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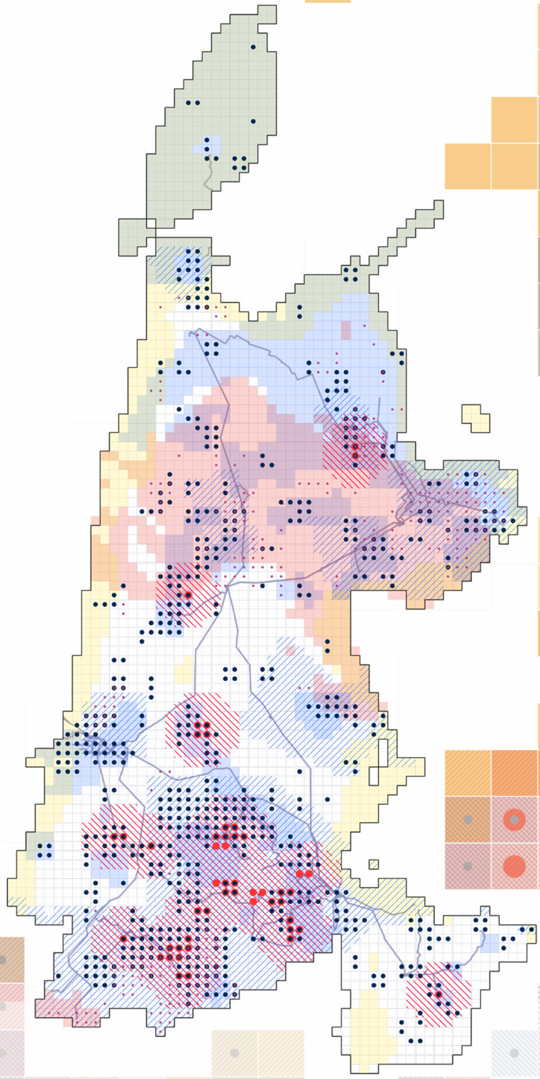
Q3- R&D Studio, 2025

a community-led regional vision



MAKE OR BREAK

Long-term Strategies for the Energy Transition & Energy Poverty in Low-income, Gas-dependent Households in North Holland

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MSc Architecture, Urbanism and Building Sciences
AR2U086 | R&D Studio: Spatial Strategies for the Global Metropolis
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WHAT IF...

the energy transition empowered and strengthened low-income communities?

Figure 0: Envisioning of energy cooperations across corporations and residents, on the benefit of low-income households.

PREFACE

We would like to extend a huge thank you to Eva De Winkel for finding the time to be interviewed as an expert on the justice challenges on grid congestion. The interview was greatly helpful to gain more depth and understanding on the topic for this project. This report was made possible by tutoring from Verena Baltz and Taneha Bacchin, as well as Roberto Rocco and Juliana Gonçalves for the methodology.

ABSTRACT

The energy transition has over the last years caused a series of challenges that affect low-income households in The Netherlands, such as grid congestion and increased energy poverty. Particularly detrimental is it for low-income households, which currently rely on gas for heating. With the inevitability of the energy transition and its financial incentives for the out-phasing of gas, it's of utmost urgency to investigate ways to avoid widespread energy poverty in these households. This study investigated ways and options for doing so on a local level before being scaled up to the regional level of North-Holland. Previous research has attempted to solve this challenge largely through top-down policy-making and solely objective analyses, however lacking incentive for local residents to partake and manage in the proposed solutions. This raised the question: How can a spatial planning strategy enable a just energy transition in Noord-Holland in which the energy grid is optimized for the empowerment and welfare of low-income communities?

A combination of quantitative and qualitative research methods was used, mainly GIS mappings and informal interviews. A research by design method was applied to form the strategies and to develop a regional vision for North-Holland, based on communal values partially through a qualitative media analysis. The analysis showed great potential for locally driven energy- and heating systems. Investigations into energy projects and opportunities in Den Helder, Egmond aan Zee, Hoorn and Middenmeer all showed the high importance of locally scaled approaches to larger challenges. The cases signified the crucialness of including not only residents but also businesses and other cross-sectoral stakeholders. Values such as accessibility, inclusivity, and autonomy were synthesized from communal desires across all four cases, in combination with the media analysis. In conclusion, these four community values, alongside intersectoral cooperation, are critical to achieve realizable energy projects on scales that low-income households can partake in. The effect these projects could have in the long term, as for example with a changed socio-economic situation, could be explored in further research.

Keywords:
Energy Transition, Community-based Planning, Gas Transition, Grid Congestion, Energy Poverty, Regional Design, Socio-spatial justice, Decentralized energy systems

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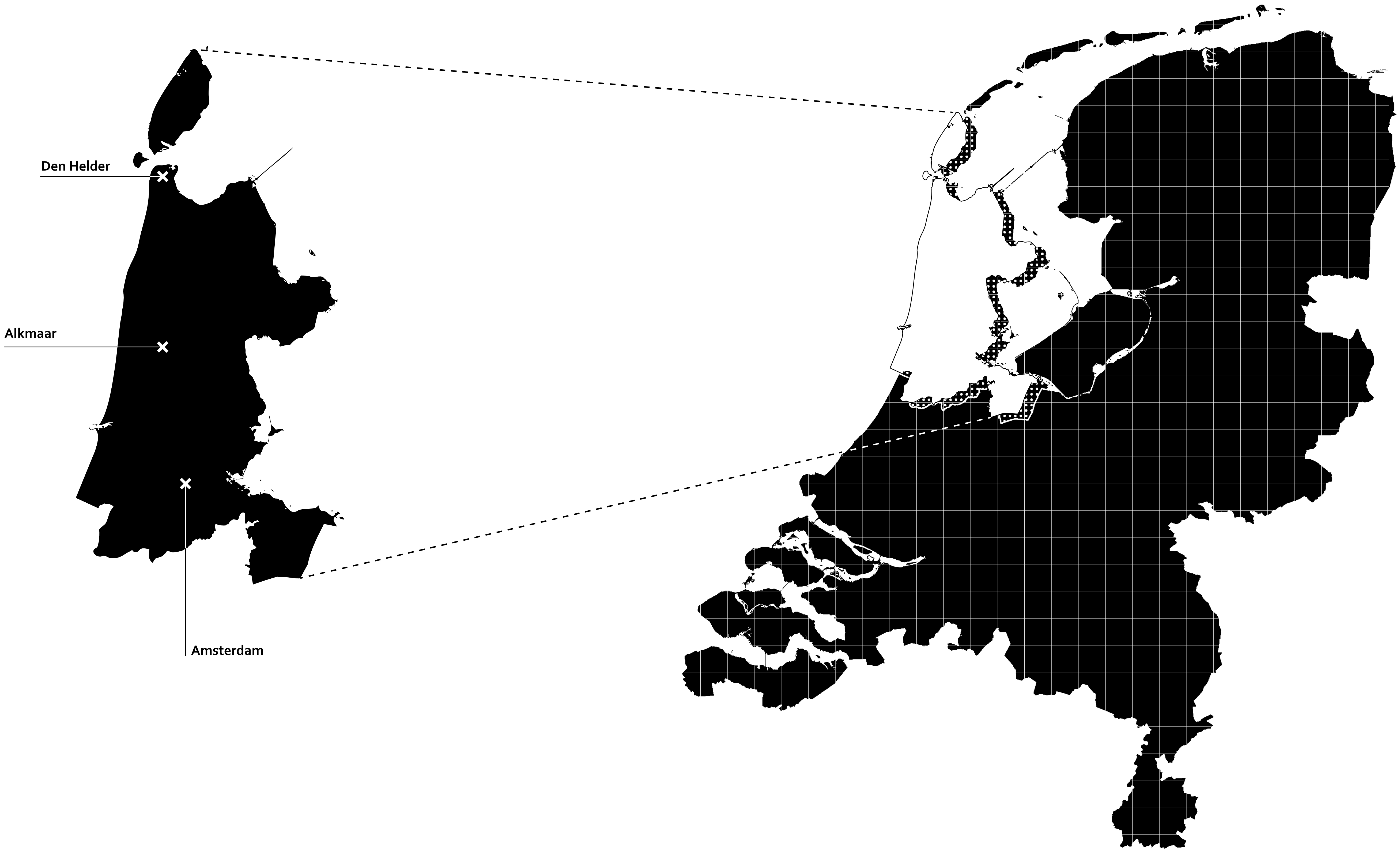
Introduction

Figure 1: HIGH-VOLTAGE CABLE TOWER
Near Stompetoren, Alkmaar
Photo: Hauge, K.T. (2025)

NORTH-HOLLAND



Regional Scale:
North Holland

National Scale:
The Netherlands

Figure 2: Regional and national placement.

INFORMATION SOURCES:

KEY DOCUMENTS

This report was made possible by pre-existing documents and research in the field. On the right are a set of key documents which enabled the understanding of current problems, perceptions, approaches and future directions of the three main challenges this report addresses: energy transition, grid congestion and energy poverty (see *figure 3-9*). If you want to know more about the topics after reading this report, these documents are highly recommended.

Figure 3: TNO report on energy poverty in the energy transition(https://publications.tno.nl/publication/34637343/rOK4vd/TNO-2020-energiearmoede.pdf).

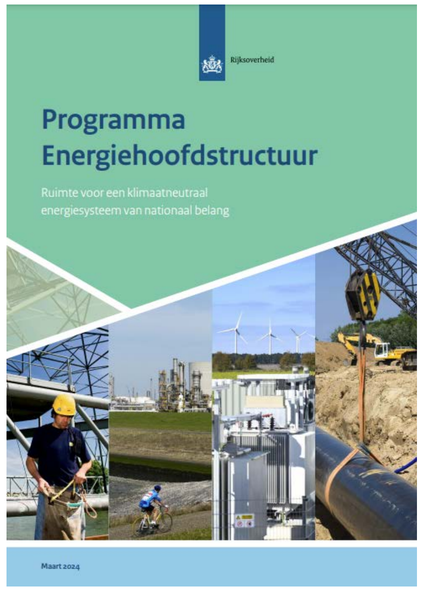


Figure 4: Energy Main Structure Programme by the Dutch central government (https://www.rijksoverheid.nl/documenten/rapporten/2024/03/04/programma-energiehoofdstructuur.)

Figure 5: National Energy System Plan by the Dutch central government (https://www.rijksoverheid.nl/documenten/rapporten/2023/12/01/nationaal-plan-energiesysteem.)

Figure 6: Research article on injustice on the grid from the energy transition by de Winkel et al., 2025 (https://doi.org/10.1016/j.erss.2025.103962).

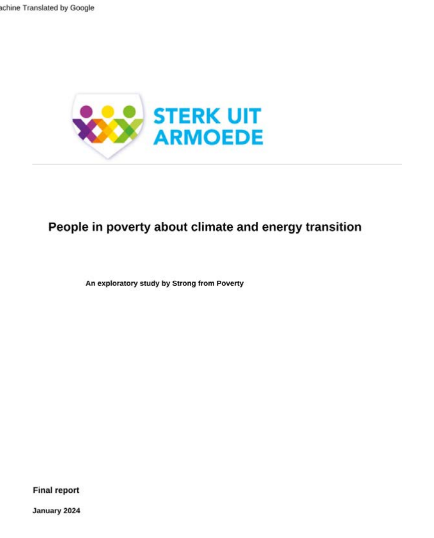


Figure 7: Booklet on energy poverty and personal stories to manage it by Sterk Uit Armoede, 2024 (https://kvdvk.nl/opgeleide-ervaringsdeskundigen-vertellen-hun-krachtige-verhaal/).

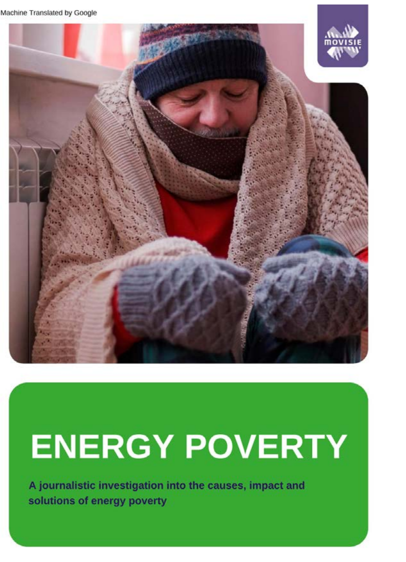


Figure 8: Energy poverty report for causes, impacts and solutions, by Zuithof et al., 2022 (https://www.movisie.nl/publicatie/energiearmoede).

Figure 9: Situation report on energy poverty by TNO, 2023 (https://www.noord-holland.nl/bestanden/pdf/TNO%20-%20Energiearmoede%20in%20Noord-Holland.pdf).

SDGs - WHAT'S TO CONSIDER

With the complexity that is the energy transition, important targets can be found in a range of goals. The report will primarily investigate the energy transition through the lens of low-income households, making goal 1 and 7 important. However, this is a challenge deeply rooted in socio-economic situation, making goal 8, 9 and 10 equally important (see *figure 10*). The outcome of the report will be based on the values of the community, by evaluating how they align with these selected targets and the overall goal. Local and inclusive empowerment are at the core to develop and face the energy transition.

Relevant Targets

All text and icons from https://sdgs.un.org/

Target 1.2
By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions

Target 1.4
By 2030, ensure that all men and women, in particular the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership and control over land and other forms of property, inheritance, natural resources, appropriate new technology and financial services, including microfinance

Target 1.b
Create sound policy frameworks at the national, regional and international levels, based on pro-poor and gender-sensitive development strategies, to support accelerated investment in poverty eradication actions

Target 7.1
By 2030, ensure universal access to affordable, reliable and modern energy services

Target 7.a
By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

Target 8.3
Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services.

Target 8.6
By 2020, substantially reduce the proportion of youth not in employment, education or training

Target 9.1
Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all

Target 9.4
By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities

Target 10.2
By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status

Target 10.4
Adopt policies, especially fiscal, wage and social protection policies, and progressively achieve greater equality

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Target 11.3
By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries

Target 11.a
Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning

Target 12.2
By 2030, achieve the sustainable management and efficient use of natural resources

Target 12.c
Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities

Target 13.2
Integrate climate change measures into national policies, strategies and planning

Target 16.7
Ensure responsive, inclusive, participatory and representative decision-making at all levels

Target 16.b
Promote and enforce non-discriminatory laws and policies for sustainable development

Target 17.17
Encourage and promote effective public, public-private, and civil society partnerships, building on the experience and resourcing strategies of partnerships.

UN's Sustainable Development Goals

Figure 10: UN sustainable development goals (UN, 2024).

CURRENT POLICIES

The energy transition is one of the greatest societal challenges of our time. In the Netherlands, this transition is supported by an extensive framework of laws, regulations, and policy initiatives. These legal and financial instruments are designed to help the country shift from fossil fuels to sustainable energy sources, with the goal of reducing CO_2 emissions, ensuring energy security, and fairly distributing the costs and benefits of the transition. Below are the seven most important laws and regulations.

The 2019 Climate Agreement (Klimaatakkoord):

The foundation of Dutch climate and energy policy. It includes agreements made with various sectors—such as industry, the built environment, and mobility—to reduce greenhouse gas emissions by at least 49% by 2030 compared to 1990 levels. The agreement promotes the heat transition, renewable energy production, energy savings, and a circular economy (Ministry of Economic Affairs and Climate Policy, 2021).

Collective Heat Supply Act (Wcw, Wet collectieve warmtevoorziening):

Currently under development and will replace the existing Heat Act. This law governs how collective heat, such as from district heating networks, is delivered, organized, and made more sustainable. Municipalities will take on a central coordinating role. The Wcw aims to ensure the reliability, affordability, and sustainability of the heat transition and grants municipalities more control over local heat planning (Collective Heat Supply Act, 2025).

Heat Act (Warmtewet, 2014):
Provided consumer protection for users of district or block heating systems. This legislation laid the foundation for the new Wcw and will remain partially in effect until the new regulations are fully implemented. The law ensures, for example, maximum tariffs and delivery security (Wikipedia contributors, 2024).

The Stimulation of Sustainable Energy Production and Climate Transition (De Stimulering Duurzame Energieproductie en Klimaattransitie, SDE++)

A key subsidy program for businesses and institutions that produce sustainable energy or reduce their CO_2 emissions. The scheme supports technologies such as solar and wind energy, geothermal energy, hydrogen, and residual heat. The SDE++ plays a crucial role in making sustainable energy projects financially viable (SDE++ Program, n.d.).

The Mining Act (Mijnbouwwet):

Essential to the energy transition, particularly for geothermal energy. In 2023, the law was amended to better support sustainable geothermal projects. Geothermal heat is a promising source of energy for collective heating networks, especially in urban areas and greenhouse horticulture regions (Anouk, 2023).

The Environmental Planning Act (omgevingswet):

It came into effect on January 1, 2024, consolidates dozens of existing laws related to the physical living environment, including spatial planning, environmental protection, and water management. The Act simplifies procedures and allows more room for local customization, making it easier to implement sustainable energy projects at the local level (Ministry of Infrastructure and Water Management, 2025).

Environmental Planning Act, the Environmental Management Act (Wet milieubeheer)

It remain important for climate policy. It includes rules on emissions, waste, monitoring, and energy conservation. Large companies in particular have obligations under this law to improve energy efficiency (Ministry of Infrastructure and Water Management, 2024).

URGENCY:

ENERGY TRANSITION

Transition: transition is a change of state to another on a fundamental level (Britannica, 2025).

The energy transition is happening. Right now, right here. It will continue to happen for the coming years until fossil fuels are phased out. Behind this massive shift is climate change, which is already showing an increase in extreme weather and sea level rises (UN, 2025). The Netherlands for now have her dikes, but local floodings and extreme weather will disrupt existing and future infrastructure. That is why, as a part of EU and subsequently the EU Climate Law, that The Netherlands are obliged to become carbon-neutral by 2050 (European Commission, 2025a; 2025b). However, undergoing such a transition is not with equal challenge. Low-income households stand today in a situation where gas is cheap and transitioning into alternatives are on the way to become cheap. As the transition will call for greater taxation on consumption of for example gas (European Commission, 2025b), this can cause low-income households to be left with even less to buy for than today. It doesn't matter that the technology in the future is cheaper and more effective, if the purchase power is reduced with equal, if not greater, force. The political road map can be seen to the right in *figure 11*.

Another challenge the energy transition pose are that of inclusivity and cooperation. If the national demand require huge wind parks, is that more important than the interests of those living near them? Going back to the low-income household; is it necessary to banish some to energy poverty, just so the larger consumers can stay supplied? With money and power, one can today get a powerful saying in decision-making processes, as usual. However, given the expansiveness of the energy transition, there will be a greater reaction from lesser actors, like communities. With an estimated 60 000 - 80 000 km of cables in need of replacement to cover for the future load (Rijksoverheid, 2023), neighboring communities can get together and plan out how and when this happens. They can mobilise, others can't. Low-income households are not gathered in a single block like the example. So what happens when change comes to them? Simply waiting to see what happens only open the door to the worst outcomes. To avoid doomsday in the inevitable, a toolbox of options and strategies must be established to aid those currently being left behind in the transition.

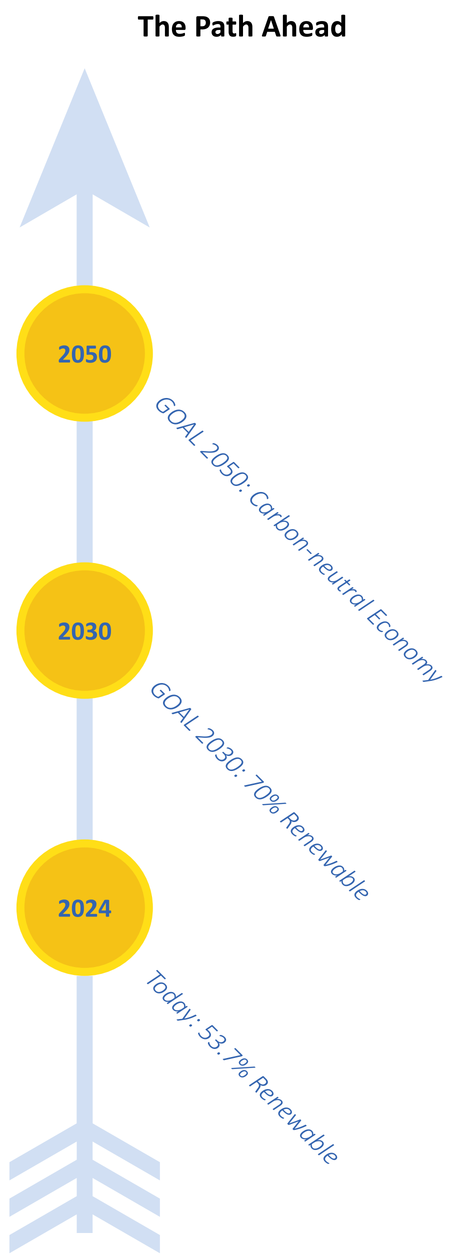

Figure 11: The transitional 'arrow' and main goals along its path. In order to reach all goals in time, it's crucial that every aspect of society are included. This notably applies to low-income, gas-dependent households. Their window of opportunity might be running out soon.

ENERGY TRANSITION: out-phasing of fossil-based energy production to zero-carbon.

Deloitte, 2023

URGENCY:

GRID CONGESTION

Grid congestion is a key challenge that needs to be addressed for a successful energy transition in The Netherlands. The grid is increasingly facing pressure from the electrification of industry, mobility and households. In many parts of the country, the grid can no longer cope with the supply and demand of electricity, resulting in grid congestion (see *figure 12 & 13*). At the moment, the high- and medium-voltage grids are congested, mainly affecting industries, businesses and social facilities. However, in the near future the low-voltage grid is expected to become congested as well, increasingly affecting households across The Netherlands (Aliander, 2023).

Grid operators are trying to mitigate the grid congestion with various measures, such as requesting large grid users to reduce their consumption/production during peak hours, waitlisting new customers who need to connect to the grid, and implementing dynamic pricing. While they are effective in mitigating congestion, these are only short-term solutions which create many challenges when it comes to procedural and distributive justice.(expert interview with De Winkel, 2025; *see also page 70*)(De Winkel, 2025).

It is clear that the expansion of the grid is necessary to reduce grid congestion. However, a shortage of workers, money and space, as well as protests from local residents against new energy infrastructure, is making it difficult to expand the grid. In addition, the first come, first serve policy that grid operators are currently implementing fails to foresee grid congestion and prioritization of social facilities and households over companies (Aliander, 2023).

Grid operators realize that local solutions are a necessary part of the solution to the grid congestion. However, local solutions are more time-consuming, expensive and require more workforce. These are resources which grid operators are facing a shortage of already. Grid operators are under pressure to act fast due to the congestion, therefore local solutions are incredibly difficult to implement, but a purely national infrastructure cannot solve the grid congestion alone. Therefore, balancing local, regional and national solutions is important (De Winkel, 2025).

Grid Congestion
in terms of severity

- Severe congestion
- Moderate congestion
- No congestion

THE NETHERLANDS

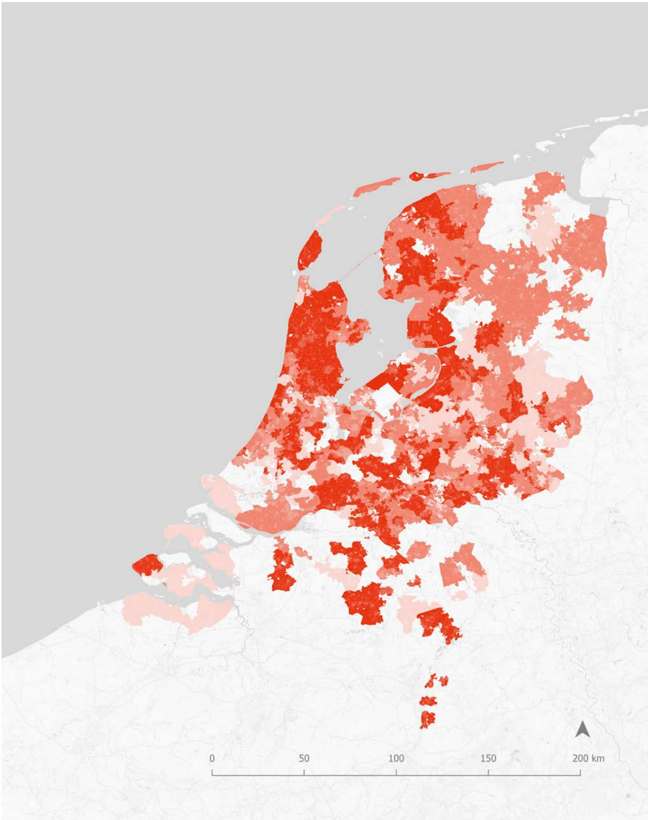

Figure 12: Grid congestion on the national level (Source: Netbeheer Nederland).

NORTH-HOLLAND

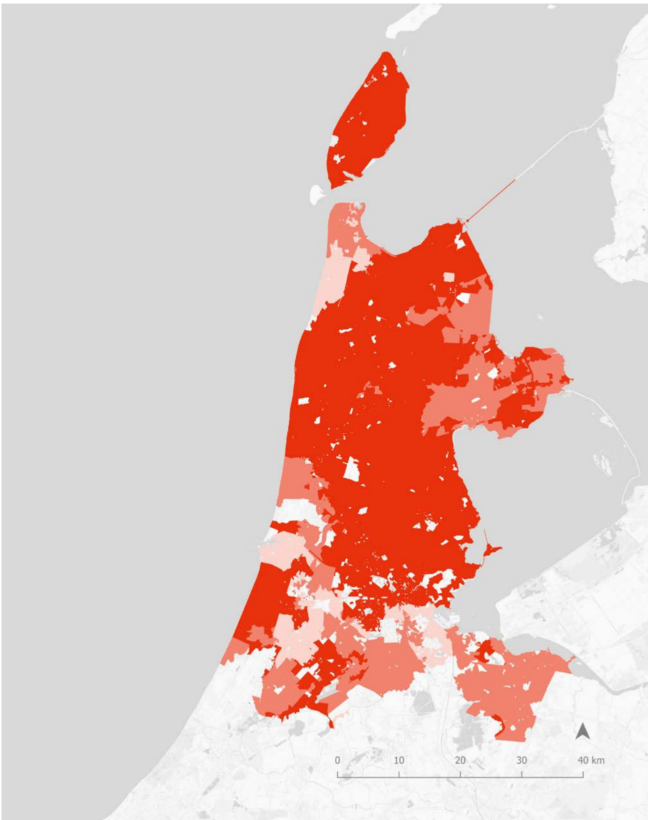

Figure 13: Grid congestion on the national level (Source: Netbeheer Nederland).

GRID CONGESTION: when the the demand for the transmission of electricity, exceeds the available transmission capacity of the existing grid.

TenneT, n.d.

URGENCY:

ENERGY POVERTY

The energy transition brings significant changes, both economically and socially. In addition to the shift towards more sustainable energy sources and the growing issue of grid congestion in the Netherlands, an increasing portion of the population is facing energy poverty. It is expected that this problem will only worsen in the future.

Energy poverty is not only a problem in developing countries, but is also becoming an urgent issue in wealthier nations such as the Netherlands. It refers to a situation where households lack sufficient access to affordable energy sources to meet their basic needs, such as heating and cooking (Straver et al., n.d.).

The issue of energy poverty is closely linked to broader financial challenges. Unpaid energy bills contribute to stress, which can lead to health problems, in turn affecting the household's income (see *figure 14*)

Although the energy transition is often presented as a top-down approach, it is crucial to recognize that the current energy poverty issue is continuing to worsen. If no specific and effective measures are taken to address the underlying problems, the gap between those who can afford energy costs and those who cannot will continue to grow, leading to serious consequences.

The steps towards sustainable energy will likely result in higher energy costs in the short and medium term, increasing the risk of further exacerbating energy poverty (Batenburg, 2023).

The Consequences of Energy Poverty

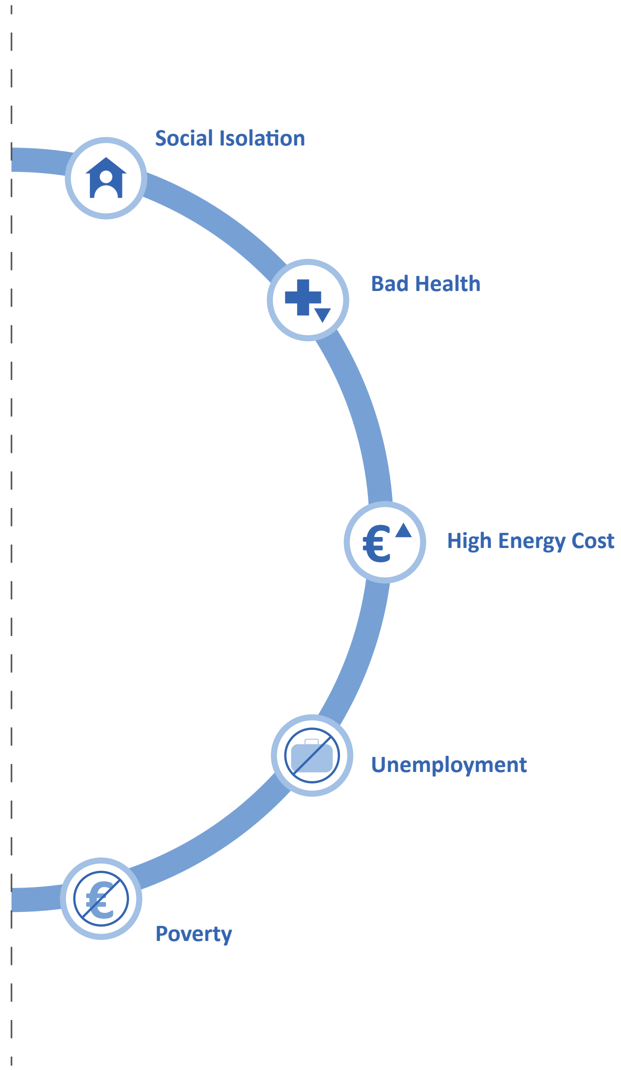

Figure 14: The consequences of energy poverty (TNO, 2020).

ENERGY POVERTY: a household which reduce its energy consumption to a degree that negatively impacts the inhabitants' health and wellbeing.

European Commission, 2025c

URGENCY:

THE MOST AFFECTED

The Energy Transition

The Netherlands needs to transition from fossil fuels to renewable energy to minimize its environmental impact and to save itself from rising sea levels and increasingly extreme weather. North-Holland is seen as the future energy hub for The Netherlands due its high renewable energy potential. Therefore the province of North-Holland is getting increasingly built-up with renewable energy infrastructure and businesses.

The Grid Congestion

This energy transition is creating challenges of grid congestion in the energy network. Due to the increasing demand for electricity for heating, industry and mobility, the grid is struggling to keep up with the demand. This creates challenges to continue with the energy transition, as in many parts of the country the grid households and businesses have to wait for new (or additional) connections. In the case of North-Holland, large businesses (e.g. data centers) have taken up a lot of space on the grid, leaving little room for social facilities or households on the grid.

The Energy Poverty

Due to the energy transition, gas-dependent low-income households are expected to transition to renewable energy sources, but are not given the means to do so. This leaves energy-poor and gas-dependent households stuck paying increasingly large bills for gas heating, and being unable to invest in renewable heating and cooking systems.

The Community

These three issues interact with each other and manifest themselves in different scales (see *figure 15*). At the center, and the smallest scale is our community: gas-dependent and low-income households in provincial towns in North-Holland. This community needs to transition from gas, and does not have the means to do so. At the same time, their energy grid is becoming increasingly congested, leaving even less room for the most vulnerable groups. The energy transition puts our community at a crossroad. Either they will have their problems amplified, or be empowered and supported by the transition. If The Netherlands wants an inclusive energy transition, it should be the latter.

A MAGNITUDE OF ISSUES ON A PERSONAL LEVEL

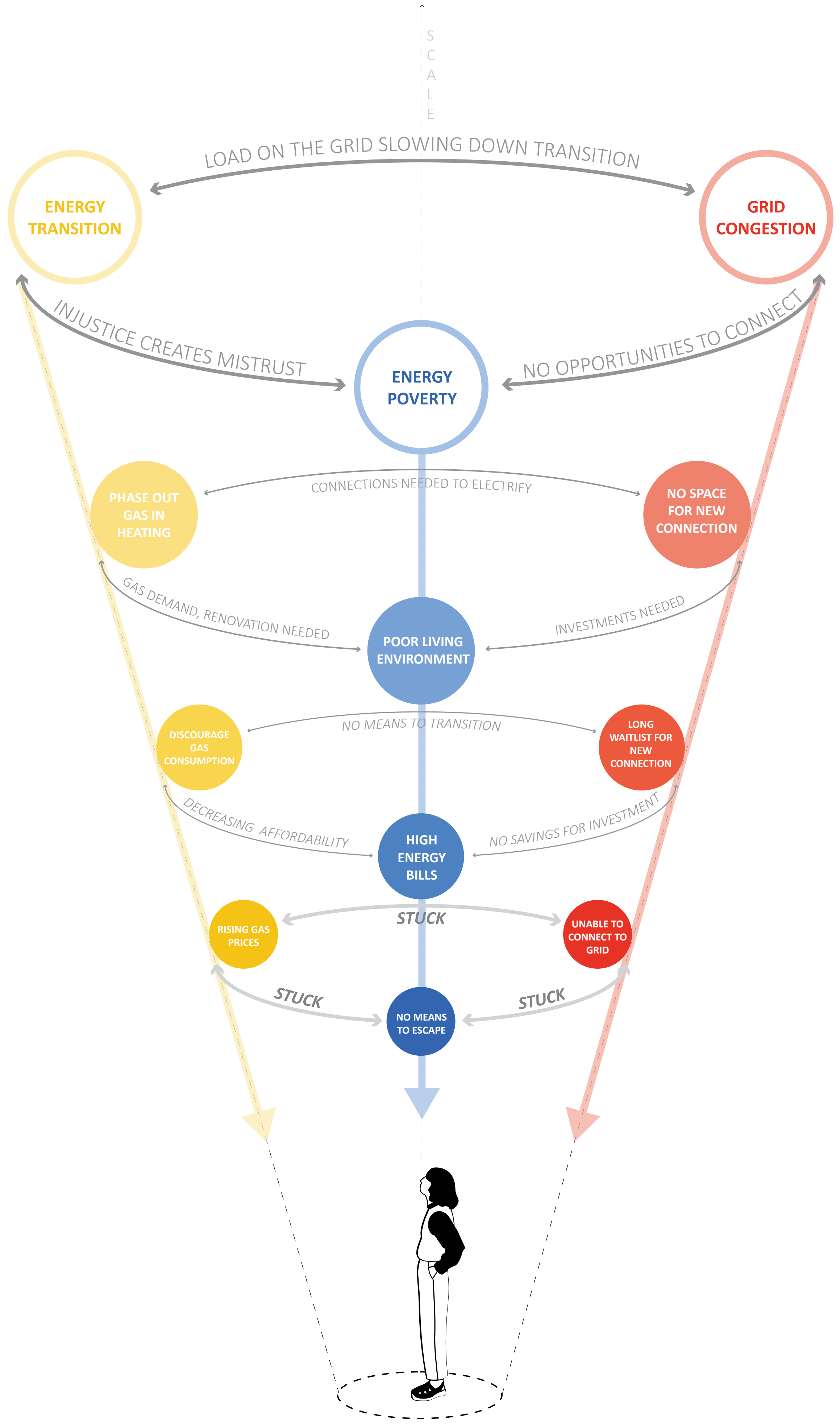

Figure 15: All the three major challenges converge down the scale to the most vulnerable, the selected community of low-income, gas-dependent households.

OBJECTIVE & REPORT OUTLINE:

WHAT TO EXPECT

This report is set out to investigate and understand the interrelationships of the energy transition, grid congestion and energy poverty for low-income households in The Netherlands. The end result will be a set of strategies which this community can apply in their own situation. The strategies were found by examining and evaluating current energy projects in areas of various density and population.

The way to these strategies, and the regional plan for North-Holland, are primarily based on that research by design method after a set of spatial mappings (see *figure 16*). Throughout the report knowledge about each sub-question will be revealed and answered. A summary of these can be found at the end of the report. A final conclusion to the main research question can be found there too.

REPORT STRUCTURE & OUTCOME

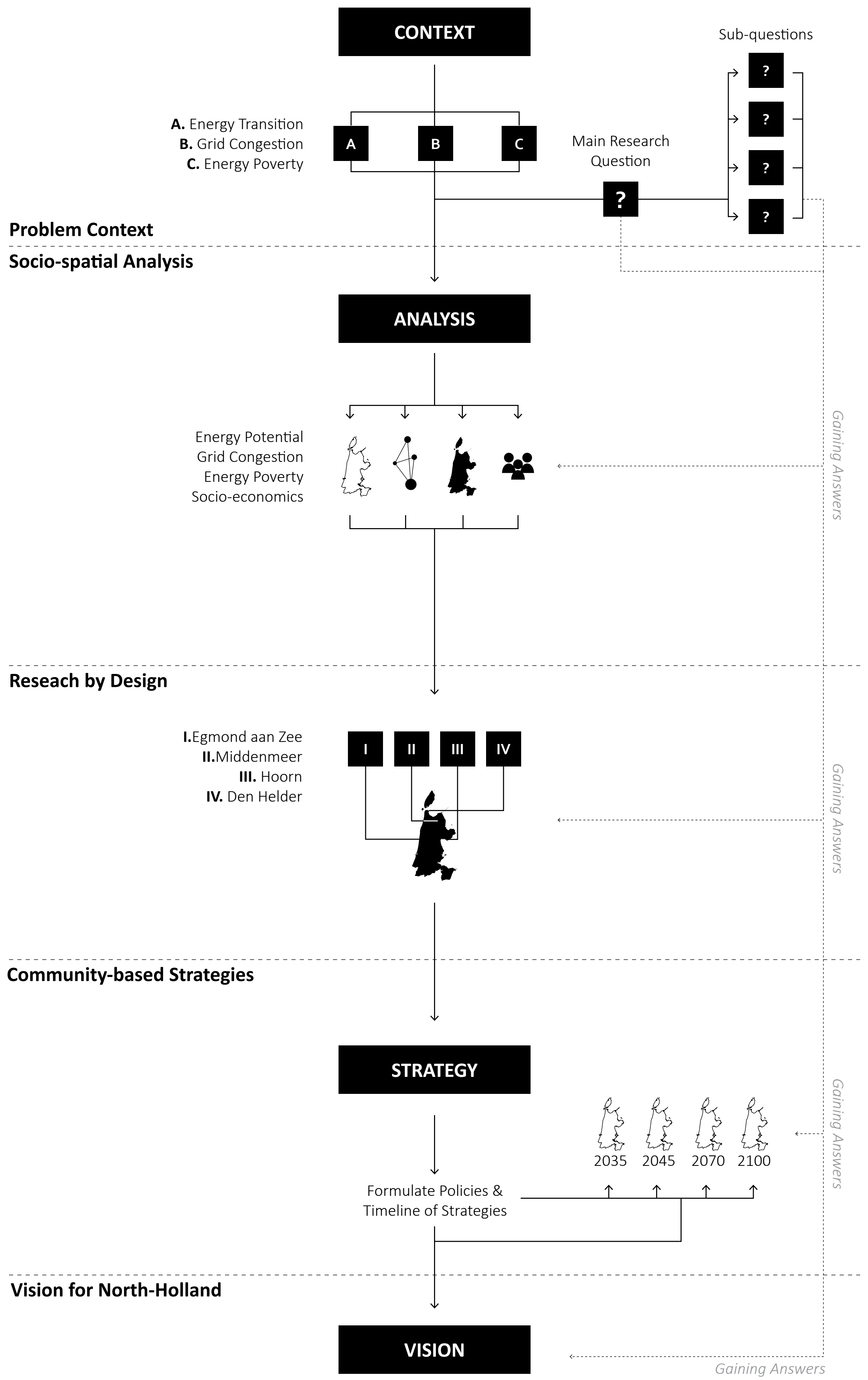

Figure 16: Structure of the report and what to expect.

CHAPTER II:
FRAMEWORKS & METHOD

Figure 17: SCALES OF ENERGY
Boekel, Near Alkmaar
Photo: Hauge, 2025

AIM:

PROBLEM STATEMENT

There is an energy transition happening in The Netherlands. North-Holland is seen as the main renewable energy hub for the country because it has high solar, wind and geothermal potential. Because of this, the region has increasing demand for the energy network capacity. However, the energy grid in North-Holland has already reached its limits. Households that want to connect to the electric grid or expand their connection (to e.g. accommodate heat pumps) are waitlisted for months, sometimes even years, making it challenging to transition from gas to electricity (Leeuwarder Courant, 2024).

Simultaneously, the energy transition is increasing the energy poverty problem in The Netherlands, particularly when it comes to phasing out natural gas. While higher-income neighborhoods have the money to invest into new electric systems (e.g. heat pumps and electric stoves), lower-income neighborhoods are stuck with gas heating and cooking systems. With attempts to transition to renewable energy systems, taxes for renewable electricity are being reduced, while gas taxes are rising, thus increasing energy prices for low-income households and decreasing them for higher-income households. This process is increasing the energy poverty and inequality in The Netherlands, and challenging the goal to have 1.5 million existing homes be off natural gas by 2030 (TNO, 2025).

AIM:

QUESTIONS & METHODS

MAIN RESEARCH QUESTION

How can a spatial planning strategy enable a just energy transition in Noord-Holland in which the energy grid is optimized for the empowerment and welfare of low-income communities?

Tabel 1: Overview of sub-questions and their methods.

SUB-QUESTION	METHOD	DURATION
1. What are the existing socio-economic and spatial (environmental) impacts of a congested grid network?	Interview, Literature Review, Site Visit	2 Weeks
2. What are the existing socio-economic and spatial (environmental) impacts of transitioning from gas to renewable energy?	Interview, Literature Review, Qualitative Media Analysis, GIS Mapping	3 Weeks
3. What are the existing and potential strategies and plans aiming to achieve a just energy transition in balance with the low-income communities while dealing with grid congestion challenges?	Interview, Literature Review,	4 Weeks
4. What are the perceptions and experiences of the energy transition regarding justice and quality of life among provincial North-Holland residents from low-income areas? (e.g. accessibility, sense of belonging, job opportunities)	Interview, Literature Review, Qualitative Media Analysis, Social Network Analysis	1 Week

IN A TRANSITION

A transition is a change of state to another on a fundamental level (Britannica, 2025). Due to the long time span in a transition, usually more than a generation, it is important to consider future participants/generations in the decision-making process (Loorbach, 2002). The x-curve in *figure 18* represent the stages of a transition and how there will be moments of chaos and uncertainty (Hebinck, 2022). It is here that proper management must be ensured, how so is described later.

As the transition is a gradual process over multiple scales, with many actors either accelerating or slowing down the process (see *figure 19*), one must consider the driving forces behind them (Loorbach, 2002). It's also important to note that not everyone participates in a transition equally. Some join earlier or later, depending on for example socio-economic factors (see *figure 18*).

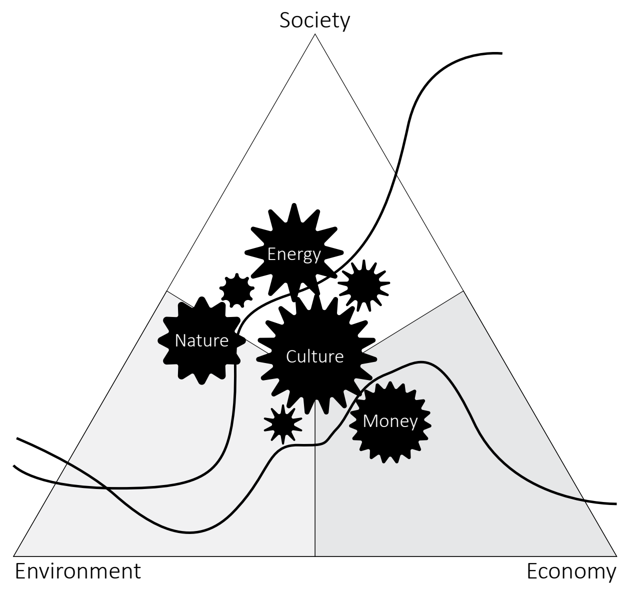

Figure 19: Cogwheels in the transition (Loorbach, 2002). How they operate and interact determine the speed and end-result of the transition.

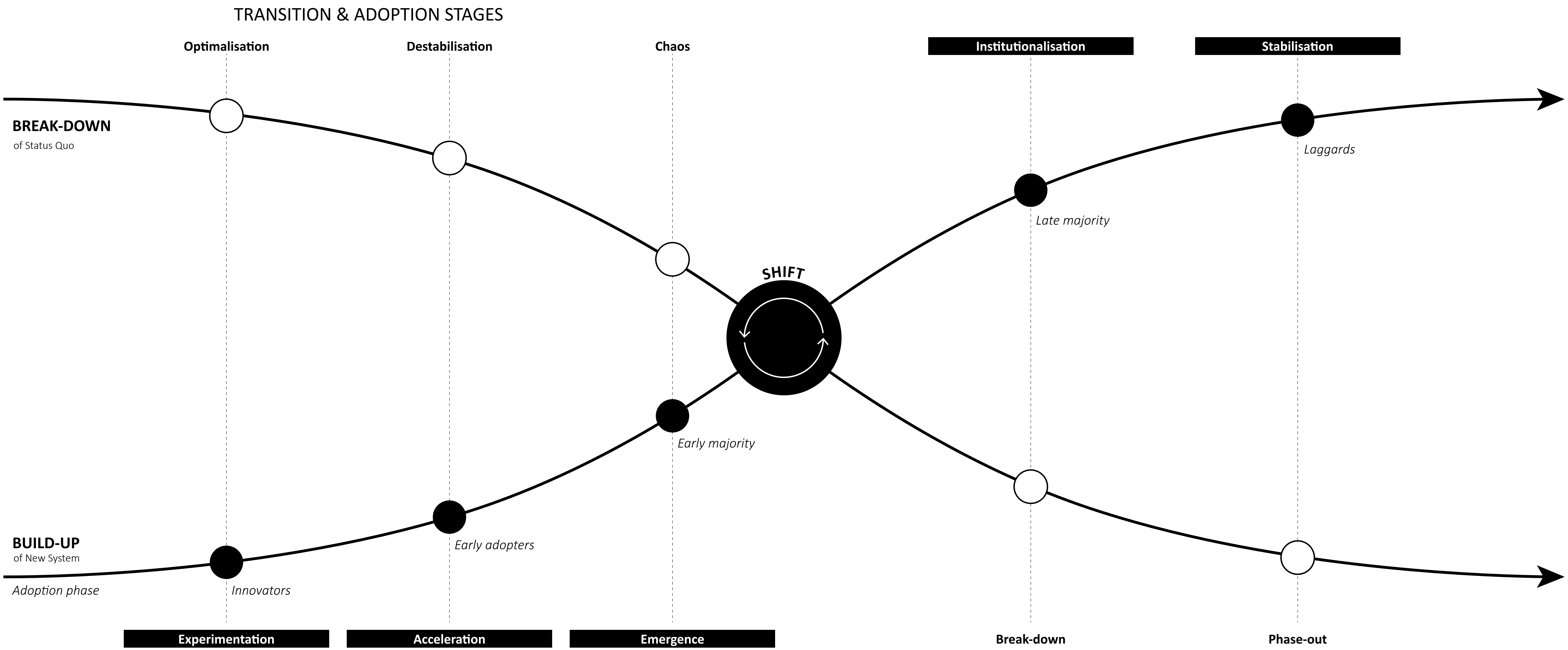

Figure 18: The transitional x-curve and its adoption phases (based on Rogers, 1995 & Hebinck, 2022).

THEORETICAL FRAMEWORK:

MANAGE THE COMMONS

Commons are public resources, independently of ownership. An example of this can be air, land, groundwater reserves, but also knowledge (IASC, 2025). What is reality today is the mismanagement of these resources, in what Garrett Hardin termed 'The tragedy of the commons' (Hardin, 1968). When a finite resource, like coal and gas, is managed with self-interest first, it will run out without regulations. If every house owner were incentivised to yield the highest energy production on their land, they would take the gains individually. However, the negative impacts on what the energy production does on the land is shared. One's wind turbine could block the other's solar panel (as seen in *figure 21*). This way of managing is in other words one of the main reasons behind energy poverty.

A crucial question comes in mind then; how can the common be managed to that consequences, like energy poverty, is avoided?

Since Hardin published *The Tragedy of the Commons*, resources have in western societies been managed by a central governing body. It grew in control from mistrust in voluntary cooperation on the smaller scale, which ultimately resulted in the current global over-consumption (Ostrom, 2008). Managing the commons from only a top-down approach is therefore not the way to go. Elinor Ostrom proposed a set of eight principles to overcome this challenge (see *figure 20*).
What's common throughout the principles are the importance of local, self-governing communities, and that will be brought into the project later on.

However, these principles are not to be accepted blindly. While Ostrom expanded on Hardin's rather isolated portrayal of commons management, it's still setting up the criteria of having clear boundaries and full acceptance. For certain homogeneous communities this might be possible, but not most. The selected community in this report will rely on other communities to realise their goal, and that could mean crossing into more fuzzy inter-communal boundaries.

Will then the monitoring and decision-making be done by the most powerful voices? What happens if they have a different value set than the initial community?

These are just some of the potential pitfalls for the community if the principles aren't adapted or expanded upon. To do so, the ways of communication and governance must be understood and catered for, so that the commons dilemma can be overcome.

> "Therein is the tragedy. Each man is locked into a system that compels him to increase his herd—without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons."

Garrett Hardin (1915-2003),
The Tragedy of the Commons (1968), p.1244

Elinor Ostrom's 8 Principles for Overcoming the Commons Dilemma.

1. Define clear boundaries.
2. Ensure that rules regarding the common-pool resource are created and accepted by everyone.
3. Ensure that the monitoring of the common-pool resource is done by the users themselves.
4. Graduated sanctions.
5. Conflict resolution.
6. Recognitions of the rights of the users.
7. Ensure that there is collective choice.
8. Ensure that there is monitoring of the group managing the common-pool resource.

Figure 20: Management principles for the commons (Ostrom, 1990)

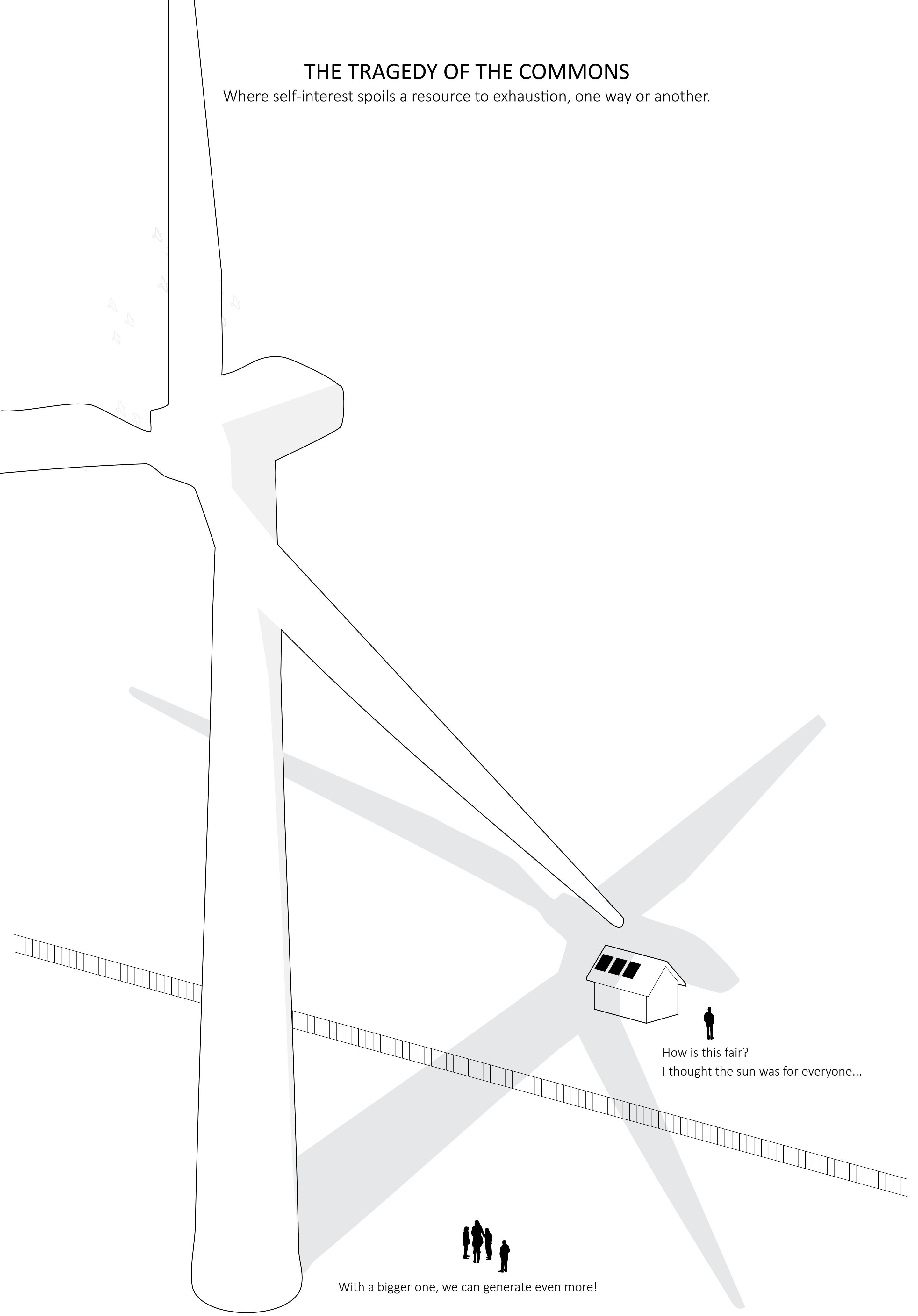

Figure 21: Although renewables are replenishable, they too have a finite yield per meter. Would you say this is fair even if they're all connected?

THEORETICAL FRAMEWORK:

GOVERNANCE & COMMUNICATION

Governance is the way one govern, and the practices and rules that allow organisation to happen (Bevir, 2024). The public sector has the government as a major example, but there's also entities in the private sector and within civil societies, the latter where the community is. These are broadly speaking the three conflicting values in the decision-making process. A weakened civil society will tip the power balance towards the public/private sector, where special social interests might not be valued as much (Dietz et al., 2003).

Following up Ostrom's principles from before, it's clear that the civil society stand as the high power. Civil societies are usually governed as network, compared to the public sector being more hierarchical and policy-driven, and private being market-based (Rocco, 2025). With a central civil society, it's important to not lose the connections with the other sectors. In order to keep the scales of governance, especially for policies, proper communication is needed (Healey, 1996). When communities or individuals meet with national policymakers, there will be a power imbalance. In order to overcome all of these hurdle's Ostrom propose having symmetric communication across a polycentric governance (see *figure 24*) (Dietz et al., 2003). Let parties talk as equals, and keep it at the scale which the participants feel attachment to (see *figure 23*). This is the ideal way for community-based and sustainable commons governance. It also gives room for unpredictability, turning into what Ostrom later 'adaptive governance' (Ostrom, 2005).

> "What we have ignored is what citizens can do and the importance of real involvement of the people involved - versus just having somebody in [the national government] make a rule."
>
> Elinor Ostrom (1933-2012)
> *in response to winning the Nobel Price in Economics, 2009*

PROCESS PRINCIPLE

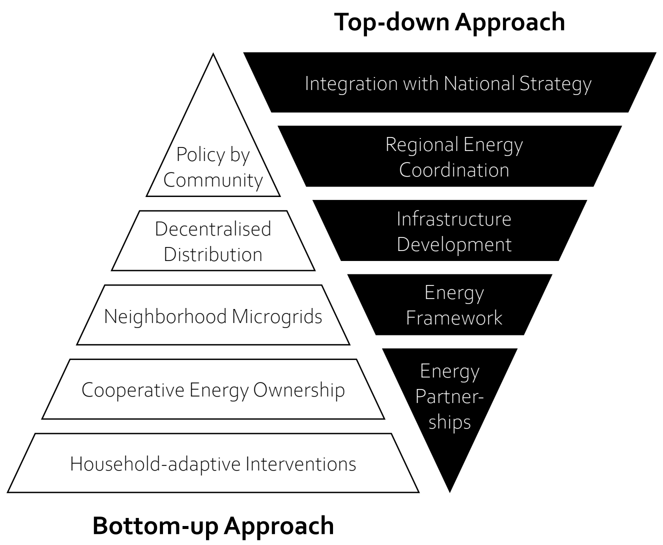

Figure 22: Top-down versus bottom-up approach. A mix of both ensures local participation, while also being aligned with the larger systems.

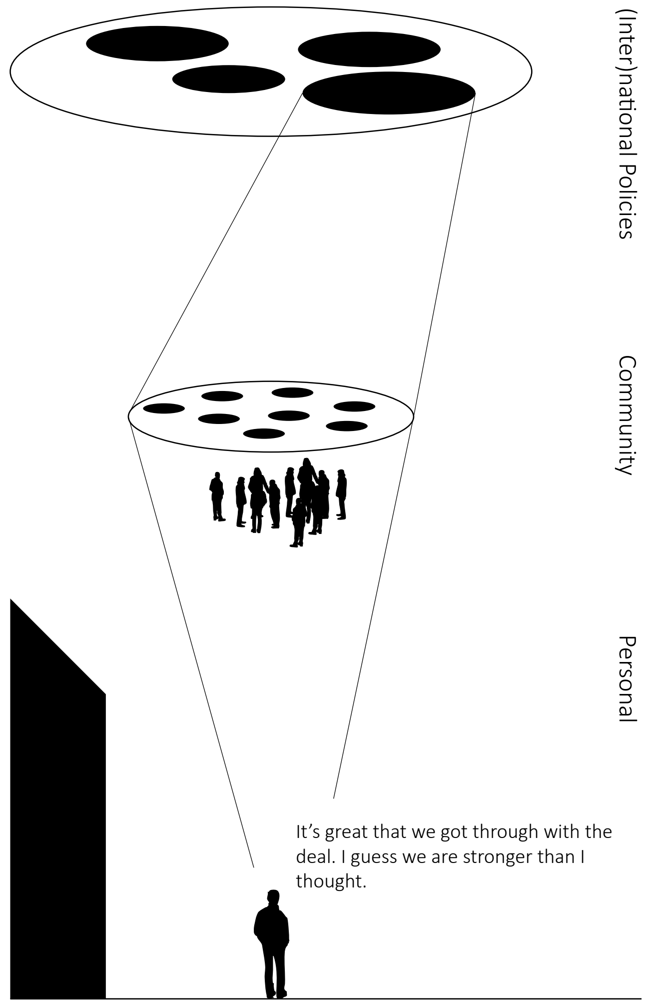

Figure 23: Scales of power and communication.

COMMUNICATION NETWORKS

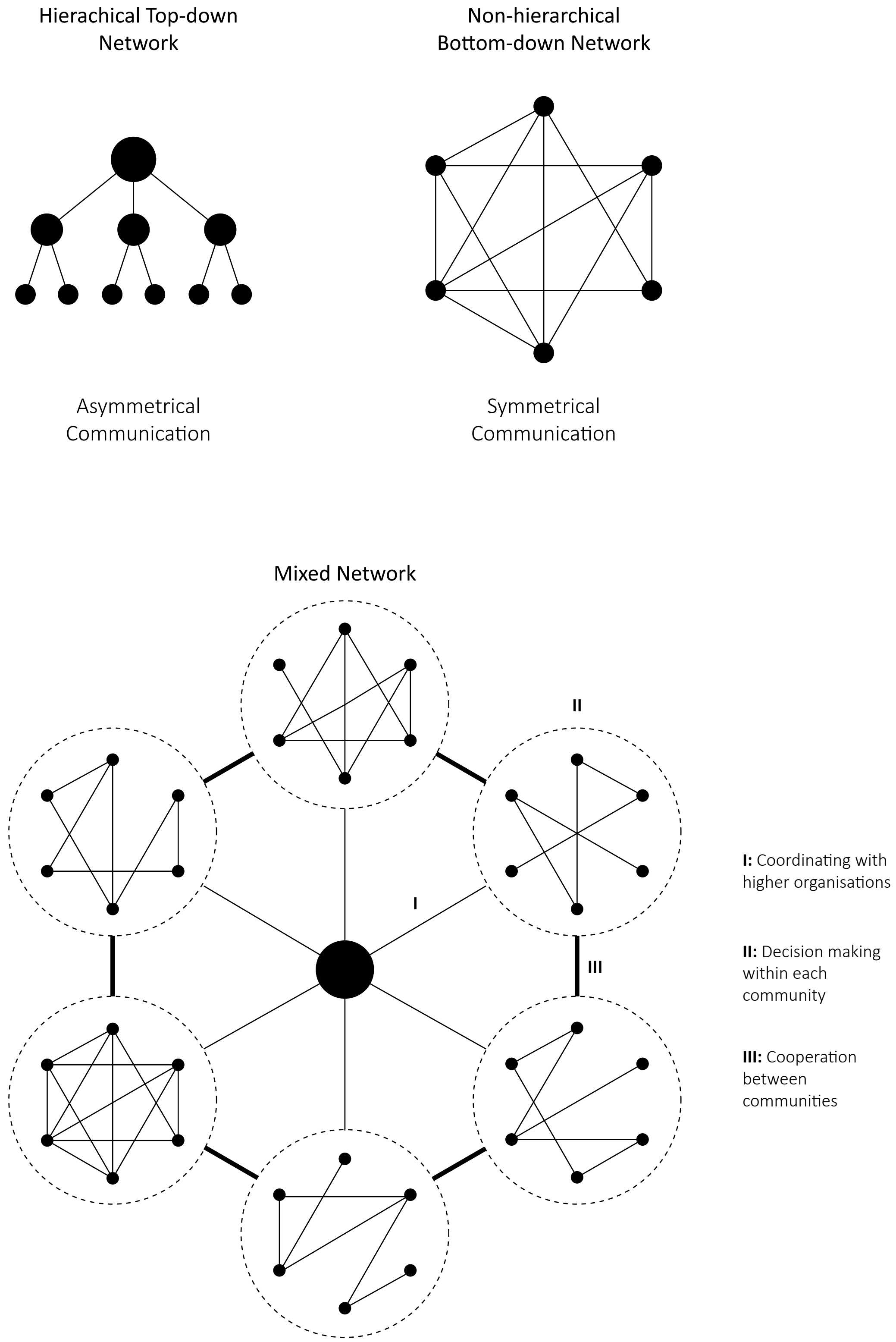

Figure 24: Communication networks and corresponding planning approach.

CONCEPTUAL FRAMEWORK

The conceptual framework connect transitional theories and ways of governance within existing definitions of sustainability (see *figure 25*). It acknowledge the transition being a process at different scales, from national/global forces to the human experience. It incorporate the relationship between multi-scalar challenges in the context of the community, that being energy transition, grid congestion and energy poverty.

It boils down to the direct effects larger challenges affect the community in terms of finance, accessibility and power. A lacking in any of the inner sections reflect where change must happen to avoid a power imbalance between either private or public actors, indicated through the higher sustainable value sets. Every force has an opposite, a push-back, which are accessbility, affordability and autonomy for energy transition, energy poverty and grid congestion respectively.

TAKE-AWAYS FROM THEORIES

Transition Process

The multi-scalarity of a transition is brought as the main axis. The greater societal values of sustainability, as stated in *Our Common Future* (1986), define the outer ring of the framework, and the drivers of transition cogwheels (Loorbach, 2002). Sustainability on the local scale should be connected with sustainability aspects on the national or global scale, and is therefore an integral part of the framework.

Knowing well that the community currently exist in the later stages of the transition process, the framework will cater for a target group in that phase.

Commons & Governance

Ostrom's ideas and principles for polycentric governance, as well as the scales of attachment, are indirectly included in the main axis too. It acknowledge the interdependencies on global and national issues, while keeping itself grounded on the community and personal scale. The challenges that will be addressed in the project are a result of greater forces and their relationships with each other, e.g. the energy transition, grid congestion and energy poverty.

As a sublayer of the framework, one can see this in three levels or scales: the greater societal values, the energy problematics and the personal experiences of those problems.

Main Values Behind the Conceptual Framework

1. Multi-scalarity
2. Polycentric governance
3. Interdependence
4. Time
5. Sustainability trifecta

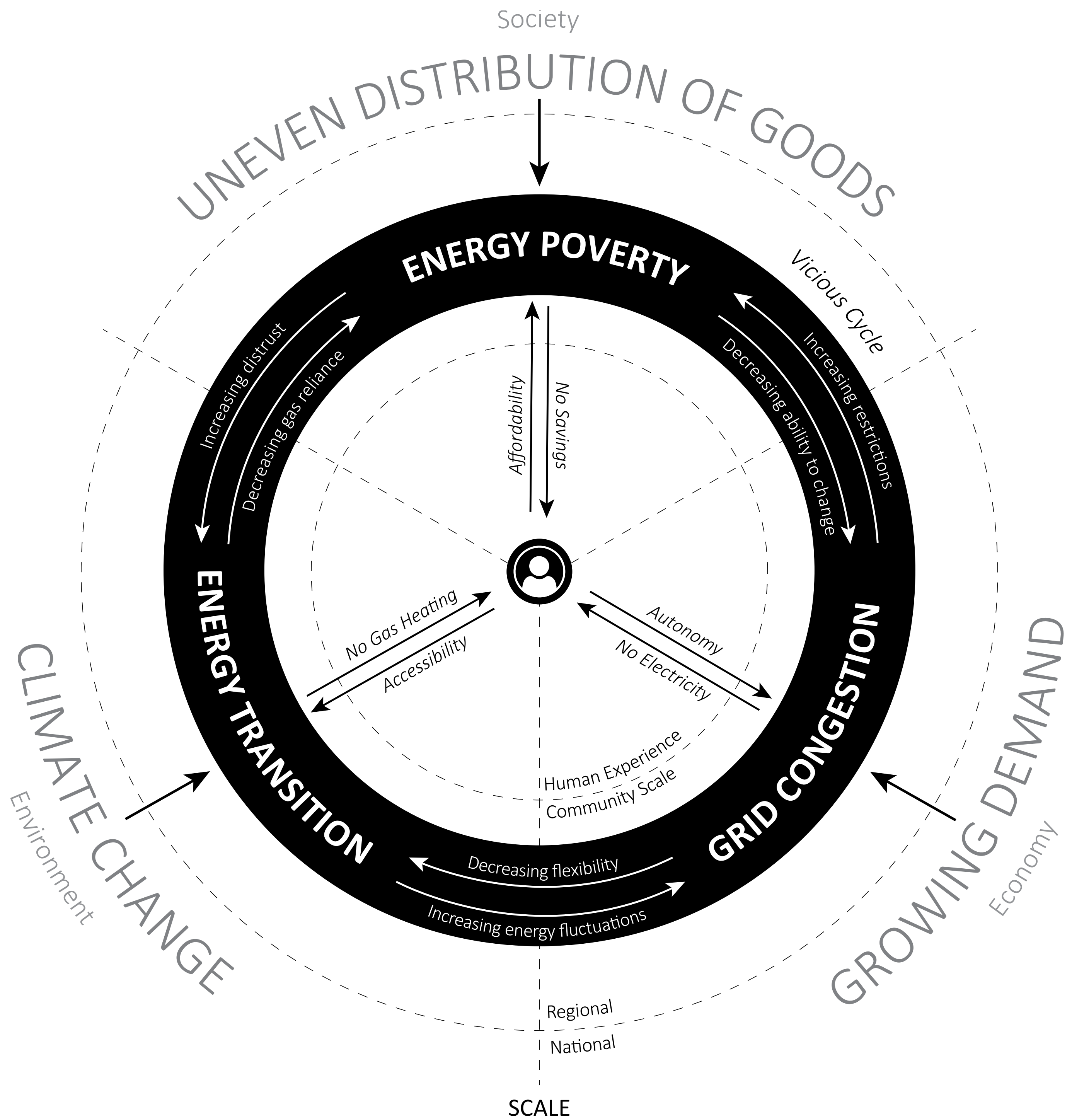

Figure 25: Conceptual framework developed based on the sustainability criteria in *Our Common Future* (1986), mulit-scalarity in transitonal theories and Elinor Ostrom's community-based governance.

