Università degli Studi di Ferrara

RIPARTIZIONE RICERCA
Ufficio Ricerca Internazionale

Al MAGNIFICO RETTORE
SEDE

Iniziative di Internazionalizzazione di Ateneo – Anno 2011
Scheda per la presentazione del progetto

Il sottoscritto prof. MICHELE BOTTARELLI chiede l'assegnazione di un contributo di € 12,000 (dodicimila), per la realizzazione della prima fase del progetto sotto descritto, a valere sui fondi di Ateneo 2011 per la promozione di iniziative di internazionalizzazione.

DESCRIZIONE PROGETTO

TITOLO: PHASE CHANGE MATERIALS COUPLED WITH GROUND HEAT EXCHANGERS

International partnership:

- Prof. Saffa Riffat, Department of Architecture and Built Environment - Institute of Building Technology, University of Nottingham, UK (*Bilateral exchanges are operating between the Departments*)
- Prof. Aleksandar Georgiev Technical University, Sofia, Bulgaria / European University Polytechnical, Pernik, Bulgaria (*A bilateral agreement is pending between the Department of Architecture and the European University Polytechnical*)
- EUR ING Charles Yousif, Institute for Sustainable Energy, University of Malta, Malta (*A ERASUM bilateral agreement is undersigned between the Departments*)
- Dr. Ing. A. Alper Aydin, Technische Universität München - Wissenschaftszentrum Weihenstephan, München, Deutschland (*Ph.D in PCMs*)

National partnership:

- Prof. Giuseppe Mincolelli, Dipartimento di Architettura, Università di Ferrara, ITALIA
- Prof. Laura Gabrielli, Dipartimento di Architettura, Università di Ferrara, ITALIA
- Prof. Michele Bottarelli, Dipartimento di Architettura, Università di Ferrara, ITALIA

Descrizione e obiettivi del progetto:

***1st Step* (*start up*)**

Coupling ground heat exchangers (GHEs) to heat pumps (HPs) for heating and cooling buildings grants significant energy savings compared to air heat systems, due to the source's better thermal properties, its higher thermal stability, and its more favorable temperature patterns. In the horizontal technology, the exchangers are put into a shallow trench a few meters deep in soil, as opposed to the

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vertical solution, whereby the exchangers are put in boreholes drilled down to a hundred meters. For the horizontal one, the main handicaps are the low energy performance and the wide installation area required. Nevertheless, this solution is easy to carry out and upkeep, more compliant with environmental regulations, and does not interfere with deep aquifers.

A novel, powered, horizontal GHE has been put to test at the Department of Architecture of the University of Ferrara; its behaviour has showed a relatively high energy performance in comparison with widespread solutions, to the extent that the University has now applied for a patent. Now, the prototype and the closed loop are an European patent pending (N. EP11177528.4), and at the stage of submitting the present proposal, a private company has negotiated with the University to acquire the patent pending and to advance in the device improvement.

We deem that a further application in horizontal GHEs, and an improvement in our novel prototype, could be made by incorporating Phase Change Materials (PCMs). It is well known, that the application of PCMs is achieving high popularity in energy saving, e.g. when mixed in plasters, bricks and other elements in buildings. So, we think that PCMs could be strategic in a similar way for the GHE, e.g. if mixed in backfill material filling the trench. The expected advantage to exploit the extra latent heat and improved energy performance would result in smaller closed loops for the same energy consumption. The idea is not diffused in literature, and the performance is not yet well knwon. Moreover, the international experiences for employing PCMs in buildings is different in comparison with this use, because the working temperatures are different. So, the question has to be approached into an experimental framework, controlled by rigorous project research.

Our international working group represents a first operations kernel, to kick off on similar topics. The goals are the following:

1. to group enough expertise and experiences to submit a European proposal for the forthcoming energy calls of the FP7;
2. to explore the possibilities for an industrial partnership, which could be interested to take part at the group and to finance our proposal.

To do so, we have to meet no less than 1 or 2 times, for planning the outlines of the project, in accordance with the guidelines of the next FP7 European Energy Calls, and for sharing knowledge about the subject. We also have to meet potential industrial partners, to expound our theme and strategies in order to involve them at an early stage and secure financing for the next step. Hence, the startup funds will cover the expenses for meetings and for producing the background for the next steps.

Next step

The working group wants to submit a proposal in next FP7 European energy calls, such as FP7-ENERGY-2012-1, ENERGY.2012.8.1.1: *Next generation heat pump technologies*. The project would broach the theme of the coupling of PCMs with ground-source heat pumps systems for space heating and cooling.
The opportunity could also enable to establish new research connections with industrial partners.

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Risultati attesi

1^ fase

1. Research and publish on PCMs coupled with ground heat exchangers in the international literature;
2. Preparatory investigation of the energy performance in coupling of the novel HGHE with PCMs, e.g. MICRONAL® or RubiTherm®;
3. Academic partnership extension with different universities and research organizations, who are interested to take part in the working group;
4. Industrial partnership involvement;
5. Outlines for European proposal or similar announcements;

2^ fase:

1. Development of the project proposal, drawing up and submitting;
2. Enhancement of the preliminary experimental results (industrial partnership, publication).

Costo totale del progetto:

1^ FASE

Costi di mobilità personale italiano (*Mobility costs for local staff)*

Ruolo	*n.*	*Durata complessiva * (giorni)*	*Previsione di spesa* €
Professore associato	1	6	2,000
Ricercatore	2	12	4,000
TOTALE	**3**	**18**	**6,000**

Costi di mobilità personale straniero (*Mobility costs for international partners)*

Ruolo	*n.*	*Durata complessiva * (giorni)*	*Previsione di spesa* €
Professore ordinario	1	3	1,000
Professore associato	1	3	1,000
Ricercatore	1	3	1,000
Ph.D	1	3	1,000
TOTALE	**4**	**12**	**4,000**

Altri costi (*Other costs*)

Descrizione attività	Previsione di spesa €
Preparatory investigation	2,000
TOTALE	**2,000**

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2^ FASE

It is difficult to define the global cost for similar European proposal composition, because the extent of the whole research project will have to be defined. Anyway, the global cost will not be lower than €50,000÷100,000.

Possibili fonti di finanziamento per la 2^ fase progettuale:

We deem that interested industrial partners taking part in the project would be financing parts of the project for the development of the prototypes.
(BASF, Chemtex, SOLVAY, RubiTherm, BOSCH, SIEMENS, …)

Ferrara, 20 Novembre 2011

Il Responsabile Scientifico
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