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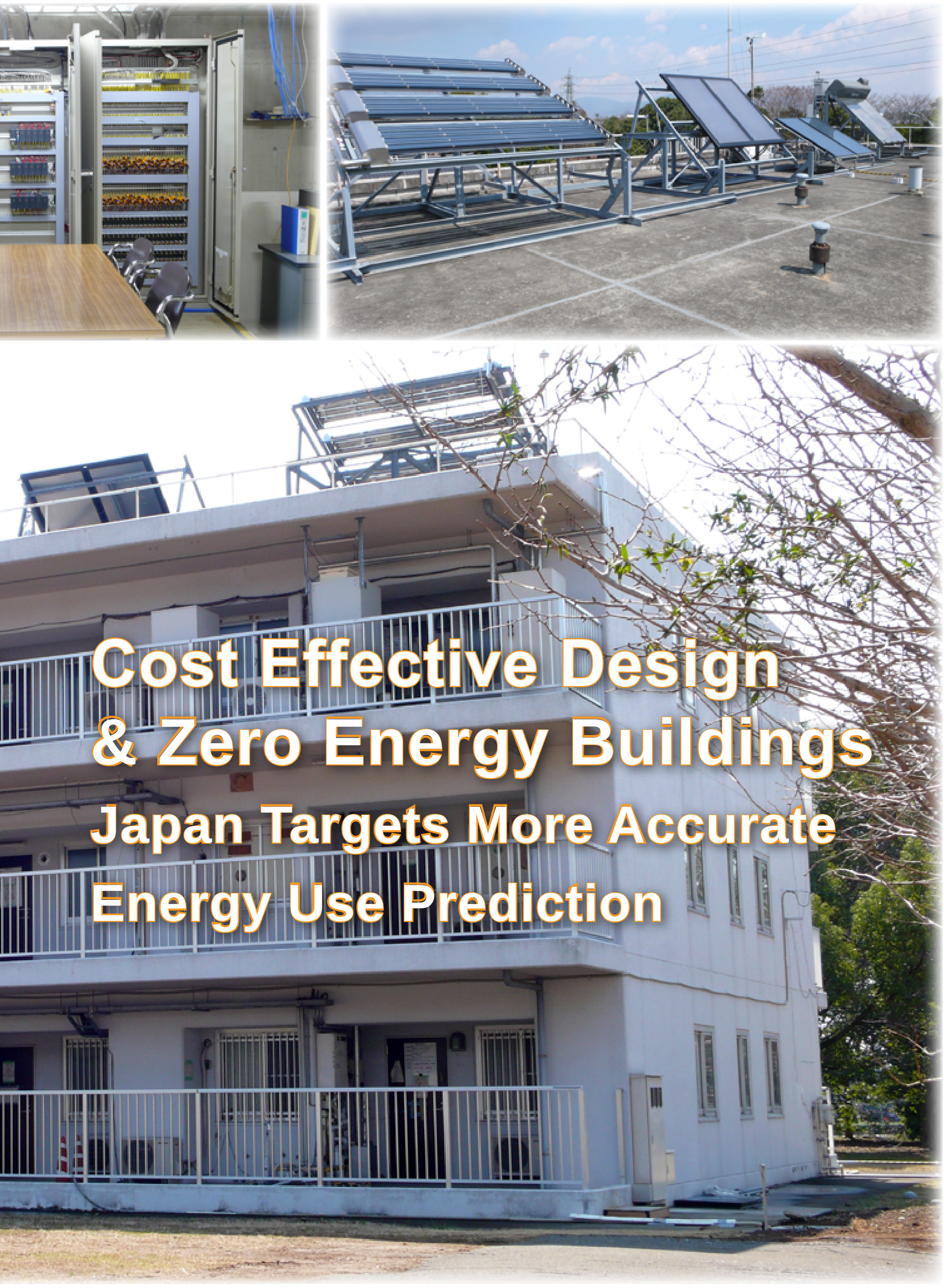
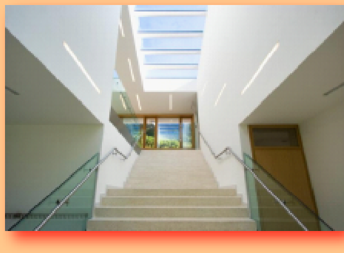


Cost Effective Design & Zero Energy Buildings

Japan Targets More Accurate Energy Use Prediction

Energy Efficient Communities

Towards Net-Zero Energy Solar Buildings



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Cost Effective Design & Zero Energy Houses

Japan Targets More Accurate Methods for Predicting Building Energy Use

Takao Sawachi, ECBCS Executive Committee Member for Japan

The energy performance of buildings in Japan is currently the focus of close attention. While energy consumption for the industrial and transportation sectors has stabilised in recent years, consumption for buildings is still increasing along with the associated carbon dioxide (CO_2) emissions. To better understand why it is increasing for buildings, it is necessary to apply more accurate methods for predicting building energy use. With this objective a new methodology for calculating the energy performance of detached houses has been in force since April 2009. Further methodologies appropriate for multi-family residential buildings and commercial buildings are also in preparation.

Estimation of building energy use

The development of reliable estimation methods for building energy consumption is not straightforward. There are many parameters that need to be taken into account. For example, space heating and cooling loads are heavily dependent on the way in which a building is used, specifically on internal heat gains and ventilation rates. Detailed assumptions of those parameters have not yet clearly been established, even those suitable for heating, ventilating and air conditioning (HVAC) system design for commercial buildings. This means that in energy use estimation a consensus needs to be reached about any reasonable assumptions relating to building use.

Actual energy efficiency of building services equipment is another influential factor that has to be treated in the development of energy use estimation methodologies. While there are numerous existing test standards for such equipment, e.g. heat sources in HVAC systems, these do not fully characterise performance in use.

A prediction method for energy use in detached houses

The Top Runner Standards for housing have been established by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in collaboration with the Ministry of Economy, Trade and Industry (METI). They have been in place since April 2009. In these standards, energy use for space heating and cooling, ventilation, domestic hot water and lighting is estimated, taking the benefits into consideration for any photovoltaic cells (PV) and cogeneration systems present. To develop the scientific foundation of the standards, various research institutes have led research projects since 2001, working in collaboration with the private sector and universities.

> *"The hot water consumption pattern is an indispensable assumption required for estimating energy use"*

Energy efficiency of room air-conditioners

Even in climatic zones with severe winter conditions, room air-conditioners are used for space heating in residential buildings. Nowadays air-conditioners

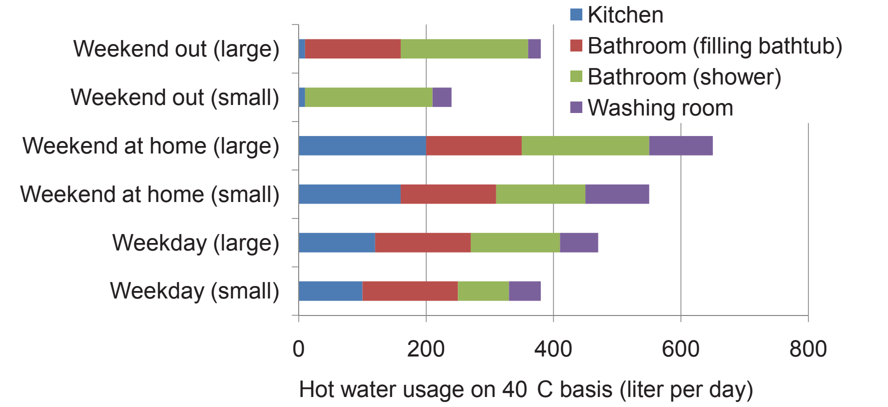

Figure 1. Domestic hot water usage pattern 'Corrected M-1 Mode' for 4-member family.

