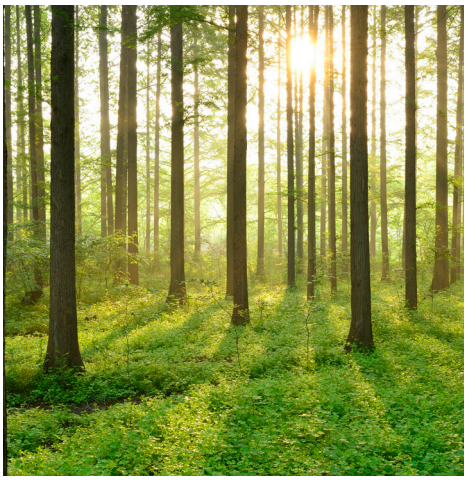
INTERNATIONAL PLATFORM FOR THERMAL ENERGY SYSTEMS RESEARCH

REPORT 2020:676



FUTUREHEAT

Energiforsk

International Platform for Thermal Energy Systems Research

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Preface

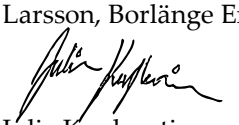
Extensive research in the field of district heating is conducted internationally. Effective access to new knowledge relevant to the Swedish case is valuable for the industry. In the project *International Platform for Thermal Energy Systems Research*, a platform for knowledge exchange and acquisition has been established. The project has revolved around the three themes: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments. The intention of the project is to contribute to the development of a continued strong and competitive district heating and cogeneration industry.

The project was led and conducted by Therese Nehler together with Louise Ödlund and Marie Magnefjord at Linköping University.

A reference group consisting of Anders Moritz, Tekniska Verken i Linköping (chair); Fabian Levihn, Stockholm Exergi; Mattias Gustavsson, Gävle Energi; Peter Ottosson, Kraftringen och Tommy Persson, E.ON Värme Sverige has followed the project and assured the quality and the usability of the results.

The project is part of the FutureHeat program, whose long-term goal is to contribute to the vision of a sustainable heating system with successful companies that utilize new technological opportunities and where the investments made in district heating and cooling are utilized to the best of their ability. This project is part of the second phase of the program. The FutureHeat program is led by a steering committee consisting of Jonas Cognell, Göteborg Energi (chair); Anders Moritz, Tekniska verken i Linköping; Anna Hinderson, Vattenfall AB; Charlotte Tengborg, E.ON Värme Sverige; Fabian Levihn, Stockholm Exergi; Holger Feurstein, Kraftringen; Joacim Cederwall, Jönköping Energi; Johan Brossberg, Borlänge Energi; Leif Bodinson, Söderenergi; Lena Olsson Ingvarson, Mölndal Energi; Magnus Ohlsson, Öresundskraft; Niklas Lindmark, Gävle Energi; Per Örvind, Eskilstuna Strängnäs Energi & Miljö; Petra Nilsson, Växjö Energi; Staffan Stymne, Norrenergi; Stefan Hjärtstam, Borås Energi och Miljö; Svante Carlsson, Skellefteå Kraft; Ulf Lindquist, Jämtkraft and Julia Kuylenstierna (co-opt), Energiforsk.

Deputies have consisted of Ann Britt Larssson, Tekniska verken i Linköping; Lars Larsson, Borlänge Energi och Peter Rosenkvist, Gävle Energi.



Julia Kuylenstierna, program manager FutureHeat

The results and conclusions in this report are presented from a project within a research program run by Energiforsk. The authors are responsible for the content

Förord

Det sker omfattande forskningsinsatser inom fjärrvärmeområdet och det är värdefullt för branschen att på ett effektivt sätt ta del av ny kunskap som är relevant för svenska energibolag. Inom projektet Internationell fjärrvärmeforskning har en plattform för kunskapsutbyte och omvärldsbevakning skapats med fokus på områdena Kundlösningar och affärsmodeller, Efterfrågeflexibilitet och digitalisering samt Policy och styrmedel. Projektets avsikt är att bidra till utvecklingen av en fortsatt stark och konkurrenskraftig fjärrvärme- och kraftvärmebransch.

Projektet har letts och genomförts av Therese Nehler tillsammans med Louise Ödlund och Marie Magnefjord från Linköpings universitet. En referensgrupp bestående av Anders Moritz, Tekniska Verken i Linköping (sammanhållande); Fabian Levihn, Stockholm Exergi; Mattias Gustavsson, Gävle Energi; Peter Ottosson, Kraftringen och Tommy Persson, E.ON Värme Sverige har följt och kvalitetssäkrat projektet.

