



(dimensions 128x79.5x192 cm)

Still using the same standard boiler? It's time to change. Choose TOTEM, heat is free!

TOTEM
asja group

in collaboration with





mCHP history and modern applications

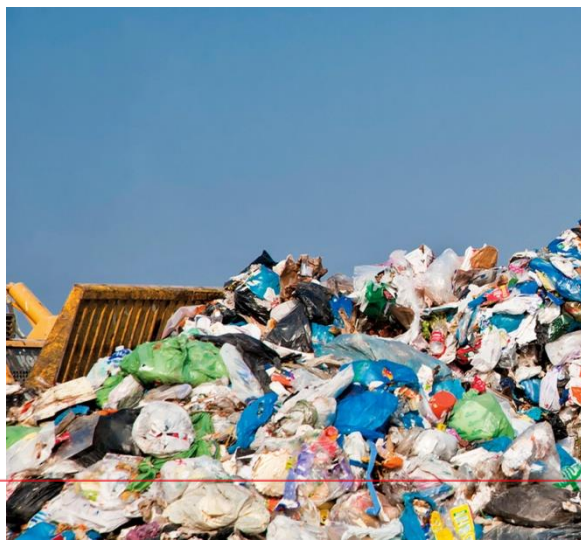


Stefano Re Fiorentin
Member of the Board of Totem Energy
s.refiorentin@totem.energy

Turin, 23rd November 2016



installed power



TOTEM ENERGY

A SUBSIDIARY OF ASJA GROUP

The Asja Group is the leader in the renewable energy sector in Italy since 1995, currently with more than 190 MW installed capacity.

With the daughter company **TOTEM ENERGY**, Asja Group moves into the world of **energy efficiency** and **microcogeneration**, with a strong awareness that energy savings and smart energy will play more and more important role in the future.



TOTEM ENERGY MANAGEMENT TEAM

Agostino Re Rebaudengo

President of TOTEM ENERGY, Asja Group and assoRinnovabili



Alessandro Casale

CEO of TOTEM ENERGY and Asja Group




Stefano Re Fiorentin

Member of the Board of TOTEM ENERGY and former head of Fiat Research Center till December 2013

TOTEM

HEAT and POWER ON DEMAND

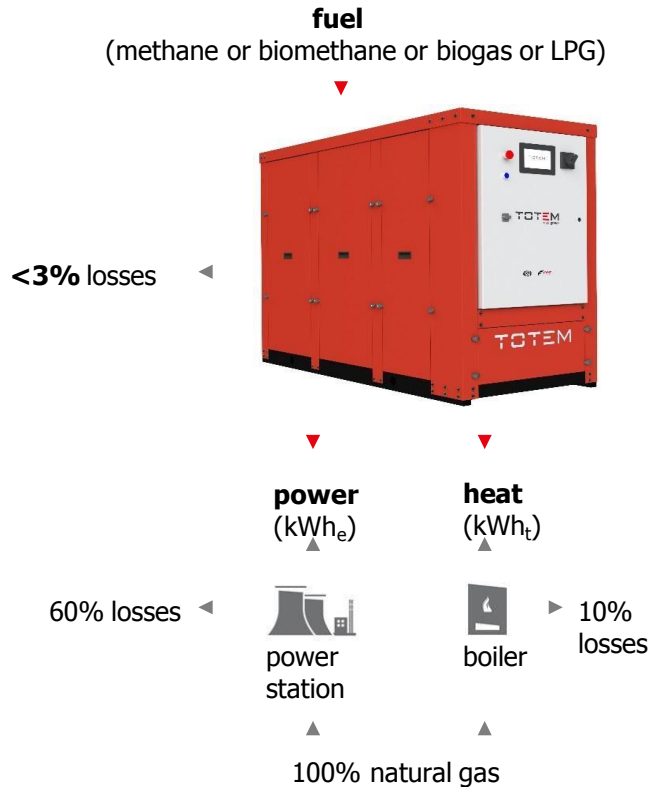
MODEL		TOTEM 10	TOTEM 20	TOTEM 25
Rated electric power	kW	10	20	25
Rated thermal power	kW	21,6 (25,2*)	41,9 (48,5*)	50,2 (57,6*)
Net electrical efficiency	%	29,6	31,2	32,5
Total efficiency	%	93,6 (104,3*)	96,5 (106,8*)	97,8 (107,4*)
Engine		Fiat Fire 1400 cc		
Engine Control Unit		Magneti Marelli 		
Fuel		Methane, bio-methane, biogas, LPG		
Methane(CH ₄)	Nm ³ /h	3,31	6,28	7,54
Emission settings (NOx)@ 5%O ₂	Mg/Nm ³	≤ 10		
Emission settings (CO) @ 5% O ₂	Mg/Nm ³	≤ 10		

TOTEM is an innovative microcogenerator, made in Italy, the evolution of the first microcogenerator in the world designed by Fiat Research and Development Center in 1977. With the efficiency up to **107%**, **TOTEM** can produce power and heat (for free) while protecting the environment.



Values are measured at Micro-Cogeneration laboratory (www.gecos.polimi.it) by Milan Polytechnic and validated by TÜV Rheinland.

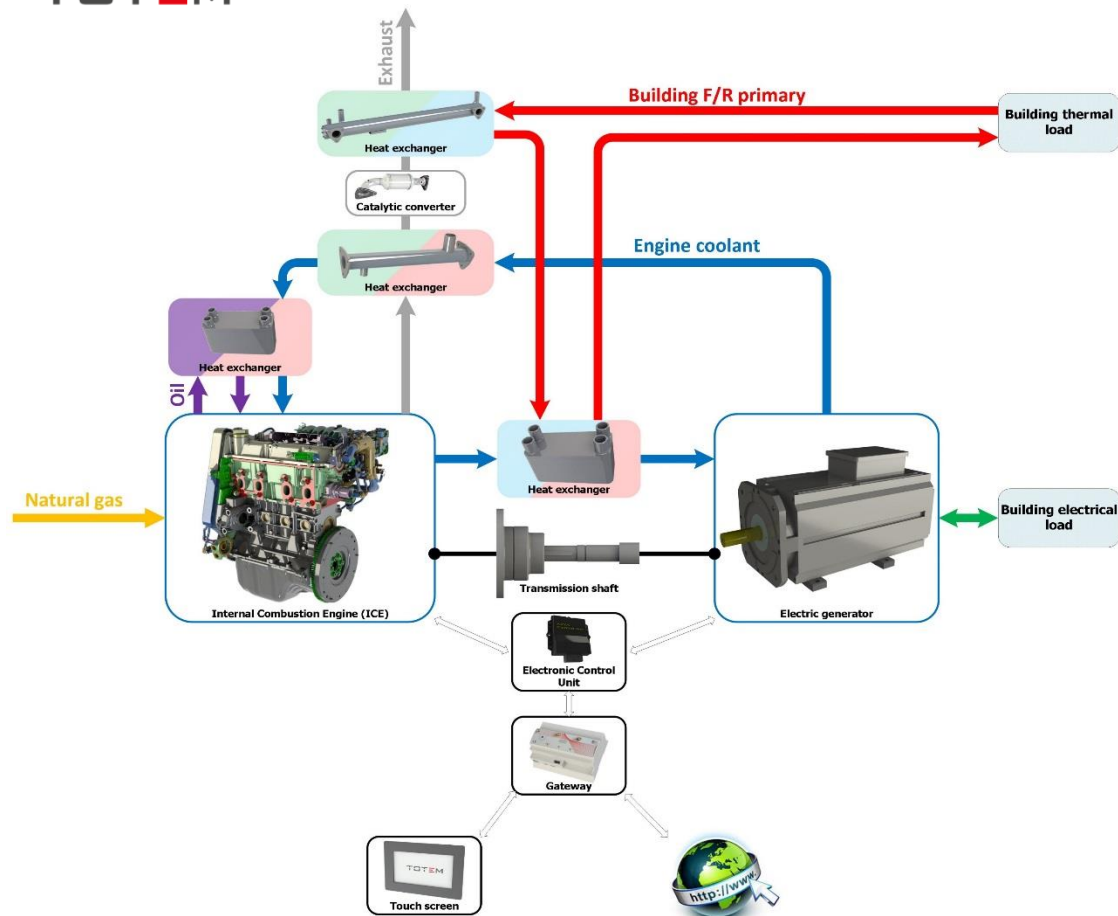
* Referred to the input water temperature 35°C.



