

**SAFEGUARDING DRINKING WATER SECURITY IN 2030: Effectiveness of
drinking water policies on the Dutch industrial sector**

MSc Thesis

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August 2023, Enschede
Version 4

ABSTRACT

This thesis evaluates the effectiveness of drinking water policies on the Dutch industrial sector. At this time, the Dutch National Institute for Public Health and Environment and Dutch drinking water companies foresee several obstacles with the water availability for the preparation of drinking water up to 2030. In the upcoming years, the Netherlands' drinking water demand is anticipated to increase due to expected population expansion, economic growth, and climate change. Strong and effective policies are needed to decrease the demand of drinking water. Encouraging conscious and efficient use of water in the industry is one of the policies presented by the government to safeguard drinking water security in 2030. Considering the threat of drinking water shortage in the future, there is a need to evaluate the effectiveness of this policy.

By conducting qualitative research, it can be concluded that the policy of stimulating conscious and efficient drinking water usage leads to change in the water consumption of industrial companies in the Netherlands. The policy is partially effective in the way that the soft instruments triggers action towards reduction of drinking water consumption in the Dutch industrial sector. The campaigns of drinking water companies towards business have increased the awareness on the situation. In addition, drinking water companies are actively trying to create efficient and conscious drinking water usage among big-customers. However, due to drinking water being so cheap and there not being any clear targets for the industry to work towards, stricter regulations are needed to increase the effectiveness of the policy. An important remark is that efficient and conscious drinking water usage should not lead to substitution effects, because this also puts pressure on fresh water sources. The demand of water in general should be decreased by the industry in order to safeguard the drinking water security in 2030.

Key words: policy evaluation, drinking water security, drinking water policies

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1. INTRODUCTION

1.1 Context

When it comes to developing innovative and effective water management systems, the Netherlands is among one of the frontrunners. According to Pahl-Wostl (2019), the Netherlands has earned this success due to its hybrid governance system in managing water resources. A hybrid governance system exists when the three governance modes (markets, networks, and hierarchies) are equally represented and no mode predominates (Pahl-Wostl, 2019). This type of governance system is key to solve complicated water management issues and to encourage radical change (Pahl-Wostl, 2019). Despite being a country with a high population density and a significant portion of its land below sea level, the Netherlands has been able to avoid most water risks due to its extensive network of dikes, dams, and water management infrastructure (Government of the Netherlands, n.d.). However, the Netherlands is not immune to water-related challenges.

In recent years, the Netherlands has experienced long periods of drought, particularly during the summer months, which has led to decreased water levels in rivers and reservoirs. This has caused concerns among the Dutch National Institute for Public Health and Environment (RIVM) and Dutch drinking water companies regarding drinking water security. Both parties have emphasised that they foresee several obstacles with the water availability for the preparation of drinking water at the moment and in the near future (the year 2030). There is currently sufficient water available in the Netherlands to meet the national drinking water demand, but regionally and depending on the season, water shortages can still occur (RIVM, 2023). Especially during warm and dry months, the drinking water demand may be significantly higher than usual. For example, in 2021, Jelle Hannema, the chairman of the executive board of Vitens¹, warned the Province of Overijssel that the security of drinking water supply was under high pressure (Hannema, 2021). Due to the dry and hot summers, the demand for drinking water was rising extremely. Hannema (2021) stated that Vitens had never supplied so much drinking water as it had done in 2018, 2019, and 2020. Vitens was even forced to exceed several permits in order to produce enough drinking water (Hannema, 2021). Exceeding water withdrawal permits can lead to a decrease in water reserves as well as to reduced groundwater levels, which causes damage to the ecosystems (Uhl et al., 2022). The issue of inadequate water reserves is that there may not be enough water to respond to unexpected demand developments during the year, but also in the long-term if the demand increases (RIVM, 2023). According to Hannema (2021), this may jeopardize the water supply to households in the future.

In the upcoming years, the Netherlands' need for drinking water is anticipated to increase. This is partially a result of expected population expansion, economic growth, and climate change (RIVM, 2023). An inventory of existing and future water availability for the production of drinking water has been prepared (up to 2030) to assess whether the increasing demand for drinking water can be fulfilled. In comparison to 2020, it is expected that an additional 100 million cubic metres of drinking water would need to be generated in 2030 to meet the future demand (RIVM, 2023).

¹ Vitens is the biggest drinking water company in the Netherlands. It produces more than 360 billion litres of drinking water annually and supplies to 5.8 million consumers in five provinces: Gelderland, Overijssel, Friesland, Utrecht, and Flevoland (Vitens, n.d.).

A reliable supply of drinking water is crucial for the public's health, prosperity, and well-being (Ministry of Infrastructure and Water Management, 2021). In 2011, the Dutch government introduced the Drinking Water Act to guarantee the quality and consistency of the drinking water supply as best as possible, while also meeting the requirements for the sustainable growth of the society and doing so at prices that are within the realm of socially acceptable expenses (van Geel, 2006). Since the introduction of the Drinking Water Act, two policy notes on drinking water were published. The aim of these policy notes was to respond to new developments and to adjust or implement policies accordingly.

In drinking water use, a distinction is often made between two types of users: households and business users. Approximately 70 percent of the total drinking water consumption is accounted for by households. The remaining 30 percent is delivered to business users (Ministry of Infrastructure and Water Management, 2021). The government and drinking water companies are stimulating conscious and efficient use of drinking water to decrease drinking water demand. However, the options for using drinking water more efficiently vary per type of use (household use or business use). According to UNESCO (2022), the industrial sector has a strong potential for mitigating the pressure on drinking water sources. The industrial sector is a significant user of water for purposes other than domestic use. In many cases, the use of drinking water in industrial processes can be substituted for water of lesser quality. Additionally, there is a greater opportunity for circular use of water in the industry. Encouraging these changes could contribute to ensuring drinking water security in 2030.

1.2 Problem statement

Dutch drinking water companies must provide sufficient drinking water of good quality, now and in the future. That is the delivery obligation enshrined in the Drinking Water Act. On the other hand, the government has a duty of care: it must create and maintain the conditions for the sustainable safeguarding of the public drinking water supply (Vewin, 2022). However, it is unsure whether there will be enough water available in 2030 to produce drinking water. Strong and effective policies are needed to decrease the water demand. Encouraging conscious and efficient use of drinking water in the industry is one of the policies presented by the government to safeguard drinking water security in 2030. Considering the threat of drinking water shortage in the future, there is a need to evaluate the effectiveness of policies. Hence, the main research question of this study will be: *“How effective are drinking water policies in reducing drinking water consumption of the Dutch industrial sector?”*

1.3 Research objective

The aim of this research is to evaluate the effectiveness of drinking water policies to reduce drinking water consumption of the Dutch industrial sector. A policy evaluation is a critical process that examines the effectiveness of a particular policy or set of policies in achieving their intended objectives. The implications and contributions of a policy evaluation can be significant, as they can inform policymakers and stakeholders about the strengths and weaknesses of the policy and provide recommendations for improvement (Bressers & Hoogerwerf, 1995). Another significant contribution of a policy evaluation is that it can generate new knowledge and understanding of the policy area under investigation. By examining the effects of the policy on various stakeholders and the broader society, the evaluation can shed light on the complex interplay between policy implementation, social

dynamics and the achievement of policy objectives. This new knowledge can inspire future policy development, academic research, and public discourse (Arentsen, 1995).

1.4 Social relevance

In recent decades, it has become apparent that due to ever-growing demand, water scarcity is posing a threat to the sustainable development of human society. The key factors influencing the rising demand for water are population growth, expanding irrigated agriculture, changing consumption patterns, improved living standards, and climate change (Gosling & Arnell, 2016; Mekonnen & Hoekstra, 2016). Tzanakakis et al. (2020, p.1) define *water scarcity* as “the lack of fresh water resources to meet water demand”. Water scarcity can have serious consequences for human health, economic development, and environmental sustainability (Kummu et al., 2016). For example, it threatens to achieve Sustainable Development Goal 6 (SDG 6), which is to ensure the availability and sustainable management of water and sanitation for all by 2030. SDG 6 is a global target set by the United Nations (UN) as part of the 17 Sustainable Development Goals (SDGs) adopted in 2015 (United Nations, 2016). However, in 2018 the United Nations already concluded that reaching SDG 6 by 2030 would be unlikely, despite progress being made. The accomplishment of other SDGs’ objectives, such as SDG 2 (‘Zero Hunger’) and SDG 14 (‘Life Below Water’), may likewise be jeopardised if SDG 6 is not met (Küfeoglu, 2022). Sadoff et al. (2020) state that to achieve SDG 6, there needs to be a common understanding that clean water is not an infinite resource that is free for the taking. In order to protect and develop sustainable water resources, as well as to utilise water efficiently and fairly, there must be an increase in research, ingenuity, and innovation.

2. METHODOLOGY

2.1 Methodological approach

This research aimed to evaluate the effectiveness of drinking water policies to reduce drinking water consumption of the Dutch industrial sector. The type of research is therefore evaluation research, which seeks to determine whether actions, such as government interventions (programs, policies, or projects) caused the desired effect or not (Sulkunen, 2008; Vedung, 2006). A qualitative methods approach has been used to conduct this research. The advantage of conducting qualitative rather than quantitative research in this study is that it enables a deeper exploration of the subject (Lakshman et al., 2000). A qualitative approach aims to explain the “how”, “what”, or “why”, while a quantitative approach seeks to answer the “how often” (Lakshman et al., 2000). A qualitative method was therefore more appropriate for this research than a quantitative one. In qualitative research methods, textual data obtained from discourse or observation is systematically gathered, organised, and interpreted (Malterud, 2001).

