PREHEAT

Policy reinforcement regarding heat storage technologies

EIE/05/036/SI2.420010

Present State of the Support for thermal storage in the European Union

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ISE	Fraunhofer Institute for Solar Energy Systems
CSTB	Centre Scientifique et Technique du Bâtiment
E&K	Ellehauge & Kildemoes
BRE	Building Research Establishment
Base	Base Consultants

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Content:

1 Introduction

This report is produced as part of the Work Package 2: “Description of decision making processes” in the PREHEAT project (Policy reinforcement regarding heat 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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ECN is coordinator of the project, while E&K is Work package leader of Work package 2.

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

2 Background

Thermal storage covers a very broad range of technologies and applications. It ranges from hot water boilers storing several hundreds litres of hot tap water overnight, through 10,000 m³ water vessels for peaks in district heating demand, all the way to experimental compact heat stores using thermo chemical materials for lossless storage of summer's solar heat for winter usage.

The technologies have minimal visibility, but nevertheless the effect of thermal storage technologies is huge. Better thermal storage can increase the solar energy produced by solar thermal systems. Thermal storage is always part of a larger system, and therefore focus is rarely put on the storage itself.

As a consequence different branches using storages do not make optimal use of experiences gained in the other branches, and as a consequence projects within R&D programmes, policies and regulations tends to forget the importance of storages

The aim of the report is to describe:

- the national and EU programmes and decision-making processes
- the role and placement of thermal storage techniques in the programs and decision-making processes
- the possibilities for reinforced focus on thermal storage techniques in the programmes and decision-making processes.
- the possibilities for utilisation of the programmes and decision-making processes in the dissemination

In the report chapter 3 to 6 summarise the EU and national findings while chapter 7 to 13 gives the specific EU and national information.

The report summarizes the outcome of the Work Package 2: “Description of decision making processes” in the PREHEAT project.

2.1 Work Package 3 – Methods for policy reinforcement

The outcome of the WP2 is the basis for the work in the PREHEAT project Work Package 3 – ”Methods for policy reinforcement”.

The WP3 will cover methods of policy reinforcement and describe strategies that can be used to influence policy-making and decision making processes with respect to implementation of heat storage. The strategies will be used to influence the future plans for the existing policies, programmes and regulations mentioned in this report.

2.2 Methodology of investigation method/report

This report is based on written sources of information on R&D programs, policies and regulations as well as on interviews with persons involved in the mentioned.

Every country has been responsible for the national information, while the overviews and the information on EU is elaborated by Ellehauge & Kildemoes.

2.3 Limitations

Of course a very broad number of programs, policies and regulations could have some impact on the development and use of storages. It has however been necessary to chose

only the programs, policies and regulations with the most impact on storages. It has been up to the participants of the PREHEAT project to judge which programs, policies and regulations to include in the investigation.

2.4 National storage markets

This report is not about the different storage technologies, but only on the programmes, policies and regulations. However some national characteristics about the use of storage techniques are worth mentioning.

In all countries dealt with in this report the main application of thermal storages is hot water tanks in combination with a boiler or heated by district heating or electricity.

All countries furthermore have solar heating systems were storage either is in the solar hot water tank or in other kind of solar storages.

Another important application in most countries is buffer storage tanks in combination with biomass boilers.

Especially in Denmark a large number of dwellings are connected to district heating networks and large buffer storages situated at the heating or cogeneration plant are of importance.

Large seasonal storages for solar energy have been investigated in most of the countries with probably the largest number in Germany.

In the Netherlands focus is on cold storage, low temperature or high temperature storage in the ground.

3 Overview of EU and national support programs relevant for thermal storages

An overview of the investigated programs is given in Table 1.

From the investigations can be concluded:

Only Switzerland has a program directly directed on storages.

EC and all the included nations have programs i.e. on energy savings and/or renewable energy which support research, development and demonstration of storages in the extent that it is relevant for the purpose of the programme.

In the above mentioned programmes there is no specific focus on thermal storages, but if mentioned at all they are mentioned in connection with the main technology

The following programmes are mentioned to be relevant for PREHEAT to influence:

EC: FP7: The programme will support R&D on storages. The work programme has been formulated, but not the calls. The technology platforms are encouraged by EC and are expected to be a dialog partner for the EC system

EC: IEE: The programme will support promotion and dissemination of information on storages. The technology platforms are encouraged by EC and are expected to be a dialog partner for the EC system.

Denmark: EFP and PSO. Both programmes are relevant for storages. Both programs relate to a number of strategies elaborated by the Danish Energy Agency. It should be discussed with the Danish Energy Agency to elaborate a strategy on storages.

France: Prebat: The programme is about reducing energy for buildings. It should be discussed with the strategic committee of PREBAT in order to get more focus on thermal storage projects.

France: The Building-Energy foundation program is a funding program for projects on reducing energy use of buildings. It should be discussed with the strategic committee of Bâtiment-Energie in order to get more focus on thermal storage projects. This could be done by quoting examples of thermal storage in their calls.

France: Several funding programmes for installations or renovations in buildings exist. It should be discussed with the key actors in order to get more focus on thermal storage projects.

Germany: All programs relevant for thermal storage are subparts of the 5. German Federal Energy Research program. Thermal storage is in several sup programmes like the Energy optimized building program (Enob) and SolarBau. The most relevant sub program is Solarthermie 2000+ (solar thermal 2000 plus program), with the focus on low temperature solar thermal applications and several pilot plants. Programs completed but should be mentioned are the 4th Energy Research program with the leading task energy generation and storage for mobile purposes. There are several local programmes from the states, e.g. BwBlus program for climate and resources protection.

Switzerland: Switzerland has a programme directed towards storages. The only problem is the level of funding. The organisation and program are correct.

The Netherlands: EIA, Due to the EIA less income tax or corporate tax has to be paid when investing in energy saving measures or investing in the implementation of sustainable energy. Due to the EIA it is allowed to subtract a certain percentage of the investment costs from the fiscal profit (5%, 30% or 40%, depending of the technology that is invested in) [10].The financial advantage depends on the amount of tax that the company would have to pay without the EIA. The EIA can only be applied if the investment project meets the requirements from the energy list [11].

The Netherlands: EOS. The Ministry of Economic Affairs supports the development of (knowledge about) energy efficiency and renewable energy because 'knowledge about energy efficiency and renewable energy will be the base for an affordable, reliable and clean energy in the future'. This support takes place by the EOS program (Energie Onderzoek Subsidie). Subsidies from the EOS program can support all stages from idea to market introduction [1].

The Netherlands: UKR. The UKR (Unieke Kansen Regeling /Unique Opportunities Arrangement), stimulates cooperation under leadership of Dutch market actors. The UKR supports experiments that fit within the 'official transition paths', determined by the Ministry of Economic Affairs. These experiments need to contribute to a more sustainable energy management. The UKR works with tenders and the second tender was open from 15 May 2005 – 31 July 2005. The project proposals need to be accepted by an independent advisory commission and will receive subsidy as long as the budget is not exceeded [13].

The Netherlands: Innovation Vouchers, In 2004 a first pilot of the Innovation Vouchers (Innovatie Vouchers) took place. The goal of the innovation voucher is to stimulate small and medium-sized enterprises to make use of the knowledge that's present in knowledge institutes. With the innovation voucher entrepreneurs can gather information by posing a question to a knowledge institute. This knowledge can be used to renew a product, process or service [1].

The Netherlands: Temporal subsidy scheme CO_2 reduction built environment 2006
This scheme stimulates large scale investments in energy reduction measures in existing buildings. Subsidies will be granted for energy saving measures described at the accompanying list, realizing at least 20 ton CO_2 per project per year. The list is not available yet, but from the press release it is clear that different types of insulation, HR++ glass and solar boilers and heat pumps will be financed (Persbericht VROM, 14-7-2006).

UK: Warmfront: Warmfront is a development program which offers a package of insulation and heating tailored to each property. There are economic restrictions that prevent the use of thermal storage technologies within the program. It could be discussed with the FPAG if a strategy for thermal storage could be promoted through their reports. In addition, the DEFRA could be contacted for that reason.

UK: Low Carbon Buildings Program. The Low Carbon Buildings Program aims to provide practical advice on energy efficient measures and practical advice and capital grants for installation of micro-renewables. The supported technologies (e.g. solar thermal) are strongly related to thermal storage and often depend on that. PREHEAT should therefore consider discussing with the programme managers if the role of thermal storage could be underlined within this program.

UK: Carbon Trust Low Carbon Programs, Technological Acceleration Programme: This program offers funding, coordination and expertise in order to accelerate sectors with great potential for carbon emissions reductions and overall impact on the U.K. economy. The technologies which are of interest are usually related to thermal storage; CHP, building (fabric, heating), biomass. Focus on thermal storage might therefore be enhanced.

Table 1 Overview of programs

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant	Funding storage/ funding Euro/Euro	Research/ development/ demonstration/ market
EU	FP6/FP7	The EC framework programmes are the central programmes for EC R&D. The FP6 is ending in 2006 and FP7 starts in 2007	http://ec.europa.eu/research/index_en.cfm	4	Overall budget 72.000 mio Euro	Research/ development/ demonstration
	IEE	The IEE programme is central for promotion and dissemination	http://ec.europa.eu/energy/intelligent/index_en.html	4	Overall budget 730 mio Euro	Market
	structural funds	The structural funds gives regional support for projects that might include storages. I.e.. Regional manufactorers might benefit	http://www.ec.europa.eu/regional_policy/ns_en.htm	2		Development/ market
DK	EFP energy research programme	EFP is a government funded R&D programme managed by the Ministry of Energy. Part of the progarm is related to renewable energy and energy use in buildings.	http://www.energiforskning.dk/	4	Overall budget 2006/08 30 mio Euro	Research/ development/ demonstration
	PSO (electricity-related)	PSO is R&D program managed by the electricity companies. The program relates to technologies and means that can save electricity.	http://www.energiforskning.dk/	3	Overall budget 2006/08 60 mio Euro	Research/ development/ demonstration
	Nordic Energy Research	The Nordic Energy Research program aims at nordic capacity building within enveronmental frinedly energy technologies	http://www.nordicenergy.net/	1		Research/ development
FR	PREBAT (Energy in buildings)	The Program is provides funding related to three main fields: a) research on materials, products, components, subsystems and their integration into buildings, b) integration of the research for the conception and construction of new and renovation of existing buildings and c) sociological aspects in the field of the PREBAT scope.	http://www.prebat.net	4	3 projects related to heat storage among 37	Research-demonstration
	Building-energy foundation (Fondation Bâtiment-Energie)	The Building-Energy foundation program is a funding program for at least 5 years with annual calls and a total envelope of 8Mio€. The foundation has been created in 2005 by four main actors on the building sector, Arcelor, EDF, GDF and Lafarge by the initiative of the ministry of research, Ademe and CSTB. The program funds technical as well as sociological aspects for projects related to the improvement of existing as well as new buildings.	http://www.batiment-energie.org	1	No funding for heat storage	Research-demonstration
	Funding programmes for installations and renovations	Different funding projects exist in France on private installations. Four possible kinds of funding come from ANAH, ADEME (only collective installations), EDF, the region or indirectly from the government by subsidies (reduced VAT or subsidies from the income tax), depending on the project. The funded products are: a) thermal insulation, b) control system, c) boiler, d) biomass fired boilers, e) solar hot water or solar heating system, f) heat pump and g) collective solar hot water production.	http://www.anah.fr, http://www.ademe.fr, http://www.edf.fr, www.impots.gouv.fr, www.cler.org/aides	1	Indirect funding in the case of solar systems	Installation

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant	Funding storage/ funding Euro/Euro	Research/ development/ demonstration/ market
DE	The 5. German Federal Energy-Research Program)	Possibilty for R&D energy related. Storage in part of the sub programmes	www.fz-juelich.de/ptj/, www.bine.info	3		
	Energy optimized building programme (main part)	Part of the 5th Energy-Research Program regarding energy optimized building	www.enob.info, www.bine.info	4	14.4 Mio in 2005 -2008	
	Energy optimized building (subpart : SolarBau) program	Part of the 5th Energy-Research Program.In order to pave the way for energy savings and utilizing solar energy in non residential buildings the German Federal Ministry of Economics and Technology (BMWi) has established a support programme called "Energy Optimized Building", known as SolarBau for short.	http://www.solarbau.de/english_version/index.htm	4		
	EnSan	Program for the improvement of the building fabric.(Part of the 5.th Energy-Research Program	http://www.ensan.enob.info/	1		
	Solar thermal 2000 program subtask 3	solar local heat - several pilot plants	www.solarthermie2000.de	3		
	Solar thermal 2000 Plus	Ministry of the enviroment : Promotion of low temperature solar thermal energy applications	www.solarthermie2000plus.de	3		
	4th Program : Energy-Research and Energy technologies	Leitprojekt Energieerzeugung und -speicherung für den dezentralen und mobilen Einsatz (Energy generation and storage for mobile purpose)	Förderprogram Energieforschung/Energietechnologien mit Zukunftsinvestitionsprogramm; http://www.surtec.com/Passivhaus/Ziele.html; www.bmwi.de; www.fh-frankfurt.de/wwwwt/forschung/forschung1.htm;	2		
	several local programmes from the states e.g. BwPlus in Baden-Württemberg	Several programs for climate and ressources protection	http://www.bwplus.fzk.de	2		
	BMBF-Projektförderung Netzwerke Grundlagenforschung erneuerbare Energien und rationelle Energieanwendung	Basic energy related research, ended in 2005	www.bmbf.de www.bmwi.de/BMWi/Navigation/Energie/energieforschung.html www.bmbf.org/foerderungen/2200.php	2		

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant	Funding storage/ funding Euro/Euro	Research/ development/ demonstration/ market
CH	Energie Schweiz	The programme SwissEnergy aimes at promoting energy efficiency and the use of renewable energy. The main strength of this programme lies in close co-operation between the federal government, the cantons and municipalities, and numerous partners from trade and industry, environmental and consumer organisations, and public and private agencies	http://www.bfe.admin.ch/energie/00458/index.html?lang=en	3	< 1%	Market: reduce energy demand
	R&D research programme	The Swiss Federal Office of Energy has 20 topics on which R&D is financed. Heat storage is linked to Solar heat and desserves a special attention since 1978.	www.solarch.ch	5	150 k / 150'000 k	Research: developp new storage technologies for solar combisystems
NL	Energy Research Subsidy (EOS) demo project support	Subsidies that can support all stages from idea to market introduction	www. Senternovem.nl	4		All phases
	Innovation Vouchers	Opportunity for small and medium size enterprises to pose questions	www. Senternovem.nl	3-4		Development
	environment investment deduction (EIA)	Less income tax or corporate tax has to be paid when investing in energy saving measures or in the implementation of sustainable energy.	www.senternovem.nl/EIA, Energielijst 2006	4		Implementation
	UKR Unique Opportunities Scheme	The UKR supports experiments that fit within the 'official transition paths'	www.ez.nl/content.jsp?objectid=41000	3-4		Experiments/ Demonstration
	Temporal subsidy scheme CO_2 reduction built environment 2006	Temporal subsidy scheme stimulating large scale investments in energy reduction measures in existing buildings.	(Persbericht VROM, 14-7-2006).	3		Market

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant	Funding storage/ funding Euro/Euro	Research/ development/ demonstration/ market
UK	Warmfront	Warm Front is the Government's main grant-funded programme for tackling fuel poverty. The scheme was launched in June 2000 and before its name changed to Warm Front it was called the Home Energy Efficiency Scheme.	www.defra.gov.uk/environment/energy/hees/	1 (2)	No such information found. The Scheme provides a grant of up to £2,700 for families and the disabled.	Market
	Community energy	The Energy Saving Trust and The Carbon Trust jointly ran a support programme providing guidance and funding for the installation and refurbishment of community heating schemes in the public sector across the UK. £50M in grants has been successfully allocated	www.est.org.uk/housingbuildings/communityenergy/	3 (3)	Not such information found on storage. £50m allocated in total.	Market
	Low-carbon buildings programme (LCBP)	The LCBP provides a holistic approach to reducing carbon emissions from buildings through a combination of practical advice on energy efficiency measures and practical advice and capital grants for the installation of micro-renewables (predesessor was clear skies www.clear-skies.org)	http://www.lowcarbonbuildings.org.uk	2 (4)	There are no grants in particular for stand alone TS applications, however they do form part of solar thermal installations.	Development, demonstration and market
	Carbon Trust Low Carbon programmes	The Carbon Trust Low Carbon programmes accelerate the development and commercialisation of new emerging low carbon technologies in the UK.	http://www.carbontrust.co.uk/technology/technicalsolutions/lcta.htm	2 (4)	There are no grants in particular for TS applications.	Development, demonstration and market
	Scottish community household renewables programme	SCHRI is a one-stop shop offering grants, advice and project support to assist the development of new community and household renewable schemes in Scotland.	www.est.org.uk/schri/	2 (4)	There are no grants in particular for TS applications.	Demonstration

4 Overview of EU and national policies relevant for thermal storages

An overview of the investigated policies is given in Table 2

From the investigations can be concluded:

EU and the countries do all have policies to promote energy efficiency and renewable energy.

Thermal storages can in principle benefit from the strategies but are often not mentioned

The following policies are mentioned to be relevant for PREHEAT to influence:

EU: Sustainable Energy Europe Campaign 2005-2008. The Sustainable Energy Europe 2005-2008 Campaign is a European Commission initiative in the framework of the IEE programme, which aims to raise public awareness and promote sustainable energy production and use among individuals and organisations, private companies and public authorities, professional and energy agencies, industry associations and NGOs across Europe. It would be relevant for the PREHEAT project to address the program and to influence it.

EU: Labelling of hot water storages. 3 drafts on the energy labelling of water storages are under preparation. It is not known when the directives will be approved and put in force.
It is relevant for the PREHEAT to follow the future development of the directive and to influence it if needed.

EU: Solar Keymark. The Solar Keymark is the result of a voluntary certification scheme supported by the European Solar Industry Federation (ESTIF) and the European Commission. It is relevant for the PREHEAT project to give input to the project.

DK: Research strategies initiated by The Danish Energy Agency. The Danish Energy Agency has initiated that a number of research strategies on technologies are formulated. The Danish R&D programs refer to the strategies. Relevant for thermal strategies are the strategies for biomass, fuel cells and energy efficient technologies. A strategy on solar heating is under preparation. It is recommended that the preheat project tries to initiate that a strategy for thermal storage is formulated by the Energy Agency.

France: Plan Climat. The Plan Climat tends to reduce greenhouse gas emission. In the Plan Climat thermal storage is mentioned once explicitly, but related to thermal storage in the building envelope. However, since the Plan Climat is realised in practice by several measures, thermal storage is or could be an important matter. It is recommended that the Preheat project tries to initiate that a strategy for thermal storage is considered in future policies.

France: Law on the orientation of the energy policies (Loi Pope) – N° 2005-781. The law defines the future orientations of the energy policies in France, transposing the European directives. It defines a framework for the development of renewables and creates a guaranty scheme for renewables. The measures put into practice are e.g. the French energy performance regulation, the creation of energy certificates etc. thermal storage is explicitly mentioned in the law. It is recommended that more research on thermal storage has to be carried out in order to increase the use of renewables. To get more impact, the PREHEAT would have to convince the key contacts for programmes or direct measures.

France: Simplification law (”Loi de simplification du droit”). The law defines the framework for a future diagnostic of the energy performance of buildings. As the Plan

Climat, it has been defined to transpose the EPBD directive in France. thermal storage is not mentioned in the text of the law. It has to be verified if the direct measure undertaken within the frame of this law will allow the consideration of thermal storage. It is recommended that the Preheat project tries to initiate that a strategy for thermal storage is considered in future policies.

Germany: The German Federal Government together with the science council decided in 1999 in the board for the estimation on education and technology sequences, to support the basic research on energy research with focus on renewables. The strategy is to develop a sustainable energy mix under the climate protection program 2000

Switzerland: Strategy on biomass. The strategy for biomass is to develop pellet heating for domestic applications and cogeneration plants 1 to 10 MW. thermal storage is not discussed within this program, and could be. It is recommended that the preheat project tries to open discussion with the biomass program.

The Netherlands: DEN. Renewable Energy in the Netherlands/ Duurzame Energie in Nederland. From 1998 on thermal storage has been stimulated with a programmatic approach ('Duurzame Energie in Nederland', DEN). This program is executed by SenterNovem, by order of the ministry of Economic Affairs. Main goals are technical development and market penetration. The DEN informs about the subsidy programs that exist (e.g. EOS and EIA) and how to apply for them (SenterNovem, 2004).

The Netherlands: Juridical Framework Ground Energy. In the 'Juridisch Kader Bodemonderzoek' bottlenecks and solutions from the market and the provincial authorities have been analysed. Aim of this study was:

1. to reduce the time between applying for an licence and receiving a licence
2. to make the requirements for a licence more uniform.

In this study a new juridical framework is suggested, which is based on present and future regulations (SenterNovem, 2006).

The Netherlands: Platform Energy Transition in the Built Environment. At 30 May 2006 the was officially installed. Het Platform Energietransitie Gebouwde Omgeving exists of representatives of the construction sector, housing corporations, users, authorities, and research institutions. The chair, Mr. Terlouw, thinks that within 15 years the energy used in buildings can be reduced with 30%-40%. On a longer term, the built environment can even become CO_2 neutral. To realize this, Mr. Terlouw thinks that especially political, economic and organizational transitions will be needed (Nieuwsblad Stromen, 23 juni 2006)

UK: The UK Climate Change program. The climate change program describes the UK plan and the ways of cooperating with other countries to tackle the Climate Change problem. Currently thermal storage technologies are not mentioned in the policy. It is important that the role and the potential of thermal storage is acknowledged in future revisions to the UKCCP as this would ensure further applications and dissemination of the technology within other, more specialized strategies and programs.

UK: Energy Efficiency commitment. The EEC is addressed to energy (gas and electricity) suppliers and it promotes improvements in the energy efficiency of dwellings. The policy doesn't refer to thermal storage in particular. It is recommended that PREHEAT should encourage the acknowledgement and inclusion of thermal storage within the EEC 3.

UK: Microgeneration Strategy. The main objective of the microgeneration strategy is "to create conditions under which microgeneration becomes a realistic alternative or supplementary energy generation source for the householder, for the community and for small businesses". It is important that the thermal storage technologies are recognized as an integral part of thermal microgeneration systems and are included in future revisions to strategies.

UK: Biomass Task Force – Action Plan (the government's response). In March 2006 the action plan to promote the exploitation of biomass for renewable energy was launched.
One of the future targets is the development of standards for biomass with aim to increase the efficiency of the systems. The funding program is expected to open for applications around the end of 2006 (subject to receiving the necessary State Aid clearances). It is recommended that the PREHEAT project raises this the relevant government departments to ensure that the role of thermal storage is understood and underlined as an integral part of highly efficient biomass installations. The same applies for the development of standards for biomass which is planned within the action plan.

UK: Energy Review Consultation. In April 2006 the DTI aimed to collect proposals on the "medium and long-term energy policy issues". The summary of the responses will be published and the statement on energy policy will be announced in the summer 2006.
TS is not referred to in the consultation paper but its role can be identified in the CHP and micro-heat technologies (GSHP, thermal solar and biomass) which are included in the heating measures. The Energy review is important for the support of thermal storage, because it will shape policies for both the energy demand and supply for the medium and long term. Including thermal storage in the Energy Review is only likely to be done indirectly though, possibly through other interrelated programs.

UK: Planning Policy Statement 22. PPS22 is the governmental policy framework to be implemented in new planning strategies and local development documents. The strategy supports the renewable resources which are related to thermal storage technologies. PREHEAT should investigate whether the policy is going to be revised in the future, so that there could be more focus on thermal storage.

Table 2 Overview of policies

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant
EU	Sustainable Energy Europe	The Sustainable Energy Europe 2005-2008 Campaign aims to raise public awareness and promote sustainable energy production and use.	http://www.sustenergy.org	4
	White Paper	The European Commission's White Paper sets out a strategy to double the share of renewable energies in gross domestic energy consumption in the European Union by 2010		
	Labelling	3 drafts on the energy labelling of water storages are under preparation.		4
	Solar Keymark	The Solar Keymark is a voluntary certification scheme for solar heating systems	http://www.estif.org/solarkeymark/	4
DK	Strategy on biomass	A strategy for R&D has been formulated by the Energy Agency	http://www.ens.dk/sw17437.asp	3
	Strategy on fuelcells	A strategy for R&D has been formulated by the Energy Agency	http://www.ens.dk/sw17445.asp	3
	Strategy on energy efficient technologies	A strategy for R&D has been formulated by the Energy Agency	http://www.ens.dk/sw16961.asp	3
	Strategy on solar heating	A strategy for R&D will be formulated by the Energy Agency. Ellehauge&Kildemoes is author.		4
FR	Plan Climat	Voted by the French government in 2004, the Plan Climat tends to reduce greenhouse gas emission in France with the following objectives: reduce greenhouse gas emissions until 2010 about 10% compared to 2003 and by a factor 4-5 until 2050. In order to accomplish the objectives, the Plan Climat is accompanied by several measures: an important information and communication campaign by ADEME, reinforcements of tax subsidies on the use of energy efficient components (cf. programmes §2.3), the extension of energy certificates for commercial products (on cars, buildings etc.) as well as the creation of foundations promoting the research and application of new technologies allowing to achieve the objectives of Plan Climat.	http://www.ecologie.gouv.fr/article.php3?id_article=2551	1
	Law on the orientation of the energy policies – N° 2005-781	Adopted in 2005, this law fixes defines the future orientations of the energy policies in France, transposing the European directives.	http://www.senat.fr/dossierleg/pjl03-328.html	2
	Law “simplification” – N°2004-1343	Voted by the French government in 2004, this law defines the frame for a future diagnostic of the energy performance of buildings. As the Plan Climat, it has been defined to transpose the EPBD directive in France.	http://www.senat.fr/apleg/pjl03-343.html	1

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant
CH	Minergie	A private label that managed to come to a national standard to limit the heat demand of buildings. MINERGIE is a quality label for new and refurbished buildings. This trade name is mutually supported by the Swiss Confederation, the Swiss Cantons along with Trade and Industry and has been registered to prevent misuse. Comfort is the central theme – the comfort of the users living or working in the building. This level of comfort is made possible by high-grade building envelopes and the systematic renewal of air. Specific energy consumption is used as the main indicator to quantify the required building quality. In this way, a reliable assessment can be assured. Only the final energy consumed is relevant. The MINERGIE Standard is widely accepted. There are many reasons for this, the most important: builders and planners – in other words architects and engineers – have complete freedom both in their design and choice of materials and also in their choice of internal and external building structures. In the meantime, the building sector has developed a wide range of products and service	www.minergie.com	1
NL	DEN Renewable Energy in the Netherlands	Inform about subsidy programs, main goals: technical development and market penetration	Nieuwsblad Stromen, Senternovem 23 juni 2006	4
	Juridical Framework:	Reduce time and requirements for licensing procedure	Senternovem, 2004, Protocol Monitoring Duurzame Energie	5
	Platform Energy Transition:	Describe required transitions to realize a more energy efficient/ energy neutral build environment	Senternovem, 2006, Juridisch Kader Bodemenergie, knelpunten en oplossingen vanuit markt en overheid – IF-Technology bv, 2/55259/MaK, 1 maart 2006	2

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant
UK	UK Climate Change Program	The climate change program describes the UK plan and the ways of cooperating with other countries to tackle the Climate Change problem. The Climate change program which was firstly launched in November 2000 was recently reviewed for a second time and the new version was published on 28 March 2006. The project was undertaken by the Reducing UK Emissions workstream of the Sustainable Energy Policy Network and was assisted by interdepartmental groups.	http://www.defra.gov.uk/environment/climatechange/uk/ukccp/index.htm	2 (3)
	energy efficiency commitment	Under the Energy Efficiency Commitment (EEC) electricity and gas suppliers are required to achieve targets for improvements in domestic energy efficiency.	www.defra.gov.uk/environment/energy/eec/	1 (3)
	Microgeneration Strategy	The DTI microgeneration strategy was launched in March 06 and its main objective is “to create conditions under which microgeneration becomes a realistic alternative or supplementary energy generation source for the householder, for the community and for small businesses”.	http://www.dti.gov.uk/energy/energy-sources/sustainable/microgeneration/microgen-strategy/page27594.html	3 (4)
	Biomass Task Force-Action Plan	On the 27th of March the Government (ministers of DEFRA and DTI) launched an action plan to promote the exploitation of biomass for renewable energy, in response to the Biomass Task Force recommendations. Currently the action plan concerns only England.	http://www.defra.gov.uk/farm/acu/energy/biomass-taskforce/	3 (4)
	Energy Review Consultation	The consultation has a broad scope and considers all aspects of the energy system including both energy supply and demand.	http://www.dti.gov.uk/files/file25079.pdf	2 (3)
	planning policy statement 22 (RE)	PPS22 sets out the Government's policies for renewable energy, which planning authorities should have regard to when preparing local development documents and when taking planning decisions.	http://www.communities.gov.uk/index.asp?id=1143908	2 (2)

5 Overview of EU and national regulations relevant for thermal storages

An overview of the investigated directives and regulations is given in Table 3

In general a number of EU directives are implemented in national regulations etc.
Most of the directives or regulations are not focussing directly on storages but include rules that are relevant for storages.

From the investigations it can be concluded:

EU: Cogeneration directive
The cogeneration directive was agreed in 2004. The purpose of the directive is to increase energy efficiency and improve security of supply by creating a framework for promotion and development of high efficiency cogeneration of heat and power.
The directive establishes a harmonised method for calculation of electricity from cogeneration in which the beneficial use of thermal storages is taken into account.

EU: Directive on energy end-use efficiency and energy services. The directive was adopted by the EU energy minister in March 2006. The countries should develop energy efficiency action plans before 30. June 2007 for the first three-year period. As a consequence of the Directive the member states shall remove barriers and ensure public information as well as putting energy companies etc under the obligation of offering energy services and energy efficiency programs. Furthermore the target shall be reached be ensuring proper financing possibilities that ensure that long term investments in energy saving measures can compete with short term investments in energy supply. Thermal storages are not mentioned in the directive but will benefit from the obligations of the directive to set up measures to ensure end- use efficiency

EU: Legislative proposal on increasing the share of renewable energies used in Europe for heating and cooling (Mechthild Rothe report) In February 2006 The European Parliament adopted a resolution based on the report drafted by Mechthild Rothe with recommendations to the Commission on heating and cooling from renewable sources of energy. It is proposed that a realistic and ambitious EU target of at least a doubling of the share of renewable heating and cooling by 2020 shall be set. Furthermore measures are proposed to promote renewable energy such as: National binding targets, Dismantling administrative barriers, National Support Schemes and Financial incentives, regulatory measures, such as the mandatory utilisation of RE systems. In the report behind the proposal thermal storage is not mentioned, but will of course benefit from the directive if elaborated and approved.

EU The Energy Performance Building Directive. The objective of the directive is to promote the improvement of building performance within the Community, and as part of this it sets up a common frame for calculation of the building performance as well as regulatory figures for the allowed energy requirement of the building. The directive has already or is being implemented in a number of countries. From the Danish implementation it is concluded that in DK the calculation method will improve the energy performance of hot water storages, but on the other hand not show the advantage of other kind of storages since they are not included in the calculation method. It could be recommended that the PREHEAT tries to influence the further development of the calculation method.

EU: CE standards for boilers, solar etc. A number of standards influencing storages exist. Since regulations and directives build on the standards they are not treated separately in this report.

DK Building regulations. The new regulations building on the Energy Performance Building Directive were implemented in April 2006. . From the Danish implementation it is concluded that in DK the calculation method will improve the energy performance of hot water storages, but on the other hand not show the advantage of other kind of storages since they are not included in the calculation method. It could be recommended that the PREHEAT tries to influence the further development of the calculation method.

France: Building regulation (RT2000 and RT2005 from September 2006)
The French building regulation is actualized every 5 years. The regulation considers thermal storage concerning several aspects: thermal storage in the building structure is fully considered since the numerical model of the building takes into account the thermal inertia. thermal storage for the production systems (all systems including solar systems) is only considered in terms of losses. Innovative concepts of thermal storage such as seasonal storage cannot be taken into account. A discussion of how to include calculation of improved performance by thermal storages in the energy frame calculation program should be initiated. For example, if a European calculation method for performance of thermal storage would exist, it would be possible to increase the impact of thermal storage in this regulation.

France: In preparation: Regulation for existing buildings (RT existent)
As part of the French building regulation RT2005, it is planned to release a regulation on existing buildings which will be actualized at least every 5 years. Since the regulation will evaluate the components of the building it could be possible to add thermal storage. The outcomes of the Preheat project could have an impact on the regulation. It is recommended that the Preheat project tries to initiate that a strategy for thermal storage is considered in this future regulation.

France: In preparation: Inspections of boilers and air conditioning systems
Following the EPBD, periodical inspections of boilers and air conditioning systems will have to be realised by qualified experts. The inspections will include the evaluation of the efficiency of the installation, the sizing related to the building needs as well as recommendations and eventual suggestions for modifications.

France: In preparation: Energy performance certificate
A set of regulations should soon be adopted requiring a standardised assessment of annual costs of energy to be notified on the occasion of the sale or rental of a building for residential or tertiary use. The regulations are now being designed and should be adopted along with the new thermal regulation. In the current stage, thermal storage is not explicitly considered. Since default values for the components are used to obtain consumption values from the heat demand, storage could be added in a certain way in this calculation method. It is recommended that the Preheat project tries to initiate that a strategy for thermal storage is considered in this future regulation.

Germany: German regulations for renewables are the national biomass regulation, the national energy saving regulations (Novellierte Energieeinsparverordnung EnEV 2004), the implementation of the European SAVE guideline (93/76/EWG) and the implementation of the European regulation ENV 12977-3 for hot water tanks and ENV-12977-2 for thermal performance examination.

Switzerland: Building regulations. The building regulations are built on a number of standards, recommendations and directions. It is a point for discussion in the PREHEAT group: how to get more involved in the storage tank homologation procedures.

The Netherlands: Wet milieubeheer (Wm). The Law for Management of the Environment (Wm) is an integral environmental law that regulates the different kinds of impacts that an activity might have on the environment.

The Netherlands: Grondwaterwet (Gww). The Ground Water Law (Gww) only lays down rules for the ground water quantity.

The Netherlands: Wet Bodembescherming (Wbb). The Law for Soil Protection (Wbb) lays down rules for the protection of the ground water quality and the cleaning up of the ground. The 'Draining decision for ground protection' (Lozingenbesluit bodembescherming) is part of the Wbb and is stated in an Order in Council. The Lozingenbesluit relates to the drainage of liquids into the ground, it doesn't relate to the drainage of water that has been pumped up before from the same ground layer (as long as no heat is added).