METHODS & STRUCTURE

A community-based regional vision, need to be based methodologically in the community. The report reorganize the typical structure of vision-making by instead of projecting a vision onto the communities, the communities are projected to the vision (see *figure 26*). Through research by design on the strategical level, common trends, patterns or features could be found. These would form the spatial and non-spatial principles in which the spatial vision would be formed by. It is a bottoms-up approach through and through.

On the way to reach this community-based vision, certain methods are used to gather insight into data, opinions and experiences. The primary method used was GIS mapping and literature review. To avoid exclusion of the emotional and personal communal aspects, informal interviews, qualitative media analysis and a site visit was conducted.

Methods Applied

SV — **Site Visit**
Round-trip in the region to gain experience on the spatial and emotional part of the challenges.

MA — **Qualitative Media Analysis**
Gathering knowledge about public opinions on current projects or policies.

IN — **Interview**
Informal interview with experts or workers in the field.

SA — **Stakeholder Analysis**
Main actors in the current and their relationship and/or co-depencence of each other.

GM — **GIS Mapping**
Spatial mapping of the community, as well as future potentials and current infrastructure to support it.

DA — **Data Analysis**
Datasets from CBS and other data banks to project future trends in energy demand and production.

RD — **Research by Design**
Exploring possible solutions from a bottoms-up approach with community values and societal needs.

LR — **Literature Review**
Concepts and theories on transitions, governance and the energy transition. Also for learning from other projects and cases in the strategy.

SN — **Social Network Analysis**
Local mapping of where power is located and how the current social infrastructure is in the region.

RESEARCH STRUCTURE & METHODS USED

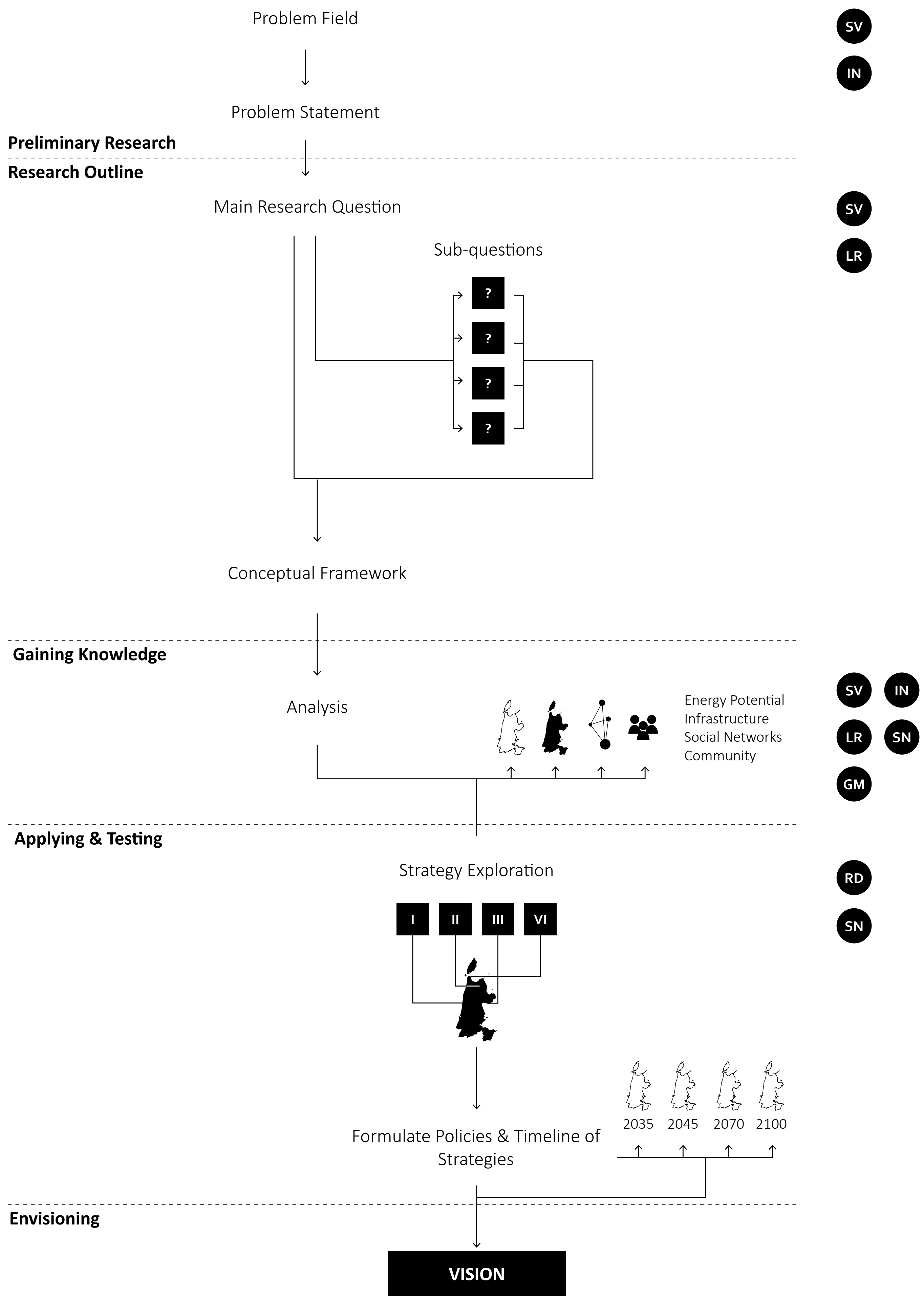

Figure 26: Report structure towards the regional vision and where the methods were applied.

APPLICATION OF METHODS

SV **Site Visit**

On February 17th, a site visit to North Holland was conducted. In preparation for it, certain locations were selected based on GIS information. These locations were typically blind spots or knots in existing energy infrastructure. The trip was underdone with a privately owned car. It started off in Amsterdam near Sloterdjik Station, before going to Tata Steel near Wjik aan Zee. The main objective here was to witness how high-emission industry, landscape and smaller villages come together. Photos and notes were done outside the industrial park, due to security, before driving to Alkmaar. This was also the main documentation method for the entire trip. In Alkmaar, the focus turned to residual heat, as HVC -Afvalenergiecentrale was visited briefly. Here some unexpected wind turbines were observed in Boekelermeer and photographed.

Further on, high-voltage meeting points were observed near Oterleek. The purpose was to observe how the highest grid level affected local, rural residents. After documenting, greenhouses east of Warmenhuizen were visited for residual heat potential. Another goal was to observe if rural households in these areas were producing their own energy, or showed other signs of self-management of energy. Lastly, Den Helder was visited on the reason of being a bottle neck for North Sea wind parks. The goal here was to see how prominent the cables and connections were in the landscape. However, due to a lack of time and a missed turn, that could only be observed from a distance on Oostoever.

MA **Qualitative Media Analysis**

The analysis was divided into two parts:
1. Gathering articles and newsletters with appropriate keywords in Nexis (see Appendix for query)
2. Analysing common features and public opinions with the software Atlas.ti.

For Atlas.ti, codes were limited to four categories: community and business experiences, infrastructural elements, location and technical themes. With these, the answers to 'who?', 'what?', 'where?' and 'how?' could be found. A combination of intentional AI coding, co-occurrence analysis and sentiment analysis was conducted, all functions within Atlas.ti.

Notably, the code infrastructural elements uncovered the topic of heat pumps, which paved the way for the current community selection.

IN **Interview**

A previous wind energy consultant, and current researcher on the grid, was contacted and informally interviewed for roughly an hour on March 5th. The reason for conducting the interview was to gain knowledge from the operator's perspective. It provided invaluable insight to the challenges of grid congestion and possible scenarios and consequences, if left untreated. It was documented through recording, which cannot be shared by the authors due to confidentiality.

SA **Stakeholder Analysis**

Main actors across all three challenges (energy transition, grid congestion, energy poverty), were mapped based on knowledge gained from the qualitative media analysis, literature review and the interview. There was no further primary information production, as such the stakeholder analysis rely on existing and shared knowledge on the topic.

GM **GIS Mapping**

A data folder was provided at the start of the project, compiled from sources like CBS Statline, WarmteAtlas, Global Wind Atlas, Global Solar Atlas and Rudifun. This was utilised in the GIS software QGIS, along with publicly available datasets. Primary sources for additional data was CBS.

DA **Data Analysis**

Basic processing methods were used from publicly available datasets, mainly CBS. Certain datasets were later imported into QGIS to spatialise it. It was also a method to determine trends, of which GIS mapping had a tendency to miss.

RD **Research by Design**

Strategies were explored by designing out solutions through a set of community values and scales. This formed the basis of all proposed strategies, which later created the foundation for the vision. It was an integral part of conceptualising the community values both in space and policies.

LR **Literature Review**

A previous wind energy consultant, and current researcher on the grid, was contacted and informally interviewed for roughly an hour on March 5th. The reason for conducting the interview was to gain knowledge from the operator's perspective. It provided invaluable insight to the challenges of grid congestion and possible scenarios and consequences, if left untreated. It was documented through recording, which cannot be shared by the authors due to confidentiality.

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Main actors across all three challenges (energy transition, grid congestion, energy poverty), were mapped based on knowledge gained from the qualitative media analysis, literature review and the interview. There was no further primary information production, as such the stakeholder analysis rely on existing and shared knowledge on the topic.

CHAPTER III:
THE PROBLEMS AT HAND

Figure 27: WIND TURBINE
Boekel, Near Alkmaar
Photo: Hauge, 2025

3.1
ENERGY TRANSITION

ENERGY TRANSITION:

WHAT & WHERE?

The Netherlands, as a part of the EU and therefore its Climate Law, are obliged to become carbon-neutral by 2050 (European Commission, 2025a; 2025b). This require transitioning away from fossil fuels, which in the home country of oil giants like Shell, mean great change. Due to its high population density, The Netherlands must look and weigh her options carefully to produce enough energy while not disrupting too many. As previously mentioned, a transition is a change of state to another on a fundamental level (Britannica, 2025), but also across scales. It's happening on the huge scale, like the port of Rotterdam, down to how your neighbor recently got an electric car. This again create a demand for charging said car. What's so bad about that?

The energy transition has caused nearly every aspect of society to change somewhat, and that disruption bring instability to more than just the energy production. With renewable energy sources, production will usually contain high daily or hourly fluctuations (Morales-España et al., 2021). This causes problems when the demand isn't there to consume that energy.

Climate change will force The Netherlands to adapt, but given its geography, stable sources of energy in the long-run might change. It's likely that The Netherlands will continue to rely on other countries for electricity, and that's where North-Holland comes in. It is all connected to wind park developments in the North Sea and international cable networks (TeleGeography, 2025).

It's role in the energy transition has solidified in the last years, and it's impacts on peoples' lives, with projects like the 759 MW Hollandse Kust (Noord) Wind Farm Zone (Noordzeeloket, 2023). Should wind parks be built in the landscape you grew up in? While change is necessary, it can be a rough transition for some. And with the selected community: what happens when one cannot join the transition? Will it sail away, forever to leave you behind? The transition require a substantial amount of money to happen, even on a personal level. This pose a high threat to those unable to afford it. It is estimated that every third street need to be dug up to replace between 60 000 to 80 000 km of existing cables (Rijksoverheid, 2023). This is just one example of how the energy transition will affect every neighborhood on one way or another.

The Netherlands aim to be carbon-neutral by 2050, as a part of EU's Climate Law.

European Commission, 2025b

70% of energy produced in The Netherlands must be renewable by 2030.

RVO, 2025

Offshore wind energy production in the North Sea must produce 21 GW by 2033.

Noordzeeloket, 2025

ENERGY TRANSITION:

NORTH-HOLLAND: A NATIONAL ENERGY HUB

North-Holland is perfectly located in terms of connections and international cooperation. Facing the North Sea, North-Holland is currently expanding its offshore wind parks to meet the national climate goals of 21 GW offshore wind energy generation by 2033 (Noordzeeloket, 2025). New wind parks are gradually being pushed further north and away from the shoreline. The power cables of these parks are currently clustered together towards the industrial areas near Amsterdam (see figure 28). The larger distances between producer and consumer can however cause excess power losses, potentially shifting its landing point closer to Den Helder (TenneT, 2020). This is also where base of operation is for many offshore companies are (RWE, 2024). It also coincide with the historical importance Den Helder has as a Dutch naval hub (Port of Den Helder, n.d).

North-Holland's international connection is critical for a fair distribution of benefits and burdens when it comes to renewable energy production (Rjiksoverheid, 2023). Like it is today, future cables are planned to connect with industrial clusters before anything else. For the community, can these mighty international forces push them further down on the electrical ladder? Or are these signs that the community must manage on their own? In order to find out if they can, the energy potential must be mapped.

1700 new offshore wind turbines by 2030.

(Rjiksoverheid, 2023)

WIND PARKS & SUBSEA POWER CABLES

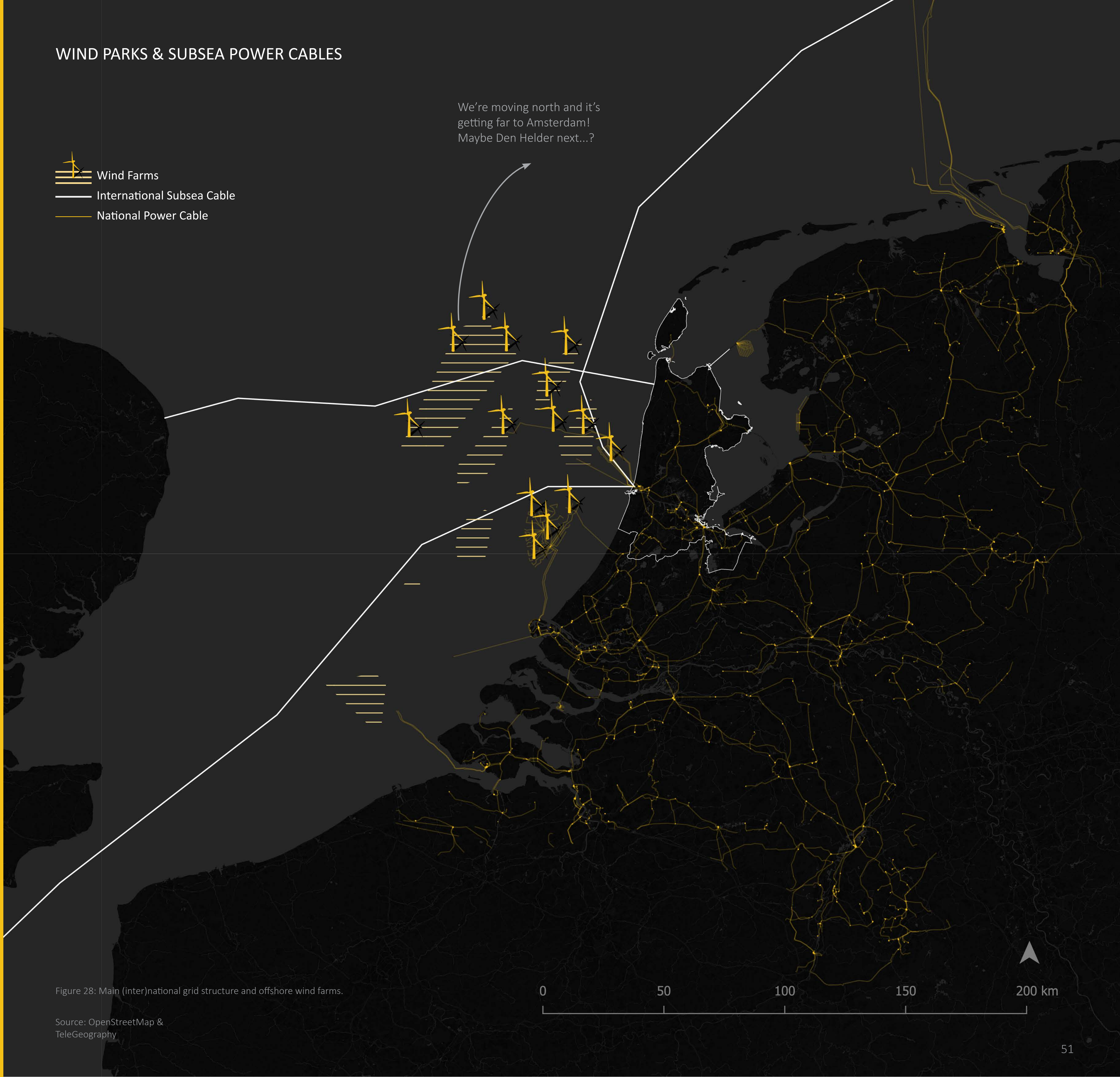


Figure 28: Main (inter)national grid structure and offshore wind farms.

Source: OpenStreetMap & TeleGeography

ENERGY IN THE LANDSCAPE

Figure 29-43: Pictures from the field trip February 17th around North-Holland showing the various forms energy production and consumption. All taken by the authors.

ENERGY TRANSITION:

GEOTHERMAL RESERVES

The greatest source for heat, geothermal reserves. Neighborhoods above geothermal hot spots are already utilising these fields for communal heating systems instead of gas. North Holland has a broad band of high potential between Alkmaar and Den Helder (see *figure 46*). The national geothermal production goal of 15 PJ, or 4 167 000 MWth, by 2030 is supporting the trend towards geothermal heating over gas (see *figure 44*) (Rijksoverheid, 2024). That amount would roughly translate to the consumption of 2,2 million households, more than North Holland's 1.4 million.

For North Holland to become self-sustained by geothermal, it would therefore require around 9.5 PJ or 2 639 000 MWth.

While the number might sound incredibly high, The Netherlands is already at just under 8 PJ with a good chance of reaching it's 15 PJ goal on time (Geothermie, 2025 & TNO, 2024). Most of this go to industries and other large consumers, as they have both the demand and purchase power to undertake geothermal projects. On the national scale it is estimated that geothermal heat can provide for 25% of the heating demand (Geothermie, 2025). For North Holland, this is arguably higher, as it lie well above the national average geothermal energy per square meter (see *figure 45*). With heating taking up 40% of the national energy demand, geothermal will play a crucial part of the energy transition (EBN, 2025). This is especially in the case of gas-dependent, low income households as it provides a stable flow of renewable energy.

Trend & National Goal

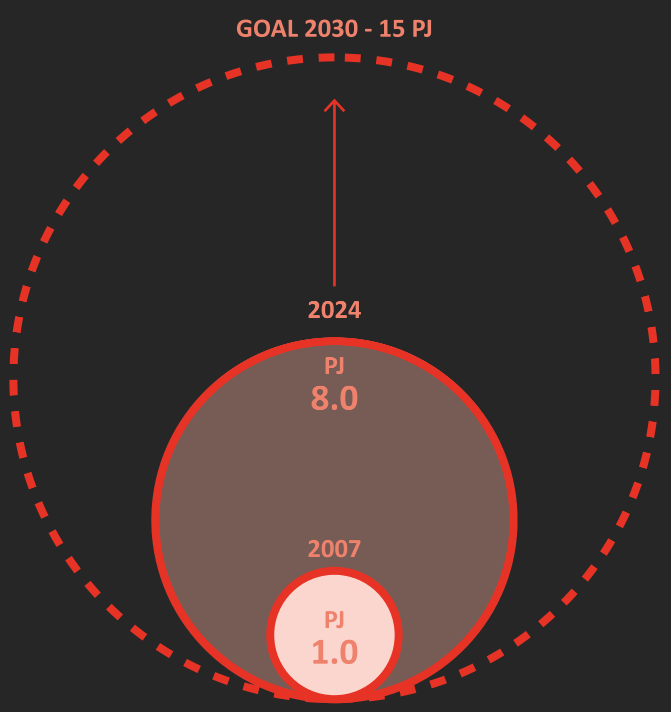


Figure 44: Geothermal output over time (CLO, 2024 & Rjiksoverheid, 2024)

Geothermal Potential Per Region

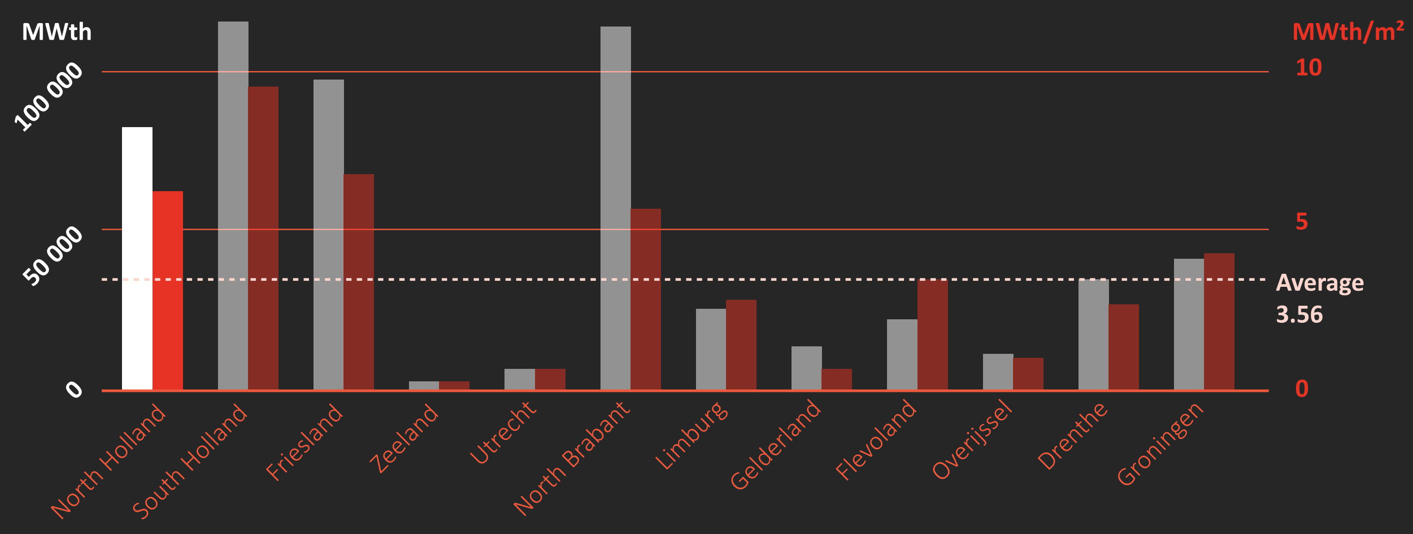


Figure 45: Distribution of geothermal energy across all 12 regions, and the average potential per square meter (Data: Warmte Atlas).

GEOTHERMAL POTENTIAL

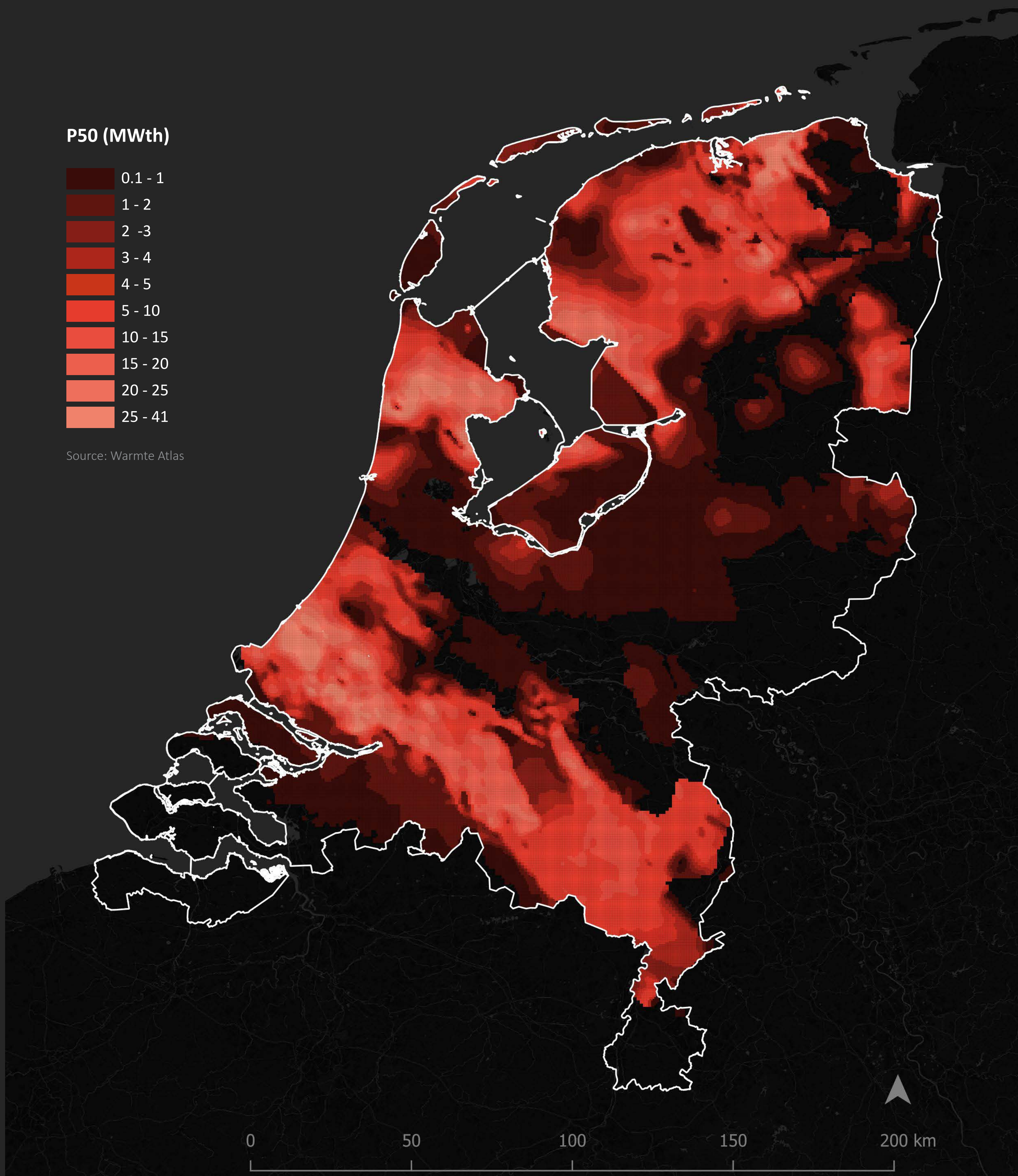


Figure 46: Geothermal potential.

SOLAR ENERGY

In the last decades, solar panels have seen a dramatic drop in prices while becoming ever-more effective (see *figure 47*). It has gone from a niche technology that only businesses or wealthy individuals could afford, to reach the middle class. In The Netherlands, expansive solar fields and subsidies have made photovoltaic, PV-, panels a common sight both in the urban and rural (see *figure 48*). As a part of the national goal of reaching 70% renewable energy production by 2030, solar is a major player to achieve that (Rijksoverheid, 2024). It's highly however highly unlikely the goal will be met by 2030 (PBL, 2024). A major cause for that is how many renewable energy sources, like solar, affects the grid. Solar will always be dependent on, that's right, the sun.

Despite being one of the sunniest provinces (see *figure 49*), North Holland as a region cannot solely rely on solar energy. Individual households can however benefit massively from its cheap electricity.

What those households need is exposure. The sun doesn't shine everywhere, especially in the cities or nearby business parks. Often this overlaps with low-income neighborhoods (Kraaijvanger, et al., 2023). The national trend is clear, solar will continue to grow for the coming years. The impendent solar inequality doesn't have to be realised for low-income communities to feel the consequences. It is happening right now with conditions they can meet. With a grid nearing its limit, there's only so much time and space before the window closes.

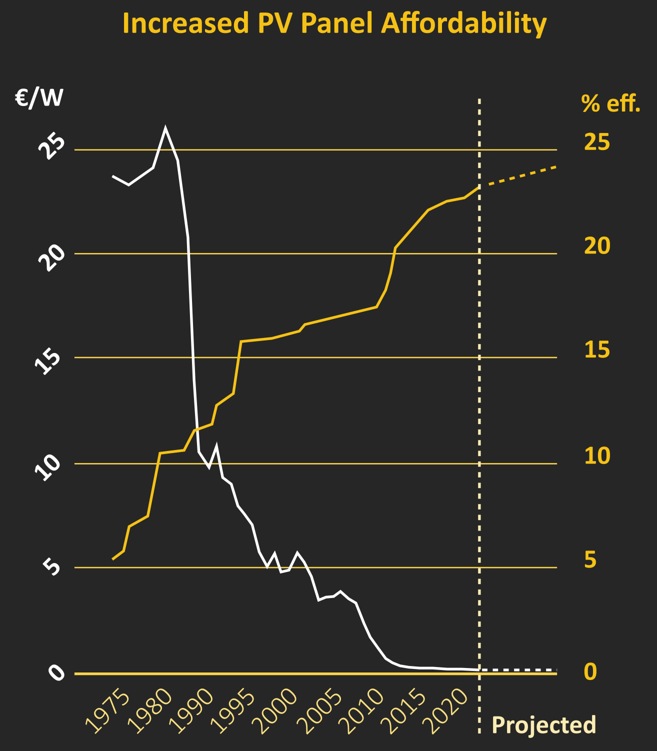


Figure 47: Prices for electricity from PV panels and the average efficiency over time (Neukom, 2016 & OurWorldinData, 2024).

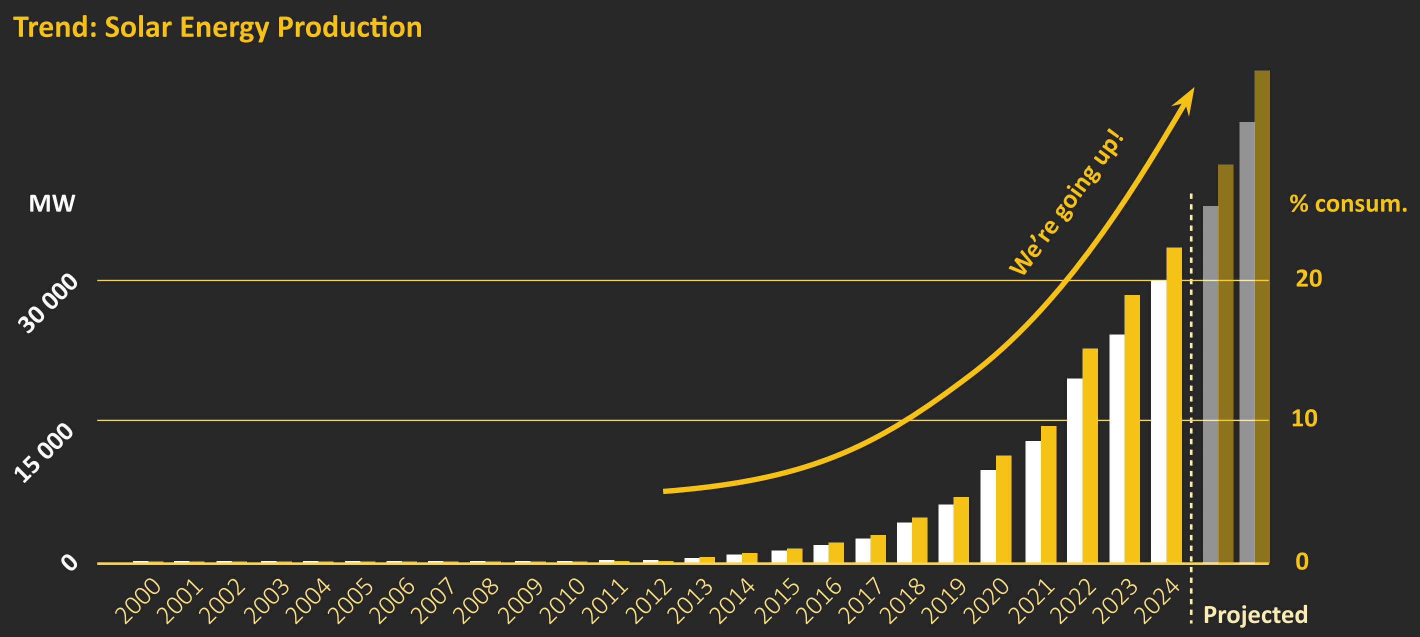


Figure 48: Solar production and share of produced energy (%) in the Netherlands (CBS, 2024a)

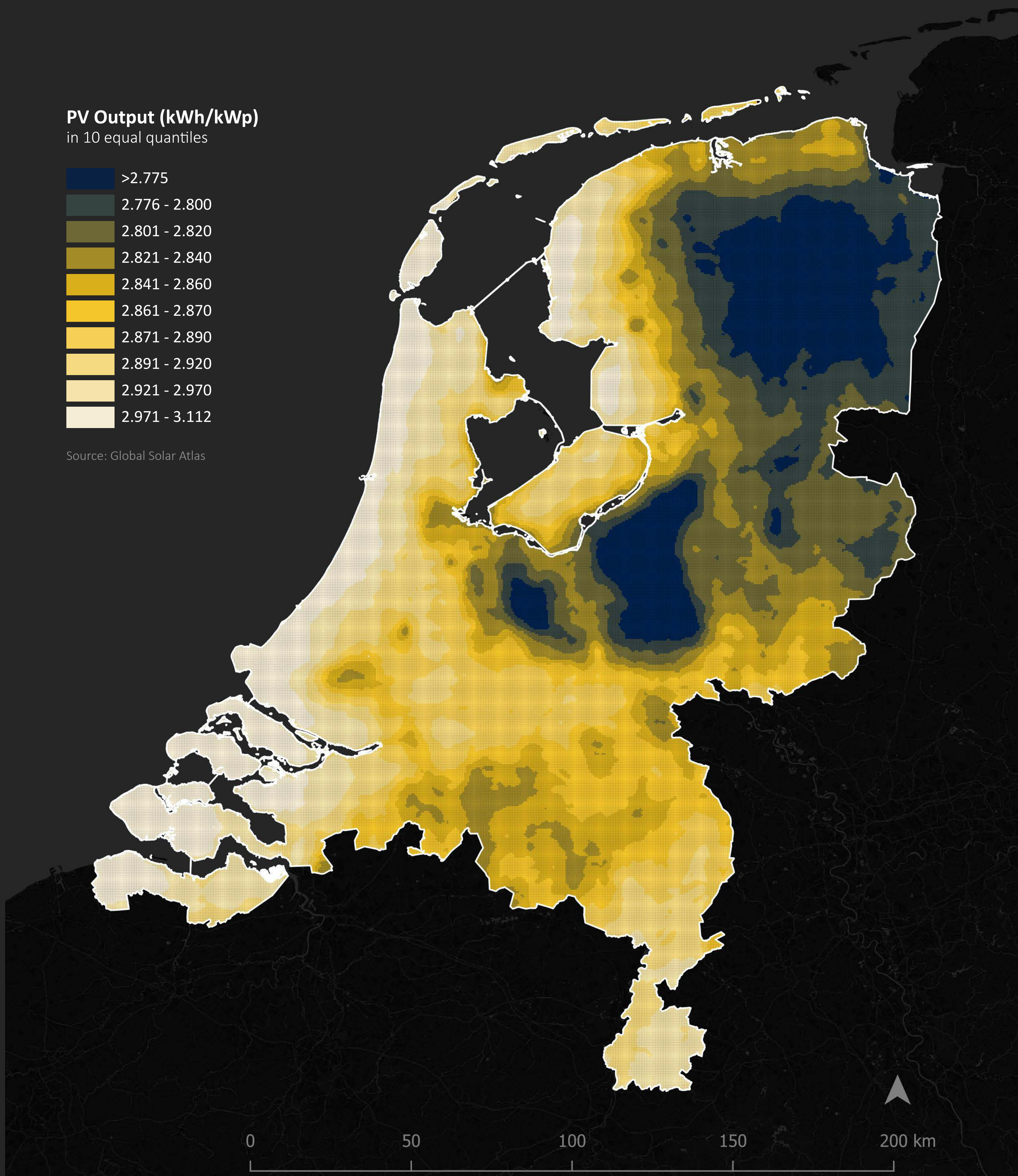


Figure 49: Solar potential.

ENERGY TRANSITION:

WIND TURBINES

With direct access to the North Sea, combined with its iconically flat landscape, The Netherlands have been able massively expand its wind parks. While initially developed inland, the last decade has seen a shift to large-scale offshore wind parks with turbine heights exceeding 200 m (RVO, 2024; CLO, 2024a). It is currently the biggest source of renewable energy, at 33.4 GW, followed closely by solar. Like solar, wind-based energy is highly dependent on the environment. No wind, no energy. The border to the North Sea is luckily within the European jet stream, ensuring a greater reliability than what other regions might experience (NASA, 2025).

North Holland have among the highest onshore wind potentials in the country (see *figure 52*), only behind Friesland and Groningen (Global Wind Atlas, n.d.).

Both Den Helder and IJmuiden serve as the hub for offshore wind parks and facilitate massive networks to handle the redistribution. Expansions and/or new wind parks in the area are under development to reach the national goal of 70 GW wind production by 2050 (see *figure 50*). With an exponential growth in energy production for every added meter to the blade size, wind turbines are gradually getting bigger (see *figure 51*). This has recently led to several projects being halted or prolonged due to local uproar. Regardless, more will be produced in the future, it's only a matter of where and which scale.

Trend & National Goal

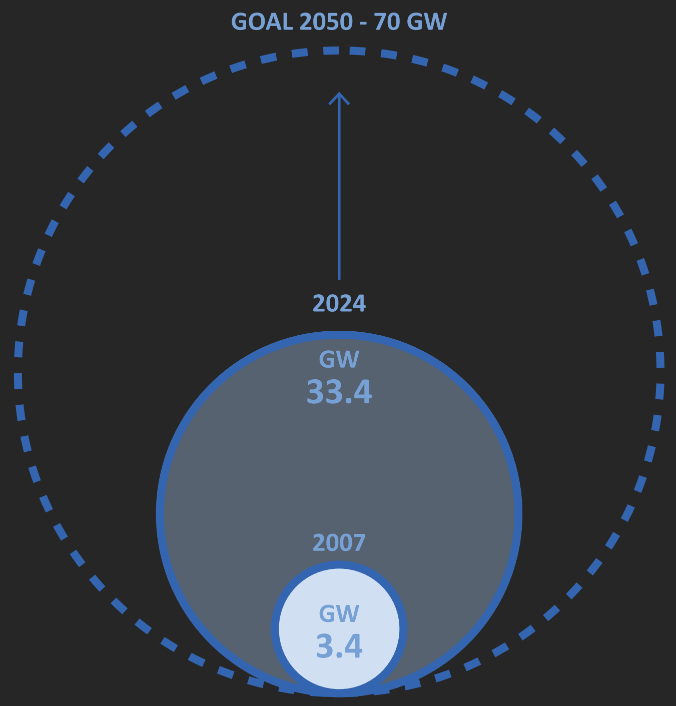


Figure 50: Developmental trends for wind energy generation since 2007 show that the national goal for 2050 can be met (CBS, 2025; RVO, 2025 & CLO, 2024a).

Wind Turbine Size (m) & Capacity (kW)

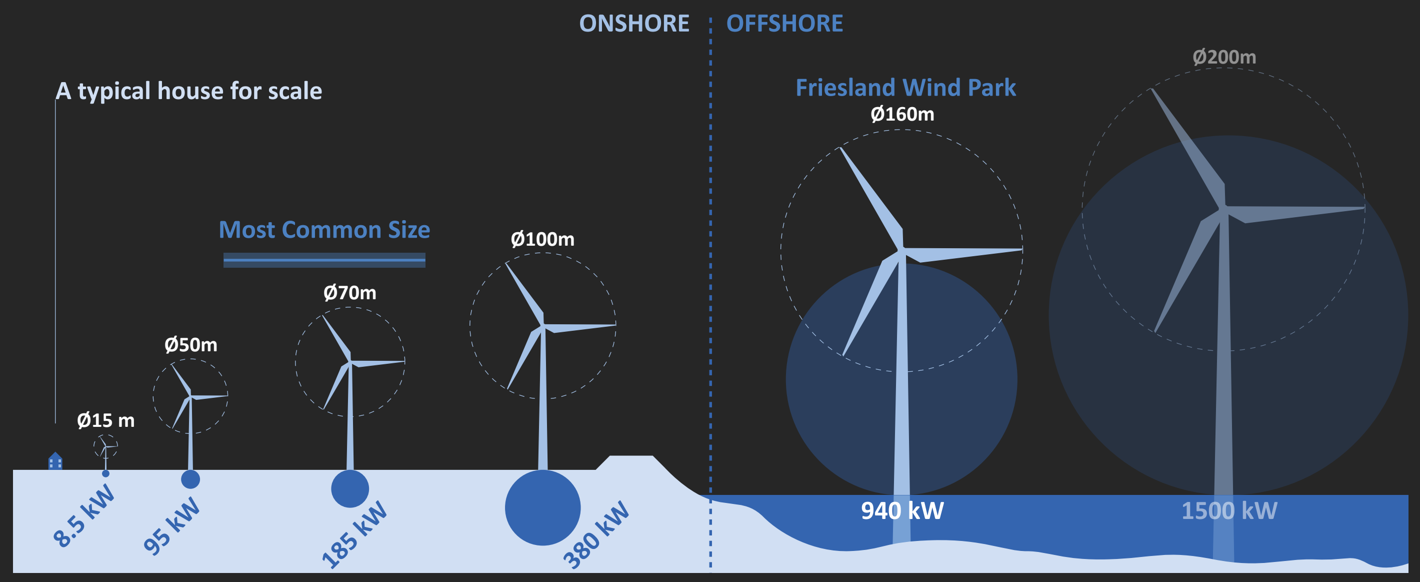


Figure 51: Capacity based on the average wind speed in North Holland at 50 m height, 6.74 m/s with a efficiency of 30%. These are rough estimations and do not take into account the varying efficiencies and wind speeds across scales or heights (CBS, 2016. Adapted with data from Global Wind Atlas).

AVERAGE ANNUAL WIND SPEED (50 M)

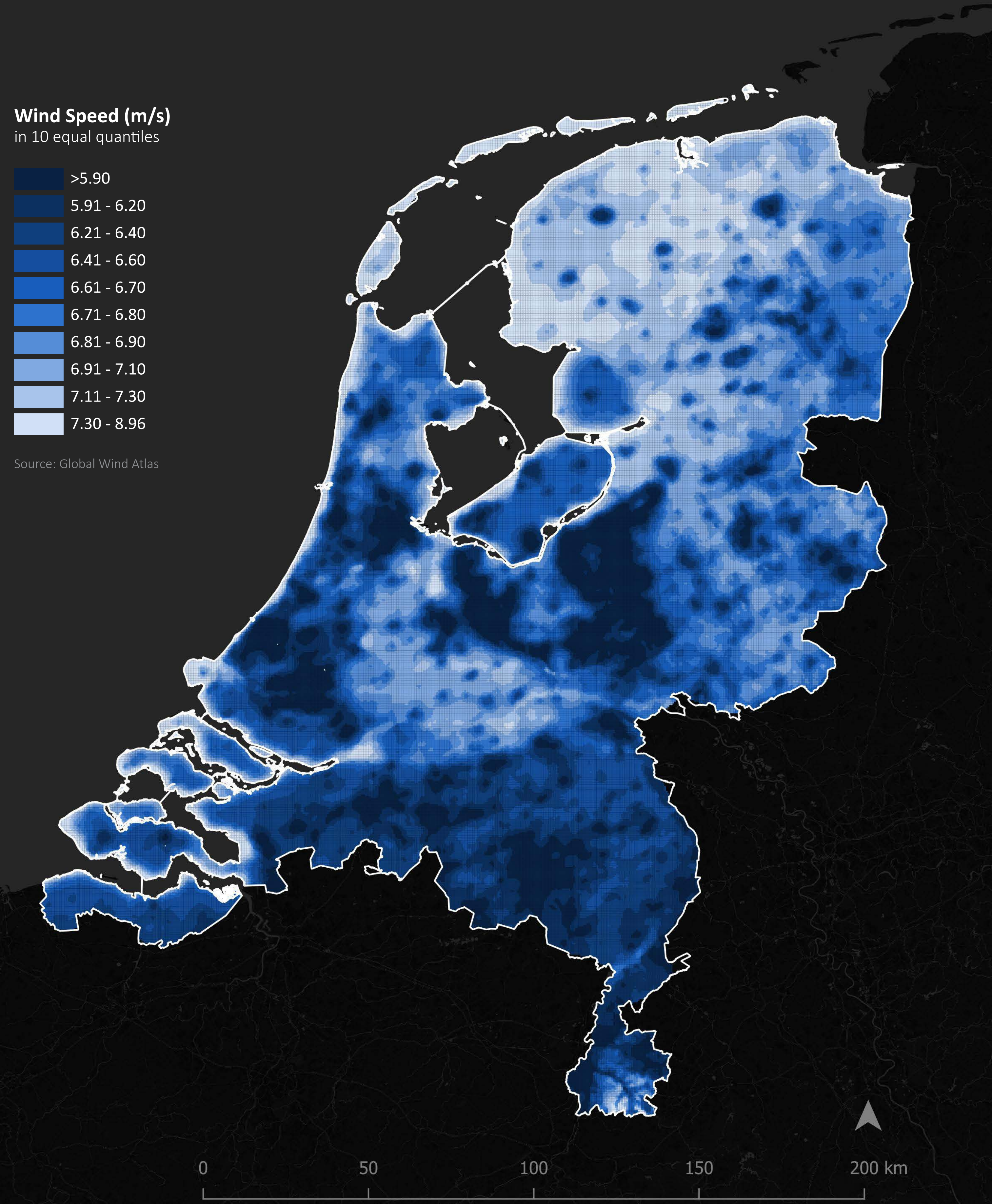


Figure 52: Wind potential.

ENERGY TRANSITION:

COMBINED POTENTIAL

The combined potential was found by combining the mean value in a given 1x1 km square with each other (see *figure 55*). It's worth to note straight away that this is not the ideal way of finding the actual combined potential. Wind will differentiate by height as with geothermal. The units which were in the datasets do not align, so expect a biased viewing (see *figure 54*). However, North-Holland is regardless located within one of the greater energy hot spots for renewables.

Geothermal remain a great player in the energy potential with its layers of depth, much like wind and its potential onshore and offshore. Due to the urban development near Amsterdam, in combination with low geothermal potential, the southern part of North-Holland would not be able to completely sustain itself locally. Residents in the northern part of North-Holland have a greater chance of so.

With all the potential both onshore and offshore, North-Holland is generally well-equipped to cover for its demand in the transition. Although the national goal of 70% renewable production might not be realised on time in 2030, there's no doubt that it will be reached eventually (see *figure 53*), and North-Holland is a critical player.

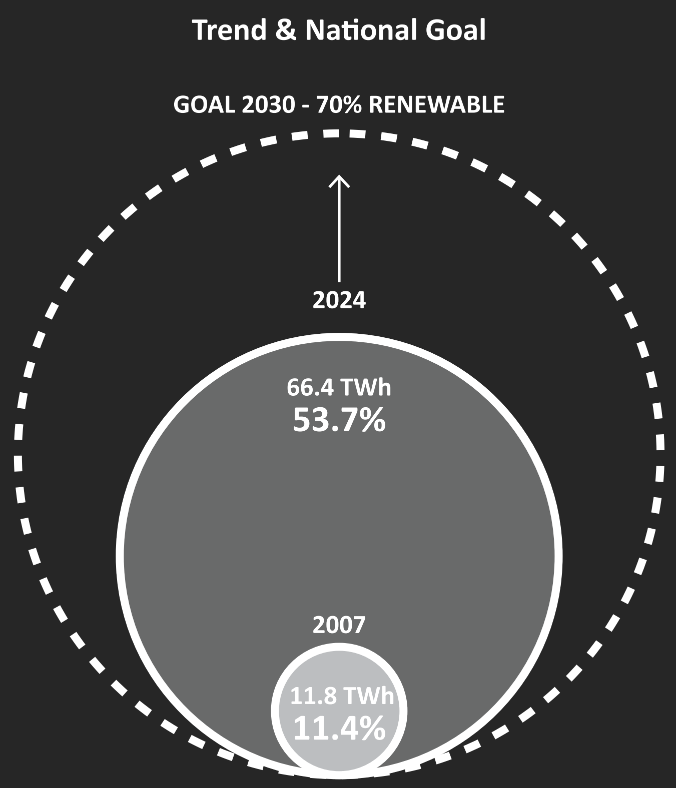


Figure 53: Following a stagnation in total energy demand in The Netherlands, renewable energy production are able to increase its share almost linearly with every new TWh produced (Ember-energy.org, 2025; RVO, 2025).

Layers of Energy & Missing Data

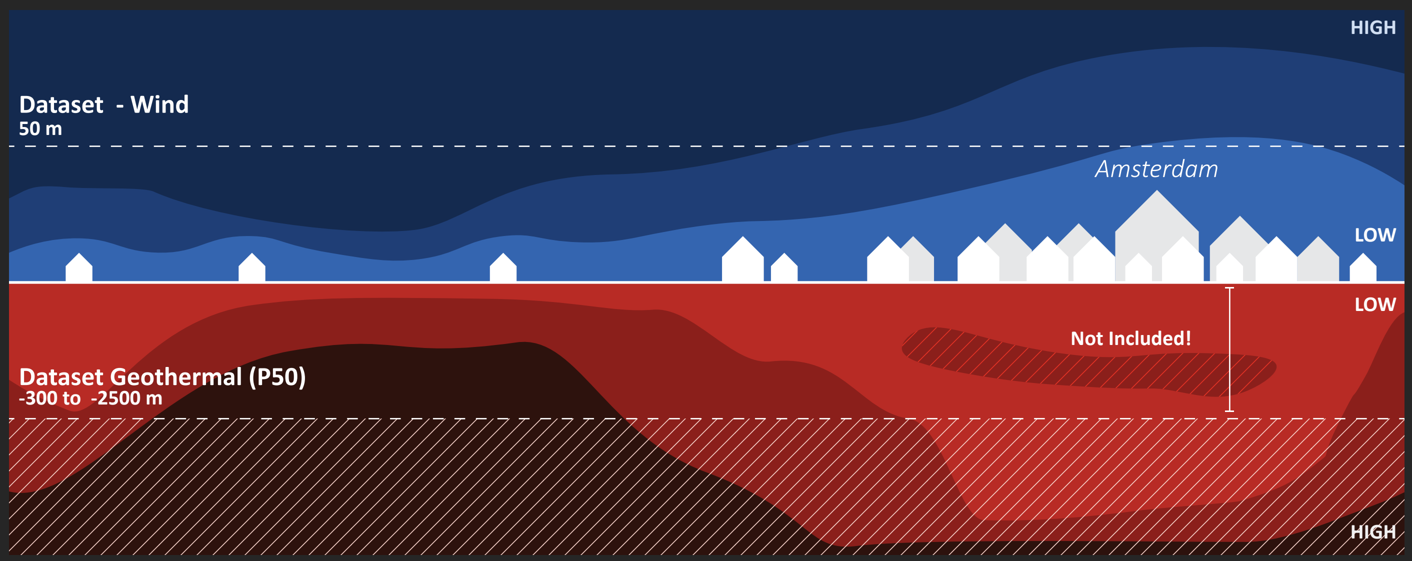


Figure 54: The authors acknowledge the missing data to make accurate mappings of the total energy potential. Above are the areas which the two most limited datasets, geothermal and wind, are based on. While Amsterdam appear as energy poor, it can still have potential in the shallower level. The authors have not managed to confirm if this is the case. Wind speed is also highly influenced by the built environment under 100 m, which can locally deviate strongly from what's presented (Di Bernardino et al., 2021).

COMBINED SELECTED ENERGY POTENTIAL

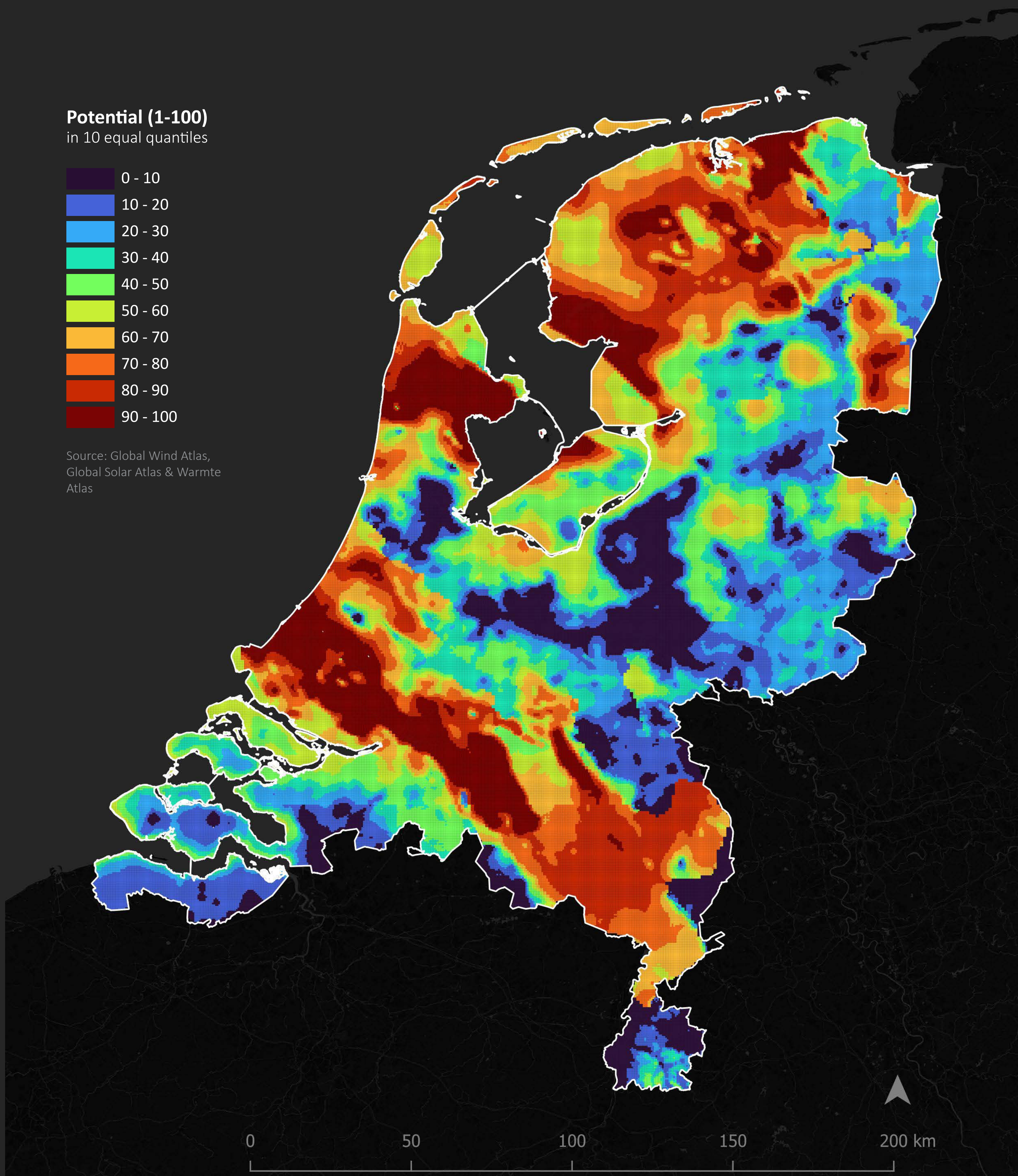


Figure 55: Combined renewable potential.

3.2
GRID CONGESTION

GRID CONGESTION:

WHAT & WHERE?

Due to the increasing electrification of households, industry and mobility, and a shortage of manpower, the Dutch electric grid is increasingly facing threats of congestion in the high- and medium-voltage network. All of that energy simply cannot be transported with the existing infrastructure, but expanding the grid is takes a lot of resources, therefore the network cannot keep up with the demand. Reports show that most regions in the Netherlands are facing grid congestion, including North-Holland, and especially its northern parts (see *figure 56* & *57*).

This mean that new housing construction and existing building improvements are being increasingly more difficult to integrate into the energy grid. While billions of investments are going into grid expansion, the supply still cannot keep up with the increasing demand. This is making it increasingly difficult for industries to electrify, households to install heat pumps and EV charging stations, therefore slowing down the energy transition (Alliander, 2023).

> [grid] congestion is the new normal.
>
> Alliander, 2023.
> *on the status of dutch grid congestion*

THE NETHERLANDS

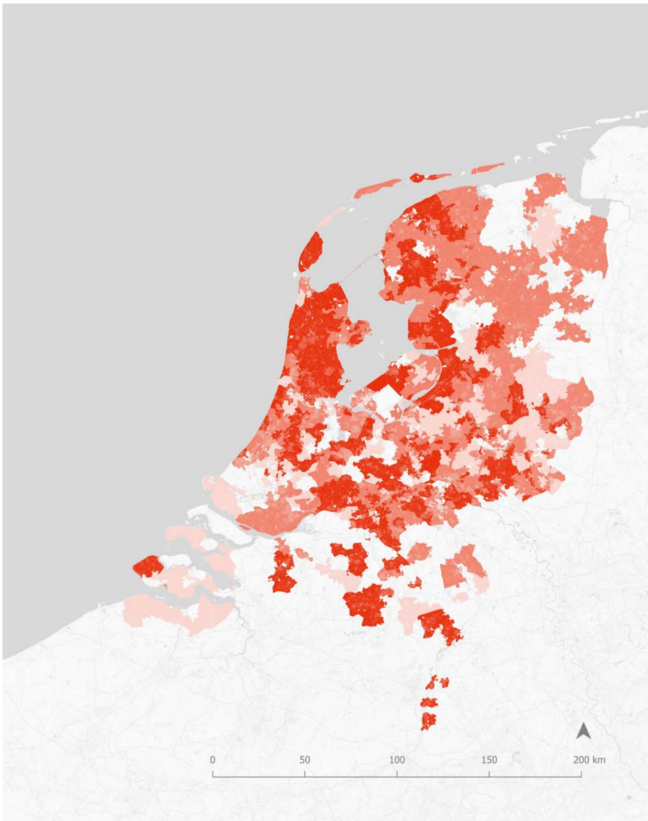


Figure 56: Grid congestion on the national level (Source: Netbeheer Nederland).

NORTH-HOLLAND

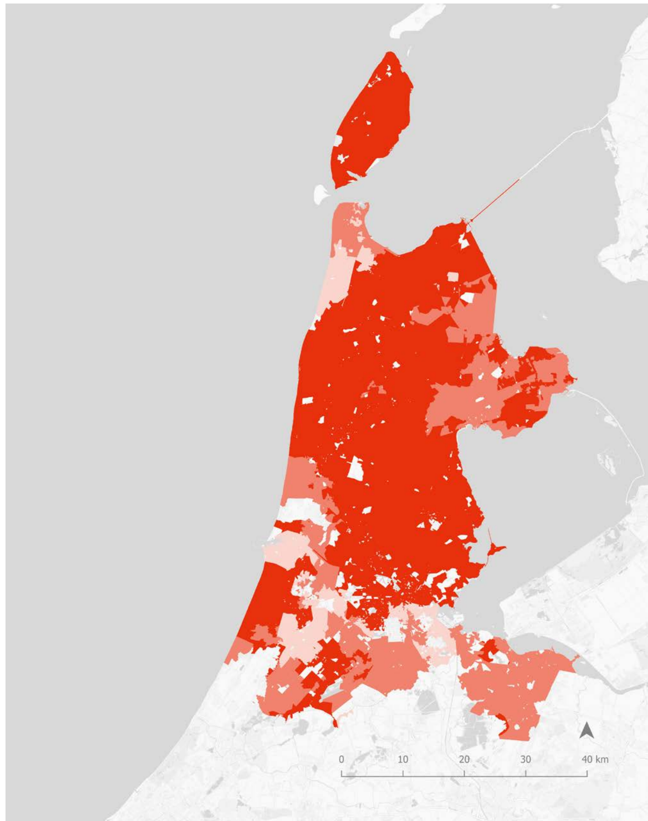


Figure 57: Grid congestion on the national level (Source: Netbeheer Nederland).

Grid Congestion
in terms of severity

- Severe congestion
- Moderate congestion
- No congestion

CURRENT CASES

In the future, it is expected that the congestion is only going to get worse, while it is already creating challenges for the energy transition as seen in *figure 58-62* (Alliander, 2023). Households and businesses are unable to connect to the grid for long times and have to resort to generators and batteries, while constructionmen have to rely on gas-powered generators.

In Nijmegen residents cannot move into newly constructed housing because there is no electricity connection, while a shopping center is using generators and battery packs.

A diesel generator is supporting power for a newly constructed residential area in Amsterdam as it waits for a connection in the grid.

In an apartment complex in Apeldoorn (De Goede Woning) new heat pumps cannot be switched on, otherwise it will create a power outage in the entire area.


12 economie

Schade voor huishoudens, bedrijven en gemeenten door

overvol stroomnet

Netbeheerders bepleiten een duur spitstarief

Figure 58: Page of Leeuwarder Courant, December 5 2023. From *Schade voor huishoudens, bedrijven en gemeenten door overvol stroomnet.* By Leeuwarder Courant, https://advance.lexis.com/document/?pdmfid=1519360&crid=54c418cc-ed29-47a5-9f63-af9ff6611d92&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A6B5G-DHG1-DYNS-J0VH-00000-00&pdcontentcomponentid=277854&pdteaserkey=sr18&pditab=allpods&ecomp=hc-yk&earg=sr18&prid=6b2f596f-d955-4b0e-b8c8-68b18ab36d3c


NIEUWS VAN DE DAG

STEKKER UIT ECONOMIE?

'WE ZIEN DAT VEEL HOOFDKANTOREN NADRUKKELIJK KIJKEN NAAR OPTIES BUITEN EUROPA'

Figure 59: Page of De Telegraaf, January 22 2024. From *Steeker Uit Economie,* by De Telegraaf (https://advance.lexis.com/document/?pdmfid=1519360&crid=0976c1e3-a894-4287-8628-d1970b23945c&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A6B58-7851-DY4D-Y00C-00000-00&pdcontentcomponentid=168873&pdteaserkey=sr26&pditab=allpods&ecomp=hc-yk&earg=sr26&prid=ee8a5594-8d4b-4ef8-83f7-1a67842db79d)

Businesses cannot get new or additional connections, while multi-national companies are moving their production out of the Netherlands due to the grid congestion.

Households need to wait months for their connections. Sometimes no new connections can be made for 10 years.

28,000 new technicians are needed to aid the alleviation of grid congestion and expand heat pump construction.


Stroomkabel gaat als 'reuzenmol' door weilanden

Een zware kabel gaat ondergronds van De Weel naar Sint Maarten.

Figure 60: Power cable runs like a 'giant mole' through meadows. Page of Noordhollands Dagblad, December 5 2023 From https://advance.lexis.com/document/?pdmfid=1519360&crid=0d348318-7c25-4cbb-9540-f40a8d8c748a&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A69T1-SWK1-JBNC-74TF-00000-00&pdcontentcomponentid=311971&pdteaserkey=sr0&pditab=allpods&ecomp=hc-yk&earg=sr0&prid=9111948f-11a6-454c-a7e7-6b334ca9a25b&cbc=0

Constructionmen working on new underground cable connections could not receive energy supply in their temporary housing complex for foreign workers, instead they had to improvise and now have their own energy production.

Households, businesses, and social facilities are being placed on waitlists for new connections.

Around 500 private households need to wait for a new power connection in North-Holland.

Households that want to install heat pumps, solar panels or EV charging stations in some areas have to wait up to 40 or even 70 weeks.

"Private individuals also in line for electricity; report Traffic jams on the electricity grid do not only affect the business community"

IJmuider Courant, 2024.


REPORTAGE Filevorming op het elektriciteitsnet treft niet alleen het bedrijfsleven

Ook particulier in de rij voor stroom

Kopers kunnen in problemen raken als oude huis is verkocht

Nieuwe transformator van Alliander in Haarlem.

Figure 61: Page of IJmuider Courant, November 15 2024. From *Ook particulier in de rij voor stroom.* By IJmuider Courant, https://advance.lexis.com/document/?pdmfid=1519360&crid=eff478b5-8eb4-44b0-8afb-473b5c647ddb&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A6DDT-TSR1-JBNC-710J-00000-00&pdcontentcomponentid=311974&pdteaserkey=sr28&pditab=allpods&ecomp=hc-yk&earg=sr28&prid=b0945331-bb20-4d8c-a975-838b43122e75&cbc=0

Large businesses have been struggling with the grid congestion problem, but this can later reach residents and small-consumers.


Regio 5

ONDERWIJS Schoolgebouw kan niet op stroomnet en gaat op accu draaien

Vroonermeerschool nog duurder

Als we het anders hadden kunnen oplossen, hadden we dat wel gedaan

Figure 62: Page of Noordhollands Dagblad, January 19 2024. From *Vroonermeerschool nok duurder.* By Noordhollands Dagblad, 2024). https://advance.lexis.com/document/?pdmfid=1519360&crid=e2694e5c-4e57-42b3-a357-307cfaea74db&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A6B4M-GB31-JBNC-700J-00000-00&pdcontentcomponentid=311971&pdteaserkey=sr1&pditab=allpods&ecomp=hc-yk&earg=sr1&prid=9111948f-11a6-454c-a7e7-6b334ca9a25b

A school in Vroonermeer cannot connect to the grid for power. Instead it has to rent a battery for 7,500 euros per month. The battery charges at night, when energy demand is low.

"Vroonermeerschool even more expensive; [when the] School buildings cannot run on main power and have to run on batteries.

Noordhollands Dagblad, 2024.

GRID CONGESTION:

GRID FLOW & MANAGEMENT

The grid congestion problem can be compared to that of a car traffic jam. Cars are travelling long distances to get from their origin to their destination; therefore they need to use the highway. During peak hours, there are so many cars that traffic jams occur. If this happens, the roads will be paralysed, and the cars will not be able to move from their origin to their destination (see *figure 63*).

Accordingly, during peak hours of consumption and production, large amounts of electricity need to travel from one place to another. This creates pressure on the high- and medium-voltage network, and if a certain threshold is reached, a power outage may occur.

Currently, the grid congestion mostly affects the high- and medium-voltage lines, and it is already causing all sorts of problems, as seen on the previous page. In the future, it is expected that the grid congestion problem will increasingly affect the low-voltage network.

HOW IS GRID CONGESTION CURRENTLY MANAGED?

Requesting customers to reduce load

Energy suppliers are doing everything in their power to avoid this from happening. As short-term measures, it has become standard practice to call solar field owners to ask to switch off the energy production during peak hours (expert interview with De Winkel, 2025; see also page 70). In addition, residents are encouraged to change their habits to reduce energy consumption during peak hours (Sneekes, 2025).

Waitlisting

Requested new connections are waitlisted and have long waiting times until more space on the grid is available. Some households have to wait as long as 40 to 70 weeks (IJmuider Courant, 2024). The waiting times are so long because grid operators prioritise quality and consistency for customers who are already connected, rather than connecting the 10 thousand applicants waitlisted in The Netherlands. Social facilities (e.g. schools and hospitals) and households are prioritised in this waiting list. However, the waitlist itself creates distributive injustice, as having a connection to the grid is becoming a privilege (De Winkel, 2025).

Smart grid management

Dynamic pricing is increasingly being implemented to manage uneven supply and demand during peak hours. While this management solution can certainly reduce the pressure on grid congestion, it has some challenges of its own. Grid operators are increasingly depending on IT companies for these management solutions, which makes the management procedures have a closed system with limited transparency. This means that management decisions can be inconsistent and unjust, while accountability for these decisions is avoided. Dynamic pricing also create many challenges for households with solar panels which do not have their own battery storage, and thus have to sell their energy to the grid during off-peak hours and buy it back during peak hours. This creates a system which financially benefits large and high-consuming companies and disadvantages households producing renewable energy (De Winkel, 2025).

