

The ENEA logo features the word "ENEA" in a bold, white, sans-serif font against a blue background with a stylized sunburst or energy symbol on the left.

AGENZIA NAZIONALE
PER LE NUOVE TECNOLOGIE, L'ENERGIA
E LO SVILUPPO ECONOMICO SOSTENIBILE



RICERCA DI
SISTEMA ELETTRICO



MINISTERO DELLO SVILUPPO ECONOMICO

Accordo di Programma MiSE-ENEA

Cattura della CO₂ con sorbenti solidi: la tecnologia 'calcium looping'. Applicazioni al settore energetico e industriale

Stendardo Stefano

ENEA

Roma, 24 Giugno 2015



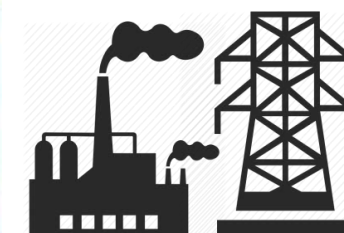
Cos'è il 'Calcium Looping'?



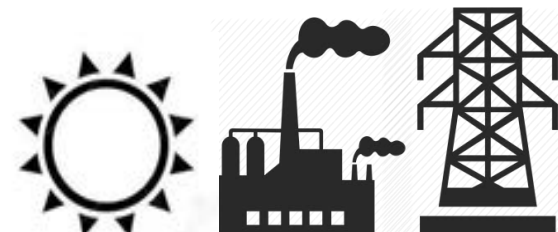
Quali sono stati i risultati ottenuti?



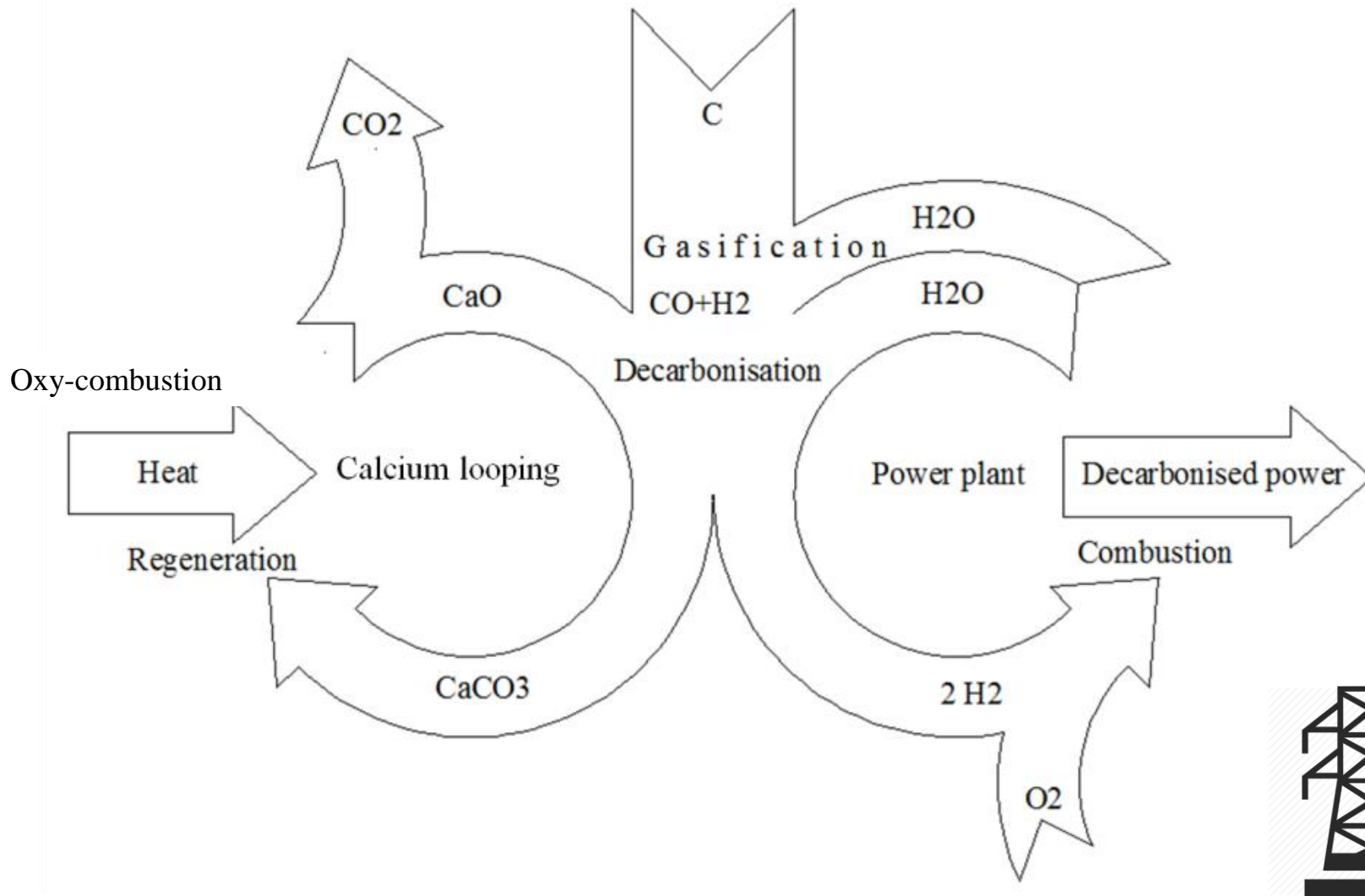
Quali saranno i nostri obiettivi futuri?



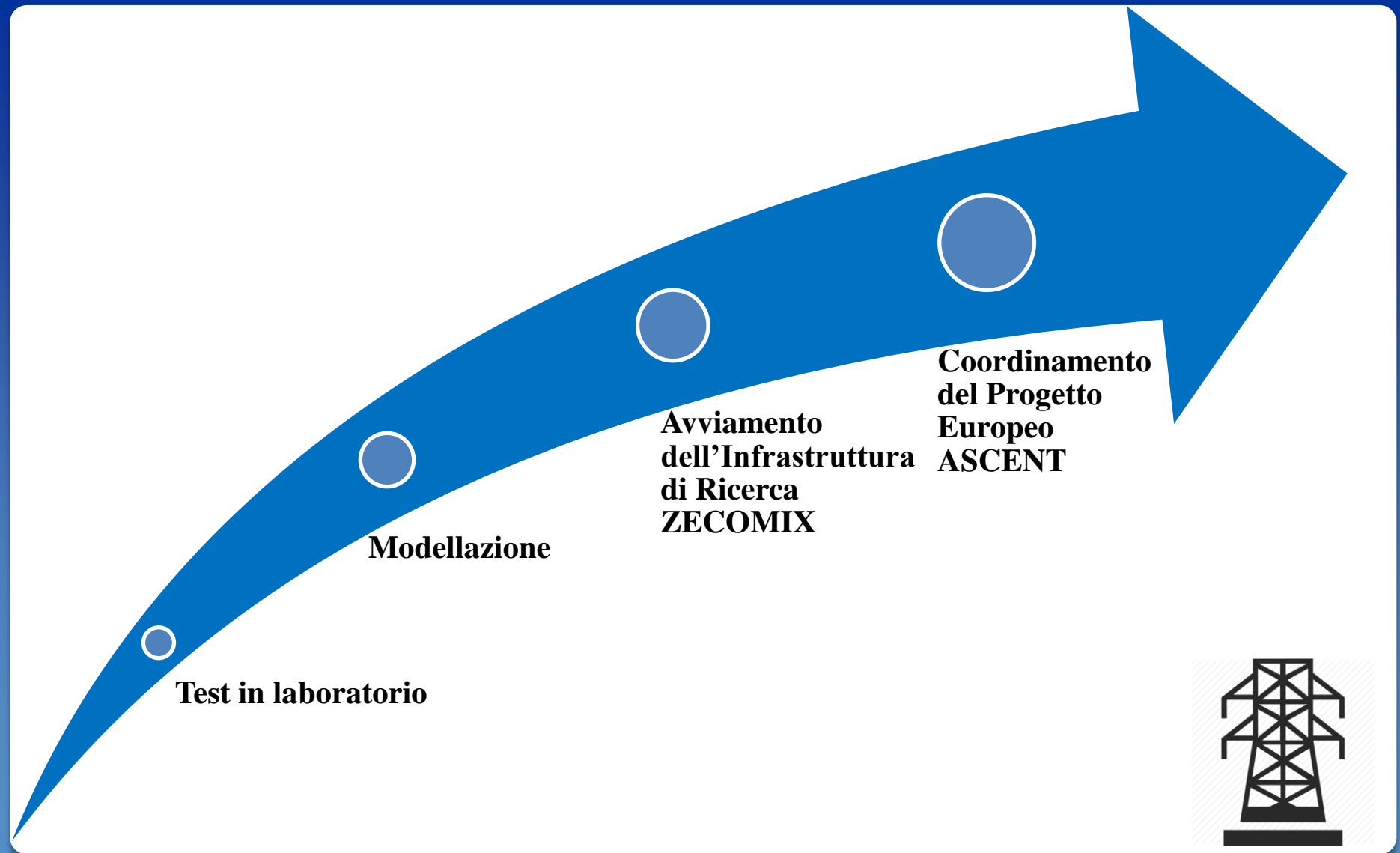
E' possibile rendere totalmente 'verde' il 'Calcium Looping'?



