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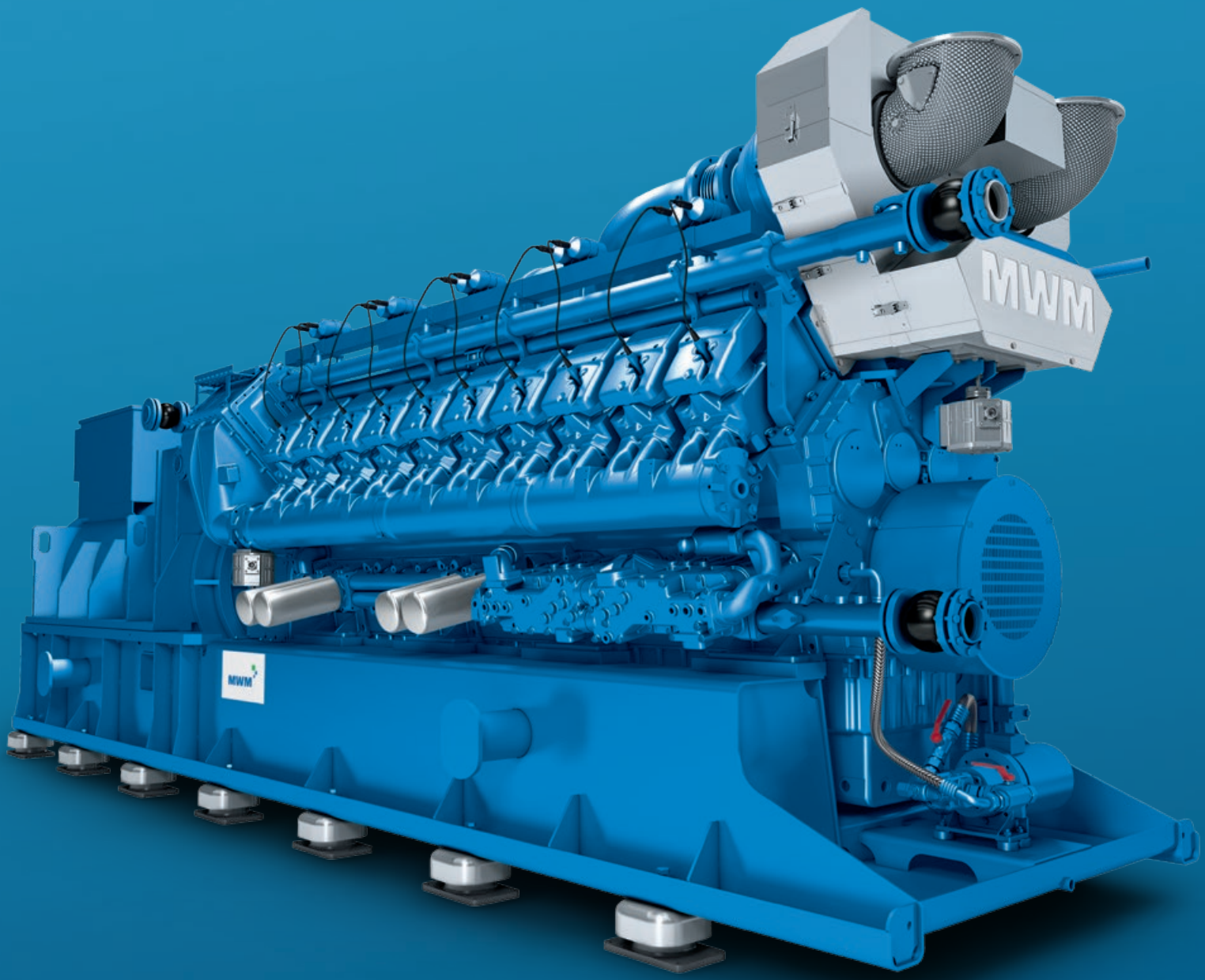
TCG 2020

Top marks for ecology and economy.

For natural gas and biogas with an output from 1,000 to 2,000 kW_{el}



MWM
Energy. Efficiency. Environment.

Our experience for your success.

The TCG 2020. Top performance from MWM – used successfully worldwide.

Strong partner for your progress

With MWM you can benefit from 150 years of experience in gas engine technology and energy production. Since 2011 the traditional company, Motorenwerke Mannheim, has belonged to the worldwide network of Caterpillar Inc. This gives us an even more unique expertise that benefits you in the development of individual complete solutions.

Worldwide successful technology

MWM offers you the confidence and experience of a specialist who has already successfully installed hundreds of biogas systems with gas power plants within and outside of the European region. Efficiency and reliability are the decisive factors everywhere.

Competent, reliable, and uncomplicated

We want you to be satisfied with us in every phase of the project: That is why we clearly spell out all agreements in a written order confirmation with a detailed schedule. MWM stands for reliability and quality of planning, right down to commissioning.

We stick to our agreements

If you put great value in an optimal return on your investment in a biogas system and smooth handling, MWM is a natural first choice. We offer comprehensive experience and always keep a close eye on the entire process. Seamless and turnkey ready – from initial consultation to handling of the completed system by our customer service. We say what we do, and we do what we say.

NanJi Water Recycle Centre, Korea

Korea District Heating Corp. is one of the largest suppliers of district heating in the world. In March 2013, two TCG 2020 V16 engines were taken into operation, providing an electrical output of 1.6 MW each. The units are part of the first plant installed in South Korea that generates electricity and heat from biogas.

2 x MWM TCG 2020 V16 | Commissioning: 2013

Queen Elizabeth University Hospital, UK

The modular CHP plant consists of three MWM manufactured TCG 2020 V12 gas engines with a combined output of 3.6 MW_{el} and 3.6 MW_{th} with an absorption chiller for cooling, the MWM gas engines have a potential to deliver an annual energy saving of up to £ 1 million and a carbon emission reduction by around one fifth.

3 x MWM TCG 2020 V12 | Commissioning: 2014

STOR, UK

10 MW_{el} containerised peak-lopping power plant provides security and stability to the grid and can be demanded during peak hours or during high electrical demand. The goal was to achieve a quick ramp-up time with the TCG 2020 V20 genset to meet the demand of the grid.

5 x MWM TCG 2020 V20 | Commissioning: 2014

Top marks for ecology and economy.

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More profit

The TCG 2020 is highly efficient thanks to its optimized inlet duct, combustion chamber and spark plugs. Save as much as 15 % per annum on fuel costs – and increase your plant's profitability.

Less overall cost

With its optimized engine components, the TCG 2020 requires up to 50 % less lubricating oil than other similar gensets. In terms of efficiency that means long-term savings.

Different engines to suit your needs

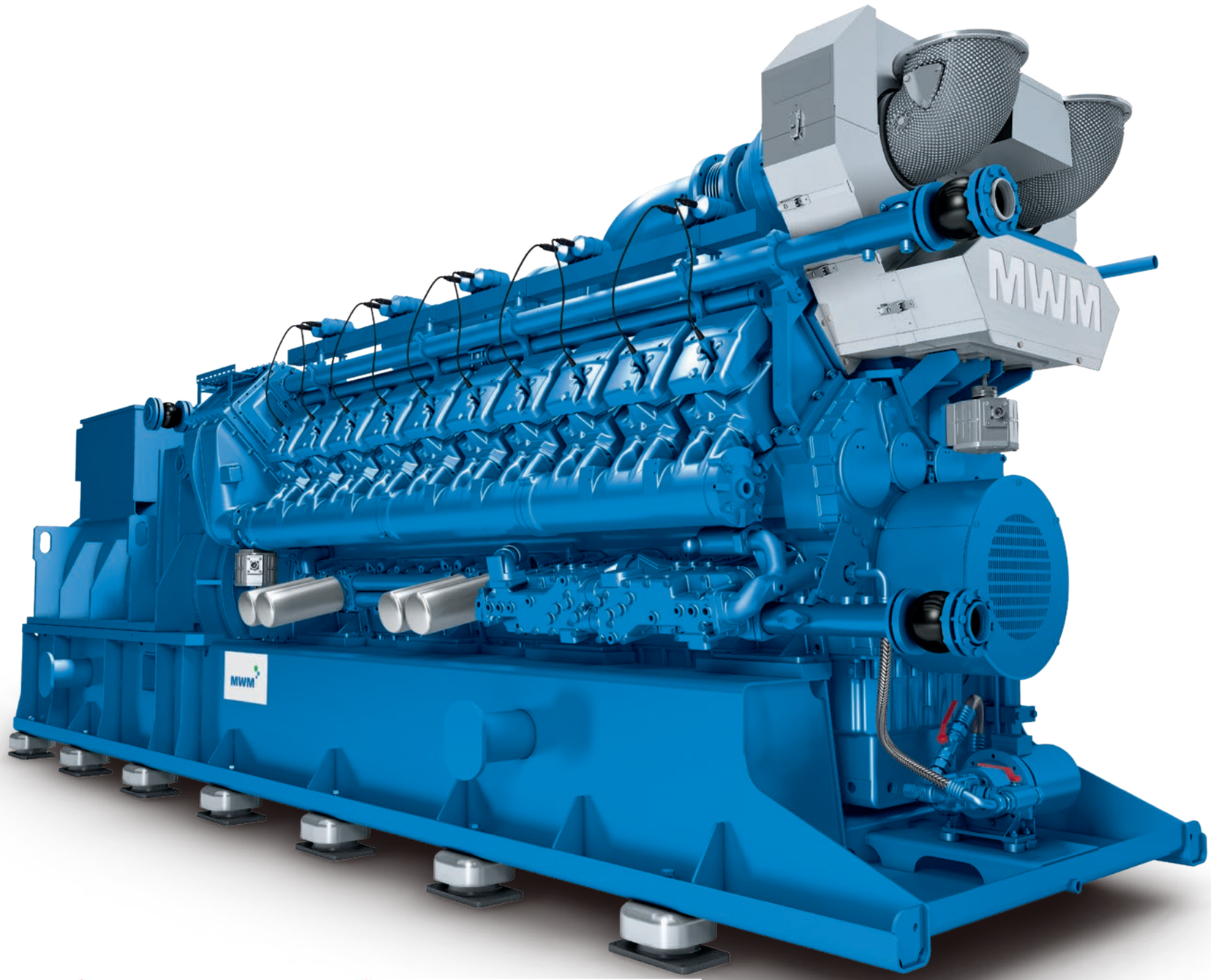
Whether you need high efficiency or an optimized standalone unit with good load compensation and black start properties – we can provide you with an engine tailored exactly to your needs.

