

## Sino-German Ecological Park Passive House Technology Center

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New Construction

Primary energy need :

**96.69** kWhpe/m<sup>2</sup>.

(Calculation method : Other )

### ENERGY CONSUMPTION

Economical building

Building

< 50 **A**

51 à 90 **B**

91 à 150 **C**

151 à 230 **D**

231 à 330 **E**

331 à 450 **F**

> 450 **G**

Energy-intensive building

**Building Type** : Office building < 28m

**Construction Year** : 2015

**Delivery year** : 2016

**Address 1 - street** : 266000 ,

**Climate zone** :

**Net Floor Area** : 13 769 m<sup>2</sup>

**Construction/refurbishment cost** : 130 700 000 ¥

**Cost/m<sup>2</sup>** : 9492.34 ¥/ m<sup>2</sup>

**Certifications :**



## General information

The project is located in the Sino-German Ecological Park in Qingdao. It is adjacent to the Ecopark No. 36 street in the west and the Ecopark No. 7 street in the north. As a second-class high-rise public building with first-class fire resistance and a structural form of reinforced concrete frame structure, its main functions are office and technology exhibition.

### **Land saving and outdoor environment**

To optimize site design by environment simulations for achievement of good built environment

To plant local tree species with low maintenance requirements for creating a conservative garden

To install barrier-free facilities for providing convenient public services

To make full advantages of site characteristics for developing rainwater infrastructures, aiming at reducing rainwater runoff

To appropriately plan green spaces for building beautiful surroundings

### **Energy saving and energy utilization**

To use high-performance exterior walls, doors, windows and other envelop that exceed the current standards for meeting passive ultra-low energy requirements

To optimize the shape of the building, the position of the window, and the position of the channel in combination with the site conditions;

To use geothermal heat pump as the main source of heat for maximum utilization of renewable energy

To use LED light as the main light source and to set the intelligent lighting control system and

infrared induction for less lighting energy consumption

To set a new wind turbine group with a total heat recovery efficiency of more than 75% to reduce the fresh air load;

To use AHU with the total heat recovery efficiency of more than 75% for less wind load;

To install energy-efficient HVAC, elevator and other electrical equipment for higher energy efficiency;

Optimize equipment operation with an energy metering and management system.

### **Water saving and utilization**

Taking effective measures to avoid leakage of the pipe network;

The water supply system has no overpressure and outflow phenomenon;

Setting a water metering device;

To use sanitary appliances with high water efficiency levels;

### **Material saving and utilization**

Elements in architectural modeling are simple and have no large number of decorative components;

To integrated design of civil engineering and renovation engineering;

To choose reusable glass partitions and lightweight partitions in transformable indoor spaces

Selection of locally produced building materials;

To use ready-mixed mortar and ready-mixed concrete;

To use high-performance steel and concrete for building materials conservation;

To building materials produced from waste materials with a waste content of no less than 30%.

### **Indoor environmental quality**

The indoor noise level of the main functional room is lower than the standard minimum limit in the current national standard "Code for Design of Sound insulation for Civil Buildings" GB 50118;

To adopt sound insulations in the room and floor of main function rooms for well sound insulation performance;

Taking measures to reduce noise interference in the elevator engine room, experimental equipment room, new fan room, and cold and heat source station;

To add adjustable shading facilities on the eastern, western and southern facades for lighting solar radiation in summer;

To installed an indoor air quality monitoring system in main function rooms where the density of personnel is high and the time varies greatly.

## Data reliability

3rd part certified

## Stakeholders

### Contractor

Name :

Contact : liulei@sgugroup.com

<http://www.lxjz.com/>

### Construction Manager

Name :

Contact : liulei@sgugroup.com

<http://www.sinogerman-ecopark.com/>

### Stakeholders

Function : Designer

yuzhen@chinaibee.com

<http://www.cabr.com.cn>

Conceptual design of architecture; Conceptual design of interior; Conceptual design of landscape; ultra-low energy electromechanical system design; Preliminary design and construction drawing design; PHI certified consultant; Green building certified cons

RONGEN TRIBUS VALLENTIN GmbH

Sven Ring sven.ring@email.de

Conceptual design of architecture; Conceptual design of ultra-low energy electromechanical system; PHI certified consultant.

