ORDINE DEI GIORNALISTI

ROADMAP

PER UN FUTURO SOSTENIBILE DELL'ENERGIA

Rivoli 4 Aprile 2018

RSE Ricerca Sistema Energetico

Le nuove frontiere della ricerca energetica

Stefano Besseghini
Presidente e AD
RSE S.p.A

Sommario

- Introduzione RSE
- Ricerca Sviluppo e Innovazione
- Le nuove spinte

- Ricerca Sviluppo Innovazione e.....regolazione

MEF
Ministero
dell'Economia
e delle Finanze

100%
shareholder

Ministero dello Sviluppo Economico

GSE group

342 people

224

133

RDS / Public

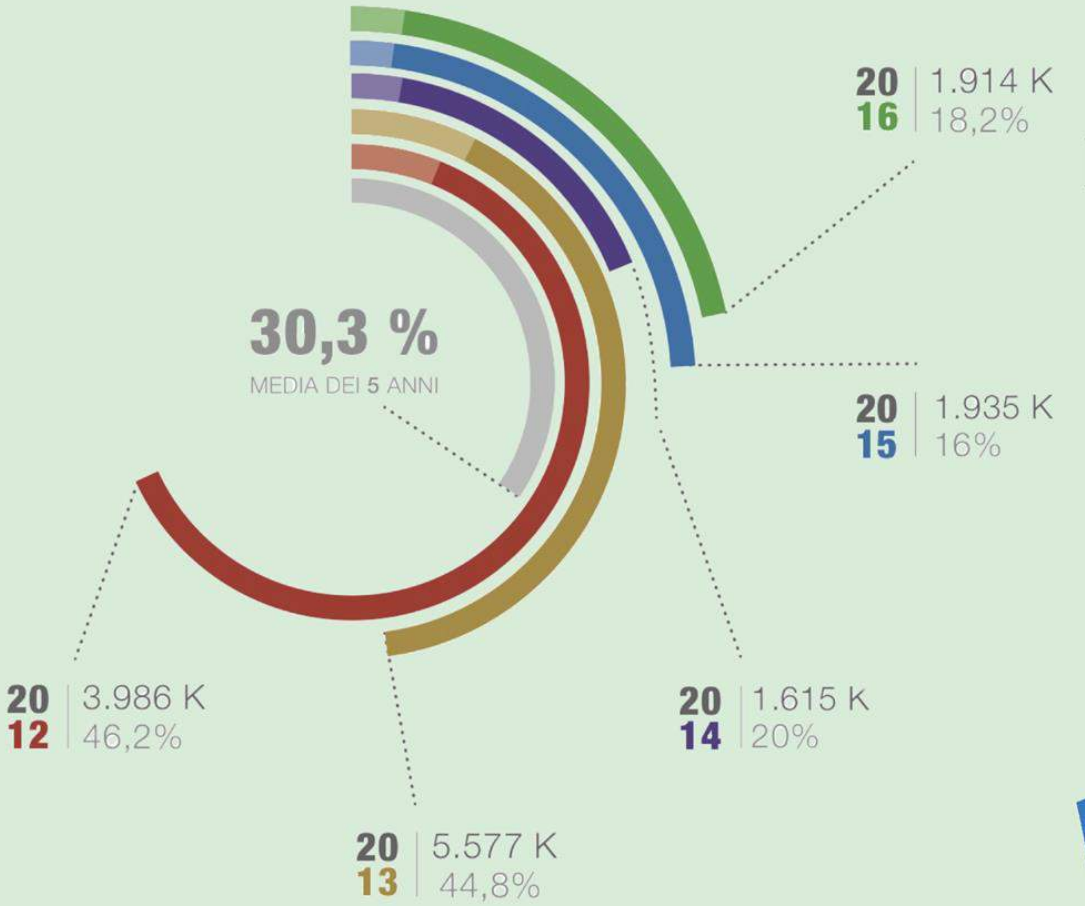
H2020

"Market"

Avverage last three years

Income

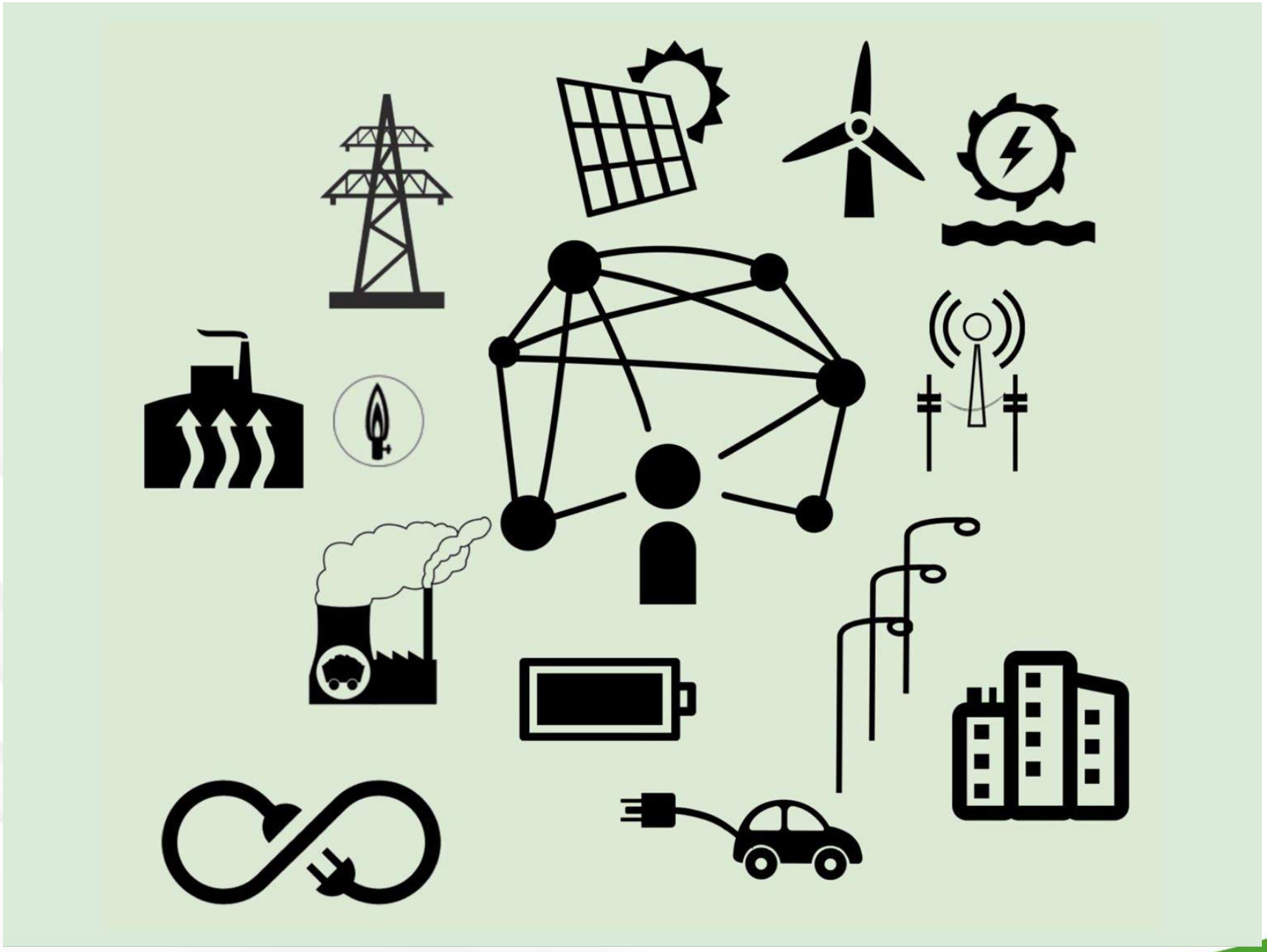
Million euros



Provisional 2017

42%

26 ongoing projects



Multidisciplinary

Interdisciplinary

RSE
Ricerca
Sistema
Energetico

Ricerca, Sviluppo e Innovazione

Ricerca

Costi ragionevoli

Grandi investimenti in formazione

Humus fertile

Massima incertezza di risultato

Controllo: nullo!

Ricadute incerte, quasi certamente non sull'investitore

Output visibile: carta!

Output reale: conoscenza

Sviluppo

Prende le mosse dalla ricerca

Costi elevati spesso MOLTO elevati

Controllo elevato in particolare dei processi

Elevata probabilità di ricaduta sull'investitore

Output visibile: prototipi, sistemi a TRL elevato (8;9)

Output reale: competitività.

Innovazione

Esiste l'innovazione da ricerca ma non è il solo tipo di innovazione

E' tutto quello che permette di mantenere una azienda sul mercato, non ha necessariamente a che fare con la tecnica

