

# 2012

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## PROCESS DESIGN DISTRICT-HEATING AMSTERDAM



[SPM8001 – PROCESS MANAGEMENT]

## Table of Contents

1	Problem definition .....	3
1.1	Introduction.....	3
1.2	Actor (stakeholder) analysis .....	4
1.2.1	Introduction .....	4
1.2.2	Main actors .....	4
1.2.3	Position.....	4
1.2.4	Power - players.....	4
1.2.5	Power – context setters and crowd .....	5
1.2.6	Dedication .....	5
1.3	Current situation.....	5
1.4	Scope .....	7
2	Process analysis.....	8
2.1	Characterization of the Process.....	8
2.2	SWOT analysis.....	8
2.2.1	SWOT analysis of a future cooperation between Amsterdam and NUON in district heating.....	9
3	Process design.....	11
3.1	Synthesis and strategic principles.....	11
3.1.1	Strategy 1 (procedure) : the key role of the closing of the small ring in future cooperation. ....	12
3.1.2	Strategy 2 (scary plan): warmtewet .....	12
3.1.3	Strategy 3 (give and take): no-regret decision for Nuon.....	12
3.2	Process rounds .....	12
3.2.1	Round 1 .....	12
3.2.2	Round 2 .....	13
3.2.3	Round 3 .....	13
4	Conclusion and recommendations.....	14
5	Literature.....	15
	Appendices.....	16
	Appendix A: Stakeholder analysis .....	16
	Appendix B: Process Analysis .....	16

# 1 Problem definition

## 1.1 Introduction

Heating in the Netherlands has always been a matter of residential central heating systems. The exploitation of a huge gas field in the Northern Netherlands, starting in 1956, drove the development of the finely forked residential gas network. Almost every house in the Netherlands is connected. Now, 55 years later, the gas field is almost empty and national and regional authorities are looking for new ways for the Dutch citizens to heat their homes. One of the already widely used alternatives is communal heating. The city of Amsterdam made policy dictating that every new house has to be connected to the communal heating system unless it is not practically achievable. This policy is a result of both the lack of cheap natural gas in the future and the desire to vastly decrease the CO<sub>2</sub> emissions inside the city limits. A number of power plants are situated in the vicinity of the city. Superfluous heat from these installations is used to provide heat for the already existing network connecting 60.000 residential equivalent units (REU's).

The district-heating network consists of two main parts, co-developed by the municipality and energy company Nuon. In the current situation, the two parts of the network operate as independent systems. Both the municipality and Nuon would like to connect the two systems through the so-called "small ring". There are a few reasons for interconnecting the two networks. Among others: increasing the scale of the operation to reach critical mass and increasing the capacity of the system to minimize the use of backup heaters. And, also important, the psychological drive to finish an almost completed circle. More on that further on in the report.

The planned interconnection will cost around 10 million Euro's. Both Nuon and the municipality would like to have it but are wary to pay for it. For Nuon the business case in the current plans is not attractive enough while constructing the interconnection anyway could generate a lot of political goodwill. The municipality, on the other hand, is confronted with budget cuts and would like to have Nuon build and operate the better part of the infrastructure. The dilemma is characterized by the stratification of technical, political and financial decision-making.

This report will analyze the impasse and recommend on a process to come to a breakthrough. In paragraph 1 onwards the problem is defined in great detail. Special attention will be given to the stakeholder network and a detailed structure of the Amsterdam district heating network. Paragraph 2 further characterizes the problem and goes into the strategies currently used by the actors. This paragraph is based on a careful actor analysis on all actors surrounding the problem. The research comes together in paragraph 3 where the different analysis techniques are synthesized and a process design is presented. The final paragraph contains the conclusions and recommendations. If you are a reader in hurry, reading paragraph 3 suffices to get a good understanding of the research.

## 1.2 Actor (stakeholder) analysis

### 1.2.1 Introduction

In the process, which resulted from the initiative to “close the small ring” of the district heating network in Amsterdam, a number of different involved actors can be distinguished. In the stakeholder analysis their primary perceptions, goals and interests, and therefore their “position” in the process, will become apparent. The position these different actors obtain is parallel to the power they have to influence the process. Finally, from an elaboration on the position and power-indication for the different actors, it can be concluded how dedicated and critical these actors are to the process.

### 1.2.2 Main actors

The main actors which can be distinguished in the process are, first of all; the Municipality of Amsterdam, responsible for the “Warmte, tenzij...” policy. The main implementing agency of the Municipality’s policy is Waternet. Then, the main heat supplier and owner of Amsterdam’s districting heating network, and therefore main actor in the “closing of the small ring,” is Nuon. Another involved stakeholder is the waste-fired power plant owned by the Municipality ;AfvalEnergieBedrijf (AEB Afval). In this process, the actors Nuon, the Municipality and AEB Afval collaborated into a joint venture called WestpoortWarmte; creating a new stakeholder. Finally, also the citizens of Amsterdam are important actors, which are to be considered in the process.

### 1.2.3 Position

The position these different actors obtain coincides with their incentives to dedicate themselves to the process. These incentives consist from their main interest in the process, their perceptions and goals. The municipality of Amsterdam takes up a prominent position in the actor network and process, due to their main interest in the execution of the “Warmte, tenzij...” policy in which the “closing of the small ring” is the most important component. Together with Waternet, the Municipality pursues the execution of this policy. Wherefore Waternet their main goals consist of implementing and meeting the standards set by the Municipality, the goals of the Municipality in this process are much broader. Their main goals in the process are to result in a balanced budget, good liveability and well-developed district-heating infrastructure. To achieve their goals, the Municipality needs cooperation from Nuon, which immediately ascertains Nuon of a key position in the process. The main interest behind the involvement of Nuon is to expand their district-heating network and create a more certain heating supply. Though, currently their perceived problem is the low rate of return on the investment. Where the main goal from the Municipality in the cooperation with Nuon is a well-developed district-heating infrastructure, the goals from Nuon follow from a corporate strategy of continuity of the company, good return on investment, good strategy for energy transition, a diverse product base and a high market share.

### 1.2.4 Power - players

The power, which these different actors obtain in the process, results from a number of aspects, namely; their replaceability, their particular and important resources and how they can strategically use their resources to make other actors in the process dependent on them. For instance the municipality, which has legislative and investment power as their most important resources, is very dependent on the resources of Nuon. Where the municipality obtains the formal power, Nuon has production power. They have the financial resources and technical knowledge to make the project a success and are the biggest stakeholder in current district heating network. Perhaps, in the construction of the small ring, Nuon could be replaceable but since they have so many important resources for the other involved stakeholders, Nuon can be indicated as the most powerful and critical actor in this process together with the municipality.

Another powerful actor is Waternet. They obtain their powerful position due to the fact that they are ‘the’ implementing agency of the municipality. In order for the municipality to implement their “Warmte,

tenzij...” policy, they are very reliant on the cooperation and implementation by Waternet. This makes them an irreplaceable actor.

