

Energy Codes & Ratings for Green Buildings

Summary for the MED-ENEC National Consultation Israel 2007

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1. Introduction

This report pretends to give a short introduction into the development of the German Energy Code from 1970 to 2007, which has resulted in a reduction of the energy consumption of well over 90% for space heating in new buildings.

The latest development, the German “Building Energy Evaluation Certificate”, being introduced in 2007, pretends to foster the market transformation towards more energy efficient solutions through transparency.

Green Building Rating systems are relatively new tools to guide the market towards a more sustainable building industry. As this approach is much more complex, considering for example the use of soil, water consumption, indoor environmental quality and resource efficiency beside the aspect of energy efficiency, these systems mean an important step toward sustainability. This report compares four different rating systems, considering the market impact and their costs.

The chapter “Lessons learnt” summarizes personal experiences as active architect and engineer, consultant, researcher and University professor.

The chapter “Outlook” tries to predict the future development in the area of sustainable construction, deduced from actual tendencies.

2. Energy Codes

2.1. Summary on the development in Germany 1970 - 2002

In 1918 the era of social housing began in Germany. Nearly from the start a trend away from the conventional, extravagant toward economical construction techniques could be noted. Compromises between the technical necessities and the desires of the landlords and the inhabitants were sought after in various ways. The fundamentals for modern construction—materials, their (physical) properties, architecture, new techniques as well as the industrial production of buildings – were set in the 20s. Model communities were realised whose effects reached into the 80s.

In 1950 state-subsidised housing construction with injunctions, such as minimum dwelling/room size and maximum rent began. 1951 dwelling ownership was recognised. In 1952 the DIN 4108 with minimum requirements for thermal insulation in construction, takes effect - later continued. Oil crises forced the state to react. 1976 the "Law to Reduce Energy Consumption in Buildings" is decreed and the details written in the 1st – 3rd heat saving regulations (WSVo from 1976, 1984, 1991 respectively), heating unit regulation, and the heating operations regulations. These regulations mirror the economic possibilities at that time. Parallel to this a wide-ranging research program in the construction industry was initialised.

2.2. Actual Energy Code in Germany

The actual Energy Code (Energieeinsparverordnung) was implemented in 2002 and actualised in 2004.

Reasons for the new Energy Code:

- 37% of the total consumption of primary energy in Germany used for heating and hot water
- Objective of German Government:
 - Reduction of CO₂ emissions by 25% until 2005
- Rise in m² per person
- New technologies available
- conflation of the Energy Code for the Building Envelope and the Energy Code for the Heating & Warm water installations

Requirements for New Buildings

- Reduction in Energy Consumption in 30%
- New methodology for calculations:

- Compensation between thermal insulation, heating-/cooling systems (including hot water)
- Consideration of Primary Energy
- Facilitation of Integration of Solar Energy
- Simplified calculations for buildings with less than 30% of glazed areas in the facades
- Air tightness of building envelope (Bonus – Malus system)
- Special shading demands for buildings with more than 30% of glazed facades
- “Building Energy Evaluation Certificate” to be introduced in 2007

Requirements for Existing Buildings

For all existing buildings

- Thermal isolation also towards the basement
- Thermal isolation for heat water pipes in unheated parts of the building
- Substitution of very inefficient heating systems (basically systems before 1978) until 2006

Buildings facing mayor retrofits

- Reduction of primary energy consumption by 40%
- Requirements for heating systems
- “Building Energy Evaluation Certificate” to be introduced in 2007

Buildings’ facing minor retrofits

- Limits to the energy loss through the building envelope
- or
- Reduction of primary energy consumption by 40%
- +
- Requirements for heating systems
- +
- “Building Energy Evaluation Certificate” (voluntarily)

Calculations

A) Building

Energy losses through transmission + losses through natural ventilation (+ lack of air tightness) + internal and solar gains
 = Energy Consumption for Heating

