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How to Improve Building Performance, Save Energy & Costs

2020 Sea Change in Sight

Low Cost & Carbon Energy for Buildings in the Netherlands

2020 Sea Change in Sight

Low Cost & Carbon Energy for Buildings in the Netherlands

Piet Heijnen, ECBCS Executive Committee Member for the Netherlands

Clean Efficient Energy & Innovation

The Netherlands is a small, productive country with a wide range of energy-dependent industrial and social sectors. In recognition of global energy and climate change concerns, the Dutch government introduced its so-called **Schoon & Zuinig (S&Z)** climate and energy strategy aimed at having one of the cleanest and most efficient energy infrastructures in Europe by 2020. Measures for achieving this goal include improved efficiency, increased use of renewable energy sources and CO_2 reduction.

To stimulate innovation, the government has developed an innovation agenda, identified a number of research and development (R&D) themes and instituted transition and public-private platforms focused on sustainability and the country's strengths. This includes the Built Environment R&D theme and the **Energy in the Built Environment Platform (PeGO)**.

Besides existing committed investments over the next 4 years, in 2009 the government introduced an incentive package for offshore wind farms and energy efficient homes. Funding is provided via SenterNovem's **Energy Research Subsidy (EOS)** scheme.

Background

Climate and Energy Vision and Strategy

The S&Z climate and energy strategy is intended to achieve one of the cleanest and most efficient energy infrastructures in Europe by 2020. To achieve this goal, in 2007 the government set the following ambitious targets for 2020:

- a 2% efficiency gain per year,
- 20% of energy from renewable energy sources, and
- 30% CO_2 reduction.

A cornerstone in achieving the government's vision is *innovation*. The government's energy innovation agenda includes seven themes, including energy in the built environment. Each theme is embodied by a platform consisting of representatives from market participants, scientific and civic organizations and the government. The platforms are public-private frameworks of cooperation focusing on achieving a sustainable energy supply. Seven platforms are now operating, including PeGO.

The government's 2008 Energy Report identified several new areas

Figure 1. Examples of 'near zero energy' dwellings in the Netherlands.

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About the Netherlands

The Netherlands is a small, flat, densely populated country surrounded by sea to the west and to the north. Its struggle against the sea is historic and takes on even greater significance in the light of present-day and projected future climate change.

The Netherlands has an open economy with well-developed economic sectors that include the chemical and petrochemical, agro / food and life sciences, manufacturing and production sectors, the financial and services sectors, as well as the gas and offshore energy sector.

The country has been a natural gas producer since 1970, supplying around 70 billion m^3/year. About 61% of the country's fuel mix is used for electricity production purposes. Primary energy use is focused on industry, domestic, transport and other sectors.

of focus, including the use of the North Sea as a source of energy, smart grids and gas roundabouts. The report also calls for energy systems that are reliable, affordable and clean, changes that produce systems that are cleaner, smarter and more diverse and for an integrated approach to energy, consumer, industrial and innovation policy.

Committed Investments and 2009 Stimulus Package

The government's current committed investments over the next 4 years total over €7.4 billion in the areas of renewable energy, energy efficiency, CO_2 reduction, innovation and energy security.

Furthermore, in 2009 the government introduced an incentive package aimed at the development of offshore wind energy (an additional €2 billion) and the development of energy efficient homes (€160 million in 2009 / 2010).

The Built Environment

Context

The **Built Environment Innovation Agenda (BEIA)** is part of the Dutch S&Z climate and energy strategy and focuses on both residential and commercial buildings. The main objective is to ensure that, by 2020, the built environment reduces CO_2 emissions by 6 - 11 megatons per year. Considerable CO_2 reductions are possible for both existing and new buildings. Over the past few years, a wide range of new techniques has become available, although large-scale applications are still in their infancy. Collaboration between the government, construction sector, housing corporations and private home owners or tenants is vital and ways must be found to remove financial and institutional bottlenecks.

The BEIA is based on recommendations by bodies such as PeGO, and describes the route along which energy innovations could be encouraged and implemented on a large scale.

The BEIA consists of three programmes:

- **Thinking**: conceiving and developing new energy techniques, concepts and collaborative forms;
- **Doing**: where small-scale basic techniques and concepts are implemented in practice and closely monitored; and
- **Scaling Up**: where successful concepts and techniques are implemented on a large scale.

Intended Results

If national policies remain unchanged, the total net primary energy use for the built environment in the Netherlands will develop to a level of 1000 PJ/year. The total transition scenario ensures that, by around 2040, energy use in the built environment will be reduced to a level of 100 PJ/year.

The BEIA specifically focuses on removing obstacles to innovation by promoting research into market creation, arranging attractive forms of financing and persuading stakeholders to implement innovative projects. In particular, competent and careful monitoring of demonstration projects (Doing) forms the basis for selecting market-ready concepts and optimising innovations.

When implementing these concepts, it is vital that the BEIA is implemented in close collaboration between the federal government, stakeholders (developers, builders), as well as the demand side of the market and knowledge institutes.

Other S&Z Built Environment Related Measures

The Dutch government is tightening the Energy Performance Requirements (EPR) for new residential buildings by 25% in 2011, up to 50% in 2015 (compared with 2007) and targetting energy-neutral construction in 2020. The EPRs for commercial buildings are also being tightened, so that (from 2017) new buildings will be 50% more energy efficient.

Energy suppliers, together with housing corporations, builders and installation companies, have drawn up a plan known as **Meer met Minder**, which focuses on existing residential and commercial buildings. The plan is to ensure that 500,000 buildings will be 20%-30% more energy efficient from 2011. In the same year, 100,000 existing homes will be using sustainable energy supplies. Various subsidy schemes are among the measures aimed at achieving this plan.

The government has also made agreements with housing corporations concerning energy performance improvements to homes in the rental sector.

