

## PRELIMINARY PROGRAM

### TUESDAY, 15 MAY 2012

19:00 – 22:00 Registration

20:00 – 23:00 Welcome cocktail

### WEDNESDAY, 16 MAY 2012

8:00 – 9:00 Registration

9:00 – 10:45 Opening session

9:00 – 9:45 Inauguration

9:45 – 10:15 Fredrik Setterwall Lecture

10:15 – 10:45 Status and needs for the optimisation of seasonal storage for community-level energy systems

Marc A. Rosen

University of Ontario (Canada)

10:45 – 11:15 Coffee break

11:15 – 13:00 Plenary session

*Chair: Halime Paksoy, Çukurova University (Turkey)*

11:15 – 11:40 Introduction to energy storage - Peter Cunz (IEA)

11:40 – 12:00 UTES – Bo Nordell (Sweden)

12:00 – 12:20 Sensible, latent and thermochemical storage – Jean Christophe Hadorn (Switzerland)

12:20 – 12:40 Electrical storage – Christian Doetsch (Germany)

12:40 – 13:00 Thermal energy storage potential for energy savings and climate change mitigation – Albert Castell (Spain)

13:00 – 15:00 Lunch

15:00 – 16:30 Session 1: poster session

#### SESSION 1A – GSHP

*Chair: Dirk Vanhoudt - VITO (Belgium)*

INNO-U-04 - Influence of Intermittent Operation on Ground Thermal Balance in GCHP System

Yong Wang, Yuanyuan Ma, Qinghua Liu, Ming Luo

Chongqing University (China)

INNO-U-06 - Heat Transfer Performance of Ground Heat Exchangers based on Heat Storage Mode of Domestic Hot Water

Xi Tang, Yong Wang, Yuanyuan Ma

Chongqing University (China)

INNO-U-07 - Optimization of ground coupled heating and cooling supply systems in office buildings – reversible heat pump and free cooling

- Franziska Bockelmann, M. Norbert Fisch, Lars Kühl, Tim Petruszek, Fritz Nüßle, Burkhard Sanner  
Technical University of Braunschweig (Germany), Ostfalia University (Germany), Zent-Frenger GmbH (Germany), and UBeG GbR (Germany)
- INNO-U-14 - Analysis of the Layer Heat Transfer Theory of the Vertical U-tube Heat Exchangers of the GSHP System  
Yong Wang, Fang Liu, Xiangzhao Fu, Jing Qing  
Chongqing University (China)
- INNO-U-20 - Suitability evaluation for applying ground coupled heat pump system in office building in different climatic zones in China  
Cheng Qian, Wei Xu, Qing-yu Zhu, Xiao-chen Lv  
China Academy of Building Research (China)
- INNO-U-23 - Experimental Results and Simulation of Ground Heat Exchangers for a Solar and Heat Pump System for a Passive House  
F. Ochs, W. Feist  
University of Innsbruck (Austria) and Passive House Institute (Austria)
- INNO-U-25 - Geotrained: European Scheme for Training and Education of Designers and Drillers for GSHP and UTES to take effect  
Burkhard Sanner, Isabel Fernandez, Philippe Dumas  
European Geothermal Energy Council (Belgium) and European Federation of Geologists (Belgium)
- INNO-U-34 - Research and Demonstration on Key Technology of Ground Source Heat Pump (GSHP) Systems in China  
Wei Xu, Shicong Zhang, Deyu Sun  
China Academy of Building Research (China)
- INNO-U-35 - Design and optimization of solar energy and geothermal heat pump hybrid system  
Wei Xu, Deyu Sun, Shicong Zhang  
China Academy of Building Research (China)
- INNO-U-41 - Field experiment of cooling system utilizing underground thermal storage and heat pump for hot water supply  
Junya Mishima, Takao Katsura  
The University of Kitakyushu, Japan
- INNO-U-42 - Performance evaluation of net-zero energy building integrated with the ground source heat pump system  
Yusuke Onomiya, Takao Katsura, Yasushi Nakamura  
The University of Kitakyushu (Japan) and Nippon Steel Engineering (Japan)

SESSION 1B – UTES + ATES + CTES

*Chair: Signhild Gehlin - Swedvac (Sweden)*

- INNO-U-03 - Next Generation of Seasonal Gravel-Water Thermal Energy Store – Design and Operating Results from Eggenstein-Leopoldshafen, Germany  
Roman Marx, Dan Bauer, Harald Drucek  
University of Stuttgart, Germany
- INNO-U-05 - Field Tests and Numerical Modeling of Double-layered Straight Horizontal Ground Heat exchangers  
Hikari Fujii, Takahiro Maehara, Yoshihito Komaniwa, Naokatsu Chou, Takashi Ishikami  
Kyushu University (Japan), Kyushu Electric Power Co. (Japan) and Mitsubishi Materials Techno Corporation (Japan)

INNO-U-51 - Underground Thermal Energy Storage (UTES) - Applications and market development in Sweden

Olof Andersson, Jonas Ekkestubbe, Anna Ekdahl  
Sweco Environment AB (Sweden)

INNO-U-65 - Contrast experiment research on three different types of underground energy-storage heat exchangers

Yimin Xiao, Xichen Liu, Xiangzhao Fu  
Chongqing university (China)

INNO-U-68 - Seasonal Underground Thermal Energy Storage in Germany – Status Quo and Perspectives

Oliver Miedaner, Dirk Mangold, Thomas Schmidt  
Solites (Germany)

INNO-U-10 - Calculation Method of heat-carrying capacity of Static Water in Open-loop SWHP System

Yuanyuan Ma, Yong Wang, Chuanpu Han  
Chongqing University (China)

INNO-U-52 - Aquifer Thermal Energy Storage for heating and cooling of a new demonstration centre and an existing office building: results of a 3 years monitoring period

Johan Van Bael, Johan Desmedt, Hans Hoes, Nico Robeyn  
VITO (Belgium) and

INNO-U-64 - Energy Storage in the Visingsö sandstone – A regional potential study to enhance the use of UTES

Michael Hägg, Niklas Ekstrand, Anna Ekdahl  
SWECO Environment AB (Sweden)

INNO-U-70 - Turn threats into opportunities by combining groundwater remediation with ATEs, Systems and simulations

Hans Hoes, Johan Patyn, Richard Lookman  
Terra Energy (Belgium) and VITO (Belgium)

INNO-U-72 - First Commercial Scale ATEs System in the United States in planning stages

John Rhyner, Steve Giordano, Aart Snijders, Lynn Stiles  
P.W. Grosser Consulting (USA), IFTech International (The Netherlands)  
and Richard Stockton College/IFTech USA (USA)

INNO-U-69 - Identification of the Cavern Thermal Energy Storage Potential of Abandoned Mines in Cobalt, Ontario, Canada

Andrew Day and Frederick Michel  
Carleton University (Canada)

#### SESSION 1C – Electrical storage

*Chair: Juan M. Coronado – Institute IMDEA Energy (Spain)*

INNO-E-03 - Assessment of copper-based electrolytes for Redox Flow Batteries applications

Laura Sanz, Jesús Palma, Marc Anderson, Enrique García-Quismondo  
Institute IMDEA Energy (Spain) and University of Wisconsin (USA)

INNO-E-04 - State of the Art of Electrochemical Energy Storage

Patricio Aguirre, Miriam Zubizarreta, Jose Ángel Alzola, Alberto García  
Tecnalia Research & Innovation (Spain)

INNO-E-06 - Battery State of Charge Determination from Phase Measurements

Angel Cuadras  
Universitat Politècnica de Catalunya (Spain)

INNO-E-09 - Photovoltaic energy storage FOR energy management IN residential building: modelisation aspect

Sandrine Pincemin, Simon Boddaert, Thierry Guiot, Stephan Dulou  
EPF Ecole d'ingénieur (France), CSTB (France) and Saft Batteries (France)

INNO-E-11 - VRB Prototyping of Flow Battery elements for large energy storage systems

Marcel Skoumal, Javier Rubio, Cristina Flox, Teresa Andreu, Joan Ramon Morante  
IREC (Spain) and Universitat de Barcelona (Spain)

INNO-E-13 - New LCI materials for DMFC and DEFC

A. Martínez-Felipe, J.D. Badía, L. Santonja-Blasco, S. Sánchez-Ballester, R. Teruel-Juanes, C. Moliner-Estopiñán, M. Rosado-Gil, V. Sáenz de Juano, M.J. Felipe-Román, L. Monreal-Mengual, V. Soria, C.T. Imrie, A. Ribes-Greus  
Universidad Politécnica de Valencia (Spain), Universidad de Valencia (Spain) and University of Aberdeen (UK)

#### SESSION 1D – Storage tanks

*Chair: Cynthia Cruickshank – Carleton University (Canada)*

INNO-S-06 - Case Study on Energy Consumption in Unrenovated, Partially Renovated and Newly Erected Day-care Buildings in Riga, Latvia

