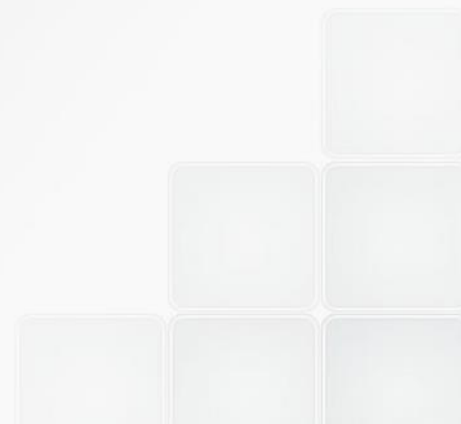




Research and Innovation for Sustainable Development

Overview of ENEA role and activities

EnR meetings, 13-15 June 2017



About us



- ENEA is the Italian National Agency for New Technologies, Energy and Sustainable Economic Development.
- It is a **Public Research Institution** operating in the fields of **energy**, **environment** and **new technologies** to support Country's competitiveness and sustainable development.
- ENEA's mission is to search for new technological solutions to **meet the societal challenges**, fostering transition to the Green Economy.
- The institutional mandate of the Agency is to disseminate and transfer **knowledge, innovation and technology** to industry, institutions and civil society at large.

65-year-old history of research and innovation



1952

- Establishment of the National Committee for Nuclear Research (CNRN) within CNR
- Mission and scope: development of **civil applications of nuclear energy** in a **multidisciplinary** approach

1962

- Conversion into the National Committee for Nuclear Energy (CNEN)
- Mission: **centre of excellence for technology development** to support rising national industry

1982

- Establishment of ENEA, Italian National Agency for Atomic Energy and Alternative Energies
- **Energy** issues became a **major research focus** alongside the traditional nuclear research

1991

2003

- Further enlargements of the mission and broadening of the research areas
- **Renewable energy, environmental protection, innovation**, become central

2009

- ENEA becomes **Agency, under the Ministry of Economic Development** with a revised mission of R&TD in the fields of energy and new technologies
- The Agency has a leading role in promoting **innovation for a sustainable and competitive development**

