SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

TASK 48

Quality assurance and support measures for Solar Cooling

Task description and Work plan

October 2011

This text has been produced by

Daniel Mugnier (TECSOL, France)

With the support of
Mario Motta (Politecnico di Milano, Italy) and
Hans-Martin Henning (Fraunhofer ISE, Freiburg, Germany)

With inputs from many participants (especially Tomas Nunez (FhG ISE), Stephen White (CSIRO), Uli Jakob (Green Chiller))

Table of Contents

1 Task description

1.1 Background

The results of IEA SHC Task 38 Solar Air-Conditioning and Refrigeration on the one hand showed the great potential of this technology for building air-conditioning, particularly in sunny regions. On the other hand, it has been shown that further work is necessary in order to achieve economically competitive systems and which presents solid long term energy performance and reliability. One Task definition workshop has been held with the aim to define the required new activities and to develop a structure for a new Task entitled „ Quality assurance and support measures for Solar Cooling ". Stimulated by the successful conclusion of Task 38 worldwide numerous new developments in the field of solar cooling have arisen. However, still many deficits exist in the market deployment of solar cooling and heating systems. The latter can be reduced by development of quality assurance at the component and system's level, through: production of market support measures, by creating dissemination tools and policy advice on the solar cooling technology.

Cooling market

Worldwide trend:

A tremendous increase in the market for air-conditioning can be observed worldwide especially in developing countries. Figure 1 below shows the sales rates of room air-conditioners (RAC units) in different regions of the world (blue mark representing Worldwide sales and green one European ones). The number of sold units increased from about 44 million units worldwide in 2002 to more than 82 million units in 2008 (JARN, 2010). In order to limit the negative impact on the energy consumption and on the electricity network management, new environmentally sound concepts are of particular importance.

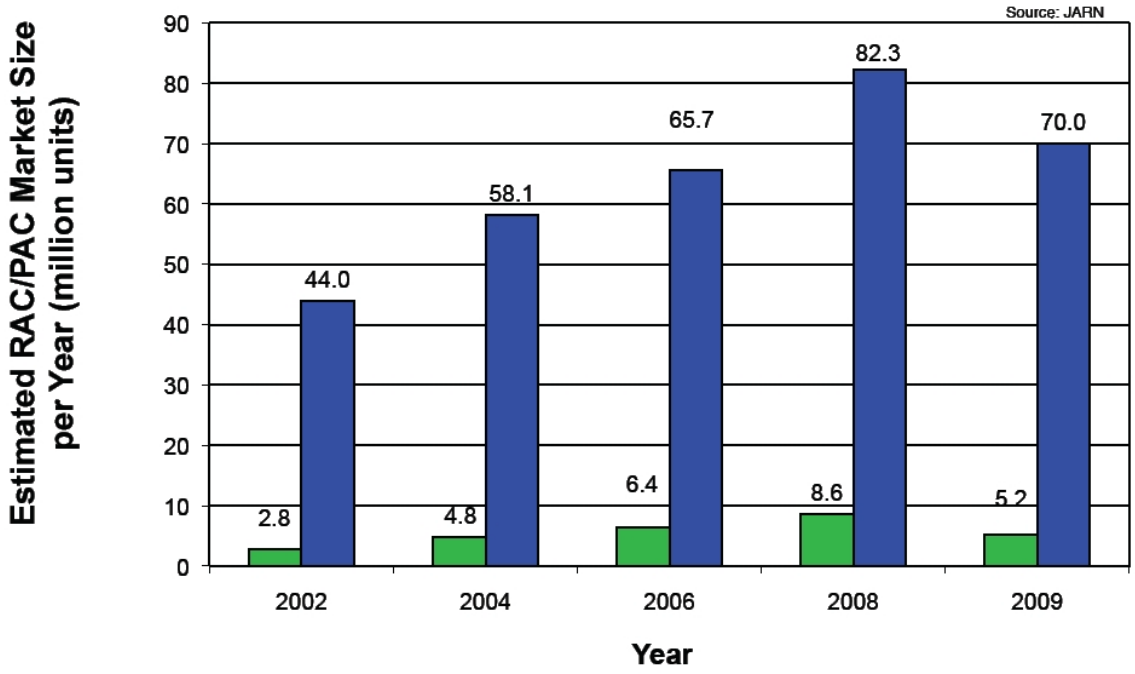


Figure 1: Evolution of air conditioning market worldwide (source: Jakob, 2010)

European trend:

In Europe, Energy consumption for cooling purposes is expected to face an increase of demand within the next 30 years. Climate and comfort requirements make the cooling market grow, and the architecture and technical equipment of larger, commercial buildings require more and more cooling. To reduce the cooling demand would require massive changes in public perception followed by modifications in (commercial) building design. As this seems unlikely for the foreseeable future, addressing the demand for cooling will become more relevant in the coming years. Space cooling is moving quickly from luxury into necessity and represents a fast growing market. This has remained relatively unnoticed by policy planners, partly because cooling needs are traditionally being met by electrical air conditioners, hiding the cooling element within the building's overall electricity consumption.

The rise in cooling demands is attributable to rising ambient temperatures, greater comfort expectations, the perception that cooling contributes to higher productivity, and the increase in internal loads of electronic equipment. A rise of the share of commercial buildings in Europe equipped with cooling to at least 60% is expected by 2020. The maximum potential cooling demand in Europe, if 100% of all useful space were air-conditioned, is estimated to an annual 1400 TWh cooling (RHC Common vision, 2011). Beside, Europe through its European Union has recently sent an important signal to decrease this forecast cooling load development: the new building directive (DIRECTIVE 2010/31/EU). By 2020 all new and refurbished buildings should be near zero energy. So the cooling demand will have to decrease. But this means as well that a massive use of Renewable energy sources will have to be done. Therefore solar cooling will have a chance to develop because of this context (RES HEAT directive, 2010).

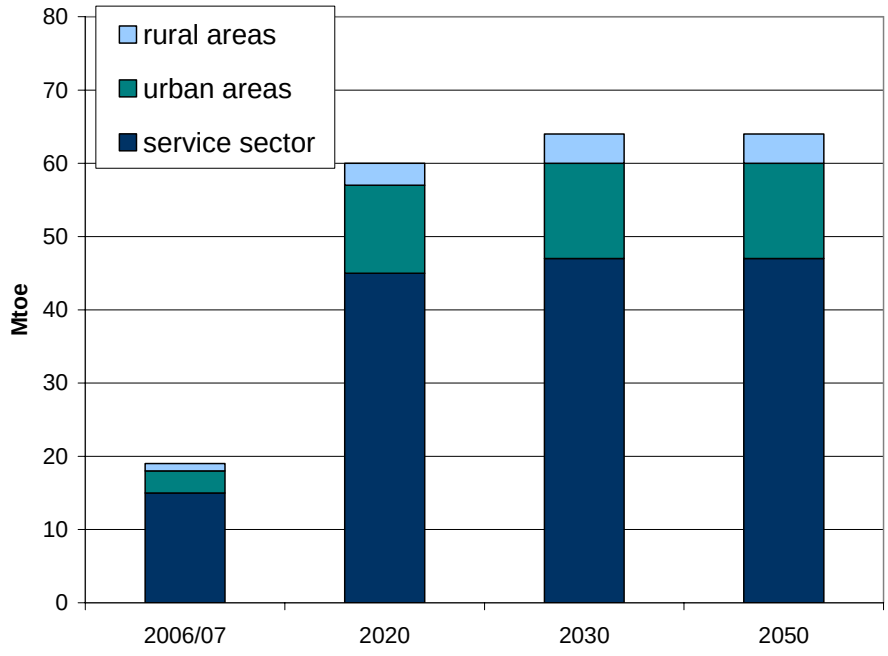


Figure 2 : Expected evolution of cooling demand (source: RHC Common vision, 2011)

Because today most cooling is provided by electrically driven devices, rising electrical power demand has been identified as one key indicator of the increase in cooling demands. Electrical peak loads, traditionally occurring during winters, are now shifting to the summer months and challenging capacity limits and therefore increasing the need of the solar cooling technology even in Europe.