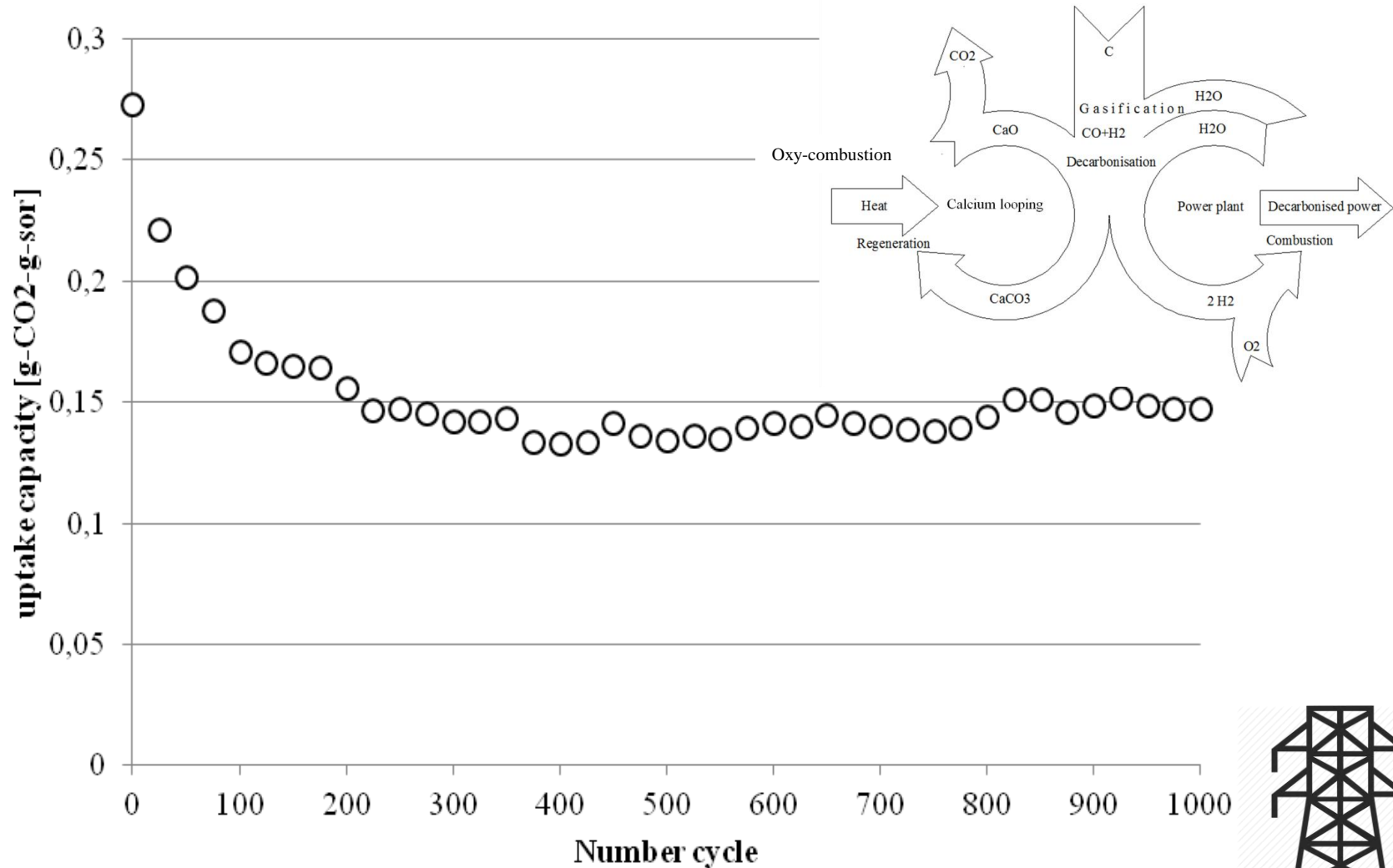
Applicazione del 'Calcium Looping' alla produzione dell'energia elettrica da combustibili solidi



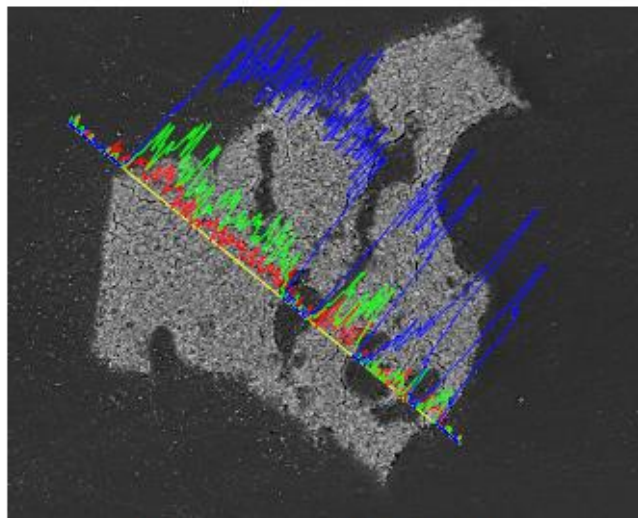
Principali aree di ricerca nella tecnologia CaL



Materiale sorbente ad alta stabilità chimica

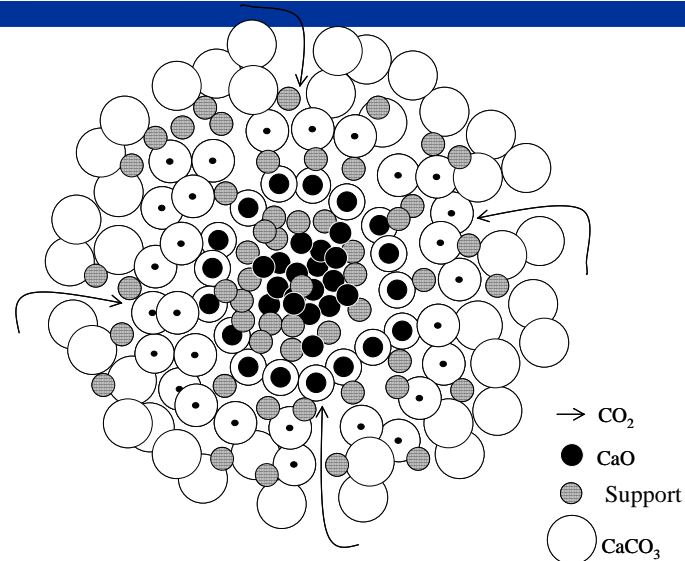
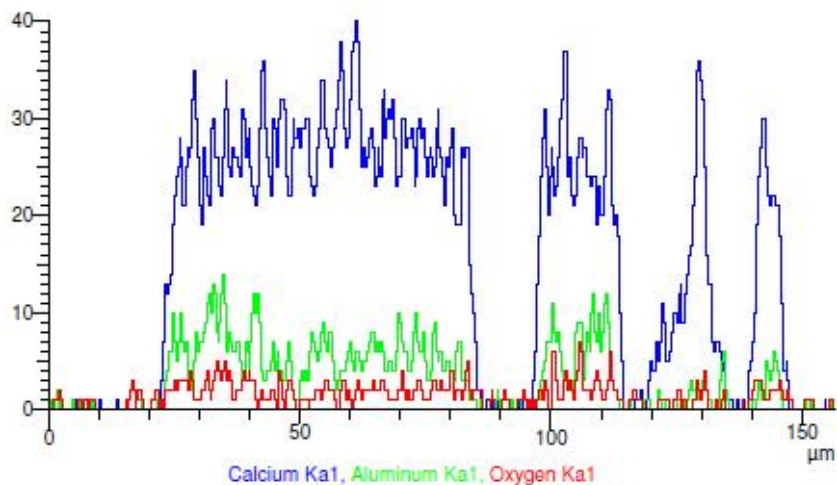


