

KeepCool: Promoting the Market Penetration of Sustainable Summer Comfort

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ABSTRACT

Recent studies predict a dramatic increase of cooling energy demand in Europe, despite the available knowledge and technologies of passive cooling. The international project KeepCool addressed this gap, searching for intelligent ways to promote the market penetration of passive cooling technologies and a new definition of sustainable summer comfort based on the adaptive comfort model. The project tailored the available information into a toolkit for building owners, planners and building users. In the eight participating countries, KeepCool explored various marketing strategies to reach these target groups. In addition, the project successfully influenced the development of a European norm on indoor thermal environment, and made first attempts to include sustainable summer comfort into national/regional energy policies. The experience within the eight countries revealed three success factors for the dissemination: National awareness on energy efficiency, a balanced and flexible marketing strategy, and access to already existing networks. In conclusion, KeepCool provided a good base for the further market implementation of sustainable summer comfort, which can be used by future dissemination-oriented projects in this field.

KEYWORDS

Sustainable summer comfort, passive cooling, toolkit, thermal comfort standards, dissemination, success factors.

INTRODUCTION

Despite the available knowledge and technologies of passive cooling, cooling energy consumption is dramatically increasing in Europe. The studies EECCAC and EERAC predict a four-fold growth in air-conditioned space between 1990 and 2020 (Adnot et al, 1999; 2003). The IEA Future Building Forum even named cooling as one of the fastest growing sources of new energy demand (International Energy Agency, 2004).

In order to address this gap, the international project KeepCool was initiated in early 2005. The overall goal of the project is to facilitate market penetration of sustainable cooling approaches and technologies in the participating countries, and implement activities that prevent a further increase of cooling demand in Europe. KeepCool addresses both newly constructed and existing service buildings in the public and private sector. Since the building owners are the driving force in the investment process, the project focuses on convincing building owners on the benefits of sustainable cooling solutions through marketing and dissemination of already existing technologies, knowledge and tools. In addition, the project aims at supporting the cooperation between suppliers and ensuring the link to norms and policy instruments that might support sustainable summer comfort.

ACTIVITIES AND RESULTS OF THE KEEP COOL PROJECT

State of the Art of Sustainable Summer Comfort

First, the project collected the available information on the state of the art in passive cooling technologies. Besides technology profiles, KeepCool also analysed the national comfort legislation in the participating countries, described 13 Best Practice Projects in English and 16 others in national languages (German and Portuguese). Further, a list of experts and suppliers of passive cooling technologies was prepared for each participating country.

In order to make all this information usable for building owners and planners, we developed a logical pathway to reduce cooling energy demand in buildings, towards a target that we call sustainable summer comfort. Sustainable summer comfort can be defined as “achieving good summer comfort conditions with no or limited use of conventional energy (fossil and nuclear) and through the use of environmentally non-harmful materials” (Varga & Pagliano, 2006, p. 3).

Instead of setting maximum energy input or prescribing certain technologies to be used, we propose a logical sequence of steps that should be considered when designing, constructing and operating a building. This approach has the advantage of leaving ample freedom to designers while supporting them in adapting the building to the local situation (climate, culture, locally available materials). Not all steps and actions will be available in a specific situation to the owner/designer, but our suggestion is to follow this path and closely analyse the possibilities for action in a given situation for each step.

1. Define explicitly the thermal comfort objectives, using the Adaptive Comfort model wherever possible.
2. Intervene on the site layout and features which can affect summer comfort
3. Control and reduce heat gains at the external surface of the envelope
4. Control and modulate heat transfer through the building envelope
5. Reduce internal gains
6. Allow for local and individual adaptation
7. Use passive means to remove energy from the building
8. Use active solar assisted cooling plants
9. Use high efficiency active conventional cooling plants
10. Train building managers and occupants on how to use, monitor the performance of and adequately operate and maintain the building.

The ten steps were presented in detail in Varga & Pagliano (2006). Technology profiles to almost all steps, and the above mentioned reports on best practice, legislation and market analysis are available at the project's Website www.keepcool.info.

Toolkit for building owners and other target groups

The information material developed in the project has been processed into an online toolkit for building owners and other target groups (see Figure 1). This toolkit is not only a new resource base for passive cooling. It combines our approach for sustainable summer comfort with the complex set of roles the different actors take when constructing, using, operating or maintaining a building.