2.2 Steps in policy evaluation

A policy is the pursuit of certain objectives with certain means and a certain time span (Hoogerwerf, 1989). Bressers (1989) defines policy evaluation as the evaluations of the content, processes or effects of the policy. In policy evaluation research, it is not only about determining the effects of the policy, but also to explain it. Research into the effectiveness of a policy tests the assumption that a certain goal has been achieved as a result of pursuing a certain policy or applying a certain means (Bressers & Hoogerwerf, 1995). There are four steps in evaluating the effectiveness of a policy (Bressers, 1989):

1. The systematic description of the policy content in relation to the policy field
2. Determining the extent to which the set criteria are met
3. Determining the contribution of the policy to the goal achievement
4. Explain the effectiveness of the policy

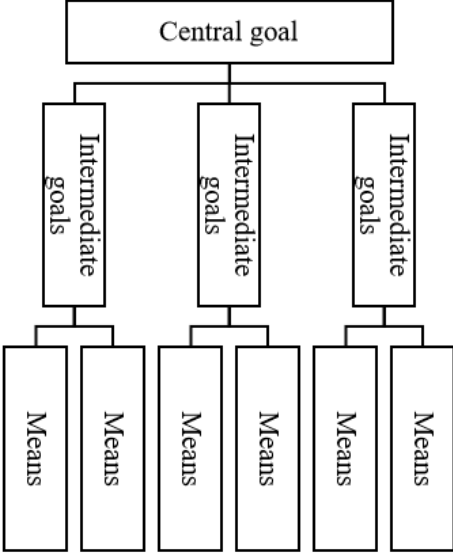
2.2.1 *The policy and the policy field*

Providing a systematic description of the policy content in relation to the policy field consists of two aspects: (1) it should account for what the policy looks like, and (2) it should assess the effects of the policy on the policy field (Bressers & Hoogerwerf, 1995). Each policy focuses on a specific policy field, i.e. a specific sector of society. The content of a policy should be analysed by using a model of the relevant policy field. This model can function as a kind of map on which the objectives and means of the policy can be noted. The objectives of the policy can be described in terms of elements of the policy field. This forms the basis of a policy analysis (Bressers & Hoogerwerf, 1995).

In order to analyse a policy, one must systematically arrange and present it using a certain methodology. By doing this, one builds upon the distinguishable policy components and elements (Coenen & Lulofs, n.d.). A model that shows the relationships between a policy's goals and means is known as a ‘policy tree’, ‘goal tree’ or ‘goal-means tree’. This model contains three layers: the top of the tree represents the ultimate goal, the second tier depicts the intermediate goals, and the bottom of the tree indicates the means (Coenen & Lulofs, n.d.). The three layers have been visualised in Figure 1. To analyse the policy field a causal field model

can be used. By thinking in terms of causes and consequences, structure is brought to the relationship between the instruments and the policy field (Bressers & Klok, 1989).

Figure 1
Visualisation of a policy tree



2.2.2 Determining the achievement of criteria

The main question in this step is to what extent certain objectives have been achieved (Bressers, 1989). The most straightforward method of determining goal attainment involves directly comparing the actual situation of the policy field to the stated policy objectives (Lulofs, 1995). This step contains two parts; (1) the criteria must be made into measurable indicators, and (2) the required data must be collected (Bressers, 1989). The criteria that will be used to evaluate policy objectives must be carefully considered. In the first place, because the official objectives from the policy programme are sometimes not defined in quantifiable terms or are instead vaguely formulated, it is frequently impossible to assess goal attainment on the basis of these objectives (Lulofs, 1995). Also, it is not always obvious what time frame the intended impacts are aiming for (Lulofs, 1995). If the goals are not too ambiguous, there is some guidance for the policy evaluation based on direction such as an increase or a decrease (Lulofs, 1995).

2.2.3 Determining the contribution of the policy

According to Coenen (1995), the level of objective attainment (step 2) indicates nothing about how well the policy is working. The degree to which a certain policy aids in the accomplishment of specific objectives is referred to as its effectiveness. A policy is only effective to the extent that it contributes to the degree of goal attainment (Coenen, 1995). An important aspect in this step is causality. Determining the contribution of the policy to the goal attainment can be done by using qualitative methods as well as quantitative methods. Quantitative research designs mainly focus on a (quasi-)experimental research design that focus on the period before the policy intervention and after the intervention, using qualitative indicators (Coenen, 1995). Qualitative methods are particularly suitable for discovering

relationships and enriching the foundation for developing a theory (Bressers & Herweijer, 1995).

2.2.4 Explaining the effectiveness of the policy

However, the policy implementation is not the only factor that determines how effective a policy is. The ultimate determining element is whether the constituents of the implemented policy's target group react to the implemented instruments of the policy in the desired way (Maarse, 1995). In addition, it also seeks to understand whether policy instruments have been applied properly and how contribution of the policy to the objectives can be increased (Bressers, 1989). Policy implementation is a process that involves many different actors. These can be divided into three categories: (1) executive actors, (2) policy subjects, and (3) other actors (Maarse, 1995).

2.3 Research questions

The main research question is:

“How effective are drinking water policies in reducing drinking water consumption of the Dutch industrial sector?”

Based on the literature of steps that need to be taken to conduct policy evaluation research, the following sub-questions have been formulated to answer the main question:

1. What are the drinking water policies aimed at the Dutch industrial sector?
2. To what extent are the set policy objectives met?
3. To what extent do the policies contribute to achieving the set policy objectives?
4. Have the policy instruments been applied properly and how can contribution of the policy to the objectives be increased?

2.4 Data collection

This study has employed a qualitative approach to collect data. The study has used both primary data as secondary data. Primary data refers to data that is gathered specifically for a particular research objective, whereas secondary data refers to data that was initially collected by other researchers for a different purpose and is being reused for another research question (Hox & Boeije, 2005). Table 1 presents the method of data collection per sub-question.

Table 1

Data collection method per sub-question

Research question	Type of question	Data collection method
Sub-question 1	Descriptive	Secondary data: <ul style="list-style-type: none"> ▪ Dutch government reports
Sub-question 2	Descriptive	Secondary data: <ul style="list-style-type: none"> ▪ Database CBS ▪ Dutch government documents
Sub-question 3	Explanatory	Primary data:

		<ul style="list-style-type: none"> ▪ Semi-structured individual in-depth interviews
Sub-question 4	Prescriptive	Primary data: <ul style="list-style-type: none"> ▪ Semi-structured individual in-depth interviews

Sub-question 1 has been answered by using secondary data. The main source of data for this question was collected by Dutch government reports. These reports all focused on the Drinking Water Act, policy note on drinking water 2014, evaluation of the policy note 2014, or policy note on drinking water 2021-2026. Sub-question 2 has been answered by secondary data. Statistics from the Central Statistical Office (CBS) on drinking water consumption have been used to determine the achievement of the policy objectives. Sub-question 3 and sub-question 4 have both been answered by primary data collected through interviews.

For this research, primary data has been collected through semi-structured individual in-depth interviews. This type of interview is often framed around a series of pre-established open-ended questions, with additional questions developing from the conversation between the interviewee and interviewer (DiCicco-Bloom & Crabtree, 2006). By doing the interview one-on-one, the interviewer is given the chance to explore deeper into societal and personal themes (DiCicco-Bloom & Crabtree, 2006).

Interviews have been held with two types of stakeholders: Dutch industrial companies and Dutch drinking water companies. Insights from the industrial companies were needed to explain whether the policy objectives have been achieved and to what extent the policies contributed to reaching the objectives. Drinking water companies were interviewed to get their perspective on whether the policies contribute to achieving the objectives and whether the policies are effective. Unfortunately, it was challenging to get interviewees. Eventually, four employees from industrial companies and two employees from drinking water companies were interviewed. Table 2 presents a more specific description of the interviewees of industrial companies. A more detailed description of the interviewees of drinking water companies is given in Table 3.

Table 2

Overview interviewees industrial companies

Interview no.	Function	Sector	Dependent on water²
1	SHEQ Coordinator	Waste processing/ biomass production	Yes
2	Sustainability Manager	Beverage industry	Yes
3	Competence Manager	Machine industry	No
4	Sustainability Coordinator	Electrotechnical industry	Yes

² Without water supply this company can not continue with their activities

Table 3
Overview interviewees drinking water companies

Interview no.	Function	Critical region³
5	Policy advisor drinking water	No
6	Policy advisor drinking water	No
7	Policy advisor drinking water (1), and Market and Innovation Manager (2)	Yes

2.5 Data analysis

A policy tree as well as a causal field model have been created to analyse the data gathered in sub-question 1. The data collected from semi-structured in-depth interviews required careful analysis to identify key themes and patterns. The first step of analysing this data was to transcribe the interviews into written text. Once transcribed, the data has been reviewed through a process called ‘coding’, which involves assigning labels of categories to different sections of the text based on their content (Vollstedt & Rezat, 2019). There are three phases for coding: (1) open coding, (2) axial coding, and (3) selective coding. However, these three phases do not have to be followed in a strict sequence. Coding is an iterative process in which the researcher can move back and forth between phases (Vollstedt & Rezat, 2019). Based on the labels of the coding, the results section was written.

