

ECOMAX[®] NGS

INDUSTRIAL COGENERATION:
ENERGY SAVING AND ECOSUSTAINABILITY

 AB Energy
www.abenergy.it

 AB Energy

ECOMAX

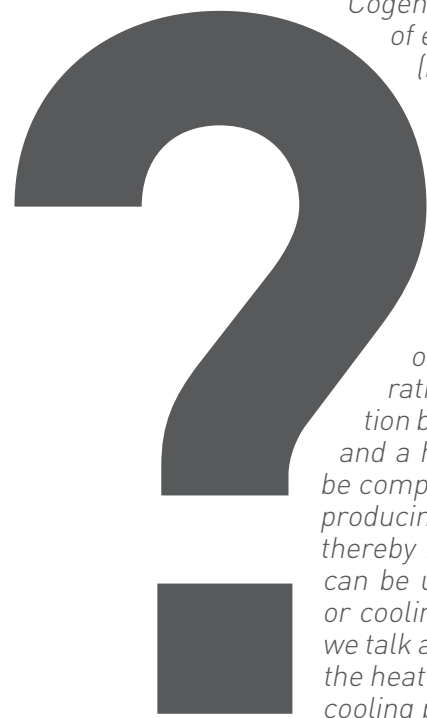


The global CHP leader:

→ 30 YEARS OF EXPERIENCE → 800 INSTALLED PLANTS (1.100MWE) → 36,000 SQ M OF PRODUCTION FACILITIES → PEAKS OF 98% PLANT AVAILABILITY → 150 SERVICE OPERATORS

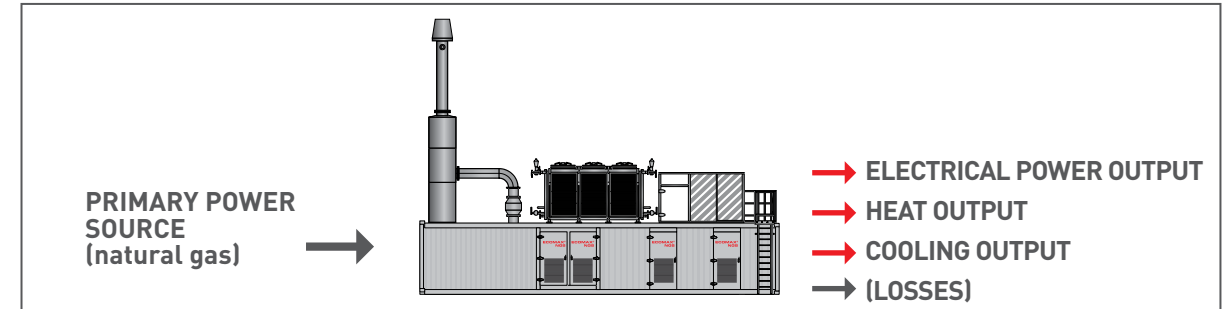


COGENERATION: WHAT IS IT



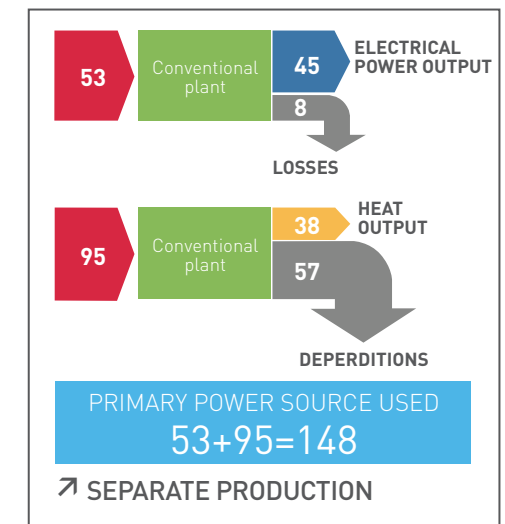
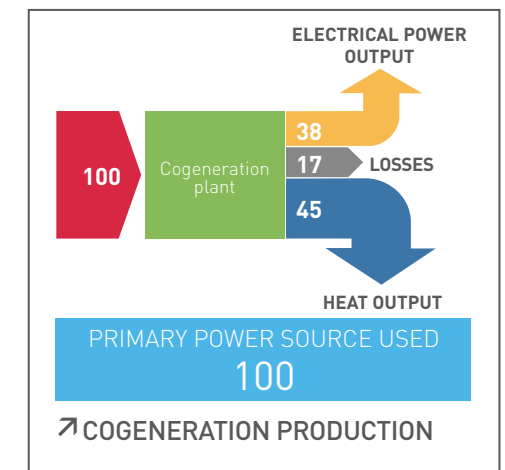
Cogeneration consists in the simultaneous production of electricity and heat, starting from a single source (both fossil and renewable), inside a single integrated system. The main advantage compared to traditional separate-process energy production is that the heat is reused that normally remains unused and is dispersed in the atmosphere.

The cogeneration concept is closely related to that of "cogeneration plant", i.e., the technology able to implement the simultaneous production of electricity and heat. The most common configuration of a cogeneration plant calls for the integration between a motor, connected to a power generator, and a heat recycling system. A cogeneration plant can be compared to a power generator which, instead of only producing electricity, also recycles the generated heat, thereby increasing the total output. The thermal energy can be used for industrial processes, for home heating or cooling and air-conditioning systems. In these cases, we talk about trigeneration: besides producing electricity, the heat recycled from transformation is used to produce cooling power.



THE ADVANTAGES

Cogeneration allows saving up to 30% of primary energy and affords objective, measurable and quantifiable benefits. Trigeneration is based on the same guiding principle, i.e., the simultaneous production of heat, electrical power and cooling power from just one power source. Cogeneration and trigeneration fall within the strategic choices of companies which see energy efficiency as an essential opportunity for cutting costs and bettering their competitive edge. Equally important are the advantages at environmental-impact level, inasmuch as CO₂ emissions are significantly reduced thanks to the lower consumption of fossil fuels. That is why cogeneration plays a major role in sustainable-energy policies, in line with "20-20-20" European Union goals and other community environment-protection provisions.