The Netherlands: Wet verontreiniging oppervlaktewateren (Wvo). The law Polution of Surface Water (Wvo) lays down rules for the protection of surface water from waste matters and/or harmful and polluting matters.

The Netherlands: Energie Prestatie Norm (EPN). In 1995, the Energy Performance Standard (EPN) was introduced, both for dwellings and buildings in the service sector. The EPN enables calculation of the integral energy performance of a new building and consists of a standardised method for the calculation of an energy performance coefficient (EPC). The Dutch government is considering setting a stricter standard (EPN) for utility buildings, which will promote the use of different energy saving measures.

Table 3 Overview of regulations and directives

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant
EU	Cogeneration directive	The purpose of the directive is to increase energy efficiency and improve security of supply by creating a framework for promotion and development of high efficiency cogeneration of heat and power	http://www.managenergy.net/products/R81.htm	4
	Directive on energy end-use efficiency and energy services	The directive forces the member states to initiate measures to reach a target of 1% annual cumulative energy savings.	http://ec.europa.eu/energy/demand/legislation/end_use_en.htm	4
	Legislative proposal on increasing the share of renewable energies used in Europe for heating and cooling (Mechthild Rothe report)	It is proposed that a realistic and ambitious EU target of at least a doubling of the share of renewable heating and cooling by 2020 shall be set	http://www.europarl.europa.eu/oeil/file.jsp?id=5254662	5
	Energy Performance Building Directive.	The objective of the directive is to promote the improvement of building performance within the Community.	http://www.managenergy.net/products/R210.htm	4
DK	Building regulations	The building regulations is based on a number of standards and recoommendations, i.e. regarding security, insolation etc	http://www.ebst.dk/tema_bygger i/51136/1/0	4
FR	Building regulation (RT2000 and RT2005)	This regulation on the energy consumption of new buildings, including space heating and domestic hot water	http://www.rt2000.net	3
	In preparation: Building regulation existing buildings	This regulation on the energy consumption of existing buildings that have to be renovated, including space heating and domestic hot water		3
	In preparation: Inspections of boilers and air conditioning systems	Inspection of boilers and air conditioning systems.		1
	In preparation: Energy performance certificate	A set of regulations should soon be adopted requiring a standardised assessment of annual costs of energy to be notified on the occasion of the sale or rental of a building for residential or tertiary use. The regulations are now being designed and should be adopted along with the new thermal regulation.		3

	Name	Short characterization	Information sources	Relevance for storage (1-5) 5 most relevant
DE	Building directive Energieeinsparverordnung (EnEV) 2004 and 2006	The federal German Energy Saving regulation.This regulation limits the primary energy consumption of buildings, including heating energy and domestic water heating	http://www.enev-online.de/	3
	DENA Energiepass	The european guideline for the efficiency of buildings bounds every member to establish an energy pass for buildings.The german energy agency established this pass for germany.	http://www.gebaeudeenergiepass.de/	2
	SIA 380	recommendations of the swiss engineers and architects association regarding energy demand and savings in building	http://www.sia.ch	1
	[Regulation on boilers]	CEN norm	http://www.sia.ch/forum/attachment.php?attachmentid=677	5
NL	Grondwaterwet Gww	regulations for the ground water quantity	www.wetten.overheid.nl	4
	Wet bodem bescherming Wbb	regulations for the ground water quality	www.wetten.overheid.nl	3
	Wet milieubeheer Wm	law for general environment protection	www.wetten.overheid.nl	2
	Wet verontreiniging oppervlaktewater Wvo			1
	Energy performance standard EPN	standard for new to construct buildings	www.senternovem.nl/epn/	3
UK	Approved document L1a & L1b (domestic dw)	Provides information and guidance about the conservation of fuel and power in dwellings - set out in Approved Documents L1a and L1b	www.odpm.gov.uk	3(4)
	Approved document L2a & L2b (non-domestic)	Provides information and guidance about the conservation of fuel and power in those buildings that are not dwellings as set out in Approved Documents L2a and L2b.	www.odpm.gov.uk	2(4)

6 Overview of other decision making processes and barriers

Of other conditions relevant for beneficial use of thermal storages can be mentioned:

The future growth of the cooling market for building should be addressed somehow since for big projects underground cooling is possible.

As a barrier could be mentioned that in some fields standards and regulations are still not harmonized in the EU. I.e. hot water storages have to follow different national standards and regulations in the different countries. This means that i.e. in Denmark very few hot water tanks are imported.

The Netherlands: EPK (Energie Prestatie Keur), The aim of EPK (see Appendix N) is to promote the installation and use of energy efficient and high quality boilers with environmental friendly constructions. At the moment there exist a quality mark for boilers of the type HR100- HR104 and HR107. The use of heat storage will be positively influenced when the PREHEAT project team can realise that there also becomes a quality mark for heat storage systems, which will make it possible to distinguish between high and low quality systems

The Netherlands: GIW (Garantie Instituut Woningbouw). When a house is constructed, often different companies/parters work on the different parts of the construction. In case of mistakes, it is difficult to point out the responsible company. Therefore the GIW has been developed. The GIW takes responsibility for the entire construction chain (and all partners working on that) (see Appendix N). In case of mistakes or troubles, the GIW is the partner to communicate with and the partner that gives the guarantee on the house [5]. The GIW gives only guarantee on a house with thermal storage, if the storage system fulfills a number of requirements. Because of this development fewer thermal storage systems will be realized by incompetent organizations.

7 EU programs, policies, regulations etc.

7.1 EC support programs relevant for thermal storages

7.1.1 Overview

Until 2007
Existing programmes relevant for thermal storages and of which is given information in this report are:

- FP6 (The EU's Sixth Framework Programme for Research and Technological Development,
- IEE (the 'Intelligent Energy - Europe' Programme) and
- The Structural Funds.

After 2006 a new period of programs starts in which the programmes are structured differently.

From 2007
From 2007 actions on innovation, research and development will be organised in a series of flagship programmes. They will work in parallel and complement each other.
The 4 major programmes are:

- Competitiveness and Innovation Framework Programme (CIP).
- Cohesion activities
- Research, Technological Development and Demonstration Activities (The FP7 program,), and
- Lifelong Learning

Competitiveness and Innovation framework Programme (CIP)
The first "Competitiveness and Innovation framework Programme (CIP)" is running from 2007 to 2013. It will support actions that develop the capacity of enterprise and industry to innovate, with a budget of €3.6 billion in the next seven years. It is also intended to boost energy efficiency and renewable energy sources, environmental technologies and a wider take-up and innovative use of information and communication technology (ICT). It represents a 60 % increase in annual spending on actions related to competitiveness and innovation by 2013 compared to 2006.
The three specific programmes in the CIP framework are:

- Entrepreneurship and Innovation Programme
- ICT Policy Support Programme
- Intelligent Energy-Europe Programme

The "Entrepreneurship and Innovation Programme" will facilitate SMEs access to finance, better integrate the existing networks of business support services (EuroInfoCentres and Innovation Relay Centres) and support innovation activities (INNOVA, Pro-Inno etc). It is uncertain if this program will be available for the purpose of thermal storages.

The "ICT Policy Support Programme", will support information technology purposes and is not relevant for thermal storages

The "Intelligent Energy-Europe Programme" will support energy efficiency, new and renewable energy sources, and technological solution to reduce greenhouse gas emission cause by the transport sector. It will encourage the wider uptake of new and renewable energies and improve energy efficiency, and shall foster compliance with EC energy regulatory framework. The programme aims at accelerating action in

relation to the agreed EU strategy and targets in the field of sustainable energy, increasing the share of renewable energy and further reducing our final energy consumption. It includes actions to:

- increase the uptake and demand for energy efficiency
- to promote renewable energy sources and energy diversification, and
- to stimulate the diversification of fuels and energy efficiency in transport.

The programme will also help to increase the level of investment in new and best performing technologies and bridge the gap between the successful demonstration of innovative technologies and their effective introduction to the market to achieve mass deployment. Furthermore, it will strengthen the administrative capacity both to develop strategies and policies and to implement existing regulations. The program is very relevant for the promotion of thermal storages.

Cohesion activities,
The Guidelines set out a framework for new programmes which will be supported by the European Regional Development Funds (ERDF), the European Social Fund (ESF) and the Cohesion Fund. It is expected that projects with thermal storage that are part of regional development will have a possibility for support.

EU Research frameworks programmes
The FP7 program that will be the successor of FP6 in the years 2007-2013 is under preparation.

It is expected that part of the FP7 program will have some of the same aims as the FP6 program and information on the FP6 program may therefore also be valid for the FP7 program.

The FP7 program is the major EU program relevant for research and demonstration of thermal storage purposes.

Lifelong Learning
The Lifelong Learning programme is about education and probably not relevant for thermal storages.

In this chapter information on FP6 and FP7 is given in the same paragraphs as well as information on the IEE programme before and after 2006/2007 and projects under the cohesion/structural funds before and after 2006/2007

7.1.2 EC Research frameworks programmes FP6/FP7

7.1.2.1 Aim and structure of the program

7.1.2.1.1 FP6

The FP6 has to serve two main strategic objectives: Strengthening the scientific and technological bases of industry and encourage its international competitiveness while promoting research activities in support of other EU policies. (CORDIS).

The program is structured in three main blocks off activities grouped in two specific programmes (plus a third specific program on nuclear research)

The 2 programs are:

- Integrating and strengthening the European research area
- Structuring the European Research Area

The programme is structured vertically in a number of activities whereof the activity “sustainable development, global change and Ecosystems” is the activity with main relevance for storage technologies.

Furthermore the program is structured in a number of instruments (types of project)

The total budget of the program is 17.500 million Euros with 2.120 allocated for "Sustainable development, global change and ecosystems"

In general, the EU contributes only a certain percentage of the total costs of a project. Participants have to mobilise their own resources accordingly. The percentage of the EU's financial contribution depends on the type of activity

Following the principle of subsidiarity, projects have to be transnational. In other words: only consortia of partners from different member and associated countries can apply; for mobility and training actions the fellows typically have to go to a country different from their country of origin or residence. Activities that can better be carried out at national or regional level, i.e. without co-operation across borders will not be eligible under the Framework Programme. FP6 provides also possibilities and funding for organisations from third countries ("international co-operation").

The programme is aiming both at research, demonstration and innovation activities. The balance between the activities is specified in the description of the different topics and in the calls.

7.1.2.1.2 FP7

The 7th Framework Programme will be organised in four specific programmes, corresponding to four major objectives of European research policy:

- Cooperation
  Support will be given to the whole range of research activities carried out in transnational cooperation, from collaborative projects and networks to the coordination of research programmes. International cooperation between the EU and third countries is an integral part of this action.

- Ideas
  An autonomous European Research Council will be created to support investigator driven "frontier research" carried out by individual teams competing at the European level, in all scientific and technological fields, including engineering, socioeconomic sciences and the humanities.

- People
  The activities supporting training and career development of researchers, referred to as "Marie Curie" actions, will be reinforced with a better focus on the key aspects of skills and career development and strengthened links with national systems.

- Capacities
  Key aspects of European research and innovation capacities will be supported: research infrastructures; research for the benefit of SMEs; regional research driven clusters; unlocking the full research potential in the EU's "convergence" regions; "Science in Society" issues; horizontal activities of international co-operation.

Through these four specific programmes, the aim is to allow for the creation of European poles of excellence.

In addition, there will be a specific programme for the non-nuclear actions of the Joint Research Centre.

The programme on Cooperation will be organised into sub-programmes, each of which will be operationally autonomous as far as possible while at the same time demonstrating coherence and consistency and allowing for joint, cross-thematic approaches to research subjects of common interest.

The nine themes identified for the “Cooperation” part are:

- 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.

The total budget of the program is 72.000 million Euros with 2.931 allocated for “Cooperation” on “Energy”

In general, the EU contributes only a certain percentage of the total costs of a project. Participants have to mobilise their own resources accordingly. The percentage of the EU’s financial contribution depends on the type of activity.

Following the principle of subsidiarity, projects have to be transnational. In other words: only consortia of partners from different member and associated countries can apply; for mobility and training actions the fellows typically have to go to a country different from their country of origin or residence. Activities that can better be carried out at national or regional level, i.e. without co-operation across borders will not be eligible under the Framework Programme. FP6 provides also possibilities and funding for organisations from third countries (“international co-operation”).

The programme is aiming both at research, demonstration and innovation activities. The balance between the activities is specified in the description of the different topics and in the calls.

7.1.2.2 How does thermal storage fit with formulated areas of focus?

7.1.2.2.1 FP6

Within the ”Sustainable development, global change and ecosystems” area are defined the following research activities:

Research activities having an impact in the short and medium term

1) Clean energy, in particular renewable energy sources and their integration in the energy system, including storage, distribution and use
   a) Cost-effective supply of renewable energies
   b) Large-scale integration of renewable energy sources into energy supplies

2) Energy savings and energy efficiency, including those to be achieved through the use of renewable raw materials
   a) Eco-buildings
   b) Polygeneration
3) Alternative motor fuels

Research activities having an impact in the medium and longer term

4) Fuel cells, including their applications

5) New technologies for energy carriers/transport and storage, in particular hydrogen
6) New and advanced concepts in renewable energy technologies
7) Capture and sequestration ofCO2, associated with cleaner fossil fuel plants
8) Socio-economic tools and concepts for energy strategy

Within the FP6 program is different focusing on different target. An example is the Concerto initiative that will support local communities - urban, suburban, or rural - in developing sustainable and highly energy-efficient policies. Such communities may be newly established or may be seeking to improve their energy performance.

In the work program of FP6 Sustainable energy systems storage is mentioned several times especially in connection with the activities “Large scale integration of renewable energies sources into energy supplies”, “Polygeneration” and in the Concerto program.

Generally storages are described as a helping technology connected to the specific main technology or activity. It is the impression that in general storages are mentioned as a helping technology where applicable and will also be supported. However development and improvement of thermal storages is not mentioned as a separate activity.

Furthermore thermal storage is mainly mentioned as an activity within technologies having an impact in the short and medium term and not in activities having an impact in the medium and longer term.

The huge potential of i.e. improved seasonal storages in the longer term is not mentioned in the program

7.1.2.2.2 FP7

In the “Cooperation” part of FP7 the following specific activities are defined:

– 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

Storages are specifically mentioned in the paragraphs about ”Renewables for heating and cooling” and ”Smart Energy networks”

The “Ideas” program aims at strengthening frontier research and no specific subjects for research are mentioned.

The “People” program aims at supporting training and career development and no specific subjects are mentioned.

The specific programme on 'Capacities' will focus on improving research capacities throughout Europe. The main actions include support to research infrastructures, research for the benefit of SMEs, regional research-driven clusters, help for convergence regions to unlock their full research potential, 'Science in Society' (activities aimed at strengthening the link between science and society in general) and horizontal activities of international cooperation.

7.1.2.3 Who – how is decided which projects to support

Submission of proposals is only possible in response to calls for proposals. Proposals are evaluated and selected for funding by the European Commission with the help of independent external experts (peer review). Evaluation criteria and a detailed description of the process of evaluation, including the ethical review, are published in advance. For successful proposals, the European Commission enters into (financial and scientific-technical) contract negotiations. Successful negotiation will lead to a contract between the European Commission and participants.

7.1.2.4 Key persons

Pietro Menna, European Commission, Directorate General for Energy and Transport

7.1.2.5 Statistics of applications and supported projects on thermal storage

Within the CORDIS database was found information on 3477 projects of which 323 projects are within the activity for “Sustainable development, global change and ecosystems”. Out of the 323 projects no projects was addressing thermal storage as the main topic while 5 projects mentioned that they will work with storage as part of the project. 2 of the projects are about solar thermal systems, one is about buildings and 2 projects are about the overall energy delivery system.

7.1.2.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude was identified. See above paragraphs with information on FP7.

7.1.2.7 Trends, future changes and/or new programs coming up?

See above paragraphs with information on FP7.

7.1.2.8 Guide for applicants.

Submission of proposals is only possible in response to calls for proposals, which are published in the Official Journal of the European Communities and on the Internet (CORDIS: http://www.cordis.lu/fp6/calls.htm). Special information packages are issued for each call comprising documents, explanations and forms which are needed for the preparation of a proposal. An electronic proposal submission system (EPSS) is offered and proposers are strongly encouraged to use electronic submission. Calls have strict deadlines which are enforced to the minute.

Within the priority 6-1 “Sustainable energy systems” there are no more planned calls of FP6.

7.1.2.9 Can the program be used for dissemination of information about thermal storage?

Dissemination activities are part of the programme, but not mentioned as a separate activity. In general is preferred large projects.

7.1.2.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

As seen from the statistics given in paragraph7.1.2.5 only 5 of the projects that were found in the CORDIS database were about storages and no one was addressing the storage as the main topic. It can therefore be concluded that the program did not support the development of storages sufficiently, either because applications on storages were rejected or because the program and call text did not mentioned storage separately and therefore did not encourage applications focussing on storages.

7.1.2.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

It is concluded that the PREHEAT project should try to influence the content of calls within FP7.

7.1.3 IEE

7.1.3.1 Aim and structure of the program

The Intelligent Energy -Europe (EIE) Programme (2003-2006) is intended to support the European Union's policies in the field of energy as laid down in the Green Paper on Security of Energy Supply, the White Paper on Transport and other related Community legislation. Its aim is to support sustainable development in the energy context, making a balanced contribution to achieving the general objectives of security of energy supply, competitiveness, and environmental protection (Art. 1 of the programme Decision).

The EIE programme is designed as the main Community instrument for non-technological support in the field of energy. It provides continuity for the actions under the ALTENER, SAVE and, to a certain extent, SYNERGY programmes and combines all activities in the energy sectors contributing to the accomplishment of the main aims of Community energy and transport strategies in terms of energy aspects and also the sustainable development strategy. For the latter the Commission's communication on a sustainable Europe3, subsequently approved by the Gothenburg European Council and the conclusions of the World Summit on Sustainable Development held in Johannesburg, as well as the Johannesburg Renewable Energy Declaration, are of particular note.

The programme is structured in four specific fields:

a) "SAVE", which concerns the improvement of energy efficiency and the rational use of energy, in particular in the building and industry sectors (with the exception of actions under STEER), including the preparation of legislative measures and their application;
b) "ALTENER", which concerns the promotion of new and renewable energy sources for centralised and decentralised production of electricity and heat and their integration into the local environment and energy systems (with the exception of actions under STEER), including the preparation of legislative measures and their application;
c) "STEER", which concerns support for initiatives relating to all energy aspects of transport, the diversification of fuels such as through new developing and renewable energy sources and the promotion of renewable fuels and energy efficiency in transport, including the preparation of legislative measures and their application;
d) "COOPENER", which concerns support for initiatives relating to the promotion of renewable energy sources and energy efficiency in the developing countries, in

particular in the framework of the Community cooperation with developing countries in Africa, Asia, Latin America and the Pacific.

Apart from the formal requirements stated above, the programme also seeks the active involvement of the relevant market actors needed to implement the proposed actions successfully.26

SMEs have already been playing a vital role in the previous SAVE and ALTENER programmes (e.g. in 2002 more than 70% of the proposers of SAVE actions have been SMEs) and the EIE programme is continuing along that line. SMEs as well as applicants from remote/outermost regions are especially encouraged to participate in all the suggested key actions. The mid-term evaluation of the EIE programme will address the participation of SMEs as well as of the involvement of applicants from remote/outermost regions, and additional measures shall be undertaken for the second half of the programme if this proves to be necessary. Referring to the Community's commitment to gender mainstreaming27 a balanced gender distribution among proposers is encouraged.

The Community's contribution is provided as a grant to the budget established by the participants to carry out the action or project. In general, according to Article 4(2) of the programme Decision, co-financed actions or projects will be supported by the Community up to a maximum of 50% of the total costs of the action or project.22. The other minimum of 50% co-financing may come from the public and/or the private sector. The program is in general supporting promotion activities and will not support hardware.

When launching a call for proposals a minimum number of participants and their place of establishment are determined as part of the eligibility criteria. The details are published in each call for proposals. This minimum number is a formal lower limit. Proposers should decide upon the number of participants on the basis of the objectives and the approach of the proposed action so as to best ensure European added value.

In the case of COOPENER additional minimum requirements are foreseen since organisations from developing countries cannot be participants (in the sense of a contracting party), and therefore will formally be subcontractors. Nevertheless, the participants from developing countries must have clear and substantial roles in the projects.

IEE 2007 -2013

Between 2007 and 2013, some 350 000 SMEs will receive EU support to invest in all forms of innovation and growth. On 1 June 2006, the European Parliament adopted the first "Competitiveness and Innovation Framework Programme" (CIP). It will support actions that develop the capacity of enterprise and industry to innovate, with a budget of €3.6 billion in the next seven years. It will also boost energy efficiency and renewable energy sources, environmental technologies and a wider take-up and innovative use of information and communication technology (ICT).

Whilst eco-innovation will be a transversal theme of the whole programme, CIP is composed of three specific programmes:

- Entrepreneurship and Innovation Programme
- ICT Policy Support Programme
- Intelligent Energy-Europe Programme: with a budget of €730 million, the programme aims to increase use of renewable energy and reduced energy consumption by supporting energy efficiency, new and renewable energy sources, and technological solutions to reduce greenhouse gas emissions caused by the transport sector.

7.1.3.2 How does thermal storage fit with formulated areas of focus?

It is only the “Save” and the “Altener” activities that are relevant for thermal storage.

The Target areas of the Save and Altener activities are:

- MULTIPLYING SUCCESS IN BUILDINGS
  - Tools for the take-off of the Buildings Directive
  - Schemes for implementation of energy services in buildings
  - Public buildings as shining examples
  - Promotion of best practice examples of high energy performance buildings
- RETROFITTING OF SOCIAL HOUSES
  - Awareness raising, education and training
  - Tailored financing schemes
  - Advanced integrated retrofitting solutions
  - Legal and institutional changes
- INNOVATIVE APPROACHES IN INDUSTRY
  - (Instruments for) Energy management
  - Energy services in SMEs
  - Polygeneration
- ENERGY EFFICIENT EQUIPMENT AND PRODUCTS
  - Enforcing the application and enhancing the awareness of EU labels and minimum energy efficiency standards
  - Technology procurement, buyer-initiatives and other approaches to accelerate the
  - Transformation of the market
  - Monitoring market transformation and preparing the ground for new policy initiatives
- RES-ELECTRICITY
  - National indicative targets
  - Support schemes
  - Grid system issues
  - Green electricity
  - Distributed electricity generation
- RES-HEAT
  - Legislation, fuel standards and norms
  - Supply chain and market structures
  - Specific applications and building integration
- SMALL SCALE RES APPLICATIONS
  - Solar water and space heating and cooling
  - PV electricity generation
  - Biomass for domestic heating
  - Small scale CHP and heat pumps

In the work program storage is only mentioned once in combination with electricity from fuel cells and hydrogen technologies.

7.1.3.3 Who – how is decided which projects to support

The evaluation of proposals will be made by the Commission. For this purpose an evaluation committee will be formed. Projects and activities to be funded by the Community under the EIE programme need to meet a clear set of criteria and have to comply with the rules and procedures for proposal evaluation.

In principle each proposal has to fulfil a set of formal “eligibility criteria”. The proposal will be evaluated in detail only if these eligibility criteria are met. Unless otherwise specified in the call, proposals will not be evaluated anonymously. The evaluation will be divided into two steps: first compliance with a set of selection criteria is assessed and following this, the content of the proposal is assessed according to a set of award criteria. Marks will be given for each criterion and proposals meeting a defined minimum number of points will qualify for selection/funding. The results of the evaluation will consist of a list of proposals divided into those «Worth funding» and those «Not worth funding». The decision about the selection of a proposal will be made by the Commission on the basis of this list, subject to available funding. All submitted proposals are treated confidentially. This principle is upheld in all procedures. Immediately after the evaluation and selection procedure the programme committee will be informed about the results of this procedure.

7.1.3.4 Key persons

Contact: Krzysztof Gierulski, Project Officer, European Commission, Intelligent Energy Executive Agency

7.1.3.5 Statistics of applications and supported projects on thermal storage

The IntelEBase is a database of projects supported since 1996 in the IEE program or in the 4 underlying programmes that form the IEE (SAVE, Altener…)

In the base was found 626 Altener or Save projects. Out of this only 2 Altener projects mention the use of thermal storage both in combination with solar heating. In the Save program thermal storage is mentioned 4 times (in combination with cold storage, CHP, water heating)

7.1.3.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude was identified.

7.1.3.7 Trends, future changes and/or new programs coming up?

See above paragraphs with information on the new IEE program.

7.1.3.8 Guide for applicants.

The last call closes in October 2006.

Information on how to apply is found on http://ec.europa.eu/energy/intelligent/call_for_proposals/index_en.htm

Applicants are encouraged to discuss project ideas in advance with the IEEA project officers.

7.1.3.9 Can the program be used for dissemination of information about thermal storage?

The program is aimed for promotion and information is part of the program.

7.1.3.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

As seen from the statistics given in paragraph 7.1.3.5 only few of the projects that were found in the IntelIEBase database were about storages and no one was addressing the storage as the main topic. It can therefore be concluded that the program did not support the promotion of storages sufficiently, either because applications on storages were rejected or because the program and call text did not mentioned storage separately and therefore did not encourage applications focussing on storages.

7.1.3.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

It is concluded that the PREHEAT project should try to influence the content of calls within the future IEE program.

7.1.4 Structural funds

7.1.4.1 Aim and structure of the program

European regional policy allocates more than a third of the budget of the EU to the reduction of the gaps in development among the regions and disparities among the citizens. It sets job creation as its primary concern and it seeks to strengthen the economic, social and territorial 'cohesion' of the Union.

Each of the four existing Structural Funds has its own specific thematic area. The European Regional Development Fund (ERDF) finances infrastructure, job creating investment, local development projects and aid for small firms. The European Social Fund (ESF) promotes the return of the unemployed and disadvantaged groups to the workforce. The Financial Instrument for Fisheries Guidance (FIFG) helps adapt and modernise the fishing industry. The Guidance Section of the European Agricultural Guidance and Guarantee Fund (EAGGF-Guidance) finances rural development measures and provides aid for farmers. Other financial instruments exist in addition to these Structural Funds, including the Cohesion Fund.

For the period 2000–06 94% of structural funding is concentrated on three objectives:

– Objective 1: Helping regions whose development is lagging behind to catch up.

– Objective 2: Supporting economic and social conversion in industrial, rural, urban or fisheries dependent areas facing structural difficulties.

– Objective 3: Modernising systems of training and promoting employment.

Furthermore four Community initiatives exist: Interreg III for the development of crossborder, interregional and transnational cooperation; URBAN II to support innovative strategies in cities and urban neighbourhoods; Leader+ to promote rural development initiatives; EQUAL to combat discrimination in the labour market.

A special fund, the Cohesion Fund, is designed to assist the least prosperous countries of the Union: the 10 new Member States as well as Ireland (until the end of 2003), Greece, Portugal and Spain. Cohesion Fund intervenes throughout the national territory to co-finance major projects involving the environment and trans-European transportation networks rather than programmes.

The management of the structural funds is performed by the national authorities and information on supported activities etc. is found on national level. In Denmark the management of the fund is performed by the National Agency for Enterprise and Construction in collaboration with regional authorities.

7.1.4.2 How does thermal storage fit with formulated areas of focus?

The European Regional Development Fund (ERDF) finances infrastructure, job creating investment, local development projects and aid for small firms. Activities with thermal storages can be supported in connection with creating jobs. I.e. production of storages or establishing of energy systems that will facilitate development.

7.1.4.3 Who – how is decided which projects to support

It is the regional authorities who decide which projects to support. The program is supervised by a national committee.

7.1.4.4 Key persons

Denmark: Lone Rose, The Danish National Agency for Enterprise and Construction

7.1.4.5 Statistics of applications and supported projects on thermal storage

Denmark:
Out of 705 supported projects no project descriptions mention the use of thermal storage.

However 2 projects were about establishing biogas plants, where thermal storage might be used. One project was about establishing a solar heating plant including storage.

7.1.4.6 How is the attitude towards more focus on thermal storage in the program?

There is no focus on specific technologies.

7.1.4.7 Trends, future changes and/or new programs coming up?

The structural funds will continue as part of the Cohesion activities as described in paragraph 7.1.1

7.1.4.8 Guide for applicants.

Application forms are found at the regional authorities.
Denmark: (See: http://www.ebst.dk/reg_ansoeg)

7.1.4.9 Can the program be used for dissemination of information about thermal storage?

It will depend on how the idea fit with regional development purposes.

7.1.4.10 Conclusions about the present state of support and the resulting impact of the programs for different heat techniques storage

In DK the program has had no impact on the development or use of storages.

7.1.4.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

The program will probable not tend to focus on specific technologies, but is well suited for establishment of new productions in less developed regions or establishment of energy systems that can help development in less developed regions.

7.2 EC policies relevant for thermal storages

7.2.1 Sustainable Energy Europe Campaign 2005-2008

7.2.1.1 General

The Sustainable Energy Europe 2005-2008 Campaign is a European Commission initiative in the framework of the Intelligent Energy - Europe (2003-2006) programme, which aims to raise public awareness and promote sustainable energy production and use among individuals and organisations, private companies and public authorities, professional and energy agencies, industry associations and NGOs across Europe.

The specific objectives of the Sustainable Energy Europe 2005-2008 Campaign are to:

- Raise the awareness of decision-makers at local, regional, national and European level
- Spread best-practice
- Ensure a strong level of public awareness, understanding and support
- Stimulate the necessary trends towards an increase in private investment in sustainable energy technologies

Within the Campaign, achievable benchmarks for 2008 are also provided, in order to measure the progress of sustainable energy actions and serve as goals for decision-makers and planners.

The Sustainable Energy Europe 2005-2008 Campaign is specifically to support and promote actions in the following nine Main Campaigning Areas:

- Sustainable Energy Communities - Regions
- Sustainable Energy Communities – Cities
- Sustainable Energy Communities - Islands and Rural Areas
- Sustainable Energy in Communities aiming at 100% RES Supply
- Sustainable Energy in Transport
- Sustainable Energy in Buildings
- Sustainable Energy Lighting Systems and Appliances
- Sustainable Energy Co-operation with Developing Countries
- Sustainable Energy Promotion and Communication

7.2.1.2 In which respect is the policy relevant for thermal storage.

The campaign has for 2008 the following benchmarks involving (or possible involving) storages:

Solar thermal:	35 million m² of solar thermal installations
Geothermal:	15 new power plants and 10 new low-mid temperature plants and 250 000 new installed geothermal heat pumps
Biogas:	6 000 new biogas plants
Biomass:	450 new combined heat and power plants and 13 000 new district / centralized heating units installations

Furthermore the EU directive on the Energy performance of buildings is seen as part of the campaign where heating systems in 5.000 million buildings will be inspected and assessed leading to more efficient heating installations including storages.

7.2.1.3 How is the attitude towards more focus on thermal storage in the policy?

Not known

7.2.1.4 Can the policy be used for dissemination of information about thermal storage?

It is estimated that the campaign gives good opportunities to promote storages.

7.2.1.5 Conclusions and recommendations about more focus in the policy on storage and different storage techniques.

It would be relevant for the PREHEAT project to address the program and to influence it.

7.2.2 White paper

7.2.2.1 General

The European Commission's White Paper for a Community Strategy sets out a strategy to double the share of renewable energies in gross domestic energy consumption in the European Union by 2010 (from the present 6% to 12%) including a timetable of actions to achieve this objective in the form of an Action Plan.

The main features of the Action Plan include internal market measures in the regulatory and fiscal spheres; reinforcement of those Community policies which have a bearing on increased penetration by renewable energies; proposals for strengthening co-operation between Member States; and support measures to facilitate investment and enhance dissemination and information in the renewables field.

An important part of the Action Programme is the Campaign for Take-Off for Renewables, which forms an integral part of the Community Strategy and Action Plan for Renewable Energy Sources by 2010. It is designed to kick-start implementation of the Strategy and is expected to have reached its goals by 2004. Focusing on certain key sectors, the Campaign for Take-Off sets out a framework for action to highlight investment opportunities and attract the necessary private funding which is expected to make up the lion’s share of the capital required. The Campaign also seeks to encourage public spending to focus on the key sectors, and, in the process, to complement and trigger private investment. The Campaign is a highly visible vehicle, involving key sectors (solar, wind energy and biomass), for the drive towards a significant increase in renewables use and penetration.

7.2.2.2 In which respect is the policy relevant for thermal storage.

As part of the White paper was formulated the “campaign for take off”, which took place 1999-2003.

7.2.3 Labelling

7.2.3.1 General

3 drafts on the energy labelling of water storages are under preparation. The drafts refer to the EC Directive 92/75/EEC from 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances.

The drafts are about:

- Energy labelling of Gas and oil Water Heaters and water storage devices.
- energy labelling of Electric Water Heater
- Labelling of Solar Water Heaters and water storage devices.

It is the idea that the storages are classified after their energy consumption for a yearly average EU consumption. The storages are tested according to EU standard test method.

It is possible for storages making use of solar collectors to obtain an A+ or A++ label.

It is not known when the directives will be approved and put in force.

7.2.3.2 In which respect is the policy relevant for thermal storage.

It is expected that the directives will promote the use of energy efficient storages.

7.2.3.3 Key persons

Jan Erik Nielsen, PlanEnergi, Denmark

7.2.3.4 How is the attitude towards more focus on thermal storage in the policy?

The focus on storage is obvious

7.2.3.5 Can the policy be used for dissemination of information about thermal storage?

The introduction of the labelling will probably be followed by information campaigns.

7.2.3.6 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It is relevant for the PREHEAT to follow the future development of the directive and to influence it if needed.

7.2.4 Solar Keymark

7.2.4.1 General

The Solar Keymark is the result of a voluntary certification scheme supported by the European Solar Industry Federation (ESTIF) and the European Commission.

It is based on the CEN/CENELEC European Mark - The Keymark -, which is a general voluntary mark, developed by the European Committee for Standardisation (CEN). The

message of The Keymark is that the product complies with the European Standard(s) covering the product. The basic elements in the certification scheme are:

- Type testing of products according to the EN standards.
- Factory production control (ISO9000 level).

For the time being the Keymark is licensed for use in combination with a national mark.

The aim of the Keymark for solar thermal products is to assist users to select quality solar collectors and systems conforming to the European standards.

7.2.4.2 In which respect is the policy relevant for thermal storage.

The Solar Keymark issues certificates on solar collectors, referring to European standard EN 129-75 and on factory made solar heating systems referring to European standard EN 129-76.

The Solar Keymark on factory build systems is based on the overall testing of a solar system together with storage. A better storage will give a better test result.