Le particelle di sorbente come 'cluster' di grani



90µm

Electron Image 1



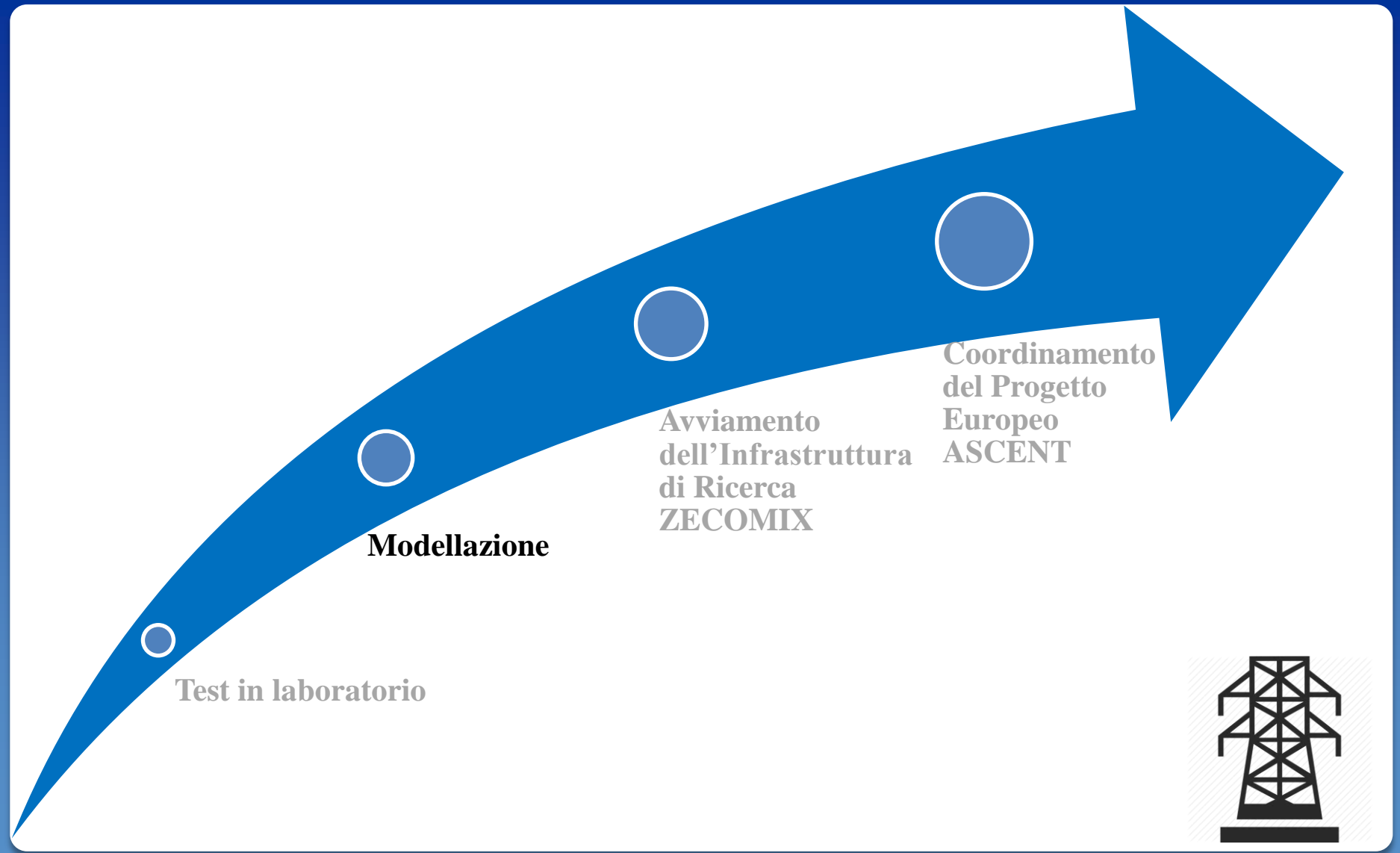
$$\partial \varepsilon = -f_{CaO} \left(\frac{\partial X}{\partial t} \right)$$

$$N_{Ca} \frac{dX}{dt} = \frac{\sigma_{0,CaO} k \left(1 - X \right)^{2/3} \left(C_{AS} - C_{Ae} \right)}{1 + \frac{k}{2D_{PL}} \delta_{CaO} \sqrt[3]{1 - X} \left(1 - \sqrt[3]{\frac{1 - X}{1 - X + XZ}} \right)}$$

Stando and Foscolo 2009

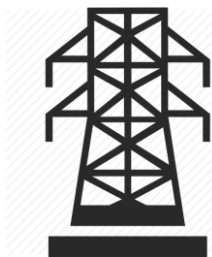
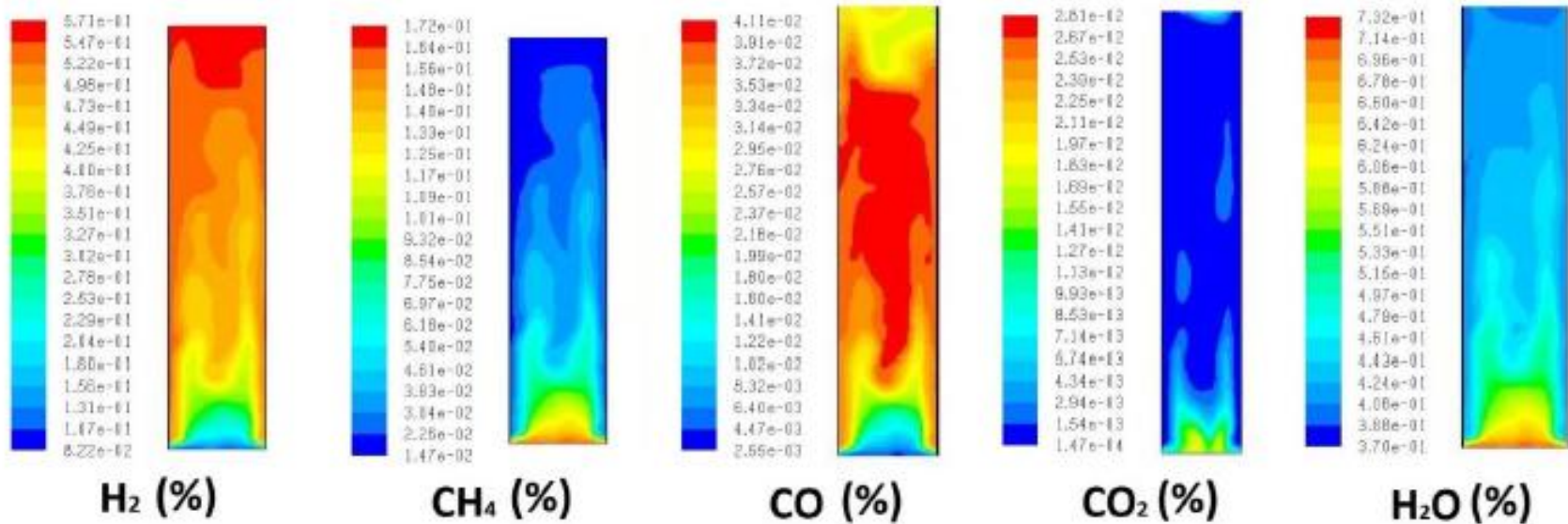


Applicazioni del modello a grani

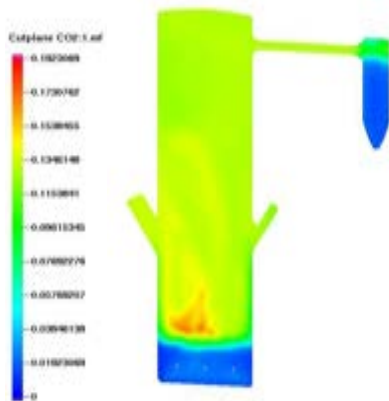


Applicazione del modello a grani in ambito CFD: Cooperazione ENEA – CIRCE

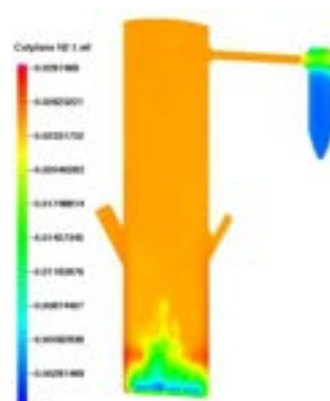
Modellazione di letti fluidi



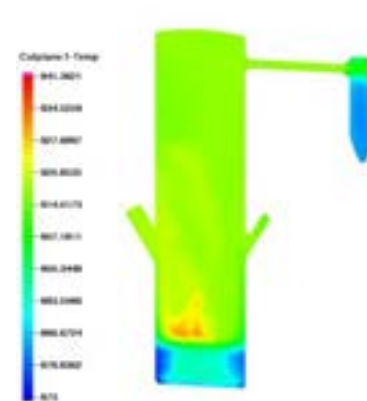
Modellazione di letti fluidi



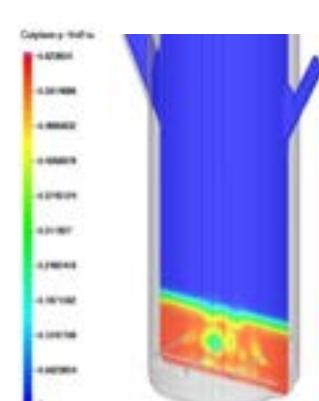
CO2 (-)



H2 (-)



Temperatura [K]