COGENERATION MEANS: ENERGY EFFICIENCY - ECOSUSTAINABILITY - MONEY SAVING - RENEWABLE ENERGY - IMAGE VALUE.

ENERGY EFFICIENCY

a strategic industrial policy factor, to promote growth on increasingly more competitive markets.

Energy efficiency is an increasingly more decisive factor when it comes to industrial policies on highly competitive markets and which therefore require the optimisation of each specific expense item.

The importance of energy efficiency has also been reiterated in high-ranking places: from industrialists' associations to European offices charged with planning the future of energy production and its rules.

A significant fact is that attention for renewable sources is gradually being joined by and even shifted, above all at industrial level in high-energy consumption sectors, onto cogeneration.

Cogeneration plants are in fact able to achieve very high levels of energy efficiency, with the advantage of being able to manage the production of electricity and heat in a continuative, reliable and safe way. In many cases, cogeneration even fuels growth in many different industrial manufacturing sectors on the competitive scenario of globalisation.

Cogeneration is the best choice for reducing energy bills in a reasonable space of time and for cutting CO₂ emissions. Such efficiency is also recognised by the European Community which some time ago expressed itself in favour of this technology, saying that it was "one of the few able to provide a major contribution in the short and medium term, a valid reference for the realisation of environmental policies throughout the Union".

The AB Group has the products, the skills and the integrated approach to make it unique on the European cogeneration scene. The companies making it up, among their synergies, avail themselves of common and constantly evolving know-how and multidisciplinary resources: all this translates into plants capable of high performance levels and utmost reliability.

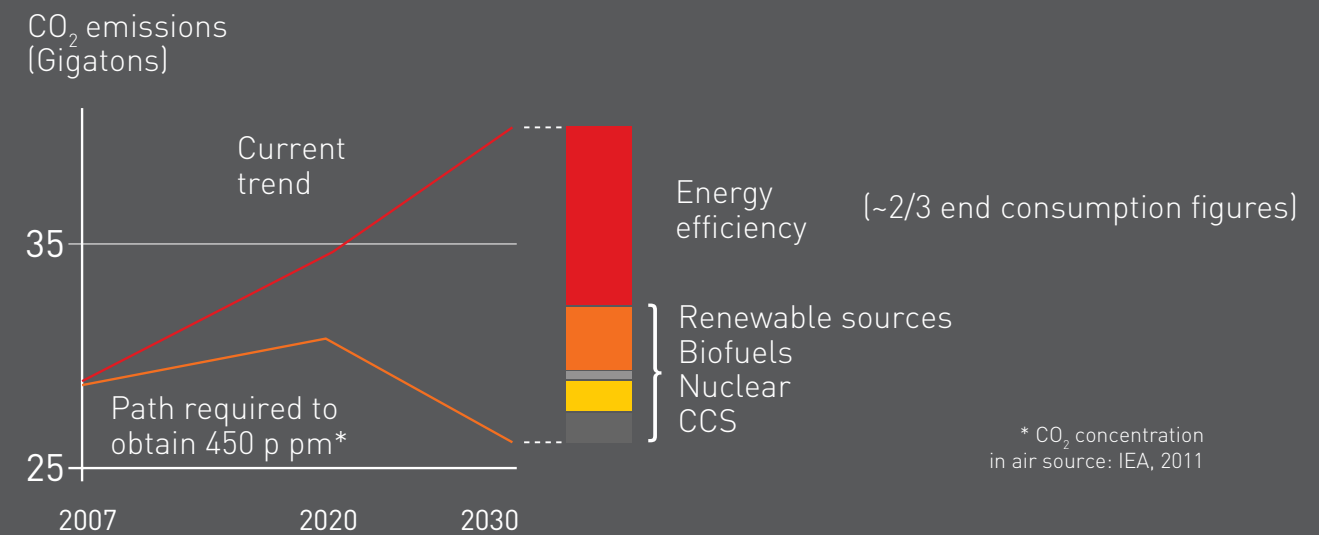


WHAT DOES ENERGY EFFICIENCY MEAN?

