Our mission

We convert energy into sustainable progress and prosperity. We drive the transition towards a carbon-neutral world together with our partners.
Based in Augsburg, Germany, MAN Diesel & Turbo is one of the world’s leading creators of pioneering solutions based on large engines and turbomachinery. The company employs around 15,000 staff and is represented in more than 100 sites globally with manufacturing bases in Germany, Denmark, France, Switzerland, Czech Republic, India and China.

The product portfolio comprises four-stroke and two-stroke engines with power outputs ranging from 625 kW to 87 MW for power and marine applications. MAN Diesel & Turbo also designs and manufactures gas turbines of up to 13 MW, steam turbines of up to 160 MW and compressors with volume flows of up to 1.5 million m³/h and pressures of up to 1,000 bar. The product range includes gas engines, turbochargers, propellers, chemical reactors, cryogenic equipment, energy management and energy storage solutions. Additional services and supplies include tailor-made solutions like engine- or turbine-based power plants, ship propulsion systems, and turbomachinery trains for the oil & gas as well as the process industries. Customers receive worldwide after-sales services marketed under the MAN PrimeServ brand.

MAN Diesel & Turbo has been creating pioneering solutions since 1758, when the St. Antony ironworks laid the foundation for the development of the coal and steel industry in Germany. In 1897, Rudolf Diesel completed development work on his engine in the halls of today’s MAN Diesel & Turbo in Augsburg. The world’s first diesel engine, the original, was built and tested there.

MAN Diesel & Turbo is a company in the Power Engineering business area of MAN SE.
Competencies
Power engineering

Generating customer benefit
Decentralized and flexible power generation solutions are becoming more and more important in a changing energy world. MAN offers an advanced product and service portfolio combined with extensive experience in power plant engineering and construction.

Our products and services:
- From individual GenSets to power plant EPC (Engineering, Procurement, Construction)
- From spare parts supply to full operation and maintenance services
- From engine supply to full project development and financing

MAN is your reliable partner for complete power solutions from one source and reduction of CO₂ emissions by integrating renewables:
- Highest fuel efficiency
- High availability and reliability
- Operational flexibility, from backup power plant to base load power plant
- Wide scope for thermal energy recovery
- High fuel flexibility
- Rapid construction from earthworks to first kWh
- Resilience in “hot and high” locations
- Modular concept for flexible capacity expansion
- Compliance with emission regulations

Quality + Reliability = Availability
Thorough design, high quality engineering and precise manufacturing guarantee the reliability and operational safety of engines or turbines at the heart of MAN power plants. Robustness, reliability, ease of operation and maintenance are the preconditions for availabilities of above 8,000 hours per year.

MAN Diesel & Turbo is the winner of a Global Energy Award 2017!
Competencies
Scope of supply

MAN is your reliable partner in all aspects of power plant construction. We provide a complete range of engine- and turbine-based power solutions, from GenSet and equipment supply to a full EPC power plant ready for operation.

- **Basic ES (Equipment Supply)**
  This scope of supply also includes mechanical and process systems which cover the GenSet related auxiliaries. Optionally, you can order the GenSet control and interface panel.

- **Extended ES & EC (Equipment Supply & Electric and Control)**
  This scope includes the Basic ES plus the plant-related mechanical auxiliaries. This contains the MV and LV equipment as well as the station transformers.

- **Basic EPC (Engineering, Procurement and Construction)**
  This scope includes the Extended ES & EC plus engineering and procurement for the entire mechanical and electrical equipment of the power plant. This includes cable routing, HV equipment, special mechanical/process solutions, 3D-planning, piping and steelworks.

- **Extended EPC**
  This scope includes a complete power plant, ready for operation, with all engineering services as well as project management, site management, supervision and commissioning.

- **Services**
  Services can be fully aligned with your special needs. The range of services varies depending on the selected scope of supply.

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**Services at a glance**

1. Power house
2. Exhaust gas treatment
3. Firefighting pump house
4. Water tanks
5. Fuel tank farm
6. Radiator coolers
7. Pump house, fuel treatment
8. Warehouse
9. Workshop
10. Administration building
11. Unloading station
12. Substation
Power solutions
Overview

**Base load**
MAN can provide decentralized and highly reliable and efficient base load power plants which contribute to global decarbonization targets. MAN base load solutions allow for continuous full, part and low load operation.

The generating sets have a high single cycle efficiency of around 50%. However, in combination with MAN steam turbines, plant efficiency can even be enhanced in a combined cycle. MAN base load power systems follow a modular concept and are scalable to meet even your future demands. They run on most available fuels, liquid or gaseous. MAN base load solutions provide reliable power with high flexibility and availability. Please refer to pages 34-39, 69, 72.

**Peaking**
MAN provides responsive, flexible and highly efficient peaking power solutions for applications which require frequent ramping up and down, or cycling in response to changes in demand and load. The flexible peaking power plant can provide short-duration load, or pulse load, for example, in response to sudden output reduction from renewable power sources or spikes in demand. Optimized systems allow short starting times, as well as safe and efficient engine part and low load operation down to 5% load. With the integration of battery systems, excessive power can be stored, the power reserve of the system can be enhanced and standby cost savings can be achieved. MAN peaking systems follow a modular concept and are scalable to meet your future demands. Fuel flexibility allows you to run the GenSets on most available liquid or gaseous fuels. Please refer to pages 40-41.

**Combined heat & power**
MAN CHP (Combined Heat & Power) solutions can help you to reach a fuel efficiency of up to 95% and to contribute to global decarbonization targets.

MAN CHP systems follow a modular concept and are scalable to meet even your future demands. MAN CHP systems are based on engine or turbine-based GenSets and can produce electrical power and thermal power for district heating, process heating or cooling. Power or heat optimized operation can be provided throughout the year and allow a high degree of flexibility which is enhanced with the integration of heat storage systems. Due to their fast-start capability, MAN CHP systems can even be used for the energy balance market. Please refer to pages 42-47, 70-71.

**Hybrid power**
MAN also provides power solutions that support global decarbonization targets. Increasing the share in renewable energy sources improves the carbon footprint. Wind and solar power can be made more reliable by storing surplus power and using instant power top-ups from engine and turbine GenSets fuelled with gas or even biofuels. Renewable energy systems can even be added to power plants to act as fuel savers and hybrid island power systems.

MAN Microgrid Controls allow an optimized and reliable operation of hybrid power systems wherever and whenever you need them. Please refer to pages 48-53.
Power solutions
Overview

Power barges
With the help of specialist partners, MAN provides floating power solutions that enhance your flexibility and reduce your investment risk, as the barge is a low-risk mobile asset.

The tried and tested modular generating equipment and auxiliary systems associated with traditional land-based power plants are installed on a pre-engineered, heavy steel, rigid floating box.

The barge can be easily removed and relocated to another site, ensuring an extremely high asset value and minimum dependency on changing local conditions.
*Please refer to pages 54-55.*

LNG storage and infrastructure
MAN LNG solutions enable CO₂-reduced gas power even in areas where no natural gas is presently available. For new gas power or even for conversion projects of existing power installations MAN can provide the full package including the LNG infrastructure comprised of discharge, storage and re-gasification from one source.

MAN LNG systems follow a modular concept and are scalable to meet even your future demands. With our engineering competence and product portfolio for power and cryogenic plants, we can provide the best solution for you.
*Please refer to pages 56-57.*

Storage
The increased share in renewable energy sources improves the carbon footprint to a great extent, but sometimes also produces a surplus of energy which cannot be consumed immediately. By storing surplus power, the efficiency of the systems can be increased.

MAN offers solutions for Battery Energy Storage Systems (BESS), Electro-Thermal Energy Storage (ETES) as well as Power-to-X (P2X). In addition, MAN can provide key equipment for a variety of other storage technologies like Liquid Air Energy Storage (LAES) or Compressed Air Energy Storage (CAES).
*Please refer to pages 58-59.*

Emergency diesel generators
MAN can provide supremely reliable solutions for nuclear power plants. When fast start-up and absolute reliability are of essence, diesel engines have always been the superior technology.

Under the brand of S.E.M.T. Pielstick, MAN provides the best solutions for emergency diesel generator applications.
*Please refer to pages 60-61.*
Power solutions
Overview

Biomass
MAN provides biomass power plant solutions that reduce carbon emissions as well as fossil fuel consumption. MAN high-performance biomass power plants are based on modular and standardized steam turbine generator sets and provide reliable electrical and thermal power with high efficiency, flexibility and availability. In combination with other renewable energy sources, biomass power ensures energy security due to its steady availability.
Please refer to page 63.

Concentrated Solar Power (CSP)
MAN offers concentrated solar power plant solutions with tailored, efficient, reliable and cost-effective steam turbine generator sets. Our solutions are based on installed capacity and support different plant concepts, including the integration of high-temperature heat storage facilities and hybrid concepts with co-firing configurations, parabolic troughs and tower technologies. MAN steam turbines installed in CSP plants match application-specific demands including maximum level of efficiency, large number of starts, rapid start-up capabilities as well as re-heat options for maximum performance.
Please refer to page 64.

Geothermal energy
MAN provides geothermal power plant solutions which use the hydrothermal resources of the earth. Geothermal power is considered as reliable and sustainable. The technologies used to convert geothermal energy to electricity include dry steam and flash steam power stations. The robust and well-proven design of MAN steam turbines makes them suitable for aggressive steam conditions and seismic vibration.
Please refer to page 65.

