Sustainable **M**etropolis **A**nd **R**esponsible **T**ransition

Facilitate Just Energy Transition in the Context of Smart Renewable Energy Community in North Holland South

Haoyang Tang // 6032109

P5 Presentation // June 20th, 2025

Content

1 Background

2 Problem & Research Questions

3 Multidimentional Analysis

4 Strategy & Design

5 Conclusions

1

Background

Trigger point

- **November 10th, 2024** — Protesters from across the **Scottish Borders** are fighting plans for giant pylons to be used to run wind farm energy into England. **Residents living in rural areas along the 50-mile route are concerned about the impact of the pylons and are calling for a complete rethink**.
- **October 22nd, 2024**
- **August 25th, 2024**
- **July 4th, 2024**
- **February 22nd, 2024**
- **October 12th, 2023**
- ...

Trigger point

November 10th, 2024

October 22nd, 2024 — **Botley (UK)** West Solar Farm objectors staged protest walk. **The 11 miles long and 4 miles wide solar farm with 110km of security fencing will affect 15 more villages and overwhelm 35km footpaths.**

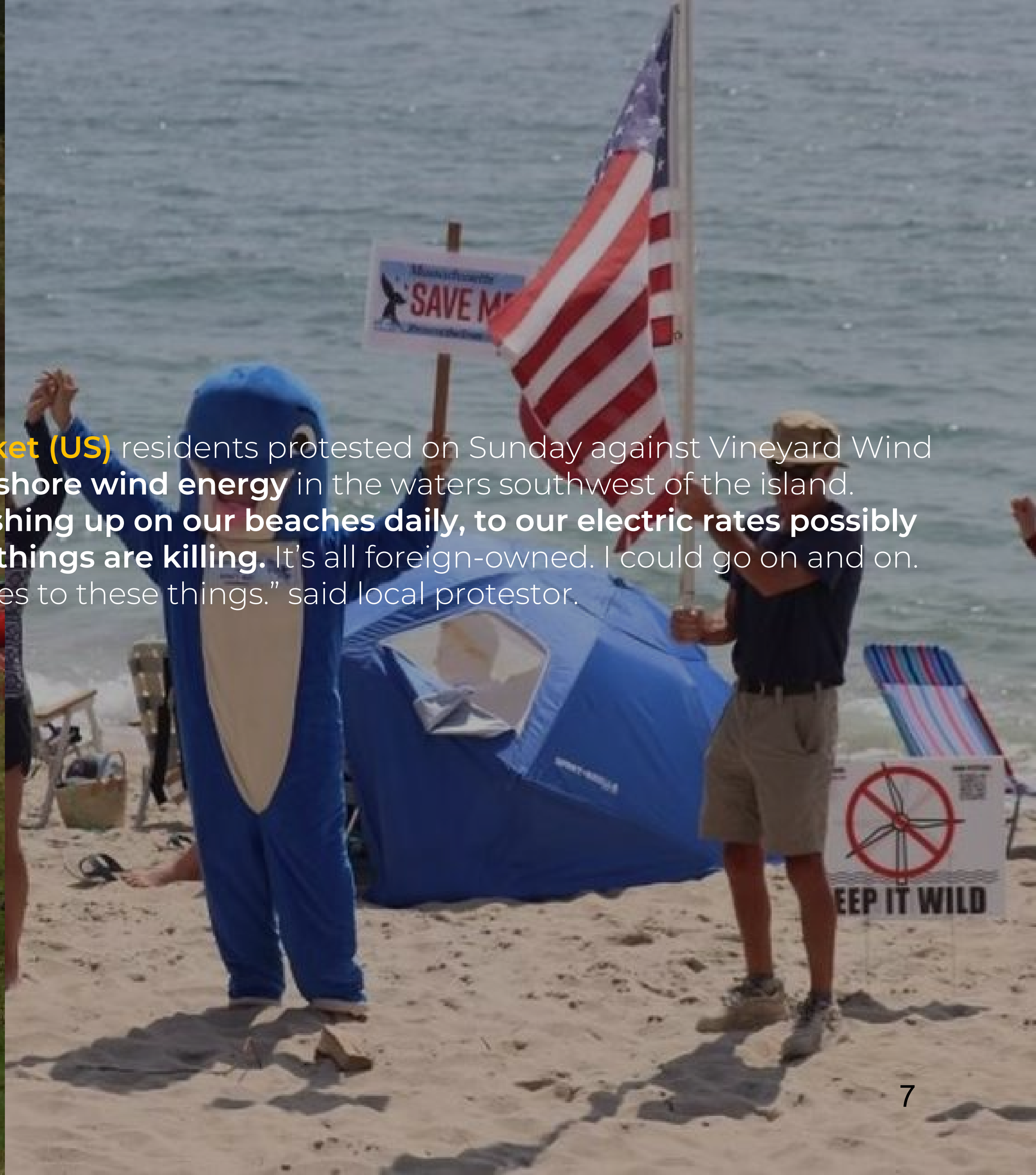
August 25th, 2024

July 4th, 2024

February 22nd, 2024

October 12th, 2023

...



Trigger point

November 10th, 2024

October 22nd, 2024

August 25th, 2024

July 4th, 2024

February 22nd, 2024

October 12th, 2023

...

At sea and on land, **Nantucket (US)** residents protested on Sunday against Vineyard Wind and the development of **offshore wind energy** in the waters southwest of the island. “**Between the garbage washing up on our beaches daily, to our electric rates possibly tripling. The wildlife these things are killing.** It’s all foreign-owned. I could go on and on. There aren’t any positive sides to these things.” said local protestor.

Trigger point

November 10th, 2024

October 22nd, 2024

August 25th, 2024

July 4th, 2024

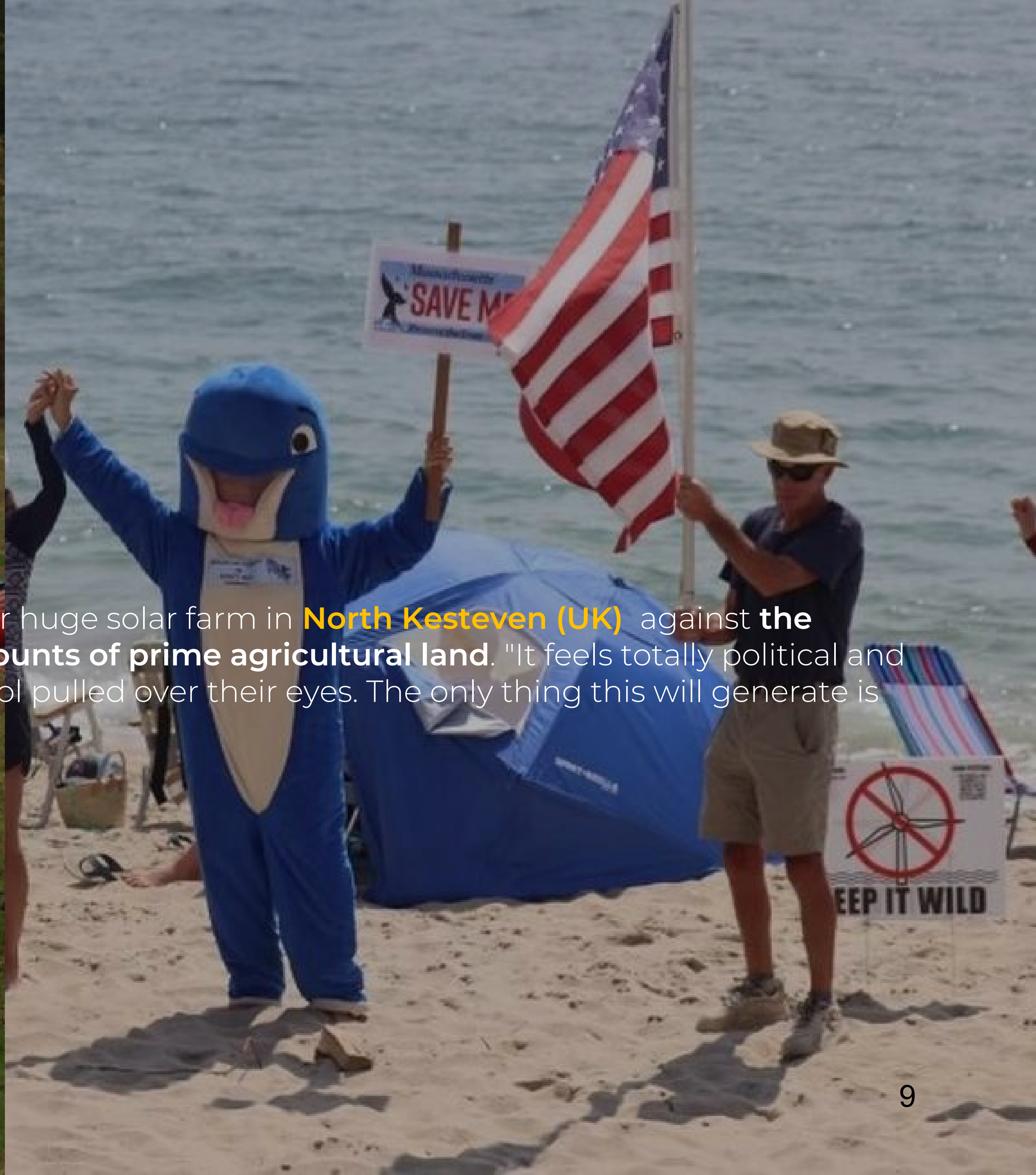
February 22nd, 2024

October 12th, 2023

...

Wiltshire (UK) villagers protested **solar farm plans** on iconic hill to protect the iconic landmark, many of them are concerned **solar panels will "deface" the picturesque landscape**, which is a popular public right of way.

Trigger point



November 10th, 2024

October 22nd, 2024

August 25th, 2024

July 4th, 2024

February 22nd, 2024 —— Protest staged over plans for huge solar farm in **North Kesteven (UK)** against **the occupation of massive amounts of prime agricultural land**. "It feels totally political and residents are having the wool pulled over their eyes. The only thing this will generate is profits," said local resident.

October 12th, 2023

...

Trigger point

November 10th, 2024

October 22nd, 2024

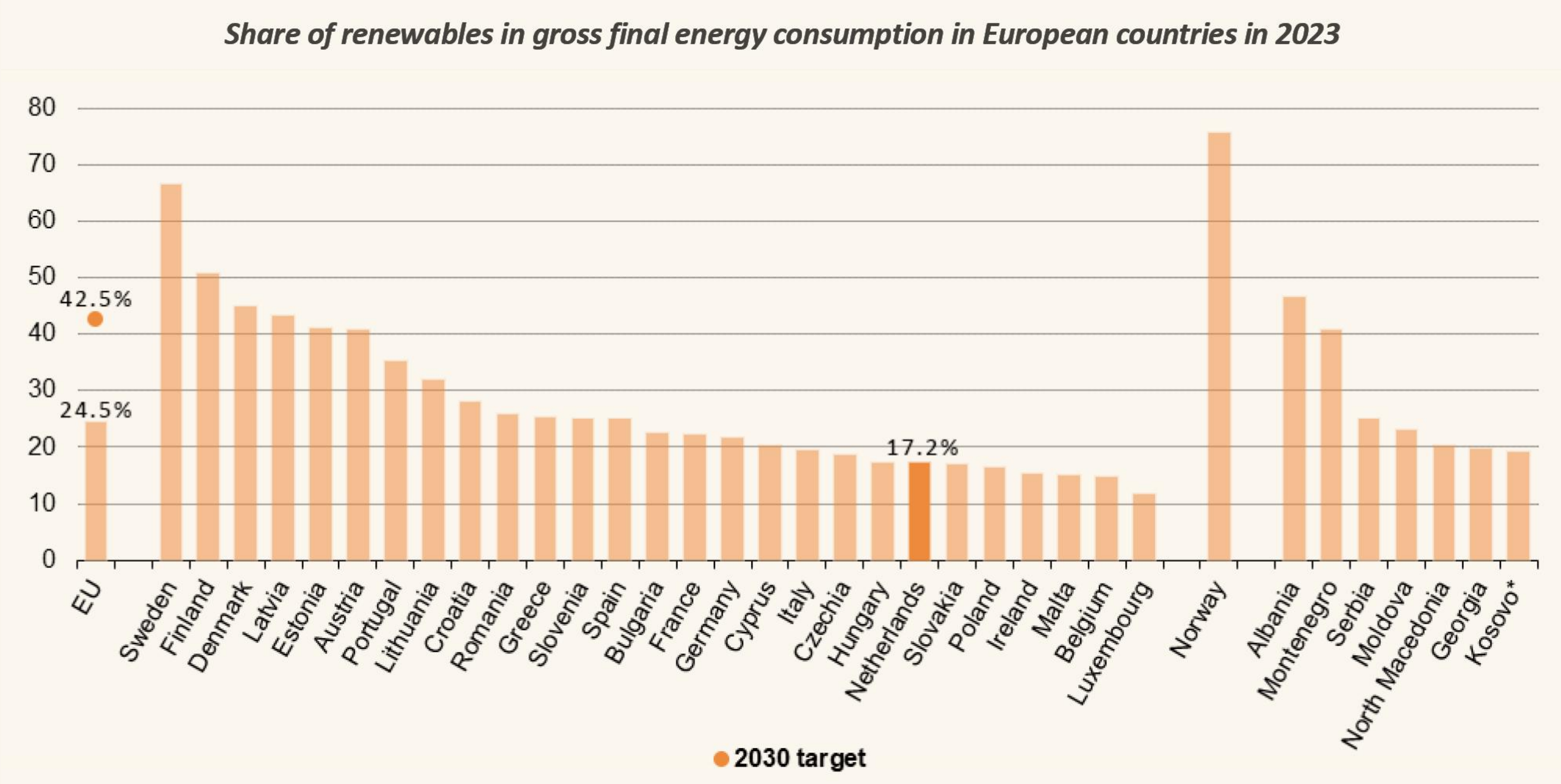
August 25th, 2024

July 4th, 2024

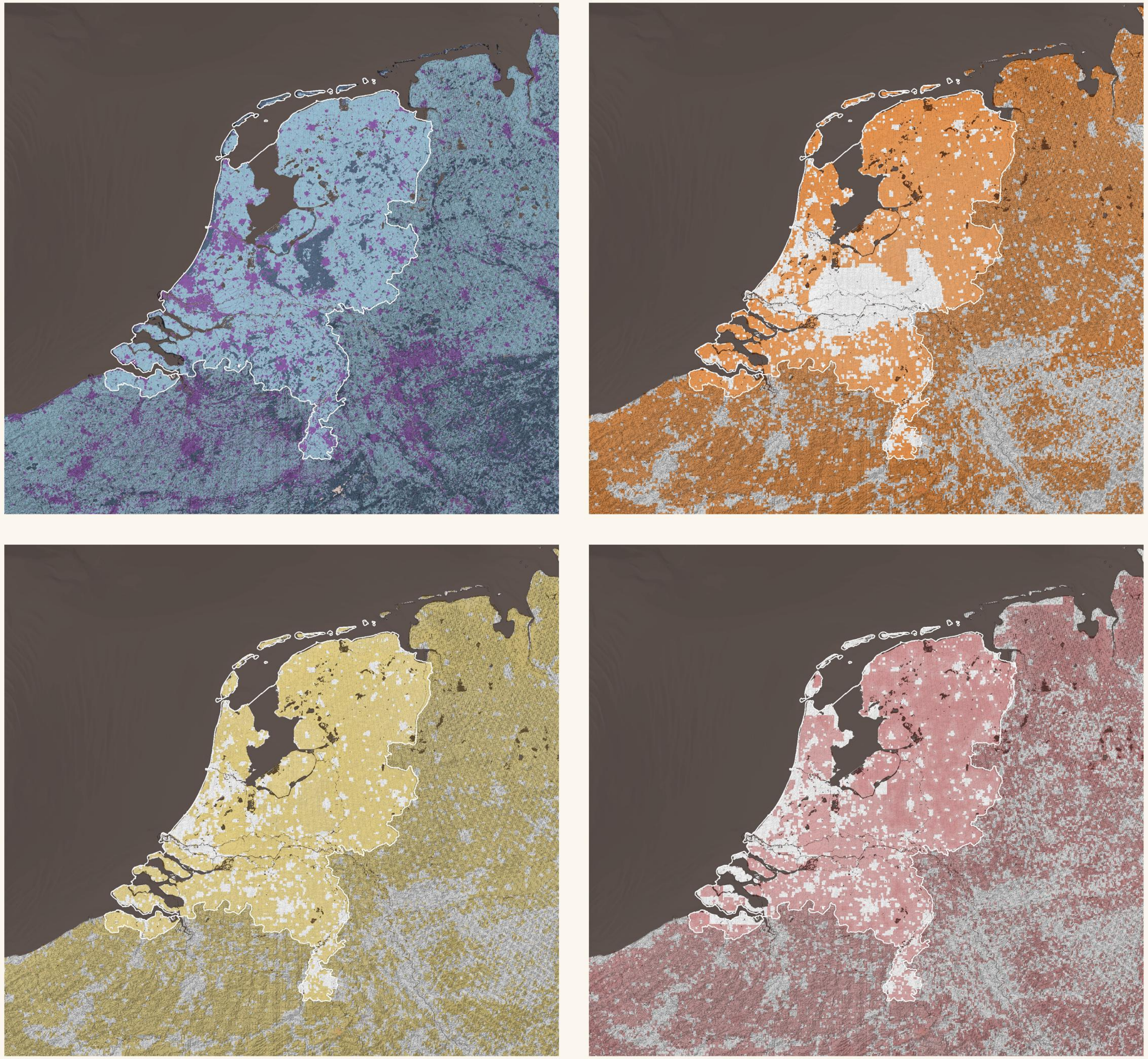
February 22nd, 2024

October 12th, 2023 —— Climate activist Greta Thunberg has returned to **Oslo** to join a renewed protest **demanding partial demolition of one of Europe's largest onshore wind projects, which was ruled to violate the rights of indigenous Norwegian reindeer herders**.

...


Share of renewables in gross final energy consumption in European countries in 2023
80
70
60
50
40
30
20
10
0
42.5%
24.5%
17.2%
EU
Sweden
Finland
Denmark
Latvia
Estonia
Austria
Portugal
Lithuania
Croatia
Romania
Greece
Slovenia
Spain
Bulgaria
France
Germany
Cyprus
Italy
Czechia
Hungary
Netherlands
Slovakia
Poland
Ireland
Malta
Belgium
Luxembourg
Norway
Albania
Montenegro
Serbia
Moldova
North Macedonia
Georgia
Kosovo*
2030 target

Dutch Energy Transition

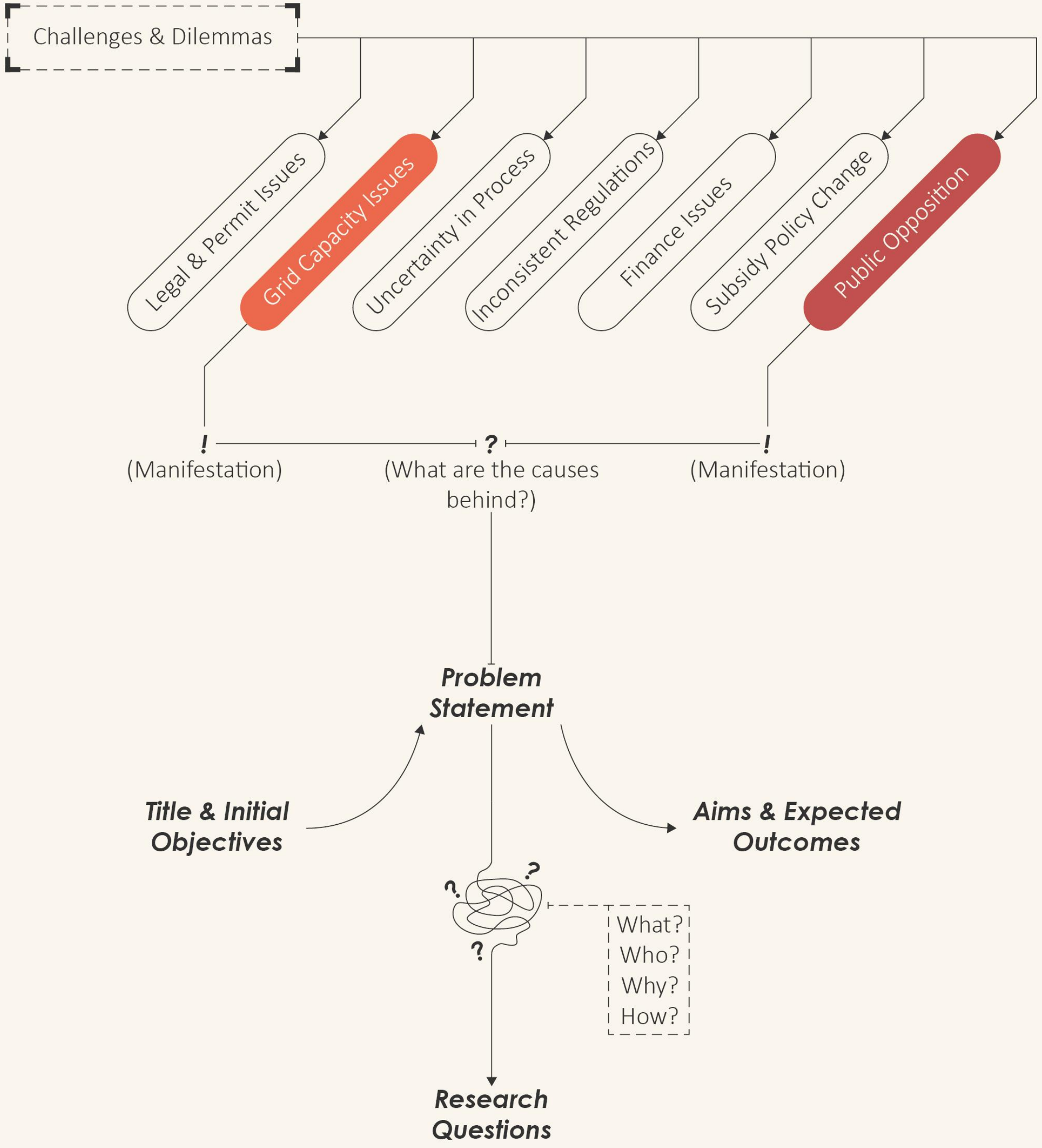


Legends

- Waterbodies
- Urban Area
- Nature Forestry
- Agriculture Land

- Wind Potential
- Solar Potential
- Hydro Potential
- Biomass Potential

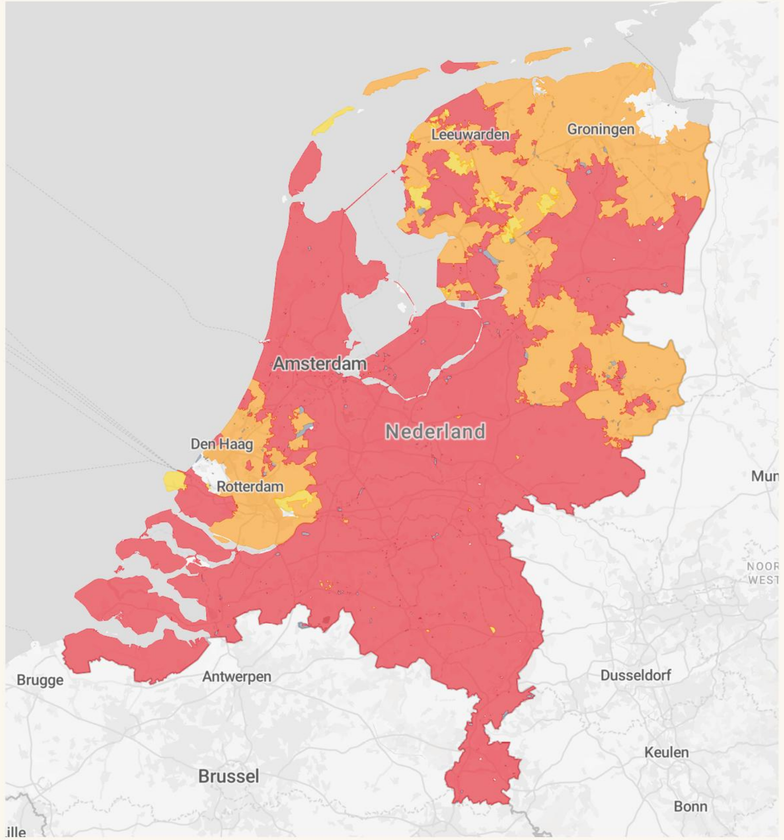
Wind Energy Dilemmas



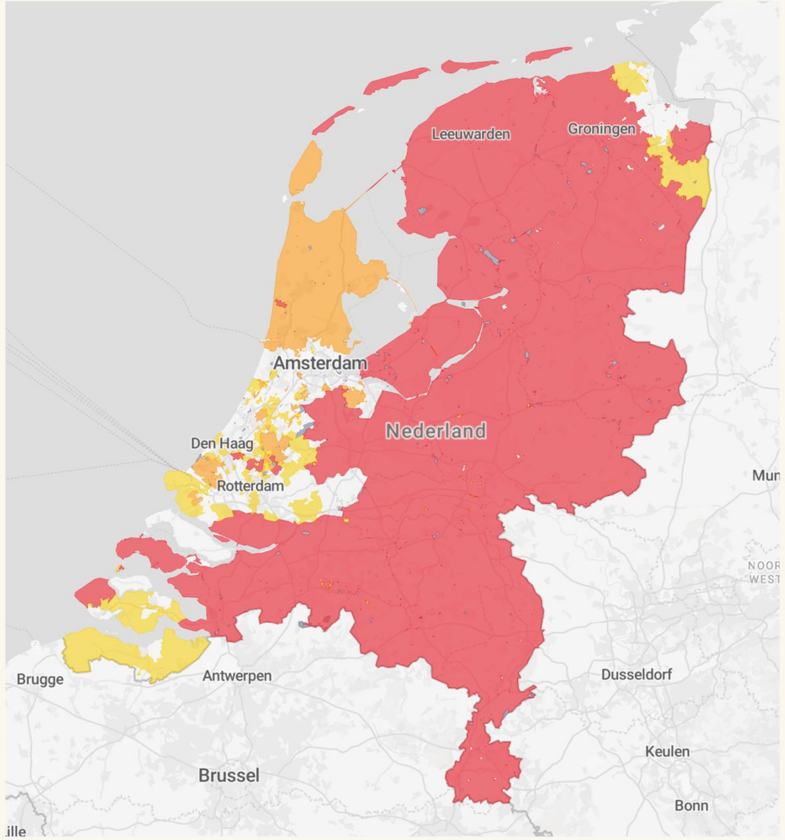
Probelm Manifestation

Grid Capacity Issue // Grid Congestion

Capacity map: Consumption / Afname



Capacity map: Feed-in / Teruglevering



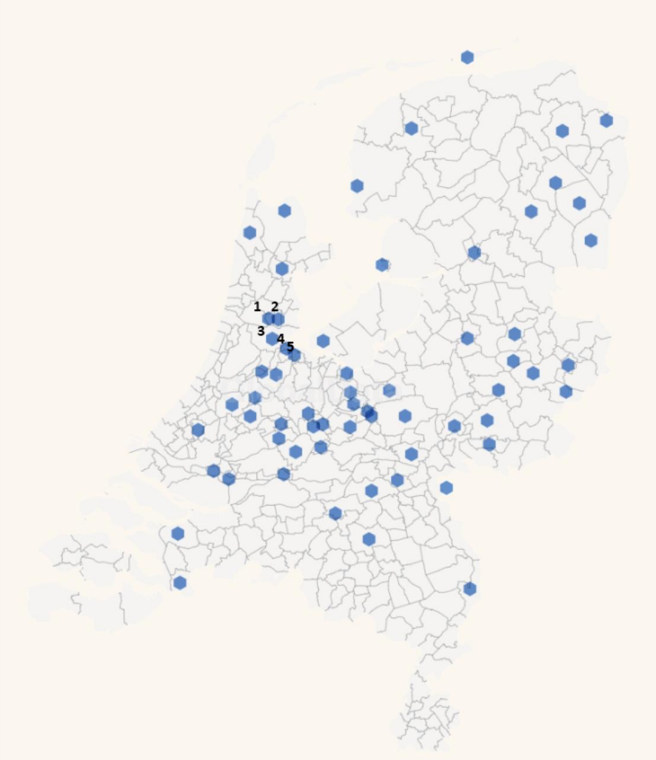
Legends

- Transport capacity available / ***No congestion***
- Transport capacity available to a limited extent / ***Limited congestion***
- Limited shortage of transport capacity / ***Some congestion***
- Shortage of transport capacity / ***Heavy congestion***
- Area is under investigation

Probelm Manifestation

Public Opposition // Lack of Public Participation

Locations of reported opposition



Legends

Locations of groups where opposition behaviors had taken place and were reported in regional news

Cases

1: In **Oostzaan**, protests against onshore wind projects are led by advocacy group(s) Windalarm Oostzaan, for the concern of a nearby nature reserve named Noorder IJplas, and the horizon pollution by wind turbines.

2: In **Landsmeer**, protests against onshore wind projects are led by advocacy group(s) Geen windmolens in Landsmeer and Windalarm Landsmeer. For the noise pollution, landscape pollution, shadow flicker that would plague twenty-two thousand households.

3: In **Amsterdam**, protests against onshore wind projects are led by advocacy group(s) Windalarm Amsterdam, Noord-Verstoord, Stichting Beschermers Amstelland and Windalarm Schellingwoude. They are against mega wind turbines for public health, such as stress and insomnia due to the noise pollution caused by the turbines.

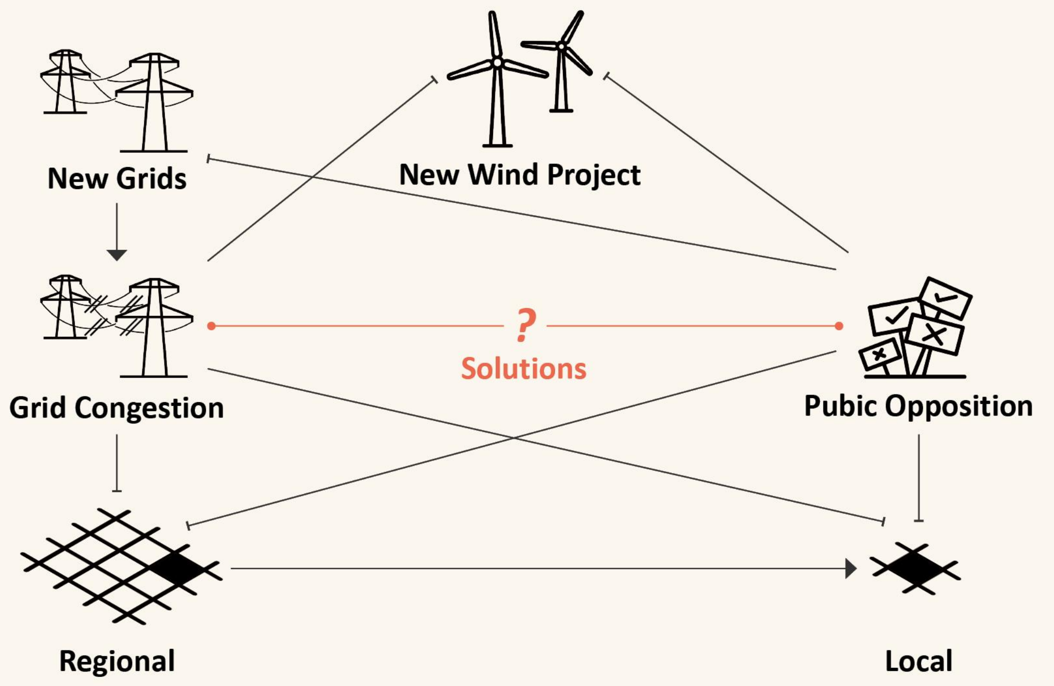
4: In **Diemen**, protests against onshore wind projects are led by advocacy group(s) Windalarm Diemen and Windalarm Driemond & Diemerbos. For the projects are too close to households, and the fear of their health damage to people, animals and nature.

