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## Storylines and Imaginaries of Wastewater Reuse and Desalination: The Rise of Local Discourses on the Swedish Islands of Öland and Gotland

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**ABSTRACT:** Increased pressure on existing freshwater resources has given rise to interest in new raw water sources. Wastewater reuse and desalination are two alternatives that are frequently compared and discussed in the literature. In this study, local discourses in the form of storylines and imaginaries were identified on the Swedish islands of Öland and Gotland. These local storylines and imaginaries were then compared to those found in the literature on wastewater reuse and desalination; in the process, overlaps and variations were identified. On Gotland, a controversy over desalination was observed where arguments were raised for and against 'natural' (nature-based and therefore 'good') solutions and 'unnatural' or engineered solutions (desalination). Such a controversy was not observed on Öland. The controversy on Gotland arose out of competing imaginaries of the future. Such discourses can affect the transitions of water systems. Understanding local discourses may thus be crucial to our understanding of the larger transitions underway in the water sector and may figure importantly in the acceptance of new water sources.

**KEYWORDS:** Wastewater reuse, desalination, discourses, imaginaries, storylines, Sweden

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## INTRODUCTION

Water shortages have existed throughout human history and the last decade has shown that they can be a reality in certain regions of Sweden. Wastewater reuse and desalination are methods that can be used to expand water resources in times of drought. They are often based on similar membrane technology (reverse osmosis) but can be perceived differently. Desalinated water is often considered to be purer and thus it more easily gains acceptance, whereas reused wastewater frequently raises health concerns regarding water quality. Wastewater reuse, on the other hand, is generally considered to be cheaper, more energy efficient, and more environmentally friendly than desalination (Dolnicar and Schäfer, 2009; Fuenfschilling and Truffer, 2016; Williams, 2022).

Perceptions of water reuse and desalination can vary between locations due to region-specific factors and experiences, and a particular type of solution can give rise to controversies in one area but not in another (Sherren et al., 2017). Protests against certain projects can be influential and public opposition

has contributed to the cancellation of reuse projects such as in the Toowoomba case in Australia (Hurlimann and Dolnicar, 2010).

Changes in the design of water systems can be understood in terms of socio-technical transitions that are affected by the actors involved and by the struggles between various interests (Kern, 2014; Rosenbloom et al., 2016; Leipprand and Flachslund, 2018; Rosenbloom, 2018). In this paper, we draw on discourse theory from Hajer (2006), Jasanoff and Kim (2009), and Benediktsson (2021) to understand the discourses that surround wastewater reuse and desalination. We are especially interested in how local discourses arise and evolve. In this paper, they are operationalised as storylines and imaginaries. We study the discourses that surround one combined reuse and desalination plant and three desalination plants; all of these are located on the two geographically similar and adjacent Swedish islands of Öland and Gotland. Local storylines and imaginaries are compared to general ones that have been identified from literature, a comparison that is made in order to distinguish their similarities and differences. The two islands are studied to identify potential variations in local discourses, to understand why similarities or differences have arisen, and to understand what it is that shapes local discourses. Knowledge about these local discourses is then used to discuss if, and how, they affect transitions in the water sector in terms of the design of water systems, technology choices, and what alternatives are discussed and considered viable.

The paper is structured as follows. The next section discusses the literature on transition-related discourses. It summarises how discourses are created and evolve, how they can be understood, how they can be affected by societal variations, and how they can impact transition pathways. Following the theoretical review, we present a literature background from which we identify imaginaries and storylines surrounding water infrastructure in general, and wastewater reuse and desalination in particular. We then detail the cases and methods, and the literature review is then used to understand local discourses and their implications for transition pathways. The paper concludes with reflections on future research.

## **DISCOURSES AND SOCIO-TECHNICAL TRANSITIONS**

Societal systems that provide basic needs such as energy, transportation and water can be referred to as socio-technical systems (Markard et al., 2012). These systems consist of material components – including existing infrastructure and technologies – and social factors such as norms, knowledge and legislation (Geels, 2004; Markard et al., 2012). Long-term processes that fundamentally change the configuration of socio-technical systems toward greater sustainability are referred to as sustainability transitions (Markard et al., 2012).

This paper will focus on discourses around transitions in terms of imaginaries and storylines (see, among others, Jasanoff and Kim, 2009; Benediktsson, 2021). We will describe how discourses are shaped by actors and how they vary between, and are influenced by, geographical locations. We will also discuss how such differences can affect transition pathways in certain areas.

Water infrastructure projects can contain great political symbolism and can be affected by different opinions and interests (Molle et al., 2009; Williams, 2022). Transitions of socio-technical systems are affected by the involved actors and their opinions, priorities, and problem definitions (Kern, 2014; Rosenbloom et al., 2016; Leipprand and Flachslund, 2018; Rosenbloom, 2018). The study of discourses is a useful tool for understanding the struggle between actors and interests, and discourses can be examined to better understand their influence on transitions (Brugger and Henry, 2021). Hajer (2006: 67) defines discourse as, "an ensemble of ideas, concepts and categories through which meaning is given to social and physical phenomena, and which is produced and reproduces through an identifiable set of practices". A discourse can be, for example, a certain tradition and set of ideas about how to address a problem such as water scarcity; what, for instance, are the important roles and priorities, and what defines a good solution?

In socio-technical transitions, the struggle between different opinions or beliefs can be understood as a struggle between storylines (Rosenbloom et al., 2016; Rosenbloom, 2018) or imaginaries (Jasanoff and Kim, 2009; Tidwell and Smith, 2015). A storyline is a component of a discourse; it is defined as "a condensed statement summarizing complex narratives, used by people as 'short hand' in discussions" (Hajer, 2006: 69). Storylines are simplified pictures of the truth. They often draw on common sense and, as such, may seem uncontroversial (Molle, 2008). The simplified and 'common sense' nature of storylines can make them resilient even though they have, for example, been proven wrong scientifically (Molle, 2008). Storylines are used by actors to legitimise a certain view. They are continuously evolving and changing (Geels and Verhees, 2011; Isoaho and Markard, 2020; Rosenbloom et al., 2016).

Tozer and Klenk (2018) and Gross et al. (2019) describe how storylines are driving what are referred to as socio-technical imaginaries in the context of carbon neutrality and air quality. The concept of socio-technical imaginaries was introduced by Jasanoff and Kim (2009: 120), and was defined by them as, "collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects". Socio-technical imaginaries can have an impact on broad political development and can affect economic priorities as well as technological and infrastructural development (Jasanoff and Kim, 2009, 2013). Socio-technical imaginaries define a desirable and viable future, and different imaginaries of the future lead to different socio-technical paths (Tozer and Klenk, 2018).

Benediktsson (2021: 91), introducing the concept of nature imaginaries, described them as "particular, usually unarticulated, premises held by certain groups of people about how human-nonhuman relations should be structured in order to ensure a morally sound future". Benediktsson argued that the discussion about socio-technical imaginaries is limited by its strong focus on technology and on the state. Technology can be considered as a way of relating to nature through, for example, extraction of natural resources; however, it is not the only way. State policies are one place where nature imaginaries can be expressed, but they can also be expressed by civil society groups. Using the example of geothermal energy in Iceland, Benediktsson (ibid) identified two conflicting imaginaries: the geothermal socio-technical imaginary and the Icelandic nature imaginary. The geothermal sociotechnical imaginary was based on the use of geoengineering to address climate change; it called for unlimited extraction of geothermal energy and was motivated by a moral obligation to provide the world with fossil free energy. Central to the Icelandic nature imaginary is the natural, untouched, wild landscape and its preservation; this, combined with nationalism, are core to the Icelandic identity, demonstrating that different imaginaries can coexist in a single place.

Gross et al. (2019) highlight the importance of comparing socio-technical imaginaries from different places and contexts in order to more clearly expose their elements. Jasanoff and Kim (2013) and Tozer and Klenk (2018) observed how socio-technical imaginaries in the context of carbon neutrality can differ from one geographical location to another. Gross et al. (2019) observed general similarities in the socio-technical imaginaries on three different continents around air quality action plans. Socio-technical imaginaries can thus both differ and show similarities from one place to another.