7.2.4.3 Key persons

Jan Erik Nielsen, PlanEnergi, Denmark

7.2.4.4 How is the attitude towards more focus on thermal storage in the policy?

It is the plan also to issue certificates for domestic hot water solar tanks based on European standard EN 129-77 (Custom build systems, part 3 on hot water tanks) which is not fully completed.

7.2.4.5 Are there future changes in the policies and/or new policies coming up?

See above

7.2.4.6 Can the policy be used for dissemination of information about thermal storage?

The Solar Keymark website disseminate information on certified components

7.2.4.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It is relevant for the PREHEAT project to give input to the project.

7.3 EU regulations relevant for thermal storages.

7.3.1 Cogeneration directive

The cogeneration directive was agreed in 2004.

The purpose of the directive is to increase energy efficiency and improve security of supply by creating a framework for promotion and development of high efficiency cogeneration of heat and power.

7.3.1.1 In which respect is the regulation relevant for thermal storage ?

The directive establishes a harmonised method for calculation of electricity from cogeneration taking into account methodologies such as those currently under development by European standardisation organisations.

The method for calculation of electricity and efficiency is based on annual useful electricity and heat output and on annual fuel input.

The beneficial use of thermal storages is therefore taken into account.

7.3.2 Directive on energy end-use efficiency and energy services

The directive was adopted by the EU energy minister in March 2006. The countries should develop energy efficiency action plans before 30. June 2007 for the first three-year period.

The directive forces the member states to initiate measures to reach a target of 1% annual cumulative energy savings. The target shall be reached by using a number of operational measures. One of these measures is to develop the market for energy services, thus making energy efficiency an integral part of the internal market for energy. The proposal does this by providing a framework to promote the market both for energy services and for energy efficiency measures in general in major energy end-use sectors.

As a consequence of the Directive the member states shall i.e. remove barriers and ensure public information as well as putting energy companies etc under the obligation of offering energy services and energy efficiency programs. Furthermore the target shall be reached be ensuring proper financing possibilities that ensure that long term investments in energy saving measures can compete with short term investments in energy supply.

Thermal storages are not mentioned in the directive but will benefit from the obligations of the directive to set up measures to ensure end- use efficiency

7.3.3 Legislative proposal on increasing the share of renewable energies used in Europe for heating and cooling (Mechthild Rothe report)

In February 2006 The European Parliament adopted a resolution based on the report drafted by Mechthild Rothe with recommendations to the Commission on heating and

cooling from renewable sources of energy. The Parliament requested the Commission to submit a legislative proposal on increasing the share of renewable energies used in Europe for heating and cooling.

The proposal is inspired by, that directives to promote renewable sources of energy in the fields of electricity and transport have resulted in, or boosted, sustainable development in the Member States.

In the proposal it is stated that market developments in renewable energies in the individual Member States, vary enormously from one to another, and that this is due for the most part not to differences in potential, but rather to different, and in some cases inadequate, political and legal framework conditions.

It is proposed that a realistic and ambitious EU target of at least a doubling of the share of renewable heating and cooling by 2020 shall be set.
Furthermore are proposed measures to promote renewable energy such as:

- National binding targets,
- Dismantling administrative barriers
- National Support Schemes and Financial incentives.
- regulatory measures, such as the mandatory utilisation of RE systems,

Furthermore the EU shall encourage the utilisation of structural and cohesion funds for the support and promotion of renewable heating and cooling, and research efforts shall be increased.

In the report behind the proposal thermal storage is not mentioned, but will of course benefit from the directive if elaborated and approved.

7.3.4 The Energy Performance Building Directive.

The Energy Performance Building Directive directive was approved in December 2002.

The objective of the directive is to promote the improvement of building performance within the Community, and as part of this it sets up a common frame for calculation of the building performance as well as regulatory figures for the allowed energy requirement of the building.

The directive has already or is being implemented in a number of countries.

In DK (See paragraph 8.4.1) the directive was implemented in April 2006:

7.3.4.1 In which respect is the regulation relevant for thermal storage ?

As part of the implementation, the building regulation was revised and a new PC-program for the calculation of the performance was elaborated. Included in the calculations is also the effect of domestic hot water storages, while other kinds of storages are not included. It is the conclusion from paragraph 8.4.1 that in DK the calculation method will improve the energy performance from hot water stages, but on the other hand not show the advantage of other kind of storages.

7.3.5 CE standards for boilers, solar,

See labelling

7.4 References

FP6:
The Sixth Framework Programme in brief, December 2002 Edition

Work Programme for the specific programme for research, technological development and demonstration: "Integrating and strengthening the European Research Area"

European Commission Community Research SP1 – Priority 6-1,6.1 Sustainable energy systems Work Programme, Revision 5 for the Energy-4 Call September 2005

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http://www.ec.europa.eu/regional_policy/ns_en.htm

Sustainable Energy Europe:
Sustainable Energy Europe 2005-2008 A European campaign to raise awareness and change the landscape of energy, Directorate-General EUROPEAN for Energy and Transport COMMISSION

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DRAFT: Commission Directive 200X/YY/EC of XXXXXX implementing Council Directive 92/75/EEC with regard to energy labelling of Electric Water Heater (Text with EEA relevance)

Commission Directive 200X/YY/EC of XXXXXX implementing Council Directive 92/75/EEC with regard to energy labelling of Solar Water Heaters and water storage devices. (Text with EEA relevance)

Solar Keymark
SOLAR KEYMARK, THE QUALITY LABEL FOR SOLAR THERMAL PRODUCTS BASED ON EUROPEAN STANDARDS Editor: Jan Erik Nielsen, Danish Technological Institute, February 2003.

http://www.estif.org/solarkeymark/

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Reference number EN 12975-2:2001. Document title: Thermal solar systems and components - Solar collectors - Part 2: Test methods. CEN publication date 2001-06-06

Reference number EN 12976-1:2000. Document title: Thermal solar systems and components - Factory made systems - Part 1: General requirements. CEN publication date 2000-12-13

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Reference number ENV 12977-3:2001. Document title: Thermal solar systems and components - Custom built systems - Part 3: Performance characterisation of stores for solar heating systems. CEN publication date 2001-04-25

Cogeneration directive:
DIRECTIVE 2004/8/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC

Directive on energy end-use efficiency and energy services:
Brussels, 10.12.2003 COM(2003) 739 final 2003/0300 (COD) Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy end-use efficiency and energy services (presented by the Commission)

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8 Denmark

8.1 Introduction

In Denmark the main categories of thermal storages in use are:

- Domestic hot water tanks
- Solar hot water tanks
- Water storages in combination with biomass boilers
- Large water storages for short term storage in combination with district heating plants.

Domestic hot water tanks
There are in DK around 1,9 million buildings (buildings for industry purposes excluded)
Most of those are using hot water tanks heated by either an oil, gas or biomass boiler or by district heating. In district heating networks (which include around 40% of buildings) heat exchangers for hot water preparation are also common.

For single family houses hot water tank of 80- 200 litres are common. For apartment buildings it is common to have central hot water tanks f up to 10 m³.

Nearly all hot water tanks in use are black steel produced in Denmark by around 5-10 manufactures and need to have a Danish approval.

Solar hot water tanks
There are around 40.000 solar heating systems in DK. The solar hot water tanks are around 150 – 250 litres for one family houses and mostly produced in Denmark. Combisystems with larger storages are not common but exist.

Water storages in combination with biomass boilers
There are perhaps about 50.000 biomass boilers in Denmark and most of these deliver heat to a water storage on typical 500 to 1000 litre (the storages are often under dimensioned). Some of the tanks are produced in DK while others are imported.

Large water storages for short term storage in combination with district heating plants.
A number of district heating plants uses water storage for the levelling of peaks on the production and delivery side. Typical sizes are around 2.000 – 30.000 m³.

Research & development
Especially the BYG department at the Danish Technical University has been active on research and development of thermal storages for solar heating plants.

Furthermore a group of consultants together with the university has been active on establishing experimental storages for seasonal storage of solar heat in combination with district heating plants.

At the worlds largest solar collector area at Marstal district heating plant experimental earth pipe storage of 4.000 m³ and a water pit storage of 10.000 m³ exist.

8.2 Danish support programs relevant for thermal storages

8.2.1 EFP energy research program

8.2.1.1 Aim and structure of the program

The overall aim of the EFP program is to support a well functioning energy market that contributes to economic growth, a high degree of security of supply and clean environment.

The program is situated at the Danish Energy Agency
In general projects only on demonstration have difficulties in the program.

Until 2002 another programme called the ENSUVE program existed with special focus on renewable energy, which also included demonstration projects

8.2.1.2 How does thermal storage fit with formulated areas of focus?

There are no formulated focus areas. The projects should however fit with national formulated R&D strategies if they exist for the area. There are formulated strategies within biomass, bio fuels, fuel cells, energy efficient technologies, PV and hydrogen. A strategy on solar heating is under preparation. In general large projects are preferred.

8.2.1.3 Who – how is decided which projects to support

It is the Energy Agency who decides which projects to support. In practice the officer in charge will prepare the recommendation based on 2 experts which is nominated for the specific project.

However for research projects the level of research will also be evaluated by the Ministry of Science which has 4 scientific committees where one is about Energy & Environment

8.2.1.4 Key persons

Axel Beck from Danish Energy Agency

8.2.1.5 Statistics of applications and supported projects on thermal storage

Supported projects since 1980 in the EFP, ENSUVE (see paragraph 8.2.1.1) and the PSO programs (see paragraph 8.2.2) are registered in a project database.
A search on the word “storage” found that 171 projects out of 5352 involved thermal storages.

The projects are in the following categories:

Projects on water storages in solar heating systems	21
Projects on latent/sorptiv or chemical storages	12
Projects on seasonal storages	50
Projects on building integrated storages	19
Projects on central solar heating systems in district heating networks	10
Projects on storages in co-generation and district heating networks (without solar)	14
Projects on storages in connection with heat pumps	5

Projects on storages in combination with biomass boilers	2
Projects on solar heating systems including storages	36
Projects on fuel cells including storages	1
Other projects including thermal storage	1
Total	171

8.2.1.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude. A valuable input from the PREHEAT project could be to influence that a thermal storage strategy would be formulated.

8.2.1.7 Trends, future changes and/or new programs coming up?

As a result of a government settled committee working on the challenge of globalisation for DK the government has decided to increase research substantial and energy is supposed to be a recommended focus area.

It is therefore expected that existing programs might be changed or new programs may come up. However specific plans have not yet been formulated.

8.2.1.8 Guide for applicants.

Information for applicants can be found on www.energiforskning.dk.

There is an annual call for proposals in September.

8.2.1.9 Can the program be used for dissemination of information about thermal storage?

In general research projects are preferred, however projects involving dissemination have been granted.

8.2.1.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

The largest number of supported projects is within storage of solar heating, with projects on seasonal storage as the main group. Despite the the large number of projects on seasonal storage this has until now not given results on the market.

Also a big number of projects has been on small solar storages mainly at the Technical University were the work has resulted in improved solar storages on the market.

8.2.1.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

It should be discussed with the Energy Agency if a strategy for thermal storage could be initiated.

8.2.2 PSO energy research program

8.2.2.1 Aim and structure of the program

The PSO program is funded by tariffs on the electricity and is managed by the electricity utilities as part of their public service obligations.

The PSO programme is divided in 2 parts:

- PSO Environmental technologies for production of electricity
- PSO Effective use of energy

Both parts of the programme are about electricity and only projects which influence the electricity production or consumption are supported.

Recently a part of the funding has been reserved for projects about how solar heating can influence the co-generation system.

8.2.2.2 How does thermal storage fit with formulated areas of focus?

Thermal storages for the use in combination with co-generation plants fit well in the programme as well as storages inn combination with solar heating plants in combination with co-generation plants

Other applications of storages that do not influence the electricity production or use do not fit

8.2.2.3 Who – how is decided which projects to support

It is the Electricity utilities who decide which projects to support.

However for research projects the level of research will also be evaluated by the Ministry of Science which has 4 scientific committees where one is about Energy & Environment

8.2.2.4 Key persons

PSO Environmental technologies for production of electricity: Lise Nielson, Energinet.dk
PSO Effective use of energy: Jørn Borup Jensen, Elfor

8.2.2.5 Statistics of applications and supported projects on thermal storage

See paragraph 8.2.1.5

8.2.2.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude. A valuable input from the PREHEAT project could be to influence that a thermal storage strategy would be formulated.

8.2.2.7 Trends, future changes and/or new programs coming up?

As a result of a government settled committee working on the challenge of globalisation for DK the government has decided to increase research substantial and energy is supposed to be a recommended focus area.

It is therefore expected that existing programs might be changed or new programs may come up. However specific plans have not yet been formulated.

8.2.2.8 Guide for applicants.

Information for applicants can be found on www.energiforskning.dk.

There is an annual call for proposals in September.

8.2.2.9 Can the program be used for dissemination of information about thermal storage?

In general research projects are preferred, however projects involving dissemination have been granted.

8.2.2.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

The program will in the future support projects on solar storages in district heating networks.

8.2.2.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

It should be discussed with the Energy Agency if a strategy for thermal storage could be initiated.

8.2.3 Nordic Energy Research

8.2.3.1 Aim and structure of the program

The Nordic Energy Research Programme support collaboration projects on energy between Nordic countries. On of the aims is to support environmentally energy production. Another aim is to support capacity building in the countries.

8.2.3.2 How does thermal storage fit with formulated areas of focus?

Projects supported so far is within the categories:

- Consequences of climate changes
- The hydrogen society
- Energy efficiency
- Renewable energy
- Integration of the energy market

In the category “energy efficiency” a project on “underground cold storage” is supported and in the category “renewable energy” a project on solar Combisystems is supported

8.2.3.3 Who – how is decided which projects to support

The committee decide which projects to support based on external expert evaluations.

8.2.3.4 Key persons

Manager: Birte Holst Jørgensen

8.2.3.5 Statistics of applications and supported projects on thermal storage

So far 2 projects on storage have been supported (see above)

8.2.3.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude

8.2.3.7 Trends, future changes and/or new programs coming up?

Areas of focus are revised

8.2.3.8 Guide for applicants.

There is an annual call for letters of interests from which is decided who can formulate applications

8.2.3.9 Can the program be used for dissemination of information about thermal storage?

No

8.2.3.10 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

If a Danish research strategy on storages is formulated it will probably be the best way to influence the program.

8.3 Danish policies relevant for thermal storages

The Danish Energy Agency has initiated that a number of research strategies are formulated. The strategies have been formulated in collaboration with the Agency and branch organisations
There have been formulated strategies on biomass, bio fuels, wind power, PV, fuel cells energy efficient technologies, hydrogen technologies and wave power. A strategy on solar heating is under preparation.

In the following is given information on the strategies for biomass, fuel cells and energy efficient technologies

8.3.1 Strategy on biomass

8.3.1.1 General

The strategy for biomass is formulated by the Energy Agency and two major Electricity utilities.

The focus is on biomass for cogeneration plants.

8.3.1.2 In which respect is the policy relevant for thermal storage.

The strategy does not mention thermal storages but areas of focus are more efficient utilization of the biomass and optimization of thermal transformation. Since thermal storages are well known at cogeneration plants it is estimated that there have been only little impact from the stagy on thermal storage usage.

8.3.1.3 Key persons

Jan Bünger The Danish Energy Agency

8.3.1.4 How is the attitude towards more focus on thermal storage in the policy?

Not answered yet

8.3.1.5 Are there future changes in the policies and/or new policies coming up?

The strategy is continuously revised

8.3.1.6 Can the policy be used for dissemination of information about thermal storage?

Dissemination of information is not part the strategy

8.3.1.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It is recommended that the preheat project tries to initiate that a strategy for thermal storage is formulated by the Energy Agency.

8.3.2 Strategy on fuel cells

8.3.2.1 General

The strategy for fuel cells is formulated by the Energy Agency and two major Electricity utilities.

8.3.2.2 In which respect is the policy relevant for thermal storage.

In the strategy is concluded that besides the transport sector is the co-generation of heat and electricity for buildings a major potential. The most interesting potential is perhaps seen for decentralized co-generation plants within the natural gas distribution net.

The strategy does not mention thermal storages, which however will be relevant for co-generation purposes for buildings.

It is however anticipated that focus on the use of thermal storages in combination with fuel cells will not be in the early stage of the research effort where focus will be on fundamental research.

8.3.2.3 Key persons

Aksel Mortensgaard, The Danish Energy Agency

8.3.2.4 How is the attitude towards more focus on thermal storage in the policy?
8.3.2.5 Are there future changes in the policies and/or new policies coming up?
8.3.2.6 Can the policy be used for dissemination of information about thermal storage?
8.3.2.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

8.3.3 Strategy on energy efficient technologies

8.3.3.1 General

The strategy for energy efficient technologies is formulated by a consultant company on behalf of the Energy Agency.

8.3.3.2 In which respect is the policy relevant for thermal storage.

The strategy does mention the following focus areas:

- Industrial processes- process integration and control
- Buildings
- Ventilation
- Cooling and freezing plants for industrial use
- LED-lighting
- Electronics for power and control
- Behaviour, barriers and means

Storages are mentioned as cool storages for cooling and freezing purposes, but are also relevant for the efficiency and control of industrial processes and for buildings where one focus area is on interaction between building and installations.

8.3.3.3 Key persons

Finn R. Josefsen The Danish Energy Agency

8.4 Danish regulations relevant for thermal storages.

8.4.1 Building regulations

The building regulations are built on a number of standards, recommendations and directions.

Relevant for thermal storage are:

- Standard for heating systems with water, “DS 469 "Norm for varmeanlæg med vand som varmebærende medium“
- Standard for domestic water installation: ”DS 439 "Vandinstallationer"
- Standard for thermal insulation of technical installation.DS 452 "Termisk isolering af tekniske in-stallationer“
- Security standard for hot water installation: ”Arbejdstilsynets regler for ufyrede varmtvandsanlæg, 58/1-975,”
- Security standard for pressurized tanks: ”Arbejdstilsynets bekendtgørelse vedr. trykbeholdere,746/1987”

The new energy labelling of building involves calculation of the building energy use with a newly developed PC program Be06.

8.4.1.1 In which respect is the regulation relevant for thermal storage ?

It is estimated that the standards that the building regulation is based on implies in itself no big influences on the beneficial use of thermal storages. However since standards are different in the European countries this is a barrier for import and export of beneficial storage tanks that are included in the standards.

Storage tanks with domestic water have to be approved in a national approval scheme.

The new calculation program Be06 which is used for calculations of the energy use in respect to the energy frame might contain an obstacle for the realising of the benefits thermal storages in new building. The program can only take into account domestic hot water tanks - eventually used in a solar water heater, while storage tanks used i.e. in combination with a biomass boiler or in a combined solar heating system is not taken into account.

8.4.1.2 Key persons

Building regulations in general: Ejner Jerking (Erhvervs og Boligstyrelsen)
Energy frame calculations: Søren Aggerholm (SBI)

8.4.1.3 Are there future changes in the regulation and/or new regulations coming up?

Not known

8.4.1.4 Can the regulation be used for dissemination of information about thermal storage?

No

8.4.1.5 Conclusions and recommendations about modifications in regulations that will ease beneficial use of thermal storage techniques

A point for discussion in the PREHEAT group. Are different national standards a barrier for beneficial use of storages? Do we have examples?

A discussion of how to include calculation of improved performance by thermal storages in the energy frame calculation program should be initiated.

8.5 References

EFP energy research programme
http://www.energiforskning.dk/

PSO energy research programme
http://www.energiforskning.dk/

Nordic Energy Research
http://www.nordicenergy.net/

Strategy on fuelcells
Overordnet strategi for udvikling af brændselscelleteknologi i Danmark Juli 2003
http://www.ens.dk/sw17445.asp

Strategy on energy efficient technologies
Energieffektive teknologier – strategi F&U 2005-2015
http://www.ens.dk/sw16961.asp

Strategy on bio fuels
Strategi for forskning og udvikling vedr. fremstilling af flydende biobrændstoffer Juni 2005

Strategy on hydrogen technologies
Brintteknologier - strategi for forskning, udvikling og demonstration i Danmark Juni 2005

Strategy on PV
Solceller Oplæg til en national strategi for forskning, udvikling og demonstration

Strategy on wave power
Bølgekraftteknologi Strategi for forskning og udvikling Juni 2005 Energistyrelsen, Elkraft System og Eltra

Strategy on biomass
Strategi for forskning, udvikling og demonstration af biomasseteknologi til el-og kraftvarmeproduktion i Danmark August 2003
http://www.ens.dk/sw17437.asp

Strategy on wind power,
Juli 2004 Strategi for dansk vindenergiforskning

Building regulations
SBi-anvisning 213 Bygningers energibehov Pc-program og beregningsvejledning Beregningsvejledning Søren Aggerholm Karl Grau Statens Byggeforskningsinstitut 2005

9 France

9.1 Introduction

In France the main categories of thermal storages in use are domestic hot water tanks for heating systems composed by boilers (biomass, fuel, gas or electric) and solar collectors. The main part of these installations is equipped with a storage tank. In the case of boilers, storage is mainly used for reasons of comfort and lifetime of the boiler (although the storage tank will also contribute to better energy performances) and for increasing efficiency in the case of solar systems.

In the case of solar systems a storage volume of 50-100 l/m² is usual with a tendency towards the lower value for collective systems and about 75 l/m² for individual systems.
The statistics given for solar thermal systems is based on total installed collector area that is about 700000 leading to about 150000 units (and thus storage tanks) if an average collector area of 4m² is assumed per system.

In general, in France, 5.7 million apartments and about 12 million single family houses are heated individually with, in most cases, a hot water storage tank for domestic hot water with 80-200 liters.

Latent thermal storage tanks are less common to date, chemical storage is almost non-existing.

Seasonal storage in aquifers or with borehole heat exchangers has been developed in the 80's but the activities have been stopped middle 80's.

In the following text is given examples of French programs, policies and regulations. Please give your national information using the same paragraphs.

9.2 French support programs relevant for thermal storages.

9.2.1 PREBAT

9.2.1.1 Aim and structure of the program

The program is managed by the National Agency for Research (ANR) and the national agency of environment and energy (ADEME).

The overall aim of the PREBAT program is to achieve a division by 4 of green house gas emissions with three main objectives: a) sustainable modernization of existing buildings, b) conception of new buildings and c) passive or energy producing buildings.

The Program is provides funding related to three main fields: a) research on materials, products, components, subsystems and their integration into buildings, b) integration of the research for the conception and construction of new and renovation of existing buildings and c) sociological aspects in the field of the PREBAT scope.

Two calls have been carried out: a technological call (point a) and a sociological call (point c), the first one with a total number of funded projects of 37 projects, the second one with a total number of 16 projects.

Projects oriented towards fundamental research are managed by ANR and projects on applied research by ADEME.

9.2.1.2 How does thermal storage fit with formulated areas of focus?

The first call in 2005 was mainly focused on technical and sociological projects, other calls are planned dealing with demonstration, focused on research on new buildings and another one on existing buildings.

Technological call: thermal storage fits in the formulated areas. The key word “thermal storage” is even quoted in the examples section for possible projects.
No direct fit in the case of the sociological call.
In the technological call in 2006 thermal storage is mentioned in the same way as in 2005.

9.2.1.3 Who – how is decided which projects to support

The strategic committee defines an evaluation committee that decides on project support. For each submitted project a member of the evaluation committee will be in charge of the project review and will prepare a recommendation based on 1 to 6 experts (one from ADEME and several others).

9.2.1.4 Key persons

For the technological call:
Head of strategic committee: François Perdrizet, Ministry of transport and equipment
Head of evaluation committee: Denis Clodic from Ecole des Mines de Paris

9.2.1.5 Statistics of applications and supported projects on thermal storage

In 2005, ANR funded 13 projects of larger size. Among them, one project focuses directly on thermal storage in the envelope; two others are multi-objective with thermal storage as one of the objectives. ADEME funded 24 projects of smaller size. No project is directly focusing on thermal storage but three of them have thermal storage as one of several objectives.

In 2006, project selection is still ongoing.

9.2.1.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude. A valuable input from the PREHEAT project could be to influence that a thermal storage strategy would be formulated.

9.2.1.7 Trends, future changes and/or new programs coming up?

PREBAT is an ongoing funding program with its main objectives that have been fixed at its start, in 2005. However, each yearly call is updated. Results of PREHEAT could allow to pay more attention to projects on thermal storage.

9.2.1.8 Guide for applicants.

Information for applicants can be found on http://www.prebat.net

There is an annual call for proposals in winter/spring with deadlines for submission in spring.

9.2.1.9 Can the program be used for dissemination of information about thermal storage?

In general research projects are preferred (with always a minimum dissemination workpackage in order to publish the results). However, projects with mainly dissemination work might be granted in the part of projects funded by ADEME.

9.2.1.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

The program is in the initial phase. No information is available yet.

9.2.1.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

It should be discussed with the strategic committee of PREBAT in order to get more focus on thermal storage projects.

9.2.2 Building-energy foundation (Fondation Bâtiment-Energie)

9.2.2.1 Aim and structure of the program

The Building-Energy foundation program is a funding program for at least 5 years with annual calls and a total envelope of 8Mio€. The foundation has been created in 2005 by four main actors on the building sector, Arcelor, EDF, GDF and Lafarge by the initiative of the ministry of research, Ademe and CSTB.

The overall aim of the Building-Energy program is to achieve a division by 4 of green house gas emissions with a main focus on the improvement of building materials, isolation, HVAC and renewable energy. The program funds technical as well as sociological aspects for projects related to the improvement of existing as well as new buildings.

The board of directors of the foundation is composed by representatives of all four founders, the concerned ministries (interior, industry, research and equipment) and four qualified persons. It nominates the twelve members of the scientific committee that suggests the themes of the annual calls for projects. The themes are defined annually.
Two calls have been opened since 2005: one on the renovation of individual housings, a second one on the construction or renovation of office buildings.

9.2.2.2 How does thermal storage fit with formulated areas of focus?

In the 2005 call there was no particular focus on thermal storage. The call was mainly focused on the renovation of existing buildings, especially on complete methodologies. Projects on isolated components were not admitted.

As for the call in 2005, the call in 2006 does not mention thermal storage neither. The main focus lies in global approaches for the construction and renovation of buildings.

9.2.2.3 Who – how is decided which projects to support

The twelve members of the scientific committee select the projects. The selection is carried out in two phases: in a first phase, summary project descriptions (<15 pages) are submitted. A restricted number of projects will be further developed (some funding is provided for the project development in the second phase) and then a final selection will be made. In the call of 2005, 31 projects have been submitted. 6 projects have been selected for the second phase and 3 projects have finally been accepted.

9.2.2.4 Key persons

Head of board of directors: Pierre Bourrier, Senior Vice-President of Arcelor
Head of scientific committee: Philippe Chartier, SER

9.2.2.5 Statistics of applications and supported projects on thermal storage

In 2005, no project related to thermal storage has been selected (neither proposed due to the call). The call 2006 is not closed yet.

9.2.2.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude. A valuable input from the PREHEAT project could be to influence that a thermal storage strategy would be formulated.

9.2.2.7 Trends, future changes and/or new programs coming up?

Building-Energy is an ongoing funding program with its main objectives that have been fixed at its start, in 2005. However, each yearly call is updated. Results of PREHEAT could allow to pay more attention to projects on thermal storage.

9.2.2.8 Guide for applicants.

Information for applicants can be found on http://www.batiment-energie.org

No regular call dates, but at least one call per year.

9.2.2.9 Can the program be used for dissemination of information about thermal storage?

One of the main objectives and criteria for selection of the program is a large dissemination of the results in order to have a maximum market impact. However, dissemination on thermal storage is directly linked to the technical scope of the projects which is, for the past project, very restricted.

9.2.2.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

In the call of 2005, 31 projects have been submitted. 6 projects have been selected for the second phase and 3 projects have finally been accepted. None of them was dealing specifically with thermal storage.

9.2.2.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

It should be discussed with the strategic committee of Bâtiment-Energie in order to get more focus on thermal storage projects. This could be done by quoting examples of thermal storage in their calls.

9.2.3 Several funding programmes for installations or renovations in buildings

9.2.3.1 Aim and structure of the program

Different funding projects exist in France on private installations. Four possible kinds of funding come from ANAH, ADEME (only collective installations), EDF, the region or indirectly from the government by subsidies (reduced VAT or subsidies from the income tax), depending on the project.

The funded products are: a) thermal insulation, b) control system, c) boiler, d) biomass fired boilers, e) solar hot water or solar heating system, f) heat pump and g) collective solar hot water production

The funding can vary for the different regions in France and their amount can be a percentage of the costs or a percentage on the income tax.

Investment funds are provided by the FIDEME foundation (investment funds) to facilitate the funding of projects related to energy and waste management on the fields of wind, hydro, geothermal and biomass as well as waste recycling. The project selection is carried out by ADEME.

9.2.3.2 How does thermal storage fit with formulated areas of focus?

Thermal storage is not considered as a specific product. Indirectly it is part of the solar systems, but it does not have any impact if a better storage system is used.

9.2.3.3 Who – how is decided which projects to support

The funding is open to everybody.

9.2.3.4 Key persons

http://www.anah.fr/, http://www.ademe.fr, http://www.edf.fr, www.impots.gouv.fr, www.cler.org/aides,

9.2.3.5 Statistics of applications and supported projects on thermal storage

No specific statistics

9.2.3.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude. A valuable input from the PREHEAT project could be to influence that a thermal storage strategy would be formulated.

9.2.3.7 Trends, future changes and/or new programs coming up?

Continuing funding. Amounts of funding depend and vary as a function of the region.

9.2.3.8 Guide for applicants.

A general overview can be found on http://www.ademe.fr/credit-impot

9.2.3.9 Can the program be used for dissemination of information about thermal storage?

Dissemination could be possible by building demonstration projects funded by the programmes.

9.2.3.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

No information available.

9.2.3.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

It should be discussed with the key actors in order to get more focus on thermal storage projects.

9.3 French policies relevant for thermal storages

9.3.1 Plan Climat

9.3.1.1 General

Voted by the French government in 2004, the Plan Climat tends to reduce greenhouse gas emission in France with the following objectives: reduce greenhouse gas emissions until 2010 about 10% compared to 2003 and by a factor 4-5 until 2050.
In order to accomplish the objectives, the Plan Climat is accompanied by several measures: an important information and communication campaign by ADEME, reinforcements of tax subsidies on the use of energy efficient components (cf. programmes §2.3), the extension of energy certificates for commercial products (on cars, buildings etc.) as well as the creation of foundations promoting the research and application of new technologies allowing to achieve the objectives of Plan Climat.
The measures to be undertaken concern information, regulation, incitation, cooperation and research and can be found in §2.1 and §2.2 on programmes and regulations.

9.3.1.2 In which respect is the policy relevant for thermal storage.

In the Plan Climat thermal storage is mentioned once explicitly, but related to thermal storage in the building envelope. However, since the Plan Climat is realised in practice by several measures (e.g. the programmes mentioned in §2) such as the PREBAT, thermal storage is or could be an important matter.

9.3.1.3 Key persons

The Plan Climat has been presented by the Serge LEPELTIER, Minister of ecology and sustainable development.

9.3.1.4 How is the attitude towards more focus on thermal storage in the policy?

Thermal storage is mentioned and is part of measures on the reinforcement of renewable energy.

9.3.1.5 Are there future changes in the policies and/or new policies coming up?

No visible changes in the future, the objectives are fixed until 2010.

9.3.1.6 Can the policy be used for dissemination of information about thermal storage?

Dissemination is part of the strategy of this policy, but the direct measure will depend on the programme related to dissemination.

9.3.1.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It is recommended that the Preheat project tries to initiate that a strategy for thermal storage is considered in future policies.

9.3.2 Law on the orientation of the energy policies (Loi Pope) – N° 2005-781

9.3.2.1 General

Adopted in 2005, this law fixes defines the future orientations of the energy policies in France, transposing the European directives. The objectives are as follows:

- reduction of the energy consumption by 2% annually until 2015 and annually by 2.5% until 2030.
- Reduction of greenhouse gas emissions by 3% annually to achieve a reduction by factor 4 until 2050

- 10% of energy production from renewables until 2010
- 21% of the electricity production from renewables until 2010
- 50% of heat generation from renewables until 2050

The Pope law indicates three “mobilizing schemes” for increasing the energy efficiency and the development of renewables:

- scheme “energy for the development”: this scheme tends to provide access to energy services for development countries
- scheme “facing south” to allow the installation of 200000 solar domestic hot water systems and 50000 solar roofs until 2010
- scheme “earth-energy” to achieve an economy of 10 millions of TOE until 2010 by increasing the use of biomass for heat and biofuel production

The law also considers maintaining the option of nuclear energy in France.
It defines a framework for the development of renewables and creates a guaranty scheme for renewables.

The measures put into practice are e.g. the French energy performance regulation, the creation of energy certificates etc.

9.3.2.2 In which respect is the policy relevant for thermal storage.

Thermal storage is explicitly mentioned in §5 of the law. It is recommended that more research on thermal storage has to be carried out in order to increase the use of renewables.

9.3.2.3 Key persons

DGEMP-DIDEME, Direction of energy demand and market

9.3.2.4 Are there future changes in the policy and/or new policies coming up?

Not clear.

9.3.2.5 Can the policy be used for dissemination of information about thermal storage?

No.

9.3.2.6 Conclusions and recommendations about modifications in policies that will ease beneficial use of thermal storage techniques

Thermal storage is already mentioned in the law. To get more impact, the main work would have to convince the key contacts for programmes or direct measures.

9.3.3 Simplification law (“Loi de simplification du droit”)

9.3.3.1 General

Voted by the French government in 2004, this law defines the frame for a future diagnostic of the energy performance of buildings. As the Plan Climat, it has been defined to transpose the EPBD directive in France.

9.3.3.2 In which respect is the policy relevant for thermal storage.

Thermal storage is not mentioned in the text of the law. It has to be verified if the direct measure undertaken within the frame of this law will allow the consideration of thermal storage.

9.3.3.3 Key persons

DGEMP-DIDEME, Direction of energy demand and market

9.3.3.4 How is the attitude towards more focus on thermal storage in the policy?

No information.

9.3.3.5 Are there future changes in the policies and/or new policies coming up?

No information.

9.3.3.6 Can the policy be used for dissemination of information about thermal storage?

Will depend on the regulation that brings this policy into practice.

9.3.3.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It is recommended that the Preheat project tries to initiate that a strategy for thermal storage is considered in future policies.

9.4 French regulations relevant for thermal storages.

9.4.1 Building regulation (RT2000 and RT2005 from September 2006)

9.4.1.1 General

The French building regulation is actualized every 5 years. The last regulation, the RT2005, is signed and will be applicable from September 2005.