Projektet ingår i programmet Futureheat vars långsiktiga mål är att bidra till visionen om ett hållbart uppvärmningssystem med framgångsrika företag som utnyttjar nya tekniska möjligheter och där de samhällsinvesteringar som gjorts i fjärrvärme- och fjärrkyla tas till vara på bästa sätt. Detta projekt ingår i programmets andra etapp. Programmet leds av en styrgrupp bestående av Jonas Cognell, Göteborg Energi (ordförande); Anders Moritz, Tekniska verken i Linköping; Anna Hinderson, Vattenfall AB; Charlotte Tengborg, E.ON Värme Sverige; Fabian Levihn, Stockholm Exergi; Holger Feurstein, Kraftringen; Joacim Cederwall, Jönköping Energi; Johan Brossberg, Borlänge Energi; Leif Bodinson, Söderenergi; Lena Olsson Ingvarson, Mölndal Energi; Magnus Ohlsson, Öresundskraft; Niklas Lindmark, Gävle Energi; Per Örvind, Eskilstuna Strängnäs Energi & Miljö; Petra Nilsson, Växjö Energi; Staffan Stymne, Norrenergi; Stefan Hjärtstam, Borås Energi och Miljö; Svante Carlsson, Skellefteå Kraft; Ulf Lindquist, Jämtkraft och Julia Kuylenstierna (adjungerande), Energiforsk.

Suppleanter utgörs av Ann Britt Larssson, Tekniska verken i Linköping; Lars Larsson, Borlänge Energi och Peter Rosenkvist, Gävle Energi.

Här redovisas resultat och slutsatser från ett projekt inom ett forskningsprogram som drivs av Energiforsk. Det är rapportförfattaren/-författarna som ansvarar för innehållet.

Sammanfattning

Projektet Internationell fjärrvärmeforskning har utvecklat och driftsatt en kunskapsplattform kring internationell forskning om termiska energisystem såsom fjärrvärme och fjärrkyla. Som grund för arbetet med kunskapsplattformen har projektet ordnat workshops inom projektets fokusområden: Kundlösningar och affärsmodeller, Efterfrågeflexibilitet och digitalisering samt Policy och styrmedel. Inom ramen för dessa områden har projektet Internationell fjärrvärmeforskning även förberett för en internationell konferens vars innehåll har planerats utifrån de resultat som framkommit i projektet.

Med avsikt att bidra till utvecklingen av en fortsatt stark och konkurrenskraftig fjärrvärme- och kraftvärmebransch har detta projekt utvecklat och driftsatt en kunskapsplattform för kunskapsutbyte och omvärldsbevakning. Syftet med projektet har varit att samla internationell forskning om termiska energisystem såsom fjärrvärme och fjärrkyla via olika metoder för informationssökning och omvärldsbevakning. Arbetet med att samla och analysera forskning och kunskap inom området har utgått från beskrivna utmaningar inom den svenska fjärrvärmebranschen, vilket även kopplar till de tre områden kring vilka projektet speciellt har koncentrerat arbetet: Kundlösningar och affärsmodeller, Efterfrågeflexibilitet och digitalisering samt Policy och styrmedel. Som grund för en djupare förståelse av dessa områden och för att få insikt i de erfarenheter och möjligheter branschen ser inom dessa områden, anordnades workshops i form av frukostseminarier under hösten 2019 inom respektive fokusområde. Baserat på resultat av projektets arbete samt vad som framkom under diskussioner på genomförda workshops har projektet som ytterligare delmål förberett ett program för en session på en internationell fjärrvärmekonferens som planeras att genomföras i november 2020.

Summary

The project International platform for thermal energy systems research has developed and launched a knowledge platform aiming at monitoring international research on thermal energy systems such as systems for district heating and district cooling. As a basis for the development of the knowledge platform, the project has organized workshops within the project's focus areas: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments. Finally, the project International platform for thermal energy systems, has prepared for an international conference in respect to the focus areas of the project. The content and the program of the conference has been planned based on the results that have emerged from the project.

With the intention of contributing to the development of a sustained competitive sector of district heating and combined heat and power, this project has developed and launched a knowledge platform for exchange of knowledge and monitoring of related research. The aim of the project has been to monitor the international research on thermal energy systems such as district heating and district cooling applying various methods for searching, retrieving and analyzing information. The work of searching, collecting and analyzing research and knowledge in the area of thermal energy systems has been based on the described future challenges in the Swedish district heating sector, which also links to the three focus areas on which the project has concentrated the work: Customer solutions and business models, Flexible response to demand and digitization, and Policy instrument. As a basis for a deeper understanding of these focus areas and to gain insight into the experiences and opportunities the district heating sector sees in these areas, workshops were organized in the form of breakfast seminars during the fall of 2019 for each focus area respectively. Based on the results of this project's work and what emerged during discussions at completed workshops, the project, as an additional delivery, has prepared a program for a session at an international district heating conference to be conducted in November 2020.

List of content

1 Background

This report summarizes the work with the project International platform for thermal energy systems research. The deliveries of this project include developing and commissioning a knowledge platform for monitoring international research on thermal energy systems such as district heating and district cooling, arranging three workshops and preparing a program for an international district heating conference. The work within the project has focused on three main areas: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments. The development and construction of the platform will be described in this report together with the main results of the workshops and an overview on how the content of the conference has been planned. In addition, the purpose of the report is to provide a basis for a continued operation and further development of the knowledge platform.