The Energy Research Subsidy Programme

Introduction

The Dutch government's current plans should enjoy smooth sailing. Agreements incorporating ambi-

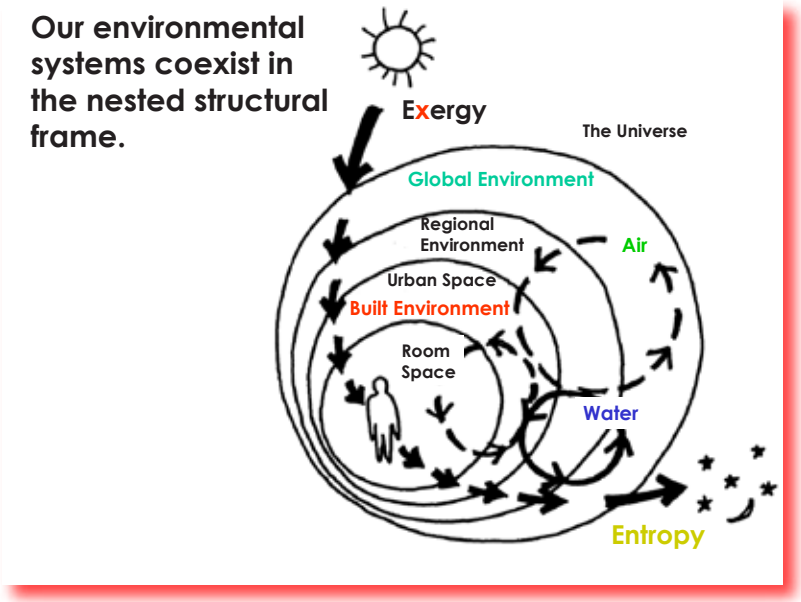


Figure 2. The Netherlands is investigating 'low exergy integral approaches'. Source: Prof Masanori Shukuya.

tious energy saving goals are being signed on many fronts between government and implementing bodies. One of the ways in which the Dutch government is providing support is through the provision of subsidies for research and demonstration projects. SenterNovem, an agency of the Dutch Ministry of Economic Affairs, is responsible for implementing the **Energy Research Subsidy (EOS)** Programme.

The EOS Programme includes the following subsidy schemes that cover the entire development process from the initial idea right up to market introduction:

- **New Energy Research**: the breeding ground for radically new ideas.
- **Long Term Research**: for acquiring fundamental knowledge.
- **Demonstration**: for testing innovative technologies.
- **Short Term Research**: feasibility studies and new product and system research and development.
- **Unique Opportunities Scheme**: large-scale implementation of energy saving measures.

EOS Subsidy Schemes & the Built Environment

New Energy Research

This scheme is designed to recognise ideas that could provide the motivation for entirely new development directions: radical ideas for achieving energy savings.

Long Term Research

A number of interesting projects have already been submitted for consideration under this scheme. The common denominator of all these projects is that they are taking a new look at the relationship between construction and installation engineering: the integral approach.

Examples of such projects include:

- Homes as energy supply systems.
- Integral approach for achieving energy reductions of 75% or more through renovations.
- How to transform a building into an integral energy supply machine.

Demonstration

This scheme subsidises building projects that demonstrate innovative technologies. The basic principle underlying all projects is that they must achieve energy savings representing a 50% to 60% improvement over buildings that meet current regulations.

Nine demonstration tenders have been completed since 2005, with a 10th currently underway. A budget of around €10 million has been set aside for each tender. To date approx 35 built environment-related projects have been accepted.

Short Term Research

This scheme is primarily designed to provide access to financial resources for small and medium-sized enterprises (SMEs) for research and development into products that require a final push to bring them to market. This scheme was only introduced two years ago in its current form, but is used often. SMEs are an important source of innovations.

The Unique Opportunities Scheme

This scheme provides opportunities for large-scale applications as a means of stimulating the scaling up of new energy saving measures and / or products.

Of the four Unique Opportunities tenders completed, two had a very specific objective: one for residential construction projects with energy savings of 55% or more and the other specifically designed for offices and schools with high energy saving targets.

Additional Information

www.senternovem.nl/eos

www.senternovem.nl/enegietransitiego.nl

www.meer-met-minder.nl

www.senternovem.nl/eos/infotheek/publicaties/publicaties/energy_innovation_agenda.asp

The Future's Bright

New ECBCS Guidebook on Efficient Artificial Lighting for Buildings

Liisa Halonen & Eino Tetri, Helsinki University of Technology, Finland

Introduction

The ECBCS project "Annex 45: Energy-Efficient Future Electric Lighting for Buildings" has recently produced a new Guidebook on energy efficient lighting. The Guidebook is intended to be useful for lighting designers, electrical building services and system integrators in buildings, end-users / owners and all others interested in energy efficient lighting.

The goal of the project is to identify and to accelerate the widespread use of appropriate energy efficient high-quality lighting technologies and their integration with other building systems, making them the preferred choice of lighting designers, owners and users.

The project has assessed and documented the technical performance of existing promising, but largely underused, innovative lighting technologies, as well as future lighting technologies and their impact on other building equipment and systems (i.e. daylighting, HVAC). These novel lighting concepts have to meet the functional, aesthetic, and comfort requirements of building occupants. The aim is to assess and document the barriers preventing the adoption of these promising existing and future technologies (i.e. technical, economic, risk factors, resistance to change, legislative, etc.) and propose means to resolve these barriers.

Global Context

Lighting was the first service offered by electric utilities and it continues to be a major source of electricity use. Globally, almost one fifth of total electricity generated is used in lighting. According to an International Energy Agency (IEA) study, global grid based electricity used about 2650 TWh of electricity in 2005; an equivalent of 19% of total global electricity use. More than 50% of this lighting electricity is used in IEA member countries, but will not continue to be the case in a few years due to the increasing growth rate of lighting electricity use in non-IEA countries.