Elevato rapporto costo/benefici

Elevato controllo

Massima ricaduta su chi investe

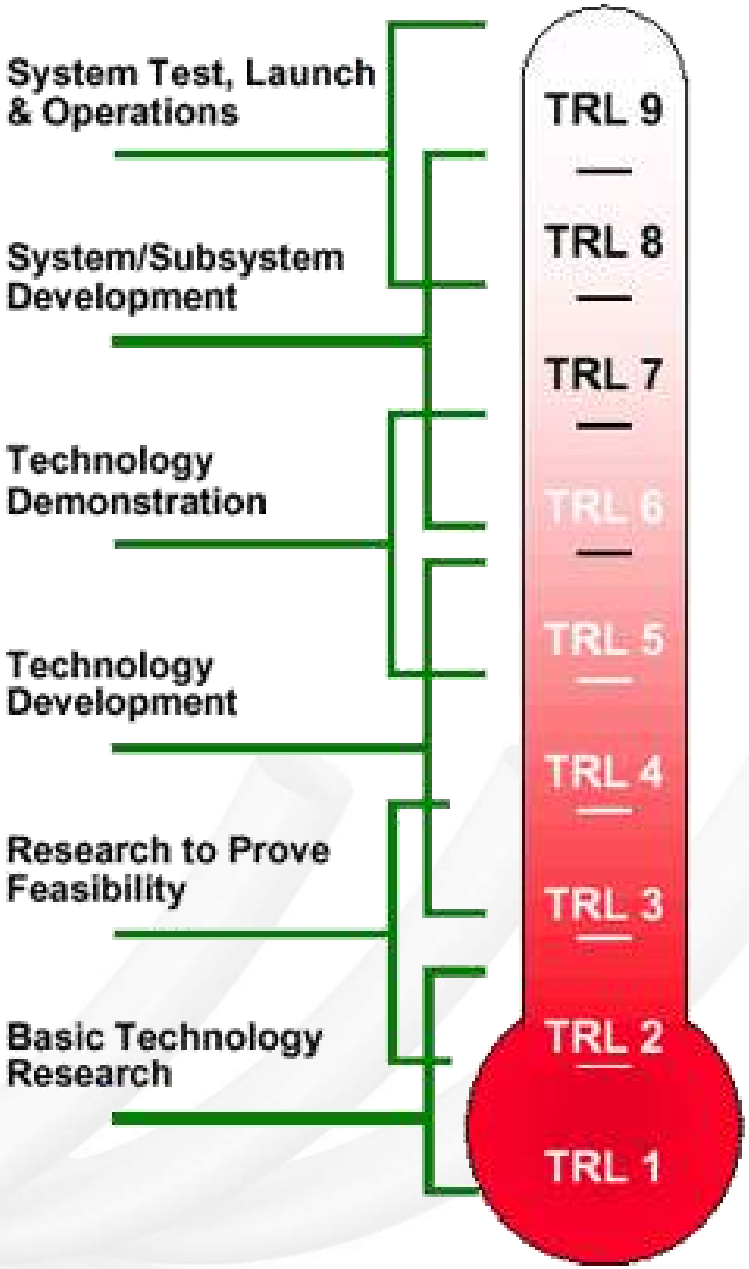
Ampia disponibilità

Output visibile: nuove proposte ai clienti o nuovi clienti

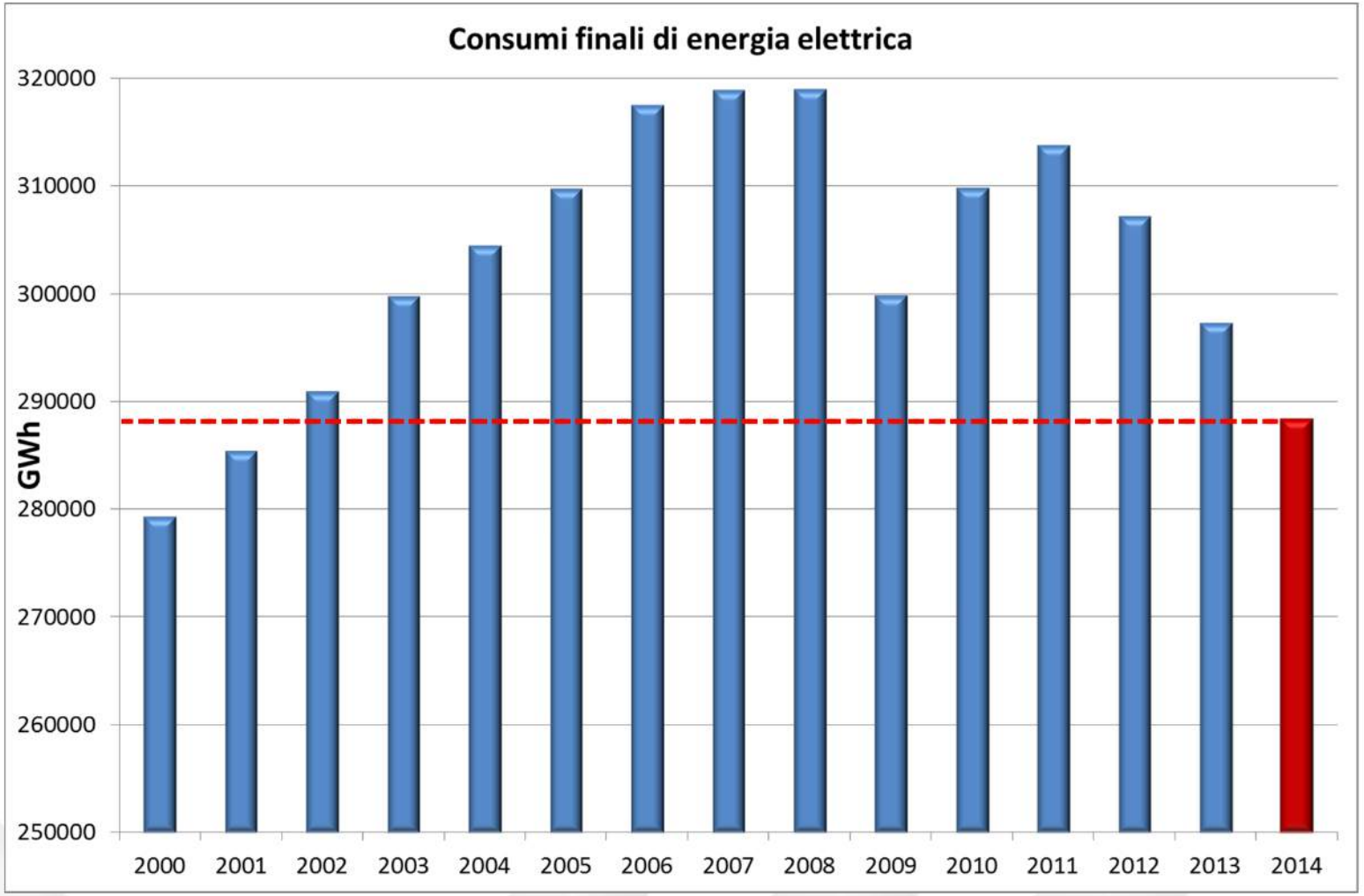
Output reale: spazi di mercato

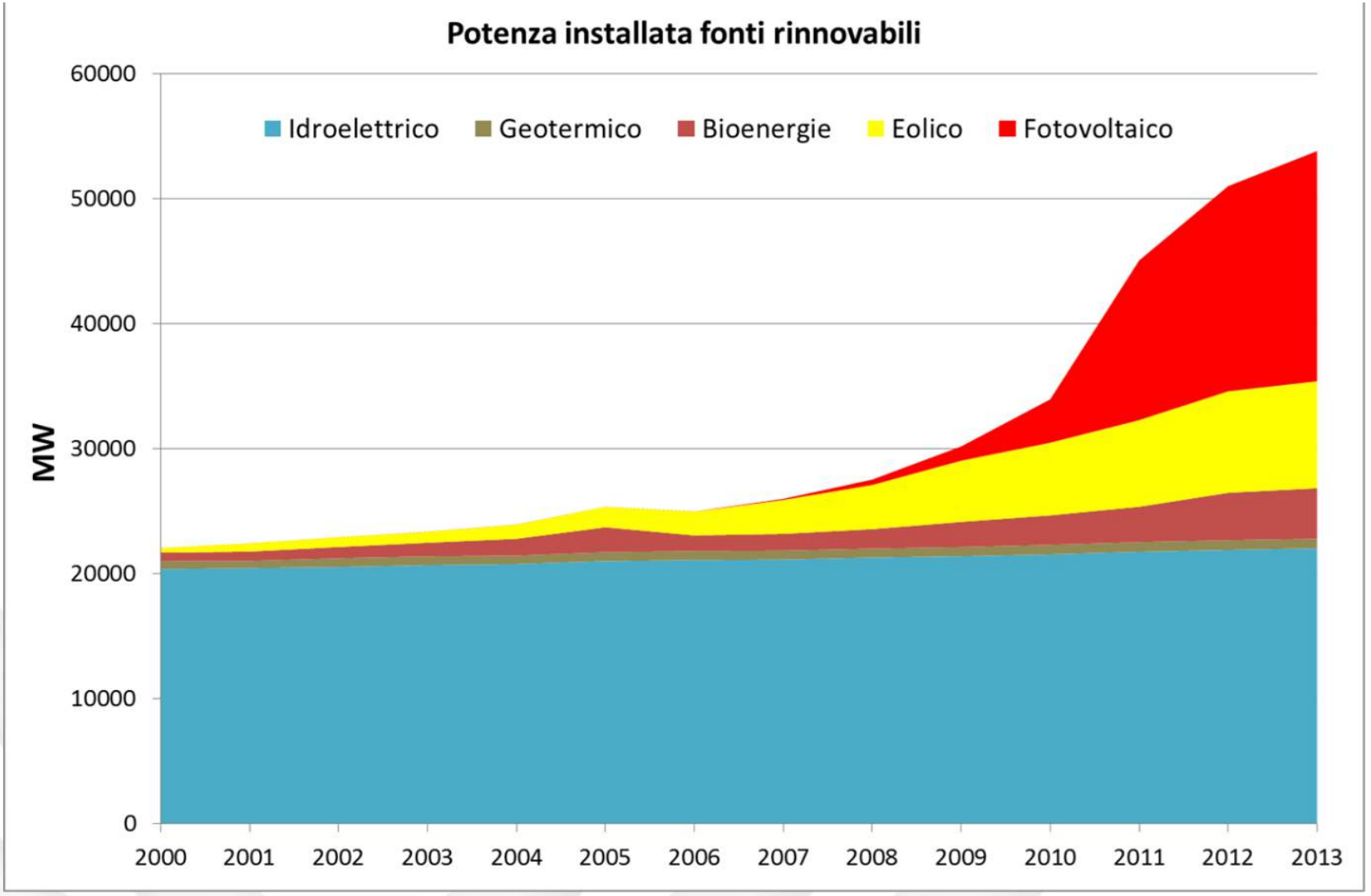
TRL

Technology Readiness Level

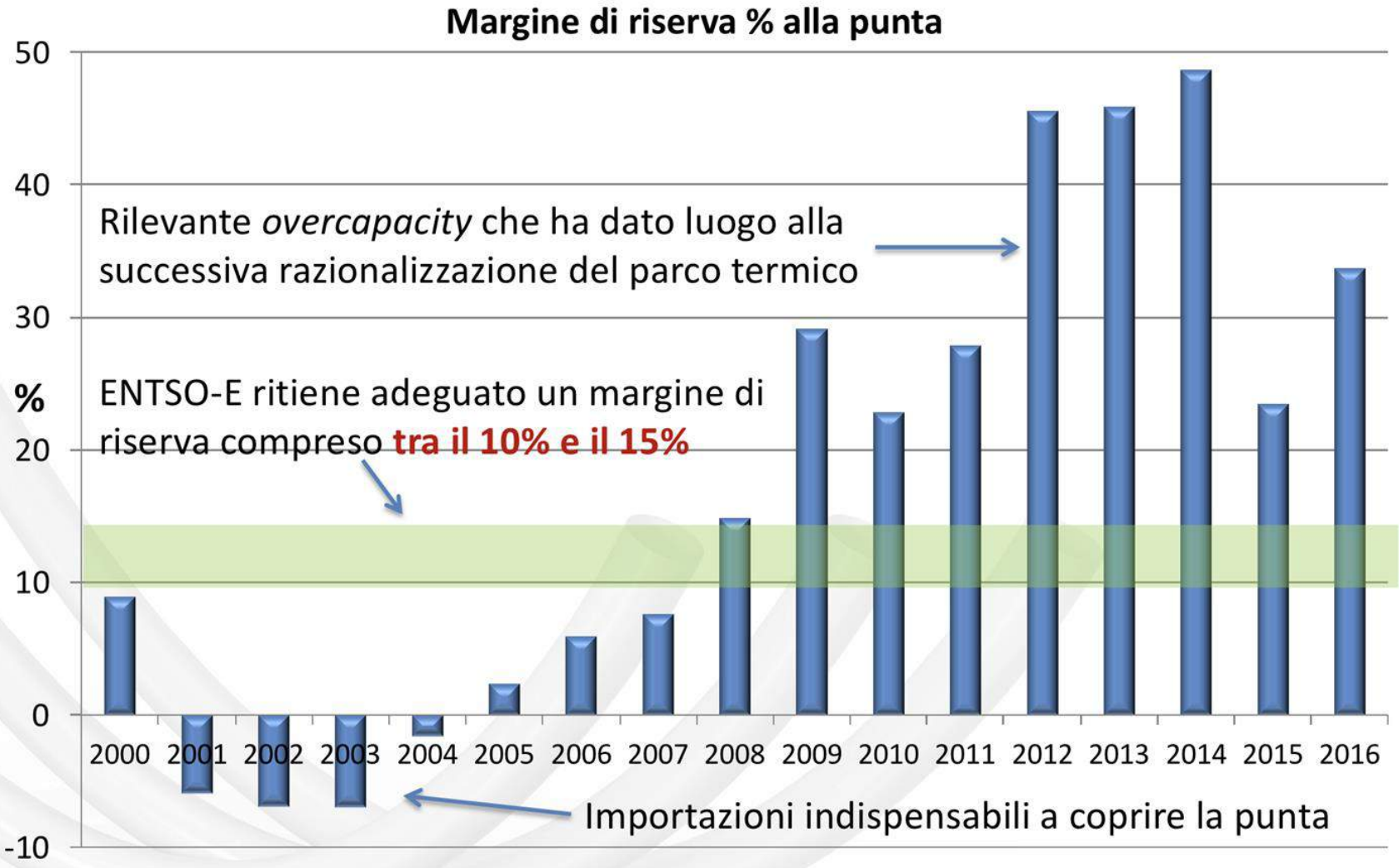


Le nuove spinte…

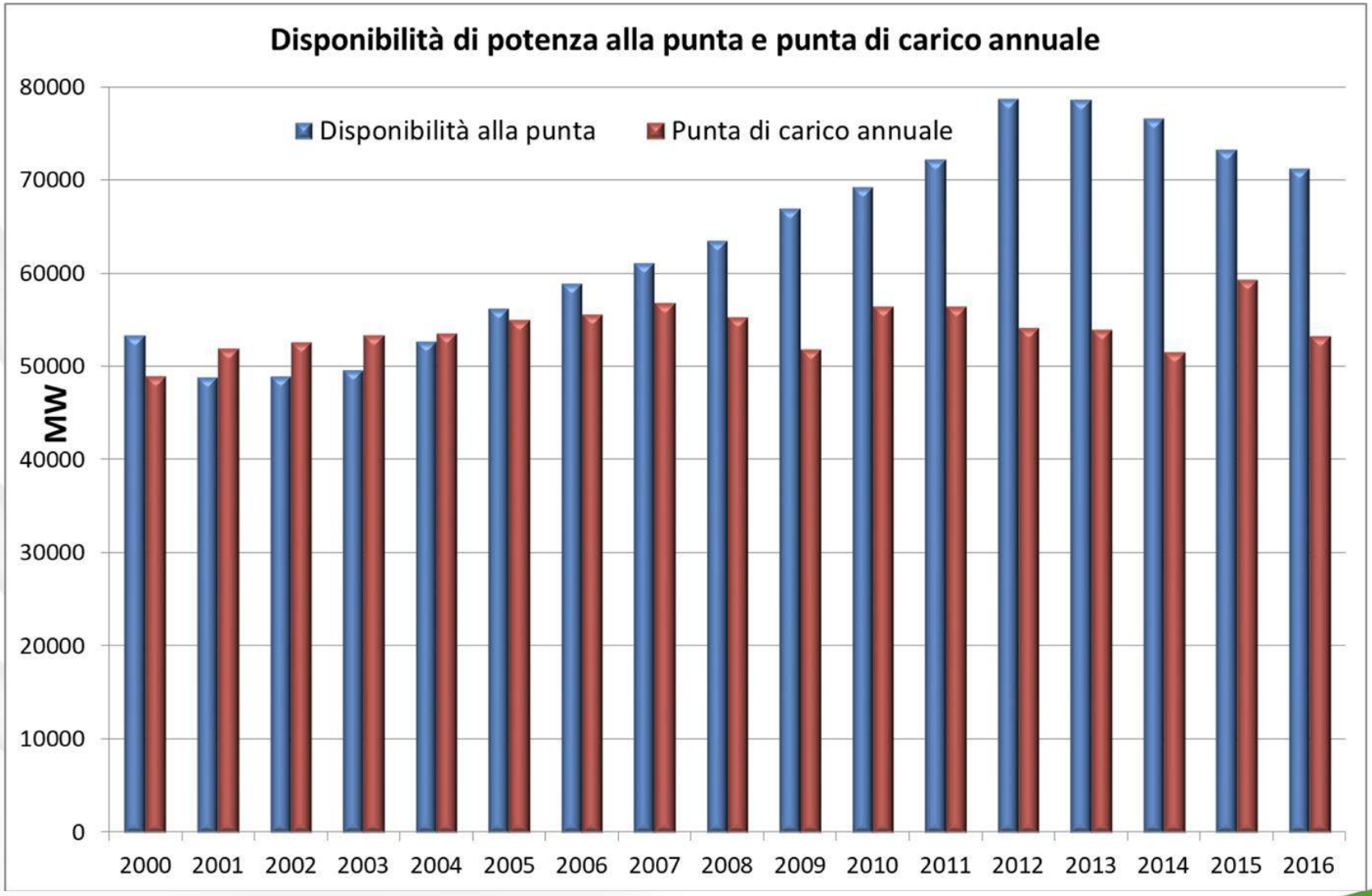

Consumi finali di energia elettrica
GWh
320000
310000
300000
290000
280000
270000
260000
250000
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014