2.6 Research ethics

This research was carried out based on the requirements of the Ethics Committee of the faculty Behavioural, Management, and Social Sciences of the University of Twente. Human participants were involved in a direct manner through interviews. Before the interview, the participants were informed about the research and the goal of the interview by e-mail. At the start of the interview, the participants were once again reminded about the research and the goal of the interview. They were also informed about their rights as a participants (e.g. stopping the interview at any point without having to give an explanation). The participants were asked whether the interviewer was allowed to record the session for transcription purposes, and were informed that recordings would be deleted before the 1st of September 2023. The participants gave oral consent to being recorded. At last, before the interview started, the participants were asked if they had any questions for the interviewer. The two interview scripts that have been used can be found in Appendix A.

³ A drinking water company that is located in a region where there is an immediate problem with safeguarding the drinking water supply

3. RESULTS

3.1 Policy Analysis

This section will focus on answering sub-question 1: “*What are the drinking water policies aimed at the Dutch industrial sector?*” First, a brief history of the development of drinking water supply in the Netherlands is provided in paragraph 3.1.1. Following that, the Dutch Drinking Water Act will be explained in paragraph 3.1.2. The progress that has been made regarding this act is further elaborated upon in paragraph 3.1.3 and paragraph 3.1.4. In paragraph 3.1.5 it is described how the drinking water policies target the Dutch industrial sector. At last, a policy tree in paragraph 3.1.6 and causal field model in paragraph 3.1.7 are presented to visualise the drinking water policies and how they are aimed at the Dutch industrial sector.

3.1.1 History of drinking water supply in the Netherlands

The Netherlands saw the installation of the first water tap in 1853 (Vewin, 2016). Nevertheless, it was not until around 1900 that the water supply through pipelines really took off, as did the number of water supply companies (Vewin, 2016). According to Cals (1996), there were two events that undeniably accelerated the water supply through pipelines. The yearly Dutch conferences for Public Health Regulations, where mostly doctors positioned themselves as the leading advocate for a central water supply, served as one strong incentive. The purpose of these conferences was to exert political pressure on the government to take action (Cals, 1996). For instance, during the second congress in 1897, the standards for what constitutes as an acceptable drinking water supply were established. These standards concerned the sources, the quality of the water, the pressure at which delivery was required, and the quantity to be provided (Cals, 1996). The constant insistence was successful since the government introduced legislation in 1901 (the Housing Act and Health Act) and established the ‘State Commission on Drinking Water Supply’ in 1910 (Cals, 1996). The other incentive was the founding of the ‘Association for Water Supply Interests in the Netherlands’ (VWN) on January 15, 1899. This association sought to become the focal point for everything concerning water supply in the Netherlands. The number of water supply companies increased significantly as a result of the government’s influence and that of the VWN specialists (Cals, 1996). Even though the vast majority of companies were privately held, there were also several municipalities which collaborated to establish a water supply company. The role of the provinces focused on stimulating municipal and private initiatives (Vewin, 2016).

In the beginning of tap water supply, there was no guarantee of a certain quality, and there were no laws or regulations dictating how reliable the water should be or how it should be monitored (Vewin, 2016). However, with the organisation of the water supply sector in order as a result of VWN, there was also enough backing to pass the Water Supply Act (Cals, 1996). Between 1920 and 1930, provincial water supply regulations were created to ensure the quality of the drinking water in all provinces. From the beginning of the 20th century, government involvement in the quality and availability of tap water increased, but it was not until 1957 that the Water Supply Act was enacted. Since then, the Dutch national government and the European Union have become increasingly involved in tap water and its supply through legislation and regulations (Vewin, 2016). Cals (1996) argues that the Netherlands has been successful in meeting the needs of the public health by offering reliable drinking water at the lowest possible price. The VWN’s open structure and the central government’s encouraging, but non-coercive, involvement were key success factors in realising the drinking water supply (Cals, 1996).

Since the instalment of the Water Supply Act, the law was amended on a number of points, most recently in 2004. The organisation of the water supply had become more controlled as a result of these changes. The final piece of 2004 legislation included a clause that forbade the privatisation of drinking water suppliers (Vewin, 2009). This led to a decline in the number of water supply companies (Cals, 1996). The number of water supply companies had reached its peak around 1940 with 225 water suppliers (Cals, 1996). Currently, 10 drinking water companies supply the whole of the Netherlands with water (Geudens & Kramer, 2022). However, decision-makers thought that the Water Supply Act's changes would not be sufficient. The necessity for a completely new legislation was primarily brought on by the drastically altered dynamic between the public sector and the drinking water supply sector, as well as the already anticipated strengthening and expansion of the role of the public water supply (Vewin, 2009). As a result, the Water Supply Act was replaced by the Dutch Drinking Water Act on 1 July 2011 (Vewin, 2016).

3.1.2. The Dutch Drinking Water Act

The main goal of the Dutch Drinking Water act is to establish water supply security that is sustainable and benefits society's health, wealth, and well-being (van Geel, 2006). In other words, the act is meant to guarantee the quality and consistency of the water supply as best as possible, while also meeting the requirements for the sustainable growth of the society and doing so at prices that are within the realm of socially acceptable expenses (van Geel, 2006). It is regarded as the primary task of the water companies to guarantee that users receive reliable water while reducing uncertainties at various stages of the production process, from raw materials to end product. In addition to exercising supervision, the role of the Dutch national government is mainly one of creating conditions and setting a framework for the public drinking water supply (van Geel, 2006). The act emphasises that the drinking water supply is regarded as an important part of the vital infrastructure in the Netherlands. After all, drinking water is a primary necessity of life for humans. If this vital infrastructure were to fail, it can cause social disruption (van Geel, 2006). Therefore, the protection of the drinking water supply aims to avoid discontinuity and covers defence against technical-organisational failure, overload and external natural events, or unintentional and intentional human behaviour (van Geel, 2006). The way in which drinking water companies guarantee security of supply and continuity must be verifiable, in particular for the Dutch Human Environment and Transport Inspectorate charged with supervising the drinking water companies. Thereby, a drinking water company must have a supply plan (van Geel, 2006). In addition, a periodic (every six years) policy note will be published on the public drinking water supply with the main lines of government policy on the production and distribution of drinking water (Vewin, 2009). The establishment of the Dutch Drinking Water Act was also highly influenced by the European Drinking Water Directive, and is also closely linked to the European Water Framework Directive and the Dutch Environmental Protection Act (Phernambucq et al., 2019).

The government and the drinking water companies are the sole parties accountable for following the drinking water act. There are no obligations mentioned for businesses or households to contribute to a sustainable water supply.

3.1.3 Policy note drinking water 2014

The first policy note on the public drinking water supply was already established in 2014, which is three years earlier than the periodic timing of six years that was agreed upon. The

reason why this document was published in advance was because the topic deserved more attention according to the Ministry of Infrastructure and Environment (this ministry is now known as Ministry of Infrastructure and Water Management). While the quality of drinking water was still considered very good, the quality of the sources were under pressure. This motivated the ministry to further develop this policy together with provinces, municipalities, water boards, and drinking water companies (Ministry of Infrastructure and Environment, 2014).

The quality of the sources to produce drinking water has been decreasing due to pollution (e.g. increasing concentration of chemicals in groundwater and surface water), climate change, and competing activities in the subsurface (e.g. thermal energy storage). This necessitates continuous efforts to conserve (drinking) water, as well as further attention to the conservation of drinking water sources in light of a potential future rise in drinking water demand. Both are relevant because it is anticipated that water – and hence drinking water – will become more significant in geopolitics in the following years (Ministry of Infrastructure and Environment, 2014).

The objective of this policy note is the same as the objective of the Drinking Water Act: the sustainable safeguarding of the public drinking water supply. However, to achieve this objective, the following seven subgoals were determined (Ministry of Infrastructure and Environment, 2014, p.17):

1. Sufficient water of good quality for now and in the future (or at least until 2040);
2. Good drinking water quality – quality assurance through risk management and innovation;
3. Maintaining the good condition of the drinking water infrastructure;
4. Increasing the resilience of vital drinking water infrastructure;
5. Continued attention to consumer confidence;
6. Access to sufficient and clean drinking water;
7. Strengthening the international position of drinking water companies.

These goals concern not just the drinking water companies, but also other stakeholders. Subgoal 2 entails that it is crucial that new methods for producing drinking water are developed in order to ensure the long-term security of the industrial and drinking water supplies. The responsibility for this lies primarily with the industry. Numerous beneficial technological advancements have been made as a result of the desire for high quality drinking water. The industry is being encouraged to invest in innovative (technological) solutions that are aimed at limiting negative side effects (e.g. reuse of residual materials), water savings and reducing costs (Ministry of Infrastructure and Environment, 2014). In addition, there is more focus on international collaboration. Subgoal 7 aims to strengthen the international position of Dutch drinking water companies by involving the industry more closely. According to the ministry, this offers the opportunity to combine international cooperation with boosting employment and economic stability of the Dutch drinking water sector (Ministry of Infrastructure and Environment, 2014).

