INTELLIGENT AND SUSTAINABLE DEVELOPMENT TRENDS OF AIRPORT PLANNING AND DESIGN

01 Development of the China Aviation

02 Intelligent Development Trends

03 Sustainable Development Trends

04 Action by the Meeting

Development Trends of the China Aviation

Over the past decades, China has added an average of 7 transport airports annually.

And will add 13 transport airports annually in next fifteen years.

China's civil aviation industry is expected to sustain relatively high growth in the coming period.

According to the "Outline for Building a Strong Civil Aviation Power in the New Era," by 2035:

- **Number of transport airports: 450 (196 additional to be constructed)**
- **Average number of flights per capita will be ≥1**

Annual passenger throughput ≥ 3 billion

(In 2019, the figure was 0.47, which was half of the world average of 0.87 and one-fifth of the U.S. figure of 2.48)

- **Largest in the world (currently ranked second)**

Airport Construction Distribution （China and Overseas ）

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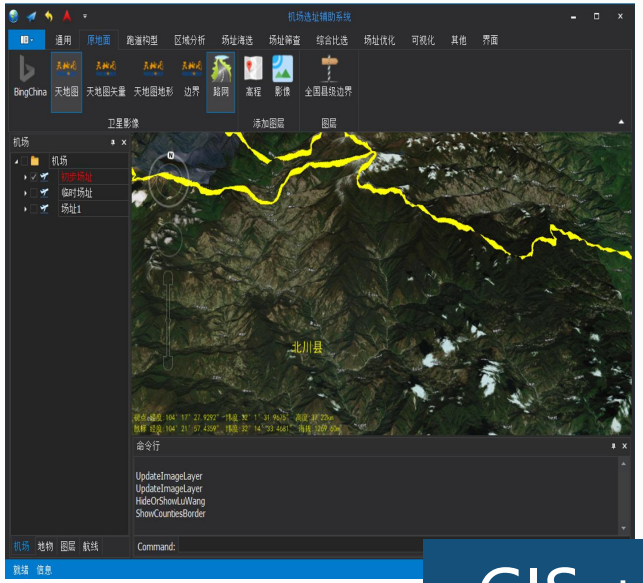
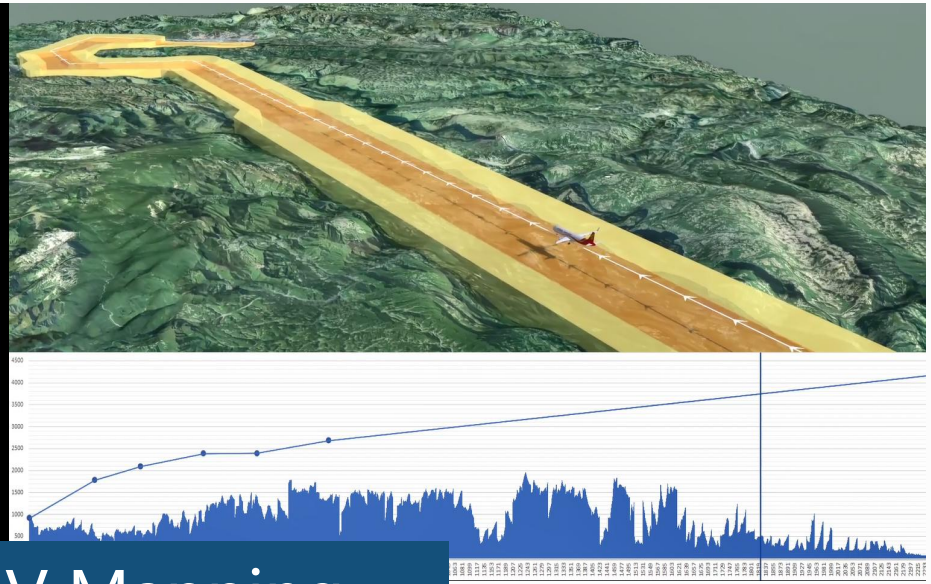
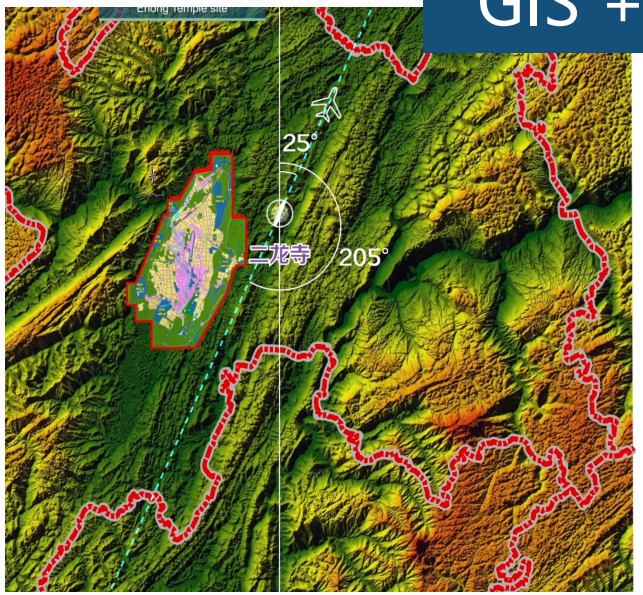
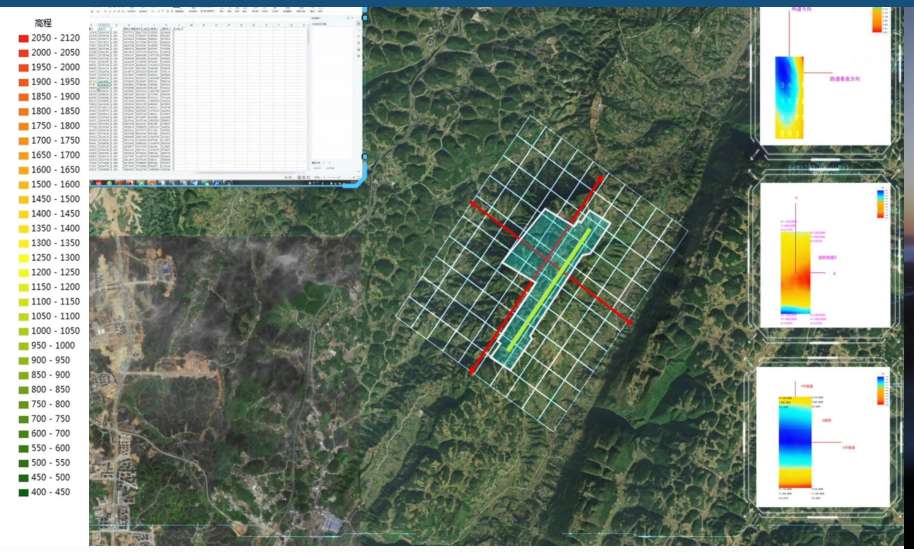
Digital Site Selection