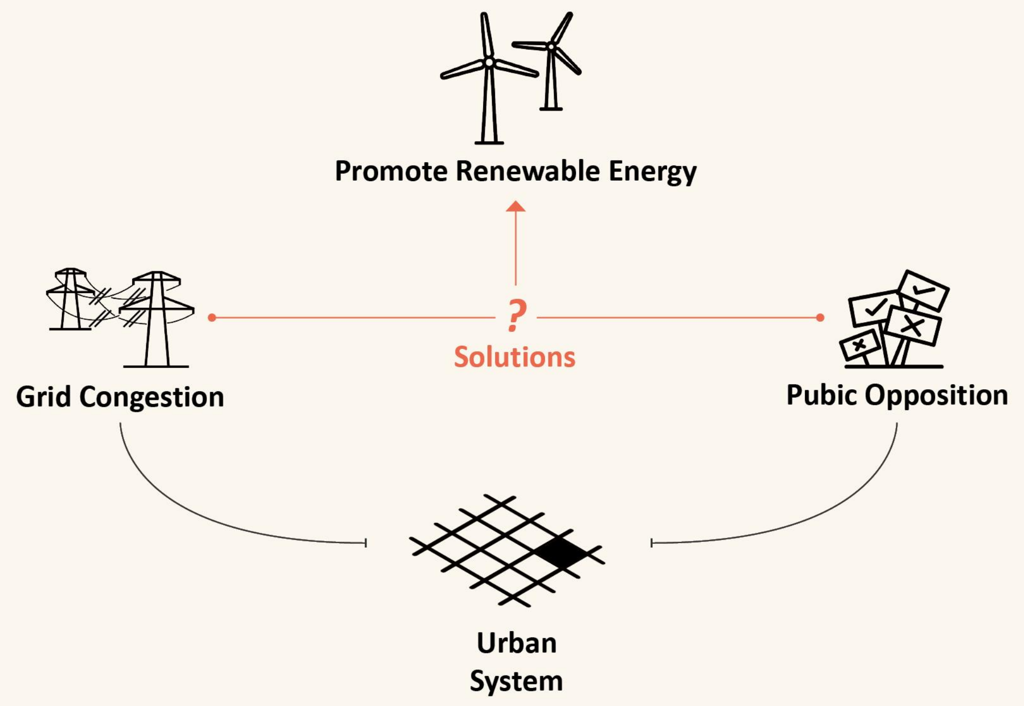
5: In **Weesp**, protests against onshore wind projects are led by advocacy group(s) Stop windturbines in de Aetsveldsepolder! and Windalarm Weesp.

2

Problem & Research Questions

Probelm Proposition

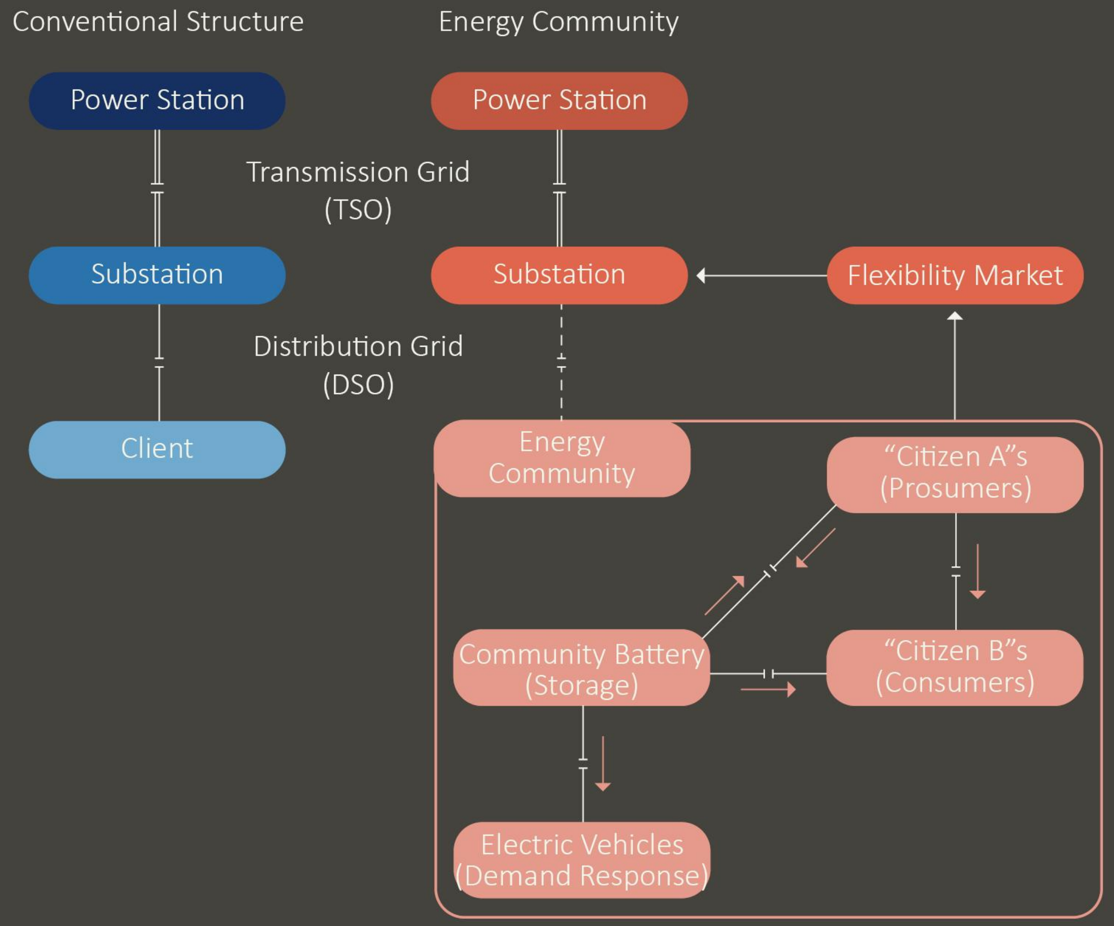




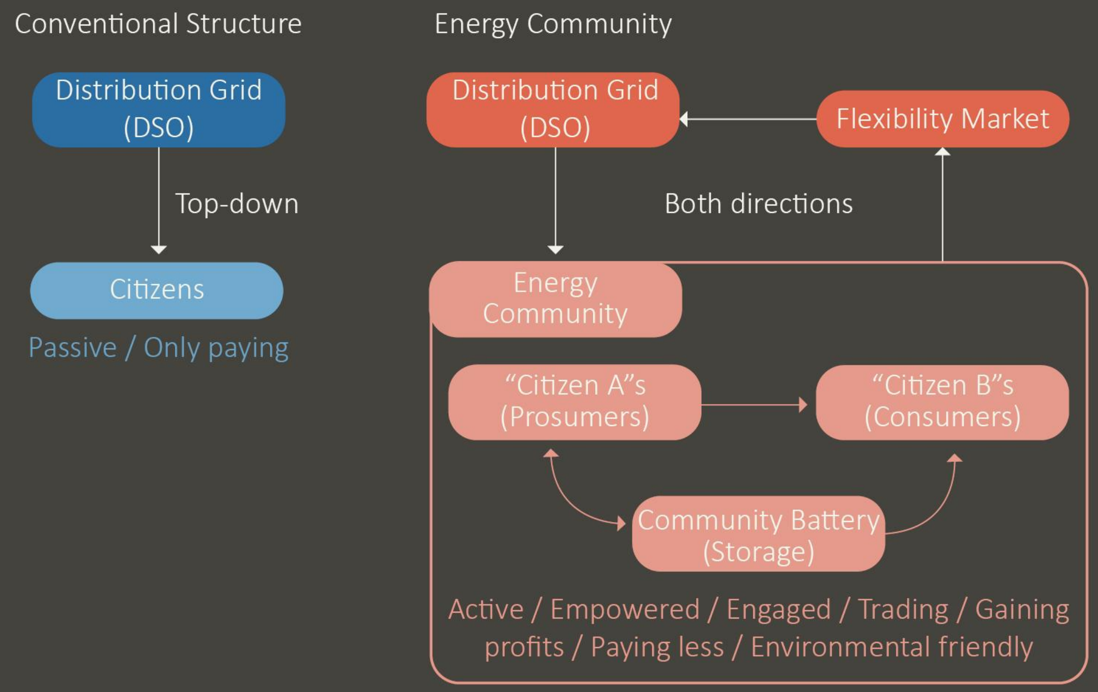
Energy Communities *(or "Citizen Energy Communities", "Renewable Energy Communities) are* ***legal entities based on open and voluntary participation and effectively controlled by their shareholders or members who are citizens, SMEs and/or local authorities and whose primary purpose is to provide environmental, economic or social community benefits for their members or the local area members****. These concepts have been set up to enable the participation of the civil society into the provision of energy services, where profit is not the main goal ("Energy Communities to Increase Local System Efficiency," 2022).*

Energy communities can contribute to local system efficiency, which means ***optimising the use of existing grid, integrating more renewable energy and engaging local stakeholders****.*

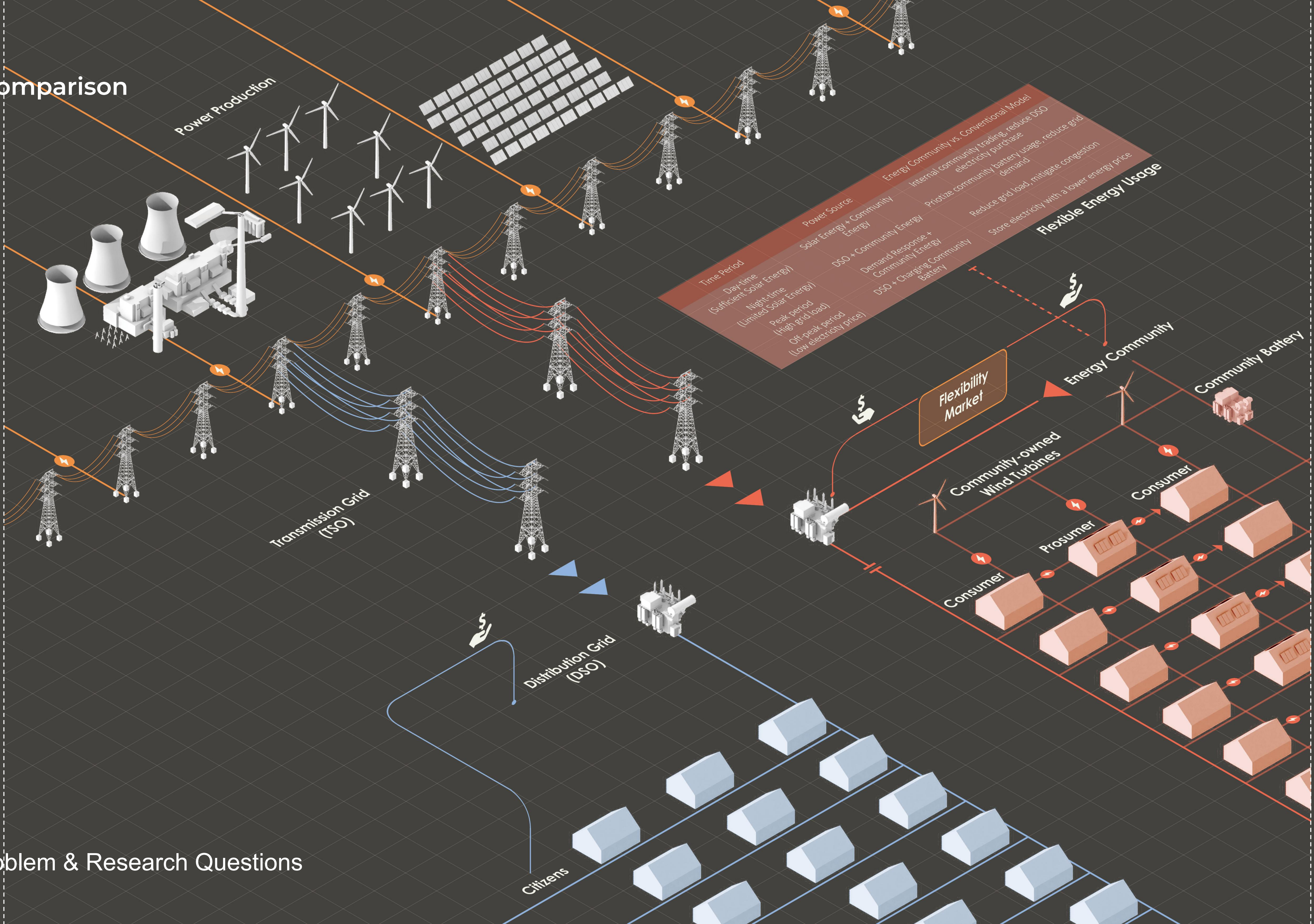
Mitigate grid congestion



Promote citizen participation



Spatial comparison



Time Period	Power Source	Energy Community vs. Conventional Model
Day-time (Sufficient Solar Energy)	Solar Energy + Community Energy	Internal community trading, reduce DSO electricity purchase
Night-time (Limited Solar Energy)	DSO + Community Energy	Priotize community battery usage, reduce grid demand
Peak period (High grid load)	Demand Response + Community Energy	Reduce grid load, mitigate congestion
Off-peak period (Low electricity price)	DSO + Charging Community Battery	Store electricity with a lower energy price

Research Questions

Main RQ

How could the energy community strategy be leveraged to address the renewable energy dilemmas and facilitate just and sustainable energy transition in the Netherlands?

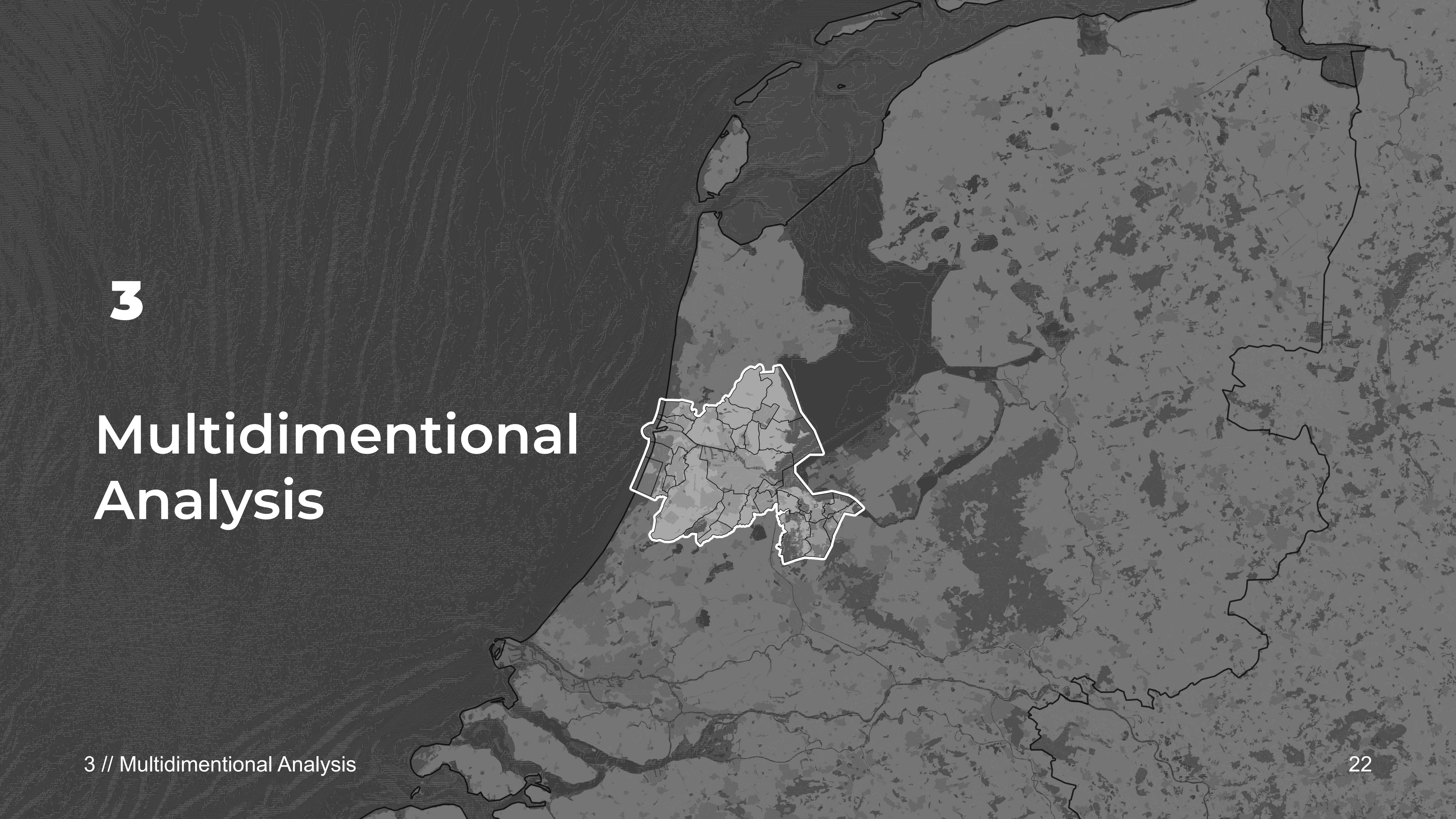
Sub RQs

1: Who are the important stakeholders involved in the development of energy communities, and how do their interests and actions influence the empowerment of ECs?

2: What are the spatial plans and policies currently influence the development of ECs in the Netherlands, and what are the gaps or deficiencies exist in the current approach?

3: What are the strategies that could contribute to enhancing the development and scalability of ECs that helps to address the two wind energy dilemmas from local and regional level simultaneously?

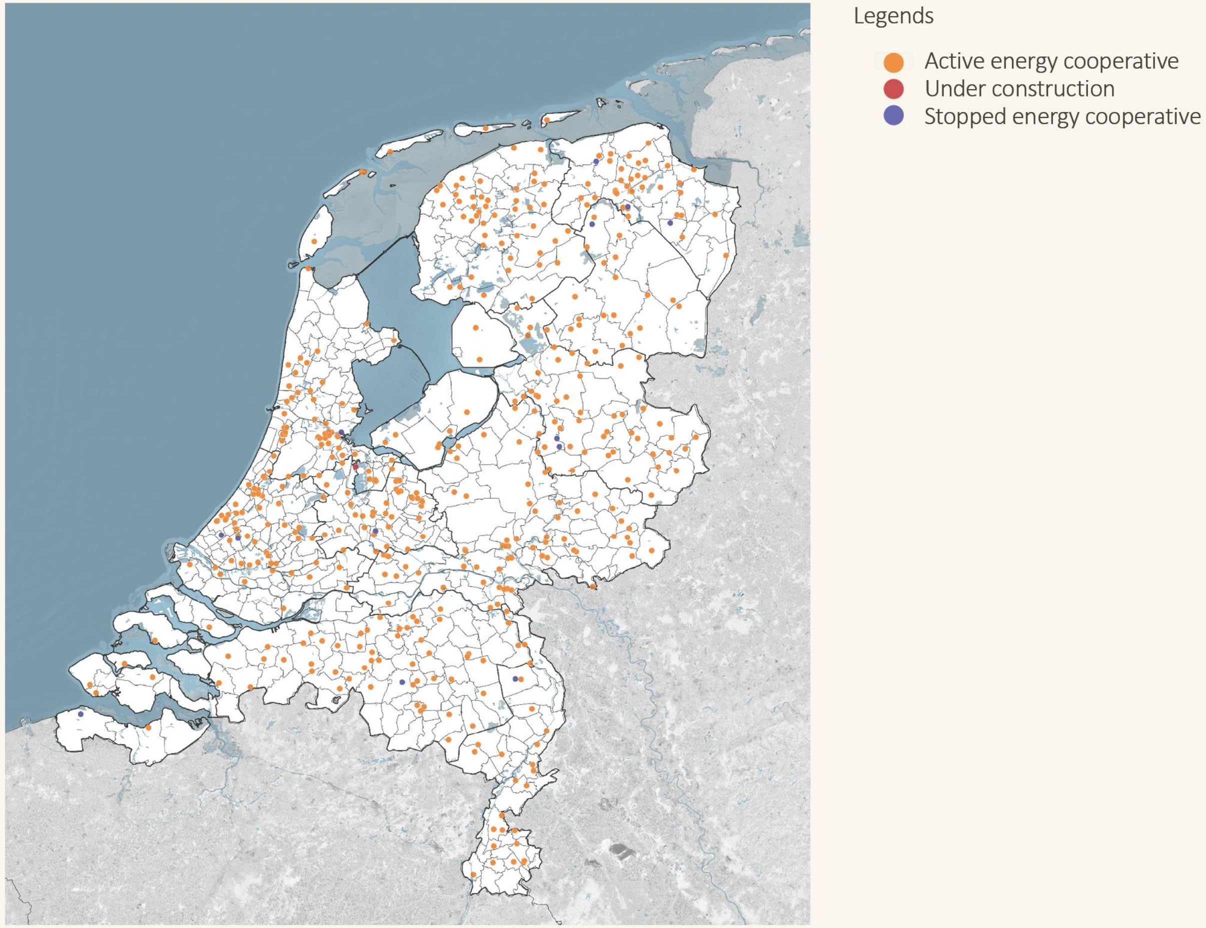
4: How could the EC strategy be planned and implemented in the Dutch urban context, and how can the results be presented to demonstrate the effectiveness of this integrated approach in mitigating wind energy challenges?

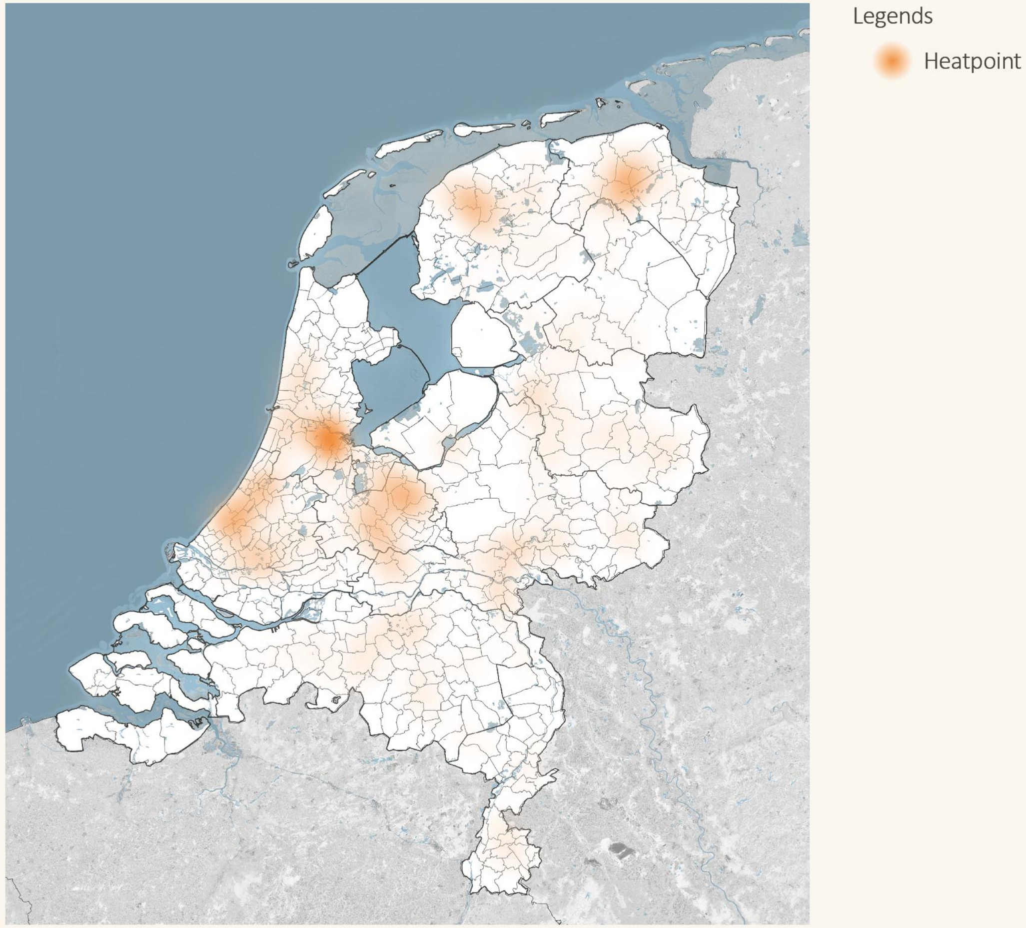


3

Multidimentional Analysis

Energy Community in the Netherlands





Desk Research: a total of 714 energy cooperatives (communities)

Energy Community in the Netherlands

Basic Information	Scale	Type of Energy	Stakeholder & Governance	Installation	Business Model	Digital Tools	Policy & Regulation	Social Impact	Environmental Impact
- *FlexCitizen* - Sporenburg, Amsterdam - 2024.01	- Neighborhood - 540 Households	- Solar - Electricity	- Residents(Prosumers), Amsterdam Municipality, Resourcefully(Consulting), OpenRemote(System developer) - P2P energy sharing	- Solar panels(35) - Smart meters - EV charging station(45)	- P2P energy sharing - Incentives for flexible electricity usage	- Real-time IoT platform for residents		- Been estimated to relieve the grid congestion of Amsterdam city	
- *Republica Papaverweg* - Buiksloterham, Amsterdam North - 2023	- Neighborhood - 15,000 m^2 - Six buildings: Residential building, Loft tower, Rental apartment, Hotel, Cafe&office, Business space	- Solar, Geothermal - Electricity, Heat	- Residents/ companies(Prosumers), Amsterdam Municipality, EU(Subsidy), Spectral(System developer), Marc Koehler Architects(Design) - Energy cooperative	- Solar panels, battery storage, micro grid - Geothermal well, heat pumps, aquifer thermal energy storage - EV charging station	- Local energy production& exchange - Energy cooperative consisting of residents(homeowners and tenants) and companies	- Smart energy management system(software)	- SDE++ subsidy	- Energy cooperative becomes own private grid operator, bringing lower tariff and costs, energy saving and longer lifespan	- Green roofs, facade gardens and nesting boxes for swifts and bats, promoting biodiversity
- *Schoonschip* - Buiksloterham, Amsterdam North - 2020	- Neighborhood - 46 Households, 144 residents	- Solar - Electricity, Heat	- Residents(Prosumers& private developers&Schoonschip corporation members), Amsterdam Municipality, Spectral(Smart grid system developer), Investors - Community governance	- Solar panels(516), battery - Heat pumps(30) - Thermal panels(60), solar boilers - Smart grids	- Local energy production& exchange - Amsterdam Klimaat & Energiefonds(government funding), GreenCrowd(crowdfunding), Stichting DOEN(investor)	- Smart community platform: real-time energy flow visualization(household applience, solar panels, smart heat pumps, battery system)	- Experiments Powergrid *The Ministry of Economics and Climate has assigned The Netherlands Enterprise Agency to found the "Experiments Powergrid" organisation which enables communities to experiment and innovatewith their own sustainable local energy network, without the involvement of any current energy suppliers, and exempt from the current energy laws.	- Schoonschip is a concrete, practical case study that shows that prosumers can play an active role in the sustainable energy transition. As far as we know, the Schoonschip Smart Grid is the most innovative residential smart grid in the world .	- Green roofs, floating gardens, promoting biodiversity - Rainwater collection and wastewater reuse system
- *Aardehuis* - Olst - 2015	- Neighborhood - 23 Houses - an estimated 63,300 kWh annually with soar panels	- Solar, Biomass - Electricity, Heat	- Residents(Prosumers, partner developer), Olst Municipality, Recycling company(Material provider), Transition Town Deventer (TTD, local community for transition)	- Solar panels(274), battery, electric boilers(22) - Heat pumps(3) - Thermal panels(20) - Wood stoves(22)	- Collective use of local produced energy			- Many people worked in the project left with ideas for other projects of building ecovillages	- Won the title 'Most sustainable village' in regional contest in 2012 - All materials were from waste reuse or local building materials
- *Meerwind* - near the Burgerveen junction, Haarlemmermeer-South - 1993	- Regional - Produce electricity for approximately 2,400 households	- Wind - Electricity	- Residents(Consumers), Meerwind(Energy Cooperative) Haarlem Municipality, Provincial Council(Permission)	- Wind turbines(3)	- Provide lower tariff for members		- Wind farm development has much more restrictions than solar, including legal restriction like building permit and subsidy, and practical ones like the distance, and impact on airport for instance	- Inspired different resident groups to develope community wind turbines	
- *Onze Energie* - Amsterdam North - 2007-2012, 2016-2020	- Regional	- Wind - Electricity	- Residents(Consumers, Partner developer), Amsterdam Municipality, Province of North Holland, NDSM Energie(Energy cooperative of companies)	- Wind turbines(in proposal)			- The project was objected by the Province of North Holland and thus stopped in 2012 - The project started again after new policy of extra windmills but the province of North Holland is arguing the lack of support		
- *Energiek Broekland* - Broekland, Raalte - 2018-2020	- Multiple neighborhood	- Solar - Electricity	- Residents(Prosumers, Partner developer)	- Solar panels(in proposal)	- Of the net proceeds of a project (roof), 25% goes directly to the participating members and is divided among them. - No project due to lack of market				

Elements

- Basic Information, Scale, Type of Energy, Stakeholder & Governance, Installation, Business Model, Digtal Tools, Policy & Regulation, Social Impact, Environmental Impact.

Findings

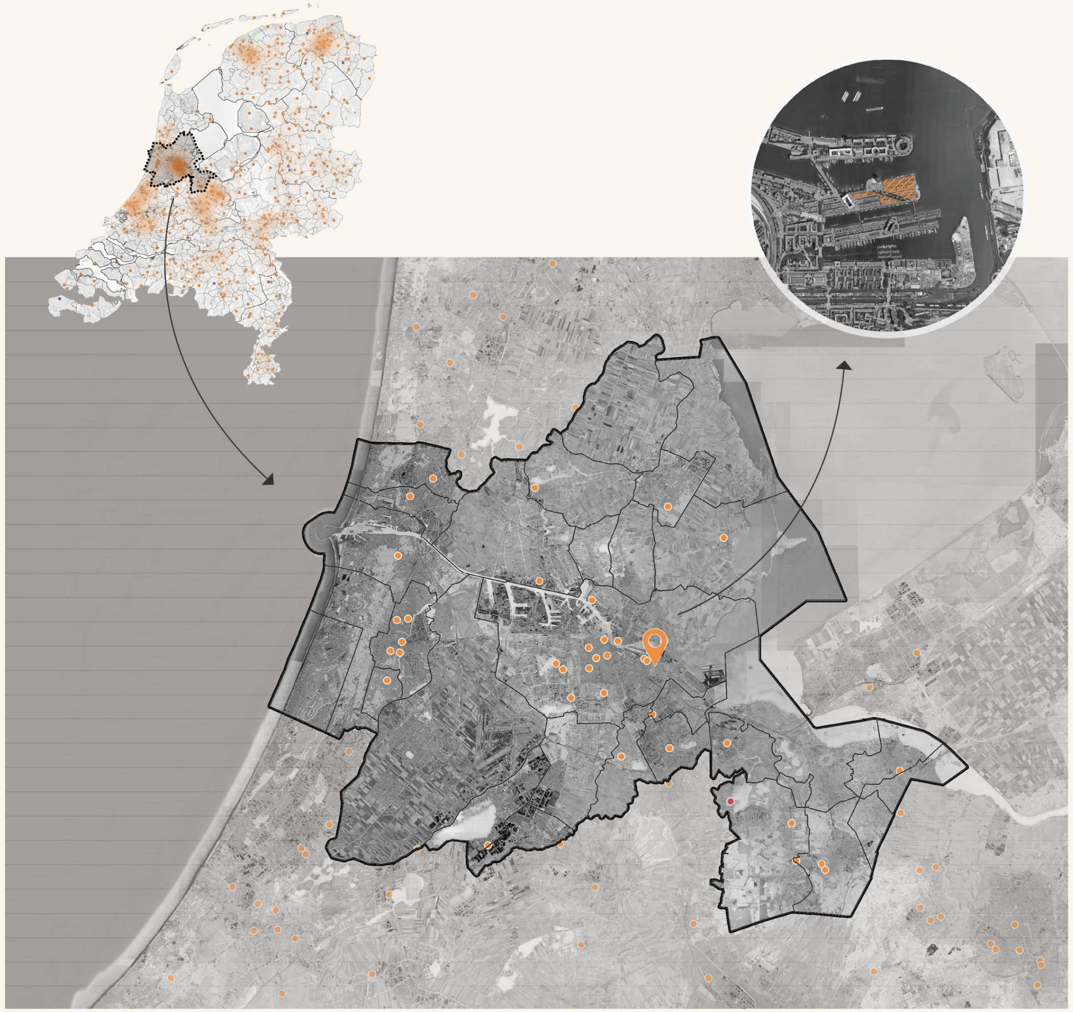
- Residents often act as prosumers and developers simultaneously with continuing participation and contribution.

- Complete system of energy self-generation, energy storage, energy exchange/trading, and smart energy monitoring.

- *External support is very important, especially in terms of funding and policy.*

...

Residents Meeting & Interview



FlexCitizen

Starts at 2024.01

March 11th, 2025

Residents Meeting & Interview

Interesting & Inspiring things

- A resident earned 170 euros from engaging in the project.

- Many people have signed up to use "plug and play" home batteries.

- Why not centralise energy storage?Why does every home need a small battery?

- • The optimization is not "A or B", but "A + B + C", moving forward in parallel.
- • Household batteries promote individual awareness of energy saving.

- Subsidies of selling electricity back to the grid are now being phased out, so sharing is more benefitial than selling electricity.

- Demand-Response Mechanism through Application

Interview

Q: Capability to exchange or trade energy with other energy communities?

A: It really depends on where the grid bottlenecks are. if two areas don't have a bottleneck between them, then yes, energy exchange is possible. Right now, we limit participation to people within this area, but it could easily be expanded.

Q: Is this project replicable in other areas or other countries?

A: This project is meant to be a demonstration, and the goal is to inspire policymakers and DSOs to implement it on a larger scale. They need to embrace the idea and provide funding.

Stakeholder Analysis

RQ1: Who are the important stakeholders involved in the development of energy communities, and how do their interests and actions influence the empowerment of ECs?