Pulp & paper
MAN provides power plant solutions for the pulp & paper industry. Wood as a raw material is used to produce pulp, paper and other cellulose-based product as well as electricity and process steam for the pulp & paper plant. The plant can also serve electricity and district heating for the local utilities. MAN tailor-made steam turbines used in the pulp & paper industry have an important function in the overall plant process. They deliver enthalpy-controlled steam that ensures the quality of the pulp & paper production. MAN has the experience and the expertise to optimize the complete water/steam cycle in close cooperation with our customers to find the most favourable and efficient solution.
Please refer to page 66.

Waste-to-Energy (WtE)
MAN offers waste-to-energy plant solutions that generate electrical and thermal power for district heating from the burning of waste. This form of energy recovery prevents one ton of CO₂ release for every ton of waste burned and eliminates methane that would have leaked from landfill disposal. Landfill volume can be reduced by more than 90%. MAN standardized and modular steam turbines are well suited for electrical power generation based on waste incineration because of their high efficiency and flexibility.
Please refer to page 67.
Engine applications
Overview

We invest in the development of core components:
MAN continuously improves its products with the aim of generating customer benefit. To maintain full control in this process, it is our policy to control the entire process from R&D, production and testing to field surveillance. Core components include safety and control systems, turbochargers, injection systems, Selective Catalytic Reduction (SCR) and relevant engine components such as crank cases and connecting rods. All of these components have a vital impact on performance and reliability.

SaCoS engine safety and control system
- Intuitive and function-oriented modular software
- Modular, flexible, robust, and reliable "plug and work" hardware solution for all engines
- A highly secure data network with optional add-on products

Turbochargers
- Tailor-made charging system concepts for every engine type
- Matching of the turbocharger parts for highest performance
- Engine and turbocharger from one source
- Market leader in two-stage turbocharging
- Supplier for other OEMs

CR injection systems
- High pressure system enabling constant fuel injection pressure in accumulator (rail) units
- Maximum flexibility for combustion
- Electronic controlled injection time and pressure
- Maximum fuel pressure for all operating conditions (load and engine speed)
- Significantly improved dynamic engine response to transient load change
- Electronic adaption to different fuel types (e.g. DMA, HFO)
- Optimum SFOC and reduced smoke emissions

SCR systems
- SCR and oxidation catalyst
- Modularized concept for MAN engines
- Common control for SCR and engine for optimized trade-off between fuel and urea consumption
- Reliable operation

SaCoS engine safety and control system  New TCX turbochargers  Common rail injection system  SCR system
Engine portfolio
Overview

Our engine portfolio comprises medium and two-stroke engines and covers a range of 625 to 68 000 kW. The medium speed engines are based on a family concept. Each engine family has multiple references in the field. In a process of continuous development, the features of the engines are constantly adjusted to meet customer needs.

The families are clustered according to their bore size and represented by certain models:

- **2X** e.g. 28/32SDF
- **3X** e.g. 35/44G
- **4X** e.g. 48/60 and 51/60G

Our products are optimized for:

- High fuel efficiency
- High reliability
- Flexibility in application decentralized and modular for flexible capacity expansion
- Fuel flexibility – diesel, heavy fuel oil, gas, dual fuel, liquid biofuel and crude oil
- Enhanced fuel flexibility for operation on ethane, methanol, LPG, biofuel and other special fuels on two-stroke engines

**Flexibility in operation:**
- Fast start and ramp up capability
- Manageable instant load steps
- Wide scope for thermal energy recovery

**Flexibility in harsh ambient conditions:**
- Resistant to high ambient temperatures and high altitudes

**Flexibility over the full load range:**
- Highest efficiency in full load as well as in part load of single units
- Highest plant part-load efficiency due to modular plant system

**Flexibility in condition-based maintenance:**
- Long overhaul periods and short downtimes of units due to condition-based maintenance
- No downtime of complete power plant (overhaul of single units instead of full plant)
- No derating caused by aging effects
Engine portfolio
Overview

Gas fuel engines
Please refer to pages 82-83.

- MAN 4X
- MAN 3X

Dual fuel engines
Please refer to pages 84-85.

- MAN 4X
- MAN 3X
- MAN 2X

Liquid fuel engines
Please refer to pages 86-87.

- MAN 4X
- MAN 3X
- MAN 2X

Emergency diesel generators
Please refer to pages 88-89.

- MAN PC2.6 B N
- MAN PA6 B N

Two-stroke engines*
Please refer to page 119.

- G90
- S80
- S70
- S60

* The engines are also available for dual fuel operation as ME-GI-S version.
Steam turbines

Overview

MAN is one of the leading suppliers of industrial steam turbines worldwide with a comprehensive range of products and services. The first industrial steam turbine was supplied in 1904. Today our portfolio comprises a wide array of turbine models for power generation and mechanical drive applications within a power range between 1-160 MW.

Our steam turbines are characterized by a variety of modular design features for an optimized turbine configuration to meet challenging process conditions and specific customer needs. The proven steam turbine modules constitute a fundamental element of the design and have demonstrated a high level of reliability in operation.

This concept keeps delivery time and cost at minimum levels.

Design features and benefits:

- Various turbine models and sizes are available, including condensing type turbines, backpressure turbines, admission/extraction turbines and saturated steam turbines
- Highest efficiency based on optimized turbine design
- Highest availability
- Modular arrangement for fast installation and service
- Adaptable, space-saving arrangement
- Long overhaul periods
- Different applications – biomass, waste-to-energy and even concentrated solar power

Comprehensive OEM service:

- Special service solutions for each customer
- Condition based maintenance
- Online services
- Long Term Service Agreements (LTSA)
- Consulting on operation and maintenance
- Proven OEM competency
- Efficiency improvement
- Full lifecycle support
- Service for other brands available as well

Steam turbines

![Steam turbine generator set with auxiliaries](image)

Power output [MW el.]

Please refer to pages 90-91.
MAN counts on more than two decades of industrial gas turbine experience and profound application knowledge. Our reliable, efficient and modern industrial gas turbines are engineered and produced in Germany. The gas turbine portfolio from MAN consists of two different gas turbine series with power outputs up to 13 MW.

The MGT6000 series with power outputs of up to 7 MW for both power generation and mechanical drive applications is one of the world’s most modern industrial gas turbine in its power class. Based on experience and design skills gathered in-house over decades, MAN has developed a modern gas turbine series that combines the advantages of heavy duty and aeroderivate gas turbines.

The THM 1304 heavy-duty gas turbine series, with a power range between 9 to 13 MW, offers an extremely long life with a high level of reliability and availability. The modular design facilitates easy installation and maintenance features to realize an optimized cost-to-benefit ratio over the entire lifecycle.

**Design features and benefits:**
- High efficiency
- High reliability and availability
- Low emission combustion chambers with extreme low emission values
- Dual fuel capability
- Long major overhaul interval
- Excellent part-load characteristics
- Modular design ensuring good accessibility for maintenance measures (e.g. 3 days standstill for gas turbine exchange)

**Comprehensive OEM service:**
- Special service solutions for each customer
- Online services
- Comprehensive service agreements
- Consulting on operation and maintenance
- Proven OEM competency
- Efficiency improvement
- Full lifecycle support

### Gas turbines

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<th>THM series</th>
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<td>Power output [kW el.]</td>
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Gas turbine MGT6000
MAN Power services
Overview

Power plant projects are capital intensive and have a high demand for consultancy throughout their entire lifetime. A lot of expertise is required to install and operate the system with the highest efficiency.

We fully understand customers’ needs and expectations, and are able to develop the best tailor-made solutions together with our clients. Early project development, financing support, and technical consulting are key building blocks. Here we can demonstrate our expertise and ability to offer complete solutions from one source.

Our consultant role does not end after the power solution has been taken over by the customer but is continued by our brand label MAN PrimeServ with high quality aftersales support for the complete product portfolio of MAN. We will maintain the efficiency and availability of your plant and optimize operation.

You have a wide choice of services ranging from simple spare parts supply to staff training, retrofit solutions for plant performance enhancement and on to the full operation and maintenance of your plant.

MAN PrimeServ offers you excellent global 24/7 support, available through a global network of service facilities.

- **Consulting**
  *Please refer to pages 96-97.*

- **Financial services**
  *Please refer to pages 98-99.*

- **MAN PrimeServ**
  *Please refer to pages 100-109.*
MAN power plant solutions are designed for high efficiency, flexibility, safety and reliability. In order to safeguard the professional integration of these key parameters and streamline interface management, we continuously update the power plant engineering expertise in our organization. A world-wide team of engineers continuously strives to generate innovative solutions to improve the power plant reference design with regard to reliability, cost-efficiency and modularity, but also to design tailor-made power plant solutions for your project.

The detailed system, electrical, safety, environmental and civil design comes from one source and includes:
- Concept design
- Basic design
- Detailed design

It is structured to support new plant projects, refurbishment projects such as an adjustment to enhance the environmental focus, or upgrade projects, such as the expansion of a power plant. The single-source design also provides the data that are required for operation optimization and lifecycle management.

You benefit from over 100 years of expertise in power plant design and implementation, and our strong tradition of continuously linking field experience and plant engineering excellence in one loop.

**Benefits:**
- High fuel efficiency (in single cycle up to 50% in CHP mode around 95%)
- High plant availability due to smart maintenance concepts and high product reliability
- High operational flexibility in terms of fuels, start-up times and operation mode
- Low emissions and solutions to fulfill World Bank or other environmental regulations
- Smart concepts for fast plant implementation schedules
- Modular concepts for flexible capacity extension
- Long plant lifetime due to the robust plant design
Base load
Solutions overview

For utilities, municipalities, independent power producers, industrial customers and all those whose business is to produce at low cost and sell energy with a low CO₂ footprint.

