PRODUCT GUIDE
SR400001.r3

ADVECO

TOTEM
Cogeneration (CHP) Range

A+++

Highest total efficiency with modulating output and lowest NO_x emissions available

PRACTICAL, EFFICIENT & SUSTAINABLE BUILDING SERVICES SOLUTIONS

Why Cogeneration?

A combined heat and power (CHP) system allows a building to produce electricity on site and recover energy from the exhaust heat, which can then be used for central heating or water heating in the building.

On site cogeneration of electricity with heat reclaim is one of the most effective ways of reducing emissions outside of usage limitations. As appliance and plant designs have neared their maximum energy efficiency, it has become necessary to find other ways of reducing Carbon emissions. One way is through reduced consumption by limiting maximum temperatures and flow rates - an unpopular choice. Another way is to use less gas by finding free or waste heat sources and reduce the amount of Carbon intensive grid-supplied electricity that is consumed by utilising on-site production. Cogeneration effectively achieves both of these things. Carbon Dioxide emissions are reduced by 28% when the electricity and recovered heat is used on site. A 20kW Totem CHP unit is capable of reducing Carbon Dioxide emissions by over 50 tonnes per year compared to consuming the same amount of electricity and gas from the mains.

In a modern, well designed cogeneration unit like the Totem, the NO_X emissions are also greatly reduced. The average UK NO_X emissions from the production of electricity that enters the grid is 750 mg/kWh. In comparison, the NO_X emissions from a Totem unit are less than 40 mg/kWh of electricity output. This does not take into account the heat output which, when considered in this way as a waste product, becomes NO_X free. The BREEAM scheme awards 3 points for these reduced emissions.

Combined heat and power systems prove very beneficial against the Target Emission Rate within SBEM software, as well as giving the client Enhanced Capital Allowances. In addition, large businesses can benefit from Carbon Reduction Commitment (CRC) advantages.

Perhaps the best advantage for combined heat and power for the end user is the reduction in running costs. The electricity output from the cogenerator will be at a similar cost to electricity from the grid, however for each kWh of electricity produced approximately 2.5 kWh of free, high grade heat will be recovered. This is where running cost savings of over 25% can be achieved.

"A 120 bedroom luxury hotel that replaced atmospheric water heaters with CHP and direct fired water heaters saved over £10,000 per year in running costs."

Totem CHP unit

Totem History

Totem: Total Energy Module.

During the energy crisis of the 1970's, the Fiat Centre of Research began a groundbreaking project to utilise a Fiat internal combustion engine to produce electricity, while recovering heat from the exhaust. This led to the development of the world's first microcogenerator, or small combined heat and power unit. The concept was not new, but cogeneration projects at the time were adapted generators using standard available market components. This created poorly engineered solutions with noise and reliability problems.

Fiat released the Totem, a 15kW electrical, 39kW thermal microcogenerator, in 1978 using a 903cc engine and produced it in house until the early 1980s. The Totem was a highly reliable, well-engineered unit that was known to last over 20 years with good maintenance. However, by the time it was in production, energy costs were falling and carbon emissions had not yet become a worldwide concern. As the energy crisis ended and the economy changed, Fiat's sole focus returned to automobiles. The production rights of the Totem were sold off and it was manufactured by others 'under licence of' Fiat until 2003 with only minor changes and upgrades during that time period.

In 2003, the Totem design was updated and rebranded the Tandem; Thermal and Electrical Machine. It was designed with a 1.2L Fiat engine that was purpose built for natural gas, instead of an aftermarket conversion from petrol. It had a higher efficiency level, higher set point temperature, and lower noise emissions than the original Totem, as well as having a more sensible footprint. The Tandem was built up until the end of 2014, when this latest generation of Totem went into production as a vastly superior cogeneration unit compared with anything that has ever been produced before.

TOTEM ENERGY: From Tandem to Totem

The design and manufacturing rights of Tandem were purchased in 2013 and the new generation CHP project began under the banner Totem Energy. The goal was to produce the best cogeneration range possible. The first step was to rebuild the relationship with FCA Fiat Chrysler Automobiles. This was crucially important because the engine and how it runs is the key to a good product. This re-kindled relationship immediately made a huge impact in a number of ways. It reintroduced the technology back to where it began and opened the door for the new unit to be branded Totem and to draw on the history of the technology. It also brought automotive and engine expertise that cannot be found anywhere else. Fiat are leaders in compressed natural gas engine design. At the end of 2014, they had produced over 600,000 natural gas powered cars, as well as 22,000 industrial engines (3L and bigger). The new Totem was fitted out with the new 1.4L Fiat Fire engine, which has a reliability rate of 99.6% over 100,000 units per year.

