让我们共同打造气候中和的未来
Building a climate-neutral future together

Sino-Swiss Cooperation on Zero Emissions Building

Zero Emissions Building Demonstration Project Report

Shanghai Jiading Future City

Public and Residential District, Market Building and Exhibition Building

ENGLISH VERSION

JULY 2024

中华人民共和国
住房和城乡建设部

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Agency for Development and Cooperation SDC

IBEC 环能科技 intep skat

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Building a climate-neutral future together

This report has been produced within the framework Sino-Swiss Zero Emissions Building Project; an international collaboration funded by the Swiss Agency for Development and Cooperation in partnership with the Chinese Ministry of Housing and Urban-Rural Development.

Authors:

Dr. Feng Lu-Pagenkopf, Intep

Wesley Wojtas, Skat Consulting

Roland Stulz, Intep

Jilong Zhu, Intep

Xinyu Wang, Intep

Contributions and review:

Dr. Shicong Zhang, China Academy of Building Research

Dr. Xinyan Yang, China Academy of Building Research

Yin Li, Architectural Design & Research Institute, Zhejiang University

Jiayan Wu Architectural Design & Research Institute, Zhejiang University

Yiqi Hu Architectural Design & Research Institute, Zhejiang University

Design and layout:

Intep-Skat

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The Sino-Swiss Zero Emissions Building Project is an international collaboration funded by the Swiss Agency for Development Cooperation in partnership with the Chinese Ministry of Housing and Urban-Rural Development. The project aims to reduce greenhouse gas emissions and enable carbon neural development of the building sector in China by sharing Swiss know-how on sustainable and zero emission building.

Implementation partners:

Intep Integrated Planning

Skat Consulting

China Academy of Building Research

WeChat:

Web:
zeb-china.org

Cover image:Shanghai Jiading Future City, Market Building. Courtesy Shanghai Jiading Future Property Co., Ltd

Contents

1. PROJECT BACKGROUND

1.1. About Sino-Swiss ZEB Project

To jointly address global climate change and to strengthen cooperation between China and Switzerland in the field of emissions reduction in the construction industry, the Ministry of Housing and Urban-Rural Development of the People' s Republic of China and the Swiss Federal Ministry of Foreign Affairs signed a Memorandum of Understanding (MoU) on 24 November 2020. The Memorandum focuses on fostering international cooperation in the field of building energy efficiency. Within the framework of this MoU, the Swiss Agency for Development and Cooperation (SDC) initiated and funded the Sino-Swiss Zero Emission Building (ZEB) Project. The project aims to support China in formulating the technical standard for zero carbon buildings and long-term roadmaps for reducing carbon emissions in the construction industry. Switzerland contributes by sharing know-how, showcasing demonstration projects of zero emission buildings in four different climate zones, and carrying out various forms of capacity building activities to promote the carbon-neutral development of China' s construction industry.

Project Purposes:

- Upgrading existing building energy efficiency standards to zero carbon technical standards
- Implementing demonstration projects (DP) in four typical climate zones to test the new ZEB standards and finding potential for optimization
- ZEB capacity building and knowledge dissemination

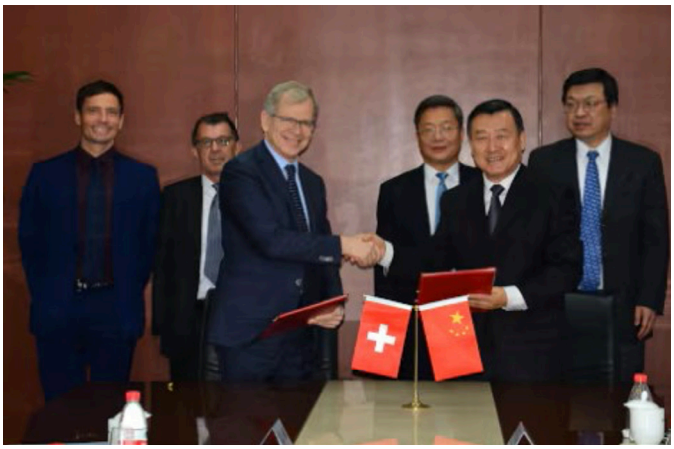


Figure 1. Ambassador Bernardino Regazzoni and Vice Minister Ni Hong, sign the project agreement. Image: Swiss Embassy in Beijing

1.2. Selecting process of Demo Project

Demo project goals

- To reach the requirements of China' s national technical standards for zero carbon buildings.
- To serve as case studies to guide and educate further projects in achieving the ZEB standard.
- Evaluation committee and selection process
- CABR collected applications for potential demonstration projects by an official call.
- Prior to the evaluation of applications, a project presentation with Q&A was held, in which Chinese and Swiss experts participated.
- A separate evaluation based on selection criteria was carried out by Chinese and Swiss experts.
- With Sino-Swiss joint feedback and recommendations, Mohurd announced the selected demo projects.

Selection criteria

- ELIGIBILITY CRITERIA: Political commitment, funding commitment, possibility of intervention, potential for affordability and replicability, visibility and accessibility, diversity
- RATING CRITERIA (Evaluation weight): CO2 emissions reduction potential and other environmental benefits (40%), number of beneficiaries (20%), light-house potential (20%), incentives by local government (20%)
- PILOT- PROJECT SUITABILITY (1st batch): Quick-starter, compatibility with draft ZEB-Standards, pilot characteristics, availability of data

Selecting time

April 2023 as one of second batch Sino-Swiss ZEB Demo Project

Selection justification

- Competent planning team with well-understanding of ZEB/ZED-Solutions and well-structured management as well as openness for optimizations
- Cooperation with local authority seems to be positive.
- Concept adjustments seem possible; funding commitment is there.

- The project is already advanced, and the timeline seems to be optimistic. However, the team seems to be very open to adaptations of Swiss inputs.
- All cities over China have similar spaces like the project which offers great replicability. The project seems also well thought through and affordable. Visible results could be generated within 1-1,5 years.
- Many people will access this area and thus, the concept will certainly create great visibility.
- The concept as such offers different building types and a great diversity.
- CO2 reduction is definitely high due to the community / areal approach.
- Different people can benefit from the proposed project.
- Local government seems to be included in the process and supports the approach.
- Targets defined in the drafted ZEB-Standards can be met with limited adjustments or extra cost (of any)
- The project and its surroundings can serve as tool for the communication of benefits, challenges in design guides for 2nd & 3rd generation demo Projects of same or larger scale (incl. e.g. Zero-Carbon District features)
- The combination of open and closed spaces as well as dynamic and diverse usage of the building offer great opportunities for innovative technical solutions.
- The required data is available to calculate the baseline and emission reduction potentials and to verify them.

