SOFCPOWER
SOLID OXIDE FUEL CELLS

HTceramix

Fuel Cells
Related activities at SOFCpower S.p.A.

Stefano Modena
SOFCpower SpA

The new generation of energy

1 Dec 2014

5th IPHE Higher Educational Round

OUTLINE

- SOFCpower: the company
- Technology
- Market and Products
- Conclusions

Facts & figures

2014 EnGen™ roll-out within the European project Ene.field

2011 2.5 kW modular mCHP generator design

2008 Pilot Plant Mezzolombardo (IT) operative

2007 SOFCpower set-up, acquisition HTceramix

2000 EPFL (CH) Spin Off HTceramix S.A. invention HotBox™ technology

> 20’000	Cells produced
> 2’000	Stack modules
> 100	HotBox™ Generators
2 MW/y	Prod. capacity Plant ONE

Dec ’14 - 80 employees in R&D, production and adm. staff

www.sofcpower.com

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

COMPANY

A young and motivated team of 80 people

CLEANTECH FROM TRENTINO

- SOFCpower is a worlwide leader* in an innovative technology for a new energy world with a significant growth potential**: the distributed generation of clean energy.

  ** currently less than 5 company in the world manufacturing products with the same technology*

  *** hundreds of jobs, following the experiences done in the past*

- SOFCpower signed technical and industrial international agreements

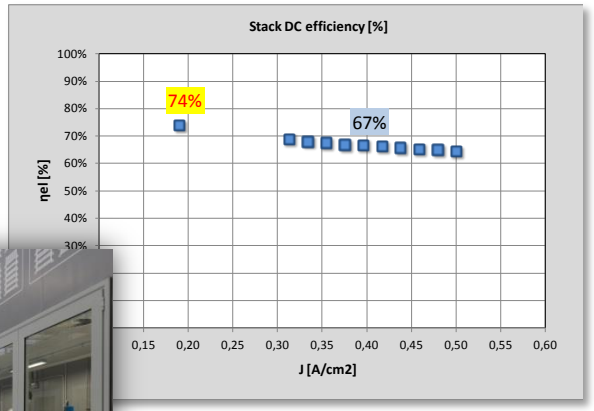
- SOFCpower started product commercialization. Success key = volume increase

