Building for the future.

IDEAS Innovative Building System achieves excellent efficiencies from advanced Renewable Energy Systems

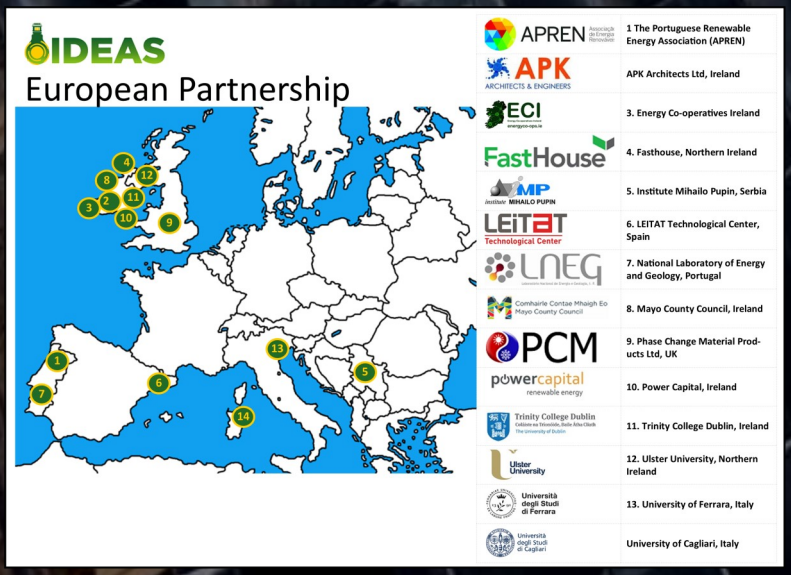
A Community Centre in County Mayo, Ireland, and a Snack Bar in Ferrara, Italy showcase international scientific co-operation and citizen participation creating more sustainable built environment.

Efficiency of the buildings heating and cooling systems are improved with IDEAS state-of-the-art solar photovoltaic-thermal panels combined with novel Heat Pump technologies tailored to maximise efficiency with reduced space requirements and the latest in heating control systems.
IDEAS, a project funded by the European Commission (Grant Agreement No. 815271) brings together a team of engineering researchers , architects and software developers in an international team showcasing excellence in sustainable buildings.

Background

Buildings play a significant role in the global energy balance. Typically, they account for 20-30% of the total primary energy requirement of industrialized countries, 40% in EU. Global buildings sector energy intensity fell by 1.3% per year between 2010 and 2014, thanks to continued adoption and enforcement of building energy codes and efficiency standards. Yet progress has not been fast enough to offset growth in floor area (3% per year globally) and increasing energy demand. Applying the proposed integrated RES to buildings is an important application for wider integration and deployment of renewable energy and to achieving our binding EU targets of at least a 40% reduction in greenhouse gas emissions (GHG) by 2030.

All the details of the IDEAS technologies are on the project website: horizon2020ideas.eu



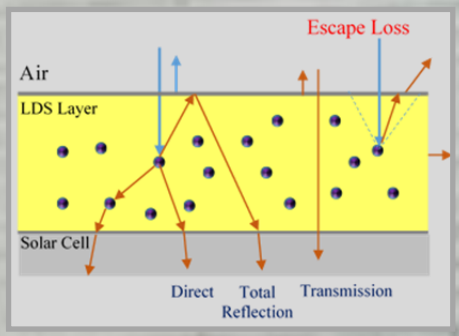
Renewable Energy Systems often require more space than is practicable in the urban setting. Apartment blocks and offices have restricted roof space and surrounding building footprints which mean that traditional solar and geothermal technologies space requirements are insufficient to meet the needs of the buildings' energy needs. IDEAS brings together a number of efficiency and scale improvements to solar PV, thermal and geothermal RES that will enable more energy efficiencies can be achieved using a smaller area. This will mean that buildings in urban settings will be able to have more of their energy needs met by sustainable sources.

IDEAS is an EU Commission funded research project led by Trinity College Dublin. This project is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 815271

What is *IDEAS*?

