European Cooperation in the field of Scientific and Technical Research - COST -

Brussels, 21 November 2012

TU1205

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action TU1205: Building Integration of Solar Thermal Systems (BISTS)

Delegations will find attached the Memorandum of Understanding for COST Action as approved by the COST Committee of Senior Officials (CSO) at its 186th meeting on 20 - 21 November 2012.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action TU1205
BUILDING INTEGRATION OF SOLAR THERMAL SYSTEMS (BISTS)

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4154/11 "Rules and Procedures for Implementing COST Actions", or in any new document amending or replacing it, the contents of which the Parties are fully aware of.

2. The main objective of the Action is to develop new novel solar thermal systems solutions suitable for building integration, definition of key parameters for their characterisation, modelling, simulation, demonstration and dissemination activities.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 36 million in 2012 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter V of the document referred to in Point 1 above.

A. ABSTRACT AND KEYWORDS

Energy use in buildings represents 40% of the total primary energy used in the EU and therefore developing effective energy alternatives is imperative. Solar thermal systems (STS) will have a main role to play as they contribute directly to the heating and cooling of buildings and the provision of domestic hot water. STS are typically mounted on building roofs with no attempt to incorporate them into the building envelope, creating aesthetic challenges and space availability problems. The Action will foster and accelerate long-term development in STS through critical review, experimentation, simulation and demonstration of viable systems for full incorporation and integration into the traditional building envelope. Viable solutions will also consider economic constraints, resulting in cost effective Building Integrated STS. Additionally, factors like structural integrity, weather impact protection, fire and noise protection will be considered. The most important benefit of this Action is the increased adoption of Renewable Energy Systems (RES) in buildings. Three generic European regions are considered; Southern Mediterranean, Central Continental and Northern Maritime Europe, to fully explore the Pan-European nature of STS integration. The Action consortium presents a critical mass of European knowledge, expertise, resources, skills and R&D in the area of STS, supporting innovation and conceptual thinking.

A.2 Keywords: Building integration, Solar thermal systems, Renewable energy, Envelope integrity problems, Cost effective solutions

B. BACKGROUND

B.1 General background

The Renewable Energy Framework Directive sets a target of 20% for renewables by 2020. Buildings account for 40% of the total primary energy requirements in the EU and are responsible for 30% of the generated greenhouse gas emissions. Therefore, developing effective energy alternatives for buildings is imperative. This energy is used primarily for heating and cooling of buildings and for the provision of hot water for domestic use. One way to reduce this dependence on fossil fuels is the use of renewable energy sources and systems which are generally environmentally benign. In some countries, such as Cyprus, RES and in particular solar water heating are used extensively, with 93% of all domestic dwellings currently equipped with such a system. The benefits of such systems are well known but one area of concern has been their

integration. Most solar collecting components are mounted on building roofs with no attempt to incorporate them into the building envelope. In many instances they are actually seen as a foreign element of the building roof. Many architects, irrespective of the potential benefits, object to this use of renewable energy systems due to this fact alone. It is therefore necessary to develop techniques that better integrate solar collectors within the building envelope and/or structures which should be done in a way that blends into the aesthetic appearance and form of the building architecture in the most cost effective way.

The Energy Performance of Buildings Directive (EPBD) requires that RES are actively promoted in offsetting conventional fossil fuel use in buildings. A better appreciation of solar thermal system (STS) integration will directly support this objective, leading to an increased uptake in the application of renewables in buildings. This uptake of RES in buildings is expected to rise dramatically in the next few years. This is further augmented by a recast of the Directive which specifies that the buildings in the EU should be nearly zero energy consumption (residential and commercial buildings by the year 2020 and public buildings by 2018, respectively). Meeting building thermal loads will be primarily achieved through an extensive use of renewables, following standard building energy saving measures, such as good insulation or advanced glazing systems. Solar thermal systems are expected to take a leading role in providing the thermal energy needs, as they can contribute directly to the building heating, cooling and domestic hot water requirements.

The Action consortium presents a critical mass of European knowledge, expertise, resources, skills and R&D in the area of solar thermal, that if harnessed would create a bridge to support the flow of new thinking and innovative ideas and concepts to further the development of the industry. Through collated consultation and enquiry, experimental investigation and development of modelling and simulation techniques, real and significant advances in Building Integrated Solar Thermal Systems (BISTS) can be achieved. This network will provide the immediate sharing of nationally based research and enable the establishment of common platforms to accelerate trans-national research projects in the area of building integrated solar thermal energy systems.

