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Environmental communication in Oslo's water management strategies and initiatives - the status quo

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International Environmental Studies

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Declaration

I, Raminta Karabitski, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged, and a reference list has been appended. This work has not been previously submitted to any other university for the award of any type of academic degree.

Signature: Raminta Karabitski

Date: 15-05-2022

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Abstract

This Master's thesis investigates environmental communication of initiatives and strategies related to climate change in water-related themes in Oslo. Environmental communication is premised on the assumption that more effective environmental messages communicated by communication experts can positively influence citizens by rethinking and reorienting global, national, and municipal environmental efforts to develop a more persuasive political practice that can rapidly accelerate the pace and scope of social change in adopting climate-friendly lifestyles. Therefore, I analyzed sound online climate strategies and initiatives to curb water-related climate threats in Oslo undertaken by scientists, municipality, and governmental actors. Essentially, I studied how stakeholders used communication strategically and compared analyzed approaches to the theoretical efficiency of such communication.

This study builds its theoretical argumentation based on empirical evidence collected through semi-structured interviews and surveys with environmental communicators and analyzed water-related climate strategies in Oslo.

Consequently, a content analysis of Oslo's strategies and initiatives revealed that climate adaptation, long-term climate strategy, and vulnerability analysis were central strategies for Oslo. Moreover, climate initiatives published on social media presented various attractive visual techniques to convey valuable messages.

According to the survey results, study participants had a solid understanding of the anthropological origins of climate change and the severe threats this crisis poses to various groups but had limited knowledge of water-related climate consequences to Oslo.

Later, the interviews with environmental communicators were arranged to enclose their implications for environmental communication. This study determined effective communication approaches such as diversification of target audience and location-based messages, utilization of language that is understandable for society, premises of using social media and engaging with the audience in social networks comments. From here, I argue that climate communication is a crucial dissemination pathway capable of meeting the information demands required for civil society to act. Nevertheless, some barriers were identified, such as disagreements on most effective climate messages, a lack of understanding of the target audience’s needs, and struggles with financial resources.

Eventually, the comparative analysis was carried out. A comparison of theoretical best practices in environmental communication with empirical findings from analyzed water-related strategies, interviews, and surveys with communication experts, revealed four major obstacles. Firstly, environmental communication was oversimplified. Secondly, there was an evident disconnection between environmental communicators and the target audience. Additionally, traditional communication methods predominated despite the climate crisis requiring more innovative approaches, especially regarding language and visual content. Finally, the link to proactive behavioral changes in the form of more direct communication with citizens was missing.

The thesis concludes with the outlines of an environmental communication process that enhances civic engagement and democratic decision-making. Finally, research desiderata are identified at the end of this thesis, and directions for further studies are shown.

Keywords: environmental communication; climate change; water-related climate threats; Oslo.

Environmental communication seeks to enhance the ability of society to respond appropriately to environmental signals relevant to the well-being of both human civilization and natural biological systems (Cox, 2007) and is recognized as a 'crisis' and 'care' disciplines" (Pezzullo and J. Robert Cox, 2018).

Table of contents

List of Figures

List of Tables

Abbreviations

CICERO	Center for International Climate Research
CRED	Center for Research on Environmental Decisions
EC	Environmental communication
GHG	Greenhouse gas
GHG Protocol	Greenhouse gas protocol is the world's most widely used greenhouse gas accounting standard.
HICC	Human-induced climate change
IPCC	Intergovernmental Panel on Climate Change
NBS	Nature-based solutions
NRK	Norwegian government-owned radio and television public broadcasting company and the largest media organization in Norway
NVE	Norwegian Water Resources and Energy Directorate
NWW	New Water Ways project
RCP 2.6	Low GHG emissions scenario
RCP 4.5	Intermediate GHG emissions scenario
RCP 8.5	Highest GHG emissions scenario
RPC	Representative Concentration Pathways, IPCC's report scenarios
Scope 3 emissions	Indirect GHG emissions resulted from activities not owned or controlled by the reporting organization, according to GHG Protocol.
UHI	Urban Heat Island
VG	Popular Norwegian newspaper that produces content for VG.no (web and app)

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1. Introduction

Environmental communication (EC) is becoming increasingly influential in addressing and tackling climate change, and there is a greater urgency than ever to do so (Pezzullo and J. Robert Cox, 2018). As a crisis and care discipline, EC may provide individuals with many possibilities to meaningfully participate in public discussions and dialogues about the environment (Pezzullo and J. Robert Cox, 2018). Besides, it creates meaning in environmental actions and defines problems such as excessive emissions that led to the climate crisis (Klöckner, 2015). Moreover, climate change communication is a key element of climate change governance at all levels (Howarth, Parsons, and Thew, 2020).

The Global North is responsible for 92 percent of excess emissions (EOS, 2020) due to its intense consumer culture resulting in extreme carbon inequality in global measures (OXFAM, 2015). Such irresponsible consumption led to environmental degradation, particularly global climate change. Even though climate change consequences are most prominent in the Global South, northern countries started to feel climate threats and are creating adaptation programs to curb climate change-related threats and developing climate mitigation strategies. As an exemplification, Oslo city is experiencing rapid population growth and evident variations in climate conditions. Therefore, the city can be seen as both the source of and a solution to today's economic, environmental, and social challenges.

The water sector in Norway is expected to face a significant rise in precipitation of 18% by 2100 and an increase in seawater levels between 15 and 55 cm (Klimaoslo, 2020a). Therefore, a sector facing such obvious climate threats must communicate the situation so that civil society is well educated and acts responsibly to minimize the effect on its people and global citizens. There is an increasing recognition that the twenty-first century's complex sustainability problems cannot be solved solely on material, physical, or technical levels (Leichenko and O'brien, 2019). We should eventually shift towards higher sustainability by redefining priorities, shifting mindsets and paradigms, and adopting low-impact lifestyles (Woiwode et al., 2021). New narratives, social behaviors, and increased emphasis on mindsets, understanding, and motivation in adaptation research are needed (Wamsler and Brink, 2018). Politicians use various media sources and online communication to provide information and mobilize climate change adaptation plans. The concern here is a failure of information-based approaches at the policy level that shows the need for more profound and long-term change (Woiwode et al., 2021) and strengthening environmental communication. Environmental communication on climate change has become a theme as stakeholders such as national and local authorities and scientists increasingly engage on the Internet and social media to disseminate information and secure citizens' support, as an increasing number of civic society members use these media.

Some studies emphasize that environmental communicators should know one's audience, tell local stories, build relationships with target audiences, and use media as an "important agent in the production, reproduction, and transformation of the meaning" of climate change (Schäfer, 2012). Consequently, environmental communication used by municipalities, national authorities, and scientific institutions and the message they send might be a compelling, robust and legitimate information source for Oslo citizens resulting in better debates.

1.1 Problem statement

Environmental communication has the premise of creating meaning in environmental actions and defining problems such as hyper-consumerism. Moreover, communication provides citizens with many possibilities to participate in public discussions and dialogues about the environment (Pezzullo and J. Robert Cox, 2018) and eventually leads them to higher sustainability by redefining priorities, shifting mindsets and paradigms by adopting low-impact lifestyles (Woiwode et al., 2021).

This study aims to address the existing knowledge gap for environmental communication and its premisses to addressing the global climate crisis. Since there is a research gap and no other studies have looked at climate communication in Oslo, this study may fill that gap. Therefore, this research will explore environmental communication in Oslo by looking at water-related climate strategies and initiatives. The premise behind an in-depth look at WRCS is the severity of water-linked threats in Oslo that started to influence Oslo citizens. The potential of legitimate environmental communicators is to raise climate awareness and urge citizens to act and move toward transformational changes favoring climate-friendly lifestyles.

If not, this might lead to apathy or disengagement in the climate crisis. Therefore, it is essential to give insight into the practice of environmental communication and not overlook the perspectives of online communication strategies and expertise of communicators, the challenges they face, and the use of different communication messages and channels. Ultimately, there is a necessity to look at a balanced way to inform civil society. By looking at a concise case study, it should be possible to understand the perspective of environmental communication by exploring the knowledge, practice, and challenges of environmental communicators engaged in Oslo's WRCS.

1.2 Research questions

This thesis will operate with three sets of research questions. Notably, the plan was to investigate current or recent climate strategies, analyze environmental communication practices by environmental communicators in Oslo, and ultimately analyze communication messages that are most capable of providing climate awareness. Nonetheless, according to interviews performed with environmental communicators, climate awareness appeared to be a negligible topic rather than a significant one. Therefore, detecting gaps in environmental communication strategies and practices and comparing them to the most preeminent theory and scientific knowledge on environmental communication became a third query interchanged during the iterative data collection and analysis processes.

Accordingly, I posed the question of how to make the present more accountable for the future by using the most effective climate communication techniques based on existing knowledge. As a result, the following research objectives were raised:

a) To identify and analyze recent climate change strategies and initiatives in the water and wastewater sector in Oslo city and describe how such initiatives are communicated to Oslo citizens.

b) To assess the knowledge of climate change and accustom environmental communication practices by environmental communicators in the Oslo municipality, Norwegian governmental agencies, and scientific institutions engaged in water-related strategies.
c) Compare and identify gaps between water-related communication strategies and common environmental communicator's practices using theory on effective environmental communication.

Thus, the following research questions were formulated for this thesis work:

Research question 1 (RQ1): What are up-to-date water-related climate change strategies and initiatives in Oslo, and how are they communicated?

Research question 2 (RQ2): What are environmental communicators' perspectives on climate change, and what implications do they have for environmental communication?

Research question 3 (RQ3): What are identified gaps in environmental communicators' practices compared to best theoretical practices?

1.3 Thesis outline

This study is structured into six main chapters. Following the introduction in **Chapter 1**, **Chapter 2** presented the literature review and conceptual framework. Here, the conceptual framework, which supports this thesis, is introduced, followed by a literature review and extraction of important variables on environmental communication, thus providing the background information and situating the study within existing debates. Further, presenting this research methodology, **Chapter 3** first explains the methodological inquiry of this study. Second, the conceptual tools to be used in this research are explored in detail in this chapter. Next, Chapter 3 gives an overview of the data collection methods used in this research. Lastly, this study's ontological and epistemological implications and limitations are assessed.

Further, **Chapter 4** presents findings derived from analyzing the collected secondary data. Here, the chapter provides a detailed presentation of water-related climate strategies and the communication channels they are placed. Following, **Chapter 5** presents findings from the survey and interviews. First, the survey represents the findings of the environmental communicator's knowledge of climate change and environmental communication. Second, interviews present communicators' implications for environmental communication.

Chapter 6 then presents the conceptual tools. Later, **Chapter 7** presents concluding thoughts and sums up this thesis. Finally, **Chapter 8** discusses the study's main findings following the posed research questions, and **Chapter 9** suggests ideas for future research.

2. Literature Review and Conceptual framework

The literature review and conceptual framework focused on three leading themes: multi-level governance in environmental domains, water-linked climate threats in Oslo, and environmental

communication for research concepts learning. The former was assessed as an extensive review of environmental communication as a field of science to communicate climate matters. First, the multi-level governance structure was discussed hierarchically to provide an overview of the structures and interactions between international, national, and municipality level authorities to address climate change challenges. Additionally, citizens' actions and concerns regarding climate change were reviewed. Subsequently, concise descriptions of main Oslo's climate threats were elucidated.

2.1 Multi-level governance in environmental domains

This section underlined the international, national, and municipality level context in environmental protection matters. Particularly, formal obligations and interconnections between the different structures were assessed. Eventually, citizens' attitudes towards climate change were explored. This section allowed the study to have a solid political and interpersonal understanding.

2.1.1 Norway's international and national obligations towards climate change

Norway has set a fairly high national climate target and placed measures to achieve them. In alignment with the Norwegian Climate Change Act 2017, Norway is legally obligated to cut at least 50-55 % of GHG by 2030 and facilitate a low-emission economy by reducing greenhouse gas emissions by 90-95 percent by 2050 (Lovdata, 2021). It has implemented a wide range of international policies to achieve the goal, including alignment to Climate targets signed under the Paris Agreement of 12 December 2015. The Norwegian Environment Agency then serves as a regional hub for the IPCC in Norway, spreading information from IPCC's reports. The country also links the national emissions trading scheme to the EU Emissions Trading Scheme, carbon taxation (Norwegian Ministry of Climate and Environment, 2019), and cooperation on the European Green Deal (Regjeringen, 2020). Through its Worldwide Climate and Forest Initiative, Norway is an active conciliator in UN climate discussions and is committed to mitigating climate change by protecting the world's rainforests and decreasing deforestation-based emissions in developing nations (NICFI, 2020).

On the other hand, while Norway has established rather ambitious national climate goals, its international GHG emission footprint has a tremendous impact and is lamentably neglected. Worths specifying that Norway's oil and gas exports have contributed significantly to the exponential economic growth in Norway and the Norwegian welfare state (Ministry of Petroleum and Energy, 2021). Almost all of Norway's oil and gas production is exported: Norway is the world's third-largest gas exporter and the fifteenth largest oil exporter (NorwegianPetroleum, 2021).

According to Greenpeace (2021), Norwegian nonterritorial emissions that account for around 95 percent are excluded from the government's environmental impact assessments. Norway is only liable for greenhouse gas emissions that occur on Norwegian territory. Even when evaluating emissions per capita, Norway is one of the top 20 GHG emitters in the world (CCPI, 2021; Voigt, 2021; Worldometer, 2016). Another illustration is given by Climate Action Tracker (2019), which assessed Norway's preparedness to achieve a temperature reduction of less than 2°C by 2030 and concluded that the overall ranking and efforts are "insufficient" to achieve it.

Furthermore, on October 18, 2016, a coalition of environmental organizations, including Greenpeace Nordic Association and Nature and Youth, as well as the Grandparents Climate Campaign as an intervener, filed a lawsuit against the Norwegian government, specifically the Norwegian Ministry of Petroleum and Energy (Voigt, 2021). The claim related to petroleum licenses issued by the Norwegian government supposedly violated the 'right to a healthy environment' as contained in the Norwegian Constitution. However, the Court rejected the claim and provided a judgment that aligned the law with the current politics in favor of continuous petroleum extraction on Norwegian territory (Voigt, 2021). To conclude, one can claim that the image of Norway as a green country with high environmental ambitions contrasts sharply with the country's economy being heavily reliant on fossil fuel exploitation.

2.1.2 Oslo municipality's obligations toward meeting climate targets

Oslo has one of the most ambitious climate goals of any major city on the planet (Nordregioprojects, 2021) and seeks to be a pioneer in the transition to a greener, more inclusive society and significantly contribute to the green shift. In fact, the city's five arduous climate goals are outlined in Oslo's Climate and Energy Strategy, which is aligned with the Municipal Master Plan for Oslo, "Oslo 2030: Smart, Safe, and Green." A leading climate goal is a 95% reduction in emissions by 2030 compared to 2009, and it goes in line with the Paris Agreement's 1.5°C targets (KlimaOslo, 2021). Thus, the city will be carbon-free in the next eight years if climate targets are met. The second goal claimed by KlimaOslo (2020c) is the management of Oslo's natural areas to protect carbon storage in vegetation and soil and promote greenhouse gas sequestration in forests and other vegetation in the years running up to 2030. The third stated objective is a 10 percent reduction of Oslo's overall energy usage by 2030, compared to 2009. The fourth objective relates to climate adaptation and aims to strengthen Oslo's capacity to withstand climate change towards 2030 and even lead up to 2100. Lastly, KlimaOslo (2020c) declared an ambitious goal to go beyond city boundaries and significantly lower Oslo's impact on greenhouse gas emissions outside the city in 2030 compared to 2020.

The city's government has prioritized tightening the instruments to reduce emissions from building and construction, road transport, and waste incineration sectors. Oslo's Climate and Energy Strategy stated that the three industries mentioned above account for 88 percent of Oslo's total GHG emissions (KlimaOslo, 2021). The visual presentation of industries that contribute to the city's most significant climate gas emissions is illustrated in Figure 2.1.2.

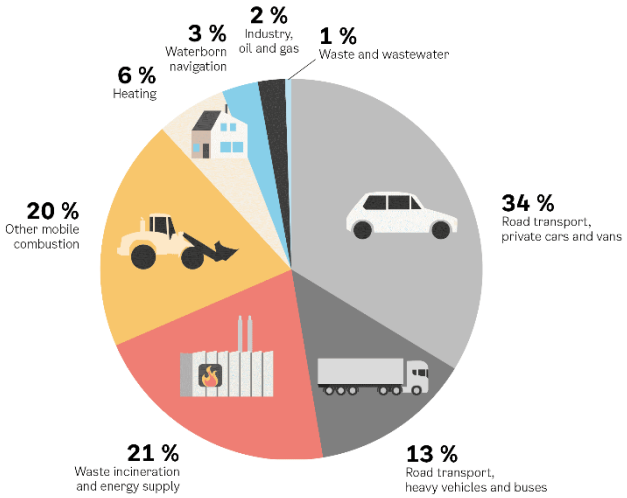


Figure 2.1.2 Sectoral shares of GHG emissions in Oslo, KlimaOslo (2020c).

In order to track and be accountable for the city's GHG emissions, Oslo introduced a climate budget in 2017 and was one of the world's first cities to do so. The climate budget is then an instrument to achieve the city's climate goals and climate strategy. The tool is integrated and presented alongside the annual municipal budget, with the Department of Climate in charge of developing the academic foundation (KlimaOslo, 2021). An instrument works analogously to financial budget limits - the climate budget establishes a limit on the amount of carbon dioxide emitted in the city in a given year (Carbon Neutral Cities Alliance, 2019). Overall, the Climate Budget goals are being accomplished cooperatively, with citizens and the business community actively participating, says Oslo kommune (n.d.).

Such coordinated and cross-sectoral endeavor has already significantly contributed to the significant improvements in Oslo, according to Carbon Neutral Cities Alliance (2019):

- Per capita greenhouse gas emissions are decreasing, while the number of people using public transportation, cycling, and walking is increasing — all at the expense of car traffic.
- Oslo is known for its proximity to green spaces, open areas, and the Oslo fjord and the highest proportion of electric vehicles globally.
- The green commercial sector was innovated by a circular economy-based waste management system where waste is turned into valuable goods.

In fact, Oslo's innovative climate budgeting system proves that the city's emissions are falling despite Oslo being one of Europe's fastest-growing cities (Knowledge C40, 2021). Besides, New York, Rio de Janeiro, Toronto, Vancouver, San Francisco, Stockholm, Amsterdam, Paris, Copenhagen, Helsinki, Sydney, and Portland have adopted or are developing climate budgets based on Oslo's model (The Nordic Page, n.d.). To conclude, this demonstrates the city's efficiency and potential to lead other global cities in reaching climate targets in line with the Paris Agreement.

2.1.3 Political structure and dependencies

Levels of government in Norway include central government (along with central government agencies at the regional and local level), county authorities, and municipalities. Dependencies between distinct levels explained by the Norwegian Ministry of Local Government and Modernization (n.d.) revealed that while local governments have the authority to prioritize and decide how to implement policies to meet local needs, the national government retains overall responsibility. Moreover, Norwegian authorities expect much information about how local governments are doing. Then Norwegian Ministry of Local Government and Modernization (n.d.) explained that such tight control is crucial for developing national policy and ensuring that each municipality adheres to national norms.

Oslo, the capital, is nominally a municipality, although it performs the same functions as the county governments. Consequently, the county authorities' responsibilities expand to more regional planning, including environmental issues.

Næss et al. (2005) looked at how the structural links between the national, county, and municipal levels of government shape the ability of local governments to adapt to climate change, particularly flood incidents. In Norway, local institutions are closely regulated by specific guidelines, legislation, and budgets established at the national level, declared Næss et al. (2005). However, according to research authors, only in a time of crisis local economic interests and influential actors may gain greater influence, leading to ad hoc decisions being made. Accordingly, the findings have been extensively analyzed and concluded that while municipal governments in Norway attract investors, there is a willingness to take the risk of damage. Hence, Næss et al. (2005) provided evidence from a neighboring municipality near Oslo. He asserted that the decision to build on a flood-prone area was accepted in favor of a local company that threatened Oslo's neighboring municipality to relocate from an area.

Næss et al. (2005) study then came up with three conclusions:

- At the municipal level, the existing institutional framework for flood management provides limited incentives for proactive flood management. A common perception is that large-scale flood events are outside the responsibility of municipalities and that the national government should cover damage; therefore, local municipalities have weak political representation.
- Despite environmental NGOs' protests, technical measures were chosen as the preferred policy solution in municipalities. Many policies, therefore, could be classified as 'trash can' decisions.
- There is a high degree of individualized rather than institutionalized learning, reliance on crucial persons, and cultural and perception variations between local and national governing levels.

Similarly, Orderud and Naustdalslid's (2019) study came to similar conclusions: municipalities' resources and political agendas are key barriers to pursuing adaptation steps. Due to a lack of resources, local administrations cannot acquire the expertise necessary to adapt to climate change. In addition, it makes it more difficult for municipal officers to argue for or against activities taken by public agencies or private enterprises (Orderud and Naustdalslid, 2019). Researchers then concluded that the increased frequency of extreme occurrences might prompt rapid shifts in political priorities

but developing the necessary knowledge and systems for what to do and how to do it may be insufficient.

2.1.4 Citizen attitudes and concerns about climate change

Due to a lack of appropriate statistical and scientific coverage on the topic, local and national residents' perceptions were explored. In fact, numerous national-level research were conducted in the Oslo area, making studies profoundly representative of the topic.

The Oslo Municipality's Climate Agency is a driving force in achieving climate goals in the city through collaborating with other municipal departments and informing and inspiring Oslo residents. The Climate Agency serves as an editor for the KlimaOslo website, which Oslo Municipality manages. Climate-related information for Oslo citizens and other city shareholders is available on the KlimaOslo website. It includes the most up-to-date climate initiatives, climate-related surveys, related paperwork, and numerous city-wide campaigns.

An annual climate survey ordered by the Climate Agency unfolded Oslo citizens' attitudes towards the climate. To begin with, Worldometer (2019) reported that Oslo has a population of 580,000 people, accounting for more than 10% of Norway's total population. According to the final annual survey, most people thus support Oslo's objective of lowering greenhouse gas emissions by 95% by 2030, with 68 percent of Oslo's population saying that the goal is very or fairly significant Opinion, (2021). Furthermore, as reported by the same source, 57% of Oslo inhabitants agree that working toward climate goals will make the city a better place to live, and 50 % believe Oslo must take the lead over other cities for Norway to meet its climate goals. Compared to 2020, where 58 percent thought the same, this represents a drop of 8 percentage points.

Likewise, adaptation to changing climate change and withstanding it appeared to be ‘very’ or ‘quite important’ to 3 out of 4 (74 percent) of Oslo citizens Opinion, (2021). In fact, the survey revealed that residents became increasingly anxious about how well their own home or building is protected from more frequent and heavy torrential rain. For instance, in 2020, 60% of respondents said their own home was well guarded; by 2021, that number had dropped to 48% (Opinion, 2021). Furthermore, according to the survey, 44% of respondents expressed concern that Oslo is not well-positioned to deal with climate change and more extreme weather.

Regarding surface water, among the Oslo residents who own their land, 40% are aware that they are responsible for surface water issues, while 60% are unaware. In 2021, only a few people faced such difficulties: only 6% of those surveyed said they had experienced such issues on their property (Opinion, 2021). To summarize, survey results are extensively used by the Climate agency in Oslo to align and coordinate their policies and strategies to pursue a climate-neutral city.

On the contrary, scientific literature suggests that Norwegians are not as climate-friendly as expected. For instance, a survey performed by Sentio Research Norway revealed that only 23 percent of the Norwegian population answered that Norway should stop exploring for oil and gas. In comparison, 59 percent believed that oil exploration should continue (TU, 2021). Likewise, in a recent

study, Poortinga et al. (2019) discovered that attributional climate skepticism[1] in Norway (12.0 percent) was surprisingly high. Similarly, Austgulen et al. (2018) found that environmental policies aimed at transferring part of the responsibility for reducing greenhouse gas emissions to consumers were challenged because most consumers were still not ready to make purchasing decisions based on what was the best climate or environment. The research was performed in the Oslo area. In addition, another study by Krange, Kaltenborn, and Hultman (2018) revealed substantial nexus between climate change denial in Norway among 'xenosceptic[2] cool dudes' leaning toward right-wing nationalism.

Further, using a national panel survey and high-resolution seasonal climate observations, Howe (2018) looked at how Norwegians perceive seasonal weather and looked for signs of motivated reasoning associated with pre-existing beliefs about climate change. Pre-existing ideas about climate change, according to the author, may obstruct effective mitigation and adaptation by limiting the ability of some people to detect the effects of climate change at the local level. Moreover, attempting to highlight recent experiences with extreme weather or climatic conditions in climate change communication and education may be ineffective in motivating citizens to change their behavior, as suggested by Howe (2018). His explanation implied that such messages might be perceived as contradictory to citizens' subjective experiences.

Moreover, according to Howe (2018), climate change communication and education that attempt to highlight recent experiences with extreme weather or climatic conditions may be ineffective in motivating citizens to change their behavior. He argued that such messages might be perceived as contradictory to citizens' subjective experiences.

Besides, the Norwegian educational system may face epistemological presuppositions that do not support a transformational approach to a green shift. A study performed by Skarstein (2020) interrogated teacher education programs in Norway that face unique challenges to their climate change education. Given that the country's economy is based on oil, the author speculated that the public could be more climate skeptical. According to research, recent recessions in the Norwegian oil business resulted in an influx of dismissed oil engineers into science teacher education in Norway (Skarstein, 2020). Due to their natural scientific backgrounds and connections to the oil business, this group of pre-service teachers may have mixed feelings about human-induced climate change (HICC) and approaches to educating about it (Skarstein, 2020). Even though the amount of factual information that Norwegian 15-year-olds have about the natural science of the greenhouse effect has consistently increased from 1989 to 2005, in line with the inclusion of the topic in national curricula and increased media attention (Hansen et al., 2010) this not necessarily lead to pro-environmental behavioral shift. As an illustration of teenagers' perceptions concerning climate change, Fløttum, Dahl, and Rivenes's (2016) study found that when Norwegian teenagers were asked about their knowledge of climate change, only a small percentage of young adults in Norway said they had 'good' or 'very good' information.

Meanwhile, 61% said they had 'some,' 'little,' or 'no knowledge.' According to the same study, Norwegian young adults were moderately concerned about climate change, believed that preventing dangerous climate change was possible but challenging and that individuals had a moral obligation to

[1] Attribution skepticism is assessed by asking the question "Do you think that climate change is caused by natural processes, human activity, or both?" (Poortinga et al., 2019).

[2] Suspicion or dislike of immigrants combined with a belief that immigration rates are too high.

strive against it. Finally, Cohen, Higham, and Cavaliere (2011) qualitative data study suggested that while Norwegians might express a clear discrepancy between, on the one hand, accepting HICC as a real problem, on the other hand, not being willing to let this affect their lifestyle. Findings are consistent with recent media reports about hypocrisy in Norway; as co-founder and Chief Executive Officer of Skift Business Climate Leaders Bjørn Kjærand Haugland noted about Norwegians: “we say the right things, and we do not do what we say” (Universitetet i Bergen, 2022, Final Panel, 35:47min), because moving toward sustainability would require radical change. Another example may be a prediction made by the deputy leader of Norway's Green Party and a media outlet that covers crises and promotes awareness of underreported worldwide concerns, as follows: “it seems, Norwegians will keep living with the contradictions. And by 2030, they might just be a country that calls itself carbon neutral but still exports a million barrels of oil a day” (Pulitzer Center, 2021). To sum up, most Norwegians and Oslo citizens have positive attitudes toward HICC. However, the green shift might create a lack of enthusiasm in an oil-dependent economy as many are unwilling to change their lifestyle.

2.2 Water-related climate threats in Oslo

This chapter investigated climate threats in Oslo that were linked to water. First, general treats at the national and municipal levels were assessed to explain the water sector's current intensity and future conditions. After that, floods, stormwater, landslides, and rising sea levels were discussed separately. Additionally, blue-green solutions were explained as green city planning and were regarded as one of the leading technology solutions to curb climate impacts and adapt to them. As a result, theoretical knowledge of climate challenges and the introduction of spacial Oslo planning solutions served as a basis for understanding climate strategies and implications of interviewees.

2.2.1 Future climate predictions in Oslo and Norway

Climate change, defined as a gradual change in average climate conditions, is a challenging process to detect and track precisely in a specific area. Furthermore, because there are numerous climate scenarios based on emissions, it is more difficult to anticipate what specific repercussions will occur in Oslo versus those more characteristically to an area, such as Northern Europe. As a result, some projections are more precise and unique to Oslo, while generic ones apply to all of Norway.

Norwegian Environment Agency (2021a) reported a 2.4°C increase in average temperature in Norway from around 1961 to 1990 until 2020. The same source speculated that an RCP-8.5 temperature will increase by 4.5°C in 2100. Higher temperatures warm the atmosphere, resulting in more water vapor condensing into droplets, forming heavy rainfall.

According to the Norwegian Environment Agency (2021a), Norway's precipitation totals in 2020 were 26% higher than the historical norm (Figure 2.2.1), coming along with rainstorm events that have been heavier in recent years.

The same source explains that Norway already sees the effects of climate change and expects warmer temperatures. It is illustrated by hourly precipitation in Oslo, which has grown by almost 60% in the last 50 years. Significant rainfall events that occur in a short period generate serious challenges, such as floods in cities and severe damage to buildings, roads, and railways, according to the Norwegian Meteorological Institute (2021).

