GREEN BUILDING AND CONSTRUCTION: PATHWAY TOWARDS INCLUSIVE GROWTH AND THE CREATION OF DECENT AND GREEN JOBS

TURIN, 10 – 14 JULY 2017

great to see you

WELCOME

asja TOTEM

DEVELOPMENT COOPERATION Co-financed by the Italian Ministry of Foreign Affairs and International Cooperation

ITC ILO International Training Centre

JULY 12 - PROGRAM

10,00
Welcome and registration

10,10
Micro-Combined Heat & Power Generation | part 01, *S. Re Fiorentin*

11,00
TOTEM Energy production plant visit, *S. Re Fiorentin*

11,30
Micro-Combined Heat & Power Generation | part 02, *S. Re Fiorentin*

11,50
Closing speech, *A. Re Rebaudengo*

Micro-Combined Heat & Power Generation

part 01

Stefano Re Fiorentin
Board Member of Totem Energy
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TOTEM ENERGY
A SUBSIDIARY OF ASJA GROUP

With a strong expertise in centralized energy generation Asja Group decided years ago to move into the business of decentralized energy generation with a strong awareness it will play an essential role in the years ahead.

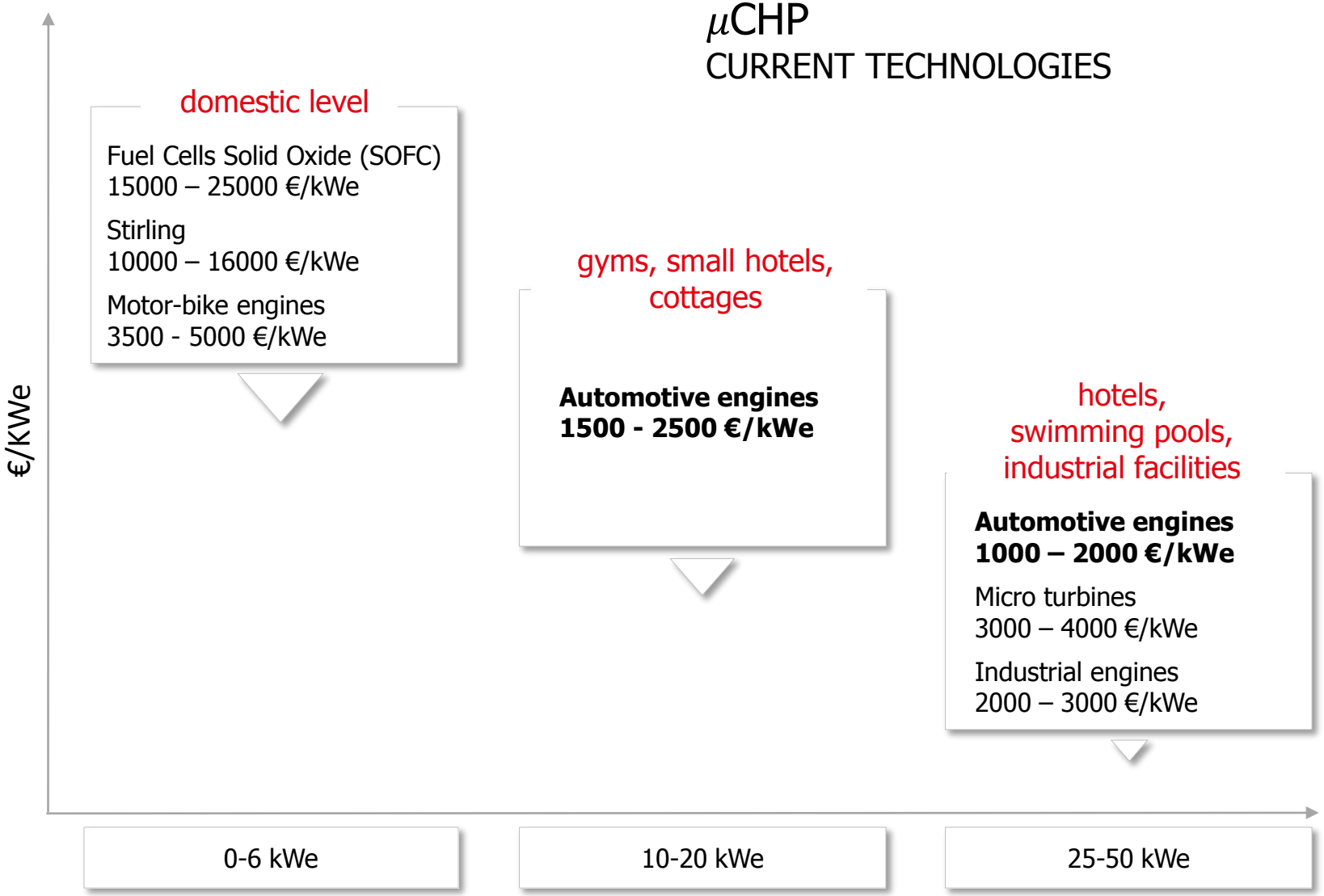
Through the daugther company TOTEM ENERGY, Asja Group has become a specialist in Onsite Energy Generation products and particularly in Micro Combined Heat and Power generation.

Its flagship product is the TOTEM micro CHP.