Optimum control concept

TEM (Total Electronic Management) controls not just the engine but the entire system including the heat supply from cogeneration. Temperature monitoring for each cylinder and anti-knock control ensure the best possible utilization of fuel and maximum power output, even if gas composition fluctuates.

Flexible usage

The latest technology such as our gas-mixer and TEM allows you to use a wide variety of gases. Even the most problematic gases such as coal mine gas, landfill gas and sewage gas can be used without difficulty.



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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

TCG 2020 V20

Technical data 50 Hz

Engine type	TCG 2020		V12	V12 K1	V12 K	V12	V16 K	V16	V20	V20
Bore/stroke		mm	170/195	170/195	170/195	170/195	170/195	170/195	170/195	170/195
Displacement		dm^3	53.1	53.1	53.1	53.1	70.8	70.8	88.5	88.5
Speed		min^{-1}	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Mean piston speed		m/s	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
Length [1]		mm	4,660	4,660	4,790	4,790	5,430	5,430	6,200	6,200
Width [1]		mm	1,810	1,810	1,810	1,810	1,810	1,810	1,710	1,710
Height [1]		mm	2,210	2,210	2,210	2,210	2,210	2,210	2,190	2,190
Dry weight genset		kg	11,200	11,200	11,700	11,700	13,300	13,300	17,900	17,900

Natural gas applications

$NO_x \leq 500$ mg/Nm³ [2]

Engine type	TCG 2020		V12	V12 K1	V12 K	V12	V16 K	V16	V20	V20
Configuration			RW[5]	KW[6]	K[7]	R[8]	K[7]	R[8]	R[8]	P[9]
Electrical power [3]		kW	1,000	1,000	1,125	1,200	1,500	1,560	2,000	2,000
Mean effective pressure		bar	15.5	15.5	17.4	18.6	17.5	18.1	18.6	18.6
Thermal output [4]	±8%	kW	1,056	1,191	1,267	1,189	1,688	1,576	1,983	1,912
Electrical efficiency [3]		%	43.0	40.0	40.7	43.7	40.8	43.3	43.7	44.4
Thermal efficiency [3]		%	45.4	47.6	45.8	43.3	45.9	43.8	43.3	42.5
Total efficiency [3]		%	88.4	87.6	86.6	87.0	86.7	87.1	87.0	86.9

Biogas applications

$NO_x \leq 500$ mg/Nm³ [2]
Sewage gas (65% CH_4 / 35% CO_2)
Biogas (60% CH_4 / 32% CO_2, Rest N_2)
Landfill gas (50% CH_4 / 27% CO_2, Rest N_2)

Minimum heating value H_u = 5.0 kWh/Nm³

Engine type	TCG 2020		V12	V12	V16	V20
Configuration			XW[10]	X[11]	X[11]	X[11]
Electrical power [3]		kW	1,000	1,200	1,560	2,000
Mean effective pressure		bar	15.5	18.6	18.1	18.6
Thermal output [4]	±8%	kW	1,035	1,192	1,566	2,010
Electrical efficiency [3]		%	42.6	43.0	42.7	43.0
Thermal efficiency [3]		%	44.1	42.7	42.9	43.2
Total efficiency [3]		%	86.7	85.7	85.6	86.2

1) Transport dimensions for gensets, components set up separately must be taken into consideration.
2) $NO_x \leq 500$ mg/Nm³; exhaust gas dry at 5% O_2.
3) According to ISO 3046-1 at U = 0.4 kV, cosphi = 1.0 for 50 Hz and a methane number of MN 80 (TCG 2020) or MN 70 (TCG 2020K) for natural gas.
4) Exhaust gas cooled to 120 °C for natural gas and 150 °C for biogas.
5) RW = High Response for Requested Power. Optimized for high total efficiency at requested power.
6) KW = Robustness for Requested Power. Optimized for robustness and low CAPEX at requested power.
7) K = Robustness. Optimized for robustness and low CAPEX.
8) R = High Response. Optimized for high total efficiency.
9) P = High Efficiency. Optimized for high electrical efficiency.
10) XW = Biogas for Requested Power. Optimized for operation with biogases at requested power.
11) X = Biogas. Optimized for operation with biogases.

Data for special gas and dual gas operation on request.
The values given on these datasheets are for information purposes only and not binding. The information given in the offer is decisive.

Technical data 60 Hz

Engine type	TCG 2020		V12 K	V12	V16 K	V16	V20
Bore/stroke		mm	170/195	170/195	170/195	170/195	170/195
Displacement		dm^3	53.1	53.1	70.8	70.8	88.5
Speed		min^{-1}	1,500	1,500	1,500	1,500	1,500
Mean piston speed		m/s	9.8	9.8	9.8	9.8	9.8
Length [1]		mm	5,970	5,970	6,640	6,640	7,470
Width [1]		mm	1,790	1,790	1,790	1,790	1,710
Height [1]		mm	2,210	2,210	2,210	2,210	2,190
Dry weight genset		kg	13,000	13,000	14,900	14,900	19,800

Natural gas applications

$NO_x \leq 500$ mg/Nm³ [2]

Engine type	TCG 2020		V12 K	V12	V16 K	V16	V20
Configuration			K[5]	R[6]	K[5]	R[6]	R[6]
Electrical power [3]		kW	1,125	1,200	1,500	1,560	2,000
Mean effective pressure		bar	17.4	18.7	17.6	18.3	18.7
Thermal output [4]	±8%	kW	1,274	1,196	1,703	1,589	1,997
Electrical efficiency [3]		%	40.4	43.4	40.4	43.0	43.4
Thermal efficiency [3]		%	45.8	43.2	45.9	43.8	43.3
Total efficiency [3]		%	86.2	86.6	86.3	86.8	86.7

Biogas applications

$NO_x \leq 500$ mg/Nm³ [2]
Sewage gas (65% CH_4 / 35% CO_2)
Biogas (60% CH_4 / 32% CO_2, Rest N_2)
Landfill gas (50% CH_4 / 27% CO_2, Rest N_2)

Minimum heating value H_u = 5.0 kWh/Nm³

Engine type	TCG 2020		V12	V16	V20
Configuration			X[7]	X[7]	X[7]
Electrical power [3]		kW	1,200	1,560	2,000
Mean effective pressure		bar	18.7	18.3	18.7
Thermal output [4]	±8%	kW	1,201	1,580	2,024
Electrical efficiency [3]		%	42.7	42.3	42.7
Thermal efficiency [3]		%	42.7	42.8	43.2
Total efficiency [3]		%	85.4	85.1	85.9

1) Transport dimensions for gensets, components set up separately must be taken into consideration.
2) $NO_x \leq 500$ mg/Nm³; exhaust gas dry at 5% O_2.
3) According to ISO 3046-1 at U = 0.48kV, cosphi = 1.0 for 60 Hz and a methane number of MN 80 (TCG 2020) or MN 70 (TCG 2020K) for natural gas.
4) Exhaust gas cooled to 120 °C for natural gas and 150 °C for biogas.
5) K = Robustness. Optimized for robustness and low CAPEX.
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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

MWM

Version 11-20/EN

www.mwm.net

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TCG 2032

Efficiency on a new level.

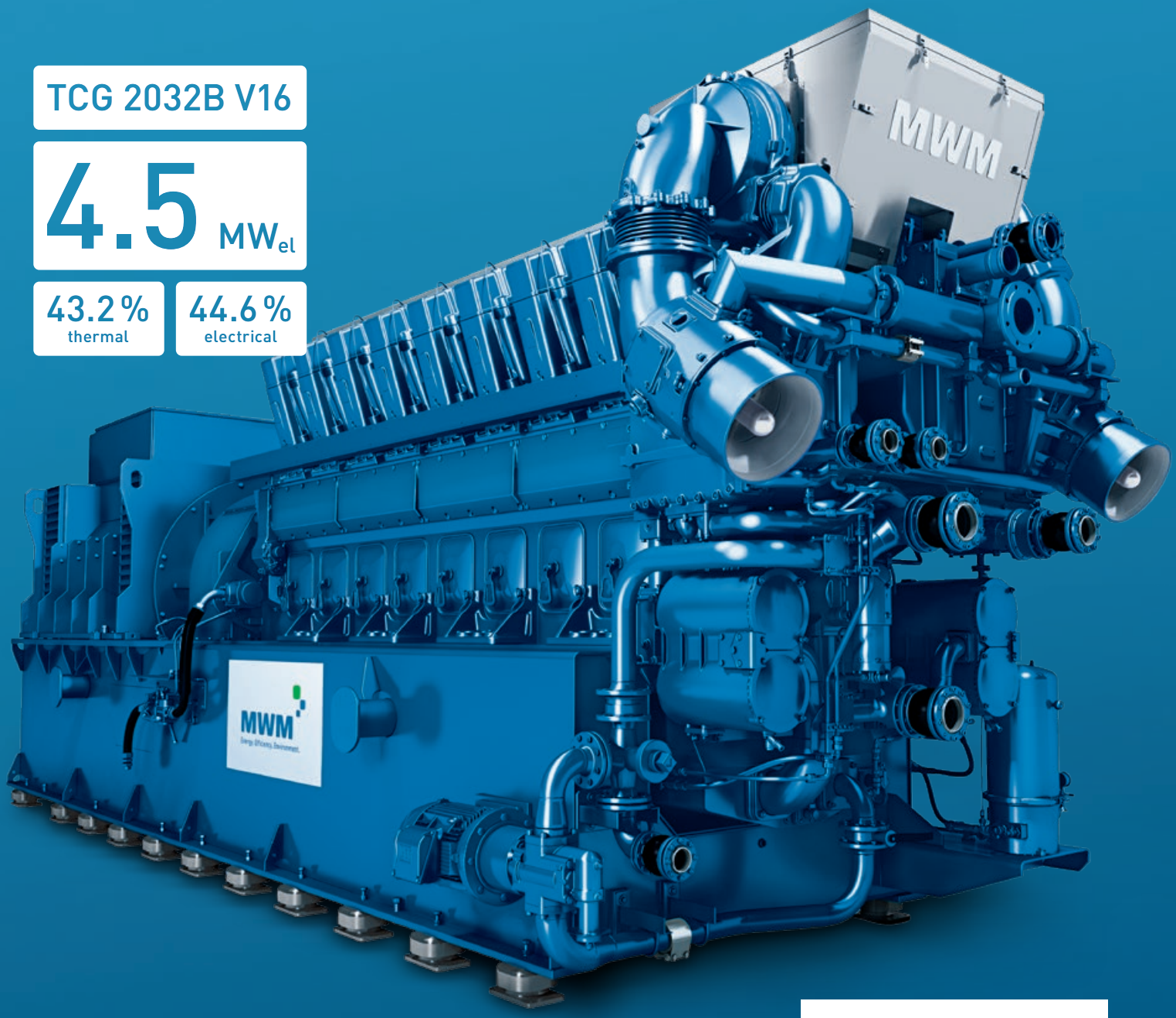
For natural gas and biogas with an output from 3,300 to 4,500 kW_{el}

TCG 2032B V16

4.5 MW_{el}

43.2 % thermal

44.6 % electrical



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Precision Energy, Bangladesh

In 2010, MWM shipped 15 TCG 2032 V16 to Precision Energy Bangladesh within just three months. The gas engines produce a constant overall output of 60 MW_{el}. All of the electric energy that has been generated is fed into the public grid. More information about this project can be found in our MWM movie "60 MW Around the World" at www.mwm.net.

