SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Solar Heat and Energy Economics in Urban Environments

IEA SHC TASK 52

WORKPLAN

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Work Plan

TASK 52

Solar Heat and Energy Economics in Urban Environments

1 Background and Scope

This Task proposal focuses on the analysis of the future role of solar thermal in energy supply systems in urban environments. Based on an energy economic analysis - reflecting future changes in the whole energy system - strategies and technical solutions as well as associated tools will be developed. Good examples of integration of solar thermal systems in urban energy systems will be developed and documented.

2 Objective and Organization

The Task focuses on the analysis of the future role of solar thermal in energy supply systems in urban environments. Based on an energy economic analysis - reflecting future changes in the whole energy system - strategies and technical solutions as well as associated chains for energy system analysis will be developed. Good examples of integration of solar thermal systems in urban energy systems will be assessed and documented.

(a) Energy Scenarios

The role of solar thermal in the energy system of urban environments will be identified with a horizon of 2050 and a 100% Renewable energy goal. The focus lies on a national or international level, but not necessarily 100% on a city or regional level solely.

The scenarios will reflect the combined view of electricity & heat as well as other key heat supply technologies like electrical and thermal heat pumps and CHP. Different district structures will be taken into account and different scenarios regarding the development of the energy system (e.g. IEA Energy Perspectives)[1]. The Scenario's will reflect all sectors including mobility. They will be based on detailed time – series in order to reflect the dynamic of the solar energy availability and will use space discretised data.

(b) Integrating Design Tools for Urban energy supply systems

Existing tools for estimating the solar potential based on geographical information systems GIS are not yet linked to existing design tools for optimizing the structure of urban energy systems. Up to now, they take not into consideration the spatial and time resolution and variability of energy production and energy consumption induced by local renewable resources. The forecast of such fluctuations is observed especially in decentralized energy infrastructure, both energy production and energy consumption not only in time will also vary greatly in the future in space.

A key approach to stabilizing the operation is the use of energy storage – in the task's scope heat storage in particular, fed by cogeneration and solar thermal systems – which are indirectly helping to operate the electricity grid stable. Existing local energy management tools for heat supply systems – in this case district network with solar thermal - have to be further developed in order deal with the change from demand driven energy supply systems towards production driven systems.

[1] http://www.iea.org/w/bookshop/add.aspx?id=425 (ETP2012)

Tools and techniques for the transition process of the energy system towards a renewable one will be addressed and case studies will be documented.

(c) Demonstration and Operation

The implementation of solar thermal in existing or new urban districts as part of an integrated energy supply system will be demonstrated and analysed. A focus will be taken on the integration of solar systems in district heating systems addressing technical and economic aspects and operation schemes governed by the link to the electrical grid. Tools for operation will be analysed. Existing sites will be included as base for identifying bottleneck's, good practises as base for further analysis.

Based on these boundary conditions, observations and statements a critical review of the goal "Solar thermal energy systems will provide up to 50% of low temperature heating and cooling demand by 2030" – as formulated in the IEA SHC Strategic Plan – is planned within the proposed Task. Further on technically and economically feasible solutions will be identified and best practice examples will be documented.

3 Process

This Task starts on 1 January, 2014 and remains in force until 31 December, 2017 (4 years).

Task meetings will be held twice a year. In addition, Subtask meetings or working group meetings may be held in between Task meetings.

Every participating country will contribute with at least one (1) case study/story.

Seminars or workshops will be held in conjunction with at least four (4) Task meetings. The seminars/workshops will be organized in the host country of the meeting and relevant target groups will be invited.

In addition, minimum one (1) local seminar or workshop will be held in each country/region to get input to the work and/or to disseminate results from the Task or Subtasks. These seminars/workshops will be organized by Task participants from the specific country.

The results of this Task will be published by different means, e.g. guidelines. Also, improved or new methods and processes will be developed, see further in the Task Information Plan (Section 5).