Future energy systems present new conditions. The energy sector including thermal energy systems will therefore face challenges and an adaption to these conditions is required, both in a Swedish and international context.

The long-term goal of the Futureheat research program is to contribute to a sustainable heating system by creating new knowledge in this area for a continued transformation of the energy system. This project, in its approach to monitor research in the area of thermal energy systems, has based the work on the challenges described by the research initiative within Futureheat (Energiforsk, 2020). Examples of future challenges regarding Swedish heating systems described in the program intentions for Futureheat are for example, presence of old district heating systems that will require major future investments (Energiforsk, 2020). Moreover, the number of competing alternatives to district heating is increasing due to low electricity prices, and energy efficiency measures lead to a reduced heat demand (Energiforsk, 2020). At the same time, increased district heating investments are taking place in other countries, which may increase the competition for waste and biomass globally (Energiforsk, 2020). The importance of efficient use of existing systems and the development of new business models, for example through the opportunities provided by new technology solutions, are therefore stressed in the program description for Futureheat. The Swedish systems for district heating and district cooling need to be adapted to present as well as future challenges. National and international collaboration is therefore of significant importance and a prerequisite for the continued competitive district heating and district cooling sector in Sweden.

In light of this, the purpose of this project was to construct and commission a platform for knowledge exchange and research monitoring intending to contribute to the development of a continued strong and competitive district heating and CHP sector in Sweden. The stakeholders for this project and for the utilization of the platform is primarily energy suppliers, energy sector organizations, authorities,

researchers, and other existing networks for research in the field of thermal energy systems. All work within the project, for instance information retrieval and external monitoring, has been carried out based on the above-described challenges in the district heating sector. These challenges further relate to the three areas around which the project has concentrated its work: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments. As a basis to deepen the understanding of these areas and to gain insight into the experiences and opportunities which the industry sees in these areas, workshops for each focus area were organized in the form of breakfast seminars during the fall of 2019. Based on the results of the project's work and what emerged during discussions during the workshops, one additional delivery of this project was to prepare a program for a session at an international district heating conference planned to be conducted in November 2020.

2 Platform

This chapter describes the construction of the platform and the methods applied for searching and monitoring research and other type of information and news for publication on the platform.

The Swedish systems for district heating and district cooling need to be adapted to prevailing conditions but also to future challenges. National and international collaboration is therefore of significant importance and a prerequisite for a continued competitive district heating sector in Sweden. Collaboration is also an important means in order to adapting and developing Swedish thermal energy systems such as district heating and district cooling to future conditions. In light of this, this project has constructed and launched a platform for knowledge exchange and research monitoring intending to contribute to the development of a continued strong and competitive district heating and CHP sector in Sweden. The envisioned target audience and considered users of the platform are for example energy suppliers, energy sector organizations, authorities, researchers, and other existing networks for research in the field of thermal energy systems.

2.1 CONSTRUCTION OF THE PLATFORM

The platform was planned, designed, and built by extending the English version of the project's website on Energiforsk's website: energiforsk.se/en/programme/international-platform-for-thermal-energy-systems-research. The work was carried out jointly between the project members at LiU and Energifork's communication officers. The project members affiliated at LiU produced and analyzed information and composed texts for publication on the platform's website and Energiforsk's communication officers assisted with web editing and publishing the material produced. The technical possibilities available on Energifork's website have guided the overall disposition and the structure and design of the website such as menus, tabs, and the positioning of them. Figure 1 below shows a screenshot of the website's homepage, *International platform for thermal energy systems research*. The Figure further presents an overall picture of the platform's feature and design. This first tab briefly presents the project and the platform.

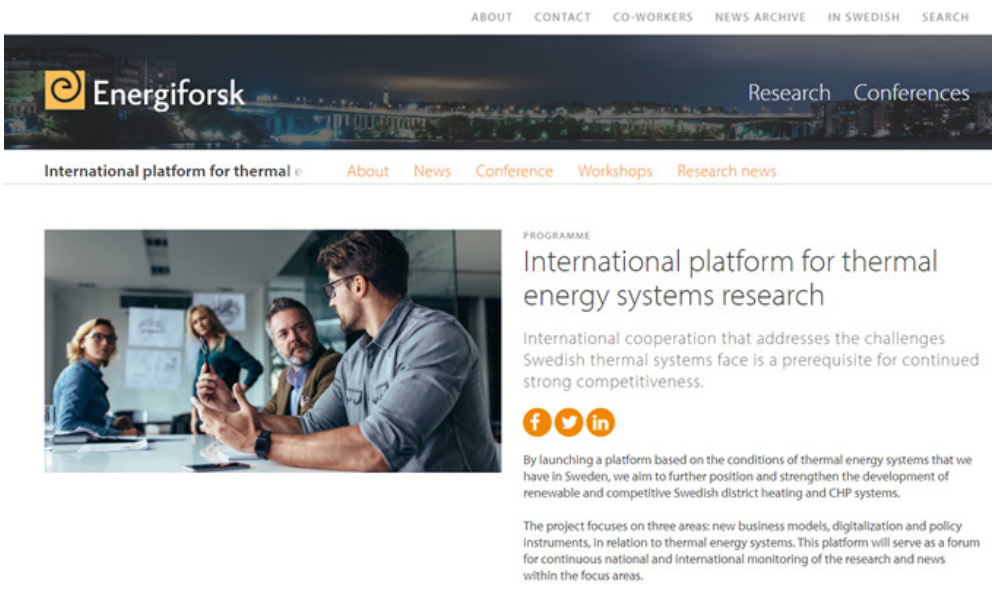


Figure 1. Screenshot of the platform's home page.

