



UNIVERSITÀ DEGLI STUDI
DI GENOVA



Towards the future Smart City: the Savona Campus Experience

University of Genoa - ITALY

The University of Genoa (UNIGE) is one of the most ancient European universities

- More than 32.000 students
- 5 Schools:
 - Natural Sciences
 - Medical Sciences
 - Engineering
 - Social Sciences
 - Humanities
- 22 Departments
- 125 Degrees (B.Sc. + M.Sc.)
- 81 Postgraduate Schools
- 27 Ph.Ds
- 30 Advanced Courses
- 4 Locations:
 - Genoa
 - Savona
 - Imperia
 - La Spezia



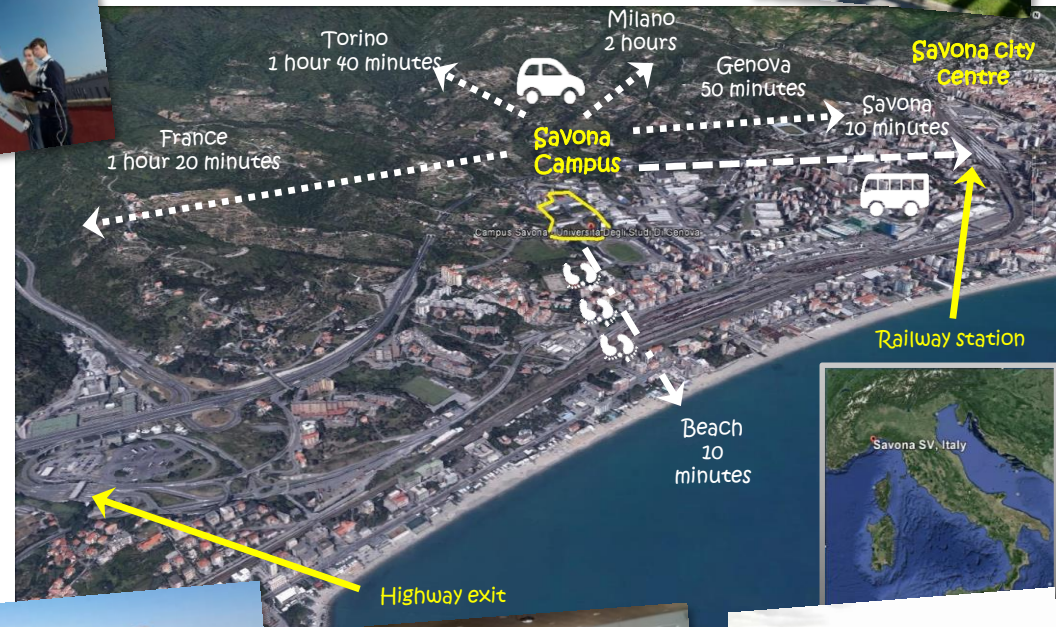
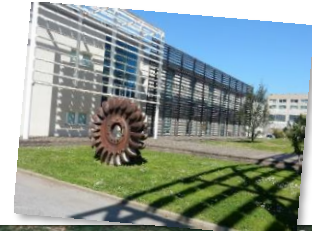
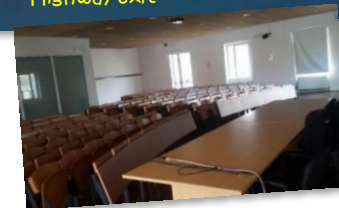
Savona Campus at a glance

Courses:

- B.Sc. Mechanical Engineering – Energy & Industry 4.0
- B.Sc. Sport Science and Health
- B.Sc. Nursing
- B.Sc. Communication Sciences
- M.Sc. Energy Engineering
- M.Sc. Management Engineering
- M.Sc. Digital Humanities – Communication and New Media
- M.Sc. Engineering for Natural Risk Management
- M.Sc. Sustainable Tourism
- Master on Rehabilitation of Musculoskeletal Disorders

Research:

- **Research & Innovation Cluster on Sustainable Energy** (www.es.sv.it):
 - Power systems engineering & control
 - Renewables & storage systems
 - Planning, design and management of smart energy systems
 - Distributed Generation modelling and simulation
- **CIMA Research Foundation** - International Environmental Research Centre (www.cimafoundation.org):
 - National Centre for Civil Protection
 - Disaster Risk Reduction
 - Biodiversity