Potenza installata fonti rinnovabili
60000
50000
40000
30000
20000
10000
0
MW
Idroelettrico
Geotermico
Bioenergie
Eolico
Fotovoltaico
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

Margine di riserva



Disponibilità di potenza alla punta



2017 summer outlook winter review 2016-2017 1 June 2017

RSE Ricerca Sistema Energetico

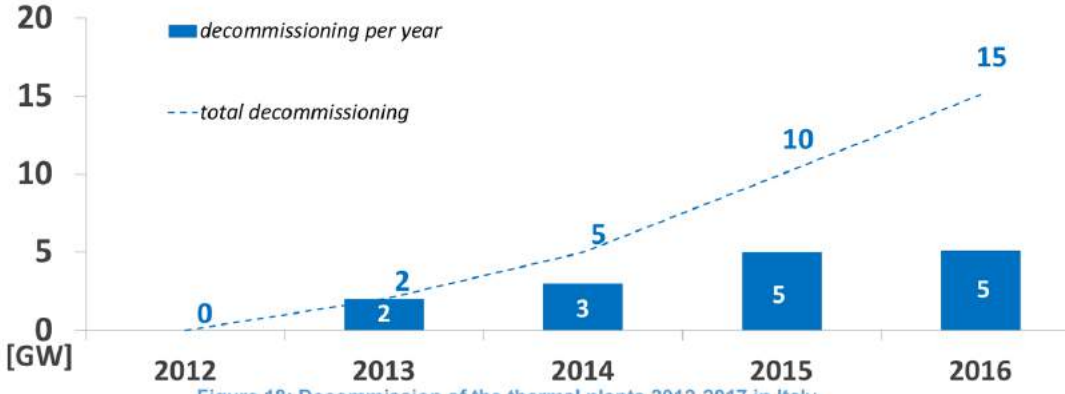
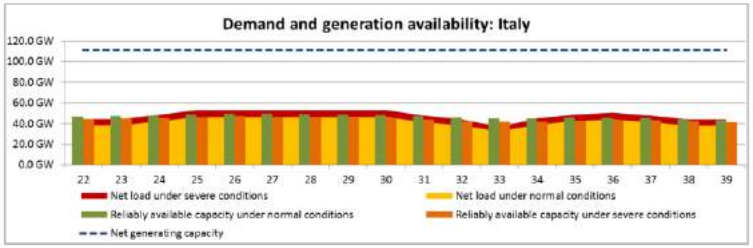
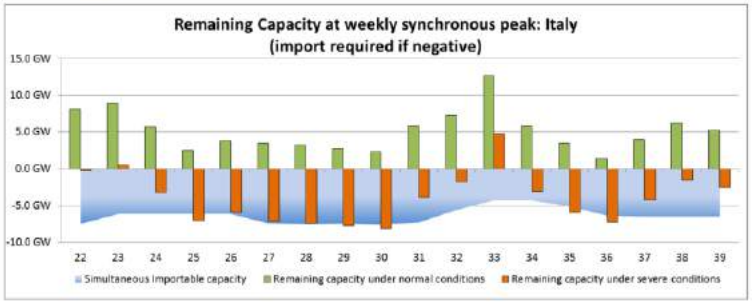


Figure 18: Decommission of the thermal plants 2012-2017 in Italy





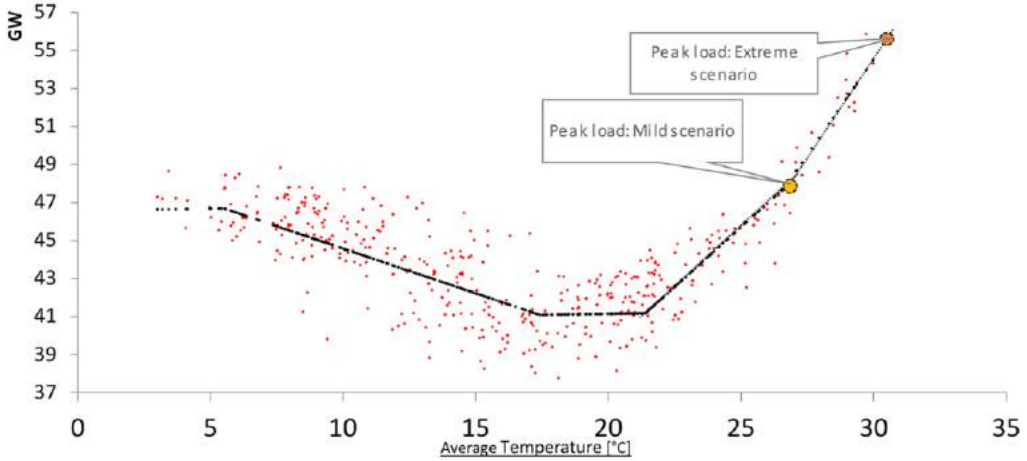


Figure 19: Load-temperature dependency in Italy

Flessibilità

La flessibilità va sviluppata a tutti i livelli

GENERAZIONE

DEMAND SIDE MANAGEMENT

SISTEMI DI ACCUMULO

Peraltro la domanda elettrica sarà soggetta a due spinte

diminuzione per l'efficienza energetica

aumento per lo switching dei consumi

Intelligenza

L'intelligenza si sostanzia nel concetto di Smart Grids ossia una rete in grado di interfacciare in maniera affidabile e sicura generazione, consumo, e tutti i nuovi soggetti che si affacciano al sistema.

Accumulo

CELL

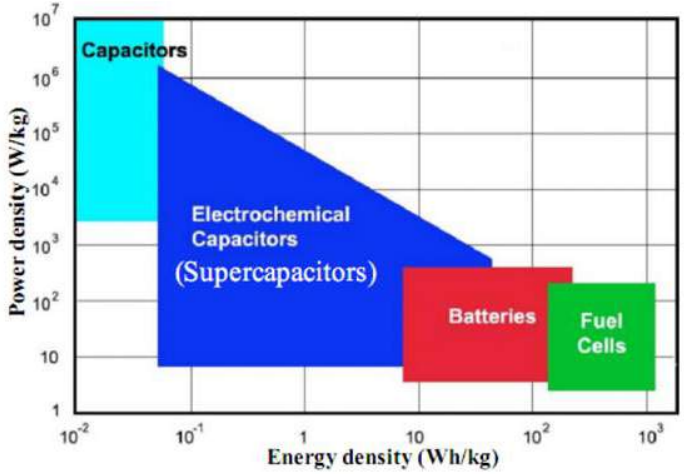
MODUL
E

BMS

BATTER
Y

Batteries: main features

- Distributed energy storage systems
- Modularity
- Rapid and flexible installations
- Not mature
- Expensive
- Low energy density