Possible inputs for improvement from Swiss experts

The following possible inputs from Swiss team were considered at very beginning:

- Review and suggestion on regional and district energy supply and comprehensive energy management, with special support by intep inhouse experts and EMPA team led by Prof Matthias Sulzer
- Experiment of energy hub with great potential for environmental and economic advantages, with special support by EMPA team led by Prof. Matthias Sulzer
- Inputs on “how to make a zero-emission district” regarding the Swiss experiences on 2000-watt-district certification system, with special support by FHNW team led by Prof. Daniel Kellenberger und Prof. Barbara Sintzel
- Suggestion on defining system boundary, either spatial or periodical of the whole life cycle
- Suggestion on synergy and interaction of energy using/sharing among the buildings
- Inputs on other energy- and emission related aspects (user behavior, Mobility etc.) of sustainability besides energy than solutions of building technology – comprehensive integrated sustainable district planning, with special support by intep inhouse experts and EMPA team led by Prof Matthias Sulzer
- Support in district energy and emission calculation, especially with consulting and monitoring by Swiss ZEB standards- and calculation expert, Martin Ménard and local ZEB expert Li Yin

1.3. Working process

Sino-Swiss team

The Sino-Swiss expert team is composed of Swiss and Chinese specialists. The Chinese DP team first proposed design prototypes and zero-carbon design strategies. After reviewing the design features of the project, the Sino-Swiss expert team gave tailored feedback to the design team on the design prototype and strategical concept, which the design team will integrate as they adapt the project. The Swiss team also arranged webinars to exchange on specific zero-carbon topics based on the questions from the DP team. The ideas contributed by the Swiss experts are based on their international experience from Switzerland, Europe, and other similar climate zones around the world.

Working process

Webinars, online workshops, RTIPs, Charrettes, WeChat discussions and site visits were held to turn ideas into constructive proposals. The transparent exchange is very helpful for determining the project’ s feasibility.

Project Duration

May. 2023 – July 2024

2. PROJECT INITIAL STATE

2.1. Project Organisation

In April 2023, the project “Public and Residential Building District, Jiading, Shanghai” was selected as one of the 2nd batch Demonstration Projects of Si-no-Swiss ZEB Project. This project is a ministerial-level international cooperation project initiated by the Chinese Ministry of Housing and Urban-Rural Development and the Swiss Agency for Development and Cooperation. The project commenced in May 2023 and, after around 1 year of joint efforts by Sino-Swiss teams, is expected officially completed with its construction in May 2024.

Investor

Shanghai Jiading Future Property Co., Ltd

Leading planning team

Huajian Group East China Architectural Design and Research Institute Co., Ltd.

Huajian Group Shanghai Science and Technology Development Branch.

Sino-Swiss ZEB international joint consulting team

Intep, Skat, CABR, Low-Tech, UAD, HSLU, EMPA, Willers and more others.

2.2. Project initial Data

Location

Jiading District, Shanghai (Climate zone hot summer cold winter)

Building use

Market, Exhibition Hall

Structural system

- Market hall: Steel frame and wood mixed structure system
- Exhibition hall: Concrete structure

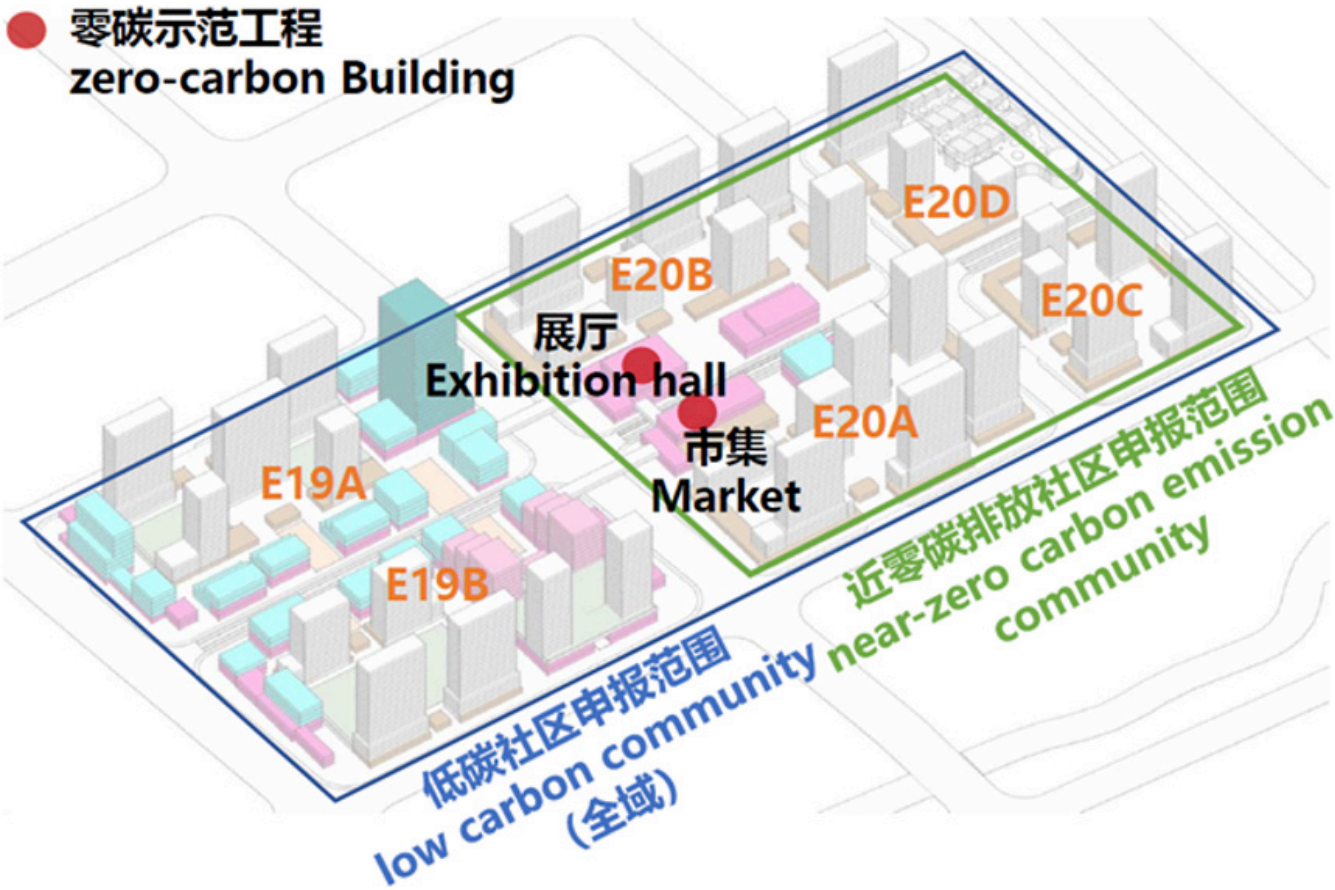


Figure 2: The Future City project achieves the goal of low carbon community (20% carbon reduction). The area E20A-E20D plots are expected to achieve the goal of near-zero carbon emission community (40% carbon reduction). The public buildings and promenade are planned in the center of the residential block, in order to activate the vivid atmosphere of the new built city center. Source: Project Presentation 11.01.2023, ©Shanghai DP