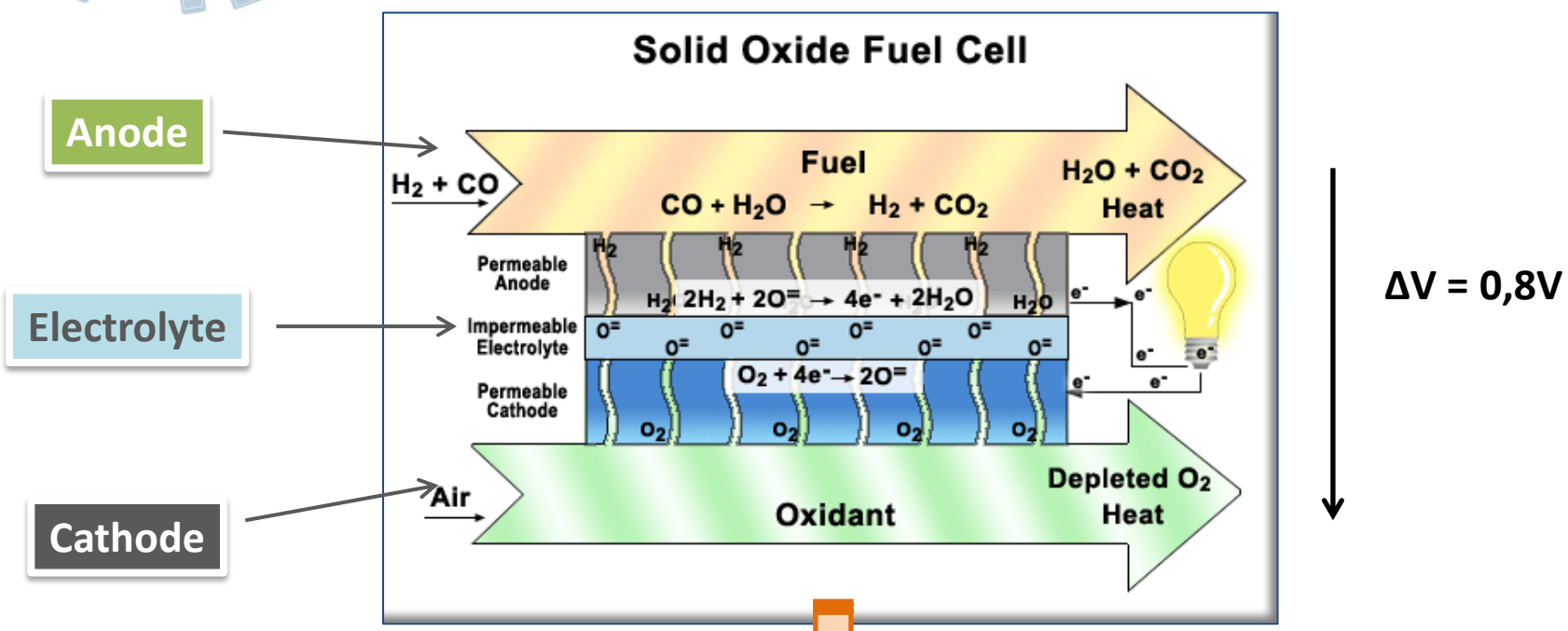



RECENT IMPROVEMENTS (LAST 12 MONTHS)

- ☑ Foreign private investments for >40mio *(private/public investments ratio > 300%)*
- ☑ 40 new jobs – currently more than 80 employees

  SOFCpower employed during crisis period
- ☑ SOFCpower entered in ene.field project for 1'000 mCHP units deployments with the major Europen manufacturers and utilities
- ☑ Record SOFC stack electrical efficiency (74%)
- ☑ New production plant (1200 m^2) in BIC center (TN)



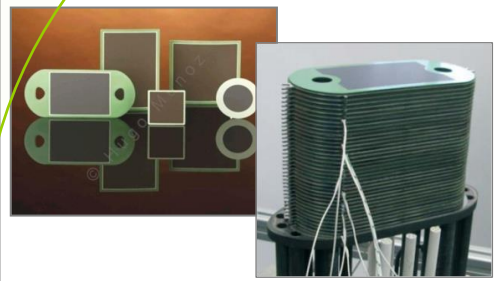


Direct conversion of the chemical energy of a fuel into **electricity** and **heat** through a chemical reaction with oxygen