PRODUCING THE SAME PRODUCTS AND SERVICES WITH LESS ENERGY EXPENDITURE

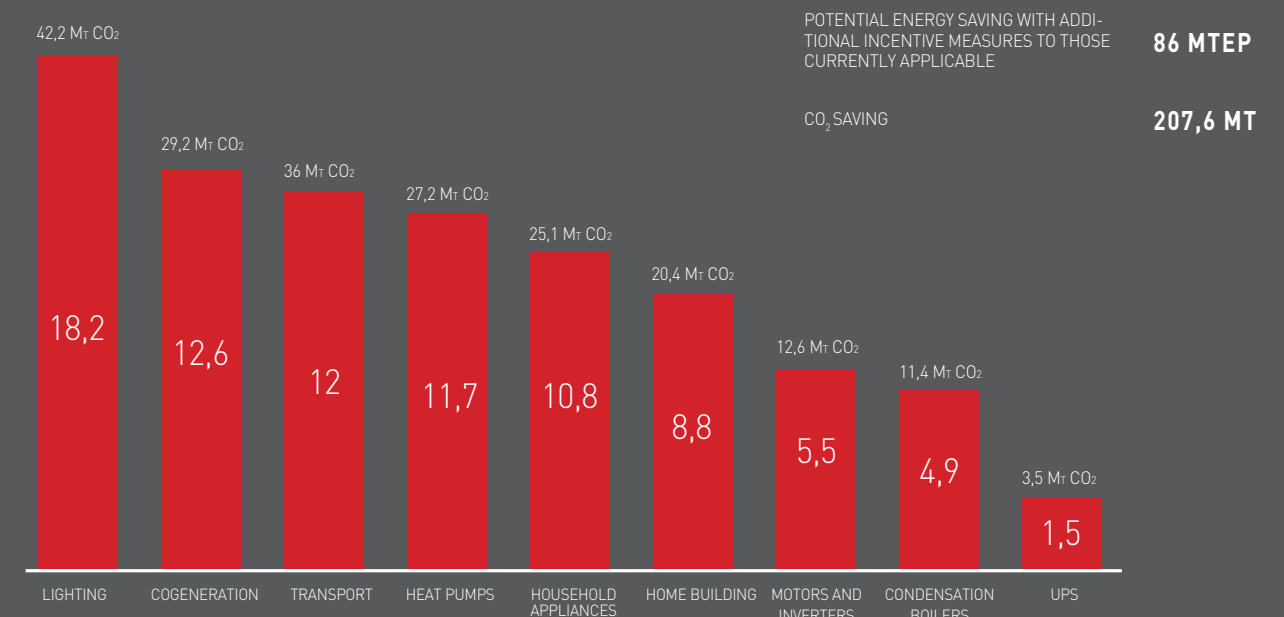
SOFTER IMPACT ON THE ENVIRONMENT / LOWER COSTS FOR COMPANIES

CUTTING CO₂ EMISSIONS: EFFICIENCY IS OVER 50% THE SOLUTION.



SAVING POTENTIAL WITH ENERGY EFFICIENCY MEASURES

FOSSIL ENERGY SAVED/ INTEGRAL VALUE 2010-2020 (MTEP)

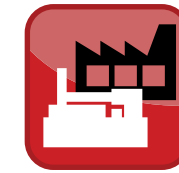


SOURCE: STRATEGIC ENERGY EFFICIENCY PLAN - ITALIAN INDUSTRIALISTS' ASSOCIATION, 2010

THE ECOMAX[®] SOLUTION

modular-package cogeneration plants, a model which is one of a kind in Europe in terms of design and production capacity.

Created in 1997, Ecomax[®] is the industrial cogeneration solution based on the principles of versatility, modularity and compactness, able to combine these distinctive features with high energy performance levels. An idea conceived and developed completely within AB, in the forefront as regards the range and possibilities of plant applications to the extent of setting the technological and market standards for modern cogeneration. Ecomax[®] characteristics offer numerous advantages: no building licence, great flexibility and relocatability, speedy installation and start-up, easy to link up to already-existing plant engineering systems. Thanks to its great flexibility, Ecomax[®] can be run at different speeds – from a load situation equivalent to 100% of rated power to 50% of plant potential, in order to optimise the produced energy carriers. Alongside vertical scalability, meaning the complete coverage of available power range, the horizontal scalability, guaranteed by a solution with several modules, especially suited to large size plants, also allows sustaining production in very reduced load conditions or during scheduled production stoppages.



THE ADVANTAGES

of the outdoor modular solution

- NO BUILDING LICENCE
- DRASTIC CUT IN INSTALLATION AND WORKSITE START-UP TIMES
- RELOCATABILITY
- FLEXIBILITY
- SCALABILITY
- AVAILABILITY
- EASY TO CONTROL AND LINK UP WITH EXISTING SYSTEMS

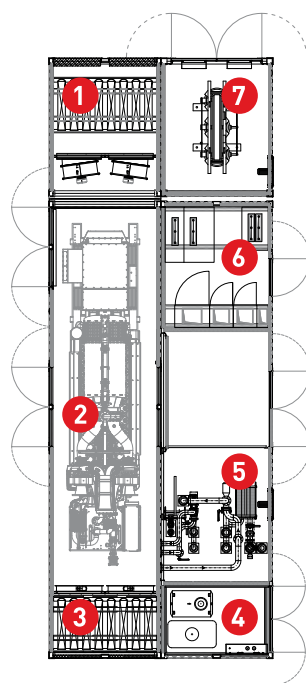
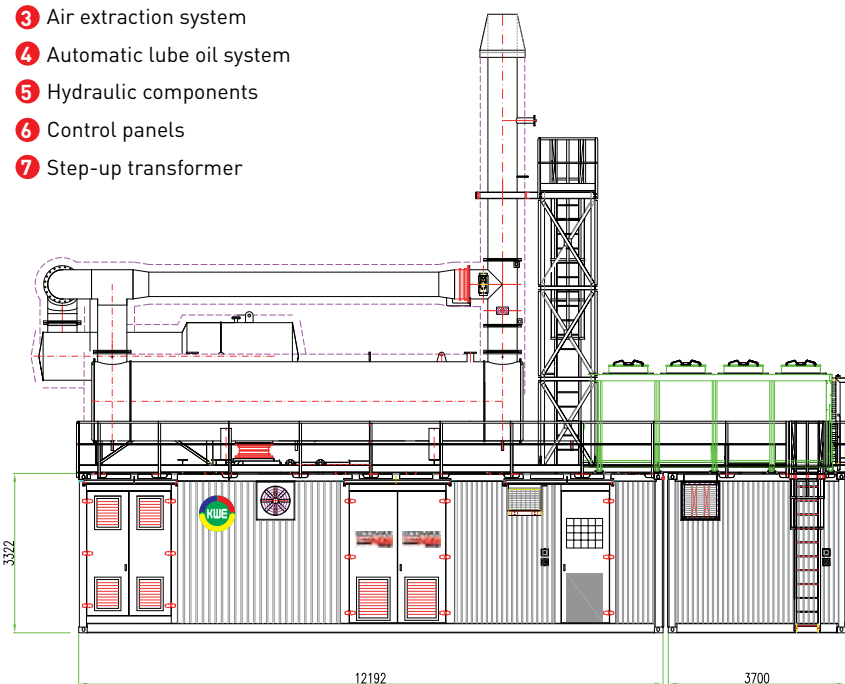


- 1** **Housing containers for engine and auxiliary devices:** designed and built for outdoor installation, made of carbon steel, the engine and the control panel are housed inside the first container, the MV Switchboards and the step up transformer housed inside the second special container.
- 2** **Silencer and exhaust stack:** made of stainless steel, designed for noise reduction and smokes emission in atmosphere.
- 3** **Emergency dry air coolers:** series of electrical fan placed on the engine container's roof and used to dissipate the heat produced by the engine if not saved by the customer's facility.
- 4** **Air inlet system:** able to guarantee the correct ventilation inside the engine containers.
- 5** **Monitoring system:** signals are acquired by the control PLC, coupled to SCADA to monitor, display and report the status of the whole CHP plant.