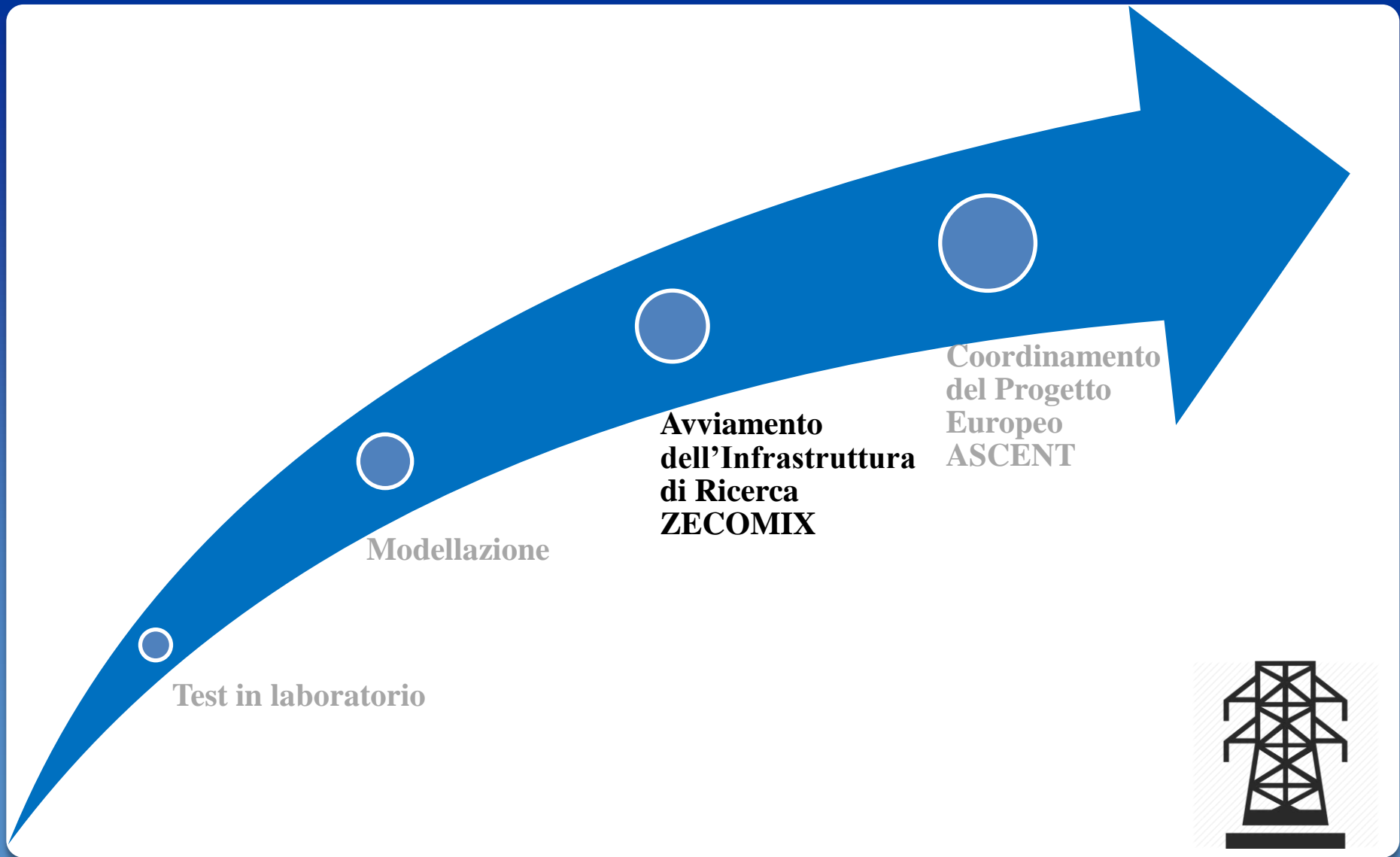
Grado di vuoto



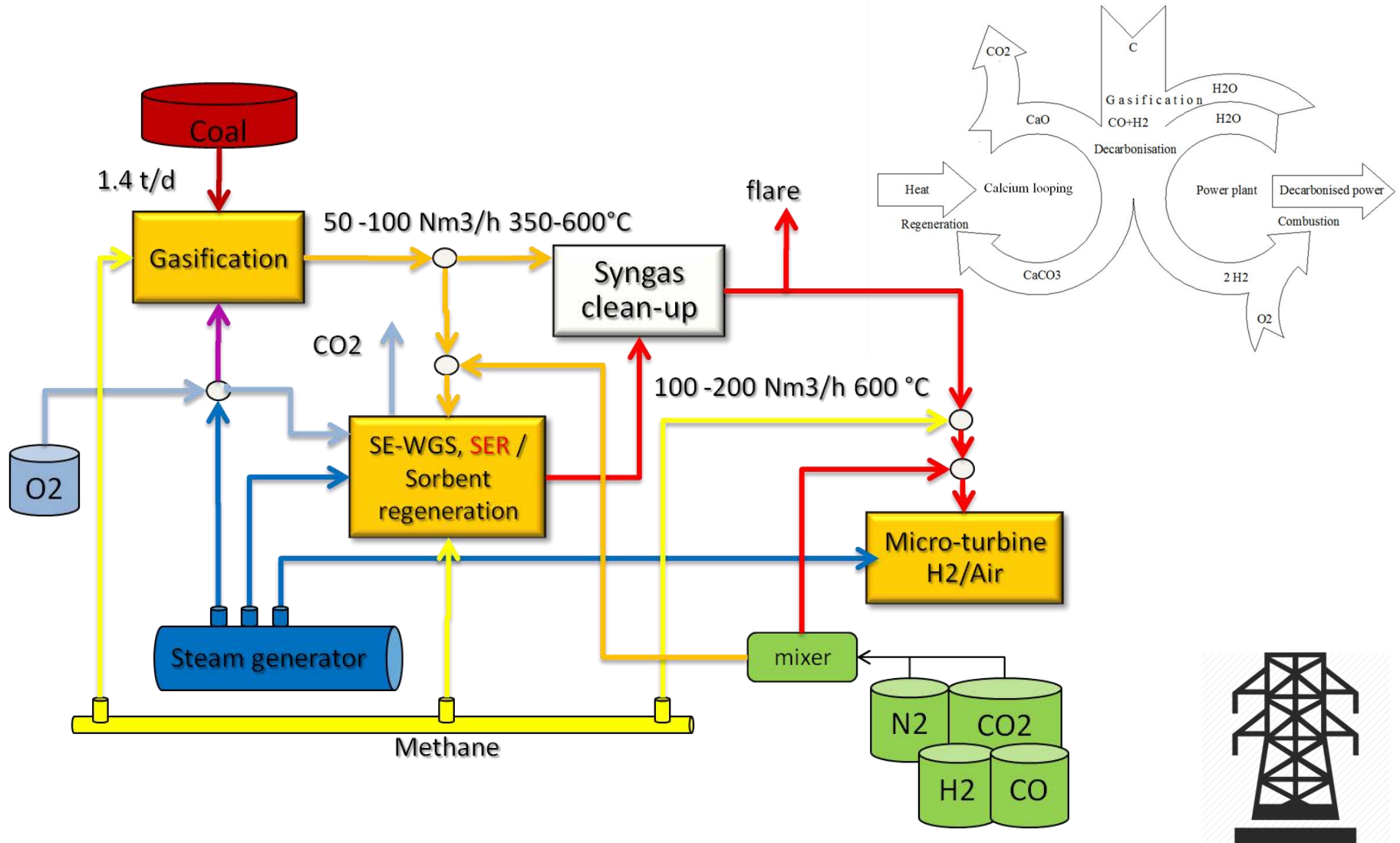
Approccio Euleriano-Lagrangiano



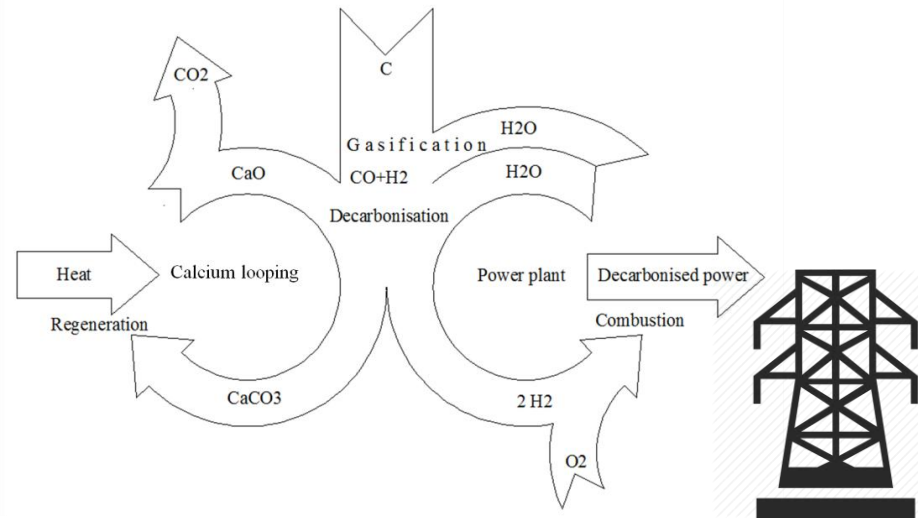
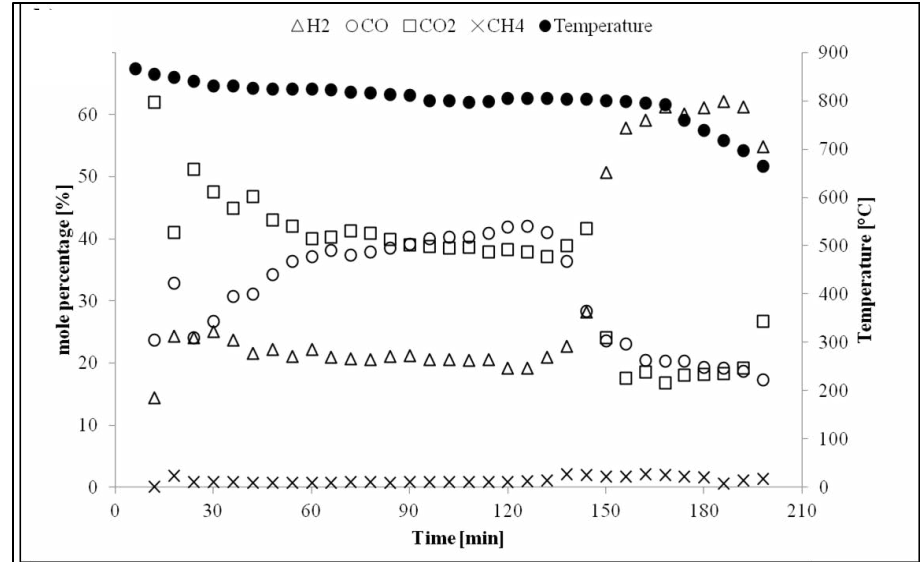
Infrastruttura di Ricerca ZECOMIX (Zero Emission of CarbOn with MIXed technology)