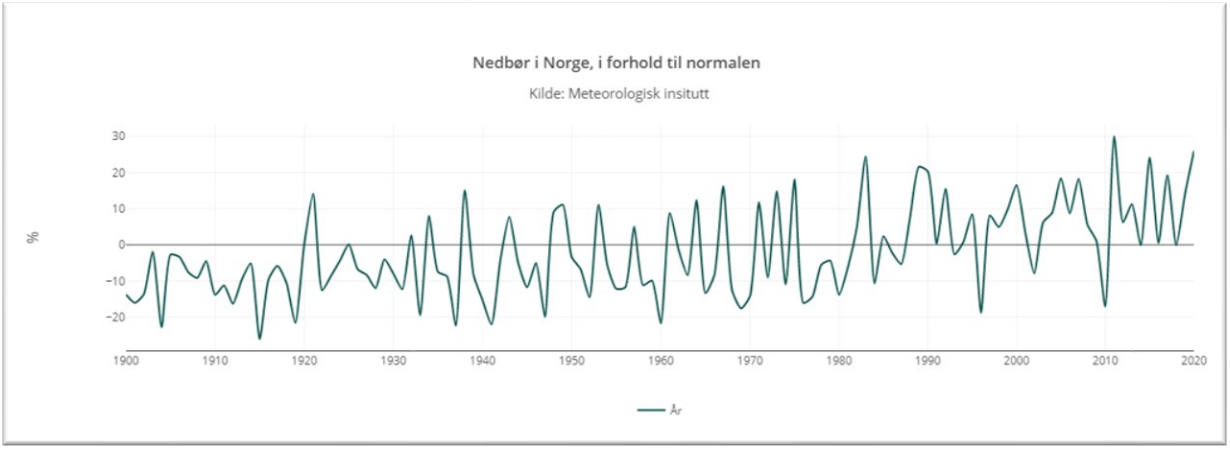


Figure 2.2.1. Precipitation in Norway normalized from 1961-to 1990. (Norwegian Environment Agency, 2021a)

The other dangers of water-related climate consequences include poorer drinking water quality and rot, according to the Norwegian Meteorological Institute (2021), as well as sea-level rise and acidification in the Norwegian seas. Specifically, heavy rainfall can harm water quality, which increases the chance that drinking water sources will be contaminated by drain leaks or run-off from livestock-raising regions.

Meanwhile, the risk of rot increases as the climate becomes more humid and milder, harmful to both health and the economy. Norwegian Meteorological Institute (2021) states that more than 600,000 Norwegian homes are now at risk of water and moisture damage, and by 2100, the population could have swelled to 2.4 million. As a result, it will be critical in the future to construct dwellings and structures that can survive a more humid climate.

Even though sea levels are predicted to rise, the Norwegian Environment Agency (2021a) emphasizes that due to land uplift, the expected sea-level rise in Norway will be lower than in other regions of the world.

To sum it up, the Ministry of the Environment (2013) concluded that Norway's most severe climate issues are projected to be water-related, including flooding, landslides and avalanches, stormwater, and rising sea levels.

2.2.2 Sea level change

The Norwegian coast's global mean sea level rise is accelerating, although the Oslo fjord is experiencing sea level decline, according to Norwegian Centre for Climate Services (2015).

BarentsWatch (2014) specified that the reduction in sea level in Oslo is attributed to specific landmass formations during the ice period. When the ice melted, the pressure was relieved, and the land in the Oslo area began to rise again, and this tectonic uplift continued (BarentsWatch, 2014). In fact, concerning these land uplifts, over the period between 1960 and 2010, it was observed an approximately 12 centimeters reduction in absolute sea level and falling of 1.7 millimeters a year (Norwegian Centre for Climate Services, 2015).

Regarding future predictions, Norwegian Centre for Climate Services (2015) stipulated that only with a climate scenario of RCP8.5, the sea level in 2081-2100 may increase by approximately 5.6 millimeters. Otherwise, as depicted in Figure 2.2.2, another climate scenario suggests a fall in Oslo fjord waters.

Location	RCP2.6 2081–2100	RCP4.5 2081–2100	RCP8.5 2081–2100
Oslo	-0.7 (-3.4 to 2.0)	-0.2 (-3.7 to 3.1)	5.6 (0.7 to 10.3)

Figure 2.2.2. Rates of anticipated relative sea-level change in Oslo from 1986 to 2005 to 2081–2100. The units are millimeters per year. Adopted from Norwegian Centre for Climate Services (2015).

Nonetheless, it is worth noting that the harbor area in Oslo (Bjørvika) has sinking foundations, with the consequent subsidence estimated as 3 to 13 millimeters per year during the last 50 years (*Norwegian Centre for Climate Services, 2015)*. Therefore, compared to the entire of Norway, sea-level rise in the Oslo fjord is highly unlikely.

2.2.3 Stormwater and flood

Stormwater and flooding are inextricably linked occurrences that necessitate coordinated responses. Miljødirektoratet (2021) describes stormwater as “runoff on impermeable surfaces such as roofs and roads that originates from precipitation, a storm surge or meltwater.” The source explained that when there is a surplus of stormwater, it might flow as temporary streams through the terrain or built-up areas, accumulating in low points where there is usually no water. When surface water flows into a stream or river, it is referred to as a watercourse. Similarly, surface water that enters a municipal sewer network is referred to as wastewater and not stormwater. Flooding definition, meanwhile, is closely related to stormwater and SNL (2020) defined flooding as “a water flow that runs across the banks” or the event where “the water level in lakes and rivers goes beyond normal and causes the water to come out over areas that are usually dry.” As a result, the relationship between the two events can be characterized as follows: stormwater is runoff from rainfall that travels overland and can produce short-term flooding, whereas floods are caused by untreated stormwater and have longer-term implications.

As a result, the interconnection between mentioned events can be explained as stormwater as a runoff from rainfall that flows overland and may cause short-term flooding. In contrast, flood is

caused by untreated stormwater. Moreover, both occurrences share the same challenges and have a solid potential to influence Oslo's urban development toward water resilience and security under climate change (Jiang, Zevenbergen, and Ma, 2018). The following are some of the significant factors that influence urban development in a city, corresponding to the *Action plan for surface water management in Oslo municipality* (City of Oslo, 2016):

- Urbanization caused more significant runoff as a result of densification and transformation from nature to impermeable surfaces
- Climate change as a driver of increased rainfall and precipitation intensity
- Insufficient surface water measures and drainage systems in response to rising runoff.

Therefore, Oslo stormwater management is an effort to reduce such runoff of rainwater or melted snow onto streets, lawns, and other sites while also improving water quality. As Climate Change Vulnerability Analysis for Oslo underlines, "stormwater is – and will continue to be – the climate-related hazard that will affect Oslo the most and is the one for which most preventive measures have been taken (KlimaOslo, 2020a)." Therefore, there is an urgent need to develop and implement stormwater management action and urban flood channel networks to protect Oslo from extreme precipitation events, as specified by KlimaOslo (2020a). Under Oslo municipalities' webpage, one can find both stormwater handling strategy and a handbook for stormwater. As stated in the *Action plan for surface water management in Oslo municipality,* this also means building floodways and networks for directing water (Oslo kommune, 2019).

Stormwater management strategies include goals, responsible parts, potential stormwater treatment methods, an underline that stormwater prevention is expensive, and early planning for effective treatment is necessary (City of Oslo, 2016). Meanwhile, the stormwater handbook provides an overview of knowledge gained thus far and the importance of staying up-to-date and sharing best practices with other municipalities. It also discusses the consequences of untreated water and the need to improve stormwater guidance and communication to Oslo citizens. More specifically, Oslo municipalities' agency for Water and Wastewater declared that stormwater should be treated as much as possible on private properties and by finding open solutions. Agency for Water and Wastewater (2019) explained that this is necessary to limit the risk of flooding and maintain the natural circulation of water.

Furthermore, this would contribute to creating a beautiful, blue-green city. Moreover, Oslo municipality emphasizes a common responsibility to treat stormwater and encourages everyone to "take measures to reduce the damage and use the water for something positive." The following are the primary stormwater and flood management treatment guidelines (Figure 2.2.3) as outlined by the Agency for Water and Wastewater (2019):

1. Smaller amounts of precipitation should be infiltrated into the ground.
2. Larger amounts of precipitation should be delayed and retained.
3. Intense amounts of precipitation should be safely passed on in open flood paths.

The Action plan (handlings plan) for stormwater management in Oslo stresses that since most of the city has already been developed, the burden of a three-step method will primarily take place in new-built districts or during significant reconstruction/maintenance works. According to the City of Oslo (2016), if such a three-step strategy (Figure 3.3) is successfully implemented in Oslo, potentially

the city should tolerate most rainfall levels and intensities with minimal damage and benefit from blue-green areas.

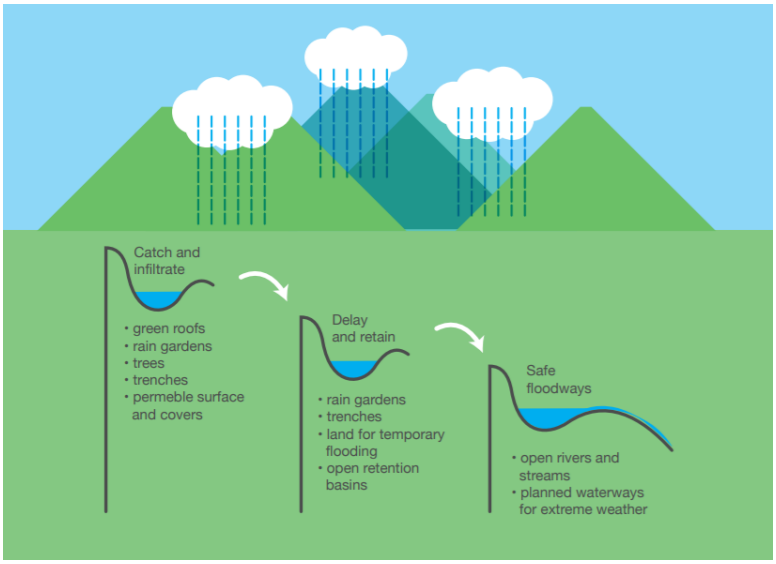


Figure 2.2.3 The three-step strategy and specific stormwater measures within the three steps. (City of Oslo, 2016)

The Office of the Auditor General of Norway published an assessment (Riksrevisjonen, 2022). Data and calculations based on the present climate showed that between 20,000 and 40,000 buildings in Oslo are in flood-prone zones, even without accounting for climate change (ibid). In terms of improved guidance and communication, the Action Plan for stormwater management in Oslo City aimed to build a stormwater communication strategy in 2016-2017 (Oslo kommune, 2019). However, it is still nonexistent as of March 2022.

According to Barbosa, Fernandes, and David (2012), who investigated vital issues for sustainable urban stormwater management, strategies for sustainable stormwater management should occur at many decision levels (for example, at the governmental, regional, or municipal levels). However, they all require information and a clear understanding of each decision's risk options and ramifications. Researchers added that an effective stormwater management strategy should be flexible, based on local characteristics, and consider temporal, spatial, and administrative variables, including proper communication and, finally, law, among other things.

2.2.4 Landslides

The Geological Survey of Norway defined landslides as “masses of rock, soil, and/or snow that move down slopes and can also contain significant amounts of water” (NGU, 2022). Norwegian Geotechnical Institute expands that landslides are typically “triggered by loose masses on steep slopes and river courses being saturated with water and slipping out” (NGI, n.d.). The institute then clarifies that landslides frequently occur due to excessive rainfall and/or snowmelt. In addition, human activity or encroachment on nature that changes stability conditions may be another reason.

Report *How to live with the dangers - about floods and landslides* conclude that landslides are caused by the unique Norwegian topography, including high mountains and steep valley sides and a geological past with ice ages and land uplift (Ministry of Petroleum and Energy, 2012). Landslides have also resulted in significant financial losses. Most importantly, it is a natural hazard that has resulted in the greatest number of fatalities in Norway (Ministry of Petroleum and Energy, 2012). Furthermore, according to KlimaOslo (2020c), certain climate scenarios can have the most profound effects on life and health and result in a massive loss of human life.

In Oslo, the largest landslides occurred at Bekkelaget in 1953 and Ulven in 1957, presumably triggered by excavation in connection with repair work on Mosseveien street (Ministry of Petroleum and Energy, 2012). As a result, an approximately 150 x 190-meter area of quick clay collapsed, separating road and train links from Oslo, killing five persons and injuring 8. (Ministry of Petroleum and Energy, 2012). To summarize, most severe landslides in the Oslo city area were caused by human activity rather than climate change, and severe landslide accidents in the city happened 65 years ago. Meanwhile, one of the most recent (December 30th, 2020) severe landslides occurred in the village of Gjerdrum, 25 kilometers northeast of the Norwegian capital, affecting over 1600 people, and ten lives were lost, according to the Gjerdrum municipality (n.d.).

Nevertheless, Climate Agency in Oslo claims that the terrain and the loose materials determine where the landslides occur (KlimaOslo, 2020c). So, the potential avalanche zones will be the same; there is no need for a climate surcharge or extended danger zones for landslides in the same way as with floods. Therefore, the assessment of landslides in building regulations goes in line with the requirements of floods. Therefore, climate vulnerability analysis for Oslo represents relevant legitimate sources where both NVE's guideline no. 2-2011 *Flood and avalanche danger* describe area plans and NVE's guide no. 3-2015 *Flood danger along streams describes* recommendations concerning landslides (NVE, 2022).

Additionally, Chapter 5 in NVE's guideline no. 2-2011 and NVE's fact sheet no. 3-2015, describe how to consider climate change in spatial planning (KlimaOslo, 2020c)

Although some landslides' guidance and recommendations exist, the Auditor General of Norway's Office concluded that Norwegian authorities do not have a flood overview on climate adaptation consequences to buildings, roads, railways, and coastal infrastructure. More specifically, the Office of the Auditor General of Norway reported that the situation is dire "in light of the significant consequences of climate change" (Riksrevisjonen, 2022). The institution explained that the situation is critical because "the authorities have not secured a sufficient overview and (not) implemented the necessary measures to secure existing buildings and infrastructure" (ibid). The institution also warns that such an unpreparedness "can lead to unnecessarily high costs for society and can also have consequences for the safety of citizens" (ibid). Namely, the Office of the Auditor General of Norway serves as an audit agency of the Norwegian parliament and is the only institution that can provide a comprehensive and independent government audit. To conclude, the threat of landslides is not investigated enough, so the impact on Oslo and its citizens is unclear. Nevertheless, landslides are linked to extreme precipitation levels and floods.

2.2.5 Blue-green solutions for stormwater treatment

The combination of intensified short-duration rainfall events, alternated with long dry episodes that accompany urbanization, makes cities more prone to flood risk (Cristiano et al., 2021). Authorities of such cities advocate holistic planning and management of water and are concerned about how to design the whole city in a more sustainable, adaptable, efficient, and resilient manner (Brears, 2018, p. xvii).

According to Brears (2018, p. xviii), Blue-Green solutions involve using natural or man-made systems to improve ecosystem services in water resource management and increase climate risk resilience. Such solutions create synergies between urban components and environmental services, resulting in multifunctional urban solutions that are more efficient and cost-effective (Ranko Bozovic et al., 2017). Blue-green systems can incorporate green roofs, street trees, permeable paving, stormwater management, parks and open spaces, gardens, and other elements (Figure 2.2.5a). The advantages of such blue-green systems are illustrated in Figure 2.2.5b.

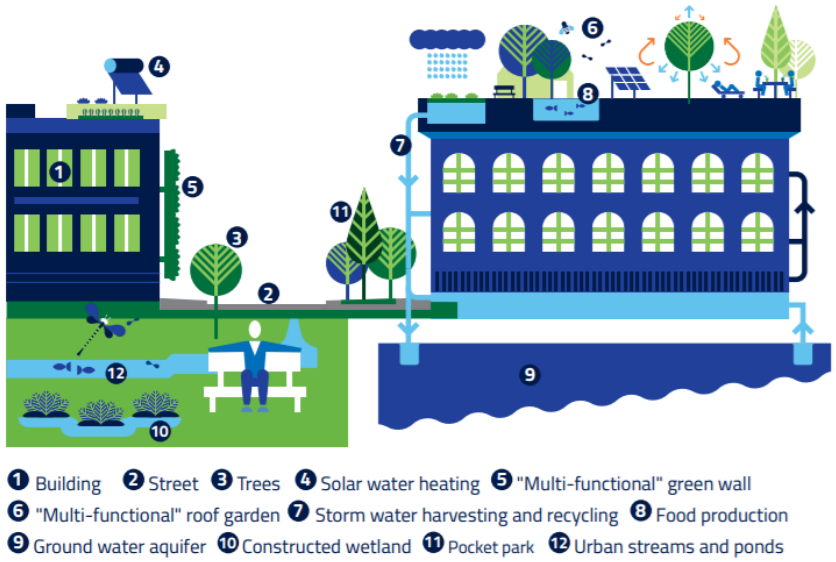


Figure 2.2.5a Examples of Green-blue solutions. (Ranko Bozovic et al., 2017)

Figure 2.2.5b Benefits of blue-green solutions. Adapted from Ranko Bozovic et al. (2017)

Oslo municipality has also recognized the importance of green urban planning. *Oslo's Municipal Plan to 2030 – challenges and opportunities for blue green infrastructure* (PBE, 2020) and, more specifically, the *Blue-green factor norm for buildings in Oslo* (BPE, 2019) introduced general and formal requirements to include greenery and water solutions in city's areal planning. As a result, blue-green planning is a global and local trend in urban planning that supports biodiversity, climate adaptation, stormwater management, recreation, and air quality (BPE, 2019).

2.3 Environmental communication

This section presented an overview of environmental communication (in terms of the history of a study field, objectives, a review of the target audience, discussion of fundamental messages, communication channels, and strategies) based on a conceptual framework. The review from a more general description was filtered down to climate change or climate EC, with communicators being scientists and actors from national or municipal governments. These entities were viewed as the most legitimate for disseminating climate messaging. Knowledge gathered about EC served as a theoretical background for creating survey questionnaires and semi-structured interview guides and a tool to respond to the third objective – comparing practical and theoretical practices.

2.3.1 Objectives and historical perspective on environmental communication

Compared to other historical periods, the modern world is defined by information overload and an acceleration in the pace, extent, and severity of environmental issues. The abundance of information over the last few decades has not been able to hinder environmental degradation. Contrarily, it could be claimed that specific environmental issues became even more prominent (World Meteorological Institution, 2021; Valencia, 2018; EEA, 2021). The amount of information itself will not prevent the deterioration of the environment. There is a need for appropriate knowledge that is efficiently channeled and integrated into social action networks required to reverse current unsustainable and

damaging environmental trends. Therefore, environmental communication is an essential component of rethinking and reorienting global environmental activities and establishing a more effective political practice capable of swiftly accelerating the pace and scope of social change (Brulle, 2010). Environmental communication also asks for a shift away from incremental actions based on short-term pragmatic considerations and toward establishing widespread global initiatives required to address global warming (Beddoe et al., 2009). Since climate change, with its slow and gradual modification of average climate conditions, is regarded as a global and complex phenomenon that has not yet been adequately solved, environmental communication is being used to solve a mass communication problem.

Despite the lack of a common agreement on a definition, the SAGE International Encyclopedia of Mass Media and Society (n.d.) describes environmental communication as "the dissemination of information and the implementation of communication practices related to the environment." The same encyclopedia clarified that EC could have the shape of "complex, involving verbal, nonverbal, personal, interpersonal, and visual communication." According to The International Environmental Communication Association (2015), the term also means "an interdisciplinary field of study that examines communication's role, techniques, and influence in environmental affairs." Besides, EC field studies the activity, and in doing so, it draws its theory and methods primarily from communication, environmental studies, psychology, sociology, and political science."

In the beginning, environmental communication was a narrow area of communication and originated in the United States in the 1980s, deviating from standard rhetorical philosophy (Harris, 2017). However, currently, it is a broad field that includes research and practices regarding how different actors (e.g., institutions, states, people) interact about topics related to the environment and how cultural products influence society toward environmental issues (Harris, 2017). After observing how environmental advocates and supporters employed images and phrasing to persuade their audiences, researchers investigated environmental communication as a separate, stand-alone theory. Since the first movements, environmental communication theory has achieved several milestones, including establishing an environmental communication journal in 2007, the International Environmental Communication Association (IECA) in 2011, and a couple of sections and divisions in established academic associations (Katz-Kimchi and Goodwin, 2015).

One of the most recognized environmental communication experts is author J. Robert Cox who wrote numerous books and articles concerning EC. He recently defined environmental communication as a crisis and care discipline, reshaping the discipline of environmental communication to reflect on a growing network of scholars and practitioners and engaging new research on everything from industrial apocalyptic rhetoric to emerging ways to assess media impact. Pezzullo and J. Robert Cox (2018), in their book "*Environmental communication" and the public sphere,* 5th edition, distinguished three core principles that serve the field of environmental communication framework:

1. Human communication is a symbolic action
2. As a result, our beliefs, choices, and behaviors about the environment are imagined, shared, and judged through communication
3. As a cornerstone of democratic life, the public sphere is a discursive area in which competing voices engage each other with environmental issues.

Authors have also identified seven major areas of study and practice in the field of environmental communication:

1. Environmental rhetoric and discourse
2. Media and environmental journalism
3. Public participation in environmental decision making
4. Social marketing and advocacy campaigns
5. Environmental collaboration and conflict resolution
6. Risk communication
7. Representations of nature in popular culture and green marketing

While knowing feasible study and practice areas is an overarching phase, there is a need for strategic thinking in assessing different environmental issues. Therefore, communication strategies should be created for a particular environmental policy. In particular, I will focus on climate change communication in my research, which will embrace both adaptation and mitigation strategies. Therefore, intending to develop an effective climate communication strategy, communicators need to define the objectives of the intended communication, identify stakeholders, define core messages and determine communication methods for disseminating information. In my thesis, I will primarily focus on finding the best practices in message formulation and presentation in the context of climate communication for Oslo residents.

With regards to the main objectives of environmental communication, it serves as a symbolic action and has both pragmatic and constitutive functions (Pezzullo and J. Robert Cox, 2018: p.47). The practical role of environmental communication includes naming, shaping, orienting, and negotiating environmental issues in a more instrumental sense (ibid). Moreover, educating, alerting, persuading, and collaborating are additional and crucial roles (Pezzullo and J. Robert Cox, 2018: p. 34). Accordingly, constitutive function serves as representations of nature and environmental problems as subjects for our understanding. Pezzullo and J. Robert Cox (2018) stated that such a type of communication invites a particular perspective, evokes certain values, attitudes, and ideologies, and thus creates conscious references for our attention and understanding. Climate-ADAPT (2020) emphasized that public awareness is an essential component that encompasses both pragmatic and constitutive functions. The reasons given were that an increased enthusiasm and support stimulated self-mobilization and action and activated local knowledge and resources of Oslo citizens would help policymakers and scientists to achieve climate adaptation and mitigation goals. Therefore, the communication strategies by mentioned stakeholders for Oslo residents may be described as an ‘awareness raising campaign’ (Climate-ADAPT, 2020).

2.3.2 Environmental communicator

Development Education and Awareness Raising (2019) program authors described a successful environmental communicator as the one that uses skillful words, is legitim, authentic[2], visible and known, has similar values and interests to the audience, concerned, knowledgeable, genuine/honest, accountable for her/his words, without personal ego or interest. Finally, a person or organization that offers a practical and positive response. Legitimacy is an exceptionally essential criterion since a 'struggle for legitimacy’ would lead to potentially detrimental ramifications for public trust in science (Ladle, Jepson, and Whittaker, 2005).

Since scientific rationalism is a crucial principle of contemporary policy, policymakers and scientists must avoid oversimplistic handling of scientific findings, which could cause public cynicism and complacency about climate change (Ladle, Jepson, and Whittaker, 2005). In fact, when scientific findings have a high degree of uncertainty, such as probable climate change scenarios, there is a reasonable possibility for media misrepresentation, claimed Ladle, Jepson, and Whittaker (2005). Following that, Environmental communication on climate change has become a theme as stakeholders such as national and local authorities and scientists increasingly engage on the Internet and social media to disseminate information and secure citizens' support; as an increasing number of civic society members use these media.

Numerous studies emphasize that environmental psychologists and communicators should know one's audience, tell local stories, build relationships with target audiences, and use media as an "important agent in the production, reproduction, and transformation of the meaning" of climate change (Schäfer, 2012). However, policymakers appear to be major players in online climate communication, while climate scientists and research institutions are considered to have a limited role (Schäfer, 2012). Regardless, the messages sent by these trustworthy communicators may be an effective, reliable, and credible source of information for Oslo residents, leading to improved debates. To summarize, an effective environment communicator must be able to navigate between being legitimate while also reflecting the target audience's identity and values, among other competencies.

2.3.3 Communication channels

It is well known that the current world is characterized by information overload, and environmental problems are not caused by a lack of environmental information but likely due to a lack of proper tools and methodologies for channeling it (European Environment Agency, n.d.). Accordingly, methodologies must be developed to ensure that the required amount of environmental information is effectively channeled, removing traditional communication models' space, time, and variability constraints imposed on information (European Environment Agency, n.d.). However, information can only become a resource for improving sustainability and environmental quality when it is turned into practical knowledge and efficiently channeled through integrated social action networks, such as internet-based communication tools (European Environment Agency, n.d.).

The use of the internet and social media has increased significantly in the past years (Briciu and Briciu, 2021). Thus, the understanding of climate change has expanded, and there is substantial evidence of positive contributions that improved due to online communication channels (Stamm, Clark, and Eblacas, 2000). Through its agenda-setting role and framing of environmental concerns, the mainstream media played and plays a significant role in shaping our view of nature and critical environmental issues such as anthropogenic climate change (Harris, 2017). Moreover, the media provides a versatile platform for sharing knowledge, raising awareness, and expressing audiences' viewpoints on environmental issues.

Norwegian Environmental Agency identified the following communication channels and dissemination methods, including online and offline ones, while invitations to offline gatherings most often happen via online channels:

- social media

- webinar
- websites and newsletters
- local media - articles, posts, and ads
- participate in events with stands or posts
- cooperation or collaboration partners' channels
- direct information to the target group (e.g., inhabitants via the mailbox; parents and children, through schools and kindergartens; information through the library or other public places where the target group resides)
- information materials such as brochures, information posters, recipe booklets, or the like
- course
- workshop
- breakfast meeting
- presentation
- exhibition or stand
- activity day with toys and quizzes.

Indeed, Pezzullo and J. Robert Cox (2018) stressed that “it is a golden age for communicating science to popular audiences.” Therefore, all those different communication channels are possible in modern times (p. 162). The authors further asserted that social media and websites provide discursive spaces for exchanging perspectives on risks and other environmental threats (p. 190). Furthermore, social media expands the public's reach, allowing individuals to influence environmental policy on a wide range of issues (p.252), enabling them to report, tag, and share content and start environmental petitions on social platforms (p. 256). Moreover, internet communication tools have the potential to transform how the environmental sector and all stakeholders - public, business, and government - interact, exchange information, and make decisions (p.252). This versatile tool is a real game-changer as policymakers use this bottom-up online site to get supporters, reach their voters, and become a “real power” (p. 256).

In spite of online communication benefits, some limitations and considerations exist applying these communication tools for both scientists/scientific institutions and governmental authorities. Aspects of losing legitimacy and neutrality are among the constraints, according to Pezzullo and J. Robert Cox (2018). The authors assessed the role of scientists in having a duty to urgently warn of climate dangers that are at the tipping point and may have catastrophic and irreversible consequences. Besides the urgency to communicate, the authors claimed that scientific institutions face a dilemma as to whether they can maintain their credibility and objectivity if they abandon their ability to freely communicate non-preconceived values in favor of seeking the truth by publicly advocating solutions to problems (p. 151). As a result, scientists and scientific institutions appear to be minor players in online environmental communication, except for episodical online events such as virtual climate change conferences (Schäfer, 2012).

Similarly, while “the Internet is increasingly being used as a tool of governance and as a means to improve the legitimacy of political action” (Schäfer, 2012; p. 531) by national and local authorities, there are potential negative consequences for the public trust in science (Ladle, Jepson and Whittaker, 2005). Notably, polarized representations of environmental research, oversimplistic treatments of scientific conclusions, and deviations from rational objectivity risk weakening public trust in science, as Ladle, Jepson, and Whittaker (2005) stated. Meanwhile, Curtin and Meijer (2006) concluded that

transparency strengthens legitimacy as a solid democratic value. However, Grimmelikhuijsen and Meijer (2015) observed similar trends but recognized that legitimacy was only minimally increased for a limited number of interested citizens.

Ultimately, online communication has emerged, allowing civil society to access environmental information and actively participate in and influence environmental policies. As a result, authorities and scientists may educate the audience and gain more authority. Nevertheless, national and local authorities, together with scientific institutions, should guard their legitimacy and objectivity by avoiding simplifications and maintaining a realistic perspective in environmental communication.

2.3.4 Environmental rhetoric and discourse/key messages

Environmental rhetoric and discourse principles, as well as message-design suggestions, were identified. This identification allowed the creation of a coherent set of guidelines to help national and municipality authorities and scientists produce more effective messages about climate change to citizens. Moreover, the identified and investigated rhetoric served as a foundation for answering the third objective, allowing for a comparison of practical and theoretical discourses.

