EXCESS

LIVE IN POSITIVE ENERGY

EXCESS

flEXible user-CEntric energy poSitive houseS

The EXCESS project builds upon concepts for residential nearly-zero energy multi-storey buildings in the main four EU climatic zones transforming them towards flEXible user-CEntric energy poSitive houseS (EXCESS).

ABOUT THE PROJECT

This project brings together 21 partners from 8 European countries to showcase how nearly-zero energy buildings (nZEBs) can be transformed into energy positive buildings. Funded by the EU Horizon 2020 Research and Innovation Programme over a 4-year period, EXCESS will spearhead four innovative demonstration projects, introducing technical solutions that enable buildings to produce more renewable energy than they consume over the course of a year.
By implementing demonstration projects that span across the Nordic, Continental, Oceanic and Mediterranean climate zones, EXCESS seeks to test, validate and share Positive Energy Building (PEB) solutions with potential replicability across Europe.

THE MAIN GOALS OF EXCESS

- ***Advancing new materials, technologies and integrated technological systems for Positive Energy residential building solutions*** *in 4 different climate zones.*
- ***Optimizing the interplay of local generation, storage, consumption at the building and district level,*** *enabling interactions with the grid, capitalising on new ICT opportunities and unlocking new revenue streams.*
- ***Promoting a user-centric approach,*** *involving the user's aspects in every optimization process.*
- ***Co-Innovation, replication and exploitation activities with a wide range of stakeholders*** *to maximise the project's technical, social and economic impact and to* ***prepare for a future market roll out of the PEB concept.***

EXCESS DEMO SITES

- *Demo Site Hasselt, Belgium*
- *Demo Site Granada, Spain*
- *Demo Site Helsinki, Finland*
- *Demo Site Graz, Austria*

THE EXCESS CONCEPT

EXCESS will merge technical concepts for Positive Energy Buildings (PEB) with **new regulatory opportunities** for the production of renewable energy, self-consumption and energy communities. It is going to advance technical developments for PEB materials to address specific climate-related needs in order to meet the PEB requirements. By facilitating technological integration, lifetime costs of PEBs can be effectively reduced, making them affordable for a larger portion of society.
EXCESS will promote a **user-centric approach** that ensures that new concepts preserve **high comfort and indoor environmental quality** for tenants.

Analysis of PEB concepts and PEB definition

Stakeholder engagement including building users

Testing and integration of novel technologies

Development of financial and business models

Integration of PEB in local, regional and national policies

EXCESS defines a positive energy building (PEB) as an energy efficient building that produces more energy than it uses via renewable sources, with high self- consumption rate and high energy flexibility, over a time span of one year.
The project builds its PEB technical solutions on the most advantageous local renewable energy resources. **Conventional solar technologies** will be used in **Mediterranean and Continental climates**, where solar irradiance is abundant, while **innovative RES solutions** (advanced PVT and Power-To-Heat flexible thermal storage) in **Oceanic** and (advanced PVT and deep borehole) in **Nordic climates** (where solar irradiance is low and higher energy performance is needed) will be implemented.
EXCESS will use the opportunities of the new EU Electricity Market Directive, that will upon adoption by the Member states enable local energy trading, advanced interaction with the grid as well as with consumers that can actively participate in energy markets. Poor economics and missing business models are the main barrier for the roll-out of PEBs.
EXCESS therefore will **identify cost-optimal levels as a combination of current and innovative technologies,** estimating figures also as service life costs. Based on this, project partners will develop business models that also include possible market revenues and flexibilities

THE CLIMATE ZONES

- ***Nordic-*** humid, cold winters and mild, humid summers
- ***Continental-*** cold long lasting winters and predominantly hot summers
- ***Oceanic***- mild, wet winters and cool, humid summers
- ***Mediterranean*** - hot dry summers and mild winters with hardly any frost