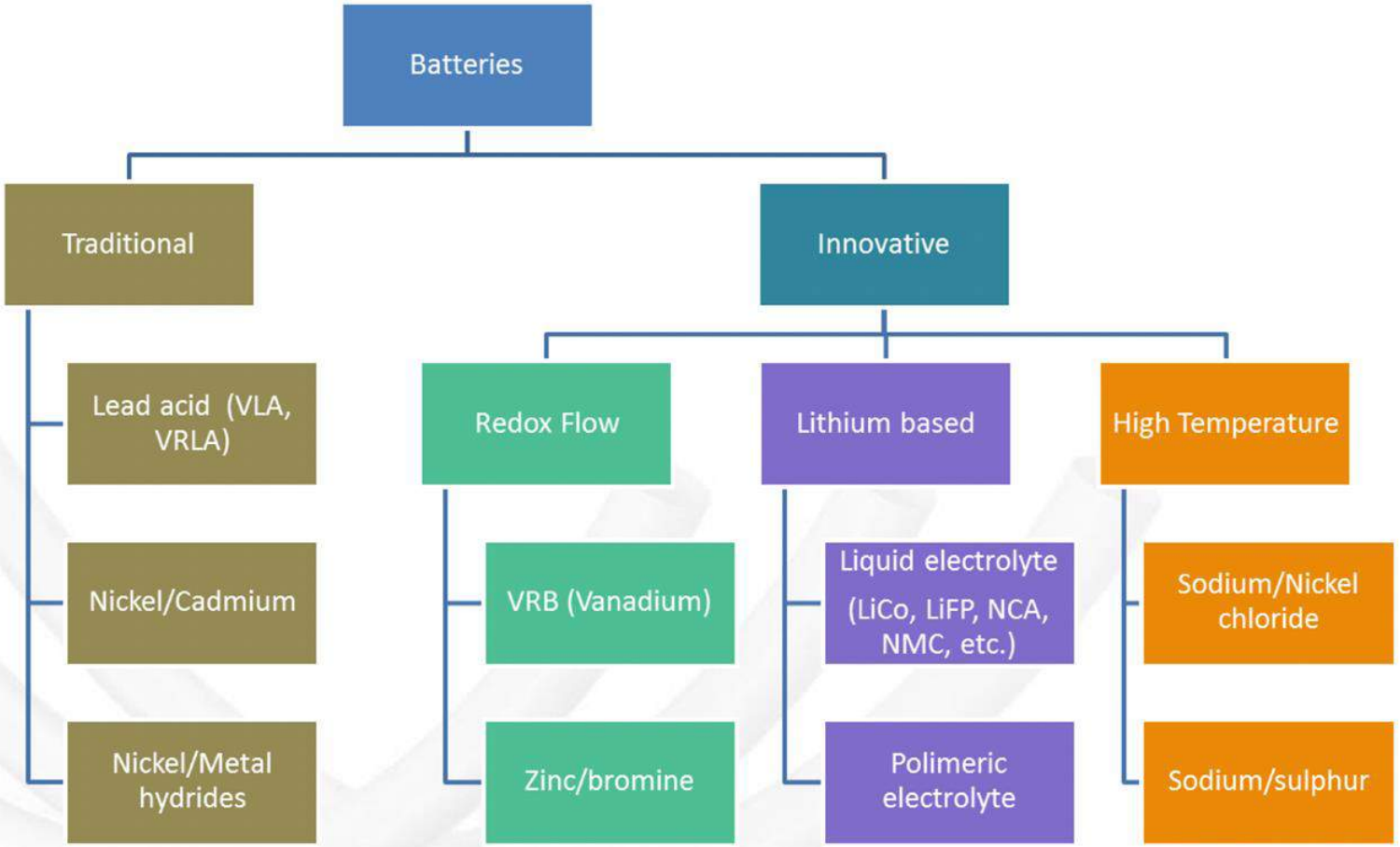
cells

EV battery 20 kWh

TLC battery48 V-4 kWh

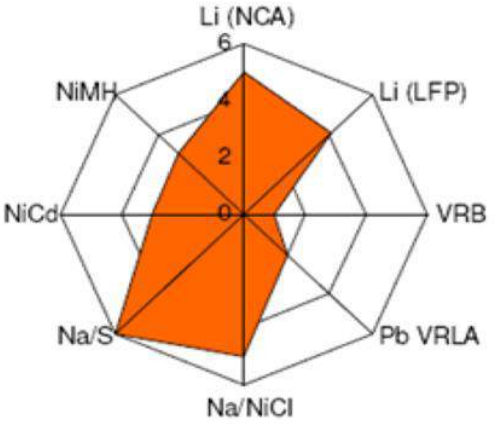
Grid-connected ESS Na/S
1 MW – 7,2 MWh

Electrochemical accumulators

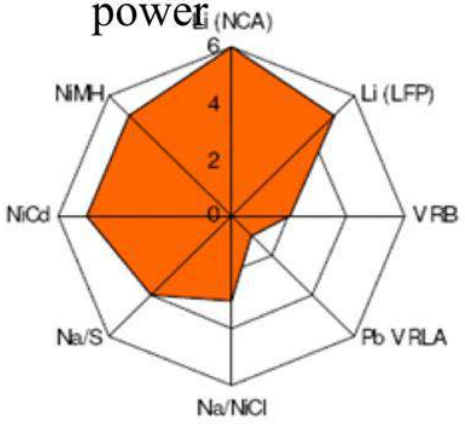


Batteries: performance comparison

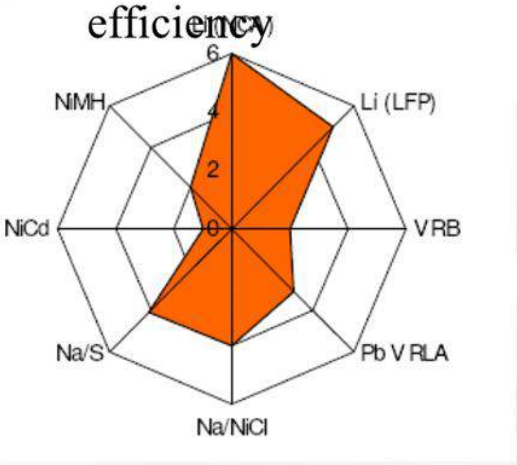
Specific energy



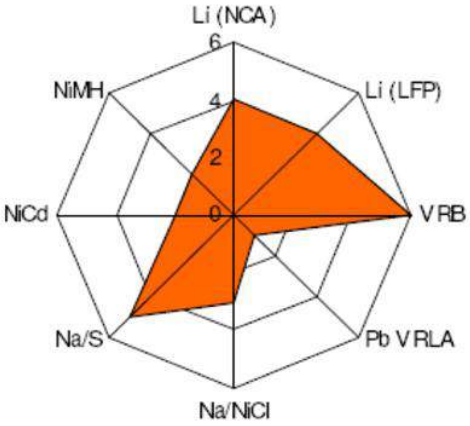
Specific power



Energy efficiency

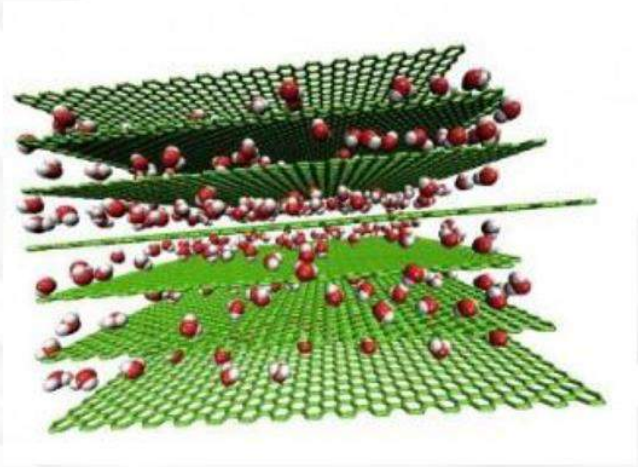


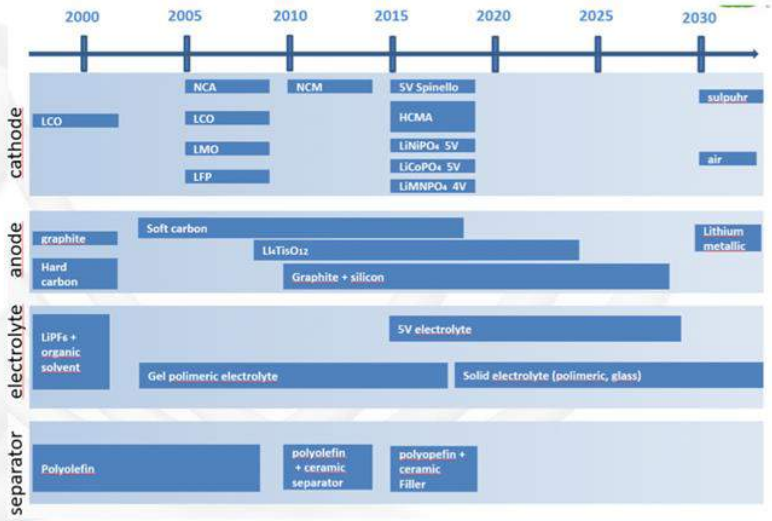
Lifetime



Lithium-ion cells: future developments

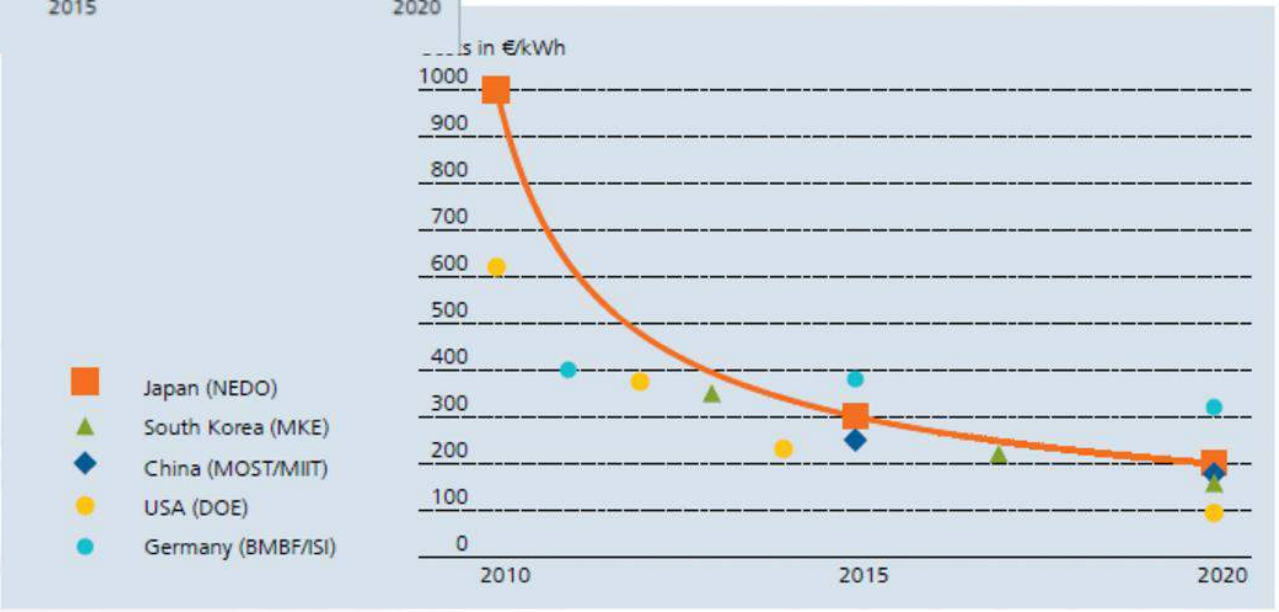
- Increase of specific energy trhough new materials for electrodes (silicon based anodes, graphene)
- Increase of safety trhough non-inflammable electrolyte (ionic liquid electrolytes)
- Solid state lithium ion with glass electrolyte





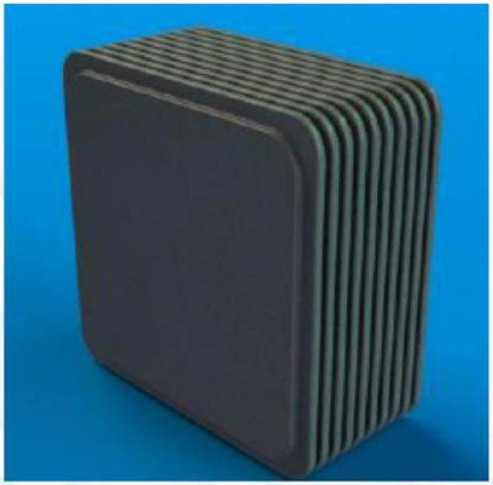
Lithium-ion development forecast

Specific energy and cost trends forecast for lithium-ion cells

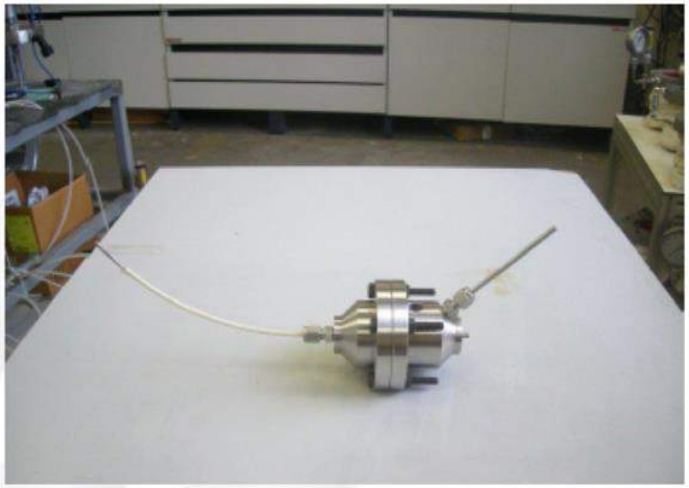


Na/NiCl2: future developments

- Planar geometry cells for increase specific power
- Improvements on cell materials (cathode, ceramic electrolyte, sealings)
- Decrease of internal operating temperature for loss reduction



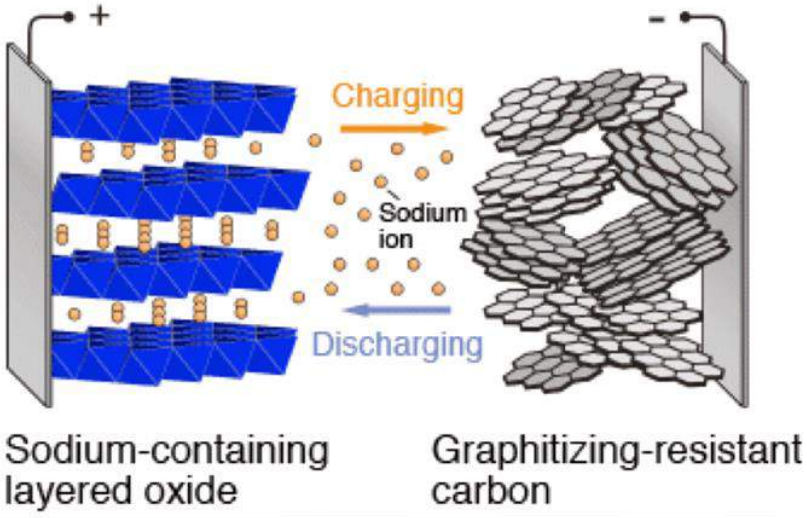
Future planar cell battery pack



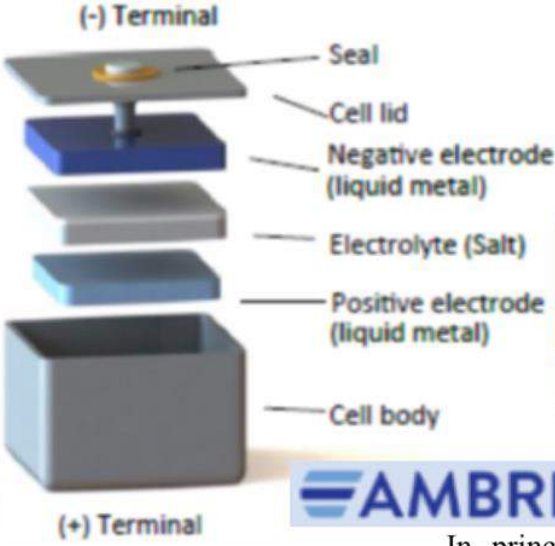
RSE planar Na/NiCl2 cell

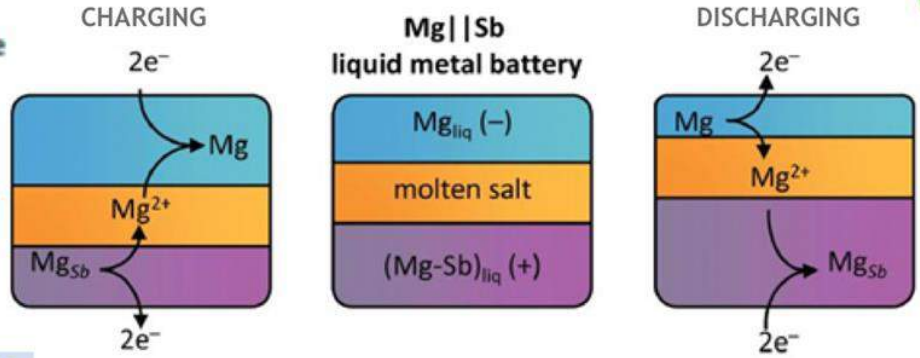
New technologies

- Sodium-ion cells
- Lithium/sulphur cells
- Lithium-air (5000 Wh/kg theoretical specific energy)
- Flow batteries with new electrochemical couples



Liquid Metal Batteries (LMB)





In principle, LMB could withstand an unprecedented number of charge and discharge cycles:

•anode and cathode are both liquid metals, separated by a mixture of molten salts (electrolyte)

(they are not susceptible to mechanical failures occurring in solid electrodes/electrolytes)

•the 3 immiscible layers float on the top of one another, due to their different densities

(this feature allows to decrease assembly costs and to facilitate scale up)