- 6** **Exhaust gas heat exchanger:** for heat recovery from the exhaust gas cooling.
- 7** **By pass circuit:** placed on the exhaust gas pipe line, it is able to deviate waste fumes from the engine to the exhaust gas heat exchanger or to the exhaust stack for emission in atmosphere.
- 8** **Exhaust gas stack:** for extracting the exhaust fumes, with featuring dedicated structure.

- 1 Air inlet system
- 2 Endothermic motor
- 3 Air extraction system
- 4 Automatic lube oil system
- 5 Hydraulic components
- 6 Control panels
- 7 Step-up transformer



➤ Ecomax® 33 NGS layout



➤ hydraulic connections



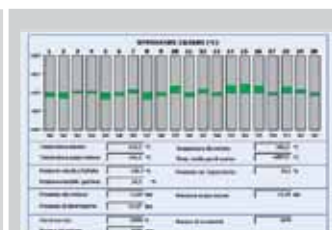
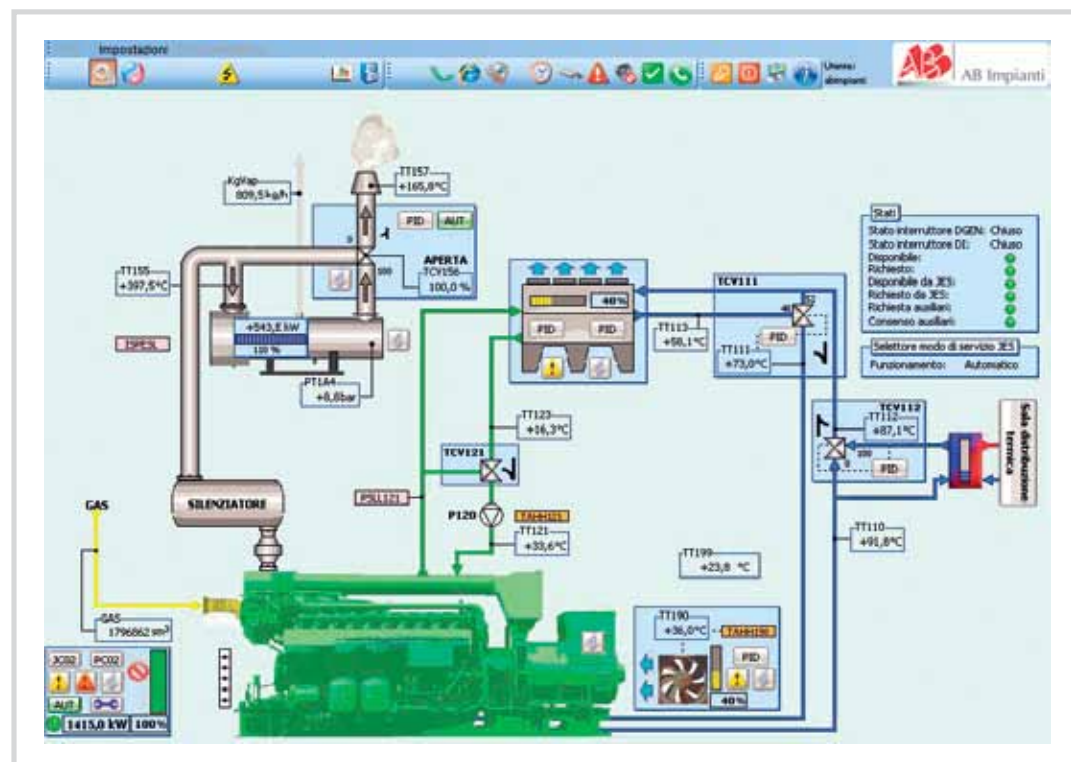
➤ Ecomax® interior, endothermic motor



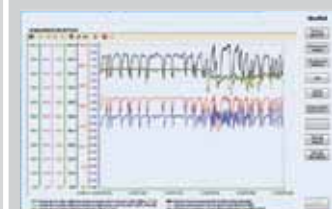
➤ piping



➤ exhaust gas heat exchanger



➤ cylinder temperature



➤ operating unit graphs



➤ connection diagram

➤ Ecomax® NGS Monitoring System



➤ control and supervision room

- 1. engineering complex
- 2. new production complex



- 3. container metal structural work
- 4. manufacture of emergency dissipator piping



- 5. outside piping pre-assembly
- 6. switchboard manufacture



- 7. fitting cogeneration motor
- 8. finished-module ready for shipment warehouse