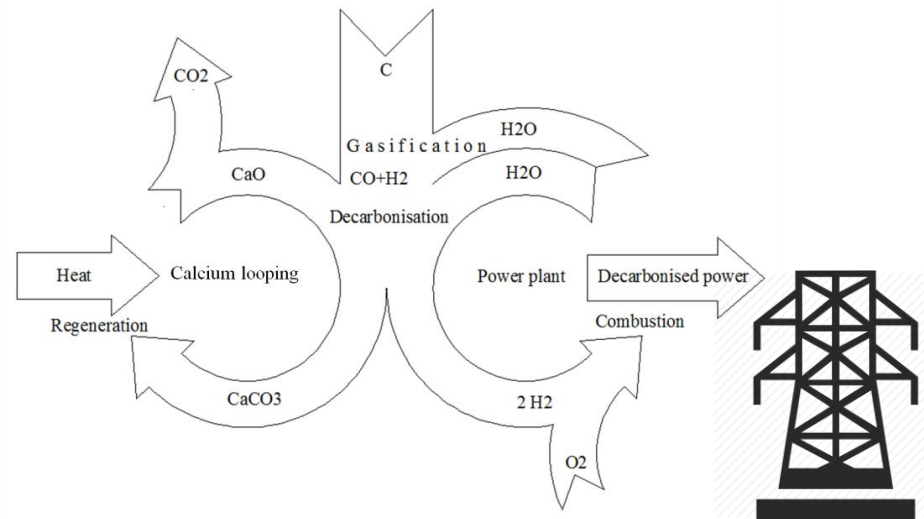
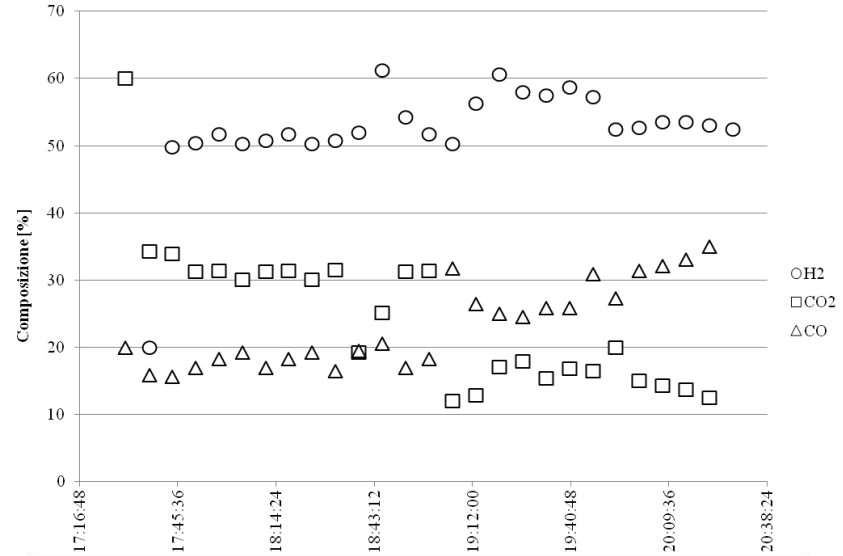
Lay-out dell'Infrastruttura di Ricerca ZECOMIX



Gassificazione del carbone: produzione di syngas ad alta qualità



Conversione del gas d'acqua ad alta temperatura (650 °C)





Latest additions

MetaboHUB Métabolomique /
MetaboHub
Last updated on: 2013-12-02 at 18:43

Vienna Scientific Cluster VSC
Last updated on: 2013-11-22 at 10:14

National Plant Phenomics Centre-
Aberystwyth University NPPC
Last updated on: 2013-11-21 at 18:04

Opificio delle Pietre Dure OPD
Last updated on: 2013-11-21 at 15:12

Nanoscience Foundries and Fine
Analysis - Demonstrator NFFA-DEMO
Last updated on: 2013-11-21 at 14:42

[See all RIs »](#)



The MERIL database is an inventory of openly accessible research infrastructures (RIs) in Europe of more-than-national relevance across all scientific domains: from archives and statistical offices to biobanks, satellites and particle accelerators. Read more [about MERIL](#).

Search below for research infrastructures in Europe that interest you and create pdf and statistical reports.

Note: The MERIL database is continuously being populated. Only complete entries are visible on the website.



General search

Free text search in the database on all Research Infrastructure related topics

Search



Scientific Domain

Engineering and Energy

RI Category

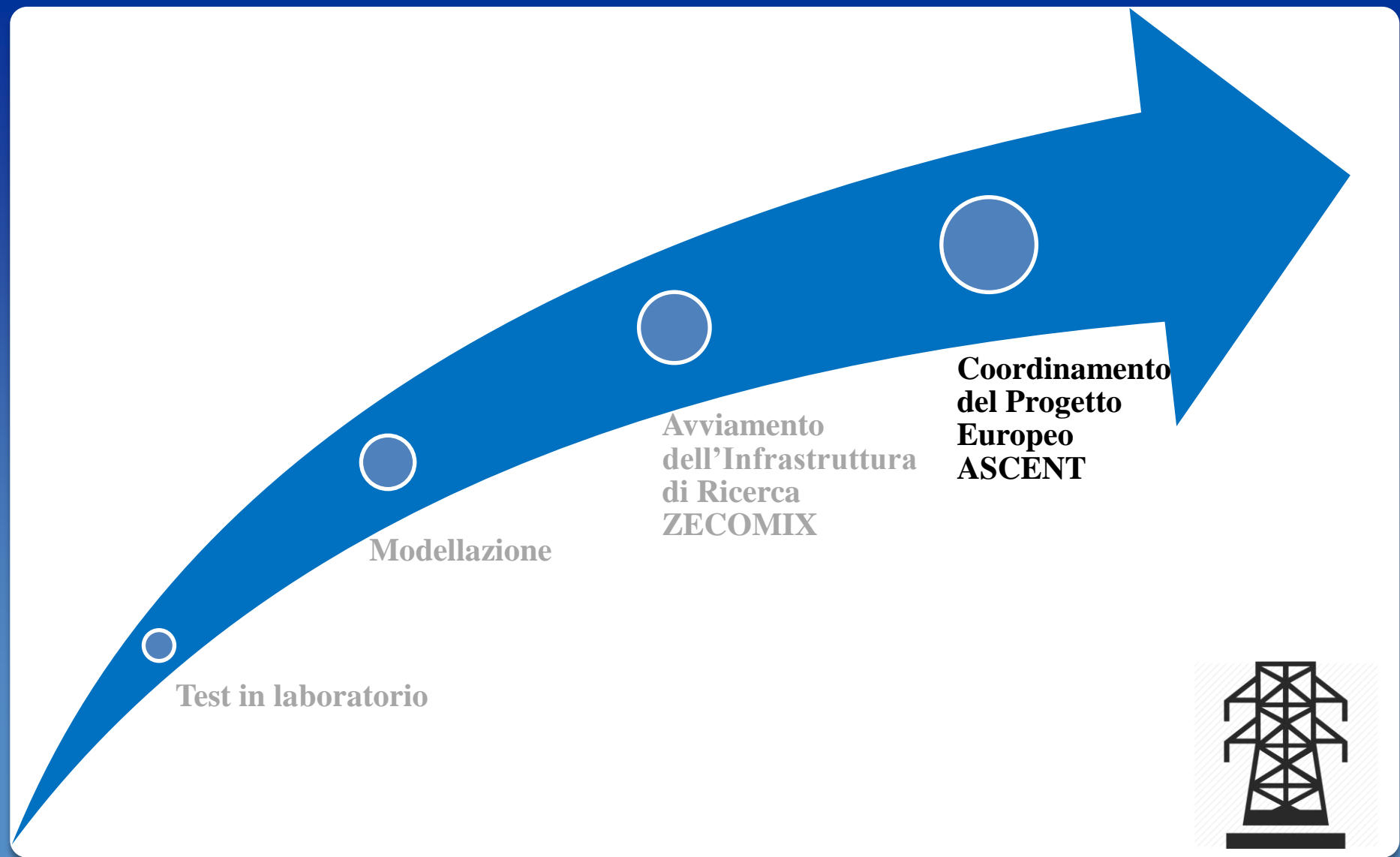
Energy Engineering Facilit

Country

Italy



Coordinamento del Progetto Europeo ASCENT



ASCENT: Advanced solids Cycles with Efficient Novel technologies



16 Partner Europei
7 Nazioni

5 Stati membri: Paesi Bassi, UK, Italia, Francia, Spagna;
2 Stati associati: Norvegia, Svizzera

Dimensione economica: 9.2M €

Sviluppo e trasferimento tecnologico di tre differenti processi usando materiali solidi a base di calcio e magnesio in condizioni industriali per la produzione di energia elettrica ed idrogeno

Call: New generation high-efficiency capture processes

www.ascentproject.eu



ASCENT: trasferimento dell'innovazione tecnologica



Stefano Stendardo



Paul Cobden



Pier Ugo Foscolo



Julien Meyer



Fausto Gallucci



Matteo Romano



Murillo Ramon



Paul Fennell



Thangavelu Jayabalan



Suzanne Ellis



Arnaud Dauriat



Richard Blom



Rob Van Ruijven



Delphine Maury



Brian Sweeney



Björg Andresen



Indici di prestazione basati sulla sintesi e caratterizzazione del materiale solido



