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
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

中瑞零碳建筑项目示范工程
大连市中山区虎滩东沟地块项目
近零路径与能源方案

THE SINO-SWISS ZERO EMISSION BUILDING DEMONSTRATION PROJECT
HUTAN DONGGOU PLOT PROJECT, ZHONGSHAN DISTRICT, DALIAN CITY
NEARLY-ZERO ENERGY PATH AND ENERGY SOLUTION

2025.3.11

【ZEB TALK】能源系统优化思路及工具研讨会

【ZEB TALK】ZERO EMISSION DISTRICT Energy system optimization Webinar

关于 About us

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Plan

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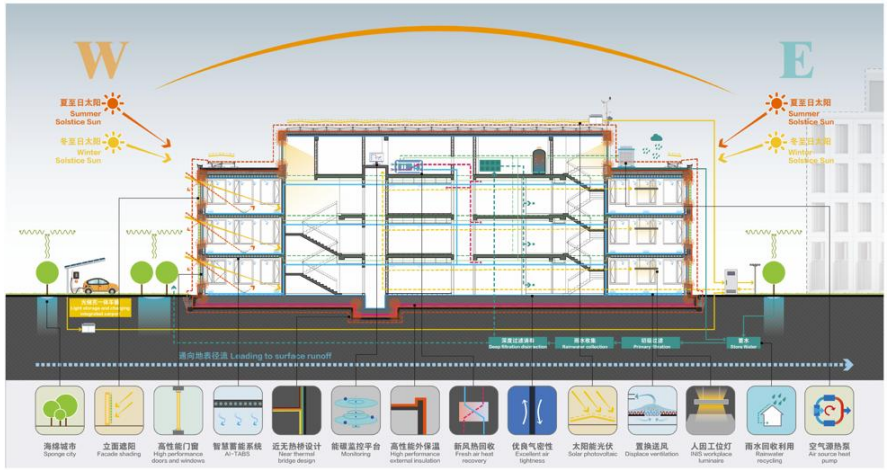
零碳建筑
Zero Carbon
Zero Emissions

野生动物园
Wildlife
Zoo

医疗建筑
Medical
Buildings

EPC
工程总承包

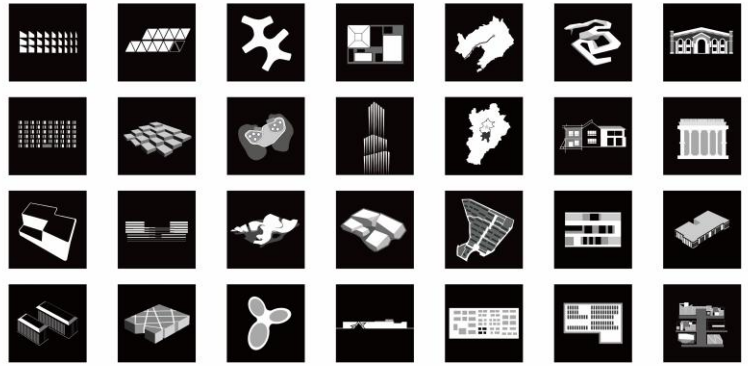


赵越 ZHAO Yue (Eric)

院长 | 零碳建筑研究院
Dean | Zero Carbon Building Research Institute
都市发展设计集团有限公司
Urban Development Design Group Co.,Ltd.

都市发展设计集团有限公司（UDD）的前身是大连市规划设计研究院，**源于1952**年。集团于2012年成立了零碳建筑研究院，致力于零碳建筑研究和实践的各个方向，掌握了行业内最完善、最深入、最先进的技术体系，拥有多项国际领先的核心技术和50多项专利著作。多年来投资并设计、咨询、施工建设了大量高品质零碳建筑案例。如今，都市发展设计集团已经成为一家聚焦于**零碳建筑领域**的应用研究型建筑科技创新企业，已被评定为**“国家级高新技术企业”**。

The predecessor of **Urban Development Design Group Co., Ltd. (UDD)** was Dalian Planning and Design Research Institute established in 1952. The group established the Zero Carbon Building Research Institute in 2012, which is dedicated to the research and practice of zero carbon buildings in all directions, and has mastered the most complete, in-depth and advanced technology system in the industry, with a number of international leading core technologies and more than 50 patented works. Over the years, the company has invested in the design, consulting and construction of a large number of high-quality zero-carbon building cases. Nowadays, Urban Development Design Group has become an applied research oriented architectural technology innovation enterprise focused on the field of zero carbon architecture.



目录 Content

01 项目概况 ——项目区位

Project Overview
——Project Position

•瑞士，苏黎世 Zurich, Switzerland

•经度：8.54 longitude: 8.54
•纬度：47.37 latitude: 47.37
•气候特征 ：温带海洋性气候
•climatic characteristics: temperate oceanic climate

•夏季 summer:
•平均温度：10~20℃ average temperature: 10~20℃

•冬季 winter:
•平均温度：-1~4℃ average temperature: -1~4℃

•年平均相对湿度：61%
•annual mean relative humidity: 61%

•年平均风速：3m/s
•annual mean wind speed: 3m/s

•中国，大连Dalian, China

•经度：120.9 longitude: 120.9
•纬度：39 latitude: 39
•气候特征：暖温带大陆性季风气候
•climatic characteristics: warm temperate continental monsoon climate

•夏季summer:
•平均温度：14~22℃ average temperature: 14~22℃

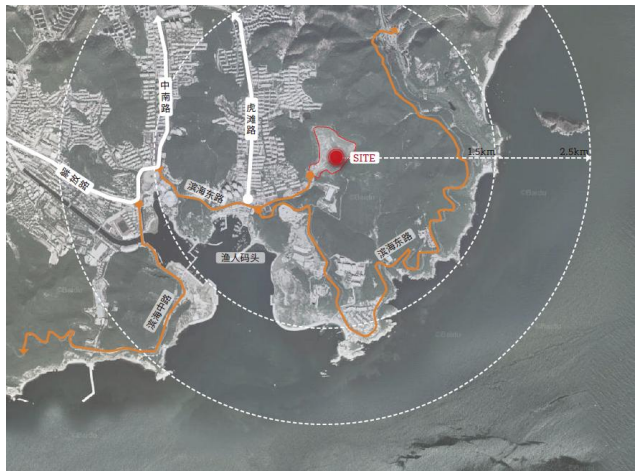
•冬季winter:
•平均温度：-3~4℃ average temperature: -3~4℃

•年平均相对湿度：63%
•annual mean relative humidity: 63%

•年平均风速：3~6m/s
•annual mean wind speed: 3~6m/s

01 项目概况 ————项目区位

Project Overview
————————Project Position



项目位于辽宁省大连市中山区虎滩东沟，地块南侧为稀缺海景资源，地理位置优越，距大连周水子国际机场约15km，驾车35分钟，距金州湾国际机场约25km，驾车约1.25小时。

The project is located in Hutan Donggou, Zhongshan District, Dalian City, Liaoning Province. To the south of the site lies rare sea view resources, offering a prime geographical location. It is approximately 15 km (35-minute drive) from Dalian Zhoushuizi International Airport and about 25 km (1.25-hour drive) from Jinzhou Bay International Airport.