2.3.4.1 Common knowledge and acknowledgment of uncertainty

One of the most significant challenges to building a collective understanding of climate change is uncertainty, which leads to polarization of opinions and indolence. Pezzullo and J. Robert Cox (2018) examined the issue and concluded that the lack of scientific certainty had allowed delays and inaction in responding to environmental and public health issues. Nonetheless, Tickner et al. (1999, p.1) described a precautionary principle issued in 1998 by scientists, researchers, philosophers, environmentalists, and labor leaders from the United States, Europe, and Canada. The precautionary principle was intended to be applied when some action poses a combination of potential harm and scientific uncertainty: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically." To illustrate, Tickner (2002), in his book *Precaution, Environmental Science, and Preventive Public Policy,* claims that the precautionary principle is quite well established in Norway, and there is a consensus on the validity of the precautionary approach by civil society, national advisory organizations, and among scientists. However, despite the precautionary principle being entrenched, a confronting idea of uncertainty exists where the call for “further research” turns the idea of “caution” against the principle itself, allowing the suspected activity to continue. For instance, researchers Ryghaug, Holtan Sørensen, and Næss (2010) discovered that media narratives in Norway in eight major Norwegian newspapers between 2002 and 2005 communicated certainty and uncertainty with respect to the underlying scientific knowledge. One strategy focused thematically on the state of knowledge about anthropogenic climate change as characterized by scientific controversy, similar to balanced reporting. However, Schweizer et al. (2009) questioned the practice of balanced coverage ethics because of contradicting scientific research abundance, which resulted in a period of uncertainty among policymakers and the public.

As important as reducing uncertainty while communicating, there is necessary to approach the climate crisis holistically and include as many influencing factors as possible. Namely, the public opinion research performed by Stamm, Clark, and Reynolds Eblacas (2000) clearly showed that awareness of an environmental problem should imply a precise understanding of the problem's causes, consequences, and solutions and not just concentrate on singular examples. Furthermore, such coverage would lead to civic understanding and climate action. Thus, only when citizens are aware of all these three dimensions is public understanding less prone to misconceptions, and citizens tend to be more engaged in environmental problems (Stamm, Clark, and Reynolds Eblacas, 2000). To summarize, applying the precautionary principle and explaining climate causes, effects, and solutions while communicating climate change could enhance public trust in climate science and lead to increased public understanding and engagement.

2.3.1.2 Storytelling

Environmental and science communicators are storytellers who turn scientific knowledge into stories for the public and present case studies at the intersection of the audience's value systems. (Brown and Scholl, 2014). In scientific communicators' storytelling, communicators show efforts and engage with target audiences using narrative, metaphors, strong characters, plot, suspense, drama, setting, and language methods (Brown and Scholl, 2014). Such local stories can then serve as important pieces of otherwise incomplete local datasets using traditional scientific methods to document widespread environmental changes, making it even more critical for environmental communicators to engage in two-way dialogue with local residents (Jarreau, Altinay, and Reynolds, 2015).

In the book *The psychology of pro-environmental communication beyond standard information strategies*, Klöckner (2015) observed that stories about climate change make it easier for people to relate to. The author suggested that infotainment[3] is a significant part of environmental communication strategy. He affirmed that climate communication should be implied "to entertain the audience, even in news coverage. Comparable, Pezzullo and J. Robert Cox (2018; p.91) quoted John Abraham, a professor and defender of science in the global warming controversy: "Climate change really is a made-for-TV story. It has all the drama of Hollywood, with real-life villains and heroes thrown in. We, scientists, struggle every day to communicate the importance of climate change to the world. It is great to see communication experts come in and accomplish what scientists alone cannot."

Controversially, some scholars emphasized that infotainment may lead to cynicism (Jebril, Albæk, and de Vreese, 2013), distraught, or downplaying of contemporary public discourse (Sandler and Pezzullo, 2007). Additionally, limited information and resources may lead to interpretations or inadequately addressed global environmental issues. In fact, Sandler and Pezzullo (2007; p.168) claimed that while "melodrama creates a space for acknowledging the moral and emotional dimensions of environmental controversies, it arguably provides a fitting response to technical and scientific discourses."

The pioneers of environmental communication and book writers Pezzullo and J. Robert Cox (2018) debated the storytelling effectiveness in climate discourse. Book authors advocated that due to the shrinking space for environmental news in relation to other topics, there is pressure and competition to disseminate news by taking costs. For that reason, writers claimed, communicators put efforts to attract readers and viewers by simplifying or dramatizing environmental issues. On the

other hand, Pezzullo and J. Robert Cox (2018) identified limitations in storytelling. For instance, stories may lack connection to a global issue, or newsworthy principles such as objectivity and balance may downgrade the real threat. For instance, objectivity will be achieved only when readers or viewers will trust “authorized knowers” of society - scientists, experts in a field, government and industry leaders” (p. 124). Likewise, the balance may unevenly address the urgency to curb climate change through stories; it may seem that there are two sides to the subject, while scientifical studies and empirical evidence adamantly support one side.

Additionally, Pezzullo and J. Robert Cox (2018) observed that emphasizing merely on conflict and human impact, which is often a major theme in a story, may lead to a negative framing for environmental news. Overall, Pezzullo and J. Robert Cox (2018) called climate science a complex story (p.185) that needs to connect different elements into one coherent story. Such a story would help audiences “make sense of new experiences, relating them to familiar assumptions about how the world works” (p.123).

Pezzullo and J. Robert Cox (2018) asserted that compelling storytelling is defined as a narrative that has value, is newsworthy, and may attract readers or viewers. Writers described stories as bits and facts of phenomena (such as climate change) that allow structurally connecting the dots and understanding "what the problem is, who is responsible, and what the solution is" (p.129).

2.3.4.3 Doom and gloom messages

Doom and gloom messages have a contradictory effect on applicability in environmental communication. While pessimistic and threatening messages can effectively raise awareness about an issue, they can also discourage people from taking action. Specifically, “scare stories” are important, asserted Klöckner (2015; p.138) in his book *The psychology of pro-environmental communication beyond standard information strategies*. He advocated “scare stories” to a certain degree. They should be communicated in conjunction with possibilities for adaptive coping since this would allow for behavioral change toward more environmentally friendly behaviors.

Similarly, according to the Development Education and Awareness Raising (2019) program, stories that emphasize the disastrous nature of what is happening without proposing solutions are regarded as weak and ineffective. To illustrate, climate disasters that are too severe to be neglected by government officials and thus unavoidably were communicated had a reverse impact on awareness - the public went from attenuating the risk to amplifying it due to their mistrust of the government (Klöckner, 2015; p.137). Nevertheless, the recent *Communicating Climate Change Risk: A Content Analysis of IPCC’s Summary for Policymakers* study identified that explicitly, informational elements of threat were predominantly used by climate communicators. At the same time, the efficiency of such messaging was not included (Poortvliet et al., 2020). Therefore, threatening messages incorporate different aspects: on the one hand, it can increase awareness, but on the other hand, lack of encouragement can trigger a denial of responsibility to curb climate issues (Klöckner, 2015; p.139).

2.3.4.4 Values, Interests, attitudes

Environmental communicators have a solid impetus to navigate civic society's values, interests, and beliefs in addressing climate change (Pezzullo and J. Robert Cox, 2018; Von Storch and Krauss, 2005). Effective communication should support connecting messages to cultural values and beliefs as people react to traditions, experiences, and shared values, not abstract concepts and scientific data (Pezzullo and J. Robert Cox, 2018). Consequently, climate communicators should be aware of these factors to determine meaningful and newsworthy science stories. In order to succeed, there is a need to eventually shift towards higher sustainability by redefining priorities, shifting mindsets and paradigms, and adopting low-impact lifestyles (Woiwode et al., 2021). New narratives, social behaviors, and increased emphasis on mindsets, understanding, and motivation in research are needed (Wamsler and Brink, 2018). Nonetheless, Pezzullo and J. Robert Cox (2018) argued that too little is known about the reasons and assumptions of audience values that underpin shared climate communication values and narrative selection criteria. In the same way, Wamsler and Brink (2018) admitted that more study on the relationship between human beings' inner dimensions and resolving climatic challenges is needed.

Still, Farrior (2005) and Vatn (2015, p. 119) provide general guiding values to approach the environment:

- Egoistic concerns ("me" rationality: maximizing individual utility)
- Social-altruistic concerns that focus on other people ("we" rationality: solidarity)
- Biospheric concerns ("they" rationality: true altruism)

Both "we" and "them" have the potential to be climate-friendly behaviors, but biospheric concerns are more intrinsic and aim to build long-term value vectors. Brown and Scholl (2014) emphasized that interests and core value orientations should govern how communicators tell science stories, construct climate narratives, and communicate scientific facts. In addition, researchers stressed that communicators should envision relevant messages to a target audience, emphasizing overarching concepts, assisting the audience in seeing how climate information affects them personally, and conveying information in an accurate, appealing, imaginative, and memorable manner. Finally, Brown and Scholl (2014) suggested that the attitude-behavior gap, which occurs when people have positive attitudes or beliefs about environmental concerns but do not act on them because of a disconnection between behavior and attitudes, should be avoided ("me").

Indeed, it is critical to communicate climatic events based on motivations, beliefs, and interests and encourage pro-environmental behaviors. Environmental psychology addresses the relationships between people and their physical and social environments, according to Jarreau, Altinay, and Reynolds (2015), is essential. However, many environmental communicators remain relatively unaware of a growing body of psychological research on environmental matters and best practices. Subsequently, environmental psychologists interviewed for Jarreau, Altinay, and Reynold's (2015) study emphasized that giving people specific action alternatives empowered them to act. Likewise, appealing to an appreciation for nature and local wildlife, local pride, and place attachment motivated people to take action to protect their local environment and communities. Briefly, values, interests, and attitudes are essential elements that should be included in environmental communication and enhance these psychological dimensions.

2.3.4.5 Localizing climatic issues

"What works in one context may not work in another," according to the authors of the *Communicating Climate Change and Global Development* program (Development Education and Awareness Raising (2019). Program authors identified the local impact of climate change as one of the main aspects enabling successful communication. In addition, there are many other scientists, environmental psychologists, and communication experts that support the idea that using a place-based approach to discuss climate change impacts on specific regions, communities, and locations has suppositions in making messages more effective (Barbosa, Fernandes, and David, 2012; Jarreau, Altinay and Reynolds (2015); Schweizer et al. (2009). Development Education and Awareness Raising (2019); Klöckner, 2015). The underlying assumption, observed by Mowen (2011, p.2), is that individuals who live near each other have shared experiences and demographic characteristics and share psychological profiles to some extent.

Localization of climate threats is also emphasized by the authors of the book *Environmental Communication and the Public Sphere*, as it means personalizing the threat by showing impacts on places that are physically close or emotionally significant, and thus generating involvement through the use of narratives (Pezzullo and J. Robert Cox, 2018: p.164). Moreover, the local knowledge complements formal means of knowing about environmental conservation by illustrating how environmental change is interpreted by local culture interpreting environmental change and offering important components of day-to-day interactions with the natural world (Jarreau, Altinay, and Reynolds, 2015). These local environmental change stories can also be essential pieces of otherwise incomplete local datasets for scientists using scientific methods to document widespread environmental changes making it even more critical for environmental communicators to engage in two-way dialogue with local residents (Bethel et al., 2014). Thereby, localizing climatic issues is a core aspect of environmental communication since it enables to connect communicator with a target audience through a personal engagement.

2.3.4.6 Empowerment

Pezzullo and J. Robert Cox (2018) define empowerment in environmental activism as "a high level of input, favoring people direct control" and explained that consultancy, involvement, and collaboration are needed for empowerment. Such latency, involvement, and collaboration, in accordance with Pezzullo and J. Robert Cox (2018), may happen in the form of public involvement, such as a guarantee of public comment (e.g., commenting on social media) which has been proved to be one of the most empowering laws of the environmental communication history.

Hence, according to Leong et al. (2018), public comments and social media play a significant role in activism by allowing the powerless to express complaints and organize unequally distributed resources. However, apart from using social media, environmental messaging that tells the audience what articular steps they can do to make a difference must also be used to empower the public (Schweizer et al., 2009). For example, Bonanno et al. (2021) suggested that public-facing environmental issues should contain messages demonstrating how acting in the community allows individuals to be the "heroes" of climate change. Therefore, Bonanno et al. (2021) claim that to effectively frame climate change and empower the audience, communicators should provide

community-based solutions and involve the public in improving the current situation. Analogically, Centre d'Estudis d'Informació Ambiental (n.d.) recommended developing participatory models of environmental information exchange and linking climate messages to options and context to the action. The former should be achieved by emphasizing personal capacities for influencing social outcomes (Centre 'Estudis d'Informació Ambiental, n.d.). On the other hand, Jarreau, Altinay, and Reynolds (2015) contended that civil society members would be committed to acting environmentally friendly if their surroundings do nothing (e.g., neighbors, other countries, et cetera).

In conclusion, ensuring public participation, giving the audience options to choose from, and recognizing personal ability to influence would promote civic empowerment within environmental concerns. Moreover, a supportive social atmosphere would contribute to citizens' empowerment.

2.3.4.7 Collaboration

Collaboration and cooperation within the public sector enhance environmental communication in municipalities (Biezina, Truksans, and Ernsteins, (2019); Hovik, Reitan, and Muthanna, (2011); Pezzullo and J. Robert Cox, (2018)). Climate change is a complex issue calling for holistic solutions and cooperation between different government sectors and among key stakeholders in the municipality. Consequently, environmental communication is expanded by professional competency and communicators' understanding of multiple governance levels and between the scientific community and local policymakers (Hovik, Reitan, and Muthanna, 2011). A comprehensive approach may allow the replacement of hierarchy-based coordination by coordination of networks, which would also mean that the roles of key stakeholders will be changed. Such professional networks of expertise can be effective communication channels to promote knowledge and solutions needed to redefine and reinterpret the policy approach of the sector at the local level (Hovik, Reitan, and Muthanna, 2011). Additionally, securing cooperation, collaboration, and dependencies, including public officials and the media, is believed to enlarge civic mobilization (Pezzullo and J. Robert Cox, 2018).

Specifically, principles of collaboration enable combining resources, improving decision-making and problem-solving processes, and increasing environmental awareness of the local community (Biezina, Truksans, and Ernsteins, 2019). Furthermore, non-governmental organizations, media, businesses, educational establishments, other municipalities, and civil society are groups that may help develop action competence and pro-environmental behavior (Mogensen and Mayer, 2005). Nevertheless, cooperation and involvement of public participation are seldom problem-free, as researchers Jarreau, Altinay, and Reynolds (2015) claimed. The reason for that is a limited culture of cooperation in the environmental domain as there are often unpredicted institutional barriers. To sum up, by taking a holistic approach to curb climate change, there is an impetus to collaborate and create integrated solutions among different stakeholders to achieve a more far-reaching EC.

2.3.4.8 Diverse audiences

Schweizer et al. (2009), in their study *Strategies for Communicating About Climate Change Impacts on Public Lands,* were eminently distinct in saying that "there is no one-size-fits-all message, as the so-called general public does not exist, and so effective outreach to diverse audiences will require

multiple communication strategies and messages." Additionally, Howarth, Parsons, and Thew (2020) emphasized that climate communication must accept the diversity of interpretations by acknowledging that science may sound different to various people; and there is a need to customize messaging appropriately. For example, authors claimed that those who accept scientific data as truth are also the most inclined to sympathize with it; yet, focusing just on this group will have minimal influence on climate-friendly attitudes. Similarly, Hine et al. (2014) advocated that differences in audience perceptions are "a significant challenge for scientists, policymakers, and others tasked with effective communication, as certain types of messages may be enthusiastically embraced by some members of the general public but elicit indifference or outrage from others."

Knowing and admitting that diverse audiences are crucial to address, it is strategically vital to conduct a segmentation analysis in environmental communication discourse. Specifically, based on findings and practices in environmental marketing, Klöckner (2015) suggested segmenting the target group into demographic, geographic, behavioral, and psychometric segments. For example, the demographic segmentation approach could subgroup citizens into younger, adults, and elderly. Further, the geographic segmentation application was thoroughly explained under the 2.3.4.5 Localizing climatic issues section. Similarly, behavioral and psychometric segmentation was introduced in the 2.3.4.4 Values, Interests, and attitudes subheading.

Another subgrouping analysis system for communicating environmental matters was proposed by Metag and Schäfer (2018) in their research on *Audience Segments in Environmental and Science Communication: Recent Findings and Future Perspectives*. The authors suggested segmentation analysis based on representative surveys and supplemented by qualitative studies. In particular, scholars defined six "attitudinal groups" ranging from nearly unconditional support for science to criticism or skepticism. In brief, classifying the audience from climate supporters to climate deniers.

Equally important, regarding political views, Jarreau, Altinay, and Reynolds (2015) discovered that political conservatives respond better to environmental issues expressed in terms of responsibility and frugality. However, liberals respond better to the notion of caregiving and nurturing the Earth. Furthermore, scholars' research suggests that, particularly for political conservatives, it is strongly advised to avoid using the phrase climate change and instead focus on specific concerns such as flood threats (Jarreau, Altinay, and Reynolds, 2015).

However, Metag and Schäfer (2018) acknowledged that while segmentation studies in science or environmental communication are crucial, there are hardly any that use "behavioral" approaches and segment the population based on their media and information use. Therefore, more interdisciplinary and cross-sectional studies on target audience segmentation are needed. To sum up, while environmental communication should be addressed for diverse target groups, it should be holistic, including segmentation analysis based on environmental messaging and the medium used.

2.3.4.9 Visual messages

Climate communication is not limited to words. (Pezzullo and J. Robert Cox, 2018, p. 97) "Sometimes pictures have a chance to change history by creating a larger understanding of a subject, thus enlightening the public and bringing greater awareness to an issue." Recently, images have been

increasingly utilized to depict environmental challenges, and visual communication through images has become more persuasive and influential. For instance, more images such as Figures 2.3.4.9a and 2.3.4.9b that illustrate water-related climate events are added. Over 350 climate change and environmental organizations, journalists, educators, and corporations use the ClimateVisuals (2020) website as a unique source of evidence and visuals and consider them positively impacting society. ClimateVisuals (2020) has identified seven core concepts for climate change visual communication that is predicted to have the most impact:

1. Show 'real people' not staged photo-ops
2. Tell new stories
3. Show climate causes at scale (understand the links between climate change and daily life)
4. Climate impacts are emotionally powerful
5. Understand the target audience
6. Show local (but severe) climate impacts
7. Be careful with protest imagery (avoid cynicism).

On the whole, climate images may increase pro-environmental behavior. However, they may also attract cynicism (such as an image of a polar bear on melting ice) and opinion polarization (Chapman et al., 2016) if the target audience's values and interests are not understood or climate events are portrayed in such a way that the audience does not believe their authenticity (ClimateVisuals, 2020; Pezzullo and J. Robert Cox, 2018).

Figures 2.3.4.9a and 2.3.4.9b Flood events in urban areas. Image to the left, photographer John Dal; image to the right, photographer Alistair Heap (Climate Visuals, 2020)

In addition, videos are gaining popularity for illustrating climate concerns because they show dynamic storytelling in ways that static pictures and text alone cannot (Cameron et al., 2021). Scholars Cameron et al. (2021) observed that climate videos might stimulate emotional reactions and localize abstract data, facts, and information into a narrative framework - storytelling. Moreover, academics revealed that video would be the prime medium to target younger people who are regularly online if the duration of climate video is short.

Furthermore, Pezzullo and J. Robert Cox (2018) described that video could multiplicate or go "viral" and attract and engage millions of viewers online. Pezzullo and J. Robert Cox (2018) have also discussed that since the space online is shrinking and the competition to disseminate knowledge increases, there is a need to mobilize efforts and provide more video content. More video coverage

would allow staying “in the game of making environmental content easily accessible to audiences” (p. 260).

In brief, both images and videos may be effective instruments for communicating climate change issues by making them more real, approachable, and engaging compared to textual messages.

2.3.5 State of affairs fluctuations

The context of environmental communication also matters as the focus can vary depending on external variables, such as informational coverage on environmental, political, and health matters. As an example, a study by European Climate Data Explorer (2015) found that while Al Gore's film "An Inconvenient Truth" (2006) and the IPCC Nobel Peace Prize had a positive impact on public awareness, 2010/2011 cold winters in Europe, minor IPCC errors, and CRU (Climate Research Unit) emails had a negative impact on public acceptance of climate change and increased public skepticism. Similarly, the recent film *Don't Look Up* (2021) drew academic and public interest for its discussion of the significance of clear communication of scientific and specifically climatic information, the dangers of misinformation, and the potential role of motivated reasoning (Buckley et al., 2022; Davis and Lewandowsky et al., 2022).

Then, as a critical event, the Covid-19 pandemic disrupted climate news framing, creating both challenges in terms of reduced coverage but also opportunities, such as creating space for climate action advocates to make connections between economic and environmental dimensions of sustainability, as well as learning about crisis management and communication through social media (Stoddart et al., 2021). In fact, academia affirmed that from a climate change perspective, the Covid-19 pandemic and related limitations drastically decreased GHG emissions (Bhat et al., 2021; NASA’s Jet Propulsion Laboratory, 2021).

Another major global disruption that may influence climate communication and pro-environmental values is the war in Ukraine. An article by Worrall (2022) *Ukraine War Helps with “Communicating the Need for [Climate] Sacrifice,”* depicted that during a horrific and terrifying invasion in Ukraine that started in February 2022, there was persistent communication on the need for sacrifice “from sleeping colder in the winters to flying less and paying more when you do.” Pressure to consume less was especially true in European countries. Moreover, according to Oxford Analytica (2022), if the EU prioritizes low-carbon energy projects while going away from fossil fuels, such a scenario will give a significant potential to speed Europe's clean energy transition and reduce climate impacts.

To summarize, dramatic events and external variables may diminish coverage of climate concerns. However, if policymakers and scientists can properly exploit this "window of opportunity," they can mobilize for change and benefit from turning around to pro-environmental actions (Birkmann et al., 2010, p. 639).

3. Research design and Methods

The 'Research design' section introduced the study's guiding principles and outlined the research strategy. Following that, the 'Methods' section delineated data collection methods for water-related climate strategies in Oslo, surveys, and interviews. Subsequently, the fundamental principles of comparative analysis were investigated. Finally, ontological and epistemological considerations, ethical implications, and study limitations that methodology has encountered were discussed.

3.1 Guiding principles for the research

One of the study's guiding principles was the emphasis on knowledge co-production, which meant that a horizontal and collaborative approach focused on mutual knowledge sharing was adopted. The expertise of environmental communicators was the primary source of data for context-specific issues in my thesis.

Another important guiding principle was reflexivity: a researcher's awareness of own position, experiences, values, reality, biases, and perceptions (Bryman, 2016, p. 388; O'Reilly, 2011, p. 222). This self-reflection was to add transparency by clearly positioning myself and critically evaluating my personal attributes, situation, lifestyle, knowledge, and interpretative directions. Relevant questions in this context are where do I, as a researcher, stand in this study, and what are my interests in undertaking this study? I have a background in environmental engineering and have taken several Master levels courses in fluvial hydrology, water and wastewater treatment, and decentralized water systems. Therefore, I have a great interest in water-related engineering and technical solutions for curbing climate change.

In addition to being a researcher, I am also an Oslo citizen and have been familiar with some climate strategies linked to water before I started this study. I am also a foreign citizen who has lived in the capital permanently for the past nine years. I have an upper-intermediate level in Norwegian and therefore used an assistant, a qualified Norwegian teacher, to clarify some phrases or words from interviews without disclosing the respondents' identities.

I have not engaged in any public movements, and my interest in the topic of this study developed gradually through my academic interest. Furthermore, while gender is not a significant subject in the study, as a female researcher, I believe it is significant enough to include in my recommendations for future research.

As the study includes specific aspects of national, regional, and local politics, and references to programs and statements from various political parties are made, it has been critical for me to maintain political neutrality throughout the study to avoid misconstrued favoring one political party over another. Therefore, I confirm that I am not a political party member and have not participated in any political actions or campaigns.

The data file accompanying this thesis does not include full interview transcripts due to ethical concerns for the privacy of the environmental communicators interviewed for this study. On request, anonymized interview excerpts can be provided. In the accompanying spreadsheet, all principal, major and minor themes are quantified for each of the seven interviewees.

3.2 Research strategy

The research is organized as a case study on environmental communication in Oslo. The case study is a method that "investigates a contemporary phenomenon in depth and within its real-world context." (Yin, 2014, p. 16). According to Berg and Lune (2017, p. 326-327), a case study is distinguished by the collection of "extremely rich, detailed, and in-depth" information on a case, and it typically has a more holistic focus in explaining a phenomenon than what may be stressed by other strategies.

The case study chosen in this research as such strategy is well suited for answering 'what' and 'how' questions (Yin, 1994, p. 5). Particularly, what are communicators' implications for environmental communication, and how do communicators' approaches to the subject differ from a theoretical perspective.

Nevertheless, as Bryman (2016, p. 64) pointed out, a common criticism of the case study is that the findings are rarely generalizable to a larger population. A case study's purpose is rarely to present generalizable findings but rather to reveal unique features and "generate an intensive examination of a single case" from which theoretical analysis can be conducted (Bryman, 2016, p. 61-64). Recognizing this, this study does not aim to provide generalizable empirical findings but rather to provide theoretical and analytical insights that could be relevant in or transferable to other contexts.

3.3. Data collection methods

As discussed above, this research aims to illustrate the theoretical reasoning behind the proposed issue area. As such, this research is not concerned with making empirical generalizations but instead seeks to make analytical ones, thereby interrogating theoretical concepts rather than statistical analysis. From here, to identify and analyze WRCS in Oslo, secondary data sources were used to make theoretical arguments. Further, the main data collection methods used in this research were surveys and semi-structured interviews conducted from November 2021 – to January 2022. The participants of the survey and interviews were environmental communicators from national, local authorities, and scientific institution. The following sections will briefly present the data collection methods and their use in this study. Finally, a look at this study's ontological, epistemological, and ethical considerations and limitations will be provided.

This section further describes the research conducted to answer the thesis' objectives. The research was carried out from November 2021 and continued through January 2022. For triangulation purposes, three types of research were used: a content analysis survey and semi-structured interviews. The methodology for this research is presented in Table 3.3.

Research Objective	Main theoretical perspectives	Methodology	Key references
1. To review existing and planned climate change strategies and initiatives in the water and wastewater sector in Oslo city and assess how such initiatives are communicated to Oslo citizens.	Literature review: ▪ Multi-level governance in environmental domains ▪ Water-related climate threats in Oslo Conceptual framework: ▪ Theory on environmental communication	**Content analysis**. Data selection for concept learning. Identification of interview participants – environmental communicators. (Input for the second objective)	(KlimaOslo, 2020d), (KlimaOslo, 2020a), (Miljødirektoratet, 2021b) (NINA, 2022)
2. To assess the knowledge of climate change and accustom environmental communication practices by environmental communicators in the Oslo municipality, Norwegian governmental agencies, and scientific institutions engaged in water-related strategies.	Theory on a close-ended questionnaire Theory of qualitative interviews Grounded theory on environmental communication	**Survey research.** Environmental communicators' perceptions of climate change and communication. **Semi-structured interviews** (private and focus group) Collection of interviewees' opinions on their environmental communication principles in Oslo regarding water-linked climate changes. (Input for the third objective)	The interview guide (Appendix 1) Survey questionnaire (Appendix 2)
3. Compare and identify gaps between water-related communication strategies and typical environmental communicator's practices using the conceptual framework of effective environmental communication.	Social contract theory Conceptual framework: Environmental communication, Literature review: multi-level governance, citizen attitudes toward climate change	**Comparative analysis.** To find the gaps between the grounded theory of environmental communication and practice.	Pezzullo and J. Robert Cox, 2018, Findings from Survey & Interviews

Table 3.3 Research methodology

3.3.1 Water-related climate strategies in Oslo

To gain a greater understanding of the environmental communication of water-linked climate strategies in Oslo and to reflect on whether such communication is systematic and efficient, I primarily conducted a qualitative review of secondary data.

Internet surveying and electronic data collection allowed more accessible data collection, larger samples, and more representative data (Benfield and Szlemko, 2006). Accordingly, the internet was used to conduct literature searches.

The first research question was addressed by performing a mixed-methods content analysis (Schram, 2014) on existing, planned, or recently performed water-related climate change strategies in Oslo city. Namely, I analyzed strategies published from 2013 onwards. Particularly, Oslo's climate change strategies, detailed plans, initiatives, and communication channels of these projects were analyzed and interpreted. The following criteria were considered to diversify the data while selecting these final strategies: the medium in the strategy is presented, campaigns involving public citizens, and democratic involvement. Furthermore, I chose to focus on underlying messages that belong to environmental communication theory and represent the most efficient communication messaging input.

In contrast, theoretically inefficient communication messages were also addressed during the analysis. In general, the content analysis serves as "a careful, detailed, systematic examination and interpretation of a particular body of material to identify patterns, themes, biases, and meanings" (Berg and Lune, 2017, p. 182). The rationales provided by the article authors subsequently were classified using a coding scheme (Bryman, 2012, p. 633) as this enabled an effective combination of quantitative and qualitative research.

