SINO-SWISS ZEB PROJECT

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Building a climate-neutral future together

ZEB

Zero Emission Building Standards:
A Comparative Analysis of China and Switzerland

中华人民共和国
住房和城乡建设部

IBE 环能科技

中国建筑节能协会

Schweizerische Eidgenossenschaft
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1. SUMMARY

This report systematically compares the standard systems, implementation pathways, and policy contexts of China and Switzerland in the field of Zero Emission Buildings (ZEB), aiming to summarize both countries' experiences in reducing carbon emissions in the building sector and to propose recommendations for future cooperation and standard improvements.

In China, building energy efficiency standards have been continuously improved since the 1980s. National standards now cover energy consumption and carbon emissions during the building operation phase, and in recent years, the concepts of "near-zero carbon" and "zero carbon buildings" have gradually been introduced. The 2019 release of the Standard for Building Carbon Emission Calculation (GB/T 51366-2019) laid the foundation for accounting carbon emissions over the building's life cycle. In 2023, the Technical Standard for Zero Carbon Buildings (Draft for Comments) defined different carbon emission levels and evaluation methods, with a focus on the operational phase, while allowing carbon offsets through green electricity and carbon trading mechanisms. Several local governments (e.g., Heilongjiang, Shaanxi, Zhejiang, Shenzhen, and Hainan) have developed supplementary technical standards tailored to specific climatic conditions and have integrated international experience through expert exchanges.

Switzerland has promoted building energy efficiency and decarbonization since the 1970s. The newly published technical standard SIA 390/1 ("Climate Pathway") is based on the full building life cycle and covers three main emission stages: construction, operation, and transport. It proposes two target values (baseline and ambitious) and is supported by a national life cycle database (KBOB). The standard is further detailed through SIA 2032 and SIA 2039, which assess emissions from building components and transportation, respectively. Swiss experience emphasizes the importance of unified thermal standards, shorter regulations, and the quantification of user behavior and the impacts of future climate change.

Comparison results show that both China and Switzerland follow similar directions in building decarbonization, but differ in implementation depth, data systematization, and life-cycle perspectives. Chinese standards focus on operational carbon management, whereas Swiss standards comprehensively address the entire building life cycle. Switzerland widely applies quantitative methods based on public databases and includes transportation and energy infrastructure in the carbon footprint assessment. Both countries promote market mechanisms (e.g., green power certificates, carbon trading) to offset residual emissions, and photovoltaic systems play a key role in ZEBs in both contexts.

To accelerate the low-carbon transition of China's building sector, the report proposes the following recommendations:

- Expand the scope of standards to include embodied carbon emissions during the construction phase in ZEB assessment;
- Develop a national carbon emission factor database covering energy, transport, and building materials;
- Standardize the thermal performance requirements for building envelopes to improve market transparency;
- Encourage alignment between local and national standards to avoid regulatory fragmentation;
- Clarify the accounting rules for photovoltaic electricity, especially regarding the differing carbon reduction contributions of self-consumed vs. grid-fed electricity;
- Incorporate user behavior and climate change projections into standards to enhance the real-world applicability of calculation models.

2. CHINESE ZEB STANDARD

China Energy Standards

China is continuously upgrading the energy standards for buildings in the last decades. The improvement started in the early 1980s, when the former Ministry of Construction began to organize the work of building energy efficiency and established an energy efficiency standard system that covers five climate zones, all types of buildings and the whole process of building.

As of 2016, China's building energy standards have stepwise achieved 30 %, 50 %, and 65 % improvement targets compared to benchmarks in the 1980s. Building energy efficiency has to be further increased by more than 75 % in the future. Besides the binding regulations for the operational demand for energy there are mandatory standards for the utilization of renewable energy.

Since 2019 standards are also promoting "nearly-zero"-concepts and are newly focusing on carbon emission, like described technically in the document GB/T 51366-2019: "Standard for building carbon emission calculation". In addition to that a zero carbon (emission) standard is to be issued.

For the future, the ambitions are set: a transition from dual control of energy consumption (total amount, energy intensity) to dual control of total carbon emissions and intensity. The switch is expected to incentivize the use of renewable energy.

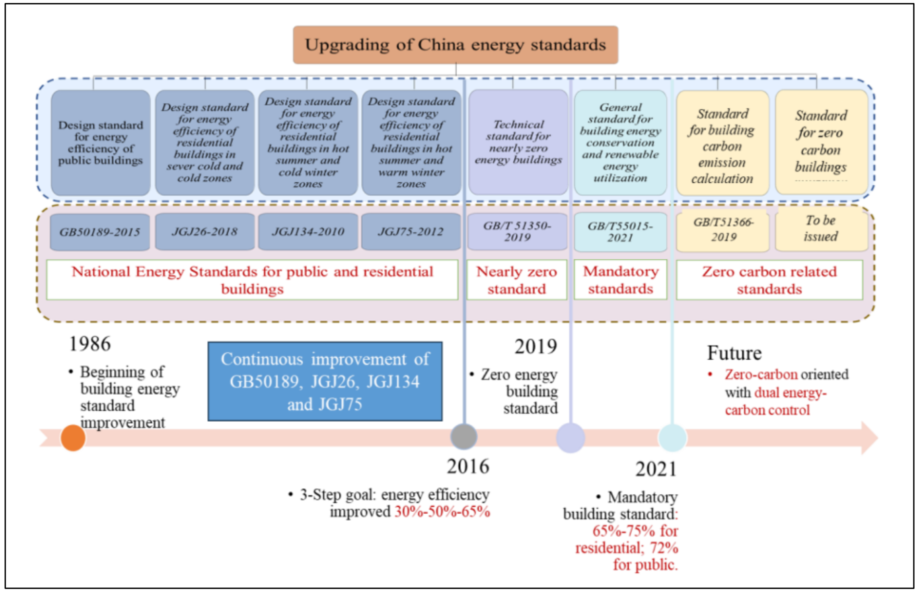


Figure 1: The Chinese building energy efficiency and carbon standard system; Source: Prof ZHANG Shicong, China Academy of Building Research, National Standards for Zero Carbon Buildings of China