A CONGESTED GRID

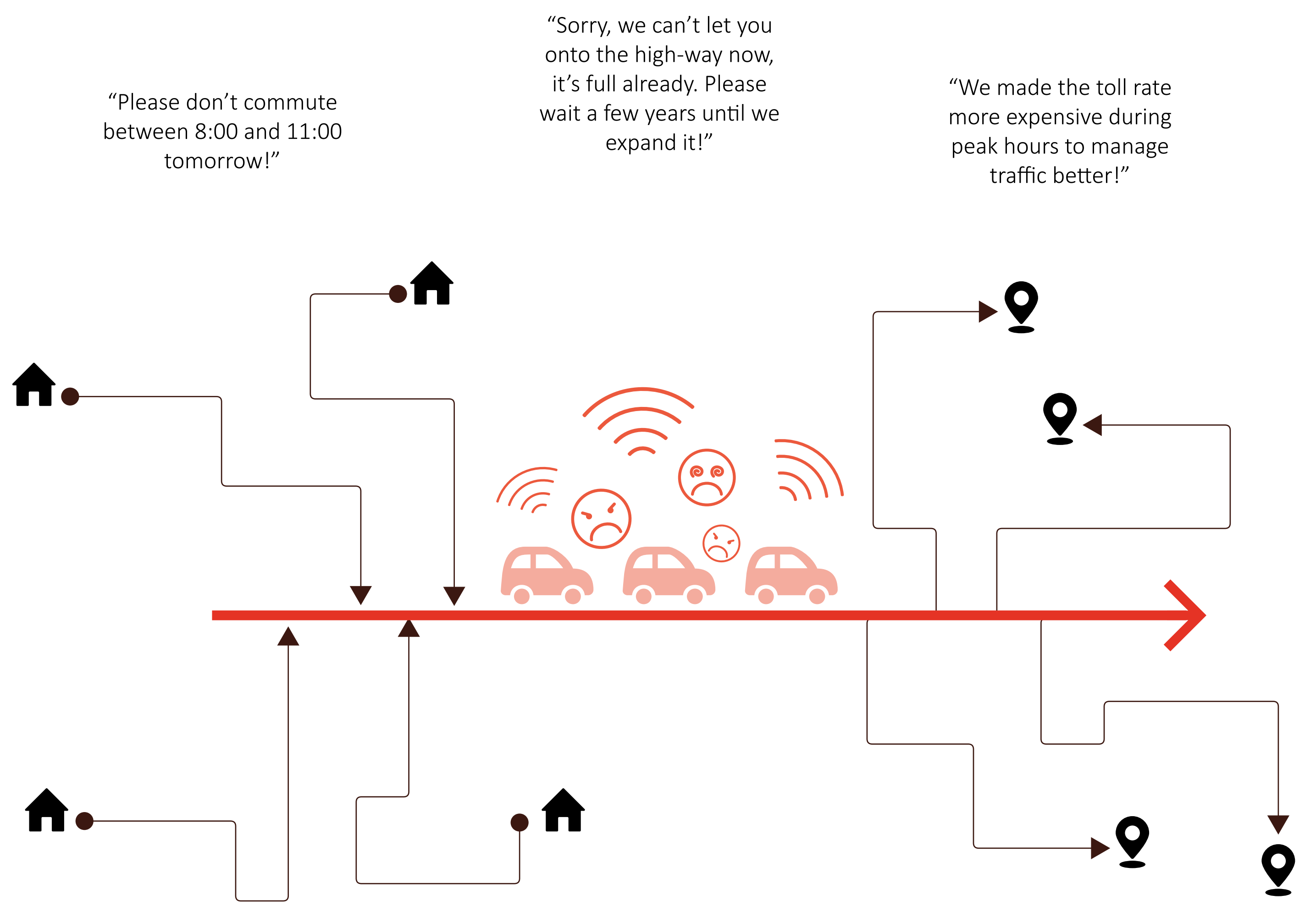


Figure 63: A highway metaphor for the grid congestion. With too many access points and travelers, and too low capacity, traffic jams will occur.

GRID CONGESTION:

KEY CHALLENGES

Some challenges have already been introduced, though there are three main ones.

Shortage of Resources

Grid expansion is highly resource-intensive, and even with large investments it faces a shortage of technical experts, space and funding (De Winkel, 2025). In 2024, 8.4 billion Euros of investments went into grid infrastructure in The Netherlands (Netbeheer Nederland, 2025). However, an estimated 200 billion Euros are needed to solve the grid congestion (NOS Nieuws, 2025). That is more than 50 times the investment in 2022. Grid operators and installation companies say that there are already 60 thousand vacancies in the field, and these spots are hard to fill (Leeuwarder Courant, 2024). In the future it is estimated that the energy transition will require another 15 thousand jobs to be filled (Noordhollands Dagblad, 2024b).

First Come, First Serve

Right up until grid congestion occurs, grid operators follow the rule of first come, first serve. This benefits large companies which have more resources and knowledge. They have the capability to reserve spots on the grid years in advance. This leaves smaller stakeholders such as households or small businesses at a disadvantage, they do not have such resources and knowledge to secure spots on the grid in advance (De Winkel, 2025). This is the case with, for example, large data centers in Noord-Holland (Telegraaf, 2022). This policy that grid operators are currently implementing fails to foresee grid congestion issues and prioritize the community, rather than large businesses.

Resistance to new construction

Plans for the expansion of the high-voltage line are already moving. For example, in Noord-Holland, a new 380 KV cable route will be implemented, and finding the right route is challenging due to diverse stakeholder interests (see *figure 65*). Local residents resist new construction plans due to concerns about magnetic fields, health, wildlife, and visual pollution (see *figure 64*) (Noordhollands Dagblad, 2024c). For example, in Julianadorp in Noord-Holland, 863 objections have been submitted against the construction of new high-voltage lines to be connected to off-shore wind farms. People express concerns about the negative consequences of high-voltage lines for meadow wildlife and landscape quality (Noordhollands Dagblad, 2024d). In Middenmeer, residents also protested the high-voltage line construction, claiming that the decision was reached in an undemocratic manner.

Nearly 200 billion euros needed for problems on the power grid

NOS Nieuws, 2025

> "Why can't a supermarket be built because there is no capacity on the power grid, but a data center can?"

Vastenhouw for Telegraaf, 2022

Figure 64: Residents protesting against high-voltage line in Middenmeer. From *Protest at evening at TenneT* by Noordhollands Dagblad,

https://advance.lexis.com/document/?pdmfid=1519360&crid=ad60fceb-0d0f-4dc9-ae2d-94cf9ebbd8b0&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A68HD-PVD1-DY4D-Y1WM-00000-00&pdcontentcomponentid=311971&pdteaserkey=sr0&pditab=allpods&ecomp=hc-yk&earg=sr0&prid=296cadad-b2e1-4595-b79e-9f5dc41fde3b#

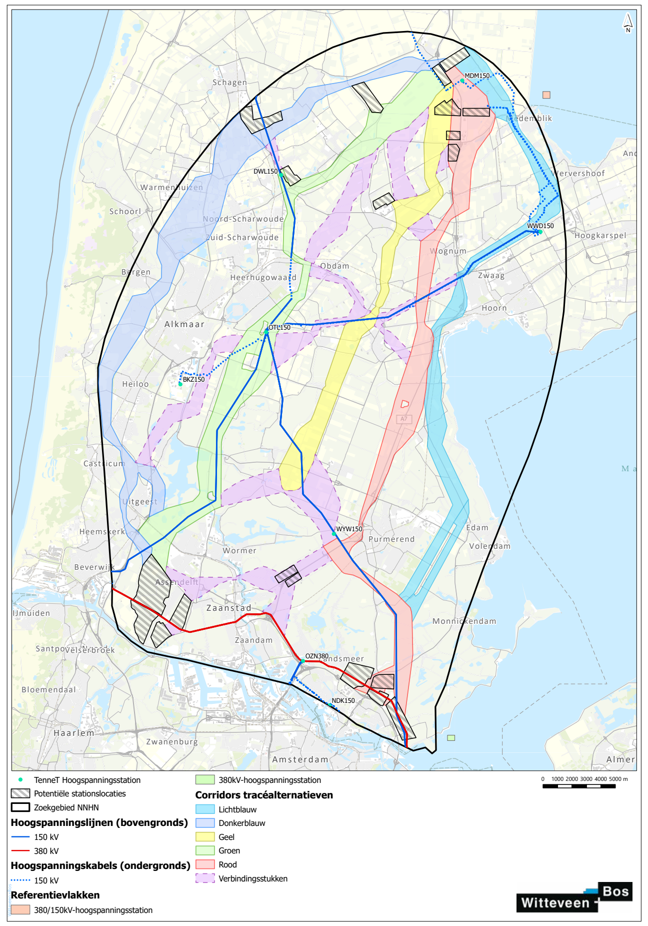


Figure 65: Research alternatives 380 kV grid extension. From *380 kV-Netuitbreiding Noord-Holland Noord.* by TenneT & Witteveen-bos, https://www.rvo.nl/sites/default/files/2024-10/Notitie-onderzoeksalternatieven-380-kV-Netuitbreiding-Noord-Holland-Noord.pdf

GRID CONGESTION:

JUSTICE ON THE GRID

Adapting to Limited Grid Capacity: Perceptions of Injustice Emerging from Grid Congestion in the Netherlands (De Winkel et al., 2025) provide an overview of key challenges emerging from the grid congestion in The Netherlands. As renewable energy adoption continue to grow, grid congestion is leading to long waiting times for new or expanded connections. To address this, operators are exploring ways to balance electricity supply and demand. As grid capacity becomes scarce, questions about fair allocation and energy justice arise (de Winkel et al., 2025).

The mentioned article examine these issues, focusing on the distributive and procedural injustices experienced by over 10,000 applicants facing delays. To gain a deeper understanding, Eva de Winkel was interviewed. De Winkel is a PhD researcher in TU Delft specializing in the responsible development, implementation, and assessment of artificial intelligence algorithms aimed at enhancing flexibility in electrical distribution networks. Her research is conducted within the AI for Energy Grids lab, in collaboration with Alliander, a major distribution system operator in the Netherlands (TU Delft, 2025).

Alliander operates extensively in the North Holland region, including Amsterdam, and employs around 10,000 people. Currently, a significant portion—approximately 9,000—are focused on addressing the issue of grid congestion, one of the company's most pressing challenges.

The interview revealed that grid operators are under increasing pressure as demand on the network grows. However, top-down guidance remains insufficient, leaving operators uncertain about how to prioritize sectors, such as housing, in grid capacity allocation. As government-driven entities, they feel decision-making responsibility lies with policy and regulation, not with them. Municipalities are working closely with operators to address these challenges, but the current regulatory framework no longer aligns with the realities of grid congestion. This lack of clear direction makes it difficult for operators to implement the necessary actions to manage the growing strain on the grid.

The interview also highlighted several constraints faced by grid operators in addressing grid congestion. Although operators are eager to help and want to and tackle the issue, they are constrained by three key factors: the legal framework they must operate within, insufficient financial resources, and a lack of personnel.

Furthermore, De Winkel emphasized the growing importance of municipalities in addressing grid congestion. She questioned whether it is necessary to manage grid congestion solely at the national level, proposing an approach that includes local solutions and calls for more investment in these approaches. However, local solutions introduce complexities, as each project is unique, requiring additional time and manpower—resources that grid operators currently lack. While local solutions hold promise, they complicate the process of integrating projects into the grid network.

De Winkel also discussed possible solutions for balancing local and national approaches to grid congestion. On one hand, local energy solutions could optimize the use of the grid, but completely moving away from a national framework is not feasible. Some suggest creating a single national energy distribution entity, similar to Rijkswaterstaat, to replace the current model of three competing grid operators. This could streamline efficiency and improve coordination for local solutions. However, not everyone agrees with this structural change. Some argue that the priority should be the rapid expansion of grid infrastructure to meet the urgent demands of the energy transition, delaying any restructuring. Another key concern is ensuring inclusivity in the energy transition, ensuring that all individuals, not just those with financial or technical means, can participate in the shift to more sustainable energy solutions.

> "[the grid operators] are willing to help out on local solutions, but lack sufficient funding, manpower and time."
>
> Eva de Winkel, 2025
> *on existing limitations of grid operators in the energy transition*

DECENTRALISED NETWORKS

To lessen the pressure on the main 'highways' of the grid

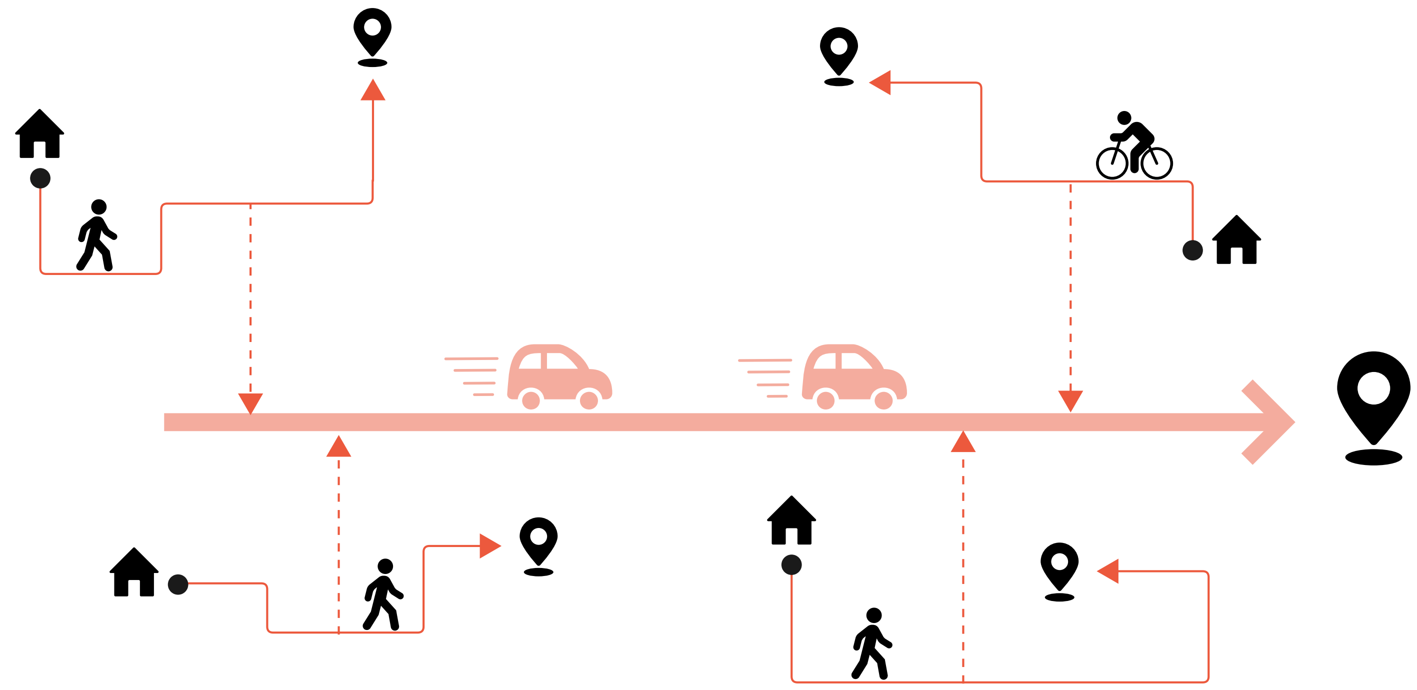


Figure 66: The grid as a streets, where the cars on the highway can move freely as other, local options are implemented.

In conclusion, grid operators are clearly motivated to tackle the growing issue of grid congestion, but they face significant barriers in their efforts to implement effective solutions. The lack of adequate manpower, insufficient financial resources, and the absence of a supportive structure with clear, actionable guidelines are hindering progress. While operators recognize the importance of balancing local and national solutions to optimize grid capacity, the current regulatory framework fails to provide the necessary direction.

As the energy transition continues to accelerate, it is crucial for both national and local authorities to collaborate with grid operators, providing the resources and clarity needed to navigate the complexities of grid congestion. Only through a more coordinated approach, with adequate support and investment, can grid operators effectively manage the increasing demands on the grid and ensure a fair and efficient distribution of energy in the future.

GRID CONGESTION:

OVERVIEW

Due to the increasing electrification of the industry, mobility and households, the grid is facing more and more pressure. In many parts of the country, the grid can no longer cope with the supply and demand of electricity, resulting in grid congestion. Currently mostly the high- and medium-voltage grids are congested, mainly affecting medium to large consumers (i.e. industries, businesses and social services). In the future it is expected that grid congestion will reach the low-voltage grid and directly affect households across the country (*figure 67*).

Various mitigation measures are being implemented to cope with the grid congestion, such as requesting large grid users to reduce their consumption/production during peak hours, waitlisting new customers who need to connect to the grid, and implementing dynamic pricing. These are, however, only short-term solutions and they create many challenges when it comes to procedural and distributive justice.

An important part of the solution to the grid congestion is to invest in the expansion of its infrastructure. However, a shortage of manpower, finance and space, as well as resistance from local residents against new energy infrastructure, is making it difficult to expand the grid. In addition, the first come, first serve policy that grid operators are currently implementing fails to foresee grid congestion issues and prioritize the community, rather than large businesses.

Grid operators recognize that local solutions are important to solve the grid congestion challenge. However, local solutions are more time-consuming, expensive and require more manpower, resources which grid operators are facing a shortage of already. Grid operators are under pressure to act fast due to the congestion challenge, therefore local solutions are incredibly difficult to implement, but a purely national operation cannot solve the grid congestion alone. Therefore, a possibility of balancing local, regional and national solutions may be the best option.

It is clear that grid congestion is a key question that needs to be addressed in the Dutch energy transition. A hybrid approach which develops both local, provincial and national solutions may be the best way to move forward and solve this issue.

This approach is similar to the way traffic jams in highways can be reduced. By reducing the distance of trips and focusing on local mobility, the load on the highways can be reduced (see *figure 65*).

THE GRID & IT'S CHALLENGES

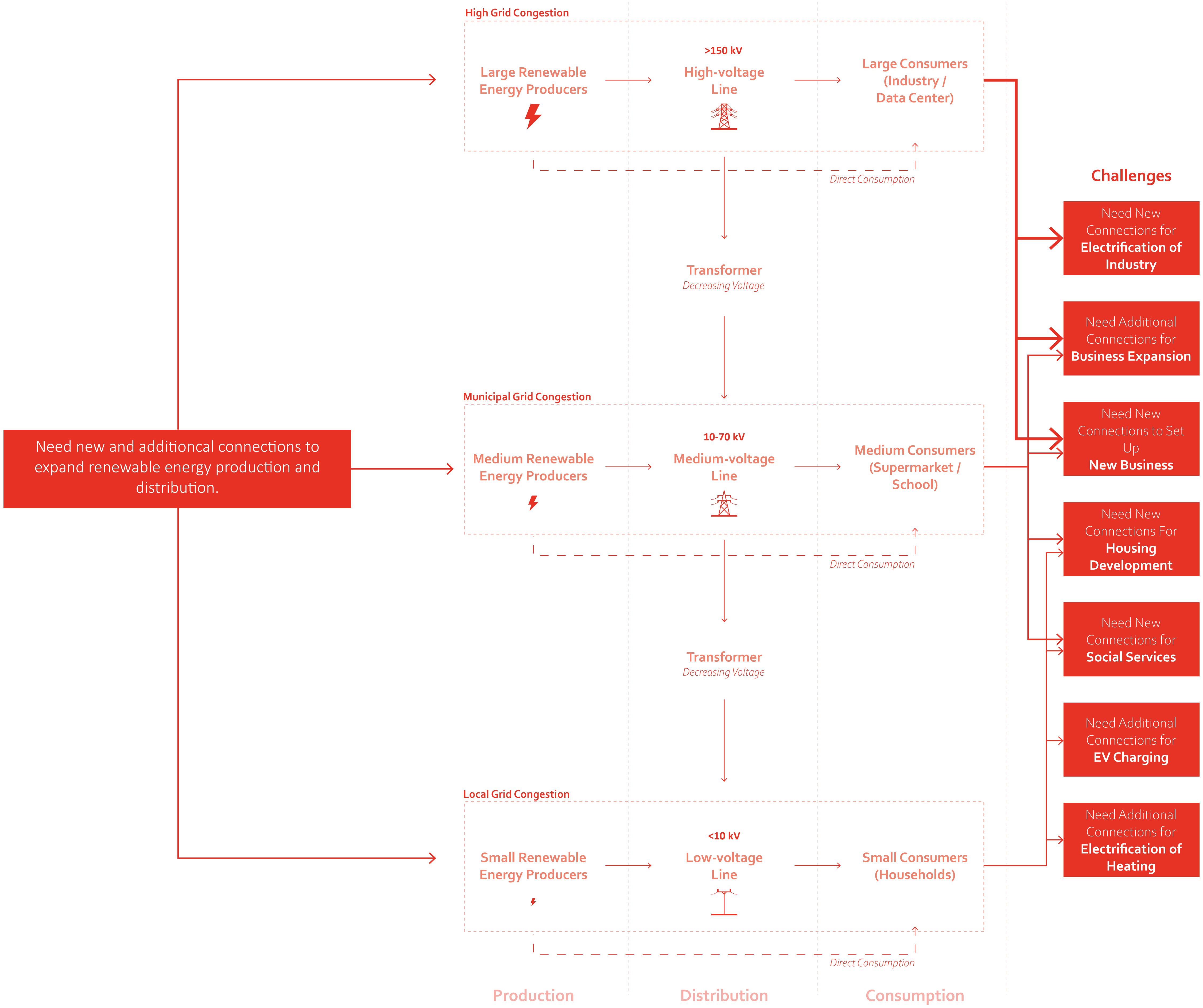


Figure 67: The grid structure and all its challenges in terms of connections and production.

3.3
ENERGY POVERTY

GRID CONGESTION:

WHAT & WHERE?

When discussing energy poverty, it refers to people with low incomes living in homes with poor energy performance, which leads to high energy costs. TNO (the Netherlands Organisation for Applied Scientific Research) defines energy poverty based on three factors: 1) the affordability of energy, 2) the energy quality of the home, and 3) the ability to invest in improving that quality (TNO et al., 2024). Energy poverty rates in the Netherlands are relatively low: in 2023, approximately 5% of households were affected (see *figure 68 & 69*). However, many households rely on government support to avoid falling into energy poverty. Thanks to measures such as the price cap and the energy allowance, more than 5% of the population was able to avoid energy poverty in 2023.

Although this is an important step forward, it only provides temporary relief for a structural problem that many people cannot solve on their own. In other words, subsidies do not address the root of the problem but rather serve as a short-term solution. In Noord-Holland, an estimated 68,000 households experienced energy poverty in 2023. Without the subsidies, this number would have risen to approximately 135,000 households (Batenburg, 2023).

Energy Poverty
by low income, high power bill, low energy rated building

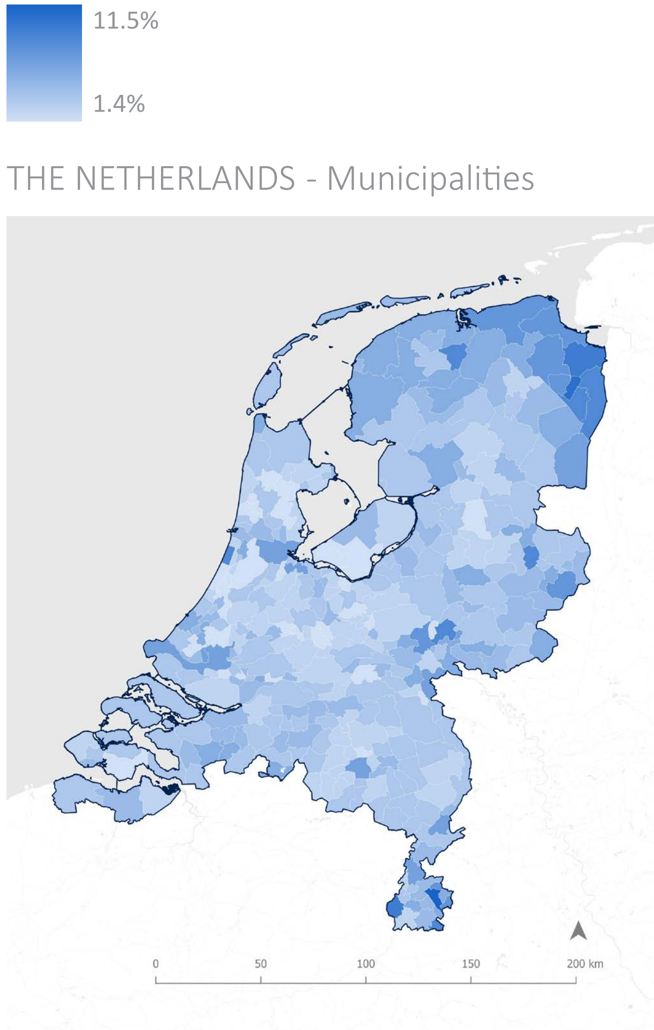


Figure 68: Energy poverty in percentage per municipality (Source: CBS, 2022).

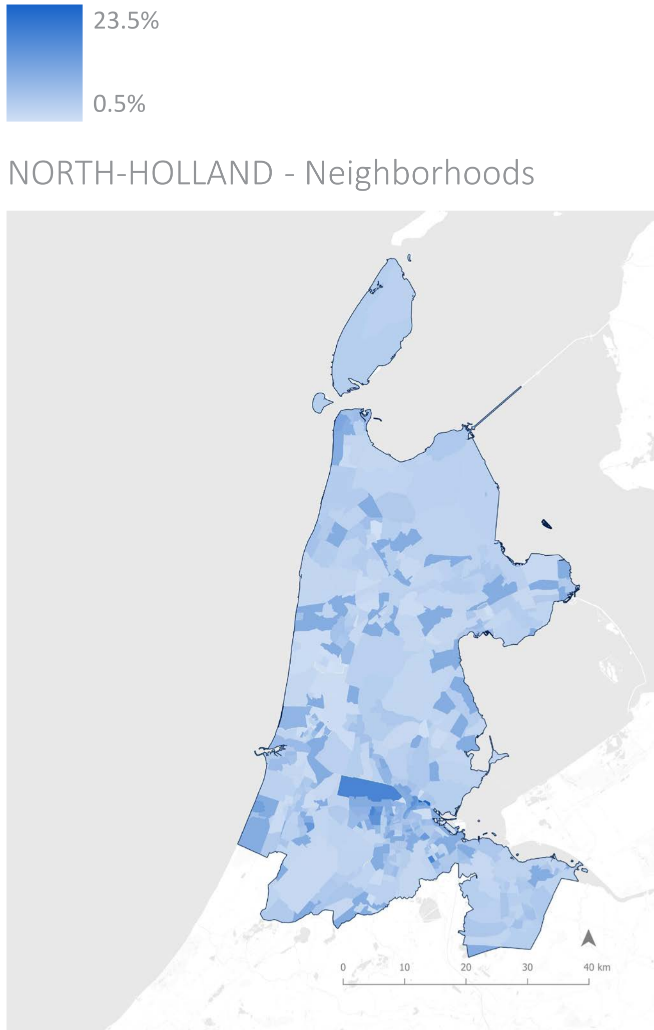


Figure 69: Energy poverty in percentage per neighborhood/wijk (Source: CBS, 2022).

ENERGY POVERTY:

NORTH-HOLLAND

A striking example mentioned in the TNO report on Energy Poverty and the Energy Transition is that everyone must eventually move away from natural gas and switch to electric heating options, such as heat pumps. However, these sustainable energy technologies are still not part of many people's vocabulary, which means that the necessity of this transition is often not quickly recognized.

Unequal access to sustainable technologies increases social inequality in several ways. Households that are unable to invest in sustainable energy technologies remain dependent on fossil fuels. As the costs of these fossil fuels rise, for example, due to taxes intended to encourage households to switch to sustainable energy, these households will face increasingly higher energy costs.

These rising costs particularly affect those who are already financially vulnerable, such as households with debt or people who are illiterate (see *figure 70 & 71*). For these groups, it is difficult to be encouraged by generic schemes to implement energy-saving measures or address issues like moisture and insulation problems. This reinforces inequality, as the people most affected often have the least resources to make changes (see *figure 72, 73 & 74*).

To effectively address these barriers, TNO proposes an energy poverty policy. This policy should focus on making sustainable technologies accessible, with a specific emphasis on vulnerable groups, and provide them with support to take measures that ensure they can also participate in the energy transition. When the Netherlands sets the goal of becoming energy-neutral, this means that everyone must be involved in this transition, and not only those who can afford the costs of sustainable technologies (Ministry of General Affairs, 2025).

Indicators defined by TNO, all using 2019 as base year for cost

* Low income is defined as 0-130% of the low income threshold for households.

** High energy cost is defined as anything higher than the average cost of a home with energy label C.

*** Low energy rating is defined by a higher expected/ measured consumption than C-label homes of same size.

**** Few investment opportunities are defined as the share of tenants and financially restricted homeowners, following first criteria for the latter.

(TNO, 2025)

National Trend of Energy Poverty

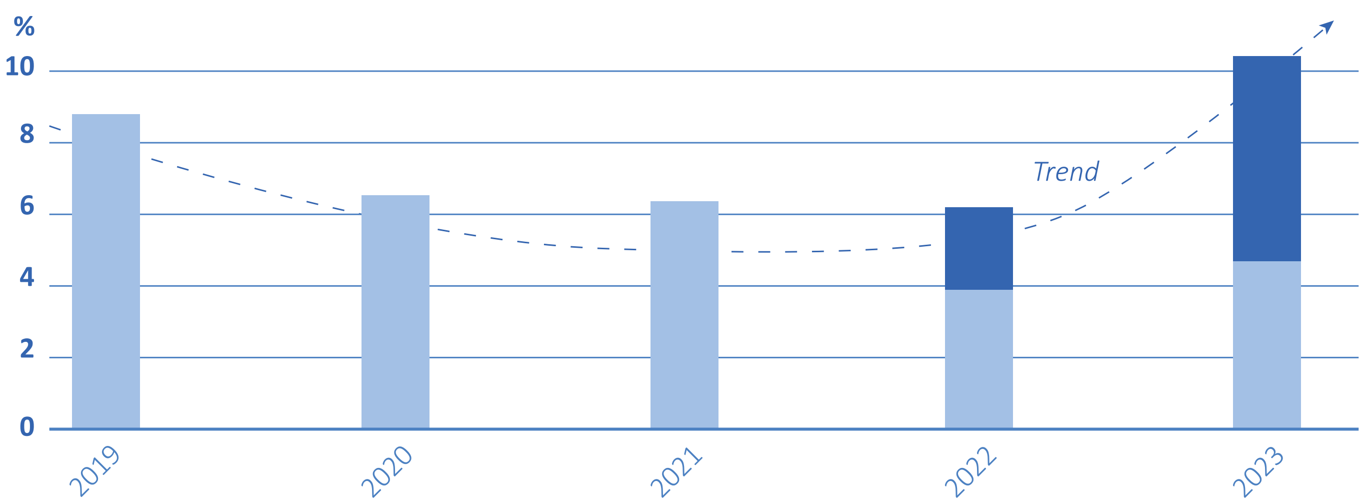


Figure 70: Trend of energy poverty in The Netherlands between 2019-2023 (CBS, 2024b).

Affordability

Low income* + high energy cost**

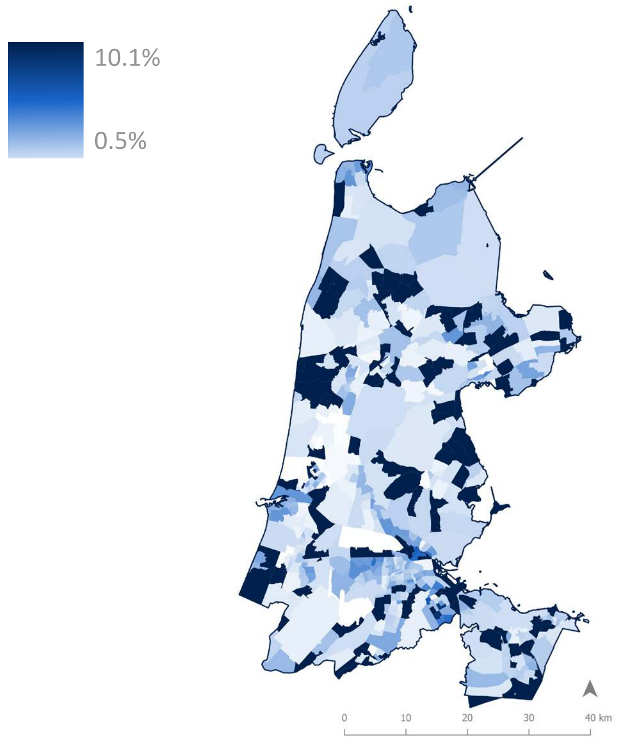


Figure 71: Neighborhoods with low income and high energy costs (Source: CBS, 2022) Adapted from energiearmoede.tno.nl.

Financial Possibilities

Low energy rating*** + few investment opportunities****

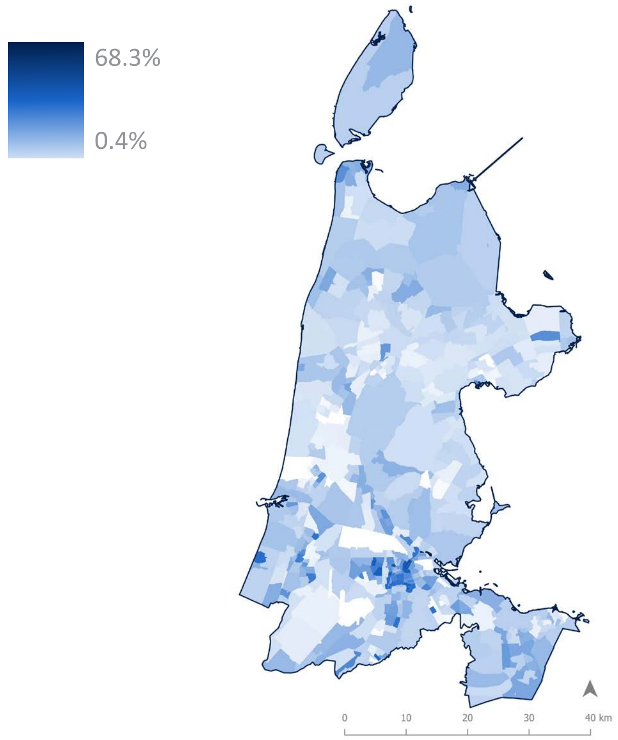


Figure 72: Neighborhoods with low energy ratings and few investment opportunities (Source: CBS, 2022) Adapted from energiearmoede.tno.nl.

Building Quality

Low energy rating*** + low income*

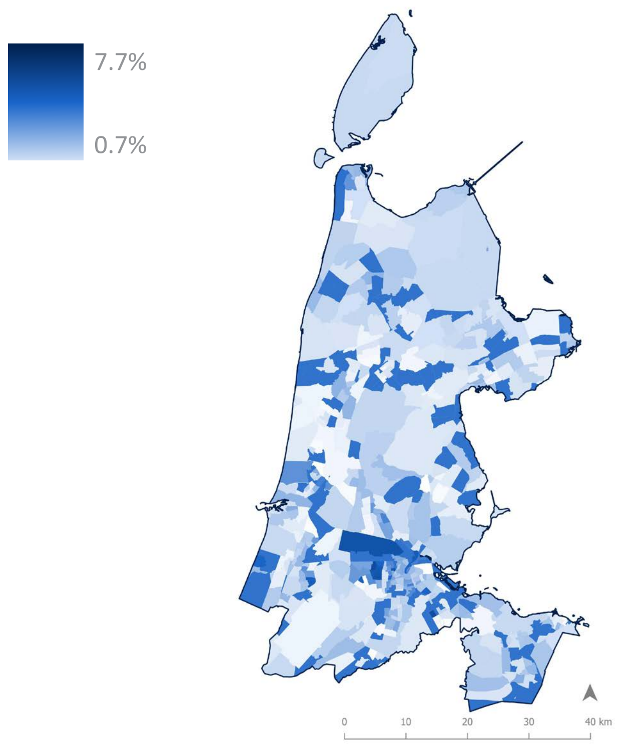


Figure 73: Neighborhoods with low energy ratings and low income (Source: CBS, 2022) Adapted from energiearmoede.tno.nl.

Building Quality

Low energy rating** +/ high energy cost****

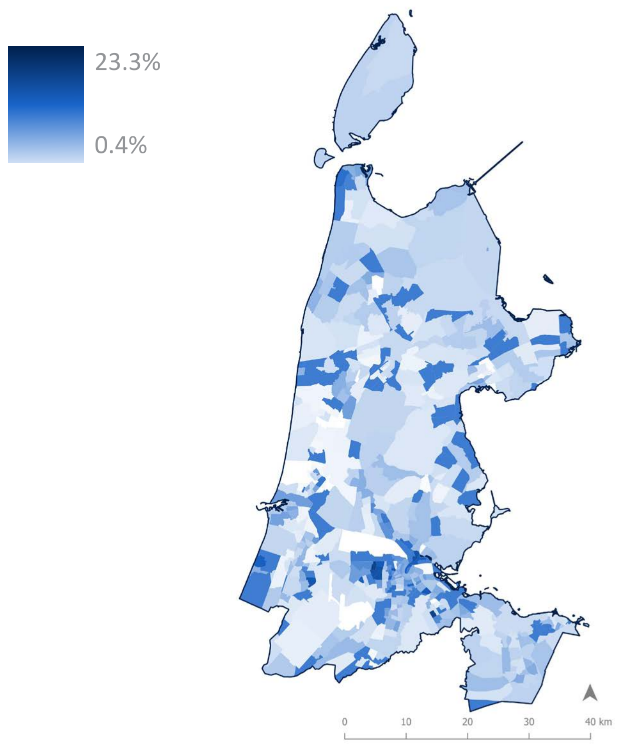


Figure 74: Neighborhoods with low energy ratings and/or high energy costs (Source: CBS, 2022) Adapted from energiearmoede.tno.nl.

ENERGY POVERTY:

CONSEQUENCES

Energy poverty is a pressing issue affecting many individuals and families, and its impact is deeply felt in daily life. The TNO created these profiles based on practical research and studies on energy poverty, shedding light on the struggles faced by those living in challenging circumstances as seen in *figure 75* (TNO, 2020).

The stories of people struggling with energy poverty reveal a complex web of causes and consequences. Limitations in financial resources, inadequate access to support networks, health issues, and poor living conditions reinforce each other, creating a vicious cycle of rising energy costs and ongoing financial stress. This not only has direct consequences for their energy consumption but also affects their physical and mental well-being, leaving them feeling isolated and overwhelmed. Many of those affected do not understand how to improve their situation, due to language barriers or a lack of knowledge about available resources.

The urgency of breaking this vicious cycle is great. Energy poverty is not just a financial issue but has far-reaching social and health impacts. It is essential for governments and societal organizations to intervene and provide structural solutions, such as improved access to subsidies, better housing, and the creation of support networks. Only through collaboration can we enable an inclusive energy transition in which no one is left behind.

The Consequences of Energy Poverty

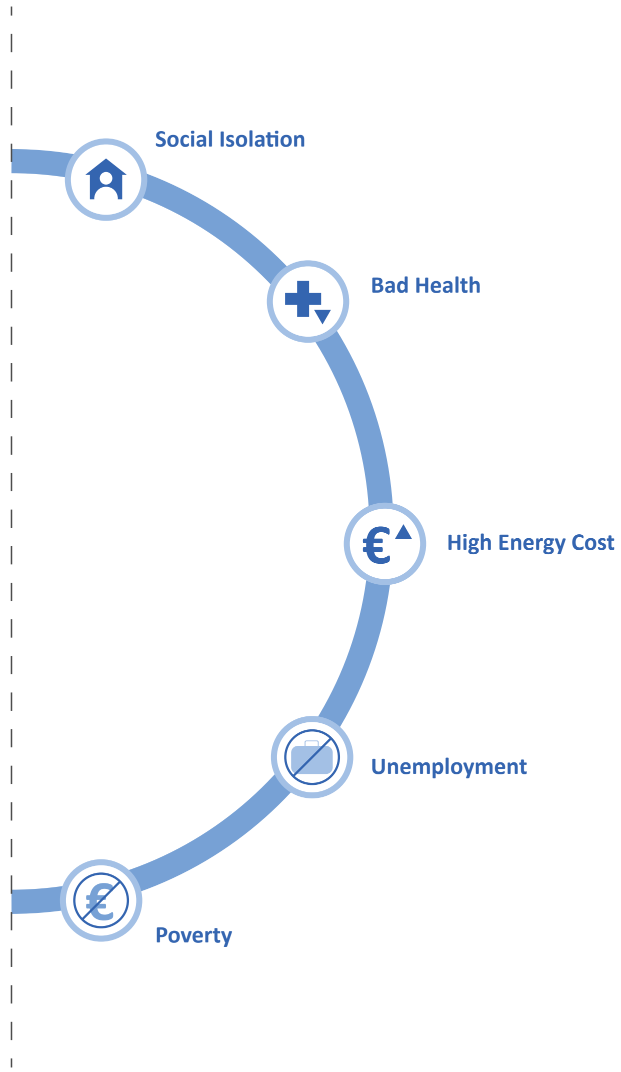


Figure 75: The consequences of energy poverty (TNO, 2020).

ENERGY POVERTY AFFECT THE MOST VULNERABLE

Figure 76: In an attempt to save power and money, many decide to turn the heating to a minimum, potentially worsening one's health (Photo: Hauge, 2025)

PEOPLE BEHIND THE PLUG

Aletta: *Retiree*

Figure 77: Aletta. From Een Vaandag, 2023, by Een Vaandag, https://eenvandaag.avrotros.nl/item/zorg-voor-fatsoenlijke-basis-aletta-carin-en-patrica-leven-in-energiearmoede-en-hopen-dat-er-na-de-verkiezingen-eindelijk-iets-verandert/

Causes & Effects

- Lives on social benefits (pension and AOW)
- Only turns on heating when she has guests over;
- Cooks one-pot meals to save energy bills.

Particia: *Single mom of three*

Figure 78: Particia. From Een Vaandag, 2023, by Een Vaandag, https://eenvandaag.avrotros.nl/item/zorg-voor-fatsoenlijke-basis-aletta-carin-en-patrica-leven-in-energiearmoede-en-hopen-dat-er-na-de-verkiezingen-eindelijk-iets-verandert/

Causes & Effects

- Trouble working due to long COVID;
- Lives in badly insulated social housing;
- Has to have her heating set to no higher than 17 degrees.

ENERGY POVERTY:

PEOPLE BEHIND THE PLUG

Energy poverty affects approx. 5% of households in The Netherlands. If not for the price caps and financial support for the government, that number would have doubled in 2023 and reached over 10% (see *figure 70*, p. 76). While this is great news, the financial support is only a temporary solution for these households, and a long-term solution needs to be found.

The energy transition is creating more challenges for energy-poor households which are already experiencing many difficulties to make ends meet. Many energy-poor households do not have the money, time, network or knowledge to ask for help, leaving them stuck with high energy bills.

These financial troubles can lead to health issues, social isolation and other challenges in their personal life.

In the future the government will be putting increasing pressure on households to move away from gas, which will further increase their energy bills. To tackle the energy poverty issue, TNO proposes to focus on increasing the accessibility of sustainable energy technologies, while giving especially high focus on vulnerable groups. It is necessary to address the challenges of this community to facilitate a just and inclusive energy transition.

Riane: *Home-owner*

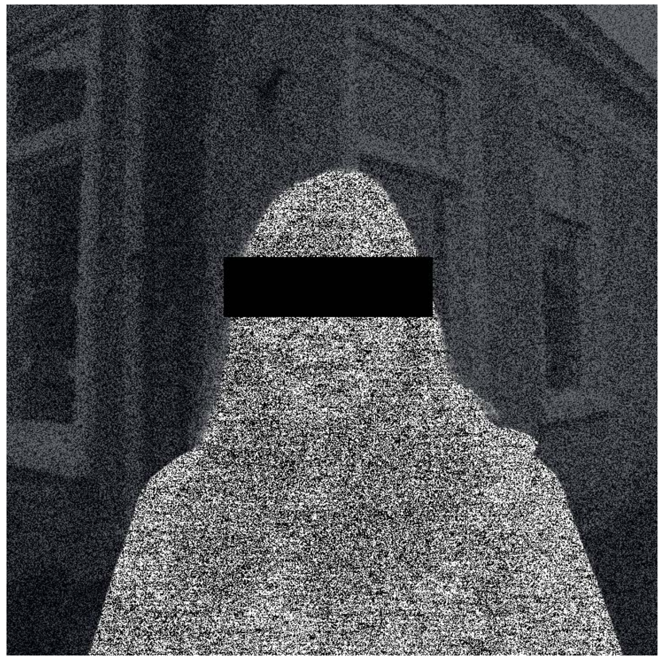


Figure 79: Riane. From Dagblad van het Noorden, 2024, by Dagblad van het Noorden, https://advance.lexis.com/document/?pdmfid=1519360&crid=59cf417a-58c8-4090-a372-e03070afc78d&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A6B9B-0C41-DYNS-J01M-00000-00&pdcontentcomponentid=277856&pdteaserkey=sr3&pditab=allpods&ecomp=hc-yk&earg=sr3&prid=0c59bd0f-f68d-4c55-8576-0cb53ae74

Causes & Effects

- Lives in a protected monument which has heavy restrictions for renovation;
- Because of this, her home is cold, damp, and moldy, and her energy bills are high.

Cosima: *Owner of two dogs*

Figure 80: Cosima. From Noordhollands Dagblad, 2022, by Noordhollands Dagblad, https://advance.lexis.com/document/?pdmfid=1519360&crid=5e16a592-7201-4a8a-aaf7-18a6c0120e26&pddocfullpath=%2Fshared%2Fdocument%2Fnews%2Furn%3AcontentItem%3A6712-4311-JBNJ-21BJ-00000-00&pdcontentcomponentid=471677&pdteaserkey=sr0&pditab=allpods&ecomp=hc-yk&earg=sr0&prid=c7cc2c3d-285c-4b36-ab9d-f5aeee4725a3

Causes & Effects

- Lives in a badly insulated home with her two dogs;
- Had to sell her car to pay her energy bills;
- Has to postpone heating as much as possible

Jolanda: *Lone resident*

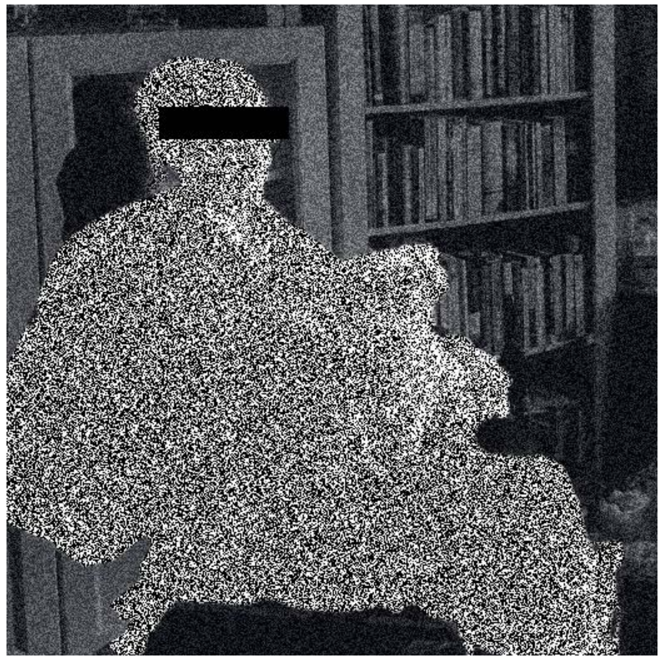


Figure 81: Jolanda. From Trouw, 2022, by Reyer Boxem, https://www.trouw.nl/economie/wie-het-leven-al-amper-kon-betalen-komt-nu-in-grote-problemen-dan-eet-ik-maar-minder~b30cf43b/

Causes & Effects

- Lives on one meal per day;
- Only has heating on when her carer is visiting;
- Due to all sorts of health conditions, her possibilities to be independent are limited;
- Government benefits are limited and after all spendinds she only has 200 euros left to do her groceries.

Didi: *Single mother of two*

Figure 82: Aletta. From Nationale Ombudsman, 2022, by Gabby Louwhoff, https://www.nationaleombudsman.nl/nieuws/artikel/2022/straatpraat-hoe-gaat-u-om-met-de-stijgende-energieprijzen

Causes & Effects

- Can not work because of an autoimmune disease;
- For her, allowance from the municipality is appreciated, but only a drop in the ocean;
- Difficult to ask for help due to paperwork.

CHAPTER IV:
OF DECLINE & ABANDONMENT

Figure 83: HIGH-VOLTAGE CABLES
Along N194, near Obdam
Photo: Hauge, 2025

SOCIO-ECONOMIC CHALLENGES:

GAS DEPENDENCE

While gas is being phased out, doing so can be expensive or not in one's control, like with the case of tenants being dependent on the landlord to make change. Postponing the gas transition will ultimately end in higher power in the long run, as it's expected to come gradually higher taxations on gas consumption versus renewables (EU, 2024). For some, it can be beneficial to use existing geothermal energy for heating. As seen in *figure 88 & 89*, there are great potential from the middle half of North-Holland and up. These neighborhoods are comparably high in terms of electricity and gas consumption (see *figure 86 & 87*).

There are in other words a unique opportunity for gas-dependent households in North-Holland to phase out gas on a locally-based systems!

However, this will require costly initial investments, of which the low-income households aren't able to do. Additionally, such systems (as seen in *figure 85*) are also dependent on everyone in the immediate area to join. That could include other demographics of higher purchase power. What is a reality is the pace of which heating pumps and similar solutions are growing (CBS, 2024c), as seen in *figure 84*.

Heat Pump Trend
in amount of installations

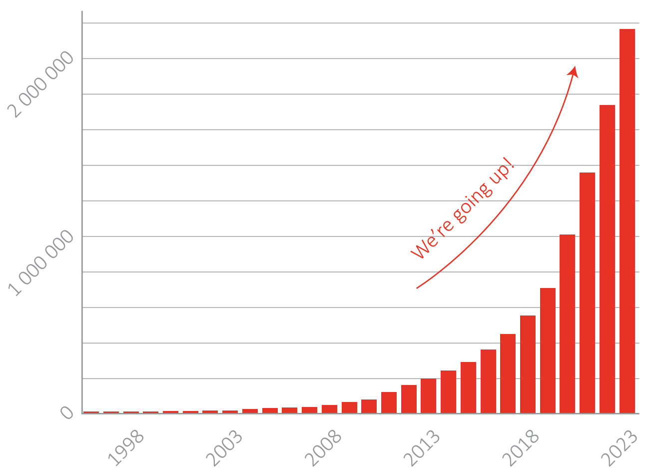


Figure 84: Trend of heat pump installations between 1995 and 2023 (CBS, 2024).

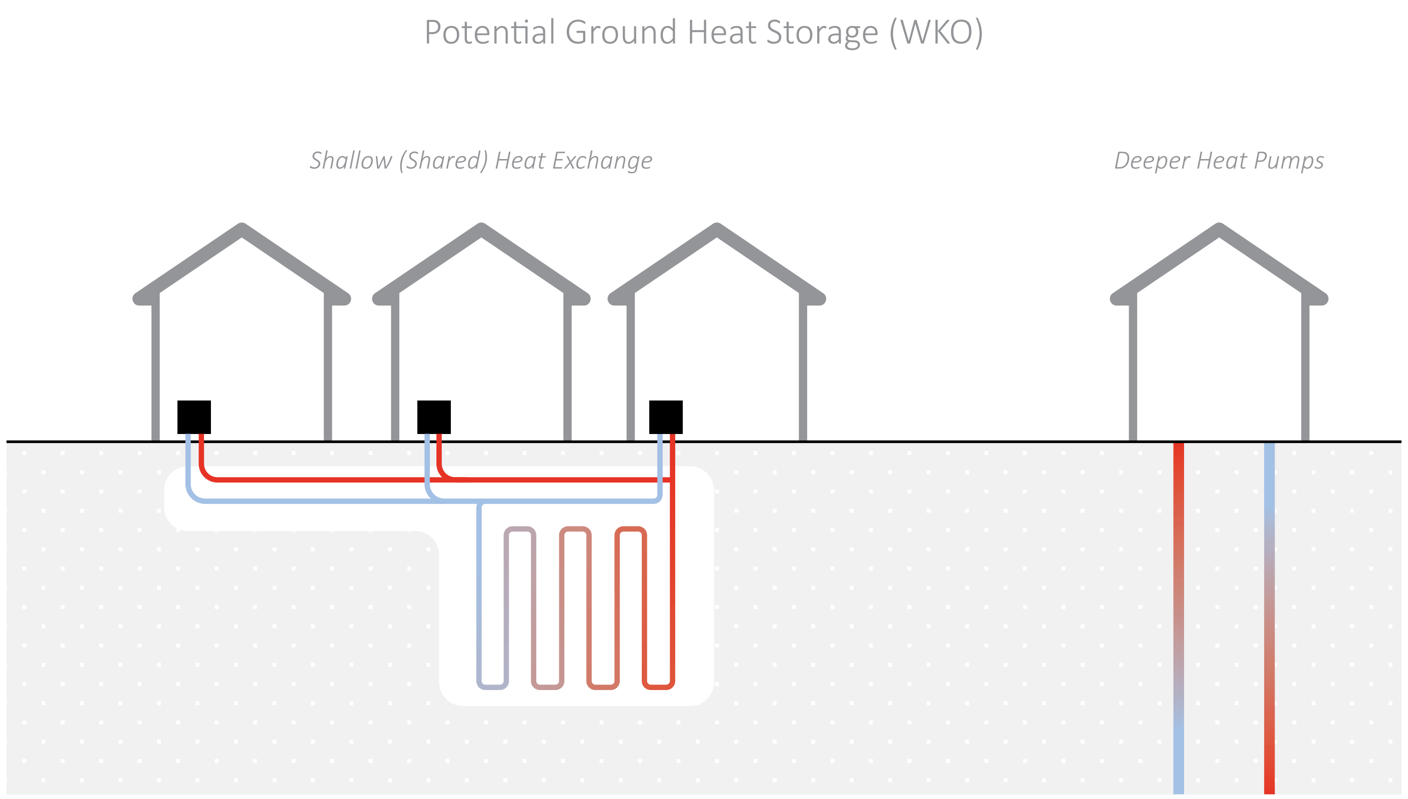


Figure 85: Difference in local heating systems and how the potentials in *figure 88 & 89* are applied (Bale et al., 2022).

Gas Consumption
m³/year

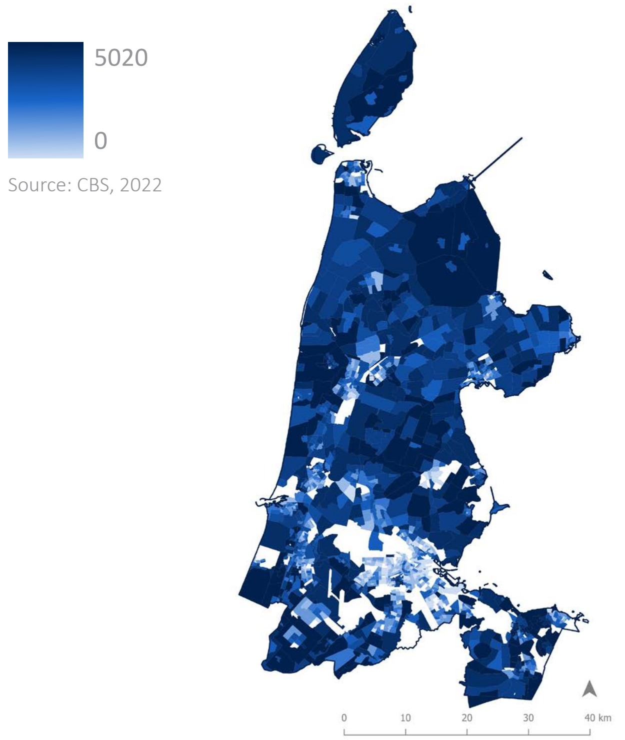


Figure 86: Average annual gas consumption for all households combined.

Electricity Consumption
GJ/(ha.year)

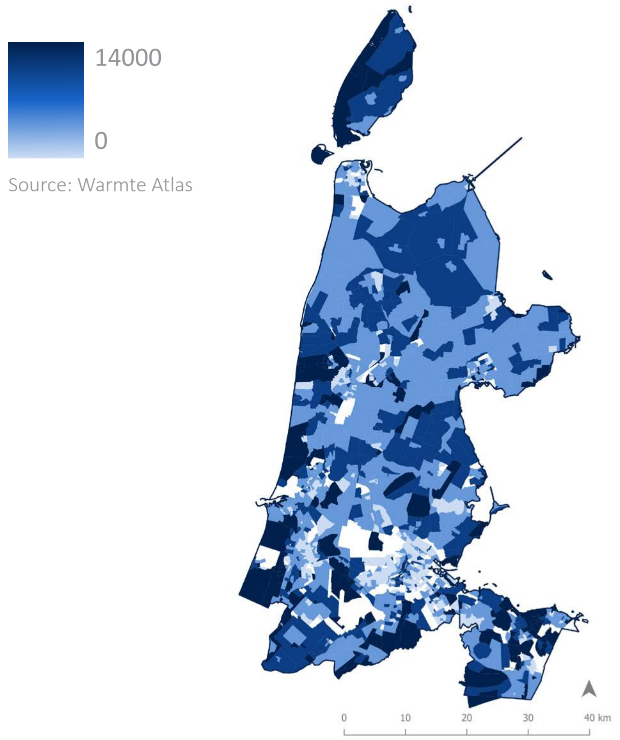


Figure 87: Average annual electricity consumption for all households combined.

Potential Ground Heat Storage (WKO)
GJ/(ha.year)

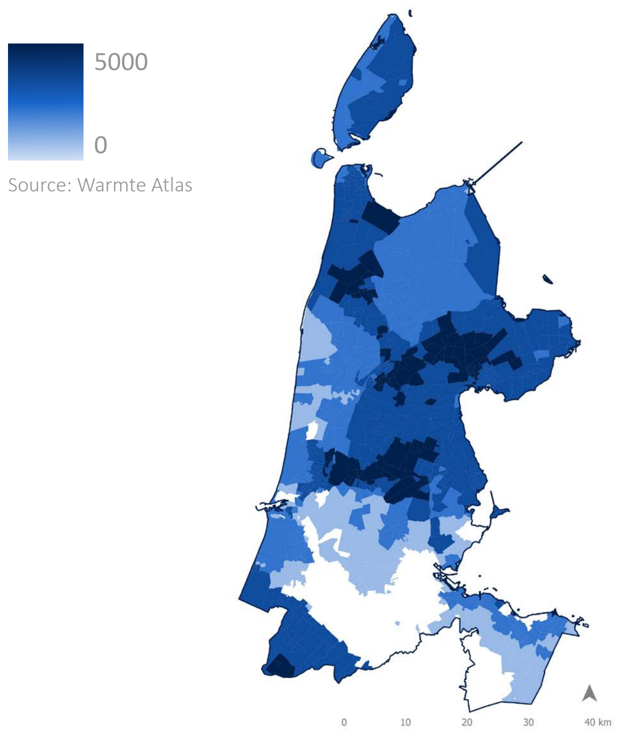


Figure 88: Geothermal potential for local ground heat storage for both heating and cooling, as open systems.

Potential Ground Heat Storage (Heat Pumps)
GJ/(ha.year)

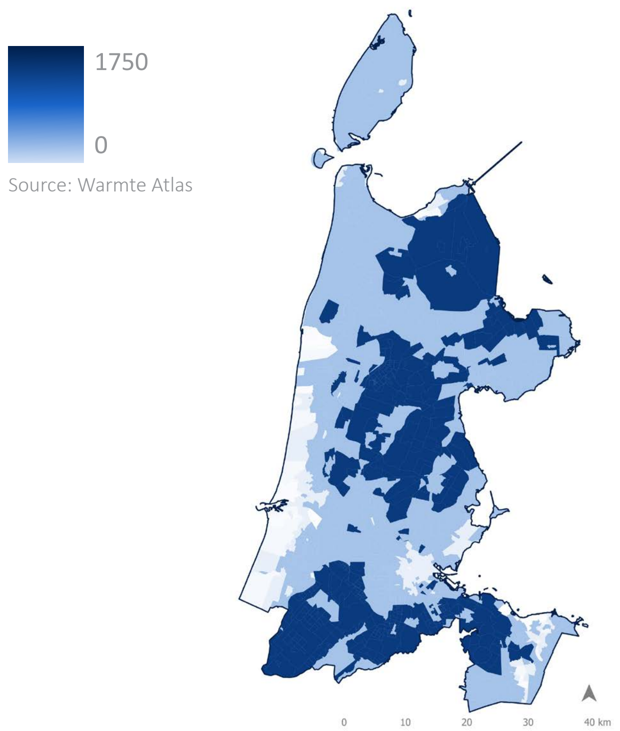


Figure 89: Geothermal potential for heat pumps or other deeper, closed systems.

SOCIO-ECONOMIC CHALLENGES:

ENERGY & SOCIAL INFRASTRUCTURE

In cities it is easier to transition from gas heating a large-scale due to the population density (see *figure 90*) and rapid development rate. Large investments are being put into real estate in cities such as Amsterdam and Alkmaar, while the province is facing a population and facilities decline (see *figure 91, 92 & 93*), and an overall lower population density. These trends reduce opportunities for private real estate investment into residential housing and various facilities in the province. Gathering places in the province are getting increasingly more difficult to access compared to the big cities (see *figure 92*).

This provincial decline also creates challenges to renovate buildings which have become outdated in terms of insulation. For housing associations, it financially makes more sense to prioritise real estate in the city, while owner-occupied households have to deal with an increasingly widening gap of real estate value between the urban and provincial areas.

> “Young talent is leaving the region, Amsterdam is of course a magnet. We want to reverse that trend, ensure that young people who go to study elsewhere do not disappear from the region for good.”
>
> Robert te Beest, alderman of Alkmaar.
> on the 65-million euro Regional Deal, 2024

Population Density
inhabitants/km²

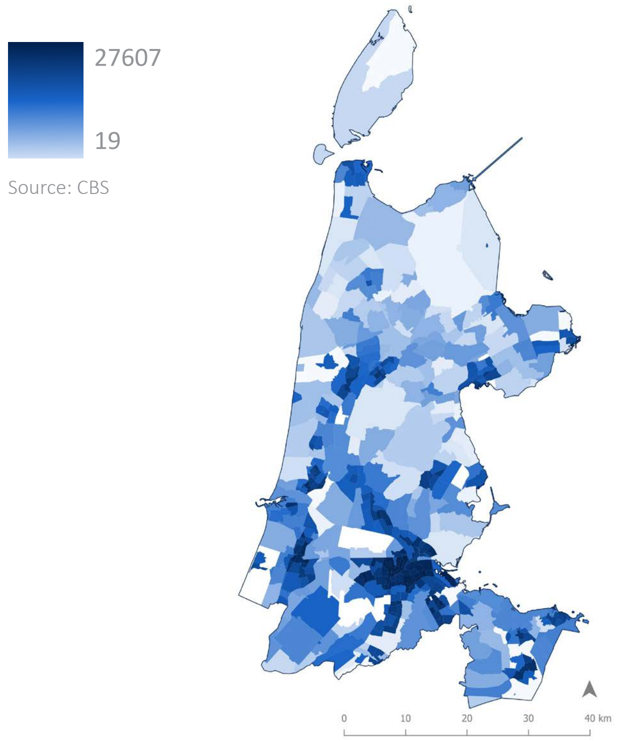


Figure 90: Population density per square kilometer (CBS, 2022).

Energy Companies
per 1000 inhabitant

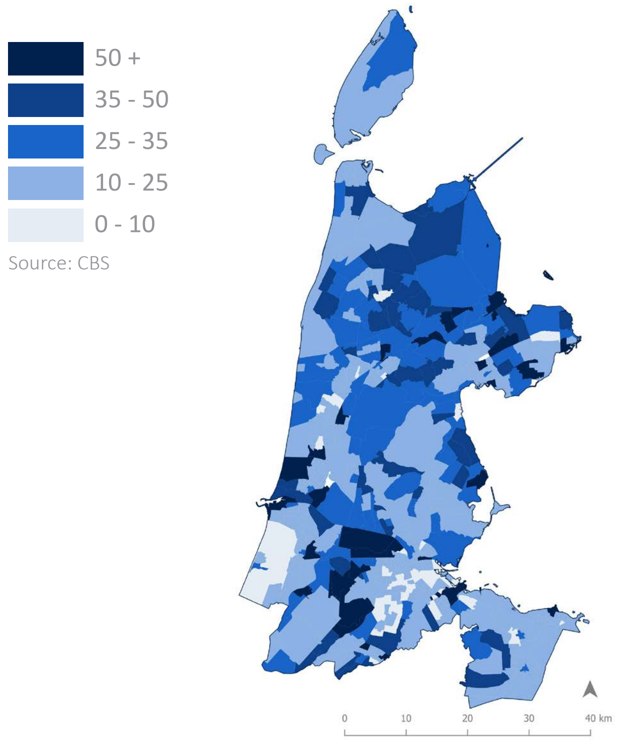


Figure 91: Number of energy companies per 1000 inhabitant (CBS, 2022).

Average Distance to Gathering Place
km

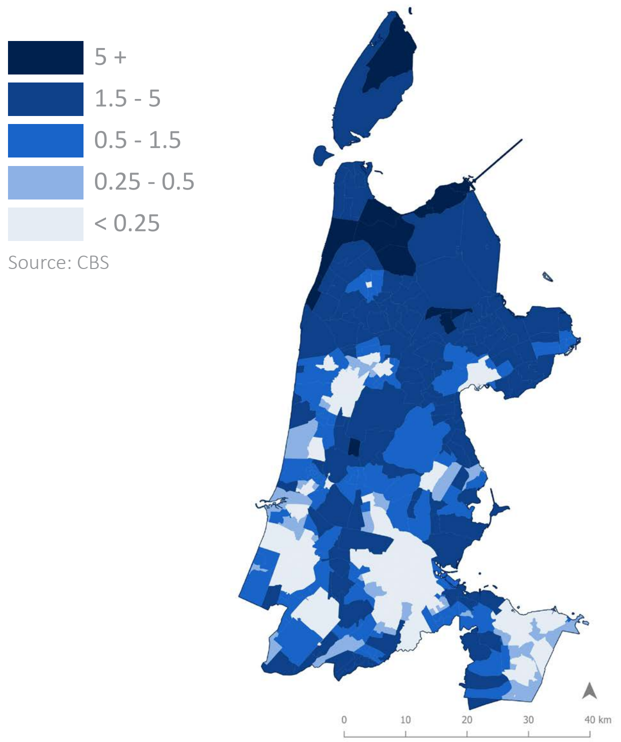


Figure 92: Average distance to schools, cafés, hotels, libraries, museums and cinemas combined, which function as typical gathering places (CBS, 2022).

Recreational Buildings
per 1000 inhabitant

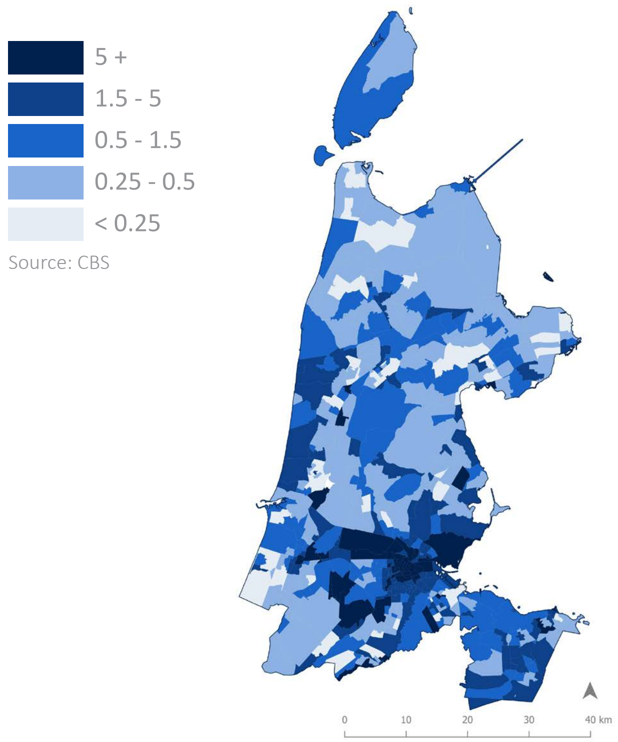


Figure 93: Number of recreational buildings per 1000 inhabitant (CBS, 2022).

SOCIO-ECONOMIC CHALLENGES:

WELFARE & ECONOMICS

Low-income households are not just concentrated in rural areas as one might assume by looking at average income (see *figure 95*). Top earners skew this vision in the cities, so looking at *figure 98* actually tell low-income households are more spread out, though heavily clustered in large cities like Amsterdam and near industrial hotspots like Beverwijk and Den Helder.

