

Identified Technologies for the SunCool pilot plant (HR)

PROJECT TITLE: Enhancing Mediterranean Initiatives Leading SMEs to innovation in building energy efficiency technologies

AXIS: Strengthening innovation capacities

OBJECTIVE: Dissemination of innovative technologies and know-how

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List of abbreviations and terms – if applicable

| | |
|--------------|---|
| AREA | stands for AREA Science Park, head quartered in Trieste, Friuli Venezia Giulia region, Italy |
| CAP | is a short name of the Capenergies cluster, headquartered in Aix-en-Provence, PACA region, France |
| CIRCE | Stands for Centro de investigación de recursos y consumos energéticos, headquartered in Zaragoza, Aragón region, Spain |
| IAT | stands for Instituto Andalousian de Technologico, headquartered in Seville, Andalousia region, Spain |
| IJS | stands for Institute Josef Stephan, headquartered in Ljubljana, Ljubljana region, Slovenia |
| REA | stands for Regionalna Energija Agenci, headquartered in Rijeka, Kvarner region, Croatia |
| PACA | stands for Provence Alpes Côte d’Azur, the south-east region of France |
| SunLab | is the short name of the pilot action implemented in Italy, Venezia Friuli region, addressing <i>Solar Cooling technology Lab for building conditioning</i> |
| HVACLab | is the short name of the pilot action implemented in Spain, Andalousia region, addressing a <i>HVAC technology Lab for office buildings</i> |
| SmartEE | is the short name of the pilot action implemented in France, PACA region, demonstrating a <i>Smart interface to impulse behaviour changes favourable to Energy Efficiency</i> |
| InfraSun | is the short name of the pilot action implemented in Slovenia, Ljubljana region, approaching <i>Sun as an energy infrastructure</i> |
| Glassolating | is the short name of the pilot action implemented in Spain, Aragón region, dealing with <i>Phase Material Change technology in glass envelopes</i> |
| SunCool | is the short name of the pilot action implemented in Croatia, Kvarner region, addressing <i>Solar Cooling technology for a thermal comfort laboratory</i> |

Executive summary and abstract

The SunCool pilot action will deliver equipment of the Laboratories for refrigeration and air-conditioning at Faculty of Engineering in Rijeka with absorption chiller / heat pump powered by solar energy. The system will be able to use the heat produced in the boiler room for operation as well. Cooling and heating of offices, laboratory spaces, air in the air – handling unit or low temperature chambers will be possible. The installation will be used for educational and research purposes. One of important goals is to investigate proper control strategies for solar powered refrigeration in order to achieve as much efficient performance as possible.

1 Introduction

English

This report is the Croatian fold of Deliverable D4.1.1., which aims at detailing the technologies that will be implemented within the pilot actions of the EMILIE project. Overall, 6 pilot plants will be installed: one per participating region. The 6 pilot plants are:

- SunLab in Italy, Venezia region, under the lead of AREA
- HVACLab in Spain, Andalusia region, under the lead of IAT
- SmartEE in France, PACA region, under the lead of Capenergies
- InfraSun in Slovenia, Ljubljana region, under the lead of IJS
- Glassolating in Spain, Aragon region, under the lead of CIRCE
- SunCool in Croatia, Kvarner region, under the lead of REA

The next sections :

- explain why the demonstration site for the SunCool pilot action has been chosen,
- what are the energy saving challenges and
- present the technologies that will participate in the challenge solving.

Sažetak (Croatian)

Ovaj izvještaj hrvatska je verzija dokumenta D4.1.1. čiji je cilj detaljno opisati tehnologije koje će biti korištene u EMILIE pilot projektima. Bit će instalirano ukupno 6 pilot postrojenja – po jedno u svakog regiji. 6 planiranih pilot projekata jesu:

- SunLab u Italiji, Venecija, voditelj pilot projekta: AREA
- HVACLab u Španjolskoj, Andaluzija, voditelj pilot projekta: IAT
- SmartEE u Francuskoj, PACA regija, voditelj pilot projekta: Capenergies
- InfraSun u Sloveniji, Ljubljana, voditelj pilot projekta: IJS
- Glassolating u Španjolskoj, Aragon, voditelj pilot projekta: CIRCE
- SunCool u Hrvatskoj, Kvarnerska regija, voditelj pilot projekta: REA

U nastavku dokumenta:

- objašnjenje izbora lokacije za implementaciju SunCool pilot projekta,
- izazovi za poboljšanje energetske učinkovitosti
- opis tehnologije koja će biti korištena

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2 Presentation of the demonstration site

2.1 Location

SunCool will be implemented in Rijeka (Croatia), on a laboratory building owned by the University of Rijeka Faculty of Engineering.