Figure 1: The KeepCool Toolkit, online at www.keepcool.info

As investors and decision-makers, **building owners** can set up requirements for buildings in general and specific targets on cooling solutions. Thus, they are able to set the framework for the planning process. Building owners are connected with the **building users** and with the **operation and maintenance (O&M) staff** via contractual agreements. These contracts might also contain comfort levels or operational prescriptions. Building users influence both the performance of the building (choice of room temperatures, operation of windows, contribution to internal heat loads) and the energy performance through rental agreements. O&M staff need information on how sustainable cooling is operated, and are also important as a link to the building users. For complex projects, building owners are increasingly accompanied by building **consultants** of different fields (see Figure 2).

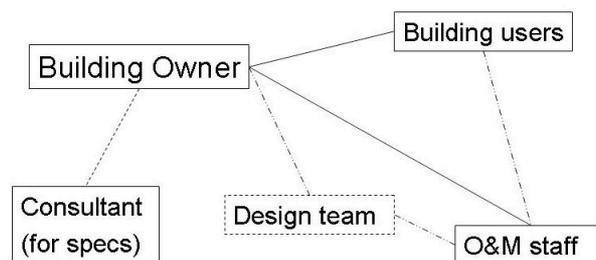


Figure 2: Relationships between actors in service buildings: Contractual agreements between building owners, building users and the O&M staff (full lines). Advice from consultants to the building owner (dashed lines). Informal communication between most target groups (semi-dashed lines).

Marketing and dissemination for sustainable summer comfort

In order to achieve real change of construction practice, the project activities must go beyond pure dissemination and information transfer. They must include also activities related to "market transformation" by bringing together the relevant actors and building up a structured supplier/customer dialogue in the scattered market of passive cooling. KeepCool applied a multifaceted and flexible marketing approach: Each participating country built up its own marketing plan with elements of direct and indirect marketing.

In **Austria**, KeepCool is part of ecofacility, the Austrian Climate Protection Programme for energy efficient service buildings. This programme built up a network of building energy advisers, developed standardised advice modules from a cost-free benchmarking up to comprehensive management information for the decision on the modernisation measures, including technical, financial, organisational and legal analysis. At the end of 2006, ecofacility has a stable network of 35 building energy advisers, covering all Austrian regions. 489 benchmarks of buildings have been made as have 200 comprehensive advice packages with recommendations for modernisation measures. Currently, the programme is working on a monitoring and verification package to get feedback on the realisation of the recommendations.

KeepCool provided the input on summer energy consumption, an issue that is only starting to be recognised in Austria, and helped to design a new advice package for the new construction of service buildings. This new package integrates energy

efficiency requirements in the summer and the winter cases, providing advice modules for each stage of the planning procedure, from helping the building owner to define energetic quality goals prior to any planning, up to a comprehensive building simulation with recommendations for improvements in the detail planning. The KeepCool toolkit provided the model for a similar toolkit in the German language on energy efficiency in the planning and construction of buildings, with the summer comfort part and some Best Practice examples directly translated from it. KeepCool and ecofacility had numerous appearances in the daily and specialist press, and provided presentations or organised numerous events for specific target groups: real estate companies, facility managers, hotel owners, etc. It was also co-organising the Austrian State Award for Architecture and Sustainability, and included sustainable summer comfort into the evaluation of the service buildings category. ecofacility was presented at the IEECB'06 Conference (Grim, 2006). Up to date information on the programme (in German) can be found at the website www.ecofacility.at.

In **Germany**, the market for sustainable cooling is a subject of growing interest for experts. In the context of a public funding programme named "SolarBau" several case studies of energy efficient office buildings were realised. But in general there is no large market penetration of "sustainably cooled" building concepts, outside some case study activities: there are less than 100 realised projects in Germany. Some passive cooling methodologies are already implemented in the existing standards, but still there is a large gap between the usual planning process and the philosophy of sustainable summer comfort.

KeepCool concentrated on events with great multiplication potential. Among others, the project organised an architecture competition for "Sustainable Cooling", with an awards session in the Berlin Energy Days 2006. The competition was accompanied by a media campaign in the technical press and German online information services. In total, 18 high quality applications were submitted, from which a jury of renowned German experts selected the three best projects. The competition provided KeepCool with 9 Best Practice cases in the German language, and with useful contacts to innovative architects and to the industry for sustainable cooling solutions.