This building regulation is applied only for new buildings by using a numerical calculation code. This code compares the consumption of a building to that of a reference building of same type and size. There is no main focus on the use of specific technologies such as renewables but more a global approach allowing the combination of innovative technologies in order to achieve an acceptable energy performance.

From the RT2000, the last building regulation, the aim is the reduction by 15% of the final energy consumption.

In the case of existing standards, the regulation is being built using these standards. In all other cases, a French methodology is used.

The regulation is prepared by working groups composed of the main actors on the specific field (e.g. solar energy) i.e. manufacturer associations, institutes etc. The development of the calculation methods and codes is carried out by CSTB. The regulation is coordinated by the Ministry of equipment, transports and housing and ADEME.

9.4.1.2 In which respect is the regulation relevant for thermal storage ?

The regulation considers thermal storage concerning several aspects: thermal storage in the building structure is fully considered since the numerical model of the building takes into account the thermal inertia. Thermal storage for the production systems (all systems including solar systems) is only considered in terms of losses. Innovative concepts of thermal storage such as seasonal storage cannot be taken into account.

9.4.1.3 Key persons

Ministry of equipment, transports and housing (Ministère de l'Équipement, des Transports et du Logement) and ADEME.

Contact coordinator: Sylvie Caffiaux (Ministry of equipment, transports and housing)
Contact calculation methodology: Jean Robert Millet (CSTB)

9.4.1.4 Are there future changes in the regulation and/or new regulations coming up?

The RT2010 will be released in 2010/2011. The outcomes of Preheat could be useful for the definition of the new regulation.

The regulation has the possibility to implement calculation methods for innovative systems by the article 5 of the regulation. As soon as a validated calculation method is available and the concerned manufacturer association or organization makes an official

request, this article allows the consideration of the new method even before the release of the next regulation RT2010.

9.4.1.5 Can the regulation be used for dissemination of information about thermal storage?

No.

9.4.1.6 Conclusions and recommendations about modifications in regulations that will ease beneficial use of thermal storage techniques

A discussion of how to include calculation of improved performance by thermal storages in the energy frame calculation program should be initiated. The article 5 would allow this implementation. For example, if a European calculation method for performance of thermal storage would exist, it would be possible to increase the impact of thermal storage in this regulation.

9.4.2 In preparation: Regulation for existing buildings (RT existant)

9.4.2.1 General

As the French building regulation RT2005, it is planned to release a regulation on existing buildings which will be actualized at least every 5 years. The official texts are in preparation by the DGUHC (Direction of urbanism and construction).

This building regulation will be applied for buildings that will be renovated with renovation costs greater than 25% of the value of the building.

The calculation method relates to the different components and not the building as whole. It is planned to be applicable in 2007.

9.4.2.2 In which respect is the regulation relevant for thermal storage ?

No clear information yet. Since the regulation will evaluate the components of the building it could be possible to add thermal storage. The outcomes of the Preheat project could have an impact on the regulation.

9.4.2.3 Key persons

Mme Marie Christine Roger - DGUHC (Direction of urbanism and construction)

9.4.2.4 Are there future changes in the regulation and/or new regulations coming up?

Regular update is planned in phase with the regulation on new buildings (probably 5 year period).

9.4.2.5 Can the regulation be used for dissemination of information about thermal storage?

No.

9.4.2.6 Conclusions and recommendations about modifications in regulations that will ease beneficial use of thermal storage techniques

It is recommended that the Preheat project tries to initiate that a strategy for thermal storage is considered in this future regulation.

9.4.3 In preparation: Inspections of boilers and air conditioning systems

9.4.3.1 General

Following the EPBD, periodical inspections of boilers and air conditioning systems will have to be realised by qualified experts.

This measure is part of the “Loi Pope” and is in the objectives of the “Plan Climat” (c.f. policy), the French transposition of the EPBD.

The inspections will include the evaluation of the efficiency of the installation, the sizing related to the building needs as well as recommendations and eventual suggestions for modifications.

Ecrit mais pas publié, év. Sur systèmes de chauffage, ensuite ok

9.4.3.2 In which respect is the regulation relevant for thermal storage ?

No relevance.

9.4.3.3 Key persons

DGEMP

9.4.3.4 Are there future changes in the regulation and/or new regulations coming up?

No relevance.

9.4.3.5 Can the regulation be used for dissemination of information about thermal storage?

No relevance.

9.4.3.6 Conclusions and recommendations about modifications in regulations that will ease beneficial use of thermal storage techniques

No relevance.

9.4.4 In preparation: Energy performance certificate

9.4.4.1 General

A set of regulations should soon be adopted requiring a standardised assessment of annual costs of energy to be notified on the occasion of the sale or rental of a building for residential or tertiary use. The regulations are now being designed and should be adopted along with the new thermal regulation.

The law for energy certificates was adopted in 2004. Further laws for implementation are being discussed in the parliament.

It is expected that the energy certificates at the point of sale of the dwelling will come into force in mid-2006, with the certificate for rentals in 2007.

Different calculation methods exist, for example 3CL for individual housings and Comfie or Delphis. The latter one is similar to the regulation on new buildings but is only used to calculate the energy demand of the building. To obtain consumption, default values for the different systems will be applied (e.g. boiler, distribution etc.).

The final consumption will be compared to reference values to obtain the energy classification from A to G.

9.4.4.2 In which respect is the regulation relevant for thermal storage ?

In the current stage, thermal storage is not explicitly considered. Since default values for the components are used to obtain consumption values from the heat demand, storage could be added in a certain way in this calculation method.

9.4.4.3 Key persons

Mme Marie Christine Roger - DGUHC (Direction of urbanism and construction)

9.4.4.4 Are there future changes in the regulation and/or new regulations coming up?

The regulation is being finalised and will be updated on a regular basis as the regulation for new buildings RT2005.

9.4.4.5 Can the regulation be used for dissemination of information about thermal storage?

No.

9.4.4.6 Conclusions and recommendations about modifications in regulations that will ease beneficial use of thermal storage techniques

It is recommended that the Preheat project tries to initiate that a strategy for thermal storage is considered in this future regulation.

10 Germany

10.1 Introduction

Renewables cover up for about 4.2 % (with 6.2 million m2 collector area at the end of 2004) of the energy consumption for heat and therefore avoid a total of 15 million tons of CO2 production. Biomass and wood account for 80 %.

The technical potential of solar thermal or geothermal energy is only used for about 1 percent. [5]

In the past 5 years the part of renewable power generation enhanced over 44 %, the use of bio-fuel has increased over 300 %.

Heat supply from renewables only increases about 12 %.

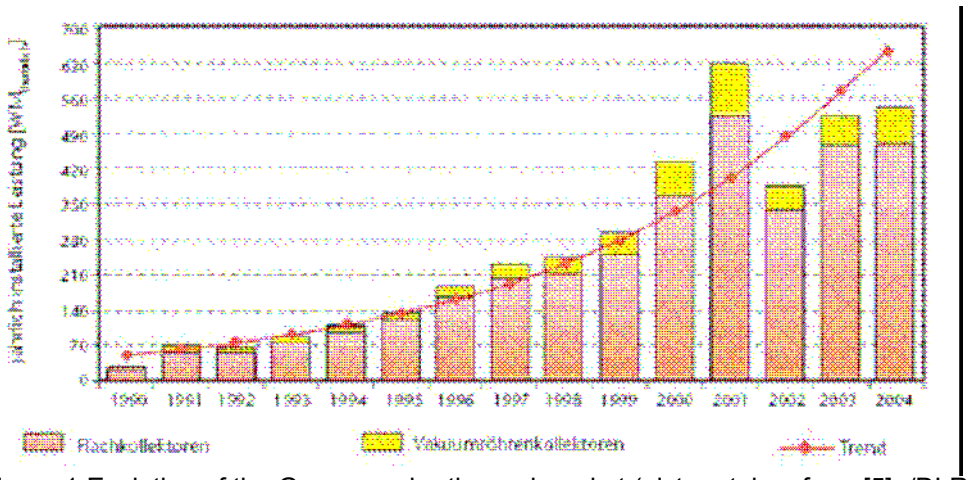

Figure 1 Evolution of the German solar-thermal market (picture taken from [5] /DLR)

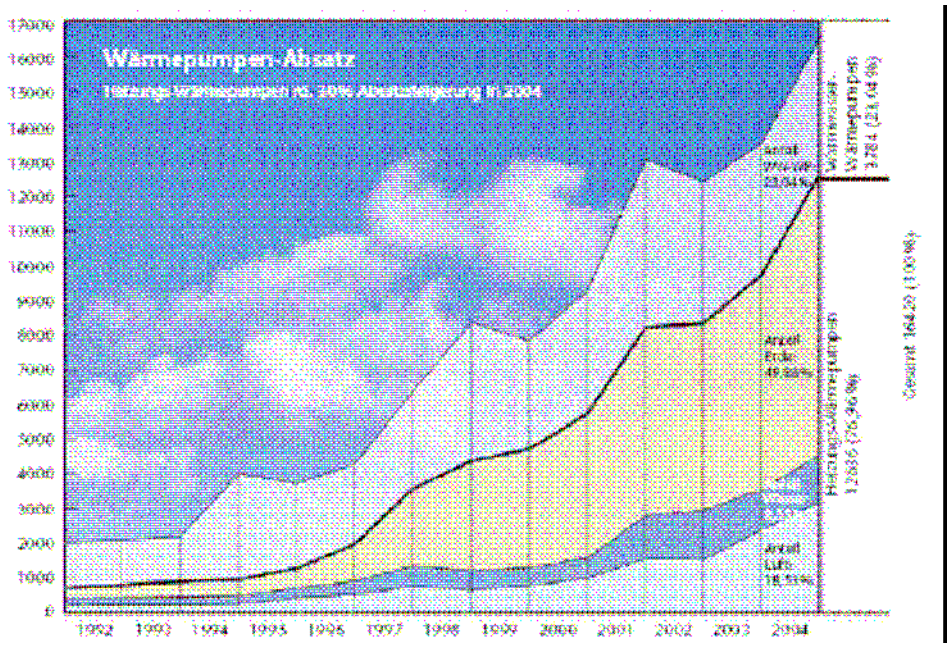

Figure 2 Evolution of the German heat pump market (picture taken from [5] / Bundesverband Wärmepumpe BWP e.V.)

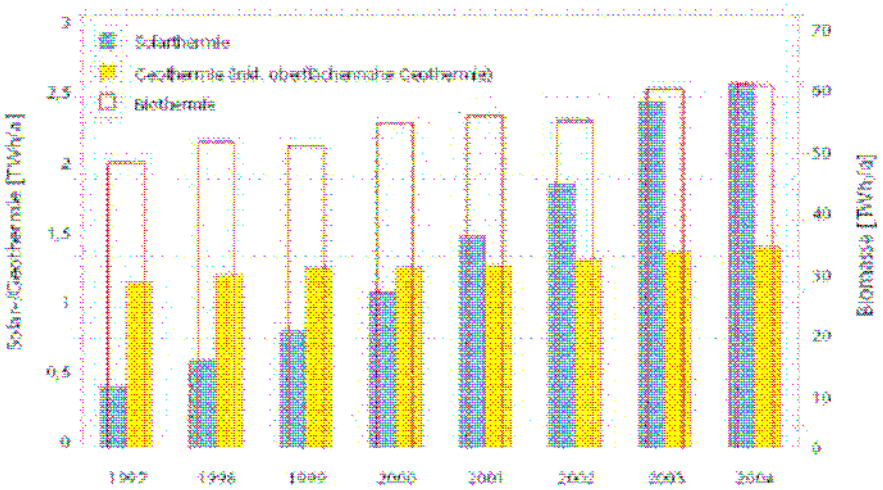

Figure 3 Share of different renewables. Biomass is the major renewable for heat with 60 TWh per year, solar- and geo-thermal has enhanced to 2.5 TWh/a (picture taken from [5] /DLR).

10.2 German support programs relevant for thermal storages

There are several programs relevant for thermal storages, for example:

- The 5th Energy Research Programme of the Federal Government "Innovation and New Energy Technologies" (Energieforschungsprogramm “Innovation und neue Energietechnologien”, 1 Juni 2005)
- Networks basic research on renewables and rational energy applications (Netzwerke Grundlagenforschung erneuerbare Energien und rationelle Energieanwendung)
- Support program energy efficient buildings (Förderprogram Energie effizientes Bauen (ENOB))
- Climate protection program 2000 (Klimaschutzprogramm)
- Solarthermie 2000

10.2.1 The 5th Energy Research Programme of the Federal Government (Energieforschungsprogramm “Innovation und neue Energietechnologien”

10.2.1.1 Aim and structure of the program

- Form the future Energy supply in a secure, enviroment-friendly and greenhouse-gas free way
- The research program is part of the German innovation program to strengthen the German competitiveness and to consolidate the German high technology corporations. Also to get these technology faster into the market
- Reduce energy consumption
- Enhance efficiency factor of fossil energy sources (Erhöhung des Wirkungsgrades bei der Umwandlung fossiler Energieträger zur Erzeugung von Strom, Kraft oder Wärme)

- CO2 sequestration and storage
- Use of renewables as alternative for fossil energy sources

10.2.1.2 How does thermal storage fit with formulated areas of focus?

Formulated areas of focus where thermal storage could fit are:

- Rational use of energy
- Energy efficient buildings (building pass!)
- High temperature solar thermal
- Low temperature solar thermal
- Renewable energies

There is no special program for thermal storage. Storage itself is always accounted in combination with hydrogen storage. See [2a]

10.2.1.3 Who – how is decided which projects to support

In principal it is the ministry who decides which project to support.
Problem at the moment for several projects regarding thermal storage is the unclear situation of the responsibility of different ministries.

10.2.1.4 Key persons

Dr. Volkmar Lottner, PTJ, not yet reachable to contact
Harald Drück, ITW , not yet reachable to contact
Rainer Lang, Vaillant , not yet reachable to contact

10.2.1.5 Statistics of applications and supported projects on thermal storage

- Hydes
- BMBF Netzwerkprojekt
- Modestore
- Solarthermie 2000+ : Promotion of low temperature solar thermal energy applications
- 5th German Federal Energy Research Program
- EnOB, Energy optimized building programme. Part of the 5th framework program, in order to pave the way for energy savings and utilizing solar energy in non residential buildings the German Federal Ministry of Economics and Technology (BMWi) hs established a support programme called “Energy Optimized building”, known as SolarBau for short.
- EnSan : Program for the improvement of the building fabric

As example for the Solarthermie 2000 programm, research project has been :

- Development and optimization of charging and discharging systems for tankstorage.
- Pilot or demo plants

- Solar thermal day to day storage in Speyer

10.2.1.6 How is the attitude towards more focus on thermal storage in the program?

There will be a new status seminar in September with focus on thermal storage and heat transformation technologies (FH Wildau). So the attitude is favourable…..

10.2.1.7 Trends, future changes and/or new programs coming up?

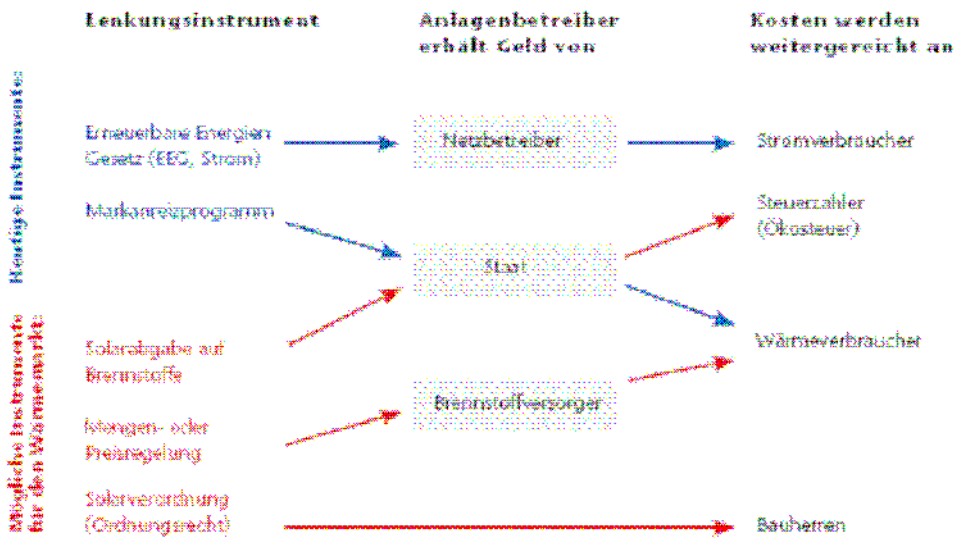

Figure 4 today available regulations and possible regulations for the near future (picture taken from [5])

Quantity- or price regulations (Mengen- oder Preisregelung) :

Euro White Cert. Project (www.ewc.polimi.it/index.php)

- White certificates, regulation on energy efficiency, fuel-provides get certificates. Established in UK, Italy, in the near future in France. On European base Euro White Certificates , (www.ewc.polimi.it/index.php)

10.3 German policies relevant for thermal storages

10.3.1 Strategy on biomass

10.3.1.1 General

Biomasse Verordnung (Bundesgesetz) (national biomass regulation)

10.4 German regulations relevant for thermal storages.

10.4.1 Building regulations

- Novellierte Energieeinsparverordnung (EnEV) 2004 (national energy saving regulation)
- SAVE-Richtlinie 93/76/EWG (European SAVE guidline)
- European regulation ENV 12977-3 for hot-water-tanks
- European regulation ENV 12977-2 for thermal performance examination

10.5 Sources of information

10.5.1 Interviews

An interview with Mr. Mangold from Solites is given in Appendix A. Mr. Mangold is one of the key persons in Germany for large heat storage systems.

10.5.2 Bibliography

[1] 5. Energieforschungsprogramm “Innovation und neue Energietechnologien”
(5. th national energy research program)

[2] BINE Informationsdienst (national project informations)
[2a] Energieforschung – Erfolgsfaktor wirtschaftlicher Innovation

[3] Bundesministerium für Wirtschaft und Arbeit (BMWA) (ministry of economics and labor)

[4] Renewables 2004, International Conference for Renewable Energies, Bonn, 2004

[5] ForschungsVerband Sonnenenergie FVS (national research alliance for solar energy)

[6] Energieforschung in Deutschland (Energy Technology in Germany) , „Aktueller Entwicklungsstand und Potenziale nichtnuklearer Energietechniken“, Schriften des FZ Jülich, Band 24

[7] Klimaschutzprogramm 2000, Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, BMU (national climate protection program, ministry of enviroment)

Gesetze und Richtlinien (policies and regulations) :

[8] Biomasse Verordnung (Bundesgesetz) (national biomass regulation)

[9] Novelliertes Eneuerbare Energiegesetz (Gesetz zur Neuregelung des Rechts der Eneuerbaren Energien im Strombereich) (national renewables energy regulation for electricity)

[10] SAVE-Richtlinie 93/76/EWG (European SAVE guidline)

[11] Novellierte Energieeinsparverordnung (EnEV) 2004 (national energy saving regulation)

11 Switzerland

11.1 Swiss support programs relevant for thermal storages

11.1.1 Energy research program

11.1.1.1 Aim and structure of the program

The overall aim of the thermal storage programme of the Swiss Federal Office of Energy is:

1. to disseminate knowledge on underground thermal storage (mainly duct storage, mainly in combination heat pump)
2. to develop new technologies to improve storage of solar heat, either to densify storage or to reach seasonal storage.

The program is coupled with the solar heat R&D program and also linked to the geothermal energy program.

11.1.1.2 How does thermal storage fit with formulated areas of focus?

Every 4 years a Swiss R&D program is written. The storage program fits with the overall objectives of this national plan written by the federal commission of energy (CORE) with inputs from the program managers.

11.1.1.3 Who – how is decided which projects to support

Projects are initiated or received by the program manager (JC Hadorn in 2006). The projects are then submitted to the domain manager at the Swiss federal office of energy and a co-decision is taken and communicated after less than 2 weeks to the project leader.

Some projects that are out of scope of program are however discussed with a steering committee, having 6 members from solar industry and engineering schools.

There is also the CTI funding: 50% for a research institute and 50% should come from an industry to develop new products.

11.1.1.4 Key persons

Urs Wolfer, domain “Solar” manager, from Swiss Federal Office of Energy
JC Hadorn, program manager under contract of SFOE

11.1.1.5 Statistics of applications and supported projects on thermal storage

1975-2000: 4 projects on aquifer storage (Neuchatel, SPEOS, Saillon, Sierre, numerous experiments and modelling)
1990-2006: 15 projects in borehole storage (research, modelling, Pilot and demonstrations installations supported)
1995-2006: 6 projects in piles for buildings
1985-2006: 10 projects in DHW solar and solar combisystems
1997-2006: 1 project in sorption storage in IEA SHC Task 32
1990-2000: 1 project for agricultural greenhouse

1994-1998: 1 project for seasonal storage in a 2500 m3 tank
2003-2006: 1 project on PCM storage for combisystems in Task 32
2000-2006: 1 project on a diurnal diffusive storage for cooling

Average funding was 300'000 euros per year for R&D and P&D projects.

11.1.1.6 How is the attitude towards more focus on thermal storage in the program?

It is understood since long that thermal storage is important: there is a specific research program since 1985, but funded on a low level.

Aquifer storage project SPEOS was well funded in 1979-1988 but success was mitigated.

11.1.1.7 Trends, future changes and/or new programs coming up?

We have developed technologies for borehole storage mainly with heat pump since 1985. We have tried aquifer and tank seasonal storage.

The program is more and more focusing on dense storage for a one family house.
But a pilot project with duct storage without heat pump is still looked for.

A P+D program existed in 1990-2003 and was a support (up to 50% of investment cost) for building more than 15 pilot projects.

This program was stopped in 2004 but there is a discussion to relaunch a P+D program if a CO2 tax comes to finance it.

11.1.1.8 Guide for applicants.

Information for applicants can be found on www.solarch.ch and http://www.bfe.admin.ch/?lang=en

There is no annual call for proposals because of the small budget of the program, the program has axis in which proposals can be received.

11.1.1.9 Can the program be used for dissemination of information about thermal storage?

It has too also.
Models are published (Pilesim, TRNDST).
All reports are published on the web (www.solarch.ch).
Conferences are given.

11.1.1.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

The program has had a great impact on:

- aquifer storage knowledge
- development of borehole storage with heat pump
- new solar tanks for combisystems,

We are no looking for dense storage for one family house at research level.

11.1.1.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

The only problem is the level of funding. The organisation and program are correct.

11.2 Swiss policies relevant for thermal storages

11.2.1 Strategy on biomass

11.2.1.1 General

The strategy for biomass is to develop pellet heating for domestic applications and cogeneration plants 1 to 10 MW.
Thermal storage is not discussed within this program, and could be.

11.2.1.2 In which respect is the policy relevant for thermal storage.

The strategy does not mention thermal storages yet.

11.2.1.3 Key persons

Daniel Binggeli at SFOE.

11.2.1.4 How is the attitude towards more focus on thermal storage in the policy?

Not asked yet !

11.2.1.5 Are there future changes in the policies and/or new policies coming up?

The program 2007-2011 is in definition.

11.2.1.6 Can the policy be used for dissemination of information about thermal storage?

Probably yes.

11.2.1.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It is recommended that the preheat project tries to open discussion with the biomass program.

11.3 Swiss regulations relevant for thermal storages.

11.3.1 Building regulations

The building regulations are built on a number of standards, recommendations and directions'
Relevant for thermal storage are:

- Standard for heating systems and DHW www.sia.ch
- Standard for thermal insulation of buildings SIA 380
- Minergie private label www.minergie.ch

11.3.1.1 In which respect is the regulation relevant for thermal storage ?

No big influences since the prescription in CH are goal to reach. Storage tanks with domestic water have to be approved in a national approval scheme but it is not strong.

11.3.1.2 Key persons

Tank storage homologation: EMPA, Dübendorf or Bern

11.3.1.3 Are there future changes in the regulation and/or new regulations coming up?

Not known

11.3.1.4 Can the regulation be used for dissemination of information about thermal storage?

No

11.3.1.5 Conclusions and recommendations about modifications in regulations that will ease beneficial use of thermal storage techniques

A point for discussion in the PREHEAT group: how to get more involved in the storage tank homologation procedures.

11.4 Overview of other national decision making processes relevant for beneficial use of thermal storage or barriers for beneficial use of thermal storages

The future growth of the cooling market for building should be addressed somehow since for big projects underground cooling is possible.

A new program manager was the solar chemistry has been appointed by SFOE. The program was focused on high temperature storage (1200C). A low temperature axis might be open?

Le programme Pompe à chaleur pourrait bénéficier d'avancée en matière de stockage dense aussi.

11.5 Other key persons

Andreas Eckmanns, Charles Filleux for the "Building" program of SFOE
Pierre Renaud for the "Solar Chemistry" program SFOE
Fabrice Rognon for the Heat pump program.
Marc Tillmanns, Minergie CH

12 The Netherlands

12.1 Present State of the Support for thermal storage in the Netherlands

12.1.1 Summary

Based on information from literature and interviews, an overview of the Dutch programs, policies and regulations has been created. General conclusion is that all programs have a general character and none of them is especially designed for thermal storage. It is possible to receive subsidies for thermal storage, but usually only for heat pump boilers and thermal storage combined with heat pumps. Barriers are the lack of support for 'further development' and for 'market introduction' and the complexity of thermal storage systems. Therefore it is often difficult for policy makers to get a good overview of all aspects of these systems and to judge themin the right way.

Several policies have been realised,most of them were especially designed to support thermal storage in the ground. From a recent study from SenterNovem (SenterNovem, 2006) it can be concluded that some of the programs only have had little effect. A list of barriers for thermal storage in the ground is stated in the different policy reports (see Paragraph 12.1.4.2). Barriers for the large scale implementation of PCMs are technical aspects (flammability and stability) and the high costs.

Several regulations play a role for thermal storage in the ground. Most of the regulations are restrictive, as they are designed for protection (of e.g. the ground, the groundwater, nature, drinking water etc). Different recommendations were designed to adapt laws and/or to develop an Order of Council. But these recommendationshave had only little effect. The barriers are the same as named in Paragraph 12.1.4.2 (e.g. different requirements in different provinces, high fees, the length of procedures to get a licence (especially a problem for small thermal storage systems in the ground) and lack of a quality mark). A new Waterwet is designed, but the recommendations from the different programs are hardly taken into account in this Waterwet. A more advantageous development is that the GIW (Garantie Instituut Woningbouw) stated requirements which have to be fulfilled for thermal storage systems, in order to get a Guarantee.

12.1.2 Background

12.1.2.1 Thermal storages in programs, policies and regulations.

The Dutch Ministry of Economic Affairs supports the development of (knowledge about) energy efficiency and renewable energy, because 'knowledge about energy efficiency and renewable energy will be the base for an affordable, reliable and clean energy in the future'[1]. Quotes from interviews with experts reflect the need for (cheap) thermal storage systems, in order to realize a more sustainable future.' thermal storage is inevitable in utilizing more sustainable energy in an efficient and effective manner. This is true especially for sources that fluctuate strongly (e.g. solar energy)' (Mr. Van Berkel, Entry Technology, see Appendix B)' To become successful, the thermal storage system should be cheap and efficient' (Mr. Smeding, ECN, see Appendix B) and 'The importance of long-term thermal storage will increase if, in the future, renewable energy forms a larger share of the total energy consumption' (Mr. Wemmers, TNO, see Appendix B).

Thus, experts think that, in achieving the goals of the Ministry of Economic Affairs, cheap and efficient thermal storage will become more important. This is why in the BEB[1] study it

[1] See also Table 6

was recommended to ‘Give thermal storage (in the ground) as a sustainable energy option a more ‘mature’ place in the national policy in order to stimulate this technology and to create the right conditions for large scale implementation’[2]. The aim of the Preheat project is closely related with the advice from the BEB study, but has a European focus instead of a national focus. In order give thermal storage a more mature place in the policy, firstthe present place of thermal storage in the Dutch policy needs to be determined. This report gives an overview of the programs, policies and regulations related to thermal storage in the Netherlands.

12.1.2.2 Methodology of investigation

For the situation in the Netherlands an analysis is made of the national policy related to four different types of thermal storage systems: low temperature thermal storage in the ground, high temperature thermal storage in the ground, Phase Changing Materials (PCMs) and thermo-chemical storage. Some of these types of thermal storage are further developed than others (see Table 4).

Type of thermal storage	Phase	Subject of study
Domestic hot water tanks	Common practice	No
Solar hot water tanks	Common practice	No
Low temperature thermal storage in the ground	Common practice in service sector	Yes
High temperature thermal storage in the ground	Pilot projects have been realised	Yes
PCMs	Demonstration	Yes
Chemical storage	Fundamental	Yes

Table 4 Development phase of different types of thermal storage

In this report not much attention is paid to thermal storage in water tanks/boilers, as more than thousands of these boilers have been realised yet (see Appendix C) and the focus of the PREHEAT project is not on mature technologies . Also low temperature thermal storage in the ground can be considered as a mature technology (which is financially feasible). At the moment about 500 open storage systems have been realised in the Netherlands. The number of closed loop systems is not known, as there is no obligation for registration for closed systems (SenterNovem, 2006). The target is to have an amount of energy stored in the ground in 2020, that equals the gas use of 230.000 households. This is almost similar to 5% of the total target of sustainable energy (the target in 2020 is to have in total 10% of sustainable energy)[3].

Despite the fact that low temperature thermal storage in the ground is a mature technology, it is analysed in this report, as it give some good examples of how laws and regulations can restrict the growth of the number of systems that is yearly realised. Information on programs, policies and regulations has been searched for by literature study and by interviewing experts.

12.1.3 Overview of national programs relevant for thermal storage

The programs related with thermal storage can be divided into programs in the past and programs in the present. A more detailed description of these programs can be found in Appendix D. In order to compare the different programs with each other, they are all depicted in Table 5. Most of the programs only stimulate the use of heat pump boilers or heat pumps (that make use of thermal storage).

Program	Past/ Present	Fundamental/ Development/ Demonstration/ Implementation	Granting	Type of support: Financial/ knowledge	Program used for dissemi-nation of info	Focus: thermal storage/ general
CO2-red. Plan	Past	Implementation	Tender (cost effectiveness)	Financial	No	General
EINP	Past	Implementation	List	Financial (tax red.)	No	General
EPR	Past	Implementation	List	Financial	No	General
OTC	Past		Order in which applications were received	Financial		General
VAMIL	Present**	Implementation	List*	Financial (liquidity advantages)	No	General
MIA	Present **	Implementation	List*	Financial (tax red)	No	General
EIA	Present	Implementation	List*	Financial (tax red.)	No	General
EOS	Present	All phases	Tender	Financial/ knowledge	Yes	General
UKR	Present	Experiments/ Demonstration	Tender	Financial	Yes	General
Innovation Vouchers	Present	Development	Distribution by government	Financial/ Knowledge	Yes	General
Temporal subsidy scheme CO_2 reduction built environme nt 2006	present	Implementation			no	General

* In case a technology is not on the list, tax reduction can only be received in case it can be proven that the requirements of the program are fulfilled.

** The MIA and the VAMIL still exist, but since 2003 energy saving investments are not longer supported under these programs

Table 5 Overview of national programs in the Netherlands

Based on Table 5, the following can be concluded. Almost all programs focus on the implementation of technologies, except the Innovation vouchers and the EOS program. The innovation vouchers program and EOS are the only programs that are (among other things) designed for knowledge transfer. The innovation vouchers program 2006 opened at 17 May 2006. The total budget for the 2006 program is 22.5 million euros. In total 3000 vouchers of 2500 euro are available and 3000 vouchers of 7500 euro (where a maximum of 5000 euro is paid by the government, the rest must be paid by the company) [15] Recently a new tender for the EOS program has been launched. Although the EOS program supports the different steps of technology development (from first idea to implementation), tenders for the different steps are not all open at the same time. The

UKR (Unieke Kansen Regeling /Unique Opportunities Arrangement, stimulates cooperation under leadership of Dutch market actors. The UKR supports experiments that fit within the 'official transition paths', determined by the Ministry of Economic Affairs. These experiments contribute to a more sustainable energy management. The second tender for this project was open from 15 May 2005 – 31 July 2005. 10 million euros were available in this tender, with a maximum budget of 4 milion euros/project and a maximum of 40% of the additional investment costs[2]. The project proposals need to be accepted by an independent advisory commission and will receive subsidy as long as the budget is not exceeded [13]. The EIA doesn't work with tenders, but with a list of technologies[3] . Investments in these technologies can be deduced from the total profit on which tax payments are based. A list of supported technologies can be found on 'www.senternovem.nl/eia/energielijst/Energielijst/index.asp'. The EIA is a program of the Ministry of Finances and the Ministry of Economic Affairs. SenterNovem and the Belastingdienst take care of the execution of this program. The attitude of the two Ministries is open minded, which means that technologies that are not on this list yet and that are not state-of-the-art technology, but that are applicable at large scale, can be proposed to become on the list. An application form for the EIA can be found on 'www.senternovem.nl/eia/energielijst/EIAAanvragen/index.asp'. In 2005 applications for the EIA amounted to in total 1,192 million euros of investment costs. The total amount of investment costs accepted by SenterNovem was about 882 million euro's. Taking into account the deduction percentage of 44% and the average tax tariffs, the total nett tax savings for the investers amounted to 123 million euros.

In 2005 the technology with the highest number of applications in the EIA was the heat pump (in total 847 applications, equal to 9% of the total number of applications). Based on the investment costs, heatpumps for buildings and processes ended at the fith place in the EIA top ten (like in 2004) with a total of investment cost of 46 million euros (equal to 4% of the total investments costs). If only renewables are taken into account, the technologies with the highest number of applications, which is related to heat storage, is heat and cold storage in aquifers (60 applications, 0.6% of the total number of applications) and solar collector systems (48 applications, 0.5% of the total number of applications). If not the number of applications is taken into account, but the total investment costs, heat and cold storage in aquifers is the only storage related technology in the EIA top five. The total investment costs for heat and cold storage in aquifers was 11 million euro, only 1% of the total investments costs within the EIA (SenterNovem, 2005c).

The application of EIA in 2006 is based on a total investment in energy saving technologies of 444 million (June 2006), compared to 279 million in June 2005 (and a total investment of 1.102 million in total in 2005)[www.senternovem.nl/eia].

The 'Tijdelijke subsidieregeling CO_2-reductie gebouwde omgeving 2006' (the temporal subsidy scheme CO_2 reduction built environment 2006) will start at 27 July 2006. This scheme stimulates large scale investments in energy reduction measures in existing buildings. The Ministry of VROM (Housing, Spatial planning and Environment) has reserved 33 million euros for this scheme. SenterNovem will take care of the program execution. In the scheme subsidy will given for reduction measures described at the accompanying list, realizing at least 20 ton CO_2 per project per year. The list is not available yet, but from the press release it is clear that different types of insulation, HR++ glass and solar boilers and heat pumps will be financed

[2] Additional costs of the project are the additional cost relative to a investment that is comparable from a technical point of view.

