## Heat Transition – a Unique Opportunity for District Oriented Approach

**Summary**

Rotterdam's unique approach to heat transition is a driver for cashing in on opportunities. Currently, 80% of the buildings in Rotterdam are heated by (domestic) gas boilers, while many houses do not have optimal insulation. The Dutch city of Rotterdam started its "heat transition programme" to reduce energy consumption and replace fossil based energy use, . This programme is having a huge impact not only on the owners and end-users of the buildings but also on the urban environment. The programme focuses on the optimal combination of energy-saving measures at buildings level (reduction of consumption & re-use) and changes at energy systems level (re-use and production of sustainable energy). The goal of heat transition is to achieve (close to) zero emission heating. The programme focuses on realising economy of scale and combining operations, while also using the transition as a driver to improve the city. The districts in transition will be scanned for opportunities for improvement arising from local concerns, e.g. parking problems or social cohesion. This will not only result in lower emissions, cleaner air, more jobs and a call for innovations, but will also have a valuable and positive social and environmental impact.

### Heat transition in built environments

80% of the buildings in Rotterdam are heated with natural gas. To reach the Paris climate goals, heating of the built environment has to be transformed from gas based heating to CO2-free alternatives. Also the energy consumption needs to be reduced. In order to have CO2 emission-free heating of all buildings by 2050, Rotterdam needs per year to transform on average 8000 buildings , and 40km of new energy systems need to be built (to replace the current gas grid).

### Opportunities for the city

The heat transition is obviously a big challenge, but it also brings opportunities:

- <u>CO2 emission reduction:</u>

The pilot project aims to disconnect 1100 houses from the gas grid and connect them to district heating. All buildings will be insulated cost efficiently. With this, the average emission reduction is calculated to be 1400kg per year (over a period of 40 years, starting in 2019). This reduction is without the expected (and necessary) change of heat sources (more sources with lower emissions). The heating system as well as the electricity system will be fed with low emission sources by 2050, and, as a result, reduction of emissions for this project will increase.

The end goal is to introduceCO2-free heating of the built environment throughout the entire city by 2050. The CO2 emissions will then be reduced by 900[1] kilotons per year (in 2050). This is based on the total sum of current emissions from heating households and utility buildings in the city of Rotterdam.

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[1] Base year 2016: 994 kiloton CO2 emission for heating all buildings (both gas heating and current district heating). Target year 2050: approximately 94 kiloton CO2 emission for heating all buildings (emissions, mainly caused by fossil based back up and peak heat)

- Cleaner air

With the transition from individual gas boilers to district heating (in Rotterdam) the reduction of NOx is calculated to be 10%. The expansion of the district heating network and the growth in demand of electricity will create opportunities for the production of renewable (and cleaner) energy.

- Adaptation & environmental improvement:

The challenges and opportunities in the districts are considered as part of the heat transition programme. The maintenance of the sewer system will be one of the elements that will be an integral part of the district-oriented agreements. Water/climate adaptation, both within the sewer system, but also within district-oriented measures (buffering, more green energy) will be taken into account.

- Jobs & innovations

An increase in jobs (insulating 8000 buildings a year, changing the energy system; 200 - 500 jobs a year on average). Innovations, within the building (insulation/ installation) sector and for the energy system (conversion and buffering of energy) is needed. The transition will create new niches in the market that will enable new (innovative) companies to emerge. There are no technical limitations in our approach, so new innovations and developments can be used for future heat transition projects.

- Social benefits

The energy transition will have a huge impact on all people living in the target areas. Changes also need to be made inside residential properties. This can only be done by involving the end-users. This community involvement is also a chance to address social issues and improve identified local problems (parking problems, safety). For example social cohesion can be improved by using heat transition projects as an opportunity for local residents to become better acquainted with each other. For every district project, challenges and opportunities in the urban environment outside the “energy” domain will be incorporated. By focusing attention on citizens' concerns and requirements, heat transition becomes a catalyst for changing and improving other domains, thus creating multiple co-benefits.