Lighting Quality

Energy efficiency in lighting cannot be reached at the expense of quality. Lighting quality is dependent on several factors. However, there is no complete answer to the question: "What does lighting quality mean?". It depends largely on people's expectations and past experiences of electric lighting. The definition that seems most generally accepted is that lighting quality is given by the extent to which the installation meets the objectives and constraints set by the client and the designer. In this way lighting quality is related to objectives such as enhancing performance of relevant tasks, creating specific impressions, generating desired patterns of behavior and ensuring visual comfort. The constraints may be set by the available financial budgets and resources, set time-lines for completing the project and pos-

Guidebook on Energy Efficient Lighting

The main deliverable of the project is the Guidebook on energy efficient lighting. The Guidebook content covers the topics listed below.

1. Introduction
2. Lighting energy in buildings
3. Lighting quality criteria
4. Lighting and energy standards and codes
5. Lighting technologies
6. Lighting system control
7. Life cycle analysis and life cycle costs
8. Lighting design and survey on lighting today and in the future
9. Commissioning of lighting systems
10. Case studies
11. Technical potential for energy efficient lighting and savings
12. Proposals to upgrade recommendations and codes
13. Conclusions

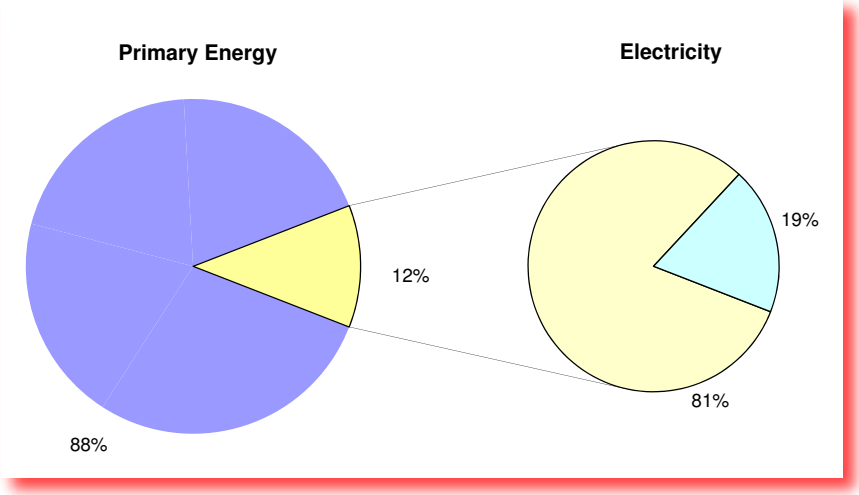


Figure 1. Global lighting energy use. Although global electricity use is equivalent to 11.8% of total worldwide primary energy use, due to the electricity generation losses, the share of electricity related primary energy use is much higher.

sible predetermined practices and design approaches that need to be followed. The Guidebook deals not only with visual aspects, such as visual performance and comfort, but also with the psychological and non-visual-aspects of light and the effect of light on productivity.

Lighting Control

Environmental and occupancy changes in a building increase the complexity of control operations. Occupants not only impose control goals related to thermal comfort, visual comfort or indoor air quality but also influence the building processes impacting indirectly on the control functions of the different processes (HVAC, lighting etc.). Due to the increase of environmental concerns, lighting control systems will play an important role in the reduction of energy use of the lighting without impeding comfort goals. To illustrate the potential gain obtained with different control strategies an office building has been simulated according to the French building energy calculation method. Tests have been carried out for two climatic zones - Paris and Nice - on a 600 m² office building. The predicted occupancy control strategy (based on a schedule) produces a 10% energy saving whereas real occupancy (based on presence detector) gains a 20% energy saving. It is noted the impact of daylight-harvesting depends on the climatic zone. So, in an office building, the potential savings vary from 30% (Paris) to 40% (Nice). Coupling of different strategies should result in increased energy savings, for instance, daylight harvesting and real occupancy achieves up to 50% gains. These gains are functions of the room and window sizes, building orientation and sensor(s) position(s).

Future Trends

Figure 2 presents an estimation of the development of the global electrical-light production in the year 2015 compared to year 2005. Generally, in comparison to 2005, an increase of approximately +25% is to be expected. It is estimated, however, that due to an improved 'facility efficiency' and 'service-life optimization', this will be reduced. Taking these into account, the outcome is a reduction in the overall light production of approximately 20%. (Light production is calculated as megalumen-hours per person per year.)

At the same time, it can be expected that there will be a clear reduction of the use of standard incandescent lamps due to legal regulations (e.g. the step by step abolition of standard incandescent lamps in the European Union) and an increase in compact fluorescent lamps and LED lamps.