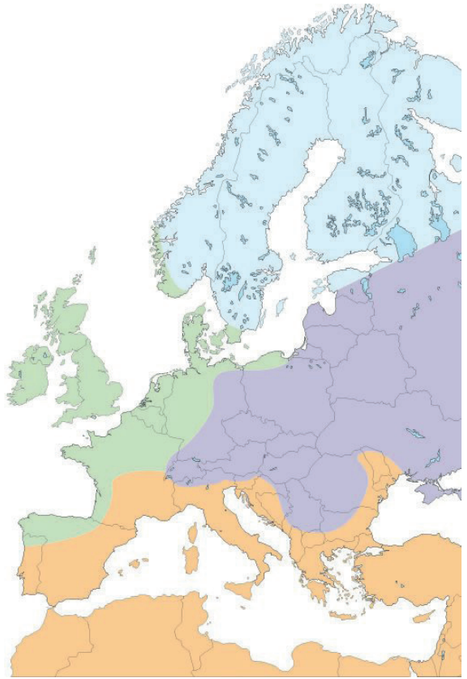
Main EXCESS technologies

PVT
heat pump
deep borehole

PV façade
heat pump
storage

heat pump
PVT
wind

storage
heat pump
PVT



Four main climatic zones of Europe
(https://www.barenbrug.biz/forage/climate-map)

OCEANIC CLIMATE: DEMO SITE

HASSELT, BELGIUM

The Belgian demo case is located in Hasselt and consists of 4 apartment buildings that were constructed in 2018 by Cordium, a Flemish social housing company. The buildings were designed with special attention to user comfort, while considering energy efficiency to guarantee optimal living conditions for the tenants. An innovative district heating system, powered by geothermal heat pumps, provides heat to a total of 70 dwellings on this site. These 4 energy efficient buildings will be converted to PEBs in the context of EXCESS. This will be achieved by integrating photovoltaics, thermal hybrid solar collectors (PVT), wind energy, thermal and electrical storage and by implementing smart control on component, building and network level. The tenants will play a central role as they can offer additional flexibility to the energy system. Activation of this thermal and electrical flexibility allows to maximize local consumption of renewable energy production onsite and to increase overall energy efficiency.

Planned Technologies

- Geothermal and air-source heat pumps provide the base load heat for the network (142 kWth)
- Gas-fired boilers used as a peak and back-up heating system (170 kWth)

EXCESS PEB technology upgrade

- **35 kWe DualSun PVT panels** for multisource heat pump system
- **Seasonal borehole storage:** PVT heat surplus will be used to charge the ground.
- **Two wind turbines** (5 kWe) on the roof of the apartment buildings
- **Power-To-Heat flexible thermal storages** integrated in the heat interface units inside the apartments
- **Expansion of the flexibilization portfolio** with batteries and EV charging facilities

MEDITERRANEAN CLIMATE:
DEMO SITE GRANADA, SPAIN

The Spanish Demo Site is located in Granada's metropolitan area in Spain's first planned neutral balance/zero emissions district, called NIVALIS. The Solar city is planned to start its construction in 2021 aiming for a self-consumption minimum rate of 50%. The pilot building will consist of one nZEB multi-apartment block that will be further developed to a PEB. The energy concept of the building takes into account the local climatic conditions, which are characterized by mild temperatures and high solar radiation. By means of an insulated envelope, the thermal energy demand in the building will be minimized. The EXCESS PEB concept relies on maximizing the electricity production from conventional PV panels and on managing efficiently the electricity consumption and generation to maximize self-consumption through an integrated controller. This controller will include a Human Machine Interface and will control the electricity flux through predictive algorithms that will lead to increase the overall efficiency of the energy system. In order to contribute to the development of a new energy standard and to promote a sustainable mobility in accordance with the EU CO2 reduction objectives Electric Vehicle (EV) charger devices will also be installed in the building. At dwelling level, an advanced control system will be installed to promote a smart energy behaviour that will lead to lower the energy consumption.

Planned Technologies

- Geothermal heat pump 120kW, 16 boreholes of 125 m depth; total 2.000 m, supplying heating and cooling to the buildings
- 100 kWe PV
- 5 eV charging stations

EXCESS PEB technology upgrade

- **Integrating PV**, geothermal heat pump with energy storage (battery) and electric vehicle charging system as one controllable system.
- **Installation of 100 kWh lithium batteries** for advanced energy flexibility service functionalities and electricity quality supply
- **Integrated controller** for easing the integration and the management of the energy generated on site
- **HMI system (human-machine interface)** for intelligent management of energy.
- **Energy sharing and trading.** BEMS will decide on the best strategy to reduce the overall energy consumption. Excess energy will be shared

