Refining, petrochemical, gas processing and alternative fuel markets
Built on rock-solid foundations

Technology licensing
  Refining – The motor fuel experts
  Petrochemicals – A pacesetter in olefins and aromatics purification
  Gas processing
  Alternative fuels

Catalysts, adsorbents and products

Advanced services

Field services

Axens and the environment

Worldwide network
Improving your performance and helping you to be more successful constitute our only business. We are a non-aligned, pure technology company. We do not sell motor fuels or chemicals; we do not operate service stations. There is only one thing that we do – provide the technologies, products and services that are needed to make your hydrocarbon processes operate at their top performance. And our goal is to do this better than anyone else in the world.

Our objective is to be your benchmark technology company for applications in the refining, petrochemicals, gas processing and alternative fuels sectors. The combination of the technology and services group with the catalyst and adsorbents manufacturing and supply business is an efficient organization that handles your needs as a single source.

Axens is built on an image of reference technology – quality products that are commercially proven, reliable and cost-effective. We hope that this image is transmitted through our corporate identity, our technical and commercial personnel and our trademarks.


We hope that you will find the information in this brochure of interest and will contact our business units for additional details or visit our Internet site at www.axens.net.

Jean Sentenac
Axens’ President and Chief Executive Officer
A historical perspective

Axens, a fully-owned subsidiary of IFP, was created in 2001 through the merger of the Procatalyse Catalysts and Adsorbents Company with IFP’s Industrial Division, which specialized in technology licensing and services. This combination provides a single-source offering of technology, products and services, and enables us to respond more efficiently and rapidly to customer needs.

Today, we are globally known as a first-class technology provider for clean fuels production; conversion processes; benzene, toluene and xylene production and purification; high-purity olefin monomer production; and sulfur production using Claus catalysts. Tomorrow, you can expect to see us as a leader in the conversion of gas, coal and biomass into liquids (XTL) with our H-Coal™ and Gasel Fischer–Tropsch technologies.
Operational organization

Axens North America, Axens Far East, Axens Beijing, Axens Middle East and Axens India are wholly owned companies serving their respective local markets.

Our operational organization covers technology licensing; catalyst and adsorbent manufacturing and supply; and operational improvement programs. Three technical departments serve these business units: Marketing, Technology and Tech. Services.

Our mission

Axens’ mission is to continually improve its customers’ performance. We will grow by a combination of internal development, targeted alliances and acquisitions with the continuous objective of providing our customers with the best overall technologies, products and services available worldwide.
Strong research and engineering (R&E) support

Continuing demand for lower investment costs, lower operating costs, lower emissions, higher yields, easier operations and shorter downtimes has led to many improvements that require multiple steps of verification before commercial implementation. Pilot plant verification is a key to commercial success. Axens’ R&E programs focus on developing new processes and products, and improving existing ones to better meet your needs.

Axens invests heavily in research and development, pilot plant testing and scale-up production of catalysts and adsorbents. Some investments are for short- to mid-term commercial applications, but a significant number are for long-term objectives that will bear fruit in a decade. We believe that is our role to provide the liquid fuels, conversion and petrochemical technologies for the coming decades.

*Engineering and design* for new processes and improvements for both grassroots and revamping projects are carried out in Rueil-Malmaison, France, and Princeton, New Jersey, USA.
Markets served

Axens is one of the world’s foremost suppliers of technologies, products and services to the refining and petrochemical intermediates markets. We are also active in the alternative fuels and gas processing markets.

Our strong position in petroleum refining covers virtually every area from liquefied petroleum gas sweetening through to vacuum residue conversion and includes commercially proven solutions for clean fuels production.

We deliver complete basic engineering design packages to our customers, including HAZOP studies, detailed engineering reviews and more. Our technical and economic feasibility and optimization studies will help to guide your improvement programs.

Axens is a world-class provider in the petrochemical sector, with leading positions in the purification of monomer intermediates and specialty olefins, and in the production and purification of cyclohexane, benzene, toluene and xylene.

In gas processing, we have a long-standing lead in the supply of performance catalysts for sulfur removal from natural gas and from refinery gases by the Claus process.

The company is also entering the natural gas liquefaction field (Liquefin process) and positioning itself in gas-to-liquids (GTL) technology (Gasel process).