Discourses in terms of storylines and imaginaries can be affected by the area in which they exist. Local discourses and actors can influence the success of certain transitions, the extent of polarisation over a particular question (Brugger and Henry, 2021), and decisions regarding systems such as dam projects, wastewater reuse, and low-carbon solutions (Hurlimann and Dolnicar, 2010; Sherren et al., 2017; Rosenbloom, 2018; Levenda et al., 2019; Flaminio, 2021). Transitions can thus be affected by discourses, which can in turn be affected by the area in which they unfold.

Although place-specific factors and preconditions can influence a transition, the potential heterogeneity of norms and values in a geographical area should also not be ignored (Boschma and Frenken, 2009). Maassen (2012), for instance, points out that differences can exist between the perspectives of different professional groups in a single location. Disagreements can even arise over the

'simple' question of defining sustainability or deciding how to prioritise between, for example, ecological, social and economic interests (Shove and Walker, 2007; Coutard and Rutherford, 2010).

This paper draws on the concept of discourses, storylines and imaginaries, how they are actively shaped by the involved actors, how they affect the socio-technical pathway, and how they can be affected by local contexts. It focuses on two research questions:

1. What storylines and imaginaries surround wastewater reuse and desalination?
2. Are these storylines and imaginaries affected by their local context?

## **GENERAL STORYLINES AND IMAGINARIES OF WASTEWATER REUSE AND DESALINATION**

Wastewater reuse and desalination have already been the subject of a variety of social science research efforts. This has allowed us to identify general discourses around those technologies, including dominant storylines and imaginaries. While some of those studies have been looking at the specifics of wastewater reuse and desalination in particular geographical areas, others have taken a more abstract and global perspective on the discourses around those technologies. From this empirical material, we identified storylines and imaginaries of wastewater reuse and desalination in order to then contrast them with the local dynamics we found in Sweden. The storylines were based on a review of some of the most prominent social science literature on desalination and wastewater reuse, which had already identified the most common lines of argumentation around these technologies. The arguments were grouped under topics such as environment, health and economy. Arguments that related to each other and often appeared together were then grouped into storylines. To identify imaginaries, a literature search was conducted on imaginaries around water, desalination and wastewater reuse. Imaginaries that appeared to be relevant for desalination and wastewater reuse were then summarised. This resulted in the identification of three distinct imaginaries.

Wastewater reuse is generally described as cheaper than desalination as well as more energy efficient, more environmentally friendly, and more ecologically sustainable (Dolnicar and Schäfer, 2009; Fuenfschilling and Truffer, 2016; Abdelrahman et al., 2020; Akpan et al., 2020; Williams, 2022). Attitudes towards desalination can also be impacted by health concerns and cost, and by attachment to marine areas due to their use for surfing or fishing (Heck et al., 2016, 2018). Awareness and/or direct experience of droughts and water scarcity can increase acceptance of new alternative water sources (Garcia-Cuerva et al., 2016; Segura et al., 2018; Hou et al., 2020; Scruggs et al., 2020). There are, however, incidences of public opposition to wastewater reuse during droughts such as in, for example, the Toowoomba case in Australia (Smith et al., 2018). Another factor that may affect acceptance of alternatives is how the previous drinking water was perceived (Dolnicar and Hurlimann, 2009, 2010; Dolnicar and Schäfer, 2009), and trust in water service organisations and governmental agencies that regulate drinking water production (Hartley, 2006; Peters and Goberdhan, 2016; Heck et al., 2018; Smith et al., 2018).

### **General arguments**

Environmental concerns over desalination include its high energy demand and its release of brine to the aquatic environment. More well-developed environmental consciousness and higher levels of concern correlate with a stronger acceptance of reused wastewater and a greater likelihood of opposition to desalination (Heck et al., 2018; Hou et al., 2020; Garin et al., 2021; López-Ruiz et al., 2021). Desalination can be perceived as a means of creating new water sources in arid regions that cannot otherwise support population growth; wastewater reuse, on the other hand, is more consistent with sustainability values such as reuse, recirculation, and closed-loop systems. These differences in perception exist even though wastewater reuse, like desalination, can enable population growth in arid regions (Harris-Lovett et al., 2015).

Environmental impacts of desalination can include: effects on the environment at the location of the water intake; changes to the aquatic environment from the release of concentrated salt water; changes in water temperature at the outlet; increased greenhouse gas emissions due to high energy consumption (depending on the energy source); the release of metals from pipes and heat exchangers; and the release of chemicals that are used in the process (Lattemann and Höpner, 2008; Dawoud, 2012; Saeed et al., 2019; Williams, 2022). Depending on what type of energy is used for the desalination process, it can also be framed as an environmentally friendly and green innovation, if, for example, the desalination plant runs on wind or solar power (Fuenfschilling, 2014). Some of the environmental effects from desalination are likely to occur in wastewater reuse as well, such as the release of metals from equipment and the use of chemicals.

Besides environmental concerns, the acceptance of desalinated or reused water is also affected by perceptions of its respective risks and water quality (Hou et al., 2020; Lee and Jepson, 2020). Desalinated water is generally perceived as being purer and cleaner than reused wastewater (Dolnicar and Hurlimann, 2009, 2010; Dolnicar and Schäfer, 2009; Toze, 2006). Concerns over reused wastewater decline with physical contact, and the acceptance of its use is higher for car washing, air conditioning, toilet flushing, house cleaning and irrigation than it is for drinking, laundry, bathing and cooking (Garcia-Cuerva et al., 2016; Peters and Goberdhan, 2016; Baghapour et al., 2017; Segura et al., 2018; Abdelrahman et al., 2020; Akpan et al., 2020; Chfadi et al., 2021; Flint and Koci, 2021). A general feeling of disgust towards using reused wastewater can be referred to as 'the yuck factor'.

Use of desalinated water has risen worldwide without any notable public health concerns or protests (Furlong et al., 2019). However, in a study by Dolnicar and Schäfer (2009), 33% of respondents had health concerns over using desalinated water, while 79% were concerned about drinking reused water. Deterioration of the marine environment from, for example, eutrophication and oil spills can decrease support for desalination (Heck et al., 2016). Researchers have also pointed out risks to human health from the low calcium and magnesium levels in desalinated water (Spungen et al., 2013; Shlezinger et al., 2018).

A new raw water source like treated wastewater can be viewed as having economic benefits, including boosting agricultural yields (Akpan et al., 2020). It can also enable economic growth in a region through water supply directly to industries or through increasing overall water security (Williams, 2022). In Australia, farmers and the mining industry have been engaged in promoting desalination; NGOs and the Green Party, on the other hand, opposed it for environmental reasons, while economists argued that it was costly and not financially sustainable (Fuenfschilling, 2014). Williams (2022) describes a connection between mining and desalination; this can take the form of either direct supply of water to the mining industry, or construction by industries of desalination plants for coastal cities as compensation for their extraction of groundwater. Williams (ibid) also identifies a connection between tourism and desalination; this takes the form of either direct supply of water to hotels or tourism-related facilities or, indirectly, increasing regional water security through construction of desalination plants. Williams (ibid) describes yet another economic driver behind desalination and wastewater reuse, that is, economic growth in the water treatment industry itself and the financial revenue from desalination or reuse projects that accrues to investors in the form of long-term revenue.

Desalination is considered to be flexible, easy to expand, and capable of providing a stable supply of drinking water (Liu et al., 2022). In Spain in the early 21st century, desalination was described as local, democratic, decentralised, market efficient, ecologically sustainable, and as a warranty for economic and cultural independence in water-scarce regions (Swyngedouw, 2013, 2014).

Desalination may fit better into current cultural and legal systems than wastewater reuse; with the latter, the regulations for water quality and ownership, for example, may be lacking (Fuenfschilling and Truffer, 2016; Lee and Jepson, 2020; Haldar et al., 2021; Williams, 2022).

The arguments about wastewater reuse and desalination are summarised in Table 1.

Table 1. Arguments about wastewater reuse and desalination.

