Environmental Benchmarks for buildings and infrastructures:
Needs, challenges and solutions, DF71,
June 18, 2019, Zurich

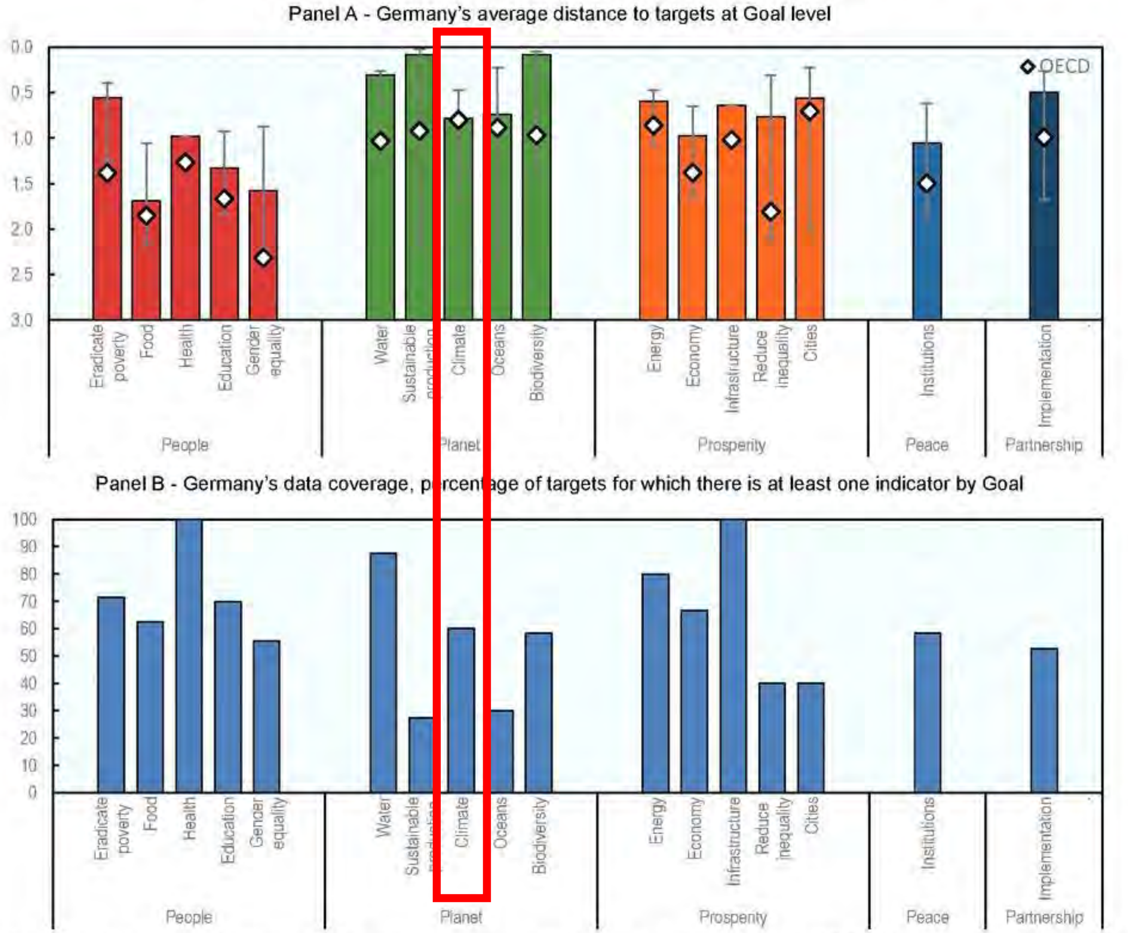
GHG budget for buildings & performance levels for sustainability assessment – the situation in Germany

Thomas Lützkendorf
Karlsruhe Institute of Technology (KIT)
Karlsruhe, Germany
thomas.luetzkendorf@kit.edu

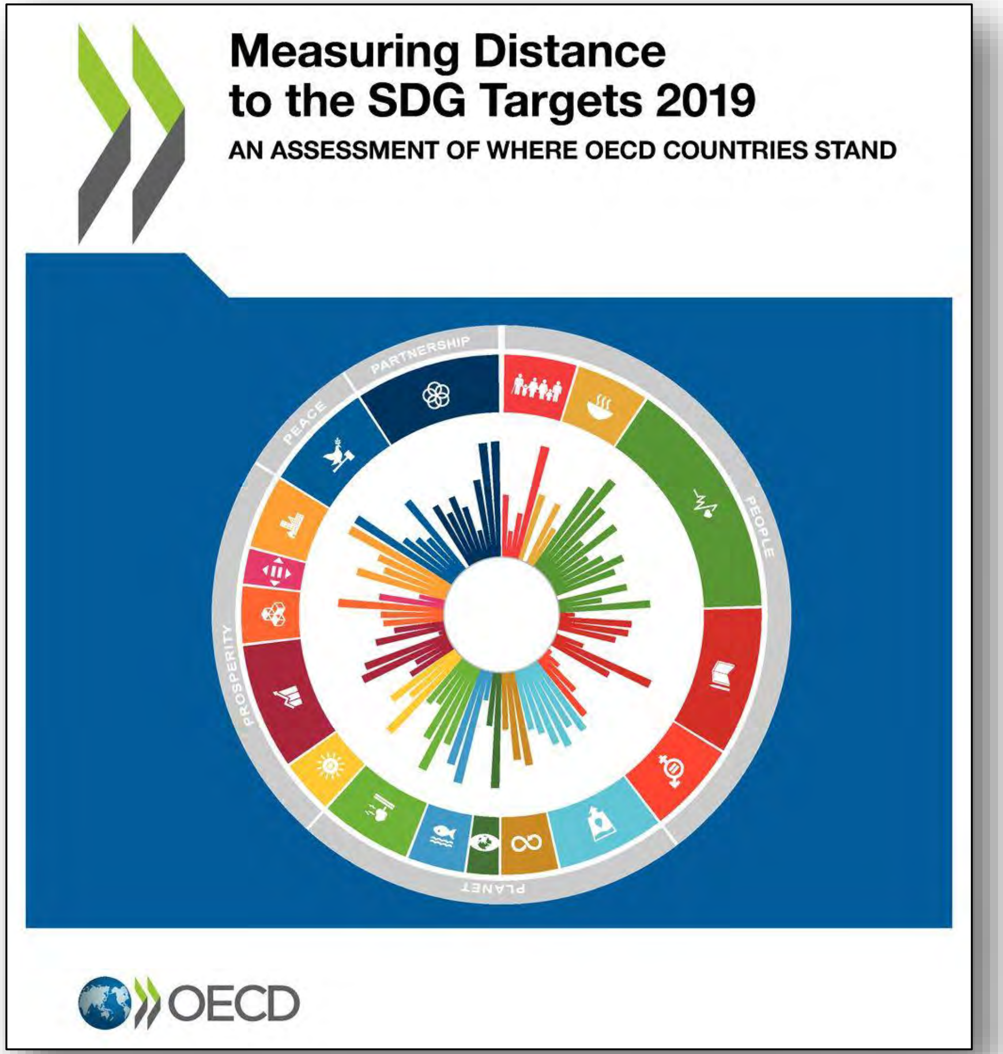
Germany – overall situation (budget for building sector)

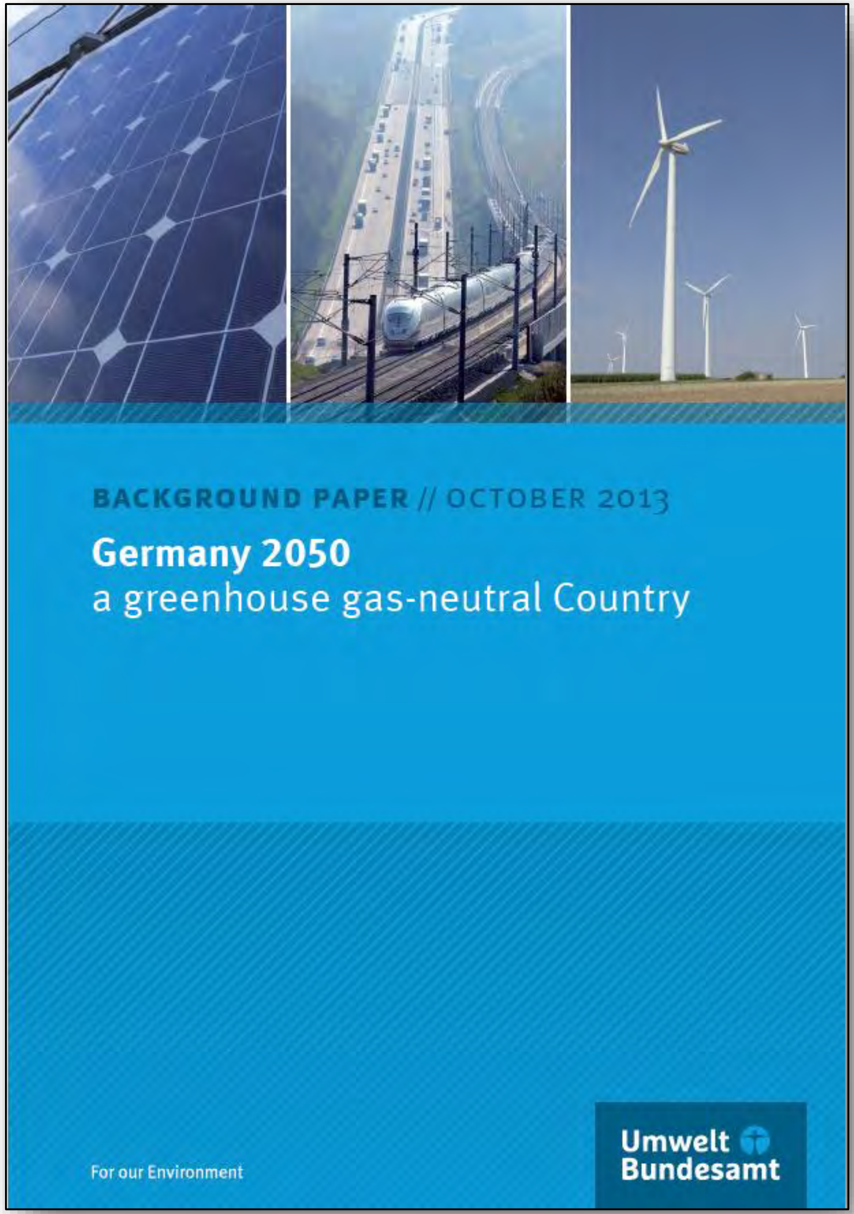
Germany‘s distance to target

Figure 2.22. Germany’s distance from targets and data coverage, by goal



Note: Panel A shows the average distance the country needs to travel to reach each SDG. Distances are measured in standardised units (see Chapter 3 for details) with 0 indicating that the level for 2030 has already been attained: and 3 is the distance most OECD countries have already travelled. Bars show the average country performance against all targets under the relevant Goal for which data are available, and diamonds show the OECD average. Whiskers show uncertainties due to missing data, ranging from assuming that missing indicators are all 3 standardised distances from the 2030 target level to assuming that they are already at the target level. Panel B shows the share of targets covered by at least one indicator out of the 169 targets of the 2030 Agenda, according to the 17 goals and 5Ps.
Source: See www.oecd.org/sdd/OECD-Measuring-Distance-to-SDGs-Targets-Metadata.pdf for detailed metadata.





https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/germany_2050_a_greenhouse_gas_neutral_country_langfassung.pdf

A greenhouse gas-neutral Germany with **per-capita emissions of just one tonne of CO2eq in 2050** is technically achievable and implies a reduction of emissions by 95 % compared to 1990.