TOTEM HOW DOES IT WORK

The TOTEM consist of an innovative combustion engine of FIAT 500 or Panda that designed to be fired with natural gas, coupled with the alternator for power production.

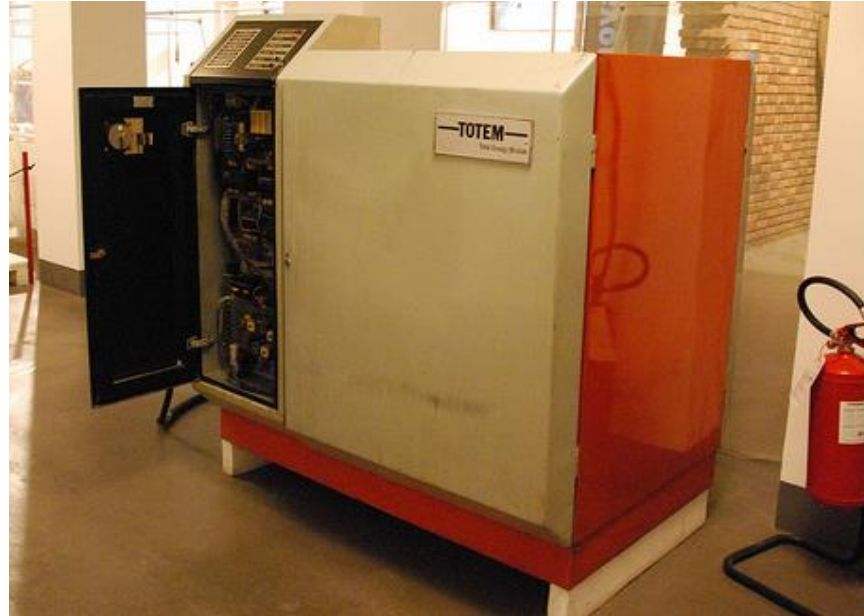
TOTEM is the smartest and cleanest way to make power directly onsite, getting heat for free.



TOTEM THE CONCEPT

1977

TOTEM
Total Energy Module



Courtesy of Technical and Science Museum, Milan

Un motore chiamato totem che illumina e riscalda le nostre case

Una "127" in cantina

L'impianto può servire per quattro appartamenti di circa 100 metri quadrati ciascuno e nello stesso tempo è in grado di erogare energia elettrica per la necessità di 10-15 alloggi. Già installati i prototipi in un palazzo con 20 alloggi.

Il progetto, presentato dalla Fiat, attraverso la casa del-
l'automobile, con il nome di
"Envieta" (Envieta Energy Motor-
bet), dimostra come anche un
motore di automobile possa
costituire all'occorrenza del-
l'energia, come all'ultimo
più razionale, che a par di
difficile l'unico forma dispo-
nibile di risparmio energetico.

L'Impianto risale in un costruttore per assicurare oltre alla sicurezza anche la più alta conservazione del calore sviluppato, soddisfacendo la tradizionale cultura con rispetto ambientale.

Questo metodo realizza uno sfruttamento quasi totale dell'energia producendo contemporaneamente energia meccanica (elettrica) e calore; con un impiego di riciclaggio energetico tradizionale invece l'energia è utilizzata solo per riscaldare l'acqua perdendo in dissipation il 50 per cento del calore.



Il Totem, il cui rendimento è di oltre il 90 per cento, è una pila-pila che integra con sé le seguenti spese: manutenzione, dalla produzione di calore, con quello della produzione di energia elettrica, utilizzando le tecnologie relative a componenti prodotti in gran-

I prototipi sono già in una fase avanzata della sperimentazione: sono stati individuati alcuni modelli in un palazzo (di alloggi) a Torino ed è in funzione (al numero di Torino, la possibilità di utilizzare una serie di moduli per il riscaldamento) ed un quartiere di circa 2000 alloggi.



Nella foto in alto un momento degli ultimi controlli del bagaglio. *Sotto: prima dell'evacuazione del modello installato in un condominio a Torino. In basso: Giuseppe Palazzetti, dell'area Ricerca di Orbassano.*

Due sistemi a confronto

Per spiegare la differenza tra l'energia trasformata e il Totem (l'energia trasformata), il fisico ha spiegato che l'energia trasformata è l'energia che si trasforma in calore, mentre l'energia trasformata è l'energia che si trasforma in calore. L'energia trasformata è l'energia che si trasforma in calore, mentre l'energia trasformata è l'energia che si trasforma in calore.

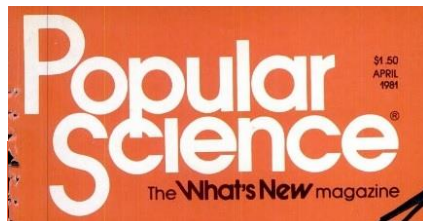
«Il Telen», hanno chiarito Palamotti e Anselmi, «per poter funzionare deve essere integrato nella infrastruttura energetica del Paese costituendo la rete elettrica e delle reti del servizio, che possono essere considerate dei grossi costi a servizio di energia».

Quando il Telen funziona ottiene dal servizio del servizio per incrementare energia in quelle delle reti elettriche per quelle e servizi in accordo con i collaboratori con le autorità sanitarie.

A metà prezzo

Altissimi citano a torto Piero Del No-
re responsabile della pi-
gnoristica del linguaggio
usato a scapito del
popolo. Tuttavia, la
ideologia della re-
gressione economica
in rapporto all'eco-
nomia a quella in-
dustria, quel ter-
minismo potrebbe por-
tare all'incoscienza, al-
l'una e quasi altro i
casi di crescita.





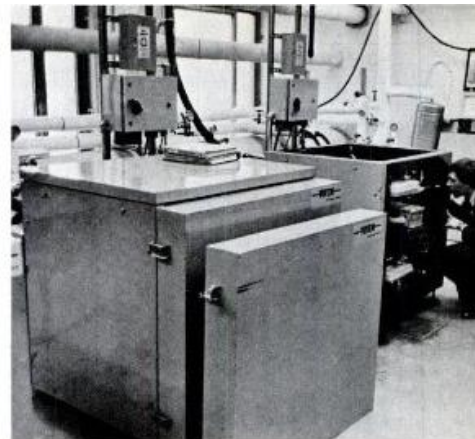
«...Now a small co-generation unit, developed and marketed by Fiat in Europe and called TOTAL Energy Module, or TOTEM, is available in the U.S. Through Brooklyn Union Gas Co. In New York City...»

Co-generator produces heat and electricity

Co-generation—burning fuel to produce both heat and electricity—is an old conservation idea that has recently been revived and hailed as an energy-saving alternative. Now a small co-generation unit, developed and marketed by Fiat in Europe and called the Total Energy Module, or Totem [PS, Aug. '77], is available in the U.S. through Brooklyn Union Gas Co. in New York City.

