Summary Integrated Energy Plan development Station Area Heerhugowaard

This report outlines the technical analysis for Heerhugowaard's Station Area (Stationsgebied). This operation has been carried out within the framework of the joint approach to develop energy and heating scenarios that fit within the municipality's carbon-neutral target scenario. Aside from content analyses, the report pays a great deal of attention to the participation process with all stakeholders within the framework of the Masterplan Station Area developed by the Council.
This report contributes to ultimately shaping and writing out the transition roadmap for Heerhugowaard's Station Area and the accompanying energy supply as has been outlined in the previously established Masterplan Station Area from 2020.

This research has been realised in collaboration with the local heating and electricity grid operators in Heerhugowaard and with Waternet, a specialist in the field of low-temperature heat/cold-distribution grids and with Woonwaard as one of the largest owners of existing and new housing in this area. Reports and calculations have been shared with them and have been commented on by them.

Phase 1 November 2019 - March 2020

During the first phase Resourcefully has conducted technical research into the energy potential of the Station Area. The research comprehensively looked at transition possibilities and in particular at the impact of the high degree of electrification of the Station Area, the resulting energy effects and the possibilities to outline an efficient plan. Heat-distribution grids have been included extensively. Hydrogen has been left out considering the time required for this plan to be market-ready. The plan covers in particular:

1) local solar energy generation,
2) electricity consumption built environment,
3) heating and cooling of buildings (housing and offices),
4) the charging of electric cars.

Station Area-specific transition dashboard

A specific Heerhugowaard transition dashboard has been developed. It calculates, visualises and displays all future electricity flows for the Station Area all year round. It does this detailed down to energy component per hour or aggregated through various Key Performance Indicators (KPI's).

It also calculates energy supply and demand spikes to provide insight into the extent to which the power grid has to factor in the effects of this transition. These spikes can be partially avoided by adapted charging of electric cars or by smart heating. The calculation and visualisation of the value of this flexibility for the area is also part of the Heerhugowaard dashboard.

The application of the dashboard is meant to provide better insight into the transition measures and the effects thereof to a wide range of stakeholders from various backgrounds and without specialist knowledge.
This enables a wide-ranging discussion about which steps should be taken at what point in this municipal transition and enhances social support. The transition dashboard itself has a high degree of technicality and matters such as the aim, the approach, the involvement of stakeholders and the progress are made widely accessible by means of a presentation variant and a summarising flyer. This flyer has been shared in advance during the interviews with the involved stakeholders to clarify the goal, process and their involvement as much as possible.

The first phase has generated valuable knowledge and insights for the transition steps towards a carbon-neutral area in terms of mobility, local energy generation on roofs or in the facade and the heating and cooling demand in the Station Area. The importance of smart charging and heating to reduce the power grid's extreme spikes and optimal use of locally generated energy have been listed and quantified. The necessity of external energy generation has also been visualised.

Phase 2 May 2020 - April 2021

Based on the first technical analyses, an in-depth investigation into the Station Area has been conducted and directions of development have been analysed. **The most important goal is to work together with all stakeholders to elaborate the possible development directions for the Station Area, formulate assessment criteria and collectively formulate development advice to submit to the council members.** Various activities have been undertaken. Firstly, the data and calculations have been improved, the most important sources here are the available data (Starting analysis PBL, research reports for the Local Energy Strategy (LES) as well as the Transition Vision Heat (TVW), data from the municipality, various conversations), the available infrastructure, source networks, data about the existing and the newly planned buildings etc. Important components are the models and resulting technical KPI's. Further steps are described below.

Including stakeholders and establishing assessment framework

Between June 2020 and January 2021, conversations have been held with a dozen local stakeholders (Liander, HVC, de Duurzame Ring Heerhugowaard, Woonwaard, HHNK, ROC Horizon College, other known project developers) about the joint tasks for the Station Area, the objective and the process. In this conversation the approach, the stakeholders' views, the priorities and the process have been addressed. During this process the stakeholders with the largest energetic interests (Liander, HVC, Duurzame Ring Heerhugowaard, Gemeente) are prioritised. An essential process is the defining and approval of the assessment framework within which the final advisement takes place. All criteria and the weighting factors have been approved widely, described in the report and briefly visualised below.

Criteria	Explanation
End-user costs	Costs for the consumer
Use of existing infrastructure	Use of the existing heat-distribution grids
CO_2-emission	Emission emitted from the energy generation for the used energetic supplies
Use of local heat sources (circular city)	Use of residual heat
Efficiency heating network	Indicator for overall efficiency heat supply
Impact on electricity supply	Maximal use of electric potential
Financing possibilities infrastructure	Financing/guarantee for main lines heat-distribution grid
Local self-supply	Self-supply through local PV
Deceleration Masterplan process	Dependency of execution of masterplan on possible delaying factors like the roll-out of new joint infrastructure

Not all criteria that could possibly be important to the decision-making have been considered in the assessment framework, e.g. when there is a lack of data or when too much subjective interpretation is possible. The two most important criteria that have been left out of consideration in this analysis are:

- The national costs.
- The reliability of a heat-cold system

The justification has been written in the report. The local circumstances are important for these criteria, making them more suitable as part of the municipal decision-making.