The following tab *About* describes the project more in-depth together with a presentation of the project group at Linköping University. The menu tab *About* and its content is visualized in Figure 2 below.

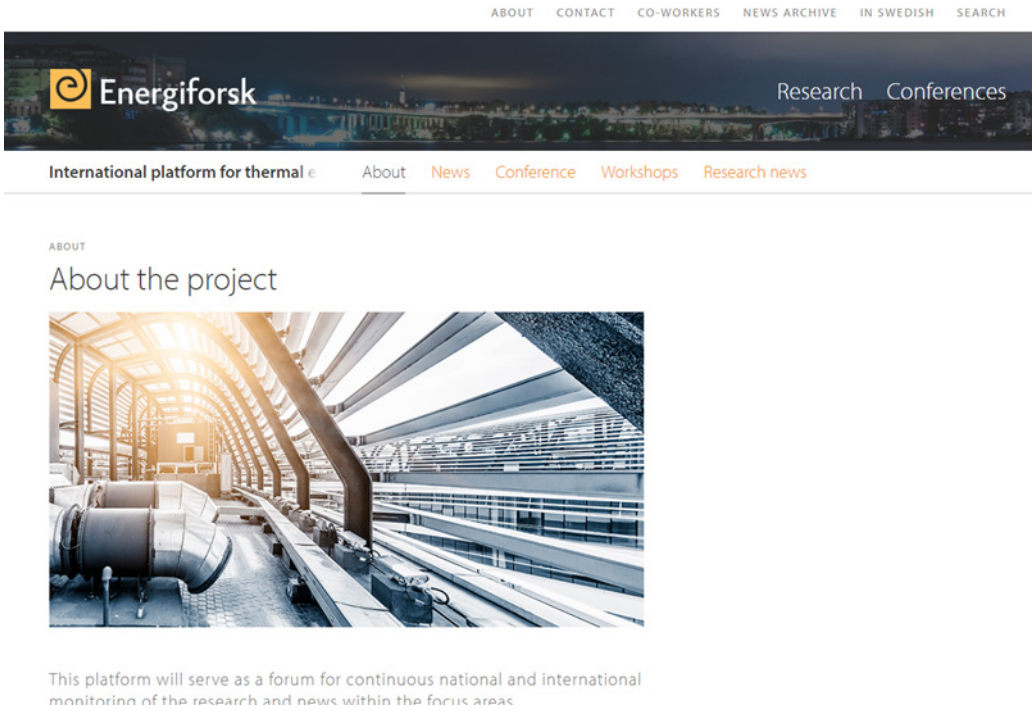


Figure 2. Screenshot of the *About* tab and its content.

In the *News* tab, current news of general character is published which may be of interest to the target groups within the thermal energy system sector. This news may for instance comprise upcoming conferences within the district heating sector. A screenshot of the News tab is shown in Figure 3.

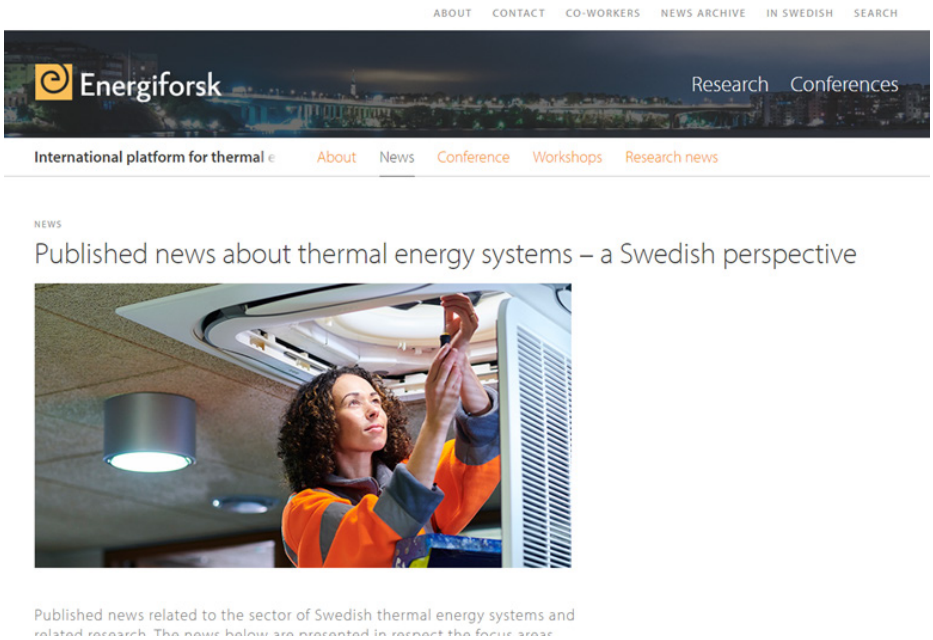


Figure 3. Screenshot of the *News* tab and its content.