MAN provides decentralized, flexible and highly efficient base load solutions designed to fulfill your requirements in terms of optimized capital and operation expenditures and sustainable reliability.

High base load efficiency is combined with load flexibility due to a modular plant concept in which the GenSets are always operated at the optimum load. The modules are scalable and, thanks to their high power density, the power plants are compact. This allows for short plant erection times and easy expansion at a later stage. MAN base load solutions allow for continuous part load operation and low load operation down to 15% load. Our base load solutions provide high-power stability as our GenSets are designed to compensate a possible ageing influence between the long intervals between overhauls. Sustainable fuel efficiency has full priority in order to have the lowest CO₂ emissions compared to other fuel-fired base load plants and to keep your cost down. The engine-based GenSets reach fuel efficiencies of up to 50% in single cycle mode. In combination with a steam turbine, the efficiency can even be increased by another 4% in an Engine Combined Cycle (ECC) mode. As we also have steam turbines in our portfolio, MAN can even provide single-source ECC plants.

Fuel efficiency is of essence but also the fuel cost. Our base load plants provide fuel flexibility and are available for liquid and gaseous fuels. This also includes biofuels and gases, which can even be generated from organic waste.

Optimized service concepts are another way to keep your operation expenses down. Long times between overhauls and optimized maintenance concepts are an integral part of our base load solutions.

Our product design and plant engineering expertise, combined with our vast global field experience, allows us to provide an optimized and reliable base load power plant for you.

Key facts:
- Robust design and high plant availability and reliability
- High fuel efficiency in single cycle (up to 50%)
- Efficiency increase up to 4% in Engine Combined Cycle (ECC)
- High plant flexibility for base load and ancillary services
- Fuel flexibility
Belawan, Indonesia

MAN equipped a newly constructed power plant in Belawan, Indonesia’s third-largest city in the north of Sumatra. This plant has four MAN 18V48/60 engines, operating on heavy fuel oil, and provides a capacity of 77 MW.

The MAN 18V48/60 achieves an outstanding level of efficiency through the principle of two-stage turbocharging, where a low-pressure and a high-pressure turbocharger are arranged in series. This two-stage turbocharging delivers vastly more charge air than conventional turbochargers, allowing a more flexible use of the engine. Depending on its operating mode, fuel consumption can be reduced by up to 3.5% at 100% load. Alternatively, the engine’s power can be boosted by 14% – while using the same amount of fuel and generating approx. 20% lower nitrous oxide emissions. This makes the MAN 18V48/60 one of the most efficient and cleanest engines in its class.

**Customer:**

**PT Berkat Bima Sentana**

**Customer Type:** IPP

**Application:** Base load power for grid

**Location of Installation:** Medan, Indonesia

**Engine Type:** 4 x MAN 18V48/60

**Fuel:** HFO

**Output:** 77 MW

**Commercial Operation:** 08/2013

**MAN’s Work Scope:** GenSets plus mechanical and electrical components
Base load
Engine Combined Cycle (ECC)
Reference case

Thika, Kenya

The independent energy production company Thika Power Ltd., a subsidiary of Matelec Group of Lebanon, selected MAN to build a diesel power plant in Thika City, near Kenya’s capital, Nairobi. The plant, which supplies energy to Kenya Power & Lighting Co., was commissioned in summer 2013 and handed over in the beginning of 2014. MAN supplied, within an EPC consortium, the equipment, engineering, plant design, supervision of installation work and commissioning services for this engine-based combined cycle power plant.

The Thika power plant is the first on the African continent which is using an Engine Combined Cycle (ECC) technology – delivered by MAN. Five MAN 18V48/60 four-stroke engines produce electricity, while the waste heat is used to drive a MAN steam turbine which generates a further 7.7 MW of electricity. The combination of diesel engines and a steam turbine improves the efficiency of the power plant, producing 9.5% more electricity from the same fuel consumption. The power plant produces a total output of 88 MW.

Selected further references:
- Atlas Power, Pakistan, 11 × MAN 18V48/60 + 1 steam turbine
- Hubco Power, Pakistan, 11 × MAN 18V48/60 + 1 steam turbine
- Thika, Kenya, 5 × MAN 18V48/60 + 1 steam turbine
- Tobene, Senegal, 5 × MAN 18V48/60 + 1 steam turbine

Customer:
Application: Base load power plant, combined cycle
Location: Thika, Kenya
No. and Engine Type: 5 x MAN 18V48/60 + 1 x MAN steam turbine
Plant Output: 88 MW
Fuel: HFO
Commissioning: August 2013
Operation & Maintenance: Management support agreement for six years
Peaking Solutions overview

For utilities, municipalities, and independent power producers whose business is to flexibly manage the balancing of a volatile power environment and provide ancillary services.

MAN provides decentralized, flexible, fast-starting, and highly efficient peaking solutions to balance power demand and production at the push of a button.

The peaking solutions are designed to fulfill your requirements with regard to optimized capital and operation expenditures, fast power availability and additional flexibility. Fast power availability is safeguarded by optimized generating sets and standby concepts which can even be enhanced by the installation of a battery system. The generating sets are dynamic in part load and allow for a safe operation down to 5% load. Even in part and low load, the generating sets show high fuel efficiency. With the optional integration of battery systems, excessive power can be stored and the power reserve and cost for standby can be optimized.

The generating sets are very flexible and can optionally be adjusted to act as reactive power compensators, when they are not required for peaking and stay in standby mode. MAN peaking solutions are based on a modular concept consisting of power modules with a high power density for a compact plant and optimized capital expenditures. Multiple start and stop capability without impact on maintenance intervals ensures sustainable high-power availability. Our highly efficient multi-fuel capable generating sets are also available for peaking solutions.

Key facts:
- Very fast start time, synchronization and ramp up time
- High fuel efficiency in full and part load operation
- Low load operation down to 5% feasible
- Optionally available in combination with Energy Storage System (ESS) solutions
- Multiple start and stop capability without impact on maintenance intervals
For utilities, municipalities, and industrial customers with a high process heat demand, whose business is to produce and sell electrical and thermal energy with a low CO₂ footprint compared to other fuel-fired plants.

MAN provides decentralized, flexible and highly efficient Combined Heat & Power (CHP) solutions with efficiency rates above 90%. Our engine or gas turbine-based GenSets provide the best CHP solution for your business by utilizing the surplus heat from the engine or turbine systems, (exhaust gas, cooling water, lube-oil) to produce hot water, steam, or chilled water or a combination of all (trigeneration).

The CHP plant can easily follow changing electrical and thermal heat requirements throughout the year. Even in periods where there is no heat demand, the fast-starting engine GenSets can be used as a peaking plant. The CHP solutions are designed to fulfill your requirements with regard to sustainable electrical and thermal power production flexibility and reliability at optimized capital and operation expenditures.

The CHP solutions are set up as a number of identical and compact CHP modules. Due to the high-power density of each module, the MAN CHP power plants are compact and allow for short plant erection times and easy expansion at a later stage. MAN CHP solutions allow for continuous part load operation and low load operation down to 15% load and can therefore easily follow changing power to heat ratios. In addition, single CHP modules can be started and stopped easily to always run the plant at an optimum efficiency.

Sustainable fuel efficiency has full priority in order to have the lowest CO₂ emissions possible and to keep your cost down. Our CHP plants provide full fuel flexibility and are available for liquid and gaseous fuels. This also includes bio fuels and gases which are CO₂ neutral when generated from organic waste.

Optimized service concepts help to keep your operation expenses down. Long time between overhauls and optimized maintenance concepts are an integral part of our CHP solutions. In order to raise the plant efficiency and availability, maintenance can be executed on individual CHP modules while the remaining modules are running.

Our product design and plant engineering expertise, combined with our vast global field experience, provides the basis for a reliable CHP power plant.
Combined heat & power
Solutions overview

Key facts:
- Optimized fuel efficiency around 95.2 %
- Based on efficient single-cycle engine or turbine solutions to adjust to the requested power-to-heat ratio
- Excellent fast start and dynamic as well as low load capability
- Modular multi GenSet concept for high operation efficiency and easy expansion
- Trigeneration capability (electrical, heat and cold)
- Multi-fuel capability

Energy flow for hot water generation*

**Total efficiency of ~95.2 %**

- **Heat recovery efficiency**: 47.7 %, 47.5 %
- **Electrical efficiency**: 4.8 %
- **Economical use of primary energy by heat recovery from**:
  - Exhaust gas
  - Engine cooling water
  - Engine lube oil
  - Charge air

* Based on MAN 20V35/44G ISO 3046 conditions and efficiencies valid for:
  Return line temperature 60 °C, Supply line temperature 120 °C
Combined heat & power
Reference case

BHKW VW Brunswick, Germany
The highly efficient gas engine MAN 20V35/44G delivers about 10 MW electrical output and 9 MW thermal energy in CHP (Combined Heat & Power) application. The power plant covers the base load demand of heat and electricity of the Volkswagen factory in Brunswick, Germany, with an annual use efficiency of 80%. The plant emission limits are set to the strict TA-Luft regulation and European Union standards. This is a great improvement compared to the previously used energy supply: 90,000 tons of CO₂ can be saved per year. The CHP power plant reaches an efficiency level of 84% and can react flexibly to the variable load requirements of the Volkswagen site.

