

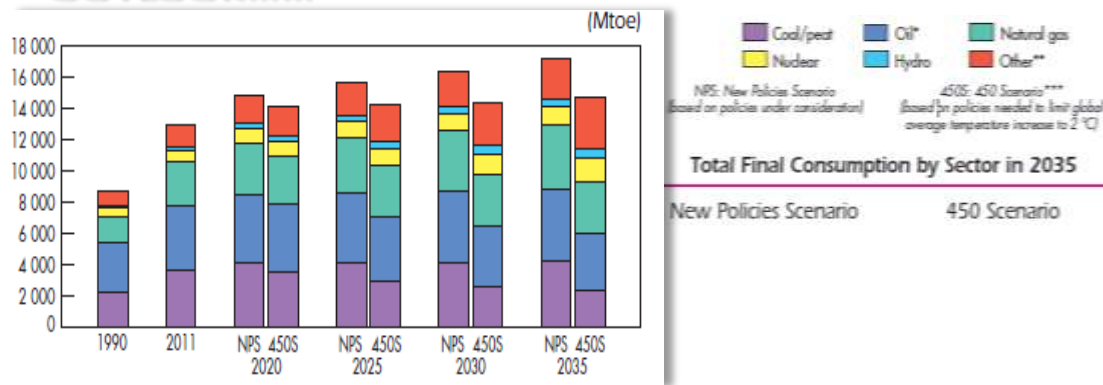
Fossil Fuels Processes and Technologies:



Clean Energy and Chemicals Production

CONTEXT

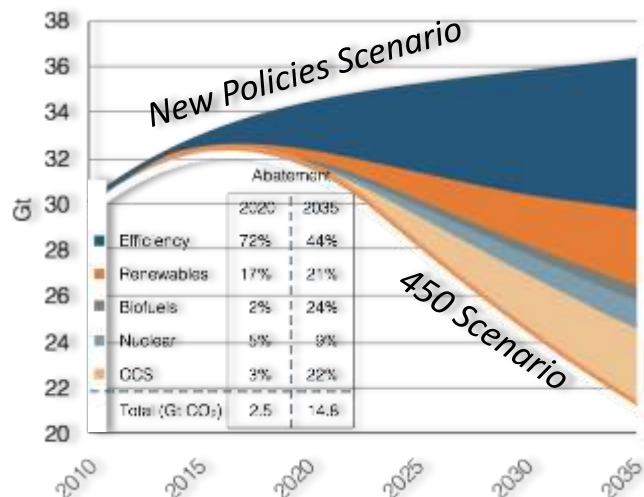
OUTLOOK.....



Total Primary Energy Supply

World Energy Outlook, International Energy Agency, 2012

GENERAL STRATEGY.....



World energy-related CO₂ emissions abatement in the 450 Scenario relative to the New Policies Scenario.