One of the deliveries of this project has been to prepare for an international conference regarding district heating for the actors active in the field. The *Conference* tab presents, describes and promotes the upcoming conference. The appearance of this tab can be viewed in Figure 4.

Figure 4. Screenshot of information under the *Conference* tab.

Another delivery of the project was to arrange and carry out three workshops, which concentrated on the project's focus areas. These workshops have provided an important basis for the work on the platform, in particular when analyzing the type of information to be presented on the website. A description of the workshops and a compilation of what was presented and discussed during these occasions can be found under the *Workshop* tab, which can be seen in Figure 5 below.

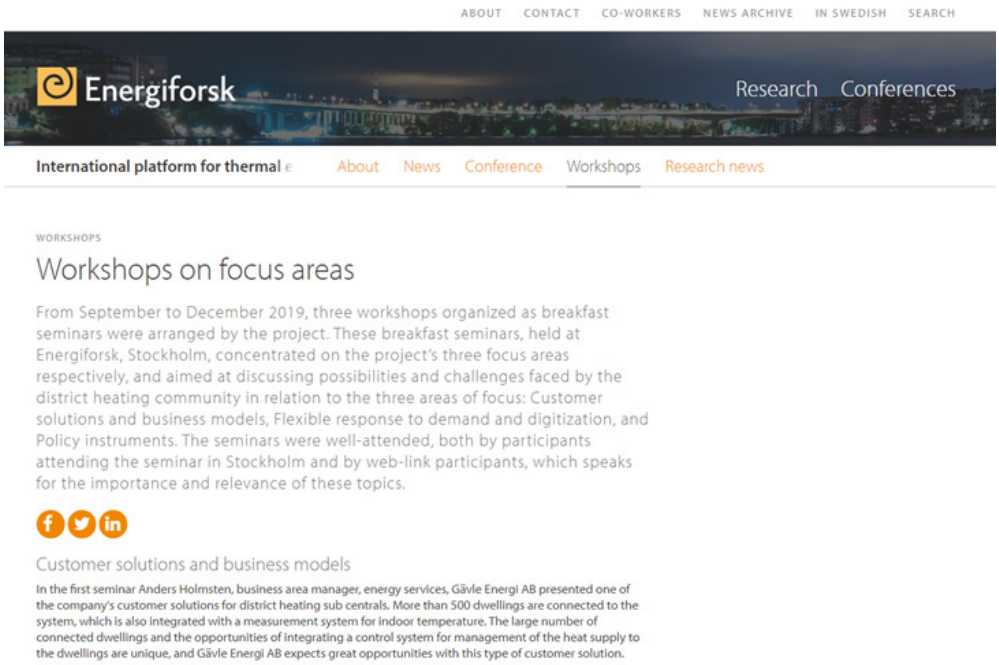


Figure 5. Screenshot of information under the *Workshop* tab.

The results of the scientific monitoring are reported and presented on the platform sorted based on the project's focus areas, see Figure 6.

Figure 6. Screenshot of *Research News* tab.

Next picture, Figure 7, shows how the research publications are presented on the platform with title, author, in which journal or at which conference the articles are published.