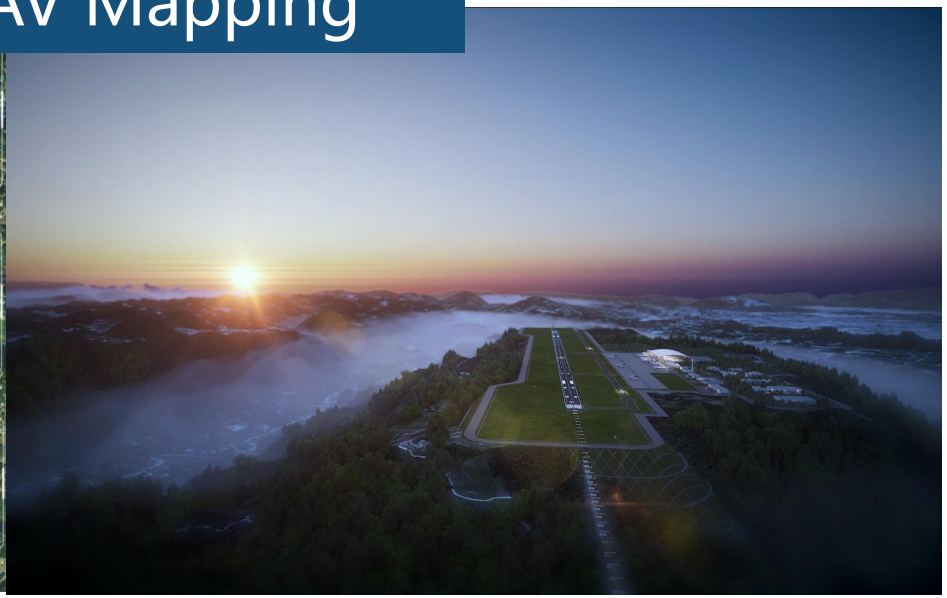




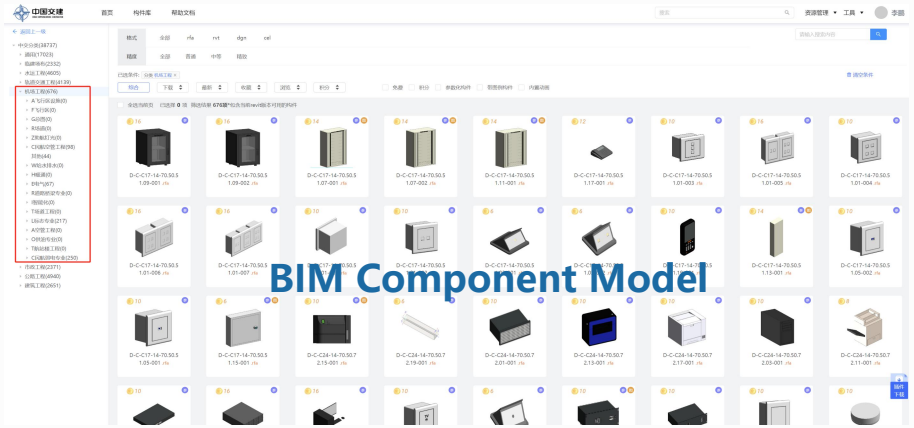
GIS + BIM + Big Data Analytics+UAV Mapping





