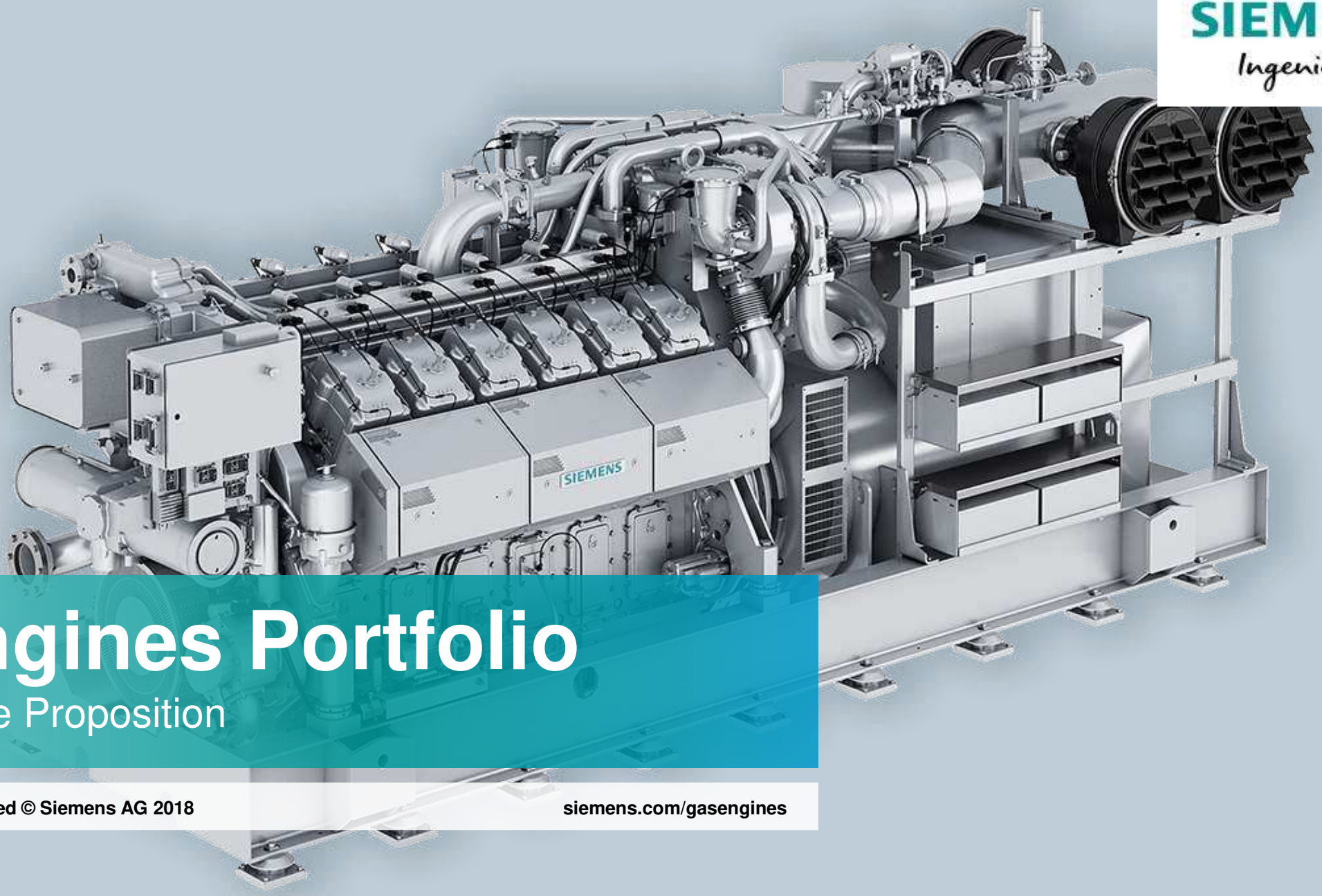
SIEMENS
Ingenio para la vida



Engines Portfolio

Value Proposition

siemens.com/gasengines

Content overview

SIEMENS
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We are dedicated to grow your business
Solutions based on your individual business needs

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- Best-in-class applications for power generation, cogeneration and waste to energy
- From small industrial to power plants

Power Generation

Utilities/ IPP

Industries

Cogeneration

District Heating

Commercial buildings

Industry

Waste to Energy

Landfill, sewage, farms, biomass

Application fields for Gas Engines

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Power Generation

Utilities/ IPPs | Industry | Oil&Gas

Gas Engine Power Plants
e.g. Peaking, Capacity market, Fast Start, Peak shaving. Power generation available at need.

