

Urban Energy Transition - International Building & Construction

Building Sector Decarbonization

Tbilisi, 23 June 2023



ევროკავშირი
საქართველოსთვის
The European Union for Georgia



KFW



საქართველოს განვითარების
და ინვესტიციების მინისტროს
სამსახურები
MINISTRY OF ECONOMY AND
SUSTAINABLE DEVELOPMENT
OF GEORGIA

intec
GFA International Energy Consultant



MRC | CONSULTANTS
AND TRANSACTION
ADVISORS
A member of the MRC Group of Companies

GOPALInfra

dena is a think tank with almost 500 experts for the applied energy transition

We combine competences

ENERGY EFFICIENCY



- **Reduce**
Conceptualisation,
intermediation and
information

INTELLIGENT ENERGY SYSTEMS



- **Produce**
Integration,
optimisation and
innovation

STAKEHOLDER PROCESSES



- **Moderate**
Moderation,
inclusion and
activation

INTERNATIONAL ACTIVITIES

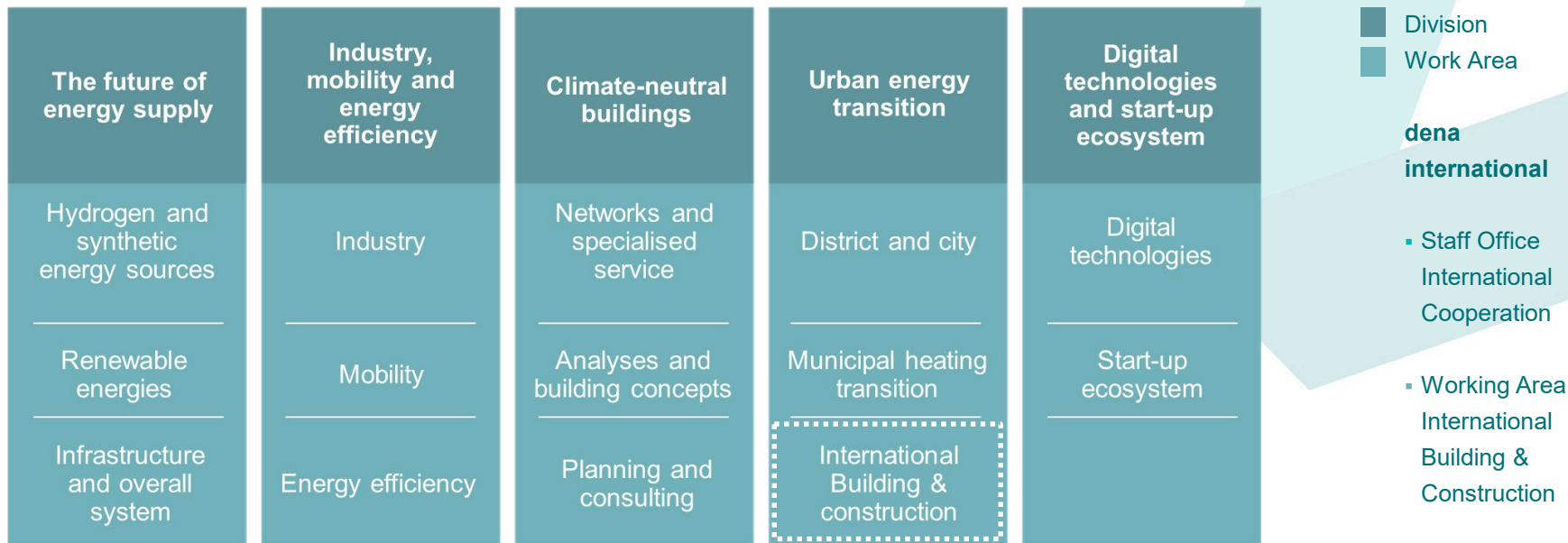


- **Share**
Consulting,
marketing and