### Contracting method

## Owner approach of sustainability

Passive House Technology Center in Sino-German Ecopark is a key project of China-Germany passive house cooperation which signed by Premier Li Keqiang and Prime Minister Merkel. the project's design and passive ultra-low energy green building certification consultant are completed by China Academy of Building Research and the German ROA firm, which is the most Representative passive house project in China. It has been certified by PHI and China Passive Nearly zero Energy Building.

- 1) The project adopts the German passive house design concept, which can effectively improve the indoor environment quality and reduce energy consumption. It is the first public building in the cold climate zone to meet China's passive ultra-low energy green building standards;
- 2) The accumulated cooling and heat load of the air-conditioning and heating period and air tightness meet the German passive house standard, and the relative energy saving rate exceeds 85%;
- 3) In terms of architectural design, the project combines the terrain and geomorphology to reasonably set the building space and reduce the body shape coefficient. It is equipped with a natural lighting, ventilated atrium, with a self-shading structure, and implements the passive concept of "active firstly, passive optimizely".
- 4) The whole process service is adopted without heat bridge, airtight fine design and design and construction. The air tightness test result of the project is  $N50 \leq 0.45$ .
- 5) Uncontrolled power chilled beam and dual heat recovery new fan unit technology with independent control of temperature and humidity bring significant energy saving benefits and high indoor comfort standards.
- 6) The transmission and distribution system is optimized to the ultra-low resistance design, which greatly reduces the energy consumption of the pump.

## Architectural description

As a passive green energy-saving building, this project strives to become a passive green building demonstration project in Qingdao. It draws on the natural forms such as ocean, river and pebbles in the planning and design concept, and adopts the design principle of building, indoor and landscape integration as energy-conservation services.

### Architectural design

The pebble shape in harmony with surrounding environment and greening. The main lighting surface of the building faces the southeast facing green space, maximizing the illumination and landscape orientation;

At the same time, the building and the semi-subsidence square are facing southeast (Qingdao

summer dominant wind direction), which is convenient for discharging of waste heat rapidly; the low-sloping sun in winter allows the building to make maximum use of sunlight while keep the northwest wind from the building and square.

### Interior design

Adopting green design concept of low energy consumption;

The sunlight is introduced into the room from the skylight for sufficient illumination, and the room around the atrium can be lit through the high window;

The atrium is made of transparent glass slats for light transmission to save energy.

### Landscape Design

The streamlined green landscape design not only improves the surrounding micro-environment of the building but also plays a good guiding role in the functional streamline. To create a “watching and being watched” interaction between architecture and landscape, nature and architecture are symbiotic, and the building is perfectly integrated into the environment;

Atrium landscape design integrates indoor part and outdoor part. The project introduces the greening into the room, which can adjust the indoor microclimate and reduce some energy consumption.

## Building users opinion

Satisfaction survey was conducted for users working in the building: lighting environment satisfaction was 100%, air quality satisfaction was 95.24%, thermal environment satisfaction was 85.72%, acoustic environment satisfaction was 90.48%, and the calculated PMV value was calculated. -0.08, the PPD value is 5.14%. The main reason for dissatisfaction is that indoor temperature and humidity in summer are slightly uncomfortable while the overall satisfaction level is good.

## Energy

### Energy consumption

Primary energy need : 96,69 kWhpe/m<sup>2</sup>.

Primary energy need for standard building : 493,50 kWhpe/m<sup>2</sup>.

Calculation method : Other

Final Energy : 28,99 kWhfe/m<sup>2</sup>.