Area

- Total construction area: 9566.8 m2
- Total Building energy reference area:
  - Market hall 3110.38m2
  - Exhibition hall 2929.19m2

Investment costs

Ca. 70 million RMB

Architectural concept

See annex

Energy concept

See schema in annex

- Air source Variable refrigerant flow (VRF) multi-connector units for space heating and cooling with primary energy efficient
- Mechanical ventilation with heat recovery (optional with natural ventilation)
- Lighting system: select efficient lighting fixtures
- Domestic hot water: solar thermal energy, heat pump (air)

Other sustainability concepts

- Exhibition hall
  - PVT system on the roof (combination of PV and solar thermal)
  - Variable external shading system
  - skylight in the atrium for indirect lighting
  - Exhibition hall: Curly grassy lattice window
- Market hall
  - PV on the roof (900m2,186.18kwp)
  - Double roof for ventilation and shading
  - Wet waste disposal on site
  - Variable external shading system
  - HVLS ceiling fan for Ventilation
  - Funnel cap for ventilation
  - Climate green atrium

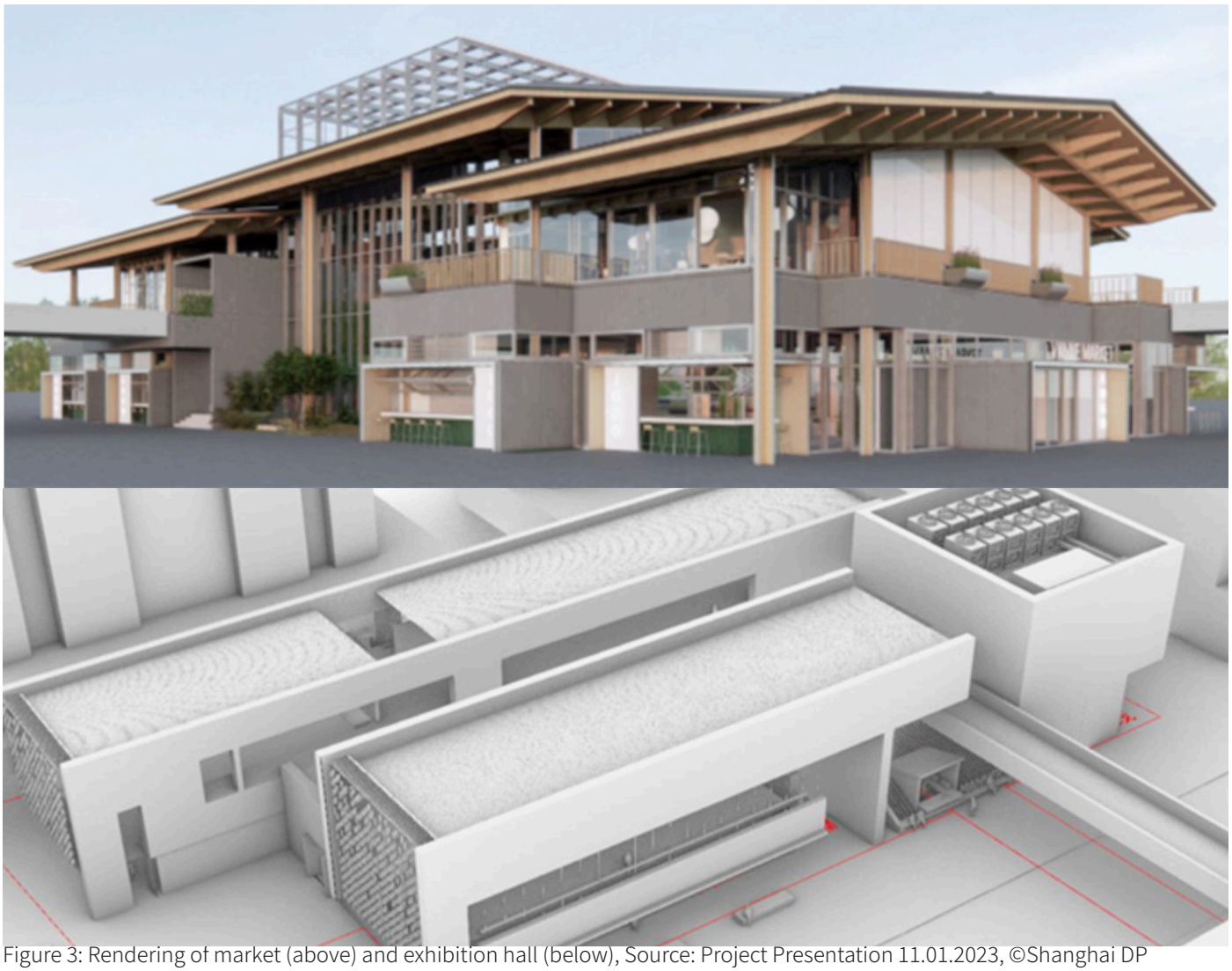


Figure 3: Rendering of market (above) and exhibition hall (below), Source: Project Presentation 11.01.2023, ©Shanghai DP

Figure 4: Low carbon highlight solutions of market hall, Source: Project Presentation 11.01.2023, ©Shanghai DP

3. SINO-SWISS COOPERATION

3.1. About the design team

This demo project was jointly completed by the teams of Huajian Group East China Architectural Design and Research Institute Co., Ltd. and Huajian Group Shanghai Science and Technology Development Branch. The group is the first in the city to conduct research and practice on energy-efficient structures. Despite the difficulties of slow promotion of ultra-low energy buildings in the south and doubtful technical paths, they bravely take on the main responsibility and assume the responsibility of pioneering research and development of local applicability. The company has developed an ultra-low-energy building technology system suitable for Shanghai, spearheaded a number of pioneering low-carbon demonstration projects, including Vanke' s No. 1 Zhongxing Road near-zero energy project, and significantly contributed to the "from scratch" advancement of ultra-low-energy buildings in Shanghai. Affirmative. The demonstration project has progressed from a single point to a large-scale promotional initiative. The company extperts presided over the preparation of the inaugural technical specification for ultra-low energy consumption buildings in hot summer and cold winter areas, entitled "Shanghai Technical Guidelines for Ultra-Low Energy Consumption Buildings". Based on these guidelines, The company experts further edited Shanghai' s "Architectural Design Standards for Ultra-Low Energy Consumption Public Buildings". "Architectural Design Standards for Ultra-Low Energy Consumption Residential Buildings", and edited the national building standard design atlas "Passive Ultra-Low Energy Consumption Buildings - Residential Building Atlas for Hot Summer and Cold Winter Areas", which is the inaugural ultra-low energy consumption atlas for hot summer and cold winter areas. Furthermore, the team contributed to the formulation of the "Zero Carbon Community Evaluation Criteria," which serves to advance the discourse on sustainable development. The team' s approach entails a comprehensive adaptation of buildings to their climatic context, an active integration with the natural environment, a thorough responsiveness to the specificities of the site and functional requirements, and a holistic optimization of building space, materials, and energy throughout their entire life cycle. This methodology is designed to achieve the long-term sustainability goals of the built environment.