Energy and environment

Although electrically driven chillers have reached a relatively high standard concerning energy consumption they still require a high amount of electricity and - equally importantly - cause significant peak loads in electricity grids. This is becoming a growing problem in regions with cooling dominated climates. In recent years an increasing number of cases occurred in which summer electricity shortages were created due to air-conditioning appliances (eg : 05/07/2010 in Toronto, Ontario). In some regions or municipalities building regulations were set up in order to limit the application of active air conditioning systems, unless they are not operated with renewable energies such as wood/biomass or photovoltaics.
This underlines the necessity of new solutions with lower electricity consumption and in particular reduced consumption at electricity peak load conditions.

Another topic related to environmental issues concerns the global warming potential of refrigerants. Refrigerant leakage in air-conditioning appliances– in particular in the automotive sector – led to several legislative initiatives towards limitation or even prohibition of classical fluorized refrigerants. Almost all thermally driven technologies use refrigerants which have no global warming potential.

Solar assisted air-conditioning and refrigeration

It seems logical to apply solar energy for cooling purposes since in many applications, such as air-conditioning, cooling loads and solar gains are more or less in phase on a daily base. The same holds not necessarily for refrigeration application e.g. in the food processing sector. However, also in these sectors a coincidence between solar gains and load occurs at least on a seasonal level. In general, solar assisted cooling can mean to produce electricity from solar radiation by photovoltaics and to drive electrically driven cooling systems or to produce heat from solar radiation by solar thermal collector systems and to employ it in thermally driven cooling processes. Thermally driven technology is of particular interest in case of applications where both cooling and heating are needed. In such cases, a solar thermal collector can be used all year around, for heating in winter and cooling in summer.

History

Solar Thermally Driven Heating and Cooling systems (STDHC systems) are belonging to the IEA SHC Strategic Plan Key Technologies because they have the potential to cover much of the rising demand for air-conditioning by solar energy.
The concluded IEA-SHC Tasks related to Solar Air conditioning (Task 25 and Task 38) have permitted to make a considerable collaborative international work to develop this technology from pure R&D to first market introduction.

IEA-SHC Task 25 (from 1999 to 2004) mainly created an outlook of the technology and initiate industrial and mature developments. During Task 38 (2006-2010), the IEA experts created tools and

methods to help the market introduction of the emerging technology and analysed the efficiency and reliability of the new generation of solar cooling systems now available for demonstration and pilot installations as well as first commercial market deployment. A recent survey made on the basis of results of the IEA Task 38 work has shown the estimated number of installation worldwide was nearly of 600 systems in 2010 (Figure 3)

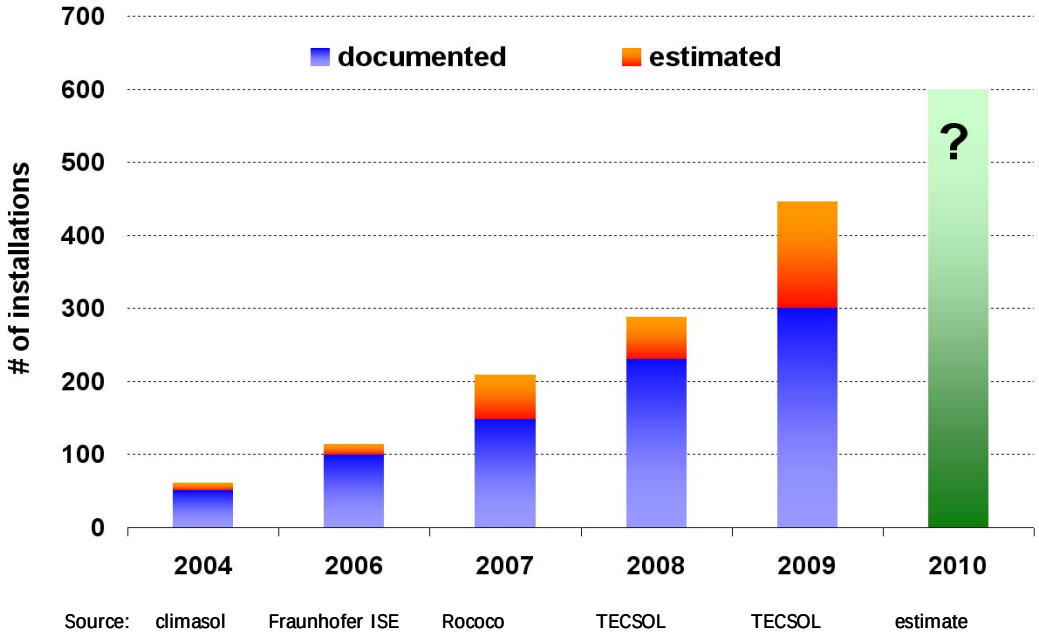


Figure 3: Estimation of number of solar cooling installations worldwide

Beside, an important work of collection on new developments has been achieved. Results have shown that under certain conditions and with a considerable effort during design, installation, commissioning and operation the technology is reliable, promising and competitive in terms of energy, environmental impact. Even some cases solar cooling systems turned economical, whereas some of the installations realised since 1999 could not yet be considered as reliable and cost competitive.

In 2010, Solar Air-Conditioning is more than ever representing a huge potential of development for solar energy (within 2030 the expected growth of energy demand in buildings especially in developed countries is far bigger on the cooling side than on the heating side) but this promising technology is facing two main issues: (1) general lack of economic competitiveness – as it is still the case for many renewable energies unless incentives are in place – and (2) secure long term energy performance and reliability.
The proposed Task addresses these obstacles: main goals are (1) to develop and provide various measures which lead to highly reliable, durable, efficient and robust solar cooling (and heating) systems and (2) to contribute to further cost reduction on all levels of the chain and identify most promising market areas in terms of cost competitiveness.
This new Annex is deeply aimed as well to enlarge the actual European centred view and work to countries out of Europe (most of them are member of IEA SHC) such as China, India, Singapore, USA, Canada, South Africa and Australia. In these countries Solar Thermally Driven Heating and Cooling technology is really dynamic and represent a much bigger market potential (because of the

climates, the energy structure, peak demand, etc.). Actions to stimulate participation to these countries will be implemented.

1.2 Why an IEA project?

The International Energy Agency offers an ideal platform for international collaborative R&D work. Several added values can be identified in a collaborative, international project compared to national activities. Participating countries take profit from the specific know-how of each of the other participants (such as study of the international state-of-the-art has to be done only once). Tools such as design or simulation programs may be similar for application in different regions. An international project may be capable to bring together technology suppliers from different countries with new markets.
Overall, the net profit for every participating country seems to be significantly higher compared to national activities with a similar level of effort.

1.3 Scope of the task

The scope of the Task are the technologies for production of cold water or conditioned air by means of solar heat, i.e., the subject which is covered by the Task starts with the solar radiation reaching the collector and ends with the chilled water and/or conditioned air transferred to the application. However, although the distribution system, the building and the interaction of both with the technical equipment are not the main topic of the Task this interaction will be considered where necessary.

The main objective of this Task is to assist a strong and sustainable market development of solar cooling systems. It is focusing on systems including any solar thermal cooling technology (no power limitation or solar collector field area) which can be used in heating mode. To avoid overlapping risks with ongoing IEA-SHC Task 45 on Large Systems, Task 45 is mainly focusing (not only but majoritarily) to district heating systems (possibly including cooling).

Technologies

In principle, solar assisted cooling systems may be operated by (1) solar thermal collectors connected to thermally driven cooling devices, (2) solar-to-electric converters (photovoltaics) combined with compression chillers or by (3) solar to mechanical energy converters (e.g. solar collector driven Rankine machines) combined with compression chillers.

The first category of systems seems to be closest to market application, although in particular in the case of small units (e.g. window units) PV driven compression chillers are the only solar solution available today. However, in areas with existing electricity grids, which are mainly focused in this task, the question of PV driven cooling reduces to the question of grid connected PV for reduction of peak loads, which result from air conditioning. Although PV driven solar cooling systems will not be specifically studied in this task, a regular update on the technology status will be carried out so as to underline possible complimentary/ synergistic aspects between solar thermal and PV. An example of synergy could be to benefit from the existing market development tools and measures on going for PV to adapt it for solar thermally driven cooling technology development.