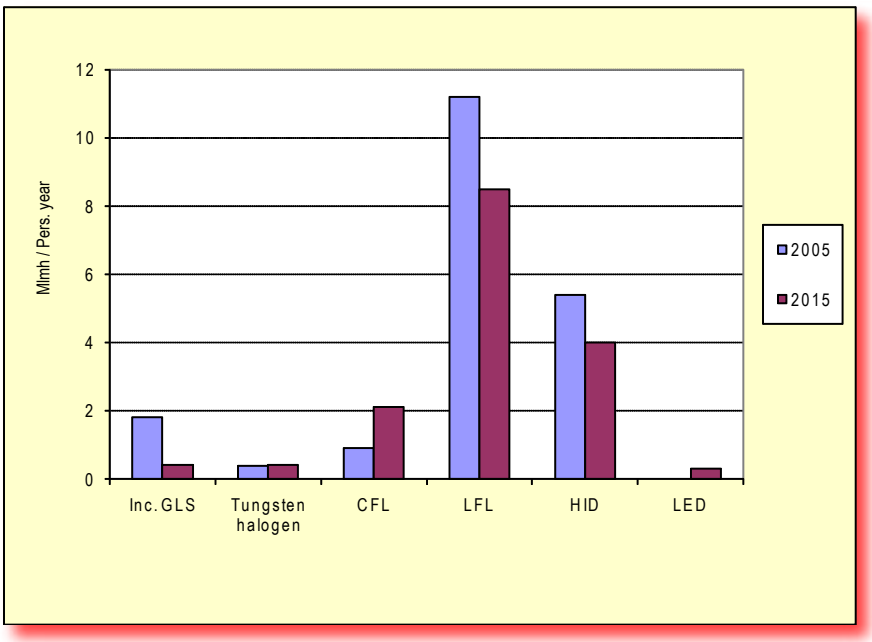


Figure 2. Change of light production, estimated by the project. Key - Inc. GLS: incandescent, general lighting service; CFL: compact fluorescent lamp; LFL: long (tubular) fluorescent lamp; HID: high intensity discharge; LED: light emitting diode.

Conclusions

There is a significant potential to improve energy efficiency of lighting installations already with existing technologies. The energy efficiency of lighting installations can be improved with the following measures:

- The choice of lamps. Incandescent lamps should and will be replaced with CFLs or LEDs, mercury lamps with high pressure sodium lamps or metal halide lamps, T12 and T8 fluorescent lamps with T5 lamps.
- Use of controllable electronic ballasts with low losses.
- The lighting design. Use of efficient luminaires and directing light where it is needed.
- The control of light with manual dimming, presence sensors and dimming according to daylight.
- Use of daylight.

Lighting is a large and rapidly growing source of energy demand and greenhouse gas emissions. At the same time the savings potential of lighting energy is high even with current technologies and there are still new energy efficient technologies entering the market.

The introduction of more energy efficient and ergonomic lighting products and procedures can simultaneously provide better working environments and also cost-effectively contribute to the global reduction of greenhouse gas emissions.

Additional Information

www.ecbcs.org
/annexes/annex45.htm

Sustainable Buildings & Communities: Integrating Emerging Low Exergy Approaches

"The Future for Sustainable Built Environments" ECBCS Conference Report

Herena Torío & Dietrich Schmidt, Fraunhofer Institute for Building Physics, Germany

Introduction

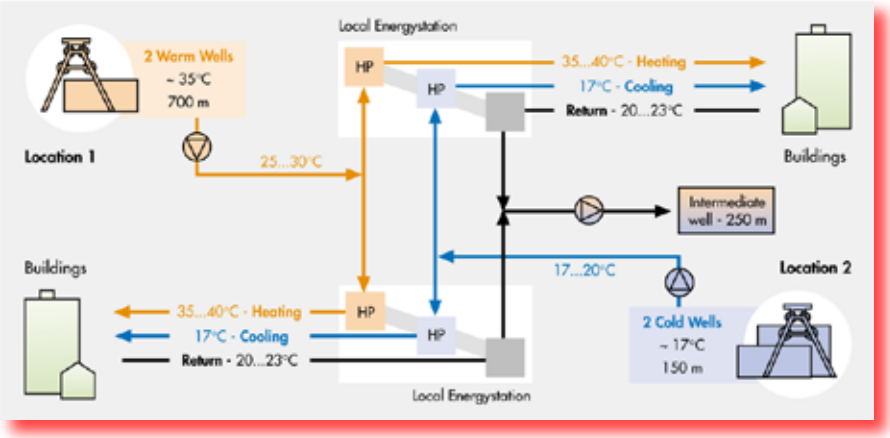
As a consequence of the latest reports on climate change and the required reduction in CO_2 emissions, huge efforts must be made in the future to conserve high quality (primary) energy resources. In addition to the considerable energy saving potential in the building stock, results of the latest research show there is an equal or greater potential in *exergy* management (see box opposite). This implies working with the whole energy supply chain to significantly reduce the fraction of primary or high-grade energy used and thereby to minimise exergy consumption, taking into consideration the different quality levels involved, from generation via the energy supply infrastructure to final end use.

Results obtained from research projects on optimised rational exergy consumption in buildings are promising and indicate a huge potential for introducing new components, techniques and system solutions to create low exergy built environments. Exergy conversion, e.g. thermal energy or electricity production, plays a crucial part in possible future activities in the overall optimisation of the entire energy system within a building. To bring these research results to a wider public and as a platform for discussions about related issues, ECBCS has organised the international conference "The Future for Sustainable Built Environments – Integrating the Low Exergy Approach".

The Conference

A one-day conference held on 21st April 2009 was a joint activity from the partners of the ECBCS research project "Annex 49: Low Exergy Systems for High-Performance Buildings and Communities" and the European COSTeXergy project "Analysis and Design of Innovative Systems for Low Exergy in the Built Environment". This conference focused on the future of sustainable built environments and was intended to provide cutting edge results in the field of exergy analyses of buildings and communities.

A collaboration platform was created for further information exchange and discussion among participants. Thus, research institutions, universities and industry partners were invited, alongside interested stakeholders and policy



Schematic of the Heerlen minewater grid

What is Exergy?

Exergy expresses the quality of an energy source in terms of the potential for useful work extraction it is able to derive from a system. The exergy content of energy sources required to satisfy the demands for heating and cooling of buildings is very low. Nevertheless, high quality energy sources like fossil fuels are commonly used to satisfy these small demands for exergy. Therefore, **low exergy (LowEx) systems** for buildings and communities are desirable. These are designed to make use of low quality energy sources for heating and cooling.

