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

Renewable Energy Technical Unit

ENEA ACTIVITIES IN RENEWABLES

Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile

National Agency for New Technologies, Energy and Substainable Economic Development

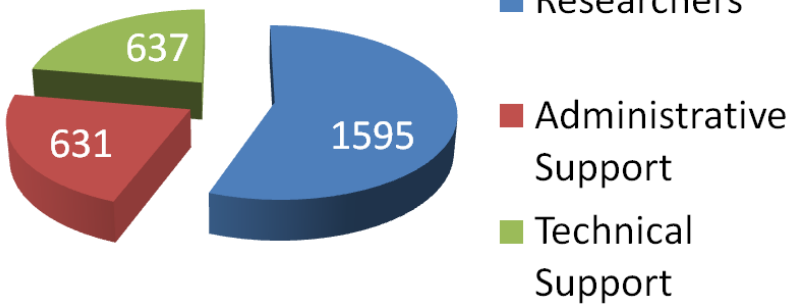
ENEA is a public organization operating in the fields of energy, sustainable economic development and new technologies in order to support competitiveness and sustainable development policies at the national level

MISSION:

supporting Italian energy policy through the promotion and innovation of sustainable technologies

ENEA in figures

Human Resources:
2700 permanent staff
71 temporary staff
Master and PhD students
International Fellows



Headquarters located in Rome
9 Research Centres
5 Research Laboratories
43 pilot plants and research facilities
11 Local Offices
Brussels Liason Office

R&D MAIN PROJECTS AND TOPICS

ENERGY
Nuclear Fusion
Nuclear Fission
Renewable Energy Sources
Energy Efficiency
Advanced Technologies for Energy and Industry
NEW TECHNOLOGIES
Radiation Applications
Material Technologies
Energy and Environment Modeling
ICT
SUSTAINABLE ECONOMIC DEVELOPMENT
Environment Characterization, Prevention and Recovery
Environmental Technologies
Sismic Protection
Radiation Biology and Human Health
Sustainable Development and Innovation of the AgroInd. System

ENEA for Renewable Energy Sources

ENEA is carrying out RD&D activities on:

- ✓ Concentrating Solar Power
- ✓ Solar Thermal
- ✓ Photovoltaic
- ✓ Biomass and Bio Fuel
- ✓ Wind Energy (Offshore and small scale)
- ✓ Energy from the sea
- ✓ Hydrogen, Fuel Cells and Storage Systems

ENEA ACTIVITIES IN RENEWABLE ENERGY

The ENEA activities in renewable energy are mainly carried out in three Centres:

- Casaccia (CSP, Photovoltaic, Bioenergy, Wind Energy, Energy from the sea, H2&FC, Storage)
- Portici (Photovoltaic)
- Trisaia (Bioenergy, Solar Thermal)

ENEA roadmap on concentrating solar power (CSP)

Industrial Demonstration plant

Test facility PCS

Lab R&D

2001 — Project Start-up

2002

2003 — Prototype Design

200

2005 — Prototype Operation start-up

2006

2007 — Components test and qualification

2008

2009 — Demo design and construction

201
0

Industrial role

Government role

Main activity lines in Concentrating Solar Power

- ✓ R, D&D of new solution for thermal fluid (new molten salt mixtures), critical components (receiver tube, steam generator, storage system) and plant configuration, in order to improve efficiency and reduce cost;
- ✓ Support to industry for components development, testing and qualification in ENEA facilities
- ✓ Support to engineering firms and utilities for design and construction of power plant of different size (from several hundred kW to 50 MW) and for various applications (power generation, hybrid plants, desalinisation, process heat...)
- ✓ Development of solar fuels

CSP – main projects

- **MATS**, European project (VII FP) started in July, 2011 and coordinated by ENEA *(Design, construction and operation in Egypt of 1 MW CSP plant for combined production of heat, power and desalinated)*
- **OPTS,** European project (VII FP) started in July, 2011 and coordinated by ENEA
- **SFERA I,II European project (VII FP)**
- **Archetype 550,** European project started in January, 2012 and coordinated by Enel Green Power *(Design, construction and operation in Sicily of 30 MW* - FP7 and NER 300)
- **EUROSOLARIS**
- **OMSoP,** European project started in February 2013 and coordinated by City University (Installation in ENEA CRE Casaccia of a DISH with MGT)
- **ORC-PLUS** European project and coordinated by ENEA *Design, construction and operation in Morocco of 1 MW CSP plant for power production)*
- **RESLAG** European project (Horizon 2020) started in September, 2015 and coordinated by CIC energune (*Design and testing of TES pilot system base on mixture of slag pallet (from iron industry) and molten salt.*