山 海 城 林 府 园






Mountain Sea City Trees Mansion Garden

01 项目概况 ————设计方案

Project Overview
————————Architectural Design

建筑鸟瞰及单体效果图
Architectural bird's-eye view and individual rendering

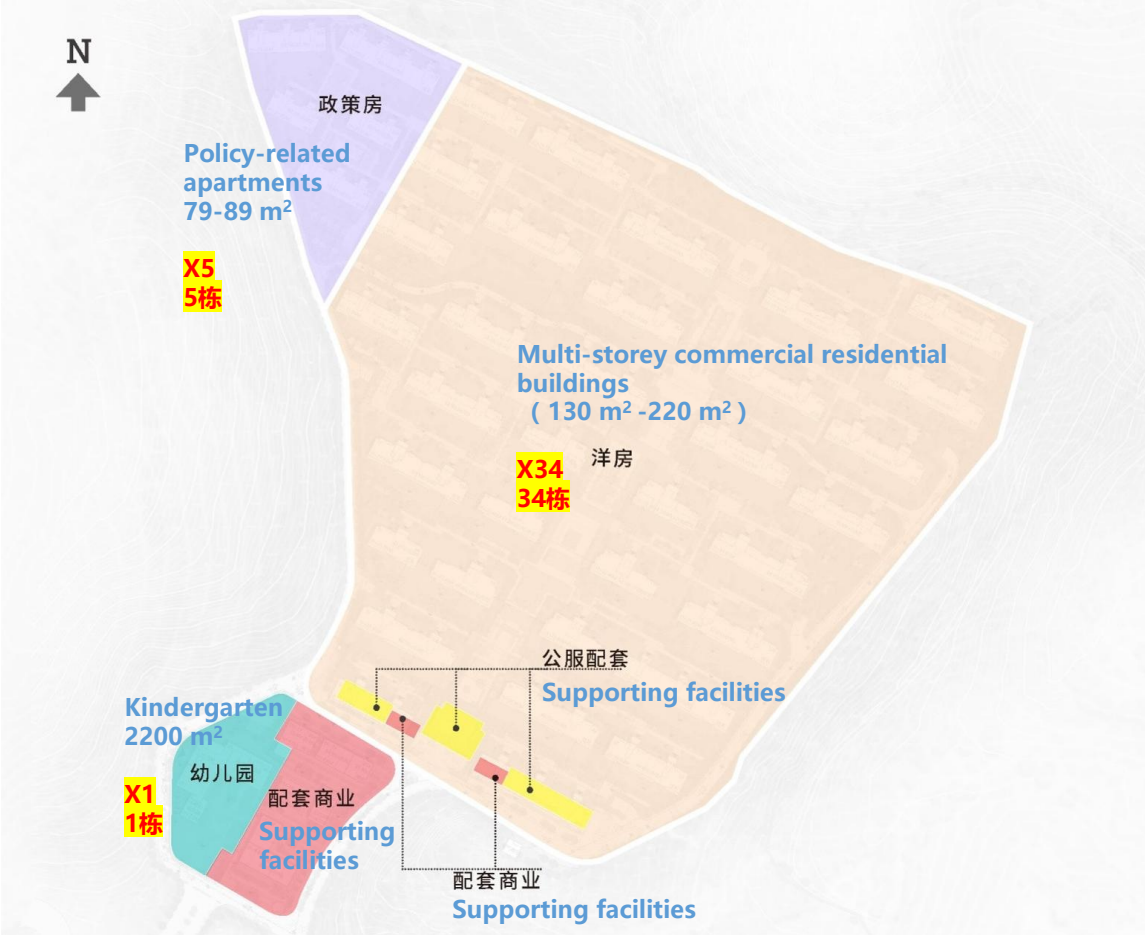
方案设计：大象建筑设计有限公司
© Group of Architects (GOA)

建筑设计从建筑总体布局、单体朝向、体形系数、采光遮阳、室内环境参数等方面进行适应性设计。项目多为7层住宅，整体朝向为南偏西27.8°，顺应山势，获得极佳建筑朝向。外立面注重展现古典美学的现代演绎，全方位营造出优雅而多义的空间秩序；材料上采用瓦屋面、仿砖饰面板及暖灰色铝板，提升建筑品质感，刻画建筑艺术性。

Take overall layout, orientation, shape coefficient, lighting and shading, indoor comfort into consideration, most buildings are 7 stories, face 27.8 ° west to south. Complying with the mountain situation, it obtains an excellent building orientation. The facade focuses on showing the modern interpretation of classical aesthetics and creates an elegant and multi-meaning spatial order in an all-round way; as materials, tile roofs, imitation brick veneer panels and warm gray aluminum panels are used to enhance the sense of architectural quality and portray architectural artistry.

01 项目概况 ————方案效果图

Project Overview
————————Project renderings



建筑功能
Planning Design

项目用地面积约131000平方米，总建筑面积161130平方米（不含地下、半地下车库建筑面积）。其中住宅建筑面积152000平方米，由39栋住宅组成，户型面积由130平方米到220平方米区间，大学生政策住房户型面积由79平方米到89平方米区间；配套商业设置建筑面积2680平方米；配套公共服务设施面积6450平方米。

The project has a land area of approximately 131000 m^2 and a total construction area of 161130 m^2 (excluding underground and semi underground garage construction areas). The residential building area is 152000 m^2 , consisting of 39 residential buildings with unit sizes ranging from 130 m^2 to 220 m^2 . The unit sizes for policy housing for college students range from 79 m^2 to 89 m^2 ; The supporting commercial facilities have a building area of 2680 m^2 ; The area of supporting public service facilities is 6450 m^2 .