Savona Campus at a glance

Savona Campus

2000
students

60.000 sqm

2 student
accommodation
buildings

1 Library

15 SMEs

1 Canteen
and 1 Cafè

More than
100
Professors &
Researchers

Sport
Facilities



**Savona Campus of the
University of Genoa**

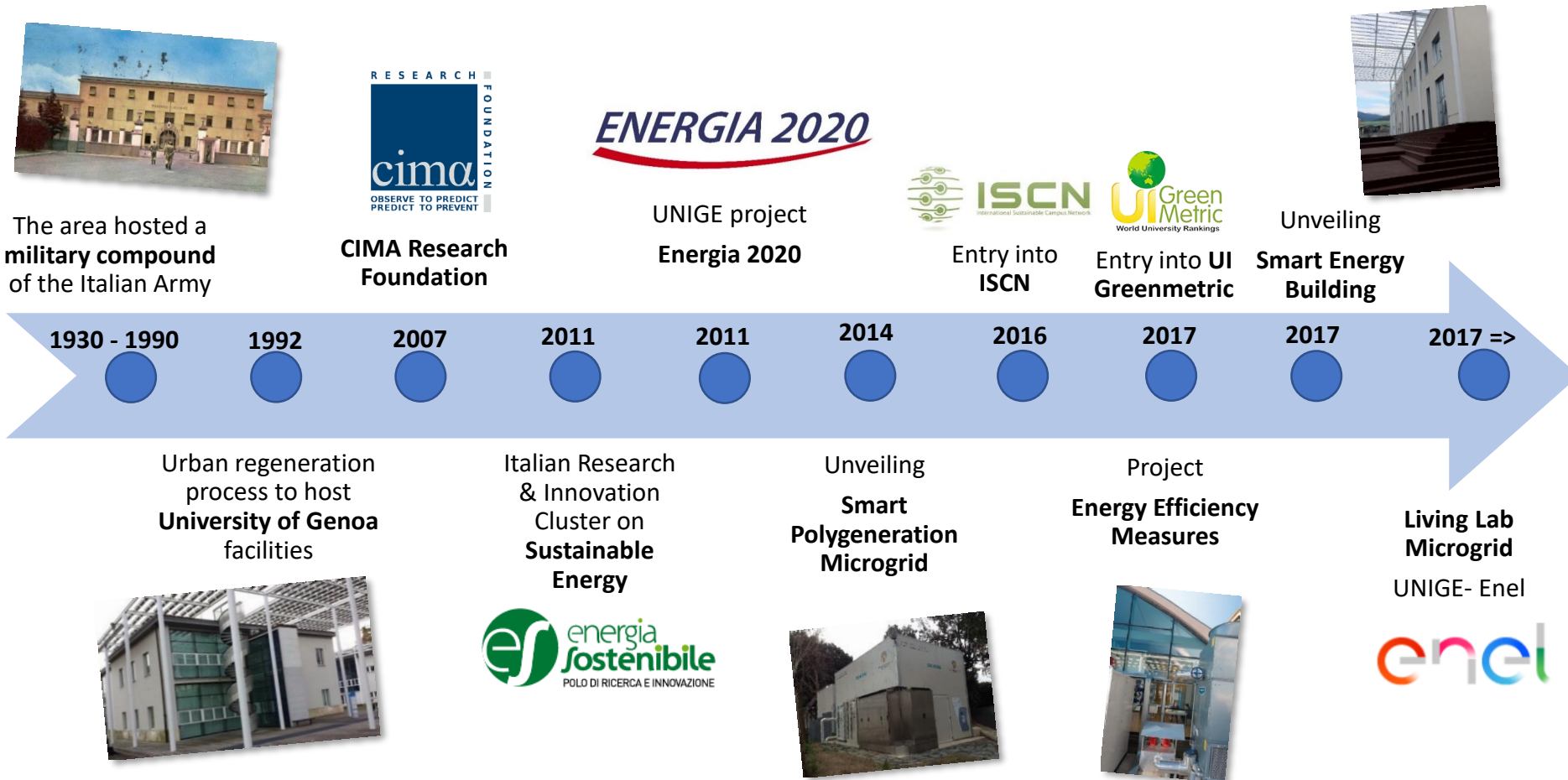
Via Magliotto, 2 I-17100 Savona (Italy)

Email: cens@unige.it

Website: www.cens.unige.it



Savona Campus: growth to Sustainability



Energia 2020 Project

ENERGIA 2020

Innovative project started in 2011 concerning with the Smart City & Sustainable Energy topics. It has been conceived, designed and developed by the University of Genoa with the final goal to make Savona Campus a Living Lab of the City of the Future.