Italian National programs

- **Accordo di programma**
- **ELIOSLab**

ENEA is member of EERA JP CSP and has the coordination of sub program Thermal Energy Storage for CSP applications

Photovoltaic activities at ENEA

Manfredonia Test site :
(8 people)
-BOS components and grid-connected systems outdoor testing

ENEA Casaccia PV group :
(~ 15 people)
-Copper based semiconductors (Cu_2O and Cu_2-II-IV-VI) for PV devices.
-Innovative Processes for c-Si cells
-Consultant for c-Si Industries
-PV systems

ENEA Portici PV group :
(~ 60 people)
-Thin film a-Si/μc-Si PV
-Semiconductor Polymer PV
-Concentrator PV systems
-Modules and BOS qualification tests
-PV Systems and Smart Grids

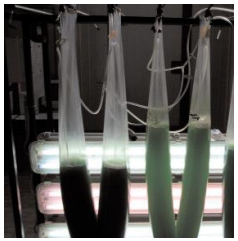
Solar thermal energy at low and medium temperature

- Quality and Reliability Test Laboratory for low temperature collectors
- Energy characterisation of collectors for uses at medium temperature (i.e. up to 300°C)
- Development of thermo-fluid-dynamic models for the optimisation of solar collectors, evaluation and optimisation of components for solar cooling systems

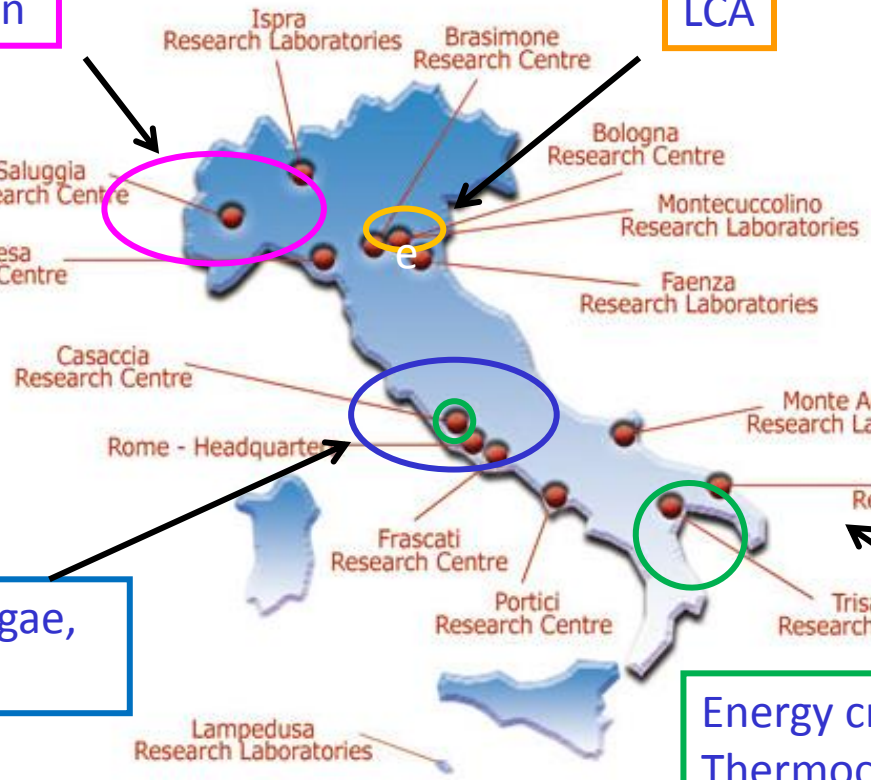
ENEA RESEARCH CENTRES WITH ACTIVITIES IN THE BIOMASS CONVERSION SECTOR

Biomass combustion

LCA



Biodiesel from microalgae, anaerobic digestion



Energy crops
Thermochemical processes
Second generation biofuels

ENEA Activities on biofuels

- **R,D&D activities for the production of:**
  - Bioethanol from glycerol and lignocellulosic materials
  - Biodiesel from microalgae and waste vegetable oil
  - Biofuels from syngas (BTL)
  - Hydrogen from AD
- **Biofuels implementation in to sustainable mobility**
- **Life Cycle Analysis on biofuels production**