Stakeholder Profile Table

PUBLIC

1. European Union
2. Dutch National Government
3. Ministry of Economic Affairs and Climate Policy (EZK)
4. Ministry of the Interior and Kingdom Relations (BZK)
5. Netherlands Enterprise Agency (RVO)
6. Transmission System Operator (TSO)
7. Noord-Holland Administration
8. Noord-Holland Zuid Energy Region (Energieregio Noord-Holland)
9. Amsterdam Municipality
10. Distribution System Operator (DSO)

PRIVATE

1. Wind Turbine Companies
2. Solar Panel Providers
3. Energy Providers (Utilities)
4. Banks/Investors
5. Energy Consultants

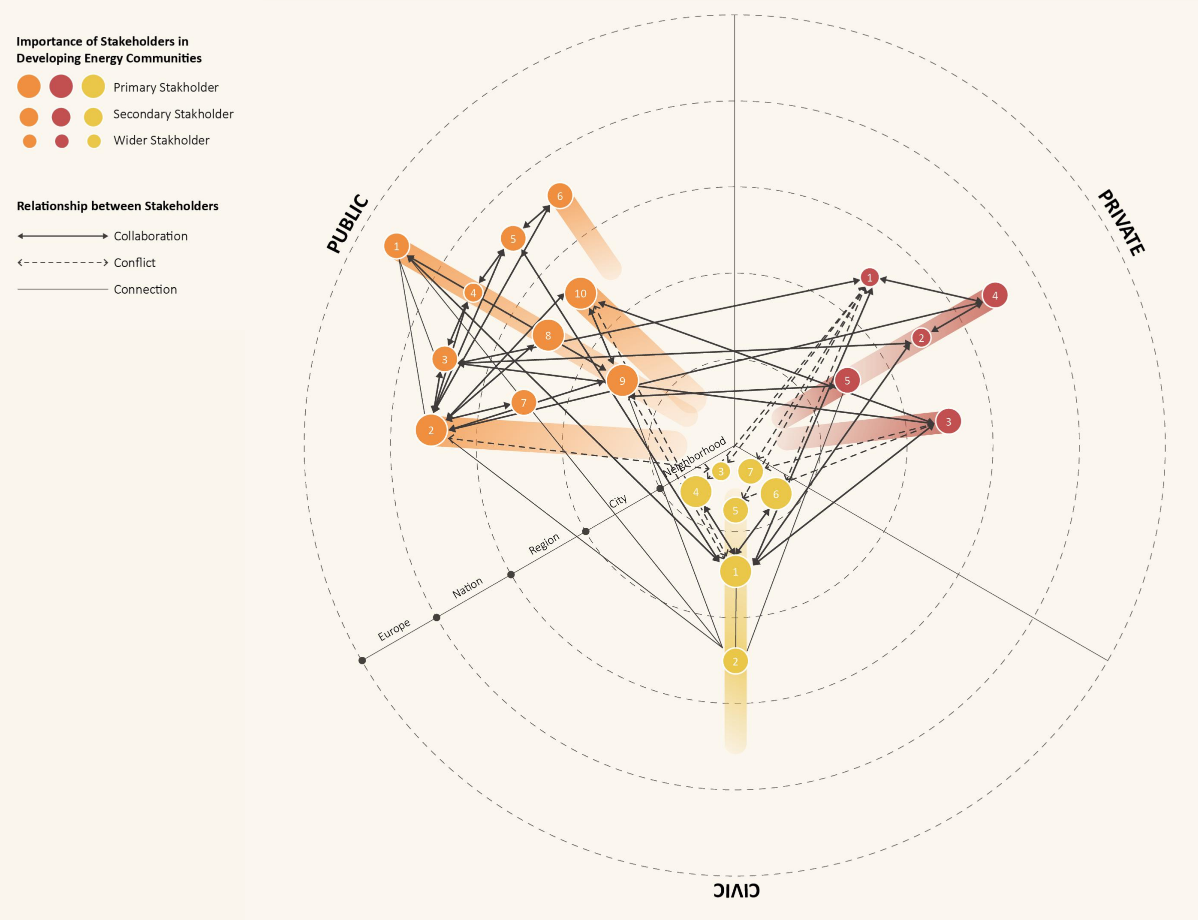
CIVIC

1. Energy Cooperatives (Energiecoöperaties)
2. Academic Institutions
3. Farmers
4. Active Urban Residents
5. Marginized Urban Residents
6. Active Rural Residents
7. Marginized Rural Residents

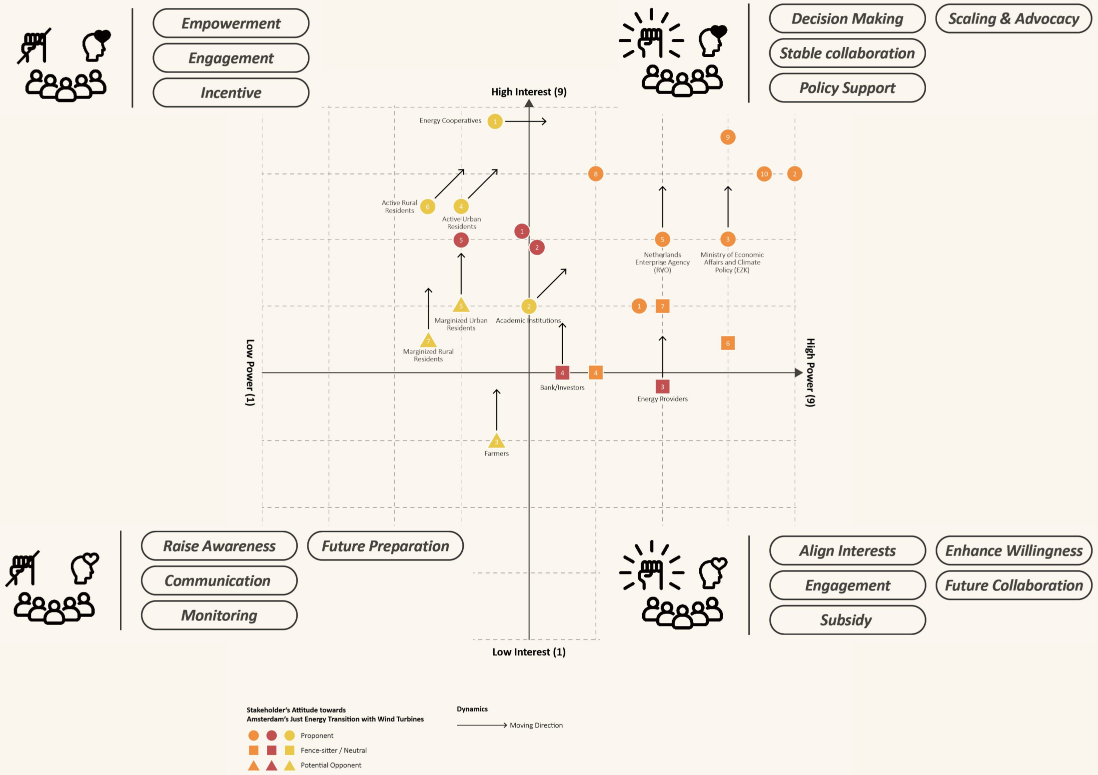
Stakeholder	Scale	Interests (1-9)	Problem Perception	Goals	Resources
European Union	Europe	7	Policy fragmentation Slow progress	Decarbonization Energy security	Policy influence Funding
Dutch National Government	Nation	8	Conflicts with local communities NIMBYism	National energy transition targets	Legislative power Funding
Ministry of Economic Affairs and Climate Policy (EZK)	Nation	7	Industry opposition Cost concerns	Economic growth Energy transition	Regulatory power Economic tools
Ministry of the Interior and Kingdom Relations (BZK)	Nation	5	Governance complexity Public pushback	Regional cooperation Urban resilience	Legislative power
Netherlands Enterprise Agency (RVO)	Nation	6	Technical and financial barriers	Support for renewable projects	Expertise Financial support
TSO (eg. TenneT)	Nation	7	Intermittent wind load, system stability	Maintain balance with growing RES (esp. wind)	Transmission infrastructure Policy influence
Banks/Investors	Nation	6	Investment risks	Return on investment	Economic influence
Noord-Holland Administration	Region	7	Balancing local interests and national goals	Regional energy planning Energy transition	Policy-making Local governance
Noord-Holland Zuid Energy Region (Energieregio Noord-Holland)	Region	8	Local resistance to energy infrastructure	Regional energy targets	Local governance
DSO (eg. Liander)	Region	9	Grid congestion Lack of smart integration	Facilitate decentralized energy connections	Grid infrastructure Smart systems
Wind Turbine Companies	Region	9	Public opposition Environmental regulations	Expand wind turbine installations	Expertise Capital
Solar Panel Providers	Region	9	Upfront costs Rooftop access	Expand rooftop solar adoption	Installation teams Capital
Energy Providers (Utilities)	Region	8	Shift from fossil fuels to renewable energy	Secure energy supply Profitability	Infrastructure
Academic Institutions	Region	6	Knowledge gap Technological challenges	Research and innovation	Research Expertise
Amsterdam Municipality	City	9	Local NIMBYism Conflicting stakeholder interests	Local energy transition	Local governance Funding Local influence
Energy Consultants	City	7	Low community literacy	Advise on design & participation	Trust Localized expertise
Energy Cooperatives (Energiecoöperaties)	City	8	Lack of support for local renewable projects	Community-owned renewable energy	Social influence Local support
Farmers	Neighborhood	6	Land use conflicts Turbine impacts on agriculture	Protect agricultural land	Land ownership Social influence
Active Urban Residents	Neighborhood	9	Noise Aesthetics Health concerns	Protect quality of life	Local advocacy Social influence Public voice
Marginized Urban Residents	Neighborhood	6	Energy costs NIMBYism	Lower energy costs	Public voice
Active Rural Residents	Neighborhood	8	Visual impact Noise Lower land value	Minimize local impacts	Local network Social influence Public voice
Marginized Rural Residents	Neighborhood	6	Unfair distribution of energy transition costs	Fair energy policies	Local network

Stakeholder Analysis

Catergorization, Importance & Relationships



Power, Interest & Attitude



Stakeholder Analysis

Spectrum of Stakeholder Engagement

Inform	Consult	Involve	Collaborate	Empower
	Ministry of the Interior and Kingdom Relations (BZK) 4	Netherlands Enterprise Agency (RVO) 5	European Union 1	
	Transmission System Operator (TSO) 6	Noord-Holland Administration 7	Dutch National Government 2	
			Ministry of Economic Affairs and Climate Policy (EZK) 3	
			Noord-Holland Zuid Energy Region 8	
			Amsterdam Municipality 9	
			Distribution System Operator (DSO) 10	

Inform	Consult	Involve	Collaborate	Empower
	Banks/Investors 4	Energy Consultants 5	Wind Turbine Companies 1	
			Solar Panel Providers 2	
			Energy Providers (Utilities) 3	

Inform	Consult	Involve	Collaborate	Empower
		Farmers 3	Academic Institutions 2	Energy Cooperatives 1
			Marginized Urban Residents 5	Active Urban Residents 4
			Marginized Rural Residents 7	Active Rural Residents 6

Findings

- Polidy-makers/Municipality, TSOs/DSOs (Public Sector); Banks/Investment Company (Private Sector); Residents (Civic Sector)are the most important stakeholders among them.

- Creating **collaboration** between civic sector and other two sectors, raising awareness among residents and **empowering** them are important.

RQ2: What are the spatial plans and policies currently influence the development of ECs in the Netherlands, and what are the gaps or deficiencies exist in the current approach?

EU Policy

Clean energy for all Europeans package

- Provide financial and technical support
- Promote education and awareness campaigns
- Community owned DSO
- Integrate energy communities into broader policy frameworks (energy, climate, and spatial planning strategies at local, regional, and national levels)

Dutch Policy

The New Energy Law

Onshore wind | Energy sharing and balancing

Article 2.30 : ***Right to energy sharing within energy communities.*** *This offers opportunities for small-scale onshore wind projects to share electricity locally.*

Main existing policy gaps and challenges:

- Underdeveloped energy sharing mechanisms: While the right is established, implementation frameworks and business models are missing;

- Lack of technical and organizational capacity: Local communities often lack the experience and resources to launch and manage ECs;

- **Fragmented policy landscape**: ECs are not yet fully embedded in spatial and climate planning systems.

Energy Community +

RQ3: What are the strategies that could contribute to enhancing the development and scalability of ECs that helps to address the two wind energy dilemmas from local and regional level simultaneously?

Energy community can combine with different external services, organizations, tools, and governance mechanisms to enhance its functionality, efficiency, and scalability. This **collaboration** leads to a more integrated and adaptable system that is not only capable of managing local energy resources but also responding to broader policy, market, and technological changes.

eg:

Energy Community + Flexibility Market (EC+FM)

Energy Community + Energy Planning (EC+EP)

Energy Community + Digital Platform (EC+DP)

Energy Community + Behavioral Incentives (EC+BI)

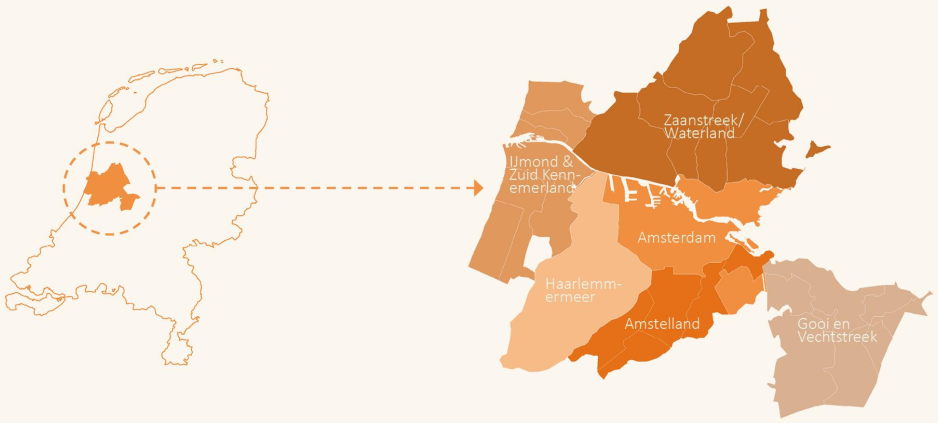
Energy Community + Municipality (EC+Muni)

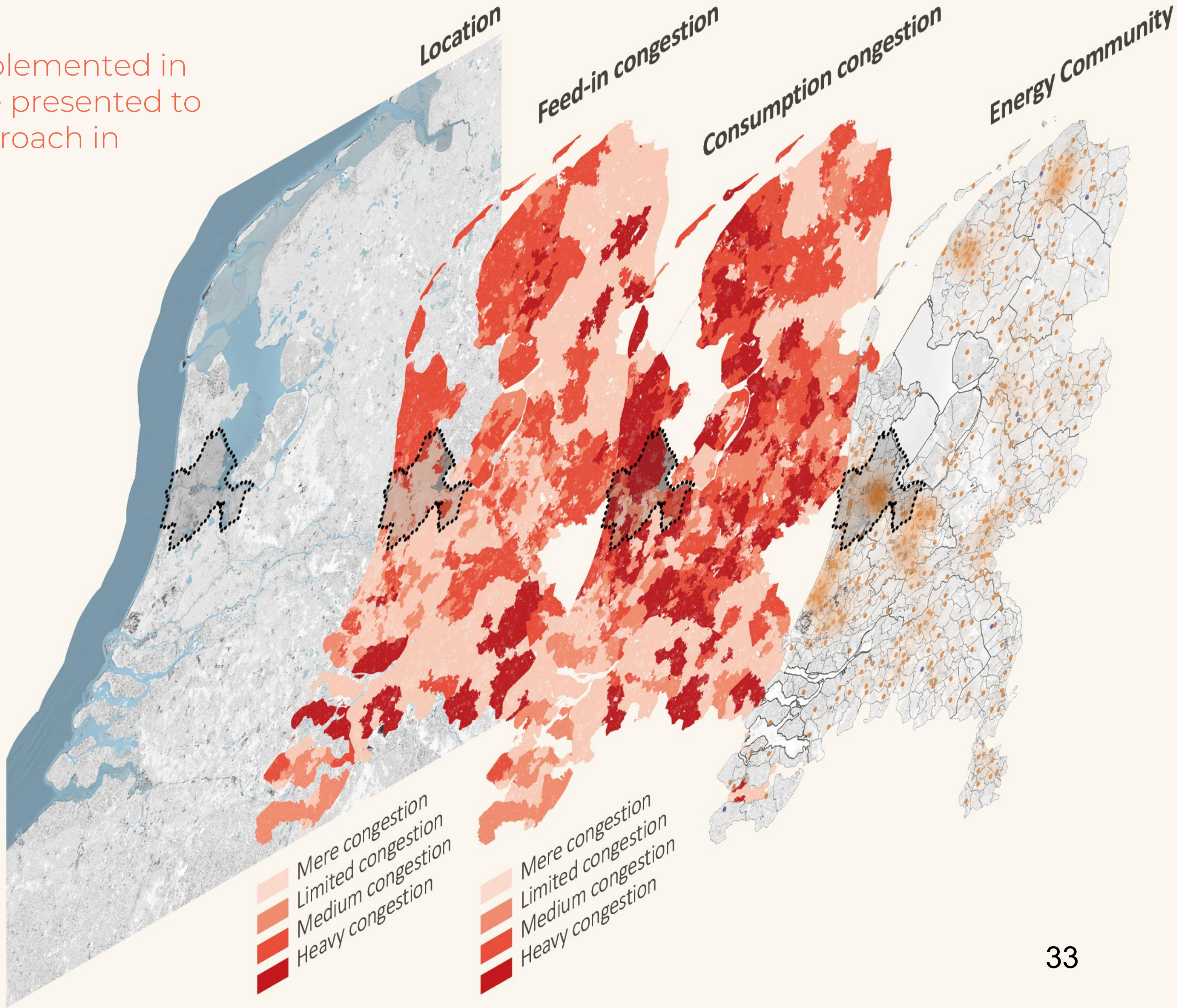
Energy Community + Energy Community (EC+EC)

North-Holland South Energy Region

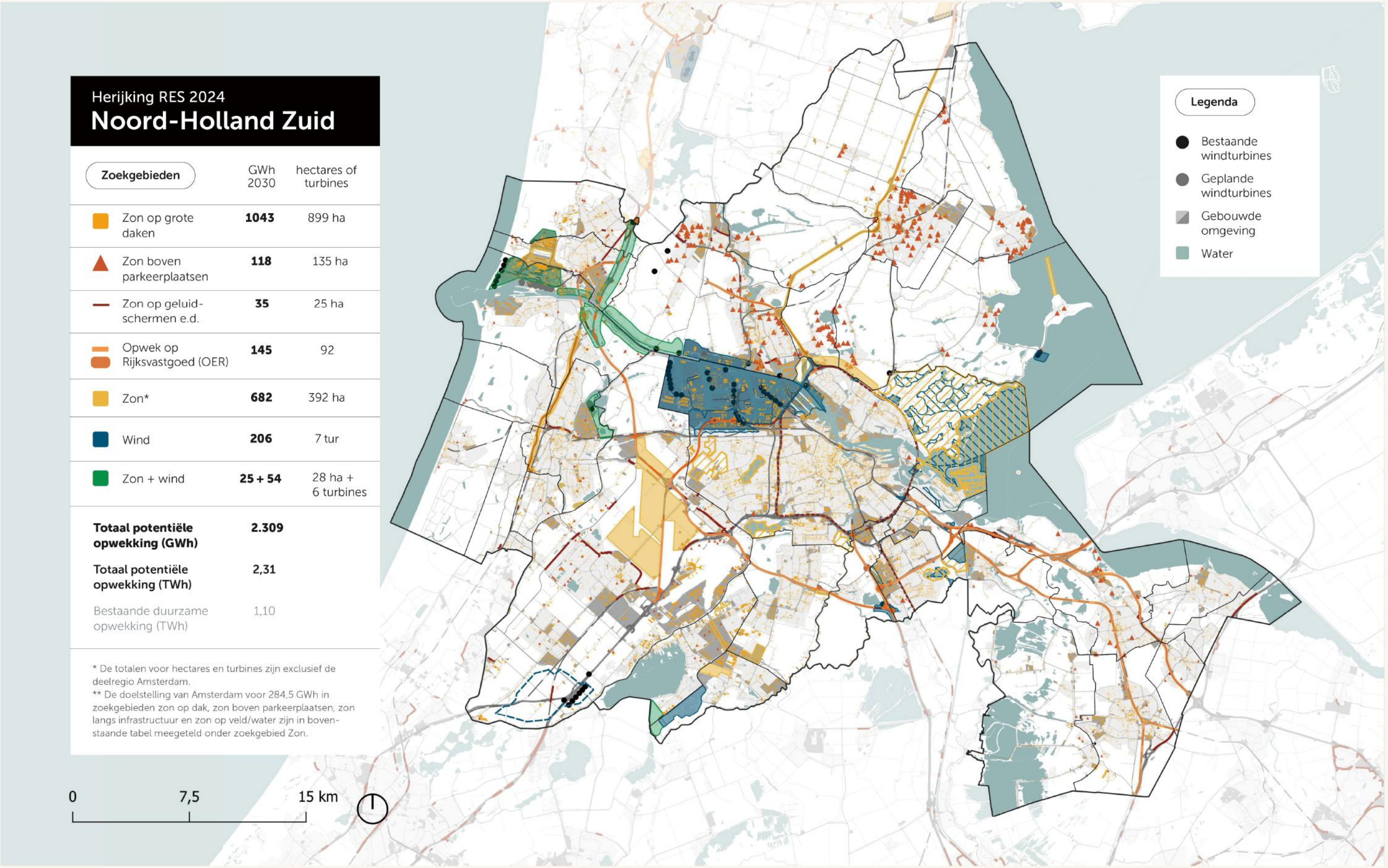
RQ4: How could the EC strategy be planned and implemented in the Dutch urban context, and how can the results be presented to demonstrate the effectiveness of this integrated approach in mitigating wind energy challenges.

Location





2024 North-Holland South Energy Region Planning



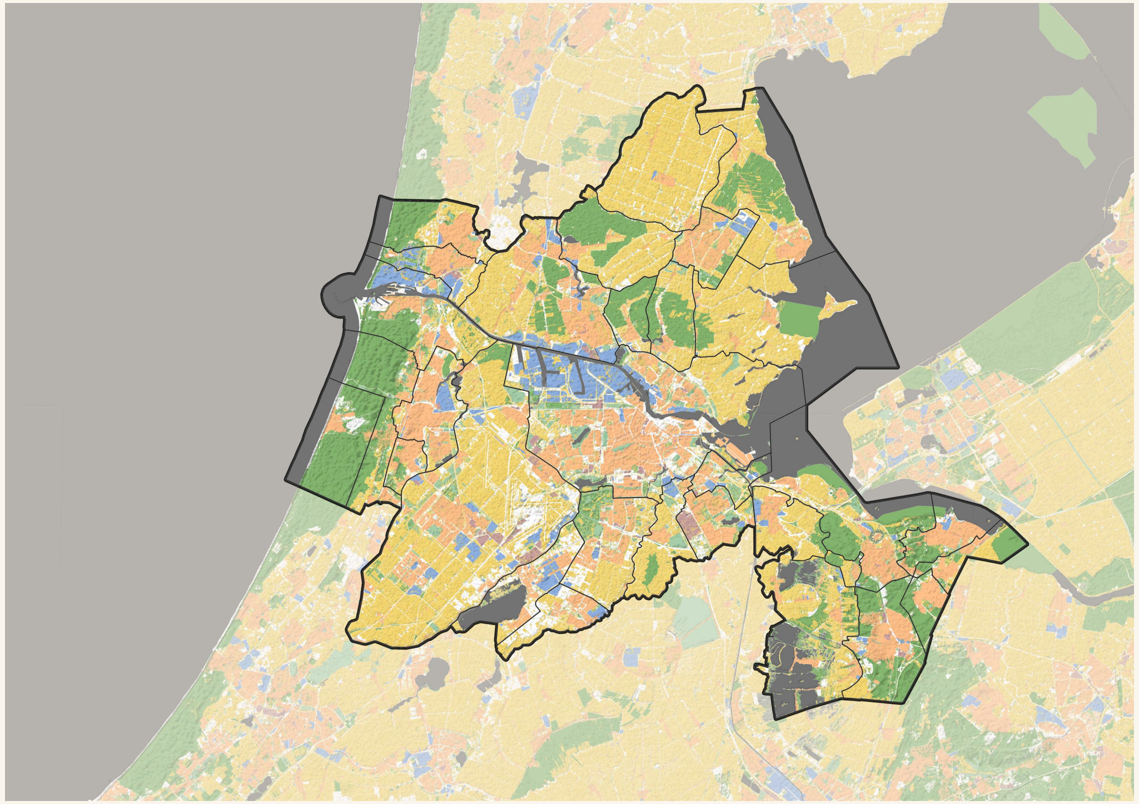
North-Holland South Energy Region

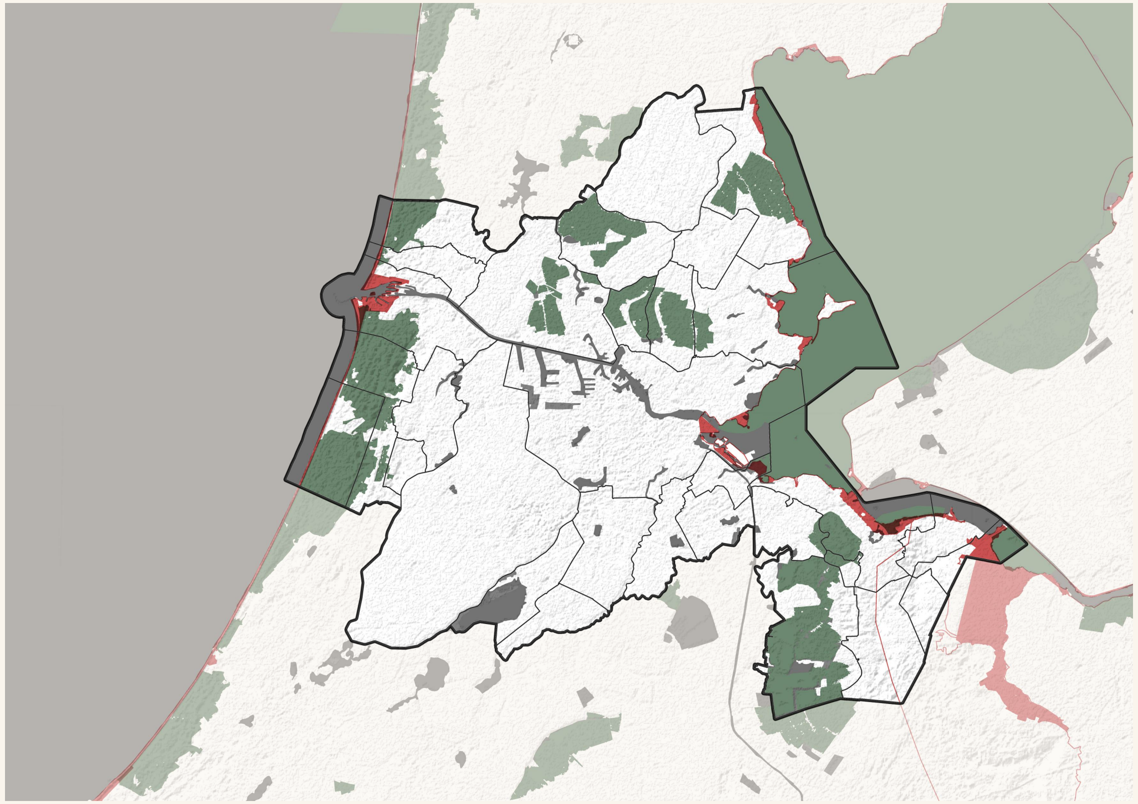
Land Use & Ecological Constraints

Legends

- Water / Wetlands
- Residential
- Commercial
- Industrial
- Open Space
- Agridulture & Suitable Nature
- Forest & Nature Reserve

- Natura2000
- Flood Risk Zone



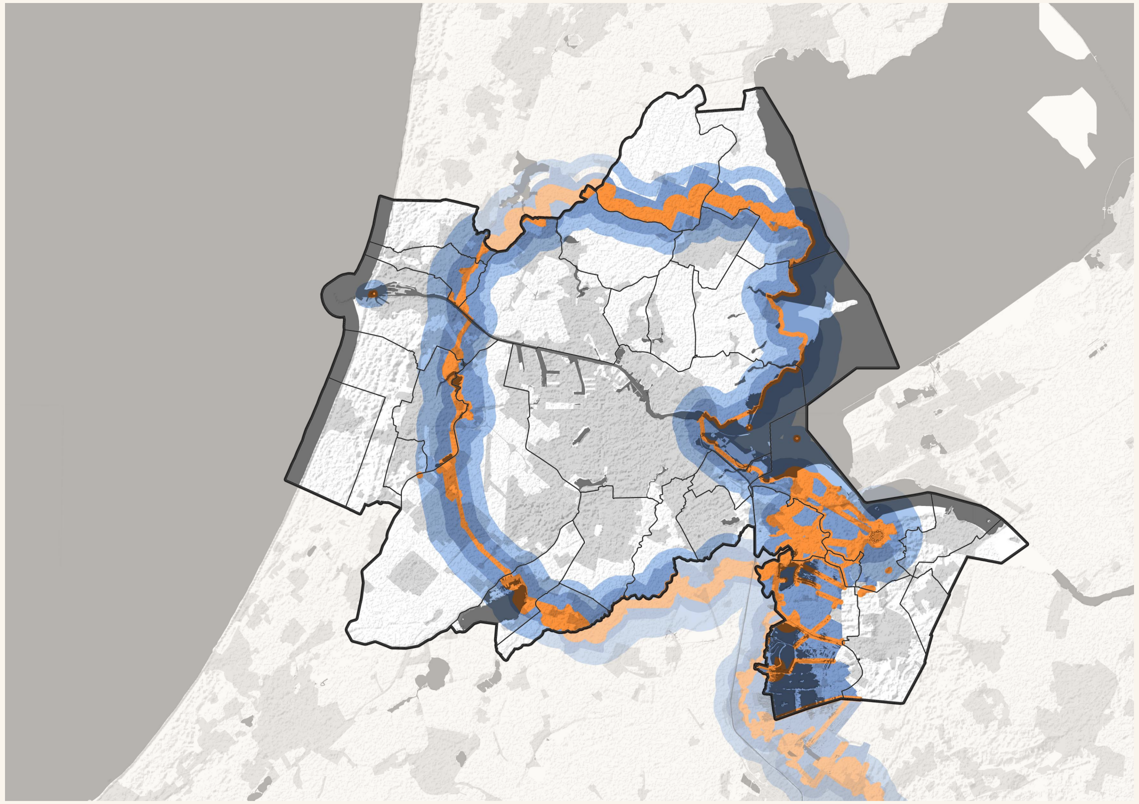


North-Holland South Energy Region

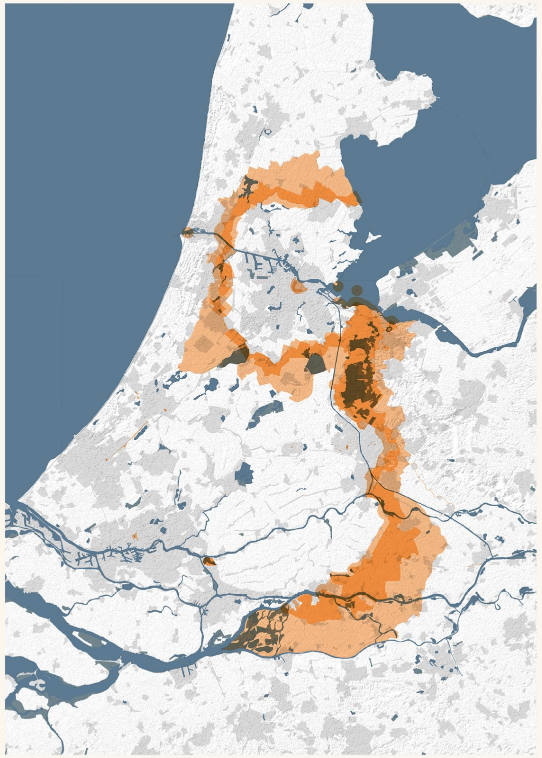
Cultural Heritage

Legends

- Water / Wetlands
- Urban Area
- Core Value Zone
- Buffer Zone
- Secondary Buffer Zone

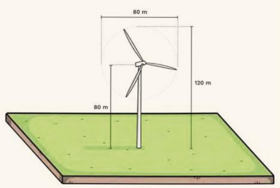


Dutch Waterlines

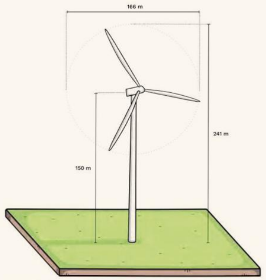


Legends

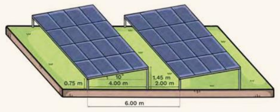
- Water / Wetlands
- Urban Area
- Dutch Waterlines Property
- Buffer Zone



Principetekening van een 3 MW windturbine met een tiphoogte van circa 120 meter.