In order to facilitate this, questions in three main R&D areas have to be answered and compiled in a common structure:

Subtask A: Energy Scenarios

Subtask B: Methodologies, Tools & Case studies for Urban Energy concepts

Subtask C: Technology and Demonstrators

4 Subtasks

4.1 A: Energy Scenarios

The objective of Subtask A is to analyse the role of solar thermal in the energy system of urban environments with a horizon of 2050 based on scenarios analyses of energy system. The scenarios will reflect the combined view of electricity, heat and transport as well as other key heat supply technologies like electrical and thermal heat pumps and CHP. Different district structures will be taken into account and different scenarios regarding the development of the energy system. The scenarios could also take into account selected key differences in current configurations of national energy systems, i.e. levels of renewable energy, nuclear, hydro etc. and the potential developments in the future i.e. high renewable

energy, high fossil fuel or high nuclear. Particularly the role of solar thermal in future smart energy systems with integrated electricity, heat and transport supplies will be addressed.

Subtask A will have to elaborate scenarios based on a common methodology.

The contents of subtask A is about:

- Using energy system analyses and GIS based data for creating scenarios highlighting the use of solar thermal in future energy systems in different types of energy systems
- Identifying balances between heat or cooling savings and supply systems with relation to solar thermal
- Identifying balances between building level solar thermal and solar thermal in local district heating networks
- Identifying the role of solar thermal in integrated renewable energy systems (smart energy systems) and in particular the interrelation with combined heat and power (CPH) and heat pump production.

The main activities of subtask A are:

A1 Identification of relevant solar thermal concepts and establishing energy system models for enabling energy system analysis of key solar thermal concepts

Based on existing work and experiences of all partners in the Task relevant concepts for the integration of solar thermal energy in urban areas will be identified. In order to allow for a comprehensive representation of the identified concepts in the different models the used approaches in each model will be discussed and further elaborated. There will be two main outcomes: on the one hand this will lead to a common understanding of how to qualify the results of the different modelling approaches regarding the use of solar thermal energy, on the other hand a common methodology for the development of scenarios within the Task will be defined. The existing models will partly be extended if it shows to be necessary in order to reflect the common methodology.

A2 Development of energy system scenarios for selected countries focusing on the analysis of the role of solar thermal with a time horizon of 2050

For selected countries we will develop energy system scenarios with the target of 100% renewable energy supply in 2050. Main focus of the analysis is to identify the role of solar thermal energy in the overall energy system and the barriers and drivers related to different solar thermal energy concepts. Therefore the parts of the energy system that are directly linked to solar thermal energy will be investigated in detail mainly based on existing scenarios and ongoing projects. In order to deepen the understanding of barriers and drivers as well as technological and economic potentials of different concepts on the national level selected further scenarios will be developed within the Task. Highly important scenario settings will be defined in accordance with the main partners of the Subtask/Task. The necessary data for the calculations will be provided by the partners within the Task and if necessary further data research will be undertaken.

A3 Analyses of the role of solar thermal concepts in future energy systems including sensitivity analyses regarding cost developments, national and international system integration and the influence of climate change

In order to identify promising configurations of future energy systems, the role of solar thermal energy and the barriers and drivers in the transition to such systems sensitivity analyses will be calculated. The barriers and drivers in the diffusion of different technologies in the transition to such systems will be elaborated based on existing scenarios for the selected countries. Parameters that have shown to be highly important will be analysed in the context of the new findings within the Task.

Deliverables

R A1 Report on advanced energy system analyses of solar thermal concepts: Methodology report

R A2 Report on future scenarios highlighting recommended uses of solar thermal and sensitivity analysis of important parameters

R A3 Contribution to the Task 52 common publications and Subtask Report

Subtask A:	**Energy Scenarios**		**Leader: Aalborg University**
	Action	Start/End	Deliverable
A1	Definition of energy system scenarios and Identification of relevant Solar Thermal concepts	1/2014-10/2015	R A1 Report on advanced energy system analyses of solar thermal concepts: Methodology report Draft: Meeting 3 4/2015 Due: Meeting 4 10/2015
A2	Establishing energy system models	1/2014-10/2015	Models established and prooved
A3	Analyses of solar thermal concepts in future energy systems and Sensitivity analyses	10/2014-4/2017	R A2 Report on future scenarios highlighting recommended uses of solar thermal and sensitivity analysis of important parameters Draft: Meeting 3 4/2016 Due: Meeting 7 4/2017
A4	Subtask report	1/2017-10/2017	R A3 Subtask Management Report Due Meeting 8 10/2017

