ASIA CLEAN ENERGY FORUM 2026
Beyond Transition: Building Secure, Resilient, Inclusive, and Intelligent Energy Systems
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Next Generation Energy Systems in Central, West and East Asia: Technology, Markets and Regional Integration

Smarter Land, Greener Power: AI and Big Data for Solar PV

Plus, Ecological Restoration, and Agriculture Synergy

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11 June 2026 | 11:05-12:00 a.m. (GMT+8)

Outline

1 Research Background

2 Research Content

3 Take-home Messege

1 Research Background

1.1 Global Energy Development Trends

Photovoltaic power spearheads the green revolution.

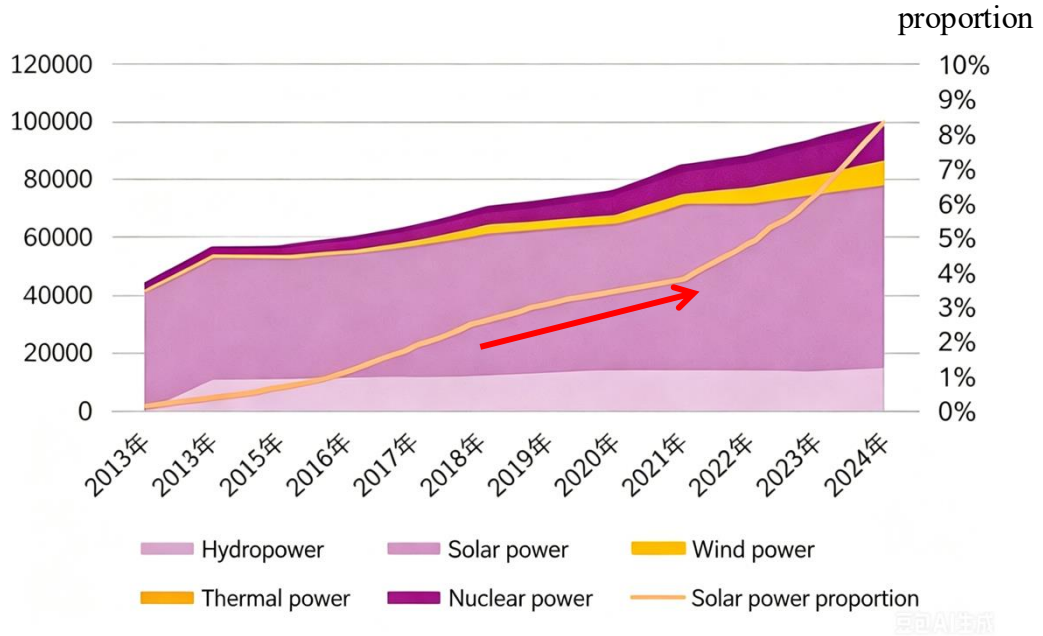
Global photovoltaics is reshaping the energy landscape with Scale & Speed, while breaking down all barriers with Cost & Tech.

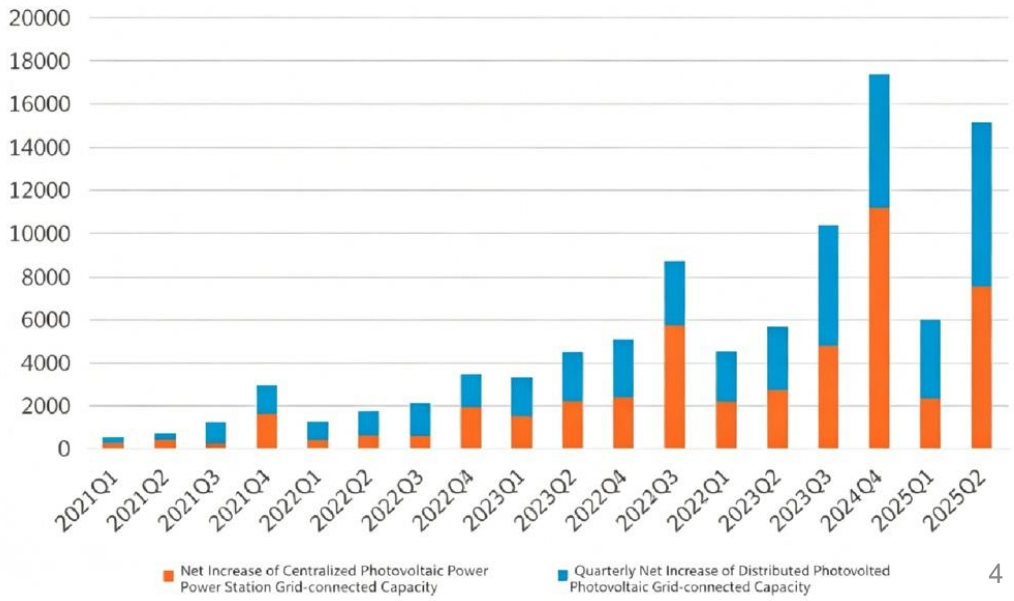
1 Research Background

1.2 National Photovoltaic Industry Situation

At the national level:

- ✓ China's solar power generation rose from 8.4 billion kWh to 839.04 billion kWh, a **hundredfold** increase compared with 2013.
- ✓ Both **centralized** and **distributed** photovoltaic power projects are developing in tandem.
- ✓ By 2025 Q2, the cumulative installed grid-connected capacity of centralized PV reached 605 million kilowatts, accounting for 55.2%, while that of distributed PV stood at 492 million kilowatts, taking up 44.8%.





1 Research Background

1.3 Current Situation of Energy Development in Hunan

The Energy Dilemma Calls for Green Endogenous Drive.

Over 80% imported

No reserves of its own

Bringing green power inside Hunan is not an option, It is an imperative.

Realistic challenge:

Development level: High quality development, continuous expansion of land demand.

Constraint level:

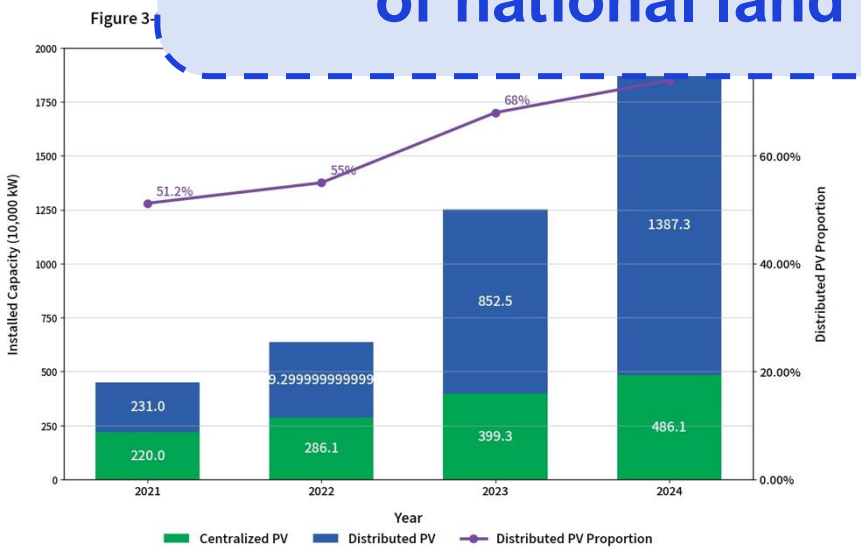
- ✓ Hunan is mainly characterized by hilly terrain, with strict constraints on resources such as **farmland protection** and **ecological management.**
- ✓ **Land conflicts** have become increasingly prominent, becoming a major obstacle to PV industrial development.