Many research centres and universities carry out research in the area of STS. This important, but distributed research encompasses modelling, simulation, design and fabrication of new collector systems and the wider performance evaluation and economic feasibility studies of STS. It is a fact however, that the building integration of RES is routinely overlooked as a complimentary element in their development. This Action therefore aims to network all this effort in an attempt to join forces and focus resources to develop aesthetic and financially acceptable solutions that are appropriate to STS integration in the modern built environment. Such an effort cannot be fully explored in other research framework programs as networking is secondary to their stated targets.

The main advantage of carrying out this project within the COST framework is the creation of a platform from which scientists and engineers with many years experience in the area of STS design and operation will work together in a concerted Action to generate viable solar solutions directed at the future integration of STS into buildings. This will be achieved mainly through the networking offered by the Action and knowledge transfer which will be enabled through Short Term Scientific Missions to be held in each partner Institute, facilitating the exchange of post-graduate students and post doctoral researchers. Training Schools will be established and held for 3-4 days in three years (except the first one) of the Action with a Symposium held in Year 2 to increase awareness of the progress made by the network and possibly receive feedback from the industry with respect to the suggested solutions. Finally, an International Conference will be held at the end of the Action to disseminate all findings.

The scientific innovation concerns the development of novel BISTS solutions through modelling, simulation and experimental investigation. This network will provide the immediate sharing of nationally based research and enable the establishment of common platforms to accelerate transnational research projects in the area of BISTS. In this way ideas and suggested solutions will be shared by all partners and instead of performing scattered research a concerted one will bring more benefit. This should explore also studies carried out beyond the EU so as to benefit from their work and findings.

B.2 Current state of knowledge

Previous research in this area has been largely diverse and defocused. Except a very few examples relating to building façade installed transpired air collectors, which until recently were protected by a patent, no other serious effort has been done in this area. Nobody has explored the range of building types/structures and the myriad of corresponding mounting structures that are possible to be employed.

There is no relevant research currently exploring this area at a large scale for STS. The International Energy Agency (IEA) Task 35 “PV/Thermal Systems” and Tack 40 “Towards Net Zero Solar Buildings”, which group a number of research centres and universities from various countries deal with building integrated photovoltaics, with little overlap into thermal applications exploiting only the thermal energy created by the building integrated PV.

Recently, a first approach towards BISTS was initiated by the Solar Heating and Cooling program (SHC) of the IEA, creating a Task named Successful Architectural Implementation of Solar Thermal Systems Project Database. This project database was started by Task 39 with support from

Task 41 (Solar Energy and Architecture) and Task 37 (Advanced Housing Renovation with Solar and Conservation). The aim is to define the criteria to develop new solar thermal technology that achieves proper building integration. These criteria are grouped into three main sections: functional, constructive and formal. The first refers to multifunctional aspects of solar collectors, i.e., shading elements; the second regards the constructive properties of the solar collector (insulating properties and waterproofing); and the last criteria concerns the characteristics of the collector which make it more or less suitable for building integration (colour, shape and size). In this Action many more aspects of BISTS will be investigated and scientists from both COST and non-COST countries participating in the above IEA Tasks may join the Action to offer their expertise.

The Action is innovative because it directly connects scientists working in the area of solar thermal systems, who have identified the building integration of these systems, and the corresponding research necessary, in order to facilitate their exploitation and wider deployment in the built environment. This is more important than ever given the growth in the number of renewable technologies used in buildings as a consequence of the recast of EPBD.

Other related research is on coloured solar thermal façade collectors carried out under the FP5 R&D program COLOURFACE. The project had as its main objective the development of a set of aesthetically-coloured thickness-insensitive spectrally selective solar absorber paints. They focused on environmentally friendly binder and pigment systems suited for glazed solar facade collectors, which could be produced by respective SME-companies and applied by collector manufacturers by spraying or brushing in the workshop or at the building itself. Guidelines for the application of solar facade collectors as part of the building envelope based on experimentally validated studies of their energetic performance, architectural appearance and impact on the building physics were developed.

Two German collector manufacturers have also developed collectors especially suitable for façade. The former is a flat-plate collector which also insulates the façade and can be used to modernize large facades of existing buildings. The latter is a semi-transparent vacuum tube collector including solar shading for the rooms behind the façade.