Complete package for the industry
e.g. Food processes, textile, ceramic, chemical, biopharma, etc. Reliable power supply.

Flare Gas Gensets
e.g. Engine systems on a well gas. Fuel flexibility in island mode. Power generation in remote areas.


Cogeneration

Comm.Buildings | DH | Industry

Cogeneration systems
e.g. hospitals, universities, hotels, data centers. Efficient and reliable energy.

District Heating full Cogeneration
e.g. combined heat and power (CHP), maximum efficiency through thermal recovery.

Complete package for the industry
e.g. laundries, food processes, others. Reliable power supply.


Waste to Energy

Landfill/ Sewage | Farms | Biomass

Biogas Gensets
e.g. waste water treatment plants, landfills, farms. Efficient use of waste to power production.

Biomass Plants
e.g. Syngas from gasification processes of wood, forest waste other waste materials.


Gas Engines portfolio

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F Series

Robust and reliable

FL- Lean burn
from 260 to 800 kW

FR- Rich burn
from 150 to 238 kW

S Series

Robust, reliable, fuel Flexible

SL-Lean burn
from 209 to 1150 kW

SM- Lean burn
NG/BG: from 1055-1100 kW
LPG: from 275 to 906 kW

SR- Rich burn
from 190 to 870 kW

H Series

High Performance

HM- Lean burn, Miller cycle
from 520 to 1350 kW

E Series

Best-in-class

EM- Lean burn, Miller cycle
Power output:
2065 kW

Innovative products matching customer needs – Scope of supply

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Bare engine	Genset	Genset+ Ancillaries+ heat recovery	Full containerized CHP package	Power Plant
				
Gas engine ▪ Clients: OEMs, Packagers (NG, Biogas, other gases)	**Genset + Controls** • Clients: Packagers, direct end clients for power generation, integrators, EPC contractors.	**Complete Genset+ ancillaries+ heat recovery** ▪ Clients: direct end clients for CHP, integrators, EPC contractors, developers, ESCOs	**Full CHP package** • Clients: direct end clients for CHP applications, integrators, EPC contractors, developers, ESCOs.	**Turnkey Power Plant** • Clients: Utilities, IPPs, Capacity market, peaking, remote areas

Tailored scopes and solutions to fit all project needs

Content overview

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Technology that matters – proven, reliable, innovative
Evolution of the efficiency

