PREHEAT

Policy reinforcement regarding thermal storage technologies

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Methods to reinforce support for Thermal storage in the European Union

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Methods to reinforce support for thermal storage in the European Union

Contents:

1 Summary

This report describes a strategy for policy reinforcement concerning thermal storage technologies at a European Level, and constitutes the deliverable of the Work Package 3 (WP3) of the PREHEAT project. It describes the strategies that can be used to influence policy-making and decision-making processes with respect to implementation of thermal storage technologies[1].
The suggestions put forward here are based on an analysis which took into consideration the following:

1. Feedback gained from the experience of other complementary technologies which have attempted recognition at a European level.
2. The output of Work Package 2 (WP2), in terms of the current support of thermal storage and the future trends: the existing policies, programs and regulations to build upon and the forthcoming actions to be influenced.
3. The identified potential for future strategies based on the good examples found at a national and at a European level, regarding relative technologies or specific thermal storage types.

A series of specific actions need to be undertaken to raise the profile of thermal storage at a European level. These actions are summarised in the list below:

EU Policies

- Storage has to be mentioned in any forthcoming Europeans policies or updates on existing policies regarding Energy Efficiency, Renewables, Environment and Sustainable Development, as it is
    - **o** a tool of energy efficiency and energy density
    - **o** a regulator of RES
    - **o** a key technology for moving towards very Low Energy or even Zero Carbon buildings when Solar Thermal, CHP, biomass and other relevant thermal storage applications are considered.

- **All commercially available types of Thermal Storage must be labelled**, under the category of “non energy using” devices of the European Energy Labelling Scheme. The Impact Assessment Study prepared the ground for this. Labelling will:
    - **o** Accelerate the development of harmonised standards for testing, which can generally be used as a benchmark for performance assessment of any available or future storage type
    - **o** Influence the public’s choice in favour of some thermal storage products which will prove more effective in terms of increasing the energy efficiency of the system they support and therefore
    - **o** Motivate manufacturers to optimise their products

- **Test methods and Solar Keymark certification of all types of thermal storage** need to be established, including storages with phase change materials which are now available in the market. From the experience gained with the Solar Keymark up to now, it can be estimated that, if certification of thermal storage relates to the process of gaining subsidies, then more products will be certified and
    - **o** More liability will apply on the thermal storage market in general,

[1] Wording taken from the Work Package 3 description of the required outcome.

- **o** More projects including thermal storage will be implemented.

EU Regulations

- **Obligations towards consideration of thermal storage** must be set within the implementation guidance for the Directives of Cogeneration, Renewable Heating and Cooling, EPBD and Energy end-use efficiency and Energy systems. These obligations have to be included at the National actions/ implementations of the Directives set up by the Member States. In particular, thermal storage has to be seriously taken into consideration when relative systems are used, e.g. Solar Thermal, CHP and heat pumps. The use of thermal storage cannot be made compulsory in any case, as its use and performance depends on the relation between energy demand and availability. Nevertheless it has to be enforced by these Directives that consideration of the technology has been undertaken prior to construction and if a choice for not including thermal storage in the system has been made, this has to be supported by appropriate evidence.
- During implementation of the directive at a national level, **all types of storage must be included in the energy calculation methods.** That way, the optimization of the energy performance of buildings would be related to different systems/ configurations with thermal storages and so the benefits of the technology would be revealed in practice.
- In the forthcoming Directive on Renewable heating and cooling **thermal storage has to be included in all the possible measures** from the National binding targets, the dismantling of the administrative barriers, the National Support Schemes, the financial incentives, and the regulatory measures.
- **Standards of thermal storage products have to be established**. Apart from the obvious implications in the societal acceptance of the products (which is similar to the certification and energy labelling) standardisation can also enhance the presence of thermal storage technologies in the regulations and directives which build mainly on standards.

EU Programs

- Specific programs or sub categories within programs have to be built for thermal storage specifically, as with the examples mentioned above. R&D for this technology has to be supported and this is only possible with focusing on the optimisation, design, simulation and monitoring of various thermal storage types.

- The update of the Work Programme of 2008 for the Cooperation program of the FP7 has to refer to thermal storage at the sub-category **'Renewables for heating and cooling'**. It should encourage proposals submission for R&D concerning thermal storage technologies which would optimise the performance of heating and cooling systems with renewable energy sources.

Opportunity for a EU forum of Thermal Storage

A step towards policy reinforcement of thermal storage necessitates support from the Technology Platforms. The European Commission uses the Technology Platforms to

gather stakeholders and it is expected that TPs will strongly influence the European R&D. PREHEAT has already achieved, up to a point, cooperation with the (European Solar Thermal Technology Platform) (ESTTP) and this is considered to be a very important outcome of the project. The creation of a Focus Group for thermal storage within the ESTTP will be supported. Forthcoming TPs with regards to District Heating, Biomass, Geothermal Energy and Heat Pumps need to be anticipated and relations with them should be built in the future.

Furthermore, the analysis shows that a coherent support of the technology at research, development, demonstration and market level is required in order to bring out the expected outcomes. This report brought out the potential of establishing a Thermal Storage Forum, identifying the need of representing the overall European thermal storage technology community and the necessity of ensuring funding sources for the PREHEAT strategy in the future and receiving international input. According to this concept, the "Thermal storage Forum" would coordinate the activities and

- ⇒ Influence the EU Institutions.
- ⇒ Communicate with the Thermal storage Focus Group of the ESTTP (which has already influential power on the EU Institutions).
- ⇒ Establish connections and communicates with other similar focus groups in other related TPs (e.g. the recently launched Technology Platform for Biofuels).
- ⇒ Create a mirror group at each Member State which prepares the ground and facilitates the implementation of the European Actions at a national level (activities such as dissemination and national lobbying also included).
- ⇒ Communicate with International Cooperation groups, such as the IEA-ECES (Energy Conservation through Energy Storage) and the IEA-DHC (District Heating and Cooling), so that the actions supported from the Forum are well tuned with those organised internationally and that expert input from the PREHEAT is achieved.
- ⇒ Approach a number of individual groups that can play an important role in the support of thermal storage technologies.

2 Introduction

This report is produced as part of Work Package 3: “Methods to reinforce support for thermal storage in the European Union” of the PREHEAT project (Policy reinforcement regarding thermal storage technologies). The project is funded by the Intelligent Energy Europe program (EIE/05/036/SI2.420010) and carried out in the period 2006 to 2008.

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For information on the PREHEAT project refer to www.PREHEAT.org

2.1 The aim of this report

This report sets out the strategies that can be used to influence policy making and decision making processes with respect to implementation of thermal storage technologies.

2.2 Description of thermal storage

The field of thermal storage technologies is very broad, but PREHEAT pertains to small scale thermal storage combined with renewable and low carbon energy sources and energy efficiency systems. Thermal storage can be combined with inefficient systems, such as electric heating. PREHEAT does not cover such applications, which are mentioned here only as a matter of completeness.

2.3 Outcome of WP2

Thermal storage is a supporting technology that when correctly designed and applied has clear benefits in terms of improving the performance of renewable energy systems and systems making rational use of energy. Although they can significantly increase the applicability of various energy supply options, research[2] has shown that thermal storage techniques and technologies are often overlooked in policies, regulations and programs.

2.4 Why should we reinforce policies to promote thermal storage?

Various potential benefits and effective applications of thermal storage can be identified. Thermal energy produced by conventional or renewable sources or as a waste product

[2] PREHEAT Work Package 2 report *‘Present state of the support for thermal storage in the European Union’*

of industrial processes can be stored daily or seasonally to cover demand at a certain time. Thermal storage can also be the solution to the problem of non-simultaneity of the demands for electricity and heat met by CHP systems. In general, thermal storage can maximise the efficiency of systems, reduce the loads, introduce energy savings and result in carbon reductions. Therefore there are many reasons to make sure that the technology is adequately mentioned in European Policies, so that acceleration in terms of research, development, demonstration, dissemination and market is achieved. In addition to that, there are other additional reasons for policy reinforcement of the technology. The technology has to be included in the legislative framework of the EU and the Member States in order to ensure the high quality of the systems and the reliability of the technology. In addition a common European framework could help the exchange of knowledge (introduce the latest trends in countries with little experience in thermal storage).

2.5 Methodology of investigation method/report

The main part of this report, consisting of the description of the methods to reinforce support for thermal storage in the EU, is built on knowledge and conclusions derived accumulatively according to the following methodology:

- Highlighting the lessons that can be learned from other enabling technologies.
- Considering the future trends and potentials within the existing European Policies, Regulations and Programs, as summarised in the WP2 report.
- Analysing the experience gained by good practice at a national and European level.

2.6 Limitations

The analysis focuses on the methods that can be implemented mainly at a European Level. Actions at a national level can be considered that will be boosted by this strategy and will be based on it, although variations from one country to another will restrict a uniform approach across the whole of Europe.

2.7 Decision Making Process in the EU

The Decision-making at the EU level involves in particular:

the European Commission,
the European Parliament (EP),
the Council of the European Union.

In general it is the European Commission that proposes new legislation, but it is the Council and Parliament that pass the laws. The co-decision procedure is now used for most (approximately 2/3rds) EU law-making. The Environment is one of the areas where co-decision applies. In the co-decision procedure, Parliament does not merely give its opinion: it shares legislative power equally with the Council.

Different stages of the legislation procedure pertain to different audiences and therefore different ways of influencing these audiences. The Commission is responsible for organising the annual legislative agenda and composing the proposals. If there is a need to bring out a technology at the European legislation framework, either because the latter is inadequately or not in the least covered by the existing regulations, it is the Commission which has to be aware of that. In order to bring the issue to the attention of the Commission, the intermediaries which are capable of doing the contact must be

used. Access to the Commission is gained mainly by the European Organizations and by those Individual Firms which can offer the expert knowledge required for composing the proposals. Assuming now that certain proposals are already drafted and are proposed to the Parliament and the Council of Ministers, it is again a subject of using the appropriate representatives to achieve influence in favour of an interest in the decision process. The Parliament seems to prefer advice from the European Organizations and from actors which hold power at a national level (possibly National Organizations), as it is desired that the proposal is also beneficial for the voters of the MEPs. National Organizations have also the first word in the Council of Ministers along with the 'National champions' which can also represent the national interest.