At the end of 2019, the Ministry of Infrastructure and Water Management (formerly known as the Ministry of Infrastructure and Environment) published a report in which the objectives of the policy note of 2014 were evaluated. The reason for this report was to prepare for determining the new policy note of 2020. To gain insights into the effectiveness and strength of the policies of 2014, a survey was distributed among different stakeholders. The stakeholders were divided into three groups. Group 1 represented 4 governmental organisations: the Ministry of Infrastructure and Water Management, the Inspection of Living Environment and Transport, RIVM, and Rijkswaterstaat. The 12 provinces constituted the second group. The third group

was made up of the 10 drinking water companies and its brand organisation Vewin (Phernambucq et al., 2019). The stakeholders were asked to score the 20 subgoals of the 7 objectives on both effectiveness and strength from 1 (negative) until 5 (positive). However, not every stakeholder from each group had scored every subgoal. While the response rate of group 1 was an average of 57.5% per subgoal, group 2 had an average of 34.5% and group 3 an average of 32.3%. It is also remarkable that group 1 scored effectiveness and strength of the subgoals higher on average compared to the other two groups. When it comes to effectiveness of the policies, group 1 scored 4.92/5 on average, whereas group 2 scored 4.18/5 and group 3 scored 4.11/5. Regarding strength of the policies, group 1 scored 4.87/5 on average, group 2 scored 3.73/5 and group 3 scored 3.97/5. This indicates that the governmental organisations of group 1 are more positive concerning the effectiveness and strength of the policies compared to the provinces and the drinking water companies including Vewin.

Phernambucq et al. (2019) concluded that the drinking water supply in the Netherlands was still secure. The objectives of the policy note of 2014 were regarded as strong and effective. Nevertheless, according to Phernambucq et al. (2014), the drinking water policy area had only limited influence on the most important goal of the policy note: subgoal 1 “Sufficient water of good quality for now and in the future”. The outcome of the survey showed that this objective had received the lowest score on strength (average of 3.7/5) and effectiveness (average of 4.1/5). Group 2 and group 3 were particularly negative towards effectiveness and strength of this policy objective and its subgoals. The respondents claim that there are not enough concrete measures in the policy note of 2014, hence more are needed for this subgoal. In the coming policy note of 2020 there is a need for action in which measures are expressed in concrete and specific steps (Phernambucq et al., 2014). In addition, the survey shows that there can be major regional differences in the tasks that provinces and water companies have with regard to drinking water. This is related to the drinking water source, land use (e.g. industry or agriculture), water supply options, and the proximity of the coast. The regional differences can lead to differences in involvement in the policy note of 2014 and differences in needs for the policy note of 2020 (Phernambucq et al., 2014). What stands out is that the respondents emphasise that attention to water demand is still missing from the current policy of 2014. The new strategy should not only focus on extractions and reserves, but also include limiting the water demand through water-saving measures. One of the respondents comments that consideration should be given to whether any rising water demand should be facilitated and that attention should also be made to saving and reusing water. These comments have led to three new focus points for the new policy note: (1) limiting the demand for drinking water by reducing water consumption (by households, companies, and in production), (2) limit the demand for drinking water by using water of a different quality where possible, and (3) research and/or use of other drinking water sources (Phernambucq et al., 2014). Once again, it is emphasised by the respondents that actual actions in the implementation must be taken in order to accomplish that water conservation and alternate sources become prevalent. For this it is necessary that laws and regulations lead to a more mandatory nature of such measures (Phernambucq et al., 2014). The other objectives (2 until 7) received a sufficient score, which means an average score between 4.0 and 5.0, on both strength and effectiveness, and have therefore received less attention in the evaluation report. Finally, Phernambucq et al. (2014) recommend that the ownership and scope of the policy note on drinking water 2020 should be clearly formulated. Also, goals and measures should be formulated specifically and measurably, in which the number of goals should be combined to keep the policy note compact and clear.

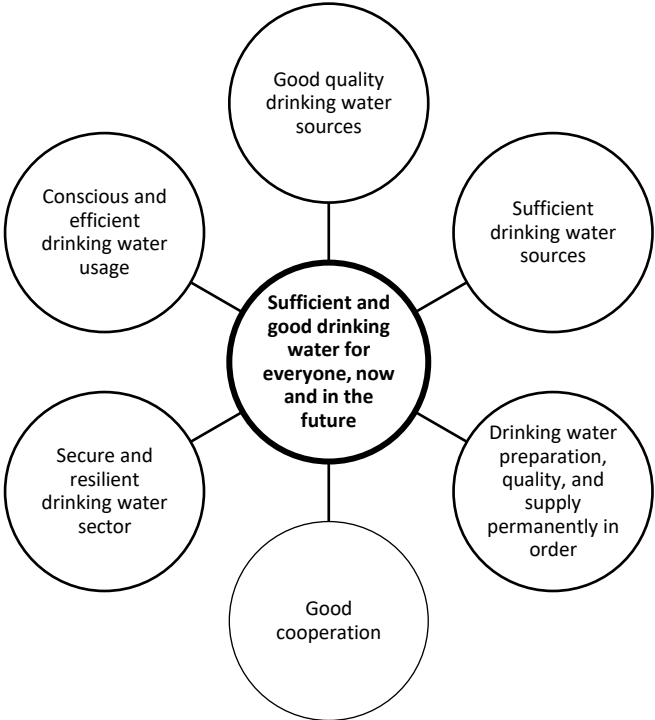
3.1.4 Policy note drinking water 2021-2026

In 2021, one year later than planned, the Ministry of Infrastructure and Water Management published the policy note on drinking water 2021-2026. In this policy note it is once again highlighted that drinking water is a necessity of life. Long-term drinking water security will have a significant positive impact on public health, national security, and welfare (Ministry of Infrastructure and Water Management, 2021). The main objective of the drinking water policy has changed compared to the policy note of 2014 and the Drinking Water Act. The Ministry of Infrastructure and Water Management (2021) describe the current objective as “sufficient drinking water of good quality, for everyone in European and Caribbean Netherlands, now and in the future” (p. 4). The establishment of this policy note was influenced by the revised European Drinking Water Directive of 2020, and the evaluation of the policy note on drinking water 2014 (Ministry of Infrastructure and Water Management, 2021). As a result, the policy note on drinking water 2021-2026 is putting more focus on the following three aspects: (1) water availability and efficient and conscious use of drinking water, (2) improving quality of surface- and groundwater, and (3) securing safe production and supply (Ministry of Infrastructure and Water Management, 2021).

This policy note addresses several water-related challenges that had also been identified in the policy note of 2014. Once again attention has been drawn to the quality of drinking water sources, which is under increasing pressure. Climate change, with higher temperatures and periods of lower river discharge, increases the risks for the quality of sources. In addition, emerging substances, medicine residues and micro-organisms have a negative impact on the quality of sources. In 2020, the outcome of the National Water Quality Analysis showed that without additional measures in the Netherlands, the European water quality targets for drinking water sources will not be achieved (Ministry of Infrastructure and Water Management, 2021). Another challenge that is being addressed is the sustainable security of drinking water sources and infrastructure. The government and drinking water companies have a difficult task in designating new location for drinking water extraction to meet future drinking water demand. Space is scarce and the pressure on the soil and subsurface is increasing, partly as a result of the housing challenge and the energy transition (Ministry of Infrastructure and Water Management, 2021). The usage and preservation of drinking water sources in the soil and subsurface in connection to other uses must always be carefully taken into account. The initial step is that more account is taken of the availability of water when allocating functions to areas. In doing so, the emphasis is on efficient usage, improved retention, and smarter distribution of water across multiple water-demanding functions, including the delivery of drinking water (Ministry of Infrastructure and Water Management, 2021). These challenges have an impact on the drinking water security. The demand of drinking water is increasing, while the availability of water is decreasing.

To ensure sufficient drinking water of good quality, for everyone in European and Caribbean Netherlands, now and in the future, the policy note of 2021-2026 has introduced six subgoals. These subgoals are presented in Figure 2.

Figure 2
Policy objectives of the policy note on drinking water of 2021-2026



Adapted from "*Beleidsnota drinkwater 2021-2026: Samen werken aan een toekomstbestendige drinkwatervoorziening*", by Ministry of Infrastructure and Water Management, 2021 (<https://www.helpdeskwater.nl/publish/pages/189498/beleidsnota-drinkwater-2021-2026.pdf>).

In comparison to the policy note of 2014, the policy note of 2021-2026 has six subgoals instead of seven. One of the recommendations provided in the evaluation of the policy note of 2014 was that the number of goals should be combined to keep the new policy note compact and clear. However, by including the main objective, the policy note of 2021-2026 still has 7 goals. Nevertheless, there are differences between the subgoals of 2014 and the subgoals of 2021. A comparison of the objectives in both policy notes is presented in Table 4.