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F Series 39%

Robust and reliable

S Series 41%

Robust, reliable, fuel flexible

H Series 44 %

High performance

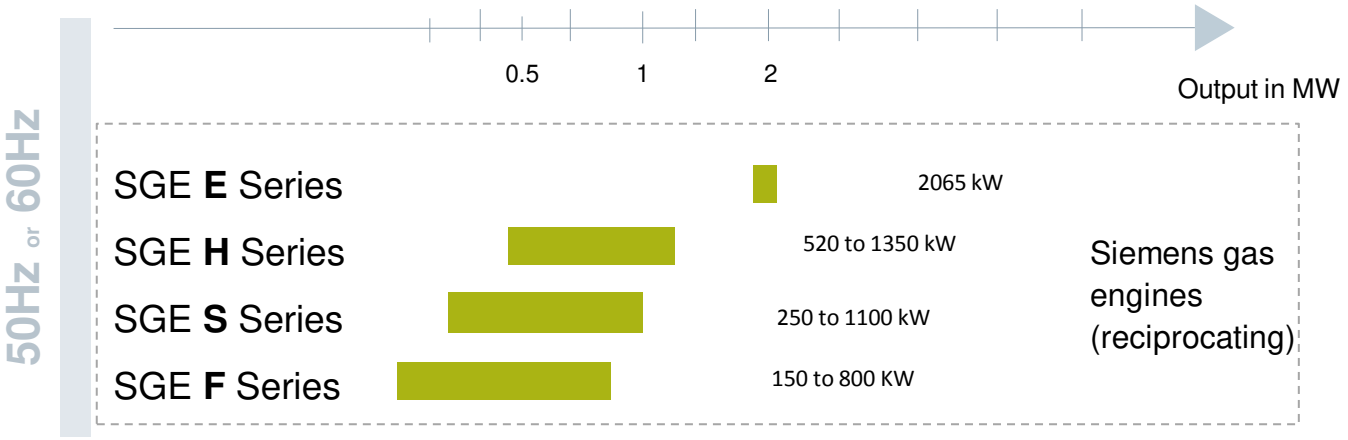
E Series 46%

Best-in-class

50 years of developments to offer the most reliable solution

Reference examples | All performance data based on ISO conditions

The right engine for every requirement
The Siemens gas engines portfolio:



State-of-the-art technology

- Excellent Global & Thermal **efficiency**
- **Standard,** interchangeable engine **parts**
- Integrated proprietary GCS-E engine and GCS-G Genset control systems
- Industry-leading **fuel flexibility**
- **Fuel blending**
- **High operational availability**
- **Low life cycle costs**
- Cost-efficient short implementation
- Compact footprint
- High flexibility through **modularity**
- Emissions compliant
- Own and distribution network for spare parts and engine service

Siemens gas engines: Fuel flexibility

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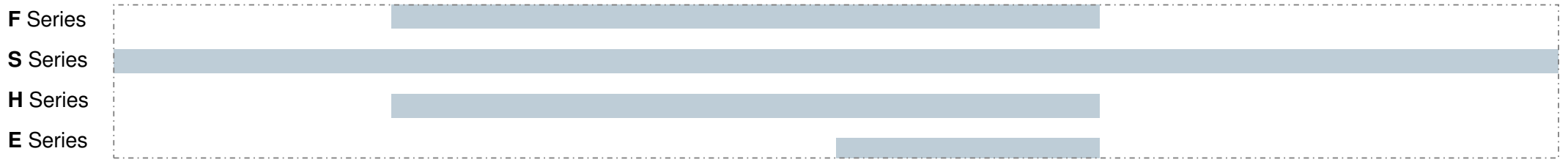
Large range of fuels of Siemens Gas Engines

Syngas | Landfill | Digester | Natural Gas | Well Gas | Propane

LHV	120 – 375 Btu/ft3	375 – 620	590 – 805	805 – 1155	1155 – 2495	2495 – 2690
	4.5 - 14 MJ/NM3	14 - 23	22 - 30	30 - 43	40 - 93	93-100



F- Series gas engines:
Designed for robust, reliable power generation

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Technical data

- **Power Output kW** 260 /800(50-60 Hz)
- **Efficiency %** 38/ 39

Features

- **Lean and Rich burn** options
- Otto **cycle**
- **Fuel type:** Natural gas, Landfill, Sewage, Biogas
- Fuel flexibility
- Wet exhaust manifold

Benefits

- Mechanical efficiency of up to **39%**
- High operational availability
- Cost efficient
- High modularity
- Short implementation
- Compact solution

S- Series gas engines:
Designed for fuel flexible power generation

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Ingenuity for life

Technical data

- **Power Output kW** 209 /1150 (50-60 Hz)
- **Efficiency %** 38/ 41

Features

- **Lean and Rich burn** options (turbocharged and aftercooled)
- Otto and Miller **cycle**
- **Fuel type:** Natural gas, Biogas, Flare, APG, Syngas, LPG-Propane
- **Fuel blending** capabilities (NG/Biogas)
- Dry/ wet exhaust manifold

Benefits

- Mechanical efficiency of up to **41%**
- Load acceptance high operational flexibility
- Low life-cycle costs
- High reliability and availability
- Low emissions (also US standard)
- Fast start availability