B.3 Reasons for the Action

The main motivation for the Action is the collective concentration of resources and the targeted focusing of scientists who are involved in the design, development and evaluation of solar thermal systems. The Action will foster and accelerate long-term (technological) improvement in STS mainly through critical review, experimentation, simulation and demonstration of viable systems for

full incorporation and integration into the traditional building envelope. Feasible solutions will also consider economic constraints, resulting in cost effective Building Integrated STS. Additionally, factors like structural integrity, weather impact protection, fire and noise protection will be considered. The most important benefit of this Action is the increased adoption of RES in buildings. Three generic European regions are considered; Southern Mediterranean, Central Continental and Northern Maritime Europe, to fully explore the Pan-European nature of STS integration. The Action consortium presents a critical mass of European knowledge, expertise, resources, skills and R&D in the area of STS, which will support the creation of innovative ideas and concepts.
The Action will cover all forms of solar collecting methodologies with a particular focus on thermosiphonic units, integrated collector storage units, forced circulation systems, evacuated tube collector systems and various low concentration compound parabolic units. The ultimate objective is to produce a suite of market ready solutions/products and tools facilitating an easier route to market and their wider application. The Action will also consider the needs of the industry (manufacturers, consultants, installers) and will try to suggest suitable solutions with the ultimate objective of increasing the penetration of STS to buildings.

B.4 Complementarity with other research programmes

There doesn't appear to be any other similar program taking place under any other projects in Europe. This makes this Action unique. In view of the upcoming introduction of renewable energy systems into the buildings as a consequence of EPBD and its recast, it is imperative to be able to find possible solutions to the integration of these systems onto the building envelope.
The general theme of this Action is included as a separate topic in the upcoming FP7 call. The scope of the FP7 topic however is too narrow (i.e., covers only facades, it has only short term objectives and offers limited networking opportunities) while the Action may lay solid foundation for a wider range of relevant topics in Horizon 2020.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The aim of the Action is to foster and accelerate long-term progress in the integration of renewable energy systems in buildings in Europe through market evaluation and expectation, design, development, characterisation and simulation of building integrated STS solutions and by addressing concerns that this system integration will generate. Coupled with aesthetic and

architectural challenges, many practical issues need to be resolved; for example rain-water sealing, protection from overheating (thus avoiding increased cooling loads during the summer) and fire safety are just some of the pressing concerns that need to be addressed and require a cross disciplinary involvement of experts in the fields of renewable energy systems, architecture and materials. As STSs are latitude dependant with respect to façade application as explained before, three generic European regions are considered; Southern Mediterranean, Central Continental and Northern Maritime Europe, to fully explore the Pan-European nature of STS integration. The STS for building applications currently developed focus on technical optimisation. Under the Action a full understanding of the economic factors and commercial environment that will direct full implementation of BISTS will be carried out. This requires that developed BISTSs will be near-to-market ready products (based upon the ongoing individual partner research projects), as both factory mass manufactured form or as a bespoke system, specifically tailored to a unique situation. Through on-going direct consultation with all relevant industry stakeholders, directed experimental investigation, problem identification and modelling/simulation resolution through to demonstration, the presented consortium of European partners, with extensive expertise in STSs can collectively pool resources to fundamentally change the accepted solar installation methodologies that affects residential, commercial (offices) and industrial buildings throughout Europe. The deliverables of the Action include the publication of booklets with material from training schools, a symposium, an international conference, journal publications and a handbook with the BISTS solutions developed as part of the Action aimed at solar energy researchers and building industry professionals. The booklets will be given to the students participating to the training schools and the handbook will be available to scientists, researchers and engineers.

C.2 Objectives

The objectives for this Action focus on creating a platform from which a working environment is developed that generates methods to further the integration of STS in buildings. To ensure the success of the Action the following objectives are set:

- Development of new novel STS solutions suitable for building integration across the three generic European regions considered.
    - The developed STS will be based on both market available systems (which will be modified for building integration) and new innovative systems. The

collective expertise of the Action consortium in STS development will be utilised.

  - Structural/material developments relating to the thermal resistance of the building element, integrity of the element to the weather impact and fire and noise protection will be reviewed.

- Definition of a set of key parameters for the BISTS characterization, taking into consideration the thermal performance, building functionality and aesthetic aspects.
- Development of standardised range of methodologies for evaluating BISTS. Comparison of façade and roof integration for different climates and applications (heating, cooling and domestic hot water).
- Modelling and simulation of STS including optical and thermal modelling for different building integration scenarios and new models of the developed solutions.
- Application of developed STS solutions for building integration including fabrication, characterisation and demonstration of prototypes.
- Dissemination of Action activities and findings in website and various publications. Booklets will be published as part of this Action and will be disseminated in training schools. The findings will also be presented in conference and journal publications, where applicable and a handbook will be written giving details of all possible solutions.

C.3 How networking within the Action will yield the objectives?