Reduced conversion losses = **HIGH EFFICIENCY**

Ceramic Materials

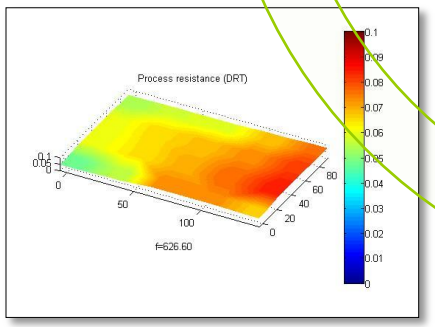
Core Components of the SOFC's Generator

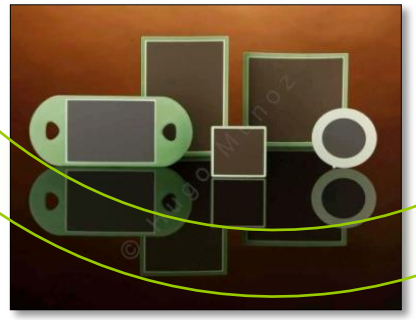


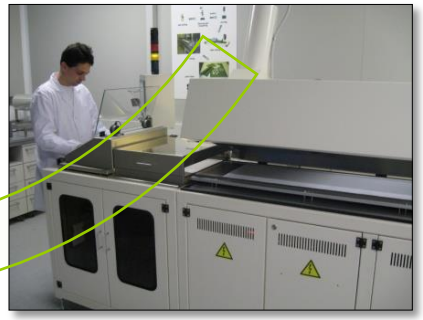
HoTbox™

Engen2500 m-CHP

SOCpower core activity







Multi-disciplinary competences and approaches

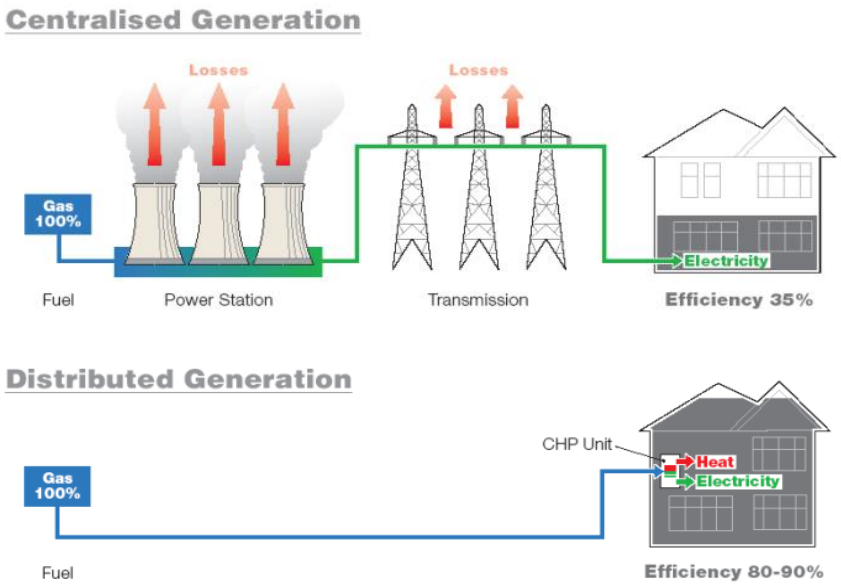
- ✓ In the Solid Oxide Fuel Cell, the electrochemical reactions are thermally activated → **MEDIUM-HIGH TEMPERATURE FC**

- ✓ More addressed to **STATIONARY** applications

Applications by Size

Power, Heating and cooling

Residential and Commercial Appliances
(Single and Multi-FH, Hotel, Schools, Swimming pool…)



- **Gas distribution instead of electricity (more eff distribution)!**
- **The heat is used for hot water and room heating**
- **Reduced losses on the grid**

+ 30%!

mCHP = micro Combined heat and Power

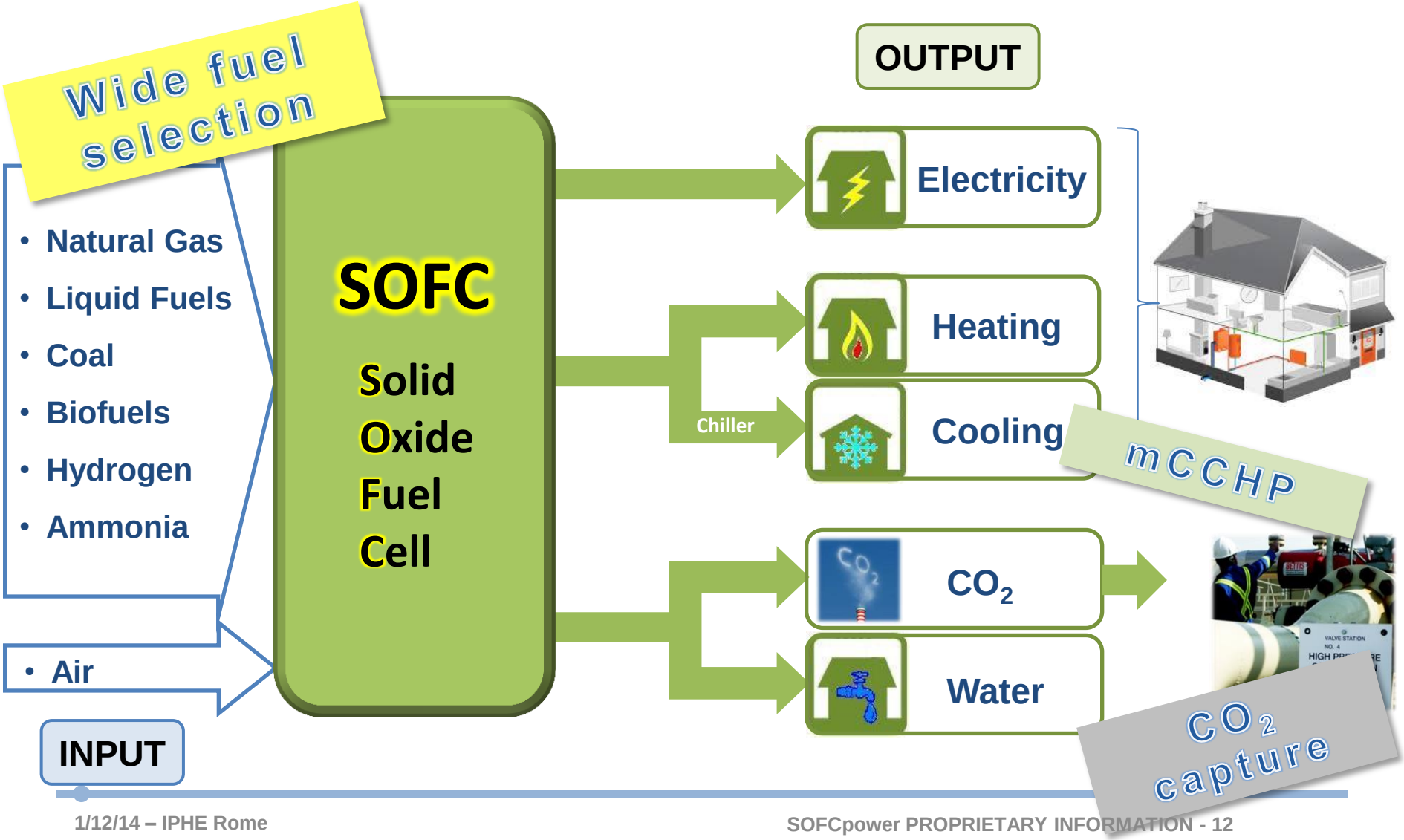
Co-generation can be performed by several technologies (i.e. Internal Combustion Engines or Stirling) with several commercial applaiances from kW_{el} to MW_{el}