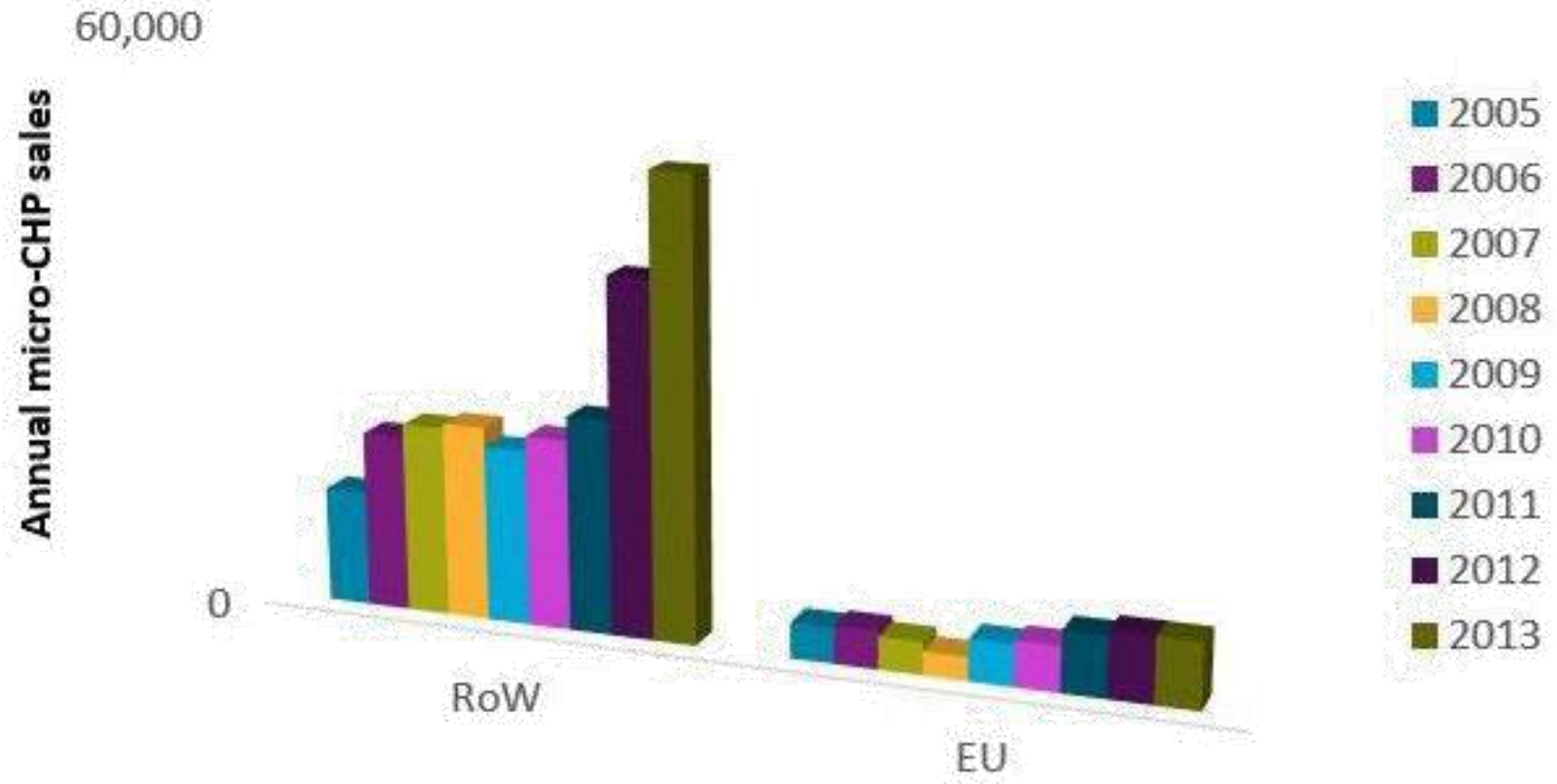
“Our energy environment is changing rapidly as Governments globally strive to make cost-efficient use of resources while enabling the emergence of a low carbon economy. Innovative policy is crucial to enabling the emergence of those technologies that will deliver this outcome.

Micro Combined Heat and Power (μCHP), a cost-effective and flexible low carbon solution that generates heat and electricity on-site, can support the transformation of the energy system and the achievement of relevant policy objectives, including environmental ones. Widespread μCHP deployment can transfer a significant part of electricity generation at local level, creating significant benefits for the energy system and for consumers.”