[3] Within the EIA tax reduction can be received for heat pumps, with ground heat exchanger or ground water source, or heat storage tank (code 211101) and for a heat pump boiler, with ground heat exchanger or ground water source, or heat storage tank (cde 211102).

It is clear from Table 5 that there are no programs especially designed for thermal storage, all programs have a general focus. No new programs are expected to be introduced soon.

12.1.3.1 Barriers

In the interviews there were some signs that the programs can be improved, e.g. for the phase of 'further development', which is the phase following on the innovative ("Proof of Concept") phase. 'Further development is needed to bring concepts to the market, but often subsidies/ grants are hard to acquire and cover a minor part of the development costs. For the market actors, this phase is not yet interesting, so they are not very willing to financially support the activities in this phase' (Mr. Van Berkel, Entry Technology, see Appendix B). Also the 'lack of financing available for market introduction' is named as a barrier, because the step from pilot projects to a mature product is difficult to realize' (Mr Van Aarssen, IF Technology bv, see Appendix B). There is also a commend on the EU programs, designed to stimulate the development of promising technologies: 'for a relatively small company, the costs and time needed to write a subsidy proposal is often a heavy burden. Especially since there is a high risk of getting the project not funded' (Mr. Van Aarssen, IF Technology bv, see Appendix B).

Furthermore, the issue is raised, that the persons that decide about budgets, 'don't have necessarily enough knowledge of the new technology to see it in the proper perspective and to judge it in the right way' (Mr. Van Berkel, Entry Technology, see Appendix B). Mr. Wemmers (TNO, see Appendix B) agrees with this, stating that 'for policy makers without a technical background, it is difficult to get a good overview of all aspects of an integral approach to the energy system'. It is important that literature isn't too technical, so that they are accessible for most public officers, as 'it is very important that the public officers (that design the policy) see the saving potential of thermal storage' (Mr. Van Aarssen, IF Technology bv, see Appendix B). In the Province of Noord-Brabant, management tries to prevent this problem: 'all persons that are responsible for attributing licences have a technical background. An assistance, which has a different background, is now following a course to learn all the required aspects of thermal storage' (Mr. Maessen, Province of Noord-Brabant, see Appendix B).

12.1.3.2 Conclusions and recommendations

It is recommended to try to get heat storage explicitely on the EIA list and try to form a consortium to realise a heat storage project when a next tender for the UKR will open. Further it is recommended to reduce barriers existing in relation with successful market introduction (get support for bringing concepts to the market and for the step to large scale production). Furthermore, it is important that literature on heat storage becomes available that is not too technical and that gives a clear overview of the advantages of heat storages.

12.1.4 Overview of national policies relevant for thermal storage

While the 'programs' all have a general focus, there are some 'policies' especially designed for stimulating thermal storage (low temperature thermal storage in aquifers). A description of these policies is given in Appendix E. An overview of the policies is given in Table 6.

Some of the policies stated in Table 6 (e.g. BAB, BEB, the advice of the TCB and Juridical Framework Ground Energy) are only focussing on energy storage in the ground, often combined with a heat pump. These programs are focused on removing barriers

(e.g. the lack of information of local authorities and juridical barriers). Other policies focus more on heat pumps (and renewable energy in general – like DEN) and especially on market penetration. DEN (Duurzame Energie in Nederland/ Sustainable Energy in the Netherlands) informs about the different subsidy programs. Medio 2004 900 applications for subsidies were received and 325 projects were finished (Senternovem, 2005b) (for information on the project investment and the granted subsidies, see Appendix E).No information has been found about programs for high temperature thermal storage in the ground, PCMs and chemical storage.

12.1.4.1 Key persons/ key groups

There are several groups and authorities that play an important role in these policies. First of all three ministries: the Ministry of Economic Affairs, the Ministry of Housing, Spatial Planning and Environment and the Ministry of Transport, Public Works and Water Management. The person within the Ministry of Economic affairs that is at the moment responsible for heat pumps (and energy storage) is Mr. Noordhoek. But also the StuBo (Steering group Ground Energy) plays an important role as formal taskmaster of the BEB project. SenterNovem contributed to the BEB project by forming a project team existing of external professionals. The person within SenterNovem, who is at the moment responsible for sustainable heat, is Mr. Lex Bosselaar. The role of municipalities and provinces is represented by respectively the VNG (Vereniging Nederlandse Gemeenten) and the IPO (Interprovinciaal overleg). Another player in the field, for thermal storage combined with heat pumps, is the Nederlands Platform Warmtepompen (NPW, Dutch Platform for Heat pumps). For projects concerning underground energy storage, the Dutch Association of Underground Energy storage systems (NVOE, and the NVOE (Nederlandse Vereniging voor Ondergrondse Energieopslagsystemen - see Appendix F)) has been founded (on initiative of SenterNovem) [4].

Policy-abbrev.	Policy -Full name	Content	Technology	Main actor	year
BAB '95	Policy recommendations for ground protection from cold storage/ Beleidsaanbevelingen voor bodembescherming bij koude opslag	Streamline regulations for cold storage	Thermal storage in the ground		1995
BEB	Ground as Energy source and buffer/Bodem als energiebron en –buffer	Analysis of BAB'95, recommend-dations	Thermal storage in the ground		2000-2003
Conve-nant	Convenant Heat pumps in Dwellings/ Warmtepompsystemen in de Woningbouw	Large scale market introduction of heat pumps in the residential sector	Heat pumps		2000-2003
TCB-advice	Recommendation of the Technical Commission Ground Protection/ Advies van Technische Commissie Bodembescherming	Advice for the draft policies recommend-dations from BEB	Thermal storage in the ground	TCB	Marc h 2004
	StuBo Policy recommendations/ StuBo Beleidsaanbevelingen		Thermal storage in the ground	StuBo	Sept 2004
	Policy letter Spatial Planning of the Underground/ Beleidsbrief Ruimtelijke Ordening van de ondergrond		Thermal storage in the ground		End of 2004
DEN	Program Sustainable Energy in the Netherlands / Programma Duurzame Energie in Nederland	Technical development and market penetration	Renewable energy		Still runni ng
	Juridical Framework Ground Energy/ Juridisch Kader Bodemenergie		Thermal storage in the ground	SenterNove m, IF Techno-logy bv	
	Platform Energietransitie Gebouwde Omgeving'	political, economic and organizational transitions	-	The chair, Mr. Terlouw	2006

Table 6 Overview of national policies

12.1.4.2 Barriers

In the BEB project (Appendix G) weaknesses and threats are stated and many recommendations have been formulatedTo streamline regulations for thermal storage and to enlarge knowledge. In Appendix H and Appendix Ian overview is given for respectively barriers and recommendations for thermal storage, found from different literature sources). In the study 'Juridisch Kader Bodemenergie'an analysis has been made about the advises from earlier studies and policies and the amount in which these have been realised/ are being realised (Appendix J). On base of the outcomes of this analysis a new juridical framework is suggested by the NVOE (Appendix K).By a questionnaire the opinions of different parties (consultant, installers, drilling companies, suppliers, users and authorities that grant licences) about this new framework has been investigated (Appendix L).

One of the conclusions of questionnaires is that a lot of interest exists for the laws and regulations related to energy storage, both from the market and authorities. And it is clear that there is a need for a new juridical framework. Furhtermore is concluded that the proposed Order in Council is a step in the good direction in the opinion of the market parties. Therefore the promotion of the Order in Council Bodemenergie needs to be continued. Barriers are still the complexity of laws and regulations, the time needed for procedures, and the different requirements in different provinces. Laws need to be cleared up and requirements from the different provinces need to be uniformed. One important condition is that the administrative burden may not increase (SenterNovem, 2006).

While, or maybe because of, the policies don't focus on PCMs, or, because of the policies don't focus on PCMs, some barriers exist for this technology.

- PCMs, can be used for small scale projects, e.g. to enlarge the thermal mass of walls in buildings. A disadvantage is that most PCMs, which have a melting point at about 20 °C and that have been studied so far, are very flammable. Due to safety considerations, these materials cannot be used and further studies will be needed (Mr. Buitenhuis, DWA, see Appendix B).
- The stability of PCMs can be a problem. After some time, the phase change doesn't take place at a certain small temperature range anymore, but the range broadens and a form of hysteresis takes place. This problem however has been strongly reduced in the last years. (Mr. Buitenhuis, DWA, see Appendix B)
- Costs of PCMs are still high (10 euro/kg-12 euro/kg). Due to the high costs, the demand for PCMs stays small, while large scale production is needed in order to reduce production costs and prices. For increasing the scale of production, it would help if some pilot projects would be realised (Mr. Buitenhuis, DWA, see Appendix B). Mr. Joode (Forteck Energie Systemen, see Appendix B) agrees, 'PCMs don't lead to many technical barriers anymore. But PCMs are still expensive, and therefore they are expected only to be used in the industry for high temperature energy storage. There will be an enormous potential. But to realize this potential subsidies and pilot projects might be needed'. Financial aspects[4] are considered to be the main barrier for large scale use of PCMs . 'Subsidy won't solve this problem, as these lead only to a temporary cost reduction. However, subsidy will increase the familiarity and acceptance of the technology as a real climate control solution as more systems are installed and used, outside of the laboratory'(Mr. Joode, Forteck Energie Systemen, see Appendix B).

12.1.5 Overview of national regulations relevant for thermal storages

From literature only 'regulations' have been found that are related to low temperature thermal storage in the ground (especially for systems with an open loop). These regulations are shown in Table 7. A description of each of this regulations can be found in Appendix M. All these regulations are general regulations, in the sense that they are not especially designed for thermal storage in the ground. These regulations are often designed for protection (of the ground, of the ground water, of the nature, of the drinking water etc), and therefore they have often a restricting effect on the thermal storage in the ground. In case of open ground stores, a licence is needed for: Grondwaterwet, Wet Bodembescherming, Wet verontreiniging oppervlaktewater and the Wet Milieubeheer. For closed loop systems, only licences may be needed for the Wet Milieubeheer and the Wet Bodembescherming (SenterNovem, 2006) Only two of all regulations can have a positive

[4] There are three types of financial aspects: research costs, material costs and testing costs before market introduction.

influence on thermal storage: the EPN (Energy Performance Standard/ EnergiePrestatieNorm) and the EPA (Energy Performance Advise/ EnergiePrestatieAdvies)see Appendix M).

Law/regulation	Competent authority	Timeline (max.)	Licence required for open system	Licence required for closed loop system	Same requirements in every Province
Grondwaterwet (Gww)	Province	7,5 months	Yes/depend on speed	No	No
Wet Bodembescher-ming (Wbb)/Lozingenbe sluit	Municipality/ Province		No Every 4 year new exemption	No Every 4 year new exemption	No
Wet verontreiniging oppervlakte water (Wvo)	Hoogheemraads chap Waterschap Zuiveringsschap Rijkswaterstaat	7,5 months			Not clear
Wet milieubeheer (Wm)	Municipality	7,5 months	Yes	Yes	Not clear
EPN	Municipality		-	-	Yes

Table 7 National regulations influencing low temperature thermal storage in the ground.

12.1.5.1 Barriers

From the interviews with experts (see Appendix B)several barriers, which are related with laws and regulations, were named:
Different requirements. Different provinces can have different requirements and building parties have to take into account the specific requirements for each project' (Mr. Buitenhuis DWA). Mr. de Joode (Forteck Energie Systemen) agrees, 'While there is only one Grondwaterwet (Ground Water Law), different conditions are set for drilling depths, capacities of storage systems and how to apply for a licence. Therefore a system might be feasible in one province, whereas the same system won't get a licence in an other province.' The Province of Noord-Brabant (and others) realizes that rules of their Province are different from that of other Provinces. To make the rules more similar between all the Provinces, a working group IPO (InterProvinciaal Overlegorgaan), with representatives from different provinces, has deliberated. The aim was to define the same boundary conditions and the same rules for small[5] thermal storage systems in all provinces. The project has nearly been finished. The results have to be proposed to the other provinces. Provinces cannot be forced to implement the recommendations, but they can be advised to use the recommendations as a guide. It is expected that the results of the IPO will be published soon (Mr. Maessen, Province of Noord-Brabant). Also Mr. Noordhoek (Ministry of Economic Affairs) realizes that 'different provinces have at the moment different requirements for licences. A commission (of the Ministry of Housing, Spatial Planning and the Environment) is studying how to solve this problem and establish the same requirements for all provinces'

[5] (Mr. Maessen, Province of Noord-Brabant). For the bigger systems it is difficult to define general rules for all provinces, as the boundary conditions often depend on the local situation. In Noord-Brabant drilling up to a maximum depth of 80 m is allowed (to not disturb drink water exploitation. In e.g. Noord-Holland thermal storage systems are preferred to be realized at depths of more than 80 m. In this case the thermal storage will take place in layers with salt water, and will therefore not influence the winning of tap(drink) water.

Unfamiliarity. Designing partners are often unfamiliar with laws. (SenterNovem, 2000).
Fees. Fees for applying for a licence differ from province to province. Publication costs to get a licence, can vary, while in some provinces no fees have to be paid.
Monitoring costs. In some of the provinces rather extensive monitoring of performance indicators is required. Often, these data seem not to be analysed and it is not clear where these data are needed for (Mr. Buitenhuis, DWA).
Length of procedure. Mr. Buitenhuis (DWA): 'For small scaled projects the procedure at the province takes too long (8 - 9 months). This period is much longer than the construction process of new buildings takes. It is recommended to reduce this period for small projects especially if it is proved that they meet standardized provincial guidelines.
Quality mark. Mr. Noordhoek (EZ) At the moment a quality mark exists for heat pumps. But there's not yet a quality mark for complete heat pump systems, while the proper functioning of a heat pump system does not only depend on the heat pump itself. Other components of the system are critical as well. Since the whole heat pump market would suffer badly from the publicity around failing heat pump systems the introduction of such a quality mark is studied and might be introduced for the Dutch market. At the moment, low cost (and often low quality) systems can be realised without any quality control. Low quality systems may perform worse and influence the good image of the whole sector, so that the high quality companies suffer from the activities of low quality companies' (Mr. Buitenhuis, DWA). Also Mr. Witte (GroenHolland) and his colleagues consider regulation as very useful, as regulation makes it possible to see the difference between low quality and high quality systems. As customers usually have limited experience with / knowledge of these systems, the decision is often mainly based on costs. The risk of competition on cost (low quality systems) is especially present in the residential sector. Different certifying initiatives are being introduced. But it would be better if there would be an international, obligatory certifying system.

12.1.5.2 Future changes in the regulation and new regulations

Recent developments regulations are focused on thermal storage in the ground, and not on other forms of thermal storage. The Dutch government strives for implementing a new law (Waterwet) in 2008. This Law will replace 8 existing laws[6], only a few of them are relevant for thermal storage. With the new law, regulations will become much clearer and only one licence will be required for all water related issues. The new Water Law will distinct between indirect drainage (in the sewer system) and direct drainage. Direct drainage will be part of the Water Law and Waterschappen will be responsible. The indirect drainage will be part of the 'Omgevingsvergunning', of which the municipality or province will be the competent authority (Persbericht, 30 augustus 2005).

12.1.6 Overview of other decision making processes

EPK (Energie Prestatie Keur)
The aim of EPK (see Appendix N) is to promote the installation and use of energy efficient and high quality boilers with environmental friendly constructions. At the moment there exist a quality mark for boilers of the type HR100- HR104 and HR107. The use of heat storage will be positively influenced when the PREHEAT project team can realise that there also becomes a quality mark for heat storage systems, which will make it possible to distinguish between high and low quality systems

[6] Wet op de waterhuishouding, Wet verontreiniging oppervlakte wateren, Wet verontreiniging zeewater, Grondwaterwet, Wet droogmakerijen en indijkingen,Wet op de Waterkering, Wet beheer Rijkstwaterstaatswerken, Waterstaatswet 1900

GIW (Garantie Instituut Woningbouw).
When a house is constructed, often different companies/parters work on the different parts of the construction. In case of mistakes, it is difficult to point out the responsible company. Therefore the GIW has been developed. The GIW takes responsibility for the entire construction chain (and all partners working on that) (see Appendix N). In case of mistakes or troubles, the GIW is the partner to communicate with and the partner that gives the guarantee on the house [5]. The GIW gives only guarantee on a house with thermal storage, if the storage system fulfills a number of requirements. Because of this development fewer thermal storage systems will be realized by incompetent organizations.

12.1.7 Conclusions and recommendations about modifications in programs, policies and regulations that will ease beneficial use of thermal storage techniques

In general all programs and regulations are of a general character, and not especially designed for thermal storage The policies, on the other hand, often are developed with a focus on energy storage (in aquifers) and heat pumps.. Improvements for thermal storage in aquifers is possible, by resolving the barriers (see Paragraph 12.1.3.1, 12.1.4.2 and 12.1.5.1, and Appendix H, H and J).

More relevant for PREHEAT project is how to stimulate forms of thermal storage that are still in the phase of fundamental research or in the demonstration phase. For these storage technologies, no information about barriers has been found in literature. However, the interviews with experts from the field (see Appendix B) give some information. Barriers that need to be solved are often strongly related with the financing aspects of research and of market introduction. Solutions need to be found for the following barriers:

- often subsidies/ grants are hard to acquire for the innovative phase and often cover only a minor part of the development costs (Mr. van Berkel, Entry Technology).
- the 'lack of financing available for market introduction' (Mr. van Aarssen, IF Technolgy bv).
- the risks and costs to apply for money in an EU programs, designed to stimulate the development of promising technologies. Costs can be a heavy burden especially for smaller companies, while there is also a high risk of getting the project not funded (Mr. van Aarssen, IF Technology bv).
- sometimes the lack of a good overview of the persons that decide about budgets that exists, especially for persons without a technical background. For them it is difficult to see the new technology in the proper perspective and to judge it in the right way (Mr. van Berkel, Entry Technology).

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Abbreviations

AWB	Algemene Wet Bestuursrecht	General Law Administrative Law
BAB	Beleidsaanbevelingen voor bodem bescherming bij koude opslag	Policy recommendations for ground protection from cold storage
BEB	Bodem als energiebron en –buffer	Ground as Energy source and buffer
BRL	Beoordelingsrichtlijn	Assessment Guidelines
EPC	EnergiePrestatieCoefficient	Energy Performance Coefficient
EPK	Energie Prestatie Keur	Energy Performance Mark
EPN	EnergiePrestatieNorm	Energy Performance Standard
EZ (Ministry)	Economische Zaken	Economic Affairs (ministry)
Gww	Grondwaterwet	Ground water law
IPO	Interprovinciaal Overlegorgaan	-
JuKa	Juridisch Kader Bodemenergie	Juridical Framework Ground Energy
MeA	Milieu-effecten van bodemenergie en de Afweging ervan	Environmental Effects of ground energy and the consideration of it
mer	Milieu effect rapportage	Environment Effect report
NVOE	Nederlandse Vereniging voor Ondergrondse Energieopslagsystemen	Dutch Association for Underground Energy storage systems
NPW	Nederlands Platform Warmtepompen	Dutch Platform Heat Pumps
StuBo	Stuurgroep Bodemenergie	Steering Group Ground Energy
TCB	Advies Technische Commissie Bodemenergie	Advice Technical Commission Ground energy
V en W (Ministry)	Verkeer en Waterstaat	Transport, Public Works and watermanagement (ministry)
VNG	Vereniging Nederlandse Gemeenten	Association of Dutch Municipalities
VROM (Ministry)	Volkshuisvesting, Ruimtelijke Ordening en Milieu	Housing, spatial planning and Environment (ministry)
WABO	Wet Algemene Bepalingen Omgevingsrecht	-
Wbb	Wet bodembescherming	Law for Soil Protection
Wm	Wet milieubeheer	Law for Management of the Environment
Wvo	Wet verontreiniging oppervlakte wateren	Law for pollution surface waters

13 United Kingdom

13.1.1 Overview

A review of current governmental practice in the UK towards thermal storage (TS) reveals that, in general, the actual role of TS is not clearly identified. On the other hand there is a certain level of support that TS applications receive from particular programs, policies and regulations related mainly to carbon reduction targets. TS, as an enabling technology for renewables, CHP and others, benefits indirectly from the promotion of low carbon technologies as well as from strategies tackling fuel poverty. A wide variety of programs, policies and regulations exist which support technologies related to TS but they tend not to draw attention directly to the technology itself. There is currently very limited dissemination of information about TS, and therefore there are very few statistics on the number of storages available from governmental sources.

The Community Energy program, which is in the process of closing down, supported a series of projects which made use of TS technologies. Consistent with the overall framework of the program (community heating systems, renewables and CHP, carbon savings) TS techniques were implemented in a number of cases to enable efficient use of the energy sources. Other currently active programs are expected to bring further attention towards TS. The Low Carbon Buildings Program (DTI), which was initiated in early 2006, is intended to offer both grants and advice for the installation of micro-renewables. It is envisaged that the program will cover a wide range of technologies and carbon savings will be taken into account as one of a number of criteria. Similarly, other possible opportunities for TS technologies appear through the Carbon Trust Low Carbon Programs which aim to support development, commercialization and acceleration of sectors which are proved to contribute towards carbon reduction, although TS interest does not exist up to date. Of similar interest is the Scottish Community and Householder Renewables Initiative (SCHRI) which offers grants and advice in order to promote the use of renewables for households and community schemes in Scotland. Smaller opportunities arise via the Warmfront which generally incorporates more conventional technologies, e.g. insulation, to tackle fuel poverty.

There are certain policies relevant to TS, those which deal with energy efficiency, carbon reduction and fuel poverty. The 2006 Energy Review, the updated UK Climate change program and Planning Policy Statement 22 cover high level policies and therefore there is little likelihood of significantly acknowledging TS in particular. This is likely to be done only indirectly along with renewables, CHP and district heating. The third phase of the Efficiency Commitment is intended to promote more innovative methods of increasing energy efficiency and carbon savings for dwellings and therefore TS techniques could be supported. Up to the present time, in the second phase of the strategy the heating sector has contributed only 3% to the targets, including the first community projects and ground source heat pump systems. The Microgeneration Strategy and the Biomass Task force are of particular interest as the energy efficiency of the supported technologies is significantly dependent on TS techniques. Although there are no direct references to TS, it may be that acknowledgement of the role of TS could be developed within revisions to strategies in the future. In general, there is an increasing interest within UK policies towards energy efficiency and carbon reductions, which could probably be influenced to include more on TS techniques.

In the Buildings Regulations' (Part L) there is considerable attention paid towards TS but only as far as it concerns conventional methods of TS in the heating/hot water mode and for the domestic sector exclusively. SAP 2005, the calculation method for the energy performance of dwellings, can deal with such kinds of TS highlighting the energy savings achieved. It is one of the targets of the designers of the SBEM software – the analogous piece of software for buildings other than dwellings - that the contribution of any kind of TS towards energy savings would be calculated within future versions of the program.

In conclusion, it is apparent that the role of TS in UK programs, policies and regulations needs to be highlighted in tandem with the major technologies promoted for carbon reductions and energy savings. There is significant interest in environmental and energy issues and it may therefore be that there is potential for developing a more holistic approach towards TS within the existing government supported activities in the UK.

13.2 British support programs relevant for thermal storages

13.2.1 Warmfront

13.2.1.1 Aim and structure of the program

The Warmfront (formerly called the Home Energy Efficiency Scheme) was launched in 2000 and is the Government's main grant funded program for tackling fuel poverty. The first target to be reached aims to help the most vulnerable to the cold/ill health until 2010. Both energy efficiency and low incomes are identified as the main dimensions of the problem of fuel poverty.

Defra and DTI have a joint Public Service Agreement target to: Eliminate fuel poverty in vulnerable households in England by 2010 in line with the Government's Fuel Poverty Strategy Objectives". Defra holds overall responsibility for policy in Warmfront and the scheme manager across England is Eaga Partnership Ltd.

13.2.1.2 How does thermal storage fit with formulated areas of focus?

Warmfront is a development program which offers a package of insulation and heating tailored to each property. Among the available measures, hot water tank insulation and the hot water tank jacket are references to basic installations of thermal storage Gas boilers are the preferable heating solution and oil central heating systems are in some cases acceptable although this conflicts with the Government's Climate Change Objectives. Although the Government's Plan for Action (where the Warmfront is derived from) sets a SAP rating of 65, increasing the required level of efficiency of the proposed measures, renewable energy sources and other types of thermal storage are not supported by the scheme.

13.2.1.3 Who – how is decided which projects to support

The eligibility criteria for funding are clearly identified by the program's website and are indicators of unemployment, low-income, disability and other types of vulnerability. Further explanation on that is provided by the EAGA call centre. In case the applicant isn't in receipt of such qualifying benefits a health check is conducted to identify eligibility for benefits and Warm Front grant.

13.2.1.4 Key persons

The Fuel Poverty Advisory Group is an Advisory Non-Departmental Public Body sponsored by DTI and Defra. Its primary task is to report on the progress of delivery of the Government's Fuel Poverty Strategy and to propose and implement improvements to regional or local mechanisms for its delivery. Annual reports of the FPAG are available from the site and identify the critical role of the FPAG on the progress of the program, as many changes have been implemented with their interference.

John McDaid (Head of Contracts, EAGA partnership) is the key person on information of joining the scheme as an installer and Ross Garner (HR Manager, EAGA partnership) the one related to Home Energy Advisors.

13.2.1.5 Statistics of applications and supported projects on thermal storage

In general for the period between 2000-04 17,570 storage heaters and 95,891 hot water thermal jackets were installed by Warm front (information from the Fuel Poverty Action Plan).

Results for the last financial year (1st of April of 2004 to 31st of March 2005) are provided by POWERGEN only, the scheme manager in East of England, East Midlands and Yorkshire and Humberside: among the 68,000 houses assisted, 2,300 were installed storage heaters and 7,700 hot water thermal jackets. For the rest of areas, no information found.

13.2.1.6 How is the attitude towards more focus on thermal storage in the program?

No specific attitude. It could be discussed with DEFRA whether thermal storage technologies appropriate to the scheme can be included in the available measures.

13.2.1.7 Trends, future changes and/or new programs coming up?

The third Annual report of the Fuel Poverty Advisory Group (FPAG) identifies and proposes more solutions, which refer directly or indirectly to T.S and/or renewable energy sources, such as

- Community rather than individual house solutions
- Encouragement of low income customers to take advantage of low prices/better value offers from suppliers.

Although the latter could refer directly to off-peak prices and enhance thermal storage, the FPAG report refers only to the role of Government, Ofgem and energywatch of informing the customers. This is of particular interest as the problem of the run costs (which are not covered by the grant) could be solved by the integration of T.S technologies. The third report of the FPAG mentions also the lack of funding for relevant assessment for solutions outside the gas supply areas, which prevent the use of renewable heating (in addition such systems would have normally higher capital cost than conventional gas and oil boilers). Carbon emissions issues could play an important role in the integration of technologies related to thermal storage as Warm Front is controlled by Defra and should be in accordance with the Government's Climate Change objectives.

13.2.1.8 Guide for applicants.

Information for applicants can be found on the website http://www.defra.gov.uk/environment/energy/hees/index.htm or by calling the freephone provided by the EAGA Partnership Warmfront Team (details at http://www.defra.gov.uk/environment/energy/hees/02.htm).

13.2.1.9 Can the program be used for dissemination of information about thermal storage?

Dissemination is not included in the program.

13.2.1.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

Very basic types of thermal storage have been installed up to date within the scheme. Applications of commercially available advanced technology of thermal storage and relevant systems are not included in the proposed measures.

13.2.1.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

There are economic restrictions that prevent the use of thermal storage technologies within the program. In addition it is subject to the scheme managers' knowledge of the technology, as they are the ones to propose the type of installation. It could be discussed with the FPAG if a strategy for thermal storage could be promoted through their reports. In addition, the DEFRA could be contacted for that reason.

13.2.2 Community Energy

13.2.2.1 Aim and structure of the program

The aim of the Community Energy program was to provide guidance and funding for the installation and refurbishment of community heating schemes in the public sector across the U.K. The long term intentions included, apart from the social and economical benefits, the reduction of carbon emissions and the contribution to the UK Government's target of achieving 10 GWe of good-quality CHP by 2010.

The program is managed jointly by the Energy Saving Trust and the Carbon Trust on behalf of Defra.

13.2.2.2 How does thermal storage fit with formulated areas of focus?

The Community Energy is a development program which supports a wide variety of systems and types of energy sources. The energy sources considered by the program (including renewables and waste heat) and the CHP systems (another proposed solution by the program) sometimes include some kind of thermal storage.

13.2.2.3 Who – how is decided which projects to support

An independent committee drawn from industry, central and local government was responsible for the decision making, based on recommendations from the programme's technical experts.

13.2.2.4 Key persons

Samantha Kennedy – Energy Saving Trust programme manager
Tim Brooks – Technical Expert to the programme

13.2.2.5 Statistics of applications and supported projects on thermal storage

No statistics are available. Applications of thermal storage are described in the case studies of the Community Heating Program.

13.2.2.6 How is the attitude towards more focus on thermal storage in the program?

There is no potential for more focus on thermal storage as the program ends soon.

13.2.2.7 Trends, future changes and/or new programs coming up?

The program didn't extend as expected.

13.2.2.8 Guide for applicants.

The period for applications has expired. The program will end the 31st of March of 2007. Final grant claims for already qualified projects only can be made until the end of February of 2007.

13.2.2.9 Can the program be used for dissemination of information about thermal storage?

As the program's website and publications provide case studies including analysis of granted projects, limited dissemination of thermal storage information is provided there...

13.2.2.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

Applications of thermal storage have been supported by the Community Heating Program as it is apparent mainly from the case studies described in the published documents of Energy Saving Trust7. Nevertheless there is very limited focus on thermal storage and reference to it is given as a secondary part of the systems proposed.

[7] References on thermal storage exist on the *"Community heating using new and renewable sources"* document. A heat sink is described in the case study of Bryce Road Dudley in combination with GSHP and CHP (pp19-20).A 3000 litre sink stores heat (in 45^{o}C for space heating) supplied either from the GSHP or from the return flow of the domestic water heating system circuit which works in 70^{o}C (heated by the CHP and backed up by gas boilers). The Geothermal heating in Lumphinnans, Fife uses a large thermal store so as the heat pump (which extracts warm water from 170 m depth) to work in economic tariff, 18 hours per day.

13.2.2.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

There is no opportunity within this program for more focus on applications of thermal storage as there is no potential for new projects to be granted, and the qualified ones are already designed.

13.2.3 Low Carbon Buildings Program

13.2.3.1 Aim and structure of the program

The LCBP aims to provide practical advice on energy efficient measures and practical advice and capital grants for installation of micro-renewables. The overall target of the program is to achieve reductions of carbon emissions from buildings. There is currently only one stream open for applications, the one for small scale projects (e.g. home owners, community groups).

The LCBP is the succession of the “Clear Skies” program and it is operated by the DTI.

13.2.3.2 How does thermal storage fit with formulated areas of focus?

The LCBP is a development program which promotes the energy efficiency and the use of renewables and microgeneration, technologies which correlate with thermal storage

13.2.3.3 Who – how is decided which projects to support

A set of published criteria developed by a panel of experts and the Renewables Advisory Board will be used to assess the proposals. The Consultation Document of 2005 mentions that the selections will be done on a competitive basis and it is desired that the full range of eligible technologies will be represented by the program. Since the emerging technologies are at different stages of economic liability the impact of the cost will be assessed in conjunction with the carbon reduction and the electricity generation. More information on that is expected in the future.

13.2.3.4 Key persons

Kirk Archibald, Energy Saving Trust programme manager
Chris Roberts – Technical Manager

13.2.3.5 Statistics of applications and supported projects on thermal storage

The program started the 1st of April and so no statistics are available.

13.2.3.6 How is the attitude towards more focus on thermal storage in the program?

There is no attitude towards thermal storage. It could be possible to promote a thermal storage strategy with the help of PREHEAT.

13.2.3.7 Trends, future changes and/or new programs coming up?

Information about the second one (businesses, community organizations and public sector) will be announced in July.

13.2.3.8 Guide for applicants.

The application forms and the guidance for applicants for stream one are available at the Energy Saving Trust website at http://www.est.org.uk/myhome/generating/application/ . A freephone is also available (0800 915 0990).

13.2.3.9 Can the program be used for dissemination of information about thermal storage?

The website provides information on the supported technologies (including products and accredited installers). Thermal storage is not included in the list and therefore no reference to thermal storage was found. If thermal storage installations were promoted there would be an opportunity of disseminating such information through the program.

13.2.3.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

There is no available data in case studies or statistics as the program was just initiated.

13.2.3.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

The supported technologies (e.g. GSHP, CHP) are strongly related to thermal storage and often depend on that. It should be therefore discussed with the DTI if the role of thermal storage could be underlined within this program, as part of these systems as well as a separate technology. In addition, as the program is intended to reduce the market prices of the technologies used (continuing and improving the work of the Clear Skies and Major PV Demonstration Programs) the benefits could be essential for the thermal storage installations as well. In addition, the evaluation which is intended to be done 5 years after can provide essential feedback on thermal storage applications.

13.2.4 Carbon Trust Low Carbon Programs: Technological Acceleration Programs.

13.2.4.1 Aim and structure of the program

The CTTAPs aim to offer funding, coordination and expertise in order to accelerate sectors with great potential for carbon emissions reductions and overall impact on the U.K. economy.

The CTTAPs are situtated in the Carbon Trust.

13.2.4.2 How does thermal storage fit with formulated areas of focus?

The CCTAPs aim to fill technological and commercial gaps. Some thermal storage installations are at the experimental stage or lack commercial support and could therefore benefit from the programs.

13.2.4.3 Who – how is decided which projects to support

The Carbon Trust decides which projects to support (no analytical information found). Two main criteria are assessed in relation with the proposed technologies; the estimated reduction in carbon emissions and the potential assistance which can be offered by Carbon Trust.

13.2.4.4 Key persons

Dr Garry Staunton.Technology Manager, the Carbon Trust.
Sandra Gomez, Technical Advisor to Carbon Trust

13.2.4.5 Statistics of applications and supported projects on thermal storage

Among the six streams of the general program, three of them can be related to the thermal storage; Small Scale CHP Pilot Field Trials, Low-Carbon Building Accelerator (LCBA) and Biomass Heat Accelerator. There is currently no feedback available for the Small Scale CHP which is the only one running at the moment.