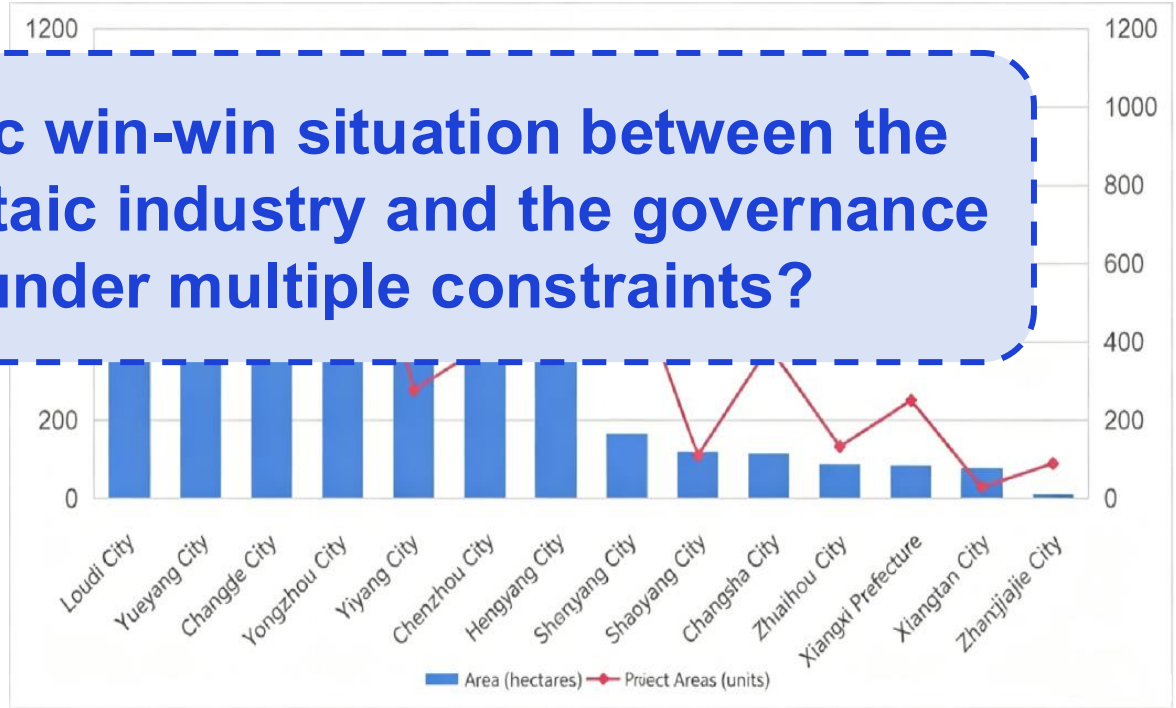
1 Research Background

1.3 Current Situation of Energy Development in Hunan

- In Hunan Province, more than 5,300 photovoltaic panel zones have been constructed, with a total area of approximately 6300 hectares.

How to achieve a synergistic win-win situation between the development of the photovoltaic industry and the governance of national land space under multiple constraints?





What have we done?