Finally, an important player in the process is the joint venture between the Municipality, Nuon and AEB afval, called WestpoortWarmte. These actors have collaborated into a joint venture, because they have a shared interest in the “closing of the small ring”. Due to their collaboration model, they will pursue succeeding their common goals, which makes them a powerful actor having joined forces.

### 1.2.5 Power – context setters and crowd

Indicating the Municipality, Nuon, Waternet and WestpoortWarmte as the main players in the process, AEB afval can be indicated as more or less a “context setter”. They are connected to the district heating system and are one of the companies delivering superfluous heat from the waste fire into the district heating system. AEB afval is also the cheapest supplier of heat. In the process they are replaceable and therefore not one of the most powerful actors. Also the citizens involved in the process do not have that much of a direct interest in the closing of the small ring and certainly have low power. Therefore they can be designated to the “crowd”.

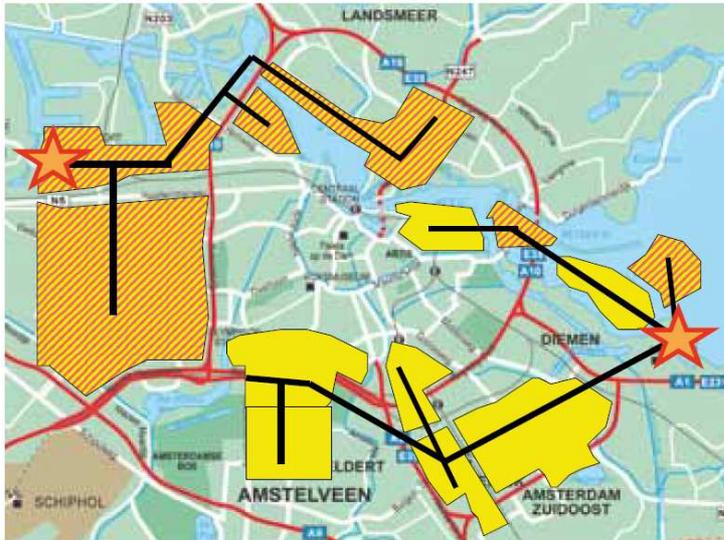
### 1.2.6 Dedication

In order to finally conclude whether how critical the involved actors are, it is of importance to assess their dedication to the process. A critical actor, which is less dedicated to the process, will probably be less overpowering and more bidding. Dedicated and critical actors are the ones who are most actively involved in the process. In the case of the “closing of the small ring” the dedicated actors are the Municipality, Nuon, Waternet and WestpoortWarmte. Incentives for their dedication have been described in the above. The most dedicated and critical actors in this process are the Municipality and Nuon. Currently, most negotiations are taking place between these two actors to achieve the same goal. WestpoortWarmte is also an actor, which dedicated itself to the process by combining forces into a collaboration model. Though, this model is not critical for a successful progression of the process, because the actors in the model are replaceable. WestpoortWarmte is a dedicated actor, but non-critical in this process. Finally, Waternet is dedicated to the process, but will not exercise a great influence on the course of the process and is therefore a dedicated, but non-critical actor.

## 1.3 Current situation

Amsterdam has an ambitious programme for district heating since the early nineties (Gemeente Amsterdam & NUON/Vattenfall, 2011). The construction of the district heating system started in 1993 and is still growing. There are currently two district heating networks, one on east part of Amsterdam owned by Nuon (since 2009 a Vattenfall Company) and one in the west side of Amsterdam owned WestpoortWarmte which is a joint venture between Nuon and the municipality of Amsterdam.

Nuon began constructing pipes in Amsterdam South-East and continued in Amsterdam South and IJburg, the WPW joint venture started in 2000 in the Westpoort area and continued in Amsterdam New West and Amsterdam North. In the map below there is an overview of the current existing and already contracted infrastructure. Yellow: NUON. Yellow/red: WPW, the joint venture.

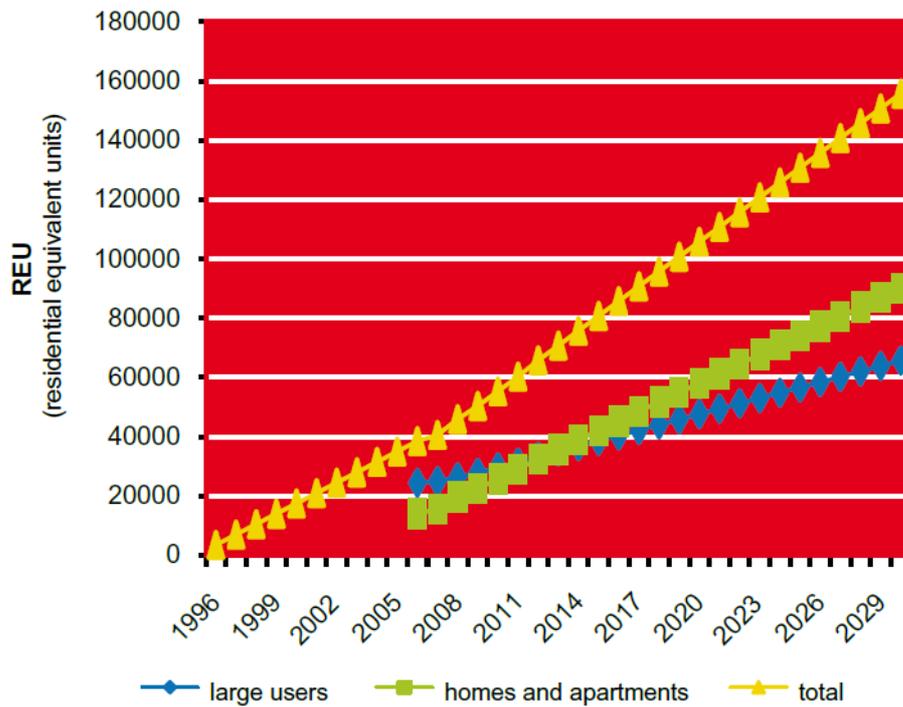


Figuur1 The existing and contracted networks

The system is using heat from two heating plants (the stars in the picture). The left one is the Waste and Energy Company (AEB), which is a waste-fired power plant (WFPP). AEB belongs to the City of Amsterdam and is part of the WestpoortWarmte network. The heat energy provided by AEB represents a saving in CO<sub>2</sub> emissions of 80%. This is due to the fact that half of the waste used to fire AEB's waste-fuelled power plant consists of biomass and because the plant uses biogas from next to AEB located Amsterdam's sewage treatment plant. The right one is Diemen, a gas-burning power plant that belongs to the Nuon part of the district heating system. The district heating energy supplied by Diemen represents a 50% saving in energy and CO<sub>2</sub> emissions compared to traditional central heating boilers. In the peak day when it's very cold outside the system uses gas heaters to boost the system.