support throughout
implementation



The five dena pillars

14 working areas in 5 divisions



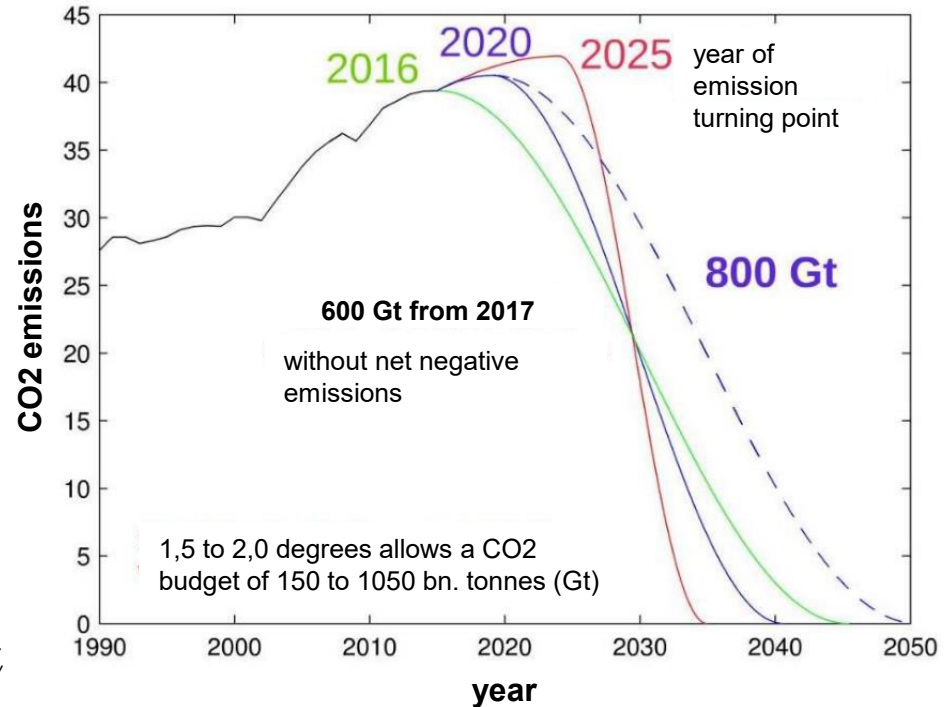
Building decarbonisation approach



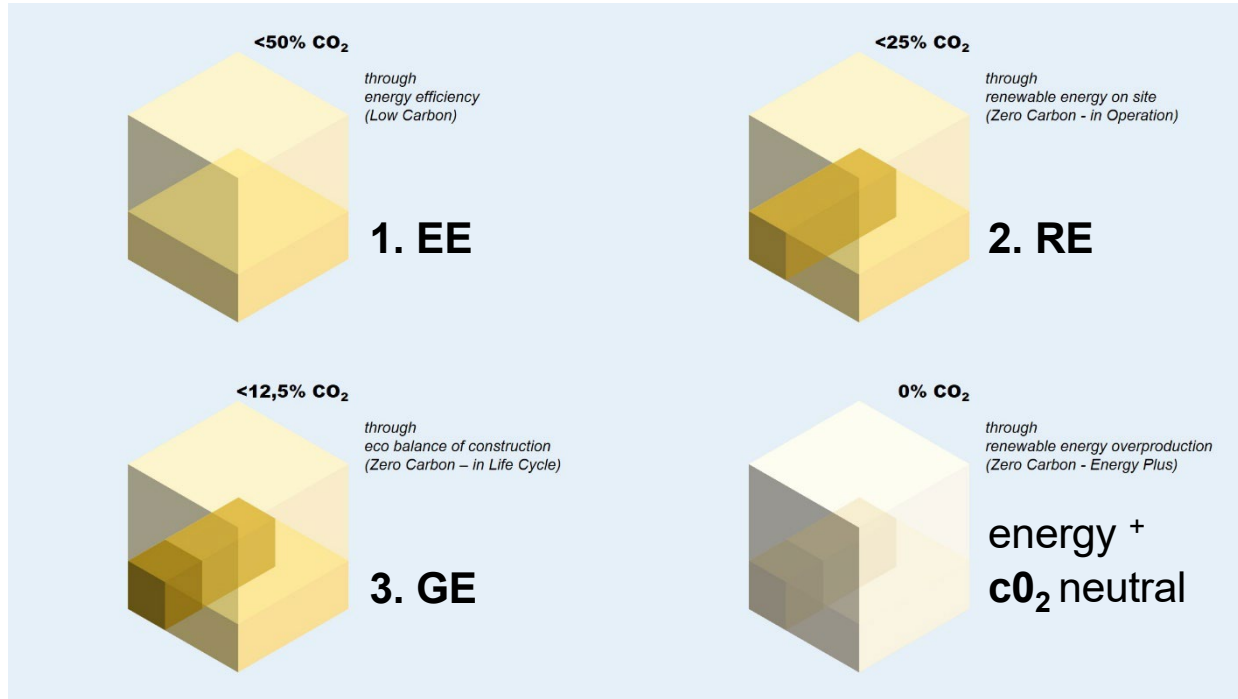
Climate warming

- Being able to limit global warming up to 1,5 to 2 degrees, only 700 bn. to of CO2 max. should be emitted globally.
- Therefore emissions of 40 bn. to in year 2020 have to be halved each decade, down to 20 bn. to in 2030, 10 bn. to in 2040 and 5 bn. to in 2050.
- In parallel the share of renewable energies has to be doubled all 5 years, which complies with the historical development of the last 10 years.
- In case it might not be possible to remove CO2 from the atmosphere additionally, CO2 emissions have to be stopped already until 2040.

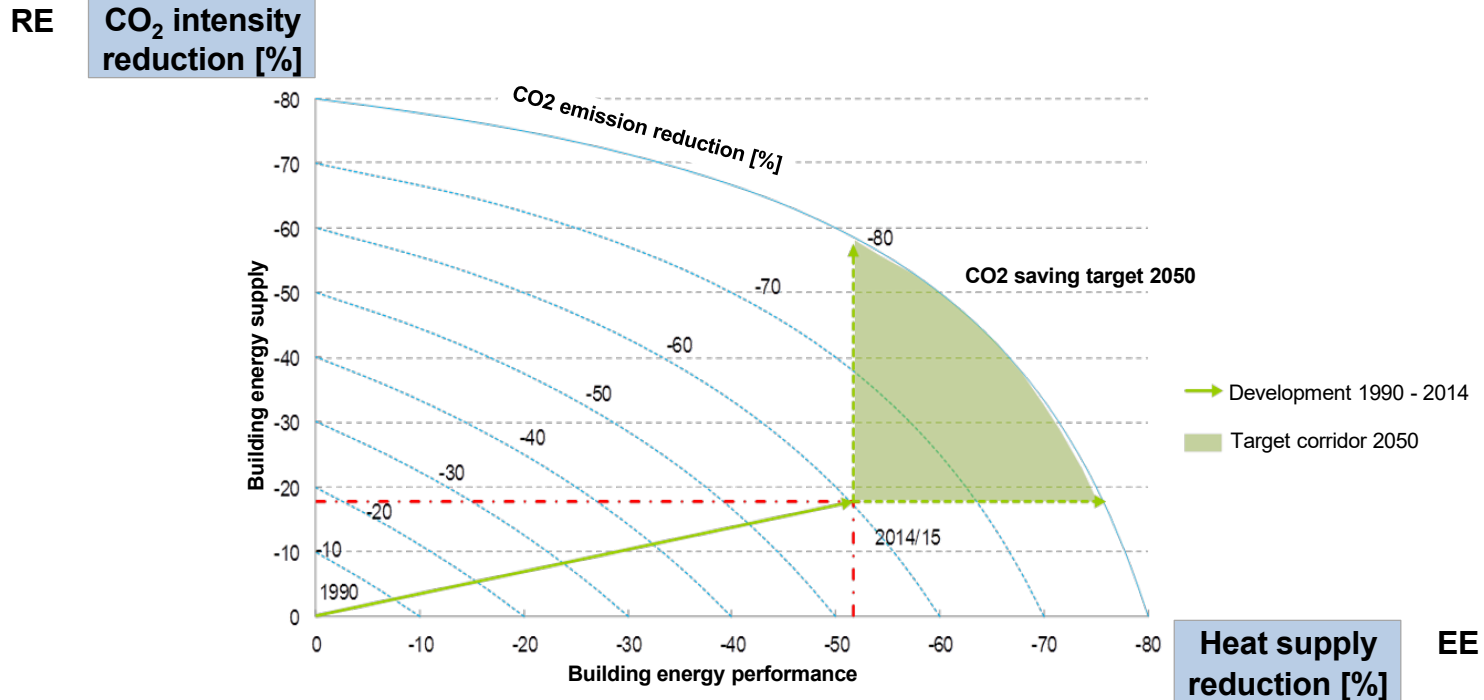
Source: scilogs.spektrum.de/klimalounge/koennen-wir-die-globale-erwaermung-rechtzeitig-stoppen/



