CHESS SETUP... a European project seeking buildings' energy self sufficiency

Urban Ecology Agency of Barcelona

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Barcelona
15th-17th November 2016

European Commission | Horizon 2020 European Union funding for Research & Innovation

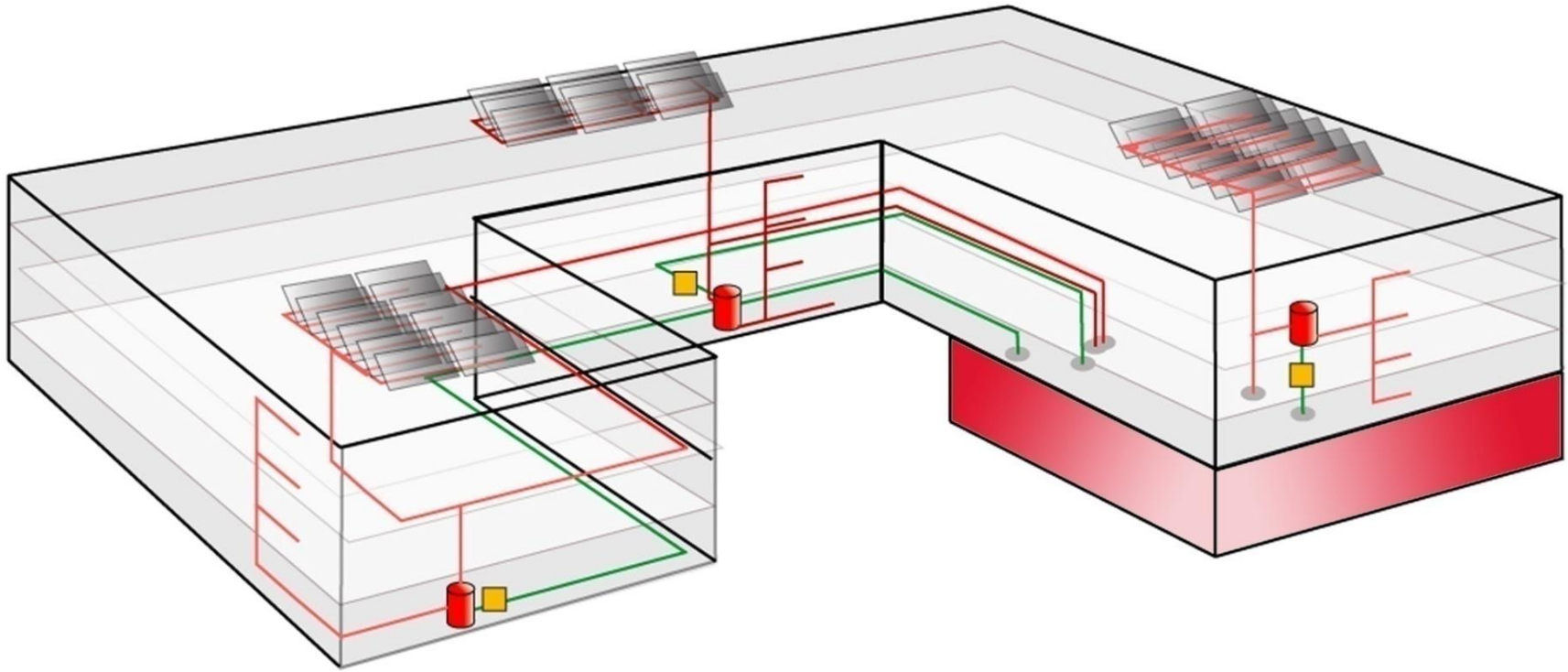
smart city expo WORLD CONGRESS

Horizon2020 project

- Topic: EE-02-2015
Design for new highly energy performing buildings

-The European Energy Performance of Buildings Directive requires all new buildings to be nearly zero-energy (NZEB) by the end of 2020. All new public buildings must be nearly zero-energy by 2018.

CHESS SETUP: Combined HEat Supply System by using Solar Energy and heaT pUmPs (2016-2019)



About BCNecologia

Organisation

Public consortium (2000)

Barcelona municipality
AMB (Metropolitan Area)
Diputació (Province of Barcelona)

Main objective

Rethink cities in key of sustainability

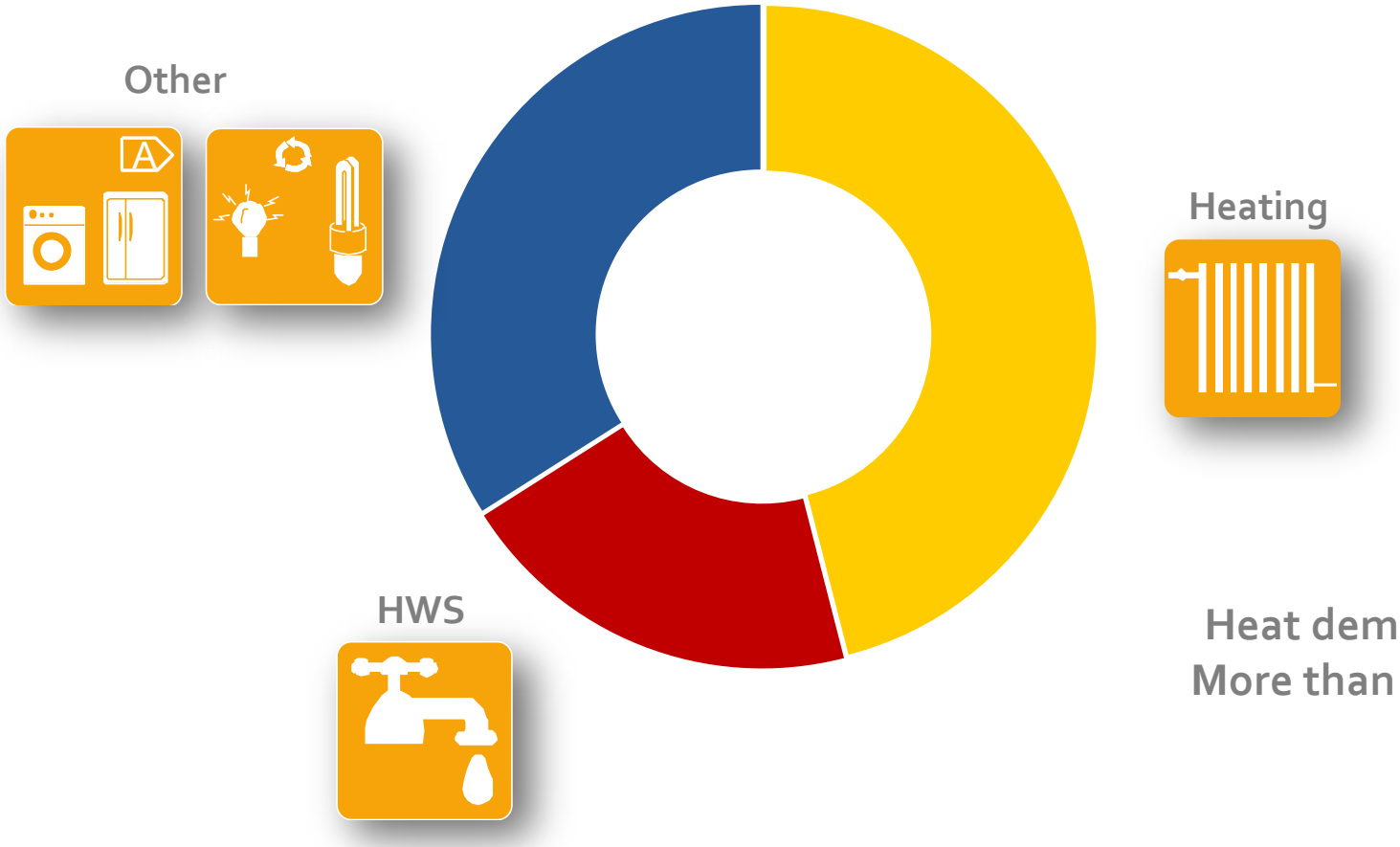
Develop the necessary instruments to drive planning and urban strategies towards this direction