Eriks Kruminis, Arturs Gredzens, Ilze Dimdina, Arturs Lesinskis  
Latvia University of Agriculture (Latvia) and Riga Technical University (Latvia)

INNO-SS-06 - Experimental and numerical study of horizontal charging pipes

Stefan Göppert, Thorsten Urbaneck, Rolf Lohse, Bernd Platzer, Oliver Meinig, Lutz Friedrich  
Chemnitz University of Technology (Germany) and Institut for Applied Building Research (IAB) (Germany)

INNO-SS-19 - Hot Water Storages – Influence of Geometry and Operation Parameters on Thermal Stratification

Carola Brämer, Thorsten Urbaneck, Rolf Lohse, Stefan Göppert, Bernd Platzer  
Chemnitz University of Technology (Germany)

INNO-SS-21 - New Storage Concept for Power Plants with Gas Turbines

Thorsten Urbaneck, Bernd Platzer  
Chemnitz University of Technology (Germany)

INNO-SS-28 - Impact of demand management on solar water heaters

François Laurencelle, Alain Moreau  
Hydro-Québec Research Institute (Canada)

INNO-SP-05 - Use of phase change materials (PCM) for the improvement of energy storage in solar water heating systems

Soteris A. Kalogirou, Vassiliki Antoniou, Gregoris Panayiotou  
Cyprus University of Technology (Cyprus)

INNO-SP-86 - Energy storage test module for medium-low temperature water supply

Jesús Marcos García-Alonso, Fernando Aguilar, Eduardo Montero  
Universidad de Burgos (Spain)

INNO-SP-99 - Verification and simulation of a heat storage tank using a phase change material with a medium melting temperature

Hitoshi Naruse, Motoi Yamaha, Hisashi Fujita, Tsuyoshi Ito, Tadafumi Yokota  
Chubu University (Japan), Obayashi Corporation (Japan) and JX Nippon Oil & Energy Corporation (Japan)

SESSION 1E – Research in storage materials

*Chair: Sam Behzadi – The University of Auckland (New Zealand)*

INNO-SS-15 - Bulk good heat storage

Robert Daschner, Samir Binder

ATZ Entwicklungszentrum (Germany)

INNO-SP-51 - Nano Magnetite Paraffin Composite as PCM

Nurten Şahan, Halime Paksoy

Çukurova University (Turkey)

INNO-SP-79 - Preparation and thermal analysis of novel phase change material based on paraffin and olefinic block copolymer

Susumu Komiyama, Katsumi Suzuki, Nobuyuki Toyoda, Kentarou Kanae  
JSR Corporation (Japan)

INNO-SP-80 - Thermophysical characterization of a composite phase change material: the specific case of Energain

Mathieu Le Dû, Laurent Zalewski, Stéphane Lassue, Yvan Dutil, Daniel Rousse

École de technologie supérieure (Canada) and Univ Lille Nord de France (France)

INNO-SP-87 - New Binary Mixtures As Phase Change Materials For Industrial Process Heat Applications

Engin Küçükaltun, Halime Paksoy, Hunay Evliya

Çukurova University (Turkey)

INNO-SP-94 - Looking for “low cost” Phase Change Materials and their application

Conchita Peñalosa, Ana Lázaro, Mónica Delgado, Belén Zalba

Universidad de Zaragoza (Spain)

INNO-SP-100 - Flowability thermal storage material using emulsion containing phase change nano particles

Koji Fumoto, Noriaki Sato, Masahiro Kawaji, Tsuyoshi Kawanami, Takao Inamura

Hirosako University (Japan), City College of New York (USA) and Kobe University (Japan)

INNO-SP-111 - Long term thermal stability of organic PCMs

S. Behzadi and M.M. Farid

The University of Auckland (New Zealand)

INNO-SP-120 - Pilot application of Phase Change Slurry in a 5 m<sup>3</sup> storage

Laura Vorbeck, Stefan Gschwander, Peter Thiel, Bruno Lüdemann, Peter Schossig

Fraunhofer ISE (Germany) and Imtech Deutschland GmbH & Co. KG (Germany)

INNO-SP-122 - Influence of metallization of paraffin micronals on thermophysical properties of polymer matrix composites

Sana Sari-Bey, Magali Fois, Igor Krupa, Boumédiène Benyoucef, Yves Candau

Université Paris Est Créteil (France), Slovak Academy of Sciences (Slovakia) and Université Abou bakr Belkaid (Argelia)

SESSION 1F - Heat transfer and modelling

*Chair: Pablo Dolado – Universidad de Zaragoza (Spain)*

INNO-SP-90 - Effective method of using pcm encapsulated spherical container for short duration charging and discharging applications

Chandrasekaran P, Kumaresan V, Cheralathan M, Velraj.R  
SRM University (India) and Anna University (India)

INNO-SP-121 - Performance analysis of a cross-flow PCM-air heat exchanger

Vadim Dubovsky, Gennady Ziskind, Ruth Letan  
Ben-Gurion University of the Negev (Israel)

INNO-SP-132 - Phase Change Materials with Enhanced Thermal Conductivity

Preston Williams, Luke Haun  
Entropy Solutions, Inc. (USA)

INNO-SP-02 - Modeling of a Thermal Storage with Phase Change Material

Corinna Leonhardt, Dirk Müller  
RWTH Aachen (Germany)

INNO-SP-06 - Uncertainty propagation to a PCM-Air thermal energy storage unit: experimentation and numerical modeling

Pablo Dolado, Javier Mazo, Ana Lázaro, José M. Marín, Belén Zalba  
Universidad de Zaragoza (Spain)

INNO-SP-11 - Impact of Convective Heat Transfer Mechanism in Latent Heat Storage Modeling

Petter Johansson, Justin Ningwei Chiu, Viktoria Martin  
KTH (Sweden)

INNO-SP-31 - Simulation of the performance of a solar air collector with an absorber containing phase change material

Pavel Charvat, Tomas Mauder, Lubomir Klimes, Milan Ostry  
Brno University of Technology (Czech Republic)

INNO-SP-56 - Numerical simulations of energy storage with encapsulated phase change materials. Special emphasis on solid-liquid phase change CFD modelling

P. A. Galione, O. Lehmkuhl, J. Rigola, A. Oliva, I. Rodríguez  
Universitat Politècnica de Catalunya (Spain) and Termo Fluids SL (Spain)

INNO-SP-73 - Analysis of the natural convection in a plate-and-fins latent thermal energy storage system using the CFD technique

Alvaro Campos-Celador, Karnele Urbikain, Gonzalo Diarce, José María Sala  
Universidad del País Vasco (Spain)

INNO-SP-77 - Circulating fluidized bed application of coated phase-change-material (PCM) particles: mathematical modelling and experimental validation

F. Pitié, C Y Zhao, Z. Tamainot-Telto and G. Caceres  
University of Warwick (UK), Shanghai Jiaotong University (China) and Universidad Adolfo Ibáñez (Chile)

INNO-SP-93 - Numerical simulation of a thermal energy storage system with PCM in a shell and tube tank

Á. Ruiz-Pardo, José Manuel Salmerón, A. Cerezuela-Parish, Antoni Gil, Servando Álvarez, L.F. Cabeza  
Universidad de Sevilla (Spain) and Universitat de Lleida (Spain)

SESSION 1G – PCM IN BUILDINGS

*Chair: Masashi Momota - Tokyo Denki University (Japan)*

INNO-SP-30 - Optimization strategy for energy saving in buildings with the PCMs

Tomáš Mauder, Pavel Charvát, Milan Ostrý  
Brno University of Technology (Czech Republic)

INNO-SP-33 - Thermal storage system for low-temperature heating of buildings  
Eneja Osterman, Vincenc Butala, Uroš Stritih  
University of Ljubljana (Slovenia)

INNO-SP-36 - Experimental and numerical investigation of performance characteristics of ceiling panel with ventilation channels made of gypsum-PCM mixture

Maciej Jaworski, Piotr Łapka, Piotr Furmański  
Warsaw University of Technology (Poland)

INNO-SP-12 - Use of phase change materials in buildings with internal thermal loads: experimental results

Lidia Navarro, Alvaro de Gracia, Cristian Solé, Albert Castell, Luisa F. Cabeza  
Universitat de Lleida

INNO-SP-15 - Volatile Organic Emission from PCM Building Materials

Vida Safari, Camila Barreneche, Albert Castell, Arash Basatni, Lidia Navarro, Luisa F. Cabeza, Fariborz Haghighat  
Concordia University (Canada) and Universitat de Lleida (Spain)

INNO-SP-18 - Experimental thermal analysis of a ventilated facade with PCM inside the air channel