Energy Efficiency Technologies: Overview Report World Energy Council 2013

**In the medium term
Fossil Fuels will remain the
main energy source**

**Conventional fuels must
be used in
unconventional ways**

Low-Carbon technology

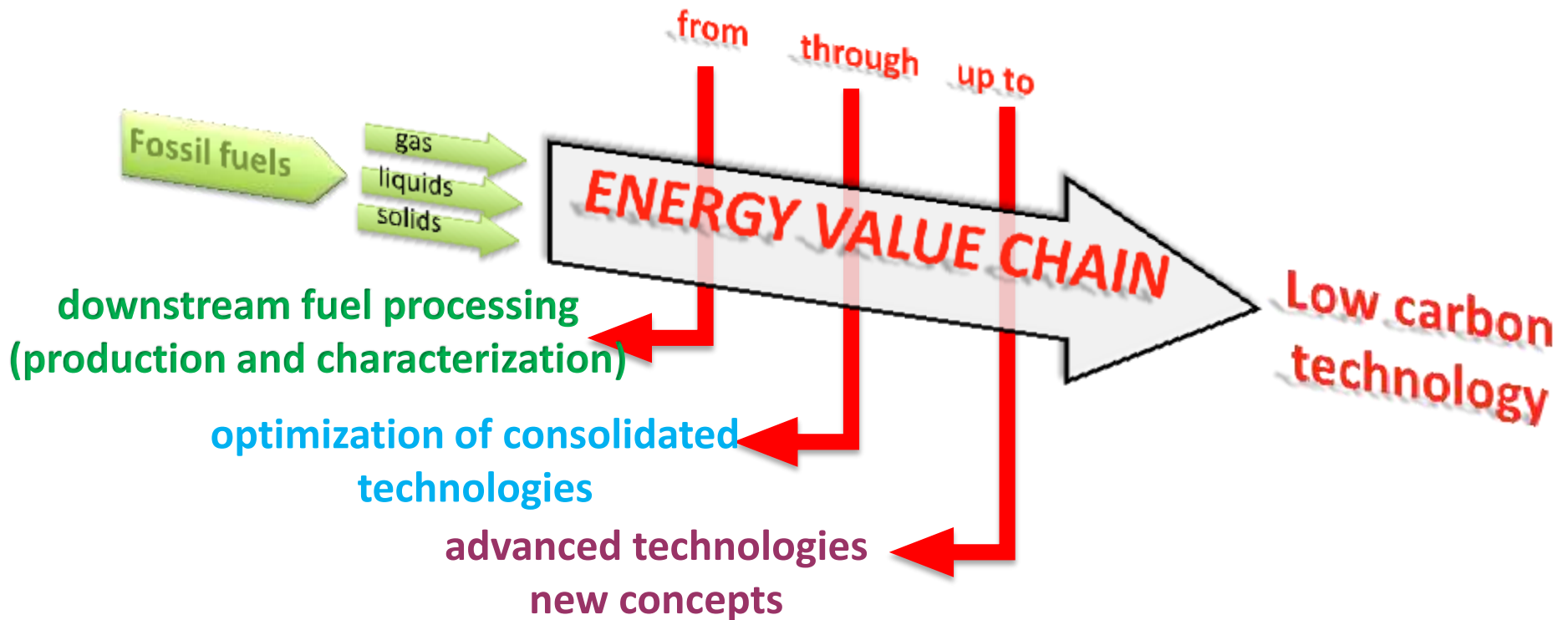
Efficiency

TOWARD

CCS

CHALLENGES.....at IRC

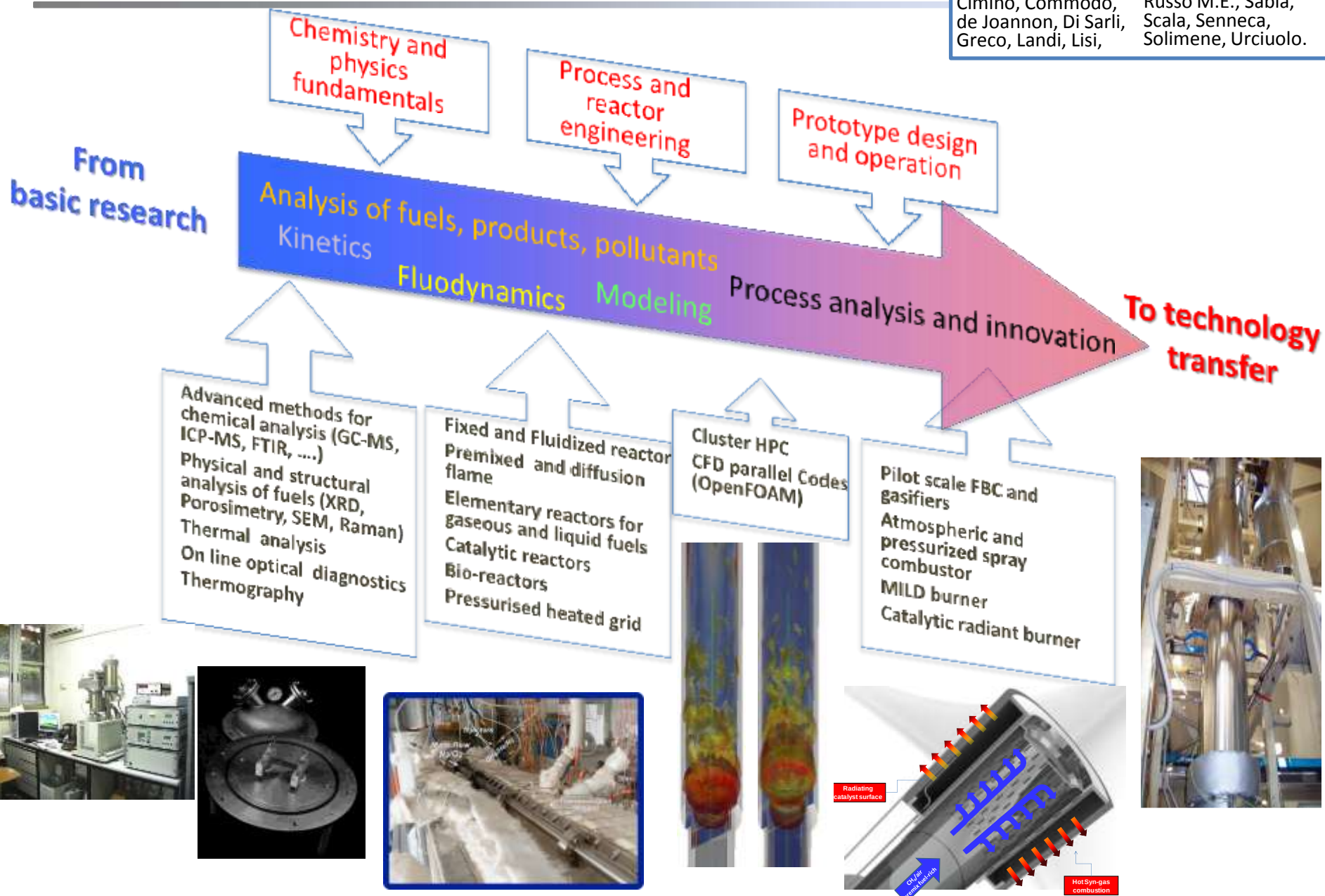
1. From fossils to added value feedstocks
2. Efficiency and performance of available processes
3. New concepts for low carbon technologies



SKILLS, APPROACH, FACILITIES

Researchers

Alfè, Allouis, Marra, Miccio,
Ammendola, Apicella, Minutolo, Ragucci,