Table 4
Comparison of the objectives in policy note 2014 and policy note 2021-2026

Policy note of 2014	Policy note of 2021-2026
1. Sufficient water of good quality for now and in the future	This subgoal is represented again in the policy note of 2021-2026 as the main objective (see circle in the middle). It can also be linked to the subgoal “good quality of drinking water sources” since the policy note of 2014 also addresses safeguarding the quality of drinking water sources. Also, it connects to the subgoal “sufficient drinking

	water sources” because the policy note of 2014 describes the importance of the availability of sufficient groundwater for drinking water extraction, now and in the future (Ministry of Infrastructure and Water Management, 2021).
2. Good drinking water quality – quality assurance through risk management and innovation	Good drinking water quality is brought back in the subgoal of “drinking water preparation, quality, and supply permanently in order”. In terms of quality, this subgoal aims to comply to the quality requirements of drinking water as is determined in the revised European Drinking Water Directive of 2020. It also includes quality assurance through risk management. Stimulating innovation can be found in another subgoal, namely “conscious and efficient drinking water usage”. However, in this context, stimulating innovation is more focused on implementing water-saving measures and not directly on quality assurance.
3. Maintaining the good condition of the drinking water infrastructure	Safeguarding the drinking water infrastructure is part of the subgoal “drinking water preparation, quality, and supply in order”. This goal emphasises that security of the drinking water infrastructure is an important condition for guaranteeing the quality and security of supply of drinking water (Ministry of Infrastructure and Water Management, 2021).
4. Increasing the resilience of vital drinking water infrastructure	This subgoal has also been represented in the policy note of 2021-2026. The name of the subgoal has changed to “secure and resilient drinking water sector” although the objective’s subject matter remains the same.
5. Continued attention to consumer confidence	This subgoal is not highlighted as much in the policy note of 2021-2026. In the subgoal of “drinking water preparation, quality, and supply permanently in order” it is briefly described that continued attention to consumer confidence is crucial.
6. Access to sufficient and clean drinking water	This subgoal is about international collaboration in which the Dutch drinking water companies contribute to sufficient and clean drinking water worldwide. In the policy note of 2021-2026, international collaboration has become part of the subgoal “good cooperation”. A part of this subgoal focuses on the Netherlands having international collaboration to create access to

	drinking water and sanitation for all by 2030 (as part of SDG6).
7. Strengthening the international position of drinking water companies	This subgoal has somewhat been integrated in the policy note 2021-2026 as part of the subgoal “good cooperation”. The focus is not so much on strengthening the international position of Dutch drinking water companies, but more on improving cooperation of the international drinking water sector.

By comparing the objectives of the two policy notes, it has become clear that the most recent note has put more focus on drinking water sources. There are now two separate goals that aim to protect the quality (1) and the sufficiency (2) of drinking water sources. Three out of the seven subgoals of 2014 have been combined to one subgoal in 2021: “drinking water preparation, quality, and supply permanently in order”. Creating a secure and resilient drinking water sector is a subgoal in both the policy notes. Subgoal 6 and subgoal 7 of 2014 are integrated in one subgoal of 2021: “good cooperation”. What stands out is that the subgoal “conscious and efficient drinking water usage” of 2021 is not significantly present in the subgoals of 2014.

3.1.5 Drinking water policies and the industrial sector

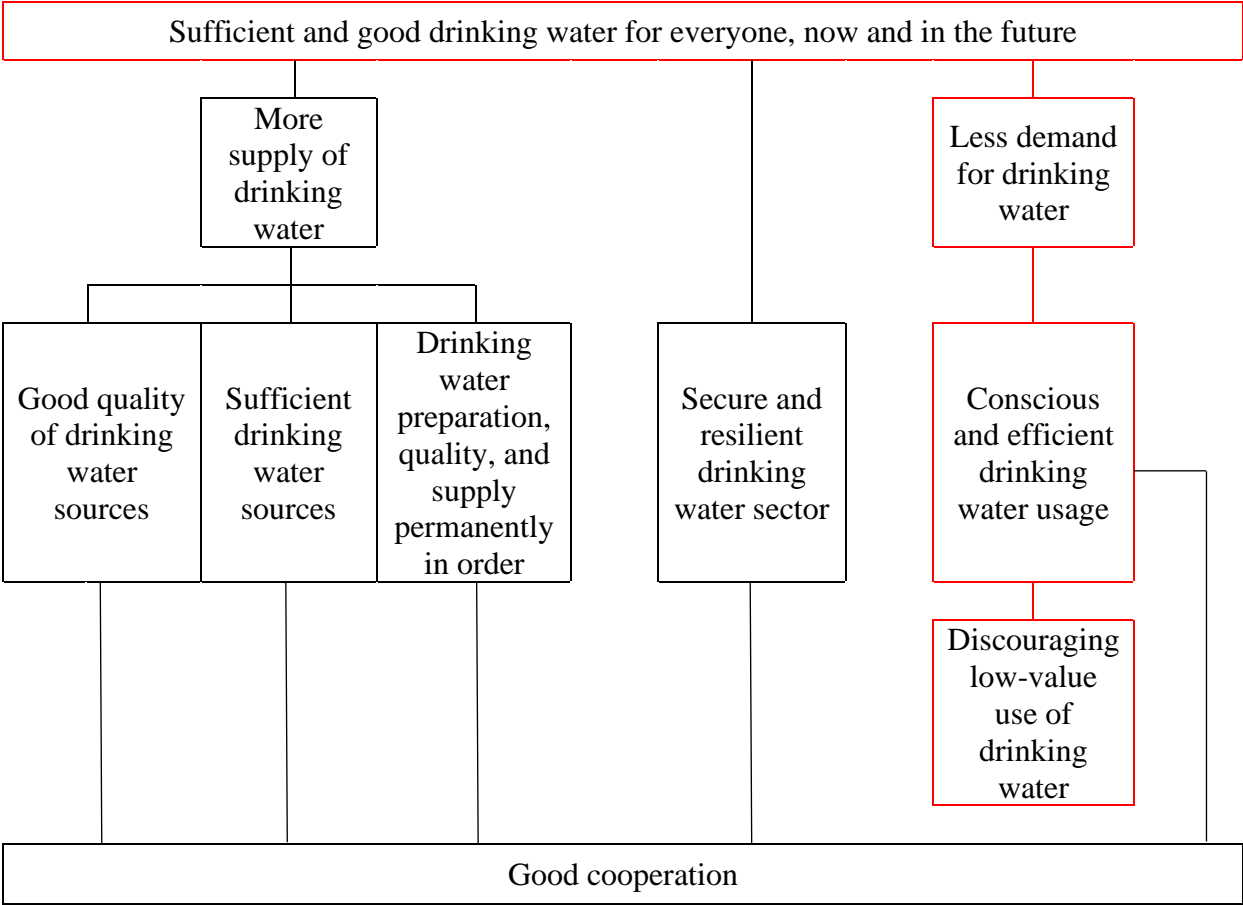
The responsibility of creating sufficient water of good quality lies with the government and the drinking water companies. The Drinking Water Act and the policy note of 2014 have primarily focused on the tasks of the government and drinking water companies. However, in the policy note of 2021, there seems to be a shift in who is responsible for securing drinking water. The challenges regarding drinking water security are presented as a societal problem and thus require an approach that includes other members of the society. This is especially visible in the subgoal of “conscious and efficient drinking water usage”, where the government and drinking water companies expect a more active contribution of households and the economic sector. Assuming that societal actors are not just involved in the problem, but may also be active in finding solutions. All non-household drinking water consumption is referred to as ‘commercial use’. This covers the use of drinking water by industry, agriculture, hospitality, and government (Ministry of Infrastructure and Water Management, 2021). This mostly pertains to drinking water for consumption purposes, such as the manufacturing of food. Another part of the drinking water is used for applications where drinking water quality is not strictly necessary (e.g. cooling or rinsing), which is referred to as ‘low-value use’. In 2019, the Policy Board on Drought suggested that big water consumers should be restricted from using drinking water for low-value purposes. As a result, the government has included discouraging low-value use of drinking water as an intermediate goal in the policy objective of conscious and efficient drinking water usage. The government is exploring several instruments to make this possible, for example stimulating innovation and reuse of water, adjusting legislations and regulations, conduct scans for drinking water savings, and concluding covenants (Ministry of Infrastructure and Water Management, 2021). Over the years there has also been a discussion regarding the tap water taxes. The Ministry of Infrastructure and Water Management has put this financial instrument back on the agenda of the House of Representatives. The reason for this is to reconsider possible taxes on tap water for big water consumers, not only to stimulate water saving measures, but also from a ‘polluter/consumer pays’ point of view (Ministry of

Infrastructure and Water Management). In this section, the focus was on the role of societal actors. Especially the industrial sector, since this study envisions to evaluate the drinking water policy that addresses the industrial sector.

3.1.6 Policy tree

Figure 3 presents a simplified policy tree of the objectives mentioned in the policy note on drinking water 2021-2026. The focus of this research is on the policies and means presented in the red boxes. These will be further explored in the causal field model.