任务
Task

获得
中国近零能耗建筑认证

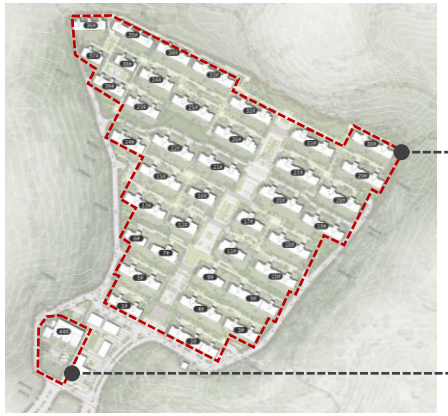
Get
Chinese nearly zero energy building certification

目标
Goal

探索
瑞士低碳建筑能耗标准

Explore
Swiss Minergie certification

MINERGIE®



近零能耗建筑
Nearly-zero
Energy Buildings

绿色建筑标准
Green
Buildings

Minergie
Efficiency and Quality
迷你能源
效率及质量

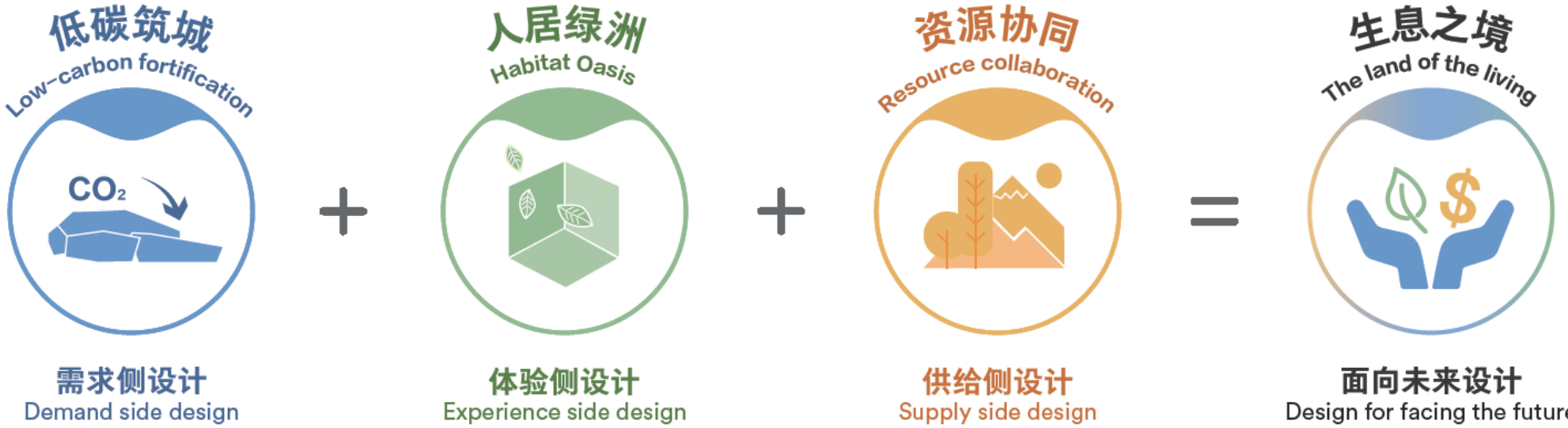
Minergie-P
Swiss Passive House Standard
迷你能源-P级
瑞士被动房标准

Minergie-A
Top-Standard, Production higher Consumption
迷你能源-A级
顶级标准，生产能源大于能源消耗

ECO
The addition for health and ecology
迷你能源-ECO
健康和生态相关的补充认证

MQS Bau
Quality Control in Construction
迷你能源质量标准建造
建设中控制质量

MQS Betrieb
Quality Control in Operation
迷你能源质量标准运营
运营中控制质量



需求侧设计
Demand side design

体验侧设计
Experience side design

供给侧设计
Supply side design

面向未来设计
Design for facing the future

三维九环 环环相扣 生生不息

The rowing cycle links by 9 highlights from 3 dimentions, and brings vitality & vigor to every corner of the city.

零碳设计之路是多维度多层次的设计融合；
第一维度，以需求侧为导向的低碳筑城设计，有针对性的选取被动式与主动式技术进行建筑建造；
第二维度，以体验侧为导向的人居绿洲设计，基于生态本底特征创造全天候的六恒品质生活空间；
第三维度，以供给侧为导向的资源协同设计，气候响应，采用在地化的可再生能源进行能源规划；
三维叠合，应生九环，面向未来，缔造生息之境。

The road of zero-carbon design is a multi-dimensional and multi-level design integration;
Carry out the first-dimensional low-carbon city construction design guided by the demand side, and select passive and active technologies for building construction;
Guided by the experience side, the second-dimensional living oasis design is carried out, and an all-weather Liuheng quality living space is created based on the ecological background characteristics;Supply-side-oriented resource collaborative design in the third dimension, climate response, and localized renewable energy for energy planning;Three-dimensional superposition, should give birth to nine rings, facing the future, creating a realm of life and interest.

建筑低能耗、低碳化原则：**被动为先+主动优化+再生能源**

被动式技术

- 冬季冷却
- 夏季预冷
- 电致变色玻璃
- 蓄热楼板/墙体
- 室内隔音
- 眩光控制
- 建筑外遮阳
- 被动式得热
- 绿植灌木
- 自然通风
- 自然采光
- 优良气密性
- 无热桥处理
- 高保温性能外窗
- 高保温性能墙体

主动式技术

- 新风热回收
- 辐射供冷
- 智慧照明系统
- 辐射供暖
- 全新风置换通风
- 高效电器
- 能耗监测系统
- 室内空气品质监测
- 自控外遮阳
- 工位照明
- 自控照明
- 自控开启外窗
- 分散供暖

可再生能源

- 生物质锅炉
- 污水源热泵
- 空气源热泵
- 地源热泵
- 太阳能光热
- 太阳能光伏

Principle of ZEB: **Passive+Active+Renewable Energy**

Passive Technology

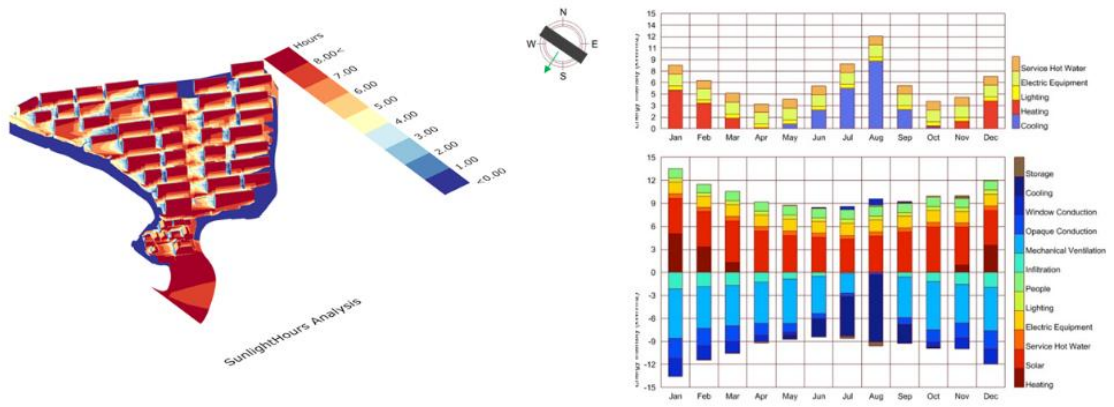
- Pre heating
- Pre-cooling
- Electrochromic glass
- Heat storage slab
- Sound insulation
- Glare control
- Outside shading
- Passive heat gain
- Green plant
- Natural ventilation
- Natural lighting
- Good air tightness
- No thermal bridge design
- High performance window
- High performance insulation