Chirone, Cialolo, Ruoppolo, Russo L.,
Cimino, Commodo, Russo M.E., Sabia,
de Joannon, Di Sarli, Scala, Senneca,
Greco, Landi, Lisi, Solimene, Urciuolo.



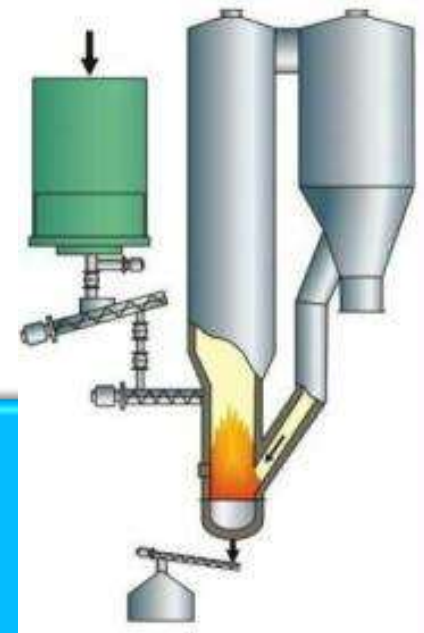


- Advanced analytical techniques for the characterization of liquid and solid fuels
- Behavior of solid fuels in different reactors and process conditions (fragmentation, agglomeration...)
- Fuels and products pretreatments (purification, ash valorization...)
- Detailed kinetics of solid carbon oxidation
- Catalytic Partial Oxidation/Reforming of gaseous fuels for production of syngas or olefines