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Table 1. Standard values of energy consumption in the Top Runner Standards for housing (2009 - 2013).

Climatic Regions	Heating Degree Days based on 18-18°C	Space heating and cooling method and behaviour (only representative method and behaviour is shown for other than Ia & Ib)	Standard values of energy consumption	
			Balanced ventilation	Exhaust only ventilation
Ia	≥ 4500	All methods (overall & continuous heating is assumed)	128.9 GJ/a	**125.2 GJ/a**
Ib	4500 - 3500	The same as above	117.9 GJ/a	114.2 GJ/a
II	3000 - 3500	All habitable rooms are heated or cooled continuously with other than room air-conditioners	103.9 GJ/a	100.2 GJ/a
III	2500 - 3000	The same as above	106.9 GJ/a	103.2 GJ/a
IVa	2000 - 2500	Only occupied habitable rooms are heated or cooled with room air-conditioners	56.9 GJ/a	53.2 GJ/a
IVb	1500 - 2000	The same as above	53.9 GJ/a	**50.2 GJ/a**
V	500 - 1500	The same as above	47.9 GJ/a	44.2 GJ/a
VI	< 500	Only occupied habitable rooms are cooled with room air-conditioners	42.9 GJ/a	39.2 GJ/a

achieve relatively high thermal efficiency. However, thermal efficiency depends on the outdoor air temperature and partial load conditions and this is typically not reflected in energy efficiency calculations. Therefore, to improve this, energy consumption for heating and cooling is calculated from hourly heating or cooling loads. The energy efficiency parameters commonly used with the loads to determine the consumption are then:

- rated coefficient of performance (COP),
- rated cooling and heating capacity, and
- maximum air-conditioner capacity.

Energy efficiency of domestic hot water systems

There are a number of promising technologies for energy conserving domestic hot water generation. Gas or oil fired condensing boilers may help to conserve energy (Figure 2). Particularly in such cases, solar hot water systems can increase the efficiency remarkably, but the performance is dependent on the hot water consumption pattern. The hot water consumption pattern is an indispensable assumption required for estimating energy use. Figure 1 shows a representative pattern for a four person household, which was developed on the basis of a large scale survey of hot water consumption. Under this consumption pattern, various types of domestic hot water systems have been tested for the development of the Top Runner Standards for housing, both in laboratory based studies and in a full scale research building (see front cover). In the testing, auxiliary electricity consumption for gas or oil boiler based systems is also measured.

An 'EcoCute' heat pump domestic hot water system is shown In Figure 3. This type of system was recently introduced to the market in Japan. More than 2.2 million of these units have been sold between 2001 and 2009, and are

Figure 2. Condensing boiler under test.

Figure 3. EcoCute - heat pump domestic hot water system.

Cover picture: Multi-family research building (north façade)

The building contains nine dwelling units, however, the test measurements were carried out only in four outside units on the top and bottom floors. The building was equiped with experimental facilities and potentially energy-saving technologies, which were tested under various occupancy patterns including diverse appliance usages and window / curtain opening behaviour. The measurement testing took place from 2001 to 2002.

Location: Tsukuba, Japan
Completion: 2000

supplanting conventional electric water heaters. The system consists of a hot water storage unit (with capacity between 300 to 460 litres) and sophisticated hot water temperature control. The hot water temperature is set according to the next day's predicted consumption, which is based on the actual consumption during previous days. Its overall efficiency is evidently dependent on hot water consumption patterns and so realistic patterns are needed for standardised test conditions.

Space heating & cooling loads

Space heating and cooling loads for houses are highly dependent on the building envelope and residents' behaviour. So, for the energy calculations, different space heating and cooling loads are assessed for each of eight climatic zones. Separate standards for the thermal properties of the building envelope coexist with the Top Runner Standards. These originally came into effect in 1980, and were subsequently revised in 1992 and 1999. In the Top Runner Standards, reference is made to the 1980, 1992 and 1999 building envelope standards. The total energy consumption is evaluated in comparison with standard values. These values are determined as 10% less than those found assuming a 1999 standard building envelope and with the most commonly used building services systems in each climatic zone. Some examples of standard energy consumption values are shown in Table 1.

In the evaluation, the room layout, occupancy pattern and internal heat gains are fixed. In addition, the following are taking into account:

- ventilation heat recovery, if present,
- the applicability of natural ventilation for heat removal during hot seasons, and
- the extent and duration of space heating and cooling ('whole house and continuous' or 'partial and intermittent').

Higher building envelope standards can also be evaluated for their effectiveness in reducing space heating or cooling loads. But, due to the comparative nature of the evaluation, improvement of the envelope is not the only available approach to comply with the relevant standards. In fact, there are almost unlimited compliant solutions available including the selection of high efficiency services.

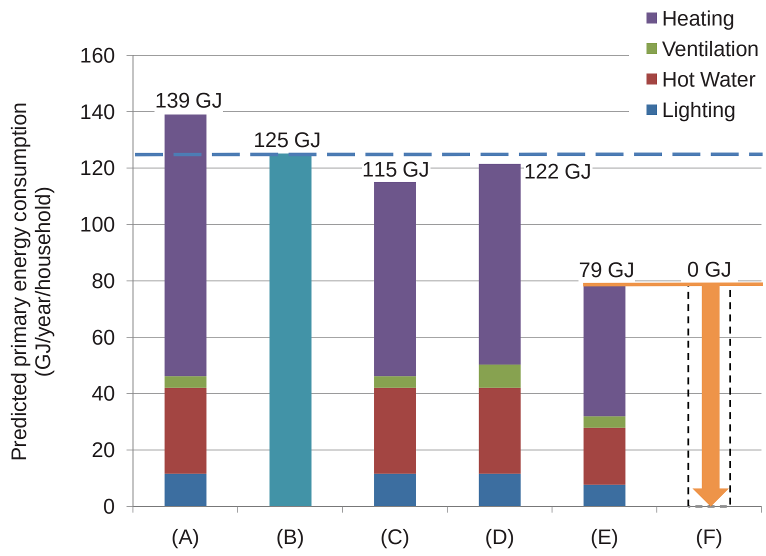


Figure 4. Results of the energy calculation for region "Ia" in the Top Runner Standards for Housing.