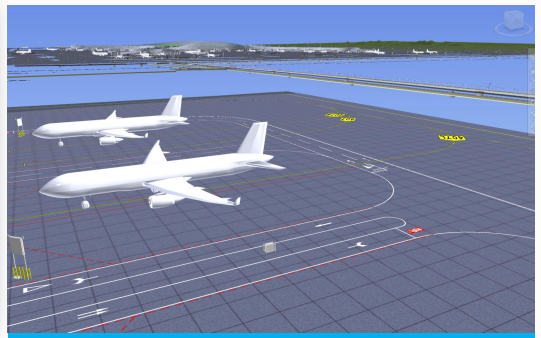


BIM Technology

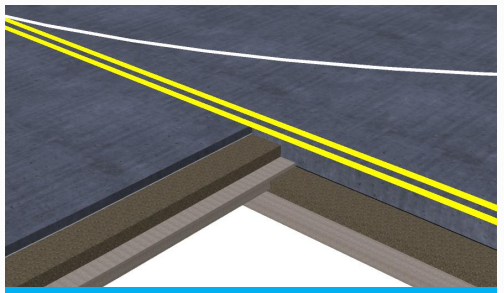


BIM Component Model

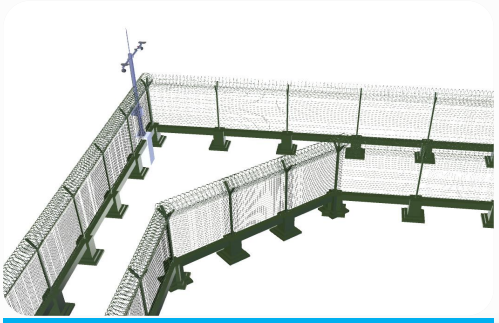
Pavement Marking



Pavement Segments

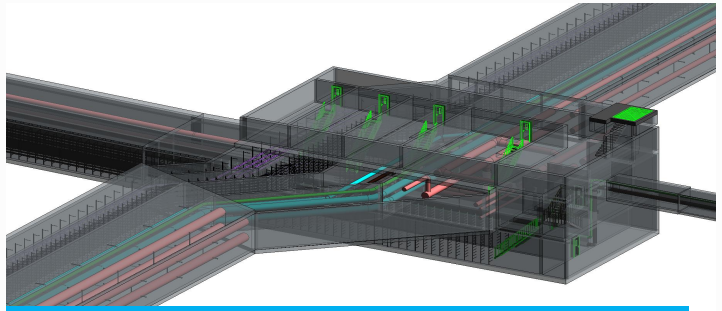


Pavement Structural Layers

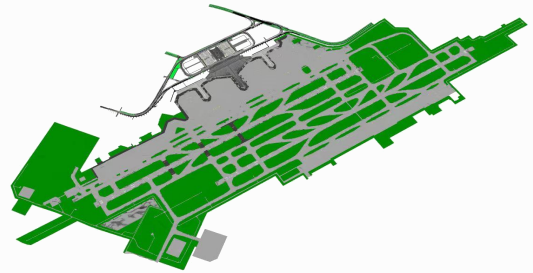


Dual Fence

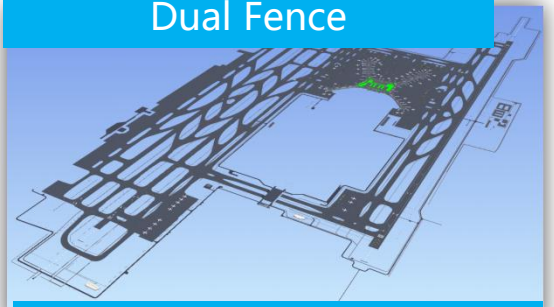
Dual Fence Corner



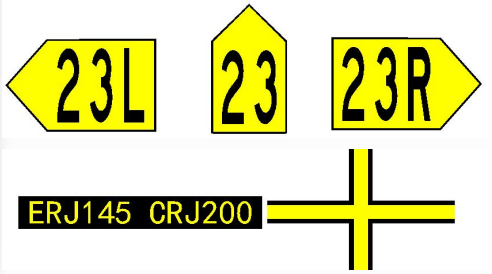
Complex Utility Tunnel Junction



Aerial View of the Entire Airport



3D Model of the Entire Pavement



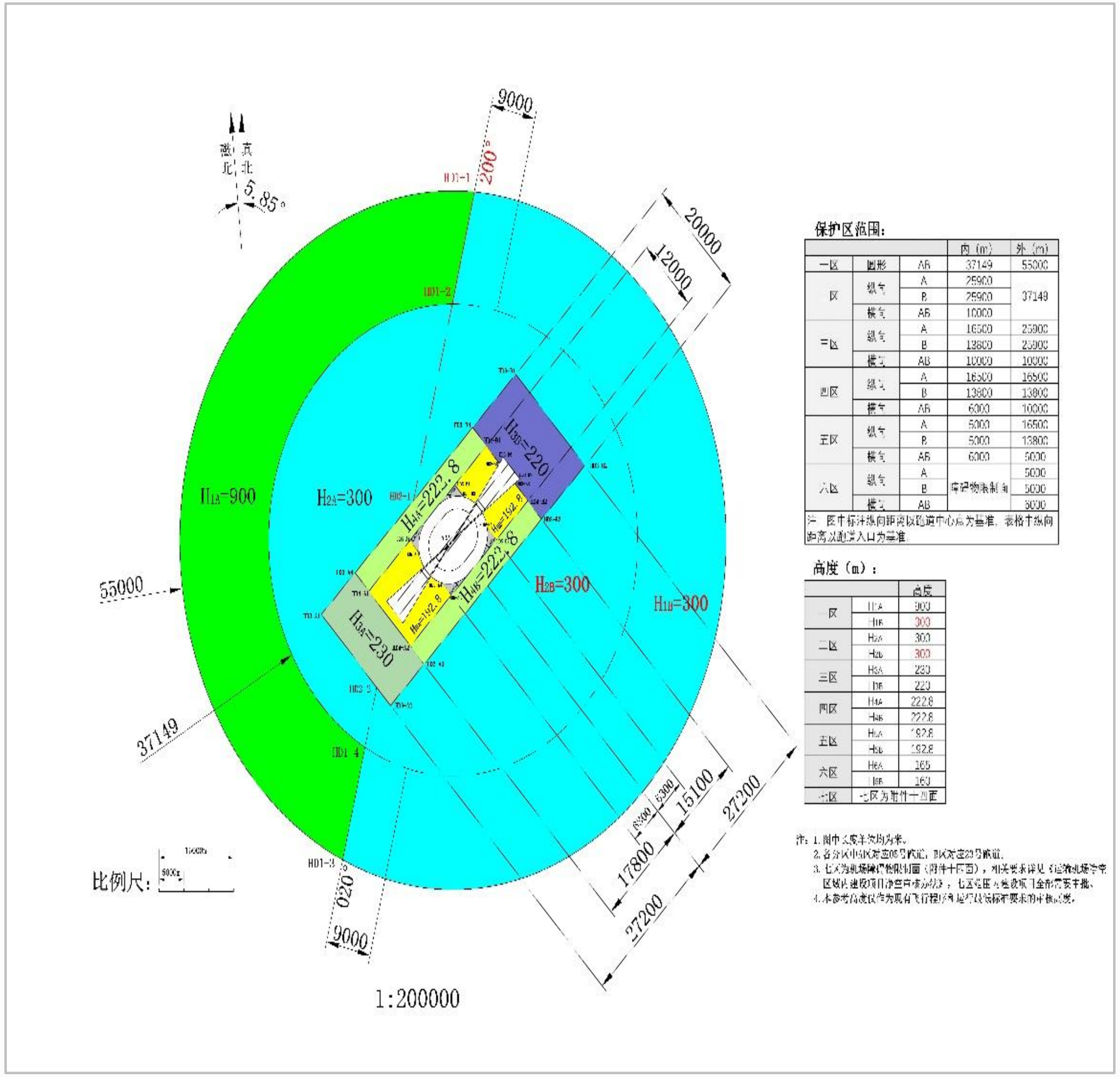
Apron Marking

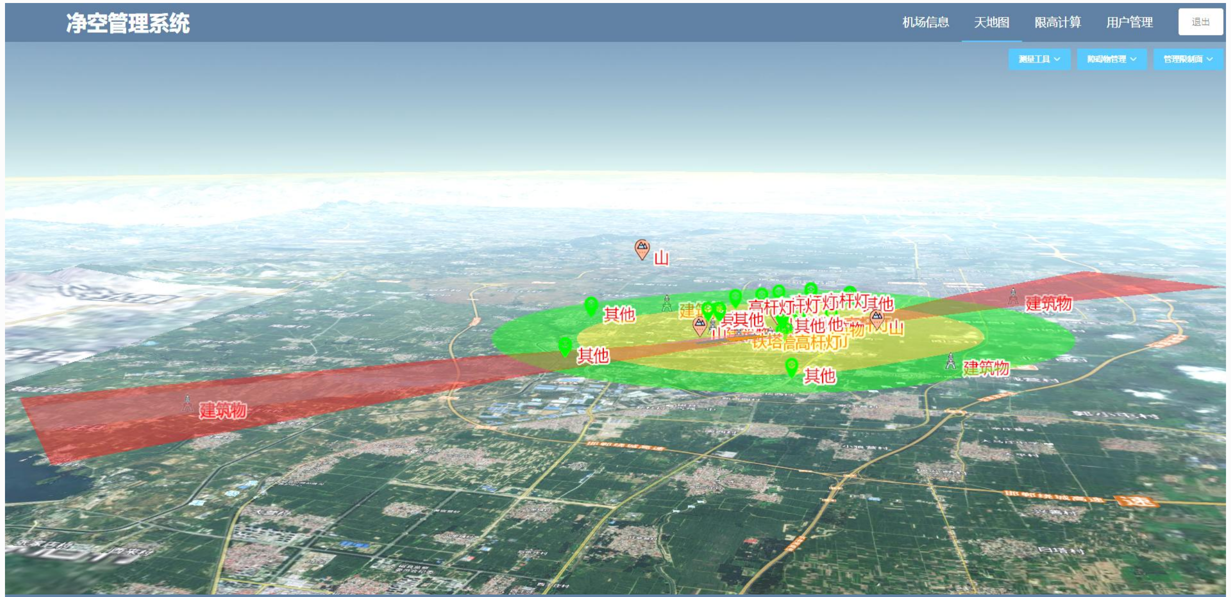
DVOR/DME

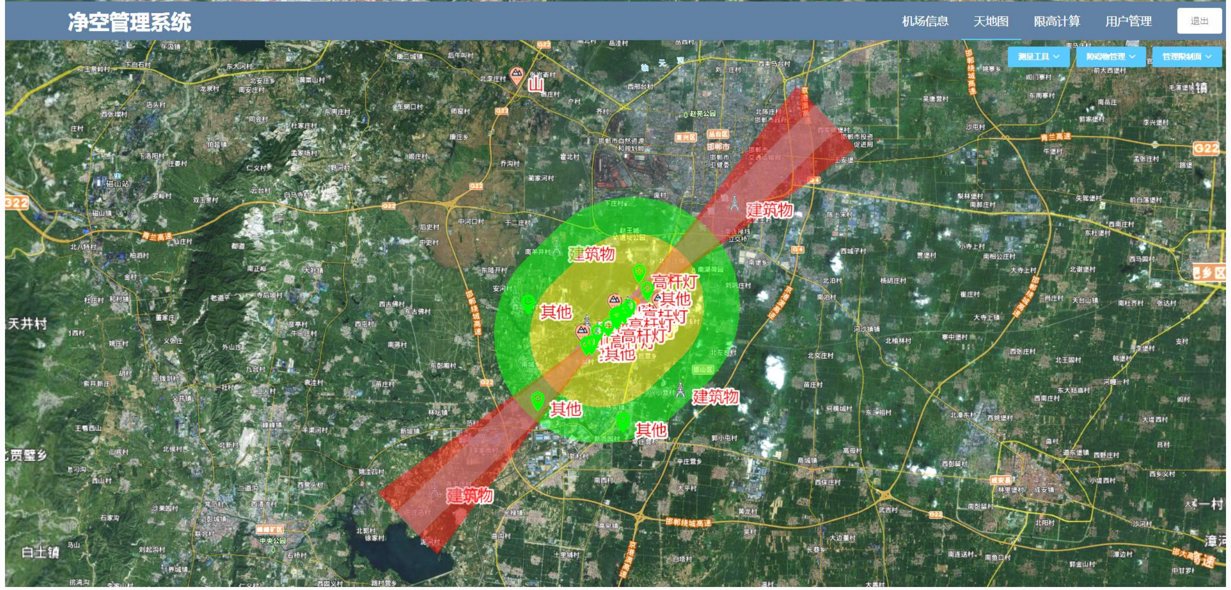
Taxiway Guidance Signs

Lift-Up Service Well

Integrated Design Technology for Airport Airspace and Ground Operations







Remote Tower Technology

- Remote monitoring in different places, get rid of the shackles of civil tower sites
- Wide dynamic range, high depth of field, ultra-high resolution panoramic video
- 24-hour non-stop operation