Principetekening van een 5,6 MW windturbine met een tiphoogte van circa 240 meter.



Principetekening van een zonneveld met een lage opstelling van 1,50 meter hoog.

Principetekening een zonneveld met een hoge opstelling van circa 2,50 meter hoog.

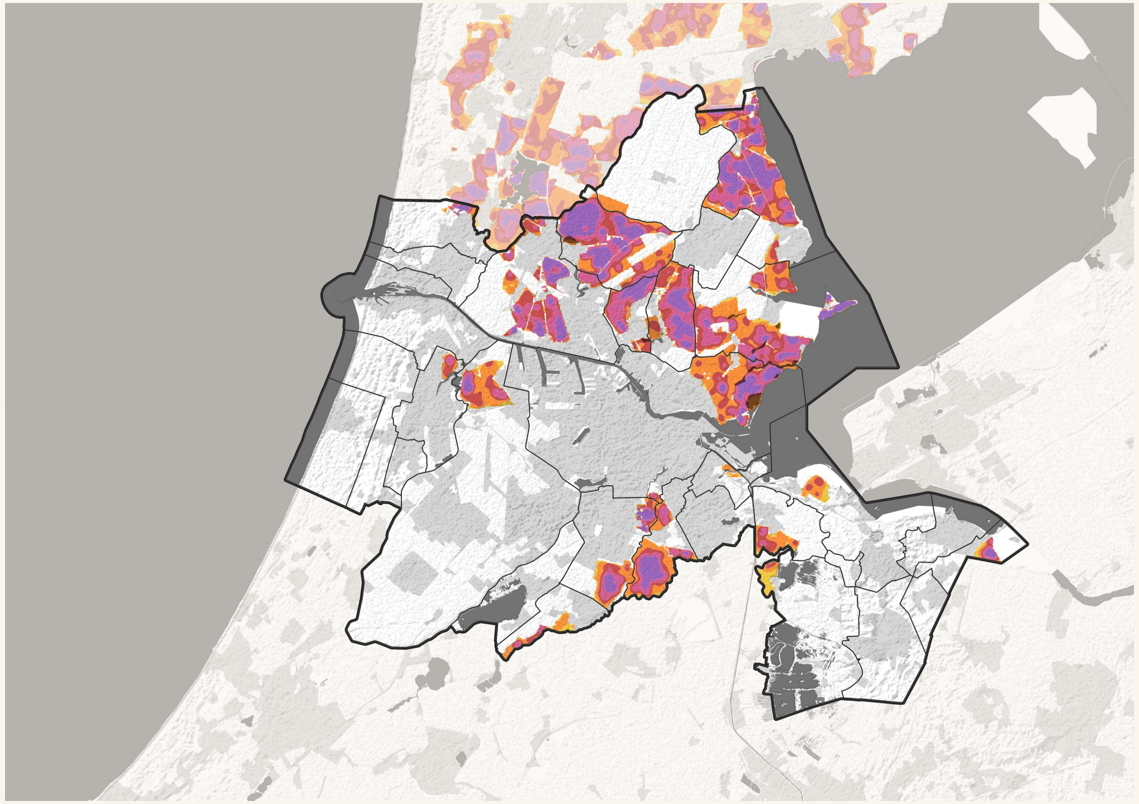
North-Holland South Energy Region

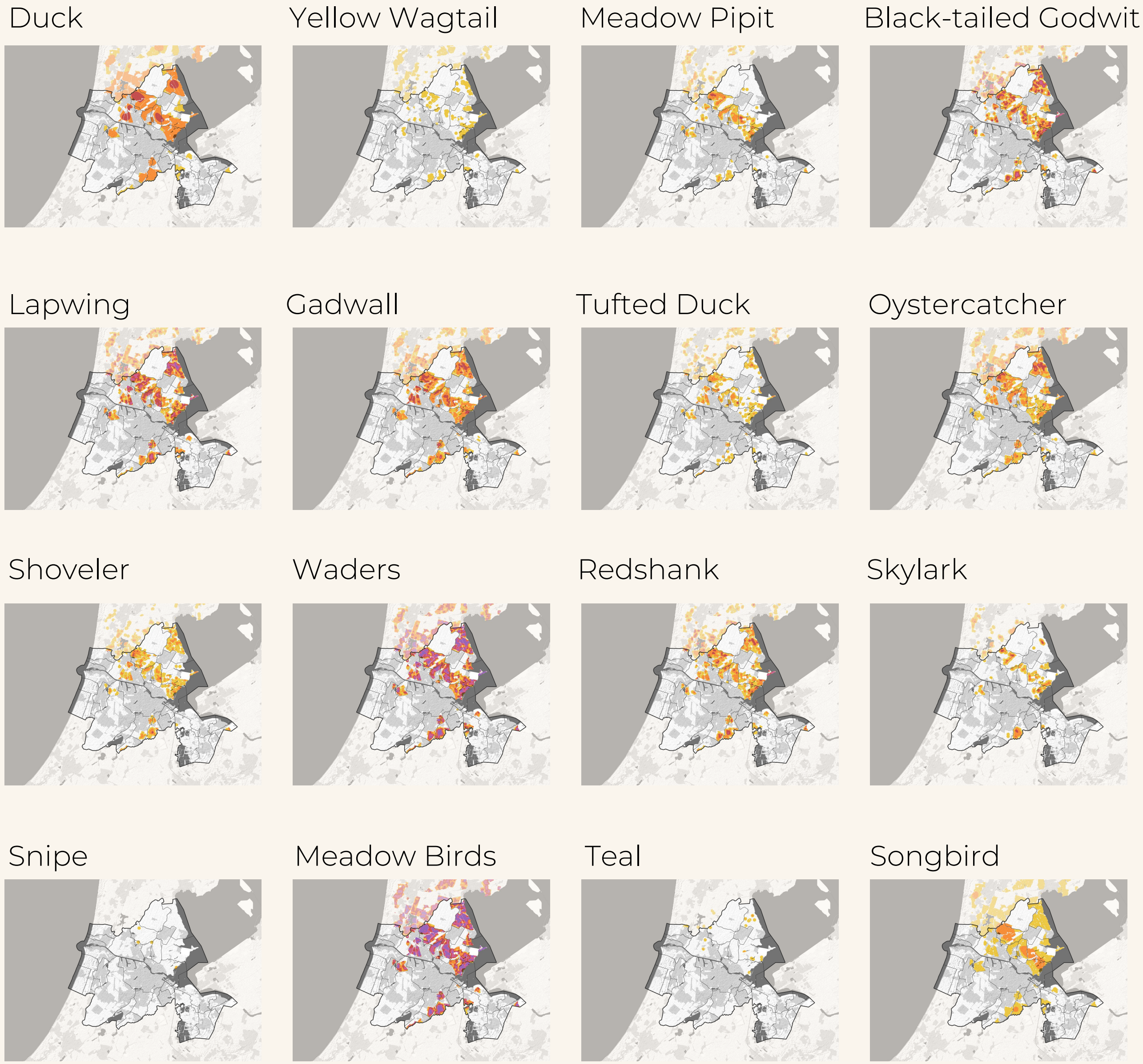
Biodiversity (Bird Breeding Density Areas)

16 Species (according to North-Holland Dataportal)

Legends

- Water / Wetlands
- Urban Area
- 5th Level Breeding Density Area (Most Restricted Area)
- 4th Level Breeding Density Area
- 3rd Level Breeding Density Area
- 2nd Level Breeding Density Area
- 1st Level Breeding Density Area (Least Restricted Area)





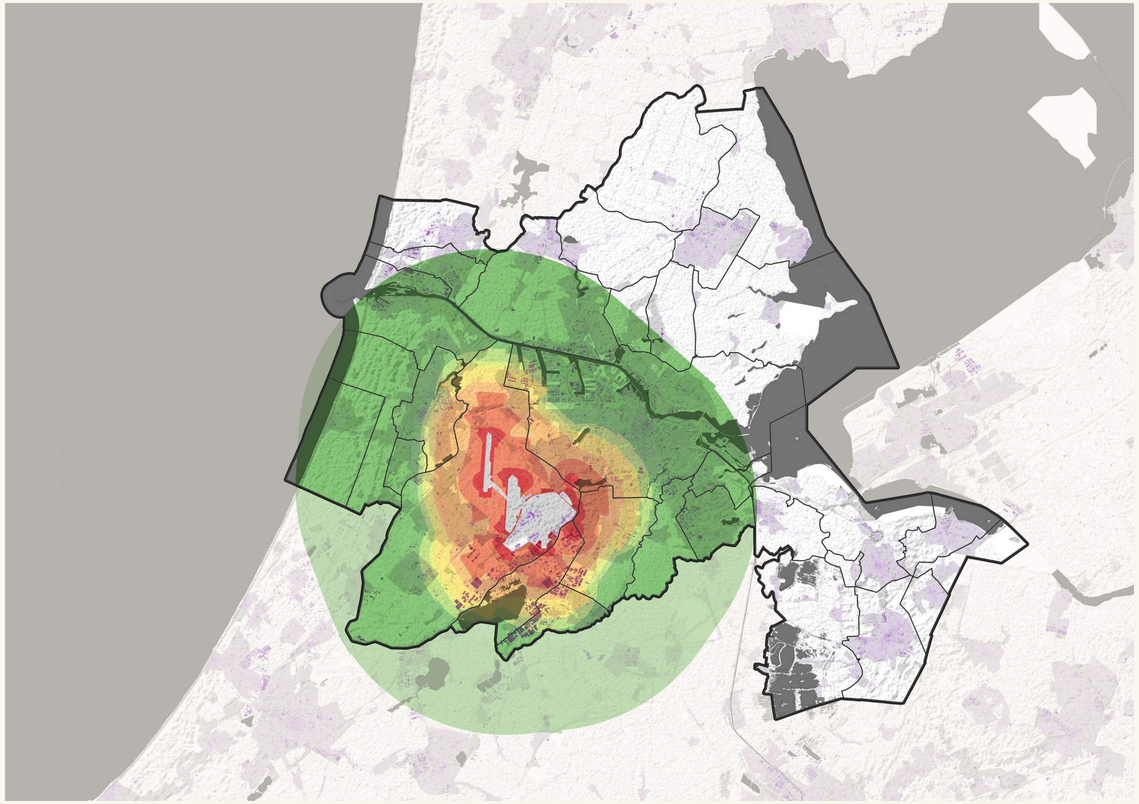
North-Holland South Energy Region

Height Restriction Zones

Legends

- Water / Wetlands
- Urban Area
- Buildings

Height Restriction
- -10 ~ 0m Built Height Limit
- 0 ~ 20m Built Height Limit
- 20 ~ 40m Built Height Limit
- 40 ~ 60m Built Height Limit
- 60 ~ 80m Built Height Limit
- 80 ~ 100m Built Height Limit
- 100 ~ 140m Built Height Limit
- ≥140m Built Height Limit



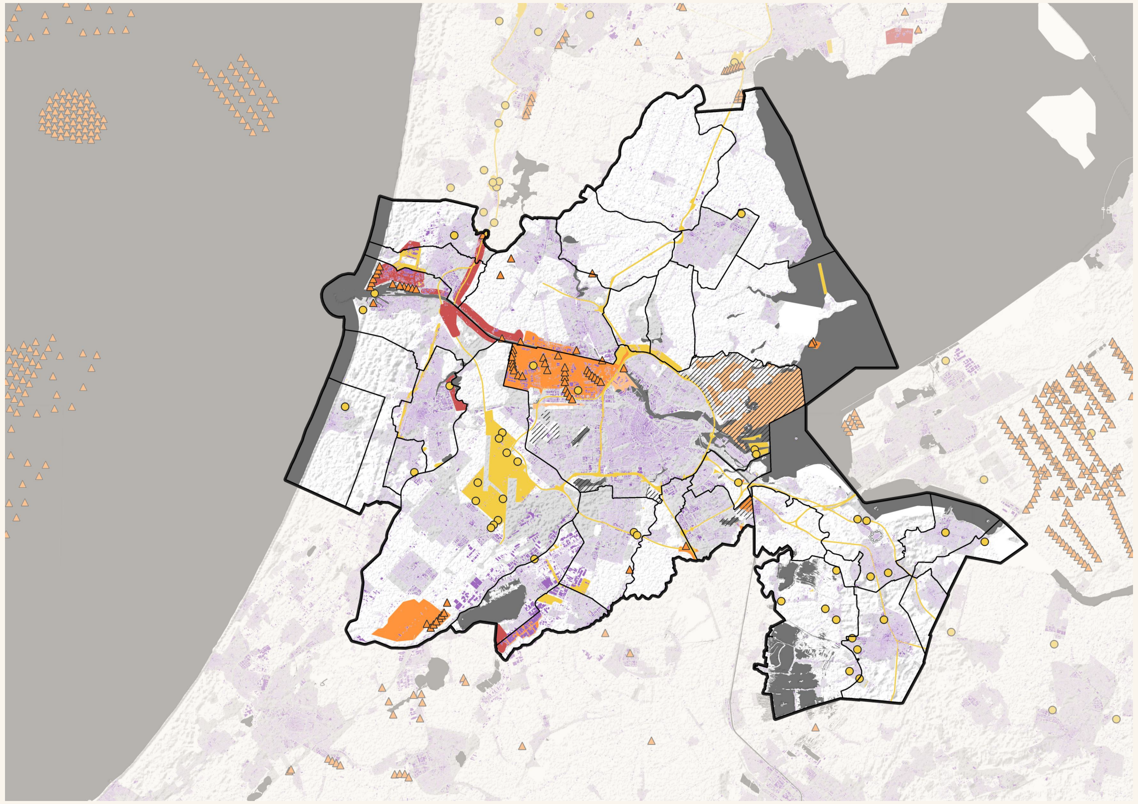
Current Energy Planning & Existing Renewable Energy Infrastructure

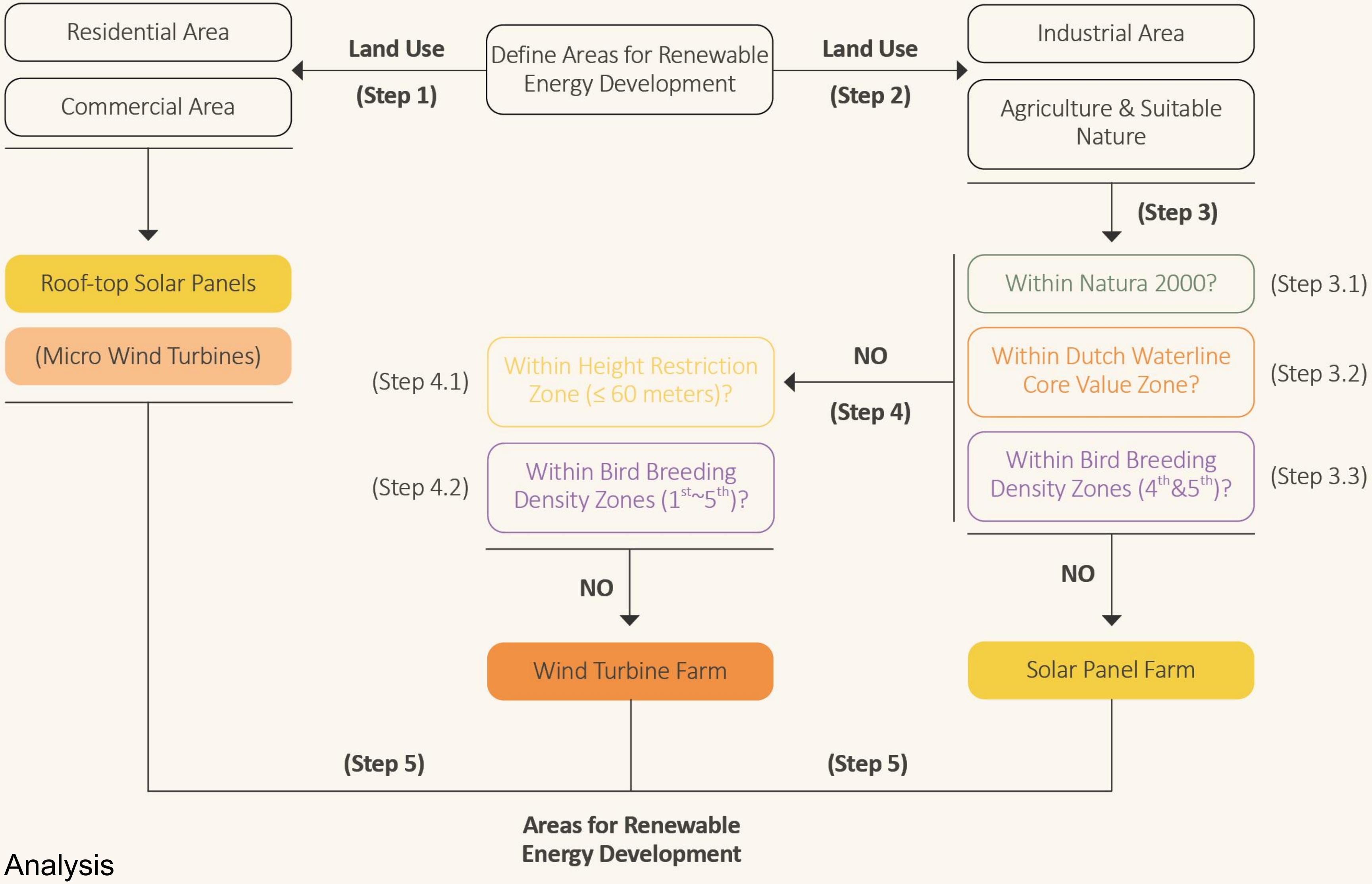
Legends

- Water / Wetlands
- Urban Area
- Buildings

Current Energy Planning (RES)
- Wind & Solar Development
- Wind Development
- Wind Development Alternate
- Solar Development
- Solar Development Alternate

Existing Infrastructure
- Wind Turbines
- Solar Panels



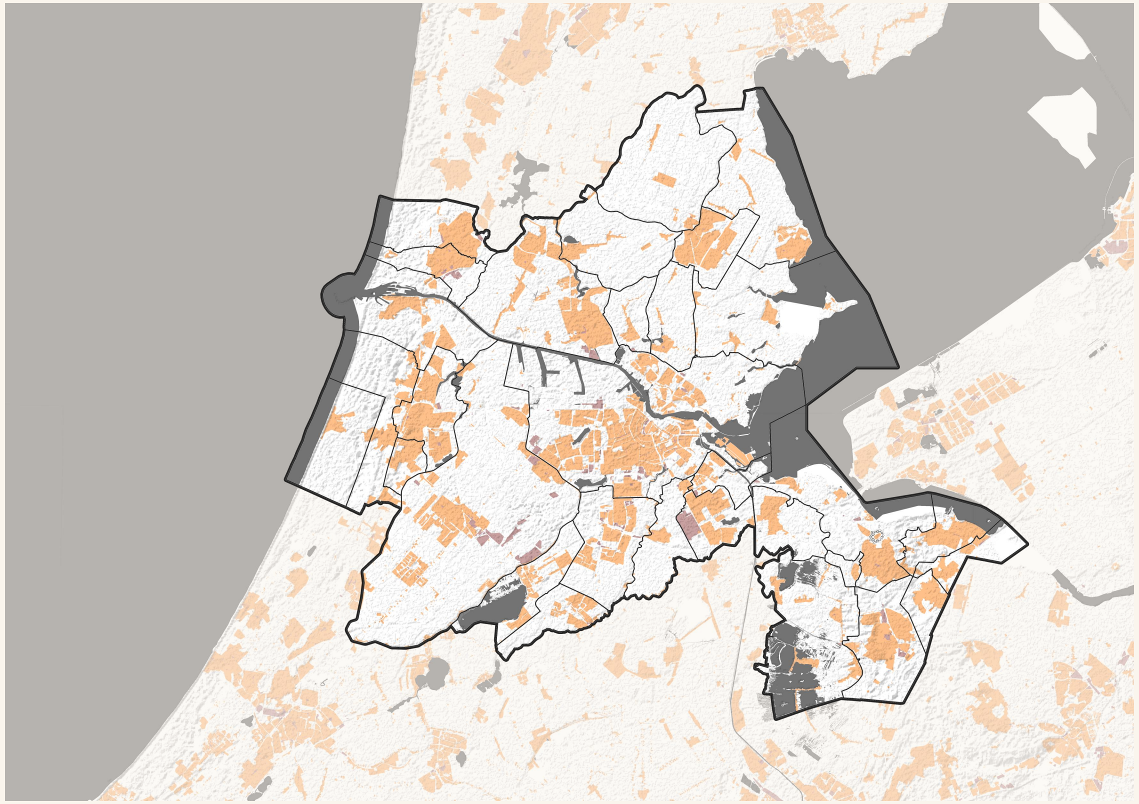

Residential Area
Commercial Area
Land Use
(Step 1)
Define Areas for Renewable Energy Development
Land Use
(Step 2)
Industrial Area
Agriculture & Suitable Nature
(Step 3)
Roof-top Solar Panels
(Micro Wind Turbines)
Within Natura 2000?
(Step 3.1)
Within Dutch Waterline Core Value Zone?
(Step 3.2)
Within Bird Breeding Density Zones (4th&5th)?
(Step 3.3)
NO
(Step 4)
(Step 4.1)
Within Height Restriction Zone (≤ 60 meters)?
(Step 4.2)
Within Bird Breeding Density Zones (1st~5th)?
NO
NO
Wind Turbine Farm
Solar Panel Farm
(Step 5)
(Step 5)
Areas for Renewable Energy Development

North-Holland South Energy Region

Step 1: Roof-top Solar Panels (& micro wind turbines)

Legends

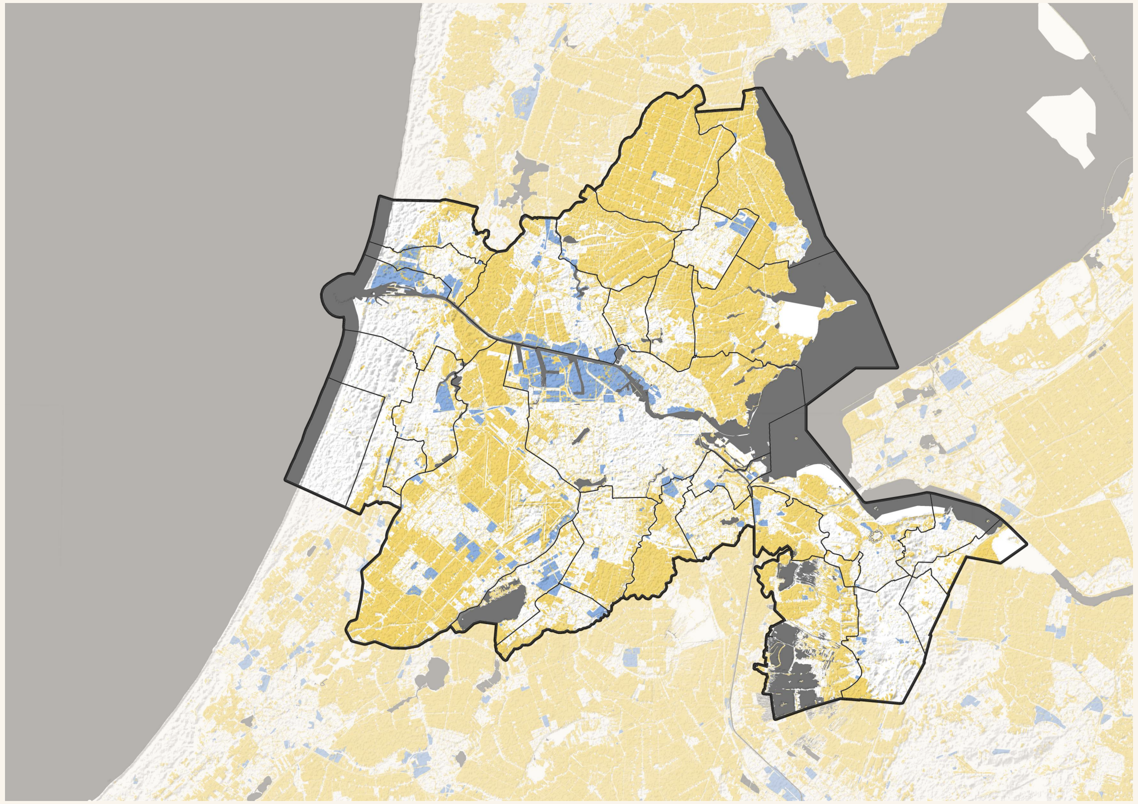
- Water / Wetlands
- Residential
- Commercial



Step 2: Wind & Solar Farms (with no restriction)

Legends

- Water / Wetlands
- Industrial
- Agriculture & Suitable Nature

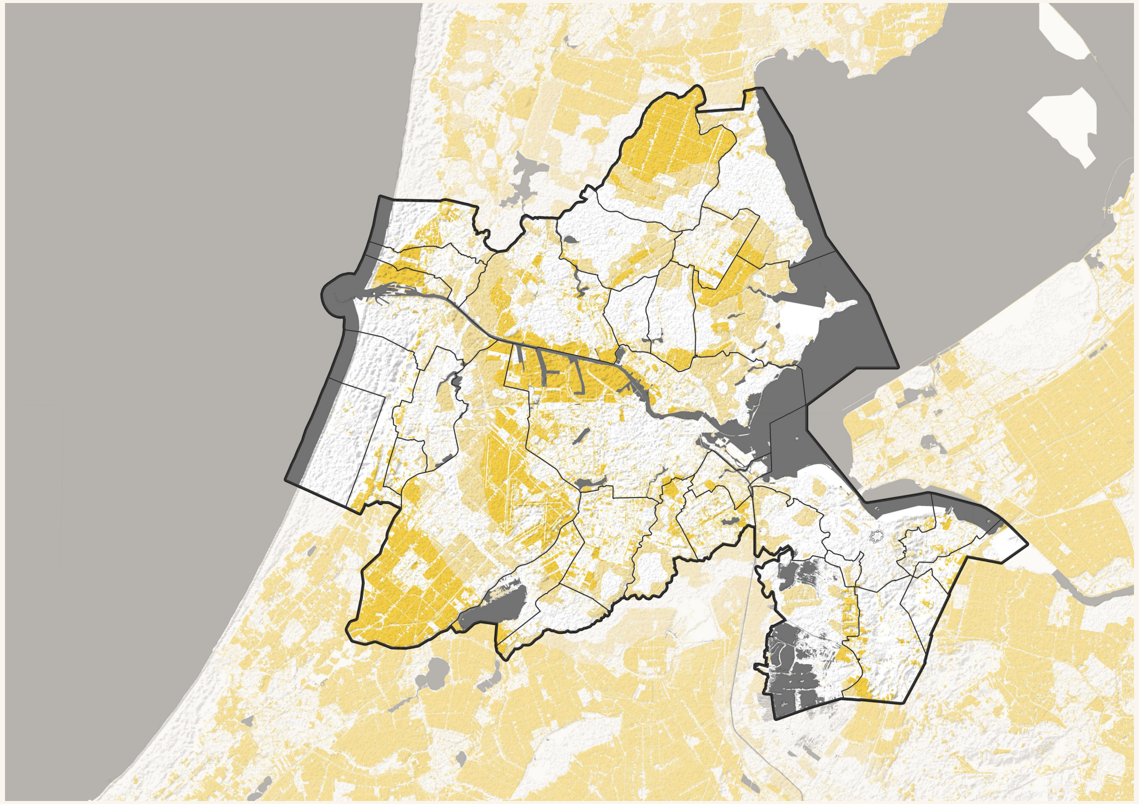


North-Holland South Energy Region

Step 3: Solar Farms (with restrictions)

Legends

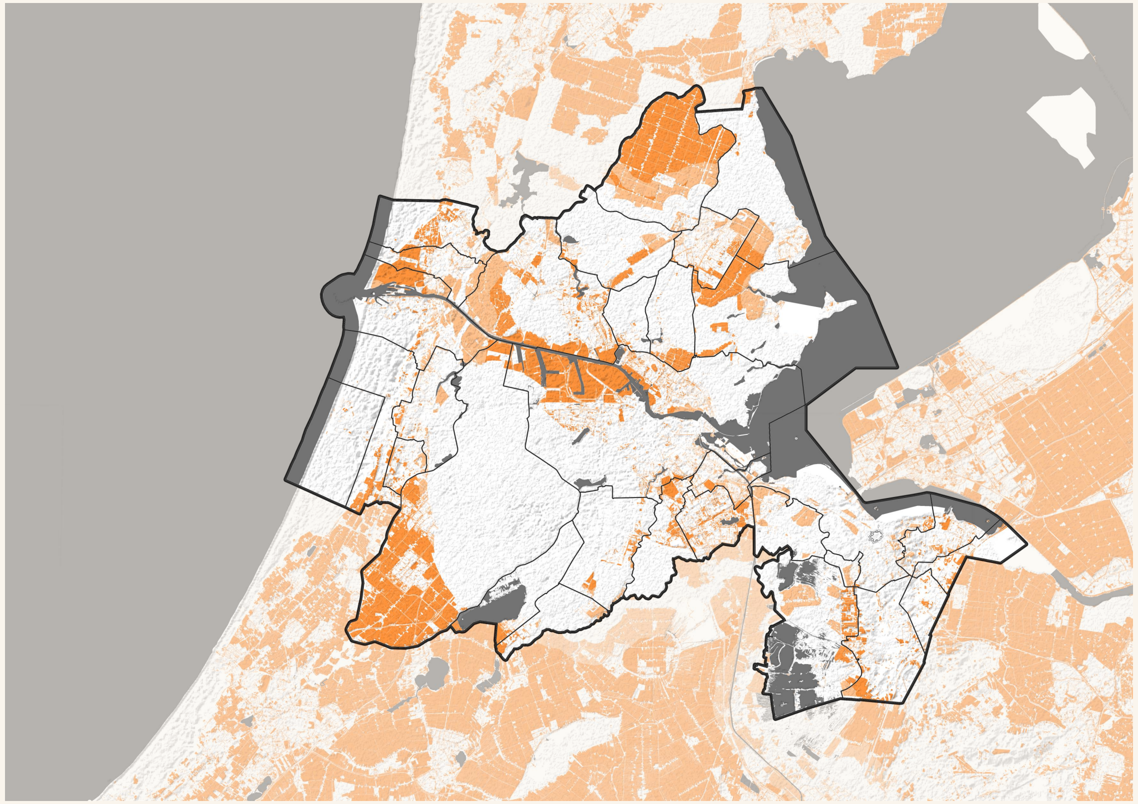
- Water / Wetlands
- Primary Development Area
- Alternate Development Area



Step 4: Wind Farms (with restrictions)