The scientific objectives of the Action will be achieved through the programme which is outlined in section D. Networking within the Action is essential to the achievement of its non-scientific objectives which are the responsibility of Working Group 4 (WG4). These include the organisation/coordination of all meetings between the Actions participants, Training Schools, Symposium and an International Conference; organisation of stakeholder meetings and Workshops; scientific exchanges between Action participants; archiving and dissemination of documentation on the Action website; and publication of the scientific outcomes of the Action in scientific and related trade journals. The analysis of these objectives is presented in section E.2.

C.4 Potential impact of the Action

The single most important benefit that can be derived through this Action is the increased adoption of renewables in buildings by facilitating greater market penetration of building integration of solar thermal systems. The individual benefits can be expressed through:

- Increased range of potential STS options, greater choice and wider application contributing to the achievement of targets outlined above by EU and by individual nations.
- National partnerships fostering a greater level of co-operation and access to specialism related to the Action, providing a platform that will allow the cross fertilisation of new ideas and concepts to meet the specific challenges that face the solar industry.
- Through dissemination activities such as conferences, workshops, symposium and seminars, where all relevant stakeholders, including architects, construction professionals, building services engineers, policy makers and building component and solar collector manufacturers will gain an insight into RES integration in buildings.
- Aesthetic integration, architectural rhythms and themes.
- Structural/material developments relating to the thermal resistance of the building element, integrity of the element to the weather impact and fire and noise protection.

The potential impact will result in increased knowledge of BISTS application by improving cost-efficiencies and aesthetic integration into the buildings. The new software models for integrated simulation of BISTS (e.g. new models in TRNSYS) will lead to relevant investment by commercial software companies. The activities will result in the enhancement and expansion of the scope of the EPBD. Also the introduction of new technologies and materials into the building sector is expected and relevant impact on the standards in the field. There will also be an impact on manufacturers, designers, architects, installers and the wider building construction industry.

C.5 Target groups/end users

Groups interested in the outcomes of this Action include both Government officials having the responsibilities for the application of EPBD in Member States, the relevant industry, including solar collector manufacturers, building developers and consultants and other professionals working in the

field, and different federations (like Engineering and professional Associations), the industry federation, Energy Agencies, energy producers, energy distribution companies and generally community groups and associations across EU with an interest in green energy solutions.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

This COST Action will focus on the coordination of current research undertaken through national programmes in three scientific areas (1) Development of new innovative methods for building integration of STS; (2) Modelling and simulation of new BISTS and their behaviour as a renewable energy system (RES); (3) Investigation of new applications for innovative integration of STS in various application areas like domestic, commercial and industrial buildings. Three Working Groups (WG) will be set up to co ordinate research within each theme and a fourth one is dedicated to dissemination activities.

The scientific exchange resulting from the Action will facilitate the cross fertilisation between these areas to obtain improved results in the RES and will pave the way to new scientific understanding and technological advancement in the area of BISTS and modelling techniques.

Dissemination of the research between the partners within the Action will be undertaken through the STSMs and Training Schools and to end users through the Symposium and International Conference and website.

D.2 Scientific work plan methods and means

The scientific innovation relates to the development of novel building integrated STS. There is a critical mass of European knowledge, expertise, resources, skills and R&D in the area of solar thermal, that if harnessed creates a bridge to support the flow of new thinking and innovative ideas and concepts to further the development of the industry. Through collated consultation and enquiry, experimental investigation and development of modelling and simulation techniques, real and significant advances in building integrated solar thermal energy systems can be achieved. This network will provide the immediate sharing of nationally based research and enable the establishment of common platforms to accelerate trans-national research projects in the area of building integrated solar thermal systems.

The potential impact is an increasing knowledge base, with an emphasis on viable building integrated STS solutions through an improved practical understanding and cost-efficiency awareness and reduction in building energy and effective heating and cooling load management. The activities will bring a broadening impact upon the scope of the Energy Performance of Buildings Directive and its recast, whilst facilitating the introduction of new technologies into building sector, and knock-on effects on building related regulations, systems standards such as the on-site performance testing of solar collectors and installation practices as well as off-site constructed building elements with the STS directly integrated which could improve cost and reduce unwanted site waste.

Eight scientific tasks have been identified which will be undertaken through the above 3 Working Groups (WG). A fourth WG (WG4) will be set up to co-ordinate the dissemination activities and has four tasks as presented in section C.3 and E.2.

WG1. Development and characterisation of new BISTS

The objectives for WG1 are:

- Perform a literature review to determine the state of the art technological developments published in the area
- To develop new novel BISTS solutions
- To develop standardised methodologies to characterise and classify BISTS performance
- To evaluate methods for improving BISTS performance (overcoming problems such as over temperature, thermal resistance of the building component, rain and fire protection, noise etc.)