	Environment	Health	Economy	Security and stability	Legislation
<i>Wastewater reuse</i>	Lower CO <sub>2</sub> emissions than desalination due to lower energy consumption (+)	Health concerns due to pathogens (-) Health concerns due to chemicals (-)	Cheaper than desalination due to lower energy consumption (+)	Higher perceived risk (-) A way of increasing water independence (+)	Water quality regulation sometimes lacking (-) Regulation of ownership of water sometimes lacking (-)
	Consistent with recirculation and closed-loop systems (+)	Yuck factor (-)	Necessary or advantageous for local businesses (+)	Local, decentralised and democratic (+)	
			Financial revenue available to investors from wastewater reuse projects (+)		
<i>Desalination</i>	CO <sub>2</sub> emissions due to high energy consumption (-)	Desalination produces a pure water free from health risks (+)	Expensive due to high energy consumption (-)	Infinite raw water supply (+)	Good fit with current legislation (+)
	Release of brine to environment (salt, chemicals) (-)	Health concerns due to a deteriorated marine environment (-)	Necessary or advantageous for local industries and businesses (+)	Stable technology (+) A way of increasing water independence (+)	
	Environmental effects from water intake (-)	Health concerns due to low mineral levels in the water produced (-)	Financial revenue available to investors from desalination projects (+)	Local, decentralised and democratic (+)	
	Fixing the effect rather than the cause (-)				

Note: (+) indicates that the argument is positive and (-) that it is negative.

## Storylines and imaginaries

Especially during the 20th century, water infrastructure has generally been part of national modernisation imaginaries or visions to solve agricultural and social problems (Swyngedouw, 2013, 2014; Randle and Barnes, 2018; Flaminio, 2021). These imaginaries were based on centralised, top-down and state-driven development, with the aim of shaping and engineering nature to meet human needs. They were later challenged due to environmental and ecological concerns and because of growing regional quests for autonomy (Swyngedouw, 2014; Flaminio, 2021). An example of this can be found in Spain in the early 21st century, where desalination was described as local, democratic and decentralised (Swyngedouw, 2013, 2014). Dajani (2020) described how modernisation imaginaries have also been used in the Sahl al-Battuf region of Israel as part of, and as a means of justifying, colonisation; these were opposed by what the authors refer to as "natural native imaginaries", as well as the native peoples struggle for the right to water and land.

Water infrastructure such as dams can be a source of national pride and identity and a means of economic growth, though this has been challenged on the basis of their negative environmental and social effects (Somokanta et al., 2021). State-driven imaginaries, however, can be challenged by arguments other than those grounded in ecological sustainability. In Maharashtra, India, for example, a state government project promoted a community-level imaginary where residents were encouraged to take collective responsibility for, and enjoy a common right to, the locality's groundwater resources; this was challenged by a local 'better life' imaginary where overexploitation of water resources for cultivation of water-intensive crops was legitimised by a striving towards a better life and the chance of upward social and economic mobility (Argade and Narayanan, 2019).

The literature on how visions and imaginaries influence water infrastructure does not always specifically analyse wastewater reuse and desalination projects, but it can still give insights into the motivations behind such projects. Through summarising the arguments and symbolism surrounding desalination, wastewater reuse and water infrastructure from the discussion and review above, we have identified six general storylines followed by three general imaginaries. The storylines and imaginaries summarised in this section are shorter and less detailed than those for the local cases on Öland and Gotland because of being based on less information.

### Storylines

1. In the first storyline, it is argued that *desalination has negative environmental impacts and is expensive, while wastewater reuse is an environmentally friendly alternative*. The negative environmental impact of desalination is caused by the CO<sub>2</sub> emissions from its high energy use and by harm to the aquatic environment from the water intake and release of brine. Desalination is also considered to be fixing the effect rather than the cause and is seen as a means of enabling growth in regions that cannot naturally support it. Due to its high energy use, desalination is also considered to be an expensive technology; wastewater reuse is thus perceived to be a cheaper and more environmentally friendly alternative and one that aligns with sustainability values such as recirculation and closed-loop systems.
2. *Desalinated water is unhealthy*. In this storyline, the extreme purity of the desalinated water and the low mineral concentrations are considered unhealthy. Desalinated water can also be described as unhealthy and unpure due to the negative state of the marine environment from which the water is taken, for example due to pollution, oil spills or eutrophication, which is argued to have a negative impact on the drinking water quality.
3. *Wastewater reuse and desalination is economically necessary and advantageous*. This storyline highlights the importance of new water (such as desalinated water or reused wastewater) to local businesses and local society in general. Economic growth is directly related to the availability of

water, and it is expected that long-term financial returns will accrue to investors from the desalination or reuse projects.

4. *Desalination is a stable and proven technology that uses an infinite raw water source and produces pure water.* In this storyline, desalination, in addition to being a proven and stable technology, produces water that is so pure that minerals must be added before it is consumed. Desalination thus contributes to a stable and trustworthy water supply that is independent of potential decreases in rainfall or freshwater supply due to climate change. This storyline prioritises stability and low risk, which can legitimise higher costs and negative environmental impact.
5. *Wastewater reuse and desalination are ways of increasing water independence in water-scarce regions.* As a result, desalination and wastewater reuse are considered to be local, decentralised and democratic.
6. *Wastewater reuse is a risky and legally complicated way of producing drinking water.* It is considered to be unfeasible for drinking water production due to chemical and microbial health risks; it also can give rise to a feeling of disgust (the so-called 'yuck factor'). For both these reasons, the risk of public opposition is perceived as high. Desalination, on the other hand, is perceived to be safe, and it thus more easily gains acceptance. Wastewater reuse is also considered to be more legally complicated than desalination, raising questions of water ownership and water quality requirements.

Table 2 summarises general storylines and the related arguments from Table 1.

### *Imaginaries*

1. *The modernisation imaginary* is based on an ambition to modernise and a striving towards a better and more modern life and society. The imaginary can be large scale and centralised, driven by a strong state with a national modernisation vision; it can also be an individual's own striving towards a better life. The modernisation imaginary can legitimise negative environmental impacts and overexploitation of water resources. It has also been argued that modernisation imaginaries have been used as part of and as a means of justifying colonisation (Dajani, 2020). This imaginary relates to the storyline that describes wastewater reuse and desalination as economically necessary or advantageous to economic growth and social welfare.
2. *The decentralised, democratic community imaginary* focuses on local rights and responsibilities. In this imaginary, desalination has been described as local, democratic and decentralised, and as a warranty for independence for water-scarce regions. Related to this imaginary is the storyline that describes wastewater reuse and desalination as ways to increase water independence. In certain instances, the decentralised, democratic community imaginary has opposed the national and state-led modernisation imaginary; Swyngedouw (2014), for example, describes how this happened in Spain. This imaginary has also played a role in the articulation of opposition to colonialism and in the struggle by Indigenous people for their right to water and land (Dajani, 2020). In Maharashtra, India, this democratic community imaginary was promoted by a state governmental project and was, in turn, opposed by inhabitants who adhered to a modernisation (or 'better life') imaginary (Argade and Narayanan, 2019).
3. *The sustainability imaginary* prioritises ecological sustainability. It has often opposed large-scale modernisation imaginaries over the negative environmental impact of, for example, dams. Related to this imaginary is the storyline that argues that desalination has negative environmental impacts and is expensive, while wastewater reuse is an environmentally friendly alternative. This imaginary is different from the decentralised, democratic community imaginary in that the focus is on ecological sustainability; however, the sustainability imaginary and the decentralised, democratic community imaginary can join forces in a struggle against the negative environmental and social effects of large-scale, state-led projects.

The three general imaginaries are summarised in Table 3, together with their related storylines.

Table 2. Summary of general storylines.