BUT…

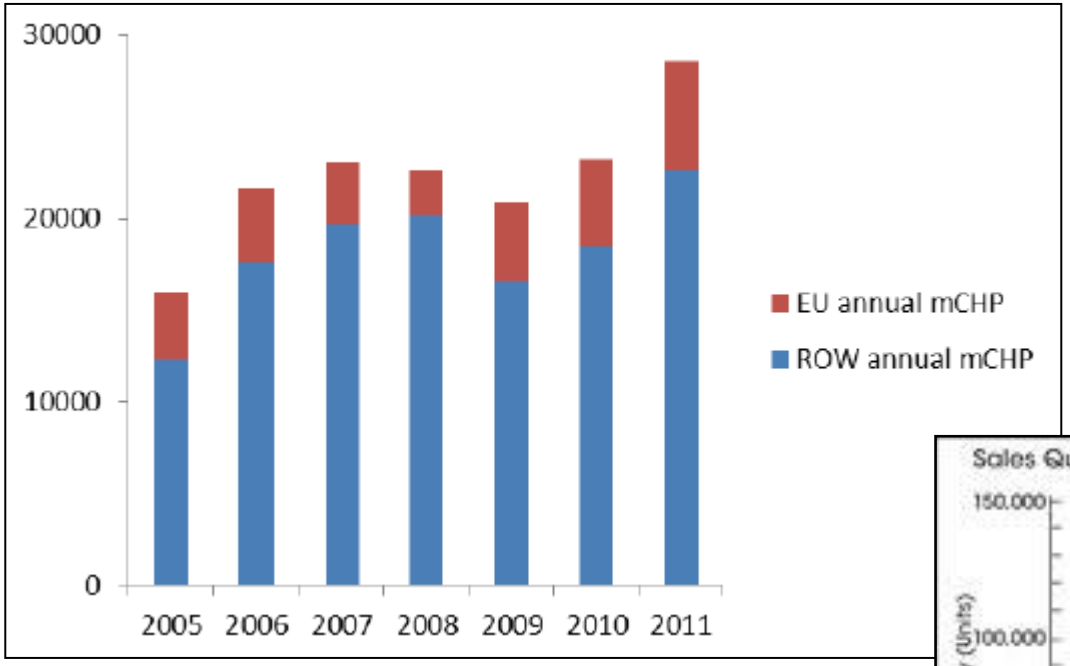
SOFC-based mCHP overcome some limits, offering:

- High electrical (**<u>up to 60%!</u>**) and co-generation efficiencies (**>90%**) also under typical residential size (kW_{el})
- Heat/Power ratio < 1
- Wide range of fuels
- CO_2 reduced emissions and environmental friend applaiances (**no NO_x e SO_x, emissions**)
- Wide modulation range (**30-100%**) with no effects on efficiency value;
- Long operations (hr/y) up to 7’500 hrs
- Only static components (=reduced service)

