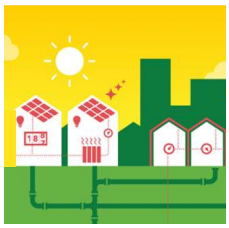
WP2 - Project Initiation

Key Innovation Form

PHASE CHANGE MATERIAL HEAT STORAGE FOR DISTRICT HEATING

DHC



DELIVERABLE INFORMATION

Number	D2.1	**Reviewers**	Benjamin Giron (HESP)
Title	Key Innovation Forms	**Nature**	R – Report
Lead organization	Hespul	**Dissemination level**	PU – Public;
Main author(s)	Fabrice Bentivoglio (CEA)	**Delivery Date**	DD/MM/YYYY
Contributors	Nicolas Giraud (CCIAG)	**Reviewers**	XXXX

VERSION HISTORY

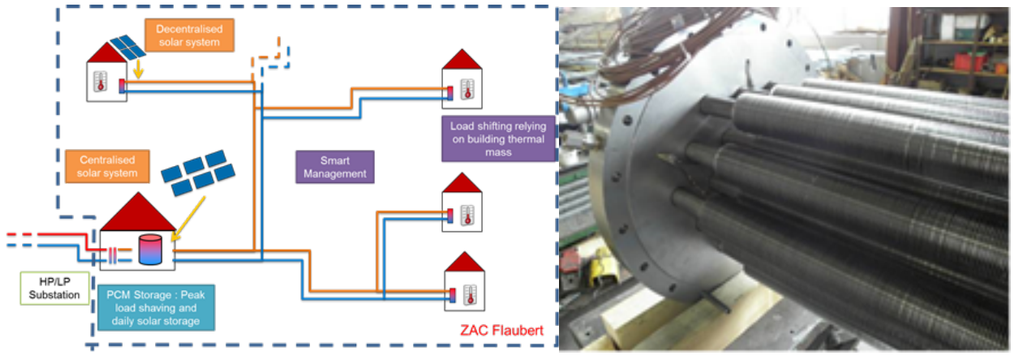
Version	Date	Author/Reviewer	Description
1.0	01/09/2016	F.Bentivoglio / -	-

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 608702.

Smart DHC with Phase Change Material Storage

Main information

- **Subtitle**: Implementation in the Flaubert district heating network of an innovative PCM storage located in the district sub-station.

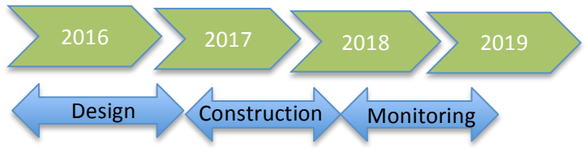


- **Principle:** The **PCM storage**, located in the Flaubert sub-station, will be used to smooth the peak load of the network in order to limit the use of expensive combustibles and to decrease CO2 emissions.

- **Location: Grenoble**

- **District: Flaubert**

- **Work Progress:**



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Opportunities, Barriers and Solutions

	Opportunities	Barriers/Challenges	Solutions
Technical	Increase the efficiency of the heating network by adding a storage located in the substation	Classical hot water storage are not really suitable for substation application due to the low density storage (~35kW.h/m^3)	Heat storage based on phase change material with a density storage of the PCM higher than 100 kW.h/m^3
Legal		As the heat storage is located into the substation, safety is of prime importance.	The selected PCM must be non-flammable, non-oxidant, non-explosive and non-toxic
Financial/ Economic	Economical opportunity to build a PCM heat storage must be studied carefully. Urban heating network with a high potentiality of substitution of fossil energy by renewable energy will be better adapted. Urban heating network with cogeneration plants are also well adapted. Lower investment by minimizing installed capacity ? At long term (dissemination), lower prices for users	The management of the heat storage is the key point to reach the expected benefits.	The coupling between the heat storage and an advanced management of the network (see [*]) is highly recommended.
Environmental	The objective is to limit CO2 emission by replacing fossil energy by renewable energy.	The management of the heat storage is the key point to reach the expected benefits.	The coupling between the heat storage and an advanced management of the network (see [*]) is highly recommended.

[*]: KIF - Advanced Control for Smart Heating Grid, Grenoble

News & Links

- **City-Zen news** : http://www.cityzen-smartcity.eu
- www.cciag.fr

DESCRIPTION OF THE INNOVATION AND RATIONALE FOR THE SELECTION

The technology currently use for **heat storage** in urban heating network is based on hot water tanks, with a quite low storage density (~35 kW.h/m3 for a network with temperatures in the range 40-70°C). PCM storage allow reaching higher storage density, up to 100 kW.h/m^3, making possible the storage of a higher amount of energy in a reduced volume. This is particularly interesting in substation where the space to install a storage is limited.

LEVEL OF DEVELOPMENT

TRL 4: Previous PCM storages have been built by CEA for solar application. The objective of this project is to adapt this technology for urban heating network. The two main modifications concern on the one hand the selection of a new phase change material with a melting temperature adapted to urban heating network application and on the other hand the optimization of the internal heat exchanger to a different fluid and a different power objective than in the solar application.

WHAT ARE THE MOST RELEVANT DEMONSTRATION PROJECTS?

Various heat storages are currently in operation in Europe, all based on hot water storage technology. Most of these storages are centralized storages located close to the heating plants and connecting to the primary circuits of the heating networks.
The implementation of a PCM storage in the substation of a urban heating network is an innovative solution with no previous reference.

EXPECTED IMPACTS OF THE INNOVATION

The PCM heat storage coupled with an advanced management of the network aims to limit the use of fossil energy in the global energy mix of the Flaubert district. Renewable energies such as biomass, solar energy or waste incineration will be stored during low demand periods (night). The energy stored will be released during consumption peaks on the morning to limit the use of fossil energy such as coal, fuel or natural gas.

- *Impact on Energy (supply or savings) & greenhouse gas reduction expected*

The effective performances in term of energy and CO2 saving will be measured during the Cityzen demonstration.

- *Wider potential benefits for cities*

The main expected benefits for cities is the decrease of CO2 emission.

TECHNICAL FEASIBILITY AND SOCIO-ECONOMIC VIABILITY

The opportunity to build a heat storage in a urban heating network should be studied carefully using dedicated simulation tools that will allow to quantify for each city the benefits in term of money and CO2 emission saved. The energetic mix of the network, the power demand shape and the local prices of renewable energy and fossil energy are some of the key parameters to be considered. Urban heating network with cogenerations plants or with solar panels fields are some example of particularly well adapted situations for heat storage.

INTEGRATED MEASURES

- *Integrated measures combining multiple of the domains: buildings, smart grids and district heating and cooling*

To reach the optimal benefits expected from the storage it is recommended to connect it to an advanced smart control system of the network, in particular to define the better periods to store and release energy.

CHALLENGES TO BE ADDRESSED BY CITY- ZEN

Two main challenges will be addressed in the framework of citizen project:
1 - The design of the PCM heat storage to reach the requirements of the urban heating application in term of operating temperature, power of discharge and safety. In particular the PCM must have the adequate melting temperature and must be safe (non-flammable, non-oxidant, non-explosive and non-toxic). Moreover, the heat exchanger should be designed to reach a full discharge time of 3 hours to accommodate the expected duration of morning peak consumption.
2 – The implementation of the storage on the network, with the connection to the smart control system to define the best periods for charging and discharging and with the management of the hydraulical interaction between the storage and the network.