4.2 B: Methodologies, Tools and Case studies for Urban Energy concepts

Subtask B aims at providing methodologies to support technical and economical calculations for successful integration of solar thermal in urban environments. Depending on energy scenario the use of solar thermal may or may not be energetically rational or economically viable. The intention is to identify urban planning methodologies and calculation techniques capable to ensure an objective evaluation of the role of solar thermal in urban energy scenario's reflecting future regional, national and international boundary conditions.

The content of subtask B is about:

- Development of methodologies with focus on performance indicators
- Energy planning tools and toolboxes (from Urban planning to neighbourhoods)
- Case studies analysis of different regions

The main activities of subtask B are:

B1 Development of methodologies and performance criteria

In order to develop energy concepts in the urban environment methods will be develop which allows the characterization of different urban morphologies in different climate regions. The methods will be able to identify patterns of consumption in regions (actual and long term development) and will be able to reflect and quantify effects of urban environment on consumptions and identify determinant factors. Key indicators to describe different situations will be developed (e.g. heat density; solar potential, building typology).

In addition evaluation criteria for energy scenarios on urban level will be identified and described. These performance indicators will be elaborated in order to ensure the viability of integration of solar thermal systems into urban scales. These indicators have to reflect energy scenarios, price evolution scenarios and Energy system boundaries.

B2 Review on existing tools and development of tool chains

Simulation represents a robust tool to design, evaluate/predict performance and study the impact of various parameters on the targeted performance. Simulation of the solar thermal systems is widely used and can be achieved on different level (system, house, community, urban etc…). The focus in this subtask will be on the time and space resolution of simulation tools. Tools capable to predict solar potential are usually geographical but do not present any link with design tools of energy systems in urban environment. On the other hand design tools are usually engineered to promote a system without taking into account variability of the production system and consumption evolution. With the increase of renewable energy systems and the reduction of energy consumption in the horizon of 2050 the fluctuation of the resources not only in time but also geographically has to be considered in the design tools.

A survey will be conducted on the available simulation and design tools integrating solar thermal modelling in urban planning and energy-economic calculations. This review will permit to identify and document:

- Space and time resolution of each tool
- Capability to integrate the variability and types of energy resources on a space level (different sources in different regions) and on time level (evolution of the scenario)
- Existing or potential linking of each tool with other tools (information flows etc..). This part is extremely important to accurately evaluate typologies and scenarios.

We will aim at creating energy/information flows interfaces between relevant tools to take advantage of the capabilities/strong points of each tool. This tool chain will be based on the tools considered solely or by linking different tools in order:

- to evaluate energy scenarios
- to simulate/evaluate Morphologies and typologies identified
- to calculate performance indicators relevant to each typology and energy scenario

Finally a guideline will be elaborated to document the use of tools, method/toolboxes for each particular case. This guideline will help identifying types of answer each tool is able to provide for each situation.

B3 Case studies

The use of solar thermal can be differently weighted depending on the size and the boundary of the energetic systems considered. Within this activity case studies for energy concepts of integration of solar thermal systems into urban and regional energy systems will be performed. Case studies will

- reflect different typologies of structures and integration configurations of solar thermal into the urban energy systems
- reflect different climates.
- be based on the state of the art and the lesson learned from best cases to meet the actual energy systems (joint activity with subtask C)
- reflect the evolution of the energy scenarios in the horizon of 2050 (up to 100 % renewable)

Based on the results of these four case studies Key findings will be documented in guidelines and solution sets specific to different regions and contexts.