Alvaro de Gracia, Lidia Navarro, Albert Castell, Álvaro Ruiz-Pardo, Servando Álvarez, Luisa F. Cabeza  
Universitat de Lleida (Spain) and Universidad de Sevilla (Spain)

INNO-SP-19 - Thermal inertia of rammed earth compared to alveolar brick facade with Phase Change Materials

Lidia Rincón, Susana Serrano, Albert Castell, Gabriel Pérez, Luisa F. Cabeza  
Universitat de Lleida

INNO-SP-21 - Optimization and improvement of rammed earth incorporating PCM

Susana Serrano, Camila Barreneche, Alvaro de Gracia, A. Inés Fernández, Luisa F. Cabeza  
Universitat de Lleida (Spain) and Universitat de Barcelona (Spain)

INNO-SP-25 - Thermal energy storage versus thermal conductivity on natural stone

M.D Romero-Sánchez, M. Fuensanta, C. Guillem-López, A.M. López Buendía  
AIDICO (Spain)

INNO-SP-27 - Comparison of different latent heat storage techniques integrated in building structures

Milan Ostrý, Tomáš Klubal, Pavel Charvát, Lubomir Klimes  
Brno University of Technology (Czech Republic)

INNO-SP-57 - Peak power reduction using a PCM storage coupled with a heat pump in a ventilation system

Joseph Virgone, Andrea Kindinis  
University of Lyon (France)

SESSION 1H – STORAGE IN BUILDINGS

Chair: *Kévy Johanne - University of Lyon (France)*

INNO-S-02 - Passive Cooling and Humidity Control in the Built Environment, Potential for the Zimbabwean Conditions. Review paper

Edson Manyumbu, Viktoria Martin  
University of Zimbabwe (Zimbabwe) and KTH (Sweden)

INNO-S-07 - Heating and cooling using a combination of several TES technologies in the new R&D building of the ZAE Bayern in Würzburg

Felix Klinker, Helmut Weinläder, Harald Mehling, Stephan Weismann, Dietrich Büttner, Hans-Peter Ebert, Eberhard Lävemann, Thilo Ebert, Werner Jensch  
ZAE Bayern (Germany) and Ebert-Ingenieure (Germany)

INNO-SS-03 - Life Cycle Assessment of green roofs compared to conventional roof

Lidia Rincón, Gabriel Pérez, Albert Castell, Dieter Boer, Luisa F. Cabeza  
Universitat de Lleida (Spain)

INNO-SS-04 - Green roofs as passive system for energy savings in Mediterranean Continental climate when using rubber crumbs as drainage layer

Gabriel Pérez, Julià Coma, Anna Vila, Cristian Solé, Albert Castell, Luisa F. Cabeza  
Universitat de Lleida (Spain)

INNO-SS-05 - Green facades as passive systems for energy savings in Mediterranean Continental climate

Gabriel Pérez, Julià Coma, Anna Vila, Cristian Solé, Albert Castell, Luisa F. Cabeza  
Universitat de Lleida (Spain)

INNO-SS-07 - Heat recovery-heat pump system with a thermal storage: A case study from an industrial application

Ehab Foda, Kai Sirén, Janne Hirvonen  
Aalto University - Finland

INNO-SS-23 - Thermal Storage Below House Basement

Patrick Belzile, Stanislaw Kajl, Daniel Rousse, Louis Lamarche, Yvan Dutil  
École de technologie supérieure (Canada)

16:30 – 17:00 Coffee break

17:00 – 19:00 Session 2: parallel session

Session 2A – PCM in buildings

Chairs: *Fariborz Haghighat – Concordia University (Canada) and Albert Castell – Universitat de Lleida (Spain)*

17:00 – 17:20 Annex 23 - Applying Energy Storage in Ultra-low Energy Buildings

Fariborz Haghighat, OA  
Concordia University (Canada)

17:20 – 17:40 INNO-SP-16 - Evaluation of the environmental impact of experimental buildings with different constructive solutions using. Life Cycle Assessment and Material Flow Analysis

- Lídia Rincón, Albert Castell, Gabriel Pérez, Cristian Solé, Dieter Boer, Luisa F. Cabeza  
University of Lleida (Spain) and Universitat Rovirai Virgili (Spain)
- 17:40 – 18:00 INNO-SP-64 - Phase Change Slurries in Panel Cooling Systems for Buildings  
Lucian Hanu, Tobias Kappels, Clemens Pollerberg, Armin Knels, Pooyan Jahangiri  
Fraunhofer Institute UMSICHT (Germany) and E.ON Research Center / RWTH Aachen (Germany)
- 18:00 – 18:20 INNO-SP-60 - Ventilated active façades with PCM  
Aitor Urresti, Gonzalo Diarce, Ana García-Romero, Alejandra Delgado, Aitor Ercoreca, Cesar Escudero, Alvaro Campos Celador  
University of the Basque Country (Spain) and Construction Quality Control Laboratory of the Basque Government (Spain)
- 18:20 – 18:40 INNO-SP-08 - Active free cooling optimization with thermal energy storage in Stockholm  
Justin Ningwei Chiu, Pauline Gravoille, Viktoria Martin  
KTH (Sweden) and National Institute of Energy (France)
- 18:40 – 19:00 INNO-SP-32 - Analysis of a floor heating system with PCM coupled to a heat pump. Study of its technical and economic feasibility  
Javier Mazo, Mónica Delgado, José María Marín, Belén Zalba  
Aragon Institute of Engineering Research (I3A) (Spain)

#### Session 2B – Electrical storage

*Chairs: Christian Doetsch - Fraunhofer UMSICHT (Germany) and Joan Ramon Morante – IREC (Spain)*

- 17:00–17:20 Annex 26 – Electric Energy Storage: Future Energy Storage Demand  
Christian Doetsch, OA  
Fraunhofer UMSICHT (Germany)
- 17:20– 17:40 INNO-E-10 - Progress in Electrical Energy Storage Technologies  
Mathieu Lasfargues, Xiang Wang, Yongliang Li, Hui Cao, Yi Jin, David Lawlor and Yulong Ding  
University of Leeds (UK) and Chinese Academy of Sciences (China)
- 17:40 – 18:00 INNO-E-05 - Battery state of charge determination from heat and entropy measurements  
Victoria Julia Ovejas, Angel Cuadras  
IREC (Spain) and Universitat Politècnica de Catalunya (Spain)
- 18:00 – 18:20 INNO-E-12 - Novel carbon-derived electrodes for improving the cathode of all-vanadium redox flow batteries  
Cristina Flox, Javier Rubio-Garcia, Marcel Skoumal, Teresa Andreu, Juan Ramón Morante  
IREC (Spain) and Universitat de Barcelona (Spain)
- 18:20 – 18:40 INNO-E-07 – The dimensioning of PV-battery systems depending on the prices and subsidy conditions  
Grietus Mulder, Bert Claessens, Thijs Broes, Daan Six, Thomas Nuytten  
VITO (Belgium) and Katholieke Hogeschool Kempen (Belgium)

18:40 – 19:00 INNO-E-02 - Smart building as a power plant – Plus-energy house with energy charge management and e-mobility  
Christina Stähr, M. Norbert Fisch  
Technical University of Braunschweig (Germany)

Session 2C – New PCM materials

*Chairs: Elena Palomo – University of Bordeaux (France) and HunayEvliya – Çukurova University (Turkey)*

17:00– 17:20 INNO-SP-49 - Physico-chemical and mechanical properties of microencapsulated phase change material  
Jessica Giro-Paloma, Gerard Oncins, Camila Barreneche, Mònica Martínez, A. Inés Fernández, Luisa F. Cabeza  
Universitat de Barcelona (Spain), Centres Científics i Tecnològics de la Universitat de Barcelona (Spain) and Universitat de Lleida (Spain)

17:20 – 17:40 INNO-SP-52 - New generation of phase change materials with pseudo solid-solid transitions and higher thermal conductivity based on composites with cellulose decorated with ZnO nanoparticles  
Marta López, Estíbaliz Gómez, Amaia Martínez-Goitandia, Estíbaliz Aranzabe, Arrate Marcaide  
TEKNIKER (Spain)

17:40 – 18:00 INNO-SP-61 - Experimental study on poly-ethylene glycols to investigate their potential as phase change materials  
Peter Hennemann , Eva Günther, Stefan Hiebler  
Bavarian Center for Applied Energy Research (Germany)

18:00 – 18:20 INNO-SP-70 - Investigation of UHMW-polyethylene as a form stable melting phase change material for thermal energy storage  
Roland Müller, Jörg Waschull, Bernhard Ferse  
ILK Dresden (Germany)

18:20 – 18:40 INNO-SP-95 - Investigation of the thermal properties and heat-storage reliability of a paraffin wax for LHTES application under direct solar radiation  
Francesco Goia, Enrico Boccaleri, Marco Perino  
Politecnico di Torino (Italy), Norwegian University of Science and Technology (Norway) and Università del Piemonte Orientale “A. Avogadro” (Italy)