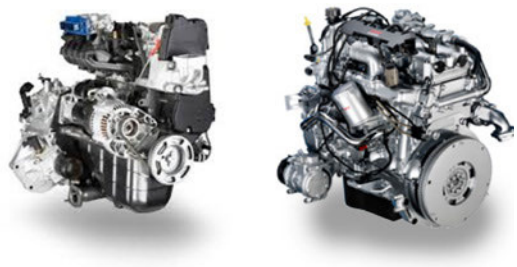
To control the engine, Fiat partner Magneti Marelli was invited to provide the Engine Control Unit (ECU) and catalytic converter in order to fine-tune the parameters to suit the stationary, natural gas engine. These relationships have meant that the Totem has very high efficiencies, as well as ultra low NO_X and CO emission rates - less than 10% of most microcogeneration units available on the market. This has been the result from the added value of developing the Totem with the automotive manufacturers and their partners who have significant R&D departments, demanding regulations, and a desire for efficiency and close control. The new Totem uses parts that are manufactured, tested, and quality controlled in their many thousands, as opposed to off-the-shelf CHP parts that are produced in much smaller batches.

The pride taken in the design has ensured that the finished product is at its absolute best. Components such as condensing heat exchangers, condensate traps, and noise attenuators that have traditionally been installed outside of the unit, have been neatly contained inside the box in a compact manner. The casing has been specially designed to limit noise emissions to a very low level. All parts within the casing are fixed to the baseplate, allowing all of the panels, the lid and the uprights to be removed to assist servicing and maintenance.

The newest generation of Totem builds on the history and experiences of the past, and incorporates the latest engineering practices in the automotive industry. This ensures that the Totem is the best cogeneration unit available on the market.

Totem Design & Key Technologies

Engines



Totem internal combustion engines are specifically designed to run on natural gas. They are controlled with automotive engine control units with high efficiency catalytic converters which give ultra low NO_X and CO emissions under 10mg/Nm^3.

The lowest emissions available with any reciprocating engine CHP and lower NO_X emissions than a condensing gas boiler.

High Efficiency Heat Exchange

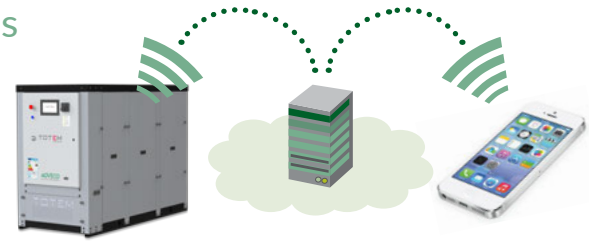
Maximum thermal efficiency is achieved by reclaiming heat from every available source. The building's central heating water is heated directly in two stainless steel shell and tube heat exchangers and a water to water stainless steel plate heat exchanger to transfer heat from the engine coolant system.

The engine coolant system is used to cool the engine, oil, and generator water jacket.

This level of heat exchange gives the Totem a thermal efficiency of 65% or higher depending on the return water temperature.

The Totem will condensate when the return water temperature is less than 50°C without the need for an additional flue heat exchanger.

Advanced Controls



An innovative cloud platform is standard to Totem, designed for Smart Buildings and allows monitoring of Totem performance by any system online (laptop, tablet or smartphone). The Totem can provide this functionality through either a hard wire network connection or via a WiFi module installed in the unit.

The remote monitoring system can be interrogated for real time information, or set to upload a packet of data every 24 hours detailing the unit performance over the past day. Faults can automatically create email alerts.