Efficiency, renewables, material & compensation



Energy efficiency versus renewable energies



Aspects of decarbonization

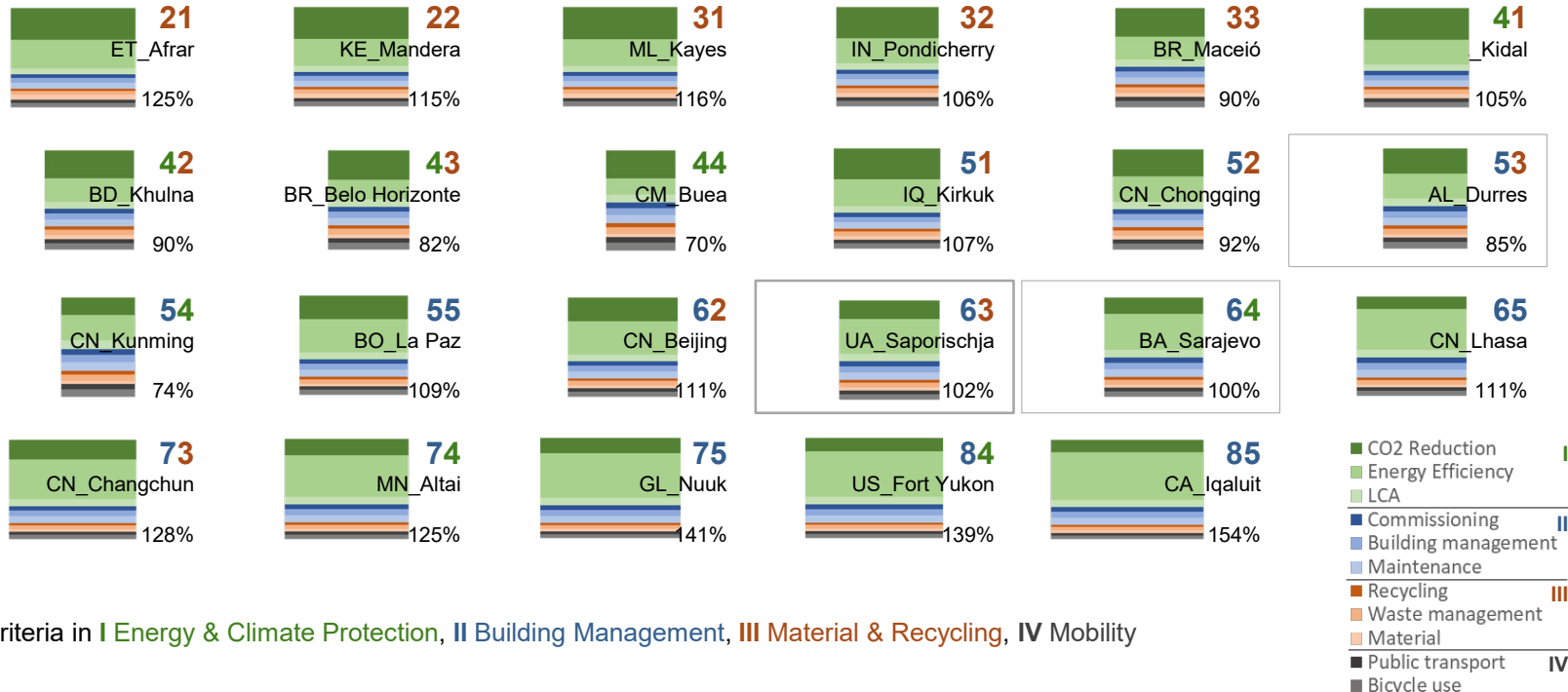
36 measures, 11 criteria, 4 categories
 50% environmental, 25% sustainable
 23 climate codes / regions

- 21 ET_Afar
- 22 KE_Mandera
- 31 ML_Kayes
- 32 IN_Pondicherry
- 33 BR_Maceió
- 41 ML_Kidal
- 42 BD_Khulna
- 43 AO_Luena
- 44 RW_Kibuye
- 51 IQ_Kirkuk
- 52 CN_Chongqing
- 53 JO_Amman
- 54 BT_Trashigang
- 55 BO_Ururu
- 62 UZ_Nukus
- 63 UA_Saporischschja
- 64 GE_Achalziche
- 65 CN_Lhasa
- 73 CN_Harbin
- 74 MN_Altai
- 75 GL_Nuuk
- 84 US_Fort Yukon
- 85 CA_Iqaluit