18:40 – 19:00 INNO-SP-109 - Theoretical Prediction of the Eutectic Point of Mixtures Including Phase Change Materials (PCM) Using Physico-Chemical Laws  
Nasser Al-Hajri, S. Behzadi, J.J.J. Chen, M.M. Farid  
The University of Auckland (New Zealand)

21:00 - Dinner

**THURSDAY, 17 MAY 2012**

9:00 – 10:30 Plenary session: IEA Implementing Agreements Outlook

Chair: *Halime Paksoy, Çukurova University (Turkey)*

9:00 – 9:20 ECES IA – Halime Paksoy, Chair, Turkey

9:20 – 9:40 SHC Programme – Ricardo Enríquez, ExCo member, Spain

9:40 – 10:00 ECBCS Research Programme – José M. Campos, ExCo member, Spain

10:00 – 10:20 SolarPACES – Manuel Blanco, Chair, Spain

10:30 – 11:00 Coffee break

11:00 – 13:00 Session 3: parallel session

Session 3A – Heat transfer

Chairs: *Andreas Hauer - ZAE Bayern (Germany) and Wim van Helden – Wim van Helden Renewable Heat (The Netherlands)*

11:00 – 11:20 Annex 24 - Material Development for Improved Thermal Energy Storage Systems

Andreas Hauer, OA

Bavarian Center for Applied Energy Research (Germany)

11:20 – 11:40 INNO-SP-40 - Numerical model of macroscopic latent heat thermal energy storage capsules

Fabian Rösler, Dieter Brüggemann

Universität of Bayreuth (Germany)

11:40 – 12:00 INNO-SP-29 - Comparison of two numerical approaches of modeling phase change materials

Mohammadreza Nabavitatabayi,

Arash Bastani,

Fariborz Haghighat, Janusz A. Kozinski, Marek Dziedzic

Concordia University (Canada), York University (Canada) and

Public Works Government Services Canada (Canada)

12:00 – 12:20 INNO-SP-41 - Convective heat transfer coefficient between an air flow and a PCM flat plate

Alvaro de Gracia, Damien David, Albert Castell, Luisa F. Cabeza,

Joseph Virgone

Universitat de Lleida (Spain) and Université de Lyon (France)

12:20 – 12:40 INNO-SP-58 - Melting with convection and radiation in a participating PCM

Johann Miranda Fuentes, Kévy Johannes, Joseph Virgone,

Matthieu Cosnier

Université de Lyon (France) and Université Paris-Est (France)

12:40 – 13:00 INNO-S-19 - Feasibility of vehicle thermal energy storage (VTES)

Yukitaka Kato

Tokyo Institute of Technology (Japan)

Session 3B – Thermal Response Test (TRT)

Chairs: *Manfred Reuss - ZAE Bayern (Germany) and Javier Urchueguía - Universidad Politécnica de Valencia (Spain)*

11:00 – 11:20 Annex 21 – Thermal Response Test for Underground Thermal Energy Storages

Manfred Reuss, OA

- Bavarian Center for Applied Energy Research (Germany)
- 11:20 – 11:40 INNO-U-08 - Error Analysis of Thermal Response Tests  
Henk J.L. Witte  
Groenholland Geo-Energy Systems (The Netherlands)
- 11:40 – 12:00 INNO-U-11 - Distributed Thermal Response Test on a Pipe-in-Pipe Borehole Heat Exchangers  
José Acuña, Björn Palm  
KTH (Sweden)
- 12:00 – 12:20 INNO-U-16 - Multilevel simulation of thermal response tests  
Jasmin Raymond, Louis Lamarche  
École de Technologie Supérieure (Canada)
- 12:20 – 12:40 INNO-U-27 - Thermal Response Test: Practical Experience and extended range of application  
Marc Sauer, Burkhard Sanner, Erich Mands, Edgar Grundmann, Alfredo Fernández  
UbeG Dr. Mands & Sauer GbR (Germany) and INGEO Ingestigación Geotérmica (Spain)
- 12:40 – 13:00 INNO-U-33 - A parametric sensitivity study into borehole performance design parameters  
Henk J.L. Witte  
Groenholland Geo-Energy Systems (The Netherlands)

### Session 3C – PCM in buildings

*Chairs: Joseph Virgone - Université de Lyon (France) and Servando Álvarez - Universidad de Sevilla (Spain)*

- 11:00 – 11:20 INNO-SP-59 - Numerical modeling and experimental study of a box-section tube bundle thermal energy storage for free-cooling of buildings  
Fabien Rouault, Denis Bruneau, Patrick Sebastian, Serge EkomyAngo, Jérôme Lopez  
Université de Bordeaux (France), Nobatek (France), Institut de recherches technologiques (IRT) (France) and Arts et Métiers ParisTech (France)
- 11:20 – 11:40 INNO-SP-55 - Latent heat of water in combined heating systems for family houses  
Julius Eyern  
Instchemas AB (Sweden)
- 11:40 – 12:00 INNO-SP-102 - Optimization of Solar DHW system including PCM media  
Didier Haillot, Erwin Franquet, Stéphane Gibout, Jean-Pierre Bédécarrats  
Université de Pau et des Pays de l'Adour (France) and CagireTeam - INRIA BordeauxSud Ouest (France)
- 12:00 – 12:20 INNO-S-15 - Application of thermal energy storage in the closed greenhouse concept  
Amir Vadiee, Viktoria Martin  
KTH (Sweden)
- 12:20 – 12:40 INNO-SP-37 - Phase change materials for root-zone passive heating in greenhouses  
BeyzaBeyhan, Halime O. Paksoy  
Çukurova University (Turkey)

12:40 – 13:00 INNO-SP-103 - Study on practical use of the “High density cold energy network”  
Yuta Inada, Tadahiko Yamamoto, Masashi Momota,  
Takumo Miyanaga, Naoki Kemmotsu  
Tokyo Denki University (Japan)

13:00 – 15:00 Lunch

15:00 – 16:30 Session 4: poster session

SESSION 4A – TRT + GSHP

*Chair: Jeffrey Spitler – Oklahoma State University (USA)*

INNO-U-15 - Thermal response test – evaluation of a series of measurements in the same rock environment

Petr Hemza, Zdeněk Rozehnal, David Grycz  
Green Gas DPB (Czech Republic)

INNO-U-58 - Analysis of the influence of the heat power rate variations in different phases of a Distributed Thermal Response Test

Patricia Monzó, José Acuna, Björn Palm  
KTH (Sweden)

INNO-U-60 - Design methodology in thermoactive diaphragm walls

Salvador Quilis, Luis Carlos Antón, Javier F. Urchueguía  
Energesis Ingeniería S.L. (Spain) and Universidad Politécnica de Valencia (Spain)

INNO-U-67 - Uncertainty of ground thermal conductivity in the line-source model application of thermal response test

Byoung Ohan Shim, Chan-Hee Park  
Korea Institute of Geoscience and Mineral Resources (Korea)

INNO-U-43 - Approaches to Solar Hybridization of Ground Source Heat Pump Systems

Vonden M. Sleight  
Energy Initiatives, Inc. (USA)

INNO-U-44 - A new model for slinky heat exchanger and the experimental verification

Huai Li, Katsunori Nagano, Yuanxiang Lai  
Hokkaido University (Japan)

INNO-U-45 - Measuring temperature evolution inside the pipes of a ground heat exchanger by wireless sensors

Julio Martos, Álvaro Montero, Jesús Soret, José Torres, Raimundo García-Olcina, Iván Leiva  
Universidad de Valencia (Spain) and Universidad Politécnica de Valencia (Spain)

INNO-U-47 - Control of Ground Coupled Heat Pump Systems in Offices to Optimally Exploit Ground Thermal Storage on the Long Term

Stefan Antonov, Clara Verhelst, Lieve Helsen  
University of Leuven (Belgium)

INNO-U-49 - Experimental and modeling analysis of a ground source heat pump system

C. Montagud, J.M. Corberán, F. Ruíz-Calvo  
Universidad Politécnica de Valencia (Spain)

INNO-U-53 - Results of an in-situ measurement campaign on a direct expansion geothermal heat pump with vertical drillings for space heating and domestic hot water supply

Dries Vos, Luc Jespers, Dirk Vanhoudt, Johan Van Bael  
VITO (Belgium)

INNO-U-66 - New Solutions for Short-time calculation of underground energy-storage heat exchanger in GSHP using numerical calculation method and experiment certification

Xichen Liu, Yimin Xiao, Xiangzhao Fu  
Chongqing university (China)

#### SESSION 4B – BTES

*Chair: Marcel Hendriks – IFTec GeoEnergía S.L. (Spain)*

INNO-U-01 - Validation of a groundwater flow and transport modeling tool for borehole thermal energy stores based on FEFLOW