Area of action	1990 (in million tonnes of CO_2 equivalent)	2014 (in million tonnes of CO_2 equivalent)	2030 (in million tonnes of CO_2 equivalent)	2030 (reduction in % compared to 1990)
Energy sector	466	358	175 – 183	62 – 61 %
Buildings	209	119	70 – 72	67 – 66 %
Transport	163	160	95 – 98	42 – 40 %
Industry	283	181	140 – 143	51 – 49 %
Agriculture	88	72	58 – 61	34 – 31 %
Subtotal	**1,209**	**890**	**538 – 557**	**56 – 54 %**
Other	39	12	5	87 %
Total	**1,248**	**902**	**543 – 562**	**56 – 55 %**

Source: Climate Action Plan 2050 of the Federal Government

The **German government's Energy Concept** aims to lower the primary energy demand in the buildings sector by at least 80 percent compared with 2008 levels by 2050. If Germany is to achieve its **goal of making its building stock virtually climate-neutral by 2050**, it is crucial that the available potential for avoiding emissions be fully exploited over the next years and decades. In 2050 the entire **residential building stock will need on average only just less than 40 kilowatt hours per square metre per year (kWh/m2a)**. For **non-residential buildings this average target value, which is based on primary energy demand, is approximately 52 kWh/m2a**. These values should be seen as targets and are averages for the entire building stock.

https://www.bmu.de/fileadmin/Daten_BMU/Pools/Broschueren/klimaschutzplan_2050_en_bf.pdf

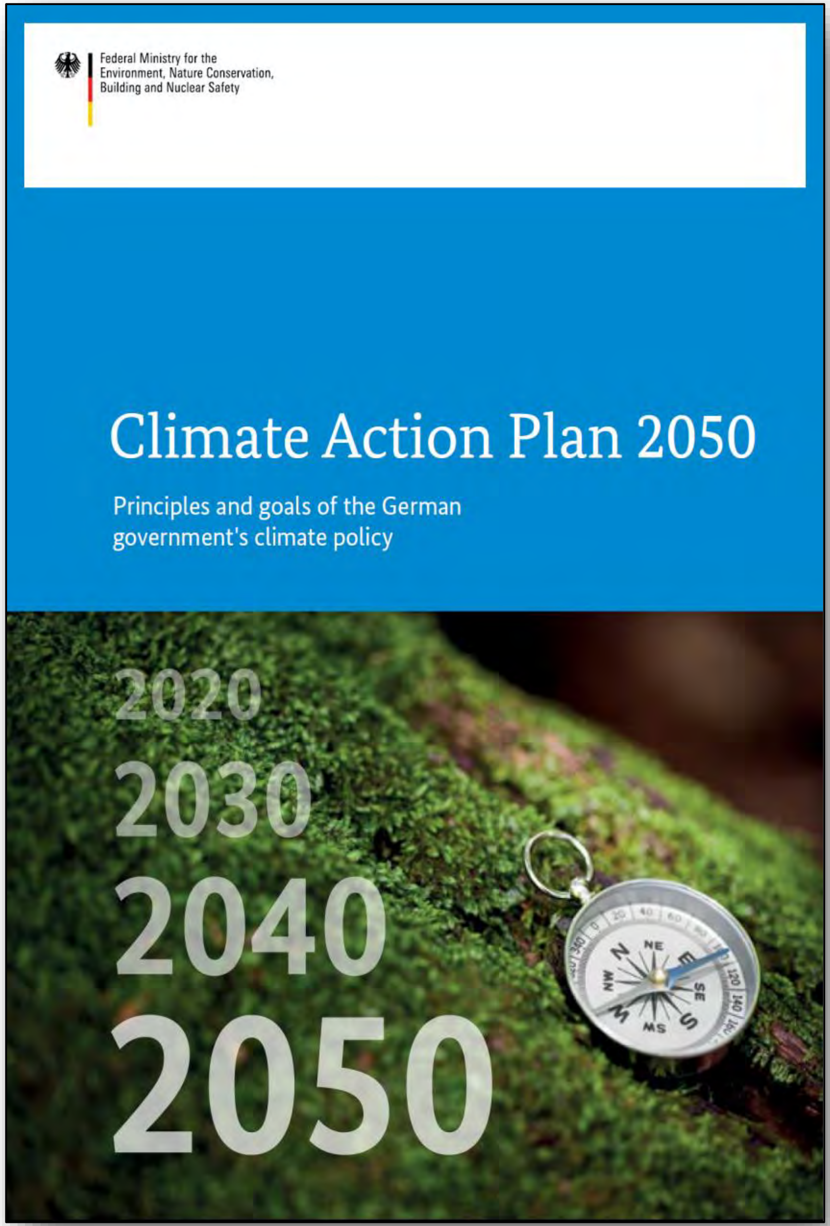


Table 3.1

Greenhouse gas reduction according to the GreenEe scenario[a] by 2030 compared to the Federal Government's targets

	Climate Action Plan				GreenEe scenario		
	2030 emission target		Reduction against 1990			2030 emissions	Reduction against 1990[b]
	From	To					
	Million t CO_2eq		%			Million t CO_2eq	%
Energy sector	175	183	62 %	61 %	Energy (without transport) and industry	330	66 %
Industry	140	143	51 %	49 %			
Buildings	70	72	67 %	66 %			
Transport	95	98	42 %	40 %	Transport	109	34 %
Agriculture	58	61	34 %	31 %	Agriculture	51	35 %
Others	5	5	87 %	87 %	Waste	6	83 %
Overall total	**543**	**562**	**56 %**	**55 %**		**496**	**60 %**

a) Data without LULUCF and international aviation and maritime transport.
b) The National Inventory Report 2016 v6 is the basis of the 1990 figures as opposed to the Climate Action Plan.

Source: BMUB 2016f and model calculation

Informal calculation !

Residential buildings	Living area in Mrd. m²	Mio. t GHG	kg GHG /m²/a
2015	3,8	87	23
2030	4,1	47	**12**

These values are averages for the entire building stock of residential buildings – just for operation!.

https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/171220_uba_fachbrosch_rtd_bf_engl.pdf

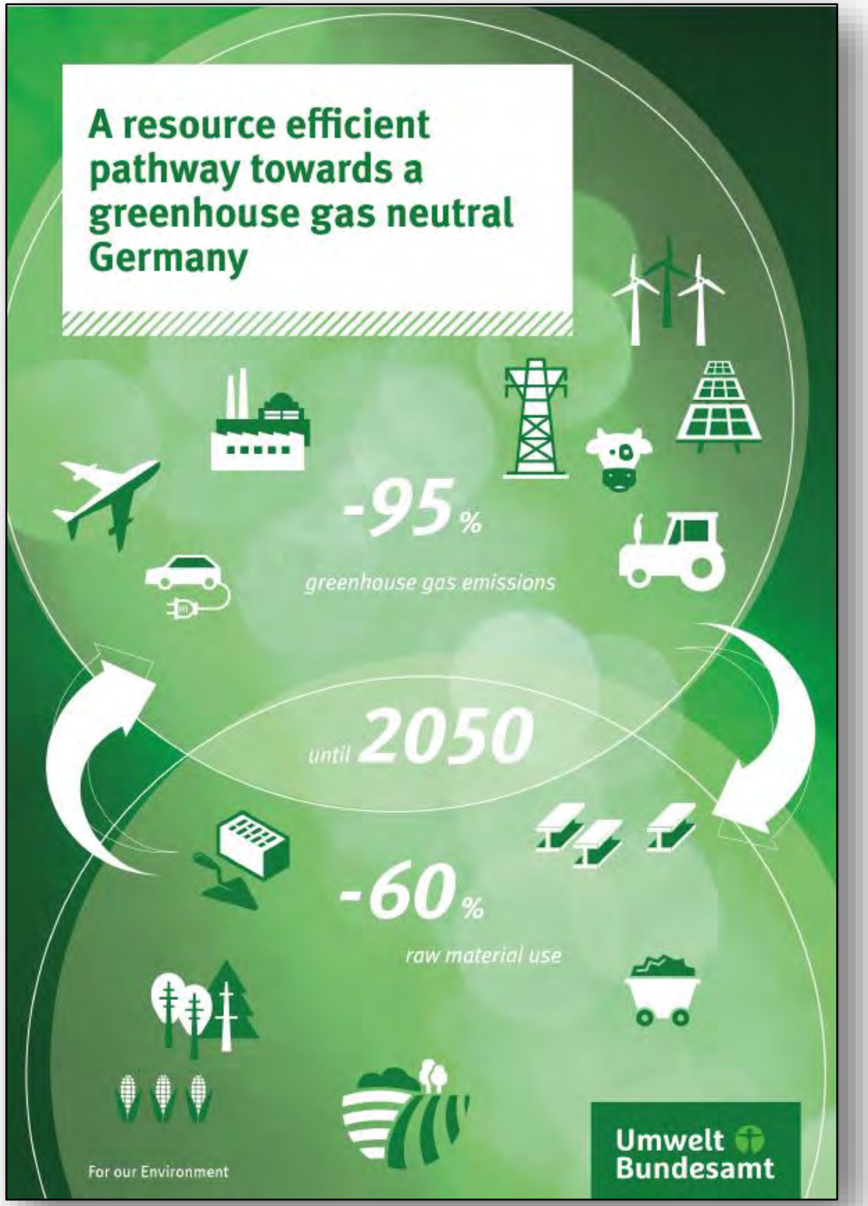
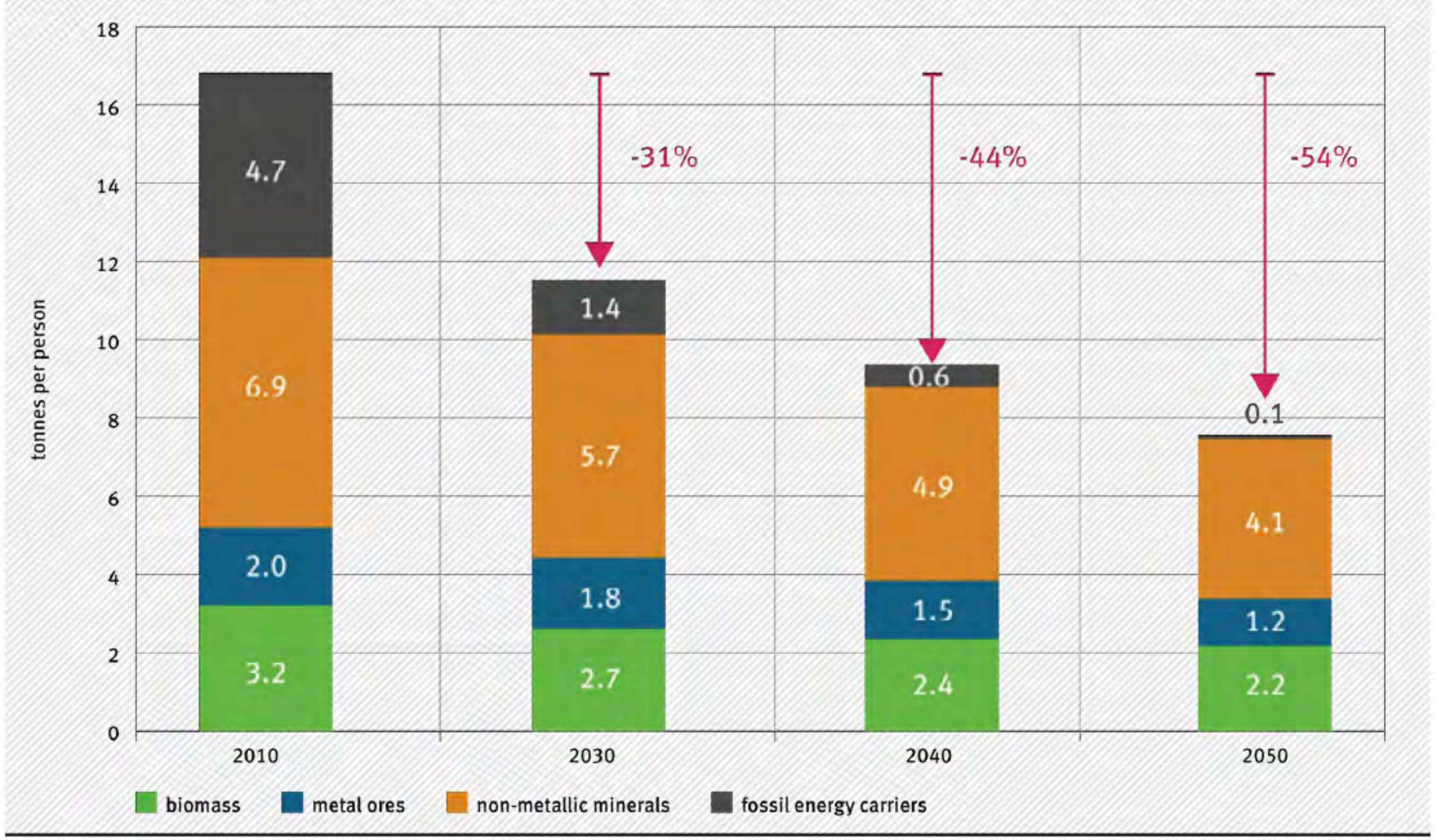


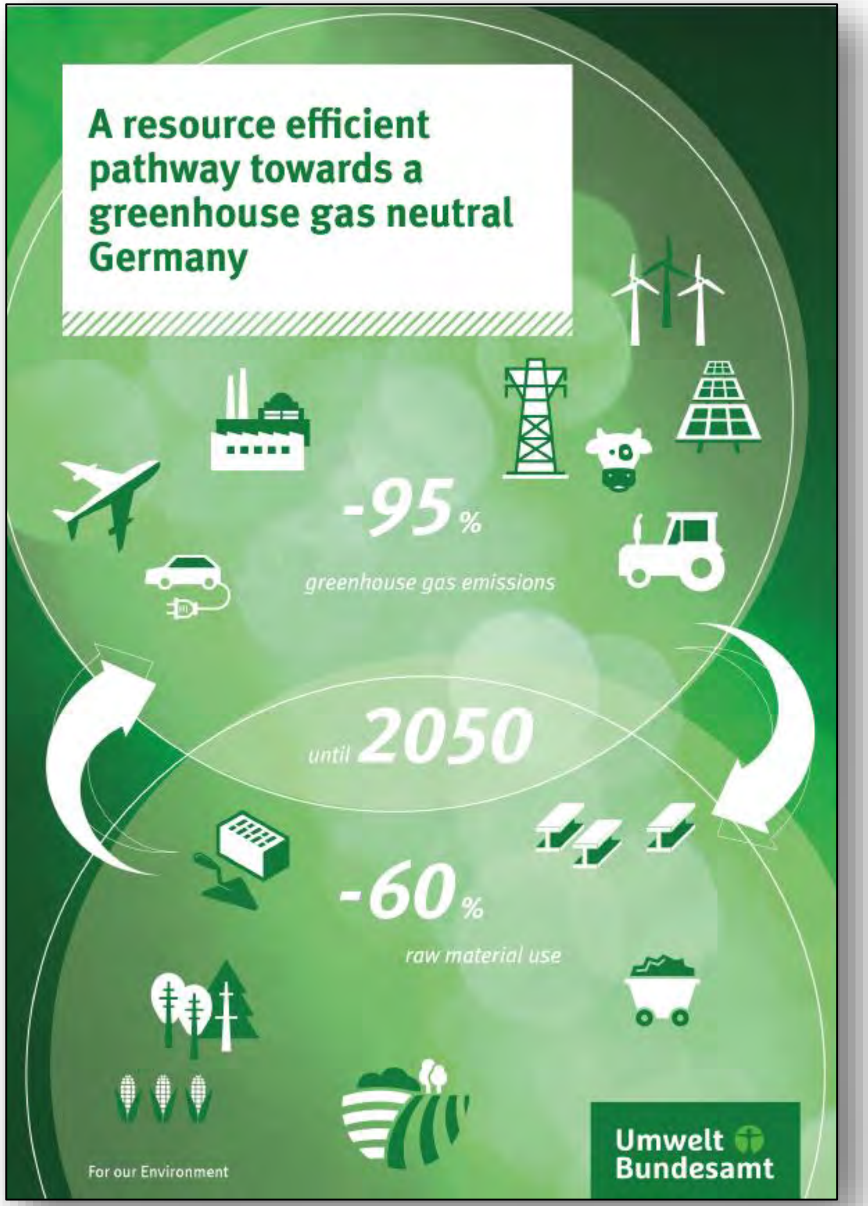
Figure 3.4

Raw material use per person (RMC/cap), absolute and percentage change, in the GreenEe-Scenario