2 Research Content

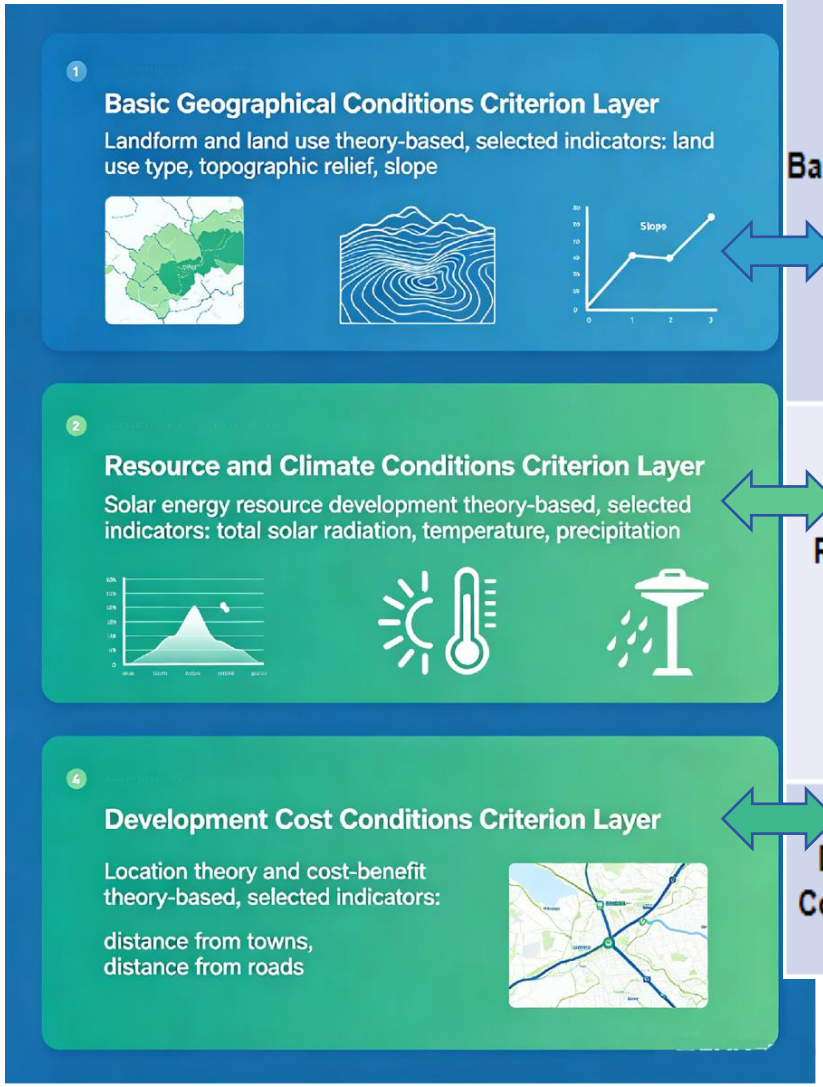
2.1 Suitability Evaluation of PV

2.2 PV Intelligent Site Selection

2.3 PV+ models

2.1 Suitability Evaluation of PV

◆ Research data



Criterion layer	Index layer	Weight	Indicator assignment
Basic Geographic Conditions	Land use type(LUCC)	0.217	Bare land & bare rocky land: 4 pts; Reservoirs, ponds, marshes, shoals, other forest lands, low-coverage grasslands: 3 pts; Shrub lands, medium-coverage grasslands, other construction lands: 2 pts; Dry farmland, high-coverage grasslands, rural residential areas: 1 pt; Lakes, rivers, canals, forested land, sparse forest land, urban land, paddy fields: 0 pts.
	Toppographic relief(TUD)	0.0343	0≤TUD≤20: 4 pts;20<TUD≤200: 3 pts;200<TUD≤329: 2 pts
	Slope (SIO)	0.0176	0≤SLO≤3: 4 pts;3<SLO≤20: 3 pts;20<SLO≤69: 2 pts
Resource and Climatic Conditions	Global Solar Radiation (GHI)	0.2433	1050≤GHI<1290: 2 pts;1039.87≤GHI<1050: 1 pt
	Annual precipitation (AOR)	0.1869	1089.20≤AOR<1281.84: 4 pts;1281.84≤AOR<1388.86: 3 pts;1388.86≤AOR<1520.86: 2 pts;1520.86≤AOR≤1998.90: 1 pt
	Temperature(TEMP)	0.1144	10.76≤TEMP<15.87: 4 pts;15.87≤TEMP<17.62: 3 pts;17.62≤TEMP<18.82: 2 pts;18.82≤TEMP≤20.64: 1 pt
Development Cost Conditions	Distance from town (DFT)	0.0783	0≤DFT<5: 4 pts;5≤DFT<10: 3 pts;10≤DFT<15: 2 pts;15≤DFT<26.75: 1 pts
	Distance from road (DFR)	0.1083	0≤DFR<3: 4 pts; 3≤DFR<6: 3 pts; 6≤DFR<10: 2 pts; 10≤DFR<14.85: 1 pt

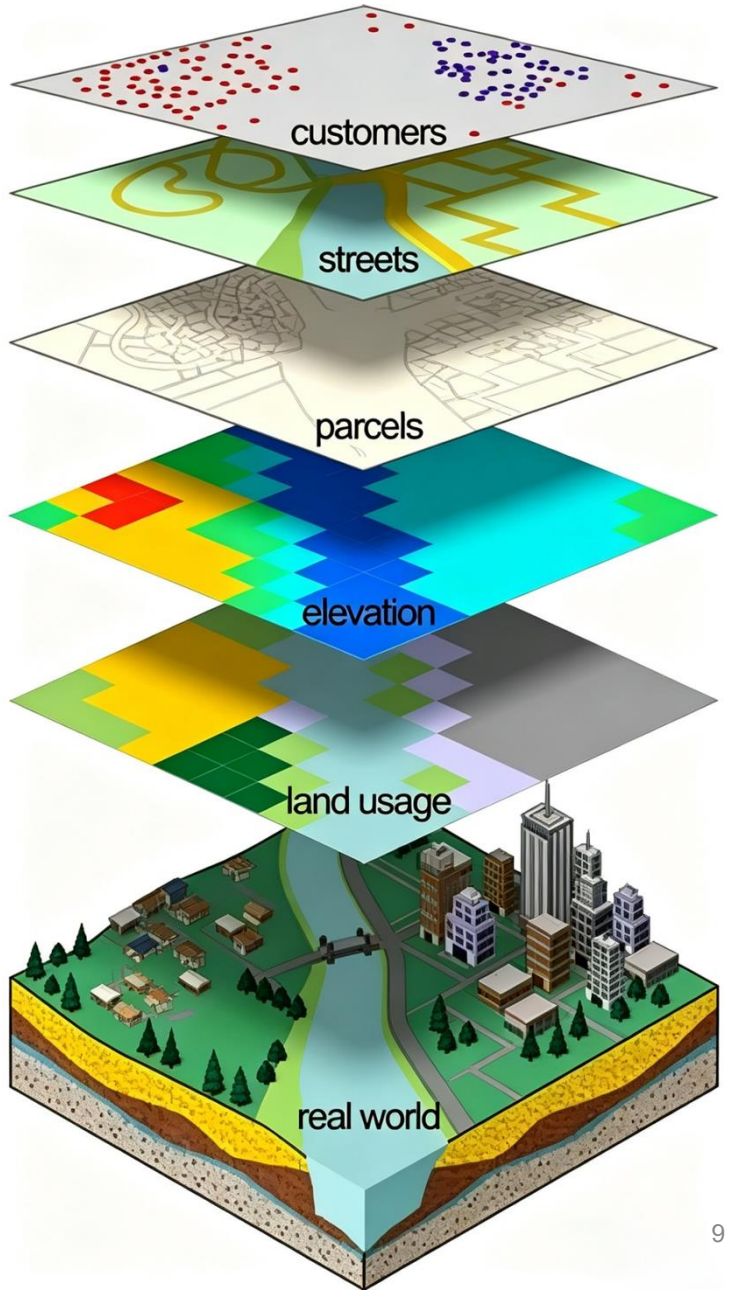
a. Global Solar b. Slope c. Topographic d. Temperature

2.1 Suitability Evaluation of PV

◆ Research Model

➢ Spatially Weighted Overlay Analysis Method

- ✓ Adopts a **linear weighting model** to calculate the values of **multiple superimposed grid cells**.
- ✓ Integrates them into a **single output result** according to the importance and corresponding **weight of each grid**.
- ✓ Based on the calculated weight vectors of each index, then applied to conduct **overlay analysis** on various index factors.