The Diemen and AEB power plants are designed to produce heat to the network. One of the major misunderstandings came in view after an interview with Boudewijn Tjeertes (Tjeertes, 2011), Asset Manager Nuon Hemweg coal-burning power plant, the misunderstanding is that every energy plant is suitable to deliver heat to the district heating system. The Hemweg coal-burning power plant is built to deliver energy and has no usable superfluous heat left for the district heating system. Converting this power plant into a suitable plant is an inefficient way of using energy because you need to use heat from the core process.

The system is currently serving 55.000 REU (residential equivalent unit) and growing by around 4.000 REU every year. The goal of the municipality of Amsterdam is to grow to 100.000 REU in 2020. This is done by a new act forcing inhabitants of new neighbourhoods and urban renewal projects to connect to the district heating system. The expectation of the number of REU served by the district heating system is in the graph below.



Figuur2 Expectation REUs connected to the network until 2030

### 1.4 Scope

The system boundary is limited to the Amsterdam Area, excluding the old historical part of Amsterdam. In the old historical part it's economical not feasible to introduce district heating. In the new neighbourhoods and city renewal projects it's feasible to introduce district heating. When the heat is transferred in pipes it's cooling down, so the distance from heat plant to customers is an important factor for the feasibility of the network.

## 2 Process analysis

### 2.1 Characterization of the Process

In the process of the Amsterdam case, there is a significant variety between the actors in the actor network. Especially considering the main actors, the Municipality of Amsterdam and Nuon. There is a difference in the means of power (political power versus investment power), in the organization structure (public versus private) and there is a variety of main objectives (public well-being versus profit). These differences between the actors involved are very limited for the future intervention and has consequences such as limited reach of interventions and limited possibilities to tailor-made approaches. In the Amsterdam case there it is the actor Nuon who resists the intervention of the municipality of Amsterdam. The municipality wants to follow their strategy called “Warmte tenzij”, but Nuon has financial reasons for not wanting to build small ring in the district heating. The municipality does not have the power to oblige Nuon to build the small ring. Important to notice is the high interdependency between Nuon and the Municipality of Amsterdam. Nuon and the Municipality are dependent on each other in the process of the “closing of the small ring”. Especially the Municipality is dependent on the funding resources and technical knowledge of Nuon. In case of the negotiations between Amsterdam and Nuon, there is a high opaqueness, since the position of Nuon in the process is very unclear to the Municipality of Amsterdam, currently resulting in non-decision making. Also, the dynamic in the Amsterdam case has currently turned stable. A possible actor to enter the network would be public housing corporations, which would be an incentive for dynamic in the network. The full process analysis is included in the appendices.

### 2.2 SWOT analysis

In the process analysis, a SWOT-analysis presents more insight into the strengths, weaknesses, opportunities and threats of a project and therefore simultaneously the incentives for the cooperation between involved actors. In this process two different SWOT-analysis can be distinguished, namely for the closing of the small ring and for the future cooperation between the main players in this process: Nuon and the municipality. In the analysis it is of importance to look at the strengths together with the opportunities and to anticipate on weaknesses together with threats. Information used to elaborate the SWOT analysis has been derived from the interviews performed. SWOT analysis of the process which has the goal to close the small ring

#### *Superfluous heat*

A strength, which can be indicated by the closing of the small ring, is the more efficient use of superfluous heat and reduction of CO2 emissions. AEB Afval“ superfluous heat” can immediately be used in the heating of households. For Nuon this is different. Nuon currently does not necessarily possess superfluous heat. There is an opportunity for the Hemweg stations to deliver superfluous heat, but it calls for an intervention in the power or electricity process by the integration of a drainage-point. In order for Nuon to be able to maintain the deliverance of the same amount of current, Nuon is forced to increase their use of resources (fuel) to maintain the same return. Therefore, there is a possibility for Nuon to deliver superfluous heat during peak hours. To do this, the turbines would have to turn at highest capacity and an advantageous return is attained by generating heat. Also, it could be generated during off-peak hours and stored in buffers. These buffers can be used to deliver superfluous heat to the district heating network during it’s peak hours. In order for Nuon to also deliver heat to the district heating network from their buffers during off-peak hours, this would demand a huge increase of the return by the turbines. The Diemen power station is currently connected to the eastern part of the district heating network, however, designed to deliver electricity and superfluous heat.

The demand for superfluous heat has been increasing and it has become a commercially interesting opportunity for Nuon. Though, a current weakness of the closing of the small ring is the low return on investment for Nuon. It is only commercially interesting for Nuon when the return on the investment becomes about 7%, which is currently only 2-3%. A strength of the closing of the small ring, in order to deliver

superfluous heat to foresee in the supply during peak hours, is the fact that only one auxiliary heating plant is needed.

### *Flexible heat sources*

Another strength, which can be distinguished in the closing of the small ring, is the ability to use flexible heat sources. When closing the small ring, it will create opportunities for the future to use different available heat sources. Without the necessity for either gas burning, or coal burning power plants. Also heat from heat pumps, thermal heat storage, solar cells and other innovative technologies can be used to deliver heat to the network. Amsterdam's university hospitals can also be connected to the district heating network by peak and back-up generators. Therefore, consuming heat and also delivering heat back to the network is creating an opportunity for integrating suppliers and users by introducing the "smart grid". The closing of the small ring also creates opportunities for the expansion of a district heating and cooling network. Amsterdam is fortunate in having three sustainable heating and cooling technologies, namely: district heating, district cooling and thermal energy storage, and the closing of the small ring aims to integrate and facilitate expansion of all these systems.

### *Residents*

By the closing of the small ring, the district heating network is expanded and many more households will be connected to the network, contributing to a reduction of CO2 emissions. Though a weakness of the project is the "stalinistic" image, which is perceived by the citizens as a problem. Since the aim is to connect new households and many existing buildings to the district heating network, many citizens feel as if they do not have a choice left. Though, the closing of the small ring poses as an opportunity for the passing of the "Warmtewet" in the national government. The Warmtewet provides the necessary legal protection for consumers of prices and reliability of supply. And therefore ensures citizens of a smooth transition from their former heat supply by gas burning to district heating. But also includes taxes on dumping heat, which immediately ensures efficient use of superfluous heat (second paragraph).

### *Stakeholders*

The actors in the "closing of the small ring" are involved in a small stakeholder network, which can be seen as a strength. The most critical actors in this project are Nuon and the Municipality. Other actors involved, such as AEB Afval and Waternet are supporting actors to the project by carrying information. This increases the redundancy, which can be considered a strength, because less interdependencies imply less opportunities to block decision-making. Though, a large number of channels to receive information is necessary in the decision-making process. Therefore, this can also be seen as a weakness, since Nuon and the Municipality are highly interdependent on each other in successfully closing the small ring. In case Nuon and the Municipality can come to an agreement, then this project may potentially pose as a pilot project creating opportunities for a smooth cooperation-model for future projects. Though, the construction of the "small ring" doesn't guarantee cooperation between the players in the future, which is the only threat to come across in this SWOT-analysis and the next SWOT-analysis therefore focuses on.