3.2. First impression of Swiss team to the project

General impression

- A very interesting complex project with very high visibility and multilocality

- Competent planning team with well-understanding of ZEB/ZED-Solutions and well-structured management as well as openness for optimizations
- The great complexity and openness to innovation promise to be a very interesting project for ZEB.
- The combination of open and closed spaces as well as dynamic and diverse usage of the building offer great opportunities for innovative technical solutions

Targeted topics that our swiss team decided to contribute

- Design for disassembly (DfD), Potential for reuse of material
- Guideline for tenants to reduce emissions from operational use

3.3. First Swiss inputs and suggestions

A list of inputs and consulting activities that delivered by Swiss team (see rapid technical inputs sheets, webinars, workshops and special coordination etc.):

- The connection of the two buildings to each other and to the district development with an energy/anergy network should be examined.
- It' s highly recommended to analyze the potential of district heating and cooling through local renewable energy and the potential of development of integrated energy system for the whole district, incl. use of renewable energy, energy storage, district energy distribution, micro grid etc.
- Prepare green and low-carbon behavioral guidelines for shop operators.
- For circular construction we suggested the planning team to pay attention on the regional possibilities to collect the used material for reuse on the new buildings.
- Since cooking accounts for about 47% of energy consumption, alternative cooking methods need to be proposed: e.g. induction stoves, biogas stoves, etc.
- The energy benefit of the ventilated roof construction is not yet clear. It is to be examined whether a simple construction is not more efficient in terms of embodied energy and costs.

3.4. Reaction of DP team and concept improvement

After receiving the first inputs of Swiss team, the DP team gave the following responses:

- Suggested doors/windows/folding doors from the above-mentioned RTIS will be considered.
- The potential of circular construction will be further tapped in the project:
- DfD concept and recycled building component are considered in the planning concept. e.g. in market construction, some Connect nodes can be later disassemble.
- For the exhibition hall, the concrete aggregate will use the construction waste and the rebar will use the recycled short process steel within 300km. next step looking for the potential suitable old windows/ doors from other regional demolition project.
- Biggest changing lies with kitchen/catering section: DP teams decide the energy supply method of catering facility now only electricity instead of natural gas to decrease the energy consumption and the carbon emission of cooking.
- Organic waste from the catering will be used as compost.
- Green and low-carbon behavioral guidelines under the consult of Swiss expert is under considering.
- The linking of the two buildings, as well as their integration into the district' s energy/anergy network, cannot be achieved due to the immature state of the cross-wall electricity sales policy, the stringent construction timeline, and the fact that the buildings in the district have different owners.
- The use of wood remains the primary characteristic material for the market. Steel columns and beams are concealed by wooden panels. The wooden roof, carefully designed and implemented, spans the entire market. With an extended eave, the outdoor space is transformed into a high-quality public space, fostering outdoor activities.

3.5. Further knowledge exchanged and improvement achieved

Regarding to Reuse and DfD, the Swiss experts from ZHAW provide concrete suggestions for exhibition hall after a constructive online meeting with DP team:

- Partition wall with reused wooden frame and reused rock wool insulation for noise protection.
- Bared finishing on ceiling and wall, in order to reduce the waste of building material.
- Built examples in Europe on circular construction.

On October 19, 2023, the Swiss delegation visited the project site for further discussions with the DP team and the investor. The concept of a Low-Carbon Lifestyle was effectively showcased in the established market, featuring elements such as the carbon footprint of coffee, products made from reused materials, and green plants in the atrium, among others. The wooden structure was particularly striking, even though the main structure remained steel construction. The exhibition hall was still under construction and scheduled to open in early 2024.

In China, load-bearing structures are often over-dimensioned due to stringent regulations and the limited skill level of workers, resulting in larger embodied carbon emissions. A balanced dialogue involving various stakeholders could foster a better understanding of structural requirements and efficient resource utilization.

The investor is willing to turn the demonstration project into a base for academical research and learning, collaborating with local universities, aims to make the demonstration project the core of industrial research and learning. This is done to facilitate a deep integration of teaching and practice, achieving an organic connection between knowledge and practical application.

3.6. Calculations

Market Hall:

- Energy consumption Reference building: 145.23 kWh/m2a
- After optimization: 106.06 kWh/m2a
- Total energy demand: 365,525.94 kWh/a
- Yield of PV system: 27,675.23 kWh/a
- Carbon intensity indicator: (with consideration of sockets and cooking electricity demand): 72.69 kg/m2a

Exhibition Hall:

- Energy consumption Reference building: 144.29 kWh/m2a
- After optimization: 114.60 kWh/m2a
- Total energy demand: 321,444.72 kWh/a
- Yield of PV system: 109,985.92 kWh/a
- Carbon intensity indicator: (with consideration of sockets and cooking electricity demand): 37.69 kg/m2a

Figure 5: Onsite visit for the newly opened market with Swiss team and DP team, Source: Onsite visit 23.10.2023 and 25.04.2024, ©Sino-Swiss ZEB Project

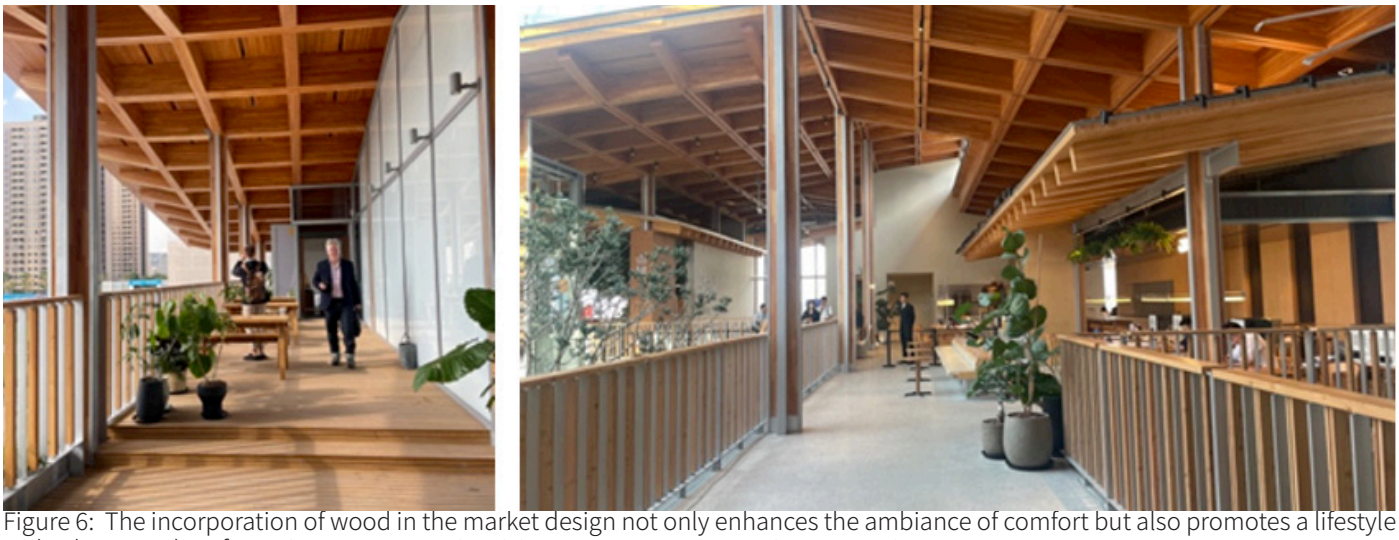


Figure 6: The incorporation of wood in the market design not only enhances the ambiance of comfort but also promotes a lifestyle with a lower carbon footprint, Source: Onsite visit 23.10.2023, ©Sino-Swiss ZEB Project