H- Series gas engines:
Designed for high performance power generation

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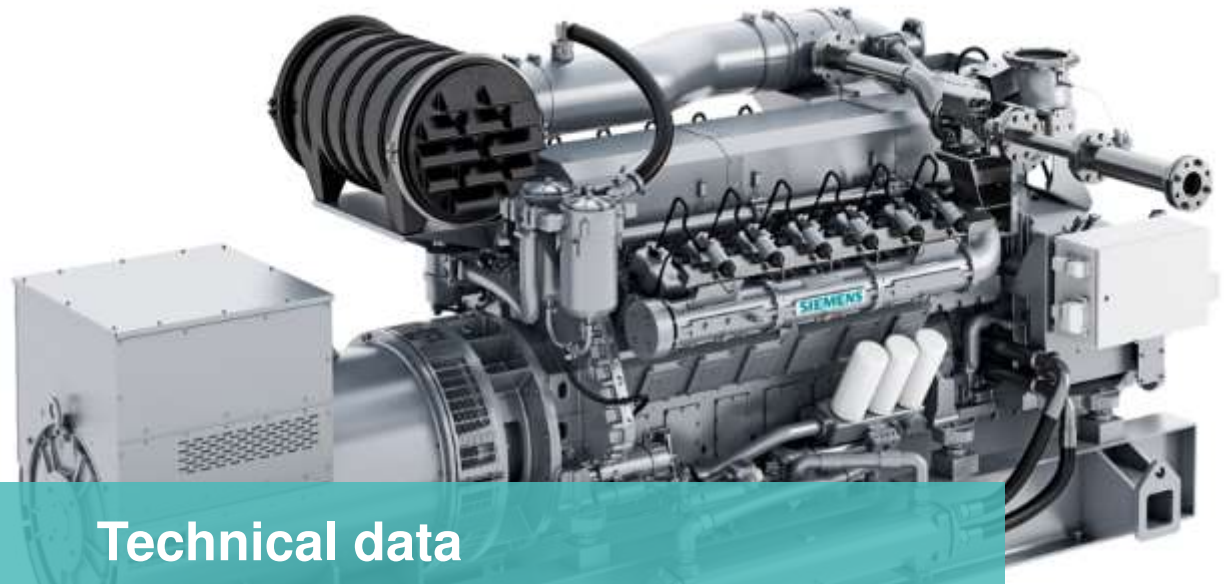

Technical data

- **Power Output kW** 520 /1350 (50-60 Hz)
- **Efficiency %** 42/ 44

Features

- **Lean burn** (turbocharged and aftercooled)
- Miller **cycle**
- **Fuel type:** Natural gas, Sewage, Landfill, Biogas
- **Fuel flexibility and fuel blending** capability
- Dry exhaust manifold

Benefits

- Mechanical efficiency of up to **44%**
- High performance
- Low life-cycle costs
- Cost efficient
- Low emissions (**250** mg/NOx)
- Compact Solution

E- Series gas engines:
Designed as best-in-class alternative

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Technical data

- **Power Output kW** 2065 (50-60 Hz)
- **Efficiency %** 46.4

Features

- **Lean burn** (turbocharged and aftercooled)
- Miller **cycle**
- **Fuel type:** Natural gas
- **Best-in-class**: excellent efficiency within small footprint
- **90,000 hours** until **Overhaul** operation

Benefits

- Mechanical efficiency of up to **46.4%**
- High operational availability
- Low life-cycle costs
- High reliability and availability
- Lowest emissions (**200** mg/ NOx)
- Compact design

