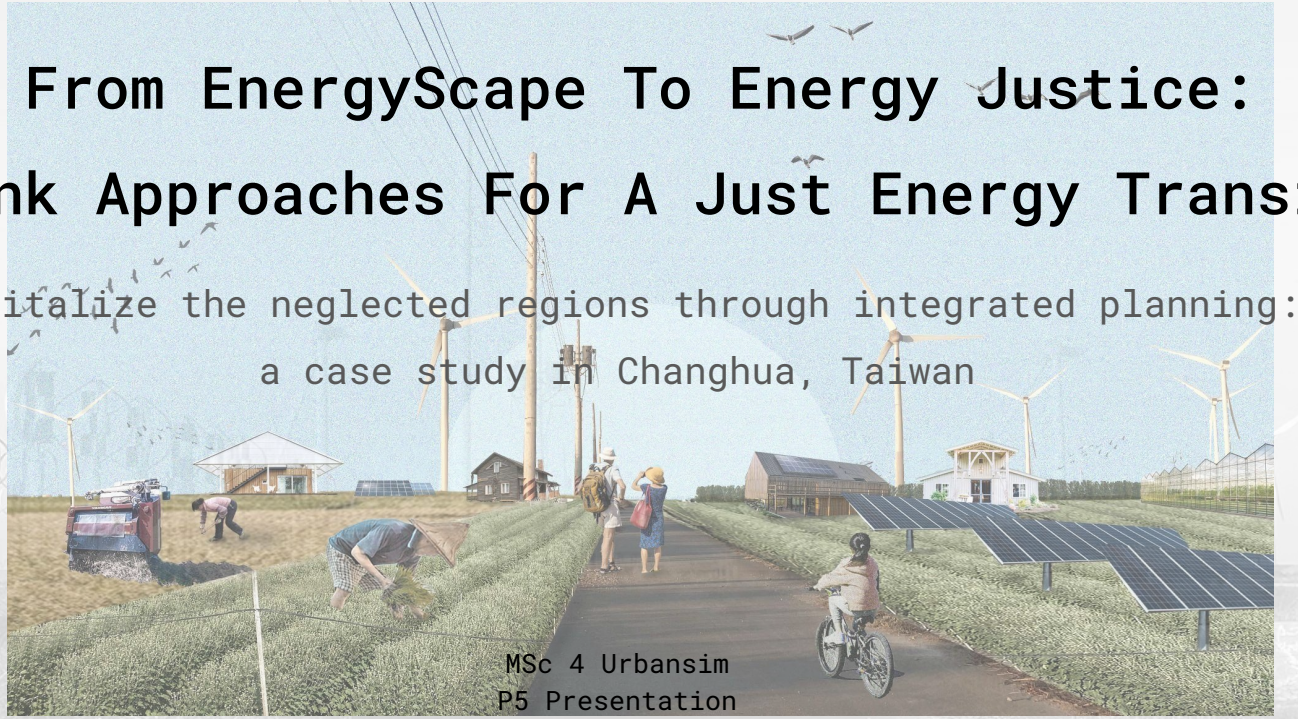
From EnergyScape To Energy Justice:

Rethink Approaches For A Just Energy Transition

Revitalize the neglected regions through integrated planning:

a case study in Changhua, Taiwan



MSc 4 Urbansim

P5 Presentation

Kuan-Ting Liu (Lucy) 5582911

Planning Complex Cities

First mentor: Marcin Dabrowsk

Second mentor: Ulf Hackauf

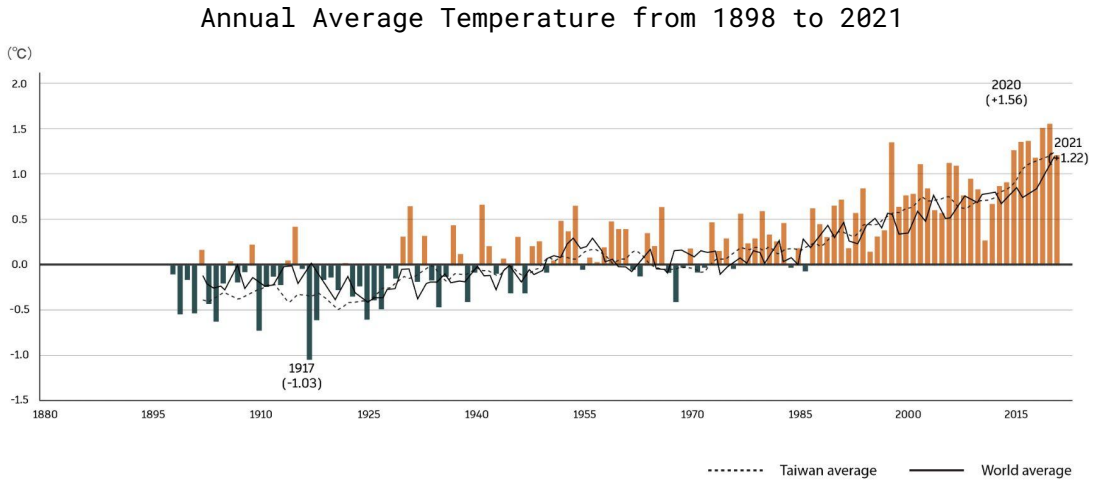
Contents

01

Context Of Problem Field

Context Of Problem Field

-Climate change



source: Central Weather Bureau & NASA
Edited by Author

Context Of Problem Field

People protest for climate justice at COP27

source: UNFCC (2022)

Context Of Problem Field

-Two nuclear power plants: within 30 km of the capital

-⅓ of Taiwanese are included

Location of the Nuclear Power Plants

source:Google Earth (2023)

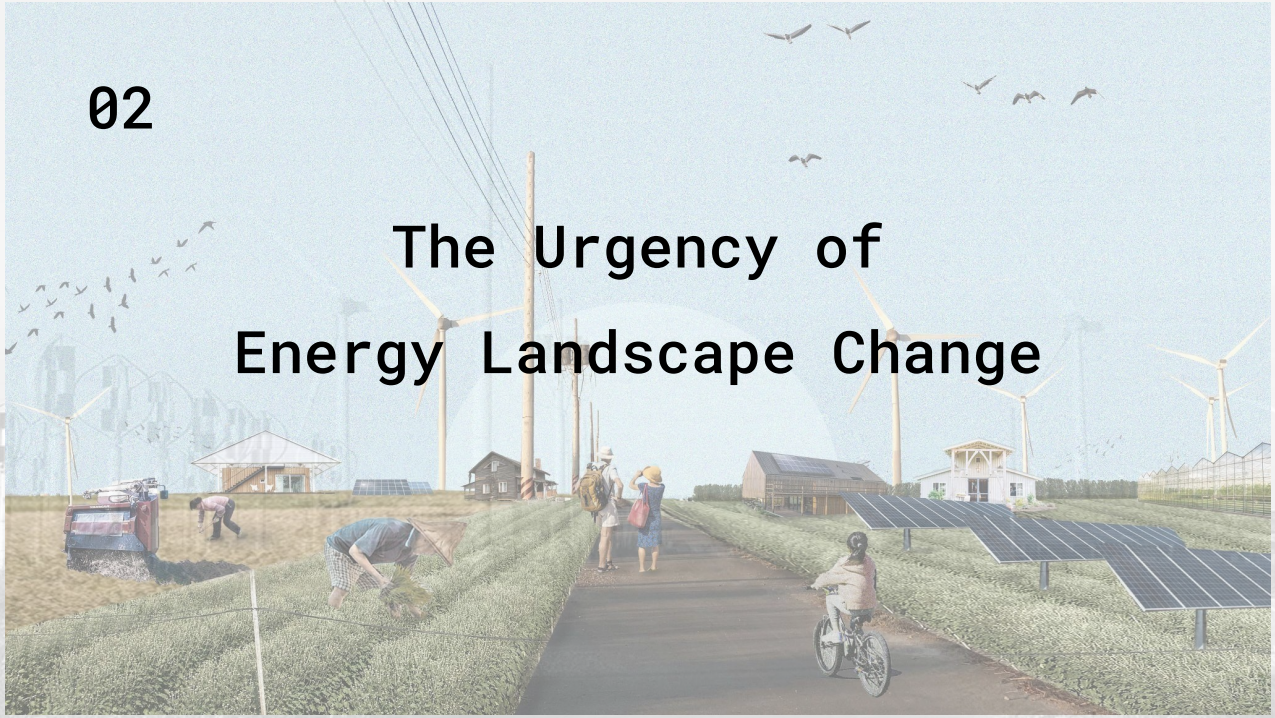
Context Of Problem Field

nuclear power plants in Taiwan

source: Business Today(2021)

02

The Urgency of Energy Landscape Change



The Urgency of Energy Landscape Change

-The proposed of ideal condition: agriculture

Ideal multifunctional use in agricultural lands

source:UEUE Cooperation (2023)

The Urgency of Energy Landscape Change

-Current condition: agriculture

Current multifunctional use in agricultural lands

source:News&Market (2020)

The Urgency of Energy Landscape Change

-The proposed of ideal condition: aquaculture

Ideal multifunctional use in aquacultural lands

source:News&Market (2020)

The Urgency of Energy Landscape Change

-Current condition: aquaculture

Current multifunctional use in aquacultural lands

source:MEA (2021)

The Urgency of Energy Landscape Change

-The landscape change in agricultural lands

The landscape changes from 2018 to 2023

source:Google Earth (2023)

The Urgency of Energy Landscape Change

- The landscape change in aquacultural lands

The landscape changes from 2018 to 2023

source:Google Earth (2023)

The Urgency of Energy Landscape Change

-The landscape change in mountainside areas

The landscape changes from 2018 to 2023

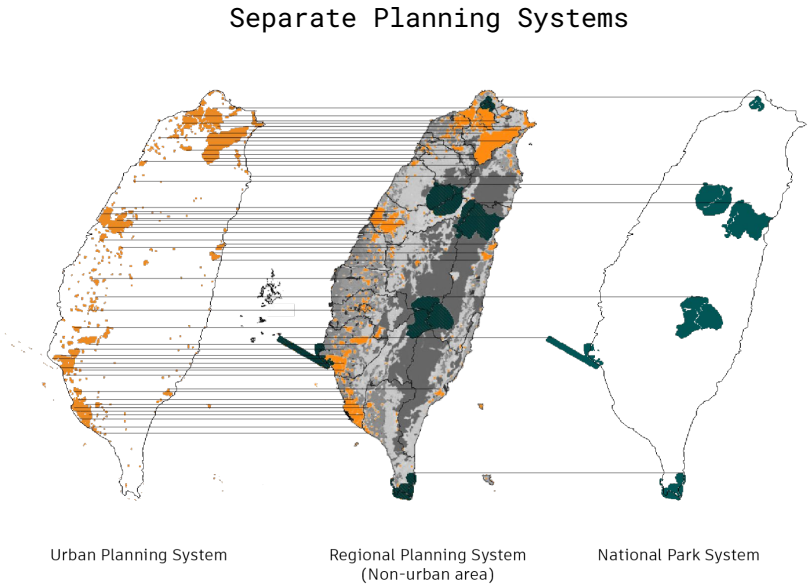
source:Google Earth (2023)

03

The Challenges Behind The Urgency

The Challenges Behind The Urgency

-Systematic deficiencies lead to disorderly changes in the landscape.



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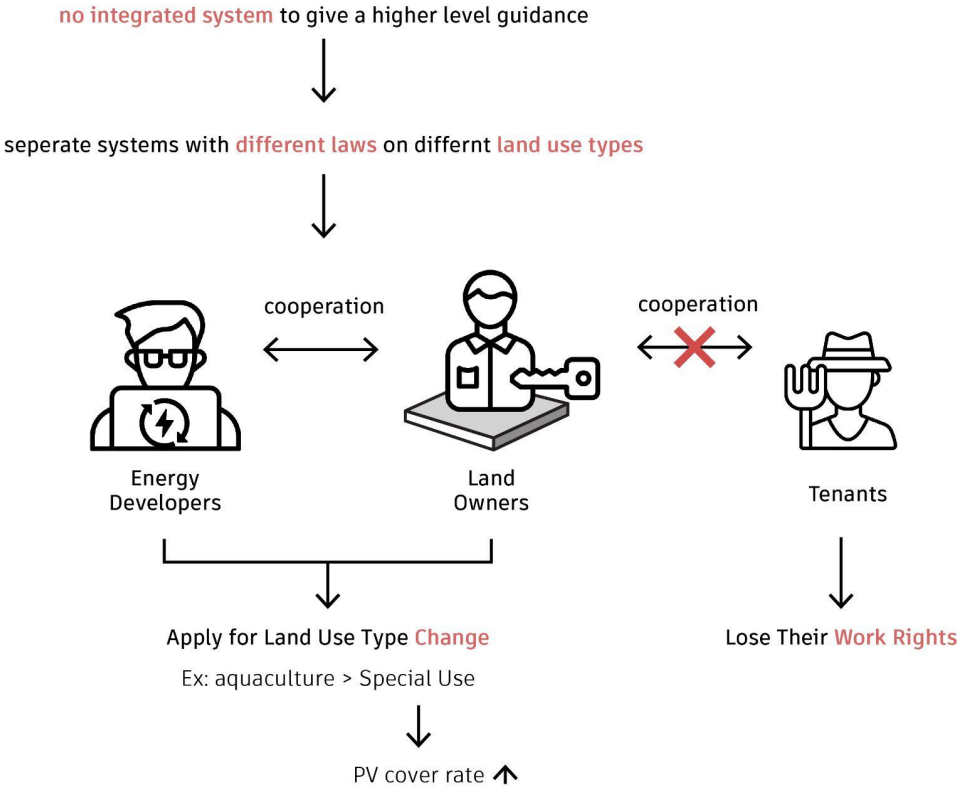

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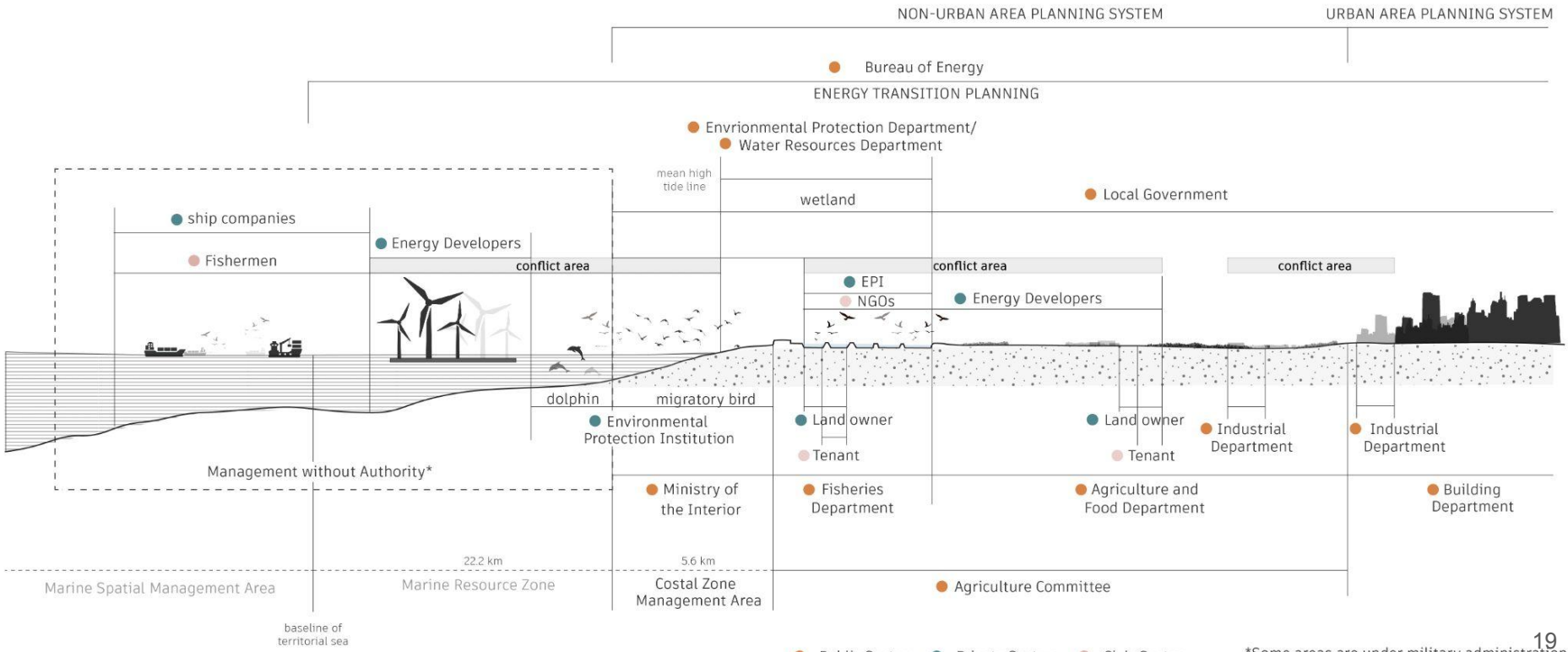
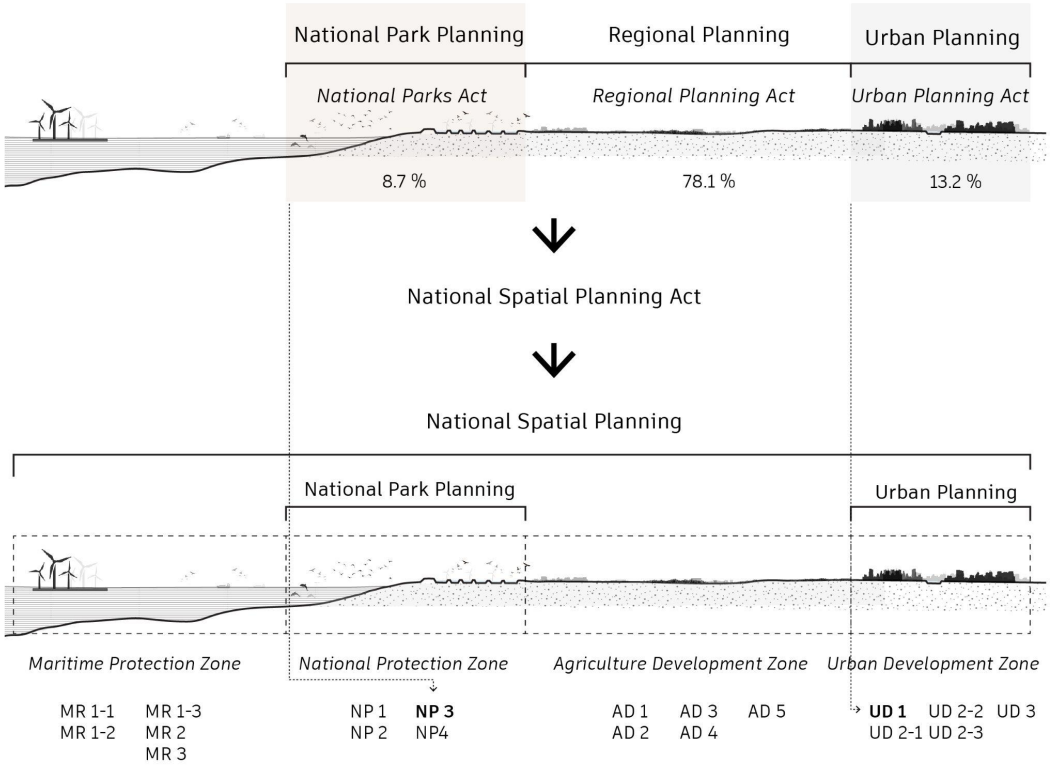


The Challenges Behind The Urgency

-2025 National Spatial Plan: another threat? or a tool to mitigate problems?



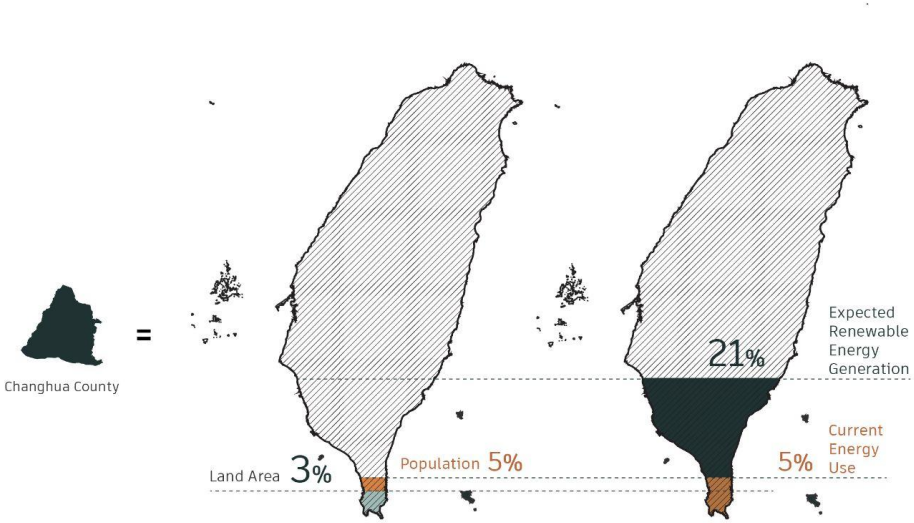
04

Case Study Area: Changhua

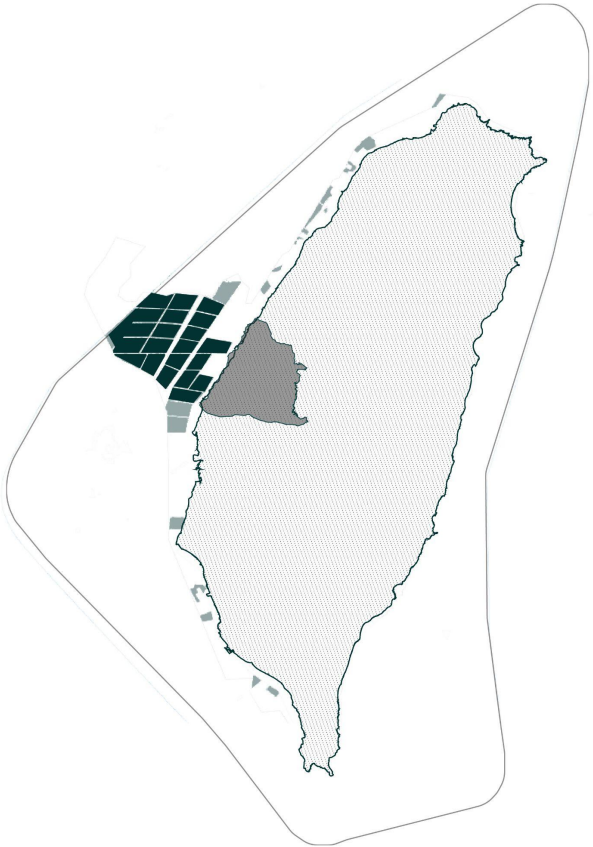
Case Study Area: Changhua

-**Best solar** and **wind energy potential** in Taiwan
    -21 of Taiwan's 36 wind farms are located here
    -Most efficient solar potential

-Many hidden threats



Wind Farm Locations



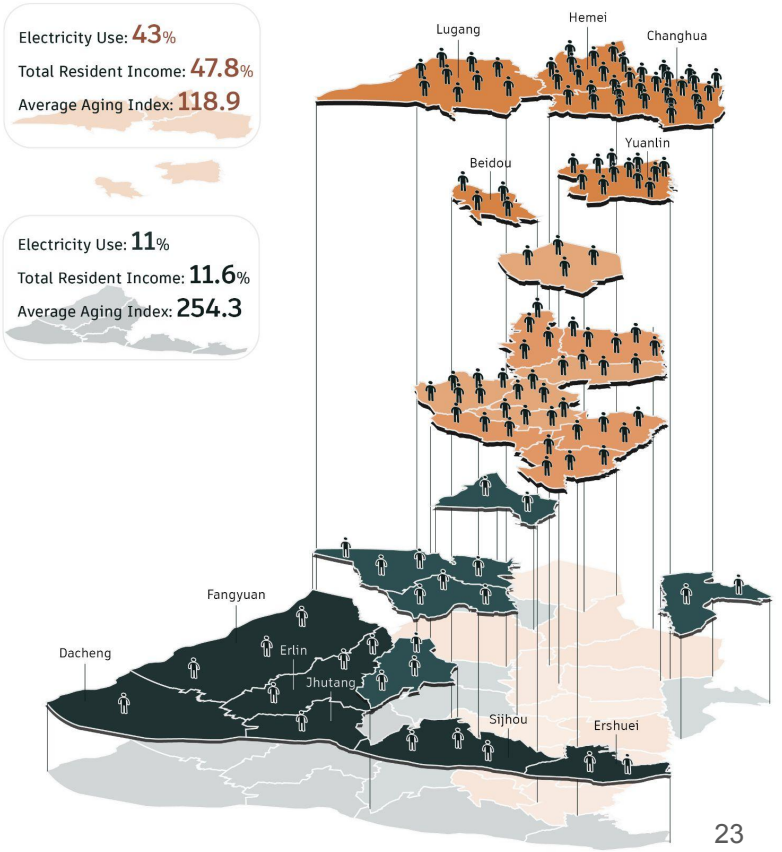
source:Energy Bureau(2016); Made by Author

Case Study Area: Changhua

-Significant imbalance in development between districts

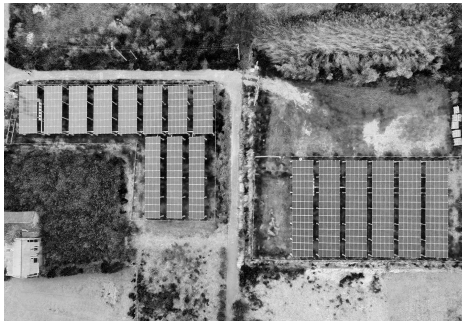
-**Inequality** of regional development strategies

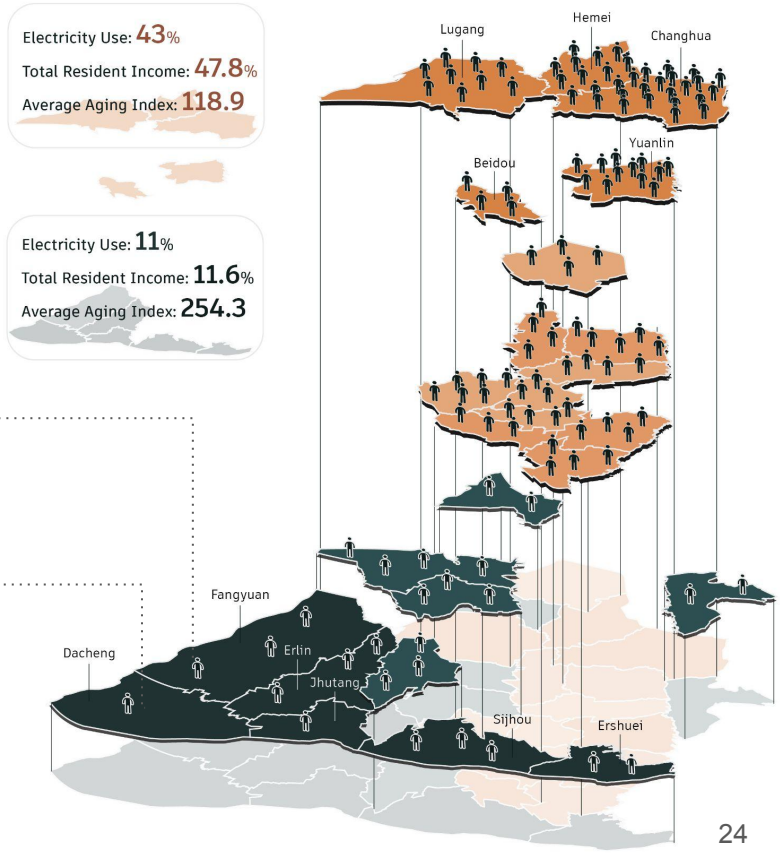
-**Uneven** resources distribution between townships



Case Study Area: Changhua

-RE development projects are concentrated in South-West regions





Case Study Area: Changhua

RE conflicts in society, living environment, and ecosystem.

source:Xu Zhen Tang & Lin Ji Yang (2021)

05

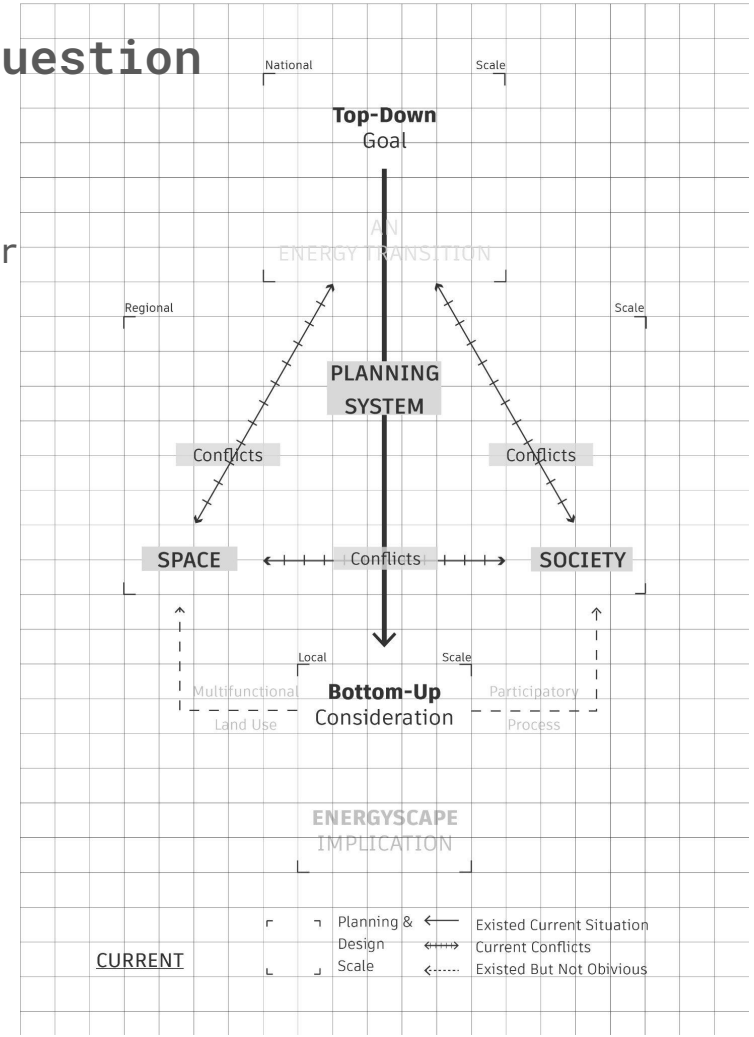
Conceptual Framework & Research Question

Conceptual Framework & Research Question

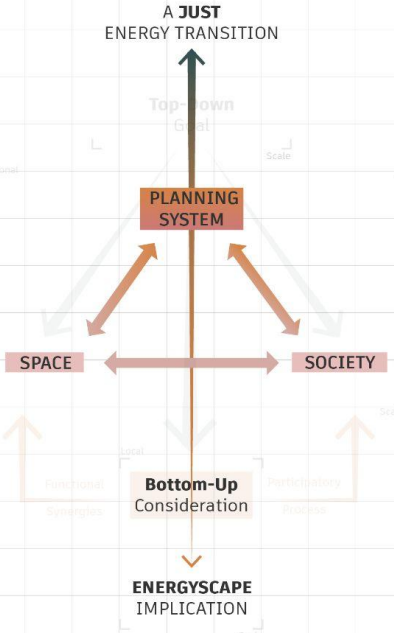
-**Spatial** and **Social** perspectives: not included

-Local considerations and needs can not be hear

-Top-Down Goal and Bottom-up: **huge gap**



Conceptual Framework & Research Question



Research Question

What **spatial** and **social** needs and considerations should be included in regional planning and design, building up the systemic changes for **integrated planning** for a **just** energy transition in Taiwan?