Source: own illustration of model calculation

https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/171220_uba_fachbrosch_rtd_bf_engl.pdf



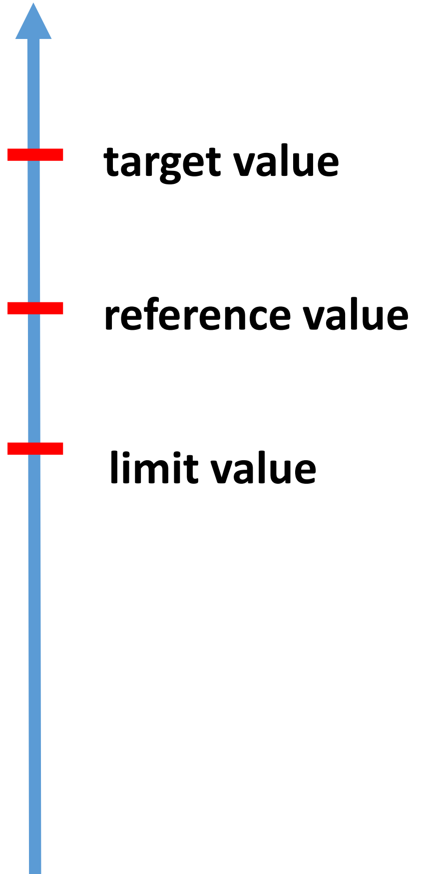
Additional targets / budgets for raw material use / capita * year ?!

Benchmarks – the background

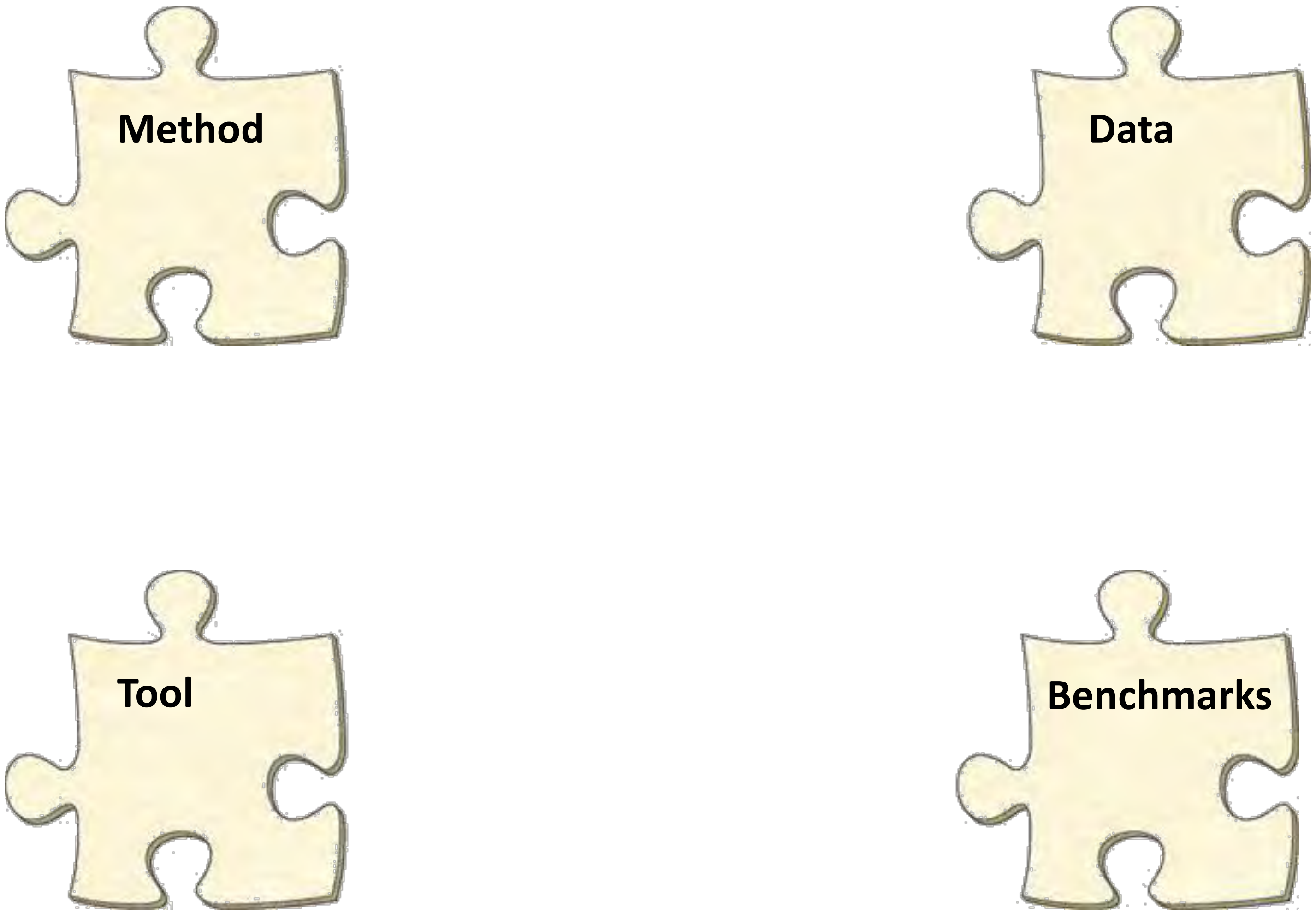
ISO/CD 21678

[Under development]

Sustainability in buildings and civil engineering works - Methodological principles for the development of benchmarks for sustainable buildings



The packgage approach

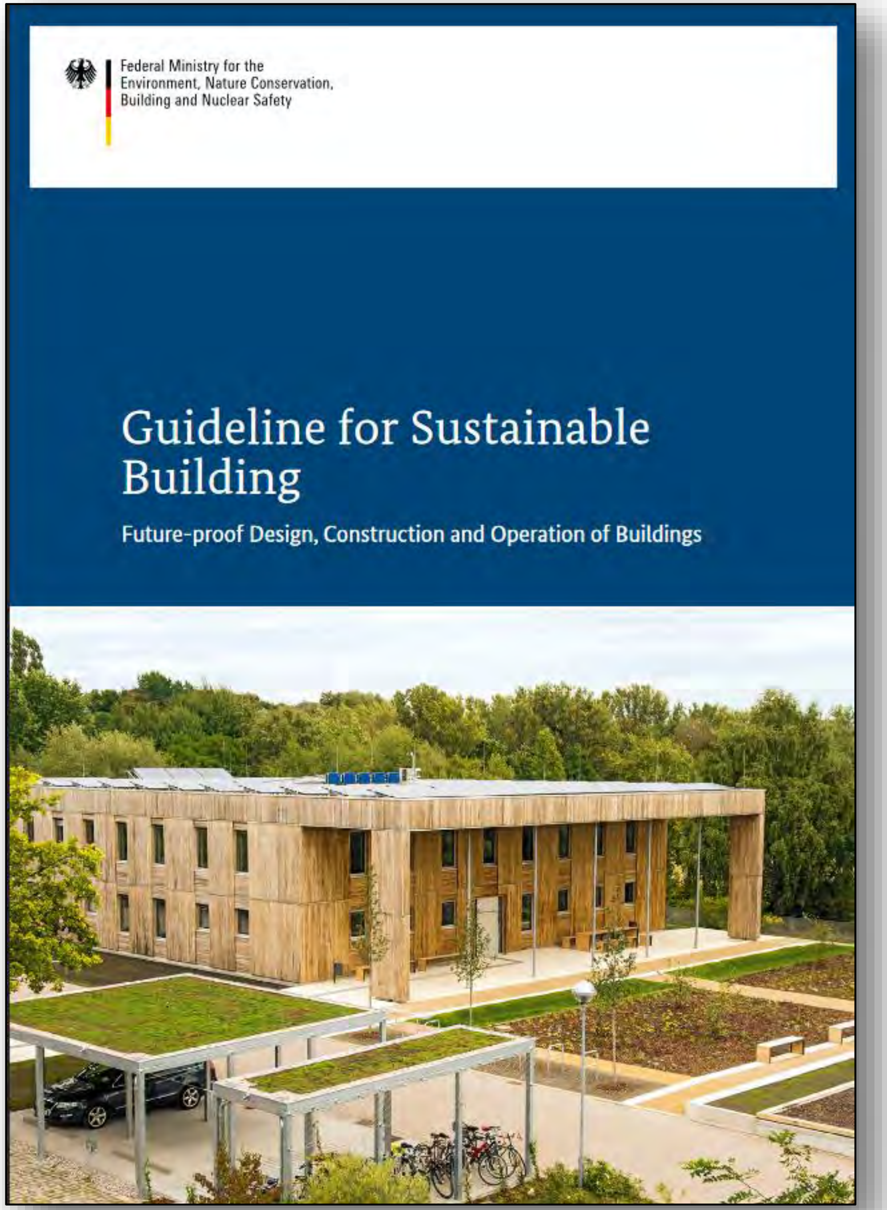


BNB - Sustainability assessment systems for public buildings (office buildings)

Elements of an overall approach in Germany

- Guideline
- **Assessment system** (public available)
- Rules for target setting
- Rules for integration into design process
- Rules for documentation & data storage
- Data base (public available)
- Calculation tool (public available)
- **Benchmarks**
- Weighting factors for indicators
- Web based product group information system

- Training programmes for assessors
- Demand in case of public buildings



GWP = indicator in sustainability assessment

		Verification management	Time of documentation
1.	Ecological Quality		
1.1	Effects on Global and Local Environment		
	Global Warming Potential	E	DE
1.1.2	Ozone Depletion Potential	E	DE
1.1.3	Photochemical Ozone Creation Potential	E	DE
1.1.4	Acidification Potential	E	DE
1.1.5	Eutrophication Potential	E	DE
1.1.6	Risks to the Local Environment	P	TP
1.1.7	Sustainable Logging / Wood	P	TP
1.2	Demand of Resources		
1.2.1	Primary Energy Demand Not Renewable (PE_{nre})		
1.2.2	Total Primary Demand (PE_{tot}) and Amount of PE_{re}		
1.2.3	Fresh Water Demand and Quantity of Wastewater		
1.2.4	Demand of Space		

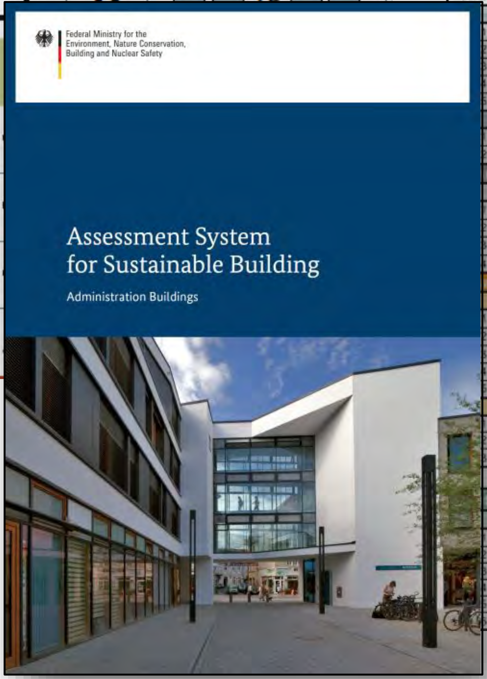
https://www.nachhaltigesbauen.de/fileadmin/pdf/Systainable_Building/assessment_system_bnb.pdf

Relevant life phase
- Total life cycle
- Realisation
- Utilisation
- Dismantling

Assessment method
- Linear assessment
- Quality level
- Checklists

Verification management
- C Client
- P (specialist) Planners
- E External

Time of documentation
- PD Project development
- DE Design
- TP Tender and placing
- RE Realisation
- HU Hand-over and utilisation