## **2.2.1 SWOT analysis of a future cooperation between Amsterdam and NUON in district heating**

### *Small network*

As already mentioned, the main actors are involved in a small stakeholder network. Which can be considered a "strength" for the communication between these actors, since a small number of players encourages efficient communication. Though, the main weakness to be mentioned is the risk of hit-and-run. In case one of these parties decides to back out of the plan, the closing of the small ring and district heating in Amsterdam is done (due to their high interdependencies). Also the opaqueness of Nuon's position in the process raises the complexity, which increase the demand for substantive enrichment. This is where we focus on a SWOT analysis for a future cooperation between Amsterdam and Nuon.

### *Future positions*

In order to ensure cooperation from both critical parties, it is of importance to assess the future consequences for both Nuon and the Municipality. The strength of this project is the fact that it could lead to a win-win situation for both parties. The closing of the small ring would eventually lead to more profit for Nuon and an improved environment for the Government following their “Warmte, tenzij...” policy. Especially for Nuon there are potentially more opportunities to seize in the future from an integrated district heating system, combining heating-, cooling-, thermal energy storage and smart grids. Nuon has to opportunity to expand their company and together with the Municipal policy to connect many households to the network, it will have advantageous network effects as result for Nuon. “Bigger network brings greater interest,” potentially increasing their share of consumers. The main threat, which may result from the initial win-win situation, is a potential monopolistic position for Nuon. Considering the EU law on tendering, Nuon has, until now, always been the only involved party in the closing of the small ring.

## 3 Process design

### 3.1 Synthesis and strategic principles

The different analysis made clear that the two main actors have very different interests. (see APENDIX). These are the commercial goals of Nuon/Vattenfall and the liveability and sustainability goals of the municipality. In the problems surrounding the closing of the small ring, this is a clash of interests. The nature of this problem is a well understood and described.

The municipality sees positive external effects of the district heating network for instance in cleaner air by the reduction of CO<sub>2</sub> emissions and the possibility to use flexible heat sources to feed the system and heat homes. Nuon, on the other hand, is not primarily interested in the external effects but mostly looks at the return on their investments. In short, construction of infrastructure by private parties will always face problems. If we look at the closing of the small ring, we see also see this problem. The municipality wants the relative small piece of pipe to ensure redundancy of the network and place district heating on the agenda while for Nuon the financial return of investment isn't just good enough to sanction the investment. The contained problem of the small ring is actually an exponent of the systematic clash between private and public interests regarding infrastructure. In this chapter, we will present a process to solve the standoff. The general goal of the process is to get the parties talking again to find a solution that serves the interests of the municipality and returns a healthy profit for Nuon.

The analysed problem can be characterized in two interwoven dilemma's. The large external effects of the district heating network are mainly enjoyed by the municipality, leading to underinvestment by Nuon. A process in which a win-win solution for both main actors is designed is therefore recommended. This process serves to partly internalize the external effects in Nuon. The next paragraph describes a process design that sets a framework for this solution. A solution in itself will not be presented; both actors have to come to a mutually acceptable solution themselves. Asymmetrical information, difficulties in interpretation and deep lying interdependencies make it undoable to force a solution on both actors.

The process to create a framework for a win-win solution for the district heating network will consist of three rounds. The rounds model is generally used to in stagnated problems. In every round a different and specific dilemma is taken on. Every actor can communicate their views on the dilemma so a trade off can be made. The transparently sharing of dilemmas is the core of a process design. A round consists of a dilemma, an approach and the 'rules of the game' that set the framework for the interactions in the round. The round is terminated by coming to a crucial decision. A decision can entail abortion of the process, a unilateral step, a compromise or a winning coalition.

While designing the process it could be very helpful to take certain strategies into account that can accomplish a result in the process. In this case, the closing of the small ring is the purpose of the start of the process, but there might be a future beyond the closing of the small ring for Amsterdam and Nuon. Since district heating has a lot of growth potential and therefore financial potential. Furthermore, CO<sub>2</sub> reduction can be achieved when expansion of the district heating network is a fact.

**Therefore it is believed that the design of the process should focus on these two main actors and their future cooperation.**

In order to achieve this cooperation there are three process rounds suggested. The following strategies are used to establish the coming process rounds (Bruijn & Heuvelhof, 2008):

- Strategy 1: unilateral intervention as incentive.
- Strategy 2: procedures.
- Strategy 3: give and take.

### **3.1.1 Strategy 1 (procedure) : the key role of the closing of the small ring in future cooperation.**

Both actors should put their issues regarding the closing of the small ring aside, since this issue is a breaking point in the negotiations. Looking forward towards a future where both parties cooperate and are helping each other with their goals, could result in huge win-win situations which make it a lot easier to solve the issues on the closing of the small ring.

Conclusion: Steer the actors Waternet and Nuon should focus on long-term goals and long-term opportunities. If they agree upon that strategy (e.g. Nuon can get the exclusive right for district heating of Amsterdam in the next 30 years?) it is likely that short-term problems can be relatively easily solved.

### **3.1.2 Strategy 2 (scary plan): warmtewet**

A scary plan tactic can be used: the passing of the “Warmtewet” can result in extra taxes on dumping heat. Amsterdam has the possibility to influence the national government for the passing of this law.

If these taxes will become a fact, it is best for Nuon to be on the safe side in the cooperation with Amsterdam. When another actor is then the main supplier for Amsterdam, Nuon has to pay a lot of taxes!

Conclusion: it is best for Nuon to work in a future cooperation with Amsterdam, because when the Warmtewet becomes a fact, there could be a lot of taxes on dumping heat, and Amsterdam can influence that decision.

### **3.1.3 Strategy 3 (give and take): no-regret decision for Nuon**

Regarding the two strategies mentioned above, Nuon can conclude that they have a choice: either they do not participate in the closing of the small ring with a high risk of losing Amsterdam as a partner in the district heating network (and a risk of paying taxes on dumping heat), or they cooperate in closing the small ring in the return for a guaranteed growth and offset of their heat which could generate large profits.

Conclusion: this aggressive strategy can be used to speed up the process and push Nuon towards a solution, but we should be aware of the fact that this strategy could also blow up the entire process between these two actors.

## **3.2 Process rounds**

The process to create a framework for a win-win solution for the district heating network will consist of three rounds. The rounds model is generally used to in stagnated problems. In every round a different and specific dilemma is taken on. Every actor can communicate their views on the dilemma so a trade off can be made. The transparently sharing of dilemmas is the core of a process design. A round consists of a dilemma, an approach and the ‘rules of the game’ that set the framework for the interactions in the round. The round is terminated by coming to a crucial decision. A decision can entail abortion of the process, a unilateral step, a compromise or a winning coalition.

A comprehensive set of default round strategies are available in the literature (Bruijn & Heuvelhof, 2008).

### **3.2.1 Round 1**

#### ***Dilemma***

In round 1 the following dilemma is put on the table: The construction of the small ring is currently in an impasse. Municipality wants it, Nuon doesn’t want to pay it.