Figure 3
Policy tree based on the objectives of the policy note on drinking water 2021-2026

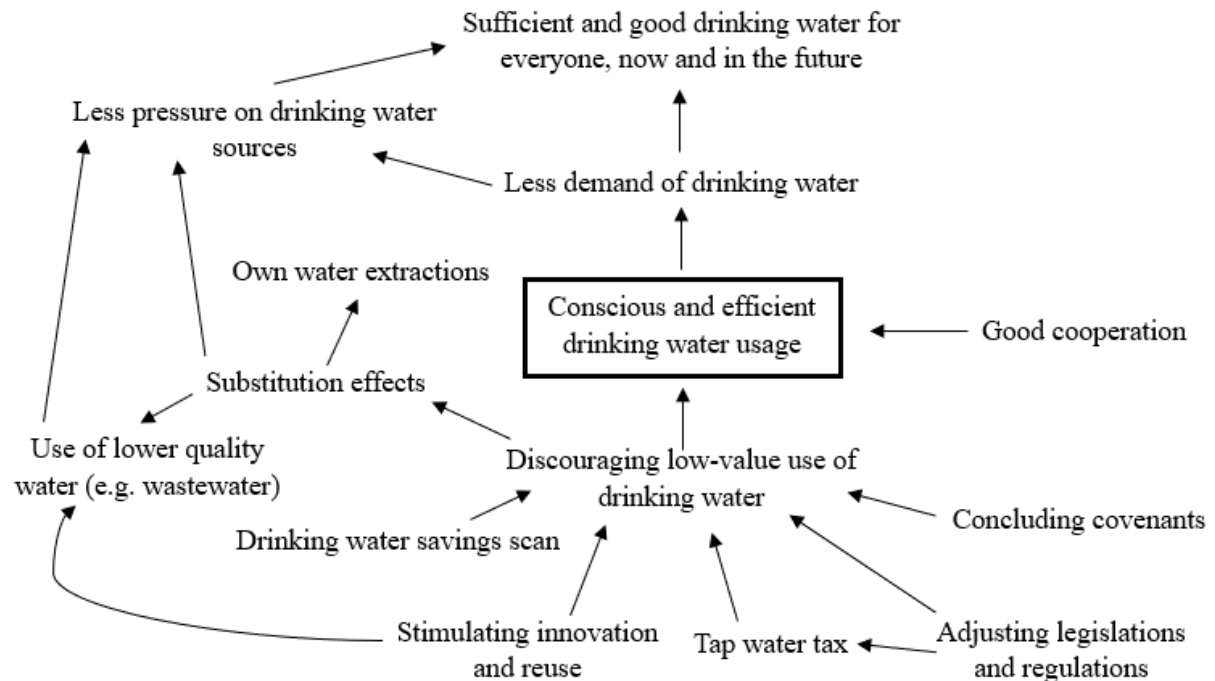


3.1.7 Causal field model

The causal field model is presented in Figure 4. It represents the policy field in relation to the policy objective of conscious and efficient drinking water usage.

Figure 4

Causal field model of the policy objective ‘conscious and efficient drinking water usage’



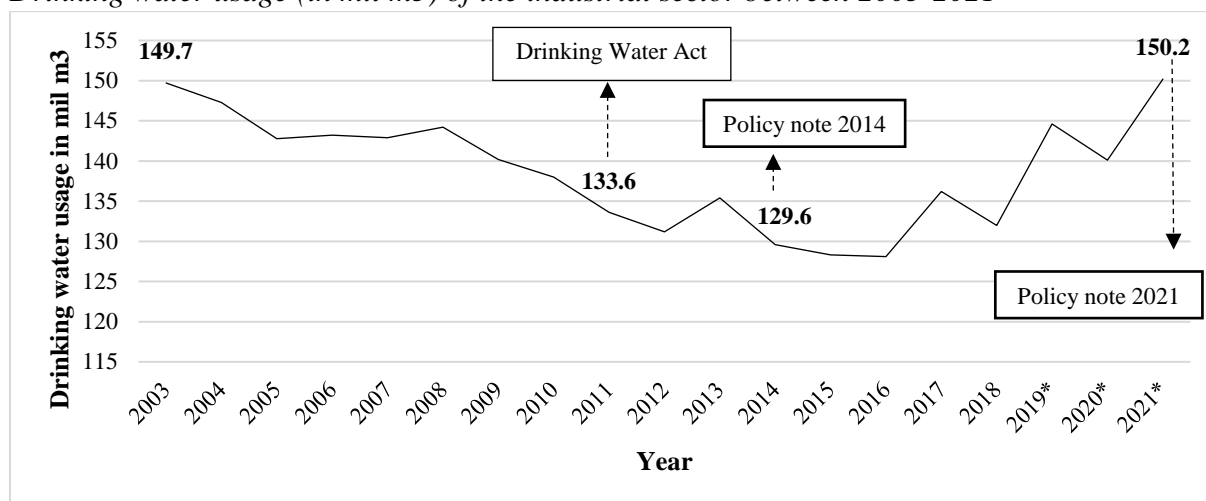
3.2 Goal achievement

This paragraph will address sub-question 2: “*To what extent are the set policy objectives met?*”

Achieving the main goal of the drinking water act and the two policy notes has been successful up until now. There is sufficient and good drinking water available to meet the current demand. However, measuring the objective of conscious and efficient drinking water usage directly is difficult. There is no mention of direct measurable or observable items, which makes it challenging to find good indicators. Since conscious and efficient drinking water usage leads to less demand of drinking water, this objective can be measured by the demand of drinking water. Figure 5 shows the demand of drinking water in the industrial sector between 2003 and 2021. It is impossible to determine whether the policy note of 2021 has had any effect on the demand of drinking water by the industry, since there is no data available beyond the year 2021. Before 2016, the demand was slowly decreasing. Nevertheless, it is clear that between 2016 and 2021 the demand for drinking water has significantly increased. An increasing demand puts more pressure on drinking water sources and thus also influences the main goal of sufficient and good drinking water supply. Yet, the increase in demand has not been in the way of ensuring sufficient and good drinking water for everyone. In conclusion, the main goal has been achieved. On the other hand, creating less demand and therefore putting less pressure on drinking water sources has not been achieved since there is no continuous decrease in drinking water demand over the past few years.

Figure 5

Drinking water usage (in mil m³) of the industrial sector between 2003-2021



* provisional figures

Adapted from “*Watergebruik bedrijven en particuliere huishoudens; nationale rekeningen*”, by CBS, 2023 (<https://opendata.cbs.nl/statline/#/CBS/nl/dataset/82883NED/table?from=statweb>).

However, recently, there have been developments regarding setting targets to reduce drinking water demand. In November 2022, the Ministry of Infrastructure and Water Management sent a letter to the House of Representatives about the Water and Soil Leading programme (in Dutch: *Water en Bodem Sturend*). In the form of objectives and “structuring choices”, the letter to parliament outlines how the notion that water and soil must guide spatial planning is being put into practise. One of the ambitions mentioned in the letter is to reduce drinking water demand. According to Harbers & Heijnen (2022), this requires greater focus on circularity in large consumers (e.g. industries) as well as limiting low-value use of drinking water. For all drinking water users, a reduction target of 20% by 2035 applies. Considering the variety of water consumers, feasibility, and the action perspective, the Ministry of Infrastructure and Water Management will consult with Vewin and the VEMW12 about the implementation of this principle (Harbers & Heijnen, 2022).

3.3 Influence of the policy on the goal

In theory, conscious and efficient drinking water usage will lead to less demand for drinking water and thus safeguard sufficient and good drinking water for everyone, now and in the future. However, in practice, the contribution of the policy to the goal attainment is not always as simple. This section explores to what extent conscious and efficient drinking water usage aids in the accomplishment of less drinking water demand. It will therefore answer sub-question 3: “*To what extent do the policies contribute to achieving the set policy objectives?*”. Paragraph 3.3.1 will discuss to what extent this policy affects the drinking water demand of Dutch industrial companies. Paragraph 3.3.2 will further elaborate on this topic by incorporating the perspectives of drinking water companies.

3.3.1 Conscious and efficient drinking water usage in the Dutch industrial sector

The interviewees of industrial companies all mention that reducing (drinking) water consumption has been part of their organisations' agenda for a few years, even before the policy note on drinking water 2021-2026 was published. What is notable is how each respondent acknowledges the company's ambitions and values as driving forces for the reduction of (drinking) water consumption in their operations. There is a sense of social responsibility to lower the environmental impact of the companies activities. The interviewees describe how their company has established its own goals for cutting water use as part of its sustainability initiatives. Setting own targets is a protective measure, according to two interviewees, as they anticipate tougher regulations in the future. By focusing on reducing water consumption right now, they expect that they can respond to stricter policies quicker. An example of possible stricter policies that is given, is the target presented in the letter to parliament on the Water and Soil Leading Programme. Another respondent adds that the government's goal of establishing a completely circular economy in the Netherlands by 2050 has prompted their company to review its industrial processes and implement measures that increases the reuse of water.

There is also a strong economic incentive as to why companies are reducing their drinking water consumption. Three out of four interviewees indicate that their processes depend heavily on the use of water. In the case that there is not a sufficient water supply, due to the possibility that drinking water companies are not able to produce enough drinking water in the future, it could lead to severe economic losses for the company. This stimulates companies to look for alternatives of using drinking water and implement water-saving measures to ensure the continuity of the business in the future. For example, one interviewee remarks that the use of drinking water for low-value use, such as cooling, is unnecessary. According to this interviewee, an industrial company should not be able to rely solely on drinking water. Decreasing the low-value use of drinking water is an opportunity to lower negative impacts as well as working towards diversifying water sources.