The MAN scope included engineering, procurement and construction services for the GenSet, emission monitoring, auxiliary modules and hot water systems. Furthermore, MAN was in full charge of commissioning the power supply and the very challenging heat system in combination with the back-up heat boilers and the heat supply control system of the factory.

Customer: VW Kraftwerk GmbH
Customer Type: Industry
Application: Combined heat & power for own consumption & grid
Location of Installation: Brunswick, Germany
Engine Type: 1 x MAN 20V35/44G
Fuel: Natural gas
Output: 10.4 MW electrical & 9.1 MW thermal
Commercial Operation: 07/2015
MAN’s Work Scope: EPC without civil (engineering, procurement, construction and commissioning services)

Customer: VW Kraftwerk GmbH
Output: 10.4 MW electrical & 9.1 MW thermal
Overall Efficiency: 84%
GenSet: MAN 20V35/44G
Fuel: Natural gas
Recovered Heat Utilization: Process heat & building heating

Selected further references:
- MAN Augsburg, Germany, 1 x MAN 12V32/40G
- Electrawinds, Belgium, 1 x MAN 18V48/60
- Voestalpine, Austria, 2 x MAN 12V32/40DF
- Mosoblenergas, Russia, 2 x MAN 18V32/40G
- Mosoblenergas Extension, Russia, 1 x MAN 18V32/40G
MAN provides optimized hybrid power solutions for utilities, municipalities, industrial customers, and independent power producers (IPPs) who want to reduce their CO₂ footprint.

Global decarbonization targets encourage the installation of power plants with reduced CO₂ emissions. These targets are supported by the use of clean fuels in combination with highly fuel-efficient systems and the integration of renewable energy systems (RES). Hybrid power plants comprise different power production and/or storage systems including RES components.

**MAN hybrid power solutions are available as:**
- Fuel savers
- Grid stabilizers
- Hybrid island power systems

**Fuel saver**
MAN provides a solution that integrates RES, such as solar and wind power, with highly fuel-efficient GenSets via an energy management system. The solution provides a reliable power supply to satisfy customer demands. The power plant is dimensioned so that the RES system can always provide the maximum possible CO₂-neutral power, with the GenSet smoothening power fluctuations and providing a certain share of base load power. The GenSets always run at their optimum fuel efficiency point. The overall benefits are saving fuel and reducing CO₂ emissions. MAN provides the expertise to integrate various systems into highly efficient power plants.
Grid stabilizer
Wind and sun are attractive sources of renewable energy – they are free, widely available and produce no greenhouse gases. However, they do have one serious drawback – they are fairly unpredictable. Seen from the grid operator’s perspective, increasing the share of RES leads to power fluctuations that have to be matched with the energy consumer’s demand for a reliable and flexible power supply. MAN provides dispatchable dynamic capacity solutions. They have a frequent fast-start-stop and load ramp capability with highly efficient multi-fuel generators for reliable, flexible and efficient power generation. They can also be integrated in various systems for a stable and efficient power grid.

Hybrid island power systems
The installation of Renewable Energy Systems (RES) like wind and solar power plants on islands fosters a green footprint and supports global decarbonization targets. Seen from the grid operator’s perspective, RES typically provide a fluctuating power supply that has to be matched with the energy consumer’s demand for a reliable and flexible power supply. MAN provides solutions to fill the gap and stabilize the grid, by integrating stabilizing elements, such as fast and flexible generators, storage systems and the Energy Management System to enable a reliable and flexible green RES-Microgrid.

MAN provides innovative one-source products and the expertise to integrate various systems into highly efficient power plants.

Key facts:
- Flexibility to integrate renewable and fuel-fired power generators as well as energy storage into a stable and efficient system
- Low CO₂ footprint
- Fast start times and dynamic capability for reliable power systems
- High fuel efficiency and fuel saving schemes
Hybrid-Wind-Diesel Plant Bonaire, Netherlands Antilles

After a fire in the existing power plant, the power company in Bonaire wanted to build up a new power system. This created the opportunity of becoming the first CO$_2$-neutral Caribbean island. The use of renewable energy systems was key, but so was the wish not to compromise on a reliable power supply. The system that fulfills the above criteria is a power management and control system that combines wind turbines as the main power supply with diesel generating sets and a battery storage system to stabilize the grid and emergency diesel generators as back-up power. The system enables an outstanding low CO$_2$ footprint, flexibility and reliability.

The MAN diesel generators provide excellent grid stabilizing performance at a high fuel efficiency, at full and part load and at changing ambient temperatures. With the short ramp-up capability, the diesel generators provide a fast spinning reserve.

<table>
<thead>
<tr>
<th>Customer:</th>
<th>ECOPOWER Bonaire EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Type:</td>
<td>Utility</td>
</tr>
<tr>
<td>Application:</td>
<td>Hybrid-Wind-Diesel Plant for island grid</td>
</tr>
<tr>
<td>Location of Installation:</td>
<td>Karpata, Bonaire-Netherlands Antilles</td>
</tr>
</tbody>
</table>
| Power System: | Power management control system  
12 wind turbines, each 0.9 MW  
5 diesel GenSets 9L27/38, each 2.5 MW  
2 emergency diesel generators  
1 battery storage system, 3 MW |
| Fuel: | Bio diesel + Diesel oil + HFO |
| Commercial Operation: | 03/2010 |
| MAN’s Work Scope: | GenSet + mechanical |

Selected further references:
- Biomass hybrid power plant, Naturenergie Heidenrod, Germany
- Sewage sludge-hybrid power plant, Emscher, Bottrop, Germany

3D Model of WEB Bonaire, Island of Bonaire
Power barges
Solutions overview

With their high flexibility, power barges are an ideal solution for sudden power demands or in advance of other land-based power plants. They can be rapidly delivered and moored in sheltered coastal areas, river estuaries, on existing docks or at a simple piled wharf. Power barges comprise tried and tested engine power plant technology installed on a floating box structure. MAN and its partners have extensive experience in EPC power plants and marine applications and together form the business platform for the power barge solutions.

The floating box structures can be set up efficiently in shipyards. They have short delivery times and enable a fast return of investment.

Key facts:
- Tried and tested power plant systems provided by the experienced teams of MAN and its partners
- MAN quality features such as high efficiency, fast start and dynamic capability, low emissions
- Fast and stable power to remote areas
- Low-risk mobile asset, easily financed and with little or no stranded cost
- Can easily be removed and relocated to another site
- Multi-fuel capability
- Standard power plant spacing between engines for optimal operability and maintenance
The LNG market is rapidly expanding and LNG is becoming one of the preferred sources of energy. LNG contributes to creating a cleaner and healthier environment. To reduce the emission footprint of existing liquid fuel and oil-based power plants, MAN helps its clients plan their fuel switch and transition to a more environmentally friendly LNG and natural gas-based power generation.

MAN offers the entire value chain of LNG based power generation, including facilitating the right LNG fuel logistic concept, support for the customization of LNG infrastructure at the site and storage solutions in combination with high efficient, decentralized power plants. MAN can provide complete, small-scale, one-source, EPC LNG solutions, even in locations where presently no gas is available, remote islands, coastal areas or any other location.

By combining power plant know-how from a globally active EPC company and the cryogenic system know-how of our experts from MAN Cryo in Sweden, MAN is able to provide complete solutions for LNG power plants and the related infrastructure.

- The LNG infrastructure includes unloading facilities from LNG tankers or trucks, LNG storage in tanks and highly efficient re-gasification units dimensioned to the gas demand of the power station.
- The power plant solutions deliver lifecycle-cost-optimized power-generating equipment ranging from highly efficient and flexible gas and dual fuel engines to gas turbine plants.

A modular concept enables a fast track installation by optimizing the time to completion (TTC) and assures high quality results at all locations.

From project development to entire EPC management and operating & maintenance concepts – MAN covers all stages of the lifecycle of the small-scale LNG solutions.
Global decarbonization targets and improved economics encourage the installation of renewable energy systems (e.g., wind and solar) around the globe. The increasing share of renewable electricity generation is key to reducing CO₂ emissions but also creates new challenges for the power system due to their non-controllable variability, limited predictability and regular mismatch of supply and demand. In this context energy storage systems become a key component to ensure a reliable, efficient and economic power supply, both in-front-of-the-meter and behind-the-meter. They can, for example, integrate renewables by shifting surplus energy to times of demand and can provide grid services like frequency control or spinning reserve.

MAN offers solutions for Battery Energy Storage Systems (BESS), Electro-Thermal Energy Storage (ETES) as well as Power-to-X (P2X). In addition, MAN can provide key equipment for a variety of other storage technologies like Liquid Air Energy Storage (LAES) or Compressed Air Energy Storage (CAES).

**Battery Energy Storage Systems (BESS)**

MAN Battery Energy Storage Systems are most suitable for applications with a fast response time and a power demand over a short to medium duration. Battery Energy Storage Systems help improve the reliability, availability and efficiency of the power supply. The MAN BESS is ideal for applications like peak shifting, system frequency regulation and load balancing as well as renewable integration though ramp rate control and energy time shift. In order to generate most value out of a storage system, multiple applications can be combined according to the specific project needs and market opportunities.

MAN provides complete Battery Energy Storage Systems on a plug and play basis. The BESS can be deployed in stand-alone applications, in combination with an engine or turbine, or as a part of a hybrid power solution with renewables.