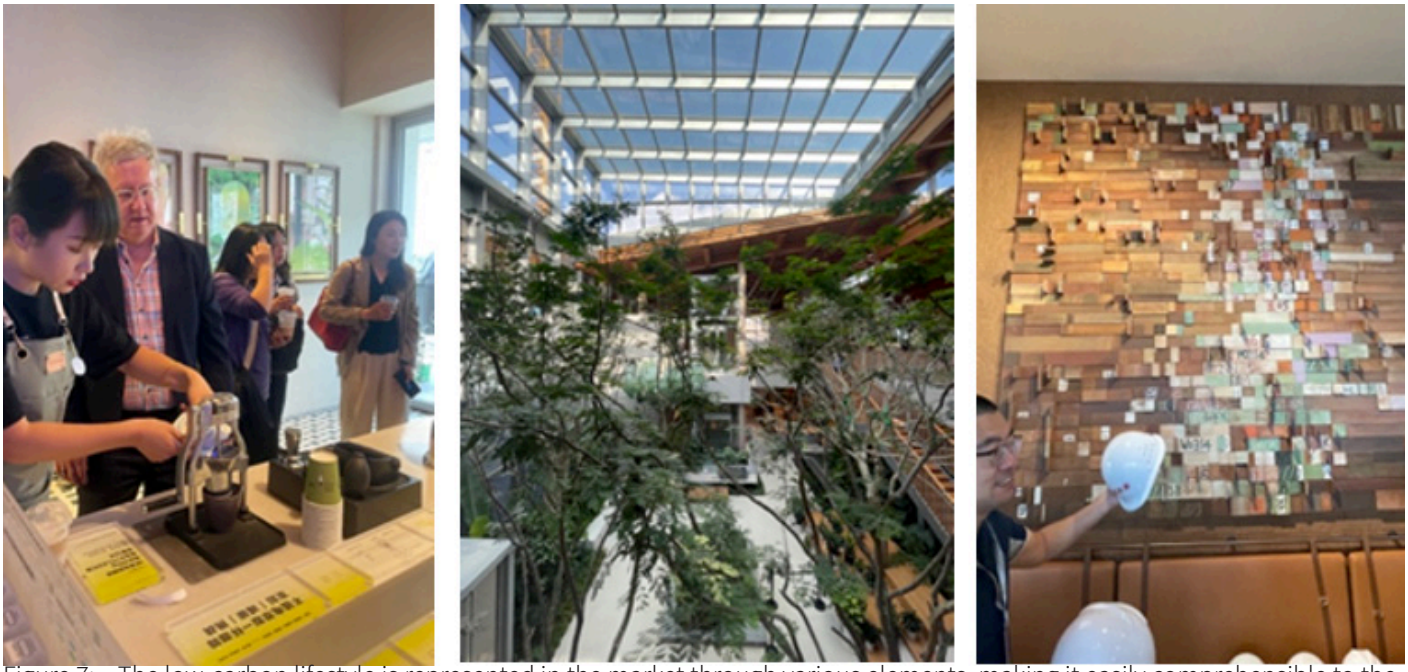


Figure 7: The low-carbon lifestyle is represented in the market through various elements, making it easily comprehensible to the public, such as coffee footprint, indoor biodiversity, recycled building material, etc., Source: Onsite visit 23.10.2023, ©Sino-Swiss ZEB Project

Figure 8: The exhibition hall is under construction. Source: Onsite visit 23.10.2023, ©Sino-Swiss ZEB Project

Figure 9: The exhibition hall after construction. Source: Onsite visit 25.04.2024, ©Sino-Swiss ZEB Project

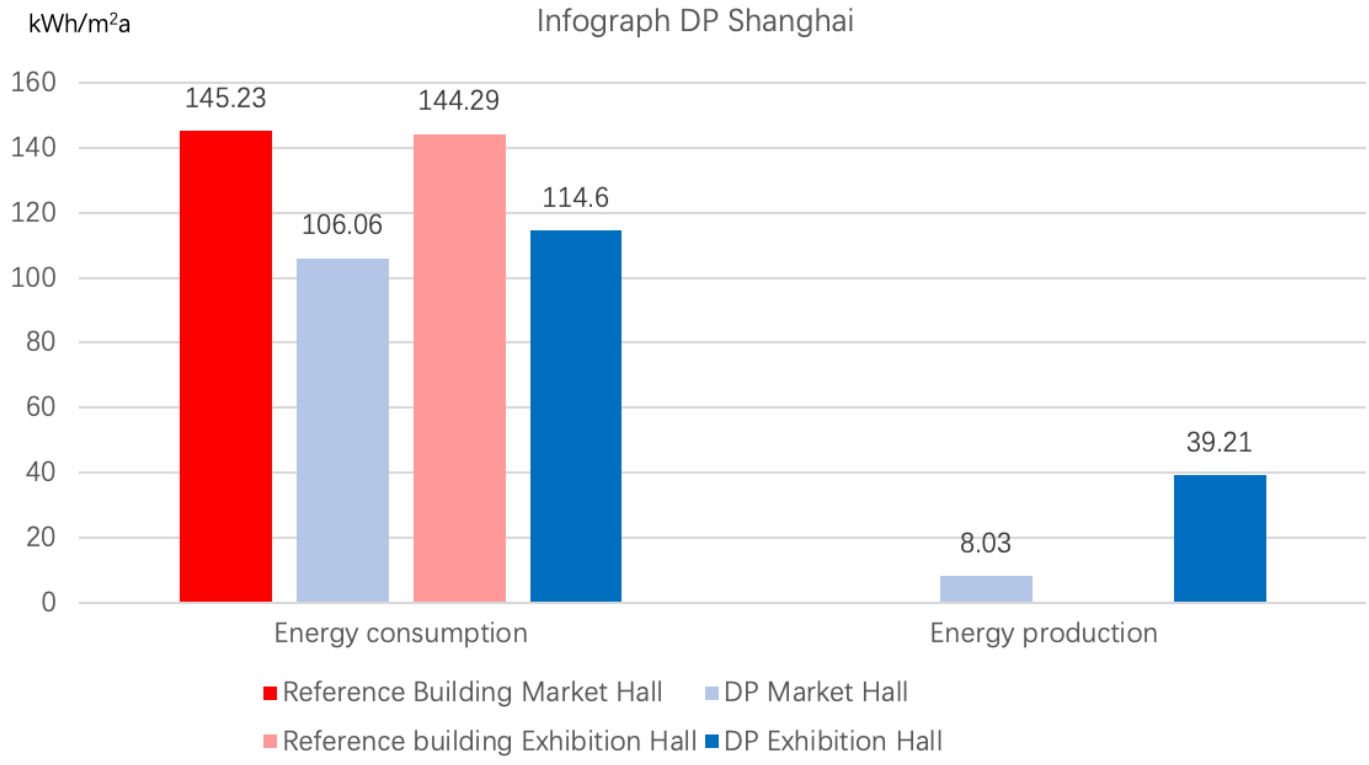


Figure 10：Comparison with reference building after calculation, source: Sino-Swiss ZEB Project Team