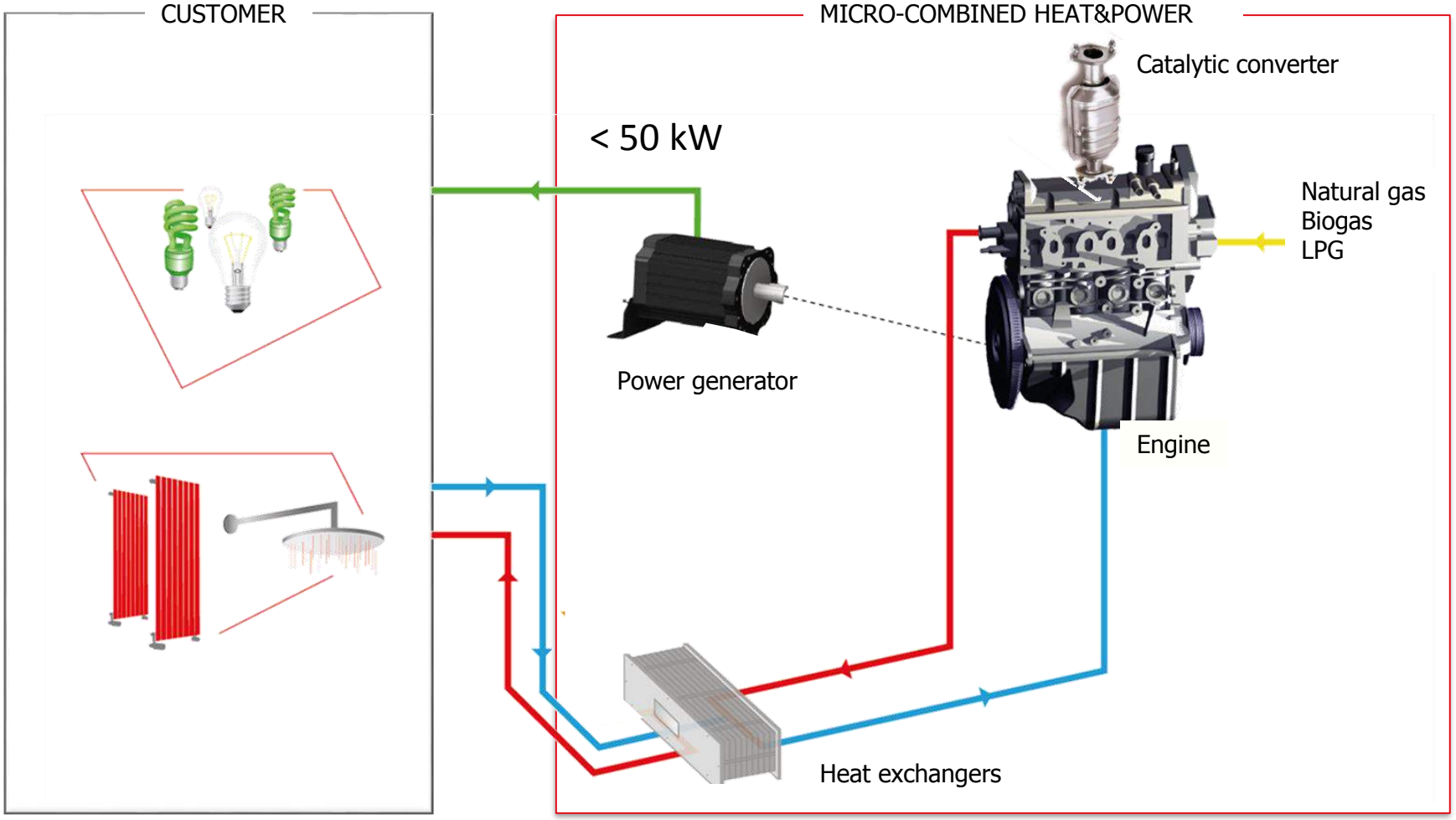
μCHP
CURRENT TECHNOLOGIES



μCHP
IN THE WORLD

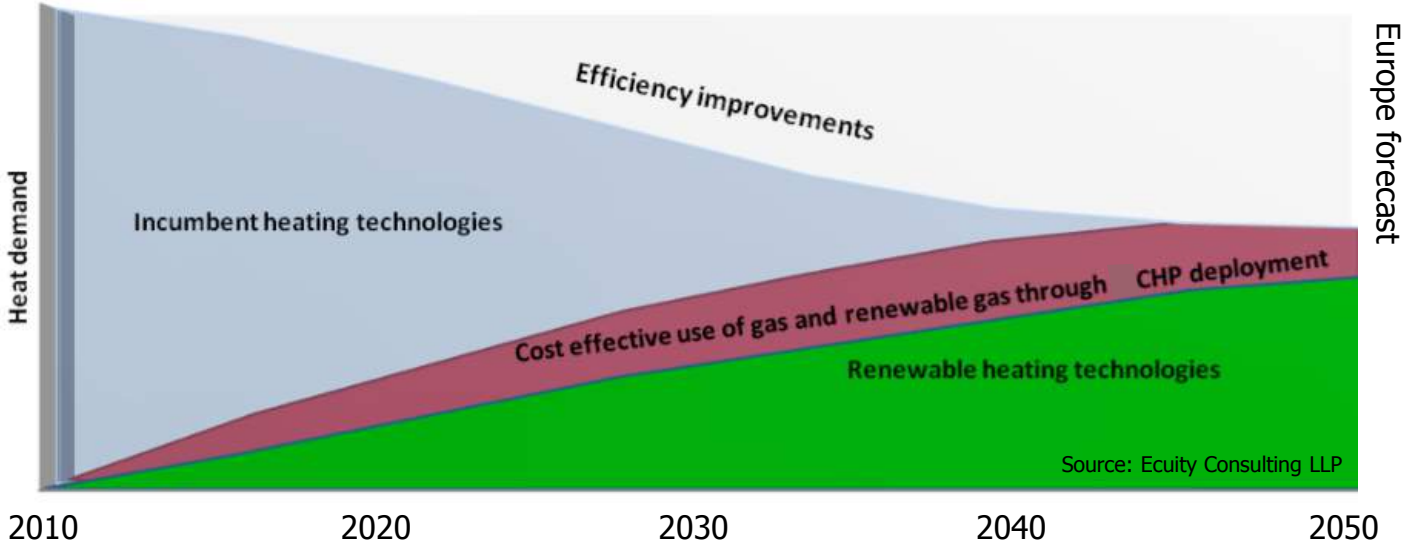


μCHP BASED ON INTERNAL COMBUSTION ENGINES



μCHP AND BIOMETHANE / BIOGAS

- Engine-based μCHP are flexible in terms of fuel type utilisation.
- Therefore, renewable gases like biomethane should not be overlooked as the eventual fuel of preference for μCHP.
- Renewable gas fuelled μCHP would allow the technology to become part of the portfolio of renewable solutions to attain full decarbonisation of power and heating.



μCHP BENEFITS FOR THE USER

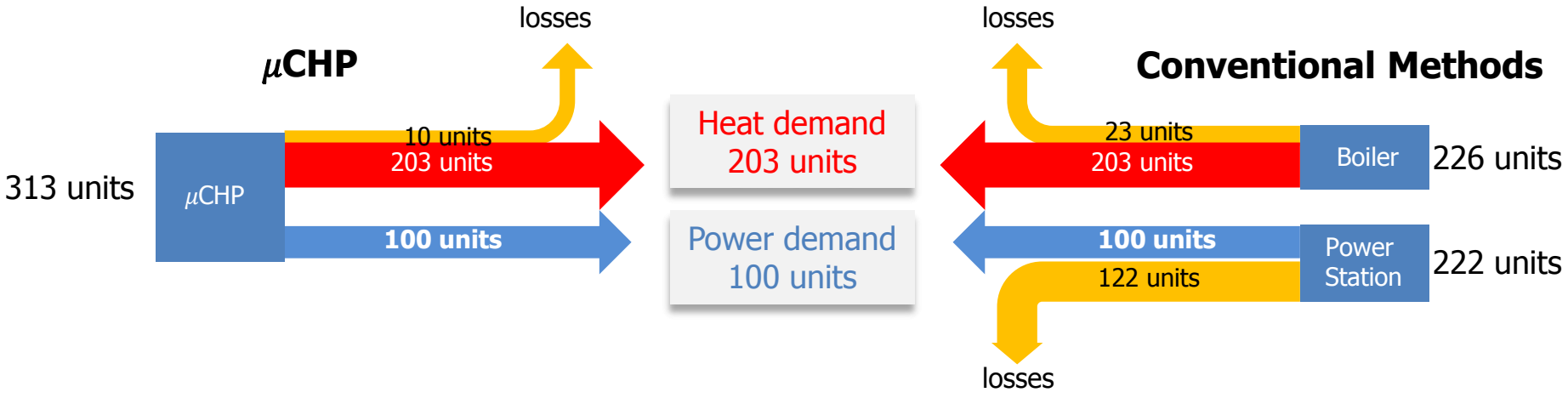
Choose TOTEM, heat is free!