**Power-to-X (P2X) solutions**

The MAN P2X solution allows storing large amounts of energy over a long period of time by converting surplus electricity in gas or liquid e-fuels. For the production of these e-fuels, CO₂ from other processes and hydrogen produced from water is converted into green fuels. Long-term storage solutions like power-to-gas are the way to a reliable, economic and green power supply in the future. The conversion of surplus electricity in synthetic gas opens multiple uses cases in the mobility, heat and electricity sector. By coupling the major energy sectors, P2X will make a significant contribution to decarbonizing the energy system and to reaching climate protection goals.

MAN offers turnkey power-to-gas plants and helps customers to develop projects from the first ideas to project execution and operations.

**Key facts:**

- Energy storage solutions for multiple applications and requirements
- Standalone solutions, in combination with engine or gas plants as well as in hybrid systems and microgrids
- Single-source solutions
- Increased efficiency of the power system and integration of renewable energy systems
The MAN PC2.6 B N and the MAN PA6 B N have been granted the nuclear qualification after stringent testing according to the IEEE 387, RCC-E and KTA standards, which involve 100-300 consecutive hot and cold starts. Both the PC2 engine and the PA6 engine can operate under seismic conditions. The nuclear power GenSet business is centrally run by MAN Diesel & Turbo France, which has been granted the ISO 9001:2000 certification by the BVQI and the ISO 14001:2004 certification by LRQA as well.

Benefits:
- Outstanding reliability and availability
- Well-proven technology
- Certified according to all relevant standards

For example MAN’s PC2 and PA6 diesel engines have been certified for nuclear application in countries such as China, France, India, Japan, Korea, Russia, and the USA.
Steam turbines

Applications

MAN covers the specific needs of the power generation industry with its comprehensive range of modularized, but also custom-made, steam turbines with a power range of 1 to 160 MW.

Our steam turbines serve Combined Heat & Power (CHP), Engine Combined Cycle (ECC), biomass, Concentrated Solar Power (CSP), geothermal energy, pulp & paper, Waste-to-Energy (WtE) and storage applications.

Biomass

Bioenergy is renewable energy made available from biological sources. Biomass is any organic material which has stored sunlight in the form of chemical energy, for example: wood, straw, manure, sugarcane or many other byproducts from a variety of agricultural processes. Bioenergy contributes to reducing atmospheric methane and carbon emissions as well as fossil fuel consumption and strengthens energy security due to its availability.

MAN offers a highly comprehensive range of steam turbines with proven performance and high availability. In industrial biomass plants, the efficiency of combined heat & power plays an important role. MAN is well prepared to optimize the complete water/steam cycle in close cooperation with its customers.

Selected further references:

<table>
<thead>
<tr>
<th>Order year</th>
<th>Country</th>
<th>Customer</th>
<th>MDT equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>Denmark</td>
<td>Helsingor Kraftvarmevaerk A/S</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2017</td>
<td>Japan</td>
<td>MES</td>
<td>Reheat steam turbine set</td>
</tr>
<tr>
<td>2017</td>
<td>Latvia</td>
<td>Dobele Eko SIA</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2016</td>
<td>France</td>
<td>Dalkia</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2014</td>
<td>Sweden</td>
<td>Andritz</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2013</td>
<td>Germany</td>
<td>Elslether Bioenergie GmbH</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2012</td>
<td>France</td>
<td>Dalkia France</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2012</td>
<td>Romania</td>
<td>Fritz Egger GmbH &amp; Co.</td>
<td>Steam turbine-generator set</td>
</tr>
</tbody>
</table>
**Concentrated Solar Power (CSP)**

World energy consumption is forecast to grow significantly over the next decades. Solar thermal power plants built around the sun belt provide a sustainable, environmentally responsible solution – covering a portion of the increasing energy demands. Investment in commercial-scale solar thermal power plants has been reinvigorated in recent years. Several gigawatts are in the planning and construction phases.

Although various collector technologies are available, the general principle is similar. Solar energy is focused by mirrors to heat a receiver medium to about 400 °C and steam is generated to drive a steam turbine generator set.

Steam turbines installed in CSP plants need to match the application-specific demands including a large number of starts, rapid start-up capabilities as well as re-heat options for maximum performance.

With their high available efficiency, the extremely reliable MAN steam turbines provide the ideal solution for all solar thermal power plants.

**Selected further references:**

<table>
<thead>
<tr>
<th>Order year</th>
<th>Country</th>
<th>Customer / Operator</th>
<th>MDT equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>Les Borges Blanques, Spain</td>
<td>UTE Termosolar Borges</td>
<td>Steam turbine-generator (water-cooled condenser)</td>
</tr>
<tr>
<td>2011</td>
<td>Vielena, Spain</td>
<td>UTE Termosolar</td>
<td>Steam turbine-generator set (reheat)</td>
</tr>
<tr>
<td>2010</td>
<td>Palma del Rio, Spain</td>
<td>UTE Termosolar</td>
<td>Steam turbine-generator set (reheat)</td>
</tr>
<tr>
<td>2009</td>
<td>Kanchanaburi, Thailand</td>
<td>Thai Solar Energy</td>
<td>Steam turbine-generator (water-cooled condenser)</td>
</tr>
<tr>
<td>2008</td>
<td>Alcudia de Guadix, Spain</td>
<td>Solar Millenium AG</td>
<td>Steam turbine-generator set (reheat)</td>
</tr>
<tr>
<td>2008</td>
<td>Shams, UAE</td>
<td>PJSC</td>
<td>Steam turbine-generator set</td>
</tr>
</tbody>
</table>

**Geothermal energy**

Geothermal energy is accessed by drilling water or steam wells in a process similar to drilling for oil. Typically, wells recover high temperature steam at a range of 200-300 °C from a depth of 1,500-3,000 m.

The proven, robust design of MAN steam turbines means they are suitable for geothermal application even with aggressive steam conditions and seismic vibration.

MAN has already delivered 20 steam turbines for wellhead power plants in Kenya.

**Selected further references:**

<table>
<thead>
<tr>
<th>Order year</th>
<th>Country</th>
<th>Customer / Operator</th>
<th>MDT equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>Kenya</td>
<td>Green Energy Group</td>
<td>5 Steam turbine-generator sets</td>
</tr>
<tr>
<td>2014</td>
<td>Kenya</td>
<td>Green Energy Group</td>
<td>5 Steam turbine-generator sets</td>
</tr>
<tr>
<td>2013</td>
<td>Kenya</td>
<td>Green Energy Group</td>
<td>6 Steam turbine-generator sets</td>
</tr>
<tr>
<td>2012</td>
<td>Kenya</td>
<td>Green Energy Group</td>
<td>2 Steam turbine-generator sets</td>
</tr>
</tbody>
</table>

*Steam turbine geothermal power plant, Kenya*
Pulp & paper

The pulp & paper industry is mainly situated in North America, Scandinavia, East Asia and South America. It uses wood as raw material to produce pulp, paper and other cellulose-based products.

MAN tailor-made steam turbines used in the pulp & paper industry have an important function in the overall plant process. They deliver enthalpy-controlled steam that ensures the quality of the pulp & paper production. MAN has the experience and the expertise to optimize the complete water/steam cycle in close cooperation with our customers to find the most favorable and efficient solution.

We offer controlled and uncontrolled extractions and are able to provide all relevant equipment for the steam turbine generator set (i.e. generator and condenser).

Selected further references:

<table>
<thead>
<tr>
<th>Order year</th>
<th>Country</th>
<th>Customer / Operator</th>
<th>MDT equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>Santa Fe, Chile</td>
<td>CMPC</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2009</td>
<td>Laja, Chile</td>
<td>CMPC</td>
<td>Steam turbine-generator set</td>
</tr>
</tbody>
</table>

Waste-to-Energy (WtE)

Waste-to-energy refers to the treatment and conversion of waste sources into electricity or/and heat. In many WtE plants the objective is waste removal by incineration rather than landfill. The heat generated by this combustion process can be used for power generation resulting in additional profit for the operator. WtE activities in Europe intensified after the 2005 EU Directive prohibiting landfill of non-treated waste.

Depending on the customer requirements, MAN can include parts of the water/steam cycle into its scope of supply in addition to the steam turbine generator set. This may include heating condensers, air-cooled condensers, pre-heaters, bypass stations and some connecting pipe work. A special operational requirement that we encounter in the WtE business is long-term turbine bypass operation (island mode). For this requirement turbine blading design can be adapted.

In 2011 MAN delivered the biggest steam turbine generator set for a WtE plant in London, U.K. with a power output of 80 MW el.

Selected further references:

<table>
<thead>
<tr>
<th>Order year</th>
<th>Country</th>
<th>Customer / Operator</th>
<th>MDT equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>Gloucester, UK</td>
<td>B&amp;W Volund</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2016</td>
<td>Bottrop, Germany</td>
<td>Emschergenossenschaft</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2016</td>
<td>Parc Adfer, UK</td>
<td>Wheelabrator</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2015</td>
<td>Tampere, Finland</td>
<td>Tammervoiima Oy</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2014</td>
<td>Wilton, UK</td>
<td>CNIM</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2012</td>
<td>Hørsholm, Denmark</td>
<td>I/S Nordforbrænding</td>
<td>Steam turbine-generator set</td>
</tr>
<tr>
<td>2011</td>
<td>Oxfordshire, UK</td>
<td>CNIM</td>
<td>Steam turbine-generator set</td>
</tr>
</tbody>
</table>
Gas turbines
Applications

In the near future, the new energy economy will see greater use of intermittent renewable power generation sources such as wind and solar power. This will go hand in hand with the use of highly flexible and efficient decentralized plants, offering power for peak demands and so-called dispatchable power for grid stabilization in response to the volatility of wind and solar. Highly efficient simple cycle, Combined Cycle (CC) and Combined Heat & Power (CHP) solutions provide a fast-operating reserve (in a time window of 5-10 minutes).