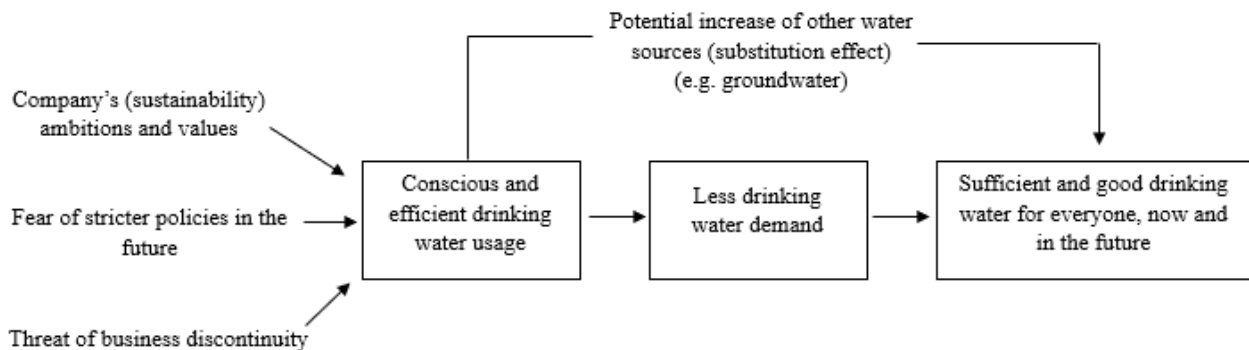
The interviewees were also asked about whether they expect their water consumption to increase or decrease in the future. The one interviewee whose company does not necessarily rely on sufficient water for their activities, said that their drinking water consumption is expected to decrease in the future. However, the decrease will not be significant. The other interviewees respond by saying that they expect their water consumption to increase, mainly due to anticipated economic growth. Nevertheless, the drinking water consumption will decrease because companies are planning to use alternative water sources. One interviewee explained that their organisation is working towards replacing low-value drinking water usage with groundwater. Another interviewee described how their company is investing in the reuse of water within their processes to decrease their demand for drinking water. The other interviewee replied that they know for sure that their water consumption is going to increase, but they want to reduce the amount of drinking water. So, they are working on projects that focus on rainwater harvesting through retention roofs on the buildings. Nevertheless, this interviewee emphasises that their organisation does not want the water consumption to grow exactly at the same pace as of the growth of the company.

Based on the interviews, it is clear that reducing drinking water for low-value purposes is an important topic within these four industrial companies. Their willingness to decrease their drinking water demand is a result of conscious and efficient water use. Nevertheless, achieving conscious and efficient water use within industrial companies is not only stimulated by government interventions, it is also strongly influenced by other factors. Figure 6 outlines to what extent the policy influences the goal achievement. There is however the risk that conscious

and efficient drinking water usage can lead to a substitution effect. Companies might replace their consumption of drinking water by other water sources such as groundwater or surface water. This has a negative impact on safeguarding sufficient and good drinking water, since it will put pressure on the water sources where drinking water is made from.

Figure 6

Causality of conscious and efficient drinking water usage on the goal attainment



3.3.2 Perspective drinking water companies

The interviewees of drinking water companies were asked about their perspective as well as their role in the effectiveness of this policy. The interviewees all agree that stimulating conscious and efficient drinking water usage will contribute to ensuring the drinking water supply in the Netherlands by 2030. One interviewee remarks that switching to different water sources other than drinking water (substitution) is not the solution. Conscious and efficient water use is the only way to protect the freshwater availability. The right water for the right use is an interesting topic for the industry. However, in the end, the solution is to use less together. Switching to other water sources will also not work in the long run. It will only put further pressure on the freshwater availability. Therefore, one interviewee suggests that the focus should not be solely on reducing drinking water demand in the industry, but water demand as a whole.

In the last few years, the interviewees have seen that awareness concerning a possible insecure drinking water supply is growing among the industrial companies. Nevertheless, drinking water companies are often the ones who are contacting the big consumers to discuss opportunities for implementing water-saving measures. While businesses used to be hesitant to discuss their water consumption, they are now more open to look for opportunities to improve their water use in their processes. It is expected that businesses did not feel the need to talk because they were not aware of the problems concerning drinking water production in the Netherlands. Due to increased informing measures by the drinking water companies in the past, the industrial customers are now more aware of the situation that the drinking water companies are in.

Drinking water companies are together with the Dutch government the executive actor. So they also play a role in stimulating conscious and efficient drinking water usage. Drinking water companies want to increase the availability of drinking water, while also decreasing the demand

of drinking water. For the industry it means that drinking water companies are more careful with providing drinking water to new customers. For example, some drinking water companies will not supply drinking water to new customers if it will be used for low-value activities such as cooling. Current big-consumers of drinking water are contacted by the drinking water companies to analyse the processes in order to find opportunities to reduce drinking water consumption. This is done by performing water scans or setting up water profiles. While most companies welcome the idea of doing these scans, it does not always lead to reduction of drinking water within these companies. The interviewees think that this is because of the low cost of drinking water. This makes it difficult for a company to make up an investment plan. Also because sustainability projects sometimes have a slightly longer payback period than ordinary investment projects. Another obstacle for the industry regarding investments is that companies have already invested millions in decreasing their energy demand. Which leaves less money to invest into decreasing water demand.

Over the last few years, the drinking water companies have seen an increase in water demand from the industry. This not only includes drinking water, but also industrial water. This causes drinking water companies to work together with other organisations to arrange the supply of industrial water. It is expected that industrial companies will substitute their drinking water consumption with other water sources. However, arranging these new sources of water needs big investments. These projects often depend on financial contributions from the government or big customers.

The interviewees hope that with the potential arrival of the programme Water and Soil Leading, there will be progress in reducing water demand by the industry.

3.4 Increasing effectiveness of the policy

As described in the steps of a policy evaluation, determining the effectiveness also includes understanding whether the policy instruments have been applied properly and how contribution of the policy to the objectives can be increased. Therefore, this section will answer sub-question 4: *“Have the policy instruments been applied properly and how can contribution of the policy to the objectives be increased?”*

The executive actors in this case are the Dutch government and the drinking water companies. The industrial companies are the policy subjects. One of the instruments applied in stimulating conscious and efficient drinking water usage is discouraging low-value use of drinking water. This instrument would have been applied properly if it did not result in substitution effect. Industries are replacing drinking water with other water sources such as groundwater, which still puts pressure on the production of drinking water. Instruments such as stimulating innovation and reuse, providing water saving scans, and a potential tap water tax for big consumers can result in less water demand from industrial companies. However, the outcome of water saving scans are not always used by the industries to implement water saving measures because the investments will be too high. Making drinking water more expensive for big consumers will thus have a positive impact on pushing investment projects but also innovation.

The effectiveness of the policy can be improved by having concrete numbers for reducing (drinking) water consumption in the industry. This was also already mentioned as an improvement in the evaluation of the policy note drinking water of 2014 for the establishment of the policy note drinking water of 2020. The current policies still lack specific targets for the industry to work towards. This is also why the companies set targets for themselves. One of the

interviewees of an industrial company remarks that when industry specific targets were set by the government to reduce energy consumption, the reduction has picked up. But for water it still remains unclear what is expected from the industry. Another interviewee seconds this. The development concerning the Water and Soil Leading programme could contribute in this improvement, since it has already introduced a clear target of 20% reduction of drinking water by 2035. Nevertheless, it is important that there is elaborate description of what is expected from the industry, and even other sectors.

Another way to improve the effectiveness of the policy towards industry is to look at the cost of drinking water. All interviewees from the industrial companies express that the price of drinking water is so cheap that it is difficult to make an investment plan for water-saving measures. It is often cheaper to keep using drinking water than to turn to other sources. One of the interviewees expresses that it is important to look at the real costs of water consumption, so not only the price for which the water is purchased, but also to look at how much money is for example paid to have the water purified at the purification plants. A good cost calculation from the water consumption in a company depends on the processes in the company. An organisation needs to figure out where the biggest gains are when it comes to reducing water consumption. So analysing where the water is coming in, how much is going out and where it is being used right are important steps in getting grip on the water consumption. The water scans provided by drinking water companies can help big water consumers such as the industry to gain an understanding of their water consumption. Increasing the prices of drinking water is expected to have an impact on the drinking water consumption of the companies. However, the prices should be way higher in order to have an effect. The costs of drinking water in comparison to energy costs are out of proportion, according to an interviewee. While companies are spending millions on energy costs, the cost of water remains low. This interviewee also said that if it is necessary to pay more taxes to keep a secure water supply then most companies will do so.

Knowledge exchange is also named as means to improve the effectiveness of the policy. Places or events where companies can learn from each other, for example at symposia, are important for innovation in the sector. Also, the government should stimulate initiatives that come from the industrial community itself. These initiatives would work best in a regional setting, where there is a strong collaboration with the water board and province.

4. CONCLUSION

This research aimed to evaluate the effectiveness of drinking water policies in reducing drinking water consumption in the Dutch industrial sector. In order to conduct this research, four sub-questions had been formulated.

To answer sub-question 1: *“What are the drinking water policies aimed at the Dutch industrial sector?”* Based on desk research, the industrial sector is influenced by the drinking water policy that encourages conscious and efficient use of drinking water. According to this policy, stimulating conscious and efficient use of drinking water will lead to a decrease in water demand from the industrial sector. This will have a positive impact on securing sufficient and good drinking water for everyone, now and in the future.

To answer sub-question 2: *“To what extent are the set policy objectives met?”* Based on desk research, the demand of drinking water by the industrial sector has been increasing since 2016. Hence, putting more pressure on drinking water sources. Fortunately, there is currently still sufficient water availability to produce drinking water in order to meet the demand. So the main policy objective of the policy note on drinking water 2021-2026 has been met. Currently, it is difficult to determine whether conscious and effective drinking water leads to less drinking water demand by the Dutch industry, because there have not yet been numbers on the year 2022 and so on.