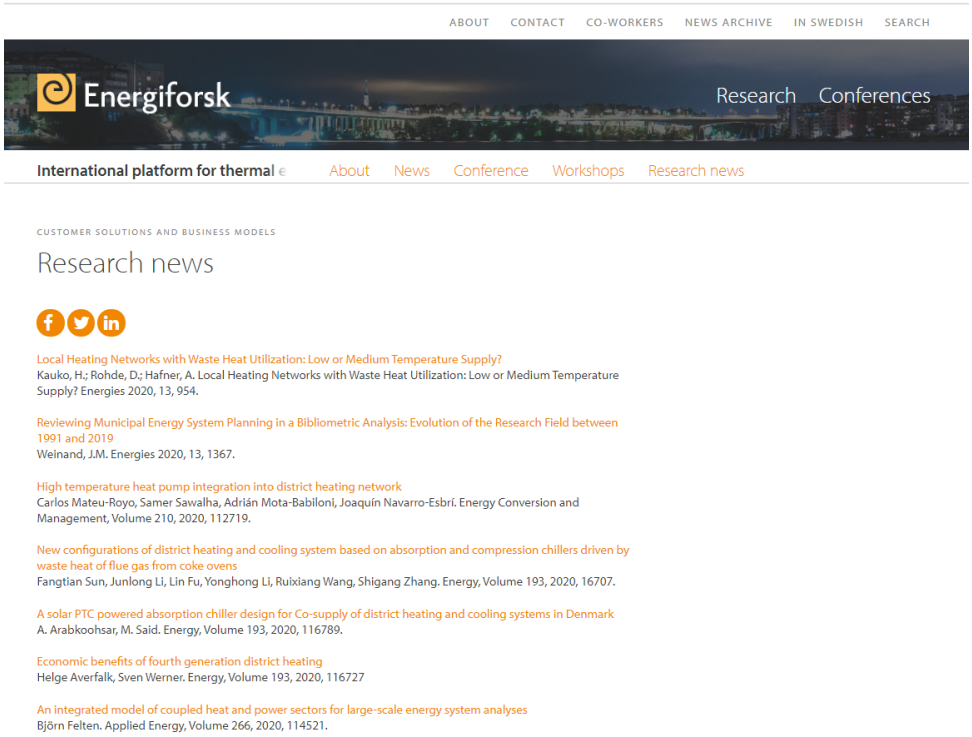


Figure 7. Screenshot of the *Research news* tab.

Behind the publication's title is a link to the publication, which is a technical solution that is supported by the regulations of the scientific journals (Elsevier, 2020). It is, for instance not allowed to publish the articles in full on the platform.

2.2 METHODS FOR MONITORING, SEARCHING AND ANALYSING INFORMATION

2.2.1 Scientific publications

Monitoring and searching for scientific articles published in the field of thermal energy systems were conducted by applying scholarly databases. Via the university library at Linköping University, many scientific databases can be accessed, of which two databases were selected to apply in this project: Web of Science and Scopus. The Web of Science itself includes several databases: Arts & Humanities Citation Index, Science Citation Index, Social Sciences Citation Index and Conference Proceedings Citation Index (LiU, 2020). In addition, Web of Science is part of the Web of Knowledge portal (LiU, 2020). Scopus, which is a multidisciplinary database, is characterized as a database with a wider scope than the Web of Science and collects more than 21,000 journals from over 5,000 publishers, and the subjects that are mainly represented in the database are natural sciences, technology, medicine and social sciences (LiU, 2020).

In order to obtain an overview of the number of scientific articles and expected content of the scientific articles published in the field, searches were made by applying a relatively broad scope. This wide search strategy was also made aiming at minimizing the risk of possibly excluding relevant search hits among the publications. The search strings applied for this broad search contained the keywords: district, heating, and cooling with the condition that search hits obtained should contain one or more of those keywords. Searches were made to look for the keywords in the publications' title, abstract and keywords.

Searches for scientific publications in the databases Scopus and Web of Science have been conducted daily since August 2019. The articles compiled have continuously been manually analyzed within the framework of the project's work. The analysis was based on the relevance of the articles in respect to the objective of this project and, in particular, the relevance in respect to the project's focus areas: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments. The publication's title, abstract and in some cases also the entire publication, has been analyzed and based on the results of this analysis, the articles were divided and sorted in respect to the focus areas stated above.

2.2.2 Other search strategies used provided by the library at Linköping University

In order to identify further search strategies for monitoring and compiling scientific material and other types of relevant information for publication on the platform, the project's work has utilized competence via librarians at the University Library, LiU. Through the tools provided by the library, in addition to

searching the scientific databases, there are also tools for searching material such as reports, dissertations, books, trade journals and other types of trade press. When using these tools for searches, mainly Swedish material is obtained.

2.2.3 Meltwater

Meltwater's tools for external monitoring have been examined as a tool for searching news about research on thermal energy systems. Via Meltwater's services, daily reports for external monitoring of media are offered based on selected search criteria. Searches can be made in both a Swedish and international context and Meltwater's services provide a comprehensive coverage of media in general as well as social media (Meltwater, 2020). The searches via Meltwater were made based on search strings based on selected keywords and similar to the searches made in the scientific databases, these searches were conducted applying a relatively broad scope, and as a result, a large number of search hits. Consequently, more specified searches including limitations searches have been conducted. Search hits were analyzed in respect to the project's focus areas: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments.

2.2.4 Searching on the Swedish universities' and institutes' websites

The work within this project has also covered efforts for monitoring the websites of the Swedish universities and institutes aiming at collecting information about national research on thermal energy systems. Information on the universities' and the institutes' websites about ongoing research and news about this was analyzed with regard to the relevance based on the project's focus areas: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments.

2.2.5 Searching the trade associations websites and journals

The project has further scrutinized the websites of trade associations and related journals within the Swedish sector of thermal energy systems. The information retrieved on the web pages and in the journals were analyzed in respect to the relevance based on the project's focus areas: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments.

2.2.6 Overview of existing research networks in relation to thermal energy systems

In order to create an overview of and to identify international research in the field of thermal energy systems, a review of existing networks such as DHC + and 4DH that cluster research and build networks in this area was made. In order to further deepen the information and the external monitoring of what is occurring in the research field, and especially regarding European research on thermal energy systems, an expert active in this field has been consulted.