TOTEM asja group

- Economic benefits
  savings on energy bills
- Enabler for District Power and Heating
- Increased security in electrical supply
  (μCHP can also work in "island" mode in the event of blackouts)
- Operation in "Peak-shaving"
  to cope with high power demand for limited time periods
- Increased "Power quality"
  to ensure constant voltage and frequency to safeguard production processes

μCHP ENERGY SAVINGS

- μCHP brings savings as the primary energy used is less than that required for the separate production of heat and power

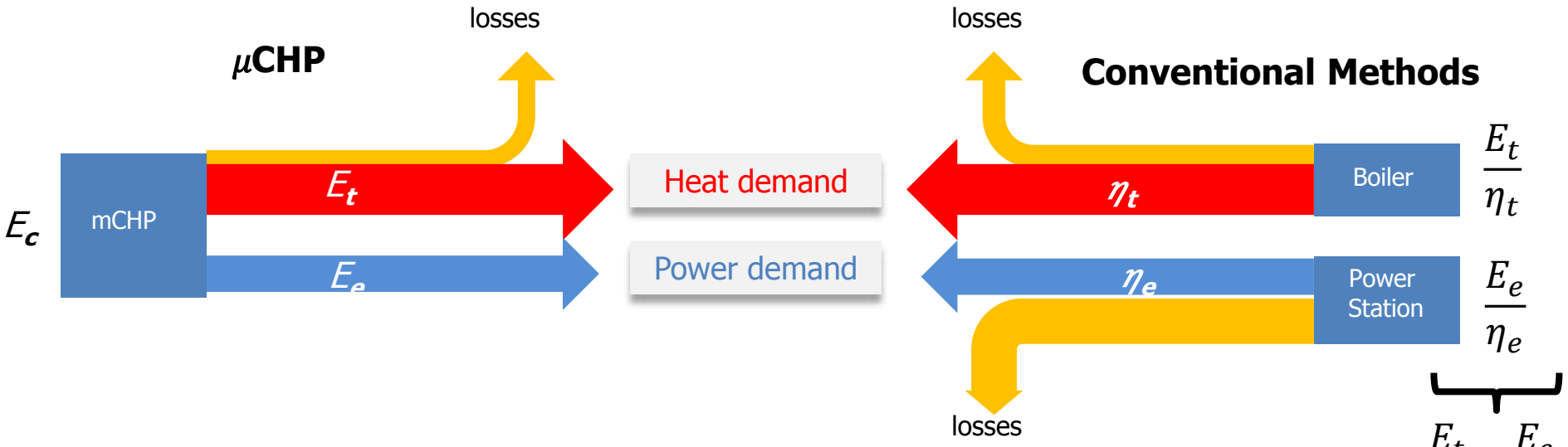


313 units of fuel input
303 units of delivered energy

30% saving

448 units of fuel input
303 units of delivered energy

μCHP PRIMARY ENERGY SAVINGS

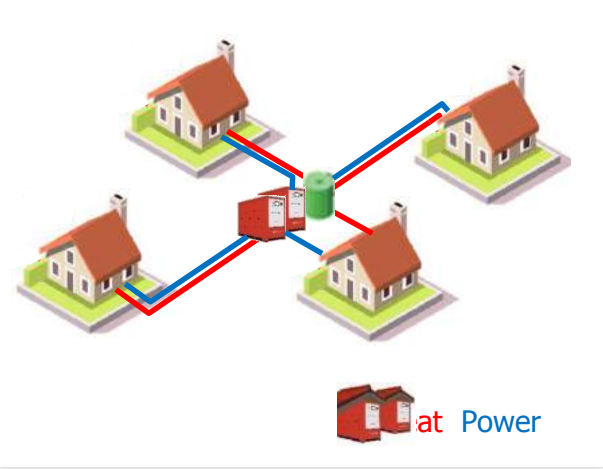


Energy Saving: $\Delta E_c = E_p - E_c$

Primary Energy Saving: $PES = \frac{\Delta E_c}{E_p} = 1 - \frac{E_c}{E_p} > 0$

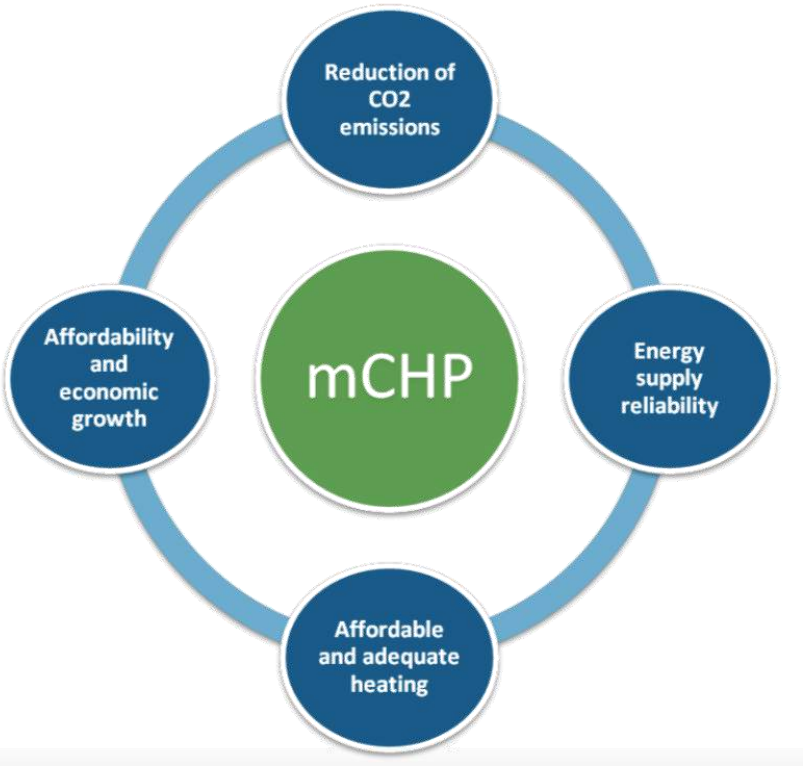
μCHP DISTRICT POWER & HEATING

- Aside from an ideal like-for-like heating replacement in individual properties, μCHP is well placed to operate in a modular fashion in a shared environment, benefiting from economies of scale.
- μCHP is an ideal solution for social housing or for a block of flats and community heating schemes.
- The modular deployment of μCHP may become the predominant commercialisation means as the decarbonisation targets become more stringent.



- Distributed μCHP clusters can jointly make a low emission District Power and Heating.
- μCHP can meet with flexibility the distributed customer demand of heat & power with emissions much lower than modern boilers and 20% less CO_2 over centralized thermo-electricity generation.