Parallel to these activities, KeepCool set up a comprehensive German language information website on sustainable cooling, within the frame of the online info line www.baunetz.de (including a direct URL to the cooling part: www.keep-cool.net). This website provides not only short technology profiles from the most important steps to achieve sustainable summer comfort, but is also an information point for the German events in this sector, including reports and Best Practice examples from the architecture competition, and contact details of the KeepCool team in Germany. The team is also providing direct advice to building owners and planners in the questions of energy efficient construction and sustainable cooling. In an adapted version, the German technology profiles were also published in the Austrian online encyclopaedia www.energytech.at.

Italy is responsible for 25% of the European AC market (Adnot et al., 2003). However, the hot climatic conditions make the realisation of passive buildings a challenge. A few industrial actors are trying to promote their energy-efficient products, but up to now they have mostly focused on winter comfort and consumption and acoustic comfort. Similarly, there is only a small number of

examples of recent buildings built explicitly with the aim of achieving low energy summer comfort and little monitoring documentation is available.

Here, our activities concentrate on the education of a new generation of architects and engineers who are aware of the potential of envelope and passive technologies to reduce the cooling loads and improve comfort. The above mentioned strategy for sustainable summer comfort, and selected technologies were included into a number of university courses for architecture and building engineering students in different universities.

In addition, KeepCool was present on the media in Italy in order to sensitise the broad population to the necessity and the advantages of passive cooling measures, especially for the inclusion of the adaptive comfort model and for individual adaptation. Beside numerous appearances in daily press, KeepCool has appeared on radio and TV broadcasts. Finally, the project has promoted sustainable summer comfort and passive and envelope technologies at a high political level.

In **Lithuania**, passive cooling is an almost unknown concept. KeepCool concentrates on creating awareness among architects and building owners. We translated Best Practice examples and produced other dissemination material in the Lithuanian language. The Lithuanian KeepCool team distributed this material at national and international events, has authored two newspaper articles, and is giving direct advice to interested building owners in individual meetings or on the telephone.

In **Portugal**, the existing market for “sustainable cooling” is very small. A very small number of passively cooled buildings exist. The main reasons behind their existence are the demonstration technology approach or the environmental marketing benefits for the respective promoters/building owners. External shading is avoided by architects in many tertiary buildings for aesthetical reasons. Air conditioning equipment sales are growing fast.

Here, KeepCool’s goal is to increase awareness within selected target groups, especially for building owners. This was achieved by organising and participating in meetings and seminars, and by direct advice to building owners in individual meetings. The point of this advice was to show that sustainable cooling can be achieved today, with the help of the toolkit and of the Best Practice Examples from other countries.

There are established markets in **Scotland** for measures such as solar control glazing, energy efficient lighting and natural ventilation. A recent study (Hacker, Belcher, & Connell, 2005) suggests that summertime thermal discomfort is unlikely to be a problem in Edinburgh until the 2080’s. In spite of this, air conditioning is becoming part of the standard specification for many new developments. New building regulations, rising energy prices, climate change and rising expectations of comfort drive the demand for sustainable cooling.

The dissemination strategy in Scotland concentrated on direct meetings with large building owners from the public and the commercial sectors, establishing links to architects and suppliers of passive cooling solutions, and providing advice on possible pilot projects. These individual meetings were accompanied by national

events for building owners, an appearance on the World Wide Web and articles in the national technical press for the building energy sector.

In **Spain (Andalusia)**, sustainable cooling is restricted to demonstration buildings. KeepCool's approach focuses on personal or telephone contacts with a large number of agents who intervene in the design, construction, operation and maintenance (O&M) of buildings and their installations: Associations of architects, engineers, building promoters, construction, HVAC and O&M companies. This information and advice activity is backed up with a Spanish translation of parts of the Toolkit.

In addition, the Andalusian Energy Agency included sustainable summer comfort into the architecture competition run to define its new Headquarters building in Sevilla. This pilot project will generate publicity about sustainable summer comfort: The publication of texts in various media is expected, as well as an exhibition of the 7 final architectural projects in the architectural competition.

Even in **Sweden**, there is a large potential for decreasing cooling energy use. Consultants try to minimize the need for cooling in many projects, but this is still not the standard approach. Up to now, the market for passive cooling technology is not established.