Accordingly, web searches were conducted in two languages: English and Norwegian. In both languages, I searched for WRCS using the keywords 'strategy,' 'plan,' 'adaptation,' "mitigation," 'Oslo,' 'municipality,' 'climate change,' "water-related," "flood," surface water," "landslides." I considered WRCS at the state and municipality levels since state government plans define local strategies in Oslo. Simultaneously, WRCS from scientific institutions were examined. The data collected through web research initially generated 28 relevant strategies, of which eight were of national origin, 17 from municipal authorities, and three of scientific origin.

Consequently, nine strategies or initiatives were chosen based on the abovementioned criteria. Collected WRCSs were archived in a database organized by alphabet, access date, and internet links to the full-text document and publisher. The database can be found in Appendix 3. Notwithstanding a thorough web search, certain WRCS may be missing because the strategy or plan is located in a small district/area without mentioning Oslo. Nevertheless, central WRCSs were identified with various supplementary strategies and initiatives at national and local levels.

3.3.2 Survey

To answer the second research question, a survey, as a follow-up and data triangulation approach, was used to cross-check findings from interviews (Bryman, 2012, p. 392) and gain environmental communicators' knowledge on climate change.

All survey participants were chosen using purposive sampling as the selection of actors directly referred to the research questions being asked (Bryman, 2012, p. 416). The selection was made based on actors' identification as environmental communicators and their involvement in WRCS.

As a result, an online questionnaire was used to gather background information from environmental communicators who work with water-related strategies and initiatives. The survey was divided into two parts where the first part was dedicated to broad questions about survey participants' knowledge of climate change causes, water-linked climate consequences, and climate threats. Answers then provided unique insights into environmental communicators' knowledge of climate

change and its implications for the capital. Due to the busy time schedules of experts, broad questions were asked only in the survey questionnaire to allow more time to discuss specific initiatives and strategies.

Meanwhile, the second part of the survey served as a triangulation approach to understand environmental communicators' perceptions of environmental communication and develop a comprehensive understanding of this phenomenon. During interviews, the second part's questions were then asked. Furthermore, an earmark and speaker image with the caption "Communicating Climate Change" were used to divide two sections.

Finally, five municipality or governmental actors and two actors from scientific institutions have responded to the survey. Five local and national participants were the same as those that participated in the interviews, while one interviewee did not fill in the questionnaire after repetitive requests and friendly reminders. Nevertheless, one scientific actor agreed to contribute to the survey but did not participate in the interview. Therefore, a total of seven environmental communicators completed the questionnaire. The survey sample can be found in Appendix 1.

3.3.3 Semi-structured interviews

I have conducted seven semi-structured interviews with elite environmental communicators. I used a set of open-ended questions that kept the interview within the theme to be addressed without restricting me as a researcher from going beyond them and addressing themes and topics that emerged during interviews (Bryman, 2012). In this study, an interview guide was used (see Appendix 2). However, the order of the questions varied in each interview to make it more organic and conversational and allow the space for follow-up questions and intervening questions upon the rise of new themes.

Totally five in-person and one focus-group in-depth interviews were conducted with those identified as environmental communicators. Notably, environmental communicators, communication advisors, and water and wastewater managers with communicator experience that interface with WRCS in Oslo were interviewed.

The structure of the desired sample group was decided after completing a content analysis of WRCS. The final sample of communicators interviewed was recruited via a personal email invitation, approaching them via LinkedIn platform or by contacting via telephone and followed by a snowball convenience sample of communicators suggested by initial interviewees. In email invitations, interviewees were briefed on the study's goal “to provide personal insights and knowledge with regards to water-related climate changes in Oslo and communication of these matters” and were chosen to participate based on their knowledge in the field of environmental communication. In responding to initial email invitation responses, participants were also sent digital consent form files, later approved orally during interviews. Potential participants identified by "snowball" sampling were deliberately approached to ensure coverage of major Oslo municipal agencies dealing with water. Out of 16 potential environmental communicators invited initially to interview via private email, five responded. One communicator responded after the primary invitation in English. Meanwhile, the other 3 responded to the invitation in Norwegian, one after recurring private correspondence on the

social network, and one – agreed to be interviewed after the individual call (after the snowball method).

Another two respondents agreed to be interviewed at the early stage, but one representative, after numerous tries to agree upon conversation time, was unresponsive. Another respondent from Agency for Urban Environment later declined to be interviewed due to scheduling problems and suggested answering briefly via email. Five interviews were held via the zoom application, while one was held via telephone. The semi-structured interviews, which typically lasted between 33 to 60 minutes, with an average of 53 minutes, were digitally recorded and later transcribed. Transcription included three steps; where first was an audio file transcription of Norwegian text. I used Microsoft Office 365 transcription functionality hosted in University's one drive file share. The second phase used the same functionality as the first, but the transcription was done in English. Finally, the transcriptions were integrated and manually verified to ensure they were as accurate as possible.

Participants were assured of the confidentiality of the interview transcripts and are consequently only identifiable by number (Interviewees 1–7 were labeled according to the sequence of interview conduction). My analysis is based on the interview transcripts and notes taken during each interview.

The environmental communication strategies of the seven science communicators were first investigated as a group. Then the communicators were divided according to analysis considered emergent divisions based on the communicator's preferred science topic, e.g., "water supply," "surface water." The gender breakdown of interviewees was 3/4 male/ female, and interviewees ranged in age from 25 to 57+ years old.

3.3.4 Comparative analysis

For answering the third research question, I relied on findings from previous sections. I carried out a comparative analysis which was performed to compare findings from analyzed WRCS, interviews, and surveys and leaned on the environmental communication theory (Esser and Vliegenthart, 2017, p. 20). Comparison helped to establish relationships between the phenomena and provide valid reasons.

Conventionally, comparative analysis emphasizes the "explanation of differences, and the explanation of similarities" (Azarian, 2011). (p.2). In this particular comparative explanatory analysis, the focus was on differences - gaps between theory and practice. Therefore, the variation-finding comparison type was used to "establish a principle of variation in the character or intensity of a phenomenon by examining systematic differences between instances" (Tilly, 1984). Nevertheless, some positive illustrations were introduced.

As a result, the comparative analysis allowed me to identify patterns and analyze the most effective practices of environmental communication and recognize potential deficiencies in participants' perceptions of environmental communication. Furthermore, applying scientific knowledge to confront practical challenges allowed me to bridge the theory-practice gaps. Consequently, a deeper understanding of the social phenomena of climate communication in connection to various substantially contrasting cases or situations was gained (Bryman, 2012, p. 72).

The data for analysis was gathered as a conceptual framework and findings from the first and second research objectives. From here, a conceptual framework on environmental communication and theoretical knowledge procedures followed by scientific evidence of effective environmental communication served as a fundament for comparison.

The variables were chosen based on the findings from the interviews, survey, and identified WRCSs. Specifically, subchapters of various WRCS, survey results, as well as designated central, major, and minor themes were considered and compared to scientific findings on environmental communication theory. There were 9 WRCS considered and a chapter on climate knowledge of environmental communicators. Most importantly, interview data consisted of a total of 32 additional themes. Simultaneously, all subchapters from environmental communication theory were compared to the abovementioned themes. In terms of comparison criteria, since the primary purpose of climate communication is to raise citizens' climate awareness and empower them, these factors were deemed desirable communication outcomes. Accordingly, citizens' participation in WRCSs, messages aligned with raising climate awareness, and empowering citizens to act were considered parameters in the comparative analysis.

Later, clusters were developed based on the comparison. Finally, clusters were given broad and circumstantial names, such as *Oversimplification of EC, Disconnection with the target audience, Adhering to traditional communication methods, and Not urging for action*.

3.4 Ontological considerations

The study's ontological assumptions are based on constructionism, which means that my idea of social reality is that actors, their understandings build it, and interactions with one another are not constant through time (Bryman, 2012, p. 29, 375). Because the context that created the 'case' for this case study included a complex set of social and political ties and acts, I thought this was an optimal technique. However, it was difficult to construct any objective criteria to analyze the meanings and reasons for the research's conclusions in this setting, making it more challenging to conduct research.

3.5 Epistemological considerations

Interpretivism is an epistemological perspective in which the researcher strives to make sense of and reconstruct the participants' reality by interpreting their reflections and other data sources through the lens of the researcher's prior knowledge and theoretical framework (Bryman, 2016, p. 26–28). According to (O'Brien et al., 2006) and Orderud and Naustdalslid's (2019) research, climate projects in Norway are frequently viewed as climate change programs are about technical solutions within existing systems. Respectively, my multidisciplinary understanding could have been misconstrued as disrespect for the expertise and traditions of the Oslo municipality, in particular (Scheyvens, 2014, p. 161). Therefore, even though communicating this interdisciplinary topic was challenging, I suspended a judgment on the subject's one-sidedness so that all research participants felt free and interceded. As a result, remaining neutral was an appropriate approach to provide a reasonable explanation of my perspective while still enabling participants to debate and criticize it. Besides, the Norwegian National Research Ethics Committee emphasized the duty to inform, stating that researchers must provide

participants with adequate information about the nature of the study, the purpose, the expected application, and the consequences of participation in the research project (NESH, 2019). Following this principle, I have provided study participants with a relatively extensive description of my study goals and application in a written document.

3.6 Ethics and limitations

Prior to conducting interviews, registration with the Norwegian Center for Research Data (NSD) was produced. Registration included a detailed description of the proposed study and the methods to be used to ensure that ethical boundaries were respected. During NSD registration, a consent form was drafted and later distributed to participants before each interview, which included a detailed description of the topic and research design, their role in the research, how collected data would be processed, and the anonymity and withdrawal enclosures. Due to their privileged positions in their institutions, the risk of harm, and presumably limited willingness to talk, I anonymized all seven respondents and then verbalized it to the participants. As a result, no identifiable traits of the participants are used in this study, other than the fact that they are or have been environmental communicators in their institution at the time. The interviews were recorded after receiving verbal consent and then transcribed later. It was agreed that the final study would be sent to a few environmental communicators upon request. Personal interviews were not conducted due to the pandemic/post-pandemic circumstances. As a result, most semi-structured interviews were scheduled and conducted online, with one conducted over the phone. As a result, understanding nonverbal communication, such as body language, was greatly undermined (Bryman, 2012, p. 667). According to Bryman (2012, p. 668), establishing trust between two parties and engaging with interviewees in digital formats is more challenging (Bryman, 2012, p. 668). Respondents who were online at home or work, on the other hand, were better able to fit the interviews into their schedules. Furthermore, interviewees who were online at home presumably felt safer, and their willingness to open up was likely higher (Bryman, 2012, p. 667).

Nonetheless, a respondent who only agreed to be interviewed by phone was on a business trip at the time of the interview. Therefore, there were sound issues and disturbances resulting from the interrupted dialogue. As a result, the conversation was less fruitful, as many questions were asked repeatedly, and responses were brief. However, such a situation allowed me to ask all of the questions from a semi-structured interview guide.

Using two languages was also unavoidable since only one interviewee agreed to be interviewed in English. There could have been misinterpretations due to my limited Norwegian proficiency. Additionally, there was only one person from a scientific institution, and such a profile of environmental communicator could have influenced analysis findings. Nevertheless, the purpose of a study is not to generalize or examine differences between different communicators but rather to investigate a particular phenomenon of environmental communication in water-related climate strategies.

Finally, I believe that not including a question about communication strategies in respondents' institutions is a significant limitation. In my defense, I concentrated on unique communication approaches. Moreover, I asked about respondents' target audience, communication purpose, messaging, and communication channels, which are central principles to include in a strategy.

4. RQ1 Findings. Analysis of water-related climate strategies in Oslo

The section answered the first raised objective. Specifically, this chapter reviewed existing and planned climate change strategies and initiatives in the water and wastewater sector in Oslo city and defined how such initiatives were communicated to Oslo citizens. Findings on water-related strategies in Oslo encompassed strategies and initiatives documented or proposed by Norwegian national authorities, Oslo municipality actors, or scientific institutions. The majority of plans were assessed independently, although interrelationships were discussed where needed.

4.1 Oslo's new climate strategy

Following the Paris Agreement, Oslo municipality unveiled its new climate policy, claiming that the city should contribute and "limit global warming to no more than two degrees" (KlimaOslo, 2020b; KlimaOslo, 2020d).

Although Oslo was one of the first cities to implement strict climate-change mitigation measures, the Paris agreement states that global temperature rise this century should be kept "well below 2 degrees Celsius above pre-industrial levels, with efforts to limit the temperature increase even further to 1.5 degrees Celsius (IPCC, 2018)." As a result, the Oslo municipality's efforts appear a little ambiguous, given that even "at 1.5°C... - hundreds of millions of people will experience devastating heat waves, droughts, severe weather, and sea-level rise, even as an overwhelming number of animal and plant species go extinct," as stated by United Nations Foundation (2021). Moreover, "many scientists consider (1.5°C) the upper bound of Earth's safe zone," according to the same source. As a result, an objective of at least 1.5°C should be set to have a more ambitious plan.

Nonetheless, Oslo's new climate strategy, published on the Climate Agency's web page KlimaOslo, has set five main goals and 18 target areas to achieve those mentioned above "no more than two degrees" goals. According to KlimaOslo (2020d), the objectives are:

1. 95% reduction in Oslo's greenhouse gas emissions by 2030, compared to 2009
2. Management of Oslo's natural areas to protect carbon storage in vegetation and soil and to increase sequestration of greenhouse gases in forests and other vegetation leading up to 2030
3. 10% reduction in total energy consumption in Oslo by 2030, compared with 2009
4. Oslo's capacity to withstand climate change is strengthened towards 2030, and the city develops so that it can withstand the changes expected leading up to 2100
5. Oslo's impact on greenhouse gas emissions outside the city is significantly lower in 2030 than in 2020.

The first target to reduce 95% greenhouse gas emissions only included direct emissions, even though the same source admitted that “indirect emissions are often higher than direct emissions within the city limits.” The fifth goal claimed that the city would encourage increasing product reuse and repair and give knowledge on climate-friendly consumer choices, in part addressing and taking responsibility for the problem (KlimaOslo, 2020d). "Significantly lower" emissions appear to be a vague phrase that might be replaced with more specific wording such as "no less than," "minimum of... but targeting to..."

A proposed strategy is to protect green areas in the city and recreational forested areas on Oslo's outskirts due to the increased risk of excess surface water and flooding, which is acknowledged as the "climate change challenge expected to have the most significant impact on Oslo" (KlimaOslo, 2020d). Protected greenery would also help to maintain the carbon in trees and soil.

Regarding communication, the strategy pledged to “encourage climate-friendly behavior by its inhabitants by means of communication, dialogue, training, and cooperation” (ibid). Moreover, the strategy itself was compiled by civil society engagement, where breakfast meetings and a public input meeting were organized and provided input for this technical paper (ibid).

To sum up, Oslo’s New climate strategy is placed on the Climate Agency’s webpage KlimaOslo. The strategy described five goals for Oslo, where the reduction of greenhouse gas emissions, the protection of green areas to withstand water-linked climate threats, the reduction of energy consumption, climate adaptation, and indirect GHG emissions were addressed. Furthermore, it was claimed that communication will be employed as part of a strategy to enlighten Oslo citizens about climate-friendly practices.

4.2 Climate Change Adaptation Strategy for the City of Oslo

In 2013, the Urban Environment Agency issued a Climate Adaptation Strategy, which can be found on Oslo municipality’s home page (Bymiljøetaten, 2013). As a result, the city of Oslo is adopting a variety of initiatives to become climate-resilient, which will also make the city safer, greener, and more pleasant (Bymiljøetaten, 2013). However, the paper stated that Oslo must prepare for a changing environment that awaits heavier rain, warmer temperatures, and stronger winds. Notably, Bymiljøetaten (2013) claimed that “stormwater is, and will be our biggest challenge, and is the main priority,” making it highly relevant to water-related climate strategy (WRCS).

Given that Oslo is one of Europe's fastest-growing capitals, with a forecasted growth rate of 1.38 percent from 2020 to 2025 (Ghosh, 2021), all municipal agencies will be influenced by the difficulties of coping with the increased population density in a climate-resilient way. Therefore, Oslo is implementing a two-pronged approach to climate change mitigation and adaptation, according to Oslo kommune (2014), and both strategies necessitate cross-sector collaboration. Nevertheless, the primary responsibility has been given to the local government.

As stated in the white paper of Oslo municipality, Oslo needs more information on topics such as which streets are prone to flooding and how climate change will impact structures (Oslo kommune, 2014). Additionally, which invasive species or new diseases may be introduced to Norway because of climate change, and how citizens and municipality may respond (Oslo kommune, 2014). The report

proclaimed that global climate change might indirectly impact Norway, resulting in repercussions such as food shortages and climate refugees requiring immediate action. Municipality accented that identifying the benefits of climate change is also a key adaptation component.

There are six priority areas listed (Figure 5.2), with stormwater management being the most influential. Natural drainage will be hampered by impermeable surfaces between buildings and more heavy precipitation events, making Oslo more vulnerable. Consequently, Oslo's approach is to proactively introduce blue-green aspects to address increased rainfall and storm-water difficulties. Particularly re-establishing rivers and streams, additional parks, fountains, green areas, tree conservation, and building more green roofs (Oslo kommune, 2014).

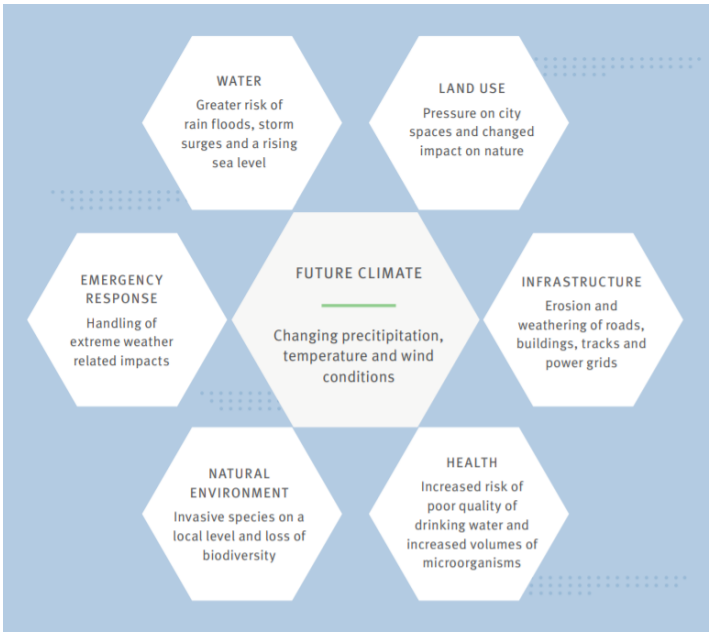


Figure 4.2. Six priority areas for climate adaptation in Oslo, Bymiljøetaten, 2013.

Furthermore, the climate adaptation strategy was compared with Copenhagen's plan. Copenhagen was chosen due to the 1000-year flood[3] that happened in 2011. While Copenhagen has a different topological situation, flat surfaces, the source claims that it "is certain is that a 1000-year rain in Oslo would create enormous destruction" (Bymiljøetaten, 2013). Furthermore, the insurance industry projected the economic impact of untreated stormwater to be around 5 billion Danish kroner. Meanwhile, the benefit of preventing against different precipitation scenarios (20 - 400 years of precipitation) revealed that the greatest savings were by preventing against 100-years rain (Bymiljøetaten, 2013). Therefore, the municipality urges active and precautionary actions regarding climate strategy while comparing Norway's capital with a Danish one.

Another worrying rain-caused consequence may be a sea-level rise or landslides in agreement with the adaptation strategy. Both have a high inaccuracy in current predictions and scenarios. As The

[3] A flood of that magnitude has a 1 in 1,000 chance of occurring in any given year. In terms of probability, the 1,000-year flood has a 0.1% chance of happening in any given year" according to the U.S. Geological Survey (n.d.)

Urban Environment Agency stated, “there is great uncertainty associated with how large the sea level rise will be in this century “(Bymiljøetaten, 2013).

As a result, such claims create unpredictability and lead to inaction due to confronting ideas. Due to increased precipitation, there is a risk of landslides, and “analyzes also show that Oslo also has quick clay areas. Even small "pockets" with quick clay can have dramatic consequences in densely populated areas.”

Nonetheless, (Bymiljøetaten, 2013) described established needs that have undeniable benefits to the City:

- formal requirements to introduce green roofs on new buildings and restoration objects as well (based on pilot projects in Copenhagen and Oslo)
- a separate municipal sub-plan for dealing with rain and snow melting water should be developed in Oslo municipality, based on the flood zone mapping and similar to Copenhagen’s Municipality created "Cloudburst Plan" (plans that show how the Danish capital can protect the city from damage from floods by heavy rain (Copenhagen municipality, n.d.))

To sum up, the development of blue-green solutions, including storm-water management, is a central instrument in Oslo’s adaptation to climate change. Nevertheless, the strategy acknowledged worrying and uncertain rain-caused consequences such as rising sea levels or landslides that are not adequately addressed. Finally, the Climate Change Adaptation Strategy for the City of Oslo can be found on the Oslo municipality’s home page.

4.3 Climate Change Vulnerability Analysis for Oslo

Vulnerability analysis can be found on the Environmental Agency’s home page (Klimaetaten, 2020). Climate change vulnerability was determined by how vulnerable society is to climate change and its ability to adapt to and mitigate the effects of climate change. The analysis was said to aim to develop the knowledge base for a more climate-adapted city, in which climate change issues are examined, and climate adaptation options are integrated.

The report started with an opening image of kids jumping on the green grass from a tree branch. A picture sets a positive feeling since dominant facial expressions are smiley, except for one girl with a more worried face. Nevertheless, her play friends were holding hands with her, which could be a nexus to a vulnerability that will be solved by cooperation. The greenery that dominated in the same picture could be linked to blue-green solutions that are a confirmed strategy to overcome climate challenges and vulnerabilities.

The city’s vulnerability analysis explained that water-related accidents were the dominant climate threats that compromised Oslo’s resilience (Klimaetaten, 2020). Namely, extreme precipitation, river floods, and quick-clay slides were reported as the most ominous climate events (Klimaetaten, 2020).

Further, under the section, *How will climate change affect Oslo?* an image illustrated a heavy rain event on the main street in Oslo city, seen in Figure 4.3. Since extreme precipitation was chosen to represent the section, this implies that rain-caused climatic threats will most affect Oslo. Moreover,

the localized climate picture personalized the threat by showing impacts on a place that Oslo citizens could recognize.

Figure 4.3. Karl Johans street under a heavy rain event (Klimaetaten, 2020)

Later, it was concluded that Oslo is on the way to achieving the goal of becoming a climate resilience, especially concerning stormwater management. Indeed, it was admitted that the city's forest boundary and spacious forest areas around the city serve as "a sponge by filtering and purifying water" and, therefore, significantly contribute to minimizing resilience. Nevertheless, vulnerability analysis argued that more measures are still needed to achieve this goal, such as more knowledge of successfully integrating climatic matters with municipal plans and increased operational and maintenance activities investment. Notably, the analysis affirmed that climate change might still threaten many assets that Oslo citizens value as a society, "and some assets will be lost" (Klimaetaten, 2020, p.8). Following that, apart from climatic conditions, other grounds for vulnerability were listed as dense population and a built environment.

Finally, the last section described climate adaptation guidelines that were already discussed in section 4.2 Climate Change Adaptation Strategy for the City of Oslo. Nevertheless, it is worth noting that the strategy was based on the precautionary principle. Klimaetaten (2020) reported that the principle suggests that climate adaptation planning in Oslo depicted the highest GHG projection scenario, where anthropogenic emissions will continue to increase as before.

To sum up, water-related climate accidents were admitted as the most significant vulnerability threats. However, despite that, Oslo was presented as on the 'right track' to becoming a resilient city due to the spacious forest areas in Oslo and its surroundings. The main barriers to resilience were identified as a lack of knowledge about climatic issues integration into municipal plans and insufficient funding. Finally, the vulnerability analysis is placed on the Oslo municipalities Climate Agencies webpage.

4.4 What does one of the pioneer municipalities - Oslo - wants?

On behalf of the Agency for Planning and Building Services of the City of Oslo, a stormwater coordinator has prepared a presentation for climate adaptation days 2020. The presentation is in the online document library used for Oslo municipalities' presentations (PBE, 2020). The study focused on smart and green technology (blue-green) solutions used in stormwater management in urban locations worldwide, including Oslo. Moreover, the existing and lacking parameters for successful stormwater management in

Oslo were discussed. Finally, some images depicted a street in Oslo's city center that was supposed to be converted into a more sustainable, blue-green avenue, Figure 4.4.

Main proposals included:

- Legal and economic instruments
- Knowledge and mapping tools
- Good communication and accountability of all actors, awareness-raising
- Organization and interaction (Established routines, utilization of expertise inwards and outwards)
- Resources (money, professionals)

Specifically, communication and awareness-raising would necessitate good guidance with more explicit rules and responsibilities, examples of solutions that inspire, and lastly, participation of the population and business community in influencing stormwater solutions.

To conclude, blue-green solutions were central to implementing effective stormwater management. However, the presentation author notified some obstacles such as lack of legal and economic instruments, lack of knowledge, established procedures, and inadequate communication. Finally, the WRCS can be found in the Oslo municipality's online document library.

Figure 4.4 Central Oslo street and the same street with vegetation. Photograph and illustration by Rainer Stange (PBE, 2020).

4.5 The New Water Ways research project - Citizens' panel

According to NINA (n.d.), citizen panels and citizen gatherings are research-based methods of involving and engaging residents. In fact, the method is becoming increasingly popular worldwide on large and smaller issues at the local, national, and international levels NINA (n.d.). Elstub and Escobar (2019) stated that a citizens' panel is a type of democratic innovation that broadens citizens' opportunities for participation and influences and engages in critical discourse. Therefore, recommendations from a citizens' panel are a final report of the New Water Ways research project. The New Water Ways was introduced to examine present Norwegian water management systems holistically, identifying obstacles and potential triggers for shifting to a water-sensitive and climate-adapted society (NINA, 2022). The project investigated alternatives to today's conventional urban water management, particularly stormwater management (ibid). The following steps in line with the source were planned to ensure the transition:

- Evaluate current systems (tools: workshops, interviews, and document analysis)

- Create new strategies including all stakeholders
- Develop approaches and implement tools to assess and evaluate the economic, social, and environmental implications of each of the solutions, combinations of solutions (pathways), and complex management strategies besides creating a meta-modeling tool
- Establish “learning laboratories” where citizen participation is part of stormwater management.

NINA (2022) affirmed a need to bring together a wide range of partners from academia, business, and government to collaborate on tackling urban water issues to achieve the objectives. Moreover, Oslo municipality was used as a case study to achieve these goals, Copenhagen and Amsterdam were used as learning sources, and Trondheim and Bergen as upscaling cases (ibid). The project was a partnership between So Central (partner on collaborative projects), NINA (The Norwegian Institute for Water Research), and Oslo municipality, albeit The Norwegian Research Council was sponsoring it. The final report was released in 2021 and can be found on NINA’s (ibid) and So central’s online home pages (So Central, n.d.).

According to the NINA (n.d.) report, policymakers acknowledged that societal challenges related to surface water are so complex that the authorities could not develop and deliver solutions to the inhabitants on their own. As a result, the project was planned to implement necessary adjustments with the collaboration of authorities and citizens. This initiative aimed to help other Norwegian communities stay pioneers in the transition to sustainable water management and help cities become more green, habitable, climate-adapted, and resilient to heavy rainfall. The final report contains recommendations from 20 randomly selected inhabitants from Grefsen and Kjelsås districts in Oslo. In November 2020, the research team invited 3000 randomly selected inhabitants in the Grefsen- and Kjelsås neighborhood of Oslo to participate in a citizens' panel through text message. They were all between 18 and 85 and were chosen based on their zip code, and 267 people responded positively to the message. The final selection was based on gender, age, and place of residence. The result of such a deliberate process were recommendations that were divided into three themes:

1. Plan and strategy
2. Communication and guidance
3. Facilitation and cooperation

The plan and strategy sections called for systematic public participation, such as the ability to report surface water concerns and issues and the inclusion of Oslo citizens in strategic planning. In terms of communication, project participants agreed that Oslo municipality's communications should focus on portraying surface water concerns as shared concerns, with multiple actors sharing responsibility. Namely, the municipality, scientists, and residents, so that "individuals become motivated to support solving common challenges" (NINA, n.d.). It is worth noting that, based on the current communication, the Oslo municipality delegated primary responsibility for surface water management to Oslo citizens on their properties (Figure 4.1) and currently operates just as advisers (Oslovann, 2021). One of the participants claimed that “as residents have a responsibility for managing surface water - it is positive that the municipality now wants to involve the inhabitants.” From the other angle, such a claim and visual (flooded housing area) claiming responsibility on property owners doubtfully shape Oslo municipality as credible in solving such a severe issue.

Figure 4.5a Did you know that you are in charge of surface water management on your property? (Klimaetaten i Oslo kommune, 2021)

Further proposals from the citizen panel requested more visualizations that would be used to raise awareness of the challenges associated with surface water. In addition, participants requested more storytelling to demonstrate how the issue affects each citizen and the introduction of applications and interactive games that engage and drive residents to act. In addition, sharing good examples was also a favorable suggestion.

Participants have also asked for more easily accessible information, including the ability to upload photos, share experiences, view surface water maps, and examine concrete examples.

Regarding communication channels, project members recommended using targeted information brochures, spreading knowledge in local newspapers and local radio, on city days, and on social media, such as Facebook.