The type of welfare benefits also reveal which kind of challenges exist throughout the region compared to the total (see *figure 100*). Unemployment benefits are largely in the cities (see *figure 99*), while pension welfare are given out in the more rural areas (see *figure 97*). However, the social assistance benefit, which aid those with insufficient income to support themselves, are more equally distributed (see *figure 96*). All of these indicators show that the low-income communities of North-Holland are not bound by a place, but rather situation.

Entering the Transition with Different Conditions

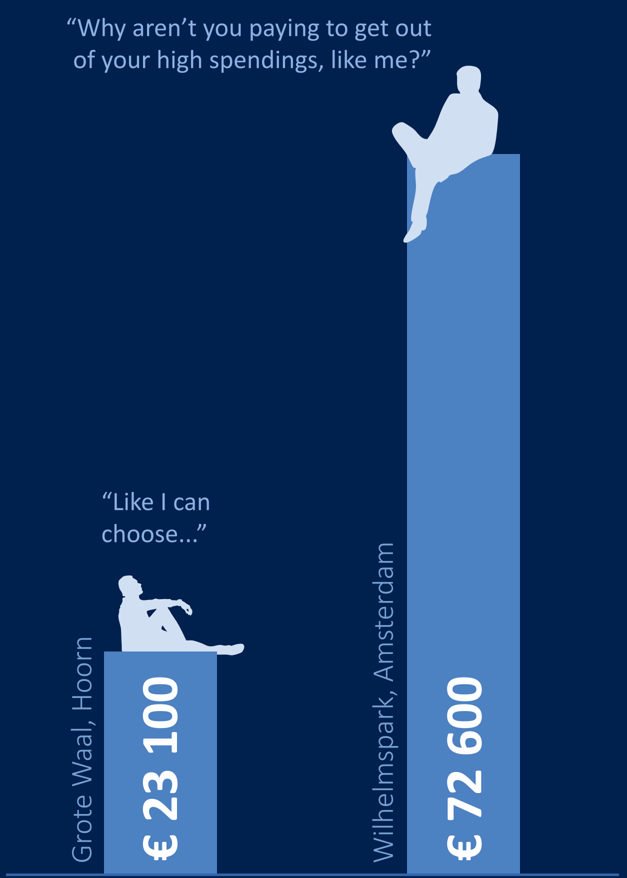


Figure 94: People have different income and expenses, and that affect how they can participate in the energy transition (CBS, 2020).

Average Income
in 1000 euro, €

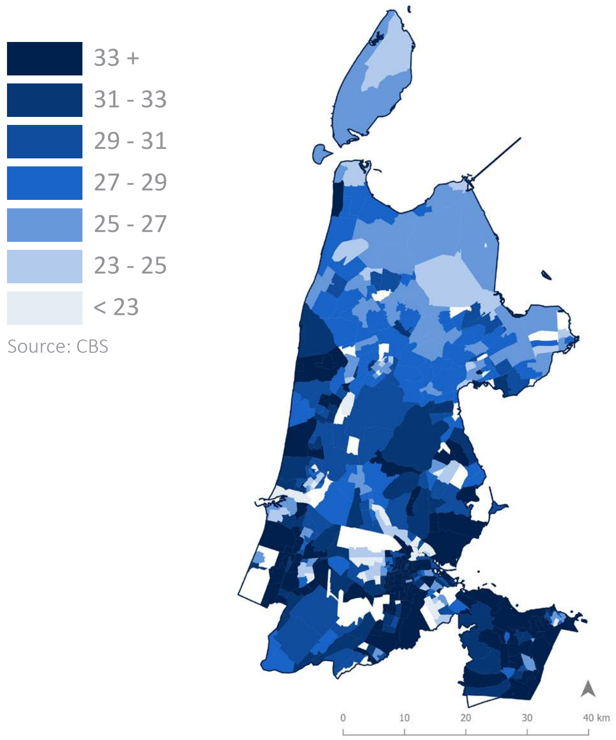


Figure 95 Average income per thousand euro (CBS, 2020).

Social Assistance Benefit
per 1000 inhabitant

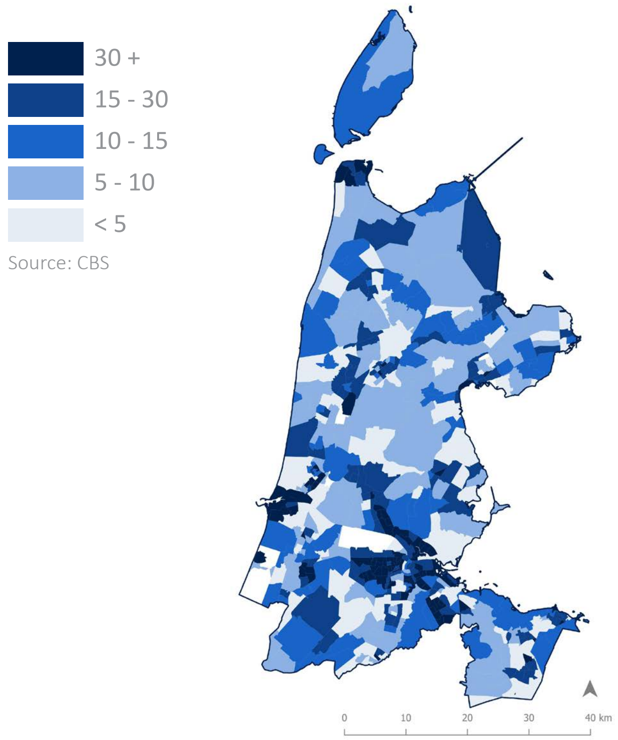


Figure 96: Number of people on social assistance benefits per 1000 inhabitant (Source: CBS, 2022).

Pension Welfare Benefit
per 1000 inhabitant

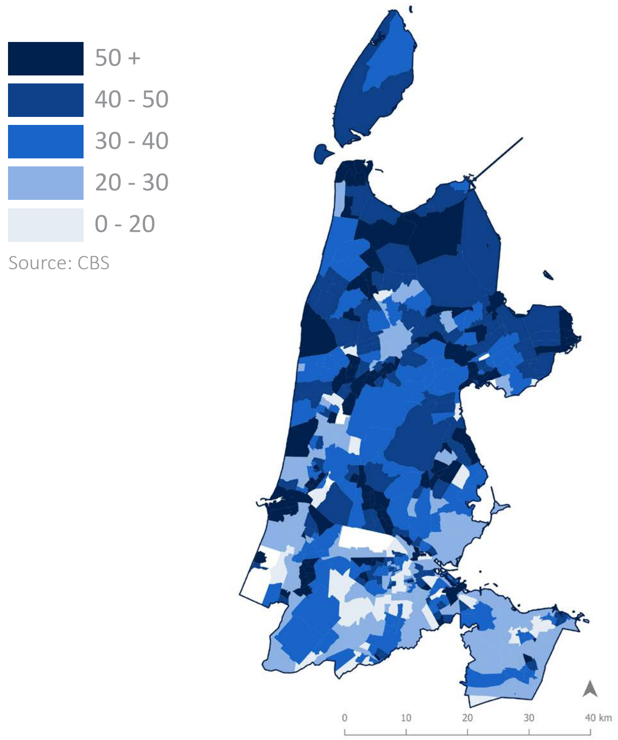


Figure 97: Number of pension welfare benefits per 1000 inhabitants (Source: CBS, 2022).

Income of National Lowest 40%
%

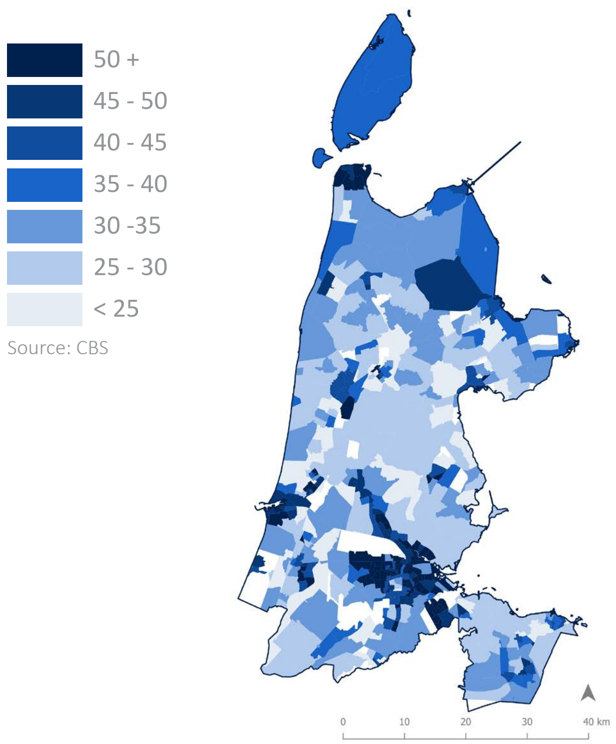


Figure 98: Percentage of households with a lower income than the national 40% average (CBS, 2020).

Unemployment Benefit
per 1000 inhabitant

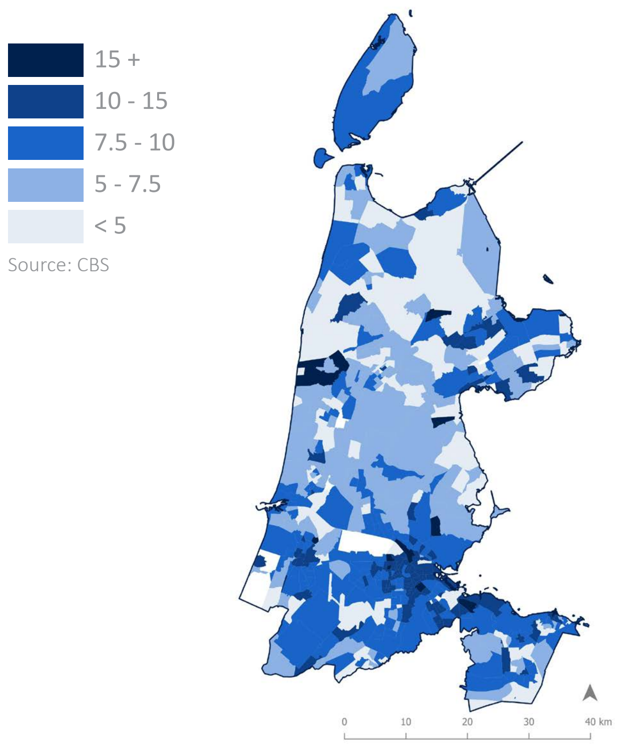


Figure 99: Average distance to schools, cafés, hotels, libraries, museums and cinemas combined, which function as typical gathering places (CBS, 2022).

Total Welfare Benefit
per 1000 inhabitant

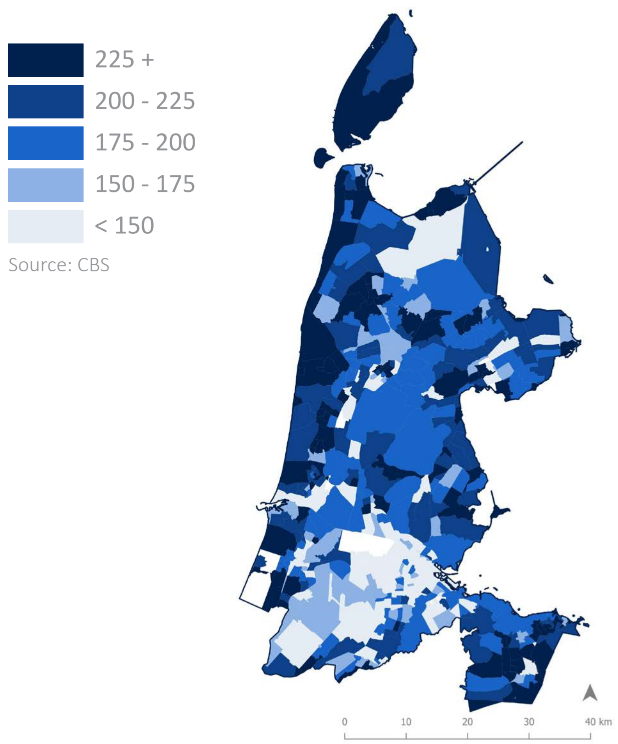


Figure 100: Neighborhoods with low energy ratings and/or high energy costs (Source: CBS, 2022) Adapted from energiearmoede.tno.nl.

SOCIO-ECONOMIC CHALLENGES:

POPULATION & AGING

The Netherlands are in the same position as many other European countries, it's aging (Eurostat, 2025; CBS, 2024d). This however isn't happening equally across regions or neighborhoods. The change in share of elderly and children to young adults between 2007 and 2022 show rural areas being more susceptible to this problem than Amsterdam (see *figure 103, 105 & 106*). The share of youth indicate if an area will continue to have a flow of works and manpower to locally maintain energy projects or not. Elderly, which might have more time on hand, are less mobile and capable on average to participate in the construction of such projects. There's also a discussion to have of whether or not they have the financial means to do so. Pension payments, as seen previously in *figure 97*, contribute differently with the range of living costs between the cities and the rural.

The current trend is that the share of elderly will rise, along with the general population (see *figure 102*). Immigration will be a major factor, which could result in an uneven distribution the between workforce and children (CBS, 2024e). For the energy transition in the province this creates challenges due to a loss of experts and investment from the private sector.

Ratio Between Elderly & Children in 2050

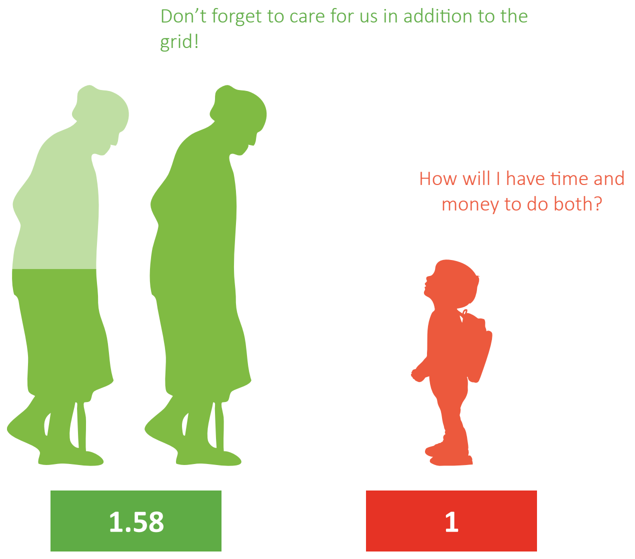


Figure 101: In 2050, the number of elderly, 65+, and children, 0-15, will be almost 1,6 (Source: CBS, 2024d).

Population Forecast towards 2070

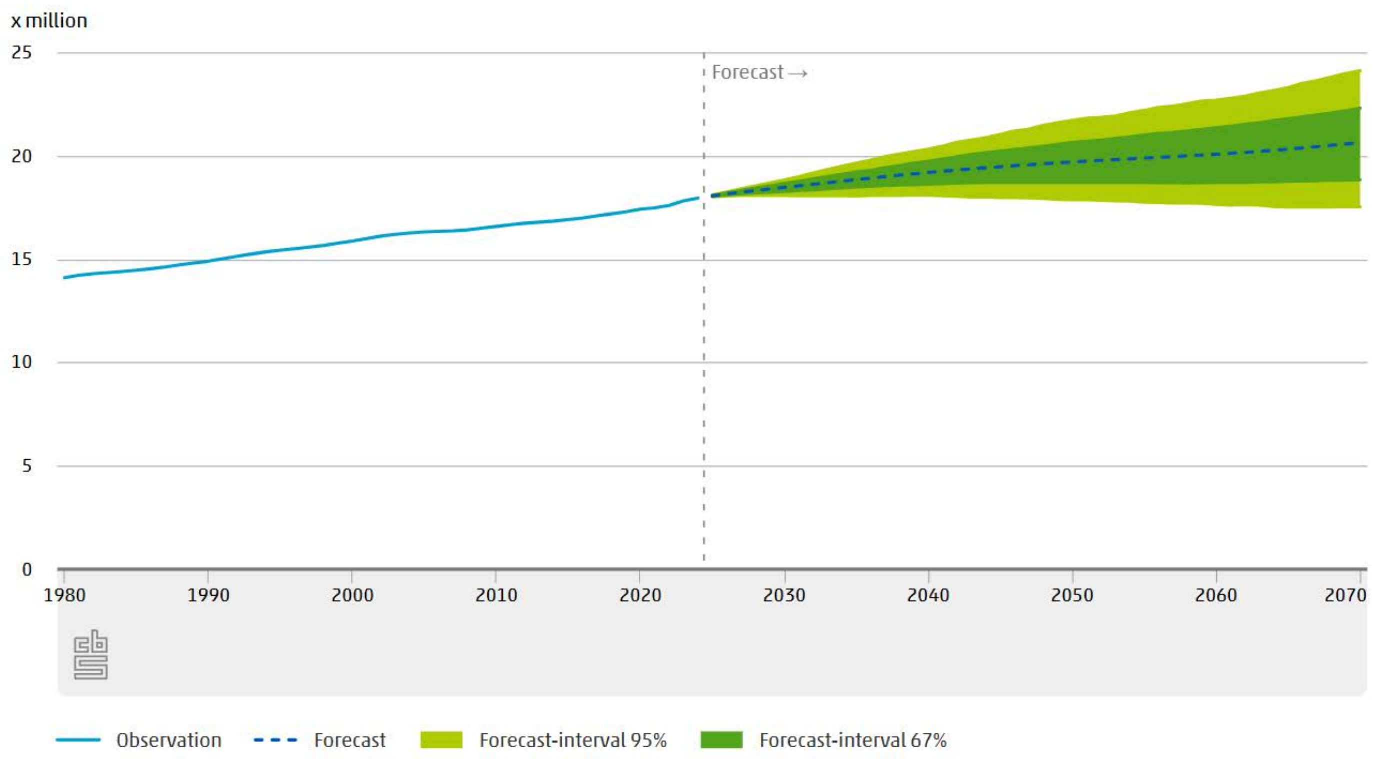


Figure 102: Population projection for The Netherlands until 2070. The share of elderly are expected to increase by 2070 (CBS, 2024d). From: https://opendata.cbs.nl/statline/#/CBS/en/dataset/85496ENG/table?ts=1744018928667

Share of Youth

0-25 years, 2022, %

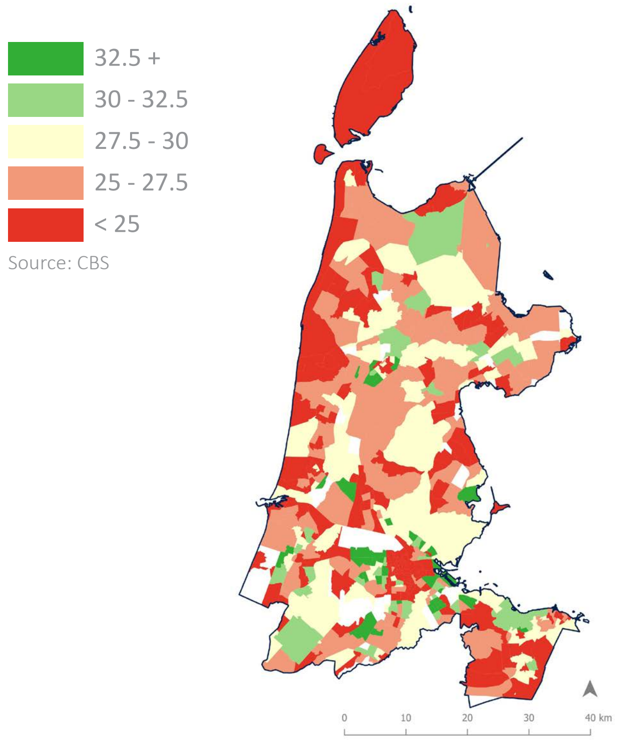


Figure 103: Share of youth in percentage of total population (Source: CBS, 2022).

Population Change

2007-2022, %

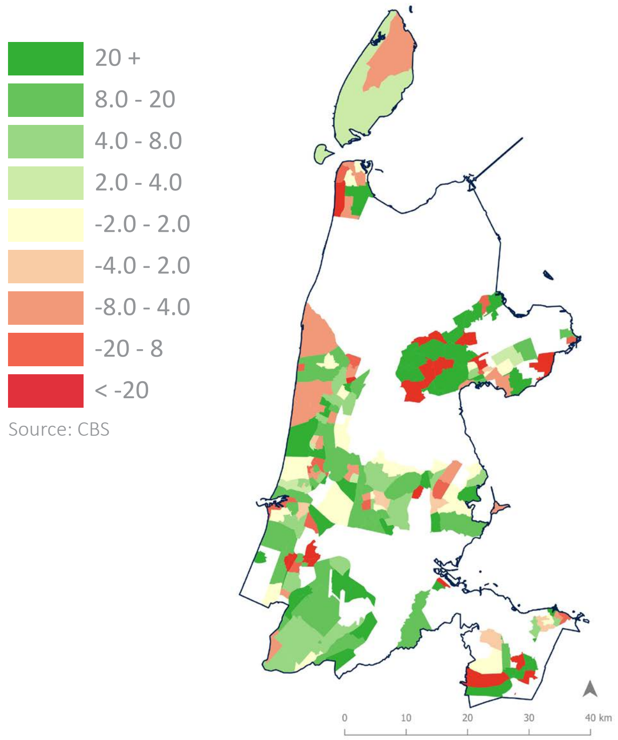


Figure 104: Population change from 2007 to 2022 (Source: CBS, 2022 & CBS, 2011).

Share of Elderly

65+ years, 2022, %

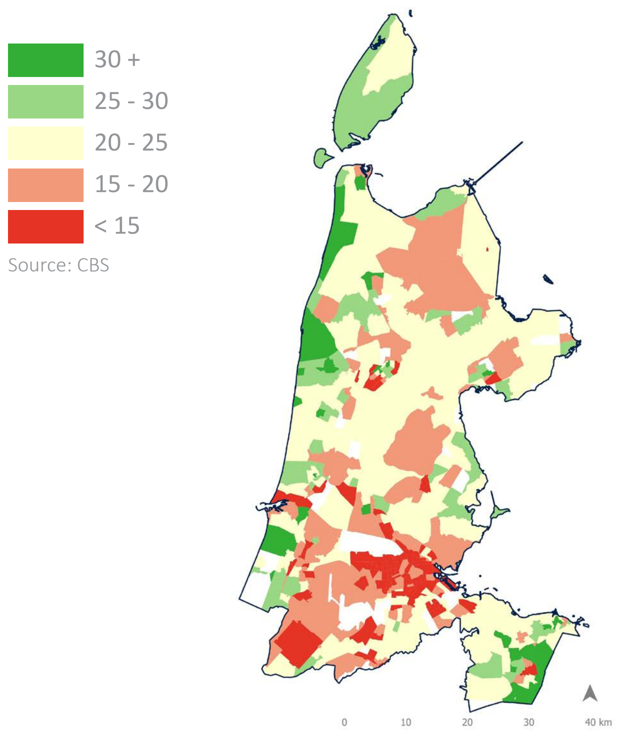


Figure 105: Share of elderly in percentage of total population (CBS, 2022).

Change in Share of Elderly

65+ years, 2007-2022, %

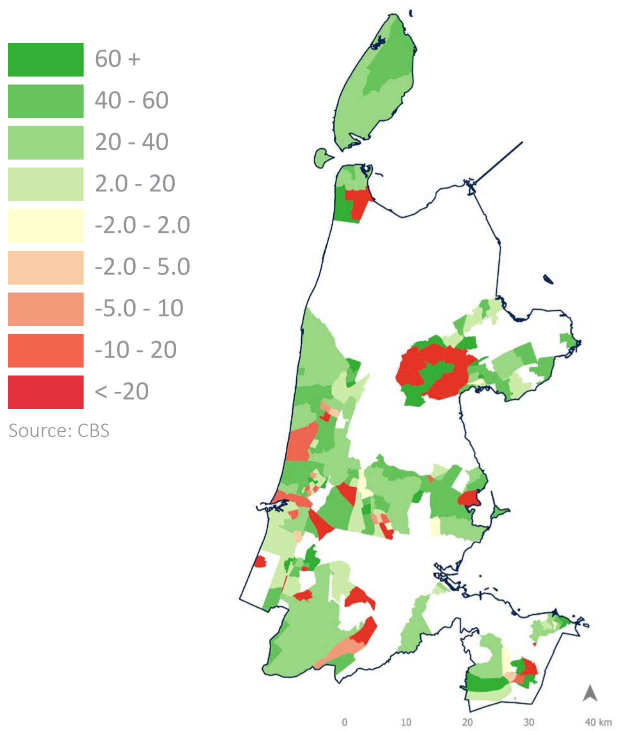


Figure 106: Change in share of elderly from 2007 to 2022 (Source: CBS, 2022 & CBS, 2011).

POLITICS & TRUST

Figure 107 presents the results of the 2023 Dutch Provincial Council elections, which highlight a clear political divide between urban and rural areas. Urban voters predominantly supported parties with ambitious energy transition agendas, such as GroenLinks and the VVD. In contrast, the Farmer–Citizen Movement (BoerBurgerBeweging, BBB) gained the most support in rural regions. BBB takes a more cautious stance toward the energy transition, emphasizing concerns about affordability and the preservation of the Dutch cultural landscape.

The election outcomes suggest that rural residents are not opposed to the energy transition itself but tend to approach it from a more socially driven perspective. Urban voters, by contrast, are more likely to prioritize environmental and economic objectives. This divide reflects an unequal geographic distribution of both the burdens and benefits associated with the energy transition in North Holland—and more broadly across the Netherlands.

The strong support for BBB in rural areas also suggests a sense of being neglected. These regions are facing declining populations, shrinking public services, and fewer economic opportunities. Many rural communities feel that farmers are being unfairly targeted in the nitrogen crisis. While there is a willingness among farmers to transition toward more sustainable practices, they feel they receive little support and are instead met with punitive measures (BBB, 2022).

> “The BBB does know how to appeal to broader themes. The depopulation of the countryside and The disappearance of facilities outside the big cities. Of libraries, banks, bakeries, even primary schools and swimming pools. In this way it gives shape to discontent.”
>
> Tom van de Meer, political scientist (De Correspondent, 2023).

Strikingly, people living in poverty express solidarity with farmers. They see their own situation reflected in the challenges farmers face—particularly in the sense that the energy transition imposes many restrictions and obligations, yet offers limited support in return (Sterk Uit Armoede, 2024).

TRUST

Trust in the government is declining, particularly in the less urbanized areas of Noord-Holland (see *figure 109 & 110*). Both the graph and the map (see *figure 108*) show a decrease in political engagement. The graph reveals a clear decline in trust in both the Dutch Parliament (Tweede Kamer) and politicians in general since 2020. At the same time, the map shows that voter turnout in elections between 2019 and 2023 has significantly dropped in many rural municipalities.

Trust in the government is declining, particularly in the less urbanized areas of Noord-Holland. Both the graph and the map show a decrease in political engagement. The graph reveals a clear decline in trust in both the Dutch Parliament (Tweede Kamer) and politicians in general since 2020. At the same time, *figure 108* show that voter turnout in elections between 2019 and 2023 has significantly dropped in many rural municipalities.

Voting Results
Dutch Provincial Elections 2023

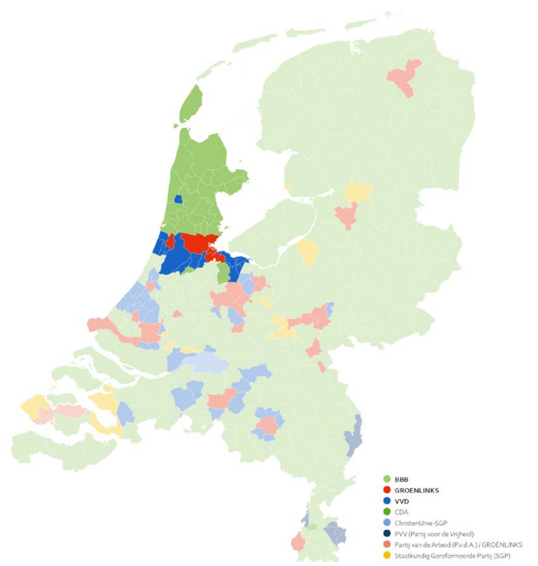


Figure 107: The result of the Dutch Provincial Election in 2023 (Kiesraad, 2023).

Change in Voting Turnout
2019-2023

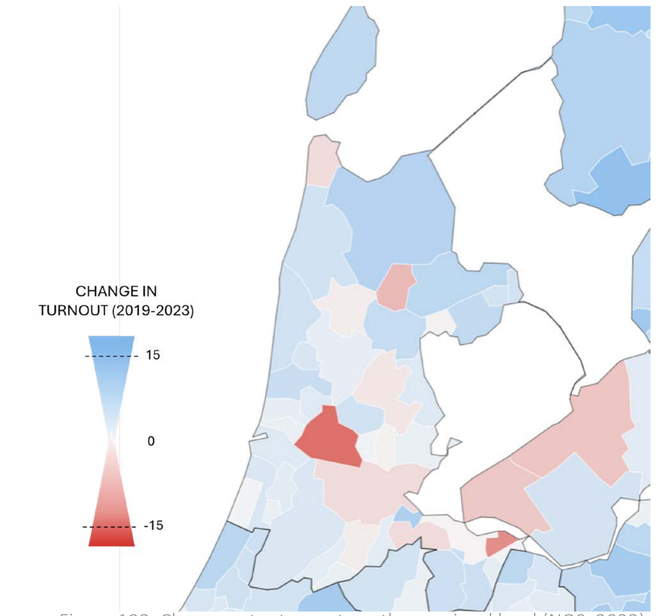


Figure 108: Change voter turnouts as the municpal level (NOS, 2023).

Trust in Politics
% of people 15 years or older

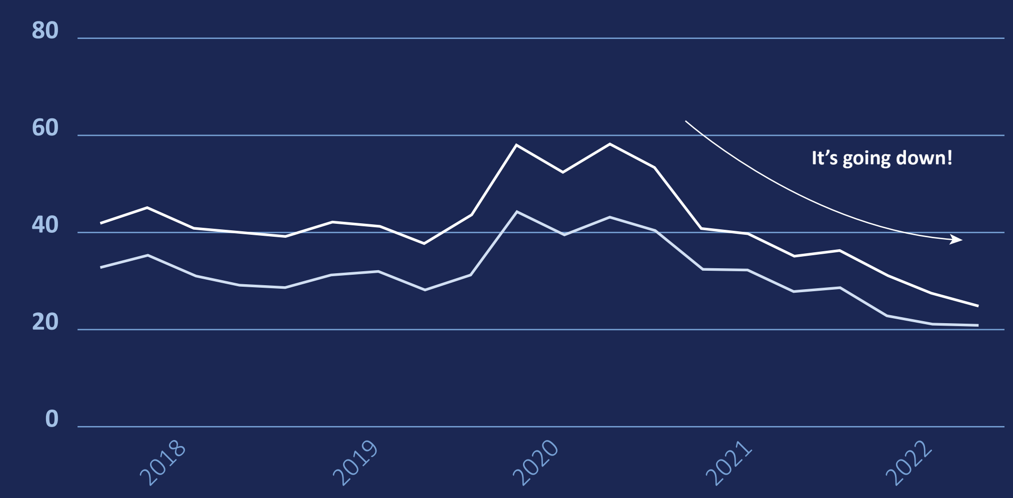


Figure 109: National trust in politicians and the House of Representatives (CBS, 2023a).

Trust Across Governing Bodies
% of people 15 years or older

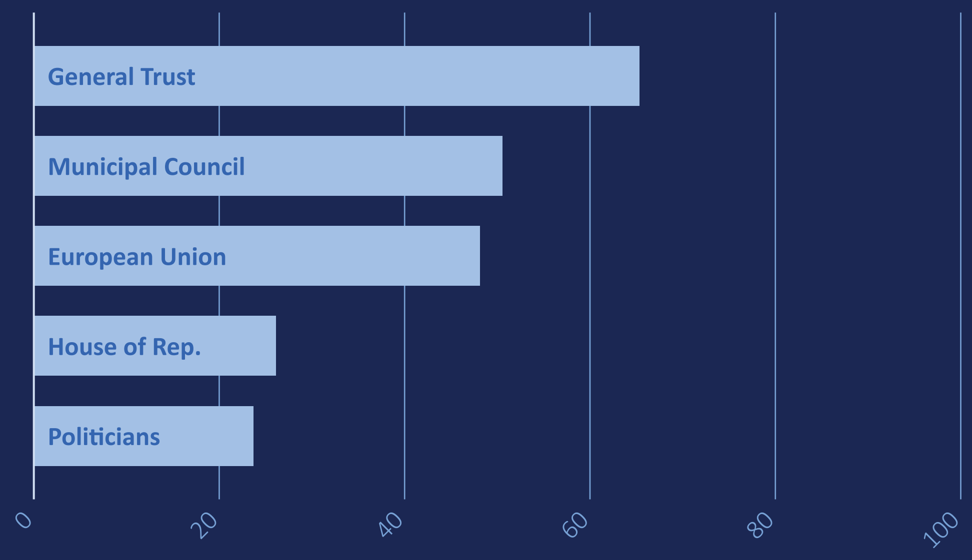


Figure 110: National trust in different types of public servants and governing bodies (CBS, 2023b).

PERCEPTIONS ON THE ENERGY TRANSITION

In the report "Mensen in armoede over klimaat- en energietransitie" (Sterk uit Armoede, 2024) 90 diverse Dutch people in poverty were interviewed to learn about their thoughts, perspectives, and wishes regarding participation in the climate and energy transition. Overall, the study found that these people acknowledge the importance and necessity of the energy transition. They wish to be part of this transition but find it difficult due to various limitations. Below is a summary of the sentiments, opinions, experiences, wishes, and suggestions synthesized from the report.

AFFORDABILITY OF THE TRANSITION

People in poverty recognize the importance of the energy transition but lack the financial means to participate. Instead, their sustainable behavior is driven by money-saving measures (e.g. buying clothes second-hand, repairing instead of throwing out). In that sense, they see solar panels as a means to reduce their energy bills. People are highly concerned about the price increase and affordability. They feel that the government is imposing measures that people cannot afford. They think that the pricing is unfair, as they do not have money to invest and they lack financial knowledge as well.

CONFUSING & RESTRICTING POLICIES

People in poverty feel that having less money and lower levels of education makes it difficult for them to orient themselves in policies, regulations, and subsidies. They experienced frustrations when applying for support and facilities, and often they are unable to ask for help. They feel that it is unfair because highly educated and financially secure people do not have this problem. They want simple regulations that are easy to apply for and that are flexible for different needs.

TOP-DOWN DECISIONS MISS THE MARK

People criticize the top-down approach of policy implementation, which often feels forced and foreign to them. The proposed solutions to not always fit in with their reality. Instead, they think that more customization and better communication is necessary. They suggest giving the energy allowance to municipalities so that more customization is possible.

People are unhappy that they have no opportunities to participate in the decision-making without filing complaints. This also makes the developers see these communities as an unhelpful obstacle. The people want to be involved in the search for solutions and also have a say in the decision-making process. They want the government to invest in equality and community participation. More contact with the citizens is seen as necessary for better solutions.

SENSE OF MISTRUST & INJUSTICE

People in poverty suspect that they will be tricked and will have to pay surprise expenses due to past experiences. In the past, it was thought that the costs would be fully covered switching to an induction stove would, while in the end, they had to buy new pots and pans themselves (Movisie, 2022). They have a sense of powerlessness and injustice. They feel that it is unfair that the burdens of the energy transition are being placed on them and not on big polluting companies. Some people have become skeptical about climate change and think that the numbers are being exaggerated to make the government and big businesses richer.

ADDITIONAL EXPERIENCES

People in poverty had great experience with energy coaches, which help to implement quick energy-saving measures and are more personal. Especially door-to-door energy coaches were highly regarded. Any help that is received to participate in the energy transition is greatly appreciated. Outdated quality of housing (bad insulation and energy-inefficient appliances) is seen as a major bottleneck to reducing energy consumption. There is no way to reduce energy costs in these cases.

> "In energy transition, solving social problems is a joint opportunity."
>
> Marcel van Leeuwen, manager of welfare company Mensenwerk Hogeland & OCO Tinten (Movisie, 2022).

> "People in poverty are actually always trying to survive. Many people cannot really imagine a term like energy transition. There are also people who want to participate, but do not know how."
>
> Yvonne Zuidgeest, manager of welfare company Diverz (Movisie, 2022).

> "The aim is to involve residents in the transition through co-creation. They must be given space to think, come up with plans and organise themselves in interaction with the local government."
>
> André Lodder, energy transition development worker (Movisie, 2022).

STAKEHOLDER ANALYSIS:

STAKEHOLDERS

The energy transition in North Holland, where grid congestion and energy poverty play a central role, requires a strong capacity for collaboration among the various stakeholders involved in this study. This transition not only presents opportunities for cooperation, but also creates tensions and conflicts between different stakeholders. *Figure 111* presents an overview in the form of a circle diagram, which visualizes the key stakeholders. These stakeholders are divided into three main sectors: public, private, and civic. The type of circle for each stakeholder reflects their influence on the energy transition. The lines between stakeholders indicate the nature of their relationships: neutral, collaborative, or conflicting.

Furthermore, the further a stakeholder is positioned toward the outer edge of the circle, the lower their level of involvement in the energy transition. However, this does not mean these parties lack influence—actors in the outer ring can still have a significant impact on the progress and outcome of the transition.

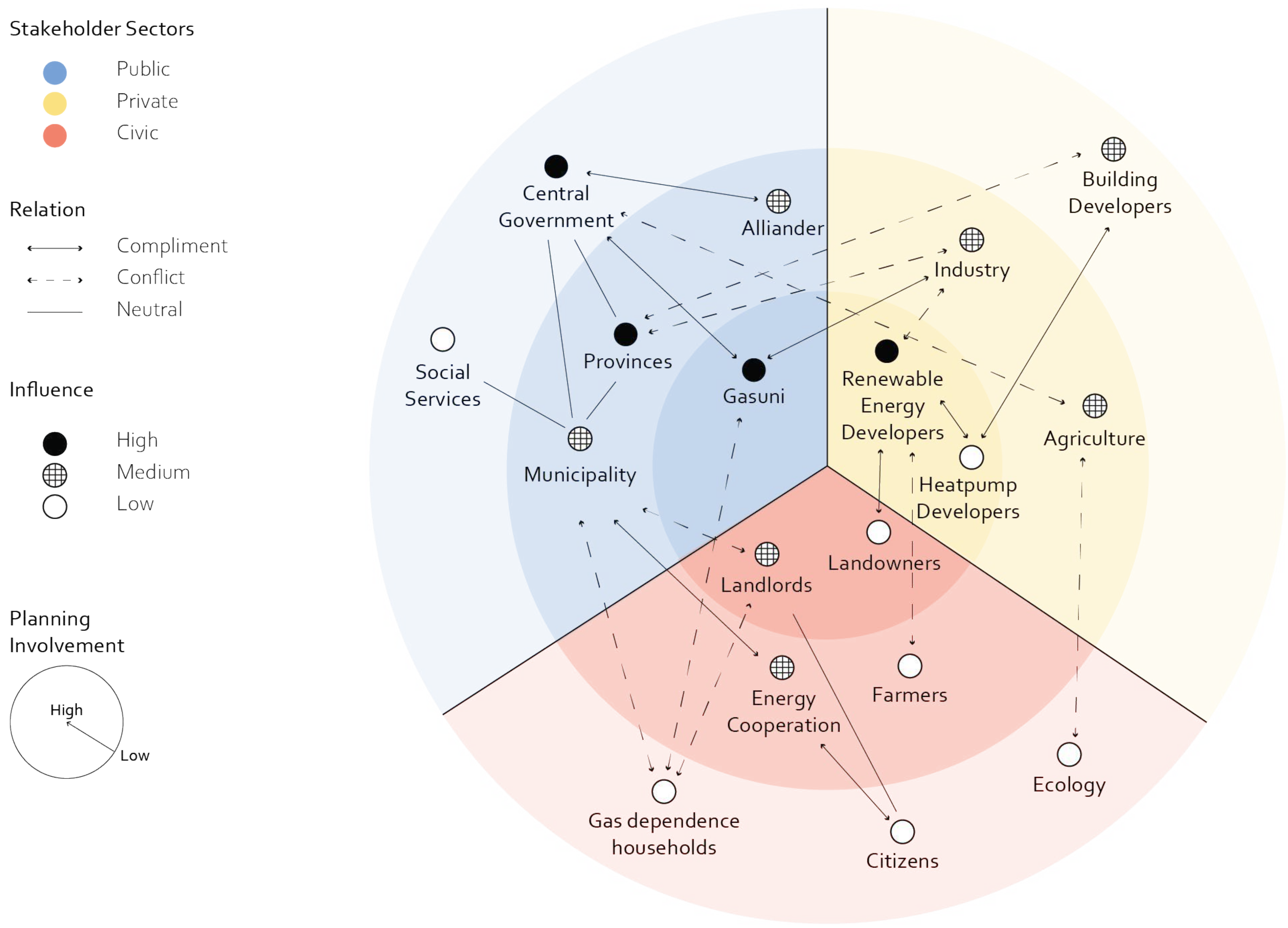


Figure 111: Stakeholders and their degree of involvement in planning.

STAKEHOLDER ANALYSIS:

STAKEHOLDERS

Public Sector

In the public sector (see *figure 112*), relatively few key players are depicted in the stakeholder diagram. These stakeholders are all government organizations operating at various levels. Public companies, or state-owned enterprises, are companies in which the government holds a full or partial stake. Although these companies often operate independently and are commercially organized, they carry a special responsibility toward society.

Through shareholding, the government ensures that public interests are safeguarded, even when these interests may not always align with commercial objectives.

Private Sector

Within the private sector (see *figure 113*), the primary actors are included, such as industry, real estate developers, and the agricultural sector. These groups are positioned more toward the outer edge of the diagram, indicating a relatively lower level of involvement in the collaboration.

However, these sectors still have significant influence on the energy transition. Additionally, two key players within the private sector are highlighted in this report: developers of renewable energy and heat pump technology. These parties contribute positively to accelerating the shift to sustainable energy sources.

Civic Sector

Finally, within the civic sector of the diagram (see *figure 114*), some actors represent the community in which this study takes place—a group with low income and high dependence on gas. While it has not been possible to actively involve these stakeholders in the process, it is important to recognize them as part of the energy transition, regardless of their level of influence.

Public Sector

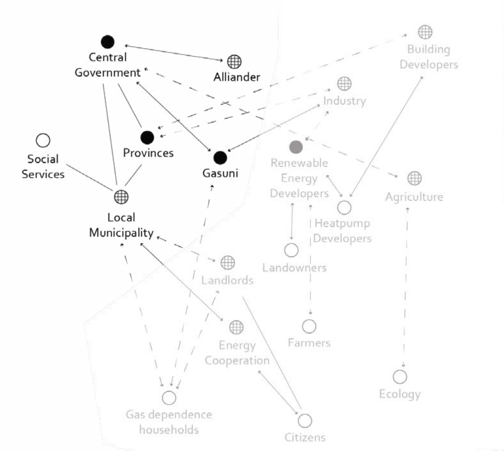


Figure 112: Stakeholders in the public sector.

Private Sector

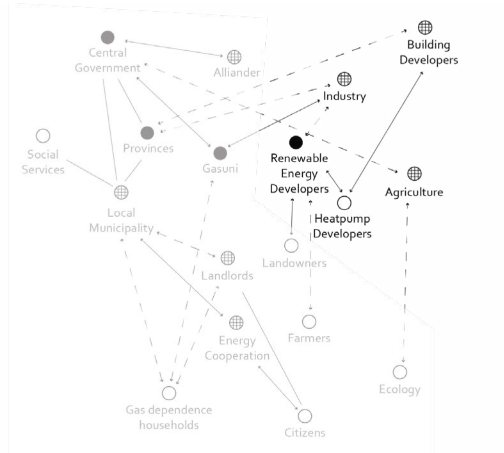


Figure 113: Stakeholders in the private sector.

Civic Sector

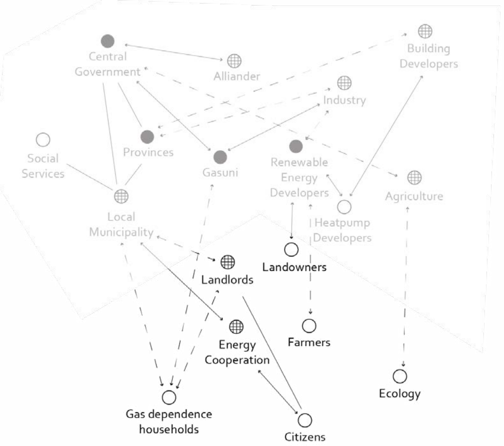


Figure 114: Stakeholders in the civic sector.

STAKEHOLDER RELATIONS

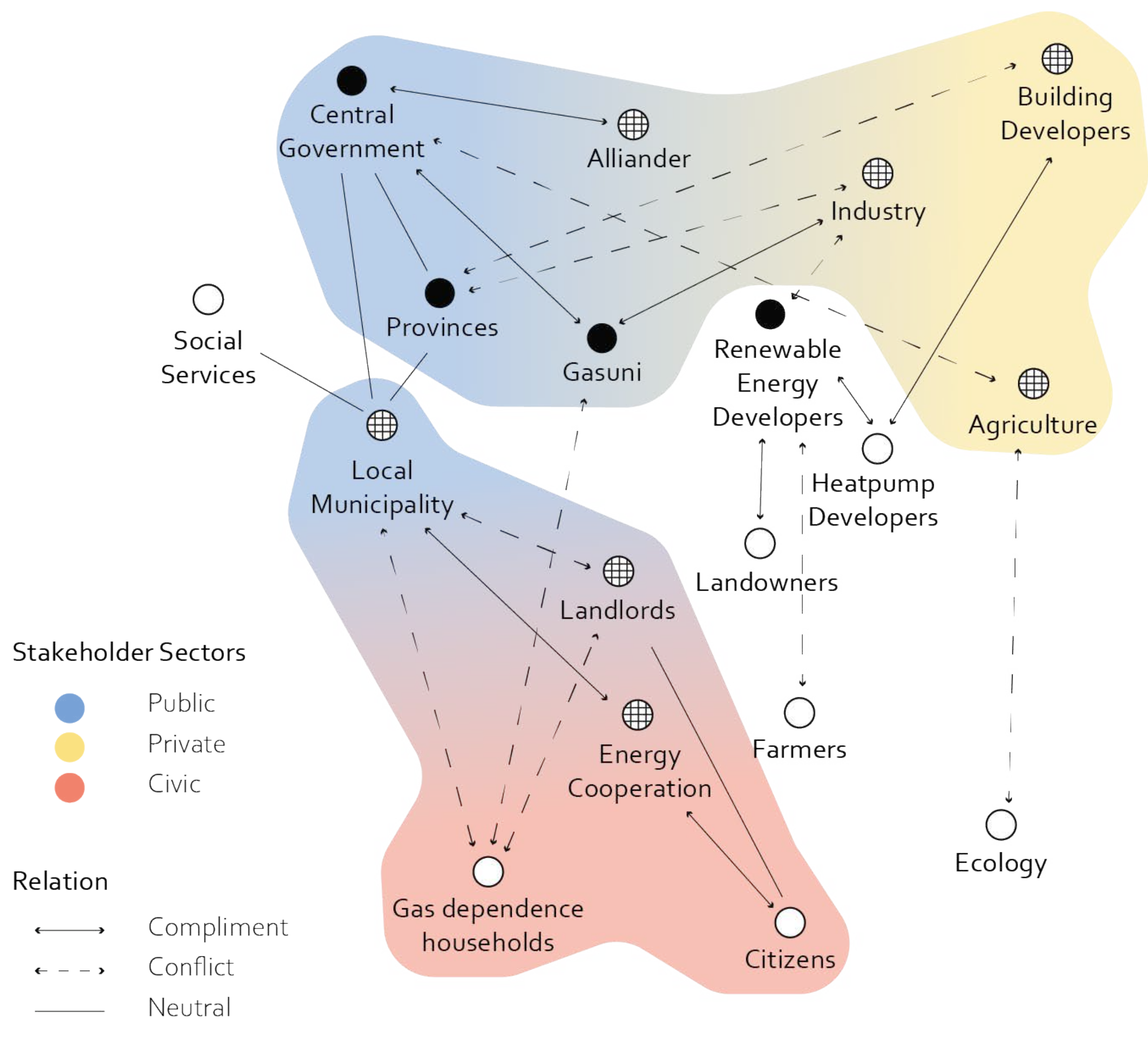


Figure 115: Stakeholders and their relations across each other and sectors.

The analysis of the circle diagram reveals that the various sectors are closely interconnected. Two key fields have emerged from the diagram, highlighting both collaborations and conflicts among several stakeholders (see *figure 115*). Developments in the industry, construction, and agriculture sectors show both close collaboration and conflicts with government institutions. This presents a complex and often challenging process, as the government aims to be energy-neutral by 2050 (Ministry of General Affairs, 2025). Nevertheless, the responsibility for implementing this transition lies with the other stakeholders. A major question today is how this transition can be carried out in a fair and balanced way.

A notable conclusion from the analysis is that municipalities play a crucial intermediary role between the national government and citizens. Municipalities often serve as the first point of contact for residents and play a key role in implementing policy at the local level.

STAKEHOLDERS

Unlike the circle diagram, which shows the level of involvement closer to the center of the circle, *figure 116* illustrates the relationship between power and interest of the various stakeholders. This provides additional insights into the dynamics of the energy transition, highlighting who the most influential players are and which parties may seem less involved but are still crucial to the success of the transition.

A key finding from this diagram is that government institutions, while holding the most power, do not always have the highest level of interest in the energy transition. This creates a challenge, as the actual implementation often falls to other stakeholders, such as private companies and civil society organizations, who may have greater interest but less power. The success of the transition depends on understanding power dynamics and effectively engaging those with the right influence.

The diagram also shows that municipalities, with both power and interest, play a vital role in bridging the national government and citizens. Municipalities can effectively implement local policies, provided they receive the necessary support from higher levels of government and other stakeholders.

Furthermore, it is evident that, although sectors like industry and agriculture show less interest, their influence on the energy transition is substantial. It is essential to actively involve these actors in decision-making to minimize conflicts and foster collaboration (see *figure 117*).

Overall, in the context of the energy transition, it is crucial that the various stakeholders, with their varying levels of power and interest, are effectively brought together to ensure a sustainable and equitable transition. The success of this transition will largely depend on the ability to strike a balance between the different interests and actors involved. The next chapter presents case studies, analyzing various energy transition-related projects and visualizing stakeholders in diagrams. Additionally, the strategy chapter focuses on empowering low-income citizens with high dependence on gas.

POWER-INTEREST MATRIX & INTERDEPENDENCE

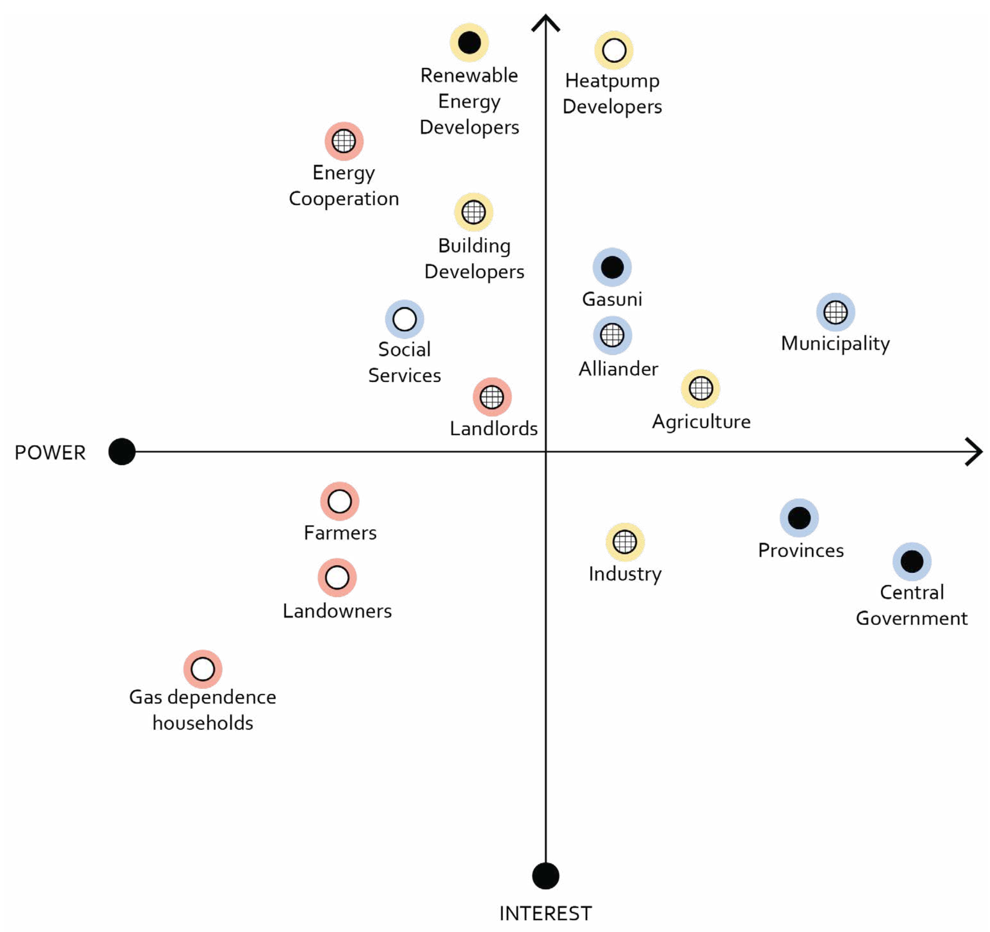


Figure 116: Power-interest matrix of stakeholders.

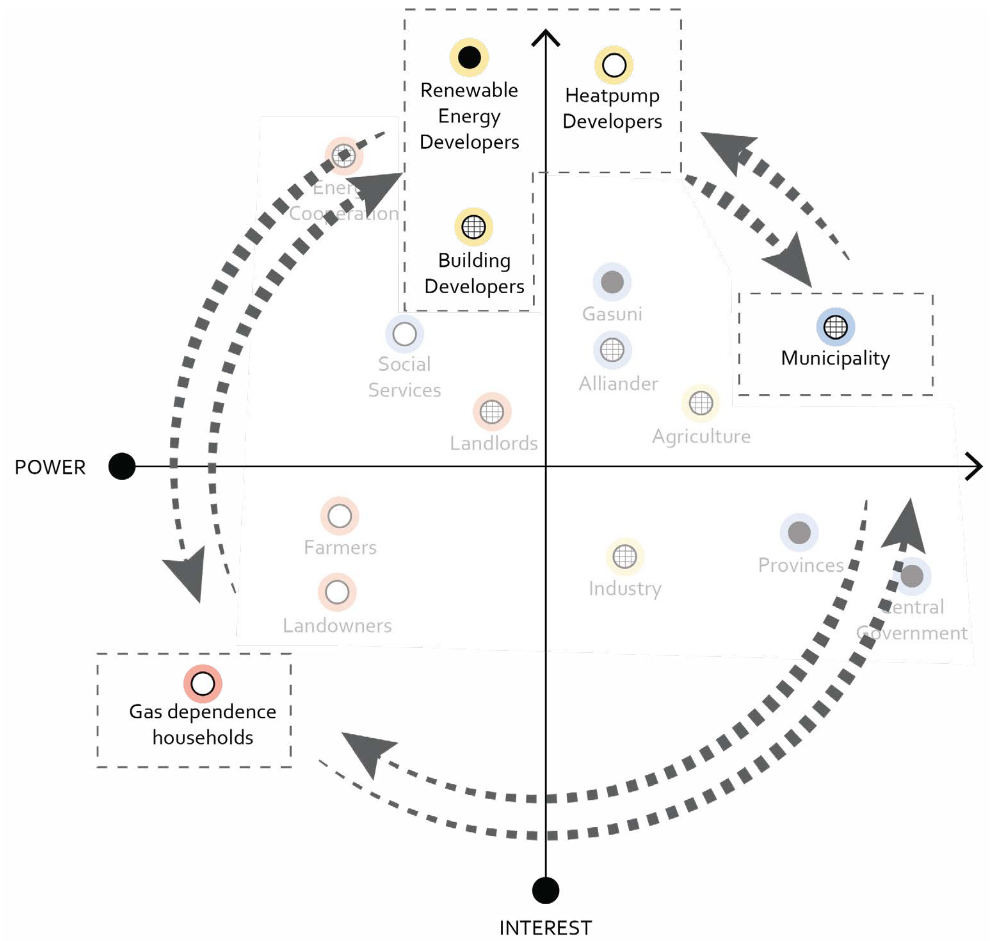


Figure 117: Enabling of less interested, or powerless, stakeholders are crucia. Cooperation between private, public and civic is essential.

CHAPTER V:
SEEKING WAYS

Figure 118: WINDMILL
Oterleek, Near Alkmaar
Photo: Hauge, 2025

POSSIBLE PATHS

WHICH WAY AHEAD?

In the energy transition, various technologies and systems are being explored to efficiently cluster sustainable energy sources. The diagram on the right (see *figure 119*) provides insight into the relationship between geothermal energy (x-axis) and wind and solar energy (y-axis), distinguishing between high and low potential for both energy sources. This results in a matrix with four quadrants and generic outcomes: on-grid, hybrid I, hybrid II, and off-grid.

TYPE I: On the Grid

The on-grid system is suitable for areas with high potential for both geothermal energy and wind or solar energy. It allows excess energy to be fed back into the grid, making it efficient for large-scale applications. This system can be ideal for both urban and rural areas with access to a reliable electricity grid.

TYPE II: Hybrid I

The Hybrid I system uses a combination of renewable energy sources, primarily wind and solar energy, while staying connected to the large electricity grid to ensure a stable energy supply. By integrating multiple energy sources, the reliance on a single source is reduced, increasing the system's reliability.

TYPE III: Hybrid II

In the case of Hybrid II, there is a high potential for geothermal energy in the area, while still maintaining a link to the main grid. In this case, the goal is also to find a good balance between self-sufficiency and integration with the existing grid.

TYPE IV: Off the Grid

In Hybrid II, there is a high potential for geothermal energy in the area, while maintaining the connection to the main grid. Again, the aim is to achieve an optimal balance between self-sufficiency and integration with the existing grid.

Based on this matrix, four case studies were selected, which examine which energy transitions have already been implemented and where further developments are possible (see *figure 120 & 121*). By conducting these case studies, we as a group have not only gained insight into the practical application of energy transitions but also gained better control over the next steps within the strategy.

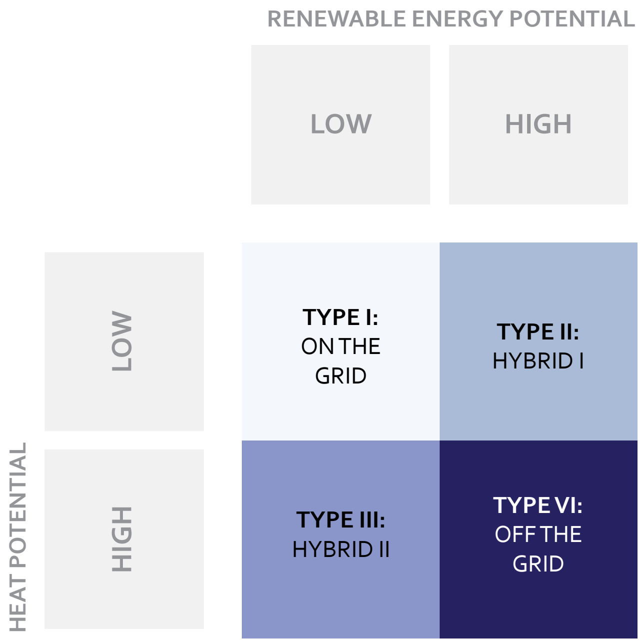


Figure 119: Possible paths depending on overall energy potential.

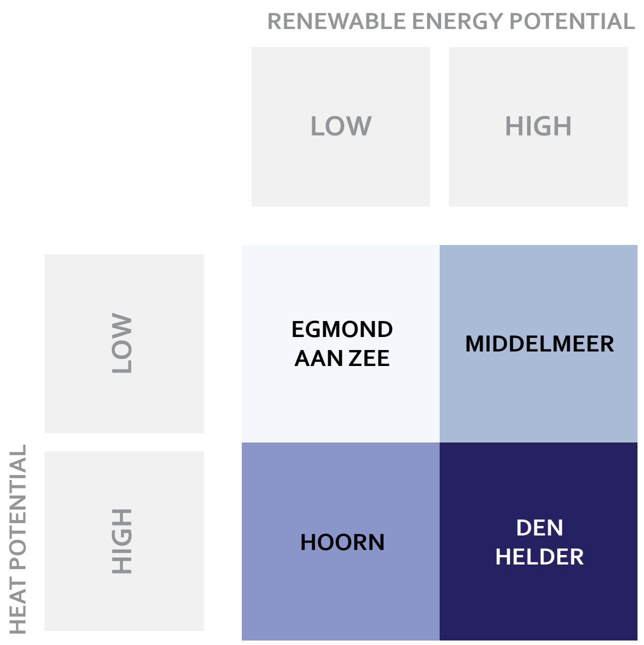


Figure 120: Site selections for each quadrant.

REGIONAL LOCATION OF CASES

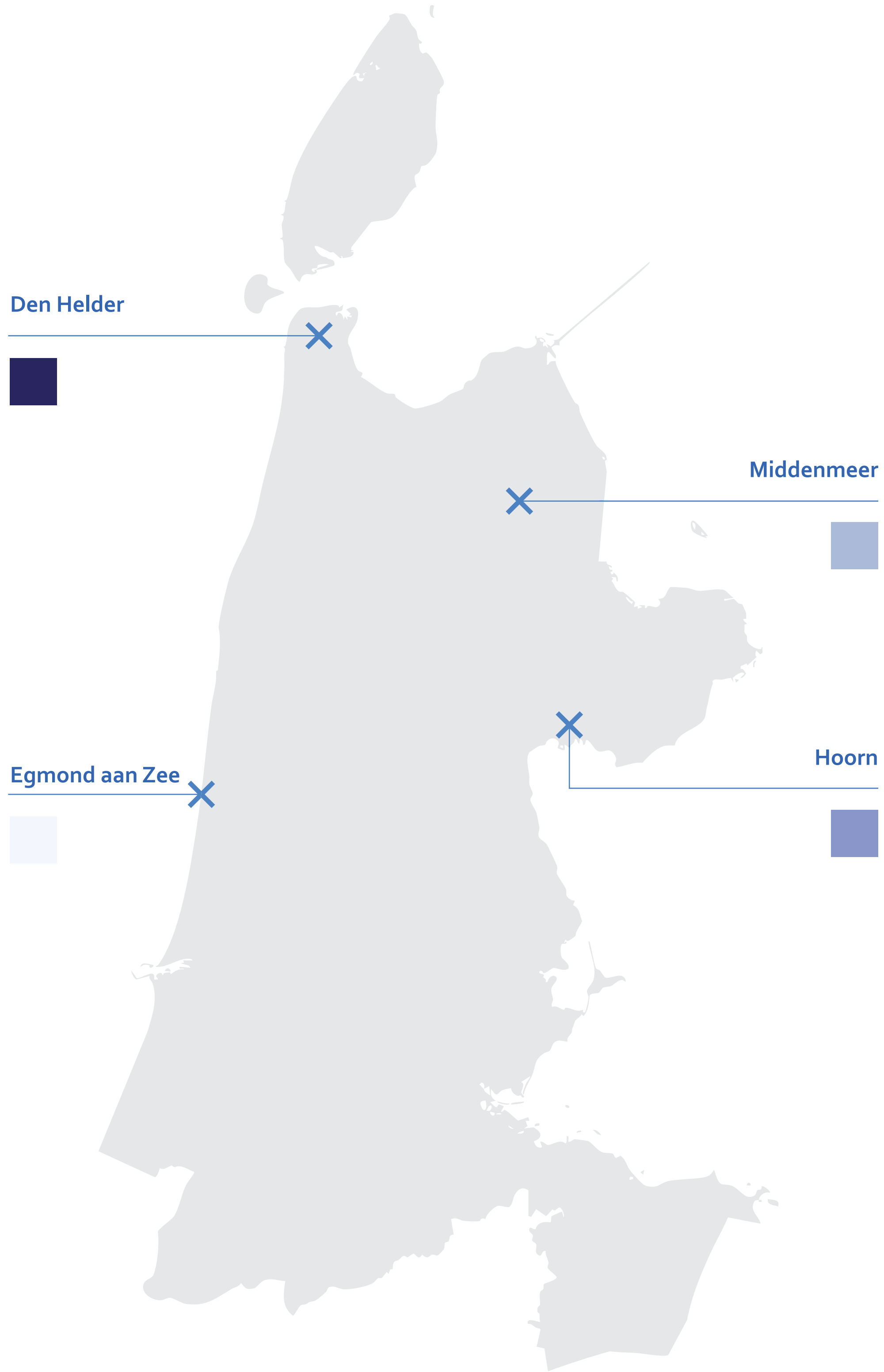


Figure 121: Case locations in North-Holland.

CURRENT SITUATION

Den Helder, one of the larger cities in the province of North Holland, is located on the coast near the Wadden Sea and is known for its maritime history and as the home base of the Royal Netherlands Navy. Despite this strong maritime identity, the city faced a negative image in the late 20th century due to economic decline, population shrinkage, a weaker social structure, and the presence of post-war buildings of moderate quality. Combined with its remote location, these factors made the city less attractive to new residents, putting urban development under pressure (Den Helder, 2023).

To ensure future resilience, Den Helder is focusing on a more sustainable energy system through energy conservation, the localization of supply and demand (*figure 124*), and the development of energy hubs. Energy conservation is essential, as expanding the energy system requires significant investments. The municipality, therefore, promotes initiatives such as home insulation to reduce energy consumption.

Additionally, energy generation and consumption are being brought closer together by placing wind and solar energy near consumers, minimizing transport losses. In areas with high energy demand, energy hubs are being developed to concentrate infrastructure and efficiently support energy-intensive industries (Nieuwe Stap Naar Energiesysteem Van De Toekomst, n.d.). Before starting projects and strategies, it is essential to gain an understanding of the existing structures. On the left, the current main structures for electricity and gas are shown. The main structures are clearly visible, along with the size of the business parks.

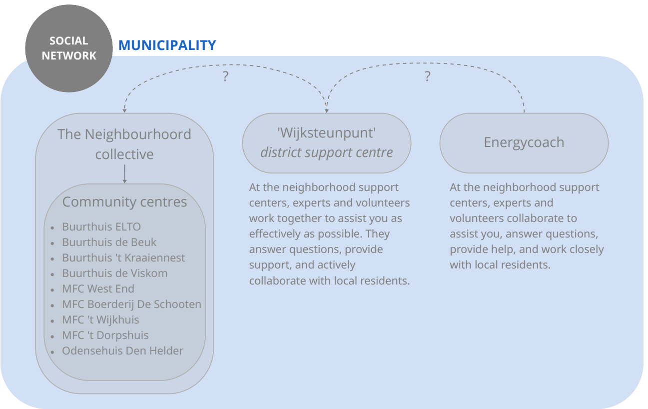


Figure 122: Network of communication and knowledge-sharing.

Social Network

To make the energy transition more accessible, the municipality has established a network to actively involve residents. The Buurtcollectief plays a key role in connecting various community centers across Den Helder (see *figure 123*). Additionally, the wijksteunpunt serves as a physical contact point where residents can ask questions. Since 2022, the municipality has also been training local energy coaches to raise awareness about the energy transition and provide practical advice on energy conservation (Redactie et al., 2024).