It is apparent, that a high level of encompassing and power is required in order to ensure access and therefore potential influence towards the EU institutions. Nevertheless it is generally perceived that some large associations have a complex and rather ineffective structure of decision making which sometimes encumber their approaches towards the EU institutions. The following analysis aims to cast some light on how the decision making has occurred in practice concerning other enabling technologies and how much the reality differs from the theoretical framework presented here. Nevertheless, as far as it concerns the environmental legislation, the Sustainable Development Strategy adopted in June 2006 states that *"…all EU institutions should ensure that major policy decisions are based on proposals that have undergone high quality Impact Assessment, assessing in a balanced way the social, environmental and economic dimensions of sustainable development and taking into account the external dimension of sustainable development and of costs of inaction..."* (Renewed EU SDS, 2006:7/29).

(See Appendix A for further information.)

3 How other enabling technologies have achieved policy recognition

The way other enabling technologies have been promoted at a European level is the main topic of this section. As part of the work done for the WP3 by the PREHEAT participants, discussions were held with policy makers, regulators, industrial stakeholders and program managers/ advisors regarding the following technologies:

- Building Envelope Insulation (FR),
- Heat Networks (UK),
- Batteries for Electric cars (CH),
- Energy Labelling (DK) and
- Compact Flash Cards (D).

Information derived from these interviews and further analysis on some of these technologies was used to determine what lessons could be learned and applied to thermal storage.

A selection of enabling technologies is listed in Appendix B. Appendix C contains an example of the Questionnaire Template used in discussions with stakeholders.

3.1 An example of an enabling technology

Building Envelope Insulation[3] was selected and examined by the French participants (CSTB). Nowadays, it is widely recognised that this technology can contribute to achieving energy targets and economies, and this appears to be a result of extensive research conducted and presented up to date.

According to the industrial stakeholder representatives for the technology it was mainly the influence of the EURIMA, for the EU, and local associations of industrial organizations and building institutes, for each country, which brought the technology to the attention of policy makers initially. EURIMA (European Insulation Manufacturers Association of mineral wool producers[4]) promotes even now (since 1959) the technology at a European level and one of the main targets is to enhance, update and measure the regulatory support. The other way of promoting the technology at that stage was lobbying members of parliament, as explained by all the industry stakeholder representatives who were contacted. Apart from the obvious benefits achieved by the advocacy, they also add the stimulation of a general ecological realisation in the public opinion which is possible to further enhance competitiveness and funding.

Furthermore, it is also apparent from the interviews that it was at the development and demonstration stage that the technology was promoted to policy makers and this was done by presenting the multiple objectives which can be achieved with the implementation of the technology. One of the industry stakeholders referred to an Austrian study which played an important role by presenting, apart from the financial benefits, the positive effect on the thermal comfort and furthermore on the productivity of the employees when sufficient insulation was applied in buildings. The program manager representative explained that it was the industry's initiative that brought the technology to

[3] It is acknowledged that the technology can also be described as complementary rather than enabling.
[4] Related Information can be found in URL:< http://www.eurima.org>

his attention. Speaking about the program in which he was involved, he mentions that theoretical results on energy savings and thermal comfort were provided within 2 years and a demonstration dwelling was built one year after. Such information was used to demonstrate the benefits of the technology.

As with thermal storage, the building insulation did not offer a quick financial return because of its high capital cost. In addition to that, it was difficult to present the actual benefits and get them understood by the end users. It was therefore the role of the lobbyists once again and the demonstrators, (adequately trained) contractors and distributors of the technology to assist in overcoming both barriers, as stated by the same interviewees and also by the policy makers representatives for the topic. One of the policy makers interviewed gave an example of advocacy which is organised nowadays for this reason by the association "Insulate the Earth against CO2[5]", inviting members of the Parliament to promote large scale retrofit on existing buildings. Press conferences and industry comments during the policy formulation process were other ways of achieving that. It was also generally underlined by the industry stakeholders that establishing certificates and assessments for the technology was a prerequisite for making the users aware of the actual advantages of the technology.

From most of the discussions it was apparent that the high capital cost was a significant barrier to the take up of the technology, even when a quick financial return was possible. One of the interviewees, referring in particular to the case of the low-emissivity glazing, explained that producers and customers perceived in different ways the cost of the technology, when that was at a primitive commercial stage. The manufacturers were looking at the cost which would apply when the technology would have already been established in the market, while the potential users were interested in the actual cost at the time. Eventually the producers had to reduce the price of the product to enhance the market.

One of the interviewees, whose work involves offering governmental advice regarding building regulations, confirmed that although all related actors played their role in establishing the way the technology would be regulated, it was mainly the policy makers' influence which was critical. The same opinion was also shared by the other regulator representative who underlined the importance of the direct approach by the industrial stakeholders. Both the regulators and policy makers made clear that the consultations' responses ensured that the industry's opinion was taken into account while the regulations were built up.

3.2 Making Policy Makers aware of the enabling technology

The crucial role of the European Associations and Technology Platforms was underlined in the interviews regarding the cases of the Building Insulation (the EURIMA) and the Heat Networks (the UK CHPA). It is apparent that a coherent way of support works very effectively when the target is the European programs, policies and regulations. Furthermore the role of the industrial stakeholders is proven to be critical, as it was often mentioned in the interviews that their role in lobbying members of Parliament has also proved to be effective. In most of the cases policy makers acknowledged that the consultations' responses from industry could bring a technology to their attention. Very often, policy advisors become aware of technologies as part of their job role. Answers

[5] Information for the association can found at URL:< http://www.saint-gobain.com/en/html/presse/dossier_14.asp> and URL:< http://www.isolonslaterre.org/proposition.html>.

within these interviews also highlight that the conferences and the press are usually means of introducing new innovative technologies to policy makers as well as to regulators, program managers and end users.

The interviews generally reveal that for a technology to be presented to policy makers, a demonstration project is necessary. Although such projects are sometimes possible to be built even if the technology is only at the research level, it was derived from the interviews that most of the technologies were presented to policy makers when they had already reached the development or demonstration stage. It is clear that studies which reveal the benefits of the technologies, and data derived from relative research or demonstration projects would have a significant impact on the promotion of a technology during the advocacy process.

3.3 Convincing Policy Makers that the technology should be promoted

When dealing with an enabling technology, the general perception of the market towards the technologies which this enables is important. The effort of promoting a technology which is combined with widely recognised ones will be relatively low. According to the answers given by most of the policy makers/advisors approached for these interviews, technologies which support wider policy goals are usually gaining approval more easily. Technologies which can bring energy savings and have also socio-economic potentials (e.g. help to tackle the fuel poverty) will attract additional attention. It is also apparent that technologies which assist in carbon reductions are nowadays under focus.

The clear promotion of the benefits of the technologies for the end users was described as critical for convincing the policy makers and for the take up of the technology in most of the related discussions. It is quite common though that innovative technologies have a higher capital cost and the payback period is sometimes long. In relation to that, the policy advisor representative for the case of Heat Networks explained that Relative Cost Effectiveness and Life cycle Cost Analysis are required so that the actual benefits of such technologies are acknowledged. It was also made clear that all the potential benefits must be presented, from running costs to environmental incentives. The industrial stakeholder representative for the Compact Flash Cards example added that a complete business concept must be presented in each case, including technical and business support and potential connections with distributors.

3.4 Establishing the technology within Policies, Programs and Regulations

Having convinced the policy makers that a technology should be covered within new Policies, it is then the industry responses to the policy formulation process and effective lobbying which will ensure that the procedure will result in the desired outcomes. Furthermore, it can be concluded by the discussions, that it is usually the policy makers' and the industrial stakeholders' initiative which brings a technology to the attention of program managers and regulators.

The experience gained from Energy Labelling shows that analyses of the potential savings from white goods made it clear to the regulators that the scheme should be directly covered within the regulations, without prior establishment of policies. In general, it is derived from the interviews that the regulators are often influenced by

representations from the industry sector regarding both unregulated technologies and anomalous treatment within existing regulations. Regulators acknowledged also that dedicated regulator workshops regarding a specific sector are also strong influential procedures. Nevertheless, one of the contacts interviewed regarding the related regulations to Heat Networks (UK), clarified that although a multi-level promotion of the technology is required each time, it is the lobbying of ministers which is the most important. He also explained that when Policies with particular relevance to the technology exist, it is more possible that regulations will be established soon. In addition, he underlined that although political support is necessary, the most critical factor when promoting a technology at that level is that the industrial interest, and therefore investment, is ensured. Most of the regulators participating in the discussions stated that it is the consultations' responses on draft proposals for new regulations, which help to ensure that the technology will be adequately catered for within the final text.

As far as it concerns a technology which is either enabling or is not yet at a mature level, making it mandatory is not always the issue. Feedback gained from these interviews showed that a technology which can result in energy savings could be introduced in the Energy Performance Calculation method so that its benefits are recognised in practice. It was also underlined that by establishing Certificates and Standards the reliability of the technology could be enhanced and therefore the market would be boosted.

4 Reinforcing support for thermal storage in the EU

4.1 General Objectives

The goal is the initiation of a coherent mechanism for supporting the technology at the research, development and market level, which will ensure optimization of the technology itself.

The targets of a general strategy concerning thermal storage could be summarised as follows:

1. Locate and coordinate Research in Europe and in collaboration with other countries
2. Ensure Grant Support (within EU programs) for research, development and demonstration.
3. Introduce fiscal incentives (levy exemptions, vat reductions[6] etc).
4. Emphasize the benefits of thermal storage (as revealed by the R&D) when policies are introduced or renewed.
5. Ensure consideration of all aspects of thermal storage when related technologies are regulated.
6. Include every type of thermal storage in the existing energy calculations (complementing building regulations) so that its benefits are clearly understood and acknowledged widely.
7. Regulate thermal storage, introduce assessments, certification and/or standards and assess its relative cost effectiveness in order to enhance high quality and efficiency of the systems, reduce uncertainty about future market developments and increase societal acceptance
8. Disseminate information.
9. Involve the individual related groups (engineers, architects, educational professionals etc).
10. Coordinate activities with other Groups operating at an international level.
11. Prepare the ground for implementation of the strategy at each Member State.

The analysis shows that a coherent support of the technology at research, development, demonstration and market level is required in order to bring out the expected outcomes. Appendix D describes a possible Thermal Storage Forum which may be a mechanism for helping to implement this strategy.

4.2 Barriers

In this section the barriers to the take up of the technology are identified. Conclusions derived within the WP2 report were also taken into account. The barriers are summarised in the following categories:

1. **Economical:** The various thermal storage technologies are at different levels of market development and therefore there is a wide range of acquisition costs. Sometimes the systems are expensive and a long pay back period is experienced. Furthermore there is a lack of grants dedicated to thermal storage projects from European and National programs (research/ development/ demonstration/

[6] The EU SDS: 24/29, underlines the burden carried by the member states in shifting the taxation from the labour to the resource and energy/consumption and/or pollution and that the Commission should gather relevant information by 2007.

dissemination). This is mainly due to the fact that people in the decision making process for funding are not very aware about the technology.