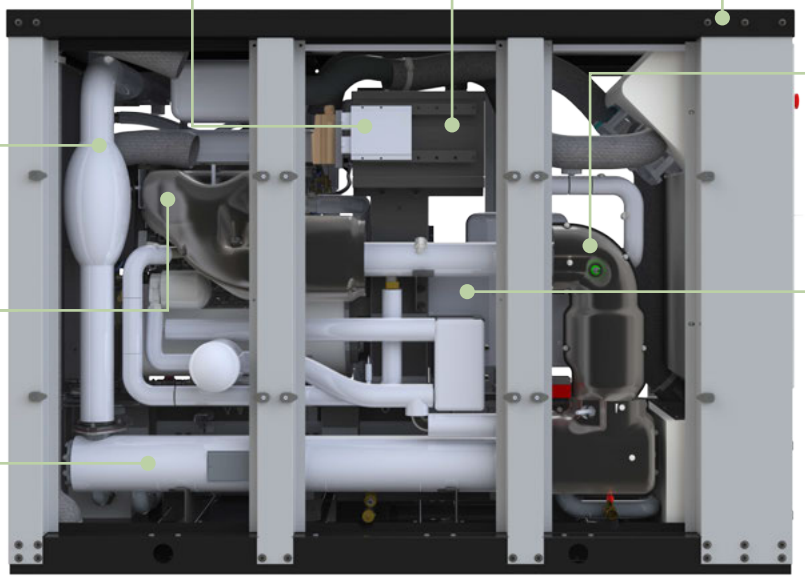
Additional Features:

Machine Control PLC for modulation, cascade control, power factor correction, and mains synchronisation.

Clean oil reservoir allows unit to automatically change its oil 5 times between service visits.

The compact casing has sound proofing and is completely removable for maintenance.

Internal silencer as standard keeps noise levels low.



Catalytic converter and lambda sensor controls ultra low emissions.

Engine directly coupled to generator.

Water cooled generator achieves 31.5% electrical generation efficiency.

High efficiency shell and tube heat exchanger designed to condense exhaust gases.

BX+ System controller.

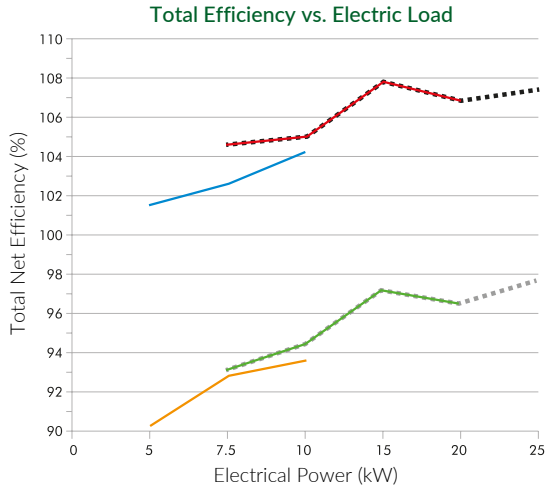
Touch screen interface with GSM modem and WiFi for remote monitoring, real time information, and fault signalling.

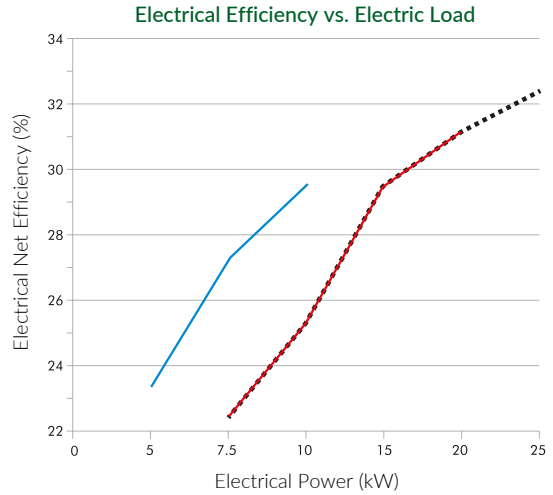
IP Relay.