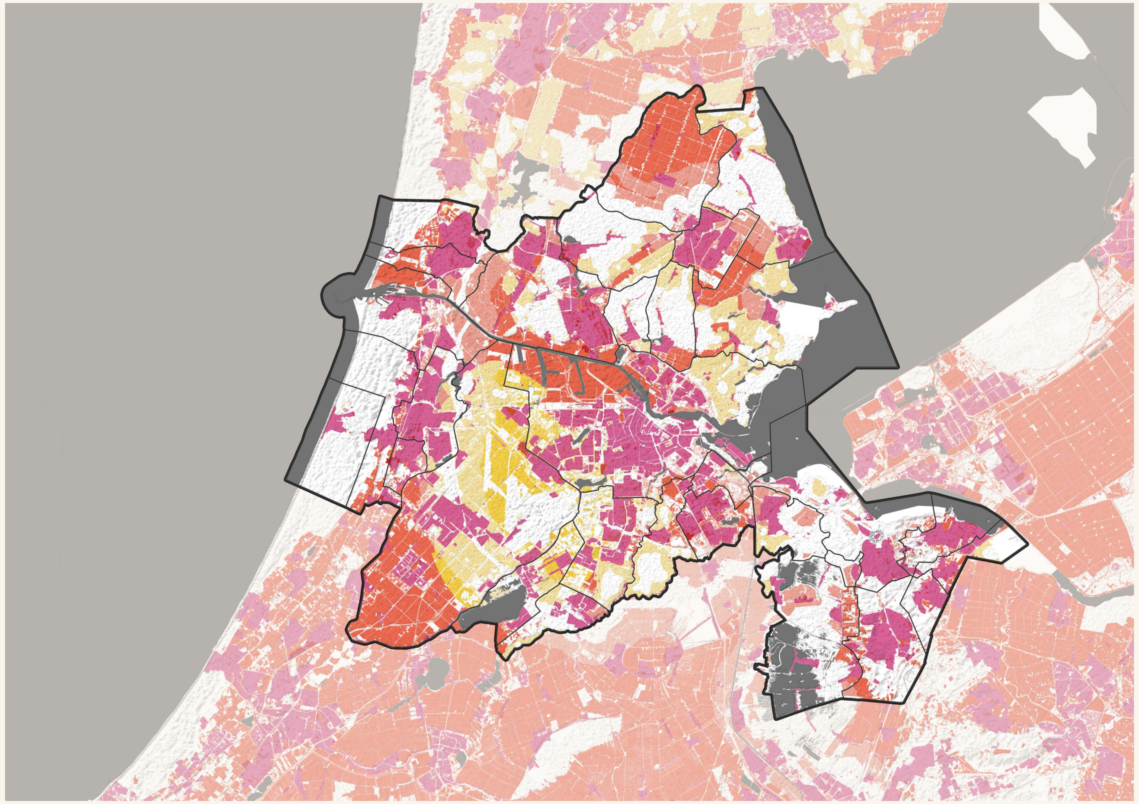
Legends

- Water / Wetlands
- Primary Development Area
- Alternate Development Area



North-Holland South Energy Region

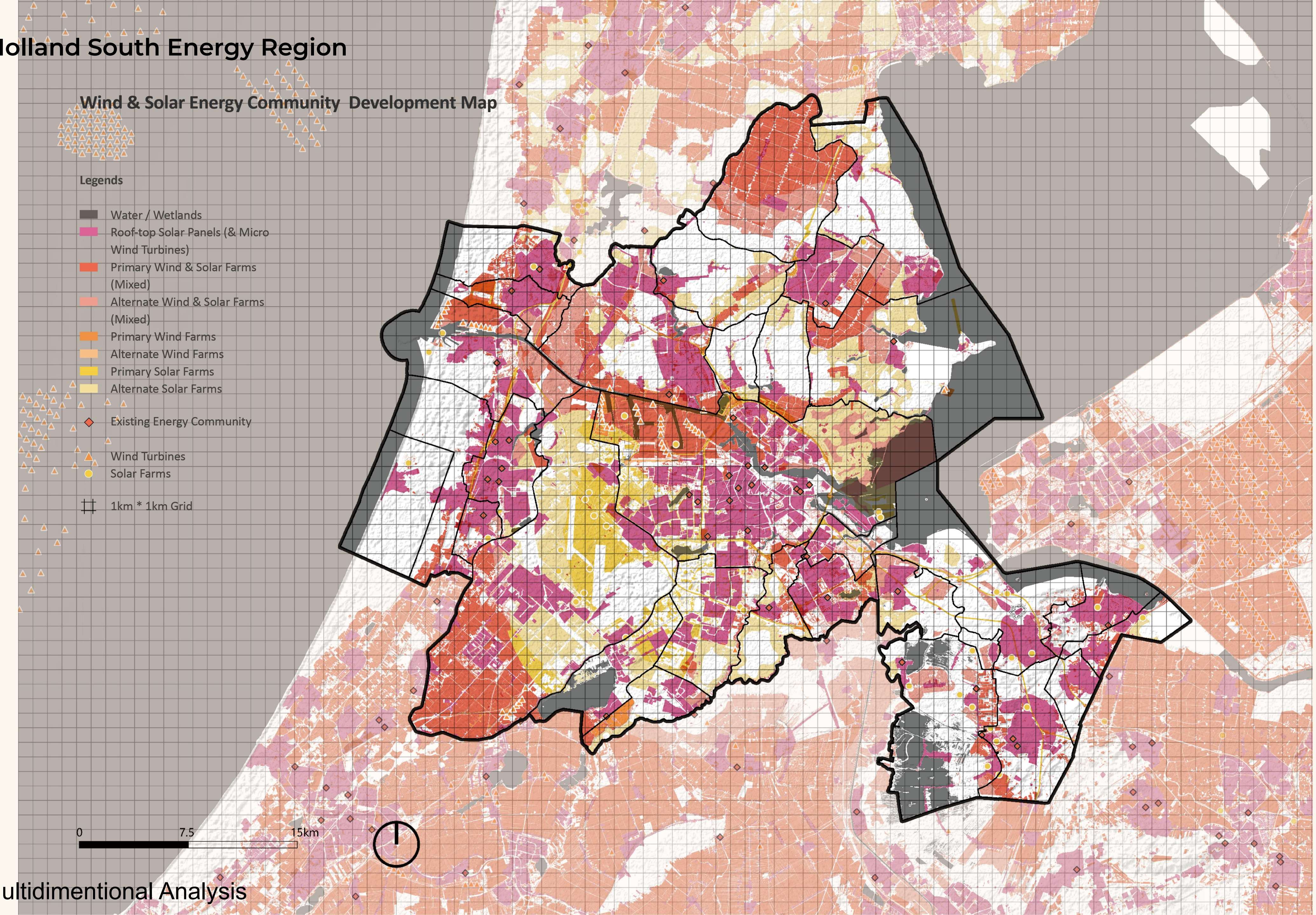
Step 5: Overall Development Map



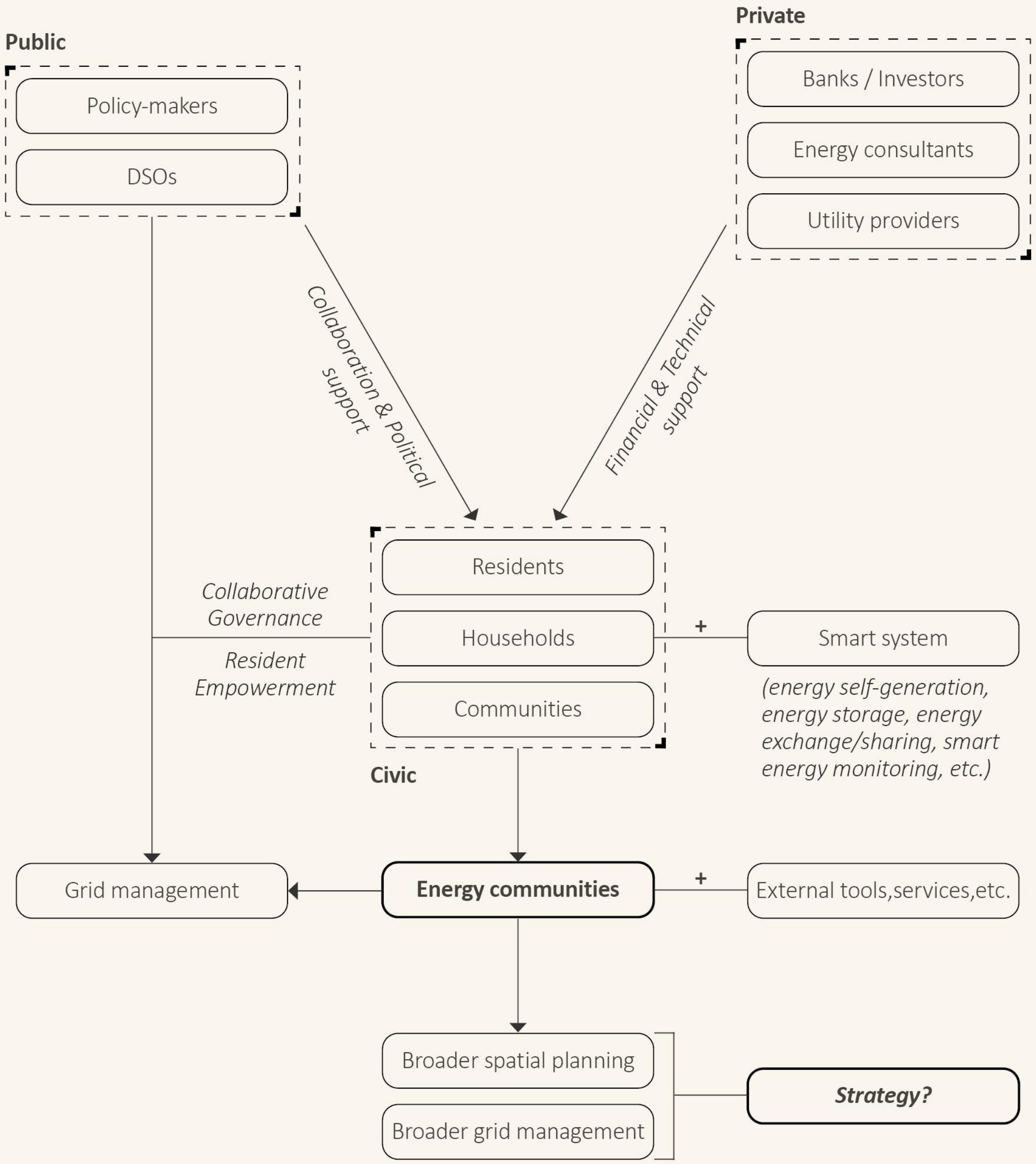
Legends

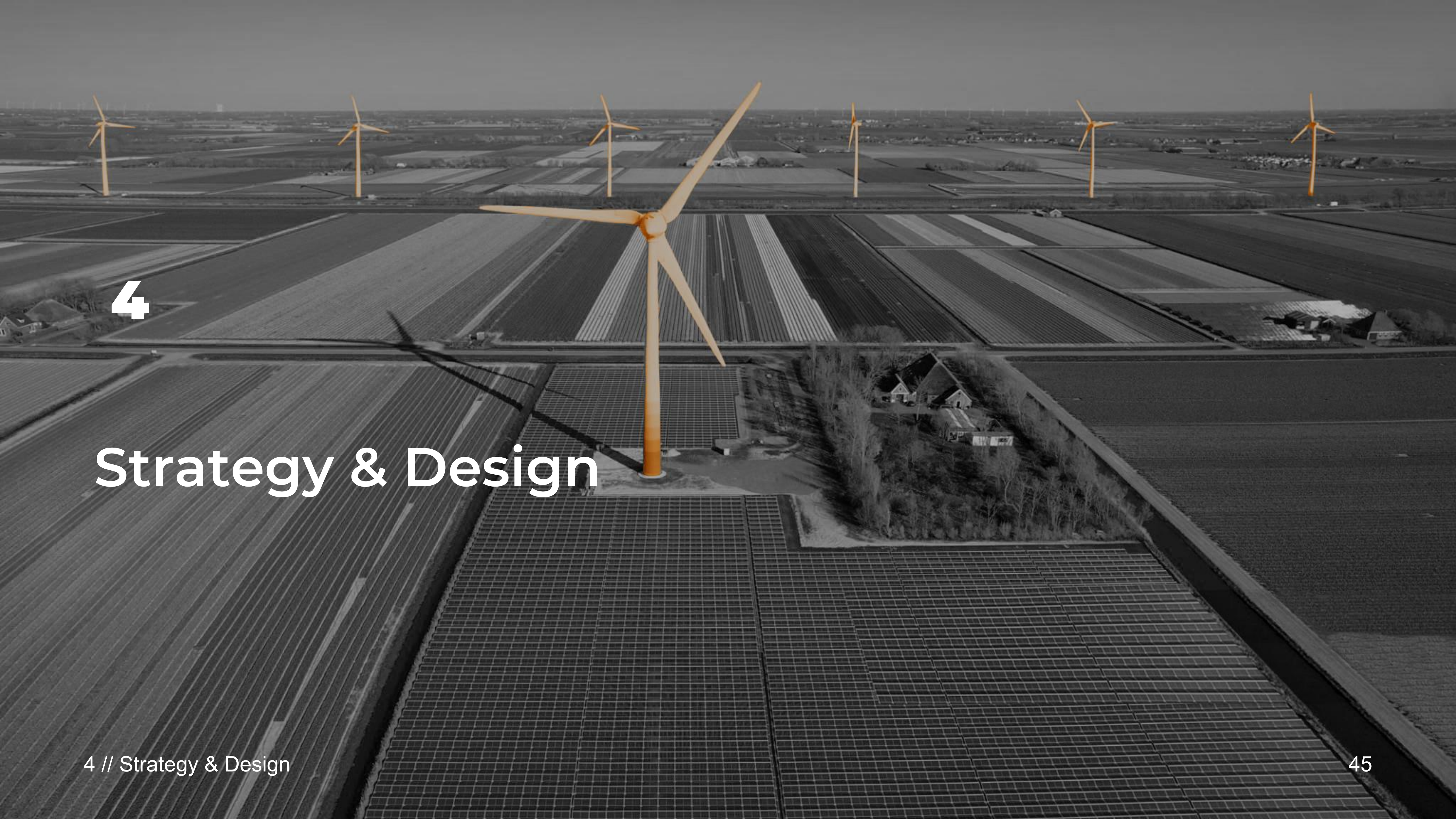
- Water / Wetlands
- Roof-top Solar Panels (& Micro Wind Turbines)
- Primary Wind & Solar Farms (Mixed)
- Alternate Wind & Solar Farms (Mixed)
- Primary Solar Farms
- Alternate Solar Farms

North-Holland South Energy Region



Conclusions





4

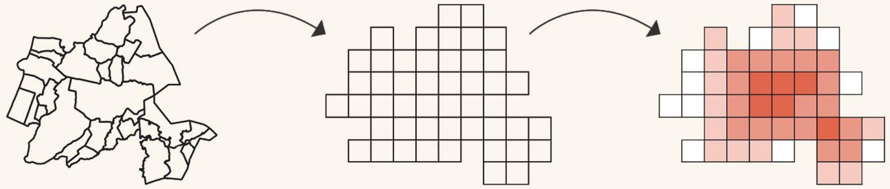
Strategy & Design

Strategy Structure

Pre-configured Analysis

Desk research / Interview / Stakeholder analysis / Policy analysis / Spatial analysis / etc.

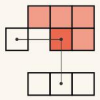
Strategy Preparation



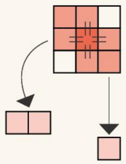
Strategy Implementation

Congestion Conditions

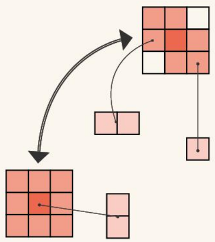
2025~2030: Scale-deep phase



2030~2035: Scale-out phase



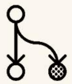
2035~2050: Scale-up phase



Strategy Evaluation

Vision making

E.C. Territory Scenarios



Expert reviewing

Recommendation

Strategy Structure

Pre-configured Analysis

Desk research To gain a preliminary understanding of the overall development, location and current status of the energy communities in a certain region.

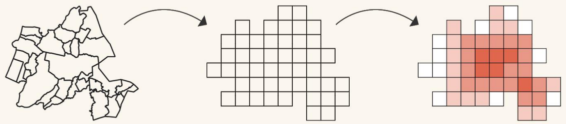
Interview Obtaining first-hand insights and feelings from energy community participants through field visits and interviews, which contribute to a more objective analysis.

Stakeholder analysis Conduct a series of specialized stakeholder analyses to obtain key information on which stakeholders to focus on, which ones to collaborate with, which ones have conflicts of interest that need to be resolved, and what level of involvement a particular type of stakeholder should have in the project, etc.

Policy analysis Analyze which existing policies contribute to the building of energy communities and what is lacking in terms of policies that can be recommended in the future.

Spatial analysis Analyze the constraints of renewable energy development to obtain a spatial scope suitable for energy communities and renewable energy development.

Strategy Preparation



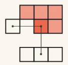
The renewable energy development map derived from multi-dimentional analysis is transformed into a grid map that will be further assigned with points according to the development potential.

Strategy Implementation

Congestion Conditions

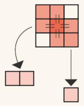
- Implementing what strategy is deeply related to the different conditions of grid congestion in the region. Depending on the congestion, different strategies will be recommended.
- "**Consumption Congestion**" and "**Feed-in Congestion**" are the crucial conditions for considering developing strategy.
- Consumption congestion affects the community more in daily life, while feed-in congestion mainly affects the community when new energy prodction is needed.
- Different congestion condition areas will have corresponding strategy phase as recommendations.

2025~2030: Scale-deep phase



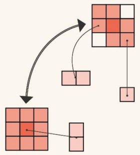
- Enrich the functions and facilities of the existing energy communities.
- Optimize the participation mechanism of residents and community management.
- Drive the construction of energy communities in the surrounding areas that has potential.
- Areas with mere or limited Consumption Congestion can either stay on their own or enter next phase of collaboration.

2030~2035: Scale-out phase



- Areas with the potential to implement roof-top renewable energy and to form energy community are nearly fully integrated.
- Energy communities are collaborating with each other, in the way like energy sharing or energy exchange.
- Energy communities are beginning to invest in wind turbines or field solar panels in the suitable areas nearby.
- Banks, utility providers and consultant companies are involved to provide financial and technical support.
- Municipalities and DSOs are involved to plan and build micro grid within the area.
- Areas with medium or heavy Consumption Congestion are highly recommended to collaborate with surrounding energy communities.

2035~2050: Scale-up phase



- Energy communities with their community-owned assets form an E.C. Cluster.
- The E.C. Cluster can collaborate with other clusters that bring the energy community to a broader planning and grid management scope.
- Municipalities and DSOs are involved to plan and build micro grid between each cluster to further eliminate the grid bottlenecks on the main grid.
- Areas with meduim or heavy Consumption Congestion and also Feed-in Congestion are highly recommended to join the collaborating energy communities and form the E.C. Cluster.

Strategy Evaluation

Vision making

2025~2030 Scale-deep phase
Utilizing application interface to illustrate how residents use the platform to participate in grid management and engage in community facility planning.

2030~2035 Scale-out phase
Utilizing spatial representation to illustrate the spatial configurations for energy communities that are collaborating with each other and investing in renewable energy in nearby areas.

2035~2050 Scale-up phase
Utilizing spatial representation to illustrate the collaboration of different energy community clusters and the planning of microgrids or transmission lines inbetween to further eliminate congestion in the main grid.

E.C. Territory Scenarios

With different collaborating conditions, the energy community territory will evolve to various situations. The scenario

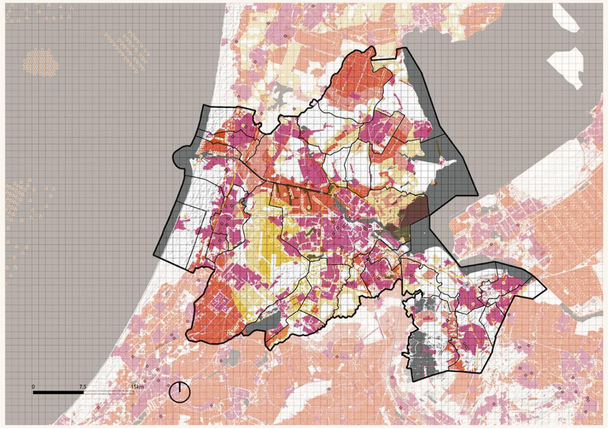
Expert reviewing

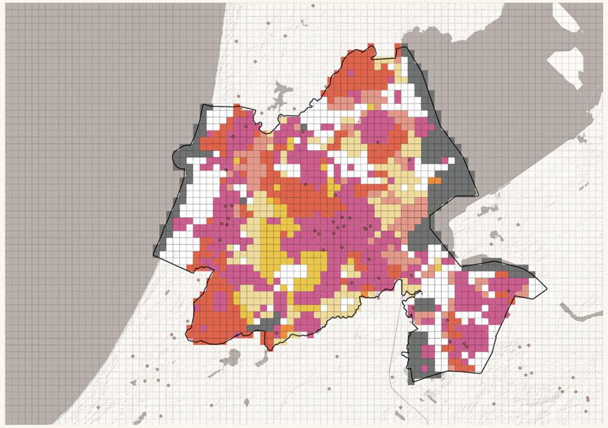
The strategy will be sent to experts that have worked on topics of energy community from the industry for review. They can also give comments on the scenarios.

Recommendation

The recommendations are based on the strategy and the feedback obtained from expert review. For future studies that want to replicate this project, and also for policy-makers and DSOs that play essential roles in the development of energy community.

Strategy Preparation





Legends

- Water / Wetlands
- Roof-top Solar Panels (& Micro Wind Turbines)
- Primary Wind & Solar Farms (Mixed)
- Alternate Wind & Solar Farms (Mixed)
- Primary Solar Farms
- Alternate Solar Farms
- Primary Solar Farms
- Alternate Solar Farms

- Existing Energy Community

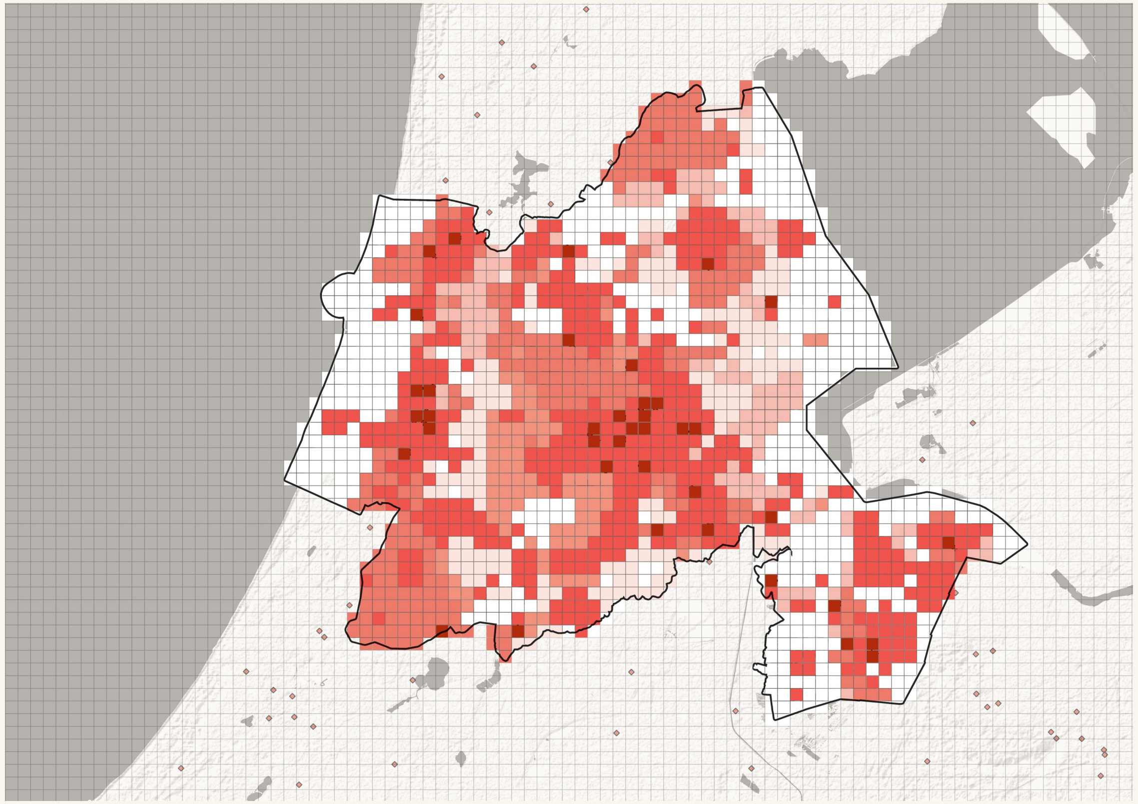
- Wind Turbines
- Solar Farms

- 1km * 1km Grid

Board for Strategy Design

Legends

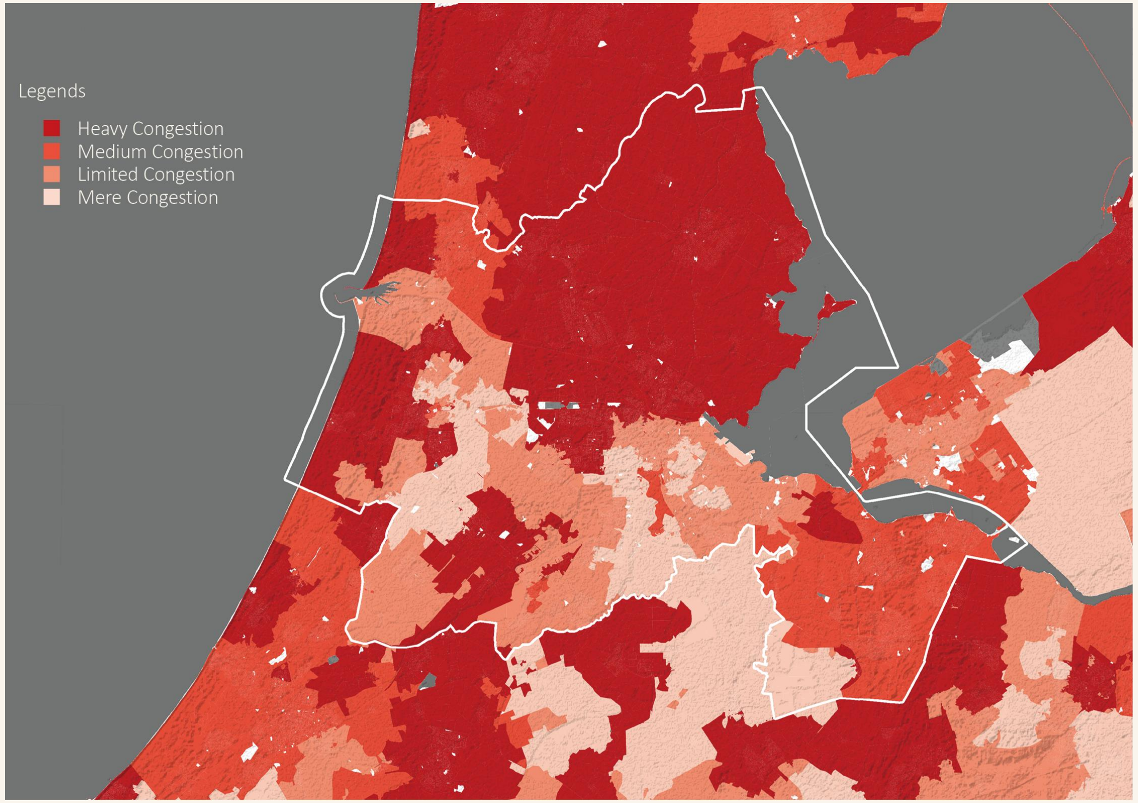
- 6: Existing Energy Community
- 5: Roof-top Renewable Energy
- 4: Primary Mixed Energy Development Area
- 3: Primary Sole Energy Development Area
- 2: Alternate Mixed Energy Development Area
- 1: Alternate Sole Energy Development Area
- 0: Non Suitability



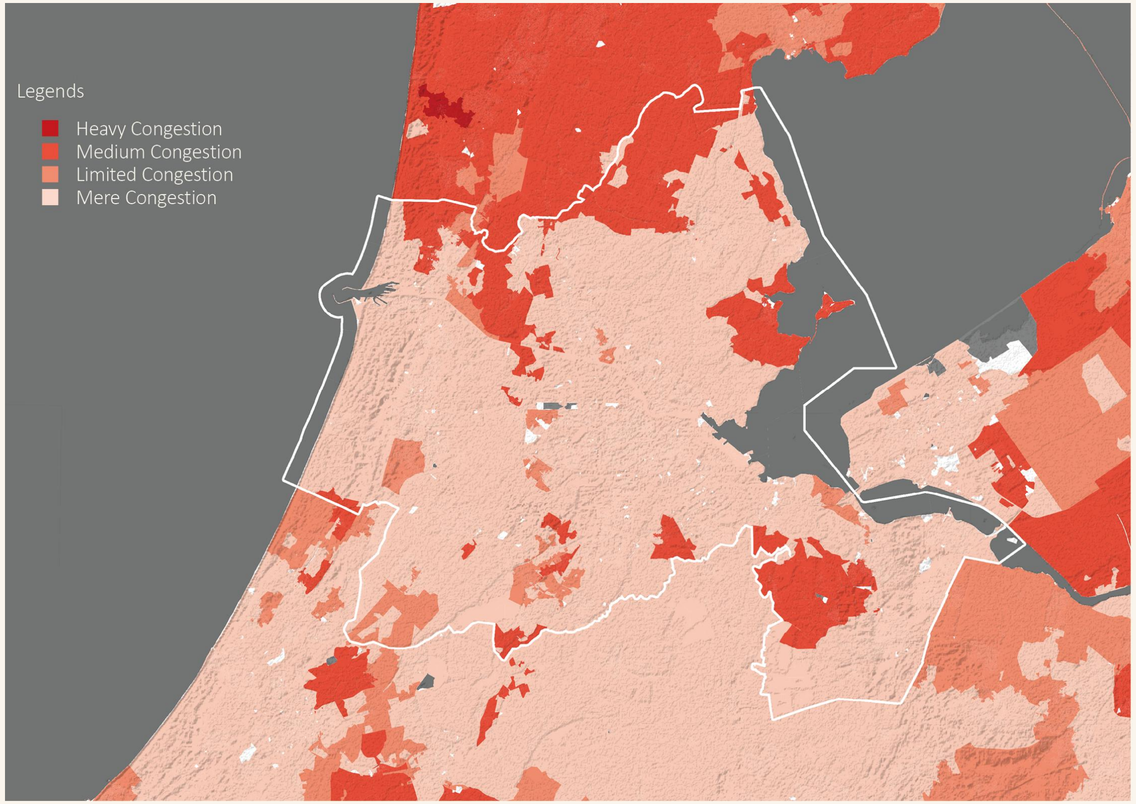
Strategy Implementation

Congestion Conditions

Consumption Congestion in NHZ



Feed-in Congestion in NHZ



Congestion - Strategy Matrix

Feed-in Congestion \ Consumption Congestion	Mere Congestion	Limited Congestion	Medium Congestion	Heavy Congestion
Mere Congestion	Optimize management	Optimize management (and Expand Production)	Optimize management & Expand Production (and Collaboration)	Optimize management & Expand Production & Collaboration
Limited Congestion	Optimize management (and Collaboration)	Optimize management & (Expand Production/ Collaboration)	Optimize management & Expand Production (and Collaboration)	Optimize management & Expand Production & Collaboration
Medium Congestion	Optimize management & Collaboration (and Expand Production)	Optimize management & Collaboration (and Expand Production)	Optimize management & Collaboration Cluster	Optimize management & Collaboration Cluster
Heavy Congestion	Optimize management & Collaboration & Expand Production	Optimize management & Collaboration & Expand Production	Optimize management & Collaboration Cluster	Optimize management & Collaboration Cluster

Legend (cell colours): Scale-deep (Mere/Limited feed-in with Mere/Limited consumption); Scale-out (Mere/Limited feed-in with Medium/Heavy consumption, and Medium/Heavy feed-in with Mere/Limited consumption); Scale-up (Medium/Heavy feed-in with Medium/Heavy consumption)

Strategy Implementation

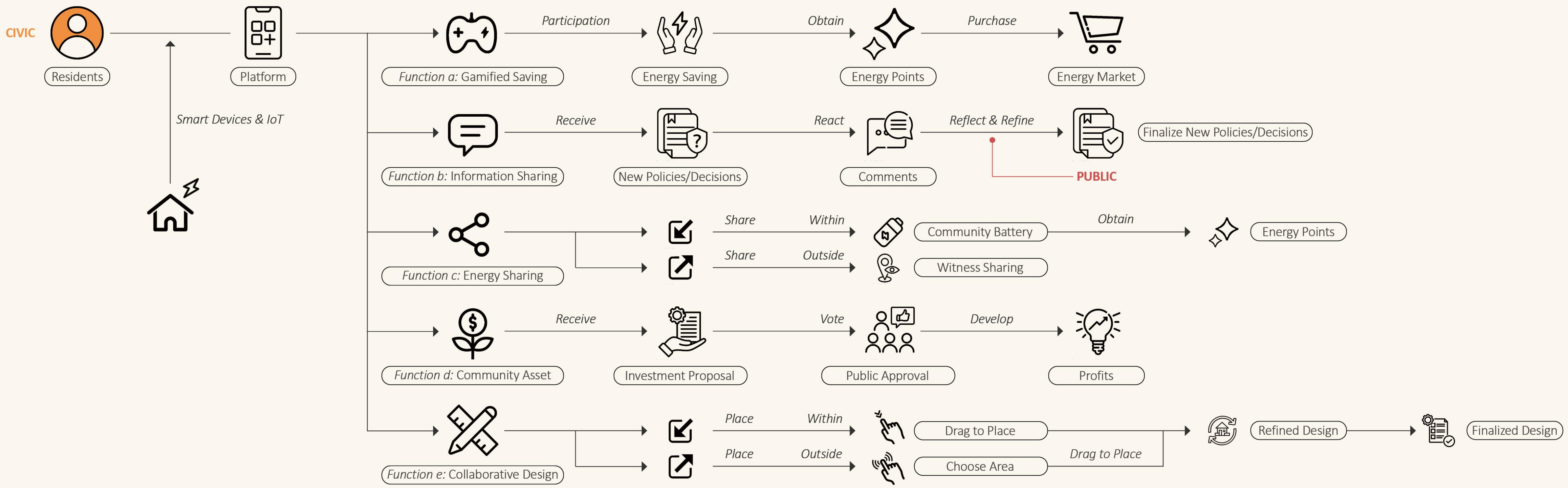
2025~2030 | Scale-Deep Phase

Feed-in Congestion \ Consumption Congestion	Mere Congestion	Limited Congestion	Medium Congestion	Heavy Congestion
Mere Congestion	Optimize management	Optimize management (and Expand Production)	Optimize management & Expand Production (and Collaboration)	Optimize management & Expand Production & Collaboration
Limited Congestion	Optimize management (and Collaboration)	Optimize management & (Expand Production/ Collaboration)	Optimize management & Expand Production (and Collaboration)	Optimize management & Expand Production & Collaboration
Medium Congestion	Optimize management & Collaboration (and Expand Production)	Optimize management & Collaboration (and Expand Production)	Optimize management & Collaboration Cluster	Optimize management & Collaboration Cluster
Heavy Congestion	Optimize management & Collaboration & Expand Production	Optimize management & Collaboration & Expand Production	Optimize management & Collaboration Cluster	Optimize management & Collaboration Cluster