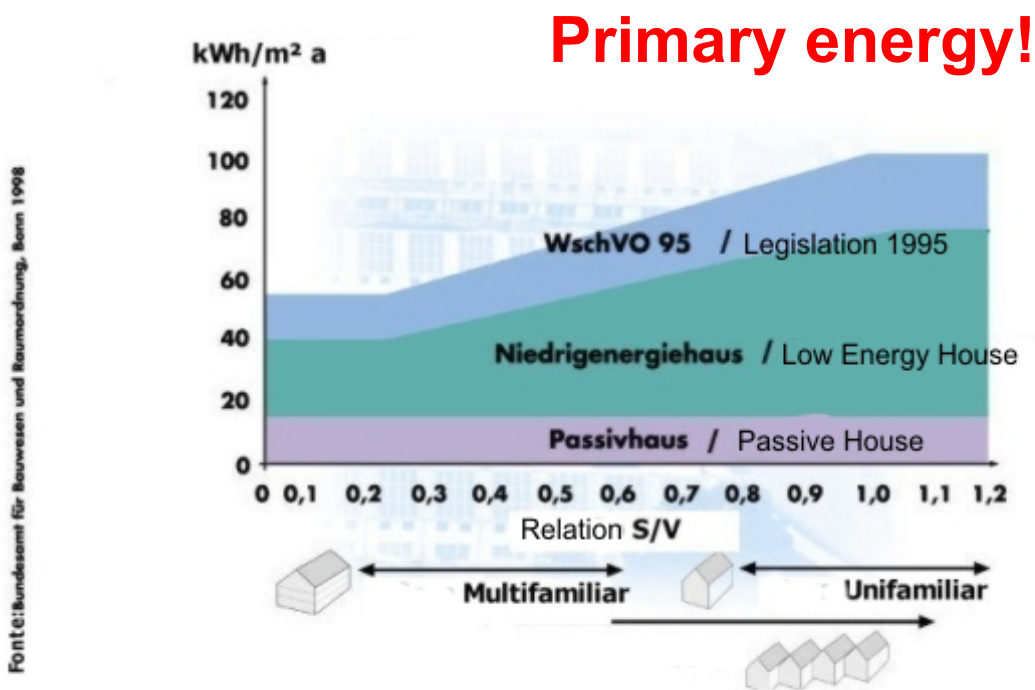
B) Installations

Energy losses through the technical installations + Energy for Water heating + electrical energy consumption of installations = Final Energy Consumption

C) Energy

Final Energy Consumption x Efficiency of Energy Production = Primary Energy Consumption

Energy Consumption for Heating



Source: Bundesamt für Bauwesen und Bauordnung, Bonn/Germany 1998, updated by the author

2.3. The latest development - "Gebäudeenergieausweis" – The German "Building Energy Evaluation Certificate" -

ENERGIEAUSWEIS

für Wohngebäude
gemäß den §§ 16 ff. Energieeinsparverordnung (EnEV)

Berechneter Energiebedarf des Gebäudes 2

Energiebedarf

CO₂-Emissionen¹⁾ [kg/(m²·a)]

Endenergiebedarf
228,4 kWh/(m²·a)

Primärenergiebedarf "Gesamtenergieeffizienz"
227,5 kWh/(m²·a)

Nachweis der Einhaltung des § 3 oder § 9 Abs. 1 EnEV ²⁾

Primärenergiebedarf		Energetische Qualität der Gebäudedämmung	
Gebäude Ist-Wert	227,5 kWh/(m ² ·a)	Gebäude Ist-Wert H _t	1,30 W/(m ² ·K)
EnEV-Anforderungswert	113,4 kWh/(m ² ·a)	EnEV-Anforderungswert H _t	0,65 W/(m ² ·K)

Endenergiebedarf

Energieträger	täglicher Endenergiebedarf in kWh/(m ² ·a) für Hilfsgeräte ³⁾			Gesamt in kWh/(m ² ·a)
	Holzgas	Wärme aus Holz	Hilfsgeräte ⁴⁾	
Erdgas H		151,2	15,6	166,8
Strom		0,0	0,0	12,3
Holz-Pellets		40,1	8,2	48,3