Axens continues to develop new technologies for the growing alternative fuels markets: biodiesel, high-quality distillates from coal and liquid products through the conversion of the synthesis gas from various feedstocks.
Refining – The motor fuel experts

Working with Axens offers many advantages: skilled engineering assets; our commitment to continuous development and the search for improvement; and our wide array of technologies, products and services. One of our strongest core businesses is motor fuels production, purification and optimization.

**Gasoline**

Gasoline production and specification attainment are areas in which we are market pacesetters. Our Octanizing (continuous catalyst regeneration) and R2R (residue fluidized catalytic cracking) technologies are cornerstones for gasoline production.

Our Prime-G+ (selective desulfurization of gasoline fractions), Benfree (benzene reduction by hydrogenation), light naphtha isomerization, advanced recycle isomerization (including Ipsorb and Hexorb) and ethenification technologies such as MTBE, ETBE, TAME and TAEE are key process blocks for ensuring gasoline specification attainment. Classed by the number of awarded licenses, many of these technologies are worldwide market leaders.

Prime-G+ received the Kirkpatrick Honor Award for Chemical Engineering Achievement from the US journal *Chemical Engineering* in 2003.

**Diesel fuel**

We have been in diesel hydrotreating longer than in any other refining technology. Our Prime-D Toolbox is a market frontrunner in ensuring high-quality, ultra-low-sulfur diesel (ULSD).

The toolbox contains high-activity and high-stability HR Series catalysts and EquiFlow, the most advanced reactor internals in the industry.
**Expertise in residue conversion and heavy-ends upgrading technologies**

With the steady increase of lower API, higher-sulfur crudes in the feedstock mix and declining markets for heavy fuels, interest in the conversion of bottom-of-the-barrel streams to lighter, lower-sulfur products has gathered momentum. Axens has the right conversion process or combination of processes ready to upgrade the most intractable residues and gas oils.

Axens offers an extensive line of residue and heavy-fraction conversion technologies, among which are H-OilRC, H-OilDC, Hyvahl, MHCK (mild hydrocracking), HyC-10 (MHCK with integrated diesel hydrotreating), HyK (high-conversion hydrocracking), HDHPlus, R2R and Solvahl.

In addition, HySCOP enables the conversion of low API, high sulfur crude oil into improved quality syncrude.
Selective hydrogenation, aromatics production and purification, and olefins transformation are synonymous with Axens.

Our satisfied customers have made us a leading provider of petrochemical intermediate production and purification solutions.

Olefins processing
Steam crackers lie at the heart of the world’s olefins production. Ultra-high-purity olefin building blocks are needed to respond to the quality requirements for polymerization reactions. Axens has the world’s largest portfolio of olefin processing technologies and catalysts, which is backed by a cumulative onstream operating experience that exceeds 30 million hours. Our LD series catalysts are the clear market choice for all liquid-phase hydrogenation reactions, including the purification of C₃, C₄, C₅ and pygas cuts. Olefin transformation reactions using homogeneous catalysts are Axens’ best sellers. They include Alphabutol, for the production of high purity butene-1 from ethylene; and Dimersol, for the production of hexenes and octenes from propylene and butenes.
Paraxylene production and purification

Benzene, toluene and paraxylene (BTX) are produced by naphtha steam cracking or by naphtha catalytic reforming using continuous catalyst regeneration technology (Aromizing). Paraxylene (PX) is used as a building block in the production of polyethylene terephthalate (PET), which is used in plastic bottles and a vast array of synthetic fibers.

Axens is a leader in PX production and purification technologies with the ParamaX suite of aromatics technologies. The Eluxyl process for PX separation is at the heart of the ParamaX suite and is known for its excellence in operation, high-capacity trains and high-stability molecular sieve adsorbent. Other aromatics process technologies in the ParamaX suite, including xylenes isomerization, transalkylation and extractive distillation, offer improved yield performance, and lower investment and operating costs.

Cyclohexane production

Axens is the world leader in high-purity cyclohexane production through benzene hydrogenation with its HC series catalysts.
Gas processing

We provide gas treating processes that address this rapidly expanding market.

The RAM process
Downstream processing and environmental needs require the removal of arsenic and mercury compounds from natural gas and condensate streams at a parts-per-billion level. Axens’ processes recover these contaminants for controlled disposal.

Multibed
Multibed processing removes contaminants such as liquid or gaseous water, carbon dioxide, hydrogen sulfide and chlorides from gas or condensate streams using combinations of specialty alumina and molecular sieve adsorbents. The ability of this patented system to withstand liquid slugs and higher-than-normal concentrations of water makes this process popular with gas processors.

