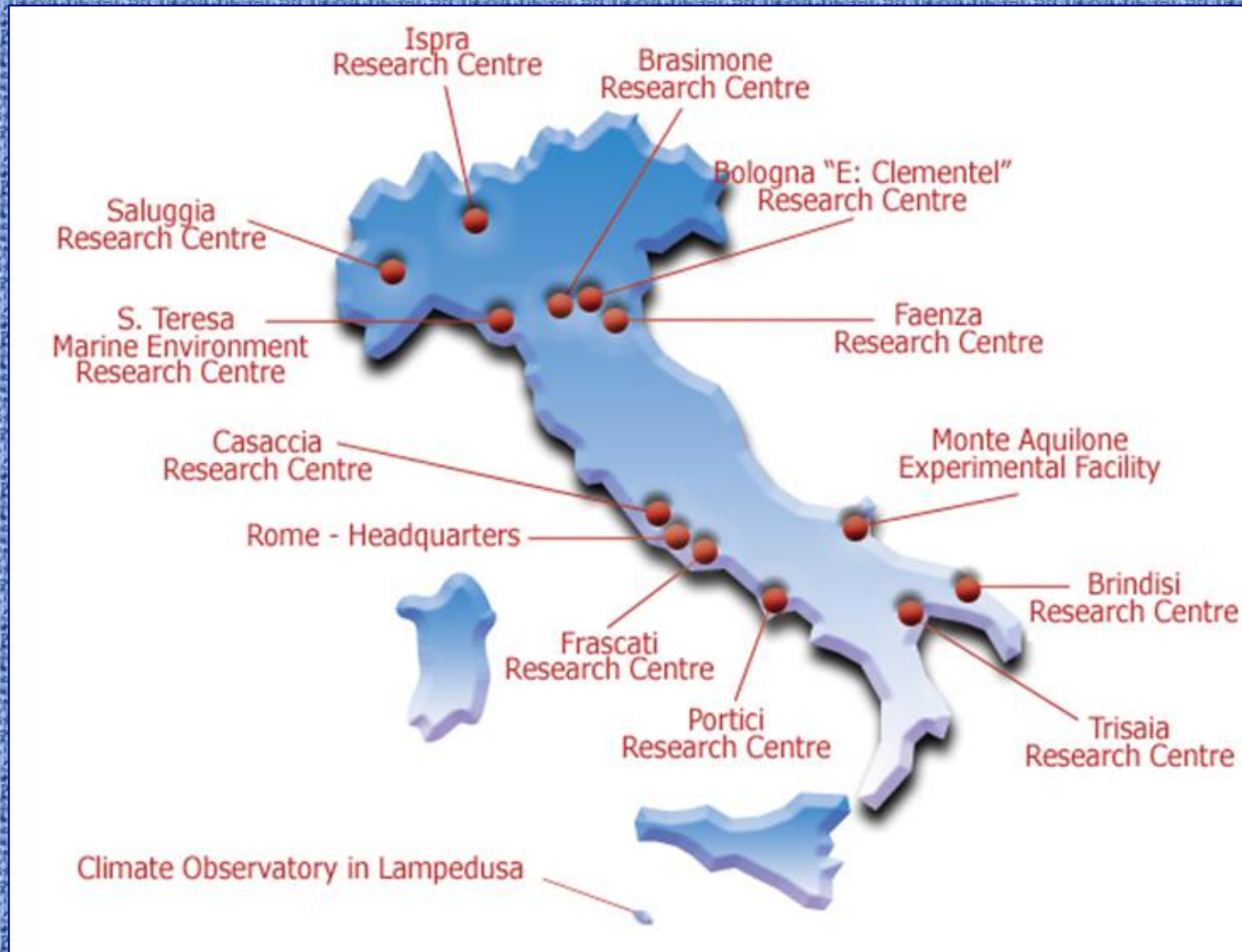


Heat Pumps: Summary of R&D Activities in ENEA

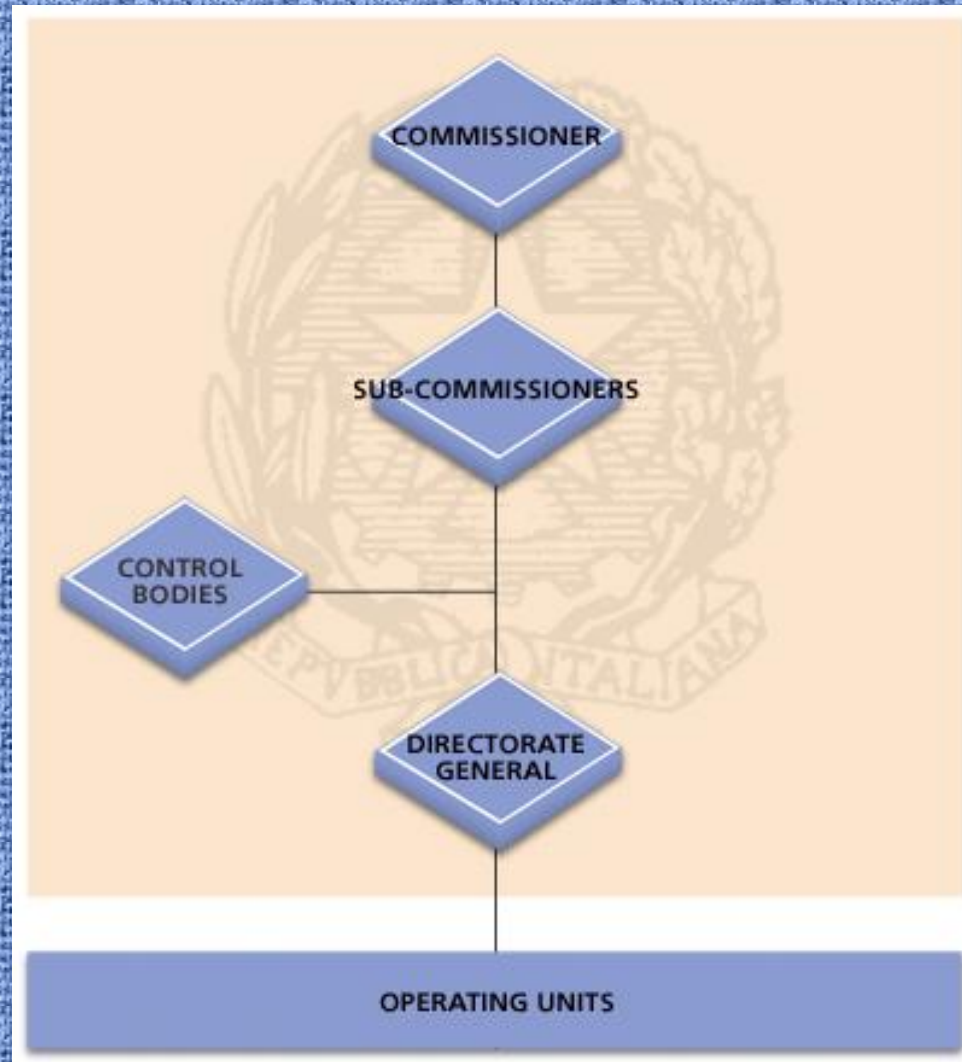
Giuseppe Corallo
ENEA
TER-ENE-TERM

- Organization