Applications

The main application covered by the project is cooling of buildings. Today it seems that solar assisted cooling has best chances for market deployment in cases of large buildings with central air conditioning systems. But there is also an increasing market seen for cooling equipment in the small residential and small commercial sector. Here reliable and cost effective solutions are necessary in which the solar collector provides heat over the whole year, i.e. for heating in winter, for cooling in summer and for production of domestic hot water in the entire year. So called pre-engineered systems are seen as a solution for this application range. Therefore this Task also focuses on packaged solutions which can be pre-engineered systems with small capacities and custom-made systems with large capacities.

1.4 Objectives

The proposed project is intended therefore to create a logical follow up of the IEA SHC work already carried out by trying to find solutions to make the solar thermally driven heating and cooling systems at the same time efficient, reliable and cost competitive. This three major targets should be reached thanks to four levels of activities:

1) Development of tools and proocedure to make the characterization of the main components of SAC systems
2) Creation of a practical and unified procedure, adapted to specific best technical configurations.
3) Development of three quality requirements targets :
    - prescriptive “deemed performance” approach (<20kW): Manufacturers who offer a standard packaged solution declare the performance level of the package under certain rating constraints. This rated performance can then be used in a variety of policy interventions (eg : award of certificates, restriction on sale of low performance products, thresholds for subsidies etc).

    - prescriptive “deemed to satisfy engineered” approach (>20 kW) : Where customised solutions are more appropriate, prescribed engineering design and implementation requirements can be specified to ensure the quality of the systems from components to operation (system, installation, etc..). The ability to “qualify” and label installations can be used in a variety of policy interventions (eg : minimum requirement for subsidies, overcoming information barriers, award of points in building rating schemes etc)

    - performance-based approach (>20 kW): While the prescriptive methods described above will be useful within their field of relevance, installers/providers of Solar Thermally Driven Heating and Cooling solutions must also have the ability to innovate and offer tailored solutions outside the direct scope of the prescribed approaches. This can be achieved by allowing direct metering and verification of performance. The ability to benchmark actual performance against alternative solutions can be used in a variety of policy interventions (eg : promotion of energy performance contracting, award of certificates etc)

4) Production of tools to promote Solar Thermally Driven Cooling and Heating systems

1.5 Task Structure

The work in this Task is organised in four Subtasks:

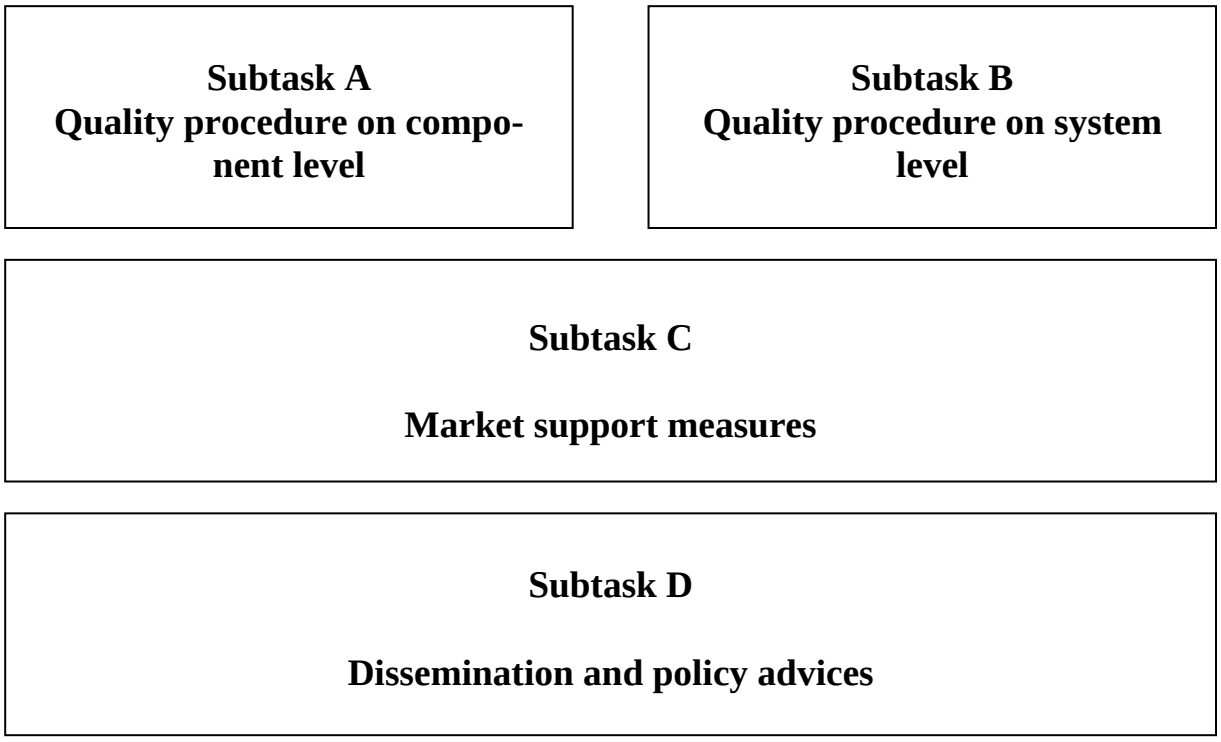
Subtask A: Quality procedure on component level

Subtask B: Quality procedure on system level

Subtask C: Market support measures

Subtask D: Dissemination and policy advice

Each Subtask consists of several work packages with specific focus and results. The Subtasks are described in more detail in the subsequent sections.



1.5.1 Subtask A: Quality procedure on component level

This subtask concentrates on developing tools and deliverables permitting to show the level of quality of the most critical components of the solar cooling and heating system. These components are mainly the chiller, the heat rejection device, the pumps and the solar collectors. The subtask is structured in the following sections:

A1: Chiller characterization

In this work, the characterization of the chillers (absorption and adsorption) will be achieved in close cooperation with the ongoing work achieved in IEA Annex 34 and IEA SHC Task 44 groups. This characterisation will be based on both steady state and transient performance approach through dynamic tests. Several participants own testing facilities so this task will be based mainly on laboratory measurements. The tests will be carried out in conformity to a common testing protocol, according to which aging effects could be also investigated. The tests conditions will permit to characterise the chiller behaviour over the entire operating range that is typical for solar cooling. In this way, the quality level of the chillers will be assessed from the seasonal performance point of view. In addition, the tests will permit to give inputs for system design tools.

A2: Life cycle analysis at component level

In this activity, the LCA approach to Solar Cooling systems initiated by IEA Task 38 will be further developed so as to give a ready to use tool allowing to estimate during Subtask C for selected generic schemes the energy and environmental overall impacts of the system. The creation of the assemblies related to the plant components and materials, supported by manufacturer's data and eventually by direct inspection and monitoring of the industrial processes for the most relevant plant components will be carried out. Provided that the construction of a complete data base of life cycle inventories for components, activities and materials is a difficult task, through the determination of the impact factors parametric analysis in respect to the data accuracy, solar fraction, recycling rate of basic materials and other relevant variables will be carried out.

A3: Heat rejection

In this section an overview about existing and novel concepts for heat rejection for solar cooling will be carried out. Recommendations will be given about which heat rejection measure has to be employed under different boundary conditions (climate, system concept etc.), always tracking the 2 main objectives: investment & operation cost minimization and re-cooling performance and efficiency. For good selected components, if possible, an effort of performance characterisation will be done in partnership with manufacturers.

A4: Pumps efficiency and adaptability

A state of the art analysis will be conducted on this component in close cooperation with ongoing IEA-SHCP Tasks 44 and 45, where these issues are tackled as well. From this starting point, an investigation will be done on the best practices for electric consumption reduction for pumping in the different hydraulic loops of a solar cooling system. A particular focus will be addressed to the

adaptability of the technology to part load production conditions. Best practice will be valorised always including the compromise between efficiency and simplicity.