THE UNIVERSITY OF
NEW SOUTH WALES
SYDNEY AUSTRALIA



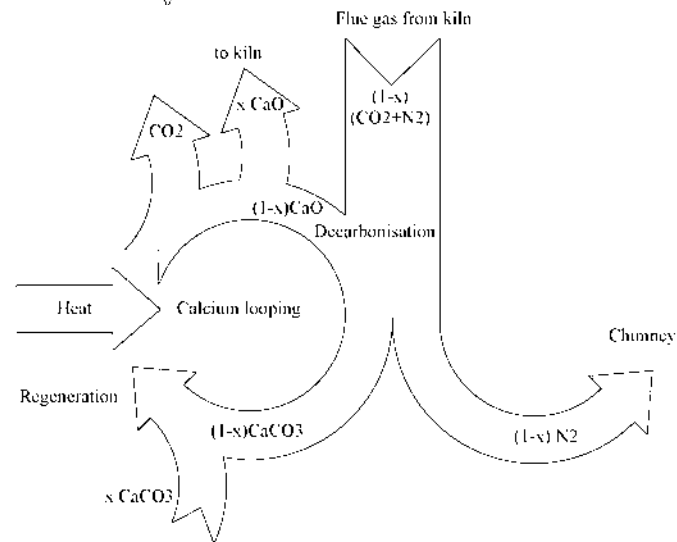
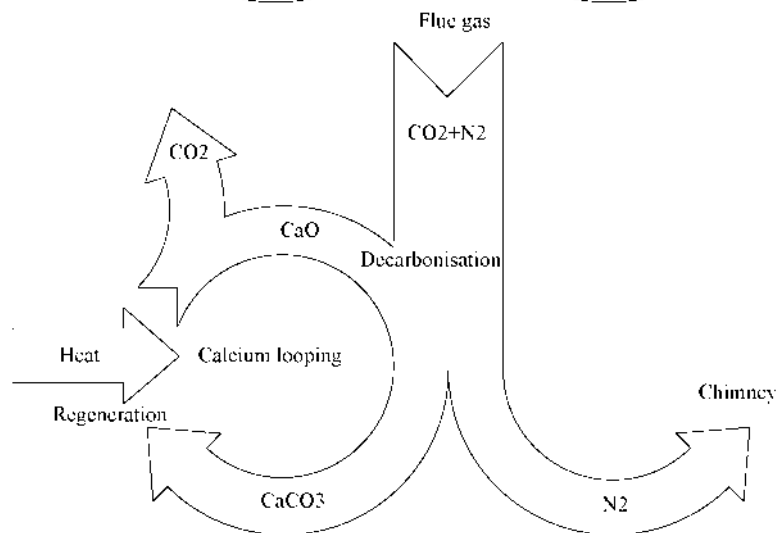
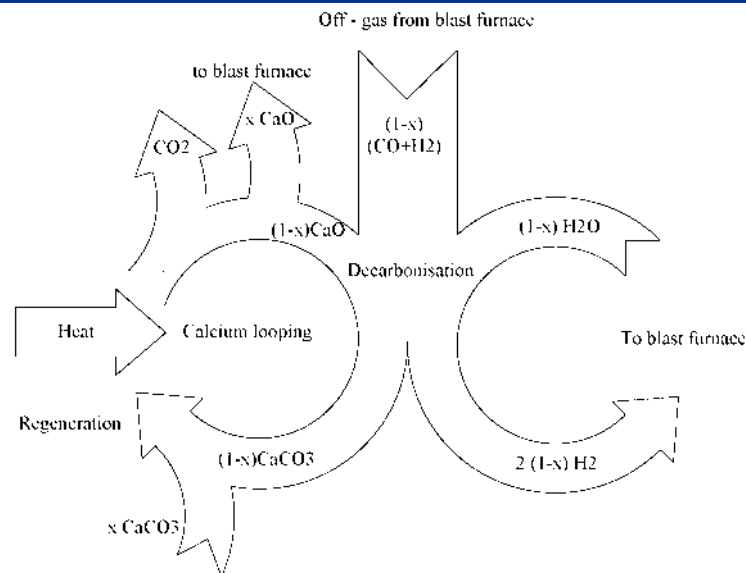
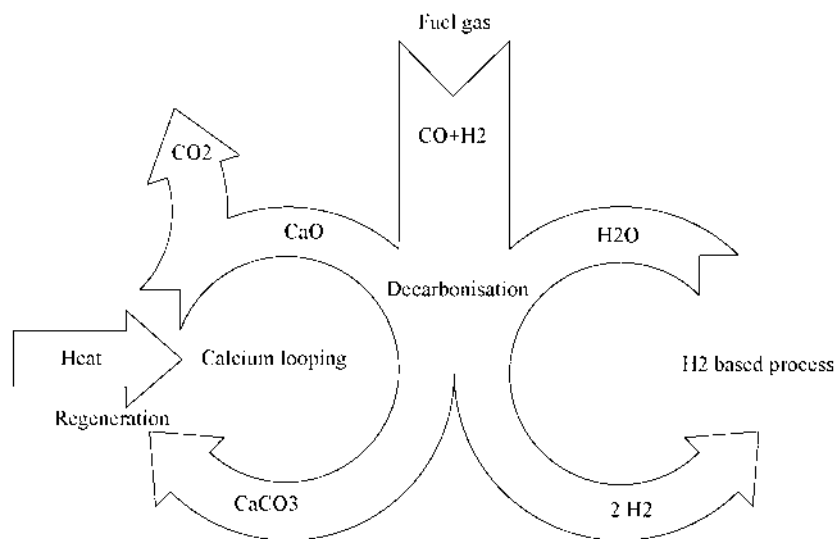
Australian
National
University

**Ottimizzazione termodinamica:
Australian National University**

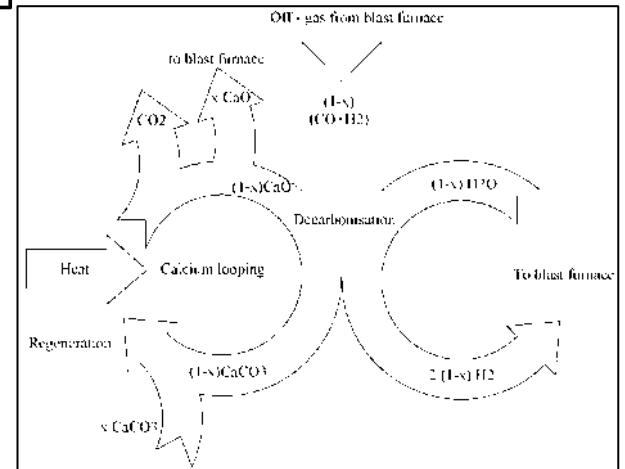
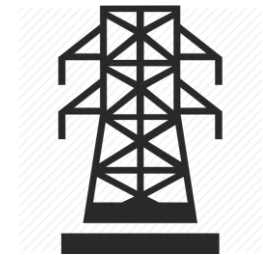
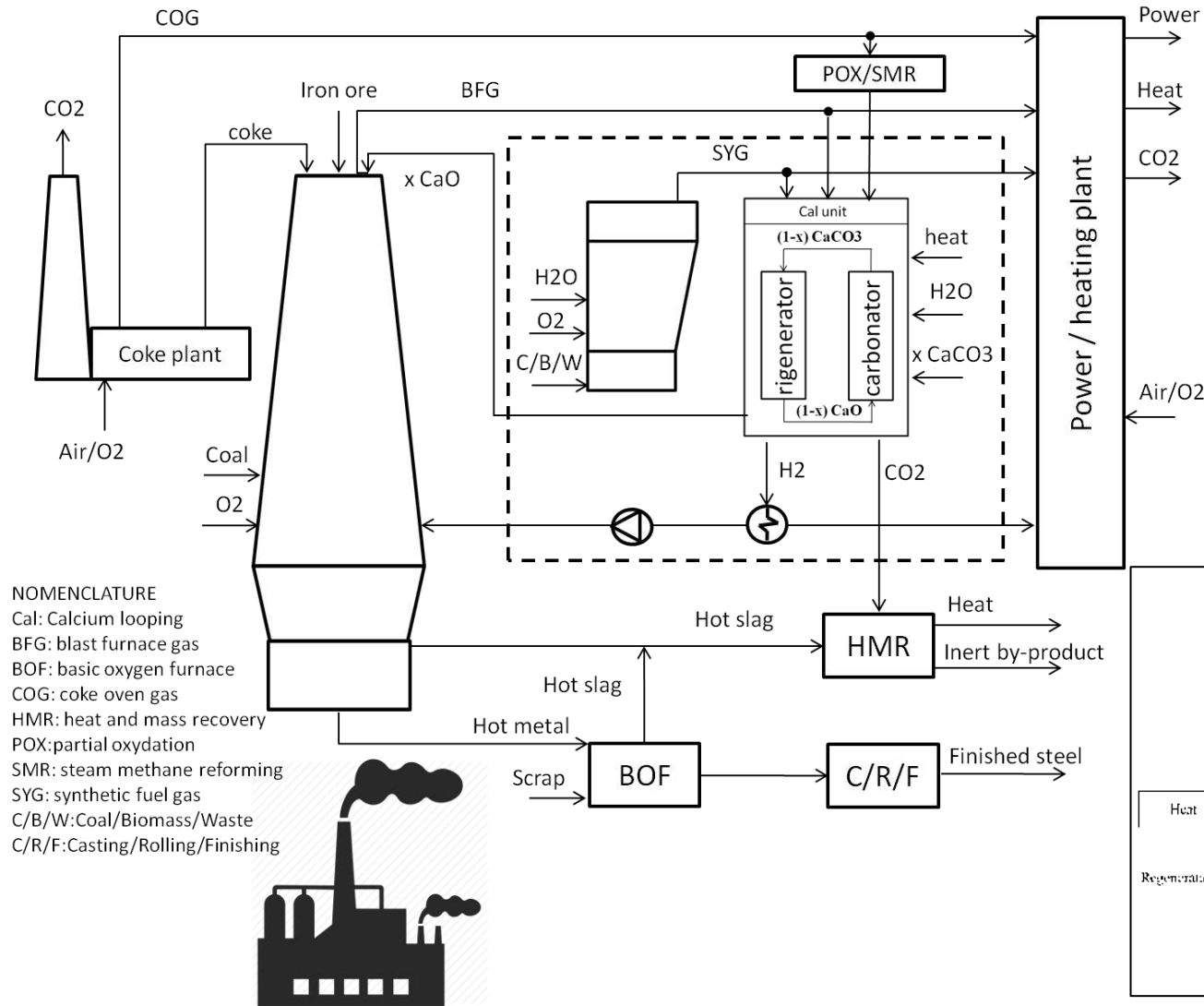
**Ottimizzazione economica:
CO₂CRC**