Dan Bauer, Wolfgang Heidemann, Harald Drück  
University of Stuttgart (Germany) and Research and Testing Centre for Thermal Solar Systems (Germany)

INNO-U-32 - The GEOTHEX geothermal heat exchanger, characterisation of a novel high efficiency heat exchanger design

Henk J.L. Witte  
Groenholland Geo-Energysystems (The Netherlands)

INNO-U-36 - Comparison of models for calculating the heat flow through the walls of buried parallel pipes

Thomas Oppelt, Thorsten Urbaneck, Bernd Platzer  
Chemnitz University of Technology (Germany)

INNO-U-37 - Experimental measurement of the ground temperature recovery time after borehole heat exchanger insertion

Álvaro Montero, Julio Martos, Guillermo Martínez, Javier Urchueguía  
Universidad Politécnica de Valencia (Spain)

INNO-U-40 - An improved methodology for the design of ground heat storage systems

Alberto Lazzarotto  
KTH (Sweden)

INNO-U-48 - Three dimensional analysis of thermal interaction of multiple vertical ground heat exchangers

Seama Koochi-Fayegh, Marc Rosen  
University of Ontario (Canada)

INNO-U-50 - The HT-BTES plant at Xylem in Emmaboda, Sweden - Experiences from design, construction and initial operation

Olof Andersson, Leif Rydell  
Sweco Environment AB (Sweden)

INNO-U-56 - A new Spanish project on the combination of geothermal, geotechnical and mechanical effects in the design of a precast geothermal pile

M. De Groot, C. De Santiago, F. Pardo de Santayana, T. Magraner, J.F. Urchueguía, J.L. Arcos  
CEDEX (Spain), Universidad Politécnica de Valencia (Spain) and Grupo Rodio Kronsa (Spain)

INNO-U-61 - Solar Heat Recovery using Thermal Ground Storage combined with Heat Pump

Eva-Lotta W Kurkinen, Pia Tiljander, Henrik Karlsson

SP Technical Research Institute of Sweden (Sweden)

INNO-U-63 - Experiments and numerical study on the effects of filling materials in ground heat exchangers

Masafumi Fujimoto, Hikari Fujii, Yoshihito Komaniwa, Naokatsu Chou  
Kyushu University (Japan)

INNO-U-71 - Quality assurance of grouting for Borehole Heat Exchangers

Hauke Anbergen, Jens Frank, Ingo Sass  
Knabe Enders DührkopIngenieure GmbH (Germany) and Technical  
University of Darmstadt (Germany)

INNO-U-73 - CO<sub>2</sub>-Thermosiphon - Borehole Heat Exchanger

Lars Staudacher, Manfred Reuss  
ZAE Bayern (Germany)

#### SESSION 4C – Thermochemical storage

*Chair: Ruud Cuypers – TNO (The Netherlands)*

INNO-ST-02 - Thermal adsorption storage properties of a Greek natural zeolitic tuff from the Metaxades-Petrota region

Jochen Jänchen, Erik Thrun, Theodoros Markopoulos, Udo Hellwig  
Technical University of Applied Sciences Wildau (Germany), ZeoSolar  
e.V. (Germany) and Technical University of Crete (Greece)

INNO-ST-03 - Two-component water sorbents for thermo-chemical energy storage – a role of the porous matrix

Alenka Ristić, Stefan Henninger, Venčeslav Kaučič  
National Institute of Chemistry (Slovenia) and Fraunhofer ISE  
(Germany)

INNO-ST-04 - Reactivity Enhance of packed bed chemical material using expanded graphite for Chemical Heat Pump

Seon Tae Kim, Junichi Ruy, Yukitaka Kato  
Tokyo Institute of Technology (Japan)

INNO-ST-05 - Modelling of a solar thermo-chemical system for energy storage in buildings

Alexandre Skrylnyk, Emilie Courbon, Marc Frère, Samuel Hennaut,  
Philippe André, Philippe Sun, Gilbert Descy  
University of Mons (Belgium), University of Liège (Belgium) and ESE s.a.  
(Belgium)

INNO-ST-08 - Characterization of the sorption process in thermochemical materials for seasonal solar heat storage application

Claire Ferchaud, Herbert Zondag, Robert de Boer and Camilo Rindt  
ECN (The Netherlands) and Eindhoven University of Technology (The  
Netherlands)

INNO-ST-10 - MERITS: More Effective use of Renewables Including compact seasonal Thermal energy Storage

Ruud Cuypers, Christian Finck, Ellemieke Henquet, Henk Oversloot,  
Aart de Geus  
TNO (The Netherlands)

INNO-ST-12 - Pilot Plant Development of High Temperature Thermochemical Heat Storage

Patrick Schmidt, Martin Bouché, Marc Linder, Antje Wörner  
DLR (Germany)

INNO-ST-13 - Hydration and Dehydration of CaO/ Ca(OH)<sub>2</sub>

Holger Urs Rammelberg, Oliver Opel, Thomas Schmidt, Wolfgang Ruck

Leuphana University of Lueneburg (Germany)

INNO-ST-14 - Mobile Sorption Heat Storage in Industrial Waste Heat Recovery

Andreas Kroenauer, Eberhard Laevemann, Andreas Hauer

ZAE Bayern (Germany)

INNO-ST-15 - Performance analysis of an atmospheric packed bed thermo-chemical heat storage system

Timo van Beek, Camilo Rindt, Herbert Zondag

KWA Business Consultants (The Netherlands), Eindhoven University of Technology (The Netherlands) and ECN (The Netherlands)

INNO-ST-16 - Quantum Chemical Analysis of the Structures of MgSO<sub>4</sub> Hydrates

Eldhose Iype, Cihan Ozen, Silvia V Nedeia, Camilo C. M. Rindt, Herbert A. Zondag

Eindhoven University of Technology (The Netherlands) and Istanbul Technical University (Turkey)

INNO-ST-17 - Influence of the Synthesis Method on the Energy Storage Capacity of Mn<sub>2-x</sub>CoxO<sub>3</sub> Materials

Javier Moya, Alicia Bayón, Prabhas Jana, Manuel Romero, José González Aguilar, Víctor de la Peña O'Shea, David P. Serrano and Juan M. Coronado

Instituto IMDEA Energía (Spain)

INNO-ST-20 - Requirements to consider when choosing a suitable thermochemical material

Aran Solé, Xavier Fontanet, Ana I. Fernández, Ingrid Martorell, Luisa F. Cabeza

Universitat de Lleida (Spain) and Universitat de Barcelona (Spain)

#### SESSION 4D – High temperature storage

*Chair: Nicolas Calvet – CIC Energigune (Spain)*

INNO-S-03 - Environmental and economic optimization of thermal energy storage in solar thermal power plants

Ekaterina Antipova, Gonzalo Guillén-Gosálbez, Laureano Jiménez, Cristian Solé, Luisa F. Cabeza, Dieter Boer

Universitat Rovira i Virgili (Spain) and Universitat de Lleida (Spain)

INNO-S-18 - Energy storage for CSP plants, overview and detailed discussion of a storage system for a new Fresnel Plant

Luís Guerreiro, Manuel Collares-Pereira, Diogo Canavarro

University of Evora (Portugal)

INNO-SS-02 - Experimental characterization of high temperature sensible thermal energy storage solid industry waste materials at pilot plant scale

Laia Miró, Priyamvada Suresh, Antoni Gil, Helena Navarro, A. Inés Fernández, Luisa F. Cabeza

Universitat de Lleida (Spain) and Universitat de Barcelona (Spain)

INNO-SS-10 - Optimization of a by-product compound for high temperature STES through design of experiments

M. Elena Navarro, Mònica Martínez, José M. Chimenos, A. Inés Fernández, Luisa F. Cabeza

Universitat de Barcelona (Spain) and Universitat de Lleida (Spain)

INNO-SS-12 - Moving Bed Heat Exchanger for solar-driven steam cycles: Modeling and validation

Torsten Baumann, Volker Dreißigacker, Stefan Zunft

DLR (Germany)

INNO-SS-17 - High temperature thermal energy storage material from vitrified coal-fired power plant Fly-Ash

Amélie Kere, Xavier Py, Régis Olives, Vincent Goetz, Najim Sadiki, Eric Mercier-Allart

University of Perpignan (France) and EDF R&D (France)

INNO-SS-27 - High temperature thermal energy storage materials – synthesis and characterisation

Mathieu Lasfargues, Feng Ye, Yongliang Li, Hui Cao, Yi Jin, David Lawlor and Yulong Ding

University of Leeds (UK) and Chinese Academy of Sciences (China)

INNO-SP-13 - Experimental analysis of the effective thermal conductivity enhancement of PCM using finned tubes in high temperature bulk tanks