Active Technology

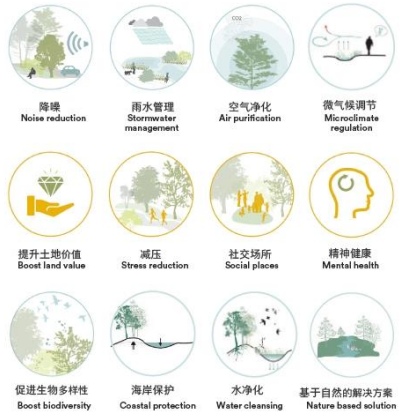
- Fresh air heat exchange
- Radiant cooling
- Smart lighting
- Radiant heating
- Displacement ventilation
- High efficiency appliance
- Energy monitor
- Indoor air quality monitor
- Smart shading
- Work area lighting
- Self study lighting
- Smart window opener
- Decentralized heating

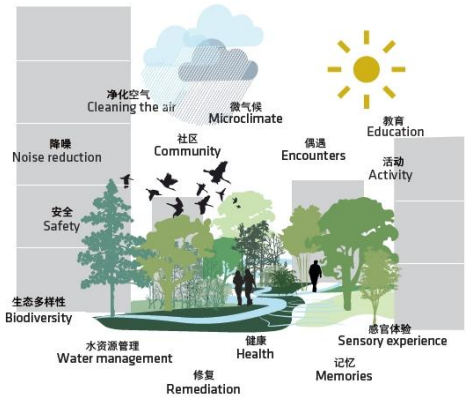
Renewable Energy

- Biomass boiler
- Water source heat pump
- Air source heat pump
- Ground source heat pump
- Solar thermal usage
- Solar photovoltaics