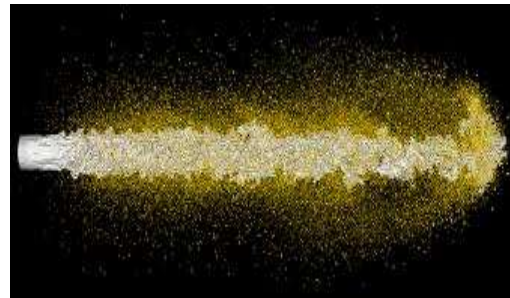
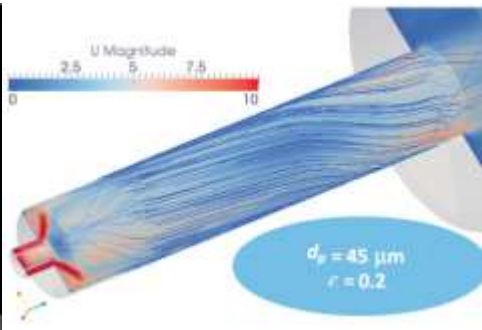
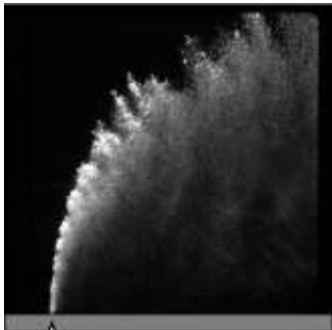


Competences

- Advanced methods for chemical analysis
- Reaction kinetics
- Chemical physical properties and microstructure
- Fragmentation phenomena
- Catalytic reaction engineering



- Turbogas flame stability and diagnostics
- Atomization of liquid fuels and high pressure spray combustion
- Mixing of turbulent gaseous flows
- Fluidinamics of entrained flow reactors and particles-slag interactions
- Advanced models of coal pyrolysis/combustion/gasification fragmentation/ annealing
- Dynamics of granular systems fluidized beds combustion and gasification
- Non linear dynamics of processes
- Particulate formation in combustion systems (gas burners, turbines, domestic stoves)