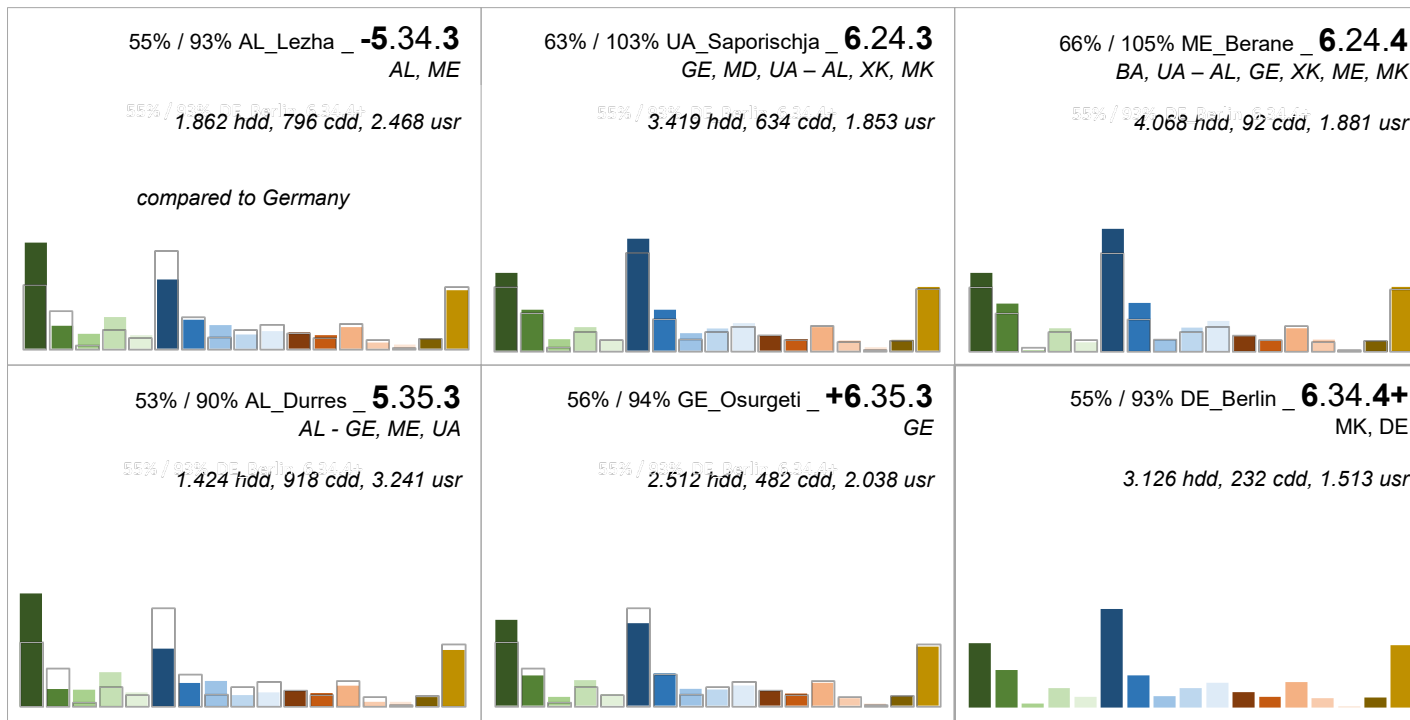
Energy and Climate Protection	21	22	31	32	33	41	42	43	44	51	52	53	54	55	62	63	64	65	73	74	75	84	85
CO2 Reduction																							
Renewable Energy Production (Electricity)	17.7%	18.9%	19.2%	19.5%	18.5%	20.1%	18.0%	21.2%	22.2%	20.2%	17.5%	17.7%	11.6%	15.4%	14.4%	10.4%	8.7%	3.4%	10.6%	7.2%	5.6%	3.6%	2.3%
Renewable Energy Production (Heating)		1.7%	2.1%	2.9%	4.5%	7.4%	5.5%	7.4%	5.5%	7.4%	4.5%	7.4%	5.5%	7.4%	3.7%	8.6%	11.6%	8.9%	10.6%	12.2%	12.7%	14.0%	
Renewable Energy Production (Cooling)	14.1%	12.5%	12.5%	10.9%	9.1%	10.7%	9.2%	6.1%	2.4%	7.6%	6.0%	3.0%	0.4%		3.7%	1.7%	0.1%		1.2%	0.1%		0.1%	
Renewable Energy Production (Hot Water Preparation)	8.9%	9.4%	9.6%	9.8%	9.2%	10.1%	9.0%	10.6%	11.1%	10.1%	8.7%	8.8%	5.8%	7.7%	7.2%	5.2%	4.4%	1.7%	5.3%	4.3%	2.8%	1.8%	1.2%
Green roofs and facades	1.8%	1.9%	1.9%	2.1%	2.5%	2.1%	2.5%	2.8%	3.3%	1.9%	2.2%	2.4%	2.7%	1.3%	1.4%	1.5%	1.4%	0.8%	0.8%	0.7%	0.3%	0.3%	
Energy Efficiency																							
U-values / Insulation level of building envelope to reduce ene	10.2%	9.1%	9.0%	7.9%	6.6%	7.8%	6.7%	4.4%	1.7%	8.8%	8.5%	8.0%	9.4%	14.7%	13.7%	15.8%	17.3%	23.2%	18.7%	21.3%	24.3%	25.6%	28.0%
Passive design solutions to reduce heating energy demand										2.0%	1.9%	2.4%	2.3%	7.0%	5.0%	4.5%	4.6%	3.5%	7.0%	6.0%	6.2%	4.7%	4.2%
Passive design solutions to reduce cooling energy demand	7.1%	6.7%	6.7%	6.2%	5.4%	6.2%	5.4%	4.7%	3.5%	5.1%	4.2%	3.2%	1.5%		3.0%	1.9%	1.1%		1.7%	0.9%		0.5%	
Energy efficient HVAC design	2.0%	1.8%	1.8%	1.6%	1.3%	1.6%	1.3%	0.9%	0.3%	1.8%	1.7%	1.6%	1.9%	2.9%	2.7%	3.2%	3.5%	4.6%	3.7%	4.3%	4.9%	5.1%	5.6%
Energy efficient HVAC equipment	2.0%	1.8%	1.8%	1.6%	1.3%	1.6%	1.3%	0.9%	0.3%	1.8%	1.7%	1.6%	1.9%	2.9%	2.7%	3.2%	3.5%	4.6%	3.7%	4.3%	4.9%	5.1%	5.6%
Other energy efficient equipment	1.8%	1.9%	1.9%	2.1%	2.5%	2.1%	2.5%	2.8%	3.3%	2.1%	2.4%	2.7%	3.2%	2.0%	2.2%	2.2%	2.0%	1.7%	2.2%	2.0%	1.7%	1.8%	1.4%
Daylight Usage																							
Energy efficient Lighting	1.7%	1.9%	1.9%	2.3%	3.2%	2.2%	3.3%	3.4%	4.3%	2.1%	3.1%	3.6%	5.2%	2.5%	2.5%	3.4%	3.6%	3.7%	2.3%	2.8%	2.5%	2.8%	2.6%
Insulation of HVAC components for heating										0.3%	0.4%	0.6%	0.9%	1.5%	1.1%	1.5%	1.7%	2.3%	1.8%	2.1%	2.4%	2.5%	2.8%
Insulation of HVAC components for cooling	1.8%	1.6%	1.6%	1.4%	1.1%	1.3%	1.2%	0.8%	0.3%	1.0%	0.7%	0.4%	0.1%		0.5%	0.2%	0.0%		0.2%	0.0%		0.0%	
Energy consumption on construction site	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
LCA																							
Life Cycle Analysis	6.8%	7.1%	7.1%	7.6%	8.5%	7.5%	8.6%	9.0%	10.1%	7.5%	8.6%	9.2%	10.9%	8.2%	8.0%	9.0%	9.3%	9.5%	7.9%	8.5%	8.3%	8.6%	8.4%
Management																							
Commissioning																							
Commissioning and Verification	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
Handover	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
Building management																							
Metering	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
Monitoring & Adjustment	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
User Behaviour control technologies	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
Maintenance																							
Maintenance plan	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
Seasonal commissioning and verification	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
Post occupancy evaluation	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
Material & Recycling																							
Recycling																							
Storage and collection of recyclables	3.5%	3.8%	3.8%	4.3%	5.0%	4.2%	5.1%	5.6%	6.6%	4.1%	4.9%	5.3%	6.3%	4.0%	4.0%	4.4%	4.5%	4.0%	3.4%	3.5%	3.1%	3.2%	2.8%
Waste management																							
Construction Waste Management	1.1%	1.2%	1.2%	1.3%	1.4%	1.2%	1.4%	1.5%	1.7%	1.2%	1.4%	1.5%	1.8%	1.4%	1.3%	1.5%	1.6%	1.6%	1.3%	1.4%	1.4%	1.4%	1.4%
Waste management concept	0.9%	1.0%	1.0%	1.1%	1.3%	1.1%	1.3%	1.4%	1.6%	1.0%	1.2%	1.3%	1.6%	1.0%	1.0%	1.1%	1.1%	1.0%	0.9%	0.9%	0.8%	0.8%	0.7%
Minimise the waste involved in installing undesirable floor fin	0.9%	1.0%	1.0%	1.1%	1.3%	1.1%	1.3%	1.4%	1.6%	1.0%	1.2%	1.3%	1.6%	1.0%	1.0%	1.1%	1.1%	1.0%	0.9%	0.9%	0.8%	0.8%	0.7%
Material																							
Ecological building material and material efficiency	2.2%	2.4%	2.4%	2.5%	2.8%	2.5%	2.9%	3.0%	3.4%	2.5%	2.9%	3.1%	3.6%	2.7%	2.7%	3.0%	3.1%	3.2%	2.6%	2.8%	2.8%	2.9%	2.8%
Refrigerant reduction and management	1.8%	1.6%	1.6%	1.4%	1.1%	1.3%	1.2%	0.8%	0.3%	1.0%	0.7%	0.4%	0.1%		0.5%	0.2%	0.0%		0.2%	0.0%		0.0%	
Mobility																							
Public transport																							
Public transport accessibility	0.9%	1.0%	1.0%	1.1%	1.3%	1.1%	1.3%	1.4%	1.6%	1.0%	1.2%	1.3%	1.6%	1.0%	1.0%	1.1%	1.1%	1.0%	0.9%	0.9%	0.8%	0.8%	0.7%
Alternative modes of transport	0.9%	1.0%	1.0%	1.1%	1.3%	1.1%	1.3%	1.4%	1.6%	1.0%	1.2%	1.3%	1.6%	1.0%	1.0%	1.1%	1.1%	1.0%	0.9%	0.9%	0.8%	0.8%	0.7%
Promotion of bicycle use																							
Bicycle network	0.9%	1.0%	1.0%	1.1%	1.3%	1.1%	1.3%	1.4%	1.6%	1.0%	1.2%	1.3%	1.6%	1.0%	1.0%	1.1%	1.1%	1.0%	0.9%	0.9%	0.8%	0.8%	0.7%
Bicycle storage	0.9%	1.0%	1.0%	1.1%	1.3%	1.1%	1.3%	1.4%	1.6%	1.0%	1.2%	1.3%	1.6%	1.0%	1.0%	1.1%	1.1%	1.0%	0.9%	0.9%	0.8%	0.8%	0.7%
Cyclist comfort																							