能碳规划 Energy planning

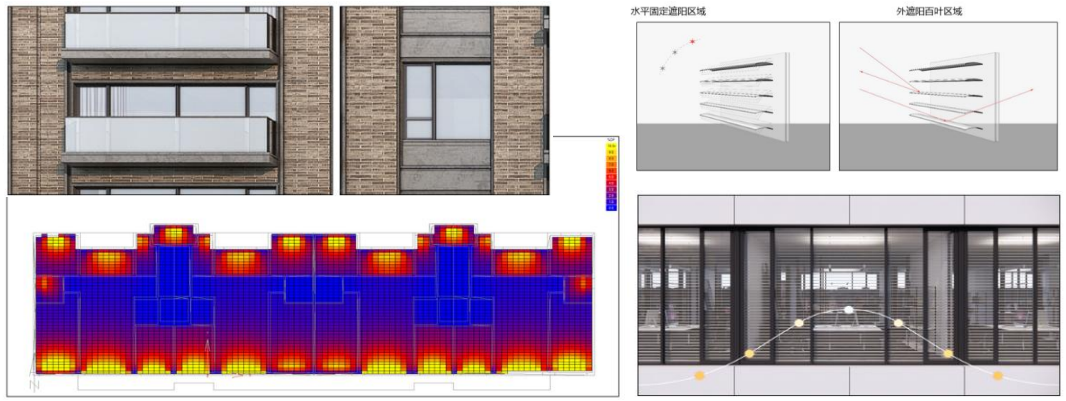




自然植被 Natural vegetation

低度开发 Low intensity excavation

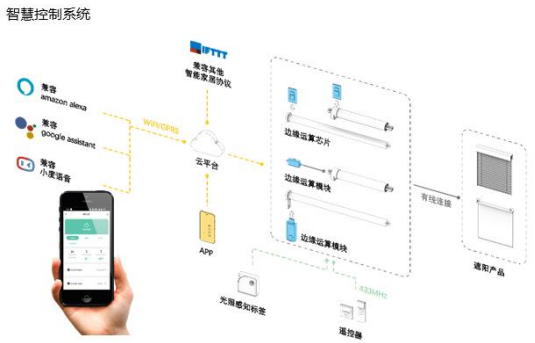
围护结构 Building envelope



遮阳采光 Sunshade and daylighting

智能感知 Intelligence and Perception

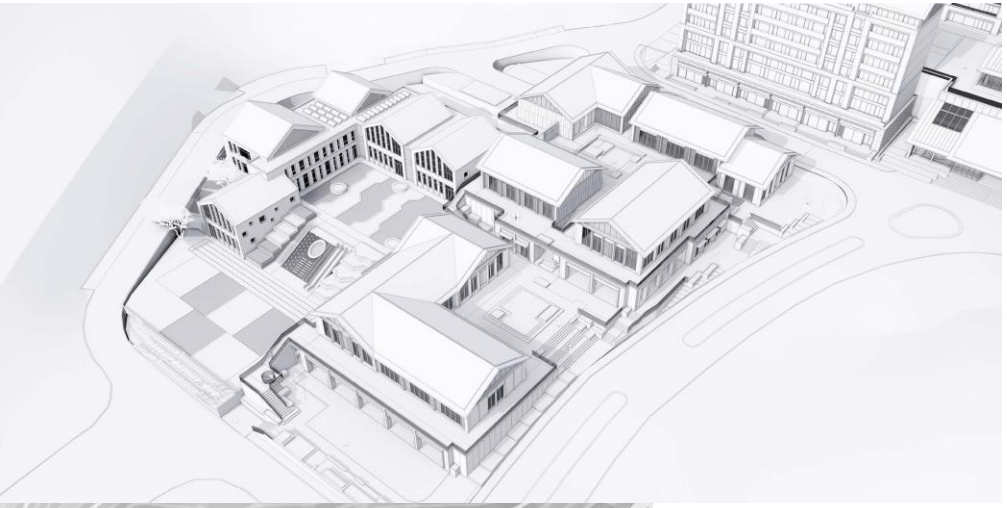
舒适末端 Mechanical and electrical terminal



能碳监测 Energy consumption & carbon emissions monitoring

02 近零路径 ——重点示范技术

Nearly-zero Path
——Key Demonstration Technologies



幼儿园
Kindergarten

优良气密性
Airtightness

连续保温
Continuous Insulation

近无热桥
Thermal Bridge Free Construction

高效热回收
High Performance Doors and Windows

高性能门窗
Energy Recovery Ventilation

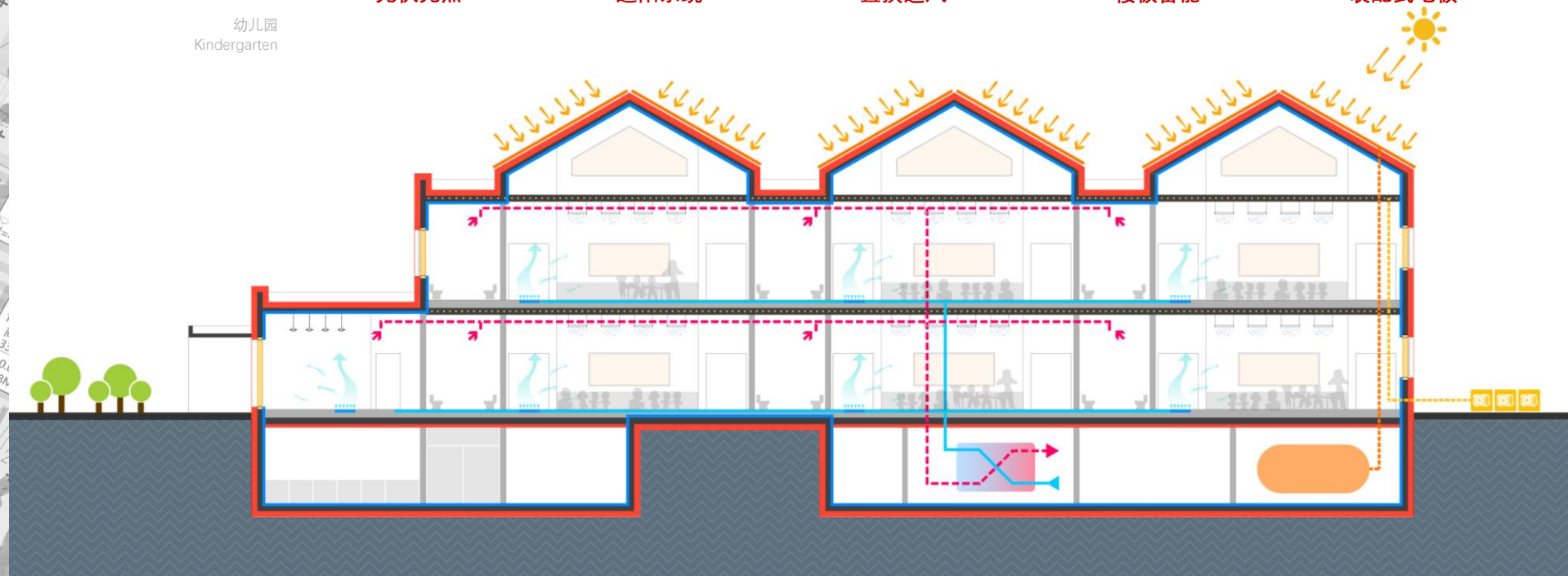
PVT
光伏光热

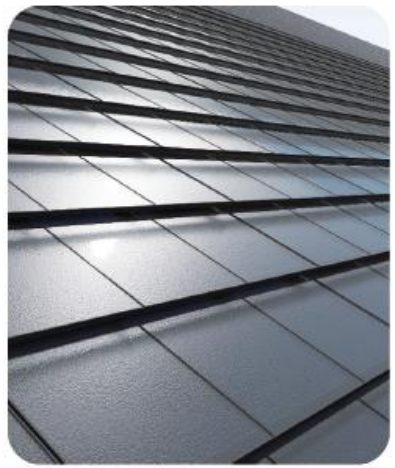
INSHADE
遮阳系统

Displacement ventilation
置换送风

TABS
楼板蓄能

Raised Floor
装配式地板





太阳能 SOLAR PV

推荐指数 ★★★★★
Recommendation index

●优势：可再生、技术成熟、可用范围广、就地取材。
Advantages: Renewable, mature technology, wide range of availability, and local materials.

●劣势：受天气影响、不稳定、只能在白天使用。
Disadvantages: Affected by the weather, unstable, and can only be used during the day.

空气能 AIR

推荐指数 ★★★★
Recommendation index

●优势：可再生、技术成熟、就地取材。
Advantages:Renewable, mature technology, and local materials.

●劣势：相对于其他热泵效率较低，需要满足室外机占地面积。
Compared with other heat pumps, the efficiency is low, and the outdoor unit needs to meet the floor area.

地热能 GEOTHERMAL

推荐指数 ★★★★★
Recommendation index

●优势：可再生，稳定性高，就地取材、运行成本低。
Advantages: Renewable, high stability, local materials, and low operating costs.

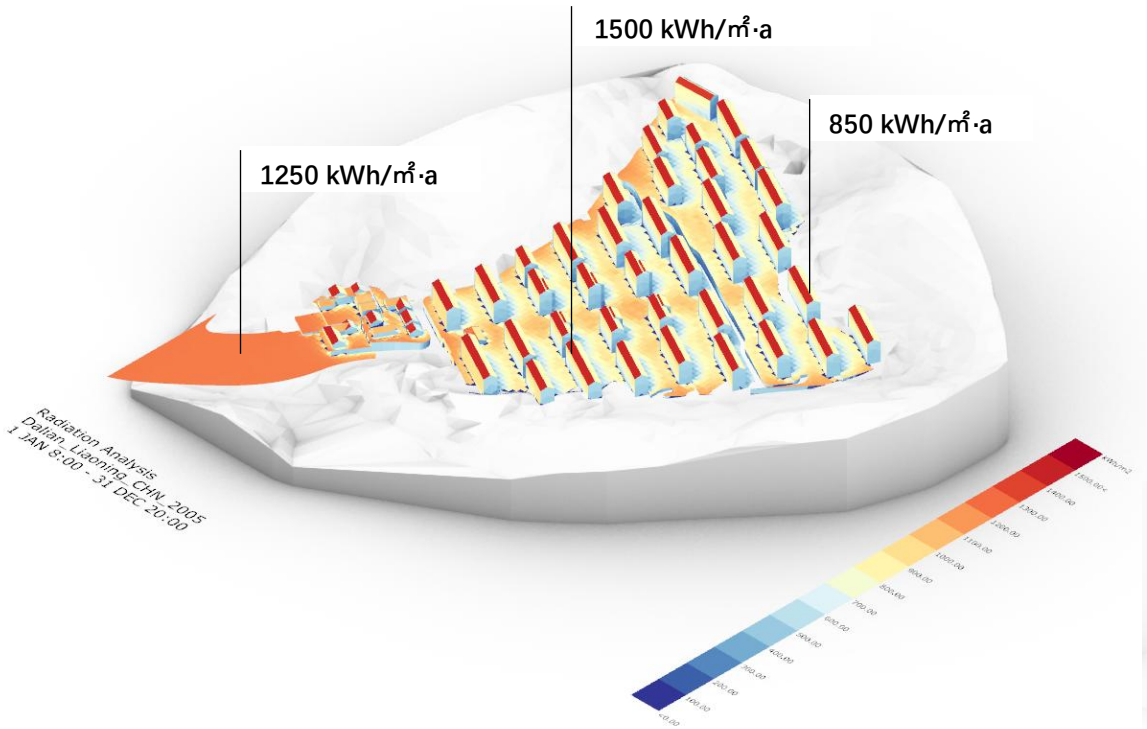
●劣势：需要冷热平衡、建设成本高。
Advantages: Renewable, high stability, local materials, and low operating costs.

