

# TOTEM

## Cogeneration (CHP) Range

A+++



Highest total efficiency  
with modulating output  
and lowest NO<sub>x</sub>  
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.

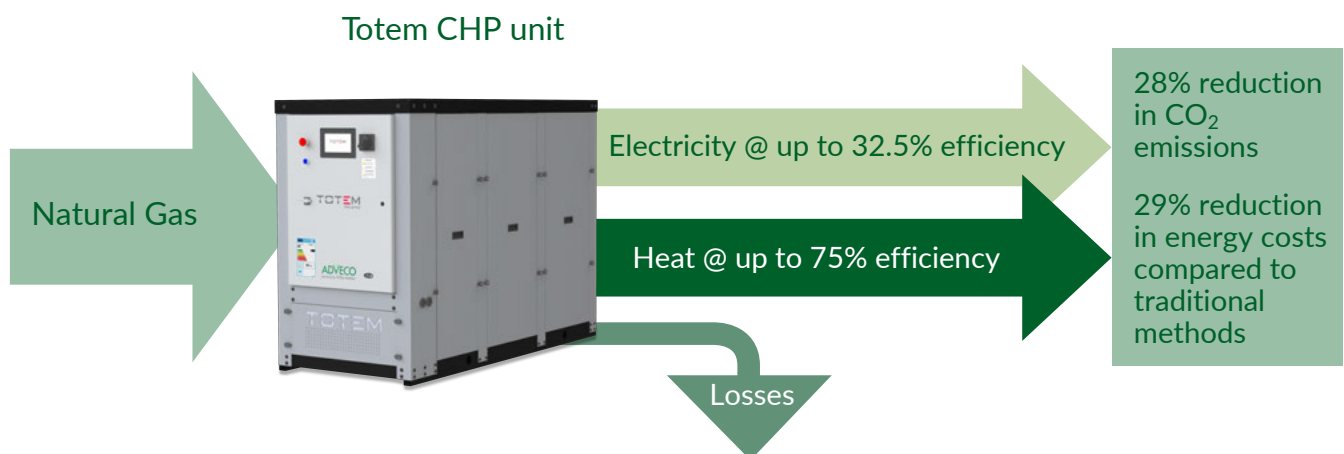
On site cogeneration of electricity with heat reclaim is one of the most effective ways of reducing emissions outside of usage limitations. As appliance and plant designs have neared their maximum energy efficiency, it has become necessary to find other ways of reducing Carbon emissions. One way is through 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<sub>x</sub> emissions are also greatly reduced. The average UK NO<sub>x</sub> emissions from the production of electricity that enters the grid is 750 mg/kWh. In comparison, the NO<sub>x</sub> 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<sub>x</sub> 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 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<sub>x</sub> 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<sub>x</sub> and CO emissions under 10mg/Nm<sup>3</sup>.

**The lowest emissions available with any reciprocating engine CHP and lower NO<sub>x</sub> emissions than a condensing gas boiler.**

## High Efficiency Heat Exchange



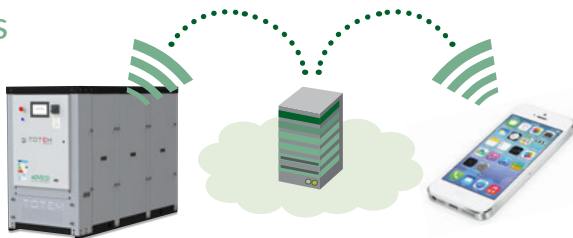
Maximum thermal efficiency is achieved by reclaiming heat from every available source. The building's central heating water is heated directly in two stainless steel shell and tube heat exchangers and a water to water stainless steel plate heat exchanger to transfer heat from the engine coolant system.