Tasks

Planning development

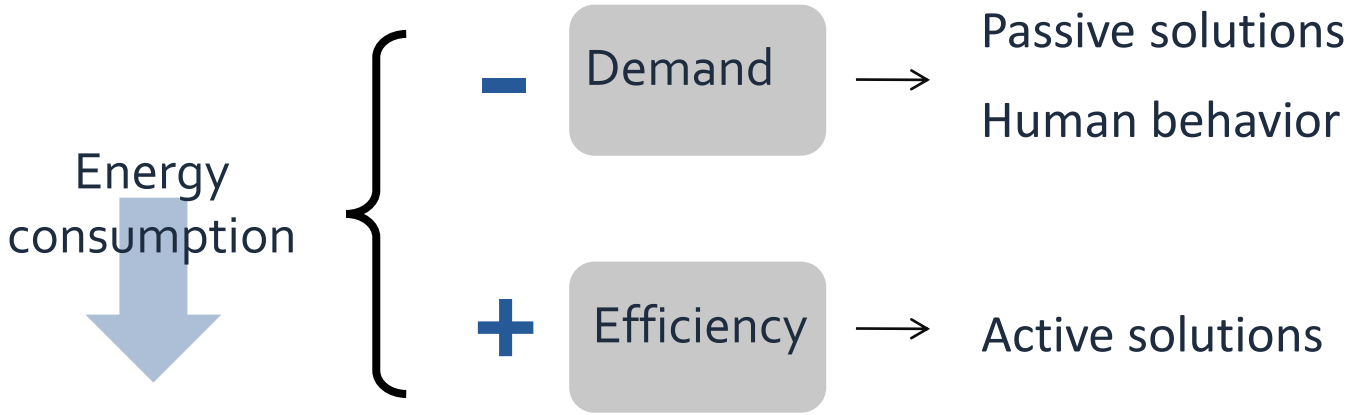
Both for public or private sector
No implementation or management role