- Past Experience
- Present Activities

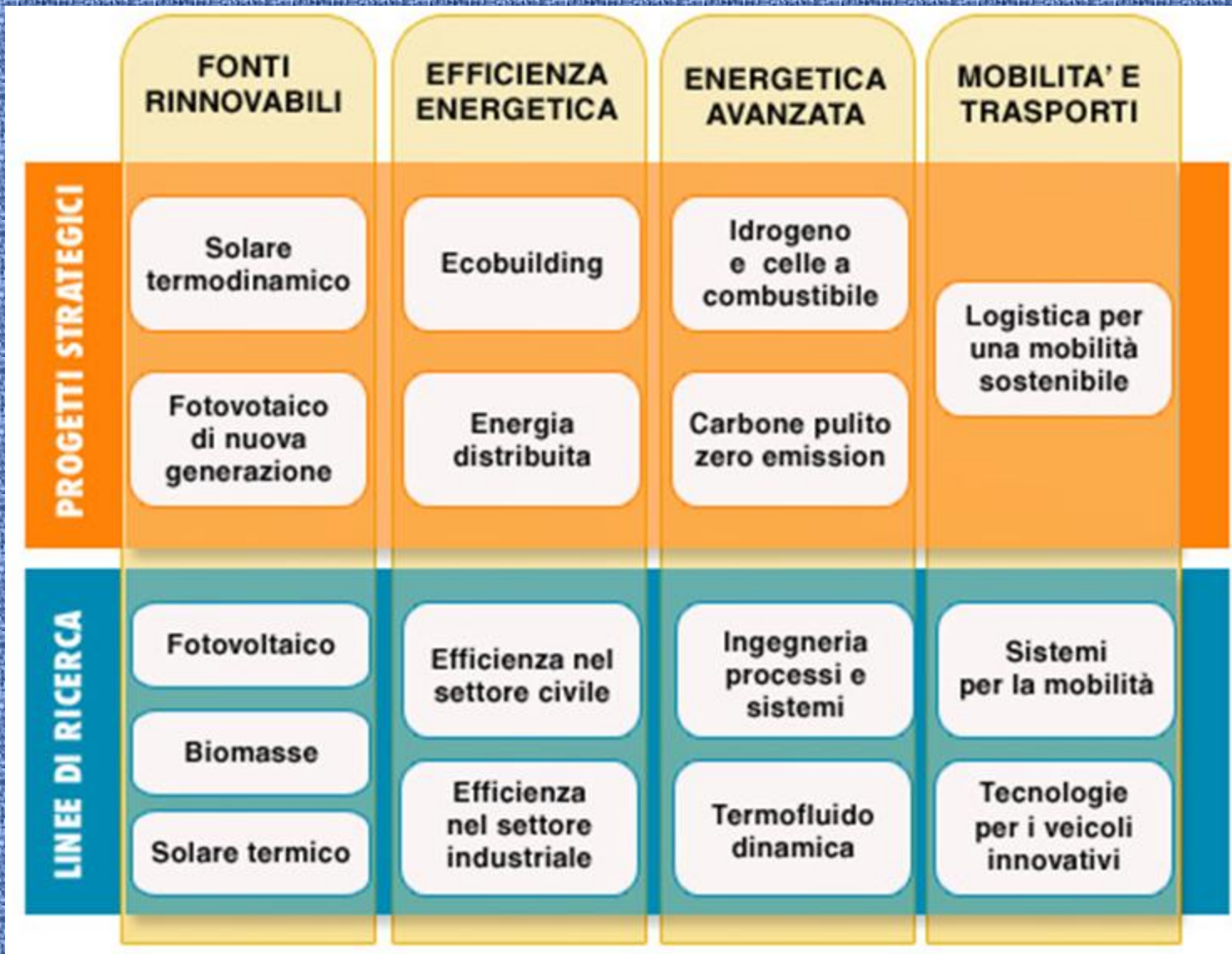
ENEA: Italian National Agency for New Technologies, Energy and Sustainable Economic Development