Siemens gas engines:
Fuel blending dynamic system

Example: Fuel Blending system

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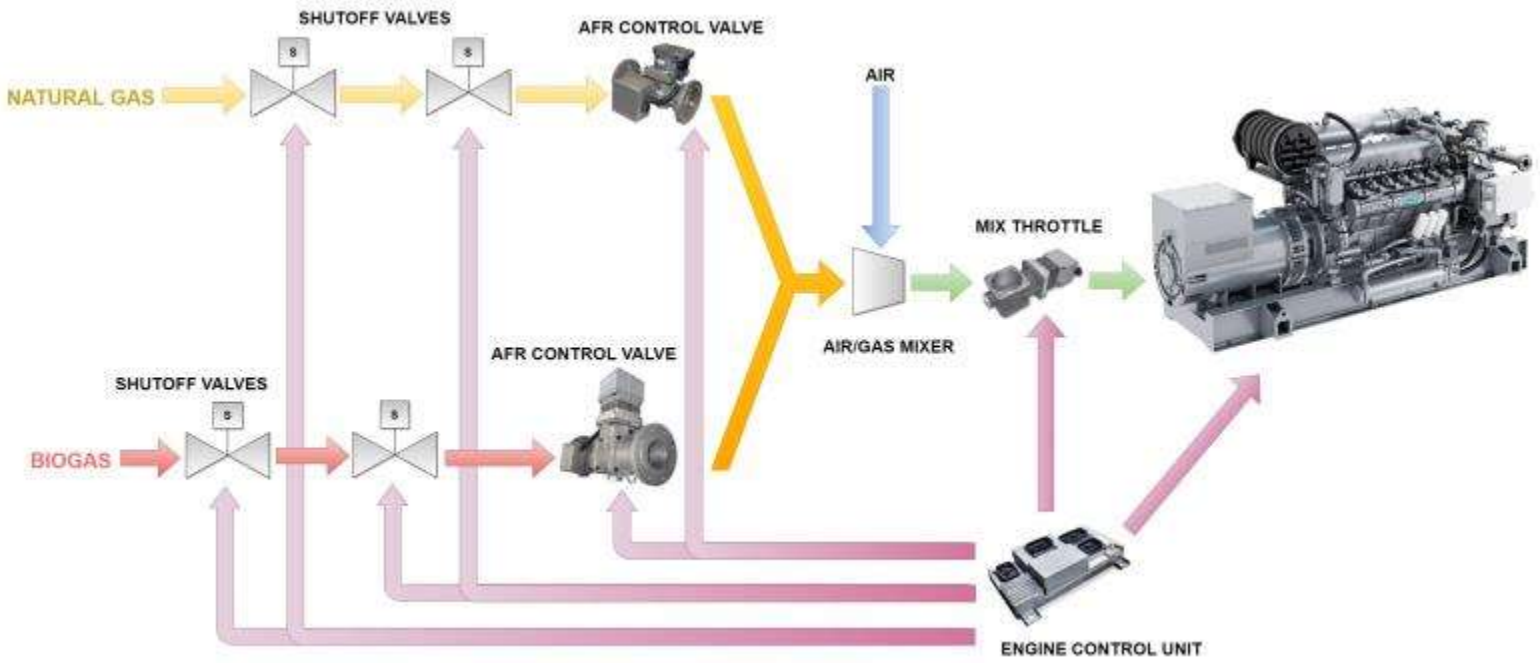
- **What is fuel blending?**

This is the ability of an engine to run on two fuels , A and B, or a mixture, being biogas the primary one and natural gas the secondary. Being the blending done on the engine and not outside.

- **Change on the fly:** Allows the change between the modes at full power from a real100% biogas (0% NG) to any fuel ratio >10%, including the possibility to run 100% NG (0% Biogas)

- **Easy start capability**: The customer can select biogas but start with Natural Gas. The control automatically changes to 100% biogas once the engine reaches the rated speed.



10+ MW gas engine based Power plants: Adapting to fluctuating power demands

Example: Power Plants

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Technical data

- **Power Output kW** 10+ MW (50-60 Hz)
- **Efficiency %** 40/ 46

Features

- **Based on Standard packages** of several sizes within **1-2 MW**
- **Application focus: Power generation for** Capacity market, peaking, peak shaving, fast start, back up, remote areas.
- **Fuel:** Natural Gas
- **High efficiency, availability, reliability**.

Benefits

- Efficiency of up to **45.5%**
- Operating flexibility and high productivity
- Compensates for changes in renewable generation, demand or use
- Lowest emissions
- Easy commissioning and maintenance schedules
- Compact design (modularity)

Siemens gas engines:
Lean burn power rating (NG, MN-75)

Example: Lean burn portfolio

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Gas Engines				Engines			Gensets		
	Type	Cyl.	Displ.	1200 rpm	1500 rpm	1800 rpm	1200 rpm	1500 rpm	1800 rpm
Electronic Carburation	SGE- 18SL	6L	18	252	315	350	242	300	336
	SGE- 24SL	8L	24	335	419	453	322	405	436
	SGE- 36SL	12V	36	503	630	700	486	609	676
	SGE- 48SL	16V	48	670	838	906	649	812	874
	SGE- 56SL	16V	56	788	985	1,067	760	957	1,028
Miller cycle, Elect. Carburation	SGE- 56SM	16V	56	-	1,055	1,100	-	1,025	1,065
High performance Miller cycle engines	SGE- 24HM	8L	24	-	520	520	-	502	502
	SGE- 42HM	12V	42		1,040	1,040	-	1,007	1,007
	SGE- 56HM	16V	56	1,040	1,240	1,350	1,007	1,204	1,308
New E- Engine Series Best-in-class	SGE- 86EM	12V	86		2065			2012	
	SGE- 100EM	12V	100	2065			2010		

