottlenecks are identified and prioritized, leading to a maximum return on investment.

MAIN STEPS INVOLVED IN THE SYSTEMATIC APPROACH TO MODERNIZATION:



Project references



USA

DOW CHEMICAL CO. LHC-9
- Contract: FEED, Technology license
- Start-up: 2017

A 1,500 KTA ethane cracker in Freeport, Texas for Dow Chemical Company. The plant has now been expanded to 2,000 KTA, making it the world's largest capacity operating ethylene plant. The facility includes one low density polyethylene and two high density polyethylene units as well as utilities and off-sites.



USA

SASOL
- Contract: EPC, Technology license
- Start-up: 2019

Sasol's 1,500 KTA ethane cracker and derivatives complex near Lake Charles, LA. Technip Energies was awarded the license and front-end engineering design for the cracker and provided engineering and procurement for 8 proprietary Ultra Selective Conversion furnaces.



SAUDI ARABIA

YANSAB
- Contract: EPC, Technology license
- Start-up: 2009

1,380 kTA ethane/ propane cracker, with pre-investment for a 1,700 kTA capacity.

USA



CPCHEM
- Contract: FEED, Technology license, Furnace engineering and procurement
- Start-up: 2018

1,500 kTA gas cracker (ethane feed).

MEXICO



ETILENO XXI
- Contract: FEED/ EPC, Technology license
- Start-up: 2016

Petrochemical complex in the Mexican state of Veracruz. That includes a 1,050 kTA ethane cracker, one low density polyethylene and two high density polyethylene units as well as utilities and off-sites.



SAUDI ARABIA

PETRORABIGH
- Contract: FEED, Technology license, Furnace engineering and procurement
- Start-up: 2009

1,500 KTA gas cracker (ethane feed), unique in being closely integrated with a Technip Energies Residue Fluid Catalytic Cracking (RFCC) unit. Propylene from the cracker and RFCC are processed in the world's largest C3 splitter (950 KTA).

SAUDI ARABIA



SADARA
- Contract: FEED, Technology license
- Start-up: 2017

The world's largest operating mixed feed cracker (ethane, LPG, naphtha), with a 1,500 KTA ethylene capacity.

INDIA



RELIANCE COMPLEX
- Contract: EPC, Technology license
- Start-up: 2017

As part of the expansion of a world scale refining petrochemical complex, Refining Off Gases Cracker (ROGC) with 1,400 KTA ethylene production. The plant uses refinery off gas as single feedstock.

ZHEJIANG PETROLEUM & CHEMICAL CO. (ZPC)
- Contract: PDP, Technology license
- Start-up: 2018

1,400 KTA liquid cracker (naphtha and LPG feeds). The client has subsequently ordered two more plants of the same basic design from Technip Energies, with the addition of Refinery Off-Gas (ROG) feed.



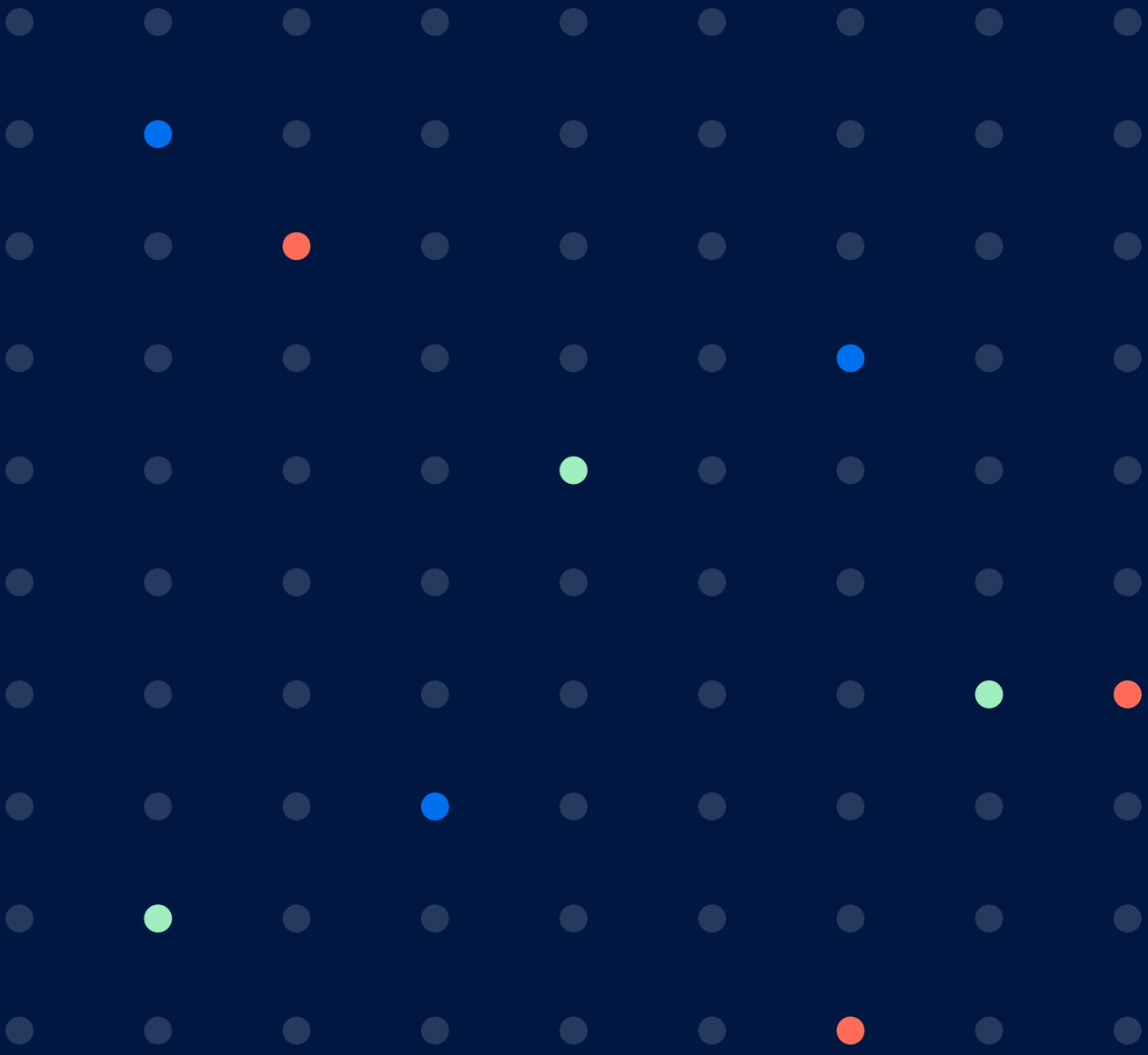
CHINA

CHINA



CNOOC
- Contract: PDP, Technology license
- Start-up: 2018

1,000 KTA liquid cracker (naphtha, hydrocracker residue and Refinery Off-Gas (ROG) feed



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