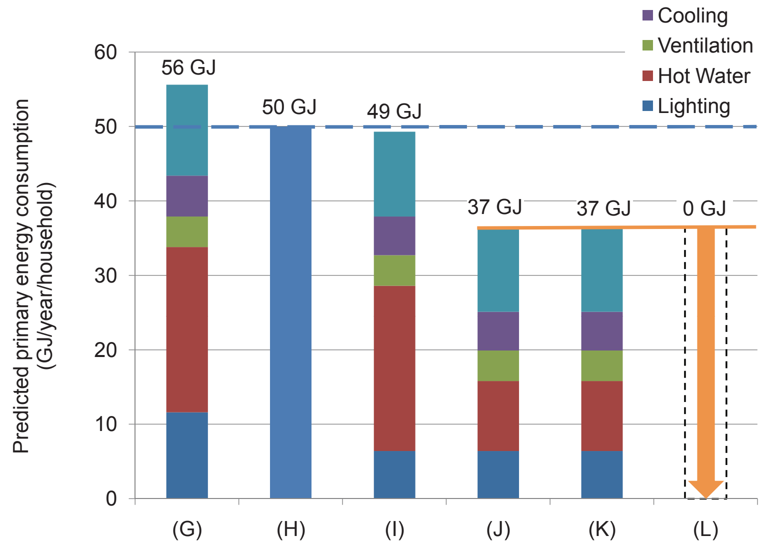


Figure 5. Results of the energy calculation for region "IVb" in the Top Runner Standards for Housing.

Case studies

Cold climate - effectiveness of a highly insulated building envelope & ventilation with heat recovery

In Figure 4, energy consumption is shown relating to six design options. When the building envelope is designed according to the present standards and services with the most common efficiencies are chosen (with whole house ventilation by ducted exhaust only), the total energy consumption is estimated as (A) 139 GJ/year, 90% of which is the standard energy consumption for that region, namely (B) 125 GJ/year. When the insulation level of the envelope is improved or when balanced ventilation with heat recovery ventilation is applied, the energy consumption is (C) 115 GJ/year or (D) 122 GJ/year, respectively. The energy consumption can be reduced to as low as (E) 79 GJ/year with both

“There are almost unlimited compliant solutions available including the selection of high efficiency services”

these measures, improvement of fan efficiency for the whole house ventilation (0.15 W/(m³/h) specific fan power), a condensing gas boiler, solar hot water heating, hot water saving faucet with small diameter piping and elimination of incandescent lamps.

The Top Runner Standards for housing exclude energy used by consumer electronics or appliances. Therefore, electricity generated onsite either fed to the external grid or contributing to energy reductions for consumer electronics or appliances cannot be deducted from the total energy consumption for the five end uses covered. However, it is natural that PV generated electricity should be directly deducted from the energy consumption. Since 9.8 GJ/year electricity can be generated by 1 kW capacity PV, a zero energy house (F) can be realized from (E) when 8 kW capacity PV is installed. Furthermore, if other energy used for consumer electronics and appliances (their energy consumption is estimated to be on average 28 GJ/year) is counted, an additional 3 kW capacity PV is needed to reach a zero energy house. Note the alternatives shown in Figure 4 are only examples, and there are many possible design solutions.

Mild climate - effectiveness of an improved building envelope, natural ventilation for heat removal & more efficient room air-conditioners

In mild climatic regions (such as type ’IVb’) cooling energy is also important, implying heat pump technologies may be advantageous, as well as solar heating for domestic hot water.

In Figure 5, six design options are shown. Alternative (G) shows the energy consumption assuming an envelope complying with the present standards and a combination of services with average efficiencies. The standard value for this climatic region is 50 GJ/year (H), which is 90% of (G). The standard value can be reached, for example, by improving the efficiency of air conditioners and the lighting system, as alternative (I) indicates. If more efficient heat sources for domestic hot water or hot water saving faucets and shower nozzles are selected, the energy consumption can be as low as 37 GJ/year, as shown by (J) or (K) respectively. In addition, if 4 kW capacity PV is chosen, the 37 GJ/year can be cancelled (L).

A prediction method of energy use in commercial buildings

Common types of parameter required for energy calculations for both commercial and residential buildings. This means that occupied hours, internal heat gains, ventilation rates and illuminance levels have to be assumed for all such buildings. Some of these are regulated by the existing building regulations and standards, but how they contribute to energy consumption depends on how a building is used and occupancy patterns.

In a proposed standardised calculation methodology for commercial buildings, 83 kinds of room use are included. Energy demands for space heating and cooling, ventilation, lighting, domestic hot water and vertical transportation are predicted according to the occupancy pattern, building layout, climatic zone, and specification of the building envelope, HVAC system, lighting system and other equipment.

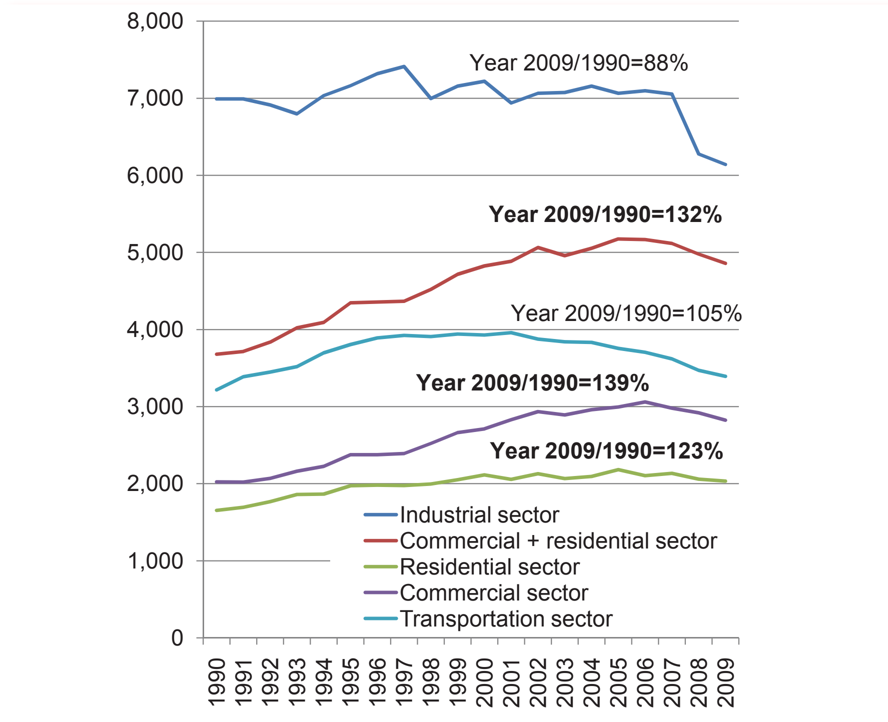


Figure 6. Total energy consumption of each sector in Japan.

Building energy use in Japan

Total energy consumption across various sectors in Japan is shown in Figure 6.

The ’commercial sector‘ is defined as buildings used as offices, shops, restaurants, schools, hospitals, gymnasiums, theatres and so forth. Office buildings attached to factories are also included, but the energy for production and manufacturing is excluded from this sector. Sectors such as industry and transport do not show any increase in energy and CO_2 emissions. For this reason, energy conservation for commercial buildings and housing has become a priority. The main causes for the growing energy consumption in these sectors are increasing floor areas in commercial buildings and an increasing number of households.