Sulfur recovery
Axens has a long history in sulfur-recovery catalysts via the Claus process. We are the world’s leading premium Claus catalysts supplier and have a complete range of catalysts, adsorbents and active support materials for Claus and tail-gas treating units, and integrated gasification combined cycle cogeneration plants.

Drying
Our high-quality AxSorb activated aluminas are used for almost every application where trace water removal is required from hydrocarbon gases or air. AxSorb adsorbents are specifically designed to provide the best combination of mechanical strength, adsorption characteristics, hydrothermal aging and retention to fouling for individual applications.

Liquefin
This new, highly competitive natural gas liquefaction process has many advantages and has a substantially lower capital cost than conventional schemes. Its modular construction means that train size is no longer limited by a single cryogenic heat exchanger. Efficient, low-cost, multiple plate-fin exchangers are employed. The heat-exchange duty, traditionally assured by two very different refrigeration systems, is balanced so that identical drivers can be used for the main compressors. Operation is simplified, and the costs for spares and maintenance are considerably reduced. Liquefin received the British Institution of Chemical Engineers’ 2002 Award for Safety, Environment, Best Practice and Innovation.
Alternative fuels

To meet future demands, non-oil-based alternative fuels will be required to supply a significant share of the motor fuel market. The key technologies or process chains of interest for supplying alternative fuel needs are natural gas to liquids (GTL), bio-ethanol, biomass to diesel (BTL), direct coal to liquids (DCL) and indirect coal to liquids (CTL).

Axens has developed and continues to work on new processes, such as Esterfip-H, H-CoalTS and Gasel Fischer–Tropsch technologies, to respond to the increasing demand for alternative fuels.

**Esterfip-H**

Axens is present in the first-generation biodiesel market, which involves vegetable oil transesterification. This is a highly efficient, continuous, heterogeneous catalyzed process that produces high-quality diesel and glycerin while generating no waste products.

Esterfip-H received the Kirkpatrick Award for Chemical Engineering Achievement by the US journal *Chemical Engineering* in 2007.

**Direct coal liquefaction**

Axens provides all technologies for direct coal liquefaction and upgrading of coal liquids. The H-CoalTS process is designed to produce high-quality distillates fuels using our commercially proven ebulated-bed reactor system.

**Gasel – a key to clean fuels**

The motor fuels sector faces a double challenge: provide an increasing quantity of ever-cleaner fuels and find sources that do not rely on crude oil. Our Gasel technology suite answers this challenge through the conversion of synthesis gas (H₂ + CO) from various origins, natural gas, biomass, and coal, into waxy materials that are hydrocracked into ultra-clean liquid fuels (XTL).
Hydrogenation

Hydrogenation is a key purification process for both the refining and petrochemical industries. Its importance is driven by the need to optimize plant operations to comply with increasingly stringent specifications. Our broad experience and catalyst technology bring you the best in performance, reliability and technical support. In addition to workhorse catalysts such as the LD series, we offer a wide range of products that can be adapted to virtually any hydrogenation scenario.

Hydrotreating and hydroconversion

With the programmed improvement in fuel product specifications and increased demand for middle distillates, hydrotreating catalyst technology has become crucial to the refining industry. Axens offers a complete product range of hydrotreating and hydroconversion catalysts from naphtha and gas oil to residue applications.

Axens’ investments in catalyst development and in its state-of-the-art manufacturing facilities brings you the best catalysts through the HR, HT, HRK, HTK, HYK, HTS, HYC and HMC series. These product lines are strongly supported by commercial experience and a complete offer of services and proprietary EquiFlow reactor internals. For more information, ask about our ACE Technology dual-activity hydrotreating catalysts.

We are committed to the development, manufacture and service of catalysts and adsorbents for the refining, petrochemical, chemical and gas markets.

Our manufacturing sites are in Salindres, France; and Calvert City, Kentucky, and Savannah, Georgia, in the USA.

A substantial portion of our revenue is reinvested in catalyst development and improvement so we can offer the best catalysts available, both now and in the future.

Catalysts, adsorbents and products
Catalysts, adsorbents and products

Reforming and isomerization
Axens is a leader in naphtha reforming. We have been very active in this market for over four decades, and provide a complete range of reforming catalysts for semiregenerative, cyclic and continuous regeneration processes that is suitable for all unit designs. Our portfolio also includes aromatics production and isomerization catalysts. Our AR, CR, RG and ATIS series products come with a complete range of expertise and services, and proprietary techniques such as Texicap and Catapac.

