



## ***Convegno progetto SHAAMS***

***“La Cooperazione nel Mediterraneo per la promozione del solare”***

# ***Il ruolo dell'ENEA nell'ambito delle politiche Energetiche internazionali legate al solare.***

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**Mostra d’Oltremare, Napoli**  
**Padiglione 6 > Sala VESUVIO**

# The Italian National Agency for new technologies, Energy and sustainable economic development



ENEA is the wider Italian public organization operating in the fields of energy, the environment and new technologies to support Country's competitiveness and sustainable development

## ENERGY

- Renewable Energy Sources
- Advanced Technologies for Energy and Industry
- Nuclear Fusion
- New generation Nuclear Fission

## SUSTAINABLE ECONOMIC DEVELOPMENT

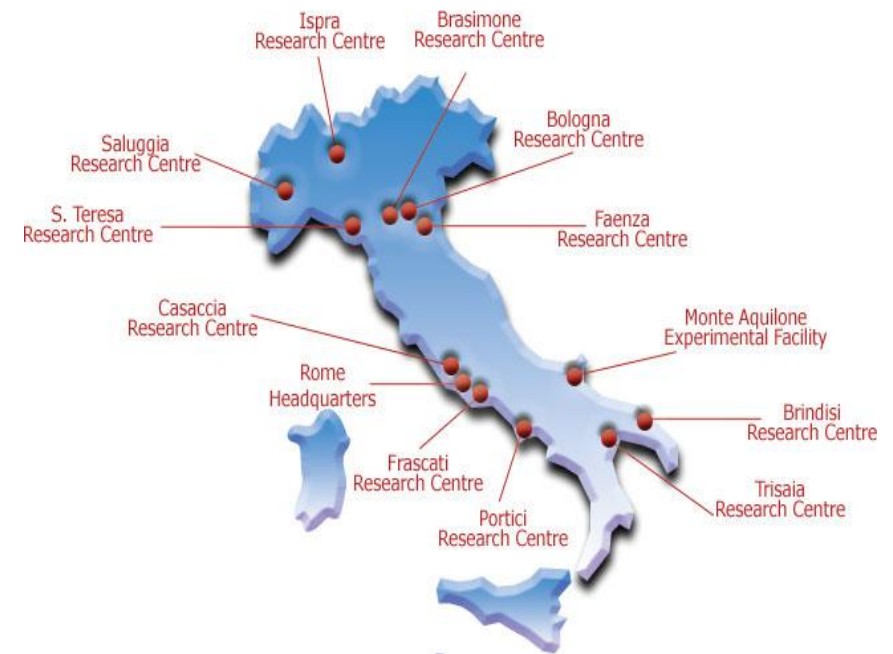
- Environmental Characterization, Prevention and Recovery
- Environmental Technologies
- Seismic Protection
- Radiation Biology and Human Health
- Sustainable Development and Innovation of the Agro-Industrial System

## NEW TECHNOLOGIES

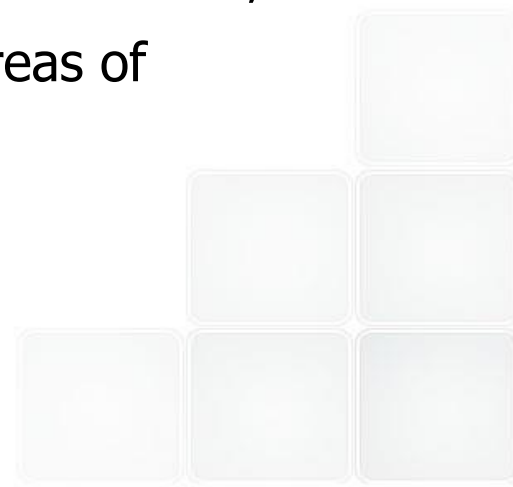
- Radiation Applications
- Materials Technologies
- Energy and Environment Modeling
- ICT

11 Research Centres

~2640 employees



- ❑ **PARTICIPATION IN PROJECTS** financed by EU programs -Euratom, European Technology Platforms (ETPs) and international initiatives;
- ❑ **BILATERAL & MULTILATERAL COOPERATION** by agreements and Memoranda of Understanding
- ❑ **PROMOTION OF THE RELATIONS** with the Ministry of Foreign Affairs, Italian scientific attachés abroad, scientific attachés of foreign embassies in Italy, and the Italian Permanent Representation to the EU;
- ❑ **SUPPORT BY DELEGATES / EXPERTS** within international R&D committees and groups (**AIEA, OCSE, IEA, NEA, etc**)
- ❑ **ORGANIZATION OF INTERNATIONAL EVENTS AND MEETINGS;**
- ❑ **HOSPITALITY OF FOREIGN FELLOWS** working in the areas of main interest of the Agency.