Social Network
with local centres & connectors

Community Centre
Main Streets

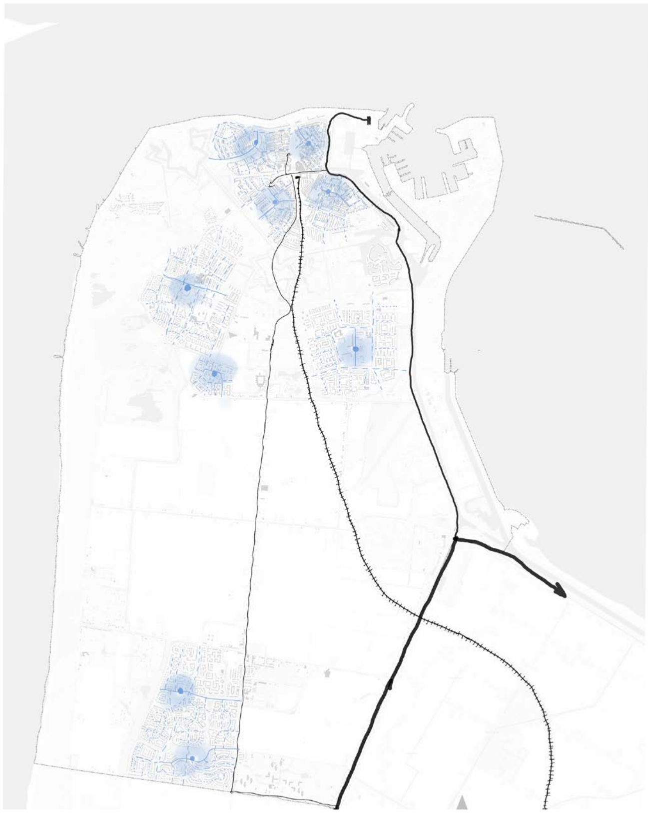


Figure 123: Map of community centres and street networks which spatially indicate the larger social networks of Den Helder (Source: OpenStreetMap).

HEATING & ELECTICAL INFRASTRUCTURE

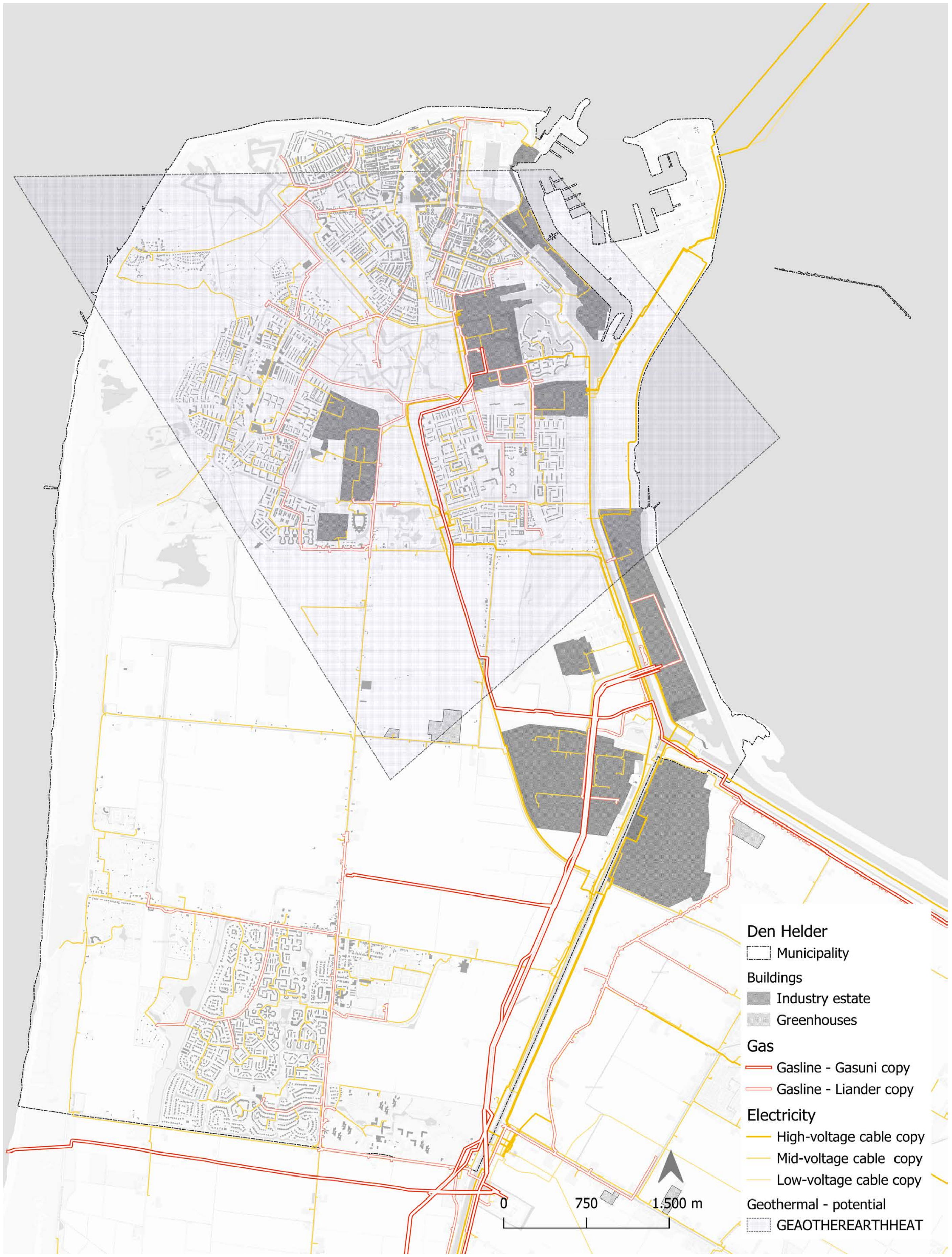


Figure 124: Map of main heating and energy networks in Den Helder, along with its geothermal potential (Source: OpenStreetMap & Warmte Atlas)

ENERGY PROJECTS

In Den Helder, several projects are underway related to the transition to sustainable energy. Valuable lessons have been learned from these three projects regarding the factors that are currently missing but have potential. First, a brief explanation of these projects is provided, followed by the addition of potential implementations to the potential map. An overview of stakeholders can be seen in *figure 125*.

Stakeholders & Relationships

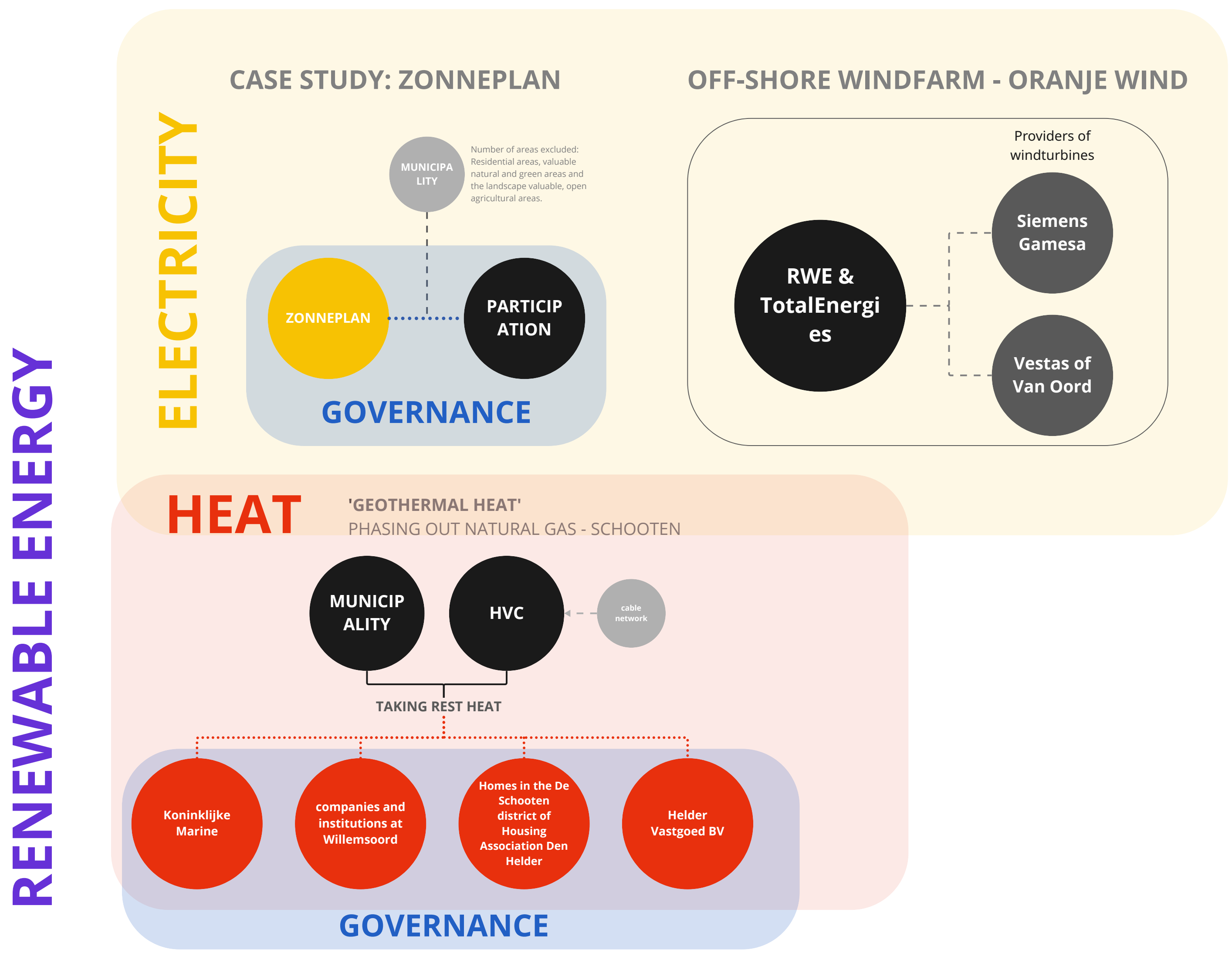


Figure 125: Stakeholders involved with the different energy projects in Den Helder.

OranjeWind - Offshore Wind Project

OranjeWind is a joint project by RWE and TotalEnergies for the development of an offshore wind farm in the North Sea. Den Helder has been selected as the home base for the operation and maintenance of the wind farm. The Blue Port Centre will serve as the onshore hub for the operational teams (RWE, 2024).

RWE & TotalEnergies

RWE is a German energy company and one of Europe's largest producers of renewable energy. It invests significantly in wind, solar, and hydropower, alongside gas-fired power plants.

TotalEnergies, a French energy group, began as an oil and gas company but is increasingly focusing on sustainable energy. It aims for a broad energy mix and plays an active role in the energy transition.

Both companies are joining forces in OranjeWind.

Siemens Gamesa and Vestas

Siemens Gamesa and Vestas are both leading technological companies that specialize in wind energy. Siemens Gamesa, with over 40 years of experience, focuses on the development, production, installation, and maintenance of wind turbines, offering a wide range of onshore technologies suitable for various conditions (Home, n.d.).

Similarly, Vestas, founded in 1945, is a Danish manufacturer and installer of wind turbines, having installed more than 154 GW of wind power across 87 countries, establishing itself as a significant player in the global market (Offshore Wind Turbines | Vestas, n.d.). Both companies are at the forefront of innovation and technological advancement in wind power solutions.

Nijverheidsweg - Geothermal Project

The Den Helder municipality has identified Nijverheidsweg 7 as a potential site for the development of a geothermal source. If established, the Royal Navy would be the main purchaser of the heat. Additionally, other potential buyers include companies and institutions in Willemsoord, as well as homes in the De Schooten district, owned by Housing Association Den Helder and Helder Vastgoed BV (Aal, 2022).

Gemeente Den Helder

The municipality has a stake in the process as it designated the location and thus granted permission for further progress.

HVC

HVC plays a key role in the development of the geothermal project at Nijverheidsweg in Den Helder. The company is responsible for applying for the government subsidy (SDE++) necessary for the project's realization. Once all conditions are met, HVC will also oversee the construction of the geothermal source (Aal, 2022).

Consumers & Users

Various parties will make use of this geothermal project. In March 2022, several parties signed a collaboration agreement with the municipality and HVC, with further research needed to make the project feasible.

Zonneplan - Solar Project

Zonneplan is a for-profit company that focuses on solar energy solutions. It operates independently and is not part of the government or a non-profit organization. The company specializes in offering solar panels, energy storage, and related services for residential customers. It is not a government entity but rather a private business within the renewable energy sector. (Projecten in Den Helder | Profiteer Met Zonneplan, n.d.)

Participation

People should invest themselves in products that are offered. However without subsidies.

Gemeente Den Helder

The municipality has a requirement that certain areas should not be included in the energy transition. So that the value of the landscape is preserved.

Zonneplan

Zonneplan is a company operating in Den Helder, however, one drawback is that it focuses on the commercial sector and does not invest in circular developments where low-income people can also be a part of.

POTENTIAL FUTURE

Den Helder demonstrates clear ambitions in the field of energy transition, supported by a wide range of initiatives. The use of geothermal energy offers opportunities to disconnect both households and businesses from natural gas. Additionally, the city has several industrial sources of residual heat that can be utilized for sustainable heating (see *figure 126*).

As previously mentioned, RWE and TotalEnergies are establishing operations in Den Helder's port. This not only creates employment but also serves as a valuable source of technological knowledge for other businesses in the region.

The municipality also places strong emphasis on involving residents in the energy transition. This opens the possibility of transforming local community centers into energy hubs where citizens collaborate on a sustainable future.

Finally, the Kooypunt industrial area is positioning itself as an emerging regional energy hub. There is also potential to connect this development with surrounding residential neighborhoods, including Julianadorp and parts of Den Helder, to further amplify the reach and impact of sustainable initiatives.

Overall, these case studies offer valuable insight into the city's future. However, certain components are still lacking—particularly the inclusion of low-income, high gas-dependence communities. This issue will be addressed in further detail later in the report.

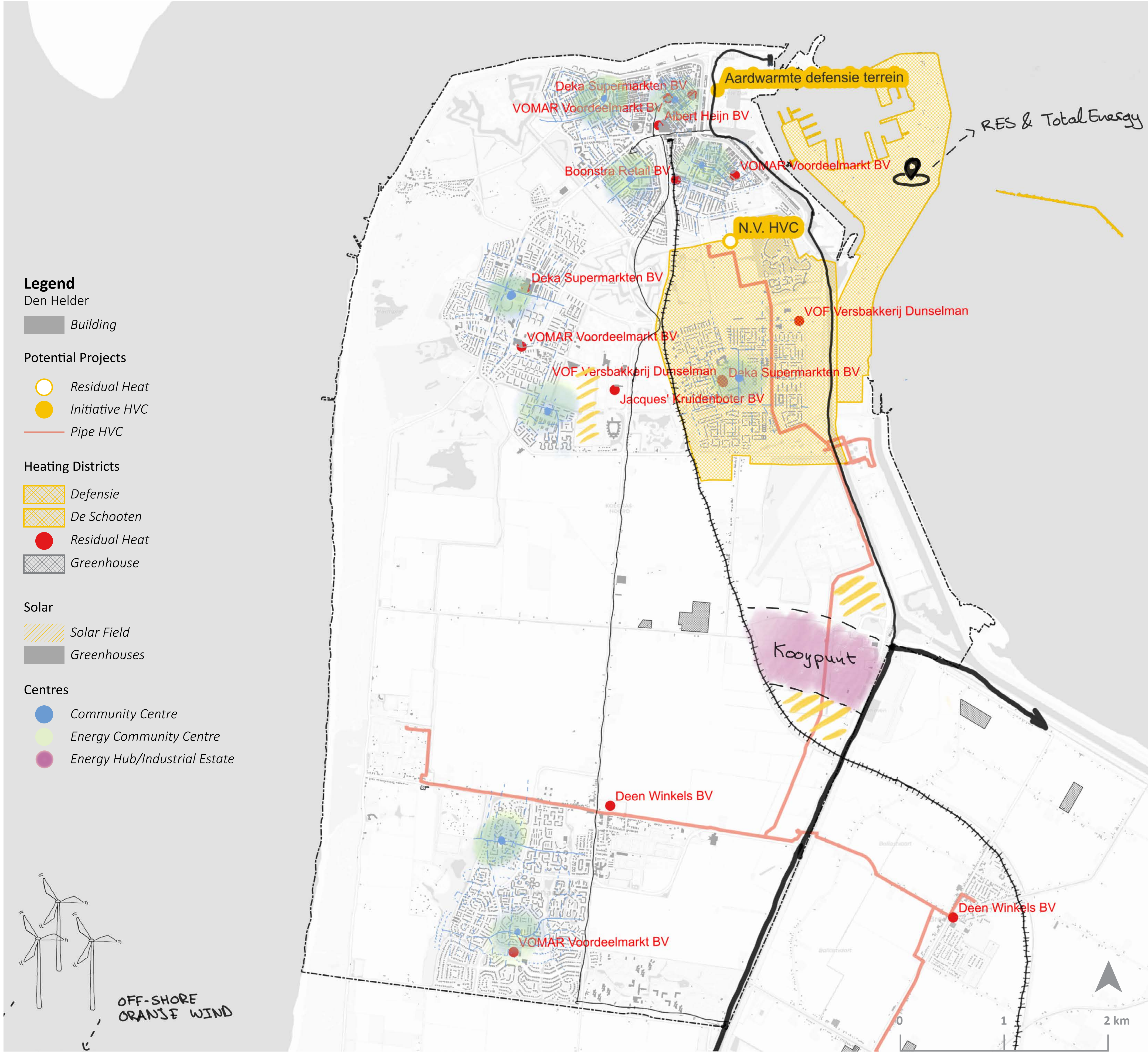


Figure 126: Map of key infrastructure in Den Helder and potential future measures (Source: OpenStreetMaps)

CURRENT SITUATION

Egmond aan Zee is a village situated on the North Sea coast. According to the energy potential quadrant, the village falls into type 1, which is characterized by low potential for renewable energy and alternative heat sources.

Based on this classification, it is anticipated that Egmond aan Zee must be fully connected to both the electricity grid and the heating grid, as the likelihood of establishing an independent grid is minimal. This is despite having a lesser demand than the national average (see *figure 127*).

Infrastructure as a Challenge

An examination of the local energy infrastructure reveals that Egmond aan Zee, within the municipality of Bergen, is disconnected from both the main heating and electricity grids (see *figure 128*). The area's low energy potential has led to reduced interest from energy operators, resulting in a sparse energy grid. This suggests that investment pressure, rather than just high energy potential, plays a significant role in grid connectivity. Consequently, residents are unlikely to rely on the existing heating grid.

In line with this, Bergen has decided against pursuing a large-scale heating network. The municipality's 2020 Vision for Natural Gas-Free Districts concluded that the area is unsuitable for such a network. As a result, the responsibility for becoming gas-free now lies primarily with homeowners. The municipality encourages residents to explore alternative heating solutions tailored to individual streets or neighborhoods.

If shifting independently is the only option for residents, how can the community establish its own heating grid without substantial infrastructure and investment?

Key Statistics

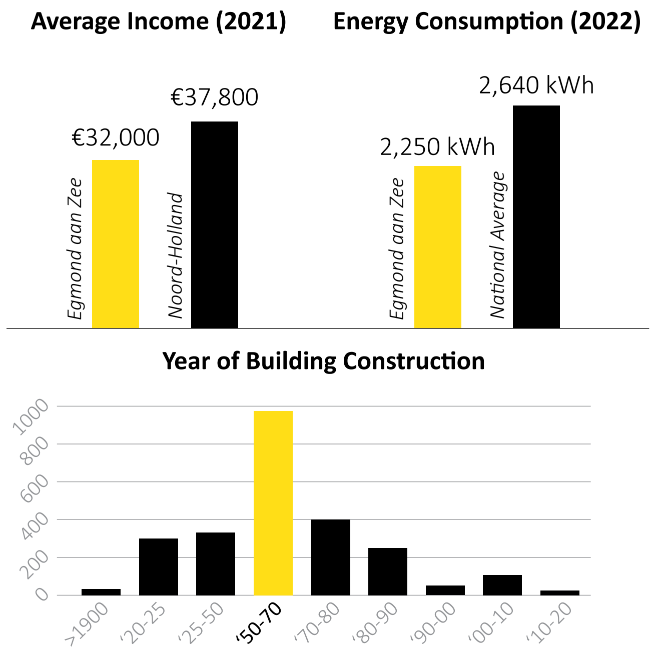


Figure 127: Average income, energy consumption and year of building age for Egmond aan Zee (CBS, 2022).

HEATING & ELECTICAL INFRASTRUCTURE

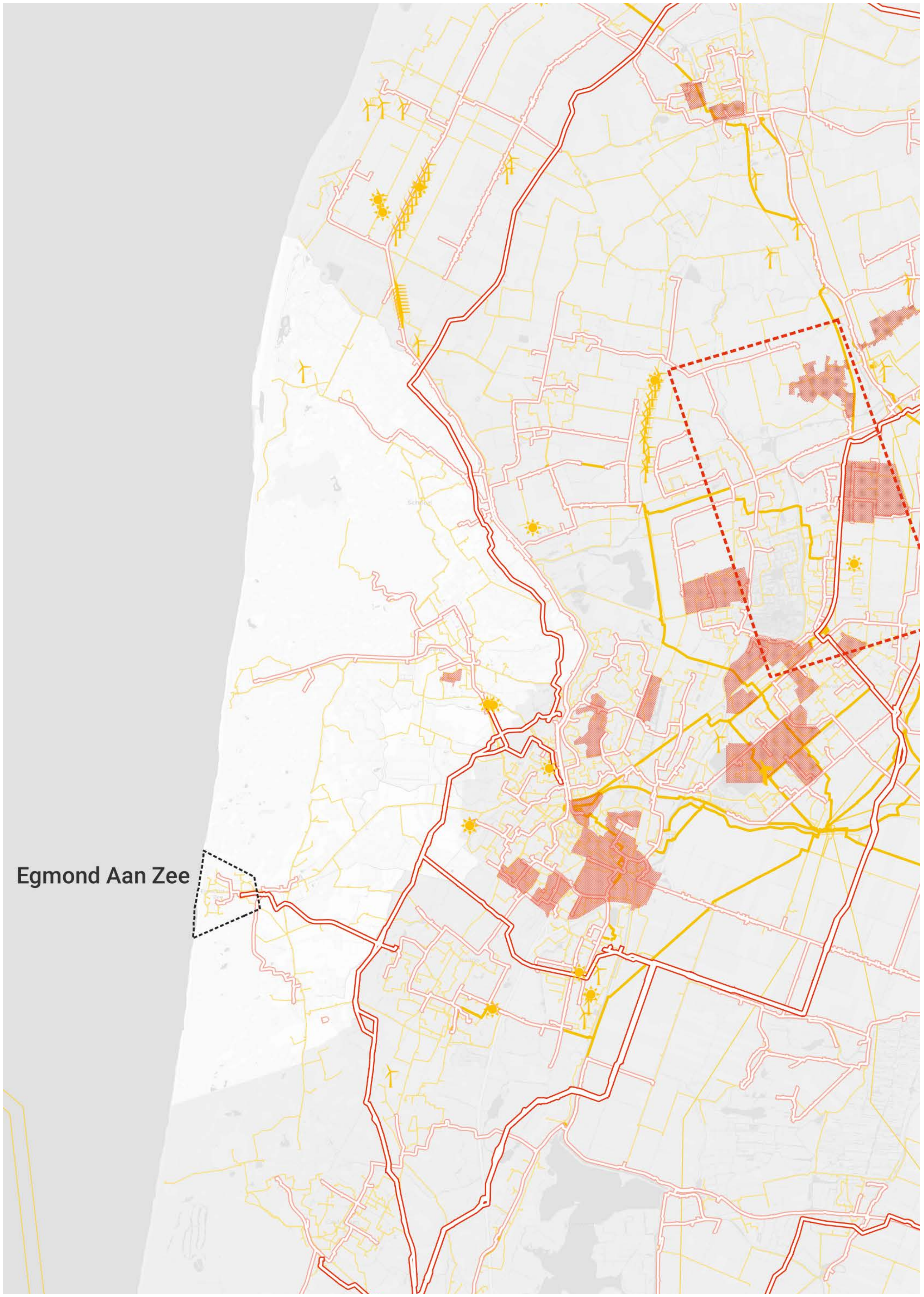


Figure 128: Map of main heating and energy networks in Egmond aan Zee (Source: OpenStreetMap)

KENNEDY FLAT

Community-Formed Energy Grid

A potential answer to this question can be found in an apartment building in Egmond aan Zee, the Kennedy Flat. This building, constructed in 1963, successfully transitioned from natural gas to sustainable heating in 2021. Moreover, it serves as a notable example of an affordable transition away from gas dependency (Eteck, 2022).

The 74 households in Kennedy Flat benefited from the support of Vereniging van Eigenaren (VvE), a homeowners' association. One of the key roles of this association is to assist residents by providing sustainable housing solutions (see *figure 129*).

For Kennedy Flat, VvE initiated collaboration with Eteck to facilitate the transition to a new heating system. Eteck, in partnership with Kersten Energy Techniek, managed the installation of a heat pump and continues to oversee its operation and maintenance.

To supply additional electricity for the heat pump, VvE installed 270 photovoltaic (PV) panels on the roof and rented them to residents. This arrangement allowed residents to transition to the new heating system without an increase in their energy bills.

To further reduce financial burdens, VvE actively utilized government support policies for the energy transition. Financing was secured through loans from the National Heating Fund, and subsidies for the installation of the heat pump were allocated to Eteck, leading to a reduction in installation costs.

Stakeholders & Relationships

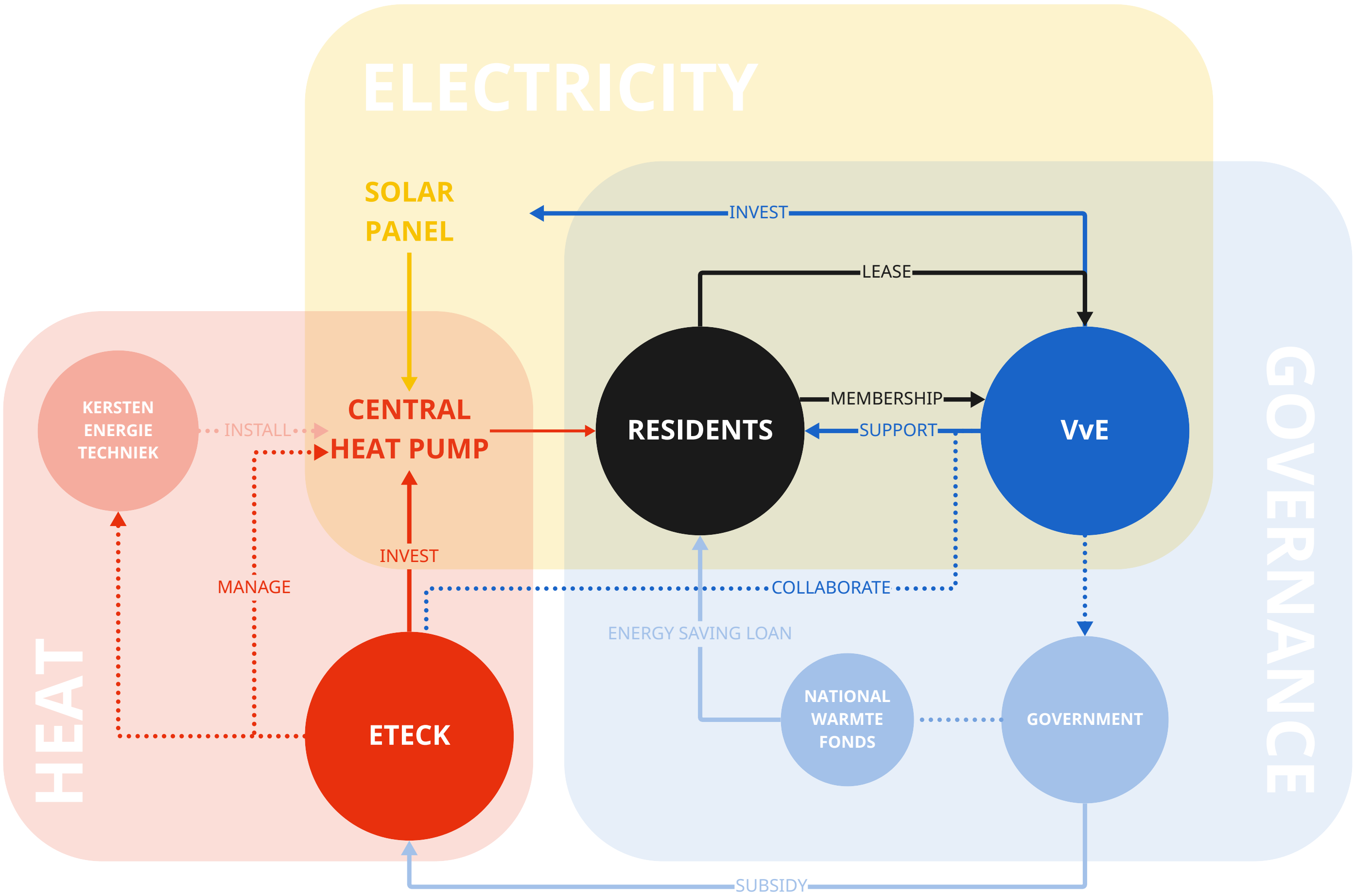


Figure 129: Stakeholders involved with the different energy projects in Egmond aan Zee.

Community

Kennedy Flat consists of 75 dwellings. The homeowners came together to form VvE Kennedyflat, aiming to implement a new heating system. Since they had already invested in building insulation in 2005, transitioning to a low-temperature heating system was easier, without requiring additional insulation improvements.

Developer, Operator

Eteck is the operator of the new heating system at Kennedy Flat. In collaboration with Kersten Energietechniek, they installed an air-water heat pump system. Eteck owns, manages, and maintains the heat pump within the building, ensuring reliable operation. As the system operator, Eteck guarantees heat production and the functionality of the installation throughout the operating period.

Central Heat Pump

The air-water heat pump is installed in building, supplying space heating and tap water. The air-water heat pump is an installation that heats the outside air to a temperature that can heat the home. The energy generation system is all-electric, not using any gas.

Supporter

The homeowners' association, VvE, played a key role in supporting the initiative, particularly in making the project more affordable. They secured financing under favorable conditions through the National Energy Saving Fund and installed 270 PV panels on the roof, renting them to residents to enhance access to renewable energy.

Energy Saving Loans

The Energy Saving Loan is a financing instrument designed to support energy-efficient upgrades in residential properties. It offers accessible funding options for owner-occupiers and homeowner associations, regardless of age or income, thereby facilitating sustainable home improvements through low monthly repayments. Residents of Kennedy flat earned €600,000 from energy saving loans.

EGMOND AAN ZEE:

SCALE MATTERS

The case of Kennedy Flat demonstrates that scale is a crucial factor in heating networks. Traditional heating systems were typically limited to two options: being part of a large district heating network or relying on an individual gas boiler. However, with the transition away from natural gas, a wider range of heating solutions has emerged, allowing for systems that cater to different scales. For communities that cannot be integrated into a large heating network, smaller-scale heating networks present a viable alternative.

In alignment with this shift, NPLW published the Guidelines for Mini and Small-Scale Heating Networks in 2024. These guidelines propose a multi-scale approach to heating networks, offering tipping points and indicators for selecting appropriate technologies and governance models based on specific circumstances. According to the guidelines, beyond well-known systems such as geothermal and aquathermal—both of which typically require at least 500 households—there are alternative solutions suited for smaller communities. One such option is a shared heat source for collective heat pumps. Additionally, smaller networks offer governance advantages, as they facilitate active community engagement. In such cases, even a resident's living room can serve as a meeting space for decision-making.

Drawing from the Kennedy Flat experience and the NPLW guidelines, there is clear potential for multiple small-scale heating networks to emerge in Egmond aan Zee. This approach provides an effective alternative to individual heating solutions, particularly given Bergen's decision not to develop a large-scale heating network. Furthermore, it represents an affordable and accessible option for other sparsely populated villages.

MINI HEATING NETWORK

Suitable for smaller communities such as individual streets, housing blocks, or collective housing units.

Less regulation for communities with 10 or fewer homes, allowing more organizational freedom.

Cost-effective and flexible, ideal for groups with lower budgets.

Lower investment requirements compared to large-scale district heating.

MINI HEATING NETWORK

Appropriate for communities at the neighborhood level.

Can be initiated by various groups, including residential and industrial sectors.

Offers potential for evolving into a system that combines multiple heat sources, providing enhanced flexibility through interconnection.

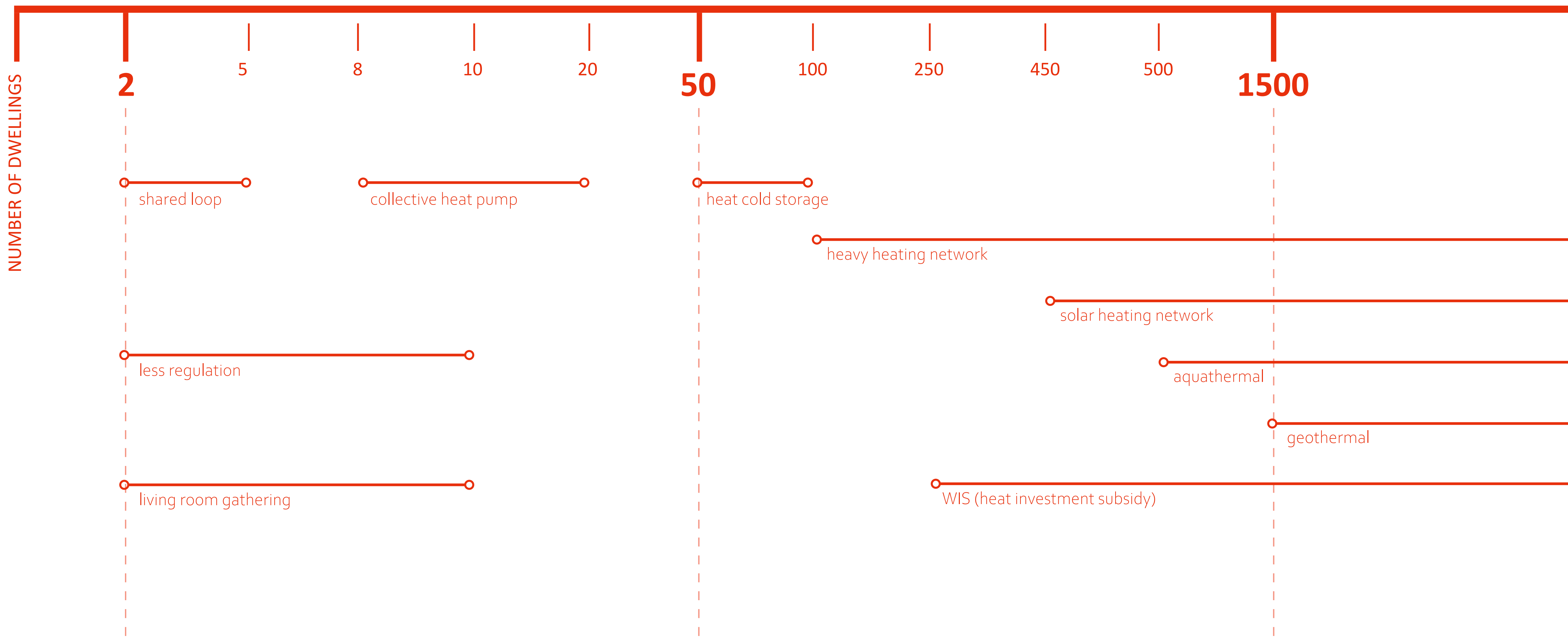
Requires collaboration with a full-fledged heating company, while still allowing communities the freedom to select a provider that best fits their unique situation.

BIGGER HEATING NETWORK

Suits the traditional scale of district heating, ranging from district to regional levels.

Offers more options for heat sources, making it suitable for complex systems such as geothermal.

Imposes less responsibility on end users.



EGMOND AAN ZEE:

POTENTIAL FUTURE

To promote mini heating networks at the district level, it is essential to utilize existing social center points as catalysts for the heat transition (see *figure 130*). Drawing on the NPLW guidelines and advice from Jelte of Energy van Rotterdam, several potential center points for mini heating projects have been identified.

One promising option is collective housing complexes containing more than 50 dwellings. These settings facilitate collaboration because the households are already organized, often through homeowners' associations or housing companies. This structure makes it easier to install a small heating network, and these complexes can later expand the network by connecting surrounding buildings to a central heat pump system.

Another viable starting point is existing community centers, such as wijks punts, which are already established to support local residents. These centers can easily integrate energy initiatives, and, if the projects are successful, other public buildings like schools may also evolve into energy centers in the future.

Ultimately, when there is significant interest in heat transition across the district, even a modest gathering—such as a living room shared by five neighbors—could become the nucleus of an energy community. The blue-highlighted areas on the map represent the initial locations for this movement, potentially spawning numerous small-scale energy change centers.

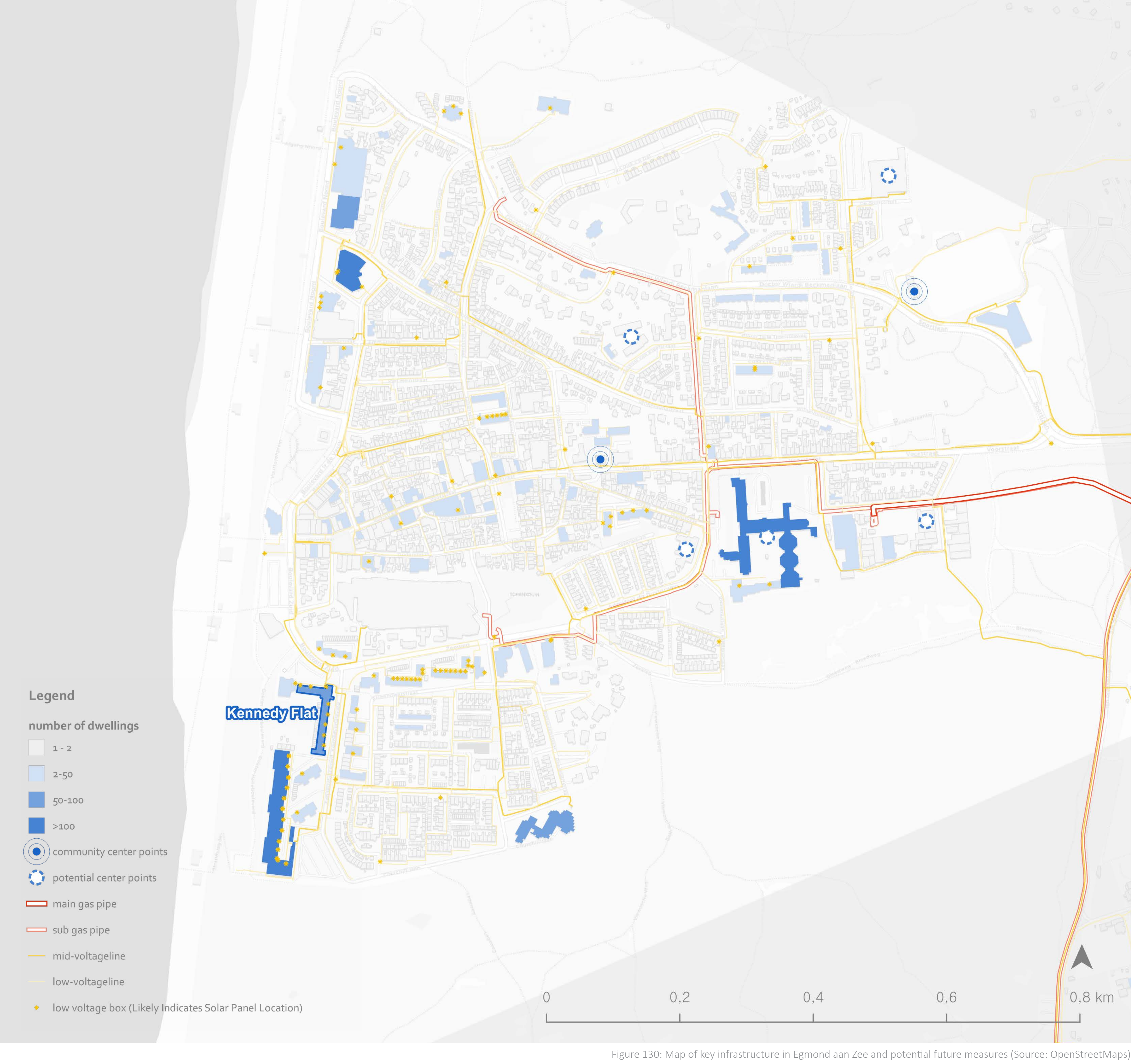


Figure 130: Map of key infrastructure in Egmond aan Zee and potential future measures (Source: OpenStreetMaps)

CURRENT SITUATION

Hoorn, located on the Markermeer in the West Friesland region, is a historic city with a rich trading history dating back to the Dutch Golden Age. Once a major hub for the Dutch East India Company (VOC), the city features a distinctive urban character with monumental buildings and harbor that reflect its maritime past. Over the course of the 20th century, Hoorn developed into a regional center with a mix of urban amenities and residential neighborhoods, partly due to its favorable location near Amsterdam (InHoorn, 2022).

Despite this growth, Hoorn also faces socio-economic challenges. The city's expansion has brought spatial and infrastructural pressures, while a portion of the housing stock consists of outdated buildings in need of redevelopment and sustainability upgrades. Additionally, certain neighborhoods struggle with energy poverty, making the energy transition not only a technical task but also a social one. In this context, the municipality of Hoorn is working toward a future-proof city, with sustainability, inclusivity, and regional cooperation at the core (Faas, 2024).

As a result, Hoorn is pursuing a sustainable future through an ambitious energy transition. The city aims to become energy-neutral by 2040. In 2019, the Hoorn city council adopted a so-called "Heat Transition Vision" ("Transitievisie Warmte"), developed in collaboration with several partners to guide the transition (see *figure 131*) (Hier.nu, n.d.).

Hoorn still has a well-developed natural gas network (see *figure 133*), with many households connected to it. Industrial areas are clearly visible on the map, and these zones hold significant potential for the future application of geothermal technologies. The municipality of Hoorn is actively exploring these opportunities.

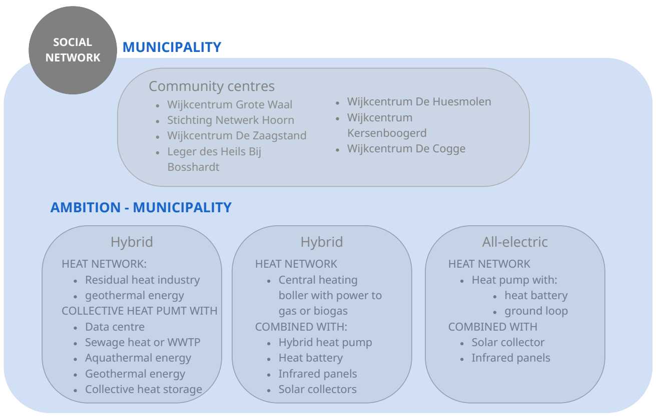


Figure 131: Overview of municipal goals and community centres.

Social Network

The municipality of Hoorn has several visions regarding the geothermal energy network, exploring various solutions. However, none of these visions have been implemented yet.

Furthermore, there are several community centers located in Hoorn. It is noteworthy that these are situated precisely in areas with rental housing typologies (see *figure 132*).

Social Network
with local centres & connectors

Rental Housing
Community Centre
Main Streets

Figure 132: Map of community centres, rental housing and street networks of Hoorn (Source: OpenStreetMap).

HEATING & ELECTICAL INFRASTRUCTURE

Figure 133: Map of geothermal potential, possible distribution through gas pipes and the local grid in Hoorn (Source: OpenStreetMap)

Stakeholders & Relationships

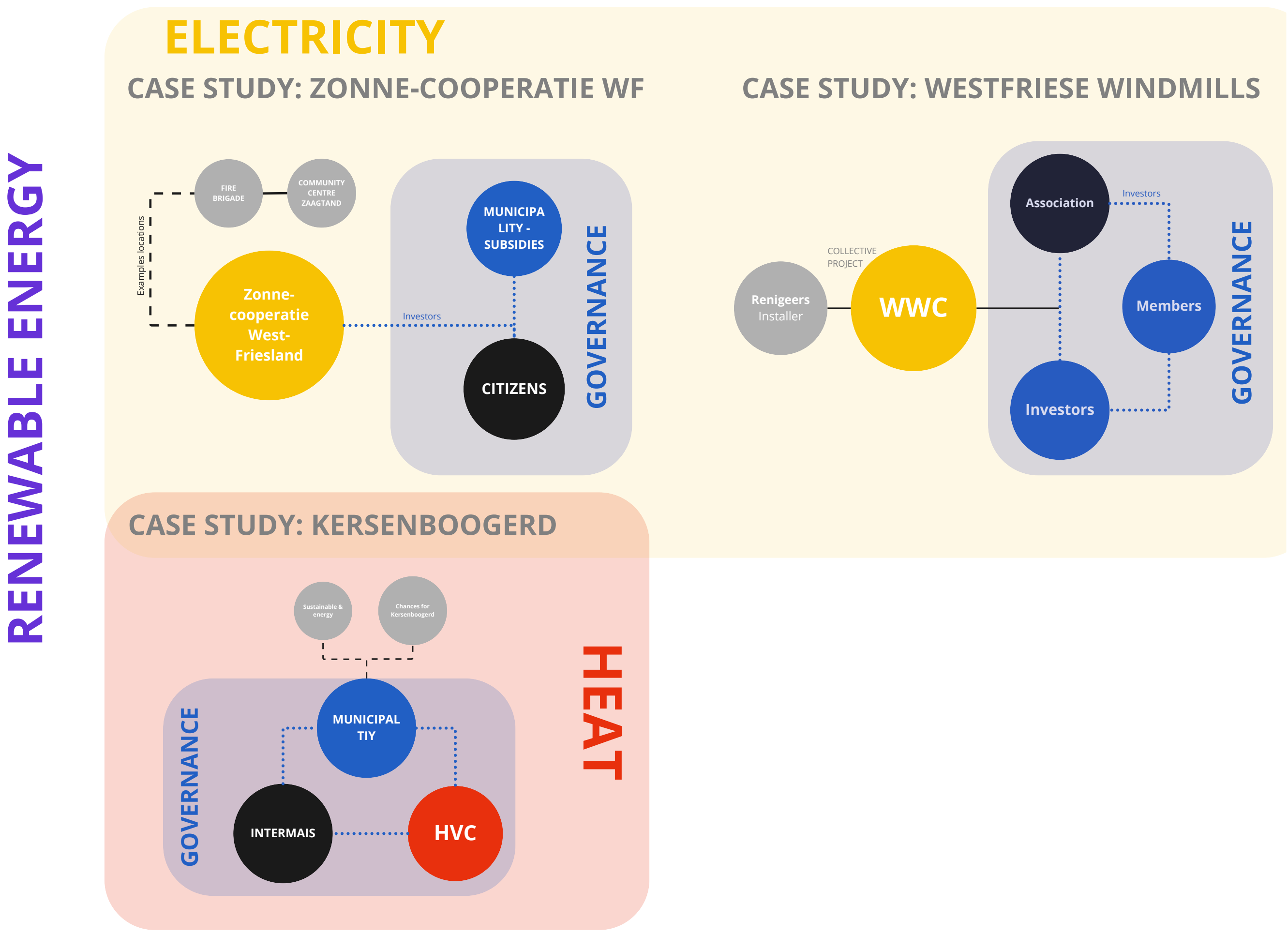


Figure 134: Stakeholders involved with the different energy projects in Egmond aan Zee.

Zonne-cooperatie- Solar Project

Zonnecoöperatie West-Friesland (ZCWF) is a sustainable energy cooperative that aims to make locally generated solar energy accessible to people who do not have a suitable roof for solar panels. By purchasing solar certificates, members can contribute to shared solar projects, where solar panels are installed on rooftops of buildings such as fire stations, sports halls, schools, and agricultural sheds. This allows participants to invest in and benefit from local green energy, without needing to install panels on their own homes (see *figure 134*) (Zonnecoöperatie West-Friesland, n.d.).

Citizens

The volunteers of the cooperative are committed to the sustainability of West-Friesland. Membership is available through registration, which requires a fee of €25, refundable upon cancellation. Members can purchase certificates for collective solar roofs (one per panel) and benefit from sustainable energy. Households and small businesses can buy between 2 and 20 certificates. The returns are paid out annually in arrears (Coöperatie Zonnecoöperatie West-Friesland (ZCWF) U.A., 2021).

Gemeente Hoorn

The municipality of Hoorn plays a supporting and facilitating role within the Zonnecoöperatie West-Friesland project. For example, the municipality provided the roof of the fire station for the installation of solar panels. By making municipal property available for such initiatives, the municipality helps local residents actively participate in the energy transition. This collaboration demonstrates how municipalities can strengthen sustainable citizen initiatives by offering space, trust, and sometimes financial or policy support (Corine, 2023).

Participation

In 2018, 16 members of Zonnecoöperatie West-Friesland collectively invested in 200 solar panels on the roof of the fire station in Hoorn. Each member purchased an average of 12.5 certificates at €390 each. The installation generates around 53,100 kWh annually and contributes to a CO_2 reduction of 28 tons per year. This way, members directly benefit from local, sustainable energy (Zonnecoöperatie West-Friesland, 2024).

Westfriesa - Offshore Wind Project

Westfriese Windmolen Coöperatie (WWC) is a cooperative focused on developing and managing wind energy projects in the West-Friesland region. WWC's goal is to generate sustainable energy while promoting local involvement through memberships and investments. The cooperative owns several wind farms and collaborates with various parties to advance the energy transition (Westfriese Windmolen Coöperatie, 2022).

Association

The cooperative itself manages and organizes the wind energy projects. This includes operational tasks such as maintaining the wind farms, handling legal and administrative matters, and communicating with members and investors. The cooperative ensures that everything runs according to plan and that the goals of sustainable energy production are achieved.

Rengineers

Rengineers is a company specializing in the installation of renewable energy systems. They are responsible for the installation of wind turbines for Friesawind, a project managed by the Westfriese Windmolen Coöperatie (WWC). As skilled installers, Rengineers plays a crucial role in ensuring the smooth and efficient setup of wind turbines, contributing to the overall success of the wind energy projects in the West-Friesland region (Rengineers – Renewable Energy Engineers, n.d.) .

WWC

The members of Westfriese Windmolen Coöperatie (WWC) play a crucial role by investing in the cooperative. As members, they can benefit from the proceeds of the wind energy projects. They actively contribute to the sustainability of their region by financing wind farms and are offered returns in the form of recurring profits.

Investors

External investors can contribute to the financing of the wind farms, which allows the cooperative to realize larger and more ambitious projects. In return for their investment, these investors receive a portion of the proceeds from energy production. This model ensures that the cooperative is not entirely dependent on its members but can be financed more broadly.

'Kersenboogerd'- Residual Heat Project

The Hoorn district heating network is an important project aimed at making the city gas-free (Hoorn Kersenboogerd, n.d a). After extensive preparations, the construction of the network began in the Kersenboogerd neighborhood. The project is being carried out by the Municipality of Hoorn, housing corporation Intermaris, and HVC, with the goal of making the region more sustainable by providing homes with renewable heat (Hoorn Kersenboogerd, n.d.b).

Internaris

Intermaris, the housing corporation, is responsible for connecting the homes in Kersenboogerd to the district heating network. The company is making the homes more energy-efficient and ensuring they are ready for the new heating source. Intermaris actively involves the residents in the process, which is crucial for the successful implementation of the district heating network (Woonlastengarantie Warmtenet Voor Huurders Intermaris | Hoornkersenboogerd, n.d.).

Gemeente Hoorn

The Municipality of Hoorn plays a key role in the district heating project by collaborating with Intermaris and HVC. Kersenboogerd was chosen as the first neighborhood to be connected to the network due to its high density of homes, making it efficient to connect this area. The project supports the municipality's goal of becoming energy and climate-neutral by 2040 (Home | Hoornkersenboogerd, n.d.).

HVC

HVC is a public heat company that supports the Municipality of Hoorn in achieving a gas-free future. They are responsible for the technical execution of the district heating network, including laying pipes and connecting the homes. HVC works with the municipality and Intermaris to integrate a sustainable heat source, such as aquathermy or geothermal energy, into the system (Feestelijke Start Warmtenet Hoorn, n.d.).

POTENTIAL FUTURE

Hoorn has significant opportunities for further sustainability. Expanding the district heating network to other neighborhoods and surrounding cities could create a broader system for sustainable heating and further reduce CO_2 emissions. Additionally, Hoorn could invest in various renewable energy sources, such as solar energy on municipal rooftops and energy storage, which would make the energy system more resilient (see *figure 135*).

By involving more local residents and businesses in energy cooperatives, engagement can increase, leading to greater support for the energy transition. The West Frisian Windmill Cooperative could also develop larger wind farms to improve efficiency. Finally, there is potential to raise awareness about renewable energy through educational programs, which could encourage more participation and demand for sustainable solutions.

OPPORTUNITY MAP

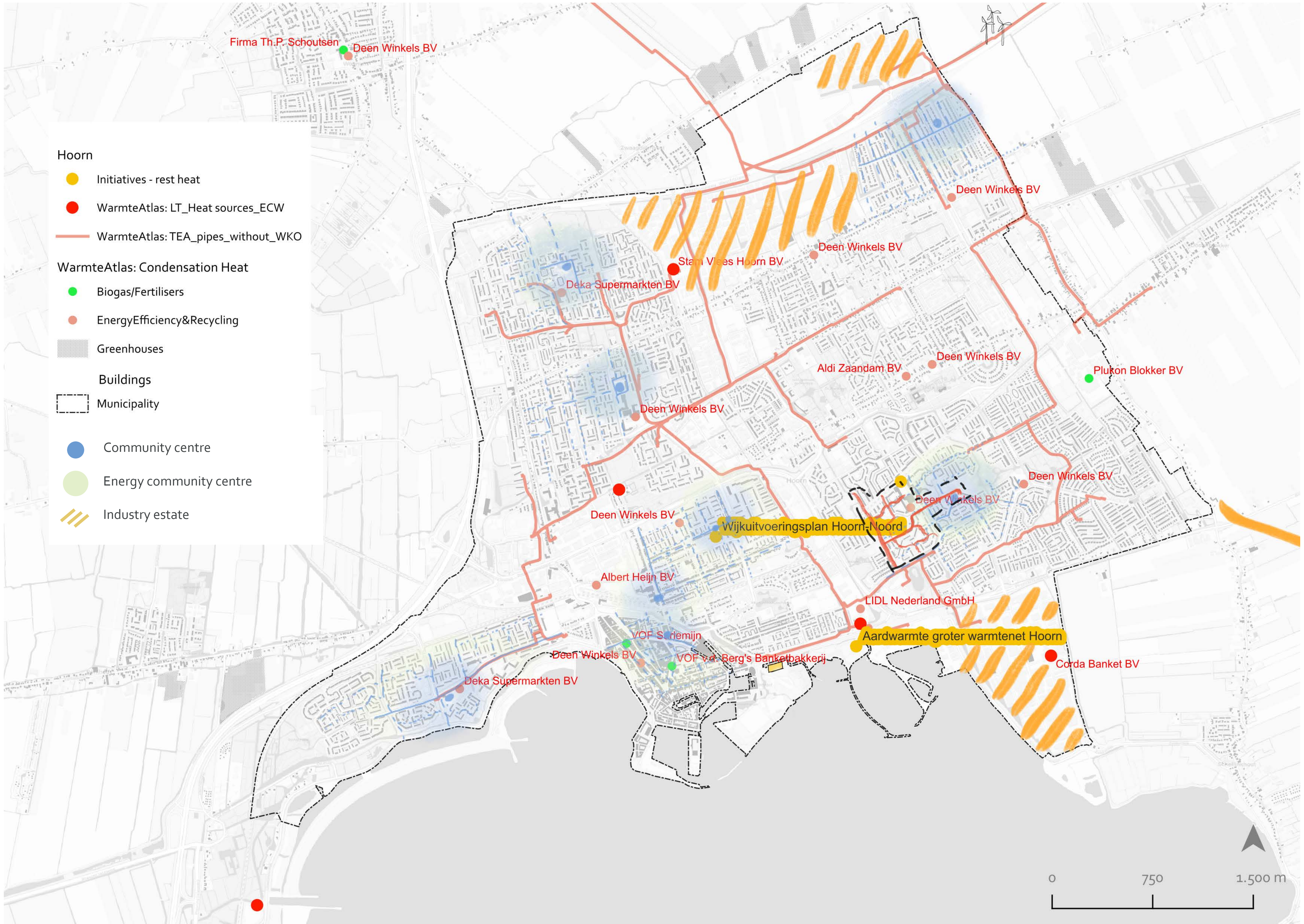


Figure 135: Map of key infrastructure in Hoorn and potential future measures (Source: OpenStreetMaps)

CURRENT SITUATION

Middenmeer is a village situated next to IJsselmeer. According to the energy potential quadrant, the village falls into type 2, which is characterized by high potential for renewable energy and low potential for alternative heat sources. Based on this classification, it is anticipated that Middenmeer can have independent energy grid but still needs to be connected to heating grid. Additionally, Middenmeer has a comparably higher average income and older buildings (*figure 136*).

High pressure of development

An examination of the local energy infrastructure reveals that Middenmeer, within the municipality of Hollands Kroon, has a well-developed and dense energy network (see *figure 137*). With high wind speeds and minimal urbanization, much of the available land is intensively used for wind energy production. A significant portion of Wieringermeer hosts Princess Ariane Wind Park, the largest onshore wind farm in the Netherlands.

This large-scale energy development has attracted major energy consumers, including data centers and greenhouses. The region also features Agriport A7, a major agricultural cluster located near the A7 highway. While Middenmeer does not have particularly high potential for alternative heat sources, the rapid growth of the agricultural sector has driven the development of a new heating grid. At Agriport, permits for geothermal energy have been granted, leading to the creation of a heating network that supplies greenhouses with geothermal heat.

As neighbors of this large energy industry, the residents of Middenmeer face a crucial decision: whether to rely on an extension of the existing grid or to establish their own independent energy system, ensuring security amidst ongoing development pressures. By analyzing the existing complex network of Agriport A7 and other energy parks, we aim to determine the best position for our community within this evolving energy landscape.

Key Statistics

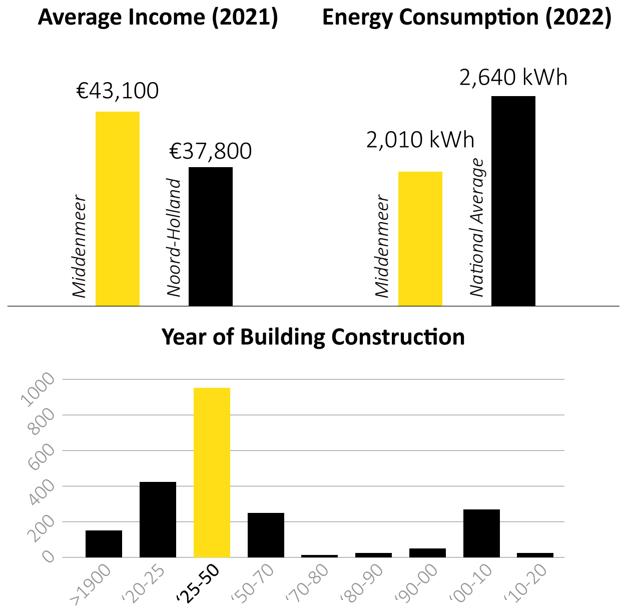
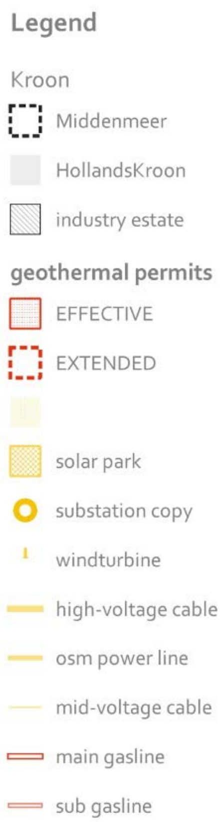


Figure 136: Average income, energy consumption and year of building age for Middenmeer (CBS, 2022).



HEATING & ELECTICAL INFRASTRUCTURE

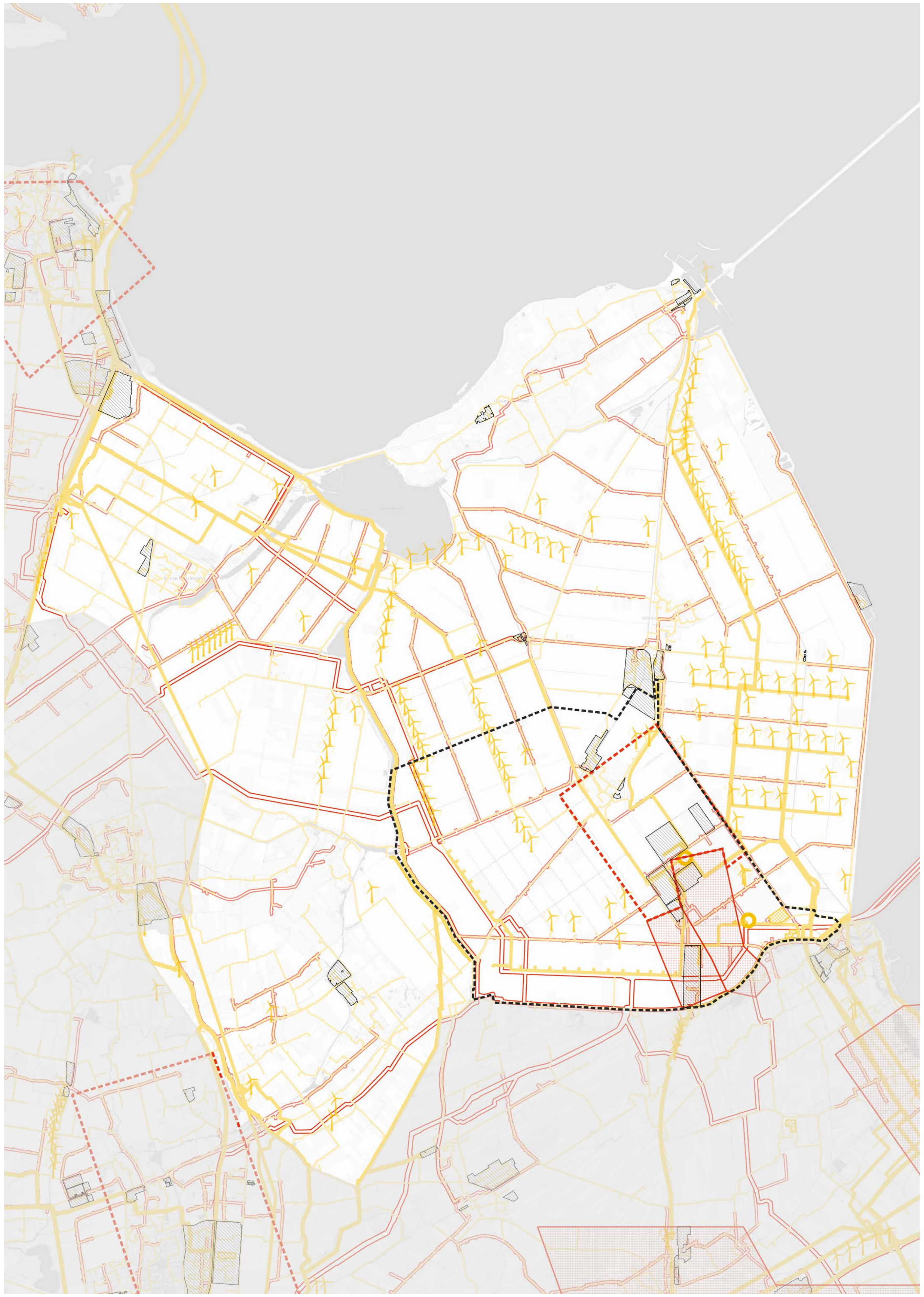
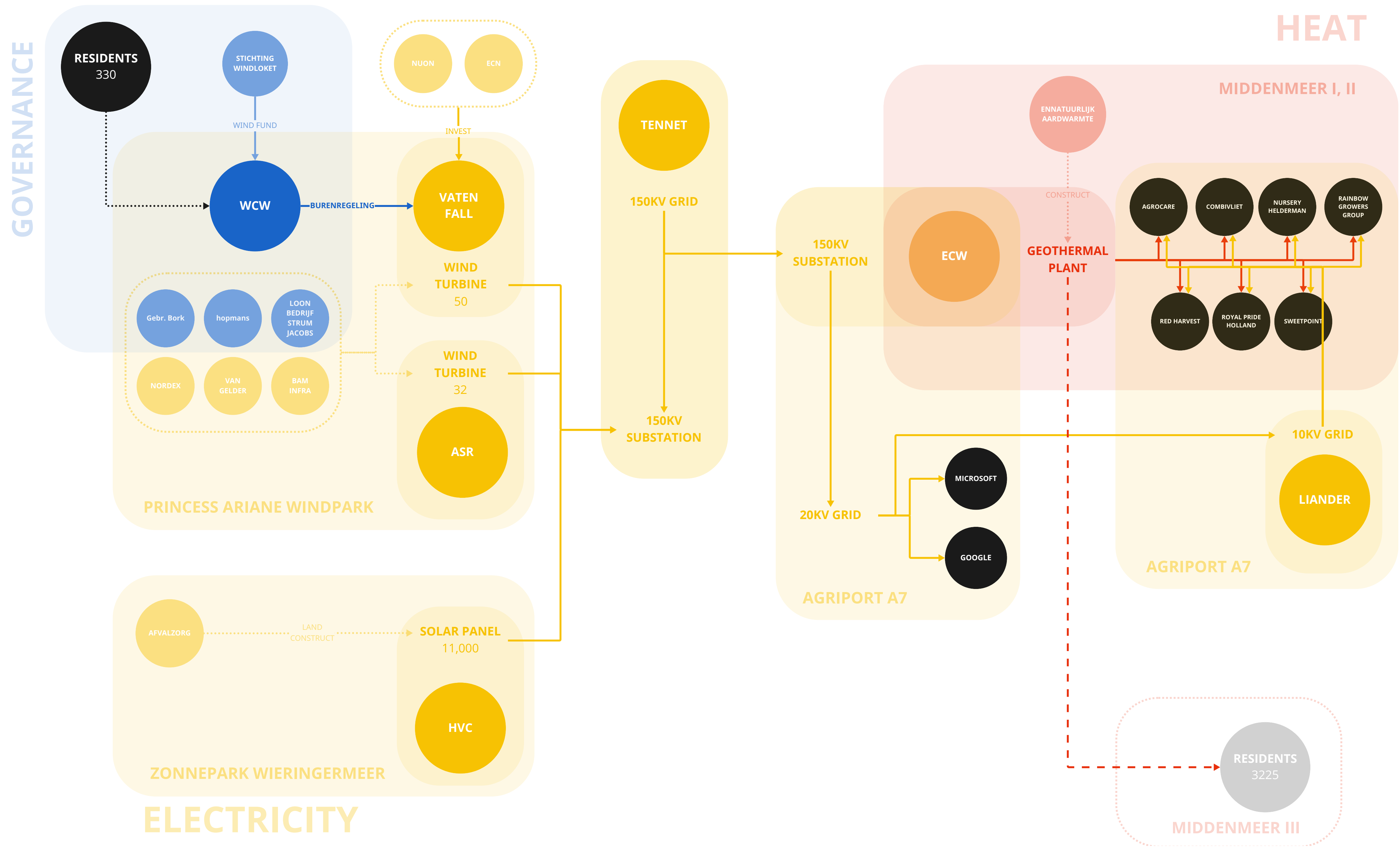


Figure 137: Map of key energy and heat infrastructure in Middenmeer (Source: OpenStreetMaps)

MIDDENMEER



AGRIPORT A7 - Combination

A defining characteristic of Middenmeer is the presence of large-scale agricultural and data center industries. Those are part of the area called Agriport , which is huge consumer of heat and electricity in Middenmeer.

In terms of heating, Ennatuurlijk Aardwarmte has developed a geothermal heating network to serve the greenhouse horticulture sector, currently supplying heat to seven greenhouses. The company has also secured permits to expand its services to residential areas in Middenmeer Centrum and Middenmeer Kroonwaard, identifying them as potential future clients.

For electricity, Middenmeer hosts an even more extensive infrastructure. Thanks to high wind speeds and vast open land, the municipality of Hollands Kroon is home to the largest onshore wind farm in the Netherlands—Princess Ariane Windpark. This abundant renewable energy production is a key reason data centers have clustered in the Agriport. Additionally, Afvalzorg and HVC have repurposed a former landfill site to develop a solar park, further diversifying the region's energy mix.