Energy requirements in homes



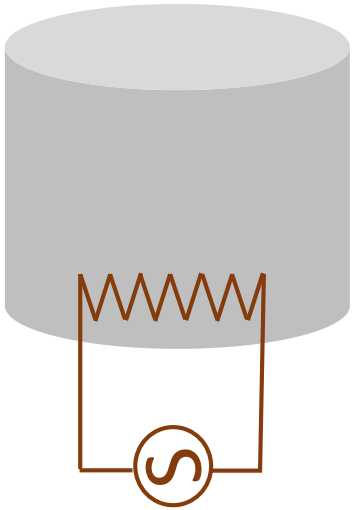
Energy saving strategies in buildings

$$\text{Consumption} = \frac{\text{Demand}}{\text{Efficiency}}$$



Technologies for heat supply

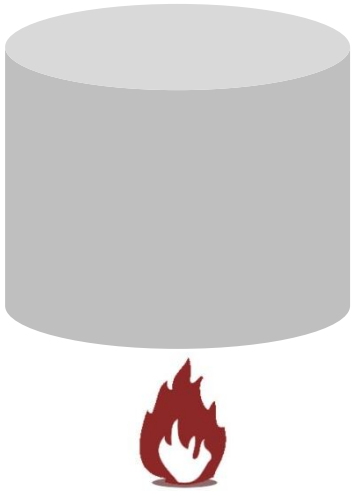
Joule effect



$Q = I^2 \cdot R$

$\eta \approx 100\%$

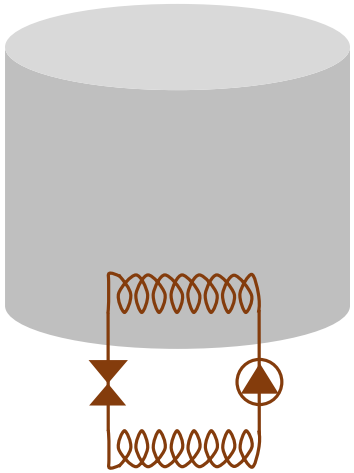
Combustion



$Q = \eta \cdot \dot{m}_c \cdot PCI$

$\eta \approx 80\text{-}95\%$

Heat pumps

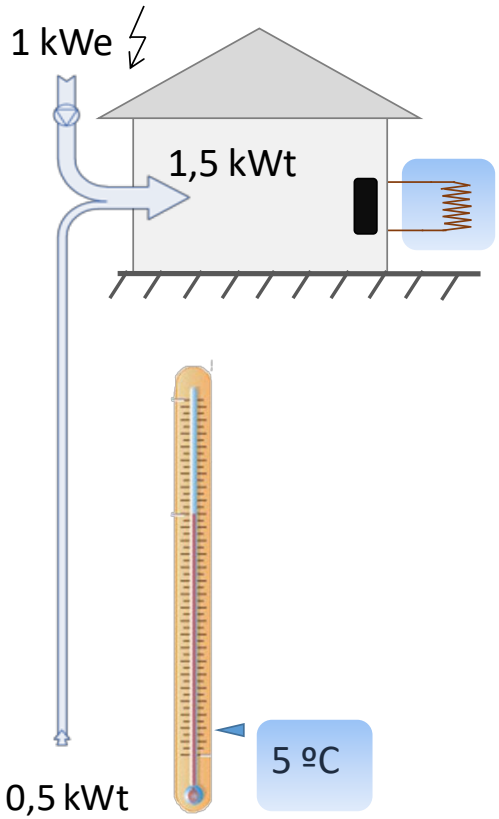


$$Q = \eta \cdot W \cdot \frac{T_C}{T_C - T_F}$$

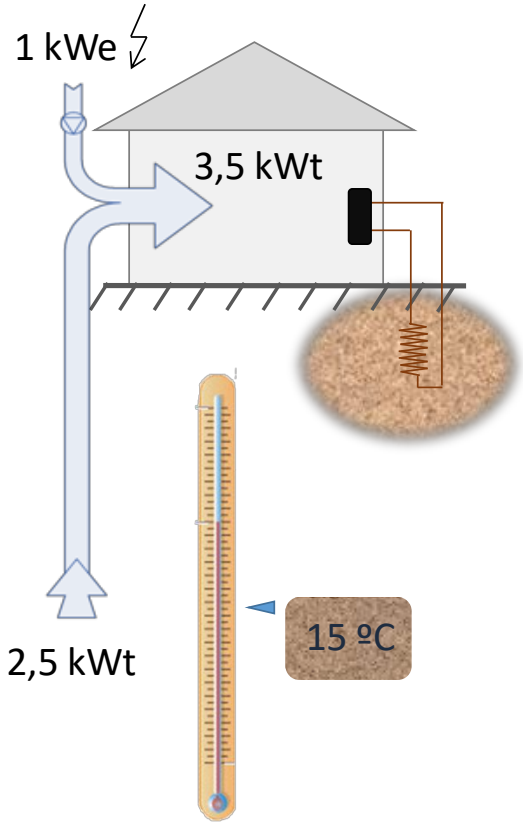
$\eta \approx 150\text{-}250\%$

Heat pumps options – COP (Coefficient of Performance)

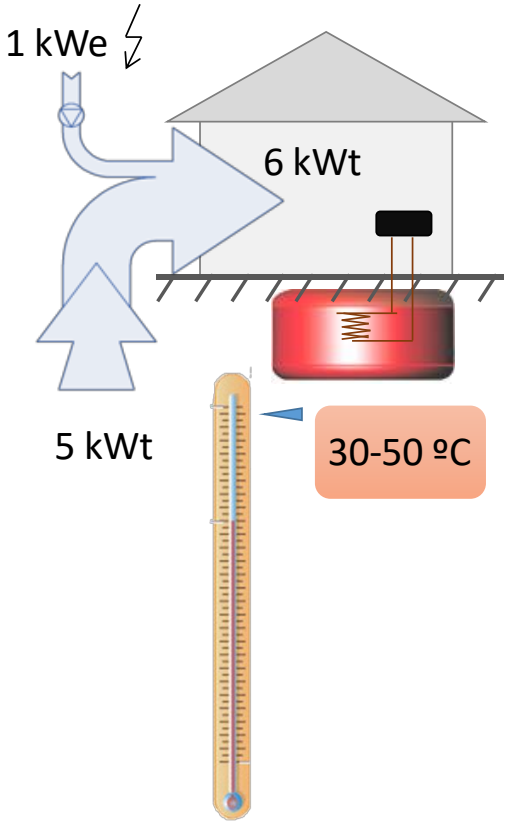
Conventional (η= 150%)



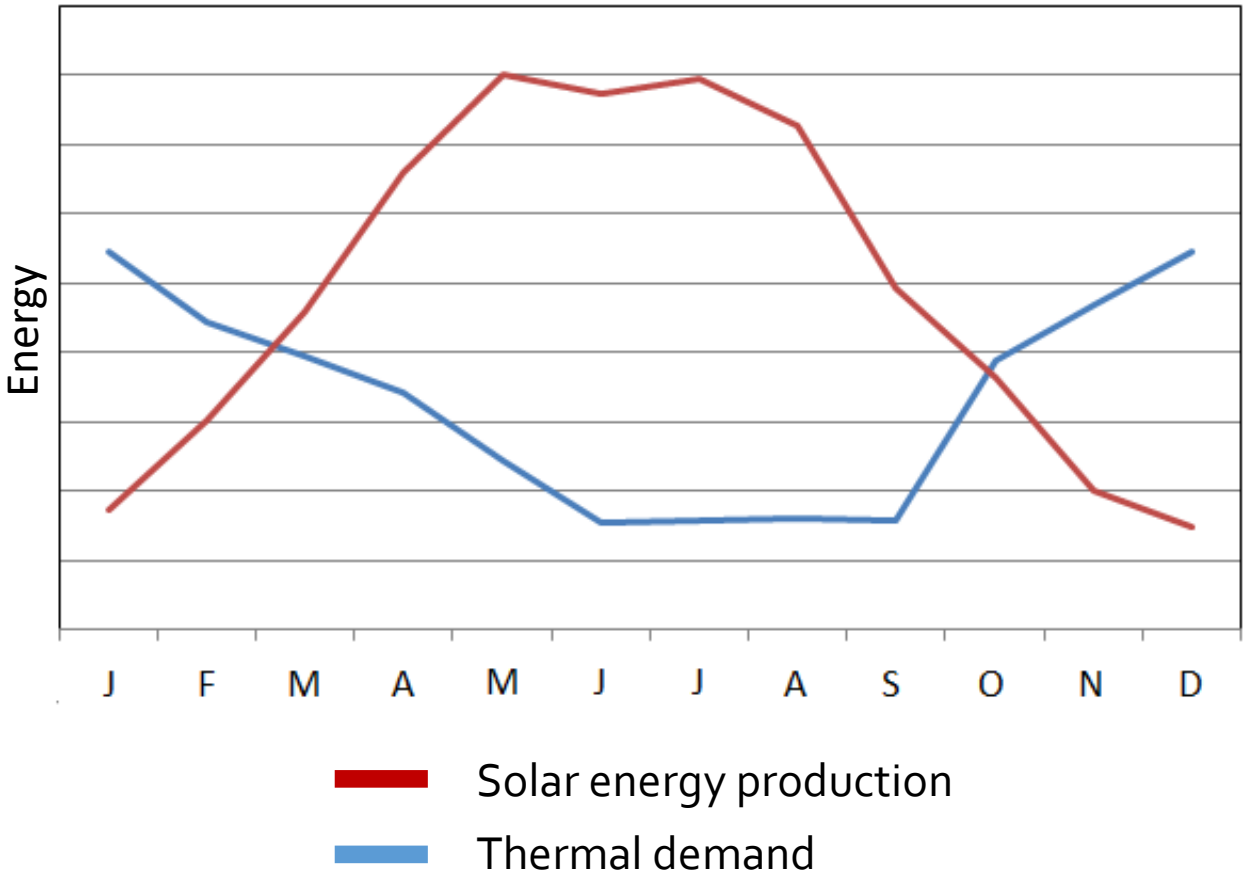
Geothermal (η= 350%)



Hot water tank (η= 600%)