#### ***Approach***

The approach for this round is two-fold. To start, the actors have to decide to shelve the plans, planning and negotiation for the construction of the small ring. By doing so, the sting is taken out of the problem and the road is cleared for future cooperation. The actors have to convince themselves that a win-win situation can arise from future cooperation. The logic behind it is that Nuon gives some now and receives future concessions for lucrative areas, earning back the money they invested on earlier accounts.

### *Rules of the game*

The rules of the game create guidelines which the actors have to follow to create a sustainable process. In this case:

- Careful – interaction between the actors has to be very careful because an important and maybe costly step is made.
- Confidential – information regarding this step cannot be leaked to the press.
- Exit strategy – in a process of this kind, a proper exit strategy is important. It gives the actors room to manoeuvre and not feel trapped in the process.
- Lastly, the decision to put the small ring on hold has to be made in due time to keep the initiative going.

### **3.2.2 Round 2**

#### *Dilemma*

The problem is treated too much on an operative level instead of a policy level. Moving the process up in hierarchy within the organisations might benefit the process, but current representatives might feel ignored and could counter this decision.

#### *Approach*

- Convince current representatives to move up in hierarchy, formulating this as a challenge that they can achieve.
- Once the higher ranks have joined the process, an agreement can be made on future cooperation between the two organizations. Pointing out the strategic line.
- It is very important to take the core values of the two actors into account.

#### *Rules of the game*

- Within a timeframe that is suitable to reach an agreement.
- Preconscious.
- Negotiated rules about budget and planning.

### **3.2.3 Round 3**

#### *Dilemma*

After the strategically agreement has been concluded, it is necessary to draw the practical design of the network. The practical design can lead to the realisation of the goals of Nuon and Amsterdam, and might include the closing of the small ring (or not). The difficulty is to realise these goals without excluding one of them.

#### *Approach*

- Design of a roadmap for district heating in the municipality of Amsterdam. The agreement can be used as a guide and is a precondition to obtain speed in the process.
- The policy of the municipality, as well as the profit for Nuon, should be taken into account while designing this process.

#### *Rules of the game*

- Exit rules are very important in this stage of the process, describing when an actor is allowed to leave the process.

## 4 Conclusion and recommendations

The delivered solution in this report for the closure of the small ring is based on a process design with three rounds. In these rounds, specific rules of the game are established. Essence of the proposed solution is to move the sting from the conflict and concentrate more on the opportunities that are determined in the SWOT-analysis. The sting in this process is defined as the small ring, which will not be financial feasible. The most important opportunity in the process is the future cooperation between the actors involved towards the district-heating system in Amsterdam.

All actors in the network that are involved in the process can be reduced to two main actors, namely the municipality of Amsterdam and the energy company Nuon. This is because of the influence of the municipality in the company's AEB and Waternet and the shared stake with Nuon in the company WestpoortWarmte. After stakeholder analysis there is a clear distinction between the core values of these two actors, namely the public versus private interests. Both actors are pretending to be committed to the result, but instead of this they should commit to the process, also if the solution is not to close the small ring. They also act in a very reserved way towards a package deal. Especially Nuon needs more incentives to speed up the process, this could be somewhat more threatening strategies from the municipality or the central government.

The focus on the future cooperation should create great advantages for both actors, in the further future. By concentrating on the future desired district-heating infrastructure they both have prospects to gain, in the case of the municipality the implementation of their policy 'Warmtetenzijs' and the reduction of CO2 and Nuon can build up a proper business case to satisfy their profit demands.

Recommendation for the continuity of the process is to follow the described rounds, but consider several difficulties that appear by implementation. For example the absence of the public housing cooperations in the process. In a later stage, these actors prove to have a substantive influence on the implementation of the connections of the new houses to the district-heating infrastructure.