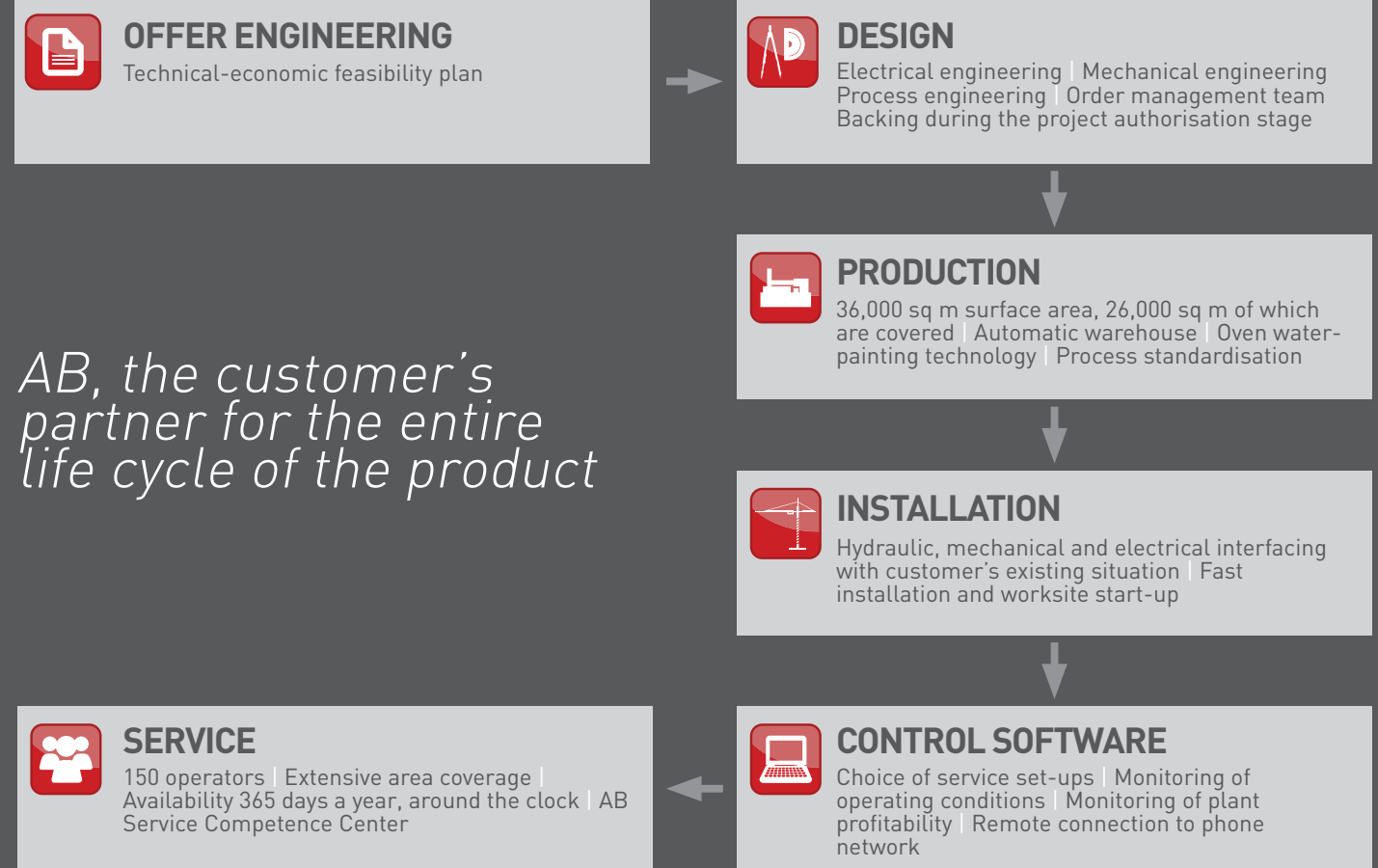
PLANT BUILDING:

each AB Ecomax® plant is the upshot of multi-disciplinary commitment

AB builds the entire plant in its Orzinuovi production facility – the only European company to do so. This enables it to acquire one-of-a-kind know-how and to be perfectly acquainted with every aspect of its systems. The entire production process is planned and organised along a defined path to optimize each single stage: metal sections, container module set-ups, motor fitting, wiring and assembly of electrical and hydraulic parts, testing and shipment.

In 2010, the new AB engineering complex was opened. About 100 cogeneration professionals work here, including engineers, technicians and specialists in the sector. The various multidisciplinary teams making up the backbone of this organisation define and plan the various plant production activities (hydraulic, electric, mechanical and process) according to the customer's specific requirements, drawing up a work protocol to which production departments can refer. AB is focused on a modern business vision, directed towards minimising wastes and even more efficient personalisation wherever necessary.

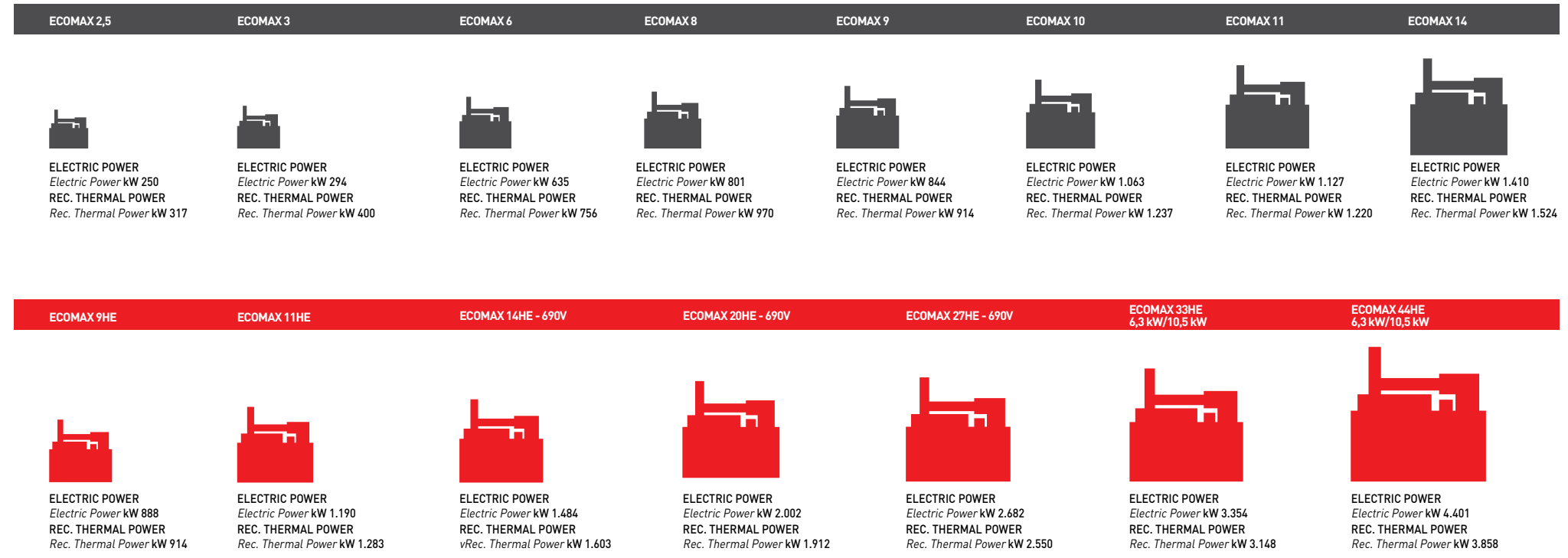
Engineering activities are performed in conjunction with the "offer engineering" team, entrusted with drawing up and presenting to the customer a detailed and reasoned technical-economic feasibility plan, especially when the need exists to integrate functions with already-existing technologies. The development of the project, up to plant installation, is followed by specialists who form links between AB and the customer, and make sure contractual provisions are stringently observed.