- ❑ **European Energy Research Alliance (EERA)**
- ❑ **ECRA (European Climate Research Alliance)**
- ❑ **Ambient Assisted Living (AAL)**
- ❑ **Eureka**
- ❑ **Eurostars**
- ❑ **European Metrology Research Programme (EMRP)**
- ❑ **Iniziativa di programmazione congiunta (JPI)**
- ❑ **Joint Technology Initiative (JTI) Artemis ed Eniac**
- ❑ **Joint Technology Initiative (JTI) Fuel Cells and Hydrogen (FCH)**
- ❑ **Joint Technology Initiative (JTI) Innovative Medicines Initiative (IMI)**
- ❑ **Joint Technology Initiative (JTI) CLEAN SKY**



ENEA is among the founders of The European Energy Research Alliance (EERA), the alliance of European public research centres and universities, helping to reduce the time it takes for each energy technology to reach the market

- ❑ **EERA** is one of the cornerstones of the European Strategic Energy Technology Plan (**SET-Plan**).
- ❑ **EERA** brings together more than **160 research centres and universities** working together on **17 joint research programmes (JP)** build on national research initiatives.
- ❑ In each **Joint Programme** European countries share priority in research projects
- ❑ EERA works together with **European industrial platforms** to align research and innovation priorities, to foster world-class technology and innovation in Europe's energy sector
- ❑ EERA Joint Programmes are important points of contact for **collaboration outside Europe**.

- AMPEA \*
- Bioenergy
- Carbon Capture and Storage
- Concentrated Solar Power (CSP)
- Economic, environmental and social impacts
- Energy Efficiency in Industrial Processes
- Energy Storage
- Fuel Cells and Hydrogen
- Geothermal
- Nuclear Materials
- Ocean Energy
- Photovoltaic Solar Energy
- Shale Gas
- Smart Cities
- Smart Grids
- Wind Energy