13.2.4.6 How is the attitude towards more focus on thermal storage in the program?

There is no certain attitude. It would be beneficial if PREHEAT could contribute to a more focused approach towards thermal storage

13.2.4.7 Trends, future changes and/or new programs coming up?

Currently only the LCBA initiative which is focusing on gathering data and demonstrating expertise in the energy-efficient refurbishment of non-residential buildings is open for applications (among the three related to the thermal storage).
On the 10th of April the new Biomass Heat Acceleration Project was announced with a budget of up to £5m over a period of up to 5 years, but it is unknown when it will initiate.

13.2.4.8 Guide for applicants.

For the biomass: email biomass@carbontrust.co.uk or contact Keiran Allen on 020 7170 7041.

For LCBA – general Carbon Trust number

13.2.4.9 Can the program be used for dissemination of information about thermal storage?

Each one of the streams of the general program will result in publications of the information gathered:lab measurements, computer models, conclusions about carbon reductions and general trends. This would be a significant source of dissemination of key findings and thermal storage could benefit from that if included in the strategies.

13.2.4.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

Final conclusions on the Small Scale CHP Pilot Field Trials should be expected in summer 2007. Information about the other two is not yet announced when it will be released.

13.2.4.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

The Future Energy Solutions and the BRE undertook the analysis and assessment of the available technologies on behalf of the Carbon Trust, concluding to where the Carbon Trust should concentrate its investments. The Low Carbon Technology Assessment doesn't identify the thermal storage as a technology to be supported but neither rejects it, as it wasn't included initially in the list of technologies to be assessed. Furthermore the technologies which are of interest to the LCTA are usually related to thermal storage; CHP, building (fabric, heating), biomass. Focus on thermal storage could be therefore enhanced within the biomass Heat Accelerator and the LCBA.

13.2.5 Carbon Trust Low Carbon Programs: Applied Research Program

13.2.5.1 Aim and structure of the program

The Carbon Trust's Applied Research Programme is open to UK businesses and research institutions and aims to support the development and commercialisation of technology with the potential to reduce UK carbon dioxide emissions.

13.2.5.2 How does thermal storage fit with formulated areas of focus?

The ARP is a development and commercialization program with interest in innovative technologies which can cause reduction in carbon emissions.

13.2.5.3 Who – how is decided which projects to support

The decision is based on certain criteria defined by the Carbon Trust and external assessors are consulted to ensure competitiveness. The final decision is taken by Carbon Trust.

13.2.5.4 Key persons

Dr Garry Staunton.Technology Manager, the Carbon Trust.
Sandra Gomez, Technical Advisor to Carbon Trust

13.2.5.5 Statistics of applications and supported projects on thermal storage

Among the successful projects listed in the website there are certain ones which are indirectly related to T.S (renewables, heat pumps), but none focusing on the thermal storage technology itself.

13.2.5.6 How is the attitude towards more focus on thermal storage in the program?

There is no certain attitude towards thermal storage neither towards other technologies. The fact that the innovation and the reduction of emissions is of particular interest for the grants, reveals opportunities for support for thermal storage installations.

13.2.5.7 Trends, future changes and/or new programs coming up?

The next call for proposals starts the 19th June 2006 and closes on the 9th August 2006.

13.2.5.8 Guide for applicants.

Online information is provided by the following link http://www.carbontrust.co.uk/technology/appliedresearch/default.htm . All proposals must be first submitted online and a second full proposal will follow.

13.2.5.9 Can the program be used for dissemination of information about thermal storage?

Dissemination is not the target of the program but information on the supported technologies is provided through the website (case studies).

13.2.5.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

Although there are no statistics available, the program assists vitally in the development of technologies relevant to thermal storage up to now.

13.2.5.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

There is no certain line given by the program about what kind of technologies to be applied. Therefore there is opportunity for projects involving thermal storage if innovation and other criteria are fulfilled by the applicants.

13.2.6 Scottish Community and Householder Renewables Initiative (SCHRI)

13.2.6.1 Aim and structure of the program

The SCHRI is a program offering grants, advice and project support aiming to enhance installations of community scale renewable projects, household renewables and to disseminate the role of renewable technologies and their benefits to Scotland.

It is funded by the Scottish Executive and managed jointly by the Energy Saving Trust and the Highlands and Islands Enterprise (HIE).

13.2.6.2 How does thermal storage fit with formulated areas of focus?

The thermal storage fits in this development and demonstration program as an integral part of the renewable technologies supported.

13.2.6.3 Who – how is decided which projects to support

“Applications for funding under Technical Assistance and Capital Grants are assessed against essential and desirable criteria. Larger capital projects may also be subject to independent technical assessment, prior to grant being offered”.

13.2.6.4 Key persons

The SCHRI Development officers, managed by EST and HIE, offer advice to the developers of community projects. Their main role is to promote the renewable projects and to inform about legislative parameters and funding. Installers and consultants for the projects are also recommended by the SCHRI, as they must fulfil certain requirements (set by the SCHRI) so as the quality of the projects to be ensured.

Janet Mackecknie, assistant manager of the program (01315557900).

13.2.6.5 Statistics of applications and supported projects on thermal storage

Such information is not provided by the program.

13.2.6.6 How is the attitude towards more focus on thermal storage in the program?

There is currently no specific attitude towards thermal storage. A valuable input from PREHEAT might be to propose a separate strategy of thermal storage

13.2.6.7 Trends, future changes and/or new programs coming up?

Not known.

13.2.6.8 Guide for applicants.

Information about the grants is provided by the website (http://www.est.org.uk/schri/). For applications and other enquiries the freephone of the SCHRI Hotline is given (0800 138 8858).

13.2.6.9 Can the program be used for dissemination of information about thermal storage?

The program is supported by a website which provides explanation of the supported technologies and presentation of case studies. Therefore there is a potential of disseminating findings of the involved technologies.

13.2.6.10 Conclusions about the present state of support and the resulting impact of the programs for different thermal storage techniques

There are no direct references on thermal storage installations. GSHP and solar water heating systems are described but no analytical data about stores is provided.

13.2.6.11 Conclusions and recommendations about more focus in the programs on storage and different storage techniques

Thermal storage coexists with the supported technologies but its role and potential aren't totally recognized within the SCHRI program. It could be discussed with both the EST and the HIE if a separate strategy for thermal storage could be formed within the program.

13.3 British policies relevant for thermal storages

13.3.1 The UK Climate Change program

13.3.1.1 General

The climate change program describes the UK plan and the ways of cooperating with other countries to tackle the Climate Change problem.

The Climate change program which was firstly launched in November 2000 was recently reviewed for a second time and the new version was published on 28 March 2006. The project was undertaken by the Reducing UK Emissions workstream of the Sustainable Energy Policy Network and was assisted by interdepartmental groups.

13.3.1.2 In which respect is the policy relevant for thermal storage.

Among the main strategies included in the revised version of the UKCCP, two of them, mentioned among the energy-supply-measures, are of particular importance for the

thermal storage; those about microgeneration, CHP and biomass. In addition thermal storage fits with the strategy for the domestic sector, as the energy efficiency and the reduction of carbon emissions are the main goal there.

13.3.1.3 Key persons

Chris Leigh, DEFRA Official

13.3.1.4 How is the attitude towards more focus on thermal storage in the policy?

There is currently no specific attitude towards thermal storage A possible input from PREHEAT could be to propose a separate strategy for thermal storage within the renewable technologies' sector, although the high level nature of the programme means this may not be possible.

13.3.1.5 Are there future changes in the policies and/or new policies coming up?

The Energy Review is responsible for recognising the need for further action and for finding new solutions to achieve future goals. It will therefore report to the Prime Minister and the Secretary of State of Trade and Industry by the summer 2006. There are several new ideas which are considered and the Government's commitment of frequent reviewing of the program can help on identifying and including additional ones for further carbon savings. PREHEAT might possibly play an important role on the integration of thermal storage in the overall strategy of the UKCCP.

13.3.1.6 Can the policy be used for dissemination of information about thermal storage?

No.

13.3.1.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

Currently thermal storage technologies are not mentioned in the policy. It is essential that the role and the great potential of thermal storage is identified in future revisions to the UKCCP as this would ensure further applications and dissemination of the technology within other, more specialized strategies and programs.

13.3.2 Energy Efficiency commitment

13.3.2.1 General

The EEC is addressed to energy (gas and electricity) suppliers and it promotes improvements in the energy efficiency of dwellings, aiming at reducing carbon emissions and assisting the governmental strategy of tackling fuel poverty. The second phase of the EEC lasts until the 31st of March of 2008 (initiated the 1st of April 2005).

The EEC is administered by the OFGEM.

13.3.2.2 In which respect is the policy relevant for thermal storage.

The policy doesn't refer to thermal storage in particular. The latest review of the suppliers, published in May 2006 reveals the progress already achieved during the first year of the EEC2. The highest contribution to the savings is done by the insulation measures, and this is because such quite standardized measures were approved earlier than others more innovative ones. The heating category had contributed for 3% of the total savings, mostly due to boilers and controls installed but also because of some GSHP and community projects implemented. Since GSHP and community projects using renewables sometimes include thermal storage installations, it is assumed that the policy enhances slightly the use of thermal storage techniques.

13.3.2.3 Key persons

Charles Hargreaves, Ofgem Head of Energy Efficiency Commitment.
Peter Iles, Technical Advisor to the EEC programme

13.3.2.4 How is the attitude towards more focus on thermal storage in the policy?

There is no particular attitude towards thermal storage. This might be influenced through PREHEAT.

13.3.2.5 Are there future changes in the policies and/or new policies coming up?

A third phase of the EEC will start in 2008 and will last until 2011. This March a two-day workshop was conducted to discuss the content of EEC3. One of the main issues which was mentioned was the intention to increase flexibility and innovation. DEFRA plans to review the EEC before 2007 in order to set the EEC strategy for 2008-2011.

13.3.2.6 Can the policy be used for dissemination of information about thermal storage?

Dissemination of technology information can be achieved through the reviews prepared by the suppliers 4 times per year and published on the website, or through the Ofgem publications. It should mention though that the identification of the benefits of thermal storage applications on energy conservation and carbon reductions would be a difficult task compared with other conventional technologies.

13.3.2.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It is recommended that PREHEAT should encourage the development of a strategy for thermal storage within the EEC 3.

13.3.3 Microgeneration Strategy

13.3.3.1 General

The microgeneration strategy was launched this March and its main objective is “to create conditions under which microgeneration becomes a realistic alternative or supplementary energy generation source for the householder, for the community and for small businesses”.

The strategy is administered by the DTI.

13.3.3.2 In which respect is the policy relevant for thermal storage.

It is apparent that a strategy which aims to commercially promote microgeneration technologies must take into account thermal storage. There are no direct references to thermal storage installations within the strategy. Thermal storage is mentioned there only as part of the solar water heating collectors. Although the other types of microgeneration technologies (CHP, GSHP and biomass) which are mentioned in the strategy can be also related to thermal storage, the thermal storage’s role is not visible elsewhere in the documentation.

13.3.3.3 Key persons

Rachel Crisp, DTI Official.

13.3.3.4 How is the attitude towards more focus on thermal storage in the policy?

There is currently no specific attitude towards thermal storage. A valuable input from PREHEAT could be to underline the role of thermal storage for the microgeneration technologies.

13.3.3.5 Are there future changes in the policies and/or new policies coming up?

The documentation mentions the DTI’s intention to create a route-mapping of the technologies. Thermal storage could benefit from that opportunity and PREHEAT might play a role in that.

13.3.3.6 Can the policy be used for dissemination of information about thermal storage?

The documentation of the strategy provides very useful information on the current state of the microgeneration technologies in the U.K., such as market analysis and manufacturers, funding potential (via national programs) and R&D related to the issue. Since the Microgeneration Strategy’s main role is to examine and underline the potential of the microgeneration technologies and to identify the ways of promoting them, there are opportunities of disseminating the information about thermal storage.

13.3.3.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It is essential that the thermal storage technologies are recognized as an integral part of the microgeneration and are included in the strategy. This is an issue worth raising with the DTI.

13.3.4 Biomass Task Force – Action Plan (the government's response)

13.3.4.1 General

On the 27th of March the Government (by ministers of DEFRA and DTI) launched an action plan to promote the exploitation of biomass for renewable energy, in response to the Biomass Task Force recommendations. The governmental strategy accepts the heating potential and identifies also the great importance of combining biomass and CHP in the future (apart from the dedicated electricity generation from biomass). The published plan constitutes a response to the Biomass Task Force proposals and sets an initial strategy which includes funding and cooperation with other programs. One of the future targets is the development of standards for biomass with aim to increase the efficiency of the systems.

Currently the action plan concerns only England.

13.3.4.2 In which respect is the policy relevant for thermal storage.

The efficiency of the Biomass technology is partially dependent on the thermal storage, as the heating demand fluctuates with time and storage can help smooth this.

13.3.4.3 Key persons

David Clayton, DEFRA Official
How is the attitude towards more focus on thermal storage in the policy?

There is no attitude towards thermal storage in particular. The strategy supports both the biomass heat and the CHP(future potential) and it is indirectly related to thermal storage.

13.3.4.4 Are there future changes in the policies and/or new policies coming up?

The funding program is expected to open for applications around the end of 2006 (subject to receiving the necessary State Aid clearances). The documentation underlines that they will "consult on the detailed design of the scheme to ensure that its aims and objectives complement those of the LCBP and to streamline administration".

Within the following year the strategy for Wales, Scotland and Northern Ireland will be announced. The program is also committed to analyze further, along with the stakeholders involved, the long-term biomass support during the following year.

13.3.4.5 Can the policy be used for dissemination of information about thermal storage?

Unlikely

13.3.4.6 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It should be discussed with DTI and DEFRA to ensure that the role of thermal storage is understood and underlined as an integral part of highly efficient biomass installations. The same applies for the development of standards for biomass which is planned within the action plan.

13.3.5 Energy Review Consultation

13.3.5.1 General

The 14th of April 2006 was the deadline for the consultation period for the Energy Review. The DTI aimed to collect proposals on the "medium and long-term energy policy issues". The summary of the responses will be published and the statement on energy policy will be announced in the summer.

13.3.5.2 In which respect is the policy relevant for thermal storage.

Thermal storage is not referred to in the consultation paper but its role can be identified in the CHP and micro-heat technologies (GSHP, thermal solar and biomass) which are included in the heating measures. The paper touches on thermal storage when it mentions the collection of the waste heat from the electricity generation for use in place of gas or other energy forms by CHP plants. It doesn't though explain it further.

13.3.5.3 Key persons

Paul McIntyre, DTI Official

13.3.5.4 How is the attitude towards more focus on thermal storage in the policy?

There is no attitude towards thermal storage in particular.

13.3.5.5 Are there future changes in the policies and/or new policies coming up?

A statement on energy policy will be made in early summer.

13.3.5.6 Can the policy be used for dissemination of information about thermal storage?

No.

13.3.5.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

The Energy review is of particular importance for the support of thermal storage, because it will shape policies for both the energy demand and supply for the medium and long term. Including thermal storage in the Energy Review can only be done indirectly though, possibly through other interrelated programs and the DTI, as the consultation period has finished.

13.3.6 Planning Policy Statement 22

13.3.6.1 General

The PPS22 is the governmental policy framework to be implemented in new planning strategies and local development documents. It aims to necessitate the use of renewable energy in development strategies of small or large scale projects, when it concerns new buildings or refurbishment of old ones and make it feasible in designated sites, with the appropriate protection measures and the inclusion of economic and social criteria in each case. A review was published in June 06.

The PPS22 is overseen by the Department for Communites and Local Government (DCLG).

13.3.6.2 In which respect is the policy relevant for thermal storage.

The strategy supports the renewable resources which are related to thermal storage technologies.

13.3.6.3 Key persons

Joan Bailey, Department for Communities and Local Government Official

13.3.6.4 How is the attitude towards more focus on thermal storage in the policy?

There is no specific attitude towards thermal storage in particular.

13.3.6.5 Are there future changes in the policies and/or new policies coming up?

Not known.

13.3.6.6 Can the policy be used for dissemination of information about thermal storage?

There is dissemination of information through the companion guide which includes technological details and good practice guidance for the renewables. Thermal storage is mentioned there only as part of the solar collectors' systems.

13.3.6.7 Conclusions and recommendations about more focus in the policy on storage and different storage techniques

It should be investigated whether the policy is going to be revised in the future, so that there could be more focus on thermal storage.

13.4 British regulations relevant for thermal storages.

13.4.1 Building regulations Part L

The part L of the British Building regulations addresses the “Conservation of Fuel and power” issue. This is the only category (in total 14 parts of the Building Regulations) of relevance to the thermal storage.

The following approved documents are providing practical guidance for compliance with the regulations:

- Approved document L1 (set out in L1a and L1b)- for domestic buildings
- Approved document L2 (set out in L2a and L2b)- for non domestic buildings

The National Calculation methodology adopted two methods of calculating the energy performance of buildings; the SAP 2005 specification/worksheet for dwellings (the calculation should be carried out using a computer program that implements the worksheet and is approved for SAP calculations) and the SBEM software for non-domestic buildings (it is the simplified tool, two accredited simulation programs are also available) . They can be used to prove compliance with the buildings regulations.

DCLG is responsible for Building Regulations.

13.4.1.1 In which respect is the regulation relevant for thermal storage ?

No big influence is imposed by the regulations themselves or by the approved documents. The energy Calculation methods are of particular importance though, as they can give an estimation of the impact of the technologies on energy conservation.

Domestic: The SAP 2005 calculation can deal with thermal storage (regarding water tanks) assigned for water and space heating, taking also into account the thermal losses. The values can be calculated, but if that is not possible tables are provided. Therefore it is estimated that the guidance provided by the Part L1 helps understanding the benefits of the use of thermal storage in water and heating systems in dwellings as far as it concerns the conventional types of thermal storage. PCMs or thermochemical storage and applications of thermal storage for cooling are not covered by the SAP 2005 (the SAP doesn’t deal with energy for cooling in general).

Non domestic: Only hot water systems which incorporate hot water storage are analyzed by the documents. No further reference to the thermal storage is given.
The calculation software SBEM doesn’t assist in understanding certain benefits of potential thermal storage applications. The thermal conductivity of the building elements is analytically calculated but when it comes to thermal storage, only integration with the DHW system is possible. A storage system can be connected to the DHW generator and a value for the thermal losses of the vessel can be included in the calculation. The Solar Energy Systems can be linked with the DHW generator (so that the energy savings to be calculated) but not with a heat store

13.4.1.2 Key persons

Ted King (DCLG Official),
Bryan Anderson BRE (SAP 2005)
Steve Irvin, Technical Advisor to DCLG

Jose Ortiz BRE (SBEM)

13.4.1.3 Are there future changes in the regulation and/or new regulations coming up?

The revision of the Part L of Building Regulations is scheduled for 2010 and a new SAP calculation method will also be available then. A review of the SAP 2005 is expected to be released in 2007.

The SBEM is reviewed regularly (it is an intention of DCLG to update it 2-3 times per year).

13.4.1.4 Can the regulation be used for dissemination of information about thermal storage?

No.

13.4.1.5 Conclusions and recommendations about modifications in regulations that will ease beneficial use of thermal storage techniques

It is important that thermal storage applications are included in the guidance and calculation methods for non domestic buildings so that the energy savings can be understood and estimated. The BRE team responsible for the SBEM identifies the need for including the thermal storage in the calculation method.

There is currently no change concerning thermal storage expected in the revision of SAP in 2006. It is something that PREHEAT could possibly promote, so that other aspects of thermal storage are taken into account.

Appendix A Interviews (Germany)

English summary of the interview with Mr. Mangold from Solites

The interviewed person is one of the key persons in Germany for large heat storage systems.

As a new point of view heat storage systems are (in the opinion of the interviewed person) widely-used.
There is a heat storage in every house if you think about domestic hot water tanks

Successful installations are mainly large heat storage systems. At the small scale Jenny (CH) and Consolar (www.consolar.de) are successful implementations.

In contrast to our previous motivations there are no political or bureaucratic but existing technical barriers, like high water return temperatures and practical barriers like the volume of the storage systems. This is not a matter of storage density, but in practical of installing this storage in an existing house, e.g. a cellar without ripping the doors.

Another barrier is the expensive investment costs.

There is no need for another regulation or policy and there are enough supporting programs, in fact the technical problems have to be solved first. If the problems are solved, the market will be opened through reduction of the costs/price.

Future developments are large storage systems because the proportion of investment costs per kWh stored energy are really good for these systems and not comparable for small scale systems.

Actual market number for this segment is one system per year, but these systems are still pilot plants. If the technical problems can be overcome, there are promising prospects for heat storage on all scales.

In the opinion of the interviewed person, there is no need for increasing the awareness of heat storage technologies. The storage system is simply „ a mean to the an end“, or better a classical enabler technology.

First you have to choose your preferd heating installation. Then there will be several technical realisations which will include unavoidable some storage system.

WP2 Fragebogen für Interview :

bürokratisch
Zunächst kurze Vorstellung, PreHEAT ,

- ein EU Projekt das sich zum Ziel gesetzt hat die Aufmerksamkeit und Förderung der Entwicklung und Forschung von Wärmespeichertechnologien zu erhöhen. Begleitend hierzu wird versucht das Bewusstsein und das Wissen von politischen Akteuren (,,policy makers'') und Entscheidungsträgern (,,decision makers'') zu stärken in Bezug auf das ökonomische und ökologische Potential der Wärmespeichertechnologien. In größeren Zeitraum zielt das Projekt auf Europäische Förderprogramme mit einem Gesamtansatz in Forschung, Industrie und Markt ab, mit dem Ziel einer rationellen Energienutzung.
- Der Ansatz des Projektes ist hierbei eine Referenz

Fragen :
bürokratisch

1. Ist Ihrer Meinung nach Wärmespeicherung viel oder wenig verbreitet ? Welche Gründe und Tatsachen führt Sie zu dieser Meinung ?

   Ja, da es in jedem Haus einen Trinkwasserspeicher gibt ! Einsatzzweck Heizung nur sehr geringe Verbreitung.

2. Welche Realisierungen gibt es bislang ? Können Sie ihrer Meinung nach gelungene Umsetzungen nennen ? Gibt es auch Fehlentwicklungen / Umsetzungen ?

   Erfolgreich sind die großen Speicher , da wesentlich günstiger. Für kleine Gebäude Kombispeicher. Erfolgreich hier Jenni, Consolar Speicher (www.consolar.de)

3. Gibt es praktische Barrieren ?
   a. Wie können diese ihrer Meinung nach gelöst werden ?

      Zu hohe Rücklauftemperatur aus dem Heiznetz
      Zu hohe Speichervolumen, genauer : ,, Ich muss den Speicher durch die Türe bekommen, das kann man entweder durch eine Verkleinerung erreichen oder durch Zweiteilung ..“
      Zu hohe Investitionskosten

4. Oder gibt es bürokratische Barrieren ?

      nein

5. Ist eine Forcierung des Einsatzes von Wärmespeichern nötig ? Wenn ja: Wie könnte die Wärmespeicherung forciert werden ?

   a. Gibt es Förderprogramme ? *Ja*
   b. Fehlt es an Regularien oder Gesetzen ? *nein*
   c. Fehlt es an technischer Entwicklung, ist die Technik ausgereift?..*s.o.*

6. Was sind zukünftige Trends in der Wärmespeicherung ?
   a. technisch ?
   b. politisch ?
   c. wirtschaftlich ?

Zunächst muss eine technische Lösung der Probleme her, dann entwickelt sich das von alleine. Den Großteils des Marktes bekommt man durch eine Kostensenknung.

7. Wie sieht der aktuelle Markt für Wärmespeicherung aus ? Marktzahlen ?

   Trend zu grossen Speicher da insgesamt geringere Investionskosten.
   Momentan 1 Speicher pro Jahr

8. Wie sieht der zukünftige Markt für Wärmespeicherung aus ? Marktzahlen ?

   Am besten den Dachverband der Heizungsbauer befragen, wo die ganzen grossen Hersteller wie Viessman Buderus etc. zusammengeschlossen sind.

9. Welche Chancen räumen sie der Wärmespeicherung in der Zukunft ein ? Was muss zur Wahrnehmung dieser Chancen in dem Bereich passieren ? Technisch, politisch, wirtschaftlich...

   Gute Chancen wenn die technischen Probleme gelöst werden.

Weitere Stichpunkte aus dem Gespräch :

Er sieht keine Notwendigkeit für eine Erhöhung des Bewusstseins der Verbraucher.
Der Speicher ist letztlich nur ein Mittel zum Zweck. Wenn man sich für eine Heizungsart entschieden hat muss anschliessend die technische Umsetzung erfolgen und hier kommt zwangsläufig ein Speicher ins Spiel.
Das ist eine Grundsatzentscheidung.
Es gibt auch schon marktfähige Technik und in jedem Haus gibt es bereits einen grosssen Wärmespeicher (Trinkwasserspeicher)
Mögliche Entwicklungen Kombispeicher

Vielen Dank für das Gespräch !

Appendix B Interviews (The Netherlands)

	Name	Company name
1	Mr. Van Aarssen	IF-technology
2	Mr. Van Berkel	Entry technology
3	Mr. Buitenhuis	DWA
4	Mr. Van Dorp	Arcadis Bouw en Vastgoed bv/ TU-Delft
5	Mr. de Joode	Forteck
6	Mr. Maessen	Province of Noord-Brabant
7	Mr. Noordhoek	Ministry of Economic affairs
8	Mr. Smeeding	ECN
9	Mr. Wemmers	TNO
10	Mr. Witte	Groen Holland

Table A.1 Overview of interviewed persons (alphabetic order)

A.1 Report Mr. van Aarssen, IF Technology, 04-05-06

IF Technology is an independent consultancy company and works in the field of water, ground and energy. In 1989 IF Technology has been founded with the goal to develop and commercialize new technologies. IF Technology has extensive experience with the realization of energy storage systems, not only with low temperature (<25°C) groundwater systems, but also some high temperature groundwater systems have been realized by IF Technology (de Uithof at the University of Utrecht, De Bruggen in Zwammerdam and the 2 MWatt project in Haarlem).

Experiences with these pilot projects have shown that high temperature storage in aquifers (90°C water) is technically feasible. However, there are two aspects that are crucial for success:

1. the return temperature of the heating system, to which the storage system is linked to, has to be low enough. In practice this means that existing high temperature (90-70°C) heating systems are not suitable for a combination with high temperature heat storage, and new low temperature heating systems have to be used.
2. water treatment and chemical reactions in the aquifer require extra attention in the design and licence process for new projects. Possibly new water treatment methods have to be developed.

In the Netherlands low temperature groundwater systems (=ATES) are more common than high temperature groundwater systems. Therefore the juridical framework is mainly based on and designed for low temperature energy storage systems (e.g. thermal balance is required, temperatures may not exceed 25°C). As the high temperature groundwater systems do not fit within the juridical framework and as the authorities prefer to stay within the existing framework, it is difficult to get a licence for these high temperature stores. While, at the same time, the market asks for high temperature storage systems.

An example of a technology for which high temperature storage systems are preferred, is a CHP-plant. A CHP-plant generates heat and power at the same time, even when there's no heat demand. High temperature heat storage can save this energy (e.g. CHP-plants used for cultivation under glass[8]). So, while there is a demand for high temperature storage systems[9] there is no or limited legal framework for these systems. A legal

[8] The cultivators don't mind the type of system used, as long as the systems works technically well and is the cheapest possible solution.
[9] especially now energy prices have increased strongly

framework can be developed at provincial level (as the licences have to be granted by the provinces[10]) or at national level.

Another barrier for high temperature storage systems is the lack of financing available for market introduction. Therefore, the step from pilot projects (of which already a number have been realized) to a mature product is difficult to realize. Subsidies are mostly aimed at the research and development stadium and not at the stadium of market introduction. Programs should be developed to support feasibility studies for energy concepts with high temperature groundwater storage systems. In these feasibility studies the technical aspects, as well as the legal and economic possibilities can be investigated.

Some of the EU programs are developed to stimulated the development of promising technologies. But for a relatively small company, the costs and time needed to write a subsidy proposal is often a heavy burden. Especially since there is a high risk of getting the project not funded. IF Technology has been working on a study (together with other European partners) to realize, demonstrate and evaluate a project with high temperature systems in a closed loop system. The report has mainly a technical focus and is therefore less accessible for the most public officers. This is a pity, as it is very important that the public officers (that design the policies) see the saving potential of heat storage.

The conclusion might be that it is hard to get a permit for high temperature stores in the ground/groundwater and that the provinces and the state do not recognize the impact that high temperature groundwater storage may have on energy savings.

A.2 Report Mr. van Berkel, Entry Technology, 24-04-06

Entry Technology carries out research in the field of technical, financial and ecological feasibility of long term heat storage in the built environment.

The different heat storage systems can be divided in two categories: short term heat storage and long term heat storage. In order to be interesting for the market, a heat storage system should be:

- compact
- efficient
- acceptable prized

Examples of short term heat storage systems are found in 'solar domestic hot water systems' and close-in boilers. A major problem with these short term storage systems is that they are relatively large. More compact systems would be easier to place (especially in existing houses). In addition, storage efficiency plays a role, especially for very small stores. Long term storage at the level of individual houses can not easily be realized with water stores (too large and too inefficient). The search for more compact and more efficient residential stores has started long ago and is now emerging. First examples involve chemical (sorption) heat stores and heat pump coupled, underground heat stores.

The financial sources for development of a storage system, depend on the phase the development is in. Three phases have to be passed:

1. Innovative ("Proof of Concept") phase: often subsidies/ grants can be applied for support in this phase.
2. Further development is needed to bring concepts to the market, but often subsidies/ grants are hard to acquire and cover only a minor part of the development costs. For the market actors this phase is not yet interesting, so they are not very willing to financially support the activities in this phase.
3. The product is ready to be introduced at the market. Market partners are willing to invest.

[10] status in The Netherlands in the year 2006

The lack of investments during the phase of 'further development' (phase 2) forms a barrier. Another barrier is that the persons that decide about budgets don't necessarily have enough knowledge of the new technology, to see it in the proper perspective and to judge it in the right way. In addition, the importance of heat storage (in general) is not often enough realized. Heat storage is inevitable in utilizing more sustainable energy in an efficient and effective manner. This is true especially for sources that fluctuate strongly (e.g. solar energy).
With the (Dutch) declined interest for solar thermal systems, also attention for heat storage reduced. On the other hand, we must acknowledge that heat storage technologies have not shown the improvement that would significantly stimulate solar heat systems. This "missing link" is further addressed internationally.Within the framework of IEA SH&C task 32, good work has been done that will stimulate further development of heat stores and associated technologies, like solar heat systems.

Another technology that will become more effective due to heat storage is micro CHP. If heat cannot be stored, the working hours of the CHP will be determined by the heat demand of buildings. If heat can be stored, the working hours of the CHP will be determined by the demand for electricity. As the demand for electricity exists all year round, and the demand for heat is mainly concentrated in winter time, the CHP can run much more hours due to heat storage. Long term heat storage is possible, but it is important to implement this in an efficient and an effective way. (There is much more to say about this.) The IEA stimulates longterm heat storage (task 32).

A.3 Report Mr. Buitenhuis, DWA, 24-04-06

Heat storage can be divided in different types:

- thermal storage vs. chemical storage and
- small scale vs. large scale storage
- short time storages vs. long time storage
- high temperature storages vs. low temperature storage.

DWA is active on thermal storage (mainly large scale, long time, low temperature storage[11])
Large scale storage systems with low temperatures (8-25° C) usually are designed for the delivery of coldness. Heat delivery can be part of the project. For these type of systems little technical or juridical problems exist. The energy is stored in a sand layer containing natural groundwater, so called aquifers.

Under the present regulations, heat storage falls under the Grondwaterwet (Gww). This law registers how and by whom groundwater is used with the target to ensure that existing interests are not damaged. The present regulations will be changed soon. The Grondwaterwet will become part of a new Waterwet (Water Law). This new law focuses on water management in a more general way. From the energy storage viewpoint it would be necessary also to take into account in the new groundwater regulation the additional value of heat and cold storage, namely the use of sustainable energy/energy savings. As energy saving is considered very important in the different provinces, it is important that all provinces have a consistent policy with respect to energy storage in aquifers. This is not the case yet. Different provinces can have different requirements, which forms a barrier for building parties as they have to take into account the specific requirements for each project. Another barrier is that for some of the provinces rather extensive monitoring with performance indicators is required. Often, these data seem not to be analysed and it is not clear where these data are needed for.

It can be concluded that under the present Grondwaterwet (Gww) almost all projects get a licence, but it is not always as easy. For example, for small scaled projects the

[11] Low temperature storage means that the temperature in the different sources differ only a few degrees from the temperature of the soil (12°C).

procedure at the province takes too long (8 - 9 months). This period is much longer than the construction process of new buildings takes. Therefore it is recommended to reduce this period for small projects especially if it is proved that they meet standardized provincial guidelines.

In order to reduce the barriers that will exist under the new Waterwet, a juridical task group is formed out of members of the NVOE (Dutch Association for Storage and Energy, Nederlandse Vereniging voor Ondergrondse Energieopslagsystemen). This task group would like an Order in Council 'bodemenergie'. This Order in Council should be based on the Environmental Law (Wet Milieubeheer) and at the new Groundwater Law (Grondwaterwet). In practice it seems to be difficult to introduce the desired Order in Council, not at least because two different ministries are involved.

A certification system or a quality guarantee system doesn't exist yet. Therefore, low cost (and often low quality) systems can be realised without any quality control. Low quality systems may perform worse and influence the good image of the whole sector, so that the high quality companies suffer from the activities of a low quality companies.

It can be concluded that harmonisation of laws and regulations is important and also the introduction of quality guarantee is desired.

So far has been spoken about low temperature systems. If you want to use the heat that has been stored in the ground directly for heating (without using a heat pump), than higher storage temperatures (50 – 90°C) are required. For high temperature storage, both groundwater wells are much warmer than the natural soil (which is about 12°C). An example of a high temperature is that the warmest source is about 80-90°C and the coldest source is about 50°C. Problems with high temperature systems are partly on a technical and economical area. The system cannot any longer be constructed out of plastic piping but needs to be made out of stainless steel. The pumps, which are used, have to withstand high temperatures and groundwater treatment is necessary to avoid problems. Moreover heat losses are much higher due to the bigger temperature differences. For large scale projects with a favourable volume / surface ratio, losses will even be about 30%. For smaller projects the losses can be as high as 50%-60%. This will have consequences for the licences, which are harder to receive. Some high temperature heat storage projects have been realized, but no large introduction is expected in the Netherlands. Considering the heat losses, high temperature heat storage will only be feasible if the demand is large, like for large buildings, e.g. hospitals (floor of 40.000-50.000 m^2) and for greenhouses. For smaller projects heat losses become too large. Consequently, the market for high temperature heat storage in the ground is not very large in the Netherlands.