2.1 Suitability Evaluation of PV

◆ Photovoltaic Suitability Evaluation

Global Solar Radiation

Slope

Topographic Relief

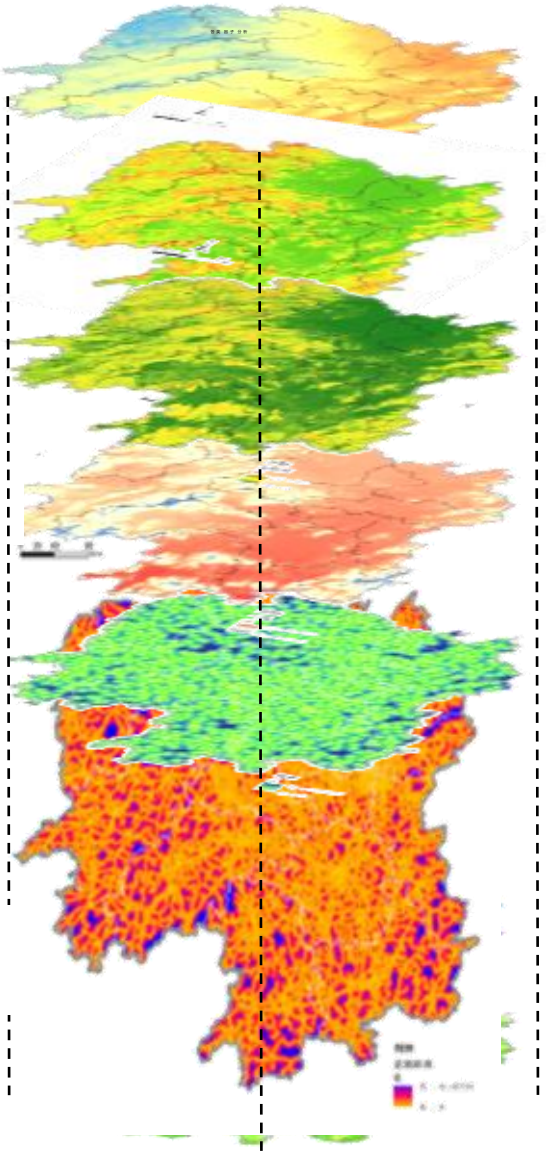
Temperature

Distance from town

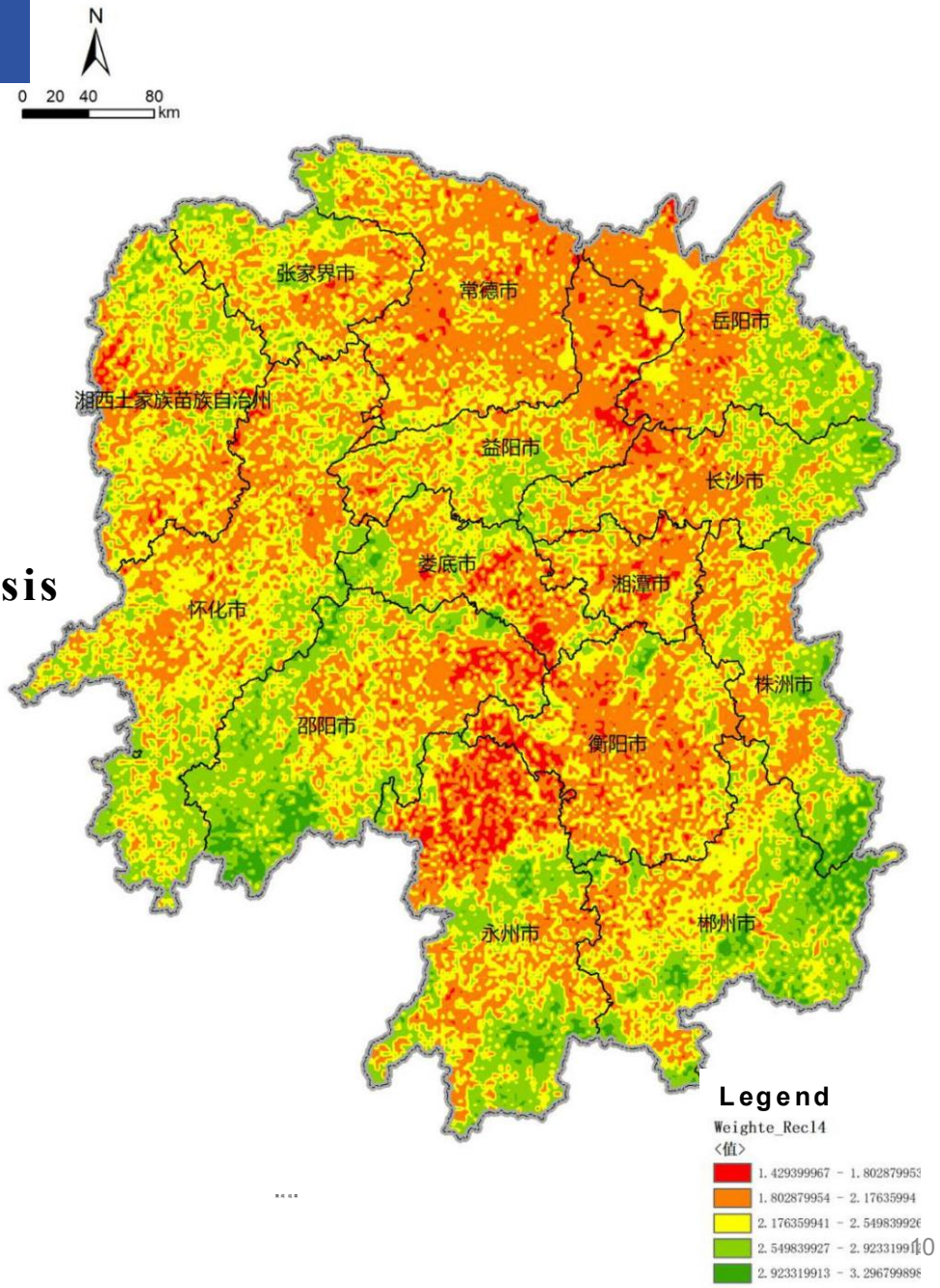
Distance from road

Annual precipitation

Land use type

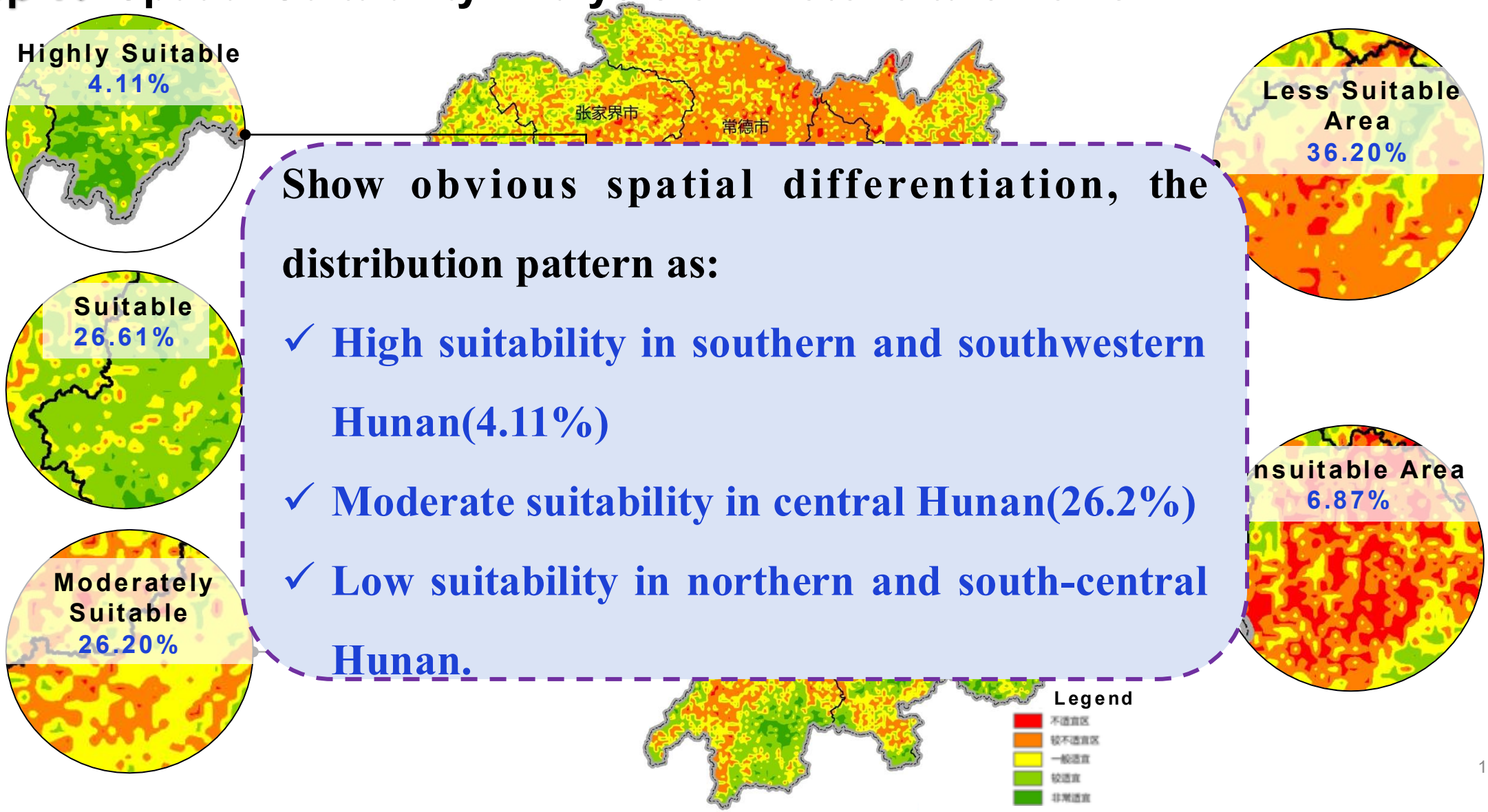


Data Integratio Analysis



2.1 Suitability Evaluation of PV

◆ Step 1: Spatial Suitability Analysis of Photovoltaic Power



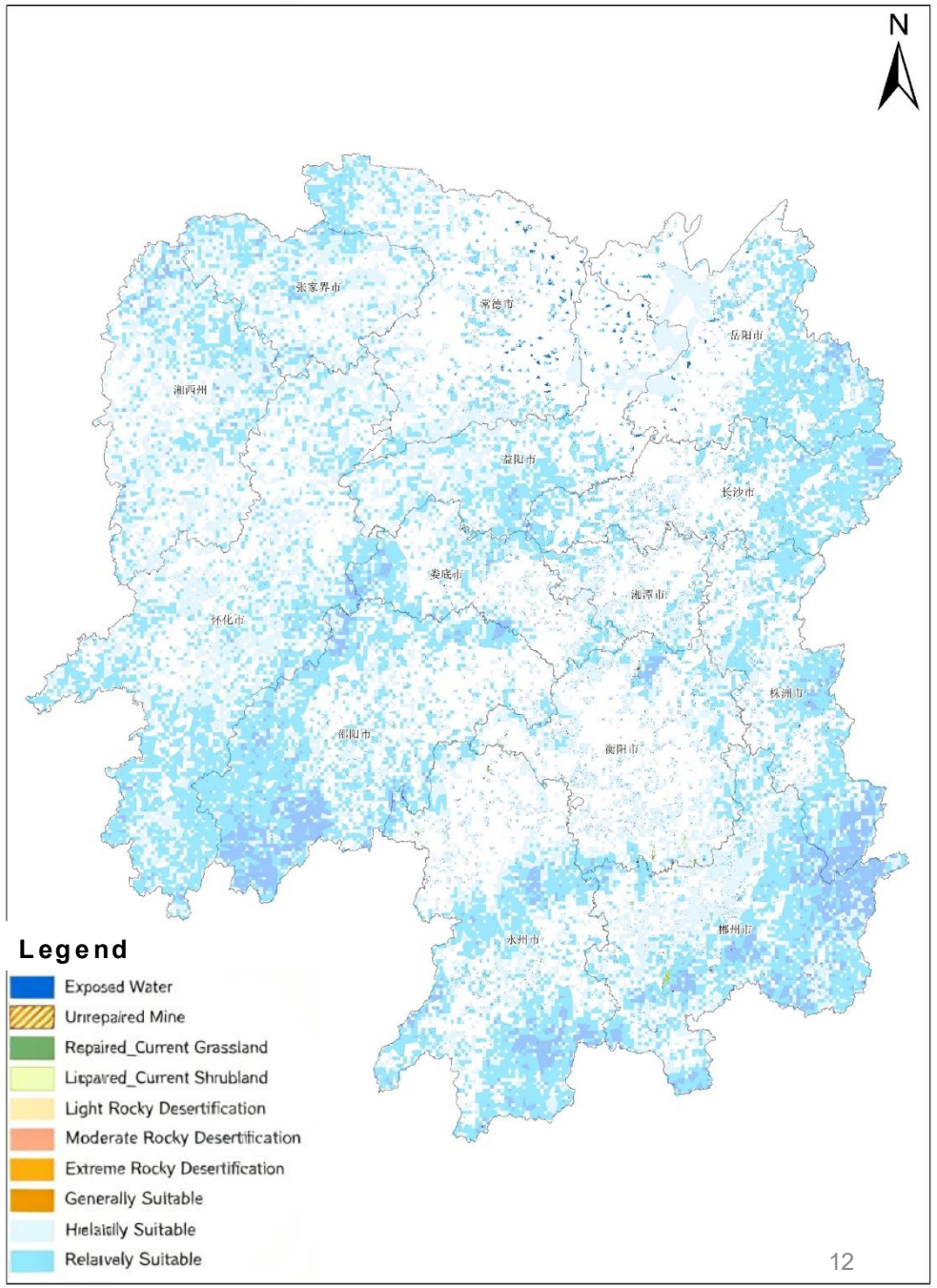
Show obvious spatial differentiation, the distribution pattern as:

- ✓ High suitability in southern and southwestern Hunan(4.11%)
- ✓ Moderate suitability in central Hunan(26.2%)