Sub-Questions

- What are the impacts of the energyscape on the surrounding environment?
- What systemic deficiences are hidden in the current energy transition planning that needs to be changed?
- How can regional planning and design drive systemic change to develop an integrated plan for the energy transition?
- How can resources be reallocated to create value and rebuild social equity for neglected areas?
- How can research on the implications of energyscapes help redistribute the power and interests of stakeholders in the energy transition?

Conceptual Framework & Research Question

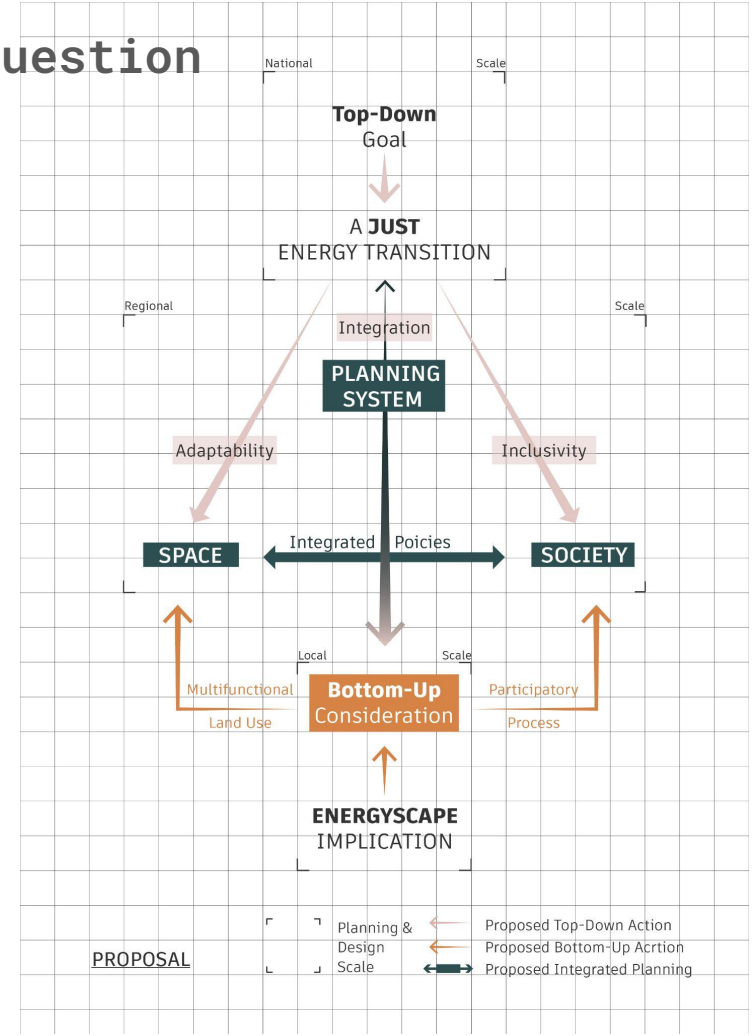
-**Energyscape impact study:** provide local considerations included social and spatial perspectives

-Space: adaptability

-Planning system: integration

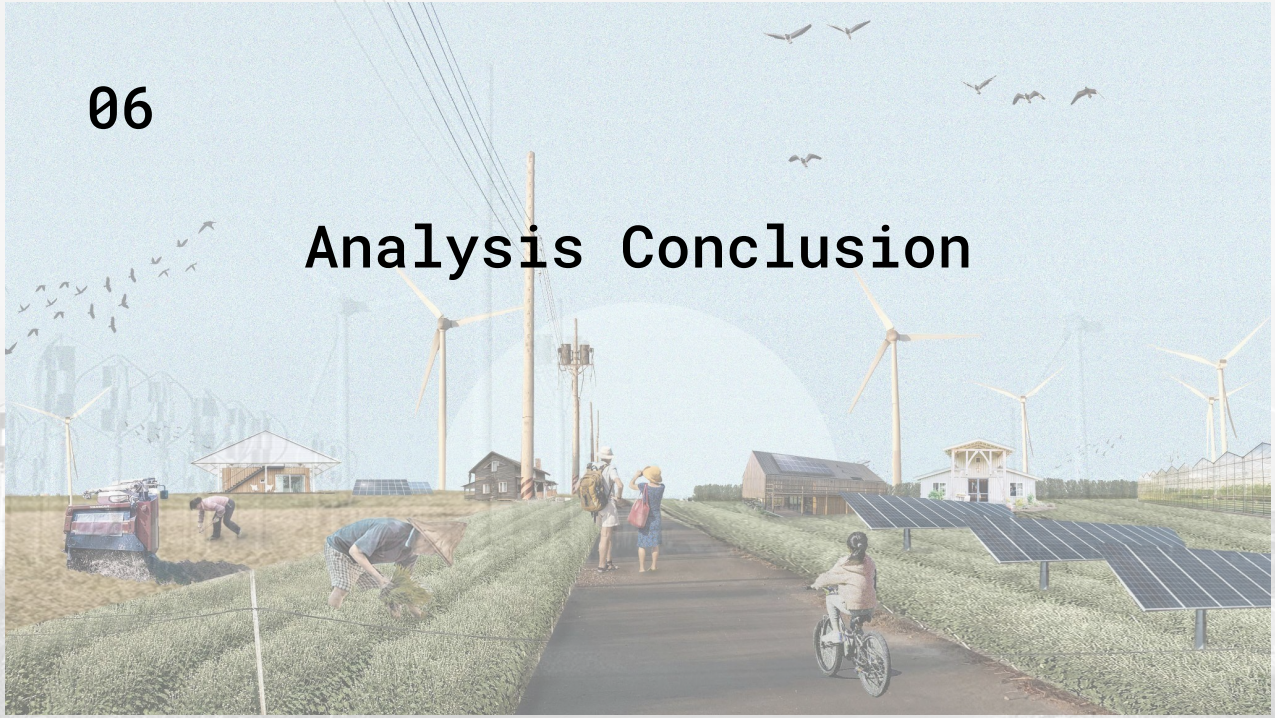
-Society: inclusivity

-Sectors: collaboration



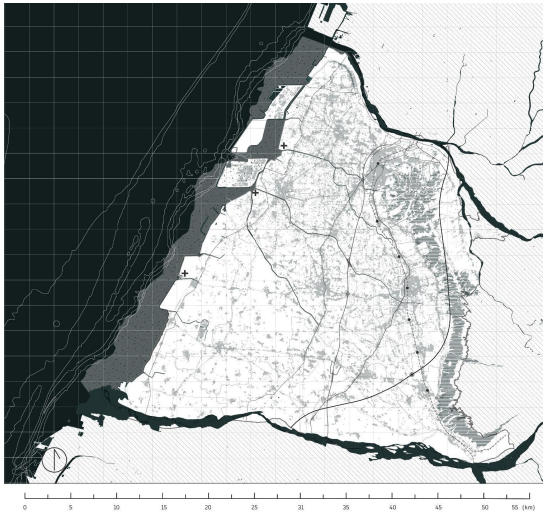
06

Analysis Conclusion

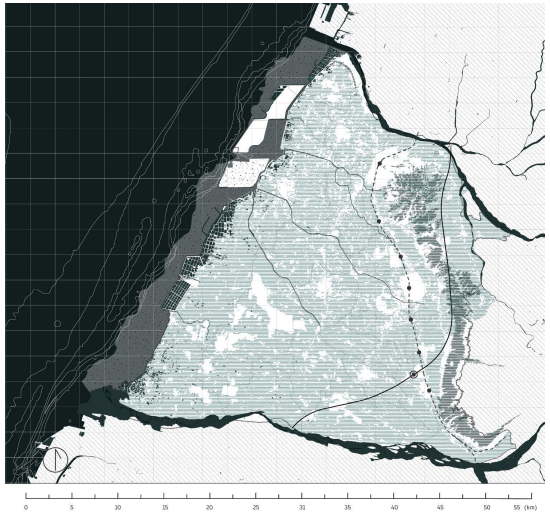


Analysis Conclusion-Spatial

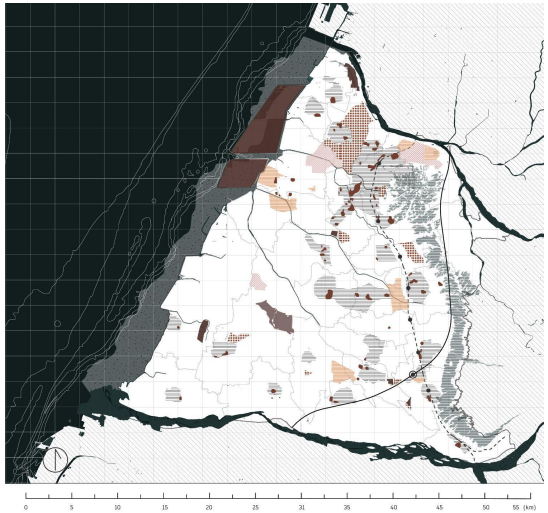
Analysis of built environment, agriculture, and industrial activities



Built Environment



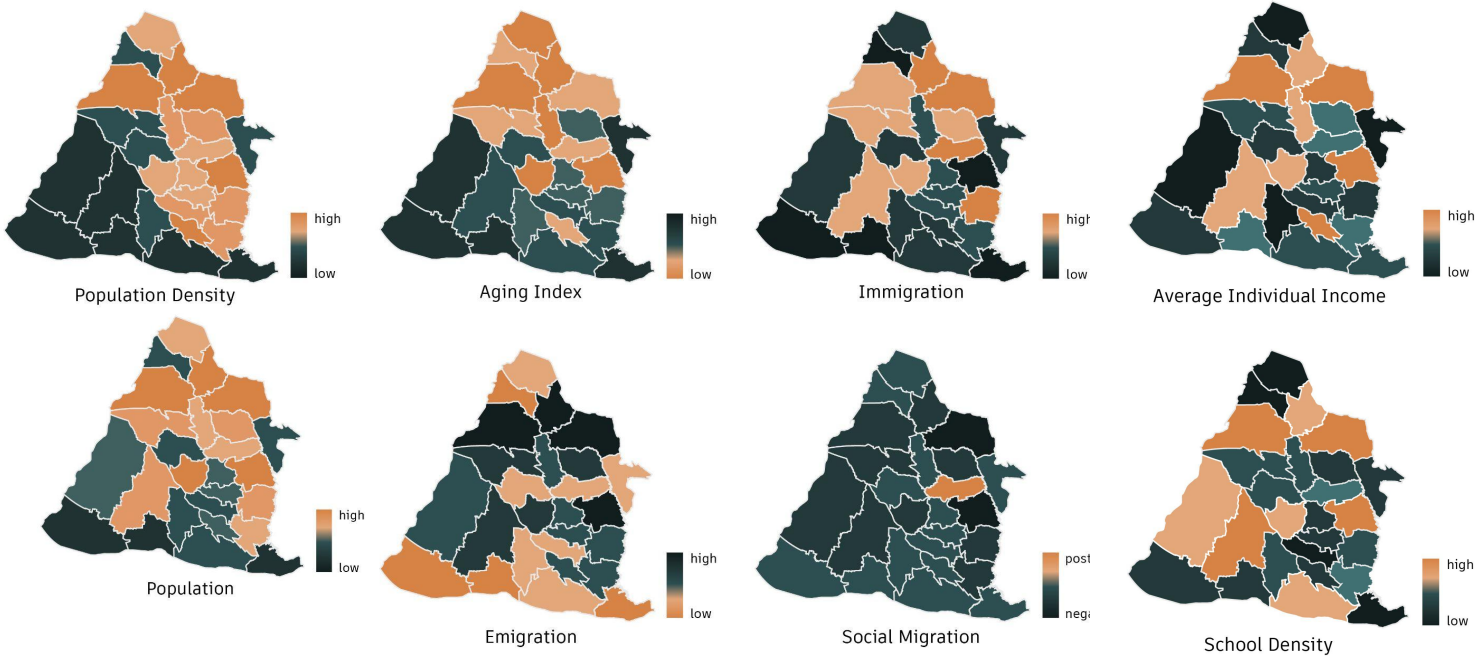
Agricultural Activities



Industrial Activities

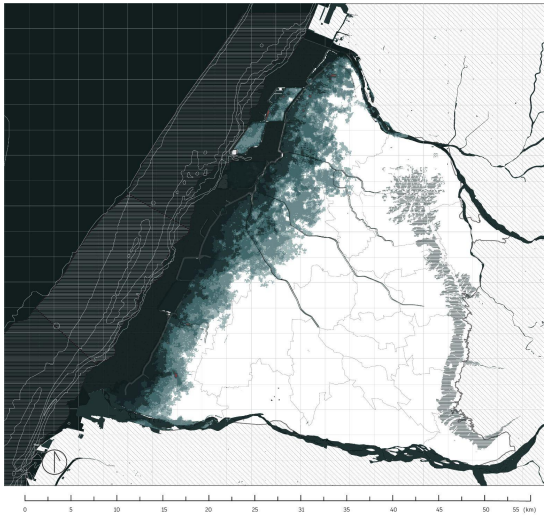
Analysis Conclusion-Socio-Economic

Analysis of socio-economic activities and conditions

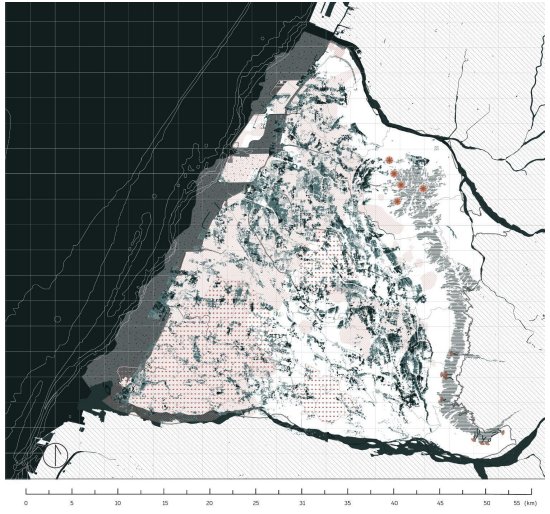


Analysis Conclusion-Environmental & Ecological

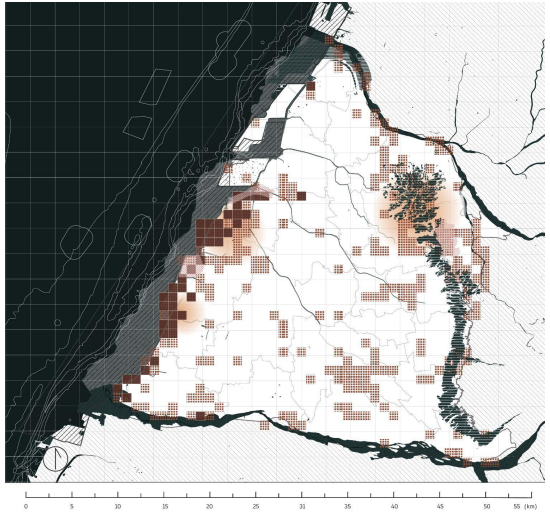
Analysis of sea-level rise, natural disasters, and ecological sensitivities



Sea-level Rise



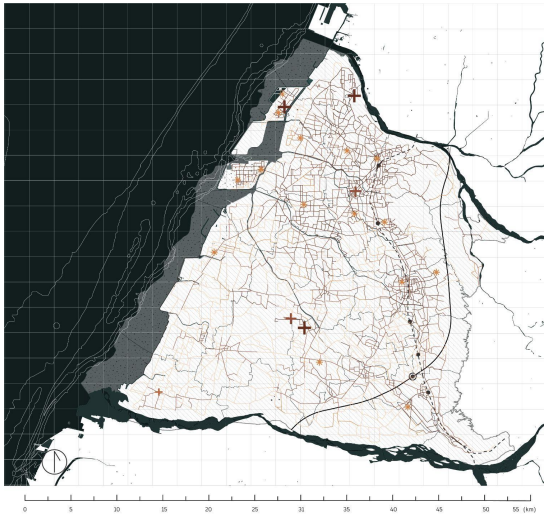
Natural Disasters



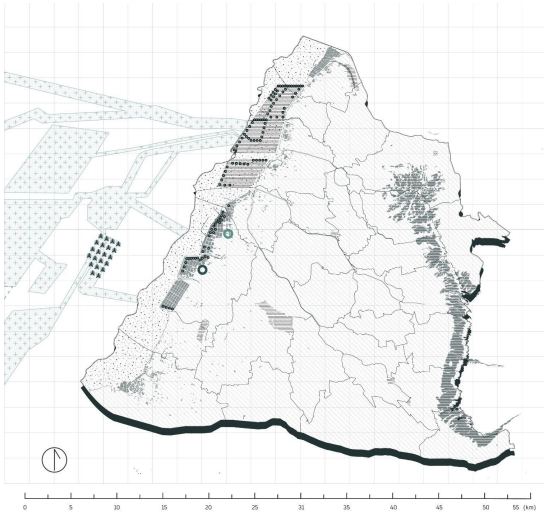
Ecological Sensitivities

Analysis Conclusion-Energy Infrastructure

Analysis of energy infrastructure, wind farms, and solar farms



Energy Capacity & Substations



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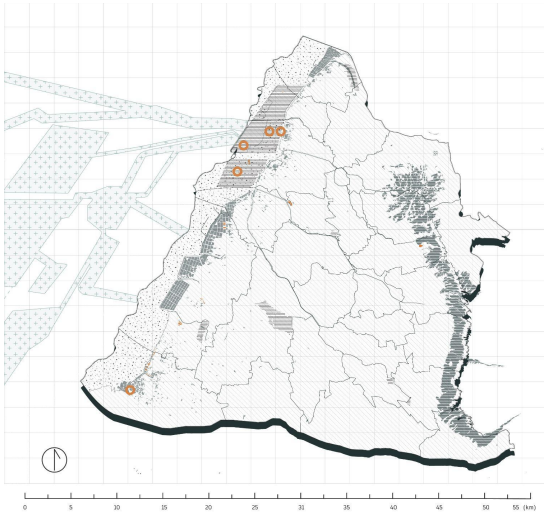
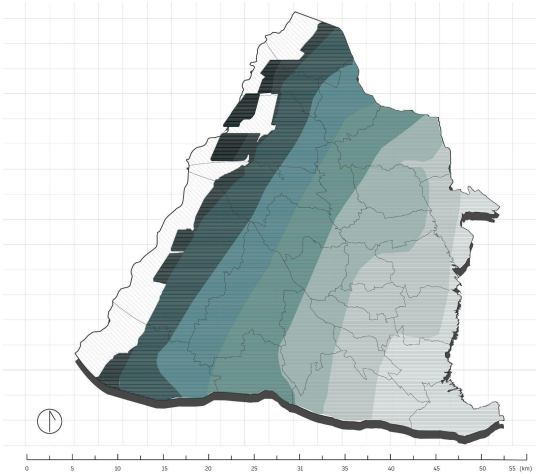


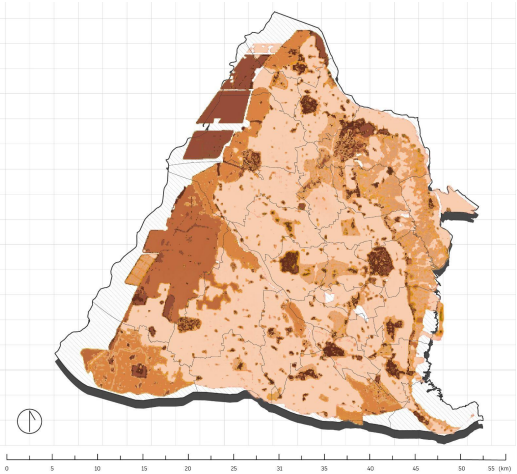
Solar Farm Locations

Analysis Conclusion-Energy Potential

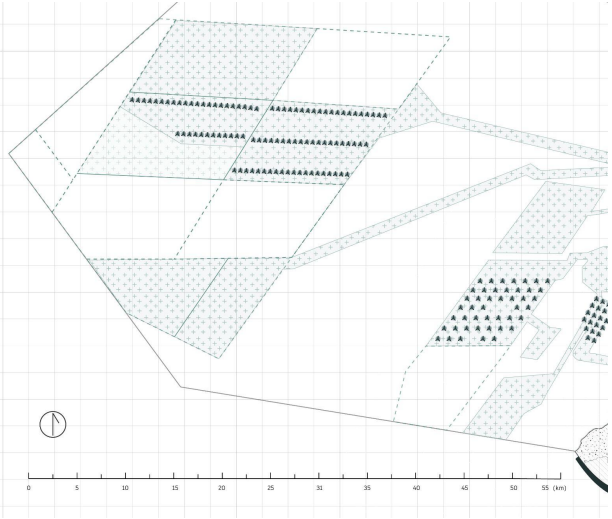
Analysis of wind potential, solar potential, and offshore wind farms