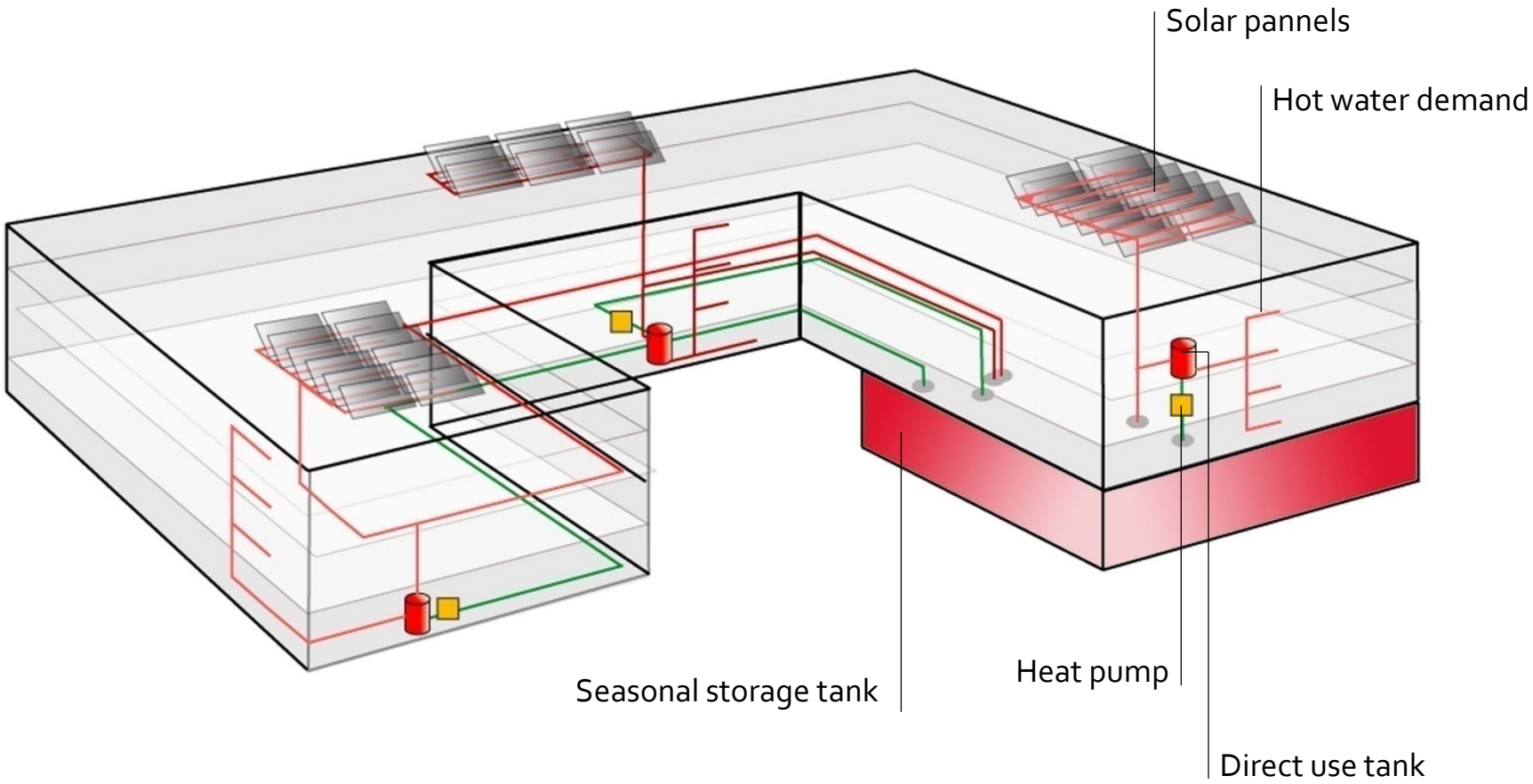


Solar thermal energy



SCACS MATE (2009)

Sistema de Calefacció i ACS Mitjançant Acumulació Tèrmica Estacional



Experiences with solar seasonal storage

***Friedichshafen*, Alemanya**

Date: 1996
Number of households: 390
Solar surface: 4.050 m^2 (2.835 kW_{th})
Tank volume: 12.000 m^3

***Neckarsulm*, Alemania**

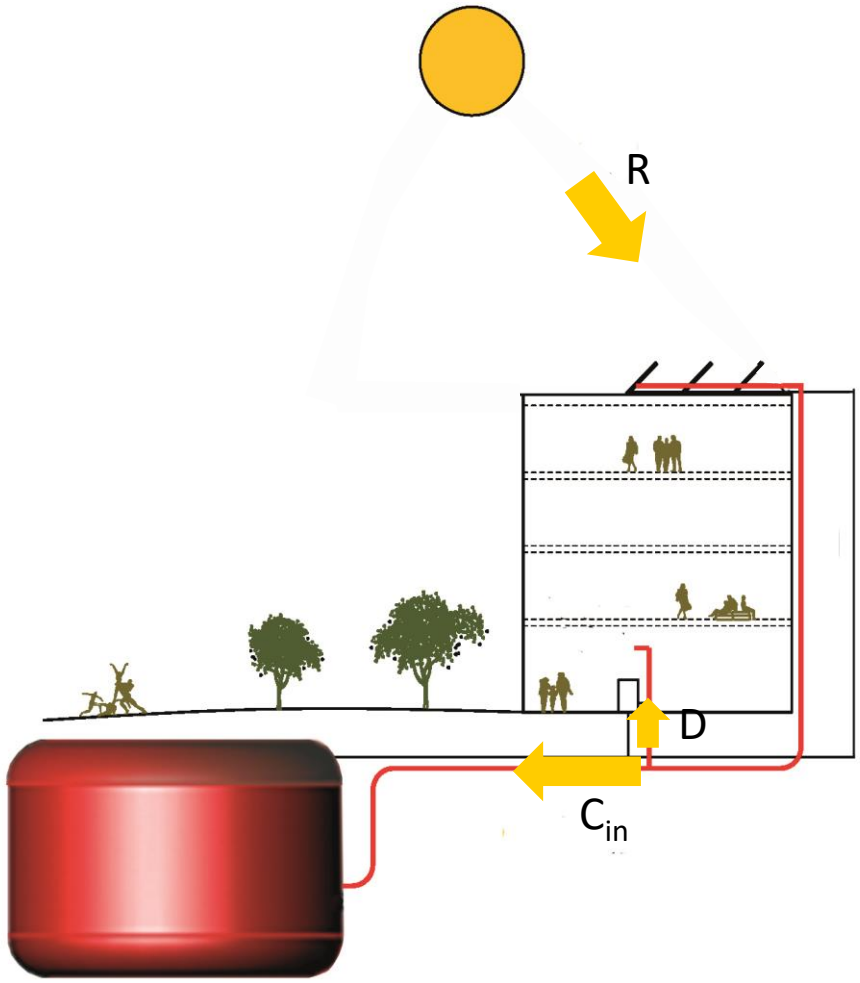
Date: 1998
Number of households: 300
Solar surface: 5.469 m^2 (3.828 kW_{th})
Tank volume: 12.000 m^3

***Steinfurt - Borghorst*, Alemania**

Date: 1999
Number of households: 42
Solar surface: 510 m^2 (357 kW_{th})
Tank volume: 1.500 m^3