- Realize that one central control of multiple airports
- Effectively reduce airport operating costs

Zero-Carbon Airports Design

2025

- 0.293 kg ton-kilometer fue consumption
- 0.886 kg ton-kilometer CO_2 emissions
- 50,000 tons of sustainable aviation fuel consumption
- 0.853 kg standard coal per passenger for airport energy consumption
- 0.43 kg CO_2 emissions per passenger for airports
- 60 liters of water consumption per passenger
- 25% of in-airport electric vehicles
- 5% of renewable energy consumption for airports

- Policy and Standard System Development
- Actively Participate in Global Aviation Emission Governance
- Market Mechanism Construction and Implementation
- Blue Sky Defense Action
- Green Civil Aviation Enterprise Benchmarking
- Strengthen Top-Level Design for Low-Carbon Aviation
- Renewable Energy Substitution and New Technology Applications
- Water Environment Protection Action
- Science and Innovation Platform Construction Action
- Green Civil Aviation Talent Cultivation Action

2035

- Green, low-carbon and circular development system is becoming increasingly sophisticated
- Transport aviation achieves carbon-neutral growth
- Airport carbon emissions gradually enter a peak plateau period
- Becomes a prominent highlight in international civil aviation exchanges
- A key leader in global sustainable civil aviation development

Special Plan for Green Development of Civil Aviation in "14th Five-Year Plan"

By 2035, the system will approach maturity, with carbon-neutral growth achieved in transport aviation and **airport carbon dioxide emissions** gradually reaching a **plateau phase**.

Excessive energy consumption in terminal

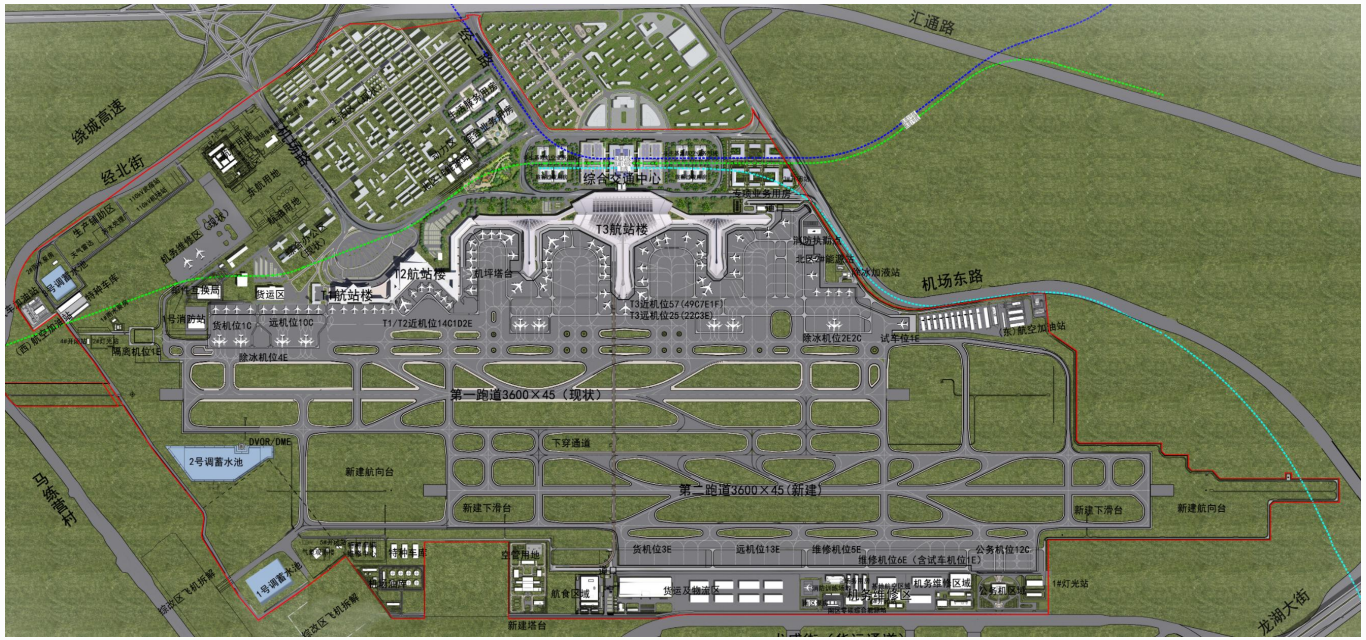
Severe ground-level carbon emissions from aircraft

large number of apron support equipment

High energy consumption of large-scale equipment

Development VS. Carbon Emission Control

Overview of the Project of Taiyuan Airport and Carbon Emission Boundaries & Scope



Scope 1: Direct emissions from owned or controlled resources primarily from carbon-based fuel combustion. This includes: On-site fuel combustion (e.g., vehicle fleets, coal/oil/gas boilers)
Scope 2: Indirect emissions from energy consumption，such as: Purchased electricity, heat, and steam etc.

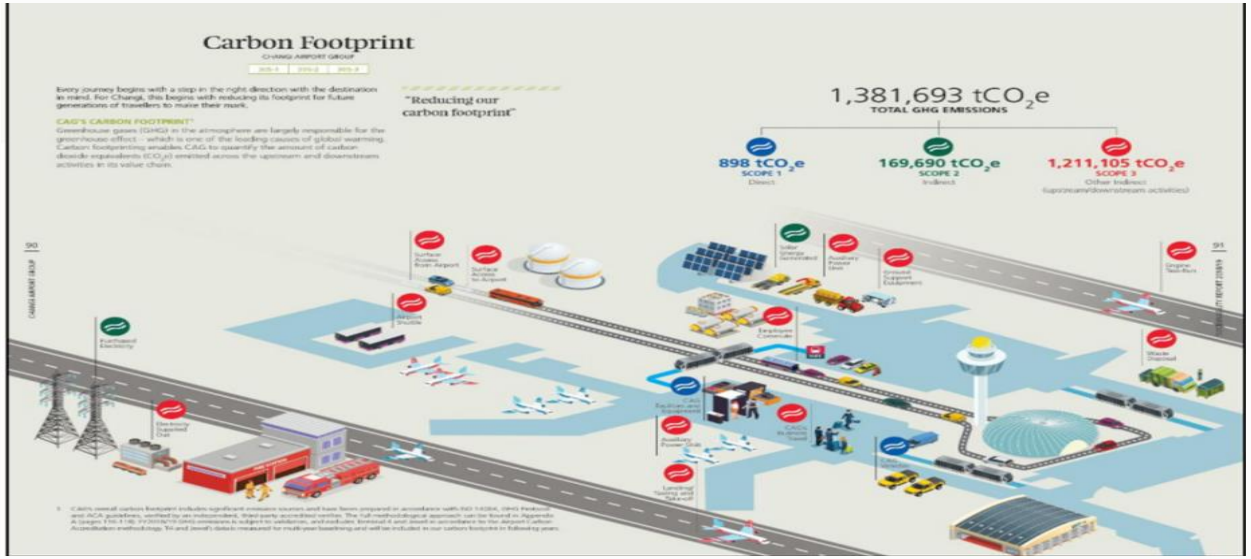
Aligning with international practices, Taiyuan Zero-Carbon Airport defines its decarbonization focus on **operational emissions**, calculating **Scope 1 and Scope 2** in its carbon accounting. The airport will eliminate all Scope 1 direct emissions and progressively reduce Scope 2 indirect emissions to net zero."