μCHP BENEFITS FOR THE ELECTRICAL SYSTEM AND FOR THE COUNTRY

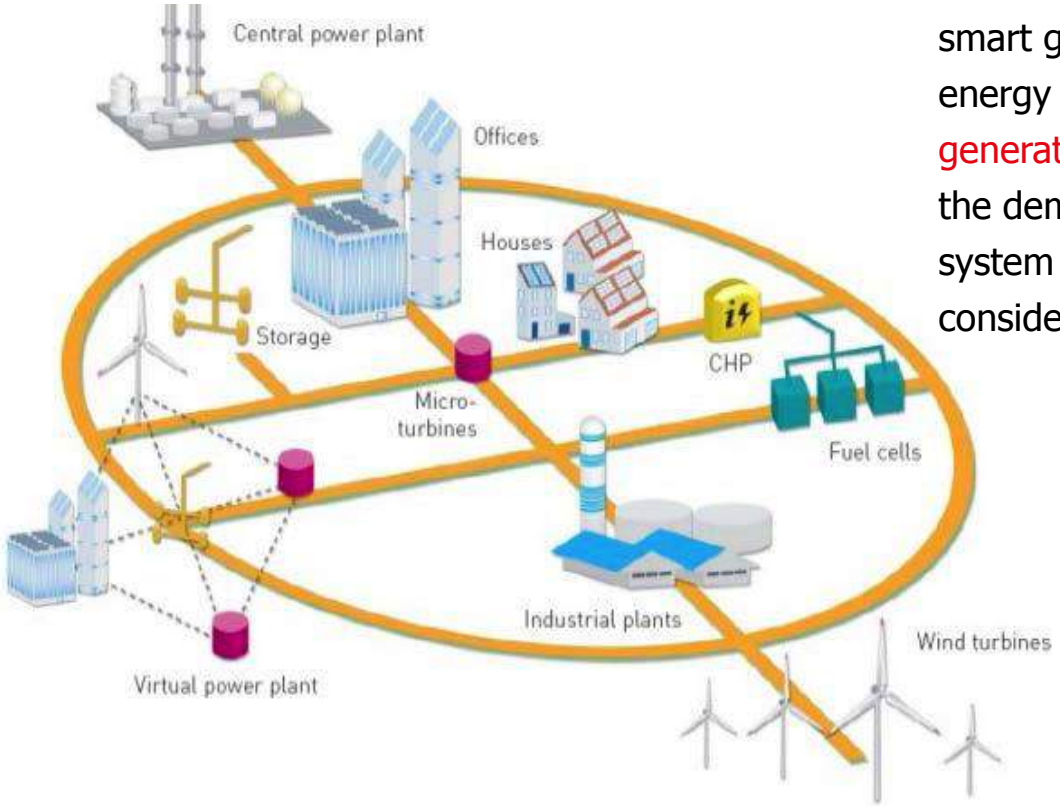


- Benefits for the balance of payments and decreased dependence on import of fossil fuels
- Reduced CO_2 and noxious emissions (reduced dead and health costs)
- Decreased occurrence of overload conditions in the transmission lines, with increased resilience of the electric grid
- Reduced transmission and distribution losses
- Encouragement of new energy providers liberalization of the energy sector

μCHP BENEFITS FOR THE ELECTRICAL SYSTEM AND FOR THE COUNTRY

- Widespread μCHP uptake could complement significant investment in centralised generation, or indeed transfer a considerable proportion of electricity generation from big centralised power stations to the local level
- At least 7% of all generated electricity is lost when it is transported to consumers as a result of transmission and distribution losses. μCHP penetration would allow the efficient generation of electricity by alleviating losses of electricity
- In an environment that favours a more important role for local energy generation, μCHP is the most controllable distributed energy technology
- The power output of μCHP can allow enhanced viability in local power generation as a result of its flexibility and natural fit with key renewable solutions and domestic electricity demand

μCHP SMART GRID INTEGRATION



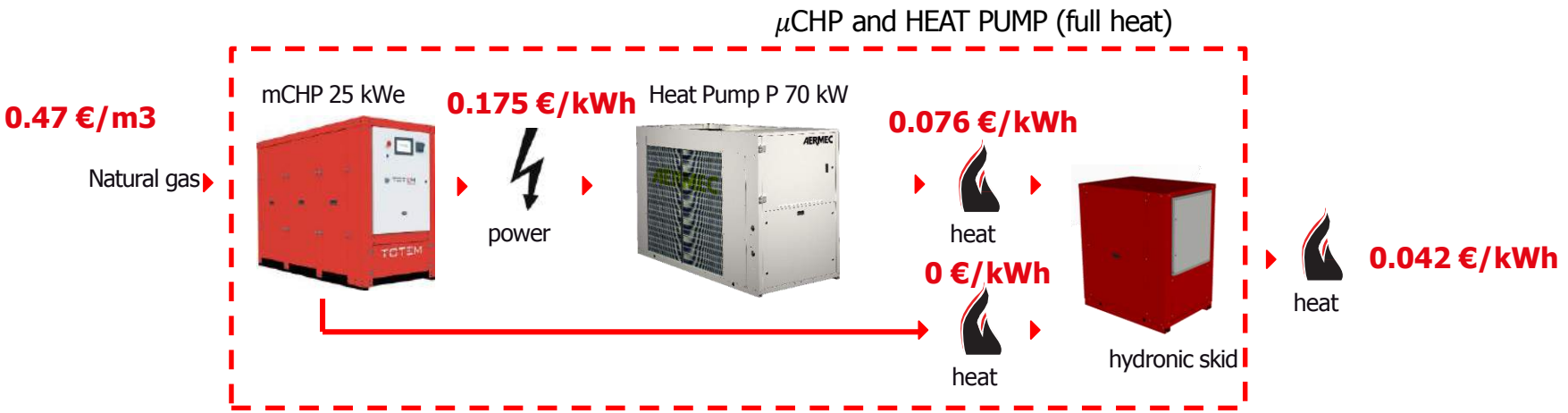
With the deployment of smart meters and the smart grid coupled with improvements in energy storage, μCHP flexibility would generate innovative possibilities to incorporate the demand side more actively in power system operation (prosumers) with considerable benefits.

INTEGRATION OF THE μCHP WITH THE HEAT PUMP

- The change in the Building Regulations by the end of the decade that will require any replacement of heating system to achieve a carbon reduction improvement vs. condensing boilers, has the potential to establish a vibrant low carbon heating market.
- Such change would generate a level playing field for low carbon heating products, including μCHP .
- The power generated by the μCHP can be used by a Heat Pump to produce additional heat or to operate as a chiller.
- The combination of μCHP + Heat Pump can serve as a simple means of readily upgrading the existing stock of residential gas boilers and can integrate with legacy high-temperature heating systems (e.g. radiators, pumps)
- The global efficiency of the μCHP + Heat Pump systems can be as high as 160%:

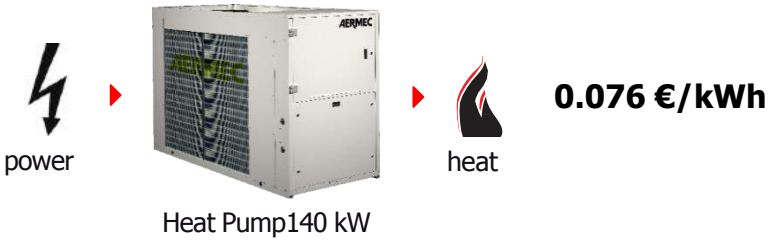
  100 energy units of natural gas become 160 units of heat to the end user