2.2 Key building/facility data

- short description of the current status: Laboratories for refrigeration and HVAC systems are located in the laboratory building of the Faculty of Engineering in Rijeka. The boiler room (1,7 MW) of the entire Faculty of Engineering is located in the same building in the vicinity of above mentioned laboratories and connected to laboratories by pipelines for heat supply. Central air – to – water chiller (150 kW) aimed for water cooling within the air – conditioning systems of several areas of the Faculty is also located in the laboratory building, with provided heat rejection through dry cooler situated on the roof of the laboratory building. Within the laboratory 3 heat pumps (1 x 120 kW cooling capacity, and 2 x 50 kW cooling capacity) are installed, with different possibilities for utilization of their heating and cooling capacities. Laboratories have been used for educational and research purposes.
- main areas and technical state of the building to which belongs the area where pilot plant will be installed/implemented: Laboratories of refrigeration and HVAC systems are situated in the ground floor of the building in the room of approximate floor area 278 m².
- occupancy characteristics: the building is occupied all year round, working days 5 days per week from 7am till 9pm. It comprises offices and laboratories, as well as several teaching rooms. During weekends access of research staff is enabled. Period of lower occupancy is August, during vacancies, but research activities take place in that month as well, but with decreased intensity.
- In the next pages: photos, schemes



Fig. ,1. Main building in front and the laboratory building behind



Fig. 2. Laboratory building southwest front

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Fig. 3. Connection between the main building and the laboratory building



Fig. 2. Laboratory building northeast front

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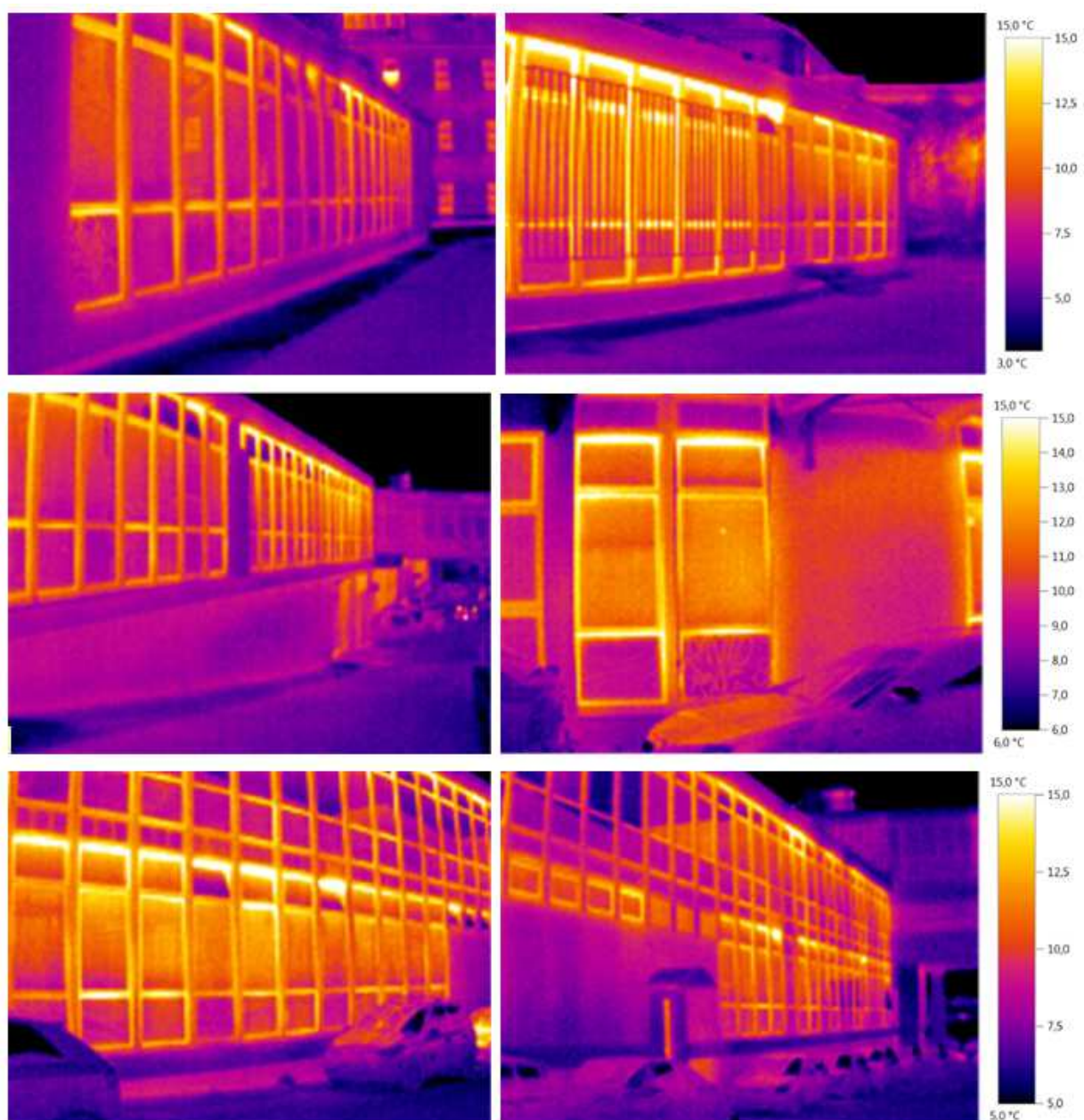