Project Positioning:
- Inland Gateway/Regional Hub

Planning Objectives:
- Regional Benchmark for "Four-Star Airports"
- Demonstration Model of Zero-Carbon Energy Supply

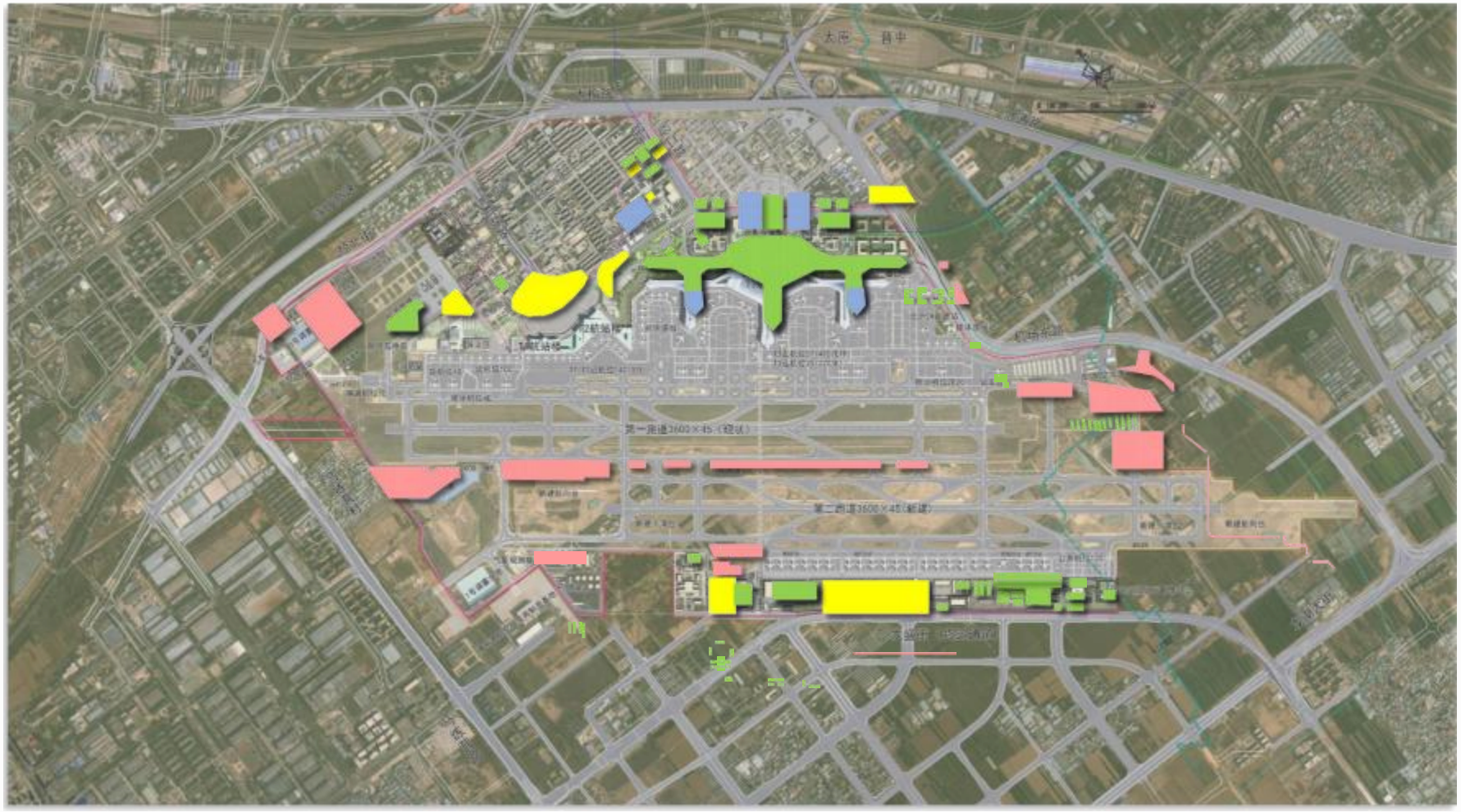
Project Scope:
- Total land area: **11.68** square kilometers.

Phase III project includes :
- T3 Terminal Building
- Airfield
- GTC + Parking Garage
- Work Areas and Ancillary Facilities
- Outer Infrastructure Projects



Airport PV Panel Layout

The project adopts the "install wherever possible" approach, deploying PV panels across airfields, terminals, and support facilities while ensuring flight safety.