From energy efficiency

GB55015: General CODE for energy efficiency and renewable energy application in buildings; National Standards of the People's Republic of China, published 2015

to nearly-zero energy

GB/T 51350-2019: Voluntary national standard of (nearly-zero energy building) NZEB; National Standards of the People's Republic of China, published 2019

Context

Building energy efficiency standards were significantly enhanced. Green and ultra-low energy buildings have been rapidly developed. Retrofitting of existing buildings advanced extensively. The application scale of renewable energy in buildings continued to expand.

Based on the 2016 national building energy-efficiency design standards, in severe cold and cold regions, the energy consumption of nearly zero energy residential buildings is reduced by more than 70%-75%, and traditional heating methods are no longer needed. The energy consumption of nearly zero energy residential buildings in hot summers and warm winters and hot summers and cold winters is reduced by more than 60%. The energy consumption of nearly zero energy public buildings in different climate zones is reduced by more than 60% on average.

A progress of standards

Ultra-low Energy Buildings

- Adapting to climate conditions, reducing energy demand via passive techniques, improving energy efficiency of building systems, and providing comfort indoor environment with low energy consumption.

Nearly-Zero Energy Buildings

- Adapting to climate conditions, reducing energy demand via passive techniques, improving energy efficiency of building systems, using renewable energy and providing comfort indoor environment with low energy consumption.

Zero Energy Buildings

- Adapting to climate conditions, reducing energy demand via passive techniques, improving energy efficiency of building systems, the total amount of energy used by the building is larger or equal to the amount of renewable energy created onsite or offsite.

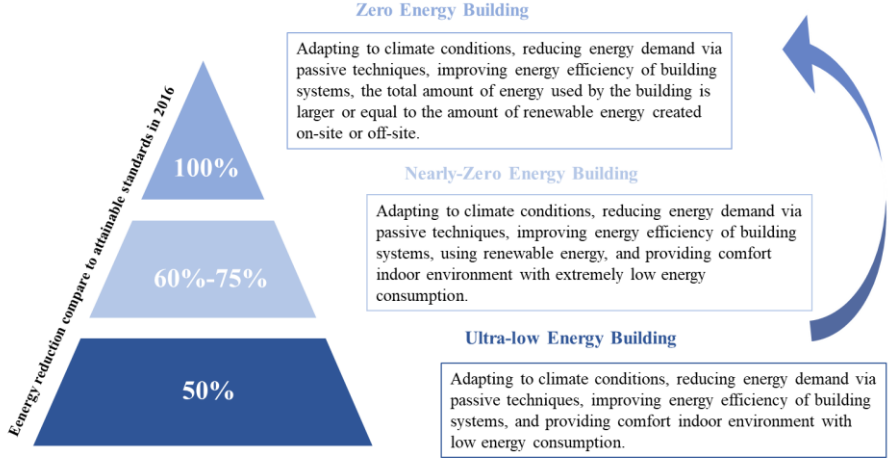


Figure 2: Voluntary national standard of nearly-zero energy buildings in PR of China

GB/T 51366 – 2019 Building carbon emission calculation standard

National Standards of the People's Republic of China, published 2019-04-09


UDC

中华人民共和国国家标准

P GB/T 51366-2019

建筑碳排放计算标准

Standard for building carbon emission calculation

2019-04-09 发布 2019-12-01 实施

中华人民共和国住房和城乡建设部
国家市场监督管理总局
联合发布

Figure 3: Building carbon emission calculation standard

In China, the National Standard for Building Carbon Emission Calculation was issued by the Ministry of Housing and Urban-Rural Development in 2019. The Standard aims to implement national policies on climate change, energy conservation, and emission reduction, standardize methods of calculating the building carbon emission, conserve resources, and protect the environment.

The standard, which entered into force in December 2019, is applicable to the calculation of carbon emissions during the production and transportation of materials, construction and demolition, and operation phases of new, expanded and renovated civil buildings. It provides calculation methods and factor values of carbon emissions for each phase of a building's lifecycle, laying the basis for emission calculation, as a solid foundation for formulating more specific carbon emission standard across buildings' lifecycles. (source: IEA)

The standard can be applied during the designing phase or after the construction phase. The calculation process can be divided into three phases, namely

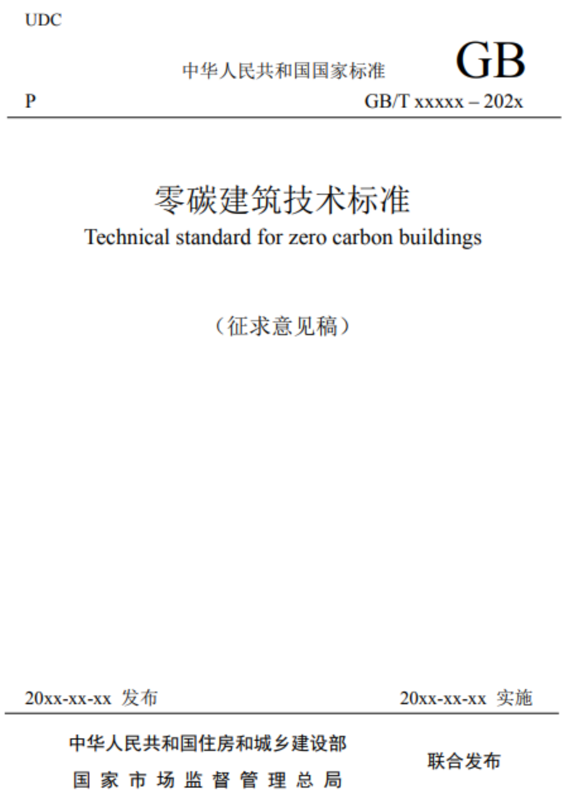
- the construction and demolition phase,
- the production of the building materials and transportation phase, and
- the operation phase.