15 x MWM TCG 2032 V16 | Commissioning: 2009/2010

AMD Dresden, Germany

MWM engines were chosen for the energy supply center of the AMD chip factory in Dresden, since our system generates electricity of supreme quality. Moreover, the waste heat is used for heat supply and cold production, thus achieving very high primary energy utilization.

9 x MWM TCG 2032 V16 | Commissioning: 2005/2007

Italiana Coke, Italy

MWM engines were installed for the environmentally friendly utilization of the coke oven gas generated at the coke oven plant Italiana Coke. The electricity rebate, the amount of which is determined by law, gives the operator a secure income from the sale of the electricity generated at the plant, in addition to the company's core business, the production of metallurgic coke.

5 x MWM TCG 2032 V16 | Commissioning: 2010

Optimized reliability for your success.

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More profit

The optimized maintenance concept with cylinder units simplifies accessibility and, along with the reduction of the number of different parts, minimizes the time required for maintenance. This saves up to 20 % in service costs. At the same time you profit from up to 30 % less lubricating oil consumption compared to other engines.

Longer runtimes

Thanks to the extended service intervals, the TCG 2032 runs up to 200 hours longer per annum than comparable products. The major overhaul is scheduled after 80,000 operating hours.

Greater reliability

The particle-free combustion with chamber plugs extends the service intervals for the exhaust gas heat exchanger and reduces service costs compared to other combustion methods.

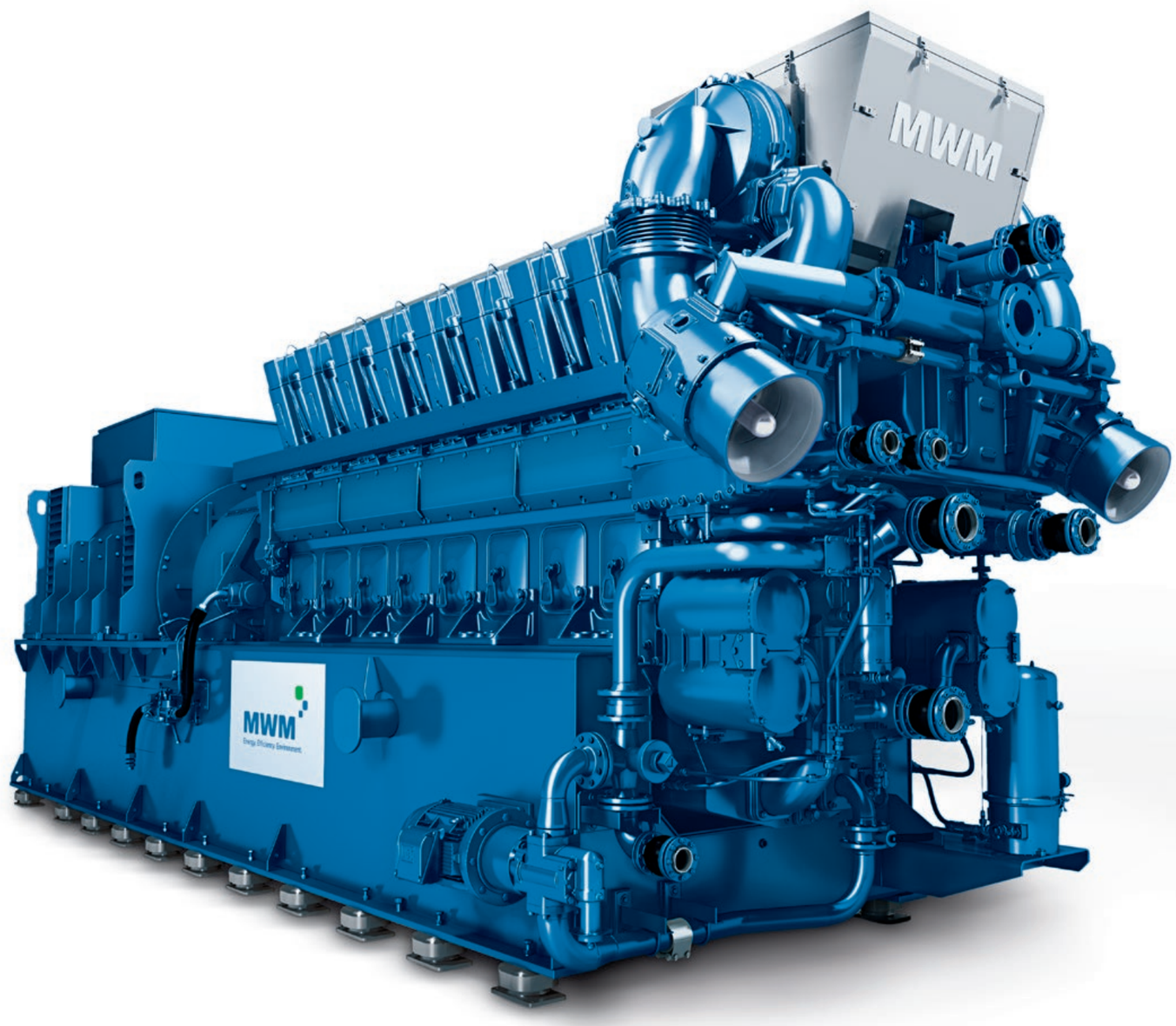
Major components such as pistons, conrods, spark plugs and cylinder heads have been improved to withstand the greater power output and deliver increased electrical efficiency.

Optimum efficiency

The interaction of all components has been improved even further. All components relevant for efficiency and power output are monitored by the TEM (Total Electronic Management). The new, upgraded wastegate in particular ensures a more efficient operation with changing conditions. This is also the case when the gas composition is fluctuating – thanks to fast response times due to the temperature monitoring for each cylinder. TEM not only controls the engine, but the entire system, including heat extraction.

Full turbo power

The high-pressure turbocharger A140 with an improved wastegate allows operation with a broader air intake temperature range and up to higher altitudes.



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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

Technical data 50 Hz

Engine type	TCG 2032		V12	V16	TCG 2032B V16
Bore/stroke		mm	260/320	260/320	260/320
Displacement		dm^3	203.9	271.8	271.8
Speed		min^{-1}	1,000	1,000	1,000
Mean piston speed		m/s	10.7	10.7	10.7
Length [1]		mm	7,860	9,271	9,272
Width [1]		mm	2,660	2,790	2,790
Height [1]		mm	3,390	3,390	3,390
Dry weight genset		kg	43,100	51,200	51,400

Natural gas applications

NO_x ≤ 500 mg/Nm^3 [2]

Engine type	TCG 2032		V12	V16	TCG 2032B V16
Configuration			R[5]	R[5]	R[5]
Electrical power [3]		kW	3,333	4,300	4,500
Mean effective pressure		bar	20.0	19.4	20.3
Thermal output [4]	±8 %	kW	2,862	3,698	3,668
Electrical efficiency [3]		%	43.9	44.1	44.6
Thermal efficiency [3]		%	42.6	42.7	43.1
Total efficiency [3]		%	86.5	86.8	87.7

Biogas applications

NO_x ≤ 500 mg/Nm^3 [2]
Sewage gas (65 % CH_4 / 35 % CO_2)
Biogas (60 % CH_4 / 32 % CO_2, Rest N_2)
Landfill gas (50 % CH_4 / 27 % CO_2, Rest N_2)

Minimum heating value H_u = 5.0 kWh/Nm^3

Engine type	TCG 2032		V16
Configuration			X[6]
Electrical power [3]		kW	3,770
Mean effective pressure		bar	17.0
Thermal output [4]	±8 %	kW	3,196
Electrical efficiency [3]		%	43.0
Thermal efficiency [3]		%	41.9
Total efficiency [3]		%	84.9

1) Transport dimensions for gensets, components set up seperately must be taken into consideration.
2) NO_x ≤ 500 mg/Nm^3; exhaust gas dry at 5 % O_2.
3) According to ISO 3046-1 at U = 11 kV, cosphi = 1.0 for 50 Hz and a minimum methane number of MN 70 for natural gas.
4) Exhaust gas cooled to 120 °C for natural gas and 180 °C for biogas.
5) R = High Response. Optimized for high total efficiency.
6) X = Biogas. Optimized for operation with biogases.

Data for special gases and dual gas operation on request.

The values given on these datasheets are for information purposes only and not binding. The information given in the offer is decisive.

Technical data 60 Hz

Engine type	TCG 2032		V12	V16	TCG 2032B V16
Bore/stroke		mm	260/320	260/320	260/320
Displacement		dm^3	203.9	271.8	271.8
Speed		min^{-1}	900	900	900
Mean piston speed		m/s	9.6	9.6	9.6
Length [1]		mm	8,000	9,420	9,420
Width [1]		mm	2,790	2,790	2,790
Height [1]		mm	3,390	3,390	3,390
Dry weight genset		kg	40,650	52,400	52,400

Natural gas applications

NO_x ≤ 500 mg/Nm^3 [2]

Engine type	TCG 2032		V12	V16	TCG 2032B V16
Configuration			R[5]	R[5]	R[5]
Electrical power [3]		kW	3,000	4,000	4,050
Mean effective pressure		bar	20.1	20.2	20.4
Thermal output [4]	±8 %	kW	2,539	3,411	3,252
Electrical efficiency [3]		%	43.9	43.8	44.3
Thermal efficiency [3]		%	42.1	42.4	42.6
Total efficiency [3]		%	86.0	86.2	86.9

Biogas applications

NO_x ≤ 500 mg/Nm^3 [2]
Sewage gas (65 % CH_4 / 35 % CO_2)
Biogas (60 % CH_4 / 32 % CO_2, Rest N_2)
Landfill gas (50 % CH_4 / 27 % CO_2, Rest N_2)

Minimum heating value H_u = 5.0 kWh/Nm^3

Engine type	TCG 2032		V16
Configuration			X[6]
Electrical power [3]		kW	3,510
Mean effective pressure		bar	17.0
Thermal output [4]	±8 %	kW	2,880
Electrical efficiency [3]		%	43.3
Thermal efficiency [3]		%	40.6
Total efficiency [3]		%	83.9

1) Transport dimensions for gensets, components set up seperately must be taken into consideration.
2) NO_x ≤ 500 mg/Nm^3; exhaust gas dry at 5 % O_2.
3) According to ISO 3046-1 at U = 4.16 kV, cosphi = 1.0 for 60 Hz and a minimum methane number of MN 80 for natural gas.
4) Exhaust gas cooled to 120 °C for natural gas and 180 °C for biogas.
5) R = High Response. Optimized for high total efficiency.
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Data for special gases and dual gas operation on request.