- ✓ Low suitability in northern and south-central Hunan.

2.1 Suitability Evaluation of PV

◆ Step 2: Analysis on Development Potential of Land for Photovoltaic Industry

- Based on the theoretical development potential areas, in accordance with territorial spatial planning and relevant policies.
- we take **urban development boundaries**, **ecological protection red lines** and **permanent basic farmland** **as control lines.**
- Meanwhile, areas classified as **urban, agricultural and ecological spaces are excluded as restricted zones.**



2.1 Suitability Evaluation of PV

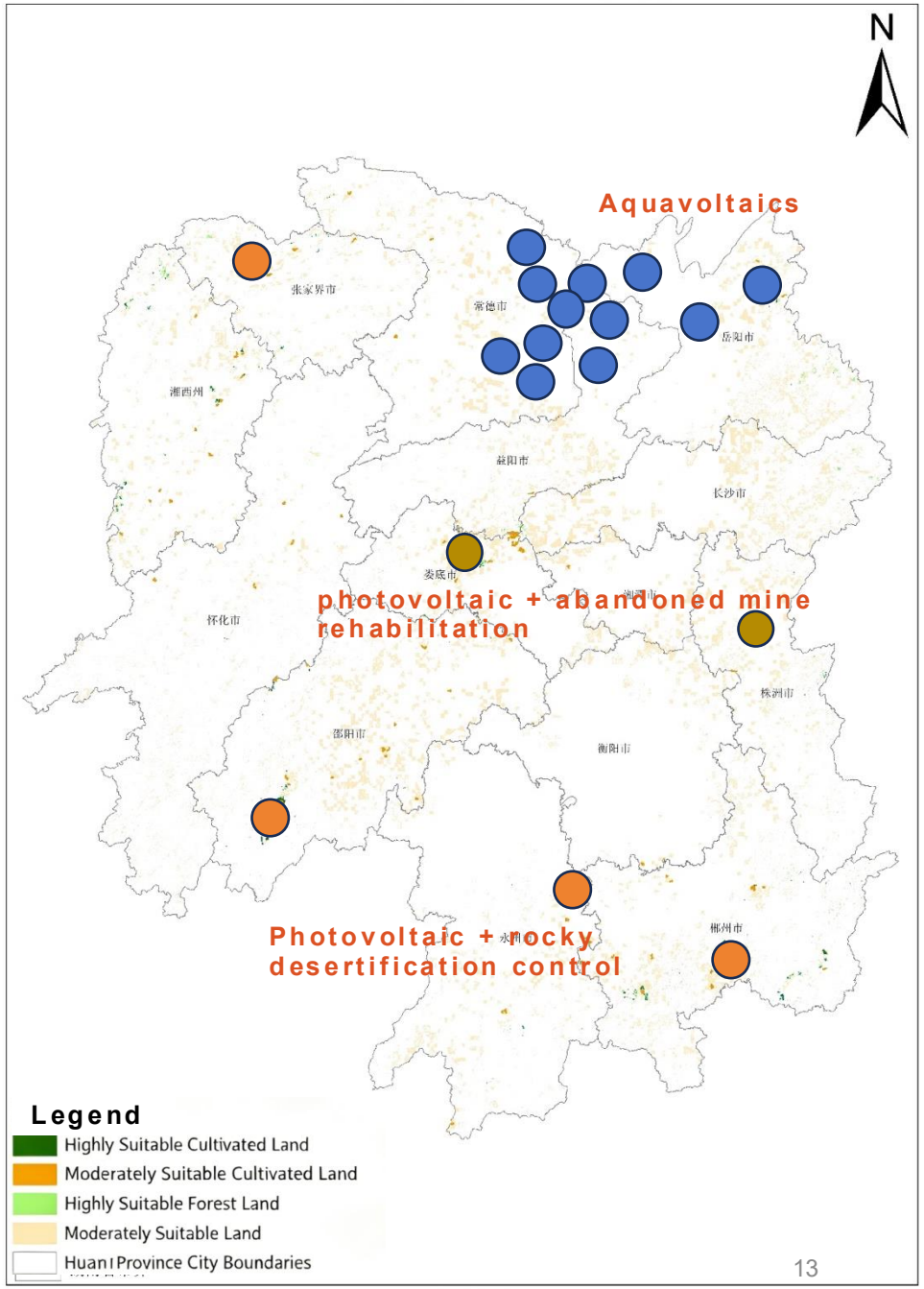
◆ Step 3: Analysis on Development Potential of Land for Photovoltaic Industry