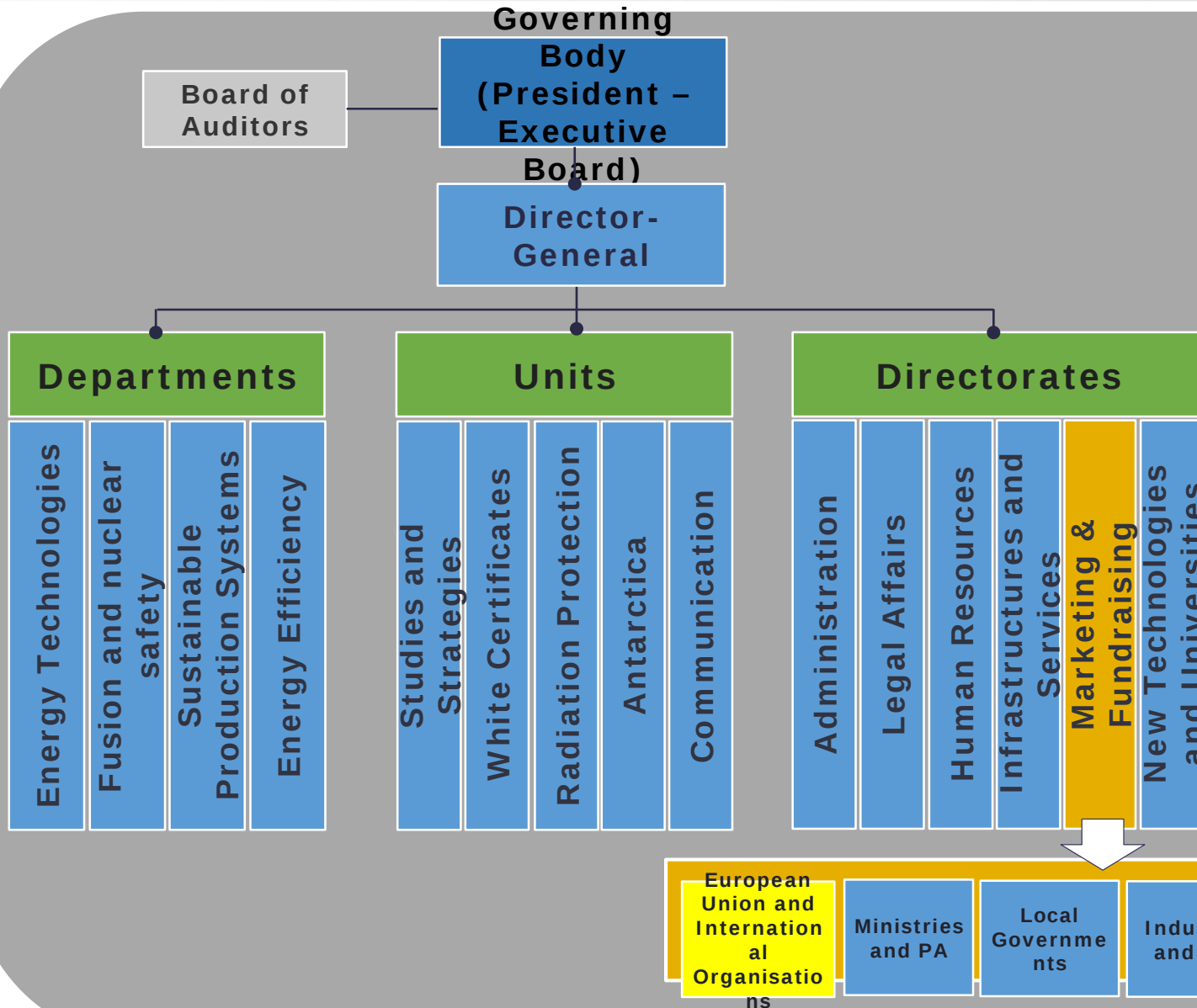
ENEA: legal framework



ENEA is a public body aimed at research and technological innovation, as well as the provision of advanced services to businesses, governmental bodies and citizens in the energy, environment and sustainable economic development fields.

*ENEA fulfills the functions of **National Agency for Energy Efficiency** under Legislative Decree 30 May 2008 n° 115, and any other function assigned by applicable law or delegated by the Ministry of Economic Development, to which ENEA provides support in the areas of competence and with reference to the participation in specific working groups at national, European and international level.”*

ENEA: organisation chart



Activities

ENEA mainly operates to promote and carry out basic and **applied research** and innovation technology activities:

- **Research**: basic, mission-oriented, and industrial research, also through development of prototypes and product industrialization
- **Technology Transfer**: dissemination and transfer of research results to industry and exploitation for production purposes
- **Advanced services**: studies, measurements, tests and assessments to both public and private bodies and enterprises
- **Training and information**: activities aimed at broadening sector expertise and public knowledge and awareness



Research facilities and staff

Research facilities

- **9** Research Centres
- **5** Research Laboratories
- **43** pilot plants and test facilities
- **11** local offices
- **Brussels** Liaison Office
- **Headquarters** in Rome

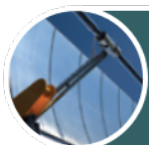
Human Resources

2487 permanent staff
(31/12/16):

- **1835** in Technical Units
- **350** in Research Centres
Directorates
- **291** in Central Units
- **11** in other staff Units



Research and Development



Energy

Renewable energy sources, Energy efficiency, Bio-fuels, Energy policy



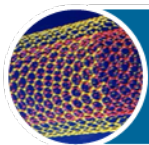
Nuclear Technologies

Fusion, Fission, Radiation protection, Ionizing/non ionizing radiation applications



Environment

Prevention and Recovery, Climate change, Environmental Technologies
Energy and Environmental Modeling



Enabling Technologies

Nanotechnologies and new materials, plant biotechnologies, photonics, sensors



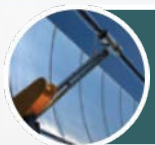
ICT

CRESCO Supercomputer, GIS, computational methods



Agri-food

Innovation for the agro-industrial chain, *green chemistry*



Energy: renewable energy

- ENEA carries out R&D of technologies for the exploitation of renewable energy sources, aiming at reducing greenhouse gas emissions and dependence on fossil fuels.