Winter / Summer code • 7 = extreme cold • 4 = moderate • 1 = extreme hot

CO₂ saving potentials per climate region



CO₂ saving potentials in Energy Communities



Ia. Renewable Energy (RE)

- *** Electricity (PV)
- *** Heating
- ** Cooling
- ** Warm water
- * Greening

Ib. Energy Efficiency (EE)

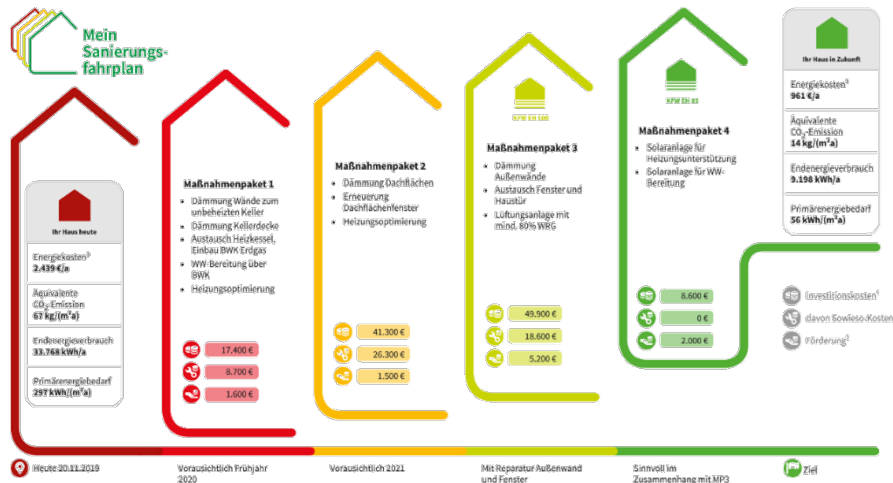
- **(*) U-values
- ** Passive design heating
- ** Passive design cooling
- ** EE HVAC design
- ** EE HVAC equipment
- * EE appliances
- * Daylight use
- * EE lighting
- * Insulation heating pipes
- * Insulation cooling pipes
- * EE construction site