Sulfur recovery
Environmental regulations concerning fuels and industrial wastes present a serious challenge to refiners who must treat increasing amounts of acid gases while simultaneously improving sulfur recovery. For years, we have brought to the marketplace attractive solutions for sulfur recovery as well as a complete portfolio of solutions for sulfur reduction in fuels. Our AM, AMS, DR, CSM, CR, CRS, and TG series products fit your needs.
Axens is the world’s leading supplier of top-of-the-line Claus sulfur-recovery catalysts.

Guard beds
As a pioneer in the field of noble metal catalyst utilization and protection of these catalysts from premature deactivation, Axens offers a full range of guard bed materials to trap catalyst contaminants and poisons such as sulfur, arsenic and mercury, and particle contaminants such as polymeric materials, rust, sand and sludge. Ask us about our ACG, CMG and MEP series products.

AxSorb adsorbents
Adsorption is a well-known technique that is employed to purify many different gas and liquid streams. Axens, with its unique range of molecular sieves and specialty aluminas, squeezes the best performance from your units. With decades of experience in adsorption technology, we not only supply products (the AA, SAS, MSE and MSB series), we also deliver global expertise and services. Our commercially proven multibed technology provides an optimized combination of our adsorbents for improved operations.

Grading materials
The ACT series of grading materials is available to prevent reactor or adsorber bed contamination through impurities entering with the feed. The series covers the complete range of inert and active grading materials in various sizes and shapes.
Grading materials are used to extend reactor or adsorber operating cycles, especially if the operation is subject to pressure drop increases. A pressure drop often occurs across a thin crust of agglomerated material, such as coke particles, metal oxides, corrosion products, polymer or gum, arriving with the feed. Grading materials trap and store the offending materials.
Axens supplies inert and active grading materials, and the expertise to ensure their proper application.
**Specialized catalysts**
Axens markets a variety of dedicated catalysts that meet special market needs. The catalytic functions cover homogeneous and heterogeneous reactions in Axens’ biodiesel, Fischer–Tropsch, oligomerization, sweetening and olefin dimerization processes.

**Toll manufacturing**
If you need for a particular catalyst or adsorbent that is not directly available from our catalogue, contact us to discuss the formulation of a product to meet your requirements.

**Reactor internals**
With product sulfur specifications converging around the 10–15 ppm level worldwide, near perfect fluid distribution in catalytic beds is crucial. The smallest disturbance in flow in the reactor has a profound impact on product quality. EquiFlow reactor internals optimize flow distribution at the entrance of each catalyst bed and ensure homogeneous mixing of fluids inside reactors, thereby providing the longest operational cycle lengths. EquiFlow internals are application-specific. By making better use of our excellent catalysts, EquiFlow reduces the number of change-outs, improves the onstream factor and reduces the overall catalyst costs.
We provide a complete service program that includes start-up assistance, performance follow-up, analysis of spent material, regeneration recommendations and performance prediction. We furnish our customers with all the technical services needed during the entire life of our products. The services covered during the products’ final phase include

- end-of-cycle catalyst analyses for regeneration decision
- technical expert evaluation and recommendations on reuse
- unloading supervision
- product disposal assistance.

**Catapac**

Catapac is an ultra-high-density loading technique that is used to add more catalyst to the same reactor volume: up to 20% additional catalyst. With Catapac, particle distribution in the bed is more homogeneous than with sock and other dense loading methods, thereby avoiding pressure gradients in the catalyst bed, which could lead to coking or gas production.

**Texicap**

Texicap is an innovative concept in reactor internals. It offers substantially higher performance from fixed-bed radial reactors where low pressure drop is critical, such as in reforming units. Applying Texicap in semiregenerative reforming reactors can provide a combined addition of up to 15% additional throughput and higher activity or longer cycle length to your operations.

**Sorbotest**

Wherever catalyst contamination is an issue, our analytical and troubleshooting Sorbotest services are available to help you identify the problem and respond with the appropriate solution. Sorbotest is a unique service using a skid-mounted adsorber that can identify an array of feedstock contaminants.
Axens’ Performance Programs business unit is well equipped with advanced services to further improve customer profitability. We bring together power and resources backed up by five decades of discovery, development, reaction kinetics, modeling, process know-how and design, control and optimization, commercial start-ups and operations with ever-present safety and environmental considerations.

Our customers need to keep abreast of the fast-growing complexity of modern hydrocarbon installations. Axens can assist by combining powerful linear programming capabilities with its process expertise.