Concentrated Solar Power (CSP)

- Research Facility with linear parabolic collectors and molten salts heat pipes (ENEA patented technology)



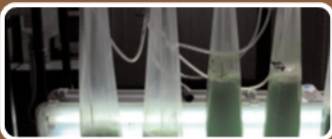
Photovoltaics

- New generation PV systems and concentrated photovoltaic (CPV)
- New PV materials: Thin film, high-efficiency PV cells, organic photovoltaics



Solar Thermal Energy at low and medium temperatures

- Optimization of solar collectors, development of components and systems for solar cooling
- Energetic characterization of solar collectors at low and medium temperature



Biomass and bio-fuels

- Production of hydrogen from agricultural waste, biogas and bio-fuels from biomass
- Production of bio-fuels from micro-algae



Distributed power generation and Energy Storage Systems

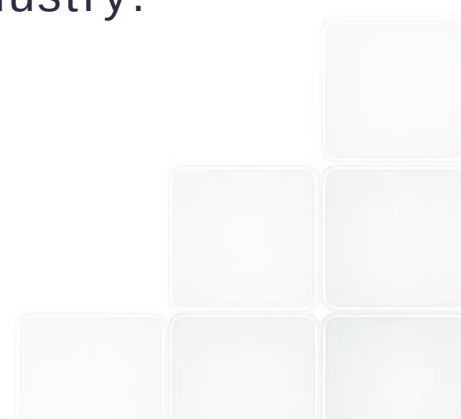
- Electrochemical systems for the conversion and storage of hydrogen energy, supercapacitors
- Co-generation systems, fuel cells, new materials, high-efficiency lithium batteries
- Distributed power generation and renewable sources



Energy: energy efficiency



- In 2008 ENEA has been appointed as the **Italian National Agency for Energy Efficiency** with the mission of contributing to the national energy policy by **implementing measures** and setting up actions for energy efficiency.
- Main tasks are: supporting State, Regions and Local governments with **technical and scientific expertise**; verifying energy saving and efficiency projects and compliance to the related measures.
- ENEA also develops methodologies and **technologies for energy efficiency** and the optimization of end-use efficiency in different sectors such as residential, services, industry.





Energy: energy efficiency



- ENEA develops methodologies and **technologies for energy efficiency** and the optimization of end-use efficiency in different sectors such as residential, services, industry:



Solar heating and cooling

- Design, development and engineering of solar heating and cooling systems for residential building
- Development and engineering of high efficiency heat pumps (air- and water-sourced heat pumps, absorption HP)



Public Lighting

Development and test of innovative **high-efficiency lamps** (LED lamps, PV lamps) and smart lampposts
Development of software for designing energy efficiency systems and intelligent control systems
Implementation of pilot systems for intelligent lighting; Transfer, technical support and advice to local governments



Residential

Development of **software for energy audits** in residential and tertiary sector (offices, schools, sports facilities...)
Definition of **standards and methodologies** for *Nearly Zero Energy Building* (NZEB); Design of net zero energy buildings compliant to the European Directive 2010/31/EC on energy performance
Development of 'Cool Materials' and **shielding envelopes** for energy efficient buildings



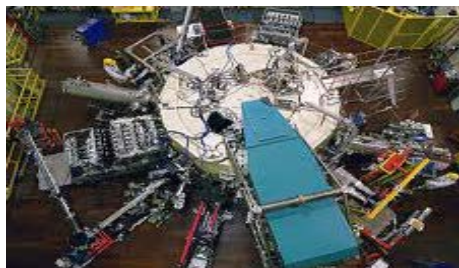
Transports

Development of modular **fast charging** batteries, electric vehicle fast charging facilities, hybrid storage systems (batteries + supercapacitors)
Light and recyclable vehicles: design and assembly of prototype vehicles with **new light materials** (foams of aluminium alloys, polymer composite loaded with natural fibers)



Nuclear technologies

Fusion, fission, radioprotection, ionizing/non ionizing radiation applications



- The Agency is a research pioneer of nuclear **fusion**, one of the most useful options to ensure the availability on a large scale of an energy source that is safe, environmental friendly and actually inexhaustible. Moreover ENEA is the Coordinator of the National Programme



- In the field of nuclear **fission** the Agency is working on the technical-economical evaluation in terms of sustainability, and safety of third generation reactors; development of new generation (III+ e IV) systems; qualification of nuclear components and systems



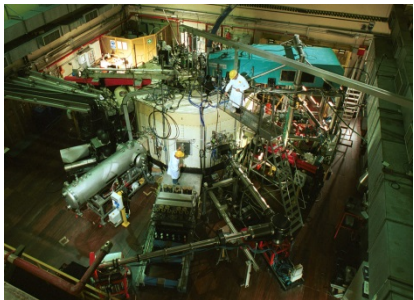
- The research activities include **ionizing radiation metrology** and **radiation protection**, for health and safety purposes



