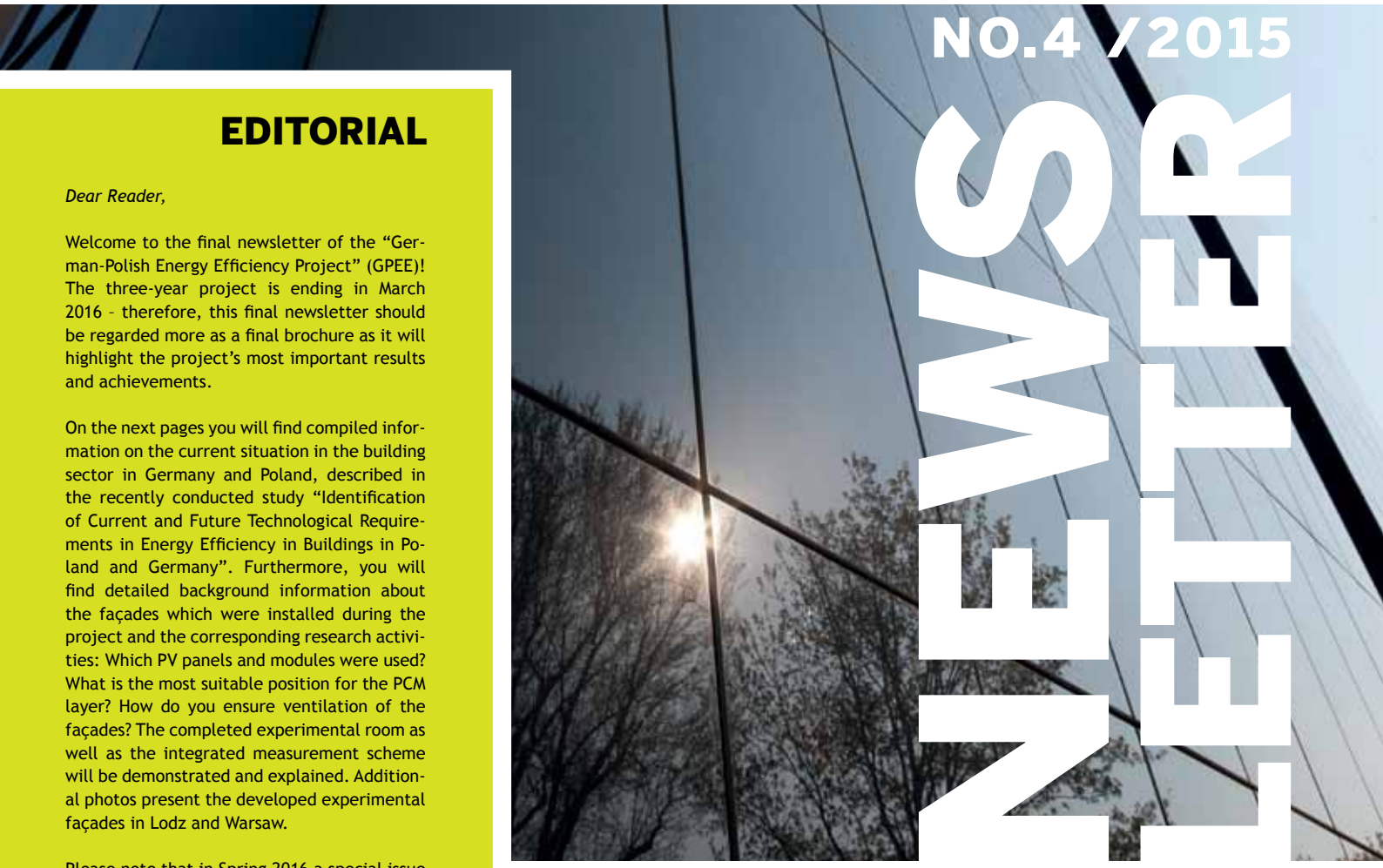

NO.4 /2015

NEWSLETTER

EDITORIAL

Dear Reader,

Welcome to the final newsletter of the "German-Polish Energy Efficiency Project" (GPEE)! The three-year project is ending in March 2016 – therefore, this final newsletter should be regarded more as a final brochure as it will highlight the project's most important results and achievements.

On the next pages you will find compiled information on the current situation in the building sector in Germany and Poland, described in the recently conducted study "Identification of Current and Future Technological Requirements in Energy Efficiency in Buildings in Poland and Germany". Furthermore, you will find detailed background information about the façades which were installed during the project and the corresponding research activities: Which PV panels and modules were used? What is the most suitable position for the PCM layer? How do you ensure ventilation of the façades? The completed experimental room as well as the integrated measurement scheme will be demonstrated and explained. Additional photos present the developed experimental façades in Lodz and Warsaw.

