IEA SHC Task 55 - Integration of Large SHC Systems into District Heating and Cooling (DHC) Networks (II)

The aim of the project is - through exchange of international knowledge - to develop and promote solar district heating plants. Denmark is in front in this field and the project gives good opportunities for promotion of Danish know how and technology. The overall objective is to increase the use of solar thermal energy throughout the world.

Project description

The project activities and expected outcomes are:
- System description and design of low cost and high performance large-sized SDH and SDC systems as well as the design and evaluation of large scale seasonal storages and hybrid technologies.
- Further, technical analyses of findings will be presented within a report for city district planners, dealing with the integration of solar thermal and seasonal storages. Additionally, a specific report for planners will focus on system requirements for SDH and SDC, modular conception and construction as well as the minimization of piping and losses.
- Established business and financing models: Objectives here are reference calculation models of SDH and SDC as well as economical requirement definitions for new systems and markets.
- Guidelines to secure low operation and maintenance efforts for very large systems including automated operational surveillance.
- Advanced control systems for large-sized solar and hybrid systems.
- A comparison of measured collector performances in the field, and singular collector tests in the laboratory. Results will be the basis for a validated measurement method of solar collector fields and the validation of performance guarantee procedures.
- Data for the optimization of very large collector fields’ performances based on adjusted hydraulics and minimized system losses.
- Promotion and technology spread of large systems in new markets through the continuation of the existing database from the IEA SHC Task 45, 48 and 49.
- Country reports including case studies and feasibilities.

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Energy and Utilities

Period: 01/01/2019 → 31/12/2020
Number of participants: 7

Large solar heating plants, District heating and cooling, System integration, Solar collector field, Large heat storages, Performance analysis, Business models, System controls
IEA Task 55

Project participant:
- Fan, Jianhua (Intern)
- Furbo, Simon (Intern)
- Perers, Bengt (Intern)
- Kong, Weiqiang (Intern)
- Dragsted, Janne (Intern)
- Andersen, Elsa (Intern)
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Financing sources
Source: Public research council
Name of research programme: EUDP
Project

IEA PVPS Task 16 Solar resource for high penetration
The purpose of this project is to develop better recommendations for understanding the solar energy resource in energy systems with high degree of renewable energy penetration. This is done as an international collaboration within the IEA PVPS programme.

Project description

With increasingly high penetration of PV, concentrating solar power (CSP), and solar heating plants into our energy and heating systems around the world, increased knowledge on the solar radiation potential become ever more important.

During meetings in 2015 and 2016 a detailed work plan was made for an upcoming task in the framework of the International Energy Agency Photovoltaic Power Systems Programme (IEA PVPS) to address the issues outlined above. The task entitled: “Solar resource for high penetration and large scale applications” was approved by the IEA PVPS Executive Committee in November 2016 as IEA PVPS Task 16. The task runs for three years from 2017 to 2020.

DTU will continue the work done in the IEA SHC Task 46 (2011-2016), where the focus was on the directional and temporal variability of the solar resource. Now the focus will be on how this affects the energy production in the rows of large scale solar collector and PV fields.

Department of Civil Engineering

Energy and Utilities
Period: 01/01/2018 → 31/12/2020
Number of participants: 6

Solar resource, high penetration renewable energy systems, Solar heating plants, PV, CSP Concentrating solar power

Acronym: IEA Task 16

Project participant:
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Financing sources
Source: Public research council
Name of research programme: EUDP
Project

Highly Efficient and Simplified Thermodynamic Cycle with Isolated Heating and Cooling – Cost Optimized

The project will develop a new combined heating/cooling system that efficiently and continuously produces hot and/or cold water with up to 30 % larger efficiency that conventional heat pump and cooling systems and generates a possibility of accumulating heat and/or cooling.

Depending on the operating conditions, an efficiency improvement of 10-50 % is shown in a completed EUDP project by employing the tank system for heating. An additional increase of 15 % is expected to be achieved by simultaneous use of the tank system for cooling also. A further advantage of the concept is the possibility of accumulation hot and cold water.
A major performance improvement can be achieved. However, it is also shown that costs of the technology provide some challenges. By studying the framework of the technology, both the temperature operating range and the economy when using this system could be increased significantly.

Thus, the focus of the ISECOP project is the development of components and the control system to achieve optimal interaction between the heat pump, the heat storage and the heat consumption. Indeed, it will be possible to construct certain essential components, e.g. the compressor, in a simpler way (e.g. without capacity control) by using the ISECOP concept.