Under the facilitation and cooperation part, citizen panel' actors recommended creating Oslo municipality financial incentive schemes for the measures they recommend to residents. In addition, the committee recommended imposing a water and sewage fee to ensure that the financial burden does not fall on individual Oslo citizens.

To conclude, one of the participants shared her/his view that (s)he "knew nothing about surface water problems and how challenging it is before (she/he) participated here. Right where I live, it is not a big problem. Now I have become a kind of ambassador and talk to friends and others about it" (NINA, n.d.). This particular actor could represent a skeptical citizen about climate-induced effects. However, after participating in a citizen panel and gaining information, he has evolved into a climate ambassador who supports climate strategies dealing with surface water.

To sum up, Citizen panel recommendations as part of the NWW project were placed on NINA's and So Central's online homepages. The Citizen panel empowered Oslo residents by allowing them to participate in the development of water management policies. For WRCS to be effective, participants advocated systematic public participation in decision making, proper and thorough communication, more visual content, financial incentives, and the municipality taking responsibility together with Oslo citizens to curb climate consequences.

Figure 4.5b *The first of its kind citizen panel initiative in Oslo, with randomly chosen people from Grefsen and Kjelsås districts (So Central, 2021).*

4.6 Do you take water for granted?

Do you take water for granted? is a more than 2-minute video on Oslovanns' Facebook channel that represented a new water supply system. The video aimed to eventually reduce the vulnerability in the current system, which is heavily reliant on a single dominant (by 90 percent) water source in Maridalsvannet. The video introduces a new water supply station in Holsfjorden, Buskerud, which will be completed in 2028.

The video started with daily activities such as drinking water, cooking, and flushing the toilet that requires freshwater. Later, the voice in a video appealed to the audience, asking if a viewer is one of the average Norwegians that use around 160 liters a day. Furthermore, it concludes that "we are used to good things" (sec 24), referring to the same overuse of water. Interestingly, the video continued with some specific activities attributed to Norwegian culture, such as eating sausages (and boiling them in freshwater, Figure 4.6a) and the lifestyle of Oslo habitant that enjoys swimming in Oslo fjord. Figure 4.6b illustrates a young woman jumping into the Oslo fjord, and there is visibly Oslo's architecture in the background. The episodes mentioned above potentially strengthen the environmental message by creating a familiarity effect by applying to audiences' habits, interests, and values. Further, the speaker asked to imagine if the water would disappear or become undrinkable and followed with words: "Water is health. Water is life. Water is safety" (min 1:01). The spokesperson finally emphasized tap water's vulnerability and explained that Oslo Municipality Water and Sewage Administration would care for clean and safe drinking water for Oslo's citizens.

To summarize, the video was posted on the Facebook page of Oslo's Water and Wastewater Agency. In addition, the WRCS portrayed Oslo residents' cultural activities and habits to highlight the vulnerability of fresh water and encourage people to limit their water consumption.

Figure 4.6a Water for boiling sausages, Figure 4.6b Young woman jumping into Oslo fjord.

4.7 IPCCs findings

The Norwegian Environmental Agency and the CICERO partnership released the promotional film on IPCC findings that can be found on the national agency's Instagram account (Miljødirektoratet, 2021a).

A person walked through a timeline from around the 1950s to the 2060s (Figure 4.7); he felt cheerful at first but then became more frown when the forceful climate (droughts and heavy rains) intensified and hit him directly. The video began with birds chirping and a slight breeze, then a sound gradually intensified, culminating in thunder, pouring rain, and strong gusts. Finally, a message emerged implying that the extremity of the weather depends on us, meaning that we are in charge of future weather conditions linking to the IPCC's five probable scenarios.

Figure 4.7 An episode from a promotional film on IPCC's findings (Miljødirektoratet, 2021a).

To summarize, a film on the Norwegian Environment Agency's Instagram post used visual and audio elements to demonstrate water-linked climate effects for Norway (and Oslo).

4.8 The sixth IPCC's main report's presentation

The Sixth IPCC's main report's video serves the same purpose as the previous strategy to raise awareness of a newly published document (*4.7 IPCCs findings*). The video was placed on the Environmental Agency's Instagram account (Miljødirektoratet, 2021b). It began with a fierce soundtrack and revealed that current climate changes are irreversible. Therefore, there is an urgent need to understand and act upon IPCC's collected knowledge on the climate crisis. In addition, a statement pointing to a human in a laboratory (Figure 4.8a) suggests that all research is based on scientific evidence rather than potential or imprecise assumptions. This statement also assisted in minimizing uncertainty by giving a one-directional and consistent signal that the human-caused climate crisis is based on science and that its occurrence is undeniable.

Figure 4.9a Therefore, we can make decisions based on facts, not feelings, stating the source (Miljødirektoratet, 2021b).

An episode of the oil platform declared that CO_2 emissions were higher than 800 000 years ago.

Finally, a graphic with a platform emphasized Norway's moral responsibility for its significant contribution to GHG emissions by extracting and burning oil despite its brief duration.

Figure 4.8b Oil and gas platform was shown in line with the statement that GHG are now higher than 800 000 years ago (Miljødirektoratet, Instagram, 2021).

There was also a sound, visual statement about the global generational shift towards environmentally friendly attitudes and a more engaging general public in massive global protests. However, few scenes represented Norwegian juveniles protesting and roaring in climate protest, as illustrated in Figure 4.8c. The other figure depicts a young person who declares that "there is no planet B" (Figure 4.8d), referring to the demand from youth to act and introduce stricter climate-related legislation.

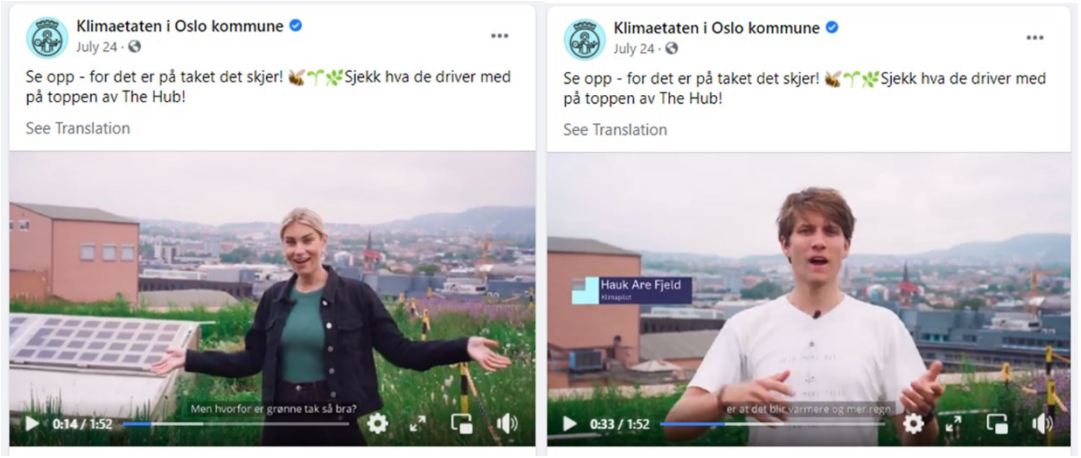
Figures 4.8c and 4.8d illustrate young climate protestants.

In brief, WRCS presenting the sixth IPCC report was placed on the Norwegian Environment Agency's Instagram page. Then, the uncertainty of climate science was addressed with a statement that the climate change process is undeniable. Later, the illustration of the Norwegian oil platform implied the moral responsibility of a country with its significant contributions to the climate crisis. Lastly, the video depicted youth protesting against current national climate policies.

4.9 Grow hub initiative

Three young communicators in the Grow Hub project showed blue-green solutions on the KlimaOslo (Oslo Climate Agency's name) Facebook page (Klimaetaten i Oslo kommune, 2021b). Reporters enthusiastically represented green roofs and explained the benefits of introducing this solution as WRCS. For example, reporters claimed that green roofs might be used as a habitat for animals, as fertile soil for food planting, or a tool to absorb rain surplus, clean air pollution, reduce noise levels,

and regulate the temperature in buildings. Figures 4.9a and 4.9b represent young reporters that encourage citizens to follow the prototype of Grow Hub and introduce green roofs on their properties.



Figures 4.10a and 4.10b portray young Grow Hub project reporters who explained the benefits of green roofs (Klimaetaten i Oslo kommune, 2021b).

Briefly, Grow Hub proposed the initiative to introduce a green roof as a blue-green structure to curb climate change consequences and reduce energy consumption. The video is placed on Oslo Climate Agency's Facebook page.

5. RQ2 Findings. Environmental communicators' perspectives on climate change and implications of environmental communication

The survey results were derived, and findings on environmental communicators' perspectives on climate change and its consequences were analyzed. As a result, respondents' perceptions of environmental communication were classified into three groups. Accordingly, the three themes were: central subject matters, major themes, and minor themes. First, the central subject matters reflected on essential characteristics derived from interviews, which aided in understanding the target audience and communication channels. Later, major themes that proved to be the most influential among respondents were investigated. Following that, minor aspects were discussed. Simultaneously, the survey findings were compared to the results of the interviews under each of the relevant themes.

5.1 Central subject matters

The section on central subject matters presented key findings regarded as interview pillars. Furthermore, survey results reflected environmental communicators involved in the WRCS, expertise in climate change.

5.1.1 Environmental communicators' background knowledge

An online questionnaire was used to gather background information from environmental communicators who work with water-related strategies and initiatives. As a result, five municipality

or governmental actors and two actors from scientific institutions have responded to the survey. Specifically, three males and four females, the age ranged from 25-40 (5 participants) to 41-56 (1 participant) and finally until 56+ (1 participant).

There was an evident agreement (100%) that global warming is happening and has an anthropogenic origin. While all respondents replied that global warming is hurting or will hurt people in developing countries, future generations, and even them personally, one respondent claimed that (s)he is not worrying about it while the rest do care.

Participants claimed that floods, soil erosion, and sea-level rise were seen as the most significant water-linked climate consequences.

Next, all respondents' primary responsibility for curbing climate change was dedicated to governments. Further, 5 out of 7 responded that they feel like they have enough knowledge about climate change causes, while two claimed they do not have enough expertise. Lastly, only one person out of 7 responded feeling like (s)he had enough knowledge about climate change's consequences on the water sector. Hence, five answered that they did not have enough knowledge, and one person did not know whether the knowledge was sufficient.

Concerning environmental communication, participants had an option to choose three main information sources to receive information on climate change. The Internet and newspapers were the most influential sources, followed by television and radio. Governmental agencies appeared to be in the middle of other sources and received 71.4% support. Academic publications and Environmental groups achieved even less support.

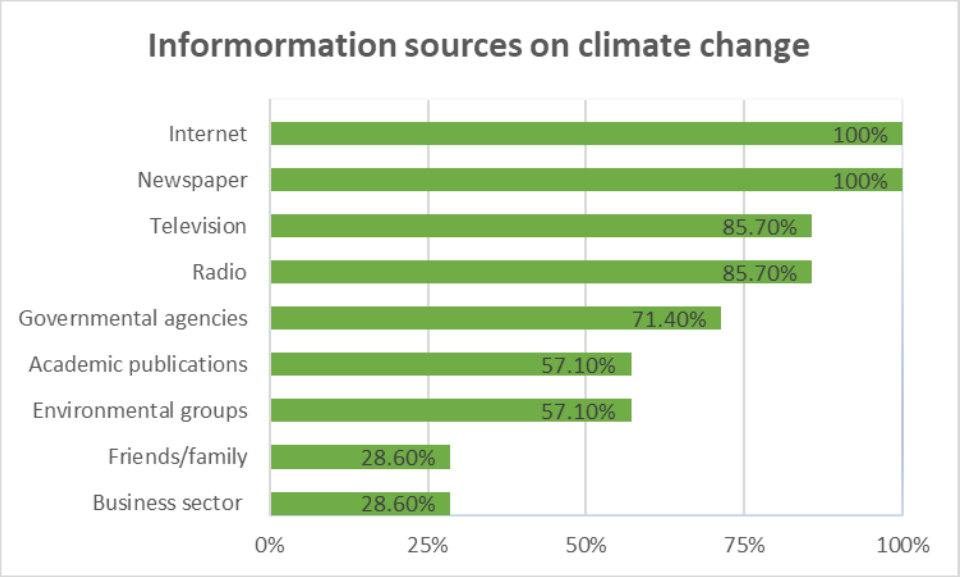


Figure 5.1.1a Information sources used by environmental communication to find information on climate change

Equally important was to estimate the level of trust in various climate change information sources, Figure 5.1.1b. Survey results depicted that scientists and governmental institutions are most respected for delivering accurate climate evidence (100% of respondents have a 'very high' or significantly 'high level' of trust in these sources). Apart from national and local actors and scientists, none of the others were highly trusted in this survey. Nonetheless, environmental communicators rated media and environmental groups as 'very likely' trustworthy sources with more than 70%.

However, environmental institutions also received a rate as ‘slightly trusted,’ implying that information providers could have previously provided unreliable information.

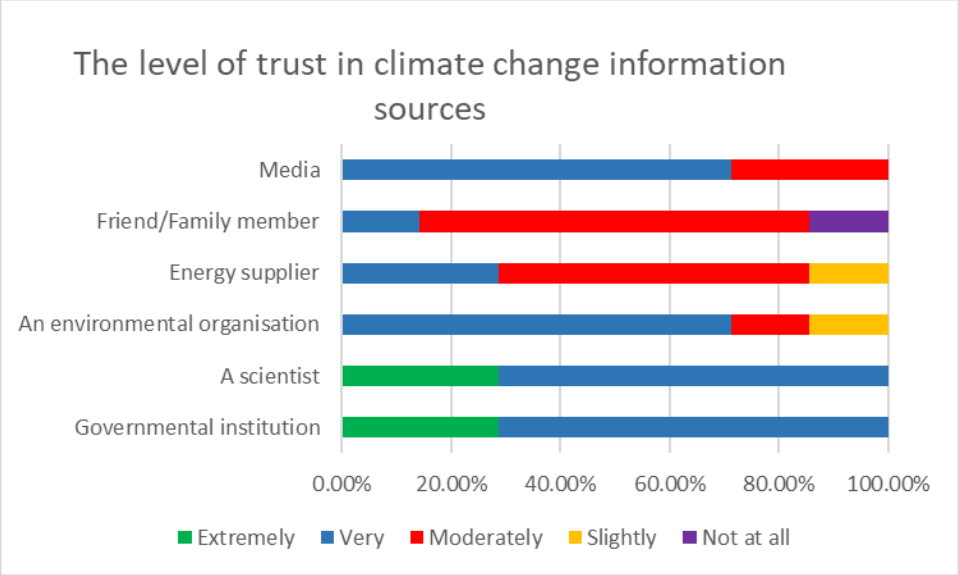


Figure 5.1.1b Environmental communicators' trust levels in various information sources

To summarize, research participants have a solid knowledge of the origins of climate change and the severe threats it poses to many groups. Survey respondents identified floods, erosion, and sea-level rise as the most severe climatic impacts. Governments agreed to carry the primary responsibility for curbing climate change. While most respondents claimed to be knowledgeable about the causes of climate change, only one individual claimed to be knowledgeable about the effects of climate change on the water sector.

5.1.2 Target audience and audience diversification

The project aims to focus on Oslo citizens as recipients of environmental communication. Target audiences may be diversified, and different strategies may be applied. Nevertheless, it is crucial to get a broader overview of a complete list of the target audience. An extensive overview would allow making assumptions and reflections on how vital the role of citizens is in the whole context.

All interviewees could identify their communication target audience. However, some respondents had difficulty distinguishing between the primary target audience and the subordinate. In addition, few respondents did not explicitly describe if they have a different EC strategy for Oslo inhabitants compared to other stakeholders.

Through personal e-mail correspondence with the senior communication advisor and project manager at The Urban Environment Agency, she ascertained that communication target audiences are "everyone who uses the city, the countryside and the islands."

Interviewee 1, who works on Environment Agency's podcast, described his main target audience as "municipality administration and local politicians." Oslo citizens, or to be more specific, climate supporters/advocates, are described as those people who "accepted the challenge" and "interested in learning more and doing something about it." Interviewee 1 did not consider that all Oslo citizens could be a target audience since a podcast was described as a niche medium. Therefore, a follow-up question was then asked whether Oslo citizens support climate action. Correspondingly, the reply was too disparaging of Oslo residents. When asked if the respondent thought Oslo inhabitants knew enough about climate change and water-related climate dangers, Interviewee 1 responded that he did not think "there are any concerns with that at all."

Regarding Oslo citizens' needs, values, and motivations related to climate change, the respondent referred to his 15-20 years of communication experience and concluded that "people, in general, do not have a high level of knowledge." Responses correlated with survey results as 85.7% of respondents believed Oslo citizens did not have sufficient information about climate change in the water sector. One can sum up that Interviewee 1 had a very targeted, niche target audience and did not consider all Oslo citizens while communicating climate-related topics.

Interviewee 2, who works in NINA, explained that they "try to reach as broadly as possible" and that "this is particularly important in the publicly funded projects" containing 25-40 % of NINA's overall portfolio. NINA's specific, research-based profile also has diversified target audiences as project topics or tasks may be relevant to smaller or more generic audiences. Taking measures in wastewater to see if there is a coronavirus, for example, would reach a prominent media audience because the results might be applicable worldwide. Contrary to that, research conducted for Oslo fjord may be limited to local media, politicians, and Oslo citizens. Nevertheless, Interviewee 2 emphasized that the main target is to reach "the groups that can make decisions based on knowledge," meaning clients of their research.

Interviewee 3, who works in Oslo Municipality's Water and Sewage Administration, explained that he is currently working on communication strategy and stakeholder analysis. However, the identified primary target audience was defined as property owners and decision-makers in the municipality. Additionally, the respondent highlighted that "it is important … that it is not everyone in Oslo because it will not work. In other words, everyone is not a good target group or an interesting group." Moreover, Interviewee 3 added that the target audience in a current preliminary communication strategy is "segmented in terms of who we think has the biggest challenges or who might be thinking of doing this in the best conceivable way."

Interviewee 4, who works in the Norwegian Environment Agency, elucidated that their target audience "it is really the general public." Meanwhile, the same interviewee expanded that "politicians who, in a way, and journalists perhaps our main target group. The ones who actually can make a difference". Actors from the business world were also mentioned. Later in the discussion, it became clear that journalists and politicians play an essential role in the agency's communication strategy. Interviewee 4 repeatedly said that "journalists are a particularly important target group for us. It is important to pass on the information. They are the ones taking the message out into the big world then."

Interviewee 5 works for the Agency for Planning and Building Services. Her responsibilities include stormwater management. She had difficulty describing her target audience since the

communication strategy is not completed yet, but the agency is in the process of establishing one. Nevertheless, from a diversity of questions, a preliminary list included Oslo citizens, specifically those who "need more detailed information on stormwater handling." To be more specific, the respondent detalized that "property owners are also a special group because they are going to do something on their own property," as well as tenants that live in properties and may be affected by stormwater. The list continues with decision-makers. Interviewee 5 emphasized that "we need to communicate well with them so we can get both the resources and the legislation. For example, the framework conditions can help us develop good solutions." Another significant audience mentioned was "schools and children." Respondent summarized that "there are different target groups, and we have to define different measures that reach these target groups through different channels to be used for it" and use "the right message, properly formulated and concerning the right target groups." Interviewee 5 clearly admitted the importance of targeted communication even though she accepted that "we are not very good at communication." "We" connoting to the Agency for Planning and Building. The respondent explained that they, in the Planning and Building Services, have a water management strategy adopted in the Oslo municipality. They also have an action plan related to the strategy. The action plan consists of 18 measures, where communication is one of them.

Both Interviewees 6 and 7 work in the Climate Agency in the city of Oslo. Their central working platform is KlimaOslo. Interviewee 7 started the interview by highlighting that she "worked strategically with climate communication since 2013". As opposed to previous interviewees, the agency has a clear communication strategy; they quickly identified their target audience: Oslo citizens and the business sector in a city. Interviewee 6 asserted that she was "working more towards changing and interpreting the behavior in the business sector." Nevertheless, Interviewee 7 admitted that "a majority of our communication is oriented to (Oslo) population. Meanwhile, the business also has a place in it, but not as visible and blended in informational messages". The same respondent confirmed that they use targeted communication that depends on various communication channels. Climate pilot is an influential climate-related platform that involves Oslo schools and juveniles that are undoubtedly a meaningful category of a target group. However, if we look at the agency's most focused communication medium, we can presume that adults and elders are their primary group. Interviewee 6 accentuated that they "have content that fits the target audience and that we reach the ones we want now." In brief, both Climate Agency respondents were confident in their communication strategy and ability to reach their target audience.

5.1.3 Communication objectives

Informing the audience was among the most important objectives of the EC and mentioned by all interviewees. For instance, Interviewee 4 emphasized and determined that distinct objectives of climate communication are to convey facts, inform everyone about what is happening in climate science, and assist municipalities in achieving climate goals. Similarly, Interviewees 3 and 5 emphasized the need to provide information about municipalities' current projects and efforts. Nonetheless, respondents indicated that some objectives were more challenging to identify since some information campaigns included uncertainty, a lack of communication channels, or long-term efforts required to continue motivating people. For example, Interviewee 3 mentioned that he had an ongoing campaign about a new water supply system in Oslo and also the issue of water disappearance.

Similarly, Interviewee 5 felt that merely informing what the municipality and different municipality agencies were doing was an essential task as citizens did not know whom they needed to approach in case of stormwater retention on their property. She stated that residents should receive clear messages and guidance on what tools they may use in the event of flooding, such as flood maps and information regarding municipal assistance, including financial schemes if they exist. It is necessary to mention that the respondents mentioned above did not have communication strategies in place; therefore, this could have been a reason for ambiguous goals.

Despite some unclear objectives mentioned, respondents 6 and 7 clarified that one of the main goals of the Environmental Agency in Oslo is to inspire citizens. Interviewee 6 commented that her communication should "inspire and show how you can change behavior to just cut emissions." Her colleague, Interviewee 7, explicated that "we have a goal with our communication that it will lead to behavioral change so that it will lead to real climate cuts in the population and business sector in Oslo indirect emissions."

Moreover, Interviewee 3 mentioned another aspiration – getting to know his audience; he argued: "I think our communication work is to actually gain insight into what citizens who are concerned about and what they think and what they want and have been challenged they will have then when we start digging and also come up with solutions that we can at least consider." During the interview, he later added: "but for me, it is important that communication is used to actually solve a problem. Not only inform about (what) the problem is."

Another personal objective for being an environmental communicator was named by Interviewee 2 as he called himself a "middleman" that can answer "those stupid questions and be the one that addresses the scientific language and try to transcribe it into something a bit more comprehensive." NINA's communicator implied that the main objective of communication was translating/converting scientific knowledge into an understandable one for the general audience.

To sum up interview results, informing, conveying facts, translating scientific knowledge, inspiring, solving problems, and familiarizing with the audience were among the environmental communication goals.

5.1.4 Communication strategy

Semi-structured interview guide focused on external climate strategies directed toward Oslo citizens. Therefore, the question of whether the institution had a communication strategy was not asked by most respondents. Therefore, I consider it a limitation for covering this section. Consequently, only 4 out of 7 respondents mentioned communication strategies. Two of them confirmed that they did not have a communication strategy at the time of the interview, but "that is what we are working on, so we are in the process of establishing a communication strategy," as stated by Interviewee 5. She then explained that the stormwater management communications strategy will be used across the agencies in Oslo, "and each thinks a little differently because they have different responsibilities and different knowledge, so now we try to collect it and create a common strategy." Interviewee 3 shared an analogous message that they "are not done with that strategy then, but I think there are a lot of stakeholders in that work here." Nevertheless, Interviewee 3 mentioned that even though a stormwater management communication strategy is underway, the Water and Sewage Agency had

an “internal strategy that it is easy to be a resident of Oslo and so we are.” Respondent implied that supporting Oslo citizens and solving their daily problems is the agency’s primary approach, providing clean water and efficiently managing wastewater.

On the contrary, both respondents from the Climate Agency in the city of Oslo confirmed having an explicit communication strategy. As Interviewee 6 described, they had a climate strategy in the municipality, “and it has also been established that communication shall be one of the instruments for achieving the overall goals set on reducing greenhouse gas emissions.” She then described that the strategy was “based on the facts and the point verifiable and reliable and that we are going to use a language that people understand.” Interestingly, Interviewee 1 shared his thoughts on the same climate strategy for Oslo city, stating that “they (Climate Agency in the city of Oslo) have realized that they are as far as it has been avoiding the word climate change talking about building a better place. I think that is a much smarter approach.” He then clarified that the strategy is “not to talk about climate change” as the agency would lose the majority of its audience but instead talk about “making a better city, upgrading the city.” Accordingly, Interviewee 7 agreed that instead of saying ‘green’ or ‘climate-friendly,’ the strategy in Climate Agency is to use the word “which gives positive associations,” and, therefore, the word ‘smart’ was chosen.

5.1.5 Communication channels

5.1.5.1 Homepages

All interview participants agreed that using several communication channels to reach the target audience is crucial. For example, interviewee 3 claimed that “you get a huge effect, only if you do several things at once. I think you have to do several things at once in different channels.” Interviewee 5 also acknowledged the importance of using various media sources for different audiences and according to messages that need to be carried out: “then we have the knowledge that we need to communicate out, but then we have to use the right media.”

Homepages of different institutions had diverse importance. At the same time, most interviewees claimed a growing emphasis on their home web pages. For instance, Interviewee 7 shared that they saw a trend that their leading KlimaOslo portal “have more and more readers who find us through organic searches,” referring to a web search. Worth mentioning that even though the Climate Agency produced nearly all content in KlimaOslo, other Oslo municipality agencies participated by posting articles, e.g., the Agency for City Environment, Water and Sewerage Agency. In addition, Interviewee 2 claimed that their “primary communication channel is our own website.” The respondent also stated that NINA's website received 230 000 unique visitors per year, sounding like a credible figure for NINA.

Contrary to the affirmative responses discussed, Interviewee 5 was immensely critical of the Agency for Planning and Building Services webpage in the City of Oslo. Compassionately suggested - “you can just look at it! There is a lot of text, and there are some images, and that is what you get.” Interviewee 5 advocated that the homepage should contain more visual information so that Oslo inhabitants would easier perceive it: “it must be very simple. People do not bother to read. They will

not read long text.” She also showed a prominent frustration towards the portal as the actual state made it challenging to communicate and send necessary messages. Despite the criticism, the respondent believed that the agency's website is an important communication platform that should be improved.

5.1.5.2 Social networks

Social media undoubtedly took an incredibly significant, and for some institutions, probably the most essential, place in communicating environmental matters. For instance, Interviewee 4 was primarily employed as a social media expert and adviser; therefore, most of her assignments were on social networking websites. Interviewee 4 revealed that they extensively use Facebook, Instagram, Twitter, and LinkedIn at Norwegian Environment Agency. Respondent disclosed that she additionally administrated a private Facebook group for “targeted municipalities and county municipalities” that consisted of 2200 members. Norwegian Environment Agency’s public Facebook page consisted of a relatively large 68,513 followers community as of April 12th, 2022 (Miljødirektoratet, 2022) and had the largest audience in their social media portfolio. For comparison, NINA held 911 followers and used Facebook as a tool to get attention on vital information “when data comes out of sight.” Meaning, that Facebook is used to refresh information posted before and did not get expected attention or needed information coverage. Interviewee 7 claimed that Climate Agency in Oslo city “has been working longer to build up Facebook. That is how Facebook is at the moment the most important channel on social media.”

Additionally, Water and Sewerage Agency had 6,500 followers. Accordingly, Interviewee 3 remarked: "that Facebook has benefited them the most because you can target it in a good way and all our users or all of our residents are grown people because they are the ones who own houses, and they are the ones who are affected by it.” Therefore, the respondent suspected that Facebook allowed him to reach the most significant target group – adults. Moreover, Interviewee 3 disclosed that Water and Sewerage Agency purchased commercials on Facebook “if there is an incident in the city regards to boiling or a leakage" and added that such “advertising is in the way very cheap and quite effective at reaching out in such a crisis situation then.”

Nevertheless, there were various opinions about the number of followers. For example, while Interviewee 6 was confident that Climate Agency needed to increase its audience on Facebook: “we want more followers and then it is also kind of the right thing to do,” Interviewee 3 asserted that “it is not an important strategy for us to increase numbers on our Facebook group itself” even though “it is always nice” to have a bigger group of supporters.

Most respondents used Instagram, and even though it was not the leading social media platform, it was still quite a critical channel to reach out to younger audiences. Interviewee 6 indeed stated that they “are very clear on Instagram towards kids or teens,” intending that this was a particular channel aimed at this age group. Interviewee 4, who worked with social media, remarked that the Norwegian Environment Agency “has started using Instagram much more in the last two years than we have done before.” Then, the shift to social media was largely due to the platform's continued popularity among younger audiences. Interviewee 4 specified that Instagram is “good for spreading information to those who do not necessarily read VG every day or NRK lectures and kind of just on Instagram all the time.” Respondent detailed that “not everyone is very source-critical,” implying that

some people did not read scientific news or traditional media. So, she believed it is vital to use the opportunity to reach out to this segment of the population who only used Instagram.