PCMs, Phase Changing Materials, can be used for small scale projects, e.g. to enlarge the thermal mass of walls in buildings. A disadvantage is that most PCMs, which have a melting point at about 20°C and that have been studied so far, are very flammable. Due to safety considerations, these materials cannot be used and further studies will be needed. Another problem with PCMs was that the stability could become a problem. After some time, the phase change doesn't take place at a certain small temperature range anymore, but the range broadens and a form of hysteresis takes place. This problem however has been strongly reduced in the last years.

At the moment, PCMs are not produced on a large scale, and therefore the costs are still high (10euro/kg-12euro/kg). Due to the high costs, the demand for PCMs stays small, while large scale production is needed in order to reduce production costs and prices. It would help if some pilot projects would be realised, to increase the scale of production, which will have a positively influence on the production costs.

In the (near) future buildings are expected to become more or less self sustainable, by applying a combination of solar collectors, heat storage (e.g. PCMs), very low-temperature heating systems and storage of winter cold for cooling purposes. Only pumping energy will be required, which can be supplied bij PV-panels.

It is expected that chemical storage becomes more important in the future, because it makes compact heat storage possible, and enables energy transport. For DWA, a company that's innovative in the application of heat storage systems, but which is not a research agency itself, chemical storage is still too much in a development phase. However, DWA has it's own ideas to realise heat storage in dwellings, without the need of PCMs.

A.4 Report Mr. Van Dorp, Arcadis Bouw en Vastgoed bv/ TU-Delft

Mr Van Dorp has first studied the characteristics of PCMs in 2001, as a student from the Technical University of Delft during an internship at Arcadis Bouw en Vastgoed bv, working for Mr. Harry Schmitz. At the moment Mr. Van Dorp is working for Arcadis Bouw en Vastgoed bv and is stationed at the Technical University of Delft (TUD) on a part-time base. Mr. Van Dorp works at Arcadis Bouw en Vastgoed bv as an advisor of climate installations in buildings and is a supervisor of students during their internship. Despite that Mr. Van Dorp is stationed at Arcadis Bouw en Vastgoed bv and despite the fact that Arcadis Bouw en Vastgoed bv is sponsoring the promotion research of Mr. Van Dorp, Mr. Van Dorp can act like an independent researcher, as Arcadis Bouw en Vastgoed bv has no financial interest in the products resulting as spin-off from the research on PCMs. Sometimes also other companies are cooperating in the research.

Main barrier for product development and marketing of PCMs are the financial aspects. These financial aspects make it difficult to compete with existing systems at current energy price levels.
There are three types of financial aspects:

1. research costs. At the moment research is performed in cooperation with the Technical University Delft (TUD), which is providing research facilities, and HunterDouglas, who is providing materials and constructions. The labour costs are paid by Arcadis Bouw en Vastgoed bv[12].
2. material costs. At the moment PCMs are too expensive to be economically feasible The simple payback time is with the present energy prices, in the most cases more than 10 year. Due to high material prices associated with start-up costs and current lack of scale, it is difficult to compete with existing technologies. Consequence is that the demand will stay low and there won't be any economies of scale. Subsidies will not solve this problem, as these lead only to a temporary cost reduction. However, subsidy will increase the familiarity and acceptance of the technology as a real climate control solution, as more systems are installed and used outside of the laboratory.
3. testing costs before market introduction. PCMs are only allowed to be introduced in the market after extensive (safety) testing. This testing is needed to prove that the material fits the standard for e.g. fire regulations and toxic effects. This extra testing will lead to delay of market introduction and will lead to additional costs for testing, despite the fact that the PCMs under consideration are based on non-toxic and non-flammable components

Research costs can be reduced by market actors sponsoring research. A disadvantage of sponsors is that they claim property rights and secrecy of the results, or just quit. On the other hand the published results of research for sponsors are usually not specific enough, not enough adjusted to practical use, and/or too superficial to analyze the specific aspects of technology (like the non-linear components of thermal behavior during phase

[12] As the use of PCMs in office buildings will be cheaper than in dwellings, the focus of the research is at office buildings.

change). In addition, the suppliers of PCMs prefer that the research costs are paid by the users, and the other way round. Another barrier is that the market parties usually expect that the TUD (Technical University Delft) or other research institutions will bring the money, which is not possible or only limited possible, as the universities usually don't have the very large budget that is needed for full scale demonstration of the technology.

Another barrier for PCMs is that their image is not so good, because of bungling companies in the past. The expected performance of PCM systems were sometimes depicted wrong (too optimistic) which has lead to the delivery of malfunctioning products. Because of the moderate economic value of a well functioning PCM system, systems were often downsized to cut investment costs. With all unfavorable consequences like insufficient cooling power as a result, leading to poor performance.

The use of PCMs is more complex than the use of conventional technologies, as the good functioning of PCMs depends on natural building dynamics of a building. Conventional technologies work opposite of the natural dynamics of a building (cooling during daytime and heating during nighttime) and are therefore easier to control.

Further Mr. Van Dorp names a number of advantages of PCMs.

1. PCMs function by storing superfluous heat during daytime and let this heat flow during nighttime. PCMs can thus be considered as cooling systems for buildings[13].
2. PCM creates (in contradiction to other 'active' technologies) the opportunity to construct very energy efficient buildings. In these buildings cooling by cooling machines is not longer needed to realize a comfortable inside climate during summer. Instead, free nighttime cooling of the PCM for daytime use will be sufficient. This will lead to large energy savings while providing the same comfort level.
3. PCMs can be used to improve the inhouse climate in existing (office) buildings, without the need for moving.
4. PCMs work in combination with conventional ventilation technologies, heat recovery systems and control systems. PCMs cannot replace these technologies. This is both a disadvantage (no elimination of the number of required technologies) as an advantage: as PCMs are not competing with installation technologies, PCMs are not a (too) big threat for the existing installation market.

A.5 Report Mr. De Joode, Forteck Energie Systemen

Mr. De Joode works for Forteck Energie Systemen, a civil contractor. Within Forteck Energie Systemen experience exists with heat storage in the ground. One of the barriers for these systems, is that laws and regulations are interpreted in different ways by different provinces. While there is only one Grondwaterwet (Ground water law), different conditions are set for drilling depths, capacities of storage systems and how to apply for a licence. Therefore a system might be feasible in one province, whereas the same system won't get a licence in an other province.

Another barrier is the financing. A traditional heating and cooling system (heating on gas, cooling with an airco system on electricity) often is realized by the end user/ lessor. The project developer doesn't have to pay for the system. In case of heat storage in the ground, the heating and cooling system need to be realized (before or) at the same time as the building. One can speak about an integrated project. Realizing of and investment

[13] It is also possible to use PCMs for heating, but this option is financially less attractive as the elimination of conventional installations is hardly possible. Consequently, in the case PCMs are used for heating, little or no reduction of investment costs will be possible.

in the system afterwards is not possible. The project developer has to make investments on beforehand. The only way to get his money back, is by raising the rent. But he's not sure if somebody will be willing to pay a higher rent. Questions that will exist are: Who pays what? Who pays back whom? Who will invest at what time? The only way to realize energy storage systems, is to bring the different parties together in the beginning of the construction process. E.g. introduce an energy company or third parties that invest in the energy storage system and that will manage it later on. In this case, a separate bill will be present for the energy use and for the higher investment in the beginning of the construction period.

In the case of a housing association it seems easier to realize heat storage systems. Housing association are often used to handle from a long term perspective (so, long payback times are accepted). But the barrier here is that housing associations are not allowed to perform like an energy supplier.

So, for heat storage systems in the ground there are two major barriers:
1. interpretation of the law and regulations
2. investment/ financing of the system

PCMs don't lead to many technical barriers anymore. But PCMs are still expensive, and therefore they are expected only to be used in the industry for high temperature energy storage. There will be an enormous potential. But to realize this potential subsidies and pilot projects might be needed.

A.6 Report Mr. Maessen, Province of Noord-Brabant

Mr. Maessen works for the Province of Noord-Brabant. He's (together with his colleagues) responsible for attributing licences for heat storage systems in the ground. When somebody is planning to realize an open-source heat storage system, first a preliminary consultation will take place. In this consultation, information is asked about the planned heat storage system (what? where? how? Etc) and information is provided about the conditions for heat storage. In this preliminary consultation it often already becomes clear if the system fits within the boundary conditions defined by the Province. If this is not the case, usually the procedure will not be continued. If the system fits within the boundary conditions, the initiative taker(s) can apply for a permit.

Under some conditions heat storage systems are prohibited. This is the case in:
- ground water protection areas and groundwater protection areas around wells for drinking water production
- functional areas which are wet nature pearls and up to a distance of 500 m of these wet pearls
- bird and habitat directives areas (EU regulation)
- depths of more than 80 meters. At these depths there are water containing layers that are important for the exploitation of drinking water. This rule is valid for the whole province, no discussion is possible.

Within the Province a high value has been ascribed to energy storage sytems. But the highest priority will always go to the exploitation of drinking water or water which is used for human consumption (e.g. used by the Breweries of Bavaria and Heineken).

Heat storage systems with a capacity smaller than 10m^3/hour and with a maximum depth of 30 meters don't need a permit (this is arranged in the Grondwaterwet)

The Province undertakes different actions to control if the heat storage system works within the boundary conditions:
- drilling reports are checked
- a controller may visit the location during the drilling activities
- reports are needed about the amount of heat added and heat subtracted.

- If the heat storage system is positioned near functional areas or if the effects are stretching out into such an area the boundary conditions can be expanded.

Preservation is mainly preventive. Only once repressive preservation was required. Preservation is only possible if the initiative taker applies for a permit. The Province suspects that some of the initiative takers don't apply for a permit, whereas a permit is needed (e.g. at depths less than 30 meter but with a capacity higher than 10m^3/hour). It is difficult to undertake action against these initiatives, as it is often not known that they are realized.

The Province of Noord-Brabant realizes that rules of their Province are different from that of other Provinces. To make the rules more similar between all the Provinces, a working group IPO (InterProvinciaal Overlegorgaan), with representatives from different provinces, has deliberated.
The aim was to define the same boundary conditions and the same rules for small heat storage systems in all provinces. The project has nearly been finished. The results have to be proposed to the other provinces. Provinces cannot be forced to implement the recommendations, but they can be adviced to use them as a guide. It is expected that the results of the IPO will be published soon.

For the bigger systems it is difficult to define general rules for all provinces, as the boundary conditions often depend on the local situation. Like explained before, in Noord-Brabant drilling up to a maximum depth of 80 m is allowed. In e.g. Noord-Holland heat storage systems are preferred to be realized at depths of more than 80 m. In this case the heat storage will take place in layers with salt water, and will therefore not influence the winning of drinking water.

A recommendation from Mr. Maessen: 'Take care that the system after realization falls under the responsibility of one person. If knowbody feels responsible, the system might not work correctly and costs can become higher than savings (e.g. in Breda)'.

In the Province of Noord-Brabant all persons that are responsible for attributing licences have a technical background. The license are always checked by a jurist so that the license operates within the law. An assistance, who has a different background, is now following a course to learn all the required aspects of heat storage.

A.7 Report Mr. Noordhoek, Ministry of Economic Affairs

Mr. Noordhoek reports three actions related to heat storage in aquifers.

The Dutch government is considering to set a stricter standard (EPN) for utility builings[14], which will promote the use of different energy saving measures. A stricter standard should thus be favourable for heat storage in aquifers, but the opponents argue that the stricter standard can ónly be realized by using heat pumps in combination with storage in aquifers, or air to air heatpumps. If this is true, this provides arguments against a stricter standard for several reasons:
The time required for applying for a permit for open system heatpumps[15] is pretty long (about half a year).

[14] For both, the residential and the service sector, the Energy Performance Standard (EPN) has been implemented in the Netherlands in 1995. This standard enables calculation of the integral energy performance of a new building and consists of a standardised method for the calculation of an energy performance coefficient (EPC). This is a theoretical value for the primary energy use, taking into account the size and type of the building and the energy conservation measures. It does not focus on the quality of individual components. The reason behind this was to minimise costs and to maximise energy saving potential.

[15] Open system heatpumps pump up groundwater and reinfiltrate it at a later stage. For soil and groundwater protection laws this is a different situation from closed system heatpumps, which use a heat transport fluid and leave groundwater in place.

Not in every region is heat storage in aquifers possible, this might be due to the absence of aquifers, the presence of a ground water protection area or the presence of other heat storage systems. If systems are realized too close in each other's vicinity, the stores will get disturbed due to heat exchange.
If use of energy storage in aquifers is not always a possibility, for some buildings that would leave only air to air het pumps as a means to satisfy the regulations. Opponents argue that this would be in contradiction with one of the characteristics of the EPN; the owner of the building has the freedom to choose himself hów to fit the norm.

At the moment SenterNovem is studying whether a stricter standard can indeed ónly be realized by using heat storage in aquifers. The governement studies on actions to make the proces for obtaining licence more accesible.

Different provinces have at the moment different requirements for licences. An EPN-commission (of the Ministry of Housing, Spatial Planning and the Environment) is studying how to solve this problem and how to establish the same requirements for all provinces)

The proper functioning of a heat pump system does not only depend on the heat pump itself. Other components of the system are critical as well, as is the way in which the components are integrated into a system. At the moment a quality mark exists for heat pumps. But there's not yet a quality mark for complete heat pump systems. Since the whole heat pump market would suffer badly from the publicity around failing heat pump systems the introduction of such a quality mark is studied and might be introduced for the Dutch market.

A.8 Report Mr. Smeeding, ECN

Energy storage is needed to create a (more of less) sustainable society. E.g. if there's heat demand while it is already dark, solar thermal energy can – in case of heat storage - still be used. In other words, energy storage can solve the problem of insimultaneity between demand and supply. To develop a storage medium, with a high capacity and with low costs, 'continuity in the research program' is very important. In the policy there has recently come more attention for micro CHP, solar collectors, heat pumps and fuel cells. These technologies work the most efficient, when the base load is low. Providing hot water will be possible by creating a buffer for warm water.

In the period 1997-1999, the department Energy Efficiency in the Industry (ECN) has examined the characteristics of heat storage. To become successful, the heat storage system should be cheap and efficient. The research was focused on heat storage in a huge rubber bag containing water. Tests were carried out in special test dwellings of ECN and the demand and supply have been simulated with 15 minutes intervals. The research was partially financed by EnergieNed. When the financing by EnergieNed reduced, the attention for heat storage declined and no choices have been made on which heat storage methodology the focus of research should be; the continuity of the research was at hazard.

In 2005, initiatives were taken to start up research for storage of heat at temperatures higher than 100°C. Also the research of low temperature storage got a new impuls recently. High temperature heat storage is especially useful for industrial use. In one of the studies realized by ECN the feasibility of high temperature storage was calculated. The simple payback time of high temperature stores is – in existing industries – more than the accepted payback time of 2-3 years. For new industrial complexes, simple payback times can be 2 or 3 years. Therefore, for existing industries, further research is needed to find out how the storage can be realized more efficient and/or cheaper. A disadvantage of industrial application of heat storage, is that the total number of stores are restricted (so there won't be economies of scale like there are for boilers in dwellings).

Another way to introduce high temperature heat storage in existing industries, is by forcing it by law.

Industries in general want to get rid of their heat, e.g. by chemical processes high temperature heat must often be carried off to optimize the process. To cool the process, large heat exchanger will be needed. Another option is to transport the superfluous heat to companies in the vicinity, which have a heat demand. Heat buffers will be needed between the two companies. In the service sector in general longer payback times will be accepted than in industry. In offices not much heat is needed (except some heat for warming water). Heat storage can take place by increasing the mass of the of the building (and provide it with good insulation).

Suggestions of Mr. Smeeding to increase the role of heat storage:

1. develop a compact water heat store
2. heat store should be an explicit part of the transition programme
3. money and time must be available to concentrate on heat storage.

A.9 Report Mr. Wemmers, TNO

Mr Wemmers carries out research in the field of long term heat storage by chemical bonds, based on a suspension of a hydrate. Due to chemical bonds, a storage medium is created that can be pumped to different places and that has favorable thermodynamic properties. This type of heat storage is called 'thermo-chemical heat storage' and makes it possible to combine heat storage, heating and cooling in one system.

The importance of long-term heat storage will increase if, in the future, renewable energy forms a larger share of the total energy consumption. To match energy demand and supply, long-term heat storage systems will be needed, which have a high energy density and no or little energy losses. Thermo-chemical heat storage is one of the technologies that fits these requirements and therefore can be used to bridge time differences between heat supply and demand.

Before chemical heat storage (which is nowadays still in an early research phase) can be used in every day practice, extensive research will be needed. Recently a project, which will be evaluated in December 2006, has started with financial support of the EOS program. Unfortunately, there is no permanently available research budget in the Netherlands. As a consequence, the intensity of energy research fluctuates like the available research budget. To stimulate the development of thermo chemical heat storage, research budget should be available on a more constant base.

It should be noticed that renewable energy technologies can only succeed in an energy system that is far less energy intensive than our current, fossil fuel based system. To get a rough idea: the energy intensity should be 5 to 10 times less than our current energy intensity. To achieve such massive reductions equal research efforts for improved energy efficiency and system integration are necessary as for the development of renewable energy technologies. For policy makers without a technical background, it is difficult to get a good overview of all aspects of such an integral approach to the energy system.

The importance of long term heat storage can only be noticed, if the focus is no longer on individual technologies or individual energy carriers, but on the total integral energy system. Thus, the focus should be both on heat supply and demand and on electricity supply and demand.

A.10 Report Mr. Witte Groenholland, 21-04-06

Groenholland is a company that has an extensive knowledge in the field of underground sources, which can be used for the delivery of heat or cold, in the residential sector and the service sector.

Groenholland only designs and installs closed-loop heat exchanger systems for the withdrawal of heat or cold from the ground. For these closed-loop systems no licence is needed. Studies are being performed at this moment, to find out what the effect of regulation can be. Mr. Witte and his colleagues consider regulation as very useful, as regulation makes it possible to see the difference between low quality and high quality systems.

At this moment the application of borehole heat exchangers is not any longer considered to be a niche market where clients are technically well informed. As more actors try to make money out of it, some of them compete on price only (without regarding the quality).

Some of the cheap systems don't function well, both from a technical (durability, maintainance) as from a thermal perspective (temperature levels that directly affect the performance of the system). As customers usually have limited experience with and knowledge of these systems, the decision is often mainly based on costs. The risk of competition on cost (low quality systems) is especially present in the residential sector. Different certifying initiatives have been introduced. But it would be better if there would be a international, obligatory certifying system.

Mr de Witte further recommends to design a good juridical framework. He's not sure wether this can be realised on a international scale, as circumstandces differ much form country to country, both technically and politically.

Appendix C Statistics (The Netherlands)

year	avoided energy	avoided emissions	collector surface
	TJ prim/jaar	kton	1000 m²
1990	73	4	76
1991	86	5	87
1992	102	6	105
1993	119	7	119
1994	140	8	139
1995	167	9	162
1996	200	11	187
1997	251	14	224
1998	302	17	264
1999	362	20	310
2000	421	23	360
2001	490	27	416
2002	563	31	475
2003	626	35	524
2004	698	39	582
2005	750	42	621

Table B.1 Solar thermic systems in the Netherlands [14]

year	avoided energy	avoided CO2 emissions	number of installations	collector surface	additional number of installations
	TJ prim/jaar	kton	absolute	1000m2	absolute
1990	11	1	2129	6	544
1991	21	1	3944	11	1815
1992	29	2	6079	18	2135
1993	38	2	7981	24	1914
1994	50	3	10481	32	2505
1995	66	4	13804	43	3375
1996	90	5	18175	57	4495
1997	129	7	25859	78	7917
1998	163	9	33059	98	7526
1999	207	11	41482	123	8565
2000	248	14	49269	147	7971
2001	295	16	57879	174	8736
2002	346	19	67674	201	10035
2003	388	21	75934	225	8385
2004	428	24	83529	245	7844
2005	464	26	90453	262	7468

Table B.2 Solar thermal, covered collectors <6m^2 [14]

	avoided energy	avoided CO2 emissions	realized collector surface
year	TJ	kton	1000m^2
1990	16	1	11
1991	17	1	11
1992	17	1	11
1993	21	1	13
1994	24	1	15
1995	28	2	16
1996	31	2	18
1997	37	2	21
1998	43	2	24
1999	47	3	26
2000	50	3	28
2001	56	3	30
2002	62	3	36
2003	69	4	40
2004	79	4	44
2005	83	5	46

Table B.3 solar thermal, covered collectors> 6m^2 [14]

year	avoided	avoided emissions	realised capacity	number	additional capacity	addional number
	TJ	kton	MWth	absolute	MWth/year	absolute/year
1995	73	2	24	1970	2	74
1996	87	3	28	2156	3	186
1997	139	4	43	3851	15	1695
1998	210	6	61	5716	18	1865
1999	287	8	86	7409	25	1693
2000	380	10	116	9327	30	1918
2001	439	10	141	11151	25	1824
2002	539	13	170	15368	29	4217
2003	702	15	225	20051	55	4683
2004	944	22	295	25431	70	5380
2005	1207	29	375	30835	84	5783

Table B.4 Number of heat pumps in the Netherlands [14]

year	avoided	avoided emissions	realised capacity	number
	TJ	kton	MWth	absolute
1990	6	0	2	5
1991	6	0	3	7
1992	6	0	5	8
1993	18	1	11	15
1994	23	2	15	23
1995	36	2	25	34
1996	68	5	44	47
1997	102	7	65	70
1998	178	12	100	103
1999	238	16	145	158
2000	296	20	186	214
2001	429	29	251	271
2002	617	42	359	353
2003	741	51	427	438
2004	812	55	469	485
2005	962	65	546	571

Table B.5 Heat and cold storage systems in the Netherlands [14]

Appendix D Programs (The Netherlands)

Table C.1 shows an overview of the different programs that existed for thermal storage.

Past programs	Present programs
CO_2-reduction plan	EIA
EINP	EOS
EPR	Innovation Vouchers
OTC	Temporal subsidy scheme CO_2 reduction built environment 2006
MIA/VAMIL*	UKR

* The MIA and the VAMIL are still running, but don't support energy saving measurements anymore

Table C.1 programs related to thermal storage

C.1 Programs from the Past

CO_2-reduction plan

The CO2 reduction plan (CO2-reductieplan) was developed for industrial concerns, official bodies, foundations, non profit organizations and one-man businesses. Subsidy could be received for projects that would contribute to a considerable reduction of the exhaustion of CO2 and other greenhouse gasses by using less fossil fuels, using renewable energy sources or by technical provisions and process adaptations (e.g. end of pipe measures in energy companies or end of pipe measures in the chemical industry)[6].

The money could be applied for by a tender. Regularly an amount of money was available for subsidies and a period is announced within project proposals can be sent. Everybody was allowed to write a proposal. The selection of the proposals that received subsidy was based on the cost effectiveness. This means that proposals with the highest reduction16 for the lowest subsidy would be supported. Tenders were announced in the Staatscourant and on the website of the Projectbureau CO2-reductieplan. This project office took care of the practical aspects of the CO2-reduction plan.

The CO2 - reduction plan can be divided in six subprograms: industrial heat, demonstration/ optimizing of heat pumps, advanced CHP and a combination of advanced CHP and heat pumps, renewable energy sources and process , advanced CHP, technology and industry and sustainable energy carriers.

In 1997 the first 12 projects within the CO2-reduction plan were accepted. Types of projects that are subsidized within the CO2- reduction plan are wind turbines, electricity production out of biomass, CHP and energy saving measures. The last tender was open from 11-10-2002 until 2-12-2002. A sixth tender, that was already been announced, has been cancelled in August 2004 [7].

Energy Investment Deduction Non Profit (EINP)

The EINP (Energie InvesteringsAftrek voor Non-Profit) supported energy savings in the nonprofit sector. The EINP run from 1995-2002. The EINP was financed by the revenues from the REB (Regulating Energy Tax/ Regulerende Energie Belasting). In the period 1997-2002 in total 130 million of euros were granted to the non profit sector (EINP)(Ecofys, 2004).

Energy Premium Scheme (EPR)

In the EPR (Energie PremieRegeling) a number of energy saving measures was subsidized during the period 2000-2003. All the measures for which subsidies could be received were stated on a list. Solar boilers and heat pump boilers were on the list. The

[16] The project may concern al types of greenhouse gasses (e.g. CO2, CH4 and N2O)

subsidies were granted by the energy distribution companies. In the period 2000-2002, in total almost 400 million euros were granted to the residential sector. About 70% of this subsidy was granted for insulation and the use of HR-glass. The other 30% was granted for electrical appliances like low energy fridges, efficient washing machines, etc. In 2003 many energy saving measures were removed from the list, because of the high percentage of free riders. The total effect of the EPR was estimated to be a CO_2-reduction of about 0,2 million ton of CO_2 by the end of 2002 (Ecofys 2004).

Budget Supporting Energy Transition Coalitions (OTC)
The subsidy OTC (Budget Ondersteuning Transitie-Coalities) was meant to support feasibility projects for the preparation of transition experiments. A transition is a structural societal change over a long period (25-50 years). Deadline for application of OTC subsidy was 1 June 2004. The granting of the subsidies took place in the order that the applications were received.

The projects might last 6 months at maximum and different partners had to cooperate in the project. The total budget per coalition that could be granted was 50.000 euro (with a maximum of 75% of the total project costs that meet the requirements).The total budget of the OTC program was 1.5 million euro. In 2004 the budget, that was applied for, was twice as big as the amount of money available [8,9].

Scheme for arbitrary debiting of environmental investments (VAMIL)
The VAMIL (Regeling Willekeurige Afschrijving Milieu investeringen) is favourable for the liquidity or the interest of a company. If a mean/device was on the EIA list and had a special code, the entrepreneur could decide himself when he wrote off the costs of this investment. This could be done in one year (and therefore the entrepreneur would pay less tax) or he could do this during the technical lifespan of the mean/device[3,10].

Environment Investment Deduction (MIA)
Due to the MIA (Milieu Investerings Aftrek) 15%, 30% or 40% of the investment costs on certain means/devices could be subtracted from the fiscal profit. If and how much of the rent could be subtracted, depended on the EIA list and on the code that the mean/device had. Investments smaller than 2.000 euro were not taken into account.

The Vamil and MIA lists were composed by VROM, based on the following criteria:

- there must be an advantage for the environment
- the investment costs must be higher than the costs of a less environmental friendly product.
- the mean/ device is not common
- market introduction is desired in short time.

Thus, for some devices the MIA and the VAMIL could be applied at the same time. Sometimes the European regulations restrict the amount of subsidy that can be given. Therefore it is possible that the MIA only migt be applied to a part of the total investment costs [10].

C.2 Present programs

Energy Investment Deduction (EIA)
EIA (EnergieInvesteringsAftrek) supports energy savings in the profit sector. The EIA was introduced in 1997 and is still running. The EIA was financed by the revenues from the REB (Regulating Energy Tax/ Regulerende Energie Belasting now: Energy Tax/EnergieBelasting).

In the period 1997-2002 in total 100 million euros were granted to the service sector for the EIA and VAMIL (for VAMIL see also ‘present programs’). In EIA/VAMIL and in EINP 60% of the money was used for installations (like lighting and condensing boilers) and

about 40% was used for to improve the quality of glazing. The total effect of the EIA/VAMIL and the EINP has been estimated to be a reduction of 0,8 million ton CO_2 (Ecofys, 2004).

Due to the EIA less income tax or corporate tax has to be paid when investing in energy saving measures or investing in the implementation of sustainable energy. Due to the EIA it is allowed to subtract a certain percentage of the investment costs from the fiscal profit (5%, 30% or 40%, depending of the technology that is invested in) [10].The financial advantage depends on the amount of tax that the company would have to pay without the EIA. The EIA can only be applied if the investment project meets the requirements from the energy list [11].

The maximum tax reduction that is allowed per company is 108 million euro. There are five categories of processes/products that can be subsidized: Buildings, Equipment and processes, CHP, Means of transport and Application of sustainable energy. If the national budget of the EIA seems to be passed the Minister of Financial Affairs is allowed to stop or to reduce the EIA.

Thermal storage is named several times in the EIA-list, but always as a not necessary part of a bigger product/process: Heat pumps, Heat pump boilers, buffer system for heat from hot tanks, heat pumps, solar collector systems and a ground water heat exchanger [11].

In some cases the MIA and the VAMIL can be applied at the same time as the EIA. Sometimes the European regulations restrict the amount of subsidy that can be given, so that the MIA only can be received for a part of the total investment costs [10].

Energy Research Subsidy (EOS)

The Ministry of Economic Affairs supports the development of (knowledge about) energy efficiency and renewable energy because 'knowledge about energy efficiency and renewable energy will be the base for an affordable, reliable and clean energy in the future'. This support takes place by the EOS program (Energie Onderzoek Subsidie). Subsidies from the EOS program can support all stages from idea to market introduction:

1. EOS Nieuw Energie Onderzoek (New Energy Research). Subsidy is available for working out new ideas. The subsidy can be applied for by individual researchers, research institutes, universities and companies.
2. EOS Lange Termijn (Long Term). Subsidy is available for research focused at future sustainable energy production and energy use in the Netherlands
3. EOS Energie en Samenwerkingsprojecten (Energy and Joint projects). The subsidy has the goal to stimulate technological cooperation to develop innovative and sustainable products, processes and services.
4. EOS Demonstratie (Demonstration). Subsidy to stimulate 'the first' realization of new energy technologies.

In the program about twenty research areas can be distinguished, split in five different areas of focus: energy efficiency in the industrial and agrarian sector, biomass, new gas/ clean fossil, built environment and production and networks. Next to financial support, the EOS program offers support for knowledge transfer in the form of symposia, knowledge networks etc. At these events national and international companies are introduced to each other [1].

Recently a new tender has been open, running from 20 march up to 11 may 2006. The focus of this tender was on Demonstration projects (see point 4). The total budget for subsidy was 5 million euros, with a maximum of 1 million per project. Subsidy could be applied for to demonstrate (re)new(ing) ideas, new systems, new functions for existing technologies and for a combining new and existing technology [8].

Innovation Vouchers

In 2004 a first pilot of the Innovation Vouchers (Innovatie Vouchers) took place. The goal of the innovation voucher is to stimulate small and medium-sized enterprises to make use of the knowledge that's present in knowledge institutes. With the innovation voucher entrepreneurs can gather information by posing a question to a knowledge institute. This knowledge can be used to renew a product, process or service.

Vouchers can be handed in at:

- Universities and academic hospitals
- Research institutes without the target to make profit (and receive at least 10% of their financing from the government)
- Foundations without the target to make profit and which do research themselves and which or receive at least for 10% of their financing from the government, or which is a public knowledge institute.
- Research departments of a number of big companies, whose costs for research and development and are more than 60 million euro/year.

The vouchers can be handed in by one enterprise or with a group of enterprises (at least three and at most 10). In 2006 3000 vouchers with a value of 2500 euros will be distributed and 3000 vouchers with a value of 5000 euros. For the last category the enterprise has to pay an additional 2500 euros. These innovation vouchers of 2006 can also be handed in abroad. Also in 2007 innovation vouchers will be distributed [1].

Temporal subsidy scheme CO_2 reduction built environment 2006

The 'Tijdelijke subsidieregeling CO_2-reductie gebouwde omgeving 2006' aims to stimulate large scale investments in energy saving measures in existing buildings. De scheme contributes to an accelerated CO_2 reduction, realized in a financial controllable and cost effective way. The minimum requirements to receive subsidy is the realization of a yearly CO_2 reduction of 20 ton per project per year. The maximum amount of subsidy is 1 million euro per project. Subsidy will only be granted if at least two measurements from the list (which is not available yet) will be realized. For citizens it is only possible to apply for the scheme, when they join (in e.g. a Association of House Owners).

Appendix E Policies (The Netherlands)

Policy recommendations for ground protection from cold storage (BAB '95)

A first step to streamline the regulations for thermal storage was taken in 1995 by the 'Beleidsaanbevelingen voor bodembescherming bij koudeopslag' (BAB '95). As the name of this policy suggest, the focus was only on the storage of coldness. Already in 1995 it has been decided to evaluate the recommendations form BAB '95 5 years later.

Ground as Energy source and buffer (BEB)

In 2000, the evaluation of BAB'95 was one of the reasons that the 'Steering group Ground energy' (Stuurgroep Bodemenergie (StuBo)) decided to start the project 'Bodem als Energiebron- en buffer (BEB)'. The is formally taskmaster of the BEB project on behalf of the two financers, the Ministry of Economic Affairs[17] and the Ministry of Housing, Spatial Planning and Environment. The project is executed by Novem with the help of a project team existing of external professionals. The steering committee existed out of a broader range of specialists (Senternovem, 2003). Aim of the project is to formulate policy recommendations to protect the ground when heat is store in the ground and to create support of the authorities and acceptance from the market actors.

BEB had two targets:

1. To find out more about the technical effects of ground energy. The technical aspects to protect the ground and the groundwater were insufficient clear. If these effects would become clear, policy recommendations could be formulated to protect the ground when thermal storage is used. In other words, information was needed about the way effects on the environment can be judged and reduced or even prevented.
2. To recommend improvements for laws and regulations. The Grondwaterwet (Gww) and the Wet Bodembescherming (Wbb) were time consuming and limited the installation of energy storage systems. Improved regulations would create support from (local) policy makers and acceptance from the market. In other words, information about a more effective and efficient juridical framework of ground energy was needed [2], (Senternovem, 2003).

Recommendations had to have both strategic and operational aspect.

- strategic, because a number of laws and regulations had to be defined for ground energy, which would form a good juridical framework, without becoming an administrative burden.
- operational, because the local authorities must be helped with putting the ground energy policy into practice in an efficient way, with a burden that's as low as possible for the market actors (Senternovem, 2003).

Not taken into account in the BEB study are:

- industrial applications (only standard use in the built environment was taken into account)
- thermal storage in areas with stricter environment protection and
- thermal storage with temperatures higher than 25C. Neither were taken into account
- aspects of underground spatial planning [2],(Senternovem 2003).
-

Convenant 'Heat pump systems in Dwellings'

[17] The Ministry of Economic Affairs stimulates the implementation of heat pumps because of the reduction of primary energy use. (wet- en regelgeving bij duurzame energiesystemen in de bodem SN)

By signing the Convenant 'Warmtepompsystemen in de Woningbouw' (heat pump systems in the residential sector) the Minister of Economic affairs, de Assistant Secretary of VROM and a large number of market parties showed in 2000 that they wanted to put effort on a large scale market introduction of heat pump systems in the residential sector. The emphasize lay on systems that use the ground as energy source or as energy buffer. The Assistant Secretary of VROM was forced by the convenant to solve 'bottlenecks in the regulation and the implementation of heat pump systems, and to reward the performance of heat pump systems in regulation' (Senternovem, 2003). Target was to realise 10.000 heat pumps in the period 2000-2003. In total in 2003 15,344 heat pumps were realized (ECN, 2005). In order to continue the knowledge transfer after 2003 (when the convenant ended), the 'Nationaal Platform Warmtepompen' (NPW) was established.