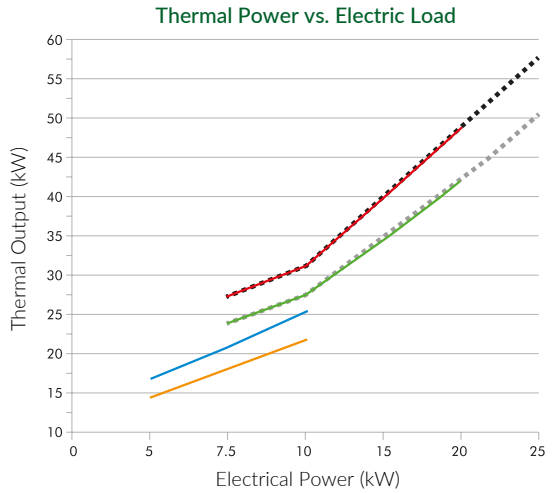
Totem Product Range

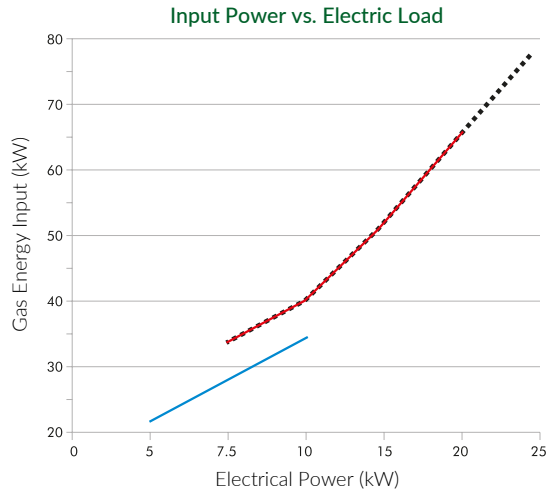
MODEL		T10	T20	T25	T50
OUTPUT air inlet @ 25°C and 101.3 kPa, natural gas (G20) @ 20 mbar					As 2× T25
MAX Output:					
Rated electrical power	kW	10	20	25	50
Power modulation range	kW	≥5	≥7.5	≥7.5	≥7.5
Seasonal space heating efficiency†	%	200	226	251	251
Electrical efficiency (net of machine consumption)*	% LHV (HHV)	29.6 (26.9)	31.2 (28.4)	32.5 (29.5)	32.5 (29.5)
Thermal output (35°C return temperature)*	kW	25.0	48.5	57.6	115.2
Thermal output (70°C return temperature)*	kW	21.6	41.9	50.2	100.4
Thermal efficiency (35°C return temperature)*	% LHV (HHV)	74.7 (67.7)	75.6 (68.7)	74.9 (68.1)	74.9 (68.1)
Thermal efficiency (70°C return temperature)*	% LHV (HHV)	64.0 (58.1)	65.3 (59.4)	65.3 (59.4)	65.3 (59.4)
Total efficiency (35°C return temperature)*	% LHV (HHV)	104.3 (94.7)	106.8 (97.1)	107.4 (97.6)	107.4 (97.6)
Total efficiency (70°C return temperature)*	% LHV (HHV)	93.6 (84.8)	96.5 (87.7)	97.8 (88.9)	97.8 (88.9)
Gas energy input*	kW LHV (HHV)	33.4 (37.0)	64.0 (70.9)	76.6 (84.9)	153.2 (169.8)
Natural gas (G20)*	Nm^3/hr	3.29	6.27	7.56	15.12
Heat to power ratio**		2.50	2.42	2.30	2.30

LHV = Lower Heat Value (Net) HHV = Higher Heat Value (Gross)









TOTEM 10 @ 35°C TOTEM 20 @ 35°C TOTEM 25 @ 35°C
TOTEM 10 @ 70°C TOTEM 20 @ 70°C TOTEM 25 @ 70°C

TOTEM 10 @ 35-70°C TOTEM 20 @ 35-70°C TOTEM 25 @ 35-70°C

* Values from independent testing at Milan Technical University and verified by TÜV Rheinland. Unit certified by TÜV Rheinland.

** Heat to Power ratio must be input into SBEM calculations alongside Maximum Gross (HHV) Total Efficiency. For normally stated net efficiencies, divide by 1.1 to calculate gross efficiency.

† As defined by EU No. 811/2013, EN 50465/2015

MODEL		T10	T20	T25	T50
OUTPUT air inlet @ 25°C and 101.3 kPa, natural gas (G20) @ 20 mbar					As 2× T25
Modulating 40/50% Output:					
Rated Electrical Power	kW	5	10	10	10
Electrical efficiency (net of machine consumption)*	% LHV (HHV)	23.7 (21.4)	25.5 (23.0)	25.5 (23.0)	25.5 (23.0)
Thermal output (35°C return temperature) *	kW	16.4	30.9	30.9	30.9
Thermal output (70°C return temperature)*	kW	14.1	27.0	27.0	27.0
Thermal efficiency (35°C return temperature)*	% LHV (HHV)	77.9 (70.5)	79.4 (71.7)	79.4 (71.7)	79.4 (71.7)
Thermal efficiency (70°C return temperature)*	% LHV (HHV)	70.0 (60.5)	69.2 (62.5)	69.2 (62.5)	69.2 (62.5)
Total efficiency (35°C return temperature)*	% LHV (HHV)	101.5 (91.6)	105.0 (94.8)	105.0 (94.8)	105.0 (94.8)
Total efficiency (70°C return temperature)*	% LHV (HHV)	90.3 (81.5)	94.4 (85.2)	94.4 (85.2)	94.4 (85.2)