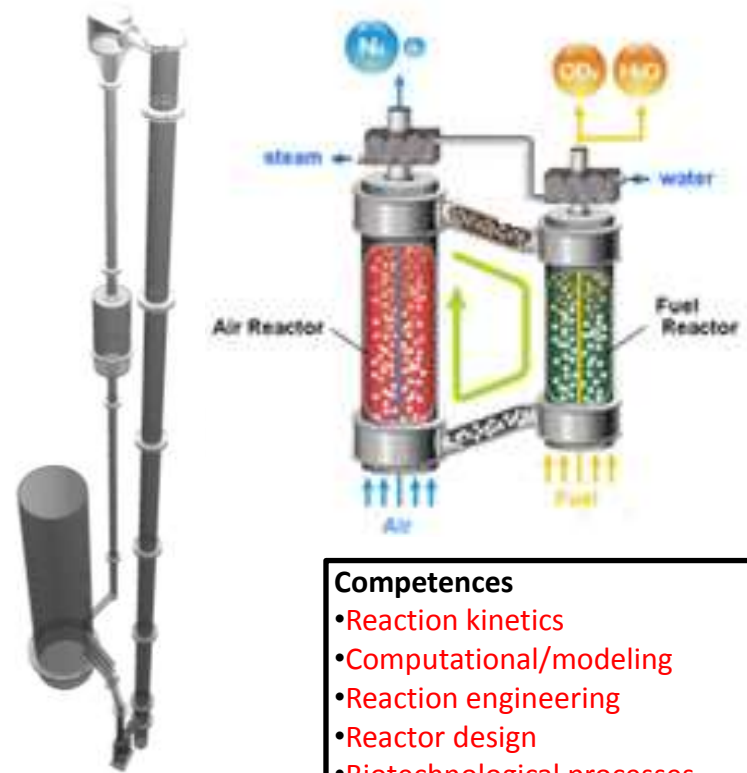
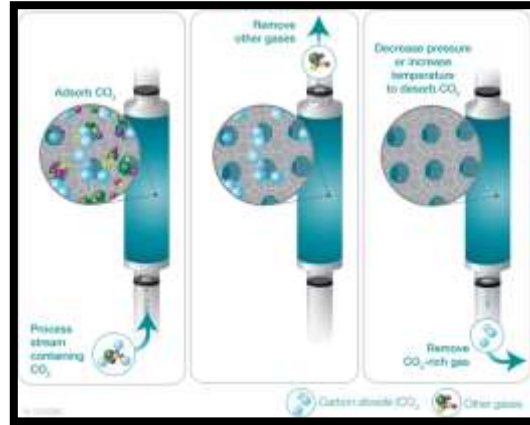
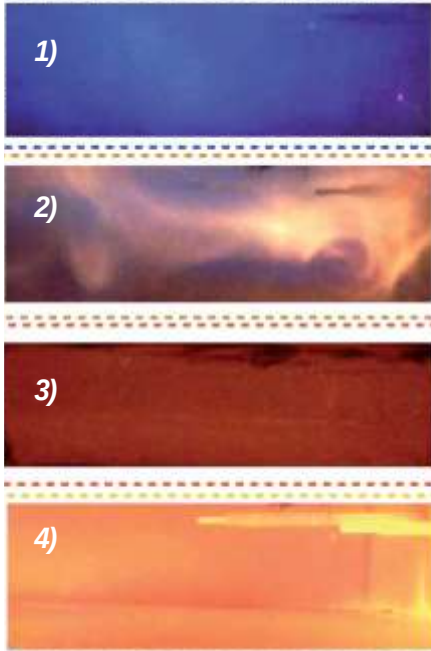


Competences

- Reaction kinetics
- Computational/modeling
- Reaction engineering
- Analysis of chemical and physical properties of fuels and products
- Fluidized beds

ACTIVITES

3. Advanced technologies/new concepts



Competences

- Reaction kinetics
- Computational/modeling
- Reaction engineering
- Reactor design
- Biotechnological processes

New combustion processes:

- Oxyfiring
- CLC
- Carboloop
- MILD
- Catalytic combustion

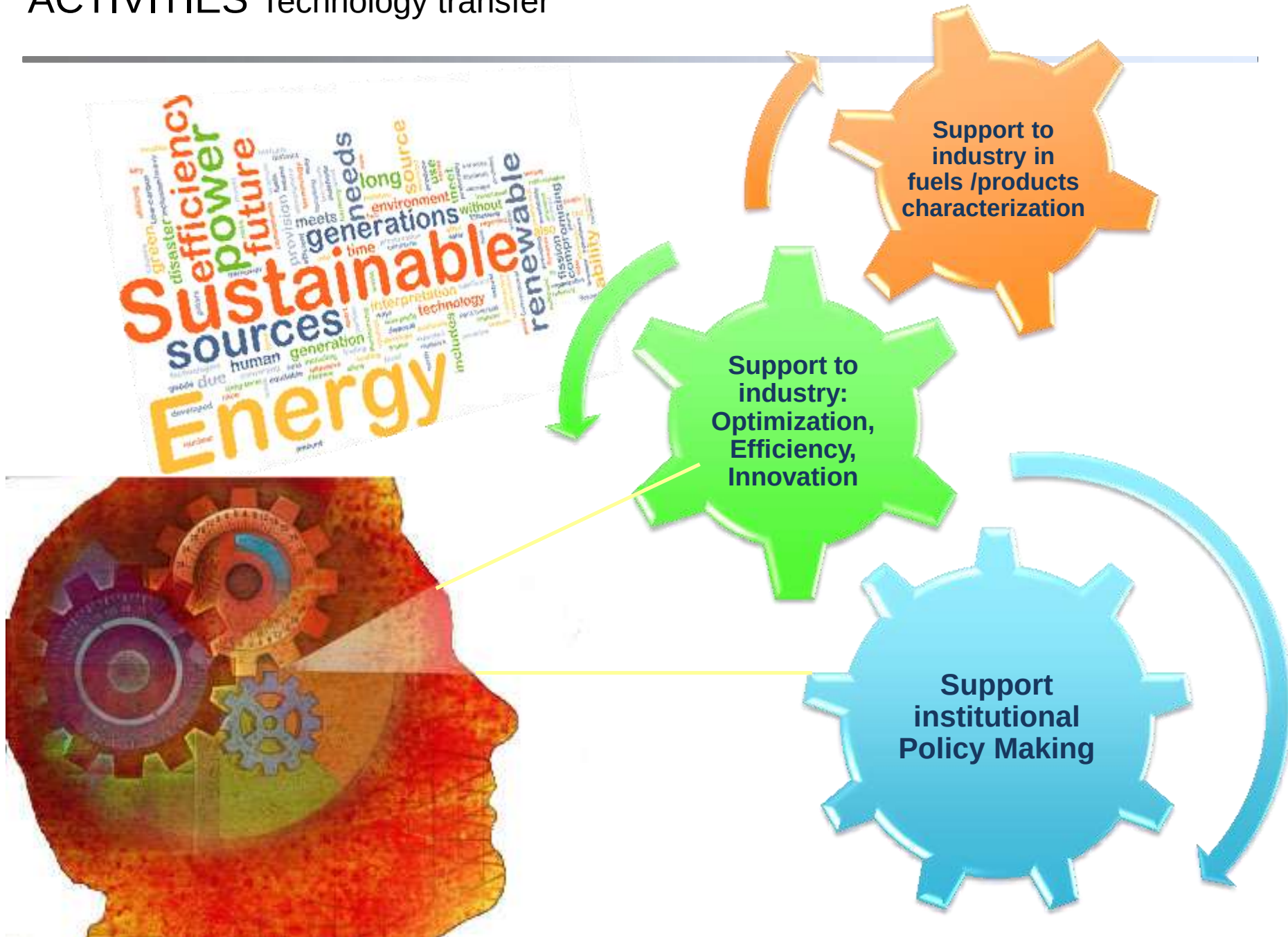
CO₂ capture:

- Calcium looping
- Biomimetic absorption
- CO₂ adsorption on nano-materials

CO₂ usage:

- Chemical storage/Power to Gas

ACTIVITIES Technology transfer



MAJOR PROJECTS AND COLLABORATIONS

Research institutions



Recent EU projects

RFCS-FLEXGAS, RFCS FECUNDUS, CAL-MOD

Industry



Public institutions



1. Downstream processing of fossil fuels

- From fuels to feedstocks: **Gas to Liquid; Coal to liquid**
- Low grade fossil fuels: **Gas Shales**, Tar Sands
- Fuels and products pretreatments/Fuel upgrade

2. Optimization of consolidated technologies

- **Flexibility** of power plants with respect to different fuels, in particular low value fuels
- Co-combustion
- Integration with ash post combustion and fuel pre-treatment
- Small scale (distributed energy, domestic boilers etc)

3. Advanced technologies/new concepts

- Chemical looping for syngas production
- Carbon looping gasification
- Integration with supercritical cycles
- Innovative methods for CO₂ utilization e.g. photocatalytic or biological processes (green chemistry)
- Frontier fuels (Methane hydrates etc...)