Please note that in Spring 2016 a special issue of the Journal "Management of Environmental Quality" dedicated to innovative approaches to energy efficiency will be published including relevant research which was undertaken in the GPEE project.

Last but not least, the project partners would like to invite you to participate in the project's final conference which will be organized in Hamburg on 9th March 2016 as part of the "Sustainable Built Environment 2016". Please save the date!

The project partners thank you very much for your interest in the GPEE project and its results -

Enjoy reading!

Maria Kowald

Prof. Dr. Walter Leal

Kathrin Rath

Identification of Current and Future Technological Requirements in Energy Efficiency in Buildings in Poland and Germany

The state of the art and current needs in technologies used in energy efficient buildings was assessed in the GPEE project and published in a booklet. The report aims to provide a current overview of the energy efficiency situation in buildings in the partner countries Poland and Germany.

Based on several best practice examples, modern technologies such as highly efficient façade components and energy efficiency increase through building automation systems are evaluated in the report.

Future trends in Poland and Germany beyond 2020 are also analyzed, leading to recommendations in line with future market developments. The assessment shows that there is a lack of information about the current energy standard of houses that calls for energy indicators which meet the demand of

continuing on page 2

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increasing transparency. A method to promote information is “The Building Turnaround – consulting, supporting, retrofitting” (“Die Hauswende – beraten, fördern, sanieren”), a German campaign which combines local information and consultations with the national subsidy programmes.

But besides the need for information, energy efficient technology can only be implemented by qualified planners and skilled workers in this field; so there is a need for constant training of workers to assure a high quality standard during all construction and planning phases.

Besides the need for information, the recycling of building components and material has to be considered as well. The aim would be to reduce the embodied energy and to reduce the waste during the construction period and at the demolition of the building.

Another big issue discussed in the report is the implementation of energy monitoring systems. Energy monitoring systems could systematically expose energy saving potentials and increase the general understanding of energy relations and dependencies of buildings. Based on this, an energy efficiency map tool was developed within the GPEE project. House owners who use the tool can document their energy consumption and will therefore be able to regularly monitor their energy usage.

You can download and read the full report on the project website:
www.gpee.net/downloads/Public/Reports

The official opening ceremony of the GPEE façades

took place in October 2015 at Lodz University of Technology. The experimental room as well as the reference room are now completed and in use. Technical details of the façade and research findings are shown in the following and published in booklets.

You can download and read the full reports on the project website: www.gpee.net/downloads/Public/Reports

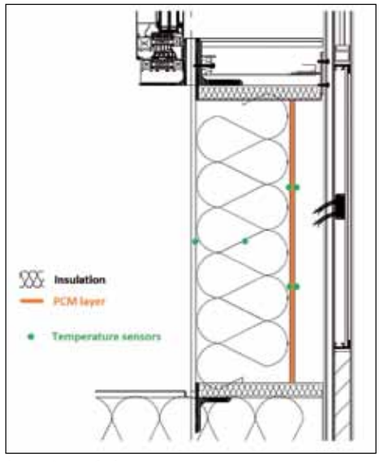
PCM – Phase Change Material

The effective performance of phase change materials depends predominantly upon its switch temperature, which should be set in consideration of the materials’ location and application, including the indoor and exterior temperature range. It is also important what the predominant heating or cooling energy is in the case analyzed.

Most research is concerned with the investigation of the performance of one layer of special material during one specific season, whether winter or summer.

In the framework of the GPEE project it was possible to design a new form of PCM application in external walls. Based on theoretical investigation into the estimation of material properties and its location in the external wall component, a new composite material containing PCM was developed.

Apart from the physical parameters of the materials, the performance of the envelope is also affected by dynamically changing external climate conditions and interferences with the stable internal environment. This means that the determination of proper physical parameters of the building envelope is not possible for the average or instantaneous values of the thermal parameters of the surrounding environment. Weather variables are changing very rapidly and with low regularity. Therefore, there is not one single solution that would provide maximum energy performance for the building external component throughout the year. Therefore, the newly developed solution of PCM application differs in terms of phase change temperature and material integration method.



Location of the temperature sensors in a PCM-insulation component

The application is tested using the experimental façade set up for the GPEE project. The façade construction consists of 12 removable PCM-insulation panels. Each of these is equipped with 6 temperature sensors, placed in the cross section of the wall. Based on the measured values, it will be possible to create a temperature distribution at a depth of the experimental wall component and compare it with traditional construction.

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PV Modules

A detailed review of all commercially available photovoltaic technologies was performed to choose the best module for the experimental façade. Two basic generations of solar cells were considered: crystalline (monocrystalline and polycrystalline silicon) as well as thin film (amorphous silicon, cadmium telluride (CdTe) and copper indium selenide (CIS)). Many parameters were taken into account: efficiency, weight and price of the PV panels as well as area needed per kW. Additionally, according to where the PV panels were to be placed on the building façade, their appearance was also considered.