DIMENSIONS AND WEIGHTS					
h x w x l (rigged up with panels - standard version)	mm	1,280x795x1,920			1,280x2,390x1,920
Weight Full	kg	720	780	780	1560

HYDRAULIC CIRCUIT					
Maximum inlet water temperature	°C	70			
Maximum outlet water temperature	°C	80			
Rated water flow	l/h	2,500	4,000	5,000	10,000
Maximum pressure drop through unit	kPa	60			
Maximum working pressure	bar	10			

ASYNCHRONOUS GENERATOR					
Operation		In parallel with grid			
Three phase voltage/Frequency	V/Hz	400/50			
Engine starter		Starter motor			
Electrical generator connection		3 phase and neutral			

WORKING CONDITIONS					
Max Ambient Conditions (temperature/relative humidity)	°C/RH	40/75%			
Acoustic impact Lp					
@ 1 m distance in open field	dB(A)	56.7	61.1	61.1	64.1
Exhaust emission					
NO_X Emissions @ 5% O_2	mg/Nm^3	<10	<10	<10	<10
NO_X Emissions @ 0% O_2	mg/kWh	<12	<12	<12	<12
CO Emissions @ 5% O_2	mg/Nm^3	<10	<10	<10	<10
Max flue gas temperature (normal conditions)	°C	77			
Max flue gas temperature (fault condition)	°C	100			
Flue gas mass flow rate	kg/h	55	100	125	250
Condensate mass flow rate (35°C return temperature)*	kg/h	1.37	3.04	3.14	6.28
Max flue system pressure drop	Pa	500			
Max flue run (80mm PP flue) Total Equivalent Length*	m	32	23	23	23
Flue material specification		T120 and H1			
Asynchronous three-phase alternator					
Rated power*	kW	10.10	20.09	25.06	50.12
Frequency	Hz	50			
Rated voltage	V	400			
Poles		4	2	2	2
Insulation Class		F			
Efficiency Class		IE3			
Power Factor		0.962			

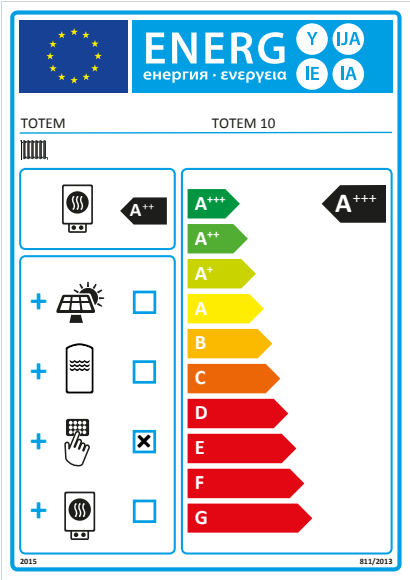
* Values from independent testing at Milan Technical University and verified by TÜV Rheinland. Unit certified by TÜV Rheinland.

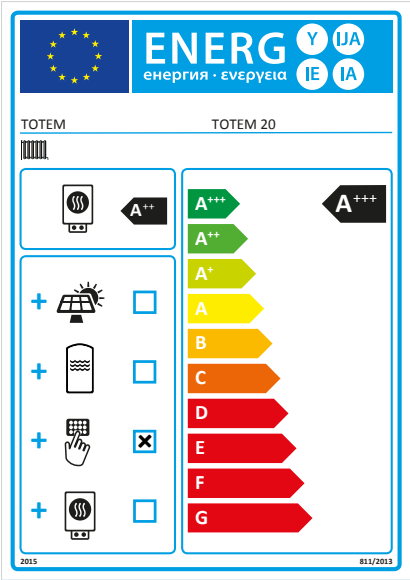
** Heat to Power ratio must be input into SBEM calculations alongside Maximum Gross (HHV) Total Efficiency. For normally stated net efficiencies, divide by 1.1 to calculate gross efficiency.

