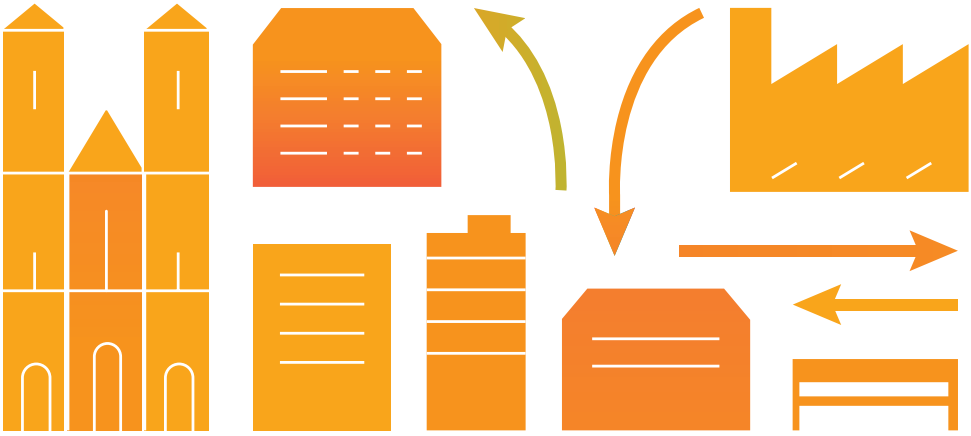
2016

EeB PPP Promising Technologies

Energy Building Systems



ENERGY EFFICIENT BUILDINGS

AN ECTP COMMITTEE FOR INNOVATIVE BUILT ENVIRONMENT

ENERGY EFFICIENT BUILDING ENVELOPES (PARIETODYNAMIC WALLS, POND ROOFS FOR PASSIVE SOLAR HEATING)

Active facade solutions for energy efficient design of buildings

The concept of energy efficient design of buildings is based on a minimized energy demand (heating and cooling). The low heating demand is assured by the combined effect of a highly insulated envelope and the heat provided by active facade elements. The design of the building also aims to minimize its environmental impact by using materials with low embodied energy and low environmental toxicity wherever possible. The thermal envelope is made of lightweight materials, glazing and metal panels.

The facade of the building is formed by active facades in its south face, and in the rest of the orientations the selected constructive solution consists on an Ytong block facade. The active facade called Solar Wall consists on a black colored perforated sheet of metal that allows the inlet of exterior air into the air gap, where the air is heated through the collected solar energy.

The air preheated by the solar wall is used as heat source by the -air to water high performance- heat pump deployed on the roof of block. The preheated air flow is delivered to the heat pump through a specifically deployed duct network, including a variable air flow rate fan to facilitate air circulation through the ducts. If the building presents a relevant heating demand, the preheated air production of the solar wall will be delivered to the heat pump, which will generate the hot water necessary to heat the building through the existing radiant floor heating system with very high performance values. However, in the absence of a relevant heating or DHW production demand on the building, the heat pump and the variable air volume fan will be deactivated and the preheated air flow rate produced by the solar wall exhausted through the opening existing between the duct and the heat pump.

An advanced control and monitoring system needs to be deployed, in order to enable the operation of all the integrated systems according to their designed strategies and to provide monitoring and optimization functionalities. The platform is formed by a dedicated sensor network, a dedicated actuator network, a meter network and control hardware and software.

- **Parieto-dynamic wall, integrated within the building ventilation system, to maximize the energy storage in the facade**

- Technical completion: less than 1 year
- Can be used in new constructions
- Can be used in renovation retro-fitting
- Compatible with existing solutions

Project: BUILDSMART, Energy efficient solutions ready for market
www.buildsmart-energy.eu

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BUILDSMART
Energy efficient solutions ready for market

TYPE II COMPOSITE GAS CYLINDERS FOR HYDROGEN STORAGE

Energy & Building Systems

A prototype hybrid energy system combining RES and hydrogen as an energy storage medium and as a green fuel has been designed, installed and is in operation in Lavrion, Greece. Among the various innovative technologies comprising the H2SusBuild hybrid energy system, the Type II Composite Gas Cylinders were developed in order to store compressed hydrogen, offering a light-weight solution compared to conventional gas tanks. The 50 litres, 200 bar operating pressure prototype was extensively tested according to standards for its ability to store the compressed gas, which resulted in certification being obtained.

