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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Energymed 2016 31 marzo 2016

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**

ENEA International Activities

- **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.

ENEA : partecipation to strategic initiatives

- **European Energy Research Alleance (EERA)**
- **ECRA (European Climate Research Alliance)**
- **Ambient Assisted Living (AAL)**
- **Eureka**
- **Eurostars**
- **European Metrology Research Programme (EMRP)**
- **Iniziative 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 & EERA

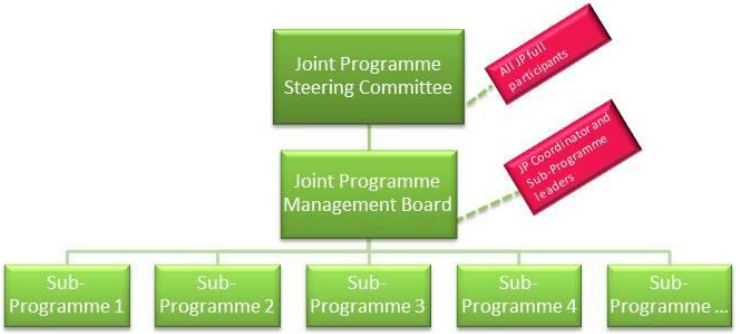
ENEA is among the founders of The European Energy Research Alliance (EERA) , the alliance of European public research centres and universities. helping to reduce the time takes for each energy technology to reach the market

- **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**.