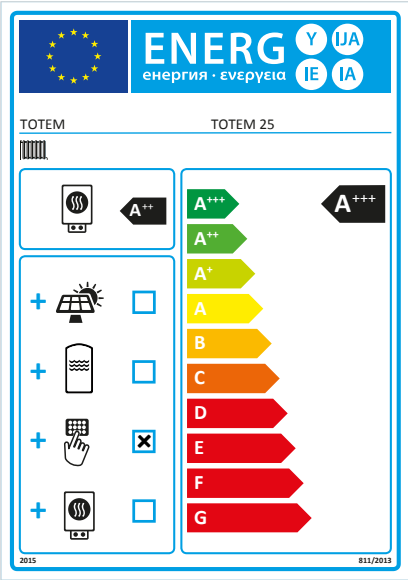
† As defined by EU No. 811/2013, EN 50465/2015

Labelling Directive

Package Labels







Package Fiche

T25

TOTEM asja group

PACKAGE FICHE

Seasonal space heating energy efficiency of the space heater with cogeneration			251 %
Temperature control (From fiche of temperature control)	Class I = 1 %, Class II = 2 % , Class III = 1,5 %, Class IV = 2 %, Class V = 3 % , Class VI = 4 %, Class VII = 3,5 %, Class VIII = 5 %	+	1 %
Supplementary boiler (From fiche of boiler)	Seasonal space heating energy efficiency in %		
	(‘I’) x ‘II’ =	-	%

Solar contribution (From fiche of solar device)

Collector size (in m²)	Tank volume (in m³)	Collector efficiency (in %)	Tank rating A+ = 0,95, A = 0,91, B = 0,86, C = 0,83, D-G = 0,81			
(‘III’ x	+ ‘IV’ x	) x 0,7 x (	/ 100) x	=	+	%

Seasonal space heating energy efficiency of package	252 %

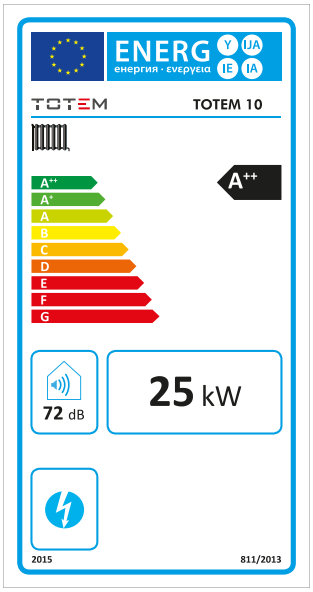
Seasonal space heating energy efficiency class of package

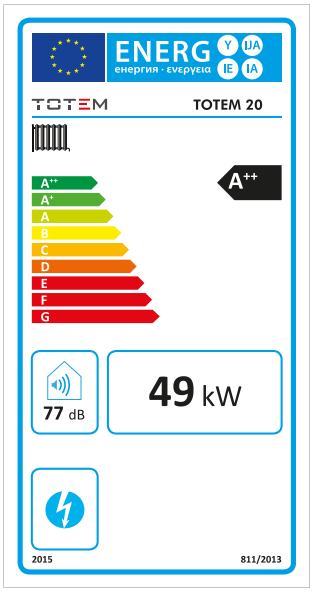
G	F	E	D	C	B	A	A+	A++	A+++
									X
< 30 %	≥ 30 %	≥ 34 %	≥ 36 %	≥ 75 %	≥ 82 %	≥ 90 %	≥ 98 %	≥ 125 %	≥ 150 %

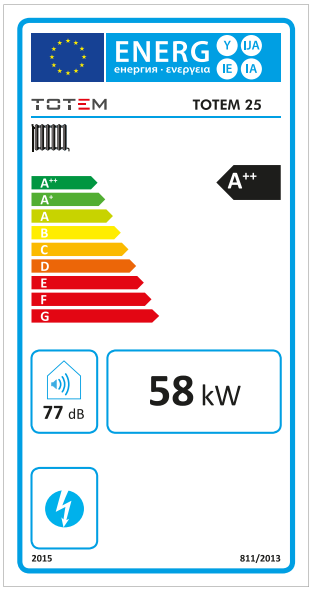
The energy efficiency of the package of products provided for in this fiche may not correspond to its actual energy efficiency once installed in a building, as the efficiency is influenced by further factors such as heat loss in the distribution system and the dimensioning of the products in relation to building size and characteristics

I: the value of the seasonal space heating energy efficiency of the preferential space heater, expressed in %
II: the factor for weighting the heat output of preferential and supplementary heaters of a package as set out in Tables 5 and 6 of ANNEX IV, EU No 811/2013
III: the value of the mathematical expression: 294/(11 · P_{rated}), whereby Prated is related to the preferential space heater;
IV: the value of the mathematical expression 115/(11 · P_{rated}), whereby Prated is related to the preferential space heater;

Product Labels







Product Fiche

TOTEM asja group — PRODUCT FICHE

MODEL IDENTIFIER		TOTEM 10
Seasonal space heating energy efficiency class		A++
Rated heat output	kW	25,2
Seasonal Space Heating Energy Efficiency	%	200
Annual energy consumption	GJ	36
Sound Power Level	L_{WA}	72,5

Specific precautions
During assembly, installation or maintenance

Please refer to the installation, user and service manual of the product. The operations of the installation, first commissioning and maintenace must be performed by qualified specialists that are trained by TOTEM ENERGY.