Sonstige Angaben

Einstellbarkeit alternativer Energieerzeugungssysteme

nach § 5 EnEV vor Baubeginn geprüft

Alternative Energieerzeugungssysteme werden genutzt für:

Heizung Warmwasser

Lüftung Kühlung

Lüftungskonzept

Die Lüftung erfolgt durch:

Fensterlüftung Schachtlüftung

Lüftungsanlage ohne Wärmerückgewinnung

Lüftungsanlage mit Wärmerückgewinnung

Vergleichswerte Endenergiebedarf

Erläuterungen zum Berechnungsverfahren

Das verwendete Berechnungsverfahren ist durch die Energieeinsparverordnung vorgegeben. Insbesondere wegen standardisierter Randbedingungen erlauben die angegebenen Werte keine Rückschlüsse auf den tatsächlichen Energieverbrauch. Die angegebenen Bedarfswerte sind spezifische Werte nach der EnEV pro Quadratmeter Gebäudenutzfläche (A_n).

1) Überlappende Angabe: 2) nur in den Fällen der Nachweise und der Meldepflicht anzuwenden 3) ggf. einschließlich Kühlung 4) z.B. Erdwärmepumpe, Wärmepumpe, Solarthermieanlage

Source: DENA – www.dena.de

Objectives

- Information about energy related quality of building
- Indication of potential for reduction of consumption
- Recommendations for concrete measures to improve energy efficiency
- Market transformation through transparency

Controversial discussion

Actual consumption or calculated average demand?

3. Green Building Rating Systems

3.1. BREEAM

Developed by the United Kingdom's Building Research Establishment, along with industry partners. This ESD design assessment tool, covers the environmental performance of both new and existing buildings.

Since	1990
Registered projects	~700,000
Certified projects	~100,000
Accreditation costs in US\$	US\$ 5,600 – 21,000 ¹ (Design & Procurement)
Soft costs in US\$	n/a
Accredited professionals/ <u>assessors</u>	n/a - <i>PREEAM Assessment Organizations</i>
Partner from industry & organizations	None
Requirements in bidding processes	Yes, e.g. UK office of Government procurement

More information:

E breeam@bre.co.uk

W www.breeam.org

3.2. LEED

Leadership in Energy and Environmental Design (LEED) Green Building Rating System. Developed in the United States through the international Green Building Challenge and promoted through the United States Green Building Council.

Since	1998
Registered projects	~6,000
Certified projects	~1,100
Accreditation costs in US\$	Max. US\$ 20,650

¹ BREEAM Price List. Recommended Fees, Quality Assurance Charges & Licensing Costs, Nov.2007

Soft costs in US\$	> US\$ 4,4 – 8,8 /m ²
<u>Accredited professionals/assessors</u>	> 40,000
Partner from industry & organizations	> 12,000
Requirements in bidding processes	Yes, eg. Worldbank

More information:

W www.usgbc.org/LEED/

3.3. Green Star

Developed by the Green Building Council of Australia, this is the outcome of several other assessment methods, including LEED, BREEAM and the Melbourne Docklands ESD Guide. Rating tools, and technical manuals can be downloaded from the website, as well as information on project certification. Case studies of certified projects, industry news, training and accreditation programmes, and policy statements are also included.