The heart of Totem is a 903-cc, four-cylinder internal-combustion engine—the standard engine in the Fiat 127 automobile. But Totem's engine has been modified to burn a variety of fuels, including natural gas, biogas, and propane, as well as methanol and other alcohols. The engine drives a 15-kW induction generator, producing electricity that can be fed into a utility grid or can supply power directly to a user's own circuits. Heat is extracted from the combustion process by circulating water through four primary and secondary heat exchangers, drawing heat from the generator, engine coolant, crankcase oil, and exhaust. The recaptured heat is used for domestic hot water, space heating, or, with the help of absorption water chillers, for air conditioning.

Totem has a fixed output ratio: Two-thirds is heat, one-third is electricity. Besides a 15-kW electrical output,



Compact Totem co-generators are 42" high, 41" wide, 46" long. Size will differ on U.S. version to fit through average door.

Totem generates 131,000 Btu/hr. That's enough heat to supply hot water for 16 apartments or heat four medium-size apartments.

With a price tag of about \$10,000, Totem is well suited to apartment buildings, restaurants, hotels, hospitals, and a variety of industrial applications. Fiat hopes to introduce the Totem concept to the U.S. by selling 100–200 units.

For more information, write to Totem Project, Bob Ritacco, Brooklyn Union Gas, 195 Montague St., Brooklyn, N.Y. 11201.—*Jeanne McDermott*



2003

Then, it was Energia Nova with it's TandEM (Thermal and Electrical Machine)



2013

TandEM



2015

TOTEM



TOTEM BRIEF HISTORY

The first
microgenerator in
the world:
the TOTEM (15 kW)



Research and Development
Center of Fiat developed
the TOTEM: first
microgenerator powered
by natural gas

Growing demand for energy
efficiency solutions

Asja Group has been
developing new TOTEM
headed by Stefano Re
Fiorentin

Launch of:
New TOTEM
(10 kW, 20 kW, 25 kW)



1977

1987

2013

2016



TOTEM

A NEW MICRO CHP WITH A LONG HISTORY

TOTEM is the evolution of the first micro-cogenerator in the world designed by FIAT Research and Development Center in 1977. TOTEM consists of the **innovative internal combustion engine of FIAT 500**. Manufactured by Fiat Chrysler Automobiles and designed to be fueled with natural gas and propane, coupled with a water cooled alternator for power production.

Thanks to an efficient heat exchanger system, heat is recovered from the internal combustion engine as well as the alternator and provided as a **by-pass product**.

In addition, TOTEM is equipped with the **Engine Controlled Unit developed by Magneti Marelli** for a real time and precise control of the FIAT 500 engine.



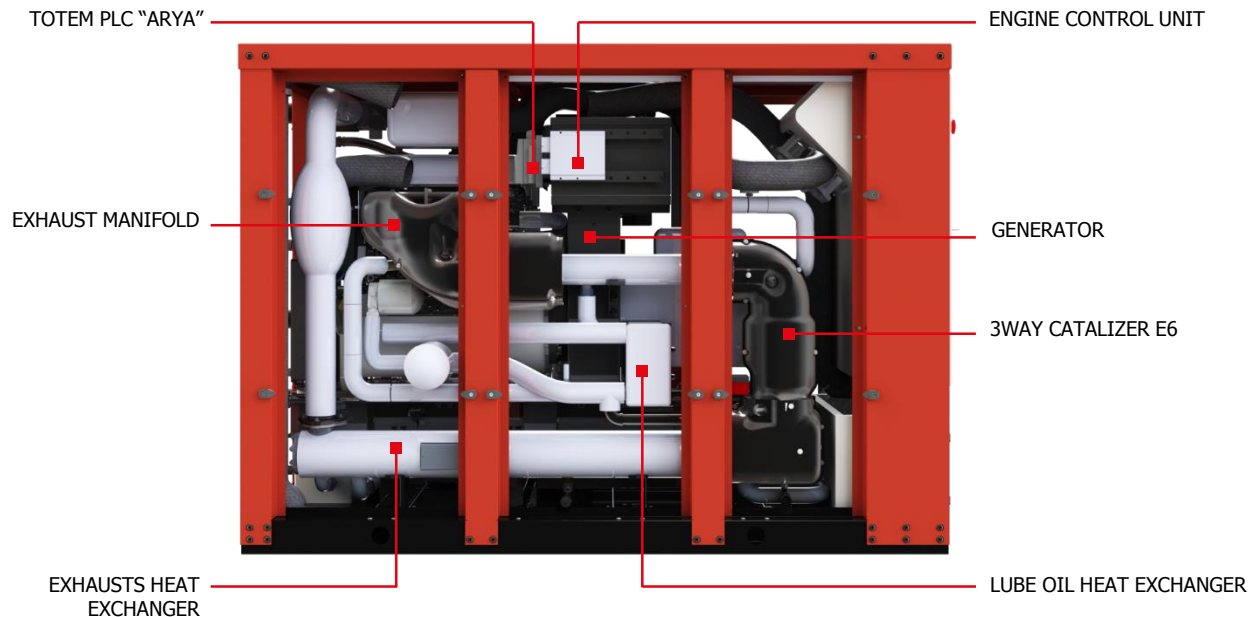
FIAT Fire 1.4 CNG E6



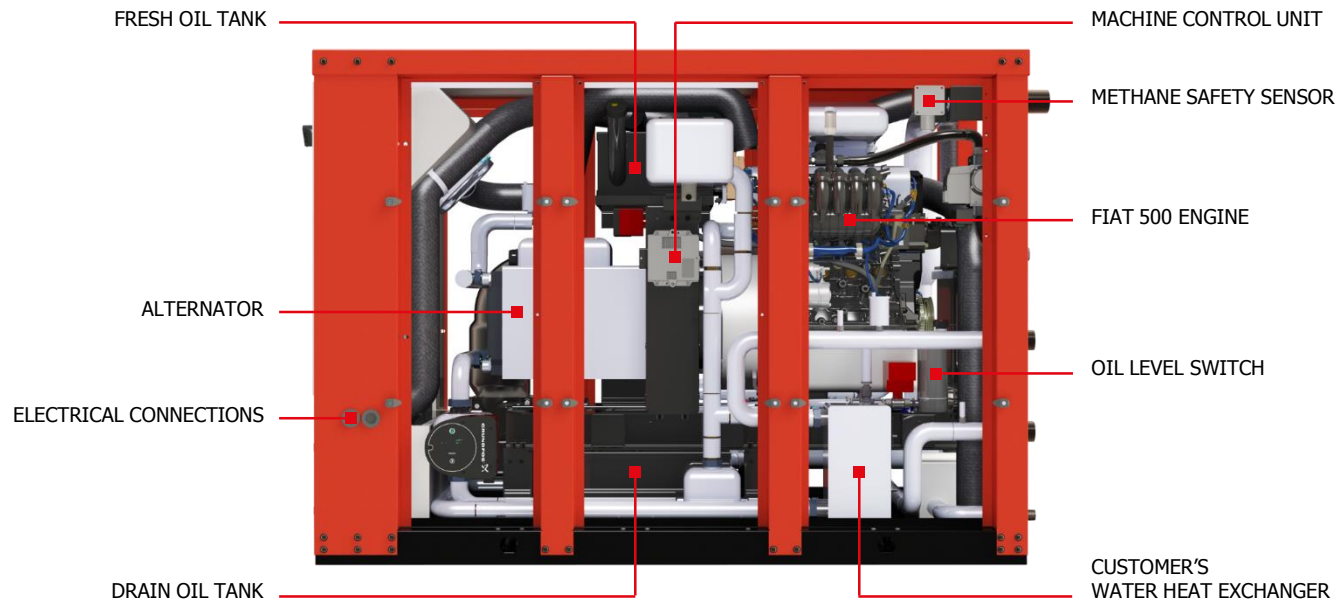
CONTROL UNIT



TOTEM INSIDE (1/2)



TOTEM INSIDE (2/2)





TOTEM

TOTEM FEATURES

100% italian

with Fiat Chrysler Automobiles and
Magneti Marelli technologies

multi fuel

methane, biogas, biomethane and LPG

reliable

with high level of efficiency over time

short payback

2 - 4 years due to savings on energy bills (heat
and power)

indoor / outdoor

installation **inside** and **outside**

operation

single and cascade operation



TOTEM PRODUCTION

2,100 m² of production area designed according to the maximum efficiency standards: all taking place within that area, from research and development of new models to the production, assembly and testing, are characterized by a rational use of energy produced and consumed.