Ic. Grey Energy (GE)

- *** Life Cycle Assessment

iSPF Individual Building Renovation Roadmap

- In use since 2017, obligatory for state financing since 01.07.2023 (proof of consulting)
- Provides a comprehensible overview of the renovations that are due in a building in the long term, suitable for either step-by-step or complete refurbishment
- Software-based, includes supplementary target group-specific background information for consultants and property owners
- Shows possible energy and CO2 savings, RE potentials, necessary investment costs based on possible sets of measures



Source: <https://www.dena.de/themen-projekte/projekte/gebaeude/individueller-sanierungsfahrplan-fuer-wohngebaeude/>

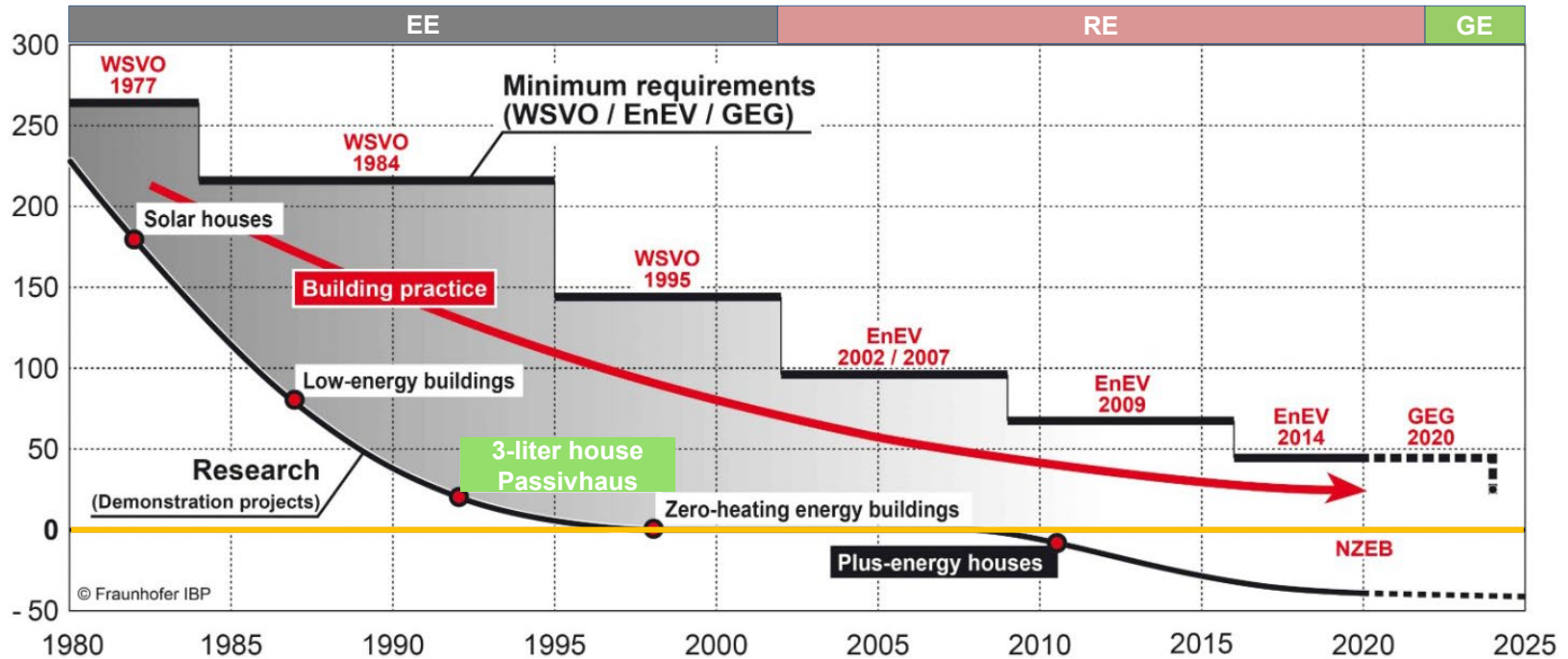
dena Guidance Study



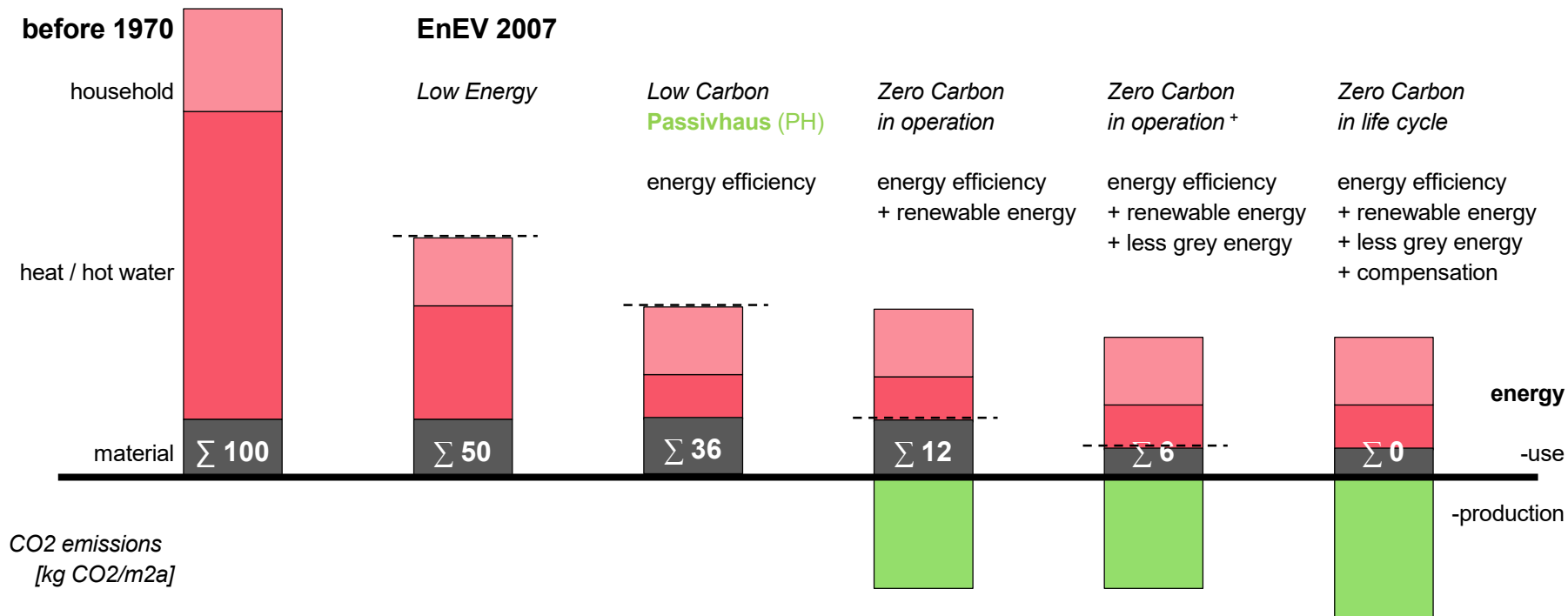
German policy instruments



Improvement of the German energy standards



Annual CO₂ emissions residential buildings / m²





Buildings Energy Act (GEG)

- **Main instrument of German energy policy in the building sector, requirements for energy in new buildings and for refurbishments**
- **13.06.2023 – „Guardrails for the GEG“ (law amendment under discussion, to come into force in 2024)**
 - Germany-wide municipal heat planning by 2028
 - Municipalities and operators must submit a binding roadmap with binding and comprehensible interim targets (monitoring) for the ramp-up of hydrogen by 2045 to ensure the transformation of the gas network
 - Wood/pellets considered to satisfy the 65% requirement (newly installed heating systems must use 65% RE sources)
 - Gas heating may still be installed if it can be converted to hydrogen or if it can use 65% biomass
 - The sale of heating systems may only take place alongside consulting regarding the possible inefficiency and effects of municipal heating planning
 - Educational campaigns about CO2 pricing and climate protection legislation
 - Special attention must be paid to the landlord-tenant relationship (mandatory use of subsidy by the tenant in order to raise the rent due to renovation)

Reference building

Reference building (100%)

average u-value H_t' calculated by fixed building envelope components
 primary energy Q_p calculated based on H_t' and a given set of building services

Real building (legal standard 70% of KfW 100 or better - KfW x)

average u-value H_t' reduced by x% from reference building result, "individual" components in design
 primary energy Q_p reduced by y% from reference building result, "individual" renewable energies

Standard	KfW 115	KfW 100	KfW 85	KfW 70	KfW 55	KfW 40	KfW 40+
average u-value H_t'	130%	115%	100%	85%	70%	55%	55%
primary energy Q_p	115%	100%	85%	70%	55%	40%	40%

energy efficient refurbishment

energy efficient new construction



Financial support

- 1. State funding program “Federal Promotional Support for Energy Efficiency in buildings” (BEG) - grants, low-interest (0,01% - 0,61%) loans and repayment bonuses. The amount of funding depends on the measures implemented, other factors e.g. income are not taken into account. The better energy efficiency improvement, the higher the funding. BEG applies to:**