SCACS operation

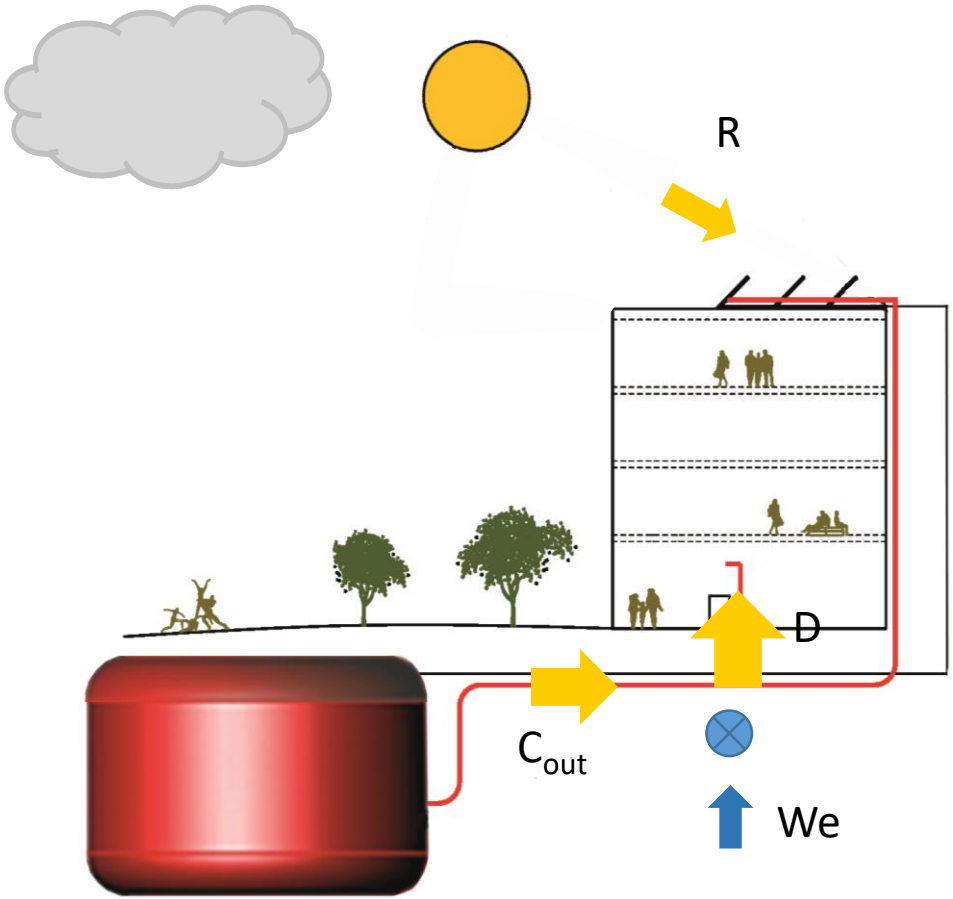
SUMMER



As the heat demand is low, most of the energy is send to the seasonal tank to be used during next winter.

SCACS operation

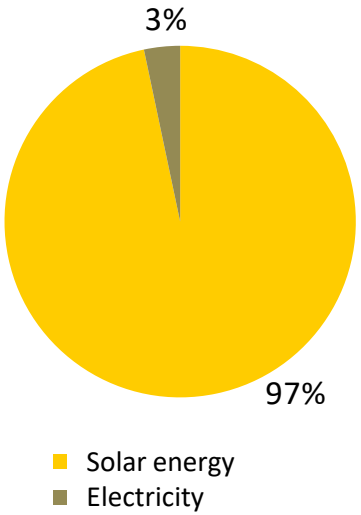
WINTER

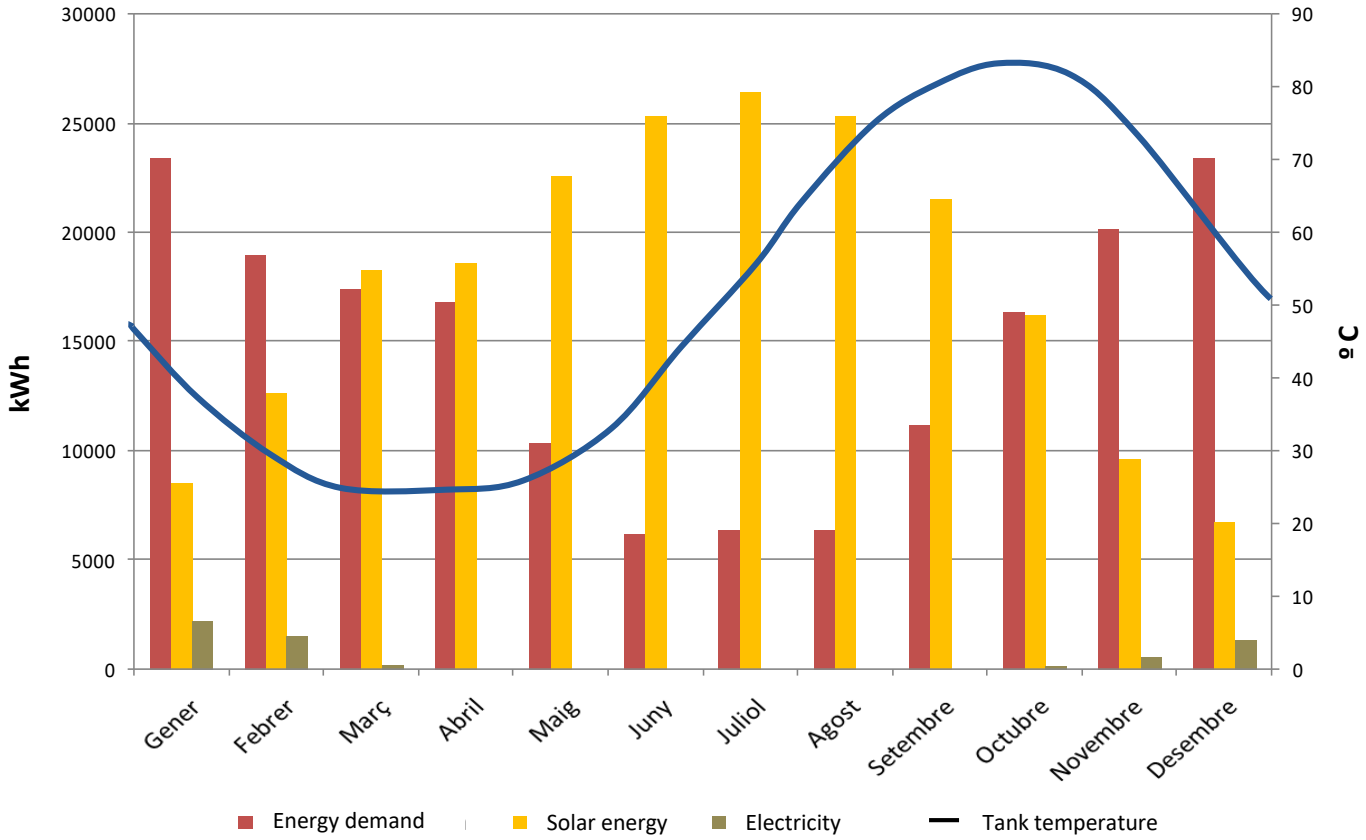


If the energy production is not enough to fulfill heat demand, the heat pumps is activated driving the heat stored in the seasonal tank.