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

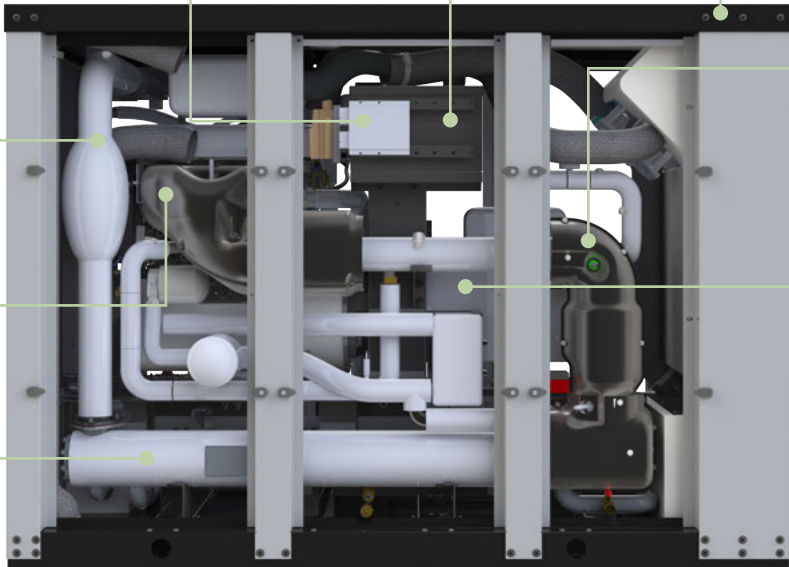


An innovative cloud platform is standard to Totem, designed for Smart Buildings and allows monitoring of Totem performance by any system online (laptop, tablet or smartphone). The Totem can provide this functionality through either a hard wire network connection or via a WiFi module installed in the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

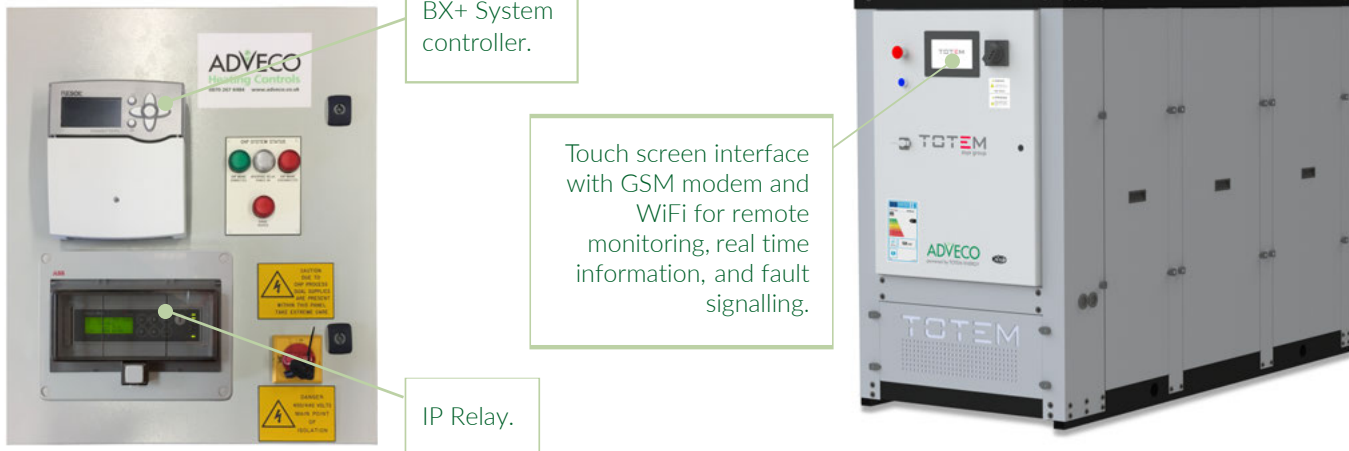
Internal silencer as standard keeps noise levels low.

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.