## EERA Joint Programme



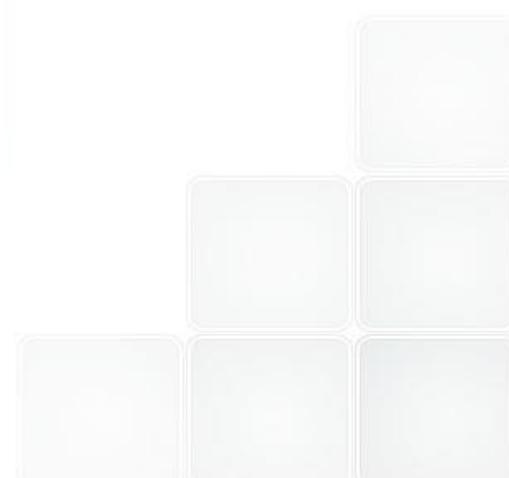


# ETP: European Technology Platforms

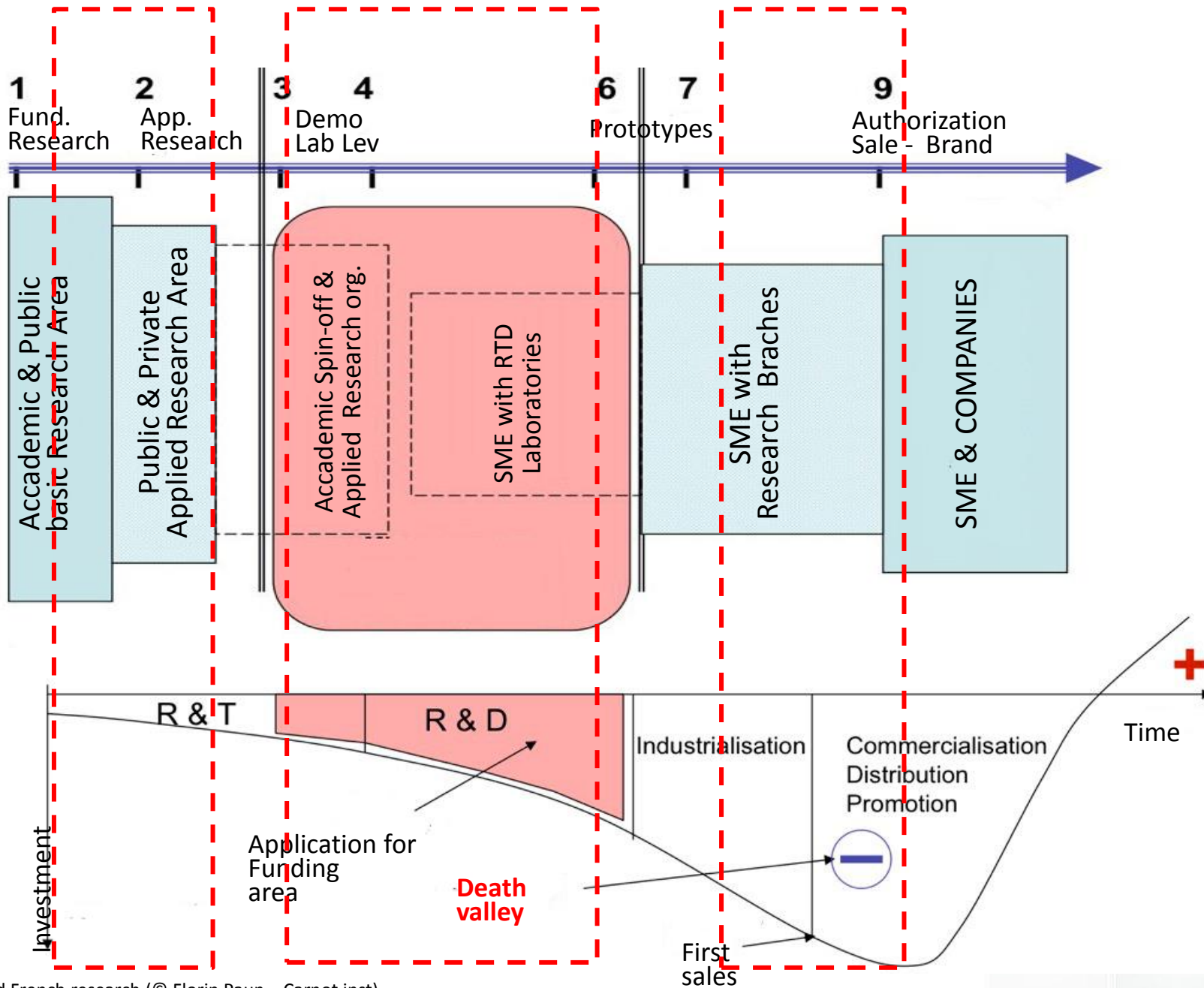


European Technology Platforms (ETPs) are industry-led stakeholder fora recognised by the European Commission as key actors in driving innovation, knowledge transfer and European competitiveness.

Energy	ICT	Bio-based economy	Production and processes	Transport
Biofuels	ARTEMIS	FABRE TP	ECTP	ACARE
SmartGrids	ENIAC	Food	ESTEP	ERRAC
TPWind	ISI	GAH	ETP SMR	ERTRAC
Photovoltaics	Net!Works	NanoMedicine	Manufuture	Waterborne
ZEP	NEM	Plants	FTC	ESTP
SNETP	NESSI	Forest-based	WSSTP	
RHC	EUROP		SusChem	
	EPoSS		EuMaT	
	Photonics21		IndustrialSafety	



# ENEA: TRL branches of application





- ❑ **R&D efforts** to reduce costs
- ❑ **Necessity to deeply involve the crosslinks** with all others science fields (materials, devices , system, smart O&M)
- ❑ **Ensure Solar and other renewables readiness** for rapid deployment
- ❑ Supporting **implementation** for existing technology (short term) and **Innovations** (medium- long term option)
- ❑ **Expand international R&D** collaboration
- ❑ Making **best use of national/international competencies**.--- > European strategy

- ❑ Accelerates the pace of technology development --- > by strongly supporting low impact technologies
- ❑ Promotes standardization
- ❑ Enhances national R&D programmes
- ❑ Permits national specialization, by strongly promoting collaboration



# ENEA Activity on PV : key information

## ENEA Casaccia

### PV activities:

- cSi and Silicon Heterojunction
- Thin polycrystalline
- Market&Incentives



Staff: 12 Researchers/technicians & 5 non permanent and students

4 Buildings, 3700 m<sup>2</sup> laboratories, 400 m<sup>2</sup> clean rooms , 130 employees:  
 (80 researchers, 35 technicians, 15 admin.)  
 + 25 non permanent  
 Running projects value:20 Mil € /3 years

### PV activities:

- Thin Silicon
- CPV Technology
- Advanced PV (Organic & QD)
- TCO, advanced coatings
- PV Modules, BOS,
- Indoor/outdoor characterization
- Distributed generation & Smart grid
- BIPV & Ecobuildings design



Staff: 35 Researchers/technicians & 10 non permanent and students



## ENEA Foggia



### PV activities:

- Large plants
- BOS
- Outdoor characterization
- PV Demo site

Staff: 12 Researchers/technicians & 2 non permanent and students

ENEA Lampedusa  
Research Unit

ENEA Portici

# ENEA Road Map on PV R&D



Short term  
Commitments

Technology  
Improvements

Science  
Improvements

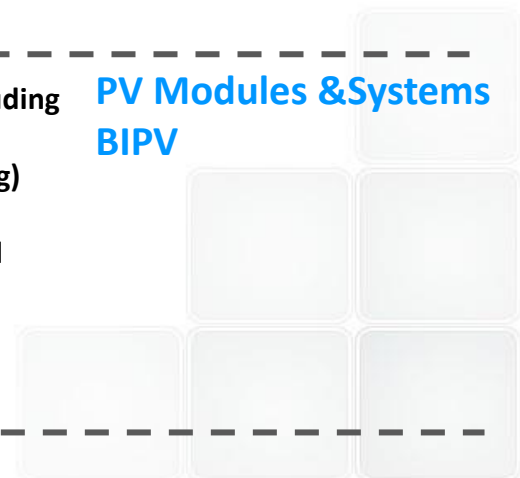


Year      •   •   •   1   •   •   •   2   •   •   •   3   •   •   •   4   •   •   •   5   •   •   •   6   •   •   •   •