## 5 Literature

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## **Appendices**

**Appendix A: Stakeholder analysis**

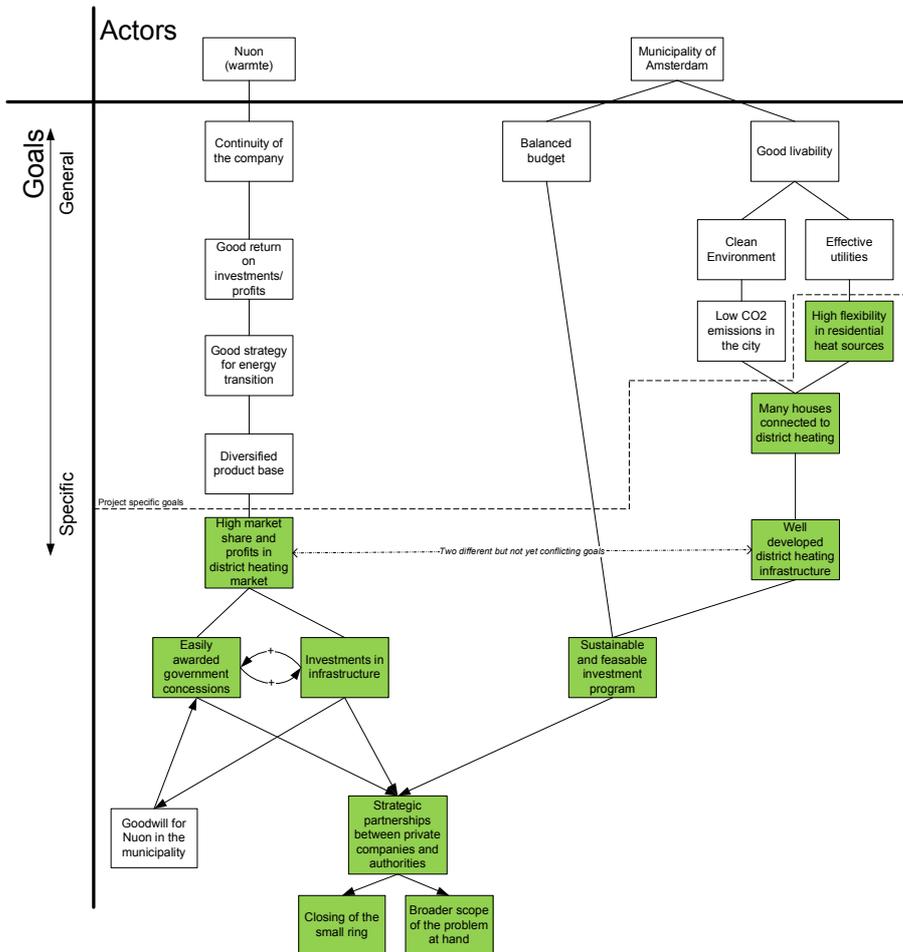
**Appendix B: Process Analysis**



## Appendix A: Stakeholder Analysis

Actor	Description	Interest	Perception	Strategies
<b>Municipality of Amsterdam</b>	The municipality is responsible for the civil works on their territory and is also a partner in Westpoortwarmte. The formal power lies with the Municipality of Amsterdam and appear to have the power in actual situations. The Municipality decides what activities and decisions occur and when and whether they occur.	The policy "Warmtetenzi" describes that all new dwellings should use district heating unless no other option is possible	Amsterdam primarily wants to follow their policy: Warmtetenzi..."	The aim of the policy is to provide sustainable, reliable and ecologically sustainable energy to the entire city of Amsterdam
<b>Nuon</b>	Nuon is the main supplier of district heating in Amsterdam. Their power plants provide a huge contribution to the system.	The main interest of Nuon in the district heating problem is to expand their district heating system and create a more certain supply. They can do so by constructing "de kleine ring".	Because of the low rate of profit Nuon doesn't see the added value of completing "de kleine ring".	With their power plants Nuon is the main supplier of district heating. By combining those two, they can reduce CO2 emission. They want more profit from completing "de kleine ring"
<b>Waternet</b>	Waternet is a company that covers the entire water cycle of the city of Amsterdam. They are the implementing agency of the municipality	Waternet wants to meet the standards prescribed by the municipality.	To guarantee the supply of district heating, it's necessary for Waternet to complete "de kleine ring".	The strategy of Waternet is cooperation because they stand in a hierarchical model below the municipality. Their aim is to implement the strategy of the municipality.
<b>AEB Afval (gemeente)</b>	The Waste and Energy Company (AEB), is a waste-fired power plant (WFPP), which belongs to the City of Amsterdam. This power plant is connected to Amsterdam's district heating network. The connection of AEB to the Amsterdam's heating network can prevent the construction of an auxiliary heating plant.	The AEB has a direct interest in the expansion of Amsterdam's district heating network, because it will increase their share of consumers and therefore their profit.	A possible solution for an increase in durable heating supply (for more than the coming two years), the AEB would have to extend their company by the construction. An advantage is the fact that the heating supply by the AEB is cheaper than that of Diemen when the connection of the 'small ring' will be pursued.	With their possibly future connection to the heating network, AEB does not guarantee the heating supply. They guarantee cooperation, but do imply the necessity of an auxiliary heating plant.
<b>WestpoortWarmte (WPW)</b>	For the delivery of district heating in Amsterdam, the Waste and Energy Company (AEB) collaborated in a joint-venture with the Municipality of Amsterdam and Nuon and is called WestpoortWarmte. The cooperations assemble different expertises. NUON provides technical expertise, while the City of Amsterdam contributes knowledge regarding urban development, the planning of housing and knowledge of the substrata below the city.	WPW wants to increase the number of dwellings connected to the district heating network in Amsterdam by the connection of the 'small ring' in order to increase their share of consumers and profit for AEB and NUON and result in a CO2-reduction, which is aimed for by the Municipality of Amsterdam.	The perceived problem of WestpoortWarmte is to bring together the different interests and goals of the three parties, in order to achieve their main goal, the connection of the 'small ring' in order to increase their number of consumers.	The strategy of WestpoortWarmte is the cooperation between the different parties in the joint-venture.
<b>Consumers/ Citizens</b>	The consumers are the residents of the city of Amsterdam who are, or will be, connected to the Amsterdam's district heating network. The citizens are the residents of Amsterdam who are confronted with the construction of the large ring.		There is much objection to the stalinistic image of district heating. Many consumers view that they do not have the option left in the need to cook using electricity (because there is no gas connection in the home).	The strategy of the consumers is either to cooperate with the plans of the connection to the heating network, or to conflict with the plans by objecting in the attempt to try to stop the construction.

## Actor specific Goals



This diagram shows the goal chain of the two main stakeholders in the problem at hand. This goal analysis gives an insight in the motivations behind the behaviour of these actors. At the top, the main, general goal of each actor is shown. By keep on posing the question "how" at each subsequent goal, we come at the project specific goals. The first project specific goals capture an interesting antithese. Both the "high marketshare etc." and the "Well developed etc." are essentially different goals but both very much possible to achieve. The question however, is how?

By subdividing both goals we come to another interesting characteristic of the problem. There is some feedback in the goals of Nuon. They are probably willing to invest heavily in infrastructure if they can be the preferred partner for the decisionmakers. To become a preferred partner, they have to show some good will to the authorities. The goal of the municipality at this level is to have an "sustainable and feasible investment program", much in line with their wish to have a well developed district heating network. A solution that satisfies both goals is a "Strategic partnerships between private companies and authorities". The actual closing of the small ring can be a logical result of such a partnership. This in contrary to one of the parties constructing and paying for the ring in it's self.

### Critical Actors

To get a clear view of which actors are critical actors, it is of importance to assess the issue of resource dependency. According to the network approach, one of the ways to make a distinction between actors is to look of what resources they have and how important they are for the total network. Usually funding is an important resource, but it could also be specific (technical) knowledge. In order to decide whether an actor is critical, the importance of a resource and whether there are other actors who can deliver the same resources are determining factors. A good way to determine the resource dependency is to use the following model.

	<b>Low importance</b>	<b>High importance</b>
<b>Low replaceability</b>	Moderate	High
<b>High replaceability</b>	Low	Moderate

If an actor obtains resources, which are really important for the project and there is no other actor who could replace him, then it is an actor acquiring high dependency in the process. Meaning; other actors are dependent on the actor owning these resources. An actor, which is necessary to bring the project to a good end, is a critical actor. The criticality of actor X is based on a few aspects. These following aspects are:

- How important are the resources of actor X?
- How replaceable are they?
- How depended are the other actors on the presence of actor X?

In the Amsterdam case, the following table elaborates on these aspects:

Actor	Important Resources	Replaceability	Dependency	Critical Actor
<b>Municipality</b>	Legislation	No	Medium	Yes (blocking power)
<b>Nuon</b>	Financial resources & knowledge, heat, infrastructure	Yes, in the construction of the 'small ring'	High	Yes (blocking power)
<b>Waternet</b>	Power implementation of	No	High	Yes (delegated decision maker)
<b>AEB Afval</b>	Heat	Yes	Medium	No (replaceable)
<b>WestpoortWarmte</b>	Infrastructure	Yes	Medium	No (replaceable)
<b>Consumers / Citizens</b>	Vox populi	No	Low	No (power to delay)

The Municipality most important resource is their controlling power and power of legislation. In order to be able to build or construct anything the municipality has to approve of it. Because of the Municipality is the only actor possessing legislation power, they are un replaceable. The other actors do not really depend on their presence, but

they do need their approval. Therefore, other actors are 'medium dependent' on the Municipality. Because the Municipality does obtain blocking power, it makes them a critical actor.

Nuon has a lot of resources. They have the financial resources for the investment, the technical knowledge to make the project a success, they have a heat source which is needed for district heating and already own a large part of the infrastructure. In order to complete the small ring, Nuon can be replaceable, though it is better to work together with this actor. The fact that Nuon has a lot of resources which are important for the project makes other actors depended on them. Therefore, Nuon can be indicated as a critical actor.