ENEA's Organization



THE ENERGY DEPARTMENT



Past Experiences

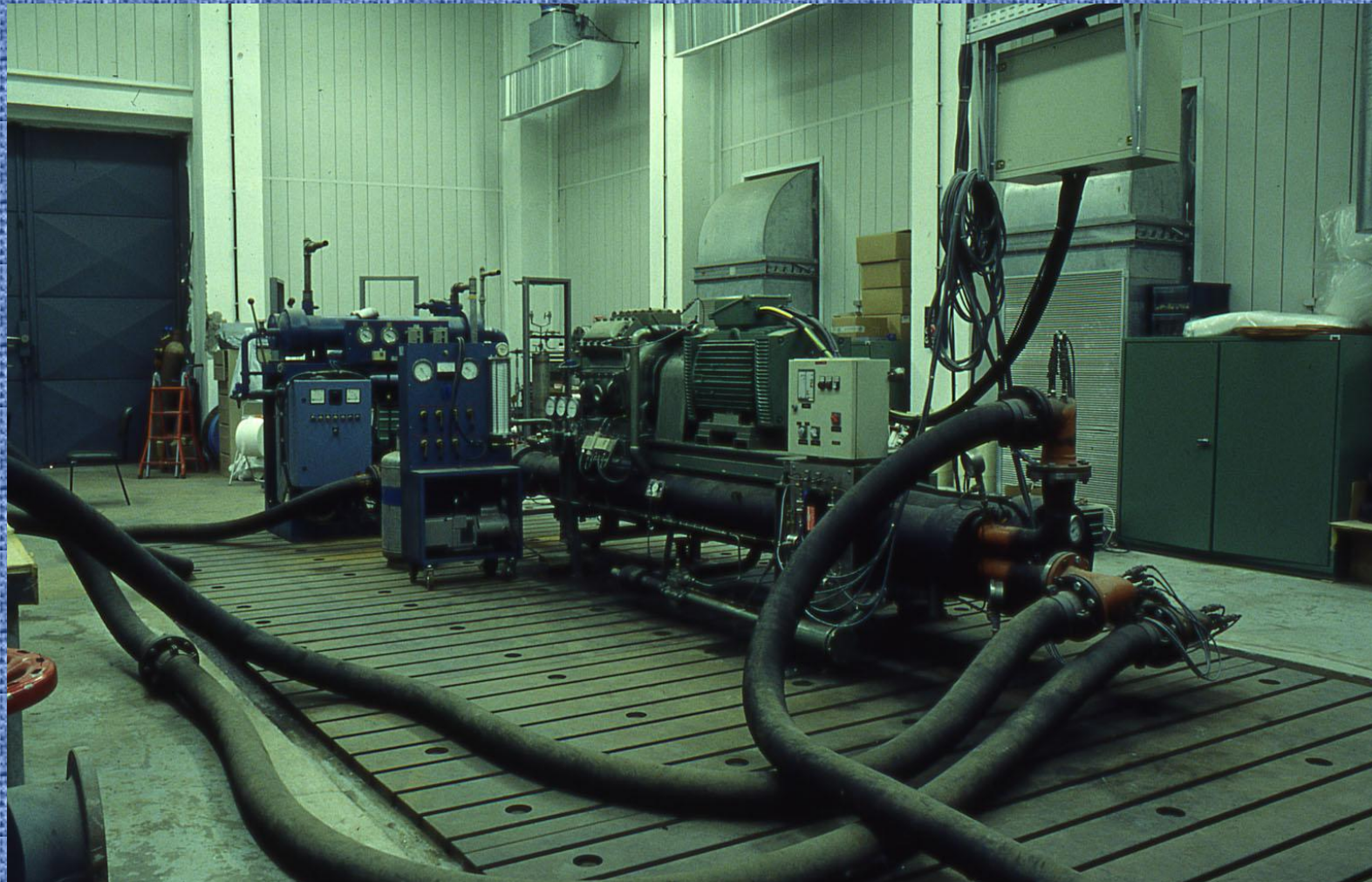
- Testing of Large CHPs
- Development of H₂O-NH₃ AHPs
- Development of Propane CHPs
- Study on Propane GSHPs

Testing of Large CHPs

- Period: 1982/1990
- ENEA Proposed a Certification Service
- Built Plant CAPOC (0.1-1MWt)
- The initiative failed due to lack of interest from Industry

The CAPOC Plant

(CAratterizzazione POmpe di Calore)



Development of H₂O-NH₃ AHPs

- Development of Demonstration Prototypes
- Development of Components

Demonstration Prototypes

- **ISPCA 1** (1983/1986) Biklim-Belleli
- **ISPCA 2 / 2 sc** (1986/1990) Biklim-Belleli
- **AR 15** (1991/1996) Merloni – Italgas
- **11/25 kW** (1995-2000) SRS-Cebelcor