2. **Judicial:** Apart from the fact that there is lack of regulations and directives concerning the complete range of thermal storage technologies, the few existing regulations are not harmonised within the EU and this encumbers imports. Furthermore, as part of the work done for the WP2, the participating group from the Netherlands produced a list of barriers existing at National level concerning Underground Thermal Storage Projects. Very briefly, the barriers could be summarised as follows:
    - Complicated regulations, difficulty in interpreting them
    - Different regulations in different provinces, (sometimes this is unavoidable as different boundary conditions apply).
    - Long wait for a license (even for small projects)

    The example of the Netherlands reveals the sensitive issue of the groundwater treatment which interferes with the implementation of ATES and UTES systems. Although research has shown that there are ways of overriding related risks, there are possibly still some barriers, which therefore hinder the establishment of a 'softer' regulation.

3. **Quality:** Bad practice experienced in the past, by poor standards of installation or companies being too optimistic have affected the liability of the systems. This is surcharged by the absence of a certification system or a quality guarantee system.

4. **Technical:** There are certain technical issues with thermal storage technologies that can encumber their development, e.g.
    - Sizing and heat losses of water stores.
    - Flammability and lack of stability of PCMs
    - Complexity of performance, due to the dependence on building dynamics. (New simple simulation tools are required).
    - Special requirements (in piping etc) of high temperature applications

    However, the main issue is not the technical difficulties, but the gap between thermal storage experts and building engineers, designers, architects and decision makers.

5. **Research:** Research overlaps between different institutes and universities in the EU, due to absence of networking and cooperation. Furthermore continuity of the research is not always achieved, as the intensity of research fluctuates with the available budget.

6. **Others:** Decision makers are not well informed. Due to that, the decision is based on the cost only, and this results in systems which might not be functioning well. In addition the benefits of the technology difficult to communicate to the end-user.

4.3 Promotion of Thermal storage within European Policies

4.3.1 Policies Overview

The overview of the existing European Policies reveals that thermal storage is rarely mentioned and its role seems to be ignored to a large extent. All the strategies built already by the European Commission and the other EU Institutions during the last decade promote the environmental technologies, the RES and the energy efficiency. The existing policies have set the framework of the key targets which need to be met towards a sustainable and energy secure future for the EU, covering all aspects from research and innovation to market development and dissemination of information. Thermal storage is related to the RES, the CHP and other low carbon technologies and has a great role to play in energy efficiency. Therefore the EU background in environmental and energy policies is certainly a critical field to be used and be influenced by this initiative in order to achieve recognition of the great potential of the technology. The following paragraphs provide an overview of the related European Policies.

In 1996 the Commission adopted the **Green Paper, titled *"Energy for the future: renewable sources of energy"*** (COM(96)576) to start a debate between the EU Institutions , the Member States and stakeholders interested in the RES. The aim of the Green Paper was to compile opinions about the measures which could be taken to enhance the use of RES. Both the European Parliament and the Council submitted their amendments on the Green Paper and opinions were shared among all the interested parties, resulting in the adoption of the *"Energy for the Future: Renewable sources of energy.* ***White Paper for a community Strategy and Action Plan****"* (COM(97)599). The overall objective of this White Paper (which was presented as a political, rather than legally binding tool) **was the doubling (from 6% to 12%) of the overall share of RES in the Community by 2010**. It was the first attempt to propose a realistic and at the same time effective synthesis of RES implementations to achieve this target.

The Green Paper on **Energy Efficiency** (COM(2005) 265 final) which was published on 22nd of June 2005 revealed that there is **a 20% saving potential of the EU energy consumption**. The paper started a debate concerning energy efficiency and the Consultation period finished on 31st of March 2006. Suggestions of particular interest raised there include lowering VAT and introducing other tax incentives for investments on RES, CHP, heat pumps, etc. as well as supporting energy efficiency in all types of buildings (even small scale and rented ones) and extending the labelling scheme. As a result of this Green paper and the consultation that followed it, the Commission presented in October 2006 the **Energy Efficiency Action Plan** (COM(2006)545 final). That set the target of **20% reduction in Energy use by 2020** and the specific measures were listed in a separate document with title "Analysis of the Action Plan for Energy Efificiency: realising the Potential" (SEC (2006) 1173). The Action Plan promotes a wide portfolio of technologies in all energy-using sectors and for all commercially viable energy vectors, but also supports demonstration of innovative and emerging technolgies and applied R&D. This portfolio is the same with the one used for the implementation of the Green Paper discussed in the next paragraph, and the so called SET-Plan.

In 2001 the Göteborg European Council launched the EU strategy for sustainable development proposing a more integrated approach to policy making in which economic, social and environmental objectives can be achieved at the same time. Based on that, in 2004 the **"Stimulation Technologies for Sustainable Development : Environmental**

Technologies Action Plan for the European Union" (ETAP) was released by the Commission (COM(2004)38). This document summarised the European Commission's attitude towards environmental technologies (as a suggestion towards the European Parliament the Council of Ministers and the Member States) categorising the actions in three main areas: getting from research to market, improving market conditions and acting globally. The context was quite general and highlighted the importance of supporting renewables, within all these areas. Various actions were described e.g. the creation of technology platforms, testing, performance verification and standardisation etc, and the appropriate parts (EU Institutions, Member States, stakeholders etc) associated with each of the actions were named. In June 2006 the renewed version of the "Sustainable Development Strategy" (10117/06) set the framework of the actions to be taken to create **sustainable communities**. The SDS addresses the issue of better-policy making, summarises the key challenges (with emphasis given to RES) identifies the obligations of the Commission and Member States and emphasizes the importance of the financing routes, the communication and dissemination of the information, the implementation and the monitoring of the results. It is a general document regarding sustainability in the EU.

The Public Consultation on a new Green Paper titled "a European Strategy for Sustainable, Competitive and secure Energy" (COM(2006) 105 final) ended the 24th of September of 2006. This Green Paper, which identified the critical issues to be considered in relation to energy in the EU, included suggestions for the creation of a **comprehensive European Energy policy**.

An example regarding increasing awareness through Policies:

The Green Paper mentioned above proposed a **European Strategic Energy Technology Plan** which will develop a coherent technology portfolio for achieving these goals. The SET-Plan is also mentioned in the Energy Efficiency Action Plan, as it could be a tool of developing further technology-driven means of energy efficiency. To provide input to the SET-Plan (COM(2007) 723 final) the Advisory Group on Energy (AGE) prepared a report from the perspective of the energy technology research and development. The report entitled as "Transition to a Sustainable Energy System in Europe :The R&D perspective" , lists the technologies which can play an important role in reducing the dependency on imported oil and gas for electricity and heat generation, shorted by time deployment potential. First in this list (as more liable for short term action) is Solar Thermal for domestic hot water and space heating and cooling, and, as a key issue to that, **the energy storage R&D requirement is underlined**. **This is a rare example of reference to thermal storage in the European policy framework.** It appears that by moving to a period when specific actions have to be defined in order to approach the desired environmental goals, more and more technologies get the attention required at a European level.

Suggestions:

It should in general be appreciated and underlined through European policies that thermal storage supports long term goals for Renewables and energy efficiency and is therefore an integral part of both. Hence any publication regarding European Strategies for Energy Efficiency, Renewables, Environment and Sustainable Development should include references to thermal storage which is

1. a tool of energy efficiency and energy density
2. a regulator of RES

3. a key technology for moving towards very Low Energy or even Zero Carbon buildings when Solar Thermal and other relevant thermal storage applications are considered.

Therefore the positive example of the AGE's report should be repeated in any similar forthcoming European documentation. This is the first step to ensure that:

- Thermal storage gets all the attention required and dissemination of information takes place.
- Products of thermal storage are labelled and certified so that liability is achieved
- R&D funding will be directed to thermal storage through relevant programs.

An example of a good policy approach in the Netherlands (WP2):

In the Netherlands, a first step to streamline the regulations for thermal storage was taken in 1995 by the 'Beleidsaanbevelingen voor bodembescherming bij koudeopslag' (BAB '95) with focus on the storage of coldness. 5 years later the recommendations from BAB '95 were evaluated and as a result the project 'Ground as Energy source and buffer (BEB)' was initiated. The project was executed with the help of a project team consisting of external professionals and a steering committee of a broader range of specialists. The aim of the project was to formulate policy recommendations to protect the ground when heat is stored in the ground, while not limiting the installation of such systems without reason and gain the support of the authorities and acceptance from the market actors. The conclusions provided by BEB could be used as a solid base for an updated and coherent environmental juridical framework regarding thermal storage in the ground.

4.3.2 Adding thermal storage products to the Energy Labelling scheme.

Currently three Directives for energy labelling of hot water storages have been drafted by the Energy Labelling Regulatory Committee. The drafts are about:

1. Energy labelling of Gas and oil Water Heaters and water storage devices.
2. Energy labelling of Electric Water Heater
3. Labelling of Solar Water Heaters and water storage devices.

Note: It should be noted that PREHEAT is concerned with thermal storage combined with renewable and low carbon energy sources and therefore does not advocate systems such as these described above (drafts 1&2). The reference to these systems was included at this point only for completeness.

The Commission intends that Energy Labelling should be based on measured energy performance, preferably to a European harmonised standard. For the storages which do not include a heat generator there is a difficulty in determining a standard method for rating the energy performance as this will depend on the heat supply. Several solutions regarding this issue are proposed by stakeholders in answers to the Consultations and therefore further development of these three Directives is expected in the future. One of the suggestions refers to labelling based on secondary characteristics such as heat loss (insulation) and re-heat time (heat exchanger). (Market Transformation Programme report, BNDH17).

The EU Sustainable Development Strategy refers to the Commission's commitment to propose extension of the performance labelling schemes (Council's Directive 92/75/EEC) to other products with high environmental impact (10117/06:13/29). The need to apply the labelling scheme of household appliances to a larger range of products was also underlined during the Consultation period for the Green Paper on Energy Efficiency (SEC(2006) 693:8/18). Extension of the labelling to all types of thermal storage would add to the reliability of these products and therefore enhance their societal acceptance.

An example with regard to the potential extension of the Energy Labelling scheme:

In October 2007 the "Impact assessment study on a possible extension, tightening or simplification of the framework directive 92/75 EEC on energy labelling of household appliances" was published. The report identified the future actions under consideration by the scheme. Among them, **the labelling of non-energy using devices** is proposed and, as examples of this type, products such as windows, tyres and building insulation are mentioned. This category refers to products which do not directly consume energy but would contribute to energy savings.