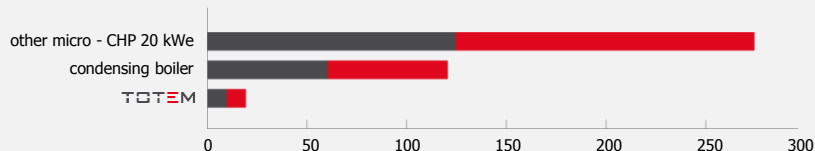
Production capacity of 600 units per year.



TOTEM TESTING ROOM

3 testing rooms within our production plant: all microgenerators can leave the production only after having passed a specific endurance test.

Emissions for different technologies

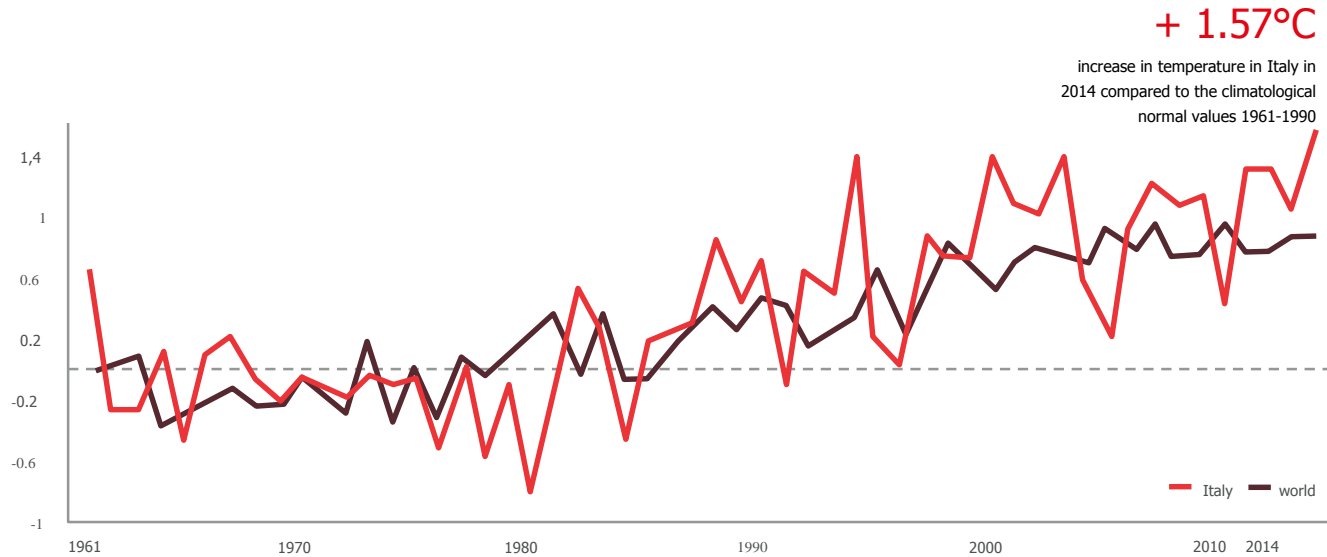


TOTEM NOT JUST CUTTING THE BILL

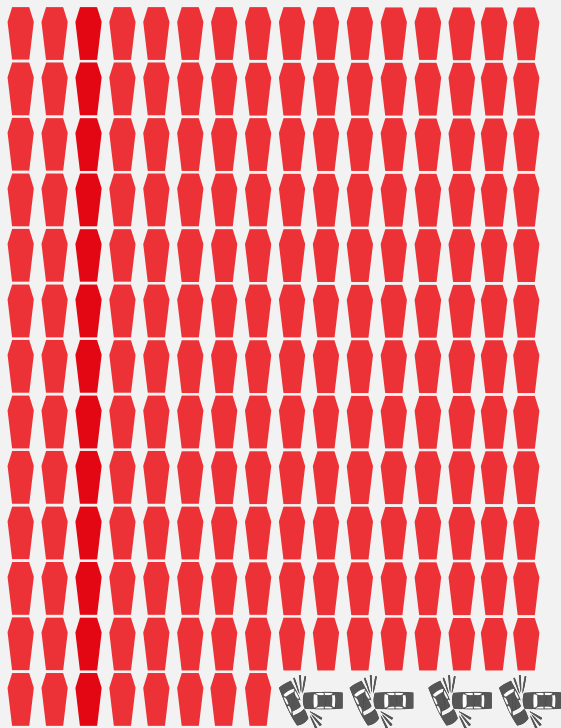
The innovative technologies developed to meet the emission limits of Euro6, ensure that TOTEM **emissions 20 times lowered compared with condensing boilers** ($\text{CO} < 10 \text{ mg/Nm}^3$ and $\text{NOx} < 10 \text{ mg/Nm}^3$), and compliant with the most stringent national standards.

TOTEM

HOW CAN WE PRESERVE THE ENVIRONMENT?



...nearly doubled than worldwide!



TOTEM HOW CAN WE SAVE LIVES?

Air pollution

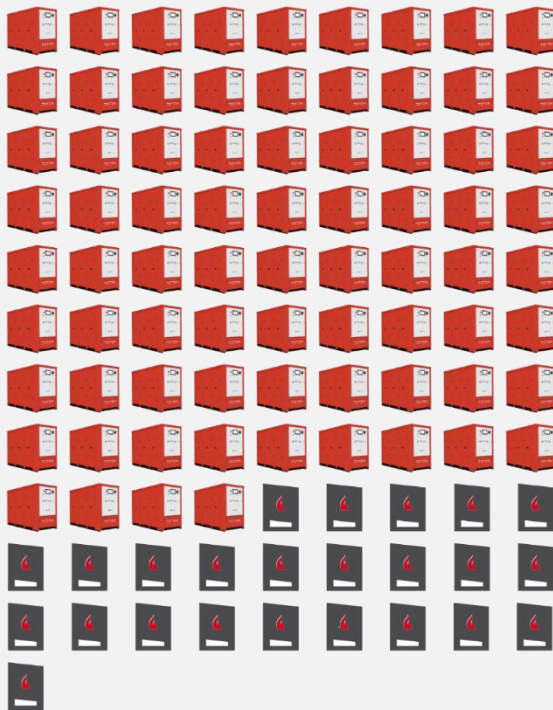
Italy, one of the worst records in Europe.

84,400

Deaths per year caused by air pollution.

25 times +

Compared with the victims of car accidents
(3,380 deaths).