Smart Polygeneration Microgrid (SPM)



1st low voltage Smart & Sustainable Microgrid in Italy feeding the electrical and the thermal loads of the Campus

Funded by: Italian Ministry of Education, University and Research

Value of the project: 2,4 M€

Status: in operation since February 2014

Smart Energy Building (SEB)



"Intelligent" & Active ZEB interacting in real-time with the SPM Energy Management System as a Prosumer

- Funded by: 90% Italian Ministry for the Environment and the Protection of Land and Sea, 10% UNIGE
- Value of the project: 3 M€
- Status: in operation since February 2017



ENERGY MANAGEMENT SYSTEM (EMS)



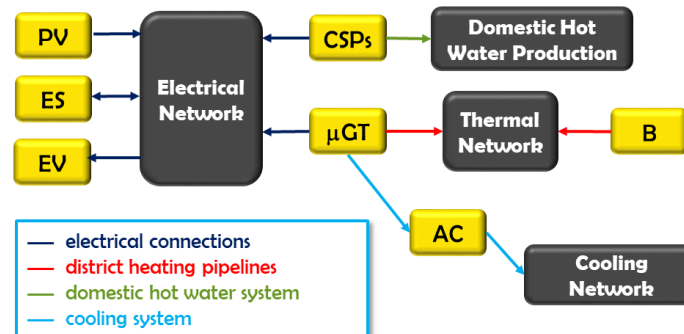
BUILDING MANAGEMENT SYSTEM (BMS)



Smart Polygeneration Microgrid



- Renewable power plants
- Storage systems
- E-mobility



- 3 micro-cogeneration gas turbine (μ GT) fed by natural gas
- 2 photovoltaic fields (PV)
- 3 Concentrating Solar Power systems (CSP)
- 2 absorption chillers (AC) to refrigerate buildings during the summer
- 2 Electrical Storage systems (ES)
- 2 standard Electrical Vehicle (EV) charging station and 2 V2G (Vehicle to Grid) charging stations
- 2 gas boilers (B)



SPM 3-level planning & control system

Energy Management System (EMS)

Optimization algorithm (time horizon: 24 hours, time interval: 15 min)

Objectives: reduction of daily operational costs & CO₂ emissions

INPUTS

Cost functions

Technical and environmental constraints (related to the performance of power plants)

Savona Campus electrical and thermal load forecast

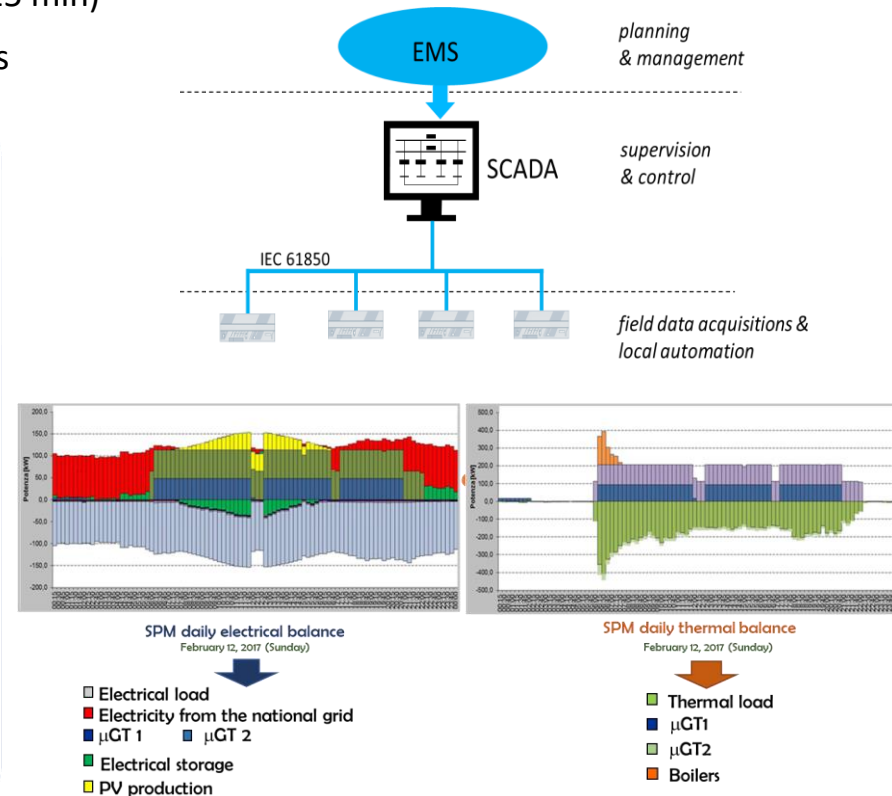
Estimation of power production from renewable sources based on weather forecast and historical data