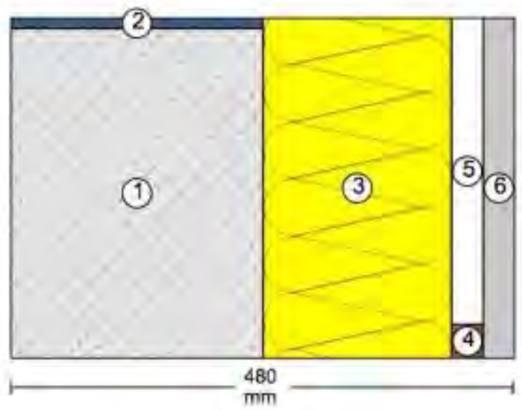


Sustainability Criteria		Percentage Share of overall Result Individual Categories	Factors of Relevance	Percentage Share of overall Result Main Criteria Groups
Ecological Quality				22,5%
	Effects on Global and Local Environment			
1.1.1	Global Warming Potential (GWP)	3,375%	3	
1.1.2	Ozone Depletion Potential (ODP)	1,125%	1	
1.1.3	Photochemical Ozone Creation Potential (POCP)	1,125%	1	
1.1.4	Acidification Potential (AP)	1,125%	1	
1.1.5	Eutrophication Potential (EP)	1,125%	1	
1.1.6	Risks to the Local Environment	3,375%	3	
1.1.7	Sustainable Logging / Wood	1,125%	1	
	Demand of Resources			
1.2.1	Primary Energy Demand Not Renewable (PE_{nre})	3,375%	3	
1.2.2	Total Primary Demand (PEtot) and Amount of PE_{re}	2,250%	2	
1.2.3	Fresh Water Demand and Quantity of Wastewater	2,250%	2	
1.2.4	Demand of Space	2,250%	2	
Economical Quality				22,5%
	Life Cycle Costs			
2.1.1	Building-related Life Cycle Costs	13,500%	3	
	Performance			
2.2.1	Stability of Value	9,000%	2	
Socio-Cultural and Functional Quality				22,5%
	Health, Comfort and User Satisfaction			
3.1.1	Thermal Comfort in Winter	1,607%	2	
3.1.2	Thermal Comfort in Summer	2,411%	3	
3.1.3	Indoor Air Quality	2,411%	3	
3.1.4	Acoustic Comfort	0,804%	1	
3.1.5	Visual Comfort	2,411%	3	
3.1.6	Influence of the User	1,607%	2	
3.1.7	Building-related Outdoor Qualities	0,804%	1	
3.1.8	Safety and Incident Risks	0,804%	1	
	Functionality			
	Barrier-free Building	1,607%	2	
	Space Efficiency	0,804%	1	
	Capability of Conversion	1,607%	2	
	Public Accessibility	1,607%	2	
	Bicycle Comfort	0,804%	1	
	Ensuring Design Quality			
	Design and urban Quality	2,411%	3	
	Art in Architecture	0,804%	1	
nical Quality				22,5%
	Technical Execution			
	Sound Insulation	5,625%	2	
	Heat Insulation and Protection against Condensate	5,625%	2	
	Cleaning and Maintenance	5,625%	2	
	Dismantling, Separation and Utilisation	5,625%	2	
ss Quality				10,0%
	Management and Design			
	Project Preparation	1,429%	3	
	Integrated Design	1,429%	3	
	Optimisation and Complexity of Planning	1,429%	3	
	Sustainablity Issues in Tender and Placing	0,952%	2	
	Requirements for an Optimal Utilisation and Management	0,952%	2	
	Building Construction			
	Building Site / Building Process	0,952%	2	
	Quality Assurance of the Building Construction	1,429%	3	
	Controlled Commissioning	1,429%	3	
tion Profile				0,0%
	Location Profile			
	Risks at the Micro-Site	–	2	
	Conditions at the Micro-Site	–	2	
	Image and Character of Location and Quarter	–	2	
	Public Transport Connections	–	3	
	Vicinity to Use-Specific Services	–	2	
	Supply Lines / Site Development	–	2	

Calculation tool

The **online-tool for life cycle assessments 'eLCA'** has been developed by Federal Institute for Research on Building, Urban Affairs and Spatial Development (Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR)) since September 2012. It can be used for LCAs for office and administration buildings. **The assessments are based on the database for building materials 'Ökobau.dat'** issued by the BBSR. In the database 'Ökobau.dat' ecological data about building materials and components as well as energy consumption for the operation of buildings are provided. The inputs can be evaluated in different variants of the same project and planning phases can be studied for their **environmental effects according to the 'Rating System for Sustainable Building'** (Bewertungssystem Nachhaltiges Bauen (BNB)), also issued by the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR).

▸ *Ergebnisse für Baustoffe*



1. Beton der Druckfestigkeitsklasse C 25/30, 240,00mm
2. Bewehrungsstahl, 240,00mm
3. Mineralwolle (Fassaden-Dämmung), 180,00mm
4. Konstruktionsvollholz (Durchschnitt DE), 30,00mm
5. Unbekannt, 30,00mm
6. Dachziegel, 30,00mm

2_Fassade _Ost

Menge: 76,60 m²

Indikator	*Einheit*	*Herstellung / $m^2_{NGF}a$*	*Entsorgung / $m^2_{NGF}a$*	*Instandhaltung / $m^2_{NGF}a$*	*Gesamt / $m^2_{NGF}a$*	*Rec.potential / $m^2_{NGF}a$*
GWP	kg CO2-Äqv.	-0,0401303341	0,1837462487	0,0138823505	0,1574982651	-0,0740171697
ODP	kg R11-Äqv.	2,4249278172E-9	1,5713425769E-10	3,2720039374E-13	2,5823892752E-9	-1,2149478989E-8
POCP	kg Ethen-Äqv.	8,1133941490E-5	1,6057578355E-6	4,0857985257E-6	8,6825497851E-5	-4,2527656318E-6
AP	kg SO2-Äqv.	3,2936850291E-4	1,5370172516E-5	4,3873251475E-5	3,8861192690E-4	-7,6249723225E-5
EP	kg PO4-Äqv.	4,9091220525E-5	2,7940853011E-6	7,0548285585E-6	5,8940134385E-5	-2,1853067437E-6
PE Ges.	MJ	4,2323014501	-1,1981777177	0,5891712483	3,6232949807	-0,2332582863
PENRT	MJ	2,3391202377	0,0223029011	0,2442418194	2,6056649582	-1,3634588212
PENRM	MJ	0,0470946903	-0,0470946903	0,0000000000	0,0000000000	0,0000000000
PENRE	MJ	2,2920799104	0,0459843543	0,2211972948	2,5592615594	-1,0675671244
PERT	MJ	1,8931812124	-1,2204806188	0,3449294289	1,0176300225	1,1302005349
PERM	MJ	1,9056678893	-1,4972647852	0,4049789458	0,8133820500	0,0000000000
PERE	MJ	0,0500984108	3,9369942799E-3	-0,2711153943	-0,2170799893	1,1766582966
ADP elem.	kg Sb-Äqv.	2,4031362947E-6	1,7892643721E-9	1,0062527874E-6	3,4111783464E-6	-3,9574712491E-9
ADP fossil	MJ	2,1680954670	0,0385553178	0,2345282634	2,4411790482	-0,8288212178

Gesamt inkl. A1 - A3, B6, C3, C4, Instandhaltung inkl. A1 - A3, C3, C4

Database ÖKOBAUDAT

The ÖKOBAUDAT platform is provided as a standardized database for ecological evaluations of buildings by the Federal Ministry of the Interior, Building and Community. At the platform's core is the **online database with life cycle assessment datasets on building materials, construction, transport, energy and disposal processes**. With the help of life cycle assessment tools, such as eLCA provided by the BBSR, the entire life cycle of a building can be reconstructed with the ÖKOBAUDAT database. ÖKOBAUDAT is not designed for performing life cycle assessment of building products.

The datasets are subject to strict quality requirements and can be used in many different building assessment systems. The database system with its search and filter functions enables user-friendly online searches of the datasets.

Data published in ÖKOBAUDAT are **publicly available at no charge**. The respective owner of the datasets remains responsible for the contents and values.

www.nachhaltigesbauen.de

More than 1,200 datasets for building products – EN 15804- and BNB-compliant

The constantly updated ÖKOBAUDAT (**current version 2019-III from 29.05.2019**) is the mandatory database for the Assessment System for Sustainable Building (Bewertungssystem Nachhaltiges Bauen, BNB). Currently more than 1,200 datasets are provided, and these have been in compliance with DIN EN 15804 since 2013. This means ÖKOBAUDAT is the first life cycle assessment database that completely complies with this standard.

ÖKOBAUDAT **offers both generic datasets and specific environmental declaration datasets from diverse companies or associations**. EPD datasets in ÖKOBAUDAT must fulfill further requirements beyond the scope of EN 15804 (see Principles for acceptance of LCA data in ÖKOBAUDAT). Before approval, the EPD programmes and data are checked for conformity with ÖKOBAUDAT requirements (→ Guidance for data providers).

Datasets in ÖKOBAUDAT are based on the background database GaBi. Besides, datasets based on ecoinvent background data are provided in 'additional datasets'. These are only by exception to be used within the Bewertungssystem Nachhaltiges Bauen für Bundesgebäude (BNB).

oekobau.dat - Google-Suche | Database search | Database | Ö | Prozess-Datensatz: Baufritz HO

https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?lang=de&uuid=2d22c5e2-ffd0-4f70-903d-a5d553f439dd

Suchen

https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=206deb33-2710-417d-9b92-aa70c7958334&stock=OBD_2019_III&lang=en

Zurück | Schließen

Prozess-Datensatz: Baufritz HOIZ Hobelspandämmung; 70 kg/m³ (de) de

Prozess-Information

Kerninformationen des Datensatzes

Ort	DE
Referenzjahr	2018
Name	Name ; Quantitative Produkt-/Prozesseigenschaften Baufritz HOIZ Hobelspandämmung; 70 kg/m³
Anwendungshinweis für Datensatz	Anwendung im Gebäude sinnvoll. Grundsätzlich ist eine Gegenüberstellung oder die Bewertung von EPD Daten nur möglich, wenn alle zu vergleichenden Datensätze nach EN 15804 erstellt wurden und die produktspezifischen Leistungsmerkmale berücksichtigt werden. Anwendung ausschließlich in Baufritz Systemwänden.
Technisches Anwendungsgebiet	Die HOIZ - Hobelspandämmung wird als Wärme- und Schalldämmstoff für Dächer, Decken und Wände als nicht belastbare Hohlraumdämmung im Holzbau eingesetzt. Generell können jedoch alle Hohlräume von Bauteilen (auch Stahlkonstruktionen) damit gedämmt bzw. akustisch gedämmt werden. Der Dämmstoff wird jedoch nur werksintern in Fertigteile verbaut und nicht als „reiner" Dämmstoff separat ausgeliefert.
Synonyme	Holzspandämmung, Holzdämmung, Holzfaserdämmung
Gliederungsnummer	2.10.02
Klassifizierung	Klassenname : Hierarchieebene OEKOBAU.DAT: 2.10.02 Dämmstoffe / Holzfasern / Holzfasern und Holzspäne, lose
Allgemeine Anmerkungen zum Datensatz	Die gegenständliche EPD bezieht sich auf das Produkt HOIZ - Hobelspandämmung, hergestellt in dem Werk in 87746 Erkheim, Deutschland. Die HOIZ - Hobelspandämmung wird als Wärme- und Schalldämmstoff für Dächer, Decken und Wände als nicht belastbare Hohlraumdämmung im Holzbau eingesetzt. Generell können jedoch alle Hohlräume von Bauteilen (auch Stahlkonstruktionen) damit gedämmt bzw. akustisch gedämmt

Parameter zur Beschreibung der Umweltwirkungen

Indikator	Einheit	Rohstoffbereits A1	Herstellung A1-A3	Transport A2	Herstellung A3	Transport A4	Einbau A5	Nutzung B1	Instandhaltung B2	Reparatur B3	Ersatz B4	Umbau/Erneue B5	Energieeinsatz B6	Wassereinsatz B7	Abbruch C1	Transport C2	Abfallbehandlu C3	Beseitigung C4	Recyclingpoter D
Globales Erwärmungspot (GWP)	kg CO2-Äqv.	0	-107	0	0	1.64	0.00126	0	0	0	0	0	0	0	0	0.366	113	0	-45.8
Abbau Potential der stratosphärische Ozonschicht (ODP)	kg R11-Äqv.	0	8.75E-9	0	0	1.17E-11	7.57E-14	0	0	0	0	0	0	0	0	2.6E-12	4.74E-11	0	-1.39E-9
Bildungspotentia für troposphärische Ozon (POCP)	kg Ethen-Äqv.	0	0.00084	0	0	-0.00245	1.35E-7	0	0	0	0	0	0	0	0	-0.000545	0.000984	0	-0.00533
Versauerungspo von Boden und Wasser (AP)	kg SO2-Äqv.	0	0.0101	0	0	0.0072	0.00000182	0	0	0	0	0	0	0	0	0.0016	0.0103	0	-0.0483
Eutrophierungsp (EP)	kg Phosphat-Äqv.	0	0.00229	0	0	0.00177	2.89E-7	0	0	0	0	0	0	0	0	0.000393	0.00226	0	-0.00754

oekobau.dat - Google-Suche | Database search | Database | Ö | Process Data set: Cotton, conv

https://oekobaudat.de/OEKOBAU.DAT/datasetdetail/process.xhtml?uuid=206deb33-2710-417d-9b92-aa70c7958334&stock=OBD_2019_III&lang=en

Suchen

Collapse all sections | Go back | Close

Process Data set: Cotton, conventional; 40 kg/m3 (en) *en* *de*

Process information

Key Data Set Information

Location	DE
Geographical representativeness description	The data set represents the country specific situation in Germany, focusing on the main technologies, the region specific characteristics and / or import statistics.
Reference year	2017
Name	Base name ; Quantitative product or process properties Cotton, conventional; 40 kg/m3
Use advice for data set	The data set represents a cradle to gate inventory. It can be used to characterise the supply chain situation of the respective commodity in a representative manner. Combination with individual unit processes using this commodity enables the generation of user-specific (product) LCAs.
Technical purpose of product or process	This product can be used in construction.
Classification number	2.14.01
Classification	Class name : Hierarchy level oekobau.dat: 2.14.01 Insulation materials / Cotton / Conventional Cotton
General comment on data set	This data set has been modeled according to the European Standard EN 15804 for Sustainable Building. Results are depicted in modules that allow the structured expression of results over the entire life cycle.
Uncertainty margins	20
Description	Product system depicted except for a few missing processes / flows. Technological, temporal and geographic representativeness partly given.
Copyright	Yes
Owner of data set	thinkstep

Indicators of the impact assessment

Indicator	Unit	Production A1-A3
Global warming potential (GWP)	kg CO2 eq.	-0.7803
Ozone Depletion Potential (ODP)	kg R11 eq.	1.198E-15
Photochemical Ozone Creation Potential (POCP)	kg Ethene eq.	0.0003181
Acidification potential (AP)	kg SO2 eq.	0.007502
Eutrophication potential (EP)	kg Phosphate eq.	0.01162
Abiotic depletion potential for non fossil resources (ADPE)	kg Sb eq.	0.000002732
Abiotic depletion potential for fossil resources (ADPF)	MJ	11.53

BNB-Berncharks – office buildings

Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit

Nachhaltiges Bauen

Bewertungssystem Nachhaltiges Bauen (BNB)
Büro- und Verwaltungsgebäude (New Office Buildings)

BNB_BN **1.1.1**

Hauptkriteriengruppe	**Ökologische Qualität**
Kriteriengruppe	**Wirkungen auf die globale und lokale Umwelt**
Kriterium	**Treibhauspotenzial (GWP)**

Bewertungsmaßstab

		Anforderungsniveau
Target value	Z: 100	≤ 24 kg CO_2-Äqu./(m^2_{NGFa}·a)
Reference value	R: 50	= 37 kg CO_2-Äqu./(m^2_{NGFa}·a)
Limit value	G: 10	≥ 66 kg CO_2-Äqu./(m^2_{NGFa}·a)
	0	Das Treibhauspotenzial (GWP) wurde nicht nachgewiesen.
	Zwischenwerte sind abschnittsweise linear zu interpolieren.	