2.3 RESULTS OF MONITORING, SEARCHING AND ANALYSING INFORMATION

During the period of August 2019 to March 2020, 530 scientific publications were compiled by daily searches in the scientific databases Scopus and Web of Science. After analyzing the title, abstract and in some cases also reviewing the entire article, 140 publications were considered to be relevant in respect to the project's focus areas: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments. From the perspective, that new solutions may be found related to flexible demand and digitalisation, the results showed that several publications could fit in and be sorted under both Customer solutions and business models and Flexible response to demand and digitization. Other publications, information and news collected by applying other search strategies were analyzed similar to described above and relevant publications, information and news are displayed on the platform via linking.

During the latter part of April 2020, the platform has been in operation. Commissioning has been marketed via Energiforsk. The project has during the project period been promoted via: Energifork's website, the project website at liu.se, and in relation to advertising and promoting the workshops conducted. Furthermore, articles about two of the completed workshops were published on Energiforsk's website. In addition, one of the project participants was interviewed about the project. This article was then published in the journal Energi.

3 Workshops

From September to December 2019, three workshops organized as breakfast seminars were arranged by the project group. These breakfast seminars, held at Energiforsk, Stockholm, concentrated on the project's three focus areas respectively, and aimed at discussing possibilities and challenges faced by the district heating community in relation to the three areas of focus: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments. For those participants who could not attend the seminar on-site, an opportunity to participate via link was offered. Each workshop lasted for two hours. The seminars were well-attended, both by participants attending the seminar in Stockholm and by web-link participants, which speaks for the importance and relevance of these topics. The results of what was presented and discussed at the completed workshops are summarized in the chapters below. This summary is also published on the platform under the Workshops tab.

3.1 WORKSHOP CUSTOMER SOLUTIONS AND BUSINESS MODELS

In the first seminar Anders Holmsten, business area manager, energy services, Gävle Energi AB presented one of the company's customer solutions for district heating sub centrals. More than 500 dwellings are connected to the system, which is also integrated with a measurement system for indoor temperature. The large number of connected dwellings and the opportunities of integrating a control system for management of the heat supply to the dwellings are unique, and Gävle Energi AB expects great opportunities with this type of customer solution.

The seminar addressed that new business models are required in order to adapted to the conditions of a future energy system, for instance business models presenting and selling complete solutions to the customer. Moreover, analyzing possible opportunities in new solutions are as important as analyzing potential risks. However, it is important that new solutions are adapted to local conditions. This also applies in gathering information and new ideas from other countries and contexts; new solutions need to be adapted to Swedish conditions, systems, and culture.

3.2 WORKSHOP FLEXIBLE RESPONSE TO DEMAND AND DIGITIZATION

The second seminar discussed different perspectives on digitalization in relation to the district heating sector and the surrounding energy system. Ebba Löfblad, analyst, Profu, presented the current state on the topic together with how digitalization can contribute in future thermal energy systems. Even though digitization in this area is still relatively unexplored, the discussions brought up digitalization's possible roles in the development of future thermal energy systems. For instance, future energy systems require flexibility and new solutions. In relation to the adaption to such conditions, what are the opportunities by an increased digitalization, and what limitations exist? A few examples from how digitalization has been applied in other countries were presented.

The seminar also addressed the need to adapt energy services to increased digitization and that the role of energy companies may change in a digitalized future. At the same time, digitalization must be integrated in a way that customers understand and considerations on possible risks of increased digitization in the district heating area are important. Security, integrity, and vulnerability are aspects that need to be analyzed and communicated.

3.3 WORKSHOP POLICY INSTRUMENTS

In the third seminar the latest policy updates with implications on the district heating and cooling sector and related areas were presented by Erik Dotzauer, expert on policy instruments, Stockholm Exergi AB. Moreover, the seminar considered the current policy instruments that affect today's district heating sector and the policy instruments' implications on the development of the future thermal system. One challenge discussed was how to design policy instruments that meet new conditions in the future energy system and at the same time fulfill set goals.

In summary, there are some changes underway in the next few years in this area. Some of the issues raised due to these policy updates were addressed in the discussions during the seminar. For instance, aspects on how the new waste incineration tax will affect environmental factors, but also how it will affect the district heating companies, their customers and other related actors. Further news in respect to the policy instruments affecting the Swedish district heating sector is the new trading period for the EU ETS, the system for electricity certificate, the revision of the Energy Efficiency Directive, new building regulations and the certification of buildings. One problem raised was that the new building regulations may lead to increased use of electricity for heating. At the same time, there is a high demand on the electricity grid in several regions in Sweden.

4 Conference

As one of the projects' deliveries, this project has prepared for a conference in the field of thermal energy systems. The preparations and planning of topics to cover during the conference have been based on and concentrated around the three focus areas of the project: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments. The planning of the content has mainly been based on what emerged during the project's work on monitoring, searching and analyzing research related to thermal energy systems. Furthermore, the three workshops and the discussions on these occasions have played an important role in shaping the proposal on the conference content.