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MWM DIGITALPOWER

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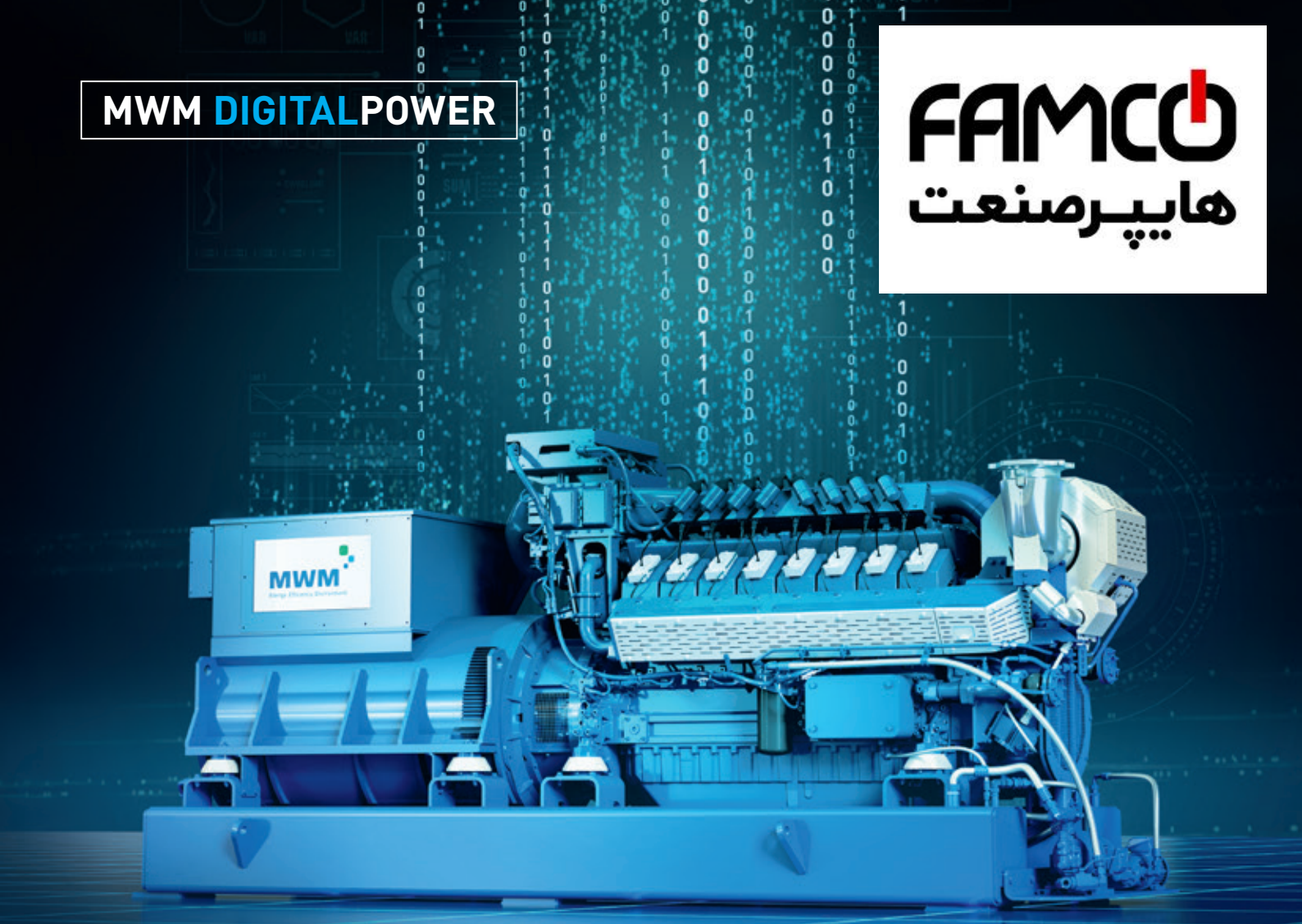

TCG 3016

Robust. Efficient. Digital.

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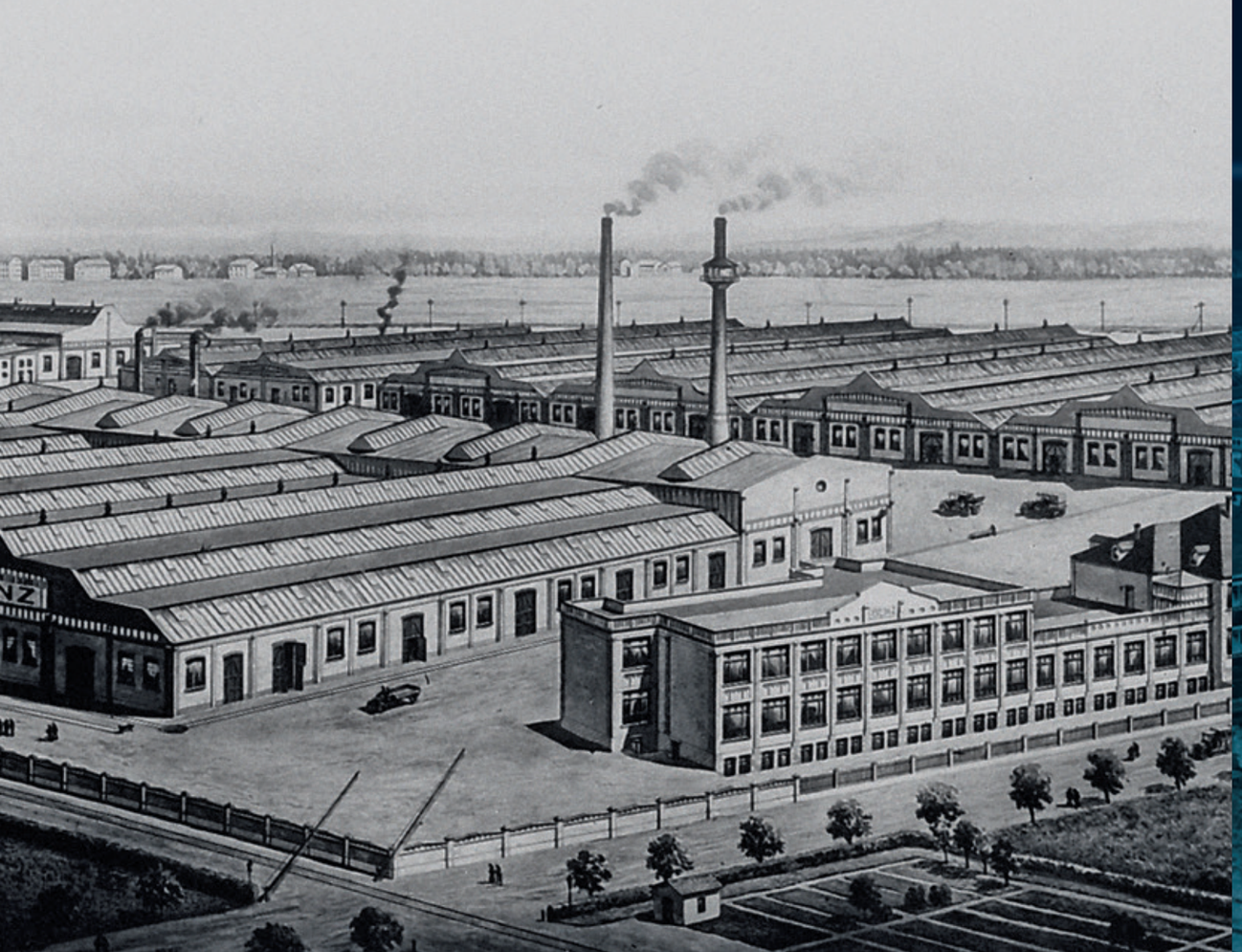
تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

MWM
Energy. Efficiency. Environment.

150 years of experience for your success.

With MWM, you benefit from 150 years of experience in gas engine technology and energy generation. Since 2011, we have been part of the network of Caterpillar Inc., gaining access to international expertise and resources on the basis of which we can develop individual turnkey solutions for you. Draw on the security and experience of a specialist that has installed thousands of highly efficient and reliable plants around the globe.