Electrical Efficiency (in accordance with HHV)		26,7
Electrical Efficiency (in accordance with LHV)		29,6

TOTEM asja group — PRODUCT FICHE

MODEL IDENTIFIER		TOTEM 20
Seasonal space heating energy efficiency class		A++
Rated heat output	kW	48.5
Seasonal Space Heating Energy Efficiency	%	226
Annual energy consumption	GJ	62
Sound Power Level	L_{WA}	77

Specific precautions
During assembly, installation or maintenance

Please refer to the installation, user and service manual of the product. The operations of the installation, first commissioning and maintenace must be performed by qualified specialists that are trained by TOTEM ENERGY.

Electrical Efficiency (in accordance with HHV)		28,1
Electrical Efficiency (in accordance with LHV)		31,2

TOTEM asja group — PRODUCT FICHE

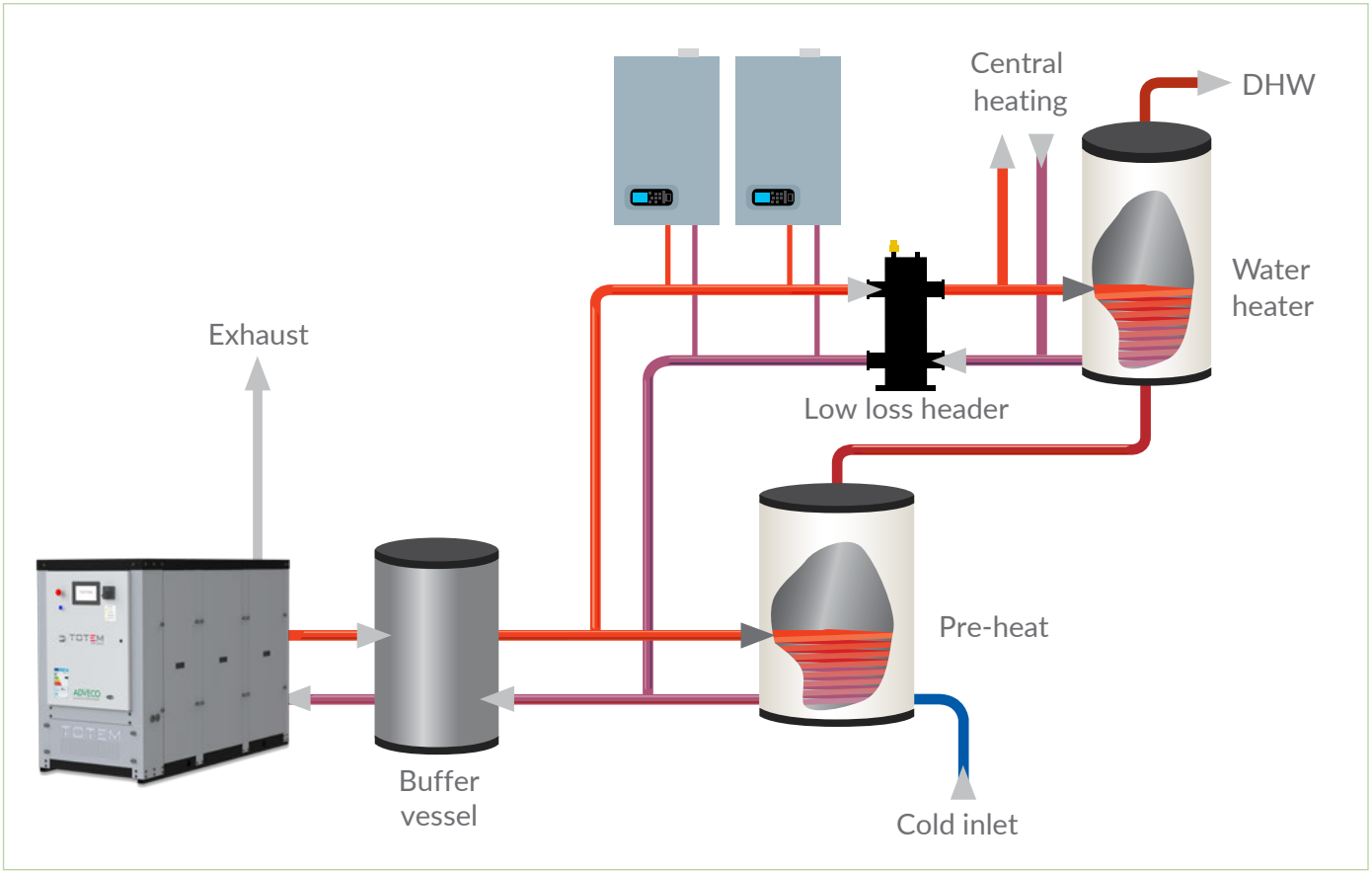
MODEL IDENTIFIER		TOTEM 25
Seasonal space heating energy efficiency class		A++
Rated heat output	kW	57,6
Seasonal Space Heating Energy Efficiency	%	251
Annual energy conumption	GJ	66
Sound Power Level	L_{WA}	77