Suggestion:

All commercially available types of Thermal Storage must be labelled, under the category of "non energy using" devices. The Impact Assessment Study prepared the ground for this. As regards to implementation, and as explained in the Impact Assessment, labelling should cover these products both at a retail and at a manufacturing level as these can be either sold to the consumers or to installers directly. Labelling at this stage will:

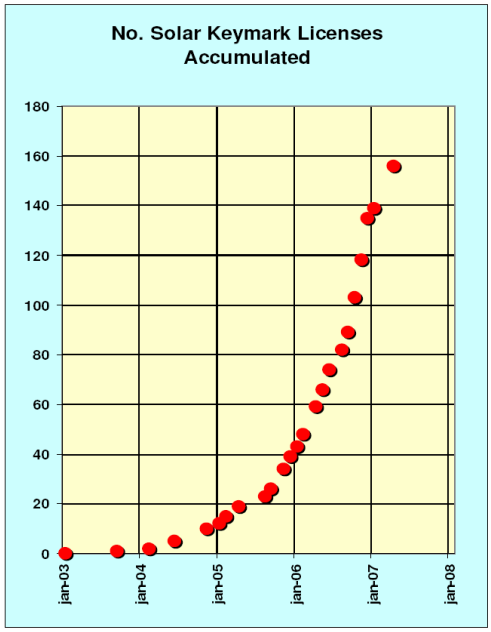
- Accelerate the development of harmonised standards for testing, which can generally be used as a benchmark for performance assessment of any available or future storage type
- Influence the public's choice in favour of some thermal storage products which will be proved more effective for increasing the energy efficiency of the system they support and therefore
- Motivate manufacturers to optimise their products

4.3.3 Certifying Storages under the Solar Keymark

The Solar Keymark, supported by the European Solar Industry Federation (ESTIF) and the European Commission provides the quality labels for solar thermal products in Europe. Currently the scheme covers only solar thermal collectors defined as "liquid heating solar collectors" and excludes those which have their thermal store as an integral part of the collector (EN 129-75). It also covers factory made solar thermal systems, products which are sold complete and ready to install, with fixed configuration (EN 129-76). Certificates for domestic hot water solar tanks based on European standard EN 129-77 (Custom build systems, part 3 on hot water tanks) are under preparation.

An example regarding Solar Keymark certificating:

The graph on the right shows the explosion of solar keymark certificating during the last years (source: Nielsen, 2007). This trend is expected to be even more boosted in the future as Solar Keymark is now a prerequisite for subsidies in Germany, the largest market in the EU (source: Nielsen, 2007) This is an example of good practice and shows that a similar approach could apply to thermal storage. The EN12977-3 "Performance testing of solar storages" has already been drafted. Involved stakeholders have already mentioned the need of extending the testing method to include combistores (combining DOMESTIC HOT WATER preparation and Space Heating).



Suggestion:

Test methods and Solar Keymark certification of all types of thermal storage need to be established, including storages with phase change materials which are now available in the market. From the experience gained with the Solar Keymark up to now, it can be estimated that, if certification of thermal storage relates to the process of gaining subsidies, then more products will be certified and therefore:

- More liability will apply on the thermal storage market in general,
- More projects including thermal storage will be implemented.

4.4 Promotion of Thermal storage within European Regulations

4.4.1 Regulations overview

Paragraph 4.3.1 referred to the support for renewables which started in 1996 with the Green Paper *"Energy for the future: renewable sources of energy"* and led to the White Paper *"Energy for the Future: Renewable sources of energy White Paper for a community Strategy and Action Plan"* in 1997. Two directives, one for the promotion of Electricity produced from renewables (from 13.9% to 21% in 2010) (Directive 2001/77/EC) and one for the promotion of the use of biofuels (5.75% by 2010) and other renewable fuels for transport (Directive 2003/30/EC) followed this White Paper. The Cogeneration Directive (which takes into account in the calculation of the efficiency of the systems the annual useful electricity and heat output, **acknowledging the savings from storages**) was published in 2004 (Directive 2004/8/EC).

A legislative proposal on increasing the share of renewable energies used in Europe for heating and cooling (at least doubling of the share of renewable heating and cooling by 2020 is proposed) was adopted by the Parliament in February 2006 (INI/2005/2122) and

the new "Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources" was prepared in January 2008. The new Directive text, as presented by the European Parliament and by the Council has no reference to thermal storage. The Parliament's Resolution recommended that *"at the latest one year after the entry into force of the directive, Member States should be required to agree on action plans to attain the objectives on the basis of their national potential and target for exploiting renewable sources for heating and cooling. The Member States' action plans should be renewed every three years and submitted to the Commission…".*

Along with the Green Paper on Energy Efficiency (COM(2005) 265 final) which revealed that the EU consumes 20% more energy than can be justified on economic grounds, the directive on Energy end-use efficiency and Energy systems (Directive 2006/32/EC) obliges the Member States to achieve savings of 9% by the ninth year of application of the directive, by means of energy services and other energy efficiency improvement measures. Another directive also related to the energy efficiency policies, (the Energy Performance of Buildings (Directive 2002/91/EC)) set the common framework of energy calculation and allowed levels of energy requirements for buildings in the EU.

According to what was summarised above and in the WP2 there are certain directives covering fields such as the RES, CHP and energy efficiency in the EU. The WP2 revealed that there are very few references to thermal storage within these documents. The following paragraphs suggest the role of thermal storage in the legislative framework of the EU.

4.4.2 Obligations towards thermal storage within Directives.

An example of forcing consideration of technologies, within a Directive:

The Energy Performance Building Directive (EPBD) (Directive 2002/91/EC) sets obligations towards RES, CHP, heat pumps and district heating. Although minimum energy performance requirements apply to any new building (few exceptions exist), only in the case of new buildings with a total useful area of more than 1000m^2 the directive forces the member states to ensure serious consideration (before construction) of options such as:

- decentralised energy supply systems based on renewable energy,
- CHP,
- district or block heating or cooling, if available and
- heat pumps, under certain conditions.

During the Consultation of the Green Paper on Energy Efficiency (SEC(2006) 693) many of the contributors suggested that the existing part of the directive should be extended to cover buildings less than 1000m^2.

Suggestions:

- **Obligations towards consideration of thermal storage** must be set within the implementation guidance for the Directives of Cogeneration, Renewable Heating and Cooling, EPBD and Energy end-use efficiency and Energy systems. These obligations have to be included at the National actions/ implementations of the Directives set up by the Member States. In particular, thermal storage has to be seriously taken into consideration when relative systems are used, e.g. Solar Thermal and CHP. The use of thermal storage cannot be made compulsory in any case, as its use and performance depends

on the relation between energy demand and availability. Nevertheless it has to be enforced by these Directives that consideration of the technology has been undertaken prior to construction and if a choice for not including thermal storage in the system has been made, this has to be supported by appropriate evidence.

Suggestions:

During implementation of the directive at a national level, **all types of storage must be included in the energy calculation methods.** That way, the optimization of the energy performance of buildings would be related to different systems/ configurations with thermal storage and so the benefits of the technology would be revealed in practice.

Suggestions:

In the forthcoming Directive on Renewable heating and cooling **thermal storage has to be included in all the possible measures** from the National binding targets, the dismantling of the administrative barriers, the National Support Schemes, the financial incentives, and the regulatory measures.

4.4.3 Influencing CE Standards

An example of (pre)EN standard for EPBD related to thermal storage:

A set of CEN standards was recently developed to support the implementation of the EPBD in the EU Member States. The standards reflect the requirements of the EPBD as given in the different articles and the annex. Amongst these, the EN15316 on heating generation systems is of relevance to thermal storage. In particular the

WI 7 - Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 1: General

Standardises the required inputs, the outputs and the structure of the calculation method for system energy requirements. Energy performance may be assessed either by values of the system efficiencies or by values of the system losses due to inefficiencies. Based on an analysis of the following parts of a space heating and domestic hot water system:

- *the emission system energy performance including control;*
- *the distribution system energy performance including control;*
- ***the storage system energy performance including control;***
- *the generation system energy performance including control (e.g. boilers, solar panels, heat pumps, cogeneration units).* (Wouter, 2006)

WI 11 - Heating systems in buildings – Method for calculation of system energy equirements and system efficiencies – Part 3. Domestic hot water systems: Part 3-1-1 Characterisation of needs (tapping patterns) And in particular the Part 3-1-3 **Storage and generation** (Wouter, 2006).

The standards will be available shortly, as soon as they pass the formal vote (P60, 2008). The information provided above was based on the information published as preEN standards. (Wouter, 2006)

Furthermore it is stated in the ETAP that both the Commission and the Member States will cooperate *"with CEN and other standardization bodies to ensure that new and revised standards are performance-related and better accommodate environmental technologies"* (COM(2004)38).

Suggestions:

Standards of thermal storage products have to be established. Apart from the obvious implications in the societal acceptance of the products (which is similar to the certification and energy labelling) standardisation can also enhance the presence of thermal storage technologies in the regulations and directives which build mainly on standards.

4.5 Promotion of Thermal storage within European Programs

4.5.1 Overview

According to the WP2, European Programs which might be of interest are:

1. The IEE program which is one of the three consisting the Competitiveness and Innovation framework Programme (CIP),
2. The 7th Framework Program (successor of the FP6),
3. The extension of the Structural Funds, included in the Cohesion Activities.

Research Funding

Three programs provide funding opportunities for research and projects related to thermal storage. None of these programs focuses on particular technologies.

1. Ideas program of the FP7: The scheme will support individuals or teams conducting research on subjects of their own choice, evaluated with the sole criterion of excellence. A significant dissemination potential is also given, as communication with the scientific community and the stakeholders is intended.

2. Capacities program: The program will provide funding opportunities for actions concerning capacities reinforcement for research and will also support the coherent development of research policies.

3. Structural Funds (Cohesion Activities program). Concerning activities which can be combined with regional development, job creating and aid for small firms.

FP7

The FP7 is organised in the four following programs:

- **Cooperation:** supporting research activities carried out in trans-national cooperation.
- **Ideas:** Supporting 'frontier research'. A European Research Council will be created for this scope.
- **People:** supporting training and career development of researchers.
- **Capacities:** supporting the European research and innovation capacity.

Within the 'Cooperation' program of the FP7 which is the most promising for thermal storage, nine thematic categories are included:

- Health;
- Food, Agriculture and Biotechnology;
- Information and Communication Technologies;
- Nanosciences, Nanotechnologies, Materials and new Production Technologies;
- **Energy;**
- Environment (including Climate Change);
- Transport (including Aeronautics);
- Socio-economic Sciences and the Humanities;
- Security and Space.