Department of Civil Engineering
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METRO THERM A/S
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CHR Møller
Egå smedegård og maskinfabrik
ARLA FOODS AMBA
Period: 01/01/2018 → 31/12/2020
Number of participants: 4
Heating and cooling, Heat pumps, Heat storages, CFD calculations, Trnsys simulations
Acronym: ISECOP
Project participant:
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Andersen, Elsa (Intern)
Kong, Weiqiang (Intern)
Financing sources
Source: Public research council
Name of research programme: EUDP
Web address: https://ens.dk/
Amount: 5,950,000.00 Danish Kroner
Year of approval: 2017

European Committee for Standardization (CEN) Project ECOTEST
This project is funded by European Committee for Standardization (CEN) under the following EU regulations:
Supplementing Directive 2010/30/EU of the European Parliament and of the Council with regards to the energy labelling of space heaters etc.
Supplementing Directive 2010/30/EU of the European Parliament of the Council with regard to the energy labelling of water heaters etc.
The project is focused on evaluation of the standards used and measurement reproducibility of EU laboratories for the application of Ecodesign requirements and labelling of heating and hot water production appliances.
There are eight work packages:
• WP 1 Emissions - CEN/TC 238 (including sound power level)
• WP2 Uncertainty calculation method of the emissions, efficiency and all other parameters and common protocols for the INTER-COMPARISON + uncertainties
• WP3 Ecodesign testing of sanitary hot water work package with CEN/TC 109
• WP4 Work package with CEN/CENELEC JWGF CGA (on mCHP)
• WP5 Work package with CEN/TC 299 (on gas heat pump)
• WP6 Work package with CEN/TC 57 (fuel oil boilers)
• WP7 Work package with CEN/TC 113 (electrical heat pumps)
• WP8 Work package with CEN/TC 312 (solar heaters)
Overall objectives:
1: EVALUATION OF EU LABORATORIES: “to provide for each parameter measured for the application of (EU) No 811/12/13/14 2013 and each appliance a value of the inter-laboratory reproducibility obtained with the test procedures of the corresponding standard developed”
2: EVALUATION OF EU STANDARDS: “to propose improvements of the procedures from the standards”
3: EVALUATION OF EU market surveillance TOLERANCES: “to propose for all parameters and appliances tested a value of a reasonable tolerance that shall be used for the market surveillance”.

Department of Civil Engineering
Energy and Utilities
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APPLUS Laboratories
IMQ
KIWA Italy
Technological Centre for the Metal Working Industry
Institute for Solar Technologies SPF
Institute of Thermodynamics and Thermal Engineering ITW
Refrigeration and Heat Pump Technology, Danish Technological Institute
AIT Austrian Institute of Technology GmbH
Wärme-pumpen-Testzentrum Buchs
Fraunhofer Institute for Solar Energy Systems ISE
Politecnico di Milano
TÜV Rheinland Energy GmbH
TÜV SÜD Industrie Service GmbH

Period: 02/10/2017 → 31/12/2018
Number of participants: 5
European Committee for Standardization (CEN), EcoDesign, EU Reference Laboratory, Space heating, Water heaters
Acronym: ECOTEST
Project participant:
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Financing sources
Source: Public research council
Name of research programme: European Committee for Standardization (CEN)

Follow up on large scale storage in Denmark, Gram
In the project the performance of the pit heat storage in Gram will be followed. The monitoring results and experience for operation of storage until 2018 will be analyzed and published.
Project description
In 2014-2015 two new large heat storage have been implemented in Denmark in Vojns and Gram. The two storages have similar design. Before that, 3 large storages were implemented in Braedstrup, Marstal and Dronninglund from 2011-2013.
Monitoring results from these 3 storages are analyzes in the project "Opfølgningsprogram for store varmelagre i Danmark" (EUDP 14-I, j.nr. 64014-0121) lasting indtil 30.06.2018.

Since the design of the pit heat storages Vojns and Gram differs from the design of the pit heat storage in Marstal and Dronninglund it is important to establish similar monitoring and analysis at least one of those storages. The performance of the pit heat storage in Gram will therefore in this project be monitored in a similar way as the performance of the storage in "Opfølgningsprogram for store varmelagre i Danmark". Especially for Gram will monitoring of the performance of new and cheaper lit construction.

SDH (Solar District Heating) Conference will be arranged in Denmark in 2016. This will be an excellent possibility to promote Danish solar solutions. Therefore support to SDH conference is included in the dissemination part of this project. 150 stakeholders from more than 20 countries are expected to participate. The intention is to arrange the conference in Billund and use Gram as the main stop at the technical tour.