A5: Conventional solar collection

In this section a review of existing material on the solar loop components (collector and supporting structures), in close cooperation with the ongoing Task 45 SHCP-IEA will be worked out. The objective will be to select the necessary information for the quality insurance tools to develop in the other subtasks (e.g. design, etc.) and in particular: collector mathematical models (e.g., TRNSYS), cost reduction potential of different solutions (e.g., drainback technology, prefabricated and easy to install supporting structures) and best practices.

A6: State of the art on new collector & characterization

An extensive market overview of existing concentrating collectors will be conducted so as to create easy to consult database (like the existing Solar Key mark one for non concentrating collectors). This database will be periodically updated and extended with information relating the certification process of such collectors. No standard is existing at the moment but this situation should change during the Task duration. This activity may as well try to assist the solar concentrating industry to accelerate its certification recognition and then the possibility to standardised performance characterisation. Target market needs in technical and economical terms are provided. New components and approaches, currently under development, will be included into the survey and their possible role in the future market on solar cooling and refrigeration will be assessed.

Effort

Estimated effort is 6 to 12 person-months per Participant (country) and 12 person-months for the Subtask Leader for the specific work for Subtask Leadership for the whole duration of the Task.

Deliverables

- D-A1: Technical report on the characterization method(s) which are adopted and selected for chillers in cooperation with other activities on the topic. The deliverable will contain as well a database including the ongoing characterisation values from existing and tested chillers
- D-A2: Data base of life cycle inventories for components for LCA method tool (see D-B2)
- D-A3: Technical report on heat rejection including sections related to market available products census, including costs, efficiency criteria ranking and performance characterisation.
- D-A4: Technical report on best practices for pumping systems: including both efficiency and adaptability in solar cooling systems
- D-A5: Report on best practices on solar collection components for quality, reliability and cost effectiveness
- D-A6: State of the art of commercial product database build up and periodic update (1 per year) for concentrating solar collectors and including certification process status

1.5.2 Subtask B: Quality procedure on system level

This subtask concentrates on developing tools and deliverables permitting to show the level of quality of the solar cooling and heating systems. In order to achieve this goal, a procedure has to be developed extending the quality characteristics from a component level to a system level. In a second step an extension of the procedure from single stationary states to a performance prediction over a whole year need to be developed. Thus subtask B is closely linked to subtask A and its results.

The subtask is structured as follows:

B1: System/Subsystem characterization & field performance assessment

In this work, the characterization of the solar cooling systems will be achieved in close cooperation with ongoing work achieved in IEA Annex 34 and IEA SHC Task 44 groups. This characterisation will be based on the output of activity A1 and from other results obtained in characterisation for the major components in Subtask A (pumps, heat rejection, collector). This characterisation will be done for steady state behaviour but as well transient behaviour through dynamic tests. Several participants own testing facilities so this task will be based on real measurement of performances. The characterization on component level in subtask A will be extended to whole systems in order to obtain procedures for performance prediction based on standardised and generally accepted conditions. If available, long term monitoring on real installations will be used for the characterization in comparison with lab tests. The overall characterisation will be crucial to qualify the quality level of the best practice systems on the performance point of view. In addition, it will permit to give inputs for design tool obtained in activity B4.

B2: Good practice for DEC design and installation

This activity is aimed at producing a technological survey and update on the Best practice systems of Desiccant cooling systems. This technology will not be the major focus in the ongoing Task concerning the other activity so this work package should constitute a mean to keep on an observatory eye on this specific technology evolution.

B3: Life cycle analysis at system level

This activity is strongly linked to the A2 activity (transversal activity on LCA). A valorisation of the work done at component level in A2 and creation of the system level database and tool will be the goal of this work. Life cycle analysis on system level includes essential information about energy performance of the whole system, thus this work will be strongly linked to the results of the work in B1 and possibly integrated into the reference calculation tool in B4.

B4: Simplified design tool used as a reference calculation tool : design facilitator

The development of a software tool called design facilitator for the fast pre-design will be based on the collection of existing characterisation models and results of successful projects including technical and non-technical (economics) issues. It will include procedures of system and subsystem

characterization developed in B1 as well as the life cycle analysis of B3. It shall help to support planners in the process of evaluation and feasibility studies of similar projects.

B5: Quality procedure document/check lists

The previous experiences of IEA Task 38 as well as outputs of Subtask A are summarized and updated in guidelines for design, installation, commissioning, operation and maintenance. This document may be an input to standardisation procedures for whole solar cooling systems.
This document will include dimensioning parameters and technical hints. Practical output in this guideline will be useful advice for calls for tenders and checklists for the technical design as a support to architects and planners.

B6: Self detection on monitoring procedure

Starting from the statement of existing efficient system control (overview achieved in former IEA Task 38), a second generation of control system is developed which includes self detection of faults and malfunctioning of the process based on a reduced monitoring. This new powerful functionality will be a key component assuring long term good reliability and performance of the system.
This activity will include beside an update of good practice on the monitoring procedure point of view starting from the experience and procedure developed during IEA SHC Task 38.

B7: Quantitative quality and cost competitiveness criteria for systems

In this activity, a proposal for an appropriate evaluation procedure for the technical and economical performance assessment of large systems is set up and tested with real cases. It delivers the basis for a comparable assessment of the installed plants independently of installation site and the specific boundary conditions.
Beside, a reflexion will be carried out on minimum economical ratios to estimate the competitiveness of solar cooling against concurrent technologies

B8: Application for validation of preselected best practice examples

This work package is focused on the description and the assessment of existing installations and demonstration projects with solar cooling systems selected in activity C1 (transversal activity following C1). The activities may consider variable applications and boundary conditions implementing experimental and monitoring activities on the selected systems, the composition of results and the assessment of the facilities.

Effort

Estimated effort is 9 to 24 person-months per Participant (country) and 15 person-months for the Subtask Leader for the specific work for Subtask Leadership for the whole duration of the Task.

Deliverables

- D-B1: Report on system/subsystem characterization & field performance assessment
- D-B2: Collection of good practice for DEC design and installation,

- D-B3: LCA method tool (which should contain at the same time a significant database adapted to the most popular solar cooling system components and an user friendly interface permitting to rapidly make an assessment of the main LC criteria : energetic payback, avoided CO2 potential)
- D-B4: Software tool for the fast pre-design and performance estimation of best practice projects
- D-B5: Quality procedure document/check lists guidelines,
- D-B6: Self detection on monitoring procedure
- D-B7: Collection of criteria to qualify the quality and cost competitiveness of solar cooling systems
- D-B8: Report on validation of preselected best practice examples

1.7 Subtask C: Market support measures

The work within this subtask is related to create a panel of measures to support the market. These measures will use the results of Subtasks A and B and will above all explore the possibilities to identify, rate and verify the quality and performance of solar cooling solutions. The resulting tools are intended to provide a framework that will enable policy makers to craft suitable interventions (eg certificates, label and contracting etc) that will support solar cooling on a level playing field with other renewable energy technologies. Even if the completion of these tools will not be achieved rapidly, the subtask should permit to initiate all and maybe conclude some of them.

For that purpose, the subtask is structured in the following way:

C1: Review of relevant international standards, rating and incentive systems

A large number of government incentive programmes and industry development programmes have been instituted in different jurisdictions, to assist the renewable energy and building energy efficiency industries. These programmes call up procedures for quantifying benefits, rating effectiveness and achieving robust measurement and verification. A database of relevant standards, processes and incentives will be created and links to the needs of the solar heating and cooling industry will be analysed. Gaps in current standards and quality assessment processes will be identified.

C2: Methodology for performance assessment, rating and benchmarking

Methodologies will be developed in collaboration with the work achieved in the B7 activity, and then used to quantify performance and quality of (i) alternative air-conditioning and renewable energy technologies and (ii) current solar air-conditioning systems. Low and high performance bounds will be identified and benchmarked, along with the factors that most influence high performance. Benchmarks will be used to set a coherent rating framework depending on the local conditions (climate, technology, application). This rating framework will enable stakeholders to understand and set design criteria and performance targets for performance based solutions. The rating framework will also guide design requirements for prescriptive solutions, and provide information for road mapping in activity D4.