Wind Potential



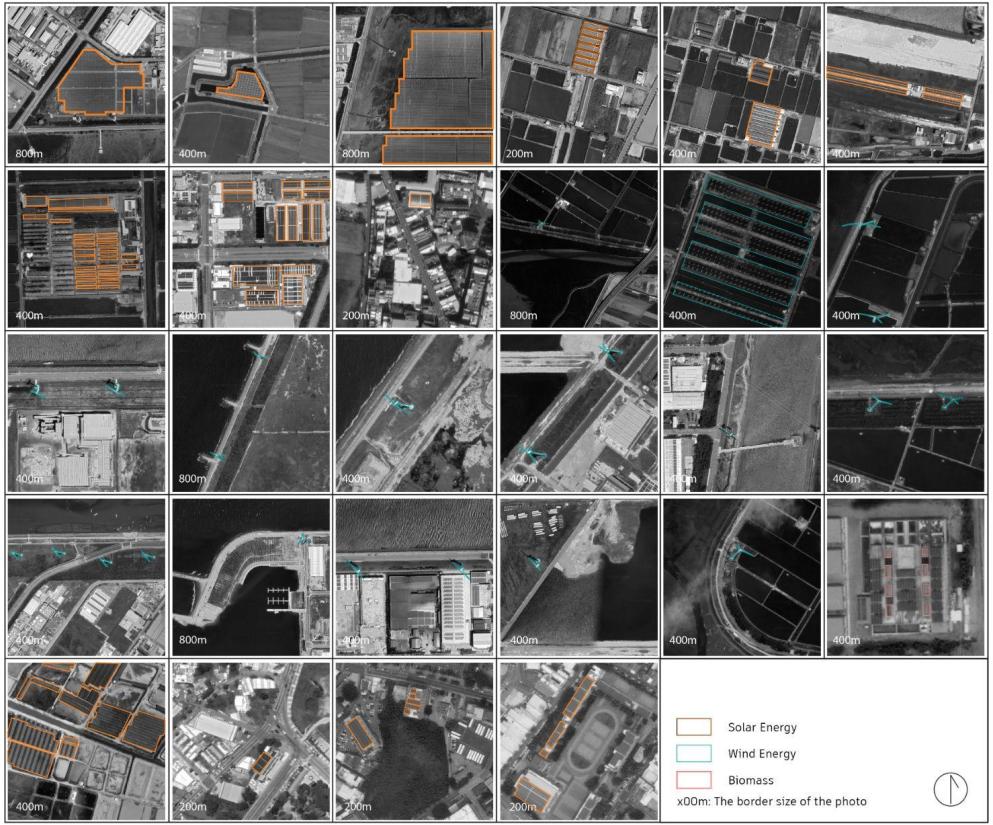
Solar Potential



Offshore Wind Farm Potential

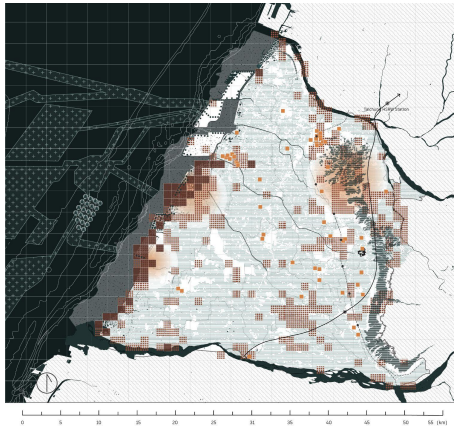
Analysis Conclusion-Energy Landscape

Energy Landscape Analysis

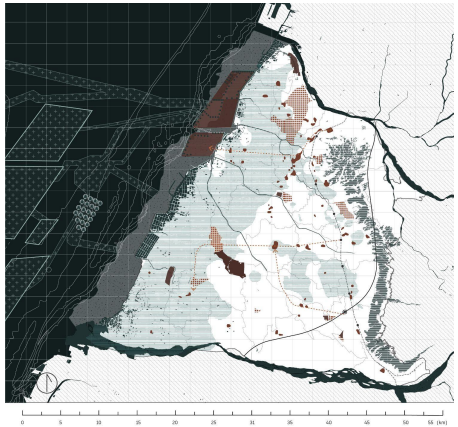


Analysis Conclusion-SWOT

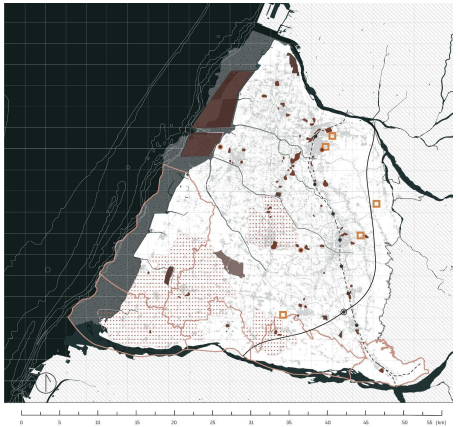
SWOT Analysis



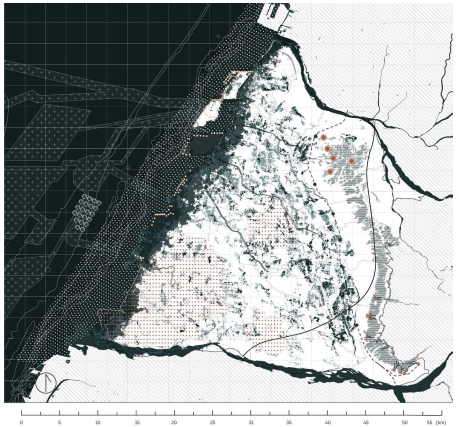
Strenghts



Opportunities



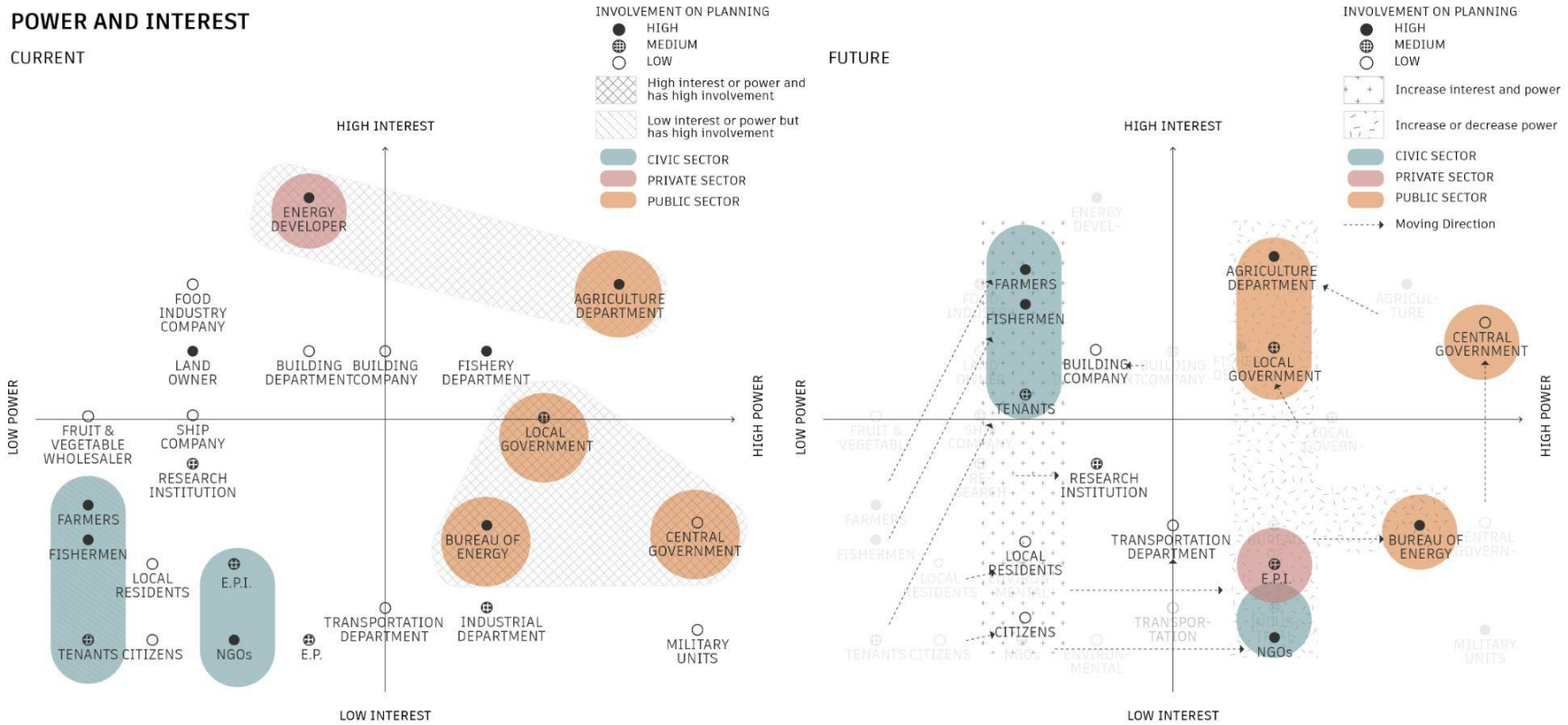
Threats



Weakness

Analysis Conclusion-Stakeholders

Stakeholders Analysis



Analysis: Conclusion

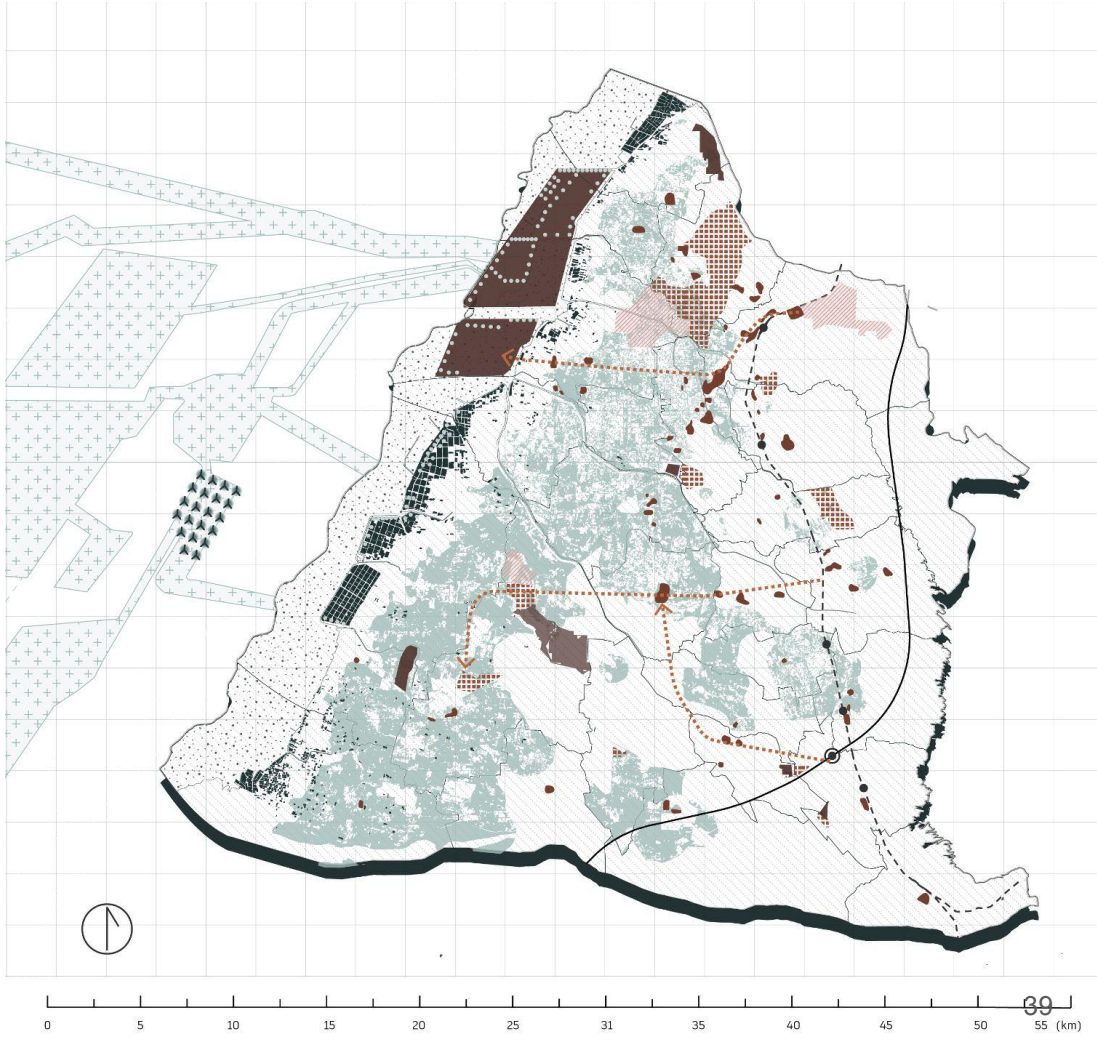
Potential Areas

-concentrated in the west

-Multifunctional land use:

-Northwestern:industry

-Southwestern:agriculture



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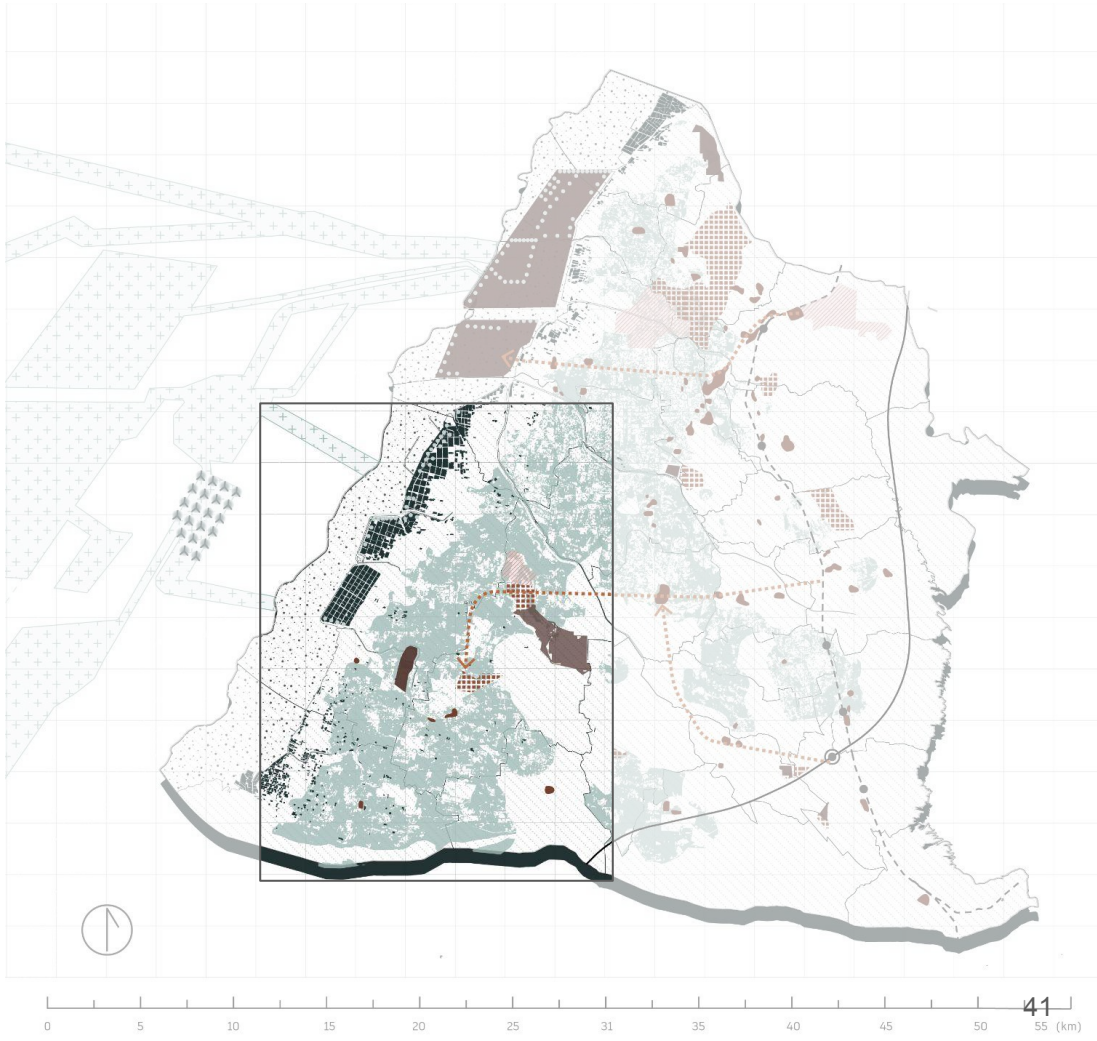


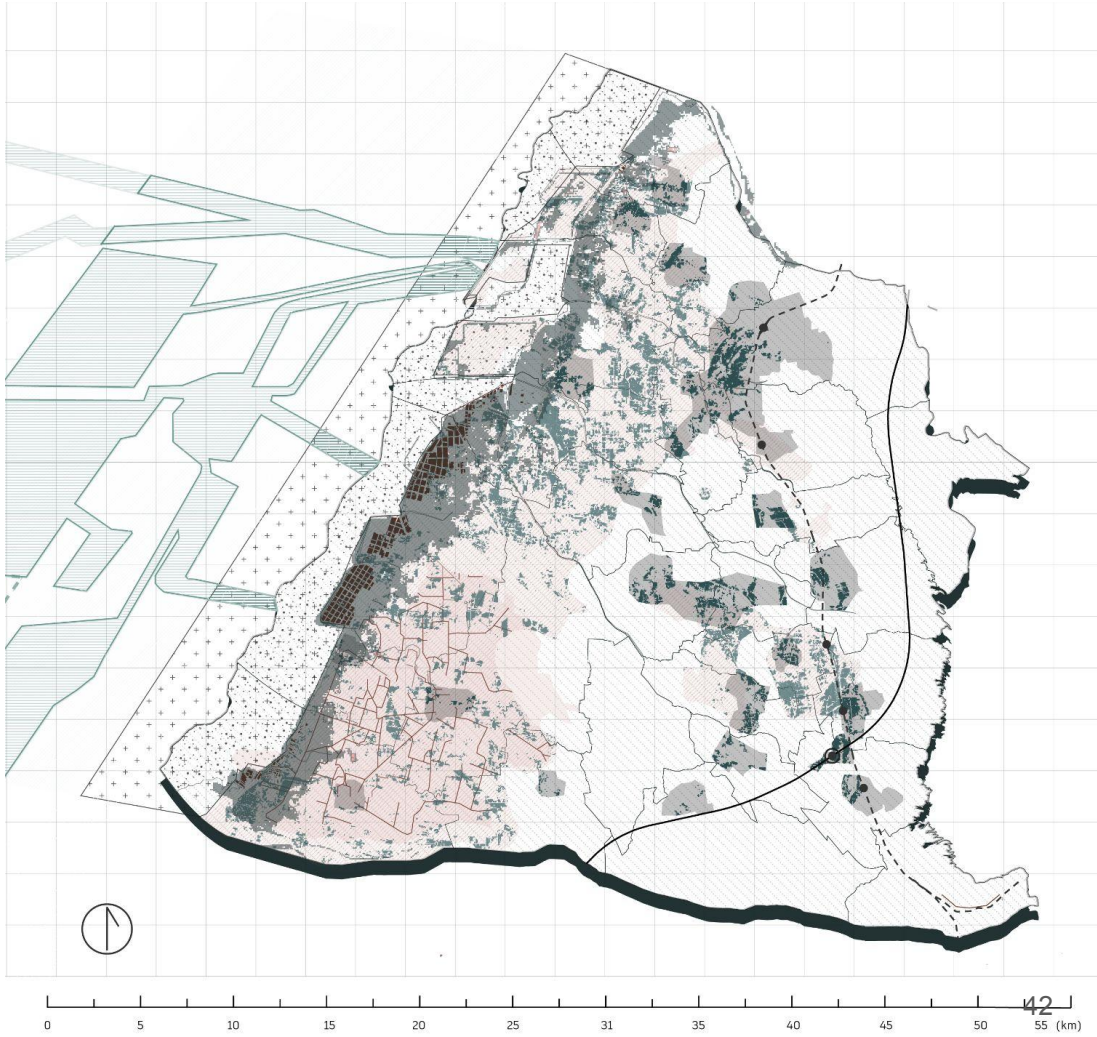
Analysis: Conclusion

Vulnerability Areas

-concentrated in the west

-Northwestern:environmental risk

-Southwestern:inadequate infrastructure



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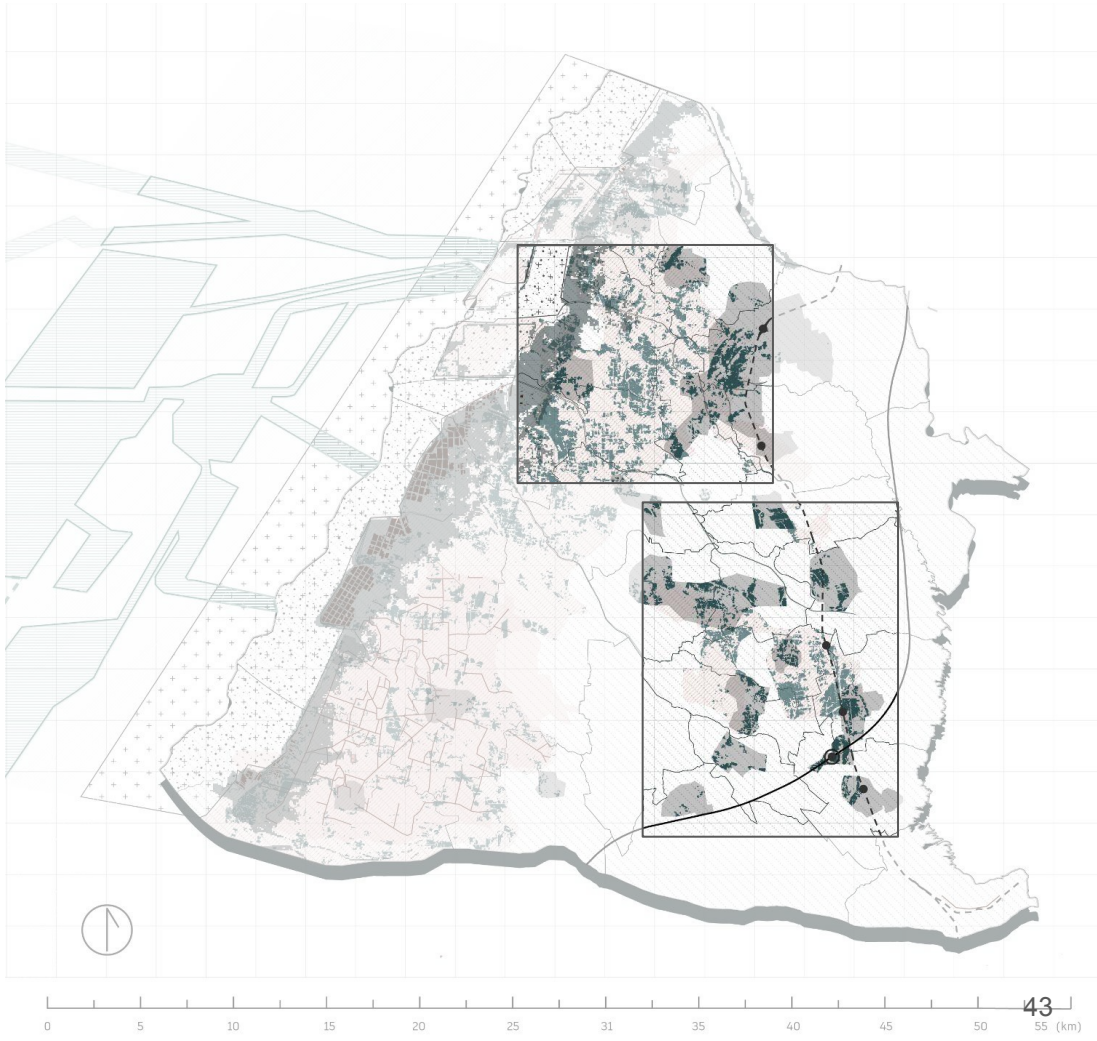

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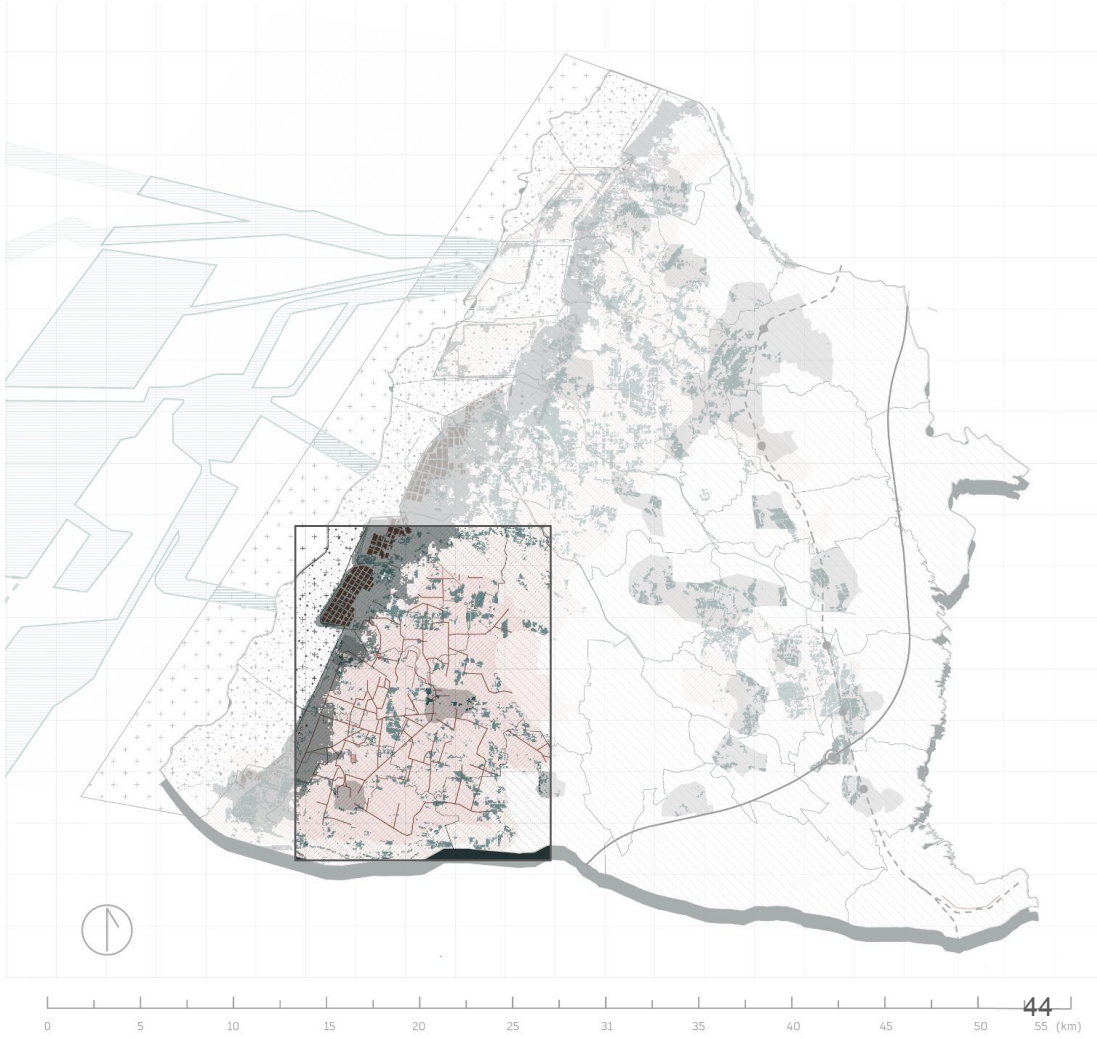