The Type II gas cylinders are made of a metal liner (steel or aluminium) reinforced with a composite wrap (fiberglass/aramide or carbon fibre) called "hood wraped". Accordingly, Type II gas cylinders are more light-weight than Type I gas cylinders, which in contrast consist of full metal tanks (of steel or aluminium). Moreover, Type II gas cylinders can sustain higher pressures because the internal pressure exercised by the compressed gas provokes equal stress onto the two structure materials (50/50), which leads to a better distributed structure.

High pressure storage of compressed hydrogen is becoming more and more important especially in regard to sustainable mobility based on fuel cells. Light-weightiness is important in construction, and in order to best comply with safety norms and standards, high pressure storage of compressed hydrogen in a building environment should be best located on the roof of the building. Composite gas cylinders are more light-weight than conventional alternative storage tanks consisting of steel cylinders and constitute therefore a preferential choice for storing the compressed hydrogen on the roof of a building without requiring the building structure to be reinforced and modified in order to sustain the exceptional weight of steel cylinders.

The H2SusBuild system is comprised of thin-film PV panels, wind turbines, a water electrolysis unit, a Hydrogen (H2) compressor, a micro-CHP unit (PEM fuel cell) and a H2 burner. The aim of this system is to cover the energy needs of a nearly 500m² office building and to render it as a self-sustained, zero CO2 emission installation.

- Light-weight gas cylinders
- Decreases storage weight by 50%
- 200 bar operating pressure

- Technical completion: between 3 to 5 years
- Can be used in new constructions
- Can be used in renovation retro-fitting
- Compatible with existing solutions

Project: H2SusBuild, Development of a clean and energy self-sustained building in the vision of integrating H2 economy with renewable energy sources
www.h2susbuild.ntua.gr

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PREFAB MICRO HEAT PUMP & VENTILATION HEAT RECOVERY

Timber + Facade

iNSPiRe's new prefabricated insulation facade incorporating a heat pump combined with a mechanical ventilation heat recovery and ducting installation is a potential technology breakthrough for deep and light renovation of energy inefficient buildings. This technology simplifies the deep and light renovation of buildings by attaching new insulated facades with the ventilation and heating system already assembled on it, requiring minimum connection time. This technology is also applicable in new buildings where the design of heating and services distribution can be made directly on the facade and externally form the building structure.

The technology is a prefabricated element containing the mechanical ventilation with heat recovery combined with heat pump and most of the main ducts. The system is assembled in the factory, thus improving the quality of the final building and reducing most of the adjustments that are often required on the construction site. Moreover, most of the ventilation ducts are also integrated in the added facade and the mounting of the whole system is simpler and quicker. In addition the design of the ducts, the heat pump stack can be standardized thus removing most of the technical issues that are linked to connecting ventilation and air heating systems to the building.

The main advantages are the quality of the mounting, the standard design and the advantage arising from building of the MVHR, heat pump and distribution ducting in the workshop instead of the building site. This can help improve the quality of the elements, facilitate distribution of services (ventilation and air heating/cooling) and reduce the installation efforts at the building site. With respect to buildings at the end of their life time, where the only alternative is demolishing, all the above advantages lead to unique life cycle cost payback ratios through raising the energy efficiency of the building and renewing the building ventilation.

- **Micro heat pump for air heating integrated to timber facade elements**
- **Ventilation with heat recovery integrated to timber facade elements**
- **New dimension of prefabrication level trough minimal space ventilation system**
- **New system for distributing ventilation ducts only in the facade – no ducts in the interior**

- Technical completion: between 1 and 2 years
- Can be used in new constructions
- Can be used in renovation/retrofitting
- Compatible with existing solutions

Project: INSPIRE, Development of Systemic Packages for Deep Energy Renovation of Residential and Tertiary Buildings including Envelope and Systems
www.inspirefp7.eu

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iNSPiRe
Systemic energy renovation of buildings

PREFAB SHAFT ELEMENT & BUILDING SERVICE RENOVATION INTEGRATED

Timber + Facade

Many buildings in Europe are facing the end of their lifetime, not only because of insufficient insulation but also because of outdated or non-existent building services. With iNSPiRe's innovative technology, there is an overall solution not only for energy retrofitting, but also to renovate the building services. A solution for the installation of a new timber envelope has been developed, providing a solution for the integration into the prefabrication process.