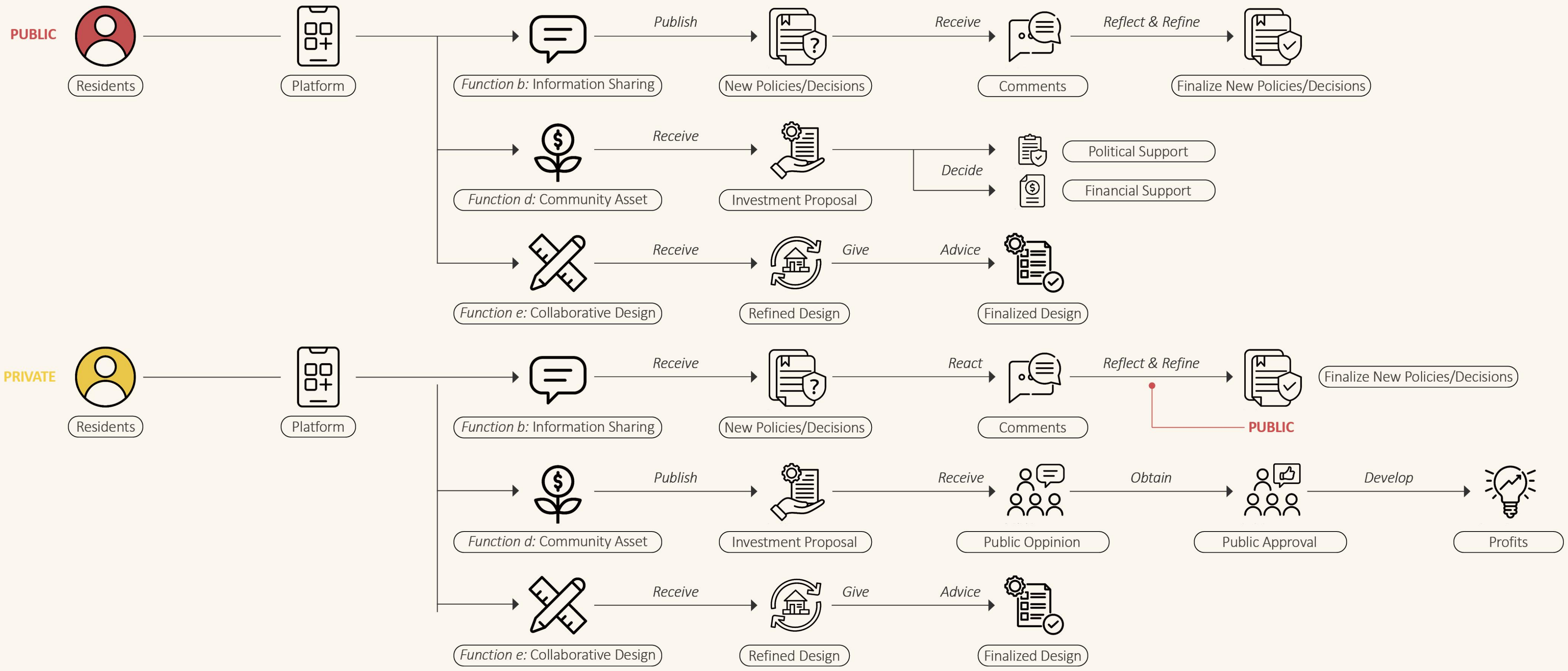
Scale-deep

Role	Function Module	Instruction
CIVIC (Citizens)	a. Energy Monitoring & Saving Game b. Information Reception & Interactive Comments c. Energy Sharing Game d. Community Assets Investment e. Collaborative Design (Participating)	- *Primary role* - Full-featured function module - Emphasizing interaction, behavior change and engagement
PUBLIC (Municipalities, DSOs)	b. Release of Policy Information & Interactive Comments Feedback d. Provide Guidance/Subsidy for Community Assets Investment e. Collaborative Design (Suggesting)	- *Secondary role* - Part-featured function module - Emphasizing information distribution, providing feedback and building up incentive mechanism
PRIVATE (Banks/Investors, Energy Provider, Consultance Company, Design Company)	b. Information Reception & Interactive Comments d. Participate in Community Assets Investment (Provision of technical/financial advice) e. Collaborative Design (Consultance/Refine)	- *Secondary role* - Part-featured function module - Emphasizing collaboration, proiding technical or financial support

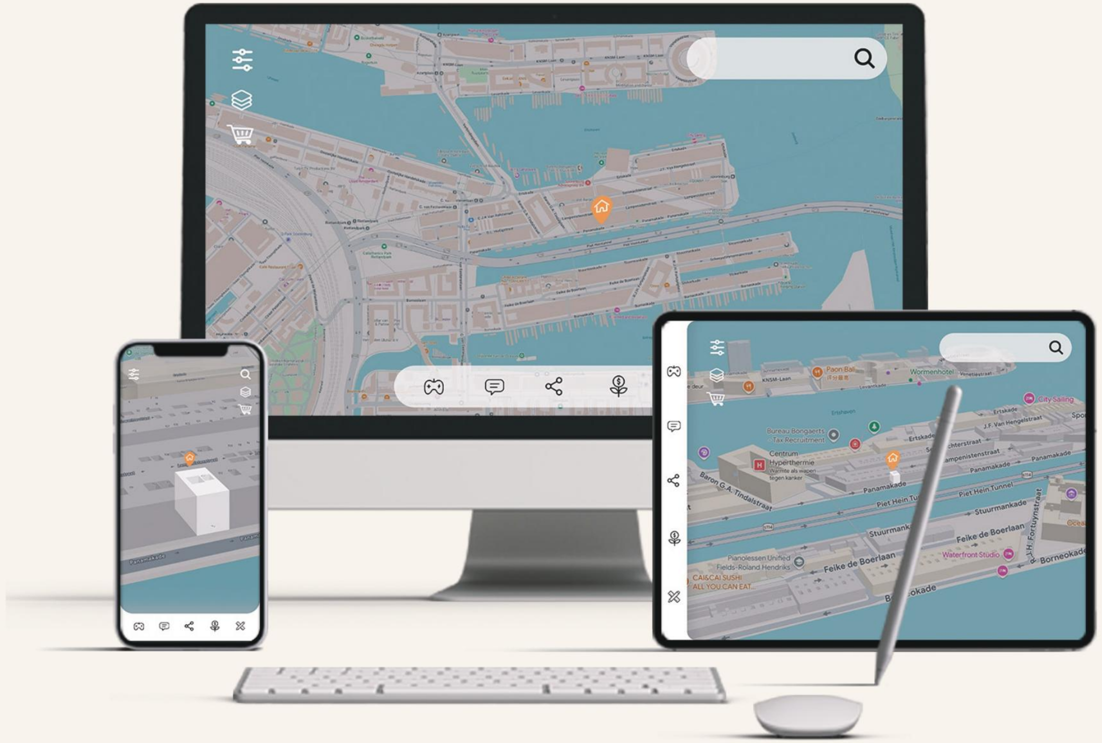
Multi-functional Platform


CIVIC
Residents
Platform
Smart Devices & IoT
Participation
Obtain
Purchase
Function a: Gamified Saving
Energy Saving
Energy Points
Energy Market
Receive
React
Reflect & Refine
Finalize New Policies/Decisions
Function b: Information Sharing
New Policies/Decisions
Comments
PUBLIC
Share
Within
Community Battery
Obtain
Energy Points
Share
Outside
Witness Sharing
Function c: Energy Sharing
Receive
Vote
Develop
Function d: Community Asset
Investment Proposal
Public Approval
Profits
Place
Within
Drag to Place
Refined Design
Finalized Design
Place
Outside
Choose Area
Drag to Place
Function e: Collaborative Design

Strategy Implementation

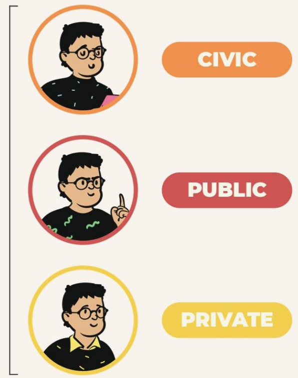


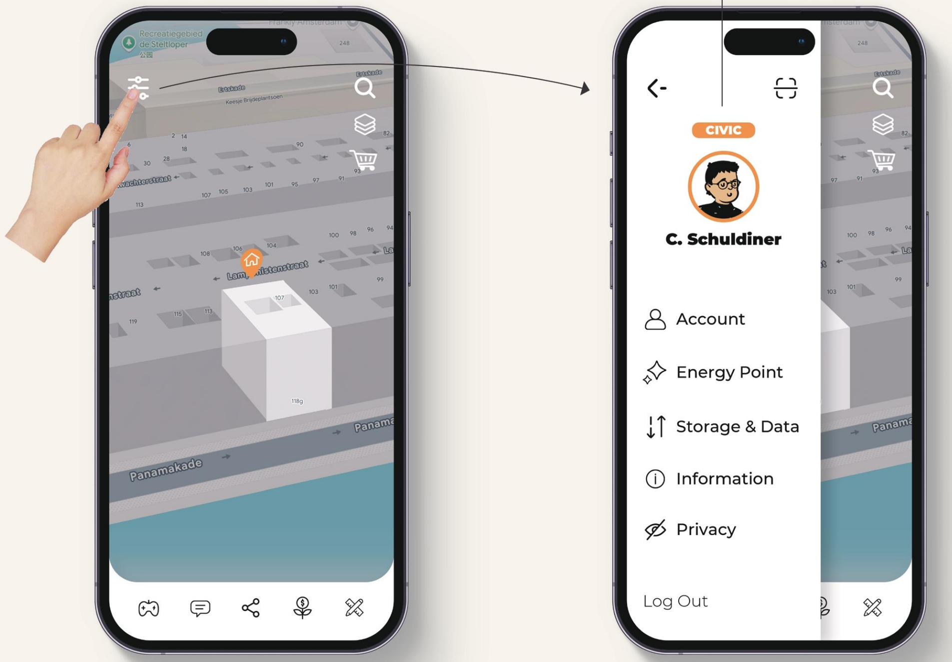
Multi-Terminal Platform



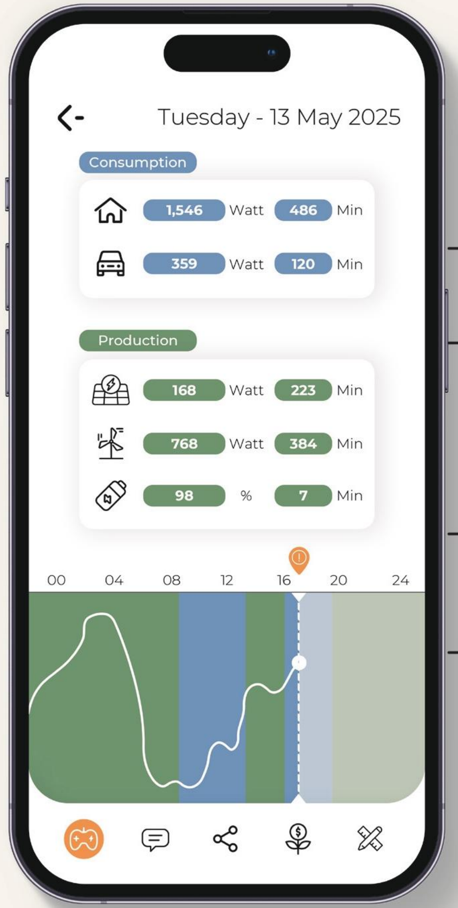
Interface

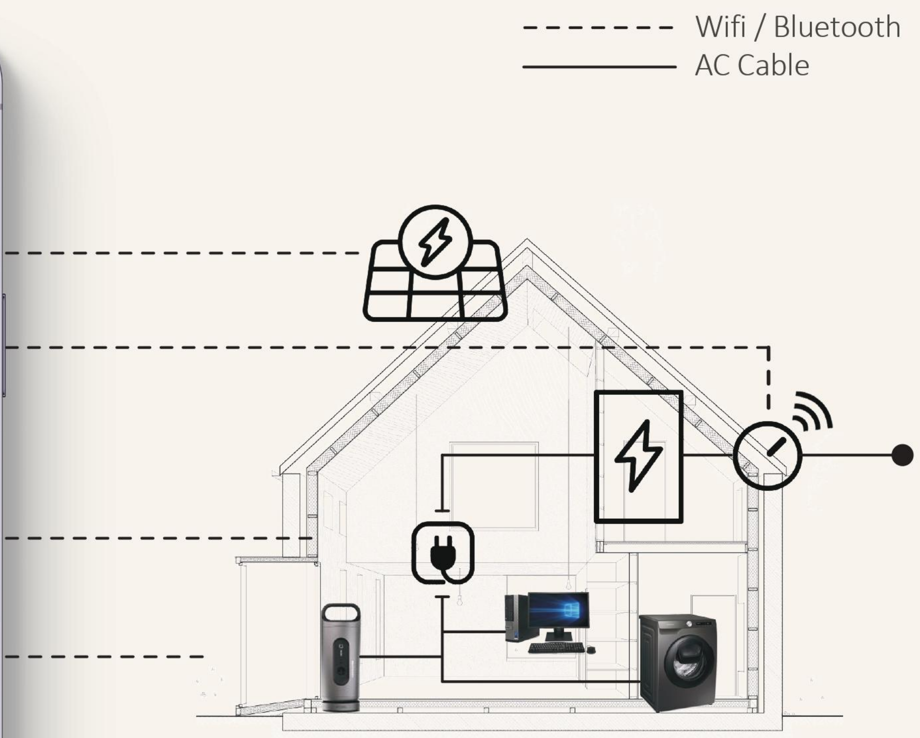
To bridge the collaboration between all sectors (Civic, Public and Private) through this platform, it is essential to integrate most of the stakeholders into it. Therefore, users can modify his/her role from civic into public or private sector, or vice versa.





a. Energy Monitoring & Saving Game



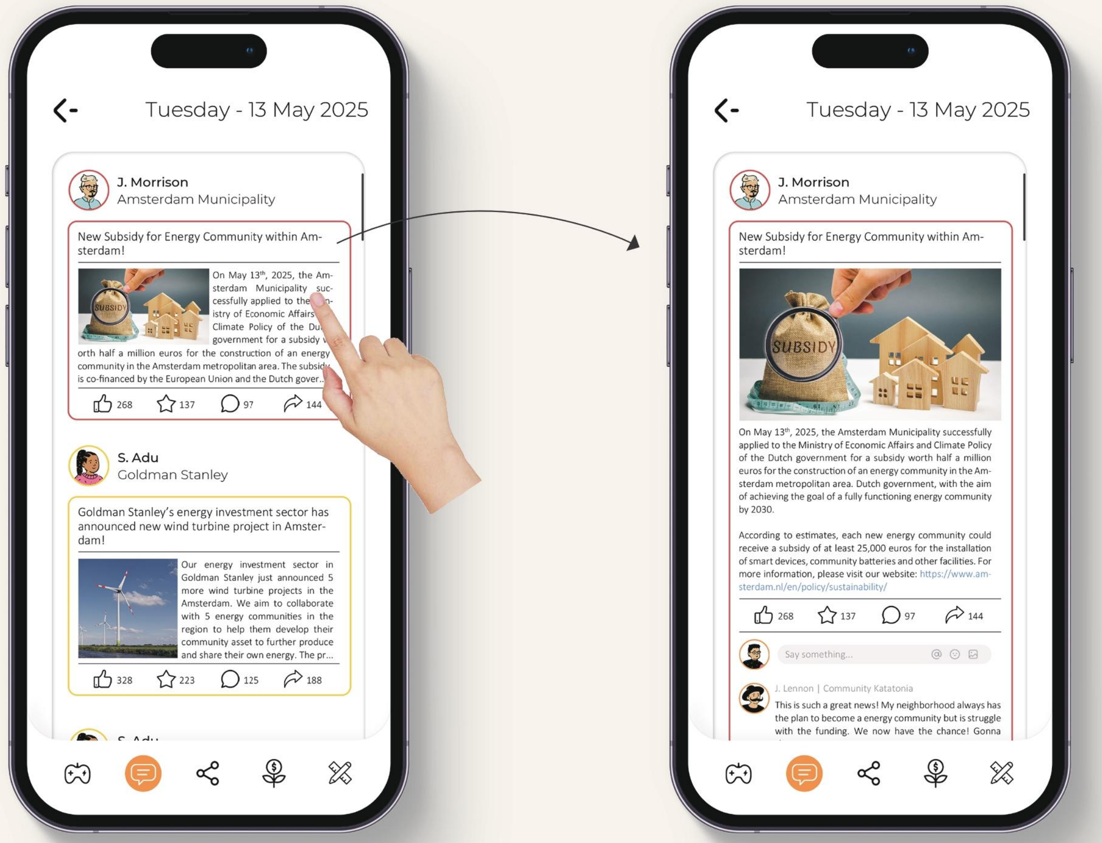


Strategy Evaluation

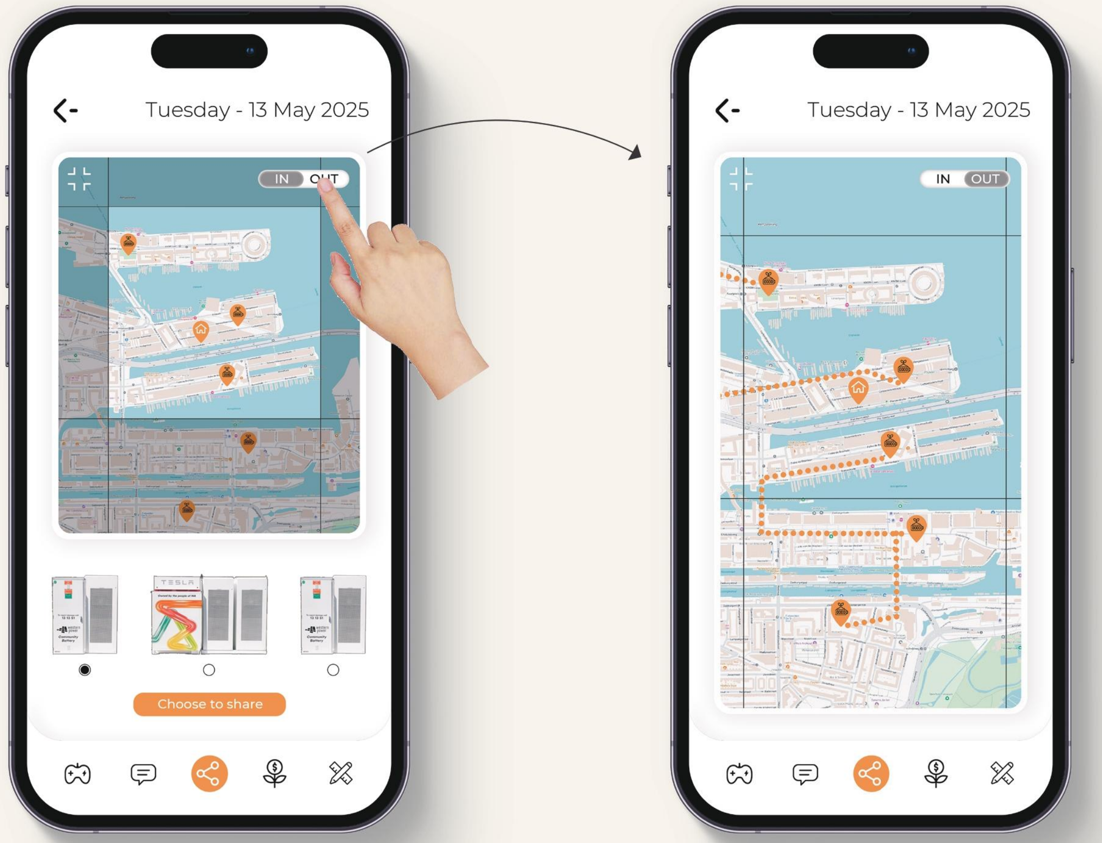
Three levels of participation

Energy point market

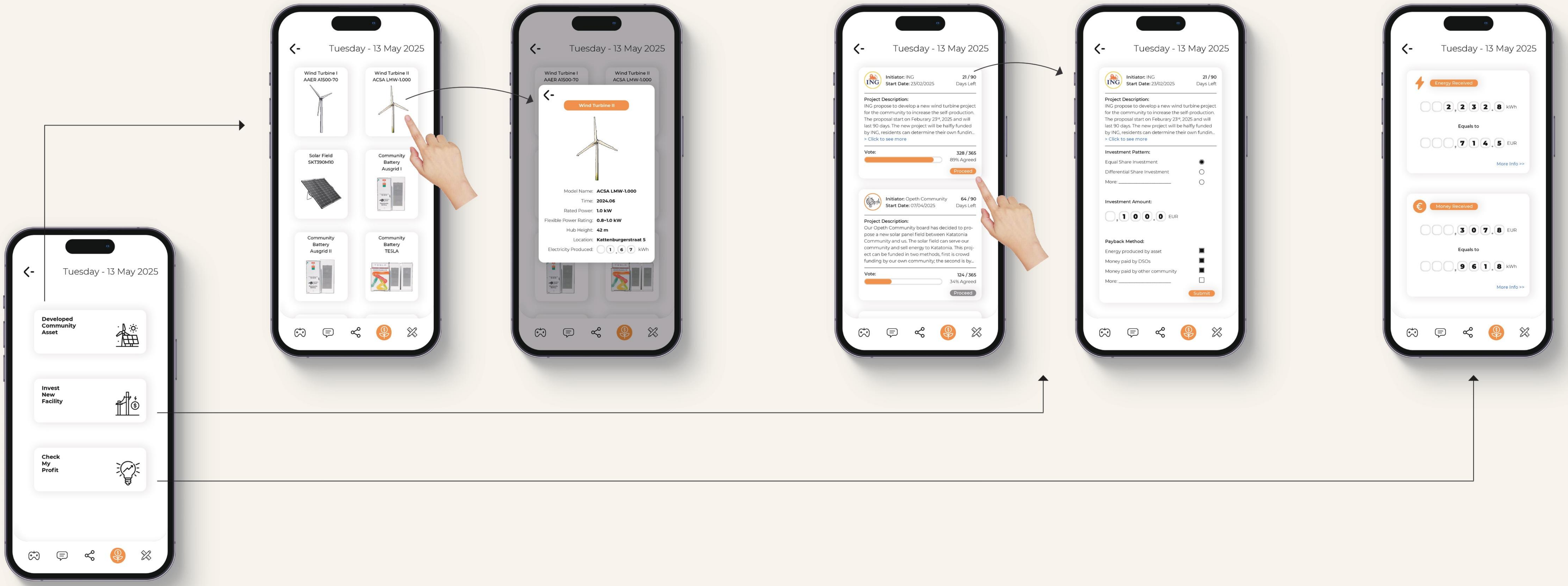
b. Information Reception & Interactive Comments



c. Energy Sharing Game

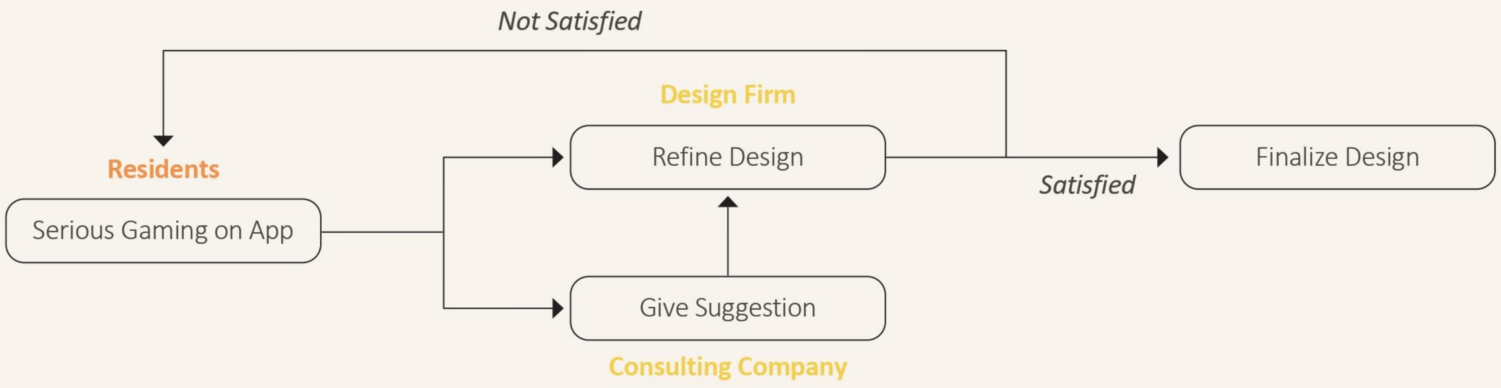


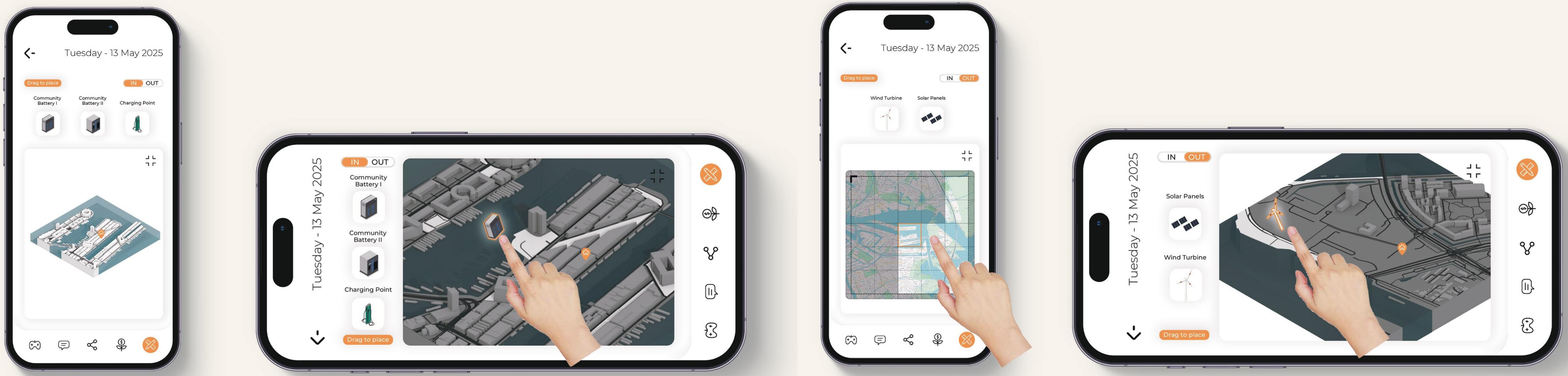
d. Community Assets Investment



189

e. Collaborative Design





Feed-in Congestion \ Consumption Congestion	Mere Congestion	Limited Congestion	Medium Congestion	Heavy Congestion
Mere Congestion	Optimize management	Optimize management (and Expand Production)	Optimize management & Expand Production (and Collaboration)	Optimize management & Expand Production & Collaboration
Limited Congestion	Optimize management (and Collaboration)	Optimize management & (Expand Production/ Collaboration)	Optimize management & Expand Production (and Collaboration)	Optimize management & Expand Production & Collaboration
Medium Congestion	Optimize management & Collaboration (and Expand Production)	Optimize management & Collaboration (and Expand Production)	Optimize management & Collaboration Cluster	Optimize management & Collaboration Cluster
Heavy Congestion	Optimize management & Collaboration & Expand Production	Optimize management & Collaboration & Expand Production	Optimize management & Collaboration Cluster	Optimize management & Collaboration Cluster

Scale-out

- Expanding the community's self-production capacity with external renewable energy assets

Wind turbines and solar panels invested and owned by the energy community that are placed outside the community itself. For areas within medium and heavy consumption congestion, expanding their self-production capacity can boost their resilience against congestion.

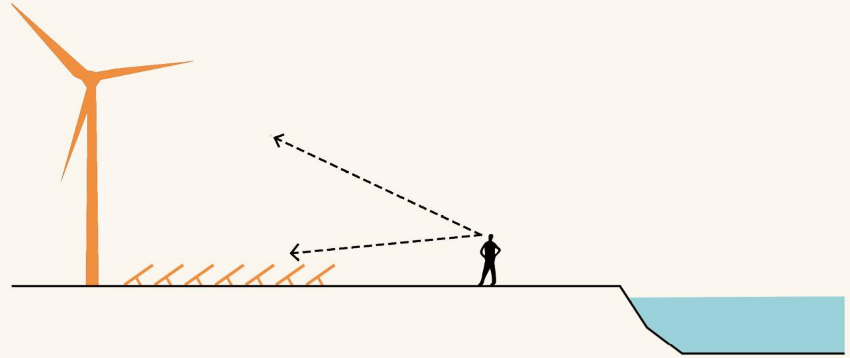
- Creating collaboration between the energy communities

Neighboring energy communities can collaborate together to boost the ability to mitigate grid bottlenecks. The collaboration are not limited to energy sharing, energy exchange, co-investment, large-scale shared battery, etc.

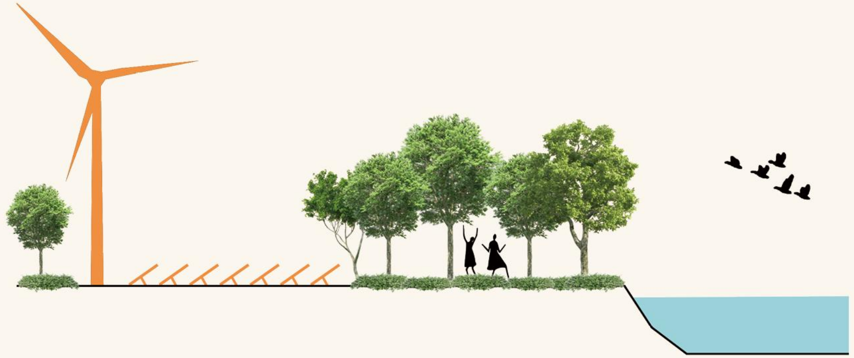
External Community Asset Planning

- Creating landscape buffers

Visual dominance of energy infrastructure

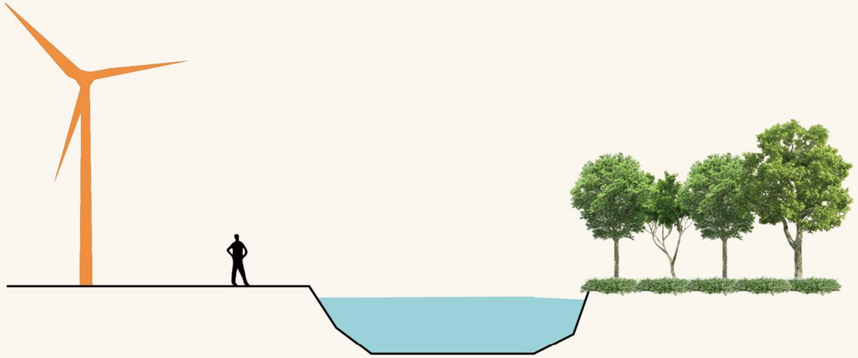


Green buffer to preserve landscape aesthetics



- Building "green energy corridor" with existing green-blue infrastructures

Fragmented energy landscape



Green energy corridor

Energy Community Collaboration

- *Community-level energy exchange platform*

The collaborating communities can set up a virtual power trading market where multiple energy communities join together to exchange and trade excess power.

- *Coordinated demand response*

Synergizing the timing of power usage in multiple communities, and algorithms are used to coordinate controllable loads such as heat pumps, water heaters, EV charging, etc. in housing, thus increasing the overall managing and buffering capacity against grid congestion.

- *Large-scale shared battery*

- *Bidirectional parking lots*

Utilizing the batteries of electric vehicles for "Vehicle-to-Grid (V2G)" power supply during parking.