50 a // A1 + A2 + A3 + B4 + B6 + C3 + C4

BNB-Berncharks – office buildings

Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit

Nachhaltiges Bauen

Bewertungssystem Nachhaltiges Bauen (BNB)

Büro- und Verwaltungsgebäude — Office Buildings

Modul Komplettmodernisierung — Major renovation

BNB_BK

1.1.1

Hauptkriteriengruppe	Ökologische Qualität
Kriteriengruppe	Wirkungen auf die globale und lokale Umwelt
Kriterium	Treibhauspotential (GWP)

Bewertungsmaßstab

		Anforderungsniveau
Target value	Z: 100	≤ 24 kg CO_2-Äqu./(m^2_{NGFa}·a)
Reference value	R: 50	= 37 kg CO_2-Äqu./(m^2_{NGFa}·a)
Limit value	G: 10	≥ 66 kg CO_2-Äqu./(m^2_{NGFa}·a)
	0	Das Treibhauspotenzial (GWP) wurde nicht nachgewiesen.
	Zwischenwerte sind abschnittsweise linear zu interpolieren.	

Background report – new LCA benchmarks 2015

In 2015, the current benchmarks for newly constructed office buildings for the sustainability assessment system BNB were developed as part of a study. The table below shows (from top to bottom) target, reference and limit values for the full life cycle - embodied + operational (reference study period = 50 years). This resulted in a **system of benchmarks** for different indicators.

The development of benchmarks was based on reference buildings (bottom up approach).

1.1.1	1.1.2	1.1.3	1.1.4	1.1.5	1.2.1	1.2.2.1	1.2.2.2
GWP (CO_2-Äqu.) [kg/m^2a]	ODP (R11-Äqu.) [kg/m^2a]	POCP (C_2H_4-Äqu.) [kg/m^2a]	AP (SO_2-Äqu.) [kg/m^2a]	EP (PO_4-Äqu.) [kg/m^2a]	PE_{ne} [kWh/m^2a]	PE_{ges} [kWh/m^2a]	PE_{em} [kWh/m^2a]
22,6	0,000000042	0,0057	0,0574	0,0077	104	114	37,2%
35,9	0,000000119	0,0100	0,0860	0,0142	160	197	29,2%
66,2	0,000000196	0,0200	0,1601	0,0277	277	343	14,8%

8,20	12,31	22,63
12,62	23,16	35,89
23,11	46,12	66,23

GWP in detail: embodied/operational/total

https://www.bbsr.bund.de/BBSR/DE/FP/ZB/Auftragsforschung/2NachhaltigesBauenBauqualitaet/2014/BNBReferenzmodell/endbericht.pdf?__blob=publicationFile&v=4

Endbericht

für das BBSR - Forschungsvorhaben

Forschungsprogramm:	Zukunft Bau
Forschungsprojekt:	Entwicklung einer Methodik zur Festlegung von Benchmarks für LCA und LCC im Rahmen der BNB-Systementwicklung – BNB-Referenzmodell
Aktenzeichen:	10.08.17.7-14.19
Forschungsgeber:	Bundesinstitut für Bau-, Stadt und Raumforschung (BBSR) Referat II 5 Nachhaltiges Bauen
Forschungsnehmer:	Steinbeis-Hochschule-Berlin GmbH Steinbeis-Transfer-Institut Bau- und Immobilienwirtschaft
Forschungsteam:	Dipl.-Ing. Bernd Landgraf (Projektleiter) Prof. Dr.-Ing Jörn Krimmling Dr.-Ing. Hendrik Müller
aufgestellt am:	07.10.2015

Reference building approach – details

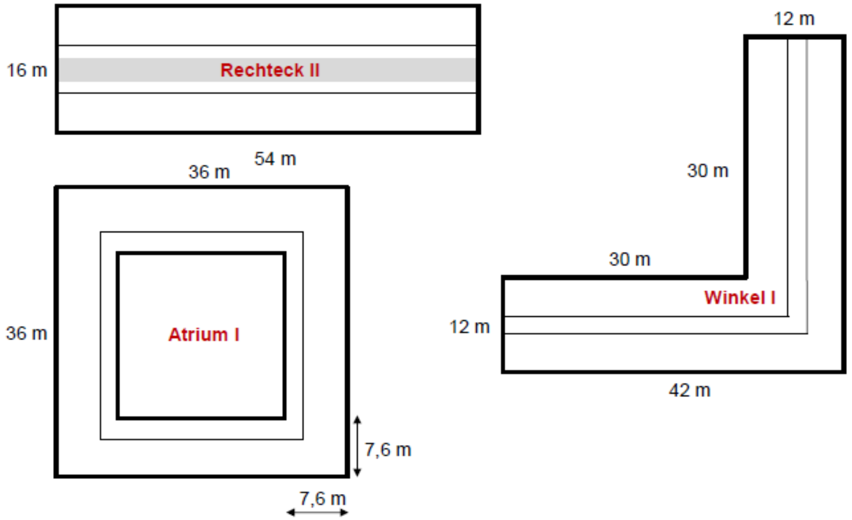
Nutzung: Büro	Variationen
Grundrisse	Rechteck / Winkel / Atrium
Raumkonzepte	Kombizone, zweibündig Zellenbüro, zweibündig Zellenbüro, einbündig
Geschosse	1 + 0 (1 OG, 0 UG) 3 + 0 (3 OG, 0 UG) 6 + 1 (6 OG, 1 UG)
Außenwände	Stahlbeton / Poroton / Holz
Fensterflächenanteile	30% (Lochfassade) / 73% (Glasfassade)
Dämmstandards	niedrig (EnEV 2009) / hoch (EnEV 2009 - 50 %)
Dämmmaterialien	Steinwolle / Mineralwolle in Poroton / Zellulose

	U-Werte [W/m²K]			
Dämmstandard	**Boden**	**Wand**	**Dach**	**Fenster**
niedrig (Referenzgebäude EnEV 2009/2014)	0,350	0,280	0,200	1,300
hoch (Referenzgebäude EnEV 2009/2014 - 50 %)	0,175	0,140	0,100	0,650

Tabelle 16: Variationselemente der Geometrie und Bauweise für die Variantenbildung der Modellgebäude

Damit die Gebäude vergleichbar sind, wurden Grundrisse mit gleicher Grundfläche (864 m^2 definiert.

Grundrisse der Modellgebäude



Die folgende Tabelle zeigt den Unterschied zwischen den verwendeten Modulen der Ökobau.dat-Versionen 2013 und 2015.

Lebenszyklusphase	Ökobau.dat Version 2013	Ökobau.dat Version 2015
Herstellung	Module A1 - A3 (teilweise - A5)	Module A1 - A3
Erneuerung	(„Herstellung" + „End of Life") x Anzahl der Erneuerungen	(„Herstellung" + „End of Life") x Anzahl der Erneuerungen
Nutzung (Energiebedarf)	Modul B6	Modul B6
End of Life	Module C3, C4 und D	Module C3, C4

Tabelle 22: Definition der zu bilanzierenden Module in der LCA zur Bewertung der BNB-Kriterien 1.1.1-1.1.5, 1.2.1, 1.2.2

	Dämmstandard niedrig		Dämmstandard hoch	
Bauteil	**Dämmmaterial**	**Dämmdicke**	**Dämmmaterial**	**Dämmdicke**
Boden	XPS	60	XPS	120
Wand A (Stahlbeton)	Steinwolle	115	Steinwolle	240
Wand B (Mauerwerk)	Porotonziegel	(365)	Mineralwolle gefüllte Porotonziegel	(490)
Wand C (Holzskelett)	Holz + Zellulose	180	Holz + Zellulose	320
Dach A und B	PU-Schaum	150	PU-Schaum	300
Dach C	Holz + Zellulose	260	Holz + Zellulose	560
Fenster	Holz	WSV 2-fach	Aluminium	WSV 3-fach

Tabelle 20: Dämmstandards der Modellgebäude

Benchmark(s) **Benchmark system with GWP, ODP, AP, EP, Penr, …**	Performance level(s) **Target value Reference value Limit value**	Country **Germany**
Calculation Method **National assessment method based on LCA**	Included Modules **A1, A2, A3, B4, B6, C3, C4**	Reference study period **50 years Static/deterministic approach**
Data base **Oekobau.dat (public available)**	Time of validity of benchmarks **2015 - 2020**	Reference unit / level of dis-aggr. **…./m² * a total (embodied + operation)**
Basis **Reference buildings / archetypes**	Approach **Bottom up**	Use case **Sustainability assessment Green public procurement**

DGNB - Sustainability assessment system

The present version is the English translation of the **German system version 2018, 3rd edition (as at June 2018)**. It is based on the requirements and benchmarks of the German market.

Criterion **ENV1.1 "Building life cycle assessment"** is assessed in the same way as the results of a building life cycle assessment. The results of this life cycle assessment are designated as an "Environmental profile" or "Environmental quality" of a building.

A building life cycle assessment determines and evaluates the environmental quality of a building, taking into account its scheme (office building, commercial building, school, etc.) and **compares the results with reference values**. The basis used for obtaining the data must be documented and provided in order to prevent any doubt when checking the results. The building life cycle assessment **should be used during the planning phase itself, where possible**. It can provide an important instrument for optimising the environmental quality of the building.

The basis used for calculating the building life cycle assessment is DIN EN 15978.

Environmental quality

The six criteria of environmental quality allow an assessment to be made with regard to the **effects of buildings on the global and local environment as well as the impact on resources and the generation of waste.**

ENV1.1 Building life cycle assessment

2.2. Reference values for the building life cycle assessment

The reference values (40 sub-points) for the environmental indicators (EIP_{Gref}) are generally derived from

- a fixed proportion for the construction-related value of the environmental impacts of emissions for construction, maintenance and recovery/disposal, as well as
- a variable proportion for the use-related value of the environmental impacts of emissions at the level of the reference building used as a basis in DIN V 18599/EnEV 2014 (or standardised energy simulation). The variable proportion is calculated from the electricity and heating demand (final energy) determined in accordance with DIN V 18599/EnEV 2014 (or standardised energy simulation), multiplied by defined factors (values of the environmental profiles for the electricity mix and a representative thermal energy mix).

$$R_{EIP} = EIP_{Gref} = EIP_{Cref} + EIP_{Uref} \qquad \textbf{(5)}$$

where

- EIP_{Cref} Reference value for the annual average value of the environmental impact potential for **construction, maintenance, recovery and disposal** of the building including the technical facilities used across the reference period considered t_d, in [kg environmental impact equivalent/(m^2_{SA}*a)]
- EIP_{Uref} Reference value for the annual environmental impact potential resulting from **operation** of the building, derived from the final energy demand of the reference building in accordance with EnEV 2014 (or standardised energy simulation) or – for selected schemes – reference value for the annual environmental impact potential resulting from the **user equipment** during building operation, derived from the final energy demand of the defined facilities in [kg environmental impact equivalent/(m^2_{SA}*a)]

The reference values for the **construction EIP_{Cref}** are determined as follows:

$$EIP_{Cref} = \text{constant} \qquad (6)$$

The EIP_{Cref} values are determined using parameters derived from statistical studies.

The reference values for the **use EIP_{Uref}** are determined as follows:

$$EIP_{Uref} = EIP_{UEref} + EIP_{UHref} + EIP_{UFref} \qquad (7)$$

where

- EIP_{UEref} Environmental impact potential of the annual **electricity demand (final energy) of the reference building** in accordance with EnEV 2014 (or standardised energy simulation) in [kg environmental impact equivalent/(m^2_{SA}*a)]
- EIP_{UHref} Environmental impact potential of the annual **heating and, where applicable, cooling demand (final energy) of the reference building** in accordance with EnEV 2014 (or standardised energy simulation) in [kg environmental impact equivalent/(m^2_{SA}*a)]
- EIP_{UFref} only for selected schemes: Reference value for the annual environmental impact potential of the **user equipment during building operation**, derived from the final energy demand of the defined facilities in [kg environmental impact equivalent/(m^2_{SA}*a)]

The calculation of the final energy demand is based on either EnEV 2014 (DIN V 18599) or a standardised energy simulation.