To achieve this matching between the quality levels of the energy demand with that supplied, new advanced technologies have to be implemented. For instance, the use of low temperature (and quality) heat sources, such as waste heat, ground heat or solar heat for providing space heating demands requires the use of low temperature heating systems such as floor heating or thermally activated systems within the building. For the cooling situation innovative technologies such as **phase change material (PCM)** systems allow reduced peak cooling loads and supply cooling demands at a high temperature level (i.e. low quality and therefore exergy efficiently).

At the same time as the use of high quality energy for heating and cooling is reduced, there is more reason to apply an integral approach, which includes all other processes where energy / exergy is used in buildings and in community systems.

The "Gen Coel" Energy Center hosted the Conference, located in Heerlen, the Netherlands. The building features shading that tracks the sun.

makers to present their subjects, approaches, products and applications as well as ongoing research relating to the exergy concept.

The Venue - A LowEx Case Study

The venue of the conference "Gen Coel" in Heerlen, The Netherlands, is itself one of the main locations for an ECBCS Annex 49 case study of a community system. In this project, the water reservoirs from old coalmines are used to run district networks to provide heating and cooling to several building sites. It represents a significant example of the application of low exergy principles in the built environment, both for building components and for community energy supply structures. Thus, it was an ideal setting to hold the conference, allowing for technical tours and a real life experience of the potential for the LowEx approach.

Outcomes

Experts at the conference were keen to ensure faster adoption of the emerging LowEx ideas for building technologies. While good technologies already exist, there is still room for development of new technologies and marketing measures are also needed. Also demonstration, education and awareness raising is mandatory for new ideas to succeed. In terms of the business case, there is a need to move from component-based to solution-based markets.

The importance of the proper consideration of changing indoor conditions on human comfort and health, as well as the required changes in HVAC system arrangements were stressed by participants in another discussion group.

A further group discussed the use of so-called capillary tube systems in combination with PCM thermal storage. It was agreed the technology is very promising, but more measured data from real built case studies are needed. Moreover, the problem of better understanding of heat storage phenomena in buildings was discussed.

Within a session on community systems the discussion focussed mainly on the planned developments on the Hoogeschool Zuyd campus. In addition, the different options for an energy and exergy efficient supply system were discussed in the final plenary session. The connection to the Heerlen minewater grid was also a big issue during the conference.

The question of how to involve students in refining exergy and energy concepts was raised. The participants agreed on the necessity to put effort into educational involvement to disseminate ideas about exergy efficiency.

The conference was targeted at strengthening political awareness of the importance and applicability of this thermodynamic approach to building and community systems. It is believed it successfully formed a first step in this ongoing process.

Additional Information

www.ecbcs.org
/annexes/annex49.htm

Tune in to High Performance Buildings

Reducing Energy & Costs through Proper Commissioning

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Daniel Choinière, CANMET Energy Technology Centre -Varennes, Canada

Building commissioning is a quality assurance process that, if applied more widely and at earlier stages in the building life cycle, has the potential to dramatically reduce building energy use and improve performance. In practice, significant inefficiencies in the building delivery process and information loss throughout the building lifecycle increase the potential for error, as seen in Figure 1. During the design, construction and occupancy phases of buildings, the players and experts, who hold the knowledge of the building and its systems, change frequently. Tasks are completed by different people and even different companies; with the change of players within a project, knowledge that would be helpful or even important for future tasks is often lost. In particular, the commissioning authority and later on the operation personnel need to have a clear understanding of the details of and intentions for the design. While for standard systems missing information can at times be compensated by experience, it is hardly possible to do so for advanced and innovative systems.

There is an internationally recognized need for improved quality assurance and it is even more critical that low energy buildings be commissioned to optimize operation based on actual occupancy and use. In several countries, the buildings industry has responded to encourage and improve commissioning practices but the process is generally carried out manually, the quality varies widely, and the perceived cost and time investment is often deemed prohibitive.

Since 2004, ECBCS has brought together experts from 12 countries in Asia, Europe, and North America to study the methodologies and tools needed to enable the cost-effective commissioning of existing and low energy buildings. The collaborative project has addressed three important research areas:

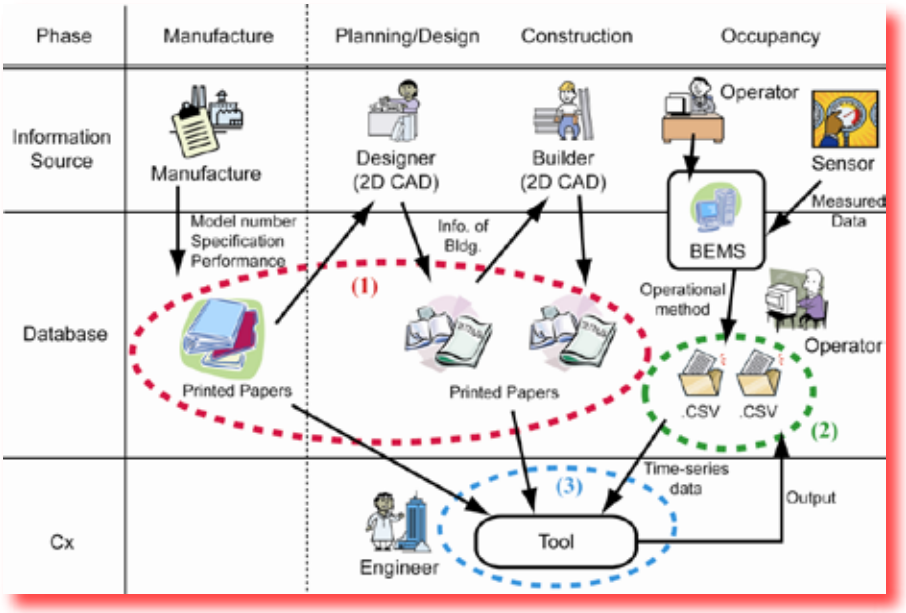

Figure 1. Present information flow.