TOTEM OUR VISION

If all the residential boilers in Italy (with exception of single houses) **were replaced by TOTEM** microcogenerators that would lead to:

-30.000 deaths

per year caused by air pollution (thanks to the yearly reduction of about 1500 Tons of Nox and 7500 Tons of Particular Matters).



POLITECNICO
MILANO 1863

TOTEM CERTIFICATION

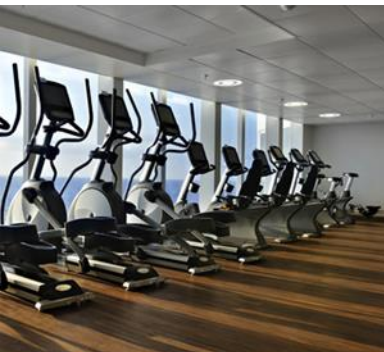
The **TOTEM** is the first microcogenerator that is awarded with the mark of an accredited institution. Technical performances, measured by Micro-Cogeneration laboratory of Politecnico di Milano, are verified by **TÜV Rheinland Italy** that also certified TOTEM's compliance with the most stringent technical safety regulations.

TOTEM



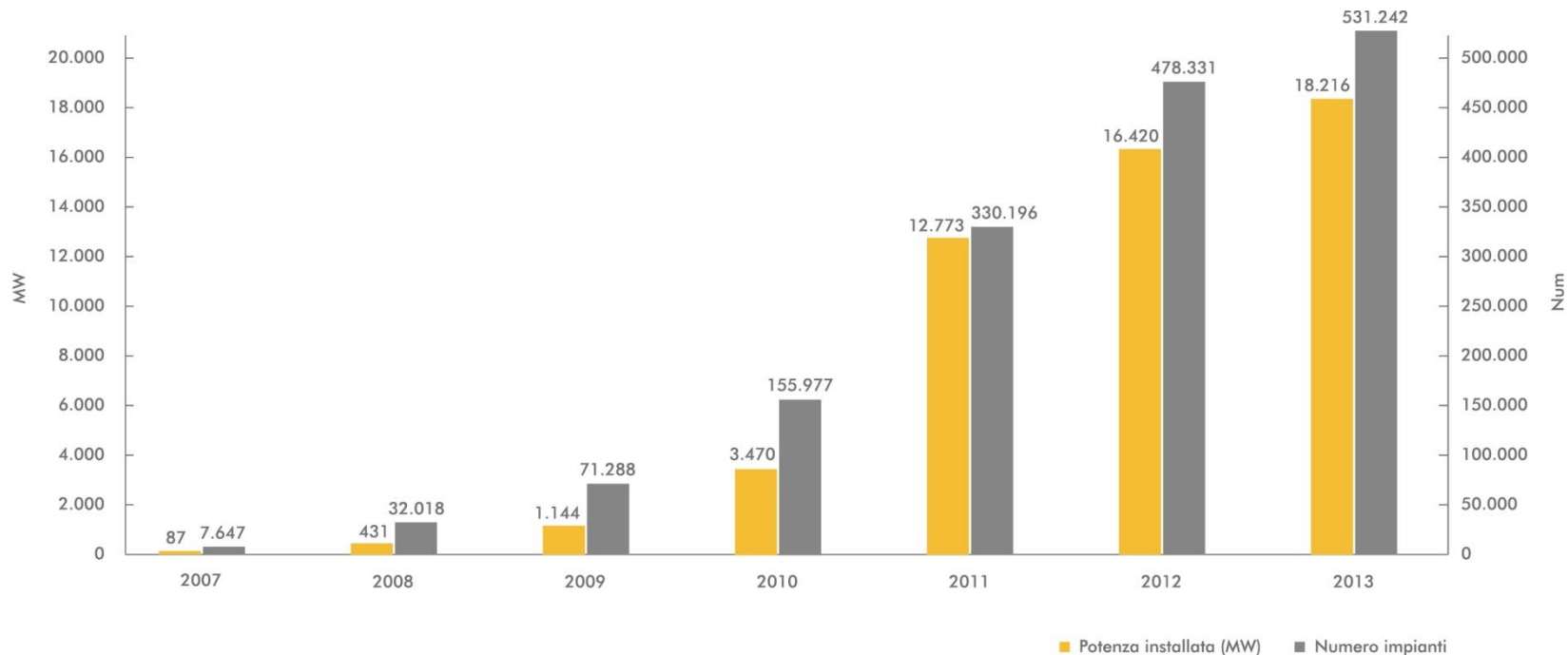
TOTEM APPLICATIONS

- Wellness centers
- Accommodations
- Restaurants
- Healthcare
- Residential
- Public
- Agricultural sector
- Distribution
- Small/medium industry