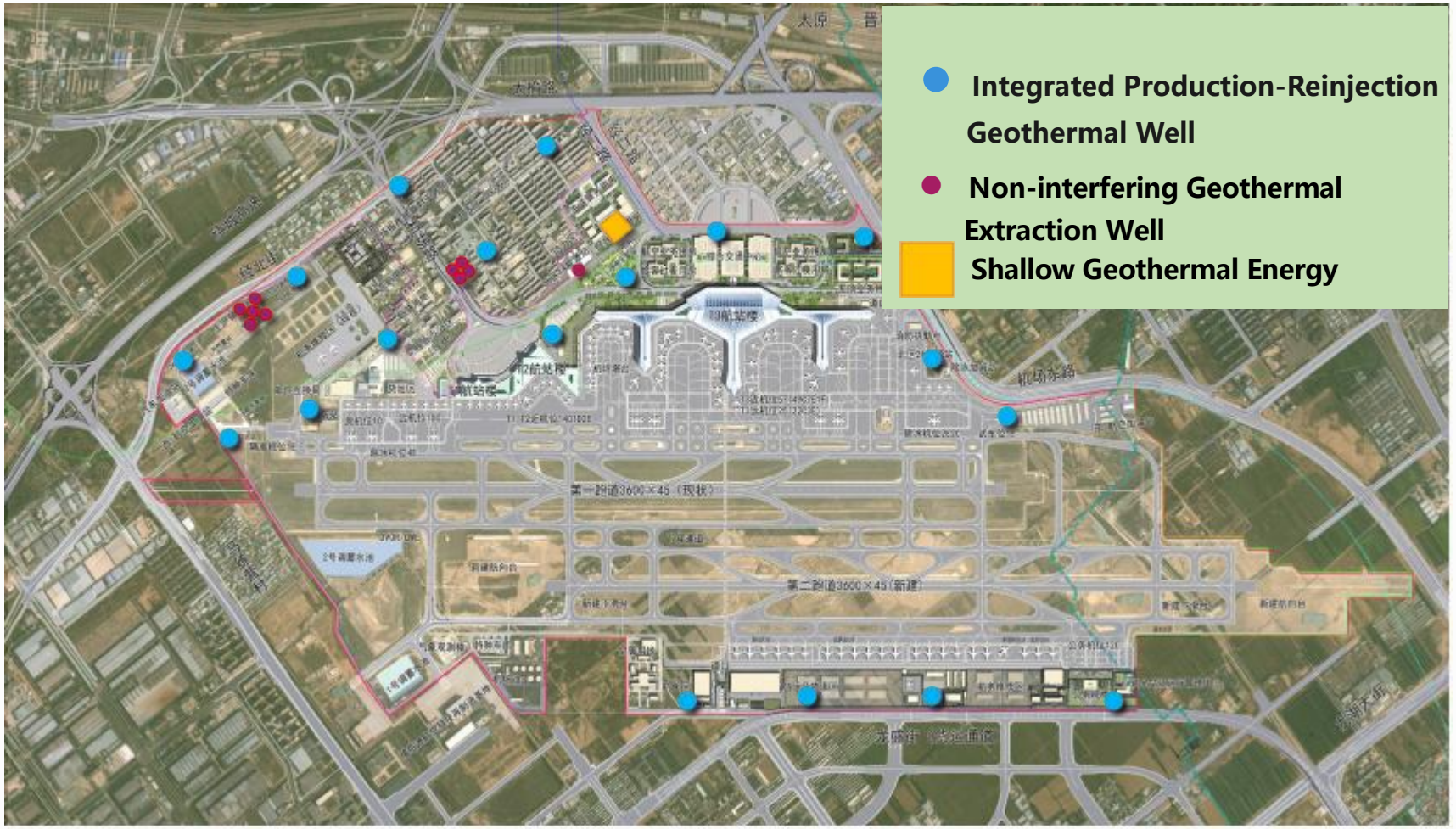


- Rooftop PV Panels
- Airfield PV Pannels
- Ground&Parking PV Pannels
- PEDF PV Pannels

The total installed PV area covers 1000,000 m² with a combined capacity of 108 MWp.

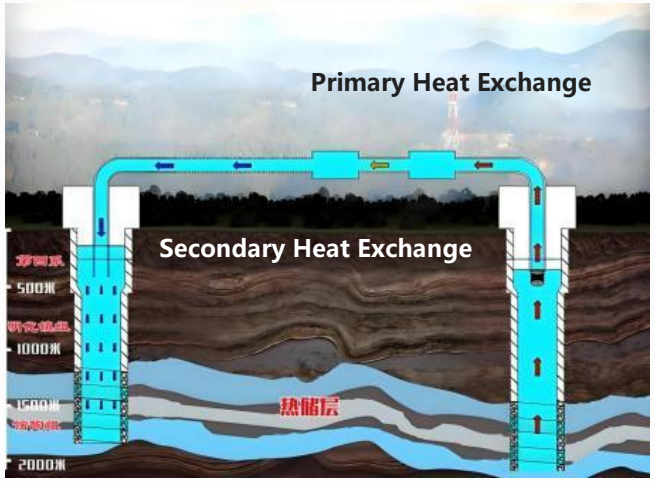
Geothermal Source Layout

In winter, the project uses geothermal energy from the Xiwenzhuang field for zero-carbon heating. In summer, solar power runs air-conditioning for zero- carbon cooling.



■ **The design includes 28 medium-deep geothermal wells: 18 extraction/injection wells and 10 non-interference wells.**

■ **Shallow geothermal ground loops: 13,000㎡, with a total of 500 boreholes planned for installation.**



Heat extraction without water consumption and reinjection atsource

Key Challenges for Airport-wide Solar PV Deployment

Impact of Construction Conditions

To achieve optimal photovoltaic efficiency, installation must account for external shading and optimal tilt angles.

Compliance with Construction Planning

Construction projects within transport airports shall comply with the airport master plan.

Airport Clearance Constraints

Structures within airport obstacle limitation surfaces must not penetrate the defined clearance envelopes.

Airfield Operational Safety

Runway clearway, runway end safety area (RESA), taxiway safety area, and lighting bands.

Electromagnetic Interference

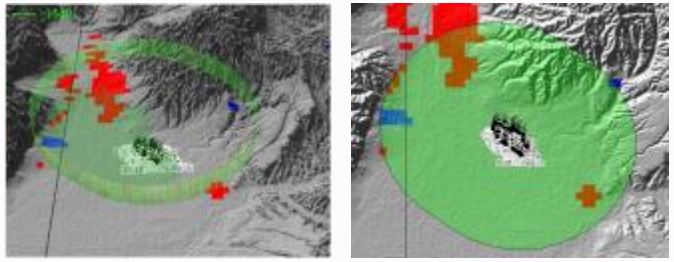
Impact of inverters on ATM equipment, voltage-boosting substations on ATM equipment, and reflected signal interference from large-area photovoltaic panels.

PV Glare Impact

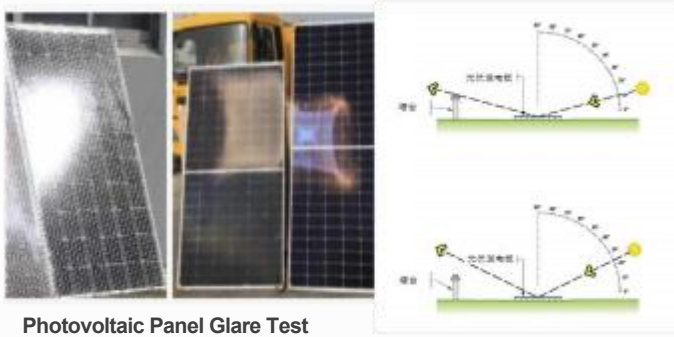
Aviation operations and ATM activities require visual references, particularly during aircraft takeoff/landing and ATC commands. Photovoltaic panels may cause glare hazards.

Aircraft Wake Turbulence Impact

Wake turbulence from aircraft may strike photovoltaic panels, generating foreign object debris (FOD).



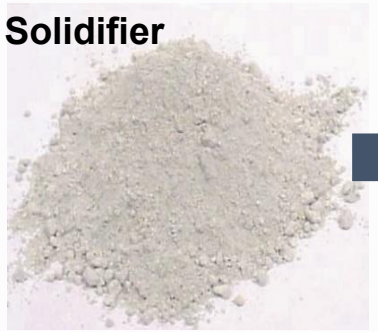
Electromagnetic Environment Impact Simulation Experiment



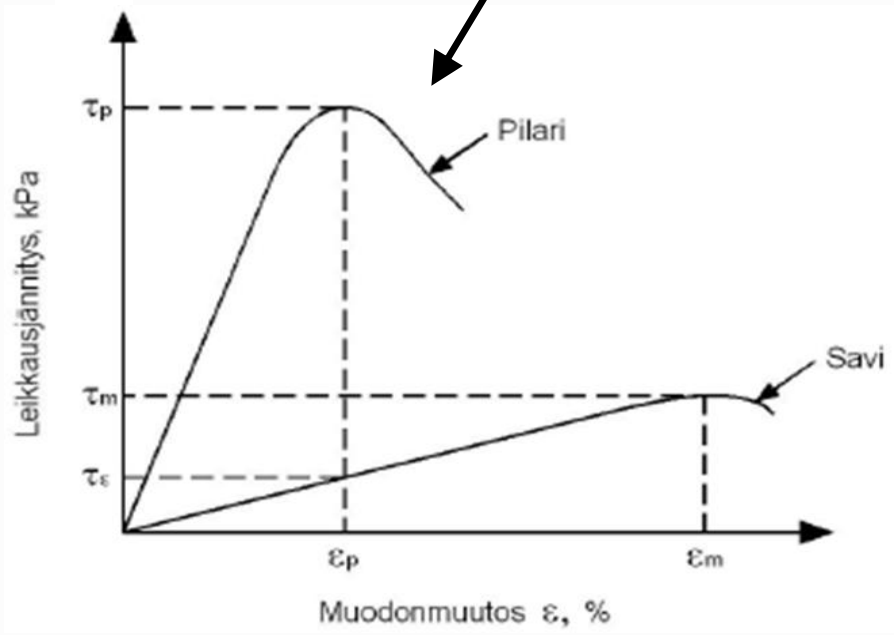
Photovoltaic Panel Glare Test

Wind Tunnel Experiment Conducted at the National Key Laboratory of Building Safety and Environment