The national costs are the expenses that the country incurs for the transition to a gas-free area. It is a listing of extra electric infrastructure, extra insulation of buildings, installing heat-distribution grids, costs of other fuels (biomass), etc. A lack of data makes these very difficult to assess.

The reliability of a heat-distribution system has to do with the supply security of heat to citizens and companies in Heerhugowaard. The municipality naturally wants to avoid possible problems for the long-term supply of heat. Perhaps another important goal is to facilitate local companies when there is a considerable amount of existing yet unused residual heat. The availability of residual heat is also dependent on what the industry will look like in the future. Heat-distribution grids on residual heat have to be installed smartly and robustly to guarantee supply security.

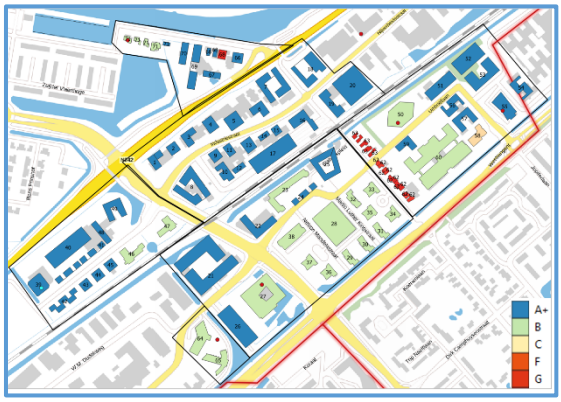
Other local political considerations, like biomass, which is part of a public debate and has limited sustainable availability. These kinds of considerations have to be taken into account, but are not quantifiable by us.
The local circumstances are important for these criteria, making them more suitable as part of the municipal decision-making.

An important factor is *the efficiency of the heating chain*. This is an element that indicates how much energy is lost from the moment heat is generated until it is consumed by the end-user.

The transmission losses and the temperatures at the point of delivery differ per heat-distribution grids; the higher the temperature of a heat-distribution grid, the more energy is lost during transmission. Additionally, the lower the temperature of a low-temperature heat-cold-grid at the point of delivery, the more efficient the heating chain. This is because water of a LT heat-distribution grid will often still have to be heated with a heat pump in order to be used for space heating, and heat pumps are more efficiënt when the temperature difference that has to be bridged is smaller. Because there will be a lot of new buildings in the station area, this method will be suitable for low temperatures of space heating, which will make the low-temperature heat-cold-grid more efficient.

5 Integrated transition scenarios

Based on the knowledge acquired, the analyses and the interaction with stakeholders, 5 possible energy transition-scenarios have been developed for Heerhugowaard's Station Area. These scenarios offer a clear direction of development, where an 'order of magnitude' and 'approach' will be provided, rather than a highly specific implementation (see the report for scenario details).



When it comes to the energy approach and the results of electric transportation, the generation of electricity through solar energy and the electricity consumption of the buildings, there is little to no difference between the 5 development scenarios.

The big differences lie in heat generation for the buildings, tap water and cooling. The high degree of insulation of the new buildings in the Station Area (many with energy label A+) makes for a very low heat demand in comparison with the existing buildings. There will also be looked at the growing energy demand for cooling, impacted by climate change, as indicated in the local Climate Stress Test, in anticipation and in conformity with the 2021 building regulations. Regarding the most efficient way of heating, a decision tree has been developed which determines which type of heating is most efficient for which buildings. This roughly comes down to a medium-temperature heat-distribution grid, a low-temperature heat-cold-grid or a heat pump solution. Different varieties and combinations are possible. The buildings that have already been connected to the heat-distribution grid of HVC, or where the insulation requires it, have been kept connected to that grid.

These 5 scenarios can be briefly summarised as following:

I. The individual approach, where residents can install and use their 'own' air-based heat pumps.

II. Collective West, the low-temperature heat-cold-grid will be massively used on this side of the train track, except for the buildings very near to the canal.

III. Collective maximum, a large-scale integration with a low-temperature heat-cold-grid to which all buildings that have been sufficiently insulated will be connected

IV. Local clustering, where grouped new buildings will use joint thermal storage points for heating and cooling

V. Medium-temperature East, where every building east of the train track is connected to the HVC heat-distribution-grid, and the rest to the low-temperature grid.

These scenarios have been calculated and visualised with the Resourcefully energy transition Dashboard, including the KPIs. Afterwards they will be tested with the municipality and three grid-stakeholders (Liander, HVC, Duurzame Ring Heerhugowaard) with the three agreed upon criteria.

As for establishing the collective and building-related (final consumer) costs, the results have to be validated by the 3 grid operators. For the heat-distribution grid operator HVC it is difficult to make an accurate estimation of their costs as of yet, as it is not yet clear

where a HCV-grid will actually be installed and their grid-design and associated costs heavily depend on the amount of connections.

To come to a long-term sustainable energetic implementation of the Station Area, which fits the climate policy of the municipality and anticipates the increase of climate extremes, it is essential to make a good estimate of the expected energy supply, energy infra-grids and the associated costs beforehand, in order to make choices.