μCHP AND HEAT PUMP
FULL HEAT

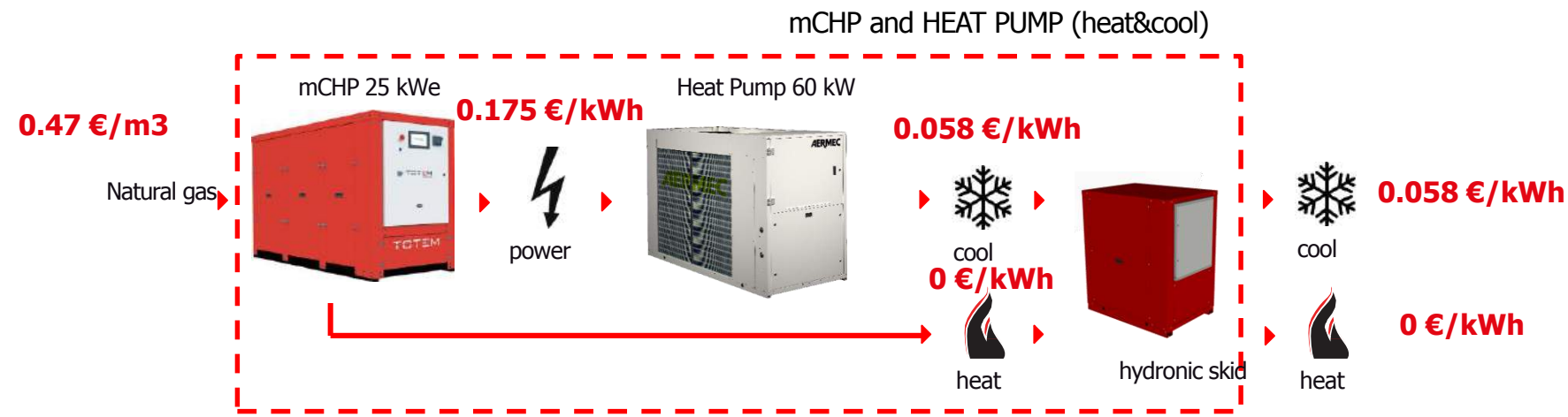


Vs Heat Pump alone

-45%

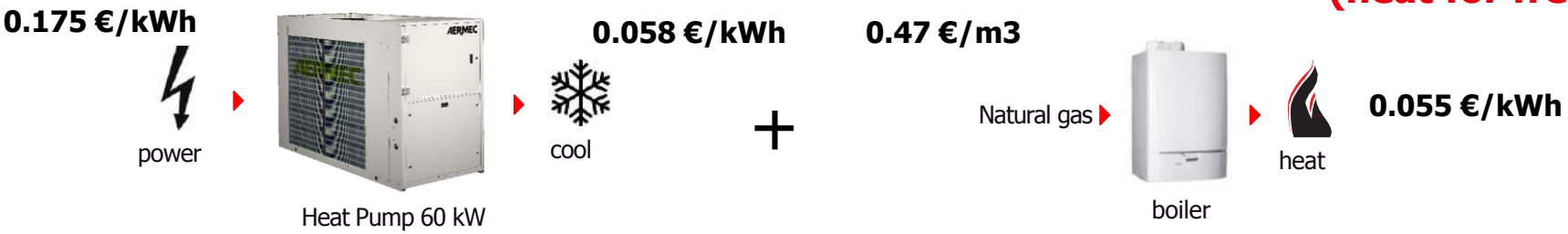


μCHP AND HEAT PUMP
HEAT & COOL



Vs Heat Pump and Boiler

-50%
(heat for free)



A BRIEF HISTORY

The first μCHP was patented in 1977 by FIAT with the trademark TOTEM (15 kWe)

1977

Growing demand for energy efficiency solutions

1987

1997

Asja Group acquired TOTEM brand and started the TOTEM 2.0 micro CHP development

2007

2013

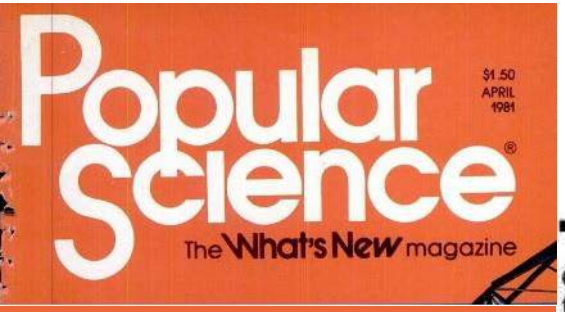
2015

2017

Launch of the New TOTEM (10- 20 - 25 kW)

40th anniversary 1977 2017

TOTEM
THE BEGINNING (1981)



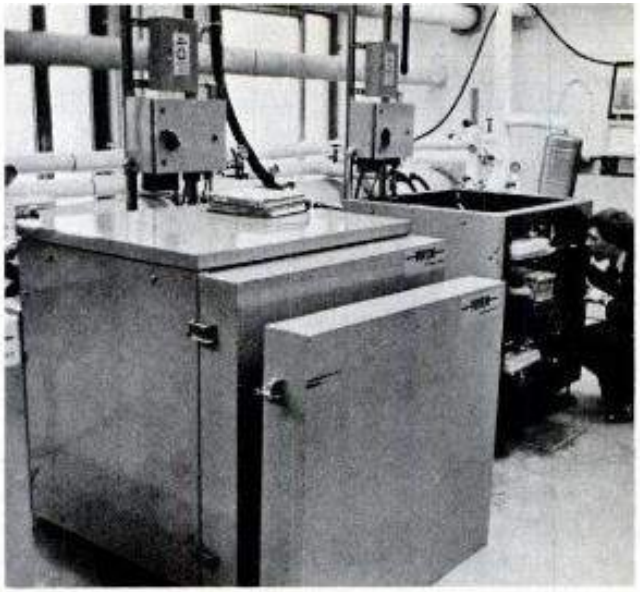
«...Now a small co-generation unit, developed and marketed by Fiat in Europe and called TOTAL Energy Module, or TOTEM, is available in the U.S. Through Brooklyn Union Gas Co. In New York City...»

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.