These objectives will be fulfilled through the following tasks:

Task 1.1 Review of the state of the art

A review of current STS will be undertaken to determine the state of the art technological developments published in the area and the most suitable options for building integration RES applications. All research in this area will be coordinated and presented at regular WG1 meetings.

Task 1.2 Development of new BISTS solutions

Research on the development of new STS is currently undertaken through national programs by all partners. Very few of these programs consider building integration of the STS and generally this area is treated as an afterthought or worse still is often ignored. Ongoing research should also be guided to consider post occupancy satisfaction, installer/end user feedback, installation education/training and certification/testing procedures. This work will be coordinated to deliver new possible BISTS solutions. Special consideration will be given so that the building integration of STS could create ways to avoid rain-water penetration into the systems (building envelope integrity in general) and the building as well as problems related to the increase of the building

cooling load.

Task 1.3 Characterisation of BISTS developed in Task 1.2

Any BISTS solutions developed in Task 1.2 need to be characterised in detail. Participants have experience in characterisation/testing of STS with different techniques. This characterisation/testing will include performance evaluation, overall heat transfer coefficient of the building component, rain penetration test, fire protection classification and noise transmission.

Deliverables include:

D.1.1. Review of current STS and identification of problems associate with their building integration. This review will also be submitted as a joint partner publication in a peer reviewed journal (Month 12)

D.1.2. Annual STSM on BISTS development and characterisation for PhD students and Early Stage Researchers (Month 6, 18, 30, 42

D.1.3. Annual Training School for dissemination of expertise on BISTS development and characterisation techniques and new architectural solutions to PhD students and Early stage researchers (Month 18, 30, 42)

D 1.4. Report on the evaluation technologies available for BISTS characterisation (Month 24)

Milestone: 1.1: Development of new and novel BISTS solutions

Milestone: 1.2: Characterisation of new BISTS for use in RES

WG2. Modelling and Simulation

Objectives of WG2 are:

- To deliver new mathematical and numerical models to predict the performance of BISTS
- To validate the models using the experimental data acquired for the BISTS stated and characterised in WG1
- To explore the validation and implementation of these models in commercial numerical codes
- To investigate the use of these new numerical codes to design new optimised RES.

These objectives will be fulfilled through the following tasks:

Task 2.1 Development of new mathematical and numerical models for BISTS

Modelling and simulation of the BISTS will be undertaken to find solutions to the challenges that currently face the industry, specifically investigating their annual behaviour and their symbiotic relationship with the building. Currently, modelling and simulation of STS is undertaken through national programs by all initial partners either by the use of TRNSYS software or by the use of mathematical and numerical modelling of STS. This work will be coordinated to deliver solutions on BISTS and predictions of long-term performance of the derived BISTS solutions (both in direct energy collection and building related benefits); exploring the validation and implementation of

these models; and investigating the use of these new numerical codes to design new BISTS.

Task 2.2 Validation and implementation of codes developed in Task 2.1

Experimental determination of the performance of BISTS will be based on existing standards. New methods will be required for the optical performance of BISTS and other characterisation methods with respect to the other parameters mentioned before. Problems related to the prediction of the performance of the new BISTS, as well as accuracy of their measurements will be directly linked to development and characterization of the new novel BISTS undertaken by WG1.

Deliverables include:

D 2.1. Review of current STS modelling techniques. This review will also be submitted as a joint partner publication in a peer reviewed journal (Month 12)

D.2.2. Annual STSM for PhD students and Early Stage Researchers on theoretical modelling and numerical simulation of thermal behaviour of BISTS (Month 6, 18, 30, 42)

D.2.3. Annual Training School for dissemination of expertise to PhD students and Early Stage Researchers (Month 18, 30, 42). This will include topics on theoretical modelling and numerical simulation of thermal behaviour of BISTS.

D 2.4. Report on the validation of developed codes, both thermal and optical (Month 30)

D 2.5. Report on the new models developed during the project and potential for adaptation for RES (Month 42).

D.2.6. Report on the development of new models for innovative integrated STS applications.