 - New construction: residential and non-residential buildings (KfW 40 with a sustainable building certificate QNG)
 - Renovation: residential and non-residential buildings (KfW40 – KfW85)
 - Single measures for improving energy efficiency in buildings (e.g. improvements of the building envelope, HVAC, heating optimization - BAFA)
 - Grants for energy advice/consulting
- 2. Tax deductions for building renovations (20%, max. 40.000 Euro pro residential property)**
- 3. Depreciation for the wear and tear of buildings (AfA)**

QNG - Quality Seal for Sustainable Buildings

- **Necessary condition for BEG funding for new construction**
- **Promotes a uniform understanding of sustainability**
- **Basic criteria for QNG similar to BREEAM etc.**
- **Specific criteria**
CO2 in lifecycle (max. 24 kg CO2 eq./m²a), primary energy demand (96 kWh/m²), sustainable materials (min. 50% of timber is sustainably sourced), housing is suitable for the elderly, green roofs (for non-residential buildings)
- **Certification process**
Needs assessment incl. Pre-check -> Planing -> Construction -> Completion and Certification



Source: <https://www.nachhaltigesbauen.de/austausch/beg/>



Funding

Energy efficiency expert

1. Persons authorized to issue building energy performance certificates (criteria listed in § 88 GEG) with an additional qualification as an en. eff. expert

Criteria in § 88 GEG:

- **Initial qualification**
 - Specialized university degree
 - Master craftsmen or certified technicians
- **Additional qualification**
 - Two years of experience in energy-efficient construction (for university graduates)
 - Additional training according to GEG etc.

Additional qualification as EnEFF expert

- 120 teaching units for architects/engineers
- 200 teaching units for other professions

2. (Since 2020) Qualification examination for energy consulting for residential buildings (BAFA) and for module 2 of the federal promotion "Energy consulting for non-residential buildings, plants and systems"

- **Corresponding training offered currently by 11 institutions in Germany**
- **This qualification does not enable the qualified person to issue building energy performance certificates**



Funding

Energy efficiency experts database

1. Registration in the database is required to apply for certain financing programs
2. The registration is valid for 3 years, every three years experts need to submit
 - Continuing education certificate: 24 teaching units
 - Proof of practical experience
3. Dena is in charge of the database, checks the experts' qualifications and conducts random quality checks of their work

~13,000
experts
in the database

8,500
architects
and
engineers

3,000
craftsmen
and technicians

52,000
searches
per month

Source: <https://www.dena.de/themen-projekte/energieeffizienz/gebaeude/beraten-und-planen/energieeffizienz-expertenliste/>