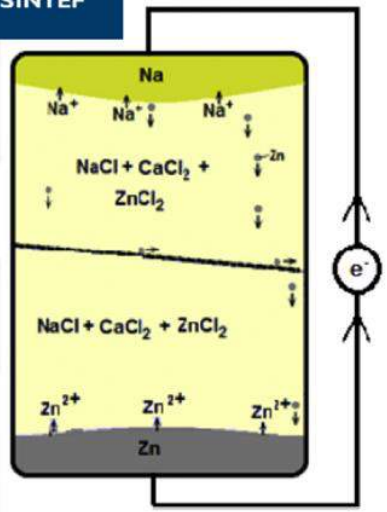
Critical issues:

•in real operation high temperature liquid metals have to withstand several charge and discharge cycles and also hot standby periods and thermal start up and shut down cycles

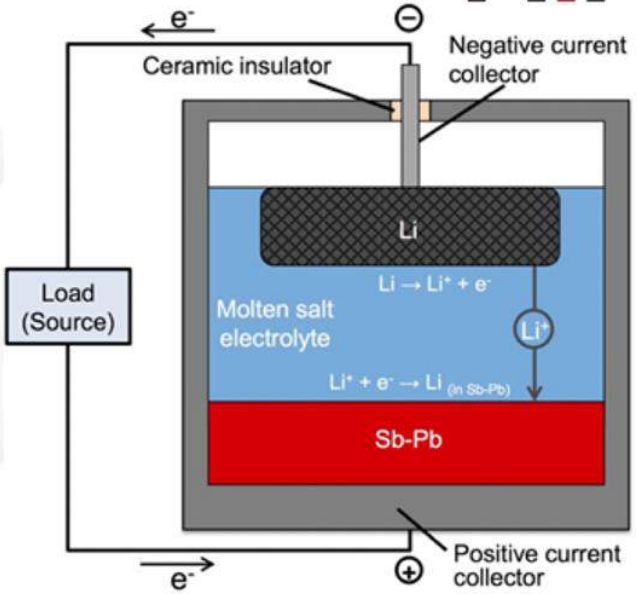
(it introduces additional degradation mechanisms)

•different kinds of instabilities may occur in liquid metal layers under operation due to both thermal dishomogeneities and magnetohydrodynamic effects

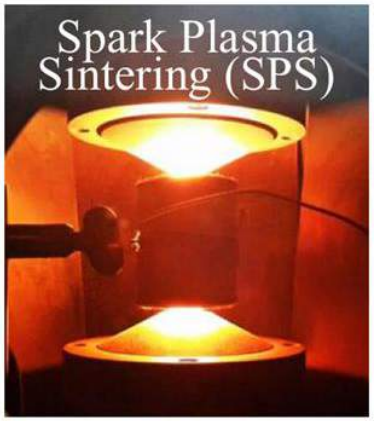
(A displacement of the fluid may locally wipe the electrolyte and lead to an internal short circuit with potentially catastrophic effects on the battery system integrity)



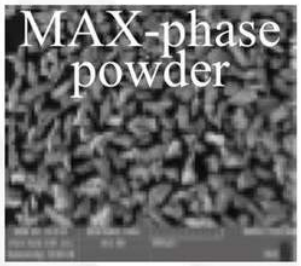
Li || Sb–Pb

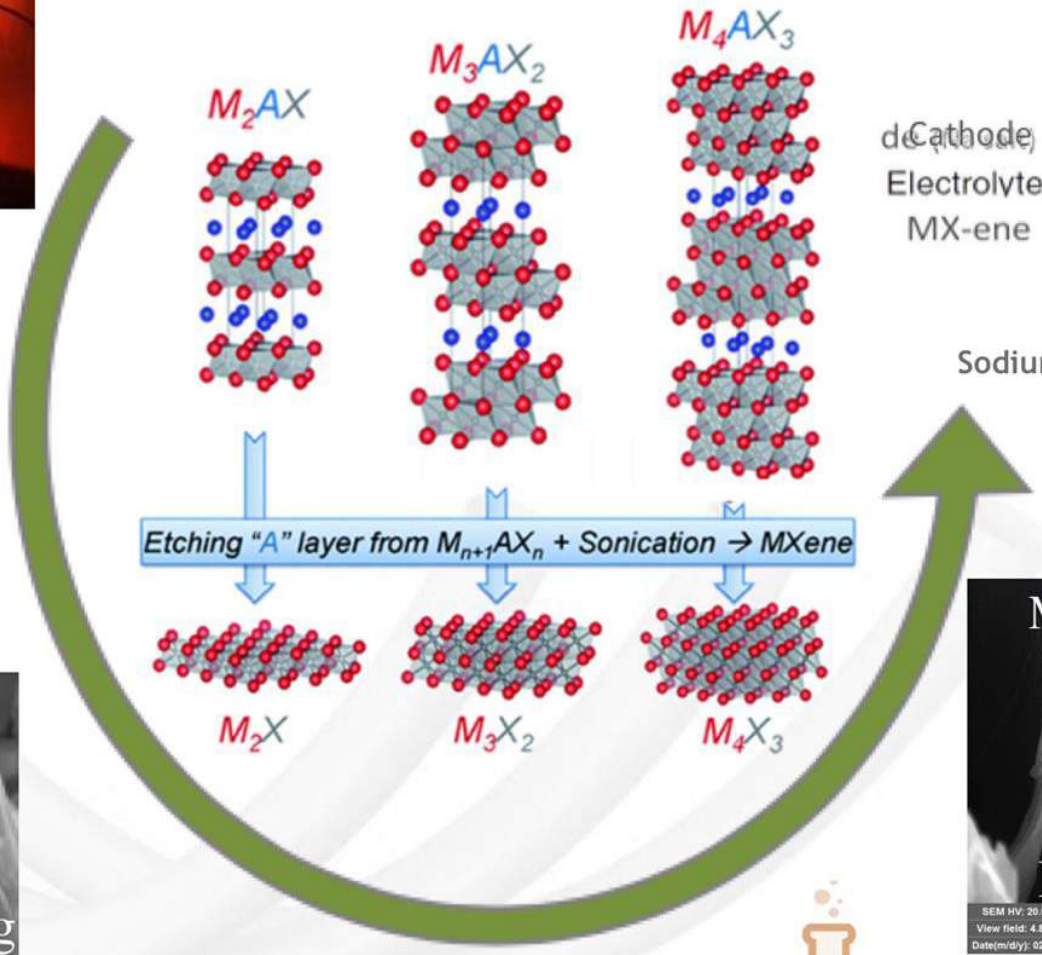


Process to produce anode material (MXene) for Sodium-ion battery (NIB)

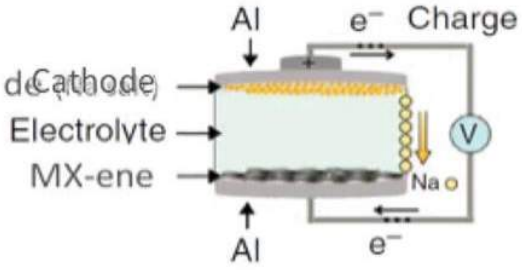


MILLING

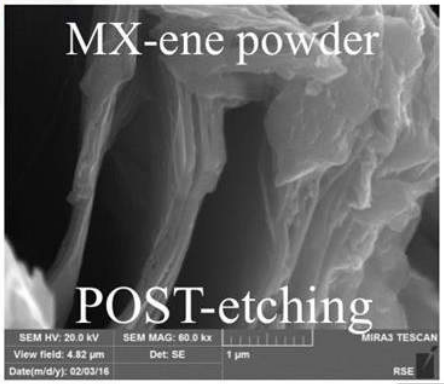




CHEMICAL ETCHING



Sodium-ion battery (NIB)

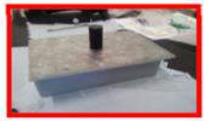


- It's hard to guess what the next couple of years will bring to this new area of materials science. Researchers have examined just a handful of the MAX phase starting materials, yet more than 70 of those compounds
- "There is no reason to think that we have seen the best materials with the most impressive properties."

Generazione
Fotovoltaico a concentrazione

KET as building blocks for advanced CPV

Photonics



CDD integrated
In the module

CPV System

Advanced materials

Solar cells

Advanced mirrors

Microelectronics

PSD control and inverter logic

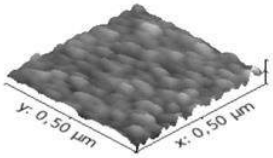
Advanced
manufacturing

ed
manufacturing?

Advanced MOCVD
reactor

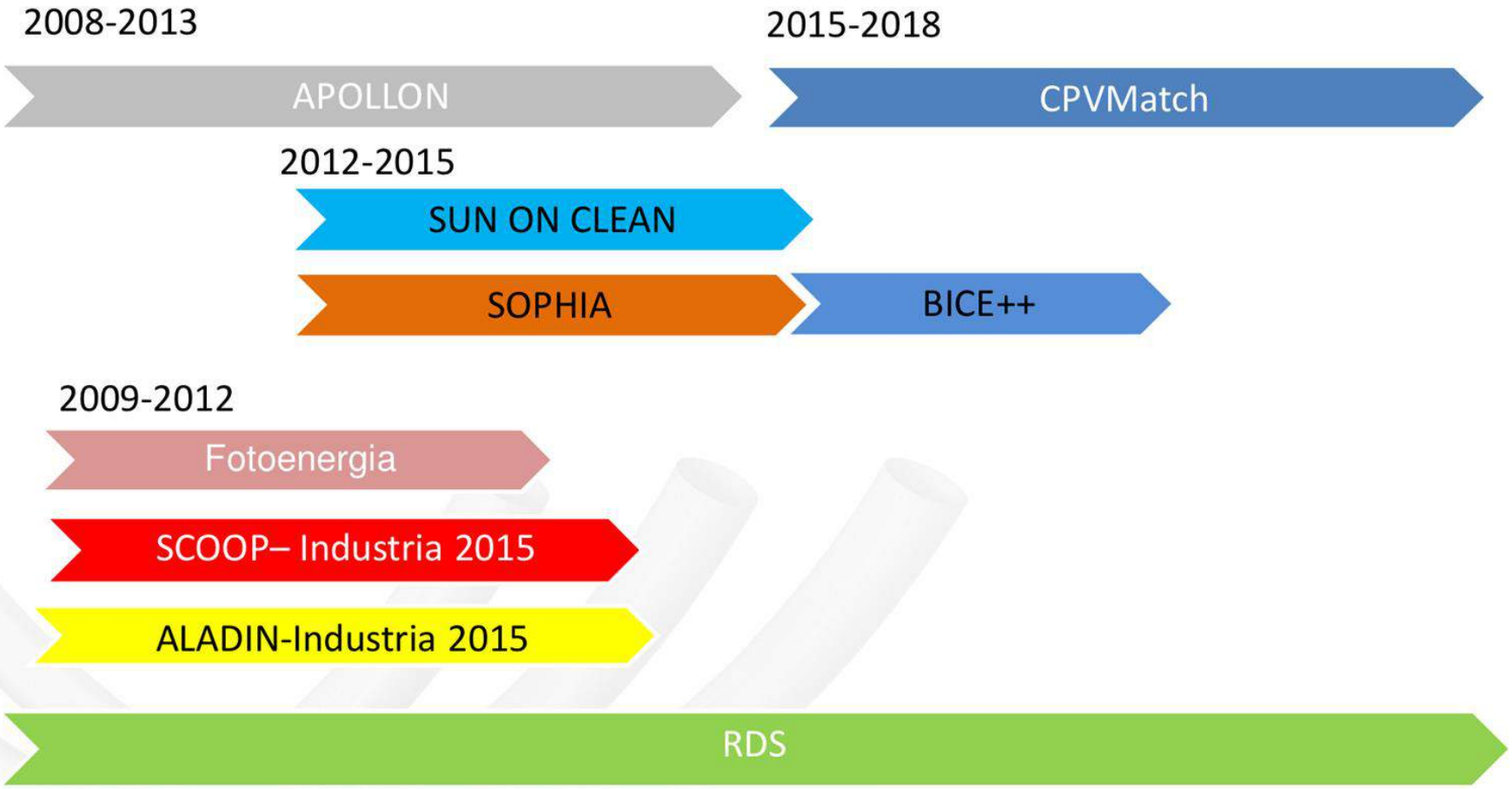
Nanotechnologies

Nanostructured coatings

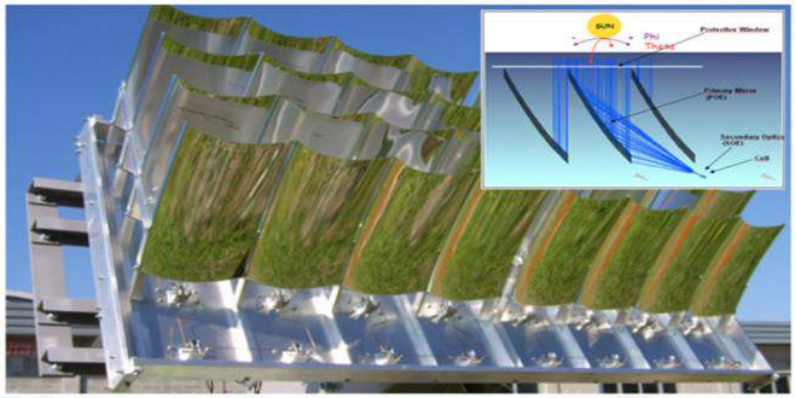


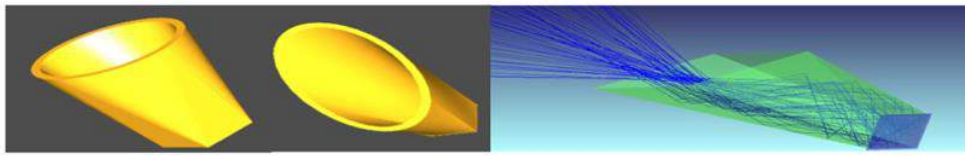
Confidential

I progetti del lab CPV



...rors





	Optical system	Optical efficiency	Average concentration	Optical angular acceptance
esults	Mirror based	82.5%	836 (1500max)	± 0.5°