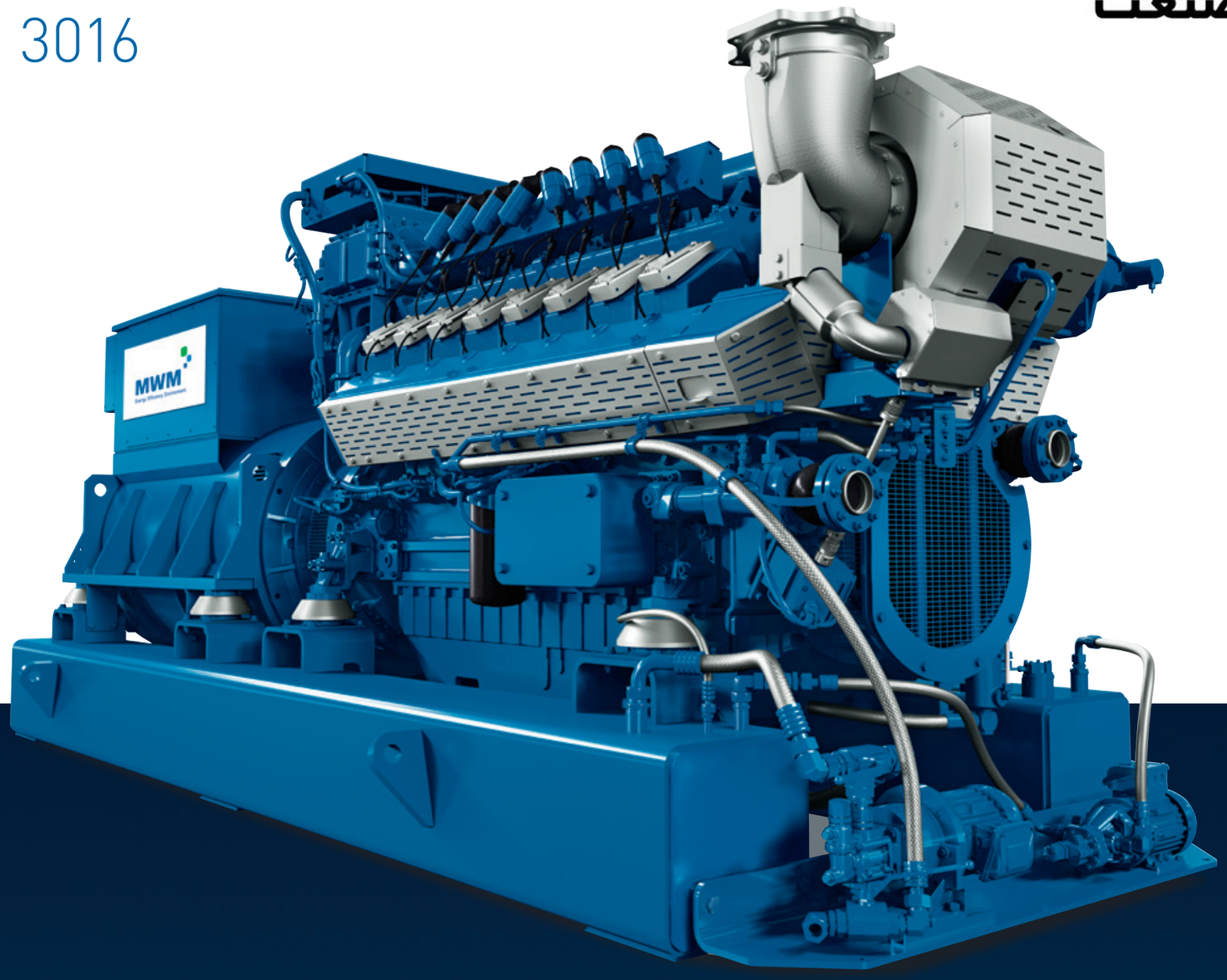


The future of efficiency is digital.

With MWM Digital Power, the energy market enters a new age. State-of-the-art components combined with smart and secure data analysis ensure improved maintenance, efficiency and optimized capacity utilization of your plants.

The MWM TCG 3016 gas engines are more than merely the next iteration of MWM's proven gas gensets. The new gas engines and turnkey solutions represent an entirely new development – perfectly tailored to the challenges of Industry 4.0 and the changed framework conditions of a dynamic energy market in the age of global value chains.

TCG 3016



Robust. Efficient. Digital.

The TCG 3016 is the first of a new generation: State-of-the-art components and the TPEM (Total Plant & Energy Management) control ensure maximum reliability and availability. The improved oil management and optimized cylinder and turbo chargers set new standards in terms of durability and reliability.

MWM DIGITALPOWER

- **Highest efficiency in its power range**
  - ☑ Electrical efficiency of up to 43.6 percent
  - ☑ Maximum profitability through rock-bottom operating costs
  - ☑ More efficiency through numerically optimized, low-loss flow design
- **Optimized lube oil management**
  - ☑ Lowest-in-class lube oil consumption: 0.1 g/kWh$_{el}$
  - ☑ Longer oil change intervals
  - ☑ Oil tank and integrated daily refill tank
- **Flanged genset concept**
  - ☑ Vibration-decoupled base frame for lower installation costs and reliable operation
  - ☑ Greater integrated lube oil volume
  - ☑ Integrated oil management
- **Improved turbo charger for a wide field of deployment**
  - ☑ Longer maintenance intervals
  - ☑ Wider suction air temperature window
- **Higher availability and longer useful life**
  - ☑ Optimized combustion through evenly charged cylinders
  - ☑ Optimized combustion with lower peak pressure
  - ☑ Smoothly running, low-vibration genset
- **Maximum reliability**
  - ☑ Very good island mode capability
  - ☑ Fulfills G1, G2 & G3 classes according to ISO 8528 with less than 10 steps in most applications
- **TPEM – the new control system**
  - ☑ Easy human-machine interface
  - ☑ Fully integrated remote access
  - ☑ Expanded scope, e.g. synchronization, power switch, and plant control

Benefit from the TCG 3016!

Contact us:
www.mwm.net or info@mwm.net

Superior operation and efficiency.

Maximum efficiency

Best total cost of ownership in its power range through unique combination of a long operating period until the major overhaul (80,000 oh for natural gas) and outstanding efficiency (electrical efficiency of up to 43.6 percent).

Lower gas consumption
through improved efficiency and fuel flexibility

Reduced maintenance costs
through longer service intervals and longer operating hours until the major overhaul

Lower lube oil consumption
lead to lower operating cost

Improved durability
ensures higher reliability and availability

The TCG 3016: Successful deployment.

Vereinigte Stadtwerke Bad Oldesloe

Holger Herzberg, project manager: "MWM/CES plants excel in terms of their adaptability to specific customer needs, by means of which the plants can be made even more efficient. Besides the plant's excellent efficiency, this feature really impresses me. The reduced lubricant consumption of less than 0.1 g/kWh is another positive aspect. Compared to the previous oil change interval of about 2,000 to 3,000 operating hours, the TCG 3016 only needs an oil change once every 5,000 operating hours, i.e. about once a year. The gas engine is extremely robust, which translates to longer service life."

MWM TCG 3016 | Go-live: 2016

Wentorf Biogas Plant

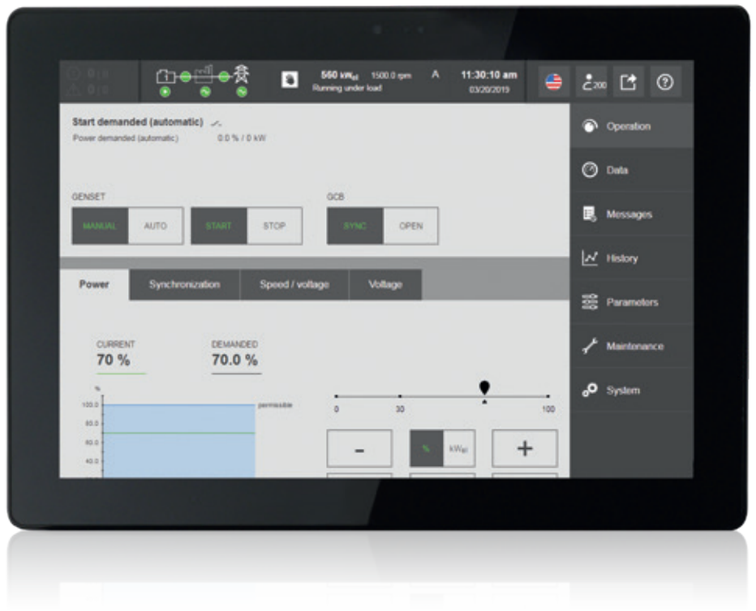
Norbert Hack, plant operator: "I've been running the TCG 3016 for a few months. As far as I'm concerned, this is the most efficient engine currently available on the market. Compared to its output, its biogas consumption is astonishingly low. The engine is perfectly tuned and runs very quietly. I have already seen many other gensets and models at my colleagues' facilities, but this engine's quality is truly outstanding – a genuine trend-setter. The new development (TPEM) from Mannheim will doubtlessly make the interaction between the control and the engine even more effective. The TPEM offers more possibilities for reading out engine data, which will further improve the plant operation."

MWM TCG 3016 | Go-live: 2016

TPEM. The door to the digital age.

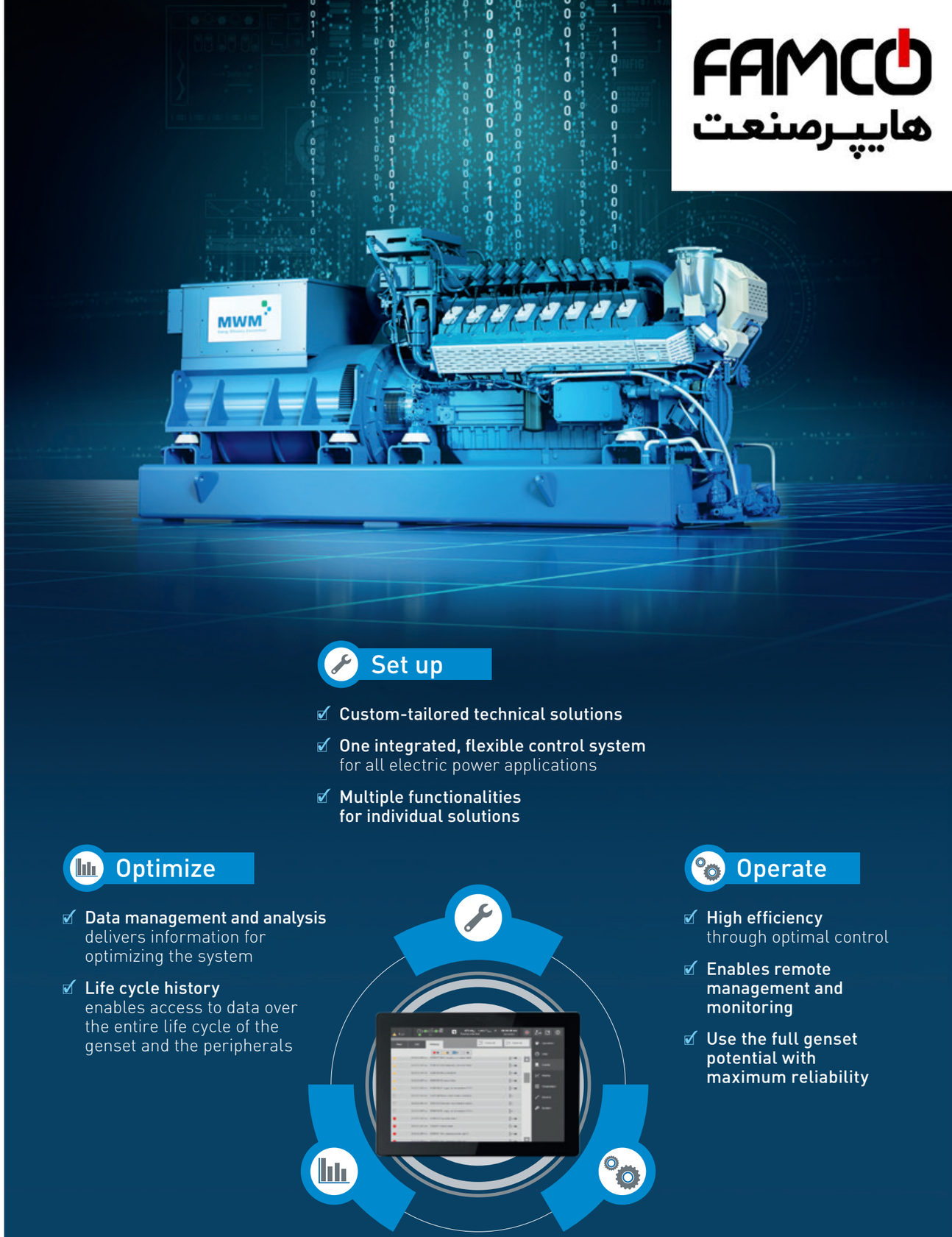
With its comprehensive digital power plant control TPEM (Total Plant & Energy Management), MWM redefines the control standard for energy solutions.