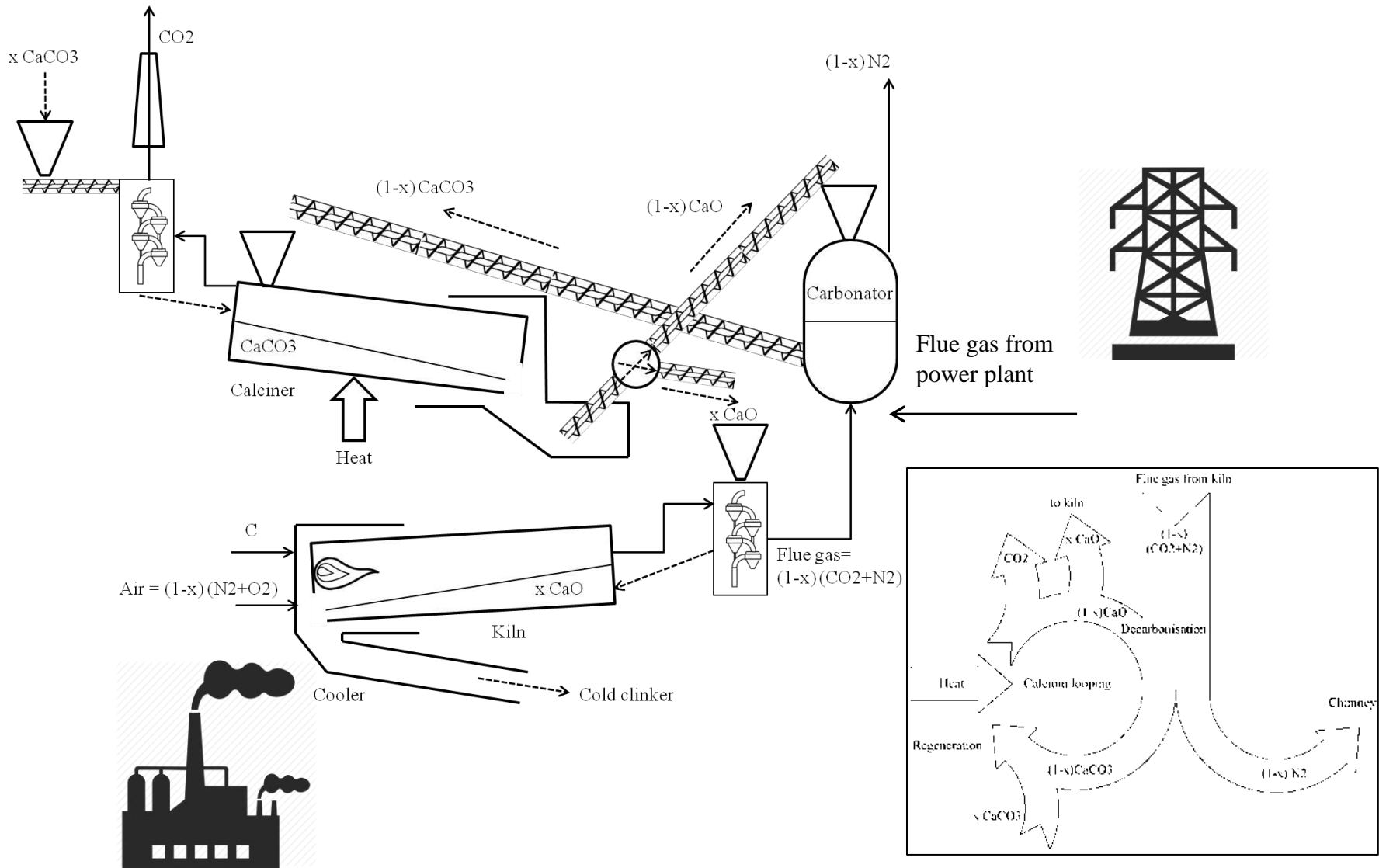
Quali saranno i nostri obiettivi futuri?

Decarbonizzazione intrinseca del settore industriale

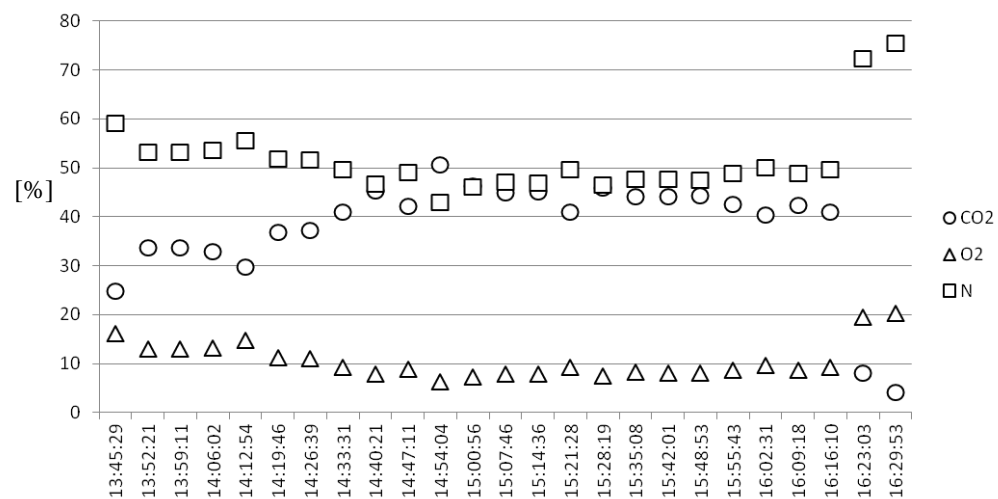
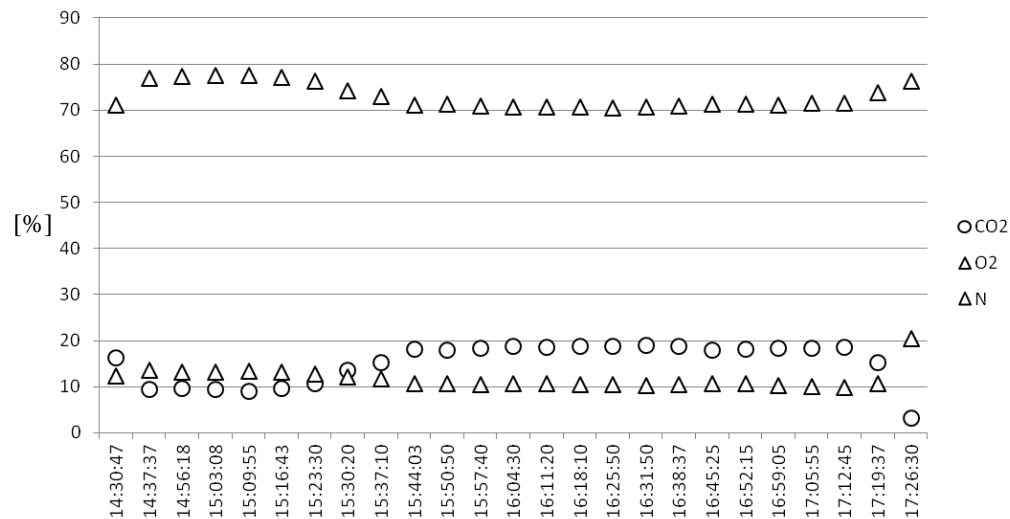
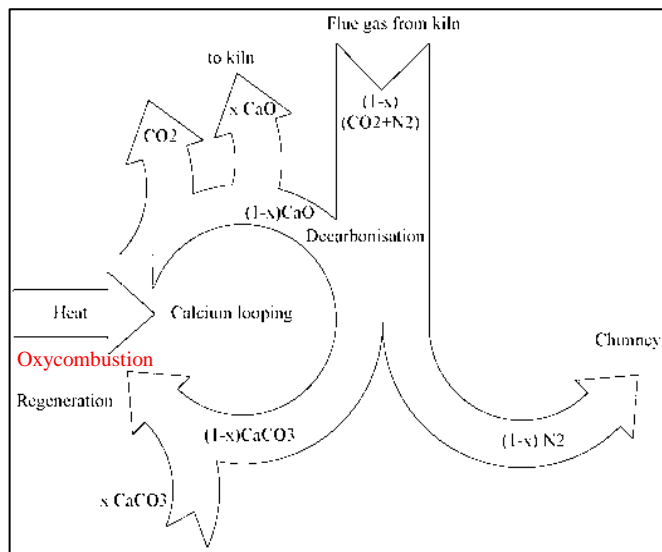