- **109 sites** available for photovoltaic construction in **highly suitable and relatively suitable areas**.

- **Centralized photovoltaic:**

- Only 28 plots remain that meet the criteria: **single patch area over 15 mu, adjacent patches within 200 meters regarded as contiguous areas, and total contiguous area exceeding 1500 mu.**

- **These plots span around 5,500 hectares with an average area of roughly 200 hectares.**



2.2 PV Intelligent Site Selection

2.2.1 PV Intelligent Site Selection Process

① Parameter Entry
Automatic Regional Screening

- Input scale and location

Classifies zones via multi-layer spatial data

② AI Comparison
Multi-dimensional Scoring Ranking

- Evaluate multi-index factors
- Recommend plots with scores and key cost notes.

③ 3D Verification
Real-scene Simulation Decision making

- Measure slope,
- Arrange PV arrays

2.2 PV Intelligent Site Selection

2.2.2 Brief Introduction to Intelligent PV Site Selection

- **PV siting across forest, aquavoltaics, grassland scenarios, etc.**

Online command-driven, reducing site selection from months to minutes.

2.2 PV Intelligent Site Selection

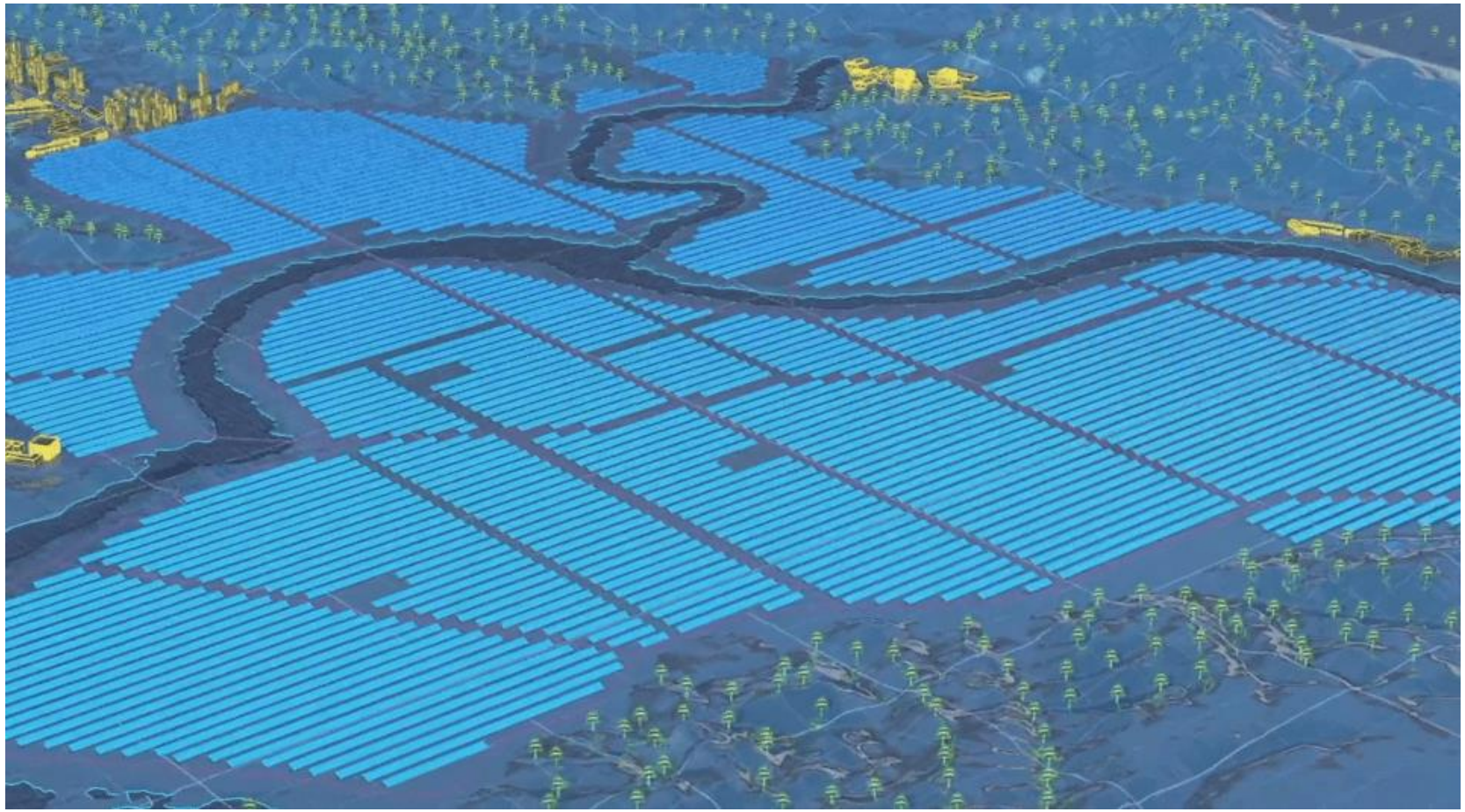
2.2.2 Brief Introduction to Intelligent PV Site Selection

- AI performs integrated modeling and quantitative analysis of slope, shadow coverage and installable capacity to automatically assess the suitability and power potential of all candidate sites.

2.2 PV Intelligent Site Selection

2.2.2 Brief Introduction to Intelligent PV Site Selection

- Combining **reinforcement learning** and **real-time modeling**, it dynamically adjusts module orientation and spacing for maximum power output.