- **Information Flow.** Documentation processes must be improved to retain the information obtained and created during the design process to leverage proper and cost-effective commissioning of advanced and low-energy building systems.
- **Commissioning Methods and Tools.** Documented commissioning methods are currently available on a limited basis for conventional HVAC systems and must be extended to address the systems and system combinations that are critical to the proper performance of **low energy buildings (LEBs)**, such as demand control ventilation, radiant floor heating, and underfloor air distribution.
- **Cost-Benefit and Persistence Data.** There is a need to address technological and process barriers to achieve greater market penetration. Although the environmental and energy saving benefits for commissioning are significant, demonstrating cost-effectiveness, including the persistence of commissioning measures will remove a major barrier to the wider market acceptance of commissioning.

Using Flowcharts & Data Models for Initial Commissioning

The fragmented building delivery process, combined with the range of disciplines participating in the process, ensures multi-dimensional demands for the data models and flow diagrams used in commissioning. Variations in international building delivery processes add another layer of complexity. This is an area of practice with complex data and process management needs. Without digital tools to assist in this management task, there are significant losses of information, time and money. Figure 2 shows how information and data accumulate in each phase of building delivery. Due to the difficulty of

maintaining consistent information representation when transitioning to each successive phase, not all of the data available in the previous phase is made available to subsequent phases. As a result, key information is lost during these transition points and has to be subsequently recovered, exposing the project to an additional risk of errors. This 'saw tooth' effect means that significant time and effort are wasted.

Figure 2 illustrates a vision of the future where the commissioning agent is able to:

- access a very large portion of the data needed through data-mining and sensor-control feeds;
- produce reports, recommendations, and persistent data stores, digitally and with interoperability; and
- share these products with a variety of building professionals including architects, design engineers, facility managers, building operators, owners and equipment manufacturers.

To enable this vision, commissioning data and processes must be formally represented in databases and associated algorithms in a format compatible with tools used by different practitioners and over long periods of time. This requires that interoperable, persistent and accurate data as well as process models are made available to the commissioning agent.

Therefore, the project team has recommended use of the following to improve the building commissioning process:

- Integrated DEFinition methods (IDEF0 and IDEF3) as a shared representation by all constituents involved.
- Functional Performance Tests (FPT) and similar commissioning protocol data as a testbed for commissioning Flow Charts and process models.

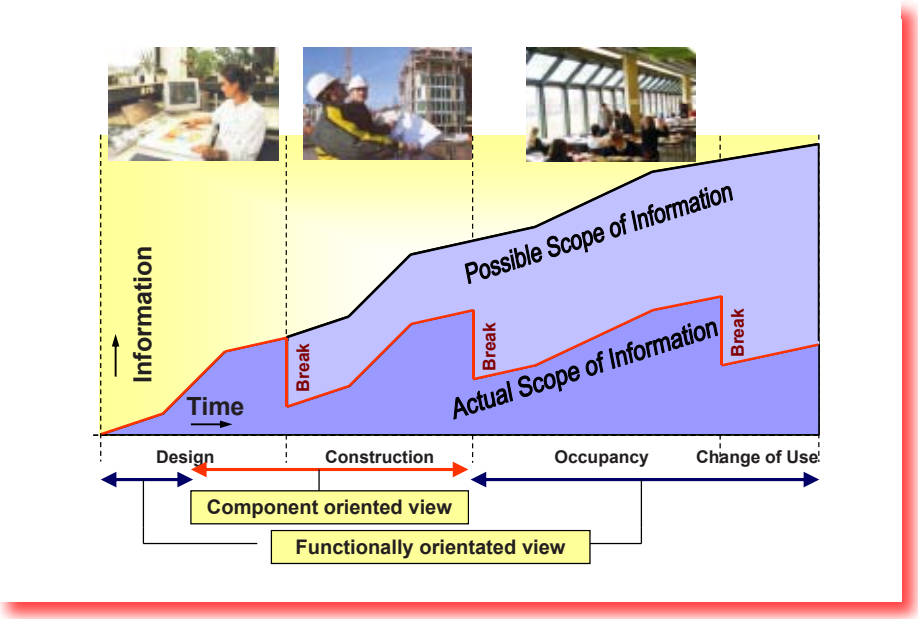

Figure 2.The vision of the future.

- existing energy auditing, the "green movement," and building occupancy certification procedures as leverage to implement the purposes of commissioning.
- available product modelling software such as Express Language of the Industry Foundation Classes (IFC), Seadec data eXchange Format (SXF), and Green Building XML (gbXML) to represent building performance data and FPT protocols for the commissioning.
- conventional database representations such as ACCESS, RDBMS, and HDF5 to formalize data representations and Flow Charts.

Participants in the commissioning process must strive towards standardizing parameters of commissioning data, users, and practices. It is critical to find representations that can carry data from one phase of building delivery to the next one seamlessly minimizing the loss of data. Current efforts in the area of building information modeling (BIM) can provide good opportunities for the development of parallel models and software applications for commissioning of advanced and low-energy buildings. As these approaches advance, researchers can use pre-specified data and flow chart categories to develop historic data records for commissioning of advanced and low-energy buildings to leverage the research challenges of cost, function, and payback in digital commissioning tools.

Re-Commissioning & Optimization of Existing Buildings

As with any type of commissioning effort, re-commissioning, retro-commissioning, and optimization can be labor and cost-intensive efforts that demand highly trained experts.

The development of tools has been identified as a key element to remove these barriers and facilitate the market penetration of the commissioning process.

One of the challenges in developing commissioning tools is to address the different needs of existing buildings and new low energy buildings. Low-energy buildings emphasize an integrated systems approach throughout their life cycle; some buildings may comprise novel and / or advanced technologies and system operation strategies, while others take full advantage of existing technologies.