OUTPUTS

Optimal scheduling of the production of fossil fuel power plants (microturbines and boilers)

Optimal scheduling of electricity provision by energy storage systems

The final goal is to minimize daily operational costs and emissions

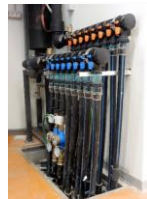
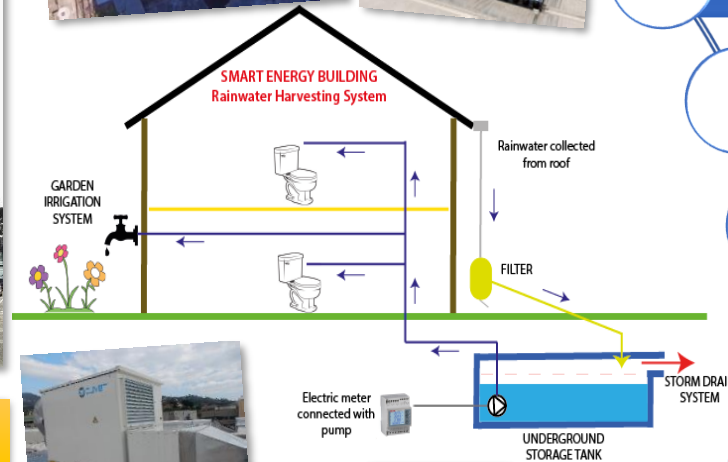


Smart Energy Building

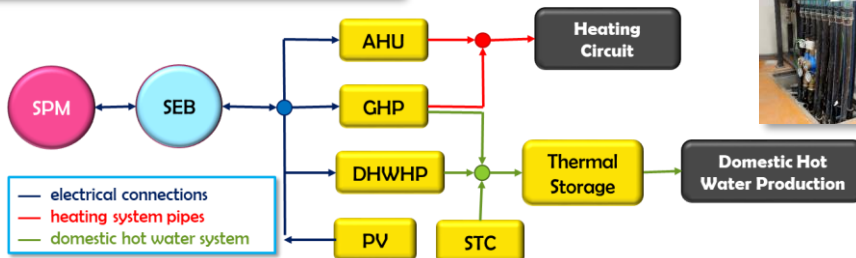


ZEB

(Zero Emission Building)



Geothermal Energy covers 100%
of winter & summer thermal
demand of the building



High performance thermal insulation materials for building applications & Extremely low consumption led lamps

Geothermal heat pump (GHP)

Controlled mechanical ventilation - Air Handling unit (AHU) & Ventilated facades

Domestic Hot Water Heat Pump (DHWHP)

85 solar panels (PV) and 2 solar thermal collectors (STC)

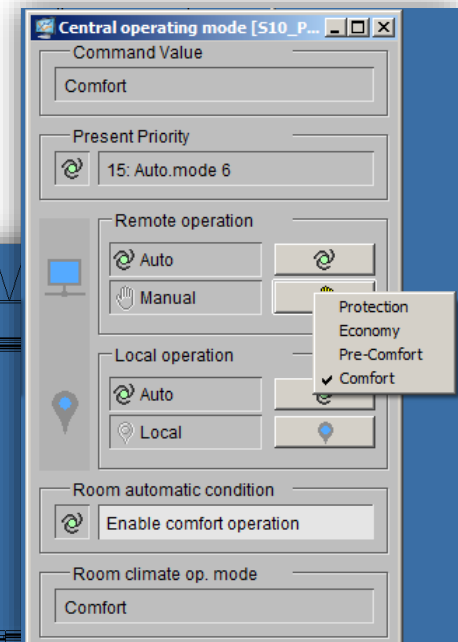
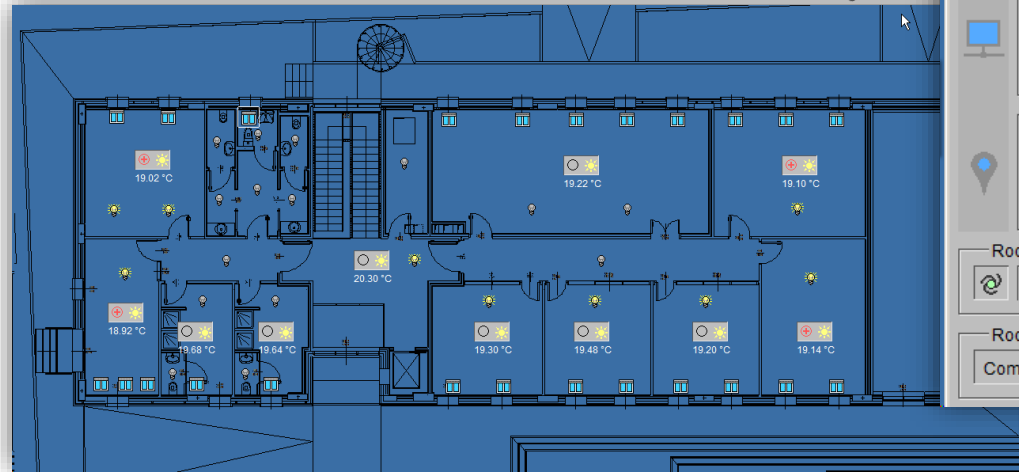
Rainwater collection system