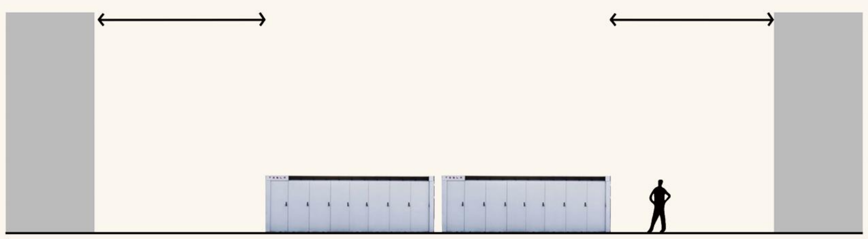
- *Shared power generation infrastructures*

- *Cross-community microgrids*

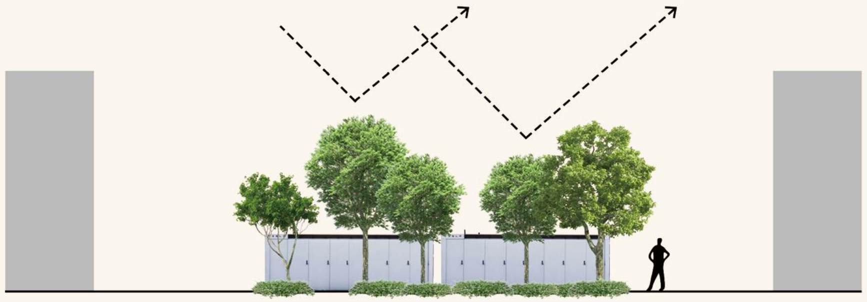
Energy Community Collaboration

- Large-scale shared battery

Appropriate distance between multiple communities

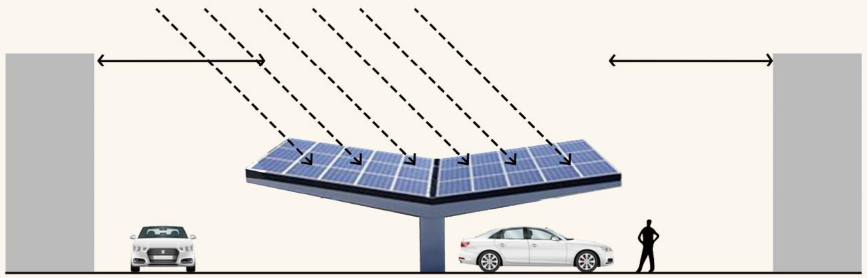


Avoid high battery temperatures



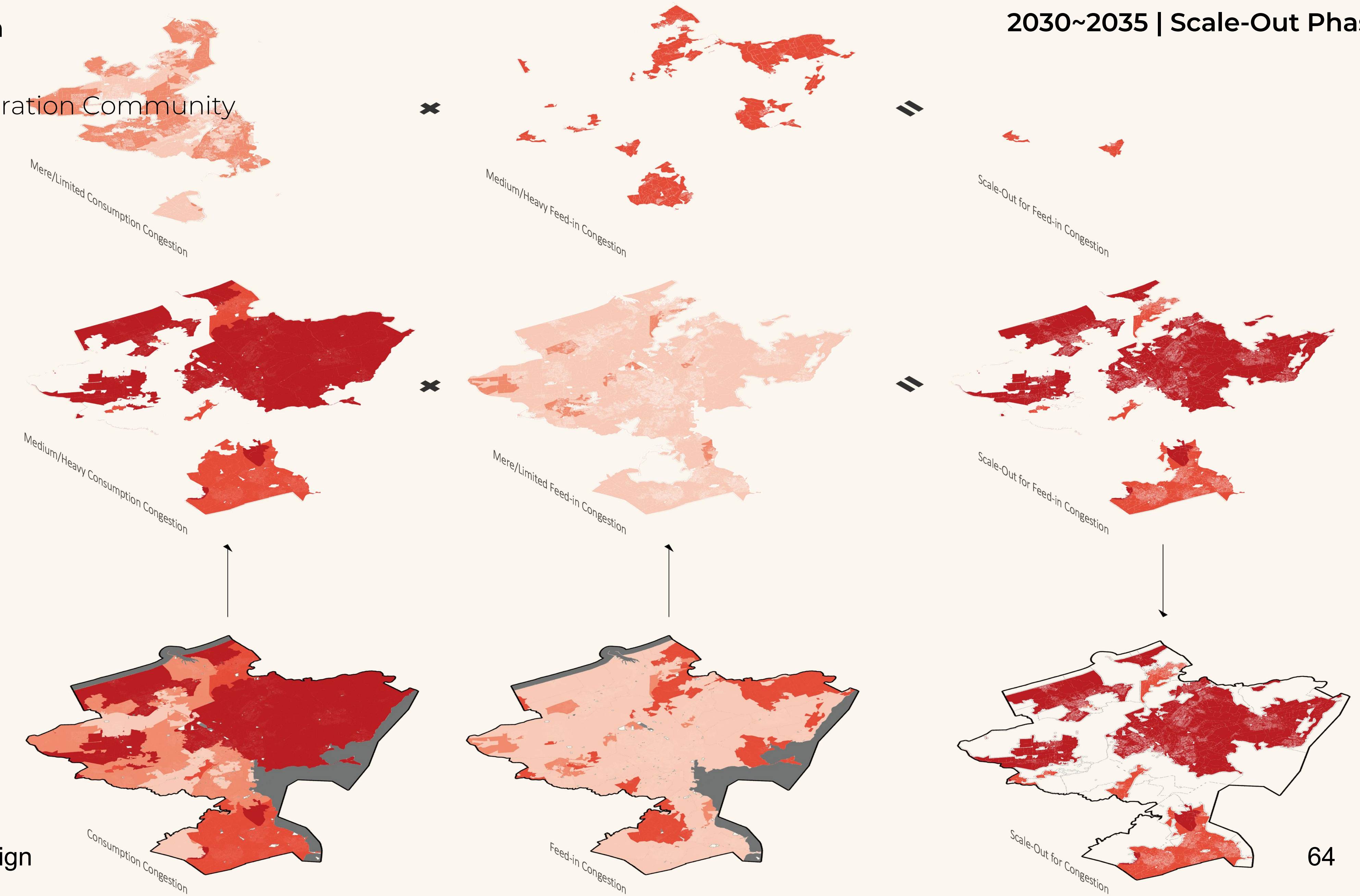
- Bidirectional parking lots

Accessbility of bidirectional/solar parking lot



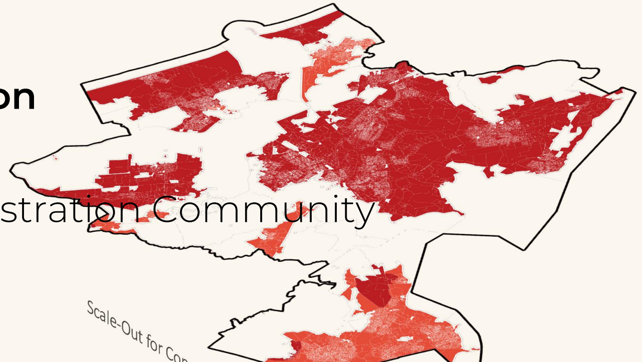
Strategy Evaluation

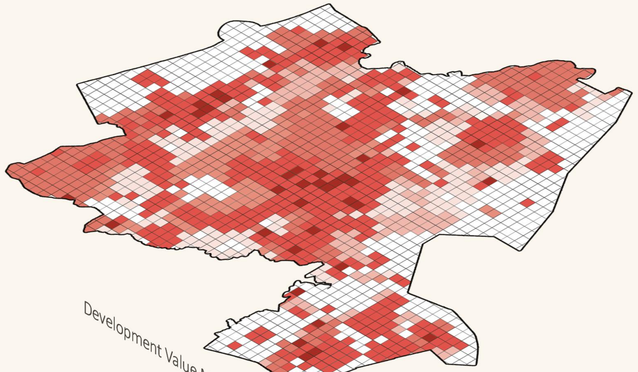
Choosing Demonstration Community

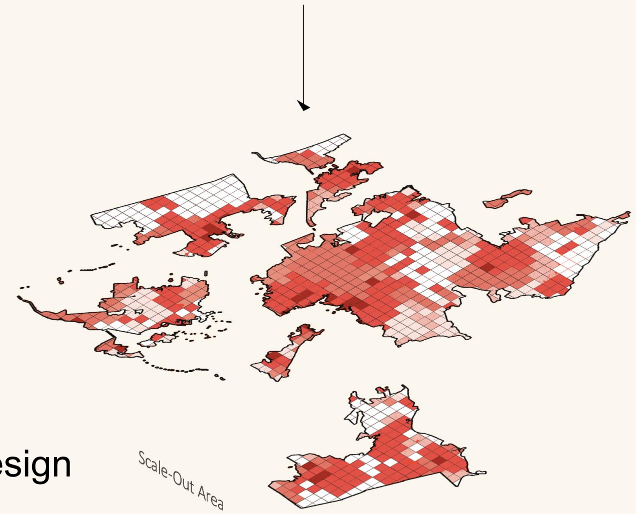


Strategy Evaluation

Choosing Demonstration Community

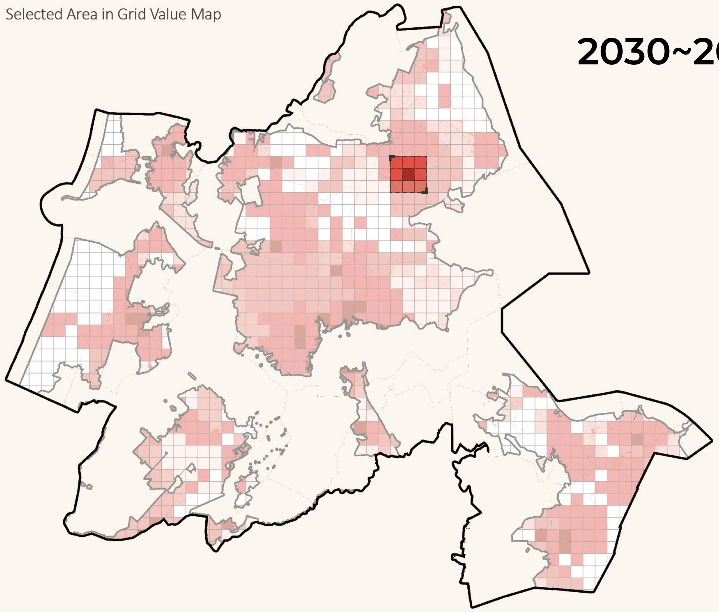




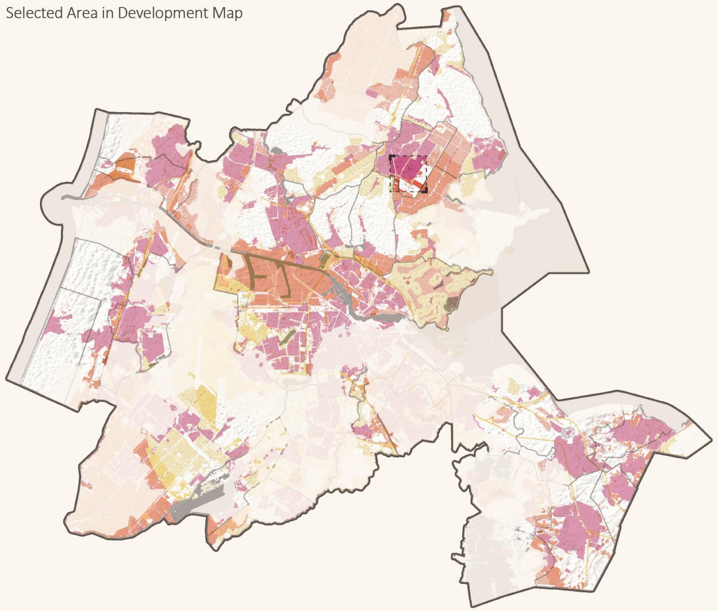


2030~2035 | Scale-Out Phase

Selected Area in Grid Value Map



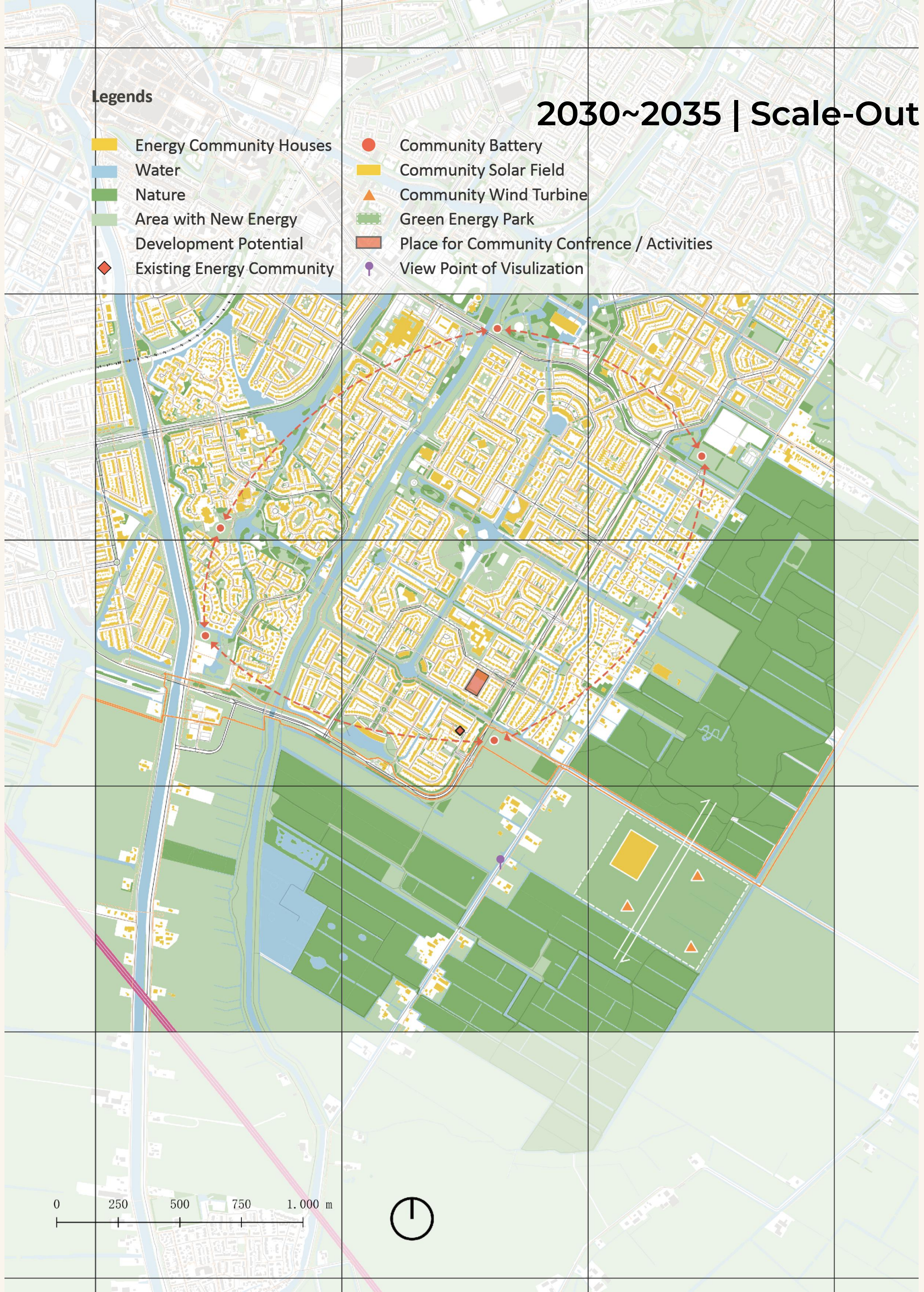
Selected Area in Development Map



Strategy Evaluation

Design Exploration

2030~2035 | Scale-Out Phase



Strategy Evaluation

Design Exploration

New Energy Development Area Status Quo

Green Energy Park to Create Green Corridor


From Demonstration Area
Place for Community Conference / Activities
Local elementary school that could be used as a location for energy community meetings on weekends or evenings.
The playground at the front can be used as an area to host events such as offline energy markets.
Community Battery
Decentralized community batteries can help regulate community energy usage.
Energy Community Houses
Equipped with a roof-top solar panels or micro wind turbines and joined the energy community.
Acting as prosumers in the energy community
Community Solar Field
Solar panel field invested and owned by the energy community.
Green Energy Park
Integrating the renewable energy infrastructures into the environment to preserve ladscape values.
Meanwhile creating green energy corridor with the existing nature.
Community Wind Turbines
Wind turbines invested and owned by the energy community.

Consumption Congestion / Feed-in Congestion	Mere Congestion	Limited Congestion	Medium Congestion	Heavy Congestion
Mere Congestion	Optimize management	Optimize management (and Expand Production)	Optimize management & Expand Production (and Collaboration)	Optimize management & Expand Production & Collaboration
Limited Congestion	Optimize management (and Collaboration)	Optimize management & (Expand Production/ Collaboration)	Optimize management & Expand Production (and Collaboration)	Optimize management & Expand Production & Collaboration
Medium Congestion	Optimize management & Collaboration (and Expand Production)	Optimize management & Collaboration (and Expand Production)	Optimize management & Collaboration Cluster	Optimize management & Collaboration Cluster
Heavy Congestion	Optimize management & Collaboration & Expand Production	Optimize management & Collaboration & Expand Production	Optimize management & Collaboration Cluster	Optimize management & Collaboration Cluster

Scale-up

Collaborate with Energy Community Cluster

By joining in the E.C. Cluster (energy communities that have already established collaboration, co-production, co-storage, co-creation, etc.), energy communities that are facing both severe consumption and feed-in congestion can have access to the cluster's energy production, storage and exchange. Thus they can be benefitted through the collaborations.

E.C. Cluster Collaboration

- *Energy Sharing*
Having access to the cluster's internal energy market.

- *Energy Storage Synergies*
Shared energy storage facilities; Shared battery agreement.

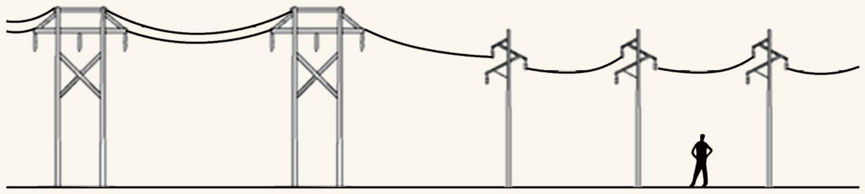
- *Data & Forecasting Sharing*
Sharing of electricity load and capacity forecast data

- *Economic Mechanisms*
Internal pricing mechanisms; Shared investment facilities.

- *Governance & Institutional Layer*
Establish cluster governance board

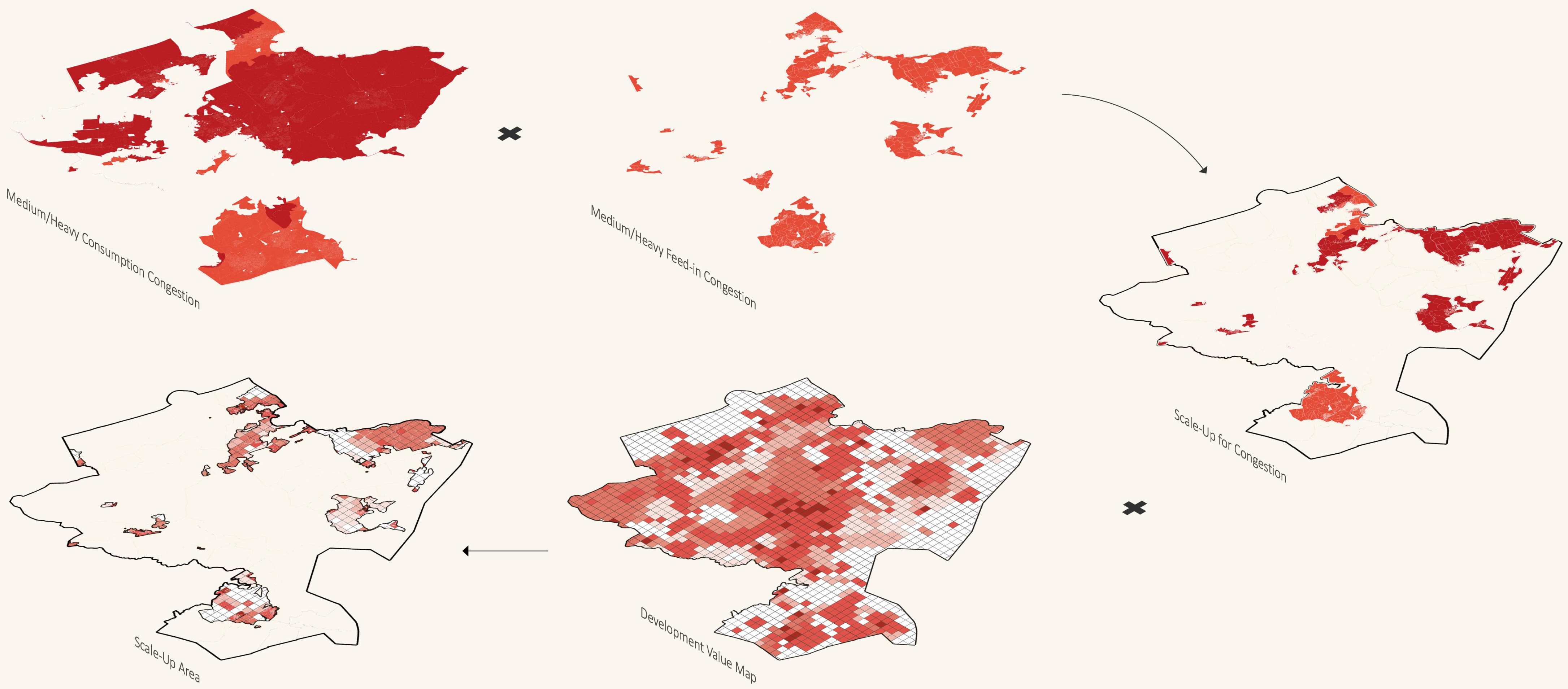
- *Building Transmission lines / Microgrids*

Build transmission line to connect with E.C. Cluster



Green energy corridor along the transmission line

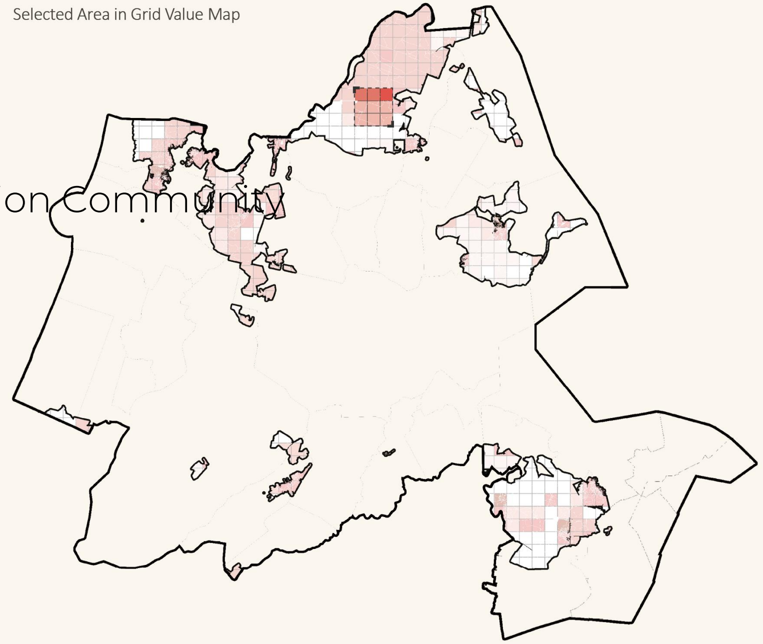
Choosing Demonstration Community



Strategy Evaluation

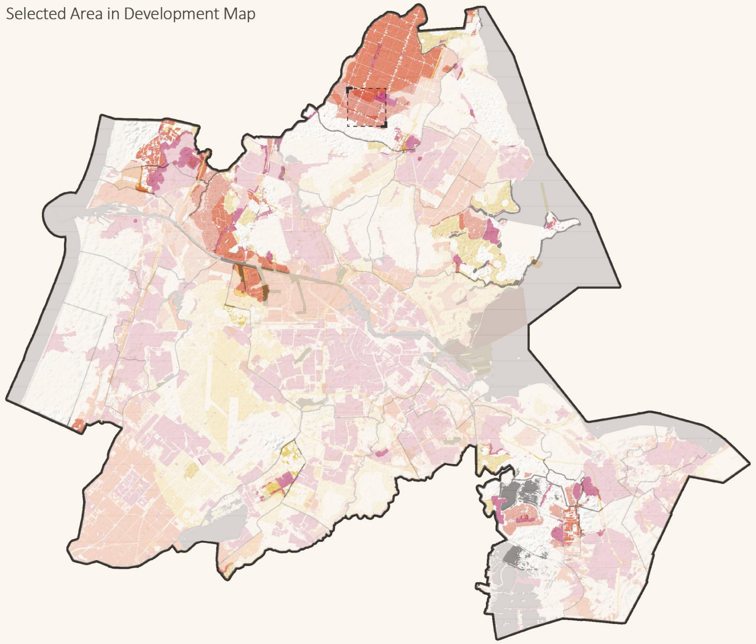
Choosing Demonstration Community

Selected Area in Grid Value Map

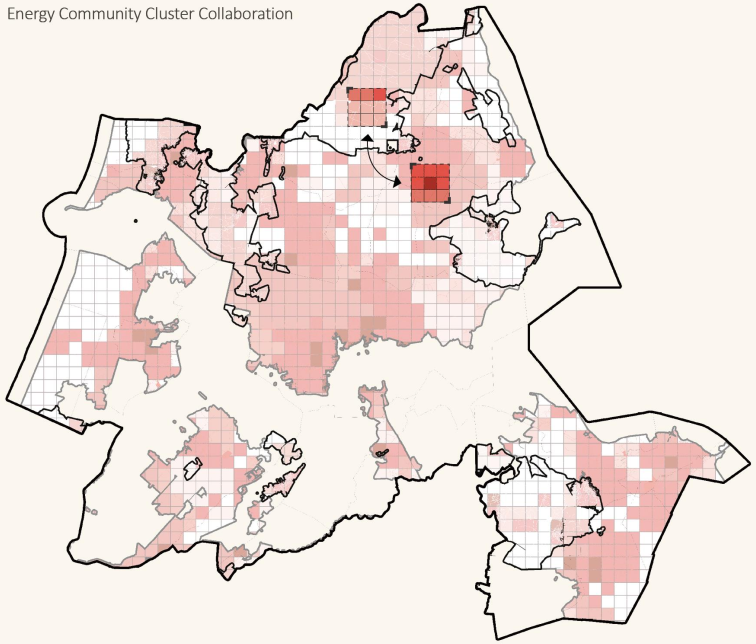


Collaborating with E.C. cluster

Selected Area in Development Map



Energy Community Cluster Collaboration



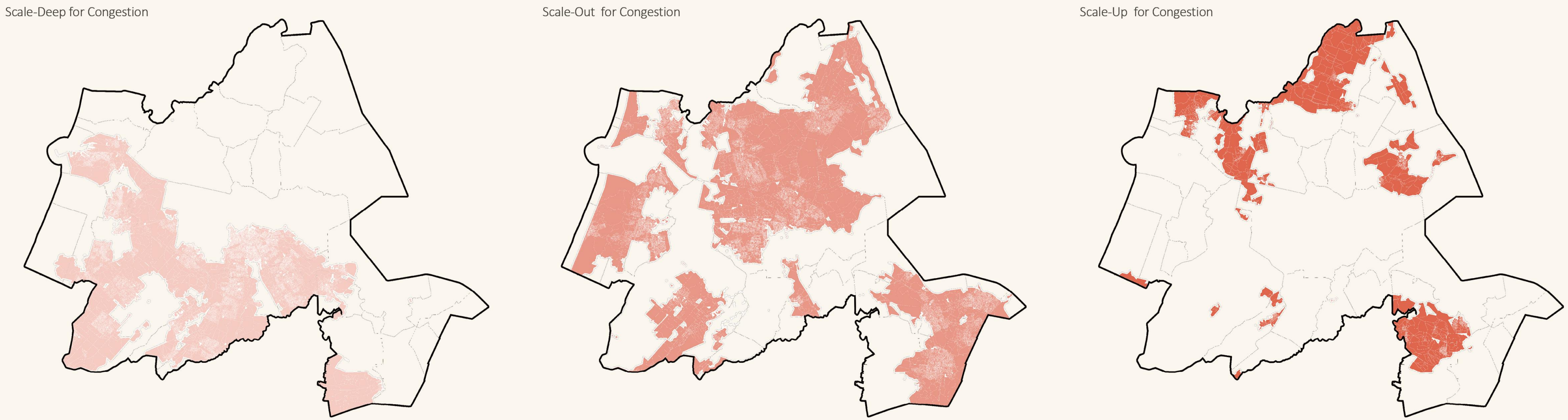
2035~2050 | Scale-Up Phase

To connect with the E.C. cluster that has the capacity of expanding self-production, the scaling up energy communities can build new transmission lines. With the exisitng major substation inbetween, the energy could be transferred either through the existing grids or new lines, depending on the real-time consumption congestion condition.

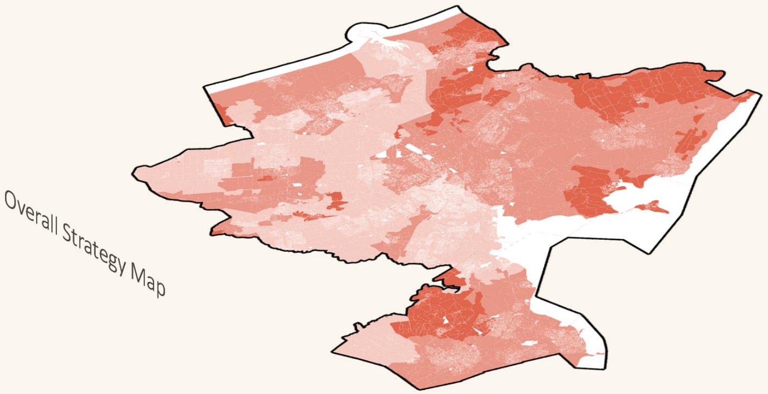
Shared battery and microgrids are established within the energy communities to manage energy storage and sharing better. The microgrids are also connected with the new transmission lines, so that they can build cross-communities collaborations, and finally scale up.