MAN is proud to offer best-in-class industrial gas turbines for compact combined cogeneration plants. Best-in-class efficiency, optimum part load efficiency and high flexibility are their contribution to sustainable and environmentally friendly power conversion solutions in public and industrial facilities.

Simple cycle
Simple Cycle Power Plants (SCPP) are a reliable solution that enables the grid to respond quickly to flexible load demands. They consist of single or multiple gas-turbine-driven generator sets. The main components of the gas turbine are the air compressor, the combustor and the turbine, which drives both the air compressor and an electric power generator. SCPPs are often used in remote areas as decentralized local power generation sets and as emergency or peaking units.

More than ever before, our development focus is on the environmental performance of our gas turbines. Using MAN’s unrivaled grasp of large engine technology, we aim to make our turbines progressively cleaner, more powerful and more efficient with MAN’s new Advanced Can Combustor (ACC) with Dry Low NOx (DLN) technology. MAN gas turbines offer robust operation, high availability, fast start-up as well as start reliability and the capability for quick transient load responses.
Gas turbines
Applications

Combined Heat & Power (CHP)
Combined Heat & Power (CHP), or cogeneration/trigeneration, is the most efficient and cleanest process for generating power and process heat from a single fuel source. CHP systems are designed to meet the facility’s thermal and electrical load requirements and greatly enhance the facility’s operational efficiency and flexibility. CHP power plants utilize a gas engine or gas turbine to drive an electrical generator while the exhaust waste heat of the gas turbine is used to produce steam in a steam generator which can be used directly for district heating. CHP systems are manifold and can also support cooling processes (absorption refrigeration), for example in food processing industry plants. CHP systems are often used for decentralized power generation. This efficient and economical method of energy conversion achieves significant primary energy savings compared with separate installation of power and heat generation equipment.

MAN provides CHP systems which are tailor-made and optimized for the facility’s demands. Total plant efficiencies exceeding 80% have been proven. MAN CHP plants provide stand-alone decentralized power generation solutions and process heat supply in manufacturing plants, food processing plants and other industrial facilities.

Benefits:
- Increased plant efficiency exceeding 80% with best-in-class MAN gas turbines as system driver
- High efficiency: reduced fuel consumption due to high CHP efficiency (low OPEX)
- Fast ramp-up, in less than 9 minutes (gas turbine only)
- Low greenhouse gas emissions
- High power density (small foot print)
- High reliability and availability level
- Modular plant design to ease overhaul
- Supply of multiple energy sources (electric power, steam, heat, cooling and drying)
- Emergency availability, e. g. black start units
Gas turbines

Applications

Combined cycle

Combined Cycle Power Plants (CCPP) use the waste heat from the gas turbine to produce steam for generating additional electrical power in steam turbines. This combination of gas and steam turbine enhances the efficiency of a simple solution. With supplementary firing, the overall efficiency can be further increased.

Selected further references:

<table>
<thead>
<tr>
<th>Order year</th>
<th>Country</th>
<th>Customer / Operator</th>
<th>Scope of delivery</th>
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<tbody>
<tr>
<td>2017</td>
<td>China</td>
<td>LIYY/ENN</td>
<td>7x MGT6000 gas turbine package</td>
</tr>
<tr>
<td>2017</td>
<td>China</td>
<td>SAE</td>
<td>MGT6000 gas turbine package</td>
</tr>
<tr>
<td>2016</td>
<td>China</td>
<td>LIYY/ENN</td>
<td>MGT6000 gas turbine package</td>
</tr>
<tr>
<td>2016</td>
<td>China</td>
<td>SAE/ENN</td>
<td>MGT6000 gas turbine package</td>
</tr>
<tr>
<td>2014</td>
<td>China</td>
<td>SAE/VW China</td>
<td>4x MGT6000 gas turbine packages</td>
</tr>
<tr>
<td>2011</td>
<td>Germany</td>
<td>Solvin (Solvay/BASF)</td>
<td>CHP power plant (MGT6000 gas turbine package, HRSC)</td>
</tr>
</tbody>
</table>
Emission reduction
Solutions overview

In recent years, local and global regulations covering exhaust emissions from internal combustion engines have become increasingly stringent. These regulations address NO\textsubscript{x}, CO, HC, SO\textsubscript{x}, particle and sound emissions and the surveillance via continuous emission monitoring thereof. MAN has developed the power plant technology to ensure full compliance. This technology is available for newly built as well as for existing power plants as a retrofit solution.

Selective Catalytic Reduction (SCR) of NO\textsubscript{x}
Catalytic after-treatment of the exhaust gases breaks down harmful NO\textsubscript{x} into harmless nitrogen and water. A reducing agent is injected into the exhaust flow, upstream from a catalytic converter. Together with the catalyst, this agent causes the breakdown of the NO\textsubscript{x}. With SCR, the engine can operate at partial and full load with maximum efficiency. With this technology a NO\textsubscript{x} reduction ratio of up to 97\% is achievable.

MAN developed a standardized portfolio of SCR systems together with leading catalyst developers and producers, applying the experience of several successful projects.

MAN SCR solutions combine lowest NO\textsubscript{x} levels with lowest related ammonia consumption.
**CO, HC & CH₂O oxidation catalysts**

Where excellent thermal efficiency is required and/or emission limits for carbon monoxide, hydrocarbons or formaldehyde are given in combination with low sulfur fuels (gas or liquid), oxidation catalysts are the key to success.

Based on the individual requirements, MAN will select the best oxidation catalyst for your application according to function and price from a series of different coated catalysts. A monitoring system will indicate when the catalyst has to be cleaned or replaced.

Oxidation catalysts can be easily combined with SCR systems, if necessary.

The main reactions in oxidation catalyst systems are:

<table>
<thead>
<tr>
<th>Reaction Type</th>
<th>Chemical Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide</td>
<td>CO + ½ O₂ → CO₂</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>CₘHₙO + (m + n/4) O₂ → m CO₂ + n/2 H₂O</td>
</tr>
<tr>
<td>Aldehydes, Ketones, etc.</td>
<td>CₘHₙO + (m + n/4 - 0.5) O₂ → m CO₂ + n/2 H₂O</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>H₂ + ½ O₂ → H₂O</td>
</tr>
</tbody>
</table>

**Desulfurization**

SOₓ emissions are caused by the sulfur content in the fuel and cannot be influenced by the engine. Any sulfur burned in the combustion process will be emitted as SOₓ. Low-sulfur fuel is usually expensive and not always available, and removing sulfur from the fuel can be costly. The sulfur has to be removed from the exhaust using the appropriate technique to adhere different emission limits.

Two established methods are available:
- Conditioned dry scrubbing with hydrated lime powder
- Dry scrubbing with sodium bicarbonate powder

The choice of a suitable desulfurization method depends mainly on the water and absorbent availability.

**Dry SOₓ scrubber with bag filter**
Particle filtration & emission monitoring

Particle emissions will occur due to the ash content and combustion characteristics of the fuel, especially in heavy fuel oil applications. Two different systems are available to reduce these already low particle emissions further where necessary:

**Electrostatic Precipitator (ESP):**
The best solution for high exhaust temperature applications is electrofiltration, the electrostatic attraction of ionized particles.

**Bag filtration:**
Where low exhaust temperatures are given, for example in CHP applications, bag filters are applicable. If necessary, these can be easily combined with a DeSO\(_x\) system.

**Emission monitoring**

MAN will choose the best solution in terms of price and practicality to fulfill local regulations regarding proof of exhaust emissions and to ensure ideal operation of exhaust treatment units. The function and reliability of these systems has been proven in a number of installations.

Acoustics in power plants

The specification of the requirements of acoustically relevant equipment follows as a result of the acoustical design of a power plant in its particular environment.

The reduction of the sound emissions is achieved by means of appropriate sound attenuation (silencers) and damping (of buildings and equipment) as well as by use of low-emission equipment (radiator coolers, transformers, compressors, etc.).

Factory and site acceptance tests are made to verify the fulfillment of the requirements of the equipment and the plant as a whole.
Power products
There are many good reasons why gas is an increasingly popular option for power generation. First of all, it is the cleanest fossil fuel and drastically reduces emissions compared to other fuels, e.g., CO₂ – 20%, NOₓ – 60%, it is widely available via gas pipeline or LNG transport by ships, and it is generally cheaper than other fossil fuels. Secondly, the key advantages of engine-based power plants apply to gas engines. Their high efficiency and flexibility, fast start and ramp-up capability, and low load performance make them an excellent choice for peak load and base load power plants. MAN gas engines are also available with MAN two-stage turbocharging technology for higher fuel efficiency and no derating at high temperatures or high altitudes.

MAN spark-ignited gas engines are an ideal option for combined heat & power applications. These engines are suitable for the primary and secondary energy markets. With the possibility of running at 5% part load, MAN engines show the biggest flexibility in the market and can optimize the number of engines. Electrical efficiency of up to 50% and total efficiency of around 95% for CHP applications are possible.

Power plants based on MAN gas engines are possible for single cycle, combined cycle and combined heat & power applications. Their modular design enables short realization times and easy extensions in the future.