Developed by an association or research teams the Hybrid Solar PVT Panel was developed in the first phase of the project and trialled in the prototype installation in University of Ferrara. The Hybrid PVT panel consists of:

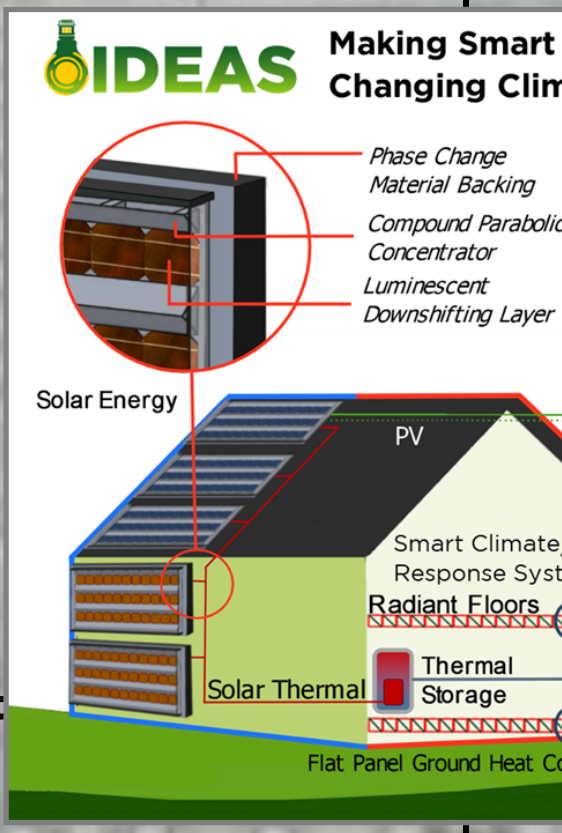
Downshifting Layer (LDS) An array of newly developed PV cells using Downshifting Layer (LDS) to increase solar energy collection and transference to electrical energy. The LDS uses specially formulated dyes which refract more energy from the sun than traditional cell coatings.

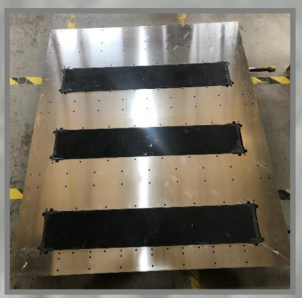


Compound Parabolic Concentrators (CPCs) These are site specific arrays of reflective material which reflects the rays of the sun to maximise the exposure of the PV array to the sun's energy. Their design means that they can be installed on the façade of the building and still produce adequate thermal and electrical power. The CPC is part of the technologies applicability to deployments where space is limited: in built up areas or on medium and high-rise urban buildings where the roof area to building volume area ratio makes building renewable energy self-sufficiency problematic.

Above: Deployment of CPC-PCM PVT panels, Ferrara, Italy

The CPC configuration varies according to the latitude of the installation – they are specifically designed for the low-sun of North Mayo (53 degrees N) and also separately for the latitudes of Ferrara, Italy (44 degrees Nth).





Above: PCM backing to PVT panels

Phase Change Material (PCM) enhanced Heat Collection PCM heat sink modules were configured to the PV cell array to increase the cells' efficiency by reducing overheating, while at the same diverting excess heat to a heat storage which combines with the Heat Pump components below to maximise the rate of energy collection.

Integrated innovations from leading specialists customise efficiency measures making the buildings of the future more sustainable and comfortable. The Mayo demonstration deployment shows how the project's technologies enable new sustainability options for the urban setting

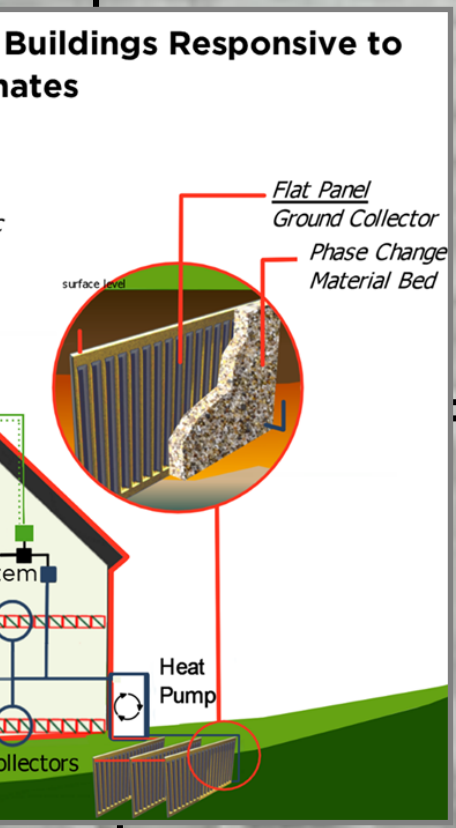
Flat Panel Ground Source Heat Exchangers (GSHX)

The solution was developed in the University of Ferrara and is the ideal complement to the high-density energy efficiency of the PVT panels. Unlike traditional ground source heat exchangers, it is concentrated in trenches and so require much less site area to achieve the same level of efficiency through exchanger surface area. The panels embedded in trenches surrounded by PCMs to increase the efficiency of the heat exchange.