Of relevance to the thermal storage is the theme 'Energy'. The main objective is the transformation of the current fossil-fuel based energy system to a more sustainable one, taking into account both the security of supply and the climate change. The theme 'Energy' is analysed into the following activities:

- Hydrogen and fuel cells
- Renewable electricity generation
- Renewable fuel production
- **Renewables for heating and cooling**
- CO2 capture and storage technologies for zero emission power generation
- Clean coal technologies
- **Smart energy networks**
- Energy efficiency and savings
- Knowledge for energy policy making
- **Horizontal Program Actions**

The paragraph describing the **'Renewables for heating and cooling'** activity explains that *'Research and demonstration should include new systems and components for industrial applications (incl. thermal seawater desalination), district and/or dedicated space heating and cooling, building integration and energy storage'* (COM(2005) 440 final:49/94). In addition to that, the paragraph referring to the **'Smart energy networks'** mentions that the scheme will support, apart from primary technologies, enabling ones such as '*storage technologies for the RES'* (COM(2005) 440 final:49/94). The feedback gained by the FP6, as analysed in the WP2, reveals that, since the calls for proposals did not mention thermal storage, submissions regarding this technology were not encouraged. Research supported by the FP7 would also enjoy coordination by the ERA (European Research Area) as the Framework Programs are considered to be the major tools in implementing the ERA concepts. The documentation regarding the FP7 clarifies that the Strategic Research Agendas set out by the Technology Platforms will provide input for the research priorities in the Theme. Tight cooperation with related Technology Platforms is once again proved to be critical for the inclusion of thermal storage technologies in European actions.

IEE

The IEE implemented by the IEEA (Intelligent Energy Executive Agency) supports financially projects which focus on

- new and renewable energy sources - ALTENER
- energy efficiency, notably in buildings and industry - SAVE
- energy aspects of transport - STEER
- co-operation with developing countries – COOPENER

Of interest in regards of thermal storage were certain target areas of the SAVE and ALTENER e.g. at Annual Work Program 2006 of the IEE (Work Program 2006). The following categories described in this document could encourage participation related to thermal storage.

- **Buildings (SAVE):** It is related to the implementation of the Energy Performance Buildings Directive. The promotion of best practice examples of energy performance in buildings is the part which could accept applications of systems with thermal storage.
- **Social Housing (SAVE).** The target area with relevance to thermal storage is the one about the advanced retrofitting solutions (the documentation refers to rational use of energy and integration of renewable energy sources).
- **Innovative approach in industry (SAVE).** Supporting Polygeneration including CHPs.
- **Energy-efficient equipment and products (SAVE).** Including Energy Labelling and minimum energy efficiency standards.
- **Heat from Renewable energy sources (ALTENER).** Including legislation and standards, supply-chain and market structures for RES heating and cooling products.
- **Small scale applications (ALTENER).** Including solar water and space heating and cooling, biomass for domestic heating, including biogas and Small-scale and micro CHP and heat pumps

4.5.2 European Programs: Suggestions based on examples

An example of the support of thermal storage by the Cooperation of FP7:

The Work Programme of 2008 for the Cooperation program under the category "Energy" has now been published (C(2007)5765 of 29 November 2007). It lists only part of the topics which will be included in the call of proposals for this year and an update is expected to be published in the spring of 2008. No opportunity for funding is given yet under the two categories mentioned previously. Nevertheless an opportunity lies under the last sub-category "Horizontal Program Actions". Specifically under the topic: "*ENERGY.2008.10.1.2: Novel materials for energy applications (Joint Call NMP"):*

> *… Projects should contribute to the establishment of strong strategic positions for Europe in emerging materials science areas of technological relevance. Important fields of application for energy technology are energy conversion and* ***storage****, photon capture and CO2 capture and storage…*

An example of the support of thermal storage by the ALTENER of IEE:

> In the Call of Proposals of IEE for 2008 it is described that within ALTENER "Proposals related to renewable energy heating/cooling (RES-H/C), covering one or more of the following activities…. Promote sustainable production and supply of biomass fuel, plus intelligent combinations of **RES-H/C and storage** (non-technological aspects)" are required. In the Work Program of IEE for 2008 the priorities for action are stated and under the "Market Transformation" the "promotion of sustainable production and supply of biomass fuel, plus intelligent combinations of **RES-H/C and storage** (non-technological aspects)" are mentioned. It is apparent that within the 2008 ALTENER thermal storage enjoys attention and has been also clearly distinguished from electrical storage.

An example of a Swiss Program about thermal storage:

The program "Le solaire Thermique" of The Swiss Federal Office of Energy (OFEN) has 20 topics on which R&D projects are funded. Thermal storage is linked to solar heat and has benefited from special attention since 1978, under the category "Active Solar: heat and thermal storage". Projects involving seasonal and short term thermal storage are supported. Focus has been drawn on high density storages (for minimum volumes), optimisation of UTES based on measurements of existing installations and simulations, thermal storage with innovative materials (e.g. zeolithe), aquifer thermal storage and other topics. The program has funded very interesting projects over a series of years and constitutes a unique example of a program dedicated to thermal storage.

Suggestions

Specific programs or sub categories within programs have to be built for thermal storage specifically, as with the examples mentioned above. R&D for this technology has to be supported and this is only possible with focusing on the optimisation, design, simulation and monitoring of various thermal storage types.

The update of the Work Programme of 2008 for the Cooperation program has to refer to thermal storage at the sub-category **'Renewables for heating and cooling'**. It should encourage proposals submission for R&D concerning thermal storage technologies which may optimise the performance of heating and cooling systems with renewable energy sources.

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Appendices

Appendix A: Decision Making in EU

Understanding the Decision Making Process in the EU

In order to understand how policies can be influenced, it is first necessary to comprehend the decision making process. Decision-making at the EU level involves various European institutions, in particular:

the European Commission,
the European Parliament (EP),
the Council of the European Union.

In general it is the European Commission that proposes new legislation, but it is the Council and Parliament that pass the laws.

The rules and procedures for EU decision-making are laid down in the treaties. Every proposal for a new European law is based on a specific treaty article, referred to as the 'legal basis' of the proposal. This determines which legislative procedure must be followed. The four main procedures are 'consultation', 'assent' 'cooperation' and 'co-decision'.

The co-decision procedure is now used for most (approximately 2/3rds) EU law-making. The Environment is one of the areas where co-decision applies. In the co-decision procedure, Parliament does not merely give its opinion: it shares legislative power equally with the Council. Both parts have the right to propose amendments or reject the draft. In any case the Commission's role, as the institution responsible for the proposals, is maintained, e.g. if the Commission gives a negative comment towards the Parliaments' amendments made upon the Council's common position, then an unanimous approval from the Council is needed for the act to be finally adopted. If Council and Parliament cannot agree on a piece of proposed legislation, not even after the second reading (meaning that amendments made at least by one of the parts), it is put before a conciliation committee, composed of equal numbers of Council and Parliament representatives (chaired jointly by the President of the Parliament and the President of the Council). Once this committee has reached an agreement, the text is sent once again to the Parliament and the Council to be finally adopted as a law.

The Commission's role

As well as drafting proposals for new European Laws, the Commission is also the EU's executive arm. In other words, it is responsible for implementing the decisions of the Parliament and the Council. This means that the Commission manages the day-to-day business of the European Union: implementing its policies, running its programs and spending its funds. As part of this role, the Commission implements the policies and programs relating to energy and, hence, is a key audience for trade associations operating, or planning to operate, in the energy field.

The Parliament's role

As already mentioned before, the role of the Parliament in the decision making for European Laws can be just consultative or of the same weight with the Council's if 'co-decision' is imposed. Apart from being a co-legislator, the Parliament can implement

political initiative, suggesting to the Commission which laws are needed to be introduced to the Council, as it examines the Commission's annual program[7]. It consists of representatives of the Union's citizens who are appointed for 5 years (minimum 6 and maximum 96 representatives per member state).

The Council's role

The Council is the EU's main decision-making body. It represents the member states, and its meetings are attended by one minister from each of the EU's national governments. Which ministers attend which meeting depends on what subjects are on the agenda. If, for example, the Council is to discuss environmental issues, the meeting will be attended by the Environment Minister from each EU country and it will be known as the 'Environment Council'. The Council's decisions are composed by working groups comprising representatives from the Member States and are then passed to the COREPER (Committee of Permanent Representatives, consisting of ambassadors of the Member States in the EU) which is responsible for organising the agenda of the Council. The Ministers are those who finally get the decisions by vote.

Individual Member States

The decision making processes of the member states sit within the framework of the EU decision making process and within that they vary from country to country. As such it is not possible within this document to cover the individual processes within each member state. Nevertheless, the importance of the decisions taken in relation to energy by individual members states should not be underestimated as within current frameworks they each have considerable influence over energy policy and, hence, whether or not thermal storage is supported in country specific policies and programs.

Promotion of an interest in the EU

Knowledge of the decision-making process itself is not sufficient to reveal the way an effective strategy promoting thermal storage should be formulated. It is essential to identify first if and what type of representation (of parties supporting thermal storage) needs to be formed before attempting to influence the appropriate EU Institutions in favour of thermal storage. For this reason this part of the analysis pertains to the process of influencing the European Institutions.

The following analysis is based on the information provided by the websites of the European Commission, the European Parliament and the Council of Ministers and on a series of studies on Business Lobbying in the European Parliament, the European Commission and the Council of Ministers conducted by Bouwen (Bouwen 2002, Bouwen

[7] This rarely used procedure (Rule 39 of Parliament's Rules of Procedure) was implemented for example in the case of the new legislation proposal for Heating and Cooling from renewable energy sources (see 4.5.2). This initiative of the Parliament took place due to pressure imposed by a group of organizations which signed a Joint Declaration for this reason, proposing a 25% share for the RES in Europe. Information can be found at URL:< http://www.eurosolar.org/new/en/downloads/PR_heating_cooling.pdf> [accessed at 14/09/06].

2004). These studies provide an understanding of how access at the EU Institutions is gained, describing the mechanism of the 'demand' and 'supply' of 'access goods'[8] exchanged between the EU institutions and the interest groups during the legislation procedure.

Rules of accessing the EU Institutions

The communication of special interest groups with the Commission takes place without explicit rules. Therefore there is no issuing of passes, neither accreditation, nor registration, apart from a basic code of conduct. Two types of interaction can be served through this open way. The advisory one, which aims to assist the Commission deals with its competences and the dialogue which takes place on an ad hoc basis. There is a general concept which prescribes that the Commission is accessible to outside input in an open way (93/C 63/02 and Euractiv article, 2005) This is generally perceived as the result of limited budget and staffing within the Commission which necessitates knowledge from the outside to be introduced for the drafting of legislation.