07

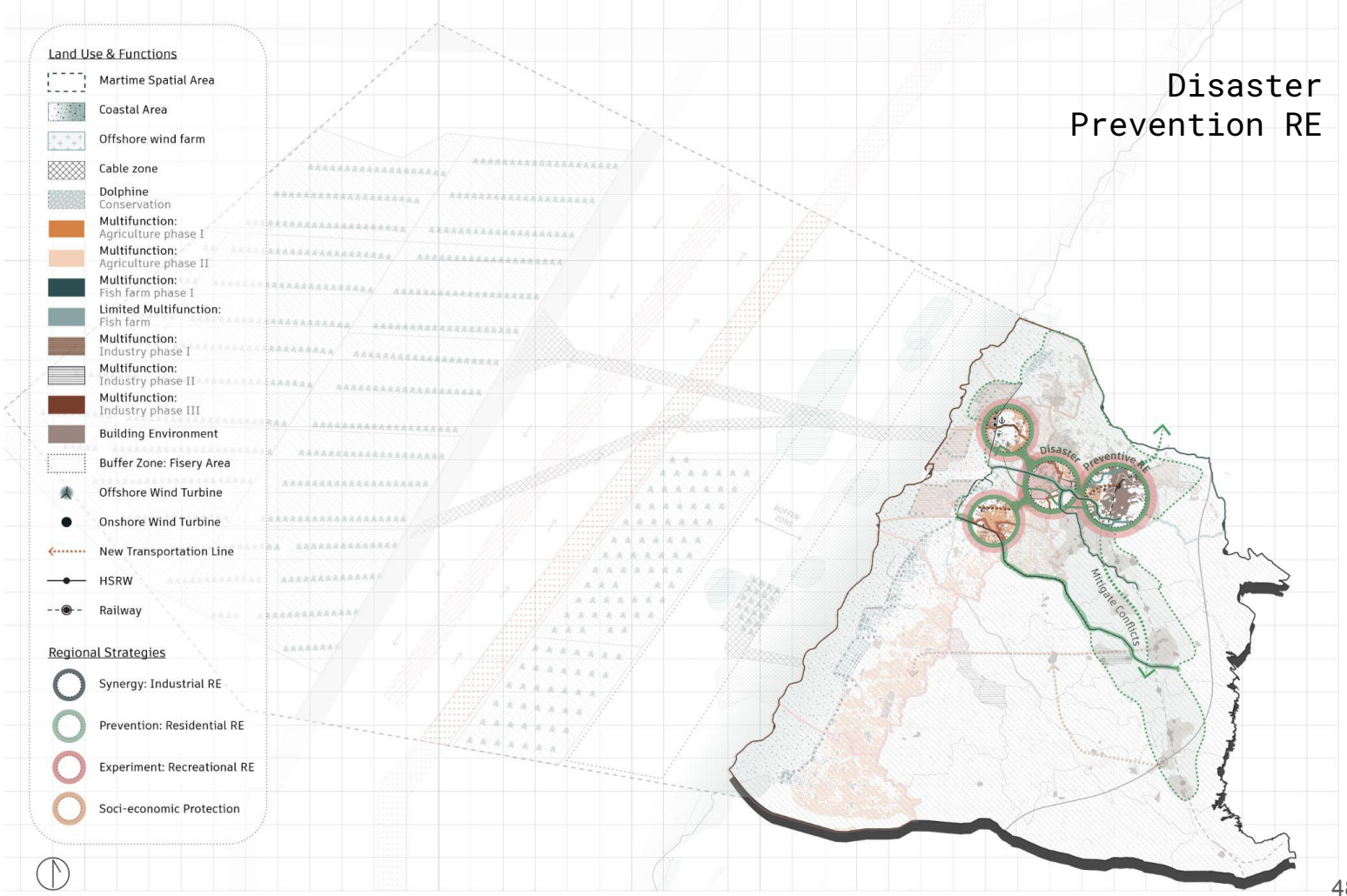
Vision

Vision

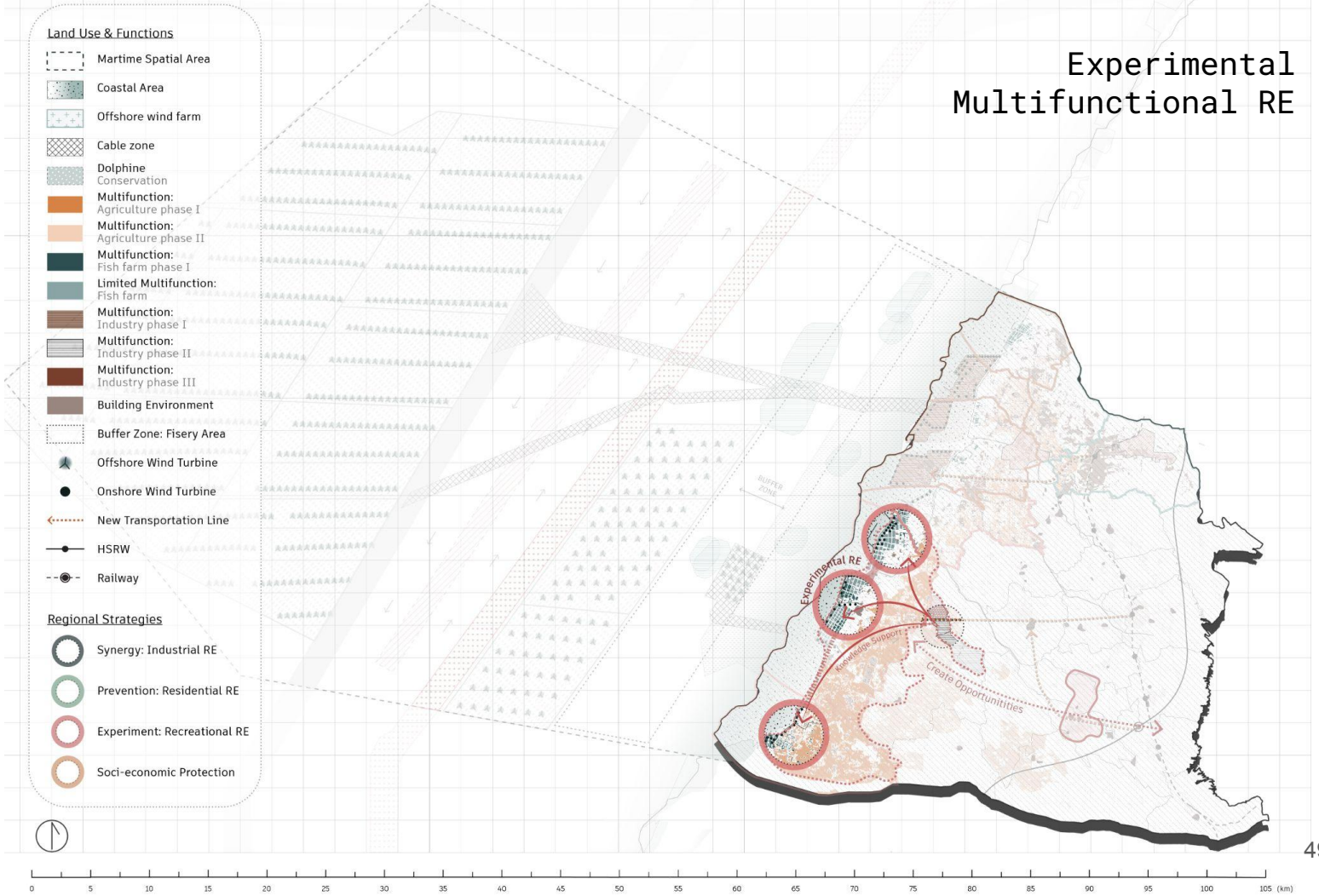
Vision

Vision

Disaster Prevention RE



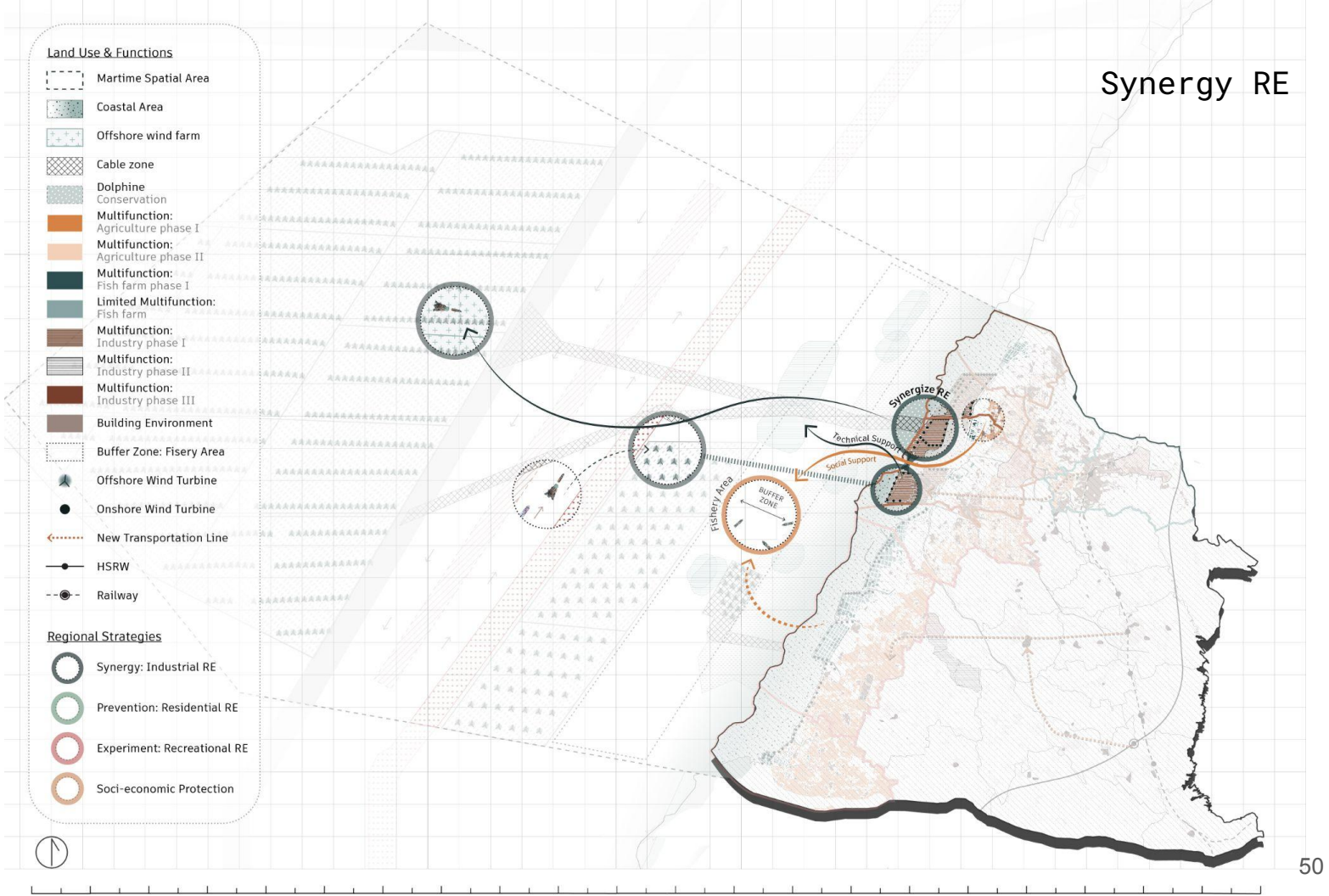
Vision



Experimental Multifunctional RE

Vision

Synergy RE



Vision

-Preventive RE

-Experimental RE

-Synergy RE

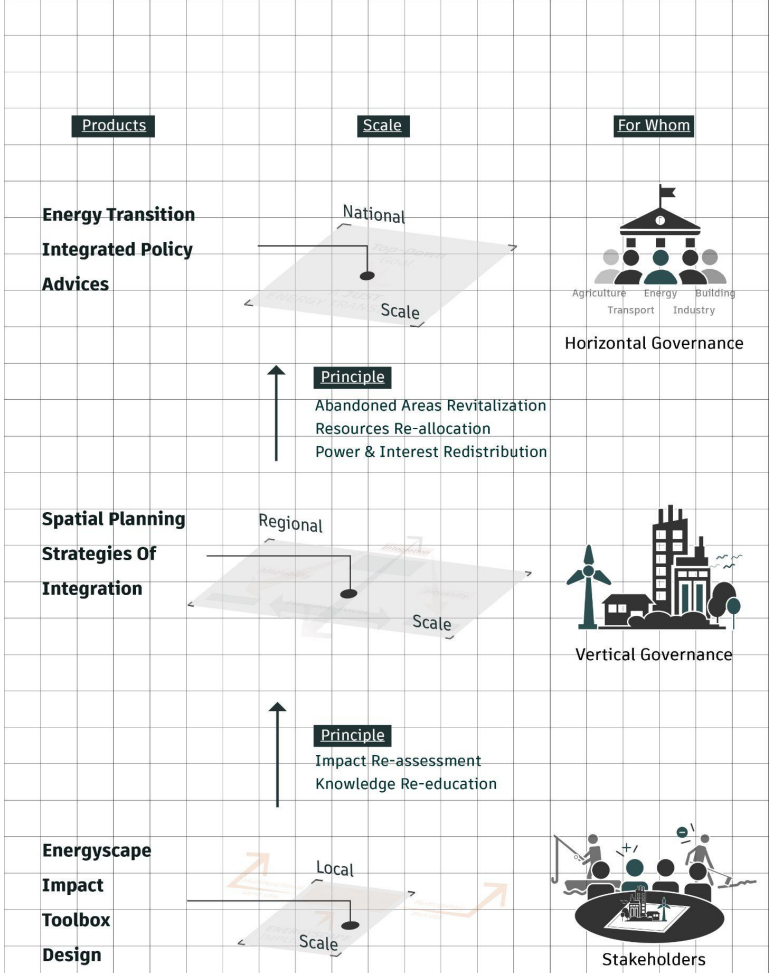
Vision

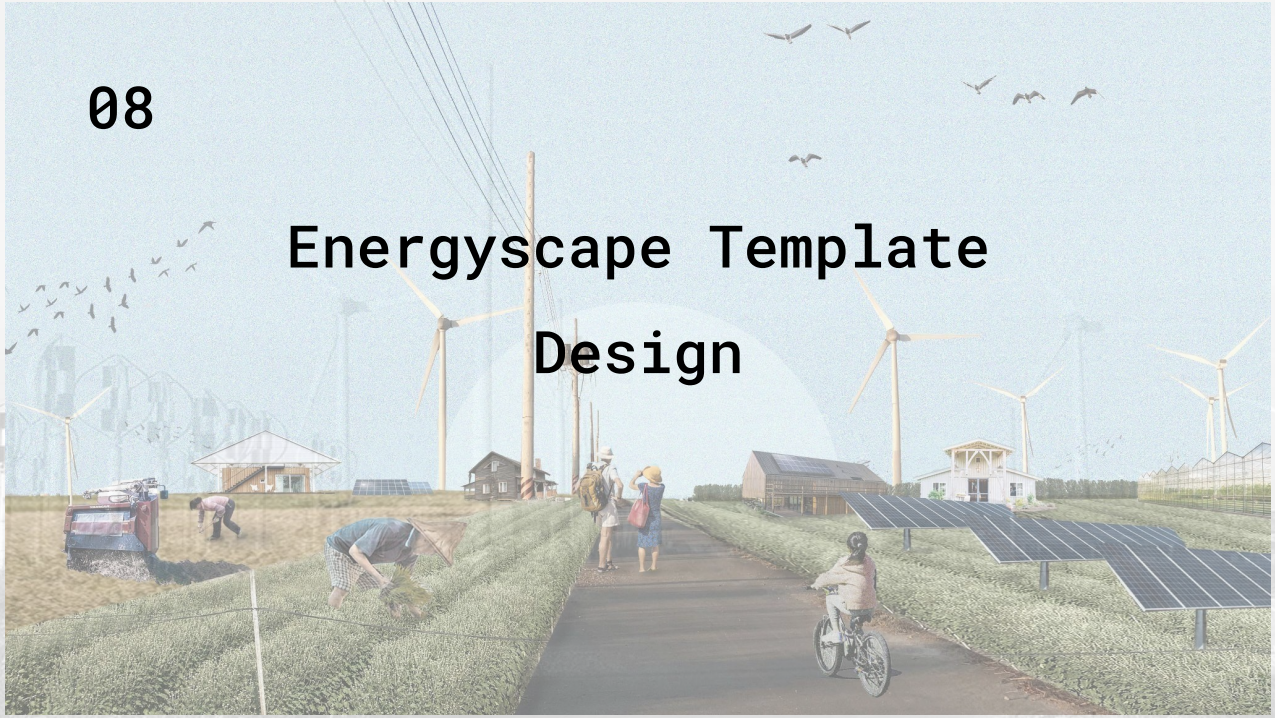
Prediction of Producs

-**Energyscape Template Design**: local scale

-**Integrated Regional Strategies**: regional scale

-**Integrated Policy Recommendations**: national scale



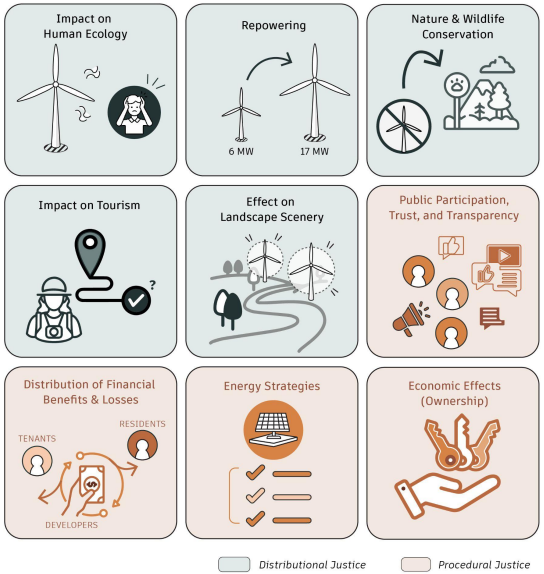


08

Energyscape Template Design

Energyscape Template Design

1. Social Acceptance of Energy Infrastructure Factors



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2. Qualification of Energy Landscape Types

Substantive Qualification
Energy Souces / Size

Spatial Qualification
Relationship with Space

Temperal Qualification
Dynamic to Permanent

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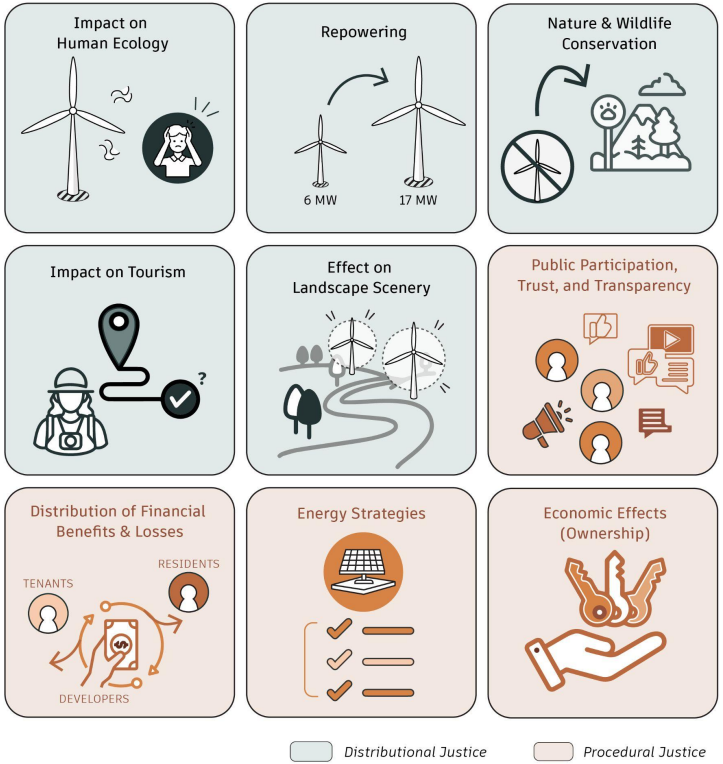
3. National Spatial Planning System

Energyscape Template Design

Design principles: Social Acceptance of Energy Infrastructure Factors



Energyscape Template Design

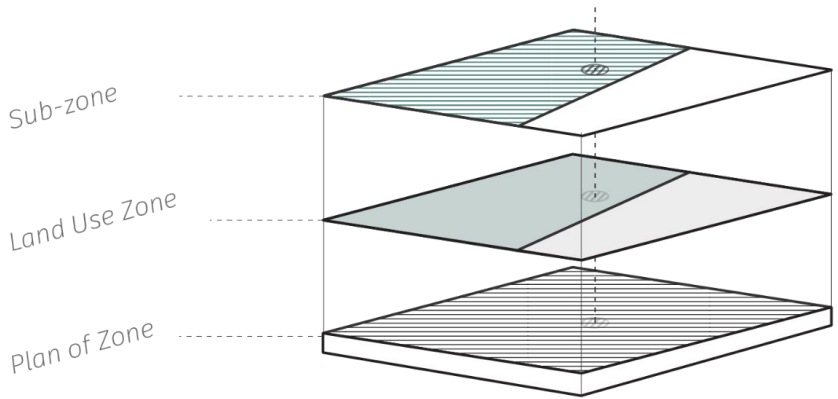
Energy Landscape Type		Impact On Social Acceptance
Substantive Qualification Energy Souces / Size	*affects*	 - Impact on Human Ecology
		 - Repowering
		 - Public Participation, Trust, Transparency
Spatial Qualification Relationship with Space	*affects*	 - Impact on Tourism
		 - Effect on Landscape Scenary
		 - Nature & Wildlife Conservation
		 - Public Participation, Trust, Transparency
Temperal Qualification Dynamic to Permanent	*affects*	 - Distribution of Financial Benefits & Losses
		 - Energy Strategies
		 - Economic Effects (Ownership)

Energyscape Template Design

-Methodology of the energyscape template design:

Temporal Qualification

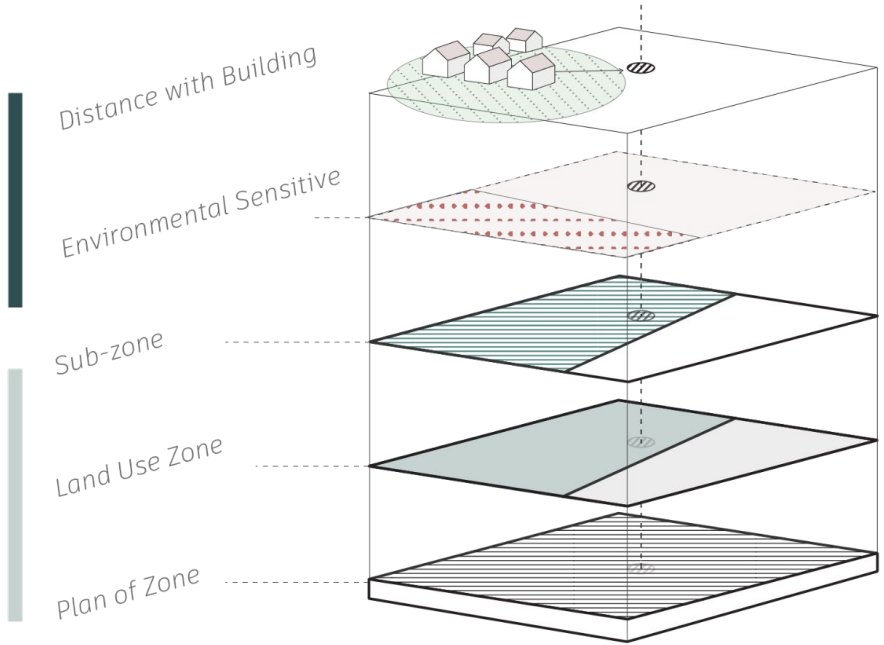
- *Distribution of Financial Benefits & Losses*
- *Energy Strategies*
- *Economic Effects (Ownership)*



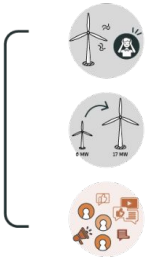
Energyscape Template Design

-Methodology of the energyscape template design:

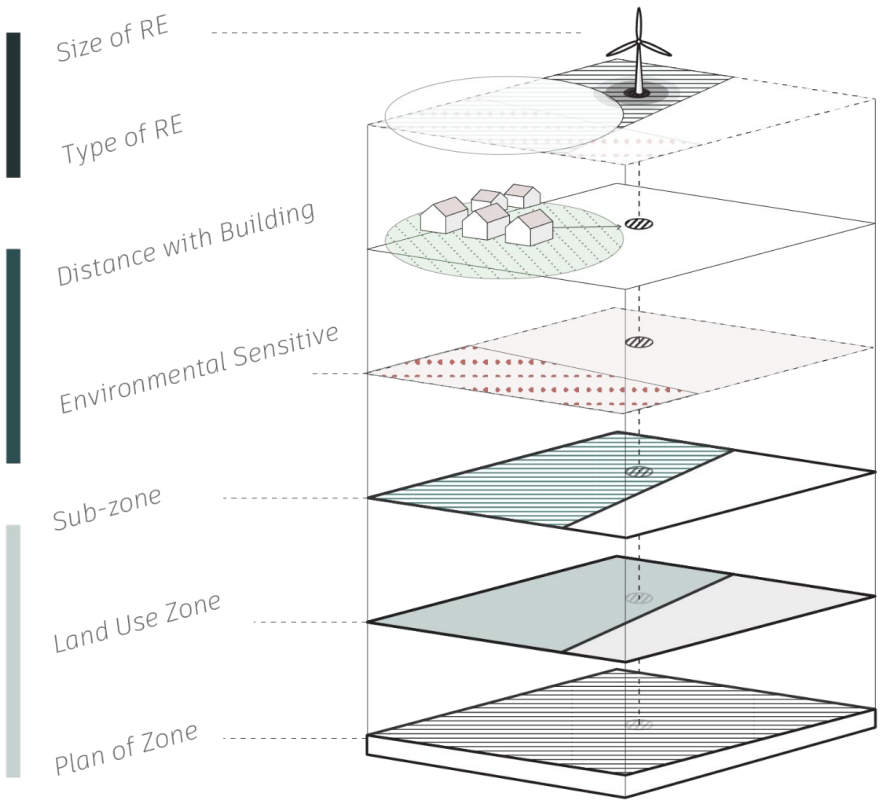
Spatial Qualification



Energyscape Template Design



- *Impact on Human Ecology*
- *Repowering*
- *Public Participation, Trust, Transparency*



-Methodology of the energyscape template design:

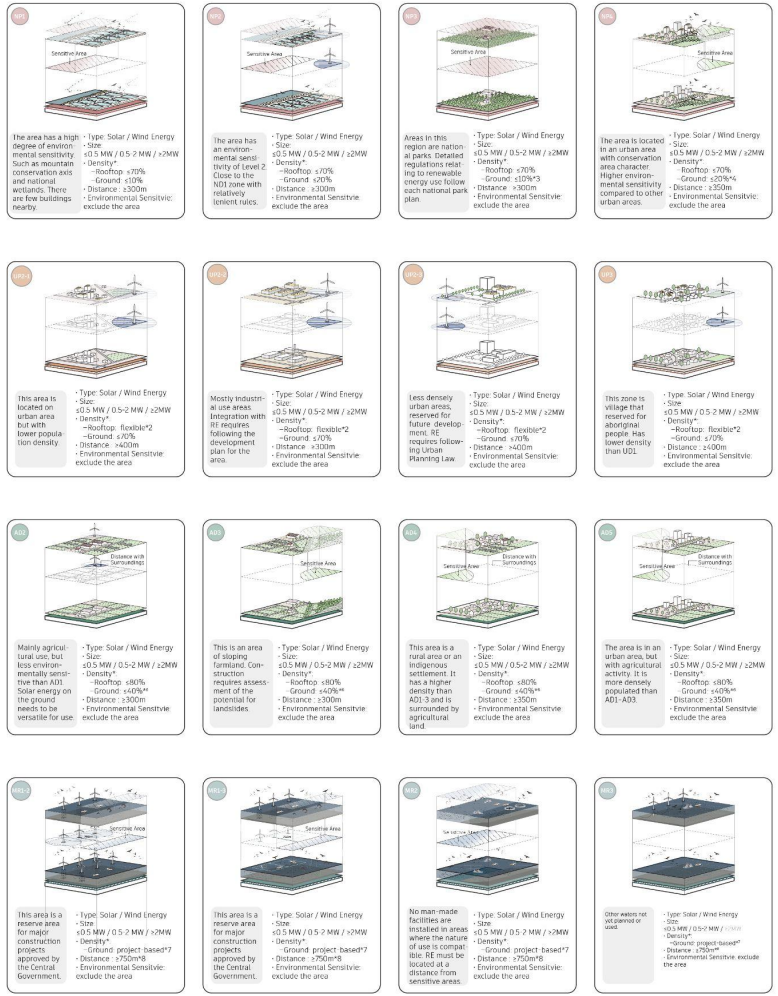
Substantive Qualification

Energyscape Template Design

-For participatory planning process

-4 main land use zone

- -National Protection Zone
- -Marine Resource Zone
- -Urban Development Zone
- -Agriculture Development Zone



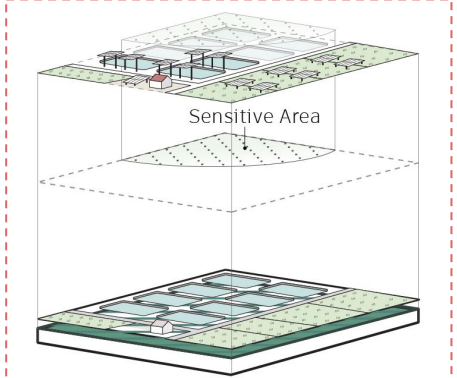
Energyscape Template Design

Visualisation

Combination Results

Example of the landscape

AD1



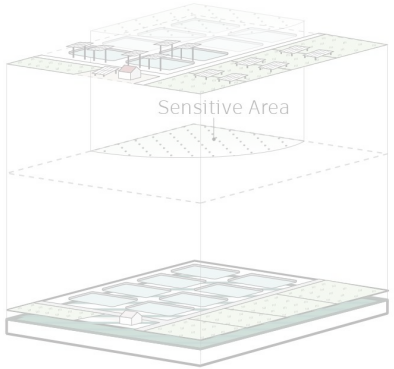
Exclusion factors

This is an area of prime agricultural land with a focus on agriculture development. Landscape change needs to be reviewed for assessment.

- Type: Solar / Wind Energy
- Size: ≤0.5 MW / 0.5-2 MW / ≥ 2MW
- Density*:
  - –Rooftop: ≤80%
  - –Ground: ≤40%*6
- Distance : ≥300m
- Environmental Sensitvie: exclude the area

Energyscape Template Design

AD1



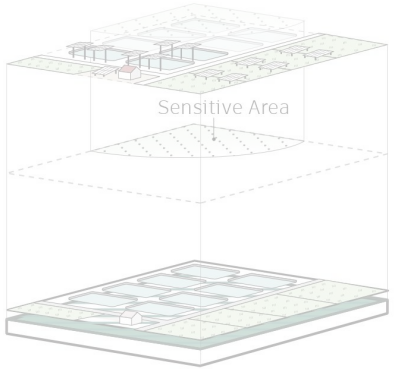
Definition of Sub-Land use zone

This is an area of prime agricultural land with a focus on agriculture development. Landscape change needs to be reviewed for assessment.

- Type: Solar / Wind Energy
- Size:
  ≤0.5 MW / 0.5-2 MW / ≥ 2MW
- Density*:
  - Rooftop: ≤80%
  - Ground: ≤40%*6
- Distance : ≥300m
- Environmental Sensitvie: exclude the area

Energyscape Template Design

AD1



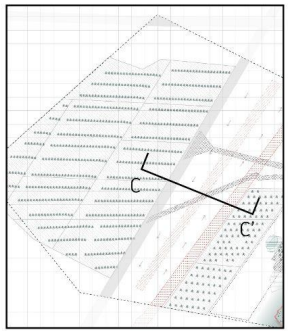
This is an area of prime agricultural land with a focus on agriculture development. Landscape change needs to be reviewed for assessment.

· Type: Solar / Wind Energy
· Size:
≤0.5 MW / 0.5-2 MW / ≥ 2MW
· Density*:
  –Rooftop: ≤80%
  –Ground: ≤40%*[6]
· Distance : ≥300m
· Environmental Sensitvie: exclude the area

Regulations

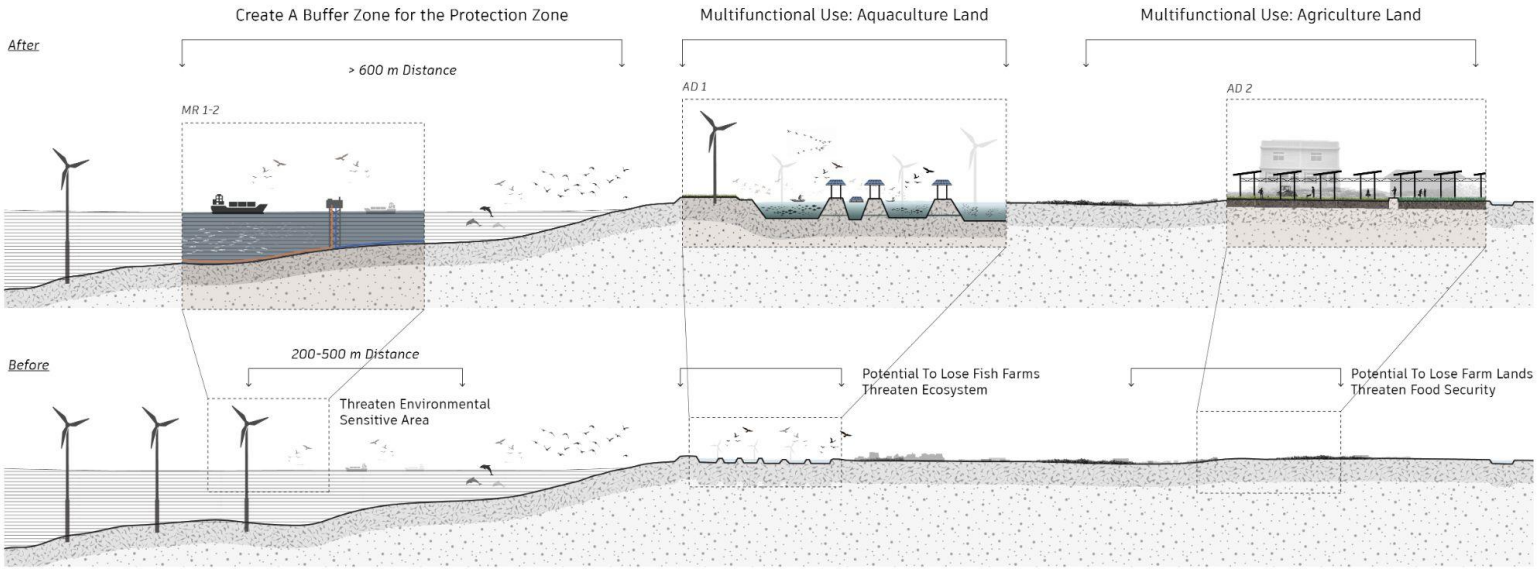
Energyscape Template Design

5 Zoomed-in Sections



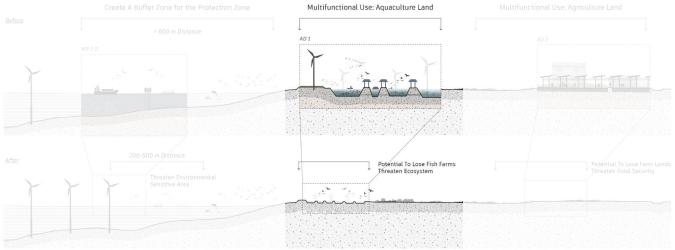
Energyscape Template Design

AA Section -Fangyuan Township—Uncompetitive Rural Area

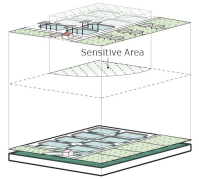


Energyscape Template Design

AA Section -AD1 / Aquacultural Land Area



AD1



This is an area of prime agricultural land with a focus on agriculture development. Landscape change needs to be reviewed for assessment.