Specific precautions
During assembly, installation or maintenance

Please refer to the installation, user and service manual of the product. The operations of the installation, first commissioning and maintenace must be performed by qualified specialists that are trained by TOTEM ENERGY.

Electrical Efficiency (in accordance with HHV)		29,4
Electrical Efficiency (in accordance with LHV)		32,5

System Schematic

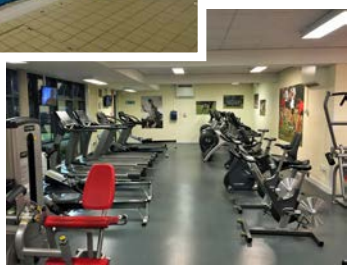


Options and Ancillaries

- System buffer vessels from 1000L to 5000L
- Primary and secondary pumps: single or twin head with controls to share load
- Installation kits for the CHP system and buffer vessel accounting for all fittings and components
- Submetering available for gas, electric and heat
- Expansion vessels and pressurisation units
- G59/G83 interface protection panels
- Commissioning and witness testing
- G59 application assistance
- Maintenance and servicing plans, including guaranteed minimum efficiency contracts to ensure lasting CHP performance

Projects

Sports Centres



A TOTEM T20 m-CHP installed at a school sports centre in Warwickshire forms the central part of a renovated heating and hot water system. The very high efficiency of the installation provides the building with considerable energy savings, equivalent to over £1,000 per month, in addition to cutting emissions by a projected 51 tonnes of CO_2 and 124kg of NO_X each year.

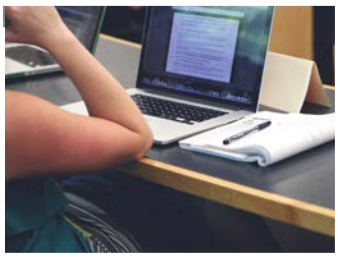
Sports, swimming and leisure facilities serve as a perfect application for CHP, where there is a large and continuous demand for heating, hot water, and power.

Student Accommodation

A newly built luxury student accommodation scheme in Lancashire was recently fitted with a TOTEM T10 m-CHP as part of a domestic hot water system. The use of CHP helped the building to meet Part L2A of the Building Regulations at substantially better value than alternative renewable technologies.

The majority of the annual energy consumption in large accommodation buildings is attributed to domestic hot water, and with a continuous background electricity demand, CHP stands out as an ideal low-carbon technology.

Schools



The use of a TOTEM T10 CHP within an Adveco GRP plantroom at a comprehensive school in Berkshire provides valuable energy savings in a compact system to serve the building's heating and hot water demands.

The high occupancy and continual background load in schools is advantageous to the design of micro-cogeneration systems. The TOTEM provides the school with a highly efficient and reliable CHP, and as a low-carbon technology, also ensures that the building's emissions are as low as possible.

Adveco also offer the following products and services:

- Bespoke system design
- Maintenance and service packages
- Buffer tanks
- Indirect and direct hot water systems
- Off site manufacturing of skids and plant rooms
- Controls systems
- Packaged plate heat exchangers
- Solar thermal systems
- Gas fired heating systems

Get in touch with us on:

01252 551 540	Sales	Option **1**
	Technical support	Option **4**
	Application design	Option **5**
	Service and commissioning	Option **6**

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