- Starting from nuclear research applications, it developed **lasers** for environmental diagnostics, industrial applications, **health applications and diagnostics**, cultural heritage preservation, security



Big Challenges: Nuclear Fusion



- ENEA is a pioneer in research on plasma physics since the '50s.
- Nuclear fusion research focuses both on magnetic confinement with activities related to reactor technologies, and on inertial confinement.
- ENEA is working on **magnetic confinement physics** by means of FTU (**Frascati Tokamak Upgrade**) plant, a nuclear fusion machine operating at the highest magnetic field (8 T).

The Agency performs its activities within **consolidated international collaborations**, working together with the industry. Nowadays the Agency:

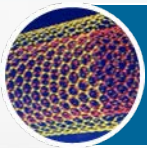
- coordinates the **National Fusion Research Programme**
- is a leading actor in the **EURATOM Programme** (EU and Switzerland)
- participates in the **ITER Project** (EU, Japan, USA, Russia, China, Korea, India)
- participates in the **Broader Approach** (EU and Japan) project, contributing to the development of **superconducting magnets** and other components of the JT60-SA tokamak being constructed in Japan (maiden ceremony on May 2013)
- is involved in the development of **FAST (Fusion Advanced Studies Torus)** tokamak reactor, an EU satellite ITER experiment

ENEA know-how makes the Agency play a key role in the ITER project as it operates in close collaboration with industry.

Thanks to its involvement in the nuclear fusion research programme, the Italian industry has obtained the largest orders for the construction of ITER core components:

- **superconducting cables**
- **the European share of superconducting magnets (9 coils out of a total of 18)**
- **and the vacuum chamber (7 sectors)**





Enabling technologies

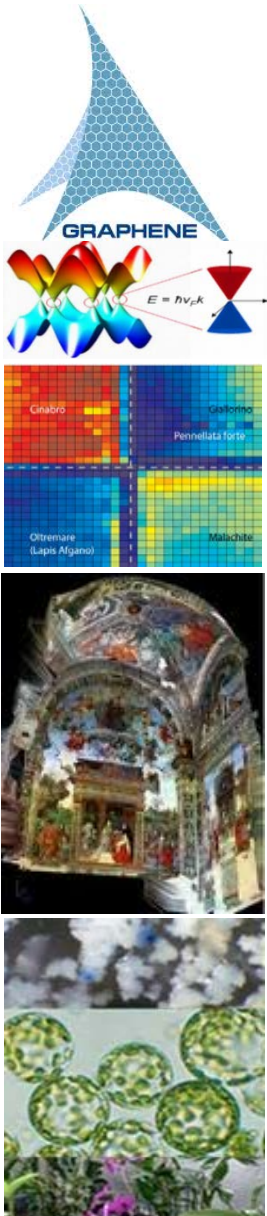
Nanotech and new materials, plant biotech, photonics, sensors



The Agency works in all those fields where the **enabling technologies** make technology breakthrough possible:

- **Nanotechnologies**, **nanomaterials** and **advanced materials** in: *energy and transport*, with main advantages in terms of safety, efficiency and costs reduction; *residential sector*, with increased reliability and resistance, energy efficiency and environmental building sustainability; *ceramic industry, chemistry, biomedicine, aeronautics, automotive, agri-food*, etc.
- **Photonics** in the fields of high energy physics, aerospace, bio-medical and industrial diagnostics; e.g.: fiber optics systems for the monitoring of residential buildings, transports, cultural heritage, remote sensing systems for aerospace
- **Plant biotechnologies** for human nutrition, food quality and safety, green chemistry, biopharmaceuticals plant vaccines, bioenergy, environmental application and bioremediation

ENEA also develops key enabling technologies for the energy sector **in an international cooperation context** e.g.: in cooperation with the *French Commissariat à l'énergie atomique et aux énergies alternatives* (CEA)



KETs are the hearth and brain of the industrial innovation and possess a still not fully expressed potential, to create new qualified employment in Europe.