Storyline	Related arguments from Table 1
Desalination has negative environmental impacts and is expensive, while wastewater reuse is an environmentally friendly alternative	<p><i>Wastewater reuse:</i></p> <ul style="list-style-type: none"> <li>• Lower energy consumption than desalination, thus lower CO<sub>2</sub> emissions and lower cost</li> <li>• Consistent with recirculation and closed-loop systems</li> </ul> <p><i>Desalination:</i></p> <ul style="list-style-type: none"> <li>• Higher energy consumption than wastewater reuse, thus higher CO<sub>2</sub> emissions and higher cost</li> <li>• Releases brine and chemicals into environment</li> <li>• Causes environmental effects at water intake point</li> <li>• Fixes the effect rather than the cause</li> </ul>
Desalinated water is unhealthy	Desalination give rise to health concerns due to low mineral levels in the water, as well as a risk of toxins due to a deterioration of the marine environment
Wastewater reuse and desalination is economically necessary or advantageous	Wastewater reuse and desalination are necessary or advantageous for local businesses and generate revenue for investors
Desalination is a stable and proven technology that uses an infinite raw water source and produces pure water	<p>Wastewater reuse is perceived to have higher risk than desalination.</p> <p><i>Desalination:</i></p> <ul style="list-style-type: none"> <li>• Has infinite raw water supply</li> <li>• Is a stable technology</li> <li>• Produces pure water that is free from health risks</li> </ul>
Wastewater reuse and desalination are ways of increasing water independence in water-scarce regions	<p><i>Wastewater reuse and desalination:</i></p> <ul style="list-style-type: none"> <li>• Are ways of increasing water independence</li> <li>• Are local, decentralised and democratic</li> </ul>
Wastewater reuse is a risky and legally complicated way of producing drinking water	<p><i>Wastewater reuse:</i></p> <ul style="list-style-type: none"> <li>• Give rise to health concerns around pathogens and chemicals</li> <li>• Give rise to 'yuck factor'</li> <li>• Water quality regulation sometimes lacking</li> <li>• Regulation of ownership of water sometimes lacking</li> </ul>

Table 3. Summary of general imaginaries.

Imaginary	Related storylines
The modernisation imaginary	Wastewater reuse and desalination is economically necessary and advantageous
The decentralised, democratic community imaginary	Wastewater reuse and desalination are ways of increasing water independence in water-scarce regions
The sustainability imaginary	Desalination has negative environmental impacts and is expensive, while wastewater reuse is an environmentally friendly alternative

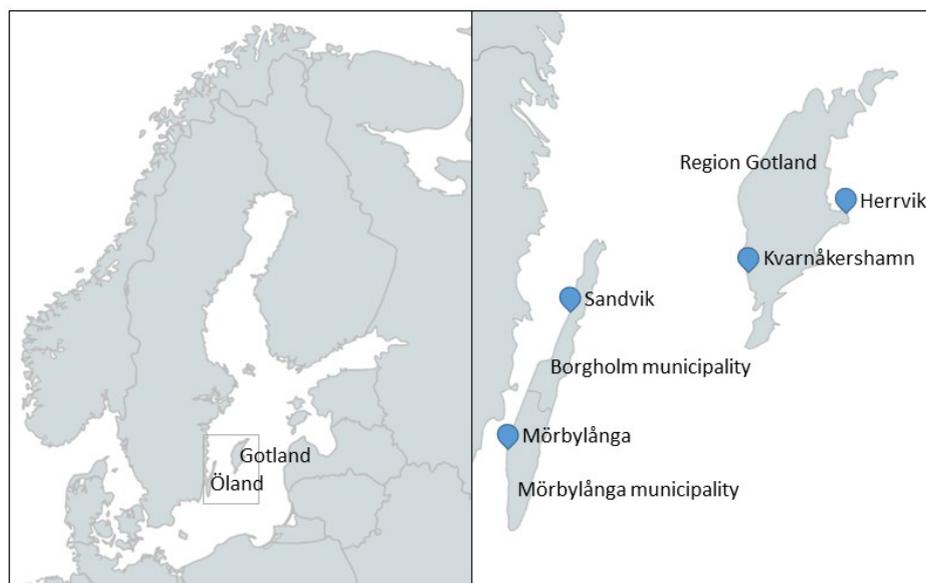
## METHODOLOGY

This study conducted an analysis of the discourses surrounding wastewater reuse and desalination projects on the islands of Öland and Gotland in the Baltic Sea, in southeast Sweden. The imaginaries and storylines that were identified on Öland and Gotland were compared to the general imaginaries and storylines we identified from the literature.

### Case description

Municipal and large-scale desalination and wastewater reuse plants have been built in Sweden only since 2016. Gotland, Sweden's largest island, has two desalination plants, one in the village of Herrvik (Lundberg, 2016) and the other at Kvarnåkershamn, (Leino, 2019); these were inaugurated in 2016 and 2019, respectively. A desalination plant is located at Sandvik on the island of Öland (Jensen, 2017), which was inaugurated in 2017. In 2019 a combined reuse and desalination plant was inaugurated in Mörbylånga (Johansson, 2019; Figure 1). The desalination component of the plant in Mörbylånga was started in 2019, followed by the reuse section in 2021. The combined reuse and desalination plant in Mörbylånga uses industrial wastewater water from the Guldfågeln poultry industry and brackish water from the Baltic Sea as raw water, whereas the desalination plants use brackish water from the Baltic Sea. The poultry industry in Mörbylånga municipality is a slaughterhouse of Swedish poultry. It is one of the major industries in the Mörbylånga municipality, and is described as economically important.

Figure 1. Map of Öland and Gotland Islands and location of desalination and wastewater reuse plants.



Source: authors

The island of Gotland consists of one municipality and one region, Region Gotland. A region is an administrative unit that is responsible for, for example, health care and public transport (Swedish Association for Local Authorities and Regions, 2021). Öland, on the other hand, is divided into two municipalities, Borgholm and Mörbylånga, both of which are part of Region Kalmar. The Sandvik desalination plant is located in the Borgholm municipality and the combined plant is located in the Mörbylånga municipality. There is one water utility for each municipality.

This study examined wastewater reuse and desalination for drinking water production, however, wastewater is also treated and reused for irrigation in the municipalities.

## Methods

Interviews and a media analysis were used to study the cases on Öland and Gotland.

### Media analysis

The media analysis included an examination of 649 newspaper and debate articles in local newspapers. They dated from five years before a plant was inaugurated until the year of inauguration. This interval was chosen to encompass the contemporary debate over the plans for the new plants. The media search was conducted in Retriever Mediearkivet. Local newspapers (listed in Table 4) were included to capture local discourse. Brugger and Henry (2021) have noted the importance of media to local discourses, in that it can influence public opinion and can provide insights into ongoing debates, discursive struggles, and conflict lines. Water scarcity and wastewater reuse and desalination have to some extent also been discussed in the national media and in, for example, media that focuses on new technology; however, these articles are not necessarily written or read by inhabitants of the municipalities where desalination and wastewater reuse projects have been implemented.

The search string for the Gotland cases was *dricksvatten Gotland* (drinking water Gotland) from 2011 to 2019. The search string for the Öland cases was *dricksvatten Öland* (drinking water Öland) from 2012 to 2019.

Table 4. Local newspapers included in the media analysis.

Newspapers, Öland	Newspapers, Gotland
<i>Ölandsbladet</i> , independent liberal-conservative, (Nationalencyklopedin, 2022a)	<i>Gotlands Allehanda</i> , moderate (Nationalencyklopedin, 2022h)
<i>Barometern</i> , moderate (Nationalencyklopedin, 2022b)	<i>Gotlands Tidningar</i> , combination of one social democratic and one centrist newspaper (Nationalencyklopedin, 2022i)
<i>Kalmar läns tidning/Nybro tidning</i> , centrist (Nationalencyklopedin, 2022c)	<i>Hela Gotland</i> (Webb), editorial line not specified
<i>Kalmarposten</i> , editorial line not specified	<i>Hela Gotland Premium</i> (Webb), editorial line not specified
<i>Smålands-tidningen</i> , independent liberal, Nationalencyklopedin, 2022d)	<i>Hela Gotland Arkiv</i> (Webb), editorial line not specified
<i>Smålandsposten</i> , moderate (Nationalencyklopedin, 2022e)	<i>Affärsliv Gotland</i> , editorial line not specified
<i>Smälänningen</i> , liberal-conservative (Nationalencyklopedin, 2022f)	
<i>Östra Småland</i> , social democratic (Nationalencyklopedin, 2022g)	

The following newspapers were included in the search but did not generate any results: Smålands Dagblad, Smålands Näringsliv, Gotlands Media Bilag, Just nu Gotland, and Nöjesguiden Gotland. Hela Gotland Premium, Hela Gotland, and Hela Gotland Arkiv are collections of newspapers on Gotland and include articles from *Gotlands Allehanda* and *Gotlands Tidningar*, which produced some duplicate results. Despite the duplications, all newspapers were included to avoid unintentional exclusion of articles. Among the Gotland newspapers, *Gotlands Allehanda*, *Gotlands Tidningar*, and *Hela Gotland* yielded the majority of the results, whereas *Affärsliv Gotland* (approximate translation: Business Life Gotland) produced one result. Among the Öland newspapers, *Ölandsbladet* and *Barometern* yielded most of the results.