4. OUTCOME/REACHES

4.1. Confirmation of ZEB Demo Project

The experts of Sino-Swiss ZEB Project can confirm, that the project has potential to achieve the ZEB-goal as required in China' s national ZEB Technical Standards, especially in the operational phase.

The experts of Sino-Swiss ZEB Project can confirm, that the project considered the carbon emission throughout the whole life cycle and did its best to reduce the embodied emission as much as possible.

4.2. Testimonial of Demo Project Team

The Energy Consultant, Ms. Qu Yan who is also the Deputy General Manager of Shanghai Research Institute of Building Sciences Co., Ltd said: "Implementing zero-carbon buildings in the future city has been a challenging journey. Through innovative design concepts, the project ultimately presents an open and flexible image, forms a good interaction with nature, and creates a model of zero-carbon buildings that adapts to the local environment."

The responsible person of Investor side, Mr. Wu Yiqun from Shanghai Jia Future Property Co., Ltd. Expressed his impression as follow: "The project implementation team and Swiss experts worked closely together to create an interesting scenario that combines both a sense of life and technical content, allowing ordinary people to understand low-carbon transformation, participate in carbon reduction activities, and benefit from it."

And, Mr. Gao Zhiyong from Shanghai Jia Future Property Co., Ltd gave his opinion as user as follow: "The project of Shanghai Jiading Future City implements zero-carbon buildings, which is not just an upgrade in construction and equipment technology, but more importantly, an advocacy for lifestyle and a commitment to social values. We also hope to collaborate with residents in the future to create more low-cost, high-comfort, and participatory low-carbon lifestyles, thereby inspiring a sustainable internal force that revitalizes the community."

5. LESSONS LEARNED

5.1. Management and Organization

The short design phase in China is very challenging for the Swiss expert team. Effective and continuous communication with the DP team is crucial for the development of the project. The Swiss team was required to respond promptly to the DP team' s enquiries and provide quick inputs to ensure swift integration of ideas into the project within the limited timeframe.

Concrete factors and numbers are more persuasive than words or theory. For instance, through the utilization of a calculation tool developed by a Swiss expert, the Swiss team communicated with the DP team in a very constructive way. The project effort is a common achievement of Sino-Swiss joint team.

This project presents considerable challenges due to the tight timeline. These two public buildings are the first to be constructed on this site with the aim of attracting people. Despite this, the DP team and the investor have demonstrated the capability in undertaking challenging tasks, ultimately presenting a feasible solution for a low-carbon lifestyle.

The investor is highly committed to low-carbon solutions and has been very responsive in communication and implementation. This has resulted in a standout lighthouse project for ZEB China.

The computation of embodied carbon emissions depends on industrial sector data, whose accuracy is currently uncertain in China. The "14th Five-Year Plan" aims to create a comprehensive database, including materials like steel and concrete. The developer of the exhibition hall project is urging material suppliers to provide carbon footprint reports and has already gathered data for reinforcement steel. Future bidding processes may consider the carbon emissions of building materials as a key criterion, with material suppliers required to submit carbon emission data for bid evaluation.

5.2. Communication and Cooperation

The following formats and means of communication were actively used in the project procedure.

Charrettes incl. technical response by the Swiss team

- Kick-off charrette
- Update charrette
- Offline workshop and onsite visit
- Kick-off meeting on building automation and smart control

Joint Charrettes with all other DPs

- ZEB Duty Book
- Circular construction
- Fire safety of timber structures
- Facility management and ZEB operation
- Zero Emission District
- Computational Fluid Dynamics (CFD) Simulation
- Green PV
- Swiss technologies and products
- Efficient elevator
- Anergy net
- Landscape design

Rapid technical input sheets (RITS) about:

- BIPV solution incl. façade PV and Photovoltaic tiles, local product manufacture recommendation
- KBOB – Swiss Coordination Conference of Building and Property Bodies of Public Sector Developers
- Low carbon cement LC3
- High performance windows and doors
- Facility Management
- Shading Systems and Products
- Greenery and PV
- Guideline ZEB operational concept

Q&A sheet and further thematic inputs about:

- Flexibility of floor plan for other functions for exhibition hall in the future
- Booklet with theme Zero Emission Districts (ZED) and the 2000-Watt-Certificate
- Booklet with theme ZEB, Guideline, Duty Book

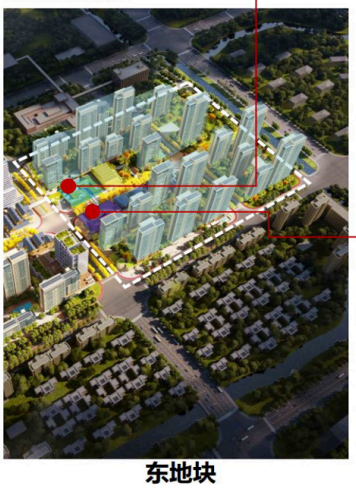
Further performances:

- ZEB Duty Book developed, shared and presented
- Regular exchanges and discussions per WeChat, telephone and email
- site visit and technical exchange on construction site
- Public and internal ZEB Talks on various ZEB Topics
- Booklet regarding e.g., ZEB policies, regulations, standards, concepts and techniques.
- Exchanges and discussion on events like National NEZB Conferences and the Sino-Swiss Industry University Research Collaboration Forum on Zero Emission

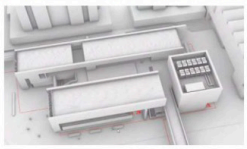
Annex 1. Architectural concept of market and exhibition hall

项目基本信息 basic information

Control requirements： The overall low-carbon community will reduce carbon emissions by 20%, and the near-zero carbon community in the eastern plot will reduce carbon emissions by 40%; Among them, the demonstration building of no less than 6600 square meters meets **the near-zero energy consumption and 3-star green building certification**