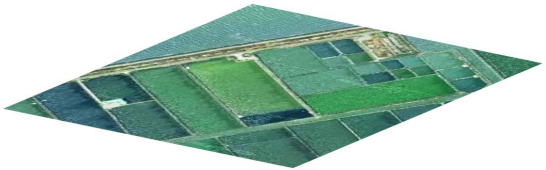
- Type: Solar / Wind Energy
- Size: ≤0.5 MW / 0.5-2 MW / ≥ 2MW
- Density*:
  - –Rooftop: ≤80%
  - –Ground: ≤40%*6
- Distance : ≥300m
- Environmental Sensitvie: exclude the area

Energyscape Template Design

Co-Exploration Process

Implementation Steps

1. **Location Selection**
2. **Land Zone Define**
3. **Environmental Sensitive Check**
   e.g. ecological sensitives
4. **Land Use Type Define:**
   define land funcitional activities



1 **Satellite Images:**

source: Geographic Information System for National Planning

Energyscape Template Design

Co-Exploration Process

Implementation Steps

1. **Location Selection**
2. **Land Zone Define**
3. **Environmental Sensitive Check**
   e.g. ecological sensitives
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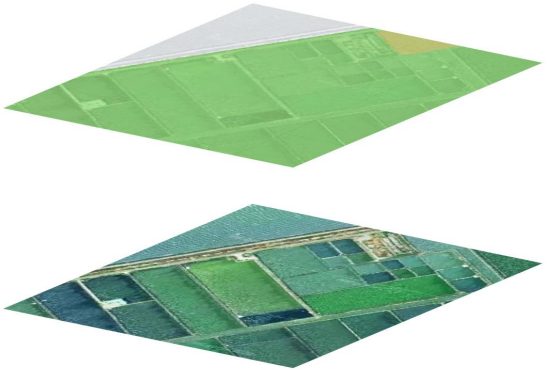
   define land funcitional activities



2 **National Spatial Planning:**
AD1 zone

1 **Satellite Images:**

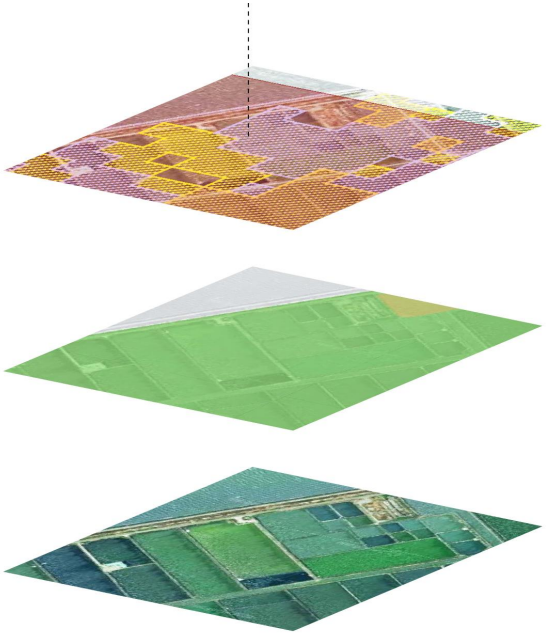
source: Geographic Information System for National Planning

Energyscape Template Design

Co-Exploration Process

Implementation Steps

1. **Location Selection**
2. **Land Zone Define**
3. **Environmental Sensitive Check**
   e.g. ecological sensitives
4. **Land Use Type Define:**
   define land funcitional activities



3. **Environmentally sensitive:** flooding, waterfowl hotspots

2. **National Spatial Planning:** AD1 zone

1. **Satellite Images:**

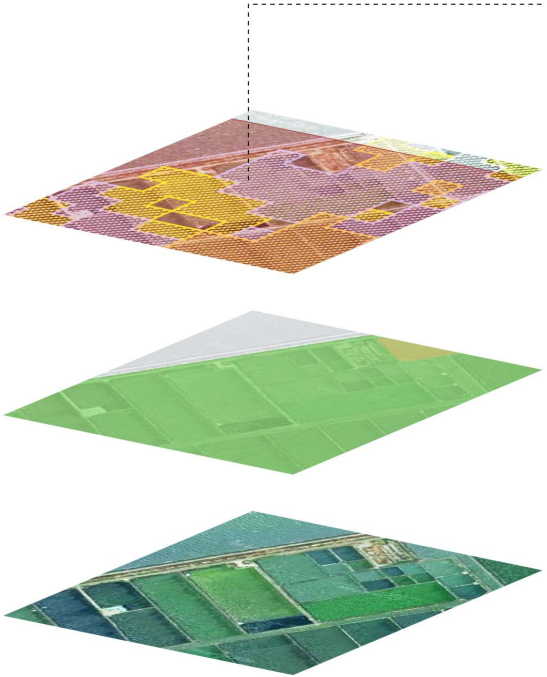
source: Geographic Information System for National Planning

Energyscape Template Design

Co-Exploration Process

Implementation Steps

1. **Location Selection**
2. **Land Zone Define**
3. **Environmental Sensitive Check**
   e.g. ecological sensitives
4. **Land Use Type Define:**
   define land funcitional activities



4. Aquaculture Use

↑

3. **Environmentally sensitive:** flooding, waterfowl hotspots

↑

2. **National Spatial Planning:** AD1 zone

↑

1. **Satellite Images:**

source: Geographic Information System for National Planning

Energyscape Template Design

Co-Exploration Process

❺ **Regulations Checking**
permission Area
distance with the built environment

❻ **Energy Source Selection**

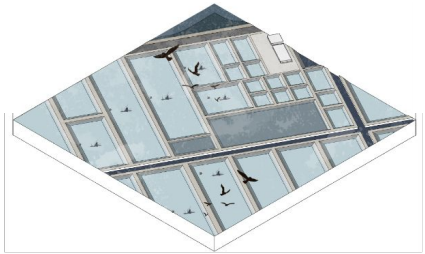
❼ **Energy Size & Type Selection**

size
- < 0.5MW
- 0.5-2MW
- >2MW

Type
- Rooftop
- On The Ground

❽ **Cover Rate**
Check on the template cards

Current



Energyscape Template Design

Co-Exploration Process

❺ Regulations Checking
permission Area
distance with the built environment

❻ Energy Source Selection

❼ Energy Size & Type Selection

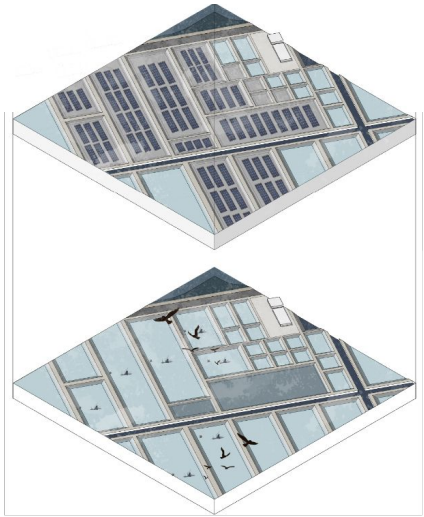
size
- < 0.5MW
- 0.5-2MW
- >2MW

Type
- Rooftop
- On The Ground

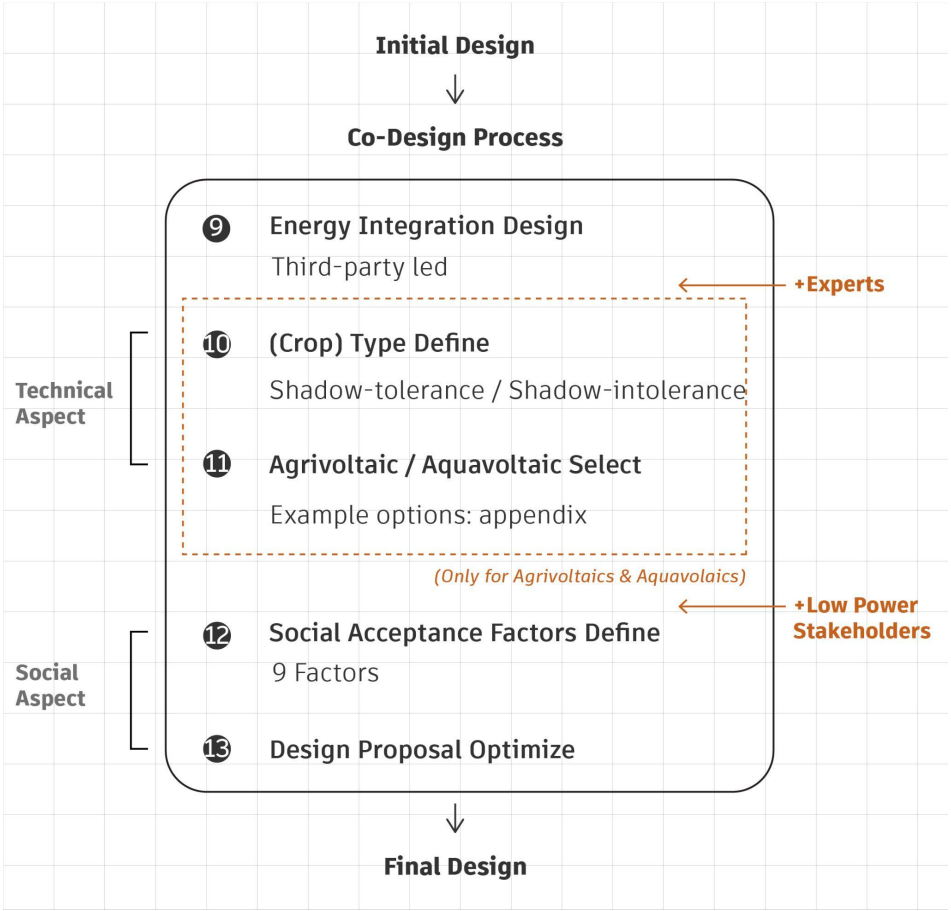
❽ Cover Rate
Check on the template cards

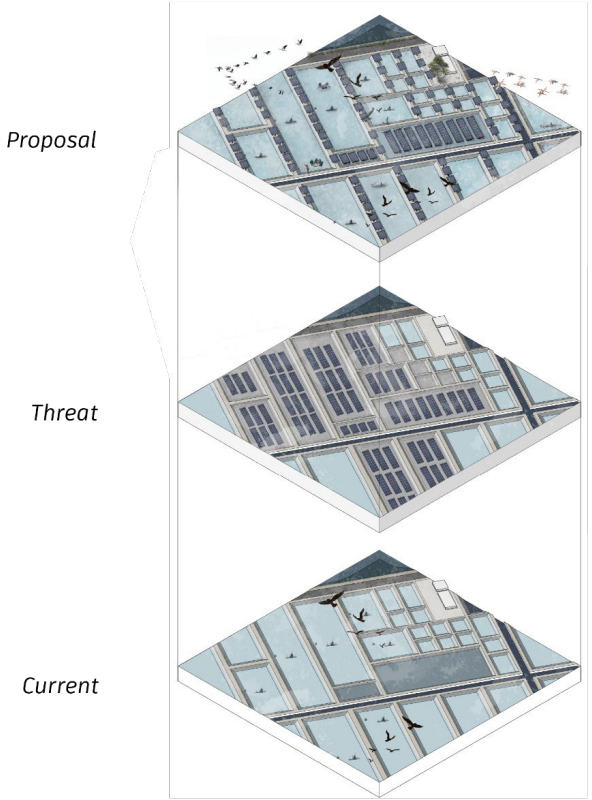
Threat

Current



Energyscape Template Design





Energyscape Template Design

Initial Design

↓

Co-Design Process

9 **Energy Integration Design**

Third-party led

← **+Experts**

Technical Aspect

10 **(Crop) Type Define**

Shadow-tolerance / Shadow-intolerance

11 **Agrivoltaic / Aquavoltaic Select**

Example options: appendix

(Only for Agrivoltaics & Aquavolaics)

← **+Low Power Stakeholders**

Social Aspect

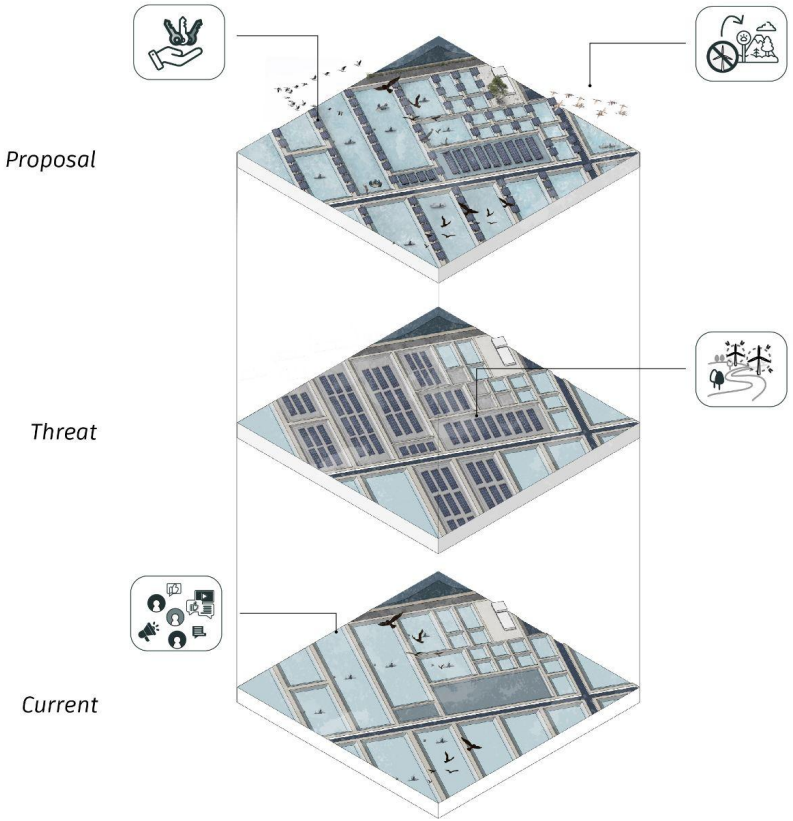
12 **Social Acceptance Factors Define**

9 Factors

13 **Design Proposal Optimize**

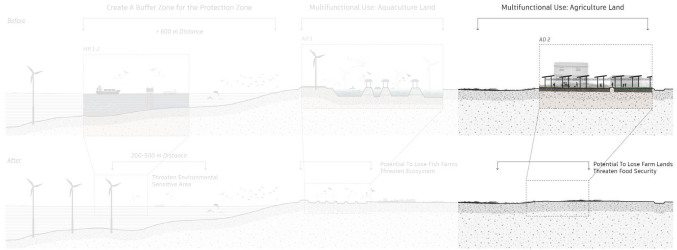
↓

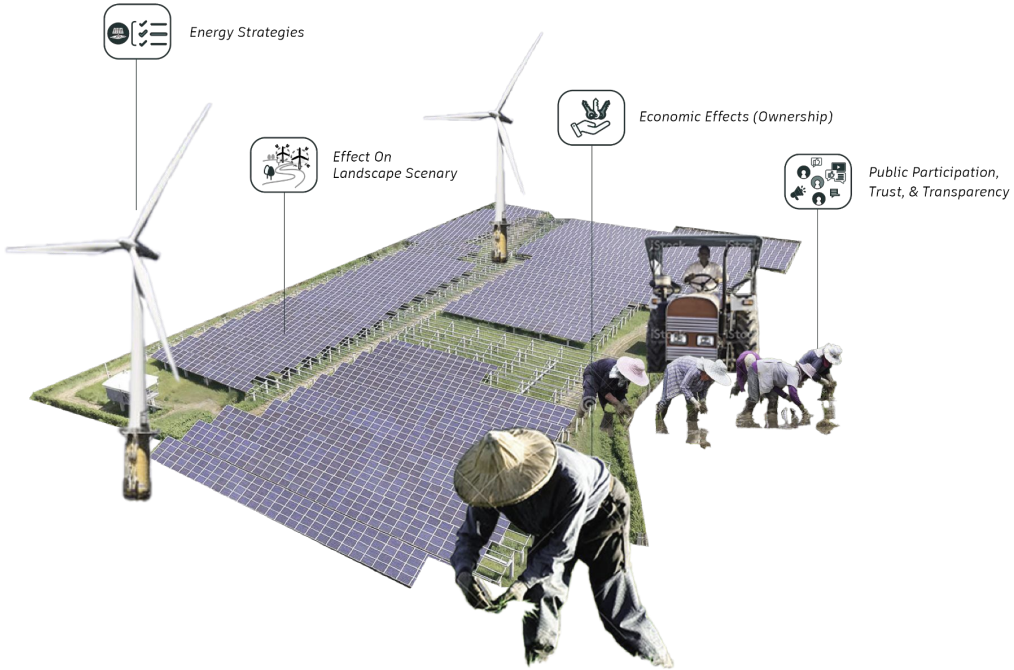
Final Design



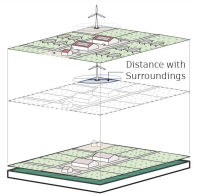
Energyscape Template Design

AA Section -AD2 / Agricultural Land Area





AD2



Mainly agricultural use, but less environmentally sensitive than AD1. Solar energy on the ground needs to be versatile for use.

- Type: Solar / Wind Energy
- Size:
  ≤0.5 MW / 0.5-2 MW / ≥2MW
- Density*:
  −Rooftop: ≤80%
  −Ground: ≤40%*6
- Distance : ≥300m
- Environmental Sensitvie: exclude the area

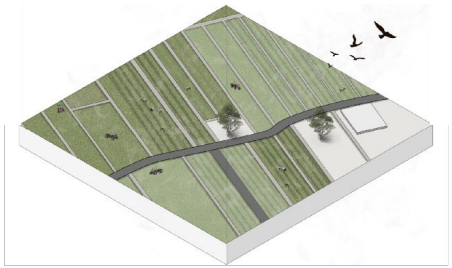
Energyscape Template Design

AA Section

-AD2

-Agricultural Land Area

Current



Energyscape Template Design

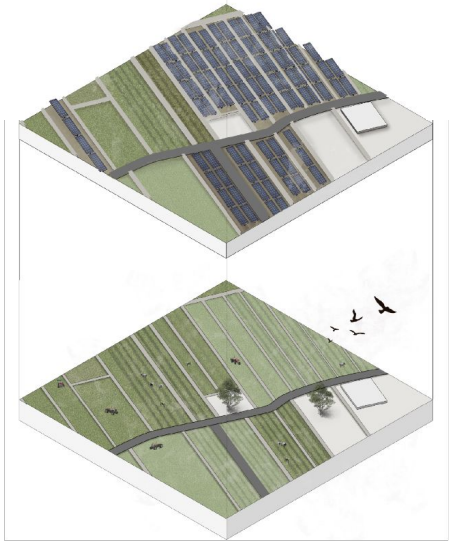
AA Section

-AD2

-Agricultural Land Area

Threat

Current

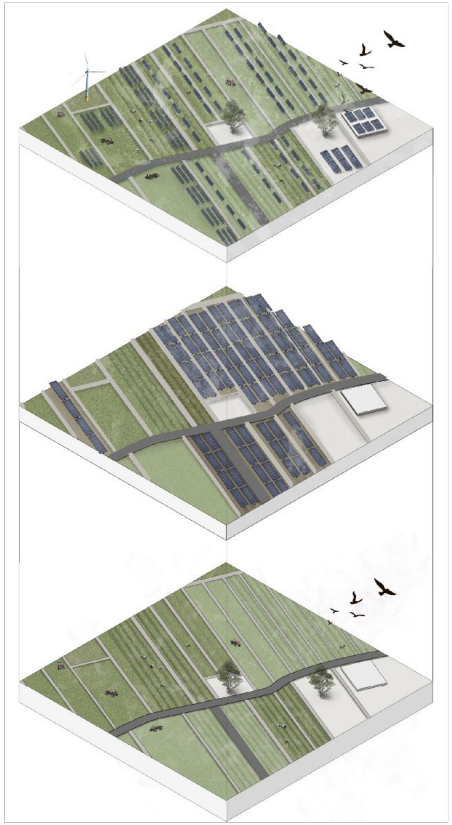


Energyscape Template Design

Proposal

Threat

Current

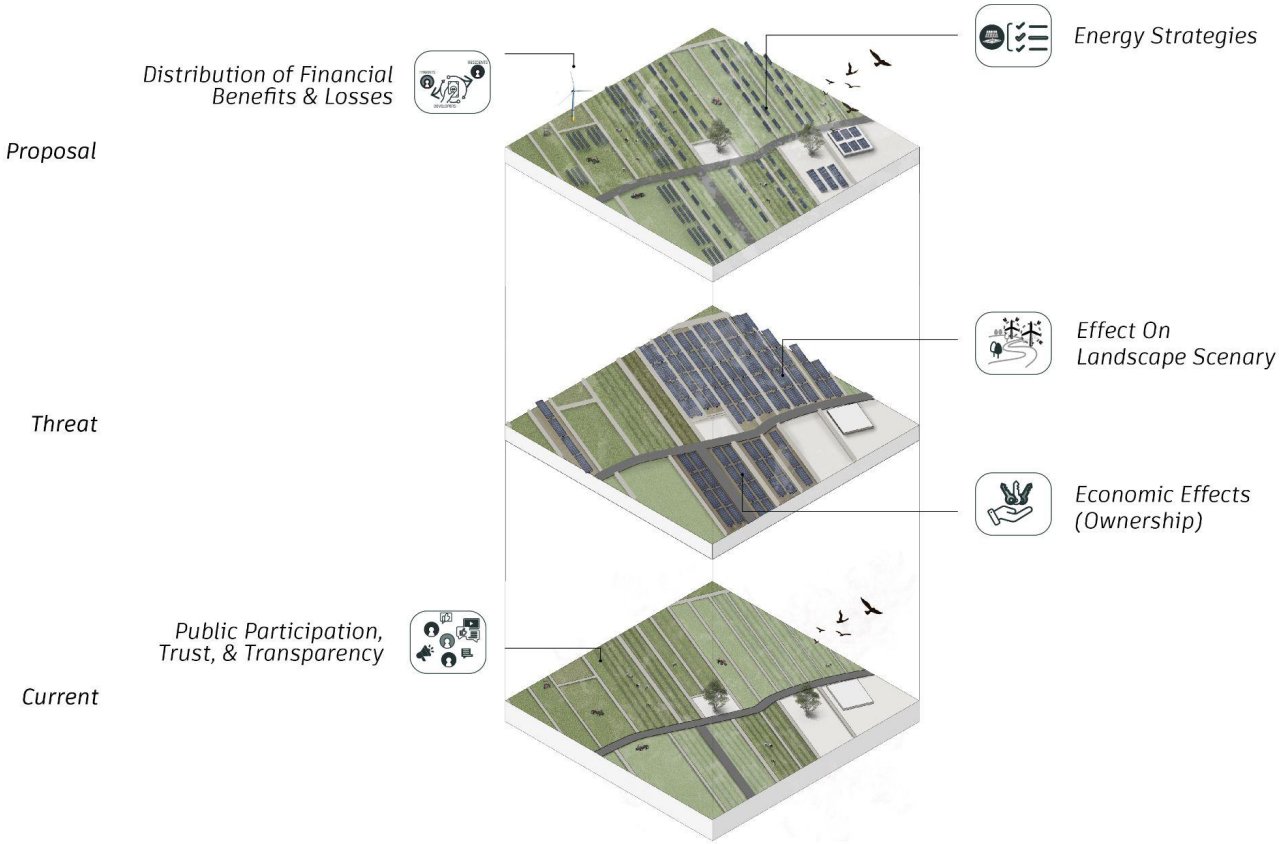


AA Section

-AD2

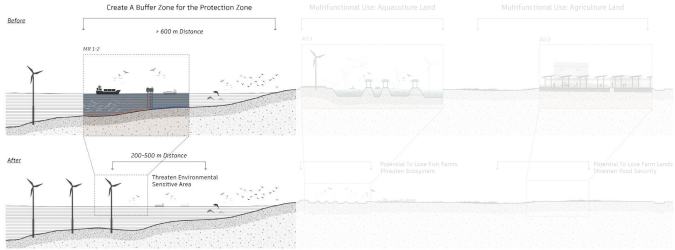
-Agricultural Land Area

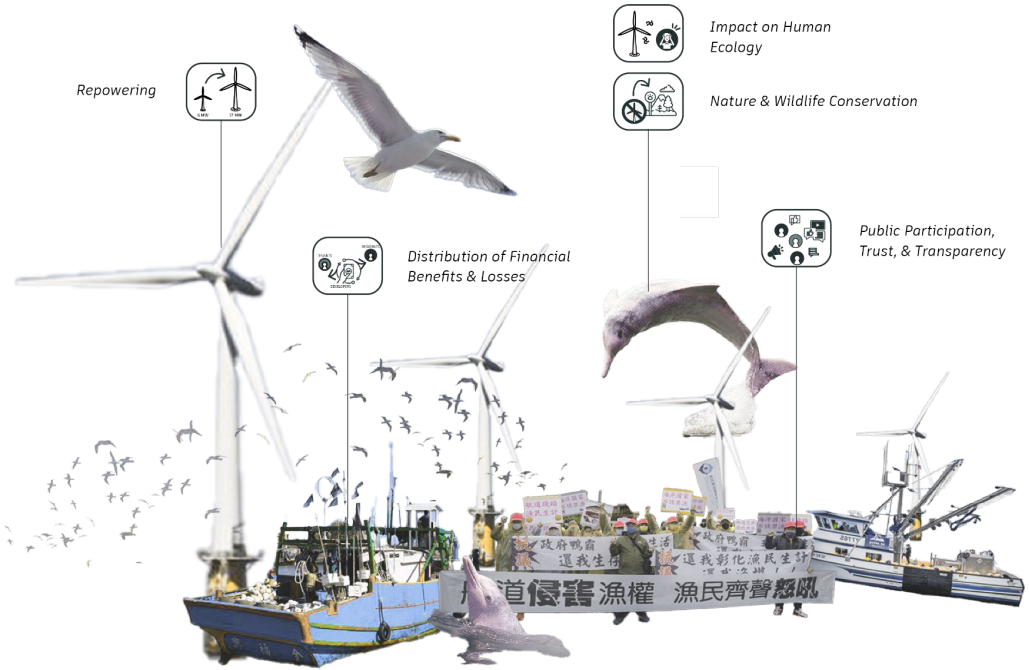
Energyscape Template Design

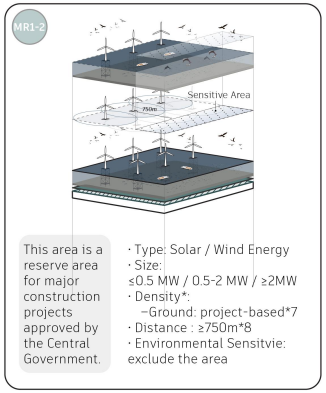


Energyscape Template Design

AA Section -MR1-2 / Marine Spatial Area





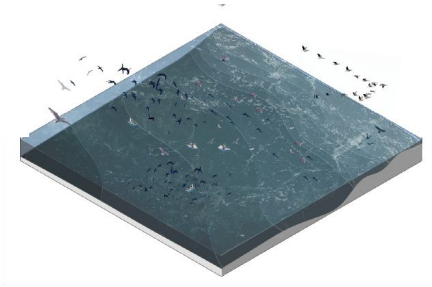


This area is a reserve area for major construction projects approved by the Central Government.

- Type: Solar / Wind Energy
- Size: ≤0.5 MW / 0.5-2 MW / ≥2MW
- Density*:
  - Ground: project-based*7
- Distance : ≥750m*8
- Environmental Sensitvie: exclude the area