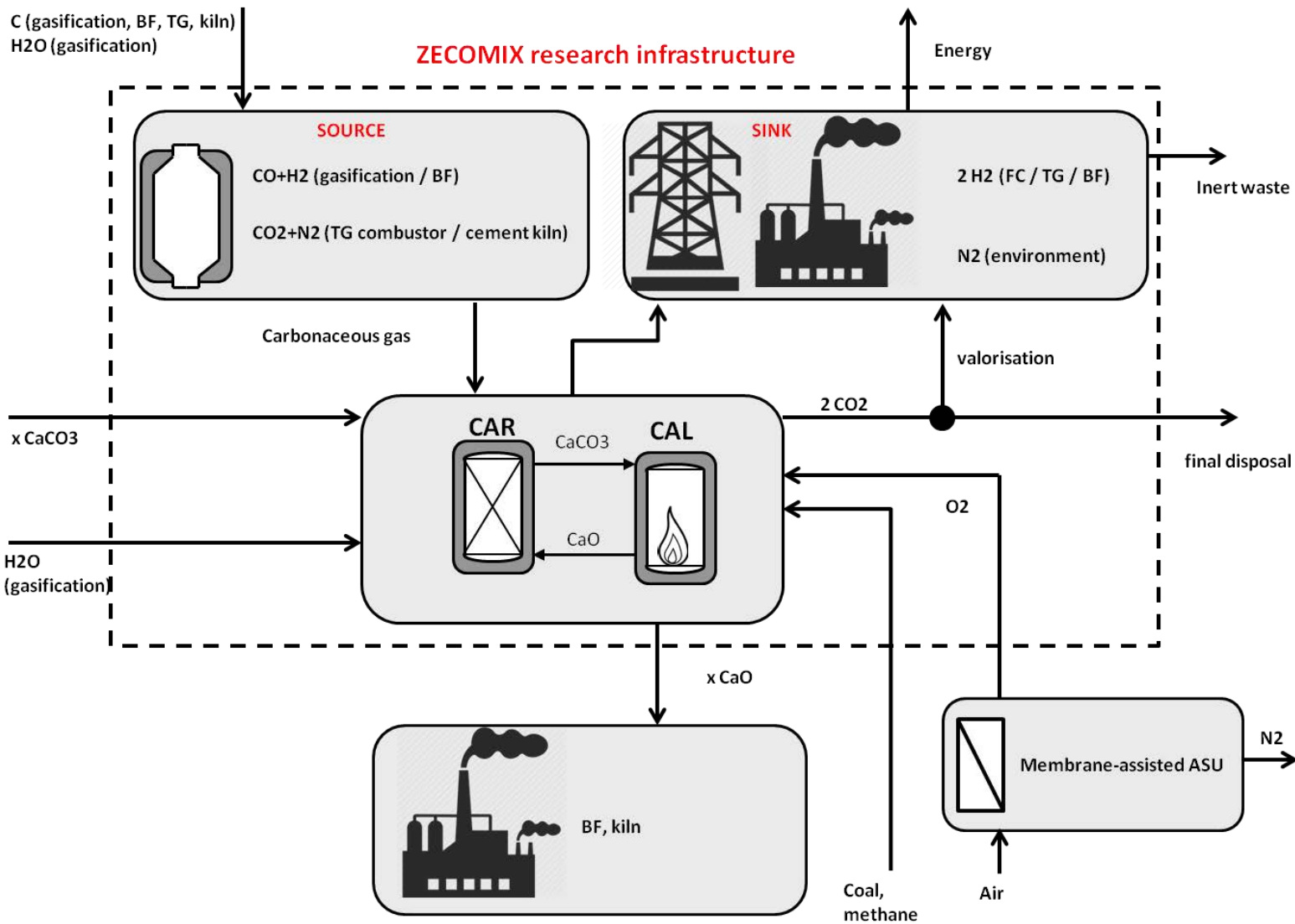
Acciaierie 2.0



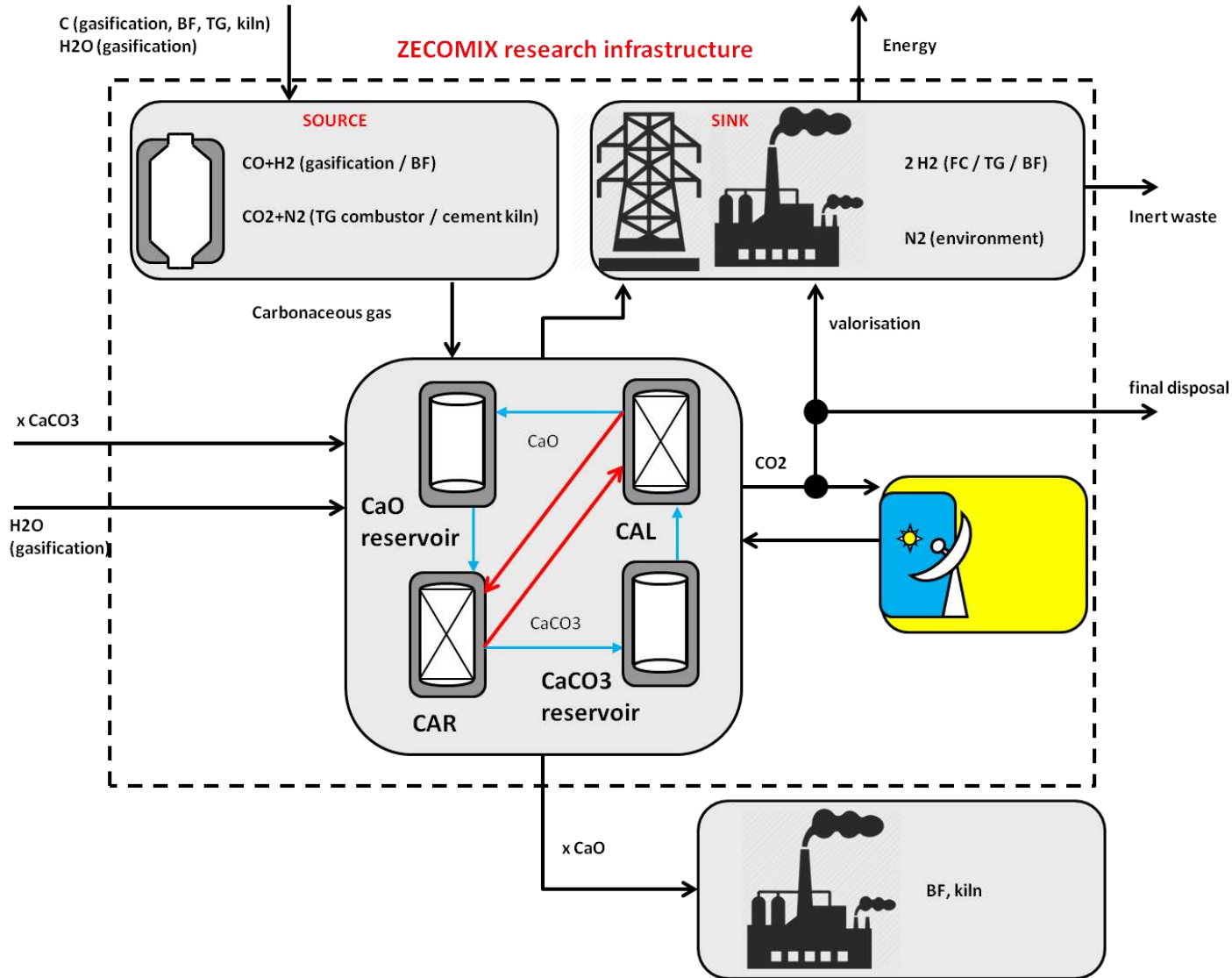


Effetti della CO2 sulla rigenerazione del sorbente





Calcium looping 2.0: la svolta sostenibile delle CCS



Sostenibile economicamente e ambientalmente

	Unità	Caso base (polverino di carbone)	CaL	Oxy-CFB
Costi specifici	[\$/kWe]	1900	2890	3500
Efficienza netta	[kWe/kWth]	0.450	0.388	0.350
Fattore emissione CO2	[kgCO2/MWhe]	750	67(*)	48(*)
Costo dell'elettricità (COE)	[\$/kWe]	0.047	0.066	0.077
Costo CO2 evitata	[\$/tCO2]	-	27	41

(*) Assumendo una efficienza di cattura della CO2 pari a 0.92 per CaL e 0.95 per Oxy-CFB ([Abanades et al 2015](#))

Possibilità di impiegare diverse tecnologie

Cilindro rotante, letto fluido

Integrazione intrinseca con industrie del cemento e dell'acciaio

Evoluzione di industrie mature: diminuzione delle materie prime, abbattimento della CO2, inertizzazione delle scorie

Cattura intrinseca dei composti solforati.

Le industrie del cemento tollerano una presenza CaSO4 non superiore al 10% in peso ([Weimer et al 2008](#))

Sinergia con le rinnovabili

Ulteriore diminuzione dell'uso delle fonti fossili, back-up per l'energia solare, accelerazione della diffusione dei sistemi a concentrazione solare (CSP)

Il trilemma delle CCS: trasferimento tecnologico verso realtà produttive intrinseco