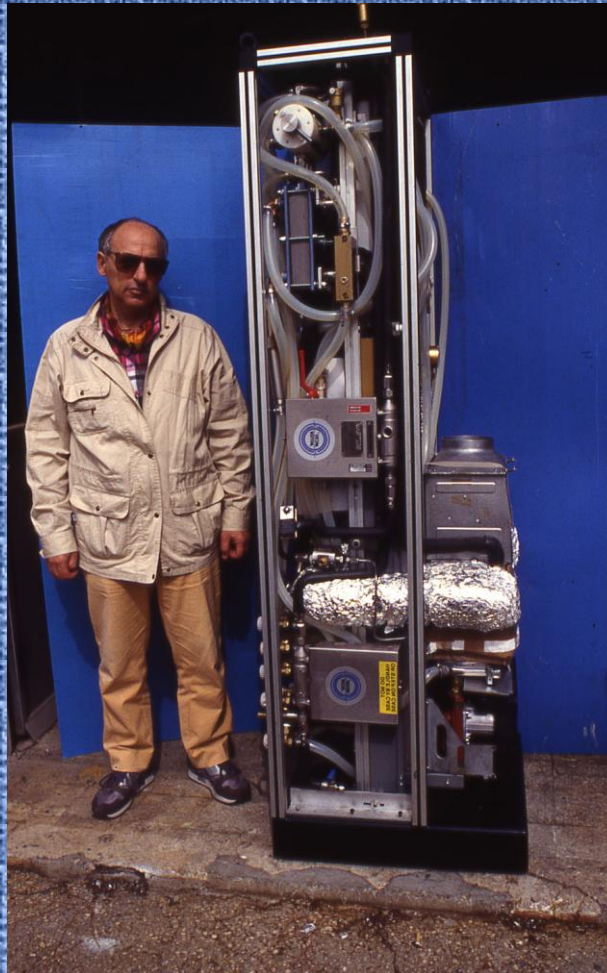
ISPCA 1



Features :

- **H₂O-NH₃ Heat Pump**
- **Electric Heating**
- **Thermal Power: 13 kW at ~ 60°C**

ISPCA 2 and 2 sc

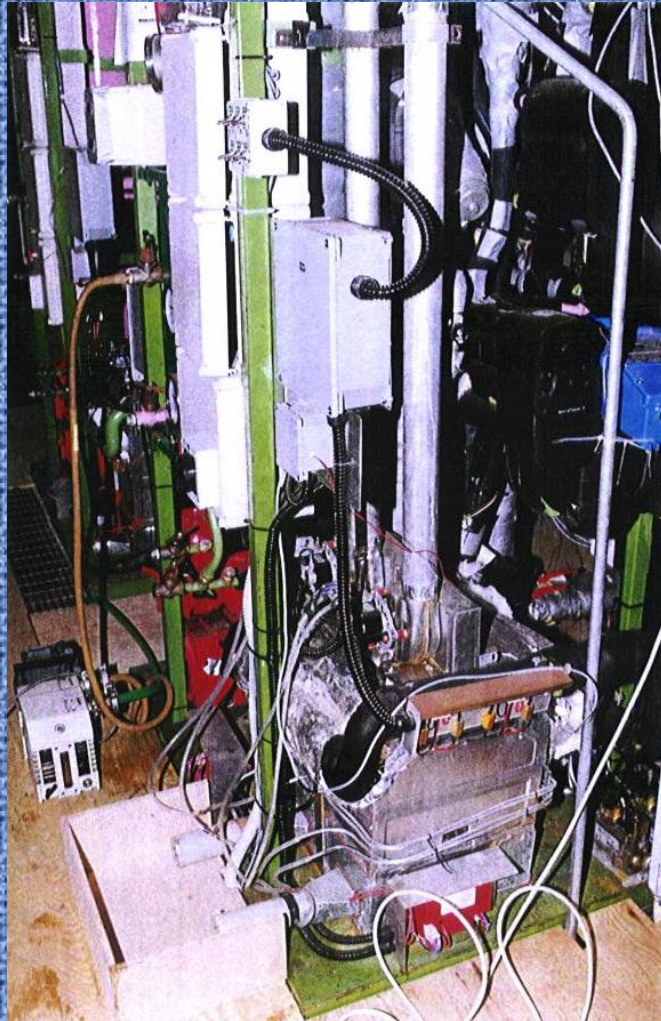


Features :

- Reversible H₂O-NH₃ Heat Pump
- Gas fired (2 SC indirectly)
- Thermal Power 13 kW at ~ 60°C
- Exhaust Condensation (2)
- Plate Grid exchangers (2 SC)
- Inversion Water Valve

AR 15 - MTS / Italgas

(Thermie BU 40/91)



Features :

- Reversible H₂O-NH₃ Heat Pump
- Gas Fired (Indirectly)
- Modulated Flame
- Exhaust Recovery
- Thermal Power: 50 kW a ~ 60°C
- Chilling Power: 15 kW
- Plate Grid Exchangers
- Inversion Water Valve

“11 e 25 kW” – NET

(Thermie BU 34/95)



Features:

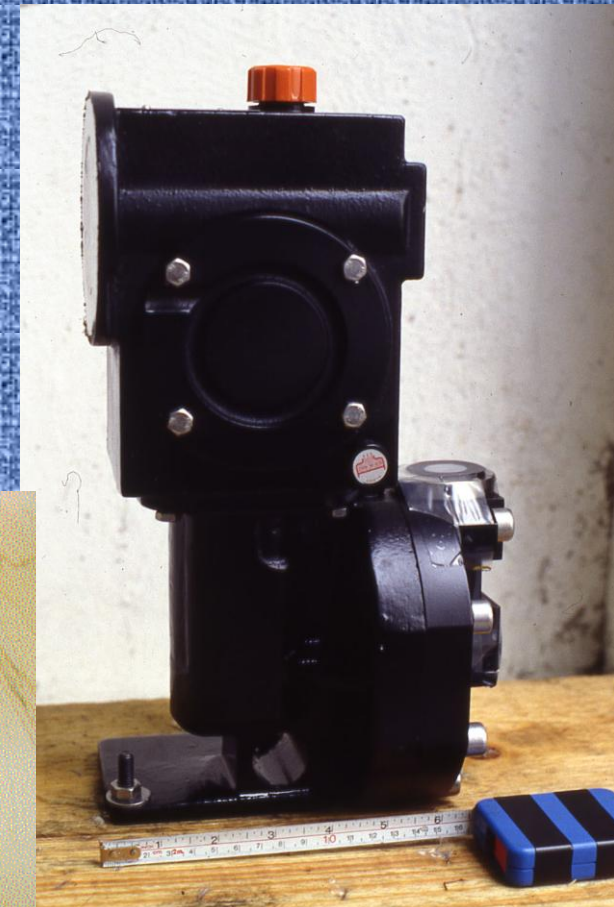
- Reversible H₂O-NH₃ Heat Pump
- Gas Fired
- Modulated Flame
- 11/25 kW chilling (7-12 °C)
- 25/50 kW thermal (45-55 °C)
- Inversion Water Valve

Development of Components :

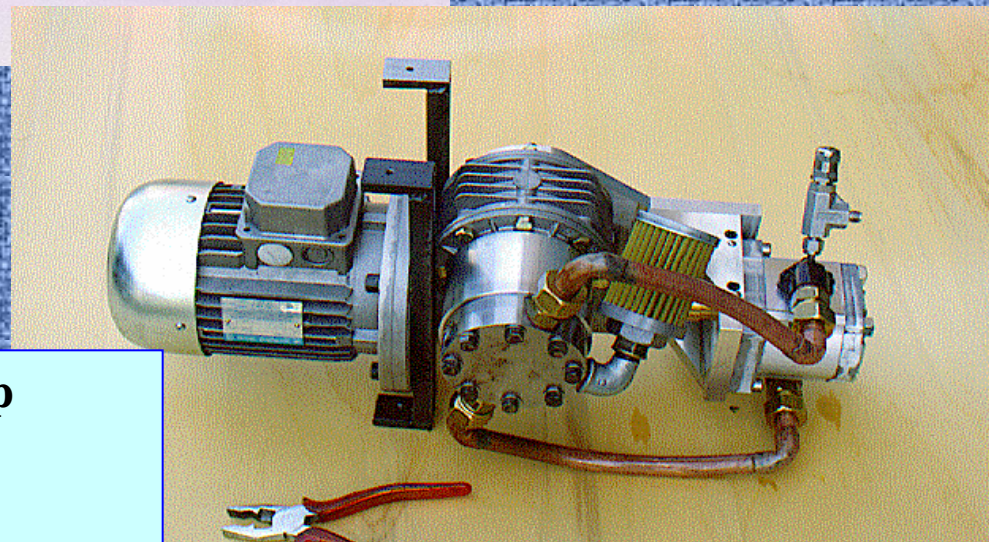
Rich Solution Pumps ($NPSH_a \sim 0$)



**Double Stage
Vane Pumps
(CASTER)**



**Membrane Pump
(OBL)**



**Oleodynamic Pump
“VR 220”
(for “11 kW” Prototype)**

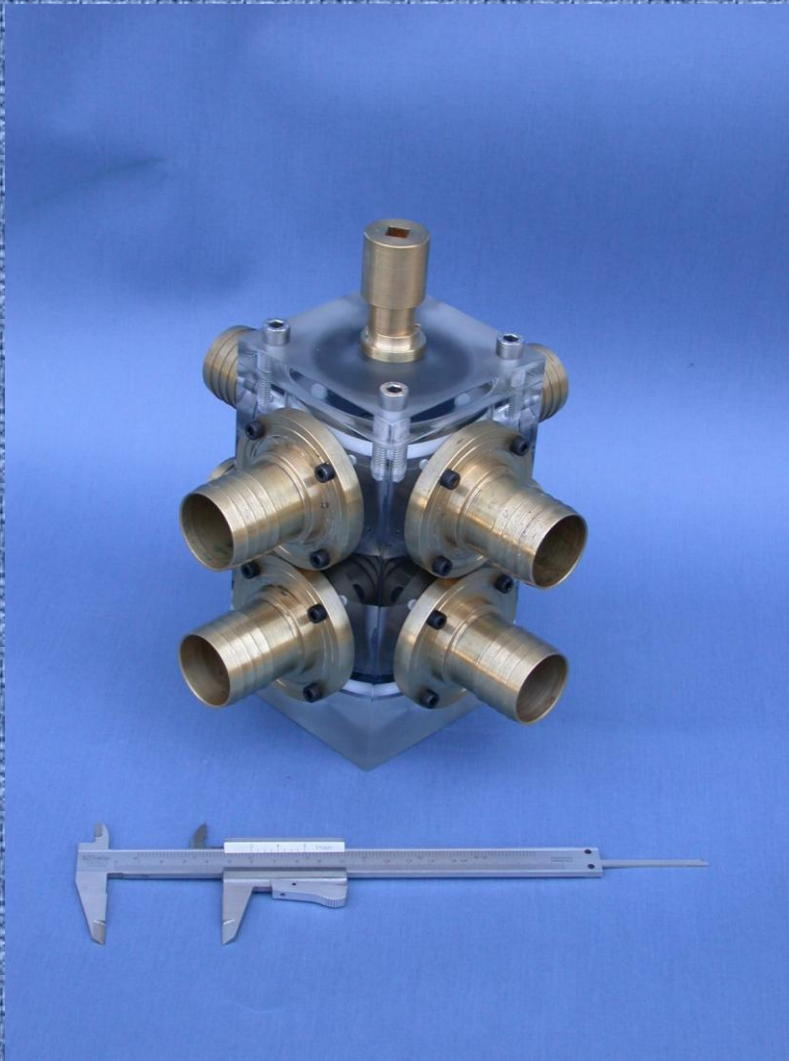
[Animation](#)