东地块

建筑形态 设计 Architectural Form Design	功能业态 特征 Functional Format Characteristics	低碳 目标 Low-carbon Targets
	**Exhibition Hall** Interactive perception + zero-carbon template 【Zero carbon showcase for the future】 **Functional format:** open and quiet, flexible sharing space. It mainly focuses on exhibitions, light catering and other Internet celebrity stores	Ultra-low energy consumption + near-zero energy consumption + 3-star green building certification + Zero-carbon buildings

- **展厅建筑面积约为2700㎡**，包括地上二层，主要业态为展厅、商业、餐饮。
- The building area of the exhibition hall is about 2700 square meters, including two floors above ground. The main business types are exhibition hall, commercial and catering

	**Market** Co-construction and sharing + low-carbon and efficient 【Low Carbon Future Lab】 **Functional format:** densely staffed, open activity space. Mainly catering, retail business, etc	Ultra-low energy consumption + near-zero energy consumption + 3-star green building certification + Low carbon or near-zero carbon

- **市集建筑面积为3100㎡，**建筑高度为16.2米，地上二层，主要为商业、餐饮；
- Market construction area of 3100 square meters, building height of 16.2 meters, two floors on the ground, mainly for business, catering
- The first basement floor is used for equipment rooms, market warehouses, garbage rooms and other supporting rooms.

低碳技术浓度

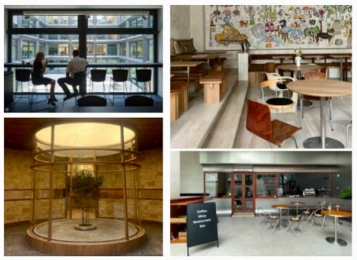
Annex 2. Low carbon highlights of exhibition hall

展厅：善用风、光、水、热、绿等自然元素，与建筑形态结合形成有特征的低碳记忆点
Exhibition hall： Make good use of natural elements such as wind, light, water, heat and green, and combine them with architectural forms to form characteristic low-carbon memory points

硬性目标：超低能耗+近零能耗+绿建三星
软性目标：零碳建筑

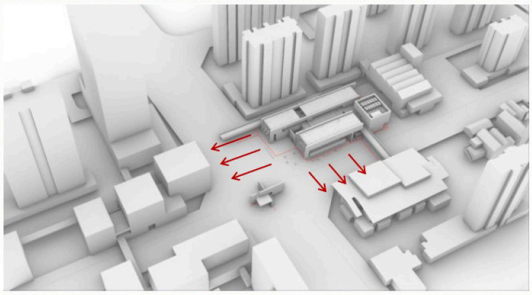
□功能适配 Functional adaptation

- 以展览、轻餐饮等网红型店铺为主。



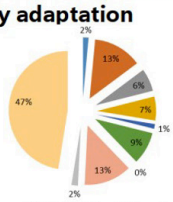
□规划、形态适配 Planning and Form adaptation

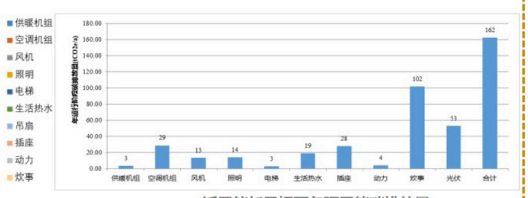
- 展厅位于道路交叉口，用地开放性较强，具有一定的展示需求。
- 展厅体量小、散，可充分利用光、风、热等自然元素。



□用能适配 Energy adaptation

- 展厅年运行碳排放量总计为160tCO_2/a（餐饮炊事为电力），其中炊事用能占比最大，其次为空调及插座。

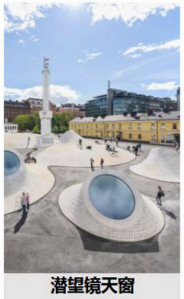




□ 低碳技术 | Low carbon technology
交互感知+零碳样板
开放安静，灵活共享空间
低碳技术内向与开放并存

呼吸式幕墙+门斗
响应冬夏气候变化

深天窗
降低眩光和热辐射进入



潜望镜天窗
防眩光设计

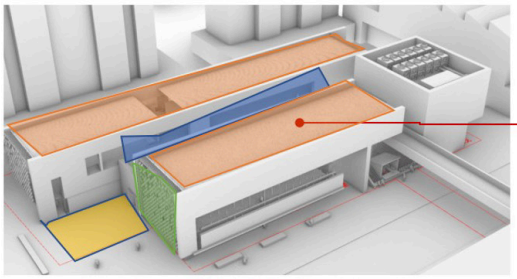
光纤导光系统
实现采光和丰富室内空间效果

Annex 3. Energy concept – Principe of PVT system

展厅低碳技术策划 Low-carbon technology planning of exhibition hall

可再生能源：屋面光热一体化设计，可实现节能量45%以上

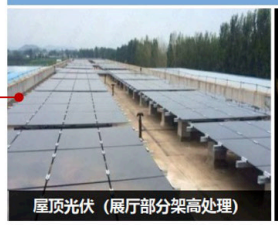
Renewable energy: The integrated design of roof light and heat can save more than 45% energy



- 项目目标：硬性——超低能耗&近零能耗&绿色三星
- 本体节能率≥20%、综合节能率≥60%、可再生能源利用率10%

技术	内容	分类	具体措施及指标
主动式节能设计	空调系统节能 aircondition	多联机APF≥4.5	
	新风热回收 Fresh air	全热回收效率不低于夏季70%/冬季75%	
	电气设备节能 Electrical	高效节能灯具、照明调光措施；电梯A级能效	
	智能化监控 Intelligent	室内空气质量监控、能耗监测与控制系统、新风控制、智能照明、楼宇自控	
	生活热水节能 Domestic hot water	1）光热photothermal系统余热（夏季免费热水）+专用空气源热泵Air source heat pump 2）氢能燃料电池Hydrogen energy余热供热水	
可再生	屋面光热一体		

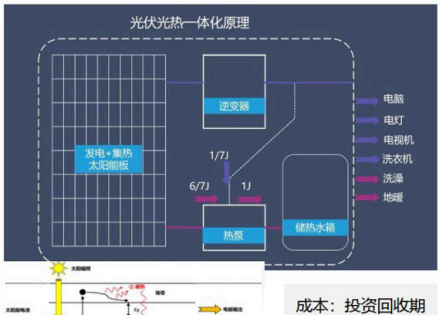
屋面光伏发电(首要满足)



屋面高效光伏组件：体块屋面布置不低于850m2单晶硅光伏组件（组件外框面积），初始发电效率不低于22.3%，年总发电量不低于12.5万KWh

成本：1100元/m2（单晶硅光伏安装面积），333元/m2(建筑单方估算)