AB, the customer's partner for the entire life cycle of the product

PLANT ENGINEERING SOLUTIONS

AB places at disposal a complete range of plant-engineering solutions such as to be able to cater to all industry requirements in the various application and market sectors. Energy-efficiency results, always at top output levels, ensure reliable investment payback periods thanks to the possibility of being able to choose the exact size of the plant in accordance with specific needs, backed by the consultancy of AB engineers.



ECOMAX® PRODUCT LINE: NGS

| | | ECOMAX 2,5 | ECOMAX 3 | ECOMAX 6 | ECOMAX 8 | ECOMAX 9 | ECOMAX 10 | ECOMAX 11 | ECOMAX 14 |
|--|---------------|------------|----------|----------|----------|----------|-----------|-----------|-----------|
| ELECTRIC POWER | kW | 250 | 294 | 635 | 801 | 844 | 1.063 | 1.127 | 1.410 |
| MECHANICAL POWER OUTPUT | kW | - | 305 | 657 | 827 | 871 | 1.095 | 1.161 | 1.451 |
| ENERGY INPUT | kW | 680 | 781 | 1.620 | 2.056 | 2.050 | 2.673 | 2.733 | 3.471 |
| FUEL GAS VOL. CONSUMPTION – PC 9,5 – MC - | NMC/h | 72 | 82 | 171 | 216 | 216 | 281 | 288 | 360 |
| FUEL GAS PRESSURE | mbar | - | 80-200 | 80-200 | 80-200 | 80-200 | 80-200 | 80-200 | 120-200 |
| HEAT RECOVERING FROM ENGINE: | | | | | | | | | |
| • LUBE OIL - RET. 70°C - | kW | - | 36 | 77 | 94 | 97 | 125 | 129 | 161 |
| • INTERCOOLER FIRST STAGE | kW | 26 | 42 | 129 | 124 | 176 | 210 | 235 | 294 |
| • JACKET WATER- EXIT 90°C - | kW | 150 | 127 | 199 | 230 | 257 | 326 | 342 | 427 |
| TOTAL | kW | 176 | 205 | 405 | 448 | 529 | 661 | 706 | 882 |
| EXHAUST GAS COOLING RECOVERY AT 120° C | kW | 141 | 195 | 351 | 522 | 385 | 579 | 514 | 642 |
| HOT WATER TOTAL RECOVERY | kW | 317 | 400 | 756 | 970 | 914 | 1.240 | 1.220 | 1.524 |
| ELECTRICAL OUTPUT | % | 36,8 | 37,6 | 39,2 | 39,0 | 41,2 | 39,8 | 41,2 | 41,3 |
| THERMAL OUTPUT | % | 46,6 | 51,2 | 46,7 | 47,2 | 44,6 | 46,3 | 44,6 | 44,6 |
| TOTAL OUTPUT | % | 83,3 | 88,8 | 85,9 | 86,1 | 85,8 | 86,0 | 85,9 | 85,9 |
| INTERCOOLER 2ND STAGE | kW | 21 | - | 56 | 64 | 73 | 91 | 96 | 120 |
| EXHAUST GAS THERMAL RECOVERY: | | | | | | | | | |
| • DIRECT 25°C AMBIENT TEMP. FUMES | KW | 182 | 246 | 457 | 657 | 527 | 755 | 703 | 879 |
| • STEAM PRODUCTION AT PRESSURE OF 8 BAR | kg/h | 126 | 180 | 312 | 483 | 322 | 515 | 429 | 536 |
| • DIATHERMIC OIL PRODUCTION 180/220°C | kW | 186 | 265 | 461 | 713 | 474 | 760 | 633 | 791 |
| | kW | 89 | 131 | 220 | 354 | 211 | 363 | 282 | 352 |
| NOX A 5% OF O₂ | mg/NMC | 500 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| CO A 5% OF O₂ (CONFIGURATION WITH CATALYTIC CONVERTER) | mg/NMC | 500 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |

ECOMAX® PRODUCT LINE: HE

| | ECOMAX 9 HE | ECOMAX 11 HE | ECOMAX 14 HE 690V | ECOMAX 20 HE 690V | ECOMAX 27 HE 690V | ECOMAX 33 HE 6,3kV / 10,5kV | ECOMAX 44 HE 6,3kV / 10,5kV |
|--|-------------|--------------|-------------------|-------------------|-------------------|-----------------------------|-----------------------------|
| ELECTRIC POWER | 888 | 1.190 | 1.484 | 2.002 | 2.682 | 3.354 | 4.401 |
| MECHANICAL POWER OUTPUT | 916 | 1.222 | 1.527 | 2.058 | 2.745 | 3.431 | 4.491 |
| ENERGY INPUT | 2.151 | 2.868 | 3.585 | 4.544 | 6.059 | 7.574 | 9.450 |
| FUEL GAS VOL. CONSUMPTION – PC 9,5 – MC - | 226 | 302 | 377 | 478 | 638 | 797 | 995 |
| FUEL GAS PRESSURE | 80-200 | 80-200 | 120-200 | 120-200 | 120-200 | 120-200 | 200 |
| HEAT RECOVERING FROM ENGINE: | | | | | | | |
| • LUBE OIL - RET. 70°C - | 100 | 133 | 167 | 178 | 238 | 297 | 431 |
| • INTERCOOLER FIRST STAGE | 201 | 268 | 335 | 492 | 656 | 781 | 1.197 |
| • JACKET WATER- EXIT 90°C - | 262 | 350 | 437 | 318 | 424 | 530 | 558 |
| TOTAL | 563 | 751 | 939 | 988 | 1.318 | 1.608 | 2.186 |
| EXHAUST GAS COOLING RECOVERY AT 120° C | 399 | 532 | 664 | 924 | 1.232 | 1.504 | 1.672 |
| HOT WATER TOTAL RECOVERY | 962 | 1.283 | 1.603 | 1.912 | 2.550 | 3.148 | 3.858 |
| ELECTRICAL OUTPUT | 41,3 | 41,5 | 41,4 | 44,1 | 44,3 | 44,3 | 46,6 |
| THERMAL OUTPUT | 44,7 | 44,7 | 44,7 | 42,1 | 42,1 | 41,6 | 40,8 |
| TOTAL OUTPUT | 86,0 | 86,2 | 86,1 | 86,1 | 86,4 | 85,8 | 87,4 |
| INTERCOOLER 2ND STAGE | 75 | 100 | 126 | 116 | 155 | 234 | 248 |
| EXHAUST GAS THERMAL RECOVERY: | | | | | | | |
| • DIRECT 25°C AMBIENT TEMP. FUMES | 548 | 731 | 913 | 1.267 | 1.689 | 2.112 | 2.340 |
| • STEAM PRODUCTION AT PRESSURE OF 8 BAR | 331 | 441 | 551 | 769 | 1.026 | 1.282 | 1.352 |
| • DIATHERMIC OIL PRODUCTION 180/220°C | 488 | 651 | 813 | 1.134 | 1.513 | 1.891 | 1.994 |
| | 216 | 288 | 360 | 504 | 672 | 840 | 856 |
| NOX A 5% OF O₂ | 250 | 250 | 250 | 250 | 250 | 250 | 500 |
| CO A 5% OF O₂ (CONFIGURATION WITH CATALYTIC CONVERTER) | 300 | 300 | 300 | 300 | 300 | 300 | 300 |



SERVICE:

with AB Service, AB represents a partner for its customers 365 days a year, around the clock. AB Service's efficiency and extensive presence ensure record results every time: peaks of 98% plant availability.

AB Service resources and organisation make it possible to provide a round-the-clock operating service, 365 days a year, covering all installed plants.

The company currently has a workforce of 150 technicians providing extensive service available around the clock.

This strategy is determined by a precise business philosophy and dialogue with the market: for its customers in fact, AB is a real partner which considers the relationship between product quality and maintaining an excellent service over the years to be vital. Anyone who purchases an AB plant knows that after-sales support is a major factor and also looks for excellence when it comes to service and maintenance – something which AB Service is committed to.

AB Service is the AB company dedicated solely to after sales service.

Among the proposed services, besides routine and special maintenance, both scheduled and unexpected, configurable solutions are available right up to complete plant management, passing through occasional call services, continuous support and "assisted training" for the customer's personnel. An excellent service organisation, tested through the management of over 525 installations. This makes AB Service Italy's number one operator as regards the maintenance of cogeneration modules.

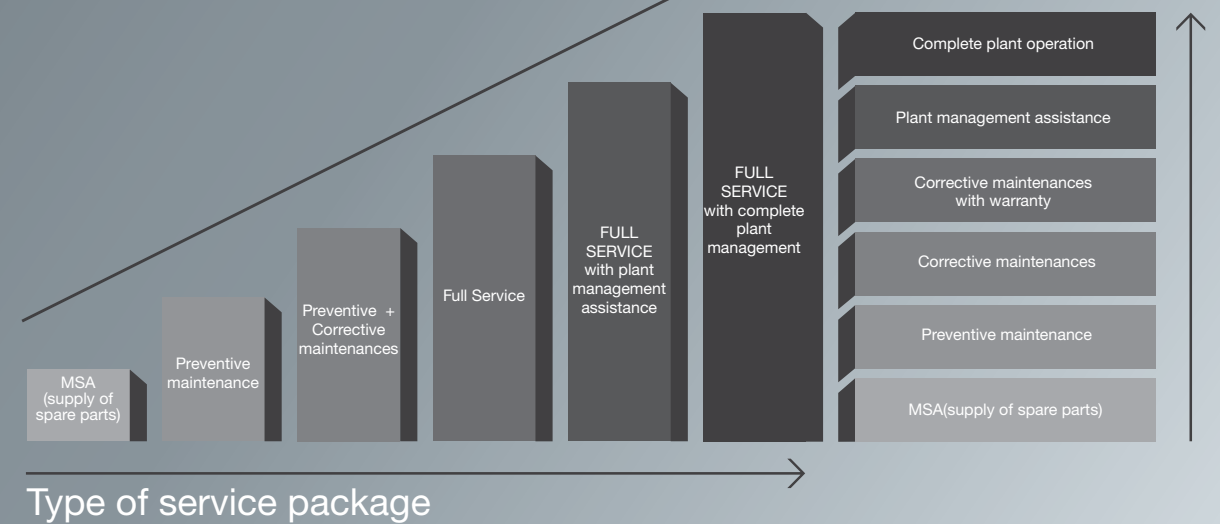
The AB after-sales service and the AB Service Competence Center.

The AB Service Competence Center ensures the quality of the after-sales and full-time support service provided for products installed by the AB Group. The Centre, run by a highly-qualified technical team, takes care of remote plant diagnosis and servicing, first requirement analysis and service team operation. Thanks to this centralised unit, AB Service is able to constantly monitor plant operation and manage scheduled and corrective maintenance jobs.



Service value added

Services provided





Food Industry



Plastic Industry



Textile Industry



Brick Manufacturing

EXPERIENCES:

Results confirmed by those who chose Ecomax®.