Development of Components : Heat Exchangers



**Brazed Plate-grid
Exchanger
(MTS; Italgas)**

Development of Components : Water Valves



8 way Valve
(for “11 kW” Prototype)

Development of Propane CHPs

HEAHP Project: (High Efficiency Air-to-water Heat pump Propane)

Development of New Reversible Propane CHPs, for High Efficiency Commercial Applications in south Europe.

Feb. 1998-Feb. 2000

Participants: AEDIE; CIATESA; UPV; KTH; Alfa Laval-Artec; ENEA

Propane Ground Coupled Heat Pumps

GEOCOOL Project :

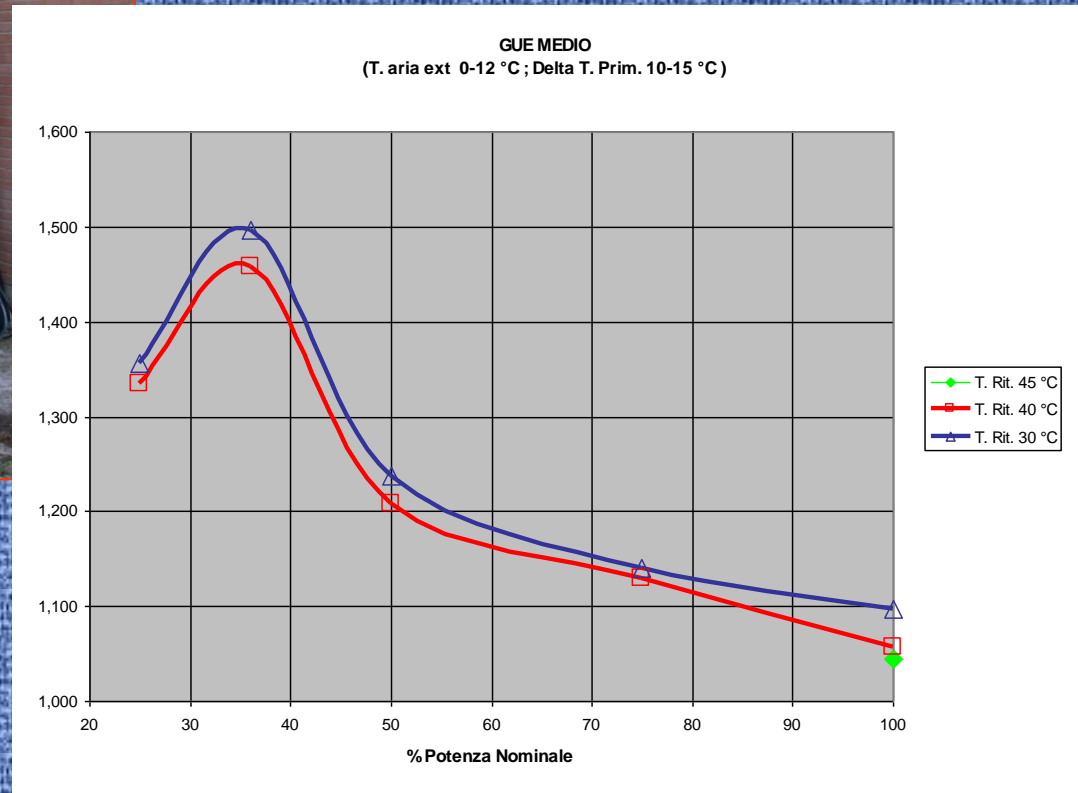
Development of a Commercial Size Ground Coupled Heat Pump,
Designed for the Southern Europe Costal Area.

Partners: UPV, AUTH, ENEA, GROHOL, CIATESA, AEDIE.

Period: 02/2003 - 02/2006

<http://www.aedie.com/geocool/index.htm>

Qualification of Commercial Products: ROBUR (GAHP+Boilers)