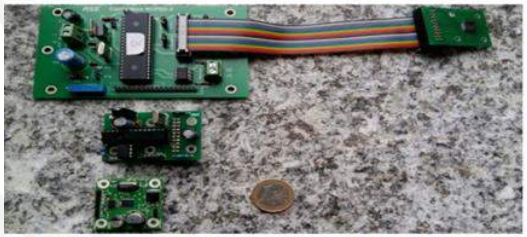
Open Problems:

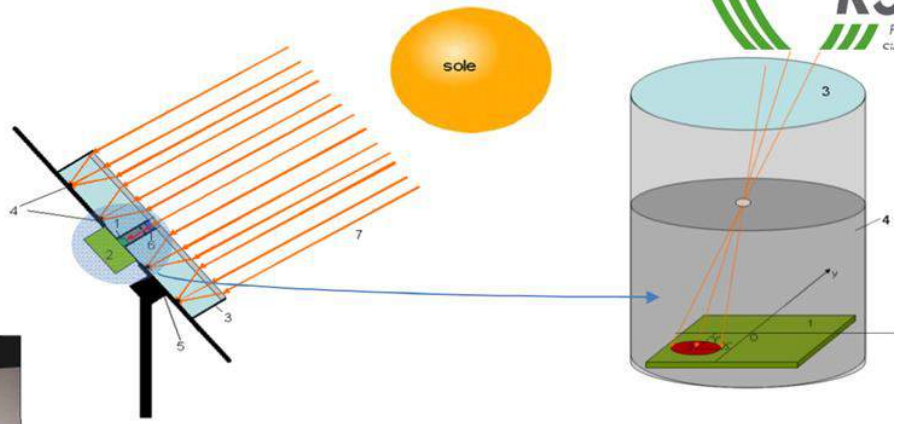
- **Reduce dimensions**
- **SOE assembling**
- **Reliability**

Confidential

PSD sensors

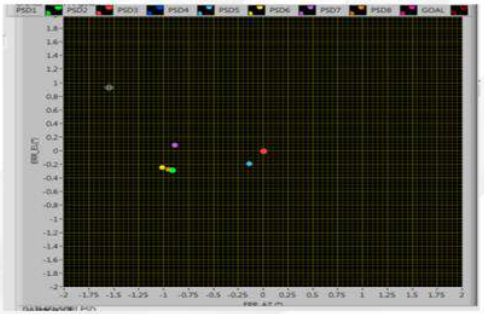
To improve tracking accuracy
For CPV, to be integrated in the modules

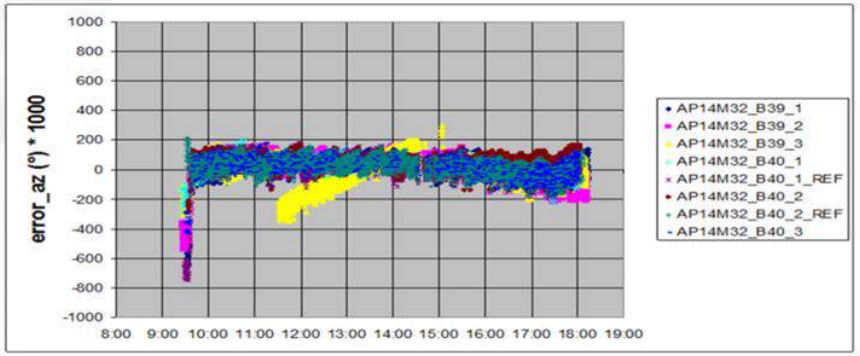


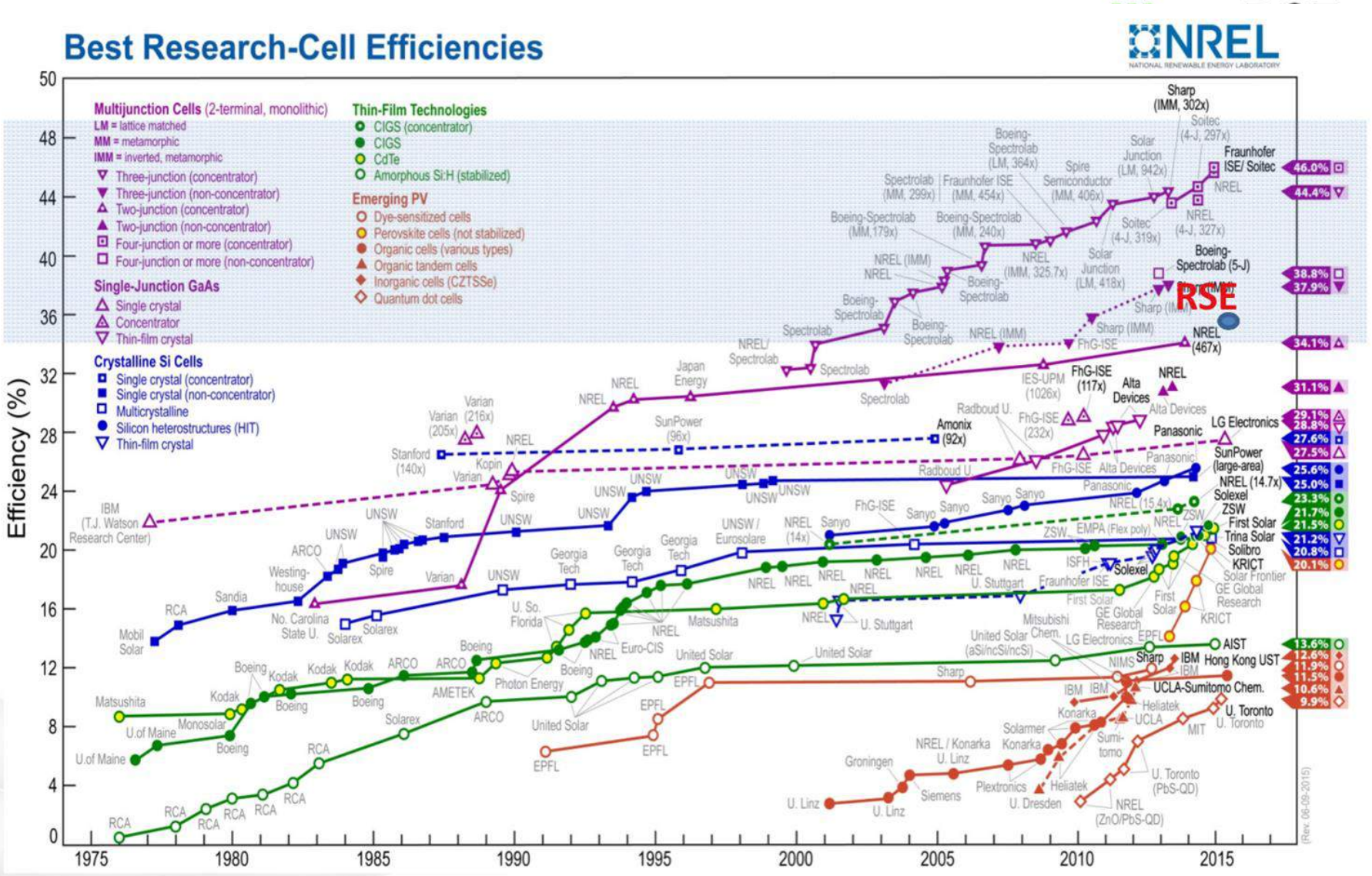


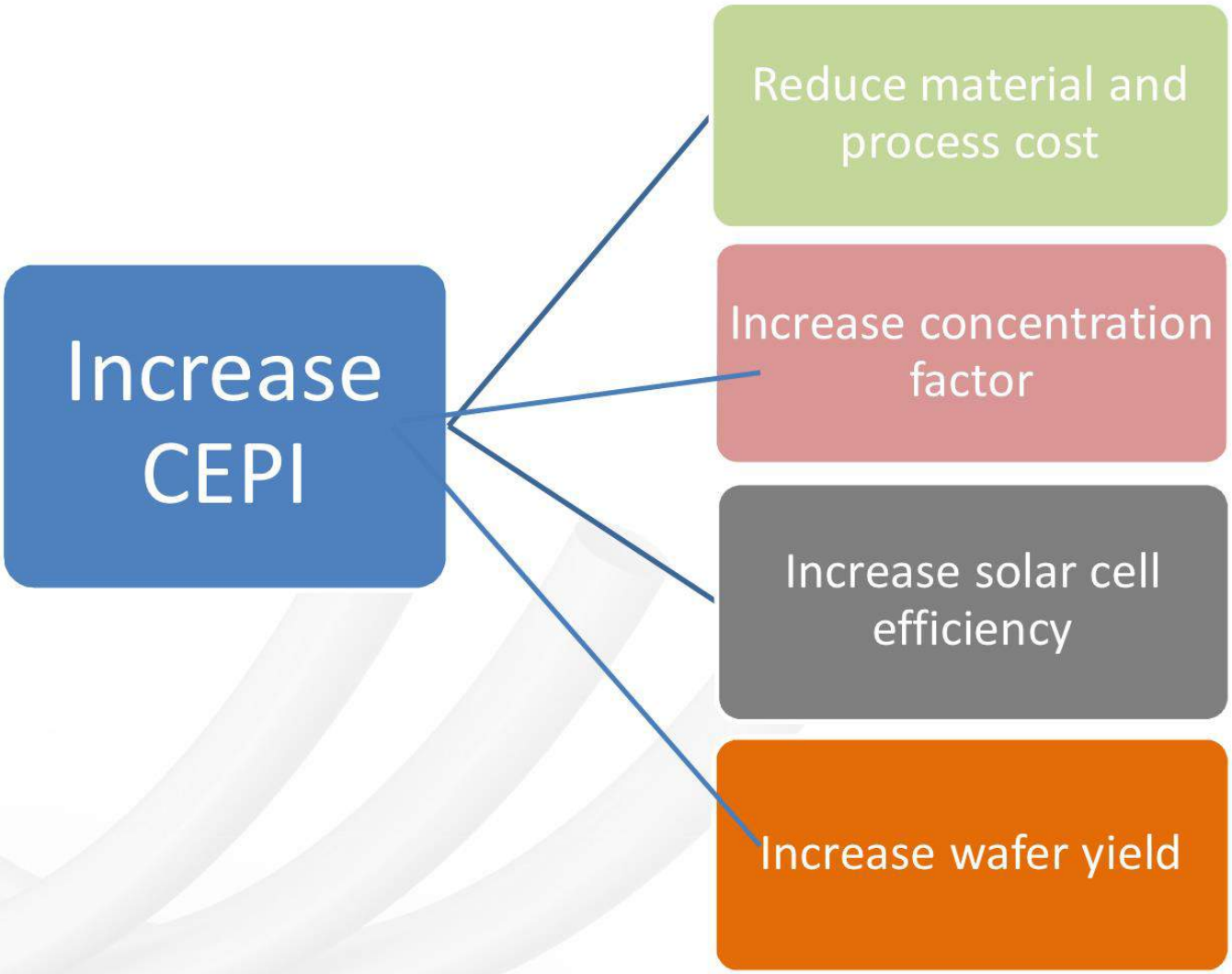
APOLLON
The integrated platform for advanced concentrating photovoltaics

CPVMatch






Best Research-Cell Efficiencies
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
Multijunction Cells (2-terminal, monolithic)
LM = lattice matched
MM = metamorphic
IMM = inverted, metamorphic
Three-junction (concentrator)
Three-junction (non-concentrator)
Two-junction (concentrator)
Two-junction (non-concentrator)
Four-junction or more (concentrator)
Four-junction or more (non-concentrator)
Single-Junction GaAs
Single crystal
Concentrator
Thin-film crystal
Crystalline Si Cells
Single crystal (concentrator)
Single crystal (non-concentrator)
Multicrystalline
Silicon heterostructures (HIT)
Thin-film crystal
Thin-Film Technologies
CIGS (concentrator)
CIGS
CdTe
Amorphous Si:H (stabilized)
Emerging PV
Dye-sensitized cells
Perovskite cells (not stabilized)
Organic cells (various types)
Organic tandem cells
Inorganic cells (CZTSSe)
Quantum dot cells
Efficiency (%)
0
4
8
12
16
20
24
28
32
36
40
44
48
50
1975
1980
1985
1990
1995
2000
2005
2010
2015
RSE
46.0%
44.4%
38.8%
37.9%
34.1%
31.1%
29.1%
28.8%
27.6%
27.5%
25.6%
25.0%
23.3%
21.7%
21.5%
21.2%
20.8%
20.1%
13.6%
12.6%
11.9%
11.5%
10.6%
9.9%
(Rev. 06-09-2015)