生物质能 BIOMASS

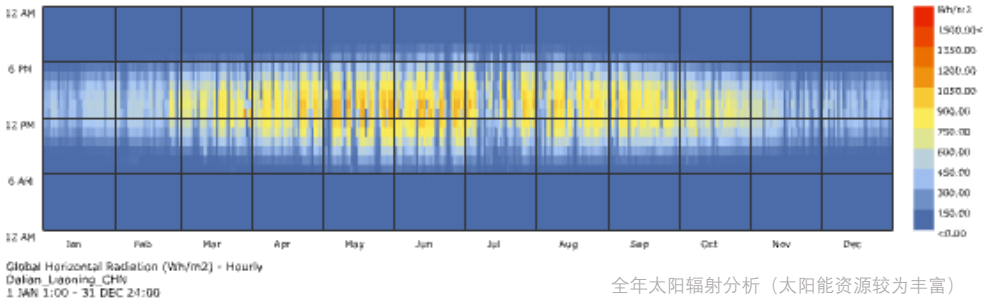
推荐指数 ★★
Recommendation index

●优势：可再生、技术成熟、就地取材。
Advantages: Renewable, mature technology, and local materials.

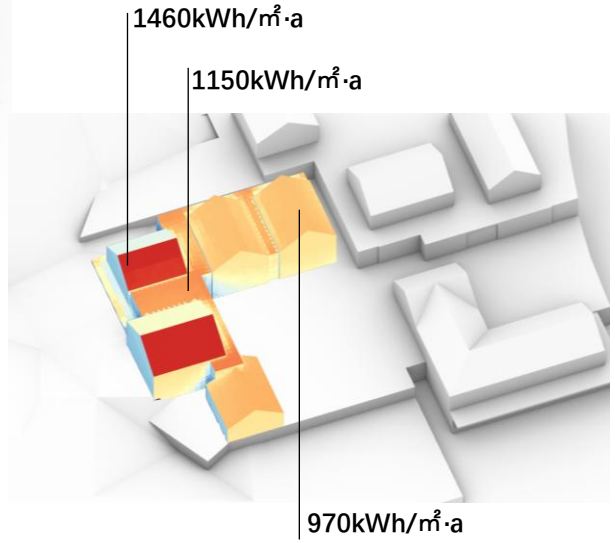
●劣势：缺少稳定的燃料供给、应用场景少。
Disadvantages: Lack of stable fuel supply and few application scenarios.



住宅屋面太阳辐射强度分析图
Analysis Diagram of Solar Radiation Intensity on Residential Roofs



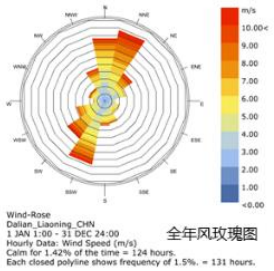
全年太阳辐射分析（太阳能资源较为丰富）
Annual Radiation (Rich)



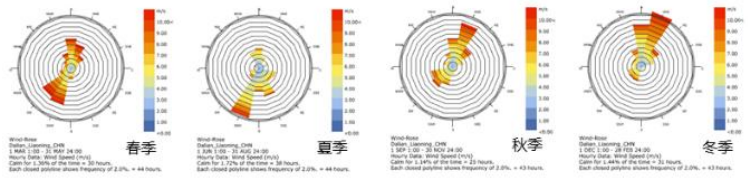
幼儿园屋面太阳辐射量分析图
Analysis diagram of solar radiation on the roof of kindergarten

设计区域内建筑及场地整体的太阳辐射强度较优秀。其中南向坡屋面辐射强度达到1500kWh/ ㎡·a，有利于太阳能资源的利用。场地内重点居民活动区域辐射强度达到1250kWh/ ㎡·a，营造健康舒适的活动场地微气候。

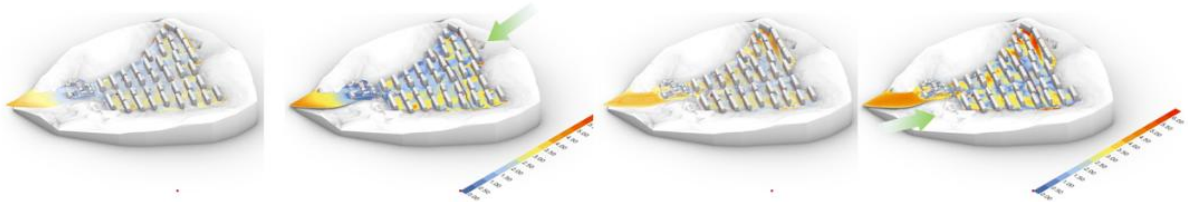
The overall solar radiation intensity of the buildings and site within the design area is excellent. The radiation intensity of the south facing sloping roof reaches 1500kWh/㎡· a, which is conducive to the utilization of solar energy resources. The radiation intensity in the key residential activity areas within the venue reaches 1250kWh/㎡· a, creating a healthy and comfortable microclimate for the activity venue.



Annual Wind Rose Diagram



Spring Summer Autumn Winter



风速矢量图-冬季 (1.5米高度水平面)
Wind Speed Vector Diagram Winter (1.5m)

风速云图-冬季 (1.5米高度水平面)
Wind Speed Cloud Diagram Winter (1.5m)

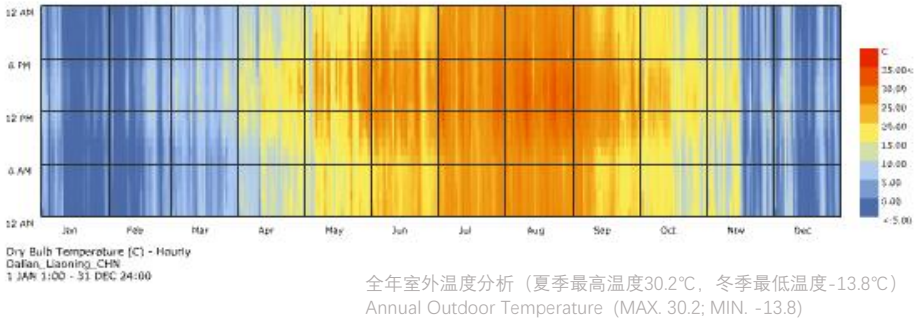
风速矢量图-夏季 (1.5米高度水平面)
Wind Speed Vector Diagram Summer (1.5m)

风速云图-夏季 (1.5米高度水平面)
Wind Speed Cloud Diagram Summer (1.5m)

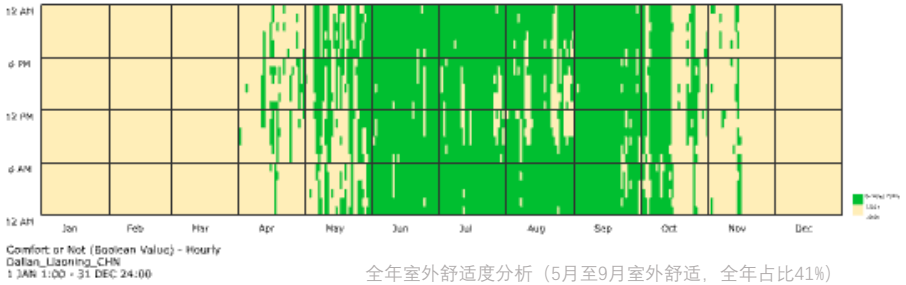
春季 (较强冷等级)
夏季 (较为舒适等级)
秋季 (较为舒适等级)
冬季 (强冷等级)