Milestone: 2.1 New validated mathematical and numerical models to predict the BISTS performance

Milestone: 2.2 New validated models to optimize BISTS in innovative RES applications

WG3 Investigation of new applications for innovative BISTS

The objectives for WG3 are:

- To develop innovative BISTS designs for various applications
- To fabricate BISTS prototype configurations to the extent own funding allows
- To characterize prototypes of these novel BISTS in indoor and outdoor conditions

This WG will work on:

- Domestic, commercial and industrial buildings
- Full building services integration (e.g. into existing heating, cooling, hot water) or stand-alone operation but integral to the structure
- Industry applications
- New prefabricated products
- In terms of solutions the ultimate objective is to design market ready products

These will be fulfilled through the following tasks:

Task 3.1 Design of innovative BISTS designs

A review of current STS which could be building integrated will be undertaken to determine the most suitable options for BISTS applications. Expert system designers will participate in this task in the development of new BISTS designs and will work closely on the model development of Task 2.1.

Task 3.2 Fabrication of BISTS prototypes

Using the outputs of task 2.1 prototypes of the innovative BISTS designs produced by task 3.1 will be fabricated. To minimise manufacturing effort each unit will be configured to facilitate easy modification to accommodate structural and material changes that may be proposed during the evaluation process. The numbers of fabricated prototype BISTS will depend on the extent that own research funding allows.

Task 3.3 Characterisation of novel BISTS indoors and outdoors to assess the actual performance in real conditions

The devices fabricated in Task 3.2 will be characterised in the laboratories of participant countries. All results will be analysed and compared. A country performance comparison with geographic diversity (South, Central and North Europe) will also be carried out.

Research in STS is currently undertaken by all partners involved in the Action. This work will be coordinated to deliver innovative BISTS prototype designs which will lead to improved system efficiencies.

The scientific exchange resulting from the Action will facilitate the cross fertilisation between the above topics to obtain new innovative concepts and techniques to further implement BISTS and will pave the way to new scientific understanding and technological advancement in the area of novel BISTS and modelling techniques. Dissemination of the research between the partners within the Action will be undertaken through the STSMs and annual Training Schools and to end users through the publications and other written dissemination material to the Symposium, International Conference and website.

Deliverables include:

D.3.1. Review of current STS and the suitability of integration onto building structures for domestic, commercial and industrial buildings (Month 12).

D.3.2. Annual STSM for PhD students and Early-stage researchers on design, fabrication and characterisation of innovative integrated STS/ RES (Month 6, 18, 30, 42)

D.3.3. Annual Training School to disseminate expertise to PhD students and Early Stage Researchers (Month 18, 30, 42). Topics will include design, fabrication and characterisation of

innovative integrated STS/ RES.
D.3.4. Report on fabricated integrated STS prototypes optimised for increased efficiency and low cost. Full building services integration (e.g. into existing heating, cooling, hot water) or stand-alone operation but integral to the structure. This will depend on the extent of own research funding allows (Month 36).
D.3.5. Report on the performance of new integrated STS/RES prototypes: A country performance comparison with geographic diversity (South, Central and North Europe), (Month 42).
D.3.6. Handbook for architects and building services engineers on the developed BISTS solutions for the design market ready products. This will include new prefabricated products, a variety of mounting surfaces (vertical, sloped, horizontal) and the use of new materials, like PCM. The handbook will also include the development of BISTS through novel modelling techniques, fabrication and assembly of BISTS prototypes specifically tailored to building element integration, performance measurement of novel BISTS and the suggestion of standardised procedures and the determination of a range of applications for BISTS (Month 46)
Milestone 3.1: Fabricated BISTS prototype designs
Milestone 3.2: Handbook to be published BISTS applications: An implementation guide.

E. ORGANISATION

E.1 Coordination and organisation

The COST Framework is ideally suited to coordinate the current national research undertaken in the partner countries such as those outlined in the scientific program above. A Management Committee (MC) will be set up and will manage the Action. The MC will be responsible for the coordination of the Working Groups and overview of event organization such as STSMs, Training Schools, Strategic Workshop and Conference. The programme of the work will be coordinated by the Chairman of the Management Committee with the support of at least one Vice-Chairman. The chairperson and vice-chairperson and those supporting them will manage the relationship with the COST office and administrative aspects of the Action. The work of the Action will be organised in Working Groups, (WG) following the research topics outlined in section D.
Each WG will have a leader which will sit on the MC of the Action. Meetings will be held twice a year, with the WG meeting held the day before the MC to reduce travel expenses. Email, video conferencing and Skype facilities will be used to facilitate communication within the WGs between official meetings. In addition, a Steering Group will be set-up which will include the Management

Committee Chair and the WG Leaders. The publications of the Action will be coordinated by the Editorial Board in which all of the participating organisations will assign a representative, whereas the STSMs will be coordinated by the STSM Manager to be elected by the participants.
The coordination of national research will be implemented through participation in the meetings of the Action and the agreement between the parties to organise coordinated actions, including the creation of possible common research teams, conferences and workshops, Short Term Scientific Missions or other exchanges between laboratories, training schools, websites, and many more.