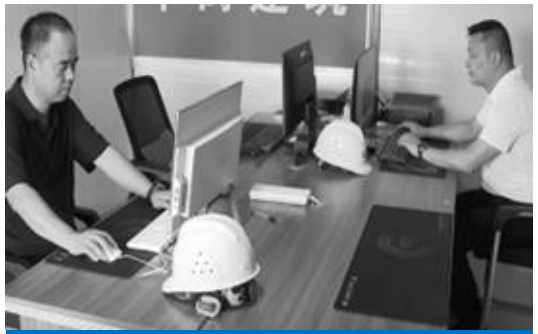
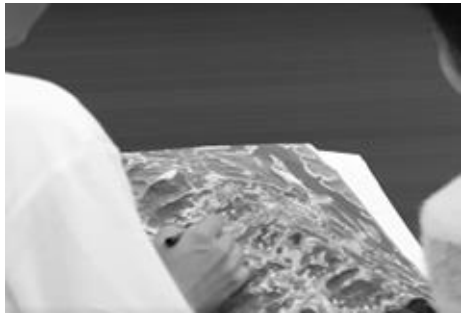


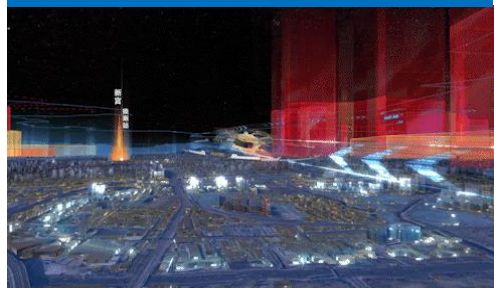
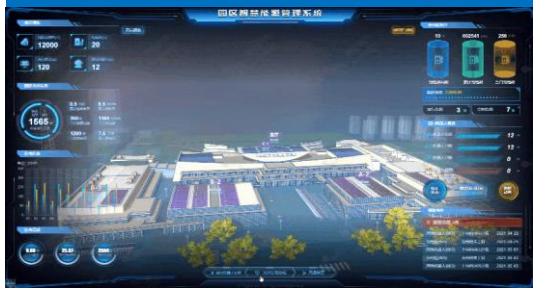
2.2 PV Intelligent Site Selection

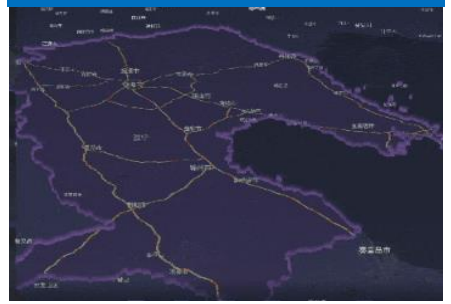
2.2.3 Summary of intelligent PV site selection

➢ **Intelligent PV siting significantly shortens site selection time, reduces upfront costs and development risks, and enables efficient, data-driven decision-making.**

	Survey Methods	Decision Basis	PV layout	Supervision
Traditional	On-site	Experience-based	Manual calculation	On-site
Intelligent	Satellite remote sensing	Algorithmic scoring	AI-based Optimization	Real-time monitoring



2.3 PV+ models

2.3.1 PV+Agri complementary model

Upper layer: Photovoltaic arrays

Lower layer: crop cultivation

Crops：rice、tea、vegetable、herbs

Smart operation measures of PV+Agri

1. Intelligent Supplemental Lighting

LED systems precisely compensate for photovoltaic shading to enhance crop yields

2. Smart Water-Fertilizer System

AI fertigation syncs meteo-soil data with crop nutrient demand

3. Pest and Disease Early Warning

Remote sensing AI enables precision pest and disease early warning

4. PV Angle Smart Adjustment Systems

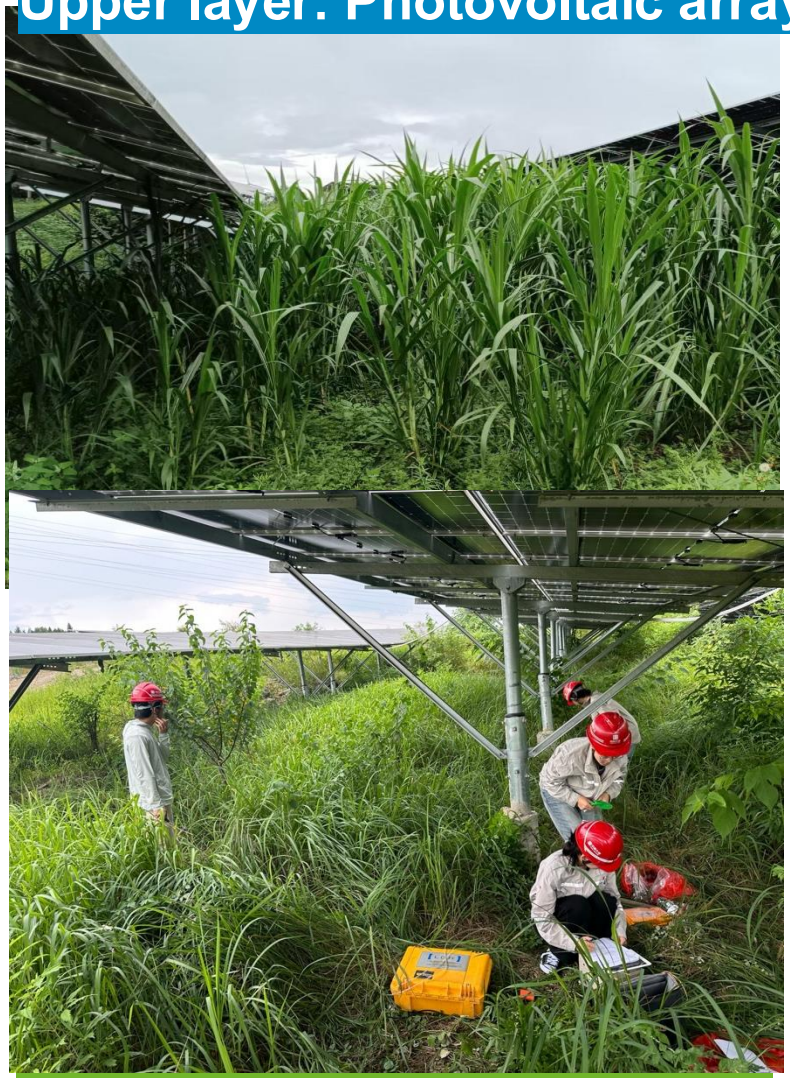
PV panel angles according to crop light requirements at different growth stages

Boosts **land-use efficiency** and adds **stable green-power revenue**.

2.3 PV+ models

2.3.2 PV+Grassland complementary model

Upper layer: Photovoltaic arrays



Lower layer: grass/tree

Grass species:

甜象草(*Pennisetum purpureum*)

黑麦草(*Lolium perenne*)

苜蓿(*Medicago sativa*)

.....

Smart operation measures of PV+Grassland

1. Intelligent Irrigation System

Automatically supplies water based on real-time soil conditions.

2. Digital Forestry Resources

LiDAR + AI Tree Measurement

3. Pest and Disease Early Warning

Remote sensing AI enables precision pest and disease early warning

4. PV-Grass-Sheep Coupling

Smart grazing systems with mobile electric fences precisely regulate livestock carrying capacity.

High **land-use efficiency** and adds **stable green-power revenue**.