One respondent mentioned LinkedIn as a medium to share knowledge. Interviewee 4 explicitly used LinkedIn to disseminate climate-related information by posting "press releases and professional messages" and going "into greater detail with the academic communities or business, municipalities." Interviewee 5 used her private LinkedIn account to share work-related material because she was unsatisfied with her networking opportunities and existing communication channels at work: "I got a lot of people who follow what I do." She later admitted that LinkedIn is also beneficial because she "sees something fascinating and gets input from other people."

5.1.5.3 Comments section on social networks

Responding to social media is crucial if one prefers to retain or increase follower count, engage with the audience, and strengthen interaction. Although not all respondents elaborated on their social media comments, it was essential for Interviewees 4, 6, and 7. Interviewee 4 worked with social media and therefore shared that a policy in the Norwegian Environment Agency was “as a general rule, we have to answer all the questions that we get in the inbox or as a comment. But it is supposed to be factual.” She also affirmed that they had “green light, orange, light, red light,” meaning some comments could be left unanswered based on their origin. Interviewee 4 enclosed that on Facebook, they turned off the inbox feature and left just the public comment section due to an overcrowded inbox. Respondent had also disclosed that on Facebook, there are “a lot of climate change deniers” or “a lot of followers who do not believe in it, in climate change.”

On the other hand, Interviewee 4 explained that while Instagram had a slightly different target group. This younger audience did not question man-made climate crisis as “they tend to believe in climate change,” both inbox messages and public comments were available. Interviewee 4 implied that climate skeptics were more engaged in social media comments sections or messaging inboxes than those who supported climate policy and accepted man-made climate change.

Oslo municipality's Climate Agency was actively not just producing posts on social media but also answering comments. Interviewee 7 shared that they “answer questions when there are facts, information that can help provide better (solutions)” she also added that they “do not answer absolutely everything, but we want to be present in the comments section so that we have a visible voice.” Once I asked about influencing factors of KlimaOslo column ‘Climate myths’ Interviewee 6 corresponded that she “commented on the field where we saw what was popular, what engaged people and what was it that I was wondering about and so it has been an important source. What is nice about social media is that we get feedback from people out there, so we could see what their concerns were.” Therefore, one can state that the Climate Agency engages with its audience and looks for inspiration for future initiatives from the comment section. Such involvement leads to a more democratic involvement in environmental communication.

Interestingly, environmental communicators did not answer several questions, such as on Environment Agencies Facebook post *Climate panel: 1.5 degrees can be reached in 10 years:* “No. This is not true. You are drawing far too dramatic conclusions. IPCC uses unscientific words such as

‘perhaps,’ ‘possibly,’ ‘high and low probability,’ etc., for politicians to get something to wind up in. Not convincing at all and really strange that after long research they write with so many reservations” (Miljødirektoratet, 2021a).

Similarly, unanswered comment in the article “UN Climate Panel with a powerful report on climate solutions, “There is a huge elephant in the room. There are no regulations and restrictions on private energy consumption or the use of resources in general. If you have a lot of money in your account, you can still just drive unrestrained” (Miljødirektoratet, 2022; April 4th).

Climate agency not only engages with its audience but also looks for inspiration for future initiatives from the comment section.

5.1.5.4 Face-to-face communication

While it is natural that recording a podcast entails face-to-face or ear-to-ear conversation, the climate podcast concept is to interrogate with experts in a field or members of the municipality. Therefore, I only discussed face-to-face communication between environmental communicators and citizens of Oslo.

Interviewee 2 enclosed that regular face-to-face communication occurs in gathering places such as conferences, seminars, and orientation meetings. The respondent accentuated that these meetings could be difficult but quite important. He mentioned that at NINA, they try to involve and invite relevant groups, such as “local users like fishermen or outdoor enthusiasts, landowners” to their semi-annual webinars or seminars and “in more detail talk about the project's progress and ask if they have input for further work. Because, after all, they are the ones who are going to make use of it.” Interviewee 2 named three recent initiatives at NINA that involved direct communication, such as leading an informational forum in Research days Status Oslofjorden: Views from the research front in the (Forskningsdagene, n.d.), hosting public involvement project in Fjord school, and garden city project in Ullevål district in Oslo.

Arrangement *Research days Status Oslofjorden: Views from the research* were live-streamed on Facebook, with the option to sign up for physical and free participation. Interviewee 2 expanded that he took a lead role in arranging the event, and “there were scientists talking in a non-scientific way or at least the more popularized one about different impacts on the fjord.” Such a communication format meant that scientists represented their research topic, and Oslo citizens could ask questions after the presentation. Respondent shared that seminar “was quite well listed and even more had watched the stream.”

In an Oslo Fjord school public involvement project, students learned "not only more about water, but also about the various environmental impacts." Interviewee 2 gladly revealed that the initiative "fortunately grew a bit broader" and that the project affected and intrigued the parents of the same students.

Meanwhile, Oslo's garden city project in the Ullevål district cooperated between Oslo municipality and NINA. Oslo municipality has helped with funding while NINA tested various nature-based solutions to deal with stormwater in the city and different drainage options and avoid flooding. Interviewee 2 described that "local residents in the garden community who are private individuals who test this out and find it really interesting and rewarding for them to be a part of something that could be escalated to more green solutions in the city." Respondent summarized that the initiative "has been good with very useful and going on for many years now."

Interview 3 also frequently mentioned eye-to-eye communication and dialog: "we work closely with residents, meeting citizens digitally during the pandemic, especially on the water supply." He also highlighted "the biggest effect you will have if you can actually talk one to one." However, at the same time, he explained that direct communication should go in conjunction with other communication methods. The third interviewee then shared his experience from a small pilot project involving blue-green solutions for roofs and drainage systems. The idea behind it was to solve problems related to surface water and minimize the consequences for wastewater systems caused by excess rainfall. The Water and Sewage Administration asked Oslo citizens to collaborate and assist in controlling and slowing down excess water on their property, but participation was minimal, and motivation was low. As a result, Interviewee 3 recommended: "that properties in this area should we have good communication around this, and also for insight about what are we talking about." He also suggested investigating "What is causing them not to do what they are supposed to do? Is it because they do not know, or is it because they do not want to, or is it because of the money?" Collocutor attempted to solve problems by direct communication rather than expecting that introducing a formal requirement to take technical measures would work without understanding the context.

Interviewee 5 was more conservative about the effectiveness of face-to-face meetings that she had participated in. For example, when I asked about the presentation she was holding at the technical museum in Oslo, Interviewee 5 responded that she had "been to some of those external presentations, but how many people get there is very limited, right"? Her skepticism stemmed from a lack of engagement with key stakeholders, and she did not believe that such seminars had a substantial impact.

5.1.5.5 Distinct communication channels

Interviewee 2 indicated that NINA used Forskring.no (the Nordic region's most prominent online channel for dissemination of Norwegian and international research) for outreach. Respondent explained that through NINA's membership or "ownership as they say" in Forskning.no, they "have an ambition of one article per month, so twelve a year and that is quite easily achieved" as NINA produces "about fifty in a year." Moreover, the communication expert pointed out that seminars, webinars, and breakfast meetings were among the other communication channels.

Additionally, the main communication channel for climate podcasts, according to Interviewee 1, were popular podcast applications on mobile phones.

5.1.6 Common knowledge between communicators

Stormwater and its management strategy planning is an interdisciplinary issue. Stormwater bridges numerous agencies in the Oslo municipality. Thus, it is critical to have a shared perspective to properly communicate concerns related to it. Interviewees 3 and 5 shared concerns regarding determined and single-minded stormwater management strategy in Oslo municipality.

Interviewee 5 explained that Agency for Planning and Building was “in the process of establishing a communication strategy for stormwater management across the agencies in Oslo. There are many agencies, and each thinks a little differently because they have different responsibilities and different knowledge, so now we try to collect it and create a common strategy.” According to Interviewee 5, information concerning stormwater was fragmented: "very limited geographically" and was primarily framed by a project that did not span the entire Oslo city. Interviewee 5 explained that there was the Water and Sewage Agency, the Urban Environment Agency, which was responsible for streets, parks, waterways, and property, the Urban Renewal Agency, which owns properties and has knowledge of pollution in landfills and finally, there is the Climate Change Agency “which was a bit of an umbrella organization.” By umbrella organization, the respondent meant that the Climate Agency was not connected in the same way as other agencies in the Oslo municipality but was above them. She also added other external difficulties: "there is Oslo municipality, but I cannot influence the City of Oslo that sits at the town hall. I have very little opportunity to influence them.” The respondent referred to a lack of coordination between the Oslo municipality and the Agency for Planning and Building and between agencies. Synchronically, the Water and Sewage Agency representative claimed that “there are challenges associated with stormwater management” across agencies in Oslo. According to Interviewee 3, “it becomes more focused on the environment and climate, but more on the sort of climate adaptation of climate and climate change means that we have to think differently then and it will be important for us.” In contrast to Interviewee 5, Interviewee 3 has accepted the challenge of dealing with stormwater and had urged for a cohesive approach in the Oslo municipality and more recognition for the subject. Interviewee 5, on the other hand, saw the topic as something that will be noteworthy in the future, but not at the moment.

5.1.7 Doom and gloom versus positivism

The majority of respondents believed that there was a demanding but necessary task to balance threatening and optimistic communication. However, there have been contradictory viewpoints on doom and gloom messaging usefulness. Some of those interviewed were adamant in their support for alarming/threatening communication, while others advocated for the dissemination of positive information. According to respondents, both tactics, especially their combination, could generate a positive attitude, improve awareness, and support environmentally-friendly solutions.

Interviewee 5 argued that sad and tragic events should be used in environmental communication since they could awaken people: “because otherwise, you sit very comfortably on the couch reading newspapers or doing other things than thinking about stormwater.” “I think that will surely scare them, and there are some who get such an eye awakening,” interviewee 5 said when I asked if Oslo municipality’s rhetoric toward Oslo citizens could frighten them by making them

primarily responsible for coping with flooding consequences in citizens' dwellings. Later, we discussed a hydraulic model with a map of Oslo that Interviewee 5 is developing in the Agency for Planning and Building Services. She then commented that while people see just drainage lines on the map, they are calm, “but when you see a model with real water that goes there at different depths on a map and down the house wall, of course, it will scare you. And that property will lose a lot of its value as well.” She later added that “it just must be acknowledged that we need that knowledge whether it scares people or not. And if it scares people, then maybe they will want more information to deal with it. If I do not scare people, they do not care.” Finally, she concluded that “so we may have to use this scary propaganda a little bit, we need to scare a little” so that Oslo citizens “would be willing to look a little closer at it and do something about it.”

Interviewee 3 had a more careful approach and suggested talking about vulnerability instead of a direct threat. He claimed that speaking about vulnerability and the possibility of adapting to a situation is essential. Interviewee 3 explained how they communicated a possible water supply disappearance in a Water and Sewage Agency: “it is important to get people to pay attention to it. That we are in a vulnerable situation in Oslo.” He also explained that he expected citizens to be prepared and “to have crispbread and gas" in emergencies. Interviewee 3 finally reflected that he and Water and Sewage Agency “do not want to scare people, but we have thought it may be important that people get a little intimidated.” Then he added that “we believe that the threshold for believing that one can be lost is somewhat greater now than it was before the pandemic,” intending that pandemic has also come unexpectedly. Therefore, inhabitants had a greater understanding that water supply obstructions could happen.

Interviewee 5 expressed similar thoughts about balancing doom and gloom and messages, saying, “it is a bit of a dilemma with having to do that,” implying that dramatic messages should not be given too much weight. "What is going to happen then? So, can we scare you?" she inquired. Respondent added that it is critical to offer opportunities alongside warnings. She observed that “it is a balancing act when we write the news reports,” implying that she attempted to find a midsection between two opposing messages when communicating climate-related issues.

Interviewee 6 said that recently, the Climate Agency in Oslo revised its climate communication strategy has been ongoing for five years now. They also asked for external evaluation of their work and compared results with research about effective climate communication. Therefore, it was summed up that agency was on the right track and “absolutely transparent and positive communication is important.” "Then there is a balancing act," she continued, "and sometimes we also have to bring out its seriousness. But that kind of freaking out is not something we do." Interviewee 6 also compared environmental and health communication, stating that "health communication has also moved away from the direct warnings on the cigarette packages to more positive and motivating" ones. She implied that cigarette packages now frequently include messages encouraging people to quit smoking rather than threatening smokers with potential health problems.

Meanwhile, Interviewee 2 believed he had profound insights into what was needed for raising awareness and getting more attention to climate-related subjects: “Again, stories about making a difference in the media, not just warning signs! The good news in Norway we need more good news about the environment. Initiatives in research and things that have been successful.”

Survey results were distributed equally to messages that highlight possible threats and hazards of climate change and also present possibilities (above 85% as “very important” and almost 15 % as “extremely important.” While survey results proposed an excellent and even prominence between threatening and positivistic messages, some interviewees prefer to choose one option over the other.

5.1.8 Values, beliefs, and attitudes

Interviewees had different opinions of Oslo citizens' values, beliefs, and attitudes. Nevertheless, the majority of respondents found these topics interesting to discuss. To the question of how respondents understood Oslo citizens’ needs, values, motivations, and references regarding climate change, Interviewee 1 answered that since he has 15 to 20 years of experience in communication, he felt like he had “a reasonable understanding of it, but that is because it is my job.” Interviewee 1 expanded that “we are in a society that is becoming quite polarized, and the trend is more polarization,” meaning Oslo citizens and all Norwegians.

According to Interviewee 1, “there is always an element of interest” in communication. He also remarked that effective communication is motivated “by two things: it is driven by facts and by interest. And if we do not have mechanisms to deal with the interest, then you are not getting anywhere.” Respondent gave an example of a 749th report from the IPCC that came recently and should bring more clarity to environmental and climate communication. Contrariwise, Interviewee 1 claimed that solely “more information from the IPCC does not mean that it is easier to make climate policy” and frequently leads to more ambiguity if the message lacks aspects of audiences' interests.

Interviewee 3 expanded on human behaviors and theories of those that could be applied to effective communication. Respondent believed that examining the audience’s beliefs was a very demanding and “probably wildly complex” task and claimed that Agency for Water and Sewage was “now in such a kind of insight phase where we are going to find out,” implying that they wished to know more about the topic. Nevertheless, Interviewee 3 believed that behavior was governed by a few things: attitudes, e.g., “subjective norms, i.e., what you think your neighbors or others around you do or do not do,” and then “whether you think you are able to solve your problem or if you have the money for it.” He also added that “we need to know why people are not doing what they are supposed to do” maybe they ”do not believe in man-made climate change,” referring to climate skeptics. Interviewee 3 had also shared a picturesque example from daily life highlighting the importance of studying people's attitudes: “everyone knows that fruits and vegetables are healthy, but why not eat with fruits and vegetables?” emphasizing that simply disseminating knowledge through public channels would not be a successful technique for changing audience’s attitudes.

Both respondents from the Climate Agency in Oslo relied on surveys that reflected Oslo citizens’ values, motivations, and attitudes. Interviewee 7 stated that the agency's main communication goal was a behavioral change, namely behavioral change among Oslo inhabitants and businesses “in relation to reducing direct emissions 95% by 2030”. Interviewee 6 has also added that “we need people also to change behavior in areas that are not regulated financially or legally. So, I think communication is a very important role in this,” intending that social norms play a significant role here. She also added that surveys showed that “people are positive about reducing greenhouse gas emissions” and that "there has been quite a big change in recent years on the willingness and

understanding and awareness of the climate challenges and solutions that are required." When asked about various values that audiences might have, Interviewee 7 contradicted her colleague by saying that "it is not important to us why people choose to do climate-friendly things if they choose to do it because of the economy, or because they want a car. The important thing is what are they doing, and then we have some strategic moves." Meanwhile, Interviewee 6 was more optimistic about understanding behaviors stating the known importance of the "effect of neighborhoods because we know that climate-friendly behavior is contagious so that the more people who cycle to work or who make climate-friendly choices to great influence here, and those friends and neighbors are perhaps just as important together." Interviewee 6 had also summed up that "climate communication does not differ very much from other types of communication, but what we see has the most effect, when there is behavioral change." She also admitted that behavioral changes set very clear goals for the communication agency's work" as "knowing what is it that works and what triggers and what barriers and drivers have an effect.

Moreover, Interviewees 1, 2, and 3 advocated that most of the audience had a consumer perspective (thoroughly described in section 5.2.2 Consumer perspective) and were looking for practical solutions to everyday problems.

Survey outcomes uncovered that knowing audiences' values, interests, and beliefs was not the most crucial factor in environmental messaging. While around 70% replied that it is 'very important' to include audiences' psychometrical aspects, almost 30% believed it is 'moderately' relevant. To conclude, both the survey and interviews revealed that knowing audiences' preferences is quite significant, but most respondents did not seem to have a deep understanding of them.

5.1.9 Place-based messages

All the respondents aligned their climate communication with a particular location. Interviewees had adequate knowledge of Norway and Oslo's current and predicted climatic conditions. For instance, Interviewee 3 disseminated messages related to a new water supply system that would decrease vulnerability in a capital. Furthermore, Interviewees 2 and 5 had extensive knowledge of stormwater concerns in Oslo and thus spread news based on their expertise. Both were also related to the New Water Way project, which had pilot campaigns in small localities, and therefore their knowledge and environmental rhetoric aligned with this experience.

Water and Sewage Agency "have a great use of resident meetings, i.e., face-to-face meetings with people in local areas of the city," according to Interviewee 3. Such meetings and additionally digital ones resulted in a close connection with local media. The research investigated popular communication channels among the target group and found that "we know that they read the local newspapers to a great extent then." In this way, place-based information could be delivered to the particular target group. As Interviewee 3 explained, only the affected target group was approached in a particular geographical area to avoid information overload.

According to NINA's communication expert, scientific institutions commonly disseminate messages based on the origin and scientific findings' relevance to the general audience. For example, if the findings were on the Oslo fjord, the information was mainly applicable to Oslo city. Nonetheless, Interviewee 2 described one of the initiatives in which NINA tested wastewater for Coronavirus during

the pandemic, and the findings unintentionally got widespread media attention. The findings had "real news value," according to the respondent. As a result, if location-based communications were judged to be highly relevant, they might be used for global purposes. Otherwise, generally, localized messages were disseminated by all respondents. Survey results strongly correlated with interview findings. Namely, 7 out of 7 respondents acknowledged the importance of telling local stories. The question specifically asked: *Which communication methods do you think are most successful in increasing climate awareness?* Among the answers, the response to show location-specific challenges garnered the most support; accordingly, 100% compared to other options where 43% support was shown.

5.1.10 Corona virus's impact on environmental communication

Two opposing opinions were on the nexus between climate communication and the Covid-19 pandemic. The first position was that pandemics increased or potentially increased communication effectiveness in various ways. For instance, Interviewee 5 claimed that digital meetings swapped with regular face-to-face meetings were more "convenient and very much more effective." She explained that "especially in our organization in the municipality where we are many agencies, it is very nice to have these digital meetings between the agencies. I am at the home office a lot and can lead the meetings with everyone and without any problem." "So, I think it is working really well," she added. Another positive outcome was shared by Interviewee 3, stating that the occurrence of a pandemic increased understanding of the likelihood of other vulnerabilities, such as those related to water. Explicitly, the respondent suggested that the pandemic phenomenon seemed to be small and doubtful for society before it happened. Nevertheless, the occurrence of an 'unlikely event' led to a new state of mind when "one may believe more that it can happen now (with more probability) than before."

Interviewee 6 confessed that she has discussed nexus with her colleagues in the Climate Agency and concluded that Covid-19 allowed the agency to talk more openly about uncertainty. She implied that health communication during a pandemic was similar to environmental communication as both required simultaneously addressing statistical facts and uncertainty. Nevertheless, Interviewee 6 remarked a significant difference between the two: "corona is so close to us and visible. And one also sees the effect of the measures quite quickly. Almost two weeks from when you introduce a face mask injunction until you see the infection rates go down". She added that the same effect on introduced climate-friendly measures would not be as quickly noticeable.

Finally, Interviewee 4 argued that during the pandemic and its restrictions, "people have more time then to sit behind the screen, too" and concluded that there were more comments on Norwegian Environment Agencies' social networks. She suggested that more time at home and in front of gadgets could have led people to spend more time reading environmental news.

In contrast, Interviewees 1 and 2 observed that the pandemic disturbed environmental communication. To start with, Interviewee 1 shared that the Norwegian Environment Agency "could not put as much effort" into climate change-related topics. Therefore, Interviewee 1 concluded that environmental communication was clearly disturbed, so it "was negative in that sense." Comparable, even though Interviewee 2 claimed that he did "not feel that the (climate) issues have been wiped out, and of course now that the Glasgow Summit is back on the agenda," nevertheless, he added that he did "not feel we have lost much rather than maybe a year in time." He then added that it was

“harder to get the messages out during pandemic because they do not have the room on the media. But the projects have been going forward and the funding aspects, so there are not many developed disruptions on that point, I think,” Interviewee 2 asserted.

5.1.11 Recommendations for climate communication improvement

Assessing the efficiency of environmental communication is a reflective action that allows identifying gaps and then redirecting communication more effectively. While some respondents affirmed having a communication strategy, others did not. Consequently, it was easier to assess efficiency if a master plan was in place or if a communicator had direct control over his/her communication methods and feedback.

In particular, the Climate Agency’s communication strategy was recently revised, reflecting on “what we have learned even in the five years that the Climate Agency exists and what we know about the effect of climate communication,” as claimed by Interviewee 6. She then explained that internal as well as external evaluations proceeded. Additionally, they have also “done the summary of what research says.” Hence, the Climate Agency concluded that the climate communication strategy was “precisely what we have implemented in our strategy,” in accordance with Interviewee 6. Thus, an evaluation of climate communication strategy effectiveness revealed that the Climate Agency was aligned with best practices based on internal, external, and scientific expertise.

Similarly, Interviewee 4 described that at Environment Agency, they “have one of those analysis programs that look how many people are involved in the case.” By ‘case,’ she referred to social media articles or posts. The agency had a statistics tool that tracked performance and measured how many readers accessed the content. According to Interviewee 4, all interactions with mass media sources were likewise tracked in an analysis tool. As a result, if the Environmental Agency discovered that a media outlet broadcasted "something so wrong," implying a misleading climate message, they would demand an explanation.

Notwithstanding, assessing the efficacy was far more difficult for Interviewees 3 and 5 due to many obstacles. As Interviewee 5 stressed, there was an urgent need to recognize stormwater as a significant threat locally in Oslo and at the national level, create legislation, strengthen knowledge, and allocate sufficient funding to move forward in environmental communication. Interviewee 5 speculated that at Planning and Building Agency, “we hope that Norway also comes up with something eventually. They really should have been defined as stormwater proposals at the national level, right? There should be a regulation that every property pays a fee for stormwater. So, the council has the money to handle that water when it comes out into the street.” She also added that “authorities talk far too little about stormwater and climate adaptation.”

Interviewee 3 did not appear to be in the same hurry as Interviewee 5 to finalize the stormwater communication strategy. He focused more on water supply and related matters than stormwater. Nevertheless, Interviewee 3 suggested that the most efficient communication happens “only if you do several things at once” and the “biggest effect you will have if you can actually talk one to one.”

Interviewee 1 described that he assessed the effectiveness and usefulness of climate podcasts: “We have not done any kind of survey on this. So far, it is based on feedback that week directly from people.” Interviewee 1 elaborated that he preferred to get direct feedback by talking to people or email. He also shared that so far, the feedback has been quite positive.

5.2 Major themes

Major themes were subjects discussed by at least three respondents and, in many cases, by all of them. Such topics were considered to play an essential part in the work approach of climate communicators. Furthermore, essential themes revealed communicators' standard working practices, challenges, and cultural similarities.

5.2.1 Fact-based

Absolutely all interviewees have mentioned that their environmental communication was based on facts. It was particularly emphasized by Interviewee 4, who worked in the Environmental Agency. The main and the only function of environmental/climate communication in an agency was to convey facts. Fact-based communication function was claimed to be using “numbers, facts, and science.” Agency's primary goal in communicating climate-related topics was “just to inform everyone about what is happening in climate change, in climate science.” Meanwhile, Interviewee 4 mentioned that even though all climate communication was based on factual information, they "still have some angle on it with communicating. " This angle was related to social media usage and algorithms that these social media sources encompass (e.g., more visual content).

Interviewee 1 had also excitedly explained that governmental institutions have no other option than just providing fact-based information: "government agency supposed to provide advice based on fact, of course, they should. I mean, the opposite solution would be insane, of course".

Interviewees 4 and 7 mentioned that responses to citizens' messages on their social media should be answered considering if there are enough facts to support opinion. At the same time, survey results aligned with collected data from interviews – over 85% of survey participants replied that messages of scientific knowledge on climate change were very or extremely important.

5.2.2 Consumer perspective

In most interviews, consumer perspective and immoderate focus on practical solutions were leading themes. When I asked Interviewee 1 if he thought Oslo residents were reasonably aware of the causes of climate change, such as consumerism and waste production, he responded that “I think that most people probably have not heard that this is a problem.” He expressed his negative opinion on climate information in a pretty direct manner as he stated that “most people are looking for practical solutions, “practical solutions to everyday problems” for example, “making sure that the public transport system actually works in a way that they can use it” or “people want to make sure that they

have water delivered to the kitchen every day. And long as that works, I do not think people think too much" about climate threats or mitigation methods.

Interviewee 2 raised a concern that "there is a small challenge here of how to reach the audience other than through this consumer perspective," implying that the respondent had most likely accepted this perspective and was attempting to adapt to it while communicating environmental issues. He then explained that it was a great challenge to disseminate environmental and climate-related messages since these kinds of messages "tend to come under the typical consumer issues." Indeed, society was said to ask, "what is in it for me? And what could this mean for my body and yours? So, it is done instead of getting a picture of the big global pretty urgent issues about climate and the environment."

Interestingly, Interviewee 3 not only did not mention consumerism as a concern, but when asked about any water consumption reduction programs and given an approximate recent value based on average water consumption statistics in Norway, which is roughly 180l per day, Interviewee 3 stated that "I think it is a little lower, somewhere between 140 and 160 liters per person per day". He also claimed that even though "it is demanding to make drinking water and it is resource-intensive and costly, and you probably should not spend that much water on all sorts of weird things, but it is something we do then (laughing)." Interviewee 3 recognized that "we have not worked to reduce water consumption" during dry periods in Oslo. The respondent was unconcerned about citizens' high water consumption levels in the aforementioned statements.

> **we probably should not spend that much water on all sorts of weird things, but it is something we do then (laughing)**

5.2.3 Struggle with financial resources

Financial struggles were mentioned by 3 out of 7 respondents. Notably, three institutions indicated communication obstacles related to lack of funding - NINA, the Water and Wastewater Agency in Oslo, and the Agency for Planning and Building.

Firstly, Interviewee 2 described that expectations on environmental communication were to communicate just at the final stage, which meant - only dissemination results. Therefore, the budget for the communication part was nominated accordingly. Interviewee 2 expressed his worry about communication effectiveness and rhetorically asked, "why not keep people in the loop throughout the budget?" to achieve public outreach on core issues.

Interviewee 5 mentioned limitations on a budget many times during the interview. Most importantly, the respondent emphasized that the agency should have had more money for communication campaigns to be good at the information in Agency for Planning and Building Services (which she denied being a decent one: "we are not very good at communication"). She called that getting proper funding for this purpose was "difficult to fight," and climate communication was not among the top priorities in the city's strategic plans. She then concluded that authorities lacked

sufficient knowledge about stormwater, making it difficult to persuade them of its importance. Consequently, an insufficient budget for communication was an alleged barrier for the agency.

Nevertheless, Interviewee 5 referred to the budget spent on Oslo fjord's communication campaigns, which received much public attention. However, she questioned if the focus on Oslo fjord was worth the money spent in terms of a relationship between spending and results "what do we get out of it? In other words, its costs the benefit assessment (should be estimated)." Furthermore, the skepticism shown by the interviewee questioned Oslo municipality's ability to determine top priorities for city management. An environmental expert from the Agency for Planning and Building believed that the Climate Agency "is a bit of an umbrella organization" and had a support scheme (on climate communication).

5.2.4 Neighbors

The factor influencing a shift to more environmentally friendly behavior might be neighbors. Two respondents explicitly mentioned this phenomenon, and circumlocutory by another two.

Neighbors' and neighborhoods' influence on environmental and climate-friendly attitudes were indirectly discussed by Interviewees 1 and 2. As Interviewee 1 advocated, "if people in the neighborhood can come together and discuss how they can make their own neighborhood better," this would lead to more productive communication. Respondent emphasized the importance of communities that could make decisions together as they were eventually the ones experiencing consequences themselves. Meanwhile, Interviewee 2 illustrated successful cooperation between city officials and residents of Oslo during The New Water Ways project. When citizens were "downloading this app and taking photos from their neighborhoods on where the water comes," they contributed to scientific knowledge by photographing flooded places next to their homes. Neighborhood in this context was used to signify the importance of community responsibility and demonstrate that being familiar with a place/location had scientific value.

Interviewees 3 and 7 more explicitly underlined the significance of neighbors. For example, interviewee 3 stipulated that "there may be subjective norms, i.e., what you think your neighbors or others around you do or do not do, and it could be problem management method." Meanwhile, Interviewee 7 accompanied that "people may make fewer daily choices based on emission factor and not least if the neighbor does it (laughing)," referring to close relationships between individuals who live close by as an influential factor to consider when developing effective climate communication strategies.