Simulation results

Efficient home in Barcelona
- 6-8 m² thermal solar panel
- 10-20 m³ water tank





Next steps

Presentation in international and national congresses:

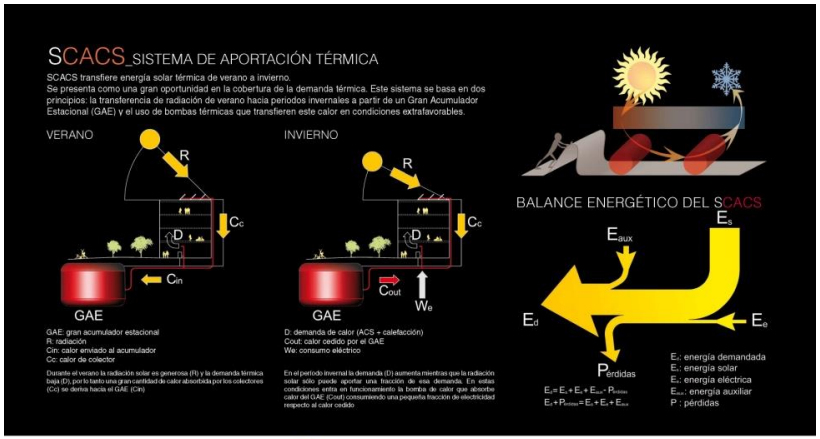
- CIBARQ, 2010 (Pamplona)
- POLIS, 2011 (Madrid)

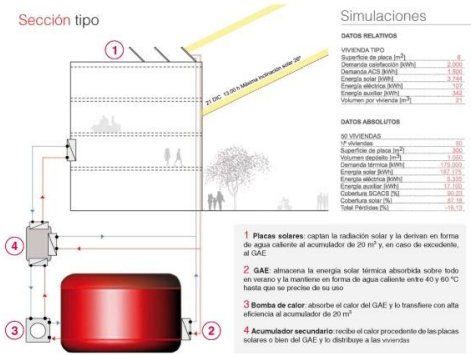
Contact with privates for implementing the system

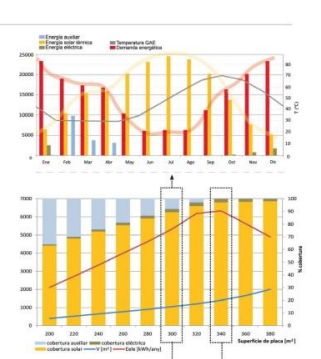
Finance of CAIXA-UNNIM for the theoretical development

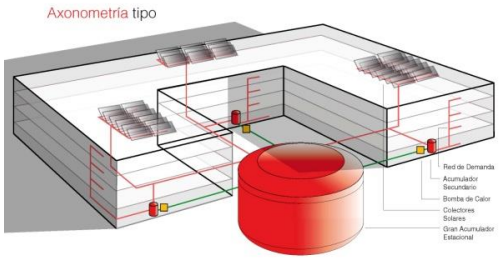
- Simulation for different building types and climate conditions
- Integration with other technologies (solar cooling and cogeneration)
- Economic evaluation

Proposal in Horizon2020!!









SCACS MATE

Sistema d'Acumulacio i ACS Mitjançant Acumulació Tèrmica Estacional

CHESS SETUP

Combined HEat Supply System by using Solar Energy and heaT pUmPs

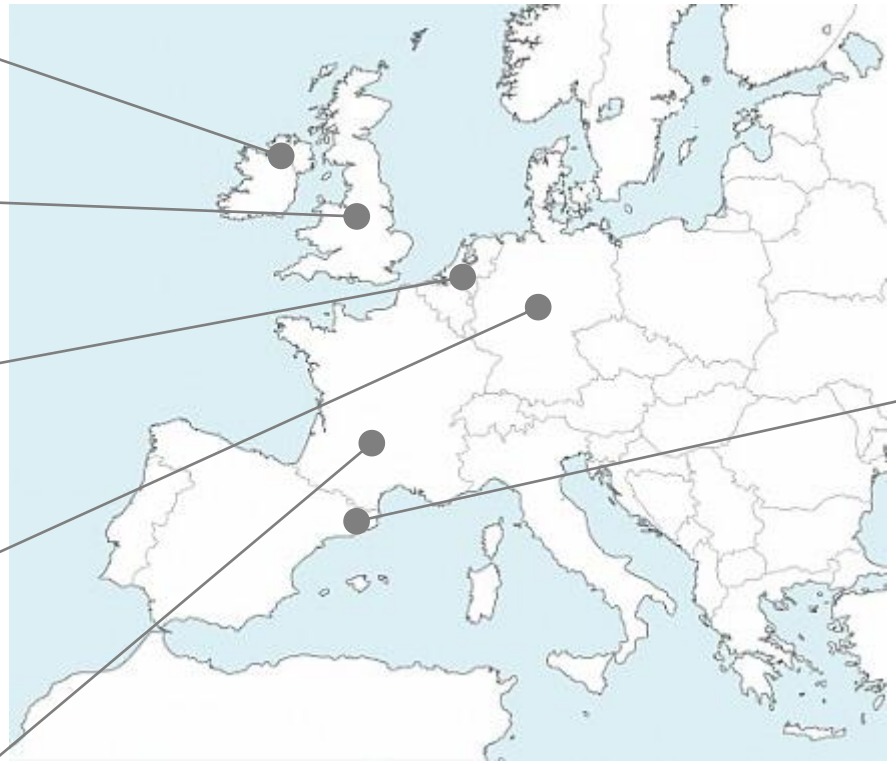
Partners (10 partners; 6 countries)