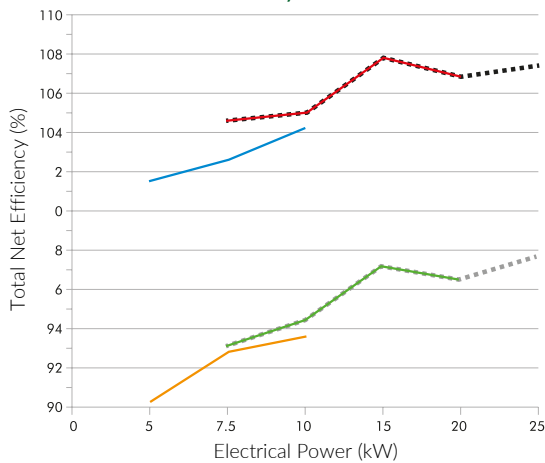
# Totem Product Range

| MODEL   |                     | T10          | T20          | T25          | T50          |
|---|---------------------|--------------|--------------|--------------|--------------|
| <b>OUTPUT</b> air inlet @ 25°C and 101.3 kPa, natural gas (G20) @ 20 mbar |                     |              |              |              | As 2× T25    |
| <b>MAX Output:</b>  |                     |              |              |              |              |
| 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)  | 76.6 (84.9)  |
| Natural gas (G20)*  | Nm <sup>3</sup> /hr | 3.29         | 6.27         | 7.56         | 15.12        |
| Heat to power ratio**   |                     | 2.50         | 2.42         | 2.30         | 2.30         |

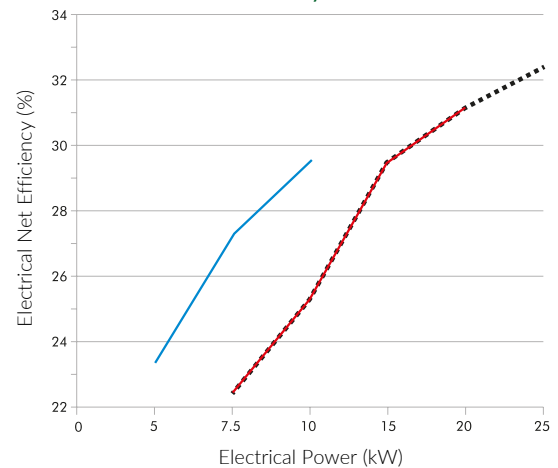
LHV = Lower Heat Value (Net)

HHV = Higher Heat Value (Gross)