TBC-advice, StuBo policy recommendations, Policy letter spatial planning of the underground
Relevant points of these policies are named in Appendix J

Program Sustainable Energy in the Netherlands (DEN)
From 1998 on thermal storage has been stimulated with a programmatic approach ('Duurzame Energie in Nederland'). This program is executed by SenterNovem, by order of the ministry of Economic Affairs. Main goals were technical development and market penetration. The DEN informs about the subsidy programs that exist (e.g. EOS and EIA) and how to apply for them.

	Projects		Investments		Subsidy	
	mln euro	%	mln euro	%	mln euro	%
Feasibility	509	57	21.0	10	7.8	12
Knowledge transfer	126	14	9.1	4	5.2	8
Research (O&O)	171	19	65.8	32	33.7	51
Market introduction	20	2	43.4	21	4.6	7
Experiments in practice	38	4	20.0	10	7.6	12
Demonstration	36	4	43.4	21	6.6	10
Total	900		202.7		65.5	

Table D.1 DEN projects, investments and subsidies per project category (SenterNovem, 2004)

Juridical Framework Ground Energy
In the 'Juridisch Kader Bodemonderzoek' bottlenecks and solutions from the market and the provincial authorities have been analysed. Aim of this study was:

3. to reduce the time between applying for an licence and receiving a licence
4. to make the requirements for a licence more uniform.

In this study a new juridical framework is suggested, which is based on present and future regulations. This new framework has been tested by sending inquiries to market actors and authorities. The results of the inquiry give a good idea of the bottlenecks that still exist in the process of submitting an application. Aim was to confer on ministerial level about the suggested framework and finally in order to realize a new juridical framework (SenterNovem, 2006).

Reason to start the study 'Juridical Framework Ground Energy'[18] was the letter send by the NVOE to SenterNovem (in October 2005). The reason for this letter was the disappointment of the NVOE about the draft Waterlaw, published by the Ministry of

[18] realised by IF Technology bv, by order of SenterNovem.

Transport, Public Works and Water Management in Juli 2005. The NVOE expected that their recommendations were taken into account during developing the new WaterLaw, however, in practice this was hardly the case. Also in the WABO (Wet Algemene Bepalingen Omgevingsrecht), the recommendations from the NVOE are hardly taken into consideration (SenterNovem, 2006). See also Appendix I, I and J.

Platform Energietransitie Gebouwde Omgeving

At 30 May 2006 the Platform Energy Transition in the Built Environment was officially installed. The Platform exists of representatives of the construction sector, housing corporations, users, authorities, and research institutions. The chair, Mr. Terlouw, thinks that within 15 years the energy used in buildings can be reduced with 30%-40%. On a longer term, the built environment can even become CO_2 neutral. To realize this, Mr. Terlouw thinks that especially political, economic and organizational transitions will be needed (Nieuwsblad Stromen, 23 juni 2006) What exactly the consequences of this platform will be for thermal storage is not clear yet.

Appendix F Key persons/ groups –NVOE (The Netherlands)

For projects concerning underground energy storage, the Dutch Association/Cooperation of Underground Energy storage systems (NVOE)) has been founded (on initiative of SenterNovem). The NVOE has about 40 members (consultancy offices, drilling companies, climat advisors and research institutes).(www.nvoe.nl) The cooperation exists of different task groups:

- task group quality. This task group has the intention to draw up regulations, to certify the design and implementation of energy storage systems.
- Task group laws and regulation: This task group focus on the Grondwaterwet, the procedure for applying for licences, certification related to licences and underground spatial planning.

Task group knowledge transfer: one of the main goals is transferring knowledge and experiences related to energy storage. Knowledge is one of the most important points for a good design and realisation of energy storage systems. Target groups for knowledge transfer are designers, executing parties (installation companies), students, users of energy storage systems, supplying companies, authorities (municipalities, provinces). From 2004 special courses have been developed. Goal is to develop and give new courses.

Task group communication and promotion: goal is to stimulate the use of energy storage in the ground as most cost effective source for the supply of both heat and coldness. Goal is to promote Energy storage in the ground for a broad public in the Netherlands [4].

Appendix G Results from BEB (The Netherlands)

The original BEB project can be split up in four different parts:

- Evaluation Policy Recommendations (Evaluatie Beleidsaanbevelingen 1995 (BAB 95)); evaluation and a preview based on the experiences with the policy recommendations defined in 1995.
- Environmental effects of ground energy and considerations of this (Milieu-effecten van bodemenergie en de Afweging ervan)(MeA). Target was to get insight in the environmental effects of thermal storage and to define measures that can reduce these effects.
- Juridical framework (Juridisch kader): description of the problems in the present framework and formulation of how the present framework can be improved, based on the results of MeA and the evaluation of BAB'95.
- Supervision and preservation (toezicht en handhaving): determination of the bottlenecks and the related points of improvement to enforce laws and regulations. Part of this preservation of rules was the question whether it was desirable to implement a quality guarantee for ground drilling [2], (Senternovem, 2003).

The emphasize of the study was the evaluation of BAB '95 (task 1) and the MeA (task 2). The tasks 3 and 4 were integrated into one study with a more orienting character. The formulation of recommendations for the juridical practice has been postponed to a special designed project of IPO (InterProvincial Consultation – Inter provincial overleg) and SenterNovem (Senternovem, 2003b).

While one of the objectives of BEB was to create support from policy makers and to create acceptance by the market, in practice not much attention was paid to these aspects. Instead, more attention than intended was paid to the strengths, weaknesses, the opportunities and threats of underground thermal storage. An outline of this analysis is shown in Table F.1 (Senternovem, 2003b)

Strengths - large potential saving on fossil fuels - proved and applied technology - economically feasible - acceptable risks for the environment - sustainable way to foresee in the trend of cooling buildings	Opportunities - CO_2-redcution target - perspective for a completely sustainable energy supply by using su generated electricity toempo pumps. - impulse to organize themselves within the sector - even within the restrictions of urban renewal, opportunities to improve performance - integration and reduction of burden of the VROM-regulations
Weaknesses - tendency to collective/large scale use - unclear juridical framework for - energy storage - no regulation for ground heat exchangers - complex juridical practice	Threats - no clear goal setting/policy by the government - not sufficient guarantees for quality - increasing competition for the soil/ ground - insufficient consensus about opportunities of thermal storage near drink water withdrawals - little information (while there is enough knowledge)

Table F.1 Overview of strengths, weaknesses, opportunities and threats (senternovem, 2003b)

Recommendations from BEB (SenterNovem 2003b).

1. Give thermal storage in the ground as a sustainable energy option a more 'mature' place in the national energy policy in order to stimulate this technology and to create the right conditions for large scale implementation (e.g. juridical requirements).
2. Implement general, technical design rules for the ground energy systems and implement general conditions for the installation and management of these systems. The implementation of directives can realize knowledge transfer and regulation (e.g. certification)
3. Use the MeA reports as much as possible to describe the 'state of the art' of ground energy to improve ground energy policy.
4. Oblige leakage detection for systems with glycol and oblige controlled sealing of the drilling wholes.
5. Stimulate if possible, the use of ground water systems instead of ground heat exchanger systems.
6. Reduce, simplify and uniform the governmental procedures and research conditions for 'ground energy projects' as much as possible, in order to provide the right conditions for large scale implementation
7. Two procedures are running: 'standaardvergunning' (standard licence) and 'afstemming en harmonisatie vergunningverlening'. Take in these two procedures as much as possible the future juridical framework into account.
8. Create, as much as possible - using the existent environmental laws and regulations - a coherent and all-embracing environmental juridical framework for ground energy. This framework can become part of the Grondwaterwet (Ground water law) and/or an Order in Council Bodemenergy (Ground Energy), based on both the Grondwaterwet (Ground water law) and the Wet bodembescherming (Law Ground Protection) and if necessary also on the Wet milieubeheer (Law Environmental Management) and the Wet op de waterhuishouding (Law on the water management). A construction of public juridical accepted certificates can become part of this and contribute to quality control without a heavy management burden. Create an environmental juridical framework that include all aspects of ground energy.
9. Create regulations for drilling for ground energy systems - as part for the recommended Order in Council bodemenergie (Ground Energy), or as part of the framework for a broader Order in Council for drilling.
10. Change the Grondwaterwet (Ground water Law) so that it can become the basis of the recommended Order in Council.
11. Create in cooperation with the ministries of VROM, EZ and V&W , de provinces, the VNG, the Unie van Waterschappen and market actors an approach to change the juridical framework for ground energy.
12. Oblige a common registration of ground energy systems and develop an information system adapted to the registration.
13. Introduce a central information point for ground energy, which gives information to potential users of ground energy, the market sector, local authorities and education institutes.
14. Carry out technical research on the areas where knowledge is missing.
15. Take in new policy measures explicitly in account the ground experience values.
16. Develop clear and broadly supported standards for the implementation of ground energy systems in areas and on depths that can be considered as long term potential for groundwater winning/long term ground water exploitation zones.
17. Carry out further research on how to design a juridical policy for the development and division of the soil (Senternovem, 2003b).

Appendix H Barriers for thermal storage systems (The Netherlands)

Barriers for the implementation of thermal storage in the ground

1. The person that applies for a licence is often unfamiliar with laws, licence procedures and the different renewable energy systems.

2. For the different actors it is often unclear how to interpret laws and regulation for renewable energy systems in the ground. In what cases falls the water that is injected in the ground (e.g. in a ground water system for a heat pump) under the definition of 'infiltration', like meant in the Grondwaterwet (Gww)? When is the 'Lozingenbesluit wet bodembescherming' applicable on a ground water system for heat pumps? When is a province the competent authority for an exemption of the 'Lozingenbesluit', and when is the municipality competent? What exactly is meant with 'infiltration of water' in the Gww? The reinjection of subtracted water? In what situations has the reinjection of groundwater to fulfil the requirements of the Grondwaterwet (Gww)? And who is the competent authority? The municipality or the province? To make it even more complicated, different provinces interprete the rules in different ways)especially the case for Wbb, Gww and the Wm'

3. The procedure to get a licence lasts long relative to the time needed to realise the energy system. The procedure of a licence for the Grondwaterwet (Gww) takes about 7.5 month, which is long relative to the time needed to prepare and realise a thermal storage project, especially for small storage projects. This period cannot be reduced as this is determined in the Algemene Wet Bestuursrecht (AWB).

4. Lack of uniformity, in relation with conditions of the system, the reports of effects and the conditions for measurements. Different provinces have different conditions.

5. High requirements of effect reporting. Some provinces require that there's a thermal balance. Often this cannot be realised (at least not on a yearly base), as the balance of a system depends on the demand for heat and cold. Another problem (especially for small systems) is that the heat demand often is much higher than the demand for cold and that the thermal losses to the environment are relatively high. If there's no longer a requirement that small systems have to be thermally in balance, many more energy storage systems will become feasible. At this moment it is unclear what the advantages and disadvantages are for the environment if there's no thermal balance.

6. High fees and high costs for the needed measurement reports in some provinces. Costs differ per province. In 2000 there were signals that the fees would be cancelled. Cost can range from 500 euro up to 5000 euro per project. Especially for small projects this leads to a strong financial burden.

7. The availability of water containing layers in some provinces. Not every where in the Netherlands are water containing layers present. Some of the provinces have excluded parts of their provinces (some areas or some water layers) from withdrawal and draining, as the water containing layers are reserved for exploitation of tap (drinking)water.

8. Risk of bad realisation of energy storage systems in the ground, due to strong growth. Most provinces don't have requirements for drilling activities.

9. In provinces there is sometime lack of knowledge on the different energy systems that make use of the groundwater (Senternovem, 2000).

10. Interaction between groundwater systems. There exists no spatial planning for the underground. In general the first person that applies for a licence, will be the one that will have the rights to pump. This means that the realisation of new storage systems can become a problem due to already existing groundwatersystems. This risk exists especially in regions with a high density of buildings (Senternovem, 2005).

Appendix I Recommendations (The Netherlands)

1. Recommendation to make in the Grondwaterwet an exemption for systems with a flow of less than 25m^3/h, a total amount of water replaced smaller than 100.000m^3/y and a closed energy balance (maximum deviation of at maximum 10% in 5 years). For a system that meets these requirements, only a notification from the Province is needed. This will mean shorter procedures and lower costs and less work for the province. Check if there's enough support on provincial/national level to realise this.

2. Or minimize the conditions for an effect report for small water systems, and uniform these conditions among the different provinces. And provinces should have written information about the requirements for a licence.

3. At this moment it is unclear what the advantages and disadvantages are for the environment if there's no thermal balance. This requires further study.

4. Costs can be reduced by reducing the required number and types of measurements.

5. Consider accepting energy storage in water containing layers. From an analysis of the realised measurements, no significant negative effects have been found for the ground. Try to convince provinces that heat and cold storage is not harmful for the ground.

6. Adapt the Gww in such a way that drilling is only allowed by certificated drilling companies (Senternovem, 2000).

7. Position ground- and ground water systems outside the Wet Bodembescherming and give it a clear place within other laws and regulations.

8. Remove differences in policies of the different provinces.

9. Take care of the spatial planning of the underground, so that interference between sources cannot take place.

10. Take care that the new Integrale Waterwet doesn't have negative consequences for thermal storage systems.

11. Require a bouwvergunning for underground heatexchangers (and therefore registration of these systems)(Senternovem, 2005).

Appendix J Overview of policies in ´Juridisch Kader bodemenergie´ (The Netherlands)

Results of former policies
In the study 'Juridisch Kader bodemenergie' recommendations from earlier studies/ policies with relation to underground energy storage have been analysed (e.g. recommendations within BEB and recommendations from working groups like TCB, StuBo and COB[19]). For the different recommendations has been checked whether they have already been realized.

1. Advise to change the Grondwaterwet (or define the New Waterwet in such a way), so that an Order in Council Bodemenergie (Ground energy) can be developed in order to create a clear juridical framework (advise : BEB, supported by StuBo).
   Status: the Grondwaterwet will disappear and become part of the New Waterwet. The draft version of the New Waterwet is published 29 july 2005. Medio 2006, the law will be send to the Lower House.

2. Develop an Order in Council Bodemenergie, which falls under the Grondwaterwet and the Wet bodembescherming (and if necessary also under the Wet milieubeheer en the Wet op de waterhuishouding) (advise by BEB). StuBo advises to make the Order in Council part of the Besluit Bodem as part of the Wet bodembescherming in the Wet milieubeheer.
   Status: no initiatives for an Order in Council Bodemenergie. Opportunity within the new Waterwet. When this Waterwet becomes active, an Order in Council Bodemenergie can be part of the regulations within this law.

3. Implement assessment guidelines (Beoordelingsrichtlijnen (BRL's), for the construction, management, maintenance of open systems, and for the phase the system will be taken out of use.
   Status: KIWA is developing inspection criteria for open systems. These will become active in the beginning of 2006. Advice of StuBo: Inspection criteria for open systems must be stated in BRLs (beoordelingsrichtlijnen/ assessment guidelines).
   Also for closed systems (loops) a quality guarantee must be stated in an assessment guideline. Status: under construction. (The ministry of VROM has asked SIKB to do this).
   Advised is, when the Wet Bodembescherming becomes part of the Wet Milieubeheer, to regulate both drilling technolgy and workmanship of drilling holes (advised by BEB, TCB and StuBo).
   status: SIKB is working on the assessment guideline, on behalf of the ministry of VROM.
   The date that the assessment guideline becomes active is unknown, expected is after 2008.

4. Make storage of cold and heat part of the provincial and municipal (underground) spatial planning (advice TCB & Beleidsbrief Ruimtelijke Ordening van de Ondergrond)
   Status: VROM wants to start in 2006 pilot projects to find out the possibilities of underground spatial planning. 4 pilots have been selected.

5. Make one desk/counter for the application for an Omgevingsvergunning and a Watervergunning.

[19] TCB = Technische Commissie Bodembescherming,
StuBo= Stuurgroep Bodem existing out of the Ministry of VROM, the Ministry of V en W, the Interprovinciaal Overlegorgaan (IPO) en de Vereniging van Nederlandse Gemeenten (VNG),
COB= Centrum voor Ondergronds Bouwen

6. Harmonisation and standardization of regulations for licences in the different provinces. This must make the process clearer and more consistent for the market actors. Also attempt to automate the application of licences.
   Status: no clue when standardization of regulations will be become active.

7. StuBo advised to oblige a construction licence for closed (loop) systems. Now there is no registration of closed systems.
   Status: not clear/ no action

8. Advised is a general obligation of cadastral registration of ground energy systems (advised by BEB, TCB and StuBo).
   Satus: not clear/ no action
   (SenterNovem, 2006)

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Recommendations and developments	Running	Not running
Change Grondwaterwet / develop Waterwet	X	
Order in Council Bodemenergie		X
KIWA- mark	X	
Quality requirements for systems (VROM)	X	
Assessment guidelines drilling technologies	X	
Underground spatial planning: pilots	X	
WABO/ one desk	X	
Make licences uniform	X	
Construction Licence closed loop systems		X
Cadastral registraton		X

Table I1, Overview of recommendations and developments (SenterNovem, 2006)

Appendix K Proposed juridical framework (The Netherlands)

From the recommendations stated in Appendix I, the Order in Council Bodemenergie, has not been realized (yet), while this is one of the priorities of the NVOE. The aim of the Order in Council is that all aspects of energy storage in the underground will be part of a juridical framework. Not only quantity aspects are important, also quality, needed space and energy reduction must be taken into account. The minimum requirements for the Order in Council Bodemenergie should be:

- the Order of Council is part of the Waterwet and the Wet Milieubeheer
- the Order of Council is valid for both open and closed loop systems
- the Order of Council obliges the registration for all system
- the Order of Council contains general rules for small systems
- the Order of Council could contain assessment guidelines for quality guarantee (SenterNovem, 2006).

The time spend on procedures can in certain cases be reduced, if the rules are stated in the Order in Council Bodemenergie. Suggested is that the Order in Council is in force for open systems of 50m^3/h or 100.000m^3/year. For these small systems no procedure is required and therefore the administrative burden will diminish for both the applicant of the licence and the province. An additional advantage is the cost savings (about 10.000 euros for the application of a licence for the Grondwaterwet).

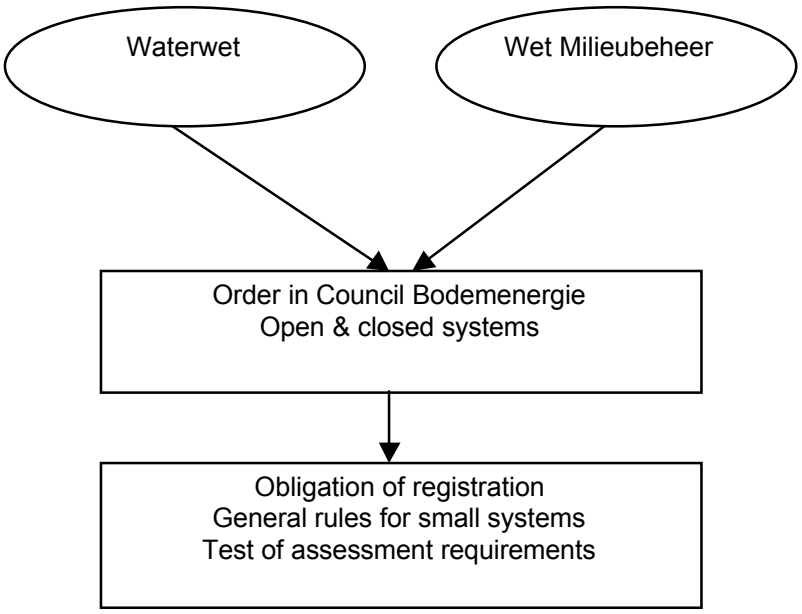

Table J.1: voorgesteld wettelijk kader, NVOE (SenterNovem, 2006)

Appendix L Reactions on the proposed Juridical Framework (The Netherlands)

A questionnaire is send to involved parties in order to find out what their opinion is about the ideas of the NVOE (like the Order in Council Bodemenergie- see Appendix 6), and in order to find out what bottlenecks exist. In January 2006 questionnaires have been send to about 80 actors like consultants, installers, drilling companies, suppliers, users and authorities that grant permissions. 32 of the questionnaires (40%) have been filled in (of whom 22% by consultants, 6% by installers, 16% by drilling companies, 3% by suppliers, 13% by users, 24% by authorities granting licences and 16% by others) (SenterNovem, 2006).

The questionnaire contained questions about 5 themes:

1. Present juridical framework
2. Provincial policy
3. Granting of licences
4. Use of underground space
5. Future laws

General conclusions of questionnaires:

- a lot of interest exists for the laws and regulations related to energy storage, both from the market and authorities
- It is also clear that there is a need for a new juridical framework.
- The proposed Order in Council is a step in the good direction in the opinion of the market parties (Order in Council will be in force for both open and closed systems and in all cases there is an obligation to register).
- Unfamiliarity with laws and regulations forms a problem and only few parties can oversee the total field of laws and regulations related to thermal storage in the ground. In general this topic is considered as ‘very complex’.
- The time needed for procedures is considered too long for small systems, because it doesn’t fit with the relative short time of construction.
- A majority of the respondents thinks that more uniformity is needed between the requirements in the different provinces.

Recommendations:

a. Based on the outcomes of the questionnaire, the promotion of the Order in Council Bodemenergie needs to be continued. Deliberation with the involved ministries VROM (Wet Milieubeheer) and V en W (Waterwet) is desired. The ministry of Economic Affairs, promoter of sustainable energy, can play an important role in this deliberation.
b. All aspects that are unclear needed to be cleared up and it must be prevented that the administrative burden will increase. Try to find out more about the process that can lead to an Order in Council, what is the opinion of the government, who is responsible for the process, etc.

For more detailed information about the results of the questionnaires, it is suggested to download the report Juridisch Kader Bodemenergie. Unfortunately it is in Dutch, but it contains a clear visual presentation of the outcomes of the questionnaire (SenterNovem, 2006).

Appendix M Laws and regulations (The Netherlands)

For thermal storage, only regulations have been found in literature, that are related to low temperature thermal storage in the ground. A number of laws and regulations are important for thermal storage in the ground (especially for open store systems). These regulations are shown in Table L.1. All these regulations have a general character, in the sense that they are not especially designed for thermal storage in the ground, but they are mainly designed for protection (of the ground, of the ground water, of the nature, of the drinking water etc).Therefore they have often a restricting effect on the thermal storage in the ground. For some laws a licence is required for open heat stores in the ground, these laws are market with a '*'. For closed loop systems, only licences are needed for the Wet Milieubeheer and the Wet Bodembescherming (Senternovem, 2003b).

Laws and regulations	Guidelines and decisions	Other
Grondwaterwet*, Wet Bodembescherming (Lozingenbesluit)*, Wet verontreiniging Oppervlaktewater*, Wet Milieubeheer*, Natuurbeschermingswetten, Mijnbouwwet, Wet belasting op milieugrondslag, Spoorwegnet Algemene Wet Bestuursrecht Woningwet **	Lozingenbesluit, Bouwbesluit, Bouwstoffenbesluit, Vogel- en habitatrichtlijnen Keur	Provincial Plans: Waterhuishoudingsplannen, Streekplannen en Omgevingsplannen Indirectly related policy EPN

* for these laws permissions (vergunningen en ontheffingen) are needed.
Table J.1 Overview of laws, regulations, guidelines and decisions

General barriers:

1. the use of energy storage will give additional administrative burden. This can form especially a burden for smaller systems
2. regulations and policies are in general no barrier. For relatively small systems the present regulation for thermal storage may form a barrier because of the administrative costs (Senternovem, 2005).

Grondwaterwet (Gww)
The Ground Water Law (Gww) only lays down rules for the ground water quantity. The goal of the Gww is to make a balanced decision of all interests that are connected with the management of ground water and to make a balanced division between all users of the present ground water stock/store. Almost in all cases where groundwater is extracted (with/without reinjection) in order to store or extract energy, a Groundwater licence (grondwatervergunning) will be needed. The Gww only gives a 'framework' for ground water extraction/ injection. The different provinces can work out the details in an Order in Council or by provincial regulation.

The Gww exists of two instruments:

- the obligation to register (registratieplicht).Every extraction and/ or injection of water needs to be registered. The amount of water that has been extracted must be reported on an annual base. By a regulation, an exception can be made.
- the obligation to apply for a licence . A licence is needed if:
  - water will be extracted with a speed of 10m3/h or more
  - water is injected in the ground. No exceptions possible.

- water will be extracted with a speed of less than 10m3/h, but the province decide that a licence is needed. (other options: the province decide that no licence is needed or that there will be an obligation to report)

Barriers

A licence will only be given if there's no risk that the ground water will be contaminated. The province is the competent authority. The difficulty of the Gww is that the word 'injection' is interpreted differently by the different provinces. Some provinces state that a licence for all infiltration projects is needed (also if the speed is less than 10m3/h), other provinces state that a licence is only needed for speeds of 10m3/h or more (Senternovem, 2000).

The Time consuming procedure (7.5 months at maximum (Algemene Wet Bestuursrecht)) may cause problems for small projects with little budget and time (wet- en regelgeving SN). As said, the competent authority is the province. It can lay down complementary requirements in it's policy plans. For this reason huge differences may exist in the requirements stated by the different provinces (SenterNovem, 2006) The uniformity between the provinces increases and the control is becoming stricter.

Wet Bodembescherming (Wbb)

The Law for Soil Protection (Wbb) lays down rules for the protection of the ground water quality and the cleaning up of the ground. This law has been stated by the Ministery of VROM (1986). Every action in which matters are inserted in the ground (which may contaminate or change the ground) falls under this law. The conditions for the protection of the ground are mainly stated by Order in Councils. In general, municipalities (or provinces) are the competent authority.

The Wbb doesn't oblige licences. But every citizen, that acts on or in the ground, has the obligation to take care of the ground and has to take care that he/she acts accurately (Zorgplicht, artikel 13). By this obligation is stated that every citizen himself is responsible for the protection of the environment. In case that inaccurate behaviour causes dammage, the citizen will be punishable even while no standard has been passed (SenterNovem, 2000).

The 'Draining decision for ground protection' (Lozingenbesluit bodembescherming) is part of the Wbb and is stated in an Order in Council. The Lozingenbesluit relates to the drainage (lozingen) of liquids into the ground, it doens't relate to the drainage of water that has been pumped up before from the same ground layer (as long as no heat is added). So water that is used for heating may be drained, as the temperature of the water will be lower when it is injected in the ground afterwards. For water used for cooling, the opposite is true.

It is not always clear to what systems the **Lozingenbesluit** is related. The Lozingenbesluit seems only to be related to systems which have the aimm to bring liquids in the ground permanently. Thus the Lozingenbesluit does't relate to systems in which the heat is only temporary stocked into the ground. The heat will later on be distracted again, to be used for e.g. the heating of a building.

For all cases that the Lozingenbesluit relates to, an exemption is needed from the competent authority. This exemption will only be valid for a certain period (max. 4 years) afterwards a new exemption needs to be applied for. What authority is competent for giving the exemption, depends on a factors like e.g. what authority gave the licence related to the Wm-vergunning and the depth of the drainage. Competent might be the

- the municipality where the drainage takes places
- the province where the drainage takes place
- the Ministery of VROM
- the Ministery of Economic Affairs.

In practice it is not always clear what authority is competent (and different provinces interprete the rules differently) (Senternovem, 2000).

Wet verontreiniging oppervlaktewateren (Wvo)

The law Polution of Surface Water (Wvo) lays down rules for the protection of surface water from waste matters and/or harmful and poluting matters. For drainage of water (spuien)on the surface water a licence is needed. The licence can be applied for at the competent authority, which may be het Hoogheemraadschap, the Waterschap of Zuiveringsschap or Rijkswaterstaat. If the amount of water drained to the surface water is below a certain standard, a licence is not obliged, but there will exist an obligation to report (there must be conferred about the drainage with the competent authority before starting the project). The standards can be stated by the competent authority.The procedure of a Wvo licence may take at maximum 7.5 months (Algemene wet Bestuursrecht) (SenterNovem, 2006)

Wet milieubeheer (Wm)

The Law for Management of the Environment (Wm) is an integral environmental law, that regulates the different kinds of impacts that an activity might have on the environment. If an activity influences the environment AND if the activity is part of the definition of the Order in Council 'Inrichtingen en vergunningenbesluit', an environmental licence (milieuvergunning) will be needed. This licence usually will contain restrictions and regulations in order to reduce the impact on the environment.A licence will be needed e.g.

- for new houses with a sustainable energy system in the ground, if the energy system contains electrical engines with a capacity larger than 1,5kW (SenterNovem, 2000)
- in case water is drained into the surface water or into the sewer system. This may take place during the installation of the system or during maintenance of the system. (SenterNovem, 2006)

Municipalities have to decide – for the companies that apply for a Milieuvergunning (Environmental Licence) – whether the energy saving measures proposed in the application form are sufficient, or whether additional measures are needed to realize more energy savings. Without an environmental licence it is not allowed to set up the activity, to change the activity (or it's way of working) or to put it into operation.

In two cases no licence is needed (but, there will be only the obligation to report).

- If the activity is named on a special list with categories of activities that only need to report (Order in Council based on article 8.40).
- If the activity or it's working will only have favourable consequences for the environment.

Competent authorities can be: the municipality where the activity is (mainly) situated. This is most often the case, Gedeputeerde Staten van de Provincie (rarely the case) or the Ministery of VROM (rarely the case)

If more than 3 million m^3 ground water is withdrawn/ infiltrated per year, there is a m.e.r.-obligation (milieu effect rapportage, environment effect report). In case an existing system will be changed, a m.e.r.- is obliged if more than 1.5 million m3 water per year is withdrawn/ infiltrated.

The time for this procedure (to get a Wm-vergunning) is restricted in the Algemene Wet Bestuursrecht and will be 7.5 months at maximum (Senternovem,2000).

Barriers

The barriers for the province (the authority that ascribes the licences) are:

1. the number of licences for energy systems, that's applied for, is increasing strongly and will further increase in the future.
2. insufficient knowledge is available about the effects of energy storage systems. Especially the consequences of the thermal effects on the ground water quality is

unknown. This lack of knowledge makes that provinces have high requirements on the effect reports and require a high number of measurements on the functioning of the system.

3. insufficient knowledge is available about the differences between the different energysystems. This might lead to misunderstandings between applicant and the authority that ascribes the licences (Senternovem, 2000)

Energie Prestatie Norm (EPN)

In 1995, the Energy Performance Standard (EPN) was introduced, both for dwellings and buildings in the service sector. The EPN enables calculation of the integral energy performance of a new building and consists of a standardised method for the calculation of an energy performance coefficient (EPC). The EPC is a theoretical value for the primary energy use, taking into account the size and type of the building and the energy conservation measures. It does not focus on the quality of individual components. The reason behind this was to minimize costs and to maximize energy saving potential. Specific life style aspects are not taken into account in the calculations.

In 1995, the standard for dwellings was 1.4. In 1998 and 2000 the standard became stricter (EPN=1.2 in 1998 and EPN=1.0 in 2000). Since January 2006 the standard for dwellings is EPN=0.8. In the service sector, there are different standards for different types of buildings. The EPN for the service sector has become stricter only in 2000. Some research suggests that in practice differences exist between the calculated and the realized energy performance. Municipalities have the task to control weather new dwellings and other buildings comply with the current standard. (Ecofys, 2004).

In an interview, Mr. Noordhoek of the Ministry of Economic Affairs explains (see Appendix B): The Dutch government is considering to set a stricter standard (EPN) for utility builings20, which will promote the use of different energy saving measures. A stricter standard should thus be favourable for thermal storage in aquifers, but the opponents argue that the stricter standard can ónly be realized by using heat pumps in combination with storage in aquifers, or air to air heatpumps. If this is true, this provides arguments against a stricter standard for two reasons:

- The time required for applying for a licence for open system heatpumps[21] is pretty long (about half a year).
- Not in every region is thermal storage in aquifers possible, this might be due to the absence of aquifers, the presence of a ground water protection area or the presence of other thermal storage systems. If systems are realized too close in each other's vicinity, the stores will get disturbed due to heat exchange. If use of energy storage in aquifers is not always a possibility, for some buildings that would leave only air to air het pumps as a means to satisfy the regulations. Opponents argue that this would be in contradiction with one of the characteristics of the EPN; the owner of the building has the freedom to choose himself hów to fit the standard.

[20] For both, the residential and the service sector, the Energy Performance Standard (EPN) has been implemented in the Netherlands in 1995. This standard enables calculation of the integral energy performance of a new building and consists of a standardised method for the calculation of an energy performance coefficient (EPC). This is a theoretical value for the primary energy use, taking into account the size and type of the building and the energy conservation measures. It does not focus on the quality of individual components. The reason behind this was to minimise costs and to maximise energy saving potential.

[21] Open system heatpumps pump up groundwater and reinfiltrate it at a later stage. For soil and groundwater protection laws this is a different situation from closed system heatpumps, which use a heat transport fluid and leave groundwater in place.

Appendix N Other decision making processes (The Netherlands)

Energie Prestatie Keur (EPK)

The foundation 'Energy Performance Mark' (EPK) is an independent organisation, stimulating the use of energy efficient, clean and functional heating and hot water installations and other sustainable and energy efficient installation products, like solar energy and heat recovery devices. The foundation introduced a quality label for gas installations (GasKeur) and for solar boiler systems (Zonnekeur).

The foundation EPK is an initiative of the Dutch heating industry an the independent Gastec (Dutch Centre for Gas Technology, Nederlands Centrum voor Gastechnologie). This industry is ahead of others in Europe, when it comes to the development of clean, functional and energy efficient installations. One of the goals of the foundation EPK is to give relevant and clear information to the end user. Openness to consumer is very important for EPK. The foundation supports initiatives on the area of heating, delivery of hot water, solar energy and and heat recovery, independent of the energy source [12].

Garantie Instituut Woningbouw (GIW)

The aim of the GIW (Guarantee Institue Dwellings) guarantee is to give a guarantee, additional to the juridical and contractual responsibility of a construction firm. The guarantees for a new dwelling exist of:

- completion of the dwelling, when the constructor becomes bankrupt
- a quality guarantee for the construction parts for 6 (and sometimes 10) year
- stricter requirements than required by law for the heating and warm water installations

a guarantee of the GIW that when the constructor fails to deliver a quality product, the GIW will take care that problems will be solved.