Global and national objectives require an adaption to the future energy system. This transition to a future energy system will pose challenges for the district heating sector in Sweden and in other countries, which stresses the importance of exchanging research findings and experiences from case studies and pilot studies conducted in various contexts. To meet and address future challenges, technological innovations and flexible solutions will be of great importance.

Based on the results of this project's work and what emerged during discussions at completed workshops, the project, as an additional delivery, has prepared a program for a special session at an international district heating conference to be conducted in November 2020. Addressing the topics below, this conference aims to offer interesting presentations and fruitful discussions on how future challenges in the district heating sector can be tackled. The content of the conference with the proposed theme *Towards future thermal energy systems* has been based on the following issues:

- How do today's policy instruments support and impact the transition to future district heating systems?
- How can digitalization and flexibility in heating and energy systems accelerate the transition towards future energy and district heating systems?
- How can new business models and customer solutions contribute to future energy and district heating systems? In particular, the new models and solutions that integrate and build on digitalization and flexibility will be addressed.

Based on the questions above, the conference can start by presenting and discussing different scenarios for the future energy system, and related to this picture, what are expected challenges in the district heating industry. Possible future scenarios are presented from a Swedish perspective and can be communicated by someone who is part of leading this development, for example a researcher, government representative or a leader from the industry. Subsequently, the conference content can focus on how we approach the future energy and district heating systems through the current and future policy instruments, such as important instruments for adaptation to future energy and district heating systems, but also how adaptation can be done through solutions based on digitalisation and flexibility in the heating sector.

In relation to above, it is relevant that the conference content considers how adaptation to new conditions in the district heating sector can be done through new business models and customer solutions, and in particular models and solutions that integrate and are based on digitalization and demand flexibility. The content of the conference session has been planned based on the importance of bringing in several actors' perspectives on current issues that are being addressed during the conference, for example from researchers, authorities, district heating companies, district heating and district cooling customers, as well as suppliers of, for example, digitization solutions. Based on Swedish conditions, this special session on the conference will take into account the importance of inspiration and experience from international research in the field of thermal energy systems, for example, by presenting and discussing conducted or ongoing international pilot and case studies.

In light of this, the project has planned for a special session on the conference that aims to offer interesting presentations and forward-looking discussions about how future challenges in the field of thermal energy systems and, in particular, the district heating sector can be addressed.

5 Future operation and development of the platform

This section aims to contribute with various aspects to consider in a continued operation and development of the platform.

This project International platform for thermal energy systems research has built and commissioned a platform for knowledge exchange and external monitoring for collaboration on described challenges within the thermal energy systems sector. The objective of this project and the knowledge platform is to contribute to the development of a continued strong and competitive district heating and CHP sector. During the project work, collaboration mainly consisted of organized workshops and to prepare for an international district heating conference which can facilitate further collaboration in this area. The construction and buildup of the platform prepares for possible new arenas for collaboration. In addition, a continued operation of this knowledge platform can provide further new opportunities for collaboration.

Prior to a continued operation and development of the platform, there are aspects that must be taken into consideration. One of those is the extent of the work on updating information and news on the platform, i.e. how often information and news should be updated, and that updating can be made in an automated way as far as possible. Hence, to minimize the workload, searches have to be automated as far as possible by using, for example, specific keywords, which primarily minimizes the work of manual analysis of the compiled search hits. However, in this context, it is important that limitations in conducted searches are made with caution to ensure that relevant information is not excluded in the searches due to too narrow search criteria. Increased automation of the searches also reduces work and thus the time to analyze the material produced, i.e. the processing and selection of the information produced in respect to the relevance for the objective with platform and its target groups. Based on conducted searches and the information obtained and analyzed after these searches, a rough estimate of the size of the work effort has been made. If searches can be automated, for example through more specific keywords, the effort approximately may be halved. The work that remains then is mainly editing work such as linking and transferring to a format that can be applied and visualized on the platform.

In addition to preparing for a session at an upcoming international district heating conference, the project's workshops have an outlined structure and experiences for a continuation of further workshops and seminars on important results of research studies that may emerge in the searches that are continuously conducted.

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Sökord

District heating, district cooling, research, knowledge platform, monitoring, thermal energy systems

INTERNATIONAL PLATFORM FOR THERMAL ENERGY SYSTEMS RESEARCH

Future energy systems will require an adaptation to new conditions. The energy sector including thermal energy systems face challenges in both a Swedish and international context, which must be addressed. Therefore, research monitoring and knowledge transfer via national and international collaboration is of utmost importance to continue a development of competitive Swedish district heating and CHP systems.

In the project International district heating research, a knowledge platform has been developed and commissioned with the aim of contributing to an increased knowledge exchange and research monitoring in the area of thermal energy systems and especially district heating and district cooling. The work of searching for and analyzing research and knowledge in the area has been based on described conditions and challenges in the Swedish district heating industry, which also corresponds to the three focus areas around which the project has concentrated the work: Customer solutions and business models, Flexible response to demand and digitization, and Policy instruments.

In addition, within the framework of these areas, the project has prepared a program for a session at an international district heating conference, which is scheduled to be carried out in November 2020.

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