While much of the development has been large-scale, there are notable instances of local involvement (see *figure 138*). During the construction of the wind park, several local construction companies were engaged and benefitted from the project. Moreover, a group of residents formed Wind Collective Wieringermeer (WCW), enabling them to co-invest in wind turbines and receive regular returns on their investment.

Figure 138: Stakeholders involved with the different energy projects in Middenmeer's Agriport A7.

Energy Development

Due to the high heating demand from greenhouses, a new geothermal district heating system has been developed at Agriport. ECW initially established the geothermal installations, which were later transferred to Ennatuurlijk Aardwarmte in 2022. While geothermal systems are costly to build, they are relatively inexpensive to operate, requiring long operating hours to remain efficient.

Middenmeer is also seeing continuous growth in renewable energy. TenneT and the Ministry of Climate and Green Growth have initiated spatial procedures for a new 380kV high-voltage connection and substation in Middenmeer, indicating further energy infrastructure expansion in the area.

Big Consumers

The greenhouses and data centers in Agriport are major energy consumers, contributing to ongoing development pressure in the area. Agriport promotes its secure energy supply, highlighting its 150kV connection to the national grid via ECW. This setup lowers transport costs and allows clients to trade directly on the national energy market, offering favorable conditions.

While such large consumers may seem to threaten local access to energy, they also present opportunities. By partnering with resident-led energy initiatives, these developments could support greater regional energy autonomy and shared benefits.

Wind Cooperative

One example of a community-led energy initiative is the Wind Cooperative Wieringermeer. In the early stages of the wind park's development, 330 households collectively invested and now receive annual payments from the operator, including a wind-dependent bonus—more wind means more return, but there's no penalty with less wind.

The cooperative is currently arranging new funding called De Burenregeling Windpark Wieringermeer, giving more residents a chance to invest. This initiative acts as a Wind Fund, letting local residents make financial contributions and deepening community involvement in the energy transition.

Potential Participant

Resident engagement movements like the Wind Cooperative could also emerge around heating. With a permit already granted for geothermal heating in Middenmeer, local residents have the opportunity to organize and participate in the expansion process before construction begins.

There's also potential for collaboration between the wind and heat sectors. For instance, a local partnership between the wind cooperative and the future heat operator could be formed to reduce overall energy costs. By adopting wind turbines as a dedicated power source for operating the geothermal plant, residents could avoid additional electricity expenses and increase local control over both energy flows.

POTENTIAL FUTURE

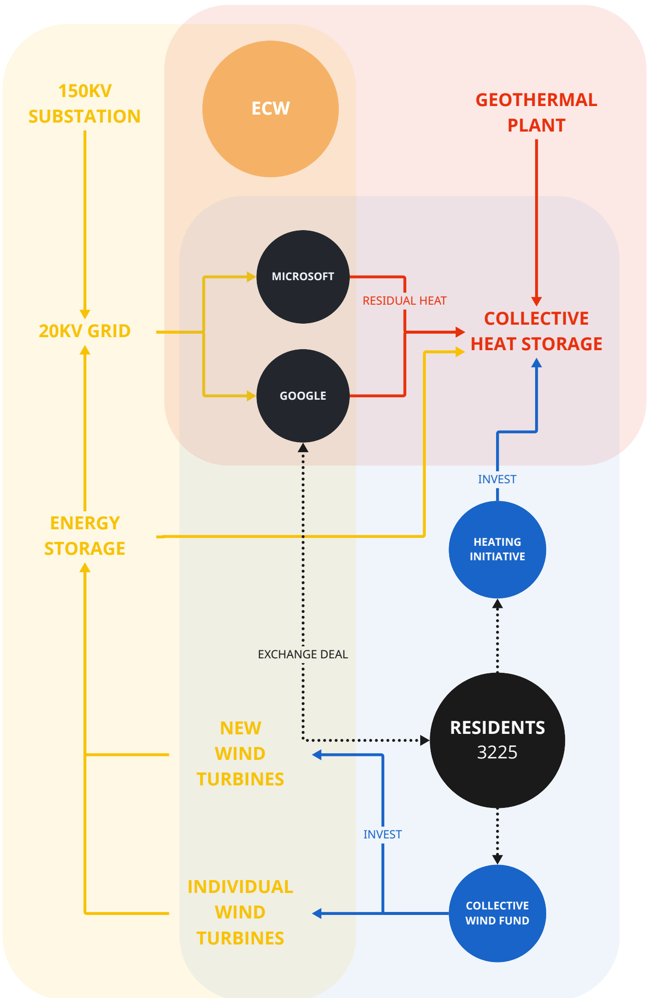


Figure 139: Network between stakeholders in Middenmeer in a possible cooperative future.

There is clear potential to form new networks between local initiatives and the large-scale energy industry (see *figure 139*). While much of the land is occupied by energy infrastructure owned by major companies, some space remains for community-led efforts to take root.

As district heating expands through geothermal developments, residents can establish heating collectives and explore opportunities to recover residual heat from nearby data centers to lower heating costs. Additionally, by investing in or co-developing wind turbines, communities can generate electricity to support local deals—such as powering geothermal operations or negotiating energy exchanges.

The potential map (see *figure 140*) highlights individually owned turbines that has potential to be adopted and suitable sites for future community wind projects. Additionally, all these project will be started from wijkenbouw, which has great central location.

Legend

- Middenmeer

Energy Ownership
- new windturbine
- independent windturbine
- industrial building with solar panel
- renting solar roof

Social Gathering
- socialcenterpoints — Meerbaak(wijkenbouw)

travel time from center
- 5 min
- 10 min

Heating
- geothermal plant
- heat well

geothermal permit
- EFFECTIVE
- EXTENDED
- datacenters — middenmeer
- main gasline
- sub gasline

Built Environment
- residential

Electricity
- substation
- high-voltage cable
- mid-voltage cable
- osm power line
- windturbine
- solar park

OPPORTUNITY MAP

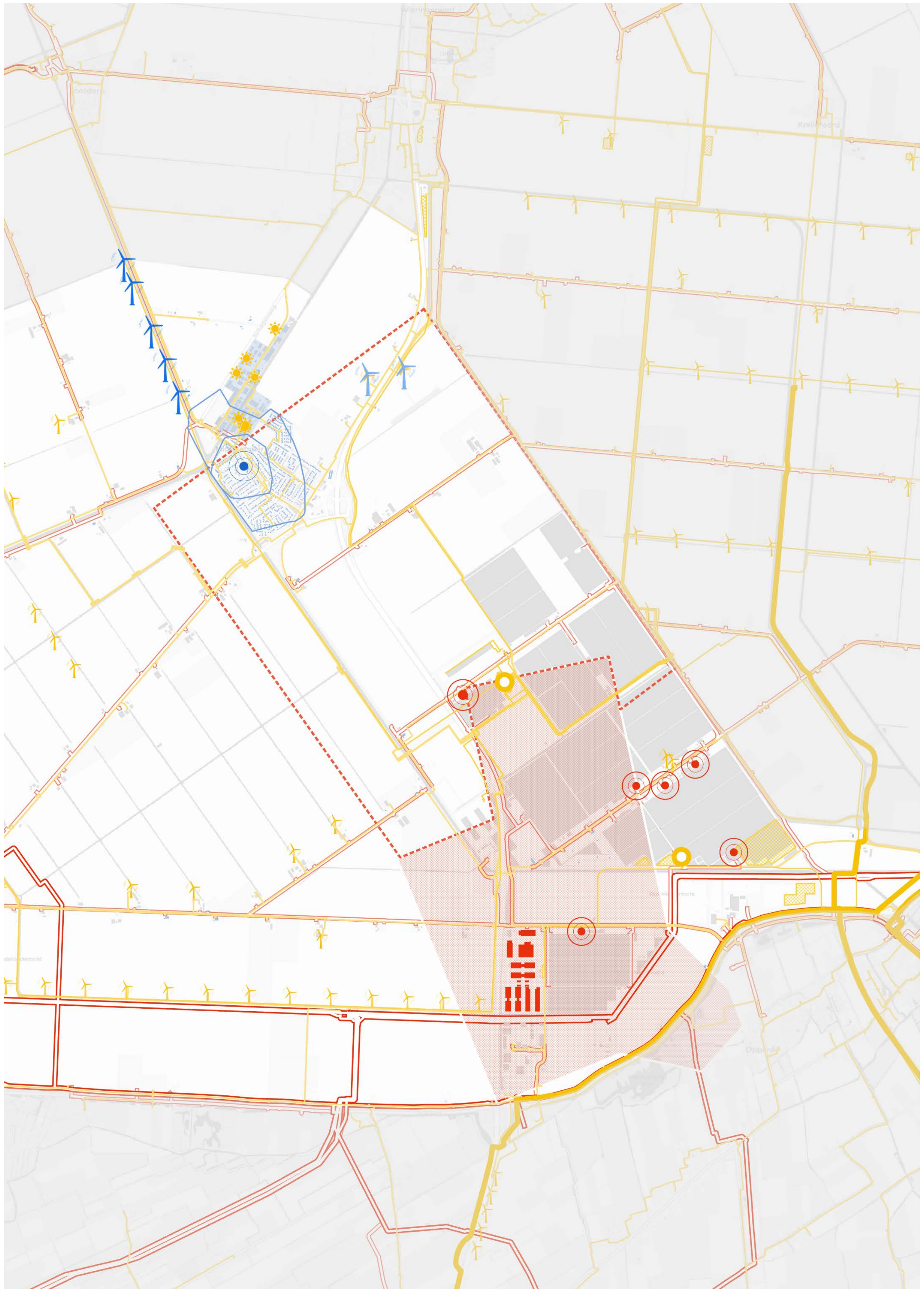


Figure 140: Map of key infrastructure in Middenmeer and potential future measures (Source: OpenStreetMaps)

CHAPTER VI:
MAKING THE TRACK: STRATEGIES

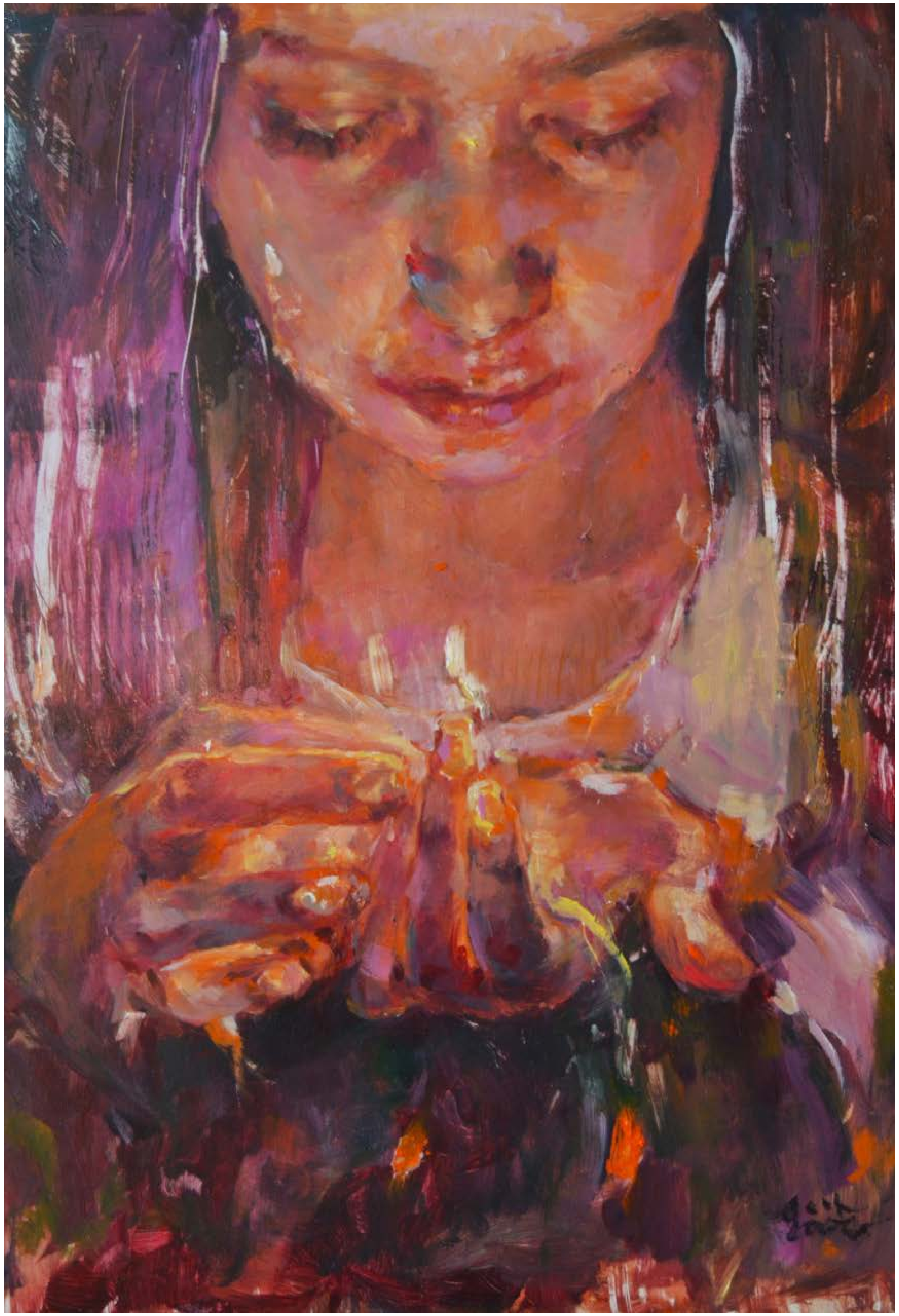


Figure 141: *TINY SPARK*
by Jaclyn Alderete 2023
from: https://jaclynalderete.com/artwork/5280464-Tiny%20Spark.html

FROM CASE TO YOU

The case studies showed the criticality of nearby industries, on top of existing potential. Industries are magnets for monetary flows and job opportunities. For low-income households, these are necessary in establishing local energy solutions.

Based on the conducted cases and the analysis, a set of factors were chosen to spatially map out the conditions which determine a neighborhood's path towards the transition (see *figure 142*). These where geothermal potential, wind potential, poverty rate, as well as greenhouses, larger industries and data centers. All of these indicators fit into at least one of three topics: potential for heat, potential for electricity and finance. Both geothermal and industry overlap in terms of heat and electricity, and heat and finance, respectively.

The indicators of each case can be seen on the next page in *figure 145*

To filter out areas of greatest opportunity and challenges, the upper quantile of energy production indicators, geothermal and wind, was chosen. For poverty, it was important to use a metric that last with time, so neighborhoods with an average salary below 20% of the national level are selected. Given the difference potentials for residual heat among the listed buildings, they were each given a number of cells to provide for by a radius. Greenhouses are local, within 500 meters or a single cell. Industries can cover larger neighborhoods or smaller districts and was given a radius of 1 000 m. Lastly, the data centers were given a radius of 3 000 m. When overlaid with a 1x1 km grid, conditions across the region could be mapped (see *figure 143*).

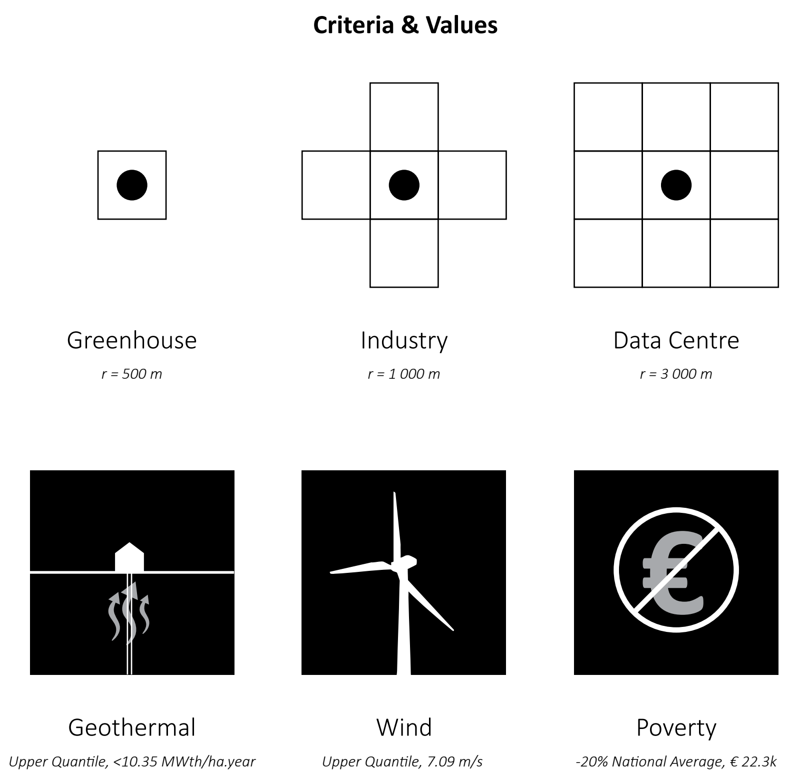


Figure 142: Criteria and their respective values used.

PROCESS OF IDENTIFICATION

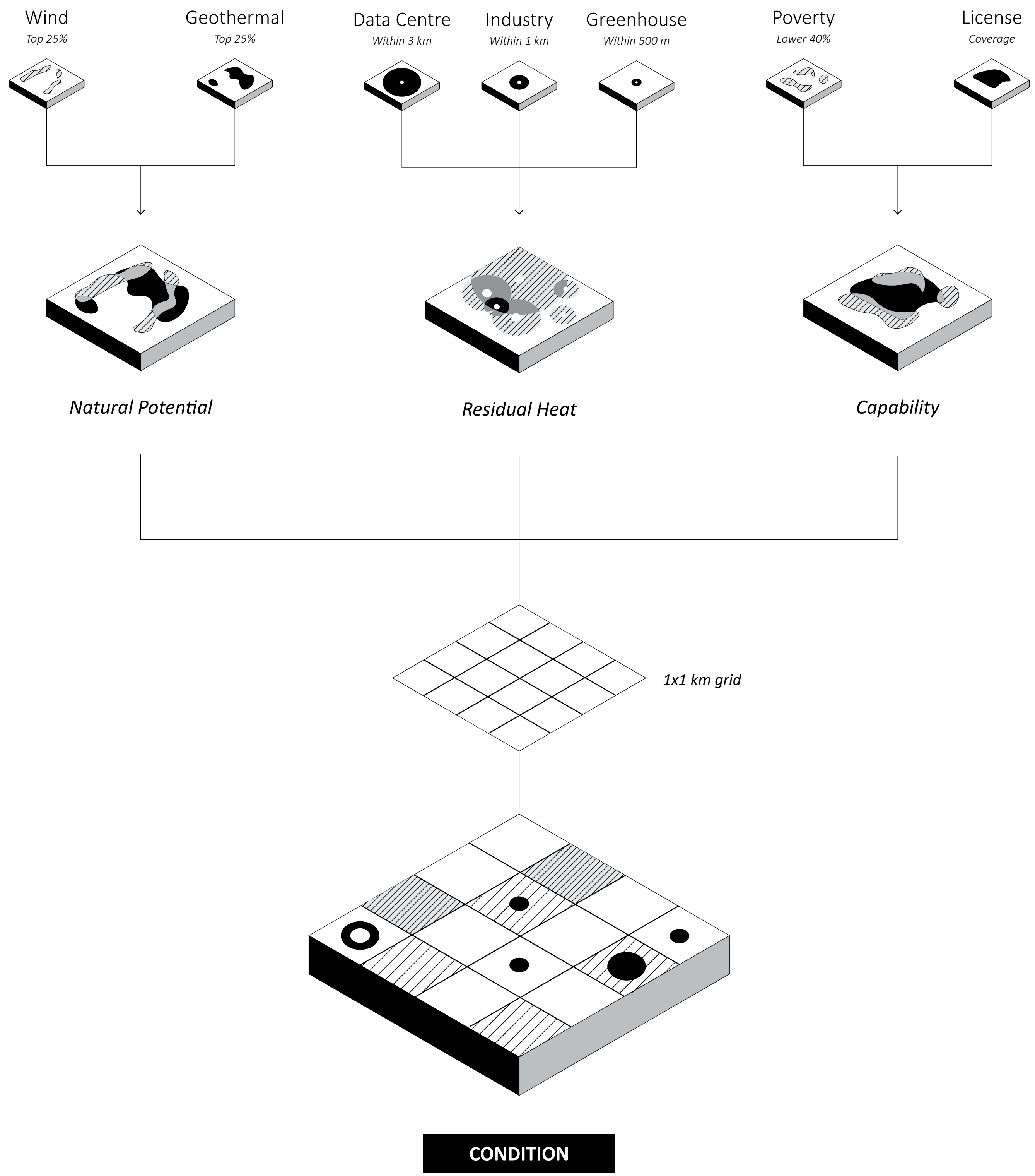


Figure 143: By combining key elements discovered in the cases studies, a set of criteria were set and placed on a 1x1 km grid to map out conditions for change.

CONDITIONS:

THE REGIONAL CONDITIONS

As seen in *figure 145-147*, the conditions of people, finance and potential vary across the region. There are noticeable groupings of conditions, like layers, from south to north. While the southern third of North-Holland is industry-heavy, it lack any higher potential for energy production. A significant portion of poor neighborhoods are found here too (see *figure 148*).

The southern-middle band of North-Holland is surprisingly empty, but to have close connections to the national grid. These are areas which might not be able to produce enough by themselves and have to rely more on the grid. The middle-northern band have a great geothermal potential, as again a cluster of industries. A number of poor neighborhoods exist here as well. The northernmost band is defined by poor neighborhoods and wind potential, with few industries outside of Den Helder. The main conditions of each case, within its municipal borders or project location, can be seen in *figure 148*. Even if the conditions were wildly different, there were commonalities that formed the coming strategy principles.

Main Condition in Cases

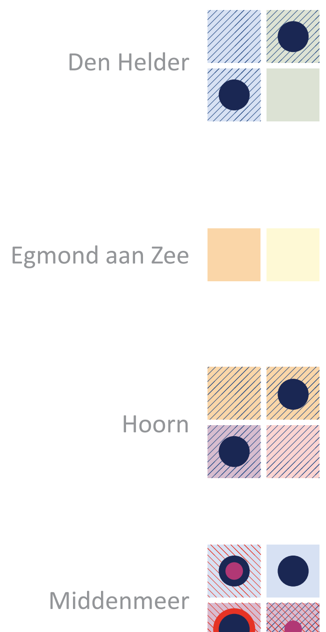


Figure 144: The most common cell conditions in each case investigated.

Industry & Poverty

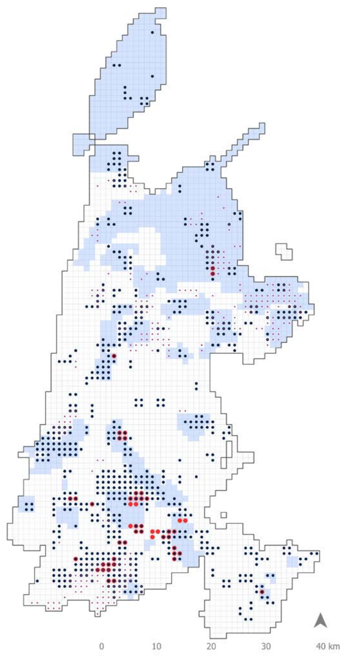


Figure 145: Industrial presence alongside impoverished neighborhoods.

Potential & Industry

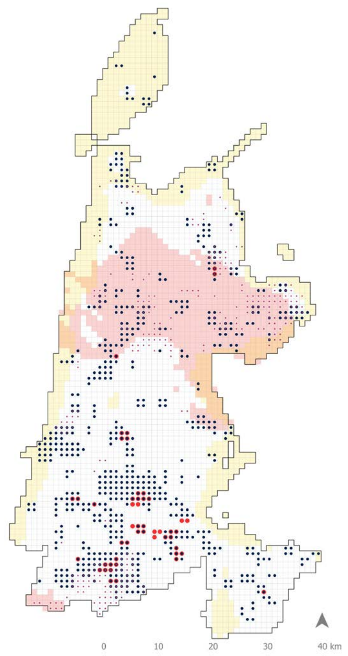


Figure 146: High potential for energy production industrial presence.

Potential & Poverty

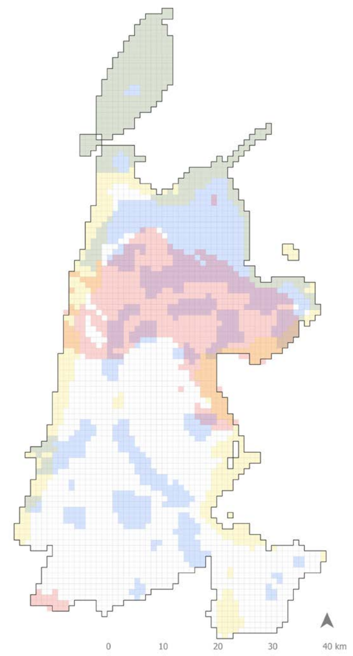


Figure 147: High potential for energy production alongside impoverished neighborhoods.

OVERVIEW OF ENABLING AND LIMITING CONDITIONS

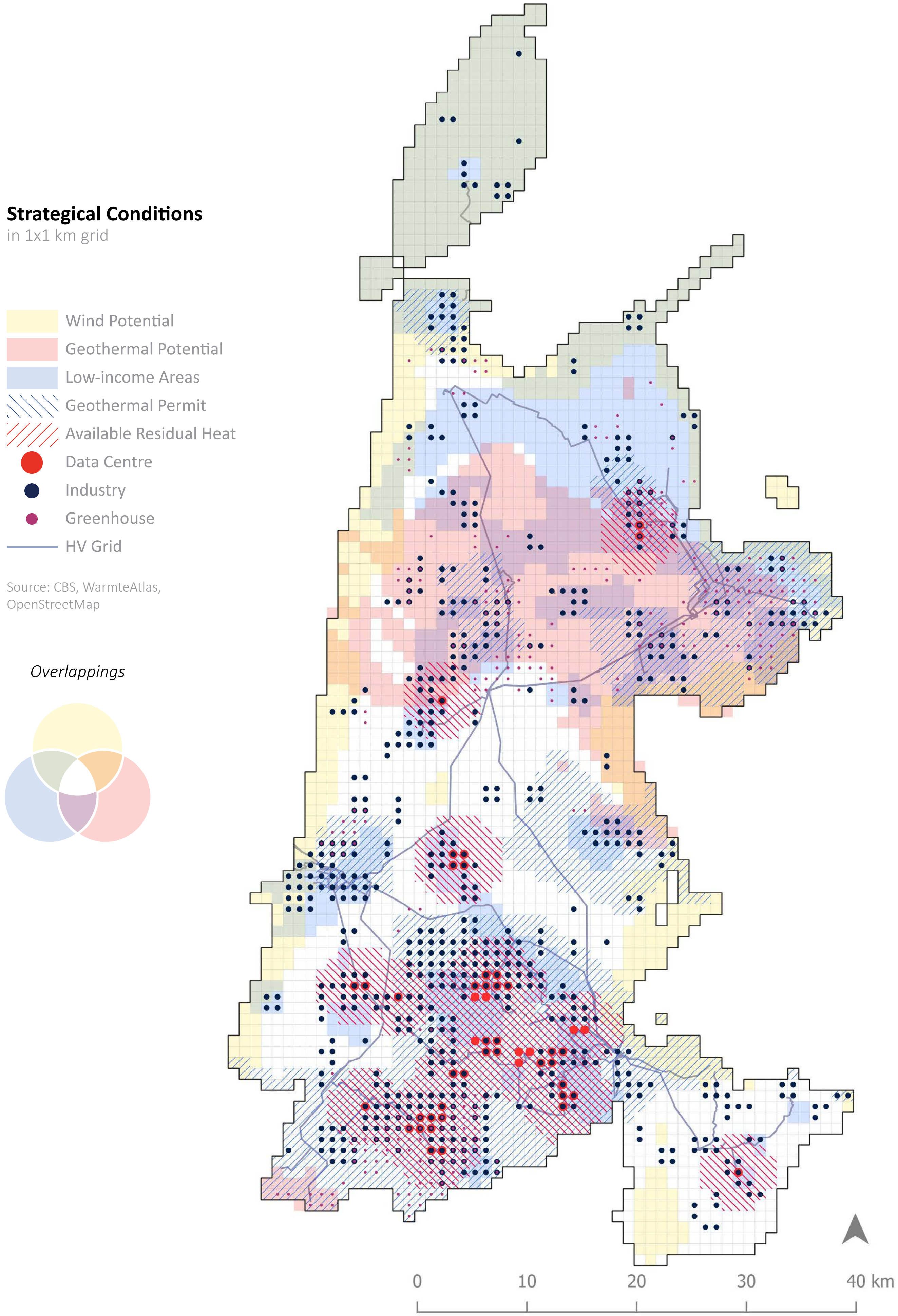


Figure 148: Location of greatest energy and heat potential, along with poverty and location of industries. These make up

PURPOSE:

CHANGE YOU CAN FEEL

Change isn't just determining the approach from a color set like it might've looked like previously. It starts, and will always, revolve around those who push for it, participate in it, either directly or indirectly. This report, and its strategies, will not leave this principle behind. The conditions for change that were identified are only to improve insight, not to control. Incremental change is the way to go, and that happens with change you can feel a sense of control over. Change you can see, attach and believe in.

In the following pages, a series of strategies are presented. There will always be more ways than what is possible to show in a report like this. That's why come cards are left blank for you, the reader, to fill inn yourself.

Figure 149: With local solutions and strategies, the sense of belonging and attachment can be kept alive. From *Something tangible* by Jaclyn Alderete, 2023. Retrieved from: https://jaclynalderete.com/artwork/5239952-Something%20Tangible%20.html

KEY STRATEGY PRINCIPLES

AFFORDABILITY — "Keep energy costs low"

SUPPORT IMPROVING ENERGY EFFICIENCY
- Financial support for improving insulation (windows, doors, roofs, walls, floors, thermal bridges)
- Financial support for energy efficient appliances and their installation
- Depots for scrap materials
- Depots for collect, repair, and exchange second hand appliances

SUPPORT INVESTMENT FOR ENERGY INFRASTURCTURE
- Financial support for install energy infrastructure (ex: loans, subsidies)
- Providing affordable option for installing energy infrastructure (ex: second-hand, rental)

TRANSPARENT AND BALANCED ENERGY PRICING
- Fair price considering supply-demand, open the calculation system for energy pricing
- Smart grid systems for secure distribution

NO SURPRISE EXPENSES
- Examine hidden expenses for energy transition
- Subsidies covering all potential expenses, not only direct costs (ex: new pots and pans for electric stove)

ACCESSIBILITY — "Make transition easier"

HELPERS FOR GETTING SUPPORT
- Give legal support to help forming framework for energy transition
- Help making documentation for applying financial support
- Helping center nearby
- Visiting supporters traveling less urbanized areas

SIMPLIFY REGULATIONS TO ENSURE EASY APPLICATION
- Simple phrasing and conditions for the regulations and subsidies
- Application procedure with minimal paperwork
- Provide fast track for urgent application

PROVIDE KNOWLEDGE AND OPPORTUNITIES
- share technological knowledge (ex: energy-saving, infrastructure installation, certification)
- share updated policies (ex: regulations, subsidies)
- help communicating different stakeholders
- Emphasize energy to children, educate
- Train more energy specialists
- Provide more job opportunity about energy

INCLUSIVITY — "Let us take a part"

GIVING DESION MAKING POWER
- local communities to decide where to invest
- local communities decide how to improve

CO-CREATE WITH COMMUNITY
- brainstorm ideas for solution with community
- let community make energy transition by themselves, on their own way
- give more room for self organization in social infrastructure

BUILD TRUST FOR GOVERNANCE
- Strengthen accountability and transparency
- enhance communication and attentivenes towards the community to facilitate trust.
- Utilize social workers and local citizen experts to build bridges towards community
- shift from market-oriented to community orientation in energy sector

COLLABORATION BETWEEN DIFFERENT SECTORS
- Utilize strengths and relationships of diverse stakeholders
- Encourage energy communities to include energy-poor households
- Energy transition as a means for improving inclusivity

AUTONOMY — "Let us do it ourselves"

PROMOTE EXPERIMENTS
- Financial support for experimental energy projects
- Financial incentives to support project of energy poor households
- less regulations for testing experimental energy system
- Extra support for energy pilot projects and start-ups

FLEXIBLE SOLUTIONS FOR CUSTOMIZATION
- Flexible, customized support for energy initiatives
- Promote scalable energy project, extra support for small scale projects
- Flexible regulations to enable more customization in energy production, storage, circulation and ownership models.

ROOM FOR SELF ORGANIZATION
- Give more room in social facilities to local initiatives (ex: schools, kindergardens, town halls, libraries, sports halls)
- Improve attractiveness of public space, to form more chance of gathering
- Invest on public transport towards public space, to make it more accessible
- Promote multi scale social infrastructure and form a link through different scales

Figure 150: Key strategy principles.

Based on the report, four key principles were identified to reflect the community's energy-related needs: affordability, accessibility, inclusivity, and autonomy (*figure 150*). These principles can also be understood as progressive steps toward empowerment—beginning with the removal of barriers for those affected by energy poverty, followed by increased access to opportunities, inclusion within the energy system, and ultimately, the ability to independently create sustainable solutions. Additionally, these principles offer a useful framework for addressing the main challenges outlined in the project.

IN RELATION TO ESTABLISHED FRAMEWORK

By grounding the approach in the four identified principles, it becomes possible to shift the framework from one of threat to one of opportunity (see *figure 151*). The principle of affordability can guide strategies that reduce the financial burden on energy-poor communities. Consideration of accessibility enables the development of user-friendly guidance for the heat transition. Inclusivity ensures that no group is left behind, while the pursuit of autonomy supports the creation of dedicated, community-controlled energy systems.

Transforming community desires into actionable strategies allows the regional energy system to evolve into a more supportive and interconnected network. Furthermore, this localized change has the potential to scale up. Since energy poverty is a widespread issue not only across the Netherlands but globally, some strategies developed in this context may be transferable to other regions. In the long term, this approach could contribute to broader positive impacts—environmentally, economically, and socially.

Easy Access To Support

- Easy Application System
- Energy Lawyers
- Energy Coaches
- Energy Transition Hub
- Energy Department in Community Centers
- Improve Slow Traffic Connection

Providing Diverse Options

- Shared Heat Source for Individual Heatpump
- Central Heatpump for multiple houses
- Utilise Residual Heat From Industry
- Installation of Single Solar Boiler
- Installation of Single Heatpump
- Transition to Renewable Source for District Heating

A FRAMEWORK OF OPPORTUNITIES

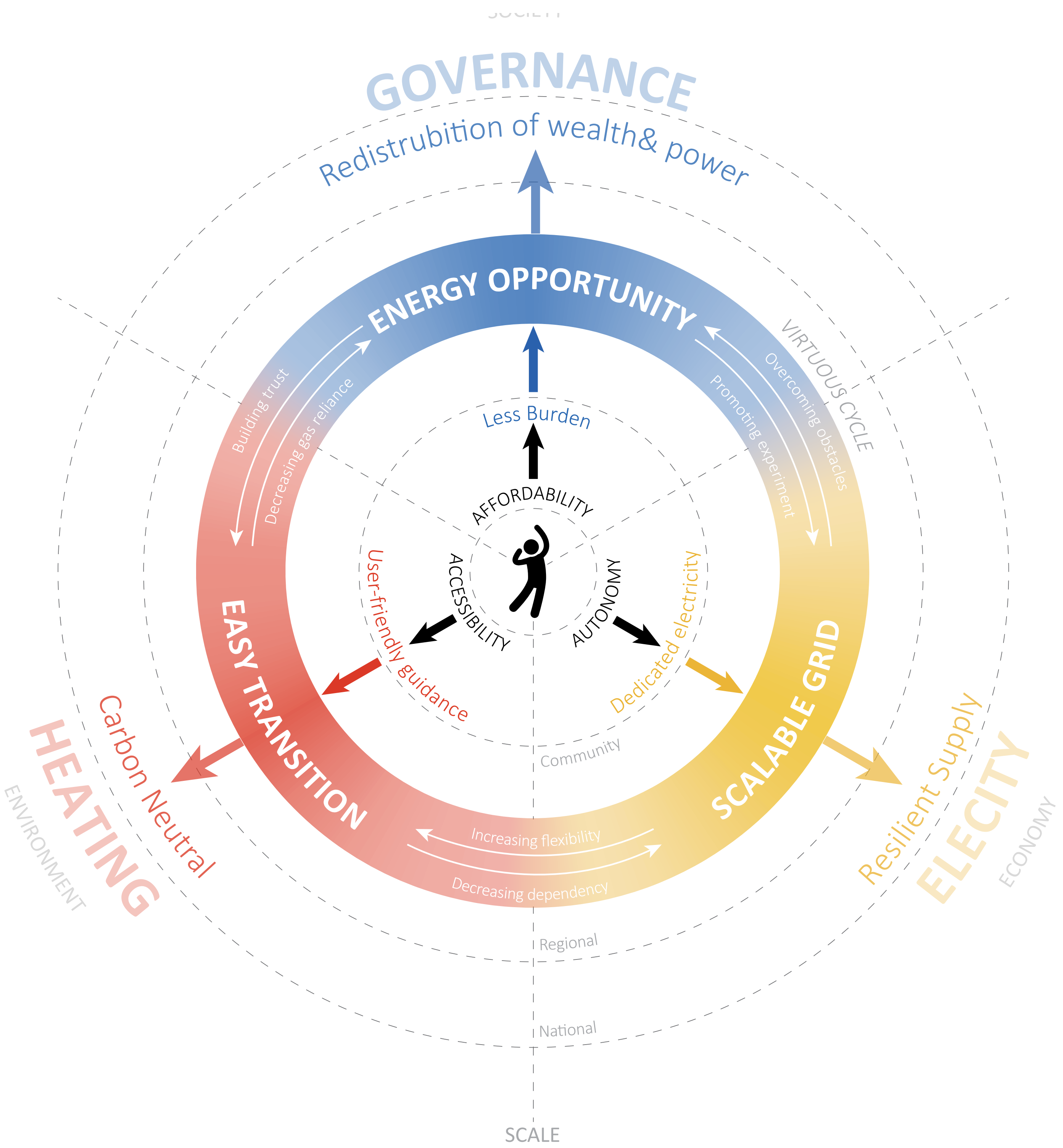


Figure 151: Strategical approaches and needs, based on the conceptual framework.

Reducing Energy Cost

- Energy Workshop
- Mandatory Investment for Local Community
- Taxing High CO2 Emmiting Business
- Insulation of Outdated Buildings
- Upgrade & Recycle Outdated Appliances

Overcoming Financial Obstacles

- Renting Solar Panels
- Renting Solar Roofs
- Energy Saving Loan
- Collective Energy Fund
- Heat & Electricity Exchange

Promoting Experiment

- Pilot Project to Overcomming Energy Poverty
- Community Participation in Descision making
- Co-Creation with Community

Being More Independent

- Shared Energy Storage
- Collective Solar Panel Ownership
- Energy Producing Street Furnitures
- Solar Panel on Public Buildings
- Adopting Wind Turbines

PRINCIPLES:

MULTI-SCALAR STRATEGY

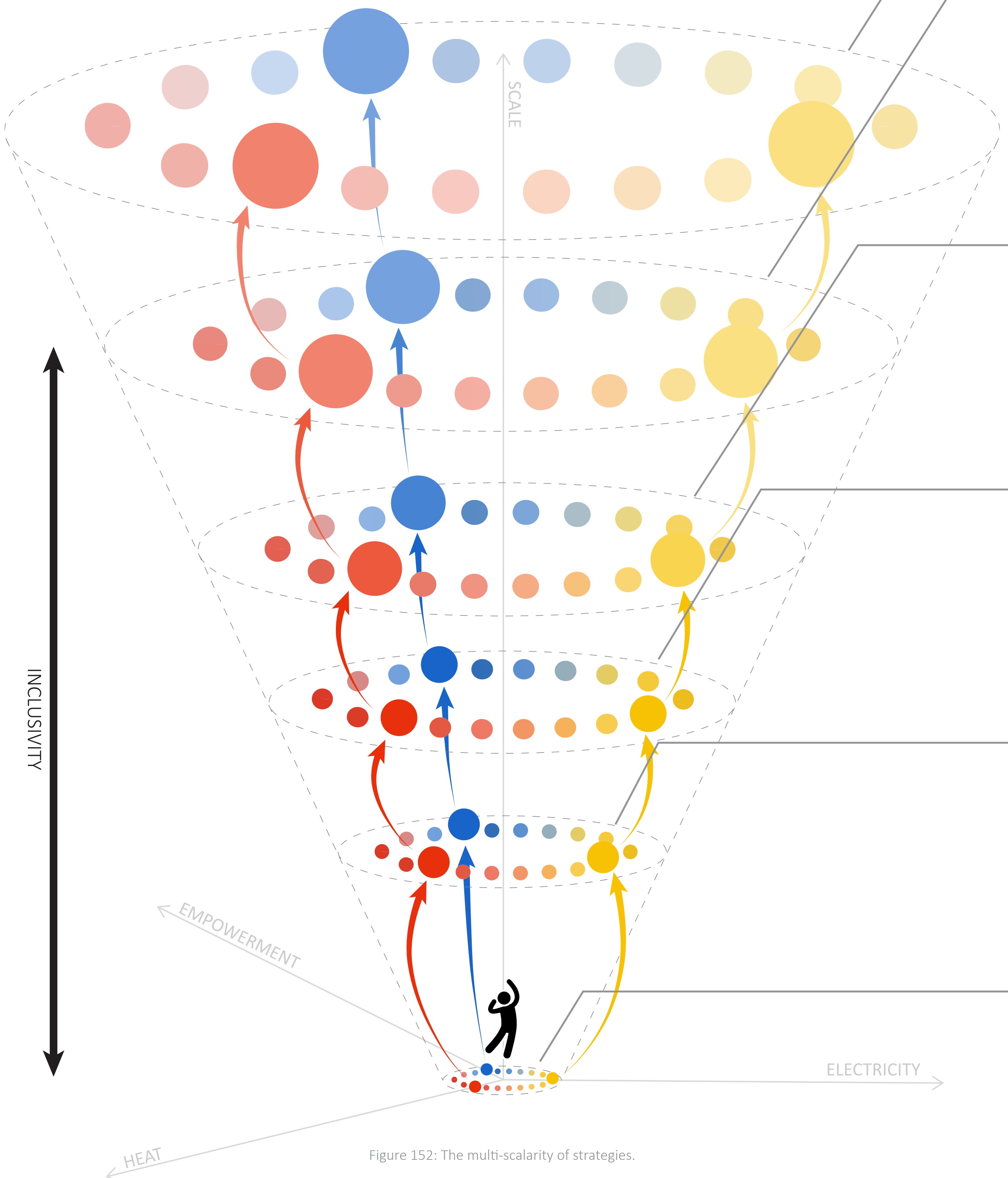
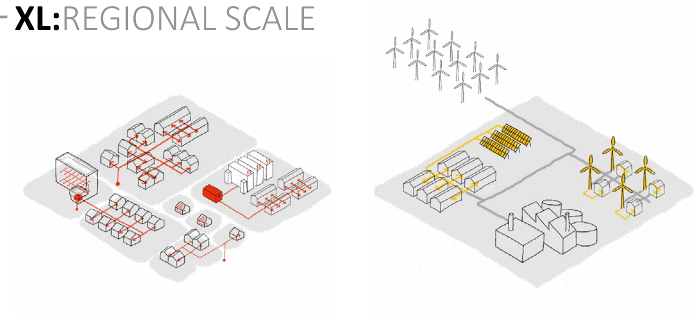


Figure 152: The multi-scalarity of strategies.

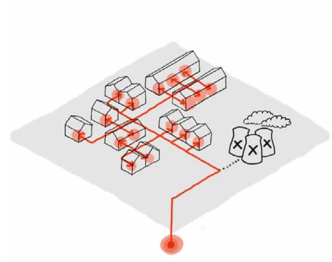
XL:REGIONAL SCALE



1. Multi-scale and diversified heating grid.
2. Local energy circulation supporting bigger grid.

Figure 153 & 154: Regional strategies.

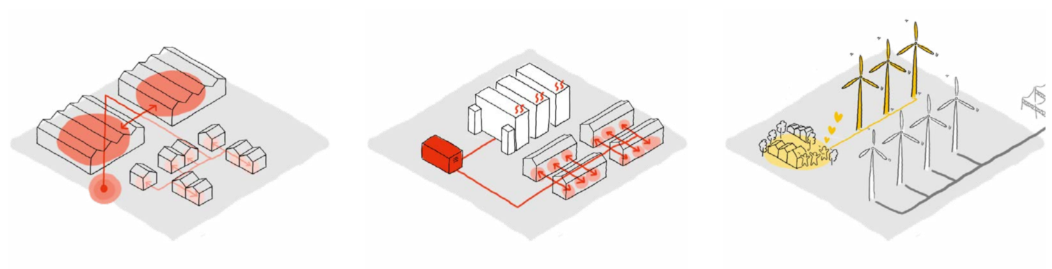
L: MUNICIPAL SCALE



1. Transition to renewable sources in the heating grid.

Figure 155: Municipal strategies.

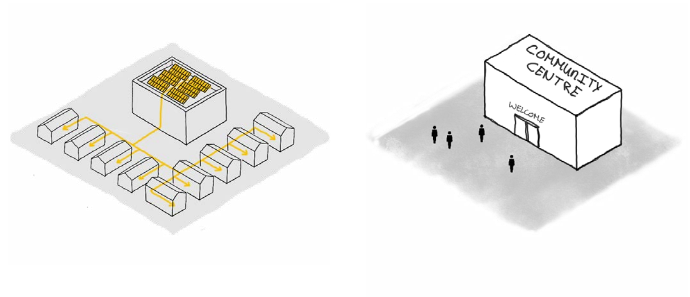
M: TOWN SCALE



1. Heating grid expansion
2. Utilise redisual heat from industry.
3. Adopting wind turbines.

Figure 156-158: Town strategies.

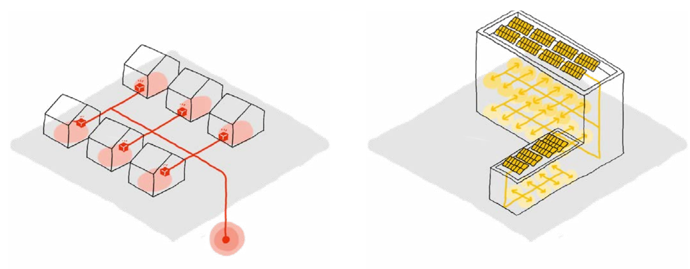
S: NEIGHBORHOOD SCLAE



1. Solar panels on public buildings.
2. Energy department in community centres.

Figure 159 & 160: Neighborhood strategies

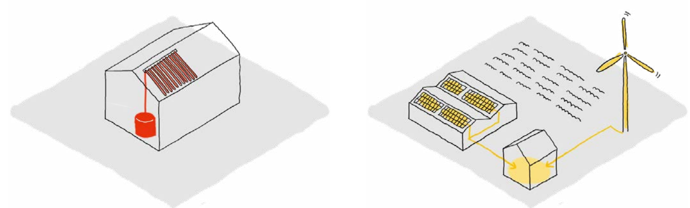
XS: STREET SCALE



1. Shared heat source for individual heat pump.
2. Collective solar panel ownership.

Figure 161 & 162: Street strategies

XXS: HOUSEHOLD SCALE



1. Installation of single solar boiler.
2. Self-sufficient building.

Figure 163 & 164: Household strategies.

INCLUSIVITY

The fourth principle, inclusivity, can be understood in a cross-sectional view of the framework, where it acts as a connecting axis across different scales (see *figure 165*). In this project, multi-scalarity plays a crucial role across three main sectors. Unlike the fossil fuel era—characterized by centralized, large-scale energy sources—the post-fossil energy landscape is expected to be far more diverse, not only in energy types but also in the scale at which they operate.

This complexity makes inclusivity particularly important. Successful energy transition requires collaboration across different levels—local, regional, and national. It cannot be achieved through a purely top-down approach, nor can it rely solely on bottom-up efforts. Instead, both directions must move simultaneously and converge at a shared middle ground. This coordinated effort is especially critical in the context of the Netherlands' national goal to reach net-zero emissions by 2050.

The figure on the right illustrates a possible network of connections between various stakeholders and strategies, spanning different scales—from individual households to streets, neighborhoods, towns, municipalities, regions, and the national level. It is important to note that this is not an exhaustive map; the potential combinations of strategies are numerous and will continue to evolve as both institutional and grassroots initiatives advance. To clarify how each principle can be put into action, the following sections present examples of strategic combinations shaped by these core values.

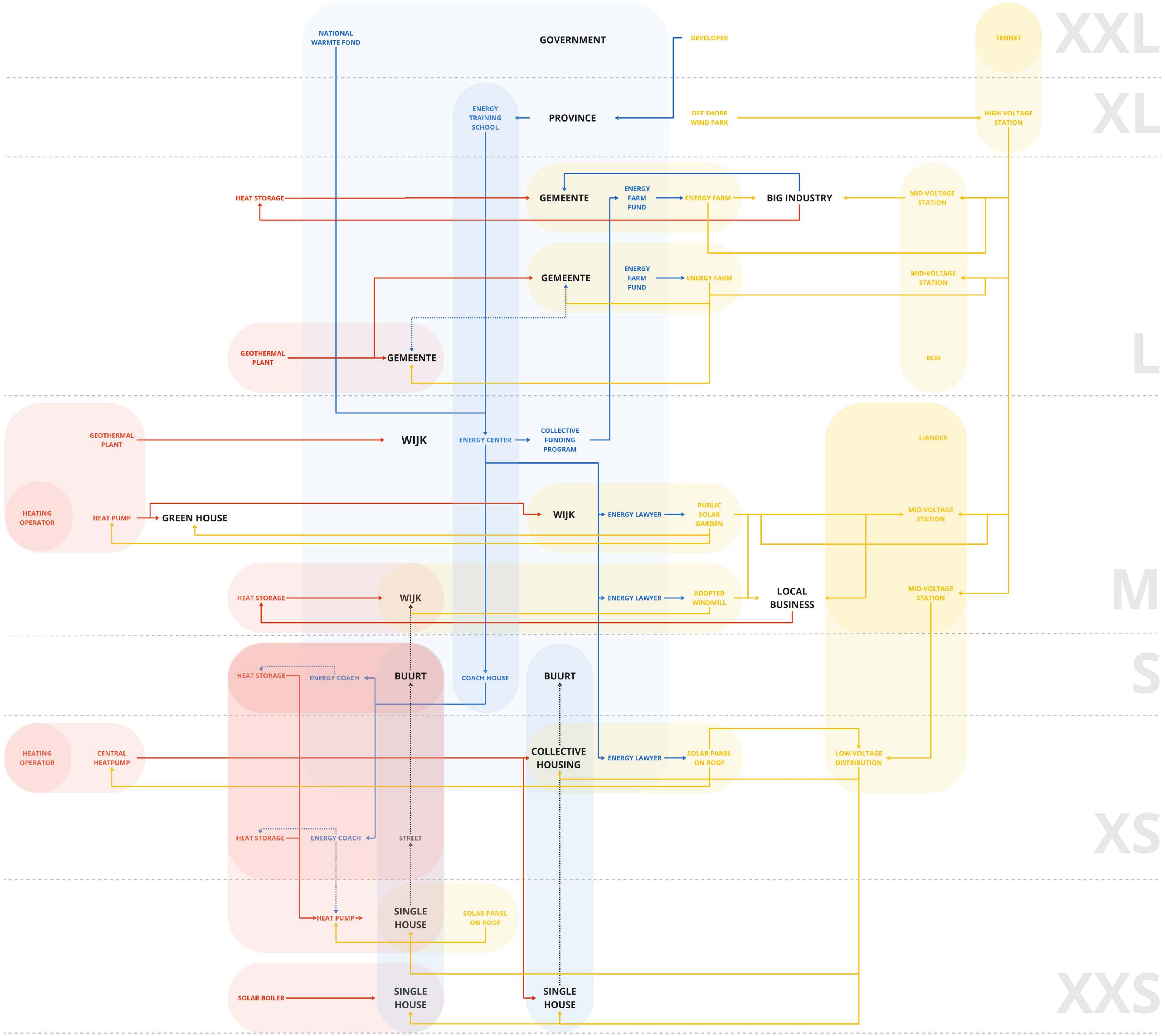


Figure 165: Overview of the strategies across scales and in which sector they belong in. Their relation/interdependence with each other are show with arrows.

AFFORDABILITY

Affordability will be the first step of the project. A primary concern for many people, especially those in energy-poor households, is whether their energy bills will suddenly increase. While this is a valid concern—since new heating systems typically require additional electricity—there is also an opportunity to reduce costs by implementing solutions such as central heat pumps, residual heat storage, or solar panels for the heat pump. The initial expenses can be alleviated through energy-saving loans, which can help mitigate the financial burden.

ACCESSIBLITY

The strategies for affordability can be supported by accessibility. For these strategies to be effective, the accessibility of the system must be ensured. In this regard, the government's role is crucial in making policies accessible to end users. Solutions such as an easy application process, institutional changes, and increased access to energy coaches and energy lawyers will be key in achieving this goal.

STRATEGIES THAT WORK TOGETHER

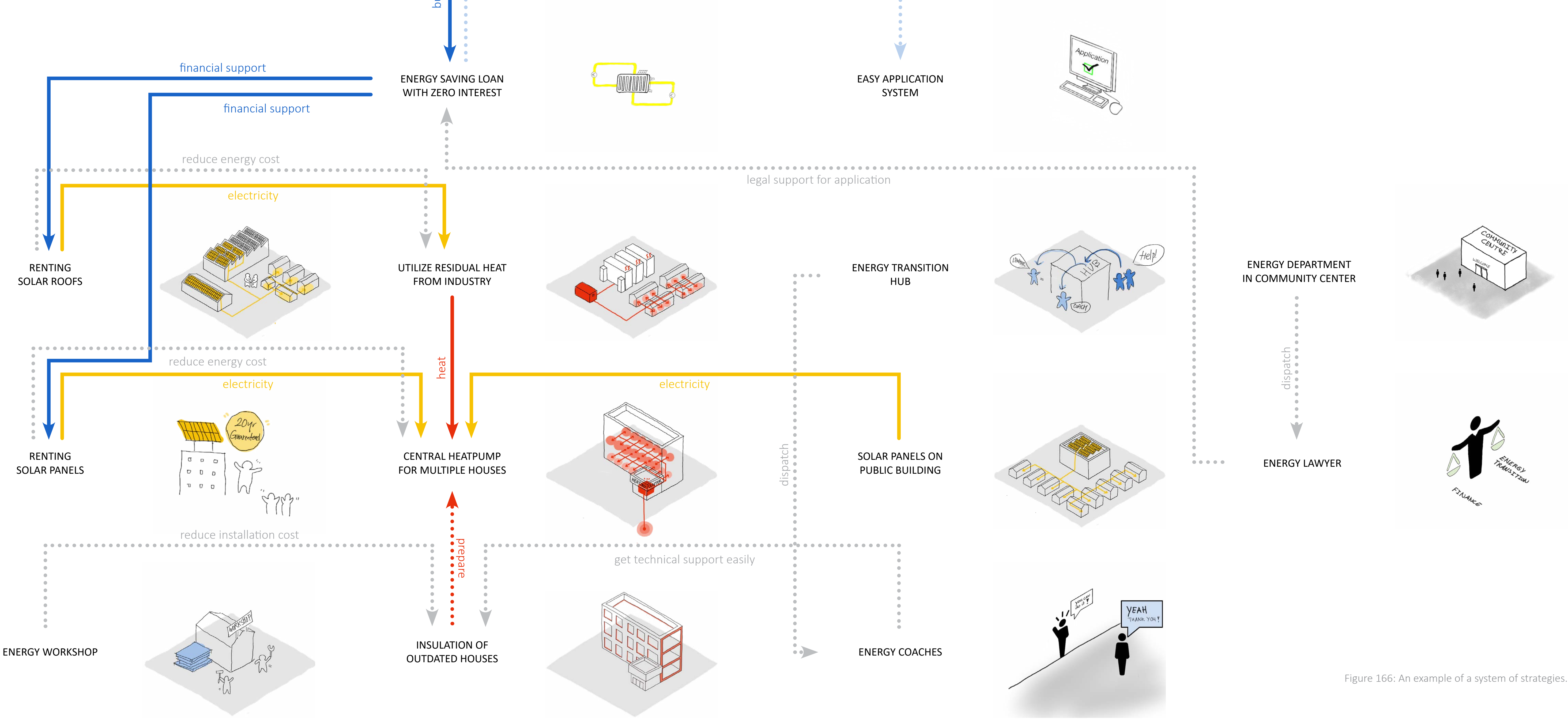


Figure 166: An example of a system of strategies.

PRINCIPLES:

AUTONOMY

The final value expected is autonomy. The aim is for the community to become a true protagonist in the energy transition, standing alongside larger stakeholders.

Starting with small, independent actions, such as forming a local heating network with just a few houses on a street, the community's influence will gradually grow (*figure 167*. Over time, this could impact larger systems, such as the selection of new heat sources for district heating (*figure 168*).

Heat potential is not the only way to achieve autonomy. Areas with high renewable energy potential can also play a crucial role in the energy transition by taking ownership of their own energy production. This allows them to trade energy with other areas. For example, a municipality with high wind potential could strike an exchange deal with a municipality with high geothermal potential, reducing energy costs for both.

These movements will ultimately benefit the broader energy network by providing local routes alongside the main grid, helping to alleviate congestion and secure a stable energy supply for the entire nation.

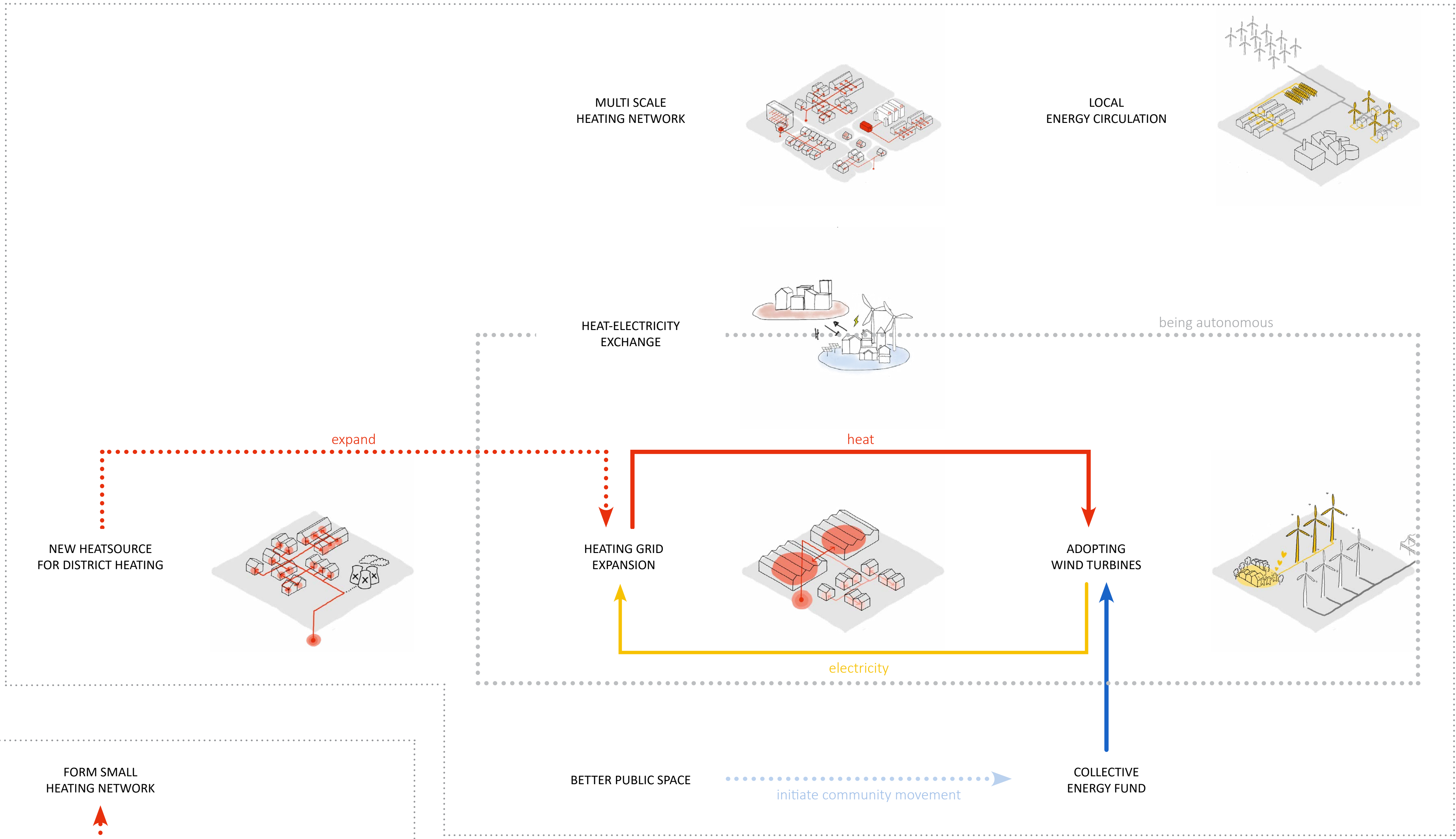


Figure 168: An example of large-scale energy system.

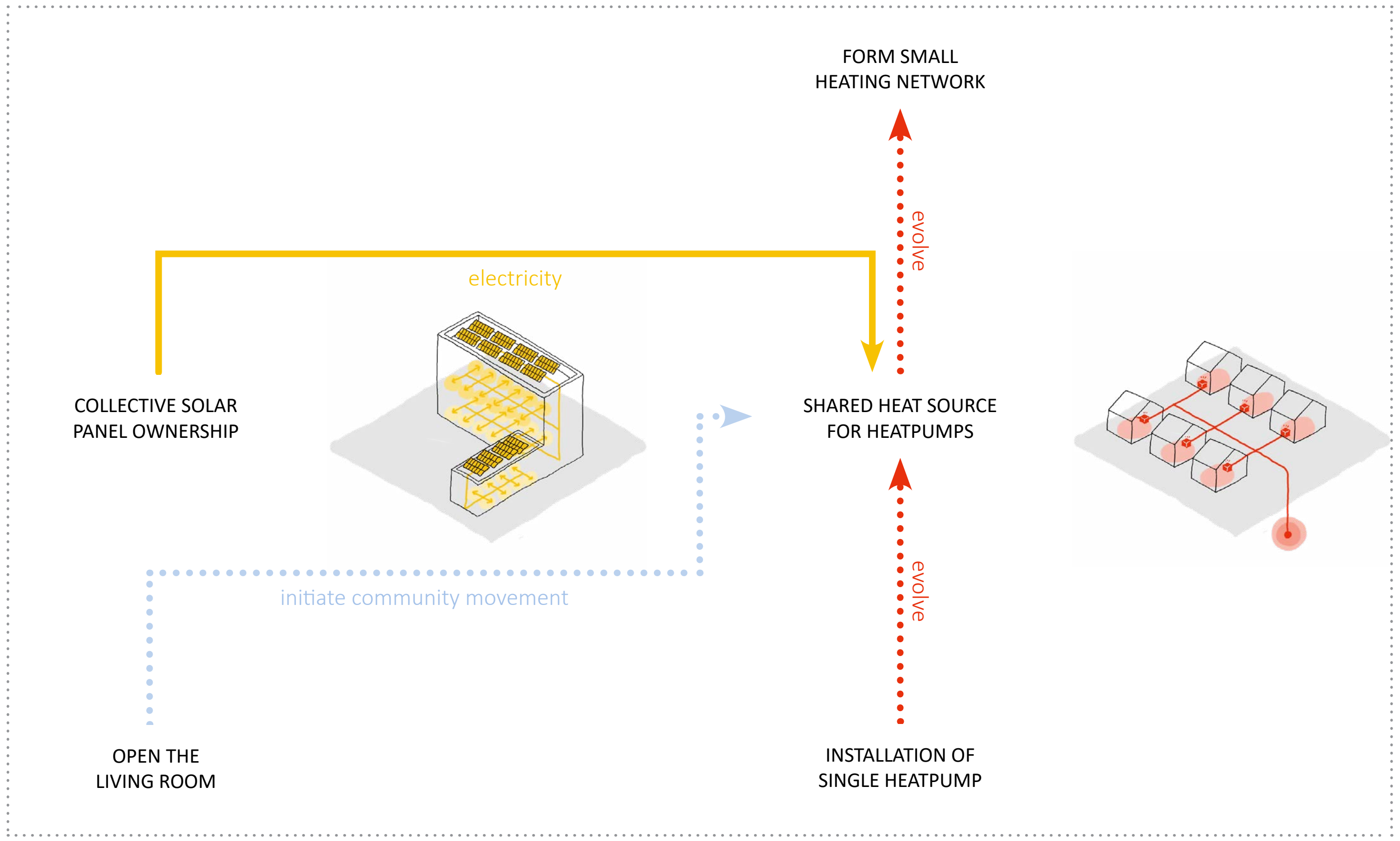


Figure 167: An example of a dual energy system.

STRATEGIES:

LETS MAKE IT TOGETHER!

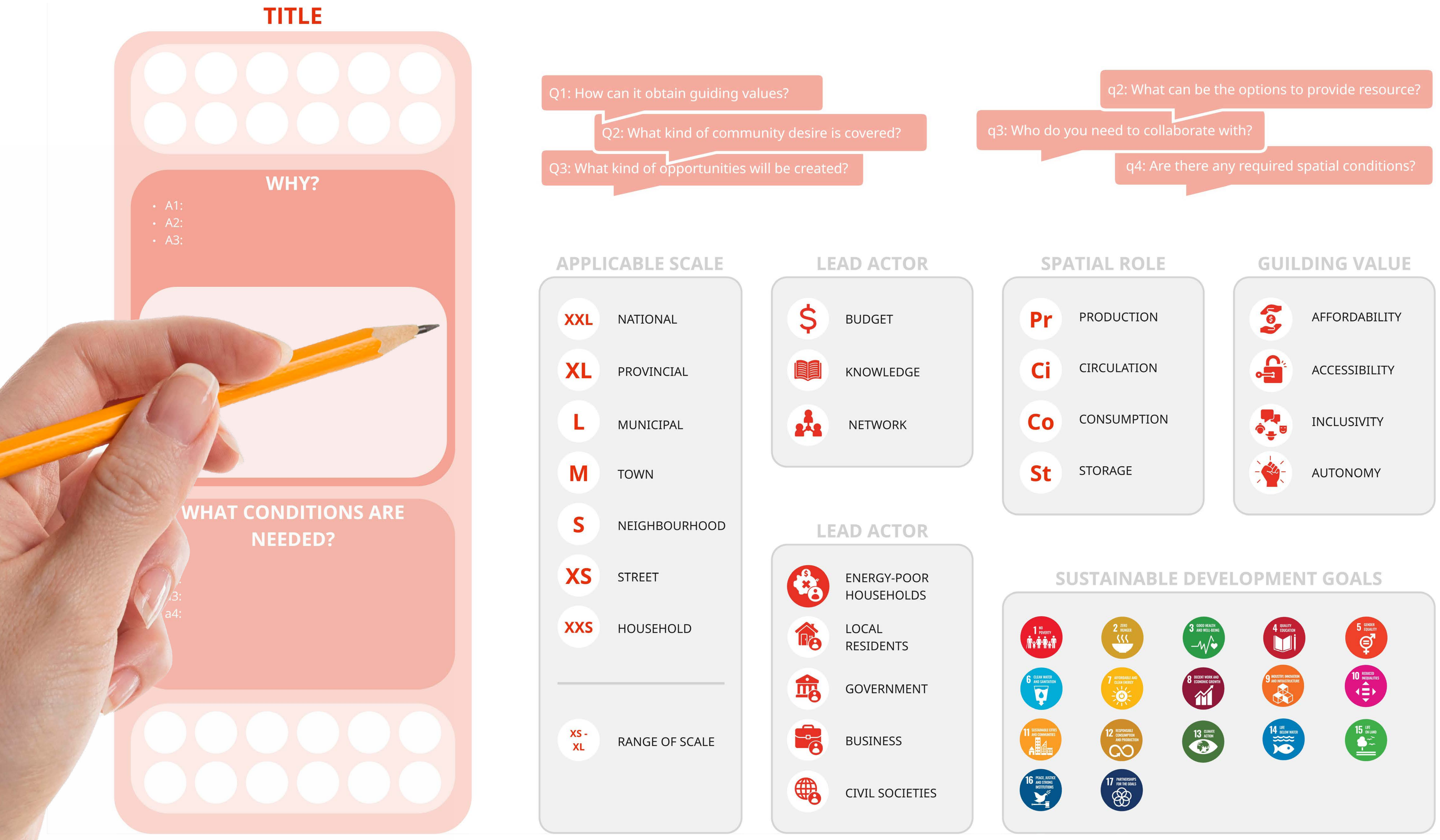


Figure 169: Definitions and set-ups for the strategical 'cards'.