EERA joint programme

- 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



*** Advanced Materials and Processes for Energy Application**

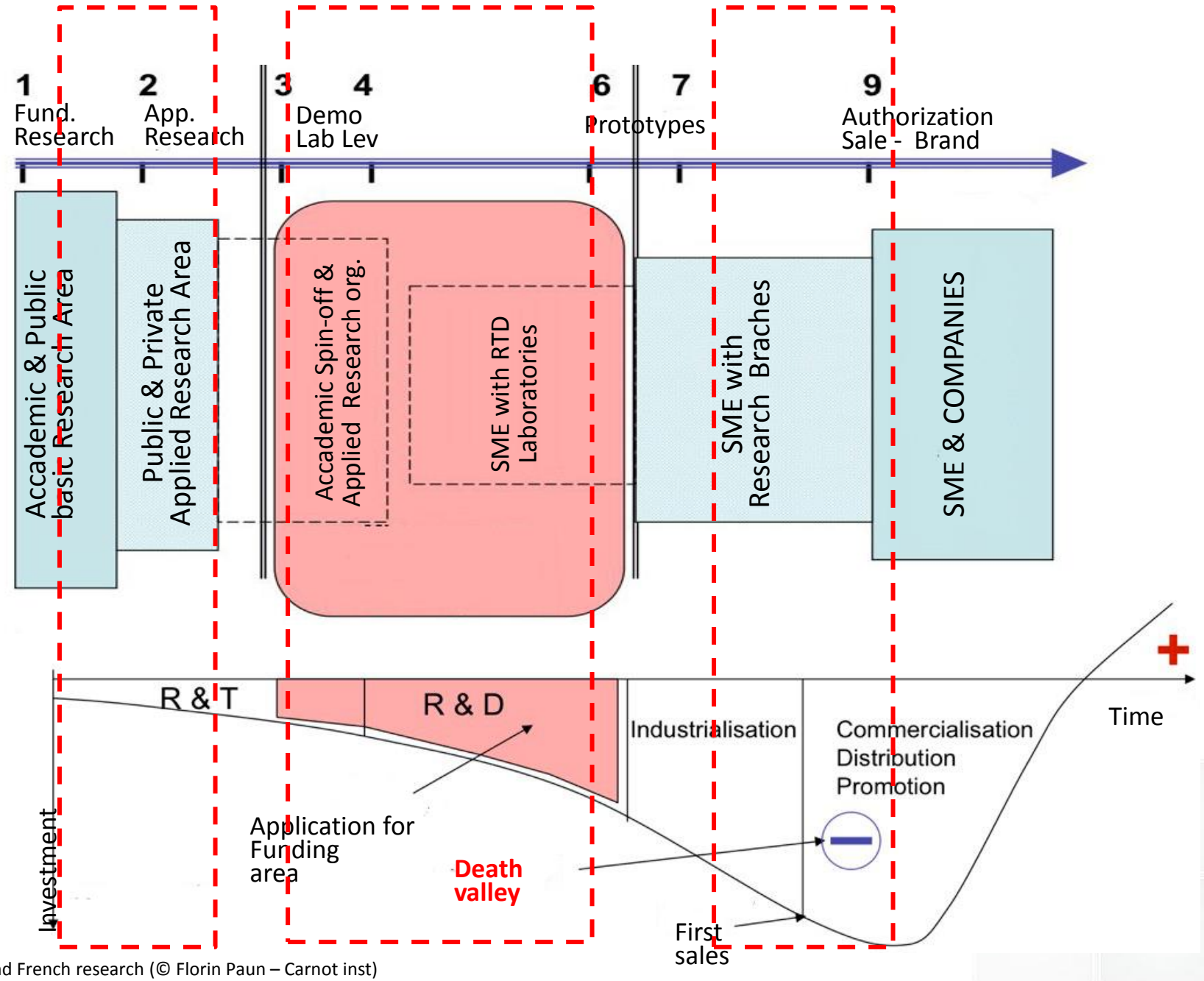
ETP: European Technology Platforms

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	

http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=etp

ENEA: TRL branches of application



Elaborated from TRLs and French research (© Florin Paun – Carnot inst)

ENEA RES R&D Roadmap

- **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

Support of ENEA to market Roadmap

- 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 m2 laboratories, 400 m^2 clean rooms , 130 employees:
(80 researchers, 35 technicians, 15 admin.)
+ 25 non permament
Running projects value:20 Mil € /3 years

ENEA Foggia

PV activities:

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

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

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 Lampedusa Reseach Unit

ENEA Portici

ENEA Road Map on PV R&D

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

Short term Commitments | **Technology Improvements** | **Science Improvements**

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

Materials &Devices

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

- 1st generation improvements
  - Epi-Wafer approach (<80 mm)
- 2nd & 3rd 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 polimeric glassily substrates

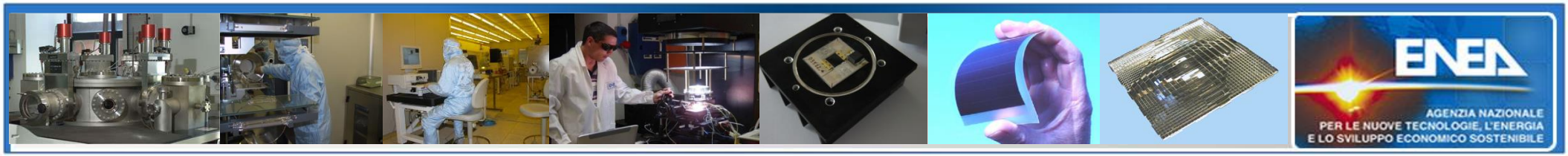
- New generation & Advanced Concepts

PV Modules &Systems BIPV

- 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)

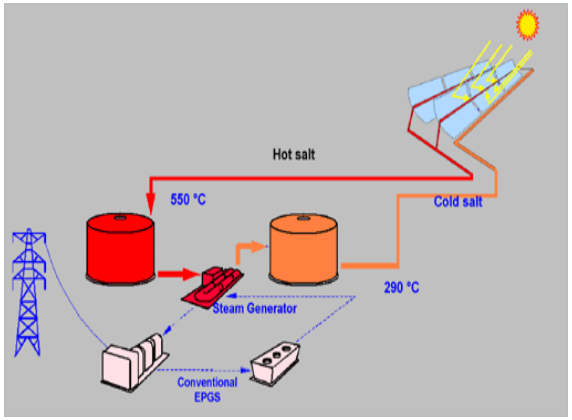
- Crystalline Silicon (Casaccia)
  - High quality Screen printed solar cells (eff >18% on cSi)
  - Cost effective/high efficiency aSi-cSi Heterojunction (eff >17% on cSi)
- Thin-Film technology (Portici)
  - Amorphous/microcrystalline tandem solar cells (eff_{ini}~11.4% eff_{stab} ~ 10%)
  - Trasparent Conductive Oxide and dielectric antireflective coatings
  - Innovative thin Si (QD, Si alloys)
  - Light trapping & intermediate reflectors
  - Indium free thin Film polycrystalline film(Kesterite-Cu_2ZnSn) (Casaccia)
  - Deposition on polymeric substrates
- PV-C technology & organic PV (Portici)
  - High efficiency cSi Solar cells (Eff. ~22% @ 30 suns >20% up 100 suns)
  - Devices, optics for PV-Concentration (opt Eff >80%)
  - Full organic solar cells based on commercial materials (eff_{ini} ~ 8%)
  - Polymeric Trasparent Electrodes (Portici-Casaccia) and DSSC (Casaccia-Brindisi)