C3: Selection and standardisation of best practice solutions

From the past and present experience with small, medium and large size solar air-conditioning systems, a reduced and documented set of system design schemes and control schemes will be selected, which exhibit favourable system operation in terms of optimised performance and reliability. Initially, around 10 case study configurations will be selected and used to define and standardise the engineering criteria which lead to target reliability, efficiency and cost competitiveness. High attention will be drawn to the standardisation of the system design schemes and defining the constraints of applicability of these standardised designs. In order to give support to planners and installers a selection of proven system designs including hydraulic schemes, will be detailed in the form of design guidelines for heating, cooling and ventilation of commercial buildings,.

C4: Measurement and verification procedures

Building upon the work of the previous Task 38, minimum metering requirements, processes and analysis procedures will be defined for assessment of solar performance, in a manner suitable for (i) performance based qualification and (ii) prescribed deemed energy saving certification.

C5: Labelling possibilities investigation

This activity will be dedicated to the investigation on the creation of a Solar cooling label itself or (more probable) on the creation of specific Solar cooling extension(s) to existing "Green quality" labels such as LEED or Green Building Council tools. This activity will be mainly exploratory and should firstly make a full state of the art of the labelling process which could welcome the solar cooling technology on their scope. From these informations, investigations on how to integrate them or even how to create an independent Solar Cooling Label will be investigated and theorized if accurate.

C6: Collaboration with T45 for contracting models

This activity will develop contracting models for solar cooling systems. For that purpose, a narrow collaboration will be established with ongoing IEA SHC Task 45 on Large systems which will specifically work on this topic but focusing on large district heating and cooling systems. An extension of and selection of most accurate models will be developed for Solar Thermally Driven Cooling and Heating systems.

C7: Certification process definition for small systems

This activity will be focusing on the development of a certification process applied for small size solar cooling systems. The opportunity of such an initiative ongoing in Australia will be an interesting case study and all the work achieved in the subtasks A and B in addition to other activities inside this subtask will give tools to reach a coherent method to qualify the quality of the solar cooling systems : software tool, minimum performance requirements and installation / O&M methodology, etc… Through this example, an extension and generalisation could be achieved towards other countries and other range of cooling power.

Effort

Estimated effort is 3 to 12 person-months per Participant (country) and 12 person-months for the Subtask Leader for the specific work for Subtask Leadership for the whole duration of the Task.

Deliverables

- D-C1: Report and database of international standards, rating and incentive systems relevant to Solar Cooling
- D-C2: Rating framework developed with benchmarks for qualifying solar cooling performance and quality
- D-C3: Selection and description of best practices into standardised engineering requirements,
- D-C4: Minimum procedures developed for measurement and verification
- D-C5: Report on labelling investigations,
- D-C6: Models of contracting for solar cooling projects,
- D-C7: Report about the certification process for small systems in Australia including generalization of the methodology to potential other interested countries and cooling power range.

1.8 Subtask D: Dissemination and policy advice

The work in this subtask covers horizontal activities related to subtasks A, B, and C. The objectives of this subtask are the implementation of targeted promotion activities based on the collective work results; production of dissemination material for external communication; the implementation of knowledge transfer measures towards the technical stakeholders; the development of instruments and their provision for policy makers and the creation and promotion of certification and standardisation schemes. The subtask is structured as follows:

D1: Web site

A website included into the IEA SHC portal will be established. This website will profit from a lot of mirror sites present among the participants of this Task, benefitting from their popularity to increase the number of vizualised pages.
This website will firstly present the Task results but it should welcome as soon as possible the presentation of first results of certification and/or Quality label tools.
If available within the end of the Task work, a draft of a public database of labelled products will be presented in this website.

D2: Best Practices brochure

This activity is aimed at producing a High quality brochure presenting the selected reduced number of Best practices. The length of the document should be nearly of 30 pages. Firstly in pdf format, this brochure will be printed out on demand of the participating countries as well as translated into national languages.
It main focus will be to constitute a media support to disseminate on the success stories available on solar cooling through several fundamental criteria : reliability, efficiency/performance, cost competitiveness.

D3: Simplified short brochure

A synthetic brochure will be produced so as to present the main results of the Task. This brochure will have maximum 4 to 6 pages and should underline what was the methodology used to progress on the development of Quality procedures for solar cooling and what could be the results on creation of tools for certification, labelling and policy support. This brochure will be edited jointly by the Subtask Leader (Greenchiller) and IEA SHC program.

D4: Guidelines for Roadmaps on Solar cooling

As a result of this work package and a summary of the whole Task activities, a list of recommendations for policy options to develop the industry will be published. This list will be structured so as to become guidelines for roadmaps on solar cooling.
So as to organise it as well as possible, a review of existing roadmaps on Solar Thermal technology will be done (Austria for example) taking inspiration of their own methodology and approach but updating it with Activities results and outputs. Beside, a review of the impact of existing incentive schemes will be carried out. This review will be closely linked to C1 activity but focussing on the efficiency of the schemes for the development of the local market (increase of turnover, improvement on quality of installations, ..).

These guidelines will include proposal for policy measures and how to make their promotion towards the local and national policy makers. If this activity leads to converging and coherent international policy measures, there could be an interest to create a final common worldwide roadmap for solar cooling, creating an added value to these guidelines.

D5: Updated specific training seminars adapted to the Quality procedure

The result of this work package is the update of the existing training material for installers and planners, already built during IEA SHC Task 38. This update will be on the technical side (available products, new components, etc..) but as well on the adaptation of the content to the Quality procedure concept.
The overall set of training material will be divided into different specific sets: one set for engineering companies, one for installers and one for building owner/contractor/utility/decision maker.
The training material will permit then to organise seminars for each targeted public in the interested participating countries.

D6: Outreach report

Customer and policy maker workshops
The task participants will organise at least once per year and in margin of one of the Expert meetings a international workshop dedicated to the policy makers and potential customers. This action will be organised during international conferences (INTERSOLAR in Munich or Sustainable Energy Week in Brussels for example) so as to touch important decision makers on solar cooling (investors, distributors, ESCO's, etc..). The workshops will present the results of the work done in the Task and try to constitute an important lobbying and promotion action. A mix and marriage of R&D institutes and industry partners will make presentations. The organisation of such workshops will be prepared by building inside this activity sets of presentations on solar cooling available for organisers. A list of contact in partnership with National Professional associations (solar, chiller, air conditioning, ..) will be built as well to create a useful database for organisers.

Industry workshops
The task participants will organise half a day national workshops dedicated to the industrial players involved in the sector (solar thermal manufacturers and installers, thermally driven cooling industry, planners). This will happen preferably once a year and before fixed experts meeting to as to test and make a feedback on the last developments achieved inside the Task. Thanks to these events, a full retrofit process will be achieved and this will permit to make participate industry interested bodies without implicating them directly and deeply inside the Task R&D work. Short report will have to be done for each event.

Industry newsletters
For further dissemination of the achieved results of the R&D activities a semi-annual electronic newsletter for the industrial players will be published.

Evidence for policy actions
This activity will be aimed at organising evidence for policy / lobbying actions to promote solar cooling : preparation of specific documents (after identifying an or several efficient funding mechanism(s), an existing scenario analysis tool provided by CSIRO could be used to identify and opti-

mise impact of evidence for policy actions), networking, preparation of press release, creation of articles relating the Task activity. Organisation of meetings with policy makers at national levels.

Effort

Estimated effort is 6 to 18 person-months per Participant (country) and 12 person-months for the Subtask Leader for the specific work for Subtask Leadership for the whole duration of the Task.