Deliverables

R B1 Report on methodologies, and existing Planning tools

R B2 Report on Case studies

R B3 Development of a guideline analysing case studies and solutions sets with performance indicators (which solution fits to which situation including the interpretation of the outcome of the scenarios (Subtask A) and including no go's)

R B4 Contribution to the Task 52 common publications and Subtask Report

Subtask B:	**Methodologies, Tools and Case studies for Urban Energy concepts**		**Leader: Sorane**
	Action	Start/End	Deliverable
B1	Development of methodologies and performance criteria	1/2014-10/2015	Performance Indicators developed Draft: Meeting 3 4/2015
B2	Review on existing tools and development of tool chains	1/2014-4/2016	R B1 Report on methodologies, and existing Planning tools Draft: Meeting 4 10/2015 Due: Meeting 5 4/2016
B3	Case studies	10/2014-4/2017	R B2 Report on Case studies Draft: Meeting 3 4/2016 Due: Meeting 7 10/2016 R B3 Development of a guideline analysing case studies and solutions sets with performance indicators Draft: Meeting 3 4/2016 Due: Meeting 7 4/2017
B4	Subtask report	1/2017-10/2017	R B4 Subtask Management Report Due Meeting 8 10/2017

4.3 C: Technology and Demonstrators

In Subtask C best practice examples of mainly renewable-based energy systems (focus: solar thermal) are investigated in more detail. Interaction between heating supply and electrical grid or gas grid will be reflected.

The investigation is limited to the following conditions:

- Solar thermal systems with direct connection to heat and, more general, to energy supply networks (urban, suburban and municipal level)
- Solar-assisted building blocks (micro-grids) in urban environments (urban level only)
- Renewable heating and cooling systems like Heat pumps in combination with PV

The content of Subtask C is about:

- Classification of relevant (renewable-based) technologies and demonstrators in urban environments
- Screening of best practice examples
- Analysis and documentation of selected best practice examples

- Technological and economic analysis
- Analysis of bottleneck's and success factors, lessons learned
- Analysis of monitoring data (subject to data availability)

• Further development of (existing) business opportunities with regard to future energy supply systems

The main activities of Subtask C are:

C1 Classification of relevant technologies and demonstrators and screening of best practice examples

Task C1 aims to give an exhaustive overview over successfully implemented energy systems in urban environments with a high share of renewable technologies (focus: solar thermal). Based on a screening on relevant technologies and demonstrators selected best practice examples will be identified for further investigations in close co-operation with the task consortium. A matrix for the identification of relevant technologies and demonstrators will be developed.

C2 Analysis and documentation of best practice examples

Practical experiences (lessons learned, bottlenecks, success factors, etc.) regarding financing, design, construction; commissioning and operation of selected best practice examples will be documented and critically assessed. Depending on data availability monitoring data of relevant demonstrators will be analysed.

C3 Further development of (existing) business opportunities with regard to future energy supply systems

In Task C3 selected best practice examples will be analysed with regard to their economic performance at present and with regard to changing future conditions in urban energy systems (as assumed in Subtask B and Subtask C).

Deliverables

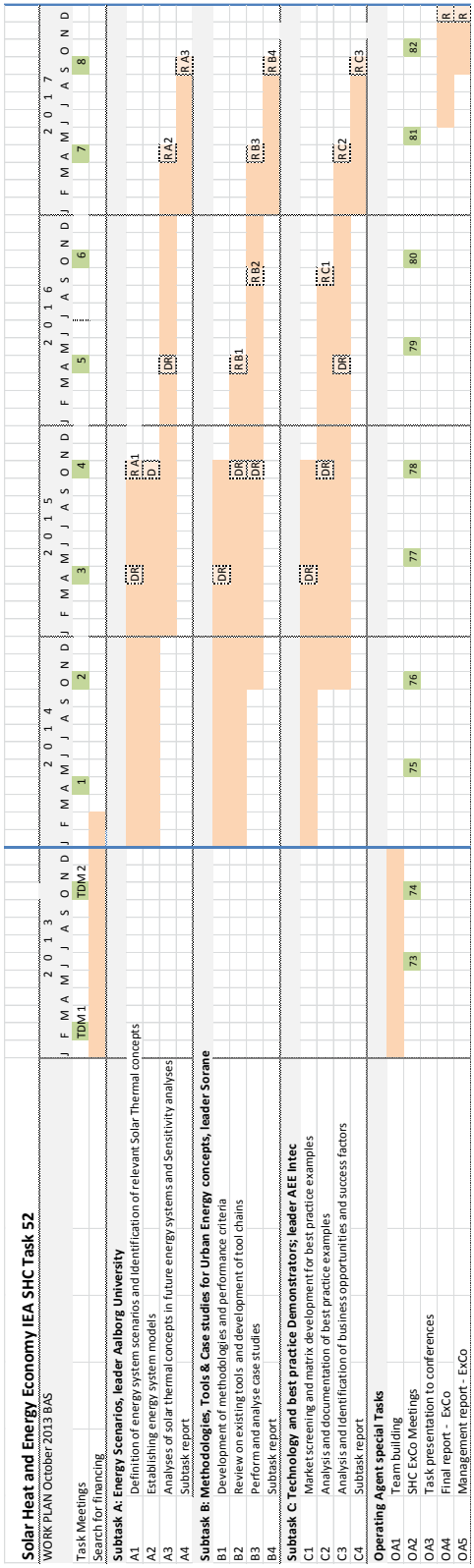
R C1 Report on innovative energy systems in urban environments and evaluation of best practice examples