Benefits:
- MAN gas engines range from 7 MW to 20.7 MW
- Electrical single cycle efficiency of up to 50%
- High efficiency even at part-load
- Low load capability down to 15%
- Fuel flexibility with natural gas and biogas
- Environmentally friendly, clean and compliant with international environmental requirements
Dual fuel engines ensure flexibility: can run either on gas or on liquid fuel and the switch from liquid mode to gas mode and vice versa is possible at any time and without power drop, depending on your choice.

Dual fuel engines can run as diesel engines or gas engines, but instead of a spark, a small amount of liquid pilot-oil ignites the gas-air mixture. A special feature of the 4X DF engine is certainly its capability to start and stop in gas mode. If gas operation is planned for the future, the 4X liquid engine can be easily retrofitted to a 4X DF engine.

Benefits:
- Dual fuel engines range from 1 MW to 20.7 MW
- GenSet single cycle up to 50 %
- Gas start capability
- Fuel and operational flexibility with HFO, diesel, natural gas, biogas
- MAN Dual fuel engines are environmentally friendly, clean and comply with international environmental requirements
- Modular design supports fast realization time and an easy extension of existing power plants
MAN diesel engines are the best choice for liquid fuels and they have a long tradition and global references dating back to 1904. Their fuel flexibility and high fuel efficiency make them reliable work-horses. But they are also agile, with a fast starting and ramp-up capability as well as high part load efficiency and low load operation capacity.

MAN liquid fuel engines are also available with MAN two-stage turbo-charging technology for higher fuel efficiency and no derating at high temperatures and high altitudes.

In 2017, MAN introduced a new liquid fuel engine. The new engine, with a power output of 26 MW, is the strongest liquid fuel engine on the market and a pioneer for power and efficiency.

MAN exhaust gas after-treatment technologies can be used to meet strict international emission levels.

**Benefits:**
- Liquid fuel engines range from 1 MW to 26 MW with a high unit power
- Fuel and operational flexibility with HFO, diesel, crude oil and liquid biofuels
- The new liquid engine in the 4X-family with 26 MW provides the highest engine output in the market
- MAN two-stage turbo charger technology available from the pioneer in this technology
- Numerous in operation
Emergency diesel generators
MAN PC2.6 B N and MAN PA6 B N

MAN PC2.6 B N
The PC2 engine is supplied under the brand name “S.E.M.T. Pielstick”. Featuring a 400 mm bore, it has been extensively used in both navy and nuclear applications. The PC2.6 B N is the most recent version of this well-proven engine.

Nuclear-qualified diesel engines
As the key component of the generating set, diesel engines play a vital role in ensuring the safety of the whole nuclear power plant. PC2 diesel engines have already proven their reliability and durability in a host of conventional applications. They are fully certified for nuclear applications in numerous countries, including China, France, Japan, Korea and the USA. Nuclear qualification is awarded only after stringent testing in accordance with standards such as the IEEE 387. This involves from 100 to as many as 300 consecutive hot and cold starts of the generating set.

Dependability in extreme conditions
The PC2 engines are also Safety Class qualified, which demonstrates their ability to operate safely and reliably under seismic conditions. Certification is achieved either by computer simulation or physical testing. The many standards that the PC engines have achieved and their long track record in a wide variety of highly demanding applications is evidence of their quality, efficiency and reliability.

MAN PA6 B N
This GenSet combines simplicity with sturdiness. Its flexible performance capability is characterized by its ability to withstand severe load pick-up sequences. It can also operate at low loads for long periods. The engine has been designed to minimize component wear, which ensures an extended working life and very long periods between overhauls. It is also extremely robust and provides outstanding shock-resistance performance. This is especially relevant when the PA6 is used in earthquake zones.

Proven success in tough applications
Since it was first launched, more than 1,000 PA6 engines have entered service in demanding applications around the world. Many countries and contractors have placed their trust in the PA6 to drive emergency diesel generators in nuclear power plants – ample evidence of the engine’s qualities and the benefits it provides.

<table>
<thead>
<tr>
<th>Power output [kW el.]</th>
<th>5,000</th>
<th>10,000</th>
<th>15,000</th>
<th>20,000</th>
<th>25,000</th>
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<tbody>
<tr>
<td>MAN PC2.6 B N</td>
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<tr>
<td>MAN PA6 B N</td>
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</table>
MAN is one of the world’s leading suppliers of industrial steam turbines with a comprehensive range of products and services. Our multistage steam turbines can be used for both power generation and mechanical drive applications and are available in sizes up to 160 MW.

Our robust turbines combine experience with state-of-the-art technology for the specific needs of the power generation industries.

Various turbine models and sizes are available, including condensing type turbines, backpressure, district heating and saturated steam turbines with several admissions/extractions.
More than ever before, MAN’s development focus is on the environmental performance of our gas turbines. Using MAN’s unrivaled grasp of large gas turbine technology, we aim to make our turbines progressively cleaner, more powerful and more efficient with MAN’s new Advanced Can Combustor (ACC) DLN technology.

The MAN gas turbine portfolio for power generation covers the range of 6-13 MW. The focus is on robust operation, high availability, fast start-up as well as start reliability and the capability for quick transient load responses.

**Benefits:**
- Best-in-class efficiency in the 7 MW power range combining the “best of two worlds” – robust heavy duty and aero-engine design
- Green power: lowest emission levels in class
- Reliable and robust part load behavior at highest-in-class performance levels
- Stable and clean solutions for wide range of fuels in the short run
- Fast ramp-up, in less than 9 minutes
- High reliability and availability level
Consulting
Service solutions

New project development services
There is an extensive demand for consulting performance with regard to the development of different alternatives and its appraisal of competitiveness, security of supply, environment-friendliness as well as financing and partnerships.

Based on our international experience as an energy solution provider, we now provide services for all power plant project phases. We perform as a system service provider for our customers to develop capital intensive projects in partnership.

The Project Development department is the MAN face to the customer in case of interest in the development of business models. Project Development works in close cooperation with Sales, Engineering and Finance to develop the most fitting project solution for the partner.

Our services include:
- Evaluation of project ideas
- Project analysis, due diligence
- Development of business models (contractual, financial, commercial)
- Set up of the judicial, financial and fiscal framework requirements and structure of contract
- Support for bidding procedure, assignment of deliveries, commercial business planning
- Risk management, project controlling (costs, quality, target dates during the development)
- Negotiations for all project contracts (under supervision of multifaceted interdependence between contracts)
- Financial engineering, financial model, negotiations with banks and guarantors
Financial services
Service solutions

Power plant projects usually require huge investments and therefore need long-term financing. Banks, especially those not in the top 100, may have difficulties obtaining long-term (10 years) refinancing on the capital markets. As a member of the MAN Group, we have relationships with a large number of first-class international banks and together with our national export credit agencies (Euler Hermes Deutschland AG, BPI France, EKF) we can provide you with long-term financing at very attractive rates. Only long-term financing makes huge investments possible.

Below you can find a chart explaining the typical structure of such financing.

**Advantages:**
- Long-term financing up to 10-12 years from the taking over of the plant
- Fixed interest rates available
- Diversification of the financing basis – access to the international capital markets
- Companies that are accepted by ECAs without additional guarantee get access to cheap long-term funds, which are much more attractive than the ones available in their local market
- Loan amount up to 85% of the contract value plus 100% of the ECA premium
- Interest during construction can be capitalized and included in the financing
- Financing is available in all major currencies
- MAN has access to banks that are in a position to finance bigger tickets. MAN can also form banking consortia that are able to finance very big power plants

**Usual conditions:**
- ECA coverage is generally linked to equipment sourced from the country of the ECA. However, there are cooperation agreements in place which allow for multi-sourcing under one ECA policy
- Local content can be included in the financing up to 23% of the contract value
- ECA cover is subject to an acceptable credit check and satisfactory environmental due diligence
- Repayments in semi-annual installments, grace period 6 months

This type of financing can also be granted to IPPs after a detailed feasibility study. In such cases, the loan term can be extended to 14 years with some flexibility in the repayment stream if the average loan term does not exceed 14 years. Fixed interest rates are possible, thus eliminating the interest rate change risk. This type of financing also covers the construction period.

*The requirement for an additional guarantee depends on the loan amount and the credit standing of the customer.
The local guarantor can be a local bank or the parent company of the customer which has a credit standing acceptable to the banks and ECAs.
Represented in all key markets and major ports, with a network of more than 100 service centers, and with skilled field service managers at the ready to provide first-class technical support, MAN PrimeServ is fully primed to provide 24/7 service, wherever you are. Offering reliable technical support when you need it most, our service solutions include OEM spare parts, engine and machinery maintenance and repairs, customized service agreements and individual consulting.

MAN PrimeServ service solutions
1. Genuine spare parts
2. Retrofit and upgrade
3. Technical service
4. Service workshops
5. Service agreements
6. Asset optimization solutions
7. Training

1. Genuine spare parts
Your MAN equipment is among your company’s greatest assets, ensuring the smooth and successful operation of your business. Why jeopardize this balance with unauthorized spare parts? Protect your investment the best way you can with OEM spare parts. Our tried and tested spare parts are backed by more than 250 years of experience and ongoing research, as well as customer feedback, aimed entirely at increasing engine performance. For the ultimate in peace-of-mind our parts come with a warranty. Our network assures a reliable supply chain, giving you privileged access to the best parts wherever and whenever you need them, right throughout your equipment’s lifecycle.