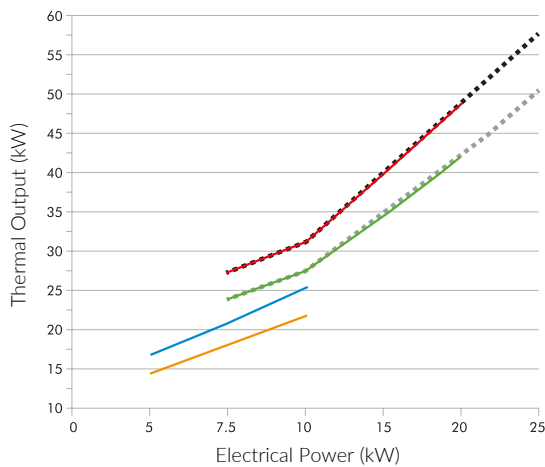
Total Efficiency vs. Electric Load



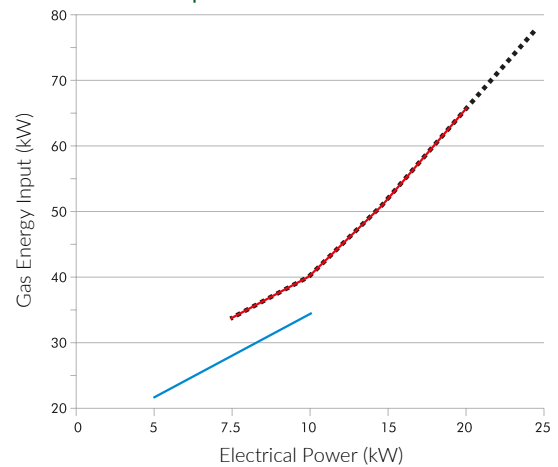
Electrical Efficiency vs. Electric Load



Thermal Power vs. Electric Load



Input Power vs. Electric Load



— 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          |
|---|-------------|--------------|--------------|--------------|--------------|
| <b>OUTPUT</b> air inlet @ 25°C and 101.3 kPa, natural gas (G20) @ 20 mbar |             |              |              |              | As 2x T25    |
| <b>Modulating 40/50% Output:</b>  |             |              |              |              |              |
| 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%      |       |       |       |
| <b>Acoustic impact Lp</b>                              |                    |             |       |       |       |
| @ 1 m distance in open field                           | dB(A)              | 56.7        | 61.1  | 61.1  | 64.1  |
| <b>Exhaust emission</b>                                |                    |             |       |       |       |
| NO <sub>x</sub> Emissions @ 5% O <sub>2</sub>          | mg/Nm <sup>3</sup> | <10         | <10   | <10   | <10   |
| NO <sub>x</sub> Emissions @ 0% O <sub>2</sub>          | mg/kWh             | <12         | <12   | <12   | <12   |
| CO Emissions @ 5% O <sub>2</sub>                       | mg/Nm <sup>3</sup> | <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 |       |       |       |
| <b>Asynchronous three-phase alternator</b>             |                    |             |       |       |       |
| 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.

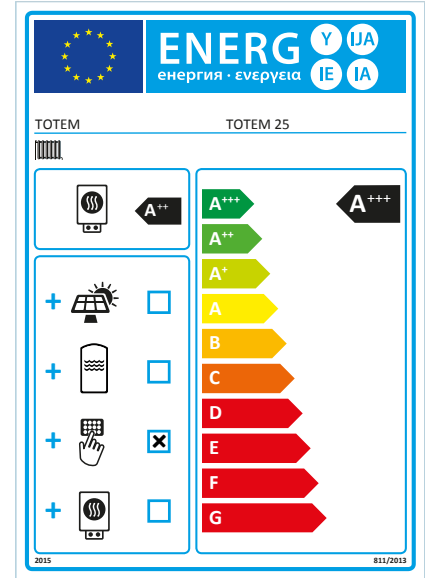
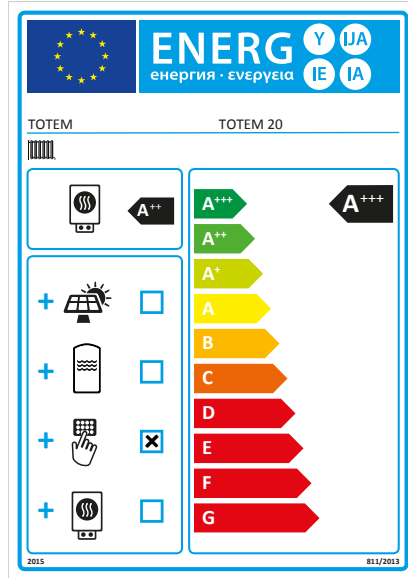
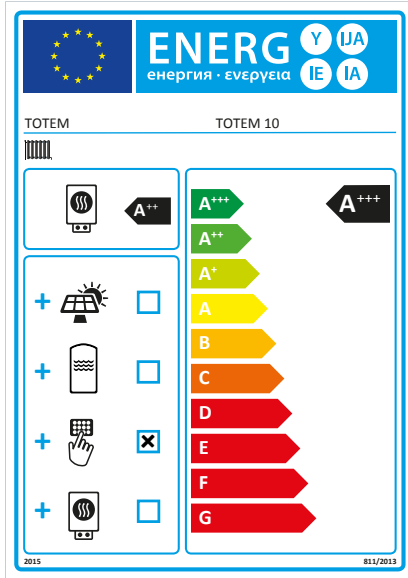
\*\* Heat to Power ratio must be input into SBEM calculations alongside Maximum Gross (HHV) Total Efficiency. For normally stated net efficiencies, divide by 1.1 to calculate gross efficiency.