ICT

CRESCO Supercomputer, GIS, computational methods

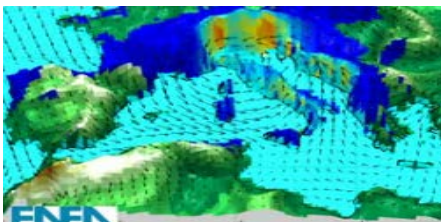
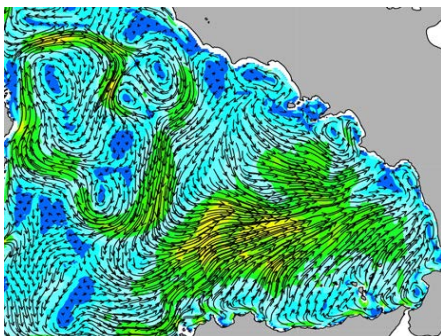


CRESCO supercomputer (Computational Centre for Research on Complex Systems) represents a **leading computational infrastructure** for the study of complex systems.

It allows to access the Agency's HPC resources, software applications and remote 3D visualization systems for **Virtual Labs**:

- Neptunius Lab for fluido-dynamics
- Madia: Multi Approach to Data Integrity Activities
- CMAST: Computational Material Science
- Fission Lab
- DySCo – Dynamic Shakers Lab
- Sophia - Software Infrastructure
- Itacha – Cultural Heritage Technologies
- Smartcities - ICT for urban systems
- Tigris - Virtual Lab for Assirology
- Graphlab – 3D Graphic Applications

The Agency produces models, **computational methods**, **GIS systems** in its R&D main sectors of competence and for specific applications for the market.





Environment

Prevention and Recovery, Climate change, Environmental Technologies
Energy and Environmental Modeling



In the environmental field the **multidisciplinary approach** includes competences in the fields of engineering, geology, chemistry, microbiology, eco-toxicology, sensors and modeling

R&D main fields:

- **Environmental protection** (soil and water)
- Characterization, prevention and **bio-remediation**
- **Water cycle** technologies and water resources management
- **Waste cycle** technologies
- Evaluation models for **atmospheric pollution**
- **Eco-innovation** of industrial processes and eco-design
- **Environmental certification and management tools**
- **Environmental modeling** with GIS e satellite systems (CC, experimental oceanography, marine environment study, regional models etc.)
- **Risk analysis** and impact evaluation for mitigation of risks linked to natural phenomena





Big challenges: Antarctica and research in Polar areas

- Antarctica is a perfect natural laboratory for a global study of the planet Earth and of **climate changes** related phenomena
- Research in polar areas started in 1985, with the First Antarctica Programme (PNRA) and the first expedition
- Activities are carried out at **Mario Zucchelli Station**, located in Terra Nova Bay, Victoria Land and at the **joint Italian-French Concordia Station** located at Dome C, on the Antarctic Plateau, at 3.233 m above sea level and also at foreign research facilities and/or ships and **in the Ross Sea**, during oceanographic campaigns
- ENEA coordinates all the **logistics**: procurement of goods and services, planning and scheduling of the logistic means supporting the campaign activities
- The Agency **selects and trains the human resources** necessary to the campaign (technicians, support staff, researchers)
- Moreover it contributes to evaluation and mitigation of environmental impact of expeditions on the Antarctic environment, in compliance with the international agreements





Agri-food

Innovation for the agro-industrial chain, *green chemistry*



Main R&D fields:

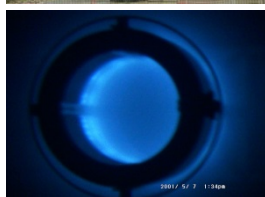
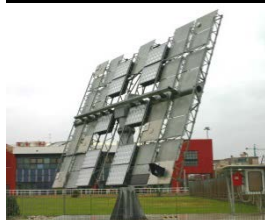
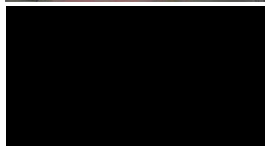
- Vegetable species selection to obtain **raw materials and products** characterized by high biological value and for the sake of biodiversity
- R&D and TT for **microbial and plant biodiversity**
- *In vivo* and *in vitro* **breeding** of new plant varieties
- Innovative **processing and preservation** technologies with low energy input
- Product/process innovation for the food chain, **functional foods (nutraceuticals)**
- Food **advanced diagnostics tools** and methodologies for microbiological and chemical analysis of raw materials and food products
- Plant systems and food waste **characterization**, down-stream processing and purification
- Methods and reference materials for **food quality and safety**



Advanced labs and plants

Wide range of expertise, advanced facilities and tools, are located in ENEA Research Centres. They operate in support of ENEA's programmes and also at disposal of scientific and productive systems:

- **Dynamic shakers:** they are among the biggest European infrastructures to perform seismic tests for new materials and innovative technologies.
- **CSP Facility:** The facility allows to test, under actual operating conditions and qualification procedures, components and systems of thermodynamic solar plants through linear parabolic trough collectors using a molten salt loop.
- **PhoCUS-5 Standard Unit:** The Photovoltaic Concentrators to Utility Scale is a 5 kWp unit made up of a two-axis tracker with a 35 m² flat plate equipped with 51 concentrating modules. It represents one of the Italian outstanding achievements in the field of concentrating photovoltaic.
- **The National Institute of Ionizing Radiation Metrology:** It is a primary Metrology Institute that ensures the reliability of the ionizing radiations measurements in all fields (radiotherapy, radiodiagnostics, radioprotection in environmental field, in hospitals etc.).
- **Calliope:** it is an experimental γ irradiation plant for qualification of materials and components of aereo-space, nuclear and electronic industry; food irradiation, environmental treatments and cultural heritage applications.
- **Divertor Test Platform:** The DTP plant reproduces a 1:1 scale portion of the vacuum chamber of a thermonuclear fusion reactor and is used for remote maintenance tests on prototypical cassettes and other divertor components
- **Agrobiopolis Innovation Center:** for R&D and TT of processing technologies and innovative diagnostic methods aimed at improving food quality and safety; new raw materials, ingredients, and "functional foods"; characterization, extraction, and purification of molecules of nutritional and industrial interest from plant and agro-industrial residues.
- **Steam Explosion Pilot Plant:** It can treat 300 kg/h biomass and allows to develop research and demonstration projects on liquid bio-fuels produced by fermentation processes (ethanol) for energy and non-energy purposes.



ENEA Research main fields of application



Multidisciplinary ENEA R&D is applied for:

- **Cultural heritage preservation:** conservation and valorization by applying its advanced know-how, sophisticated technologies, complex test facilities, data processing and interpretation skills, such as *bio-remediation*, laser scanner for 3D imaging and virtual reality, diagnostics.
- **Health:** ionizing radiation for radiotherapy, nuclear medicine, advanced materials; plant biotechnologies for medical applications (e.g.: vaccines).
- **Security:** previously developed nuclear competences are implemented with sensors, automation, ICT to improve national security standards.
- **Mobility:** development of energy vectors and electrochemical systems for energy conversion and storage, to reduce energy consumption and emissions in the distributed energy and transport sectors; implementation of Intelligent Transport Systems.
- **Grid management and security:** R&D is devoted to innovating the Italian national electric system, enhancing the system's reliability and the service quality, reducing the electric system impact on health and the environment.
- **Seismic protection:** development of innovative anti-seismic devices and systems, also providing consulting services, tests and certifications of critical and strategic structures.



International cooperation 1#2



ENEA experts participate in international projects, networks, committees and working groups:

European Research Programmes

- **167** projects in 7FP with a financial contribution of **46 Meuro** (2007-2012)
- 156 ongoing projects during 2012, financed also by other programmes, for a total contribution of 38 Meuro
- **1100** partners from Europe, the Southern Mediterranean Basin and the rest of the world (2012)

International Networks

- EERA (European Energy Research Alliance)
- ECRA (European Climate Research Alliance)
- European Energy Network
- Mediterranean Association of the National Agencies for Energy Conservation (MEDENER)
- TAFTIE - the Association For Technology Implementation In Europe
- Enterprise Europe Network, the most important European network for TT

Technology Platforms

- ENEA participates in many European Technology Platforms and respective National Platforms + 9 Technology Alliances

International Organizations

ENEA experts participate in committees and working groups of the following multilateral organisations:

- IAEA - The International Atomic Energy Agency
- IEA - International Energy Agency
- NEA - Nuclear Energy Agency
- OECD – Organisation for Economic Cooperation and Development

Bilateral Cooperation Agreements with major players

- **Europe:** Albania, Cyprus, EU (JRC), France, Germany, Luxemburg, Russia, Sweden
- **extra Europe:** China, Egypt, India, Israel, **Japan**, Latin America, South Korea, Taiwan, USA