Deliverables

- D-D1: Website dedicated to the Task
- D-D2: Best practices high quality brochure,
- D-D3: Simplified short brochure,
- D-D4: Guidelines for Roadmaps on Solar cooling,
- D-D5: Training activity:
  - D5.1: Sets of training material package
  - D5.2: Training seminars feedback and description report
- D-D6: Outreach report
  - D6.1: Customer and policy maker workshops,
  - D6.2: Organising national industry workshops, industry workshops in national languages in participating countries addressing target groups (related to Experts meetings)
  - D6.3: Publishing a semi-annual e-newsletter for the industry
  - D6.4 Report on lobbying actions describing all the actions and their impacts

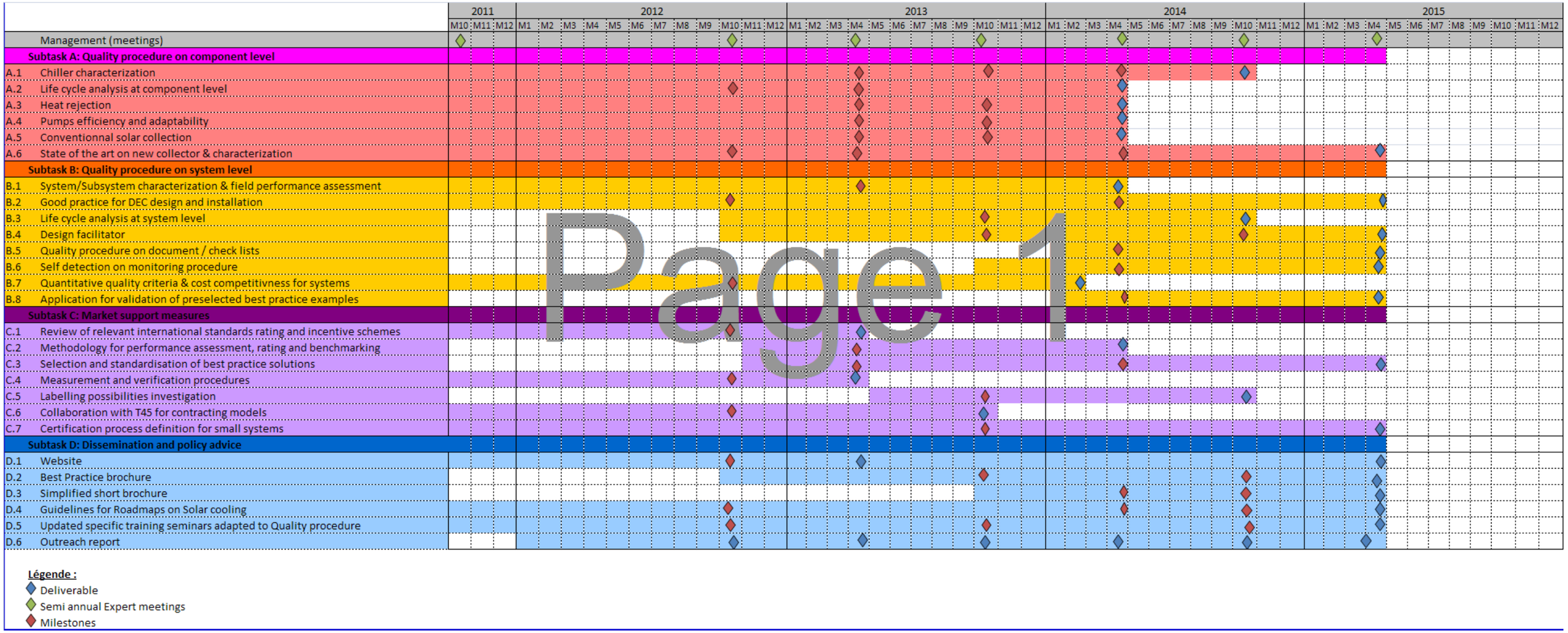
2 Information plan

The following documentation or information measures are planned during the course of the Task (corresponding Subtask in brackets):

- Report on best practices on solar collection components for quality, reliability and cost effectiveness (A)
- Quality procedure document/check lists guidelines for solar cooling (B),
- Self detection on monitoring procedure report (B)
- Soft tool package for the fast pre-design assessment of successful projects (B),
- Report and database of existing international standards, rating and incentive systems relevant to Solar Cooling (C)
- Report on the rating, measurement and verification of solar cooling performance and quality (C)
- Report on the selected standard engineering systems (C),
- Report on alternative uses of the developed standards and rating framework (C).
- Technical report about the results of the Life Cycle Assessment of Solar Cooling systems and LCA tool (A+B),
- Website dedicated to the Task (D)
- Training material for installers and planners and training seminars feedback report (D) ,
- Semi-annual e-newsletter for the industry (D),
- Industry workshops in national languages in participating countries addressing target groups (related to Experts meetings) (D),
- Best practices high quality brochure (D) : 30 pages
- Simplified short brochure (D) jointly edited by the Subtask Leader (Greenchiller) and IEA SHC program
- Guidelines for Roadmaps on Solar Cooling (D) and possibly general international Roadmap on Solar cooling (optional)

3 Work plan and milestones

The work plan for the whole task is shown in the following Gantt chart.



Working Package Structure

Subtask A: Quality procedure on component level
A1: Chiller characterization
A2: Life cycle analysis at component level
A3: Heat rejection
A4: Pumps efficiency and adaptability
A5: Conventional solar collection
A6: State of the art on new collector & characterization

Subtask B: Quality procedure on system level
B1: System/Subsystem characterization & field performance assessment
B2: Good practice for DEC design and installation
B3: Life cycle analysis at system level
B4: Simplified design tool used as a reference calculation tool : design facilitator
B5: Quality procedure document/check lists
B6: Self detection on monitoring procedure
B7: Quantitative quality and cost competitiveness criteria for systems
B8: Application for validation of preselected best practice examples

Subtask C: Market support measures
C1: Review of relevant international standards rating and incentive schemes
C2: Methodology for performance assessment, rating and benchmarking
C3: Selection and standardisation of best practice solutions
C4: Measurement and verification procedures
C5: Labelling possibilities investigation
C6: Collaboration with T45 for contracting models
C7: Certification process definition for small systems

Subtask D: Dissemination and policy advice
D1: Web site
D2: Best Practices brochure
D3: Simplified short brochure
D4: Guidelines for Roadmaps on Solar cooling
D5: Updated specific training seminars adapted to the Quality procedure
D6: Outreach report

Milestone Table

The following tables contain the major milestones of each Subtask

Subtask A: Quality procedure on component level		
No	**Description**	**Completed by month**
M-A1.1	Definition of a common testing protocol	18
M-A1.2	Draft report on characterization methods for chiller's behaviour characterisation over the entire operating range that is typical for solar cooling	24
M-A1.3	Chillers testing activities running	30
M-A1.4	Report final: Experimental activities on chillers characterisation for solar cooling	36
M-A2.1	Creation of the assemblies related to the plant components and materials	12
M-A2.2	Draft report on determination of the impact factors parametric analysis	18
M-A2.3	Report final version: Data base of life cycle inventories for components for LCA method tool	30
M-A3.1	Template for report on heat rejection	18
M-A3.2	Draft report on Technical report on heat rejection ready	24
M-A3.3	Report final version: Technical report on heat rejection	30
M-A4.1	Template for report on pumping systems	18
M-A4.2	Draft report on pumping systems	24
M-A4.3	Final report on pumping systems	30
M-A5.1	Template for report on best practices on solar collection components for quality, reliability and cost effectiveness	18
M-A5.2	Draft report on best practices on solar collection components for quality, reliability and cost effectiveness	24
M-A5.3	Final version: report on best practices on solar collection components for quality, reliability and cost effectiveness	30
M-A6.1	Start extensive market overview of concentrating collectors	12
M-A6.2	Creation of the database on market available concentrating technologies	18
M-A6.3	Updated version of the database	30
M-A6.4	Final version of the database on concentrating collectors	42