E.2 Working Groups

There will be three scientific WGs which will coordinate the research in the 3 themes of BISTS development and characterisation; modelling of BISTS and their application in buildings for innovative integration of BISTS. These scientific WGs are described in D.2. There will be a further WG on dissemination which is described in C.3 and below.

WG4 - Dissemination

Responsibilities of this WG is to organize and manage the Action website, Short Term Scientific Missions (STSM), Training Schools and Symposium (each Early Stage Researcher will present his/her work published as papers in a booklet) and co-ordinate the international conference, publication of journal papers and publication of the handbook on building integration of STS and solutions. These responsibilities of WG4 will be achieved through the following tasks:

Task 4.1 - Organisation and coordination of Action events

- The task will be responsible for organising all the meetings between WG participants including the 6-months meetings that will be coordinated with the hosting research institute. In addition stakeholder meetings will be organised with the participation of professionals from the building construction industry, policy makers and community groups. The meetings will allow the Action participants to communicate directly with the stakeholders exchanging information on the on-going scientific research and industry and policy status.
- Training Schools will be held in three years of the Action for 3-4 days and will provide dissemination from the Action activities such as the opportunity for intensive training in new modelling techniques for BISTS, system simulation and new experimental techniques applied in BISTS development.

- Mid-way through the Action a Symposium will be held to allow the participants of the STSMs to give a presentation on their results.
- An International Conference will be held in the final year where each partner will present the work developed by this Action.

Task 4.2 - Coordination of Short Term Scientific Missions (STSMs)

Based on the decision of the Management Committee scientific exchanges will be organised and coordinated between Action participants. STSMs will be supported through an exchange program for post graduate and early postdoctoral researchers where facilities/techniques not available in their home laboratories are made available through the collective sharing and 'pooling' of resources.

Task 4.3 – Creation and management of Action website.

An Action specific website will be created and routinely updated. The website will allow effective and efficient sharing of information between Action participants. It will include a document depository for archiving and safekeeping of all meeting minutes, reports, scientific and trade publications and key information of the Action. Participants of the Action will have password protected access to all the website information. One member from each participating research centre will have write access to the data. The wider stakeholder group will have access to public information on the Action website including reports, up-to-date data on demonstration activities, copyright free published material and dissemination and exploitation activities of the Action.

Task 4.4 – Dissemination through journal, conference, trade publications and website.

Action members will jointly publish the outcomes of scientific activities in conference proceedings such as Eurosun and the World Renewable Energy Congress and peer review journals such as Renewable Energy, Energy, Solar Energy, Energy Conversion & Management and Applied Energy. Booklets containing the information from Training Schools will be produced. A CD containing the proceedings of the Action conference will be distributed amongst Action and conference participants. Trade publications and displays at trade fairs will also be a part of this task in an effort to effectively transfer knowledge created by the Action between research institutes and industry.

The deliverables of WG4 are:

D.4.1. Organisation of all meetings and related minutes reports

D.4.2. Organisation of 3 training schools (1 per year) and related material published

D.4.3. Completion of 4 STSMs

D.4.4. Organisation of Action Symposium (end of the 2nd year)

D.4.5. Organisation of Action Conference (end of the 4th year) and production of proceedings CD.

D.4.6. Creation and maintenance of the Action specific website with both secure and public access.

D.4.7. Scientific journal and conference and trade publications.

E.3 Liaison and interaction with other research programmes

No liaison nor interaction is considered as there are no current Actions or research programs related to this Action. This may change in the future if the need arises, which will improve the dissemination activities of the Action.

E.4 Gender balance and involvement of early-stage researchers

This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve ESRs. This item will also be placed as a standard item on all MC agendas. ESRs and PhD students will be targeted to actively participate in this Action through the STSM, Symposium and Conference.

F. TIMETABLE

The Action is scheduled to last for 4 years. The inter-disciplinarity of the Action, the scope of the research work to be carried out and the more specific aims of the Action account for this duration. The Management Committee (MC) will develop the outline of work during the four years and the Working Groups (WG) will work on their specific tasks and will present the current research results in a specific session scheduled in the first part of the Management Committee meetings.