On the other hand the Parliament's policy towards external influence differs from that of the Commission's. There is an accreditation procedure which is followed and the Accredited lobbyists to the European Parliament have accepted the rules and the code of conduct. The passes are issued by the Quaestors and the list of the names of the holders is publicly available. Only rarely are applications for a pass denied and in general the role of the College of Quaestors is not critical in the actual lobbying procedure (Bouwen, 2004). Accredited lobbyists can be private, public or non-governmental bodies with the right to access the Parliament and assist or advocate the members of it for themselves or third parties.

As far as it concerns the Council of Ministers, it is at a National level that lobbying can occur, as the Council working groups meet in Brussels for limited periods only. Different conditions for accessing the political process in each of the Member States exist, and therefore the lobbying varies widely from one country to the other.

The 'demand and supply' concept

According to Bouwen's estimations, the EU institutions will reward with the highest degree of access (and consequently potential influence) those interest groups which provide the highest quantity and quality of information ("access good"). Each European Institution has a specific role to play and a specific audience to represent (and satisfy) and therefore requires input from certain interest groups.

- The role of the Commission among the EU Institutions is supranational (almost beyond national spheres of influence), promoting the general European interests[9] through its annual agenda. Although it is generally believed that the slow decision making within the European Organisations leads to inefficiency on influencing the EU Institutions, the documentation presented in the Commission's website supports the opposite. It is stated that *'while the Commission tends to favour European (con)federations over representatives of individual or national organizations, it is nevertheless committed to the equal treatment of all special groups…'* (93/C 63/02). Bouwen's concept confirms this fact and explains in addition that since the Commission holds the legislative initiative in the law making, it usually makes use of expertise in order to compose the draft proposals of new European Laws. Thus, it appears that both the **Individual firms and**

[8] Terms used by Bouwen.
[9] The term 'European Encompassing Interest' is used by Bouwen to express the general European Interests.

European Organizations have access to the Commission offering expert knowledge and expressing the general European interest respectively. What the Members of the Parliament need, on the other hand, is information to help them assess the proposals submitted by the Commission, rather than expert knowledge.

- The Parliament's perspective is clearly the European one, but since its members are elected at a national level, there is also the need to satisfy their voters. The European Parliament appears therefore to be interested in the **European and National interest** allowing input from European and National Organizations.

- As the counterpart of the Commission's supranational position, the Council of Ministers is strongly related to the governments of the Member States, and the national interest is dominant there. For the same reasons as with the Parliament, expert knowledge is rarely of interest for its members, but when individual firms are national champions it is the national opinion they carry which attracts the interest of the Council. Therefore **National Associations and National Champions** are the most preferable groups for access in the Council of Ministers.

The locus of the EU Institutions for the promotion of an interest.

As far as it concerns the European Parliament, it is the specialized committees which are important to be considered in relation to the promotion of an interest, for three main reasons (Bouwen 2004, Bowler and Farrell, 1995). First of all, the biggest part of the legislative process takes place in the committee sessions. Secondly, during the plenary sessions in Strasbourg or in Brussels private actors cannot be present, but access is usually allowed in the committees. The third reason is that in committee meetings individual MEPs have the right to propose amendments[10], while at the plenary only the committee in charge, a political group or a group of minimum 32 MEPs can do that. The Committees which are of interest in the case of thermal storage are the *Committee of Environment, Public Health and Food Safety* and the *Committee of Industry, Research and Energy.*

When dealing with the Commission, the role of the relevant Directorate-Generals must be taken into account. Of interest to the thermal storage is the Environment Directorate-General.

As far as it concerns the Council of Ministers the sectoral formations of the Council are of particular importance for the lobbying. Since the dominant influential power in the Council is located at a national level, it is at the governmental field of each country where the locus of effective influence can be found.

Conclusions

As it appears from the previous analysis, different stages of the legislation procedure pertain to different audiences and therefore different ways of influencing these audiences. The Commission is responsible for organising the annual legislative agenda and composing the proposals. If there is a need to bring out a technology at the European legislation framework, either because the latter is inadequately or not in the least covered by the existing regulations, it is the Commission which has to be aware of

[10] Again the example of the legislative proposal for the "Heating and Cooling from RES" can be used. The German Socialist MEP Mechtild Rothe drafted the proposal which was then voted by the Parliament.

that[11]. In order to bring the issue to the attention of the Commission, the intercessors which are capable of doing the contact must be used. Access to the Commission is gained mainly by the European Organizations and by those Individual Firms which can offer the expert knowledge required for composing the proposals. Assuming now that certain proposals are already drafted and are proposed to the Parliament and the Council of Ministers, it is again a subject of using the appropriate representatives to achieve influence in favour of an interest in the decision process. The Parliament seems to prefer advice from the European Organizations and from actors which hold power at a national level (possibly National Organizations), as it is desired that the proposal is also beneficial for the voters of the MEPs. National Organizations have also the first word in the Council of Ministers along with the 'National champions' which can also represent the national interest.

It is apparent, that a high level of encompassing and power is required in order to ensure access and therefore potential influence towards the EU institutions. Nevertheless it is generally perceived that some large associations have a complex and rather ineffective structure of decision making which sometimes encumber their approaches towards the EU institutions. The following analysis aims to cast some light on how the decision making has occurred in practice concerning other enabling technologies and how much the reality differs from the theoretical framework presented here. Nevertheless, as far as it concerns the environmental legislation, the Sustainable Development Strategy adopted in June 2006 states that *"…all EU institutions should ensure that major policy decisions are based on proposals that have undergone high quality* ***Impact Assessment****, assessing in a balanced way the social, environmental and economic dimensions of sustainable development and taking into account the external dimension of sustainable development and of costs of inaction..."* (Renewed EU SDS, 2006:7/29).

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- **Bouwen, Pieter. 2002.** A Comparative Study of Business Lobbying in the European Parliament, the European Commission and the Council of Ministers Discussion Paper of the Max Planck Institute for the Study of Societies, Cologne. Document can be found at URL:< http://www.mpi-fg-koeln.mpg.de/pu/mpifg_dp/dp02-7.pdf> [accessed at 03/08/06].)
- **Bouwen, Pieter. 2004.** The Logic of Access to the European Parliament: Business Lobbying in the Committee on Economic and Monetary Affairs, Journal of Common Market Studies, 42:2 or 42:3 (forthcoming). Document can be found at URL:< http://www.coll.mpg.de/pdf_dat/JCMS-Bouwen-2004.pdf> [accessed at 03/08/06].
  (**A full list of Peter Bouwen's publications** can be found at URL:< http://www.coll.mpg.de/bouwen.html>. [accessed at 03/08/06].)
- **Bowler, Shaun/David M. Farrell, 1995**: The Organizing of the European Parliament: Committees, Specialization and Co-ordination. In: *British Journal of Political Science* 25,219–243. (abstract available at URL:<http://links.jstor.org/sici?sici=0007-1234(199504)25%3A2%3C219%3ATOOTEP%3E2.0.CO%3B2-5#abstract> .
- **Euractiv Article. 2005:** "EU and US approaches to lobbying". Article found at URL:< http://www.euractiv.com/en/pa/eu-us-approaches-lobbying/article-135509?> [accessed at 02/08/06].

[11] To a less extent, the Parliament can play a role at that stage, since it carries a political initiative (see paragraph 2.1.2)

- **Renewed EU SDS 10117/06**: European Union Sustainable Development Strategy, 2006. Document can be found at URL:< http://register.consilium.europa.eu/pdf/en/06/st10/st10117.en06.pdf > [accessed at 10/08/06].

- **93/C 63/02:** 'An open and structured dialogue between the Commission and special interest groups', Document can be found at URL:< http://ec.europa.eu/civil_society/interest_groups/docs/v_en.pdf > [accessed at 04/08/06].

EU Institutions:

- **European Commission's** webpage: URL: < http://www.ec.europa.eu/>.
  - The Environment Directorate General: Information can be found at URL:< http://www.ec.europa.eu/dgs/environment/index_en.htm> [accessed at 04/08/06].
  - The Energy and Transport Directorate General: Information can be found at URL:< http://www.ec.europa.eu/dgs/energy_transport/index_en.html> [accessed at 04/08/06].

- **European Parliament's** webpage: URL: < http://www.europarl.europa.eu/>.
  - The Committee of Environment, Public Health and Food Safety: Information can be found at URL:< http://www.europarl.europa.eu/comparl/envi/default_en.htm> [accessed at 04/08/06].
  - The Committee of Industry, Research and Energy. Information can be found at URL:< http://www.europarl.europa.eu/committees/itre_home.htm> [accessed at 04/08/06].

- **Council of Ministers'** webpage: URL: < http://www.consilium.europa.eu/>.

Appendix B – Examples of Other Enabling Technologies

- **heat networks**: although CHP can be used without heat networks, e.g. in individual buildings, heat networks facilitate the wider use of CHP by enabling it to be used in combinations of buildings that are not suitable on an individual basis.
- **Inverters**: these are used to enable PV systems, for example those installed on dwellings, to convert their DC output to AC, thereby allowing for grid connection and significantly increasing applicability
- **Broadband networks**: these allow greater information flows thereby significantly increasing the effectiveness of the internet
- **Electricity networks**: they enable the output from wind turbines, and other generators, to be distributed to consumers
- **Catalysers in cars, or diesel soot filters**: Even though the average consumer is largely unaware of this technology, they do contribute to policy targets. They have become commonplace by being enforced. Simple but effective.
- **Computer expansions** (e.g. video cards): they are 'enabling technologies' in the sense that they don't do anything themselves, but just allow computers to run better programs. Manufacturers sell videocards because they came up with a good performance indicator, which is something that could be done for thermal storage.
- **Building insulation**: this isn't a very appealing technology by itself, but it does enhance indoor comfort. It has been supported (at least in NL) through building directives.
- **Turbo diesel engines**: these were originally designed for (semi-)stationary applications, but have now become popular in cars because diesel is so cheap. This has really stimulated technology development. However the chances of a similar price driven market in HS maybe small.
- **The energy labelling system**: this seems to be quite effective in consumer electronics (fridges, washing machines) and cars. Something similar could be done with thermal storage.
- **Low Temperature Heating/ Radiators**: Due to a Low Temperature Heating system (enlarged radiators/ floor heating/wall heating etc) the efficiency of systems like condensing boilers, heat pumps and micro CHP will improve.
- **Lighting with daylight sensors** (e.g. in offices) The amount of light needed is detected by sensors and will automatically be changed if the amount of daylight changes. This is an enabling technology in the sense that energy will be saved without any action from the user. The user will hardly notice the use of daylight sensors, because the total amount of light will always be sufficient

Appendix C – Template used in discussions with stakeholders

Questionnaire WP3: Methods of Policy reinforcement

Note for interviewers: The primary purpose of interviews/discussions undertaken as part of WP3 is to establish what lessons, specifically regarding policy reinforcement, can be learned from other enabling technologies. Although this questionnaire provides a series of standardised questions around which to base discussions, the information recorded as 'additional comments' will be crucial to gaining maximum value from this process.