The segmentation calculation results can be accumulated as the carbon offset amount of the building's full life circle. Carbon emissions calculations include the various types of greenhouse gases listed in the IPCC Guidelines for National Greenhouse Gas Inventories.

By applying the calculation methods of the standard to regulate the calculation of building carbon emission, people will pay more attention to energy-saving and carbon reduction during the building's full life cycle in the design stage, while the construction and construction materials enterprises could enhance their awareness on carbon emission accounting, reporting, testing, and verification.

Technical standards for Zero carbon buildings

Exposure version released on 19.07.2023 by Ministry of Housing and Urban-Rural Development, P.R. China



UDC

中华人民共和国国家标准 GB

P GB/T xxxxx – 202x

零碳建筑技术标准

Technical standard for zero carbon buildings

（征求意见稿）

20xx-xx-xx 发布 20xx-xx-xx 实施

中华人民共和国住房和城乡建设部

国 家 市 场 监 督 管 理 总 局

联合发布

Figure 4: Technical standards for Zero carbon buildings, Exposure version released on 19.07.2023 by MoHURD

The Technical Standard for Zero Carbon Buildings (ZCB) defines the terms and requirements for low, nearly zero and zero carbon buildings as well as for low, nearly zero and zero carbon districts. The requirements apply primarily to the operational phase of a building or district. In order to achieve the goal of zero emissions, a building can be credited to a certain extent with green electricity and/or CO_2 emission certificates. It applies to the design, construction, operation and judgement of new and existing retrofitted low-carbon, nearly zero carbon and zero carbon buildings and districts.

This standard is formulated for the purpose of achieving the national objectives of carbon peaking by 2030 and carbon neutrality by 2060, reducing the energy demand of buildings, improving the efficiency of energy use, creating a healthy and comfortable indoor environment in buildings, developing the application of renewable energy sources and zero-carbon energy buildings, and guiding the gradual realisation of low, nearly zero, and zero carbon emissions in buildings and in districts where buildings are the main source of carbon emissions.

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Extract from chapter 2 – «Terminology», GB/T XXXXX

Three target levels for building operation

- Low carbon buildings
- Nearly zero carbon buildings
- Zero carbon buildings (including carbon offset mechanisms)

Life cycle zero carbon building

- Zero carbon buildings in building materials, construction and operation

Reference building

Zero carbon buildings in building materials, construction and operation Building that meets the requirements of GB55015-2021

Three target levels for districts

- Low carbon district
- Nearly zero carbon district
- Zero carbon district (including carbon offset mechanisms)

Two levels of carbon requirements (Please note that these two requirements are alternatives; not both are required.)

- Carbon emission intensity, in kg CO_2/m^2a
- Carbon reduction ratio in %, compared to reference building

Considered carbon emissions

- Direct emissions: from onsite combustion of fossil fuels (GHG Scope 1)
- Indirect emissions: from offsite electricity production and district heat supply (GHG Scope 2)
- Embodied emissions: from construction and transport of materials (only for life cycle zero carbon buildings, GHG Scope 3)

Carbon offset mechanisms

- Green electricity trade: trading of certified green power
- Carbon trade: trading of carbon emission rights

Carbon emission factors

- Fuels: GB/T 51366-2019
- Electricity: 500 g/kWh (section 8.3.4)

3. CHINESE LOCAL ENERGY STANDARDS

Technical Principles

National building energy standards in China are supplemented at the local level by provincial energy standards. The provincial standards complement the calculation methods and technical requirements of national standards, especially in the context of local climatic conditions and local construction markets and culture. Local standards can also form the basis for voluntary or mandatory building regulations and funding programs on the provincial level.

As part of the ZEB China project, exchanges with experts on local energy standards of Hainan Province, Shenzhen Province, Zhejaing Province, Shaanxi Province and Helilongjiang Province were held. The following summarizes some of the findings and recommendations as perceived from the Swiss part.

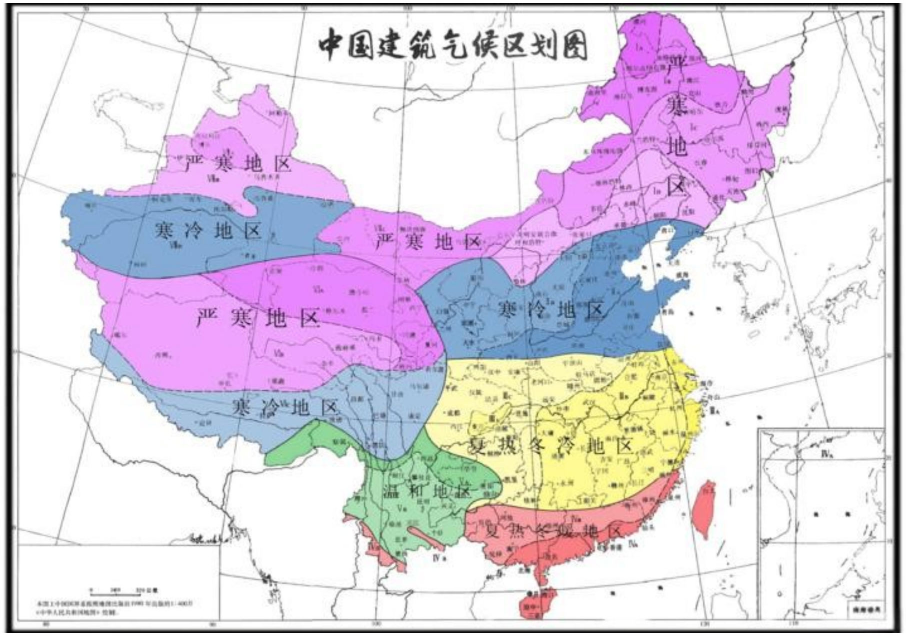


Figure 5: The defined Climate Zones in PR of China.