AB caters to all those sectors where cogeneration is able to provide the best results in terms of reduction of energy consumption and eco-environmental impact. Industrial companies and agricultural concerns rely on the AB's experience and full-offer to ensure a successful partnership.

To mention just some sectors:

- FOOD
- BEVERAGE
- DAIRY
- CHEMICAL
- PHARMACEUTICAL
- PLASTICS
- CERAMICS AND BRICKS
- TEXTILE
- WOOD
- METALLURGY
- HOSPITAL SERVICES
- ENVIRONMENTAL SERVICES
- PAPER MILLS
- TANNERIES
- GALVANIC TREATMENTS
- CENTRALISED COMMUNITY HEATING
- OIL&GAS



➤ Pharmaceutical Industry

1 x Ecomax® 18 NGS
Electrical Power: 1.824 kWe
Steam and hot water



➤ Centralised Community Heating

2 x Ecomax® 24 NGS
Electrical Power: 5.534 kWe
Hot water production



➤ Food Industry

1 x Ecomax® 8 NGS
Electrical Power: 801 kWe
Steam and hot water



➤ Dairy Industry

1 x Ecomax® 30 NGS
Electrical Power: 3.048 kWe
Steam and hot water

AB PROFILE

Established and directed by Angelo Baronchelli, AB Industrial Group has been operating for over 30 years in the field of cogeneration and the promotion of energy from renewable sources.

Today AB counts 16 operating companies and over 500 employees. Being outright Italian market leader has also favoured its growth abroad.

The Group has designed and manufactured over 800 "turnkey" cogeneration plants. AB plants stand out for their high performance, modularity, compact design and ease of transport – all features that fully cater to the energy requirements of the different customer companies. For its customers, AB is a single interlocutor, able to take care of every aspect of plant engineering. Through its Group companies in fact, it places at disposal all the technical know-how required for plant design, manufacture, installation and running, implementing the entire project, from building to start-up through to a maintenance service that covers the complete life cycle of the installation.

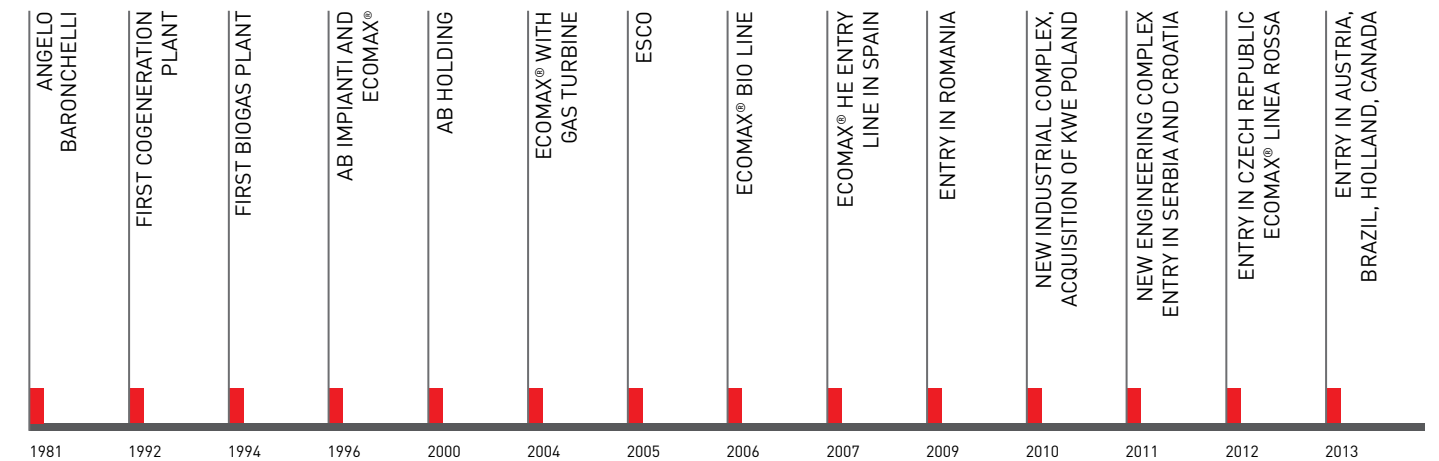
AB has recently undertaken an expansion process, which has also taken it abroad into those European countries where cogeneration is acquiring an increasingly more strategic role. After launching onto the Spanish market, with offices in Madrid and Barcelona, the Group is now also wagering on the east-European market and, in 2009, opened a subsidiary in Bucharest. In April, 2010, AB acquired the majority share of KWE Technika Energetyczna, local distributor and service partner for GE Jenbacher motors in Poland. AB and GE partnership got even stronger in 2011, with the opening of two new AB branches in Serbia and Croatia. In 2012 AB established the latest branch in Czech Republic and from 2013 also in Brazil, Austria, Holland and Canada.



AB HOLDING SPA

| ITALY SALES | FOREIGN BRANCHES | PRODUCTION | SERVICE | FINANCING | RENEWABLE ENERGY |
|---------------|--------------------------------------|-----------------|----------------|---------------------|------------------------------|
| AB Energy SpA | AB Energy International GmbH | AB Impianti Srl | AB Service Srl | AB Fin-solution Srl | AB Ambiente Farm Company Srl |
| | AB Energy España S.L. | AB Power Srl | | | |
| | AB Energy Romania Srl | | | | |
| | KWE Technika Energetyczna Sp. z.o.o. | | | | |
| | AB Energy Hrvatska d.o.o. | | | | |
| | AB Energy Srbija d.o.o. | | | | |
| | AB Energy Česká s.r.o. | | | | |
| | AB Energy do Brasil Ltda | | | | |
| | Green House Power Netherlands BV | | | | |
| | EPS AB Energy Canada Ltd | | | | |

THE MAIN STAGES OF THE 30 YEARS OF AB HISTORY



AB ENERGY, LEADING ENERGY