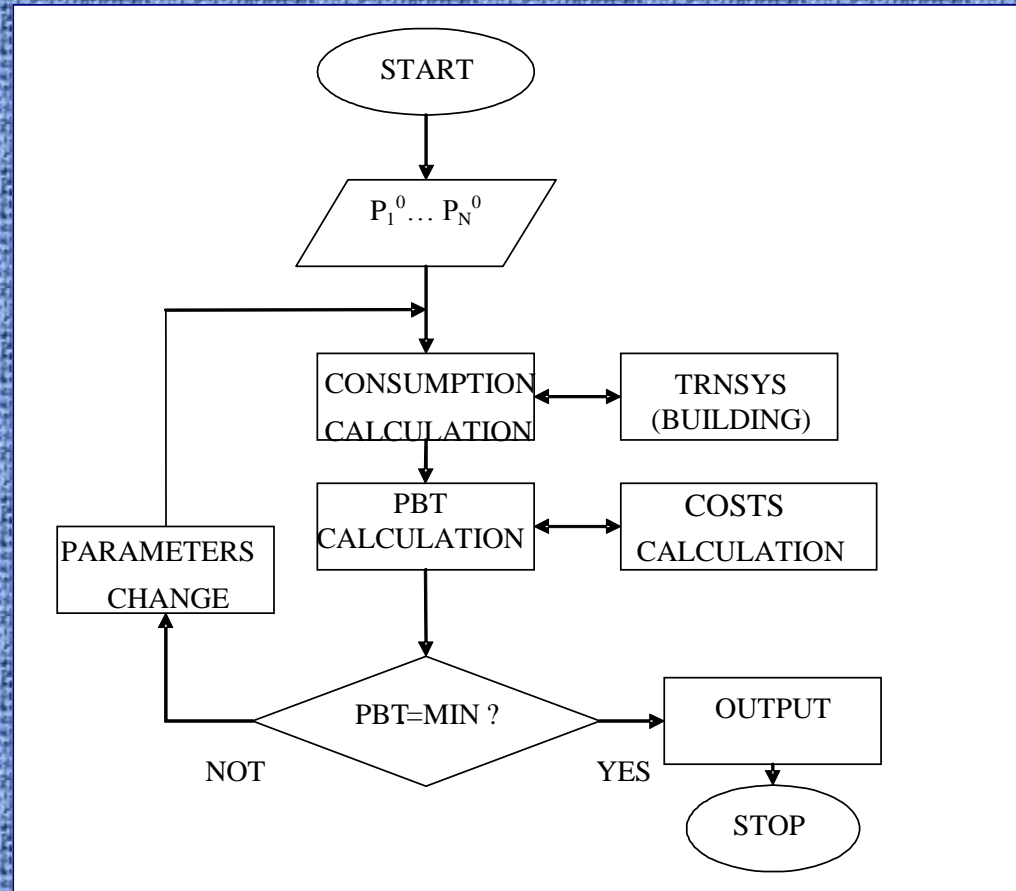


Actual Activities

- **Solar Cooling and Heating:**
 - Multivariate Optimization of Building+Plant
 - Demonstration Plant (F-51 Building near Casaccia Centre)
- **Efficiency for the Naval Sector:** The “Green Boat“ Project
- **Spin-Off** attempts

SOLAR Cooling and Heating

Multivariate Optimization on PayBack Time



SOLAR Cooling and Heating Multivariate Optimization on PayBack Time

Optimized Pay Back Times (years):