The Steam Explosion Biomass Pretreatment Plant

Experimental microalgae cultivation

Biomass gasification and anaerobic digestion

- Development and testing of different technologies of biomass gasifier (fixed bed , steam or steam/oxygen fluidised bed), coupled with gas turbine and Molten Carbonate Fuel Cell for electric power generation
- Gasification plant to produce biofuels via synthesis processes
- Optimisation of anaerobic digestion processes for different types of biomass and waste
- Biogas clean-up and upgrading by chemical, physical and biologic processes

The Circulating Fluidised Bed steam-gasification Reactor coupled with Molten Carbonate Fuel Cell

Anaerobic digestion pilot plant (Marea plant in CRA-PCM centre)

Biogas R&D

Anaerobic Digestion

- Process optimization and co-digestion of diverse mixes (animal manure, sewage sludges, agriculture residues), with different digestors;
- Construction of novel digestors (prototypes) for lab testing and experimental plants;
- Support to private companies for design and construction of industrial systems.

Biogas Clean-up

- Chemical, physical and biological processes for biogas clean-up, purification and upgrading, for diverse uses (power generation, transport fuel, distribution by natural gas networks);
- Construction and testing of laboratory systems

ENEA Activities on Hydrogen and Fuel Cell

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HYDROGEN

- *Sustainable production from renewables and fossil fuels*
- *Materials for hydrogen storage (metal and chemical hydrides)*
- *Vehicle testing*

FUEL CELLS

Development and demonstration of:

- *polymer electrolyte fuel cell for stationary and transport applications*
- *High temperature fuel cell for on-site and distributed generation*

Hydrogen Production & Storage

- Production of hydrogen and hydrogen/methane mix by natural gas reforming based on solar heat
- Thermochemical hydrogen production based on solar heat
- Hydrogen and oxygen storage systems for submarine on-board use
- Small-size systems for hydrogen production from NaBH4

Hydrogen Thermochemical production plant

H_2 Generator from $NaBH_4$ (co-operation ErreDue Co.)

Fuel Cell Systems

- R&D on fuel cells components for polymeric FC (PEMFC), molten carbonate FC (MCFC) and solid oxide FC (SOFC);
- Small-size PEMFC with GPL supply;
- SOFC-based co-generation systems for residential use (1-2.5 kW);
- High-temperature FC with biogas supply;
- Lifetime and lifecycle analysis of fuel cells and integration into electrical grids.

1-kW PEMFC, GPL supply

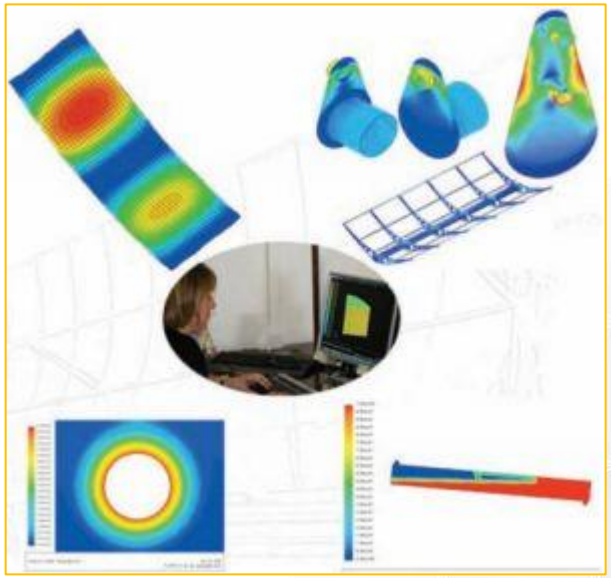
Test facility for MCFC

Plant and component design laboratory

It conducts theoretical and numerical studies and experimental tests aimed at the design of components and systems in the renewable energy sector.

Structural analysis, thermo-fluido dynamic assessment, process analysis by commercial (ANSYS, FLUENT, ABAQUS, COMSOL, ASPEN) and home made SW.

Qualifying tests on solar receiving tubes.



website: www.enea.it