Spring (Strong Cold Level) Summer (More comfortable level) Autumn (more comfortable level) Winter (Strong cooling level)

场地气候环境分析
Analysis of site climate and environment



全年室外温度分析（夏季最高温度30.2℃，冬季最低温度-13.8℃）
Annual Outdoor Temperature (MAX. 30.2; MIN. -13.8)



全年室外舒适度分析（5月至9月室外舒适，全年占比41%）
Annual Comfort Hours (41% hours comfortable)

设计区域内全年热气候温度指数在2.13℃~3.71℃区间，舒适度处于轻微冷压力等级（0℃~9℃）。
设计项目坐北朝南，通过对建筑及景观精心设计，有效降低了建筑之间行人区局部风速。营造适宜的微气候，满足室外活动的舒适性要求。

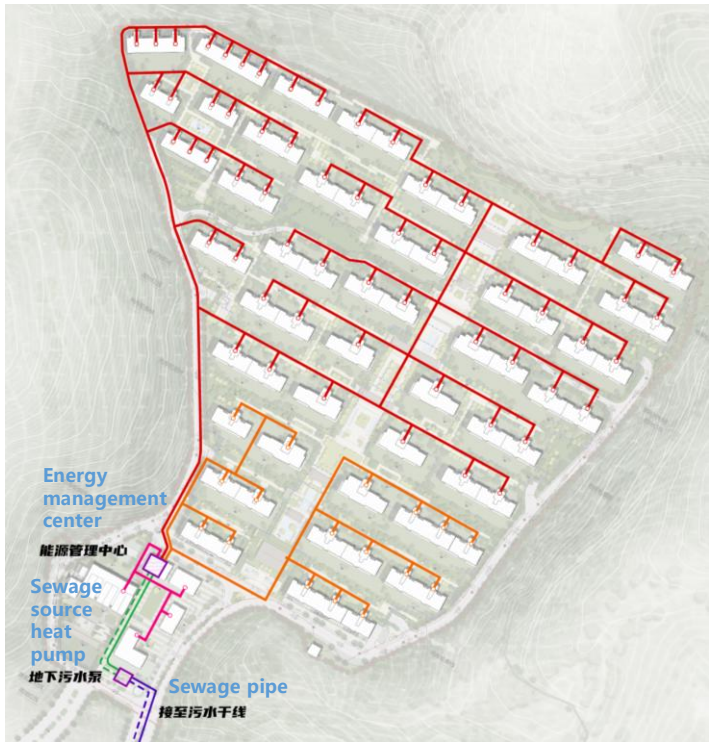
The project annual thermal climate index is between 2.13℃~3.71℃.
The design project faces south and effectively reduces the local wind speed in the pedestrian area between buildings through careful design of the building and landscape, creating a suitable microclimate to meet the comfort requirements of outdoor activities.

03 能源方案 ————资源特征-污水源

Energy Solutions ————————Resource characteristics - sewage source

污水厂污水处理能力，每天约30'000立方米污水

Sewage plant capacity: 30'000 m^3 per day



供暖：污水源热泵+蓄热水箱

Heating: sewage source HP + thermal storage water tank

制冷：污水源热泵+蓄冷水箱

Refrigeration: sewage source HP + cold storage water tank

热水：集中式污水源热泵

Hot water: sewage source HP + thermal storage water tank

太阳能光伏自发逆变集中到能源中心

Store electricity from PV panels in energy center.

冬夏季用于污水源热泵供电

Supply electricity for sewage source HP for heating and cooling.

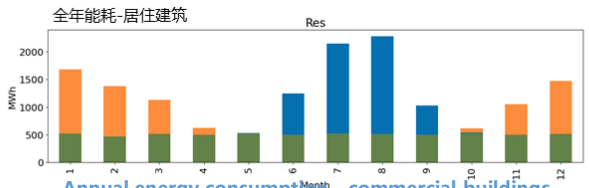
过渡季节供社区用电

Supply electricity to communities during transitional seasons

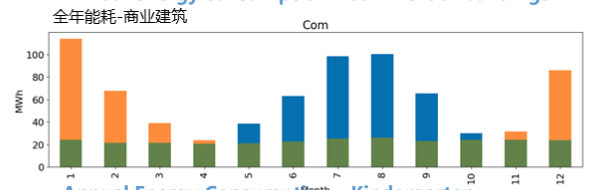
余量存储及并网

Store and send to the grid

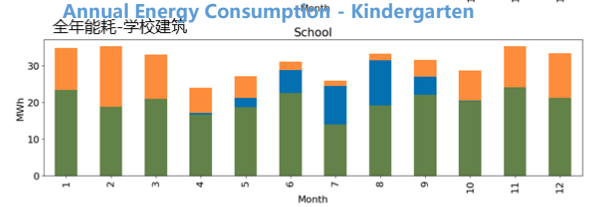
Annual energy consumption - residential buildings



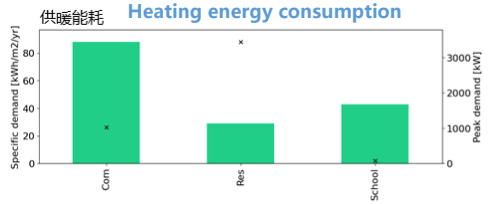
Annual energy consumption - commercial buildings



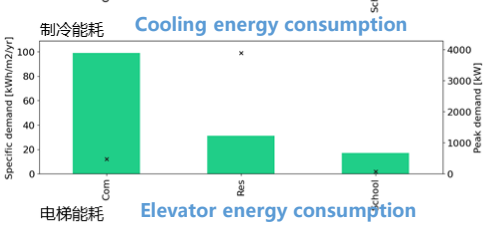
Annual Energy Consumption - Kindergarten