Rapid Modification and Recycling of Waste Soil



Stabilized Soil



Trench Backfill

Construction Project Site

“Sponge Airport” Design

Flight Area Sponge Facilities Selection： Green space, Diversion facilities(De-icing fluid collection and treatment systems,Oil separation systems),Storage ponds etc.;

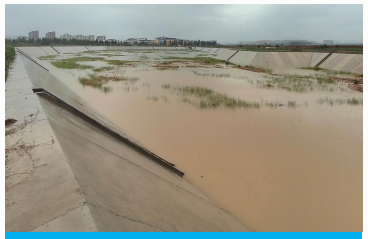
Roadways: Bioretention facilities etc.;

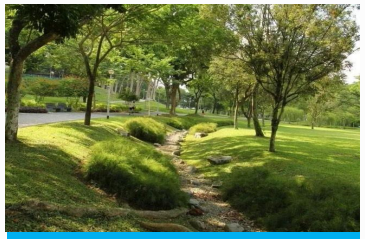
Terminal and work Areas: Permeable pavement,Sunken green space,Rain gardens,Vegetated swales etc.

Sunken green belt


Grass paver

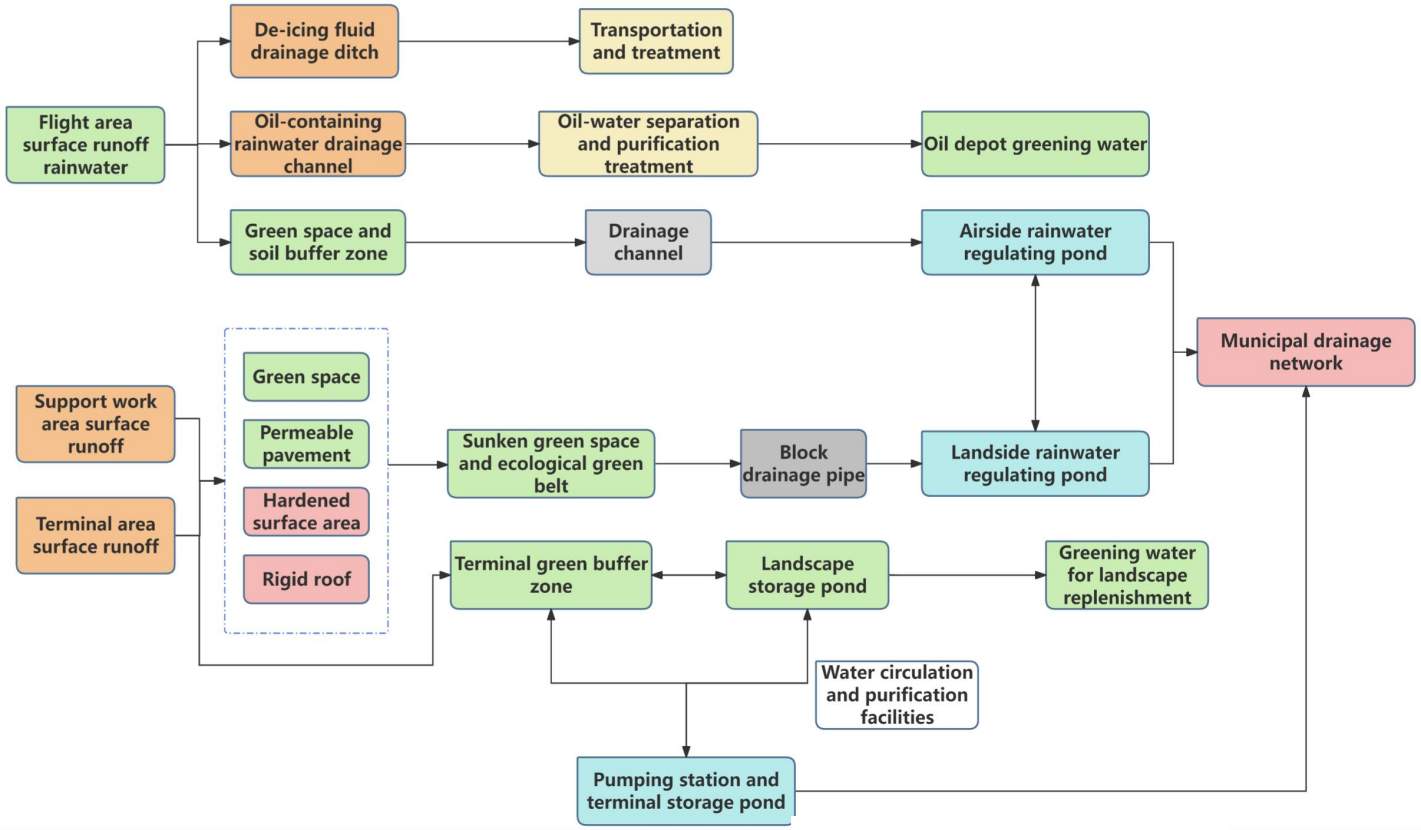

Permeable pavement

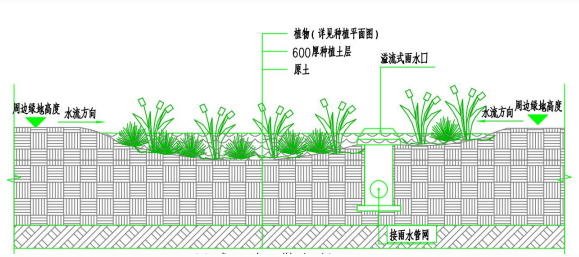

Storage pond

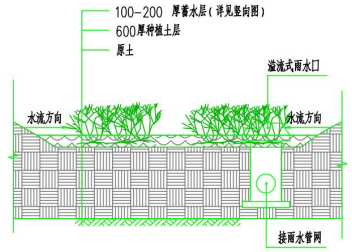

Grass swale


Bioretention strip

Overall Design Approach “Sponge Airport”