In the end, CIS thin film panels were selected because they had the best relation between efficiency and price, low weight, commercial availability and attractive appearance. The selected photovoltaic panel has an efficiency of 12% and power at the maximum power point of 80 Wp.

The definitive solution of the experimental façade was optimized in the framework of the multi-criteria optimization procedure, taking into account energy, economic and environmental factors. The external partition of the experimental façade consists of 8 CIS panels located around the centrally positioned window.

GPEE PV module

The efficiency of the photovoltaic panels is very sensitive to high temperatures. The BIPV façade was therefore constructed as a ventilated wall to enable cooling of the PV panels.

Additionally, photovoltaic systems need specialized electric equipment to receive and transform the direct current (DC) generated by PV panels to the alternating current (AC) that can be fed into an electrical network. The electrical system used in the experimental façade is an off-grid system and consists of charge controllers, accumulators and inverters.

The energy generated by the photovoltaic panels is dedicated to supplying power for ventilation and lighting requirements.

Ventilation

Providing a high quality indoor environment in a workplace is extremely important for comfort and health. Appropriate internal climate conditions ensure users feel comfortable and work efficiently.

In the experimental room as well as in the reference room the required air conditions are met by the use of special ventilation units. In the experimental room a decentralized supply and exhaust air unit is installed. This mechanical ventilation station was developed by the company TROX and is designed for underfloor installation. This solution does not require extra room space and is practically invisible once installed. The device operates in three modes, providing airflow volume from 90 m3/h up to 150 m3/h. The station has a modern design and is characterized by low power consumption. It is also worth mentioning the low noise generation of the unit, which does not adversely affect the office work.

In the reference room a simple ventilation unit supplying natural ventilation was installed. The device only works intermittently and is much less efficient than the station installed in the experimental room.

Underfloor ventilation station by TROX in the experimental room

Natural ventilation unit in the reference room

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Construction

In one office building at the Lodz University of Technology a new laboratory was designed. The experiment is the laboratory itself. Four rooms in total, two at the east side of the building and two at the west side, were isolated from the rest of the building and from each other. On each side one experimental room and one reference room was built. For the experimental rooms, the existing façade was eliminated and replaced by the special GPEE façade – for better insulation and for additional energy generation. Additionally, the insulation of the internal walls and the floor was improved. In these rooms a high quality ventilation unit and new lighting were also installed. With this nearly zero-energy type of construction, there shouldn't be any need for heating devices anymore, but for back up small electric heaters are integrated. The reference rooms on the other hand still have the old existing façade with large window areas as well as the old heating devices. The ventilation and lighting system are also the same as usual for this building. All four rooms are used as office rooms by the GPEE project members in Lodz.

In Warsaw at the Sto-ispo building, similar façades have been installed.

Unlike the Lodz façades, the original façades in Warsaw remain and no specific laboratory room was built. Therefore, the experimental façades facing north and east consist of PV panels alone. The experimental façade facing south is similar to the façades installed in Lodz but consists of opaque glass in the middle instead of a transparent window.

The façades in Warsaw are installed to compare the energy output of the PV panels depending on the panel orientation.

Experimental room

Reference room

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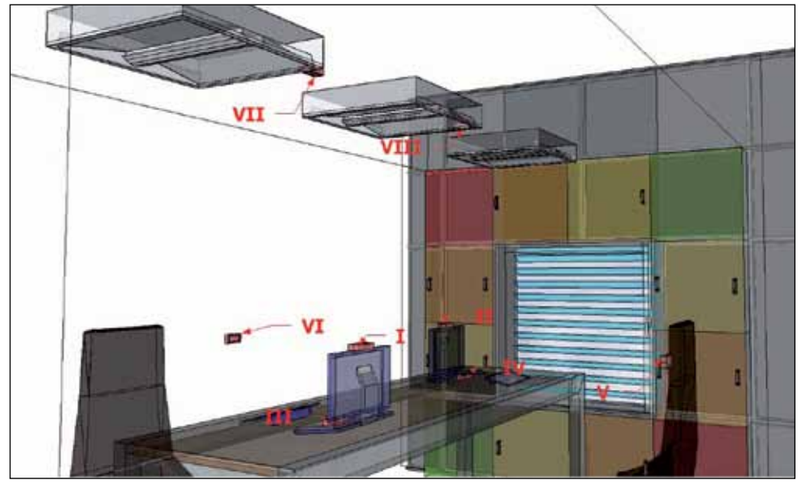
Measurement

Within the GPEE project, extensive research using an impressive measuring infrastructure is conducted. Each experimental compartment is equipped with almost 100 sensors, which allow the measurement of the temperature not only at the internal and external layers of partitions but also in the middle (within the thermal insulation layer). This allows the thermal performances of the partitions to be defined for different external conditions.