Breakdown for energy consumption :

HVAC: 20.30 Kwh/m2/year

General lighting, plug equipment: 3.55 Kwh/m<sup>2</sup>/year

General power equipment: 1.93 Kwh/m<sup>2</sup>/year

Others: 6.45 Kwh/m<sup>2</sup>/year

## Envelope performance

Envelope U-Value : 0,50 W.m<sup>-2</sup>.K<sup>-1</sup>

### More information :

1. Exterior wall insulation adopts rock wool insulation material which 250mm thick, fire rated grade A and thermal conductivity 0.035

2. heat Heat transfer coefficient:

Exterior Wall: 0.17 W/m<sup>2</sup>K Roof: 0.12 W/m<sup>2</sup>K Overhead or outer-load floor slabs 0.19W/m<sup>2</sup>K

3.Windows:

The aluminum-clad wood (outer aluminum inner wood) triple-pane Low-E vacuum glazing, which u value is 0.8 W/m<sup>2</sup>K.

Opening method: flat open, overhang. The airtightness of the outer door and window products shall not be less than 8 grades, the water tightness grade shall not be less than 6 grades, and the wind pressure resistance performance grade shall not be less than 9 grades, and the product selection shall meet the national standards.

The sealing performance and resilience performance of German Schlegel strips is three times that of ordinary EPDM strips, which can achieve better insulation and sound insulation during installation.

4. The airtightness of the project is completely in accordance with the requirements of airtight design and construction in Technical Guidance for Passive Ultra Low Energy Green Building(Residential buildings). Air tightness is critical to achieving ultra-low energy goals.

High-quality air tightness can reduce the cold air infiltration in winter, reduce the additional cooling caused by uncontrolled ventilation in summer, avoid the mold, condensation and damage of building moisture, reduce outdoor noise and air pollution, and improve the quality of life of the occupants. High-quality airtightness can reduce the cold air infiltration in winter, reduce the extra cooling caused by uncontrolled ventilation in summer, avoid the mold, condensation and damage of building moisture, reduce outdoor noise and air pollution, and improve people's residential quality.

The position of the airtight layer is clearly marked in the architectural design drawing, and the airtight layer is continuous and surrounds the entire outer protective structure. Simple styling and node design can reduce or avoid nodes that are difficult to handle with air tightness.

Using external doors and windows with high airtightness. The plaster layer, the hard material plate (such as MDF, stone), and the airtight film are selected to form an airtight layer.

Choosing the applicable airtight material for node air tightness treatment, such as compact and complete concrete, airtight film, special expansion sealing strip, special airtight treatment coating and other materials. Node design is performed on parts that are prone to air tightness such as door holes, window holes, electrical junction boxes, and pipeline penetrations.

5. motorized Motorized external shading system is installed in the eastern, western and southern side of the building.

Building Compactness Coefficient : 0,17

Indicator : EN 13829 - n50 » (en 1/h-1)

Air Tightness Value : 8,00

## Real final energy consumption

Real final energy consumption/m<sup>2</sup> : 32,23 kWhfe/m<sup>2</sup>.

Year of the real energy consumption : 2 017

## Renewables & systems

### Systems

Heating system :

- Geothermal heat pump

Hot water system :

- Heat pump
- Solar Thermal

Cooling system :

- Geothermal heat pump

Ventilation system :

- Double flow heat exchanger

Renewable systems :

- Solar photovoltaic
- Heat pump (geothermal)

Renewable energy production : 10,00

## Smart Building

BMS :

Siemens Desigo CC, building automation system, air quality and detailed monitoring system

Users' opinion on the Smart Building functions :

Through the questionnaire survey on the control system satisfaction of the management staff in the building: Siemens Desigo CC software control satisfaction 94.7%, TRA control satisfaction 91.9%, intelligent green leaf board control satisfaction 90.4%, the main reason for dissatisfaction is that the intelligent control is a bit lagging. In general, the intelligent control



system has reasonable control and stable state, which can achieve the user's control demand effect in time.

## Environment

### Urban environment

This building provides meeting rooms, exhibition space construction, restaurants and other external services to the outside.

This building where the region has a number of public bus lines service facilities, soccer fields, shopping malls, cafes and so on.

### Land plot area

Land plot area : 4 843,00 m<sup>2</sup>

### Green space

Green space : 1 932,72

### Parking spaces

The parking lot is located on the second basement.