“Sponge Airport” Detail Drawings

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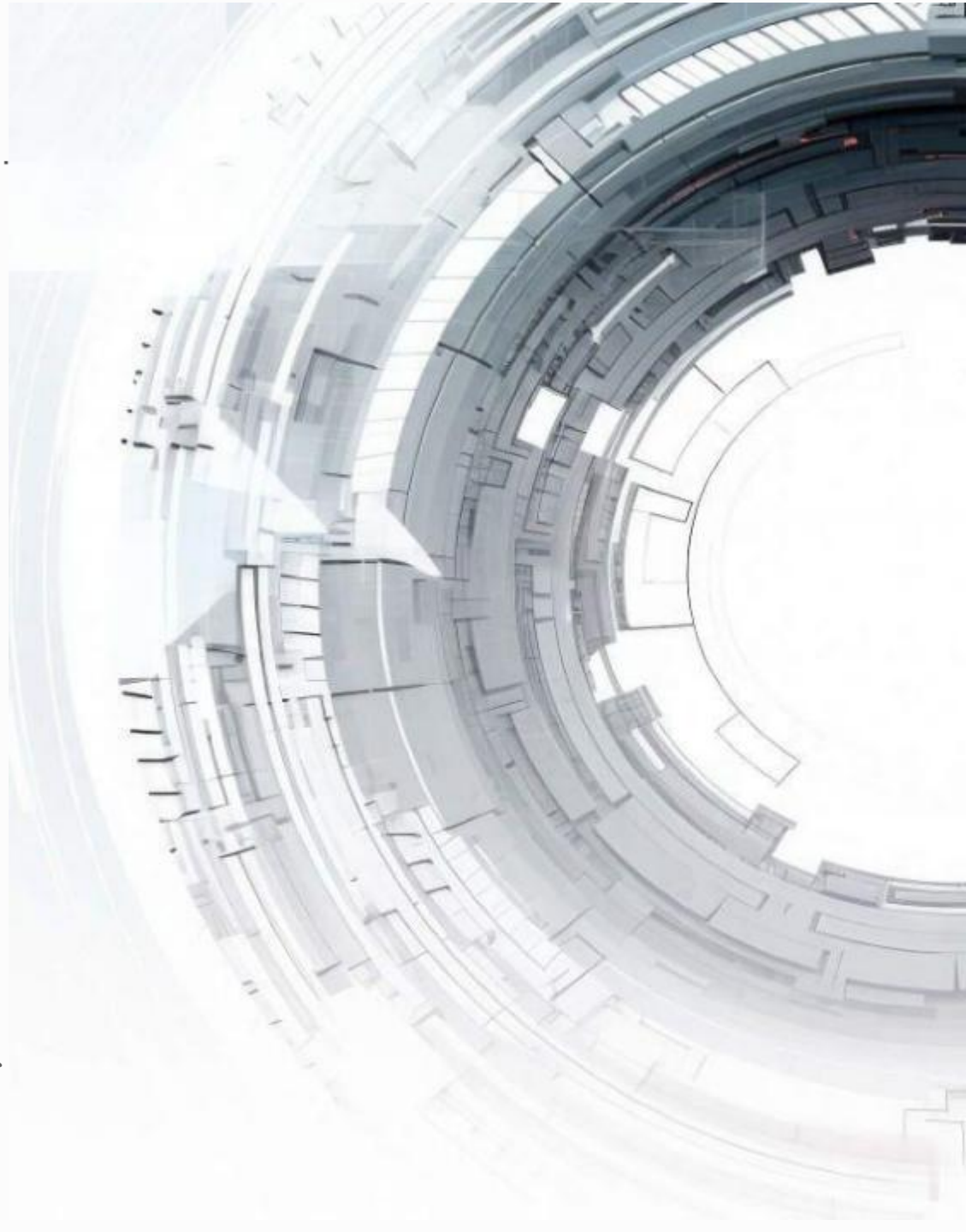
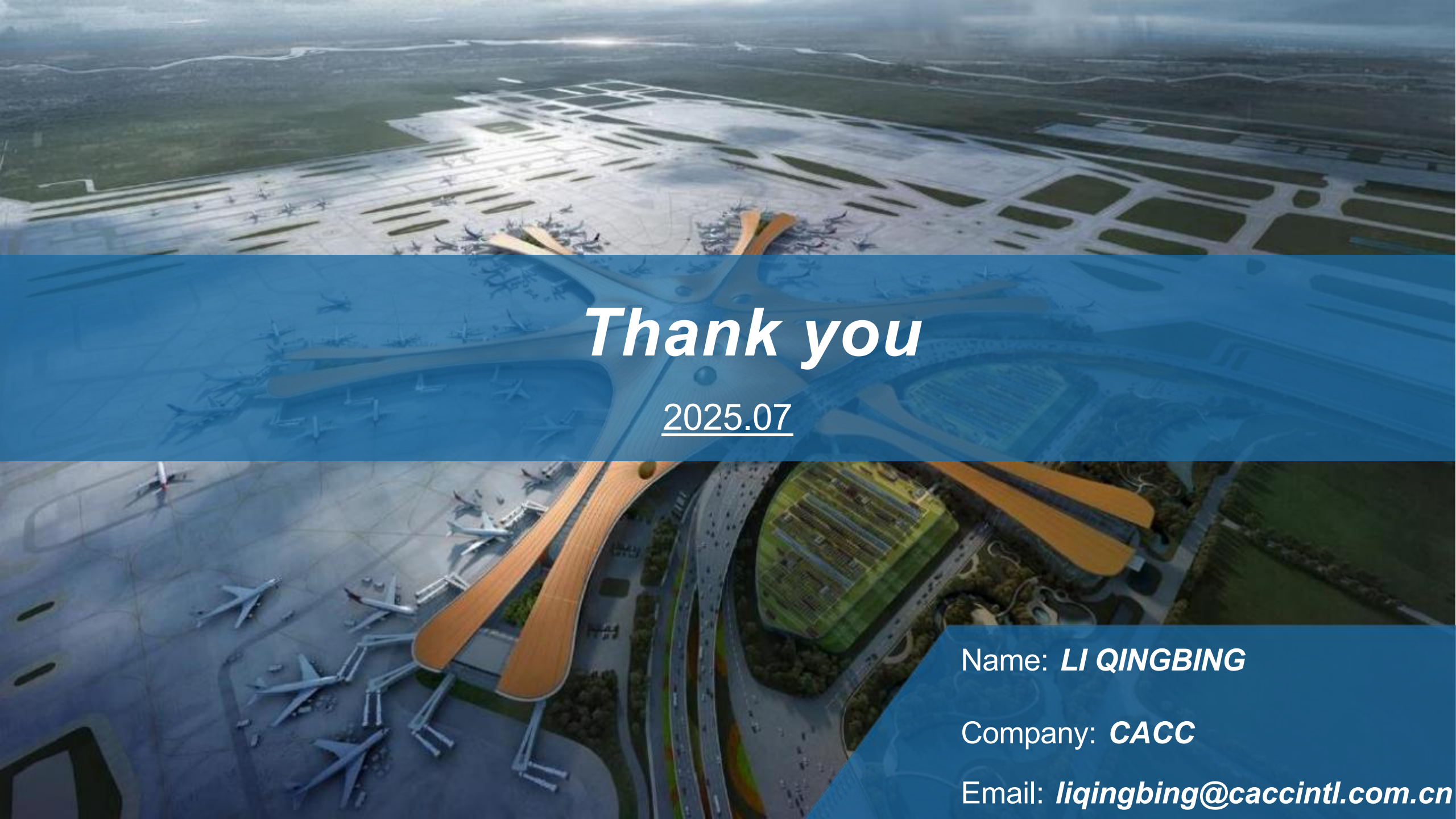
Action by the Meeting

Fully recognize the trend that global airports are moving towards intelligence and green development.

Advocate states to jointly conduct research on relevant technologies for smart airports and green and low-carbon airports, launch multi-country cooperation projects, and promote the overall improvement of airport planning and design capabilities in the Asia-Pacific region.

Encourage states to actively share their achievements in technological innovation within airport planning and design, engage in mutual exchange of experiences, and promote the proactive adoption of new concepts and technologies in more countries, to improve the intelligence and sustainability of airports.





Thank you

2025.07

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