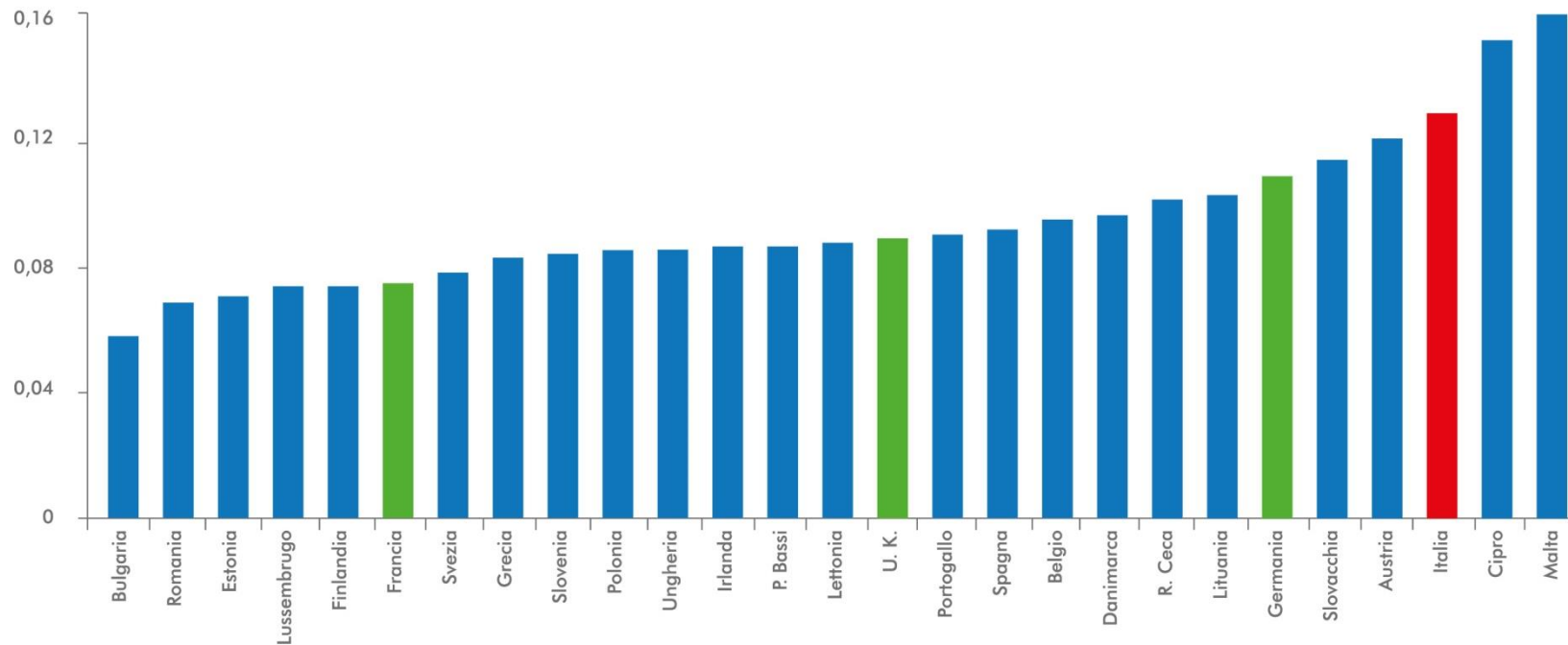
TOTEM @ Italy

GROWING NUMBER OF PV PLANTS AND INSTALLED CAPACITY IN ITALY

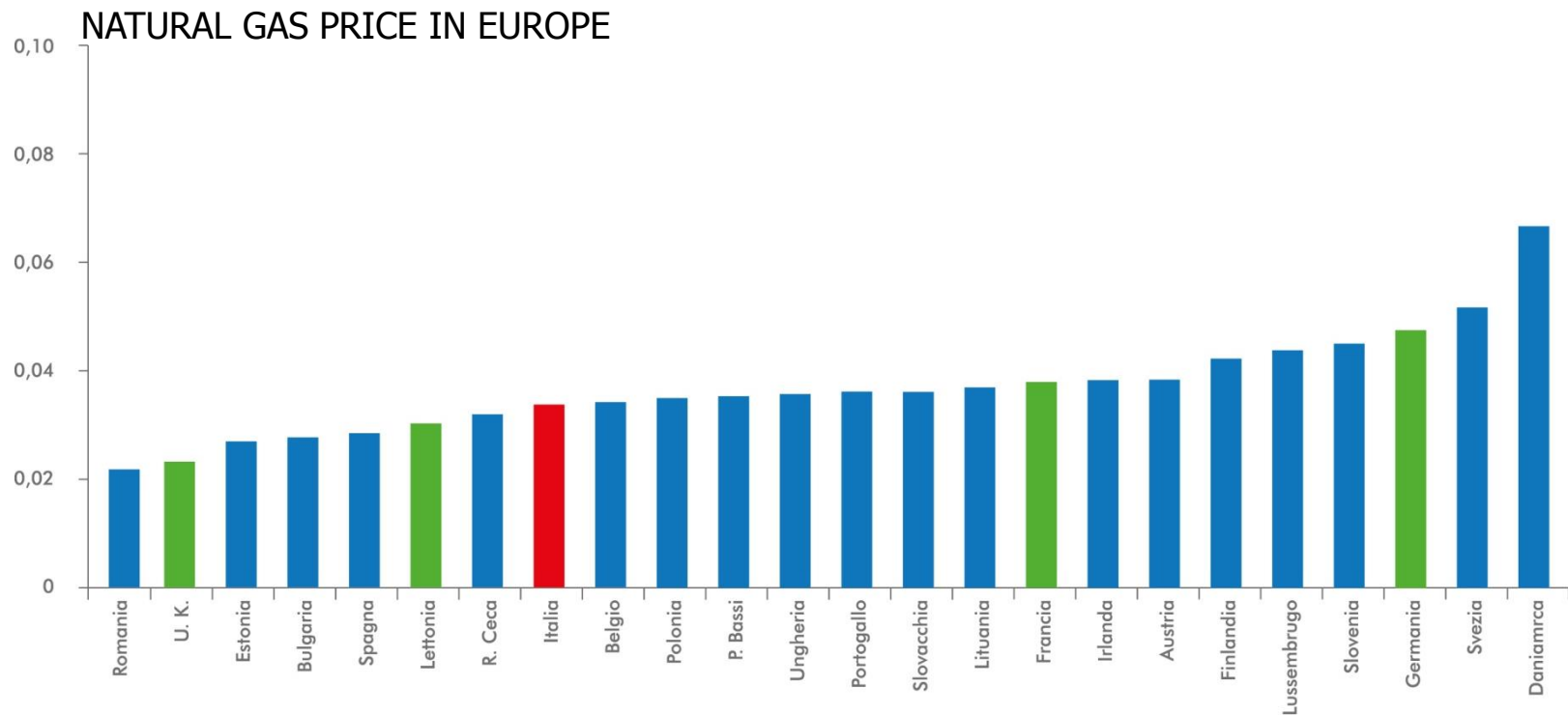


Fonte: GSE

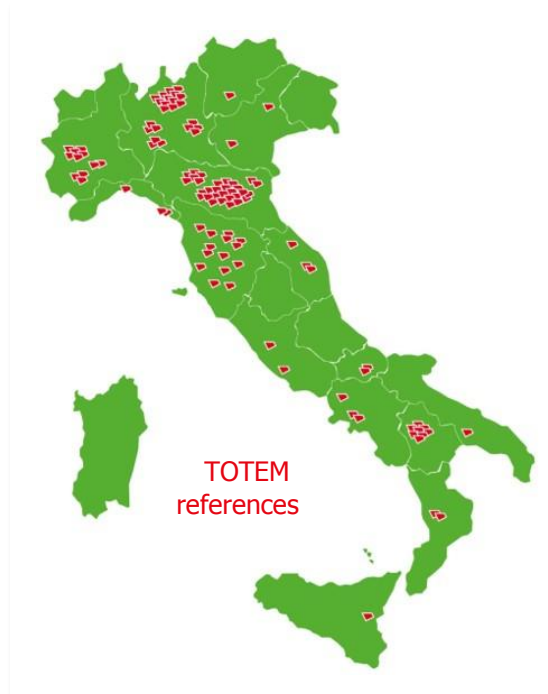
ENERGY PRICE IN EUROPE



Fonte: Energy Efficiency Report, Energy Strategy Group POLIMI, nov 2012



Fonte: Energy Efficiency Report, Energy Strategy Group POLIMI, nov 2012



Drivers

- Electricity price among the highest in Europe
- Natural gas tax exemption applied to cogeneration
- White certificates scheme. A 20 kWe microcogenerator operating for 4.000 hours/year is entitled to an annual amount of about 10 White Certificates/yr for 10 years, for a total of approximately € 1.000/yr

Opportunities

- 1.100.000 condos
- 150.000 hotels
- 80.000 swimming pools
- 72.000 sport complexes
- 7.000 retirement homes
- Growing market, currently 200 units/year