KeepCool uses a twofold approach in Sweden: First, it has set up a "reference group" with "key actors", i.e. with suppliers of sustainable cooling solutions and/or their associations. The objective is to trigger the key actors to offer solutions to building owners. Meetings with this reference group were held in order to:

- Show the actors the potential market for sustainable cooling and give them a meeting point to start cooperation;
- Show key actors the environmental and economical benefits of sustainable cooling.
- Prepare national seminars where both the project participants and the key actors will be engaged;
- Develop packaged solutions for building owners.

In addition, KeepCool organised a workshop on sustainable summer comfort with the City of Stockholm and was presented at BELOK; an initiative that brings together Sweden's largest building owners to engage in sustainable energy processes and projects. Two building owners showed interest in participating in pilot projects as a result of the meetings and direct personal contacts. Finally, appearances at national events, press articles and a website in connection with the OPET network ensured broad information dissemination in Sweden.

Since the target groups of the project are mostly organised nationally, **international dissemination** was of secondary importance. Nevertheless, international meetings were a good concentration point to scrutinise the KeepCool approach to Sustainable Summer Comfort. The project or specific parts were presented and discussed at the following international conferences: At the 9. International Passive House Conference 2005, at PALENC 2005, eceee 2005, IEECB 2006, NCEUB 2006 and with the present paper at EPIC 2006. Parallel to these activities, KeepCool was invited to an expert meeting of the WHO, and was briefly presented by the AuditAC project at the AICARR 2006 Conference.

Influence on the European standard prEN 15251

The proposed European Standard prEN 15251 “Indoor environmental input parameters for design and assessment of energy performance of buildings-addressing indoor air quality, thermal environment, lighting and acoustics” seeks to define minimum standards for the internal environment in buildings in order to complement the Directive on the Energy Performance of Buildings (EPBD) and to ensure that energy savings are not made at the expense of a poor indoor environment. There were concerns that comfort categories which are too demanding may encourage the use of unnecessarily highly serviced, highly energy consuming buildings, contrary to the spirit of the EPBD.

KeepCool staff successfully influenced the drafting committee to include amendments into the draft norm that help to mitigate this trade-off:

- Defining thermal limits for summertime in naturally ventilated buildings using the adaptive comfort theory (Humphreys & Nicol, 1998) and European data.
- Calculating the mean of outdoor temperatures with a method that takes into account the variations in weather (McCartney and Nicol 2002).
- Relaxing the upper temperature limits where fans and other means to increase air velocity are available.
- Changing the classification into control categories I, II, III and IV where I is only used in buildings where a highly controlled indoor climate is required such as hospitals or care institutions for elderly people, II and III are for new and existing buildings. This is a step forward from the A, B and C categories used in ISO standards which imply that a high level of control (= high energy use) is superior. The solution reached avoids to some extent putting an incentive on the general market towards closely controlled air conditioning.
- Introducing a broader range of humidity in buildings, to discourage the use of extensive humidification or dehumidification.

With these amendments, prEN15251 embodies the latest thinking about comfort in the variable conditions of free-running buildings thus allowing designers to take utmost advantage of occupant’s natural ability to adapt conditions to their liking. This not only means optimising the interaction between occupants and the building to ensure comfort but also enables designers to maximise energy saving by allowing indoor conditions to track those out of doors.

Introducing summertime energy efficiency into national energy policies

Partly as a result of the efforts to transpose the EPBD into national legislation, 18 Member States (MS) have adopted or are prepared to adopt requirements regarding summer comfort in the building regulation for new buildings (Gonçalves, 2006). This shows an increasing attention given to summertime energy consumption. However, these summer requirements only apply to new buildings and major renovation, so that the great majority of the building environment will not be affected. Therefore,

specific marketing activities are needed if the summer requirements are to give results – especially targeting the existing building stock.

In **Austria, Germany, Italy, and Spain**, KeepCool is convincing policy makers to consider summertime energy consumption in environmental or energy efficiency funding programmes. Such programmes are important drivers for energy efficiency investments in most of the countries. However to date they only consider energy efficiency measures in the case of heating and neglect the energy saving potential of reducing the cooling energy demand.

The new Directive on Energy End-Use Efficiency and Energy Services (ESD) is setting energy saving targets for the European Union and the Member States, and requires an Energy Efficiency Action Plan (EEAP) from each Member State. Including the Sustainable Summer Comfort approach into the EEAP seems to be a very promising option, since it leads to a considerable and long lasting reduction of the energy (and especially the peak energy) consumption of buildings. The KeepCool team will use its contacts to achieve this, however the most intensive work will take place after the project has been finished, in the frame of other projects.