Energyscape Template Design

Current



AA Section

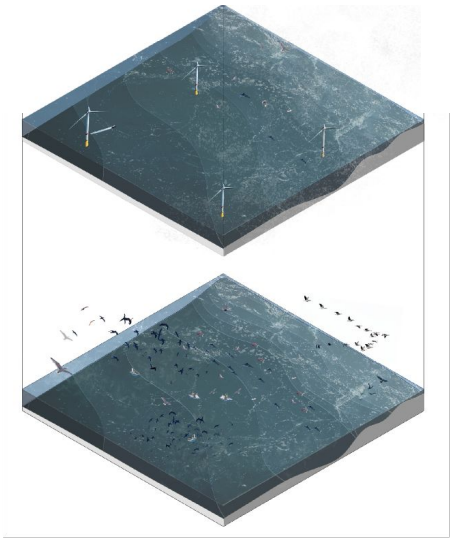
-MR1-2

-Marine Spatial Area

Energyscape Template Design

Threat

Current



AA Section

-MR1-2

-Marine Spatial Area

Energyscape Template Design

Proposal

Threat

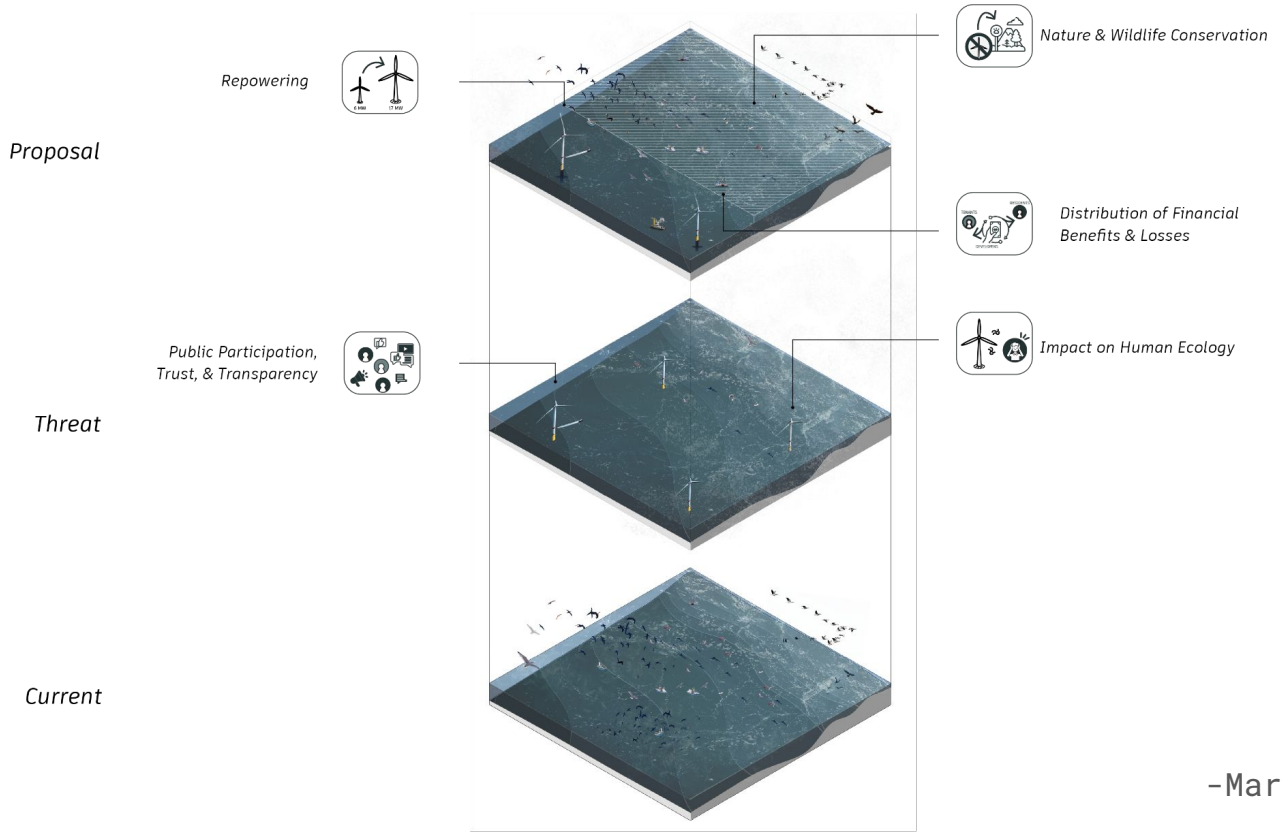
Current

AA Section

-MR1-2

-Marine Spatial Area

Energyscape Template Design



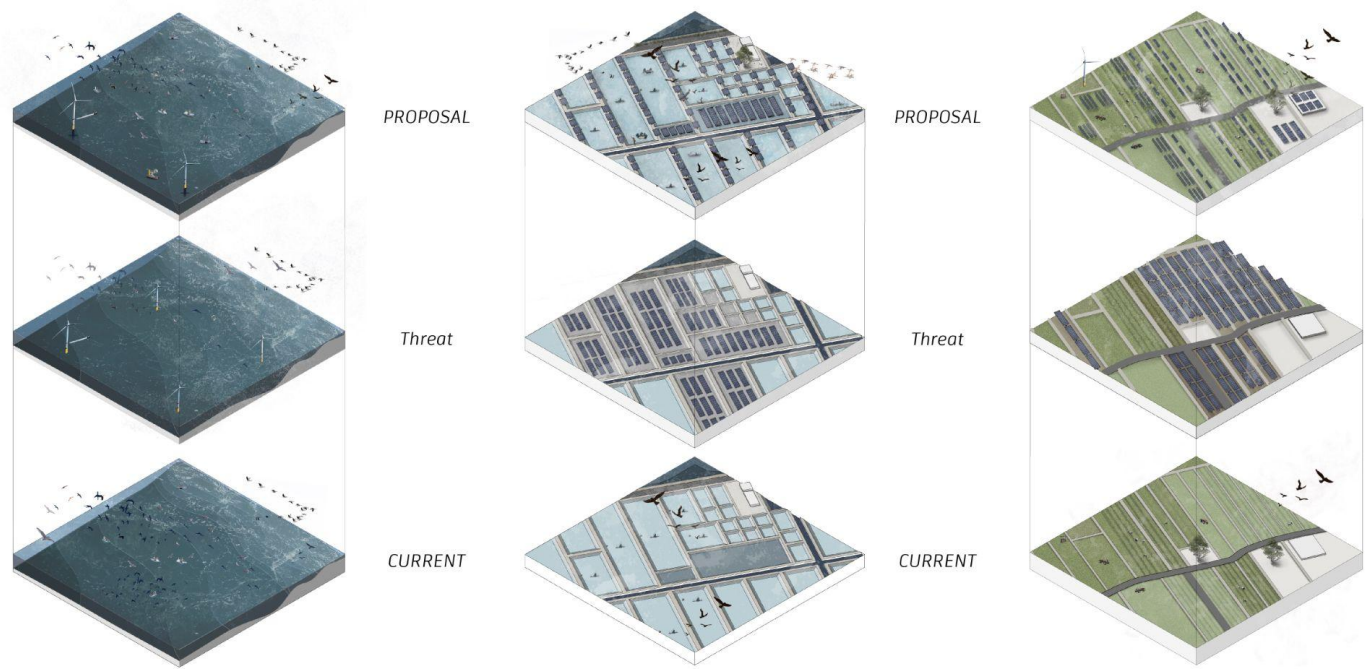
AA Section

-MR1-2

-Marine Spatial Area

Energyscape Template Design

AA Section -Fangyuan Township– Uncompetitive Rural Area



A1 Marine Spatial Area

A2 Aquacultural Land Area

A3 Agricultural Land Area

09

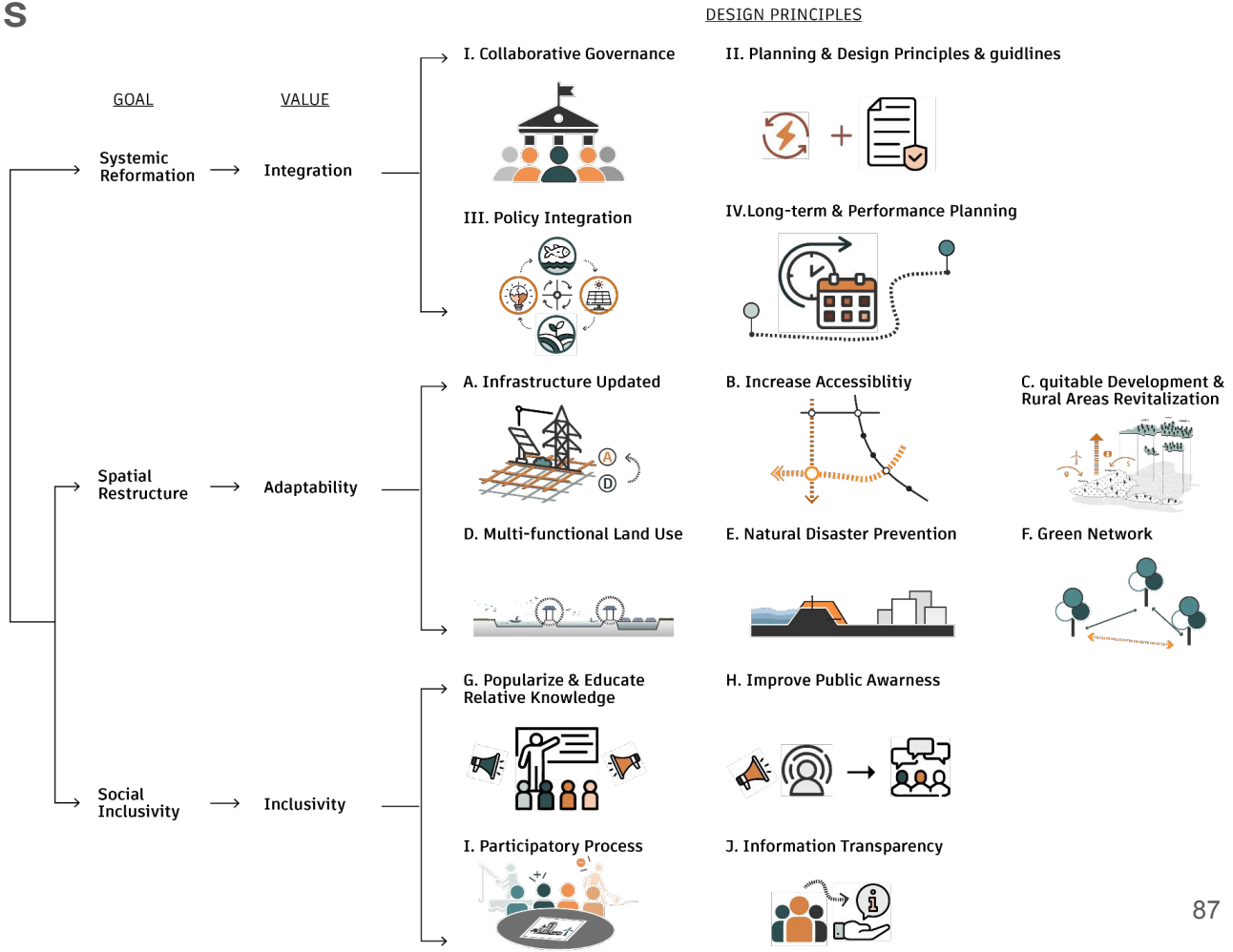
Regional Strategies

Regional Strategies

-Systemic Reformation

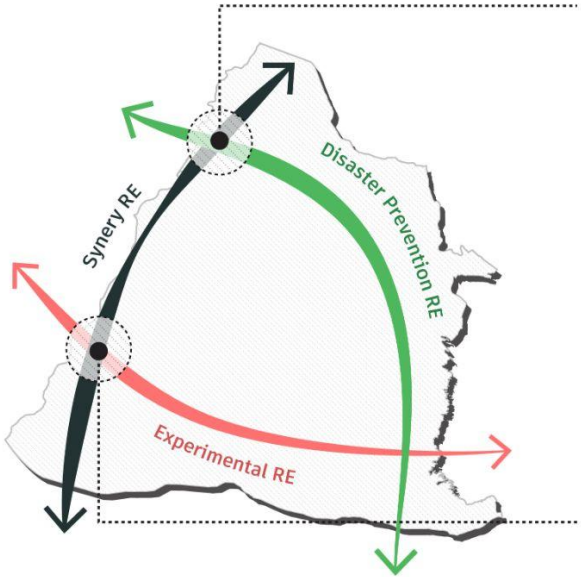
-Spatial Restructure

-Social Inclusivity



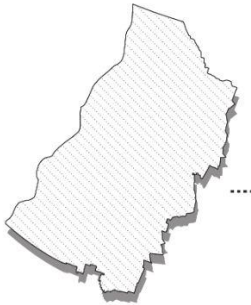
Regional Strategies

City Scale:
Regional Planning & Design



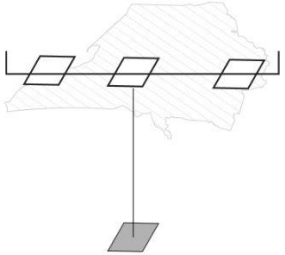
District Scale:
Regional Strategies

Lugang Township

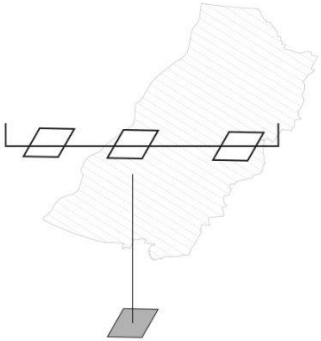


Fangyuan Township

Local:
Energyscape Design



Energyscape Template
Implementation

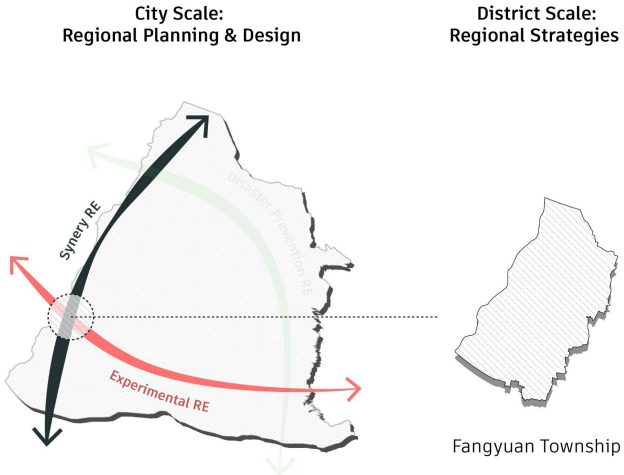


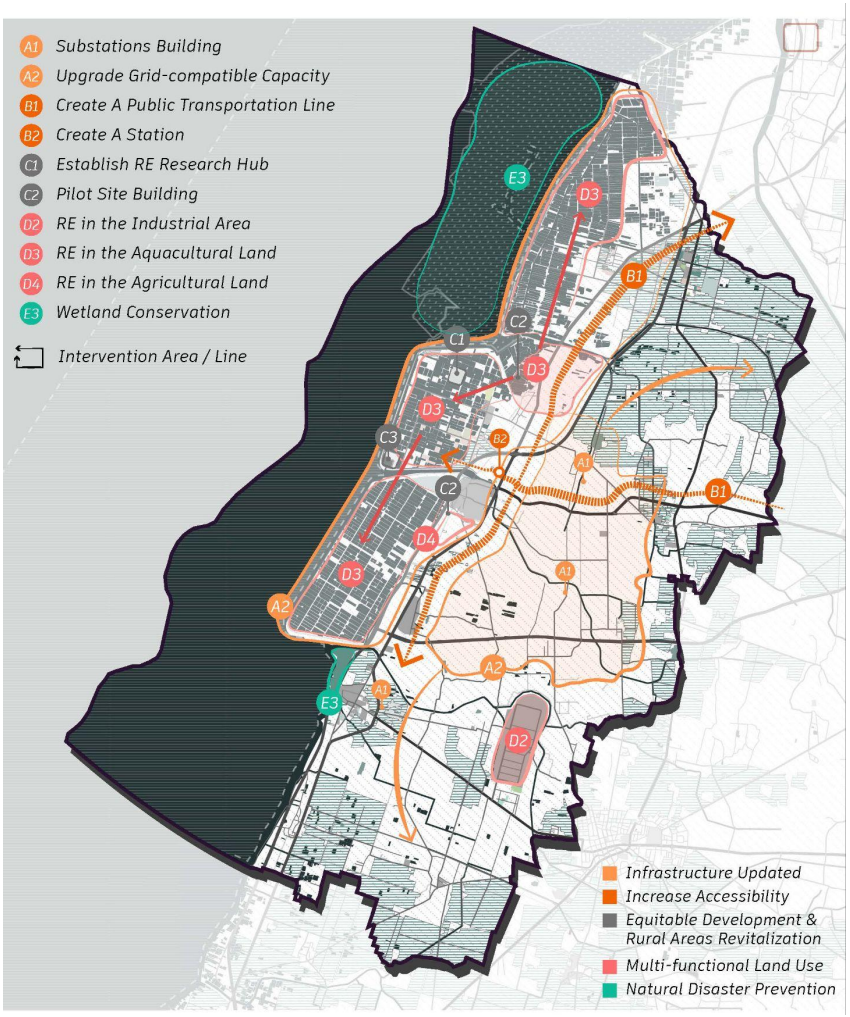
Energyscape Template
Implementation

Regional Strategies

Fangyuan Township

-Experimental RE for Synergy





Regional Strategies

Fangyuan Township

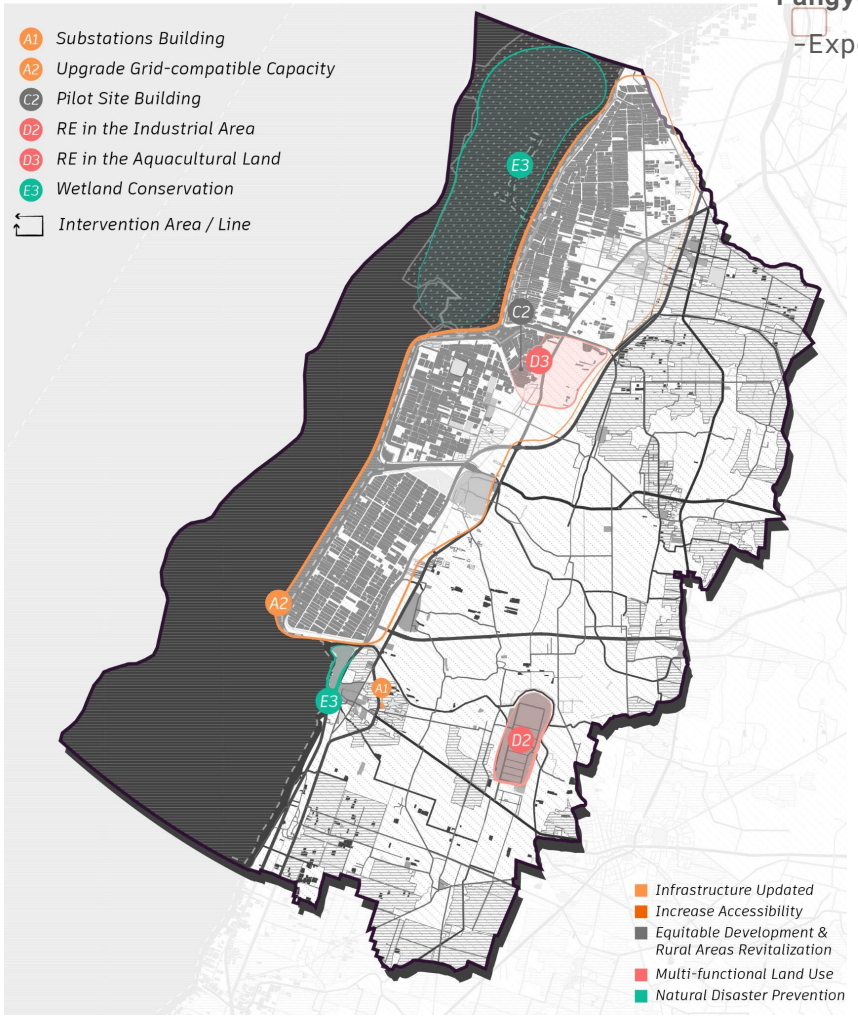
-Experimental RE for Synergy

PhaseI 2025: Preparation Stage

-RE Experiment in aquaculture

-Update RE infrastructure

-Pilot site building: combine with social strategies



Regional Strategies

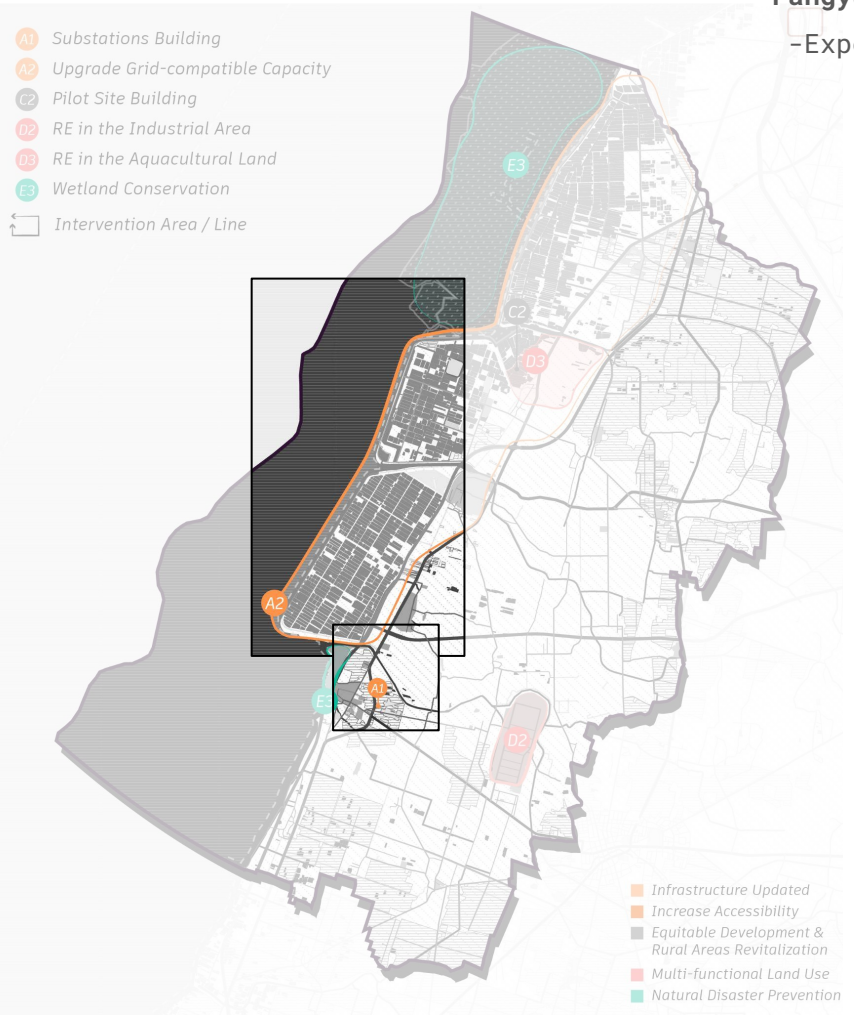
Fangyuan Township

-Experimental RE for Synergy

PhaseI 2025: Preparation Stage

-Update RE infrastructure

-Substations building



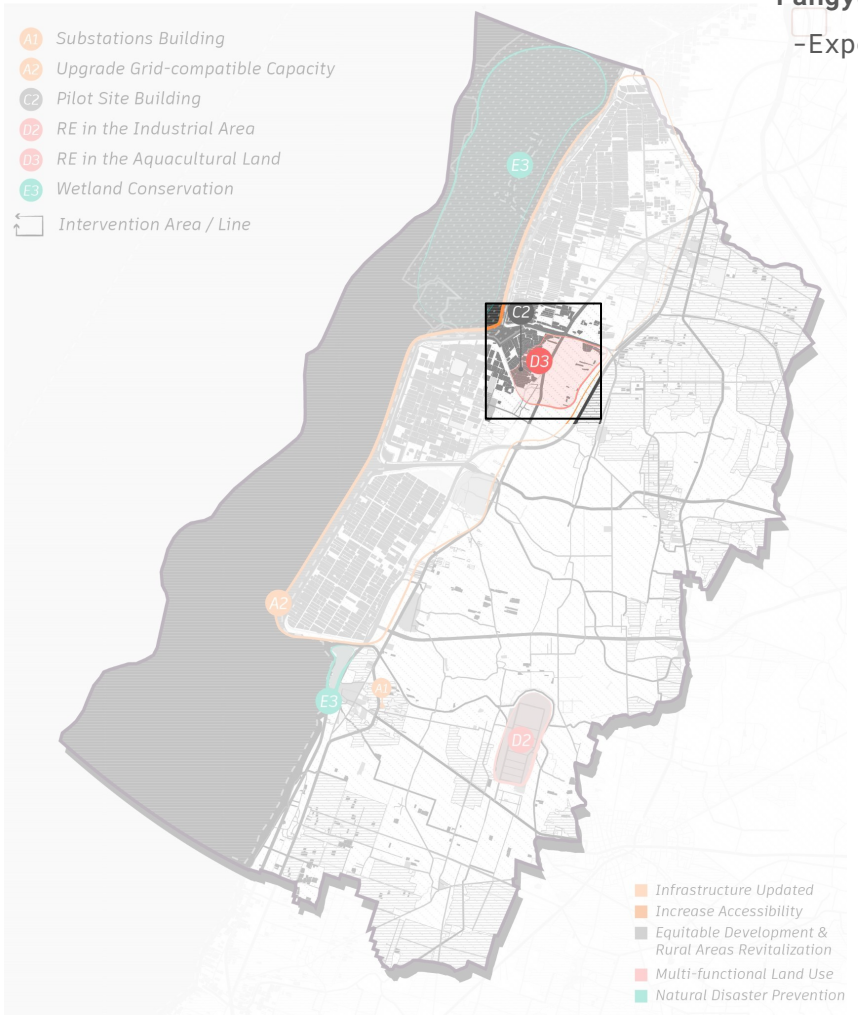
Regional Strategies

Fangyuan Township

-Experimental RE for Synergy

PhaseI 2025: Preparation Stage

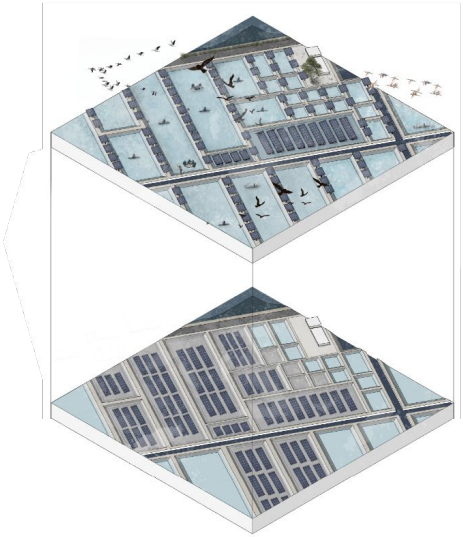
-Pilot site building: RE Experiment in aquaculture



Regional Strategies

PhaseI 2025: Preparation Stage

-Implementation of Energyscape Template

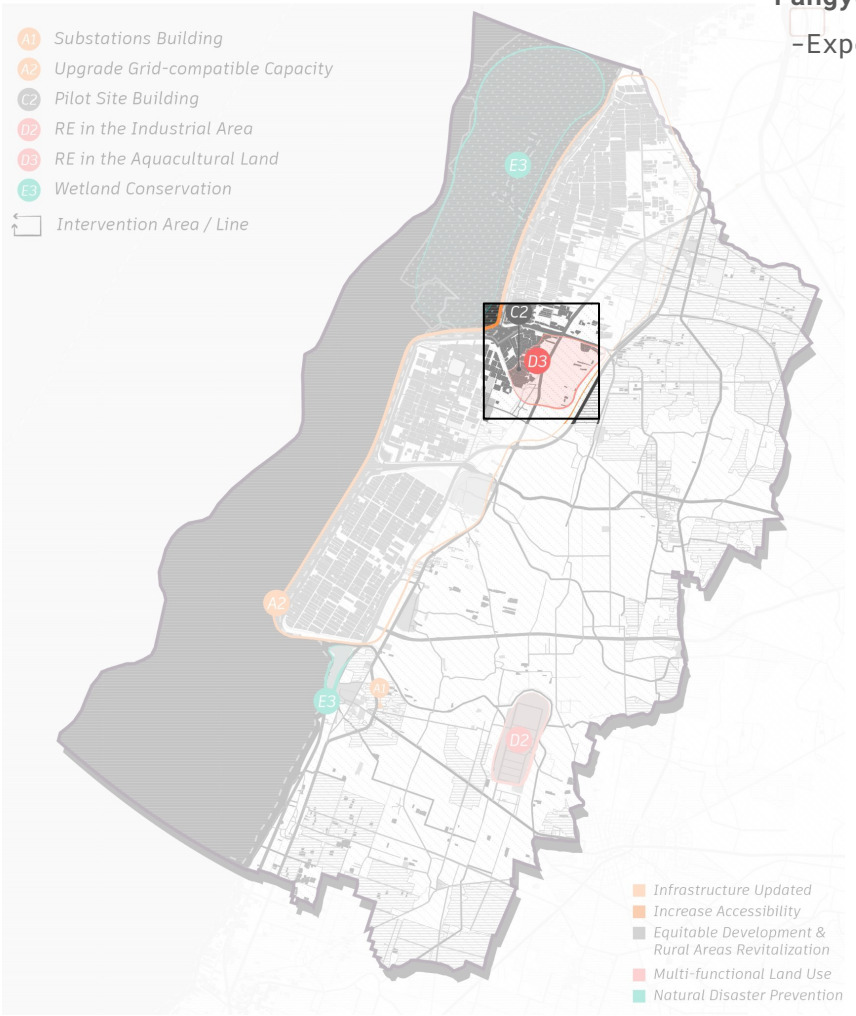


Proposal

Threat

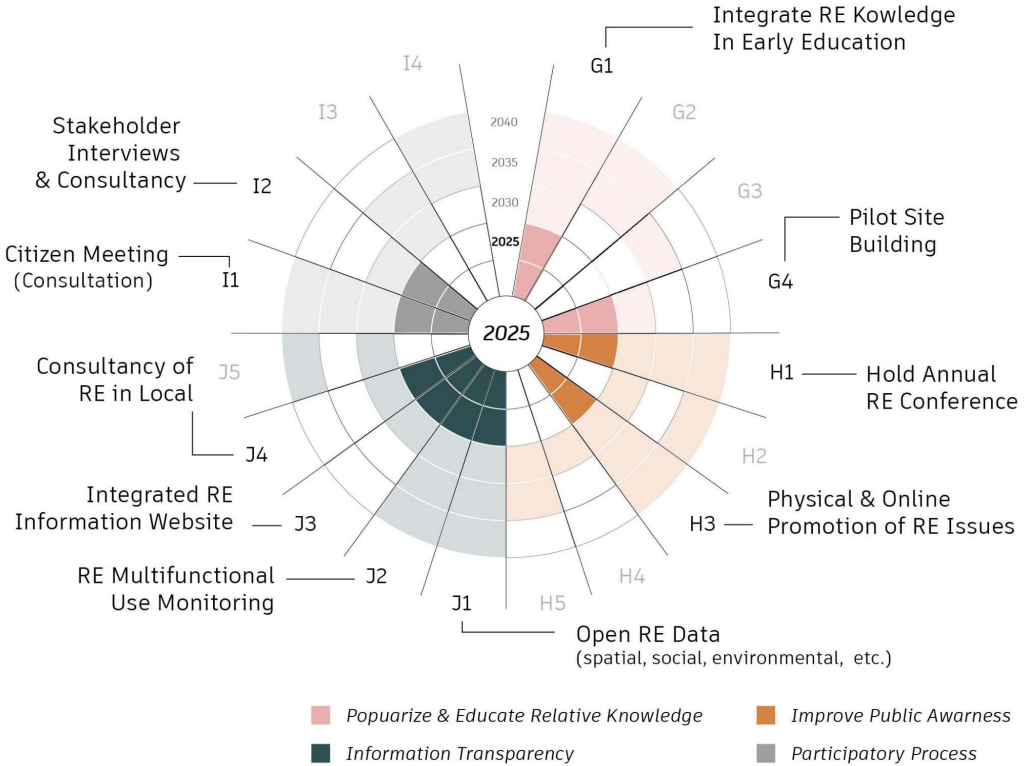
Fangyuan Township

-Experimental RE for Synergy



Regional Strategies

PhaseI 2025: Preparation Stage



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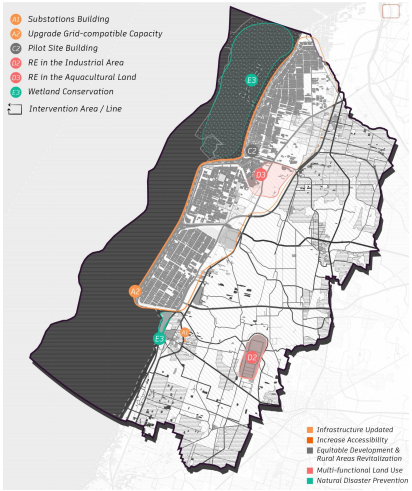


Regional Strategies

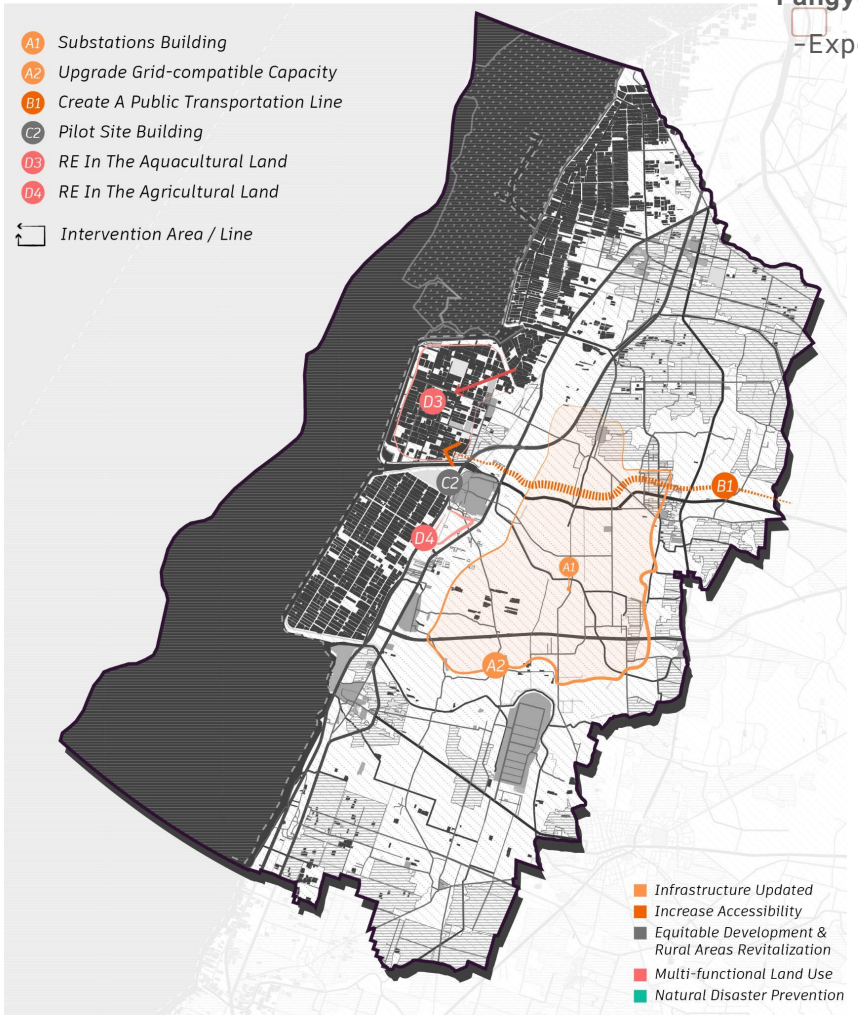
PhaseII 2030: Implementation Stage

-RE Experiment in agriculture

-Expand RE infrastructure renewal

-Pilot site building

-Create public transportation (W&E)