BUSINESS CASE SWIMMING POOL

Client type

Swimming pool

Location

Piemonte | Italy

Efficiency of present boiler

85%

Power voltage

Low

Inflation rate

2,5%

PRESENT CONSUMPTION

118.542
m³/year

267.045
kWh/year

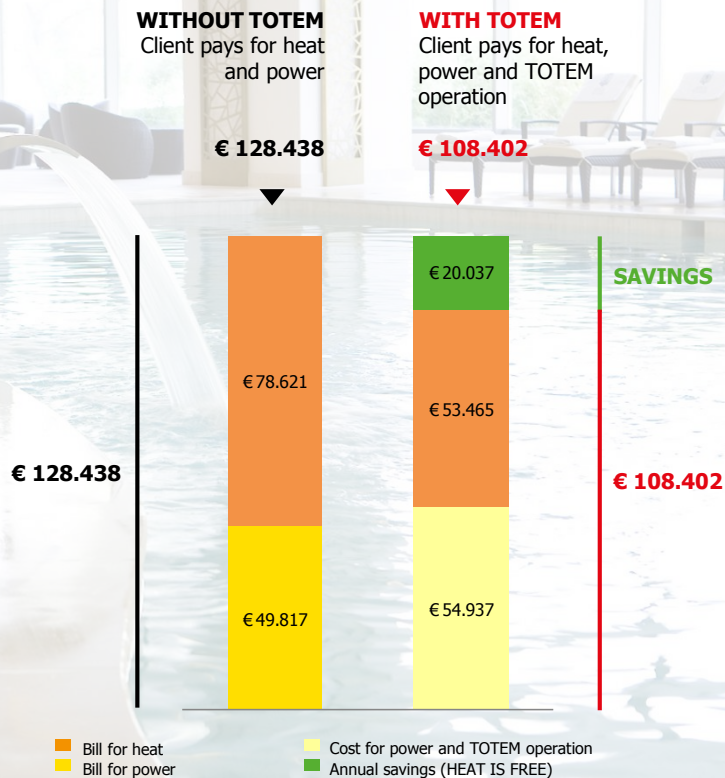
PRESENT COST

78.621
€/year

49.817
€/year

HEAT

POWER



BUSINESS CASE SWIMMING POOL | PROPOSED SOLUTION

Unit type
TOTEM 20

Rated electric power
20 kW

Rated thermal power
42 kW

Working hours per year
8.760

TOTEM covers
70% of user electricity
40% of user heat



POWER



HEAT



BUSINESS CASE SWIMMING POOL | PAYBACK CALCULATION

Annual cost | WITHOUT TOTEM

Heat	78.621 €
Power	49.817 €

Annual cost | WITH TOTEM

Heat	53.465 €
Power + TOTEM operation	54.937 €

Cumulat. savings in 10 yrs 100.978 €

Payback time* 2,2 years

* With reference to energy prices applicable to Italy.

**PRESENT
CONSUMPTION**

48.577
m³/year

**PRESENT
COST**

34.211
€/year

HEAT**POWER**

295.420
kWh/year

51.174
€/year

BUSINESS CASE HOTEL

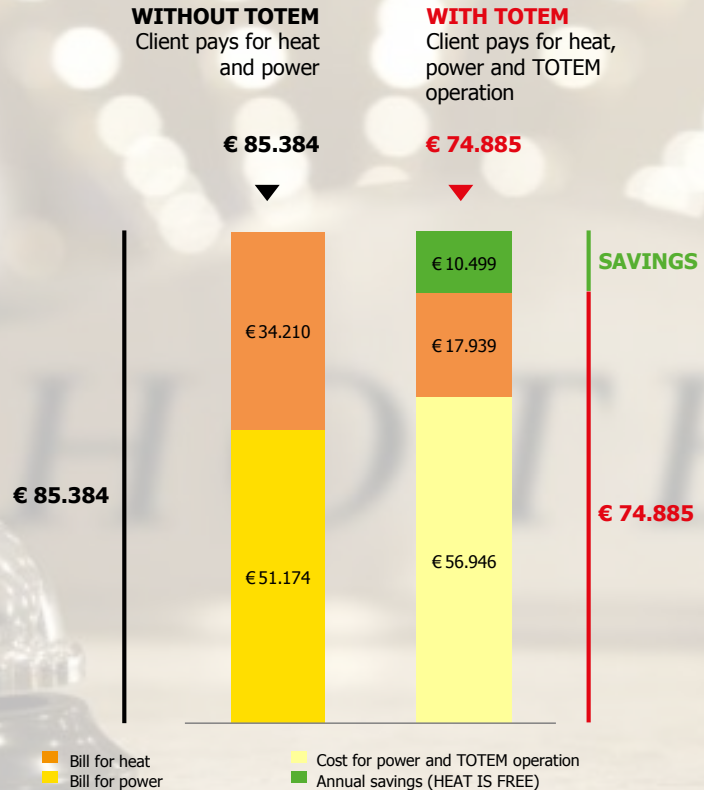
Client type
Hotel

Location
Toscana| Italy

Efficiency of present boiler
85%

Power voltage
Low

Inflation rate
2,5%



BUSINESS CASE

HOTEL | PROPOSED SOLUTION

Unit type
TOTEM 20

Rated electric power
20 kW

Rated thermal power
42 kW

Working hours per year
5.548

TOTEM covers
37% of user electricity
56% of user heat

TOTEM



POWER



HEAT



BUSINESS CASE

HOTEL | PAYBACK CALCULATION

Annual cost | WITHOUT TOTEM

Heat	34.210 €
Power	51.174 €

Annual cost| WITH TOTEM

Heat	17.939 €
Power + TOTEM operation	56.946 €

Cumulat. savings in 10 yrs 78.059 €

Payback time* 4.3 years

* With reference to energy prices applicable to Italy



HEAT

PRESENT
CONSUMPTION115.941
m³/year

POWER

496.904
kWh/yearPRESENT
COST137.015
€/year112.052
€/year

VAT included

BUSINESS CASE
CONDOMINIUM

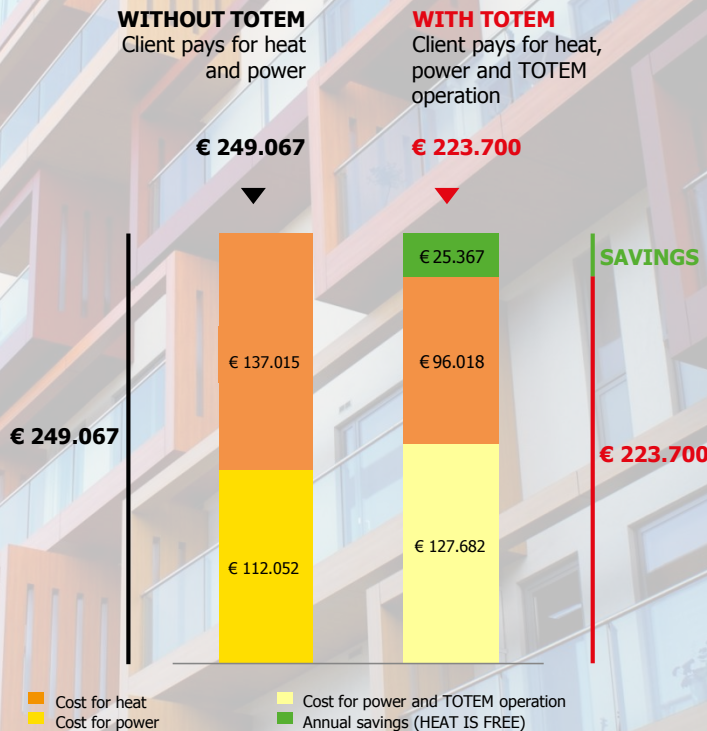
Client type
Condominium

Location
Emilia Romagna| Italy

Efficiency of present boiler
85%

Power voltage
Low voltage

Inflation rate
2,5%



BUSINESS CASE CONDOMINIUM | PROPOSED SOLUTION

Unit type

TOTEM 20

Number of units

2

Rated electric power

20 kW

Rated thermal power

42 kW

Working hours per year

4.006 (per unit)

TOTEM covers

33% of user electricity

36% of user heat

TOTEM



POWER



HEAT



BUSINESS CASE CONDOMINIUM | PAYBACK CALCULATION

Annual cost | WITHOUT TOTEM

Heat	137.015 €
Power	112.052 €

Annual cost | WITH TOTEM

Heat	96.018 €
Power + TOTEM operation	127.682 €

Cumulat. savings in 10 yrs 174.184 €

Payback time* 4,3 years

* With reference to energy prices applicable to Italy

TOTEM @ WorldWide



Drivers

- CHP supportive policy development last 15 years
- From 2012 - 2015 in the range from 10 - 50 kWel **6.937 units** were installed (192 MW el)
- BAFA incentives (major CHP incentive in the country; incentive amount up to €4.375/unit)
- KWKG incentives (€ 0,04/kWh for self consumption in addition to TOTEM generation savings or € 0,08/kWh for selling electricity back to the grid)