Technological Gym

Smart Energy Building

Building Management System (BMS)

- Room automation system & Indoor temperature control (3 different comfort levels: comfort, pre-comfort, economy)
- Real-time monitoring of electrical, thermal and environmental performances
- Regulation of heating/cooling system
- Windows blinds opening & closure
- Light intensity regulation
- Presence sensing & monitoring
- Users' feedback by smartphones



Smart Energy Building



Vertical Garden
Hydroponics



“Arcimboldo”
Artwork of a local artist
on sustainable
agriculture as a local
tradition



Unveiling on December 4th, 2017
at the presence of the Italian
Defense Minister, the President of
Enel (Italian Electricity System
Operator) and UNIGE Rector



Energia 2020 Project – Best Practices

Smart Polygeneration Microgrid (SPM)



Sustainable Energy production (Renewables + Energy Storage) to satisfy the Campus energy needs

Combined Cooling, Heating and Power (CCHP) systems to **reduce primary energy consumptions**

Electrical Storage systems to **compensate the fluctuations of power production from renewable sources**

Recharging stations with V2G (Vehicle-to-Grid) capabilities (the batteries of the electric cars can also be used as support storages to the electric grid or as a source of electricity for the SEB)

Carbon footprint and energy bill reduction

These two infrastructures are used to develop R&D activities in collaboration with different companies to create innovative products for the Smart City

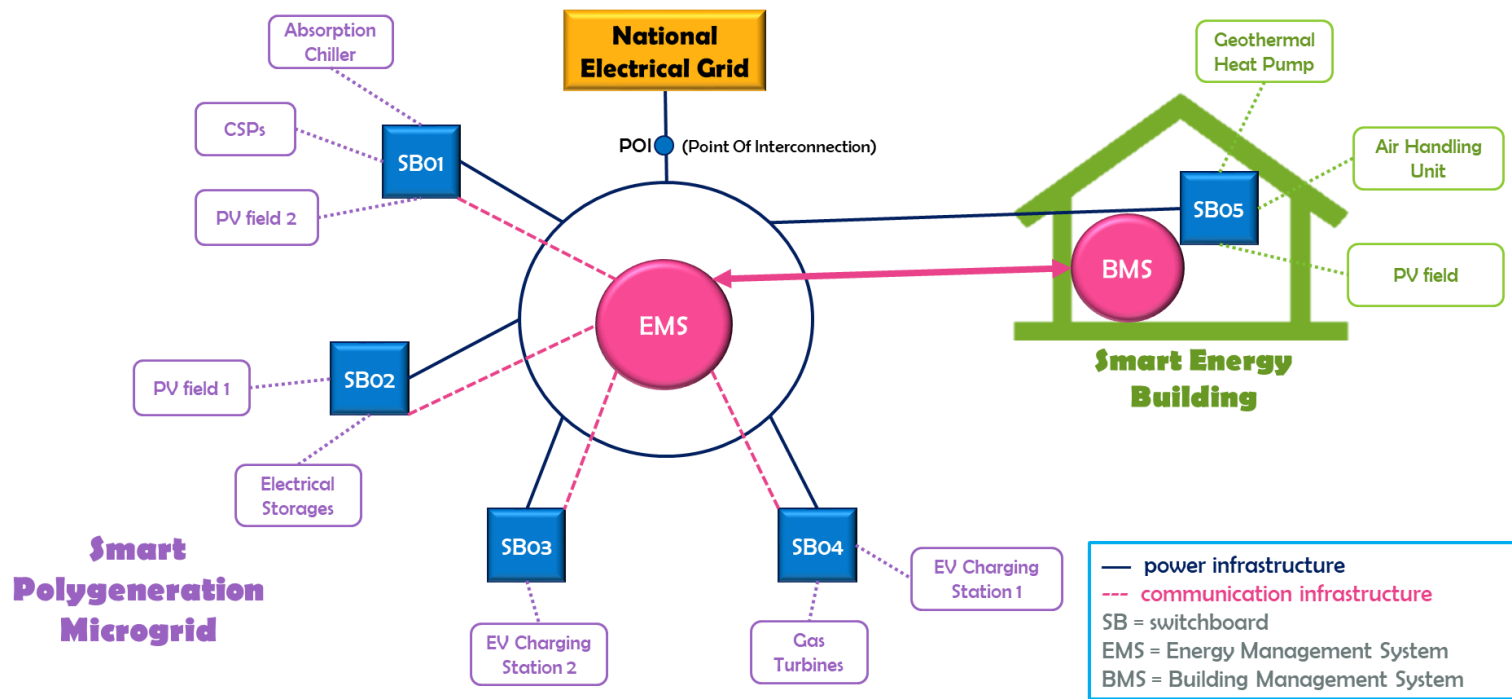
Smart Energy Building (SEB)