LE RÉSEAU MEDENER > MEDENER'S NETWORK

- > **ADEME**
FRANCE - FRANCE
- > **ADENE**
PORTUGAL - PORTUGAL
- > **ADEREE**
MAROC - MOROCCO
- > **ALMEE**
LIBAN - LEBANON
- > **ANME**
TUNISIE - TUNISIA
- > **APRUE**
ALGÉRIE - ALGERIA
- > **CRES**
GRÈCE - GREECE
- > **ENEA**
ITALIE - ITALY
- > **IDAE**
ESPAGNE - SPAIN
- > **NERC**
JORDANIE - JORDAN
- > **NERC**
SYRIE- SYRIA
- > **PEC**
AUTORITÉ PALESTINIENNE -
PALESTINIAN AUTHORITY



- 1 Échange de bonnes pratiques
Exchanging of good practices
- 2 Programmes régionaux emblématiques
Emblematic regional programmes
- 3 Observatoire de Maîtrise de l'Énergie
Energy Management Observatory
- 4 Renforcement de compétences
Capacity Building
- 5 Partenariats « public privé »
Public and private partnerships
- 6 Diffusion et Information
Disseminating and information



MEDENER

MEDENER, Platform of regional expertise, aims to promote the exchange of experiences and best practices, transfer of skills and methods for **energy efficiency** and **renewable energies**

**On November 14th, 2016
ENEA (Italy) took over
MEDENER Presidency
in Marrakech during a
side-event of the COP22**





PATENTS

- ENEA patents its invention for the industrial deployment
- **760** primary patents in Italy have originated 1200 international patents



PARTICIPATED COMPANIES

- ENEA provides technology transfer and dissemination aimed at promoting the use of expertise, facilities and results of the Agency
- ENEA participates in **33** consortia and/or companies



SPIN-OFFS

- Provides its support and encourages the creation of high-tech initiatives, such as spin-offs, in order to bring to the market research results
- At present there are 10 ENEA research spin-offs

Technology transfer



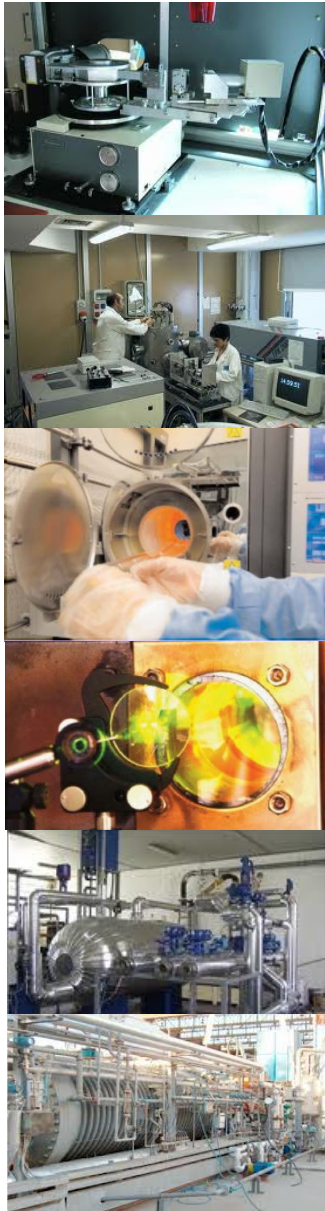
ENEA is enlarging and enriching research collaborations and technology transfer with non European partners.

The Agency is open to:

- **License agreements** and **industrial development**: related to its patents portfolio
- **Collaborative research**: on areas of common interest
- **Joint research labs**: establishment of joint laboratories of excellence; use of existing labs in ENEA Research Centres
- **Service contracts**: related to the development of specific technologies, methodologies or research fields and/or system engineering of products and services
- **Joint participation** in Horizon 2020 projects (eligible to non European countries)



Assets



- **Facilities**: labs; high-tech instrumentation; pilot, test and experimental plants among the most advanced in Italy and Europe
- **High-level** scientific and technological **expertise** on cutting-edge technologies
- **Multidisciplinary approach**: research entails a wide range of disciplines (physics, chemistry, engineering, mathematics, biology, genetics, genomics, agronomy, computer science, statistics, economics, etc.)
- **Qualified research teams**: excellence is demonstrated by the number of patents, publications, and EU projects
- **International environment**: ENEA hosts researchers and fellowships from Asia, Caribbean, Eastern Europe, Middle East and North Africa
- **Strong industrial cooperation**: Ansaldo, Archimede Solar Power, Angelantoni, ENEL, FIAT...

Thank you for your kind attention!

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