Climate Zone «Sever Cold»: e.g. Heilongjiang Province

Local Standard	Design Standard for Energy Efficiency of Ultra Low Energy Residential/Public Buildings, Sep. 2022
Reference/Number	DB23/T 3337-222 / DB23/T 3335-222
Requirements	Indicators of annual heat consumption of buildings
Exchange ZEB-Project	Meeting in Harbin with local building research representatives, April 23, 2024

Selected comments from Swiss experts

- Direct electrical heating of spaces and domestic hot water should not be allowed

- Gas boilers should only be allowed for peak load
- Higher COP limit values for air source heat pumps should be demanded

Comments to the standard

- Comprehensive content
- the building envelope and all building systems are covered
- calculation standard and design guideline character

Standard / Reference	Comments
5.1.3 Electricity for heating purpose	Direct electric heating should generally not be permitted
5.2.4 Gas boiler	Non-renewable heating systems should only be permitted to cover heating peak load (covering less than 10 % of annual heat demand)
5.3.6 Indoor heating system	Very high limit values for water supply temperatures. More suitable for low energy buildings: Radiators: less than 50 °C Floor heating: less than 35 °C

Climate Zone «Cold»: e.g. Shaanxi Province

Local Standard	Evaluation Standard for Building Carbon Emissions, Draft XX 2024
Requirements	Carbon emission evaluation indicators for residential and public (office, hotel, shopping, etc.) buildings, incl. embodied carbon emission evaluation indicators
Exchange ZEB-Project	Meeting in Shenzhen with local building research representatives (IBR), April 20, 2024

Comments from Swiss experts, see below (general recommendations)

Climate Zone «Hot Summer, Cold Winter»: e.g. Zhejiang Province

Local Standard	Design standard for ultra-low energy residential/public buildings in Zhejiang Province (Technical review version)
Requirements	…
Exchange ZEB-Project	Meeting in Shanghai with local building research representatives, April 25, 2024

Comments from Swiss experts, see below (general recommendations)

Climate Zone «Hot Summer, Warm Winter»: e.g. Shenzhen Province

Local Standard	Technical Guideline for Ultra Low Energy Buildings, Dec. 2022
Requirements	Operational carbon intensity limits (office, hotel, shopping, etc.) and fix embodied carbon intensity (400 kg/m2)
Exchange ZEB-Project	Meeting in Shenzhen with local building research representatives (IBR), April 20, 2024

Comments from Swiss experts, see below (general recommendations)

Climate Zone «Hot Summer, Warm Winter»: e.g. Hainan Province

Local Standard	Technical Guideline for Ultra Low Energy Buildings, Dec. 2022
Requirements	Energy and carbon indicators for residential and public buildings
Exchange ZEB-Project	Online meeting with Ms. Chen Xi, October 26, 2023

Selected comments from Swiss experts

- Requirements for heat transfer coefficients for external walls should be tightened, from 0.30 – 0.80 to 0.20 – 0.25 W/m^{2}K.

- Requirements for heat transfer coefficients of windows should be tightened, from 2.5 – 2.8 to 1.0 – 1.2 W/m^2K.
- Energy efficiency requirements for air dehumidification should be introduced.
- The limitations of natural ventilation in a hot and humid climate should be addressed in the standard.
- A limit of 0.1 W/m^2K for exterior roofing and walls is strict and requires a thickness of insulation layer of up to 25 cm; this is assessed as economically suboptimal.
- A limit of 1.0 W/m^2K for windows and skylights is reasonable. The assumption is, that this could be adapted in standards for warmer climate zones.

General recommendations

Harmonize heat transfer coefficient requirements across China and in all climate zones!

General recommendations for the future review and harmonization of local building energy standards

- Fragmented legal and normative requirements place a burden on all construction market players. Harmonized standards benefit the national construction industry and will help accelerate the transition to a zero-carbon economy. Therefore, refer as much as possible and deviate as little as necessary from national requirements when it comes to local standards.
- Low heat transfer coefficients of external walls, roofs and especially windows are favorable in all climate zones. Therefore, harmonize the requirements for heat transfer coefficients nationwide.
- Set ambitious requirements at a "strategic" level (e.g. total energy consumption or carbon emissions of buildings) and minimum efficiency requirements for individual components and products (product standards).
- Keep technical standards and guidelines as short as possible. A good example for a short and concise local standard is the Shenzhen Assessment Standard for Zero Carbon Buildings.
- Consider the energy performance gap, i.e. the real user behavior in normative energy calculation models.
- Anticipate the consequences of climate change in technical requirements, e.g. in most climates, natural ventilation may no longer be sufficient to maintain acceptable indoor temperatures in summer.

A short insight: comparison of the mean annual temperature, between Switzerland and selected cities in China

Switzerland, although a small nation, experiences a diverse array of climates, ranging from severely cold in its mountainous areas to temperate warm conditions in the southern parts. However, the thermal insulation standards for buildings remain consistent across all climate zones. This improved the homogeneity and transparency of the construction products market and accelerated the transformation of the Swiss building stock.