Countless benefits are possible throughout the complete spectrum of activities in the industry; for example, evaluation of the impact of crude changes on a refinery’s product slate and profitability. Optimizing operations, logistical planning, strategic studies and long-term investment decisions are among the many subjects treated through the use of linear programming.

Our advanced services are organized along three lines.

**Refining expertise services**

P² has significant experience in grassroots refinery studies for serving our customers. The scope of work typically includes market surveys, crude oil allocation studies, economic environment and financial baseline settings, site location evaluations, alternate refining configuration screening based on linear programming modeling, cost estimations, financing plan development, preliminary environmental impact assessments, conceptual studies with cost estimates at the level of Association for the Advancement of Cost Engineering (AACE) Class 4.
Process simulation
Operator-training and process-operations simulators based on customized reactor kinetic models provide accurate simulations that are well fitted to your units. Simulators are key tools for improving your operations team’s knowledge and expertise and for better understanding of how to operate the unit for specific target needs.

Profit optimization and energy-efficiency improvement
Asset maximization: Axens’ extensive operations know-how and technology background are applied to develop plans for production enhancement. This results in rapid implementation solutions to generate a fast return. For example, our P^2 team provides studies to find unexploited refinery hydrogen and to improve energy efficiency through the technical analysis of overall energy usage in the refinery and the identification of projects that could be eligible as projects for the Kyoto Protocol’s Clean Development Mechanism (CDM).

Advanced process control (APC): Process expertise supported by proprietary inferential models provides the definition of the best APC strategies. Associated with a powerful multivariable predictive controller, these strategies provide cost-effective APC implementations. Economic optimization is considerably improved by the use of rigorous kinetic models.
Customer service is our business

In serving you better, we fulfill our mission.

Training
Axens has a wide selection of training programs – from on-site and classroom-type operator training for Axens’ units to training programs for operators and foremen delivered through IFP’s Continuing Education Center, IFP Training. Axens also provides specific and generic operator-training simulators for most process applications.

Start-up assistance
As part of a process licensing or catalyst purchase agreement, Axens provides assistance for inspection, pre-commissioning, commissioning, catalyst loading and all start-up and operational know-how to ensure that your unit performs to expectations.

Operation support
Monitoring and assistance continues once your unit is up and running. We offer optimization studies; evaluation and enhancement; performance monitoring; consulting; analyses; troubleshooting; regeneration consulting; catalyst and adsorbent loading; and catalyst recovery to ensure optimal performance of your units, refineries, gas plants and petrochemical complexes.
Axens and the Environment

Contributing to a cleaner world

Our commitment includes:

• the nature of the processes, products and services that we deliver to our customers
• the operation of our industrial plants in a manner that respects the environment, the health and the safety of our employees and the public.

The nature of our processes, products and services

Through the development of technologies, catalyst and services supplied to the refining, petrochemical intermediates and gas processing markets, Axens contributes to improving energy efficiency and producing cleaner products.

• Clean fuels production: Axens is a benchmark company in clean fuels technology. Clean fuels are key ingredients in improving air quality by reducing motor vehicle emissions. We provide the refining industry with hydrotreating technologies and associated catalysts to produce clean fuels, virtually free of sulfur, that meet the most stringent specifications.

• Refinery tail gas and natural gas sulfur removal: Axens is a world’s leading premium Claus catalysts supplier for sulfur recovery units. Our products are among the most active and longest lasting for the conversion of hydrogen sulfide, present in refinery tail gas or natural gas, into saleable sulfur, thus contributing to air quality improvement worldwide.

• Natural gas and condensate purification: Downstream processing and environmental needs impose removal of arsenic and mercury compounds from natural gas and condensate streams at a parts-per-billion level. Our processes and adsorbents recover these contaminants for controlled disposal rather than release them to the local environment.

• Energy efficiency: Our Performance Programs teams provide energy efficiency studies to improve the operation of industrial plants and to identify projects that could be eligible for the Kyoto Protocol’s Clean Development Mechanism. As a result, we assist in contributing to greenhouse gas emissions reduction.

Management policy

In accordance with our Quality, Health, Safety and Environment Policy, Axens continuously strives to improve the quality of its products and services, and the safety of its operations and to reduce emissions and waste streams at its production plants. A major environmental plan was launched several years ago and emissions have been drastically reduced.
Worldwide network

Contact us on the web anytime, anywhere. We operate a worldwide network.

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The performance improvement specialists

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