### *Interviews*

23 semistructured interviews were conducted with politicians, public officials, consultants and local representatives who were involved in discussions and decisions regarding water supply. Interviewees were selected through a media search based on the names of the locations and the terms 'desalination' and 'wastewater reuse'. People who were quoted in newspaper articles and had been working with the plants or involved in their planning were contacted, though not all who were contacted wished to participate. Based on the interviews snowball sampling was used, and additional people who were suggested in the interviews were contacted. This resulted in contacts being made with representatives from the water utilities, other involved actors, and political representatives from the Social Democrats and the Green Party on Gotland, and from the Social Democrats, the Moderates, and the Centre Party on Öland.

Interviews followed a guide that had originally been developed on the basis of categories from the literature that were considered to be relevant. These categories were: (1) background on the choice of reuse or desalination, (2) legitimacy of reuse or desalination, (3) actors' knowledge on reuse or desalination, and (4) regional aspects. The questions were translated into Swedish, further explained and clarified, and then written in everyday language. Minor changes in the interview guide were continuously made on the basis of observed need for clarification. The media analysis was conducted after approximately half of the interviews had been completed; at that point, the interview guide was shifted toward a more defined focus on the perceptions and discussions of desalination and wastewater reuse (see Appendix, Section 0 Interview guide (final)). The interview guide was adapted for interviews with actors who were involved only in specific questions.

### *Coding*

The interviews were transcribed and coded using inductive coding, according to the themes in the interview questions. The codes included comments on the various technologies and systems, the background of the plants, the general freshwater situation in the region, other measures to tackle water shortages, other discussions and phenomena that related to the discussion over water (such as local industries, visions and opinions), perceptions and opinions of the systems, factors that affected the choice of technology or system, factors that affected the perception of the technologies or systems, and comments on the general discussion about the new plants (see Appendix, Section 0 Codes).

### *Identification of storylines and imaginaries*

Based on the coding, frequently brought up arguments, views, opinions and visions were summarised into storylines and imaginaries. Arguments that often appeared together, were related to each other, and were brought up by the same group of actors to express a certain view, were grouped together into storylines. Imaginaries were summarised on the basis of articulations of visions or ideas of what a good society is and of what future is realistic and aspirational, as well as on the basis of views and arguments indicating such visions or ideas.

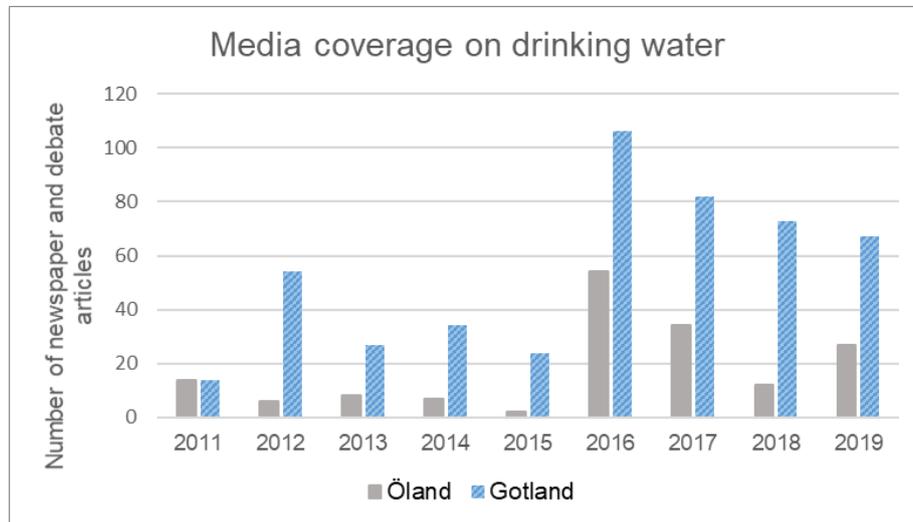
## **RESULTS**

### **Background and general discourses on wastewater reuse and desalination projects on Öland and Gotland**

Water scarcity and droughts – sometimes referred to as water crises – were mentioned as accelerating a need to change the systems for drinking water supply. The winters of 2015/2016 and 2016/2017 and the summer of 2018 were described as dry, to the point where this gained media attention (Figure 2). There were irrigation bans on both islands, water was sometimes brought to Öland from the mainland by tanker

trucks, information campaigns were launched, and there was a broad awareness of the situation in the local society.

Figure 2. Results of media search on the topic of drinking water on Öland and Gotland.



Source: authors

Öland and Gotland are categorised as rural municipalities by the Swedish Agency for Economic and Regional Growth (2021). Agriculture and tourism are described as important businesses on the islands, as is lime mining on Gotland and the poultry industry in Mörbylånga on Öland. The negative impact of lack of water on local businesses can affect the municipal economy and welfare and may impede the development of the local community and society. In the long term, this can affect basic societal functions such as schools and food stores. The threat of a school closure due to a reduced population base was mentioned as a motive behind starting a local development company; this led eventually to the first of the four plants, that is, the Herrvik desalination plant on Gotland. According to one interviewee, "The development company was started due to what had been the core of the parish, a school, Östergarn school. That school was supposed to be closed, and this created an engagement in the village, to keep this school" (Interview 1).

In interviews and in the media, lime mining was broached as a topic affecting the discussion on drinking water on Gotland. The debate over lime mining was controversial, and the question of desalination thus entered partly into an already controversial discussion. As one interviewee commented, "This whole question [of mining] has been extremely divisive, with different sides, actually almost scary, when kids have been mean to each other because their parents are on different sides" (Interview 8).

There have been various cases in which the expansion of mining activities impinged on drinking water resources. An example of this is in the Ojnare Forest on Gotland where, in 2005, a mining company applied for a concession to mine; this led to protests from local farmers, forest owners, and other inhabitants (Anshelm et al., 2018). In 2012, protesters camped in the forest and chained themselves to machines (Anshelm et al., 2018; The Swedish Society for Nature Conservation, 2021), and in 2017, it was decided that the Ojnare Forest should be protected (HFD, 2017: ref. 53).

During the time of this conflict, the same mining company suggested three methods of dealing with potential saltwater intrusion into and around the quarry area: dilution, desalination and diversion (there was not much more detail than this) (Schill, 2008). In 2014, desalination was included in the municipal water and wastewater plan, a governing document describing how water and wastewater should be

managed in the municipality (Region Gotland, 2014). The desalination plans received criticism for being expensive and energy-intensive and for creating a poor quality "dead water" as described by Leino (2014) in *Gotlands Allehanda*. There were also debate posts linking lime mining to desalination, pronouncing desalination as a way of enabling more mining, for example by Kingfors (2018) in *Gotlands Allehanda*.

At the same time, Cementa and Nordkalk are allowed to pump out groundwater to the Baltic Sea – when there is an irrigation ban and other people are told to save water. How is the acute need of water met? Through building desalination plants at many places on the island.

Desalination was described as an unnatural and technological method, while groundwater and lake water resources were described as natural. This position was expressed in *Gotlands Tidningar* by two Green Party representatives, Heilborn and Wanneby (2014), who said that, "For Region Gotland, pure, natural water is a prerequisite for the future, even though you can technically succeed in producing distilled water from the Baltic Sea and get it classified as a drinkable".