## Materials & Devices

▪ New generation & Advanced Concepts

## PV Modules & Systems BIPV

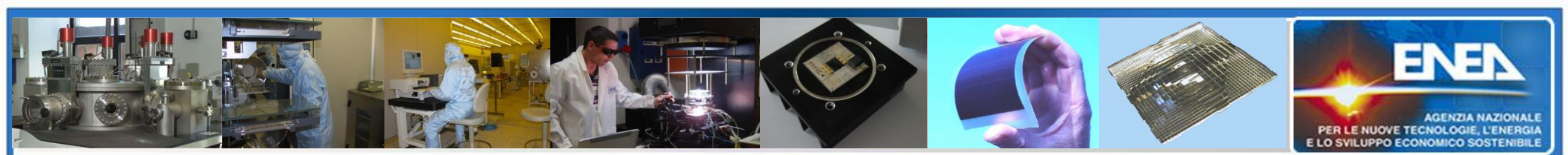


- 1<sup>st</sup> generation improvements
  - aSi-cSi SHJ advanced architectures (eff>20%)
  - Low cost /high efficiency PV-C cSi Solar cell (Eff>22%)
- 2<sup>nd</sup> & 3<sup>rd</sup> generation improvements
  - Thin Si Solar Cell light trapping improvement
  - Advanced Tandem/triple Thin Si SC (eff<sub>stab</sub> >11%)
  - TCO with enhanced optical/electrical properties
  - Thin Si Solar cell on flexible polymeric substrate
  - Full Organic Solar cell (eff >4%)

- 1<sup>st</sup> generation improvements
  - Epi-Wafer approach (<80 mm)
- 2<sup>nd</sup> & 3<sup>rd</sup> generation improvements
  - All-Si QD Solar cells
  - Indium free thin polycrystalline SC (kesterite)
  - Full Organic Solar cell (eff >7%)
  - New generation of TCO
  - Low cost polymeric glassily substrates

- Solar cells and PV-C SC & Optics characterization
- Definition of standards for PV-C and BIPV application
- Indoor/Outdoor Comparative Performance analysis of PV modules and systems.
- Energy prediction
- Reliability analysis on BOS components
- Characterization of BIPV oriented components

- Development of new generation of PV-C systems including hybrid PV/thermal systems
- New approach to BIPV (landscape, Net Energy Building)
- Development of Standard elements for sustainability
- Management of Smart RES interconnection to the grid
- Smart PV Module
- Advanced indoor/outdoor PV module and system characterization



## ENEA PV Activity: (materials & devices)

- ❑ Crystalline Silicon (Casaccia)
  - ❑ High quality Screen printed solar cells ( $\text{eff} > 18\%$  on cSi)
  - ❑ Cost effective/high efficiency aSi-cSi Heterojunction ( $\text{eff} > 17\%$  on cSi)
- ❑ Thin-Film technology (Portici)
  - ❑ Amorphous/microcrystalline tandem solar cells ( $\text{eff}_{\text{ini}} \sim 11.4\%$   $\text{eff}_{\text{stab}} \sim 10\%$ )
  - ❑ Trasparent Conductive Oxide and dielectric antireflective coatings
  - ❑ Innovative thin Si (QD, Si alloys)
  - ❑ Light trapping & intermediate reflectors
  - ❑ Indium free thin Film polycrystalline film (Kesterite-Cu<sub>2</sub>ZnSn) (Casaccia)
  - ❑ Deposition on polymeric substrates
- ❑ PV-C technology & organic PV (Portici)
  - ❑ High efficiency cSi Solar cells ( $\text{Eff.} \sim 22\%$  @ 30 suns  $> 20\%$  up 100 suns)
  - ❑ Devices, optics for PV-Concentration (opt Eff  $> 80\%$ )
  - ❑ Full organic solar cells based on commercial materials ( $\text{eff}_{\text{ini}} \sim 8\%$ )
  - ❑ Polymeric Trasparent Electrodes (Portici-Casaccia) and DSSC (Casaccia-Brindisi)