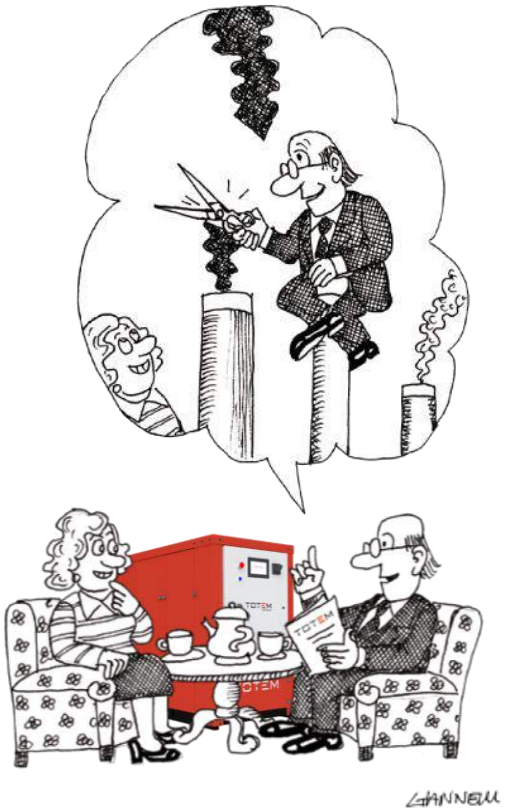
With a price tag of about $10,000, Totem is well suited to apartment buildings, restaurants, hotels, hospitals, and a variety of industrial applications. Fiat hopes to introduce the Totem concept to the U.S. by selling 100–200 units.

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

TOTEM
INSIDE (1/2)

TOTEM
INSIDE (2/2)

TOTEM
NOT JUST CUTTING THE BILL

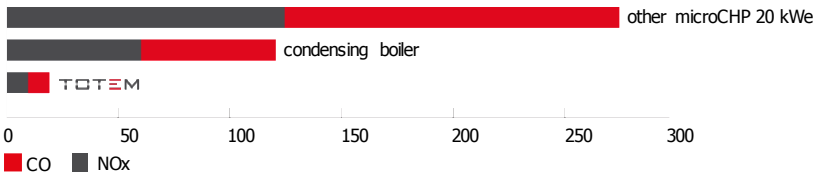


The innovative technologies developed to meet the emission limits of Euro6, ensure that TOTEM emissions are 20 times lower compared to a condensing boilers:

CO < 10 mg/Nm^3 and NOx < 10 mg/Nm^3

As such TOTEM is compliant with the most stringent national standards.

Emissions for different technologies



TOTEM
FEATURES @ 50HZ

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*)
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, biomethane, LPG		
Fuel consumption (CH_4)	Nm^3/h	3,31	6,28	7,54
Emissions (NOx)@ 5%O_2	mg/Nm^3	≤ 10		
Emissions (CO) @ 5% O_2	mg/Nm^3	≤ 10		

Fiat Chrysler Automobiles engines and
Magneti Marelli technologies

Multi fuel
methane, 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; 50 or 60 Hz

TOTEM
FEATURES @ 60HZ

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/MWhr	< 0.10
Emission settings (CO)@ 5% O_2	lb/MWhr	< 0.10

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

- **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

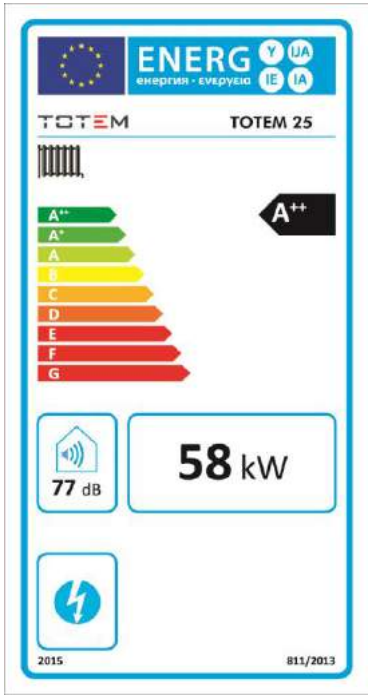
- **Emissions**

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

TOTEM
CERTIFICATIONS

Type Approved
Safety
Regular Production
Surveillance
TÜVRheinland
CERTIFIED
www.tuv.com
ID 1111210266

POLITECNICO
MILANO 1863



The TOTEM is the first μCHP 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.

UL certification will be granted within August 2017.

TOTEM
PRODUCTION

Production plant is located in Turin (Italy). It is over 2,100 m² 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, is characterized by a rational use of energy produced and consumed.

Production capacity is currently set up to 600 units per year.

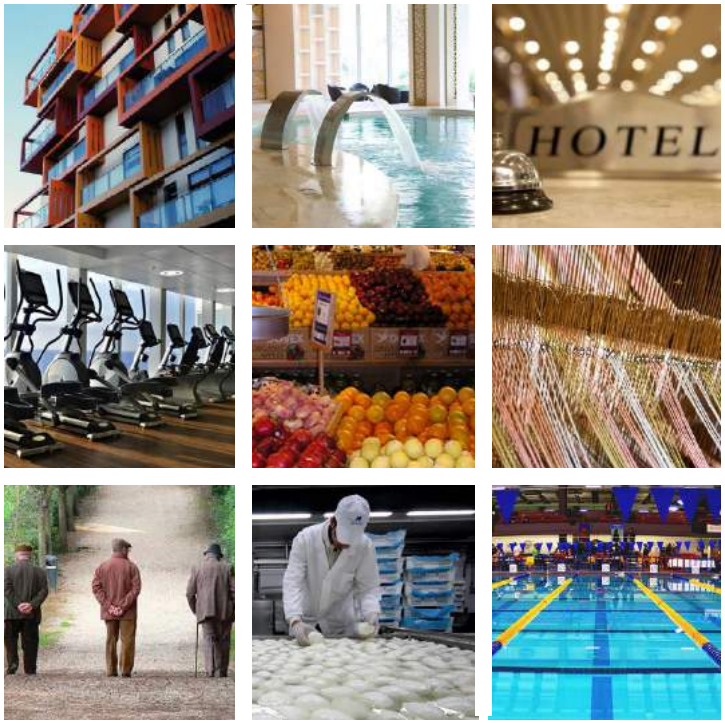
TOTEM Energy production plant visit

Micro-Combined Heat & Power Generation

part 02

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

APPLICATION



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

BUSINESS CASE
CONDOMINIUM | PAYBACK CALCULATION

Annual energy cost without TOTEM	
Heat (38,383 therm/year)	137,015 €
Power (496,904 kWh/year)	112,052 €
Solution	
TOTEM 20	× 2
Working hours	4,917
Annual energy and operation cost with TOTEM	
Heat	86,086 €
Power + TOTEM Operations cost	131,166 €
Cumulative net savings for 10 years	**209,250 €**
Payback Time*	**3.4 years**