Measures to restore natural environments were frequently brought up in the debate on Gotland as an alternative to desalination; this included, for example, increasing groundwater recharge by restoring wetlands that had been drained by the digging of ditches. A representative from the Green Party expressed a vision of Gotland as a pioneering region in sustainability, saying that, "It has been said, politically and structurally, that Gotland should be a pilot for renewable solutions and energy and things like that. I would like Gotland to be a pilot for sustainable water solutions, as well, rather than just doing what everyone else already did" (Interview 8).

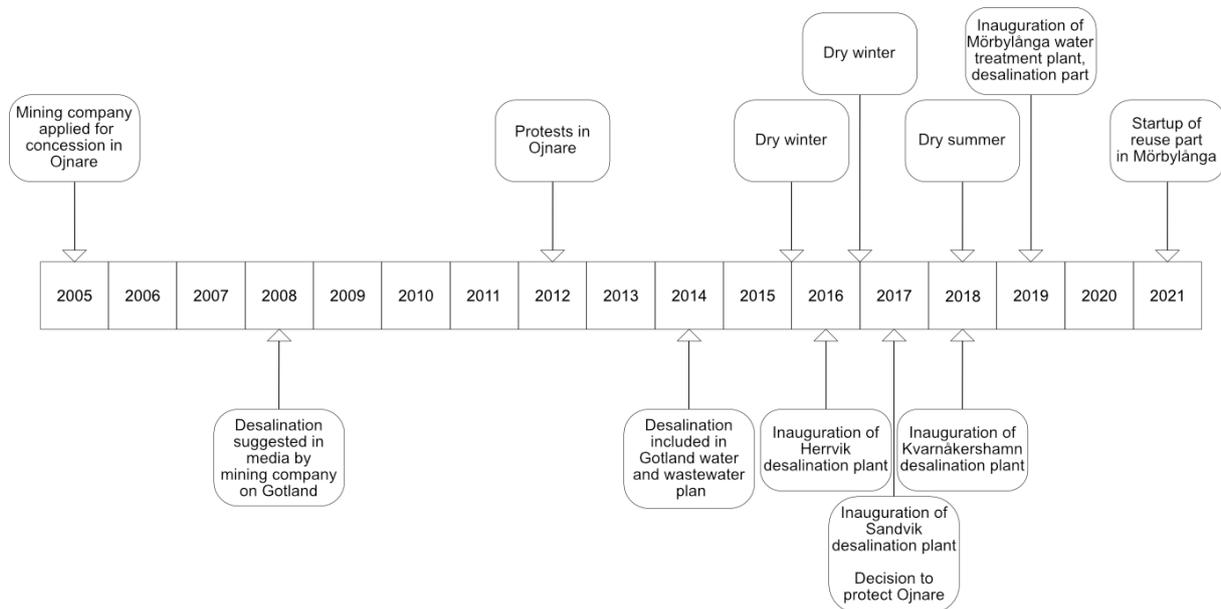
In the interviews, some expressed that the debate over desalination and its environmental impacts was affecting the development of the drinking water supply systems; through delaying implementation of desalination projects and was potentially resulting in the implementation of fewer of such projects than had been planned, and increasing the number of potential alternatives being considered. As one interviewee stated, "Yes, to some extent the opponents were right. Desalination is more energy demanding. We have advanced our understanding with these discussions as well, and will look at this a bit differently in the future" (Interview 9).

In Mörbylånga, the reuse of industrial wastewater was described as a way to sustainably use resources while supplying the water needed by the municipality's industries. Use of treated wastewater from the poultry industry was perceived as being more easily accepted than reusing treated municipal wastewater. Political and water utility representatives in Mörbylånga worried that wastewater reuse would be controversial; however, in fact, there was very little questioning of the new water. One interviewee commented that, "it went much better [than we expected, and], that there was very little questioning of the water from the poultry industry" (Interview 3).

In Borgholm municipality where the Sandvik desalination plant is located, as well as in Region Gotland, wastewater reuse was considered by some representatives to be risky and was perceived as experimentation with a new technology. Others acknowledged that wastewater reuse is implemented worldwide and is feasible, but thought that it risks causing too much controversy. Desalination was considered to be an established and stable technology that was sometimes legally less complicated than the use of ground water because it does not affect the surrounding water table and because there is no need to establish a water protection area. Regarding irrigation with reused wastewater, there was insecurity over future water quality regulations and legislation.

The timeline of the events relevant to the discourse over water resources on Öland and Gotland is summarised in Figure 3.

Figure 3. Timeline of events related to the discourse over water resources on Öland and Gotland.



Source: authors

From the coded interviews and media analyses, expressions of visions, opinions and arguments in favour of, or against, desalination, wastewater reuse, and other alternatives have been summarised and pooled into local storylines and imaginaries, together with the actors who expressed them. Five storylines and two imaginaries have been identified.

### Storylines in the local discourse

1. *Desalination is an unnatural quick fix and an unnatural way of maintaining an unsustainable society; it is used instead of taking care of existing water resources.* It is considered to be a way of enabling the exploitation of nature by actors such as the mining industry on Gotland. This storyline expresses a distrust of new technology and engineering. Desalination is criticised for its environmental impact from high energy consumption and for its release of brine into aquatic environments; it is also considered to be too expensive. Desalinated water is described as being less healthy because its lower mineral content makes it "too pure"; on the other hand, it is also described as containing more harmful substances than groundwater and lake water because it uses polluted water from the Baltic Sea. It is thus criticised for being both too pure and not pure enough. Natural processes such as those that occur in wetlands or forests are described as superb natural treatment processes that have been developed over thousands of years.
2. *Desalination is a rational way to produce drinking water.* It is described as stable, safe and proven and as using an infinite raw water source that cannot be exhausted. The water produced is considered to be safe and of good quality. Its lower mineral content compared to groundwater and lake water is framed as an advantage since it causes less clogging of appliances such as coffee makers and laundry machines. No critique is directed towards water use by industries, but the duty of the water utility is to provide sufficient volumes of water to households as well as to businesses and industries. Desalinated water is considered to be safer and is expected to be more easily accepted than treated wastewater. It is considered to be legally less complicated than groundwater and lake water due to the water protection areas needed for the latter two; it also avoids the potential land use conflicts surrounding wetland restoration. It is highlighted that the energy required for

desalination in general is lower in the Baltic Sea region due to the lower salt concentration of Baltic Sea water compared to, for example, water from the Atlantic Ocean or the Mediterranean Sea. Desalination is perceived to be economically feasible, with desalinated water being only slightly more expensive than the lake water and groundwater that was previously used. Arguments for its low cost include that membrane technology was already in use on Gotland, and that in some areas on Öland, groundwater wells are widely dispersed, making them more costly to maintain.

3. *Wastewater reuse is an ecologically and economically rational and feasible alternative.* Recirculation of existing water resources and a consideration of ecological questions in infrastructural decisions are prioritized, and wastewater reuse is considered to be a sustainable way to manage freshwater resources. Wastewater reuse is described as both an ecological and an economically rational alternative, one that enables growth of industries, businesses and populations. This storyline expresses trust in new technologies and considers reused wastewater to be a safe and feasible source of drinking water.
4. *Wastewater reuse may be advantageous but is not yet ready for the world.* Wastewater reuse is described as being advantageous in theory, but is thought of as still too risky and not well enough developed and proven. The ecological aspect is confirmed, but the focus is on water quality and quantity and the need to produce sufficient amounts of water to households, businesses and industries. This storyline expresses a general trust in new technology as a solution to water scarcity; however, it does not currently have faith in wastewater reuse, which is considered to be a solution that lies many years in the future. According to this storyline, wastewater reuse is also legally too complicated.
5. *Wastewater reuse is a safe but controversial alternative.* This storyline is related to both of the above. It is distinct from the third storyline, however, in that it is more focused on the risks of controversy; and, as opposed to the fourth storyline, it considers wastewater reuse to be safe and feasible but still too controversial. The yuck factor is a strong argument against wastewater reuse, but is considered to be lower for reuse of industrial wastewater than municipal wastewater.