This solution has been developed to integrate building services: heating and fresh water pipes, sewage pipes and electrical wires, solar thermal collector pipes and sun shading. This technology increases prefabrication to reduce time and disturbance on site, allowing tenants to stay inside the house by simplifying the renovation of buildings since the facade or the roof cover are prefabricated to fit the external wall of existing structures. The building service renovation will be process integrated and done to the outside of the existing wall, before mounting the facade elements. This enables the M&E installer to mount all pipes to the outside without usual demolishing works inside the building. A prefabricated installation shaft is the core of this kit. It is mounted to the outside of the existing building as part of the facade, providing vertical distribution of pipes, ducts and cables and solving fire protection and thermal insulation requirements. This plug and play solution is a particularly fast and reliable method, compared to nearly impossible building service renovation inside a residential building.

The technology is not based on a single or a proprietary design of piping and solar panels, but it is an integration of existing products, and different products can be used in the assembly. All building services can be included in the prefabricated modules. Moreover, the mounting of the whole system is simpler and quicker. One method of design and construction includes all the functions and services that can be integrated in the envelope.

- **Completely prefabricated plug & play solution for vertical distribution shaft element**
- **Including all fire safety and thermal insulation features**
- **Renovation system for building services (all types of pipes and cables) without demolishing in the interior**
- **New life time for old buildings, which would have been subject to demolition**

- Technical completion: less than 1 year
- Can be used in new constructions
- Can be used in renovation/retrofitting
- Compatible with existing solutions

Project: INSPIRE, Development of Systemic Packages for Deep Energy Renovation of Residential and Tertiary Buildings including Envelope and Systems
www.inspirefp7.eu

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iNSPiRe
Systemic energy renovation of buildings

BUILDING INTEGRATED SOLAR ENERGY GENERATION

Timber + Facade

Reaching Europe's ambitious goals for reducing the energy consumption of buildings requires a combination of thermal insulation and renewable energy generation. iNSPiRe's innovative retrofitting technology incorporates thermal insulation and building integrated solar energy generation. A solution for the installation of a new timber envelope has been developed, providing a renovation process from digital building survey over CAD-CAM planning, CNC production, prefabrication until mounting of the facade elements.

This solution has been developed to integrate solar energy generation into prefabricated timber facade elements. The technology increases prefabrication to reduce time and defects on site. Prefabricated components may be installed by using a crane, minimizing the work on the building. The integration of photo voltaic and solar thermal panels into the facade further improves their effectiveness and reduces energy consumption of the building through adding a warm layer to the outside of the building skin.

The new prefabricated insulation facade and roof with solar panels and piping installation is a potential technology breakthrough for deep renovation of energy inefficient buildings. The technology is also applicable for new buildings where the design of solar panels can be made directly on the facade and externally form the building structure. While especially slim designed solar panels can be integrated with aesthetically unique appearance, conventional solar elements can still be integrated using the same construction method. Thus timber manufacturers are provided a universal system solving building physics and construction issues of building integrated solar elements without being dependent on special producers.

- **Aesthetically and technically flawlessly combining solar thermal and photovoltaic elements**
- **Reducing energy consumption of building**
- **Increasing solar panel's efficiency**
- **One plane surface of photo voltaic and solar thermal panels with facade and / or roof**

- Completion in under 3 months
- Can be used in new constructions
- Can be used in renovation/retrofitting
- Compatible with existing solutions

Project: INSPIRE, Development of Systemic Packages for Deep Energy Renovation of Residential and Tertiary Buildings including Envelope and Systems
www.inspirefp7.eu

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iNSPiRe
Systemic energy renovation of buildings

This technology brochure highlights the highly promising innovations from selected co-funded European projects under the 7th Framework Program (FP7).

The Energy-Efficient Buildings (EeB) Public Private Partnership (PPP) is a joint initiative of the European Commission (EC) and the Energy Efficient Buildings Committee of the European Construction Technology Platform (ECTP).

This initiative aims at promoting research on new methods and technologies to reduce the energy footprint and CO2 emissions related to new and retrofitted buildings across Europe.

For more information on ECTP:
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ECTP
INNOVATIVE BUILT ENVIRONMENT

European Commission