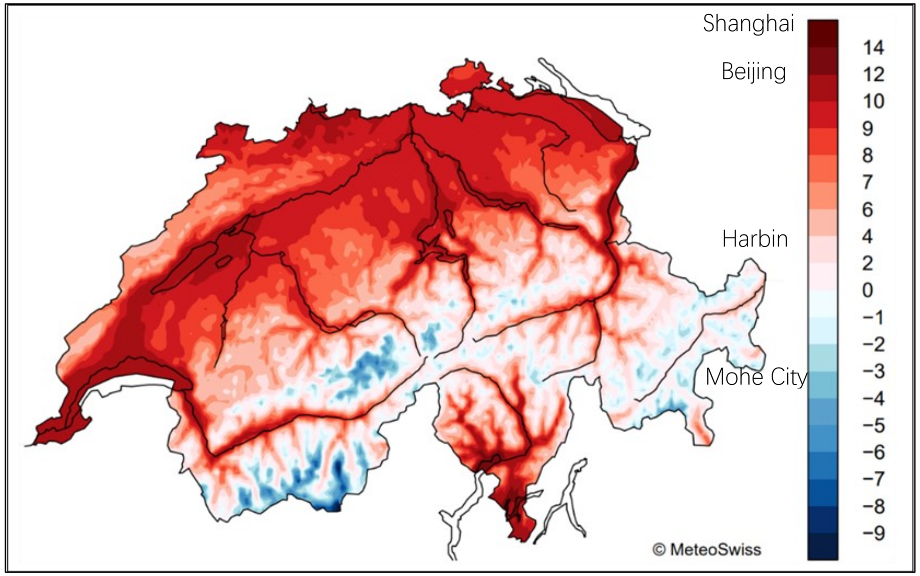


Figure 6: Climate zones in Switzerland: seasonal mean temperature for summer; compared with cities in China

4. SWISS ZEB STANDARDS

Context

Switzerland is characterised by cold winters and moderately hot summers. In the 1970'ies, the pathway towards zero emission buildings (ZEB) started, with Technical Regulations (TER) for the thermal performance of buildings, addressing also hygienic and comfort problems. The initial focus changed ongoing to energy efficiency and since the 1990'ies also to greenhouse gas emissions (carbon emissions). In Switzerland, today most new buildings are being equipped with renewable energy-based heating systems. At the level of TER for buildings, an increasing number of Cantons have issued bans for heating systems based on fossil fuel in new buildings and retrofits.

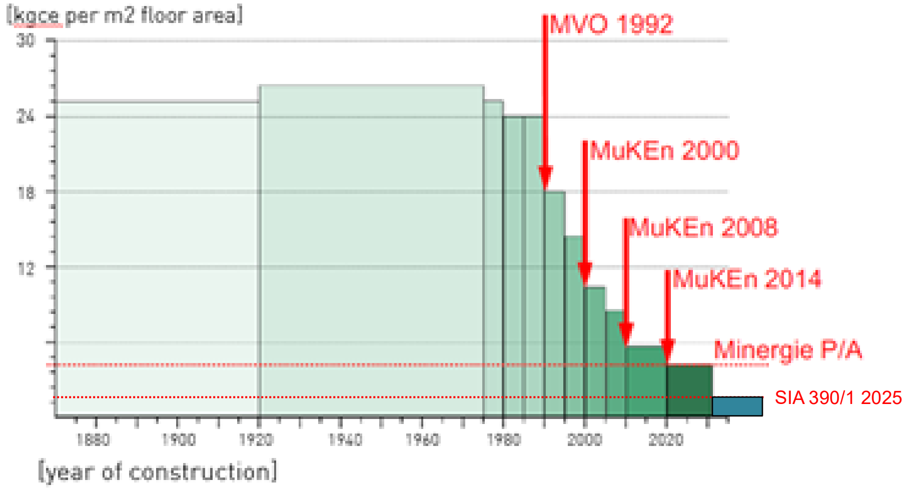


Figure 7: Development of energy standards for new residential buildings in Switzerland, expressed as operational carbon emissions per floor area per year (CO2eq in kg/(m2a); MVO/MuKEn – regulations by law, Minergie – market standard.

A voluntary pathway

In 2006, the Swiss Society of Engineers and Architects (SIA) introduced requirements for the energy efficiency of buildings throughout their entire life cycle for the first time. By 2011, this document had been transformed into a technical guideline, broadening the energy efficiency criteria to encompass greenhouse gas emissions. It was found that in Switzerland emissions produced during the construction of buildings are significantly higher and more challenging to mitigate than those generated during the operational phase, particularly for new constructions. In the subsequent years, the guideline underwent two revisions and is released in February 2025 as a new technical standard SIA 390/1 "Climate Path." The insights gained from these 20 years of standard development have been shared with experts in China.

Guideline SIA	Main requirement
SIA Efficiency Path 2006	Primary Energy
SIA Efficiency Path 2011	Primary Energy and Greenhouse Gas (GHG)
SIA Efficiency Path 2017	Primary Energy and Greenhouse Gas (GHG)
SIA Climate Path 2025	Greenhouse Gas (GHG) / Carbon Emission

Figure 8: Legende

Climate Path SIA 390/1, issued 2025

Key Features

SIA 390/1 is a voluntary technical standard. The key metric emphasizes on climate change: greenhouse gas emissions (kg $CO_{2,\,eq}/m^2a$). Further characteristics are:

- Comprehensive life-cycle-perspective: construction, operation, and (location-related) mobility
- Covered building types: residential, office, education, retail, restaurant
- A straightforward excel tool is available for project optimization in the initial design phases

Requirements

Two target levels:

- Target value B (basic), in line with national climate policy
- Target value A (ambitious), in line with IPPC-1.5-°C-scenario

The target values include carbon emissions from construction, operation and (location-related) mobility. The "additional requirement" includes only carbon emissions from construction and operation. It is planned to adjust the level of the target values and additional requirements with periodic technical reviews of SIA 390/1, every five years (see figure below).