SOFCpower Market and Product

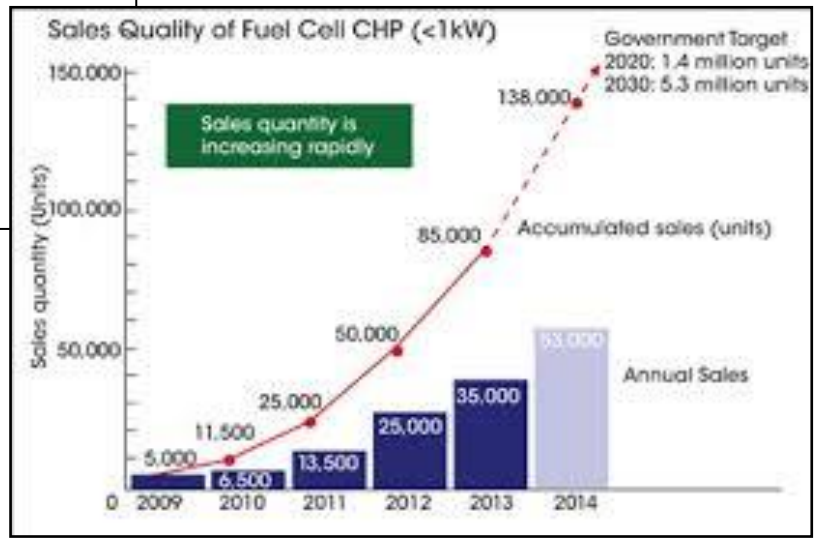


mCHP sold in EU and RoW



Source: Delta-ee 2012

Source: Enefarm Project



FC-based domestic units installed in Japan

In Italy, cumulative number of 700 mCHP (no FC-based) installed in Emilia Romagna

But, thecnical characteristics make the SOFC-based mCHP very interesting for several market sectors

Italy

- 33’500 hotels + 12’000 B&B (source: Federalberghi);
- 1 mio of MFH (Multi Family Home);
- 14 mio of SFH (Single Family Home)

- 30’000 floor-standing boilers replaced per year;
- 850’000 wall-hung domestic gas boilers replaced per year (only 30% condensing biolers)

Huge market estimation of residential appliances/y only in I

mCHP Products

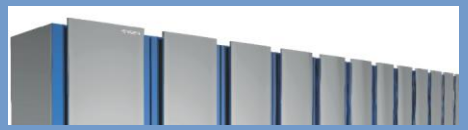
2012
CPOx based Wall-Hung
m-CHP
0,5-1 kWel
η_{el} 30%

2014
SR-based m-CHP EnGen™-2500
2,5 kWel
η_{el} >50%
CE certification

ene.field

2015
SR-based m-CHP
>10 kWel
η_{el} 50%

>100 kW, power generation modules

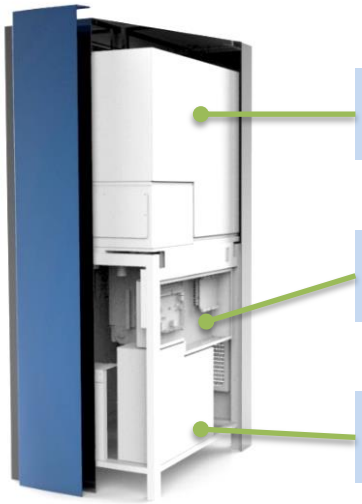


RETE CRISALIDE

ENGEN™ 2500

INTEGRATED mCHP GENERATOR

Power	**2.5 kW**
Th. Output	2 kW
Fuel	Natural Gas
Electric Efficiency	50% LHV
Total Efficiency power+heat	90%
Dimensions w x l x h	0.6 x 0.8 x 1.6 m
Water T	75°C
Price for orders >10'000 units	4'000 €/kW



TRENTINOSVILUPPO
DEVELOPMENT AGENCY AND BUSINESS INCUBATOR

production plant

- new manufacturing facilities for cells, stacks and power modules
- 2,000 mq**, 2 MW/y** capacity on single shift
- statistical-based approach
- learning curve on manufacturing process

SOFCpower Market Approach

- B2B approach with Utilities and ESCOs (currently for Field-Test, in sight of product commercialization)
- Drive of installers network for technology promotion and service warranty (training at techn. schools and by company facility)
- Technology and information dissemination (workshop, seminars…)

CONCLUSIONS

- ✓ SOFCpower offers an innovative and very promising technology, developing and maufacturing new SOFC-based appliances in the mCHP field;
- ✓ SOFC-based mCHP can achieve very high electrical efficiency (>60%), reduce CO_2 emissions, modulate heat and power
- ✓ Huge market estimation in Italy and in Europe for residential appliances;

Acknowledgements

Thanks for the attention!

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