Guidelines & Case Studies for Energy Efficient Communities

ECBCS Project Update

Reinhard Jank, Volkswohnung GmbH, Germany

The importance of the buildings sector for climate change policy

In general, over 40% of energy use in industrialised countries is due to the occupation and operation of buildings. Further, most of this energy use is concentrated in towns or cities. Consequently, a substantial increase of the energy efficiency of this sector, together with increased use of renewable energy sources, will be the key to successful energy reduction and climate change mitigation policies in the industrialised world.

Major technical progress has recently been made concerning the energy performance of new buildings in the residential and commercial sectors. New standards have been successfully introduced, such as the German 'Passivhaus', the Swiss 'Minergie', or even 'net zero buildings'. These have facilitated a reduction of final energy consumption (heating, cooling, domestic hot water, electric lighting and appliances) by a factor of at least two in comparison with 'conventional' new buildings.

Large scale reductions in energy use will need to address the existing building stock and to exploit the economies of scale gained by findings solutions for urban neighbourhoods, districts, or whole towns or cities. For this reason, an ECBCS project is underway, 'Annex 51: Energy Efficient Communities - Case Studies and Strategic Guidance for Urban Decision Makers'.

The project is delivering guidance targeted at decision makers responsible for energy planning at the community level. Ambitious targets have often been set by local policy, such as "minus 50% greenhouse gas emissions within the next 20 years", but are almost never met and in most cases are not monitored.

Neighbourhood, town & city wide energy planning

While for new buildings, even strict requirements can be met using the latest technologies, existing buildings constitute the real problem. It is probable that about 80% of the building stock in cities will still exist in 2050. In these buildings, the current primary energy consumption for heating, cooling, hot water, electric lighting and appliances is typically over 300 kWh/m². Yet an 80% abatement of energy-related carbon dioxide (CO_2) emissions would require primary energy use of around 60 kWh/m². While this is technically feasible with current technologies, there are economic limits due to non-linear increases in cost. To reduce the economic burden, alternatives must be found other than, for instance, simply increasing insulation levels beyond economic limits.

Due to economies of scale, many technologies are more efficient in technical and economic terms when used in large installations rather than small ones. Examples of these include heat and power cogeneration, waste heat recovery, biomass, geothermal energy, and solar heating and cooling. When locally available, taking advantage of these technologies will enable the primary energy consumption and CO_2 emissions achieved by optimized systems to approach the best standards that can be achieved for new buildings, but with affordable costs and the advantage of feasible community scale systems. If the energy demand density is sufficient, a community level approach may offer more economic alternatives. But, a successful urban climate change policy will only be available if such options can be identified and implemented. In contrast, a building by building approach would be just too expensive. Therefore, communities will have an essential role to play in future to make this happen.

As the number of cities with successful climate change policies is still very low, it is obvious there are powerful barriers preventing planners and other decision makers from recognizing the benefits and acting to realise them. A strategy to bypass these barriers is needed, in the form of integrated energy planning for neighbourhoods or energy master plans for whole cities – and the corresponding implementation strategies. Contrary to the objectives for individual pilot or demonstration buildings, the aim of a community-wide energy concept must be to find an optimized solution in economic terms rather than focussing on cutting-edge technical innovations. Considering the huge financial investments in the buildings and infrastructure sector

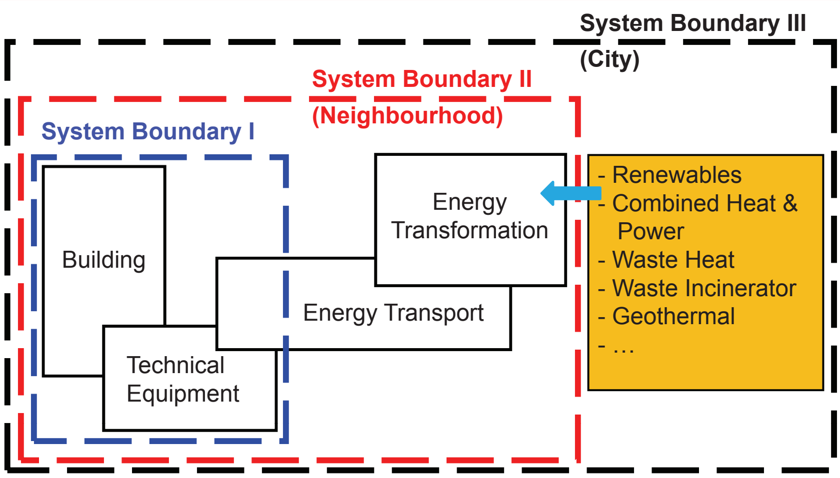


Figure 1. System boundaries and energy planning domains at neighbourhood scale.

that will be necessary over the coming decades, it will be crucially important to find an economically optimized strategy for every community. To find suitable solutions, not only the demand side, but also all stages of energy supply and transformation will have to be considered. On the supply side, existing local potential sources will need to be developed, for example cogeneration, waste heat recovery, geothermal and other renewables, and so on.

Figure 1 illustrates the overlapping planning areas that are traditionally considered separately and thus exclude existing opportunities for optimization. Approaches to design and implementation of optimized neighbourhood energy concepts are being examined within this project. By evaluating experiences based on these concepts, lessons about successes or pitfalls can be learned from the methods, tools and implementation strategies employed. So, to draw together this knowledge, a 'Guidebook to Successful Urban Energy Planning' is being created as a project outcome.

Project case studies

Within the project, 14 case studies of neighbourhood projects are being evaluated, from downtown revitalization projects to ambitious greenfield neighbourhoods. One task is to evaluate the current status of planning tools and their use in practice, or remaining development needs, in local or urban energy planning. The basic requirements for such a tool to be applied in neighbourhood or city scale projects are:

- a description of energy demands (hourly, monthly, annually) and supply systems and their future developments at neighbourhood scale;
- methodologically correct balances in terms of costs and CO_2 emissions;
- scenario building (business as usual as reference and scenarios using different technical options);
- cost and economic assessments (for example using life cycle costing) as the basis for economic optimization;
- continuous monitoring of the implementation process.

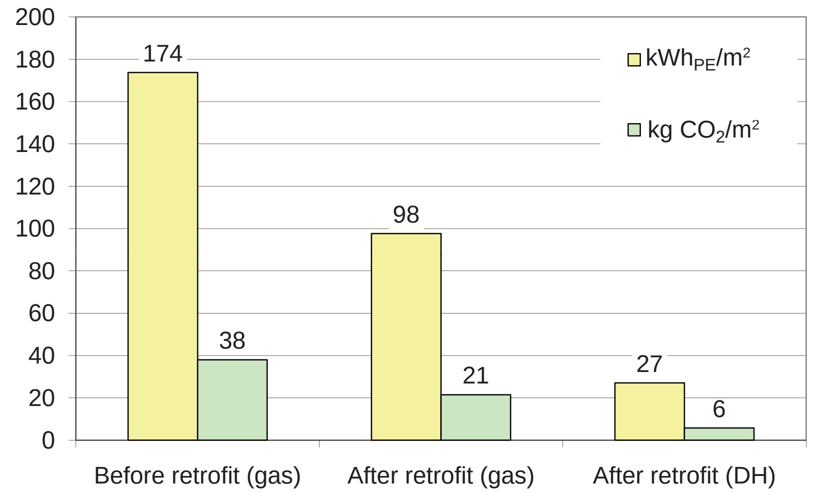


Figure 2. Karlsruhe-Rintheim neighbourhood refurbishment project - primary energy and CO_2 emissions for heating and domestic hot water supply
- before retrofit (measured)
- after building retrofit only (calculated)
- combined retrofit and district heating supply (calculated)

A preliminary result of the evaluations is that there are powerful energy system tools already available, but they are used only in the framework of research projects, not in general practice.