- Higher comfort & lower energy bills

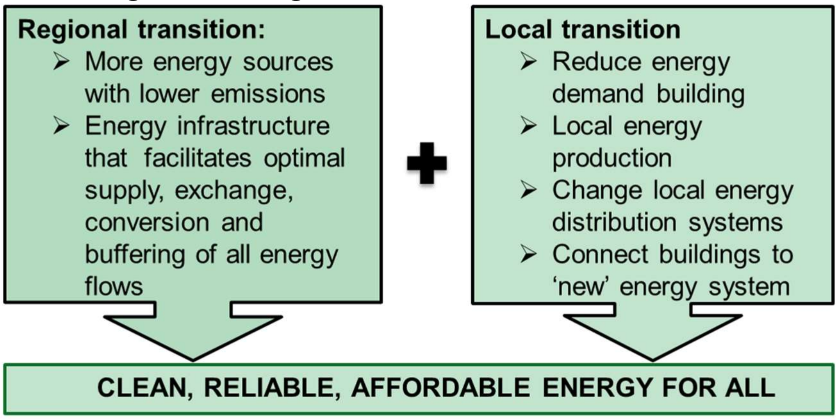
Insulating houses will not only create a healthier and more comfortable indoor climate but will also lead to substantially lower energy bills.

- Less upheaval & economy of scale

By looking at a bigger area it is possible to cash in on economy of scale opportunities. By combining operations, such as sewer maintenance or building renovation plans, the total costs and upheaval for both the buildings and the environment are significantly reduced.

**A regional and local task**

Rotterdam has a unique approach: the heat transition is split in two levels, regional and local. Each level has its own goal, challenges and stakeholders.

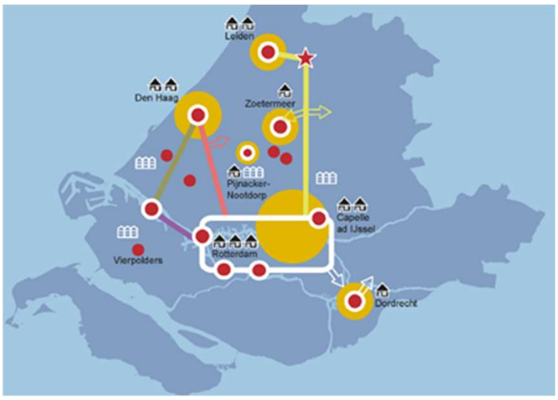



At the same time both are connected and influence each other. The tasks at both levels will be addressed and shaped in an iterative process. This approach makes the city and its citizens responsible for changing the buildings (heating, insulation, cooking) and connecting them to a new energy system. For example, the citizens are not made responsible for closing down fossil fuelled energy plants.

**Regional level**

To reach an almost zero emission energy system, new energy sources need to be connected to the energy system. Furthermore, the supply of renewable sources cannot be controlled. In order to secure the energy supply throughout the year it is important to maintain the balance between supply and demand.

A new / improved energy system that can not only exchange but also converse and buffer energy is needed.




The availability of renewable sources is limited. The regional energy mix (the type of energy production that is regionally possible) is therefore a precondition for the alternative heating on local level.

Besides the development of more renewable electricity sources, low emission heat sources also need to be developed. To distribute this heat to the local heat demand, a regional heat infrastructure is needed. Regional stakeholders are working together to build this so called "heat roundabout".

**Local task**

The first step of the transition towards (almost) zero emission heating is to reduce the heat demand by insulating the buildings. Secondly the buildings need to be connected to an energy system that has the potential to deliver zero emission energy. This potential is based on the regional energy mix.

The local approach is focused on the best combination of measures on building level (insulation) and neighbourhood level (energy system). In the pilot project the costs of several possible combinations are calculated. In order to find the most economical combination.

**The transition options at local level**

Buildings can be heated by:

- <u>Middle and high temperature solutions:</u>

The buildings are connected to a district heating system that heats up the buildings by using a temperature of 70 /120 degrees Celsius.
Insulation measures are not  essential, but are needed to reduce energy demand.


- <u>Low temperature solutions:</u>

Buildings are heated via the electricity grid (heat pumps) or are connected to low temperature (40 degrees Celsius) district heating networks. .
Low temperature heating requires extreme insulation.


The two types of heating have different costs for both the building and for the energy system:

| Temperature | 70 – 120 degrees | 40 degrees |
|---|---|---|
| Cost at buildings level | Low (cost efficient) | High |
| Costs at systems level | High | Low |

The optimum combination of measures (building + energy system) depends on the type of buildings and the environmental characteristics.