TPEM eliminates the need for additional control systems, as all power plant data for the genset and plant control are combined in one system. The optimum power plant control enables high economic efficiency, provided from a single source.



State-of-the-art system: economical, efficient and complete

- **One user interface**
  - ☑ Complete power plant control and setup
- **Connectivity solutions**
  - ☑ Remote plant control with free "TPEM Remote client" software and extensive monitoring and analytics options with "MWM RAM" subscription
- **Security-oriented technology**
  - ☑ Safety chain for cogeneration plant monitoring (TÜV-certified)



Set up

- ☑ **Custom-tailored technical solutions**
- ☑ **One integrated, flexible control system** for all electric power applications
- ☑ **Multiple functionalities for individual solutions**

Optimize

- ☑ **Data management and analysis** delivers information for optimizing the system
- ☑ **Life cycle history** enables access to data over the entire life cycle of the genset and the peripherals

Operate

- ☑ **High efficiency** through optimal control
- ☑ **Enables remote management and monitoring**
- ☑ **Use the full genset potential with maximum reliability**

Technical data 50 Hz

Engine type	TCG 3016	V08	V12	V16	V16
Bore/stroke	mm	132/160	132/160	132/160	132/160
Displacement	dm^3	17.5	26.3	35.0	35.0
Speed	min^{-1}	1,500	1,500	1,500	1,500
Mean piston speed	m/s	8.0	8.0	8.0	8.0
Length [1]	mm	3,100	3,830	4,200	4,200
Width [1]	mm	1,780	1,780	1,780	1,780
Height [1]	mm	2,150	2,150	2,150	2,150
Dry weight genset	kg	5,720	7,000	8,070	8,560

Natural gas applications

NO_x ≤ 500 mg/Nm^3 [2]

Engine type	TCG 3016		V08	V12	V16	V16
Configuration				P[5]	P[5]	P[5]	S[6]
Electrical power [3]		kW	400	600	800	1,000
Mean effective pressure		bar	18.9	18.9	18.8	23.5
Thermal output [4]	±8 %	kW	404	617	819	1,123
Electrical efficiency [3]		%	43.1	43.4	43.6	41.5
Thermal efficiency [3]		%	43.6	44.6	44.6	46.6
Total efficiency [3]		%	86.7	88.0	88.2	88.1

Biogas applications

NO_x ≤ 500 mg/Nm^3 [2]
Sewage gas (65 % CH_4 / 35 % CO_2)
Biogas (60 % CH_4 / 32 % CO_2, Rest N_2)
Landfill gas (50 % CH_4 / 27 % CO_2, Rest N_2)

Minimum heating value H_U = 5.0 kWh/Nm^3

Engine type	TCG 3016		V08	V12	V16
Configuration			X[7]	X[7]	X[7]
Electrical power [3]		kW	400	600	800
Mean effective pressure		bar	18.9	18.9	18.8
Thermal output [4]	±8 %	kW	394	598	790
Electrical efficiency [3]		%	42.8	42.9	43.2
Thermal efficiency [3]		%	42.2	42.8	42.7
Total efficiency [3]		%	85.0	85.7	85.9

1) Transport dimensions for gensets, components set up seperately must be taken into consideration.
2) NO_x ≤ 500 mg/Nm^3; exhaust gas dry at 5 % O_2.
3) According to ISO 3046-1 at U = 0.4 kV, cosphi = 1.0 for 50 Hz, a minimum methane number of MN 70 (V08, V12, V16) and MN 80 (V16 Configuration S) for natural gas and MN 134 (sewage gas) for biogas applications.
4) Exhaust gas cooled to 120 °C for natural gas and 150 °C for biogas.
5) P = High Efficiency. Optimized for high electrical efficiency.
6) S = High Density. Increased power density.
7) X = Biogas. Optimized for operation with biogases.

Data for special gases and dual gas operation on request.

The values given on these datasheets are for information purposes only and not binding. The information given in the offer is decisive.

Technical data 60 Hz

Engine type	TCG 3016	V08	V12	V16
Bore/stroke	mm	132/160	132/160	132/160
Displacement	dm^3	17.5	26.3	35.0
Speed	min^{-1}	1,800	1,800	1,800
Mean piston speed	m/s	9.6	9.6	9.6
Length [1]	mm	3,100	3,830	4,200
Width [1]	mm	1,780	1,780	1,780
Height [1]	mm	2,150	2,150	2,150
Dry weight genset	kg	5,720	7,000	7,700

Natural gas applications

NO_x ≤ 500 mg/Nm^3 [2]

Engine type	TCG 3016		V08	V12	V16
Configuration				P[5]	P[5]	P[5]
Electrical power [3]		kW	400	600	800
Mean effective pressure		bar	15.8	15.7	15.7
Thermal output [4]	±8 %	kW	428	644	856
Electrical efficiency [3]		%	42.1	42.4	42.6
Thermal efficiency [3]		%	45.0	45.7	45.5
Total efficiency [3]		%	87.1	88.1	88.1

Biogas applications

NO_x ≤ 500 mg/Nm^3 [2]
Sewage gas (65 % CH_4 / 35 % CO_2)
Biogas (60 % CH_4 / 32 % CO_2, Rest N_2)
Landfill gas (50 % CH_4 / 27 % CO_2,Rest N_2)

Minimum heating value H_U = 5.0 kWh/Nm^3

Engine type	TCG 3016		V08	V12	V16
Configuration			X[6]	X[6]	X[6]
Electrical power [3]		kW	400	600	800
Mean effective pressure		bar	15.8	15.7	15.7
Thermal output [4]	±8 %	kW	415	627	827
Electrical efficiency [3]		%	41.7	41.7	41.9
Thermal efficiency [3]		%	43.3	43.6	43.3
Total efficiency [3]		%	85.0	85.3	85.2

1) Transport dimensions for gensets, components set up seperately must be taken into consideration.
2) NO_x ≤ 500 mg/Nm^3; exhaust gas dry at 5 % O_2.
3) According to ISO 3046-1 at U = 0.48 kV, cosphi = 1.0 for 60 Hz, a minimum methane number of MN 70 for natural gas and MN 134 (sewage gas) for biogas applications.
4) Exhaust gas cooled to 120 °C for natural gas and 150 °C for biogas.
5) P = High Efficiency. Optimized for high electrical efficiency.
6) X = Biogas. Optimized for operation with biogases.

Data for special gases and dual gas operation on request.

The values given on these datasheets are for information purposes only and not binding. The information given in the offer is decisive.

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Tel:۰۲۱-۴۸۰۰۰۰۴۹
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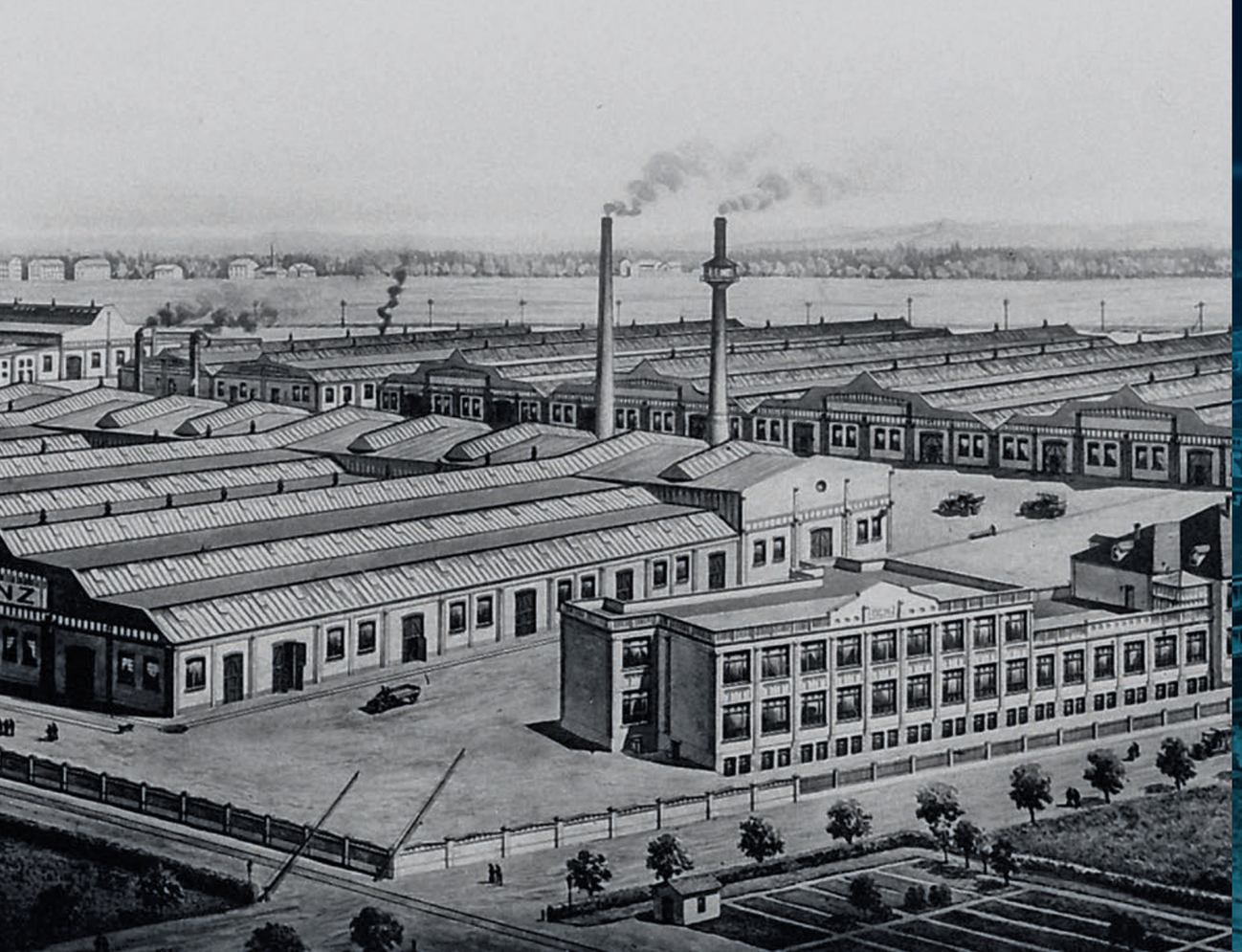
تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبـروی پالایشگاه نفت پـارس، پلاک ۱۲

MWM

Version 09-21/EN

150 years of experience for your success.