- **Public building fed only by renewables** (geothermal and solar energy for heating and cooling, PV + Energy Storage for electricity provision) with no connection to the National Electrical Grid (**SUSTAINABLE URBAN ENERGY ISLAND**)
- **LED lamps automatically controlled** according to available natural light and occupancy levels
- **Ventilated facades** and high thermal/acoustic insulation system
- **Different indoor comfort levels** can be set by the BMS to control the energy demand of the building
- The **project can be reproduced at the city level** (**SMART DISTRICTS**)

Energia 2020 Project – Best Practices

The principle of the Intelligent Urban District



Energia 2020 Project – KPIs

Electrical production from renewables index

$$REP = \frac{El_energy\ production\ from\ renewables}{El_energy\ production} \cdot 100$$

50%

Electrical production from CCHP index

$$CCHP - EP = \frac{El_energy\ production\ from\ CCHP}{El_energy\ production} \cdot 100$$

50%

Thermal production from CCHP index

$$CCHP - TP = \frac{Th_energy\ production\ from\ CCHP}{total\ thermal\ demand} \cdot 100$$

64%

Thermal production from boilers index

$$B - TP = \frac{Th_energy\ production\ from\ boilers}{total\ thermal\ demand} \cdot 100$$

36%

Electrical self-production index

$$SEP = \frac{local\ el_energy\ production}{total\ electrical\ demand} \cdot 100$$

70%

Primary energy (PE) saving index

$$PES = \frac{(PE)_{Savona-Campus} - (PE)_{without\ SPM\&\;SEB}}{(PE)_{without\ SPM\&\;SEB}} \cdot 100$$

28%

CO2 reduction index

$$CO_2 - red = \frac{(CO_2)_{Savona-Campus} - (CO_2)_{without\ SPM\&\;SEB}}{(CO_2)_{without\ SPM\&\;SEB}} \cdot 100$$

30%

Operative cost reduction index

$$Cost - red = \frac{(Op.\ cost)_{Savona-Campus} - (Op.\ cost)_{without\ SPM\&\;SEB}}{(Op.\ cost)_{without\ SPM\&\;SEB}} \cdot 100$$

32%

Living Lab Microgrid

The “Energia 2020” Research Infrastructures (RIs) (SPM & SEB) are part of the “Living Lab Microgrid”, the National Lab ENEL - UNIGE to test the innovative technologies of the City of the Future



OBJECTIVES

Test the capabilities of the RIs of the Campus to operate disconnected from the National Grid (relying only on the supply of renewables and storage systems)