**Rotterdam Heat Transition programme**

The heat transition programme aims to answer the following questions:

- **Who** needs to be involved?
- **What** is possible and what are the opportunities?
- **How** can the transition be shaped and what are the preconditions?
- **When and where** can we best start the transition?

The programme has several projects, all working towards answering the questions above:

Projects on a regional level:

Creating the circumstances that enable the city's heat transition:

- Energy mix: What combination of energy sources are able to meet future energy demands?
- Regional heat infrastructure development.

Projects on a local level:

This the main focus for the heat transition of the city and has 3 phases:

- Phase 1: Working towards a "district oriented agreement" first in pilot projects, stating how, and under which preconditions, heat transition, together with supplementary/complementary benefits in other domains, can be realised. The signing of the first district oriented agreement is planned at the end of 2017.
- Phase 2: Realisation. Implementing changes in the heating of the buildings and changing the energy system in the district. The first project will start in 2019, combined with sewer system replacement.
- Phase 3: Upscaling the project to a city wide approach. This phase is executed simultaneously with phase 1 and 2by using results from pilot projects and translating them into the following:
    - Mapping energy infrastructure (direction)
    - Mapping transition planning (timing)
    - Preconditions
    - Communication & realisation strategy

**Pilot project (Phase 1)**


Project district facts & figures:

- 1100 households of mixed ownership:
    - 65% social housing
    - 45% home owners or private tenants.
- Existing district heating network nearby.
- Replacement of the sewer system planned in 2019.

Several scenarios are compared:

1. Connection to gas grid (current situation)
2. High temperature solution (district heating)
    a) With insulation
    b) Without insulation
3. Low temperature solution (all electric)
    a) Using air/water heat pumps
    b) Using heat from sewer system (low temp district heating)
4. Combination of high and low temperature solutions

In the last scenario ground bound buildings are transformed to low temperature heating and apartment buildings to high temperature heating.

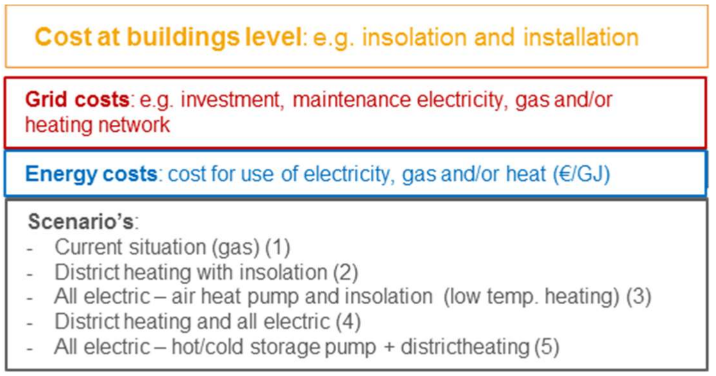
Per scenario technical, financial and social aspects are researched. At the same time the district is scanned for opportunities.

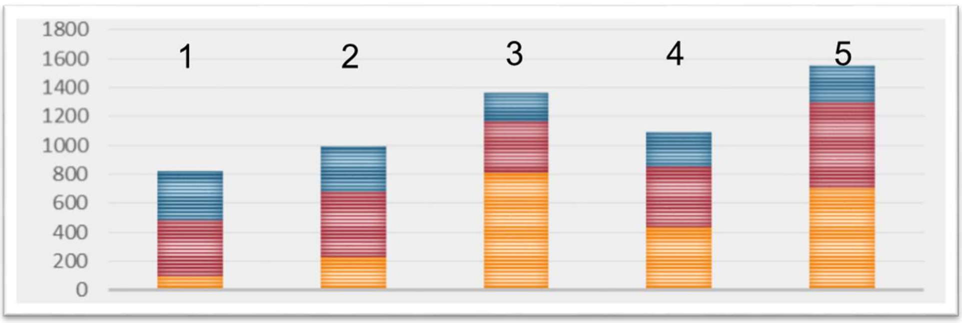

1. **Technical aspects**

17 reference buildings are visited. Based on energy scans and on site checks the possibilities and limitations of changes to the buildings are researched. Per scenario the necessary changes are listed.

## 2. Financial aspects

The total costs per scenario are calculated. The aim in this first step is to gain insight into the average total costs per building calculated over a period of 40 years. Maintenance costs are included. All the costs at buildings level and for adjusting the energy system are calculated. The costs are based on input from all stakeholders. This way the most economical scenario is identified. District heating combined with cost efficient insulation in the pilot district is identified as the optimal solution, when all costs and benefits are shared.