SUCCESS FACTORS FOR A BROAD MARKET INFLUENCE

The experience in eight countries show three success factors for the broad market implementation of sustainable summer comfort:

- National awareness about energy efficiency in buildings,
- Access to already existing networks of the target groups, and
- A balanced and flexible marketing strategy.

In countries with an already high awareness of energy efficiency in buildings, KeepCool had easier access to the target groups: In Sweden for example, the city of Stockholm asked KeepCool for presentations and to meet municipal building managers and owners. Several Austrian newspapers asked for material, or published what they found on the project website. In the last few months renewed political interest into energy efficiency emerged in Italy (e.g. incentives to energy efficient retrofitting of buildings and to new efficient buildings are present in the new budget law). KeepCool presented its sustainable comfort steps to policy makers supporting their inclusion into the national energy efficiency policy. In Lithuania on the other hand, where sustainable cooling is almost unknown, KeepCool found it hard to get public appearance.

Another success factor was the existence, and the access to, already established dissemination networks. EcoFacility in Austria started already in 2004, and KeepCool could join an already established network of building energy consultants. In Sweden, KeepCool could work with the networks of various professional associations. In Germany on the other hand, KeepCool tried to organise a national conference on sustainable cooling and had to cancel it because of a lack of registrations. The higher effectivity and security of using existing dissemination channels was also the reason for presenting KeepCool at numerous international meetings instead of organising one stand-alone conference on sustainable summer comfort.

KeepCool had the biggest impact with a dissemination strategy where indirect marketing methods (press, information on the web, events etc.) and direct advice to the target groups supported each other. In countries, where one of these elements was not given, KeepCool had difficulties in reaching the desired impact: Pure information campaigns might have great influence, but it is impossible to monitor and allocate the results to the project. On the other hand, the offer of direct advice reached only a limited number of recipients without the support of a public information campaign or of a strong existing national network.

Another important point at the marketing strategy was its flexibility: Some countries based their marketing strategy on the toolkit, which was originally planned to be one of the first outputs of the project. However, the content work took more time than expected, and was even more delayed by promising dissemination and policy opportunities that showed up in the first months of the project, so that the toolkit was only available much later than expected. Countries that had a flexible approach could make reasonable marketing without the toolkit; those who were waiting for the toolkit missed many opportunities for dissemination at the beginning of the project.

These three factors are complementary, and must have a good balance for successful dissemination. Ideally, all three factors are available: There is already some awareness at the target group, one can rely on existing national or regional networks, the marketing strategy is balanced and flexible enough to accommodate changes in conditions over time. If one of them is missing, focusing on the others can compensate for this. However, it will be difficult to have sufficient impact with only one of the named factors.

CONCLUSIONS

Sustainable summer comfort has a long way to go in Europe. For its broad market implementation not only the addition of new technologies is required, but also a change of the present planning and tendering culture. Here, architects are forced to delegate the achievement of summer comfort to HVAC engineers, who in turn cannot intervene in decisions about the building envelope, lighting systems, and not even the building layout which affects the placement of mechanical equipment and ducts. The result of this lack of integration is a large number of highly serviced buildings, which are less pleasant to inhabit, more costly to build and several times more costly to keep comfortable in summer than buildings planned with the approach of sustainable summer comfort.

The KeepCool project provided a good base for future activities in this field: It brought together the results of many research projects into one consistent approach for sustainable summer comfort, and developed understandable information material for the most important target groups. In addition, it contributed to European and national regulations that promote summertime energy efficiency with the help of passive cooling, and started with market implementation in eight European countries, delivering important experience on the opportunities and difficulties of the market.

With the help of recent political and market developments, sustainable summer comfort will gain new opportunities. The EPBD and the ESD will provide strong incentives towards energy efficient buildings in the near future. In addition, rising electricity prices and the increasing risk of local blackouts in summertime drive attention to the extensive energy consumption in air conditioning. In this context, the ideas and insights gained in KeepCool should continue to be spread. Here, a strong emphasis should be laid on using already existing networks of the target groups, the strong influence of Best Practice in the public and private sectors, and to the opportunities given with the national Energy Efficiency Action Plans and the energy certification of buildings.

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