In addition to neighbourhoods and districts, an evaluation is also being carried out of the experiences found with the energy policies of whole cities. The case study evaluations provide a discussion of the conditions and approaches of cities that are successful in terms of their energy or CO_2 mitigation policies.

The Karlsruhe case study

As an example, a scheme for a residential neighbourhood in Karlsruhe has been evaluated. In this neighbourhood almost 40 multi-family buildings are currently being refurbished. They are between 40 and 55 years old, with 1,300 flats and more than 80,000 m^2 of usable area. The ambition is for an economic optimum in terms of primary energy and greenhouse gas emissions reduction combined with minimized additional costs for the tenants. As the result of an 'integrated sustainability approach' the reduction in terms of primary energy is planned to be over 80% (Figure 2). This will be achieved by optimizing building retrofit and installing a neighbourhood scale heating scheme supplied by an urban district heating system operating with cogeneration and industrial waste heat. The reduction is due to the combined effect of energy conservation in buildings and highly efficient thermal energy supply. The calculated average specific primary consumption for heating and domestic hot water is expected to be below 30 kWh/m^2 based on usable area after completion. Although there will be rent increases to cover the retrofit investments, on average they are almost compensated for by the reduction in thermal energy demand and district heating costs.

Innovative metering to influence occupant behaviour has also been included to secure further, usually untapped, energy savings. In addition, a landscaping concept has been developed for the neighbourhood to further increase its attractiveness and to encourage the investor to provide long-term investments. The total investment sum after completion will be in the order of €60M.

Further information

For further information, please see:
www.ecbcs.org/annexes/annex51.htm

Towards Net-Zero Energy Solar Buildings

ECBCS Project Update

Josef Ayoub, CanmetENERGY Research Centre, Canada

Defining zero energy buildings

Improving energy efficiency in buildings is the most cost effective way to substantially reduce carbon dioxide emissions. By changing energy management practices and instituting technologies that enhance energy efficiency, building owners and managers can reduce energy consumption by up to 35%. However, energy efficiency efforts applied in isolation to buildings cannot address future demand for more energy by this sector.

In order to achieve breakthrough solutions to this problem, it is evident that a co-ordinated effort to achieve a whole-building systems approach is necessary. This should emphasize that integrating energy efficiency measures with renewable on-site or distributed generation is required to design the buildings of the future. Moreover, by matching supply and demand, so-called 'net-zero energy buildings' (NetZEBs) become possible.

In fact several countries have already adopted a vision of realising NetZEBs as a long-term goal of their energy policies. But, what is missing is a clear definition and international agreement on the measures of building performance that could inform 'zero energy building' policies, research, development and deployment programmes, and industry adoption worldwide.

Scientific and technical support for zero energy buildings policies

As a response to this knowledge gap, the joint international research project, 'Annex 52 - SHC Task 40: Towards Net-Zero Energy Solar Buildings', has been initiated by the ECBCS and the Solar Heating and Cooling (SHC) Programmes. The principle objective of this work is to study current net-zero, near net-zero and very low energy buildings and to develop a common understanding, a harmonized definitions framework, tools, innovative solutions and industry guidelines.

A primary means of achieving the project objective is to document existing NetZEB or near NetZEB examples and to propose practical projects with convincing architectural quality for future demonstration. These projects aim to equalize their small annual energy needs, cost-effectively, through building integrated heating / cooling systems, distributed or on-site power generation and interactions with utilities. These examples and the supporting research results are viewed as key to industry adoption. They are being disseminated by means of conference and international journal papers, reports, guidelines and tools.

The project is building upon recent industry experiences with net-zero and low energy solar buildings and the most recent developments in whole building integrated design and operation. This joint collaborative activity is addressing concerns of comparability of performance calculations between building types and communities for different climates.

The goal is to develop solution options that are attractive for broad market adoption. The scope includes new and existing major building types (residential and non-residential) for the climatic zones represented by the participating countries. The work is linked to national priorities and focuses on individual buildings, clusters of buildings and neighbourhoods. It is based on analysis of existing examples leading to the development of innovative solutions to be incorporated into demonstration buildings. To achieve these results, four main activities have been agreed.

Establishing zero energy building performance

The first activity within the project deals with establishing an internationally agreed understanding of NetZEB concepts based on a common methodology. This is being accomplished by:

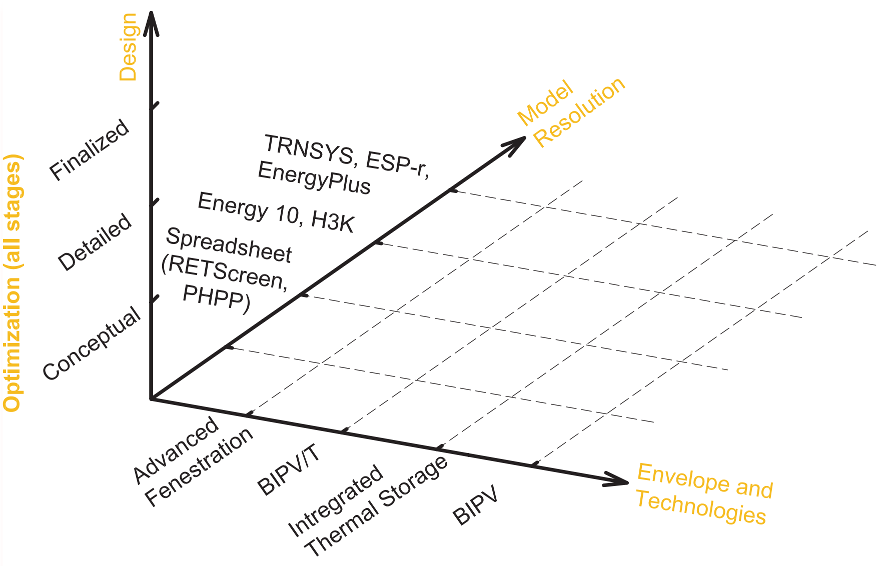


Figure 1. 3-D matrix representing model resolution, technologies and design stage. Access data on technologies and design methodology to give better models.

- reviewing and analyzing existing NetZEB definitions and data with respect to both the demand and supply sides,
- studying grid interaction (electrical power / heating / cooling) and time dependent energy mismatch analysis,
- developing a harmonized definition framework for the NetZEB concepts considering large-scale implications, exergy and credits for grid interaction (electrical power / heating / cooling),
- developing a monitoring, verification and compliance guide for checking the annual balance in practice (energy, carbon dioxide emissions and costs), harmonized with the definition.