Table 5 summarises the storylines; it also offers a selection of quotes from the media analysis and interviews to illustrate the imaginaries in more depth.

### **Imaginaries in the local discourses**

The first imaginary is *an imaginary centred on ecological sustainability*; it is aimed at creating an ecologically sustainable future. The focus is on holistic perspectives whereby biodiversity, decreased pollution, circular systems, and the saving of freshwater resources are achieved together through, for example, wetland restoration. To achieve this, it may be necessary to rethink and change how we extract natural resources and how we handle our soil and water. It needs to still be possible to make a living on an island like Gotland, even though certain industries are criticised as being unsustainable. New types of jobs in, for example, sustainable tourism should be developed as alternatives to industries such as mining. In its focus on ecological sustainability, this imaginary relates to the storyline that describes desalination as an unnatural quick fix, and to the one that describes wastewater reuse as an ecologically and economically rational and feasible alternative.

On Gotland, this imaginary was described as being in conflict with industries like mining, around which the society and economy are currently partly organised. Those expressing this imaginary on Gotland were mainly Green Party representatives, as well as individuals who attended information meetings and authored debate articles to express these views.

Table 5. Summary of storylines, with quotes from the media analysis and interviews.

Storyline	Quote
<i>Desalination is an unnatural quick fix</i>	<p>"At the same time as the ongoing destruction in Ojnare is carried out and our drinking water is directly threatened, calming messages (?) are presented – the 'solution' to the water issue: desalination of seawater" (Wrang, 2012).</p> <p>"They get the water from a natural freshwater source that is being continuously fed with fresh water that has been purified through a natural filtering system (the Ojnare area) which through undisturbed work for thousands of years now is consummate. For us with the ability to long-term thinking, free, purified, natural drinking water from a natural resource must be better than paying millions for fine membrane technology?" (Zi, 2015).</p> <p>"Some public officials and politicians on this island believe that we can get both: that we can make huge holes in the ground and use up the groundwater and get the water we need from the sea. They put all their hope in new technology with desalination of seawater" (Gardell, 2016).</p>
<i>Desalination is a rational way of producing drinking water</i>	<p>"They looked at alternatives, such as building dams or similar things. But we did not have the prerequisites for that. The only option was desalination" (Interview 1).</p> <p>"My view is that, regarding Herrvik and Kvarnåkershamn, in both those places there were no good alternatives. We had to go for desalination to get good quality water in sufficient quantities to supply the many households, even though water production became a bit more expensive than it had been" (Interview 11).</p>
<i>Wastewater reuse is an ecological and economically rational and feasible alternative</i>	<p>"We believe that the only sustainable way of managing drinking water in the future is a closed circular system, where we treat and reuse our wastewater and stormwater" (Heilborn and Krusell, 2018).</p> <p>"Since the industrial wastewater contains so little salt, less energy is needed to press the water through the membranes, which entails an economic advantage as well" (Johansson, 2019).</p> <p>"Desalination uses quite a lot of energy and sometimes it is better to reuse the water you already treated instead of releasing it to the sea" (Alåsen, 2016b).</p>
<i>Wastewater reuse may be advantageous but it is not yet ready for the world</i>	<p>"Reuse is at least ten years into the future (...). There, you cannot take any chances, you have no margins; this is really important" (Interview 4).</p> <p>"There are insecurities about what rules there will be in the future: what can you use this water for?" (Interview 6).</p>

On Öland, this imaginary underpinned the search for better approaches to resource use that at the same time maintained industries and jobs. Mining is not a big industry on Öland and there was no connection between it and wastewater reuse or desalination. A few voices were critical of certain industries and their water use; the dairy industry on the island, for example, was questioned (see *Ölandsbladet*, 2016). There were also ecologically oriented actors who argued that the best way to move forward was by thinking differently about water resources and, for example, nature restoration to increase the groundwater resources. The ecological sustainability imaginary was spread among different groups of actors. It was mainly expressed in Mörbylånga municipality where wastewater reuse is practiced, possibly because wastewater reuse is associated with ecological sustainability and the saving of resources. Representatives

from different parties considered wastewater reuse in terms of sustainability, as did representatives from the water utility.

The second imaginary is centred on *economic growth and the maintenance of industries, jobs and welfare*. It highlights the importance of water as a means of enabling and maintaining industries, businesses, employment and population growth, and it considers industries to be the creators of important jobs. In its focus on providing society and industries with sufficient volumes of water to maintain economic growth and welfare, this imaginary relates to three storylines: the one that describes desalination as a rational way of producing drinking water, the storyline that describes wastewater reuse as an ecologically and economically rational and feasible alternative, and the storyline that describes wastewater reuse as possibly advantageous but not yet ready for the world. Desalination is considered to be a feasible method for providing the necessary supplies of water and this imaginary expresses a trust in technology as a solution to water scarcity. It has some commonalities with the geothermal socio-technical imaginary described by Benediktsson (2021), including the trust in, and positive attitude towards, technology as a solution to challenges such as water scarcity (in this study) and climate change (in Benediktsson, 2021).

On Gotland, this imaginary was in conflict with the one centred around ecological sustainability. This conflict arose from its enabling of industries that were considered unsustainable and to its view that lack of freshwater could be handled with technology rather than by caring for natural systems. Representatives from the water utilities were the ones who most strongly expressed this imaginary. The duty of a water utility is to provide drinking water to the connected households and industries, not to protect the environment; desalination was thus considered to be the best available method.

On Öland, the two imaginaries were described as being more compatible than they were on Gotland. Industries on Öland were considered possible to maintain sustainably, for example through wastewater reuse. The actors who expressed this imaginary were public officials at the water utilities as well as representatives from the three biggest political parties in both municipalities, that is, the Social Democrats, the Moderates, and the Centre Party.

Table 6 summarises these imaginaries and offers a collection of quotes from the media analysis and interviews to illustrate them in more depth.

Table 6. Summary of imaginaries, with quotes from the media analysis and interviews.

Imaginary	Quote
<i>An imaginary centred on ecological sustainability</i>	"The water utility agreed that it was wasteful to release 1500 m <sup>3</sup> of freshwater into the sea, a fourth of all the drinking water we produced (...) so sort of an idea to save the water resources on Öland" (Interview 10).  "In a perfect world, how would you solve the water supply? (...). [You would use] recirculating systems with nature as support. Technical approaches are part of the solution, but the question is how we can use the water most efficiently no matter where it comes from. To be able to think those thoughts at the same time. Basic sustainability principles" (Interview 8).
<i>An imaginary centred on economic growth, maintenance of industries, jobs and welfare</i>	"For Cementa, expanded mining is a matter of fate. In a few years, the western quarry will be out of lime and 230 people will lose their jobs" (Andersson, 2019).  "We [the farmers] are an important industry on Öland. It is us and the tourists. It is clear that the municipality has an interest in helping us" (Alåsen, 2016a).

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"At the same time, Mörbylånga municipality is deeply connected to the company Guldfågeln AB. What will happen on the day, god forbid, that Guldfågeln decides to close down in Mörbylånga?" (Boström, 2018).

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## DISCUSSION AND CONCLUSIONS

Three general imaginaries were identified, that is, the modernisation imaginary, the decentralised, democratic community imaginary, and the sustainability imaginary. Two local imaginaries were identified on Öland and Gotland, one centred on ecological sustainability and one centred on economic growth and on the maintenance of industries, jobs and welfare. The imaginary centred on ecological sustainability corresponds to the general sustainability imaginary in terms of its focus. The imaginary centred on economic growth to some extent corresponds to the modernisation imaginary in its focus on social welfare and economic growth, however without the modernisation aim; the focus, rather, is on maintaining economic and social welfare, and the modernisation of society is not a specific aim.

A prominent conflict between the two local imaginaries was observed on Gotland but not on Öland. On Öland, the imaginaries seemed more compatible, and it appeared that ecological sustainability (through, for example, recirculation of wastewater) was achievable at the same time as the maintenance of growth and water production for industries, businesses and households.