Above: Deployment of ThinICE™ radiant floor in Mayo demonstration building

Radiant Floors

The floor of the community hall in Mayo was upgraded with a heating loop connected to an Air Source heat exchanger. Thin Ice™ PCMs supplied by Phase Change Materials Ltd have been co-installed with the heating loop to increase the efficiency of the radiance in an application which was devised and tested by Ulster University



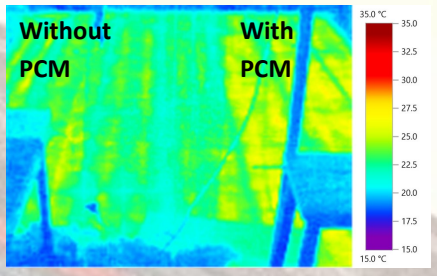
Smart Building Software System

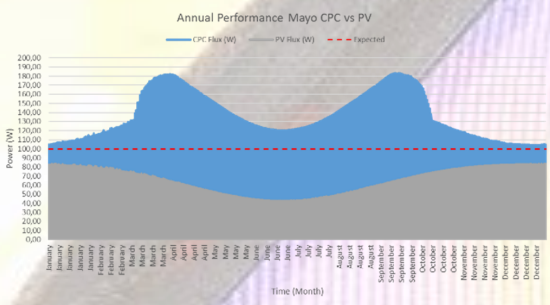
The 'brains' of the entire system, this control system whose design was led by IMP, Serbia, co-ordinates the inputs of all of the renewable energy and energy efficiency components. The system is weather and climate tuned so that energy requirements, heating and cooling, can be determined in advance so that energy can be stored in the form required for the buildings users. While there is a user-interface that facilitates user customisation, it is expected that the most users will accept the benefits of an automatically tuned climate control for their building of a steady 19 degrees centigrade all year round.

Above: Electrical network and data transmission

Performance: PCM Radiant Floor

Ulster University's research into the effectiveness of incorporating ThinICE™ Phase Change Material containing into the radiant floor shows that the PCM conserves heat for longer as well as diffusing it better to achieve a 37% improvement in performance over the same radiant floor without PCMs. This radiant floor system has now been installed in the demonstration buildings in Mayo and Ferrara.

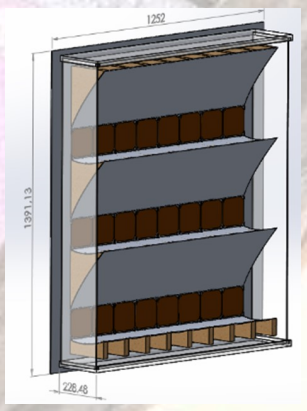




Superior performance on CPC over control

Compound Parabolic Concentrators (CPCs) :

There is a measured increased productivity from the solar cells using the CPC over the control PV panel in the demonstration buildings. The proof of additional reflection of the suns rays at the site Northern latitudes onto the PV cells means that the deployment on the façade of the demonstration building is feasible. The research team at Trinity College Dublin have found a 30% increase in cell output. Combined with efficiencies from the PCM heat sink and the LDS layer, the team expects to be able to report very strong results by the end of the project.



Above: CPC configuration

Ground Source Loop

10 novel flat-panel horizontal geothermal heat exchangers were installed in a 1.8m(D) trench. The heat exchangers are connected to a 12kW ground source heat pump. The HP installations have removed the need for the existing oil boiler making the building's heating system carbon neutral. ThinICE™ units of a salt-hydrate Phase Change Material have been installed under the floor of the community hall. Underfloor heating circulates hot water from the HP around the PCM which will absorb excess heat above 27°C which is stored in the form of latent heat. Over the next six months the performance of the system will be monitored by 24 thermocouples installed in the floor and walls.

Left: Installation of the flat panel GSHX. Right: re-instatement of landscaping.

Above: The local community making great use of the new radiant floor.

Citizen Engagement:

Technology must be tailored to suit the needs and expectations of the user community. While IDEAS itself is complex with many parts, these have been developed with ease of use in mind, designed to provide a comfortable ambient temperature for the building without overstretching the user. The Communities that make use of two sites have been central to the deployments and the project has already had strong engagement in sustainability, training, and education opportunities. The IDEAS team are very grateful to the community groups in Mayo and Ferrara and look forward to a long-lasting relationships.

Above: Local Community group members with TCD team and Duncan Stewart of Irish National television