The implementation of the municipality happens within Waternet. The power of implementation is also an important resource. If you want to complete the small ring, Waternet is needed for the implementation of the municipality's legislation. They are the only actor who can implement the legislation, which makes them irreplaceable, because other actors have to work together with Waternet. For that reason, Waternet is also a critical actor.

The only resource that AEB Afval obtains is heat that is needed for district heating. Although they can deliver the heat at a low price, it doesn't mean that they are not irreplaceable. There are other actors who can deliver the heat whether or not for a higher price. Other actors are not necessarily depended on their cooperation and are not a critical actor.

WestpoortWarmte is a partnership between the municipality, Nuon and AEB. They are owner of the infrastructure of the northern part but this isn't a really important resource. They are replaceable because they are not really needed for completing the small ring. A successful cooperation between these actors will be beneficial for the future, but there are other actors who could take place in this partnership to complete the construction of the small ring. This gives them a medium dependency and due to their replaceability they can't be denoted a critical actor.

Citizens don't have physical resources. Their power consist of voting their municipality. They can't be replaced because they are always part of the process. For the completion of the small ring other actors do not currently depend on their cooperation. That's why they are not a critical actor.

#### **Critical actors**

Processes tend to be very dynamic; actors can enter or leave the process at any time. A few facts have to be taken into account to determine the critical actors in this process. In the diagram below these facts are represented with a judgment about whether or not the specific actor is critical.

	Important resources	Replaceability (high/low)	Dependency (low, moderate, high)	Critical actor?
<b>Municipality of Amsterdam</b>	Resources in legal matters, investment power (grants) and policy	Low	High	Yes
<b>Nuon</b>	Big stakeholder of the current infrastructure. Investment power. Main supplier of the district heating system	Low	High	Yes
<b>Waternet</b>	Policy provided by the municipality	Low	Moderate	No
<b>AEB Afval</b>	Supplier of the district heating system	Moderate	Moderate	No
<b>WestpoortWarmte</b>	Different expertise about the infrastructure of heating	Moderate	High	No
<b>Consumer/Citizens</b>	None	Low	Low	No

The replaceability of Nuon is indicated as “low,” because replacing Nuon is almost impossible. Nuon is the currently the largest owner of the infrastructure and the main supplier. Without Nuon’s cooperation, there won’t be enough capacity for the Amsterdam city heating system.

Waternet’s replaceability is “low”, because Waternet is the main owner of the infrastructure and because it is a department of the municipality.

WestpoortWarmte will play an important role in the process, due to their combined knowledge, but is not a critical actor.

#### *Dedicated actors*

Dedication is important for the involvement of the specific actor in the process. Their dedication depends on the willingness of the actors to become involved and can also be concluded from their place in the power – interest grid.

Dedicated actors	Non-dedicated actors
Municipality	Consumers/citizens
Nuon	AEB Afval
Waternet	
WestpoortWarmte	

The critical actors; the Municipality and Nuon, can be denoted as dedicated actors. Waternet and WestpoortWarmte are also dedicated actors, because the possible ‘closing small ring’ project will be very attractive for them. Non-dedicated actors are the citizens, who are a kind of passive actors, and AEB Afval. The latter is just running a waste and energy company and there won’t be that much more profit in case of the closing of the small ring.

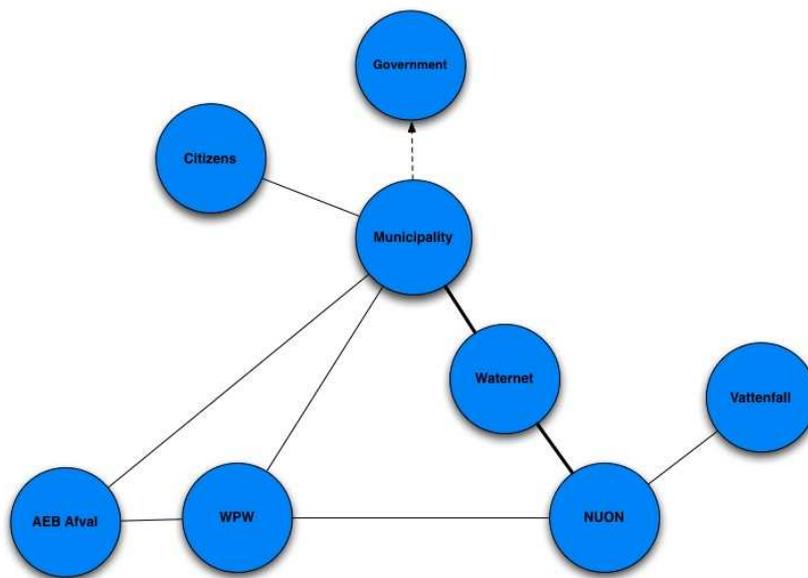
#### *Stakeholder map*

This stakeholder map will summarize the above-mentioned diagrams to obtain a clear view on the actor situations. In case of the non-dedicated actors it is very important to indicate who your potential rivals are. Dedicated and critical actors are the ones who could cause trouble or a conflict. Those are the ones you should probably actively

involved in the process and with whom negotiations should take place. Non-critical actors are most of the time 'subjects' and 'crowd' on the power vs. interest grid.

	Dedicated actors		Non-dedicated actors	
	Critical actors	Non-critical actors	Critical actors	Non-critical actors
<b>Actors with same perception, interests and goals</b>	Municipality Nuon	Waternet WestpoortWarmte		AEB Afval
<b>Actors with different perception, interest and goals</b>				Consumers/citizens

**ACTOR NETWORK**



Municipality - Government [TvdH1]

Government is a new introduced actor to the network and, in the hierarchy model, behind the Municipality of Amsterdam. The Municipality could, for instance, strategically turn to the government for tax incentives on dumping of waste heat. In case taxes are raised for the dumping of heat, actors such as Nuon and EAB afval are probably more than willing to cooperate in the process.

#### *Citizens - Municipality*

The citizens of Amsterdam are important actors in the actor network due to their blocking power. The Municipality maintains relations with the citizens.

#### *Vattenfall – Nuon*

Vattenfall is the main actor behind Nuon, having taken over Nuon in 2009. Vattenfall could have financial incentives and corporate strategies to influence Nuon's position in the process. Nuon has strategic resources in the process, such as their infrastructure and network in the Netherlands as well as financial resources. Vattenfall needs Nuon to be active in the process. Perhaps, in order for the Municipality to get Nuon to cooperate, the Municipality could determine a strategy in which Vattenfall's corporate strategies/perceptions and goals are also assessed.

#### *WPW*

What you see in the network model, is that Nuon has a direct relation with the Municipality of Amsterdam through the joint-venture of WestpoortWarmte. In case Nuon and the Municipality would not have been in this collaboration, their connection would be through Waternet. Therefore, WPW is an important collaborative model for these two actors. Waternet has the implementation power which is essential for the Municipality of Amsterdam to implement their policy. The Municipality of Amsterdam, Waternet and Nuon are the main actors in the problem definition of "Municipal policy vs. Corporate strategy".