The local imaginary that was centred on ecological sustainability included a storyline that considered desalination to be a technological quick fix enabling the exploitation of nature. In this storyline, desalinated water was also considered unhealthy, sometimes because it was considered too pure and distilled and sometimes because it was considered not pure enough because of the risk of containing toxins from the Baltic Sea. These two water quality related arguments appear to be contradictory; the reason for this is likely that it is not water quality per se that is being criticised, but rather the use of new technology to solve a problem that it is felt should be solved through caring for existing water resources. The distrust in technology expressed in this storyline conflicts with the storyline in which desalination is trusted as a proven and safe technology and is perceived as providing safe water in sufficient volumes from an infinite raw water source. This latter storyline is connected to the imaginary that is centred on economic growth and on maintenance of industries, jobs and welfare. The conflict between the storylines is visible in the conflict between the imaginaries.

On Gotland, the discussion about lime mining – which was described as controversial – is related to the discussion about water resources. The connection made between lime mining and desalination likely affected the discussion about the latter, which in turn probably made the desalination discussion more controversial. Lime mining did not fit into the ecologically sustainable imaginary, and the view of desalination as a way to enable more lime mining made desalination harder to fit into this imaginary as well. A vision of Gotland as a sustainability pilot was mentioned and we find the concept of nature imaginaries (Benediktsson, 2021) suitable for describing this.

On Öland, neither desalination nor wastewater reuse was as controversial as desalination on Gotland. Reuse of industrial wastewater was perceived as being easier to gain acceptance for than municipal wastewater reuse; this was the main difference from the general storylines on wastewater reuse that were derived from the literature. There, reuse of industrial wastewater was not a large component and no differentiation between the two was observed. The water crisis may have contributed to the limited questioning of wastewater reuse, together with a general view of the poultry industry as being important for growth and jobs, and as uncontroversial.

The differences between Öland and Gotland highlight that, due to local political discussions and local industries, discourses can differ between locations that are both geographically similar and near each other. It should thus not be expected that patterns of discourse will be uniform over entire countries, and there needs to be an analysis of how they are affected by local context in the form of, for example,

political conflicts and visions. This study also highlights that various types of alternative solutions can be broached in discussions on the development of water systems, including nature protection and restoration. Transitions in the water sector should thus not be studied solely in terms of technological development. The water cycle influences, and is affected by, the environment, and water is a necessity for humans and nature, which is not the case for socio-technical systems for, for example, transportation and energy supply.

Representatives from the water utility on Gotland commented that the debate on desalination affected the discussion about future freshwater resources, water supply and future technology choices. This debate occurred when there was a general increase in awareness of sustainability, for example with adoption in 2015 of the 2030 Agenda for Sustainable Development. Parallel processes may thus have affected development towards a situation where more alternatives are perceived as possible and viable, including reuse, circulation, water retention, and source sorting. On the other hand, it was highlighted that the duty of the water utility is to produce sufficient volumes of drinking water, not to carry out environmental measures. The water utility can thus make decisions only about what is most favourable for water and wastewater users, not about pure environmental measures. The division of water supply and environmental protection and management into different organisations may inhibit cooperation in these areas. This may cause these questions to become siloed, thus inhibiting potential positive mutual effects.

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## APPENDIX

### Interview guide (final)

- Could you explain what your role was and in what way you were involved in the questions regarding drinking water in Herrvik/Kvarnåkershamn/Sandvik/Mörbylånga?
- What was the background to the construction of the plant?
- Was water discussed before this plant was discussed? In what way? Why/why not?

- What other methods and alternatives were investigated?
- What advantages and disadvantages do you see with the chosen system compared to the alternatives?

#### *Legitimacy*

- Was desalination/reuse or membrane technology something that you and/or your colleagues had heard of or had knowledge and experience of before the plant was constructed?
- The chosen system (desalination or reuse), did you have an opinion about that from start, if it was good or bad?
- In the case Mörbylånga/Sandvik/Region Gotland, if you are in a situation where the water resources you have used are not enough, what is most important to think about when choosing solutions and ways of handling this?
- And a bit on the same theme, if you in a perfect world where you can choose the system yourself, what do you think would be the best way of solving the water situation?
- What was the acceptance like among the public or other groups regarding desalination/reuse?
  - Was there a difference between different groups?
  - Do you know why people thought it was good or bad?
  - Did your organisation do anything to affect the perception of desalination/reuse?
    - What groups were you aiming at in that case?
    - Were there any messages or activities that were extra important?
    - Do you feel that you reached out?

#### *Actors and debate*

- What persons or groups would you say had the biggest influence on the solution?
- Were there any specific groups or people that were promoting desalination/reuse?
  - Who?
  - What were the main arguments?
  - What influence did they have?
  - Did you or your organisation interact with these actors? In what way?
  - Did you affect each other's opinions or try to affect each other's opinions? Did you succeed?
- Were there people or groups of people who opposed desalination/reuse?
  - Who?
  - What were the main arguments?
  - What influence did they have?
  - Did you or your organisation interact with these actors? In what way?
  - Did you affect each other's opinions or try to affect each other's opinions? Did you succeed?

Did the debate/discussion affect the design of water and wastewater systems?

#### *Cooperation and reference plants*

- Was there any cooperation that was important for the project?
  - With whom? What was their contribution?
- Did you use knowledge from already existing plants at other places?
  - Did you have any plants as reference?
    - Which ones?
    - How did you choose these?

#### *Regional differences*

- How do you think desalination/reuse fits the region and the island?
- Are there any local prerequisites that you think are extra important when you design water supply systems?

#### *Reuse of municipal wastewater*

- Kvarnåkershamn, Herrvik, Sandvik: What do you think about the potential for wastewater reuse in the future?
- Mörbylånga: If you did not have the chicken industry, do you think you would have reused municipal wastewater to produce drinking water? What do you think about it? Was it discussed?

#### *Last questions*

- Is there anything you want to add?
- Do you have suggestions on people I can talk to?
- Can I get back to you if I have any more questions?

#### **Codes**

- Accountability
- *Almedalsveckan*
- Background to plants
  - Herrvik
  - Kvarnåkershamn
  - Mörbylånga
  - Sandvik
- Communication
  - External communication
  - Information
  - Media
- Conflicting interests
  - Conflicts about water
  - Military interests
  - Ojnare Forest, Bunge
- Courage
- Cultural history
  - Bulverket
- Curiosity
- Customer focus
- Different types of water solutions
  - Desalination and membrane technology
  - Leakage decrease
  - New groundwater aquifers
  - New wells
  - Pipe between Kalmar and Öland
  - Pressure decrease
  - Reduced water use
  - Restore nature
  - Source separation
  - Stormwater harvesting
  - Wastewater reuse
  - Water from mining quarries
  - Water tank boats
  - Water tank cars
- Economy – cost
  - Cost for membranes

- Water and wastewater fee
- Efficiency
- Energy demand
- Engineered solutions
- Flexibility
- Growth, development
  - Building boom
  - Businesses
  - Connection to the network
  - Population growth
  - Taxes
  - Welfare
- Health
- Holistic view
- Innovation
- Integrate water in societal planning
- Interviewee details
- Knowledge
  - Actors' knowledge
  - General knowledge
  - Knowledge need
  - Public knowledge
  - Role model plant
- Legal
  - Laws and environmental goals
  - Permits
  - Water quality limits (*gränsvärden*)
- Legitimacy
  - Distrust
  - Opinions
  - Trust
- Local community
  - Pride
- Motives
  - Political motives
- Networks
  - Cooperation
  - Influential actors
  - Networks for desalination
  - Networks for reuse
  - Organised networks
  - Personal networks
  - Water council
- Practical considerations, realism
  - Construction work
  - Current infrastructure
  - Timeline

- Priority of water issues
- Recreational values
  - Bathing water
- Research
- Sports
  - Soccer fields
- Sustainability, long-term perspective
  - Environment
  - Proactivity
- Systematic
- Water resources
  - Ditches (*utdikningar*)
  - Drinking water supply
  - Flooding
  - Natural groundwater and surface water
  - Natural water balance
  - Water quality
  - Water scarcity
  - Water security
  - Water soul
  - Water sources

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