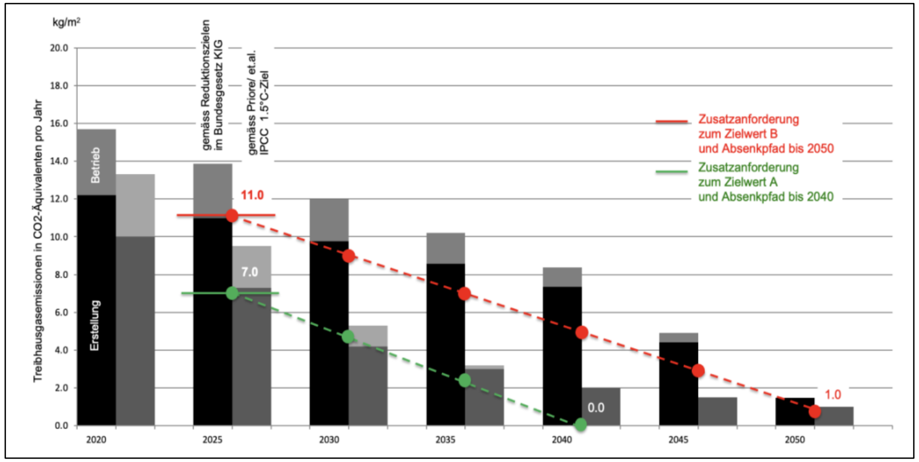


Figure 9: Target path of GHG-emissions in Switzerland (black colums) and requirements for the climate path SIA 390/1 (level A (ambitious) – green; level B (basic) – red)

Calculation Method of Carbon Emission

Operational emissions

- The calculation of operational energy demand is carried out according to the standard SIA 380 "Guideline for energy calculations of buildings" (comparable to the Chinese GB/T 51350-2019).
- The Swiss KBOB life-cycle-database is used for the $CO_{2,eq}$ emission factors of energy sources.
- All energy uses as heating, cooling, ventilation, lighting, appliances and transport (elevators etc.) are taken into account.
- The annual energy demand of each energy source is multiplied with the corresponding $CO_{2,eq}$-factor.
- With certain preconditions, long-term green electricity and/or green gas contracts can be taken into account.

Construction based carbon emissions

- The calculation of construction-based carbon emissions follows the technical guideline SIA 2032 "Embodied energy – life cycle assessment for the construction of buildings" (comparable to the Chinese GB/T 51366-2019, chapter 5).
- For carbon emission factors of building materials, the Swiss KBOB life-cycle-database is applied.
- The standard service life of building components (roof, wall, window, etc.) is defined in SIA 2032.
- The construction-based carbon emissions of each component are divided by its standard service life and thus converted into annual construction carbon emissions.
- Carbon emissions from replacement and disposal of building components over the life cycle are considered.
- Finally, the total yearly construction-based carbon emissions are related to the gross heated floor area of the building.

Mobility induced carbon emissions

- The use of buildings generates traffic, depending on their location and their mobility concept.
- The calculation of mobility induced carbon emissions is carried out according to the technical guideline SIA 2039 "Mobility – energy demand depending on the building location".
- The carbon emission calculation model is based on empirical data (Swiss mobility census).
- With the electrification of cars, bikes and bicycles, the mobility infrastructure and its electricity demand are transferred into buildings.
- The planning and optimization of the mobility infrastructure is increasingly important for building owners, architects and engineers.

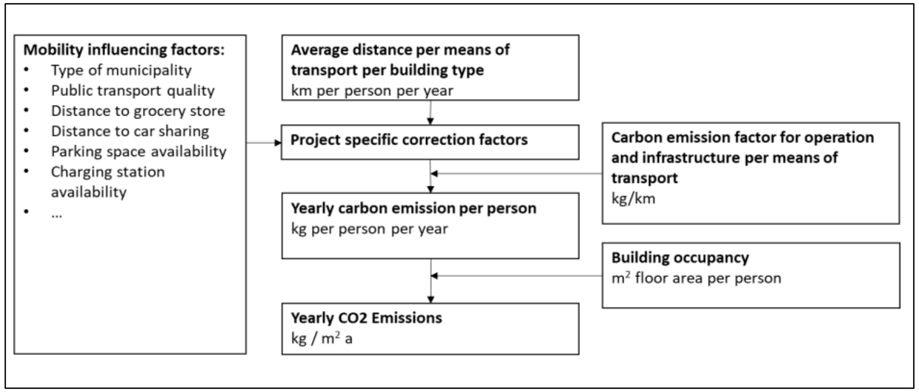


Figure 10: Calculation of building-related mobility carbon emissions, according to the technical regulation SIA 2039.

Target Value and Additional Requirement According SIA 390/1

Target value according SIA 390/1: total carbon emissions in $CO_{2,eq}$ from building construction and operation and mobility per floor area per year.

The target value for new residential buildings (15 $kg/(m^2a)$ is higher than for refurbished buildings (13 $kg/(m^2a)$), because the construction of new building generates high construction carbon emission. Average Swiss residential buildings generate in 2024 about three times higher $CO_{2,eq}$ carbon emissions (44 $kg/(m^2a)$)