Urban Energy Transition – District & City

Energy Services for Municipalities



Urban Energy Transition – Competence Center Municipal Heat Transition

Municipal Heat Transition



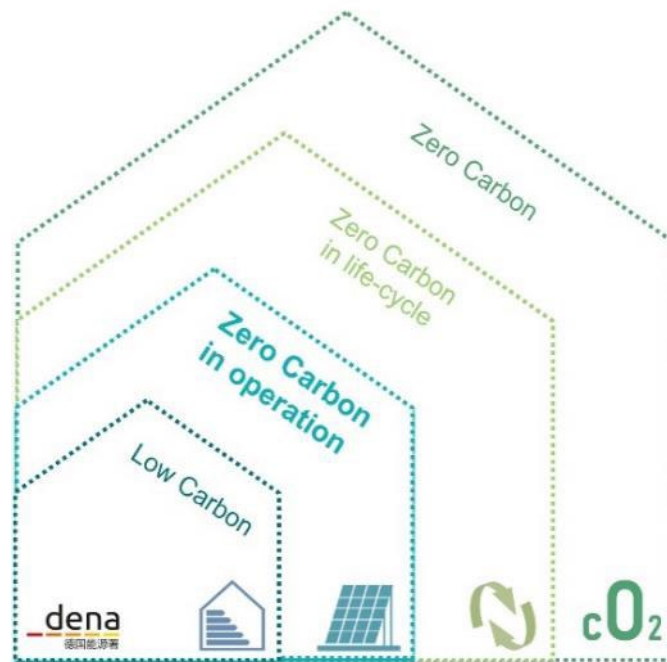
Urban Energy Transition – International Building & Construction

International Building / District / City



dena zero carbon building certification process

	Energy source	Final energy kWh/m²a	CO2 factor kg/kWh	CO2 emissions kg/m²a
Heating	Electricity	5.7	0.700	3.99
Cooling & dehumidification	Electricity	1.0	0.700	0.70
Domestic hot water	Electricity	5.0	0.700	3.50
Auxiliary electricity	Electricity	17.0	0.700	11.90
Household electricity	Electricity	20.6	0.700	14.42
I. Low Carbon (Passivhaus)		49.3	0.700	34.51
Total renewable energy generation	PV	- 49.3	0.700	-34.51
II. Zero Carbon in Operation				0.00
Grey energy construction material				15.00
Grey energy LCA optimisation				-5.00
Grey energy recycling credits				-5.00
III. Zero Carbon in Life-Cycle				5.00
Compensation/energy overproduction	PV			-5.00
IV. Zero Carbon				0



Integrated district concepts



6 steps towards an energy efficient municipality

- 1. **Define** clear **responsibilities** and work processes.
Recommendation: EKM coordinator, EKM working group.
 - 2. Mission statement: **long-term orientation of goals**, binding through municipal council resolution.
 - 3. Energy consumption and emission **data** of relevant fields of action and existing EC activities.
 - 4. Mission statement as basis -> **operational targets** according to "S.M.A.R.T" criteria (Specific, Measurable, Reasonable, Realistic, Timed) -> priority assessment of possible measures-> energy and climate protection program.
 - 5. Plan **measures** and their **financing** (subsidies, private service providers like contracting) in detail.
 - 6. Observe **good project management**: internal communication, time controlling, early error detection.
- dena certificate** for municipalities that have systematically reduced their energy consumption.



Roadmap Greater Bay Area in China

New Buildings

Scalability: significantly increase ambition to set and building codes in the region. Minimize the risks of short-term investments.

Existing Buildings

Create awareness for the decarbonisation of the building stock. Prioritize public buildings to lead by example. Accelerate scalable modularized retrofit measures.

Appliances & Systems

Increase supply and demand for high energetic performance in appliances.

Building Operations

Implement energy management obligations and processes to drive an energy efficient building operation through information and behaviour change.

Materials

Integrate life cycle perspectives through low carbon materials and recycling programmes.

Urban Planning

Promote integrated sustainable urban planning between core GBA zones, including smart city solutions.



Resilience

Implement forward-looking planning approaches and accelerate dynamic response speed and flexibility to climate emergencies.

Clean Energy

Scale up local renewable energy and regional grid supply, implement smart city solutions.

Enablers

Key to achieve the complex transition is establishing an effective stakeholder engagement network, including public, private, academic and financial sectors, and fostering of system innovation.

新建建筑

规模化: 大幅提高所有项目阶段的减排目标和建筑规范, 降低长期投资搁浅的风险

既有建筑

培养对建筑产业脱碳的意识。优先选择公共建筑项目展示示范效果。加快落实规模化的模块化改造措施。

设备系统

增加高效设备的供应并扩大需求。

建筑运营

落实能源管理义务和程序, 通过信息采集和行为改变来推动节能建筑的运行。



逐渐材料

通过低碳材料使用和回收处理推动整合生命周期的全方位减碳。

城市规划

推动粤港澳大湾区各核心区域之间的综合性可持续城市规划, 以及智慧城市解决方案。

城市韧性

实施前瞻性的规划方法, 提高对气候紧急情况的动态响应速度和灵活性。

清洁能源

扩大当地可再生能源利用和区域电网供应的规模, 实施智慧城市解决方案。

促进因素

实现复杂转型的关键是建立一个有多方利益相关者参与的高效网络, 包括公共、私营、学术和金融部门, 并促进系统创新。

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Others



39 local Energy-Agencies

A. National EA (dena)

B. Federal State EA (BW, NRW, HE, ...)

C. Local EA - Core areas

- The energy and climate protection agencies, promote energy efficiency and the use of renewable energies. With our local projects and campaigns, they are the pacesetters of the energy transition on the ground.
- Information and advice for the public sector, business and consumers on energy saving potentials.
- Integration of renewable energy sources.
- Support in planning and implementation.



EZA Energy & Environmental Centre Allgäu

- **Energy consultations**
 - 50 offices with independent experts provide free of charge information for the inhabitants of the Allgäu region
- **Training for professionals**
 - Courses "Energy Consultant“, "Energy Refurbishment of Buildings“, "Passive house designer" etc.
- **Support for local authorities**
- **Publicity and events**
 - Passive House Days, Old Buildings Days (annually, 10.000 visitors, 100 lectures and demonstrations) etc.
- **Services in the field of energy management for buildings, facilities and plants**
 - Consumption controls, optimizing the user's behavior etc.



The eza!-house, opened in 2002, is a show-case for demonstration, consultation and training. Formerly an old residential building in the centre of Kempten, it was renovated with support of the "High Tech Offensive Zukunft Bayern" program to provide an ideal centre for eza!'s work. The project demonstrates passive house technology in use, reducing the former energy demand for heating by 90%.

**Thank you
for your attention!**

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