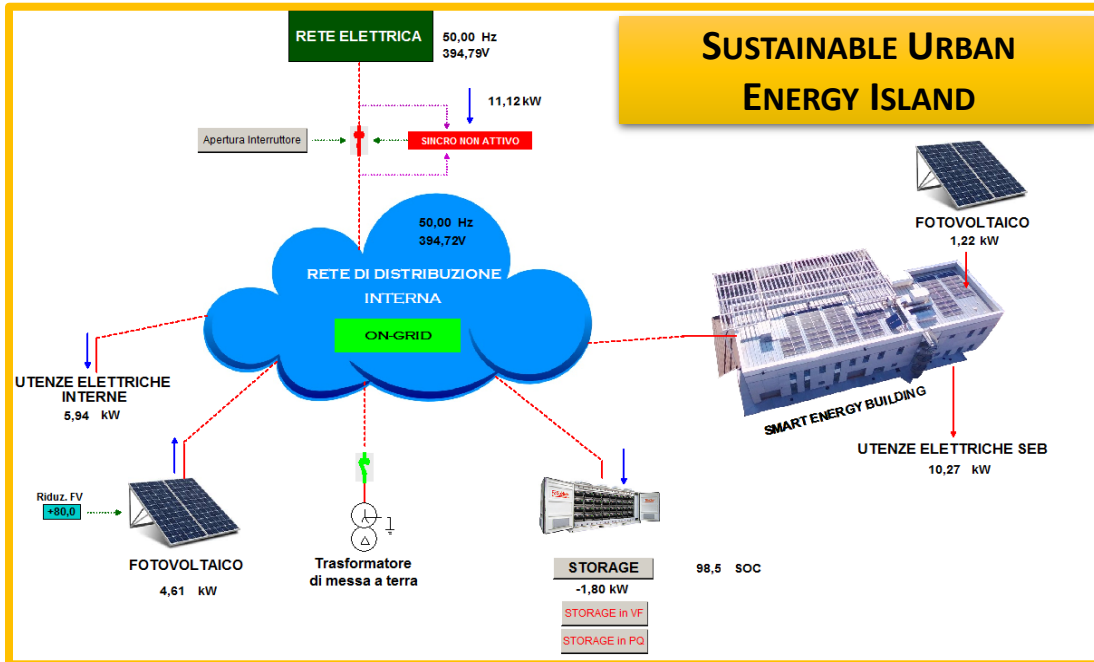
Installing state-of-the-art technologies concerning with SUSTAINABLE ENERGY, NATURAL RISK MANAGEMENT, ELECTRICAL MOBILITY, WELLBEING & HEALTH for the citizens and SOCIAL ENGAGEMENT to show a real application of the Smart City concept to population and institutional/industrial stakeholders

Management of the SUSTAINABLE URBAN ENERGY ISLAND

Provision of Vehicle to Grid (V2G) & Vehicle to Home (V2H) services



Living Lab Microgrid



V2H & V2G services



Campus for students

- ✓ **CAMPUS PRESS**, Il giornale del campus: visitate <http://savonacampuspress.it/>
- ✓ **CAMPUS WAVE**, la radio del campus: visitate <http://www.campuswave.it/>
- ✓ **Attività sportive** (campo di calcio, palestra, campo di tennis): contattate CUS Genova (segreteria@cusgenova.it, 010 362301-010 315443)
- ✓ **Servizio di ascolto degli studenti** (centro di Counseling J.E.S.): scrivete un messaggio a 3204332611 e sarete contattati per un colloquio
- ✓ **Scuola di musica DNA MUSICA Yamaha Music School** (sconto del 10% a tutti gli studenti del campus): visitate <http://www.musicayamahasavona.it/> oppure contattate Liana Saviozzi 3405445348
- ✓ **Piscina Amatori Nuoto Savona**: tariffe agevolate per gli studenti del campus (di fronte all'ingresso principale del campus)
- ✓ **Corso di fotografia** (nel secondo semestre): contattate Alessandro 3493473432
- ✓ **Fisiocampus**, fisioterapia per gli studenti del campus: contattate Dott. Luca Francini 3298975766
- ✓ **Laboratori di ricerca di arte contemporanea**: contattare Dott.ssa Tiziana Casapietra 3397140896