- CHP awareness and acceptance by end users are the highest in GE among other EU countries

Opportunities

- In 2016 the last amendment has been launched to CHP law to make conditions more favorable to self consumption.
- Need to replace mCHP units installed 10 - 15 years ago



Drivers

- Increasing power prices
- Reduced Ghg emissions
- Building regulations 2010 (legal binding requirements); micro CHP is one of the technologies that is allowed by LZC (Low and Zero Carbon Energy Source) to meet building regulations

Opportunities

- Up to 10 million new homes will be needed by 2050
- Existing stock needs boiler replacement; micro CHP is easy of retrofitting



SWIMMING POOL REFERENCE CASE

Rari Nantes Pianezza

Unit type

TOTEM 20

Number of units

1

Fuel type

Methane

Application type

Wellness centers

Location

Pianezza | Italy



SWIMMING POOL REFERENCE CASE

Public Pool Piedimonte Matese

Unit type

TOTEM 20

Number of units

1

Fuel type

Methane

Application type

Wellness centers

Location

Piedimonte Matese | Italy



SWIMMING POOL REFERENCE CASE

Swimming Pool Adria Nuoto

Unit type

TOTEM 25

Number of units

2

Fuel type

Methane

Application type

Tourist accommodation

Location

Adria | Italy



HOTEL REFERENCE CASE

Hotel Du Cheval Blanc

Unit type

TOTEM 20

Number of units

2

Fuel type

Methane

Application type

Tourist accommodation

Location

Aosta | Italy



HOTEL REFERENCE CASE

Hotel Etrusco

Unit type

TOTEM 25

Number of units

1

Fuel type

Methane

Application type

Tourist accommodation

Location

Arezzo | Italy



HOTEL & TERME REFERENCE CASE

La Reserve Hotel & Terme

Unit type

TOTEM 20

Number of units

2

Fuel type

Methane

Application type

Tourist accommodation

Wellness centers

Location

Caramanico Terme | Italy

TOTEM



INDUSTRY REFERENCE CASE

Savinelli spa

Unit type
TOTEM 20

Number of units
1

Fuel type
Methane

Application type
Industry

Location
Barasso | Italy



HOTEL & TERME REFERENCE CASE

Hotel Weiss

Unit type

TOTEM 20

Number of units

1

Fuel type

Methane

Application type

Tourist accommodation

Location

Angermünde | Germany



RESIDENTIAL REFERENCE CASE

Private house

Unit type

TOTEM 10

Number of units

1

Fuel type

Methane

Application type

Residential

Location

Illingen | Germany



RETIREMENT HOUSE REFERENCE CASE

Retirement House Sant'Anna

Unit type

TOTEM 20

Number of units

1

Fuel type

Methane

Application type

Healthcare

Location

Eisenach | Germany



CONDOMINIUM

REFERENCE CASE

Condominium

Unit type

TOTEM 10

Number of units

1

Fuel type

Methane

Application type

Residential

Location

Eisenach | Germany



STUDENT ACCOMMODATION REFERENCE CASE

Student accommodation

Unit type

TOTEM 10

Number of units

1

Fuel type

Methane

Application type

Residential

Location

Luton, London | United Kingdom





PUBLIC REFERENCE CASE

Fire station

Unit type

TOTEM 20

Number of units

1

Fuel type

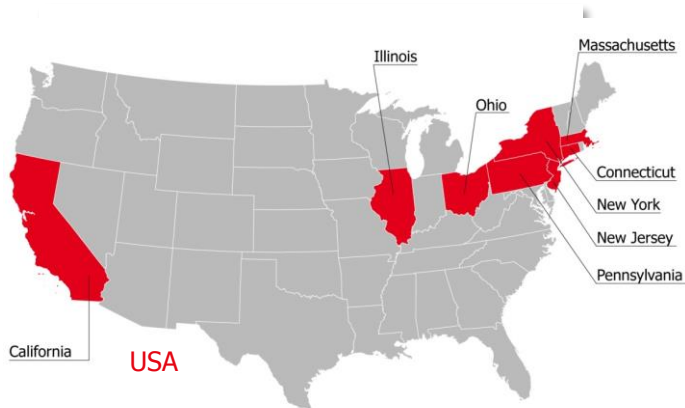
Methane

Application type

Public

Location

London | United Kingdom



Shown are the **best locations for Micro CHP** based on payback, policies, net metering rules, discounted natural gas prices, length of heating season, emissions regulations and an experienced dealer network.

Drivers

- Cut-Down in electricity expenses
- Reduced GHG emissions (Obama plan)
- Absolute product for boiler replacement (boiler replacement program to meet the emission limit)
- State supportive Government policies (payback is 1 - 2 years)

- Natural gas discounted rate (in some states) for cogeneration
- Promoting and supporting mCHP by gas utilities

Opportunities

- Boiler replacement market
- Residential/commercial applications



Shown are the **best locations for Micro CHP** based on payback, policies, net metering rules, discounted natural gas prices, length of heating season, emissions regulations and an experienced dealer network.

Drivers

- Rising energy cost
- Long heating season (up to 10 months)
- Advanced CHP technology is more accessible for properties
- 7% of electricity is produced using cogeneration
- Supportive Government policies (cover up to 80% of investment cost)

- More often grid outages
- Need to reduce grid demand and improve infrastructure cost and time effective

Opportunities

- Real estate investment companies
- Residential/commercial applications

Model		TOTEM 25
Rated Electrical Power	kW	25
Rated Thermal Power	BTU kW	170,600 (195,200*) 50 (57.2*)
Net electrical efficiency (LHV)	%	31.2%
Total efficiency (LHV)	%	94.2 % (103.3%*)
Inlet water temperature	°F / °C	158 / 70
Engine		FCA Fire 1400 cc
Engine Control Unit		Magneti Marelli
Fuel		Natural Gas
Black-out start capability		Yes
Input power rate (LHV)	BTU (kW) Th/hr	270,760 (79.3) 2.71
Input power rate (HHV)	BTU (kW) Th/hr	300,214 (87.9) 3.00
Gas pressure requirement	W.C.	8
Emission settings (NOx)@ 5% O ₂	lb/MW _{hr}	< 0.10
Emission settings (CO)@ 5% O ₂	lb/MW _{hr}	< 0.10

* Referred to the input water temperature 95 F (35 °C)

@TOTEM | 60 Hz

Modulation. From 7.5 - 25 kW of electricity and 15 - 57 kW of heat. Electricity generated matches customer's demand without exceeding the required need.

Black-out start. Working while grid failure or power outage. In black-out start mode TOTEM can be fueled either with natural gas or propane.

Single phase ready. Through the 3+1 wires inverter it can supply three single phase sub grid at once

Emissions. TOTEM emissions are up to 20 times less than a condensing boiler.

TOTEM ENERGY WORLDWIDE





New Opportunites?

@TOTEM | SAHARAN AFRICA 50 Hz

**Drivers**

- Growing economy, LNG and LPG network and reserves
- Existing projects of RES and energy efficiency
- Support country's economic growth (power and heat supply for textile, food, chemical and commercial plants)
- Urgent need for energy supply (ex. Community Care Centers, Ebola virus disease)
- Limited access to electricity (example in Kenya only 20% of population)

- Avoiding distribution losses which represents 10-12%
- Creating reliable electricity supply

Opportunities

- Residential buildings, hospitals and schools
- Small commercial industries
- Most attractive states: Morocco, Jordan, Egypt and South Africa

Challenge

- Moderate GDP



**KEEP CALM
AND
Totemize
Every Building!**



TOTEM
asja group

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