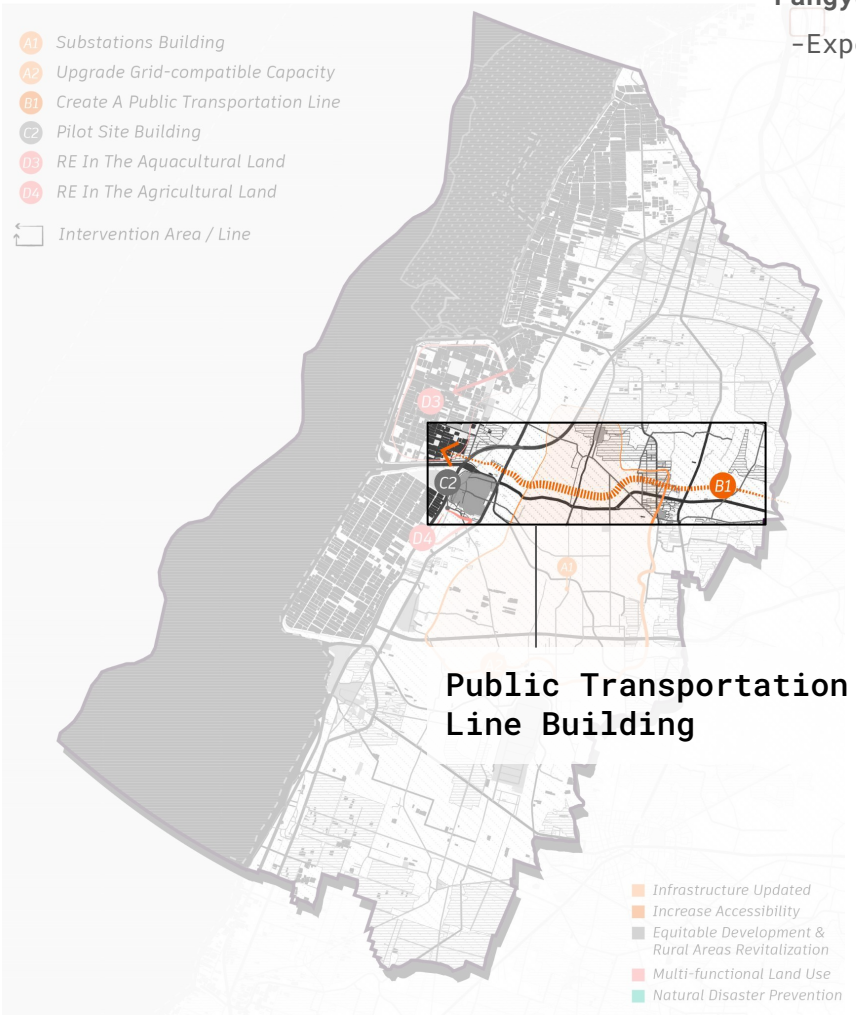
Fangyuan Township

-Experimental RE for Synergy

Regional Strategies

PhaseII 2030: Implementation Stage

-Create public transportation (W<>E)



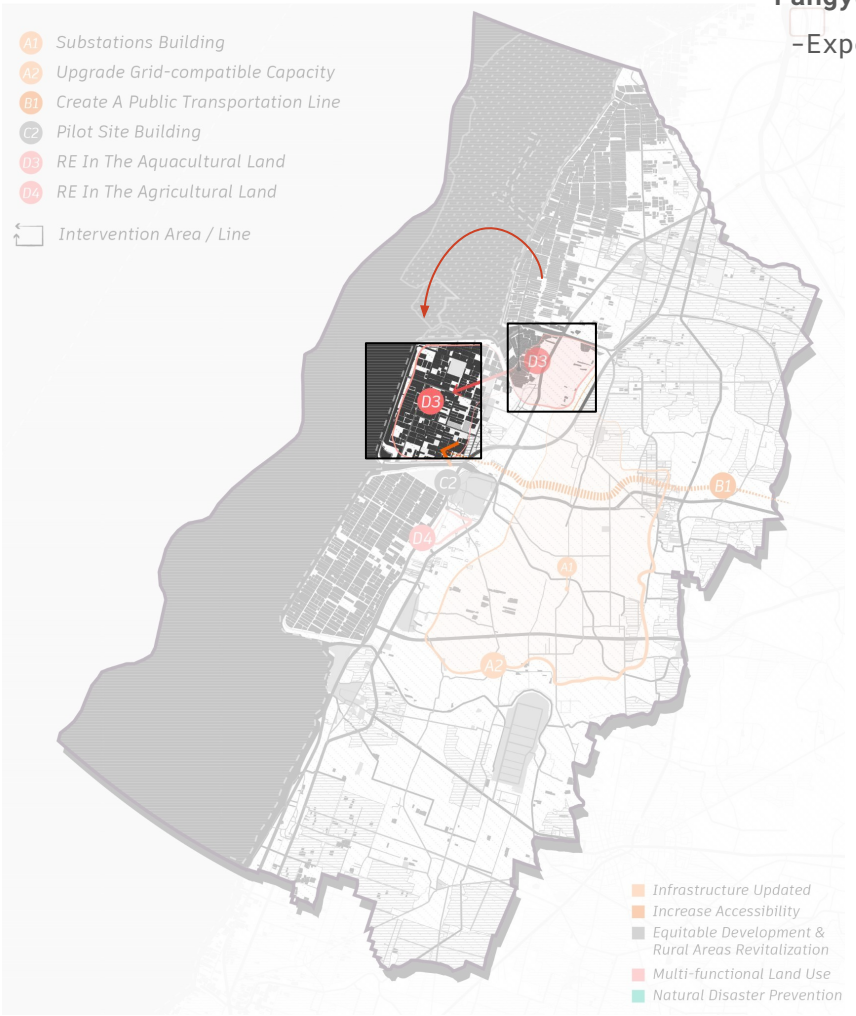
Regional Strategies

Fangyuan Township

-Experimental RE for Synergy

PhaseII 2030: Implementation Stage

-Implementation of multifunctional use of aquaculture



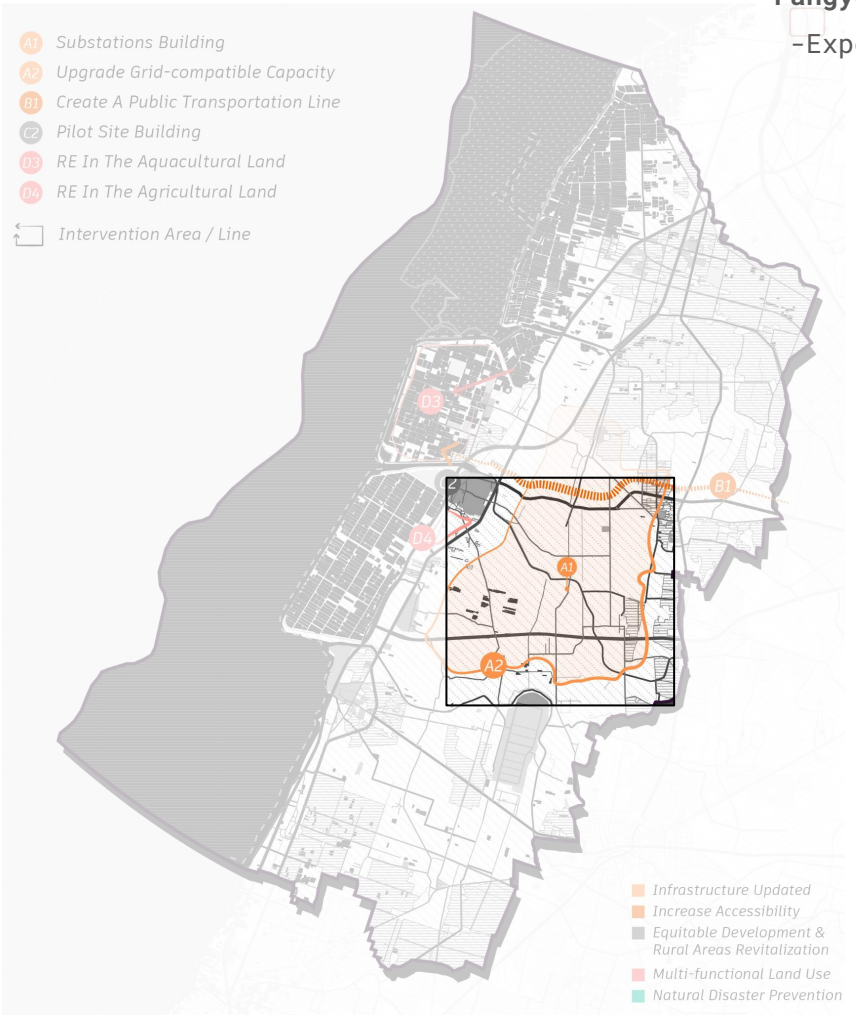
Regional Strategies

Fangyuan Township

-Experimental RE for Synergy

PhaseII 2030: Implementation Stage

-Expand the updated RE infrastructure



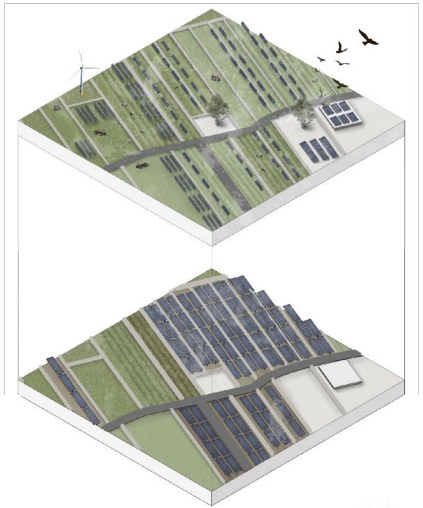
Regional Strategies

PhaseII 2030: Implementation Stage

-Implementation of Energyscape Template: Agricultural land

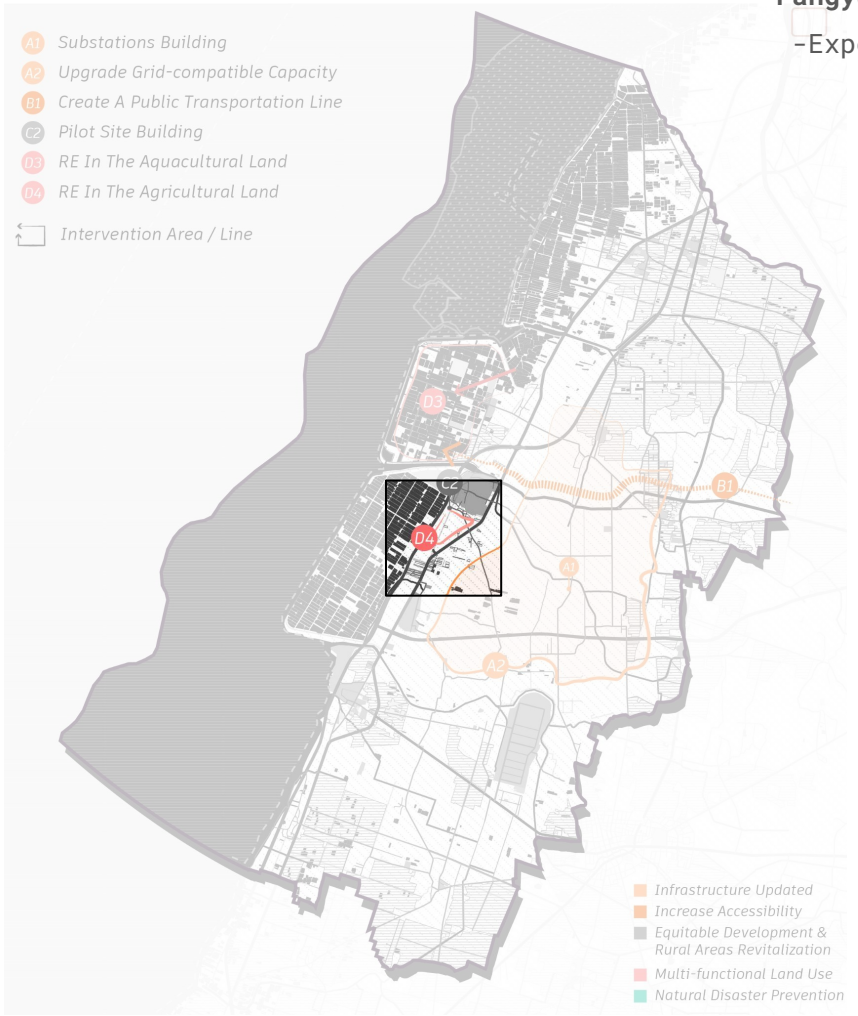
Proposal

Threat



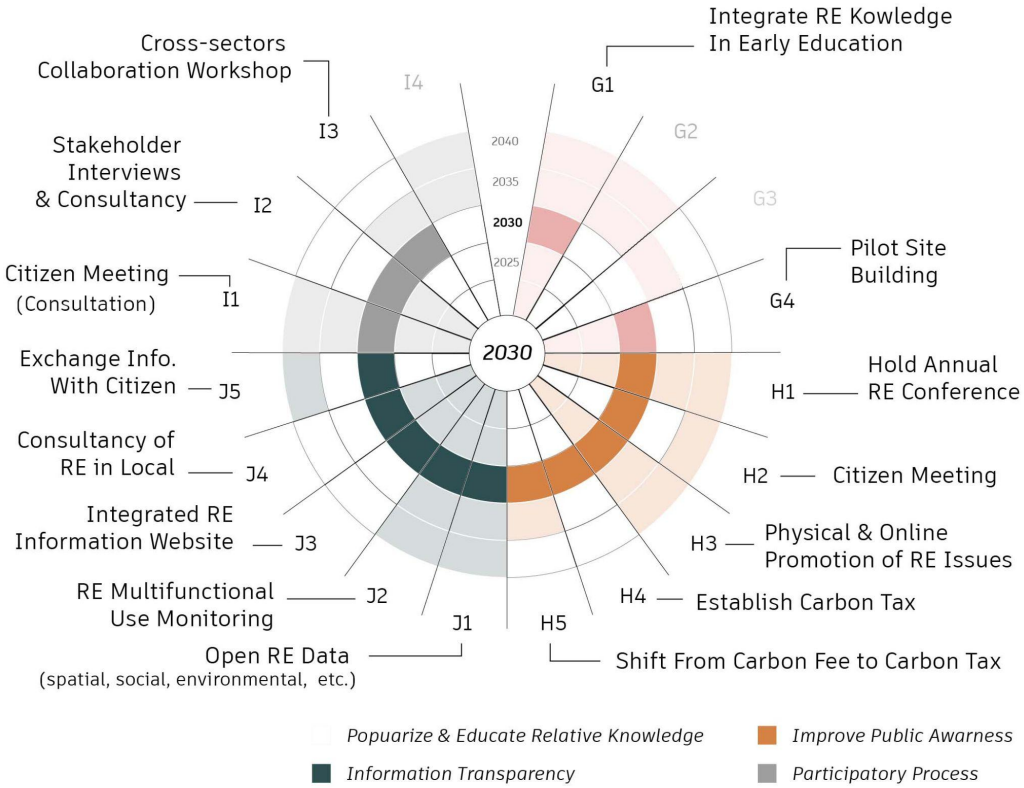
Fangyuan Township

-Experimental RE for Synergy



Regional Strategies

PhaseII 2030: Implementation Stage



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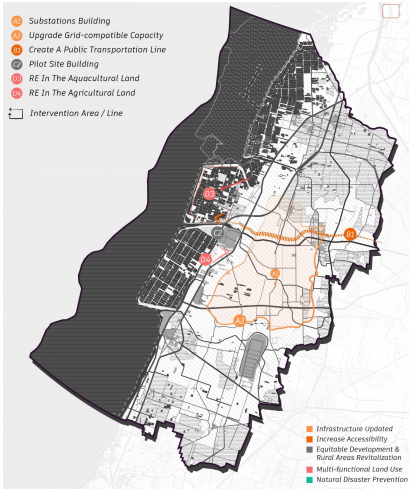


Regional Strategies

Fangyuan Township

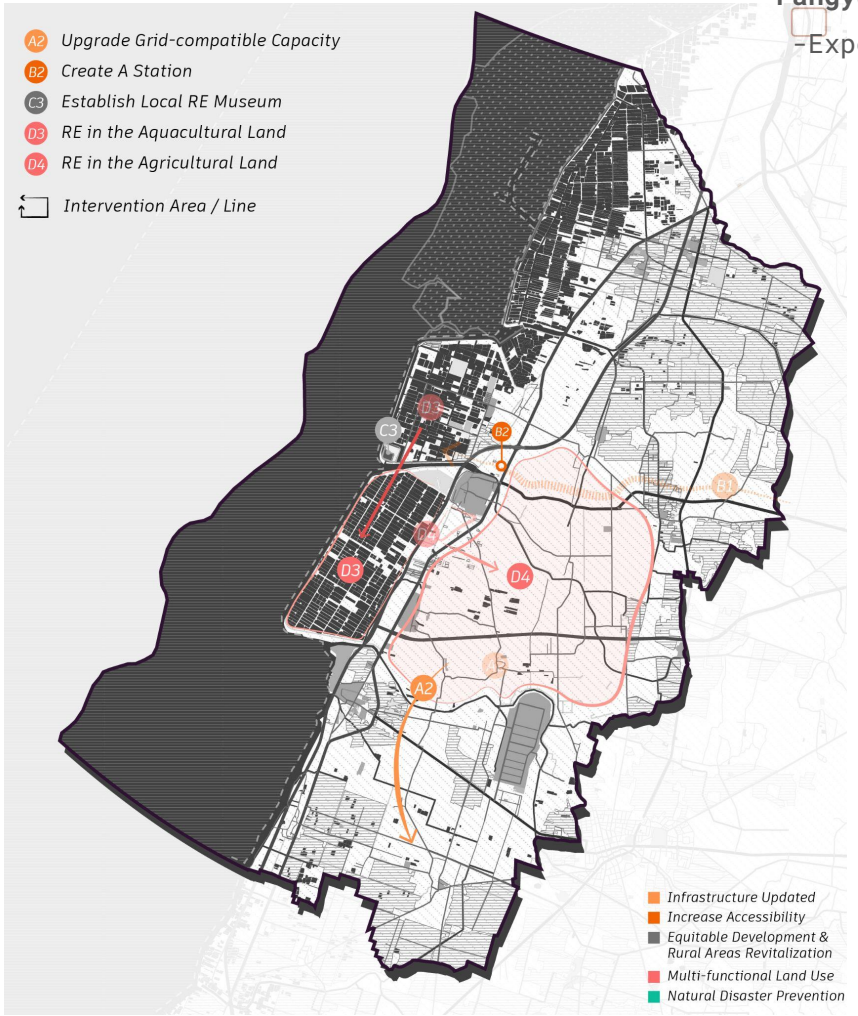
-Experimental RE for Synergy

PhaseIII 2035: Expansion Stage

-Expand RE in aquaculture & agriculture

-Expand the updated RE infrastructure

-Assessment with stakeholders: increase public awareness



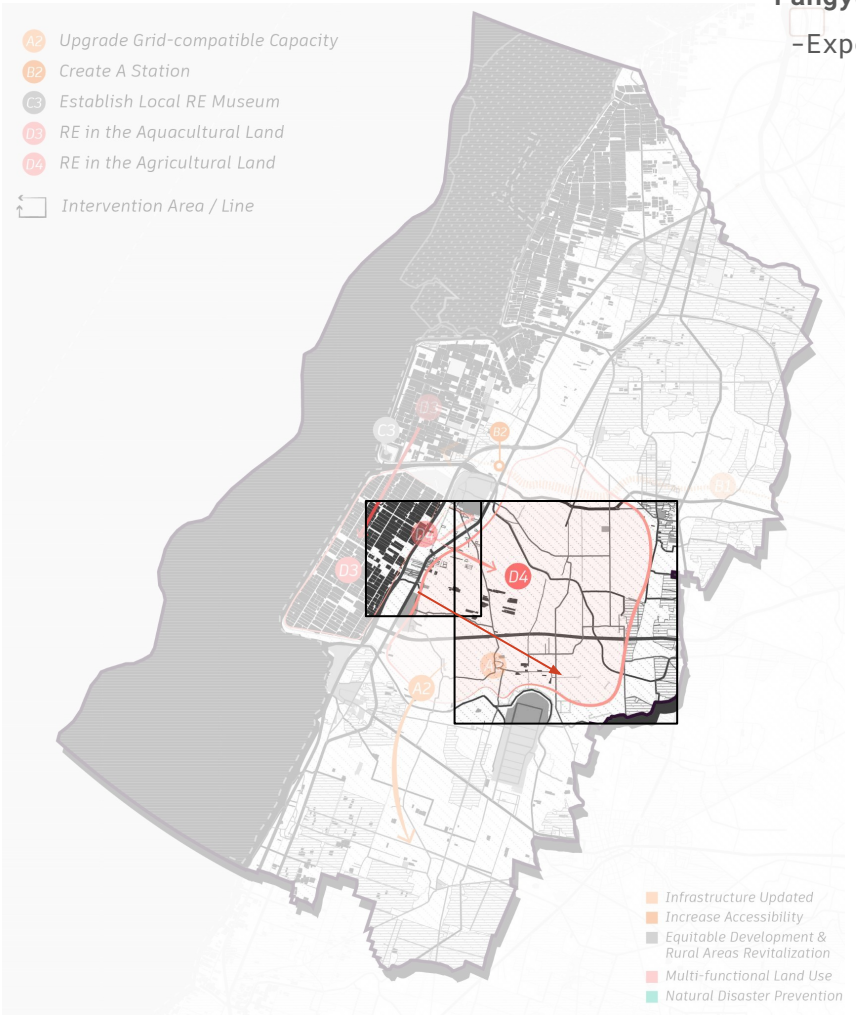
Regional Strategies

Fangyuan Township

-Experimental RE for Synergy

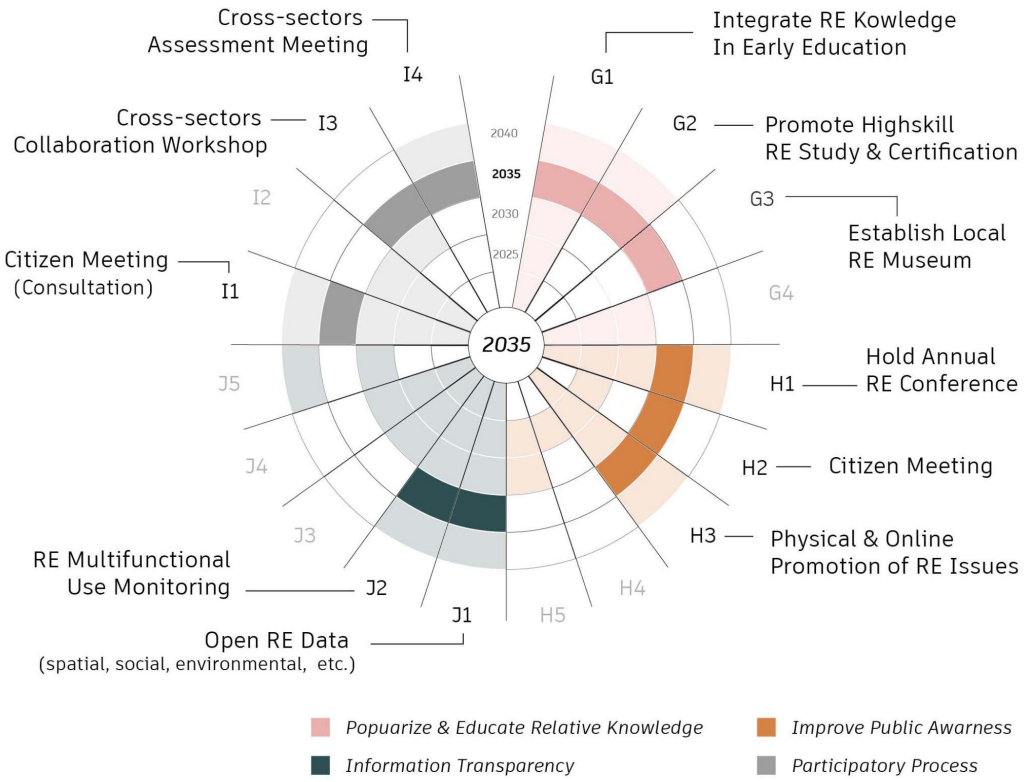
PhaseIII 2035: Expansion Stage

-Expand RE in agriculture



Regional Strategies

PhaseIII 2035: Expansion Stage



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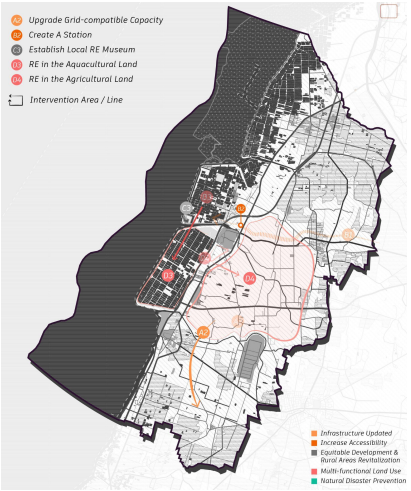


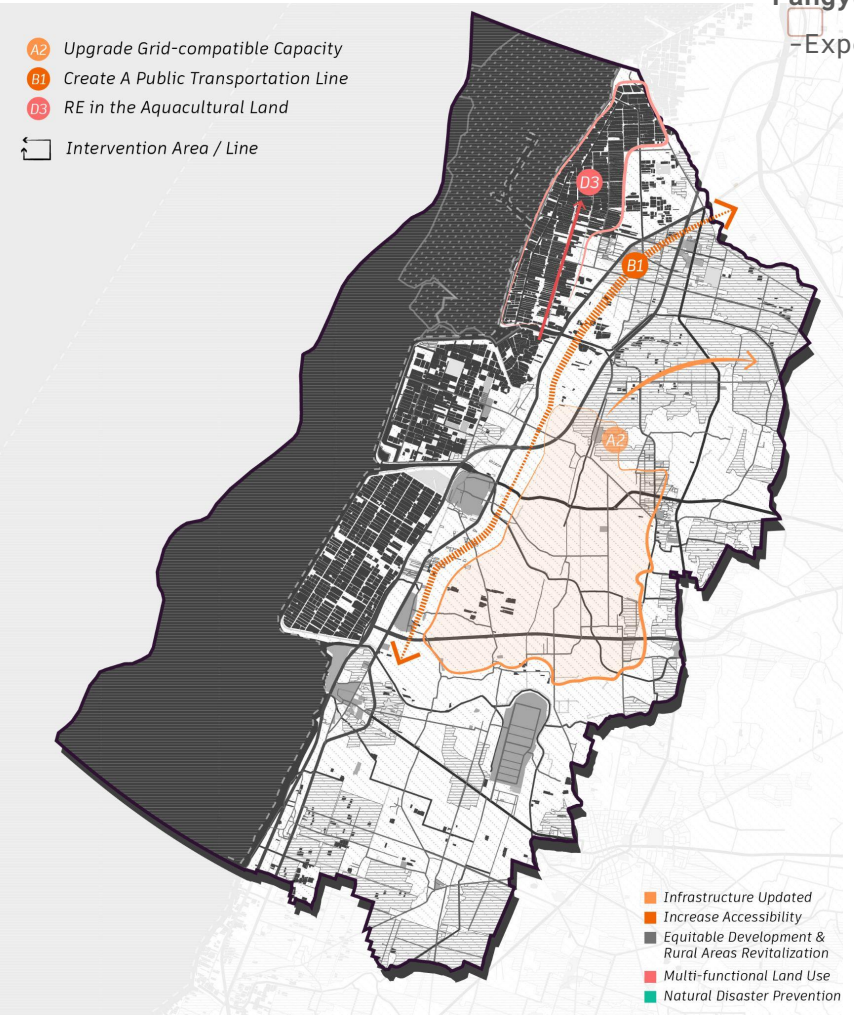
Regional Strategies

PhaseIV 2040: Enhancement Stage

-Expand the updated RE infrastructure

-Create public transportation (N&S)