The timetable for the Action is as follows:

Activity	Year 1	Year 2	Year 3	Year 4
WG1	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx
Task 1.1	xxxxxxxxxxxx	xxxxxxxxxxxx		
Task 1.2		xxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx

Task 1.3			xxxxxxxxxxxx	xxxxxxxxxxxx
WG2	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx
Task 2.1	xxxxxxxxxxxx	xxxxxxxxxxxx		
Task 2.2		xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx
WG3	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx
Task 3.1	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxx	
Task 3.2			xxxxxxxxxxxx	xxxxx
Task 3.3			xxxxxx	xxxxxxxxxxxx
WG4	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx
Task 4.1	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx
Task 4.2	xx	xx	xx	xx
Task 4.3	xxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx
Task 4.4		T S	T	T C
Note: S=Symposium, C=Conference, T=Training School				

The dissemination activities in WG4 will be held every year as shown and include a Training School, Symposium (end of Year 2) and International Conference in the last year. In order to reduce travel costs MC& WG Meetings will be held together. Tasks in the table above are outlined in Sections D.2 and E.2.

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: CH,CY,DE,EL,ES,IE,PL,RS,UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 36 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

H.1 Who?

The deliverables and milestones achieved by this Action will be significant if they reach and inspire a sufficient number of target groups. The target groups and their use of specific deliverables are outlined in Section C.5.

These target groups are represented in each country involved in terms of local energy agencies, the building industry, architects, renewable energy consultants, building services engineers, participants of other research programs, employees of standardization bodies, solar collector manufacturers federations, local and EU policy makers, regional municipality technical personnel, engineers associations through the appropriate institutions, software developers, researchers and PhD students and the general public.

The collection and dissemination of deliverables will be one of the most important tasks undertaken by the Action and there will be a specific Dissemination WG (WG4) set up to achieve maximum publicity for the work undertaken.

In the various Tasks the Working Groups will develop papers and reports and best practice criteria for BISTS design, characterization, modelling and validation and applicability in various cases taking into account that different technologies will be appropriate in different countries.

An external dissemination strategy will be developed in order to reach a wider European and International audience through presenting results in publications, workshops and conferences. The public website will provide information on the BISTS concepts and provides references to contact people for further information.

H.2 What?

A dissemination plan will determine the target groups and will include when this will occur, the best ways to disseminate the project and its result and the best strategies to exploit and quantify the outputs of the Action. Specific interest groups will be targeted through numerous dissemination channels, as discussed below, and will broadly cover the scientific community (academia, R&D institutions), the solar thermal industry (manufacturers, contractors, suppliers, designers and consultants and building service industry professionals), national and EU policy makers and end users. The dissemination methods that will be used include:

1. The symposium held at the end of year 2

2. The international conference held at the end of year 4
3. The website where information and developments related to the project will be posted (with public open site and internal site for the COST Action members only).
4. Distribution of newsletters with e-mail or internet discussion forums like LinkedIn.
5. Publication of scientific papers in International Conferences and Academic Journals.

The information provided will include:

- Posting of working documents on open or password protected websites
- Publications including state of the art reports, interim reports, case study reports, proceedings, guidelines, manuals, final reports
- Workshops, seminars and conferences papers (non-copyrighted), contributions to other national and international conferences and symposia
- Scientific papers in peer-reviewed scientific Journals
- Non-technical publications.

As part of the activities of this Action, information papers and leaflets will be published showing details of the suggested solutions and guidelines on how to achieve effective BISTS.
Target groups are:

1. Scientists from other universities and research centres
2. Engineers (including government engineering officials)
3. Government officials and the Energy Commissioner (non-engineers)
4. Industrialists federations including Energy Agencies
5. Construction companies and developers
6. The general public

H.3 How?

The potential impact is the increased knowledge of uses of BISTS by improving system cost-efficiencies and with the ultimate objective of increasing the use of STS in buildings. Three training schools will be organised as shown in the relevant time chart at the country hosting the annual

meeting. This will reduce associated costs and preferably can be organised in the same week as the meeting. The symposium can be held also next to a two-day meeting possibly on a third day (Saturday morning). In these training schools and symposium partners will present their work and answer questions from the audience.

The new software environment for simulations of BISTS will impact commercial software companies. The activities will deliver a wider scope for expanding the scope of the Energy Performance of Buildings Directive.

Also the introduction of new technologies and materials into building sector is expected and relevant impact on the standards in the field.

The dissemination of information, through websites, publications, Action brochures, symposium, training schools and an international conference, will aim to increase research capacity in these areas but will also aim to increase the knowledge of RES to end users such as architects and building service engineers.

The exchange of information and methods should contribute to the achievement of increased energy efficiency and cost-effectiveness and will help Europe to achieve its ambitious RE targets.

Techniques and facilities will be shared and tools such as the handbook will generate positive impacts on end-users and target groups.

The dissemination method will include seminars, website, leaflets for the general awareness of the public. These will be distributed through the Energy Agencies of the various participating countries.