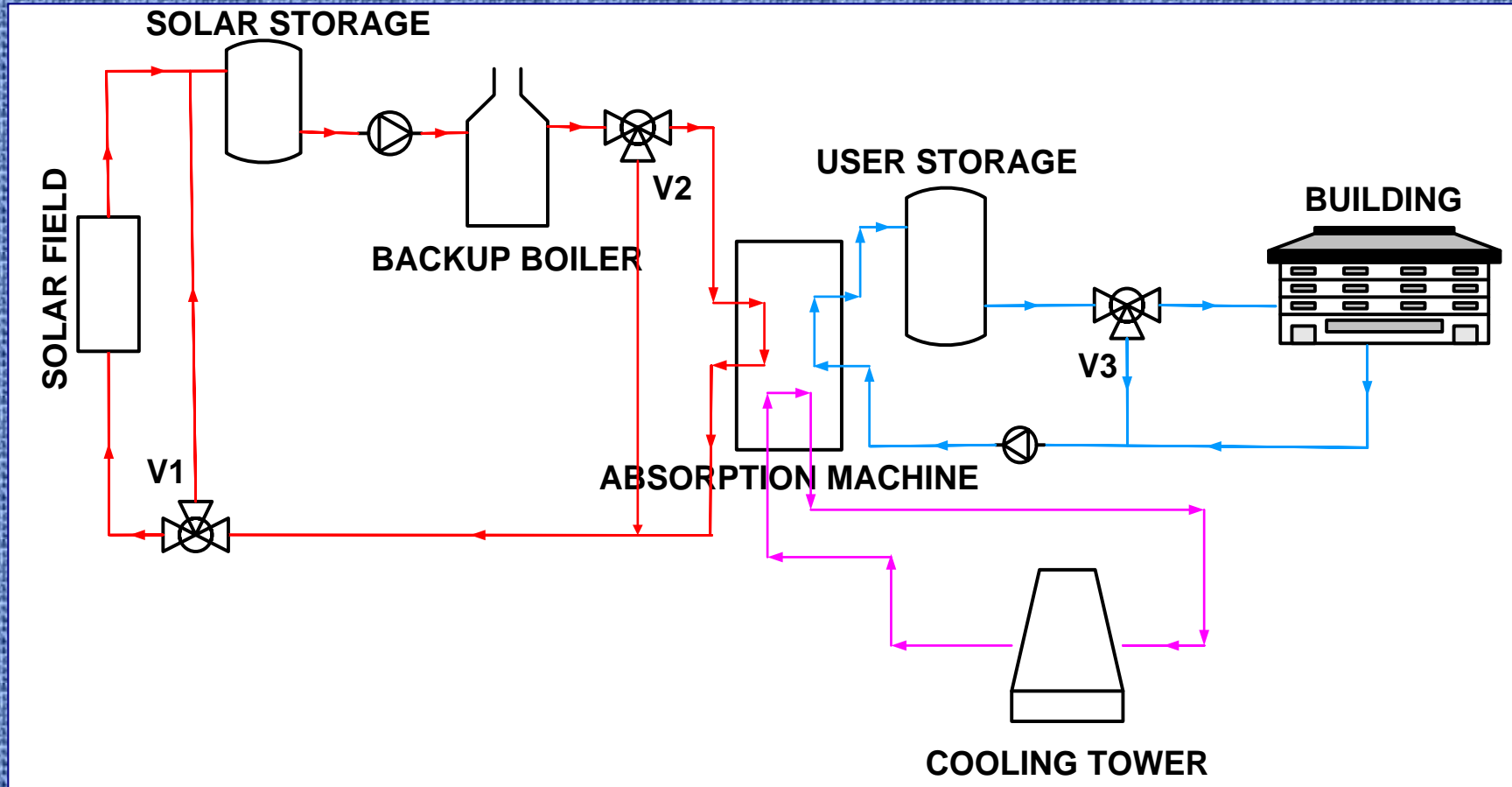
Water-LiBr (single effect) ~ 12.4

Water-LiBr (double effect) ~ 16.4

Water-NH₃ (reversible) ~ 15.6

SOLAR COOLING

F 51 Building: Simplified Scheme



SOLAR COOLING

F 51 Building (Work in Progress)



Efficiency for the Naval Sector:

The “Green Boat” Project

- Call of the Ministry for Research and University
- Participants: Rodriguez C.N., ENEA.
- Total costs: ~7.800.000 Euro
- Proposal passed on March 2007
- Work progress: Financial details in way of definition (still active).

The “Green Boat” Project

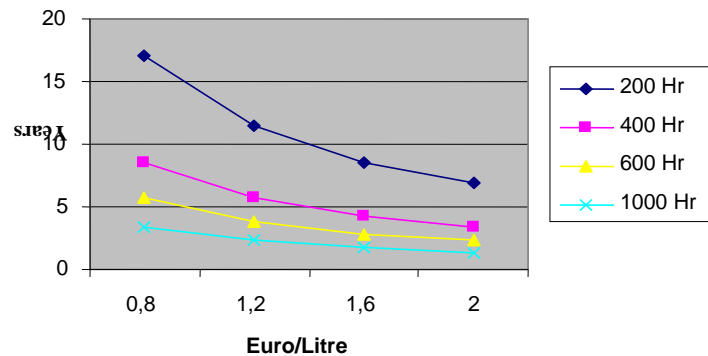
RODRIQUEZ Fast Ferry-Boat



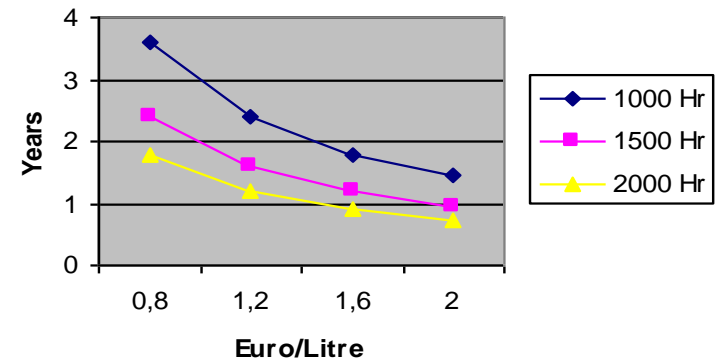
Lenght	42 m
Sailing Service	up to 5000 h/year
Speed	74 Km/h
Engine	2x2720 kW Turbodiesel
Engine Consumption	~800 l/h diesel oil
Air Cond. Plant	135 kW chilling
Elec. Generator Consumption	34.2 l/h gasolio (30 % Air Cond.)

The “Green Boat” Project

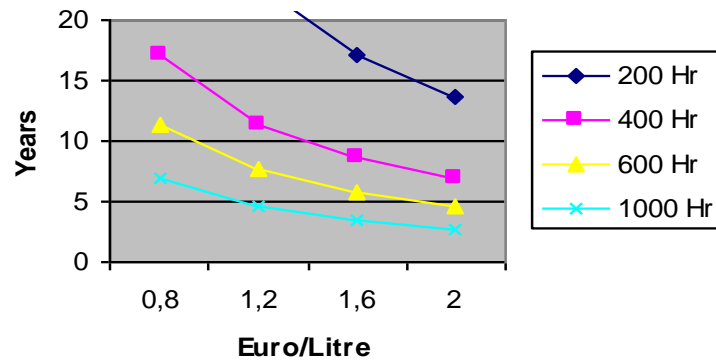
PBT YACHT $I_c/I_s=2$



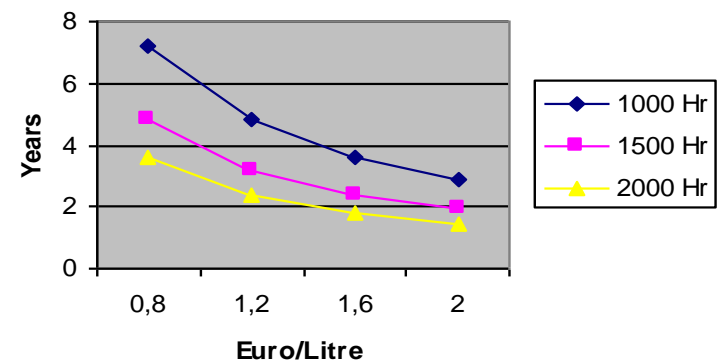
PBT FERRY-BOAT $I_c/I_s=2$



PBT YACHT $I_c/I_s=3$



PBT FERRY-BOAT $I_c/I_s=3$



Spin-Off attempts (since 2005)

- Spin-Off “STAR”: Development of Reversible Absorption Technologies
- Spin-Off “HYPUMP”: Development of Patented Pumps for Absorption Systems and Metering Pumps.

THANKS
FOR YOUR ATTENTION !