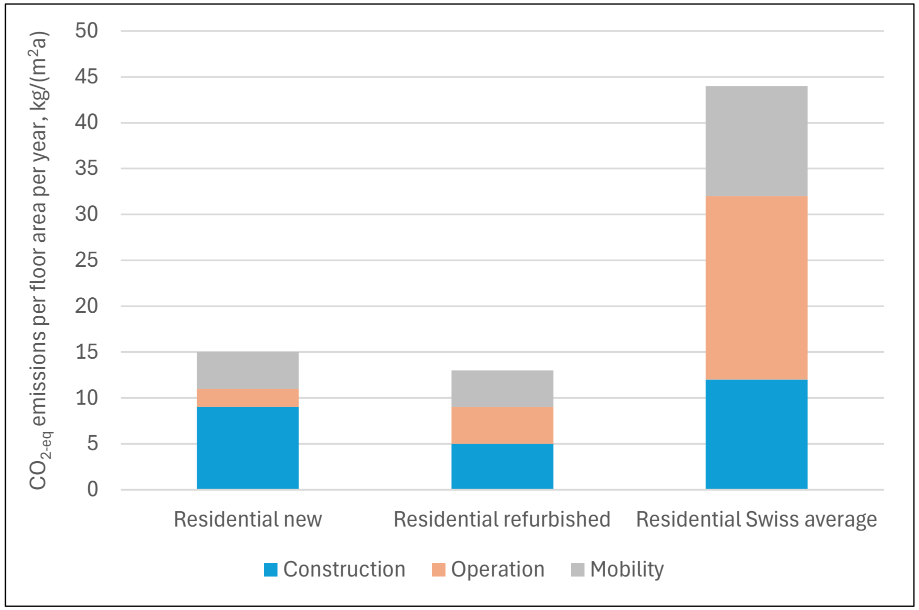


Figure 11: Target value and additional requirement for residential buildings according SIA 390/1 carbon emissions in CO2,eq per floor area per year.

Additional Requirements: Enhanced Standards for Construction and Operation Phases

Additional requirement according SIA 390/1: total carbon emissions in $CO_{2,eq}$ from building construction and operation per floor area per year.

The additional requirement for new buildings (11 $kg/(m^2a)$ is very demanding and can usually only be met with fully optimized, compact and particularly energy-efficient buildings with large PV systems. For refurbished buildings, the additional requirement (9 $kg/(m^2a)$ is usually less difficult to meet.

The additional requirement for new buildings (11 $kg/(m^2a)$ is very demanding and can usually only be met with fully optimized, compact and particularly energy-efficient buildings with large PV systems. For refurbished buildings, the additional requirement (9 $kg/(m^2a)$ is usually less difficult to meet.

Analysis of Carbon Emission for Construction Phase

For a new building, construction carbon emissions of 500 - 700 $kg/(m^2)$ are typical. Divided by the servicelife of the individual components, this results in annual construction emissions of 9 to 13 $kg/(m^2a)$. Construction carbon emissions of new buildings are thus in Switzerland about 4 to 5 times higher than the operational carbon emissions (left pie chart).

In refurbished buildings with a heat pump and a PV system, construction emissions are usually significantly lower and operational emissions are often higher than in new buildings (right pie chart).

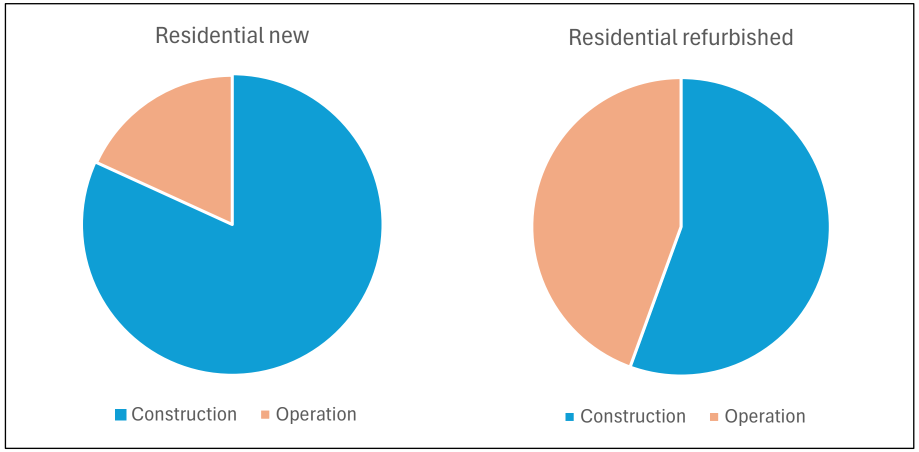


Figure 12: Share of GHG-emissions in the life-cycle of buildings.

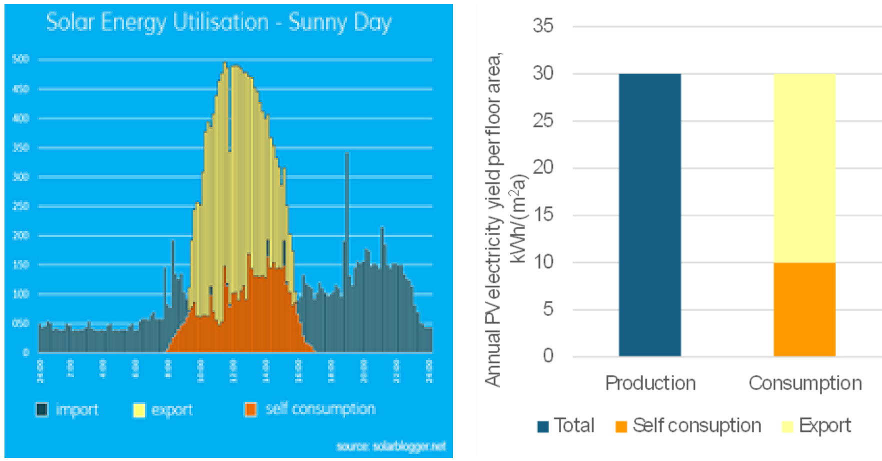


Figure 13: Crediting of PV systems as per SIA 390/1.