## Products

### Product

ventilation central unit with heat recovery

pressure difference 206Pa, sound level 90.3dB A .

In the actual construction and use process, the design, construction, development and operation units all believe that the equipment and facilities (including HVAC equipment, photovoltaic power generation, insulation materials) in the building are stable, efficient, and can meet the needs of users.



## Ground source heat pump

88

<http://www.climaveneta.com.cn>

Product category :

Ground source heat pump, two-screw compressor, refrigerant: R134a, cooling capacity/COP: 332.1kW/6.15 heat capacity/COP: 265.4kW/3.97, maximum input power: 95.8kW, HP: 2.8MPa, LP: 2.0MPa.

In the actual construction and use process, the design, construction, development and operation units all believe that the equipment and facilities (including HVAC equipment, photovoltaic power generation, insulation materials) in the building are stable, efficient, and can meet the needs of users.



## PV power generation

211

<http://1672270.b2b.tfsb.cn>

Product category :

PV power generation, more than 200 polycrystalline silicon battery modules CHSM 6610P-260 Wp are arranged on the roof, the peak power per component is 260 Wp. The total capacity of installed PV is



about 52 kWp, and the average annual power generation is 48623 kWh, accounting for 10-15% of the total passive electricity consumption.

In the actual construction and use process, the design, construction, development and operation units generally believe that the overall operation of the PV power generation equipment is stable and can meet the needs of users.

Rock wool board

3

<http://www.rockwool.com.cn>

**Product category :** Acabados / Acabado, aislamiento

Rock wool board, density 121kg/m<sup>3</sup>, thermal conductivity 0.035W/(mK), mass moisture absorption rate 0.8%, water repellency rate 99.5%, total combustion heat value PCS1.7MJ/kg, combustion performance meets Class A1 requirements of Class A materials.



In the actual construction and use process, the design, construction, development and operation units generally believe that the rock wool board insulation performance is efficient and good, and can meet the needs of users.

## Costs

### Construction and exploitation costs

Renewable energy systems cost : 6 800 000,00 ¥

Cost of studies : 10 000 000 ¥

Total cost of the building : 130 700 000 ¥

Subsidies : 5 000 000 ¥

### Energy bill

Forecasted energy bill/year : 240 000,00 ¥

Real energy cost/m<sup>2</sup> : 17.43

Real energy cost/Work station : 480

### Building Environmental Quality

- Building flexibility
- indoor air quality and health
- renewable energies
- integration in the land
- products and materials

## Health and comfort

### Water management

Consumption from water network : 3 640,00 m<sup>3</sup>

Water Consumption/m<sup>2</sup> : 0.26

Water Consumption/Work station : 7.28

### Indoor Air quality

Indoor CO<sub>2</sub> test concentration ( mg/m<sup>3</sup> ): 452.75 Ppm

Indoor TVOC test concentration ( mg/m<sup>3</sup> ): 368.42µg/m<sup>3</sup>

Indoor PM<sub>2.5</sub> test concentration ( µ g /m<sup>3</sup> ): 7.07 µg/m<sup>3</sup>

### Comfort

Health & comfort :

Average indoor temperature in January 21.0°C

Average indoor humidity in January 40%

Average indoor temperature in July 25.0°C

Average indoor humidity in July 60%

Acoustic comfort :

Considering the influence of noise on the use function in the layout of the building, the project