Since	2004
Registered projects	N/a
Certified projects	28
Accreditation costs in US\$	US\$ 5,500 – 17,825
Soft costs in US\$	> US\$ 50,000
<u>Accredited professionals/assessors</u>	1,732
Partner from industry & organizations	> 440
Requirements in bidding processes	Yes, eg. Melbourne City Council

More information:

T 02 8252 8222

E info@gbcaus.org

W www.gbcaus.org

<http://www.gbcaus.org>

3.4. Green Globes

The Green Building Initiative

Since	2004
Registered projects	N/a
Certified projects	N/a
Accreditation costs in US\$	US\$ 4,00 – 6,500
Soft costs in US\$	> LEED
Accredited professionals/assessors	Not yet existing
Partner from industry & organizations	N/a
Requirements in bidding processes	N/a

More information:

The Green Building Initiative

2104 SE Morrison
Portland, Oregon 97214

Phone: 877.GBI.GBI1 (877.424.4241)

Fax: 503.961.8991

Email: info@thegbi.org

3.5. Conclusions

- Controversial discussion on inclusion of industries: risk of negative lobbying.
- New evaluations [7] indicate the necessity to improve the current systems.
- All four rating systems are continuously updated and improved.
- Certification costs are relatively high, but even more important are soft costs.
- Before a significant market penetration starts, a sufficient number of Accredited professionals/assessors have to be trained.
- Requirements of minimum green building performance in bidding processes exercise an extremely important impact.

4. Lessons learnt

- Energy Efficiency and, as a far wider approach, sustainability in buildings is relatively complex – Capacity Building!
- Regional architecture adapted to local climatic conditions and available building materials
- Necessary: Long term investment, not first cost driven decisions
- Optimisation of Design Process + Prototypes
- Improvements through R & D, LCA
- Important role of governmental policy & incentives

5. Outlook

- Rating systems are time consuming & relatively expensive, but necessary for market transformation
- Certification costs and soft costs will be reduced gradually through more qualified professionals and more streamlined processes
- Non- sustainable products & technologies will perish from the market
- Rating systems will be adapted to regional demands, and
- finally be integrated into the local building codes
- the higher the energy + costs, the faster the market transformation

6. References

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- [2] OWEN, Cheridwen. ***Reaching for the stars***. 01. November 2006.
<http://www.architectureaustralia.com/aa/aaissue.php?issueid=200611&article=33&typoon=3>
- [3] Green Building Council Australia: homepage GBCAUS – visited 16.11.2007
- [4] BREEAM homepage: visited 16.11.2007
- [5] SMITH, T.M. et al.. ***Green Building Rating Systems. A comparison of the LEED and Green Globes systems in the US***. Prepared for the Western Council of Industrial Workers. Minnesota/USA 2006
- [6] DENA - <http://www.dena.de/de/themen/thema-bau/projekte/projekt/energieausweis/> - visited 21.11.2007

[7] HUMBERT S., ABECK H, BALI N, HORVATH A. (2007). Leadership in Energy and Environmental Design (LEED). A critical evaluation by LCA and recommendations for improvement. Int J LCA (Special issue 1) 46 –57

[8] BREEAM Price List. Recommended Fees, Quality Assurance Charges & Licensing Costs, Nov.2007

[9] BREEAM Fact File No. 5, October 2007

7. Additional information on Rating systems

DSE ESDC Guidelines

Environmentally Sustainable Design and Construction Principles and Guidelines for Capital Works Projects. Developed by the Victorian Government's Department of Sustainability.

W www.dse.vic.gov.au

NABERS

National Australian Built Environment Rating System. A performance-based rating system for existing buildings developed by the Australian Greenhouse Office, which is still in a draft form.

W www.nabers.com.au

BASIX

The New South Wales Government's Building Sustainability Index (residential only).

W www.basix.nsw.gov.au

VICBEST

Developed by Connell Wagner for the Victorian Government.

STEPS

Developed by the Moreland and Port Phillip Councils.

W www.morelandsteps.com.au

Melbourne Docklands ESD Guide

The VicUrban ESD design Assessment tool.

W www.docklands.com/docklands/about/design/esd.shtml

Australian Environmental Labelling Association and the Good Environmental Choice Label

Website details the background and standards around the Good Environmental Choice label, including access to specific standards, information on the development of standards and application processes. The site also links to the Green Procurement Database and the Certified Product Register.

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