The rooms' interiors are also precisely metered. The sensors are installed on working planes, walls, computer displays and on the ceiling to provide information on the conditions at various levels. These sensors allow measurements of temperature, air humidity, lighting intensity and occupancy of rooms.



Distribution of sensors in the experimental and reference rooms

Measuring device for heating system

This mesh of sensors, designed in a special way, allows virtual images to be created with information on conditions in the entire room. Additionally, the reference room is metered in the same way as the experimental room, so it will be possible to make a comparison between the traditional and nearly zero-energy construction types.

Furthermore, the electricity usage by each piece of the equipment located in the rooms is also metered. This allows the estimation of energy generated by the PV panels and measurement of the experimental façades effect on energy reduction.

A complex weather station is also included in the set-up. It is located on the rooftop of the building and allows the collection of real time data on external environment conditions on site, such as wind velocity and its direction, daylight intensity, external temperature and much more.

All data mentioned above will be collected and monitored. It will be analyzed and be a source of findings for studies and scientific articles. Through the use of such an accurate measurement mesh, the results obtained will allow the façade effect to be scaled up to the entire building. The measurements of the data will continue after the end of the project to give an insight into the long term energy performance of experimental façades.

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THE FAÇADES

Façade at Lodz University of Technology – west-facing

Façade at Lodz University of Technology – east-facing

Façade at Sto-ispo (Warsaw) – east-facing

Façade at Sto-ispo (Warsaw) – north-facing

Façade at Sto-ispo (Warsaw) – south-facing

Special issue of the Journal "Management of Environmental Quality" will be published in Spring 2016

In Spring 2016, a special issue of the scientific Journal "Management of Environmental Quality" will be published. This volume is dedicated to "Innovative Approaches to Energy Efficiency". Among authors from Estonia, Latvia, the Netherlands and Germany, GPEE project partners from Lodz University of Technology have contributed to this volume with a description of their scientific research work and results carried out in the framework of GPEE.

The special issue will be available at: http://www.emeraldinsight.com/journal/meq

GPEE at "SBE 16 – International Conference on Sustainable Built Environment"

The GPEE project will organize its final conference "Development of an energy efficient façade: Current technologies and measurement installation" on 9th March 2016 (2.00 – 5.30 p.m.) as part of the "SBE 16 – International Conference on Sustainable Built Environment" which will take place from 8th to 11th March 2016 at the HafenCity University in Hamburg.

The main aim of SBE16 is to showcase new and innovative concepts of sustainability in the building sector and the suitable development of (new as well as existing) neighbourhoods. Under the theme "Strategies, Stakeholders, Success Factors" SBE16 Hamburg expects to attract 300 to 400 scientists, planners, stakeholders, architects, engineers and politicians from all over the world.

The GPEE final conference "Development of an energy efficient façade: Current technologies and measurement installation" will contribute to SBE16 by showcasing the results of 3 years of scientific research towards energy efficient façade technology and measurement of energy efficiency in buildings. A detailed programme is available at: http://www.gpee.net

For more information about SBE16 and for registration please visit: http://www.sbe16hamburg.org/

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CONTACT

Hamburg University of Applied Sciences
Faculty of Life Sciences

Prof. Dr. (mult.), Dr.h.c. (mult.) Walter Leal
Kathrin Rath
Maria Kowald
Julia Haselberger

Research and Transfer Centre
»Applications of Life Sciences«
Ulmenliet 20
21033 Hamburg, Germany
Phone: +49 (0)40 428 756 331
Fax: +49 (0)40 428 756 079
E-mail: info@gpee.net

Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

CALENDAR

» 9th March 2016
2.00 - 5.30 p.m.

Final GPEE conference
"Development of an energy efficient façade: Current technologies and measurement installation"

as part of the "SBE 16 - International Conference on Sustainable Built Environment" from 8th to 11th March 2016 at the HafenCity University in Hamburg.

The GPEE project partner consortium with developed façade in the background

THE GPEE PARTNERSHIP

The following partners form the GPEE partnership:

Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

Hamburg University of Applied Sciences
Coordinator, Germany
gpee@ls.haw-hamburg.de
www.haw-hamburg.de/ftz-als.html

ENVIDATEC

Envidatec GmbH
Detlef.Borst@envidatec.com
nils.heinrich@envidatec.com
www.envidatec.com/

Lodz University of Technology

Lodz University of Technology
Coordinator, Poland
dariusz.heim@p.lodz.pl
www.p.lodz.pl

sto

Sto-ispo sp. z o.o.
d.czarny@sto.com
d.butkiewicz@sto.com
www.sto.pl/