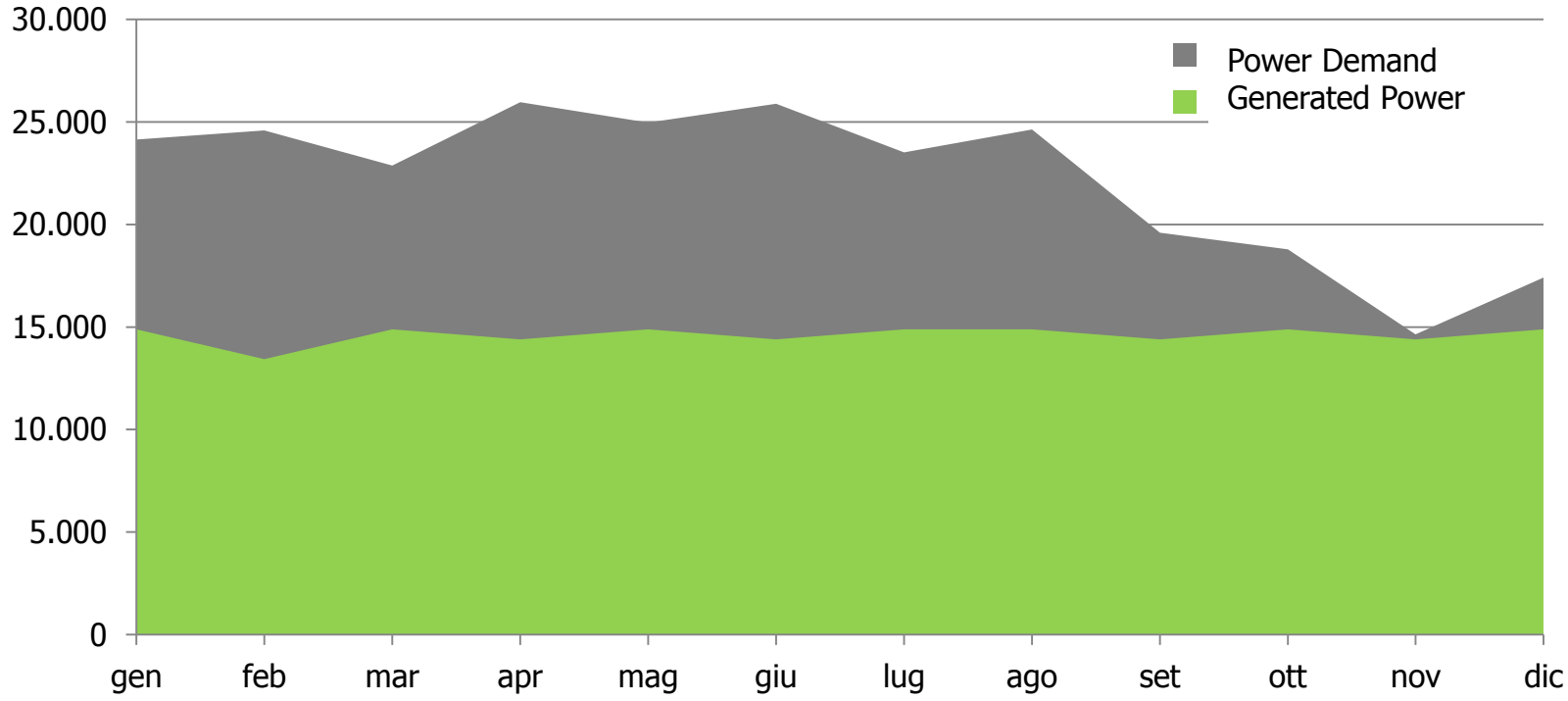
* With reference to energy prices applicable to Italy. TOTEM unots w/o black start feature.

BUSINESS CASE
SWIMMING POOL | PAYBACK CALCULATION

Annual energy cost without TOTEM	
Heat (39,247 therm/year)	78,621 €
Power (267,045 kWh/year)	49,817 €
Solution	
TOTEM 20	x 1
Working hours	8,760
Annual energy and operation cost with TOTEM	
Heat	54,937 €
Power + TOTEM Operations cost	53,465 €
Cumulative net savings for 10 years	**144,870 €**
Payback Time*	**2.7 years**

* With reference to energy prices applicable to Italy. TOTEM unots w/o black start feature.

SWIMMING POOL
POWER DEMAND COVERAGE



HOTEL
REFERENCE CASE

Hotel Du Cheval Blanc

Unit type
TOTEM 20

Number of units
2

Fuel type
Natural Gas

Application type
Tourist accommodation

Location
Northern West | Italy

HOTEL & SPA
REFERENCE CASE

Hotel Weiss

Unit type
TOTEM 20

Number of units
1

Fuel type
Natural Gas

Application type
Tourist accommodation

Location
Angermünde | Germany

RETIREMENT HOUSE
REFERENCE CASE

Retirement House Sant'Anna

Unit type
TOTEM 20

Number of units
1

Fuel type
Natural Gas

Application type
Healthcare

Location
Eisenach | Germany

STUDENT ACCOMODATION
REFERENCE CASE

Unit type
TOTEM 10

Number of units
1

Fuel type
Natural Gas

Application type
Residential

Location
Luton, London | United Kingdom

PUBLIC
REFERENCE CASE

Fire station

Unit type
TOTEM 20

Number of units
1

Fuel type
Natural Gas

Application type
Public

Location
London | United Kingdom

TOTEM @ WORLDWIDE

TOTEM
GERMANY

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 amounts 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

TOTEM
UNITED KINGDOM

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 ease of retrofitting

TOTEM
USA 60 Hz

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 polices (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.

TOTEM
CANADA 60 Hz

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)
- Recurrent grid outages
- Need to reduce grid demand and improve infrastructure cost and time effective

Opportunities

- Real estate investment companies
- Residential/commercial applications

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 Limited access to electricity
- 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

RES4MED

Asja is a member of RES4MED, a non-profit Association established in 2012 for the development of renewables in the Mediterranean Area, with a particular focus on the Countries of Maghreb.

Mr. Re Rebaudengo is Vice President of RES4MED.

RES4MED
RENEWABLE ENERGY SOLUTIONS FOR THE MEDITERRANEAN

Thank you for your attention

Stefano Re Fiorentin
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