Cell Economic Performance Index

Jna iniziativa italiana per lo sviluppo del CPV

Contesto

Sviluppo delle FER innovative, anche con realizzazione di attività sperimentali e dimostrative

50 GW nel 2030, 150 GW nel 2050

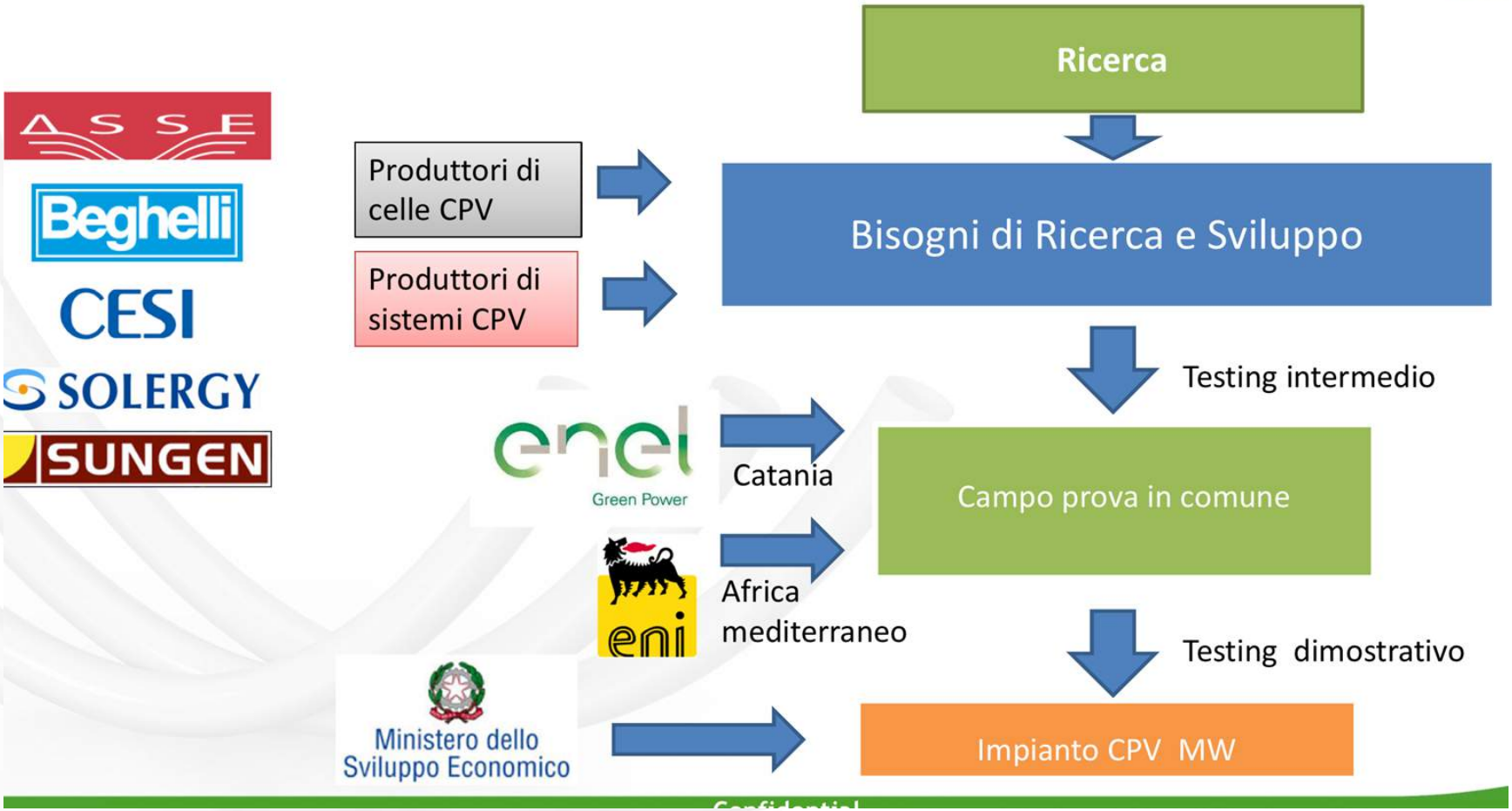
Scopo

Creare una piattaforma nazionale che aggreghi Ricerca e partner industriali per rispondere ai bisogni di sviluppo dei singoli operatori e di tutto il settore CPV in Italia.

Obiettivo

Promuovere condivisione di attività di ricerca e sperimentazione fra tutti i soggetti italiani coinvolti nel CPV, dalla Ricerca alle Industrie, per aggregare e rafforzare la filiera italiana CPV e stimolare lo sviluppo del CPV in Italia.
(Questa opportunità è stata anche indicata da MiSE in occasione di un convegno FV di RSE)

Lo schema a matrice dell'iniziativa



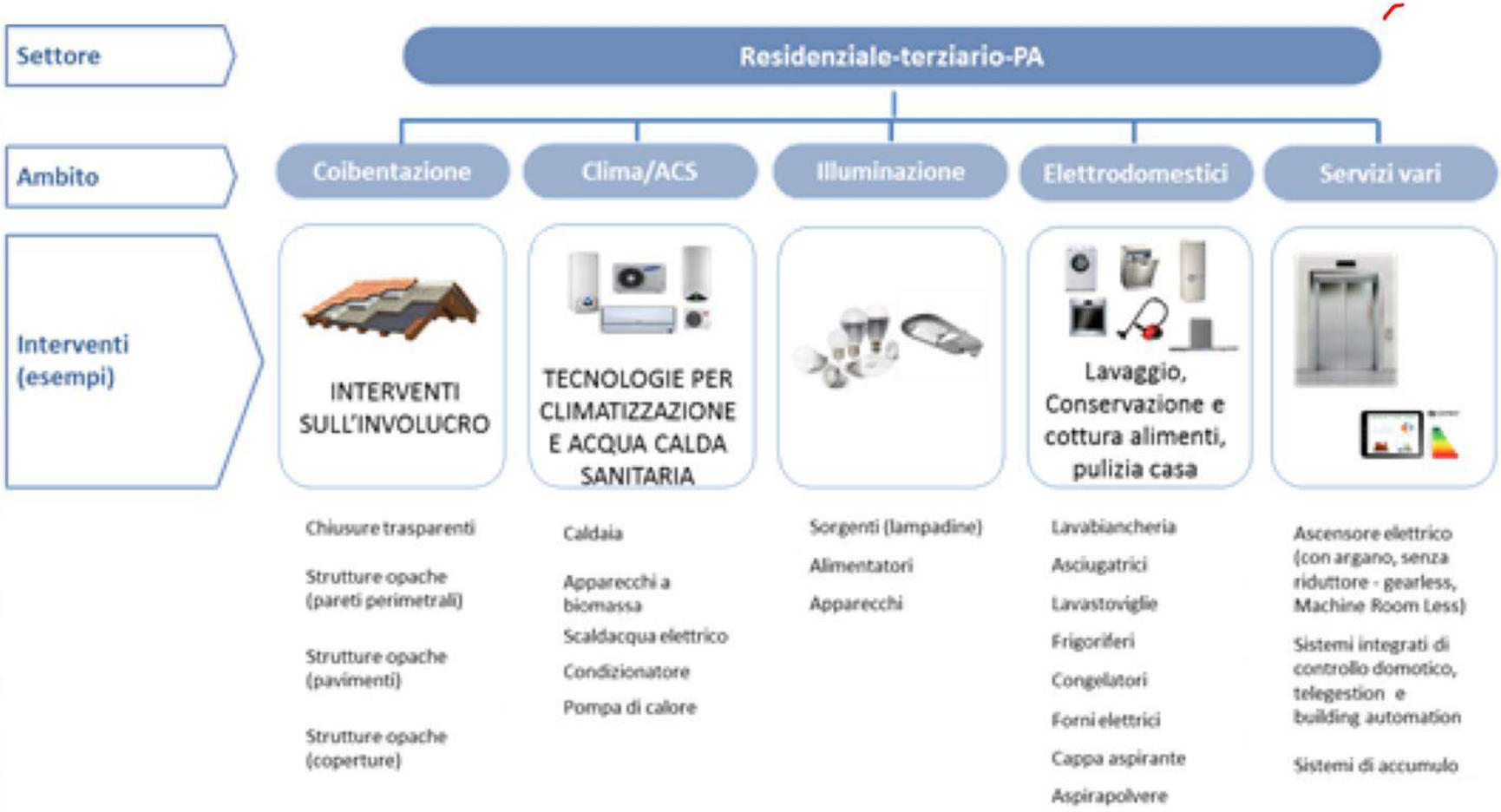
Efficienza energetica

Contesto

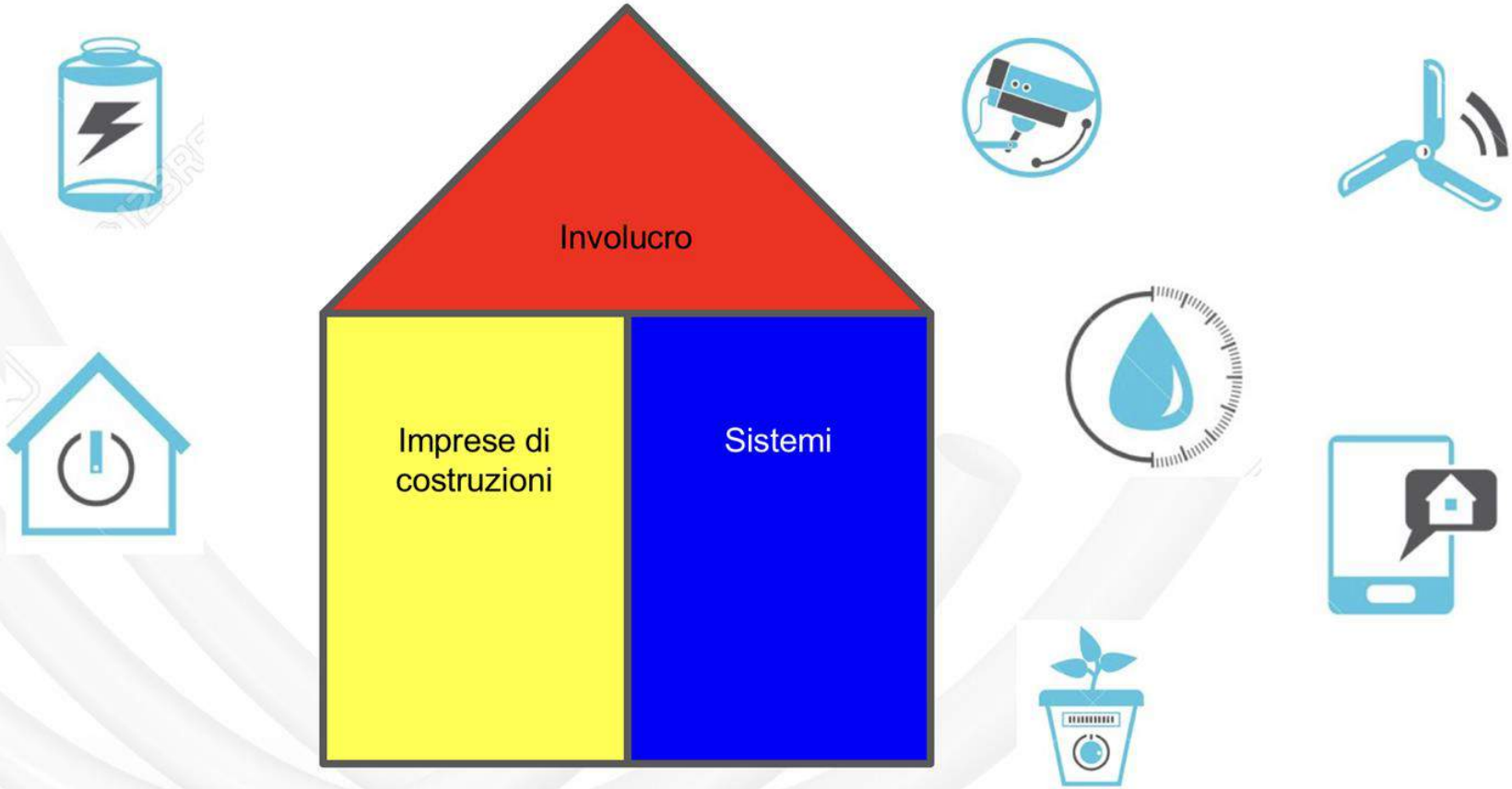
Il sistema ETS è un sistema industriale il sistema non ETS è un sistema retail

L'efficienza energetica deve aggredire con maggiore determinazione il settore non ETS quindi un settore retail