STRATEGY-HEATING

PRODUCTION

Now it's time to present all the strategies! The cards listed in this chapter represent the strategies developed through the co-creation process within the group. We've designed a strategy-making system with multiple indicators and guiding questions to help shape the process. As you explore these strategies, we encourage you to draw inspiration from our ideas and share your own vision of energy empowerment.

Rip off the left side of the page and use simple sketches to illustrate your ideas, explaining them spatially or by highlighting the empowerment input. Key guiding values and leading actors may also play an important role in explaining your concept. Additionally, consider which Sustainable Development Goals (SDGs) your strategy could contribute to (see *figure 170*). Rip off the left side of the paper and start exploring your ideas!

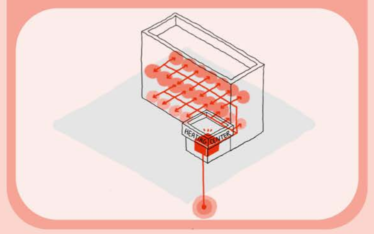
Figure 170: Icon meaning and SDGs.

CENTRAL HEAT PUMP FOR MULTIPLE HOUSES

XS - S · Pr · St

WHY?

- Autonomous heating system.
- Reduce energy bill with shared facility
- reduce burden for management per users



WHAT CONDITIONS ARE NEEDED?

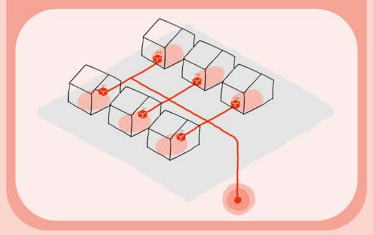
- density of houses
- shared space to install heat pump
- local initiative to
- collaboration with business

SHARED HEAT SOURCE FOR INDIVIDUAL HEAT PUMP

XS · Pr

WHY?

- provide more affordable option using heatpump
- lower the energy bill by sharing heat source
- efficient use of heatsource by shared system



WHAT CONDITIONS ARE NEEDED?

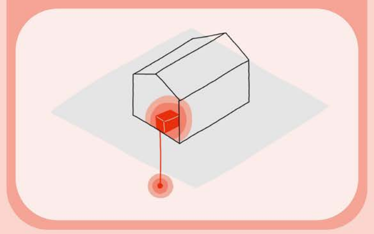
- small number of single houses
- Low level of technical knowledg
- Small footprint of dwellings.

INSTALLATION OF SINGLE HEAT PUMP

XXS · Pr

WHY?

- Provide flexible solution for heat transition, customizable for different scale
- Enable self organization of small scale heat transition



WHAT CONDITIONS ARE NEEDED?

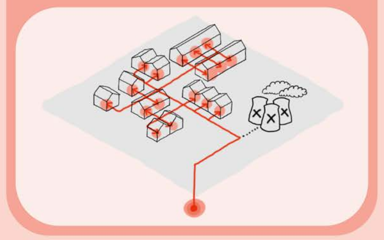
- Single houses in especially low-density area
- Low level of technical knowledge
- Enough budget for installation

TRANSITION TO RENEWABLE SOURCES IN THE HEATING GRID

XL-M · Pr

WHY?

- Provide flexible solution for heat transition, customizable for different scale
- Effective way of heat transition in large scale
- Reuse existing energy infrastructure



WHAT CONDITIONS ARE NEEDED?

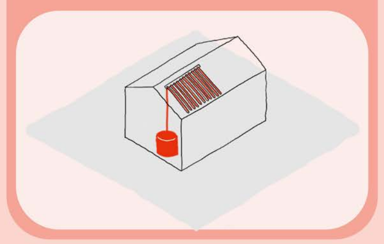
- Presence of district heating;
- Potential for alternative (renewable) heat sources.

INSTALLATION OF SINGLE SOLAR BOILER

XXS · Pr

WHY?

- Provide flexible solution for heat transition, customizable for different scale
- Enable self organization of small scale heat transition



WHAT CONDITIONS ARE NEEDED?

- Single houses in especially low-density area
- Low level of technical knowledge
- Sufficient dwelling footprint for solar boiler
- Enough budget for self-installation

TITLE

WHY?

- A1:
- A2:
- A3:

WHAT CONDITIONS ARE NEEDED?

- a1:
- a2:
- a3:
- a4:

TITLE

WHY?

- A1:
- A2:
- A3:

WHAT CONDITIONS ARE NEEDED?

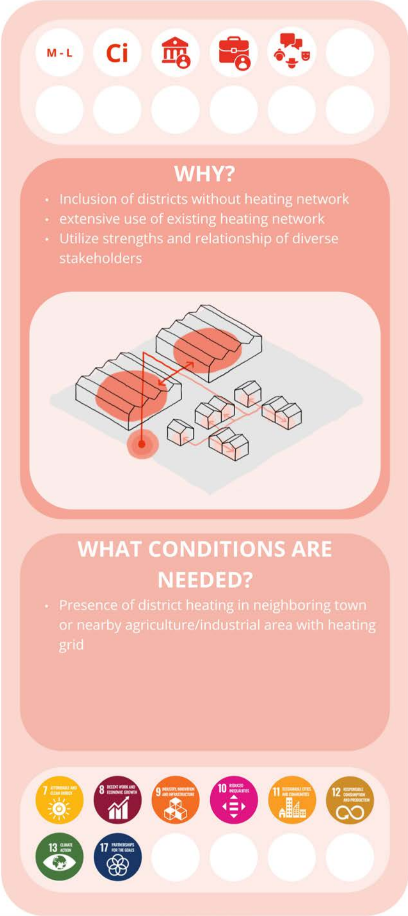
- a1:
- a2:
- a3:
- a4:

STRATEGY-HEATING

CIRCULATION

UTILIZE RESIDUAL HEAT FROM INDUSTRY

HEATING GRID EXPANSION



MULTI-SCALE AND DIVERSIFIED HEATING GRID

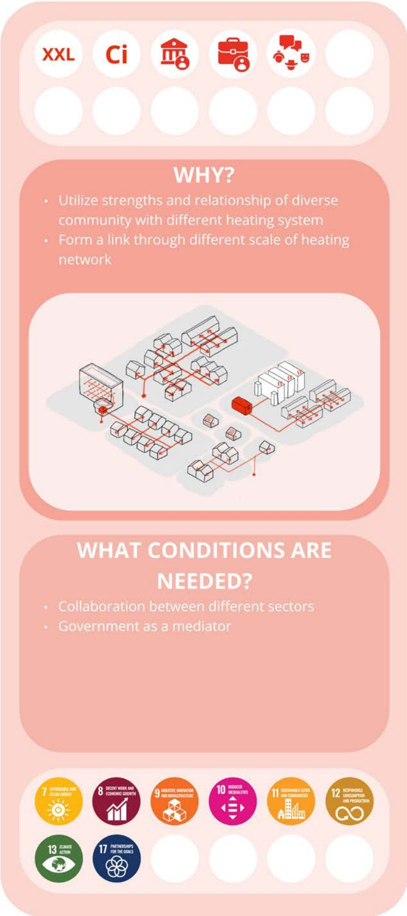
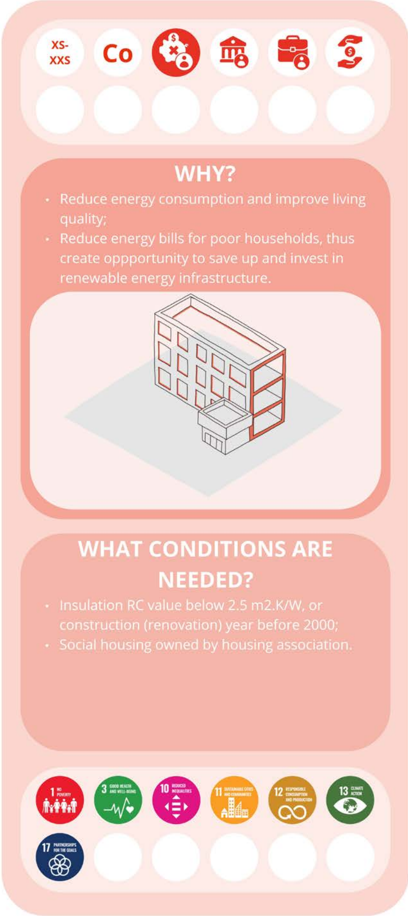


Figure 171-173: Heating strategies for circulation.

STRATEGY-HEATING

CONSUMPTION

INSULATION OF OUTDATED SOCIAL HOUSING



INSULATION OF OUTDATED PRIVATE HOUSEHOLDS

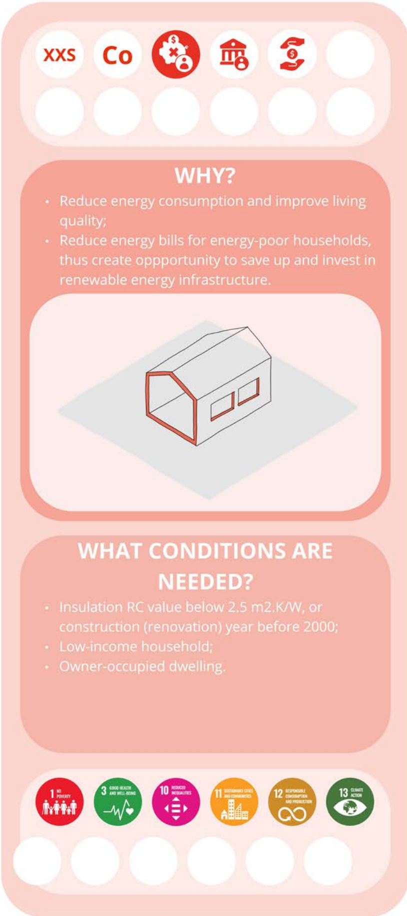


Figure 174 & 175: Heating strategies for consumption.

STRATEGY-ELECTRICITY

STORAGE

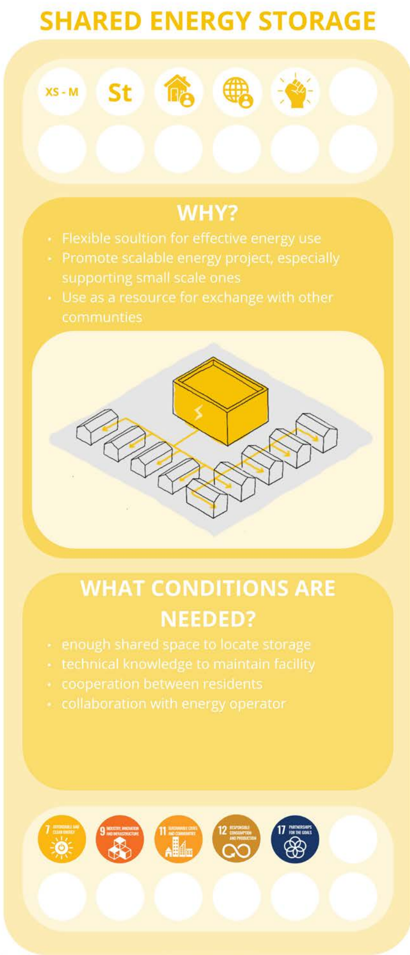


Figure 176: Electricity strategies for storage.

STRATEGY-ELECTRICITY

CONSUMPTIION

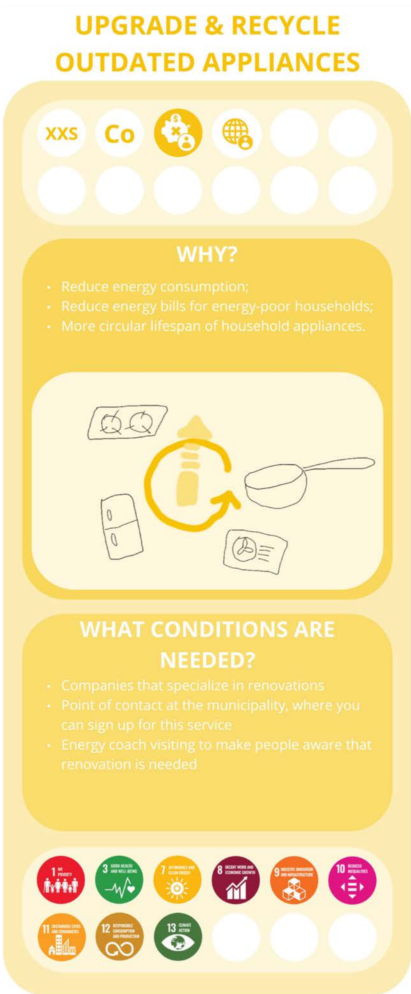
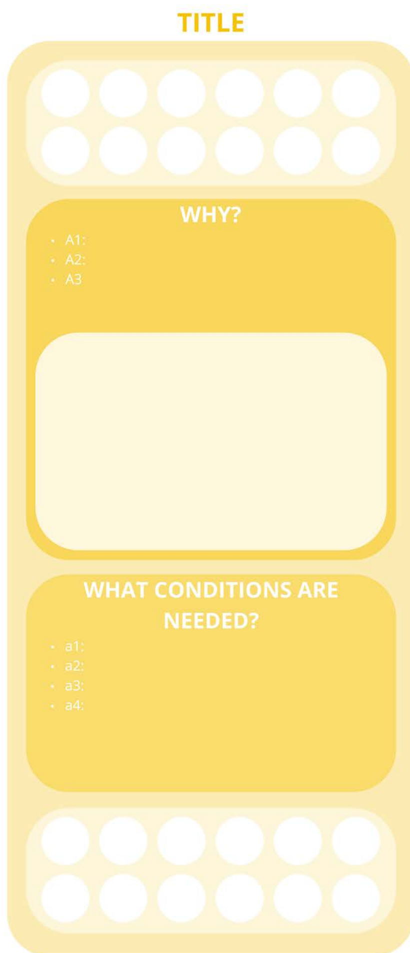


Figure 177: Electricity strategies for consumption.

Figure 178: Icon meaning and SDGs.



STRATEGY-ELECTRICITY

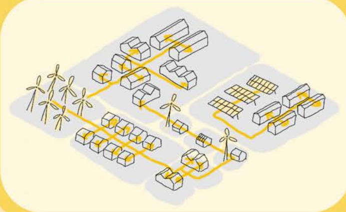
CIRCULATION

MULTI-SCALAR GRID OPERATION

XS-M · Ci

WHY?

- Flexible, customized solution for securing energy per community
- Promote scalable energy project, especially supporting small scale ones



WHAT CONDITIONS ARE NEEDED?

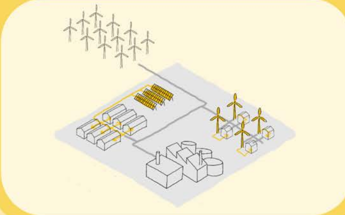
- Structural steering from the government;
- Better coordination and communication for local solutions;
- Local-scale interventions for grid congestion.

LOCAL ENERGY CIRCULATION SUPPORTING BIGGER GRID

XXL · Ci

WHY?

- Utilize strengths and relationship of diverse stakeholders
- Form a link through different scale
- Include local energy community as a main sector of energy transition



WHAT CONDITIONS ARE NEEDED?

- active communication between different stakeholders
- government supporting diverse energy transition model

ADOPTING WIND TURBINES

M-L · Pr

WHY?

- Enhancing power of local communities through bigger energy grid
- Redistribute power between diverse stakeholders
- Owning dedicated energy source for community

WHAT CONDITIONS ARE NEEDED?

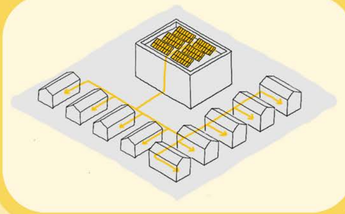
- Enough budget to get ownership of wind mill
- Proximity to existing wind mill, or enough wind speed and space to construct new one
- collaboration with wind turbine industry

SOLAR PANELS ON PUBLIC BUILDINGS

S · Pr

WHY?

- Utilize public resource for securing energy
- Encourage energy communities to include energy poor households
- Energy transition as a means for improving inclusivity



WHAT CONDITIONS ARE NEEDED?

- public sector's permission to use roof of the public building
- budget for install solar roof or rent it

Figure 179-183: Electricity strategies for circulation.

STRATEGY-ELECTRICITY

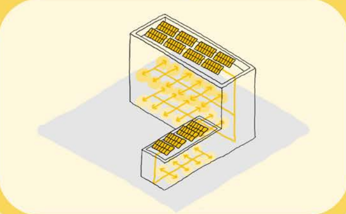
PRODUCTION

COLLECTIVE SOLAR PANEL OWNERSHIP

XS · Pr

WHY?

- Autonomous energy source for small scale community
- Rely less on existing electricity grid for operating new heating system
- Prevent increase in energy bills



WHAT CONDITIONS ARE NEEDED?

- initiative of homeowners to work together

ENERGY PRODUCING STREET FURNITURES

XS · Pr

WHY?

- To make community perceive new energy infrastructure more close to their lives
- Promote awareness for energy transition

WHAT CONDITIONS ARE NEEDED?

- Collaboration between government and energy operator

RENTING SOLAR PANELS

XS-M · Pr · $

WHY?

- To make the threshold for having a solor panel lower.
- Due to the fact a person can rent a solar panel makes the market more flexible

WHAT CONDITIONS ARE NEEDED?

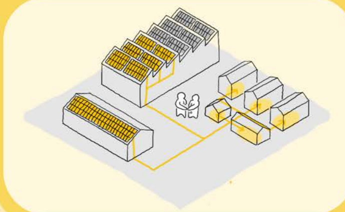
- Having a suitable roof is necessary
- Collaboration between local businesses and the grid operator
- A great network of citizens how can collobareted

RENTING SOLAR ROOFS

XS - M · Pr

WHY?

- to provide more affordable option to have dedicated electricity source
- for residents who lacks budget to install solar panel



WHAT CONDITIONS ARE NEEDED?

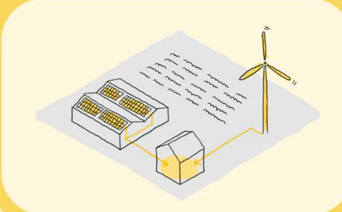
- Proximity to building with large roof
- Different electricity peak time for renters and owner
- collaboration with local businesses and grid operator

SELF SUFFICIENT BUILDING

XXS · Pr · Co

WHY?

- Independent energy source for single houses
- Not relying on existing energy grid and being free from energy bills



WHAT CONDITIONS ARE NEEDED?

- sufficient space to install energy infrastructure
- sufficient budget to install infrastructure, or arrange loans
- technical knowledge to manage own energy system

Figure 184-188: Electricity strategies for production.

KNOWLEGDE

EMPOWERMENT
- BUDGET
- KNOWLEDGE
- NETWORK

GUILDING VALUE
- AFFORDABILITY
- ACCESSIBILITY
- INCLUSIVITY
- AUTONOMY

LEAD ACTOR
- ENERGY-POOR HOUSEHOLDS
- LOCAL RESIDENTS
- GOVERNMENT
- BUSINESS
- CIVIL SOCIETIES

APPLICABLE SCALE
- XXL NATIONAL
- XL PROVINCIAL
- L MUNICIPAL
- M TOWN
- S NEIGHBOURHOOD
- XS STREET
- XXS HOUSEHOLD
- XS - XL RANGE OF SCALE

SUSTAINABLE DEVELOPMENT GOALS

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17

Figure 189: Icon meaning and SDGs.

ENERGY COACHES

XXS

WHY?
- To make supporting system more accessible
- Get technical advice easily

WHAT CONDITIONS ARE NEEDED?
- People need to be willing to open their homes to receive advice.

ENERGY PLAYGROUND

XS

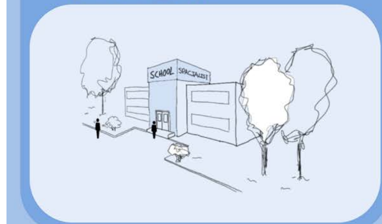
WHY?
- Make knowledge about energy transition more accessible for future generation
- To include energy transition close to daily lives
- Include children as a potential main actor for energy transition

WHAT CONDITIONS ARE NEEDED?
- Space where a playground is located
- Colourful design what is attractive to children

ENERGY SPECIALIST TRAINING WITH ENERGY INDUSTRY

X - XXL

WHY?
- Utilize energy industry to build bridges toward community
- Giving local communities job opportunity
- Provide human resource to promote self-organized energy project

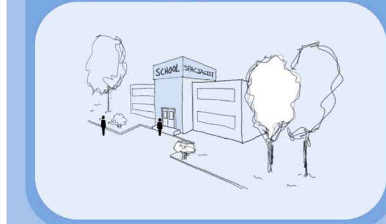


WHAT CONDITIONS ARE NEEDED?
- Collaboration between public sector and private sector
-

ENERGY SPECIALIST TRAINING WITH ENERGY INDUSTRY

X - XXL

WHY?
- Utilize energy industry to build bridges toward community
- Giving local communities job opportunity
- Provide human resource to promote self-organized energy project

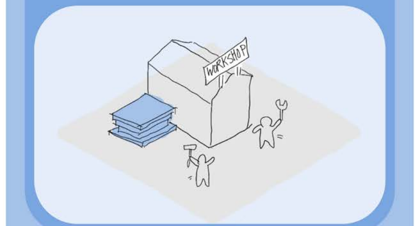


WHAT CONDITIONS ARE NEEDED?
- Collaboration between public sector and private sector
-

ENERGY WORKSHOP

S

WHY?
- Provide affordable tools, and materials for installing energy facility
- share resource and knowledge between community members



WHAT CONDITIONS ARE NEEDED?
- Organization by the municipality.
- Collaboration with companies that can conduct the workshops.
- A designated location for the workshops.

TITLE

WHY?
- A1:
- A2:
- A3:

WHAT CONDITIONS ARE NEEDED?
- a1:
- a2:
- a3:

TITLE

WHY?
- A1:
- A2:
- A3:

WHAT CONDITIONS ARE NEEDED?
- a1:
- a2:
- a3:

TITLE

WHY?
- A1:
- A2:
- A3:

WHAT CONDITIONS ARE NEEDED?
- a1:
- a2:
- a3:

Figure 190-194: Empowerment strategies for knowledge.

STRATEGY-EMPOWERMENT

BUDGET

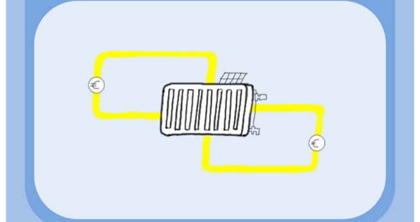
Figure 194-198: Empowerment strategies for fincance.

ENERGY SAVING LOAN WITH ZERO INTEREST

XXS-XXL

WHY?

- reduce financial burden for energy poor communities
- make energy transition more affordable for everyone



WHAT CONDITIONS ARE NEEDED?

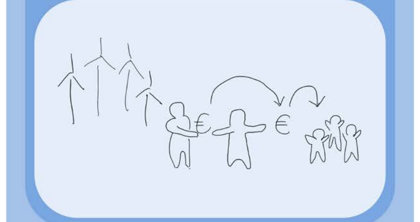
- People need to feel involved and motivated to be part of this transition
- There needs to be a party that can invest in providing loans
- There needs to be collaboration with the government

MANDATORY INVESTMENT FOR LOCAL COMMUNITY

L-XXL

WHY?

- Fair distribution of social goods and burdens
- Soften resistance against new renewable energy projects,
- build trust through government



WHAT CONDITIONS ARE NEEDED?

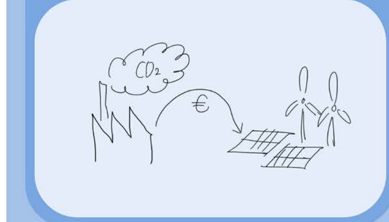
- Large potential for renewable energy
- Important location considering energy transition plan

TAXING FROM HIGH CO2 EMITTING BUSINESSES

L-XXL

WHY?

- redistribution of wealth to fund renewable energy projects
- Incentivize renewables, discourage high CO2 emitting industry



WHAT CONDITIONS ARE NEEDED?

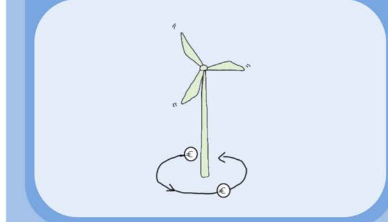
- There should be structured legislation
- Calculations need to be done showing the scale at which CO2 pollution occurs

COLLECTIVE ENERGY FUND

M-XL

WHY?

- Promote scalable energy project
- Enable more customization and autonomy in energy ownership



WHAT CONDITIONS ARE NEEDED?

- Providers how can invest in funds
- Collaboration with grid operators, energy companies, technology companies, municipalities and residents' cooperatives
- Involvement of various parties, both public and private
- Investors (public or private) must have confidence in the fund

EASY APPLICATION SYSTEM

XXL

WHY?

- Make application system more easy for diverse groups, especially for energy poor communities
- Avoid holes in financial support coverage
-

WHAT CONDITIONS ARE NEEDED?

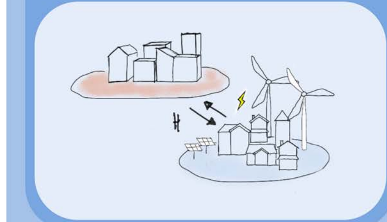
- defining obstacles for applying subsidies

HEAT & ELECTRICITY EXCHANGE

M - L

WHY?

- Flexible, customized way of energy transition
- Being more autonomous in energy world, less relying on existing energy grid
- Being more cost effective for heat and electricity



WHAT CONDITIONS ARE NEEDED?

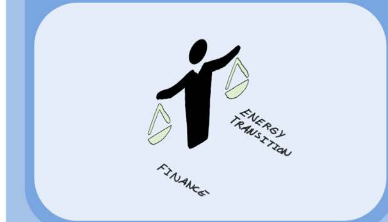
- There must be suitable companies that have waste heat.
- A community needs to be created that functions as the main connector between waste heat and electricity.

ENERGY LAWYERS

XXS

WHY?

- To make supporting system more accessible
- Get legal advice easily
- Help documentation for application of subsidies



WHAT CONDITIONS ARE NEEDED?

- From the municipality, there can be a contact person who can give legal advice.
- There should be a platform where people can sign up for this service.

NETWORK

Figure 199-205: Empowerment strategies for network.

ATTENTION TO LOW DENSITY AREAS

M

WHY?

- Avoid excluding vulnerable areas from energy transition
- Encourage energy communities to include energy poor communities

WHAT CONDITIONS ARE NEEDED?

- A thorough examination of what constitutes low-density environments.
- Research to determine whether these areas can function off the grid.

BETTER PUBLIC SPACE

S-L

WHY?

- Form natural chance of gathering between neighbors
- Promote self organization of energy project indirectly

WHAT CONDITIONS ARE NEEDED?

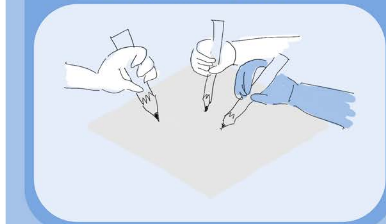
- Provide more space in social facilities for local initiatives.
- Accessibility for social facilities.
- By having accesible social facilities a social network can be created.

CO-CREATION WITH COMMUNITY

L-XXL

WHY?

- To include community perspective in energy transition project
- let community make energy transition on their own way
- give more room for self organization



WHAT CONDITIONS ARE NEEDED?

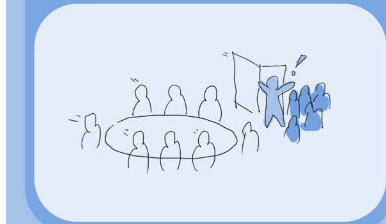
- Strong bond between civil society and government
- Effective communication tool to get diverse opinions from community

COMMUNITY PARTICIPATION IN DECISION MAKING

S-XL

WHY?

- To include community perspective in energy transition project
- Let community decide for themselves



WHAT CONDITIONS ARE NEEDED?

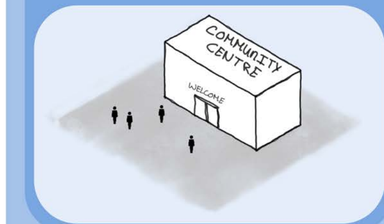
- Strong bond between civil society and government
- Diversity of civil society representing different social groups

ENERGY DEPARTMENT IN COMMUNITY CENTERS

S-M

WHY?

- To be close to communities
- getting support more easily



WHAT CONDITIONS ARE NEEDED?

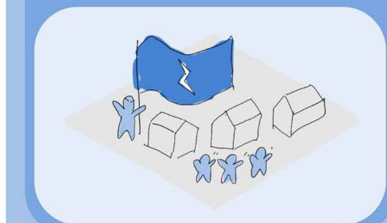
- Sustainable and Scalable Programs
- Qualified Staff and Expertise

PILOT PROJECT TO OVERCOME ENERGY POVERTY

XS-M

WHY?

- Encourage energy communities to include energy-poor households
- Energy transition as a means for improving inclusivity



WHAT CONDITIONS ARE NEEDED?

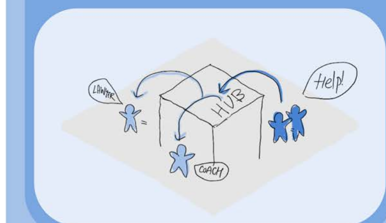
- social hub to collect participants
- advisory or helping center to support
- businesses with innovative idea for energy transition
- arranging funding or subsidy for a project

ENERGY TRANSITION HUB

L

WHY?

- Encourages Community Involvement
- Act as a hub for energy supporters
- Supports Technological Innovation



WHAT CONDITIONS ARE NEEDED?

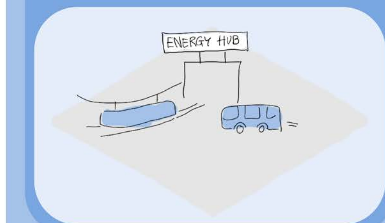
- Strong Stakeholder Engagement
- Technological Infrastructure
- Adequate Funding and Resources

MORE SLOW TRAFFIC CONNECTING TO CENTER

L

WHY?

- To improve physical accessibility to go to energy centre
- Avoid obstacles to get support, especially from low density areas



WHAT CONDITIONS ARE NEEDED?

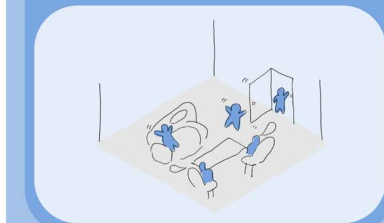
- Slow traffic infrastructure

OPEN THE LIVING ROOM

XS-S

WHY?

- Promote scalable energy project, especially small scale projects
- Enable more diverse energy transition model



WHAT CONDITIONS ARE NEEDED?

- One of the neighbor willing to open their living room to others
- People need to trust on another

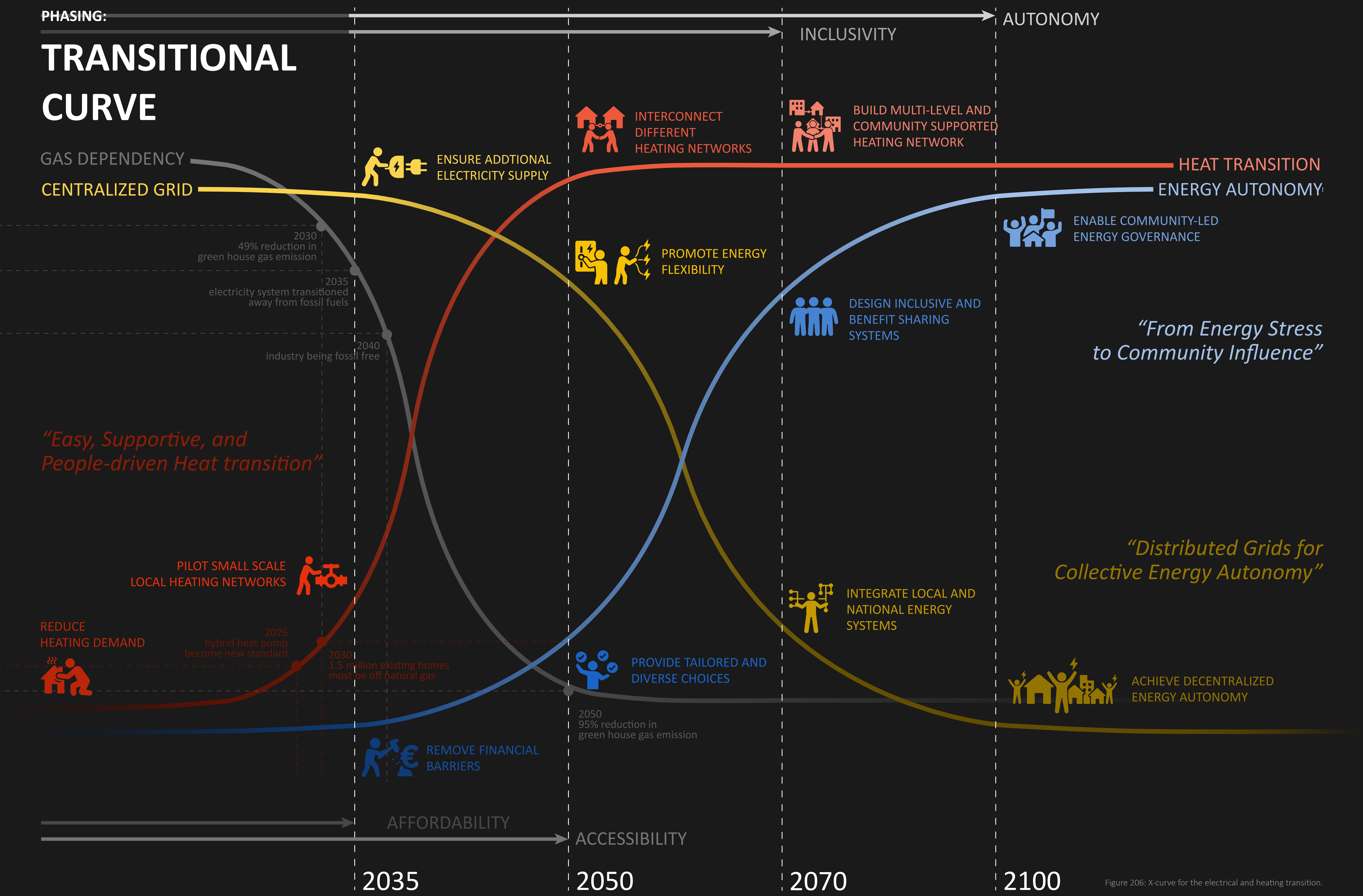


Figure 206: X-curve for the electrical and heating transition.

TIMELINE

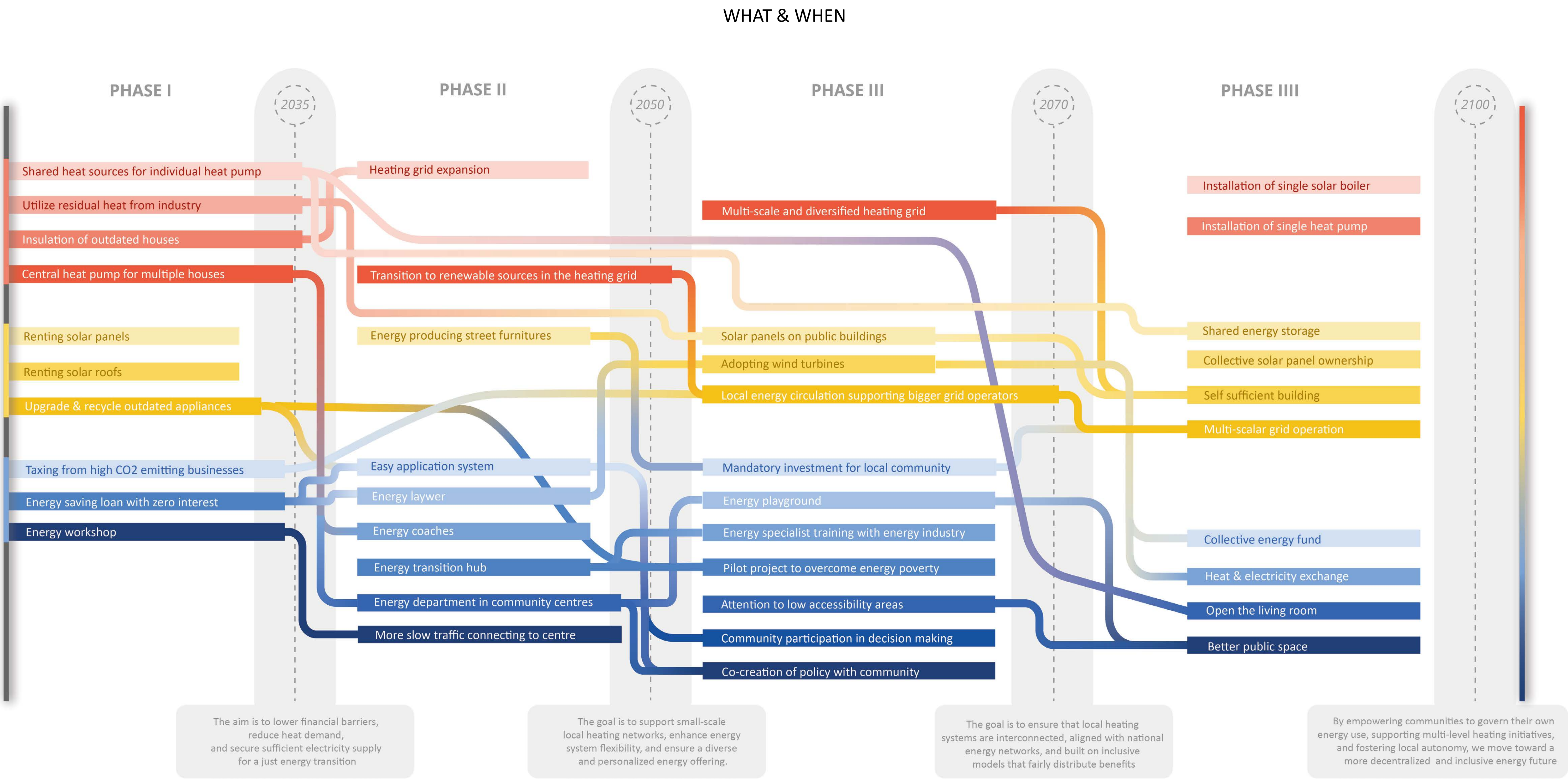


Figure 207: Timeline of strategies.

PHASE I: 2035

In the initial phase of the energy transition we are implementing, the focus is on promoting equal access to sustainable energy sources, with specific attention to low-income households that are highly dependent on natural gas (see *figure 208*).

A fair transition begins with reducing heating demand: before new systems are implemented, it is crucial to limit energy loss in homes through simple and accessible measures. Reducing heating demand not only makes the transition to sustainable heating more efficient and affordable, but it also contributes to broad societal support. At the same time, the introduction of technologies like (hybrid) heat pumps leads to an increase in electricity demand. To accommodate this growth in energy consumption, it is essential to invest in temporary grid capacity and flexibility solutions in this phase. This prevents overloads on the electricity grid and creates the conditions for a resilient and future-proof energy infrastructure.

KEY ELEMENT

Empowerment of the Community "Breaking down financial barriers to enable participation"

An inclusive energy transition requires active efforts to reduce social inequality, starting by breaking down financial barriers that hinder the participation of vulnerable groups. Structural affordability is crucial: lower investment costs through interest-free loans and subsidies. Increasing the CO2 tax for companies with high emissions generates revenue that can be invested in the community, allowing these companies to contribute to compensating the environmental damage they cause.

The transition can be co-financed through targeted taxes on high CO2-emitting companies, with the proceeds benefiting the communities with the greatest challenges. This promotes a fair distribution of costs and benefits.

Engaging the population in the energy transition is essential. This includes not only offering financial opportunities but also transferring knowledge about the meaning and implications of this transition. Energy workshops at the neighborhood level strengthen knowledge, trust, and empowerment among residents. Through practical support and collective action, local support is generated, enabling communities to become active co-creators of a sustainable energy supply.

(Further explanation and how each strategy enable the process to this phase can be found in the appendix)

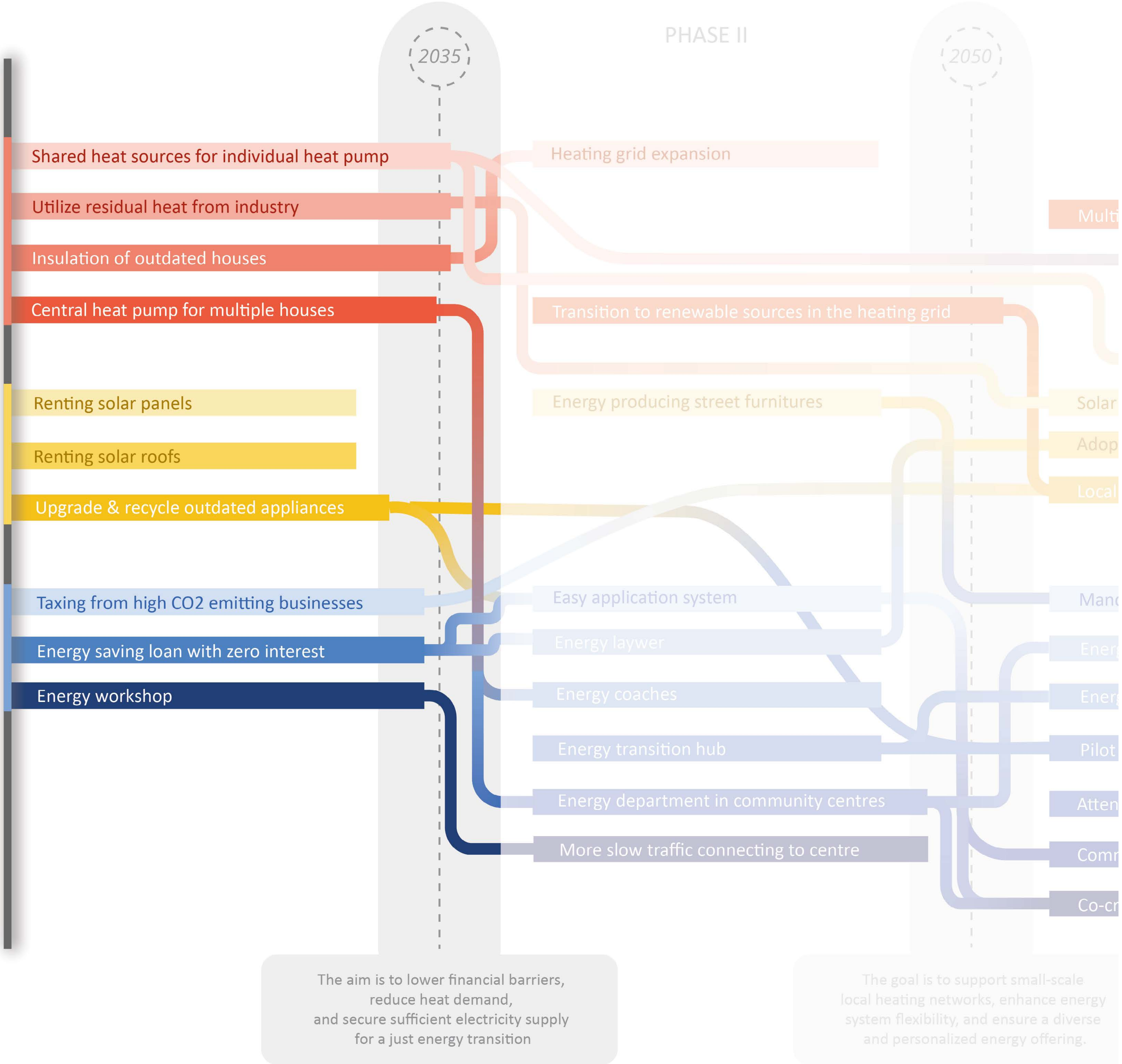


Figure 208: Phase 1 of the strategies until 2035.

PHASING:

PHASE II: 2050

By the year 2050, the goal is to create a fully integrated and sustainable energy system, where communities are provided with tailored energy solutions that meet their specific needs and environments (see *figure 209*). This includes supporting small-scale local heating networks, increasing flexibility within the energy system, and offering diverse and personalized energy options. To begin with, there will be a major focus on the development of small-scale local heating networks, which will serve as pilot projects to test practical and reliable solutions for the energy transition. These systems strengthen the involvement of residents in their energy supply. In addition, energy flexibility is promoted by offering smart tools, flexible tariffs, and decentralized storage, enabling communities to actively contribute to balancing supply and demand. This ensures a more efficient and resilient energy system, both locally and nationally.

KEY ELEMENT

Empowerment of the Community "Design inclusive and benefit-sharing systems"

In the first phase, an inclusive energy transition is initiated. Designing systems that fairly distribute the benefits of sustainability and allow everyone the opportunity to participate. Setting up a simple registration system for subsidies and schemes ensures that residents have easy access to the necessary financial support. Sharing knowledge is essential for strengthening communities and promoting the energy transition. Energy coaches provide practical support by advising residents on energy savings at home. In addition, energy advocates can guide households through the legal and practical aspects of sustainability. These initiatives help residents confidently take steps toward more sustainable energy use.

Furthermore, creating energy hubs and integrating energy departments within municipal services provide direct access to knowledge and resources, increasing residents' engagement. Energy hubs are local collaborations where residents and businesses jointly generate, use, and manage energy, contributing to a more sustainable energy system. By establishing energy departments in town halls, residents can easily access information and support in making their homes more sustainable and making energy-related decisions. At the same time, improving slow traffic routes leading to the center enhances accessibility and strengthens social cohesion, increasing community involvement in the transition.

(Further explanation and how each strategy enable the process to this phase can be found in the appendix)

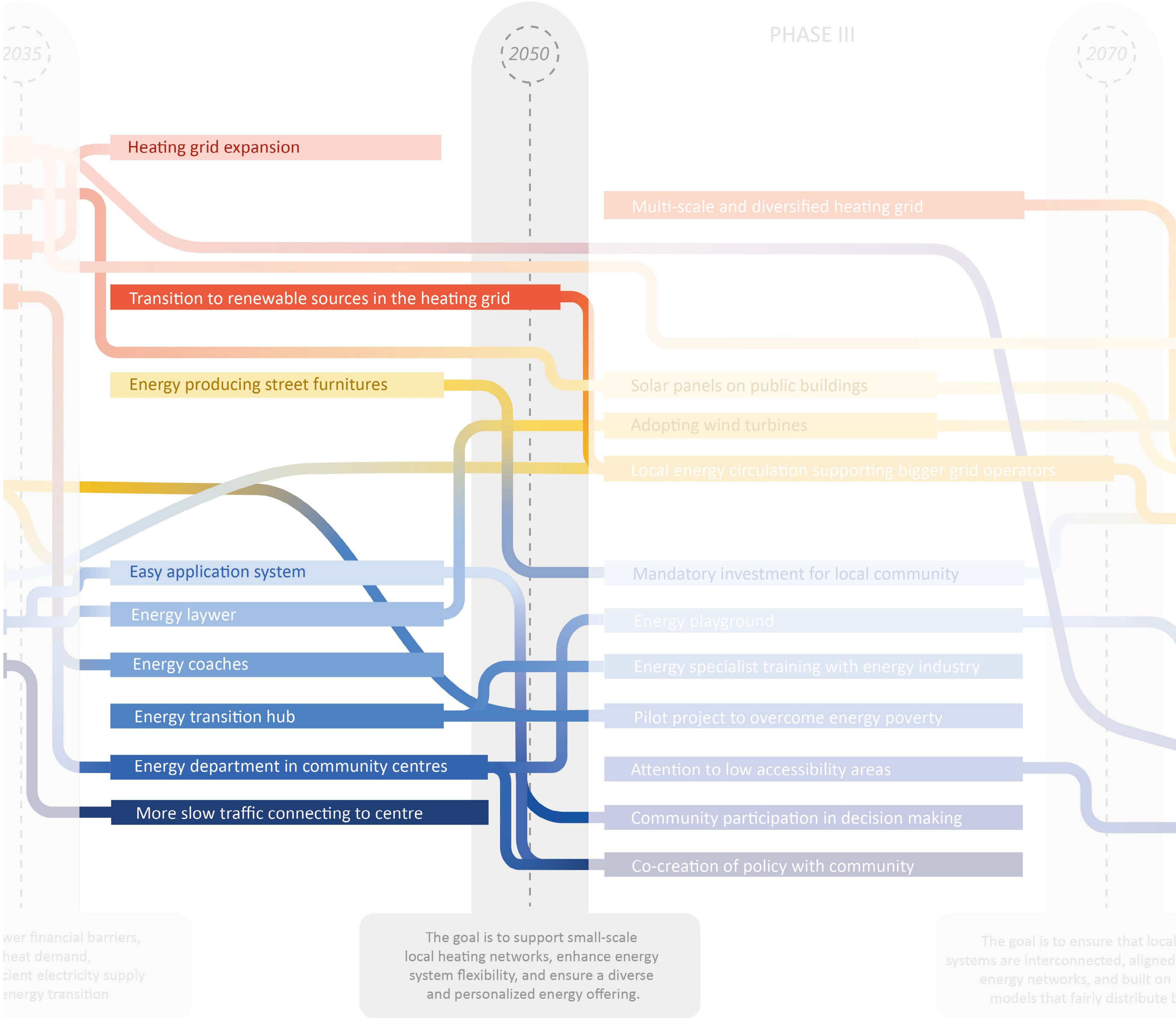


Figure 209: Phase 2 of the strategies until 2050.

PHASE III: 2070

By 2070, the energy transition enters a mature phase of systemic inclusion. The focus shifts from simply providing access to energy systems to actively integrating diverse users, needs, and infrastructures into a cohesive, community-centered ecosystem (see *figure 210*). For the target community—low-income, gas-dependent households—this marks a major turning point: from being recipients of support to becoming active contributors who gradually grow their influence within the system. This transition represents a crucial first step toward becoming true protagonists of the energy transition.

At this stage, community influence extends across the entire energy system. Heating and electricity networks, as well as their operations, will be co-designed to ensure fair distribution of benefits. Inclusivity must be central, with particular attention to marginalized groups and individuals lacking sufficient resources.

In the heating transition, small local movements will evolve into shared infrastructure models. Local heating networks will become interconnected, offering mutual stability and greater resilience. Simultaneously, energy systems will move beyond isolated solutions. Distributed energy grids will operate in coordination with centralized infrastructure, forming a hybrid model that balances local autonomy with national reliability.

This phase is about bridging scales, connecting communities, and aligning technologies—ensuring that no one is left behind. Inclusivity is no longer just a guiding principle; it becomes a driving force that powers the entire system.

(Further explanation and how each strategy enable the process to this phase can be found in the appendix)

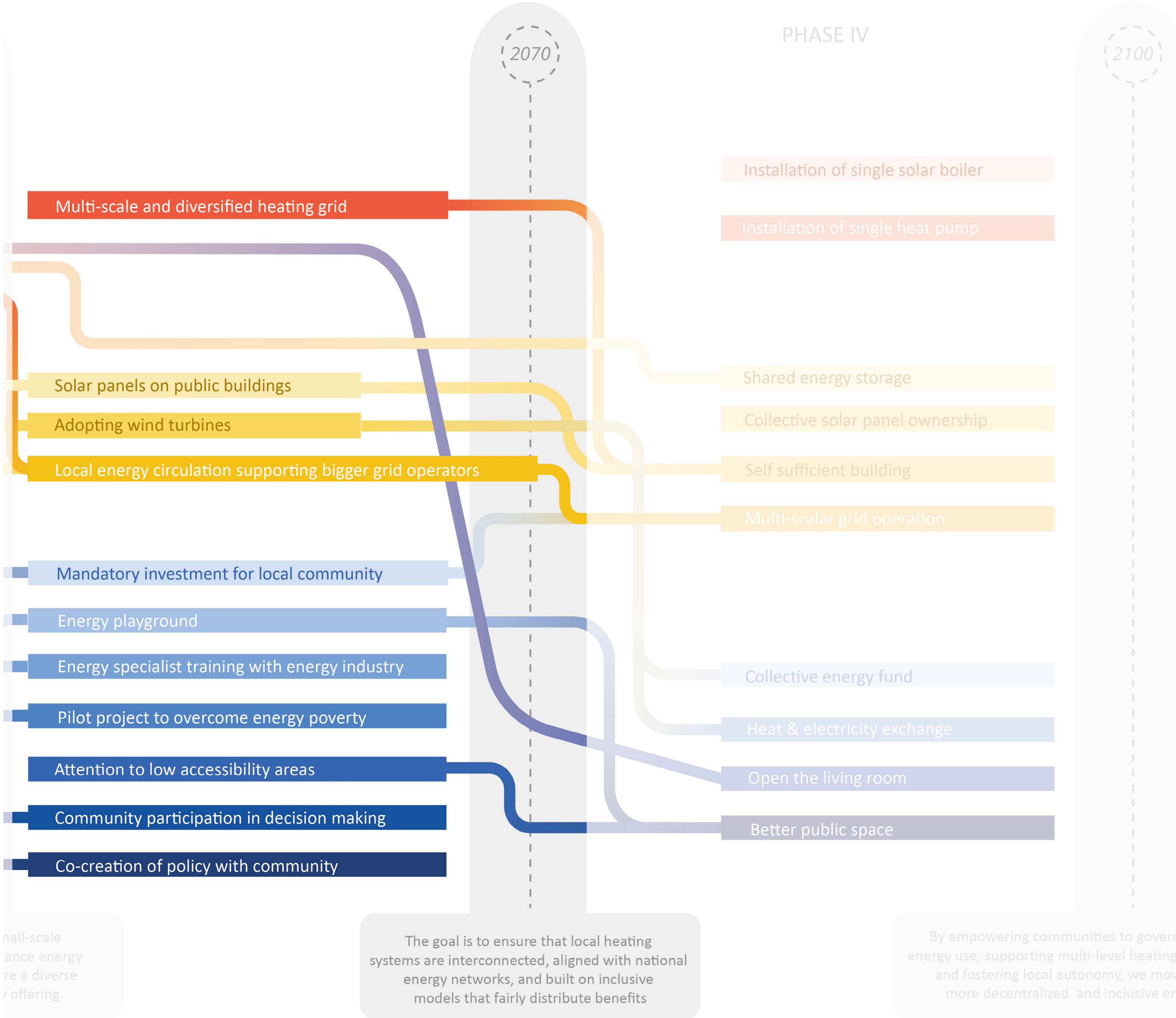


Figure 210: Phase 3 of the strategies until 2070.

PHASING:

PHASE IV: 2100

By 2100, the vision of a decentralized, community-empowered energy system becomes a vivid reality. This phase marks the full transition from participation to ownership and self-governance. Communities are no longer just consumers of energy—they become prosumers, actively generating, distributing, and sharing energy through localized, democratically managed systems (see *figure 211*).

Heating infrastructure evolves into a multi-layered, community-supported model, where neighborhoods and municipalities collaborate through shared systems that are collectively maintained and continuously adapted. At the grid level, distributed energy autonomy is achieved: diverse types of buildings independently produce and manage energy, while remaining resilient and interoperable within an interconnected network that flexibly supports one another. In this future, energy is no longer delivered through a top-down model but exists as a cooperative network of empowered communities.

This represents not only a technological transformation but a profound societal shift—where energy autonomy becomes a foundation for equity, dignity, and local resilience. By 2100, all the power once concentrated in energy production is redistributed and decentralized.

(Further explanation and how each strategy enable the process to this phase can be found in the appendix)

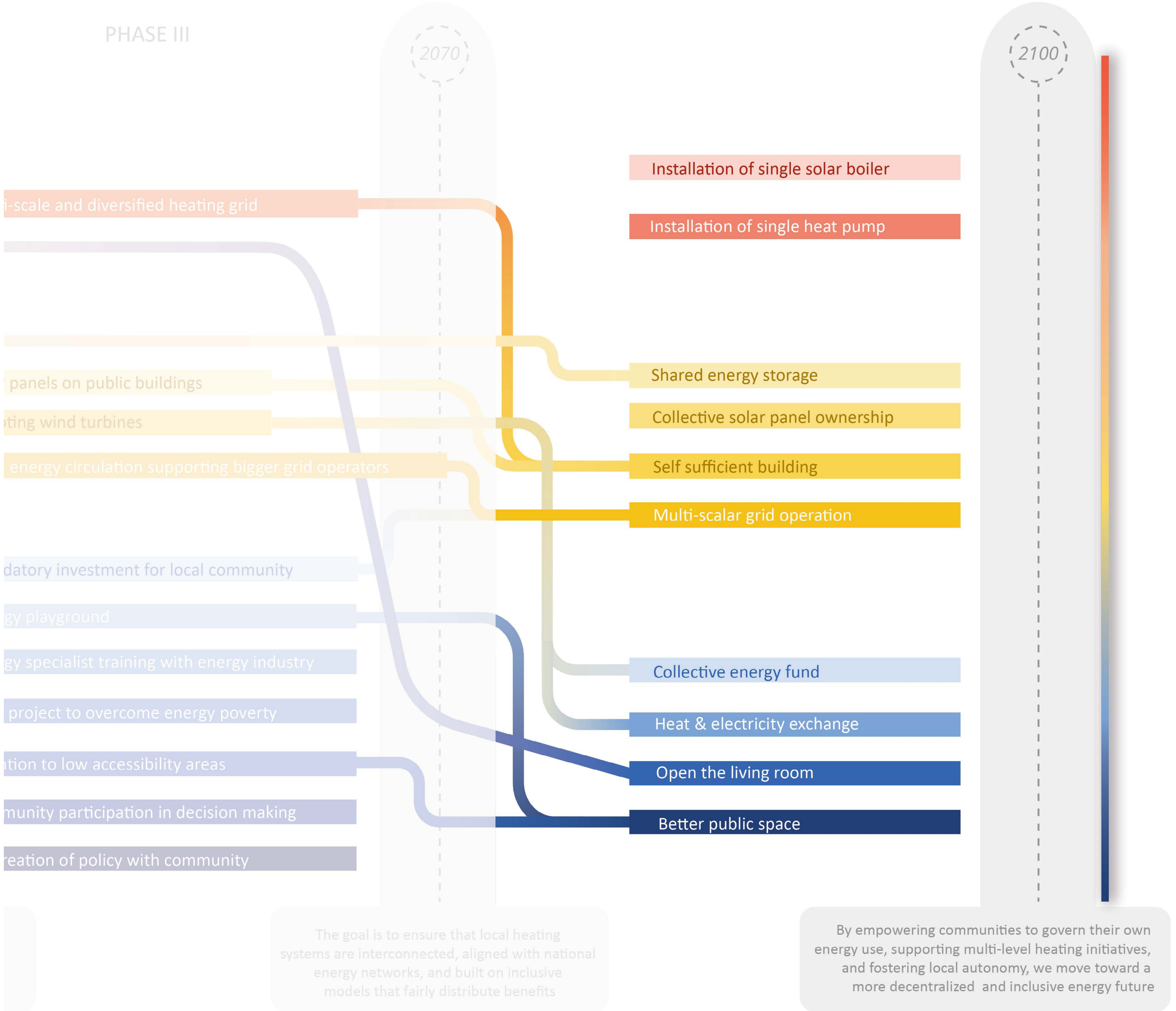


Figure 211: Phase 4 of the strategies until 2100.

WHAT IF...

the energy transition empowered and strengthened low-income communities?

Figure 212: Envisioning of energy cooperations across corporations and residents, on the benefit of low-income households.

CHAPTER VII:
LOOKING AHEAD: VISION FOR NORTH-HOLLAND

Figure 213: OLD WINDMILL
Near Ursem
Photo: Hauge, 2025

VISION:

VALUES & PRINCIPLES

Community Collaboration:
Dutch households in poverty want to participate in the energy transition, but do not have the means to do so. They dislike the top-down approach of current energy policies, as these policies often cannot fit into their daily lives (see page 94). By engaging the community to participate in the solution- and decision-making process, renewable energy projects can be made more effective and inclusive, while also strengthening communities.

Gas-free Households
Household heating creates the majority of CO_2 emissions in Noord-Holland (Provincie Noord-Holland, 2023). This is due to the reliance on natural gas for heating, as well as having outdated buildings with poor insulation and gas cooking stoves. For a successful energy transition, it is important to address the gas dependence of many Dutch households and help them to electrify, as well as reduce their heating demand through renovation.

Creating Opportunities
Provincial towns are losing facilities, businesses and people to big cities like Amsterdam or Alkmaar. Meanwhile, energy-poor households feel that the energy transition is only making their daily problems more challenging. Therefore it is important for the energy transition to create employment, education, or business opportunities in provincial towns and provide opportunities for additional income or reduced energy bills for energy-poor households.

Local Energy Circulation
Currently the energy grid in The Netherlands is experiencing grid congestion. To avoid putting additional pressure on the grid by electrifying households, a more local energy circulation system is necessary. This will also enable provincial towns to be more autonomous and resilient and create more community engagement, employment, and education opportunities.

Figure 213: Principles, as found through case studies and strategies.

Figure 214: Principles and values.

SPATIAL VISION

Empower and support energy-poor communities in declining provincial towns by addressing their needs and desires through increased autonomy, resilience and opportunity-making.

From the community values, there is need for some extrapolation to envision them spatially on the scale of North Holland. Most importantly, a need to be more self-regulating drives the larger spatial form. The national grid and other main structures are still in place, but there was given a greater emphasis on local and inter-communal collaboration. This resulted in a vision based on bands of change along the main grid, instead of within larger sub-regions. With a community that spans across the whole region, it is of great importance to give room for trust and self-realisation early on, including for the vision.

The vision is therefore more of a representation of communal utilisation of the region's resources. It does not show the outcome of the game, but the cards that's been given. It will be up to the individuals, groups and/or larger associations on how their hand will be played. This is the very fundament of the vision.

Due to the personal scale which we operate on, it can be easy to ignore larger scales or perspectives outside one's own. While lowering the energy bill is a top priority, it wouldn't be at any cost. That much is clear when looking at community reactions from large energy projects. The vision already has collaboration as a central value, so we should also look at the usual reason for conflict. Energy infrastructure changes the landscape, sometimes to something unrecognisable. The environment isn't just physical, it's also a defining part of local culture, heritage and belonging. It might be a less obvious aspect, but stitching this together with the previously mentioned values will bring a less conflict-filled transition (see *figure 215*).

Creating opportunities are a fundamental part of realising the desires for the community, whether for jobs, knowledge or participatory opportunities. Opportunities should be available for everyone, especially those affected by the lack or consequences of them. On that note, it was pivotal to include all kinds of life to be given an equal opportunity to exert their lives. Just like how nature is our culture, its residents are our neighbors.

The community values push the vision ahead with deep-rooted collaboration of existing stakeholders and institutions. For a just transition to happen, we need everyone.

Come on, let's make this transition ours!

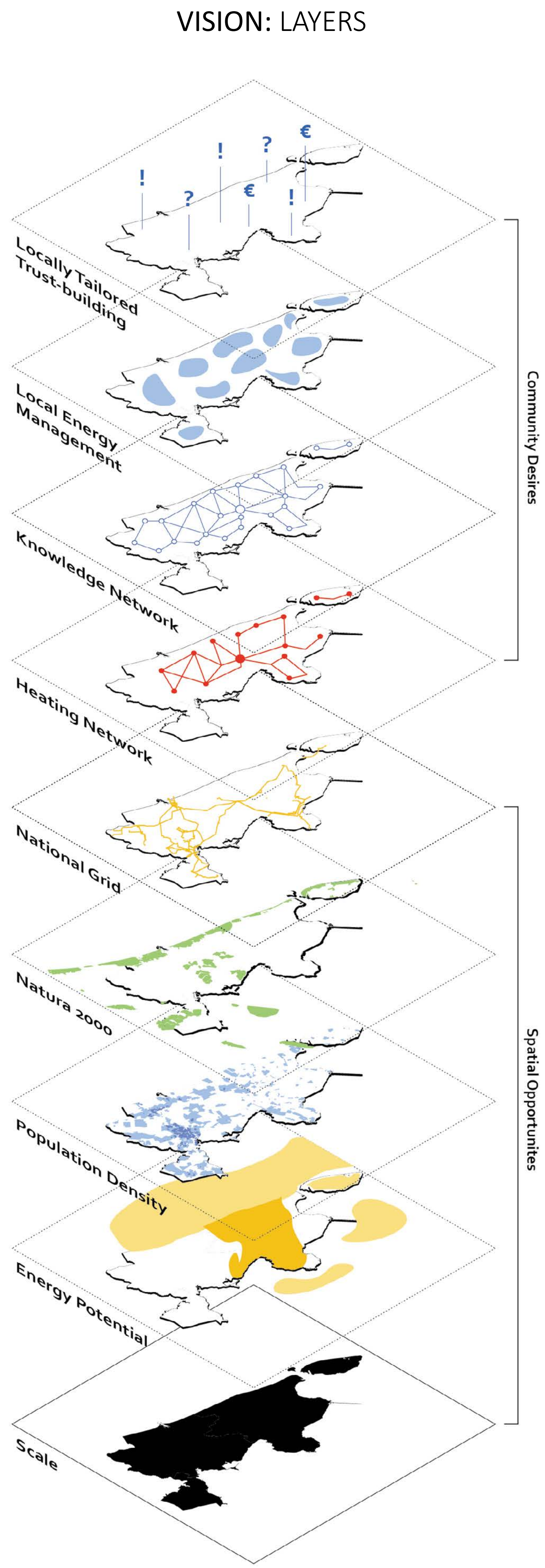


Figure 215: Vision composition. The community values are implemented onto the spatial form on a local scale, facilitating the others goals to be achieved.

VISION:

NORTH HOLLAND

Figure 216: Vision map of value-strengthening infrastructure. A combination of collaboration/governance, opportunities, production and local circulation.