With MWM, you benefit from 150 years of experience in gas engine technology and energy generation. Since 2011, we have been part of the network of Caterpillar Inc., gaining access to international expertise and resources on the basis of which we can develop individual turnkey solutions for you. Draw on the security and experience of a specialist that has installed thousands of highly efficient and reliable plants around the globe.

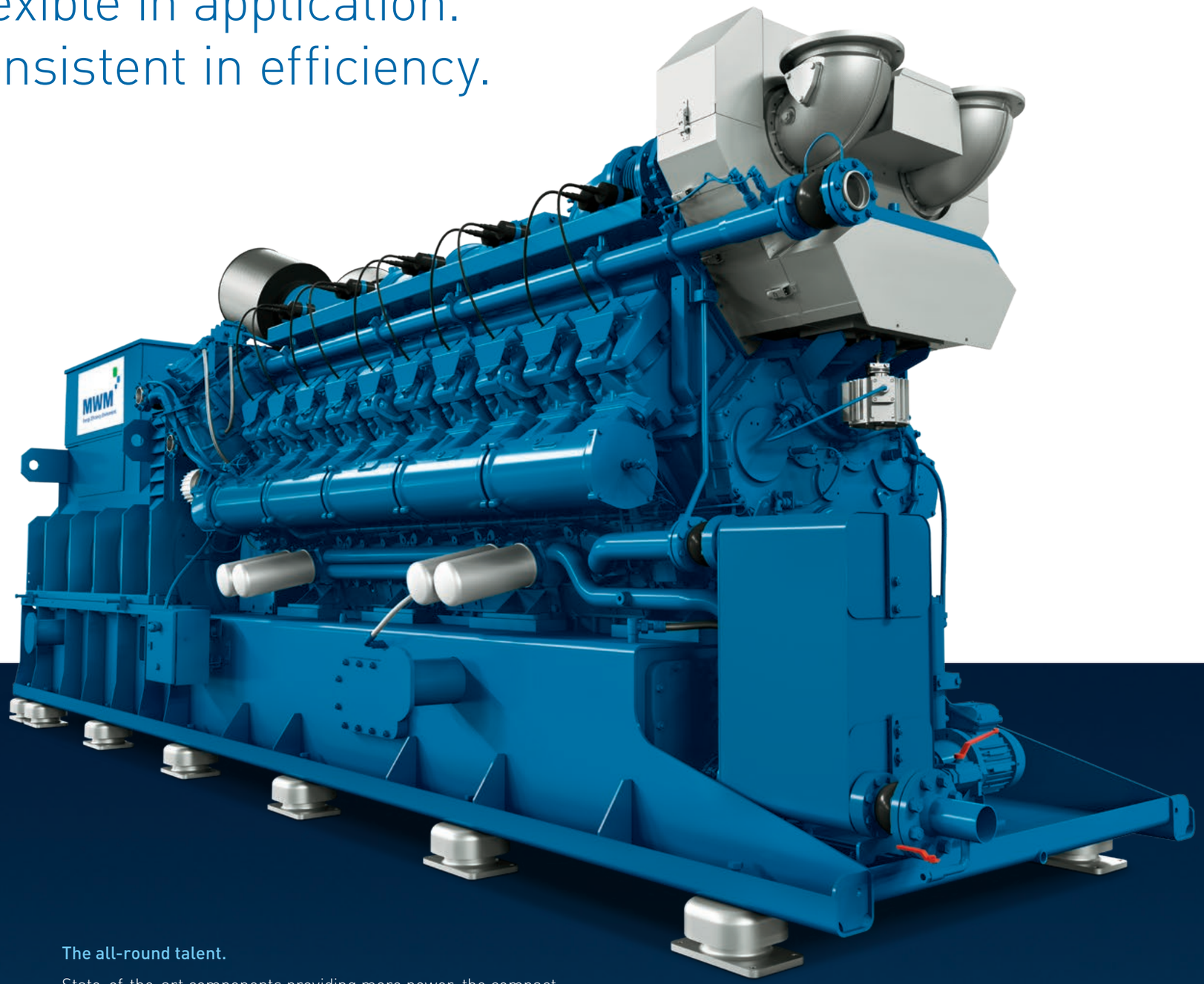


The future of efficiency is digital.

With MWM Digital Power, the energy market enters a new age. State-of-the-art components combined with smart and secure data analysis ensure improved maintenance, efficiency and optimized capacity utilization of your plants.

The MWM TCG 3020 gas engines are more than merely the next iteration of MWM's proven gas gensets. The new gas engines and turnkey solutions represent an entirely new development – perfectly tailored to the challenges of Industry 4.0 and the changed framework conditions of a dynamic energy market in the age of global value chains.

Flexible in application.
Consistent in efficiency.



The all-round talent.

State-of-the-art components providing more power: the compact design, a focus on a wide range of applications and high efficiency values make sure of that. Controlled by the smart and secure TPEM (Total Plant & Energy Management), the new TCG 3020 series offers highest profitability and reliability.

MWM DIGITALPOWER

- **High Profitability**
  - ☑ High efficiency values
  - ☑ Low oil consumption 0.15 g/kWh
  - ☑ Up to 80,000 oh until major overhaul results in high profitability for the customer
- **High Reliability**
  - ☑ Reliable and proven core engine
  - ☑ Upgraded with state of the art technologies
  - ☑ Extended maintenance intervals
- **High Efficiency**
  - ☑ Increased electrical efficiency – up to 45 % (NG) and up to 43.6 % (BG)
  - ☑ Increased electrical output up to 2,300 kW_{el}
  - ☑ Optimal combination of efficiency and reliability
- **Varieties of Gases and Applications**
  - ☑ Available for different applications like natural gas, biogas, landfill and propane gas operation
  - ☑ Optimized variants for high efficiency, flexibility and biogas
- **New Engine and Plant Control System TPEM**
  - ☑ Hardware and Software for the engine and holistic plant control
  - ☑ Enables full power capability of the genset with maximum reliability, availability, performance and usability
- **High Power Density**
  - ☑ Compact design: The TCG 3020 Series delivers up to 18 % more power output at the same size as its predecessor

Benefit from the TCG 3020!

Contact us: www.mwm.net or info@mwm.net

Superior operation and efficiency.

Reduced operating costs
Due to high efficiency, low oil consumption and low service costs

High Reliability
Providing up to 80,000 oh until major overhaul due to improved reliability

Increased performance
More power with higher efficiency

Tailor-made for your application
Optimized variants for all kind of gases and boundary conditions

One genset, various applications

Combined Heat and Power (CHP)

Utilities
District heating
Industrial
Hospitals
Airports
Greenhouses

Electrical Power

Energy services
Independent power producers
Utilities
Industrial

Biogas

Agriculture
Food industry
Sewage
Landfill

The TCG 3020: Successful deployment.

Krikato BVBA, Belgium

The TCG 3020 V20 is the second MWM genset for tomato producer Krikato BVBA in Belgium. In 2012, they decided to use the MWM brand – at that time, a TCG 2020 V12 – for the construction of a CHP. They once again selected an MWM genset for the extension of their greenhouse. Since June 2020, the two gensets together have been generating 3.5 MW of electrical and 4.2 MW of thermal power and reliably supply the greenhouse, which has been expanded from 1.2 to 1.7 hectares, with electricity and heat.

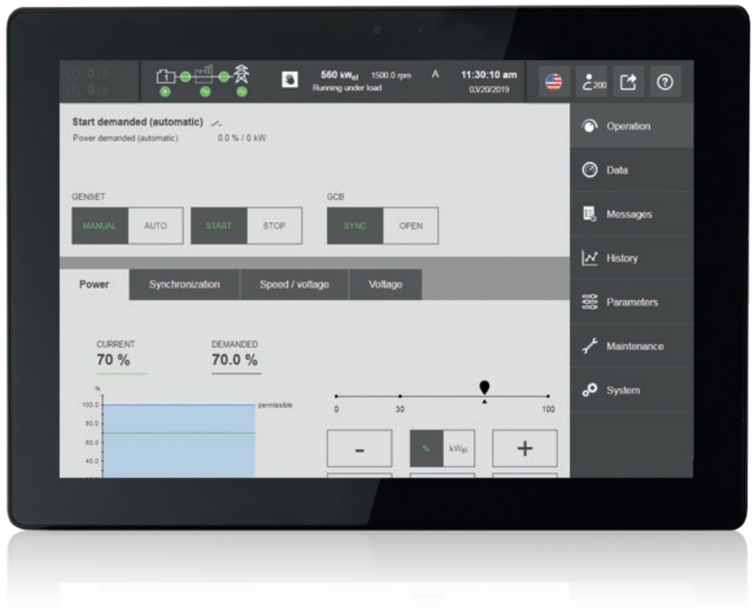
By using SCR catalysts, the carbon dioxide in the exhaust gas released by the natural gas-powered MWM gas gensets can be used for organic carbon fertilization of the plants after proper treatment, which has a positive effect on growth and yield.

1x MWM TCG 2020 V12, 1x MWM TCG 3020 V20 | Go-live: 2012 and June 2020

TPEM. The door to the digital age.