Furthermore, the US Department of Energy's High Performance Buildings Database is being adapted to capture information on example of NetZEBs in the participating countries.

The second activity is to identify and refine design approaches and tools to support industry adoption (Figure 1). To this end, four research and development streams are being carried out to:

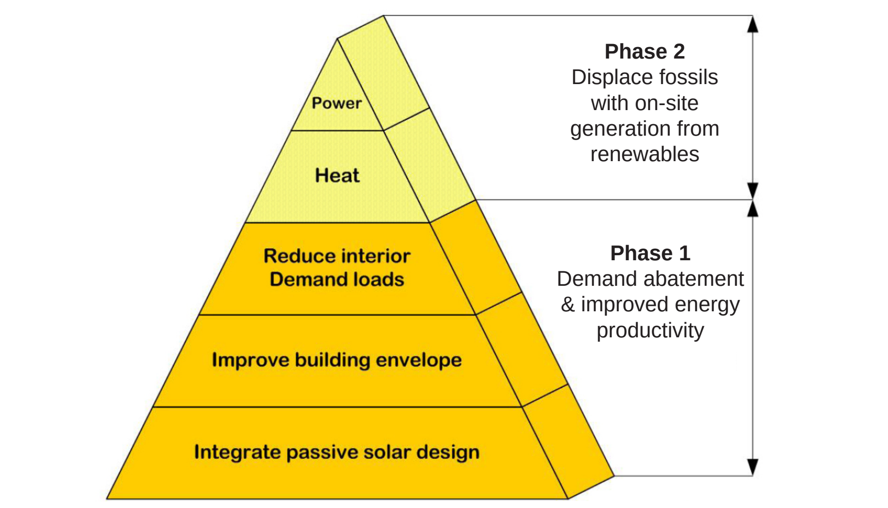


Figure 2. Solution sets approach.

- document and analyse processes and tools currently being used to design NetZEBs and those under development,
- assess gaps, needs and problems to inform simulation engine and detailed design tool developers of priorities for NetZEBs,
- benchmark selected tools qualitatively and quantitatively,
- perform detailed analyses for six case study buildings with simulated / designed versus actual performance, and propose the redesign / optimization required for these buildings.

The third activity focuses on developing and testing innovative, whole building net-zero solution sets (Figure 2) for cold, moderate and hot climates with exemplary architecture and technologies.

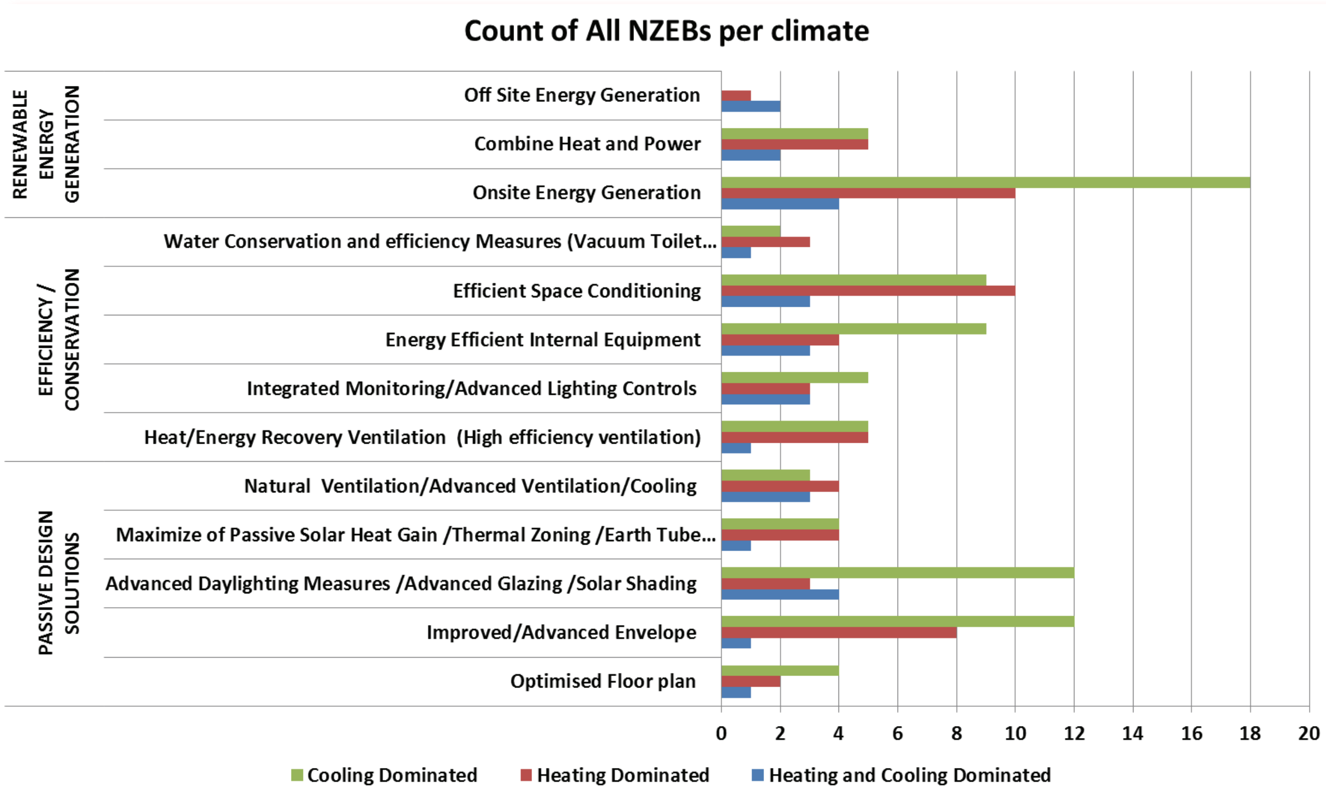


Figure 3. The whole-system approach to developing the solution sets for NetZEBs in various climates and an example of the solution set output.

These are intended be the basis for later demonstration projects and further international collaboration. This activity is being achieved by:

- documenting and analysing current NetZEB designs and technologies,
- benchmarking with near NetZEBs and other very low energy buildings (new and existing), for cold, moderate and hot climates considering sustainability, economics and future prospects using a projects database,
- carrying out a literature review and receiving practitioner input (through workshops),
- developing and assessing case studies and demonstration projects in close co-operation with practitioners,
- investigating advanced integrated design concepts and technologies in support of the case studies, demonstration projects and solution sets, and
- developing NetZEB solution sets and guidelines with respect to building types and climate and documenting design options.

The fourth activity is cross-cutting work for dissemination to support knowledge transfer and market adoption of NetZEBs on a national and international level. This is being accomplished by:

- establishing a NetZEB website, as well as a database that can be expanded and updated with future projects and experiences,
- transferring the project outputs (reports, sourcebooks, guidelines and so on) to national policy groups, industry associations, utilities, academia and national funding programs,
- participating in national and international workshop, seminars, and industry exhibitions highlighting the project results and activities,
- contributing high quality technical articles and features in journals to stimulate market adoption, and
- establishing an educational network of highly qualified people who will advance the work in this field in their future endeavours.