Antoni Gil, Eduard Oró, José M. Salmerón, Luisa F. Cabeza, Servando Álvarez

Universitat de Lleida (Spain) and Universidad de Sevilla (Spain)

INNO-SP-42 - Replacement of Wet Cooling Towers in heat rejection loops of absorption chillers with combined Dry Cooler-PCM Thermal Energy Storage

Juan Francisco Belmonte Toledo, José A. Almendros-Ibáñez, Antonio Molina Navarro, Rafael Salgado Mangual, Pablo Eguía

Universidad de Castilla-La Mancha (Spain), Universidad Interamericana de Puerto Rico (Puerto Rico) and Universidad de Vigo (Spain)

#### SESSION 4E – Materials and measurement

*Chair: Thomas Haussmann – Fraunhofer ISE (Germany)*

INNO-SP-123 - Experimental and theoretical analysis of the behaviour of a macro-encapsulated organic compound for solar cooling application

A. Frazzica, G. Maggio, A. Freni

Istituto di Tecnologie Avanzate per l'Energia "Nicola Giordano" (Italy)

INNO-SP-125 - Development of cement and lime based plaster with microencapsulated Phase Change Material (PCM)

D. Bajare, J. Kazjonovs, A. Korjakins, R. Merijs-Meri

Riga Technical University (Latvia)

INNO-SP-129 - Flame Retardant PCMs

William Sutterlin, Monte C. Magill

Renewable Alternatives, P.O. (USA) and Entropy Solutions, Inc. (USA)

INNO-SP-130 - Super Latent Heat Nanomaterials

William Sutterlin, Monte C. Magill

Renewable Alternatives, P.O. (USA) and Entropy Solutions, Inc. (USA)

INNO-SP-131 - Engineering with Engineered Phase Change Materials

Preston Williams, Luke Haun

Entropy Solutions, Inc. (USA)

INNO-SP-39 - The input of microcalorimetric techniques for the characterization of latent and sensible heat storage materials

Rémi André, Pierre Leparlouër, Stephan Moreau

SETARAM Instrumentation (France)

INNO-SP-20 - Influence of polymorphism in the thermal energy storage capacity of d-mannitol

Camila Barreneche, Antoni Gil, Cristian Solé, A. Inés Fernández, Luisa F. Cabeza

Universitat de Lleida (Spain) and Universitat de Barcelona (Spain)

INNO-SP-14 - New methodology for DSC analysis of PCM included in polymeric matrixes

Camila Barreneche, Laia Miró, Aran Solé, A. Inés Fernández, Luisa F. Cabeza

Universitat de Lleida (Spain) and Universitat de Barcelona (Spain)

INNO-SP-17 - Comparison of three different equipments available in Spain to test thermal properties of building materials including phase change materials

Camila Barreneche, Alvaro de Gracia, Susana Serrano, M. Elena Navarro, Ana M. Borreguero, A. Inés Fernández, Manuel Carmona, J. F. Rodriguez, Luisa F. Cabeza

Universitat de Lleida (Spain), Universitat de Barcelona (Spain) and Universidad de Castilla-La Mancha

INNO-SP-53 - Thermophysical Characterization of Phase-Change Materials with fluxmetrics measures - Preliminary study

Ahmed Arid, Pierre Tittlein, Laurent Zalewski, Naji Hassan, Stéphane Lassue

University Lille Nord de France (France) and University Artois (France)

INNO-SP-54 - Analysis of the physical stability of PCM slurries

Mónica Delgado, Ana Lázaro, Conchita Peñalosa, Javier Mazo, Belén Zalba

Universidad de Zaragoza (Spain)

#### SESSION 4F – Cold storage

*Chair: Cristian Solé – Universitat de Lleida (Spain)*

INNO-SP-22 - Corrosion of metal and polymer containers for use in PCM cold storage

Eduard Oró, Laia Miró, Camila Barreneche, Ingrid Martorell Mohammed M. Farid, Luisa F Cabeza

Universitat de Lleida (Spain) and The University of Auckland (New Zealand)

INNO-SP-24 - Operating and controlling of the integrated system combined water source heat pump with thermal storage

Xuelian Bai, Yun Xu, Nanqiao Zhang

Chongqing University (China) and Sichuan Institute of Architectural Design (China)

INNO-SP-65 - Evaluation of HVAC Cold Storage Using TRNSYS under Australian Conditions

Liangzhuo Hou, Mike Dennis

Australian National University (Australia)

INNO-SP-81 - Experimental analysis of a 173 kWh ice-storage tank

Alejandro López-Navarro, Bárbara Torregrosa-Jaime, Israel Martínez-Galván, Juan Luis Bote-García, Jorge Payá

Universidad Politécnica de Valencia (Spain) and ACCIONA Infraestructuras S.A. (Spain)

INNO-SP-82 - Feasibility study of a commercial ice storage installation for HVAC in a southern European building

Bárbara Torregrosa-Jaime, Javier Biosca-Taronger, José Carlos Esteban-Matías, Jorge Payá

Universidad Politécnica de Valencia (Spain) and ACCIONA Infraestructuras S.A. (Spain)

INNO-SP-106 - Potential Utilization of City Owned Snow Disposal Facilities for Seasonal Cooling in Ottawa, Canada

Paul Cipcigan and Frederick Michel  
Carleton University (Canada)

INNO-SP-118 - Actual Application of the Vertical Ice / Water Thermal Energy Storage Tank for University Campus in Japan

Masashi Momota, Tadahiko Ibamoto, Kazuhiro Hayashi, Hirokazu Nakamura  
Tokyo Denki University (Japan) and Nikken Sekkei Co. (Japan)

SESSION 4G – PCM in buildings

*Chair: Shicong Zhang – China Academy of Building Research (China)*

INNO-SP-76 - Analytical considerations of thermal performance of exterior PCM wallboards in passive-designed buildings

Dan Zhou, Changying Zhao, Robert Critoph  
University of Warwick (UK) and Shanghai Jiaotong University (China)

INNO-SP-91 - Building integration of PCM for natural cooling of buildings

Servando Álvarez, Luisa F. Cabeza, Alvaro Ruiz-Pardo, Albert Castell, José Antonio Tenorio  
Universidad de Sevilla (Spain) and Universitat de Lleida (Spain)

INNO-SP-92 - Numerical simulation of a ventilated façade with PCM inside the air channel

A. Ruiz-Pardo, F.J. Sánchez, J. Sánchez Ramos, A. de Gracia, L.F. Cabeza  
Universidad de Sevilla (Spain) and Universitat de Lleida (Spain)

INNO-SP-104 - Optimization of materials for thermal energy storage in building walls

Juan Pablo Arzamendia Lopez, Frédéric Kuznik, Dominique Baillis, Bernard Yrieix  
University of Lyon (France) and EDF R&D (France)

INNO-SP-107 - The application of using phase change material for air-source heat pump heat storage

Huang M.J, Hewitt N.J  
University of Ulster (UK)

INNO-SP-110 - Computer simulation of the application of phase change materials in domestic dwellings and harvesting of roof cavity heat energy

W.H.Leung, S.Behzadi, J.J.J. Chen and M.M. Farid  
The University of Auckland (New Zealand)

INNO-SP-112 - Design of PCM Thermal Storage Unit for a HVAC system

Pere Moreno, Cristian Solé, Albert Castell, Luisa F. Cabeza  
Universitat de Lleida (Spain)

INNO-SP-115 - Improvement of the fire behaviour of PCM in building applications

L. Haurie, A.M. Lacasta, V. Realinho, J.I. Velasco  
Universitat Politècnica de Catalunya (Spain)

INNO-SP-117 - The energy storage capabilities of clay boards with phase change materials in building applications

B.L Gowreesunker and S.A Tassou  
Brunel University (UK)

INNO-SP-119 - Central PCM storage in HVAC systems

Thomas Haussmann, Hannah Neumann, Bagdat Oral, Peter Schossig  
Fraunhofer ISE (Germany)

INNO-SP-07 - Improvement of comfort conditions in open-air swimming pools by implementing phase change materials

Gabriel Zsembinski, Mohammed M. Farid , Luisa F. Cabeza  
Universitat de Lleida (Spain) and The University of Auckland (New Zealand)

#### SESSION 4H - STORAGE SYSTEMS

*Chair: Stefan Hiebler – ZAE Bayern (Germany)*

INNO-S-04 - Behavior based load profile generator domestic hot water and electricity use

Noah Pflugradt, Bernd Platzer  
Chemnitz University of Technology (Germany)

INNO-S-08 - Exergy Assessment of the Use of Thermal Storage in a District Energy System: Case Study

Behnaz Rezaie, Bale V. Reddy and Marc A. Rosen  
University of Ontario (Canada)

INNO-S-11 - On the Economics of High Insulated Thermal Storage

Benjamin Fuchs, Klaus Hofbeck  
Georg-Simon-Ohm University of Applied Sciences (Germany)