2.3 PV+ models

2.3.3 PV+Fishery complementary model

Upper layer: Photovoltaic arrays

Lower layer: Aquaculture

Aquaculture:
Crayfish
fish
Chinese Softshell（甲鱼）
.....

Smart operation measures of PV+Fishery

1. Real-time Water Monitoring

Track dissolved oxygen, pH, temperature, ammonia nitrogen, turbidity.

2. Intelligent Aeration & Circulation

Auto-controls aerators and pumps based on water conditions.

3. Precision Feeding & Growth Management

Optimizes feeding, reduces waste and lowers disease risk.

4. Integrated PV Monitoring & Maintenance

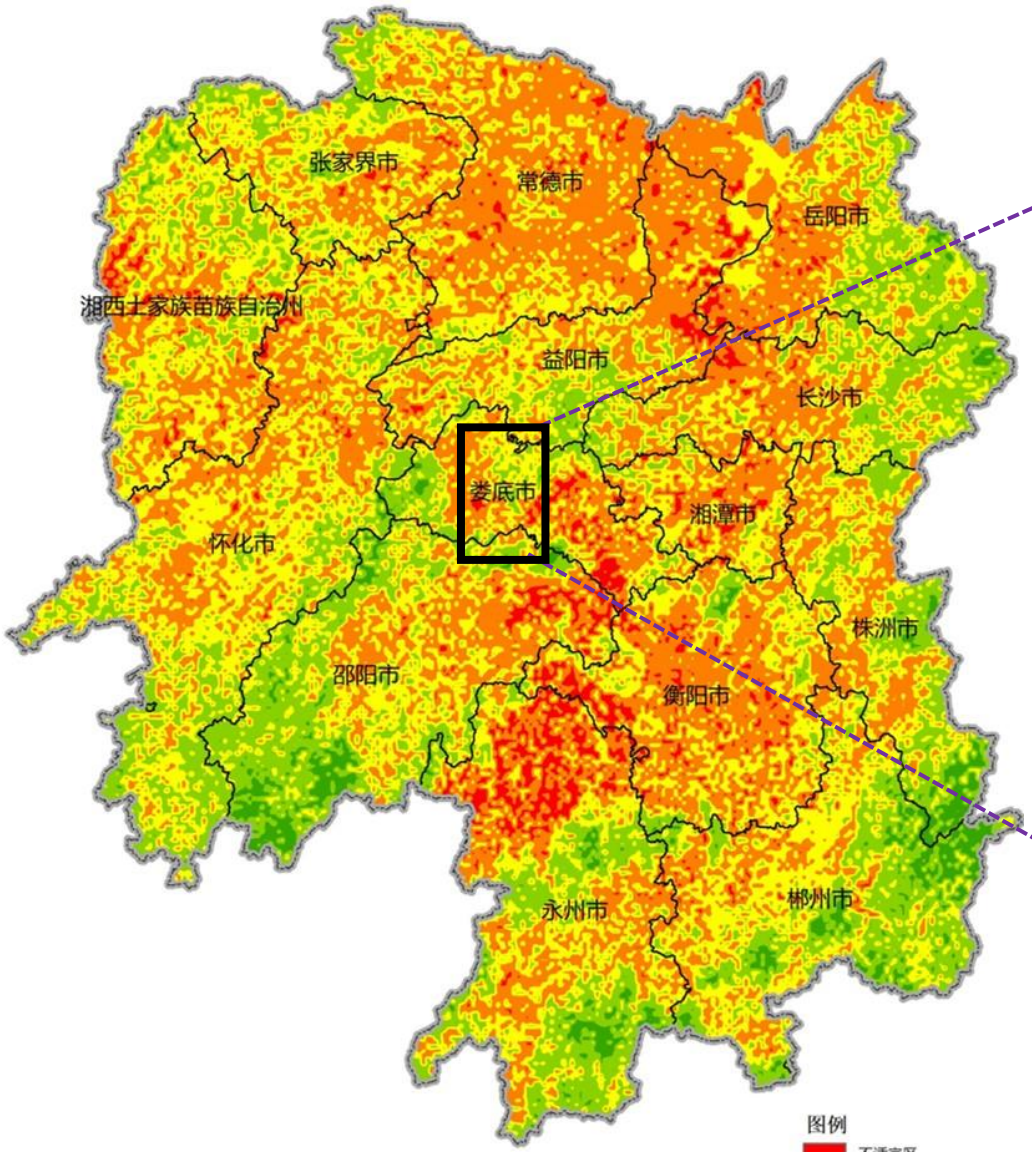
Monitors PV modules, supports, cables and safety via SCADA and drones.

- Boosts **space efficiency** and provide **stable green energy revenue**.

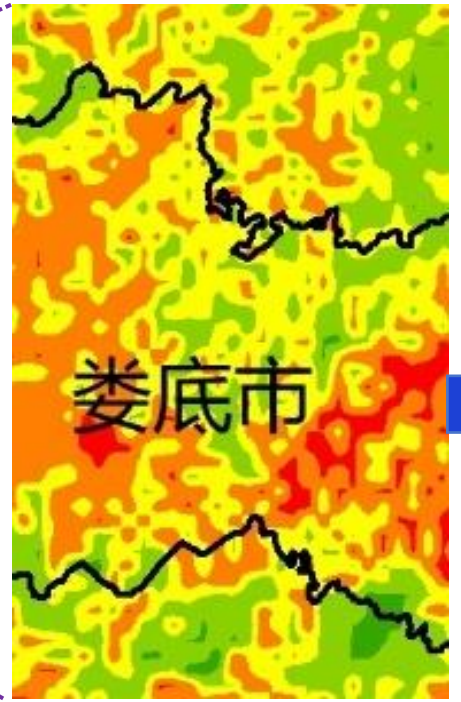
2.3 PV+ models

2.3.4 A Case study in Hunan

Xi kuangshan, is a typical ecologically degraded region plagued by heavy metal pollution, rocky desertification and mining subsidence.



PV + restoration



Ecologically degraded region

PV+ models

PV+Ecological restoration

What & how happened?

Ecological & Environmental monitoring:

- Soil physical and chemical properties
- Heavy metal migration and transformation
- Biodiversity
- Soil microorganisms
- Soil fertility(C,N,P)
- Greenhouse gas emissions
- etc.

2.3 PV+ models

2.3.4 A Case study in Hunan

PV + Agri and PV + Grassland

Ecology value

380,000 tons
Annual standard coal saved

1 million tons
Annual CO_2emission reduction

Economic value

1.27 billion kWh
Annual power generation

174 million
Annual revenue from power generation

Social value

370+
Total jobs created

Rural Revitalization
Infrastructure construction

3 Take-home Messege

- The intelligent PV site selection system delivers **high-efficiency, intelligent and accurate site evaluation**.
- **Multiple "PV+" application** models are applicable for rollout in geographically similar Asian countries.
- Further scientific research will enrich the diversity of clean energy technologies.

Thanks to all sponsors, collaborators, and participants.

TA 10433 (PRC): Research on Application of Solar Photovoltaics Integrated Ecological System Rehabilitation and Agriculture Synergy Development

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Smarter Land, Greener Power: AI and Big Data for Solar PV Plus, Ecological Restoration, and Agriculture Synergy

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Thanks for your attentaion !