Subtask B: Quality procedure on system level		
No	**Description**	**Completed by month**
M-B1.1	Template structure report on system/subsystem characterization & field performance assessment	18
M-B1.2	Delivery Report on system/subsystem characterization & field performance assessment	30
M-B2.1	First status on good practice for DEC design and installation	12
M-B2.2	Second status on good practice for DEC design and installation	30
M-B2.3	Delivery : Collection of good practice for DEC design and installation	42
M-B3.1	Template for LCA method tool	24
M-B3.2	Delivery of LCA method tool	36
M-B4.1	Template for software tool for the fast pre-design and performance estimation of best practice projects	24
M-B4.2	Draft of software tool for the fast pre-design and performance estimation of best practice projects	36
M-B4.3	Delivery of software tool for the fast pre-design and performance estimation of best practice projects	42
M-B5.1	Template for quality procedure document/check lists guidelines	30
M-B5.2	Delivery of Quality procedure document/check lists guidelines	42
M-B6.1	Template for self detection on monitoring procedure	30
M-B6.2	Delivery report on self detection on monitoring procedure	42
M-B7.1	Method to collect criteria to qualify the quality and cost competitiveness of solar cooling systems	12
M-B7.2	Collection of criteria to qualify the quality and cost competitiveness of solar cooling systems	28
M-B8.1	Template for report on validation of preselected best practice examples	30
M-B8.2	Delivery Report on validation of preselected best practice examples	42

Subtask C: Market support measures		
No	**Description**	**Completed by month**
M-C1.1	Template for review of relevant international standards rating and incentive schemes	12
M-C1.1	Delivery Report : review of relevant international standards rating and incentive schemes	18
M-C2.1	Template for Methodology for performance assessment, rating and benchmarking	18
M-C2.2	Delivery Report : Methodology for performance assessment, rating and benchmarking	30
M-C3.1	Template for Selection and standardisation of best practice solutions	18
M-C3.2	Draft of Selection and standardisation of best practice solutions	30
M-C3.3	Delivery : Selection and standardisation of best practice solutions	42
M-C4.1	Draft of Measurement and verification procedures	12
M-C4.2	Delivery : Measurement and verification procedures	18
M-C5.1	Template report structure on Labelling possibilities	24
M-C5.2	Delivery report on Labelling possibilities	36
M-C6.1	Status on existing work in T45 on contracting models	12
M-C6.2	Delivery : report on contracting models	24
M-C7.1	Template report structure on certification process definition for small systems	24
M-C7.2	Delivery report on certification process definition for small systems	42

Subtask D: Dissemination and policy advice		
No	**Description**	**Completed by month**
M-D1.1	Presentation of existing IEA Websites regarding solar cooling	12
M-D1.2	Delivery: Website	18
M-D2.1	Template for best practice installations	24
M-D2.2	Draft report on best practice brochure	36
M-D2.3	Delivery Report – Best practice brochure	42
M-D3.1	Template for quality procedure methodology	30
M-D3.2	Draft report on quality procedures	36
M-D3.3	Delivery Report – Simplified short brochure	42
M-D4.1	Presentation of existing Roadmaps on solar cooling	12
M-D4.2	Template for Roadmap methodology	30
M-D4.3	Draft report on guidelines for Roadmaps on solar cooling	36
M-D4.4	Delivery Report – Guidelines for Roadmaps on solar cooling	42
M-D5.1	Presentation of existing training material on solar cooling	12
M-D5.2	Template for updated specific training seminar material	24
M-D5.3	Draft report on updated specific training seminars	36
M-D5.4	Delivery Report – Updated specific training seminars adapted to the quality procedure	42
M-D6.1	Organisation of costumer and policy maker workshops	42
M-D6.2	Organising national industry workshops, industry workshops in national languages in participating countries addressing target groups (related to Experts meetings)	42
M-D6.3	Publishing a semi-annual e-newsletter for the industry	42
M-D6.4	Delivery Report – Outreach report on lobbying actions describing all the actions and their impacts	42

4 Contributors/participants

Country	Organization	Short name /Abbreviation
Australia	Commonwealth Scientific and Industrial Research Organisation	CSIRO
	SOLEM Consulting	SOLEM
Austria	Austrian Institute of Technology	AIT
	ASIC- Austria Solar Innovation Center	ASIC
	AEE INTEC, AEE - Institute for Sustainable Technologies	AEE INTEC
	Institut für Wärmetechnik IWT at Graz University of Technology	IWT Graz
	University of Innsbruck	UIBK
	Solarinstallation & Design S.O.L.I.D. GmbH, Graz	S.O.L.I.D.
Belgium	Université de Liège	ULG
Canada	Thermosol Consulting	THERMOSOL
	AZTEC solar	AZTEC Solar
	Kern Community College District	KCCD
France	Université de la Réunion	PIMENT
	EDF Optimal Solutions	EDFOS
	TECSOL S.A.	TECSOL
	Université de la Rochelle	LEPTIAB
	Institut national d'énergie solaire - CEA	CEA INES
Germany	AETEBA GmbH	AETEBA
	AbKM Klimatechnik GmbH	AbKM
	Institut für Luft- und Kältetechnik Gemeinnützige Gesellschaft mbH	ILK Dresden
	Universität Kassel - Institut für Thermische Energietechnik	ITE Kassel
	Fraunhofer-Institut für Solare Energiesysteme ISE	Fraunhofer ISE
	Fraunhofer Umsicht	Fraunhofer Umsicht
	Bayerisches Zentrum für Angewandte Energieforschung e.V.	ZAE Bayern
	Centre of Applied Research Sustainable Energy Technology Stuttgart University of Applied Sciences	ZAFH.net
	Industrial Solar GmbH	Industrial Solar
	Sortech GmbH	SORTECH
	Invensor GmbH	INVENSOR
	Green Chiller Association	Green Chiller
Italy	Politecnico di Milano	POLIMI
	EURAC research	EURAC research
	Università degli Studi di Palermo, Dip. Ricerche Energetiche e Ambientali	UNIPA / DREAM
	Università degli studi di Catania, (Italy) Dipartimento di Ingegneria Industriale e Meccanica	UNICT - DIIM

Country	Organization	Short name /Abbreviation
Latvia	Riga Technical University	RTU LV
Malta	Department of Mechincal Engineering University of Malta	UNI MALTA
Mexico	Centro de Investigación en Energía, Universidad Nacional Autónoma de Mexico	UNAM
Singapore	Solar Energy Research Institute NTU	SERIS NTU
Spain	AIGUASOL ENGINYERIA. Sistemes avançats d'energia solar tèrmica s.c.c.l.	AIGUASOL
	Instituto de Ciencias de la Construcción Eduardo Torroja (CSIC)-Universidad Carlos III de Madrid	CARTIF
Sweden	Climatewell	CLIMATEWELL
Switzerland	Institut für Solartechnik SPF	Institut für Solartechnik SPF
	SORANE SA	SORANE
	NEP Europe GmbH	NEP SOLAR

In the following tables the recent status of participation of all participants (countries) and partners (institutions, companies) is documented including a short description of their main activities within the Task.

Subtask A: Quality procedure on component level		
Participant (Country)	**Partner**	**Main activities in the Subtask**
Australia	CSIRO	A1 chiller characterisation facilities available
Austria	AIT	A2: Life cycle analysis at component level A3: Heat rejection A4: Pumps efficiency and adaptability
	ASIC	A3: Heat rejection
	AEE INTEC	A2: Life cycle analysis at component level A3: Heat rejection A4: Pumps efficiency and adaptability A6: State of the art on new collector & characterization
	UIBK	A1: Chiller characterization A2: Life cycle analysis at component level A3: Heat rejection (A4: Pumps efficiency and adaptability)
	S.O.L.I.D.	A3: Heat rejection A4: Pumps efficiency and adaptability
Belgium	ULG	A1 chiller characterisation A4: Pumps efficiency and adaptability
France	PIMENT	A3: Heat rejection
	LEPTIAB	A2: Life cycle analysis at component level
Germany		