5.2.5 Avoidance of addressing climate skeptics

Most respondents claimed to avoid addressing climate skeptics in their environmental communication, which would distract them from their direct tasks and goals. Meanwhile, few interviewees did not elaborate on whether climate skeptics were among their target audience, particularly, Interviewees 3 and 5. Nevertheless, Interviewee 3 philosophized about justification on

why some people refuse to admit reality, as if people “do not believe in man-made climate change, so (they) do not bother to prepare for it. And it is probably wildly complex (question), but I think we need to know” in order to prepare “a good communication plan around it then.” As a result, as Interviewee 3 speculated, simply disseminating knowledge through different communication means might be an ineffective strategy. Interviewee 3 acknowledged that there were climate deniers and that there was a necessity to understand why people do not trust science, but he did not know why.

Meanwhile, Interviewee 7 claimed that in Climate Agency, “we have chosen not to spend our powers on those who do not believe in climate change.” Similarly, Interviewee 1 explained that since a climate podcast was a niche communication channel, only those who “accepted the challenge” listened to it. Therefore, only people dealing with climate change were considered as the target audience, and there was simply no fascinating material for climate skeptics, according to Interviewee 1. Likewise, Interviewee 2 explained that climate skeptics had no place in communication due to NINA’s scientific approach: “we are not the right target for skeptics research.” He implied that all studies and initiatives were to support climate-induced consequences, and all “decisions are made on the basis of the knowledge,” and therefore contradicted ideas by skeptics.

Another vital challenge was social media, where climate skeptics had a broad media platform to express their beliefs and minds. Interviewee 4 explained that even though the Norwegian Environment Agency did not target climate deniers in its messaging, climate skeptics were active in the social media comments section. “Facebook has a lot of climate change deniers. That is a lot of the conspiracy theories” there, she discerned. Interviewee 4 then elaborated that “climate change deniers were “spreading the message further,” and there was ”a very big debate then about whether climate change exists or not” on Facebook. Because of the large number of messages from climate deniers, the quick spread of misinformation, and a shortage of human resources to respond, Facebook closed private messaging, leaving just public comments available.

5.2.6 Simple language

Interviewees 5, 6, and 7 advocated for simple language to reach the audience. First, interviewee 5 stated that Oslo residents would not read long texts and that only "very simple messages and videos" are needed to meet communication objectives. Next, Interviewee 6 described that climate communication in the Climate Agency should be “based on the facts and the point verifiable and reliable and that we are going to use a language that people understand.” The respondent later added that the *Climate myths* section on the KlimaOslo website used “a little other than a regular one” method. By irregular, Interviewee 6 implied everyday language. The *Climate myths* was indeed a unique video project where everyday language and humor were used to explain common climate myths such as “the climate change is not caused by human activity” or “the climate crisis is not that dangerous after all.”

Moreover, Interviewee 6 shared that the *Climate myths* project was recognized “in the communication environment then both nationally and internationally, so we have received several awards” for it. Finally, Interviewee 6 summed up, “That is what worked. The most important thing is that it has an effect, and then it is fun. Also, there will be positive attention.”

As a result, the respondent stated that new, non-standard projects where the agency used citizens' daily language resulted in national and international success and high engagement.

5.3 Minor themes

Minor themes were subjects that only one or two respondents mentioned during an interview. The fact that other respondents did not investigate or mention a theme did not indicate that they held conflicting views. Instead, it indicates that it was either not covered during an interview session or that the respondent did not believe it was a notable topic.

5.3.1 Climate awareness

Climate awareness was a minor theme due to the practical issues that interviewees were facing at their jobs – technical struggles and civil society's unsound involvement.

Climate awareness, in particular, appeared not to be a notable concern from the consumer's standpoint. As a result, more people identified practical solutions, consumerism, and hedonistic values instead. Interviewee 1 was strict, stating that "I do not think there are any concerns with that at all," referring to climate change and its threats. Other respondents specified financial strains that restrict communication in general.

Notwithstanding previous perspectives, Interviewee 6 was a singularly positive (together with her colleague?) person that believed in increasing numbers of climate awareness. She stated that results from the climate survey indicated that "people are positive about reducing greenhouse gas emissions" and "there has been quite a big change in recent years on the willingness and understanding and awareness of the climate challenges and solutions that are required." To be precise, the communication expert of the Climate Agency of Oslo city referred to the climate survey, which was performed in Bergen.

5.3.2 Increased popularity of EC

According to two out of seven respondents, environmental communication is becoming more important and popular. For example, Speaker 2 observed that environmental issues or issues regarding climate change were finding a place in a novelty agenda and "is an increasingly important task." Interviewee 1, likewise, acknowledged that "downloads of climate podcasts are increasing each month."

5.3.3 Information overload

NINA's communication expert mentioned information overload as an obstacle to communication. Interviewee 2 confirmed that "there is an information overload out there, but also the fact that one

must try to find someone the right knocker to hang in the message." Furthermore, the communication expert implied that due to the struggles to squeeze in environmental news in the already crowded field of information, there was necessary to find specific messages that stimulate and fascinate the public. Later, when asked whether family members or friends approached Interviewee 2 to know more about a climate crisis and projects he was involved in, he replied that no, they usually do not. Moreover, the respondent argued that he had a "basis of experience to say something about" climate but elaborated that "maybe the information overload again?" intending that people from his close circle probably were not forthcoming to him because of overwhelming amounts of information. Finally, Interviewee 2 admitted that he was "worried that (people) get too much information and is simply going to be difficult to choose which things to be worried about and what reports to rely on."

Similarly, Interviewee 1 observed that increasing information coverage on climate subjects did not ease making climate policies if other factors such as addressing audiences' interests are not included in environmental communication.

5.3.4 EC – as an insignificant, unimportant part of a strategy

Interviewee 5 mentioned a lack of internal networks between municipalities to exchange information. Furthermore, there was a lack of understanding that stormwater management and communication should be given higher priority in city strategic plans.

Analogously, Interviewee 2 pointed out that environmental communication "seems like an obligation and demand" and "it is more of a sort of a burden." He later expanded that "for many, I think communicating is just something that needs to be done because we promised it" and remarked, "I think this is quite an important point actually from this talk." At the end of the interview, the abovementioned quotes were stressed as the most critical and concluding points of our discussion, noting that environmental communication had a minor and insignificant place in the whole project/strategy, according to Interviewee 2.

5.3.5 Crisis as a kick-off

Few respondents have mentioned that dramatic increases in environmental awareness may only occur in the face of a climate crisis, either directly or indirectly. As an example, when I asked Interviewee 3 to propose communication strategies for raising awareness, he appeared overwhelmed and agreed it was a challenging task: "Ufff... It is very hard, isn't it?" and later added, "I think you need a crisis to sort of doing it."

Interviewee 3 also referred to a famous American (he could not remember his/her name) who believed that outrage was crucial to developing awareness and courage: "outrage is essential to get the focus on." If, according to Interviewee 3, Water and Sewage Agency applied the outrage theory, awareness of water supply risks might occur. He suggested "talk about vulnerability, so a big, overarching perspective" and tell Oslo citizens that water pipes were in bad condition and needed to be replaced. "Then, maybe it would create an outrage," he remarked. Respondent also added that

Oslo citizens relied on Water and Sewage Agency and gave all legitimacy to the institution. Therefore, it was hard to expect an outrage in that case: “the water is always there. It has always been there, hasn't it? When you turn on the tap, there is water there. So, if it is not believed that it can be gone, then that belief is there. And it is so strong because you have a high degree of trust, of course! We have also done surveys over the years, and the last one was done two years ago. It says the same thing - that citizens have very high confidence in the water then, on its’ delivery to Oslo, and maybe it is also because we did not have any major incidents, right?” Although Interviewee 3 acknowledged that he did not know the best way to increase awareness regards the vulnerability of Oslo's water supply. He suggested that some level of outrage among Oslo residents would be beneficial.

Extreme weather conditions, such as heavy rain, were believed by Interviewee 5 could increase climate awareness among Oslo inhabitants, municipalities, and national authorities. She mentioned the Netherlands as an example of a country dealing with serious climate issues such as flooding and sea-level rise. Moreover, Denmark, Sweden, Germany, and other nations that have recently experienced intense rainfall and used these experiences to develop climate policies and raise awareness about water-related climate threats were recommended. Respondent expanded on Copenhagen city in Denmark, saying that “they got the big rain in 2011 in Copenhagen, right? And it has woken them up!” meaning that heavy rains in the Danish capital caused local authorities to investigate the importance of taking action. Consequently, Danish scientists concluded it was more cost-effective to protect the city from heavy rains and actively adapt to climate change effects with blue-green solutions. This was opposed to allowing rain to damage property and nature. It seemed that Interviewee 5 awaited more extreme weather conditions in Oslo as this could mean more focus on Oslo’s stormwater handling: “but it is just Copenhagen, in Norway, it has not arrived yet. There was huge rain, very heavy, but it was out by the ocean, wasn't it? So, it had no impact” to Oslo, sighed respondent. She also added that there was just a minority that had experienced issues related to stormwater on their properties, and there was no severe damage from this: “but we did not have anyone die, for example. There is no personal damage directly. It has just come with financial damage” implying that since Oslo citizens had not experienced severe consequences from extreme weather. She referred to the lack of a focus on stormwater, as climatic consequences were either indirect or negligible. Nevertheless, the fifth respondent deliberated that negative stormwater consequences could occur unexpectedly.

5.3.6 Moral myopia and political neutrality

Moral myopia is defined as a moral vision distortion that prevents moral difficulties from coming into focus and "moral muteness," or the inability to discuss ethical matters (Drumwright and Murphy, 2004). Moral myopia in the context of environmental and specifically climate communication means that Norway extracts and produces oil and gas, which is seen as the predominant source of greenhouse gases. However, most respondents did not raise this question but rather stated their neutrality towards political or economic matters.

Interviewee 2 and Interviewee 4 touched upon ethical concerns in environmental communication. Interviewee 2 claimed that they were just “knowledge suppliers” at NINA and even affirmed that this could "sound a little harsh here,” but they accepted their role in the system.

Specifically, NINA had statements such as “if we do not stop petroleum activities now, then the temperature will rise by 2 degrees in the next 50 years, then that is the knowledge we provide to the authorities, and then the authorities have to react to that information”. He also alleged that “it is politically sad" but “we are not the ones who are going to make decisions based on that knowledge.”

Interviewee 4 voiced her concern about social media’s comments sections, although she asserted neutrality in public climate communication. Some commentators were seeking scapegoats, according to Interviewee 4: “there are many people that just blame China and the United States,” rather than pointing to Norway, which was one of the "countries with the highest greenhouse gas emissions per inhabitant."

To summarize, the aforementioned respondents expressed ethical concerns about the causes of the climate crisis. However, both interviewees elucidated that this was only their personal opinion, not used in their public communication.

5.3.7 Transparency

Interviewees 3 and 6 mentioned transparency and openness as a new ‘trend’ in environmental communication. Namely, Interviewee 3 affirmed that Water and Sewage Agency is “conscious of focusing on that vulnerability, i.e., on both the water source and the water distribution networks” and “a little about transparency - how things are then, that one should no longer hide the state.” Respondent implied that a new practice in the agency is to be transparent about water-related accidents in Oslo city and openly address vulnerabilities. Analogously, Interviewee 6 confessed that inspired by the coronavirus pandemic, the Climate Agency is planning to be more open while addressing uncertainty.

5.3.8 Generations

The most distinguishable division in generations was seen through different communication channels, e.g., youth were more present on Instagram while adults and elders were on Facebook. There was also a belief that the younger generation had a more pro-environmental mindset, as Interviewee 2 shared: “there is a bit of a generational shift here as well. I think that younger scientists are a bit more aware of the importance of public outreach and disseminating the results.” Interviewee 6 had shared a similar opinion and claimed that “there has been quite a big change in recent years on the willingness and understanding and awareness of the climate challenges and solutions that are required, and especially until we set now when we have revised our communication strategy, i.e., the role of children and young people, and surveys that also show that they are influencing the older generation.” To summarize, both respondents believed that new generations were more environmentally conscious.

5.3.9 Videos

Video messages were evidently gaining more attention in environmental communication in Norway and Oslo, as was seen from the increasing number of online posts on Facebook and Instagram.

Namely, Interviewee 4, an expert on social media, shared that “it seems that algorithms actually prioritize video content more than just text.” Compared to textual content or images, respondent indicated that video content would most likely be ranked higher on social media feeds and, therefore, easier accessible to readers.

It was also intuitive to Interviewee 5 that video content and animations on Planning and Building Agency's online home page would significantly enhance environmental communication. Interviewee 5 claimed that video messages would be “easily perceived by the inhabitants.” She also stated that such a practice was employed successfully in other countries, such as the Netherlands.

5.3.10 Popularized science/ citizen science

Environmental matters are a major area of concern for policymakers and society, and while research is crucial to our understanding of uncertainties, a link between science, policymakers, and the general public may be formed to help reduce climate and environmental problems. One of the solutions was mentioned by Interviewee 2 – citizen science or popularized science. Citizen science engages the general population in scientific research, both in a global and community-driven range. Such a process incorporates both scientists and society members. Both Interviewee 2 and Interviewee 5 had been involved in the New Water Ways project, which could be called a citizen science project. Interviewee 2 had a role in organizing and communicating the research project, while Interviewee 5 represented Oslo municipality and had played a role as a provider of scientific knowledge. “We also had an investigation with the involvement of the inhabitants” and “there has been a task to invite 20 people from that area to participate in 4 meetings where we both presented a little about stormwater. And then they finally came up with their thoughts. (They) compiled in a document to the municipality what they think the municipality should do to get involved inhabitants and solve stormwater in a better way,” Interviewee 5 shared. The project occurred in Grefsen and Kjelsås, two Oslo districts that faced significant stormwater and flooding issues.

Interviewee 2 acknowledged that "researchers utilized it a lot," implying that Oslo residents contributed significantly to a scientific understanding of stormwater in a city by downloading an application and sharing photographs and GPS information with flooded areas from their neighborhoods. Moreover, as Interviewee 2 pointed out, such an approach could be utilized in addition to established scientific methods: “in addition to hard science, there was also citizen science.” Respondent further admitted that the application would have been more influential if NINA and Oslo municipality had been better in communication, resulting in 200 000 citizen downloads.

Nonetheless, Interviewee 5 asserted that NWW was a hugely successful initiative in general and that it was planned to be extended: “now we also have another research project that has some continuation of the previous one that started now, precisely called SPARE.” The project was in the early stage of development; therefore, there was no official information yet. Nonetheless, the project was expected to endure for another four years, according to Interviewee 5.

Interviewee 2 was also a proponent of popularized science used in NINA's organized Research days. The idea was to have a dialogue between Oslo residents and scientists who would deliver a topic in a more accessible manner. Moreover, Interviewee 2 advocated that voluntary-based actions could

contribute to finding unique solutions to climate issues as “people who care about their local communities” could have had valuable information addressing climate challenges. Moreover, Interviewee 2 advocated that local communities have a genuine concern for protecting the environment they live in. Briefly, while the NWW project was a pilot and the first of its kind, there are premisses for directing environmental communication toward more citizen-inclusive approaches.

6. RQ3 Findings. Gaps in effective environmental communication.

Applying a conceptual framework on environmental communication, comparative analysis of findings from interviews and surveys with environmental communicators’, and analyzed WRCSs, yielded four pitfalls:

- Oversimplification of EC,
- Disconnection with the target audience,
- Sticking to traditional communication methods,
- Link from awareness to action.

6.1 Oversimplification of EC

Communicating climate change matters is a complex task as the climate crisis is a long-term environmental challenge that affects many spheres. Pezzullo and J. Robert Cox (2018) discerned that climate science as a complex story (p.185) has to integrate multiple aspects into one coherent story to assist audiences to “make sense of new experiences, relating them to familiar assumptions about the way the world works” (p.123). Accordingly, Stamm, Clark, and Reynolds Eblacas (2000) advocated that communication of profound environmental problems should imply a precise understanding of the problem's causes, consequences, and solutions and not just concentrate on singular examples.

As a result, the comparative analysis focused on gaps concerning inconsistent coverage of all three mentioned factors in mind. Therefore, oversimplification of EC was labeled if environmental messages do not link causes, consequences, and solutions.

6.1.1 Causes

Consumerism, oil and gas, waste production, and other harmful human-induced activities are among the causes of the climate crisis. Inability or reluctance to discuss ethical matters is called moral myophia (Drumwright and Murphy, 2004).

In general, moral myopia in the context of climate communication was evident in most interviews, with few exceptions. In particular, the communication expert from NINA recognized scientific findings and suggestions that went against the Norwegian political agenda. However, the respondent admitted that it was not him or the scientific institution responsible for policymaking, and therefore, he accepted his role as an information provider. Likewise, a Norwegian Environment Agency

communicator pointed to Norway as a country with one of the highest carbon emissions per inhabitant, albeit the issue and explanation were not addressed in the social media comments section.

A similar tendency was observed in analyzing central WRCS in Oslo, such as Oslo's new climate strategy, Climate Change Adaptation Strategy for the City of Oslo, and Climate Change Vulnerability Analysis for Oslo. All three climate strategies acknowledged climate change as anthropogenically caused. Nevertheless, none of the strategies addressed harmful and damaging behaviors and actions that steered the change.

Namely, *Oslo's new climate strategy* enclosed the most responsible sectors for climate gas emissions. Moreover, one of the strategy's objectives was to reduce indirect emissions from consumption and economic activities within city limits, according to KlimaOslo (2020c). In addition, the strategy pledged to encourage more product reuse and repair and give information on climate-friendly consumer choices.

Next, Climate Change Vulnerability Analysis for Oslo admitted that "reducing anthropogenic greenhouse gas emissions was, therefore, the most crucial measure for climate change adaptation" (Klimaetaten, 2020). Nevertheless, there was no detailed information on what particular causes led to a crisis. On top of the ambiguous claims with no further explanation, vulnerability analysis included a threatening message stating that "unless we reduce greenhouse gas emissions globally, the average temperature will increase by between 3 and 6 degrees Celsius and precipitation levels by between 5 and 30 percent by 2100. By that time, the climate in Oslo will have changed dramatically, particularly in the winter months". However, as previously, there were no more details about why the climatic crisis occurred.

Finally, the Climate Change Adaptation Strategy for the City of Oslo reminded us of climate variations in human history caused by natural mechanisms, such as emissions due to volcano eruptions or variances or solar radiation. After the industrial revolution, wrote Bymiljøetaten (2013), the atmosphere and the oceans absorbed large amounts of carbon dioxide, which led to an unnaturally rapid temperature increase of almost a degree.

Nevertheless, none of the central WRCS directly appealed to citizens' consuming habits or addressed Norwegian oil and gas contributions to climate change. Even more, explaining that climate has been changing before due to natural processes and not providing enough data to explain the influence of these assurances downplayed the severity of the climate crisis evoked by human activity. Worth mentioning a two-second video episode depicting a Norwegian oil and gas platform that alluded to the responsibility of Norwegian fossil fuels that significantly contributed to the climate crisis. Nevertheless, the direct message was not sounded or textualized.

To summarize, appeals addressing climate crisis causes such as oil and gas extraction or oil usage in Norway were almost non-existent in the WRCS and during interviews. Nonetheless, if Oslo's new climate policy adheres to its principles of promoting climate-friendly consumer choices and facilitating product reuse and repair services, it would also remind us of previous harmful behaviors. In that case, climate causes would be appropriately addressed.

To conclude, appeals that addressed climate crisis causes such as oil and gas extraction or oil consumption in Norway were nearly inexistent in WRCS and during interviews.

6.1.2. Consequences

On the whole, all WRCSs described broad climatic consequences on Norway and Oslo. However, survey findings suggested that six out of seven climate communicators did not feel like they had enough knowledge about climate change's consequences on the water sector. Consequently, citizens who are not experts on climate-related consequences are unlikely to have sufficient knowledge on the subject.

Additionally, Interviewee 5 determined that the consequences of stormwater were not clear due to a lack of knowledge. In particular, flood maps based on hydraulic models were not completed, and stormwater damage risk evaluation was inexistent (PBE, 2020). As a result, citizens were not endowed with a complete picture of the threats in a capital. Flood maps would provide an overview of stormwater accumulation and potential flood sites. Furthermore, the occurrence of landslides that were linked to severe precipitation levels and floods was unclear and hardly covered in WRCS. Lastly, the Office of the Auditor General of Norway concluded that the situation in Norway was dire "in light of the significant consequences of climate change" because "authorities do not have a good enough overview of where there may be more floods and landslides" (Riksrevisjonen, 2022).

To sum up, even though national and local water-linked climate consequences were defined and communicated, there was a dearth of knowledge on the occurrence of these effects (e.g., stormwater, floods, landslides) in specific areas. A comprehensive flood map for Oslo should be developed, with risks identified and consequences for Oslo residents communicated.

6.1.3 Solutions

Creutzig et al. (2018) proposed a transdisciplinary approach to identify climate solutions from a demand perspective. Scholars identified demand-side solutions for mitigating climate change as "strategies targeting technology choices, consumption, behavior, lifestyles, production–consumption infrastructures and systems, service provision and associated socio-technical transitions" (Creutzig et al., 2018). Additionally, Kabisch et al. (2016) offered nature-based solutions for climate adaptation in urban areas. Notably, based on thesis findings, Oslo city offered blue-green solutions. Aside from adaptation advantages, Kabisch et al. (2016) argued that NBSs provide climate mitigation and societal well-being benefits and serve as a solid investment option for sustainable urban planning (Kabisch et al., 2016).

To begin with, on the side of technology options, blue-green remedies were dominated solutions offered to adapt and mitigate water-linked climate consequences. However, while blue-green solutions are vital for densely urbanized areas that will face tremendous water-linked climate threats, these are not sufficient to promote comprehensive solutions. For example, handling excessive stormwater on a property was stated solely as the property owner's responsibility, with the Oslo municipality acting as an advisor. Another analogous solution to curb excessive precipitation was presented in *Grow hub initiative* – install a green roof. Beneficial sides of such green structures were presented. Nevertheless, interviewees specified a lack of information, financial means, and comprehension of various climate-related treatments (blue-green solutions) as reasons why Oslo inhabitants did not support or contribute to climate adaptation initiatives as much as expected. Among other claims, the Office of the Auditor General of Norway concluded "that the authorities have

not secured a sufficient overview and implemented the necessary measures to secure existing buildings and infrastructure" (Riksrevisjonen, 2022).

As per central WRCS, Oslo's new climate strategy has set a target of a 10% reduction in total energy consumption in Oslo by 2030, compared with 2009, and pledged to address Oslo's Scope 3 (indirect) emissions. Meanwhile, Climate Change Vulnerability Analysis suggested that "we must expect that anthropogenic emissions will continue as before and that climate changes will occur as a result," referring to the highest GHG projection scenario (Klimaetaten, 2020). Nevertheless, Miller et al. (2010), in their comprehensive analysis of resilience and vulnerability, suggested that a more desirable social-ecological state of climate could be reached if more hybrid and pluralistic approaches, such as incorporating participatory research, were integrated into vulnerability analysis. Scholars implied that certain labeling regions, such as Oslo, could result in potentially regressive policy decisions and justifications for intervention that would undermine the community's autonomy or increase marginalization. Moreover, while Oslo's vulnerability analysis indicated the need to adapt to the highest GHG projection scenario, in line with Miller et al. (2010) research findings, in such case, Oslo citizens might have limited ability to evaluate critically, downplay self-help capacities, and emphasize slow learning. Instead, the authors suggested applying research studies that focus on transformation and learning to expect more positive changes and learn to replicate and upscale vulnerabilities.

Some positive solutions were proposed in other WRCS. Namely, video *Do you take water for granted?* suggested to save tap water, while the video The sixth IPCC's main report's presentation indirectly implied that solutions lie in active citizens' hands (video illustrated protesting juveniles) to request changes in climate policies. As a result, one might state that behavioral solutions were offered. Concomitantly, in the final report of the NWW research project - Recommendations from a citizens' panel, one of the solutions proposed was establishing "learning laboratories" where citizen participation would be a part of stormwater management.

Despite attempts to provide NBSs as a technology option for Oslo residents, some behavioral and lifestyle solutions and financial and informational support were not sufficient or not provided. As a result of the challenges mentioned above, citizen support was lower than planned. Furthermore, some fragmented solutions on consumption, behavior, and service provisional transitions were given, but none were combined into a complete story.

Nevertheless, coupled production-consumption method referring to Norwegian oil and gas were not adequately articulated. UN research requires a coupled production-consumption solution, such as "government policies that decrease both the demand and supply for fossil fuels and support communities currently dependent on them" (UN, 2020). Otherwise, the UN has warned that 'catastrophic' warming is coming (2020).

To conclude, a lack of comprehensive understanding of long-term climate solutions based on behavior, lifestyles, and climate communication research was lacking. Furthermore, opposing fossil fuel extraction and consumption would be the most advantageous mitigation approach based on scientific proof. Regarding the former, increased emphasis on mindsets, understanding, and motivation in climate solutions research is needed. Meanwhile, political will and a systematical plan to decrease fossil fuel extraction on the latter are indispensable.

6.2 Disconnection with the target audience

An impetus of environmental communication is to bridge scientific players and authorities with civil society. By connecting with the target audience, communicators would be able to navigate civic society's values, interests, and beliefs in addressing climate change (Pezzullo and J. Robert Cox, 2018; Von Storch and Krauss, 2005). Effective communication in resolving climate challenges should not be confined to abstract concepts and scientific data but also touch the audience's inner dimensions (Wamsler and Brink, 2018).

As revealed during the interviews, the only appeal to location seemed to be fully engaged in understanding Oslo citizens' needs. Consequently, climate communicators should be aware of these factors to determine meaningful and newsworthy science stories. In addition, new narratives, social behaviors, and increased emphasis on mindsets, understanding, and motivation in research are needed (Wamsler and Brink, 2018).

Indeed, it is critical to communicate climatic events based on motivations, beliefs, and interests and encourage pro-environmental behaviors. Therefore, environmental psychology, which addresses the relationships between people and their physical and social environments, according to Jarreau, Altinay, and Reynolds (2015), is essential. However, many environmental communicators remained relatively unaware of a growing body of psychological research on environmental matters and best practices. Subsequently, environmental psychologists interviewed for Jarreau, Altinay, and Reynold's (2015) study, emphasized giving people specific action alternatives in order to empower them to act, as well as appealing to an appreciation for nature and local wildlife, local pride, and place attachment in motivating people to take action to protect their local environment and communities.

Briefly, values, interests, and attitudes are essential elements to include in environmental communication to enhance these psychological dimensions.

6.3 Adherence to traditional communication methods

Adherence to the traditional communication methods was detected as interviewees confirmed inadequate information and visuals on Oslo municipality's homepage. Additionally, there was a conservative approach to entering new social media channels and using overly factual language.

Meanwhile, leading scholars in the field of environmental communication recommended providing more attractive content in order to stay "in the game of making environmental content easily accessible to audiences" (Pezzullo and J. Robert Cox (2018) p. 260). Writers explained that this is needed due to the shrinking online space for environmental messages and the increased competition to disseminate knowledge. Therefore, more visual content should be propagated in the form of images and videos, which would have a more engaging effect than textual messages. In addition, the scientific language should also be adapted and easily understandable to citizens. Unfortunately, few alluring and engaging (based on comments under the posts) messages were presented by the EU Environment & Climate institution on their Instagram account, where reels, videos, visuals, and messages that ask for action were presented. For instance, "Together, we can make a real impact," "Why not start small by washing clothes in lower temperatures or running a more efficient kitchen?" or "Help us make a difference for our environment and look out for products awarded with the #EUEcolabel – for a healthier planet for all of us!" (Ourplanet EU, 2022).

6.4 Not calling for an action

The gap of not calling citizens for action was identified based on empirical findings from WRCS and interviews. As Leichenko and O'brien (2019) emphasized - the twenty-first century's complex sustainability problems cannot be solved solely on material, physical, or technical levels. As a result, authorities and scientific communication experts should offer new narratives, social behaviors, and increased emphasis on mindsets, understanding, and motivation in climate (Wamsler and Brink, 2018). Nevertheless, Woiwode et al. (2021) expressed worry about information-based approaches that fail to demonstrate the need for more profound and long-term change. For instance, such as calling for transitional and transformative action. In order to succeed, there is a need to eventually shift towards higher sustainability by redefining priorities, shifting mindsets and paradigms, and adopting low-impact lifestyles (Woiwode et al., 2021). Therefore, environmental communicators should aim to not only raise awareness by informing climatic matters but also ask for a shift toward climate-friendly actions.

Incremental changes to the current system cannot lead to transitional or transformational action, according to Leichenko and O'brien (2019). Nevertheless, most offered WRCS were not challenging citizens to act upon. Apart from fragmented attempts to challenge citizens to go to the streets (two seconds episode in one of the WRCS), protest and adapt to environmentally friendly consumption practices (reduce consumption practices), and install blue-green solutions to their properties, there is a lack of consistency and long-term communication strategy to move towards the desired state.

Scholars suggest empowering citizens and illustrating them as 'fighters' against the climate crisis to achieve a proactive attitude. For example, Bonanno et al. (2021) suggested that public-facing environmental issues should contain messages demonstrating how acting in the community would allow individuals to be 'heroes' of climate change. Next, Bonanno et al. (2021) claimed that to frame climate change and empower the audience effectively, communicators should provide community-based solutions and involve the public in improving the current situation. Lastly, the Centre d'Estudis d'Informació Ambiental (n.d.) recommended developing participatory models of environmental information exchange and linking climate messages to options and context to the action. The latter should be achieved by emphasizing personal capacities for influencing social outcomes (Centre 'Estudis d'Informació Ambiental, n.d.).