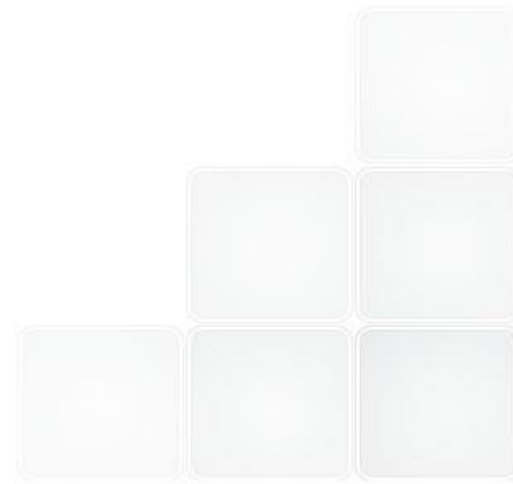
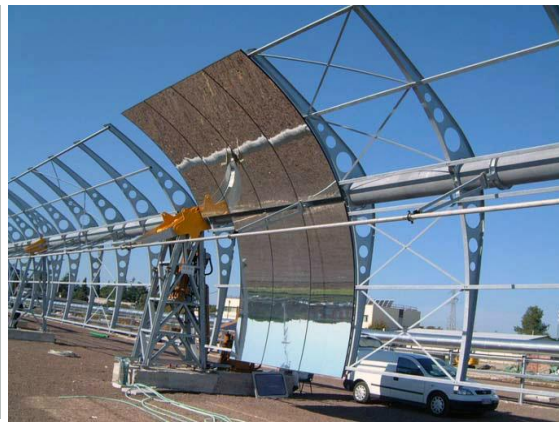
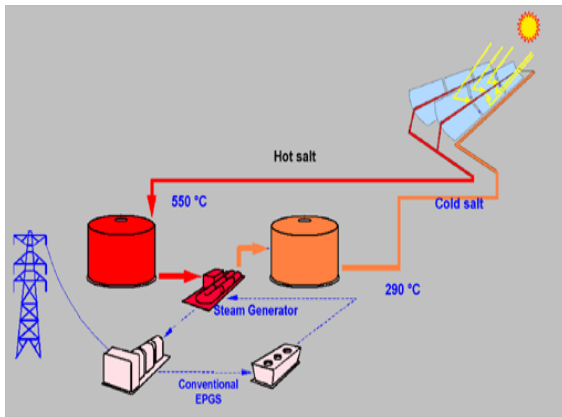


## ENEA PV Activity: (Modules & systems)

- ❑ Indoor PV Solar cells and PV-C Optics characterization (Portici)
- ❑ Flat and PV-C Module characterization and qualification (Portici)
- ❑ Indoor/Outdoor Performance analysis of PV modules and systems. Energy prediction (Portici & Foggia Unit)
- ❑ Management of Smart RES interconnection to the grid (Portici)
- ❑ Reliability analysis on BOS components (Portici & Casaccia)
- ❑ Smart PV module (DC-DC, MPPT converter)
- ❑ Build integration PV (Portici & Casaccia)
  - ❑ Development of some applications (Stapelia Street lamp, Boggie-Woggie modules, façade , etc)
  - ❑ Proposal for standard elements for sustainability (Modulegno)
  - ❑ Characterization of BIPV oriented components

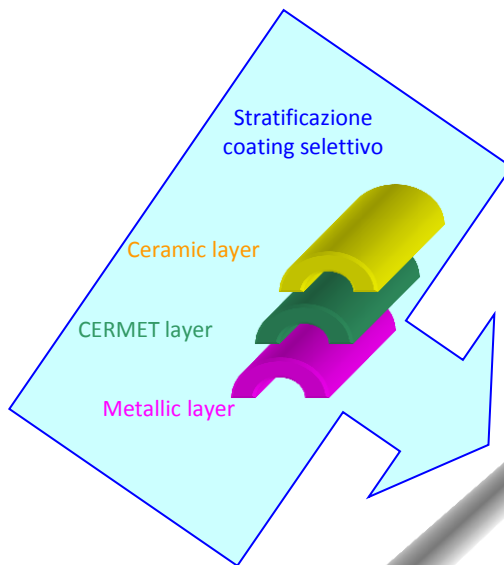
# CSP-Concentrated Solar power

The CSP S Archimede project is based on the technology developed by ENEA and Archimede Solar Energy, a joint venture between Angelantoni Industrie and Siemens Energy. Archimede is owned and operated by Enel



# Optical Selective coatings

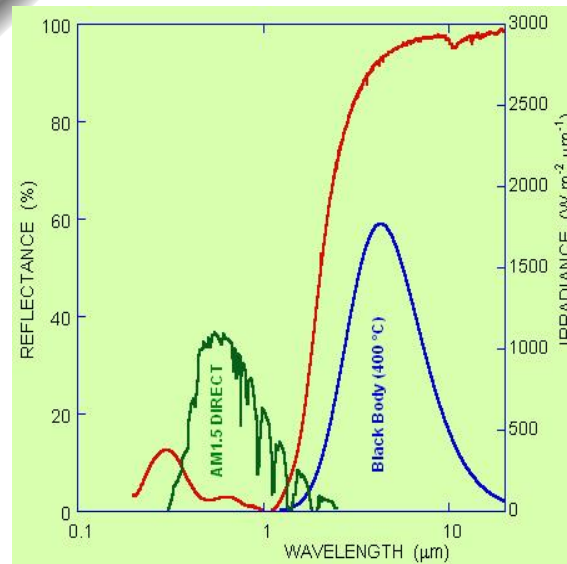
Coating selettivo per il progetto ENEA solare Termodinamico Archimede per aumentare la trasmissione della luce nei tubi del fluido termico e ridurre l'emissione di energia.