R C3 Contribution to the Task 52 common publications and Subtask Report

Subtask C:	**Technology and Demonstrators**		**Leader: AEE INTEC**
	Action	Start/End	Deliverable
C1	Classification of relevant technologies and demonstrators and screening of best practice examples	1/2014-10/2015	R C1 Report on innovative energy systems in urban environments and evaluation of best practice examples / Part 1 Draft: Meeting 3 4/2015
C2	Analysis and documentation of best practice examples	1/2014-10/2016	R C1 Report on innovative energy systems in urban environments and evaluation of best practice examples / Part 2 Draft: Meeting 4 10/2015

			Due: Meeting 5 10/2016
C3	Further development of (existing) business opportunities with regard to future energy supply systems	10/2014-4/2017	R C2 Report on existing and adapted business opportunities and success factors Draft: Meeting 3 4/2016 Due: Meeting 7 4/2017
C4	Subtask report	1/2017-10/2017	R C3 Subtask Management Report Due Meeting 8 10/2017

4.4 Activity and Time Table Summary



5 Task Information Plan

The products of work performed in this Task are designed for the solar heat industry (manufacturers of components and systems) for prescriptors such as urban planners, energy service companies and utilities, and finally, for the end-users such as owners of buildings that have to choose a heating system either for a new building or a renovated one.

5.1 Workshops and seminars

Industry workshops, during the Task duration, in conjunction with every Task meeting, will be organised in the host country of the meeting. All relevant target groups will be invited.

National industry workshops will be organised by Task participants using the information gathered during Task workshops and the material produced by the Task. This will be performed once a year

5.2 Publications/Newsletters

The overall scope and objectives of the Task and the different Subtasks will be described on a public website, possibly the IEA-Task Website. Apart from publications of scientific results in conferences, journals and magazines leaflets would be distributed to describe to scope of the Task.

Results of the activity have already been sketched. The deliverables, allocated to the 3 subtasks, will be summarizing:

5.3 Subtask A:

- *Report on advanced energy system analyses of solar thermal concepts: Methodology report*
- *Report on future scenarios highlighting recommended uses of solar thermal and sensitivity analysis of important parameters*
- *Contribution to the Task 52 common publications*

5.4 Subtask B:

- *Report on methodologies, and existing Planning tools*
- *Report on Case studies*
- *Development of a guideline analysing case studies and solutions sets with performance indicators (which solution fits to which situation including the interpretation of the outcome of the scenarios (Subtask A) and including no go's)*
- *Contribution to the Task 52 common publications*

5.5 Subtask C:

- *Report on technical and economical evaluation of best practice examples*
- *Report on existing and adapted business opportunities and success factors*
- *Contribution to the Task 52 common publications*

5.6 Operating agent in collaboration with subtasks:

- *a website with all major reports and papers*
- *2 international conferences participation*
- *4 newsletter*