Further Information

For further information, please see:
www.ecbcs.org/annexes/annex52.htm

ECBCS Facts at Your Fingertips
www.ecbcs.org

ECBCS Publications

Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings

Best Practice Guidelines for Using Energy Performance Contracts To Improve Government Buildings

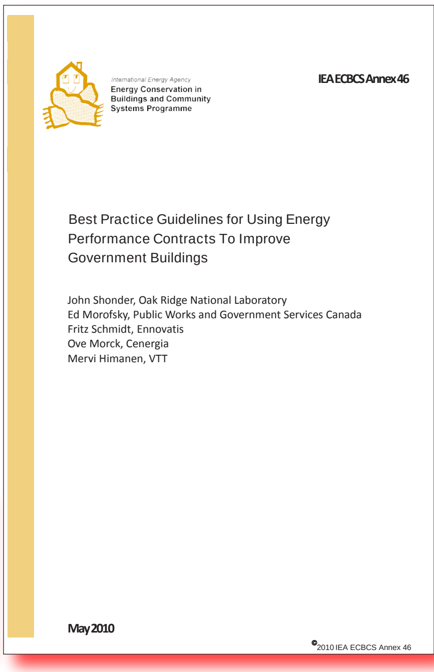
Edited by John Shonder, Ed Morofsky, Fritz Schmidt, Ove Morck, Mervi Himanen, May 2010.

This document is a product of the ECBCS project 'Annex 46: Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings'.

The objective was to develop best practice guidelines for innovative energy performance contracts (EPCs). Accordingly, it analyses the use of EPCs to implement energy efficiency upgrades in government buildings. The report presents information on the methods used to put EPCs in place at government facilities, and the building systems commonly addressed. The document also provides recommendations on the conditions necessary for successful government EPC programs. These recommendations constitute the best practice guidelines based on the experiences of government EPC programs in five countries: the United States, Canada, Germany, Finland, and Denmark.

Further Information

Further information is available from:
www.ecbcs.org/annexes/annex46.htm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Energy Conservation in Buildings and Community Systems Programme

IEA ECBCS Annex 46

Best Practice Guidelines for Using Energy Performance Contracts To Improve Government Buildings

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Ed Morofsky, Public Works and Government Services Canada
Fritz Schmidt, Ennovatis
Ove Morck, Cenergia
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May 2010

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Micro-Generation & Related Energy Technologies in Buildings

ECBCS Project Update

Evgueniy Entchev, CanmetENERGY Research Centre, Canada

Given the rapidly increasing numbers of micro-cogeneration installations around the world, there is a pressing need for further research to enable informed choices to be made on where and when such installations are appropriate. To address this issue, the ECBCS project 'Annex 54: Analysis of Micro-Generation & Related Energy Technologies in Buildings' is undertaking an in-depth analysis of micro-cogeneration and associated technologies. The scope of the project activities encompasses:

- multi-source micro-cogeneration systems, polygeneration systems (i.e. integrated heating / cooling / power generation systems) and renewable hybrid systems,
- the integration of micro-generation, energy storage and demand side management technologies at a local level (integrated systems), customised and optimum control strategies for integrated systems,
- analysis of integrated systems performance when serving single and multiple residences along with small commercial premises,
- analysis of the wider effects of micro-generation on the power distribution system.

To broaden the impact of the project's output there is significant effort to disseminate its deliverables to non-technical stakeholders working in related areas such as housing, product commercialisation and regulatory development.

Project Outcomes

The following outcomes are anticipated from the project:

- an update of occupant related domestic hot water and electric load profiles
- component models and their implementation in building simulation tools

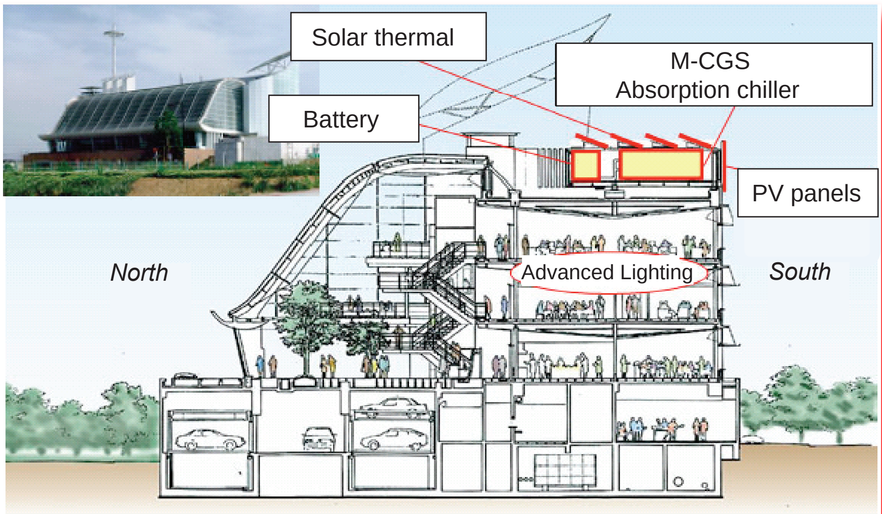


Figure 1. Various advanced technologies combined to achieve an energy efficient bulidng.

"The project is undertaking an in-depth analysis of micro-cogeneration and associated technologies"

- a review of best practice in the operation and control of integrated micro-generation systems
- control algorithms to maximize the performance and value of micro-generation
- experimental data sets for the calibration and validation of device models
- performance assessment method-ologies
- country-specific studies on the performance of a range of micro-generation systems
- studies of the viability of micro-generation systems in different operational contexts and of the impacts of micro-generation on the wider community and the potential benefits, in particular for the electricity network
- an investigation of interactions between technical performance and commercialisation / regulatory approaches for micro-generation
- a compilation of micro-generation technology case studies

The project outcomes will be of value to a wide range of stakeholders. The technical outputs (device system and control algorithm models along with technical data) will be of value to the wider simulation and research community. The detailed performance analyses and their synthesis will be of use to system installers, technology integrators and energy service companies (ESCOs).

Finally, the performance synthesis and the policy and commercialisation strategy outputs will be of great value to government from a local to trans-national level, utilities, social housing providers, technology developers and investors among others.

Further Information

Further information is available from: www.ecbcs.org/annexes/annex54.htm

ECBCS Publications

Energy-Efficient Future Electric Lighting for Buildings

Guidebook on Energy Efficient Electric Lighting for Buildings

Guidebook on Energy Efficient Electric Lighting for Buildings, edited by Liisa Halonen, Eino Tetri and Pramod Bhusal, 2010, published by Aalto University School of Science and Technology, ISBN 978-952-60-3229-0 (free download), ISSN 1455-754.