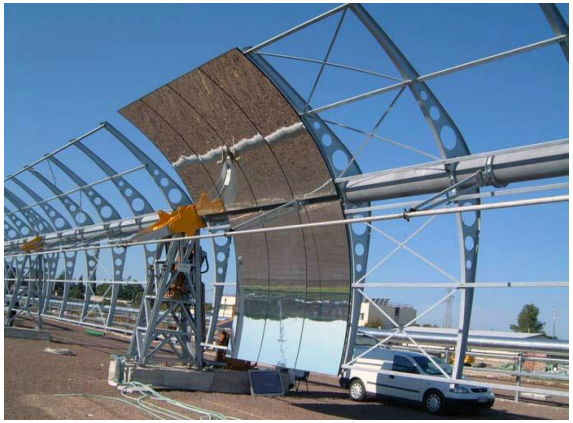
ENEA PV Activity: (Modules & systems)

- 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

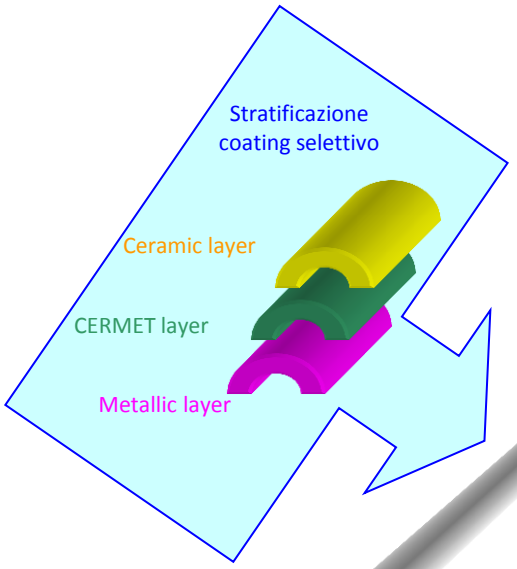
The CSP S Archimede project is based on the technology developed by ENEA and Archimede Solar Energy, a joint venture between Angelantoni Industrie and Siemens Energy. Archimede is owned and operated by Enel