To answer sub-question 3: *“To what extent do the policies contribute to achieving the set policy objectives?”* Based on semi-structured in-depth interviews it is clear that creating conscious and efficient drinking water use among industrial companies is influenced by several factors other than the government. The companies ambitions and values towards sustainability also comes into play. In addition, the industry fears that stricter policies might be introduced in the future. So, implementing water saving measures now will prepare them in advance for these potential policies. Also, there is the threat that in case of drinking water insecurity, the industrial companies will not be supplied with water. This negatively impacts the continuity of their business. By making the company less dependent on drinking water, the interviewees hope to reduce this threat. While conscious and efficient drinking water usage does lead to less demand for drinking water, and thus contribute to the goal achievement, attention should be paid to potential substitution effects.

To answer sub-question 4: *“Have the policy instruments been applied properly and how can contribution of the policy to the objectives be increased?”* Based on semi-structured in-depth interviews, it became apparent that some instruments have been applied properly, while others might not lead to the desired effect. The following improvements can be made to increase the contribution of the policy to the objectives: (1) set clear targets for the industry to work towards, (2) fasten the decision-making on tap water taxes for big consumers, and (3) stimulate knowledge exchange events.

The main research question of this study was as follows:

“How effective are drinking water policies in reducing drinking water consumption of the Dutch industrial sector?”

To conclude, the policy of stimulating conscious and efficient drinking water usage leads to change in the water consumption of industrial companies in the Netherlands. The policy is partially effective in the way that the soft instruments triggers action towards reduction of

drinking water consumption in the Dutch industrial sector. The campaigns of drinking water companies towards business have increased the awareness on the situation. In addition, drinking water companies are actively trying to create efficient and conscious drinking water usage among big-customers. However, due to drinking water being so cheap and there not being any clear targets for the industry to work towards, stricter regulations are needed to increase the effectiveness of the policy. An important remark is that efficient and conscious drinking water usage should not lead to substitution effects, because this also puts pressure on fresh water sources. The demand of water in general should be decreased in order to safeguard the drinking water security in 2030.

5. DISCUSSION

5.1 Limitations & reliability

The objective of this study was to evaluate the effectiveness of drinking water policies in reducing drinking water usage in the Dutch industrial sector. To some extent, effectiveness is determined. The policy note on drinking water 2021-2026, where the policy evaluation is mainly based on, is still going on. Thus, the assessment is based on information that is currently accessible. The results could alter if a comparable research were done in 2026 since the policies would have been in place for a longer period of time.

It is important to note that the outcome of this research is not representative for the whole Dutch industrial sector, hence not generalisable, because of a low population representation. In addition, the interviewees for the industrial companies were not selected randomly or through a well-defined sampling method. The interviewees for this group were selected based on whether the researcher thought that they were suitable for this research. The main criteria for this was that these companies were big water consumers. A list of these big consumers were made and were sent an e-mail. Those who responded were interviewed. This means that selection bias has occurred. Big water consumers are therefore overrepresented in this research, which once again means that it is not generalisable for the whole Dutch industrial sector.

The reliability of this research is weakened due to the semi-structured interviews. While semi-structured interviews allow for flexibility in asking questions, it has also led to variations in how and which questions were asked by the researcher. This resulted in inconsistencies in responses across different interviews.

5.2 Interpretations

It was a surprise that the interviewees of industrial companies were already so involved with their water consumption. The expectation of the research was that reducing consumption of (drinking) water was not taken seriously by the industrial sector because of the low costs. However, the interviewees made it clear that they are invested in this matter. This could be due to the increased attention on ensuring drinking water security in the last few years. Of course also because the challenges regarding drinking water security influences the continuity of the company. Nevertheless, there is a feeling of social responsibility to play an active role in reducing the demand for drinking water. There is a drive to improve conscious and efficient use of drinking water, but clear and concrete targets are missing in order to work towards this goal.

The letter to parliament on the programme of Water and Soil Leading presents opportunities for setting clear and concrete targets. By introducing the target of 20% reduction in drinking water demand by 2035, it would lead to including harsher instruments to the policy mix that currently consists of softer instruments (e.g. informing and stimulating).

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APPENDIX A: INTERVIEW SCRIPTS

Interview script industry

The following transcript was used for the interviewees of industrial companies.

In March 2023, the Dutch National Institute for Public Health and the Environment published a new report on the availability of water for the production of drinking water until 2030. It states that it is uncertain whether there will be enough water for the production of drinking water in 2030. The demand for drinking water in the Netherlands is expected to be much greater in 2030 than in 2020. This is partly due to the economic growth, as well as the number of inhabitants. In addition, climate change also plays a role, as a result of which more drinking water is needed, but less is available. Drinking water is made from surface and ground water. These resources can also be used for other purposes, such as in the industry.

The industry is one of the economic sectors that depends on sufficient water and water of good quality. The government's policy is aimed at the current foundation for the drinking water supply as a basis for conservation, also in the long term. Because the supply of freshwater has not always been sufficient to meet demand, the available water will have to be used more conscious and efficiently.

For my research I look at the effectiveness of Dutch drinking water policies on water use by the industry. It is my ultimate goal to indicate whether the current policy is sufficient to ensure the availability of drinking water in 2030. I will talk to various companies that depend on water or are closely linked to companies that heavily depend on water. The aim is not to map out the water use, but to see whether government measures influence a company's water behaviour.

I want to clarify that:

- *The organisation or your name will **not** be traceable in my research. There will however be a general description of your role and the industrial sector that your company is in.*
- *You have the right to stop the interview at any time, without giving a reason.*
- *You do not have to answer a question if you do not want to.*

Do you have any questions before we start?

Part 1: the organisation and water use

1. *Could you please tell me briefly about your role within your organisation?*
2. *How dependent is your organisation on water?*
3. *What is the water used for in your organisation?*
4. *What are the main sources of water used in your organisation? (e.g. surface water, groundwater, drinking water, salt water?)*

Part 2: policy (conscious and efficient use of drinking water)

5. *To what extent are you familiar with drinking water policies in the Netherlands?*
6. *What motivates this organisation to adjust its water consumption?*
7. *What are challenges the industry faces in reducing water consumption or implementing water-saving measures?*

8. *How important is collaboration with other stakeholders in reducing water consumption or implementing water-saving measures?*
9. *What could promote more efficient use of water in the Dutch industry?*

Part 3: future

10. *What do you expect from the government or water supply companies to improve efficient water use in the industry?*
 11. *What do you think the government could do better with regard to (drinking) water policies for industry?*
 12. *To what extent do you expect your organisation's water use to increase or decrease in the future?*
-

Interview script drinking water companies

The following transcript was used for the interviewees of drinking water companies

In March 2023, the Dutch National Institute for Public Health and the Environment published a new report on the availability of water for the production of drinking water until 2030. It states that it is uncertain whether there will be enough water for the production of drinking water in 2030. The demand for drinking water in the Netherlands is expected to be much greater in 2030 than in 2020. This is partly due to the economic growth, as well as the number of inhabitants. In addition, climate change also plays a role, as a result of which more drinking water is needed, but less is available. Drinking water is made from surface and ground water. These resources can also be used for other purposes, such as in the industry.

The industry is one of the economic sectors that depends on sufficient water and water of good quality. The government's policy is aimed at the current foundation for the drinking water supply as a basis for conservation, also in the long term. Because the supply of freshwater has not always been sufficient to meet demand, the available water will have to be used more conscious and efficiently.

Strong and effective policies are important for drinking water companies because they are the ones responsible for ensuring drinking water security.

For my research I look at the effectiveness of Dutch drinking water policies on water use by the industry. It is my ultimate goal to indicate whether the current policy is sufficient to ensure the availability of drinking water in 2030. I will talk to various companies that depend on water or are closely linked to companies that heavily depend on water. The aim is not to map out the water use, but to see whether government measures influence a company's water behaviour.

I want to clarify that:

- *The organisation or your name will **not** be traceable in my research. There will however be a general description of your role and the industrial sector that your company is in.*
- *You have the right to stop the interview at any time, without giving a reason.*
- *You do not have to answer a question if you do not want to.*

Do you have any questions before we start?

Part 1: introduction

- 1. Could you please tell me briefly about your role within your organisation?*
- 2. To what extent does the picture that RIVM paints correspond with the experience at your organisation? Do you share the experience of the problem with an uncertain future for the supply of drinking water?*

Part 2: policy (conscious and efficient use of drinking water)

- 3. To what extent do you see an increase or decrease in drinking water consumption among industrial consumers?*
- 4. To what extent do you see industrial companies with their own permits for extracting groundwater as a threat?*
- 5. To what extent does your company play a role in creating conscious and efficient use of drinking water in the industry?*
- 6. Do you see a difference between industrial companies in their water behaviour?*
- 7. To what extent do you think that the policy objective of 'conscious and efficient use of drinking water' will contribute to securing the drinking water supply in 2030?*
- 8. To what extent is there cooperation between your organisation and industrial companies?*
- 9. To what extent do you see cooperation between industrial companies and other parties (e.g. provinces, municipalities, water boards)?*

Part 3: future

- 10. If we look at the drinking water policy as a whole, do you think it is effective enough to ensure drinking water supply in 2030?*
 - 11. What is still missing in the current policy regarding drinking water use by industrial consumers?*
-