deliberately makes the equipment room with strong noise sources away from the office and display apartment. The standard structure of the interior of the building is from top to bottom: solid wood floor or rubber board or ceramic floor tile, floating leveling layer, impact sound insulation layer, reinforced concrete floor, plastering layer, ceiling. The standard structure of the internal partition wall is: floated coat, concrete small hollow block wall, floated coat. Its structural thickness is: floated coat (5mm), aerated concrete block (190mm), floated coat (5mm). Exterior wall is constructed as an external thermal insulation plastering system. The standard structure of the exterior walls is from the inside to the outside: inner floated coat, concrete small hollow block wall, outer insulation layer and outer floated coat. The structural thickness is: inner floated coat (15mm), concrete small hollow block wall (190mm), two layers of graphite polystyrene board (250mm), outer floated coat (20mm). The project should meet the energy conservation standards of passive house in Germany, and the outer windows should reach the ultra-high thermal insulation performance of passive external windows. Therefore, The owner finally selected a PHI certified passive curtain wall and a certified passive window produced by Harbin SAYYES Windows Stock Co., Ltd. The passive curtain wall model is SAYYES Pcw70, and the passive window model is SAYYES PASSIVE120. Their glass and whole window weighting sound insulation ( $R_w$ ) should be no less than 42dB according to the manufacturer's product performance index, and the weighted sound insulation + The traffic noise spectrum correction amount ( $R_w+C_{tr}$ ) should be no less than 37dB. These indicators ensure the sound insulation performance of the exterior windows of high-demand office buildings, as well as the airborne sound insulation of the exterior windows of the super-class hotel buildings.

The internal noise source of the project is the machine room. The equipment room of all kinds of equipment is mainly distributed in the underground floor and the second floor, without obvious noise interference to the main functional areas. From the perspective of the layout position of the building, the distribution room and the return air duct are far away from the main function room, and do not cause noise interference to the main function room.

The project is a passive ultra-low energy demonstration project. According to *Technical Guidance for Passive Ultra Low Energy Green Building*, nodes about the water supply and drainage pipelines pass through floors and walls learn from the German experience for sound and noise reduction treatment: the outer side of pipeline is wrapped with sound insulation rubber and plastic materials; Set the sound insulation rubber in the place where the pipe clamp is in contact with the water supply and drainage pipe; the water supply and drainage pipe through the wall and the floor penetration part are made of polyurethane material for Non-thermal bridge and noise reduction.

The drainage pipes are all made of silencer pipes to reduce noise interference.

## Carbon

## GHG emissions

GHG in use : 29,94 KgCO<sub>2</sub>/m<sup>2</sup>/

Methodology used :

Guidelines for General Calculation Methods for Carbon Emissions in Chinese buildings

GHG before use : 294,30 KgCO<sub>2</sub> /m<sup>2</sup>

Building lifetime : 50,00

, ie xx in use years : 9.83

GHG Cradle to Grave : 1 526,00 KgCO<sub>2</sub> /m<sup>2</sup>

Guidelines for General Calculation Methods for Carbon Emissions in Chinese buildings

## Contest

### Reasons for participating in the competition(s)

#### Economic Benefits

Due to the use of high-efficient insulation system and electromechanical system, the energy consumption of heating and cooling in the passive building in the whole year is significantly reduced. According to the simulation calculation, the energy consumption of the building can be reduced by 80%-90% compared with the current national energy consumption standard;

#### Environmental benefits

High-efficient insulation system and electromechanical system are the main technologies for achieving passive ultra-low energy green buildings. After the project is completed, it can effectively reduce the consumption of fossil energy, alleviate the pressure of energy shortage, reduce the emission of pollutants such as CO<sub>2</sub>, and achieve friendly symbiosis between people, buildings and the environment.

#### Social benefit

The implementation of passive ultra-low-energy green building routes will establish a modern corporate image that focuses on the earth's resources, protects the environment, and returns the society. Integrate green buildings, low-carbon environmental protection, energy conservation and emission reduction into corporate culture, improve employees' sense of social responsibility, and enhance the overall image of the company. By implementing passive ultra-low-energy green buildings, the improvement of building quality, energy efficiency, staff comfort, and people-oriented considerations will make the company's brand more easily recognized by the public. Excellent brand image is conducive to the long-term development of the company.

Meanwhile, users gain a higher level of comfort experience through the use of passive buildings at cost savings. This makes the awareness of energy conservation and emission reduction popular among the population, promotes the whole society to establish a good trend

of energy conservation and environmental protection, reduces resource consumption and environmental pollution, and realizes harmonious coexistence between human beings and the environment.

**Building candidate in the category**