The reference period t_d is 50 years. A reference period of 20 years must be selected for the **Production** and **Logistics** schemes.

LIFE PHASES	A 1–3			A 4–5		B 1–7							C 1–4				D
	PRODUCTION PHASE			ERECTION PHASE		USE PHASE							END OF THE LIFE CYCLE				BENEFITS AND LIABILITIES OUTSIDE OF THE SYSTEM LIMITS
	RAW MATERIALS PROCUREMENT	TRANSPORT	PRODUCTION	TRANSPORT	ERECTION/INSTALLATION	USE 1	MAINTENANCE 2	REPAIR	REPLACEMENT 2	MODERNISATION	ENERGY CONSUMPTION DURING OPERATION	WATER CONSUMPTION DURING OPERATION	DISMANTLING/DEMOLITION	TRANSPORT	WASTE RECYCLING	DISPOSAL	POTENTIAL FOR REUSE, RECOVERY AND RECYCLING
Modules in accordance with DIN EN 15978	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Declared modules	x	x	x				(x) 3		(x) 4		x	(x)5			x	x	x

1) Impacts due to emissions that can impact health in the interior and the environment are assigned to criteria ENV1.2 and SOC1.2

2) A scenario for the energy demand of the building in use, whereby only the energy demand recorded in EnEV 2014 is taken into account (module B6).

3) Maintenance processes are partially represented as water consumption in ENV2.2. Not included in the building life cycle assessment.

4) Only includes the creation and disposal of the replaced product, not the replacement process itself (same as for construction process).

5) Water consumption of the building is only taken into account for the "Water consumption" indicator.

https://static.dgnb.de/fileadmin/en/dgnb_system/system/version2018/02_ENV1.1_Building-life-cycle-assessment.pdf?m=1530286752&

Table 1: Reference values for construction, maintenance and recovery/disposal ("construction") as well as use: GWP, ODP, POCP, AP, EP

	GWP	ODP	POCP	AP	EP
Unit	[kg CO_2 equivalent/(m^2_{SA}*a)]	[kg R11 equivalent/(m^2_{SA}*a)	[kg C_2H_4 equivalent/(m^2_{SA}*a)]	[kg SO_2 equivalent/(m^2_{SA}*a)]	[kg PO_4^{3} equivalent/(m^2_{SA}*a)]
Office **Education** **Residential** **Hotel** **Consumer markets** **Shopping centre** **Business premises** Construction	$GWP_{Cref} = 9.4$	$ODP_{Cref} = 5.3 \cdot 10^{-7}$	$POCP_{Cref} = 0.0042$	$AP_{Cref} = 0.037$	$EP_{Cref} = 0.0047$
Logistics **Production** Construction (per m³ BRI)	GWP_{Cref} = 1.2/(m^3_{BRI}*a)	$ODP_{Cref} = 1.9 \cdot 10^{-8}$ /(m^3_{BRI}*a)	$POCP_{Cref} = 0.0005$ /(m^3_{BRI}*a)	$AP_{Cref} = 0.003$ /(m^3_{BRI}*a)	$EP_{Cref} = 0.0004$ /(m^3_{BRI}*a)
Logistics **Production** Construction (per m²SA)	GWP_{Cref} = 12/(m^2_{SA}*a)	$ODP_{Cref} = 1.9 \cdot 10^{-7}$ /(m^2_{SA}*a)	$POCP_{Cref}$ = 0.005/(m^2_{SA}*a)	AP_{Cref} = 0.03/(m^2_{SA}*a)	EP_{Cref} = 0.004/(m^2_{SA}*a)

Construction, maintenance and recovery/disposal

https://static.dgnb.de/fileadmin/en/dgnb_system/system/version2018/02_ENV1.1_Building-life-cycle-assessment.pdf?m=1530286752&

Table 1: Reference values for construction, maintenance and recovery/disposal ("construction") as well as use: GWP, ODP, POCP, AP, EP

	GWP	ODP	POCP	AP	EP
Unit	[kg CO_2 equivalent/(m^2_{SA}*a)]	[kg R11 equivalent/(m^2_{SA}*a)	[kg C_2H_4 equivalent/(m^2_{SA}*a)]	[kg SO_2 equivalent/(m^2_{SA}*a)]	[kg PO_4^3 equivalent/(m^2_{SA}*a)]
Use	$GWP_{Uref} = GWP_{UEref} + GWP_{UHref} + GWP_{UF,ref}$ where $GWP_{UEref} = 0.579 * E_{ref}$ $GWP_{UHref} = 0.231 * H_{ref}$	$ODP_{Uref} = ODP_{UEref} + ODP_{UHref} + ODP_{UF,ref}$ where $ODP_{UEref} = 2.08 * 10^{-12} * E_{ref}$ $ODP_{UHref} = 1.57 * 10^{-14} * H_{ref}$	$POCP_{Uref} = POCP_{UEref} + POCP_{UHref} + POCP_{UF,ref}$ where $POCP_{UEref} = 0.0000607 * E_{ref}$ $POCP_{UHref} = 3.03 * 10^{-5} * H_{ref}$	$AP_{Uref} = AP_{UEref} + AP_{UHref} + AP_{UF,ref}$ where $AP_{UEref} = 0.000871 * E_{ref}$ $AP_{UHref} = 0.00027 \cdot H_{ref}$	$EP_{Uref} = EP_{UEref} + EP_{UHref} + EP_{UF,ref}$ where $EP_{UEref} = 0.000142 * E_{ref}$ $EP_{UHref} = 2.65 * 10^{-5} * H_{ref}$
Office **Education** **Residential** **Hotel** **Consumer markets** **Shopping centre** **Business premises**	$GWP_{UF,ref} = 0$	$ODP_{UF,ref} = 0$	$POCP_{UF,ref} = 0$	$AP_{UF,ref} = 0$	$EP_{UF,ref} = 0$
Consumer markets **Shopping centre** **Business premises**	$GWP_{UFEref} = 0.579 * E_{UFref}$	$ODP_{UFEref} = 2.08 * 10^{-12} * E_{UFref}$	$POCP_{UFEref} = 0.0000607 * E_{UFref}$	$AP_{UFEref} = 0.000871 * E_{UFref}$	$EP_{UFEref} = 0.000142 * E_{UFref}$

https://static.dgnb.de/fileadmin/en/dgnb_system/system/version2018/02_ENV1.1_Building-life-cycle-assessment.pdf?m=1530286752&

Table 2: Reference values for construction, maintenance and recovery/disposal ("construction") as well as use: PEnr, PEtot and PEe/PEtot ratio

	PE_{NR}	PE_{TOT}	PE_E/PE_{TOT}
Unit	$[MJ/(m^2_{SA}*a)]$	$[MJ/(m^2_{SA}*a)]$	[%]
Office Education Residential Hotel Consumer markets Shopping centre Business premises			
Construction	$PE_{nr,Cref} = 123$	$PE_{tot,Cref} = 151$	[-]
Logistics Production			
Construction (per m³ BRI)	$PE_{nr,Cref} = 12.3$	$PE_{tot,Cref} = 13.7$	[-]
Logistics Production			
Construction (per m² SA)	$PE_{nr,Cref} = 123$	$PE_{tot,Cref} = 137$	[-]

Construction, maintenance and recovery/disposal

34,16 kWh/m²a

https://static.dgnb.de/fileadmin/en/dgnb_system/system/version2018/02_ENV1.1_Building-life-cycle-assessment.pdf?m=1530286752&

Table 2: Reference values for construction, maintenance and recovery/disposal ("construction") as well as use: PEnr, PEtot and PEe/PEtot ratio

	PE_{NR}	PE_{TOT}	PE_E/PE_{TOT}
Unit	$[MJ/(m^2_{SA}*a)]$	$[MJ/(m^2_{SA}*a)]$	[%]
Use	$PE_{nr,Uref} = (PE_{nr,UEref} + PE_{nr,UHref} + PE_{nr,UFref})$ where $PE_{nr,UEref} = 7.3\ MJ/kWh * E_{ref}$ $PE_{nr,UHref} = 3.44\ MJ/kWh * H_{ref}$	$PE_{tot,Uref} = (PE_{tot,UEref} + PE_{tot,UHref} + PE_{tot,UFref})$ where $PE_{tot,UEref} = 11.18\ MJ/kWh * E_{ref}$ $PE_{tot,UHref} = 4.13\ MJ/kWh * H_{ref}$	[-]
Office Education Residential Hotel Consumer markets Shopping centre Business premises	$PE_{nr,UFref} = 0$	$PE_{tot,UFref} = 0$	
Consumer markets Shopping centre Business premises	$PE_{nr,UFref} = 7.3\ MJ/kWh * E_{UFref}$	$PE_{tot,UFref} = 11.18\ MJ/kWh * E_{UFref}$	
All building types:			15% (use and construction)

https://static.dgnb.de/fileadmin/en/dgnb_system/system/version2018/02_ENV1.1_Building-life-cycle-assessment.pdf?m=1530286752&

GHG-Emissions for residential buildings – use stage (operation)

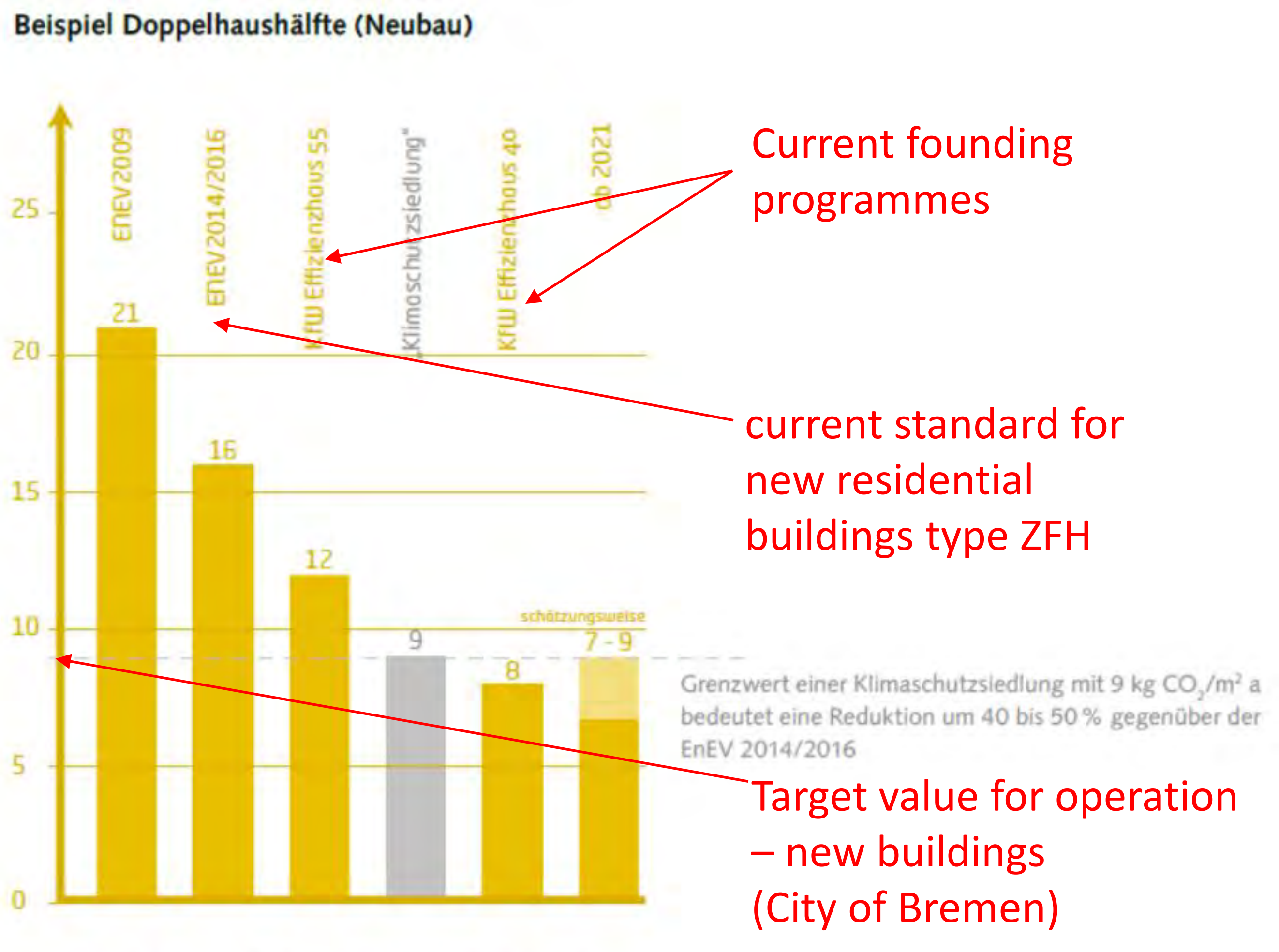


Abbildung 1: CO_2-Emissionen von Klimaschutzsiedlungen im Vergleich

CO_2-Emissionen für Heizung, Lüftung, Warmwasser, Hilfsstrombedarf (ohne Haushaltsstrom) bezogen auf die reale Wohnfläche

https://www.energiekonsens.de/bau-stadtentwicklung/broschueren/Leitfaden_Klimaschutzsiedlungen%20Bremen%20und%20Bremerhaven_web.pdf

Limit value and target value calculation

Limit values G and target values Z, which are also required for evaluation of the criterion, are generally defined as a factor applied to the reference values for the various environmental impact potentials, expressed mathematically as follows:

Limit value
Target value

$G_{EIP} = X_{EIP} * R_{EIP}$
$Z_{EIP} = Y_{EIP} * R_{EIP}$

Reference values are the basis for limit and target values.