On the other hand, Jarreau, Altinay, and Reynolds (2015) contended that civil society members would be committed to acting environmentally friendly if their surroundings do nothing (e.g., neighbors, other countries, etc.). Consequently, principles of collaboration enable combining resources, improving decision-making and problem-solving processes, and increasing environmental awareness of the local community (Biezina, Truksans, and Ernsteins, 2019).

The New Water Ways project is a unique project that integrated citizen science via collaboration of local authorities and the scientific community with Oslo inhabitants. One of the participants stated that (s)he "knew nothing about stormwaters' problems and how challenging it is before ((s)he) participated here. Right where I live, it is not a big problem. Now I have become a kind of ambassador and talk to friends and others about it." As Interviewee 5 from Planning and Building Agency shared, the upcoming research-based WRCS, called *SPARE*, is a continuation of NWW and will

last for another four years. Continuation of popularized science means that Oslo municipality appreciated knowledge gained through a previous research project and put efforts to include society in decision making and environmental policies. Nevertheless, more similar projects are needed to perpetuate the pattern of civil inclusion.

Additionally, as most interviewed admitted, neighbors' phenomena influenced raising awareness and led to climate-friendly actions. Nevertheless, the finding was not extensively used by communicators. As a result, communicators may show more examples of positive endeavors initiated or elaborated by communities in Oslo.

Along with emphasizing surrounding communication and neighbors' actions toward climate-friendly activities, communicators may provide options to choose from. For instance, explain what value may bring one activity against the other, emphasizing the benefits gained from climate-friendly activities.

In conclusion, ensuring public participation, giving the audience options to choose from, and recognizing personal ability to influence would promote civic empowerment within environmental concerns. Moreover, a supportive social atmosphere would contribute to citizens' empowerment.

7. Conclusion

This research aimed to explore environmental communication and assess whether water-linked communication strategies and initiatives in Oslo align with the theory of effective environmental communication. Correspondingly, a well-reasoned environmental communication has an impetus to positively influence citizens by rethinking and reorienting global, national, and municipal environmental efforts to develop a more persuasive political practice that can rapidly accelerate the scope and pace of social change in adopting climate-friendly lifestyles. For this purpose, legitimate climate communicators from scientific organizations and national and municipality institutions were approached to understand their knowledge of climate change and its connotations for environmental communication.

To begin, content analysis was completed to answer the first research question, which was to identify and analyze WRCS and their communication channels. In this paper, I described nine water-related climate strategies and initiatives and the media they are placed in. The results showed that central Oslo municipality's strategies are *Oslo's new Climate strategy*, *Climate Change Adaptation strategy,* and *Climate Change Vulnerability Analysis,* all posted on the Climate Agency's home page in Oslo, namely, KlimaOslo. Stormwater management and blue-green solutions as climate adaptation measures were central themes in the strategies mentioned. Later, following the central strategies, briefer and episodical initiatives, such as IPCC findings' reports, the Grow hub project, which represented green roofs, and the drinking water-saving initiative, were presented in video format on social media platforms, most notably Facebook and Instagram. The clips addressed moral humankind's responsibilities for the climate crisis, displayed indisputable scientific facts about climate change, and inspired young people to oppose existing climate policies. The presentation of Oslo's stormwater management situation in the online document library revealed that blue-green solutions were central to implementing an effective management system. The presentation mentioned implementation

barriers such as a lack of legal and economic instruments, knowledge, established procedures, and inadequate communication. Finally, the Citizen Panel, which was the first of its kind in Norway, provided recommendations on stormwater management. Recommendations were a part of the New Water Ways project, and the final report was posted on NINA's and So Central's web pages. The Citizen Panel empowered residents of Oslo by allowing them to participate in the development of water management policies.

Subsequent survey findings responded to a second research question on climate communicators' perceptions of climate change. Thus, survey results enclosed that those study participants had a solid understanding of the anthropological origin of climate change and the severe threats this crisis poses to various groups. Survey respondents identified floods, erosion, and sea-level rise as the most severe climatic impacts. It was agreed that governments should be responsible for addressing climate change. However, while most respondents claimed to understand the causes of climate change, only one person claimed to understand the effects of climate change on the water sector.

Survey respondents voted the internet and newspapers as the primary information sources regarding environmental communication, with 100 percent relying on these media. Meanwhile, 71.4 percent of respondents voted for government institutions, while 57.1 percent supported academic publications. Despite previous findings, scientists and government agencies were regarded as the most trustworthy sources of climate change information. All survey participants stated that sources were 'extremely' or 'very likely' trusted.

Next, the interviews were arranged to answer the second research question and enclose environmental communicators' implications for environmental communication. Relying on empirical findings from interviews, this study determined effective communication approaches such as diversification of target audience and usage of various communication channels, utilization of language that is understandable for society, premisses of using social media and engaging with the audience in social networks comments. Furthermore, messages supported with facts or evidence and location-based messages were employed entirely to provide reliable and relatable climate information. The latter aspect, localized messages, is generally considered one of the main elements enabling successful communication by showing climate impacts on physically close or emotionally significant places. Besides, even though only a few interview respondents stated that inspiring civil society was one of the leading environmental communication objectives. On the other side, one communication expert shared that the comments section on Oslo Climate Agency's social media-inspired communicators to pursue additional climate-related initiatives. Finally, according to a few interviewees, the popularity of the climate communication field is constantly increasing. Considering the findings mentioned above in reported methodologies, I argue that successful environmental communication with Oslo inhabitants has great potential.

However, some significant obstacles to effective communication emerged. Environmental communicators endured a dilemma between 'doom and groom' and positivistic messages, making it difficult to prioritize which messages to address. Communicating both is beneficial but has different outcomes. Furthermore, communicators experienced difficulties connecting with citizens and declared that residents are primarily concerned with practical day-to-day solutions. Following the barriers, communication experts admitted financial challenges in environmental communication. Besides, empirical results revealed that climate awareness as a societal goal was a rather utterly trivial

topic. Even more, communicators avoided addressing the Norwegian oil and gas industry's contributions to the climate crisis and refrained from directing climate skeptics to their target audience. Likewise, communicators suggested that only a climatic crisis would significantly improve communication efficiency, suggesting that current communication approaches are insufficient.

Additionally, Oslo city's agencies admitted that common knowledge on climatic threats is inadequate, and therefore, it is problematic to create a common communication strategy for stormwater management. Consequently, an urgent need to recognize stormwater as a significant threat locally in Oslo and at the national level, create legislation, strengthen knowledge, and allocate sufficient funding to move forward in environmental communication was mentioned. In line with this, some other barriers were identified, such as a conservative attitude to communication channels, insufficient and unattractive web pages, and communicators' skepticism at engaging in new social networks. Finally, general information overload and generational demographic differences have been identified as barriers to climate communication.

For comparative purposes, communicators assessed the Covid-19 pandemic as an example of an unexpected crisis that influenced environmental communication. While some interviewees complained about decreased space for climate news and noticeable communication malfunctions, others advocated for increased climate communication efficiency. For instance, understanding a previously unimaginable sudden crisis was mentioned as having the potential to make Oslo citizens more accepting of the idea of vulnerability, including vulnerability to the climate crisis. Furthermore, more active participation in the social media comment section was also a positive outcome during the pandemic. Next, an environmental communicator from Oslo's Climate Agency admitted that the pandemic's health communication encouraged the agency to communicate climate uncertainty more freely, probably referring to a more holistic presentation of climate crisis phenomena when different climatic scenarios depend on us citizens. However, contrasting communication results were addressed between environmental and health communication. Namely, one of the respondents asserted that while results from applying measures to control Coronavirus spread were seen in a few weeks, assessing climate measures took longer. Therefore, the respondent implied that it was easier to evaluate the effectiveness of health communication.

Subsequently, I compared empirical findings to environmental communication theory to enhance environmental communication. Finally, to respond to the third research question, I identified and explored gaps between environmental communication theory and practical approaches by conducting a comparative analysis. Comparison of scientific rationale with interviews, surveys, and analyzed WRCSs led to the emergence of four clear patterns that formed the basis for the themes: oversimplification of environmental communication, disconnection with the target audience, adherence to traditional communication methods, and not calling for action.

The first gap, oversimplification of EC, arose because of a lack of comprehensive understanding of long-term climate solutions based on behaviors, lifestyles, and climate communication research. Accordingly, causes, consequences, and solutions should be offered and linked to a coherent story. Furthermore, the emphasis on mindsets and motivation requires greater attention in WRCSs.

The second gap, a disconnection with the target audience, revealed that environmental communicators did not consider citizens' values, interests, and attitudes essential factors in

environmental communication. Consequently, knowledge of environmental psychology, which studies the interactions between people and their physical and social settings, could help enhance certain psychological dimensions.

The third gap, adherence to traditional communication methods, were identified from interviews with environmental communicators. In particular, online homepages lacked information and visuals, and there was a conservative approach to entering new social media channels. Meanwhile, leading scholars in environmental communication recommended providing more attractive content to stay "in the game of making environmental content easily accessible to audiences" (Pezzullo and J. Robert Cox, 2018, p. 260).

The fourth gap, not calling for action, was identified based on analyzed WRCS and empirical findings from the study's interviews. Apart from fragmented attempts, such as introducing blue-green solutions in citizens' properties, most strategies and initiatives did not challenge civil society to act. Nonetheless, Leichenko and O'brien (2019) underlined that the complex sustainability concerns of the twenty-first century could not be solved only on the material, physical, or technical levels. As a result, authorities and scientific communication professionals should provide new narratives, social behaviors, and a greater emphasis on mindsets, understanding, and motivation in climate change communication (Wamsler and Brink, 2018). Lastly, the Centre d'Estudis d'Informació Ambiental (n.d.) advocated for the development of participatory forms of environmental information exchange and proposed linking climate messages with options to citizens and providing context to the action. The New Water Ways initiative, on the other hand, was a forward-thinking example of citizens becoming empowered by allowing them to suggest improvements to current stormwater management. Nevertheless, to sum up, ensuring public participation, giving the audience options to choose from, and recognizing personal abilities to influence, would promote civic empowerment while communicating WRCS. Moreover, strategies should consider a supportive social framework (e.g., climate initiatives in the neighborhood) which would contribute to citizens' proactiveness in climate-friendly solutions.

8. Discussion

Persuasive environmental communication with compelling messages and other attributes should encourage civil society to engage in environmentally responsible behavior. However, are these persuading messages being prioritized? What are the connections to the target audience? Moreover, how can we tell if the climate strategy is effective?

This study indicates that Oslo city has set ambitious climate goals and prepared sound strategies such as a Climate strategy toward 2050, an adaptation plan, and vulnerability analysis. In addition, a growing number of initiatives use visuals and address the audience by using cultural peculiarities, directing toward proactive behaviors presenting technical solutions to adapt to and mitigate climate change. However, I argue that, despite claims of an increasing number of visitors, central city strategies published on Oslo's Climate Agency's homepage may attract a limited audience. A thorough investigation into whether or not Oslo citizens accessed and read these strategies could

solve this query. Otherwise, social networks gaining more attention could be exerted to a higher degree.

The study also revealed that environmental communicators understood climate causes and severity well, but only one person admitted knowing of water-related consequences in Oslo. Consequently, it is not easy to expect that Oslo citizens that are not experts in a field would have a higher level of understanding. Is there, however, a necessity for a more thorough examination of stormwater, landslides, and other water-linked treats? One reason for high uncertainty in water-linked climate threats could be the misjudgment of legislators. For example, although a respondent from Plan and Building Agency reported that stormwater is formally recognized as the main threat to Oslo city, it did not garner its attention. According to the interviewee, only a climatic crisis could wake up policymakers and make them realize the severity of stormwater as a highly potential trouble spot. If this were done, technical expertise, recommendations, and citizen-oriented communication would emerge, allowing everyone concerned to receive adequate information on imminent threats.

The empirical data collected from interviews suggested that incremental modifications, such as blue-green structures' or technical remedies' incorporation into urban planning, are seen as climate crisis salvage. However, climate awareness and citizens' involvement in climate policies are regarded as less pertinent. For this reason, prior to communicating environmental issues, a proper understanding of the target audience's beliefs, values, and attitudes is required. Besides, a shift in minds and transformational attitudes are expected to be discussed alongside technical solutions.

The study also demonstrated a lack of correlation between climate crisis causes, consequences, and solutions. Such a combination would create a narrative that is both appealing and - as stated by experts in the environmental communication field- also allow for to connection of missing parts in a complex phenomenon such as the climate crisis. However, storytelling should adhere to newsworthy principles such as objectivity and balance and should be presented by "authorized knowers" of society such as scientists, experts in a field, or governmental actors.

9. Recommendations for future research

There are several gaps in the knowledge around well-reasoned environmental communication. In this research, followed by empirical findings, investigation on the following themes would benefit from further research:

1. Investigation of Oslo citizens' attitudes, interests, and motivations toward climate-friendly lifestyles is needed to understand the environmental communication target audience better.
2. Investigate environmental communicators' alignment with environmental psychology practices.
3. Separate studies identify specifics of environmental communication by scientific institutions and national/municipality communication professionals.
4. Investigate the importance of climate-related information provided by traditional media, such as newspapers and television.

5. Analyze legitimacy concerns as scientific institutions, and policymakers exploit new social media platforms.

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11. Appendix

Appendix 1 - Survey template

Appendix 2 - Interview guide

Appendix 3 - Water-related climate strategies

Appendix 1

Survey template

Environmental communication of Oslo's water management strategies and initiatives - the status quo

Mandatory fields are marked with a star *

Ocupation *

- [ ] Governmental/Municipality actor
- [ ] Media actor

What is your age? *

- ○ 24 or less
- ○ 25-40
- ○ 41-56
- ○ 57+

Gender? *

- ○ Male
- ○ Female
- ○ Do not want to answer

Global warming is happening. *

- [ ] Yes
- [ ] No
- [ ] I do not know

Worried about global warming. *

- [ ] Yes
- [ ] No
- [ ] I do not know

Global warming is anthropological (caused mainly by human activities). *

- [ ] Yes
- [ ] No
- [ ] I do not know

Global warming is harming (or will harm) me personally. *

- [ ] Yes
- [ ] No
- [ ] I do not know

Global warming is harming (or will harm) Oslo citizens. *

- [ ] Yes
- [ ] No
- [ ] I do not know

Global warming is harming (or will harm) people in developing countries. *

- ( ) Yes
- ( ) No
- ( ) I do not know

Global warming will harm future generations. *

- [ ] Yes
- [ ] No
- [ ] I do not know

Due to extreme water events, which of the following consequences seems most dangerous to you? *

Please choose up to 3 options.

- [ ] Sea level rise
- [ ] Floods
- [ ] Soil erosion and harm related to it (e.g. quick clay slides)
- [ ] Water-borne illnesses (due to contaminated water)
- [ ] Changes in snow cover

Who do you think to have the primary responsibility in curbing climate change? *

Please choose only **one**, **main** actor.

Select …

- Select …
- Governments
- Environmental organisations
- Private businesses (e.g. energy suppliers)
- Civil society
- Other

Do you feel like you have enough knowledge about climate change causes? *

- [ ] Yes, enough
- [ ] No, not enough
- [ ] I do not know

Do you feel like you have enough knowledge about climate change's consequences to the water sector? *

- [ ] Yes, enough
- [ ] No, not enough
- [ ] I do not know

Where do you get your information with regards to climate change (you can choose as many variants as you feel apply) *

- [ ] Governmental agencies/information
- [ ] Friends/family
- [ ] Academic publications
- [ ] Internet
- [ ] Television
- [ ] Radio
- [ ] Newspaper
- [ ] Environmental groups
- [ ] Business sector (e.g. energy suppliers)
- [ ] Other

By ticking one box on each row, please indicate how much you would trust information(learning-knowledge) about climate change if you heard it from:

	Extremely	Very	Moderately	Slightly	Not at all
Governmental institution	☐	☐	☐	☐	☐
A scientist	☐	☐	☐	☐	☐
An environmental organisation	☐	☐	☐	☐	☐
Energy supplier	☐	☐	☐	☐	☐
Friend/Family member	☐	☐	☐	☐	☐
Media	☐	☐	☐	☐	☐

Please evaluate the importance of different environmental communication message contents.

	Extremely important	Very important	Moderately	Slightly important	Not important at all
The message should introduce scientific knowledge on climate change	☐	☐	☐	☐	☐
The message should highlight possible threats and hazards of climate change	☐	☐	☐	☐	☐
The message should reflect on readers' values, beliefs and attitudes (know your audience)	☐	☐	☐	☐	☐
The message should include both emotional and intellectual aspects	☐	☐	☐	☐	☐
The message should encompass particular impact on Oslo citizens (e.g. drinking water quality changes after heavy rainfall in Oslo)	☐	☐	☐	☐	☐
The message should address different audiences (e.g. climate sceptics and climate change advocates)	☐	☐	☐	☐	☐
The message should present possibilities related to climate change	☐	☐	☐	☐	☐

Do you think Oslo citizens have sufficient information with regards to climate change in the water sector? *

- ☐ Yes
- ☐ No
- ☐ I do not know

How well do you think climate change adaptation strategies are communicated for Oslo citizens? *

- ☐ Excellent
- ☐ Above average
- ☐ Average
- ☐ Below average
- ☐ Very poor

Which communication methods do you think are most successful to increase climate awareness? *

Please choose up to the three most relevant ones.

- [ ] Tell local stories (real life examples) about Oslo area, e.g. how many landslides can be increased due to flooding
- [ ] Share your knowledge on social media
- [ ] Mention scientific research and evidence
- [ ] Inform about possible harms
- [ ] Inform about the reasons of why global warming is happening
- [ ] Educate of how person is able to minimize their CO2 footprints, decrease energy consumption, reduce consumption in general.
- [ ] Attend environmental protest or similar
- [ ] Invite to participate in climate-friendly events

Do you think that COVID-19 disrupted environmental communication? *

- [ ] Yes
- [ ] No
- [ ] I do not know

Could you call yourself environmental communicator*? *

Environmental communication is characterized as any form of communication that is concerned with environmental issues and current events. The purpose of environmental communication is to investigate and publicize issues that influence the natural world, and humans' role in environmental protection and resource management.

- [ ] Strongly Agree
- [ ] Agree
- [ ] Undecided / Neutral
- [ ] Disagree
- [ ] Strongly Disagree

Would you like to participate in an anonymous interview* and help to investigate environmental communication in Oslo in water related issues? I would be very thankful for your support and knowledge sharing. *

*Interview can be held tete-a-tete format or via digital tools.

- [ ] Yes, I would like to help you
- [ ] No, I do not want to participate in an interview

Appendix 2

Semi-structured interview template

Interview guide

Title:

Environmental communication in Oslo's water management strategies and initiatives - the status quo

Sample:

Actors involved in climate change strategical plans related to water management planning in Oslo.

Introduction:

Present yourself, your project, and what is the intention for the information usage.

Present themselves;

Research questions:

1. Research question 1 (RQ1): What are up-to-date water-related climate change management strategies and initiatives in Oslo, and how are they communicated?
2. Research question 2 (RQ2): What are environmental communicators' perspectives on climate change, and what implications do they have for environmental communication?
3. Research question 3 (RQ3): What are identified gaps in environmental communicators' practice compared to best theoretical practices?

RQs	**Questions asked**	**Notes from Interview**
RQ1. What are up-to-date water-related climate change management strategies and initiatives in Oslo, and how are they communicated?	Which climate change (water related) managements programs/strategies you are involved in or have the knowledge at?	
	How is the program communicated to Oslo citizens? (*by report, in various media sources, Oslo municipality's)*	

RQ2. What are environmental communicators' perspectives on climate change, and what implications do they have for environmental communication?	Is global warming a “hot” topic at your workplace? (*How often you discuss issues related to global warming)*	
	Are you being approached by others (family members, friends, colleagues from other departments) to share your knowledge of water related programs/strategies in Oslo? *(if the answer is yes: do they want to know more technical details or maybe try to ask you what can we do to minimize the effects of global warming?)*	
	Do you personally think that you can influence global warming and how? a) you as a water expert/environmental communicator? b) you as Norwegian citizen?	

	Which water related climate hazards seems most threatening to you and why? *(e.g. flooding, sea level rise, landslides).*	
RQ3. What are identified gaps in environmental communicators' practice compared to best theoretical practices?	Do you feel like you understand your audience needs, values, their motivations and preferences with regards to climate change? *(e.g., biodiversity appreciation; access to fresh water, nature as untouched; fresh air, safety, high income, stability)*	
	Do you think that successful environmental communication should encompass more hazards or possibilities of climate change and why?	
	Do you feel like Oslo citizens are well informed about water related climate hazards: a) in Oslo b) and worldwide	

	Do you feel like Oslo citizens are well informed about the reasons of climate change? What is your opinion of how much Norwegian society could be influencing climate change?	
	How do you educate yourself with regards to climate change? Do you feel like your working environmental provides you with sufficient knowledge? (e.g. seminars, courses, official updates of recent scientific findings, lessons learn from previous projects). Do you share same/similar knowledge with your co-workers?	
	Which information channels do you think most appropriate for successful environmental communication and climate awareness improvement for Oslo citizens? *(e.g., governmental organizations, media, environmental INGOs etc.)*	
	Can you share your ideas of what should be the most important functions of environmental communication? *(e.g., informing, communicating scientific reality and consensus, portraying science accurately and creating awareness among a non-technical audience)*	

	Can you describe the audience you write for, in your own words? Do you feel like your article/rapport/presentation/ adaptation program engage people who have a different initial opinion/s? (Is it important to engage different audiences?) Why? *(e.g., political, value differences etc.)*	
	Conversely, what practices, methods or message attributes have you found don't connect well with your audiences, and how have you changed or overcome these?	
	Which communication methods do you think are most successful to increase climate awareness? *a) Telling local stories (real life examples) about Oslo area, e.g. how many landslides can be increased due to flooding* *b) Share your knowledge on social media* *c) Mention scientific research and evidence* *d) Informing about possible harms* *e) Informing about the reasons of why global warming is happening* *f) Educating of how person able to minimize their CO2 footprints,*	

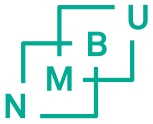
	decrease energy consumption, reduce consumption in general. *g) Attend protest against pollution or similar*	
	How would you evaluate communication of water related climate strategies in Oslo? (strategies/plans that you know)	
	What can be improved in environmental communication?	
	What improvement in environmental communication you would suggest?	
	Do you think that COVID-19 pandemic disrupted environmental communication and why?	

Appendix 3

List of water-related climate strategies and initiatives

INSTITUTION	TITLE	COMMENTS	URL	ACCESS DATE
Hydrologiraadet	Urbanhydrologi – presentasjoner		http://www.hydrologiraadet.no/urbanhydrologi/	2022.02.15
Klimaetaten i Oslo kommune	The Hub	Facebook	https://www.facebook.com/profile/100068500796019/search/?q=hub	2022.04.01
Klimaoslo	Climate Change Vulnerability Analysis for Oslo	Climate Agency's webpage	https://www.klimaoslo.no/wp-content/uploads/sites/88/2021/03/Climate-Change-Vulnerability-Analysis-for-Oslo-short-version.pdf	2022.01.07
Klimaoslo	Klimasårbarhetsanalyse for Oslo	Climate Agency's webpage	https://www.klimaoslo.no/wp-content/uploads/sites/88/2020/05/Klimasarbarhetsanalyse-for-Oslo.pdf	2022.02.10
Klimaoslo	Oslo's new Climate Strategy	Climate Agency's webpage	https://www.klimaoslo.no/2020/06/10/oslos-new-climate-strategy/	2022.03.21
KlimaOslo	Climate Strategy for Oslo towards 2030		https://www.klimaoslo.no/wp-content/uploads/sites/88/2020/09/Klimastrategi2030-Kortversjon-ENG_2608_enkeltside.pdf	2022.02.15
Miljødirektoratet		Overvann	https://www.miljodirektoratet.no/tjenester/klimapodcast/klimapodcast-12-hva-kan-sma-kommuner-lare-av-oslos-klimaarbeid/	2022.04.04
Miljødirektoratet	Klimapodcast 12: Hva kan små kommuner lære av Oslo?	Podcast	https://www.miljodirektoratet.no/tjenester/klimapodcast/klimapodcast-12-hva-kan-sma-kommuner-lare-av-oslos-klimaarbeid/	2022.04.20
Miljødirektoratet	Klimapodcast 39: Borgerpanel i lokalt klimaarbeid	Found by snowball method, podcast	https://www.miljodirektoratet.no/tjenester/klimapodcast/klimapodcast-39-borgerpanel-i-lokalt-klimaarbeid/	2022.03.22
Miljødirektoratet	Klimapodcast 44: Slipp bekkene fri, det er flom!	Podcast	https://www.miljodirektoratet.no/tjenester/klimapodcast/klimapodcast-44-slipp-bekkene-los-det-er-flom/	2022.03.21
Miljødirektoratet	IPCCs andre del av sjette hovudrapport	Instagram	https://www.instagram.com/p/CZ1E2xWrp9a/	2022.04.26
Miljødirektoratet	6th IPCC rapport	Instagram	https://www.instagram.com/p/CRwthnaKJvq/	2022.03.20
Miljødirektoratet	FNs klimapanel sier at ekstremvær blir hyppigere og mer alvorlig	Instagram	https://www.instagram.com/p/CSgWREktm_0/	2022.03.20
NINA	New Water Ways. Anbefalinger fra et borgerpanel		https://newwaterways421475860.files.wordpress.com/2021/03/new-water-ways-anbefalinger-fra-et-borgerpanel.pdf	2022.01.10
NINA	New Water Ways. Get involved! Regntønne-design		https://newwaterways421475860.wordpress.com/involvement/	2022.04.04
Oslo kommune	Strategi for overvannshåndtering i Oslo	Online homepage	https://www.oslo.kommune.no/getfile.php/1334879-1426836380/Tjenester%20og%20tilbud/Vann%20og%20avl%C3%B8p/Skjema%20og%20veiledere/Overvann/Strategi%20for%20overvannsh%C3%A5ndtering.pdf	2022.02.27
Oslo kommune	Sammen for bedre overvannhåndtering på Grefsen og Kjelsås	Online homepage	https://www.oslo.kommune.no/prosjekter/bedre-vannhandtering-grefsen-kjelsas/#gref	2022.02.27

Oslo kommune	Ny strategi skal gi Oslo grønnere tak og fasader		https://magasin.oslo.kommune.no/byplan/gr%C3%B8nnere-tak-og-fasader#gref	2022.04.05
Oslo kommune	KLIMATILPASNINGSSTRATEGI for Oslo kommune	Online homepage	https://www.oslo.kommune.no/getfile.php/13108654-1455893001/Tjenester%20og%20tilbud/Politikk%20og%20administrasjon/Milj%C3%B8%20og%20klima/Styrende%20dokumenter/Klimatilpasningsstrategi%20for%20Oslo%20kommune.PDF	2022.03.24
Oslo kommune	Klimatilpasningsstrategi – en klimarobust by	Online homepage	https://www.oslo.kommune.no/miljo-og-klima/slik-jobber-vi-med-miljo-og-klima-1/miljo-og-klimapolitikk/klimatilpasningsstrategi/#gref	2022.03.29
Oslo kommune	Kampen mot flomvannet: Alle må delta		https://magasin.oslo.kommune.no/byplan/kampen-mot-flomvannet-alle-ma-delta	2022.04.13
Oslo komunne	Climate Change Adaptation Strategy for the City of Oslo	2014-2030	https://www.oslo.kommune.no/getfile.php/13166782-1478167164/Content/Politics%20and%20administration/Green%20Oslo/Plans%20and%20programmes/Climate%20Change%20Adaptation%20Strategy%20for%20the%20City%20of%20Oslo%202014-2030.pdf	2022.03.20
Plan- og bygningsetaten, Oslo kommune	Hva ønsker en av foregangskommunene – Oslo?		https://multiblokk.no/readimage.aspx?asset=11515&down=1	2022.02.04
Plan- og bygningsetaten, Oslo kommune	Hva ønsker en av foregangskommunene – Oslo?	Presentation	https://multiblokk.no/readimage.aspx?asset=11515&down=1	2022.03.04
Plan- og bygningsetaten, Oslo kommune	Hva ønsker en av foregangskommunene – Oslo?	Presentation	https://docplayer.me/213565855-Hva-onsker-en-av-foregangskommunene-oslo-utfordringer-grep-hva-kan-vi-forvente.html	2022.03.19
Statensvegvessen	Klimatilpasning i Statens vegvesen		https://www.vegvesen.no/globalassets/fag/fokusomrader/miljo-og-omgivelser/2020-03-lesepresentasjon-klimatilpasning-1.pdf	2022.03.21
Vann- og avløpsetaten, Oslo kommune	Overvannshåndtering		https://www.oslo.kommune.no/vann-og-avlop/arbeider-pa-vann-og-avlopsnettet/overvannshandtering/	2022.02.05
Vann- og avløpsetaten, Oslo kommune	Tar du vannet for gitt?	Facebook: Oslovann	https://www.facebook.com/watch/?ref=search&v=981472929068186&external_log_id=236b98f4-28ba-4867-94a9-88c9a1b583f2&q=oslovann	2022.03.26



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