For conventional buildings, the interest to improve methodologies and develop automated and semi-

automated tools is based on the sheer number of buildings, their high-energy use, and the fact that very few have been commissioned. Therefore significant energy savings will be attained at the national level by applying cost effective processes for commissioning and optimization of building envelopes, HVAC systems, and the building energy management systems (BEMS) in conventional buildings.

The goal for re-commissioning is usually to get the best performance with existing systems (e.g, run fault detection and diagnostic, FDD algorithms and, if problems are identified, run specific FPTs). However, conventional buildings often lack design data and have limited monitored data, while the addition of new sensors and minor refinement of present systems must be shown to be cost-effective. In contrast, new low energy buildings do have design data and the goal for commissioning is performance verification. Here, FPTs can be used to clarify or diagnose any abnormal operation. In all buildings, thorough documentation is important to build the benchmark for persistence of energy savings and system performance.

The tools developed are classified as those intended for:

1. **active testing**, where setpoint changes or control overrides are used to force equipment and system responses;
2. **passive monitoring**, where performance is assessed under normal and optimal operating conditions;
3. **data management**, which help facilitate testing and data analysis; and
4. **system operator training**.

The following are examples of the range of tools developed in the research area of “Recommissioning and Optimizing Existing Buildings”:

1. **Commissioning (Cx) Tool for the Whole Building Level**: a tool that continuously monitors the overall heating, cooling, electricity use and indoor temperatures. These serve as inputs to the overall energy performance analysis and optimization of commercial office buildings. (see Figure 3).
2. **Cx Tool for HVAC Systems**: an automated tool to help users verify and optimize the performance of building HVAC systems using the capabilities of a building energy management system. A reasoning algorithm performs an intelligent analysis of all building control data and also performs additional automated commissioning of HVAC components and systems.

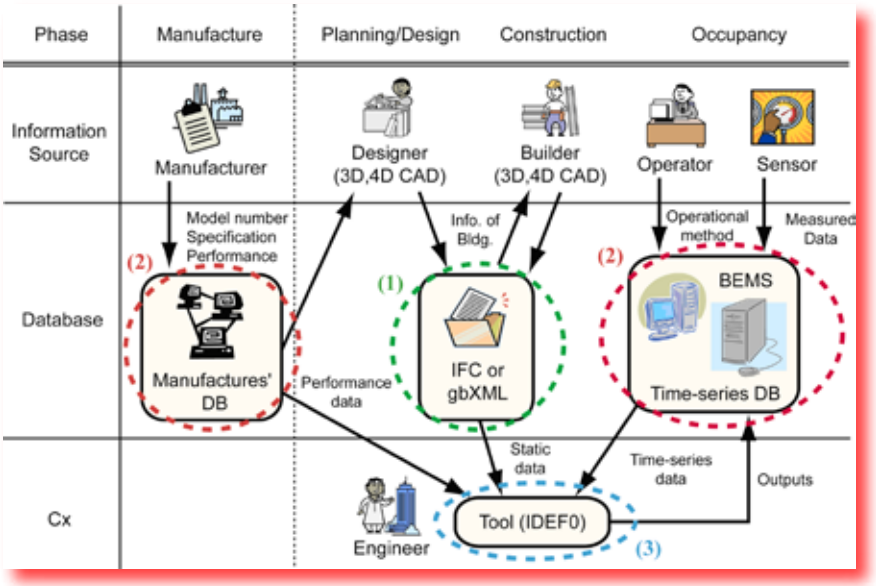

Figure 3. Proposed information flow mechanism.

Making the Case: Quantifying the Benefits, Costs, & Persistence of Commissioning

Internationally, much of the cost-benefit data available today is piecemeal or anecdotal in nature. The lack of systematically documented and quantified data on the costs and benefits of commissioning is due in part to the varying degree to which commissioning is established in countries as well as the cost and or difficulty in measuring both energy and non-energy benefits. A literature review, which focused on countries involved in the research project, found 13 relevant cost benefit case studies that ranged from single building to a 175 project meta-analysis. However, there were numerous unresolved questions about how the costs, benefits and persistence of benefits should be defined and determined. An added difficulty in the review of persistence studies is that the number of existing persistence studies in the literature was so small that each used its own evaluation approach.

The project has developed a comprehensive and systematic cost-benefit methodology that addresses the treatment of cost-benefit issues. This methodology was based on lessons learned from the literature review and issues encountered by participants. The team considered the definition of costs and benefits, level of verification, role of stakeholder interests, data collection approaches, and the influence of project organization and contractual clauses on the cost-benefit of the commissioning process. The cost benefit methodology is implemented in an Excel spreadsheet that contains fields designating the key pieces of information that are deemed essential in performing the most basic cost-benefit analysis. A more complete version of the tool is also available that is use-

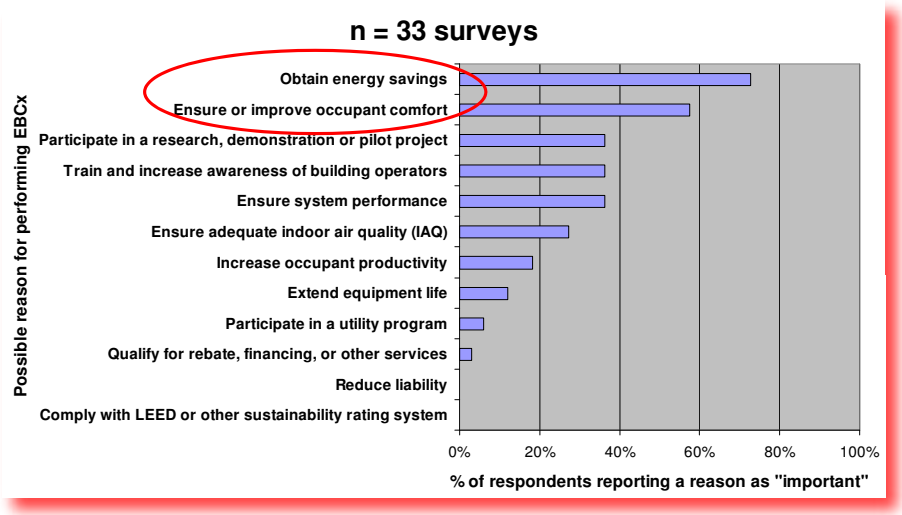

Figure 4. Reported reasons for performing Existing Building Commissioning.

ful in informing project personnel on the information that should be gathered to make a more complete assessment. The recommendations include fields for including non-energy benefits that are inherently difficult to quantify.