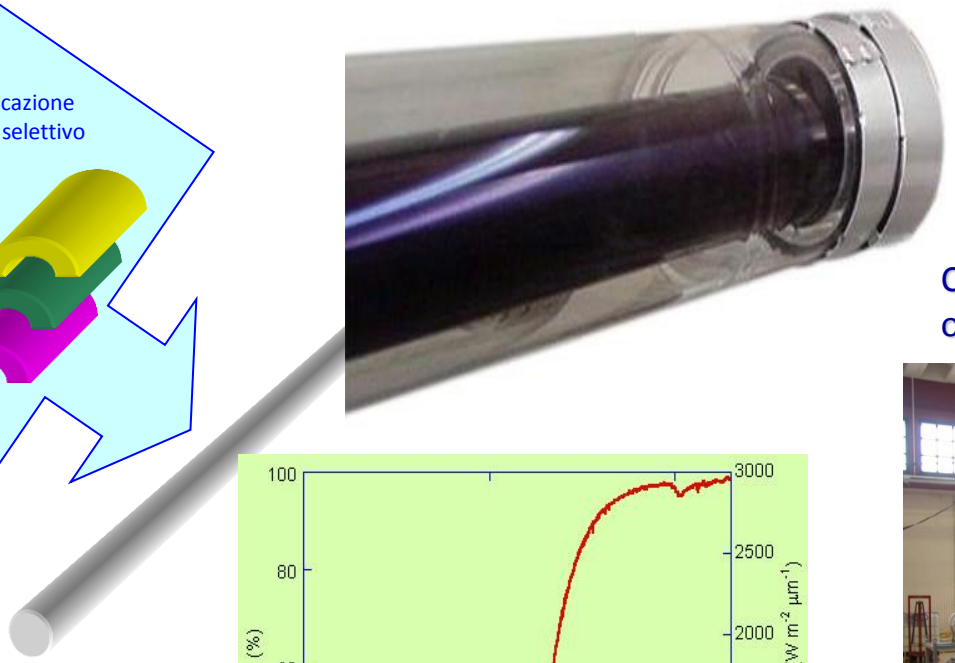




Optical Selective coatings

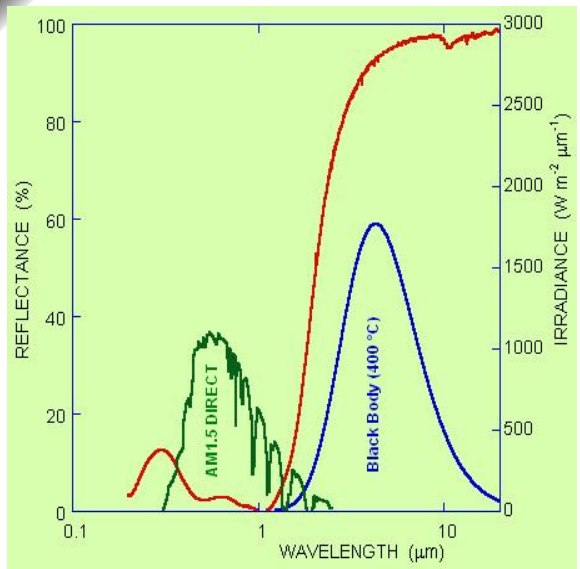
Coating selettivo per il progetto ENEA solare Termodinamico Archimede per aumentare la trasmissione della luce nei tubi del fluido termico e ridurre l'emissione di energia.





Assorbanza = 94.3%

Emissività (580° C) = 13.6%

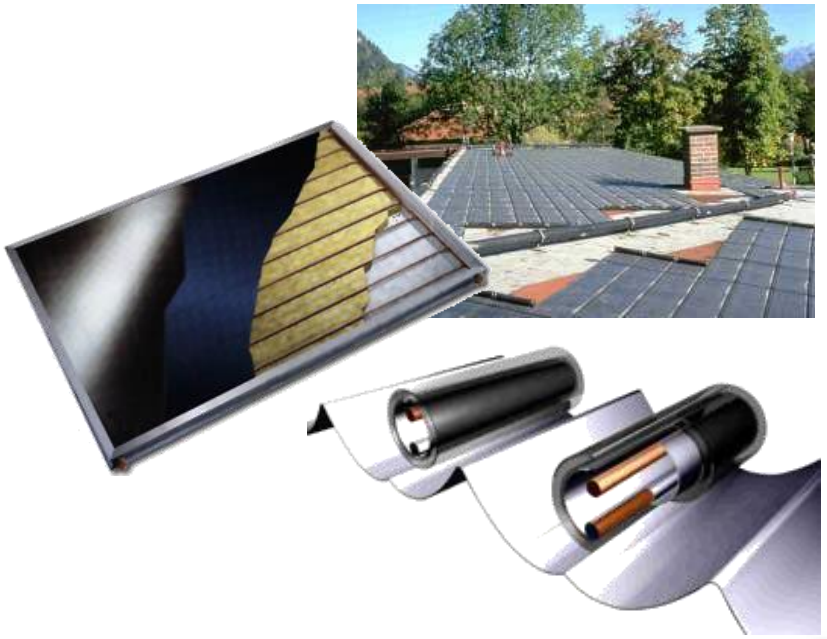


CR ENEA Portici.- Sputtering per coating otticamente selettivi su tubi da 4 metri

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.