Due to the fact that the Municipality maintains relations with different actors (Waternet, AEB Afval and Nuon), their chances for contested information becomes bigger. Though, through their position as an actor with different connections, the greater their position to influence the process. In fact, for the Municipality together with Waternet there are opportunities to include other actors or to connect with other networks when Nuon decides not to cooperate in the process. Because of Nuon's strategic resources, the Municipality and Waternet do want to keep Nuon in the process.

#### 1.1.1.1 Swot analysis of the strategy of future cooperation

Strength	Opportunities
<ul style="list-style-type: none"><li>- Small number of players encourages efficient communication.</li><li>- Win-win situation (profit for NUON and improved environment for governmental body).</li></ul>	<ul style="list-style-type: none"><li>- Potential profits for NUON from an integrated district heating system.</li><li>- Network effects (bigger network brings greater interest).</li></ul>
Weaknesses	Threats
<ul style="list-style-type: none"><li>- If one of the parties backs out of the plan, district heating in Amsterdam is done.</li></ul>	<ul style="list-style-type: none"><li>- EU law on tendering (a monopoly for NUON?)</li></ul>

#### 1.1.1.2 Conclusion of the strategy

First of all we steer two main actors in the process, Amsterdam and Nuon, towards a future cooperation and a more long-term vision.

Furthermore, we enlarge the shadow of the future. We forecast that the CO2 reduction program of the municipality will proceed, with or without Nuon. The train has left, and Nuon has to make sure they're on board before they miss that chance.

It should be noted that the chosen strategy is rather aggressive towards Nuon. This could lead to the desired result, but could also blow up the process.

#### 1.1.1.3 What if the strategy fails?

This strategy should only be applied when Nuon can be replaced by another actor, because there is some risk in this strategy. If it fails, it would mean that Amsterdam should look for another actor that can contribute to the closing of the small ring.

## Appendix B: Process analysis

### Actor specific Goals

For the process characterisation, the following hierarchical and network characterizations should be taken into account:

#### *Hierarchy*

In a hierarchy there is a leading actor at the top of the hierarchy and this actor steers its subordinates. The attraction of hierarchy models is that they reduce the complexity of intra-organizational or inter-organizational problems. In a hierarchy decision-making is a well-structured process.

There are several dubious assumptions about hierarchical models, in a hierarchy there is a kind of uniformity, the greater the differences between actors the more difficult to steer them, because what is beneficial for one actor may be a disaster of another actor. The greater the uniformity the greater will be the span of control of an intervening actor.

The second assumption is that a hierarchical model is a pyramid power structure with superiors and subordinates, not only for the formal structure but also in reality. The third assumption is that actors are open to interventions of a superior actor. All the actors are focused on, and receptive to the instructions of a superior actor. The fifth assumption is that a hierarchical structure is a reasonably stable structure. There is no space for organization units or organizations to be added or removed from the structure.

In summary can be stated that the following characteristics can be linked to the hierarchical structure:

- Uniformity
- Unilateral dependencies
- Openness/receptiveness to hierarchical signals
- Stability

However a hierarchy model is based on the assumptions mentioned that will hardly ever manifest themselves in reality (Bruijn & Heuvelhof, 2008).

In the Amsterdam case we do not detect a hierarchy model.

#### *Network*

Networks are characterized by the following terms:

- Variety
- Mutual dependencies
- Closedness to hierarchical signals
- Dynamic (Bruijn & Heuvelhof, 2008).

In the Amsterdam case there is a network model between the actors. In the following sections we will address the characteristics of the network model applied to the Amsterdam case. There is a significant variety between the actors in the network. Also can be noticed that most of the actors are not in the same sector which increase the variety even more. When considering the main actors, municipality of Amsterdam and Nuon, the variety is clear. There is a difference in the means of power (politic power versus investment power), in the organization structure (public versus private) and there are varieties of goals (public wellbeing versus profit).

These differences between the actors involved are very limited for the future intervention and could produce unforeseen effects. To handle huge variety often is referred to tailor-made interventions. Which simply means that the intervention need to be adapt to the different actors and their characteristics. Applications of these tailor-made interventions have limited possibilities.

There are several ways to manage this variety:

Higher chance of success with at least some of the parties

- Divide and rule
- Innovation
- Constructive ambiguity

### *Closedness*

Actors in networks tend to be characterized by closedness, in general they are not sensitive to external interventions. This can have some consequences on the effectiveness of any intervention from an actor in the network model.

#### **Some consequences of closedness:**

- Ineffective interventions
- Parties do not notice the intervention
- Parties ignore the intervention
- Parties resist the intervention
- Parties apparently comply with, but in reality evade the intervention
- Parties reinterpret and transform the intervention
- Parties avail themselves to every opportunity to evade the intervention (Bruijn & Heuvelhof, 2008).

In the Amsterdam case there is the actor Nuon who resist the intervention of the municipality of Amsterdam, the municipality wants to follow their strategy called “Warmtetenzij”, but Nuon has financial reasons for not wanting to build small ring in the district heating. The municipality has not the power to oblige Nuon to build the small ring.

### *Interdependence*

A third characteristic of networks is the presence of interdependence. This interdependence between actors can make a process very complex with a lot of difficulties to deal with. Risk of hit-and-run (ignoring repetitive character of the process), opaqueness (need to find out the position of other actors) and sluggishness. Poor substantive decision-making (grey compromises), incentive for moderate behaviour. Raising complexity means more possibility for exchangesubstantive enrichment (Bruijn & Heuvelhof, 2008).

There is a high interdependency between the critical actors in the Amsterdam case. Nuon and the Municipality are dependent on each other in the process of the “closing of the small ring”. Especially the Municipality is dependent on the funding resources and technical knowledge of Nuon. In case of the negotiations between Amsterdam and Nuon, there is a high opaqueness, since the position of Nuon in the process is very unclear to the Municipality of Amsterdamm, currently resulting in non-decision making.

### *Dynamics of the network*

Dynamics of the networkis characterized by the fact that the network is always in motion. Actors may enter or leave the process. In the Amsterdam case the dynamic of the network has currently turned

stable. A possible actor to enter the network would be public housing corporations, which would be an incentive for dynamic in the network.

### SWOT Analysis

#### Goals to “close the small ring”

Strengths	Opportunities
Efficient use of superfluous heat	Smooth future cooperation for potential future projects
Ability to use flexible heat sources	Passing of “Warmtewet”
Only 1 auxiliary heat plant needed	Integration of suppliers and users
Small stakeholder network involved	

Weaknesses	Threats
Stalinistic image	No guaranteed cooperation
Low return on investment	
High interdependency	

#### Future cooperation between Amsterdam and Nuon

Strengths	Opportunities
Efficient communication	Potential profits from integrated district heating system for NUON
Win-win situation	Network effects

Weaknesses	Threats
Dependency in order to succeed	EU law on tendering

Bruijn, H. d., & Heuvelhof, E. t. (2008). *Management in networks on multi-actor decision making*. London: Routledge.