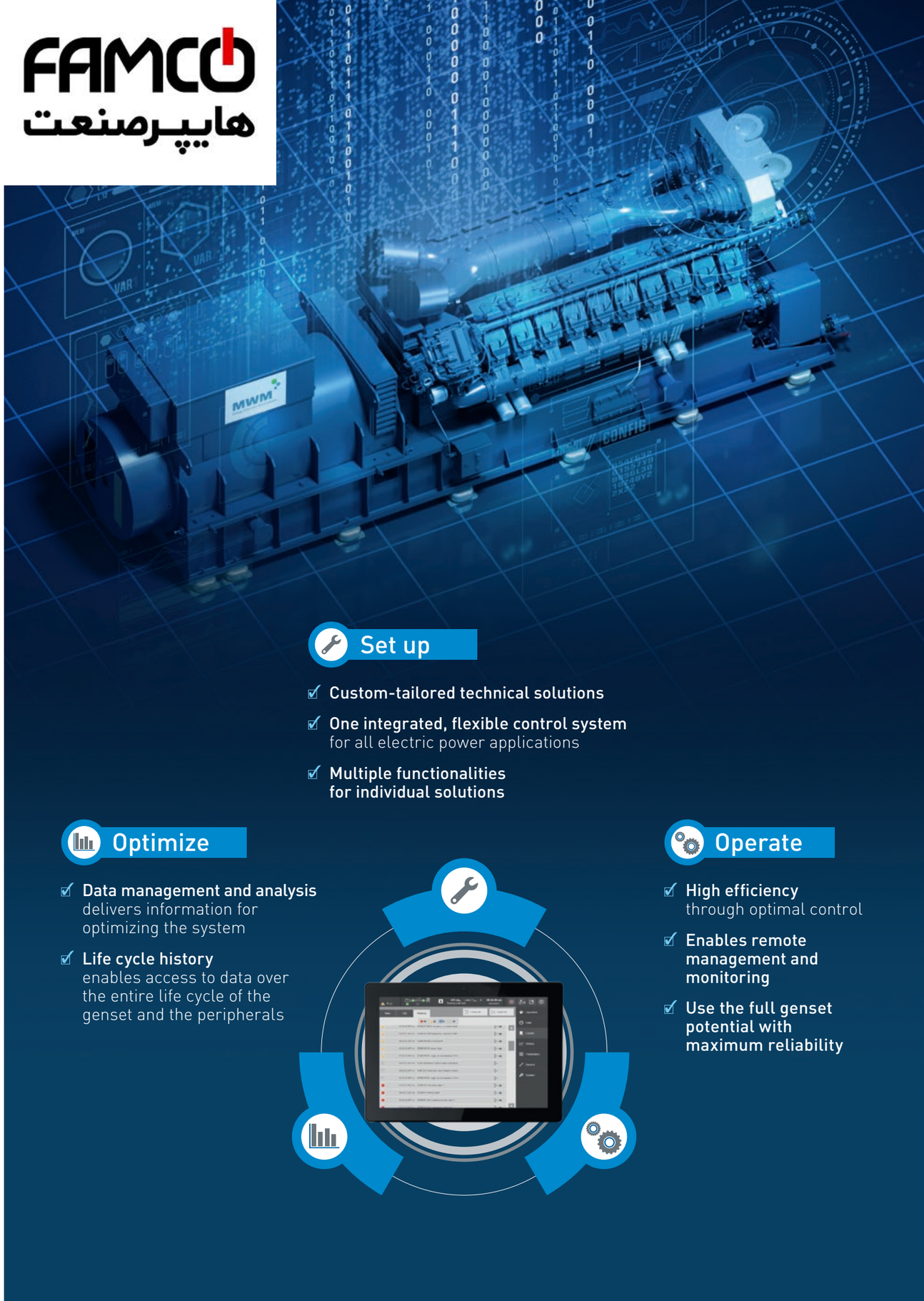
With its comprehensive digital power plant control TPEM (Total Plant & Energy Management), MWM redefines the control standard for energy solutions.

TPEM eliminates the need for additional control systems, as all power plant data for the genset and plant control are combined in one system. The optimum power plant control enables high economic efficiency, provided from a single source.



State-of-the-art system: economical, efficient and complete

- **One user interface**
  - ☑ Complete power plant control and setup
- **Connectivity solutions**
  - ☑ Remote plant control with free "TPEM Remote client" software and extensive monitoring and analytics options with "MWM RAM" subscription
- **Security-oriented technology**
  - ☑ Safety chain for cogeneration plant monitoring (TÜV-certified)



Set up

- ☑ **Custom-tailored technical solutions**
- ☑ **One integrated, flexible control system** for all electric power applications
- ☑ **Multiple functionalities for individual solutions**

Optimize

- ☑ **Data management and analysis** delivers information for optimizing the system
- ☑ **Life cycle history** enables access to data over the entire life cycle of the genset and the peripherals

Operate

- ☑ **High efficiency** through optimal control
- ☑ **Enables remote management and monitoring**
- ☑ **Use the full genset potential with maximum reliability**

Technical data 50 Hz (NO_x ≤ 500 mg/Nm³ [1])

Engine type	TCG 3020		V12	V12	V16	V16	V20	V20
Bore/stroke	mm		170/195	170/195	170/195	170/195	170/195	170/195
Displacement	dm^3		53.0	53.0	71.0	71.0	89.0	89.0
Speed	min^{-1}		1,500	1,500	1,500	1,500	1,500	1,500
Mean piston speed	m/s		9.8	9.8	9.8	9.8	9.8	9.8
Length [2]	mm		5,080	5,080	6,100	6,100	6,600	6,600
Width [2]	mm		1,710	1,710	1,710	1,710	1,710	1,710
Height [2]	mm		2,190	2,190	2,190	2,190	2,190	2,190
Dry weight genset	kg		12,900	12,900	17,400	17,400	21,400	21,400

Natural gas applications

NO_x ≤ 500 mg/Nm³ [1]

Engine type	TCG 3020		V12	V12	V16	V16	V20	V20
Configuration				P [5]	R [6]	P [5]	R [6]	P [5]	R [6]
Electrical power [3]		kW	1,380	1,380	1,840	1,840	2,300	2,300
Mean effective pressure		bar	21.5	21.5	21.5	21.5	21.5	21.5
Thermal output [4]	±8 %	kW	1,296	1,369	1,755	1,824	2,164	2,281
Electrical efficiency [3]		%	45.0	44.0	44.7	44.0	45.0	44.0
Thermal efficiency [3]		%	42.3	43.6	42.6	43.6	42.3	43.6
Total efficiency [3]		%	87.3	87.6	87.3	87.6	87.3	87.6

Biogas applications

NO_x ≤ 500 mg/Nm³ [1]
Sewage gas (65 % CH_4 / 35 % CO_2)
Biogas (50 % CH_4 / 50 % CO_2)
Landfill gas (50 % CH_4 / 27 % CO_2, Rest N_2)

Minimum heating value H_U = 5.0 kWh/Nm³

Engine type	TCG 3020		V12	V16	V20
Configuration			X [7]	X [7]	X [7]
Electrical power [3]		kW	1,380	1,840	2,300
Mean effective pressure		bar	21.5	21.5	21.5
Thermal output [4]	±8 %	kW	1,351	1,802	2,254
Electrical efficiency [3]		%	43.6	43.6	43.6
Thermal efficiency [3]		%	42.7	42.7	42.8
Total efficiency [3]		%	86.3	86.3	86.4

1) NO_x ≤ 500 mg/Nm³; exhaust gas dry at 5 % O_2.
2) Transport dimensions for gensets, components set up separately must be taken into consideration.
3) According to ISO 3046-1 at U = 0.4 kV, cosphi = 1.0 for 50 Hz, a minimum methane number of MN 70 for natural gas and MN 134 (sewage gas) for biogas applications.
4) Exhaust gas cooled to 120 °C for natural gas and 150 °C for biogas.
5) P = High Efficiency. Optimized for high electrical efficiency.
6) R = High Response. Optimized for high total efficiency.
7) X = Biogas. Optimized for operation with biogases.

Data for special gases and dual gas operation on request.

The values given on these datasheets are for information purposes only and not binding. The information given in the offer is decisive.

Technical data 50 Hz (NO_x ≤ 250 mg/Nm³ [1])

Engine type	TCG 3020		V12	V12	V16	V16	V20	V20
Bore/stroke	mm		170/195	170/195	170/195	170/195	170/195	170/195
Displacement	dm^3		53.0	53.0	71.0	71.0	89.0	89.0
Speed	min^{-1}		1,500	1,500	1,500	1,500	1,500	1,500
Mean piston speed	m/s		9.8	9.8	9.8	9.8	9.8	9.8
Length [2]	mm		5,080	5,080	6,100	6,100	6,600	6,600
Width [2]	mm		1,710	1,710	1,710	1,710	1,710	1,710
Height [2]	mm		2,190	2,190	2,190	2,190	2,190	2,190
Dry weight genset	kg		12,900	12,900	17,400	17,400	21,400	21,400

Natural gas applications

NO_x ≤ 250 mg/Nm³ [1]

Engine type	TCG 3020		V12	V12	V16	V16	V20	V20
Configuration				P [5]	R [6]	P [5]	R [6]	P [5]	R [6]
Electrical power [3]		kW	1,380	1,380	1,840	1,840	2,300	2,300
Mean effective pressure		bar	21.5	21.5	21.5	21.5	21.5	21.5
Thermal output [4]	±8 %	kW	1,359	1,431	1,835	1,910	2,255	2,391
Electrical efficiency [3]		%	43.9	42.9	43.6	42.9	44.0	42.9
Thermal efficiency [3]		%	43.2	44.5	43.5	44.5	43.1	44.6
Total efficiency [3]		%	87.1	87.4	87.1	87.4	87.1	87.5

Biogas applications

NO_x ≤ 250 mg/Nm³ [1]
Sewage gas (65 % CH_4 / 35 % CO_2)
Biogas (50 % CH_4 / 50 % CO_2)
Landfill gas (50 % CH_4 / 27 % CO_2,Rest N_2)

Minimum heating value H_U = 5.0 kWh/Nm³

Engine type	TCG 3020		V12	V16	V20
Configuration			X [7]	X [7]	X [7]
Electrical power [3]		kW	1,380	1,840	2,300
Mean effective pressure		bar	21.5	21.5	21.5
Thermal output [4]	±8 %	kW	1,407	1,878	2,346
Electrical efficiency [3]		%	42.6	42.6	42.7
Thermal efficiency [3]		%	43.4	43.5	43.5
Total efficiency [3]		%	86.0	86.1	86.2

1) NO_x ≤ 250 mg/Nm³; exhaust gas dry at 5 % O_2.
2) Transport dimensions for gensets, components set up separately must be taken into consideration.
3) According to ISO 3046-1 at U = 0.48 kV, cosphi = 1.0 for 50 Hz, a minimum methane number of MN 70 for natural gas and MN 134 (sewage gas) for biogas applications.
4) Exhaust gas cooled to 120 °C for natural gas and 150 °C for biogas.
5) P = High Efficiency. Optimized for high electrical efficiency.
6) R = High Response. Optimized for high total efficiency.
7) X = Biogas. Optimized for operation with biogases.

Data for special gases and dual gas operation on request.

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تهران، کیلومتر۲۱ بزرگراه لشگری (جاده مخصوص کرج)
روبروی پالایشگاه نفت پارس، پلاک ۱۲

MWM

Version 06-21/EN