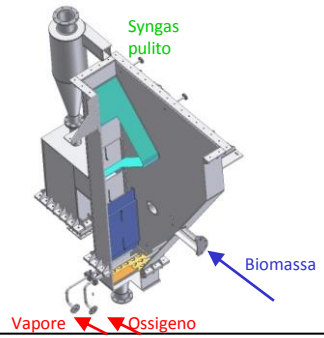
ENEA PV Activity: biofuel& green chemistry




- 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

ENEA Biomass Pilot plants

Gasification technology– Pilot Plants

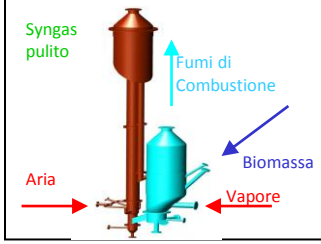


Fluidized bed –Internally recirculating

enriched air/steam 1MWth

Coupled with MCI for power generation

COMPOSITION SYNGAS	
	%Vol.
H_2	32
CO	17
CH_4	6.2
N_2	0.9
CO_2	20.9
H_2O	32

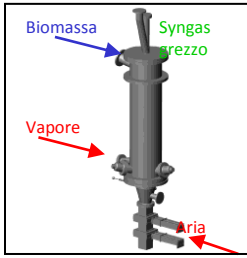


Fluidized catalitic bed –Internally recirculating

Air/steam 500kWth

Coupled with MCI or FC for power generation, Fisher Tropsh

COMPOSITION SYNGAS	
	%Vol.
H_2	34.1
CO	25.1
CH_4	10.4
N_2	9.6
CO_2	20.8

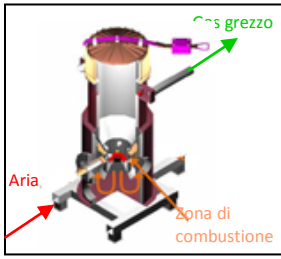


UPDRAFT fixed bed

Air/steam 150kWth

Coupled with MCI for power generation, Fisher Tropsh

COMPOSITION SYNGAS	
	%Vol.
H_2	20
CO	21
CH_4	4
N_2	40
CO_2	6
H_2O	9



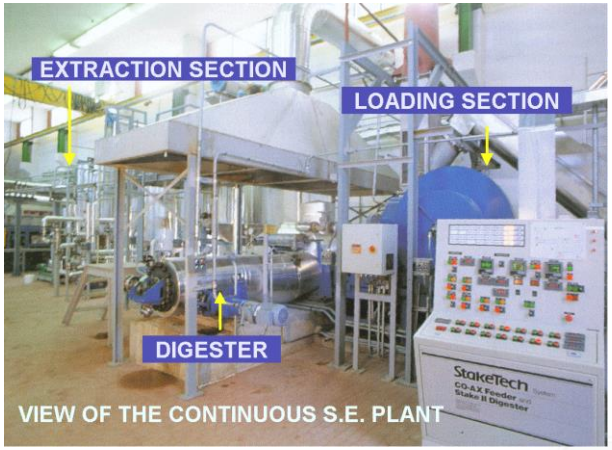
DOWNDRAFT fixed bed

Air/steam 150-450kWth

Coupled with MCI

COMPOSITION SYNGAS	
	%Vol.
H_2	15
CO	22
CH_4	3
N_2	40
CO_2	20

The bio-chemical route for biofuels



Continuous “Steam explosion” plant of 150 kg/h

Biomass fractionaction -> cellulose , hemicellulose, lignin

Ethanol

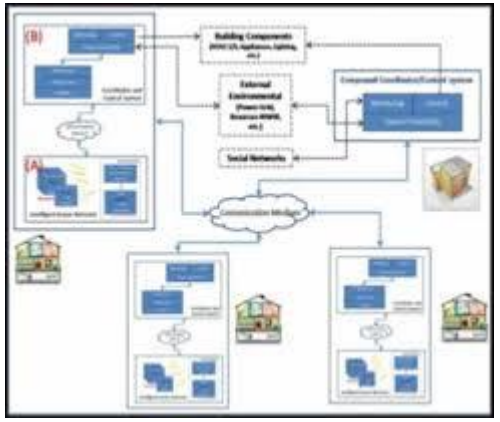
sugars, chemicals

Biodegradable composites,
Energy recovery, chemicals

Architectures and algorithms for intelligent cooperating multi-sensory smart devices