INNO-S-14 - Wind-Diesel hybrid system: energy storage system selection method

Hussein Ibrahim, Mariya Dimitrova, Yvan Dutil, Daniel Rousse, Adrian Ilinca, Jean Perron  
TechnoCentre éolien (Canada), ETS (Canada) and University of Quebec (Canada)

INNO-S-20 - Ground source heat pump combined with thermo-active building system with incorporated PCM for low-energy residential house

Georgi K. Pavlov, Bjarne W. Olesen, Martynas Skrupskelis, Ongun Kazanci  
Technical University of Denmark (Denmark)

INNO-S-24 - Thermal Wind Solar Power Plant (TWSPP) as a Solution of the Energy Security Supply Problem on Islands

Ruy Spencer  
CEA (Cabo Verde) and Technical University of Lisbon (Portugal)

INNO-SS-24 - Electrical thermal storage optimization for demand side management

Patrick Belzile, Stanislaw Kajl, Daniel Rousse, Yvan Dutil  
École de technologie supérieure (Canada)

INNO-SP-44 - Thermal Energy Storage for Solar Systems using NaNO<sub>3</sub> as Encapsulated Phase Change Material

Weihan Zhao, Ying Zheng, J. C. Sabol, John Chen, Kemal Tuzla, Alp Oztekin, Wojciech Misiolek, Sudhakar Neti  
Lehigh University (USA)

INNO-SP-78 - Exergy Optimisation for Cascaded Thermal Storage

Yuan Tian, Changying Zhao, Alexei Lapkin  
University of Warwick (UK) and Shanghai Jiaotong University (China)

INNO-SP-83 - Experimental study of a fixed and fluidized bed with PCM

María A. Izquierdo-Barrientos, Celia Sobrino, José A. Almendros-Ibáñez  
Universidad Carlos III de Madrid (Spain) and Universidad de Castilla-La Mancha (Spain)

INNO-SP-88 - Utilization of Condensation Heat Reclaim from Air-conditioning System for Hot-water Supplying in Water Spa Club

Zhenguo. Lin, Peishun. Yan, Mo. Li, Xuelian. Bai  
Chongqing University (China)

16:30 – 17:00 Coffee break

17:00 – 19:00 Session 5: parallel session

Session 5A – PCM measurement

*Chairs: Peter Schossig – Fraunhofer ISE (Germany) and Ana Lázaro – Universidad de Zaragoza (Spain)*

- 17:00 – 17:20 INNO-SP-35 - Enthalpy and temperature of the phase change solid-liquid – An analysis of data of the elements by macroscopic thermodynamics  
HaraldMehling, Eva Günther  
Bavarian Center for Applied Energy Research (Germany)
- 17:20 – 17:40 INNO-SP-74 - Advances in intercomparative tests on phase change materials characterization  
Ana Lazaro, Conchita Peñalosa, Aran Solé, Belén Zalba, Stefan Gshwander, Luisa F. Cabeza  
Aragon Institute for Engineering Research (I3A) (Spain), Fraunhofer ISE (Germany) and Universitat de Lleida (Spain)
- 17:40 – 18:00 INNO-SP-38 - Subcooling in Phase Change Materials Used for Cooling  
Selma Yilmaz, Halime O. Paksoy  
Çukurova University (Turkey)
- 18:00 – 18:20 INNO-SP-66 - Improved measurement technique for the characterisation of phase change materials using the T-history method  
StanislavaStankovic, Panayiotis Kyriacou  
City University London (UK)
- 18:20 – 18:40 INNO-SP-101 –Improvement of the thermal inertia of building materials incorporating PCM. Evaluation in the macroescale with T-t comparative curves  
M. Elena Navarro, CamilaBarreneche, Tomás Castillo, A. Inés Fernández, Luisa F. Cabeza  
Universitat de Lleida (Spain) and Universitat de Barcelona (Spain)
- 18:40 – 19:00 INNO-SP-62 - A new T-history calorimeter for phase change materials in the temperature range 50 °C to 200 °C  
Christoph Rathgeber, Michael Himpel, Stefan Hiebler,  
Bavarian Center for Applied Energy Research (Germany)

Session 5B – Storage in CSP

*Chairs: Xavier Py–Université de Perpignan (France) and Yukitaka Kato–Tokyo Institute of Technology (Japan)*

- 17:00 – 17:20 INNO-S-10 - Theoretical method for the change on dimension of thermal energy storage systems  
Antoni Gil, Régis Olives, Luisa F. Cabeza, Xavier Py  
Universitat de Lleida (Spain) and Université de Perpignan (France)

- 17:20 – 17:40 INNO-SS-01 - Compatibility of low-cost recycled ceramics with nitrate molten salts for a sustainable active direct thermocline storage system  
Nicolas Calvet, Judith Gomez, Anne Starace, Antoine Meffre, Greg Glatzmaier, Stefania Doppiu, Xavier Py  
CIC Energigune (Spain), NREL (USA) and Université de Perpignan (France)
- 17:40 – 18:00 INNO-SP-48 - High temperature latent heat storage for CSP: testing of prototype with thermal oil  
Verena Zipf, Anton Neuhäuser, Peter Nitz, Stefan Gschwander, Werner Platzler  
Fraunhofer ISE (Germany)
- 18:00 – 18:20 INNO-SP-72 - Development of High Temperature Phase-Change-Material Storages  
Doerte Laing, Thomas Bauer, Nils Breidenbach, Bernd Hachmann, Maike Johnson  
DLR (Germany) and F.W. Brökelmann Aluminiumwerk (Germany)
- 18:20 – 19:40 INNO-SP-105 - Transient numerical analysis of PCM-contained spherical capsules for heat storage in concentrating solar power plants  
Antonio Ramos Archibold, Charles-Alexis Asselineau, José Gonzalez-Aguilar, Muhammad M Rahman, Manuel Romero, D. Yogi Goswami, Elias L. Stefanakos  
Institute IMDEA Energy (Spain) and University of South Florida (USA)
- 18:40 – 19:00 INNO-SS-25 - Modular object-oriented methodology for the resolution of molten salt storage tanks for CSP plants  
Assensi Oliva, Carlos D. Pérez-Segarra, Ivette Rodríguez, Oriol Lehmkuhl, Santiago Torras  
Technical University of Catalonia (Spain) and TermoFluids S.L. (Spain)

Session 5C – Storage in buildings

*Chairs: Velraj Ramalingom – Anna University (India) and Sarah McCormack – Trinity College Dublin (Ireland)*

- 17:00 – 17:20 INNO-SS-11 - Thermal energy storage in Swedish single family houses – a case study  
Johan Heier, Chris Bales, Viktoria Martin  
Darlana University (Sweden) and KTH (Sweden)
- 17:20 – 17:40 INNO-SS-13 - Charge and discharge strategies for a multi-tank thermal energy storage  
Ryan M. Dickinson, Cynthia A. Cruickshank, Stephen J. Harrison  
Carleton University (Canada) and Queen's University (Canada)
- 17:40 – 18:00 INNO-SS-08 - First lab test results of an active heat pump with water storage for load shifting  
Dirk Vanhoudt, Bert Claessens, Davy Gysen, Filip Leemans, Luc Jaspers, Johan Van Bael  
VITO (Belgium)
- 18:00 – 18:20 INNO-S-12 - Vacuum Insulated Thermal Storage  
Benjamin Fuchs, Klaus Hofbeck

Georg-Simon-Ohm-University of Applied Sciences (Germany)  
and Technical University of Munich (Germany)

18:20 – 18:40 INNO-ST-09 - Prototype thermochemical heat storage with  
open reactor system

Herbert Zondag, Benjamin Kikkert, Simon Smeding, Robert de  
Boer, Marco Bakker

ECN (The Netherlands) and Eindhoven University of  
Technology (The Netherlands)

18:40 – 19:00 INNO-ST-07 - New high efficient regeneration process for  
thermo-chemical energy stores

Barbara Mette, Henner Kerskes, Harald Drück  
University of Stuttgart (Germany)

21:00 – Gala Dinner

**FRIDAY, 18 MAY 2012**

9:00 – 11:00 Session 6: parallel session

Session 6A – UTES in buildings and district heating

*Chairs: Henk J.L. Witte - Groenholland Geo-Energy Systems (The Netherlands) and Olof Andersson – Sweco (Sweden)*