NORDIC CLIMATE: DEMO SITE
HELSINKI, FINLAND

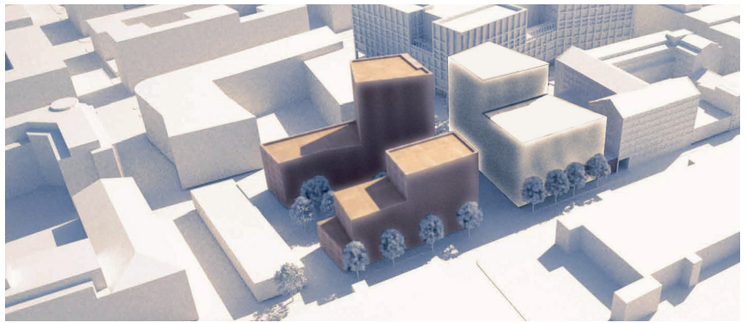
Basso's residential nZEB house will be located in the City of Helsinki at the Kalasatama Area, Finland. Given the harsh climatic conditions in Finland, energy technologies have to be further improved to reach high enough performance to reach PEB level using on-site solutions. The energy system of this demo represents a first of a kind solution. A seasonal ground storage by semi-deep energy boreholes will be used. Direct PVT or active heat pump recharge procedures will be demonstrated. Innovative hybrid energy systems combining semi-deep geothermal, geothermal collector, high COP heat pumps, balcony integrated PVT collectors and a smart control will be tested.

Planned Technologies

- 5 eV controllable charging stations
- High efficiency (75%) heat recovery ventilation system

Planned EXCESS PEB Technologies

- **Deep boreholes** 3x800m (drilling technology and heat exchangers collector)
- **70 kWel DualSun PVT panels**:
  - For multisource ground source heat pump with defrosting function supplying heat and electricity to the building and used as ground source heat pump thermal source.
  - and balcony integrated to increase the useful building area where RES can be installed.
- **Seasonal borehole storage**. PVT heat surplus will be used to charge the ground during transitional months, while during summer the HP evaporator using the PVT as thermal source will charge heat to the ground
- **Multisource ground source heat pump** system for deep boreholes with high COP for domestic hot water with 2x500 litre and 2x300 litre short term tanks and remote heat pump monitoring, on-line commissioning and fault diagnostics



CONTINENTAL CLIMATE:
DEMO SITE GRAZ, AUSTRIA

The former industrial area for feed production "Tagger-Werk" is located in the southern district of Graz. Since 2012, the complex with approx. 31.000 m² gross floor area has been transformed from an economical and sustainable point of view to a completely new concept of use. The existing building structure is integrated in a new mixed-use concept and the elements of the former industrial are retained in terms of visibility. About a third of the 19 existing buildings have already been refurbished to allow energy building standard. The demonstration building in EXCESS is a former feed silo (building 10) that will become a hostel. The declared goal for the refurbishment is to achieve passive house standard. In EXCESS the existing thermal mass of the building structure, will be activated via a pre-fabricated multifunctional façade element, which includes heating and cooling supply of the building and façade integrated PV. The entire energy supply of the area will be done based to a large extent on locally produced renewable energy (solar energy, groundwater heat pumps, small hydropower). By the integration of innovative elements for load shifting, storage, user integration, interaction with the local electricity grid as well as a smart, predictive control, maximum energy flexibility will be achieved.

Planned Technologies

- Cascading GSHPs
- Community battery (225 KWh)
- Decentralized small thermal storages
- 5 eV controllable charging stations

EXCESS PEB technology upgrade

- **Multifunctional façade element**
  - *highly insulated prefabricated modules*
  - *façade integrated PV*
  - *active layer for heating and cooling*
- **Energy system**
  - *maximum flexibility and efficiency through cascadic heat pumps for heating, water heating and cooling*
  - *thermal flexibility elements (thermal concrete activation & decentralized water storage) as well as electric flexibility elements (community battery and e-mobility)*
  - *Smart control system with weather forecast*
- **Smart Contracts**
  - *Flexible participation model for PV shares combined with automatic billing via blockchain*

EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME

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More information available at
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PARTNERS & FUNDING

EXCESS

This 4-year project brings together 21 partners from 8 European countries and is funded by the EU Horizon 2020 Research and Innovation Programme.

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EXCESS Project