## 3. Social aspects

Heat transition is only possible if owners are willing to make changes to their buildings. Inhabitants, whom are not always the owners of a building, also play an important role in the decision-making process.
Social marketing is used in this project to gain insight into barriers and incentives.

Qualitative research has been done to gain insight into the following:

- Attitude of inhabitants/residents to change.Inhabitants' responses/reactionsto various suggested solutions.
- Potential opportunities for exchanges aimed at educating/informing local residents and changing their behaviour/attitudes.

Based on interviews, leads for cost and benefits and incentives for the target audience to change were identified as follows:

- Residents in the pilot project are proud of their homes.
- They want a comfortable living environment and verification of the benefits of the new system.
- Insight into short term profit or clear limits on short term losses are needed to convince the residents
- To lower inaction a focus is needed on initial small successes.
- Residents want to be proud of their neighbourhood.

- Improvements in both the neighbourhood and in social cohesion increase residents' willingness to invest in homes.
- Urgency and setting of norms (it will happen anyway) is needed.

Steps of development of communication strategy:

| | |
|---|---|
| 1. Understand the problem | - Problem analysis<br>- Get to know the target audiance<br>- Current behaviour |
| 2. Describe desired behaviour | - Map behaviour<br>- Needs assessment<br>- Exchange analysis<br>- Segmentation |
| 3. Creating intervention mix | - Selection potential intervention and needed mix<br>- Determine exchange and positioning<br>- Pre-test potential intervention mix and behaviour promotion strategy |
| 4. Implement intervention mix | - Set up monitoring and evaluation output<br>- Implement intervention mix + promotion strategy |
| 5. Monitor, evaluate, publish | - Monitoring output<br>- Make an evaluation<br>- Publish results |

Based on research, a communication strategy will be developed. Part of the process is to arrange opportunities to engage with the residents, to ensure that their needs and wishes are considered during the transition and incorporated into the end result (for example improvements in parking or green areas.)

**4. Opportunity aspects**

The pilot project, where the energy transition is not organised building by building but on a district level will create opportunities for additional benefits, such as:

- Combining work/ operations
  - Road maintenance and sewer system replacement is planned.
- Economy of scale
  - 1100 households, 17 types
  - Financial schemes will be developed
  - Discounts (e.g. for installing electrical cooking for more houses)
- Synergy
  - Solving inhabitants' parking problems and/or security concerns
  - Improving social cohesion

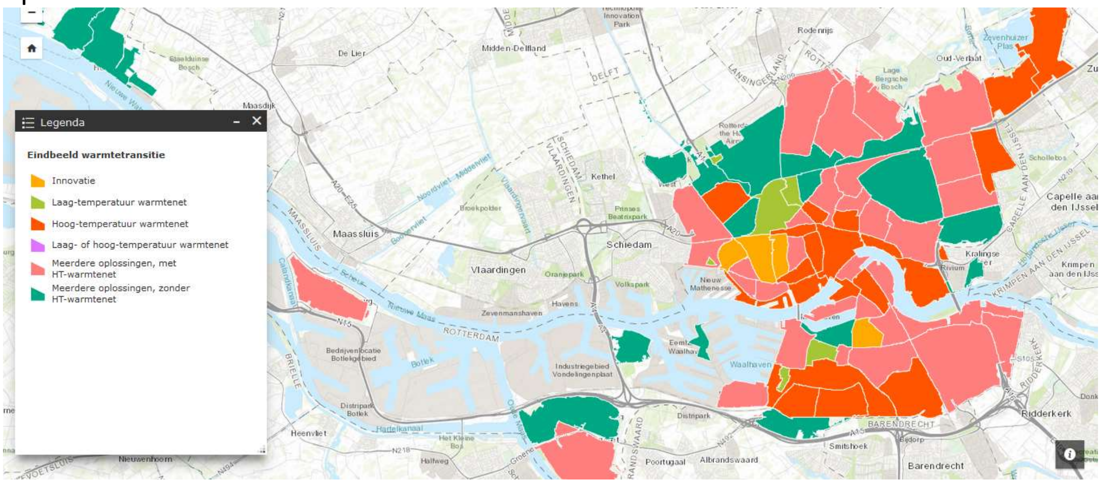
**Next steps (Phase 2)**

The stakeholders have agreed to calculate the individual business case of the overall optimal scenario (district heating with insulation). These business cases will be combined and stakeholders will work towards a "district oriented agreement". This agreement shows who will do what, under what preconditions.