Ulster University

Electric Corby
Switched on thinking

EUROGRANT

edenway



BCN ECOLOGIA Agència d'Ecologia Urbana de Barcelona

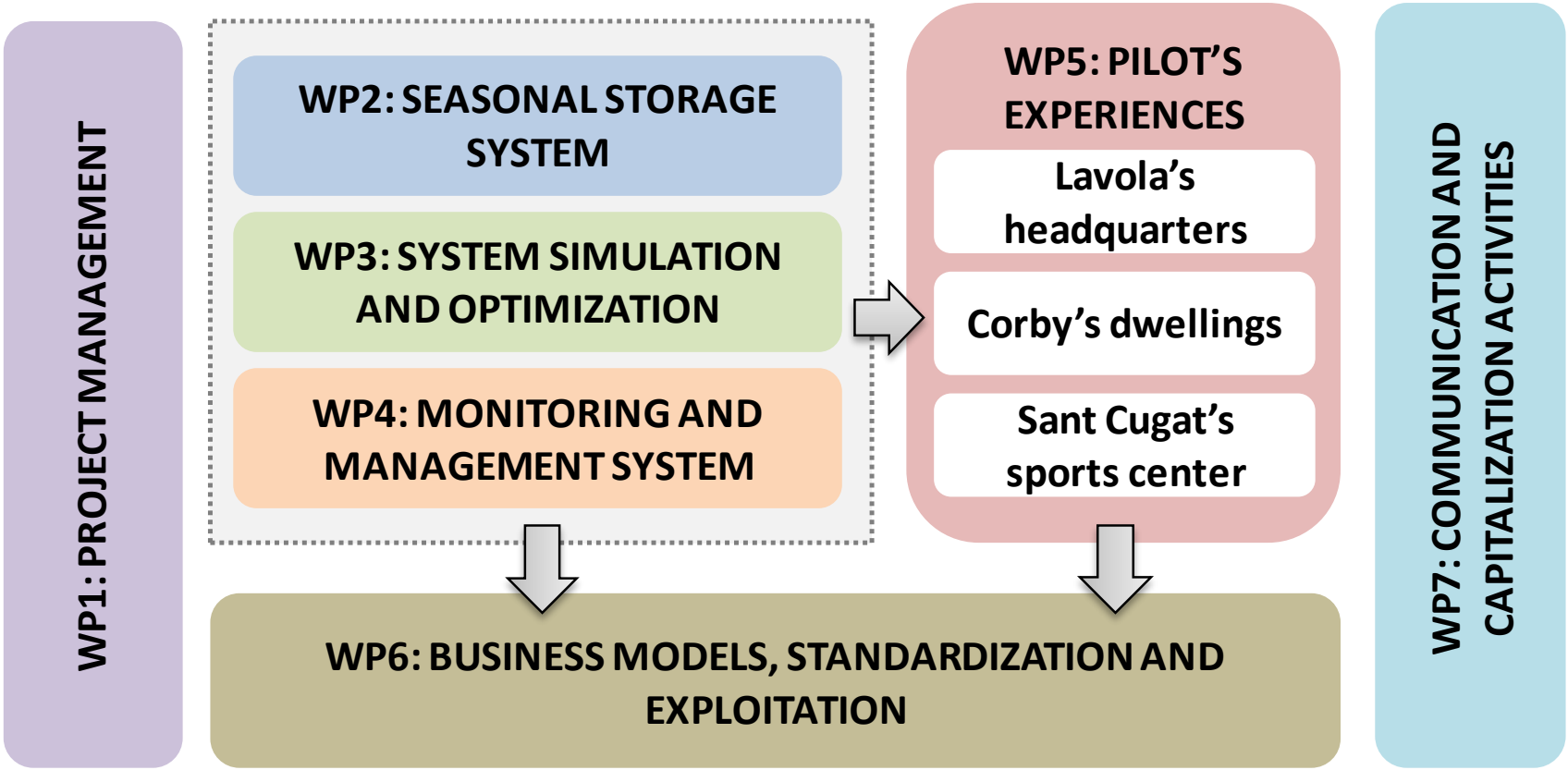
lavola
cosustainability

Ajuntament de SantCugat

WATTIA

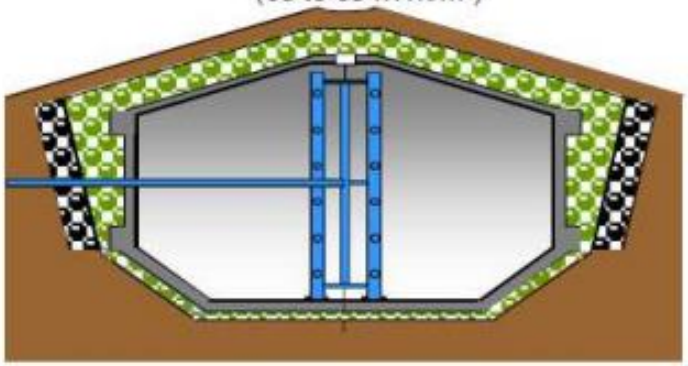
VEOLIA

WP'S DIAGRAM

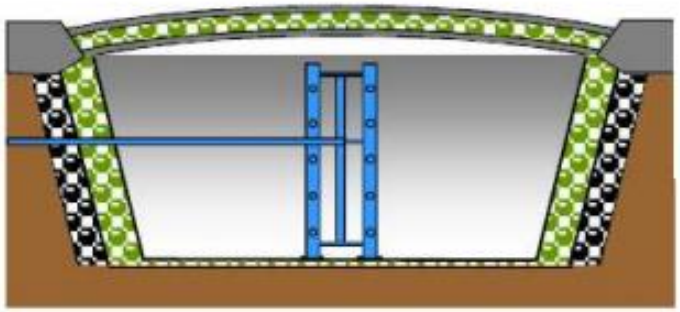

WP1: PROJECT MANAGEMENT
WP2: SEASONAL STORAGE SYSTEM
WP3: SYSTEM SIMULATION AND OPTIMIZATION
WP4: MONITORING AND MANAGEMENT SYSTEM
WP5: PILOT'S EXPERIENCES
Lavola's headquarters
Corby's dwellings
Sant Cugat's sports center
WP6: BUSINESS MODELS, STANDARDIZATION AND EXPLOITATION
WP7: COMMUNICATION AND CAPITALIZATION ACTIVITIES

WP2: SEASONAL STORAGE SYSTEM

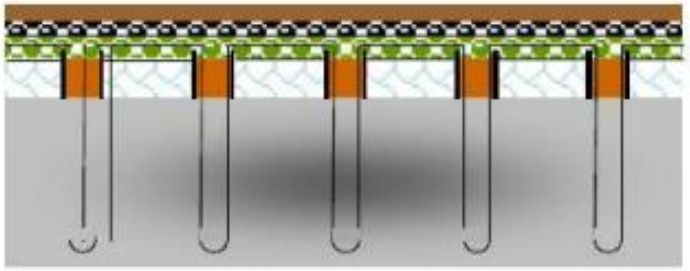
Tank thermal energy storage (TTES)
(60 to 80 kWh/m³)



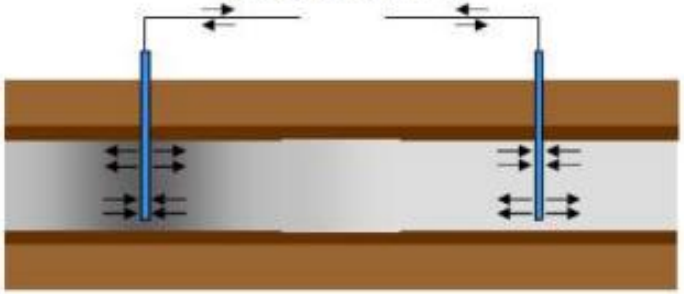
Pit thermal energy storage (PTES)
(60 to 80 kWh/m³)