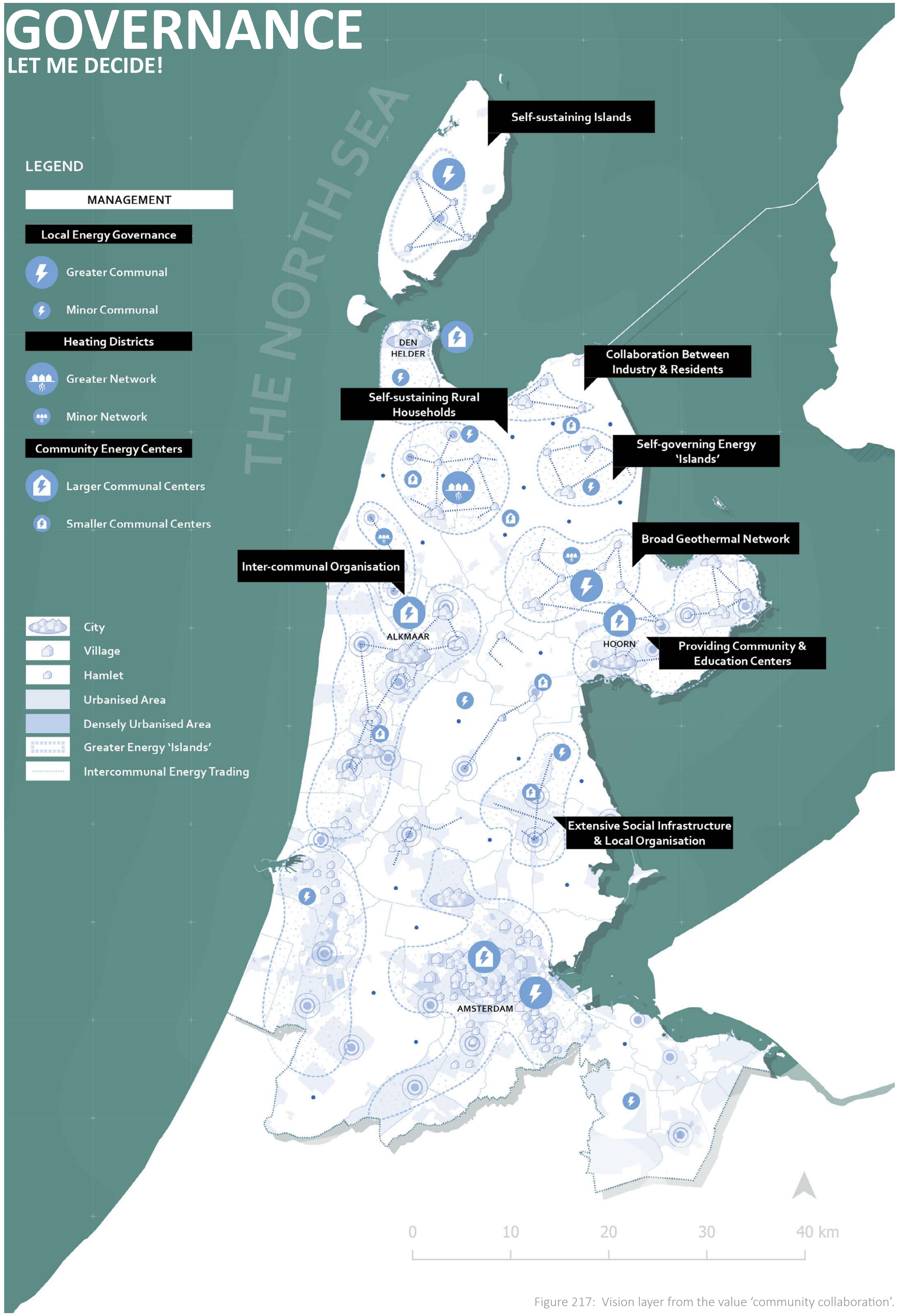


Figure 217: Vision layer from the value 'community collaboration'.

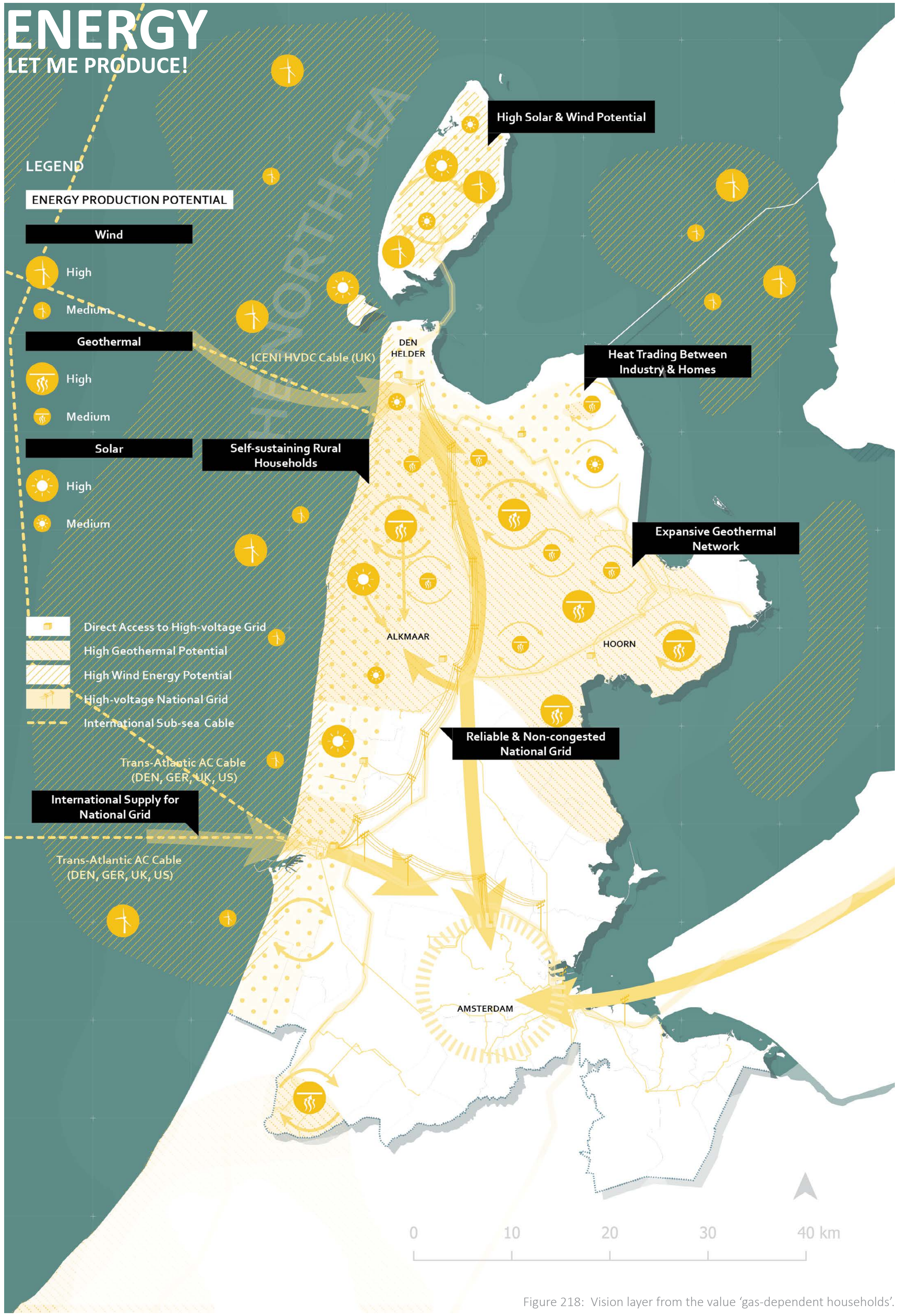


Figure 218: Vision layer from the value 'gas-dependent households'.

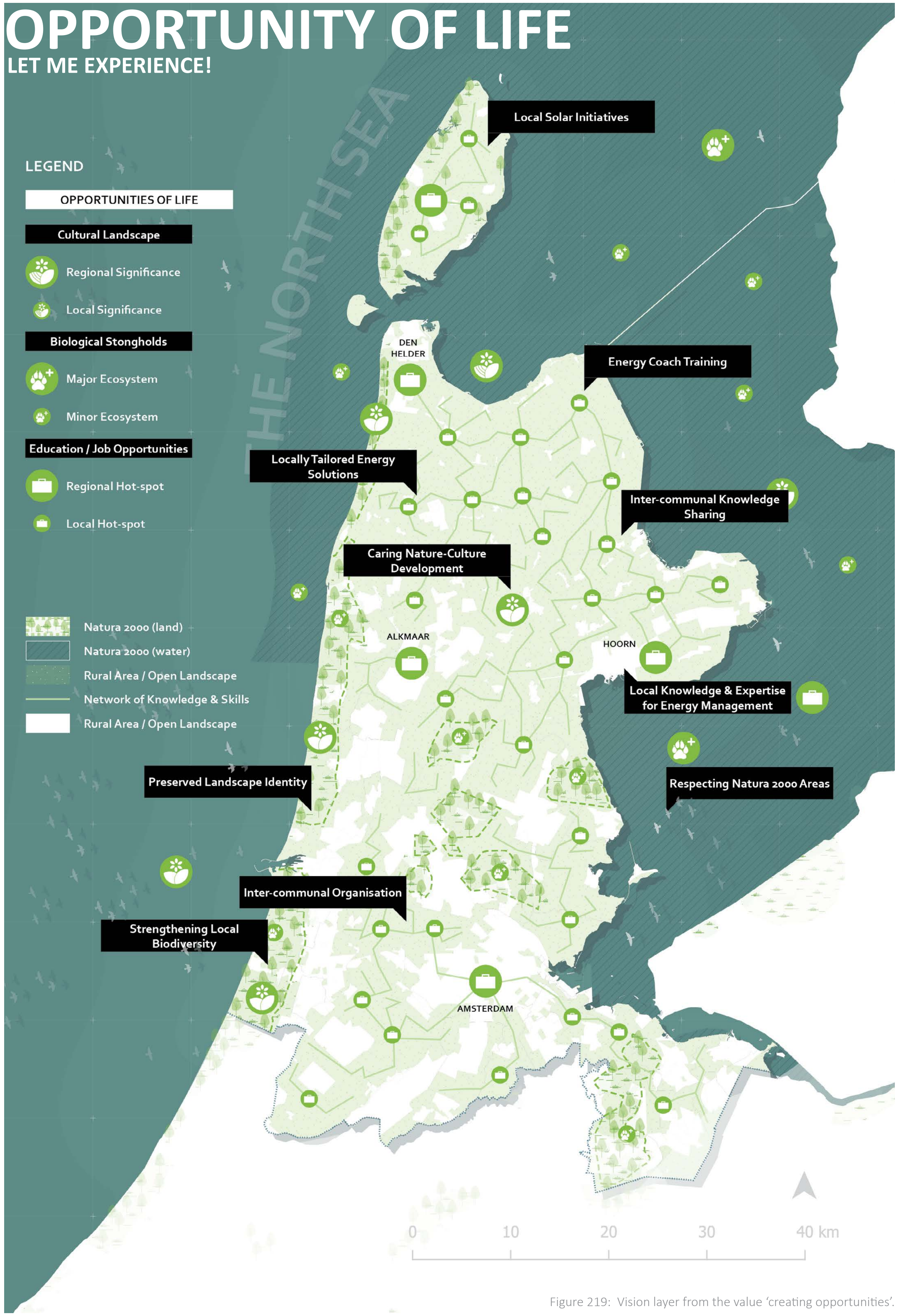


Figure 219: Vision layer from the value 'creating opportunities'.

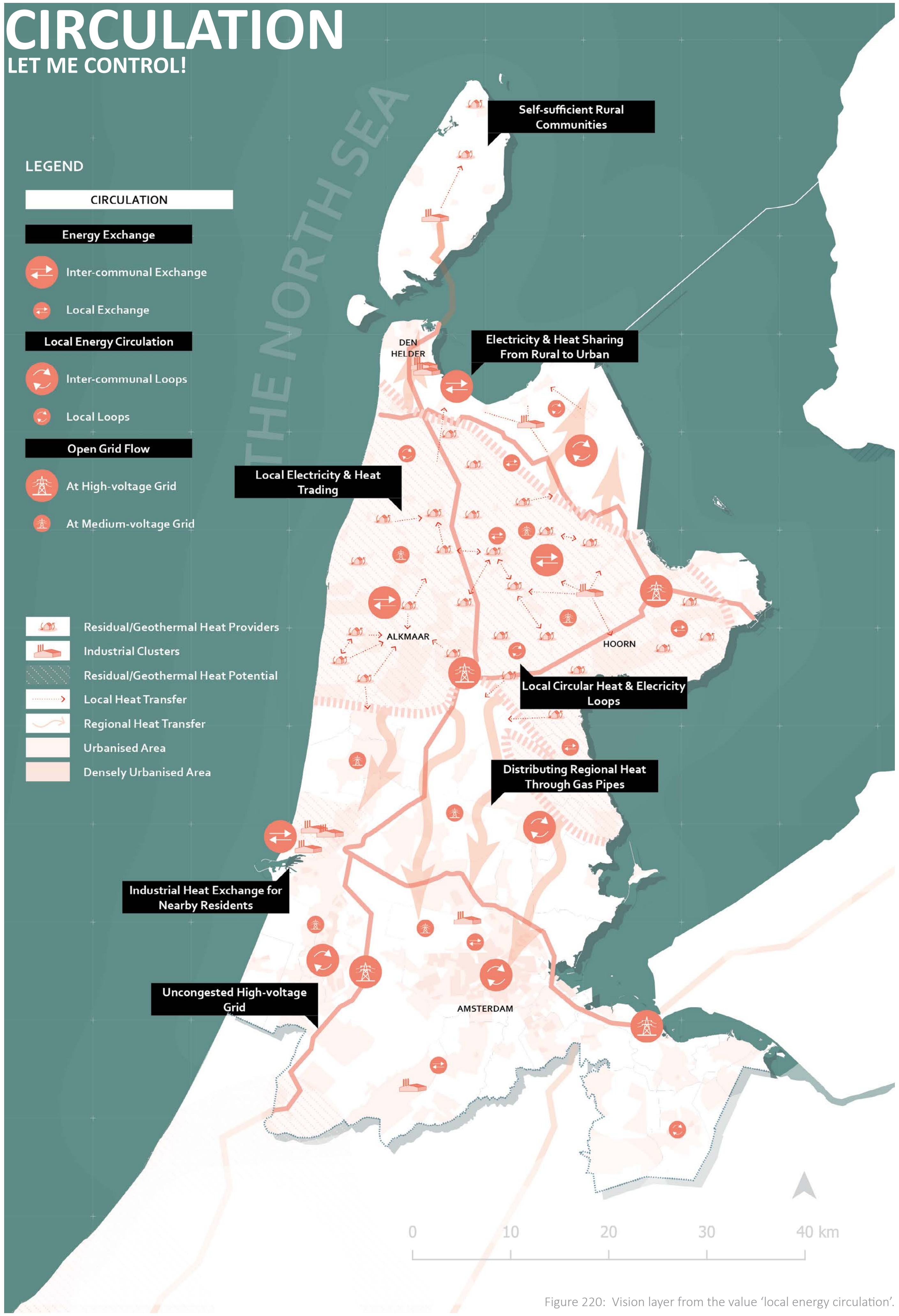


Figure 220: Vision layer from the value 'local energy circulation'.

TOWARDS THE FUTURE

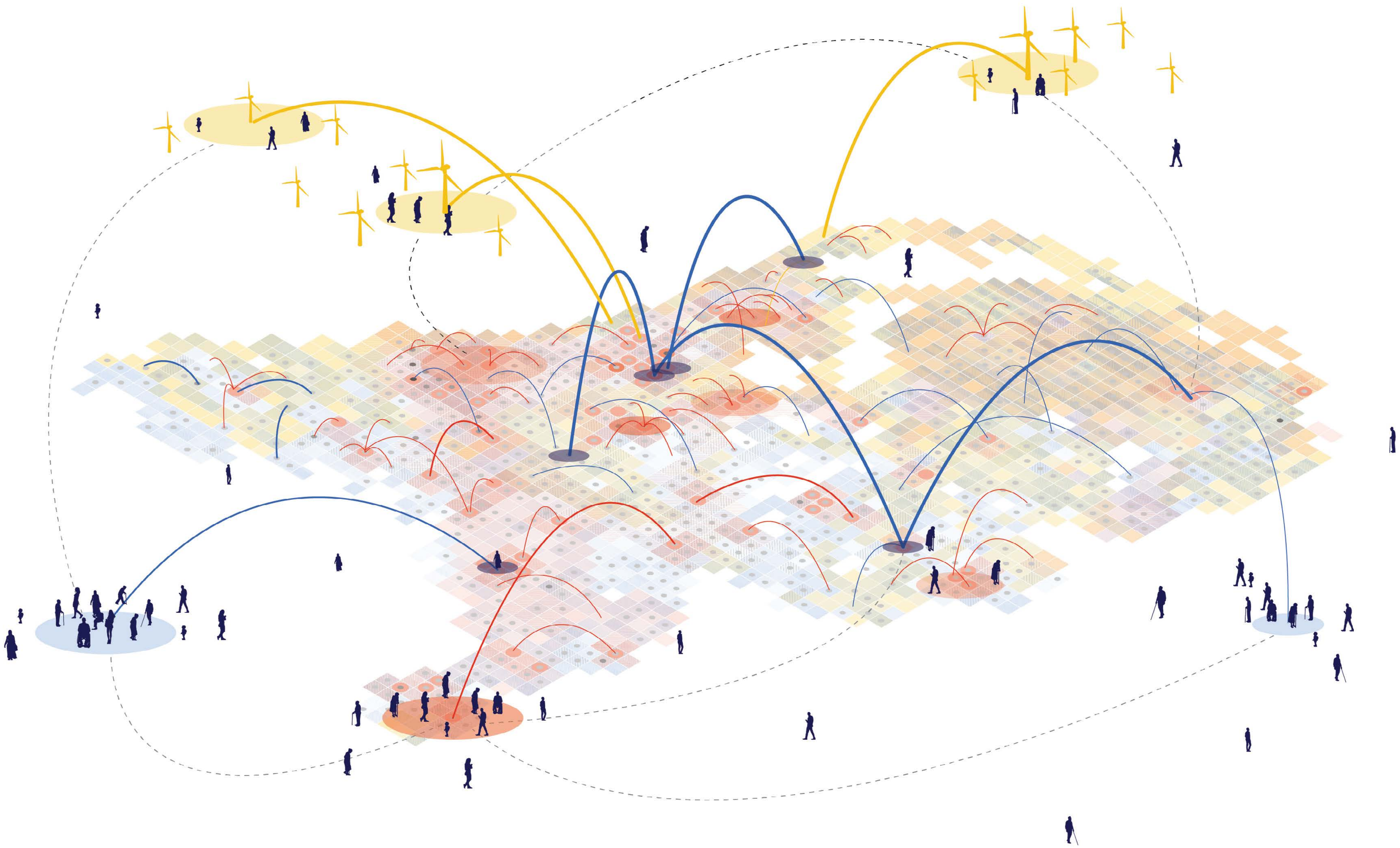
An energy transition empowered and strengthened low-income communities

Figure 221: Impression of a just future for the low-income households on their own terms.

TOWARDS THE FUTURE

An energy transition empowered and strengthened low-income communities

Figure 222: Impression of a just future for the low-income households on their own terms across the country.



CHAPTER VIII:
CONCLUSION & REFLECTION

Figure 223: COW ON A POLDER
Middelpolder, Amstelveen
Photo: Hauge, K.T. (2024).

CRITICAL DISCUSSION:

ON JUSTICE & SUSTAINABILITY

How does our strategy address social, environmental and economic sustainability in an integrated manner?

The project addresses the threats to the energy infrastructure and social sustainability which the energy transition is bringing forward. In our perspective, the three sustainability pillars come together and interact within our community. We address the energy transition (environmental sustainability), the grid congestion (economic sustainability) and the energy poverty (social sustainability) by looking through the lens of our community.

Social: The strategy addresses the question of renewable energy affordability for the low-income and gas-dependent communities. The strategy aims to empower our community and put them in a position where they can easily participate in the energy transition.

Environmental: The strategy is to keep the energy production at the smallest (human) scale. Consequently, this will also limit the environmental impact of energy infrastructure projects by creating truly local and contextual solutions.

Economic: The strategy focuses on strengthening towns in the Noord-Holland province which are declining. Currently there is a problem that most of the economic activity is being concentrated in large cities, while towns are experiencing a declining economy. By supporting energy production and circulation on the smallest scale, the strategy can give more economic autonomy to towns. By improving the economic situations of our community, the community will be able to spend more in their local town, thus strengthening its economy.

Does our strategy address intra- and inter-generational justice?

The strategy tackles the intra-generational issue of getting unfair treatment in the energy transition. Currently only the rich are benefitting from the energy transition and are getting subsidies and more autonomy and say in their energy production. However, many low-income and gas-dependent communities are also expected to transition without having the means to do so. Therefore, they are stuck paying increasingly high taxes for consuming gas, without having the money or means to electrify. This issue is only expected to get bigger in the future. The strategy aims to address this issue by empowering and enabling low-income and gas-dependent households in the province to participate in the energy transition, thus addressing inter-generational justice.

In addition, the strategy also aims to transition to a more sustainable energy system to reduce emissions and environmental degradation to maximize the opportunities for future generations. The strategy also improves the autonomy and opportunities for small towns and gives the best chance for future generations who grow up and live there to thrive.

What Sustainable Development Goals does our strategy support or enhance?

Our strategy supports a wide range of SDG's (see SDG evaluation for each policy, and page 16-17), addressing aspects from environmental, social and economic sustainability. Some of the most important SDG's for our strategy is:

No poverty (1):

Our strategy addresses energy-poor households and their position in the energy transition. They are at a crossway, at which they can either be left behind and their problems be amplified, or they can be empowered and lifted out of poverty. The strategy aims to steer the developments in the energy transition in the right path for the community supported, rather than punished by the energy transition. This means addressing root issues for energy-poor households, such as insulating social housing or low-income owner-occupied households.

Affordable and clean energy (7):

Of course, the project aims to advance the energy transition in The Netherlands. In the strategy, this means not only expanding energy infrastructure (e.g. heat pumps, renewable energy production), but also addressing the grid congestion and energy poverty, which is slowing down the transition.

The strategy addresses the grid congestion by supporting local initiatives and solutions, and reducing energy consumption where it is possible (e.g. by insulating households or utilizing residual heat from industries).

The strategy emphasizes the role of our community in the energy transition. In the province and in lower-income and less-educated communities, we see higher resistance towards it. These communities often suffer from the negative impacts of the energy transition while getting very little benefits, so it is no surprise that they are so against it. The project strategy addresses these specific communities and aims to remove their barriers to experience the benefits of the transition. The hope is that by addressing their personal concerns (e.g. affordability, inclusivity) through renewable energy infrastructure, the communities will become more supportive, rather than protesting the expansion of renewable energy.

Reduced inequalities (10):

Related to SDG 1 (No poverty), the project recognizes that currently the energy transition is only benefitting the haves, not so much the have-nots. We know that these communities want to participate in the transition, and they want to do it their way, but they lack the resources to do so. Our strategy addresses this inequality by providing the means for energy-poor and gas-dependent communities in provincial towns to self-organize. This is done by expanding social facilities where people can get together, and by providing energy-related support (e.g. with energy coaches, energy community centers and energy lawyers).

Sustainable cities and communities (11):

The strategy addresses the increasing shift of opportunities and population to the big cities. The province is declining, while cities are facing increasing pressure to accommodate new people. The locally-focused strategy aims to create more social facilities and job opportunities in provincial towns, and make them more autonomous. The goal is to turn these towns into more attractive places to stay and live, thus reducing pressure on big cities and reviving provincial towns.

Partnership for the goals (17):

It is clear that our community (low-income and gas-dependent households in the province of Noord-Holland) do not have the means to participate in the energy transition by themselves. They need support from the government and municipality, but also from their more well-off neighbors. The strategy emphasizes the collaboration between diverse stakeholders to empower our community. In addition, a public-private-civil collaboration in provincial towns is emphasized to build autonomy, local solutions and opportunities.

ON INCLUSION & PUBLIC GOODS

RECOGNITIONAL

Does our strategy recognize vulnerabilities, identities and trajectories?

For energy-poor communities, the energy transition poses a threat of increasing energy bills, while for the province it may mean more burdens from renewable energy infrastructure, with minimal benefits. Because of this, low-income and provincial communities are resisting the energy transition. To have an inclusive energy transition means to address the vulnerabilities, perceptions and trends of these communities. Therefore the strategy focuses on enabling communities to self-organize and to do the energy transition *their way.*

PROCEDURAL

Does our strategy or proposals incorporate the voices of the most vulnerable/ the voices of stakeholders (including the planet)?

The strategy is directly derived from the experiences, perceptions and desires of energy-poor communities, this way incorporating their needs and desires. In addition, by eliminating the resource-related obstacles for our community to participate in the energy transition, the strategy aims for energy-poor households to gain more power and thus better participate in the energy transition.

DISTRIBUTIVE

Does our strategy distribute the burdens and benefits of actions fairly?

On a city, province and national scale, the strategy distributes the burdens and benefits of the energy transition between diverse socio-economic groups. The strategy specifically aims to address the current inequalities in opportunities that the transition is creating between high- and low-income groups. This is done so by removing barriers for participation of energy-poor households, focusing on local solutions and emphasizing cross-stakeholder collaboration to achieve more sustainable energy systems. While the project includes vulnerable groups on a province and national scale, it fails to do so on a global scale. The project does not address what happens to the vulnerable communities (and nature) in countries of the global South, from which most of the materials for the production of renewable energy infrastructure are extracted. This is a vital that needs to be addressed for a just global energy transition.

What public goods are being created? Are they fairly distributed?

The strategy proposes the expansion of social infrastructure (e.g. community centers). Emphasis is put on the fair distribution of resources to improve the equity of opportunities for struggling communities (economic egalitarianism). For the project this means that the province is getting more care and attention in the strategy, as currently it is lacking social facilities and opportunities compared to the big cities. On the town scale, the social facilities are distributed more evenly to facilitate cross-stakeholder collaboration.

The strategy also aims to build more knowledge on renewable energy by facilitating pilot projects but also sharing that knowledge across diverse stakeholders. For example, energy coaches will share knowledge with high energy consuming households on how to reduce energy consumption with quick measures. Knowledge as a public good will be distributed equally, but an emphasis needs to be put on the low-income provincial communities, as they generally have less access to knowledge and require additional support.

In addition, the project aims to reduce the negative impact of gas-powered energy on the air and climate (as a public good). The distribution of these public goods cannot be controlled as easily as social facilities, therefore everyone on a national, continental and global scale would benefit from these public goods.

ON VALUES

DIALOGUE AND MUTUAL UNDERSTANDING

The strategy aims to eliminate the barriers for energy-poor communities to self-organise and participate in the energy transition in their own way, encouraging bottom-up initiatives rather than top-down decisions which may not fit well in their daily lives. In addition, the strategy focuses on cross-stakeholder collaboration to find local solutions; therefore, dialogue, negotiation and sharing of knowledge are necessary in our vision.

The strategy is kept flexible to provide space for the communities to decide themselves what they want and to encourage innovations and creative solutions in energy infrastructure. Participative planning, decision-making processes and locally orientated solutions in our strategy aim to facilitate the creation of pluriverses in which diverse worlds and lifestyles can co-exist. Power imbalances in the conversation are mitigated by providing more financial, educational and network support and resources for low-income and provincial communities.

INCLUSIVITY AND REPRESENTATION

Currently, low-income households are being excluded from the energy transition, while mostly the higher- income communities are benefiting from subsidies, regulations and new technology. This is due to unequal opportunities to invest time and money, make connections and gain knowledge. The goal of our project is to bring the low-income community to the table and empower them to meaningfully participate in the energy transition by eliminating structural limitations. By providing financial support, knowledge (through energy coaches, energy community centers and energy lawyers) and the social infrastructure to meet, discuss and build connections; the structural barriers to participation in the project are being addressed.

TRANSPARENCY AND ACCOUNTABILITY

The goals and procedures of the project are explicitly stated and discussed. However, the project is fairly idealistic and does not necessarily address how practical limitations of our strategy can be solved. There is a big question of where the money for all of this funding would come from and how people could be convinced to invest time and money into provincial towns at the start of the phasing.

The project is heavily based on interviews on the desires and opinions on the energy transition of energy-poor households. The interviews do not necessarily focus on the residents in the province; therefore, the reality of the desires of our community may be quite different than how we understand them now. Nevertheless, significant time and effort were put in to understand the perspectives of energy-poor communities and to facilitate their needs and concerns in the project strategy.

EMPOWERMENT AND CAPACITY BUILDING

The key goal of the project is to empower the energy-poor communities in the province to participate in the energy transition. This is done through community building, creating networks, building knowledge and improving social infrastructure in provincial towns. The strategy provides energy-poor households with the knowledge, funding, and support they need to be able to participate on a more equal footing compared to higher-income households. In the long-term, the strategy aims to build self-governance in provincial towns by helping them to be more autonomous and locally orientated.

VALUES & ETHICS

As urbanists we have a moral duty to fairly distribute the burdens and benefits within the built environment. What we see as fair is providing every person with the opportunity to participate in and benefit from the energy transition, an egalitarian approach.

Currently this is not the case in The Netherlands, as energy-poor and gas-dependent households are facing increasing pressure to electrify without being provided with the means to do so.

This structural inequality fails to provide economically and socially vulnerable communities with inherent rights to a dignified and comfortable life.

Empowering and supporting socially and economically vulnerable communities through the energy transition aims to get to the root of the energy injustice problem, which is unequal opportunities to invest and participate in the transition. Our goal is to provide these communities with the required resources (money, knowledge and network) to enable them to voluntarily participate in the transition, in the way that they see fit.

Unfortunately, in this bottom-up approach it is still challenging to prevent perceived injustices that may come out from diverse community values and interests. For example, big businesses and upper-class households generally have a more libertarian perspective on justice. They feel that they deserve more benefits and less burdens because of their hard work, therefore may perceive our vision and strategy of empowering the vulnerable communities as unfair. However, we recognize that this inequality in socio-economic class is not due to someone's attitude or work ethic but is rather a structural issue of unequal opportunities. Therefore, it is within our best moral interest (and our duty) to use the energy transition as an opportunity to solve these structural issues and provide energy-poor and gas-dependent communities with the same opportunities to actively participate in the transition as any other citizen.

CONCLUSION

This research shows that a well-thought-out spatial planning strategy is essential for achieving a just energy transition in North Holland, with a specific focus on low-income communities. The main research question was: “How can a spatial planning strategy enable a just energy transition in provincial North Holland in which the energy grid is optimized for the empowerment and well-being of low-income communities?”
The question is addressed by emphasizing that spatial planning plays not only a logistical but also a social and cultural role in this transition.

The analysis demonstrate that the optimization and transition of the energy grid should not come at the expense of the interests of vulnerable communities. On the contrary, effective spatial planning can empower these communities by offering them more autonomy, resilience, and access to opportunities. Through strategic collaboration between local and regional actors, low-income communities can actively contribute to the energy transition, without their identity or interests being subordinated to technological progress. This makes the transition not only fairer, but also more sustainable and inclusive.

The implementation of the vision and strategies underscores the importance of a bottom-up approach: the energy transition should not be imposed from above, but the involvement of all stakeholders in the design and decision-making process is crucial. Communities must be given the space to develop their own solutions, collaborate with regional and local governments, and actively participate in the transition. This ensures that the energy transition is not just a technological change but also a social recovery for the communities that need it most.

For further research it would be beneficial to experiment and implement the proposed strategies in low-income neighborhoods. There was a lack of direct communication with the low-income, gas-dependent community of North-Holland during the process, so there is yet a lot to learn about how these strategies are approved beyond the studied cases. The hopes are still that the report is sufficiently developed to contribute to these further steps, as well as being a stepping stone towards a well-understood method of community-based regional planning.

Spatial planning provide the necessary structure and strategies to achieve a just energy transition, where the well-being of vulnerable communities is safeguarded, and they actively contribute to the sustainability of their own environment. For that, the report have resulted in expanded knowledge within energy governance and ways of transitioning for low-income households.

HAUGE, K

Kristoffer Torbjørn Hauge- 6266770

On Representation & Societal Impact

Can a regional plan ever truly represent a community without neglecting the rest of society?

Given the complexity of regions, and the uncertainty of the future, regional vision will always have to be phrased so that there's space for the unexpected. It leads to simplifications of regional dynamics and patterns, down to what one chooses to focus on. When this report investigated and explored a vision for low-income household in the energy transition, it remained on that steadfast path. There are obvious benefits of raising people out of energy poverty, but that's not the concern of this approach. What is, is the negligence of the greater masses. When we proposed a more decentralised approach to the grid, depending on potential, demand and financial capabilities, we are also causing harm and disruption on the current grid. Yes, we are attempting to fix grid congestion, but it could also lead to a heavily underutilised grid. For all the people working on the high-voltage grid, almost 10 000 just for Tennet (Tennet, 2025), what happens when the manpower isn't needed? Could the empowerment of low-income households invertedly increase the general risk of being in that situation? Workers in the energy sector will continue to be in demand, but this isn't a pattern that solely reside on them. Businesses too can move away from the decentralised energy communities to access the high-voltage grid, causing further economic decline in poorer neighborhoods. The critical issue to understand is how a community-based regional design can both stay in touch with its community, without leaving everyone else behind.

That calls for compromises and open discussion, but also leads to another essential question.

On Sentiment & (Nature-cultural) Belonging

Can Sentiment and Emotions Be Equal to the Rationality in Current Planning Processes?

During the quantitative media analysis, certain cases were found in which the public opinion reshaped or even scrapped plans for new energy projects. Much of the backlash resided in arguments about landscape alteration or visual noise, of which, seemingly, the developers hadn't considered sufficiently enough. Links between landscape or nature and cultural identity have been discussed for decades (Harraway, 2003; Peters et al., 2016), so why are they seemingly only present post-decision. Emotions, and senses of belonging and identity, are more than just a reactionary force to plans, and must be treated so.

Throughout the project, it was emphasised on providing tangible, self-controlled measures. This isn't just for the low investment costs. It also enable attachment and self-adjustment in terms of scale. It is, as phrased in the report, 'change you can feel'. Both scale and societal ethics can be pointed out as the main contributors for this emotional neglect. Today, a regional wind park is built because the potential is highest and benefits the most, a utilitarian approach, and not on the emotional values of those few which it impact, an egalitarian one. So if emotions and sentiments were to have an equal weighting, from whom should it be listened to the most? Regardless, it require a mobilised voice to be listened to, which isn't always the case. The selected community is an example of that, but so is wildlife and future generations. For those who cannot mobilise, there must be emotions involved to account for. Throughout the project, it became evident that a lot was being unsaid in the media or on spatial mappings, which were invaluable to the final vision-making. There's a strong need for sentiment and emotions to partake in the planning process, though it require a shift in current governing style.

KUNIGÉLYTÉ, U

Ula Kunigélyté- 6219578

The Role of the Vision

The visioning process greatly helped the group to guide the further research and develop of strategy, phasing and policies in a directional manner. Always keeping the community and vision in mind allowed us to make efficient decisions and be organized with our work. Reflecting on the first weeks of the quarter when our group was still developing the community and vision, it was incredibly challenging and time-consuming to be coordinated and efficient with our work, especially when it came to discussions.

For me this experience put into perspective the power that a vision could have to mobilize people and organize action. The power is both inspiring and terrifying, as people like Trump and Putin take its advantage for personal gains. Therefore, I feel a great deal of responsibility to be critical and mindful of the potential pitfalls and blind spots that a vision can carry.

Our vision calls for an energy transition which supports and empowers of energy-poor and gas-dependent households in the province. While the focus is on a struggling and vulnerable community in Noord-Holland, the vision puts less emphasis on other stakeholders vital in the energy transition, such as businesses, entrepreneurs and workers in the gas industry. What happens to them in our vision is still ambiguous, it is possible that the vision will unintentionally create even more vulnerable communities or will create more societal divide. In this way the vision avoids looking at the broader picture and creates many blind spots which need to be addressed and critically evaluated. design to be just and inclusive, it is not a question of can we better understand the hopes and dreams of our transition communities. We must.

The Value of Transition Communities in the Regional Design Process

Throughout this quarter I learned that a regional design process can be broad, vague and hard to grasp. It requires meaning and direction to achieve successful results. This meaning can either be superficially decided by the people on top, or it can be taken from the perspectives of the communities who will actually be affected by these decisions (i.e. transition communities).

From our research on the perspective of our community in the energy transition, it is clear that currently the decisions made at the top are often disconnected from the communities who are affected at the bottom. This disconnect creates mistrust, polarization and injustice, and is overall socially unsustainable. Regional planning and policy making puts very little effort to listen and to understand, as in the current way of doing things it is too resource-intensive to do so. That is true, there are many communities and perspectives to consider when working on such a large scale. However, if we want regional design to be just and inclusive, it is not a question of can we better understand the hopes and dreams of our transition communities. We must.

However, we do not need to know everything about every community. There will always be context and details that will unintentionally be overlooked in regional planning and design. Therefore, it is important to remove the structural barriers for communities to self-organize, participate and do things their own way. The communities themselves know best what they need and want, all they need is some support.

This may mean that the way regional design is done needs to change to better facilitate bottom-up initiatives and minimize top-down decision-making. While this kind of approach sounds more resource-intensive at first glance, I strongly believe that mobilizing communities to participate in the design process will ultimately lead to thriving, resilient and more autonomous communities which will require less external help and effort to maintain.

LEE, Y

Youjin Lee- 6270425

The primary objective of this project was to empower the most vulnerable communities to become true protagonists in the energy transition. Our central question was straightforward: how can a potential threat be transformed into an opportunity?

The project identified low-income, gas-dependent households as particularly at risk due to the ongoing energy transition. This specific group was defined by reframing broad national issues—such as grid congestion and national climate agreement—into tangible, everyday concerns. For those experiencing energy poverty, these systemic challenges are interpreted as the immediate risk of losing access to heating. The problem is that these concerns can lead to huge resistance to political decisions, making it hard to achieve a successful transition. Therefore, effective communication between with mutual representation of this community is required.

This insight was shaped by Peter Pelzer's lecture on representation, which asked: "What is a representation of the future? Who or what is being represented?" These questions led us to reflect on our role—are we representing energy-poor communities, or acting on behalf of institutions? We saw the project as an intermediary between local and institutional scales, translating perspectives and building consensus. Still, without direct engagement, it was hard to know if we truly reflected the communities' struggles and hopes. As our strategy developed, our perspective shifted toward that of planners, raising a key dilemma: were we advocating for communities, or merely interpreting their needs from a distance?

It was also crucial to explore how the target community could gain agency within the complex network of stakeholders involved in the energy transition. By combining the stakeholder mapping approach introduced by Marcin Dąbrowski with the Material Flow Analysis framework developed by Alexander Wandl, we were able to map stakeholder relationships through the lens of systemic circulation during case study. This method provided a clearer understanding of the interconnected network shaping energy transitions and revealed the dynamics between physical infrastructure and institutional actors.

A key realization was that, as energy systems decentralize, opportunities for ownership and influence become more accessible. Traditionally, energy infrastructure was expertise-intensive, making it unreachable. However, the rise of smaller-scale, modular infrastructure has made energy assets more tradable and manageable—like real estate. This shift opens new pathways for redistributing power and creates demand for more diverse, localized, and community-responsive energy solutions.

This highlights the importance of communication. Different actors require mechanisms to voice their interests and collaborate with each other. This requires tools and skills for effective communication. These skills were also required during the project, for intensive discussion with teammates. Communication through visual storytelling helped articulate ideas more clearly when verbal explanations challenge. For example, the metaphor of a "pie" to explain grid congestion helped forming mutual understanding. Also, forming a framework integrating all main issues and key principles of strategy helped the group keep in track, clearly reminding common objectives of the project.

Ultimately, the process demonstrated that regional design is not merely about solving spatial problems, but about translating between languages, values, and scales. I now recognize the urban designer's role as a mediator, someone who facilitates inclusive, cross-scale dialogue and ensures that all voices are heard in shaping the energy future.

SCHEEPMAKER, V

Veerle Scheepmaker- 6116345

The literal translation of "Urbanism" into Dutch is "stedenbouw," a term that combines two concepts: the building of cities. When I try to explain the nature of my studies to those around me, I often describe it as a process of analysis, reflection, and discussion aimed at identifying the most effective ways to design and develop cities. In this process, the social component — the pursuit of a better living environment — plays a central role.

However, throughout this course, I came to realize the true complexity of urbanism, particularly in relation to global societal challenges such as the energy transition. While as a young adult one may have some understanding of the topic, this course fundamentally reshaped my perspective on the field. This led me to consider the crucial question: how can we include society as a whole in a fair energy transition?

The energy transition is a topic that is constantly present in the public domain: it appears in the news, is discussed in bars, brought up with concern at the kitchen table with parents, and shared as opinions among friends. It is a broad and often intimidating concept that tends to discourage many due to its complexity. I understand this reaction — when one lacks detailed knowledge of the issue but feels its impact in their wallet, it is difficult to connect with the topic.

The main goal of this project for our group (4.1) was to identify which communities are most directly impacted by the energy transition. With the advent of new technological developments in renewable energy systems, the pressure on the electricity grid has increased, while the population is required to disconnect from the gas network. This creates a dual challenge: gas becomes increasingly expensive, while the electricity grid lacks sufficient capacity. This situation exacerbates energy poverty and inequality in the Netherlands.

In order to better understand the impact of this transition, we actively engaged with the world of the affected communities. By reviewing policy reports, analyzing statistical data, and engaging in reflective discussions, we endeavored to gain as nuanced and comprehensive an understanding as possible of their perspectives.

However, I believe our report remains incomplete, as we did not engage directly with the community members themselves. It would have been invaluable to have had more time to truly immerse ourselves in the community — by speaking with them, involving them in the research, and gathering insights that would allow us to incorporate their perspectives more directly into our work.

The top-down policy approach remains the standard — the "big boss" who makes decisions from the comfort of an ivory tower. However, in our research, we aimed to adopt a community-driven, bottom-up perspective. Achieving this requires striking a balance that utilizes the "grey area" between top-down and bottom-up approaches, facilitating a collaborative effort among various stakeholders. The key to this solution lies in recognizing and embracing such collaboration.

This "grey area" exists between governmental initiatives and active community involvement. To make this concept tangible, we sought to bring it to life in our project by addressing it on a small scale. This meant engaging directly with individuals by going door-to-door and providing advice on the energy transition. By starting small, we hope to foster gradual, positive changes at the regional level.

Ultimately, throughout this process, I have learned a great deal about the meaning of the energy transition, the communities affected by it, and the complexity of developing a concrete strategy and vision. The greatest challenge lay in bridging the technical aspects of the energy transition with the lived experiences of the community. In the end, it all boils down to a fundamental question: for whom are we doing this? For society as a whole — for you and for me.

CHAPTER IX: REFERENCES

Figure 215: Medium-voltage tower
Amsterdamse Bos, Amsterdam
Photo: Hauge, K.T. (2024).

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All data used was publicly available.

APPENDIX

PHASE I - 2035

Heating Transition: "A supporting and people-driven shift away from natural gas"

The heating transition begins with tangible measures that closely align with residents' daily lives. A key principle is to reduce heating demand, including insulation of aging homes, low-barrier renovations, and behavioral changes. These efforts form the foundation for a sustainable shift in the existing built environment. The Dutch government aims to make 1.5 million existing homes gas-free by 2030, which requires a combination of individual and collective solutions (ABN AMRO Bank, n.d.)
.

A supporting strategy is the establishment of central heat pumps for multiple homes and utilizing shared heat sources to support individual systems. This allows for efficiency gains, especially in densely populated neighborhoods. Additionally, reusing waste heat from industry provides new opportunities for circular heat supply at the neighborhood level. Local district heating networks play a key role in this: as experimental spaces where technical feasibility goes hand in hand with social acceptance. This approach not only accelerates the transition but also makes it fairer and better aligned with the needs of residents.

Distributing Grid: "Building the backbone for future energy demand"

The heating transition leads to a shift from gas to electricity for heating, further increasing the existing pressure on the electricity grid. It is therefore crucial to create additional capacity in the short term to accommodate demand peaks. Grid operators must anticipate these changes and invest in temporary capacity increases.

In addition, it is essential to ensure flexibility within the system. Policy measures that promote energy flexibility, such as dynamic energy tariffs, demand response, and smart meters, allow users to actively contribute to balancing the grid. Providing opportunities such as renting solar panels makes sustainable energy more accessible to households, increasing the importance of collective contributions to the energy system. Upgrading and recycling outdated appliances also contributes to reducing pressure on the grid by lowering energy consumption. These initiatives form the basis for building a robust, distributed energy infrastructure that can effectively and efficiently support future energy demand.

PHASING:

PHASE II - 2050

Heating Transition: "Interconnect different heating networks"

Integrating different heating networks is an essential step in the transition to sustainable heating sources. It is necessary to accelerate the shift to renewable energy sources in heating networks, for example by deploying heat pumps, geothermal energy, and other renewable technologies.

At the same time, expanding existing networks is crucial to increase the reach of sustainable solutions. Local and regional networks must be connected to ensure stability and efficiency, while collaboration between different network operators and communities enables the integration of renewable energy sources. Creating flexible, interconnected networks will not only make the transition more efficient but also socially more acceptable, as it involves broader parts of the community in the process.

Distributing Grid: "Integrate local and national energy systems"

For the transition of the electricity grid, more focus should be placed on local initiatives. For example, energy-producing street furniture, such as solar panels on streetlights (InfraMarks, 2024). These contribute to the decentralization of energy production and reduce dependence on large, centralized networks.

At the same time, these local systems must be aligned with national networks to ensure the resilience and stability of the entire system. Strengthening the connections between locally produced energy and the national electricity grid requires investments in infrastructure and technologies such as smart meters and flexible tariffs. This integration will create a more robust system capable of effectively managing supply and demand peaks, while also offering local communities the opportunity to actively contribute to the energy grid.

PHASE III - 2070

Community Empowerment Step 3:
“Design inclusive and benefit-sharing systems”

This goal focuses on aligning energy systems with local needs and ensuring that the benefits of the transition are equitably shared across all groups, with the aim of leaving no one behind.

How the strategies support this:

• Mandatory investment for local communities
Whenever large-scale energy developments take place, the province or municipality imposes fees on developers and reinvests these funds into improving local conditions. This approach helps ensure that resource allocation remains equitable, preventing benefits from being concentrated solely in wealthier areas or among specific businesses.

• Pilot projects to overcome energy poverty
Establishing testing grounds for inclusive design allows feedback from marginalized communities to directly inform and shape future energy infrastructure. This ensures these groups are actively included in the energy transition and begin to influence broader decision-making processes.

• Community participation in decision-making and co-creation of policy
This approach ensures that energy systems are not solely shaped by top-down decisions but are co-created with the people who actually use them. It establishes a new flow of influence, making the transition more effective across multiple scales. Rather than waiting for decisions to trickle down from the top, change should be initiated from both directions—bottom-up and top-down—converging at a shared middle ground.

• Attention to low-accessibility areas
This broadens participation and visibility by proactively reaching those who are typically excluded from the system. Areas that are less urbanized or located far from city centers are often overlooked in community movements. By providing targeted support—such as mobile outreach teams and alternative participation methods like video calls—these efforts can include a wider range of voices and ensure more equitable representation in the transition process.

Together, these strategies institutionalize equity, making participation and benefit-sharing core components of system design — not afterthoughts that follows after bureaucratic decisions.

Heating Transition Step 3:
“Interconnect local heating systems”

The aim here is to create a resilient, collaborative heating ecosystem, where diverse building types and user groups can share resources and stabilize the system.

How the strategies support this:

• Multi-scale and diversified heating grids
After the initial transitions at various scales, the next step is to connect different networks across municipalities or even the entire region. This concept is inspired by the “Handreiking mini-en kleinschalige warmtenetten” (Guideline for Mini and Small-Scale Heating Networks) by NPLW. The guideline proposes a scalable heating system made up of multiple modular networks that supplement one another and help prevent congestion, creating a more resilient and flexible regional infrastructure.

This strategy bridges technological and social diversity, enabling participation in larger energy networks regardless of housing type, income level, or existing local infrastructure.

Distribuing Grid Step 3:
“Integrate local and national energy systems”

This is about connecting bottom-up and top-down energy flows — creating a two-way relationship between local initiatives and centralized infrastructure.

How the strategies support this:

• Local energy circulation Supporting bigger grid operators
This means that communities start to become contributors to national grid stability, rather than merely consumers. It also strengthens their position within the energy sector by giving them a clear role in balancing demand surges and enabling regional energy sharing before depending on national imports.

• Adopting wind turbines and solar on public buildings
These collectively owned energy-generating infrastructures feed into both local and broader energy systems. This also signifies the beginning of community inclusion in the larger energy market, allowing them to participate not only as consumers but also as active contributors.

This integration fosters structural inclusivity, where local systems are neither isolated nor fragile but embedded within a broader, supportive energy ecosystem. Additionally, policy tools from other pathways—such as community involvement in energy governance—help ensure that integration does not result in re-centralization, but instead promotes mutual support and shared responsibility.

PHASE IV - 2100

Community Empowerment Step 4:
"Enable community-led energy governance"

This goal focuses on the shift from participation to ownership and decision-making power. Communities are no longer just users of energy—they evolve beyond step three, actively asserting their rights and priorities during decision-making processes. At this stage, communities hold near-complete control over their own energy systems. They manage, allocate, and adapt energy infrastructure in response to their evolving needs.

How the strategies support this:

- Collective energy fund

This strategy provides communities with financial agency, enabling them to invest in, maintain, and expand local infrastructure without relying solely on top-down subsidies. While individuals may not have the capacity to fund large-scale infrastructure alone, collective investment makes it possible to own and benefit from assets like wind turbines or solar parks. Over time, local initiatives can even transition into operating their own energy systems.

- Heat and electricity exchange

- Peer-to-peer platforms allow communities to trade energy on their own terms—deciding how, when, and with whom. Since not all communities can produce both heat and electricity, these systems make it possible to exchange resources across regions, based on mutual needs and offerings. This reinforces local autonomy while strengthening inter-community collaboration.

- Open the living room and better public space

These act as forms of soft infrastructure, offering physical and social environments for governance, dialogue, and visibility to grow. While such spaces may seem more relevant in early transition phases, they become even more critical in a fully autonomous system. Maintaining energy sovereignty requires ongoing engagement, and small-scale, community-driven initiatives—like open living rooms—foster continued participation and diversity in an active, decentralized energy society.

Together, these strategies establish a distributed model of governance, where both technical and social infrastructures support local control, shared responsibility, and long-term resilience.

Heating Transition Step 4:
"Build multi-level and community-supported heating systems"

This goal focuses on establishing a fully collaborative heating infrastructure that operates across multiple levels—individual, neighborhood, and municipal—and is sustained through shared responsibility and mutual support.
How the strategies support this:

- multi-level and diversified heating grid

Building on the previous phase, where micro-systems were successfully networked and co-managed, the 2100 heating infrastructure features a regionally connected grid with scalable, nested resilience. These interconnected systems offer flexibility, allowing local grids to support one another while adapting to diverse needs and conditions.

- Installation of single solar boilers and heat pumps

This strategy enables household-level autonomy, particularly in low-density or rural areas. While remaining compatible with larger collective systems, households that have developed the capacity for self-sufficiency can opt for more independent, stand-alone heating setups. This dual approach allows for autonomy without disconnection, fostering inclusivity in system design.

Together, these strategies ensure that autonomy is not about isolation but about distributed strength—where local control is preserved yet reinforced through collaboration across levels and communities.

Distribuing Grid Step 4:
"Integrate local and national energy systems"

This final step in the grid transition is about creating a two-way relationship between bottom-up community energy systems and top-down centralized infrastructure. It envisions a cooperative model where generation, storage, and management are distributed but coordinated through intelligent systems—most notably smart grid technologies that balance supply and demand across diverse users and producers.

Autonomy doesn't mean that local and national systems will compete but rather complement each other. Centralized networks provide large-scale reliability, while local networks prioritize self-sufficiency and resilience. Within this cooperation, local communities will contribute to bigger networks while still retaining the right to prioritize their own needs. By 2100, local authorities may become the key decision-makers in how or whether they connect to the national grid, with business and government sectors eager to collaborate.
How the strategies support this:

- Shared energy storage

Communities and buildings can store surplus energy, buffer demand spikes, and stay resilient during outages. This enables each local network to retain its own generated energy, increasing autonomy and internal reliability.

- Collective solar panel ownership

Owning the means of energy production brings not only material benefits but political agency. With accumulated resources, knowledge, and governance experience, communities can move from leasing to full ownership—becoming long-term stakeholders in their own energy futures.

- Self-sufficient buildings

These buildings represent the smallest autonomous units in the energy system. Capable of sustainably meeting their own energy needs, they expand the diversity of actors within the broader network and anchor resilience at the building scale.

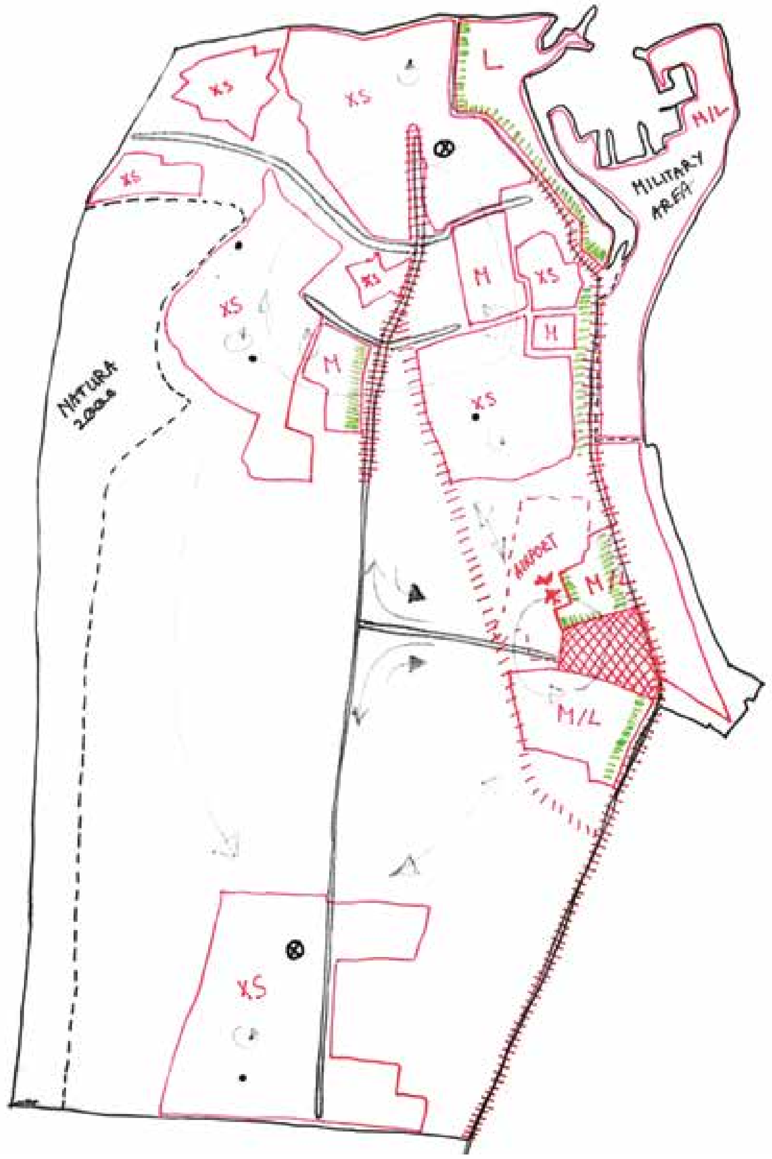
- Multi-scalar grid operation

This ensures that decentralized units are not isolated, but integrated into a flexible, cooperative system. Energy use patterns vary across scales—residential, commercial, municipal—and over time. A multi-scalar grid allows for mutual support when needed, while maintaining independent operation under normal conditions. It's autonomy in relationships, not in isolation.
Together, these strategies make decentralization technically feasible and socially equitable. They ensure that autonomy does not lead to fragmentation, but to the emergence of a resilient, distributed energy commons.

DEN HELDER: OFF-GRID SCENARIO

HIGH HEAT POTENTIAL
HIGH ELECTRICITY POTENTIAL

- SCALE OF ENERGY INFRASTRUCTURE
- ENERGY INFRASTRUCTURE ALONG MAJOR MOBILITY INFRASTRUCTURE (HIGHWAYS & MAIN ROADS)
- GEOTHERMAL PLANT
- ELECTRICITY/HEAT FLOW
- ELECTRICITY FLOW
- SCALES OF ENERGY CIRCULATION
- NEW ENERGY COMMUNITY CENTERS
- NEW ENERGY DEPARTMENT IN EXISTING COMMUNITY CENTER
- EV CHARGING STATION

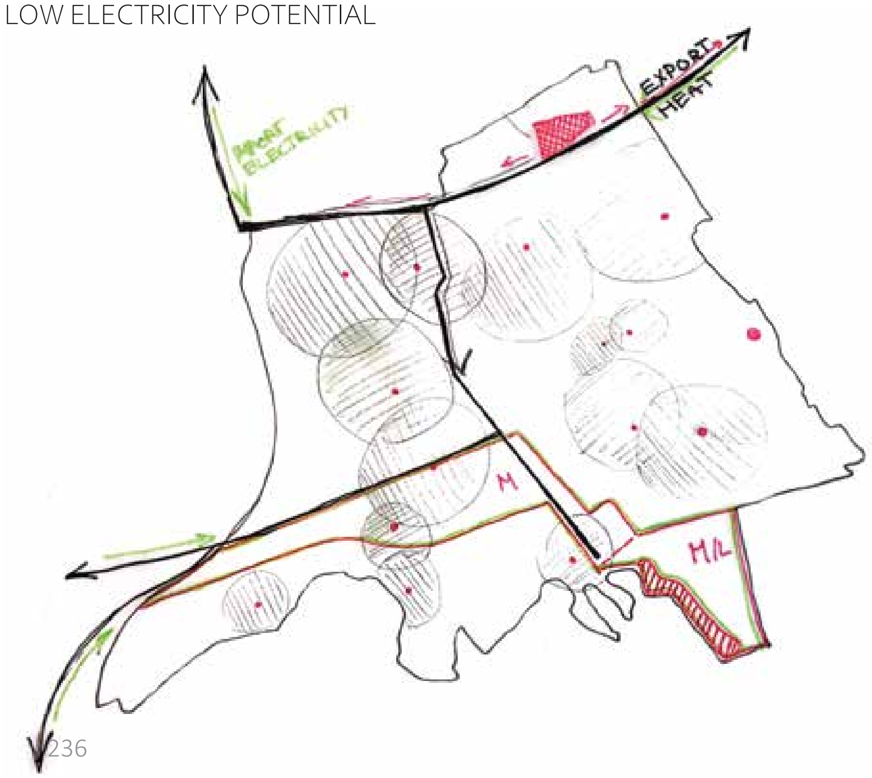


Key conclusions:
- collaboration between residential and industrial areas;
- multi-scalar energy circulation;
- scale-appropriate energy infrastructure;
- new energy infrastructure in areas which are already "ruined" by largre road or industry infrastructure;
- minimal intervention in valued landscape areas;
- bring together communities in existing community centers;
- town energy centers for improved accessibility, communication and inclusivity.

HOORN: HYBRID SCENARIO, GEOTHERMAL FOR HEATING

HIGH HEAT POTENTIAL
LOW ELECTRICITY POTENTIAL

- HIGH GAS CONSUMING BUSINESSES OBLIGATED TO PRODUCE MORE RENEWABLE ENERGY
- INDUSTRIAL PORTS FOR RENEWABLE ENERGY PRODUCTION
- FACILITIES WITH RESIDUAL HEAT POTENTIAL
- POTENTIAL RES. HEAT SERVICE AREA
- POTENTIAL GEOTHERMAL PLANT
- HEAT EXPORT TO OTHER TOWNS
- MAIN HEAT SUPPLY LINE
- ELECTRICITY IMPORTS

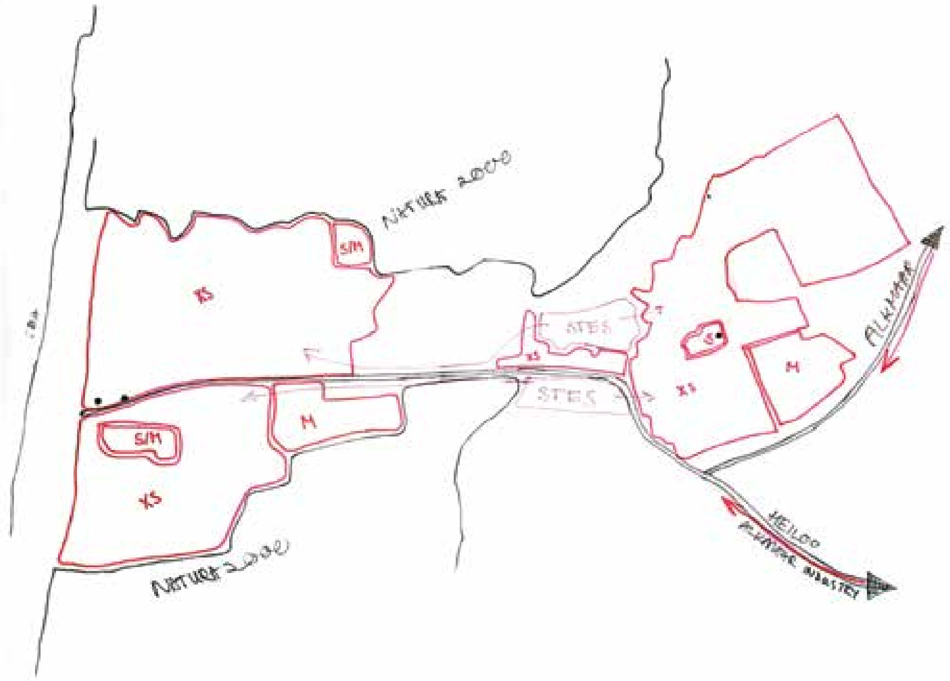


Key conclusions:
- collaboration between residential and industrial areas;
- existing functions producing residual heat to supply for residential areas;
- import electricity, export heat (net-neutral).

EGMOND ANN ZEE & AAN DEN HOEF: ON-GRID SCENARIO

LOW HEAT POTENTIAL
LOW ELECTRICITY POTENTIAL

- SCALE OF ENERGY INFRASTRUCTURE
- STES (SEASON THERMAL ENERGY STORAGE)
- ELECTRICITY FLOW
- NEW ENERGY DEPARTMENT IN EXISTING COMMUNITY CENTER

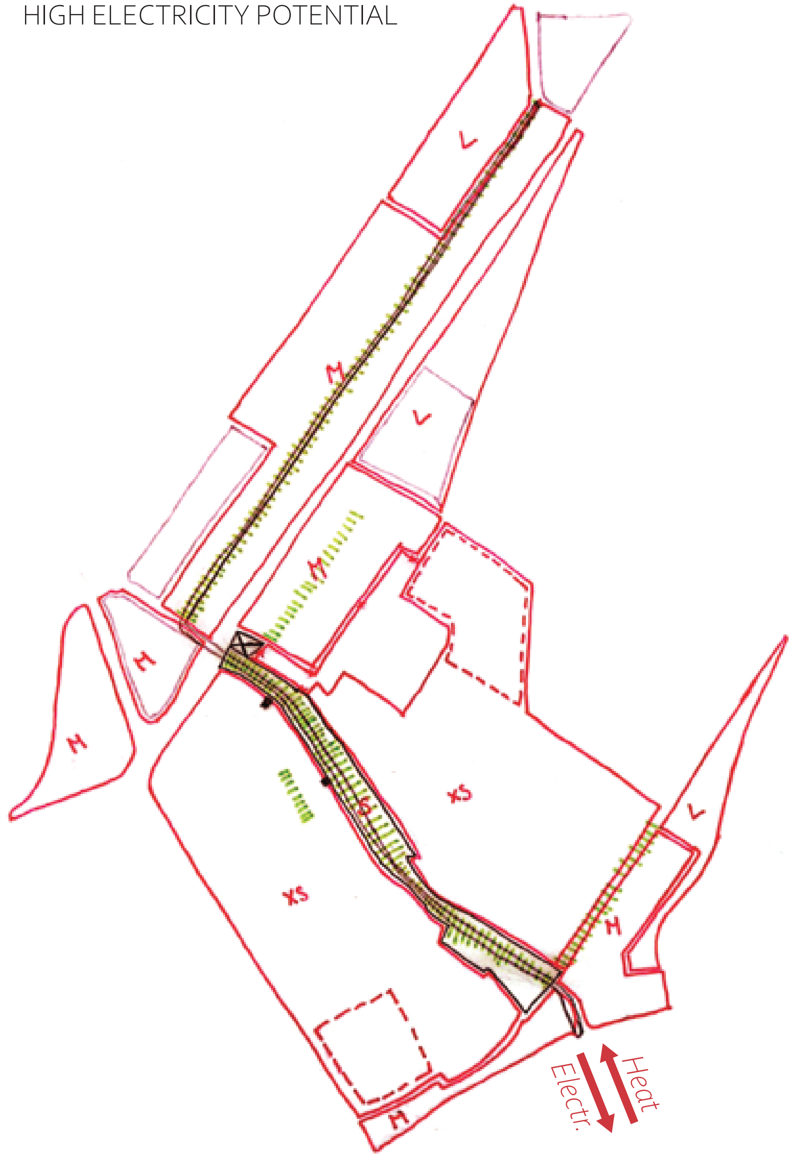


Key conclusions:
- scale-appropriate energy infrastructure;
- STES for seasonal heating and cooling;
- minimal intervention in valued landscape areas;
- bring together communities in existing community centers;
- import heating from surrounding industry
- just because the electricity production potential is comparatively low, it does not mean that there is no potential, some production still must happen.

MIDDENMEER: HYBRID SCENARIO, HEATING FROM GREENHOUSEES & LOCAL ELECTRICITY PRODUCTION

LOW HEAT POTENTIAL
HIGH ELECTRICITY POTENTIAL

- ENERGY LANE
- ENERGY COMMUNITY CENTER AS A PUBLIC LIBRARY EXTENSION
- SCALE OF ENERGY INFRASTRUCTURE
- SEASON THERMAL ENERGY STORAGE
- AREAS OF SPECIAL INTERVENTION IN HIGH GAS-CONSUMING HOUSEHOLDS
- EV CHARGING
- FACILITIES WITH RESIDUAL HEAT POTENTIAL



Key conclusions:
- electricity-heat exchange between residential and horticulture areas (greenhouses);
- scale-appropriate energy infrastructure (larger in industrial areas, smaller in residential);
- new energy infrastructure in unused in-between spaces (e.g. between residential area edge and highway);
- no new energy infrastructure in unbuilt landscape areas;
- bring together communities in existing community centers;
- more extreme interventions in trouble areas;
- EV charging facilities near workplaces and mobility hubs;
- energy infrastructure as a means to improve spatial qualities of gathering spaces;
- season thermal energy storage (STES) for heating and cooling over the year.

MEDIA ANALYSIS QUERY

Nexis UNI Search Query

(noordholland OR noord-holland OR noord holland) AND (warmtepomp) AND (gas OR aardgas) AND (laadnetwerk OR laadstation OR netuitbreiding OR netwerkuitbreiding OR stroomaansluiting OR capaciteit OR file vorming OR toegankelijkheid OR congestie)

Rentals

%

80 - 100
60 - 80
40 - 60
20 - 40
0 - 20

Source: CBS

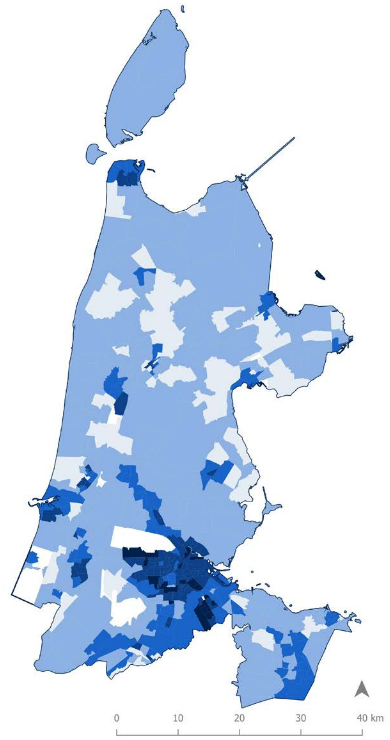


Figure a1: Percentage of rental homes (Source: CBS, 2022).

Private Car

per inhabitant

1.5 +
1.25 - 1.50
1.0 - 1.25
0.5 - 1.0
< 0.5

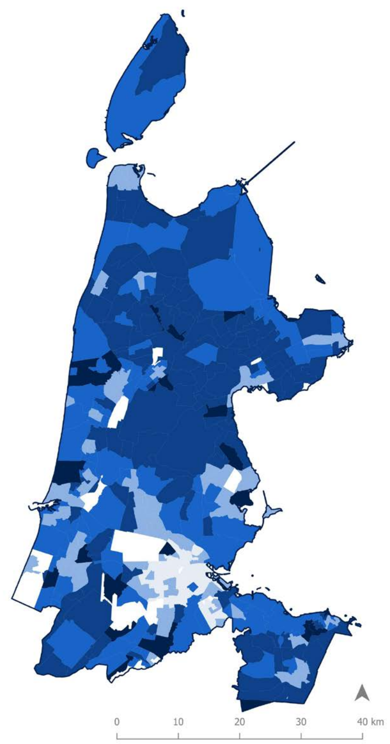


Figure a2: Average distance to schools, cafés, hotels, libraries, museums and cinemas combined, which function as typical gathering places (CBS, 2022).