Content overview

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Siemens Gas engines: Installed base

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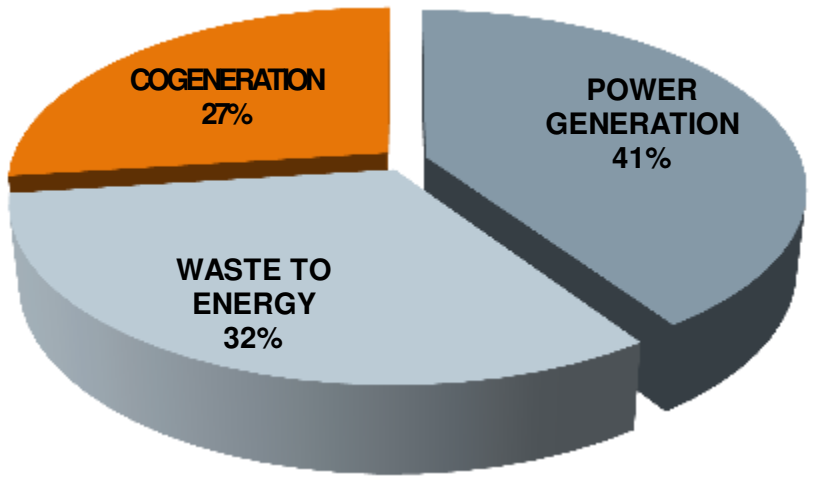
Installed base by application: 3200 units

Application	# of units
Power Generation	1300
Cogeneration	1000
Waste to Energy	900
TOTAL	**3200**

SGE installed base by application:



Content overview

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Exeter Capacity market, UK
STOR with PG gas engine

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Project Summary	
Project / Country	Exeter Capacity market, UK
Customer	STOR
Application	PG Peaking
Technology	Siemens SGE-56SL gas engine
Output	1059 kWe (total output: 20 MWe)
Complete	2016
Challenge	• Full load in less than a minute • Keep operating costs within reasonable budget while maintaining adequate energy levels
Solution	• SGE-56SL independently generates electricity at high reliability and availability for exigent start/ stop operation
Benefits	• Short delivery time • Easy commissioning and maintenance schedules

Private Medisina Van Hospital, Turkey
Hospital with CHP gas engine

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Project Summary	
Project / Country	Private Medisina Van Hospital, Turkey
Customer	Medisina Van Hospital
Application	CHP
Technology	Siemens SGE-24SL gas engine
Output	405 kWe and 546 kWt
Complete	2014
Challenge	• High energy consumption of a hospital has to be met • Heat, cooling and steam needed • Keep operating costs within reasonable budget while maintaining adequate energy levels
Solution	• SGE-24SL independently generates electricity for hospital and provides resources they need for heating and cooling • Using an heat recover boiler, the gen-set jacket cooling water and exhaust gas are used for heating of water and the building
Benefits	• Reliable heat and power supply independent from external suppliers • Reduction of energy costs by 40% and peak electric energy costs • Steam used for hospital processes like sterilization

Wolverhampton University, UK
University with CHP gas engine

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Project Summary	
Project / Country	Wolverhampton University, UK
Customer	University of Wolverhampton
Application	CHP
Technology	Siemens SGE-36SL gas engine
Output	676 kWe, 798 kWt (+35 kWt from collected intercooler)
Complete	2011
Challenge	• Boost green credentials and reduce carbon impact of university • Provide heat and electricity to south campus buildings
Solution	• Fully packaged and noise insulated SGE-36SL gas engine • System additionally collects 35 kW of thermal energy from intercooler dump • Low emission engine (250 mg/Nm^3)
Benefits	• Savings of 352.000$ and 1000 tons of emissions per year • Improved energy efficiency achieved by capturing heat that is normally wasted • Reduced dependency on carbon-based fuels