CR ENEA Portici.- Sputtering per coating otticamente selettivi su tubi da 4 metri



Assorbanza = 94.3%  
Emissività (580° C) = 13.6%

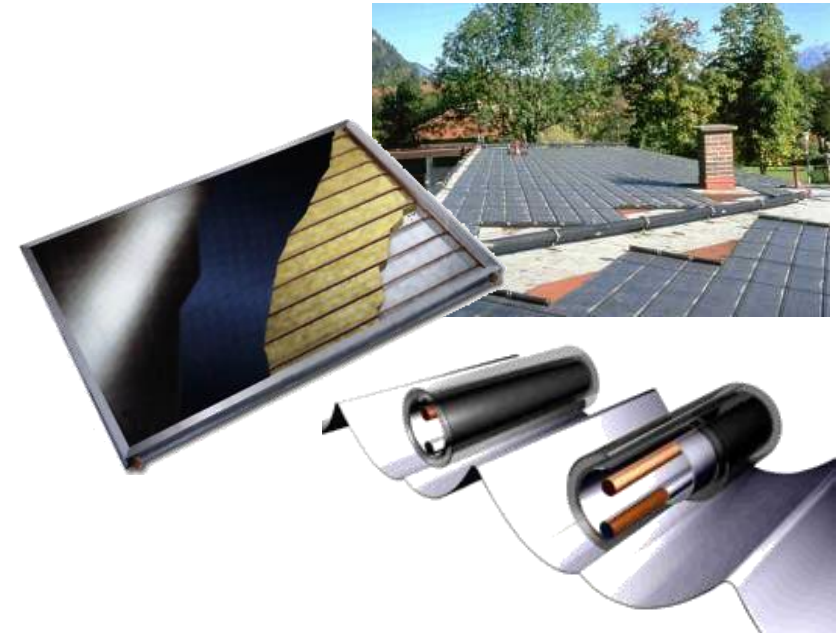




# Solar Thermal low temperature application

## *Certification of components and systems for the low temperature application*

**Certified ACCREDIA (n° 0473)**



- Research and development in the field of solar thermal technologies in low and medium temperature
- Service qualification of components and systems for determining the thermal performance and to evaluate the reliability and durability commercial collector in accordance with European and international standards.



- PROVIDE INNOVATIVE IDEAS USEFUL IN DEVELOPING TECHNOLOGIES, PROCESSES FOR ENERGY PRODUCTION AND ENERGY CARRIERS FROM BIOMASS AND SOLAR THERMAL;
- PRODUCTION OF ELECTRICITY USING BOTH THERMAL AND CHEMICAL PROCESSES ASSOCIATED WITH HIGH EFFICIENCY AND VERSATILE IN NATURE
- 2ND GENERATION BIOFUELS PRODUCTION FROM BOTH THE BIOLOGICAL AND SYNTHESIS PROCESSES



## Gasification technology– Pilot Plants

**Fluidized bed –Internally recirculating**  
**enriched air/steam 1MWth**  
 Coupled with MCI for power generation

COMPOSITION SYNGAS	
	%Vol.
H <sub>2</sub>	32
CO	17
CH <sub>4</sub>	6.2
N <sub>2</sub>	0.9
CO <sub>2</sub>	20.9
H <sub>2</sub> O	32

**Fluidized catalytic bed –Internally recirculating**  
**Air/steam 500kWth**  
 Coupled with MCI or FC for power generation, Fisher Tropsh

COMPOSITION SYNGAS	
	%Vol.
H <sub>2</sub>	34.1
CO	25.1
CH <sub>4</sub>	10.4
N <sub>2</sub>	9.6
CO <sub>2</sub>	20.8

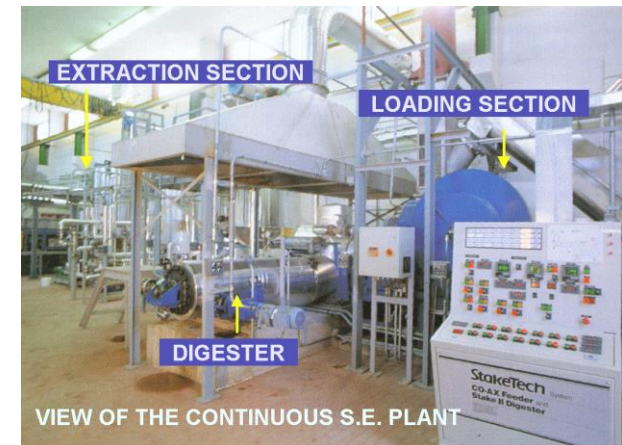
**UPDRAFT fixed bed**  
**Air/steam 150kWth**  
 Coupled with MCI for power generation, Fisher Tropsh