- 9:00 – 9:20 INNO-U-02 - The BTES project in Crailsheim (Germany) – Monitoring results  
Janet Nußbicker-Lux, Harald Drück  
University of Stuttgart (Germany)
- 9:20 – 9:40 INNO-U-24 - Underground diurnal and seasonal energy storage for a cooling and heating system in a retail building in Jerez de la Frontera / Spain  
Alfredo Fernández, Erich Mands, Burkhard Sanner, Marc Sauer, Lucía Novelle  
INGEO Investigación Geotérmica (Spain) and UbeG Dr. Mands & Sauer GbR (Germany)
- 9:40 – 10:00 INNO-U-46 - Efficient cooling energy supply with Aquifer Thermal Energy Storages  
Stefan Kranz, Stephanie Frick  
GFZ Helmholtz Centre Potsdam (Germany)
- 10:00 – 10:20 INNO-U-62 - Cooling and heating system of Shinshu University building by enhanced Aquifer Thermal Energy Storage  
Katsuyuki Fujinawa, Akira Tomigashi  
Shinshu University (Japan)
- 10:20 – 10:40 INNO-U-26 - Geothermal Monitoring of eight non-residential buildings with heat and cold production – experiences, results and optimisation  
Dirk Bohne, Matthias Wohlfahrt, Gunnar Harhausen, Burkhard Sanner, Erich Mands, Marc Sauer, Edgar Grundmann  
Leibniz Universität Hannover (Germany) and UbeG Dr. Mands & Sauer GbR (Germany)
- 10:40 – 11:00 INNO-U-31 - Comparison of a low energy house performance in continental and subtropical climate by use of a compact GSHP with desuperheater simulation for space heating, space cooling and domestic hot water  
David Blanco, Katsunori Nagano, Masahiro Morimoto  
Hokkaido University (Japan)

Session 6B – Industrial storage applications

*Chairs: Luisa F. Cabeza – Universitat de Lleida (Spain) and Tadahiko Ibamoto – Tokio Denki University (Japan)*

- 9:00 – 9:20 Annex 25 - Surplus Heat Management using Advanced TES for CO<sub>2</sub> mitigation  
Luisa F. Cabeza, OA  
Univesitat de Lleida (Spain)
- 9:20 – 9:40 INNO-SP-69 - Thermal behaviour of d-mannitol when used as PCM: comparison of results obtained by DSC and in a pilot plant storage tank  
C. Barreneche, A. Gil, P. Moreno, C. Solé, Luisa F. Cabeza

- Universitat de Lleida (Spain) and Universitat de Barcelona (Spain)
- 9:40 – 10:00 INNO-ST-11 - Thermochemical energy storage for low temperature applications: materials and first studies in a gas-solid reactor  
Margarethe Molenda, Martin Bouché, Marc Linder, Matthias Blug, Jens Busse, Antje Wörner  
DLR (Germany) and Evonik Industries AG (Germany)
- 10:00 – 10:20 INNO-SP-96 - Latent heat transportation system over long distance for supplying cold heat  
Takahiro Nomura, Masakatsu Tsubota, Teppei Oya, Noriyuki Okinaka, Tomohiro Akiyama  
Hokkaido University (Japan)
- 10:20 – 10:40 INNO-U-21 - High-temperature aquifer thermal energy storage (HT-ATES): sustainable and multi-usable  
Benno Drijver, Martijn van Aarssen, Bas de Zwart  
IF Technology (The Netherlands)
- 10:40 – 11:00 INNO-SP-47 - Thermal response of a low temperature storage unit following power failure  
Eduard Oró, Laia Miró, Mohammed M. Farid, Luisa F. Cabeza  
Universitat de Lleida (Spain) and The University of Auckland (New Zealand)

Session 6C – Other applications of PCM

*Chairs: Philip Griffiths – University of Ulster (UK) and Frank Bruno – University of South Australia (Australia)*

- 9:00 – 9:20 INNO-S-05 - Assessment of the flexibility of a combined heat and power system with thermal energy storage at residential level  
Thomas Nuytten, Kristof Paredis, Bert Claessens, Daan Six, Johan Van Bael  
VITO (Belgium)
- 9:20 – 9:40 INNO-S-21 - Technico-economic modeling of waste heat recovery chain including industrial heat pump systems and thermal energy storage  
Ali Bourig, Jean-Louis Peureux  
EDF (France)
- 9:40 – 10:00 INNO-SP-113 - Enhancement of the stratification in packed bed thermal energy storage systems  
E. Oró, A. Castell, J. Chiu, V. Martin, L.F. Cabeza  
Universitat de Lleida (Spain) and KTH (Sweden)
- 10:00 – 10:20 INNO-SP-01 - Performance of an accumulating solar cooker of the concentrating type  
Antonio Lecuona, Rubén Ventas, Ciro Vereda, José-I. Nogueira, Javier J. Martín  
Universidad Carlos III de Madrid (Spain)
- 10:20 – 10:40 INNO-SP-68 - The use of phase change materials in fish farms. A general analysis  
Gabriel Zsembinski, Cristian Solé, Albert Castell, Gabriel Pérez and Luisa F. Cabeza  
Universitat de Lleida (Spain)

10:40 – 11:00 INNO-SP-98 - Transient thermal control of electronics using phase change materials  
SashwatMahapatra, M. Cheralathan, R. Velraj  
SRM University (India) and Anna University (India)

11:00 – 11:30 Coffee break

11:30 – 13:00 Session 7: parallel session

Session 7A – Storage in CSP/CAES

*Chairs: A. Inés Fernández– Universitat de Barcelona(Barcelona) and Doerte Laing – DLR (Germany)*

- 11:30 – 11:50 INNO-SS-16 - Material aspects of solar salt for sensible heat storage  
Thomas Bauer, Nicole Pfleger, Nils Breidenbach, Markus Eck, Doerte Laing, Stefanie Kaesche  
DLR (Germany) and Materials Testing Institute University of Stuttgart (MPA) (Germany)
- 11:50 – 12:10 INNO-SS-09 - Packed-bed heat storage: A thermo-mechanical model and validating experiments  
Volker Dreißigacker, Stefan Zunft, Hans Müller-Steinhagen  
DLR (Germany) and Dresden University of Technology (Germany)
- 12:10 – 12:30 INNO-SS-18 - High Temperature TESM thermomechanical characterization and assessment of their resistance to thermal shock  
Antoine Meffre, Nicolas Calvet, Xavier Py, Régis Olives, Romuald Faure, Nicolas Tessier-Doyen, Marc Huger  
Université de Perpignan (France) and GEMH CEC (France)
- 12:30 – 12:50 INNO-SS-26 - LTA-CAESA Low-temperature approach to Adiabatic Compressed Air Energy Storage  
Marcus Budt, Daniel Wolf, H.-J. Prümper  
Fraunhofer UMSICHT (Germany) and Turbomaschinen Berlin (Germany)

Session 7B – UTES in buildings

*Chairs: Aart Snijders – IF Technology (The Netherlands) and Lynn Stiles - Richard Stockton College of New Jersey (USA)*

- 11:30 – 11:50 INNO-U-22 - Operational management of large scale UTES systems in hospitals  
Marcel Hendriks, Herman Velvis  
IFTec GeoEnergía S.L. (Spain) and IF Technology BV (The Netherlands)
- 11:50 – 12:10 INNO-U-59 - Large scale exploitation of Ground Source Energy for heating and cooling: resource constraints and management options in urban aquifers  
Alan Herbert, Simon Arthur and Grace Chillingworth  
ESI Ltd (UK)
- 12:10 – 12:30 INNO-U-39 - A quasi-two-dimensional standing column well model for ground source heat pump systems  
Annamalai Ramesh, Jeffrey D. Spittler

Oklahoma State University (USA)

12:30 – 12:50 INNO-U-38 - Seasonal thermal energy storage in an abandoned strip mine

Richard Flarend, Tim Dolney  
Penn State Altoona (USA)

Session 7C – Heat transfer

*Chairs: Gennady Ziskind – Ben Gurion University (Israel) and Mohammed M. Farid – The University of Auckland (New Zealand)*

11:30 – 11:50 INNO-SP-43 - Stochastic optimization of a multi-layer wall design with phase change materials

Lubomir Klimes, Pavel Charvat, Josef Stetina, Milan Ostry  
Brno University of Technology (Czech Republic)

11:50 – 12:10 INNO-SS-20 - Effects during loading of hot water storages with a high aspect ratio

Rolf Lohse, Thorsten Urbaneck, Carola Brämer, Bernd Platzer  
Institute for Applied Building Research (Germany) and Chemnitz University of Technology (Germany)

12:10 – 12:30 INNO-SP-09 - Experimental validation of a CFD model on a vertical finned tube heat exchanger phase change thermal energy storage system

N.H. Steven Tay, Frank Bruno, Martin Belusko, Albert Castell, Luisa F. Cabeza  
University of South Australia (Australia) and Universitat de Lleida (Spain)

12:30 – 12:50 INNO-SP-10 - Experimental investigation of dynamic melting in a tube-in-tank phase change thermal energy storage system

N.H. Steven Tay, Martin Belusko, Frank Bruno  
University of South Australia (Australia)

13:00 – 13:30 Closing ceremony

13:30 – 15:30 Lunch