Fig. 2. Laboratory building thermal images

3 Description of the pilot plant

The pilot plant will be implemented into existing already equipped laboratories for refrigeration and air-conditioning.

3.1 Characteristics of the pilot plant setup

- the relationship of the system/areas to the entire facility/building: the capacity of the system is sufficient only for research purposes, e.g. cooling of several offices, air in the air handling unit or the cold chamber.
- key technical details and features - e.g. size(s) of window surfaces, heating/cooling power, capacities : Vacuum solar collectors approximate absorber area 50 m², ammonia - water absorption chiller / heat pump capable for achieving negative temperatures cooling capacity 18,6 kW at cold water 6/12°C, cooling water 24/30°C and hot heating water 85/78°C, plate heat exchangers, hot and chilled water storages, expansion vessels, pumps, automatic control and performance data acquisition system
- instrumentation and control: central automatic control and entire monitoring of the existing system is provided. Besides the central control system delivered by Honeywell, gas, water and electricity consumption monitoring is provided via so called ISGE (Information system of energy management) where data have been collected in a central Croatian server.
- In the next pages: pictures and schemes of the initial state

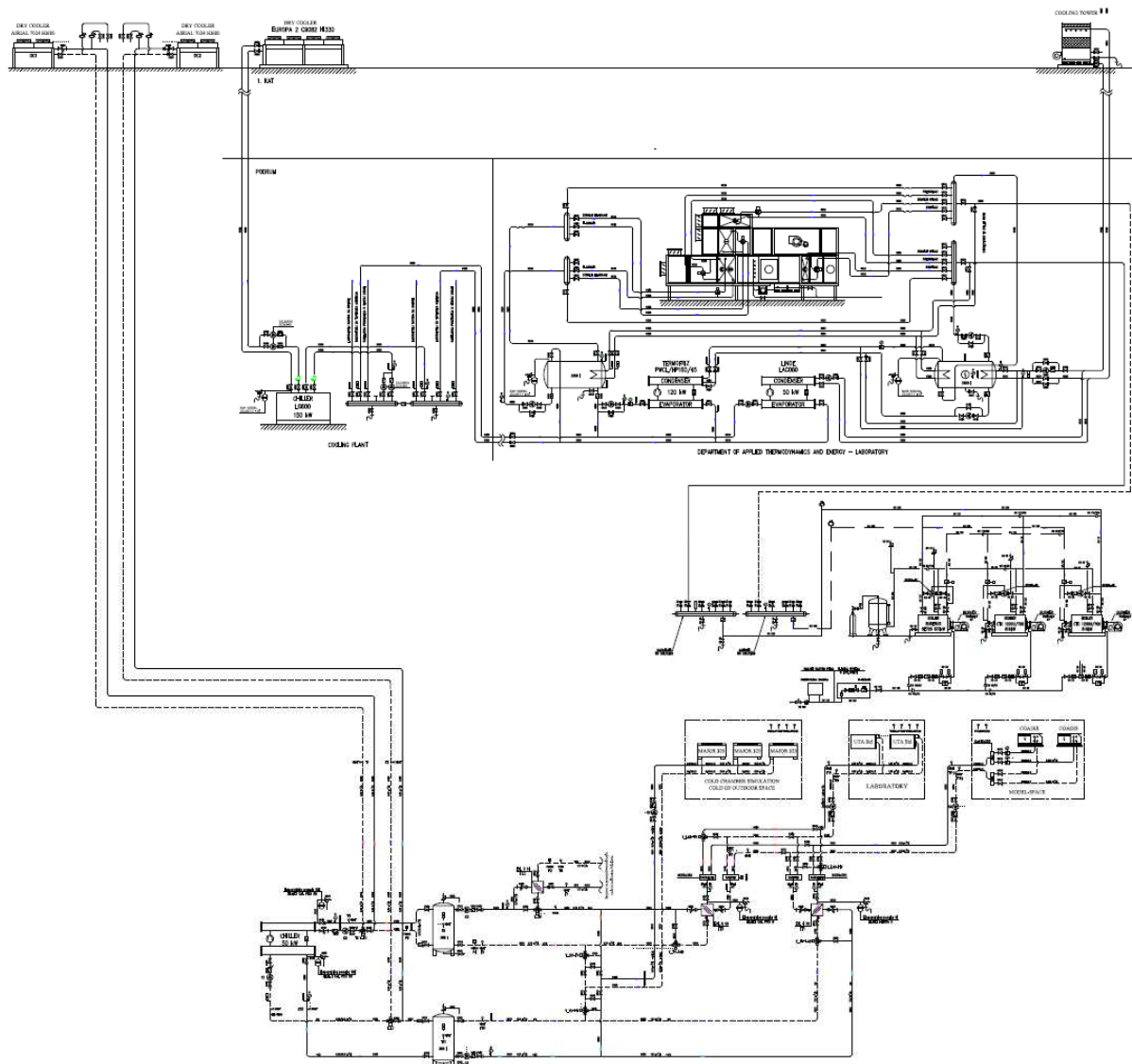


Fig. 1. Existing installation scheme



Fig. 2. Heat pumps 120kW and 50 kW in the laboratory



Fig. 3. Boilers in the boiler room

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Fig. 4. Chiller 150 kW



Fig. 5. Heat pump of the laboratory for thermal comfort with buffers