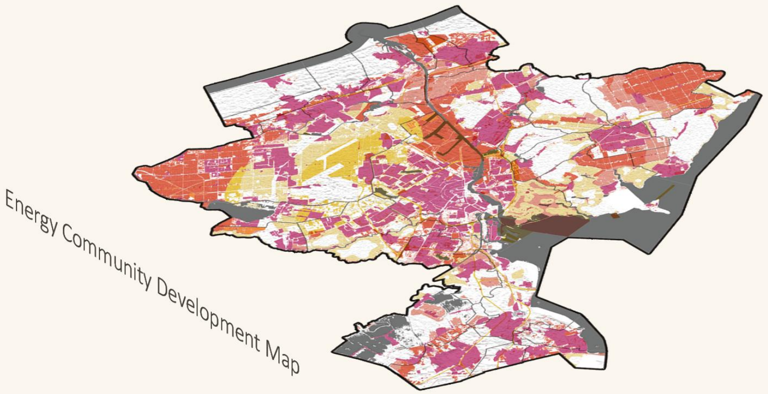
Energy Community Territory Scenarios

To develop scenario for each strategy

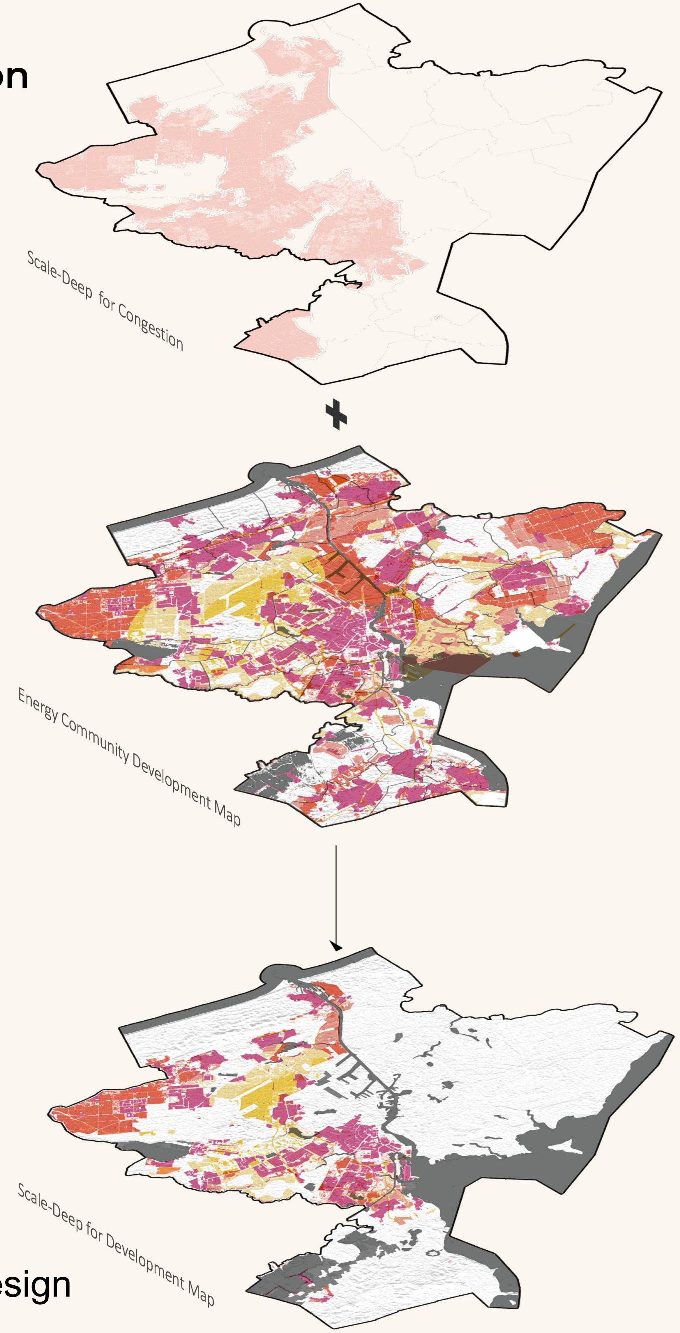


To develop territory scenario



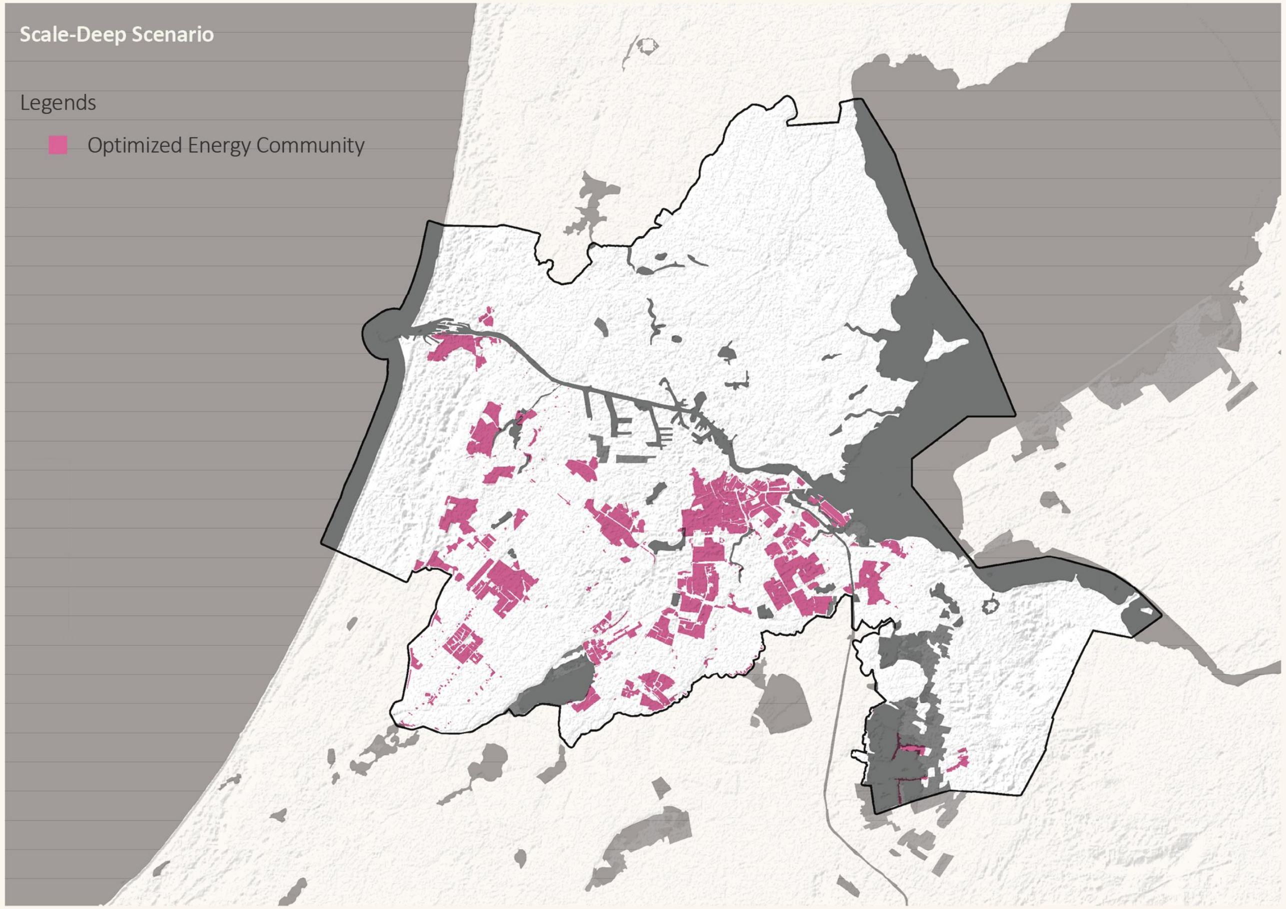


Strategy Evaluation

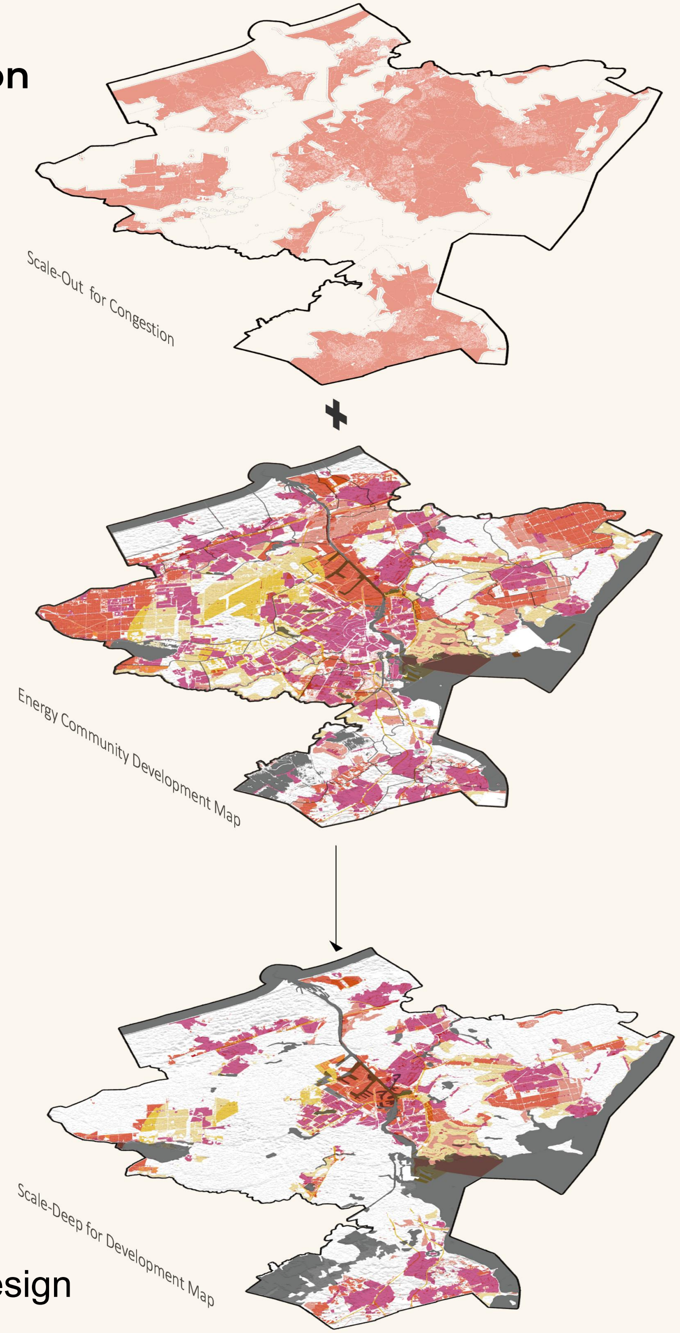


Energy Community Territory Scenarios

Scenario for scale-deep strategy

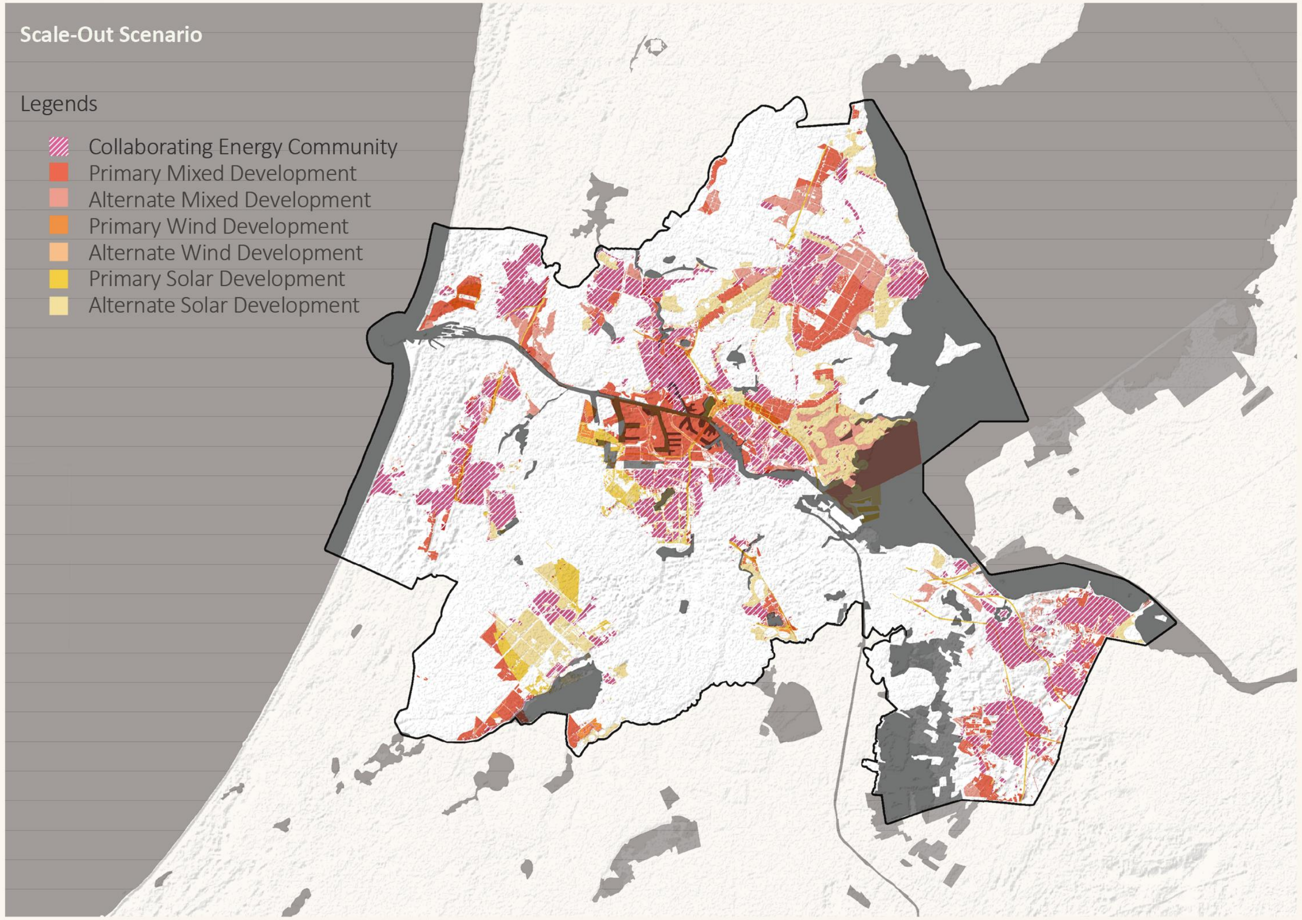


Strategy Evaluation

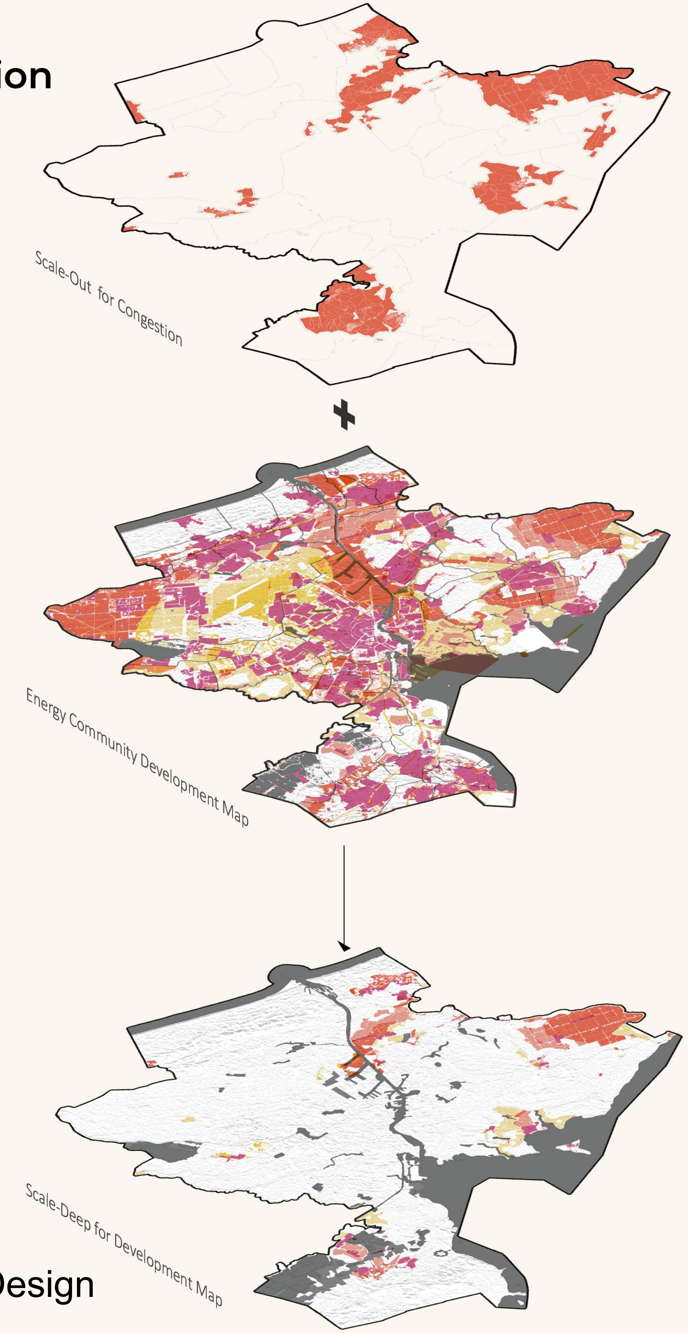


Energy Community Territory Scenarios

Scenario for scale-out strategy

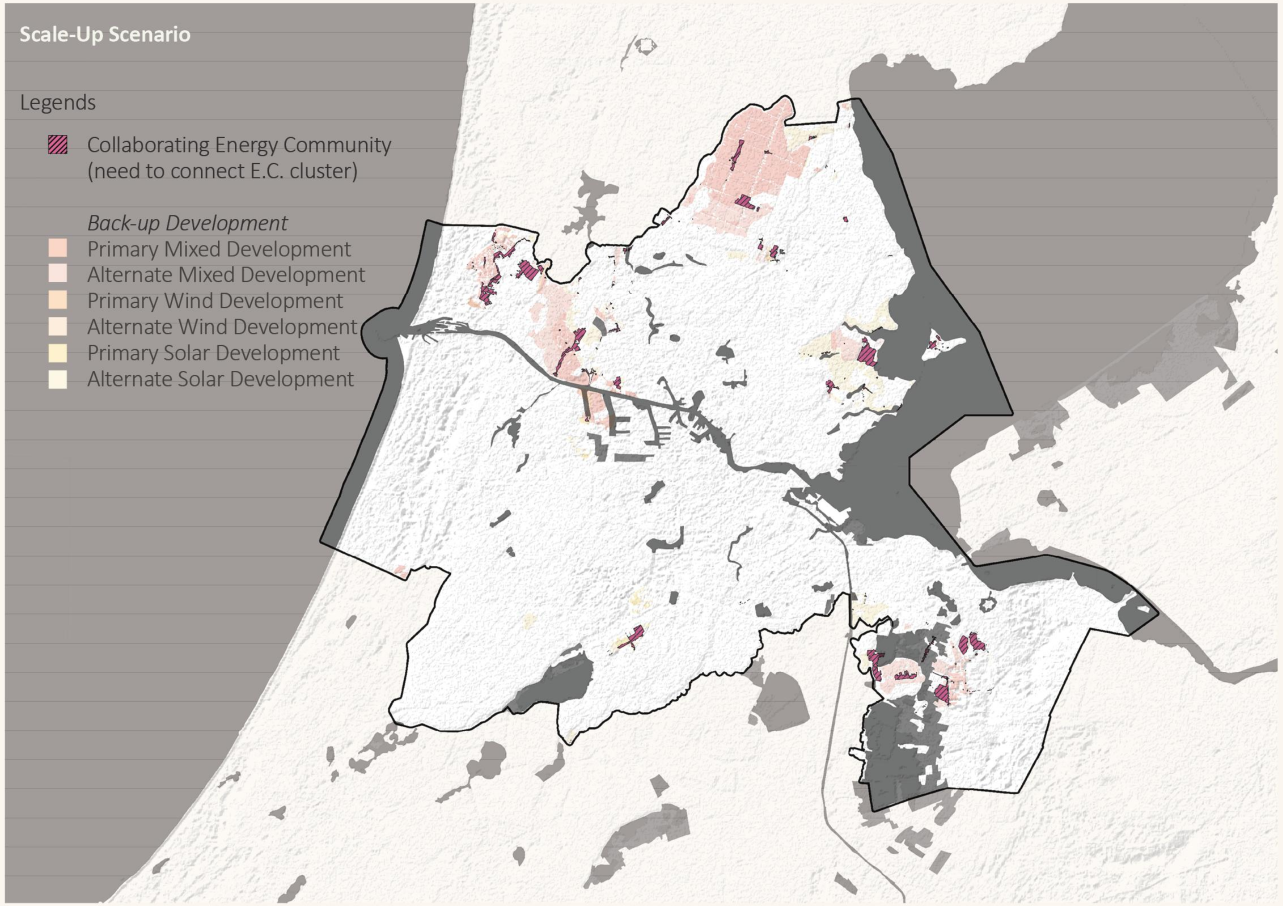


Strategy Evaluation

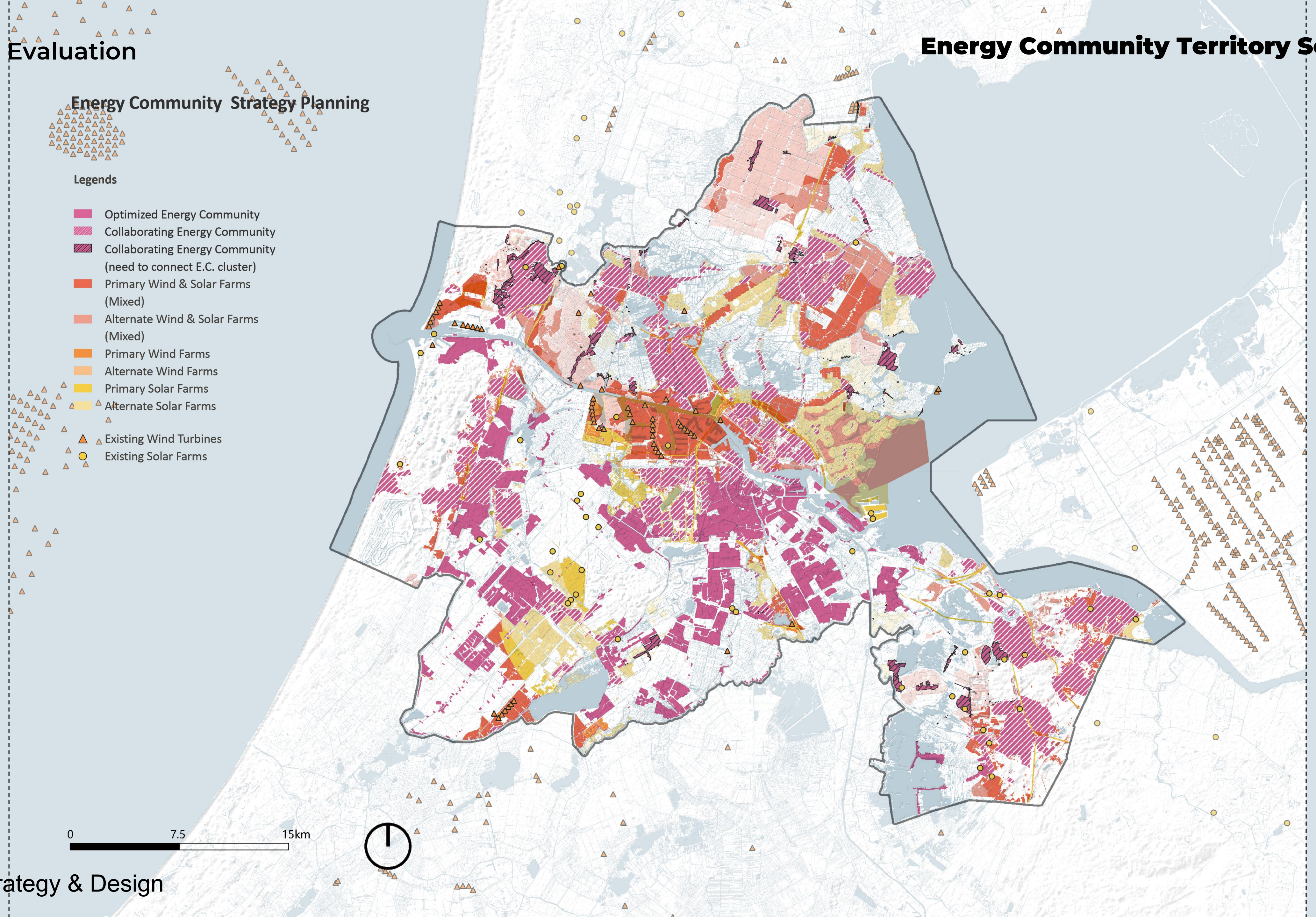


Energy Community Territory Scenarios

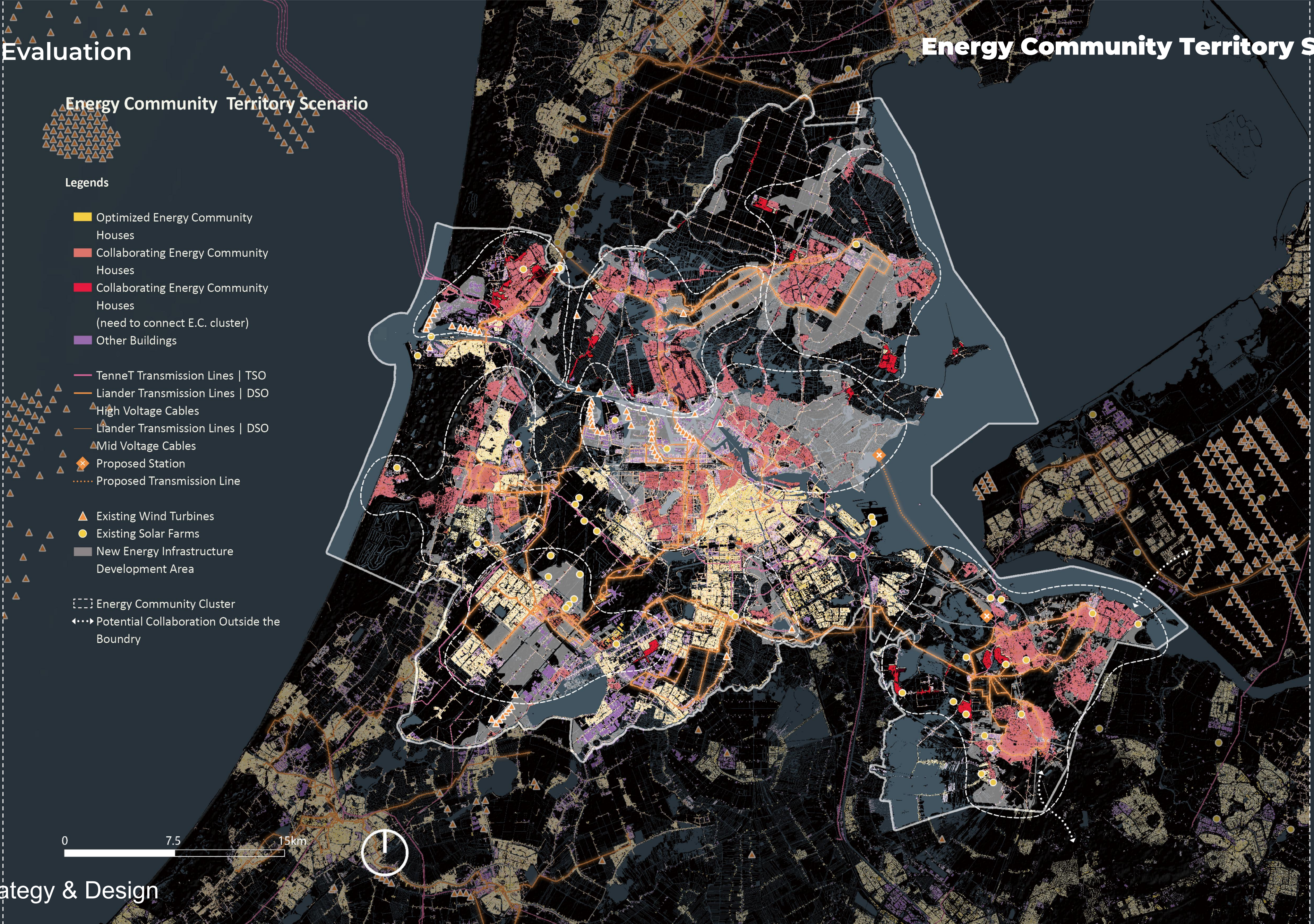
Scenario for scale-up strategy



Energy Community Territory Scenarios



Energy Community Territory Scenarios



5

Conclusion

- What challenge do you think affects the development of energy community in the Netherlands most? (Is it lack of funding, lack of relevant policies, lack of public awareness, lack of participation mechanism or something else?)

While significant progress has been made through new national laws (Electricity Law, Heating Law) and financing instruments to establish a supportive framework for energy communities, the most critical challenge now is **effectively translating these regulations into practical implementation at the local level, particularly within municipal policies**.

Despite this enabling environment and ongoing growth, energy communities still lack sufficient market share in energy production and ownership to meet ambitious future targets (like 50% in coming decades). Therefore, **bridging this gap between national frameworks and actionable local practice is crucial for communities to truly scale and secure a substantial stake in the energy system**.

- Do you think it is possible to build community owned facilities like wind-turbine, solar panel field or large-scale shared battery to enhance the community's self-production capacity and grid resilience. And do you think there is need for doing so?

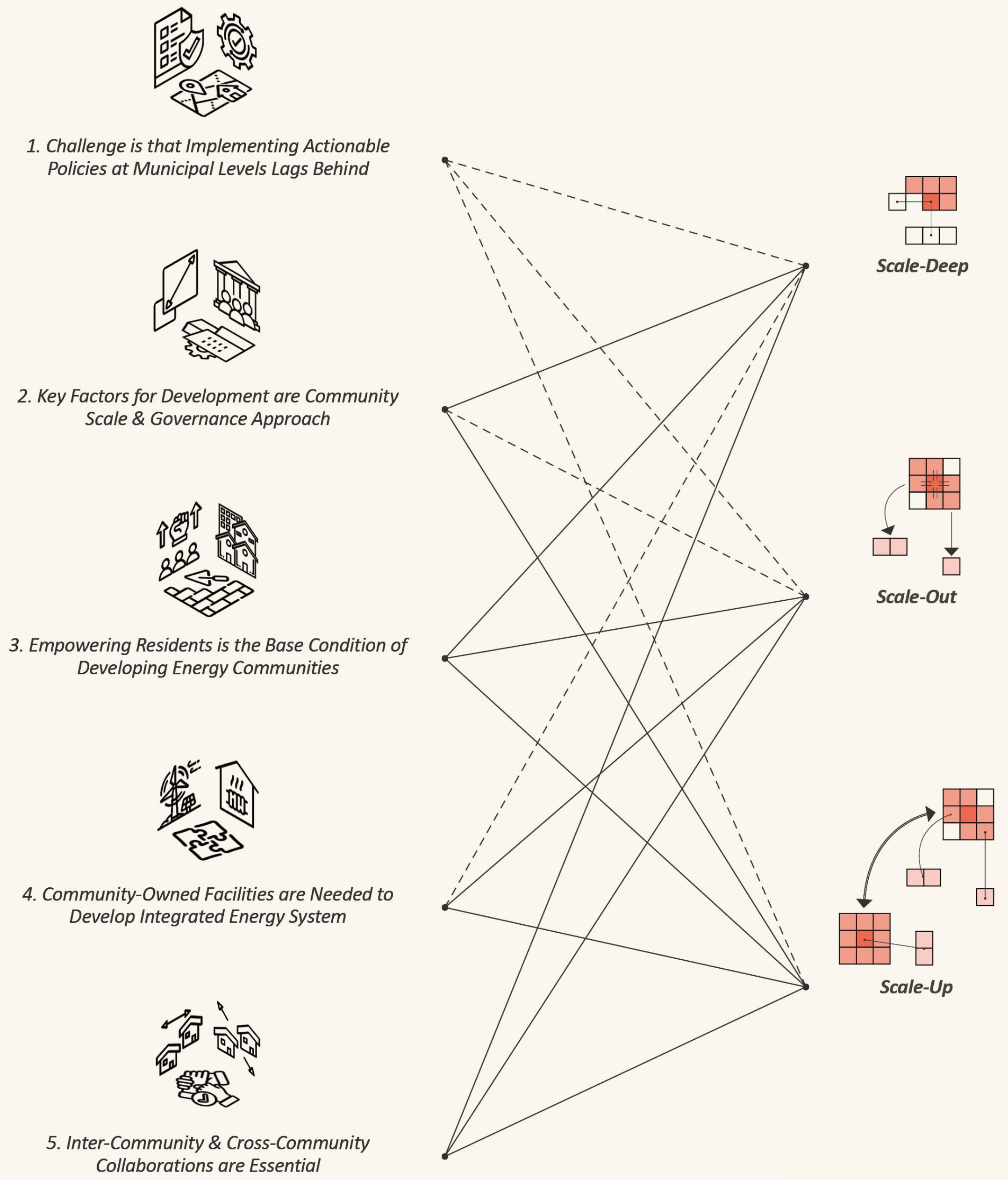
Yes, community-owned facilities like wind turbines, solar fields, and shared batteries are not only possible but essential to enhance self-production and grid resilience. Standalone solar projects alone are vulnerable and worsen grid congestion without integrated solutions. **The key is combining solar, wind, storage, and heating systems (e.g., using summer solar energy for winter district heating) to create a resilient, interconnected model**.

Without progress in energy sharing and such integration, local projects risk becoming economically unviable. **Fortunately, Dutch energy cooperatives that are driven by societal values, not profit are already collaborating through initiatives like "Local4Local" to innovate at multiple scales** (household, neighborhood, municipal), proving this systemic approach is the future.

- Do you think it is possible for energy communities to collaborate with each other, like sharing energy and storage capacity, exchange/trade self-produced energy, investing renewable energy facilities together, etc.? Or there could be more collaborations?

Yes, this kind of collaboration is actually already happening. In fact, the Local4Local initiative I mentioned connects major Dutch energy cooperatives to share resources exactly like this. Take Delta Wind, one of our largest cooperatives: they produce surplus wind power in Zeeland but can't use it all locally, so they're now sharing it with neighboring communities.

The innovation works on two levels: first, balancing supply and demand within a single community (e.g., linking production directly to members' households), and second, enabling exchanges between different communities to strengthen grid resilience. Of course, this is still in development. It'll take years and major investments to scale, but the urgency is clear. With congestion problems and wild price swings on the electricity market (driven by renewables' growth), cooperatives face huge pressure to adapt. Sometimes solar producers even pay to offload excess power when the grid is unbalanced! These market chaos and grid constraints are precisely why this collaborative model isn't just ideal; it's becoming essential for survival.


1. Challenge is that Implementing Actionable Policies at Municipal Levels Lags Behind
2. Key Factors for Development are Community Scale & Governance Approach
3. Empowering Residents is the Base Condition of Developing Energy Communities
4. Community-Owned Facilities are Needed to Develop Integrated Energy System
5. Inter-Community & Cross-Community Collaborations are Essential
Scale-Deep
Scale-Out
Scale-Up

Recommendation

- For Future Energy Communities
- For Policy Makers and Distribution System Operators (Public Sector)
- For Future Relevant Studies
- **Reflective Recommendations for Energy Community**

Energy Infrastrcture - Energy Transmission - Visual Influence

Who Pays for the "Green" and Whose Land?

The Danger of "Gamification"

- Conducting community vote to define the overall preference

- Consulting energy companies to have a calculation of the energy loss by transmission distance.

Recommendation

- For Future Energy Communities
- For Policy Makers and Distribution System Operators (Public Sector)
- For Future Relevant Studies
- **Reflective Recommendations for Energy Community**

Energy Infrastrcture - Energy Transmission - Visual Influence

Who Pays for the "Green" and Whose Land?

The Danger of "Gamification"

- Encouraging residents to participate in planting saplings rather than directly transplanting mature trees.

- Further negotiations and communications.

Recommendation

- For Future Energy Communities
- For Policy Makers and Distribution System Operators (Public Sector)
- For Future Relevant Studies
- **Reflective Recommendations for Energy Community**

Energy Infrastrcture - Energy Transmission - Visual Influence

Who Pays for the "Green" and Whose Land?

The Danger of "Gamification"

- ***Time and financially consuming.***
- ***Affecting energy justice and participation.***
- ***Infomation privacy and ethical problem***

Recommendation

The Danger of "Gamification"

1. Multiple version iterations, prioritizing the most important features

2. Maintain occasional resident meetings

3. Combination of traditional and digital publicity


Energy Community
Power to the People

Thank you!