COMPOSITION SYNGAS	
	%Vol.
H <sub>2</sub>	20
CO	21
CH <sub>4</sub>	4
N <sub>2</sub>	40
CO <sub>2</sub>	6
H <sub>2</sub> O	9

**DOWNDRAFT fixed bed**  
**Air/steam 150-450kWth**  
 Coupled with MCI

COMPOSITION SYNGAS	
	%Vol.
H <sub>2</sub>	15
CO	22
CH <sub>4</sub>	3
N <sub>2</sub>	40
CO <sub>2</sub>	20

# The bio-chemical route for biofuels



Continuous “Steam explosion” plant of 150 kg/h

Biomass fractionation -> cellulose , hemicellulose, lignin

Ethanol

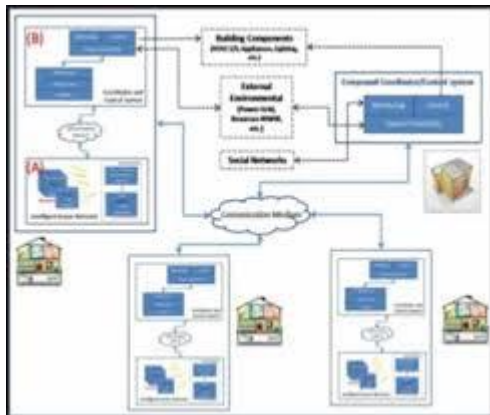
sugars, chemicals

Biodegradable composites,  
Energy recovery, chemicals

# Architectures and algorithms for intelligent cooperating multi-sensory smart devices

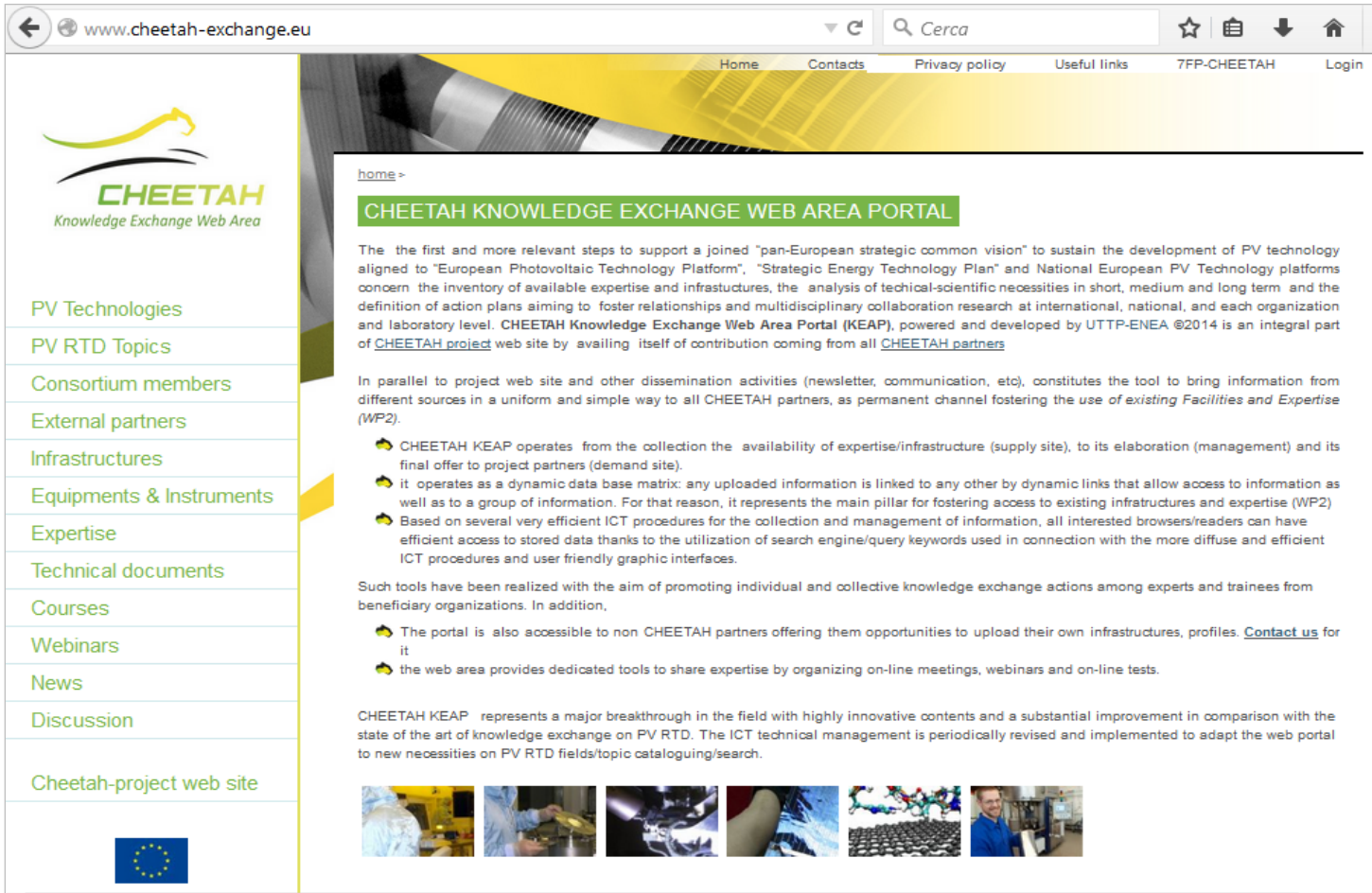
ENEA realizes transducers and develops architectures and algorithms for intelligent cooperating multi-sensory smart devices, targeted at energy efficiency in buildings, environmental quality detection and other vertical applications.