屋面PVT光伏光热一体化



工作原理：

系统具备光伏发电和太阳能集热的功能，在光伏板背面安装集热器，供应餐饮、卫生间热水。

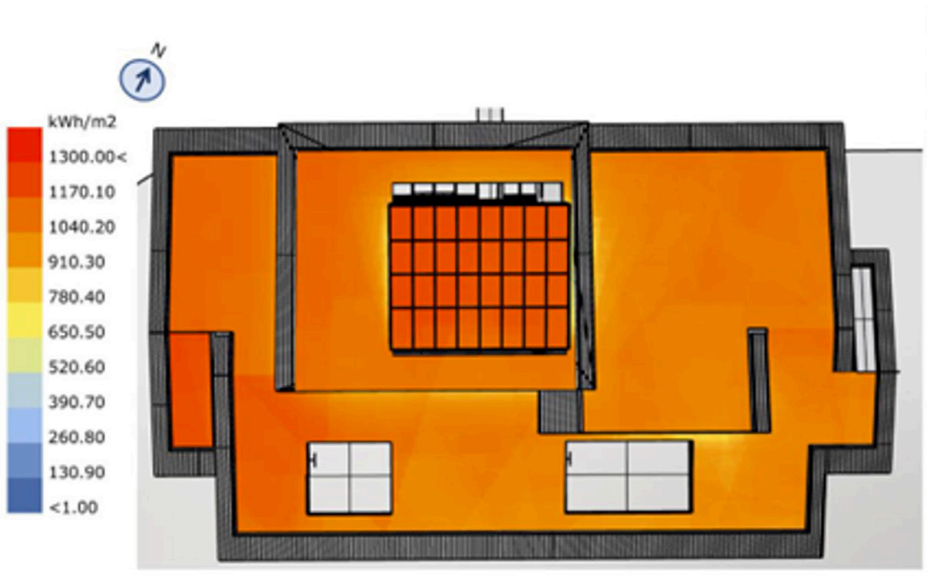
方案分析：

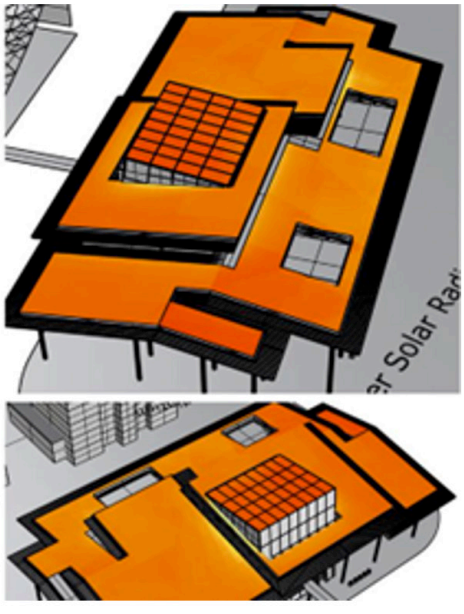
1）项目屋顶面积有限，光伏架高在室外机上方，不利于光伏和室外机运行效率，通过光伏板背面集热器Photovoltaic Panel, 可降低光伏组件温度Temperature 25℃，提升发电效率Power generation 10%，提高多联机设备效率Equipment 8%

2）设备：增加专用空气源热泵、储热水箱

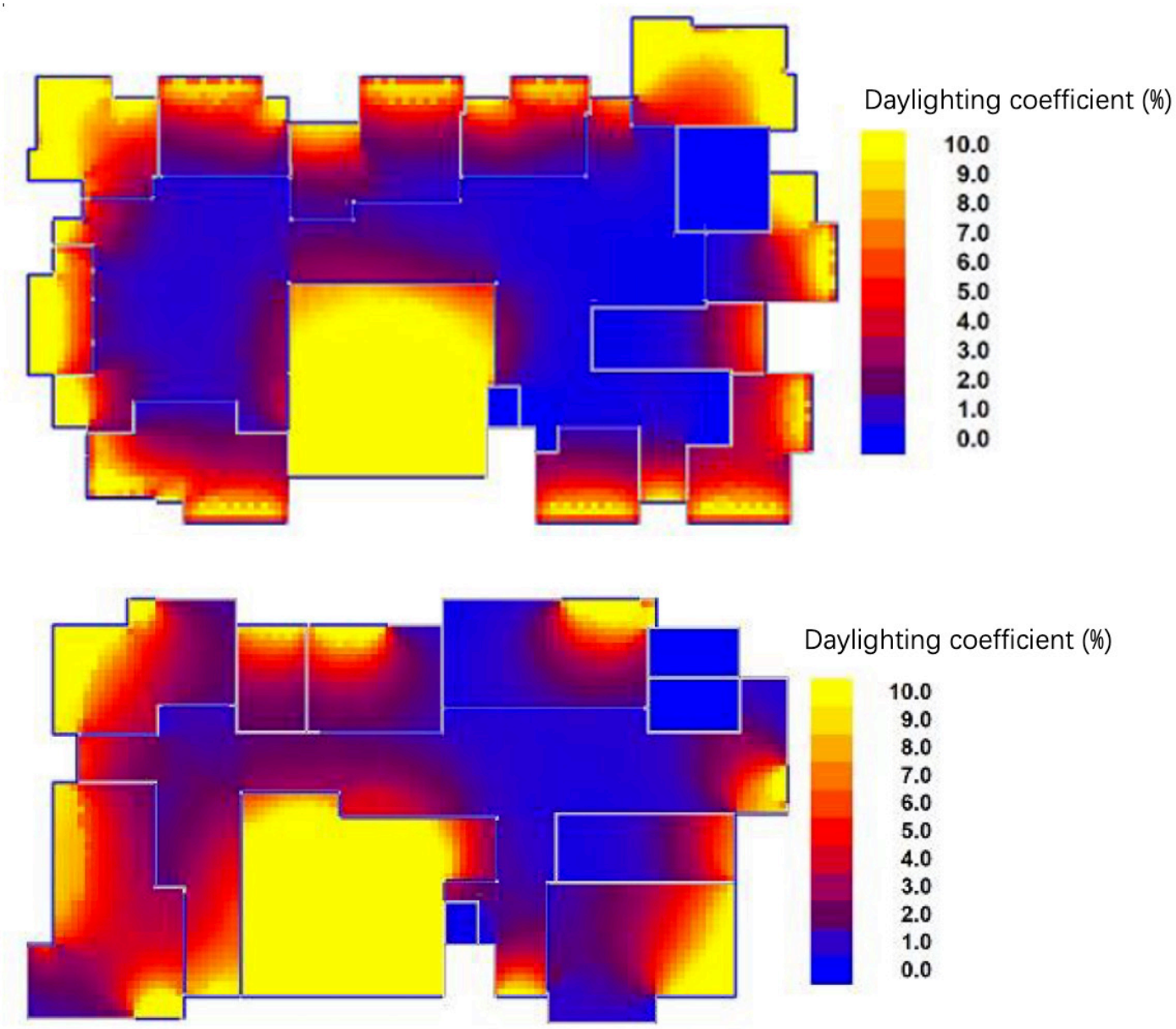
成本：投资回收期

Annex 4. Energy concept – PV simulation on the market hall roof





Annex 5. Daylighting simulation of the market hall



让我们共同打造气候中和的未来
Building a climate-neutral future together

中华人民共和国
住房和城乡建设部

Schweizerische Eidgenossenschaft
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