Sport facilities



U-GYM



U-TRAIL



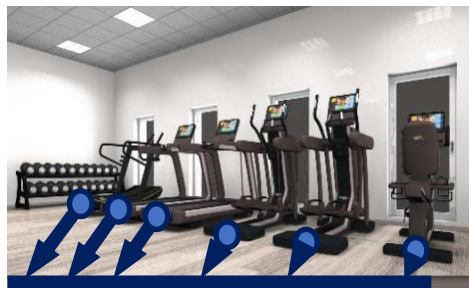
U-FIELD



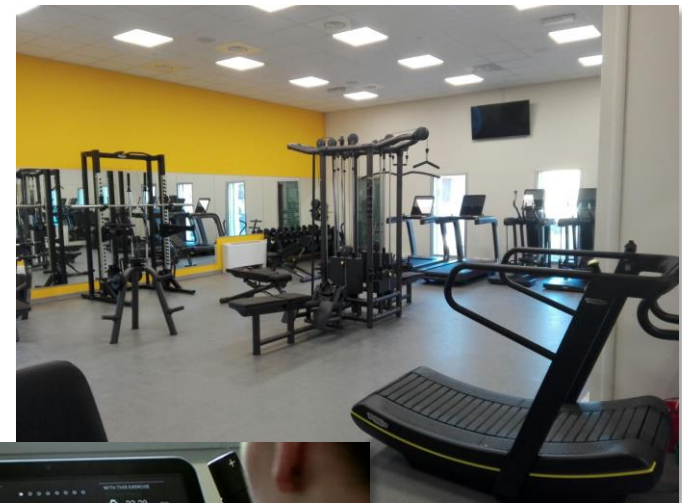
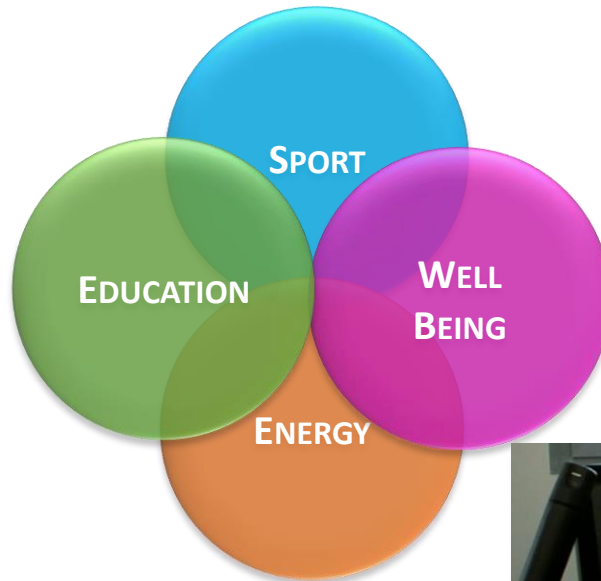
SEB U-Gym



- The Gym as an Energy Harvesting system
- Elliptical machines, tapis roulant and bikes are electrically equipped in order to transform the Human Energy of people working out into Electricity for the SPM
- U-Gym as a Sport Science and Health Lab used to sport performances studies and rehabilitation programs



More information here



Automatically controlled access:
the door can be opened by the
use of a special bracelet or by
Bluetooth driven specific Apps.

U-TRAIL

U-TRAIL is a 1 km fitness path with 3 areas for outdoor sports



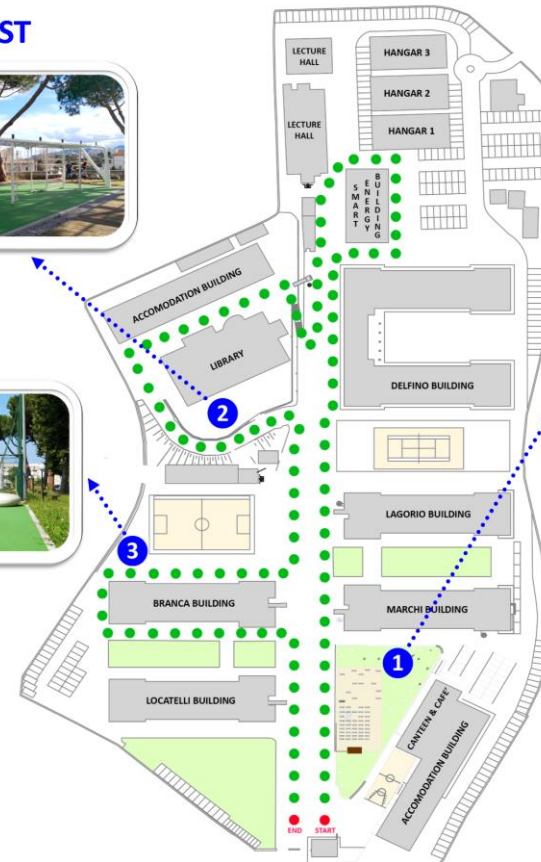
2 MyBEAST



3 MyISLE



1 MyEQUILIBRIA



MyEQUILIBRIA

GET IT ON
Google Play

Download on the
App Store

U-FIELD



U-FIELD will be an indoor facility for 5-a-side football, volley and basket





UNIVERSITÀ DEGLI STUDI
DI GENOVA

THANK YOU