- ❑ **@lisee**: multisensory devices measuring energy consumption and environmental variables for the evaluation of the indexes of energy efficiency in buildings
- ❑ **ICARO**: electronic nose for surface contaminants detection
- ❑ **MONICA**: a small portable box of sensors array for air quality monitoring.





## FP7-CHEETAH Knowledge Exchange web Portal



The screenshot shows the homepage of the CHEETAH Knowledge Exchange Web Area Portal. The browser address bar displays [www.cheetah-exchange.eu](http://www.cheetah-exchange.eu). The page features a navigation menu with links for Home, Contacts, Privacy policy, Useful links, 7FP-CHEETAH, and Login. A search bar is located in the top right corner. The main content area is titled "CHEETAH KNOWLEDGE EXCHANGE WEB AREA PORTAL" and includes a "home >" breadcrumb. The text describes the portal's purpose: to support a pan-European strategic vision for PV technology development, aligned with the European Photovoltaic Technology Platform, Strategic Energy Technology Plan, and National European PV Technology platforms. It details the portal's role in inventorying expertise and infrastructures, fostering relationships, and providing a dynamic data base matrix. Key features include: access to expertise/infrastructure availability, dynamic linking of information, and efficient ICT procedures for search and management. The portal is also accessible to non-partners for uploading their own data and provides tools for on-line meetings and tests. A row of six small images at the bottom illustrates various aspects of the project, including laboratory work, solar panels, and a person in a lab coat.

[home >](#)

### CHEETAH KNOWLEDGE EXCHANGE WEB AREA PORTAL

The the first and more relevant steps to support a joined "pan-European strategic common vision" to sustain the development of PV technology aligned to "European Photovoltaic Technology Platform", "Strategic Energy Technology Plan" and National European PV Technology platforms concern the inventory of available expertise and infrastructures, the analysis of technical-scientific necessities in short, medium and long term and the definition of action plans aiming to foster relationships and multidisciplinary collaboration research at international, national, and each organization and laboratory level. CHEETAH Knowledge Exchange Web Area Portal (KEAP), powered and developed by UTTP-ENEA @2014 is an integral part of CHEETAH project web site by availing itself of contribution coming from all [CHEETAH partners](#)

In parallel to project web site and other dissemination activities (newsletter, communication, etc), constitutes the tool to bring information from different sources in a uniform and simple way to all CHEETAH partners, as permanent channel fostering the use of existing Facilities and Expertise (WP2).

- 🔦 CHEETAH KEAP operates from the collection the availability of expertise/infrastructure (supply site), to its elaboration (management) and its final offer to project partners (demand site).
- 🔦 it operates as a dynamic data base matrix: any uploaded information is linked to any other by dynamic links that allow access to information as well as to a group of information. For that reason, it represents the main pillar for fostering access to existing infrastructures and expertise (WP2)
- 🔦 Based on several very efficient ICT procedures for the collection and management of information, all interested browsers/readers can have efficient access to stored data thanks to the utilization of search engine/query keywords used in connection with the more diffuse and efficient ICT procedures and user friendly graphic interfaces.

Such tools have been realized with the aim of promoting individual and collective knowledge exchange actions among experts and trainees from beneficiary organizations. In addition,

- 🔦 The portal is also accessible to non CHEETAH partners offering them opportunities to upload their own infrastructures, profiles. [Contact us](#) for it
- 🔦 the web area provides dedicated tools to share expertise by organizing on-line meetings, webinars and on-line tests.

CHEETAH KEAP represents a major breakthrough in the field with highly innovative contents and a substantial improvement in comparison with the state of the art of knowledge exchange on PV RTD. The ICT technical management is periodically revised and implemented to adapt the web portal to new necessities on PV RTD fields/topic cataloguing/search.