The associated variables X and Y must be formulated for the various environmental indicators as shown in Table 3.

Table 3: Target and limit values of the various environmental indicators

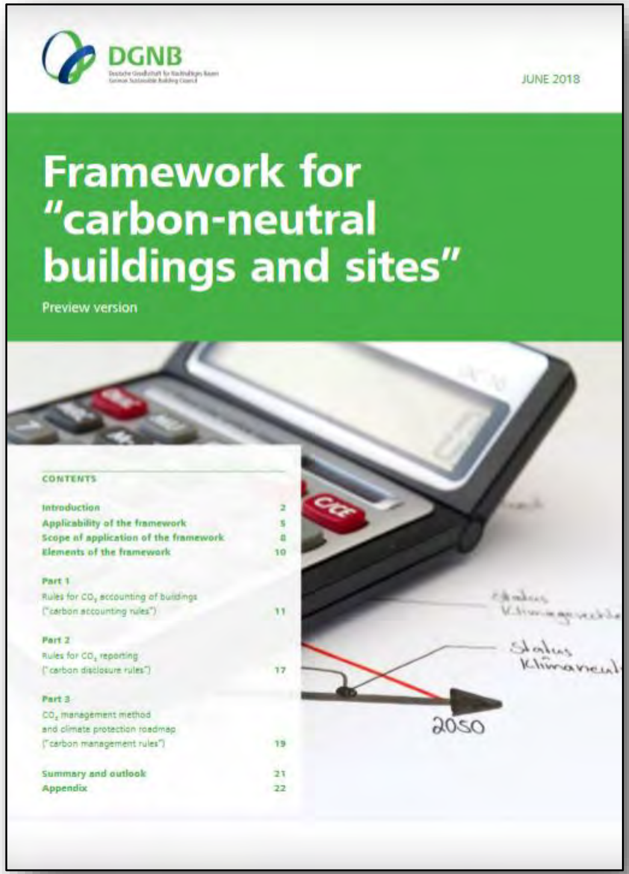
	LIMIT AND TARGET VALUE	GWP	POCP	AP	EP	PE_{NR}	PE_{TOT}	PE_E/PE_{TOT}	ODP	LS	ADP_E
Limit value	X	1.4	2.0	1.7	2.0	1.4	1.4	5%	-	-	-
Target value I	Y	0.7	0.7	0.7	0.7	0.7	0.7	30%	-	-	-
Target value II	Y+ (overfulfilment)	0.55	0.55	0.55	0.55	0.55	0.55	37.5%	-	-	-

List of criteria with agenda 2030 bonuses

CRITERION	CRITERION NAME	CONTRIBUTION TO THE AGENDA 2030 OBJECTIVES	SCORE
ENV1.1	**Building life cycle assessment**	Climate-neutral operation (building): The CO_2 emissions generated as a result of the **energy demand arising from the running of the building** are at least **offset** in accordance with the DGNB definition for establishing climate neutrality*.	Agenda 2030 bonus: +10 points
ENV1.1	**Building life cycle assessment**	Climate-neutral operation (users): The CO_2 emissions generated as a result of the **energy consumption arising from the building users' activities** are at least **offset** in accordance with the DGNB definition for establishing climate neutrality*.	Agenda 2030 bonus: +10 points
ENV1.1	**Building life cycle assessment**	Climate-neutral building construction: The total **CO2 emissions** (CO2 equivalents) from manufacturing and maintenance processes as well as end of life **that are bound in the building** and are determined by means of a DGNB life cycle assessment are at least **offset***. (Life cycle scenario analysis).	Agenda 2030 bonus: +10 points (+5 points if the value is 50% less than the reference value)

https://static.dgnb.de/fileadmin/en/dgnb_system/system/version2018/02_ENV1.1_Building-life-cycle-assessment.pdf?m=1530286752&

https://static.dgnb.de/fileadmin/en/dgnb_ev/reports/Framework-carbon-neutral-buildings.pdf



New developments

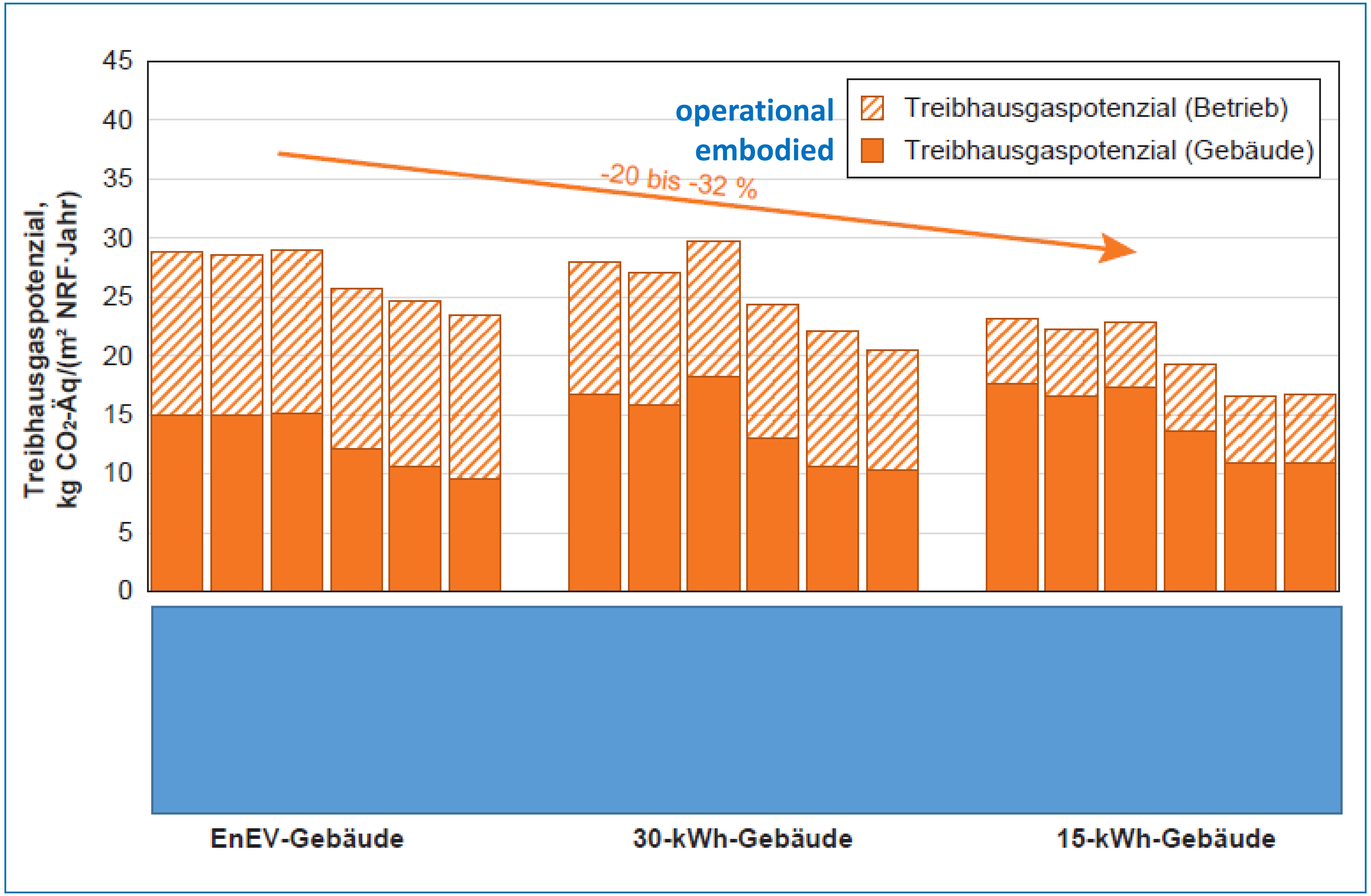
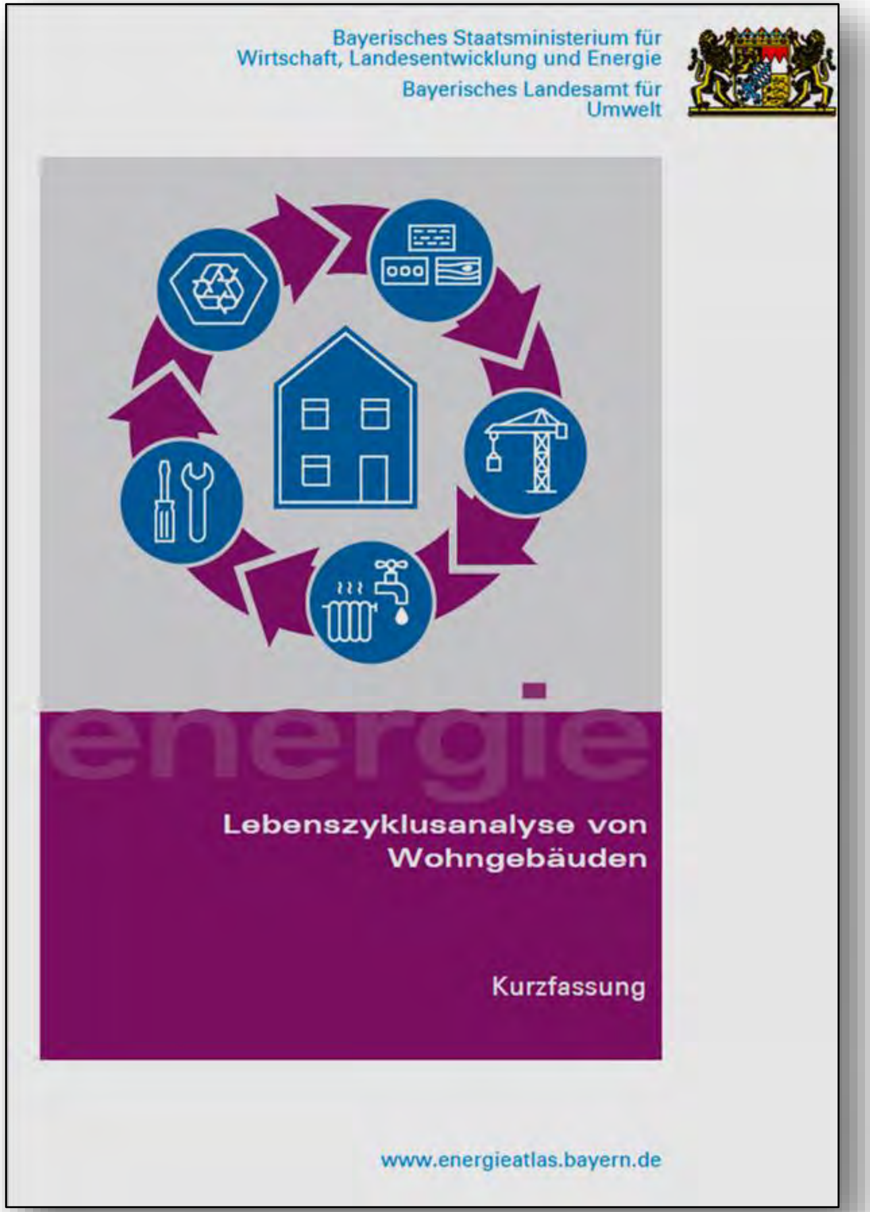


Abb. 13: Treibhausgaspotenziale der einzelnen Bauweisen und Energieniveaus am Beispiel der Luft-Wasser-Wärmepumpe



No benchmarks are presented here, but typical orders of magnitude for different types of residential buildings.

GWP total

GWP construction

GWP operation

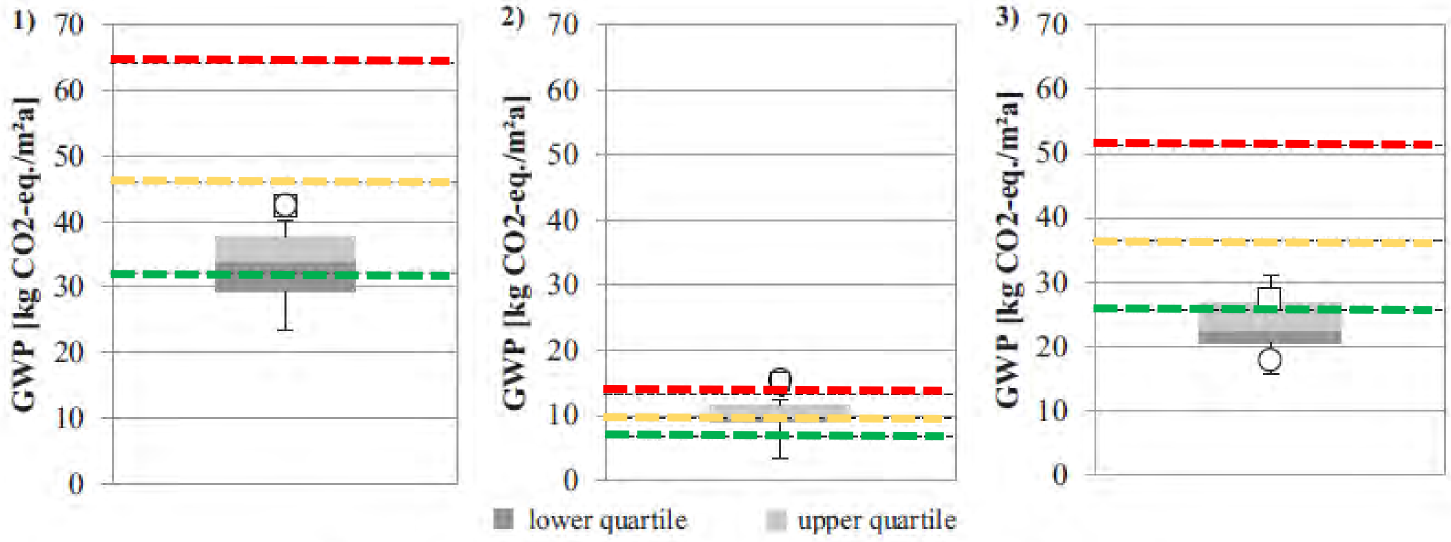


Fig 6. Variance of benchmarks (1) Total (2) Construction (3) Operation.