Subtask A: Quality procedure on component level		
	Fraunhofer ISE	A1: Chiller characterization A5: Conventional solar collection
	ZAE Bayern	A1: Chiller characterization A3: Heat rejection A4: Pumps efficiency and adaptability
	Industrial Solar	A6: State of the art on new collector & characterization
	Green Chiller	A3: Heat rejection
Italy	POLIMI	**Subtask Leadership** A1: Chiller characterization
	EURAC research	A1: Chiller characterization A3: Heat rejection
	UNIPA / DREAM	A1: Chiller characterization A2: Life cycle analysis at component level
Spain	CARTIF	A1: Chiller characterization A3: Heat rejection A4: Pumps efficiency and adaptability A5: Conventional solar collection A6: State of the art on new collector & characterization
	AIGUASOL	A6: State of the art on new collector & characterization
Sweden	CLIMATEWELL	A1: Chiller characterization A3: Heat rejection A4: Pumps efficiency and adaptability

Subtask B: Quality procedure on system level		
Participant (Country)	**Partner**	**Main activities in the Subtask**
Australia	CSIRO	B1: System/ subsystem characterisation facilities available B2: Field performance assessment
Austria	AIT	B2: Good practice for DEC design and installation B3: Life cycle analysis at system level B5: Quality procedure document/check lists B7: Quantitative quality and cost competitiveness criteria for systems
	ASIC	B5: Quality procedure document/check lists
	AEE INTEC	B1: System/Subsystem characterization & field performance assessment B2: Good practice for DEC design and installation B3: Life cycle analysis at system level B5: Quality procedure document/check lists B6: Self detection on monitoring procedure B7: Quantitative quality and cost competitiveness criteria for systems B8: Application for validation of preselected best practice examples
	UIBK	B3: Life cycle analysis at system level

Subtask B: Quality procedure on system level		
		B5: Quality procedure document/check lists B6: Self detection on monitoring procedure B7: Quantitative quality and cost competitiveness criteria for systems
	S.O.L.I.D.	B5: Quality procedure document/check lists B6: Self detection on monitoring procedure
Belgium	ULG	B1: System/Subsystem characterization & field performance assessment B4: Simplified design tool used as a reference calculation tool : design facilitator
France	PIMENT	B1: System/Subsystem characterization & field performance assessment B4: Simplified design tool used as a reference calculation tool : design facilitator B5: Quality procedure document/check lists B6: Self detection on monitoring procedure B7: Quantitative quality and cost competitiveness criteria for systems
	EDFOS	B4: Simplified design tool used as a reference calculation tool : design facilitator B7: Quantitative quality and cost competitiveness criteria for systems
	TECSOL	B4: Simplified design tool used as a reference calculation tool : design facilitator B5: Quality procedure document/check lists B6: Self detection on monitoring procedure B7: Quantitative quality and cost competitiveness criteria for systems B8: Application for validation of preselected best practice examples
	CEA INES	B1: System/Subsystem characterization & field performance assessment B4: Simplified design tool used as a reference calculation tool : design facilitator B5: Quality procedure document/check lists B6: Self detection on monitoring procedure B7: Quantitative quality and cost competitiveness criteria for systems
	LEPTIAB	B1: System/Subsystem characterization & field performance assessment B2: Good practice for DEC design and installation B3: Life cycle analysis at system level B4: Simplified design tool used as a reference calculation tool : design facilitator B7: Quantitative quality and cost competitiveness criteria for systems B8: Application for validation of preselected best practice examples

Subtask B: Quality procedure on system level		
Germany	AETEBA	B6: Self detection on monitoring procedure
	ILK Dresden	B1: System/Subsystem characterization & field performance assessment
	Fraunhofer ISE	**Subtask Leadership** B1: System/Subsystem characterization & field performance assessment B7: Quantitative quality and cost competitiveness criteria for systems B8: Application for validation of preselected best practice examples
	ZAE Bayern	B1: System/Subsystem characterization & field performance assessment B4: Simplified design tool used as a reference calculation tool : design facilitator B5: Quality procedure document/check lists B7: Quantitative quality and cost competitiveness criteria for systems
	ZAFH.net	B6: Self detection on monitoring procedure
Italy	POLIMI	B1: System/Subsystem characterization & field performance assessment B2: Good practice for DEC design and installation B4: Simplified design tool used as a reference calculation tool : design facilitator B7: Quantitative quality and cost competitiveness criteria for systems B8: Application for validation of preselected best practice examples
	EURAC research	B1: System/Subsystem characterization & field performance assessment B7: Quantitative quality and cost competitiveness criteria for systems B8: Application for validation of preselected best practice examples
	UNIPA / DREAM	B2: Good practice for DEC design and installation B3: Life cycle analysis at system level
Spain	CARTIF	B1: System/ subsystem characterisation facilities available
	AIGUASOL	B2: Good practice for DEC design and installation B4: Simplified design tool used as a reference calculation tool : design facilitator B5: Quality procedure document/check lists B6: Self detection on monitoring procedure

Subtask C: Market support measures		
Participant (Country)	**Partner**	**Main activities in the Subtask**
Australia	CSIRO	**Subtask leadership** C1: Australian standards & incentives provision C7: Small systems standards development

Austria	AIT	C3: Selection of best practices
	ASIC	C3: Selection of best practices
	AEE INTEC	C3: Selection of best practices
	S.O.L.I.D.	C3: Selection of best practices C6: Collaboration with T45 for contracting models
Canada	THERMOSOL	C3: Selection of best practices
France	PIMENT	C2: Methodology for institutions on performance requirements C5: Labelling possibilities investigation C7: Certification process definition for small systems
	EDFOS	C5: Labelling possibilities investigation
	TECSOL	C3: Selection of best practices C2: Methodology for institutions on performance requirements C6: Collaboration with T45 for contracting models
	CEA INES	C2: Methodology for institutions on performance requirements C6: Collaboration with T45 for contracting models
	LEPTIAB	C2: Methodology for institutions on performance requirements
Germany		
	Fraunhofer ISE	C2: Methodology for institutions on performance requirements C7: Certification process definition for small systems
	ZAE Bayern	C2: Methodology for institutions on performance requirements C5: Labelling possibilities investigation
	Green Chiller	C3: Selection of best practices
Italy		
	UNIPA / DREAM	C5: Labelling possibilities investigation
Spain	CARTIF	C2: Methodology for institutions on performance requirements
Sweden	CLIMATEWELL	C1: Review of relevant international standards rating and incentive schemes C2: Methodology for institutions on performance requirements C3: Selection of best practices C4: Measurement and verification procedures

Subtask D: Dissemination and policy advice		
Participant (Country)	**Partner**	**Main activities in the Subtask**
Australia	CSIRO	D4: Road-mapping contributions D5: Training for Australian industry
	SOLEM	D6: Outreach report
Austria	AIT	D2: Best Practices brochure D4: Guidelines for Roadmaps on Solar cooling D5: Updated specific training seminars adapted to the Quality procedure

		D6: Outreach report
	ASIC	D6: Outreach report
	AEE INTEC	D2: Best Practices brochure D5: Updated specific training seminars adapted to the Quality procedure D6: Outreach report
	UIBK	D5: Updated specific training seminars adapted to the Quality procedure D6: Outreach report
	S.O.L.I.D.	D2: Best Practices brochure D6: Outreach report
Canada	THERMOSOL	D2: Best Practices brochure D6: Outreach report
France	PIMENT	D6: Outreach report
	EDFOS	D6: Outreach report
	TECSOL	D1: Web site D2: Best Practices brochure D4: Guidelines for Roadmaps on Solar cooling D6: Outreach report
	LEPTIAB	D2: Best Practices brochure D6: Outreach report
	CEA INES	D6: Outreach report
Germany	AETEBA	D6: Outreach report
	ILK Dresden	D6: Outreach report
	Fraunhofer ISE	D6: Outreach report
	ZAE Bayern	D6: Outreach report
	ZAFH.net	D6: Outreach report
	Industrial Solar	D6: Outreach report
	INVENSOR	D6: Outreach report
	Green Chiller	**Subtask leadership** D1: Web site D2: Best Practices brochure D3: Simplified short brochure D4: Guidelines for Roadmaps on Solar cooling D5: Updated specific training seminars adapted to the Quality procedure D6: Outreach report
Italy	POLIMI	D6: Outreach report
	EURAC research	D6: Outreach report
	UNIPA / DREAM	D6: Outreach report
Singapore	SERIS	D4: Guidelines for Roadmaps on Solar cooling D6: Outreach report