-Improve RE education



Fangyuan Township

-Experimental RE for Synergy

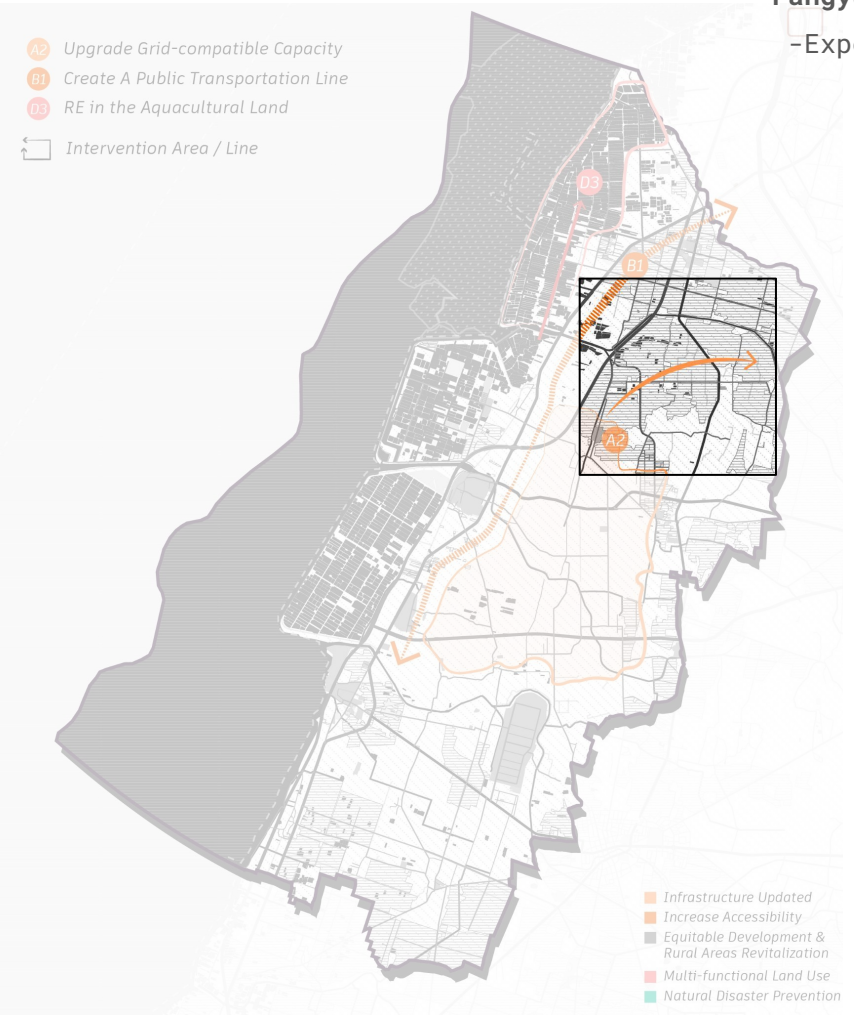
Regional Strategies

Fangyuan Township

-Experimental RE for Synergy

PhaseIV 2040: Enhancement Stage

-Expand the updated RE infrastructure



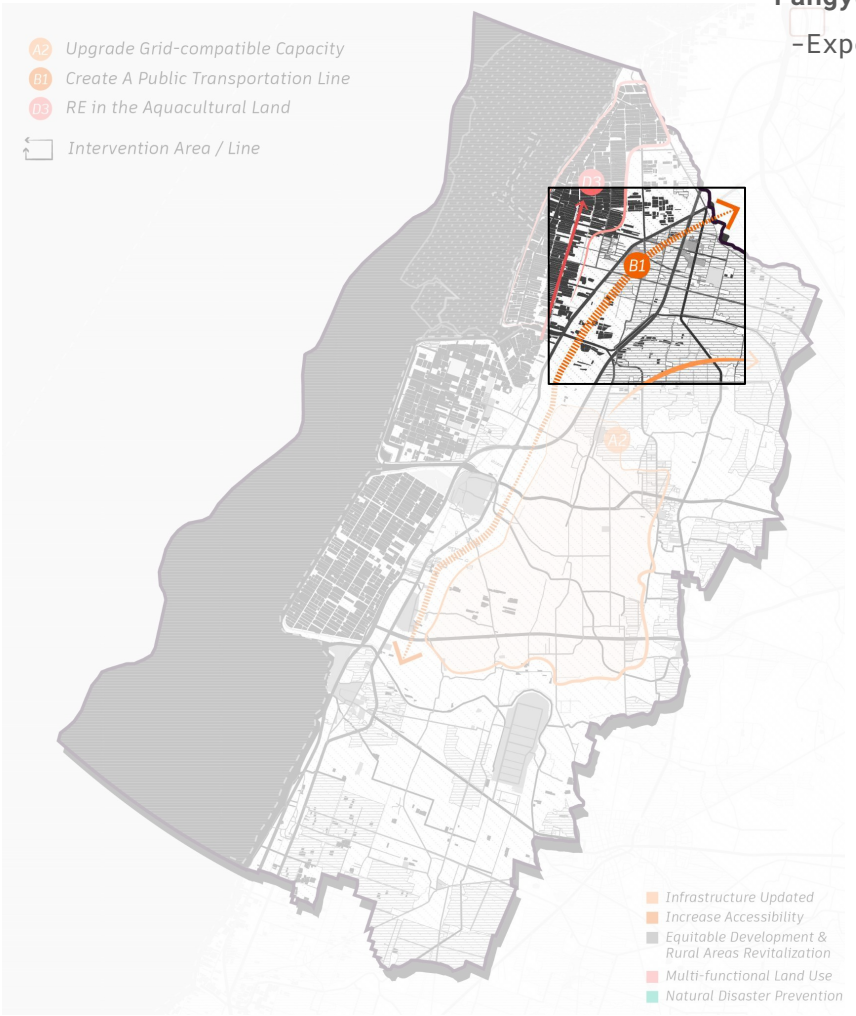
Regional Strategies

Fangyuan Township

-Experimental RE for Synergy

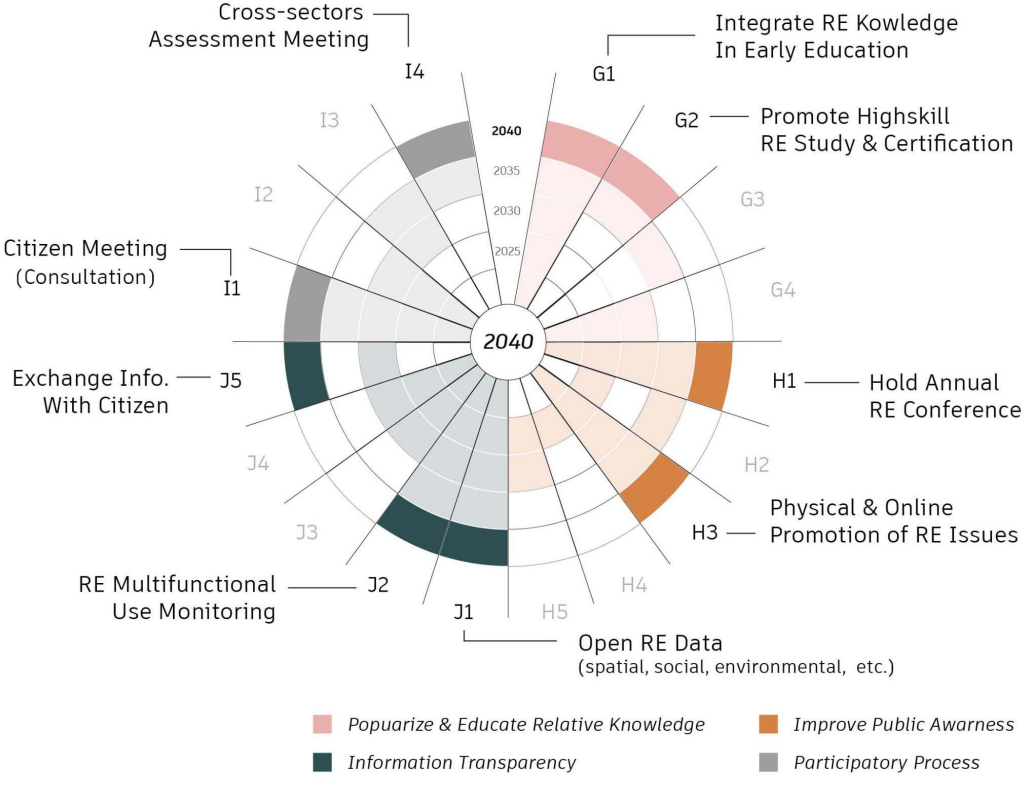
PhaseIV 2040: Enhancement Stage

-Create public transportation (N<>S)



Regional Strategies

PhaseIV 2040: Enhancement Stage



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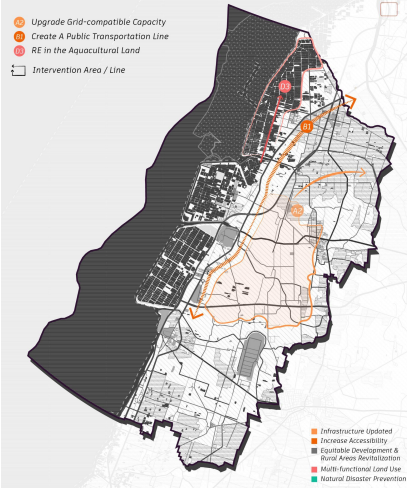
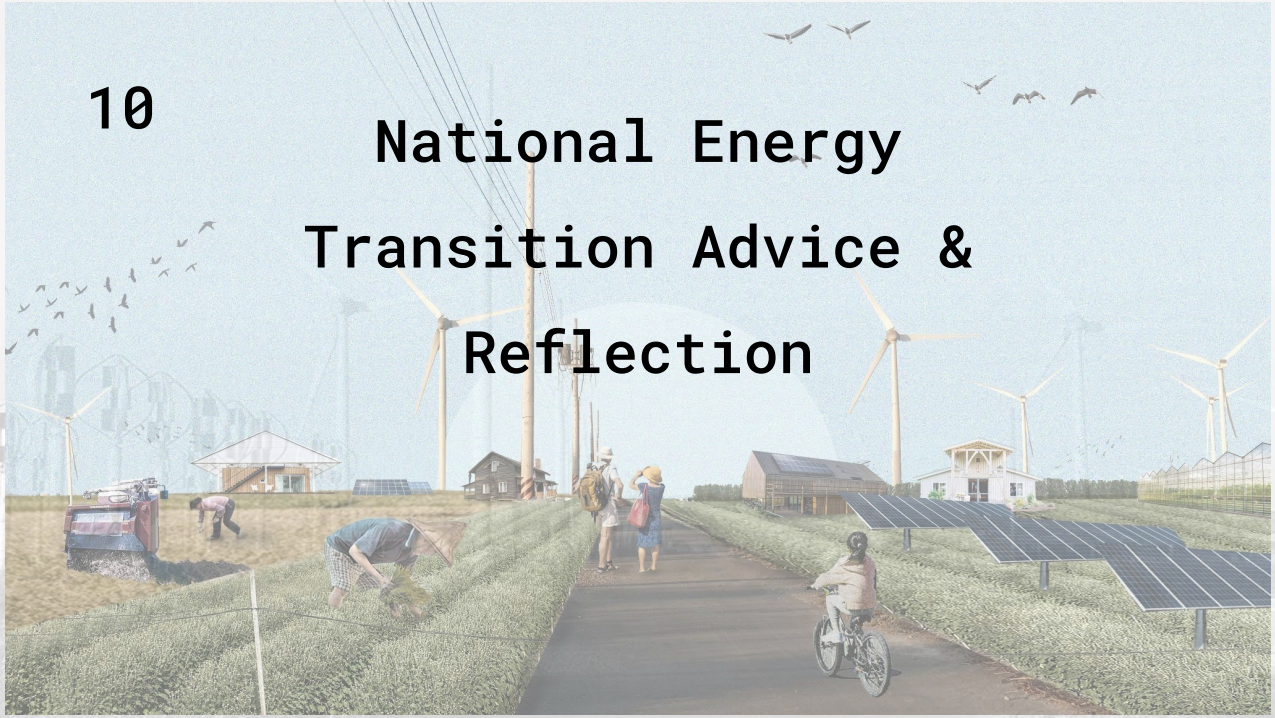
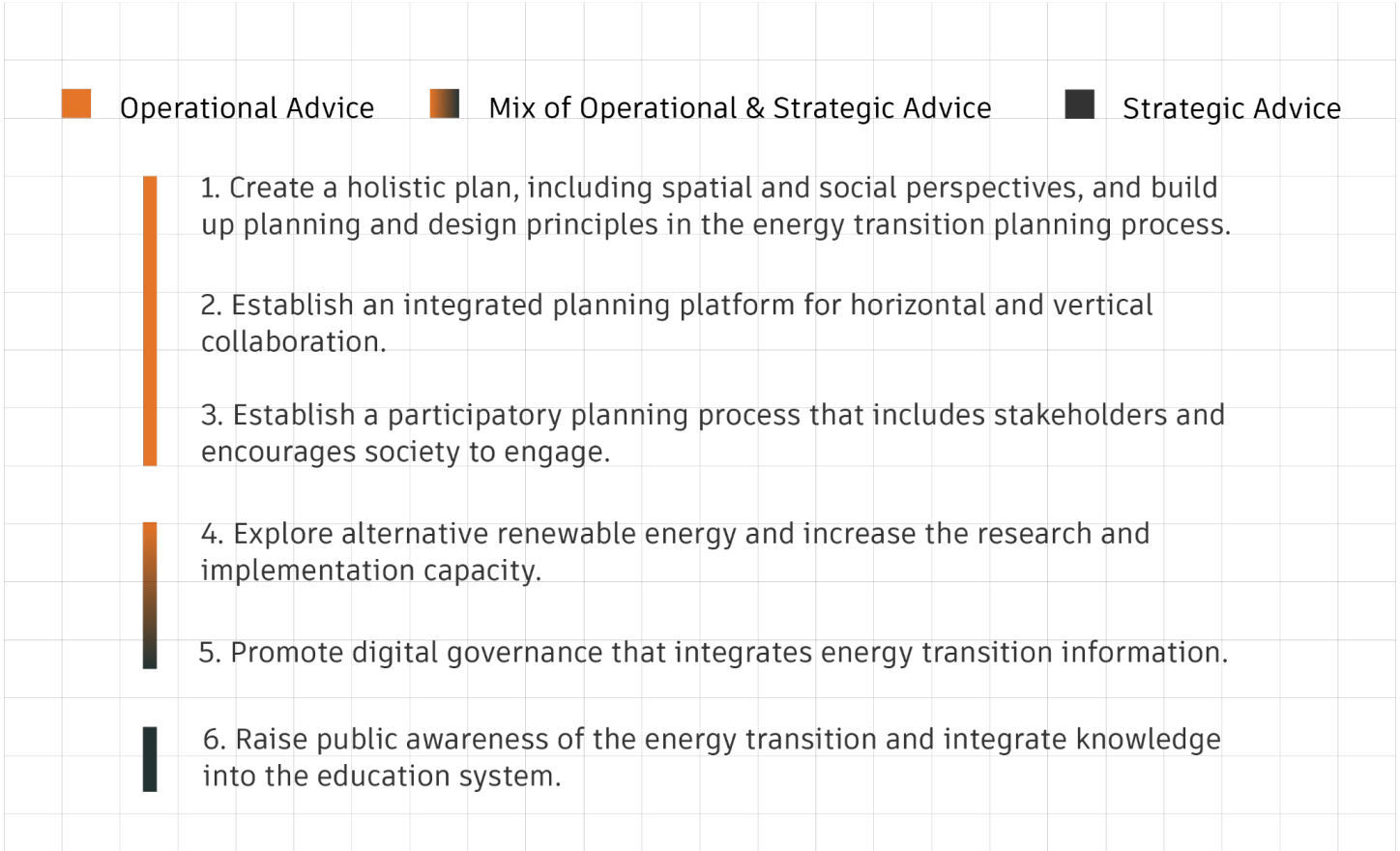


10

National Energy Transition Advice & Reflection

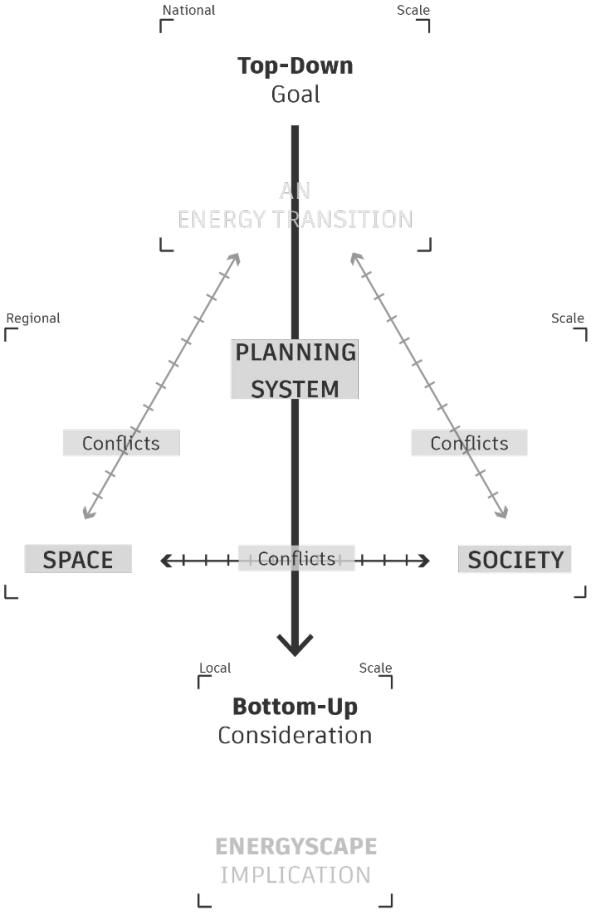


National Energy Transition Advice



Conclusion

What spatial and social needs and considerations should be included in regional planning and design, building up the systemic changes for integrated planning for a just energy transition in Taiwan?



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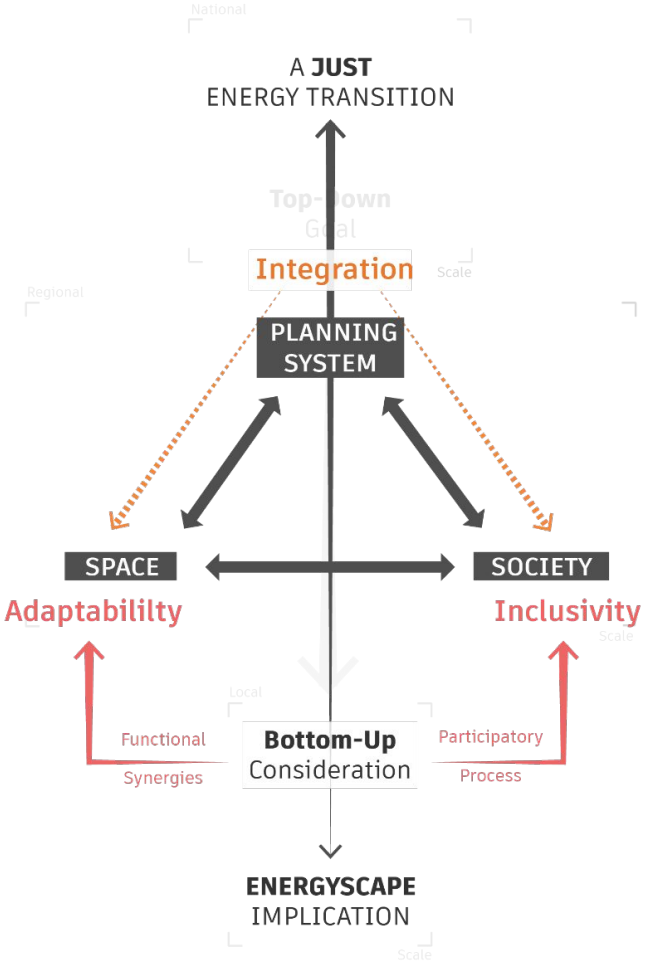
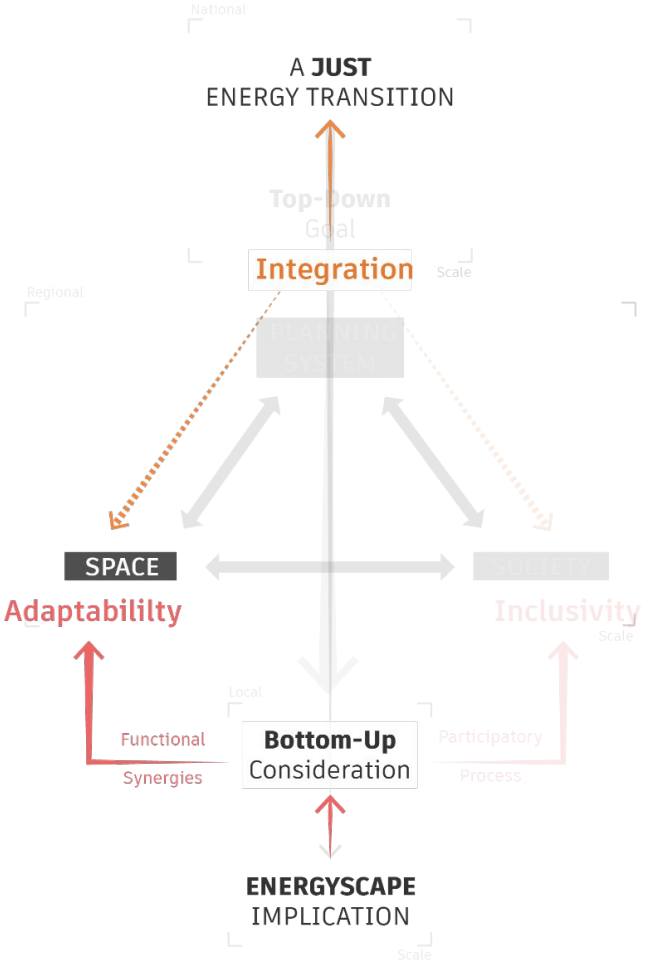


Conclusion

Scientific Perspective

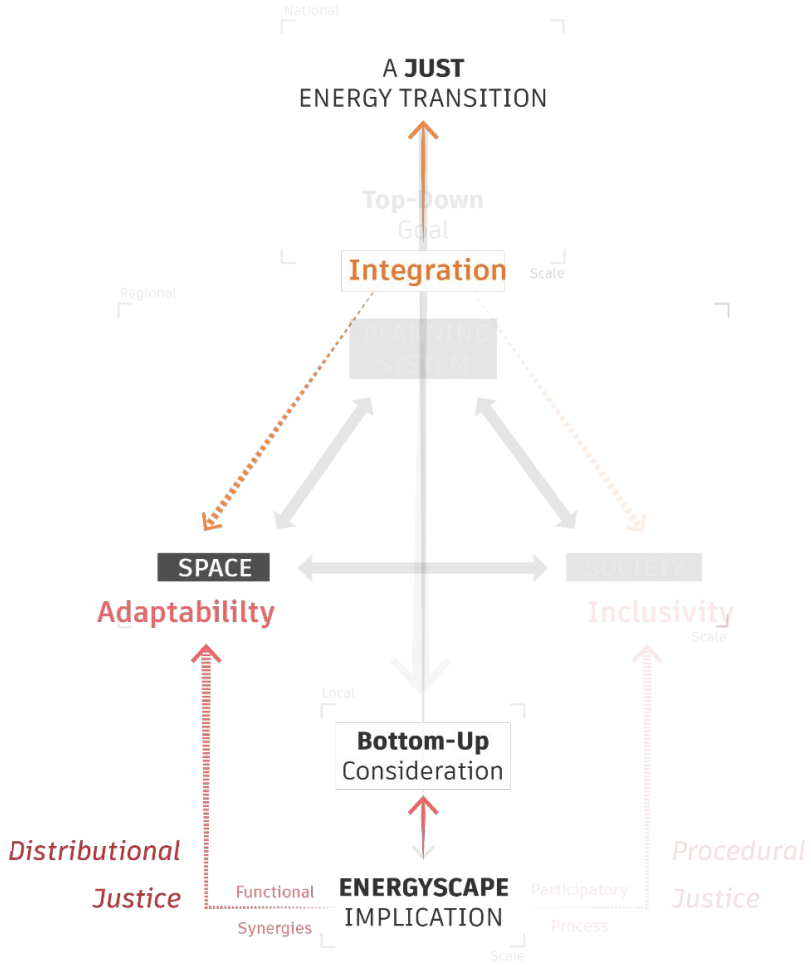
What spatial and social needs and considerations should be included in regional planning and design, building up the systemic changes for integrated planning for a just energy transition in Taiwan?



Conclusion

Social Perspective

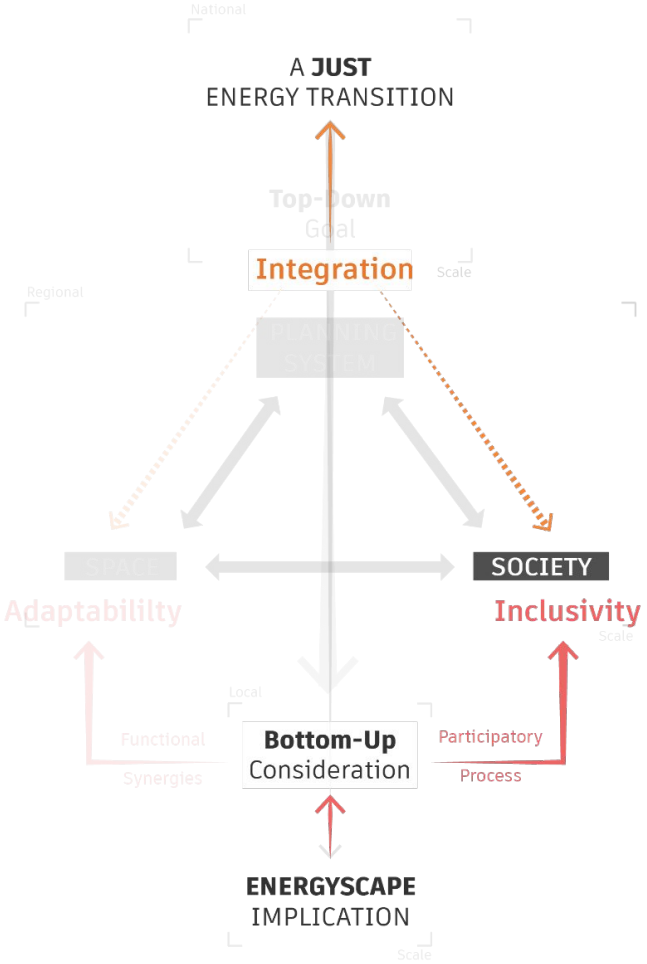
*What spatial and social **needs** and **considerations** should be included in regional planning and design, building up the systemic changes for integrated planning for a just energy transition in Taiwan?*



Conclusion

Scientific Perspective

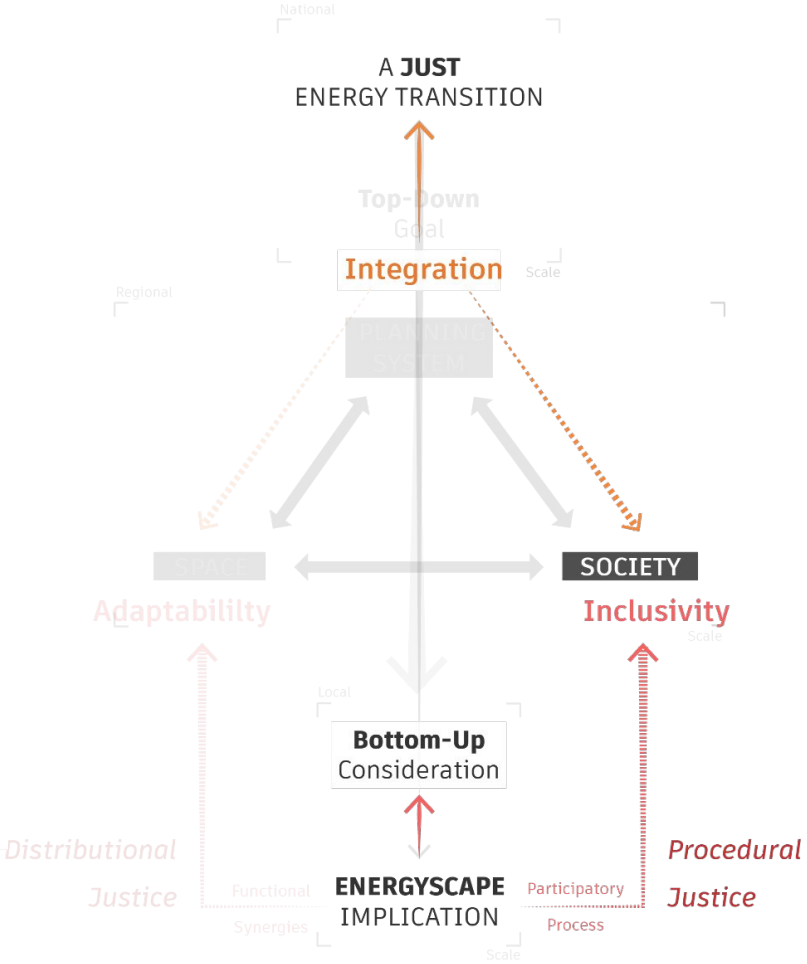
*What **spatial** and **social** **needs** and **considerations** should be included in regional planning and design, building up the systemic changes for integrated planning for a just energy transition in Taiwan?*



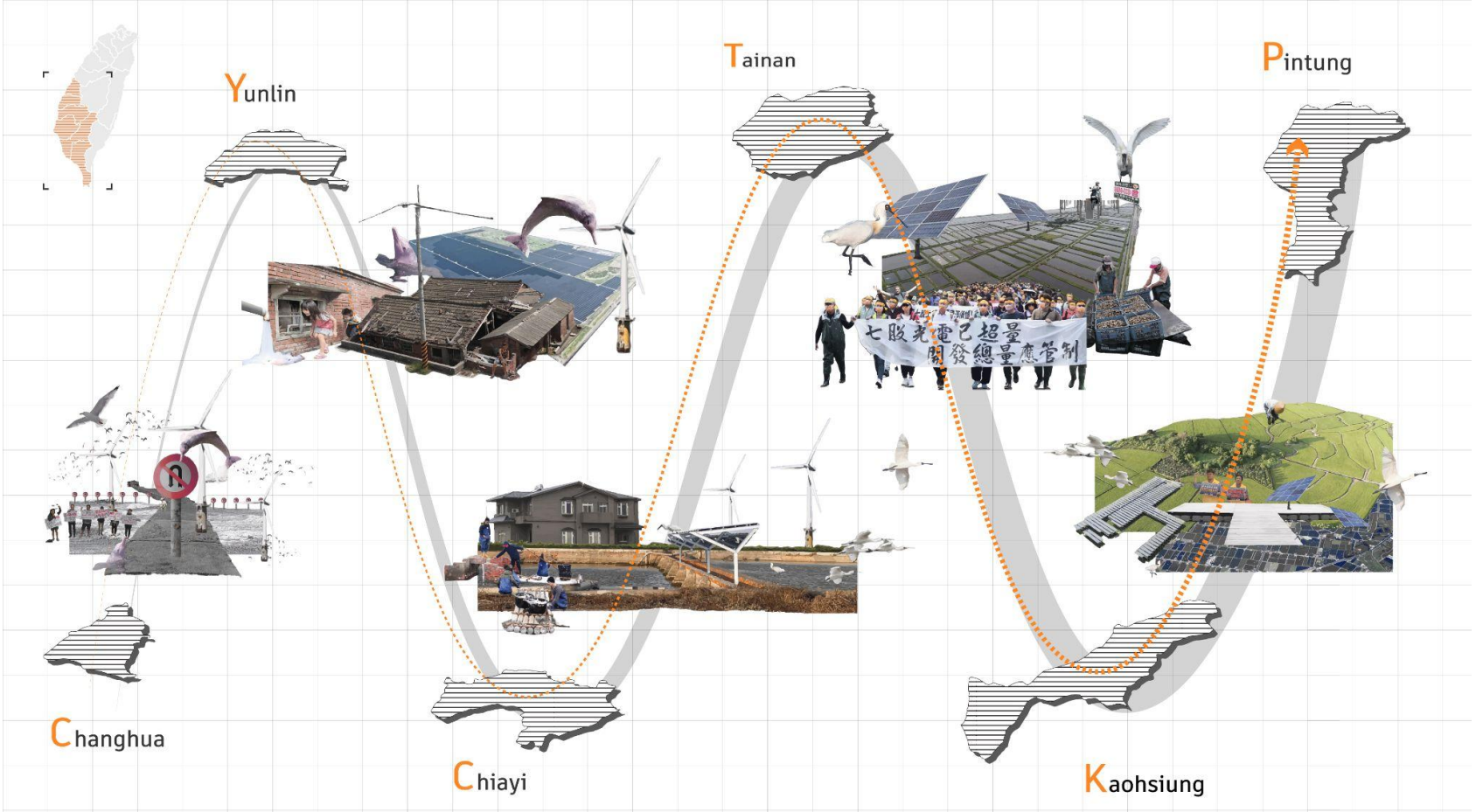
Conclusion

Social Perspective

What spatial and social needs and considerations should be included in regional planning and design, building up the systemic changes for integrated planning for a just energy transition in Taiwan?



Reflection: Transferability




Thank you