This Guidebook is the achievement of the work done in the ECBCS project ‘Annex 45: Energy Efficient Electric Lighting for Buildings’. This Guidebook is intended to be useful for lighting designers and consultants, professionals involved in building operation and maintenance, system integrators in buildings, end users / owners, and all others interested in energy efficient lighting. The content of the Guidebook includes an Introduction, Lighting energy in buildings, Lighting quality, Lighting and energy standards and codes, Lighting technologies, Lighting control systems, Life cycle analysis and life cycle costs, Lighting design and a survey on lighting today and in the future, Commissioning of lighting systems, Case studies, Technical potential for energy efficient lighting and savings, Proposals to upgrade lighting standards and recommendations, and a Summary and conclusions.

Guidebook on Energy Efficient Electric Lighting for Buildings: Summary Report

Guidebook on Energy Efficient Electric Lighting for Buildings, Summary Report, edited by Liisa Halonen, Eino Tetri and Pramod Bhusal, 2010, published by Aalto University School of Science and Technology, ISBN 978-952-60-3227-6 (printed), ISBN 978-952-60-3228-3 (free download), ISSN 1455-7541.

The Summary Report summarizes the contents of the Energy Efficient Electric Lighting for Buildings Guidebook.

Further Information
Publications are available from:
www.ecbcs.org/annexes/annex45.htm

Cost Effective Commissioning of Existing & Low Energy Buildings

Commissioning Overview

Edited by Chloé Legris, Natascha Milesi Ferretti and Daniel Choiniére, November 2010.

This report summarizes part of the work of ECBCS ‘Annex 47: Cost-Effective Commissioning of Existing and Low Energy Buildings’. It is based on the research findings from the participating countries and can be considered as an introduction to the commissioning process.

Commissioning Tools for Existing and Low Energy Buildings

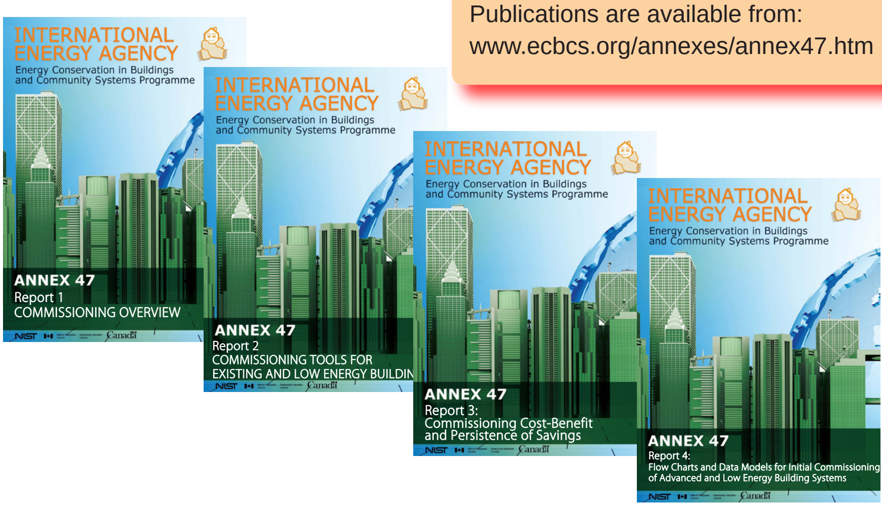
Edited by Christian Neumann, Harunori Yoshida, Daniel Choinière and Natascha Milesi Ferretti, November 2010.

The document provides general information on the use of tools to enhance the commissioning of low energy and existing buildings, summarizes the specifications for tools developed in the Annex and presents building case studies.

Commissioning Cost Benefit & Persistence of Savings

Edited by Hannah Friedman, David Claridge, Daniel Choinière and Natascha Milesi-Ferretti, November 2010.

This document presents a collection of data that would be of use in promoting commissioning of new and existing buildings and defines methods for determining costs, benefits, and persistence of commissioning. The report also highlights national differences in the definition of commissioning.



Flowcharts & Data Models for Initial Commissioning of Advanced & Low Energy Building Systems

Edited by Ömer Akın, Natascha Milesi Ferretti, Daniel Choiniere and David Claridge, November 2010.

The document provides a state of the art description of the use of flow charts and data models in the practice and research of initial commissioning of advanced and low energy building systems.

Further Information
Publications are available from:
www.ecbcs.org/annexes/annex47.htm

Prefabricated Systems for Low Energy Renovation of Residential Buildings

Retrofit Strategies Design Guide - Advanced Retrofit Strategies & 10 Steps to a Prefab Module

Edited by Peter Schwehr, Robert Fischer, Sonja Geier, Karl Höfler, Late 2011.

This building renovation guide documents strategies and typical solutions for whole building renovations and prefabrication. It serves building owners and planners to develop appropriate retrofit strategies and it describes 10 important design steps that have to be considered if prefabricated renovation modules shall be used.

Retrofit Simulation Report

Edited by Gerhard Zweifel, Late 2011.

This report documents retrofit simulation studies on the energy efficiency of renovated buildings.

Retrofit Module Design Guide

Edited by Sonja Geier, Karl Höfler, Stephane Cousin, Pedro Silva, René Kobler, Armin Binz, Gregor, Steinke, Late 2011.

The report shows four different approaches on how prefabricated renovation modules could be designed and efficiently produced. The concepts presented have been developed by national teams from Austria, France, Portugal and Switzerland. It considers the specific needs and possibilities of each country and to apply different materials. retrofit buildings in Europe. They represent concepts, which may be varied and optimised for future application. The documentation supports manufacturers and designers to evaluate the possibilities for efficient refurbishment of existing buildings. It covers the design and construction of renovation modules.

Building Renovation Case Studies

Edited by Sonja Geier, Karl Höfler, Beat Kampfen, Reto Miloni, Mark Zimmermann, Henk Kaan, Chiel Boonstra, Ake Blomsterberg, Late 2011.

This report provides case studies of seven demonstration building renovations in Austria, Netherlands, Sweden and Switzerland.

Retrofit Advisor

Mark Zimmermann, Hans Bertschinger, Kurt Christen, Walter Ott, Yvonne Kaufmann, Stefan Carl.

The Retrofit Adviser allows a simple evaluation of retrofit options for apartment buildings. Based on few input-data, the actual value of the property, its value after renovation and the estimated cost for refurbishment may be evaluated. It is an ideal tool to evaluate financially retrofit scenarios.

Further information

Publications are available from: www.ecbcs.org/annexes/annex50.htm

Conference Announcement

11th International Conference for Enhanced Building Operations (ICEBO)

18th - 20th October 2011, New York City, USA

The ICEBO conference brings together an international group of practitioners, policy makers, and researchers who routinely improve health and comfort, and minimize energy consumption, operating costs, and environmental impacts of buildings. ICEBO 2011 is the leading forum for timely exchanges among individuals interested in the continuous improvement and maintenance of buildings, design, their energy usage and environmental impact.

Major topics to be presented are:

- Best practices & policies in commisioning existing and new buildings
- Enhanced building operation, intelligent controls and emerging automation and metering technologies
- Government and utility programs for high performance buildings, demand and carbon reduction
- Training programs and on-site workshops for building operators and commissioning agents

Visit the website at icebo.tamu.edu for more information.

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www.ecbcs.org/annexes/annex45.htm

46 Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings
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53 Total Energy Use in Buildings: Analysis & Evaluation Methods
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