Interviewer	
Organisation	
Interviewee	
Organisation	
Position	

At the start of the conversation, the interviewer should introduce themselves, explain the background to the project and explain the purpose of the call.

Q1: Which category best describes the job of the interviewee?

a) Policy Maker or Adviser ☐
b) Regulator ☐
c) Programme Manager ☐
d) Industrial Stakeholder ☐

Q2: Which Enabling technology is being discussed?

a) Heat networks (BRE) ☐
b) Catalysers in Cars (ECN) ☐
c) Compact Flash Cards (ISE) ☐
d) Building Envelope Insulation (CSTB) ☐
e) Energy Labelling (E&K) ☐
f) Batteries for electric cars (BASE) ☐

Additional Comments:

If interviewing:

- **Policy Makers/Advisors** go to **Part A**
- **Regulators** go to **Part B**
- **Programme Managers** go to **Part C**
- **Industry Stakeholders** go to **Part D**

PART A – Questions for Policy Makers/Advisors

Note: there may be multiple answers to some of these questions

QA1: How did the technology first come to your attention?

a) Industrial stakeholders, e.g. suppliers, requesting meetings with Officials ☐
b) Attendance at conferences where the technology was discussed ☐
c) Research (Market, Technical, etc) ☐
d) Press coverage, e.g. TV programmes, featuring the technology ☐
e) Given responsibility as part of job role for promoting the technology ☐
f) Other (describe under Additional Comments below) ☐

Additional Comments:

QA2: Why were you convinced that the technology should be promoted?

a) It became clear that the technology would support wider policy goals ☐
b) The benefits of the technology were clear **(describe the benefits below)** ☐
c) Other (describe under Additional Comments below) ☐
d) It was not to supported (give reasons why below) ☐

Additional Comments:

QA3: How did you assess the benefits of the enabling technology?

a) Estimated cost savings based on whole life costing analysis ☐
b) Estimated emissions reductions e.g. carbon dioxide, etc ☐
c) Other (describe under Additional Comments below) ☐

Additional Comments:

QA4: What industry activities helped to establish the technology within policies (programmes and regulations)?

a) Industry comments received during the policy formulation process ☐
b) Lobbying by trade associations e.g. letter to/from members of parliament ☐
c) Other (describe under Additional Comments below) ☐

Additional Comments:

QA5: What were the primary barriers to the take up of the technology?

a) Running cost savings to users did not produce a quick financial return ☐
b) The benefits of the technology were difficult to get across to users ☐
c) Other (describe below) ☐

Additional Comments:
[Also include comments here on what solutions were used to overcome barriers]

QA6: What Policy is currently followed in relation to the technology?

a) Actively encouraging the technology e.g. through incentives, programmes ☐
b) Ensuring fair treatment of the technology ☐
c) Other (describe under Additional Comments below) ☐

Additional Comments:

QA7: What factors were critical to the development of the technology?

a) Clearly identifying the potential benefits for users ☐
b) Gaining political support and governmental backing ☐
c) Other (describe under Additional Comments below) ☐

Additional Comments:

QA8: In conclusion, briefly summarise your role in helping the technology establish itself?

Additional Comments:

PART B – Questions for Regulators

Note: there may be multiple answers to some of these questions

QB1: How did the technology come to your attention?

a) Raised with you by Policy Makers ☐
b) Industrial stakeholders, e.g. suppliers, requesting meetings with Officials ☐
c) Attendance at conferences where the technology was discussed ☐
d) Press coverage, e.g. TV programmes, featuring the technology ☐
e) Given responsibility for the technology as part of job role ☐
f) Other (describe under Additional Comments below) ☐

Additional Comments:

QB2: What was the initial reason for considering how to cover the technology within the regulations?

a) Asked by Policy Makers to consider how it could be included ☐
b) Representations from industry that their technology was not covered ☐
c) Other (describe under Additional Comments below) ☐

Additional Comments:

QB3: What industry activities helped to ensure that the technology was adequately catered for within the regulations?

a) Input into regulator reviews on how the technology could be integrated ☐
b) Attendance at dedicated regulator workshops regarding the sector ☐
c) Responses to consultations regarding draft versions of the regulations ☐
d) Anomalous treatment within existing regulations was highlighted ☐
e) Other (describe under Additional Comments below) ☐

Additional Comments:

QB4: What were the primary barriers to the take up of the technology?

a) Running cost savings to users did not produce a quick financial return ☐
b) The benefits of the technology were not understood by users ☐

c) Other (describe below) ☐

Additional Comments:
[Also include comments here on what solutions were used to overcome barriers]

QB5: What regulations are currently followed?

a) The technology is now mandatory ☐
b) Technology optional, but if used it must achieve a performance level ☐
c) Other (describe below) ☐

Additional Comments:

5

QB6: What factors were critical to the development of the technology?

a) Clearly identifying the potential benefits for users ☐
b) Gaining political support and governmental backing ☐
c) Other (describe under Additional Comments below) ☐

Additional Comments:

QB7: In conclusion, briefly summarise your role in helping the technology establish itself?

Additional Comments:

PART C – Questions for Programme Managers

QC1: How did the technology first come to your attention?

a) Raised with you by Policy Makers ☐
b) Industrial stakeholders, e.g. suppliers, requesting meetings with Officials ☐
c) Attendance at conferences where the technology was discussed ☐
d) Research (Market, Technical, etc) ☐
e) Press coverage, e.g. TV programmes, featuring the technology ☐
f) Given responsibility for the technology as part of job role ☐
g) Other (describe under Additional Comments below) ☐

Additional Comments:

QC2: What is the primary purpose of the programme(s) in question?

a) Pure or applied **research** ☐
b) Technology **development**/acceleration e.g. field trials ☐
c) Grants for **demonstration**/installation of technologies ☐

Additional Comments:

QC3: In developing the programme what factors, specific to the technology, did you consider?

a) Potential for reduction in units costs from increase installation volumes ☐
b) How the range of applicability of the technology could be demonstrated ☐
c) Benefits (environmental, economic, social & educational) ☐
d) Other (describe under Additional Comments below) ☐

Additional Comments:

QC4: What were the primary barriers to the take up of the technology?

a) Running cost savings to users did not produce a quick financial return ☐
b) The benefits of the technology were difficult to get across to users ☐
c) Other (describe below) ☐

Additional Comments:
[Also include comments here on what solutions were used to overcome barriers]

QC5: What results have been achieved and over what time frame?

Additional Comments:

QC6: What factors were critical to the development of the technology?

d) Clearly identifying the potential benefits for users ☐
e) Gaining political support and governmental backing ☐
f) Other (describe under Additional Comments below) ☐

Additional Comments:

QC7: In conclusion, briefly summarise your role in helping the technology establish itself?

Additional Comments:

PART D – Questions for Industry Stakeholders

Note: there may be multiple answers to some of these questions

QD1: How did you bring the technology to the attention of Policy Makers?

a) requesting meetings with officials and/or ministers ☐
b) lobbying members of parliament ☐
c) other ☐

Additional Comments:

QD2: At what stage in the technology development process did you start actively engaging with Policy Makers?

a) At the **research** stage ☐
b) At the **development** stage ☐
c) At the **demonstration** stage ☐
d) At the **production** stage ☐
e) Other (describe under Additional Comments below) ☐

Additional Comments:

QD3: How did you persuade Policy Makers that the technology should be supported?

a) Clearly set out the benefits ☐
b) Explain how it could meet multiple policy objectives ☐
c) Other ☐

Additional Comments:

QD4: What were the primary barriers to the take up of the technology?

a) Running cost savings to users did not produce a quick financial return ☐
b) The benefits of the technology were difficult to get across to users ☐
c) Other (describe below) ☐

Additional Comments:
[Also include comments here on what solutions were used to overcome barriers]

QD5: What proved to be the best way(s) of promoting the technology?

a) web site ☐
b) newsletter ☐
c) education ☐
d) demonstration ☐
e) other ☐

Additional Comments:

QD6: What factors were critical to the development of the technology?

a) Clearly identifying the potential benefits for users ☐
b) Gaining political support and governmental backing ☐
c) Other (describe under Additional Comments below) ☐

Additional Comments:

QD7: In conclusion, briefly summarise your role in helping the technology establish itself?

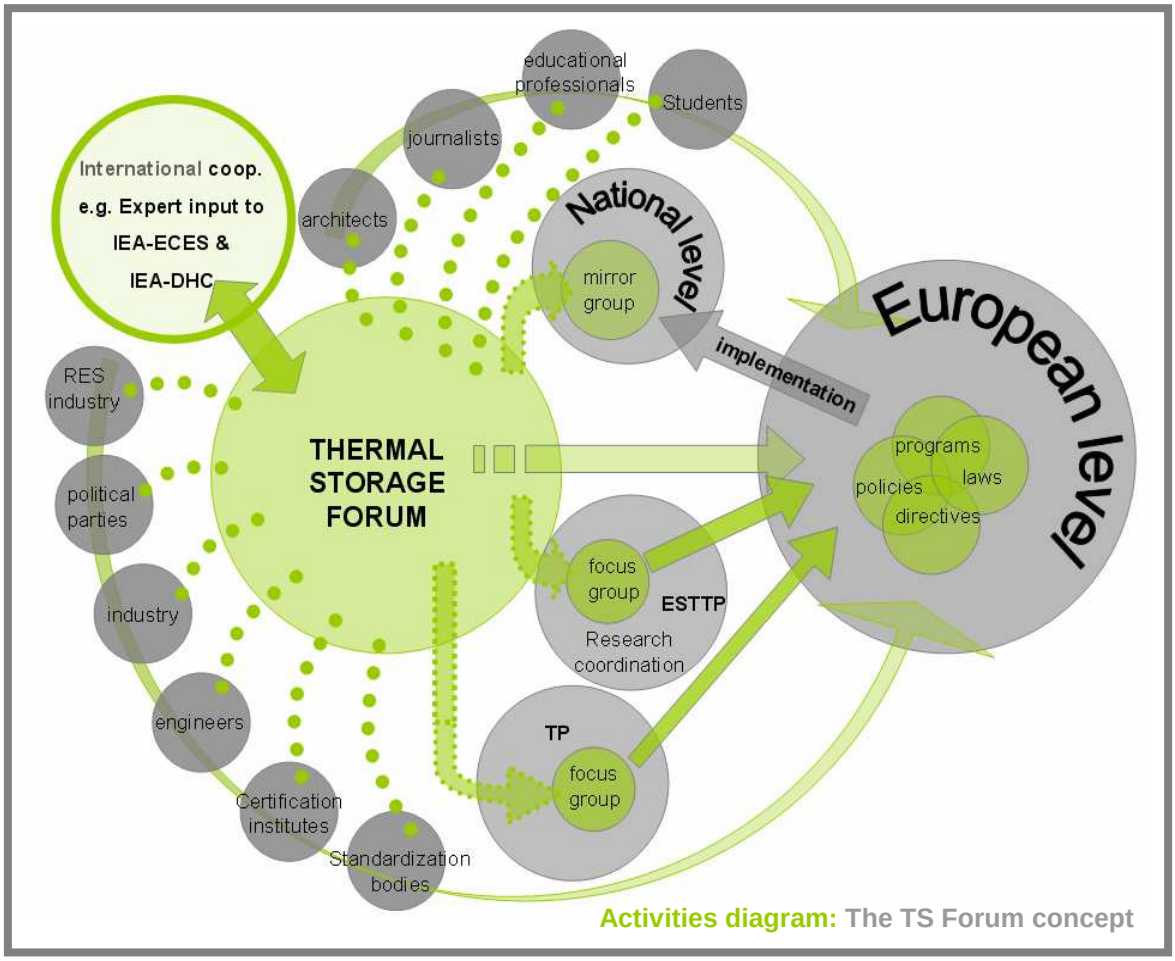
Additional Comments:

Appendix D – Supporting the thermal storage interest in the EU: A Thermal Storage Forum?

Various reasons suggest that the actions relating to the promotion of Thermal Storage must be organised in a systematic and consistent way:

- The need to link industry, research and market,
- the need to coordinate research around Europe,
- the need to summarize all the thermal storage technologies together so that they can be considered as a distinctive group with many alternatives and
- the conditions for effective promotion of an interest at the EU Institutions (when a wide range of encompassed interests is supported, access to the EU institutions is facilitated).

The following diagram summarises the future activities that need to be undertaken:



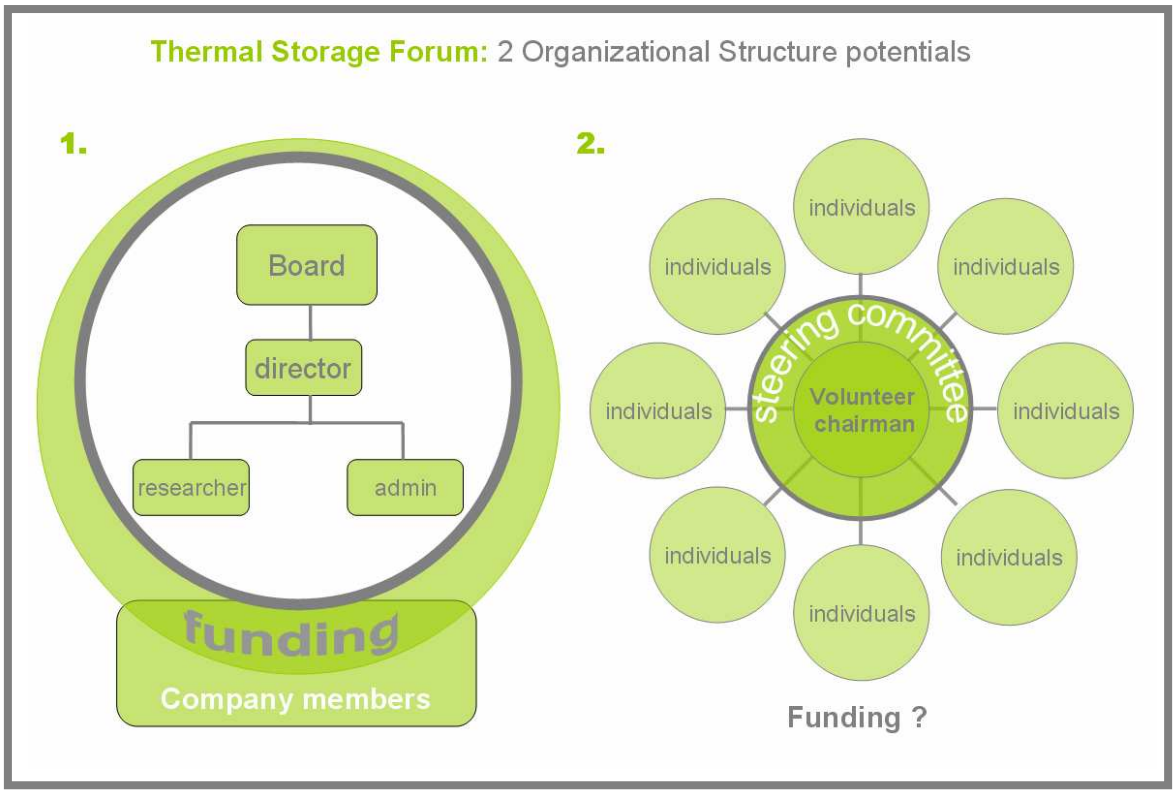
Activities diagram: The TS Forum concept

This report brings out the potential of establishing a Thermal Storage Forum, identifying the need of representing the overall European thermal storage technology community and the necessity of ensuring funding sources for the strategy in the future and receiving international input. According to this concept the "Thermal storage Forum" coordinates the activities and

⇒ Influences the EU Institutions.

⇒ Communicates with the Thermal storage Focus Group of the ESTTP (which has already influential power on the EU Institutions).
⇒ Establishes connections and communicates with other similar focus groups in other related TPs (e.g. the recently launched Technology Platform for Biofuels).
⇒ Creates a mirror group at each Member State which prepares the ground and facilitates the implementation of the European Actions at a national level (activities such as dissemination and national lobbying also included).
⇒ Communicates with International Cooperation groups, such as the IEA-ECES (Energy Conservation through Energy Storage) and the IEA-DHC (District Heating and Cooling), so that the actions supported from the Forum are well tuned with those organised internationally and that expert input from the PREHEAT is achieved.
⇒ Approaches a number of individual groups that can play an important role in the support of thermal storage technologies.

Two different scenarios for the organisational structure of this “Thermal storage Forum” are considered and are presented in the following diagram.



The first one pertains to a T.S. Forum funded by company members and organised with an hierarchical structure, while the second represents a more vague and loose group of interested individuals (e.g. engineers, researchers) represented by a voluntary Steering Committee and a volunteer chairman. It is apparent that the second scenario lacks substantial funding. Nevertheless it is important to acknowledge that in practice it is the actual interest by potential members which will determine the structure of the Forum. It is at the moment impossible to estimate what type of members a collaboration of this type would attract. Access to information and new business are two possible benefits for potential members. This requires further investigation and demonstration of some first achievements by the PREHEAT. It is therefore a subject to be discussed after the completion of this Work Package, along with potential members and the PREHEAT Steering Committee.

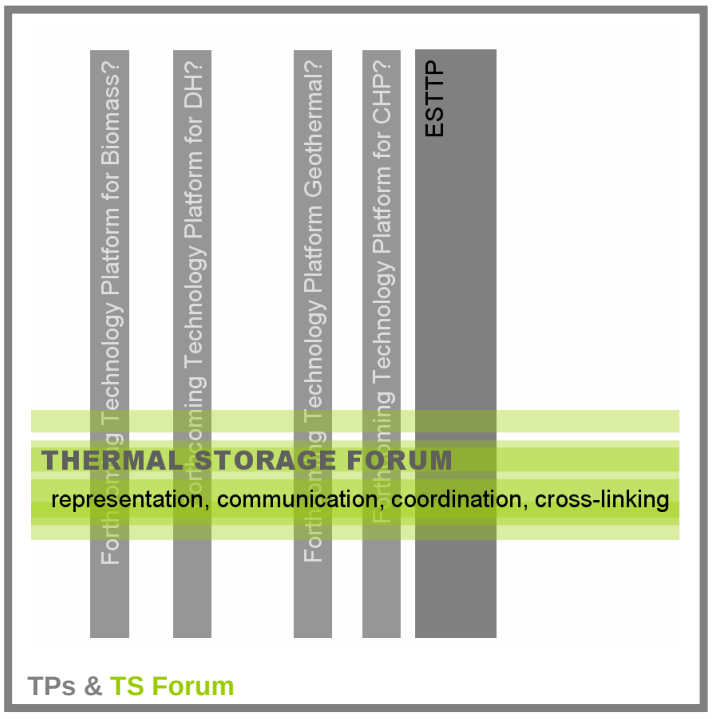
Cooperating with existing Technology Platforms

As far as it concerns the EC programs, the technology platforms are considered as the main dialog partners and therefore formation is encouraged by the EC. Thermal storage is an enabling technology and as experienced with the Heat Networks' case (chapter 3) promotion of the technology can be realised on the back of existing platforms of other related technologies. The UK CHPA (Combined Heat and Power Association) brought the Heat Networks' technology to the attention of the policy makers, because it was acknowledged that optimisation of the CHP district systems strongly depended on the former technology.

The following arguments support the cooperation with other related TPs:

- Thermal storage is not a primary technology and therefore establishing a dedicated technology platform for the technology might not be a priority at the moment and might not be economically feasible either.
- The actual benefits of the thermal Storage in carbon reductions and energy savings can be clearly understood in relation to the technologies with which it can be combined (solar, biomass, CHP, etc).
- Thermal Storage can benefit from existing policies and from already well established connections within the EU institutions, and therefore time and effort can be saved.

In any case the Strategic Research Agenda of these TPs must be influenced so that thermal storage is supported. The idea is that a 'horizontal area' is created to cross-link the 'vertical' ones represented by the TPs.



The PREHEAT has already achieved cooperation with the ESTTP and a Thermal Storage Focus (sub-)Group is planned there. More analytically, the ESTTP consists of three main focus groups:

1. "Solar Thermal systems for buildings (heating and cooling)",
2. "Industrial application (including refrigeration)" and
3. "Solar thermal deployment strategy, scenarios (market and policy aspects)".

Under the first group, five sub-groups are planned and one of them will be the 'Storage' group. Discussions have already been held within PREHEAT and along with the ESTTP regarding the influential power of this group.

As far as it concerns thermal storage types which are not related to solar thermal, relations with other (forthcoming) technology platforms must be identified in the future.