Fig. 6 Air handling unit

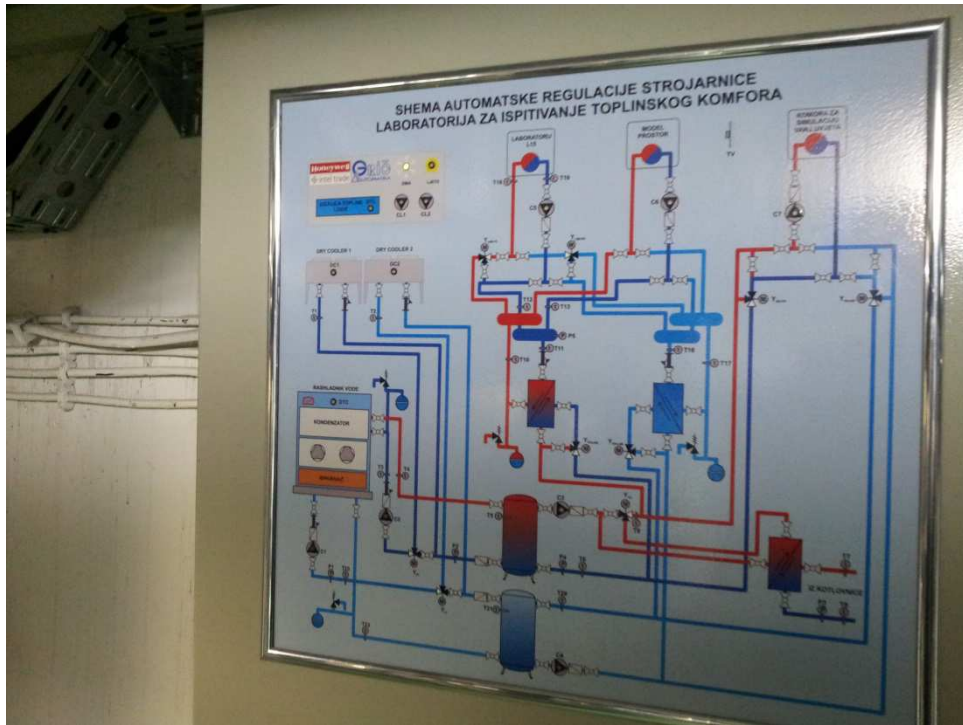


Fig. 7 Front panel of the control system

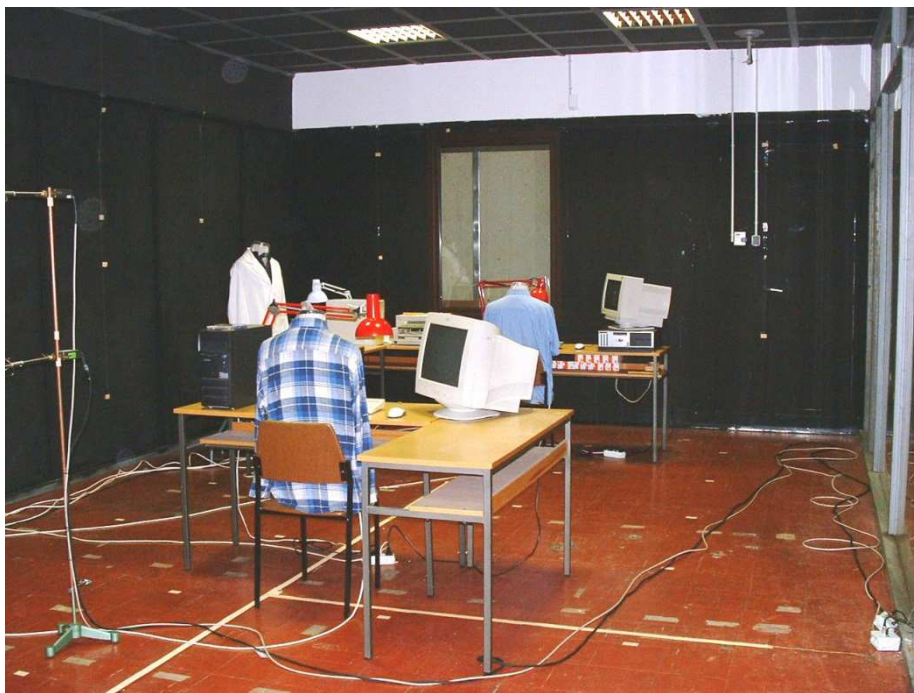


Fig. 8 Interior of the laboratory for thermal comfort



Fig. 9 Arrangement for laser doppler anamometry within the laboratory for thermal comfort



Fig. 10. FlowLite 2D Laser Doppler anemometry (LDA) system



Fig. 11. Data acquisition system NATIONAL INSTRUMENTS, (DAQCard-AI-16XE-50, SCXI-1102B 32 Channel Amplifier, 2xSCXI Process Current Resistor Kit, SCXI 1300 Low voltage Screw terminal Block, SCXI 1125 8 Channel Programmable Isolated Input Module, SCXI 1313 Programmable Voltage Attenuator Terminal Block, SCXI 1126 8 Channel Isolated frequency Input Module, SCXI 1320 Temperature Sensor Terminal Block, SCXI 1161 8 Channel Power Relay Module, SCXI 1000 4 Slot Chasis, PCMCIA Cable, SCXI 1349 Shielded Cable Assembly, PCMCIA and GPIB software)



Fig. 12. Data acquisition system Fieldpoint Bundle National instruments

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Fig. 13. Data acquisition system ADAPCOOL Danfoss

3.2 What will be retrofitted/installed/implemented

Ammonia - water absorption chiller / heat pump will be installed, capable for achieving negative temperatures cooling capacity 18,6 kW at cold water 6/12°C, cooling water 24/30°C and hot heating water 85/78°C. The chiller will be powered either by hot water from the boiler room or by vacuum solar collectors with approximate absorber area 50 m² placed on the roof. All equipment such as plate heat exchangers, hot and chilled water storages, expansion vessels, pumps, automatic control and performance data acquisition system will be installed for the new, added part of the system.

- Layout of the target state

- absorber-condenser). Meteorological data (temperature, relative humidity, wind speed, diffuse and direct solar radiation). Electric energy consumption of auxiliary equipment.
- equipment/system and IT support: Data acquisition systems owned by beneficiary (Producer: National Instruments), software support LabVIEW by National Instruments. Some basic control features and measurements will be covered by programmable PLCs and field measurement equipment.

4 Expected impacts

4.1 Energy savings

Expected energy savings are limited, because of the limited budget available within the EMILIE project with regards to the overall campus of the Technical Faculty on the one hand and because the pilot action addresses a substitution of the energy supply means. Yet, the new installation will take advantage of solar energy instead of electricity and heat pump consumptions.

4.2 Other environmental benefits

Increased possibility for education in the area of refrigeration and solar technology. Increased knowledge about possibilities and limits for feasible application of solar absorption cooling.

4.3 Social impact

No significant impact, as entire building has already built-in heating and air-conditioning systems

4.4 Financial advantages

Significant financial impacts by utilization of cooling are not expected. Solar collectors can be used for hot water production as well, but existing distribution systems and dislocated consumption do not allow for financially efficient utilization of heat. Financial savings are expected in planned acquisition of laboratory equipment and instruments.