Crediting of PV-Systems as per SIA 390/1

PV systems generate electricity that is utilized partially within the building (self-consumption) and partially exported to the power grid. The owner of the PV system is compensated for the energy exported, along with an extra premium for the certificates of origin (COO) associated with the PV electricity. If the COO are sold, only the self-consumed energy, not the exported PV electricity, can be credited to the building. Conversely, if the COO are retained, both the self-consumed and exported PV electricity—essentially the full annual output of the PV system—can be credited to the building. For larger PV systems that meet a significant portion of a building's yearly electricity needs, it is only beneficial if the COO are not sold.

SIA 390/1 Target values

Refurbished Buildings	**Building Type (values in kg/(m^{2}a))**							
	Residential	Office	Primary School	Secondary School	University	Shopping mall	Supermarket	Restaurant
Construction	5	5	5	5	5	5	5	5
Operation	4	5	4	4	5	7	29	9
Mobility	4	7	3	5	8	6	20	24
Target Value B	13	17	12	14	18	18	54	38
Target Value A	10	14	9	11	14	13	40	33

New Buildings	**Building Type (values in kg/(m²a))**							
	Residential	Office	Primary School	Secondary School	University	Shopping mall	Supermarket	Restaurant
Construction	9	9	9	9	9	9	9	9
Operation	2	3	2	2	3	5	27	7
Mobility	4	7	3	5	8	6	20	24
Target Value B	15	19	14	16	20	20	56	40
Target Vwalue A	10	14	9	11	14	13	40	33

5. COMPARISON AND OUTLOOK

	China ZEB Standard 中国	Swiss ZEB Standard 瑞士
Indicator	Carbon dioxide (CO_2)	Greenhouse gas ($CO_{2,eq}$)
Building Use	Residential, office, hotel, shop, school	Residential, office, school, shop, restaurant
Building Life Cycle	Operation phase	Operation, construction, (mobility)
Electricity Carbon Factor	500 g/kWh	125 g/kWh
Carbon Intensity (Target)	approx. 10 kg/m^{2}a	2 kg/m^{2}a (+ 9 kg/m^{2}a for construction)

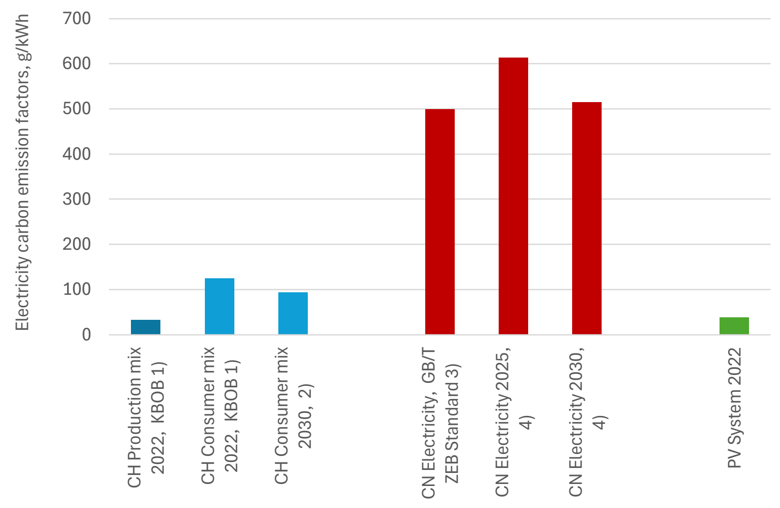
CO_2 Intensity of Electricity

Typical Zero Energy Buildings (ZEB) rely solely on electricity as their energy source. Consequently, the CO_2 intensity of the electricity mix they utilize plays a crucial role in determining their operational emissions.

In Switzerland, the production mix has a low CO_2 intensity of approximately 32 g/kWh. However, since fossil fuel-based electricity is imported from neighbouring countries, particularly during the winter months, the average consumer mix stands at 125 g/kWh. With the growth of wind and photovoltaic (PV) power plants, this consumer mix is expected to reduce to about 94 g/kWh by 2030.

In contrast, the CO_2 intensity of electricity in China is considerably higher, averaging around 500 g/kWh (Scope 2) or 614 g/kWh (Scope 2 and 3).

For ZEB buildings in both China and Switzerland, minimizing grid power consumption through large PV systems is essential.



Sources
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2) Netto-Null Treibhausgasemissionen im Gebäudebereich, Grundlagen für die Grenz- und Zielwertsetzung, Schlussbericht: 31. Oktober 2024
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Figure 14: CO_2-intensity of grid power in Switzerland (CH) and China (CN).

Not yet regulated

How is biogenic carbon accounted in a life cycle assessment? How is the carbon fixation in mineral building materials accounted? Or: How are negative carbon emissions technologies considered?

6. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

China and Switzerland have published comparable technical standards for Zero Carbon Buildings.

The requirements of the Chinese standard focus on operational carbon emissions. In Switzerland the mandatory Technical Regulations are comparable. Additionally the climate pathway of SIA takes into account the entire building life cycle including construction-based carbon emissions (and building-related mobility emissions).

Both Chinese and Swiss ZEB standards also take market mechanisms into account, e.g. green electricity certificates are intended to compensate for remaining CO_2 emissions that are difficult to avoid. PV-systems, integrated in buildings (roofs, facades) play a crucial role in the implementation of ZEB buildings in China and Switzerland

Recommendations

- The carbon emissions from the construction of new buildings outweigh the operational emissions of ZEB buildings. The requirements for ZEB buildings should therefore also be extended to construction emissions in the future.
- When balancing the carbon emissions of grid-connected PV-systems, a distinction should be made between self-consumption and local export to the grid.
- A national database of common CO_2 factors for energy sources, transportation processes and construction materials would support the implementation of ZEB design in the Chinese construction industry.

ZEB

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Building a climate-neutral future together

The Sino-Swiss Zero Emission Building Project is a national-level collaboration jointly initiated and fully guided by SDC and MoHURD. It is implemented by the Swiss intep-skat team and the China Academy of Building Research.

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