Department of Civil Engineering

Energy and Utilities

PlanEnergi

Solites

Rambøll Danmark A/S

Kristensen Consulting

Period: 01/01/2016 → 31/12/2018

Number of participants: 5

Large scale heat storages, Long term measurement, Performance analysis

Project participant:

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Financing sources

Source: Public research council

Name of research programme: EUDP

Project

Follow up on large scale heat storages in Denmark

The purpose of the project is to follow the performance of two pit heat storages and one borehole storage implemented 2011-2013 in Denmark. In the project monitoring results and experiences from operation of the storages until 2018 will be analyzed and published. Project description Long term heat storages are important in the future energy system in Denmark. This can a.o. be seen in two reports required by the Danish Energy Agency during 2013: "Status and Recommendations for RD&D on Energy Storage Technologies in a Danish Context" and "Udredning vedrørende varmelagringsteknologier og store varmepumper til brug i fjernvarmesystemet" (analyses of heat storage technologies and large heat pumps for district heating) From 2011 to 2013 three large long term storages has been implemented in Brædstrup (borehole storage), Marstal (pit heat storage) and Dronninglund (pit heat storage) connected to large scale solar heat plants and heat pumps for district heating. The monitoring programs for these storages end when the projects are finalized. But long term heat storages change performance the first years because the surrounding soil is heated up. Therefore there is a need to continue the monitoring programmes. This application has as purpose to secure a continuation of the monitoring programmes and to analyse and make the results public. Beside the application includes tests and measures that can support future storage projects. The main activity in the project is a real time publication of monitoring results at Solvarmedatadb and yearly analysis of performance of the storages. Pit heat storages has beside that three problems, that the application shall solve for existing and future owners: Corrosion in in-and outlet pipes. The problem has showed up in Marstal. Effect of actions taken and future development has to be carefully supervised. Life time for the liner in Dronninglund. The liner has until now not been tested for long term durability, but the supplier has guaranteed 20 years life time by 90° C. This must be tested, because such a liner can extend the market for pit heat storages to storing heat from incineration plants, CHP and industrial processes. The durability of the insulation material in the floating lid constructions in Marstal and Dronninglund. Also here a test will show if the market can be extended. Long term heat storages can make the future district heating systems flexible, so that they can integrate fluctuating power production. In Denmark the future market is estimated to 5 mio. m³ water storages. Outside Denmark similar systems are developed. For instance a resent german study has showed a marked of 15 mio. m³ water storages and China has showed beginning interest for the technology.

Department of Civil Engineering
Solar Heat Integration NEwork
Large solar heating systems are decisive to cover a major part of European low temperature heat demand by solar energy and therewith to meet European policy aims. However, today only a negligible share of solar heating systems installed in Europe are large units due to manifold technical and socio-economic obstacles. The challenge of solar thermal technology and the overall objective of the proposed initial training network is to supply heat in larger solar heating systems for applications like industrial processes, to feed-in into district heating networks, or sorption drying and cooling. The obstacles will be approached with an innovative inter-disciplinary consortium, including 13 PhD students. Six universities and five private sector participants from six different European countries will provide research and training in cooperation with four associated partners from the private sector. The SHINE project will cover detailed new experimental material-, component- and system studies, system integration analysis and numerical optimization, as well as chemical investigations on storage materials. A close cooperation with industry will ensure fast exploitation of the results. With the SHINE network, the critical mass of PhD students will be gathered on a European level to offer a specialized and structured PhD course programme of large solar heating systems. After the end of SHINE, the key course modules will be offered as a standard curriculum of European PhD education in solar thermal in the long term. The SHINE students will face excellent job perspectives, they will have a sound background in energy economics and complementary skills, regarded as important skills to reach a break through of solar thermal technology. The project consists of eight work packages:
WP1: District Heating
WP2: Industrial Process Heat
WP 3: Advanced Storage Concepts: Open sorption processes
WP4: PhD Courses
WP5: Workshops
WP6: Dissemination
WP7: Cooperations
WP8: Management

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Energy and Utilities

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SAMPOL INGENIERIA Y OBRAS S.A.

STEINBEIS GMBH & CO. KG FUER TECHNOLOGIETRANSFER
Period: 01/10/2013 → 30/04/2018
Number of participants: 3
solar heating plants, District Heating, Industrial processes, New storage concept, PhD Training
Acronym: SHINE
Number of related Ph.D. students: 13
Project participant:
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Bava, Federico (Intern)

Financing sources
Source: Public research council
Name of research programme: Marie Curie Initial Training Networks
Web address: https://cordis.europa.eu/project/rcn/109061_en.html
Amount: 3,461,561.30 Euro
Year of approval: 2013
Project