Goal of the agreement is to cash in on the opportunities and reach economy of scale. This can only be done if the stakeholders agree to distribute the costs and benefits within the project and are willing to focus on the overall results and not only their own individual optimisation.
This process and integrated approach is unique.

**Upscaling (Phase 3)**
The results of the pilot project as well as experiences in other projects and interviews with our stakeholders are used for upscaling.

<u>Mapping</u>
To give insight into de planning and direction of the transition, maps are made. These maps help organisations and citizens to plan their own actions and renovation plans related to insulation and heating.
Based on the results of the pilot project and several other research projects, the expected optimal new energy infrastructure (low or middle/high temperature) is plotted on a map, indicating the direction of the heat transition per area. This map has a dynamic character, since innovations and local development can change the optimal solution.




A second map will show the planning of heat transition. This last will be done based on infrastructure maintenance planning (sewer, water, roads etc.), renovation planning of buildings, city development and/or social factors.

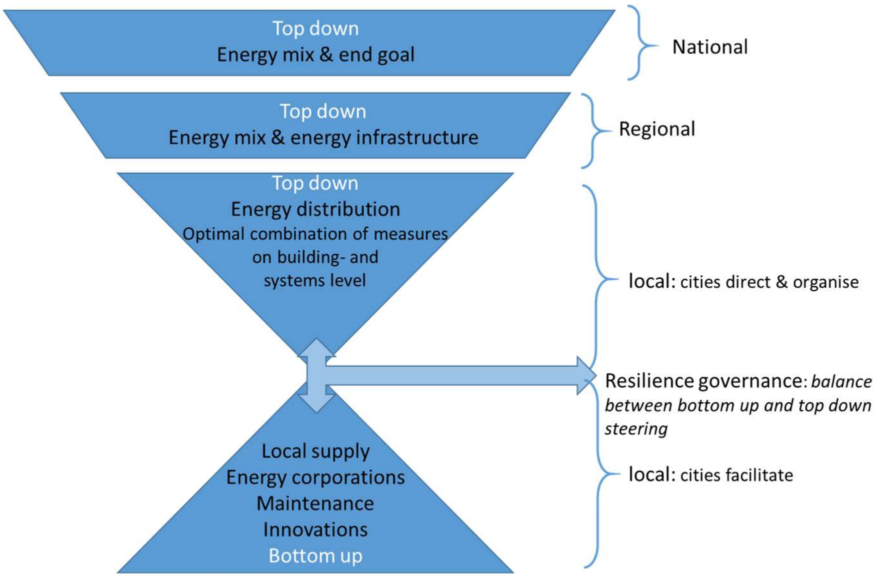
<u>Preconditions</u>
Recommendation on what kind of rules and regulations and financial arrangements are needed for a successful heat transition are made based on the results of the pilot project and stakeholder interviews.

This list of preconditions is for both stakeholders within the project as well for national government, affecting rules and regulations and financial arrangements. Already some preconditions are known:

- Energy system has to transform to low emission sources
- Everybody participates and is willing to:

- ✓ distribute all cost & benefits
- ✓ cash in on opportunities
- Willingness to rethink and change governance and financing of (new) energy system

The results and decisions made on one level influence the other. The possibilities on regional level are limiting to the possibilities on local level. On a local level cities coordinate the transition by deciding on the optimal energy system, while at the same time facilitating bottom-up projects. The challenge is to find the balance




between top-down and bottom-up governance.

<u>Communication</u>

There are two levels of involvement and communication;

1) On project level (focus on realisation): Based on in-depth interviews a communications and involvement strategy is developed. Part of this strategy is meetings, social media etc.
2) On a city level (focus on general information): As part of the sustainability program, several stakeholder involvement events were organised. General information about sustainability is shared via social media, campaigns such as pop-up stores etc.

<u>Realisation strategy</u>

The outcome of the pilot project is a blue-print approach for other districts. Parallel to this pilot project, another similar project has been started.

With this the city of Rotterdam has a strategy to realise the transition of our heating system while cashing in on opportunities, using district energy systems and individual solutions.