Maintenance kits
MAN PrimeServ Maintenance Kits offer an all-in-one maintenance solution when overhauling equipment and components, such as exhaust valves, fuel pumps, etc. Each MAN PrimeServ Maintenance Kit contains all the quality OEM parts you need, as well as an installation guide for the specific engine, based on simple-to-understand visual diagrams, hence avoiding any possible language misunderstandings, and ensuring that maintenance work can be performed correctly and in the shortest time possible. Our Maintenance Kits are available for all engine types and turbochargers.

2. Retrofit and upgrade
MAN PrimeServ offers you advanced retrofit solutions to optimize the reliability, availability, economic efficiency, and environmental sustainability of your existing equipment. Our retrofit solutions are tailor-made for your specific machinery. The concepts involve not only the core machine itself, but also the auxiliary systems, instruments, and control systems your equipment requires. By improving efficiency, and thus performance, our solutions can help you save on fuel oil and lube oil, enable flexible operation, while increasing time between overhauls and hence reducing maintenance. Plus, our retrofit solutions for upgrading existing diesel engines to dual-fuel capability help you to benefit from the economic and environmental advantages of gas operation.

3. Technical service
OEM service is the logical step from the moment your equipment is installed and commissioned – who better to provide technical assistance to you and your operation team. Ensuring quality 24-hour service for quality equipment, our skilled engineers are best placed to advise and act on all technical matters, with the ultimate goal of guiding customers and their personnel towards the optimal performance of their system. By choosing OEM technical assistance from our engineers around the globe, you reap the benefits of genuine OEM parts and expertise, reducing downtime, enabling more efficient operation and hence lowering running costs, while extending engine life and increasing productivity. In addition, we provide full warranty and breakdown support, to speedily and effectively return your equipment to full service.
4. Service workshops
Thanks to the broad reach of our network, there’s a good chance a MAN PrimeServ workshop is nearby wherever you operate. More than 40 workshops around the globe carry all the tools and systems they need to conduct complete overhauls of engines, components, and auxiliary systems, including turbochargers, and electronic controls. Offering the best support when the unforeseeable happens, our workshops are there to get you back in control fast. Taking full advantage of our worldwide network, quick and effective response offers everything from technical support to complex repairs in the event of unexpected damage. Our workshops are manned by highly trained personnel with years of experience, including specialists fully briefed on the latest MAN research developments, and well stocked with OEM spare parts. We can even take care of the logistic chain between your installation and our service centers, if needed.

5. Service agreements
PrimeServ O&M has a wide portfolio of service agreements. The basic agreements are flexible so that they can be adapted to meet the specific needs of any project. The portfolio is grouped into two categories:

<table>
<thead>
<tr>
<th>Power Plant</th>
<th>Marine</th>
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<tr>
<td>O &amp; MA</td>
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<tr>
<td>OMSA</td>
<td>O&amp;M Support Agreement</td>
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<tr>
<td>OMMA</td>
<td>O&amp;M Management Agreement</td>
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<tr>
<td>FOMA</td>
<td>Full Operation &amp; Maintenance Agreement</td>
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<tr>
<th>LTSA</th>
<th>Long Term Service Agreements</th>
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<tbody>
<tr>
<td>TMA</td>
<td>Time and Material Agreement</td>
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<tr>
<td>BMA</td>
<td>Basic Maintenance Agreement</td>
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<tr>
<td>AMA</td>
<td>Accelerated Maintenance Agreement</td>
</tr>
<tr>
<td>PMA</td>
<td>Performance Maintenance Agreement</td>
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</table>

5.1 Long Term Service Agreements (LTSA)
The LTSA program is a series of long-term contractual relationships in which MAN PrimeServ supports the customer with maintenance services and spare parts.

**Time and Material Agreement (TMA)**
A TMA is a frame agreement, outlining the terms and conditions for any services or supplies ordered by the customer. The customer is responsible for logistics planning and orders spare parts and service when needed.

Benefits of the TMA:
- Pre-agreed upon terms and conditions
- Reduced order processing times
- Price predictability

**Basic Maintenance Agreement (BMA)**
With a Basic Maintenance Agreement (BMA) the customer is assigned a designated contract manager who is responsible for the scheduling and logistics of each maintenance, as well as monitoring customer needs and work execution. It is a long-term arrangement covering the supply of spare parts and superintendent services on site for specified planned maintenance intervals within a predefined period.

Benefits of the BMA package:
- Preferred pricing
- Key account relationship
- Collaborative maintenance planning
- MAN responsibility for spare parts and service logistics
- Regular meetings on management level
Accelerated Maintenance Agreement (AMA)
In the Accelerated Maintenance Agreement (AMA), downtime for planned maintenance is minimized by using a pit-stop style approach to maintenance. Strategic spare parts are kept in stock on site for rapid exchange during maintenance, reducing the scheduled outage time. After the exchange, the engine is returned to service and the removed parts undergo reconditioning and quality inspection before being added to the strategic stock of spare parts.

Additional benefits of the AMA package:
- Reduced downtime for planned maintenance
- Preferential pricing on strategic spare part packages
- Option for full maintenance crew from MAN
- Strategic stock for reducing unscheduled maintenance outages

Performance Maintenance Agreement (PMA)
The Performance Maintenance Agreement (PMA) covers both planned and unplanned maintenance. The contract is structured so that PrimeServ O&M and the customer are aligned and incentivized to meet certain pre-defined performance goals. In addition, the scope typically includes online monitoring, periodic on-site support, priority access to spare parts, as well as logistics support to minimize unscheduled events.

Additional benefits of the PMA package:
- Availability commitments
- Price predictability for scheduled and unscheduled maintenance
- Priority access to long lead spare parts
- Faster troubleshooting and error elimination
- Regular data reporting and analysis sharing

5.2 Operation & Maintenance Agreements (O&MA)
The O&MA program is a series of long-term contractual relationships in which PrimeServ O&M plays a large role in the management and operation of complete power plant facilities on top of the maintenance services.

O&M Support Agreement (OMSA)
The Operation & Maintenance Support Agreement (OMSA) is an advisory agreement in which PrimeServ O&M arranges for one or more operation and maintenance specialists to provide guidance to the customer during the mobilization and operation of the power plant.

Benefits of an OMSA:
- Management and supply of spare parts and service
- On-site support from experienced professionals
- On-the-job mentoring
- Proven methods and procedures
O&M Management Agreement (OMMA)
The Operation & Maintenance Management Agreement (OMMA) embeds PrimeServ O&M staff into key management positions in the customer’s operation and maintenance organization. During the operation period PrimeServ O&M staff will assume the key positions and authority to manage the customer’s organization in the execution of all administration, operation and maintenance activities.

Benefits of an OMMA:
- Management responsibility of the complete facility on a 24/7 basis
- On-site mentoring
- Management and supply of all plant spare parts and related services
- Downtime commitments for scheduled maintenance

Full Operation & Maintenance Agreement (FOMA)
The Full Operation & Maintenance Agreement (FOMA) is a holistic solution in which PrimeServ O&M manages, operates and maintains the complete facility on behalf of the customer. The scope typically includes mobilization services prior to the start of commercial operations such as the hiring of the staff, staff and plant outfitting, establishment of computerized maintenance management systems and development of standard procedures. From the start of commercial operations PrimeServ O&M is responsible for the management, operations and maintenance of the full power plant facility including daily operations, routine maintenance, major overhauls, feedstock and inventory management.

Benefits of an FOMA:
- Responsibility for the entire facility on a 24/7 basis
- Performance commitments
- Proven operation & maintenance practices
- Single point of responsibility
- Local solution, global support

6. Asset optimization solutions

Online service
At the forefront of connectivity, MAN PrimeServ offers secure remote support for customers all over the world. From the Control Center in its German headquarters, MAN PrimeServ remotely monitors engines in power plant installations thousands of miles away. The MAN PrimeServ Online Service transmits key data from any place in the world via secure data connections. Secure online access to engines allows us to monitor operating parameters and provide appropriate services. Online connectivity enables interactive troubleshooting where MAN PrimeServ may access data simultaneously with on-site technical personnel for immediate support. The experts also monitor data in real time and provide valuable recommendations for the maintenance or repairs of the machinery without delay.

Live data indicator
With the live data indicator, MAN Online Service customers receive the performance data of their engines in real-time. The information can be viewed from all over the world and accessed via app from stationary as well as mobile devices.

eLearning
Offering a convenient and effective training solution, eLearning at MAN PrimeServ ensures you and your employees are best prepared to use and service your MAN equipment. Using web-based instruction solutions, we are able to provide valuable teaching and training in engine operation and maintenance, inside and outside the classroom. Instructor-led or self-directed, eLearning comes in a range of formats, and can even be accessed offline.

PrimeServ Lab
MAN provides analysis for engine fluids and non-metallic materials such as fuel, lubricating oil and cooling water. Testing is conducted in accordance with common standards for operating fluids such as ISO8217 for fuels.
7. Training
We believe that training our customers’ technical personnel ensures the best results can be achieved with our products. That’s why MAN PrimeServ Academies are committed to instructing your staff in the operation, maintenance and troubleshooting of MAN equipment. Our innovative training solutions are tailored to your needs and help sustain your company’s competitive advantage.

At its 13 academies located in Europe, North and South America and Asia, participants receive hands-on instruction on full-scale machinery and simulators. Striving to recreate real-life situations, so that participants can relate what they learn to their own working environment, our academies provide the best technical know-how available.

With expertly-trained personnel and quality machinery your business can only succeed.
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DieselFacts brings you the most recent news from the world of two-stroke and four-stroke engines, including the latest technical papers, in-depth features and videos.

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