† 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) **1** %

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 %

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 m <sup>2</sup> ) | Tank volume (in m <sup>3</sup> ) | Collector efficiency (in %) | Tank rating<br>A+ = 0,95, A = 0,91,<br>B = 0,86, C = 0,83,<br>D-G = 0,81 |
|-------------------------------------|----------------------------------|-----------------------------|--|
| <input type="text"/>                | <input type="text"/>             | <input type="text"/>        | <input type="text"/>   |

( '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+++**

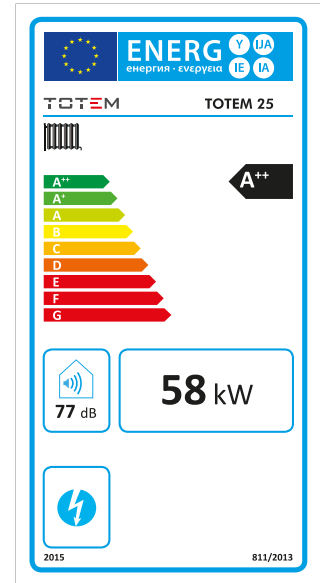
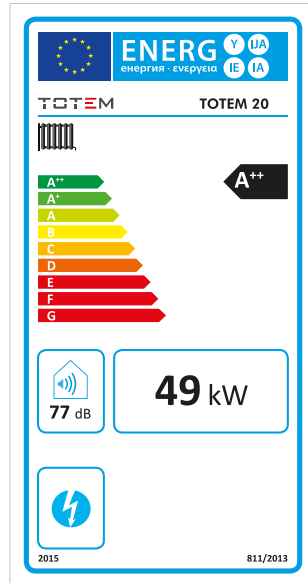
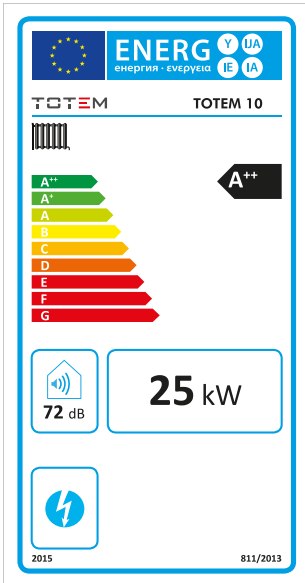
< 30 % ≥ 30 % ≥ 34 % ≥ 36 % ≥ 75 % ≥ 82 % ≥ 90 % ≥ 98 % ≥ 125 % ≥ 150 %

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:  $294 / (11 \cdot Prated)$ , whereby Prated is related to the preferential space heater;  
 IV: the value of the mathematical expression  $115 / (11 \cdot Prated)$ , whereby Prated is related to the preferential space heater;



## Product Labels



## Product Fiche



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 <sub>WA</sub> | 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 maintenance 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 |