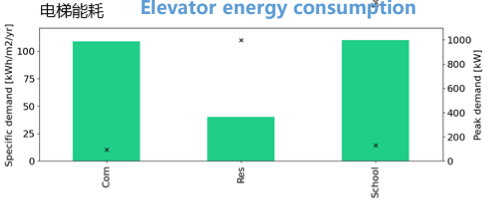
Heating energy consumption



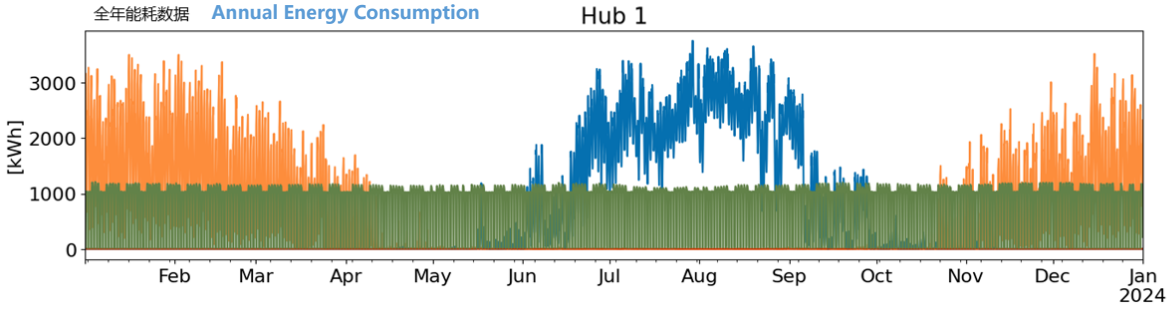
Cooling energy consumption



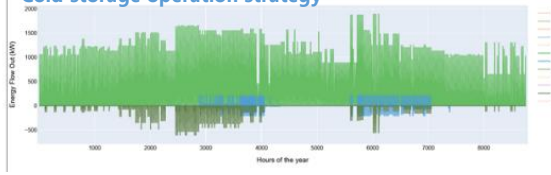
Elevator energy consumption



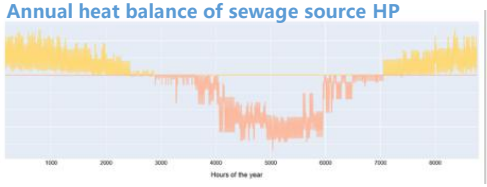
Annual Energy Consumption

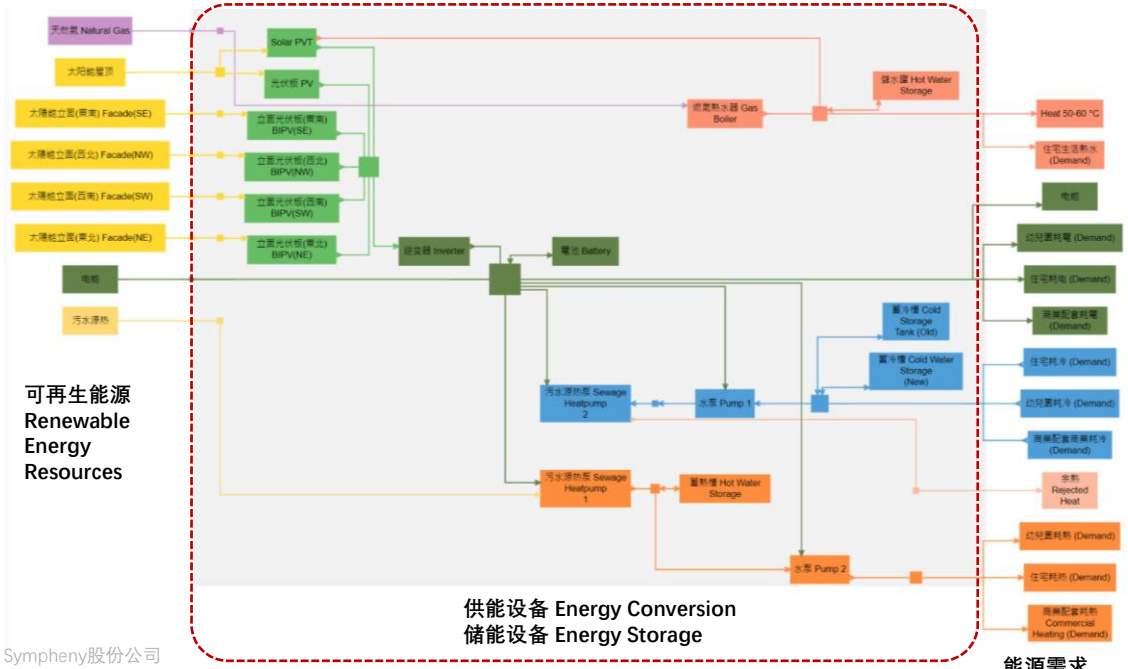


蓄冷运行策略
Cold storage operation strategy



污水源热泵全年热平衡
Annual heat balance of sewage source HP





资料来源: Sympheny股份公司
Sympheny Optimization of the overall energy concept for the Dalian Demonstration Project

能源需求 Energy Demands
供电/供暖/供冷/生活热水需求
Electricity, Space Heating, Space Cooling, Domestic Hot Water

模拟可能的能源方案 Possible energy concepts
+ 10万个可能的系统方案
+ 100k possible Systems

04 总结探讨 ——亮点提炼

Summary and Discussion
——Highlights Summary

■ **能源方案亮点：**
- 供暖：污水源热泵+地暖末端
- 制冷：污水源热泵和蓄冷水箱+空调末端
- 通风：高效热回收机械通风
- 热水：集中式污水源热泵 或 分散式电热器
- 太阳能：坡屋顶中央部分铺设光伏瓦（BIPV）幼儿园屋面铺设光伏光热（PVT）
- 遮阳： 外部光线动态追踪遮阳（铝制百叶遮阳帘）和固定式阳台

■ **其他可持续设计亮点：**
- 污水厂污水处理能力：每天约30'000立方米污水
- 用于夏季降温的蓄冷水箱
- 能源管理中心负责能源制备及存储，设置能碳运维监测平台

能耗计算迭代：

■ 中方团队首次计算结果（1#-135 m^2 户型，2023年6 月）
- 能耗总量： 35.2 kWh/m^2a
- 光伏发电量： 10.34 kWh/m^2a

■ 瑞方核算反馈（2023年11月）
- 能耗总量： 20.9 kWh/m^2a
- 光伏发电量： 19.77 kWh/m^2a

■ **Energy concept:**
- Heating: Sewage source heat pump + floor heating end
- Cooling: Sewage source heat pump and water storage tank + air conditioning terminal
- Ventilation: High-efficiency heat recovery mechanical ventilation
- Hot water: centralized sewage source heat pump or decentralized electric boiler
- Solar: The central part of the sloping roof is covered with photovoltaic tiles (BIPV), and the kindergarten roof is covered with photovoltaic thermal (PVT)
- Shading: Dynamic external light tracking shading (aluminum blinds) and fixed balconies

■ **Other sustainability concepts:**
- Sewage plant capacity: 30'000 m^3 per day
- Cold storage tank for summer cooling
- The Energy Management Center is responsible for energy preparation and storage and sets up an energy and carbon operation and maintenance monitoring platform.

■ Initial Chinese calculation (Building 1#-135m^2, June. 2023)
- Energy consumption total: 35.2 kWh/m^2a
- PV production: 10.34 kWh/m^2a

■ Calculation of Swiss experts （June 2023）
- Energy consumption total: 20.9 kWh/m^2a
- PV production: 19.77 kWh/m^2a

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

IBE环能科技
中国建筑节能协会

Schweizerische Eidgenossenschaft
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