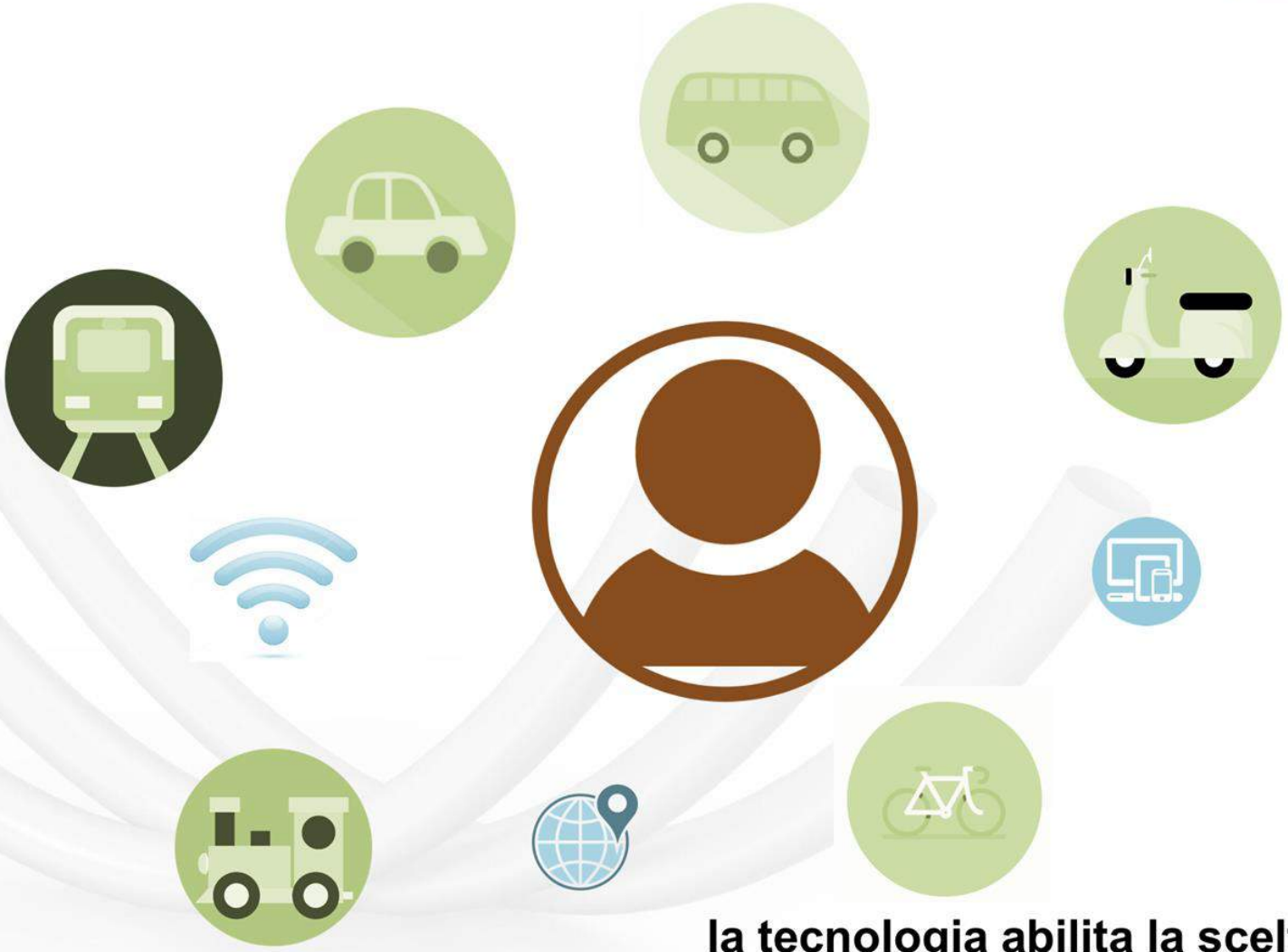
Settore residenziale



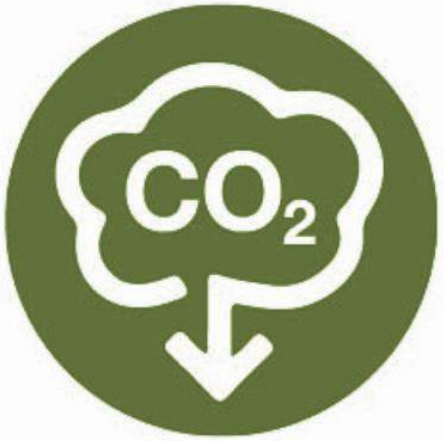
Settore residenziale



Mobilità



la tecnologia abilita la scelta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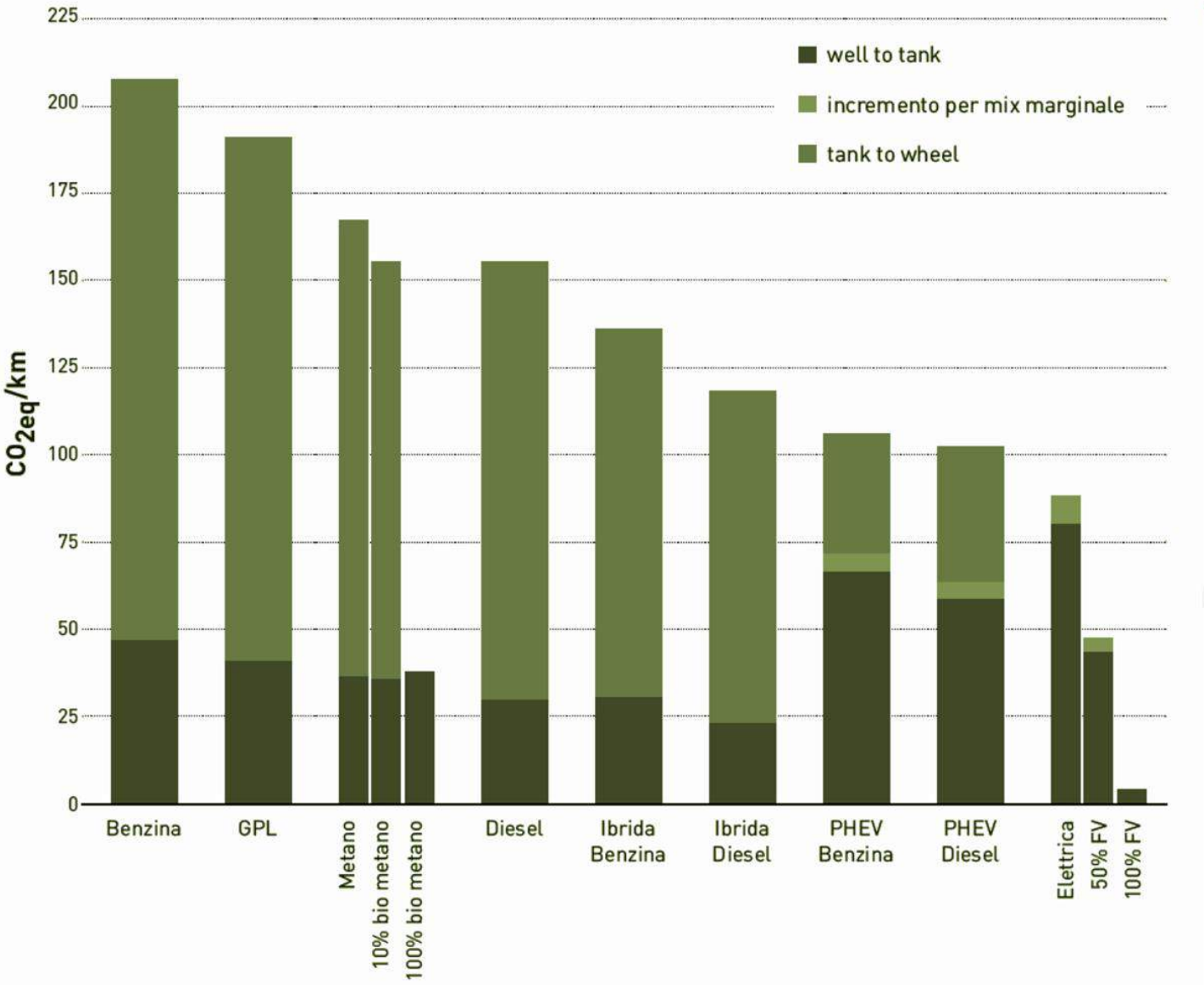
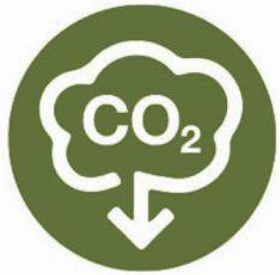
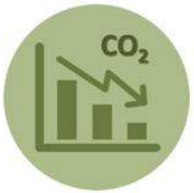


RSE
Ricerca Sistema Energetico



RSE
Ricerca
Sistema
Energetico

Tradizionali



Elettrico/FC

Gas

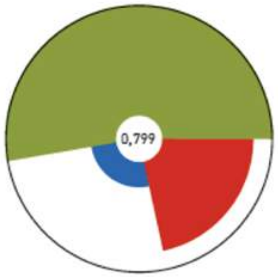
Tradizionali

Elettrico/FC

Gas

- Emissioni inquinanti
- Economia
- Decarbonizzazione

Elettrica A B

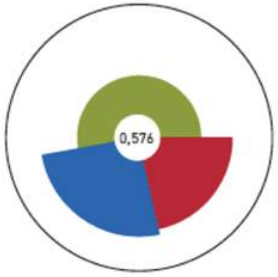


Ibrida Benzina Plug-in

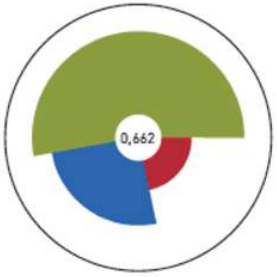
Ibrida Benzina A B

Ibrida Diesel Plug-in

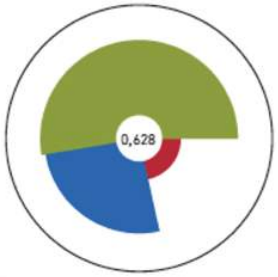
Ibrida Diesel A B



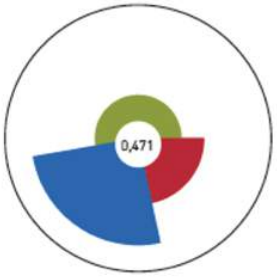
Metano A B



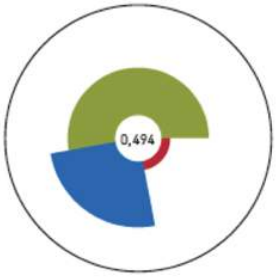
GPL A B



Diesel A B



Benzina A B



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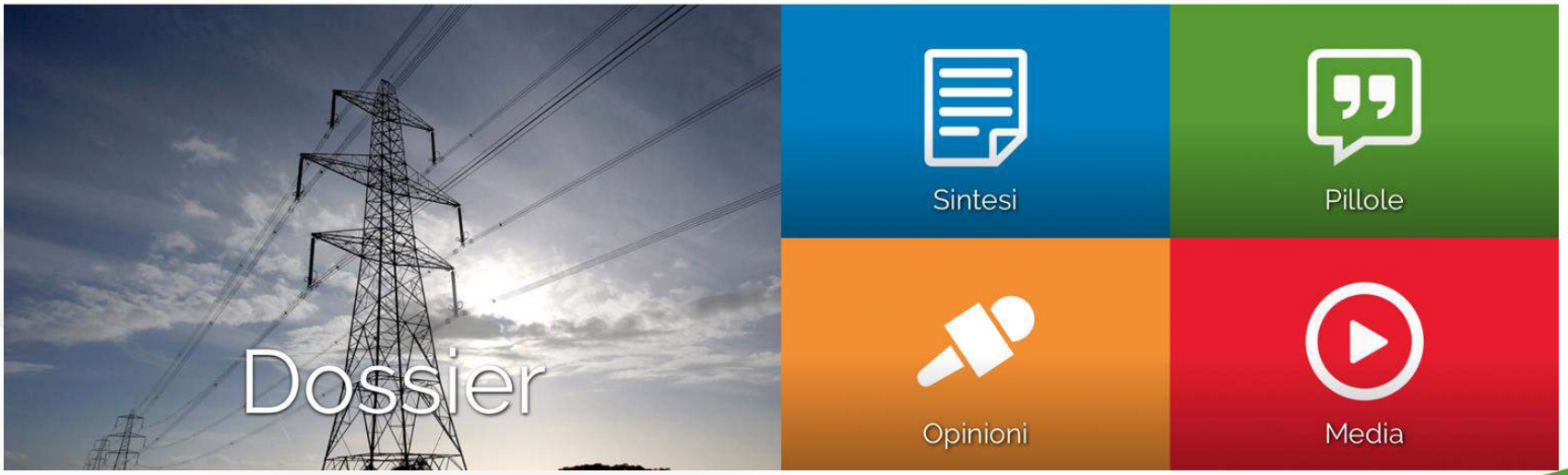

Grazie

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