The calculation of the CO_2 emission of heat where biomass and waste are the primary source materials is subject to a public debate. The Netherlands does not have enough, which is why it is largely imported. Forest are even being cut down for it. Seeing as this has a large impact on Heerhugowaard's CO_2 emission balance, it is a very important criterium.

The costs for Liander's electricity grid depend on the total/aggregated spikes (for supply and return) and the capacity needed for the sum of connections. Liander states that an optimal balance between supply and demand helps to keep the social costs of infrastructure low. Accordingly, the electricity grid will be used in the most efficient way since generation and consumption are brought as much as possible in line, which reduces the transport of electricity through the grid. The scenario that is most suited for this method has been given preference by the grid operator.

Furthermore, medium-temperature grids are better applied in buildings where the insulation is not good enough for low-temperature. The use of residual heat of existing industry in a low-temperature grid (heat and cold) would increase the sustainability of energy generation and would mean a bigger leap towards a CO_2-neutral municipality. These are social and political choices.

The many new buildings in the station make it a unique place in Heerhugowaard. Most of the buildings in the city have label C or worse, making them unsuitable for low-temperature heating. It is possible to connect these buildings to a low-temperature residual-heat grid, but it would mean a higher consumption of electricity by the heat pumps, because the temperature of space heating must be higher.

Meanwhile, there is a medium-temperature heat-distribution grid available that can practically be directly connected to these relatively poorly insulated buildings, to provide them with heating without losing the grid's efficiency.

Advice

It can be concluded that the alternatives differ in the details as well as in the possible consequences for the long-term durability, but are overall quite similar.

Within the assessment framework, Scenario 3 'Collective Maximum' surfaced as the best option. It has the highest long-term durability from an integrated energetic point of view. This is the scenario where the entirety of the new buildings of the Station Area will be connected to the low-temperature heat-cold-grid for the demand of heat and cold and the existing buildings to the medium-temperature heat-distribution grid.

Criteria	Weighing	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
End-user costs	5	5	4	3	3	3
Use of existing infrastructure	5	3	4	5	3	5
CO_2-emission	4	2	3	5	3	4
Use of local heat sources	4	2	4	5	3	4
Efficiency heating network	3	3	4	5	4	3
Impact on electricity infrastructure	3	1	3	5	3	4
Financing possibilities infrastructure	3	4	3	3	2	5
Local self-supply	2	2	3	5	3	5
Deceleration Masterplan process	2	5	3	2	3	3
Score		**94**	**110**	**133**	**93**	**124**

Right behind is Scenario 5 'Medium-temperature East', with the most important difference being that a large part of the buildings east of the train tracks will be connected to the medium-temperature heat-distribution grid. In this scenario the demand for cooling will be realised differently for the long-term durability of this area.

The two scenarios notably differ from the other scenarios by scoring better on the sustainability criteria.

Council Advice and outstanding questions:

To come to the realisation of the policy objectives of the municipality of Heerhugowaard, important steps have to be taken quickly and choices will have to be made. Heerhugowaard wants to be CO_2-neutral in 2030 and has the additional ambition to become the most sustainable Station Area of the Netherlands.

A choice has been made for the development of a joint area approach, broadly supported by stakeholders to substantiate the urgent steps that have to be taken in order to realise the municipal policy objectives. The Station Area partners have collectively decided upon the preconditions and the assessment framework and it has been filled in in full transparency.

This integrated approach, where the municipal transition is implemented on a local level, is unique and in line with the local energy strategy. The traditional 'Warmtevisie' approach is included in a complete integrated approach and scenario development. In these scenarios mobility, energy generation, heat and cold demand are integrated. This integration effort is essential for the success of the transition path and has a 'very strong locally tailored' character. Regarding the generation of energy, the advice is to obligate the use of 75% of the roof surface of the new buildings for solar panels and, where possible, integrate facade panels to realise the municipal sustainability objectives.

- For the sake of realising further implementation of the policy objectives, the council is asked to decide upon a direction of development, as suggested in the scenarios
- The council can incorporate the advised scenario in the 'integrated energy plan' of the Station Area
- The proposed, area-specific, integrated choices that are now before us determine the degree of feasibility of the municipal climate objectives in 2030.

Functionally, these choices are translated into 'no-regret measures'. It is very important to take the steps in the right order, to allow optimal adjustments in both urban development and technical design.

Overview of the roadmap

Advised follow-up phase:

- Further shape the decision-making process, specify which parties carry which costs and benefits in a well-informed and transparent manner (separating infrastructure and operational management) and also specify and guarantee this for end-users;
- Establish broader information and interaction with all stakeholders for clarity and role definitions, essential components;
    - Briefing,
    - Involve and create support,
    - Explanation ‘direction-giving character’;
- Improvement of the energy-information of the future companies in the Station Area, especially the typology and consumption;
- An in-depth and customised implementation of the chosen scenario;
- Developing a Roadmap with phased implementation of measures, the Station Area technical site planning, preconditions for infrastructure, spatial application of infrastructure (pipelines, land use, transformers) etc.