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 <sub>WA</sub> | 77   |

**Specific precautions**  
During assembly, installation or maintenance

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



PRODUCT FICHE

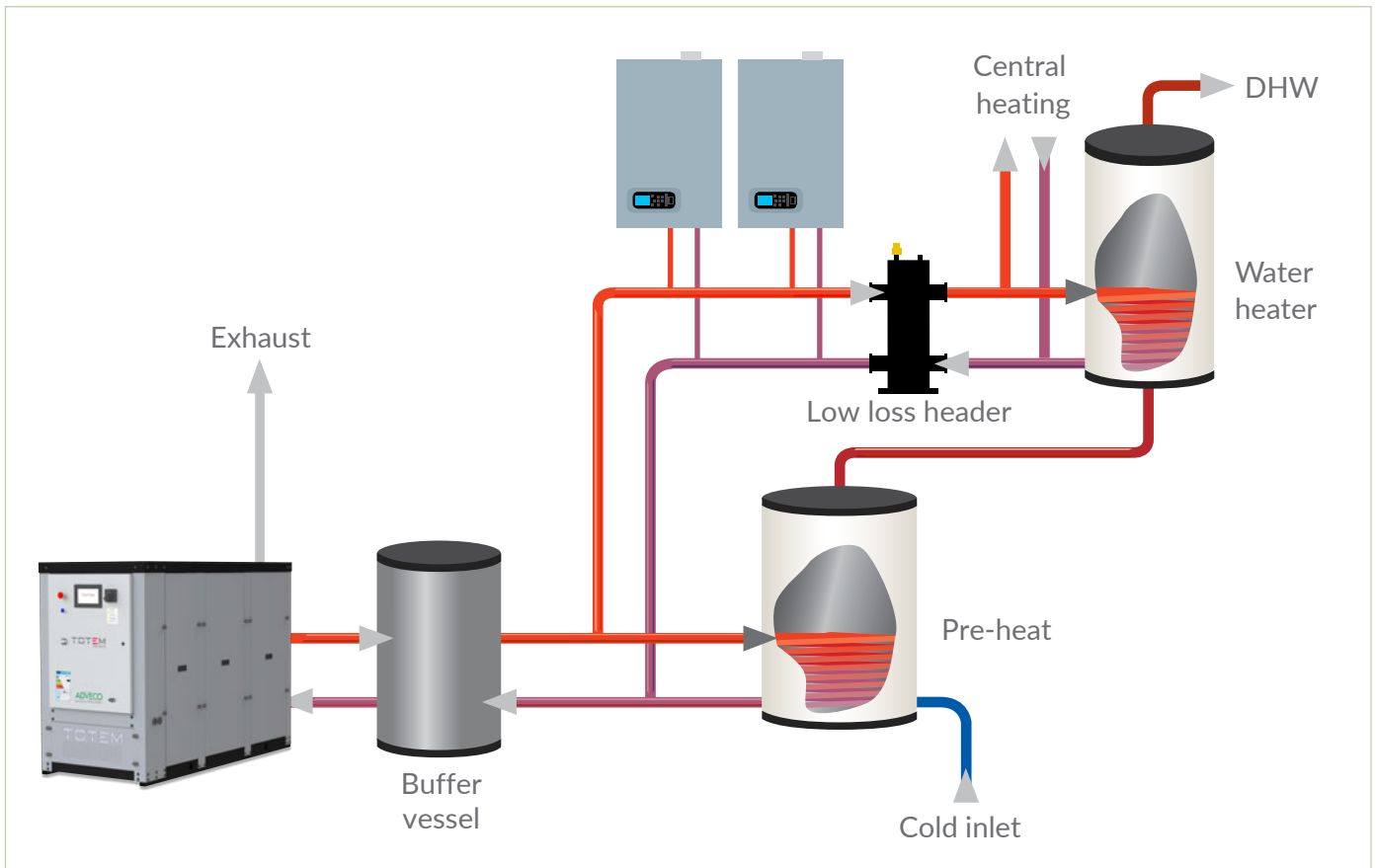
| MODEL IDENTIFIER                               | TOTEM 25        |      |
|--|-----------------|------|
| Seasonal space heating energy efficiency class |                 | A**  |
| Rated heat output                              | kW              | 57,6 |
| Seasonal Space Heating Energy Efficiency       | %               | 251  |
| Annual energy consumption                      | GJ              | 66   |
| Sound Power Level                              | L <sub>WA</sub> | 77   |

**Specific precautions**  
During assembly, installation or maintenance

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|  |      |
|--|------|
| 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 500L to 10000L
- 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 plans



# Buffer Vessel Options:

The Adveco MSS range of 500L - 10000L carbon steel system buffer vessels have been carefully designed to fit any heating application that requires an inertia tank or thermal energy store.

The units come as standard with high and low level flow and return connections and have extra tappings in the middle to be used with multiple heat sources, low and high grade heat sources, varying return temperatures, or glycol-filled primary loops.

MSS vessels up to 5000L include the option for 0, 1, or 2 internal heat exchange coils for use with indirect heat sources, and vessels up to 10000L are available without coils to serve as system buffers only. Almost any heating application can be served by the Adveco MSS range, but for those that require special features a bespoke tank can be designed on request.

## Standard Features

- Vertical tanks for hot water storage
- Available as buffer vessels (up to 10000L) or as indirect tanks (up to 5000L) with up to two high capacity internal heat exchange coils
- 5 bar working pressure
- 100mm flexible polyurethane insulation with removable outer PVC jacket

## Available Options

- Flanged connections in any size
- Additional ports
- Control and overheat stats
- AAVs and gauges



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

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