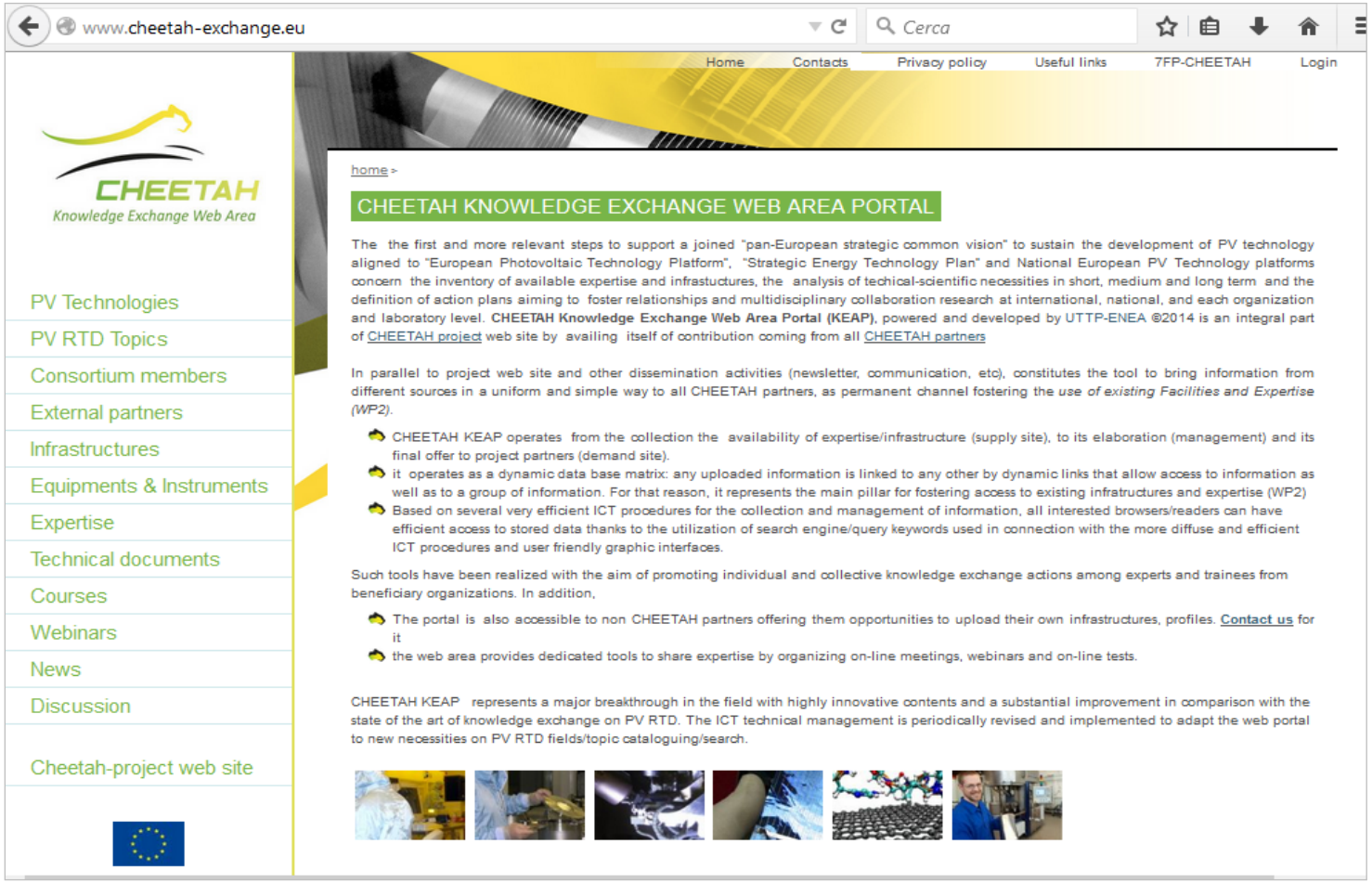
ENEA realizes tranducers and develops architectures and algorithms for intelligent cooperating multi-sensory smart devices, targeret at energy efficiency in buildings, environmental quality detection and other vertical applications.

- **@lisee**: multisensory devices measuring energy consumption and environmental variables for he 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.



Partecipation to Networks

FP7-CHEETAH Knowledge Exchange web Portal



http://www.cheetah-exchange.eu

Thanks for your attention

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