More Siemens Gas Engine References

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Project Summary	
Project / Country	Grand Hotel Vindgof, Chelybinsk, Russia
Technology	SGE-36SL with **CHP**
Power output	609 kWe

Project Summary	
Project / Country	Iguatemi business center, Brazil
Technology	3 x SGE-56SL with **CHP**
Power output	2700 kWe

Project Summary	
Project / Country	Tuscan Lucca & Massa Hospital, Italy
Technology	SGE-36SL & SGE-48SL with **CHP**
Power output	609 & 812 kWe

Project Summary	
Project / Country	OFIM business center, Ankara, Turkey
Technology	2 x SGE-56SL with **CHP**
Power output	2 MWe, 2.6 MWt

Thank you!

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Back up

Back up

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Natural Gas fueled engines & gensets, MN=75 MN						
	Cyl.	Displ.	Engines (kWb)		Gensets (kWe)	
F Series			**1500 rpm**	**1800 rpm**	**1500 rpm**	**1800 rpm**
SGE-18FR	6L	18	150	180	142	171
SGE-24FR	8L	24	200	238	191	226
SGE-18FL	6L	18	275	300	264	287
SGE-24FL	8L	24	360	400	347	385
SGE-36FL	12V	36	550	600	529	577
SGE-48FL	16V	48	725	792	703	761

Back up

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Rich Burn Power Ratings								
			Engines			Gensets		
Type	Cyl.	Displ.	Continuous Duty	Prime Duty	Stand-by Duty	Continuous Duty	Prime Duty	Stand-by Duty
			kWb	kWb	kWb	kWe	kWe	kWe
			1800	1800	1800	60 Hz	60 Hz	60 Hz
SGE- 18SR	6L	18	281	300	330	273	291	320
SGE- 24SR	8L	24	375	380	420	364	369	407
SGE- 36SR	12V	36	562	600	660	545	582	565
SGE- 48SR	16V	48	750	760	840	728	737	715
SGE- 56SR	16V	56	870	--	--	844	--	--

Synthesis gas engines & gen-sets								
			Engines			Gensets		
	Cyl.	Displ.	kWb	kWb	kWb	kWe	kWe	kWe
			1200	1500	1800	1200	1500	1800
SGE- 18SL	6L	18	209	263	238	199	253	271
SGE- 24SL	8L	24	281	350	377	269	338	362
SGE- 36SL	12V	36	418	526	565	401	508	544
SGE- 48SL	16V	48	561	700	754	541	678	729
SGE- 56SL	16V	56	663	827	882	639	801	849

Back up

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Propane fueled engines & gen-sets										
			Engines				Gensets			
	Cyl.	Displ.	kWb	kWb	kWb	kWb	kWe	kWe	kWe	kWe
			1500	1500	1800	1800	1500	1500	1800	1800
			C_3H_8>95%	C_3H_8>80%	C_3H_8>95%	C_3H_8>80%	C_3H_8>95%	C_3H_8>95%	C_3H_8>95%	C_3H_8>95%
SGE- 18SM	6L	18	315	275	350	300	303	264	335	287
SGE- 24SM	8L	24	419	360	453	400	404	347	436	385
SGE- 36SM	12V	36	630	550	700	600	610	530	676	577
SGE- 48SM	16V	48	838	725	906	800	811	702	873	770

Oil&gas well gas, flare gas, APG, mining gas engines & gen-sets										
	Cyl.	Displ.	MN35		MN45			MN55		
			kWb/kWe		kWb/kWe			kWb/kWe		
			1500	1800	1200	1500	180	1200	1500	1800
SGE- 18SL	6L	18	290/279	240/325	220/210	275/264	300/287	252/242	315/303	350/335
SGE- 24SL	8L	24	390/376	450/433	290/278	360/347	400/385	335/322	419/404	453/436
SGE- 36SL	12V	36	580/562	675/652	440/422	550/530	600/577	503/485	630/610	700/676
SGE- 48SL	16V	48	775/750	900/867	580/559	725/702	800/770	670/645	838/811	906/873
SGE- 56SL	16V	56	900/872	1,050/1,012	671/646	900/872	905/872	788/760	1,055/1,025	1,067/1,028