“Three horizontal dashed lines can be seen per box plot. These lines show the benchmarks of the DGNB.
For the operation and thus for the total value, the value is an arithmetic mean of the 20 buildings. In the case of construction, the DGNB generally sets a value of 9.4. It can be seen that there are slight deviations between the statistical building evaluations and the DGNB benchmarks.”

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LCA of buildings in Germany: Proposal for a future benchmark based on existing databases

Friederike Schlegl[a,*], Johannes Gantner[b], René Traunspurger[c], Stefan Albrecht[b], Philip Leistner[b]

[a] University of Stuttgart, Institute for Acoustics and Building Physics (IABP), Department of Life Cycle Engineering (GaBi), Wankelstraße 5, Stuttgart 70563, Germany
[b] Fraunhofer Institute for Building Physics (IBP), Department of Life Cycle Engineering (GaBi), Nobelstraße 12, Stuttgart 70563, Germany
[c] German Sustainable Building Council (DGNB) e.V., Tübinger Straße 43, Stuttgart 70178, Germany

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DGNB

ABSTRACT

The evaluation of environmental aspects in the early planning phase of buildings can support the reduction of the resource use and environmental impacts associated with the building sector over the whole building life-cycle. The integration of life cycle assessment (LCA) benchmarks in the planning phase is one potential measure. To derive these benchmarks a large database of existing building assessment is essential. Potential data input is available from the German Sustainable Building Council (DGNB), as it certifies more than 200 buildings annually and the certification includes a mandatory LCA. In this study, the current submission files and database of the DGNB are assessed and critically reviewed with regard to their usability for automated LCA benchmarks. First, a harmonized database is created from the large number of assessed buildings. Second, the data is examined for its suitability for benchmarking with regard to data format, structure and level of detail. The data that were declared fit for purpose were used to create an exemplary, harmonized data set with 22 office buildings. The evaluation of these data for various environmental indicators of the individual life-cycle phases shows their respective relevance and can thus serve as a benchmark. Another focus is to encourage improvement of the additional documentation like the energy source required for better benchmarking, interpretation of results and auditing of the LCA rules for building certification. The results of this study highlight the opportunities and challenges in the development of a database for benchmarking. Before long-term LCA benchmarks can be developed and deployed, a standardized and uniform submission format of results, that is indifferent regarding the used LCA software, needs to be developed. In the future the submission process should be extended by an automated quality assurance to prevent restraints from low data quality and data gaps that otherwise have to be detected manually.

1. Introduction

The building and construction industry is held responsible for approximately 60% of the resource consumption, 35% of the energy consumption and about 35% of the greenhouse gas emissions worldwide [30]. The world's population is growing constantly and it is necessary to significantly minimize the environmental impact in this area in the future. Early planning phases of buildings offer a general opportunity to reduce long-term environmental impacts in the building industry, since the most important and far-reaching decisions are made at this stage [9,16]. However, early planning phases only sparse information on the planned buildings or components is available, whereas the necessary decisions in theses phases are very complex [22,28]. Above all, innovative research and development is aimed at significantly reducing the resource requirements of future buildings. In order to make these ambitious targets achievable, benchmarks are needed as a starting point. Benchmarks, i.e. arithmetical averages of the life cycle assessment (LCA) results of realized assessed projects offer a good opportunity to receive information on environmental issues at an early stage. In addition, they can be used to specify target values for future buildings.

Currently, LCA is only used as proof for the buildings after project completion, because the process of conducting an LCA for buildings – data gathering, modelling and interpretation of the results – is very time-consuming and therefore cost-intensive [17].

* Corresponding author.
E-mail address: frederike.schlegl@iabp.uni-stuttgart.de (F. Schlegl).

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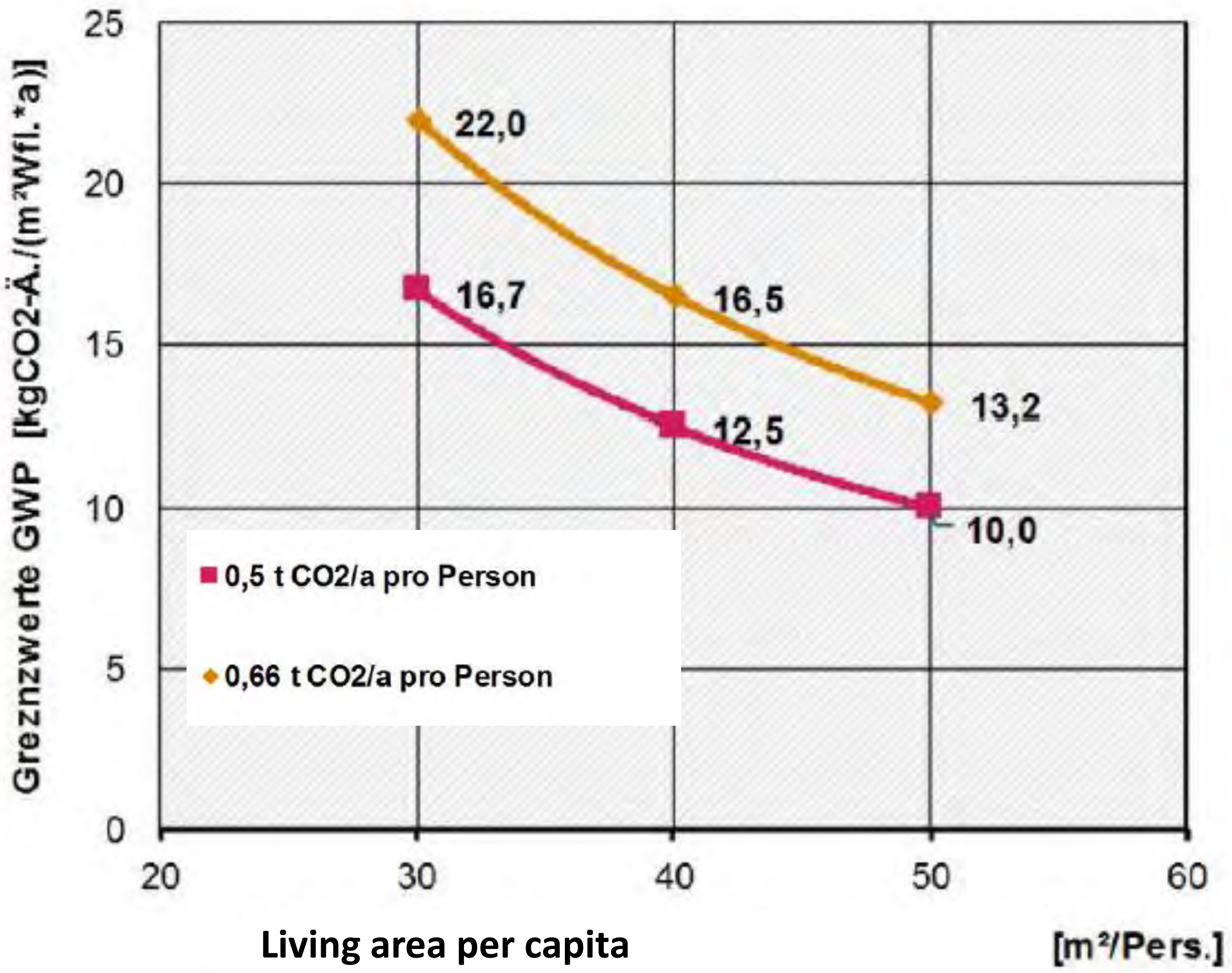
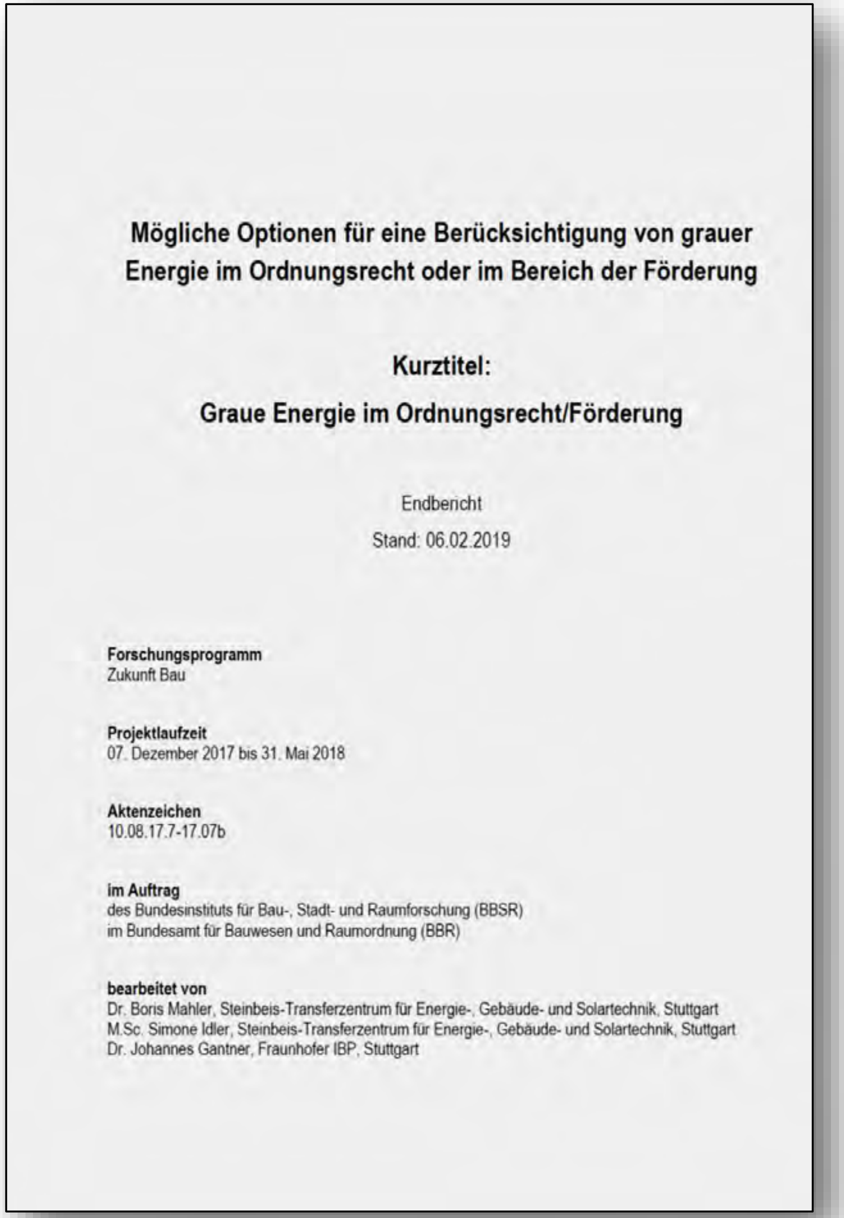


Will we see legal requirements in future ???

https://www.bbsr.bund.de/BBSR/DE/FP/ZB/Auftragsforschung/5EnergieKlimaBauen/2017/graue-energie/Endbericht.pdf?__blob=publicationFile&v=3



Mögliche Optionen für eine Berücksichtigung von grauer Energie im Ordnungsrecht oder im Bereich der Förderung

Kurztitel:

Graue Energie im Ordnungsrecht/Förderung

Endbericht

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bearbeitet von
Dr. Boris Mahler, Steinbeis-Transferzentrum für Energie-, Gebäude- und Solartechnik, Stuttgart
M.Sc. Simone Idler, Steinbeis-Transferzentrum für Energie-, Gebäude- und Solartechnik, Stuttgart
Dr. Johannes Gantner, Fraunhofer IBP, Stuttgart

Outlook and summary

Estimation of a per-capita "budget" for construction & housing in kg CO_2equ./m² of living area and year

Budget for construction and housing
in kg CO_2equ. / person and year

Living area in m² per person

	600	500	400	300	200	100
60	10,0	8,3	6,7	5,0	3,3	1,7
55	10,9	9,1	7,3	5,5	3,6	1,8
50	12,0	10,0	8,0	6,0	4,0	2,0
45	13,3	11,1	8,9	6,7	4,4	2,2
40	15,0	12,5	10,0	***7,5***	5,0	2,5
35	17,1	14,3	11,4	8,6	5,7	2,9
30	20,0	16,7	13,3	10,0	6,7	3,3
25	24,0	20,0	16,0	12,0	8,0	4,0

Lützkendorf, 2018

Total budget ca.
2 t CO_2equ./year

Total budget ca.
1 t CO_2equ./year

Summary

Benchmarks for individual buildings are **unavoidable for supporting the design process**.

So far, benchmarks have been inseparably tied to a system of methods (including system boundary, data set and calculation tool) and **can only be used in this context**.

The driver for the development and application of benchmarks in Germany was the **sustainability assessment of public and private buildings. Here, experiences of more than 10 years exist.**

Benchmark systems are used on the basis of **deterministic models** for construction and the entire life cycle. **Benchmarks are based on legal requirements, best practice and technical /economic feasibility**.

The German sustainability assessment systems are currently in the process of further developing their benchmarks in the **“top-down”** direction.

The system of limit, reference and target values has proven successful, but **new target values for GWP must be based on the requirements of climate neutrality.**