A standard methodology will ensure future assessments can be carried out in a systematic manner and added to a searchable database of projects. By enabling decision makers to access relevant cost-benefit data from similar projects, they can learn from the experience of their peers and move towards adopting best practices with a long-term outlook.

The research team used the cost benefit methodology and applied it to data available from 10 new construction and 54 existing building commissioning projects across a range of countries. From the data, it was found that while most projects had complete data for the project information section, very few had the data required to determine the cost effectiveness. This deficiency highlights the need to establish a standard set of data that is documented throughout the commissioning process. The data collected identified some of the market drivers and current practice. For example, Figure 4 shows a bar graph of the motivation for existing building commissioning in 33 international commissioning projects while Figure 5 shows the percentage of measures implemented by type.

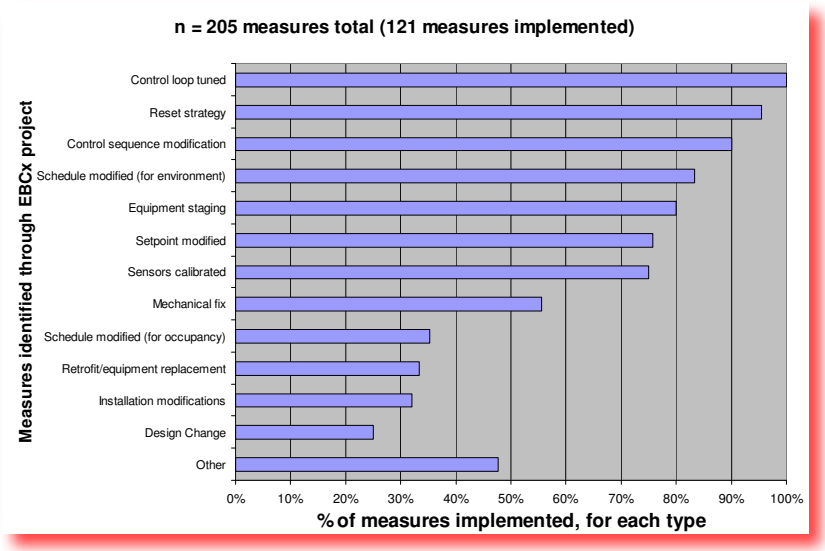

Figure 5. Percent of measures implemented, by type.

Dissemination of Results

The new procedures and tools that have been developed and applied to low energy buildings have shown significant benefits. The aim of this research project is to scale up the impact by incorporating the validated procedures and tools into standard commissioning practice in order to achieve even greater energy savings and green house gas reduction in the building stock. The final reports of the research project on “Cost Effective Commissioning in Existing and Low-Energy Buildings” are now available.

Additional Information

www.ecbcs.org
/annexes/annex47.htm

Over 90 reports from ECBCS projects are available now for free download from:

www.ecbcs.org/docs

New Member Country: China Joins the ECBCS Programme

On behalf of the ECBCS Executive Committee, I am pleased to announce the recent decision of the Ministry of Housing and Urban-Rural Development (MOHURD) of the Government of the People's Republic of China to accept an invitation to join the ECBCS Programme. The Government of China has designated Tsinghua University in Beijing to represent them. The Executive Committee welcomes Prof Yi Jiang, currently Head of the Building Energy Research Centre at Tsinghua University as the first Executive Committee member for China and we look forward to co-operating with their research community to pursue the ECBCS Strategic Plan. More information about energy in buildings and communities in China will be provided in a future edition of ECBCS News.

Dr Morad R. Atif

ECBCS Executive Committee Chair

Additional Information

ECBCS Strategic Plan: www.ecbcs.org/policy.htm

Tsinghua University, Building Energy Research Centre: arch.tsinghua.edu.cn/chs/eng/about/3.htm

SSB 2010 Conference Announcement

8th International Conference on System Simulation in Buildings

13th - 15th December 2010, University of Liège, Belgium

Scope of the Conference

Since 1982, the SSB conference has been an opportunity for researchers and specialists in building and HVAC&R systems simulation to present high quality papers and attend sessions and discussions on the latest developments and progress in this challenging and evolutionary sector.

Once again, the conference will be organized in very close cooperation with the International Energy Agency (IEA, Energy Conservation in Building and Community Systems) and with the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).

This conference will be, among others, the occasion to present some final results arising from the ECBCS projects "*Annex 47: Cost Effective Commissioning of Existing and Low-Energy Buildings*", "*Annex 48: Heat Pumping and Reversible Air Conditioning*", the EU project HarmonAC *"Harmonizing Air Conditioning Inspection and Audit Procedures in the Tertiary Building Sector"* and some initial results from the more recent ECBCS project "*Annex 53: Total Energy Use in Buildings: Analysis and Evaluation Methods*".

Conference Topics

- Advances in modelling of HVAC&R systems and components
- Latest developments in building energy simulation methods and tools
- Simulation assisted analysis and evaluation of building energy use
- Application to commissioning, energy management and maintenance
- Application to building energy audit and retrofit
- High quality case studies exhibiting in depth use of simulation tools

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