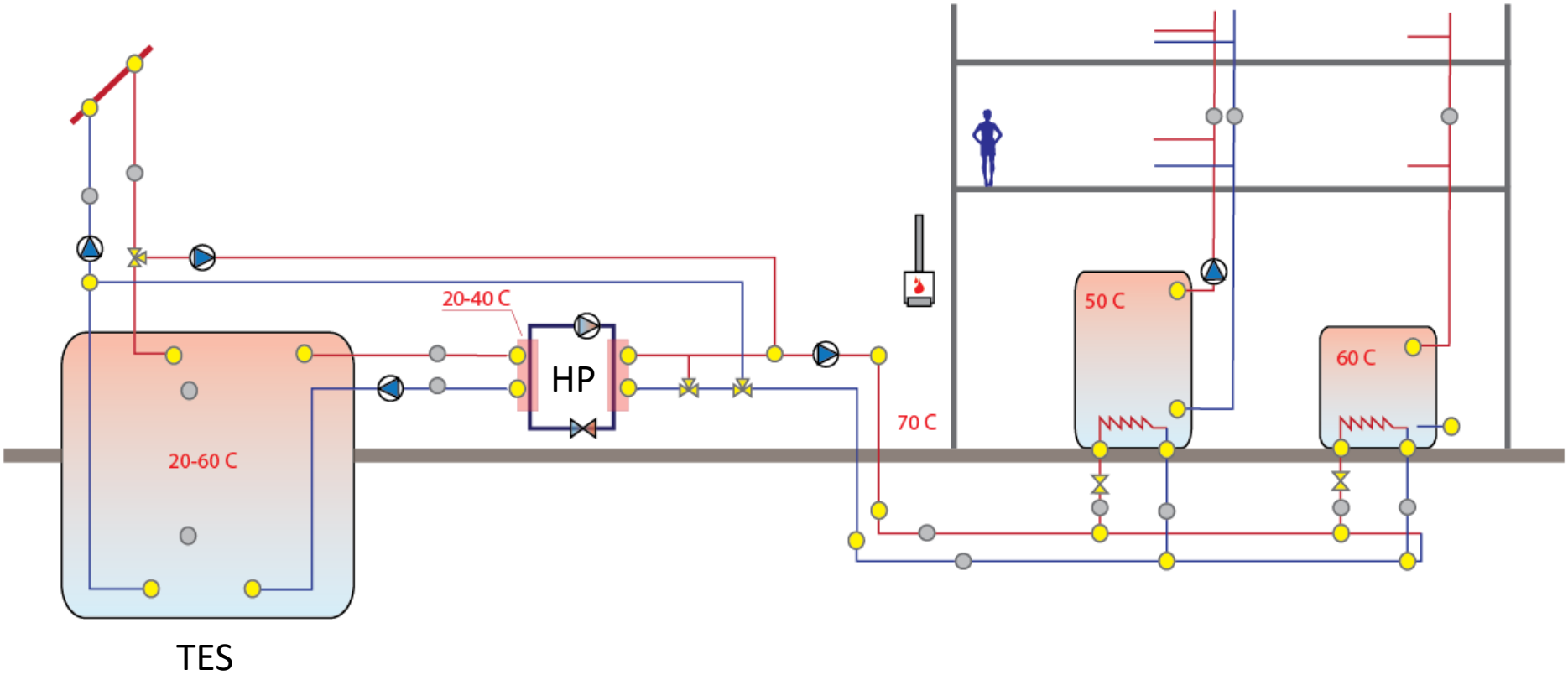
Borehole thermal energy storage (BTES)
(15 to 30 kWh/m³)



Aquifer thermal energy storage (ATES)
(30 to 40 kWh/m³)

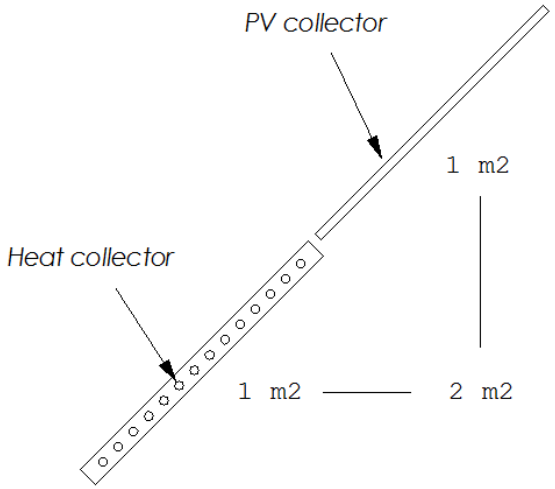


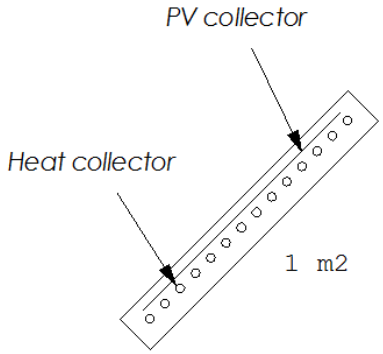
WP3: SYSTEM SIMULATION AND OPTIMIZATION



Solar hybrid panels: electricity and heat production

http://ecomesh.es/pdf/CTG-ecomesh.pdf

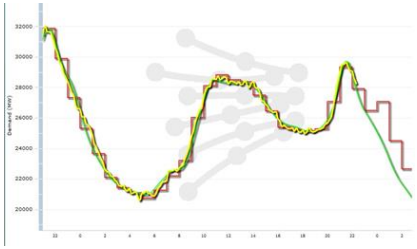




	1.-Conventional system	2.-Hybrid system
PV efficiency [%]	15	17
Thermal efficiency [%]	55	45
Global efficiency [%]	70	62
Gross PV production [kWh/m2/year]	200	227
Gross thermal production [kWh/m2/year]	700	573
Net global production [kWh/m2/year]	450	800

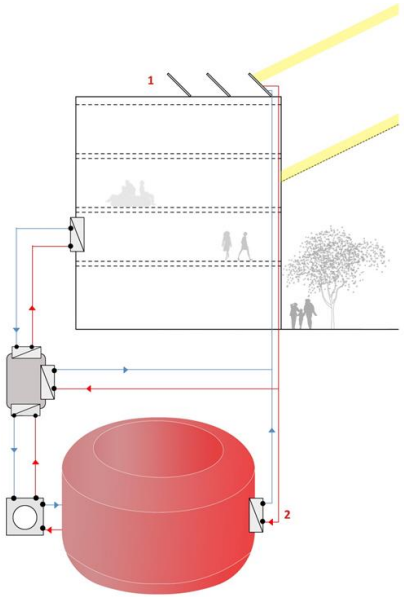
WP4: MONITORING AND CONTROL SYSTEM

Electricity price



User requirements

Weather forecast



WP5: PILOT'S EXPERICES

CORBY (46 homes)
Earth bank heat storage system

MANLLEU (Ecoedifici)
Small scale pilot
Short term storage
Possibility to integrate it with solar cooling

SANT CUGAT (Sport center)
4 sport centers including a swimming pool
Big storage tank (around 500 m3)

Thanks for your attention!

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Moisès Morató

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